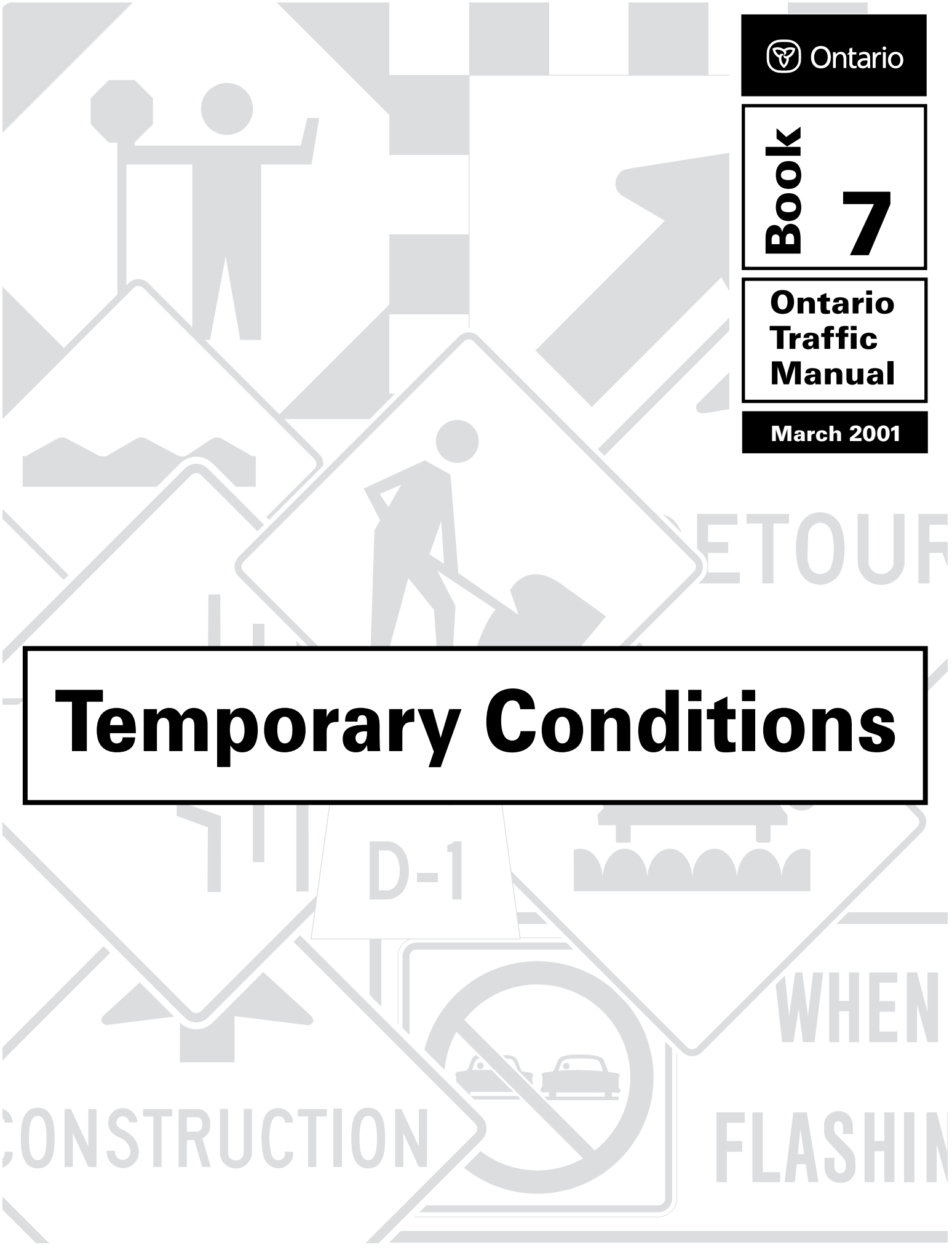
Ontario

Book 7

Ontario Traffic Manual

March 2001

Temporary Conditions



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Ontario Traffic Manual

Foreword

The purpose of the Ontario Traffic Manual (OTM) is to provide information and guidance for transportation practitioners and to promote uniformity of treatment in the design, application and operation of traffic control devices and systems across Ontario. The objective is safe driving behaviour, achieved by a predictable roadway environment through the consistent, appropriate application of traffic control devices. Further purposes of the OTM are to provide a set of guidelines consistent with the intent of the Highway Traffic Act and to provide a basis for road authorities to generate or update their own guidelines and standards.

The OTM is made up of a number of Books, which are being generated over a period of time, and for which a process of continuous updating is planned. Through the updating process, it is proposed that the OTM will become more comprehensive and representative by including many traffic control devices and applications specific to municipal use. Some of the Books of the OTM are new, while others incorporate updated material from the Ontario Manual of Uniform Traffic Control Devices (MUTCD) and the King's Highway Guide Signing Policy Manual (KHGSPM).

The Ontario Traffic Manual is directed to its primary users, traffic practitioners. The OTM incorporates current best practices in the Province of Ontario. The interpretations, recommendations and guidelines in the Ontario Traffic Manual are intended to provide an understanding of traffic operations and they cover a broad range of traffic situations encountered in practice. They are based on many factors which may determine the specific design and operational effectiveness of traffic control systems. However, no manual can cover all contingencies or all cases encountered in the field. Therefore, field experience and knowledge of application are essential in deciding what to do in the absence of specific direction from the Manual itself and in overriding any recommendations in this Manual.

The traffic practitioner's fundamental responsibility is to exercise engineering judgement and experience on technical matters in the best interests of the public and workers. Guidelines are provided in the OTM to assist in making those judgements, but they should not be used as a substitute for judgement.

Design, application and operational guidelines and procedures should be used with judicious care and proper consideration of the prevailing circumstances. In some designs, applications, or operational features, the traffic practitioner's judgement is to meet or exceed a guideline while in others a guideline might not be met for sound reasons, such as space availability, yet still produce a design or operation which may be judged to be safe. Every effort should be made to stay as close to the guidelines as possible in situations like these, and to document reasons for departures from them.

Custodial Office

Inquiries about amendments, suggestions or comments regarding the Ontario Traffic Manual or about training sources may be directed to:

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A user response form is provided at the end of Book 1 of this Manual. Inquiries regarding the purchase and distribution of this Manual may be directed to the custodial office.

Book 7 (Temporary Conditions) and its associated Field Edition for site workers were developed with the assistance of a Technical Advisory Committee organized by the Ministry of Transportation.

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NOTE: A training package is available separately. For more information, contact:

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1. Introduction

Book 7 (Temporary Conditions) and its accompanying Field Edition are part of a series of volumes that makes up the Ontario Traffic Manual (OTM). Book 7 and the Field Edition address the application of control devices in temporary construction (including pre-engineering), maintenance, and utility work zones. They should be read in conjunction with Book 1 (Introduction to the Ontario Traffic Manual) and its three appendices, which contain considerable essential information about the fundamental principles and policies behind the design and application of traffic control signs, signals, markings and delineation devices.

As used in Book 7, the terms "Temporary Conditions," "Temporary Work Zones," and "Work Zones" are considered to mean essentially the same thing, and are used interchangeably unless otherwise noted.

Book 7 is not intended to provide sufficient detailed information to allow the design and fabrication of individual signs. For these purposes, reference should be made to Book 1b (Sign Design Principles), Book 2 (Sign Patterns and Fabrication), and Book 3 (Sign Support and Installation). Where French language or bilingual versions of signs are available, they have not been illustrated in Book 7, but are contained in Book 2 (Sign Patterns and Fabrication).

Other Books in the OTM series provide practical guidance on a full range of traffic control devices and their application. A complete listing of the planned and currently available volumes, as well as the tables of contents for all Books and an illustrated master index, is found in Book 1 and Book 1a (Illustrated Sign and Signal Display Index).

Other documents, not in the OTM series, are also useful. The Ontario Geometric Design Manual and the Ontario Roadside Safety Manual also provide guidance in the design of temporary conditions. These and other references are listed in Appendix B, References.

1.1 Purpose and Scope

The OTM Book 7 (Temporary Conditions) has been developed to provide basic uniform requirements for traffic control in work zones during roadway or utility construction (including pre-engineering) and maintenance operations on or adjacent to public highways including ramps and municipal roads and streets, (as well as other public ways to which road traffic has access), and is intended for use by the following agencies and organizations:

(1) The Provincial, Municipal, and private road authorities in Ontario and their contractors.

(2) Utilities, contractors, and others who may have approval to work on public roadways.

Safety for workers and motorists is paramount, including workers setting up, operating, and removing traffic control. The purpose of this manual is to provide the basic **Minimum Typical Guidelines** for traffic control to be used by persons or agencies performing construction, maintenance, and utility work on any street or highway open to the public in the Province of Ontario, in order to achieve satisfactory levels of safety for workers and motorists.

Safety in road work zones depends on the application of a number of key elements which must work together as a system, or a "safety chain" which is only as strong as its weakest link. If a key element is weak or absent, safety may be compromised. These elements include:

- design of: the road, the construction or maintenance plan, and staging;
- the traffic control plan, identifying all necessary elements;
- the traffic protection plan for protection of workers;
- training of all personnel involved in traffic control;
- contractor compliance with the traffic control plan and traffic protection plan, including safe installation, application, and removal of all necessary traffic control elements;
- quality assurance checks of contractor compliance with the traffic control plan, with appropriate consequences for non-compliance;
- safe work habits on the part of workers;
- appropriate police enforcement.

The scope of Book 7 and the Field Edition includes the following:

- rural and urban applications, including those involving pedestrians;
- signs and other traffic control devices to be used in temporary conditions;
- sign specifications, reflectorization, installation, positioning, and maintenance;
- speed control in construction areas;
- mobile operations, very short duration, short duration, and long duration work zone conditions;
- decision matrix to assist in selection of typical layouts for work zone traffic control;
- typical sign/device layouts for various work zone durations, road types, and situations;
- special situations, including pre-engineering activities and zone painting.

1.2 Legal Authority

The Ministry of Labour, through the Occupational Health and Safety Act (OHSA) and Regulations for Construction Projects, R.S.O. 1990 and R.R.O. 213/91 as amended by 631/94 and 145/00, and as amended from time to time thereafter, has the legal authority to regulate the safety of workers. This includes protection measures for all workers, including requirements relating to traffic control persons directing traffic through or around a road construction site. The OHSA and regulations take precedence over Book 7 in matters of worker safety.

The Ministry of Transportation, through the Highway Traffic Act, the Public Transportation and Highway Improvement Act, and various related statutes, has the legal authority and responsibility to regulate and control traffic on a highway (see definition), and to regulate and control motor vehicles operating in the province. Municipalities, through the Municipal Act and various regional municipality acts, and as empowered to enact municipal by-laws through various provisions of the Highway Traffic Act and other provincial acts, have the legal authority and responsibility to regulate and control traffic on their highways. This authority and responsibility also applies to construction and maintenance activities on highways.

Traffic signs, pavement markings, traffic control signals, and other devices to regulate, warn or guide traffic are to be installed only under the authority of the road agency having jurisdiction.

When they have been authorized, work zone contractors and utility companies may install temporary conditions signs and devices, or use traffic control persons to protect road users, the public, workers, and equipment, subject to the guidelines of this Manual, the Occupational Health and Safety Act and its regulations, and the requirements of the road authority.

Contractors may be authorized by the road authority to slow upstream traffic (e.g., rolling closures). The contractor may also implement short-term road closures, as authorized by the road authority. As the use of police to slow traffic or to implement road closures is not a legal requirement, it is the road authority's decision whether to use contractor staff or police for these operations.

Regulatory devices may need to be supported by applicable legislation, regulations, or by-laws. Effective traffic control requires both the appropriate application of traffic control devices and reasonable, effective enforcement.

1.3 Fundamental Principles of Work Zone Design

Risk to both drivers and workers can be reduced by the provision of a predictable, familiar roadway environment, to the extent practicable. The consistent and appropriate application of traffic control devices increases the probability of roadway users exhibiting the desired behaviour, and helps ensure the safety of workers. Work zones must be designed with explicit consideration of worker and traffic safety.

Worker and traffic safety must be designed into construction and maintenance projects, rather than applied on a makeshift basis. Positive guidance, and the avoidance of violating driver expectation, should be used. See also Book 1c (Positive Guidance Toolkit).

Roadway work zones should be designed around the following basic principles:

- Worker Safety;
- Motorist Safety;
- Motorist Mobility;
- Advanced Warning (provision of advance notice to motorists that they are approaching a work zone);
- Work Site Identification (visible identification of the work area by passive and/or active traffic control devices to show road users where work is taking place);
- Positive Guidance (provision to drivers of the information they need to avoid hazards, when and where they need it, in a form they can best use it).

It is recommended that a traffic control plan be prepared in advance for any construction project, in conformity with road authority policies and guidelines.

If practical, maintenance and construction activities should not be scheduled during peak hours, especially at high traffic volume locations. Peak hours for traffic flow are typically from 7:00 a.m. to 9:00 a.m. and from 4:00 p.m. to 6:00 p.m. The road authority may designate these or other hours as periods during which maintenance and construction activities are not to be conducted.

Where practicable, workers should be positioned at least 3 m (or 1.5 m for low speed facilities) from a live traffic lane, as stipulated by the road authority. See also General Note 11 in Section 8.

Where work vehicles are present, workers should stay ahead of (downstream of) the vehicle, not behind (upstream of) the vehicle.

Traffic movement should be interfered with or inhibited as little as possible. Frequent or unnecessary changes such as sudden lane narrowing, lane closings, reductions in speeds and risky manoeuvring should be avoided. Special precautions must be taken to ensure that construction equipment can be operated safely without making it hazardous to passing traffic. Roadway occupancy and work completion time should be minimized to reduce exposure to potential hazards.

Where interference is unavoidable, drivers and pedestrians must be guided in a clear and positive manner by adequate signs, channelizing devices, pavement markings, traffic signals, or by traffic control persons, whichever control device/measure or combination of control devices/measures is most appropriate, in accordance with the basic principles outlined above. Approval of the road authority is required for the use of any traffic control device(s) not shown in Book 7.

Persons engaged in traffic control must check the traffic control elements regularly to ensure that the traffic operations in the work zones are acceptable.

The persons engaged in traffic control must also check the worksites carefully to make sure that traffic controls are continually updated to suit changing construction conditions due to work staging and progress, or if an immediate improvement to the traffic control is needed. Work zone traffic controls must reflect actual conditions, so that signing is credible, increasing the likelihood of driver compliance. All temporary conditions traffic control devices should be removed when no longer needed. When work is suspended for short periods, advance warning signs that are no longer appropriate must be removed, covered, or turned, and other inappropriate devices removed from the work area so they are not visible to drivers.

Maintaining good public relations is necessary. Road users should be kept informed of the existence of and reasons for work sites.

1.4 Application of Guidelines

The standard use of traffic control devices is illustrated for typical and most common situations. Hills, curves, intersections, driveways and other physical features, and adverse weather conditions, may require variations from the guidelines, and good, informed judgement must be used to select the most appropriate devices. However, all temporary conditions installations shall conform to the general principles and guidelines presented in OTM Book 7.

With the possible exception of routine municipal maintenance and utility operations, to the extent that they may be exempted by the road authority, work must not commence without first obtaining a work permit or the approval of the road authority concerned.

Signs and other devices should be designed to be recognizable and comprehensible at a glance. Uniformity and simplicity in design, position and application are of the greatest importance in aiding recognition. However, it is difficult to illustrate detailed guidelines of applications for all situations that may arise. Where special situations occur, requiring more than the minimum guideline, additional protection should be provided. Such protection should be determined on the basis of traffic speeds, vehicle (and pedestrian) volume, sight distance, duration of operation, and exposure risk to hazards. The Traffic Engineer or Road Superintendent of the road authority should be consulted before any deviation is made from OTM Book 7 and for guidance in special traffic control circumstances. Any deviations from Book 7 guidelines should be documented, along with the reasons for the deviations. Where messages are required other than

those provided, signs should be the same shape as standard signs of the same classification, and should be in the colours described in Book 1, Table 1 (Shape and Colour Codes for Signs) and Book 7, Section 3.1.

The Ministry of Labour, through the Occupational Health and Safety Act, has the authority for regulating worker safety. Regulation 213/91 as revised by Regulation 145/00 under the OHSA states that following the OTM Book 7 (Temporary Conditions) meets with the intent of Sections 67, 68, and 69 of the Regulations.

It is expected that the temporary conditions guidelines outlined in Book 7 will be adopted by all public authorities and private companies and contractors with safety responsibilities in construction, maintenance and utility work zones on public highways and streets. Instructions must be given to all employees and contractors and the guidelines should be included or referenced in the specifications for all contracts.

1.5 Appropriate Use of Traffic Control Devices

Temporary conditions signs, devices, and typical layouts depicted in this Manual constitute a minimum guideline. Road authorities may have additional typical layouts suitable for local requirements. Signs, signals and pavement markings specified in Book 7 and the Book 7 Field Edition should be installed and maintained in accordance with the guidelines outlined in the appropriate sections of Book 1 (Introduction to the Ontario Traffic Manual), Book 1b (Sign Design Principles), Book 5 (Regulatory Signs), Book 6 (Warning Signs), Book 11 (Markings and Delineation), and Book 12 (Traffic Signals). The location of these signs and devices must be revised as required to guide drivers safely through the temporary conditions. All non-essential and inconsistent devices should be removed, since they divert attention from official devices. Traffic devices and supports must not bear any unauthorized labels, logos, or commercial advertising on the face of the sign.

Flags should not be used as channelizing devices or traffic control devices. Flags should be used in conjunction with low-mounted signs, to enhance sign visibility. When used with low-mounted signs (A-frame), flags must be 1.5 m to 2.5 m above roadways, to improve visibility of signs that might otherwise not be readily seen.

Flags may also be used as supplements to other traffic control devices, for example, on zone-striper trucks, or utility vehicles used for very short duration activities. Where used, flags must be orange or fluorescent orange, and of solid fabric or plastic, robust, minimum size 45 cm x 45 cm. Flags should be mounted at a 45 degree angle approximately to maximize their visual effectiveness. When flag effectiveness is lost due to fading, they must be replaced. Where flags are used on trucks, they must have a diagonal 5 cm stripe of white retroreflective sheeting, and additional devices (e.g., cones) will be necessary to delineate the work areas if workers are required to enter the space between traffic and the truck-mounted flags.

Every effort should be made to plan and design work zones to the best possible standard and to maintain the best possible road conditions through work zones, having regard to the volume and type of traffic being accommodated. Special care must be taken in the planning of traffic control for work zone staging and with sign placement so that traffic may be guided through the work zone as effectively and safely as possible.

1.6 Rural and Urban Application

The general principles outlined in this book and the Book 7 Field Edition are applicable to both rural and urban areas. The differences between rural and urban situations warrant some separate treatment of traffic control requirements because of the lower speeds, higher volumes, limited manoeuvring space, frequent turn and cross movements, need for pedestrian protection, and encroachment by buildings found in an urban environment. However, many larger municipalities now include areas which are rural in nature, and roads which cover a wide range of posted and operating speeds.

The reader is referred to OTM Book 1, Section 6 "Classification of Highways for Application of Traffic Control Devices." That section indicates that:

- type of signing is affected by the highway/road classification, namely urban or rural freeways, and urban or rural non-freeways. (In Book 7, the type of signing is affected primarily by whether the road is a freeway or non-freeway, by the cross-section of the road, and by the nature and duration of the construction or maintenance operation).

- size of signing is related to many factors, but primarily to highway/road speed and number of lanes. The three speed ranges adopted are based on posted speed limits. The recommended sign sizes for each speed range have taken into account the fact that 85th percentile operating speeds are often higher than posted speed limits. For determining sign type, road classifications used in the OTM are shown in Book 1, Figure 3, and defined in Appendix A (Definitions). For determining sign size, the following three speed ranges have been adopted:

  (1) Speed limits of 60 km/h or lower;

  (2) Speed limits of 70 or 80 km/h;

  (3) Speed limits of 90 km/h or higher.

Where various sign sizes are shown in the OTM, the base or standard sign size is recommended as the minimum sign size. It is typically the sign size that will apply for the lowest speed range. Where specific sign sizes are recommended for the other speed ranges, they should also be regarded as minimum sizes for those speeds. For some sign designs, only one or two sign sizes are shown. In this case, two or more of the three speed ranges are combined into one. Where, in the road authority's or traffic practitioner's judgement, it is felt that the recommended minimum size is too small, and/or greater emphasis is needed, a larger sign size may be used. Other factors relating to sign design are described in Book 1b (Sign Design Principles). More information on sign size is provided in Book 1b (Sign Design Principles).

In practical terms, in Book 7, the minimum sign sizes generally apply to non-freeways (typically speeds less than or equal to 80 km/h), with increased sign sizes specified for some signs on freeways. As noted above, these are minimum guidelines. Sign sizes may and should be increased where the road authority or traffic practitioner considers it desirable and advisable. See also Section 3 and Table 2.

At urban locations, standard size warning signs are generally acceptable at lower speeds. However, larger or additional signs will generally be needed on wide streets with high traffic speeds and volumes, especially when advertising displays and distracting backgrounds compete with a standard sized warning sign for the motorist's attention. The required advance distances for the placement of warning signs, shown in Book 7 typical layouts, must be adhered to as closely as is practicable, but may have to be reduced in some areas of urban municipalities, such as central

business districts, characterized by signalized intersections, low speeds, frequent driveways, and short block lengths. Where such distances are reduced, active control devices such as flashing arrow boards and/or changeable message signs should be considered.

Every precaution reasonable under the circumstances should be taken for the protection of workers and the motoring public. For example, although the typical layouts might recommend a given taper length, this length might not be possible in an area of the city with many driveways and entrances. This might be offset by the additional use of traffic control devices such as a TC-12 flashing arrow board or reduced barrel spacing. Or, if visibility is limited by a horizontal or vertical curve, a taper might be lengthened (beyond the length shown in typical layouts) so as to give drivers adequate warning and visibility of the start of the taper.

The amount of street space taken up by construction and maintenance work should be no more than is absolutely necessary. However, this does not justify any failure to use sufficient warning and channelizing devices as may be required for public protection and guidance, or for the protection of the worker.

Pedestrian safety must be given special consideration, particularly when the work encroaches upon a sidewalk. Protective barricades, barrels, construction markers, and/or fencing should be used in addition to warning and guidance devices to separate pedestrians from road traffic. Pedestrian barricades, fencing, handrails or specifically designed passageways should be used to separate pedestrians from the work area. See also Section 1.12.

1.7 Component Areas of a Temporary Work Zone

A temporary conditions traffic control work zone includes the entire section of roadway from the first advance warning sign through to the last traffic control device, where traffic returns to its normal path and conditions. A well-designed work zone normally contains six distinct component areas, which are:

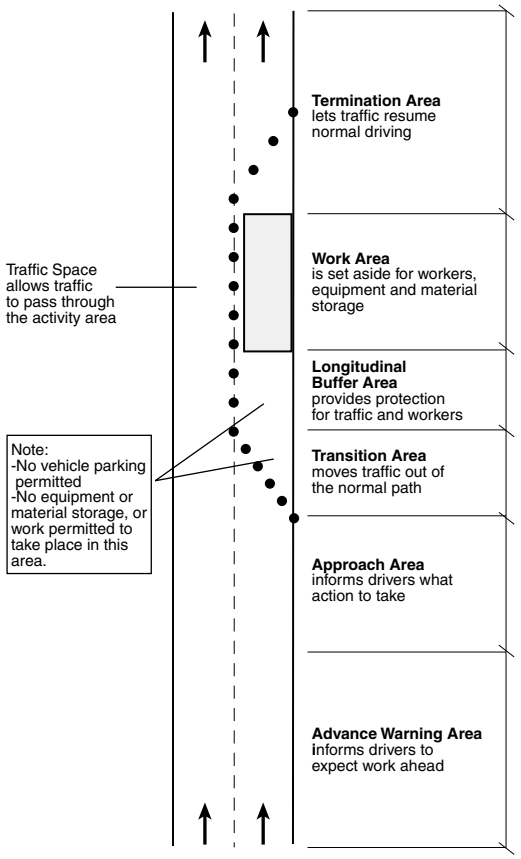
- Advance Warning Area
- Approach Area
- Transition Area
- Longitudinal Buffer Area (LBA). See Section 5 for Buffer Vehicle (BV) combinations with the LBA, including Lateral Intrusion Deterrence Gap (LIDG)
- Work Area
- Termination Area

These six areas are illustrated in Figure 1. Each component area will be present in some form in most work zones. Two or more of the component areas may be combined in situations where traffic volume, speed, and visibility do not permit the use of all of the above individually. For example, an LBA is not possible in a mobile work operation, an LBA is not required where Traffic Control Persons are used, and a termination area is generally not required in low speed urban situations.

In laying out a work zone, attention must be given to provisions for the safe access to and egress from the work area for work vehicles.

These six component areas are described below in the order that drivers encounter them.

Figure 1 – Component Areas of a Temporary Work Zone



Advance Warning Area

The advance warning area is used to alert drivers to road work ahead. The advance warning may vary from a single sign or flashing lights on a vehicle to a series of signs in advance of the approach area signing. On freeways and expressways, where driver speed is generally higher (70 km/h or more), signs may be placed as far as 2 km or more in advance of the approach area. Where it is beneficial to motorists to give warning in advance of an interchange, this distance may be increased. When active devices such as flashing arrow boards or flashers are used, or when the activity area is sufficiently removed from the driver's path that it does not interfere with traffic, the advance warning area may be eliminated, as shown in the typical layouts.

Approach Area

In the approach area, the driver is informed of lane changes, speed reductions, passing restrictions and the like. Drivers require the information at a sufficient distance in advance in order to be able to adjust to the altered situation before reaching it. The devices may vary from a single sign or flashing lights to a series of signs in advance of the transition area.

Transition Area

In the transition area, traffic is channelled from the normal path to a new path required to move traffic past the work space. Work material, vehicles, and equipment must not be stored or parked in the transition area.

The transition area must be delineated by channelizing devices, unless otherwise indicated in the typical layouts. It contains the tapers and parallel sections (if more than one lane closed) that are used to close the lanes effectively. The length of the tapers and the parallel sections are extremely important. Guidelines for taper and parallel section lengths are outlined in Tables A, B, and C used in conjunction with the typical layouts.

Note: the parallel sections referred to here are the lengths between successive tapers, and are not the same as the longitudinal buffer area described below.

The transition area must be obvious to drivers. The intended travel path must be clearly delineated so that drivers will not mistakenly follow the wrong path. For long duration operations, there may be a requirement to remove or mask out existing pavement

markings and possibly to enhance the transition area with temporary pavement markings to identify a clear route where there could be confusion regarding the proper path.

Longitudinal Buffer Area (LBA)

In stationary work zones, the longitudinal buffer area provides protection for traffic and workers, by providing an opportunity for drivers to brake to a halt between the end of the transition area and the work space.

Buffer protection is required as described in Section 5, and where shown on the typical layouts and General Notes to the typical layouts in Section 8. Buffer protection may be provided through use of a longitudinal buffer area alone (non-freeways) or with a buffer vehicle (freeways).

Where indicated as being required, the longitudinal buffer area must be provided where work zones require a lane closure or reduction of a lane to less than 3 m (3.5 m preferable on freeways), and must be defined by delineation devices, except for moving operations. This space provides a recovery area for an errant vehicle. No work material, vehicles, or equipment should be stored or parked in the buffer area. A flashing arrow board, if deployed, should be located at the downstream end of the taper, in advance of or at the upstream end of the buffer area.

Provided lane widths of at least 3 m are maintained, a longitudinal buffer area is not required for partial lane shifts (See Section 1.9) or for non-freeway shoulder operations. If a buffer vehicle (blocker truck or crash truck) is used, either for roadway operations or for shoulder operations, an appropriate Lateral Intrusion Deterrence Gap (LIDG) between the truck and the work area must be provided, as outlined in Section 5 and on the typical layouts.

A longitudinal buffer area or a buffer vehicle is not required where traffic is controlled by means of traffic control persons, remote control devices, or portable traffic control signals or temporary traffic signals. Hence, a longitudinal buffer area will usually not be required on two-lane roads.

The longitudinal buffer area length may be taken from Table 1. Longitudinal buffer lengths are also included in Tables A, B, C and D used in conjunction with the typical layouts, and are illustrated on the typical layouts, where applicable. As is noted on Tables A, B, and C, when the 85th percentile speed is known, it may be used instead of the posted regulatory limit.

Roads with posted speeds of 60 km/h or lower are usually located in urban areas, with more frequent intersections, many of them signalized, and driveways and entrances. A longitudinal buffer area or buffer vehicle is not required where posted speeds are 60 km/h or lower because:

- in urban areas there are many more stimuli to drivers, including traffic signals, and drivers are less likely to be drowsy or inattentive. The other traffic control devices at the work zone should be sufficient to alert the driver of the work area ahead, without requiring a longitudinal buffer area.

- space restrictions in urban areas will often mean that there is insufficient space for a longitudinal buffer area.

However, where space permits, and other concerns are present, a longitudinal buffer area or a buffer vehicle should be considered for speeds of 60 km/h or lower, as shown in parentheses in Table 1.

Table 1 – Longitudinal Buffer Area (LBA) Length

Posted Speed (km/h)	Longitudinal Buffer Area Length (m)
50	(30)
60	(40)
70	50
80	60
90	75
100	95

Work Area

The work area is where the work takes place. It is set aside for workers, equipment and material storage.

The work area may be in a fixed location or may move as work progresses. It may be defined by delineation devices. In a confined location, the work space may be shielded by barriers as an additional feature. Every practical effort should be made to minimize hazards and distractions to drivers and workers. See also the requirements of Regulation 213/91 under the OHSA.

Termination Area

The termination area is used for traffic to make the transition back to the normal path of the road. The termination area extends from the downstream end of the work space to the point where traffic is able to resume normal driving. The spacing between markers may be opened up in the termination area or extended across only one lane (in the termination of a multiple lane closure) so as not to hinder access/egress of work vehicles.

Linear Space Restrictions

Situations may be encountered where the recommended values for taper lengths and longitudinal buffer area cannot be achieved within the available linear space, e.g., urban areas involving closely-spaced intersections and/or many driveways and entrances.

