

Traffic Design Manual

Volume 2: Temporary Traffic Control

CITY OF PORTLAND, OREGON

2019

The logo for the Portland Bureau of Transportation (PBOT) features the letters 'PBOT' in a large, bold, white, sans-serif font. The letters are set against a solid orange background. The 'P' and 'B' are connected, and the 'O' is a simple circle. The 'T' is a simple vertical bar with a horizontal top bar.

PORTLAND BUREAU OF TRANSPORTATION

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Traffic Design Manual, Volume 2: Temporary Traffic Control

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1 Preface

While this manual provides interpretive guidance, it does not change the intent of Part 6 of the Manual on Uniform Traffic Control Devices (MUTCD). This manual is a supplement to the MUTCD and applies to temporary traffic control operations on City of Portland streets. Any interpretation or clarification regarding this manual will be made by the City Traffic Engineer. See the MUTCD for definitions of words and terms not otherwise defined herein.

The City Traffic Engineer may periodically update this manual electronically.

The typical applications in this manual are not intended to recommend the use of specific traffic control devices or measures that work in every situation but are intended to illustrate and provide guidance on minimum solutions for a variety of work zone scenarios commonly encountered.

In this manual, the words "**shall**", "**should**", and "**may**" are used to describe specific conditions. To clarify the use of these terms, the following definitions apply.

1. **SHALL:** A mandatory condition or action.
2. **SHOULD:** The practice under normal conditions.
3. **MAY:** An option where no requirement for design, application, or standards is intended.

2 Glossary

ACCESSIBLE ROUTE

An accessible route is a continuous, unobstructed path specifically designed to provide access for individuals with disabilities, including those using wheelchairs or mobility devices. Accessible routes **shall** conform to the ADA Standards.

ADA STANDARDS

The 2010 Americans with Disabilities Act (ADA) Standards for Accessible Design and, if any, supplemental ADA standards for application within the public right-of-way, as adopted by the US Department of Justice and US Department of Transportation.

BUSY STREET

Arterials, collectors and residential streets with either lane markings or on a transit bus route.

BIKEWAY

A generic term for any road, street, path, or way that in some manner is specifically designated for bicycle travel, regardless of whether such facilities are designated for the exclusive use of bicycles or are to be shared with other transportation modes. As a general guide, any city street or path with bicycle lanes, "sharrows", or other bicycle amenities can be considered a bikeway.

CENTRAL BUSINESS DISTRICT (CBD)

The Special Traffic Control District as defined by Portland City Code chapter 17.23. This is generally the area bounded by the Willamette River and I-405, with some exceptions.

CITY CREWS

Maintenance Operations employees, Portland Water Bureau and Environmental Services employees performing utility repair and maintenance in the right-of-way, and Portland Parks employees performing mowing operations in the right-of-way.

CITY TRAFFIC ENGINEER

The City Traffic Engineer designated by the Commissioner-In-Charge of the Bureau of Transportation with duties defined in Portland City Code chapter 16.10.200.

CONSTRUCTION PRODUCTS LIST (CPL)

A list of devices pre-approved for use as prescribed in Standard Specifications.

CONTRACTORS

Persons other than city crews. For example: utility contractors, development contractors, people under contract with the City, the public.

DISTRICT SIGNAL ENGINEER

Traffic Engineer working for the SSL division who is responsible for managing the operation and maintenance of the traffic signals, street lighting, and Intelligent Transportation System (ITS) within a geographical district.

HIGH SPEED STREET

Road with an operating speed of 35mph or greater.

HIGH VOLUME STREET

Road with traffic volume greater than 5,000 AADT (Annual Average Daily Traffic).

Rule of thumb: if volumes are unknown, count the number of vehicles in both directions that pass a single reference point in five minutes between 7am and 6pm. If more than fifty vehicles, the road can be considered a high-volume road for establishing temporary traffic controls.

LOW VOLUME STREET

Road with automobile traffic volume less than 400 AADT (Annual Average Daily Traffic), and not designated on the State or National Highway System.

Rule of thumb: if volumes are unknown, count the number of vehicles that pass a single reference point in five minutes between 7am and 6pm. If less than three vehicles, the road can be considered a low volume road for establishing temporary traffic controls.

PEAK HOURS

Generally, 7am to 9am and 4pm to 6pm Monday through Friday.

Certain roads may have different peak hours, such as industrial areas. For instance, NE Alderwood Rd has a morning peak of 6-8am. Other roads may have directional peak hours.

PERMITTEE

Contractor or City Crew working in the right-of-way, permitted through a general or specific permit approved by the City Traffic Engineer or designee.

PORTABLE CHANGEABLE MESSAGE SIGN (PCMS)

A traffic control device that can display a variety of messages to inform motorists of unusual driving conditions. A PCMS is housed on a trailer or on a truck bed and can be

deployed quickly for meeting the temporary requirements frequently found in work zones or accident areas.

SIGNIFICANT PROJECT

A project with sustained work-zone impacts to *busy streets*, or to sidewalks or *non-busy streets* for more than four weeks.

SIGNALS AND STREET LIGHTING (SSL)

The Signals, Street Lighting, Intelligent Transportation System (ITS) and maintenance division of PBOT.

TEMPORARY TRAFFIC CONTROL PLAN (TCP)

A plan that describes the TCM to be used for facilitating road users through a work zone. TCPs range in scope from being very detailed to simply referencing typical plans contained in this Manual, or specific drawings contained in City of Portland contract documents.

TRAFFIC CONTROL DEVICES (TCD)

Devices used to regulate, warn, and guide traffic safely through a work zone. Some devices may be designed to protect the public or workers if a road user departs from the intended path of travel.

TRAFFIC CONTROL MEASURES (TCM)

Tools and strategies employed to optimize the safety and effectiveness of the work zone for both road users and highway workers. TCM may range from a single traffic control device to a complex variety or sequence of devices, personnel, materials and equipment used to control traffic through a work zone.

TRAFFIC ENGINEER

Traffic engineering staff designated by the City Traffic Engineer to review temporary traffic control plans.

TRAFFIC INCIDENT

Any emergency, natural disaster or other unplanned event that affects or impedes the normal flow of traffic.

TRANSPORTATION MANAGEMENT PLAN (TMP)

A document that includes strategies to manage the work zone impacts of a project. A typical TMP will include a TCP, address Transportation Operations, and Public Information and Outreach components.

TRUCK MOUNTED ATTENUATOR (TMA)

An impact attenuator or crash cushion mounted on a construction vehicle that is designed to reduce damage to structures, vehicles, and motorists resulting from a collision.

WORK DURATION

The three categories of work duration and their time at a location are:

Mobile is work that occupies a location for up to one hour, moves intermittently or moves continuously.

Short-term stationary is work that occupies a location up to three days.

Long-term stationary is work that occupies a location for more than three days.

WORK SPACE

The work space is that portion of the highway closed to road users and set aside for workers, equipment, and material, and a shadow vehicle if one is used upstream. Work spaces are usually delineated for road users by channelizing devices or, to exclude vehicles and pedestrians, by temporary barriers.

WORK ZONE

An area identified by advance warning where construction, repair, utility, or maintenance work is being done by workers on or adjacent to the street, regardless of whether workers are present. The work zone begins with the initial warning sign or traffic control change and ends at the last traffic control device or where traffic resumes normal operation.

3 General Requirements

3.1 PURPOSE AND INTENT

The purpose of this manual is to set forth City of Portland specific practices and guidelines to be observed by all those who perform work in a public right-of-way (ROW) with the goal of providing safe and effective work areas and to warn, control, protect, and expedite all modes of traffic, including transit, bicycle and pedestrian traffic.

To increase the road user's comprehension and facilitate traffic flow, it is desirable to standardize the type and placement of traffic control devices as much as possible. This manual aims to accomplish this objective by:

- Utilizing standard traffic control measures (TCM);
- Identifying TCM practices unique to the City of Portland; and
- Including typical applications for a variety of situations commonly encountered.

Although each situation should be dealt with individually, conformity with the general provisions and techniques established herein is necessary. When a specific situation is not adequately covered by the provisions of this manual, the protection of the traveling public and the worksite will dictate the measures to be taken. These protections should address the transportation hierarchy by prioritizing the safety of pedestrians, bicyclists, and workers above capacity and convenience of other travel modes.

3.2 RESPONSIBILITY

All persons or agencies doing work within or infringing upon the ROW **shall** conduct said work to acceptable standards of safety and efficiency and, except where specified in their City of Portland contract, **shall** be responsible for the following:

- Obtaining all necessary authorization to perform work in the ROW from the Portland Bureau of Transportation;
- Following approved temporary traffic control plans (TCP), and providing safeguards for the protection of workers and the public as outlined herein;
- Supplying, installing, and maintaining all personnel and traffic control devices (TCD) required for use of the ROW;
- Scheduling and expediting the work to minimize inconvenience to the traveling public.

Failure to meet these or other standards will subject permittees to enforcement policy, TRN-8.14. Penalties can be assessed for misuse of the privilege of taking portions of the public right-of-way out of service or implementing traffic control measures without the approval of the City Traffic Engineer. Below is an example of common violations, with sanctions based on 2018 adopted fee schedules.

Description	Code	Civil Sanction
Closure without a permit	PCC 17.24.010	\$500
Creating imminent risk of injury to public	TRN 8.14	\$500
Work outside approved hours	PCC 17.24.010	\$500
Violation of City Traffic Engineer's conditions	PCC 17.24.017	\$300
Incorrect traffic control devices	PCC 17.24.060	\$300
Sign blocking bike lane	PCC 17.24.060	\$300
Missing or improper warning signs	PCC 17.24.060	\$300
Missing or improper barricades/channelizing devices	PCC 17.24.060	\$300
Failure to remove a warning signs after the restriction has been removed	PCC 17.24.060	\$300
Use of unacceptable quality traffic control devices	PCC 17.24.060	\$300
Drop box within 50' of a non-signalized intersection	PCC 16.20.120	\$300
Personal vehicles within work space	PCC 16.20.510	\$300
Advertising from ROW	PCC 17.44.010	\$300
Failure to meet notification requirements	PCC 17.24.060	\$300
Chronic offender, first occurrence	TRN 8.14	\$800
Chronic offender, second or additional occurrence	TRN 8.14	\$1,200

Table 3.1 Example Violations and Penalties

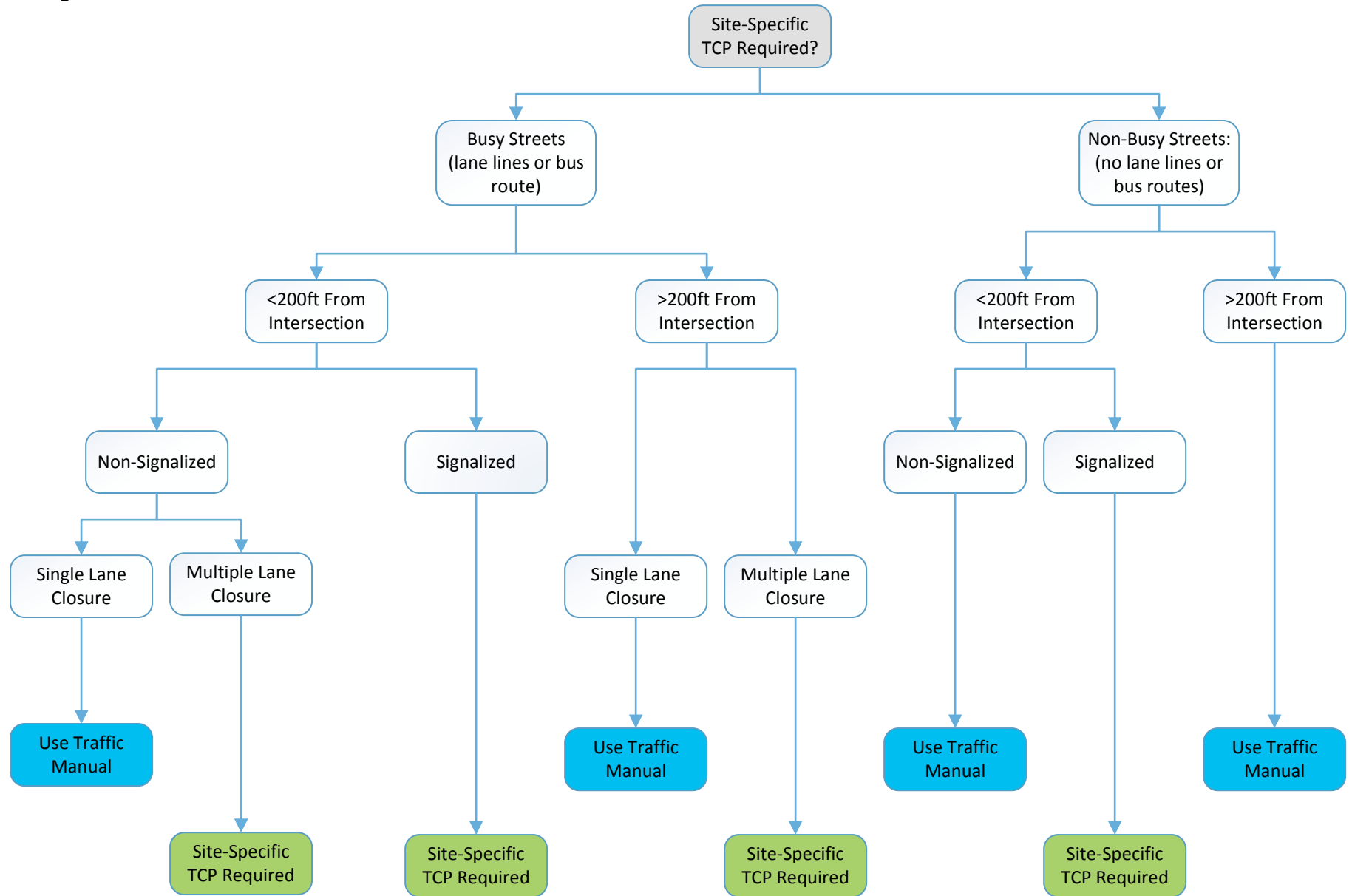
3.3 TCP AND PERMIT REQUIREMENTS

Permission of the City Traffic Engineer is required to work in any portion of the ROW within the City of Portland. A site-specific TCP approved by the Traffic Engineer is required for work zones that

- cannot be implemented using the typical application drawings included in this manual, or
- are classified as *long-term*, or
- detour traffic from a *busy street*, or
- reduces the capacity at a traffic signal, or
- shifts vehicle and/or bicycle lanes approaching a traffic signal.

A flowchart is shown in Figure 3.1 to help guide when a site-specific TCP should be submitted for review. The City of Portland Temporary Street Use Permitting (TSUP) is the conduit for obtaining permission to work in the right-of-way. Appropriate forms and information for applying for a permit can be found on the following website:

www.tsup.info



Bike lanes are considered lanes.

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Figure 3.1 Site-Specific TCP Flowchart

TCPs should address the information included in the following checklist, if applicable:

OK	N/A	
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<p>GENERAL</p> <p>Company name, onsite contact information.</p> <p>Number and date of the submittal.</p> <p>Proposed work hours.</p> <p>Existing conditions.</p> <p>Existing curbs, sidewalks, pavement striping, markings (arrows and crosswalks).</p> <p>Street names.</p> <p>Posted or statutory speed.</p> <p>Required signal modifications</p>
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<p>WORK ZONE</p> <p>Description of work.</p> <p>Clearly define the work space with dimensions.</p> <p>Lanes or roadways to be closed.</p> <p>Cone spacing.</p> <p>Stripe or pavement marking removal.</p> <p>Temporary striping or pavement marking.</p> <p>Conflicting traffic control, e.g. for a shift over centerline, show opposing traffic controls.</p> <p>Flagging.</p>
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<p>PEDESTRIANS</p> <p>Existing sidewalk, pedestrian walkways, and crosswalks.</p> <p>Temporary pedestrian routes, with specific signage and devices for pedestrians.</p> <p>Temporary ADA ramps, walkways, or bridges.</p> <p>Sidewalks and or crosswalks to be closed (last resort only).</p> <p>Covered or relocated pedestrian signal heads.</p>
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<p>BICYCLES</p> <p>Existing bicycle lanes or multiuse paths.</p> <p>Temporary bicycle routes, with specific signage and devices for bicycles.</p> <p>Bicycle lanes and multiuse paths to be closed (last resort only).</p> <p>Covered or relocated bicycle signal heads.</p>
<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<p>TRANSIT</p> <p>Existing bus or light rail stops.</p> <p>Existing bus or light rail routes.</p>

		MOTORIZED VEHICLES
		Special vehicle types and their limitations should be considered (i.e. trucks, buses, Streetcar, LRT, and Emergency vehicles).
<input type="checkbox"/>	<input type="checkbox"/>	Taper lengths.
<input type="checkbox"/>	<input type="checkbox"/>	Required materials, e.g. cones, candlesticks, drums, barricades.
<input type="checkbox"/>	<input type="checkbox"/>	Sign sizes.
<input type="checkbox"/>	<input type="checkbox"/>	Sign locations and spacing.
<input type="checkbox"/>	<input type="checkbox"/>	Parking removal in 20-foot increments, including any special zones (loading, taxi, handicapped, angle, etc.).
<input type="checkbox"/>	<input type="checkbox"/>	Existing and proposed lane widths.
<input type="checkbox"/>	<input type="checkbox"/>	Closed or restricted driveways.

Table 3.2 Temporary Traffic Control Plan Checklist

3.4 EMERGENCY

An emergency requires immediate response to save lives, prevent serious injury or remove debris using whatever resources are available, usually in response to a crash or incident.

3.5 EMERGENT CONDITIONS

An emergent condition requires an expedient yet planned response to a situation that has the potential to cause a crash, or damage needing quick repair. Often referred to as “call outs,” these events require quick response to a report of debris, urgent repairs, or other situation where the exact nature of the work or location may not be completely known. After performing an on-site assessment, determine whether work can proceed without creating additional risks to workers or road users. Response vehicles should be able to implement mobile work zone traffic control measures, at a minimum. If work is expected to last more than 60 minutes, request additional traffic control devices needed to implement a traditional stationary work zone. Assistance from the Traffic Engineer is available to develop a TCP. Emergent conditions may develop into emergencies.

3.6 REASONABLE PUBLIC ACCESS

Access to fire stations, police stations, hospitals, public transit, and schools should be maintained. When restrictions are necessary, coordinate such access restrictions with the Traffic Engineer and the responsible person-in-charge of the affected facility.

3.7 WORK NOTIFICATION REQUIREMENTS

Provide work zone notifications in accordance with City of Portland Standard Construction Specifications 220, and any project-specific provisions. For work not under contract with the City of Portland, provide the following specific notifications.

Type of Work or Closure	Days	Who to Notify
Parking Closure < 2 weeks	48 hours	Property Owner

Transit Closures	5 days	TriMet, Streetcar, CTRAN
Other Access Restrictions	5-10 days	Property/Business Owner
Traffic Signal Modification	7 days	SSL
<i>Busy Street</i> Closure	14 days	Schools, BOEC, Transit, Fire, USPS
Driveway Closures	14 days	Property Owner
Parking Closure > 2 weeks	14 days	Property Owner
Within 100' of Bridge	14 days	Multnomah County, ODOT
Dimension Restrictions	10-35 days	See Section 3.23
Within Rail right-of-way	varies	Railroad

Table 3.3 Work Notification Table

Provide notice to property and business owners in writing (letter, email, flyer, posted sign). The notice should be on an approved form or letter, and include the project name, the name and address of the contractor, daytime and emergency phone numbers, contact person and emergency contact person's name.

3.8 GENERAL AND EMERGENCY CONTACTS

The following parties should be informed of ongoing construction activities and detours to improve coordination and response to emergencies in, around, and through work zones, if applicable. Other school districts, such as Parkrose, Reynolds, and David Douglas may need to be notified.

Bureau of Emergency Communication	503-823-0911
TriMet Bus	503-962-4949 or foc@trimet.org
Portland Streetcar	503-823-2764 (Emergency) 503-823-2904 (Track Access)
SSL	503-823-1700 (Emergency) 503-823-5530 (Scheduling)
TriMet Light Rail	503-962-8138 (Rail Access) 503-962-4937 (Scheduling)
ODOT Rail Division	503-986-4321
Police Dispatch	503-823-4800
USPS	503-735-9816
Portland Fire Bureau Special Operations	503-823-3930
Portland Public Schools Transportation	503-916-6901
Oregon Department of Transportation	971-673-6200 or d2bup@odot.state.or.us
Multnomah County	503-988-3582 or row.permits@multco.us

Table 3.4 Contacts List

3.9 WORKER SAFETY APPAREL

All workers within the right of way within the work zone **shall** wear high visibility safety apparel, as specified in the MUTCD. Safety apparel **shall** meet the requirements of the ANSI/ISEA High Visibility Safety Apparel Guidelines, or equivalent revisions, and labeled as ANSI 107-2004 or current standard performance for Class II risk exposure during day operations, and Class III risk exposure during night operations.

3.10 UNOCCUPIED WORK ZONES

Do not leave portions of the roadway closed unless hazards exist, or the roadway is not otherwise acceptable to traffic. If hazards exist, and the work site will be left unattended before the work is completed, maintain all appropriate warning signs and channelization devices.

The permittee shall complete the following:

- Install the appropriate warning signs in advance of changes in road surface such as rough pavement, excavations or raised plates.
- Delineate all obstructions and protect them with cones, drums, barricades.
- Protect the sharp edges of steel plates with asphalt.

The permittee is responsible for maintaining all existing and temporary traffic control devices and should have them routinely inspected by a knowledgeable person for adequate compliance, visibility and condition of the traffic control devices. Immediately replace all damaged or missing devices. Devices left in place should be appropriate for all expected or anticipated conditions. The standard for vehicle channelization devices is different for unoccupied work zones, as detailed in Section 4.3, Channelizing Devices.

3.11 RESTRICTION TIMES

Generally, lane closures are not permitted on a *busy street* during the weekday *peak hours*, unless approved by the Traffic Engineer.

To keep nighttime noise to acceptable levels, Permittees **shall** conduct work between the hours of 7am to 6pm, Monday through Saturday, unless approved for a Noise Variance through the Office of Neighborhood Involvement.

3.12 POSITIVE PROTECTION

The primary function of positive protection devices is to provide a method to keep vehicles out of an area occupied by persons. Per the FHWA Temporary Traffic Control Devices Rule (23 CFR 630, Subpart K), positive protection devices, such as barriers, impact attenuators, and shadow vehicles, **shall** be considered in work zone situations that place workers at increased risk from motorized traffic, and where positive protection devices offer the highest potential for increased safety for workers and road users. Temporary barriers may be used when the consequence of a vehicle entering an area is graver than the consequence of a vehicle impacting the barrier.

3.13 EMERGENCY RESPONDERS

Fire apparatus require a minimum width of eleven feet to travel through a work zone. Traffic Engineer approval is required at unoccupied work zones which cannot maintain eleven-foot lanes, or when work cannot be stopped to open an eleven-foot passage through the work zone. A temporary emergency response plan may be required whenever access to public or private properties is restricted or fire apparatus response time is increased because of a complete street closure. Temporary emergency response plans are generally not required for dead-end streets or cul-de-sacs whenever properties can be accessed by fire apparatus to within 250 feet of all properties at the restricted location. A temporary emergency response plan may be required if a complete road closure results in a delay in emergency response travel time of more than one-minute from the nearest PF&R fire station. Traffic flagging operations which limit the flow of traffic shall at no time restrict fire apparatus access to property locations. The PF&R Deputy Chief of Special Operations or their designee will review and approve all required emergency response plans.

3.14 SCHOOL ZONES OR ROUTES

Work zone operations near schools require consideration to ensure that children walking, and student transportation conflicts are kept to a minimum. Provide notification of all planned work activities to the school principal so that work times can be coordinated with the school schedule to minimize conflicts with children. Issues that should be considered include:

- Student path to and from the school
- Bus movements for loading and unloading students
- Coordination with crossing guards
- School hours to minimize impacts
- Parent pick-up and drop-off areas and routes

3.15 LIGHT RAIL TRANSIT TRACKS

A Track Access Permit is required for work in and adjacent to Light Rail Transit (LRT) tracks. Contact Portland Streetcar or TriMet (See Table 3.4) to obtain a permit in addition to the City's street use permit approval process. A track access training certificate may be required. All personnel must have attended TriMet's Roadway Worker Protection (RWP) training and have in their possession a current RWP card.

The overhead catenary electrical system must be considered live and hot (energized) always. In situations where it is required to remove power, electrical power removal must be confirmed in the field with the designated power personnel.

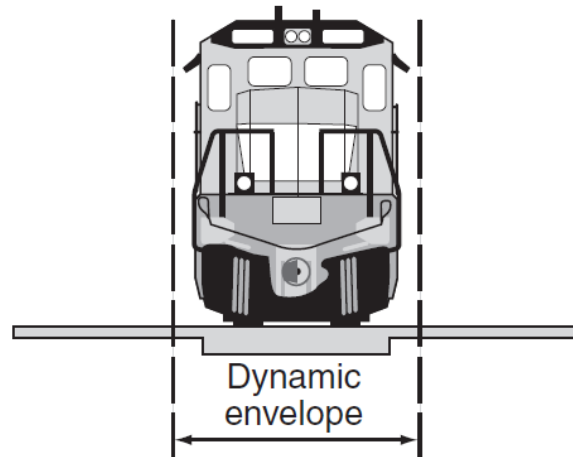


Figure 3.2 Dynamic Envelope

Unsecured fences are prohibited adjacent to LRT. Fences may be secured atop barriers so long as they do not encroach into the dynamic envelope of the train. Any damages caused by the trucks, materials or equipment encroaching into the dynamic envelope are the responsibility of the contractor and may require train repair.

The use or impact to parking spaces adjacent to streetcar requires special consideration to prevent encroachment into the dynamic envelope of the streetcar. Remove parking adjacent to streetcar unless the entire parking space and furnishing zone is completely accessible. Do not place trucks, materials, or equipment adjacent to streetcar without providing a barrier to maintain separation.

3.16 WORK ABOVE AN ACTIVE TRAVEL LANE

Avoid work above an open lane of traffic where possible. Whenever work is being performed over the right-of-way, close that portion of the right-of-way to public use. For instance, when working on a traffic signal, close the lane under the signal to all traffic. When lifting a load over a street, close the street to public traffic under where the load could potentially fall.

3.17 PROTECTION OF TRAFFIC SIGNS AND DEVICES

Protect all existing traffic signs and devices, including pavement markings, regulatory, warning, and guide signs. Do not tear down, cover up, block from view, or otherwise remove signs from their location except as directed by the Traffic Engineer. See Section 4.11, Sign and Signal Covers, for approved devices and protocol.

Temporarily relocated STOP signs should be placed at least seven feet from the ground to the bottom of the sign and installed on temporary sign supports (see ODOT Std. Drg. No. TM821), as directed by the Traffic Engineer. Permittees are responsible for all costs related to the modification, adjustment, repair, removal, and restoration of existing traffic control devices.

Maintain at least one set of existing street name signs at each intersection all times during construction to provide positive route identification and information to emergency responders.

3.18 PROTECTION OF TRAFFIC SIGNALS

Traffic signal poles, cabinets, and junction boxes, should be protected throughout construction. The traffic signal is intended to provide safe crossings for all users including people in mobility devices and should be operational when practical. Maintain access to and around all signal and street lighting infrastructure, including signal cabinets, poles, and lighting panels. Provide at least six feet clearance both front and back of signal cabinets and lighting panels unless otherwise approved by the District Signal Engineer. See Section 4.11, Sign and Signal Covers, for approved devices and protocol.

In cases where signals need to be turned off, the contractor must contact SSL Scheduling per Section 3.7 of this Manual.

At unattended work zones, cover traffic signal faces not in operation. Always cover pedestrian signals not in operation. When traffic signal modifications are required, notify SSL Scheduling per Section 3.7 of this Manual. Workers should exercise caution to prevent damage to all existing traffic signal equipment. If traffic signal equipment is damaged, immediately notify SSL Emergency, as shown in Table 3.4, so that necessary repairs can be performed, and the traffic signals can return to normal operation.

Whenever a contractor will cut or excavate into the street, a street opening permit and utility notification (one-call locate) is required. SSL electricians will locate all existing electrical conduit in orange paint and provide conditions of approval. Conditions may require signal timing adjustments, a loop replacement plan, or temporary traffic signal detection. Temporary traffic signal detection may require the implementation of a microwave radar (Wavetronix or approved equal) or another detection type (as approved by District Signal Engineer). If a video detection unit is to be used, communication to the unit must be provided, so remote troubleshooting can be completed.

3.19 TEMPORARY LIGHTING

Do not alter, remove, adjust, or otherwise impact street lighting equipment without approval from the District Signal Engineer. Whenever temporary lighting is required, maintain existing lighting levels, as approved by the District Signal Engineer in a temporary lighting plan. The applicant may be required to submit a photometric analysis justifying that lighting levels meet City guidelines.

3.20 TRAFFIC CAMERAS

The Traffic Engineer may require cameras be installed at significant projects to aid with vigilance regarding traffic operations and safety. Commonly, cameras can be accessed electronically, and can archive data from a period for later review by the Traffic

Engineer. Typically, large construction sites employ cameras around the site as a theft deterrent, and to monitor work operations, and at times, the Traffic Engineer can be given access to those cameras instead of requiring independent cameras be installed. Camera mounts on SSL equipment are possible and can be discussed with the SSL Division by contacting the District Signal Engineer.

3.21 TRANSPORTATION MANAGEMENT PLAN (TMP) AND TRAFFIC ANALYSIS

Per the federal Work Zone Safety and Mobility Rule (23 CFR 630, Subpart J), *significant projects* are required to develop and implement a TMP, or Transportation Management Plan. PBOT defines a significant project as one with sustained work zone impacts to *busy* streets, or to sidewalks on *non-busy* streets for more than four weeks.

A TMP is used to document and track critical design and implementation decisions made over the course of a project. Referring to and using the contents of the TMP, the TCP can be developed to minimize traffic delays and improve safety for all road users and construction workers. Documented decisions, stakeholder partnership agreements, and previously-explored staging options can all be recalled during construction if a proposal is made to modify the TCP, staging or construction schedule that might compromise the integrity of those decisions or the TCP.

The TMP, and amount of detail within it, is relative to the scope of work – the more complex the project, the more details and information should be included in the TMP. Examples of documented details include:

- Scope of work for individual stages;
- Staging alternatives (rejected and advanced);
- Specific materials, equipment needs or construction techniques;
- Critical timeframes or constraints;
- Summary of traffic signal, vehicle detection, and street lighting modifications;
- Traffic analysis data and impact scenarios in addition to the more obvious TCP-related issues, stakeholder agreements, public notification strategies, project site conditions/restrictions, constructability concerns, budgetary compromises and other issues should also be included in the TMP.