The longitudinal buffer area length is derived such that the taper plus the longitudinal buffer area length are greater than the stopping sight distance. Where necessary, the longitudinal buffer area may have to be reduced or even eliminated. In such cases, additional advance warning and delineation devices should be considered. Reducing or eliminating the longitudinal buffer area should only be undertaken once alternatives, such as relocating the taper and buffer area upstream of the intervening obstruction, have been considered and deemed impractical.

There may be situations where, even with the elimination of the longitudinal buffer area, it will be necessary to implement reduced taper lengths. Under such conditions, the use of a buffer vehicle or other protection/attenuation device, if used, along with additional advance warning and guidance devices, must be in accordance with the guidelines outlined in Section 5 and in the General Notes, Section 8.

In the urban situations described above, a buffer vehicle is not required. On freeways, where a buffer vehicle is required, linear space restrictions are less likely to arise. They may arise, however, when working in the vicinity of interchange ramps, for example. In this case, consideration should be given to lengthening the taper and/or LBA, bringing the start of the taper further upstream, and closing the interchange ramps. If this is not feasible, and some reduction in linear dimensions cannot be avoided, the LBA should be reduced, in conjunction with a reduction in the length of the taper. If such reductions are made, additional active advance warning devices

must be used. The LIDG between the buffer vehicle and the work area should not be reduced, and the taper should not be reduced by more than 50% of its normal length (see Table C).

1.8 Duration of Work

Work duration is a major factor in determining the number and types of signs and devices to be used in temporary work zones and the manner in which they are used. The four categories of work duration used in Book 7 are:

- Mobile Operations
- Very Short Duration Work
- Short Duration Work
- Long Duration Work

The last three categories are all Stationary Operations.

Mobile Operations

Mobile operations (MO) involve work that is done while moving continuously, usually at low speeds (typically 25 km/h), or intermittently, with periodic brief stops related to the mobile activity, which do not exceed a few minutes in duration. Generally, if a short stop is required to be made at a specific location, it is very short duration (VSD) work rather than mobile operations. The advance warning area moves with the activity area. For some continuously moving operations, where volume is light and visibility is good, a well-marked and well-signed vehicle may be sufficient. If volume and/or speed is higher, a buffer vehicle equipped with a flashing arrow board should follow the work vehicle. In addition, vehicles may be equipped with devices such as flashing vehicle lights, truck-mounted attenuators, and appropriate signs, as illustrated in the typical layouts.

Where mobile operations are in effect on a high-speed travel lane of a multi-lane divided highway, flashing arrow boards must be used.

Examples of mobile operations include longitudinal pavement marking, zone painting, and street sweeping.

Paving operations are a very low-speed type of mobile operations. However, their speed is so low that the typical layouts used for paving operations are those for stationary operations. Where specific requirements apply for paving operations, they are described in the General Notes to the typical layouts in Section 8.

Very Short Duration Work

Very short duration (VSD) work occupies a fixed location for up to 30 minutes, including set-up and take-down time. The work site may be moved along the road and make frequent, short stops. Generally, if a short stop is required to be made at a specific location, it is very short duration work rather than mobile operations.

Examples of very short duration work include some utility work, minor road maintenance, pothole patching, surveying, stormwater catchbasin cleanout, and the like.

The time required to set up and remove normal traffic control devices in these situations may approach or exceed the time required to perform the work itself. Hence, the use of active devices such as flashers and flashing arrow boards, along with simplified set up and removal procedures, is considered most appropriate for very short duration work. The

investment in these active devices helps ensure adequate traffic control, reduces worker time spent exposed to traffic hazards, and yields more efficient, productive work operations.

Short Duration Work

Short duration (SD) work refers to stationary maintenance, construction, or utility activities which require a separate work space, which are continuously occupied by workers and/or equipment, and which are more than 30 minutes and less than one 24-hour period in duration. Short duration work does not include work at a site extending beyond 24 hours; such work is long duration.

Table A applies to short duration work on non-freeways. Table C applies to freeways (both short duration and long duration).

If work is done during nighttime, Nighttime SD Provisions must be followed (see Notes following).

Work at the same location may be extended to more than one day, and still be considered SD work if (1) the approval of the road authority is obtained for such work; (2) any additional conditions stipulated by the road authority, including working hours, are complied with; (3) all other conditions described in this definition are met; and (4) the roadway (and sidewalk, if present) are restored, to the satisfaction of the road authority, and returned to normal operation when the daily work shift (or authorized working period) is complete.

For emergency work, short duration traffic control provisions should be implemented to the greatest extent practicable, including adequate reflectorization if at night, in order to avoid the creation of additional hazard. Also, if emergency work must be done in adverse precipitation or visibility conditions, consideration should be given to using longer taper lengths and/or additional active devices. All agencies and vehicles actively involved in emergency traffic control situations should carry at least the equipment listed under Condition B for nighttime operations.

Notes: For nighttime work of any duration, traffic garments meeting OHSA requirements for nighttime work must be used.

Nighttime SD Provisions
These provisions are required for nighttime short duration work, even though one or more may be shown as optional for the daytime short duration operations illustrated in the typical layouts:

- *Condition A*
  Shoulder or Road Edge Work
  Encroachment on the roadway which still leaves at least 3 m width (3.5 m preferable on freeways) for traffic in the adjacent lane:

  - TC-2B or TC-2A Sign, as required in typical layouts, and as per Table A;

  - 360 degree flashing amber light and 4-way flashers (except where a TC-12 flashing arrowboard is shown as a requirement) (truck/trailer mounted TC-12 flashing arrowboard(s) may always be used in place of 360 degree flashing amber light and four-way flashers). (Note: in Figures TL-5, TL-6, and TL-8, for shoulder and road edge operations; this requirement does not apply for the situation with no vehicle present.)

  - Retroreflective sheeting on all traffic control devices, to the reflectivity level prescribed for each device;

  - If cones are shown as being required in typical layouts, they must be 70 cm cones with one standard white retroreflective (minimum Type III, high intensity) 10 cm to 15 cm wide cone collar mounted on the upper one-third of the cone taper, 10 cm below the top of the cone.

(Reflectorized TC-52s or TC-54s should be used as an alternative to cones on multi-lane roads, where conditions permit, and must be used on freeways, such as where shown on the typical layouts and in Table E.2)

- *Condition B*
  Lane Closure, or Lane Encroachment leaving less than 3 m width (3.5 m preferable on freeways) for traffic in the adjacent lane:

  - Requirements listed under Condition A plus the following:

    - Truck/trailer mounted TC-12 flashing arrowboard(s).

    - For intersection zone painting: 45 cm cones with a white retroreflective (minimum Type III, high intensity) cone collar may be used instead of 70 cm cones during the painting operation; after painting is completed, while paint is drying, a TC-4 may be used as a replacement for the TC-12.

    - Under normal circumstances, planned short duration nighttime work should not be conducted in fog or when roads are slippery. If wet or slippery roads or poor visibility are present when *emergency* work must be performed, an advance trailer-mounted TC-12 must be used and positioned as soon as practicable. Long duration taper lengths (Table B) (rather than short duration taper lengths (Table A)) should be considered.

- *Condition C*
  Situations requiring traffic control for pedestrians (may be a stand-alone condition, or in combination with Condition A or B): See Section 1.12.

- Pedestrian barricades should be used where necessary to provide adequate protection and guidance to pedestrians in work zones.

Long Duration Work

Long duration (LD) work refers to stationary maintenance, construction, or utility activities which require a separate work space for longer than 24 hours. At long duration temporary work zones, there is ample time to install and to realize the benefits from the full range of traffic control devices and procedures that are available for use. Temporary roadways and barriers may be provided, and inappropriate markings which cause driver confusion should be removed and replaced with temporary markings.

Long duration work is treated differently for non-freeways and freeways, because of the greater driver expectation of smooth, uninterrupted traffic flow on freeways. For this reason, the tables for the typical layouts are applied as follows:

- Table B: Long Duration (Non-Freeways);

- Table C: Freeways (both Short Duration and Long Duration).

For stationary operations on freeways longer than five days in duration, temporary barriers or appropriate alternatives are required, as described in OHSA. See Section 8, General Notes.

1.9 Partial Lane Shifts

Where visibility is good, and for short (up to 50 m) work areas on two-lane roads with posted speeds of 60 km/h or lower, partial lane shifting for short duration roadside operations is an accepted practice. Use of partial lane shifts must be approved by the road authority. In this practice, where roadside operations (for example, utility vehicle outrigger lane encroachment) will result in a remaining lane width of less than 3 m, but squeezing all lanes minimally will still result in usable lane widths of at least 3 m in each lane, the lanes may be temporarily and partially

shifted by demarcating them through use of cones, as shown in Figures TL-9 and TL-10. Normally, partial lane shifting should occur only on hard-surfaced roadways. Motorists should not be directed onto the gravel shoulder of a roadway unless there is a posted speed reduction. When a lane shift is required on an all-gravel surfaced roadway, vehicles should not be directed off the roadway onto a shoulder that is soft or of a different texture.

This practice avoids closing one lane and the use of Traffic Control Person(s). However, additional care must be taken for worker safety in setting up and removing the cones or barrels demarcating the shifted lanes.

Where visibility is good, and for short (up to 50 m) work areas on low volume two-lane roads with posted speeds of 70 km/h or 80 km/h, partial lane shifting for short duration roadside operations is also acceptable under certain conditions, as shown in Figure TL-9. Each lane must have a usable lane width of at least 3 m. These higher speeds require more advance notice and a more gradual transition, with an appropriate taper length in advance of the lane shift. If the lane shift (measured as the amount of shift of the right edge of the shifted lane) is less than or equal to 1 m, the taper length to be used from Table A is 1b*. If the lane shift is greater than 1 m, the taper length to be used from Table A is one-half of 1a*.

Lane shifts of more than 1 m on a typical two-lane road will occur only rarely, as this would create lane widths of less than 3 m, in which case a lane closure must be used. Lane shifts of more than 1 m can occur on two-lane roads with parking spaces on one or both side, where parking is temporarily removed, and the parking area is occupied by a shifted lane.

Partial lane shifts, demarcating lanes through the use of cones only, must not be used on multi-lane roads or where posted speeds are higher than 80 km/h. For multi-lane roads or where posted speeds are higher than 80 km/h, lane shifting is typically achieved through use of one or more of the following:

- temporary concrete barriers to provide work area protection;
- construction markers or barrels for tapers; and
- temporary pavement markings for lane demarcation, along with removal of existing pavement markings.

1.10 Route Detours

A route detour should be signed when a driver is required to depart completely from major roads and will be directed to follow an alternative route. The alternative route will be signed using a combination of the appropriate TC-10 directional signs.

Guidance of traffic on detour routes associated with the above work zone conditions requires detour signing that is continuous and complete to guide drivers back to the normal route.

Prior to the closing of a roadway and the opening of a route detour, a TC-65 "Roadway Closing Notice" sign must be erected at strategically selected locations of the road at least one week in advance of the actual closing. At the same time, information regarding the closing may be given to local radio and T.V. stations and local newspapers, in accordance with road authority policy. Notices may also be distributed to affected households and businesses advising them of the upcoming disruption to their area.

A pre-construction planning meeting should be held with representatives of Police, Ministry of Labour, Fire, and Ambulance departments as well as any affected Transit Authority to advise them of the situation and to allow them to assess how this will affect their functions and responsibilities.

Before a route or a temporary detour is opened to the public, all signs pertinent to the condition must be installed in their proper positions. Construction ahead signs must be installed when work first commences. The Detour signs, etc., must not be exposed to view until the detour is required.

On some highways, particularly freeways, it may be desirable to close specific sections of a highway (such as longitudinal sections, or one of the roadways in an express/collector configuration) without providing specific route detours. In this case, drivers, usually commuters familiar with the road network, can make their own decisions on alternate routes. Such advisory signing of road closures may be provided with either static signs or portable variable message signs. Information is typically provided on the road section closed, the hours closed, and the period of closure (starting and finishing date). Such signing should be designed in accordance with the sign design principles provided in Book 1b. To avoid information overload for drivers, it may be necessary to provide the information on successive signs (or VMS phases) rather than on a single sign or sign display. See also Section 3 for more information on Portable Variable Message Signs.

1.11 Speed Control in Temporary Work Zones

It has generally been found that control of traffic speeds by imposing unwarranted regulatory speed limits has not been very effective. The majority of drivers disregard posted speed limits if the construction activities or hazards encountered are not severe enough to warrant such lower speeds, or if there is no visible sign of work activity. The travelled way through the work zone should be designed at a design speed that is equal to or as close as possible to that of the approaches to the work zone.

There are many types of construction projects where a reduction of the normal speed limit is not required. Work zone speed limit reductions should be avoided, where possible, where all work activities are located on shoulder or roadside areas and in work zones where no work activities are under way. A basic guideline to follow is to attempt to reduce speeds only if there is a good reason for it.

Experience has shown that it is difficult to achieve an average speed reduction of more than 15 km/h. For this reason, posted speed limits in construction zones should not be more than 20 km/h below the normal posted speed limit for that road section, except where required by restricted geometrics or other work zone features that cannot be modified.

Experience has also shown that speed reductions are more likely to be obeyed by the motorist if they are perceived as being necessary. If there is a good reason for reducing speed which may not be readily apparent to the motorist, then he/she should be informed of the reason for speed reduction through advance notice, including advance signing, possibly repeated, and other means, such as highway advisory radio. In some cases, advisory speed limit signs (orange and black) together with narrower roadways or lanes through the work site may be more effective in reducing traffic speeds than the posting of legal speed limit controls. All reduced speed zones should be used in a flexible and up-to-date manner to reflect the changing conditions within the construction or maintenance zone.

Measures which have proven to be effective in helping to manage speeds in work zones include:

- Police presence and enforcement in the work zone has been shown in some locations to reduce not only the 85th percentile speeds, but also the speed variance. In some locations, police presence has been shown to increase speed limit compliance by 15% in work zones where speed limits were not reduced. Several studies have shown that police presence has resulted in significant collision reductions. In general, most measures are unlikely to be effective unless supported by some police enforcement.

- Measurement of drivers' speed by means of radar, and display of the measured speeds on variable message signs (VMSs). The use of radar-controlled speed signs has been shown to reduce 85th percentile speeds an additional 4 km/h to 8 km/h over the reduction caused by static signs. The effect of a single VMS may be reduced with distance from the sign, but the reductions can often be sustained with two or more VMSs. This measure will have lasting effectiveness only if supported by periodic police enforcement.

- Use of pilot vehicles, pace vehicles or rolling closures (See Section 2.5) for speed reductions in specific periods of time or for specific work operations.

It is strongly recommended that the road authority and police authority discuss enforcement and speed.

For MTO construction projects requiring traffic control, construction speed zones may be established, as directed by MTO. The contractor does not have the authority to establish such zones. Only MTO can establish construction speed zones on provincial highways. If construction speed zones with enforceable speed limits are to be established on provincial highways, it is an HTA requirement first to establish a designated construction zone and to install Construction Zone Begins and Ends signs (Rb-90A and Rb-90B, formerly TC-41A and TC-41B) at the beginning and end of the construction zone, respectively.

The limits of the construction zone should be selected such that sufficient room within the zone is provided to accommodate **all** signs (including speed zone ahead) except for TC-1, 1A, 1B, TC-5, 5A, 5B and the information and directional guide signs in Section 6.3. See Figures TL-3 and TL-4.

Both regulatory and advisory speed limit signs can be used on different portions of the same contract; however, regulatory speed limit signs shall be installed only when the appropriate police authority has been informed. Otherwise, only advisory signs should be used and all existing regulatory speed limit signs within the construction speed zone must be covered or removed for the duration of the construction project, or until agreement on enforcement can be reached with the police authority. Reduced speed limit signs should only be used either:

- when work activity is actually occurring, and should be covered or removed when work is suspended or completed; or

- when reduced or restricted design situations, such as narrow lanes, detours, diversions, or cross-overs, remain, even though work is suspended.

Where reduced speed limit zones are implemented, contractors and agencies can help achieve effective speed control by complying themselves, and encouraging staff compliance, with the speed limits posted.

For municipal construction projects requiring traffic control, construction speed zones may also be established. At present, the establishment of municipal construction speed zones, with enforceable

regulatory reduced speed limit signs, must be done by municipal by-law. Advisory speed limit signs may be posted without requiring a by-law.

On a highway, the road authority may permit different speed limits in either direction of travel. If construction involves only one side of a highway, the speed limit may be lowered in the affected direction of travel but remain unaltered in the opposite direction, or, in the case of an express/collector freeway, may be lowered on one roadway in a given direction, but not on the other. Caution is recommended in applying different speed limits for the two directions on a two-lane highway, as drivers in the slow direction may assume drivers in the other direction are also travelling slowly.

1.12 Pedestrian Safety Considerations

Traffic control for pedestrians may be necessary to separate pedestrians from moving traffic, from a work area (including work vehicles), or from both, particularly in urban areas. Pedestrians should be provided with a safe, convenient, clearly delineated travel path. Pedestrian control may be effected through use of a pedestrian direction sign (TC-40) and/or pedestrian barricades. Minimum sidewalk or path width for pedestrians should be 1.2 m, and wider if necessary, for example, in commercial or school areas.

Pedestrian barricades are used to separate pedestrians from a work area, and to provide pedestrians a clear indication of a safe path through the work site. Pedestrian barricades are generally of light construction, potentially becoming hazardous projectiles when struck by a vehicle. They are not to be used for the control or channelization of moving vehicular traffic, which is to be achieved through the use of cones, construction markers, flexible drums (barrels), traffic barricades, or barriers.

There are no regulatory requirements or specifications that apply specifically to pedestrian barricades. A useful guideline is that:

- the pedestrian pathway should be clearly defined and the pedestrian barricade should consist of rails or a fence;
- the top of a pedestrian barricade should be located approximately 1 m above the surface on which it is installed.

As pedestrian barricades are not to be used for vehicular traffic control, no specific colour or reflectivity specification is prescribed for them.

A number of products are available on the market which are intended to function as pedestrian (and/or worker) barricades.

1.13 Cyclist Safety Considerations

Specific traffic control for cyclists may be necessary in some circumstances. These arise principally in connection with bicycle paths/facilities, which are covered in Book 18 (Bicycle Facilities). If bicycle paths/facilities are present in the work zone, reference should be made to Book 18 and also to the road authority with jurisdiction, which may have local policies for the treatment of bicycle paths in work zones.

If there are no separate bicycle paths/facilities through the work zone, there are two alternatives:

- Cyclists use the road, and are subject to the same traffic control devices that apply to other vehicular traffic;

- Cyclists are directed to use the pedestrian path through the work zone, by a CYCLISTS USE PEDESTRIAN PATH Sign, in which case they should be advised to dismount and walk their bicycle on the pedestrian path through the work zone, with a CYCLISTS DISMOUNT AND WALK Sign.

1.14 Work Zone Lighting

Lighting of Work Area

OHSA requires adequate lighting for its intended use.

Construction and maintenance activities often create conditions that are particularly hazardous at night when the ability of drivers to see clearly is reduced. The need for illumination by floodlight or steady burning lamps must be thoroughly investigated. Care must be taken to ensure that lighting used to illuminate the work site is not aimed at drivers, making it more difficult for them to see their intended path.

Lighting systems used for nighttime work in work zones must be mounted at least 5 m above the roadway, except for dome or balloon style lights with soft wide light that does not produce glare. Lighting should be set up so that it is aimed in an arc from 90 degrees to the traffic flow, up to 45 degrees away from the traffic, but under no circumstances should lights be aimed at, or spill over onto, oncoming traffic. Any additional lighting mounted on construction or maintenance equipment should be directed and focused on the immediate work area, and should not be used as general floodlights to illuminate a construction site. This lighting should not interfere with motorists' ability to navigate their way through the work zone.

Roadway Lighting through a Work Zone

Illumination of the driver's path through a construction work zone may assist the driver in making timely decisions, partially compensate for an undesirable alignment, or lessen the visual impact of an illuminated work area on the driver. Nighttime construction often requires that lighting of working areas be brighter than the adjacent roadway. Construction illumination is directed away from the driver's path; however, some illumination typically spills onto the pavement surface and is reflected into the driver's field of vision. Illumination of the roadway through a work zone can reduce the impact of the construction lighting on the driver.

Anti-glare Screening

Anti-glare screening on freeway construction work zones should be considered, to reduce the impact of headlights on the driver, when:

- A crossover is built on a freeway;
- Median width is reduced to 4 m or less;
- A curved highway alignment directs headlights into the path of opposing drivers;
- Nighttime truck volume is greater than 10%;
- Nighttime traffic volume is Level of Service (LOS) D or greater.

Anti-glare screening should not be used in the winter because of the impact on snow drifting.

2. Procedures for Temporary Work Zones

2.1 Preparation before Beginning Work

Depending on the organization involved, responsibilities for work zone tasks and activities will be assigned to various staff positions, each with its own particular skill and responsibilities. Because of a multiplicity of organizational arrangements, this section does not allocate tasks to a given individual or position, but rather lists those tasks which should be assigned and carried out in preparation for the temporary work by the appropriate designated individual(s) or position(s).

The following list of tasks should be checked for all work zone activities, although some of them apply primarily or exclusively to long duration construction work zones.

Preparation tasks to be completed before beginning work on the road include:

- Obtain the necessary approvals and/or permit from the road authority. Be familiar with all applicable regulations.
- Notify the police, fire department, ambulance services, transit authorities, and the appropriate road authority, if required, and any other agencies which may be affected by the maintenance or construction activities.
- Provide advice to the public of the works planned or in progress, as appropriate, through local media.
- Inform occupants of abutting properties, either orally or by written notice, of parking prohibitions or access limitations.
- If this is short duration work, determine the posted speed limit and hourly and daily traffic volumes in order to establish the signing and channelization requirements for the worksite.

  The best available traffic count data, or at least a three-minute count of traffic at the site multiplied by 300 will give a workable estimate of the daily traffic volume. The purpose of this brief count is to determine whether the road is a low volume or high volume road (a low volume road is one with less than 3,000 vehicles per day). Normally, road work is not done in peak traffic periods, and hence it is appropriate to take the count in off-peak periods. If road work must be done in peak traffic periods, the traffic count should be made in the peak period.
- Determine the category and duration of the work to be undertaken.
- Select hours of work to avoid peak periods, if possible.
- Perform site evaluation:
  - level of encroachment
  - stopping sight distance
  - existing traffic control devices
  - need for temporary barriers
  - need for Traffic Control Person(s) (TCPs)
  - pedestrian routes/school zones
  - overhead/underground wiring
  - weather conditions
  - visibility for night operations, if applicable.

- Prepare a Traffic Control Plan, in detail appropriate to the complexity of the work project. For major projects, this plan may be complex and include detours, staging sequences, construction vehicle access to and egress from worksites, temporary barriers, and removal of old pavement markings. As the work is planned and defined, appropriate typical layouts will be selected for application. For minor projects, this plan may be primarily the selection of appropriate typical layouts. Ensure that the plan is understood by all responsible parties before the site is occupied. Any changes in the Traffic Control Plan should be approved by an authorized individual/position.

- Discuss enforcement and speed between the road authority and police authority.

- Develop a Traffic Protection Plan for the protection of workers in the work zone, as required by Regulations 213/91 and 145/00 under the OHSA.

- Develop, as part of the Traffic Control Plan, an emergency and incident management traffic control plan, which facilitates emergency vehicle access to work zone locations as necessary.

- If this is long duration work, determine whether existing pavement markings must be removed and replaced by temporary pavement markings.

- Consider and plan for the safe movements of pedestrians and cyclists, ensuring that vehicle and pedestrian movements are properly separated.

- Refer to Section 8, or to the Book 7 Field Edition to select the most appropriate typical layout(s) for the work. Ensure that the staff of the road authority, contractors, and utilities are using the latest edition of Book 7. A copy of the Field Edition should be kept on-site. Consult, if necessary, to confirm that the proposed typical layout(s) is appropriate (if standard typical layouts are not appropriate, it may be necessary to design a new typical layout in accordance with sound traffic engineering principles).

- As required by Regulations 213/91 and 145/00 under the OHSA, ensure that all workers responsible for, and installing or removing traffic control devices or measures, and Traffic Control Persons (TCPs) are competent workers, are aware of the requirements of OHSA, have been trained in the application of Book 7, and have been given written and oral instructions in a language they can understand. Workers must not perform other functions while installing or removing traffic control devices. (For TCPs, see also Section 4.4.)

- Record and sign the choice of typical layout(s) to be used, by the person/position responsible for its selection. Record that the traffic control devices were installed according to the plan (or typical layout), or any modifications to or deviations from the plan.

- Determine sign sizes and sign quantities required.

- Ensure that enough vehicles (including buffer vehicles), signs, barriers, barricades, and markers are taken to the worksite to provide the appropriate protection, and that Traffic Control Persons are available and on site when required. If nighttime protection is required, ensure that the appropriate devices are available.

- Ensure that the vehicles, signs, barricades, and markers are in good and clean condition, with specified reflectivity levels.

- Ensure that approval is requested and obtained, as necessary, for the use of:

  - construction zone speed limits

  - temporary traffic control signals

  - portable traffic signals.

- Ensure that, where flashing arrow boards (TC-12s) are specified, only equipment complying with the specification in Section 3.2 is used.

2.2 General Principles for Set-up and Removal of Traffic Control

It is recognized that, even with good signing and advance warning devices, the set-up or removal of traffic control (e.g., lane closures) on highways inevitably involves an element of risk due to factors such as driver inattentiveness or driving at excessive speeds. There are risks for the traffic control workers, risks for the operators of buffer vehicles (if applicable) and risks for the motorists. The principles and procedures set out below have been developed with a view to minimizing the risks for all concerned to the greatest degree possible and, where there have been competing risks to be weighed, the safety of the workers who are actually handling the traffic control devices on the highway has been considered paramount since these workers have been deemed the most vulnerable.

Workers setting up, using, or removing (taking down) work zone traffic control should apply the following safety principles. These principles apply to both non-freeways and freeways:

- Plan the set-up and take-down in advance.
- Position work vehicles upstream of the work area rather than downstream (between workers and approaching traffic), so that their flashing lights and/or flashing arrows indicate a visual presence and visual obstacle to drivers.
- Assemble and disassemble traffic control devices away from the roadway. Where practicable, deposit traffic barrels in advance, along the shoulders adjacent to the lane closure.
- Minimize worker exposure to traffic.
- Make sure workers are visible and conspicuous to oncoming traffic and construction vehicle operators.
- Set up work zone traffic control devices starting at the upstream end of the work zone and proceeding downstream.
- Be aware of approaching traffic when setting up work zone traffic control. Plan an escape route.
- On multi-lane divided highways, where signing on both sides of the roadway is required, first place the signs on the opposite side of the roadway from the lane being closed, and then the signs on the same side of the roadway as the closed lane. If signs cannot be placed on both sides of the roadway, repeat signing on the one side.
- Avoid installer "leapfrogging" when installing a continuous line of channelizing devices.
- Ensure that traffic control devices are not obscured by other objects.
- Ensure that any Traffic Control Persons (TCPs) deployed are given written instructions and training by a qualified person, and are properly equipped/clothed as per OHSA.
- Cover (or turn or remove) signs and devices at times when they are not required. Remove the cover immediately before work at the worksite begins.
- Ensure that the typical layout is implemented as approved (or as modified), record this, and keep a copy available on site, as part of the Traffic Control Plan and the Traffic Protection Plan.
- Drive through the work zone before removal of traffic control devices to ensure that all workers are off the road, and that there are no gaps in the closure.

- Remove traffic control devices in the opposite order from which they were installed, starting with the closed lane(s), that is, the last barrel (or cone) installed is the first barrel removed. Advance signs are an exception. Remove them in the same direction they were installed.

- Do not point work vehicles upstream when removing lane closures except in unusual circumstances; never point work vehicles upstream at night.

Additional principles for **freeways** include:

- Use a buffer vehicle to protect workers installing or removing lane closures (except when 3 m or more from a live lane or when installing or removing advance signing on shoulders wide enough to park on).

- Position and maintain the buffer vehicle a Lateral Intrusion Deterrence Gap (LIDG) distance (see Table D, Stationary Work Operations) upstream of workers when lane closures are being installed or removed.

- Install and remove freeway lane closures as quickly as possible, particularly the tapers.

- Back up the buffer and work vehicles during removal of lane closures to provide protection for downstream workers. Do not back buffer and work vehicles into a live lane of traffic.

- Use cones for short duration daytime work only (barrels are preferred).

- Consider tightening up of the barrel spacing in the taper, on the inside of curves, on hills, and in the immediate vicinity of ramps and of the work area, to reinforce the closure.

2.3 Set-up of Freeway Lane Closures

MTO has identified the set-up and removal of freeway lane closures as one operation that requires special consideration. For that reason, the best practices outlined in this Section must be used for provincial freeway lane closure set ups and removals. Sections 2.3 and 2.4 must be read in conjunction with the Section 8 Typical Layouts TL-77 to TL-82. The same procedures can be used on non-freeways, with or without a buffer vehicle (BV).

The ministry and other road authorities may approve the use of alternative procedures or modifications of the procedures listed below to suit particular situations.

Freeway Closure of Single Right or Left Lane
(with shoulders)

The procedure described below is for a single right lane closure. The same approach (with necessary and appropriate modifications) is to be used for a single left lane closure with shoulders.

- At the time of the closure, appropriate signing is installed on the shoulders, in the Advance Warning Area (TC-101, TC-101A, TC-101B, TC-2B or TC-2A) and in the Approach Area (TC-103 and TC-104), in accordance with Figure TL-11 (Very Short Duration). These signs are not shown on Figures TL-77A to TL-77C. A BV is not required, to install signs on the shoulders, if the duration is less than 30 minutes and there is no encroachment into the adjacent traffic lane.

- A BV is positioned on the right shoulder, approximately 1 km to 2 km upstream of the beginning (upstream end) of the taper.

- A sign truck (ST) with installers and a detachable TC-12 arrow board trailer in left arrow mode positions itself on the shoulder at the beginning of the lane closure taper. (Figure TL-77A)

- The BV (when directed by the installers) enters the traffic stream in the right lane with its flashing TC-12 arrow board in left arrow mode and proceeds downstream. The BV gradually reduces its speed while monitoring upstream traffic to ensure that it is responding to the TC-12 flashing left arrow board.

- When the BV is within the LIDG distance from the start of the taper, the installers begin retrieving barrels from the shoulder and place them every 24 m (Dimension 3* in Table C) to form the taper.

- The installers move forward installing barrels on foot, in front of the ST. The BV shadows the ST at an LIDG distance. After reaching the third traffic barrel placed by the installers, the BV drives through the barrels and positions itself downstream of the taper barrels that have been placed. (Figure TL-77B)

- As the installers place the rest of the taper barrels, the BV then follows the ST at an LIDG distance moving parallel to the taper.

- As the end of the taper is reached, the BV positions itself an LIDG distance upstream of the end of the taper. The ST detaches its TC-12 arrow board trailer at the end of the taper and positions it in the lane being closed in left arrow mode. Room is provided on the right to ensure that the BV can pass the arrow board trailer on the right. (Figure TL-77C)

- The installers then begin to install the barrels for the Longitudinal Buffer Area downstream of the ST. The BV moves downstream maintaining a separation distance of LIDG to the ST.

- When the BV reaches the TC-12 arrow board trailer at the end of the taper, the BV drives around the trailer on the right and repositions itself an LIDG distance from the ST in the lane being closed. The BV switches its TC-12 arrow board to bar mode.

- The remaining barrels for the Longitudinal Buffer, Work and Termination Areas are installed in a downstream direction with the BV following the ST at an LIDG distance.

Freeway Closure of Two Right or Left Lanes
(with shoulders)

The procedure described below is for a two right lane closure. A similar approach (with necessary and appropriate modifications) is to be used for a two left lane closure with shoulders.

- A BV and a ST (with installers) pulling one TC-12 arrow board trailer is used, along with a TC-12 trailer pre-positioned on the right shoulder at the downstream end of the first taper.

- The procedure detailed above for a Single Right Lane Closure is used to install the first taper in the right-most (outer) lane (Figure TL-78A). When the end of the right-most lane taper is reached, the TC-12 arrow board pre-positioned on the shoulder is brought over from the shoulder and positioned in the centre of the lane at the end of the taper in left arrow mode. (Figure TL-78B)

- The installers then begin to install the barrels for the tangent or parallel section in front of the ST. The BV shadows the ST at a separation distance of LIDG.

- When the BV reaches the TC-12 arrow board at the end of the first taper, the BV drives around the TC-12 on the right, and repositions itself an LIDG distance from the ST in the lane being closed. (Figure TL-78B)

- The remaining barrels for the parallel section are installed in a downstream direction with the BV following the ST at an LIDG distance. A TC-103 is installed in the parallel section. A TC-104 is installed at the start of the second taper. The BV drives around the TC-103 and TC-104 on the right.

- When the parallel section has been installed, the installers place the barrels for the second taper. The installers work in front of the ST. The BV shadows the ST at an LIDG distance. When the end of the second taper is reached, the ST detaches its trailer-mounted TC-12 and leaves it in left arrow mode. (Figure TL-78C)

- The installers then begin to place the barrels for the Longitudinal Buffer Area in front of the ST. The BV shadows the ST at a distance of LIDG. When the BV reaches the TC-12 arrow board trailer at the end of the second taper, the BV drives around the trailer on the right, and repositions itself LIDG distance from the ST and switches to bar mode.

- The remaining barrels for the Longitudinal Buffer, Work and Termination Areas are installed in a downstream direction with the BV following the ST at an LIDG distance. (Figure TL-78D)

Freeway Closure of Two Right or Left Lanes
(no shoulder on side of roadway where lanes are being closed)

This procedure describes a freeway closure for two left lanes where the left shoulder is too narrow to permit a BV to use that shoulder to drive around a TC-12 sign trailer positioned in the adjacent lane. The approach is similar for a two right lane closure where the right shoulder is too narrow to permit a BV to use that shoulder to drive around a TC-12 sign trailer positioned in the adjacent lane. In addition, if only the left-most or right-most lane is to be closed, where there is a narrow or minimal shoulder, the procedures are similar. The steps relating to closure of the second lane are omitted and only one BV is required.

- At the time of the closure, appropriate signing is installed either on both sides of the freeway if space permits, or on the right side of the roadway using double signing, in the Advance Warning Area (TC-101, TC-101A, TC-101B, TC-2B or TC-2A) and in the Approach Area (TC-103 and TC-104). These signs are not shown on Figures TL-79A to TL-79E.

- If the ST installing advance signing must encroach into the adjacent live lane, a BV must be used to protect the ST, located an LIDG distance upstream of the sign truck.

- A convoy of lane closure work vehicles is positioned on the right shoulder or an on-ramp, approximately 1 km to 2 km upstream of the beginning (upstream end) of the taper. (Figure TL-79A)

- Starting at the upstream end, the convoy consists of Buffer Vehicle #1 (BV#1), Buffer Vehicle #2 (BV#2), Sign Truck (ST) with a TC-12 arrow board trailer and installers and a Work Truck (WT) loaded with barrels. BV#1 and BV#2 are crash trucks (i.e., with truck-mounted attenuators). (Figure TL-79A)

- The WT is needed, as the barrels cannot be placed on the left shoulder in advance of the lane closure operation because of the lack of a shoulder, and not all of the barrels required can be carried in the ST.

- The convoy enters the traffic stream from the right side. The convoy then gradually changes lanes until it enters the left-most lane. The TC-12s on the ST trailer and on BV#1 and BV#2 are in flashing bar mode, until they enter the left-most lane, at which time the BV operators use their in-cab switches to

change their TC-12s to right arrow mode. The WT operates with the 360 beacon and four-way flashers activated. The convoy slowly decreases speed. (Figure TL-79B)

- BV#1 and BV#2 monitor upstream traffic to ensure that it is responding to the flashing right arrow. If traffic is responding, the convoy slows to a stop such that BV#2 is positioned an LIDG distance upstream of the start of the taper. BV#1 stays an LIDG distance upstream of BV#2.

- The ST and WT are positioned downstream of the start of the taper. The installers remove barrels from the ST and quickly install them for the first taper at a 24 m spacing (Dimension 3* in Table C). BV#1 and BV#2 move forward as the installers move forward. BV#2 maintains an LIDG distance upstream of the installers.

- BV#2 moves through the taper around the third barrel and maintains an LIDG distance upstream of the installers, as they continue to install the barrels and close the lane over a distance of 300 m (see Table C). BV#1 follows BV#2 through the taper around the third barrel. (Figure TL-79C)

- The whole convoy moves ahead and approaches the end of the first taper. When BV#1 reaches the end of the taper, it parks at the end of the taper with its TC-12 in right arrow mode. The BV#1 driver/operator leaves BV#1 on the left and joins the installers.

- The barrels in the tangent or parallel section are then installed in a downstream direction with BV#2 following the installers at an LIDG distance. The installers install a TC-103 in the parallel section as far to the right as possible. When BV#2 reaches the TC-103, it passes it on the left.

- Once the parallel section has been installed, the installers begin to place the barrels for the second taper in the second lane. A TC-104 is installed at the start of the second taper. BV#2 drives around the TC-104 on the left and moves forward, parallel to the taper, maintaining an LIDG distance to the ST. When the end of the second taper is reached the ST detaches its TC-12 trailer and installs it in the second lane in right arrow mode. (Figure TL-79D)

- The ST then pulls into the left-most lane and moves downstream, leaving the installation area. BV#2 pulls to the left around the TC-12 arrow board trailer at the end of the second taper and back into the second lane and switches its TC-12 to bar mode.

- BV#2 maintains a distance of LIDG to the installers. The installers take barrels from the WT and place them to install the Longitudinal Buffer, Work and Termination Areas. (Figure TL-79E)

  Note: On a freeway, drivers may not expect the high speed left (median) lane to be closed. To avoid confusing drivers during extended long duration left lane closures, the road authority may require the contractor to close the right-most lane(s) first, shift the traffic to the left lane(s), then re-open the right lane and close the left lane.

2.4 Removal (take-down) of Freeway Lane Closures

Removal of Single Right or Left Lane Closure (with shoulders)

The procedure described below is for removal of a single right lane closure. A similar approach (with necessary and appropriate modifications) is to be used for the removal of a single left lane closure with shoulders.

- The ST and barrel installers (now removers) are positioned at the downstream end of the Termination Area, at the last barrel installed. The BV is located an LIDG distance upstream of the ST. The removers work downstream of the ST. (Figure TL-80A)

- The traffic barrels are removed in the reverse direction that they were installed, so that the last barrel installed is the first removed. The barrels are set on the shoulder for later re-use or retrieval.

- The ST and BV slowly back up through the Termination Area, Work Area and Longitudinal Buffer Area as the barrels are removed, maintaining the same relative spacing and positioning throughout.

- When the BV comes to the TC-12 trailer at the upstream end of the lane closure taper, it backs around the TC-12 on the right side and positions itself an LIDG distance upstream of the TC-12. When the lane closure removers come to the TC-12, they place it on the shoulder for later retrieval.

- The BV then backs up parallel to the taper barrels on the downstream side of the barrels. The BV maintains an LIDG distance to the ST as the barrels are quickly moved to the shoulder by the removers. (Figure TL-80B)

- When the BV reaches the last barrel in the taper, it will be on the shoulder of the road. The last barrels are quickly moved to the shoulder as the BV backs up on the shoulder while maintaining an LIDG distance to the removers (Figure TL-80C)

- The ST and BV then proceed downstream to the next interchange. The ST circles around, drives downstream on the right shoulder and retrieves the signs in the order they were installed in the Advance Working and Approach Areas using a very short duration operation. The ST then circles around and removes any advance signs on the left side of the roadway in a similar manner.

- Depending on the duration of the project, the barrels on the right shoulder may either be removed or left there for re-installation.

Removal of Two Right or Two Left Lane Closure (with shoulders)

The procedure described below is for the removal of a two right lane closure with shoulders. A similar approach (with necessary and appropriate modifications) is to be used for the removal of a two left lane closure with shoulders.

- The ST and the lane closure installers (now removers) are positioned in the second lane at the downstream end of the Termination Area, at the last barrel installed. The BV is located in the second lane upstream of the ST by an LIDG distance. (Figure TL-81A)

- The removers remove the barrels in the reverse direction that they were installed, so that the last barrel installed is the first removed. The barrels are set on the shoulder for later re-use or retrieval.

- The ST and BV slowly back up through the Termination Area, Work Area and Longitudinal Buffer Area as the barrels are removed. The BV maintains an LIDG distance upstream of the ST.

- The BV backs up until it comes to the TC-12 trailer at the upstream end of the centre lane closure taper. The BV backs around the TC-12 on the right side and positions itself an LIDG distance upstream of the TC-12 in the centre lane taper. When the removers come to the TC-12, they place it on the shoulder for later retrieval. (Figure TL-81B)

- The BV backs up parallel to the taper barrels on the downstream side of the barrels. The BV maintains an LIDG distance to the ST. The removers work in front of the ST as the taper barrels are moved to the shoulder.

- When the BV reaches the last barrel in the centre lane taper, it backs down the parallel section with the ST an LIDG distance downstream of the buffer vehicle. The removers continue to remove the barrels and, as they come to them, the TC-104 and TC-103 signs. (Figure TL-81C)

- The rest of the lane closure removal is the same as the removal of a single right lane closure removal (see above). (Figure TL-81D)

Removal of Two Right or Two Left Lane Closure
(no shoulder on side of roadway
where lanes are being closed)

This procedure describes the removal of a freeway closure of two left lanes where there is no shoulder or a minimal shoulder on the left side of the roadway. The procedure is similar to the removal of a freeway closure of two right lanes with no or minimal right shoulder. If only the left lane has been closed, the procedure is essentially the same, except that those steps relating to removal of the closure of the second lane are omitted.

- The lane closure installers (now removers) and the WT are located in the second lane at the downstream end of the Termination Area. BV#2 is located in the second lane an LIDG distance upstream of the WT with its arrow board sign in bar mode. A ST is located in the left-most lane beside BV#2. (Figure TL-82A)

- All three vehicles back up through the lane closure maintaining the same spacing and positioning throughout as the removers remove the barrels in the reverse order that they were installed and place them in the WT.

- When the TC-12 at the downstream end of the second lane taper is reached, BV#2 backs around it on the left side and positions itself an LIDG distance upstream of the TC-12 in the taper with its arrow board in right flashing mode. The ST hooks up the TC-12 trailer and tows it out of the closure to a storage area with the arrow board collapsed and switched off. (Figure TL-82B)

- The lane closure removers then remove the second lane taper barrels and place them in the WT. BV#2 backs up parallel to the taper as the removers remove the barrels. BV#2 maintains an LIDG distance upstream of the WT.

- BV#2 backs around the TC-104 into the parallel section with its TC-12 arrow board in right arrow mode. The removers remove the TC-104 and work upstream removing the parallel section barrels.

- As the removers remove the parallel section, BV#2 backs up in the parallel section and around the TC-103. The removers remove the TC-103 and work upstream removing the parallel section barrels, until BV#1 is reached at the downstream end of the first taper. (Figure TL-82C)

- BV#2 and the WT leave the work area, turn around at the next interchange and circle back to the upstream end of the first taper. BV#2 slows to a stop in the left-most lane an LIDG distance upstream of the start of the taper. (Figure TL-82D)

- The removers exit the WT on the left and quickly remove the barrels in the first taper and load them in the WT.

- BV#2 moves forward as the WT moves forward, maintaining an LIDG distance upstream of the WT.

- When the end of the first taper is reached, BV#1, the WT and BV#2 move off in a convoy.

- The ST, protected by a BV shadowing it at an LIDG distance, picks up any advance signs on the left and right shoulders in a downstream direction.

2.5 Inspection and Documentation

Ongoing inspection of work zones is important to try to ensure that the appropriate traffic control devices are in place at all times:

- Inspect the work zone initially by driving through it, by day and by night, as appropriate, after the temporary traffic control devices for the work zone are in place.

- Note and record drivers' actions and reactions, such as speeds, conflicts, late lane changes, frequent braking, and the like.

- Correct any problems as soon as possible.

- Document any changes to the Traffic Control Plan or typical layouts, and the reasons for the changes, including the reasons for any devices shown but not used, or used but not shown.

- Inspect the work zone traffic control devices at least daily over the life of the project, as specified by the road authority, while traffic control is in effect or is to be removed.

- Record in a daily journal the traffic control devices in place, including starting and ending times when they were in effect, locations, names of personnel, and traffic controls used.

- Replace and/or correct any inappropriate, damaged, knocked over, or displaced traffic control devices.

- Ensure that traffic control devices that are no longer needed, either on a long-term or short-term basis, are either removed from the roadway, removed to the outside of the shoulder, covered, or turned, so as not to be visible to passing motorists.

2.6 Traffic Control with Moving Vehicles

In some situations the road authority may determine that it is appropriate to control traffic through the use of moving vehicles. Other than buffer vehicles used in the set up and take down of lane closures, contractors cannot control traffic with moving vehicles without the road authority's approval. The control of traffic with moving vehicles should be decided by the road authority before contract tendering.

Traffic control with moving vehicles has previously often been considered to fall within police authority and responsibility. It is now the road authority's decision whether to use police for such control, or its own staff and vehicles, or contractor staff and vehicles, or a combination of these. If forces other than the police are to be used for such traffic control, adequate and appropriate training must be provided to the staff operating the vehicles controlling traffic. Traffic control using moving vehicles includes:

- use of pilot vehicles to provide clearer guidance to drivers of the route through a complex construction project, or to control the speed of vehicles through a construction site;

- use of pace vehicles to control the speed of vehicles through a construction site, where reduced speed is necessary, but it is difficult to achieve speed reductions by other means;

- use of rolling closures, to control the speed of vehicles upstream of a construction site, so as to create a time window when the road downstream of the lead vehicles is effectively clear of vehicles, creating an unhindered opportunity for workers to do work or make traffic control changes at the work site.

  Note: Prevention of traffic getting past the rolling closure is critical to ensure worker safety.

Pilot Vehicles

A pilot vehicle is used on a two-lane road to guide a queue of vehicles through a one-lane section of a complex temporary traffic control zone or detour, or to control the speed of vehicles through the construction site, especially immediately adjacent to areas where workers are present. Its operation must be coordinated, and communication links established, with other traffic controls at each end of the one-lane section, such as Traffic Control Persons (TCPs). The pilot vehicle should move into the position at the head of the queue of vehicles about to be released by the TCP, and, when directed by the TCP, guide the vehicles through the work zone (Direction 1). At the far end of the one-lane section, beyond the work zone, the pilot vehicle should pull over at the earliest safe opportunity, signaling the following queue to pass.

When the last vehicle of that queue clears the one-lane work zone section, the pilot vehicle in the other direction (Direction 2) should follow the same procedure as outlined above. Preferably, two pilot vehicles are used for this operation, one in each direction, to reduce motorist delay and driver frustration. Alternatively, if traffic volumes are low, the pilot vehicle in Direction 2 may be the same pilot vehicle as in Direction 1 (which turns around at the end of the work zone and takes its position at the head of the queue).

The pilot vehicle should display the name of the contractor or road authority. The DO NOT PASS WHEN FLASHING Sign (TC-27) must be mounted at a conspicuous location on the rear of the vehicle. Where significant queuing occurs or is expected to occur, consideration should be given to using the PREPARE TO STOP Sign (TC-20 or TC-20A) upstream of the expected end of queue.

Two or more pilot vehicles may be used to guide two-way traffic through a particularly complex detour.

Work vehicles entering the work zone should be managed by the TCP so that they are the last vehicle(s) in the queue, to avoid other vehicles following them into the work area.

Pace Vehicles

The purpose of pace vehicles is to constrain and control the speed of vehicles travelling through the work zone, where reduced speed is necessary but it is difficult to achieve speed reductions by other means. This kind of situation may arise where, on a long duration construction site, temporary concrete barriers cannot be provided, and yet workers must work within 1.5 m to 3 m of a live lane of traffic. Pace vehicles are sometimes required on such freeway paving operations.

It is the road authority's decision whether to use pace vehicles. If so decided, it is the road authority's decision whether to use the police to act as pace vehicles, or to use its own staff and vehicles, or to authorize contractors to fulfill this function, or to use a combination of both police and contractor vehicles. Note that driver compliance is likely to be higher when paced by a police vehicle than when paced by a contractor vehicle.

The deployment of pace vehicles is not simple or straightforward, and extra care must be taken to ensure that it is done safely. Where significant queuing and congestion are expected, or where pace vehicles must be deployed in low volume situations with vehicles approaching at high speed, advance signing should be provided, to warn of possible stops or of the use of pace vehicles. Caution and experience are necessary to apply pace vehicles effectively and safely in low volume, high speed traffic situations.

Principles to be followed when pace vehicles are used include:

- The pace vehicle(s) (one per lane) must lead at a reasonable speed, not one that is so low that drivers approaching the work zone from upstream have such a large speed differential relative to the last vehicles in the queue, that they collide with those vehicles. A realistically achievable speed reduction from the normal regulatory posted speed is about 10 km/h to 15 km/h. The DO NOT PASS WHEN FLASHING Sign (TC-27) must be mounted at a conspicuous location on the rear of non-police pace vehicles.

- Pace vehicles should generally be used in a single lane through the work zone. One or more vehicles may be necessary to pace traffic through one or more lane closures to reach the single lane section, with the pace vehicle in the closed lane merging into the traffic behind the pace vehicle in the remaining open lane.

- Sufficient pace vehicles are required to provide speed reductions on a continuous basis. When the last vehicle in one queue has entered the work zone, a pace vehicle(s) must be in place to lead and pace the next vehicles through the work zone. Otherwise, a high speed vehicle might reach the end of the slower queue, with a resulting collision right in the work zone itself, posing a hazard to workers. This means that the time to traverse the work zone, plus the time required to circle back and take position back in the traffic stream, must be considered.

  $PV = N_L \times (Cycle\ Time/Work\ Zone\ Traversal\ Time)$

  Where *PV* is the number of pace vehicles needed, and N_L is the number of lanes in the direction of interest (assuming one lane is left open to traffic in the work zone). *Work zone traversal time* is the time required to drive through the work zone at the pace vehicle speed, and the *cycle time* is the time required for a given pace vehicle to drive through the work zone, plus the time required to circle back to start another run through the work zone. The cycle time will be affected by traffic volume, and by the characteristics of the road network, that is, how directly and quickly a pace vehicle can drive around and get back to the beginning of the work zone.

  For example, consider an operation with three lanes being progressively closed down to one, with a work zone traversal time of 10 minutes, and a return time of 20 minutes from the end of the work zone back to the beginning. To avoid the risk of fast vehicles closing in on slow vehicles adjacent to workers in the work zone, a new set of three pace vehicles will be required every 10 minutes. With a return time of 20 minutes, this means a total cycle time of 30 minutes for one set of three vehicles. The number of pace vehicles required is then 3 vehicles/set x 30/10 work zone passages per cycle = 9 pace vehicles. If the total cycle time is 40 minutes, this will require 3 x 40/10 = 12 pace vehicles.

- since the purpose of pace vehicles is to control traffic speed, pace vehicles are not required during periods when traffic congestion alone results in traffic speeds at or below the desired speed. When congestion eases, however, and speeds increase, a

careful eye on traffic conditions must be maintained, so that pace vehicles can be re-introduced into the traffic stream to control speeds when required.

In order to estimate the number of pace vehicles (and pace vehicle hours) required over the duration of a contract, it is necessary to relate these to the hours of the day or night during which work will be done, and to estimate:

- the number of hours during which lane closures will result in congestion and speeds below 80 km/h (pace vehicles not required);
- the number of traffic condition cases (volumes, work zone traversal times, and cycle times) and number of hours during which pace vehicles are required;
- the number of pace vehicles required for each of the traffic condition cases and the number of hours they are required for each case.

- good communication among pace vehicles is essential for good traffic control.

Rolling Closures

It is the road authority's decision whether to use rolling closures.

The purpose of rolling closures is to control the speed of vehicles upstream of a construction site, so as to create a time window when the road downstream of the lead vehicles is effectively clear of vehicles, creating an unhindered opportunity for workers to do work and/or make traffic control changes at the work site.

Example situations of where rolling closures may be a good method of traffic control include the following:

- changing a lane closure on a freeway from a right lane closure to a left lane closure, or vice versa;
- installing or removing an overhead sign structure.

In such cases, these very short duration operations can be carried out safely and efficiently if traffic is temporarily prevented from entering the work zone.

The concept embodied in a rolling closure is to let unrestrained traffic (downstream from the selected point at which traffic will be restrained) pass through the work area, and to hold back (restrain) all upstream traffic at a lower speed, by means of pace vehicles, to create a free, clear time window of 5 to 15 minutes in which the work operation can be carried out. On a freeway with a regulatory speed of 100 km/h, the maximum planned speed reduction should normally be about 20 km/h, that is a rolling closure speed of 70 km/h to 80 km/h, led by the lead vehicles. The DO NOT PASS WHEN FLASHING Sign (TC-27) must be mounted at a conspicuous location on the rear of non-police pace vehicles.

One of the following two approaches for rolling closures should be used:

(1) **Urban, high volume freeways, with frequent interchanges**
On such freeways, drivers are generally accustomed to congestion, which may occur frequently. Also on such freeways, it is neither desirable nor practicable to prevent vehicles from entering the highway at all upstream entrance ramps. The rolling closure operation is initiated by sufficient lead pace vehicles travelling abreast, one vehicle per lane, several kilometres upstream of the closure site, to control the flow and speed of traffic approaching the closure site. As they approach the site, they gradually reduce their speed, allowing traffic ahead of them to clear out at normal speed. After they pass the entrance ramps of the last upstream interchange, the

pace vehicles continue to reduce their speed, coming to a complete halt if necessary, just upstream of the closure site, to create the necessary time window. If the pace vehicle slowing and stopping is done progressively and gradually, drivers will have time to adjust to the situation, as in a similar congestion situation. When the work at the closure site is complete, the pace vehicles turn off their flashing lights and allow traffic to resume normal flow.

(2) **Rural, low volume freeways, with infrequent interchanges**

On such freeways, drivers expect free flow conditions, and do not expect sudden congestion which may require them to come to a halt. Such a requirement would violate driver expectation, leading to potential hazard. For this reason, the approach for rolling closures on such freeways needs to be different. The use of advance warning signs, such as the PREPARE TO STOP Sign (TC-20), should be considered.

The rolling closure operation will have to be initiated a specific calculated distance upstream of the work zone, in order to create a time window of the desired duration, and for a given travel speed. This distance may be as great as 15 km to 25 km. This means that a rolling closure is unlikely to be suitable in all situations, but must be carefully tailored to the road configuration and network involved. As the rolling closure is approaching the work zone, all entrance ramps at intermediate interchanges must be closed until the rolling closure has passed, to prevent vehicles (which, being unrestricted, might be travelling at high speed) from entering the clear zone ahead of the rolling closure lead vehicles.

It is often difficult to restrain entrance ramp traffic from entering the freeway if drivers are determined to go through. If these drivers see a rolling closure approaching, they are likely to want to enter the highway ahead of the queue rather than behind it. If the rolling closure starts a considerable distance upstream of the work zone, more than one interchange back, it may be desirable to have the lead vehicles in the rolling closure drive at a speed closer to the normal posted speed until they have passed the last interchange, and then decelerate to a lower speed when it is no longer possible for entrance ramp traffic to pass them or enter ahead of them. It is essential that all work vehicles involved in the rolling closure, at intermediate interchange entrance ramps, and at the work area itself, be in good communication with each other. It is important, if a determined driver at an entrance ramp forces his/her way onto the freeway, that others, particularly workers at the work area, can be given timely notice of such an approaching, unexpected vehicle.

The rolling closure requires one lead vehicle per lane, travelling side by side to prevent other vehicles from overtaking any of the lead vehicles and entering the clear zone. If the work operation results in a longer-term single-lane closure, as the taper is approached by the lead vehicles, the lead vehicle in the closed lane should merge behind the lead vehicle in the open lane. If the work operation, when completed, leaves both lanes clear, the lead vehicles may speed up at or beyond the work zone, and merge into one lane, permitting other traffic to pass them. As described above, the operation is more like a rolling slowdown. However, in some circumstances, it may be necessary or desirable to bring following

vehicles to a very low speed or even to a stopped position. In this case the operation is truly a rolling closure. This need may arise if operations at the work area run into unexpected difficulties and require more time. Where such rolling closure operations are planned, or anticipated to be necessary, advance signing should be used to advise drivers that they may have to stop. Otherwise, their sudden arrival at the end of an unexpected queue may pose a traffic hazard.

It may often be best practice to arrange for police (if available) to deploy the lead vehicles in a rolling closure, although the road authority may authorize contractors to fulfill this function. An advantage of using police for lead vehicles is that driver compliance is likely to be higher when controlled by a police vehicle than when controlled by a contractor vehicle. This is particularly the case on urban, high volume freeways.

3. Signs

Most of the signs in Book 7 and the associated Field Edition are designated by the letters "TC" followed by a number. The letters "TC" indicate the "Temporary Conditions" series of signs. Regulatory signs used in Temporary Conditions have been redesignated as regulatory signs, and have been given "Rb" numbers.

All sign dimensions, including supports, positioning and pertinent installation details are shown in Book 2 (Sign Patterns and Fabrication) and Book 3 (Sign Support and Installation) and are given in metric measurement standards. The dimensions of signs shown in Book 7 and the Field Edition generally are standard sizes recommended for typical work zones on normal two-lane roadways with posted speed limits of 80 km/h or lower. The use of oversized dimensions, where illustrated, applies basically to multi-lane roadways and/or roads with posted speed limits of 90 km/h or higher. Where sign sizes are prescribed in the descriptions for individual signs (Section 6.1), those sizes must be used. Where they are not so prescribed, Table 2 provides a general guideline of sign sizes to be used for a range of work zone situations.

All temporary signs must be removed or covered immediately after they are no longer applicable. Permanent standard signs must be in place at the completion of each work project. Signs pertaining to a moving operation, e.g., hot mix paving, must be shifted along the roadway as the operation proceeds.

All sign patterns are provided in Book 2 (Sign Patterns and Fabrication) and are available in full size from the OTM publisher.

3.1 Classification of Signs

Warning Signs
(TC-1 to TC-39, and Wb-1A)

Warning signs for construction and maintenance work are the most important signs used to advise vehicle operators of specific hazards that may be encountered where roadway or utility construction or maintenance operations are underway.

Warning signs for construction and maintenance must generally be diamond shaped with an orange reflectorized background and a black symbol and/or legend message and black sign border. The YIELD AHEAD Sign (Wb-1A) is a standard warning sign which is black on yellow (containing a red and white yield symbol) rather than black on orange. Where warning signs refer to permanent conditions that exist before, during, and after construction (e.g., steep hill, merge), standard black on yellow warning signs should be used.

Table 2 – Minimum Dimensions of Work Zone Warning Signs

Road Type	Normal Regulatory Speed Limit (km/h)	Sign Size	
		Standard	Oversize
Two-lane Roads	All	**X**	
Multi-lane Roads (undivided, up to 4 lanes)	80 or lower	**X**	
	90 or higher	**X** (only if signing is repeated on right side)	**X** (preferred)
Multi-lane Roads (undivided, 6 lanes)	60 or lower	**X**	
	70 or higher	**X** (if space does not permit oversize signs, signing is to be repeated on right side)	**X** (where space permits)
Multi-lane Roads (divided)	80 or lower	**X** (both sides if space permits and more than two lanes in one direction)	
	90 or higher		**X** (both sides if more than two lanes in one direction)
Freeways	All		**X** (both sides if more than two lanes in one direction)

Regulatory Signs
(Rb-90A, Rb-90B, Rb-91, Rb-92)
(formerly TC-41 to TC-46)

Regulatory signs impose legal obligations and/or restrictions on all traffic. While provisional control of traffic will generally be accomplished through warning signs, there are temporary traffic situations in construction and maintenance where the use of regulatory signs becomes necessary.

Regulatory signs, with few exceptions, must be rectangular in shape with a white reflectorized background and a black painted symbol or legend message and a black sign border, and must conform to the OTM Book 5 (Regulatory Signs).