For all significant projects, the TMP should include the following:

- **A temporary Traffic Control Plan (TCP)**
- **Transportation Operation strategies** – Efforts to minimize or mitigate traffic congestion, delay, volumes, peak hour surges, etc., during construction. When impacting the capacity of an existing signal, collect peak-hour turning movement counts and perform a traffic analysis in Synchro. Provide all count data and Synchro files to District Signal Engineer.
- **Public Information and Outreach (PI) campaigns** – Communication strategies to notify affected stakeholders and the traveling public, and inform them of project schedules, changes, alternate routes and mobility options.

3.22 OUTDOOR ADVERTISEMENT

Drivers in an urban environment are challenged by numerous visual distractions competing for attention. Excess signs contribute to the visual workload of drivers and can lead to inattention blindness. Because the consequences of not noticing work zone warning signs are particularly severe, outdoor advertisement is prohibited from being displayed from the right-of-way at work zones. This includes scrim sheeting with advertisements placed on construction fencing located at the curb line. Private advertisements and other signs along the National High System are expressly prohibited per ORS 377.

3.23 MOBILITY NOTIFICATION

Whenever construction or maintenance work will close or restrict the width, length, height or weight of trucks within a work zone on a highway or ramp, a Highway Restriction Notice Form must be completed.

Restrictions or closures on ODOT facilities must be submitted to the Motor Carrier Transportation Division 35 days prior to the restriction beginning. The highway restriction notice form and procedures manual is available at:

<http://www.oregon.gov/ODOT/MCT/Pages/StatewideTrafficMobility.aspx>

Restrictions or closures on PBOT facilities must be submitted to PBOT Over Dimension Permits 10-14 days in advance of the restriction at:

Attn: PBOT OD Permits; 1120 SW 5th Ave, Suite 800; Portland, OR 97204

4 Traffic Control Devices

4.1 PURPOSE AND PRINCIPLES OF TCD

The needs and control of all road users (pedestrians, bicyclists, transit, and motorists) open to public travel including persons with disabilities in accordance with the Americans with Disabilities Act of 1990 (ADA) through a temporary traffic control zone shall be an essential part of any construction, utility work, maintenance operations, and the management of traffic incidents.

The primary purpose of Traffic Control Devices (TCD) is to provide for the safe movement of traffic through or around the work zone. Safety for roadway users and workers within the work zone is enhanced through uniform usage of TCD. Temporary traffic control devices are used to regulate, warn, and guide. TCD used in work zones should exhibit the following characteristics:

- Fulfill a need
- Command attention
- Convey a clear and simple meaning
- Command respect from the road user
- Give adequate response time

TCD that are not needed for the current conditions within the work zone should be turned away from traffic, covered, or removed from the roadway. Maintain all TCD to the "Acceptable" category shown in the ATSSA "Quality Guidelines for Temporary Traffic Control Devices and Features" handbook.

4.2 SIGNS

Warning signs in work zones **shall** have a black legend and border on an orange (or fluorescent orange) background except for emergency response which may use a fluorescent pink background. All signs used at night **shall** be retroreflective. Use type VIII or IX sheeting for aluminum, plywood, or other substrates. Use type VI sheeting for roll-up signs.

Signs should be placed so that neither the sign nor support restrict bike lanes or sidewalks to less than 4 feet in width; for this reason, 48-inch warning signs are typically prohibited except on *high-speed* streets (35mph and faster). Along roads with bike lanes adjacent to the curb with curb-tight sidewalks, or other locations where typical sign placement may restrict sidewalks, bike lanes, paths, or vehicle lanes, consider the following:

- Place sign behind the sidewalk.
- Adjust sign spacing so that the sign can be placed behind the sidewalk.
- Install the signs on an existing utility pole, street light pole, or other sign support with permission from the owner of the support.

- Install the sign on a new perforated steel tube sign support (PSST) with a flange base.
- Use more prominent devices (PCMS, Arrow Boards).
- Install the sign on a traffic barrier sign support.



Figure 4.1 Typical Sign Supports

When signs are placed in a parking lane, parking should be removed in advance of the sign to provide a clear and unobstructed view by an approaching vehicle. Twenty feet of parking space should be removed in front of the sign along streets where the operating speed is 30mph or less. Forty feet of parking spaces should be removed in front of the sign along streets where the operating speed limit is 35mph or greater.

On one-way streets with two or more lanes, signs should be used on both the left and right sides of the street.

Signs should be removed from the road when the condition they warn of is no longer in effect.

Roll-up signs or signs on portable sign supports may be used for 48 hours. Roll-up signs should not be mounted to vehicles. Sandbags may be used to weigh down portable sign supports; manhole riser rings or other devices may not be used as ballast.

For *long-term* work, signs should be mounted on a wood post, TSS, PSST, or barrier support. See ODOT Standard Drawing TM821, PBOT Standard Drawings P-400, P-405 & P-406. Pedestrian signs may be bolted to the sidewalk or asphalt so that they are not moved.

Install temporary STOP signs on a support approved for *long-term* work or provide a flagger for the entire duration of the closure.

4.3 CHANNELIZING DEVICES

The function of channelizing devices is to delineate a desired path, mark specific hazards, separate opposing traffic flows and partially or totally close the roadway. Because space is more constrained in the urban environment, narrower devices may frequently be chosen in lieu of more prominent, conspicuous devices. For example, traffic drums would be used only in key locations because they restrict the opportunity to provide better accommodations for other road users, like people riding bikes. When a more conspicuous device is prescribed, such as a traffic drum, barricade, or vertical panel, tubular markers may be substituted with reducing the device spacing by half.

When channelizing devices conflict with pavement markings, space the devices at no more than $\frac{1}{2} S$ feet, where S is the speed in mph. For example, when it is necessary to create a temporary center line on a 30mph street that is not consistent with the pavement markings, reduce the spacing between channelizing devices to 15 feet. Channelizing device spacing may also be reduced for night work, when shifting traffic, or when it is otherwise desirable to create a more conspicuous path for drivers to follow.

4.3.1 Barricades

Barricade rails consist of orange and white stripes sloping downward at an angle of 45 degrees in the direction road users are to pass. Select barricades from the CPL, or equal. When barricades are used to close a sidewalk, they should extend the full width of the sidewalk surface, and include a detectable edging meeting the requirements of a pedestrian channelizing device.

4.3.2 Cones

Cones should not be used in unoccupied work sites, as they are prone to move in high wind. Cones should be 28 inches tall on *busy streets*. On lower classification streets, cones used only during daylight may be 18 inches tall. Cones used at night **shall** be at least 28 inches tall and retroreflectorized. All cones should have a weighted base and be capable of remaining upright and in place during normal traffic flow and wind conditions.

4.3.3 Plastic Drums (Barrels)

Drums should be used in place of cones or tubular markers for merging tapers on *high-speed* streets. Drums may also be used where it is desirable to provide a more effective visual separation between the work area and active travel lanes. Two rubber ballast rings may be used to prevent drums from moving out of position due to winds.

4.3.4 Tubular Markers

Tubular markers should be at least 28 inches tall. Tubular markers used at night **shall** be at least 28 inches tall and retroreflectorized. Tubular markers are typically used to override existing pavement markings for temporary traffic control setup when it is not otherwise practical to provide clear delineation with pavement markings.

Surface-mount tubular markers should be used to restrict the movement of the device, or when a smaller base width is preferred (e.g. adjacent to a bike lane). Surface-mount tubular markers are preferred to tubular markers with weighted bases for *long-term* work.

Blue tubular markers should be used to delineate business accesses within a work zone.

4.3.5 Vertical Panels

Vertical panels are used to display narrow signs, as channelizing devices, and to replace barricades where space is limited. Vertical panels **shall** be at least 36 inches tall.

4.3.6 Pedestrian Channelizing Devices (PCD)

Longitudinal barricades meeting the ADA Standard may be used to provide a continuously detectable edge along a temporary pedestrian access route. When used in the street, PCDs should have retroreflective markings for enhanced visibility. PCDs may not be used in place of barrier when positive protection is required.

PCDs may be selected from the CPL or fabricated to meet the following requirements.

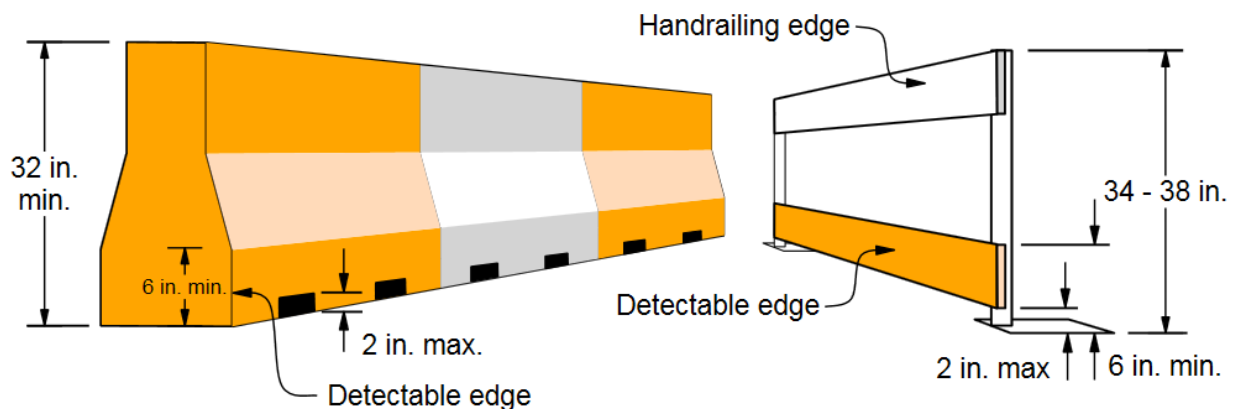


Figure 4.2 Typical Pedestrian Channelizing Devices

1. To prevent any tripping hazard, locate ballast and supports outside of the pedestrian route when not internal to the device.
2. Provide continuously detectable edges for long canes that extend at least six inches above the walkway surface and have color or markings contrasting with the walkway surface.
3. Do not block water drainage from the walkway. A gap height or opening from the walkway surface up to two inches is allowed for drainage purposes.
4. Objects may not protrude into the walkway clear space, except as allowed by the ADA Standard.
5. The minimum height is 32 inches.
6. When hand guidance is required, provide a continuous top rail or surface meeting the following specifications: be in a vertical plane perpendicular to the walkway above the detectable edge; be continuous at a height of 34 to 38 inches above

the walkway surface; and be supported with minimal interference to the hands or fingers.

7. Remove all sharp or rough edges, and round all fasteners (bolts) to prevent harm to hands, arms or clothing.
8. Devices should interlock such that gaps do not allow pedestrians to stray from the channelized path.
9. Devices not allowed: caution tape strung between candlesticks, barricades, cones, or other objects.

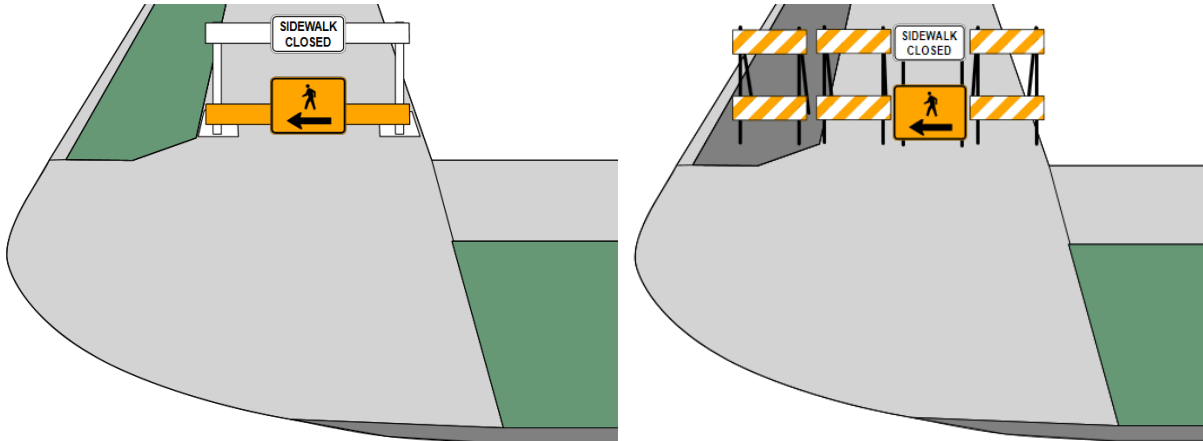


Figure 4.3 PCD or Type II Barricades for Sidewalk Closure

4.3.7 Bicycle Channelizing Devices (BCD)

Longitudinal devices designed primarily to separate bicycles from the work space. These devices may be used between an auto lane and a multi-use or where bicycles will not need to merge with auto traffic to execute a turn or other movement.

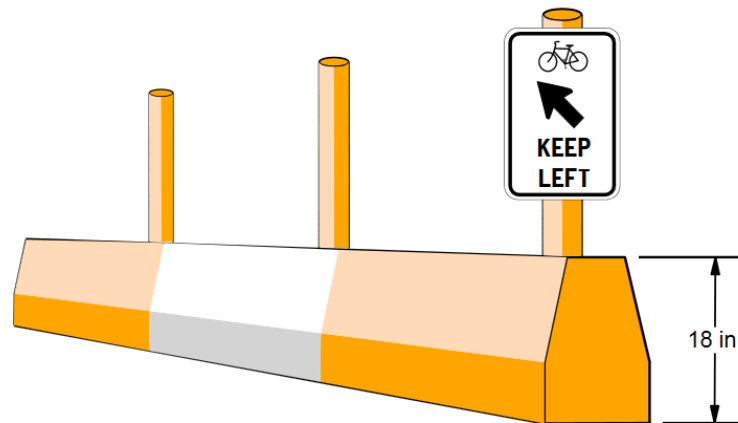


Figure 4.4 Typical Bicycle Channelizing Device

4.4 TEMPORARY PAVEMENT MARKINGS

Paint should be used for temporary pavement markings applied with a stencil, e.g. bicycle symbols, lane use arrows, words. Paint should also be used for lane line

markings for long-term work more than two weeks where tape will require frequent replacement. Four-inch wide lines may be used to simulate permanent lines, except for crosswalk markings, which must be at least six inches wide.

Non-removable tape should be used only when the pavement surface will be removed or overlaid, however, paint is more commonly used to save costs.

Temporary, removable, reflective preformed tape may be used instead of paint for temporary crosswalk striping, as it provides the same function, is easily removed, and does not damage the roadway surface or leave "ghost" markings. Remove temporary crosswalk markings in a manner that is not destructive to the pavement, to the method and satisfaction of the Traffic Engineer, else grind and inlay the entire crosswalk.

Temporary, removable, non-reflective preformed (blackout) tape should be used to cover conflicting existing pavement markings. In situations where blackout tape is not performing well, black paint may be used so long as it is regularly maintained to completely cover existing pavement markings.

Temporary flexible pavement markers may be used for temporary lane line markings and crosswalks. These devices are typically used when the roadway will be opened to traffic following grinding or paving in advance of permanent pavement markings. Do not use temporary flexible pavement markings for more than two weeks without replacement. For skip lines, place groups of three markers on 3-foot spacing every 14 feet. For edge lines or solid centerlines, place markers every five feet. For transverse lines, place markers every foot. Marker colors **shall** match the color of the line they are simulating.

4.5 CURB RAMPS

Temporary curb ramps should be used along accessible routes to transition people from the sidewalk to the street surface. A sample is shown below, with detail requirements. Handrails are required for ramp runs with a rise greater than six inches.

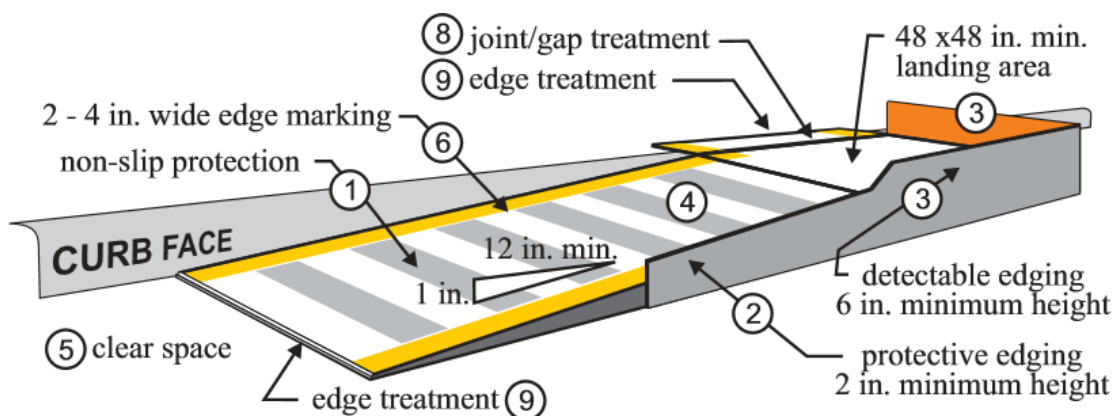


Figure 4.5 Temporary Curb Ramp Parallel to Curb

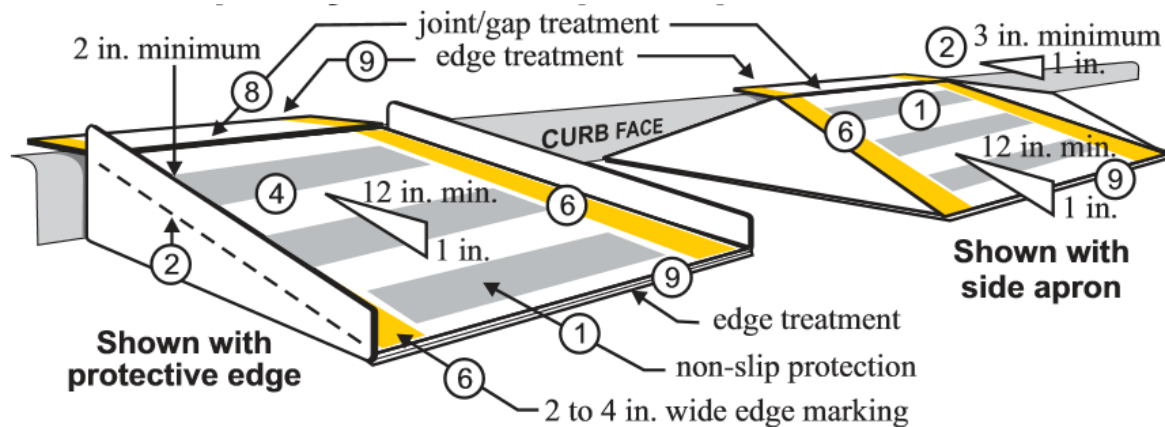


Figure 4.6 Temporary Curb Ramp Perpendicular to Curb

1. Curb ramps are required to be at least 36 inches wide with a firm, stable, and non-slip surface.
2. Edge protection with a two-inch minimum height is required for ramps with a rise greater than six inches or a side apron slope greater than 33 percent.
3. Edge protection is required on ramps with a vertical elevation over six inches and show a contrasting color where the walkway changes direction (turns).
4. Curb ramps and landings are required to have a two-percent maximum cross slope.
5. Provide a clear space of at least 48 inches by 48 inches above and below the curb ramp.
6. Mark the curb ramp walkway edge with a contrasting color two to four inches wide unless color-contrasting edging is used, as required by item 3 above.
7. Water flow in the gutter should have minimum restriction.
8. Limit lateral joints or gaps between surfaces to be less than half an inch wide.
9. Changes between surface heights should not exceed half an inch. Lateral edges should be vertical up to 0.25 inches high and beveled at 1:2 when between 0.25 and 0.5 inches high.

4.6 DETECTABLE WARNING DEVICES

Detectable warnings are required to alert people with vision impairments of their approach to a street crossing or hazard. They are used where pedestrian and vehicle routes cross.

Install temporary truncated domes across the entire width of a temporary pedestrian route at locations where pedestrians are entering an environment shared with motorized traffic, such as at crosswalks and construction entrances. See section 00759.12 of the CPL for a list of acceptable devices.

Temporary guide strips or directional surfaces may be used where vertical detectable devices, such as PCDs, cannot be otherwise used. For example, traffic lane separators may be used to separate a multi-use path from an auto lane.



Figure 4.7 Temporary Curb Installation as Detectable Edging

4.7 LIGHTS AND LIGHTED SIGNS

4.7.1 Beacons

Vehicle-mounted high-intensity rotating, flashing, oscillating, or strobe lights (beacons) may be used on work vehicles to provide advance warning of a potentially hazardous situation. Because they do not inform road users of the nature of the hazard, they should be used only as a supplemental warning device or when it would otherwise be more hazardous to implement more explicit traffic control measures. Only vehicles operated by police officers may be equipped with blue lights.

4.7.2 Warning Lights

Warning lights are portable, powered, yellow, lens-directed, enclosed lights. Do not add warning lights to any channelization device (drums, barricades, etc.)

4.7.3 Arrow Boards

Arrow boards may be used in conjunction with other delineating devices on multi-lane roads to help warn of lane closures requiring merging of travel lanes. Arrow board panels should be 6 feet wide by 3.5 feet tall. Place arrow boards outside of active automobile and bike lanes.

An arrow board in the arrow or chevron mode **shall** be used only for lane closures on multi-lane roadways not to indicate a lane shift. When arrow boards are used to close multiple lanes, a separate arrow board **shall** be used for each closed lane. Vehicles displaying an arrow board **shall** be equipped with beacons.

4.7.4 Flood Lights

Floodlights should be used during night operations to illuminate the work space, equipment crossings, and other areas as required to perform the work. Floodlights **shall** not produce a disabling glare for approaching road users, flaggers, or workers.

4.7.5 Portable Changeable Message Signs

Portable Changeable Message Signs (PCMS) **shall** conform to the requirements of the MUTCD and the ODOT PCMS Handbook. PCMS messages should be no more than two panels. PCMS panels should be 6 feet wide by 3.5 feet tall.

Continuous use of PCMS can desensitize roadway users and should be limited to alert users of changes. PCMS are typically used to alert road users to a new condition and may not be required for the entire duration of a *long-term* project. For example, install PCMS two weeks in advance of major roadway impacts, and remove PCMS after implementation of the TCP. If there will be a second phase of the project with new roadway impacts, install the PCMS again for two weeks with a new message.

4.8 SHADOW AND PROTECTION VEHICLES

A *shadow vehicle* is used as a warning and traffic control vehicle in a mobile work zone. Shadow vehicles provide both the advance warning and lane or shoulder closures for a mobile work zone.

A *protection vehicle* may be used in stationary or mobile operations to protect the workers and work activity.

Shadow and Protection Vehicles are strategically placed to protect the workers and work activity and to warn traffic of the operation ahead. A Truck-Mounted Attenuator (TMA) may be used on either vehicle (see Truck-Mounted Attenuators). If using shadow or protection vehicles, flashing warning lights should be installed on or attached to all vehicles, where practical. Electronic arrow boards in "caution" mode mounted to shadow or protection vehicles may be used to supplement flashing warning lights.

The protection vehicle is placed after the buffer space. For stationary operations, the vehicle should be at least 30 feet in advance of the work space. For mobile operations, the vehicle should be at least 50 feet in advance of the work space. Do not place the vehicle so far in advance of the work space that road users drive around the protection vehicle. Protection vehicles should have a mass of at least 27,000 lbs. on *high-speed* streets, and 17,000 lbs. on all other streets to reduce the likelihood that it rolls ahead into the work zone in a crash.

4.9 BARRIERS

Steel and concrete barriers may be used to provide positive protection or channelization. Select barriers from the CPL, or equal. TL-1 approved devices may be used for operating speeds up to 30mph. TL-2 approved devices may be used for operating speeds up to 45mph. Barriers used for a merging taper **shall** be delineated.

Barriers may move upon impact, thus, either all obstructions should be removed from the expected lateral deflection area behind the barrier or the barrier should be pinned to the road surface. Connect barriers together so that they function as designed. Protect blunt ends with impact attenuators, or flare away from traffic toward the curb at

a rate consistent with ODOT standard drawing TM800 until the barrier is outside of the clear zone.

CONCRETE BARRIER FLARE RATE TABLE	
★ SPEED (mph)	MINIMUM FLARE RATE
≤ 30	8:1
35	9:1
40	10:1
45	12:1

Table 4.1 Barrier Taper Rates from ODOT Std. Drg. No. TM800 (as of 12/1/2016)

Narrow-site impact attenuators may be used in lieu of barrel-arrays in constrained environments. Barriers should be reflectorized with type VIII or IX reflective panels.

There are many longitudinal channelization devices that resemble barriers. These devices are not designed to prevent a vehicle from entering the work area. Plastic water-filled barricades do not provide positive protection for pedestrians or workers. Such devices typically have a posted decal to identify that they do not provide positive protection.

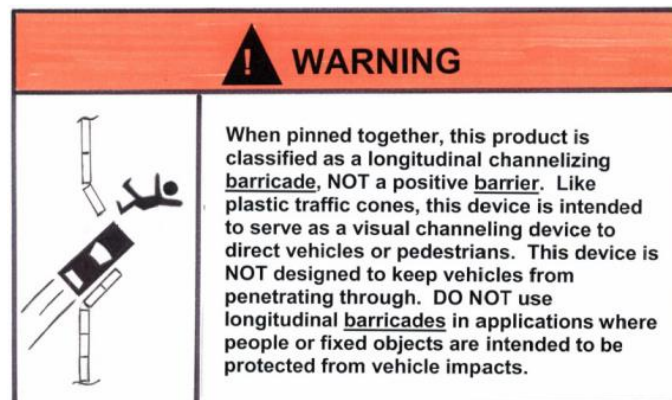


Figure 4.8 Typical Barricade Decal

4.10 TRUCK-MOUNTED ATTENUATORS

Truck-mounted attenuators (TMAs) are crash cushion systems that lower the severity of a collision an errant vehicle. TMAs are mounted on protection vehicles or trailers towed by protection vehicles and located to protect workers within the work area. Consider the manufacturer's rating when choosing equipment for any job site. When traveling to or from the work site, the TMA **shall** be in an upright position. When used, the attenuator should be in the full down and locked position.

4.11 SIGN AND SIGNAL COVERS

Covers for signs are required to be of sufficient size and density to completely block out the message so that it is not visible either during the day or at night. Securely fasten

covers to prevent movement caused by wind action. Devices listed on the CPL may be used to cover signs.

Traffic signal heads, including pedestrian signal heads, are required to be covered with a product that is specifically designed to cover the signal. Coverings should be canvas and display the legend "NOT IN SERVICE" in contrasting lettering.

5 Flaggers and Training

5.1 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 devices.

Flagging operations are typically used when one direction of a roadway is closed, and traffic shares the remaining lane in an alternating manner. When flagging, accommodate all road users, including non-motorized users. Flaggers can also be used to hold traffic for truck entering or exiting the activity area, and to assist pedestrians and bicyclists through the work zone.

Additionally, take special care whenever a work zone causes traffic to backup up to and/or across a rail crossing.

5.2 FLAGGING QUALIFICATION

Flaggers, who have completed formal training and have certification in Oregon, Washington, Idaho, or Montana, may practice as a Certified Flagger in Oregon. Training **shall** be repeated every three years.

5.3 FLAGGING PRINCIPLES

- Flaggers **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.
- Do not control traffic by flagging in conflict with normal intersection traffic control. Only uniformed police officers may control traffic by flagging in conflict with traffic control devices under Oregon law (ORS 811.265). Traffic cannot be flagged to proceed through a traffic signal when facing a red traffic signal light or STOP sign, nor flagged to stop when the traffic signal is green except in an emergency. In rare circumstances, with approval of the Traffic Engineer, flaggers can be used to hold traffic during a green light, so long as there is a separate flagger for each lane of traffic, and they begin to hold vehicles during the red phase of the signal.
- For work which requires traffic signal to be turned off or modified, flagging shall continue until the signal is back in operation or until alternative traffic control is in place.
- Under normal conditions, vehicles should not be delayed longer than five 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 and Traffic Engineer approval. Every effort should be made through media communications to alert the public of long delays.
- Flaggers should provide priority to busses, and clear busses from queueing traffic to minimize rider delays.

- Flaggers should lead out pedestrians and people riding bikes and allow them to clear the work space before allowing auto traffic to proceed.
- Flagger should not be used to slow traffic.

To slow traffic on *high-speed, high-volume* streets, consider using PCMS messages, tighter channelization device spacing, additional static signing, or other mechanical measures. Use of a TMA may provide additional protection for workers where it is difficult to slow traffic.

5.4 FLAGGER STATION PRACTICES

Under normal operating conditions:

- 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;
- Flagger stations should be kept clear of all equipment and vehicles;
- Flaggers should identify an unobstructed escape route to avoid errant vehicles;
- Flagger stations should include one to three cones on the shoulder in front of the flagger station to enhance the visibility of the flagger station;
- Flaggers should stand within closed lanes or on the shoulder;
- After stopping the first few vehicles, flaggers may move from the shoulder to near centerline to be more visible to approaching traffic;
- Flaggers should stand alone, never permitting a group of workers to congregate around the flagger station.

5.5 FLAGGING SIGNS & EQUIPMENT

The Flagger Ahead (CW23-2) sign **shall** be placed in advance of flaggers.

The FHWA Standard Highway Signs (SHS) Flagger symbol sign (W20-7a), showing a flagger holding a flag instead of a STOP/SLOW paddle, should not be used. The Flagger Ahead (CW23-2) sign 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.

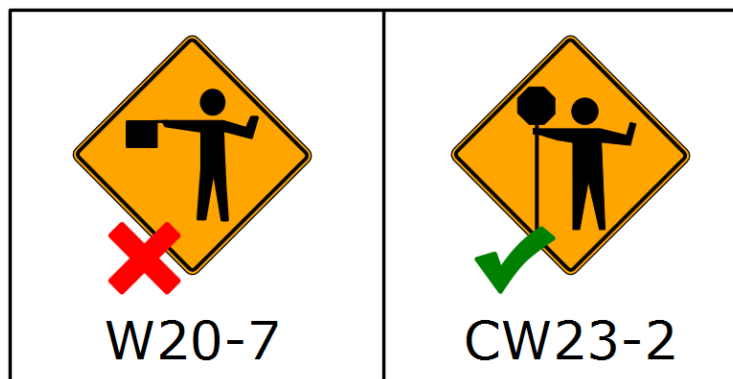


Figure 5.1 Incorrect and Correct Flagger Warning Signs

Extended traffic queues can form when a line of vehicles stopped at the beginning of a work zone extend beyond the initial warning sign. When extended queues repeatedly develop, install additional ROAD WORK AHEAD (W20-1) and BE PREPARED TO STOP signing upstream of the beginning of the traffic queue in accordance with the sign spacing table shown in Appendix A.