The regulatory signs which previously were assigned TC numbers have now been renumbered as regulatory signs as follows. See also Book 5 (Regulatory Signs):

- TC-41A (CONSTRUCTION ZONE BEGINS Sign) renumbered to Rb-90A
- TC-41B (CONSTRUCTION ZONE ENDS Sign) renumbered to Rb-90B
- TC-43 (YIELD TO ONCOMING TRAFFIC Sign) renumbered to Rb-91
- TC-46 (ROAD CLOSED Sign) renumbered to Rb-92

These signs are to be used only in temporary conditions and are not to be used in permanent installations.

Guide Signs
(TC-61 to TC-75)

Guide signs are required at construction and maintenance work areas to guide traffic around or through work areas or to provide information to vehicle operators relative to detours, directions, types of construction and other information considered beneficial or essential to the motorist.

Guide signs, with few exceptions, have a rectangular shape with the longer dimension being horizontal. In some locations, because of lateral space limitations, the longer dimension may be vertical. Temporary Conditions guide signs typically may have one of several designs:

- a white reflectorized background with a black legend and a sign border, except as noted in the sign descriptions for Contract Identification signs. Part of the sign legend may be black on orange to tell the driver what has changed due to the work zone;
- an orange reflectorized background with a black legend and sign border.

Guide signs indicating road names and directions generally have a reflectorized green or blue background with a white legend and border, or a white background with a black legend. To show changes due to construction, black legends or symbols on an orange reflectorized background may be used as an overlay on the existing directional guide signs.

3.2 Sign Specifications

Sign Reflectivity Standards

Signs that convey regulatory, warning, or guidance (directional) information that is relevant during hours of darkness need to be legible and conspicuous at night as well as during the day. Since conspicuity depends to some degree on colour code recognition, the colour of the sign must appear the same by night as by day. Reflectorization is important for maintaining a satisfactory level of sign legibility and conspicuity at night.

Three levels of minimum reflectivity are described below for temporary conditions signs. Those signs and devices requiring the highest levels of reflectivity are the more crucial ones for driver recognition and motorist and worker safety. The reflectivity requirements are stated as minimums, suggesting that higher reflectivity sheeting may be used where the road authority considers it necessary. However, the relative importance of the signs in the three-level hierarchy should not be lost in doing so.

The lowest reflectivity level specified is Type I (engineering grade). The next higher reflectivity level is Type III (high-intensity). The highest reflectivity level is high reflectivity micro-prismatic fluorescent sheeting (diamond grade or equivalent). Reflectivity standards for Types I and III are defined in ASTM Spcification D 4956-95 or its subsequent revisions.

Minimum reflectivity requirements for various signs are shown in Table 3.

Sign Blanks and Specification Details

Table 4 lists the sign dimensions, sign material and material thickness of the more common signs through Blank Numbers as assigned by MTO. (Refer also to Sign Schedule in Section 6.1).

Fibreglass reinforced plastic or other material may be substituted for some aluminum or galvanized steel sign blanks. The use of plastic or other material as sign blank material should be subject to approval by the road authority's road engineer or superintendent.

Use and Specifications for TC-12 (Flashing Arrow Board Signs)

The use of TC-12 Flashing Arrow Board signs in work zones is covered, in this section, in Section 6.1, and in Section 8 (Typical Layouts). Section 6.1 identifies and describes different versions of the TC-12 for freeway and non-freeway use, respectively, including sign sizes.

Truck- or trailer-mounted flashing arrow boards display flashing messages, or flashing sequencing arrow panels, and are used not only to increase conspicuity but also to guide traffic along the desired path. They are most frequently used on urban and rural freeways, or other multi-lane major roadways where day or night closures, slow-moving maintenance or construction activities, and high-risk operations require more elaborate means to warn and guide traffic through the work area, while also providing some physical protection to the work crew. As shown on the Typical Layouts, a TC-12, being an active fail-safe device, may sometimes be used to replace one or more static passive signs. Only TC-12s which conform to the requirements stated in Book 7 may be used as a replacement for the TC-3 and TC-4 in very short duration and short duration operations, where shown on various typical layouts.

Table 3 – Minimum Reflectivity Requirements

Minimum Reflectivity	Signs/Devices	Effective Date
High intensity (Type III) (intermediate reflectivity level)	TC-3 TC-7 TC-12 TC-18 TC-22 ("Stop" side) Rb-91 Rb-92 TC-51A, B, C TC-52 TC-53 TC-54	January 1, 1995 except January 1, 2001 for TC-22 and January 1, 2002 for TC-12, TC-51A, B and C (collars) [4]
High reflectivity micro-prismatic fluorescent (e.g., diamond grade or equivalent) (highest reflectivity level)	TC-1 TC-1A TC-1B TC-2A TC-2B TC-4 TC-9 TC-16E TC-21 TC-22 ("Slow" side) double-sided Slow Paddle	January 1, 2003 except January 1, 2001 for TC-22, and recommended for all signs after January 1, 2001
Engineering Grade (Type I)	All other Temporary Conditions signs	

Notes:

1 Except for the TC-12, signs may be upgraded to higher reflectivity sheeting, where it is considered desirable to do so.

2. Sign size for TC-2A, TC-2B and TC-21 also increases to 90 cm x 90 cm on January 1, 2003.

3. The shape of the TC-22 is octagonal.

4. All cones require white reflective collars for nighttime operations, and for daytime or nighttime after January 1, 2002.

Table 4 – Standard Sign Blank Descriptions (MTO)

MTO Blank Number	Size (cm)	Material and Thickness
B-8	30 x 90	**Note:** Typical materials for signs are: – aluminum (thickness 2.1 mm) – galvanized steel (thickness 1.6 mm) – plywood (thickness 11 mm or 19 mm) Signs larger than 90 cm x 90 cm should be made of plywood rather than aluminum or steel. Plywood may also be used for smaller signs. If plywood is used, the thickness should be 19 mm for signs larger than 120 cm x 120 cm. A plywood thickness of 11 mm may be used for sign sizes of 90 cm x 120 cm, or 120 cm x 120 cm or smaller.
B-9	20 x 90	
B-10	45 x 45 trapezoidal	
B-11	45 x 45	
B-12	45 x 75	
B-13	45 x 90	
B-15	45 x 60	
B-17	61 x 61	
B-18	60 x 60	
B-20	60 x 90	
B-23a	75 x 75	
B-25a	20 x 60	
B-25b	30 x 60	
B-27	90 x 90	
B-29	90 x 120	
B-30	120 x 120	
B-38a	90 x 180	
B-43	120 x 180	
B-44	120 x 210	
B-45	120 x 240	
B-52	60 x 75	
B-54	90 x 240	
B-55	150 x 240	

A TC-12 (Freeway) must meet the following specifications:

Sign Panel

- The panel shall be one-piece design, equipped with remote-controlled mode activation mechanisms mounted on the panel.
- The actuation time of the mode activation mechanisms from the closed position to the open position or vice versa shall be 10 seconds maximum.
- The arrows and arrow shaft (bar) shall be black in colour, also the arrow shaft (bar) shall be 30 cm wide.
- By January 1, 2002, the background must be Type III, high intensity, retroreflective orange sheeting, to provide for fail-safe operation in case of power failure.
- The sign panel should incorporate four modes, right arrow, left arrow, both arrows, and bar mode. Only one mode shall be visible at a time to the approaching traffic, and only the lights within the operating mode shall be visible.

Sign Panel Lighting

- 19 or 20 amber sealed beam lamps or halogen lamps or a continuous matrix of programmable LED lights, or approved equivalent, shall be arranged in the form of an arrow, as shown in Section 6.1. If sealed beam lamps, they shall be G.E. Part #7414Y or approved equivalent.
- The visibility distance, by night or day, must be 900 m for the light, and 350 m for the recognizable arrow or bar shape.
- The arrow head and shaft shall flash simultaneously (arrow on/off). Alternatively, the arrow shaft and head may flash sequentially, with the arrow shaft coming on first and then the arrow head, the shaft remaining on so that at the end of the cycle the complete arrow appears (shaft and head).
- A photo-electric cell with 110 lux (10-foot candles) sensitivity for night dimmer shall be supplied for automatically reducing the lamp intensity.
- The lights shall flash approximately 40 to 50 times per minute. The "ON" phase must be on for 50% of the cycle time.

Electronic Controller

- The controller shall operate the following functions (preferably from inside the cab, if truck-mounted) (some of these functions may be automatically adjusted):
  - the left flashing arrow
  - the right flashing arrow
  - the bar mode
  - the specified flashes per minutes
  - the light intensity
  - the keep warm and soft start circuit
  - the remote controlled mode activation mechanisms.

Crashworthiness

Since trailer-mounted TC-12s are often located in the roadway, they should be crashworthy. The design should be lightweight with the centre of gravity of the unit near or below the centre of gravity of impacting vehicles. If impacted, detached elements, fragments,

or other debris from the device should not penetrate or show potential for penetrating the passenger compartments of vehicles or present undue hazard to the public or workers.

Except for differences in size and number of lamps, the TC-12 (Non-freeway) and TC-12A (Striper) must meet the same specifications as for the TC-12 (Freeway). The smaller TC-12 (Non-freeway) must have sufficient lights to provide a distinct arrow shape and bar shape.

Required visibility distance for the TC-12 (Non-freeway) is as follows:

- For speeds of 70 km/h to 90 km/h, the visibility distance, by night or day, must be 600 m for the light, and 250 m for the recognizable arrow or bar shape.
- For speeds of 60 km/h and lower, the visibility distance, by night or day, must be 450 m for the light, and 175 m for the recognizable arrow or bar shape.

3.3 Portable Variable Message Signs (PVMSs)

The use of portable variable message signs in work zones is covered in this section of Book 7. Technical descriptions and specifications for portable variable message signs are included in Book 10 (Dynamic Message Signs).

As defined in OTM Book 10 (Dynamic Message Signs) (DMSs) is an umbrella term which includes both Changeable Message Signs (CMSs) and Variable Message Signs (VMSs). CMSs are limited-function DMSs, with only one or a few fixed messages, shown either on or off. VMSs are more full-function DMSs, with matrix displays of various degrees of flexibility for a variety of messages, including custom messages.

As defined in Book 10, the kinds of DMSs typically used in work zones are called Portable Variable Message Signs (PVMSs), and this is the term used in Book 7.

Previous Ontario practice was to use the term Changeable Message Signs for what are now called Variable Message Signs. Note that in earlier documentation, the terminology may vary from the usage adopted in Books 7 and 10.

Introduction

Portable Variable Message Signs (PVMSs) are intended to provide motorists with advance information of work operations which are outside their expectation, such as closures or speed reductions. Although they may also be used for maintenance and emergency operations, the most common use of PVMSs in work zones is for long duration construction work zones. For this reason, the emphasis in this section is on PVMSs used in construction work zones.

The use of pre-programmed messages, and in some cases custom-designed messages, can be an effective means to inform drivers of roadway conditions ahead, thus providing an opportunity to take necessary precautions or to select alternate routes. In addition, this information would help ensure a greater margin of safety for workers and responding emergency personnel.

In order to achieve a high level of respect for the PVMSs, the message displays must provide motorists with a concise message relevant to the situation they will be encountering. Providing accurate information will enhance the system's credibility and therefore effectiveness.

The success of these signs and their future applications depends upon their proper use.

The determination of whether and where PVMSs must be used in construction work zones is at the discretion of the road authority.

In order to establish relatively uniform application of the signs, the following guidelines have been prepared.

PVMS Technologies

PVMS technologies have changed over the years, and continue to change, from early electro-mechanical shuttered signs and bulb matrix displays through fluorescent flip-disk to fibre optic and light-emitting diode (LED) displays. Some technologies used in the past, while possibly the best of their time, have been superseded by newer technologies with superior performance and lower operating and maintenance costs.

PVMSs may have various degrees of functionality:

Discrete Character Matrix Signs

These signs are the most limited in function, with the lowest cost. They have a display board containing an individual display module for each character, separated by a dark space. The size of the module limits the size of the characters or symbols.

Line Matrix Signs

These signs have full matrix capability within a line of one character height, and can display a full array of characters along that line, but have spaces between the lines. This limits the ability to show graphics. This is not a commonly available format for PVMSs.

Full Matrix Signs

These signs offer the most flexibility, and are the most expensive. The entire area of the sign face can be used for display and can be divided into lines to display text messages, or used in its entirety to display full graphics, or can be broken into sections of text and graphics.

Combination Signs

These signs typically integrate static and dynamic components into one sign, depending on the functionality required for the different areas of the sign. They optimize functionality while reducing cost.

The preferred (in some jurisdictions the only acceptable) technology option for PVMSs is light-emitting signs, as they provide the best visibility to motorists over a wide range of lighting conditions. The preferred types of light-emitting signs are LEDs, and hybrid signs. (Hybrid VMSs combine LED or fibre-optic technologies with reflective flip-disk technology.) These technologies are described in more detail in Book 10 (Dynamic Message Signs).

Design and Operational Considerations

As outlined in Book 1b (Sign Design Principles) and Book 10 (Dynamic Message Signs), PVMSs should be designed and placed, taking into account the need for sign conspicuity, legibility, comprehensibility, credibility, and driver response time.

Sign visibility should be at least 300 m for freeway applications and at least 200 m for arterial road applications.

Colours used should be either amber or white, as they have good visibility. Orange is not easily achievable or common on light-emitting signs. The colour of all pixels should be uniform across the display. Each PVMS pixel should be capable of

achieving a luminance of 30 to 40 candela at the brightest level. Signs must have a photosensor array to enable the luminance of the sign to be controlled both automatically and manually in relation to ambient light levels.

Contrast ratios should be determined as outlined in Book 10 (Dynamic Message Signs). Luminance of a PVMS pixel should not decrease by more than 50% when viewed at a minimum angle of 15 degrees centred about the optical axis and perpendicular to the surface of the display (half angle of 7.5 degrees). With such a narrow angle of good luminance, sign positioning (angle) in work zones becomes critical.

Technology details, and line and character spacing and fonts should be designed as outlined in Book 10 (Dynamic Message Signs).

On freeways, PVMSs should be located 1,000 m to 1,500 m upstream of interchange decision points. On arterial roads, they should be located 600 m to 1,000 m upstream of decision points.

Typically up to four alternate display techniques are possible with PVMSs:

- Message flashing, where the message cycles on and off several times a minute to draw the observer's attention to the message. Flashing messages may take longer to read than static messages and may require a shorter message.

- Message phasing, where two or more parts of a message are displayed in sequential time slots, separated by a brief blank period, to accommodate longer messages than would otherwise be possible. Generally, no more than two phases should be used in high speed applications.

- Message alternating, where two separate messages are displayed in sequential time slots, separated by a brief blank period, to accommodate more messages than would otherwise be possible. Two unrelated messages generally require more reading time than two parts of the same message.

- Message scrolling, where the message appears to scroll from right to left across the screen or from top to bottom. Message scrolling generally should not be used on PVMSs in work zones.

On PVMSs in work zones, message flashing or message phasing may often be effective in helping to attract the driver's attention in a complex driving environment. Caution must be exercised against presenting PVMS messages which are too long or too complex. All messages should be approved by the road authority.

PVMSs have to be easily moveable and able to be placed so as to be readily seen from the roadway without compromising public safety. PVMSs can be located on the back of vehicles or mounted on a trailer and towed from site to site. Where possible, the signs should be placed in an area with existing barrier protection. If this is not possible, they must be located a sufficient distance away from moving traffic so as not to introduce a hazard to motorists.

Most PVMSs now operate with batteries that are recharged using solar panels. Consequently, some signs may not operate continuously over a 24-hour period without periodic inspection. Communications to temporary sites can also be a challenge if it is intended to change messages displayed without requiring a site visit. This is commonly achieved using cellular telephone, in which case, care must be taken to ensure that sites have good cellular coverage. Security issues also arise with PVMSs, so wheels and towing devices should be removed to prevent theft and vandal-proof locks should be installed on all controls.

Application Guidelines for PVMSs in Work Zones

- The signs should be displayed primarily to provide advance notice of road or lane closures for construction or maintenance operations.
- The signs should be placed a short time before the construction, maintenance, or emergency operation begins and removed immediately upon completion.
- The distances displayed on the signs should be accurate.
- Where possible, two signs should be used on divided highways, one sign on the left shoulder, one on the right, approximately 60 m apart. The location should be prominent but not a hazard to motorists. If this is not possible, consideration should be given to placing two PVMSs on the right side.
- Preferably, messages should be developed and selected by the road authority. In the case of straightforward, short-term operations, the supervisor of the work crew may select a pre-programmed message. If a pre-programmed message does not satisfactorily address the situation, new custom-designed messages may be developed, subject to procedures and approvals by the road authority. Custom messages should be accepted only after processing through a designated approval path.
- The sign(s) should be located far enough from the construction, maintenance, or emergency site so as to provide at least one alternate route. Also, if the work activity is likely to result in congestion (e.g., a lane closure), it is beneficial to postion the PVMS(s) advising of a lane closure upstream of expected ends of queues.
- The signs should only be used for real-time situations which affect traffic flow.
- The signs must not be used to replace any devices prescribed in the Ontario Traffic Manual, but only as a supplement to such devices.
- If permanent VMSs are also used on the same or other nearby roadways as part of a centrally controlled ATMS, to provide information on incidents and on lane or roadway blockages, the information on the PVMSs and the permanent VMSs should be coordinated, so that consistent, non-conflicting information can be provided to motorists. Care must be taken to ensure that the PVMSs and the permanent VMSs are operated in a coordinated manner, not displaying messages on one sign that are in conflict with another or with the actual traffic conditions on the road. The dynamic nature of the signs leads the public to believe that the information displayed is updated regularly, and considerable loss of credibility can be experienced if two signs display conflicting information. The contractor and the road authority responsible for the ATMS should coordinate PVMS and VMS messages. See Book 10 (Dynamic Message Signs) and Book 19 (Advanced Traffic Management Systems) on the integration of PVMSs into the operation of a centrally controlled ATMS.

PVMS Message Format and Content

Sign messages should be designed in accordance with the sign size selected. Sign messages should fit on no more than three lines displayed at any time. Depending on sign size, line length may range from 8 to 12 characters. If messages use two phases, a dwell time of approximately 2.5 to 3 seconds per phase should be used. Where possible, all message lines should be centre-justified.

Table 5 – PVMS Messages for Road Closure Scenarios

Scenario	Message for Advanced Notification		Message During Closure	
	Phase 1	**Phase 2**	**Phase 1**	**Phase 2**
Single Night Total Closure on Freeway	417 EAST TO BE CLOSED	TONIGHT 10 PM AT MAITLAND	417 EAST CLOSED TILL 6 AM	MAITLAND TO PARKDALE
Consecutive Nights Total Closure on Freeway	417 EAST TO BE CLOSED	NIGHTLY 10 PM AT MAITLAND	417 EAST CLOSED TILL 6 AM	MAITLAND TO PARKDALE
Full Weekend Total Closure on Freeway	WEEKEND CLOSURE 417 WEST	EAGLESON TO MOODIE	417 EAST RE-OPENS MON 6 AM	EAGLESON TO MOODIE
Daytime Total Closure on Freeway	417 EAST TO BE CLOSED	TODAY 3 PM AT EAGLESON	417 EAST CLOSED TILL 6 PM	EAGLESON TO MOODIE
Single Night Partial Closure on Freeway	LANE REDUCT'N 417 EAST	TONIGHT 10 PM AT MAITLAND	2 LEFT LANES CLOSED	417 EAST BEYOND MAITLAND
Consecutive Nights Partial Closure on Freeway	LANE REDUCT'N 417 EAST	NIGHTLY 10 PM AT PARKDALE	2 LEFT LANES CLOSED	417 EAST BEYOND PARKDALE
Full Weekend Partial Closure on Freeway	WEEKEND LANE REDUCT'N	417 WEST AT PINECRST	2 RIGHT LANES CLOSED	417 WEST BEYOND PINECRST
Daytime Partial Closure on Freeway	LANE REDUCT'N 417 WEST	TODAY 3 PM AT MOODIE	2 RIGHT LANES CLOSED	417 WEST BEYOND MOODIE
Single Night Exit Ramp Total Closure	MAITLAND AVENUE EXIT	CLOSED TONIGHT AT 10 PM	MAITLAND AVENUE EXIT	CLOSED UNTIL 9 AM
Consecutive Nights Exit Ramp Total Closure	MAITLAND AVENUE EXIT	CLOSED NIGHTLY AT 10 PM	MAITLAND AVENUE EXIT	CLOSED UNTIL 9 AM

Table 5 – PVMS Messages for Road Closure Scenarios (cont'd)

Scenario	Message for Advanced Notification		Message During Closure	
	Phase 1	**Phase 2**	**Phase 1**	**Phase 2**
Full Weekend Exit Ramp Total Closure	MOODIE DRIVE EXIT	CLOSED THIS WEEKEND	MOODIE DRIVE EXIT	CLOSED UNTIL MON 9 AM
Daytime Exit Ramp Total Closure	MOODIE DRIVE EXIT	CLOSED TODAY AT 2 PM	MOODIE DRIVE EXIT	CLOSED UNTIL 6 PM
Single Night Exit Ramp Partial Closure	Not necessary	Not necessary	MOODIE DRIVE EXIT	REDUCED TO 1 LANE TILL 9 AM
Consecutive Nights Exit Ramp Partial Closure	Not necessary	Not necessary	MOODIE DRIVE EXIT	REDUCED TO 1 LANE TILL 9 AM
Full Weekend Exit Ramp Partial Closure	Not necessary	Not necessary	MOODIE DRIVE EXIT	REDUCED TO 1 LANE TILL MON
Daytime Exit Ramp Partial Closure	Not necessary	Not necessary	MOODIE DRIVE EXIT	REDUCED TO 1 LANE TILL 4 PM
Total Freeway Blockage at One Point	Not necessary	Not necessary	ALL LANES BLOCKED	417 WEST BEYOND PINECREST
Partial Freeway Blockage at One Point	Not necessary	Not necessary	2 LEFT LANES BLOCKED	417 EAST BEYOND MAITLAND
Total Blockage on Exit Ramp	Not necessary	Not necessary	EXIT TO MOODIE BLOCKED	
Partial Blockage on Exit Ramp	Not necessary	Not necessary	2 RAMP LANES BLOCKED	MAITLAND AVENUE EXIT

The following pre-programmed generic messages have been adapted for PVMSs in work zones from MTO freeway use. Road authorities may also develop other standard pre-programmed messages appropriate to their use:

- DIAGNOSTICS (Test Pattern)
- DETOUR AHEAD
- RIGHT LANE CLOSED
- 2 RIGHT LANES CLOSED
- 3 RIGHT LANES CLOSED
- LEFT LANE CLOSED
- 2 LEFT LANES CLOSED
- 3 LEFT LANES CLOSED
- ROAD CLOSED 1–20 km

The message sets shown in Table 5 have been developed by MTO for specific construction projects and scenarios on freeways, and are included as general guidelines for the use of PVMSs in similar situations, both freeway and non-freeway. The messages are designed on the basis of 3 line by 8 character PVMS with no graphics capability.

The message formats for total/partial freeway closures are suitable for PVMSs placed either on the affected streets or on connecting roads. Message formats for total/partial exit ramp closures are only suitable for PVMSs located on the freeway upstream of the affected exit ramp.

The message sets presented in Table 5 have been developed on a consistent basis, to provide required information efficiently. Depending on the scenario (row) in Table 5, some or all of the following information is required in the PVMS message:

For advanced notification

- Identify which road (or exit) is to be closed (fully or partially) and the direction of travel;
- State (day and) time that the closure will start (specific day(s) or every day), or duration of closure (e.g., weekend);
- Indicate the beginning (and end) of closure location with the nearest upstream exit name(s).

During closure

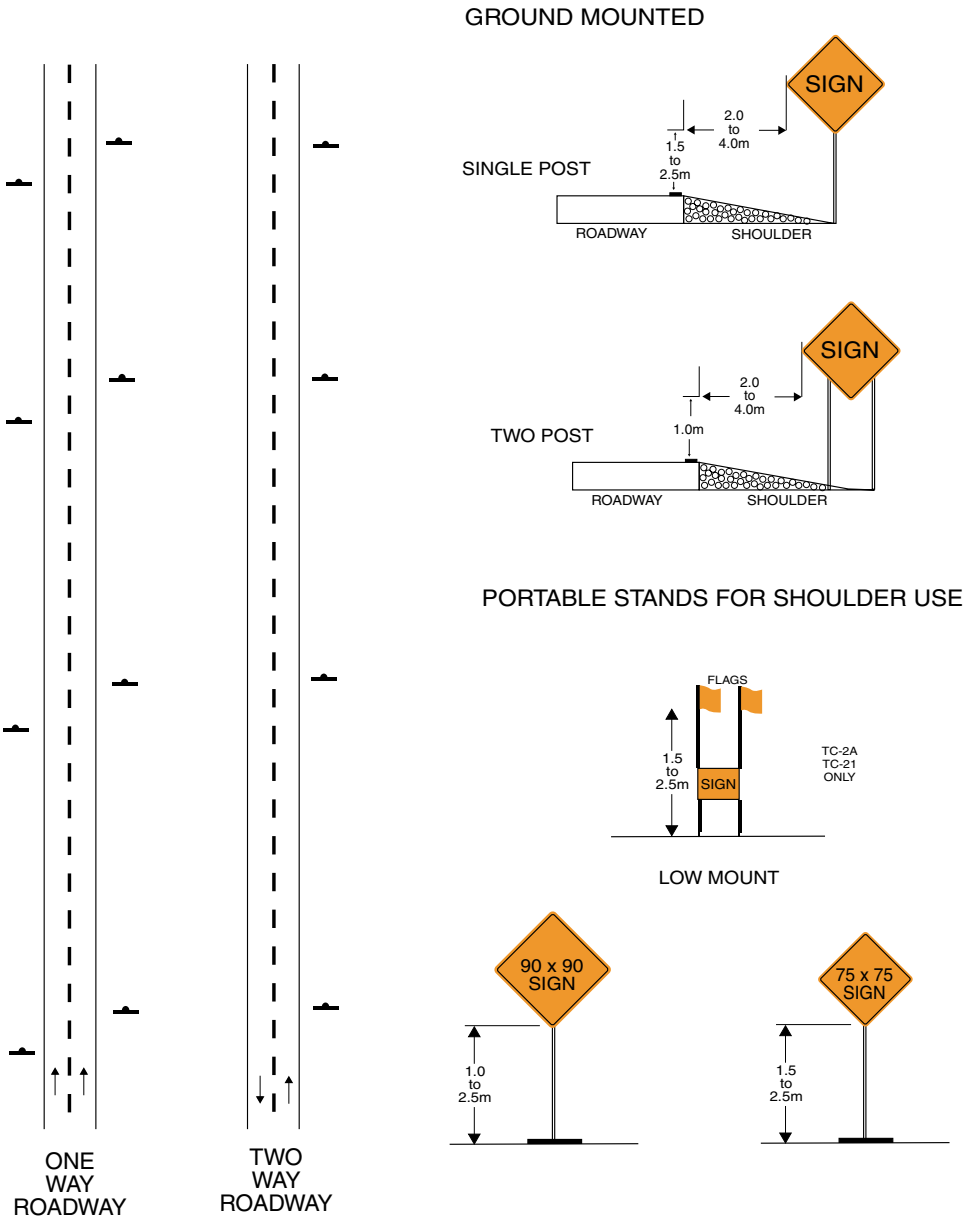
- Identify the road (or exit) and direction of closure, and partial closure conditions as applicable;
- State (day and) time that the closure will end;
- Indicate the beginning and end point of closure with nearest exit names;
- Indicate which road (or exit) is blocked (e.g., incident) and the direction of travel;
- Relate the location of the blockage to the nearest upstream exit;
- Indicate which lanes are blocked.

All messages should be pre-approved as required by the road authority responsible for the work zone and the PVMSs used in the work zone.

3.4 Installation of Signs

This section addresses a number of important aspects of sign installation in work zones. A more comprehensive treatment of this subject is found in OTM Book 1b (Sign Design Principles) and Book 3 (Sign Support and Installation). Typical sign placement is shown in Figure 2.

Figure 2 – Typical Sign Placement



THE OBJECTIVE IS TO PLACE THE SIGNS IN THE DRIVER'S CONE OF VISION

Signs generally must be located where drivers expect to see them, typically on the right side of the roadway. Supplementary signs may be located on the left side of the roadway where the median is wide enough to accommodate the signs. They should also be used on multi-lane, one-way roadways, and in situations where experience has shown that drivers fail to see the primary signs.

Adjustments to the height and distance requirements may have to be made to allow placement of signs in constricted urban areas.

Note: Signs must not be mounted in or on weighted barrels (e.g., 45 gallon steel drums).

Positioning of Signs

Signs must be placed in positions where they will convey the message most effectively without restricting lateral clearance or sight distance, and at advance distances that allow sufficient response time. They must be mounted approximately at right angles to the direction of travel they are to serve.

Sign supports placed in the clear zone adjacent to the roadway should yield or break away upon impact to minimize hazards to motorists and not present an undue hazard to workers.

Signs for construction projects on both freeways and non-freeways must either be installed on direct buried posts or mounted on bases with sufficient ballast that they will remain in position for the duration of the project. Fixed supports are preferable for long-term projects. Sign supports or bases should be designed to be safe when impacted. The ballast should not be of a material and/or size, such as a piece of steel or block of concrete, that could be hazardous if struck by a vehicle.

For long duration freeway operations, signs 120 cm or less in width must be installed on single or double posts with the bottom edge of the sign at a height of 1.5 m to 2.5 m above the travelled portion of the roadway. Signs exceeding 120 cm in width must be installed on two posts at a general height of 1.5 m above the travelled portion of the roadway to the bottom edge of the sign, with the exception of the diamond shaped two-post sign which shall have a minimum height of 1 m. The lateral distance from the edge of roadway to the nearer edge of the sign must be from 2 m to 4 m on freeways (rural and urban) and roads in rural areas, and 0.3 m to 2 m on non-freeways in urban areas.

Signs installed for maintenance projects (short duration) are usually positioned on the usable portion of the shoulder. The portable supports for these signs should be constructed in such a manner that they will not be a hazard to errant vehicles, yet be sufficient to remain upright. Signs less than 90 cm in width must be installed at a height of 1.5 m to 2.5 m above the roadway. Signs 90 cm or larger in width must be installed at a height of 1 m to 2.5 m above the roadway.