- Flaggers **shall** use a minimum 18-inch by 18-inch octagon-shaped retro reflective 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 whenever the paddle is in use. A 24-inch by 24-inch paddle is recommended on *high-speed* streets or in other situations where increased visibility is needed. Roll-up STOP/SLOW paddles are only for emergency use.
- Do not use a flag to control traffic, except in an emergency.
- Flaggers **shall** use only those hand signals approved as shown in the MUTCD, Figure 6E-3.
- 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.

5.6 FLAGGING THROUGH INTERSECTIONS

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 include:

- Contact the Traffic Engineer to determine what closures or detours can be set up.
- Avoid flagging during *peak hours*, especially on major commuter routes.
- There should be one flagger for each approach, and sometimes one flagger for each movement on one approach (i.e. left turn lane and through lane). One flagger may be used to control the entire intersection if the intersection has a total approach volume less than a *low volume* road (<400ADT). Additional flaggers may be required to direct pedestrian traffic.
- With multiple flaggers, designate one as the lead flagger. Effective means of communication, such as radio devices, should be used.
- Approach lanes should be reduced to a single through lane, or one flagger for each lane will be needed. 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 obstruction within the intersection.
- Dedicated lanes may be provided for major turning movements with appropriate regulatory signing such as RIGHT TURN ONLY (R3-5) or RIGHT LANE MUST TURN RIGHT (R3-7) signs. Non-conflicting turning movements may be combined with other movements.
- Conflicting regulatory signs, such as STOP, YIELD or RIGHT TURN ONLY, **shall** be covered.

5.7 NIGHT FLAGGING

When flaggers and/or pilot cars are necessary during night operations, flagger stations **shall** be illuminated separately from the work space. ANSI Class III high visibility safety apparel should be worn during night operations.

Nighttime Flagger illumination strategies should include the following.

- Select flagger station lighting from the CPL. Locate lighting on the same side of the roadway as the flagger, shield from traffic, and illuminate the flagger from 18 feet \pm 3 feet.
- Place the flagger station lighting to direct the lighting away from the approaching traffic in the near lane at approximately a 15° horizontal angle \pm 10° perpendicular to the centerline of the roadway.
- Aim all the luminaries directly at the flagger.
- Increase the output wattage or number of luminaries as the luminance from, and number of, surrounding and background lights increases. Do not provide a total output of more than 2,500 watts, unless otherwise directed.
- The flagger should be visible and discernible as a flagger from 1,000 feet.
- When flagging-station lighting is in use, have on the project site, the following:
 - Repair equipment and electronic components recommended by the manufacturer.
 - At the beginning of each shift, have approved backup flagger station lighting available for immediate use in event of failure.
 - Sufficient fuel to maintain continuous operation of a diesel generator.
- 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:
 - LED lights on the STOP/SLOW paddle, as allowed by the MUTCD;
 - Using a 24-inch by 24-inch STOP/SLOW paddle;
 - Adding two-inch-wide diagonal bands of alternating white and red retro reflective sheeting on the staff of the STOP/SLOW paddle;
 - Lighted safety apparel.

5.8 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. Where an escape route is not available, include a *buffer space* between the Flagger and the *work space*.

5.9 SPOTTERS

A spotter's duty is to provide immediate warning of approaching vehicles, equipment, or other hazards to co-workers, assist with construction equipment backing maneuvers, and help pedestrians or people biking through the work zone when a temporary route

cannot be provided. A spotter is not a flagger. Do not use a spotter to stop automobile traffic.

Prior to the beginning of a shift, the spotter and operators should agree on hand signals and positioning to perform backing operations.

6 Traffic Control Measures

6.1 GENERAL DESIGN CONSIDERATIONS

6.1.1 Work Protections Guiding Principle

Traffic control measures implemented should be proportional to the scope of the work. For example, pothole repair will more often utilize beacons and a short taper of cones than warning signs and arrow boards. Typically, it should not take more time to setup the traffic control measures than it takes to perform the work. Thus, select measures that reduce worker exposure and adequately warn, regulate, and guide road users.

6.1.2 Implementing the Temporary Traffic Control Plan

Operations to set up and take down traffic control often are the times when crews are at their greatest exposure. Due to the multiple variations of crew size, available equipment and location, no one procedure can fit all situations. To provide consistency and guidance on how to best perform the operation, the following steps should be taken:

- Prior to any operation beginning and before any crew member is exposed to live traffic the crew will discuss the daily pre-activity safety plan involving the activity with the crew leader or lead flagger.
- Within the pre-activity safety plan, discussion regarding the procedure for the setup and take down operation for the traffic control is to be decided and all crew members will be fully aware of their duties and what is expected of them.
- The traffic control plan being implemented for the work operation will be discussed and any modifications to the plan will be noted by the supervisor and the plan will be onsite during work operation.

6.1.3 Adjust to Fit Field Conditions

Typical taper lengths and sign spacing may vary depending upon site conditions. If the work is near a crest curve or hill that hinders sight distance additional warning signs may need to be added. If the work is in an urban area, additional warning signs may be required on multiple approaches to the work zone.

Adjustments to device and sign spacing may be required when working on Portland's 200-foot blocks or in commercial districts where available curb space is limited. Rather than remove parking to provide adequate sight distance to warning signs, consider placing signs in nearby locations without conflicting parking, such as downstream from a crosswalk or driveway.

6.1.4 Lane Requirements

Motorized vehicle travel lanes should be maintained to 10 feet minimum unless otherwise required for emergency responders as indicated in section 3.13, or busses as indicated in section 6.4.

6.1.5 Shy Distance and Buffer Space

Shy distance is the lateral distance from the edge of the traveled way beyond which a roadside object will not be perceived as an immediate hazard by the typical driver to the extent that the driver will change the vehicle's placement or speed. At least one foot of shy distance should exist from low, fixed objects such as curbs. At least two feet of shy distance should exist from vertical objects greater than one foot tall, such as barriers, fences, dumpsters, or crane outriggers. Thus, wherever practical, an existing 10-foot lane should be increased to an 11-foot lane when adjacent to a curb, or 12-foot lane when adjacent to a barrier.

Buffer space is a lateral or longitudinal area that separates road user flow from the work space or an unsafe area and might provide some recovery space for an errant vehicle. Lateral buffer space provides space between the driver and the active work space, traffic control device, or to a potential hazard such as an abrupt lane edge or drop-off. At least two feet of lateral buffer space should separate traffic from the work zone. Devices used to separate the driver from the work space should not encroach into adjacent lanes. If encroachment is necessary, it is recommended that the adjacent lane be closed to maintain the lateral buffer space. In the case of lane closure operations, the adjacent lane may need to be closed, or traffic may need to be temporarily shifted onto a shoulder to maintain a lateral buffer space. Longitudinal buffer is the space between the end of the taper and the buffer vehicle or active work zone. Longitudinal buffers should be provided when space is available but are optional.

6.1.6 Night Time Operations

Night time can pragmatically be defined as any time where street lights are on. On clear days, this can include civil twilight, approximately one hour before dawn and after dusk. Working at night time when there is less traffic on the road can be the only practical way to accomplish some work tasks. Any time drivers require the use of their headlights for visibility is considered "night-time conditions." Use the following basic principles for adjusting your traffic control for night-time operations.

1. Use enough lighting to provide a safe environment in the work zone. Avoid creating glare for oncoming traffic.
2. All TCDs **shall** be retro reflective, including signs, channelization devices, and flagger STOP/SLOW paddles.
3. All TCDs and worker safety apparel should be kept in good condition, without damage or graffiti, and provide sufficient reflectivity to be visible from 1000 feet.
4. Pedestrian diversions, detours, and vehicle lanes adjacent to sidewalk closures should be adequately lit.
5. In residential areas, avoid aiming work space floodlights into homes or yards.
6. For information on flagging at night, see the Flagging Section.

6.1.7 Mobile Work

Mobile work zones include planned work activities that last up to 60 minutes at any one location. Due to the short work time, the time it takes to set up a full complement of

signs and devices could approach or exceed the time required to perform the work, so simplified traffic control measures can reduce worker traffic exposure. Mobile work may reduce worker exposure to traffic hazards by using larger, more mobile equipment instead of smaller devices.

Examples of mobile work zone operations include, but are not limited to:

- Loading and unloading equipment
- Re-lamping
- Pothole patching and other minor repairs
- Surveying
- Bridge inspection
- Field reconnaissance
- Pre-work layout
- TTC placement and removal
- Sanitation pickup
- Street sweeping
- Pavement marking
- Traffic signal and sign maintenance.

Although these are very short duration activities, always consider the key work zone elements. High worker exposure locations dictate the traffic control measures. It is recommended to apply more work zone safety measures if the level of safety can be raised without adding to worker exposure time. Working in teams of two, where one worker can act as a spotter from a safe location, is a good example of an additional safety measure. The workers' ability to maintain awareness of traffic conditions and potential hazards is a key concern.

For work vehicles that travel slowly or stop for brief periods, display at least the following based on the time at each location:

- **Up to 15 minutes:**
 - Vehicle hazard warning lights.
 - One beacon.
- **16 to 60 minutes:**
 - Short taper of cones (at least 50 feet long with six 28-inch-tall cones).
 - Vehicle hazard warning lights.
 - One beacon.
 - One advance warning sign, arrow board or portable changeable message sign.
- **Any Duration Lane Closure on *High-Speed* Streets:**
 - Mobile truck-mounted impact attenuator
 - Truck-mounted Arrow Board

Locate beacons and arrow boards so that they always remain in full view, front and rear, and are not obscured by dump beds, mounted equipment, trailers, or work

activity. Mount arrow boards seven feet from the ground to the bottom of the board, except when installed on vehicles, where they should be mounted as high as practicable.

When a work vehicle will stop on a sidewalk and block the pedestrian route, provide a spotter to assist pedestrians through the work zone.

When a work vehicle will stop in a bike lane, place an appropriate warning sign, such as BIKE LANE CLOSED AHEAD, 50 feet in advance of the work zone. The BICYCLES ON ROADWAY sign, or some other variant, is confusing and not acceptable.

Mobile work zones are not permitted within or adjacent to existing active work zones without prior approval from the Traffic Engineer, and a plan to adjust TCM to adapt to the mobile work.

6.1.8 Steel Plating

City right-of-way inspectors may require that plates be placed without pinning, pinned to the roadway, or inlaid into the surface. Place the STEEL PLATE AHEAD (W8-24) signs in accordance with the sign spacing shown in the distance table. Plates must be skid resistant if the surface is part of a pedestrian or bicycle route.

6.1.9 Shifting and Merging Through Intersections

Traffic may be shifted laterally through an intersection if minimum shifting tapers can be maintained in accordance with the MUTCD. Shifting tapers should begin before the intersection to give vehicles positive guidance as to the direction of the shift. Consider temporary skip markings through the intersection, particularly when shifting on multilane roadways. Check turning movements, especially the paths of left turning vehicles, to ensure that vehicles will be able to make turns without conflicting with stopped vehicles on a cross-street.

Merging two travel lanes into one **shall** be done either before or after an intersection.

When lanes are shifted at signalized intersections the angle of view to the traffic signal should be within the angle required in MUTCD (20 degrees left and right of center). Consideration should be given for traffic signal detection, as sensors may not function as designed. See 3.18, Protection of Traffic Signals.

6.1.10 Heavy Rail Crossings

If the queuing of vehicles across active rail tracks cannot be avoided, flaggers **shall** be provided to prevent traffic from stopping within 15 feet on either side of the rail, even if automatic warning devices are in place. When sufficient downstream storage becomes available, and there are no approaching trains, the flaggers may release traffic. The TCP should be specific about the expected flagging operation and the city crew, inspector, or other project representative should talk to the flagger(s) on site prior to the work zone implementation to discuss the flagging operation.

Roadway Worker Protection (RWP) Safety Training may be necessary for any work zones in proximity of a rail crossing. The implementation and oversight of RWP training is handled by each railroad. Accordingly, contact a carrier before beginning work to determine how the railroad's specific training is to be accomplished.

6.1.11 Use of Police Officers

Uniformed law enforcement officers and marked law enforcement vehicles should be considered in special cases where their presence can reduce the overall complexity of TCM and increase road user's compliance in complex situations. Because only police officers may flag traffic against an active traffic signal (ORS 811.265), police have been used in special events and community events based on engineering judgment.

The Portland Police Association may provide an opportunity for a permittee to hire off-duty officers. The Portland Police Association (PPA) may be contacted at 503-225-9760.

6.2 PEDESTRIAN ACCOMMODATIONS

When existing pedestrian facilities are disrupted, closed, or relocated in a TTC zone, the temporary facilities **shall** be detectable and include accessibility features consistent with the features present in the existing pedestrian facility. Accommodate pedestrians in accordance with Bureau of Transportation Administrative Rule TRN-8.12, Safe Accommodation for Pedestrians and Cyclists in and Around Work Zone. When an existing walkway or sidewalk is disrupted or closed, a diversion should be implemented rather than a detour. Detours should not last more than three days on a *busy street*, or one week on other streets. A pedestrian route may be given priority over parking, bicycle, and vehicle lanes.

6.2.1 Priority

The method for providing safe accommodations for pedestrians should be prioritized as follows:

- A. Protect the existing pedestrian route from the worksite.
- B. Provide a temporary pedestrian route in a parking lane and protect it from adjacent traffic.
- C. Provide a multi-use path in an existing bike lane (eight-foot minimum).
- D. Provide a pedestrian route in an existing bike lane, protect it from traffic, and merge cycles with traffic on streets with operating speeds of 30mph or less.
- E. Provide a pedestrian route in an existing traffic lane.
- F. Provide a pedestrian detour route.

6.2.2 Accessible Route Standards

The following technical standards apply to accessible routes:

- Six-foot minimum unobstructed width on *busy streets*;
- Five-foot minimum unobstructed width on *non-busy streets*;
- Eight-foot minimum unobstructed width where bicycle traffic is expected to share with people walking;

- The route may be reduced to 36 inches for no more than 200 feet, with Traffic Engineer approval;
- The route may be reduced to 32 inches for no more than two feet around fixed objects, with Traffic Engineer approval;
- Two-percent maximum cross slope;
- 80-inches minimum overhead clearance (or 96-inches for a multi-use path);
- The route should be continuously detectable and free of obstructions such as temporary fence support legs, signposts, and scaffolding;
- Barricades used to close the sidewalk should span the entire width of the walkway surface.

Do not use caution or warning tape to delineate the path of travel or create a barricade. Use only approved pedestrian channelizing devices (PCDs) or barricades and other devices meeting the requirements of a PCD to close a pedestrian route or prevent pedestrians from entering an area.

Barriers, barricades, fences, or PCDs should be used to separate pedestrians from hazards, including excavations, open utility access, overhanging equipment, or other such conditions. Install detectable edging or PCDs between accessible routes and travel lanes along streets with operating speeds less than 35mph. Consider barriers to provide positive protection to pedestrians along streets with operating speeds greater than 30mph.

Accessible routes should be continuously detectable and safely guide pedestrians back to the original sidewalk or walkway. Detectable edges should be provided along the bottom of any obstacles, such as signs or barricades. See section 4.3.6 of this manual for specifications.

When an accessible route is transitioned to a surface with a different elevation, such as from the sidewalk to the parking lane, the route should cross the transition at right-angles.

6.2.3 Short-Term Impacts

If an existing sidewalk or walkway is impacted by *short-term* work that is attended by workers, establishing an accessible route may not be necessary if the work can be stopped and pedestrians can navigate the work zone safely. When an accessible route extends through an active work zone, it is the permittee's responsibility to maintain a safe passage. Pedestrians may be held for a short period for project personnel to move equipment and materials to facilitate passage. Project personnel may also assist people with disabilities through the work zone. Pavement markings or temporary tactile warning devices may be placed on the sidewalk and additional warning signage may be used to alert pedestrians of the beginning of a work zone.

6.2.4 Closing Crosswalks

When an existing crosswalk is closed, the entire width of the crosswalk should be closed with a type III barricade, fence, PCD, or barrier. In instances where such a measure

would obscure viewing angles for intersection traffic, smaller devices such as type II barricades, may be used.

At signalized intersections, cover existing pedestrian signal heads on both sides of the closed crosswalk. Access to the pedestrian push buttons for traffic signals or pedestrian hybrid beacons should be maintained in all cases unless the contractor has approval from SSL to set the traffic signal on pedestrian recall. The maximum reach requirement for a pedestrian push button is 10 inches per the ADA Standard.

6.2.5 Temporary Marked Crosswalks

Temporary marked crosswalks or crossing enhancements should not be installed without the support of an engineering study. Such a study should consider the volume of pedestrians and automobiles, the distance between the curbs, a gap distance analysis, vehicle speed, pedestrian walking speed, and observed use. The use of the methods outlined in NCHRP 562 is a currently acceptable practice before a decision is made whether to install a marked or enhanced crosswalk. Curb parking **shall be** prohibited for at least 50 feet in advance of a temporary midblock crosswalk. Parking should be prohibited for at least 20 feet in advance of a temporary marked crosswalk at a legal crossing. Temporary marked crosswalks should be installed based on the current guidelines and design criteria listed in section 1.2.3 of the Portland Traffic Design Manual, Crosswalks.

Temporary crosswalk pavement markings should be installed per section 4.4.

6.3 BICYCLE ACCOMMODATIONS

Accommodate bicycles in accordance with Bureau of Transportation Administrative Rule TRN-8.12, Safe Accommodation for Pedestrians and Cyclists in and Around Work Zone. When an existing bicycle lane or path is disrupted or closed, a temporary bicycle facility should include the features and characteristics present in the existing facility. For example, if a bike lane will be closed, a temporary bike lane should be created to guide bikes past the work zone, rather than closing the bike lane. Temporary bicycle facilities may be given priority over parking and general-purpose auto lanes on a multilane road, as determined by the Traffic Engineer. Bicycles should be separated from automobile traffic whenever possible except for shared bus/bike lanes. In situations where it is not feasible to provide an exclusive bicycle facility, bicycles should be directed to either a shared path (such as a sidewalk) before being directed to share a travel lane with automobile traffic.

6.3.1 Priority

The method for providing safe accommodations for cyclists should be prioritized as follows:

- A. Provide a temporary bike lane on the same roadway past the work zone by shifting and narrowing the adjacent traffic lanes.
- B. Provide a temporary bike lane in an existing traffic lane on multilane streets.

- C. Merging cyclists and adjacent traffic into a shared travel lane (except on *high-speed* streets).
- D. Directing cyclists onto a shared path with pedestrians.
- E. Provide a bicycle detour route.

6.3.2 Bike Lane Standards

Do not merge bikes with autos on streets with operating speeds of 35mph and greater. Maintain four-foot wide temporary bicycle lanes. The Traffic Engineer may approve temporary bike lanes as narrow as three feet wide. When there is insufficient roadway width to maintain a separate bicycle and automobile lanes, mitigations should be made with relevant traffic control measures, e.g. advisory speed zone, warning signage, bike route detours, or auto detours.

6.3.3 Multi-Use Path Standards

A multi-use pedestrian/bicycle path (MUP) should be maintained to a minimum width and vertical clearance of eight feet. Separate the path from the work space in accordance with 6.2.2, Accessible Route Standards. When the path is located on the roadway surface, separate it from automobile traffic with barriers, BCDs, or detectable edging. Give proper notice to bicycles, pedestrians, and vehicles regarding a change in use to a shared route.



Figure 6.1 Shared Facility Signs

6.3.4 Work Space Protections

People riding bikes will frequently ride behind a line of channelizing devices, such as cones, when they do not perceive a hazard, even if it is not safe to ride in the work space. To prevent cyclists from entering the work space, place appropriate regulatory signs, as shown in Figure 6.2, along the work space following access points and at regular intervals throughout a longer work zone as a reminder bicycle traffic. Caution tape or cone bars may also be used to prevent bicycles from encroaching into the work space. Temporary ramps can be used to maintain the bike lane over temporary hoses and bypass pipes.

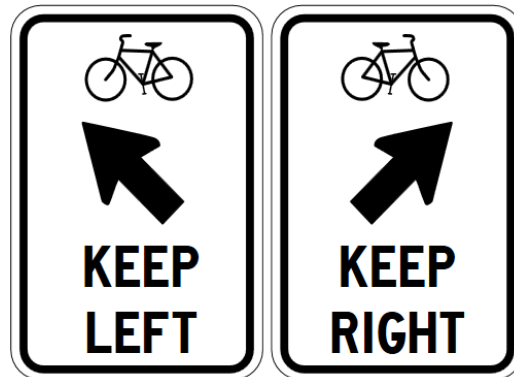


Figure 6.2 Bicycle Regulatory Signs



Figure 6.3 Bicycle Work Space Protections

6.3.5 Bike Facilities on Streets with Tracks

Do not shift bicycle into lanes with parallel rail tracks. When shifting or merging traffic into a lane with parallel rail tracks, plan an alternate route for bikes that is smooth and free of tracks or other obstructions which may be hazardous to bicycles.

Bike routes should be directed to cross tracks at an angle of at least 60 degrees. A perpendicular crossing of 90 degrees is ideal. Do not cross cyclists over tracks within a curve, as bicycles must be able to cross tracks fully upright and not leaning. When bike lanes will be transitioned across tracks, warning signs should be used to alert people on bikes of the hazard. Some examples of such signs are shown below.

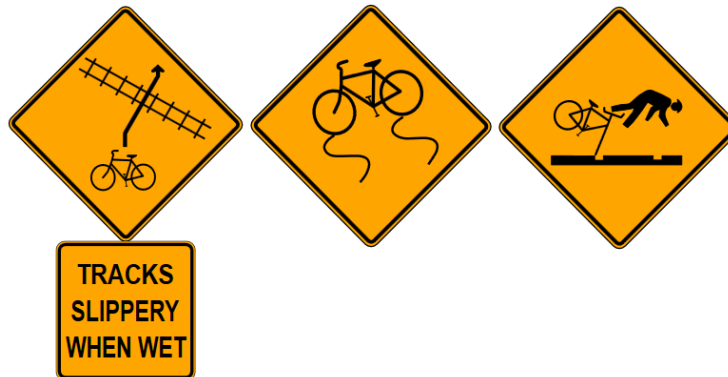


Figure 6.4 Warning Signs for Bicycles Near Rail

6.4 TRANSIT ACCOMMODATIONS

Visit ride.trimet.org to identify current bus routes and stops potentially impacted by the work. When an existing bus stop is disrupted or closed, a temporary bus stop will be considered by TriMet. Contact TriMet early to address impacts and mitigations.

Temporary bus stops should be given priority over parking.

TriMet buses require a minimum width of eleven feet to travel through a work zone. The newest busses (Gillig 3000 series and later) are 10.66 feet, including mirrors. When busses operate in lanes less than eleven-feet wide, they must straddle adjacent vehicle, buffers, or bike lanes. Physical constraints less than eleven feet precludes bus service and requires a bus detour or route closure. Because bus routes have priority over parking and construction worker convenience, bus detours should only be implemented as a last resort after parking removal and work hour changes have been considered.

6.5 BUSINESS ACCOMMODATIONS

Use BUSINESS ACCESS (CG20-11) signs based on engineering judgment. Specific business names (e.g. "Chevron", "Burger King", "Fred Meyer", "Woodburn Factory Stores", "Washington Square", etc.) **shall not** be used on BUSINESS ACCESS signs or riders. Use blue plastic tubular markers with blue reflective bands to delineate the radii for all affected business accesses. Use blue BUSINESS OPEN AHEAD signs in advance of businesses that have been isolated by an adjacent sidewalk closure which has eliminated pass-by traffic.

6.6 COVERED WALKWAYS

Whether overhead protection is required for an accessible route is determined based on the Oregon Structural Specialty Code (2010 OSSC Section 3306.7). Table 3306.1 from the OSSC is shown below for reference.

TABLE 3306.1
PROTECTION OF PEDESTRIANS

HEIGHT OF CONSTRUCTION	DISTANCE FROM CONSTRUCTION TO LOT LINE	TYPE OF PROTECTION REQUIRED
8 feet or less	Less than 5 feet	Construction railings
	5 feet or more	None
More than 8 feet	Less than 5 feet	Barrier and covered walkway
	5 feet or more, but not more than one-fourth the height of construction	Barrier and covered walkway
	5 feet or more, but between one-fourth and one-half the height of construction	Barrier
	5 feet or more, but exceeding one-half the height of construction	None

For SI: 1 foot = 304.8 mm.

Table 6.1 OSSC Overhead Protections Excerpt

6.7 LANE CLOSURES AND DETOURS

Lane use changes should be clearly marked to direct the traveling public through a safe route. Traffic volumes should be considered whenever closing lanes, as drivers may not anticipate extended traffic queues. Where extended queues are expected, install warning signage upstream of the expected 95th percentile queue length.

Do not detour *busy street* traffic through non-*busy streets*, unless approved by the Traffic Engineer. Whenever implementing long-term detours, consult the district signal engineer concerning signal timing adjustments.

Detour signs should have street name rider plaques placed above the detour signs. Include advance detour signs, e.g. NEXT LEFT, DETOUR RIGHT, along detour routes in advance of decision points that require lane changes and slowing to safely follow the route.

6.8 WORK ZONE SPEED REDUCTION

Under some circumstances, it may be necessary or advantageous to implement a temporary speed reduction through a work zone. Speed zones are not enforceable unless an official Speed Zone Reduction Order is approved and signed by the City Traffic Engineer. Temporary speed zone reductions **shall** be implemented in accordance with ORS 810.180(8).

In general, construction speed zone reductions are not warranted under the following conditions.

- Activities which are more than ten feet from the edge of the traveled way
- Activities which require an intermittent or moving operation on the shoulder

National Cooperative Highway Research Program (NCHRP) study 581/482 provides conditions under which temporary speed zones may be warranted. Below are combinations of ODOT and NCHRP conditions which are considered when evaluating requests for temporary reduced speed zones.

- A high crash rate within the work zone.
- Workers present for extended periods within 10 feet of the traveled way unprotected by barriers.
- Traffic control devices encroaching on a lane open to traffic or within a closed lane but within 2 feet of the edge of the open lane that can't be moved to a safer location.
- Barrier or pavement edge drop-off within 2 feet of the traveled way.
- Horizontal curvature with a safe speed of 10 or more mph lower than the posted speed.
- Reduced design speed for detour or transitions (radius of curvature, super-elevation and sight distance) when the distance between restrictions is less than ¼ mile.
- Lane width reductions of 1 foot or more with resulting lane width less than 10 feet.
- Unusual conditions which are hard to sign or otherwise communicate to travelers effectively.

Work zone speeds are signed with a fluorescent orange Speed Reduction (W3-5) sign followed by a WORK ZONE (G20-5ap) above a SPEED LIMIT XX (R2-1) sign, as shown below. This will more clearly identify that it is a temporary speed zone.

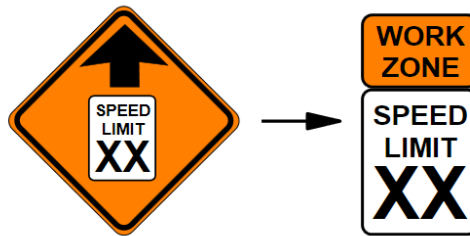


Figure 6.5 Speed Zone Reduction Signage

Include the following in a temporary speed zone order:

- the affected roadways,
- the beginning and ending location of the speed zone order measured in feet from the nearest cross-street,
- the temporary construction zone speed,
- the dates the order is in effect,
- the reason for the speed zone order.

Speed zone orders should be sent to ODOT State and Region 1 Traffic Division, and acting Captain of the Portland Police Bureau Traffic Division.

There are non-enforceable alternatives to warn of conditions that warrant reduced speeds, including:

- Advisory Speed (W13-1) riders below warning signs;

- ROAD WORK XX MPH (CW20-1a);
- Curve (W1-2a) with an advisory speed included on the sign face.



Figure 6.6 Warning Signs with Advisory Speeds

Advisory speeds **shall** only be used where an engineering study determines the need to advise drivers of an advisory speed for a condition. Advisory speed plaques **shall** be fluorescent orange and in 5 mph increments. The speed displayed on the sign should be determined through engineering judgment and have Traffic Engineer approval.

Avoid creating a temporary situation that would require an advisory speed of more than 10mph below the pre-construction posted speed. Reducing the posted speed of a facility through a Temporary Speed Zone reduction or by signing an advisory speed does not constitute a reduction in the design speed for traffic control measures or the traffic control plan.

7 Typical Applications

The typical applications herein represent traffic control measures that can be applied to a variety of scenarios. These illustrations are not backed by engineering analysis, or calculations. These typical applications should be used as standard details to quickly add detail to a specific project and may require modification by the project professional of record or Traffic Engineer. Specific situations, not specifically illustrated, need to be addressed making best use of the general principles described in this manual, the MUTCD, and these illustrations.

7.1 GENERAL

General Conditions, Symbol Definitions, and Tables

Commonly Used Regulatory and Guide Signs

Commonly Used Warning Signs

7.2 SIDEWALKS

TA-S1 Diversions

TA-S2 Detours

7.3 BIKE LANES

TA-B1 Temporary Bike Lane

TA-B2 Bike Lane in Closed Auto Lane

TA-B3 Merging Bikes and Autos

TA-B4 Diverting Bikes onto a Sidewalk

TA-B5 Diverting Bikes into Parking

7.4 INTERSECTIONS

TA-I1 Right Turn Lane or Shoulder Closure

TA-I2 Left Turn Lane Closure

TA-I3 Inside Lane Closure

TA-I4 Outside Lane Closure with Turn Lane

TA-I5 Shift through Shoulder

TA-I6 Shift through Left Turn Lane (Far Side Work)

TA-I7 Shift through Left Turn Lane (Near Side Work)

TA-I8 Flagging

TA-I9 Left Turn Lane Pocket

7.5 TWO-WAY STREETS

TA-T1 Half-Street Road Closure

TA-T2 Shoulder Closure

TA-T3 Flagging

TA-T4 Two-Way Left-Turn Lane Closure

TA-T5 Work in Center of Road

TA-T6 Shift through Two-Way, Left-Turn Lane

TA-T7 Shift over Centerline

TA-T8 Shift on Multilane Road

7.6 NON-BUSY STREETS

TA-L1 Road Closure on City Bikeway

TA-L2 Road Closure

TA-L3 Half-Street Closure

TA-L4 Shoulder Closure

TA-L5 Flagging

TA-L6 Shift Over Centerline

TA-L7 Self-Regulating Lane Closure

7.7 ONE-WAY STREETS

TA-O1 Merge

TA-O2 Shift

TA-O3 Center Lane Closure

TA-O4 Street Closure

7.8 MOBILE OPERATIONS

TA-M1 Shoulder Closure

TA-M2 Self-Regulating Lane Closure

TA-M3 Flagging

7.9 OTHER



















TA-X1 Parking Removal in Work Zone

TA-X2 Auxiliary Lane Closure

TA-X3 Flagging Auxiliary Lane Closure

TA-X4 Work Adjacent to Streetcar

Legend of Symbols on Typical Applications

 Arrow board	 Spotter
 Arrow board support or trailer (shown facing down)	 Temporary barrier
 Channelizing device	 Temporary pedestrian signal
 Changeable message sign or support trailer	 Temporary ramp
 Flagger	 Traffic signal
 Pavement marking removal	 Truncated dome
 Pedestrian channelizing device	 Type 3 barricade
 Pedestrian signal	 Work space
 Sign (shown facing left)	 Work vehicle

General Conditions for Typical Applications

- 1) All traffic control devices and measures must be placed per the MUTCD and may require adjustment to fit field conditions.
- 2) Traffic control measures must be implemented under the supervision of a competent person having a card or certificate indicating their completion of an approved work zone traffic control course.
- 3) Provide work notifications according to section 3.7.
- 4) When a project restricts the width, length, height, or weight of vehicles through a work zone or detours trucks around a work zone, Traffic Engineer approval is required.
- 5) Do not close any traffic lanes on busy streets between noon on the day before a legal holiday or holiday weekend and 11:59 p.m. on a legal holiday or the last day of a holiday weekend, except for Thanksgiving, when no lanes may be closed between noon on Wednesday and 11:59 p.m. on the following Sunday.

Table to Determine Distance Represented by Letter Codes Shown on Typical Applications.

	Speed	Sign Spacing		Buffer	Device	Taper Length (12ft lane)		
	S* (mph)	A (min)	A (max)	B	C** (max)	Merge (L)	Shift (L/2)	Shoulder (L/3)
LOW SPEED	20	100	200	50	20	80	40	30
	25	100	200	75	25	125	65	45
	30	100	200	100	30	180	90	60
HIGH SPEED	35	200	350	100	35	245	125	85
	40	200	350	150	40	320	160	110
	45	200	500	180	45	540	270	180

All distances shown in feet.

* Pre-construction posted speed limit or statutory speed.

** Place traffic control devices on 10ft spacing within intersections, along access radii, and for channelizing bikes.

Formulas for Determining Taper Lengths

Speed (S)	Taper Length (L) in feet
40 mph or less	$L = \frac{WS^2}{60}$
45 mph or more	$L = WS$

Where: L = taper length in feet
 W = width of offset in feet
 S = posted speed limit, or off-peak 85th-percentile speed prior to work starting, or the anticipated operating speed in mph







































































REGULATORY SIGNS

R1-5b 36"x36"	R2-1 30"x36"	R2-12 24"x36"	R2-6aP 24"x18"	R3-1 18"x18"	R3-2 18"x18"	R3-5 30"x36"	R3-5hP 30"x12"	R3-6 30"x36"	R3-6 30"x36"	R3-7 30"x30"
R3-7a 24"x18"	R3-7a 18"x18"	R3-8 30"x30"	R3-8 30"x30"	R3-8 66"x30"	R3-17 24"x8"	R3-17aP 24"x8"	R3-27 18"x18"	R4-7 24"x30"	R4-7c 18"x30"	
R4-9 24"x30"	R4-11 30"x30"	CR4-20 24"x15"	CR4-20a 12"x12"	CR4-22a 12"x18"	R5-1 30"x30"	R5-1a 36"x24"	R5-2 24"x24"	R6-1 36"x12"	R8-8 24"x30"	R9-3 18"x18"
R9-6 12"x18"	R9-7 12"x18"	R9-9 24"x12"	R9-11 24"x18"	OR17-1 30"x36"	OR10-15a 42"x36"	OR10-15b 30"x30"	OR10-15 36"x30"	R11-2 48"x30"	R11-4 60"x30"	

GUIDE SIGNS

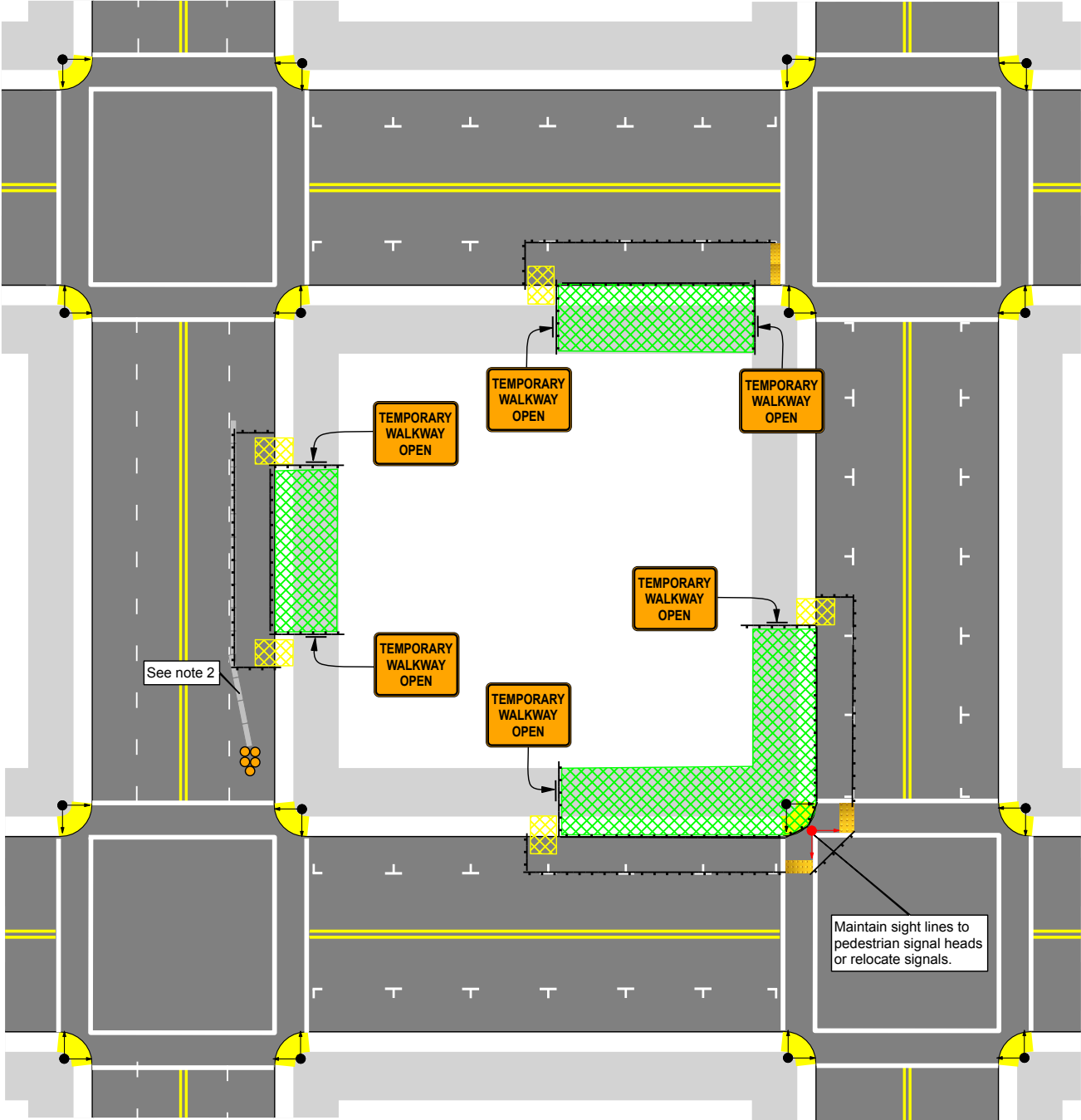
CG20-11 24"x16"	D3-1 12"x30"	D3-1 12"xVar.	G20-4 36"x18"	G20-5aP 24"x18"	M1-1 24"x24"	M3-1 24"x12"	M4-5 24"x12"	M5-1 21"x15"	M6-1 21"x15"	M5-4 24"x18"
M4-10 48"x18"	M4-8 24"x12"	M4-8a 24"x18"	M4-8b 24"x12"	M4-9 30"x24"	M4-9a 24"x18"	M4-9b 24"x18"	M4-9c 24"x18"	M4-9b 24"x18"	M4-9b 24"x18"	M4-9c 18"x24"
M4-9a 24"x36"	M4-9 MOD 24"x18"									

WARNING SIGNS

										
W1-1 36"x36"	W1-2 36"x36"	W1-3 36"x36"	W1-4 36"x36"	W1-6 48"x24"	W1-8 18"x24"	OBW1-9 36"x36"	W3-1 36"x36"	W3-2 36"x36"	W3-3 36"x36"	W3-4 36"x36"
										
W3-5 36"x36"	W4-1 36"x36"	W4-1 36"x36"	W4-1 36"x36"	W4-2 36"x36"	W16-1P 24"x18"	W4-3 36"x36"	W4-7 36"x36"	W5-1 36"x36"	W6-3 36"x36"	W6-4 12"x18"
										
W8-3 36"x36"	W8-11 36"x36"	W8-15 36"x36"	W8-15p 24"x18"	W8-23 36"x36"	W8-24 36"x36"	W8-25 36"x36"	W9-3 36"x36"	W11-2 36"x36"	W16-7p 24"x12"	W16-9p 24"x12"
										
W8-1 36"x36"	W8-2 36"x36"	W12-1 36"x36"	W12-2 36"x36"	W13-1 36"x36"	OW15-1 36"x36"	C19 36"x36"	W20-1 36"x36"	W20-1 36"x36"	CW20-1a 36"x36"	W20-2 36"x36"
										
W20-3 36"x36"	W20-4 36"x36"	W20-5 36"x36"	CW20-5a 36"x36"	W20-5 36"x36"	W21-2 36"x36"	W21-5 36"x36"	W21-6 36"x36"	CW21-7 36"x36"	W21-8 36"x36"	CW21-8A 24"x12"
										
CW21-8B 36"x12"	CW21-8C 12"x24"	SC21 30"x42"	W16-PW16-1P 24"x18"	MOD 24"x18"	W22-15 36"x36"	CW23-2 36"x36"	W23-2 36"x36"	CW23-12 36"x36"	CW23-14 72"x24"	
										
CW23-13 36"x36"	W24-1 36"x36"	W24-1a 36"x36"	C30 36"x36"	CW11-3 15"x9"						

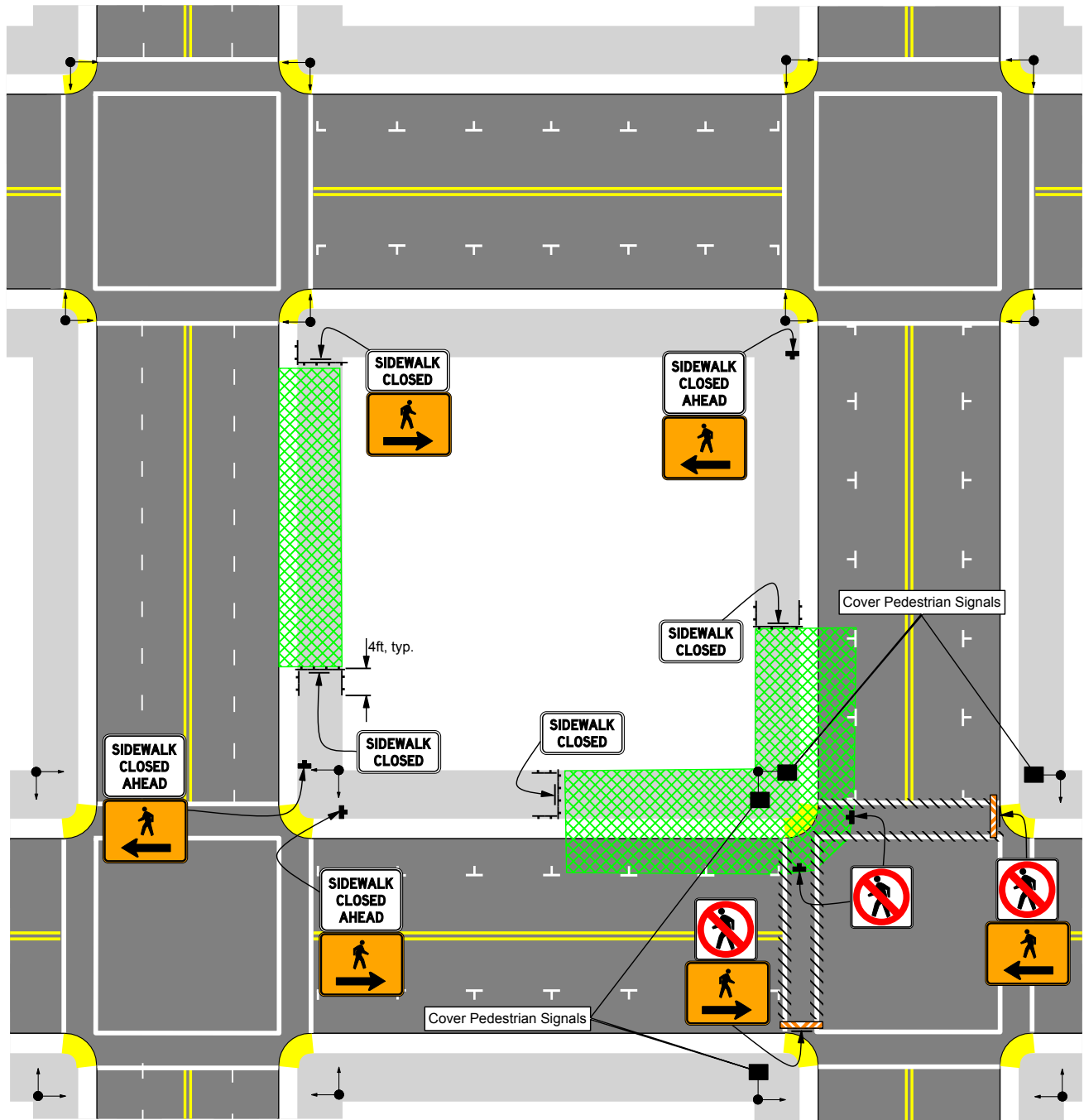
Conditions:

- 1) This plan shows the pedestrian traffic control measures only. Additional traffic control measures may be required to manage vehicular traffic.
- 2) A barrier may be required for positive protection on high-speed or high-volume streets.
- 3) Guide signs are required for long-term closures.

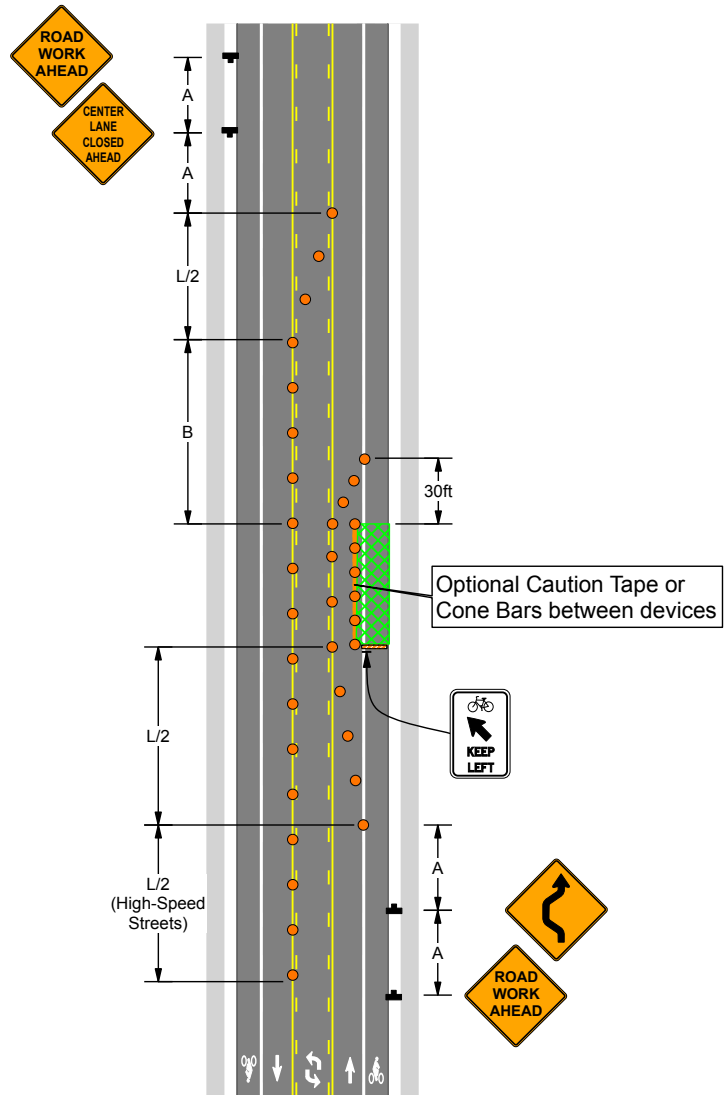


TA-S1
Diversions

1) This plan shows the pedestrian traffic control measures only. Additional traffic control measures may be required to manage vehicular traffic.



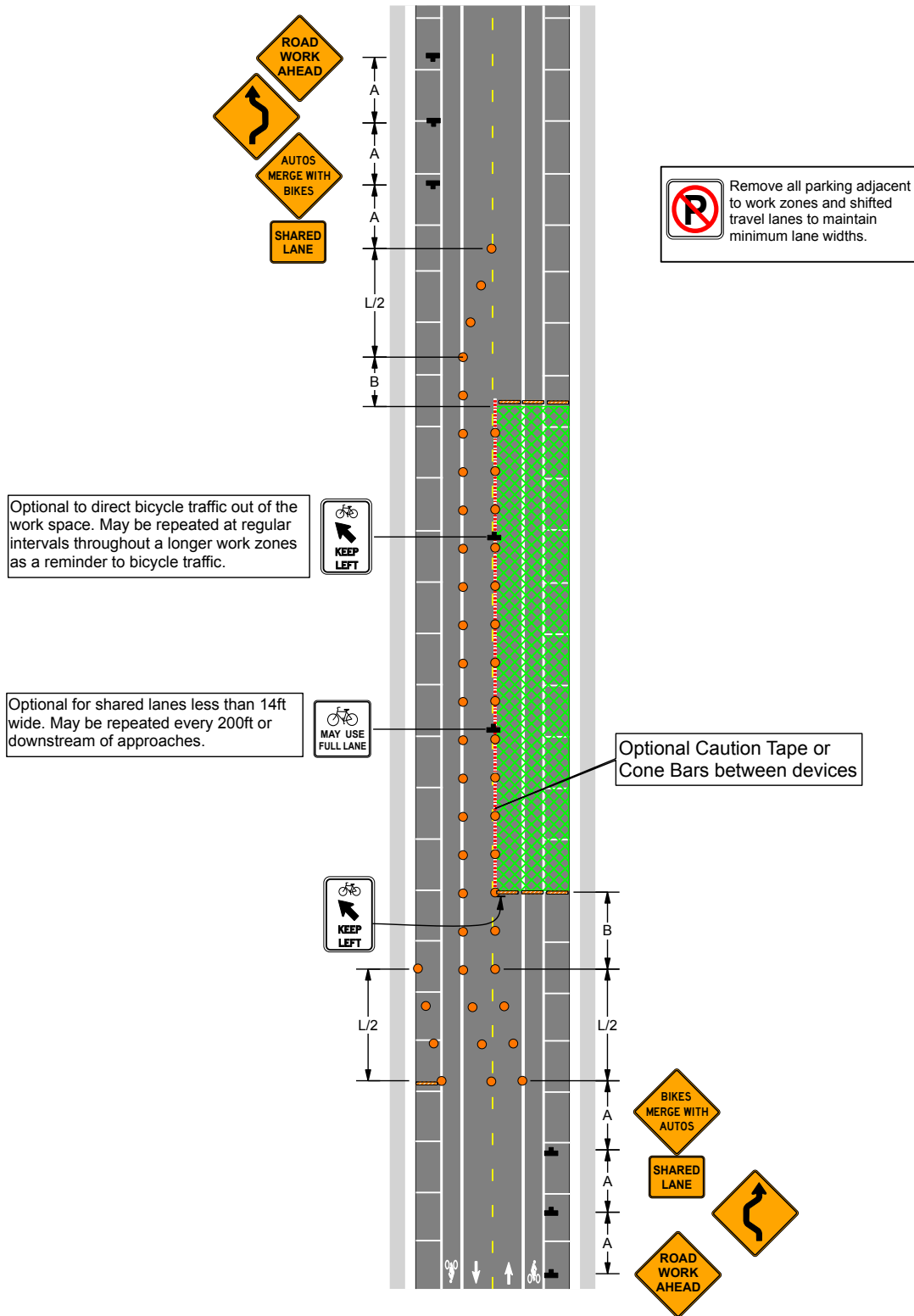
TA-S2
Detours



TA-B1
Temporary Bike Lane

Conditions:

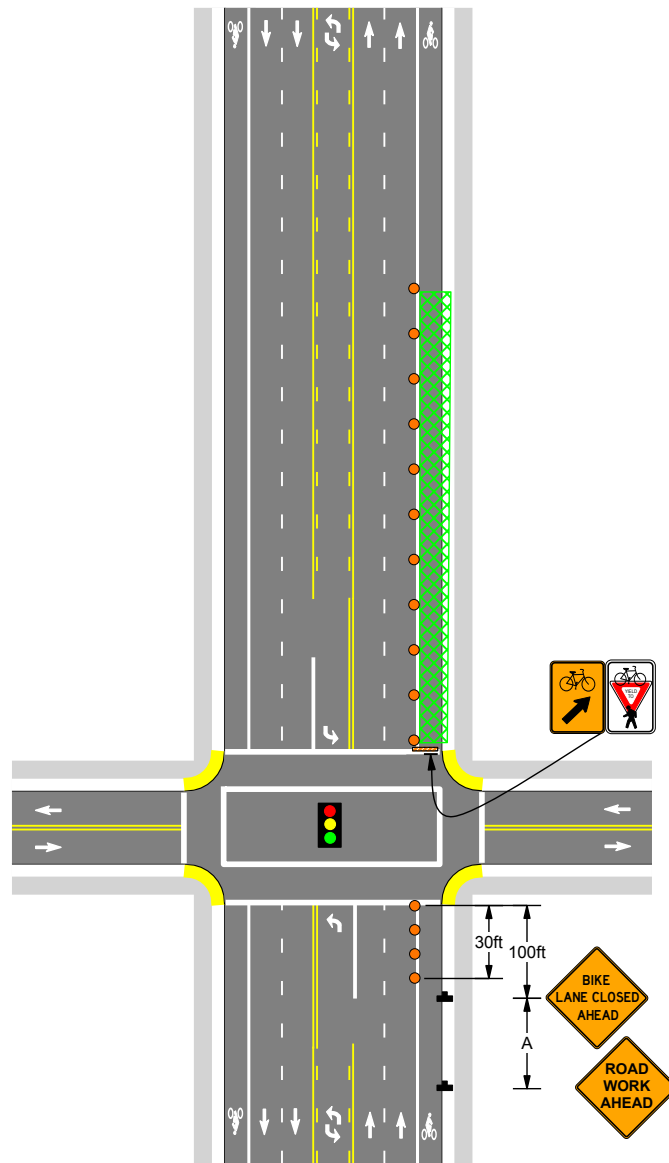
1) This plan is for use on low-speed streets.



TA-B3
Merging Bikes and Autos

Conditions:

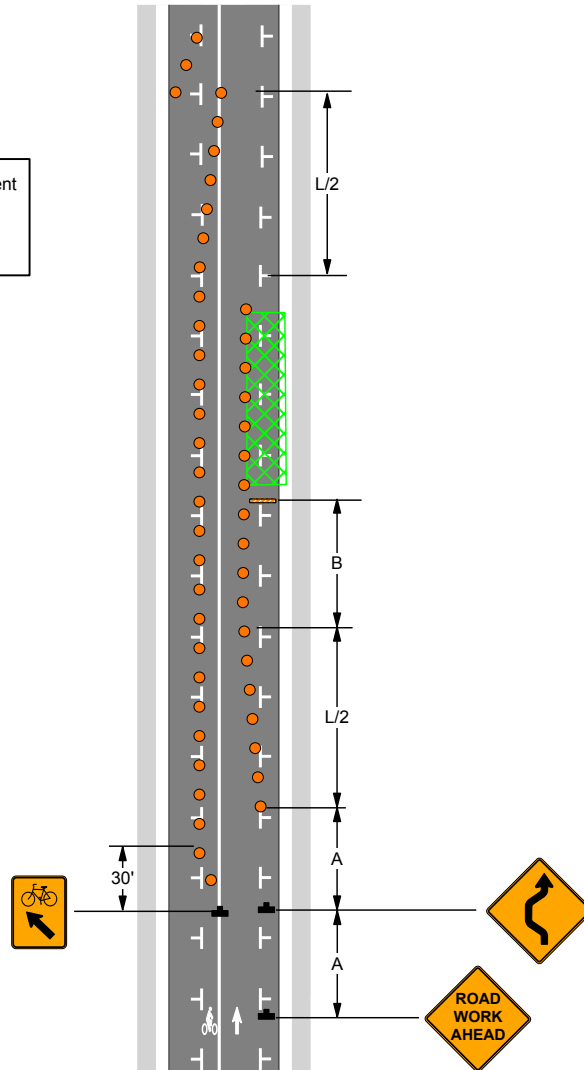
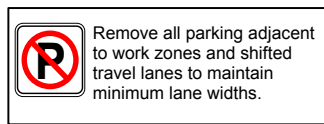
- 1) This plan is typically for use on high-speed streets, or where merging bikes with autos is not recommended.
- 2) Provide an access to return to the bike lane if no access exists within 200-ft of the downstream end of work zone.
- 3) Orange guide signs do not require bikes to ride on the sidewalk. Provide wider lane widths where practicable to accommodate cyclists that choose to ride in the automobile lane.



TA-B4
Diverting Bikes onto a Sidewalk

Conditions:

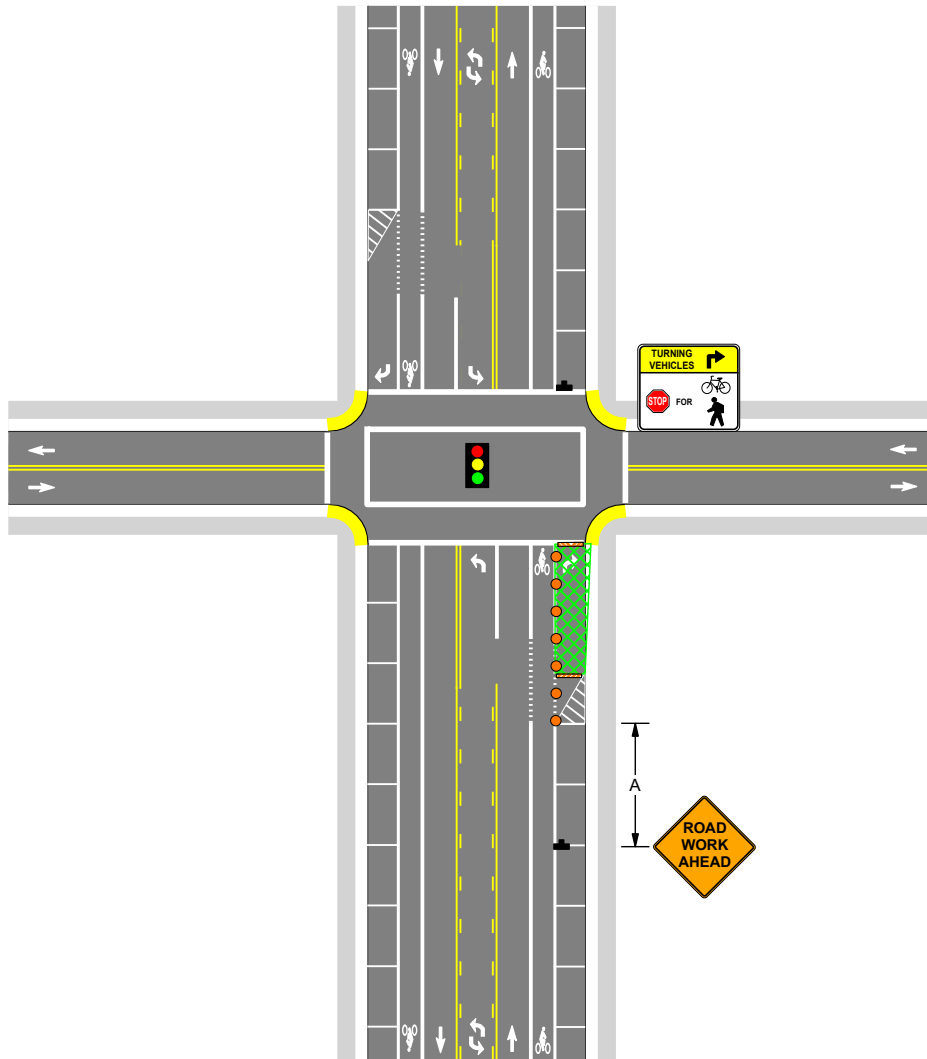
1) This plan can be used to shift traffic into a bike lane on the right side of the street by using corresponding warning signs.