Low-mounted Portable Sign Stands

Low-mounted Portable Sign Stands (e.g., A-Frame Type) may be used only for the TC-2A or the TC-21. Signs mounted on these stands must have flags attached to them to bring the drivers' attention to the message on the sign. The bottom of the flags should be approximately 1.5 m to 2.5 m from the ground. The sign bases must be of sound material so as to support the sign adequately; however, the base should not be appreciably wider than the sign. Ballast, if required, will help prevent the sign from blowing over in the wind. The ballast must not be of a material and/or size, such as a piece of steel or block of concrete, that could be hazardous if struck by a vehicle.

3.5 Maintenance of Signs in Temporary Work Zones

All signs for work projects must be where drivers expect to see them, and must be in position where they can be readily seen by the travelling public at all times. Intersections must be identified with standard intersection signs. Route markers must be located along the roadway to ensure route continuity. All work zone signs are important. The location and maintenance of all regulatory signs need to be given high priority. **STOP signs in particular must be maintained and visible at all times and must be properly located and relocated as necessary through the various stages of construction or maintenance, to ensure that the desired, intended right-of-way control is in effect at all times.**

On any work project, the supervisor is responsible for keeping on site a record of traffic control used. For major projects, a separate field book should be maintained. The daily status and the times of any moves should be recorded. As soon as possible after any collision, the status of signs in the area concerned and the time of inspection shall be recorded and any necessary measurements or photographs taken.

Signs and other devices that have been damaged or defaced should be replaced immediately.

Dirty signs and other devices result in poor visibility, particularly at night. Therefore, ALL signs must be maintained in a clean, legible and good working condition in order to be effective.

The maintenance of signs is addressed more fully in OTM Book 3 (Sign Maintenance).

4. Other Traffic Control Devices

4.1 Channelizing Devices

The functions of channelizing devices are:

- to warn and alert vehicle operators to hazards created by construction or maintenance activities in or near the travelled way;
- to guide and direct traffic safely past the hazards;
- to produce the desired behaviour in roadway users.

Channelizing devices as used herein include cones, construction markers, flexible drums (barrels), pavement markings and various types of temporary barriers.

Channelizing devices should provide a smooth and gradual transition in moving traffic from one lane to another, into a detour, or in reducing the width of the travelled way. Channelizing devices may also be used to separate traffic from the work area, pavement drop-offs, or storage areas. Where possible, they should be set 0.3 m to 0.6 m back from the edge of the traffic lane.

The single most important element within the system of traffic control devices used in construction or maintenance work areas is the transition taper for full lane closure or for other reductions in pavement width. An inadequate taper is likely to produce undesirable traffic operations with resulting congestion and the possibility of collisions through the area. Vehicles and equipment must not be kept in the taper area, except for TC-12 flashing arrow boards.

The minimum desirable taper length for common offset widths has been calculated for various approach speeds, and subsequent taper length values as well as cone or marker spacings can be read from the appropriate Table (A, B, or C) in Section 8. These tables also provide guidance as to speed-related distances and spacing relationships for the placement of general warning signs and channelizing devices.

Channelizing cones, markers or flexible drums used for transition taper alignments may get out of their normal alignment and spacing due to being struck by vehicles or moved by the wind and suction created by fast-moving trucks, construction, maintenance, or utility activities. It is therefore necessary to patrol the channelization at frequent intervals to ensure it is functioning properly. On long-term construction projects, repositioning of channelizing devices can be accomplished expeditiously if the original taper alignment has been indicated by paint markings or the application of removable marking tape on the pavement.

4.2 Barricades and Barriers

Barricades

A traffic barricade is a device, typically with one to three rails, which provides a visual indicator of a hazardous location or the desired path a motorist should take, but is not intended to contain or redirect a vehicle. TC-53A and TC-53B devices are traffic barricades described in Section 6.2.

The primary function of traffic barricades is to block off a portion or all of the road where partial or full road closures become a necessity, and to delineate excavation or construction areas in or near the travelled portion of the roadways. Barricades are only supplemental to other delineation devices, and are not the primary delineation around the excavation or obstacle. Approaches to barricades should be adequately marked.

Markings on barricades must be alternating vertical orange retroreflective and black stripes. Normally stripes must be 15 cm wide, but on rails less than 90 cm long, they may be only 10 cm wide.

Barricades for pedestrian safety are generally described in Section 1.12.

Barricades for worker safety, in and around the work site, including excavations, are covered by OHSA and Regulations for Construction Projects, R.S.O. 1990, 213/91, Section 85.

Barriers

A barrier is a device which provides a physical limitation, through which a vehicle would not normally pass, and is intended to contain or redirect an errant vehicle of a particular size range, at a given speed and angle of impact.

Barriers are required to protect workers from traffic in an adjacent live lane under the following conditions (requirement of Regulation 213/91, Section 67, under the OHSA):

- construction projects on freeways;
- not a mobile operation; and
- the project requires more than five days to complete.

Where all of these conditions are present, but it is not practical to install the barriers as required, or where the project requires five days or less to complete, a longitudinal buffer area (LBA) and a buffer vehicle must be adequately positioned to protect the workers working on the highway.

On divided high-speed, high-volume roadways, vehicular penetration into work sites can be prevented or reduced in severity by the use of temporary concrete barriers (e.g., "New Jersey" type barrier), or other temporary barriers. Their use should be determined by the protective requirements of the location, and they should not be considered to be channelizing devices. Temporary pavement edge lines as well as reflective delineation should be used with temporary barriers. See also Section 4.3. Any sharp change in the alignment of temporary barriers should be protected by the use of flexible drums (TC-54s) as required in Tables A, B, and C in Section 8.

The standards described in the U.S. NCHRP Report 350 have become generally accepted as the standards for barriers and truck-mounted attenuators (TMAs). For temporary barriers, the following standards apply:

- NCHRP TL-2: 70 km/h impact speed;
- NCHRP TL-3: 100 km/h impact speed.

Note: the TL-2 and TL-3 referenced by NCHRP relate to TMAs and are unrelated to the TL- numbers in the Typical Layout figures in Section 8.

Barriers protect work zones and drivers by preventing or reducing penetration to the work zone and through a controlled redirection of the errant vehicle. The effectiveness of the barrier system depends on its correct placement, and on the size, speed, and angle of approach of the errant vehicle. Most systems can absorb a hit from a passenger car up to an angle of 20 degrees without penetration.

Some of the barrier systems used in Ontario work zones include:

Temporary Concrete Barrier (TCB)

The most common system is temporary concrete barrier. TCBs used in Ontario must meet the requirements of the Ontario Provincial Standard Specifications (OPSS) for TCBs and be placed in accordance with the Ontario Roadside Safety Manual. They are commonly used in section lengths of 2.5 m to 4 m, connected together to form a continuous barrier. Factors to consider include:

- TCBs can be laterally displaced when struck. Vertical excavation behind a barrier should only occur when the barrier is anchored against lateral displacement, the probability of a high-energy hit is low, or when the excavation starts at least 1 m from the barrier.
- Lane closures are required to place the barrier. It should be constructed in the downstream direction. Barrier that is not placed in accordance with the Ontario Roadside Safety Manual could constitute a hazard.
- An offset or "shy" distance of at least 0.5 m from the edge of the lane to the barrier is desirable. At a barrier offset of 1 m, traffic flow is likely to be unaffected.
- The barrier should be offset in accordance with the OPSS. The leading end of the barrier can then be tapered towards the edge of the lane. This practice should be undertaken regardless of whether energy absorbing end treatments are used. Placement of energy absorbing terminals without an offset will often result in expensive hits to the system that might have been avoided with a greater offset.

- TCB can impact on roadway drainage. Winter sand and other debris can block drainage channels. Construction of 1 m gaps spanned by steel beam and channel at key drainage locations (sumps, catch basins, etc) should be considered.

Moveable Barrier

A moveable barrier consists of 1 m sections of linked concrete barrier that can be mechanically shifted. The barrier can be laterally shifted by up to 5 m at a speed of 12 km/h, using a special purpose vehicle. Moveable barrier is typically used:

- To provide a reversible lane;

- When the risk associated with frequent lane closures required to accommodate construction staging warrants the expense of moveable barrier.

Applications of such barriers must be approved by the road authority.

Plastic Barriers

Plastic barriers are used for lower speed applications (up to 70 km/h) where the portability of the barriers is desired. These barriers are susceptible to lateral displacement when struck. Care must be taken to ensure that they are used as intended (filled with water or sand ballast, for example), and not underfilled to facilitate portability, which diminishes their effectiveness as a barrier.

In all cases, attention must be given to the provision of temporary barrier energy absorbing terminals, if the design of the barrier itself does not satisfy this requirement.

4.3 Temporary Markings and Delineation

Temporary Markings

Adequate pavement markings must be maintained along paved roads in temporary work zones. To the extent practicable, motorists should be provided pavement markings within a work zone comparable to the markings normally maintained along adjacent roads. Markings must be maintained in long duration stationary work zones on non-freeways, and in both long duration and short duration work zones on freeways. Markings must meet the markings in place at both ends of the work zone. Markings should be placed on hard-surfaced detours or temporary roadways before they are opened to traffic. Directional dividing lines should be placed, replaced, or delineated where appropriate before the roadway is opened to traffic.

Temporary pavement markings are normally used in combination with appropriate warning signs, channelizing devices and delineation to mark the intended vehicle path that traffic is to follow. Temporary pavement markings must be used for those long duration and short duration work zones indicated in the paragraph above, where traffic is diverted from normal paths, and where guidance by channelizing devices, delineation or warning signs does not clearly and adequately indicate the required vehicle path.

Pavement markings that are no longer applicable or no longer define the safe path of travel must be removed, masked, or obliterated as soon as practical, to prevent motorist confusion. Markings are commonly removed by sandblasting, grinding, or chipping. Less commonly, markings can be removed by chemical means, high-pressure water jet, hot compressed-air burning, or excess-oxygen burning. Removal should minimize damage to the road surface or texture. Thermoplastics and permanent

tapes are generally more difficult than paints to remove effectively. Temporary tapes are fabricated to be easily removed by hand, and are the preferred solution.

Painting over invalid markings with black paint or bituminous solutions is not a proper removal technique. The covering material wears, so that the invalid markings eventually reappear. Also, markings covered in this way remain visible under some low-light conditions.

Temporary pavement markings should also be considered on projects with a partial pavement removal (milling). These markings should as closely as possible reflect the pavement markings which had been removed.

Where there is little colour contrast between the pavement and the white pavement markings, the contrast may be improved by using marking tape with white stripes bordered by black on both sides, or by applying white paints over a double-application black painted line.

When a temporary roadway is constructed to bypass a closed portion of highway, appropriate reflectorized pavement markings must be placed on the approach to, and throughout the length of, the hard surface temporary roadway. At locations where the temporary roadway is relatively short, temporary traffic paint or pressure sensitive marking tape, which can be supplemented by raised pavement markers, may be used to provide short-term expendable pavement markings.

Permanent pavement markings must be installed on six-lane freeways before opening to traffic. On other roads, if permanent pavement markings cannot be installed immediately, interim temporary pavement markings must be installed, and the permanent markings must be installed within the following time frame, depending on road type:

- four-lane freeways – within 15 working days;
- multi-lane non-freeways – within 15 working days;
- two-lane roads – within 20 working days.

Interim temporary pavement markings in these situations should be a 0.3 m marking with a 15 m gap. If no-passing zones cannot be marked with pavement markings during the interim period, they should be established through the use of signs (Rb-31 and Rb-35).

Pavement markings are more fully addressed in OTM Book 11 (Markings and Delineation). Temporary pavement markings must comply with the standards prescribed in OTM Book 7 and Book 11. For more detailed information on temporary roadway marking and delineation techniques, refer to the U.S. Federal Highways Administration (FHWA) *Roadway Delineation Practices Handbook*. Any deviations from the standards, for economical or other reasons, are subject to approval by the road authority, and such deviations must not compromise the safety or the proper guidance of the traffic flow.

Where temporary markings are placed in accordance with the principles of colour and pattern described in Book 11, Section 3.1, temporary roadway pavement markers may be used as an enhancement. Temporary roadway markers may also be used to provide short-term delineation in construction zones prior to the placement of permanent markings. In such short-term uses, temporary roadway pavement markers take the place of short-term markings that are normally applied. Where a line of temporary roadway markers is used as an alternative to temporary markings, the result must be comparable to temporary pavement markings and conform to the principles of colour and pattern described in Book 11, Section 3.1.

Delineation

Delineation of the roadside during daytime can be accomplished effectively with pavement markings. However, nighttime visibility often requires the use of delineators to provide long-range delineation of the roadway alignment. Further, delineators remain visible under adverse weather conditions. Delineation is more fully addressed in OTM Book 11 (Markings and Delineation), Section 4.

Delineators are small retroreflective devices that are erected in series to guide drivers, and are typically mounted on posts or barriers, or in the roadway (e.g., temporary roadway pavement markers). They are placed in or on the roadway, adjacent to the shoulder (in rural areas) or on the edge of the travelled portion of the roadway (in urban areas), or on the top or side of median or temporary barriers. Delineators describe the horizontal alignment of the roadway and help the driver to identify its limits. Delineators are guidance devices and are generally not intended as warning devices.

Effective January 1, 2002, all in-service delineators must, as a minimum, employ materials conforming to ASTM Specification D4956-90 or its subsequent revisions for Type III (high intensity) and Type IV (prismatic) materials.

Off-roadway delineators should be installed so that they are within the driver's cone of vision, and positioned at 1.25 m to 4 m from the edge of pavement. They should usually be placed 0.6 m to 2.4 m beyond the outside edge of the shoulder, or, if appropriate, in line with the roadside barrier that is 2.4 m or less beyond the outer edge of the shoulder. Delineators should be placed a constant distance from the edge of the roadway. Post-mounted delineators (PMDs) or saddle-mounted delineators (SMDs) should be placed on or as close as possible to a temporary barrier, at spacings from 20 m to 40 m. Delineator conditions must be regularly inspected and maintenance or replacement of damaged delineators should be implemented as soon as practical.

Delineation devices include:

- traffic cones (TC-51A and B);
- construction markers (TC-52);
- barrels (flexible drums) (TC-54);
- temporary roadway pavement markers;
- painted curb markings for delineation (islands);
- small reflective post-mounted delineators (various designs and manufacturers);
- saddle-barrel delineators (and other barrier-mounted delineators) (various designs and manufacturers);
- TC-18 CHEVRON ALIGNMENT Sign.

4.4 Traffic Control Persons (TCPs)

When a Traffic Control Person (TCP) is on duty, the TC-21 sign must be used at all times. The TC-21 sign must be removed when the TCP is not on duty. The sign is placed in advance of the TCP at a distance determined by referring to the appropriate typical layout in Section 8.

Application of TCPs

TCPs are used at work zones to regulate vehicle traffic and to prevent conflicts between construction/maintenance workers, work zone activities, road traffic, construction/maintenance vehicles, and pedestrians. They may be used at work sites to stop

Table 6 – Deployment of Traffic Control Persons (TCP)
(Workers Directing Traffic by Means of Signs)

Conditions under which a TCP can be used	Normal regulatory posted speed 60 km/h or lower, one lane or reduced to one lane	Normal regulatory posted speed 70 km/h to 90 km/h, one lane or reduced to one lane	Any speed, more than one lane in each direction
To protect workers on public way	Yes	Yes	No
To protect construction vehicles crossing roadway	Yes	Direct construction traffic only, not public traffic	No
To protect construction vehicles entering a roadway	Yes	Direct construction traffic only, not public traffic	No

Note: See the OCCUPATIONAL HEALTH AND SAFETY ACT AND REGULATIONS FOR CONSTRUCTION PROJECTS, R.S.O. 1990, Regulation 213/91 as amended by Regulations 631/94 and 145/00.

traffic intermittently as necessitated by work progress, or to maintain continuous traffic flow past the work site at reduced speeds to protect workers. They must be positioned, and operate, in a manner which will not conflict with other traffic control devices such as stop signs, traffic signals, or railway crossing signals. (If this is not possible, either the traffic signal should be turned off, or the police should be brought in to control traffic.) Where traffic must use a single lane in situations where the roadway is normally a two-way operation, TCPs may be used to control a one-way traffic movement so that vehicles will not be moving in opposing directions at the same time. On sections where TCPs are not in sight of each other, a third TCP or some other means of communication is required to relay instructions to the TCP at either end.

When a TCP is required for nighttime operations, appropriate lighting must be provided so that the TCP is clearly visible to traffic in both directions.

TCPs must not be used on freeways, or on any roadway with a TC-12.

TCPs may be deployed in those situations shown in Table 6, Deployment of Traffic Control Persons.

Responsibilities

The responsibilities of TCPs, to meet the objectives of work zone traffic control, are:

- To protect construction workers and the motoring public by regulating traffic flow and directing traffic safely through the work zone;
- To stop traffic whenever required by the progress of the work, and otherwise to keep traffic moving at reduced speeds to avoid tie-ups and delays;
- To allow construction to proceed safely and efficiently;
- To warn workers of impending danger;
- To ensure that public traffic has priority over construction equipment;
- To focus on the traffic control task and not to perform other work while directing traffic.

Qualifications

The qualifications of a good traffic control person include:

- Sound health, good vision and hearing, mental and physical alertness;
- Mature judgement and pleasant manner;
- Ability to judge speed and distance of oncoming vehicles;
- Meeting the OHSA requirement of a competent worker;
- Preferably a driver's licence;
- The ability to give motorists simple directions, explain hazards, and answer questions;
- Liking, understanding, and respect for the responsibilities of the job.

Training

The responsibilities prescribed by the Occupational Health and Safety Act make it mandatory that adequate safety precautions are taken to protect the TCP from particular hazards to which the TCP may be exposed. This includes not only personal protective clothing, equipment and devices but extends to appropriate protective measures against dangers and risks imposed by vehicular traffic. This safety aspect must receive prime consideration during the planning stages of traffic control. The appropriate equipment, dress, training requirements and the duties of a TCP are outlined in OHSA, in this Manual and in the Book 7 Training Package, as well as in the *Handbook for Construction Traffic Control Persons* which is published by the Construction Safety Association of Ontario. **TCPs must be given written and oral instructions regarding their duties in a language they can understand**. Information about publications and training courses for Traffic Control Persons can be obtained from:

The Construction Safety Association of Ontario
21 Voyager Court South
Etobicoke, Ontario, M9W 5M7
Telephone: (416) 674-2726
or 1-800-781-2726 toll-free
Fax: (416) 674-8866
e-mail: info@csao.org

Equipment

Clothing

A TCP (and indeed any worker who may be endangered by vehicular traffic) must wear a garment, with reflective materials, which meets the requirements of OHSA Reg. 213/91, Section 69.1.

The TCP also requires:

- Hard hat, Canadian Standards Association (CSA) certified, Class B. If used at night, the hard hat must have reflective tape.
- Safety boots, CSA-certified, Grade 1 (green triangular CSA patch outside, green rectangular label inside).
- Eye protection, e.g., goggles when windy, safety sunglasses when sunny.

Tools

For hand signalling, the standard TC-22 Traffic Control Sign (STOP/SLOW Paddle) (See Section 6.1 for description) with extension handle must be used by TCPs to direct traffic. The use of flags is prohibited. Figure 3 illustrates TCP use of the STOP/SLOW Paddle.

The TCP also requires:

- For nighttime work, a flashlight with a red or orange cone attachment and spare batteries;
- Two-way communication device, depending on the situation.

Nighttime traffic control requires proper and adequate illumination of TCP and equipment. A well-lighted TCP station, a reflectorized traffic control sign, and a flashlight with a red or orange cone attachment must be used. Illumination from above is generally more effective than from the side.

TCP Position and Location

TCPs must be clearly visible to the approaching motorist at all times. The TCP should be located for good conspicuity and contrast, so that the motorist does not have to compete for visual attention with other illuminated or reflective objects. Colour contrast should be maintained between the TCP and the background, to the extent possible. The TCP should not stand in shadow or where the sun impedes visibility. Typical TCP locations are shown in Figure 4 for straight road, hill, and curve situations, and in the typical layouts in Section 8.

TCPs must also:

- Be alert, standing at all times while on duty;
- Face oncoming traffic, and not turn his/her back on moving traffic;

Figure 3 – Traffic Control Person Use of STOP/SLOW Paddle

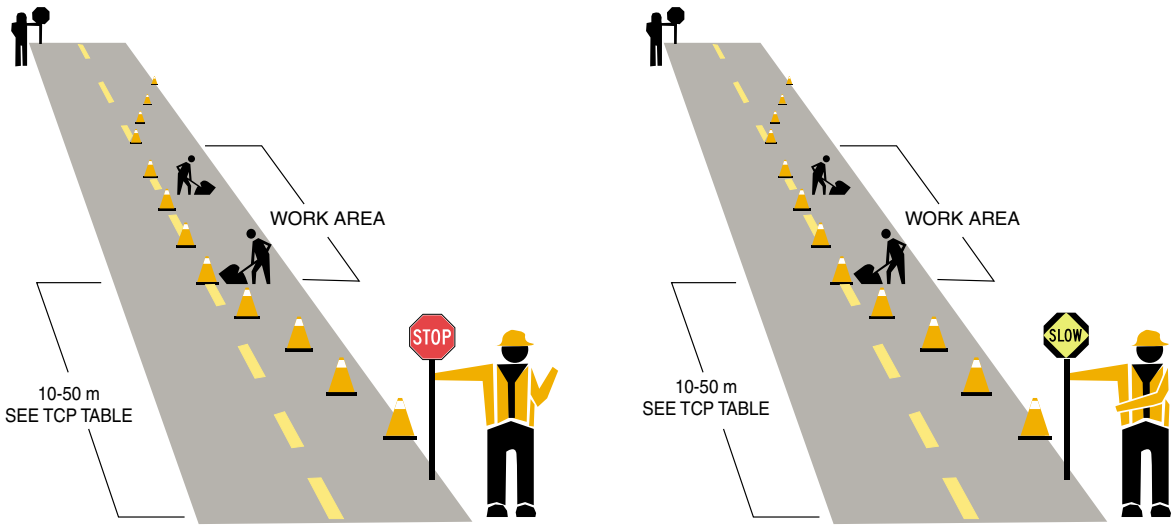
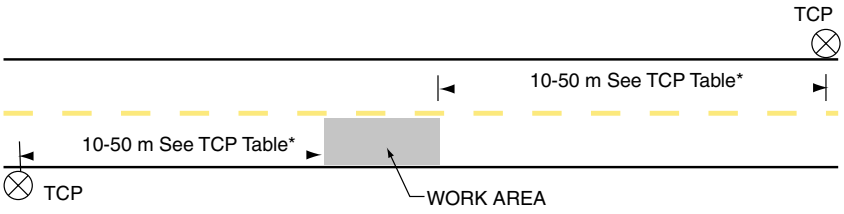
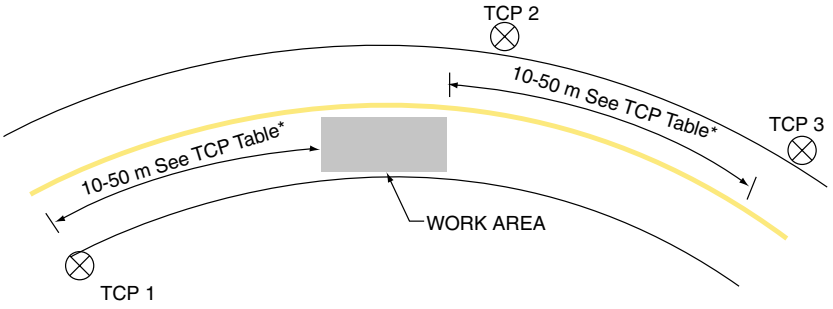


Figure 4 – Positioning of Traffic Control Persons

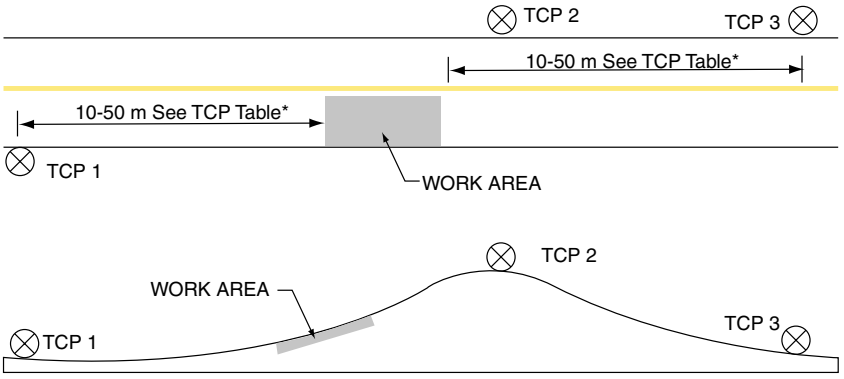
Straight Road



Curve



Hill



Note: On curves and hills, three TCPs or some other means of communication are required. The duty of TCP 2 is to relay signals between TCP 1 and TCP 3.

* TCP Table is Table 7.

- Stand alone, not mingling with workers or the public;
- Stand just outside the lane of traffic;
- Stand from 10 m to 50 m in advance of the start of the work area (See Table 7, TCP Table), so as to be able to protect workers and equipment;
- Stand where he/she can be seen in time to allow approaching traffic adequate time to respond, and where he/she can see for 150 m;
- Remove or cover all signs indicating a TCP (TC-21), when a TCP is not present to control traffic, including lunch and other breaks, if applicable;
- Not perform any other work while directing traffic;
- Be alert for emergency vehicles, which have "priority rights," and allow them to pass as quickly as possible;
- Coordinate his/her operations with any nearby traffic control signal systems and railway crossing signals, and not override or conflict with them.

TCP Control Procedures

When stopping traffic, the TCP must display the STOP sign to the motorist, extending the traffic control sign into the lane of oncoming traffic, and giving the motorist enough warning for a safe and comfortable stop. The TCP must stand off the travelled portion of the roadway until traffic has come to a stop. When traffic has stopped, the TCP may move to a point on the road where traffic in the queue can see him/her. Before moving traffic from a stopped position, the TCP must ensure that the opposing traffic has stopped and that the last opposing vehicle has passed his/her post.

When slowing traffic, the TCP must display the SLOW sign, slowly moving the sign back and forth, if necessary, using hand signals to wave traffic forward or to command a further reduction in speed.

The most typical TCP situation is that where two TCPs are used. When two TCPs are required, lines of communication must be established prior to the start of operations. The two TCPs must be able to see each other or have two-way radios for proper communication. One TCP should be the lead TCP and coordinate all activities. When using visual communications on curves or hills, a third TCP may be required to relay signals between the two TCPs at the ends of the work area.

Table 7 – Traffic Control Person Distance from Work Area (TCP Table)

Normal Regulatory Posted Speed	**60 km/h or lower, one lane or reduced to one lane**		**70 km/h to 90 km/h, one lane or reduced to one lane**	
Traffic Volume	**Low**	**High**	**Low**	**High**
Distance of TCP from Work Area	10 – 15 m	20 – 30 m	30 – 40 m	40 – 50 m

A single TCP may be used to control traffic at work areas where the length of closed lane is short (up to 50 m), traffic volumes and speeds are low, and visibility is good, and in daylight hours only. This may only be done in such a way that it is effectively one-way control, such as where traffic in one direction has an unobstructed lane, and the TCP holds traffic in the obstructed lane until the unobstructed lane is clear of traffic. In this one-way control situation, the TCP serves the same function as the YIELD TO ONCOMING TRAFFIC Sign (Rb-91, formerly TC-43).

Remote Control Devices

Remote control devices (RCDs) have recently been developed which may provide a safer operation by acting as supplements to TCPs in certain situations. Before these devices are used, approval from the road authority must be obtained.

Where used, the remote control devices (one at each end of the work area) must be controlled by one or more on-site TCPs in communication with each other (in the case of two TCPs). In some instances, where the work zone is short in length and visibility is good, two remote control devices may be controlled by a single TCP.

Where remote control devices are used, the following application guidelines must be met:

- RCDs are to be used only in situations where TCPs are used, that is, for the control of two-way traffic on two-lane highways reduced to one lane.
- The RCD must not use a traffic signal head with a red, amber, and green lens.
- A red display, together with a control arm, will be used to stop vehicles from entering a one-lane section. When the TCP wishes to allow traffic to enter the one-lane section, the red display will turn off, the amber display will flash, and the control arm will be raised. When the TCP wishes to stop vehicles again, the amber display will go from flashing to solid for four to six seconds, before the red display appears and the control arm is lowered.
- A TCP must be nearby, in a safe location away from live traffic, and where practicable, at least 3 m off the roadway, controlling the RCD.
- On longer work areas (from 50 m to 500 m) two TCPs must be used, in communication with each other, one at each end, controlling the RCD at that end.
- On shorter work areas (50 m or less), if only one TCP controls two RCDs, there must be a failsafe mechanism to ensure that both ends of the one lane section will not receive a flashing amber display at the same time.
- The TCPs must be equipped with STOP/SLOW paddles, readily available in case of failure.
- Traffic must be channelled into a single lane in advance of the RCD, by means of cones, barrels, and an Rb-25 (KEEP RIGHT Sign).
- Signing for use of the RCD must be in accordance with Typical Layout TL-20B.

It is important that RCDs be used as prescribed. Misapplication of RCDs can be hazardous, and may result in road authority refusal to approve them.

4.5 Portable Traffic Control Signals

Portable traffic control signals may be used as an alternative to TCPs, and only to control traffic flow reduced to a single lane in alternate directions at local work areas on a roadway which requires a lane closure. The road authority must be advised of the intent to use this device so that road authority staff may monitor the operation of all portable traffic control signals and require the contractor to adjust the timing if the traffic flow is adversely affected.

Where portable traffic control signals are used they must comply in all respects with Regulation 606 under the Highway Traffic Act (R.S.O. 1990). The term used for these signals in Regulation 606 is "portable lane control signals." A portable traffic control signal is not to be confused with temporary traffic signals (see Section 4.6), which must comply with Section 144 (31) of the Highway Traffic Act.

Portable traffic control signals consist of single "standard" vehicle traffic signal heads, normally mounted on moveable poles at a minimum height of 2.75 m from the roadway surface to the bottom of the backboard around the traffic signal head, as shown in Figure 5. They must be placed to the right of and facing traffic, and must be used only under conditions where the signal lights are clearly visible to an approaching motorist such that the vehicle can be brought to a safe stop having regard for the approach speeds. Intensity of the signal lamps must be maintained in such manner that the lights are clearly visible for a distance of at least 100 m (minimum requirement in the Highway Traffic Act). Recommended signal visibility distances vary with posted speed as shown in Table 8.

For portable traffic control signals, the phasing intervals must be for a two-phase operation only, with the all-red clearance interval sufficiently long to clear the previous approach lane of all vehicular traffic while travelling at the desired operating speed. Communications between the signal heads on opposite ends of the lane closure must be provided in order to prevent conflicting delays. Should conflicting displays occur, the system must ensure that both directions receive a solid red signal indication.

The closure area controlled by portable traffic control signals should not include intersections or driveways, because of the risk of entering traffic travelling the wrong way in the open lane. If the closure continues at night, consideration should be given to providing illumination.

The signal system must be preceded by the following three signs erected to distance specifications as laid out in the appropriate Table (A or B) in Section 8, and in the following order: Rb-31 DO NOT PASS Sign, TC-23 SIGNALS AHEAD Sign and Rb-78 STOP HERE ON RED SIGNAL Sign. See Figure TL-21.

Portable traffic control signals must not be used as a signal control system at entrances, truck access routes, pedestrian crossings, or other fixed locations. If this condition exists, then Temporary Traffic Control Signals are required. The design specifications for temporary signals, which require prior approval by MTO or the appropriate road authority, are those specifications which apply to permanent traffic control signals at signalized intersections (for details,

Table 8 – Signal Visibility Table

Posted Speed (km/h)	Minimum distance from which signal must be clearly visible
60	110
70	140
80	170
90	200

see OTM Book 12 (Traffic Signals)). Portable and temporary traffic control signal systems must not be located in any place or manner so as to conflict with any existing signals or traffic control systems.

Remember! When operating a portable traffic control signal system or a temporary traffic control system, you are using a legal traffic control device and any improper use could result in forcing a motorist into a position where he/she could be liable to charges under The Highway Traffic Act.

Figure 5 – Portable Traffic Control Signal

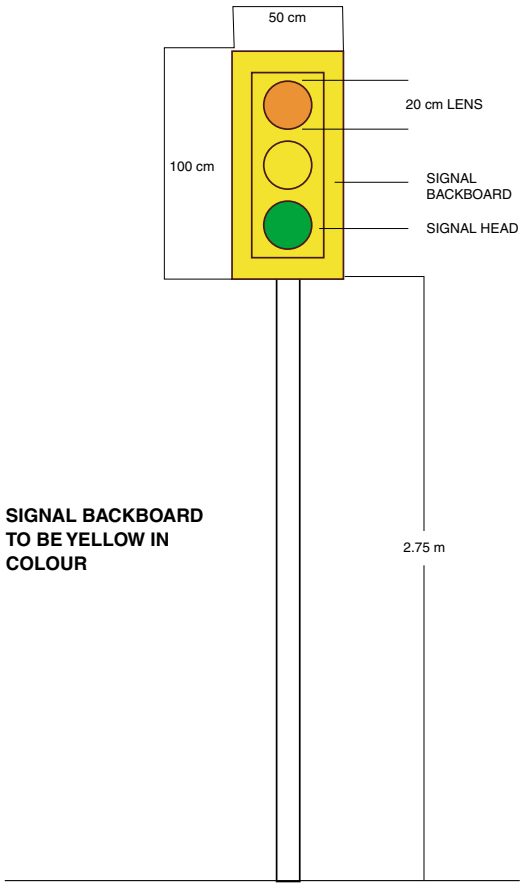


Table 9 shows the service volumes at signalized single lane construction sites for a range of lengths of the single lane. Table 9 can be used to determine the cycle lengths and all-red times required for a portable traffic control signal or a temporary traffic signal when used to alternate the right-of-way through a one-lane section of roadway.

Note: Table 9 gives a green and all-red time requirement for a specific speed through the construction zone of 40 km/h. When a portable traffic control signal or temporary signal is set up and turned on, a field review is required. The timing should be reviewed and modified, if necessary, as the speed of traffic through the construction zone may vary from that used to calculate the timing.

Example

Given: Heaviest approach volume (one way) = 520 veh/hr
Length of single lane section = 150 m

Find: Length of green interval (one direction)
Length of all-red interval

Solution: By applying the given figures to Table 9 we find
(a) Cycle length = 90 s
(b) All-red interval = 14 s

The amber clearance from OTM Book 12 (Traffic Signals) using a 1.8 second perception-reaction time is 3.6 seconds at 40 km/h. Round this value up to 4 seconds if the portable traffic control signal is unable to provide 10ths of a second for the amber interval.

Table 9 – Service Volume at Signalized Single Lane Construction Sites (Vehicles per Hour – One Way)

Length of Single Lane (m)		15	30	45	60	75	90	105	120	135	150	165	180	195	210	225	240	255	270	285	300	315	330	345	360
"All Red" Interval One Way (sec)		2	3	4	6	7	8	10	11	12	14	15	16	18	19	20	22	23	25	26	27	29	30	31	33
Cycle Lengths (seconds)	**150**	810	805	780	755	745	730	710	700	685	660	650	640	615	600	590	565	550	530	520	505	480	470	460	435
	140	800	785	770	745	735	720	695	685	670	645	630	620	595	580	565	540	530	505	490	475	450	440	425	405
	130	795	775	760	735	720	705	680	665	650	625	610	595	570	555	540	515	500	470	460	445	425	410		
	120	785	765	750	720	705	690	660	645	630	600	585	570	540	525	510	490	475	450	430					
	110	775	755	735	705	690	670	640	625	610	575	560	550	515	500	485	450								
	100	760	740	720	685	665	650	615	605	580	550	530	515	480	460										
	90	745	720	700	680	650	640	600	570	570	520	490	480												
	85	740	720	700	660	635	615	575	550	530	490	465													
	80	730	700	695	640	630	600	555	540	510	475														
	75	725	695	675	625	600	575	530	505	495															
	70	715	695	670	615	590	565	515	490																
	65	705	665	640	580	570	530	485																	
	60	695	660	630	570	540																			
	55	675	620	620	555																				
	50	660	615	580																					
	45	640	600																						
	40	625																							

Notes

1. Operating speed through the work area of 40 km/h.
2. Minimum green approximately 15 seconds.
3. Minimum amber of 4 seconds.
4. Based on 50% probability.

Since the green time for each approach is equal to the cycle length, minus two all-red intervals (28 s), minus two amber intervals (8 s if minimum) divided by two, then

Green Time (for each approach) =

$$\frac{90 - (2 \times 14) - (2 \times 4)}{2} = 27 \text{ s}$$

Not all single lane construction zones will have a speed of 40 km/h. The following describes how the timing of portable traffic signals at signalized single lane construction zones may be calculated for speeds other than 40 km/h.

Given: Heaviest approach volume (one-way) – SV
Length of single lane – L

(1) Calculate the all-red interval, AR seconds

$$\text{AR (s)} = \frac{\text{Length of Single Lane (m)}}{\text{Operating speed (m/s)}} = \frac{3.6 \times \text{Length of Single Lane (m)}}{\text{Operating speed (km/h)}}$$

(2) Choose a Desired Cycle Length, C seconds (ranging from 40 to 150 seconds)

(3) Calculate the Average Vehicle Arrival Rate, VAR

$$\text{VAR} = \frac{\text{SV} \times \text{C}}{3{,}600}$$

Where:
VAR = Average Vehicle Arrival Rate obtained from Table 10, showing Vehicle Arrival Rates for rural and urban conditions, for Level of Service "E".

(4) Calculate Green + Amber time for each approach, (G + A) seconds, from Table 10 for rural or urban conditions.

(G + A) (both approaches) = C – AR – AR

$$\text{(G + A) (one approach)} = \frac{\text{C} - \text{AR} - \text{AR}}{2}$$

(5) Green Time (G) = (G + A) – A (seconds)

Example

Heaviest approach volume = 365 veh/h
Length of single lane section = 150 m
Operating speed = 25 km/h
Amber = 3 s

(1) $\text{AR} = \frac{3.6 \times 150}{25} = 21.6 \text{ s}$

(2) Choose Cycle length of 90 seconds

(3) $\text{VAR} = \frac{365 \times 90}{3{,}600} =$ 9.1 passenger cars per cycle per lane

(4) (G + A) from Table 10 for rural conditons = 23 seconds

(5) Green time (G) = 23 – 3 = 20 seconds

4.6 Temporary Traffic Control Signals

Where signal control is required for an extended period, consideration should be given to the use of Temporary Traffic Control Signals which have a constant power supply and more closely resemble a normal signal installation. These installations require MTO or appropriate road authority approval of a schematic layout drawing prepared on the standard signal base drawing or base plan, as identified in OTM Book 12 (Traffic Signals). The design standards/specifications for temporary traffic signals are those that apply to permanent traffic signals as identified in OTM Book 12. Operational and timing requirements for temporary traffic signals are the same as for permanent signals, including the use of Tables 9 and 10.

Table 10 – Vehicle Arrival Rates and Green plus Amber Times (Level of Service "E")

Vehicle Arrival Rate VAR (vehicles/cycle)	Green + Amber (sec) Rural Intersections	Green + Amber (sec) Urban/ Commuter Intersections
1	3.8	2.6
2	7.0	4.9
3	9.7	7.0
4	12.0	8.9
5	14.2	10.8
6	16.4	12.7
7	18.6	14.6
8	20.8	16.5
9	23.0	18.4
10	25.1	20.2
11	27.2	22.0
12	29.3	23.8
13	31.4	25.6
14	33.5	27.4
15	35.6	29.2
16	37.7	31.0
17	39.8	32.8
18	41.9	34.6
19	44.0	36.4
20	46.0	38.2
21	48.0	40.0
22	50.0	41.8
23	52.0	43.7
24	54.0	45.6
25	56.0	47.5
26	58.0	49.4
27	60.0	51.3
28	62.0	53.2
29	64.0	55.1
30	66.0	57.0
31	68.0	58.9
32	70.0	60.8
33	72.0	62.7
34	74.0	64.6
35	76.0	66.5

Each truck or bus is equivalent to 2 passenger cars.

4.7 Supplementary Flashing Lights

Construction and maintenance activities often create conditions that are particularly hazardous at night when the ability of drivers to see clearly is reduced. There are both daytime and nighttime situations where it is desirable, or by engineering judgement necessary, to increase the target value and impact of warning signs by installing amber flashing devices over these signs to attract the driver's attention to the sign message, or to identify a particular hazard or obstruction.

Truck- or trailer-mounted lighting units (arrow boards) display flashing messages, or flashing sequencing arrow panels, and are used not only to increase conspicuity but also to guide traffic along the desired path. They are most frequently used on high density urban freeways, or other multi-lane major roadways where day or night closures, slow-moving maintenance or construction activities, and high-risk operations require more elaborate means to warn and guide traffic through the work area, while also providing some physical protection to the work crew.

Flashing devices, with the exception of the TC-12, must not be used for channelization purposes alone as they may obscure the intended vehicle path.

All flashing lights must operate on a lower setting of light intensity during hours of darkness.

Flashing lights must not be used in conjunction with Portable Variable Message Signs.

4.8 Application of New Technologies

Technology and best practice are not static. New technologies and techniques continue to be developed for application in work zones. Technology development is welcome, and it is important that new technologies and techniques are tested in real-life situations. It is also important, however, that new

technologies and techniques be accepted into standard practice and guidelines through an orderly, controlled process. Initially, some new technologies may be accepted as supplements to existing prescribed traffic control devices, but not as replacements for them. As experience and satisfaction are gained with the new technologies, some of them may be accepted as part of the family of prescribed traffic control devices, while others may continue to be accepted, but as supplemental devices only. For competitiveness or cost-effectiveness reasons, supplemental devices are unlikely to be bid or used if they are optional. Their mandatory use will be at the discretion of the road authority.

The new technologies and techniques described in this edition of Book 7 are:

- Traffic control with moving vehicles (pilot vehicles, pace vehicles, rolling closures) (See Section 2.5);
- Portable Variable Message Signs (See Section 3.3);
- Use of Remote Control Devices (e.g., Flaggers) (See Section 4.4);
- Use of Longitudinal Buffer Areas (LBAs) and Buffer Vehicles (BVs) (See Section 5);
- Highway Advisory Radio (HAR);
- Radar-speed display signs;
- Multi-function Dynamic Message Signs;
- Road Information Telephone Lines.

The last four of the technologies listed are described briefly in this section.

Highway Advisory Radio (HAR)

Highway Advisory Radio (HAR) may be used to provide travel advisory information to motorists as they are travelling in their vehicles. Information provided may relate to tourism and tourist attractions, major events, road construction or maintenance activities and road closures, road collisions, airline information, and border crossing information.

Where HAR is used to provide construction/ maintenance related information, it is typically necessary to cover only a relatively limited geographical area.

HAR systems can use a licensed AM frequency (530 to 1700 kHz) or licensed FM frequency (88 to 108 MHz) for extended range broadcast. The higher bandwidth of FM frequencies offers an improved signal, with a shorter range, when compared to AM frequencies. Where competition for radio frequencies is intense, HAR frequencies tend to be allocated at the less-attractive extremes of the frequency bands.

HAR information can be provided by means of:

- a low power radio transmitter with limited range (e.g., 10 to 20 km) which provides area coverage, or
- a very low power transmitter cable laid along the highway in question and along several approaching or intersecting roads. This often tends to be more expensive than the first option, depending on the length of the system, but is sometimes easier to license because of its limited range and hence unlikely interference with other radio stations.

As with any real-time travel advisory system, the information must be up-to-date and accurate, otherwise credibility will be lost.

Radar – Speed Display Signs

Some devices are available on the market which, in a combined unit, permit the measurement of vehicle speed by means of radar, along with a sign display of the actual speed travelled. Optionally, the sign may also display the legal posted speed at the time of measurement. Such signs, while not used for speed enforcement, have been demonstrated in some applications to reduce 85th percentile speeds an additional 4 km/h to 8 km/h over the reduction caused by static signs. When seeing their speeds displayed, some drivers may be genuinely surprised that they are travelling that fast, and may reduce their speeds. Other drivers may be uncertain whether a sign showing their speed means that enforcement is nearby, and may reduce speed to avoid a potential fine.

The effect of a single speed display sign is likely to diminish as motorists travel downstream from the sign. This may be overcome to some degree with the use of more speed display signs. Regular drivers along the section of road in question may also become accustomed to the signs, with diminished effect, if they see that no enforcement is in place. For this reason, it is desirable to supplement such signs with enforcement from time to time, to achieve the necessary degree of uncertainty for drivers, as to whether they may be charged.

Multi-function Dynamic Message Signs

Various signs have been developed in recent years which can fulfill a variety of functions, but which may not meet all specified requirements for existing approved traffic control devices. With time, it will be necessary to reconcile these differences.

These message signs are portable (trailer-mounted) and usually provide message capability that achieves or approaches that of other single-function devices, such as:

- flashing arrow board meeting some but not all TC-12 requirements;
- pre-programmed messages (100 or more) that can be displayed in flashing, alternating, phased, or scroll modes, and some limited capability for one-off custom messages;
- capability for radar speed measurement and speed display.

While some of these signs may currently be too expensive for only one of these functions (e.g., flashing arrow board), they have considerable potential, and with time and further development, they are likely to become approved devices. In the interim, they should be used only for those applications where they fully meet the requirements.

Road Information Telephone Lines

Some road authorities have found road information telephone lines to be an effective and useful means of communicating information to drivers on construction activities. The travelling public may be advised of this service in a variety of ways, including brochures, newspaper and radio advertisements, and highway signs, either static or VMS or both. Highway signs usually display a telephone number where the information can be accessed. Other media, especially brochures, can provide a menu of extension numbers to be dialled for information on specific projects, routes, or areas of the city.

5. Buffer Vehicles

5.1 Introduction

The purpose of a Buffer Vehicle (BV) is to provide a protective shield for workers against an out of control vehicle approaching a work area. The purpose of this section is to provide an overview of how BVs are used most effectively. This section is to be read in conjunction with typical layout diagrams for traffic control (see Section 8).

For stationary operations on freeways, BVs are used in combination with a Longitudinal Buffer Area (LBA). An LBA is an empty space upstream of the BV that out of control vehicles can use to brake to a full stop.

5.2 Buffer Vehicle Requirements

The Construction Regulations prescribed under the Occupational Health and Safety Act (OHSA) (O. Regulation 213/91) and amended by O. Regulation 145/00, requires the use of BVs, often with a LBA, to enhance worker safety on many work operations on freeways.

The Construction Regulations define a BV, *without* a truck mounted attenuator (TMA), as a Blocker Truck (BT). A BV *with* a TMA is defined as a Crash Truck (CT). As defined, a BV also requires a mounted flashing arrow board and four-way flashers.

TMAs must meet the requirements of NCHRP 350 Level TL-2 (70 km/h) or higher. TMAs should be selected for the appropriate posted speed. After January 1, 2006, TMAs used on freeways must meet the requirements of NCHRP 350 Level 3 (100 km/h).

The Construction Regulations also require that BVs used on freeways with an Annual Average Daily Traffic (AADT) of 25,000 vehicles per day or more, or where the AADT is not known, must be CTs. AADT values should be obtained from the applicable road authority. Until January 1, 2003, BVs used on freeways with an AADT less than 25,000 may be BTs or CTs. After January 1, 2003, all BVs used on freeways must be CTs. A CT is preferred over a BT. The TMA on the CT reduces the risk of injury to the occupants of the incoming vehicle and the CT driver.

Temporary barriers are required on freeway projects expected to require more than five days to complete. For projects requiring five days or less to complete, or where barriers are not practical, BVs and an LBA are required for stationary operations, and one or more BVs are required for mobile operations, to protect workers. BVs are not required on freeways where a lateral offset of 3 m or more exists between the work area and traffic. BVs are not required for very short duration work on freeway shoulders, but a vehicle with 360 beacon and four-way flashers is required. BVs are not specifically required on non-freeways under the regulations. However, an LBA is required for stationary operations on multi-lane roads for normal regulatory posted speeds of 70 km/h or higher.

Buffer Vehicles used on ministry contracts must have a minimum mass of 6,800 kg (15,000 pounds) and a maximum mass of 12,000 kg (26,400 pounds), including any ballast, flashing arrow board and TMA. This range is consistent with other jurisdictions and BVs used in service.

If a loose material such as sand is used for ballast it must be kept below the level of the sides of the BV box. If solid objects such as concrete blocks are used they must be attached to the truck body in such a manner as to withstand a major impact without breaking free of its attachments.

For both stationary work areas and mobile work operations, no passengers are allowed in the BV when it is used in traffic control situations, except for special reasons.

Buffer vehicle brakes must be mechanically fit and properly adjusted. A BV with tandem rear axles must have both axles braked when parked in a stationary operation. Air brakes are preferable to hydraulic brakes on a BV. Users should ensure that at least two-thirds of the BV mass is over the rear axles(s).

Buffer Vehicles used on ministry contracts must have:

- A mounted 1.2 m x 2.1 m flashing arrow board (TC-12) with in-cab remote controls;
- A high back seat and head rest for the operator;
- A competent, trained operator; and
- An audio alert which automatically activates when backing up.

Where Buffer Vehicles are used to protect stationary work operations, the driver of the BV must ensure that the BV is positioned in accordance with the Typical Layout figures in this Book. The driver ensures that the flashing arrow board is operating, locks the brakes and angles the wheels slightly away from the work area and live traffic. The driver/operator then leaves the BV for the duration of the work operation.

5.3 Implementation Considerations

For purposes of BV placement, two general types of out of control vehicular behaviour need to be considered: longitudinal and lateral intrusions into the work area.

Longitudinal Intrusions

The first type of out of control vehicle behaviour occurs when a vehicle intrudes into a closed lane upstream of the work area and approaches the work area from a *longitudinal* direction.

To mitigate the risk of longitudinal intrusions into *stationary* work areas on freeways, a lane closure taper and an LBA are used in sequence upstream of the BV, as illustrated in the middle (freeway) diagram in Figure 6. A BV should not be placed at the end of the taper because of the long BV roll-ahead distance that may result. LBA and lane closure taper distances used for various freeway speeds are given in Table C, Freeway Conditions; LBA distances are also shown in Table D, Stationary Work Operations.

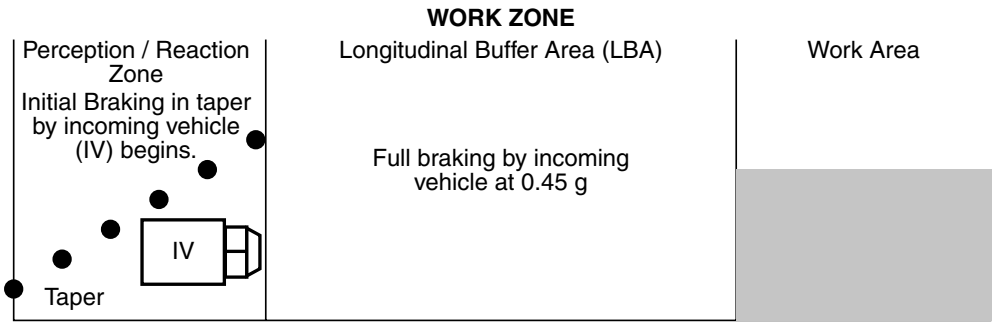
The driver of an out of control vehicle entering the lane closure taper longitudinally upstream of the work area will likely begin braking in the taper, after running over the barrels or cones at the start of the taper, and come to a stop within the taper itself. If the driver does not begin braking until the end of the taper, the LBA should provide sufficient additional braking distance for vehicles to come to a halt before the end of the LBA. If the driver has still not come to a complete stop by the end of the LBA, the BV provides a third line of defence for workers.

Lateral Intrusions

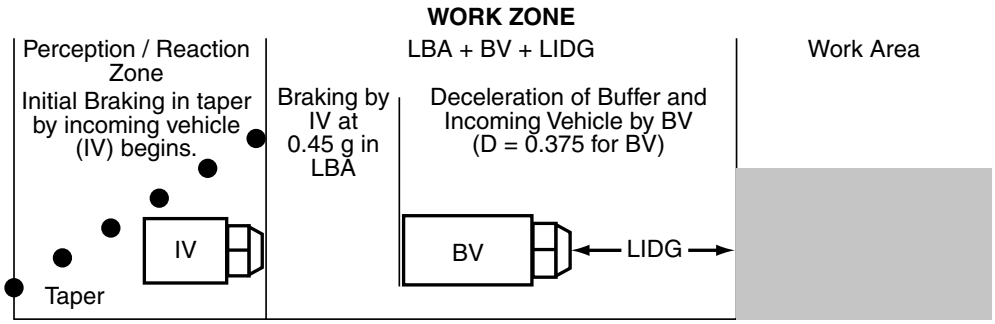
The second type of out of control vehicle behaviour occurs when a vehicle, in a live lane adjacent to the work area, intrudes *laterally* into the gap in the closed lane between the BV and the work area.

(1) **Stationary Work Areas**
To mitigate the risk of lateral intrusions from the side into the gap between the BV and a *stationary* work area, the BV is positioned about 2.5 seconds in travel time upstream of the workers. It takes the driver of the errant vehicle

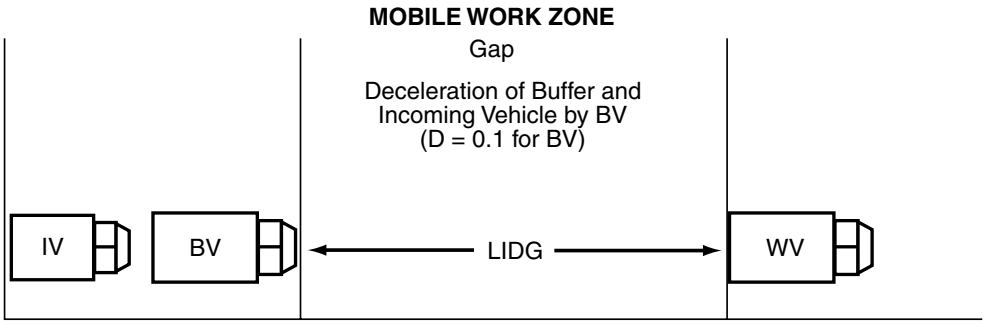
Figure 6 – Buffer Vehicles and LBA Scenarios



Stationary Operations - Non-freeways (LBA)



Stationary Operations - Freeways (LBA + BV + LIDG)



Mobile Operations - Buffer Vehicle Protection of Mobile Work Vehicle
(Illustration shows only one Buffer Vehicle)

about 2.5 seconds to perceive and react to the gap in front of a BV. An errant vehicle travelling at 100 km/h covers 70 m in 2.5 seconds. If a BV is positioned 70 m upstream of the work area, the driver of the errant vehicle will likely pass by the work area in front of the BV before a decision can be made to turn into the gap. The appropriate distance to use in front (downstream) of the BV for stationary work operations is called the Lateral Intrusion Deterrence Gap (LIDG). Its use on freeways in combination with the taper, the LBA, and the BV, is illustrated in the middle (freeway) diagram in Figure 6. LIDGs for various normal regulatory speeds are chosen from Table D, Stationary Work Operations.

(2) **Mobile Work Operations**

To mitigate the risk of lateral intrusions into *mobile* work operations, a BV is positioned upstream of the moving work vehicle.

The BV shadows the work vehicle as it moves along the highway. To mitigate the risk of *lateral* intrusions from the side into the gap between the BV and the moving work vehicle, the BV is positioned about 2.5 seconds in *relative* travel time upstream of the moving work vehicle.

It takes the driver of an errant vehicle about 2.5 seconds to perceive and react to the gap in front of the moving BV. An errant vehicle travelling at 100 km/h covers 70 m in 2.5 seconds. A BV shadowing a moving work operation typically travels at 20 km/h. In 2.5 seconds, the BV would cover 14 m at 20 km/h. If a BV is positioned about 55 m (i.e., 70 m minus 14 m) upstream of the work area, the driver of the errant vehicle will likely pass by the moving work vehicle in front of the BV before a decision can be made to turn into the gap.

The appropriate distance to use in front of the BVs shadowing moving work vehicles is called the Lateral Intrusion Deterrence Gap (LIDG). LIDGs for various normal regulatory speeds are chosen from Table D, Mobile Work Operations.

A stationary LBA cannot be used for mobile work operations, which increases the risk of an out of control vehicle striking the back of the BV in a longitudinal direction. Depending on the mass, speed, angle and braking of the two vehicles, roadway geometrics, weather conditions and the reaction of the drivers, the BV may be pushed ahead a distance that exceeds the LIDG and strike the back of the moving work vehicle.

To mitigate against this risk, contractors and staff working for the Ministry of Transportation on zone striping operations on high speed, multi-lane provincial highways must use one BV shadowing the zone striper at the LIDG distance (i.e., BV#3) (Figure TL-68). Two additional BVs are added upstream of BV#3 (i.e., BV#1 and BV#2). BV#2 shadows BV#3 at a distance of 100 m to 300 m. BV#1 shadows BV#2 at a distance of 300 m to 600 m. The additional BVs are spaced out depending on roadway geometrics and the time it takes for the paint to dry. In addition, where shoulder conditions and geometrics will permit, a pre-warning sign truck with an overhead beacon shadows BV#1 at a distance of 500 m to 800 m on the right shoulder with a sign indicating "Road Painting – Left (or Right) Lane – 2 km". A pre-warning sign truck is not required on high traffic volume, urban freeways with physical space limitations (e.g., within city limits of Toronto or Ottawa).

It is recognized that zone striping operations on municipal roads do not require the same degree of protection required on multi-lane high speed, provincial freeways.

(3) **Freeway Paving Operations**

The Construction Regulations under the Occupational Health and Safety Act include paving as a mobile operation and require the use of BVs for freeway paving operations. While paving operations do move progressively along the road, they do so very slowly, at only a few kilometres each day. In terms of traffic control required, paving operations are more similar to short duration or long duration stationary operations and are treated as such in the Typical Layouts in Book 7 which fully complies with the traffic control requirements for mobile operations as prescribed in Section 67 (12) of the Construction Regulations.

Table D – Application of Longitudinal Buffer Area and Buffer Vehicles

Stationary Work Operations **Required Protection (Freeways): LBA + Buffer Vehicle + LIDG** **Required Protection (Non-freeways): LBA only**		
(1) **Normal Regulatory Speed Limit (km/h)**	**(2)** **Longitudinal Buffer Area (LBA) (m)**	**(3)** **Lateral Intrusion Deterrence Gap (LIDG) (m)**
50	(30)	(35)
60	(40)	(40)
70	50	50
80	60	60
90	75	65
100	95	70

Mobile Work Operations	
(1) **Normal Regulatory Speed Limit (km/h)**	**(2)** **Lateral Intrusion Deterrence Gap (LIDG) (m)**
70	35
80	45
90	50
100	55

Notes:

1. See also General Notes to Typical Layouts in Section 8.

6. Schedule of Traffic Control Devices

6.1 Traffic Control Signs

Sign Schedule

In addition to a detailed description in this section of the purpose and proper use of each sign, Figures A1 to A5 in Section 8 are sign illustrations for frequently used traffic control devices for roadway work operations.

Full Scale patterns for the signs indicated herein are available from the publisher.

Sign Reflectivity Standards

Signs that convey regulatory, warning, or guidance (directional) information that is relevant during hours of darkness need to be legible and conspicuous at night as well as during the day. Since conspicuity depends to some degree on colour code recognition, the colour of the sign must appear the same by night as by day. Reflectorization is important for maintaining a satisfactory level of sign legibility and conspicuity at night.

Three levels of minimum reflectivity are described below for temporary conditions signs. Those signs and devices requiring the highest levels of reflectivity are the more crucial ones for driver recognition and motorist and worker safety. The reflectivity requirements are stated as minimums, suggesting that higher reflectivity sheeting may be used where the road authority considers it necessary. However, the relative importance of the signs in the three-level hierarchy should not be lost in doing so.

The lowest reflectivity level specified is Type I (engineering grade). The next higher reflectivity level is Type III (high-intensity). The highest reflectivity level is high reflectivity micro-prismatic fluorescent sheeting (diamond grade or equivalent). Reflectivity standards for Types I and III are defined in ASTM Spcification D 4956-95 or its subsequent revisions.