TA-B5
Diverting Bikes into Parking

Conditions:

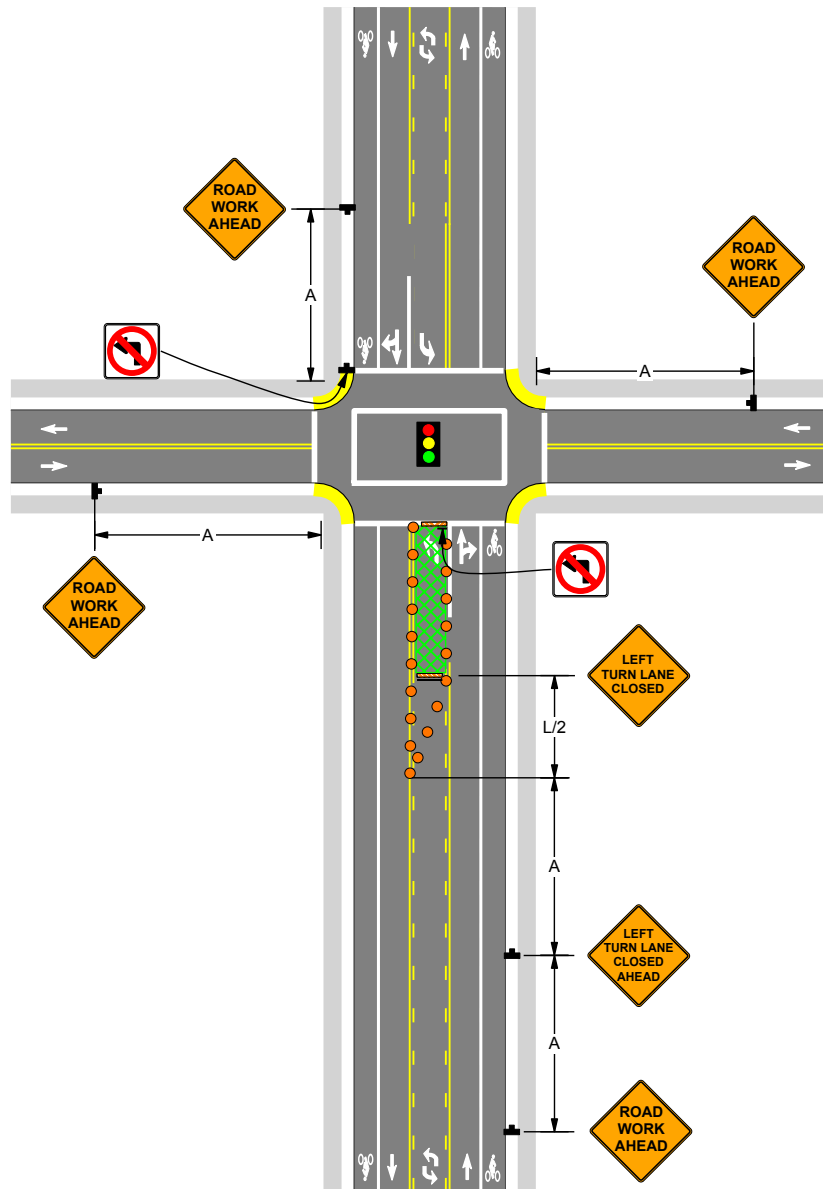
- 1) When work vehicles are located over signal detection loops, contact SSL to disable loops or modify signal timing.



TA-11
Right Turn Lane or Shoulder Closure

Conditions:

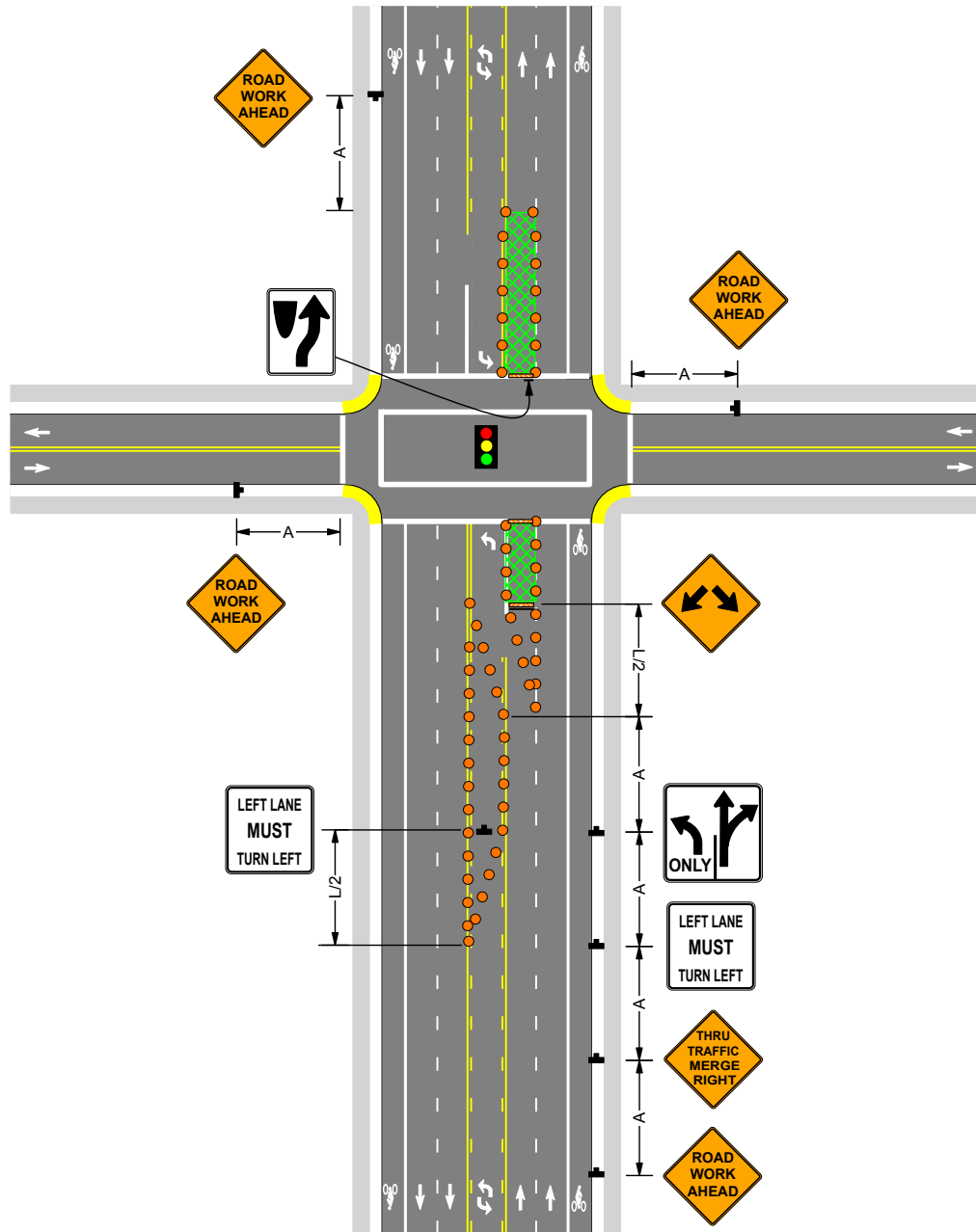
- 1) This plan requires Traffic Engineer approval.
- 2) If the median is not a continuous two-way left turn lane and there is adequate space available, place an additional LEFT TURN LANE CLOSED AHEAD sign in the median.
- 3) When work vehicles are located over signal detection loops, contact SSL to disable loops or modify signal timing.
- 4) When closing protected left turn lanes, disable the left turn signal and detection.



TA-I2
Left Turn Lane Closure

Conditions:

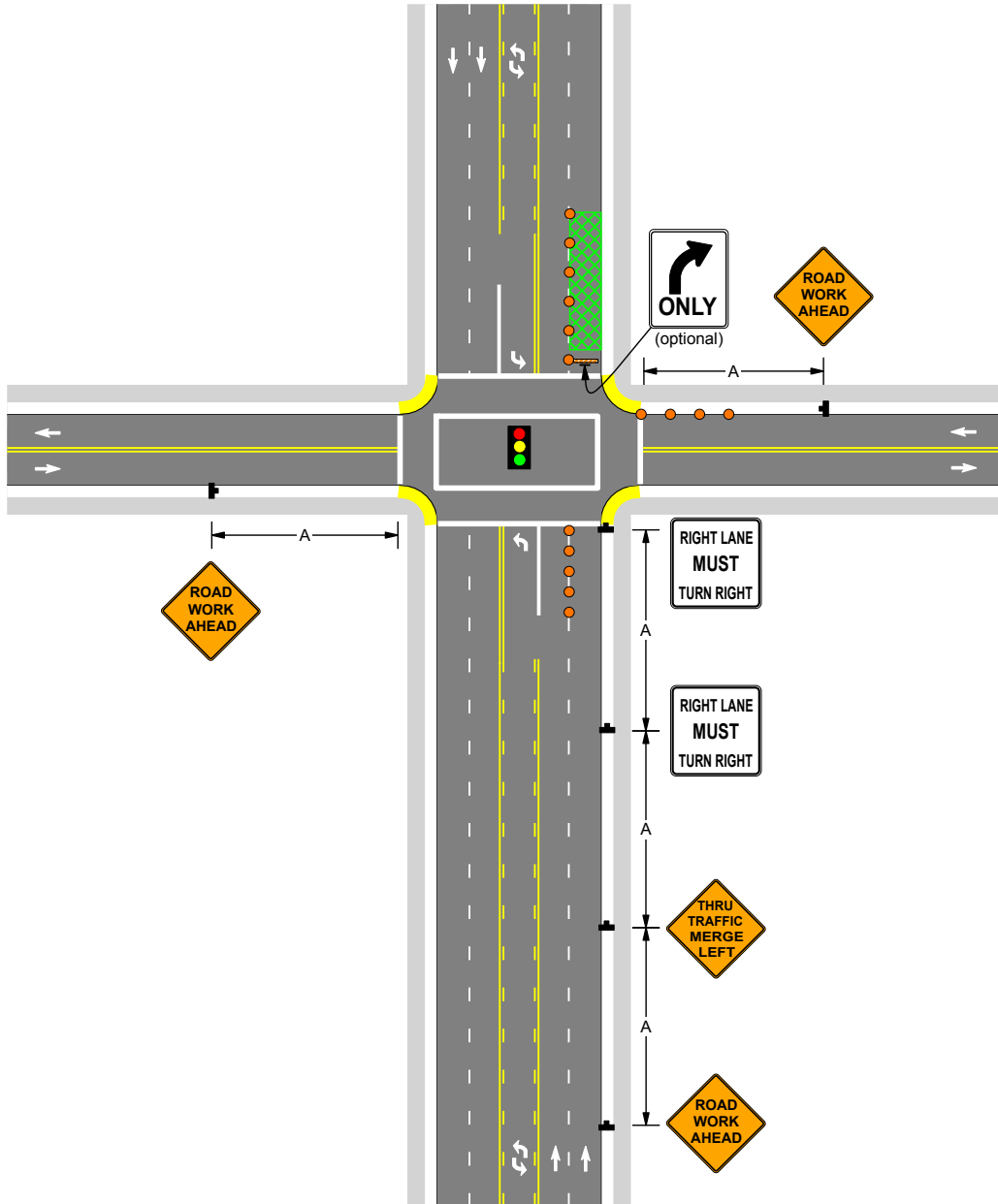
- 1) This plan requires Traffic Engineer approval.
- 2) When work vehicles are located over signal detection loops, contact SSL to disable loops or modify signal timing.



TA-I3
Inside Lane Closure

Conditions:

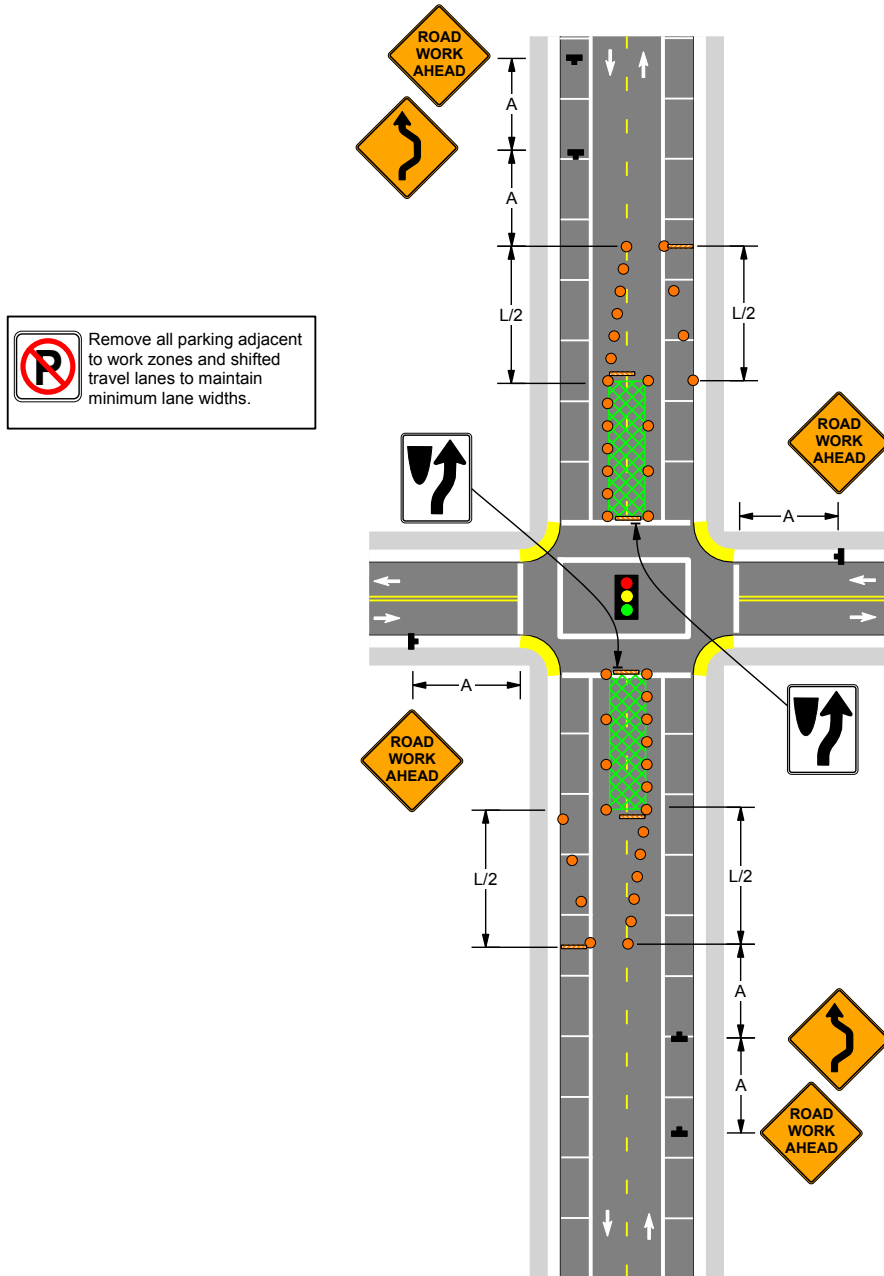
- 1) This plan requires Traffic Engineer approval.
- 2) This plan may be used on multilane one-way streets for closing a left or right lane. For closing a left lane, use the corresponding warning and regulatory signs.



TA-I4
Outside Lane Closure with Turn Lane

Conditions:

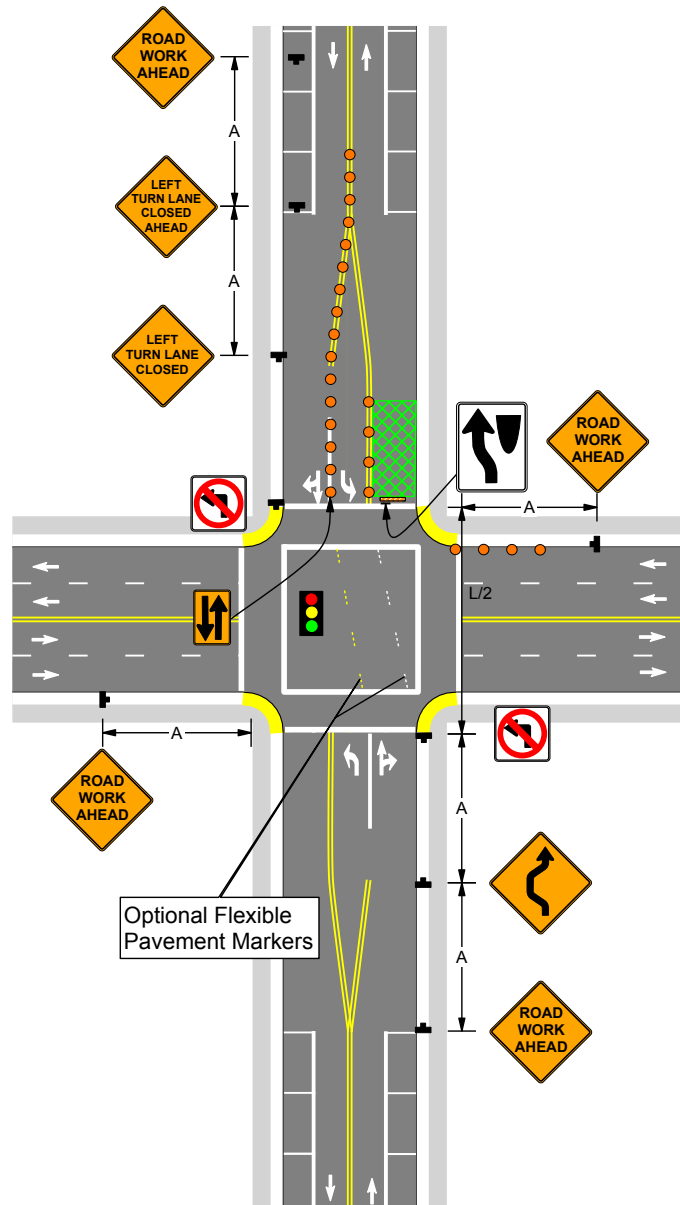
- 1) When work vehicles are located over signal detection loops, contact SSL to disable loops or modify signal timing.
- 2) When channelizing devices conflict with pavement markings, space the devices no more than $\frac{1}{2} S$ feet, where S is the speed in mph.



TA-15
Shift Through Shoulder

Conditions:

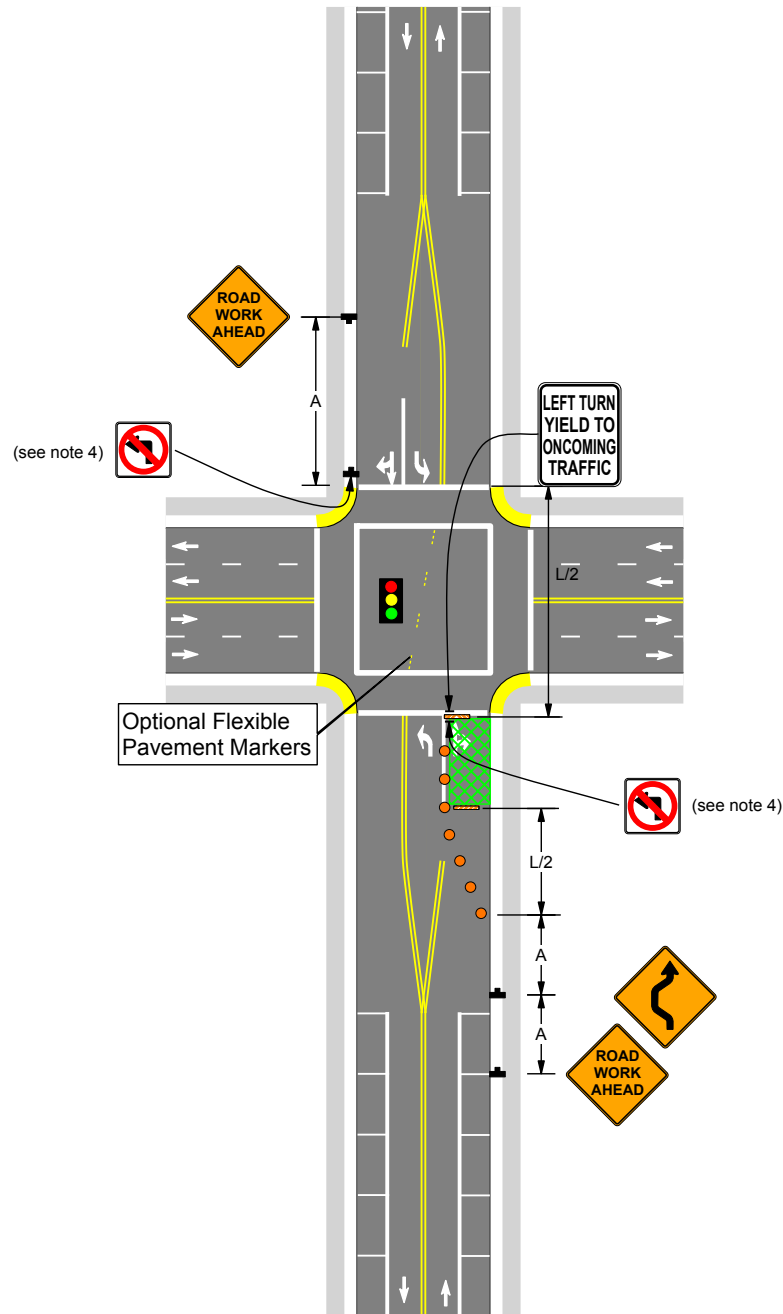
- 1) This plan requires Traffic Engineer approval.
- 2) This plan is for use on low-speed streets, where the intersection is long enough to permit a shifting maneuver.
- 3) When closing protected left turn lanes, disable the left turn signal and detection.
- 4) When channelizing devices conflict with pavement markings, space the devices at no more than $\frac{1}{2}$ S feet, where S is the speed in mph.



TA-I6
Shift Through Left Turn Lane (Far Side Work)

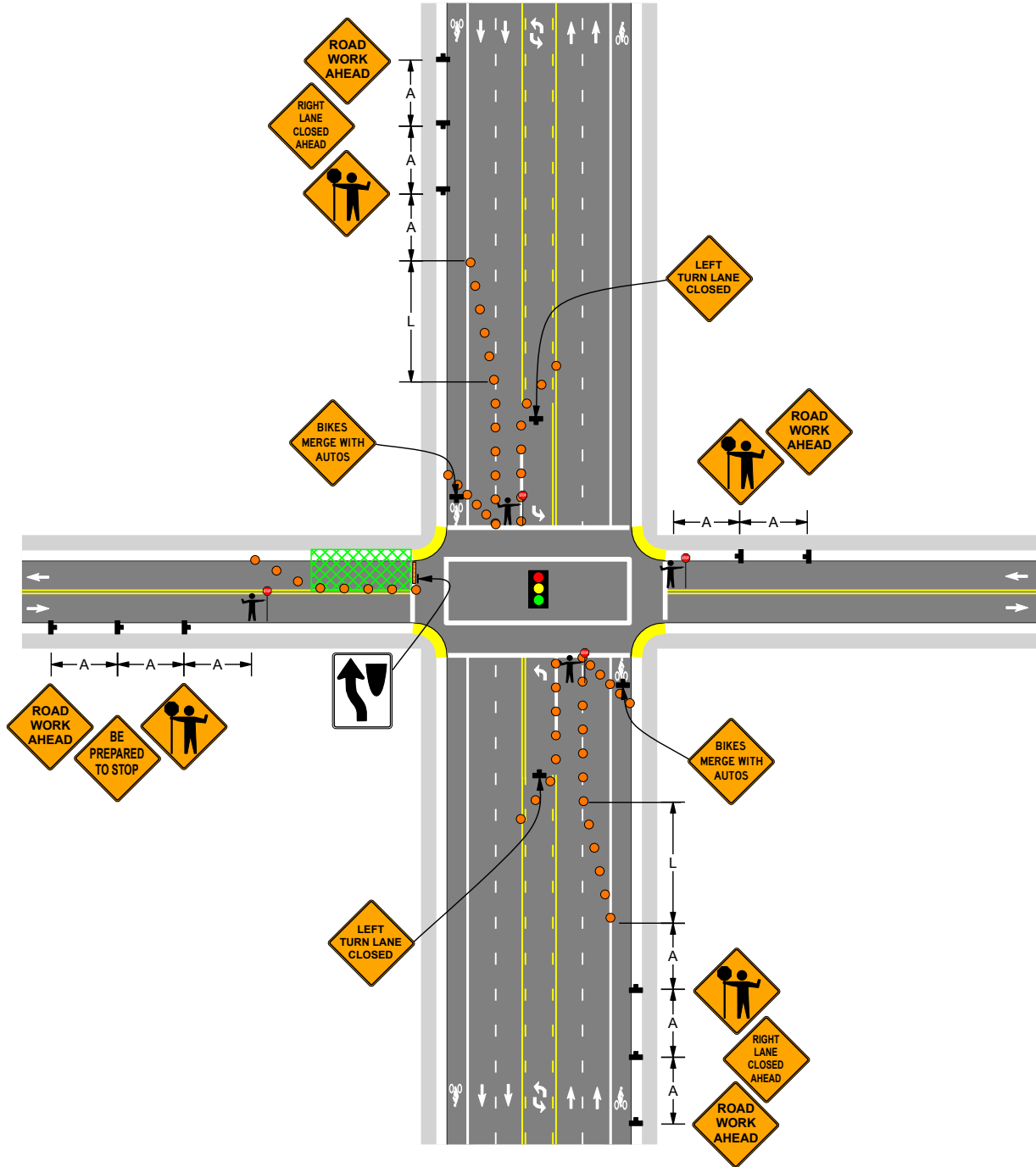
Conditions:

- 1) This plan requires Traffic Engineer approval.
- 2) This plan is for use on low-speed streets, where the intersection is long enough to permit a shifting maneuver.
- 3) When closing protected left turn lanes, disable the left turn signal and detection.
- 4) Left turns should be prohibited, and a detour route established, when the left-turn volume exceeds 300 vehicles per hours, or the product of the opposing through and left-turn hourly volumes exceed 150,000.



TA-I7
Shift Through Left Turn Lane (Near Side Work)

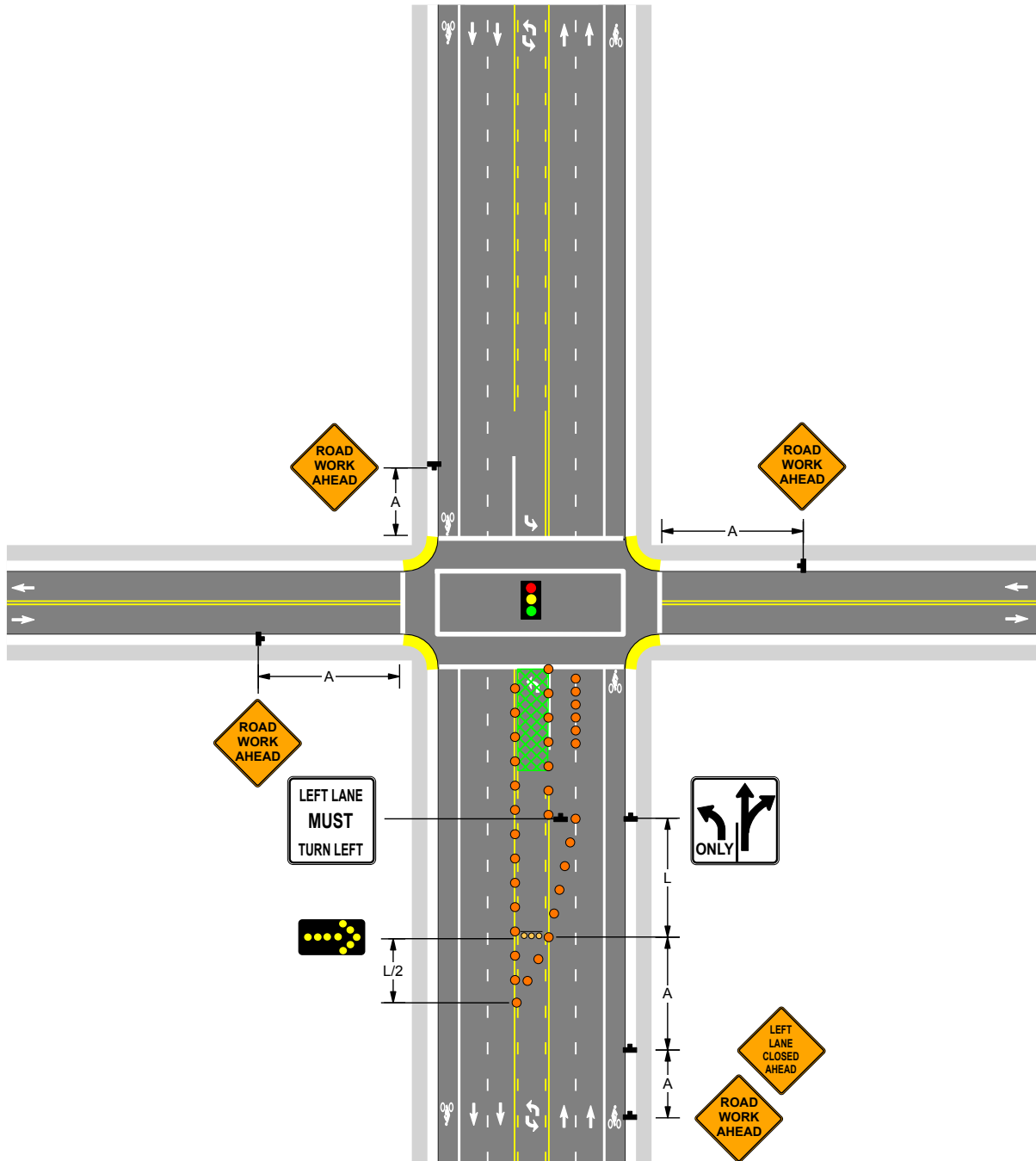
Conditions:
1) Contact SSL to turn off signal.