Minimum reflectivity requirements for various signs are shown in Table 3.

Table 3 – Minimum Reflectivity Requirements

Minimum Reflectivity	Signs/Devices	Effective Date
High intensity (Type III) (intermediate reflectivity level)	TC-3 TC-7 TC-12 TC-18 TC-22 ("Stop" side) Rb-91 Rb-92 TC-51A, B, C TC-52 TC-53 TC-54	January 1, 1995 except January 1, 2001 for TC-22 and January 1, 2002 for TC-12, TC-51A, B and C (collars) [4]
High reflectivity micro-prismatic fluorescent (e.g., diamond grade or equivalent) (highest reflectivity level)	TC-1 TC-1A TC-1B TC-2A TC-2B TC-4 TC-9 TC-16E TC-21 TC-22 ("Slow" side) double-sided Slow Paddle	January 1, 2003 except January 1, 2001 for TC-22, and recommended for all signs after January 1, 2001
Engineering Grade (Type I)	All other Temporary Conditions signs	

Notes:

1 Except for the TC-12, signs may be upgraded to higher reflectivity sheeting, where it is considered desirable to do so.

2. Sign size for TC-2A, TC-2B and TC-21 also increases to 90 cm x 90 cm on January 1, 2003.

3. The shape of the TC-22 is octagonal.

4. All cones require white reflective collars for nighttime operations, and for daytime or nighttime after January 1, 2002.

CONSTRUCTION AHEAD Sign

TC-1	90 cm x 90 cm
TC-101	120 cm x 120 cm
Font	Highway Gothic C
Colour	Legend & Border – Black Background – Orange Reflective
Minimum Sheeting	High reflectivity micro-prismatic fluorescent after January 1, 2003. Type I, engineering grade before January 1, 2003

CONSTRUCTION AHEAD 1 KM Sign

TC-1A	90 cm x 90 cm
TC-101A	120 cm x 120 cm
Font	Highway Gothic C
Colour	Legend & Border – Black Background – Orange Reflective
Minimum Sheeting	High reflectivity micro-prismatic fluorescent after January 1, 2003. Type I, engineering grade before January 1, 2003

CONSTRUCTION AHEAD 2 KM Sign

TC-1B	**90 cm x 90 cm**
TC-101B	**120 cm x 120 cm**
Font	**Highway Gothic C**
Colour	**Legend & Border – Black** **Background – Orange Reflective**
Minimum Sheeting	**High reflectivity micro-prismatic fluorescent after January 1, 2003.** **Type I, engineering grade before January 1, 2003**

The TC-1 sign must be used to provide advance warning of a major long duration construction zone. The over-sized TC-101 sign must be used on roadways having more than two lanes, and posted speeds of 70 km/h or higher, except that in urban areas, the standard size sign may be used if space does not permit the over-sized sign in these conditions.

On a divided highway, two TC-101 signs must be installed, one on each side of the approaching lanes, with the exception that the TC-1 sign may be used in place of the oversized TC-101 sign on a narrow median.

The TC-1 sign must be installed in advance of the construction zone at a distance which is to be determined by reference to the appropriate Table (A, B, or C). In urban areas (60km/h or lower) one sign is sufficient. In rural areas a TC-1A (TC-101A) sign must be added at a distance of 1 km in advance of the construction zone. For freeways a TC-101A and a TC-101B sign must be installed at distances of 1 km and 2 km from the work area respectively.

On minor intersecting roads the TC-1 sign must be installed in advance of the construction site on the major roadway at a distance that is to be established by referring to the appropriate Table (A, B, or C). On major intersecting roads the TC-101 sign must be preceded by a TC-101A sign 1 km in advance of the construction area on the crossing road.

ROAD WORK Sign (Short duration)

TC-2A	**60 cm x 60 cm**
TC-102A	**90 cm x 90 cm** **(after January 1, 2003, the oversize sign must be used)**
Font	**N/A**
Colour	**Legend & Border – Black** **Background – Orange Reflective**
Minimum Sheeting	**High reflectivity micro-prismatic fluorescent after January 1, 2003.** **Type I, engineering grade before January 1, 2003**

ROAD WORK Sign (Short and long duration)

TC-2B	**75 cm x 75 cm**
TC-102B	**90 cm x 90 cm (after January 1, 2003, the oversize sign must be used)**
Font	**N/A**
Colour	**Legend & Border – Black Background – Orange Reflective**
Minimum Sheeting	**High reflectivity micro-prismatic fluorescent after January 1, 2003. Type I, engineering grade before January 1, 2003**

The TC-2B or TC-2A sign must be used as indicated in the typical layouts at all times when maintenance repairs or minor construction work is carried out. The sign must be installed on a portable stand and must be displayed only during the times when repair or minor construction work is in progress. It must be placed face down or removed when activities are temporarily suspended such as at lunch time or at the close of the day. The TC-2A must be mounted on a portable stand with flagpoles and opaque fluorescent orange flags, 45 cm x 45 cm in size, mounted at a height of 1.5 m to 2.5 m above the ground.

The TC-2B sign must be installed when the maintenance or minor construction activity extends over longer periods of time, and is of a more stationary nature. It should also be used at locations within long construction sites whenever and wherever workers are present. It must be covered or removed when activities are temporarily suspended such as at lunch time or at the close of the day.

The signs must be located on the shoulder or at the curb in full view of approaching traffic. The signs must be installed at a distance from the work site to be established by referring to Table A, Table B, or Table C. When the TC-21 TRAFFIC CONTROL PERSON AHEAD sign is used, the ROAD WORK signs must be located at the same distance as defined above, in advance of the TC-21 sign.

RIGHT LANE CLOSED AHEAD Sign

TC-3R	**75 cm x 75 cm**
TC-103R	**90 cm x 90 cm**
Font	**N/A**
Colour	**Legend & Border – Black Background – Orange Reflective**
Minimum Sheeting	**Type III, high intensity**

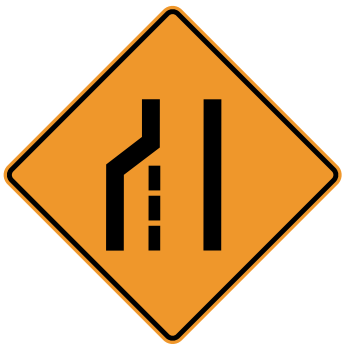
RIGHT LANE CLOSED Tab Sign

TC-3Rt	60 cm x 60 cm
Font	Highway Gothic C
Colour	Legend & Border – Black Background – Orange Reflective
Minimum Sheeting	Type III, high intensity

LEFT LANE CLOSED Tab Sign

TC-3Lt	60 cm x 60 cm
Font	Highway Gothic C
Colour	Legend & Border – Black Background – Orange Reflective
Minimum Sheeting	Type III, high intensity

LEFT LANE CLOSED AHEAD Sign



TC-3L	75 cm x 75 cm
TC-103L	90 cm x 90 cm
Font	N/A
Colour	Legend & Border – Black Background – Orange Reflective
Minimum Sheeting	Type III, high intensity

300 M Tab Sign

TC-3tA	30 cm x 60 cm
TC-103tA	45 cm x 90 cm
Font	Highway Gothic C
Colour	Legend & Border – Black Background – Orange Reflective
Minimum Sheeting	Type I, engineering grade

The TC-3 sign must be used to provide advance warning of a lane closed for road work, except where, as shown in the typical layouts, it may be replaced by a TC-12 flashing arrow board. The oversized TC-103 sign must be used on roadways with more than two lanes, although the smaller TC-3 signs may be used where they are required only for short duration work operations in urban work operations where posted speeds are 60 km/h or less.

On a divided highway, two TC-103 signs must be installed, one on each side of the approaching lanes, with the exception that the TC-3 sign may be used in place of the oversized TC-103 sign on a narrow median.

The signs must be installed at a distance in advance of the TC-4 LANE CLOSURE Sign which is to be established by reference to the appropriate Table (A, B, or C).

The tab signs TC-3Rt RIGHT LANE CLOSED and TC-3Lt LEFT LANE CLOSED should be used for "Right" and "Left" lane closures respectively, with the appropriate reversal of the sign symbol layout. Where lane closures involve more than one lane, signs must be used twice in accordance with the staging of two lane closures.

The educational tab sign (TC-3Lt) or (TC-3Rt) should be used until such time that the meaning of the symbol has become sufficiently familiar to the driving public.

The supplementary tab sign (TC-3tA) may be used where, due to vertical curvature or other reasons, the start of the lane reduction is not visible in advance for a sufficient distance.

The TC-3tA tab sign may be used with other signs and other distances where appropriate.

LANE CLOSURE ARROW Sign

TC-4L	**90 cm x 90 cm (truck-mounted TC-4 may be 75 cm x 75 cm)**
TC-104L	**120 x 120 cm**
Font	**N/A**
Colour	**Legend & Border – Black Background – Orange Reflective**
Minimum Sheeting	**High reflectivity micro-prismatic fluorescent after January 1, 2003. Type III, high intensity before January 1, 2003**

The TC-4 sign must be installed at or just beyond the beginning of the lane closure taper, except where, as shown in the typical layouts, it may be replaced by a TC-12 flashing arrow board. For short duration work operations, and where speeds are 60 km/h or lower, a truck-mounted 75 cm x 75 cm TC-4 sign may be used in place of the standard 90 cm x 90 cm ground-mounted sign.

The TC-104 oversized sign must be installed at or just past the beginning of the lane closure taper on freeways and must be used together with the TC-103 LANE CLOSED AHEAD sign.

DETOUR AHEAD Sign

TC-5	90 cm x 90 cm
TC-105	120 cm x 120 cm
TC-1105	180 cm x 180 cm
Font	Highway Gothic D
Colour	Legend & Border – Black Background – Orange Reflective
Minimum Sheeting	Type I, engineering grade

DETOUR AHEAD 1 KM Sign

TC-5A	90 cm x 90 cm
TC-105A	120 cm x 120 cm
TC-1105A	180 cm x 180 cm
Font	Highway Gothic D
Colour	Legend & Border – Black Background – Orange Reflective
Minimum Sheeting	Type I, engineering grade

DETOUR AHEAD 2 KM Sign

15

TC-5B	**90 cm x 90 cm**
TC-105B	**120 cm x 120 cm**
TC-1105B	**180 cm x 180 cm**
Font	**Highway Gothic D**
Colour	**Legend & Border – Black** **Background – Orange Reflective**
Minimum Sheeting	**Type I, engineering grade**

A TC-5, TC-105 or TC-1105 sign must be installed in advance of the detour information signs (TC-64 to TC-67 and TC-10) at a distance that is to be determined by referring to the appropriate Table (A, B or C).

The TC-5A sign is positioned 1 km in advance of the detour, and the TC-5B is positioned 2 km in advance of the detour.

The TC-5A and TC-5B signs must be used (where space permits) where one direction of a divided highway detours across the median and travels in one lane of the opposing direction. The signs must also be installed 2 km in advance of the TC-7 DETOUR-TURN OFF/DIVERSION Sign, where the TC-7 is used to indicate a detour.

The TC-105 sign must be installed in advance of the TC-7 DETOUR-TURN OFF/DIVERSION Sign (where used to indicate a detour) on roadways having more than two lanes. The TC-5 sign may be used in place of the TC-105 sign on a roadway having more than two lanes where the signs are required only for short duration operations in urban work zones where posted speeds are 60 km/h or lower.

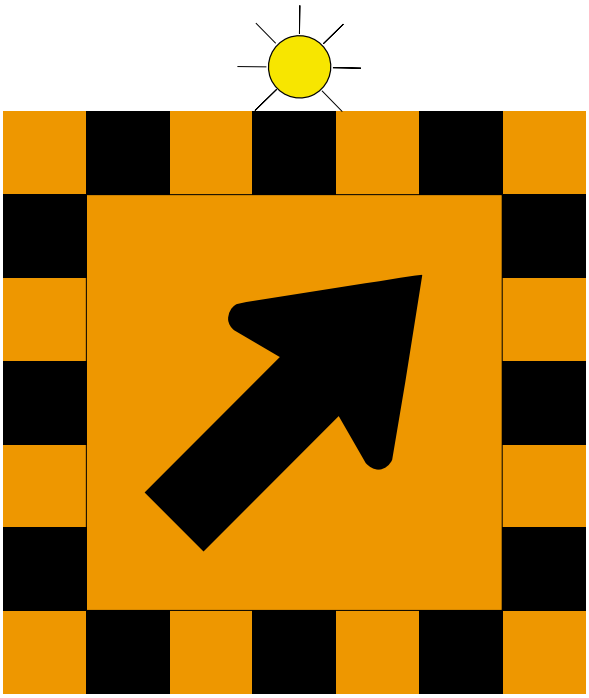
Two TC-105 signs must be installed, one on each side of the approaching lanes, if the highway is divided. A TC-5 sign may be used in place of the TC-105 sign on divided highways where the sign must be mounted on a narrow median.

Two TC-105A signs and two TC-105B signs must be installed, one of each pair on each side of the approaching lanes. The smaller TC-5A or TC-5B sign may be used on a narrow median, or where the signs are required only for short duration work operations.

On freeways, the oversize TC-1105 (180 x 180 cm) sign must be used. A TC-105 sign may be used where the sign must be mounted on a narrow median.

On freeways, one pair of oversized TC-1105A and one pair of oversized TC-1105B signs must be installed. TC-105B signs may be used where the sign must be mounted on a narrow median.

DETOUR-TURN OFF/DIVERSION Sign



TC-7R	**210 cm x 210 cm**
TC-7R (urban)	**120 cm x 120 cm**
Font	**N/A**
Colour	**Legend & Border – Black**
	Background – Orange Reflective
Minimum Sheeting	**Type III, high intensity**

The TC-7 sign must be used to indicate a road closure or route detour, as illustrated on the typical sign layouts.

Because of its large size, the TC-7 sign must be mounted on stands at a height of 1.2 m from pavement level to the bottom edge of the sign (rather than the normal minimum of 1.5 m).

A light visible for a minimum distance of 150 m must be used in conjunction with this sign and must be exposed and kept in flashing operation continuously from sunset until sunrise, except where the flashing light would cause confusion where the sign is used near a signalized intersection.

ROAD CLOSED Tab Sign

15 ROAD CLOSED

TC-7tA	**25 cm x 210 cm**
Font	**Highway Gothic C**
Colour	**Legend & Border – Black**
	Background – Orange Reflective
Minimum Sheeting	**Type III, high intensity**

A TC-7tA tab sign should be used as a separate tab when a roadway is physically closed and an alternative route must be taken.

Note: See section 28(3) and 103(3) of the Public Transportation and Highway Improvement Act R.S.O. 1990, R.R.O. May 1986.

LOCAL TRAFFIC ONLY Tab Sign

15 LOCAL TRAFFIC ONLY

TC-7tB	**25 cm x 210 cm**
Font	**Highway Gothic C**
Colour	**Legend & Border – Black**
	Background – Orange Reflective
Minimum Sheeting	**Type III, high intensity**

A TC-7tB tab sign should be used as a separate tab when access to an area beyond the TC-7 DETOUR TURN OFF/DIVERSION Sign or TC-7tA ROAD CLOSED Tab is permitted.

ROADSIDE DIVERSION WARNING Sign (one arrow)

TC-9R	75 cm x 75 cm
TC-109R	90 cm x 90 cm
Font	N/A
Colour	Legend & Border – Black Background – Orange Reflective
Minimum Sheeting	High reflectivity micro-prismatic fluorescent after January 1, 2003 Type I, engineering grade before January 1, 2003

ROADSIDE DIVERSION WARNING Sign (two arrows)

TC-9L (2)	90 cm x 90 cm
TC-109L (2)	120 cm x 120 cm
Font	N/A
Colour	Legend & Border – Black Background – Orange Reflective
Minimum Sheeting	High reflectivity micro-prismatic fluorescent after January 1, 2003 Type I, engineering grade before January 1, 2003

ROADSIDE DIVERSION WARNING Sign (three arrows)

TC-9R (3)	120 cm x 120 cm
Font	N/A
Colour	Legend & Border – Black Background – Orange Reflective
Minimum Sheeting	High reflectivity micro-prismatic fluorescent after January 1, 2003 Type I, engineering grade before January 1, 2003

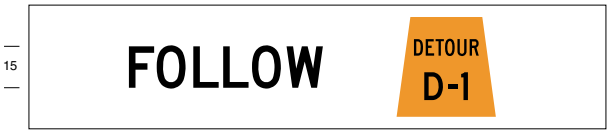
The TC-9 must be installed at locations where traffic is diverted around work areas, largely or entirely within the highway right-of-way. The sign indicates the vehicle path to be followed. Where the diversion has more than one lane, a sign with the appropriate number of arrows (one arrow per lane) may be used to indicate to drivers that the roadway lanes are continuous through the diversion. If a sign with more than one arrow is used, the number of arrows on the sign must match the number of lanes on the road.

The sign must be installed in advance of the road diversion at a distance determined by referring to the appropriate Table (A, B, or C).

If the highway is divided, two signs must be installed, one on each side of the approaching lanes.

On freeways, the larger sign sizes must be used.

DETOUR DESIGNATION Sign (including DETOUR Marker)

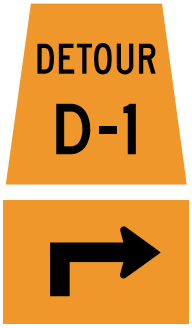


TC-10 Sign	60 cm x 120 cm (Urban, min.) (Non-freeway) 120 cm x 210 cm (Freeway)
Font	Highway Gothic D
Colour	Legend & Border – Black Background – Orange Reflective
Minimum Sheeting	Type I, engineering grade

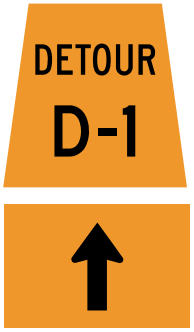
DETOUR Marker

TC-10 TC-110	45 cm x 45 cm trapezoid 60 cm x 60 cm trapezoid
Font	Highway Gothic D
Colour	Legend & Border – Black Background – Orange Reflective
Minimum Sheeting	Type I, engineering grade

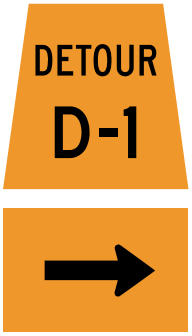
DETOUR Markers



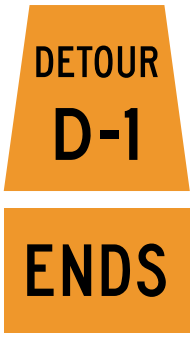
TC-10AR	45 cm x 45 cm trapezoid 30 cm x 45 cm arrow
TC-110AR	60 cm x 60 cm trapezoid 45 cm x 60 cm arrow
Font	N/A
Colour	Legend & Border – Black Background – Orange Reflective
Minimum Sheeting	Type I, engineering grade



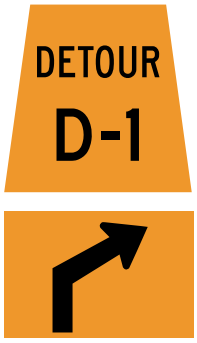
TC-10C	45 cm x 45 cm trapezoid 30 cm x 45 cm arrow
TC-110C	60 cm x 60 cm trapezoid 45 cm x 60 cm arrow
Font	N/A
Colour	Legend & Border – Black Background – Orange Reflective
Minimum Sheeting	Type I, engineering grade



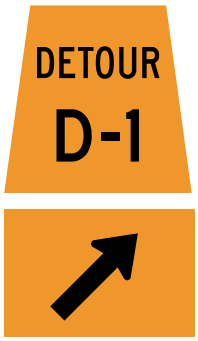
TC-10BR	45 cm x 45 cm trapezoid 30 cm x 45 cm arrow
TC-110BR	60 cm x 60 cm trapezoid 45 cm x 60 cm arrow
Font	N/A
Colour	Legend & Border – Black Background – Orange Reflective
Minimum Sheeting	Type I, engineering grade



TC-10D	45 cm x 45 cm trapezoid 30 cm x 45 cm "ENDS" tab
TC-110D	60 cm x 60 cm trapezoid 45 cm x 60 cm "ENDS" tab
Font	Highway Gothic D
Colour	Legend & Border – Black Background – Orange Reflective
Minimum Sheeting	Type I, engineering grade



TC-10ER	45 cm x 45 cm trapezoid 30 cm x 45 cm arrow
TC-110ER	60 cm x 60 cm trapezoid 45 cm x 60 cm arrow
Font	N/A
Colour	Legend & Border – Black Background – Orange Reflective
Minimum Sheeting	Type I, engineering grade



TC-10FR	45 cm x 45 cm trapezoid 30 cm x 45 cm arrow
TC-110FR	60 cm x 60 cm trapezoid 45 cm x 60 cm arrow
Font	N/A
Colour	Legend & Border – Black Background – Orange Reflective
Minimum Sheeting	Type I, engineering grade

The TC-10 DETOUR DESIGNATION sign, TC-10 marker, and TC-10 A, B, C, D, E, and F markers must be used to indicate an alternate route for traffic to follow where construction activities require the total or partial closure of roads or streets, and signed detour routes are required to handle the traffic. The TC-10 DETOUR DESIGNATION sign must be used as a tab with a TC-66 or TC-67 in order to provide motorists with advance warning of the detour and to inform them of the signs they are required to follow. In urban areas, the TC-10 may be reduced to a minimum of 60 cm x 120 cm. The oversize DETOUR markers should be used on freeways.

The detour route will be given a "Detour Route Number" in order to clearly indicate to motorists the route they are required to follow. This will also minimize the confusion for other motorists who are not following the detour route.

NARROW LANES Sign

TC-11	90 x 90 cm
Font	Highway Gothic D
Colour	Legend & Border – Black Background – Orange Reflective
Minimum Sheeting	Type I, engineering grade

The TC-11 NARROW LANES sign should be used to warn drivers on multi-lane roads that they are approaching a long duration work area where, because of work operations, the lane widths have been reduced. In addition to the sign, old pavement markings should be removed or covered, and temporary solid edge lines and lane lines should be provided.

TRUCKS USE CENTRE LANE Tab Sign

TC-11t	**45 x 75 cm**
Font	**Highway Gothic D**
Colour	**Legend & Border – Black** **Background – Orange Reflective**
Minimum Sheeting	**Type I, engineering grade**

FOR XX KM Tab Sign

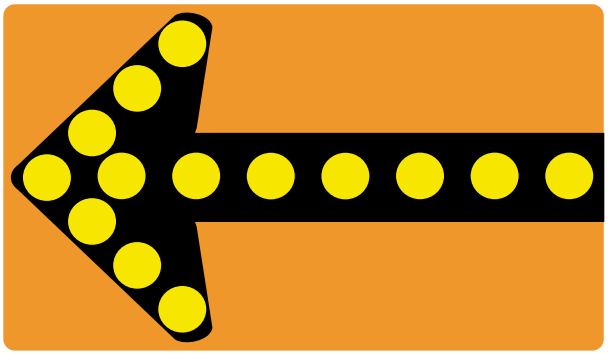
TC-11tA	**30 cm x 60 cm**
TC-111tA	**45 cm x 90 cm**
Font	**Highway Gothic C**
Colour	**Legend & Border – Black** **Background – Orange Reflective**
Minimum Sheeting	**Type I, engineering grade**

The TC-11t TRUCKS USE CENTRE LANE tab sign should be used to advise drivers of trucks which lane to use (e.g., Centre, Right, or Left), where lanes have been narrowed and the designated lane is the widest or preferred lane for trucks to use.

The supplementary TC-11tA FOR XX KM tab sign may be used to advise drivers of the length of road for which the narrow lanes condition exists.

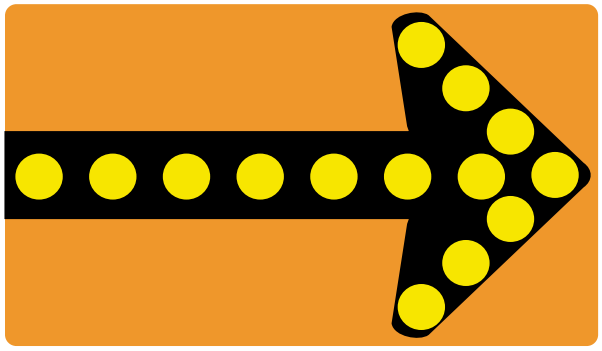
The TC-11tA tab sign may be used with other signs where it is considered desirable to advise drivers of the length of a given work zone or condition.

FLASHING ARROW BOARD Sign (Freeway)



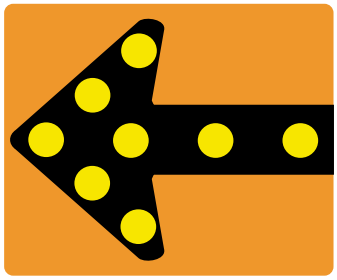
TC-12L	**120 cm x 210 cm**
Font	**N/A**
Colour	**Black Arrow on Orange Reflective Background** **Flashing Amber Lights along Stroke of Arrow and Edges of Arrow Head**
Minimum Sheeting	**Type III, high intensity**

FLASHING ARROW BOARD Sign (Freeway)



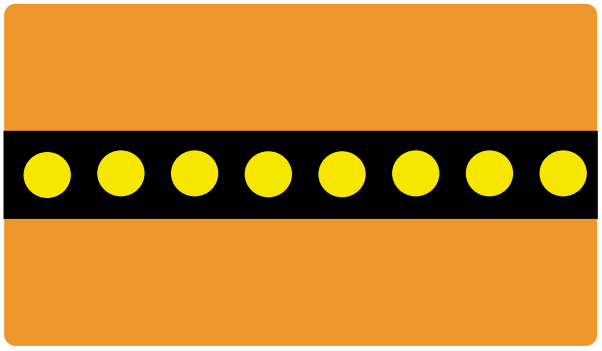
TC-12R	120 cm x 210 cm
Font	N/A
Colour	Black Arrow on Orange Reflective Background Flashing Amber Lights along Stroke of Arrow and Edges of Arrow Head
Minimum Sheeting	Type III, high intensity

FLASHING ARROW BOARD Sign (Non-freeway)



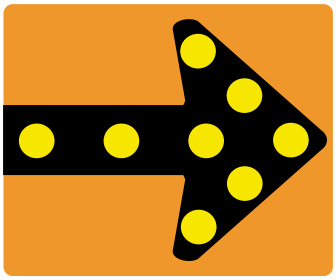
TC-12L	60 cm x 75 cm
Font	N/A
Colour	Black Arrow on Orange Reflective Background Flashing Amber Lights along Stroke of Arrow and Edges of Arrow Head
Minimum Sheeting	Type III, high intensity

FLASHING ARROW BOARD Sign (Freeway) (Bar Mode)



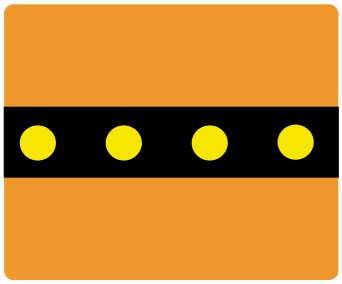
TC-12	120 cm x 210 cm
Font	N/A
Colour	Black Line on Orange Reflective Background Flashing Amber Lights along Stroke of Line
Minimum Sheeting	Type III, high intensity

FLASHING ARROW BOARD Sign (Non-freeway)



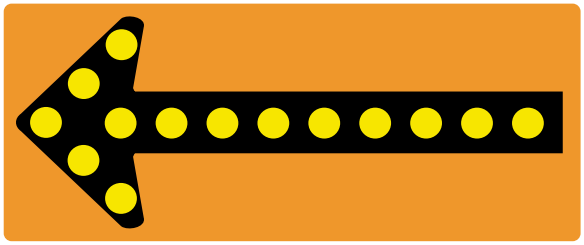
TC-12R	60 cm x 75 cm
Font	N/A
Colour	Black Arrow on Orange Reflective Background Flashing Amber Lights along Stroke of Arrow and Edges of Arrow Head
Minimum Sheeting	Type III, high intensity

FLASHING ARROW BOARD Sign (Non-freeway) (Bar Mode)



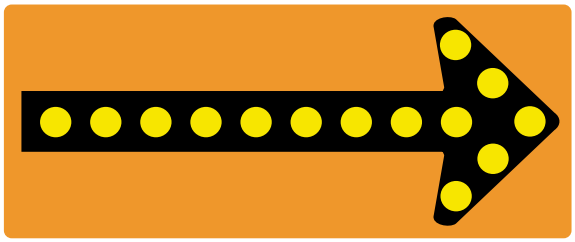
TC-12R	60 cm x 75 cm
Font	N/A
Colour	Black Line on Orange Reflective Background Flashing Amber Lights along Stroke of Line
Minimum Sheeting	Type III, high intensity

FLASHING ARROW BOARD Sign (Striper)



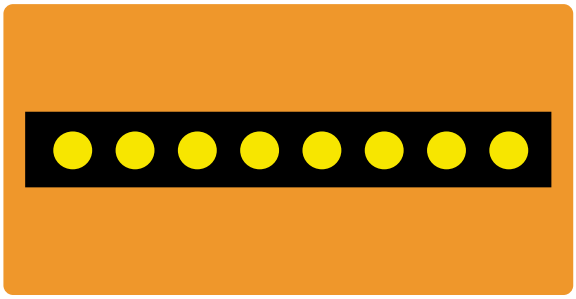
TC-12AL	60 cm x 150 cm
Font	N/A
Colour	Black Arrow on Orange Reflective Background Flashing Amber Lights along Stroke of Arrow and Edges of Arrow Head
Minimum Sheeting	Type III, high intensity

FLASHING ARROW BOARD Sign (Striper)



TC-12AR	60 cm x 150 cm
Font	N/A
Colour	Black Arrow on Orange Reflective Background Flashing Amber Lights along Stroke of Arrow and Edges of Arrow Head
Minimum Sheeting	Type III, high intensity

FLASHING ARROW BOARD Sign (Striper) (Bar Mode)



TC-12A	60 cm x 150 cm
Font	N/A
Colour	Black Line on Orange Reflective Background Flashing Amber Lights along Stroke of Line
Minimum Sheeting	Type III, high intensity

The TC-12 FREEWAY FLASHING ARROW BOARD sign (or, on non-freeways, the TC-12 NON-FREEWAY FLASHING ARROW BOARD), used for lane closures in stationary or mobile work operations, must be mounted on vehicles or trailers, as shown in the typical layouts.