TA-18
Flagging

Conditions:

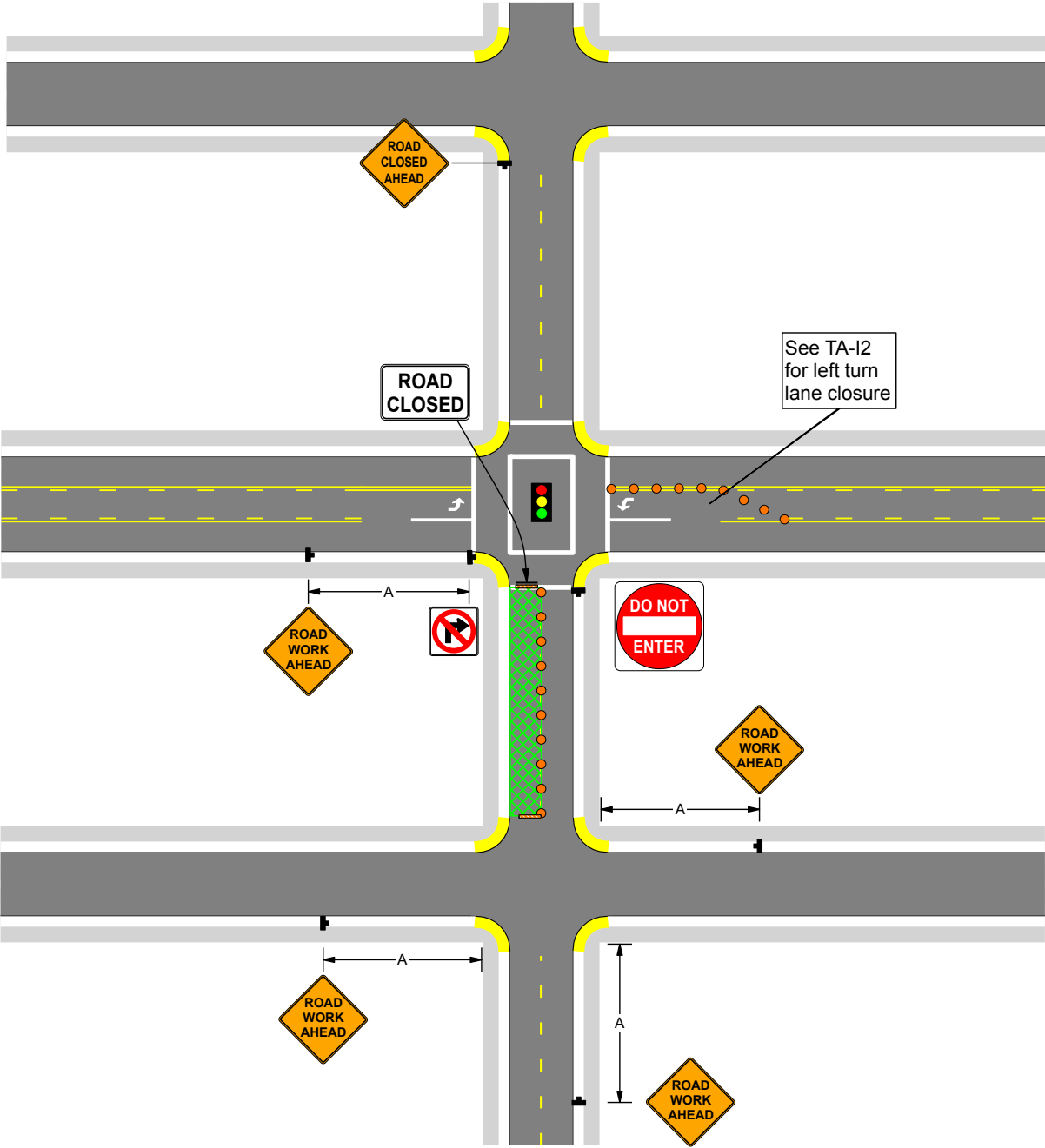
- 1) This plan requires Traffic Engineer and District Signal Engineer approval.
- 2) This plan is for use at locations with protected left turn signals, and may require signal modifications.
- 3) An arrow board is required on high-speed streets.



TA-19
Left Turn Lane Pocket

Conditions:

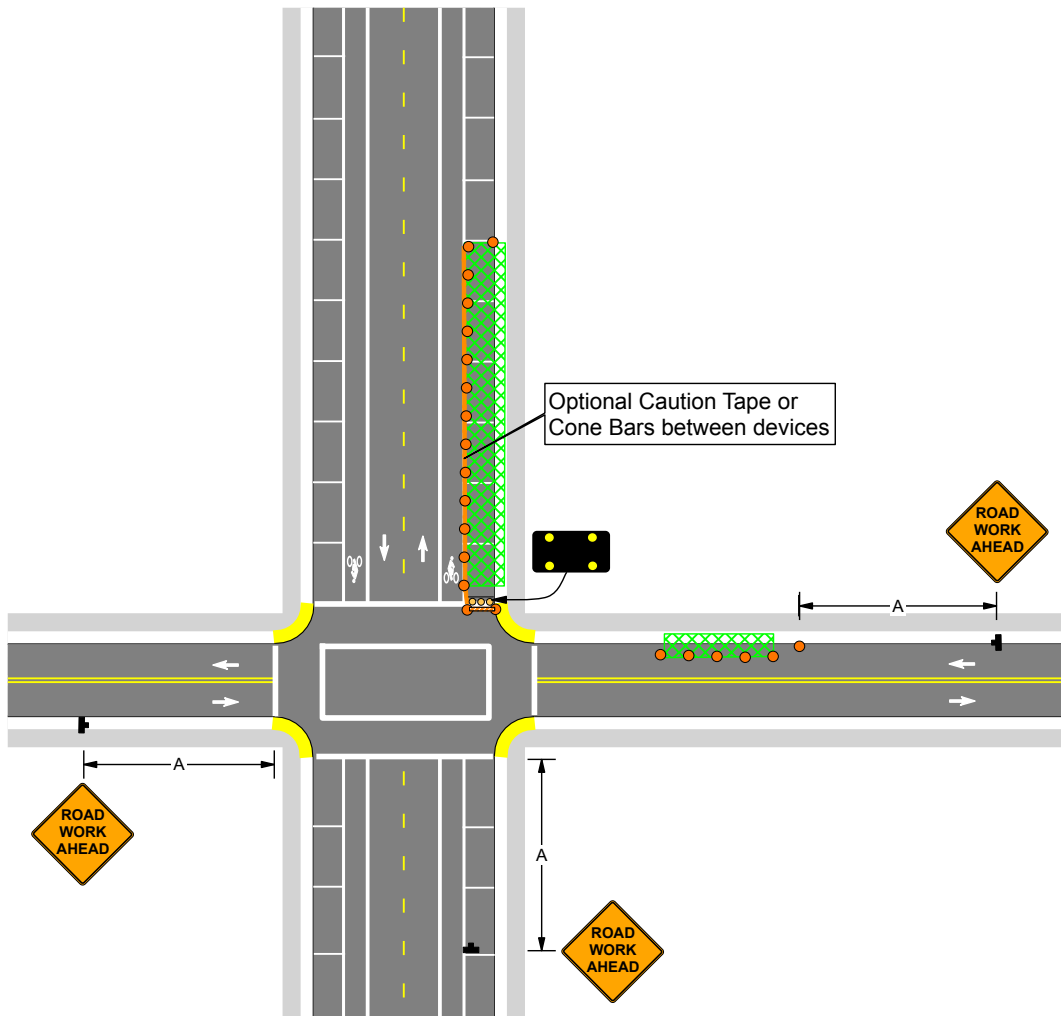
- 1) This plan requires Traffic Engineer approval.
- 2) Provide and maintain local access and egress at all times for residents and businesses.
- 3) A detour plan, with additional signing, may be required.



TA-T1
Half-Street Road Closure

Conditions:

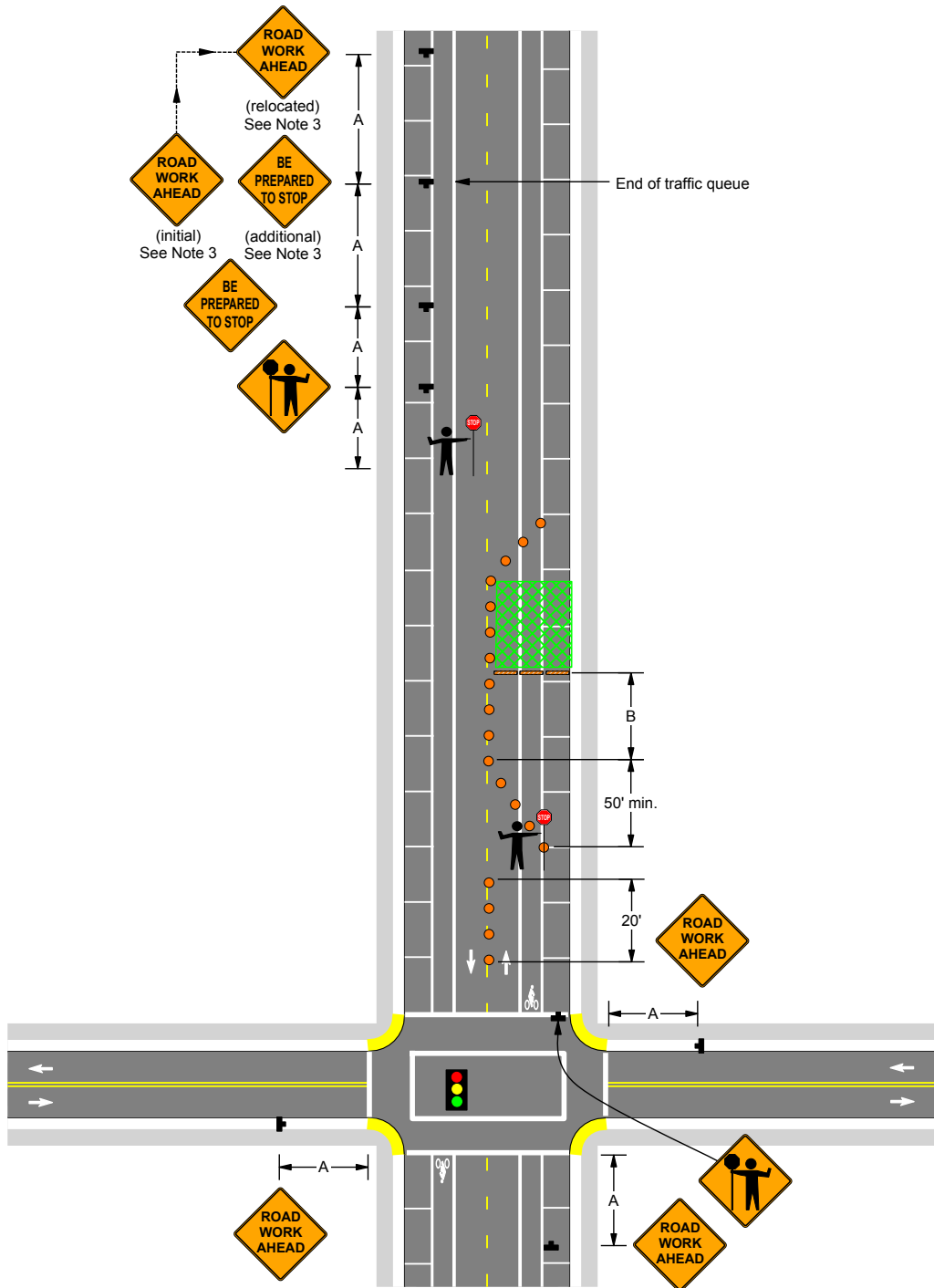
- 1) This plan shows the vehicular traffic control devices only. Additional traffic control measures may be required to manage pedestrian traffic.
- 2) If work equipment has to be partially in the travel lane, maintain minimum lane widths.
- 3) An arrow board in caution mode is recommended for work on high-speed, high-volume roads.



TA-T2
Shoulder Closure

Conditions:

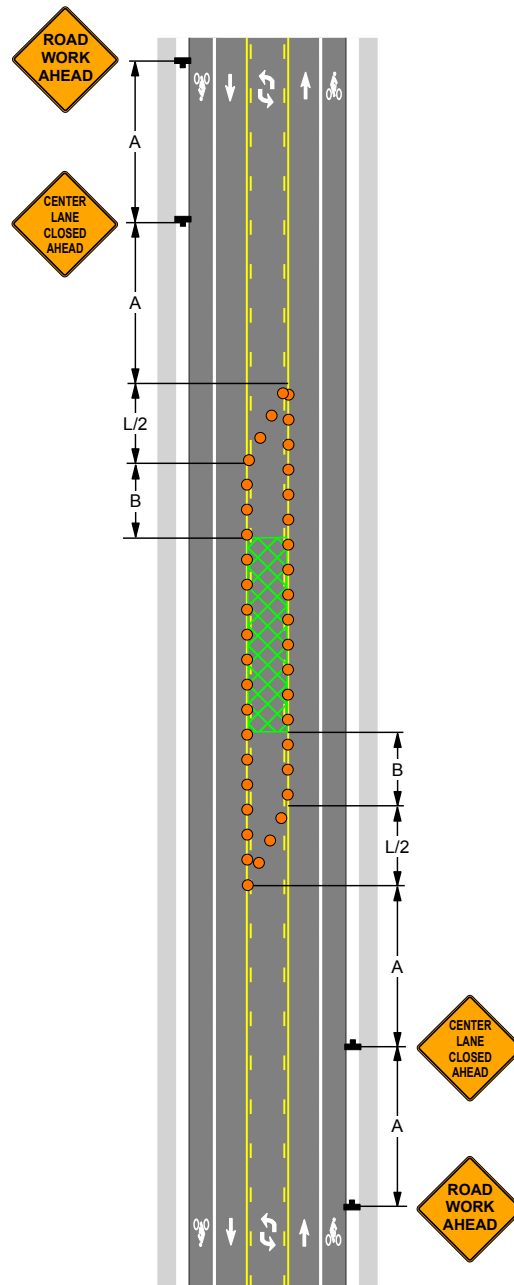
- 1) Provide priority to traffic that will queue into upstream signalized intersections.
- 2) The Oregon Flagger Symbol sign shall always precede flaggers.
- 3) When traffic queues extend beyond the initial advance warning sign, adjust ROAD WORK AHEAD, and install additional BE PREPARED TO STOP signs as shown or directed.
- 4) If line of sight between flaggers is not possible, flaggers shall maintain radio communication.



**TA-T3
Flagging**

Conditions:

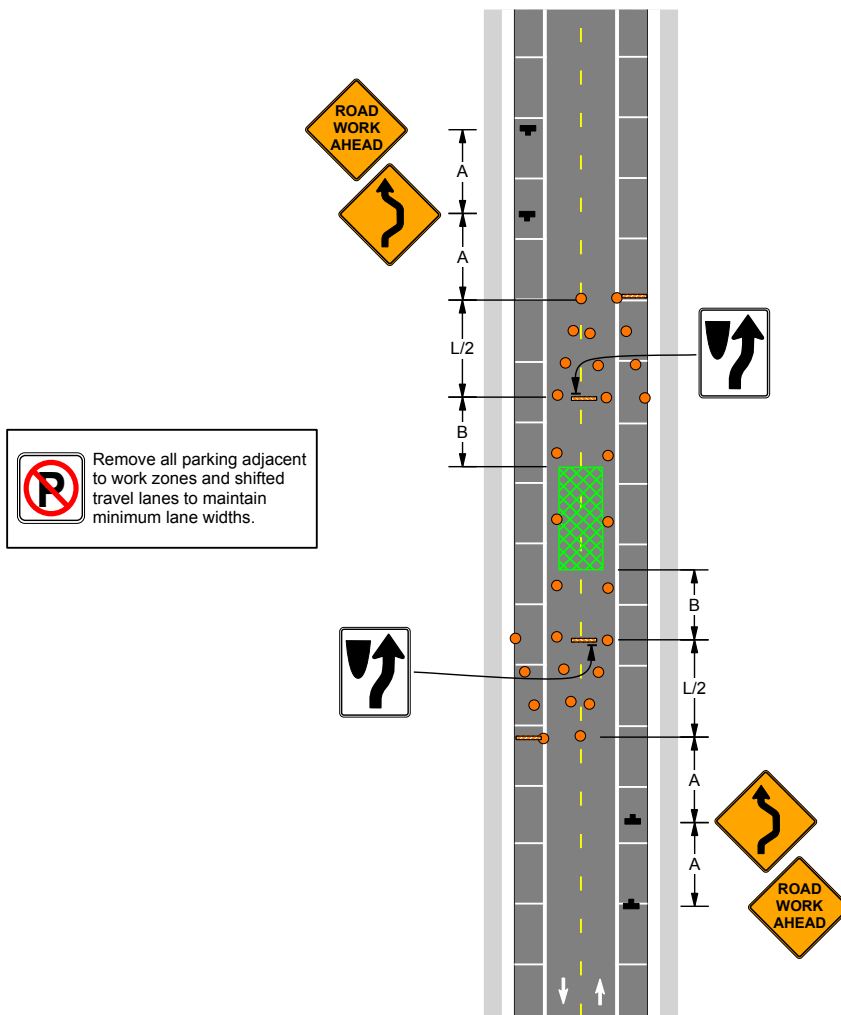
1) On high-speed streets, use a protection vehicle with beacons, or a truck-mounted arrow board in caution mode between the buffer and the work zone.



TA-T4
Two-Way Left-Turn Lane Closure

Conditions:

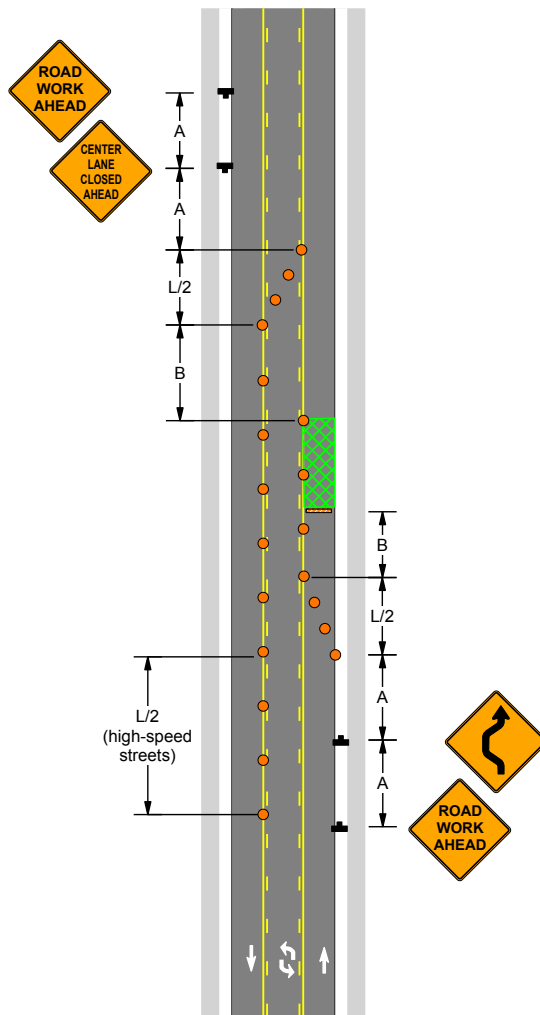
- 1) When channelizing devices conflict with pavement markings, space the devices no more than $\frac{1}{2} S$ feet, where S is the speed in mph.



TA-T5
Work in Center of Road

Conditions:

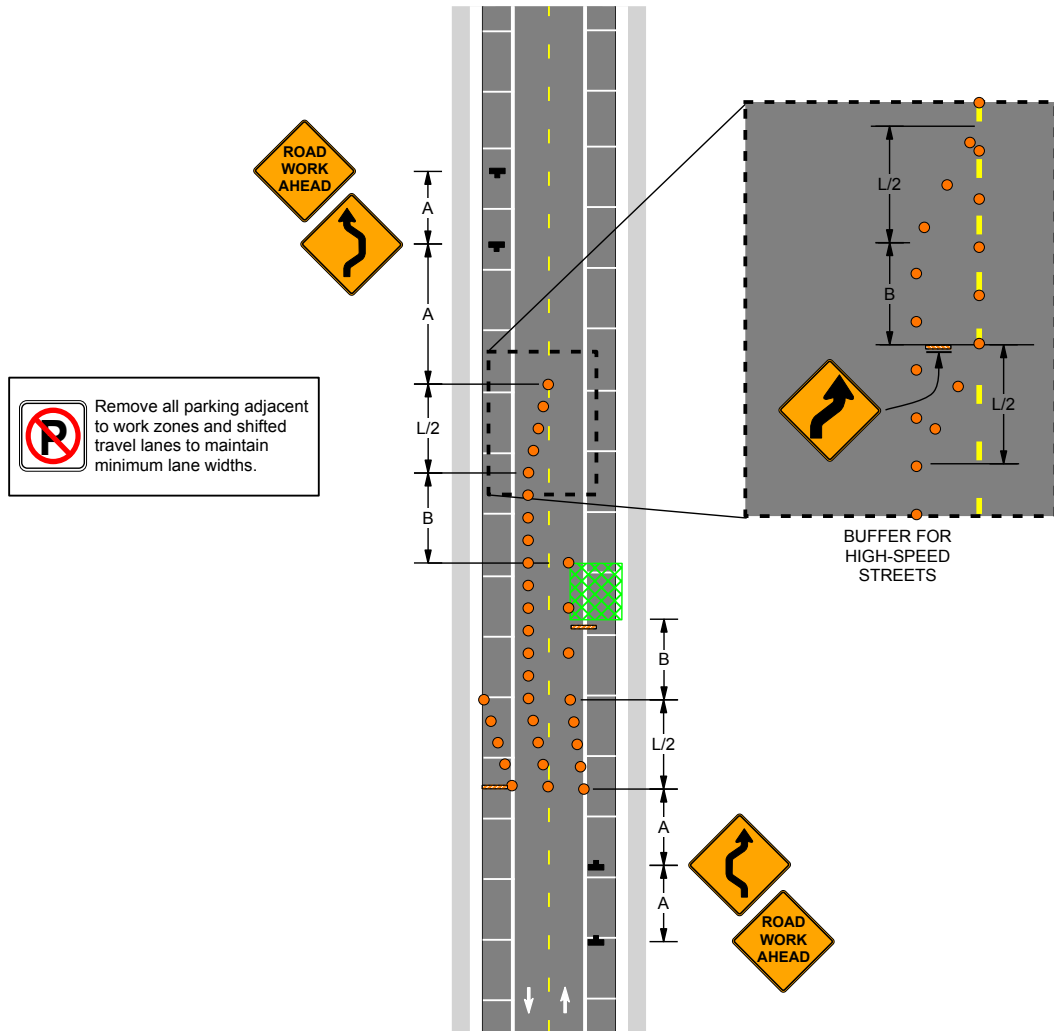
1) When channelizing devices conflict with pavement markings, space the devices no more than $\frac{1}{2} S$ feet, where S is the speed in mph.



TA-T6
Shift Through Two-Way, Left-Turn Lane

Conditions:

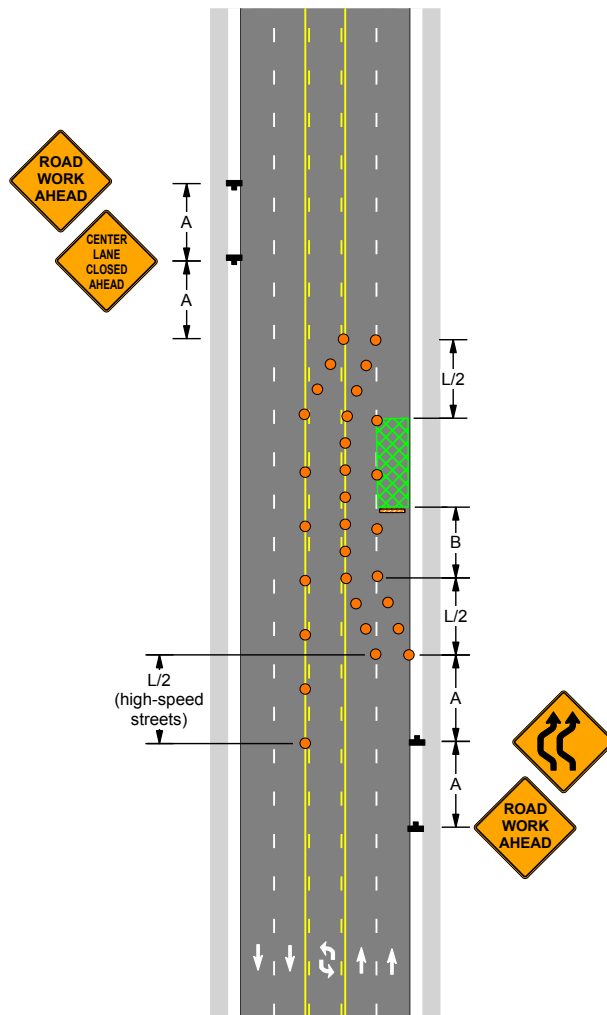
- 1) When channelizing devices conflict with pavement markings, space the devices as no more than $\frac{1}{2} S$ feet, where S is the speed in mph.



TA-T7
Shift Over Centerline

Conditions:

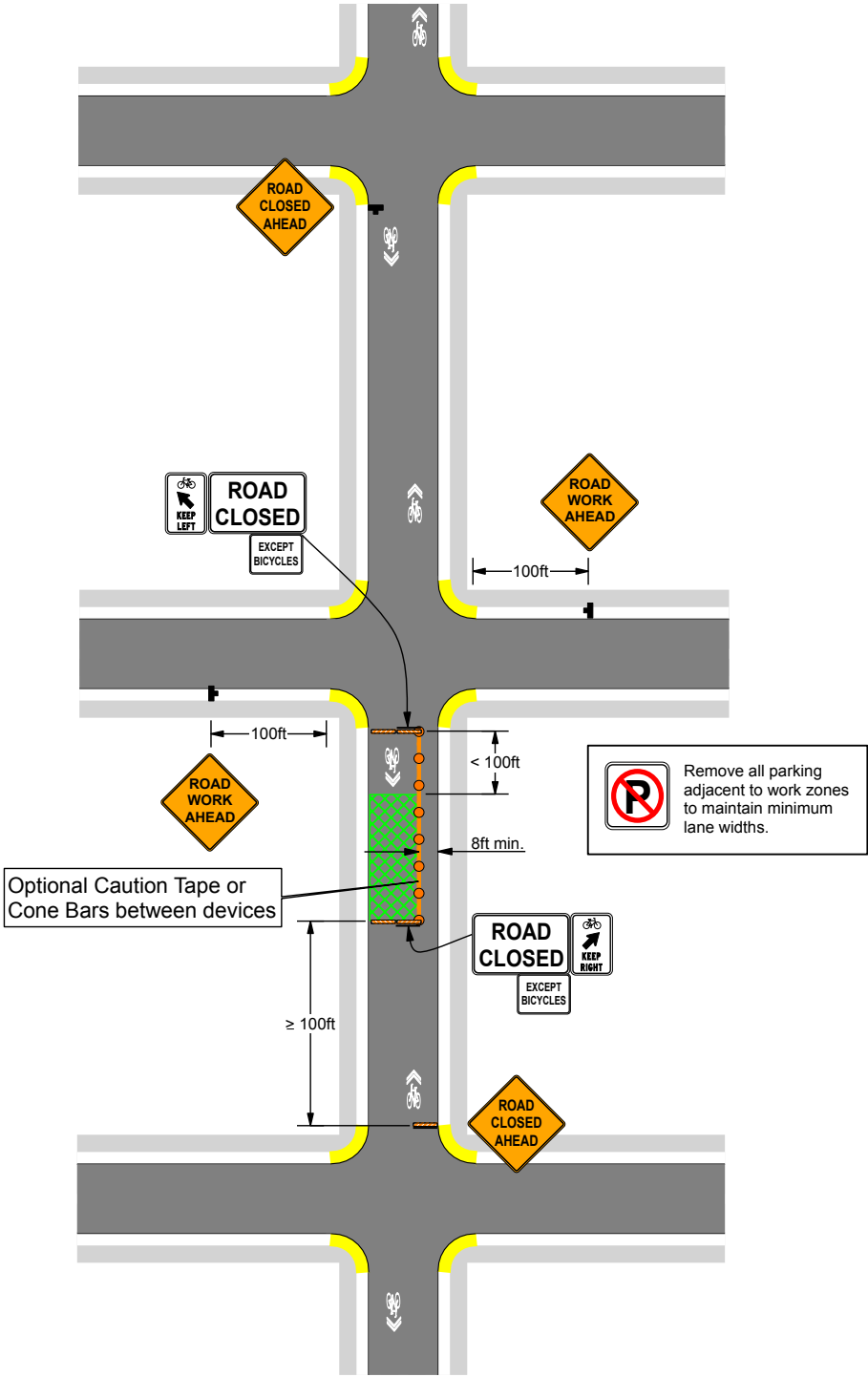
- 1) When channelizing devices conflict with pavement markings, space the devices as no more than $\frac{1}{2} S$ feet, where S is the speed in mph.



TA-T8
Shift on Multilane Road

Conditions:

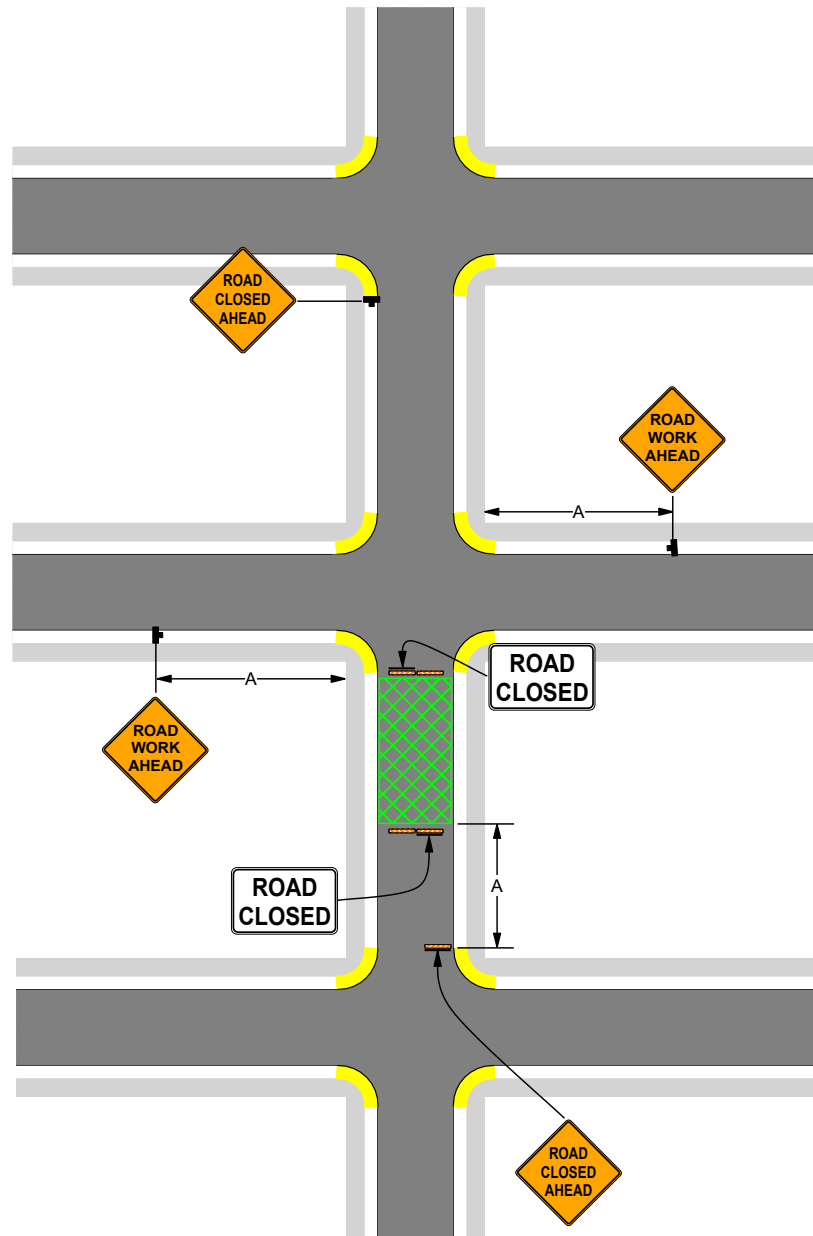
- 1) This plan may be used on local service streets with no pavement markings, at least 200ft from a traffic signal.
- 2) Provide and maintain local access and egress at all times for residents and businesses.
- 3) If the distance between the beginning of the block and work zone is less than 100ft, close the road at the beginning of the block as shown.
- 4) If the distance between the beginning of the block and work zone is greater than or equal to 100ft, close the road at the beginning of the work zone as shown.



TA-L1
Road Closure on City Bikeway

Conditions:

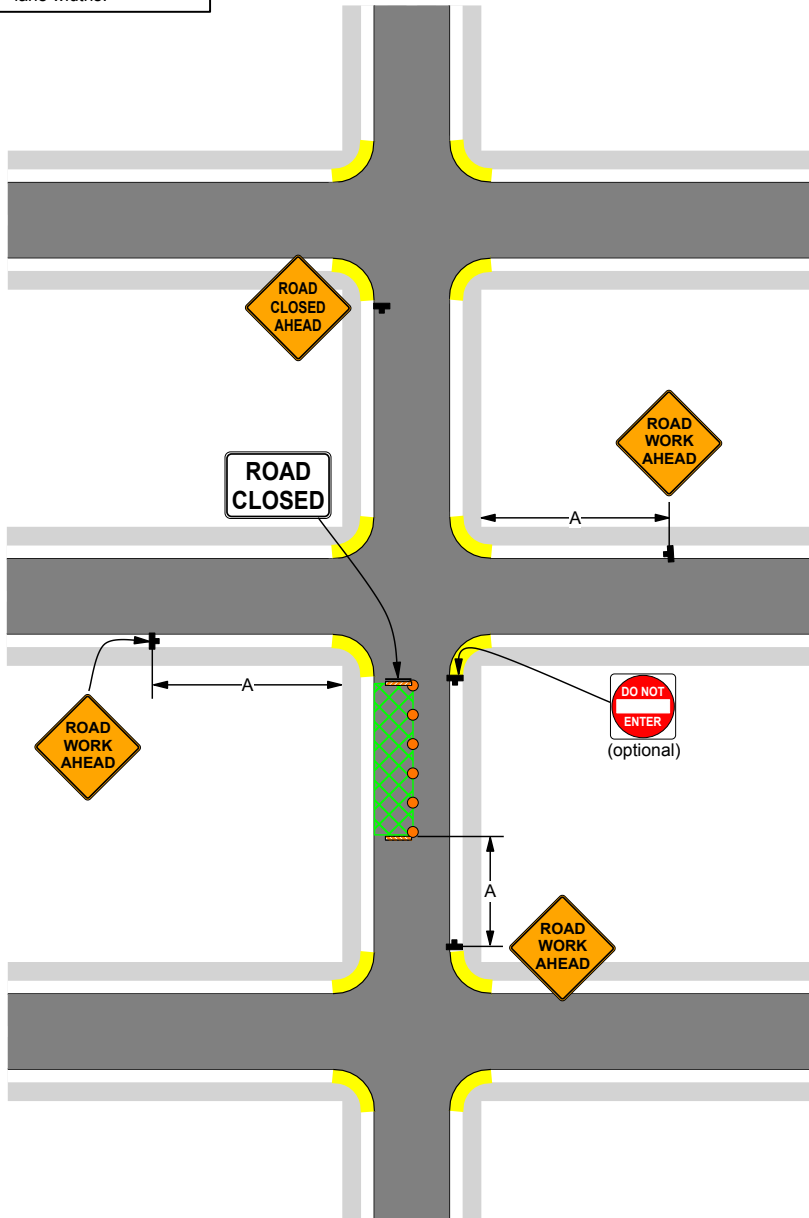
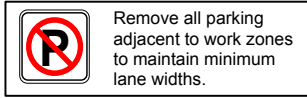
- 1) This plan may be used on local service streets with no pavement markings, at least 200ft from a traffic signal.
- 2) Provide and maintain local access and egress at all times for residents and businesses.
- 3) Use a minimum of two Type III barricades for a road closure. For roads 36ft wide or greater between curbs or edge of pavement, use a minimum of three Type III barricades for the closure point.



TA-L2
Road Closure

Conditions:

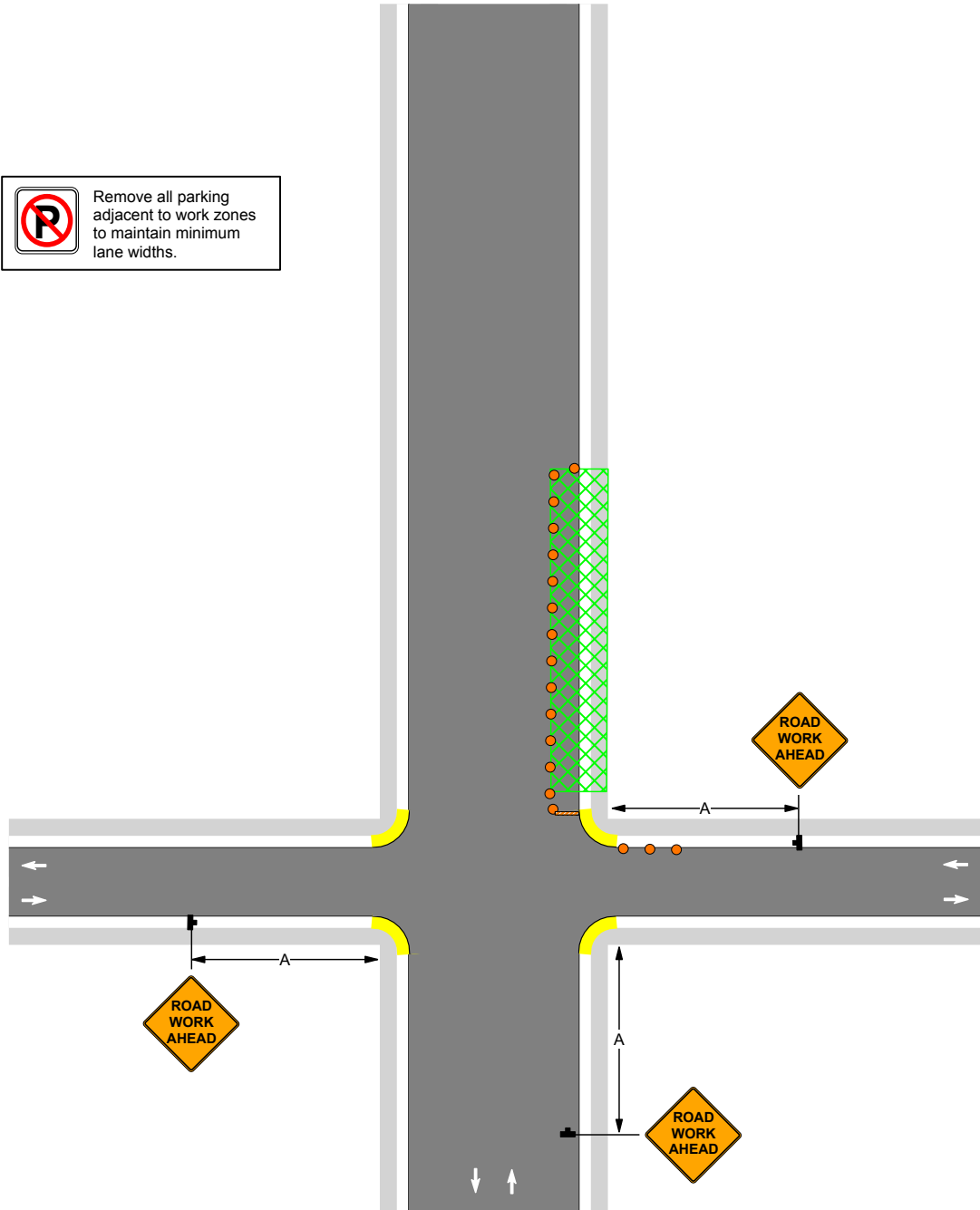
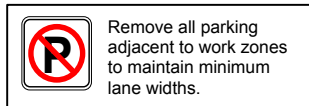
- 1) This plan may be used on local service streets with no pavement markings, at least 200ft from a traffic signal.
- 2) Provide and maintain local access and egress at all times for residents and businesses.



TA-L3
Half-Street Closure

Conditions:

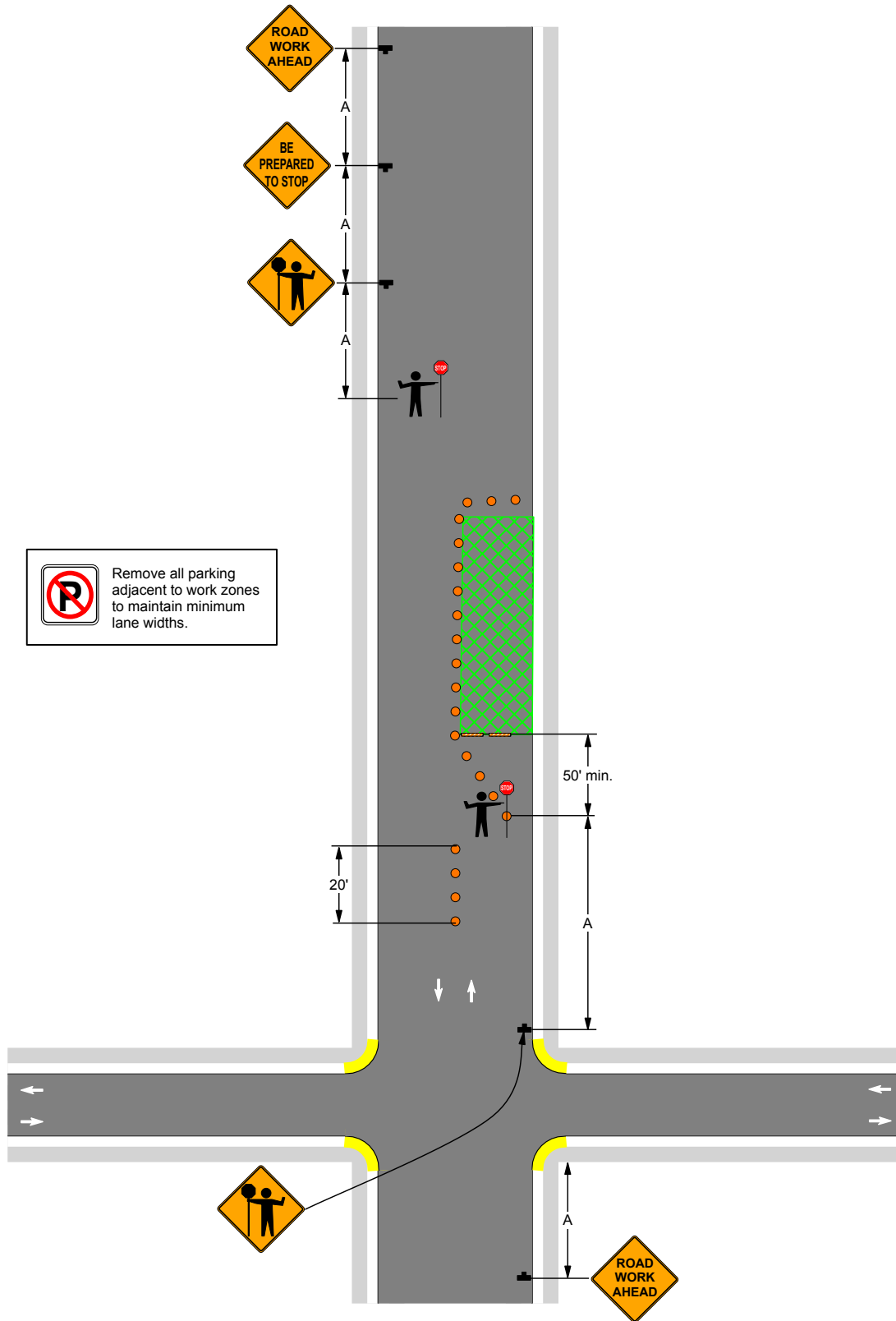
- 1) This plan may be used on local service streets with no pavement markings, at least 200ft from a traffic signal.
- 2) This plan shows the vehicular traffic control devices only. Additional traffic control measures may be required to manage pedestrian traffic.



TA-L4
Shoulder Closure

Conditions:

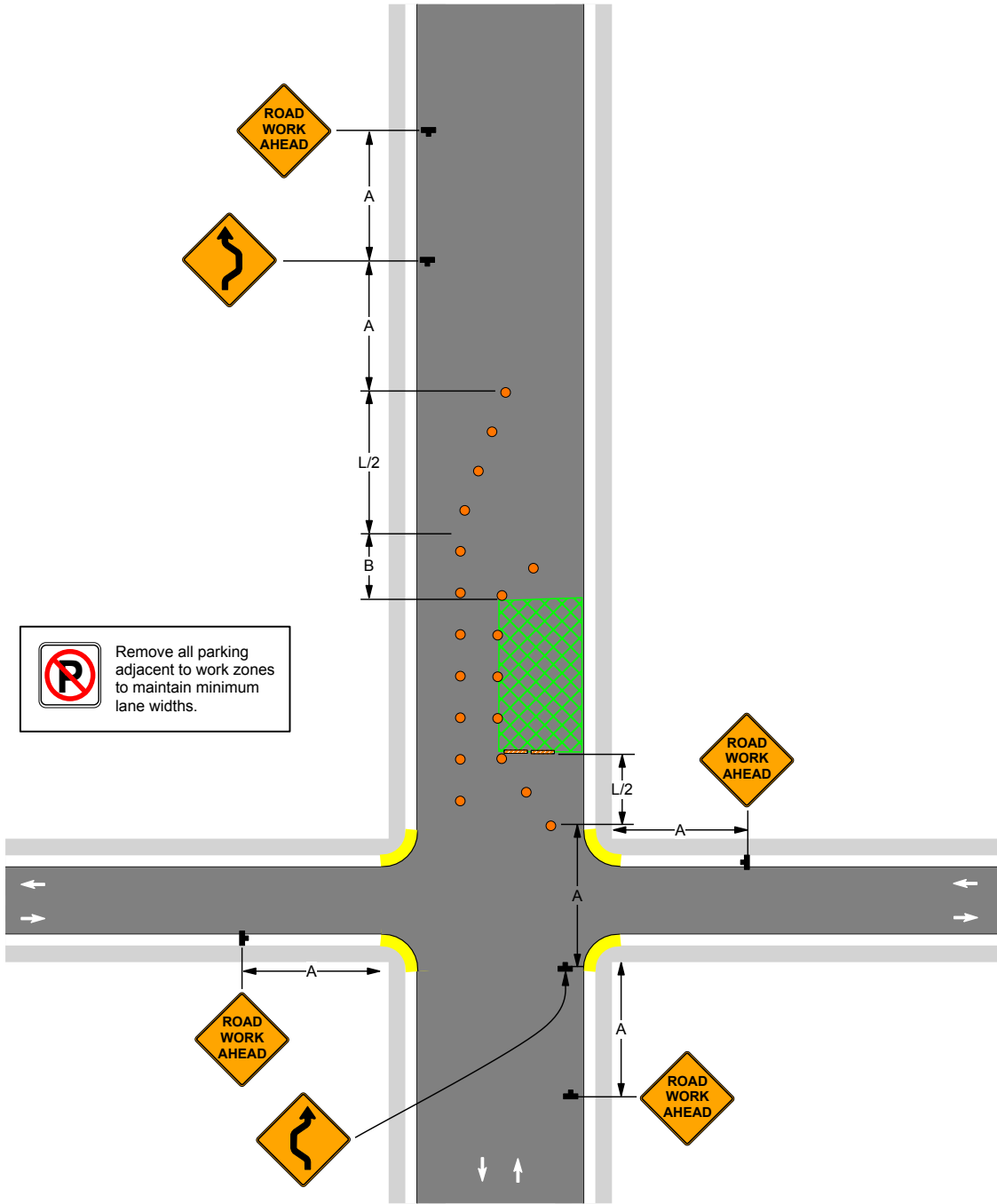
- 1) This plan may be used on local service streets with no pavement markings.
- 2) When flagging near an intersection, the [OREGON FLAGGER SYMBOL] sign should be visible to traffic entering from any side road.



**TA-L5
Flagging**

Conditions:

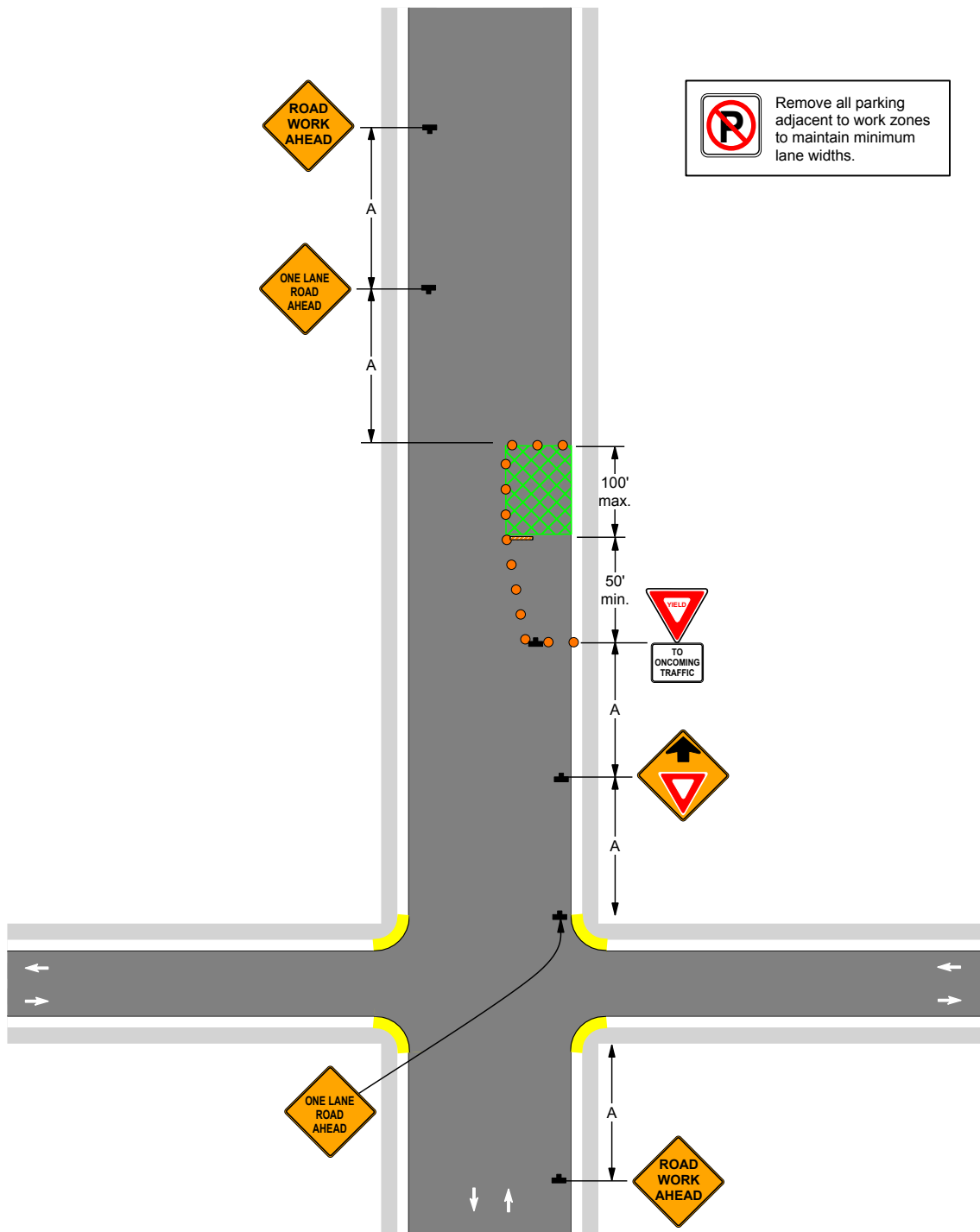
1) This plan may be used on local service streets with no pavement markings, at least 200' from a traffic signal.



TA-L6
Shift Over Centerline

Conditions:

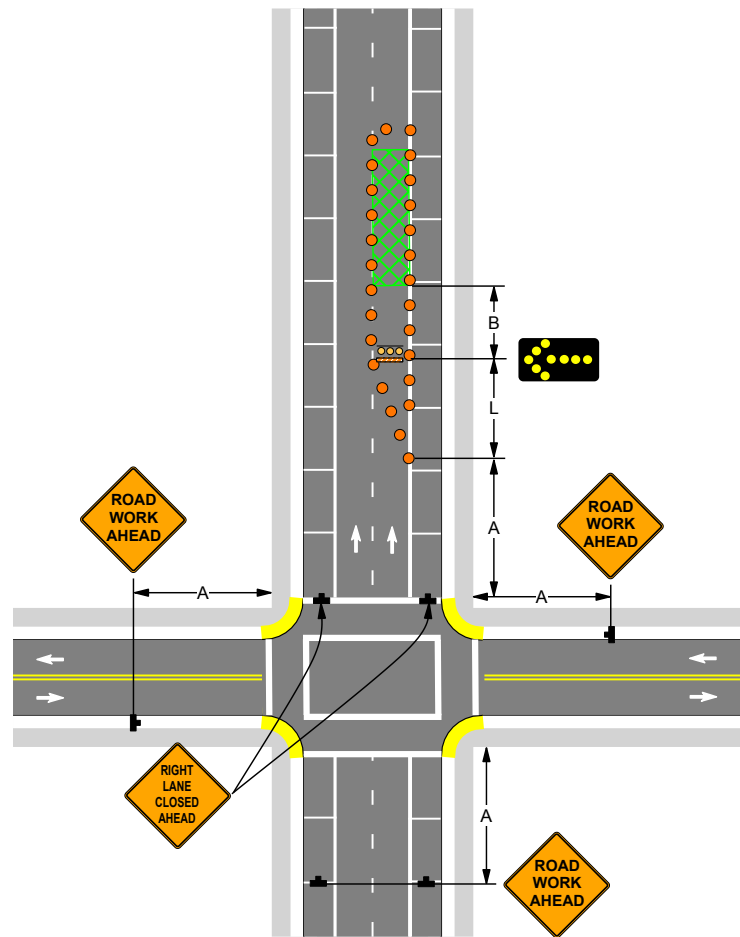
- 1) This plan may be used on local service streets with no pavement markings, at least 200' from a traffic signal.
- 2) Not for use when sight distance is less than 310ft at each end.



TA-L7
Self-Regulating Lane Closure

Conditions:

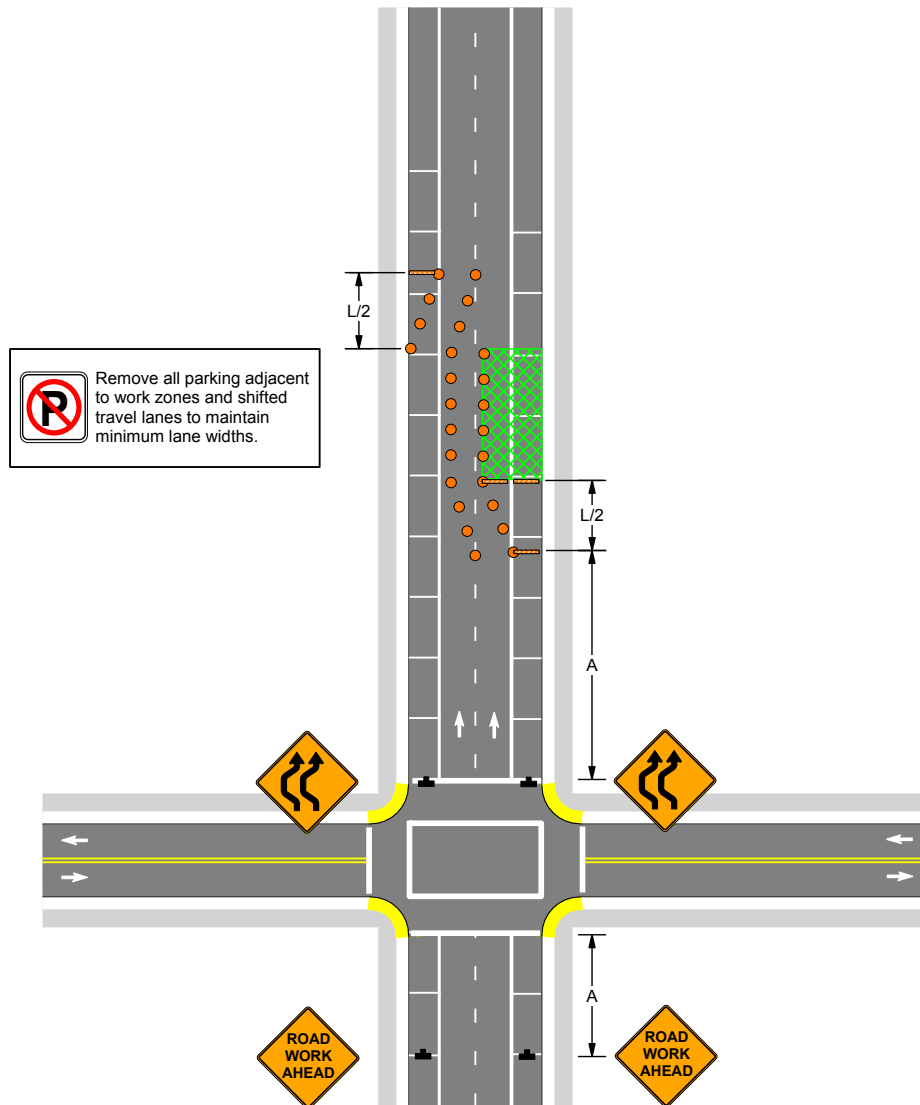
- 1) This plan can be used to close either the left or right outside lane on one-way or multilane two-way streets. For closing the left lane, use corresponding LANE CLOSED and [LANE ENDS SYMBOL] signs.
- 2) An arrow board is required on high-speed streets.
- 3) When space permits, install a [LANE ENDS SYMBOL] sign between the LANE CLOSED sign and the work zone while maintaining sign spacing between each warning sign.



TA-O1
Merge

Conditions:

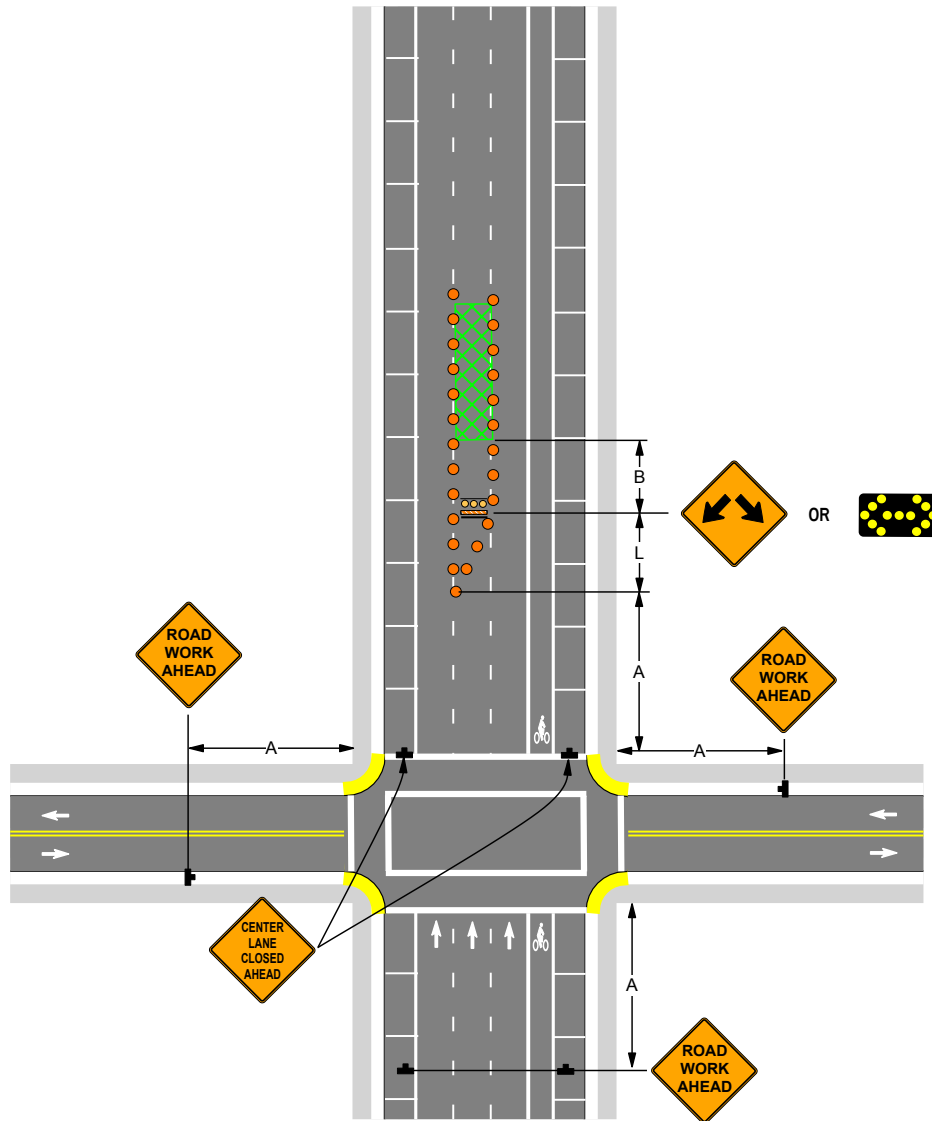
- 1) This plan can be used to shift traffic to the right by using corresponding warning signs.
- 2) When channelizing devices conflict with pavement markings, space the devices no more than $\frac{1}{2} S$ feet, where S is the speed in mph.



TA-O2
Shift

Conditions:

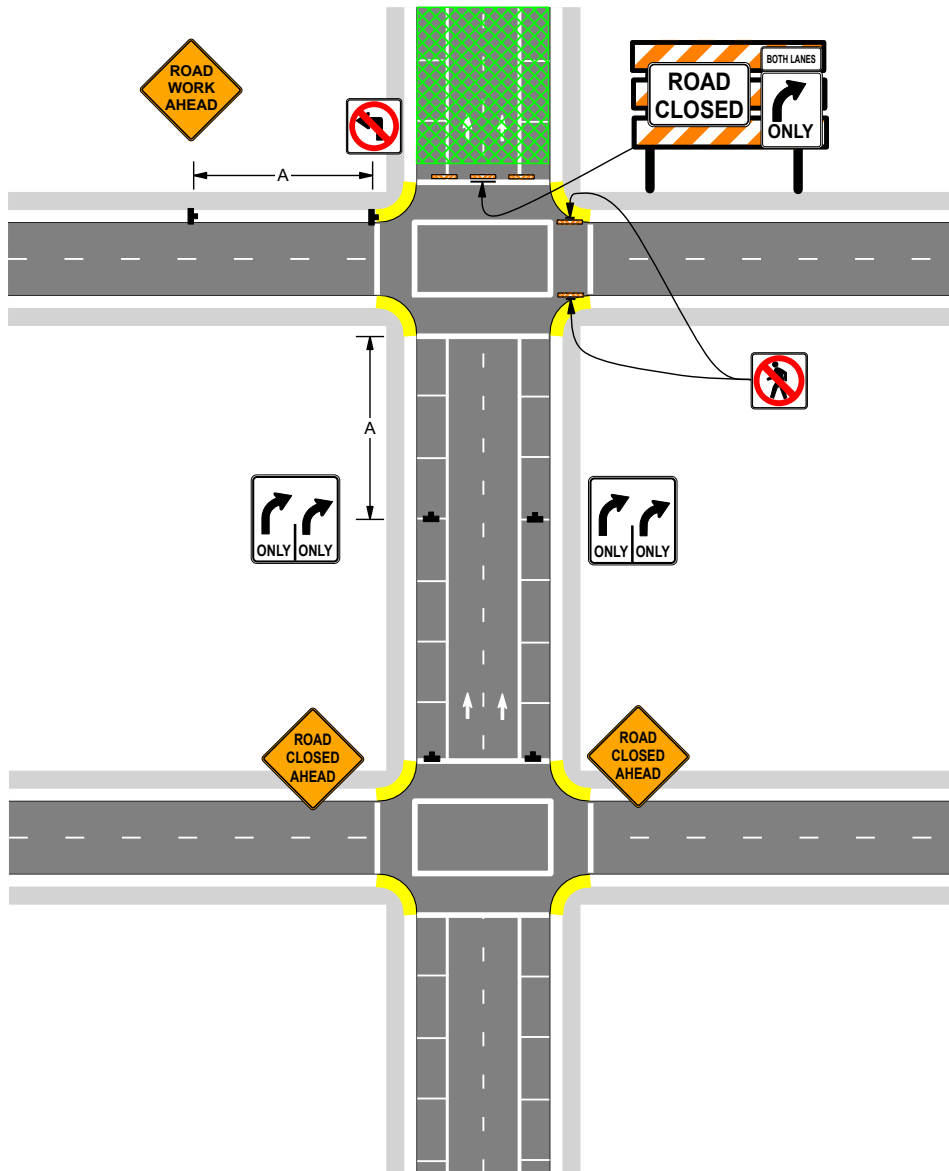
- 1) The merging taper shall direct traffic into either the right-hand or left-hand lane, but not both.
- 2) An arrow board is required on high-speed streets.



TA-03
Center Lane Closure

Conditions:

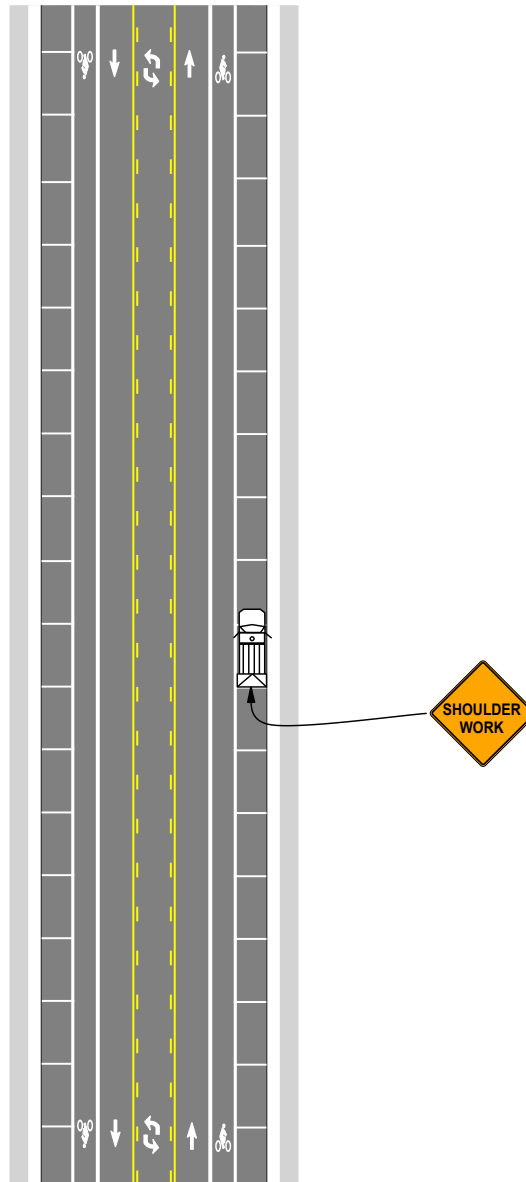
- 1) This plan requires Traffic Engineer approval.
- 2) This plan can be used to close streets which require traffic to turn left at the street closure by using corresponding warning and regulatory signs.
- 3) A detour plan, with additional signing, may be required.



TA-O4
Street Closure

Conditions:

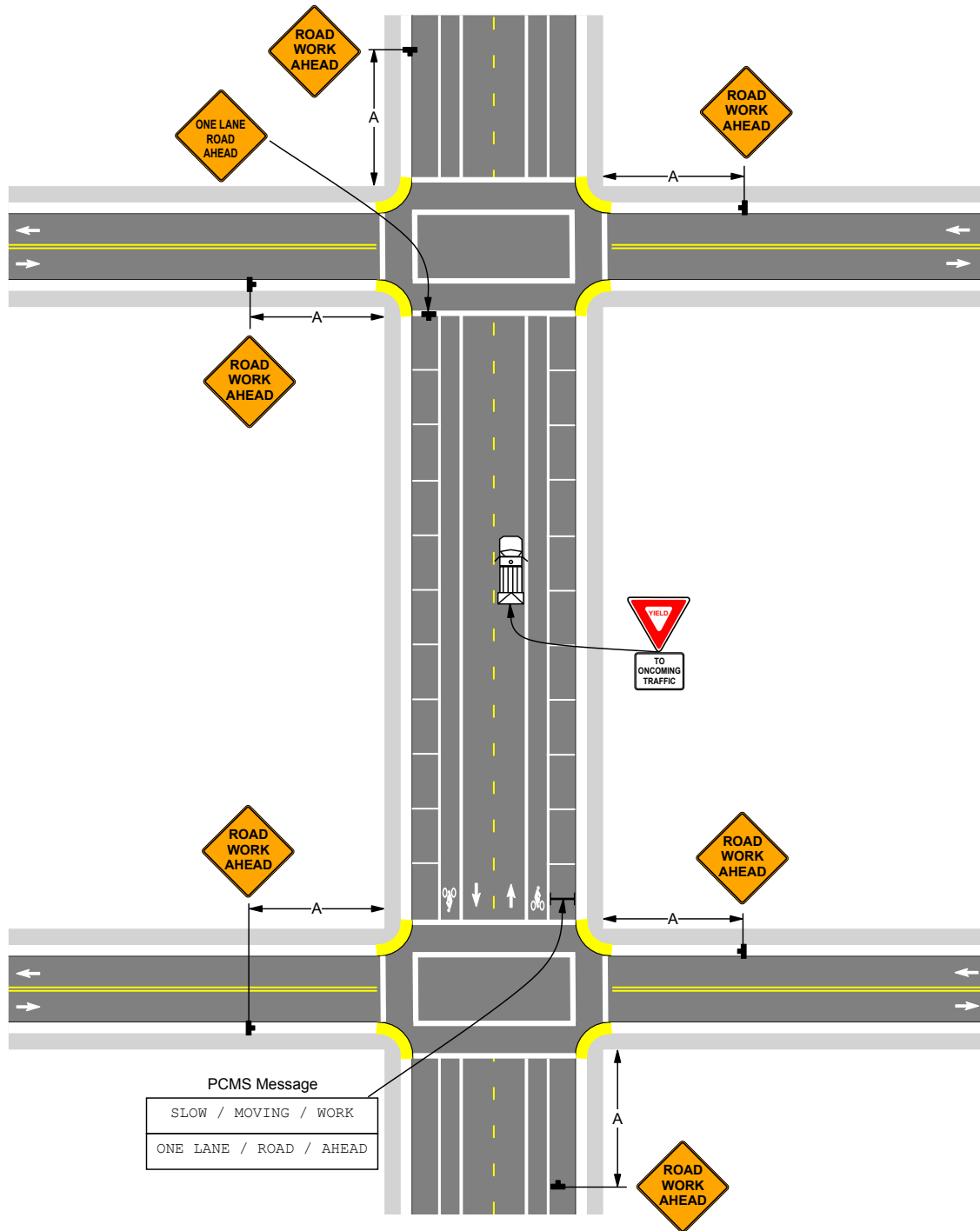
- 1) Vehicles should be parked as far off of the roadway as practical.
- 2) For added visibility on high-speed streets, truck-mounted arrow board in caution mode should be used.



TA-M1
Shoulder Closure

Conditions:

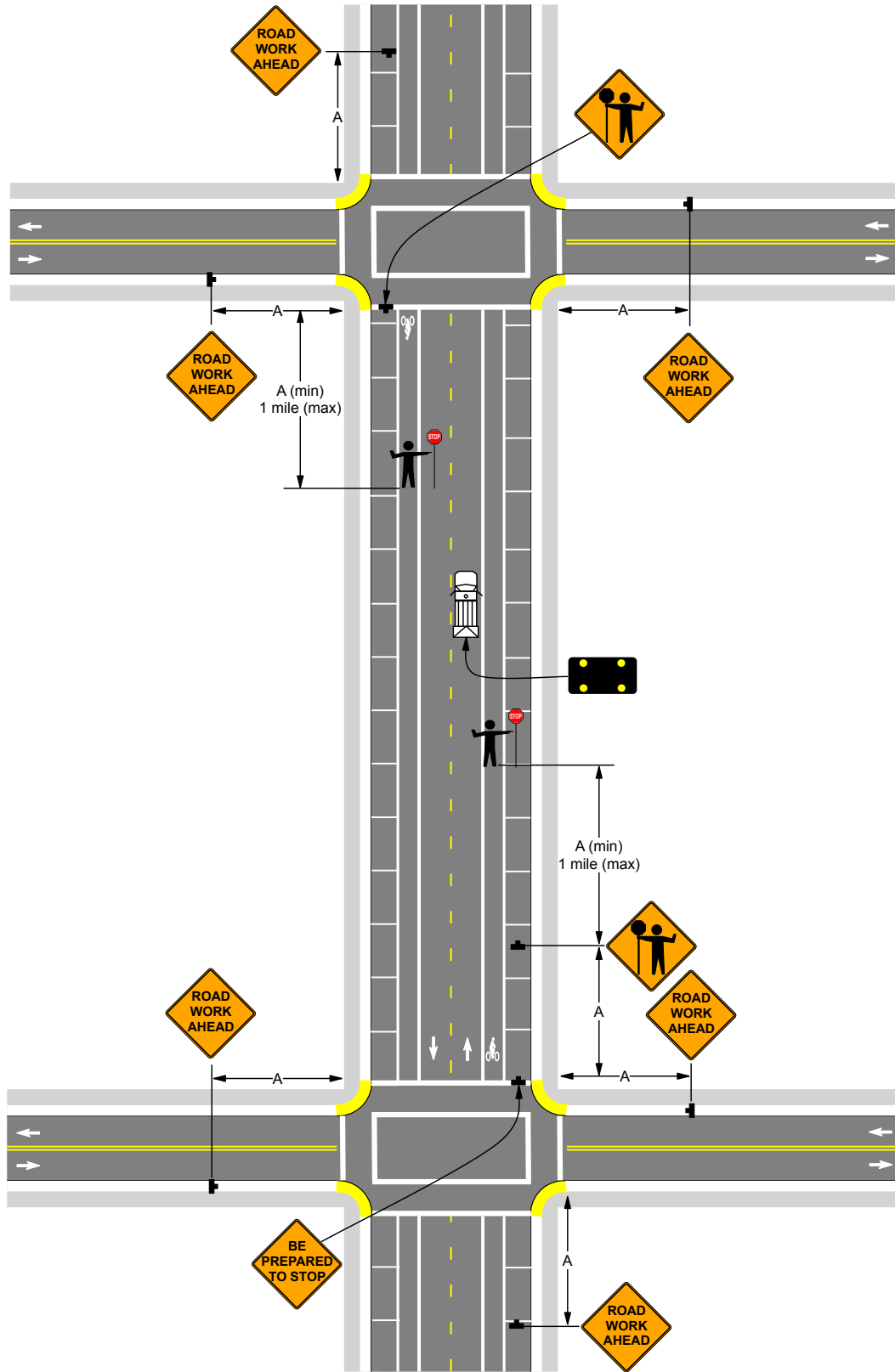
- 1) This plan requires Traffic Engineer approval.
- 2) This plan is for use on low-volume streets.
- 3) For added visibility, truck-mounted arrow boards in caution mode should be used.
- 4) Where practical and when needed, the work and shadow vehicles should pull over to allow traffic to pass.
- 5) A shadow vehicle may be required on high speed streets.
- 6) Not for use when sight distance is less than 310ft at each end.



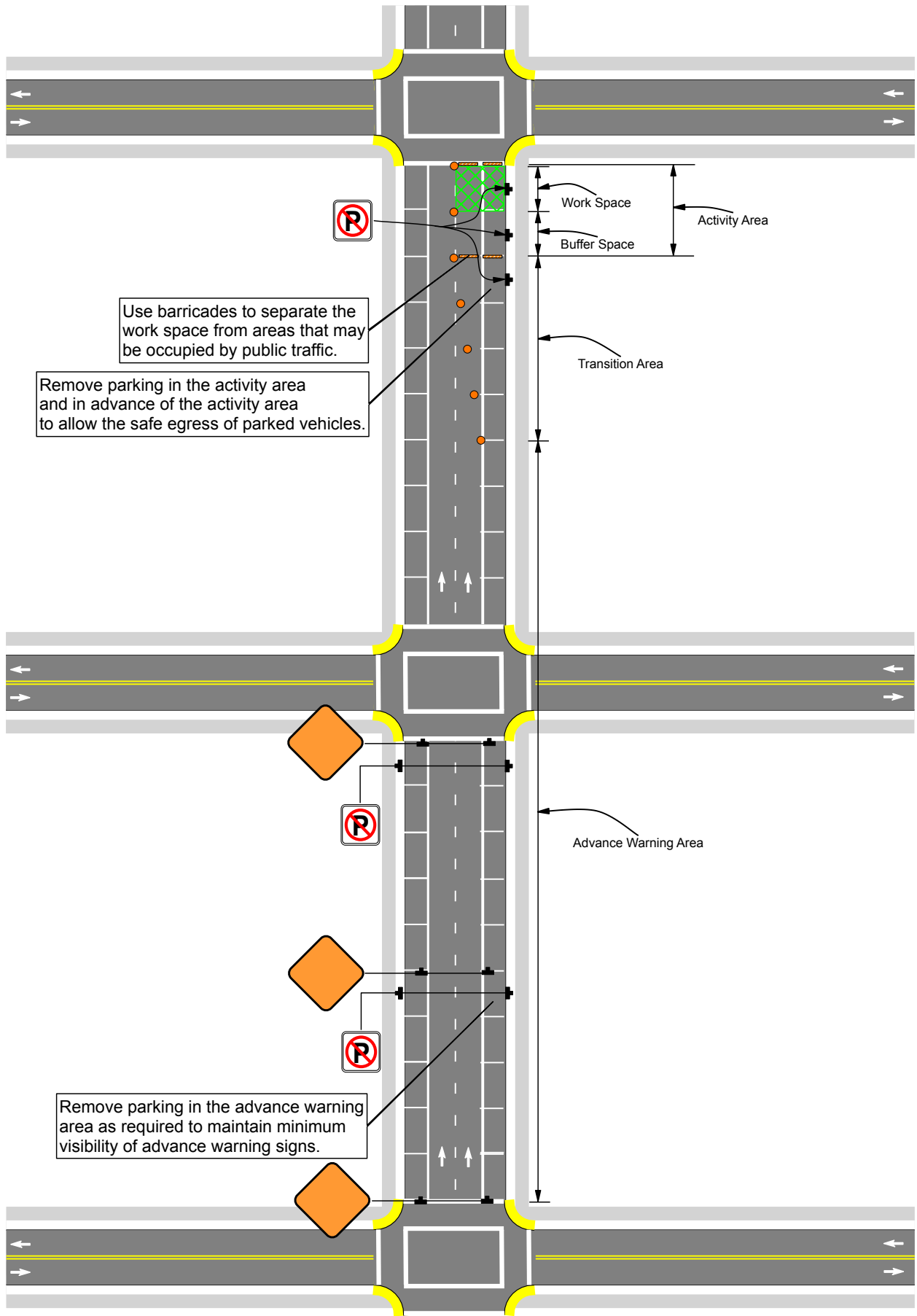
TA-M2
Self-Regulating Lane Closure

Conditions:

- 1) This plan requires Traffic Engineer approval if closer than 200ft from a signalized intersection, and on high-speed streets.
- 2) For added visibility on high-speed streets, a truck-mounted arrow board in caution mode should be used.



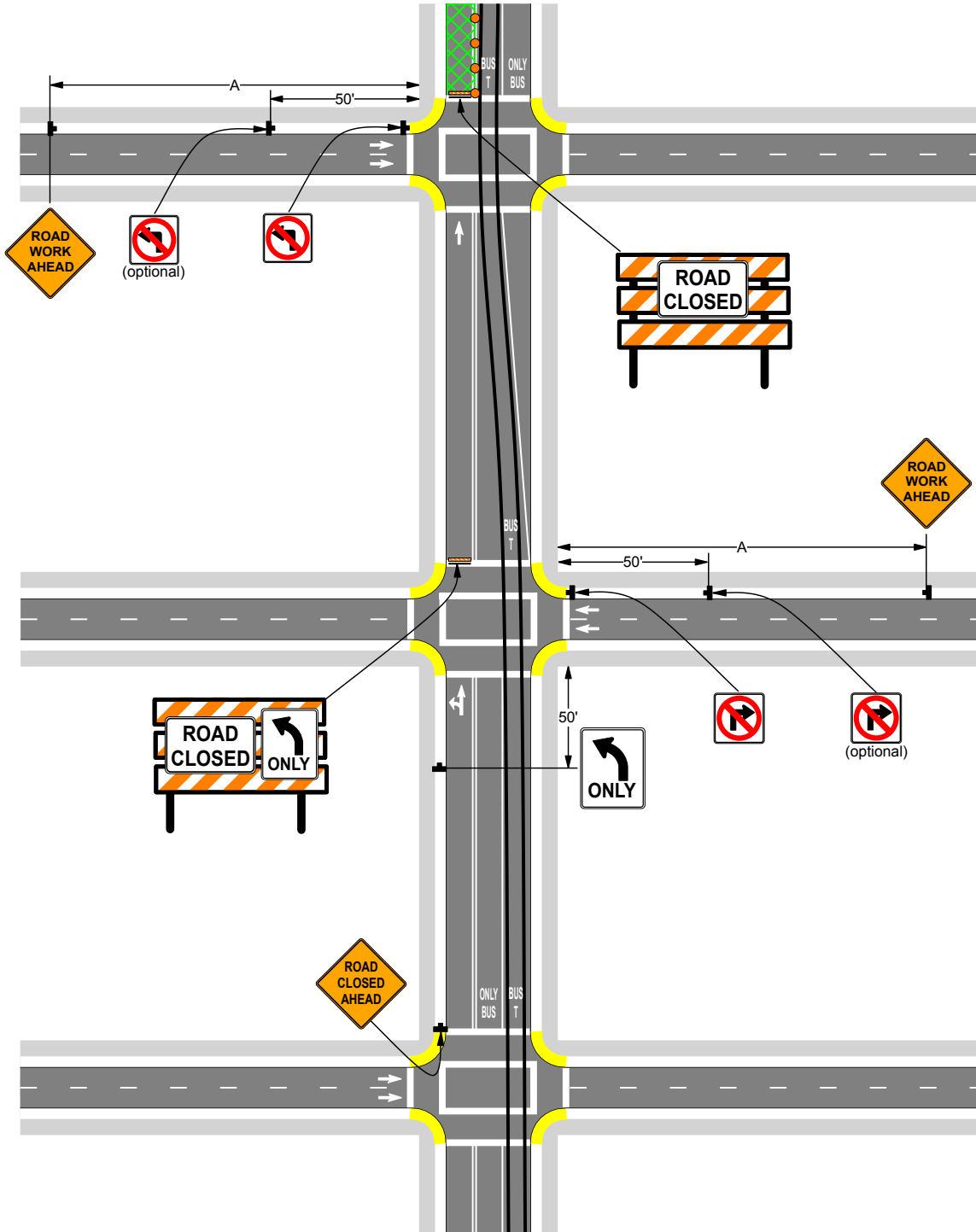
**TA-M3
Flagging**



**TA-X1
Parking Removal in Work Zone**

Conditions:

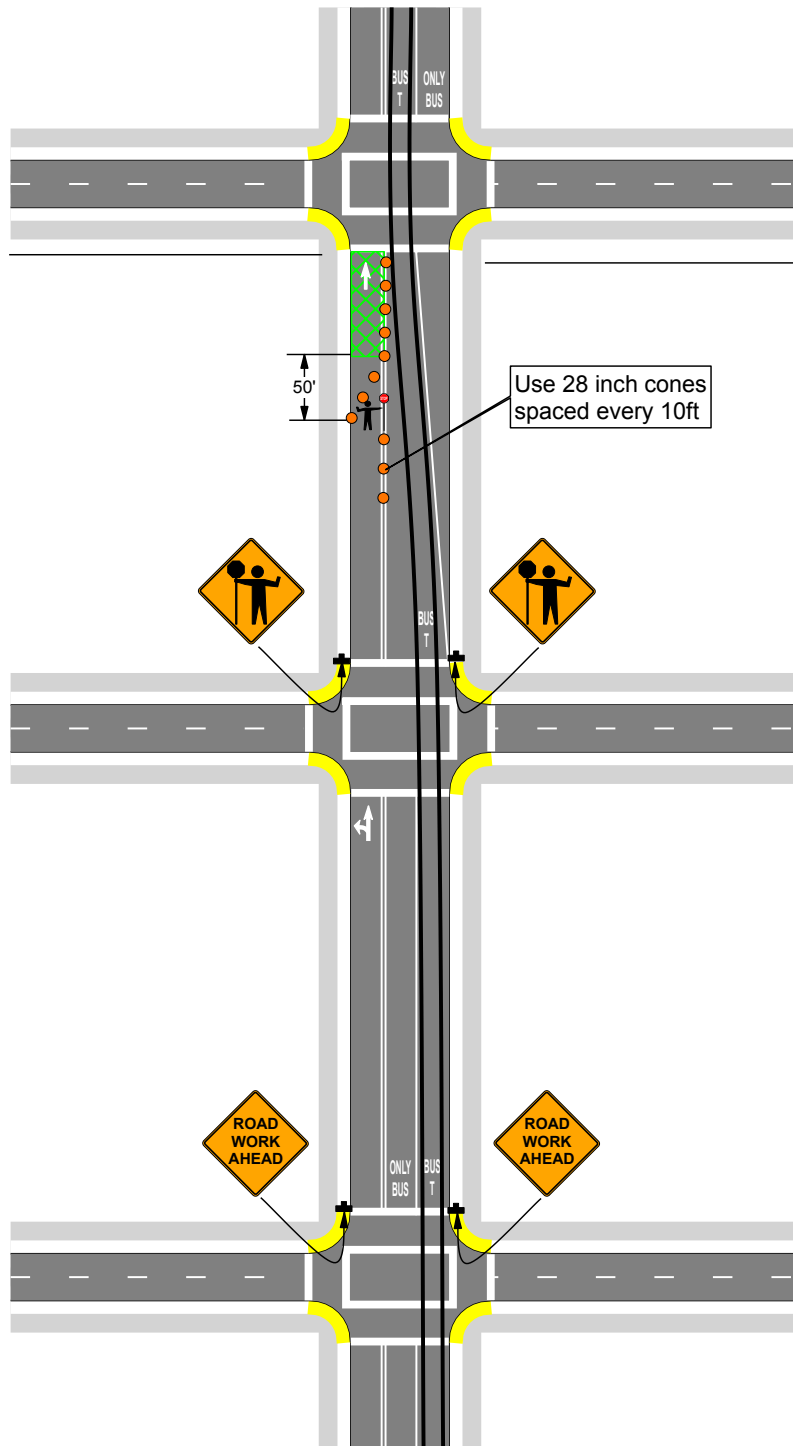
- 1) Where work is located after a one-way that permits legal turns, it is not necessary to barricade the next street.
- 2) Per PCC 16.50.410, work in Transit Mall Auxiliary Vehicle Lanes is restricted from 7:00 p.m. to 6:00 a.m. Monday through Friday, and any time on Saturday or Sunday, and shall not interrupt TriMet service.
- 3) Per PCC 16.50.400, work in Non Transit Mall is restricted from 9:00 a.m. to 4:00 p.m. and 6:00 p.m. to 7:00 a.m. Monday through Friday, and any time on Saturday or Sunday, unless otherwise allowed by permit.
- 4) The Transit Mall is defined as 5th and 6th Ave between NW Irving St and SW Jackson St, NW Irving St between 5th and 6th Ave., and SW Morrison and Yamhill St. between SW 4th Ave and Broadway.
- 5) TriMet Track Access permits are required for use of transit lanes. Contact TriMet at 503-661-8138 or



TA-X2
Auxiliary Lane Closure

Conditions:

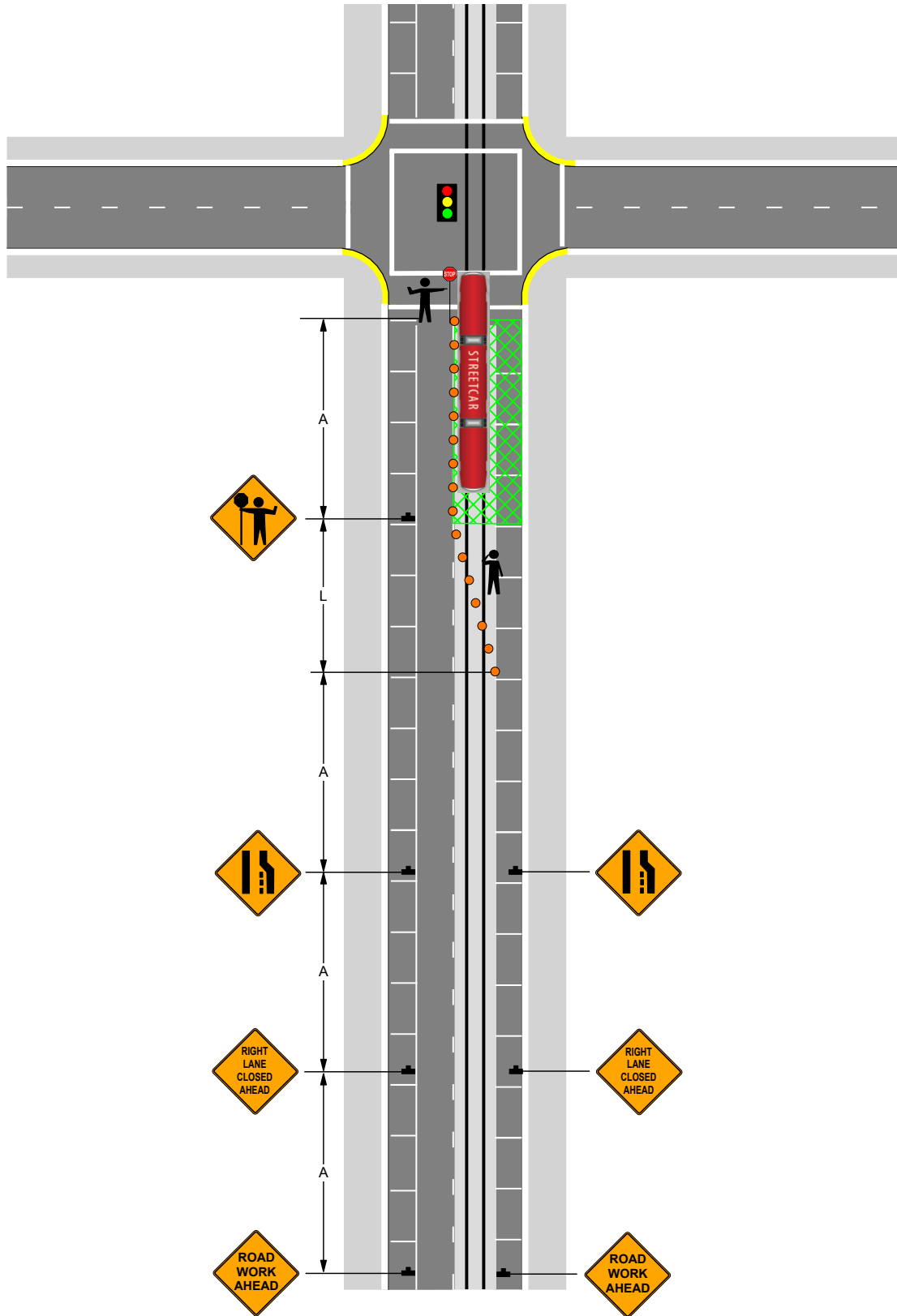
- 1) The train has priority over vehicles. Traffic to be held until the train has cleared the area.
- 2) Per PCC 16.50.410, work in Transit Mall Auxiliary Vehicle Lanes is restricted from 7:00 p.m. to 6:00 a.m. Monday through Friday, and any time on Saturday or Sunday, and shall not interrupt TriMet service.
- 3) Per PCC 16.50.400, work in Non Transit Mall is restricted from 9:00 a.m. to 4:00 p.m. and 6:00 p.m. to 7:00 a.m. Monday through Friday, and any time on Saturday or Sunday, unless otherwise allowed by permit.
- 4) The Transit Mall is defined as 5th and 6th Ave between NW Irving St and SW Jackson St, NW Irving St between 5th and 6th Ave., and SW Morrison and Yamhill St. between SW 4th Ave and Broadway.
- 5) TriMet Track Access permits are required for use of transit lanes. Contact TriMet at 503-962-4937 or 503-962-8867



TA-X3
Flagging Auxiliary Lane Closure

Conditions:

- 1) Spotter to remove appropriate cones in taper when train approaches.
- 2) Flagger to stop traffic on red signal phase when streetcar is approaching and hold automobile traffic until streetcar clears the intersection.
- 3) A site specific plan may be required.



TA-X4
Work Adjacent to Streetcar