The black arrow silhouette design and orange reflective background (to act as a fail safe device) must be used on all TC-12s. Only TC-12s which conform to the requirements stated in Book 7 may be used as a replacement for the TC-3 and TC-4 in short duration operations where shown on various typical layouts.

The convention for use of TC-12s in stationary work operations is to use the flashing arrow mode to indicate that a lane shift is required, and to use the flashing bar mode to indicate that the vehicle or trailer on which the TC-12 is mounted is in a closed lane or on the shoulder, but that no further lane shift is required. An exception to this is when two flashing arrow mode TC-12s are used, an advance one on the shoulder and a second one at the end of the taper in the closed lane, to indicate a single lane shift.

The convention for use of TC-12s in mobile work operations is to use the flashing arrow mode on multi-lane roads (to reinforce the need to keep to the side of the vehicle, where no cones can be used), and to use the bar mode on two-lane roads (where a flashing arrow could suggest to drivers that they can safely overtake the work/buffer vehicle).

The TC-12 FLASHING ARROW BOARD sign must not be used in arrow or bar mode with:

- a Traffic Control Person;
- a Remote Control Device;
- a traffic control signal (portable or temporary);
- a YIELD TO ONCOMING TRAFFIC Sign.

The TC-12 must not be used in arrow mode on two-lane roads.

The amber lights on all TC-12s must flash simultaneously or sequentially to increase the conspicuity and attention-getting value of the arrow. For night use, the light intensity must be reduced. For positive guidance purposes, the two arrowheads should not normally be displayed at the same time.

Vehicles used for freeway patrol or emergency response on freeways may be equipped with a flashing arrow board sign measuring a minimum of 60 cm x 150 cm. These arrow board signs are strictly used for emergency use and are not considered sufficient for any type of planned maintenance or construction activity.

For details on the operation and design of arrowboards please contact the Custodial Office.

Note: The TC-12 must be mounted a minimum of 1.5 m above the roadway to qualify as a replacement device for other traffic control devices.

The TC-12 must meet the specifications outlined in Section 3.2.

The TC-12 NON-FREEWAY FLASHING ARROW BOARD sign must be a minimum of 60 cm x 75 cm. This smaller TC-12 is approved for non-freeway use as specified in this manual and the Field Edition. The TC-12 NON-FREEWAY FLASHING ARROW BOARD sign may also be used at nighttime for non-freeway mobile operations.

Since the TC-12 NON-FREEWAY sign is reduced in size, extra consideration must be given to the light intensity and mounting height to ensure that the TC-12 sign is visible to approaching motorists and that the arrow shape is retained.

The TC-12A sign (striper) is truck mounted and may be used for lane closures in pavement-marking operations. The arrowhead will indicate the direction in which traffic is permitted to pass.

The black arrow silhouette design and orange reflective background (to act as a fail safe design) must be used on the TC-12A.

The amber lights must flash simultaneously or sequentially to increase the conspicuity and attention-getting value of the arrow. For night use the light intensity must be reduced. For positive guidance purposes, the two arrowheads should not normally be displayed at the same time.

Except where obviously different in size and number of lamps, the TC-12 (Non-freeway) and the TC-12A (Striper) must meet the same specifications as for the TC-12 (Freeway), outlined in Section 3.2.

PAVEMENT ENDS Sign

TC-13	**90 cm x 90 cm**
Font	**N/A**
Colour	**Legend & Border – Black** **Background – Orange Reflective**
Minimum Sheeting	**Type I, engineering grade**

The TC-13 sign must be installed in advance of the point where the pavement ends because of roadwork and changes to a gravel surface. The advance distance from this point is established by referring to the appropriate Table (A, B or C).

The TC-13 sign is to be used only if the gravel surface extends for more than 10 m. For distances less than 10 m, a TC-15 BUMP sign should be used.

BUMP AHEAD Sign

TC-14	**60 cm x 60 cm**
Font	**N/A**
Colour	**Legend & Border – Black** **Background – Orange Reflective**
Minimum Sheeting	**Type I, engineering grade**

The TC-14 sign must be used as an advance warning sign preceding the TC-15 BUMP sign. The TC-14 sign must be located in advance of the TC-15 sign, at a distance taken from the appropriate Table (A, B or C). It must be removed as soon as the roadway deficiency no longer exists. The TC-14 sign may not be required in low speed urban areas.

BUMP Sign

TC-15	60 cm x 60 cm
Font	N/A
Colour	Legend & Border – Black Background – Orange Reflective
Minimum Sheeting	Type I, engineering grade

The TC-15 sign must be used to give warning of a sharp change in the profile of the road that is sufficiently abrupt to create a hazardous discomfort to passengers, to cause a shifting of cargo or to deflect a vehicle from its intended course when the bump is crossed at the posted speed limit. The sign must be installed adjacent to the bump and removed as soon as the roadway deficiency no longer exists.

TURN Sign

TC-16AL TC-116AL	60 cm x 60 cm 75 cm x 75 cm
Font	N/A
Colour	Legend & Border – Black Background – Orange Reflective
Minimum Sheeting	Type I, engineering grade

SHARP CURVE Sign

TC-16BL TC-116BL	60 cm x 60 cm 75 cm x 75 cm
Font	N/A
Colour	Legend & Border – Black Background – Orange Reflective
Minimum Sheeting	Type I, engineering grade

CURVE Sign

TC-16CL	60 cm x 60 cm
TC-116CL	75 cm x 75 cm
Font	N/A
Colour	Legend & Border – Black Background – Orange Reflective
Minimum Sheeting	Type I, engineering grade

REVERSE CURVE Sign (one arrow)

TC-16EL	60 cm x 60 cm
TC-116EL	75 cm x 75 cm
Font	N/A
Colour	Legend & Border – Black Background – Orange Reflective
Minimum Sheeting	High reflectivity micro-prismatic fluorescent after January 1, 2003 Type I, engineering grade before January 1, 2003

SHARP REVERSE CURVE Sign

TC-16DL	60 cm x 60 cm
TC-116DL	75 cm x 75 cm
Font	N/A
Colour	Legend & Border – Black Background – Orange Reflective
Minimum Sheeting	Type I, engineering grade

REVERSE CURVE Sign (two arrows)

TC-16EL (2)	75 cm x 75 cm
TC-116EL (2)	90 cm x 90 cm
Font	N/A
Colour	Legend & Border – Black Background – Orange Reflective
Minimum Sheeting	High reflectivity micro-prismatic fluorescent after January 1, 2003 Type I, engineering grade before January 1, 2003

REVERSE CURVE Sign (three arrows)

TC-16EL (3)	**90 cm x 90 cm**
TC-116EL (3)	**120 cm x 120 cm**
Font	**N/A**
Colour	**Legend & Border – Black**
	Background – Orange Reflective
Minimum Sheeting	**High reflectivity micro-prismatic fluorescent after January 1, 2003**
	Type I, engineering grade before January 1, 2003

Curve warning signs are required in construction areas to indicate a sharp curve or turn and physical curvature of the roadway. Any existing warning signs (yellow background) need not be replaced by the orange signs. In general, oversize curve warning signs must be used on construction projects in rural areas, and on all road sections where higher operating speeds (70 km/h or higher) can be safely maintained. Where there are severe space restrictions in urban areas, and low vehicle speed conditions prevail, the smaller curve warning signs may be used.

The TC-16E REVERSE CURVE sign must be used where two curves in opposite directions are separated by a tangent of less than 120 m. The TC-16D SHARP REVERSE CURVE sign must be used to indicate the route of a detour. A TC-16ER RIGHT REVERSE CURVE sign must be used if the first curve is to the right. A TC-16EL LEFT REVERSE CURVE sign must be used where the first curve is to the left.

On freeways, the larger sign sizes must be used.

ADVISORY SPEED Tab Sign

TC-17t	**45 cm x 45 cm**
Font	**Highway Gothic D**
Colour	**Legend & Border – Black**
	Background – Orange Reflective
Minimum Sheeting	**Type I, engineering grade**

The TC-17t sign should only be displayed where the safe speed has been determined by the use of a ball bank indicator (or equivalent method) in accordance with the procedure outlined in OTM Book 6 (Warning Signs), Section 2.

If necessary, the TC-17t sign will be mounted below the primary signs TC-9 and TC-16A to E.

CHEVRON ALIGNMENT Sign

TC-18	**45 cm x 60 cm**
TC-118	**60 cm x 75 cm**
Font	**N/A**
Colour	**Legend & Border – Black** **Background – Orange Reflective**
Minimum Sheeting	**High reflectivity micro-prismatic fluorescent after January 1, 2003.** **Type III, high intensity before January 1, 2003**

CHEVRON ALIGNMENT signs may be used to provide additional guidance for the vehicle operator as to changes in the horizontal alignment in the roadway. See also Book 6 (Warning Signs) and Book 11 (Markings and Delineation).

CHEVRON ALIGNMENT signs may be installed only on the outside of a curve or sharp turn and must normally be located at right angles to oncoming traffic, but must not be so located as to be misread by opposing traffic. As sight conditions will vary, the spacing of the CHEVRON ALIGNMENT signs should be determined by a field investigation. All signs used at a location must be of the same size, and spacing of the signs should be such that the motorist always has two signs in view until the change in alignment eliminates the need for the signs. Where used, a minimum of four CHEVRON ALIGNMENT signs must be used.

The signs should be installed at a height of 1.2 m to 1.5 m above the near edge of the nearest traffic lane to the bottom of the sign. Otherwise they are to be installed in accordance with the general spacing requirement of Book 6, Table 7, or Book 11, Table 5.

The CHEVRON ALIGNMENT sign consists of a black symbol on an orange background. This sign may only be installed where in the opinion of the responsible traffic officials, such a warning is essential.

GROOVED PAVEMENT Sign

TC-19	**90 cm x 90 cm**
Font	**N/A**
Colour	**Legend & Border – Black** **Background – Orange Reflective**
Minimum Sheeting	**Type I, engineering grade**

The TC-19 GROOVED PAVEMENT sign may be used to provide warning to motorists, including motorcyclists, where the pavement has been milled or grooved.

GROOVED PAVEMENT Tab Sign

TC-19t	**45 cm x 75 cm**
Font	**Highway Gothic D**
Colour	**Legend & Border – Black**
	Background – Orange Reflective
Minimum Sheeting	**Type I, engineering grade**

The supplementary TC-19t GROOVED PAVEMENT tab sign may be used with the TC-19 sign for an educational period.

PREPARE TO STOP Sign

TC-20	**75 cm x 75 cm**
TC-120	**90 cm x 90 cm**
Font	**Highway Gothic D**
Colour	**Legend & Border – Black**
	Background – Orange Reflective
Minimum Sheeting	**Type I, engineering grade**

PREPARE TO STOP Sign (with amber flashers)

TC-20A	**75 cm x 75 cm**
TC-120A	**90 cm x 90 cm**
Font	**Highway Gothic D**
Colour	**Legend & Border – Black**
	Background – Orange Reflective
Minimum Sheeting	**Type I, engineering grade**

The TC-20 PREPARE TO STOP sign may be used where there is a high probability, or certainty, that motorists will have to stop for particular kinds of work operations or for recurring congestion resulting in stop and go traffic. This sign must be covered or removed in periods where there is not a high expectation or certainty of having to stop. The TC-20A PREPARE TO STOP sign with two amber flashers, one on each side of the sign, alternating in a "side to side" manner, may be used together with the TC-20At tab sign, when the amber flashers are triggered by an event or situation that will require a stop.

WHEN FLASHING Tab Sign

TC-20At	**45 cm x 75 cm**
TC-120At	**60 cm x 90 cm**
Font	**Highway Gothic D**
Colour	**Legend & Border – Black**
	Background – Orange Reflective
Minimum Sheeting	**Type I, engineering grade**

The TC-20At WHEN FLASHING tab sign may be used with the TC-20A sign (or with the TC-31 TRUCK ENTRANCE sign) when there is a high probability that motorists will have to stop, when triggered by an event or situation that will require a stop.

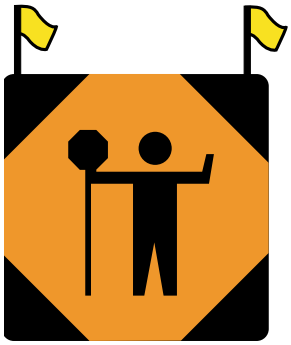
These signs may be considered at locations such as one or more of the following conditions:

- at work operations where periodic traffic stops are necessary, and can be signalled to motorists, and visibility of the operation and the need to stop is otherwise poor;

- at work operations where motorist visibility of congested end-of-queue conditions is poor, and where the sign can be activated by a presence detector at such locations.

The amber flashers used with the sign must not flash continuously, but only when triggered by an event or situation that will require a stop.

TRAFFIC CONTROL PERSON (TCP) AHEAD Sign

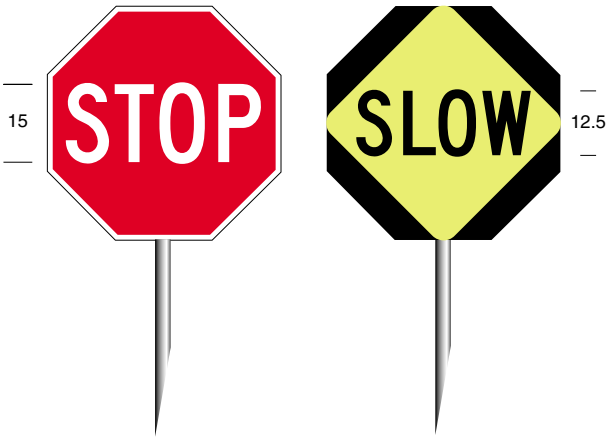


TC-21	**60 cm x 60 cm**
TC-121	**90 cm x 90 cm**
	(after January 1, 2003, the oversize sign must be used)
Font	**N/A**
Colour	**Legend & Border – Black**
	Background – Orange Reflective
Minimum Sheeting	**High reflectivity micro-prismatic fluorescent after January 1, 2003**
	Type I engineering grade before January 1, 2003

The TC-21 sign must be used at all times when a TCP is on duty and must be taken down when the TCP is not on duty.

The sign must be placed in advance of the TCP at a distance determined by referring to the appropriate Table (A or B) and must be mounted on a portable stand with flagpoles and opaque fluorescent orange flags, 45 cm x 45 cm in size, mounted at a height of 1.5 m to 2.5 m above the ground.

TRAFFIC CONTROL Sign (STOP/SLOW Paddle)



TC-22	**45 cm x 45 cm**
Font	**Highway Gothic C**
Colour & Sheeting	**SLOW – High reflectivity micro-prismatic fluorescent yellow-green sheeting after January 1, 2001, for diamond-shaped background; black legend, border and corners** **STOP – Type III, high-intensity retroreflective red after January 1, 2001, for octagon-shaped background; Type III, high-intensity retroreflective white legend and border**

This double-sided hand-held traffic control device must be used by the TCPs to direct traffic by signaling the desired warning towards oncoming vehicles in accordance with instructions detailed in Section 4.4, and the training given by the road authority or the contractor. If only one TCP is being used, the side of the sign not facing the intended direction of control must be covered so as not to confuse drivers in the opposing direction. The TC-22 must meet the requirements of OHSA R.R.O. 213/91 and 145/00, Section 68.

SIGNALS AHEAD Sign

TC-23	**60 cm x 60 cm**
TC-123	**75 cm x 75 cm**
Font	**N/A**
Colour	**Legend – Black, with red, yellow, and green balls** **Border – Black** **Background – Orange Reflective**
Minimum Sheeting	**Type I, engineering grade**

The TC-23 sign must be used as an advance warning sign in conjunction with all Portable Traffic Control Signals or Temporary Traffic Signals.

This sign is to be installed in advance of the signal system at a distance specified in the appropriate Table (A or B).

The sign must be removed or covered when the Portable Traffic Control Signal or Temporary Traffic Signal is not in operation.

REMOTE CONTROL DEVICE AHEAD Sign

TC-23A	**60 cm x 60 cm**
TC-123A	**75 cm x 75 cm**
Font	**N/A**
Colour	**Legend – Black, with red and yellow balls**
	Border – Black
	Background – Orange Reflective
Minimum Sheeting	**Type I, engineering grade**

The TC-23A sign must be used as an advance warning sign in conjunction with Remote Control Devices.

This sign is to be installed in advance of the Remote Control Device at a distance specified in the appropriate Table (A or B).

The sign must be removed or covered when the Remote Control Device is not in operation.

PREPARE TO STOP Tab Sign

TC-23At	**45 cm x 75 cm**
Font	**Highway Gothic D**
Colour	**Legend & Border – Black**
	Background – Orange Reflective
Minimum Sheeting	**Type I, engineering grade**

The TC-23At PREPARE TO STOP tab sign must be used with the TC-23A sign.

UNEVEN LANES Sign

TC-24	**75 cm x 75 cm**
TC-124	**90 cm x 90 cm**
Font	**N/A**
Colour	**Legend & Border – Black**
	Background – Orange Reflective
Minimum Sheeting	**Type I, engineering grade**

The TC-24 UNEVEN LANES sign should be used during work operations which create a difference in elevation between adjacent lanes that is large enough to create a hazard for motorists.

DO NOT PASS WHEN FLASHING Sign

TC-27	**75 cm x 150 cm**
Font	**Helvetica Bold Condensed**
Colour	**Legend & Border – Black** **Background – Orange Reflective**
Minimum Sheeting	**Type I, engineering grade**

The DO NOT PASS WHEN FLASHING sign must be used where a pilot vehicle is used to guide traffic through a single lane work zone on a two-lane highway, or where one or more pace vehicles is used to control the speed of traffic through a work zone or to implement a rolling closure. The sign is mounted on the rear of the pilot vehicle or pace vehicle(s), in plain view of following vehicles. See Section 2.5 on the use of pilot vehicles, pace vehicles, and rolling closures. The sign is not required on police vehicles acting as pilot or pace vehicles.

TRUCK ENTRANCE Sign

TC-31L	**90 cm x 90 cm**
Font	**N/A**
Colour	**Legend & Border – Black** **Background – Orange Reflective**
Minimum Sheeting	**Type I, engineering grade**

TRUCK ENTRANCE Sign (with amber flashers)

TC-31AL	**90 cm x 90 cm**
Font	**N/A**
Colour	**Legend & Border – Black** **Background – Orange Reflective**
Minimum Sheeting	**Type I, engineering grade**

WHEN FLASHING Tab Sign

8

TC-120At	**60 cm x 90 cm**
Font	**Highway Gothic D**
Colour	**Legend & Border – Black** **Background – Orange Reflective**
Minimum Sheeting	**Type I, engineering grade**

These signs must be used when trucks are using a temporary entrance where they would not normally be expected. The signs may also be used to compensate for limited vision of a crossing heavily use by trucks.

When the signs are used to compensate for limited vision, this sign must be installed where the site distance is less than that given in Table 11. The sight distance of the vision triangle is measured from the centre-line of the entry road at a distance of 5 m from the edge of the pavement of the travelled portion of the main road. It is measured from a point at a height of 1.05 m above the side road level to a point on the centre line of the main road and 1.05 m above the travelled surface on the main road.

The TC-31 sign must be installed in advance of the crossing in accordance with distances set out in the appropriate Table (A, B or C).

If the truck entrance is on the left, the TC-31L shown above must be used. The reverse symbol sign TC-31R must be used where the truck entrance is on the right. For a truck crossing only the TC-31R is to be used.

Where the presence of a truck about to enter the road is detected automatically, the TC-31A sign may be used, with two amber flashers, one on each side of the sign, alternating in a "side to side" manner, activated by the detector, so that the amber flashers provide a positive signal to motorists that a truck is about to enter the road. When the TC-31A sign is used, the TC-120At WHEN FLASHING tab sign must also be used. The flashers should not be flashing continuously, otherwise they will lose their effectiveness. Care must also be taken to ensure that the detector system activating the flashers is intact and functioning properly.

Table 11 – Sight Distance Criteria for Truck Entrance Signing (m)

Speed Limit (km/h)	50	60	70	80	90	100
Two-lane roadway	90	105	125	150	165	
Four-lane divided roadway (where the divider is 5.5 m or more in width)	90	105	125	150	165	180
Three-lane roadway	100	115	135	160	175	200
Other four-lane roadways	110	130	150	180	200	220

TEMPORARY BRIDGE Sign

TC-32	90 cm x 90 cm
Font	N/A
Colour	Legend & Border – Black Background – Orange Reflective
Minimum Sheeting	Type I, engineering grade

TEMPORARY BRIDGE XX KM/H Tab Sign

TC-32t	60 cm x 90 cm
Font	Highway Gothic D
Colour	Legend & Border – Black Background – Orange Reflective
Minimum Sheeting	Type I, engineering grade

The TC-32 sign must be used to warn of a temporary (usually a bailey) bridge ahead, on which the traffic speed is severely reduced, normally to approximately 30km/h. The TC-32 sign must be installed about 150 m in advance of the bridge.

The TC-32t TEMPORARY BRIDGE XX KM/H tab sign is not mandatory but may be used for optional messages regarding the bridge, advisory speed rates, or both, if deemed necessary for the safety of motorists.

LOW BRIDGE AHEAD Sign

TC-33	90 cm x 240 cm
Font	Highway Gothic D
Colour	Legend & Border – Black Background – White Reflective
Minimum Sheeting	Type I, engineering grade

LOW CLEARANCE AHEAD XX M Sign

20 15 10

TC-33A	**60 cm x 60 cm**
TC-133A	**90 cm x 90 cm**
Font	**N/A**
Colour	**Legend & Border – Black**
	Background – Orange Reflective
Minimum Sheeting	**Type I, engineering grade**

LOW CLEARANCE XX M Sign

20 15 10

TC-33B	**60 cm x 90 cm**
Font	**N/A**
Colour	**Legend & Border – Black**
	Background – Orange Reflective
Minimum Sheeting	**Type I, engineering grade**

The TC-33 sign must be installed about 400 m in advance of the last exit that trucks can use to avoid the low clearance in a construction area. This sign must be used only where the clearance of the structure is less than 4.5 m.

It should be borne in mind that the clearance may be changing frequently and that trucks may not be confined to the normal travelled portion. Frequent changes may be necessary as the work progresses.

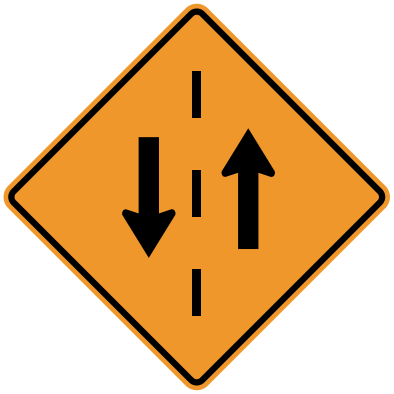
Immediately after construction, resurfacing, or surface treatment, or any action which would modify the clearance of the structure, the revised clearance should be accurately measured and the obtained clearance figures reported without any delay to the road or traffic authority for determination of the need for clearance signing.

As an alternative to the TC-33 sign, where space is limited and where frequent opportunities exist to bypass the low bridge (e.g., urban areas), the TC-33A and TC-33B LOW CLEARANCE signs may be used. The TC-33A and the black and orange TC-33 signs should be used only where the low clearance is a result of the work zone activities. If the low clearance is a permanent or semi-permanent condition, the black and yellow Wa-26 and Wa-27 signs should be used instead.

The advance sign TC-33A is located in advance of the low clearance. The TC-33B is installed, if possible, on the structure just above the opening and over the centre of the roadway, unless the clearance varies over the width of the structure, in which case a second sign is installed to indicate the lesser clearance.

Whenever possible, advance warning of the low clearance condition should be located to permit overheight vehicles to select an alternate route. Additional advance signing, with a TC-3tA distance tab, may be used for this purpose.

TWO-WAY TRAFFIC Sign



TC-34	**90 cm x 90 cm**
Font	**N/A**
Colour	**Legend & Border – Black** **Background – Orange Reflective**
Minimum Sheeting	**Type I, engineering grade**

The TC-34 sign must be used to warn motorists driving on a one-way street or highway, that they are approaching a road section where a two-way traffic flow is temporarily in operation because of construction. This situation will occur mainly where opposing traffic has been directed across the median of a multi-lane highway because of construction on the other side.

The TC-34 sign must be installed in advance of the two-way traffic area at a distance defined by the appropriate Table (A, B or C), in order to prepare the motorist for the change in the mode of traffic flow.

Note: The beginning of the two-way traffic flow, and additional reminder signs as appropriate, will be marked by regulatory Rb-24 (Rb-124) signs.

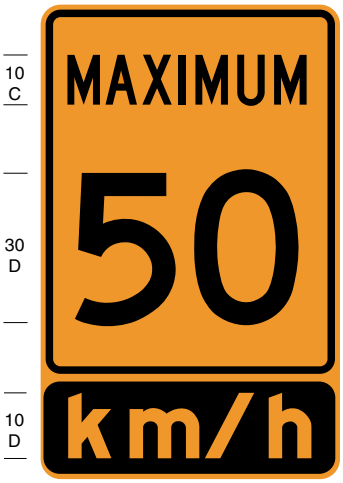
RAMP CLOSED AHEAD Sign

TC-35	**90 cm x 90 cm**
Font	**Highway Gothic D**
Colour	**Legend & Border – Black** **Background – Orange Reflective**
Minimum Sheeting	**Type I, engineering grade**

The TC-35 sign is used to warn motorists driving on a multi-lane street or highway, that they are approaching an exit ramp which is temporarily closed because of construction or maintenance. It must be used for Short Duration operations, and may be used to supplement Long Duration signs, such as the TC-64A or TC-64B.

The TC-35 sign must be installed in advance of the exit taper/deceleration lane (if present), or channelization, at a distance defined by the appropriate Table (A, B or C), in order to prepare the motorist for the closure.

MAXIMUM SPEED Advisory Sign



TC-36	**60 cm x 90 cm**
Font	**"Maximum" Highway Gothic C** **"Speed" Highway Gothic D** **"km/h" Highway Gothic D**
Colour	**Legend & Border "Max. 50" – Black** **Background "Max. 50" – Orange Reflective** **Legend & Border "km/h" – Orange Reflective** **Background "km/h" – Black**
Minimum Sheeting	**Type I, engineering grade**

The TC-36 sign is to be used in place of the Rb-1 and Rb-7t MAXIMUM SPEED sign where it is not practical to impose a regulatory speed limit. This would include sections where the geometrics of the roadway are not reduced due to construction but public traffic is required to mingle with heavy grading or similar operations and it is considered that a combination of advisory speed signing and proper procedures by traffic control persons should be adequate provisions for the safe passage of traffic.

The signs should be installed approximately 600 m apart for advisory speed zones up to 2 km long, and approximately 1.5 km apart for advisory speed zones of longer distances. Regulatory speed limit sign placement must comply with longitudinal spacing requirements as stipulated by the Highway Traffic Act.

SOFT SHOULDERS Sign

TC-37	**60 cm x 60 cm**
Font	**Highway Gothic C**
Colour	**Legend & Border – Black** **Background – Orange Reflective**
Minimum Sheeting	**Type I, engineering grade**

The TC-37 sign must be used in work zones where soft shoulders present a hazard to vehicles that may get off the pavement.

The signs must be installed at regular intervals approximately 300 m apart over a 1 km stretch and 900 m apart on longer sections, and must be removed after the shoulders have become thoroughly compacted, or are safe for low-speed traversal.

NO EXIT Sign

TC-39	**45 cm x 45 cm**
Font	**Highway Gothic C**
Colour	**Legend & Border – Black** **Background – Orange Reflective**
Minimum Sheeting	**Type I, engineering grade**

The TC-39 sign must be used to warn motorists at the entrance to a side road or side street that, due to maintenance or construction, the highway or the street temporarily has no outlet.

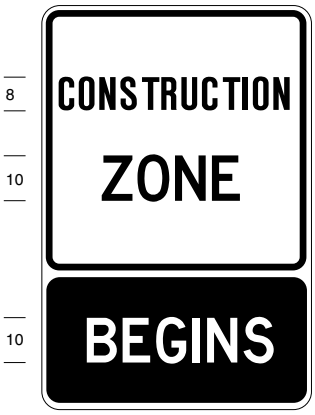
This sign must be conspicuously posted, on both sides of the entrance to the side road either individually on separate posts or mounted on the barricade blocking the entrance.

PEDESTRIAN DIRECTION Sign

TC-40L	**45 cm x 45 cm**
Font	**N/A**
Colour	**Legend & Border – Black** **Background – Orange Reflective**
Minimum Sheeting	**Type I, engineering grade**

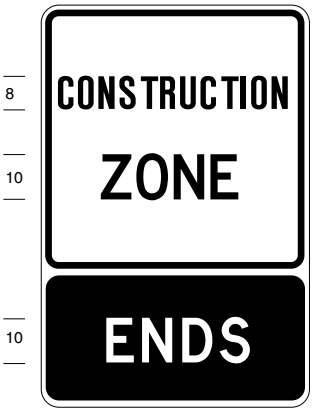
The TC-40 sign is used to indicate to pedestrians the intended pathway through or around a construction, maintenance, or utility work area. The sign should be used where the pedestrian is likely to be uncertain as to the intended pathway.

CONSTRUCTION ZONE BEGINS Sign (formerly TC-41A)



Rb-90A	**60 cm x 90 cm**
Font	**"Construction" Highway Gothic D** **"Begins" Helvetica Bold Condensed**
Colour	**"Construction Zone":** **Legend & Border – Black** **Background – White Reflective** **"Begins":** **Legend & Border – White Reflective** **Background – Black**
Minimum Sheeting	**Type I, engineering grade**

CONSTRUCTION ZONE ENDS Sign (formerly (TC-41B)



Rb-90B	**60 cm x 90 cm**
Font	**"Construction" Highway Gothic D** **"Ends" Helvetica Bold Condensed**
Colour	**"Construction Zone":** **Legend & Border – Black** **Background – White Reflective** **"Ends":** **Legend & Border – White Reflective** **Background – Black**
Minimum Sheeting	**Type I, engineering grade**

The Rb-90A and Rb-90B signs are used to indicate the limits of a construction zone. The Rb-90A (formerly TC-41A) CONSTRUCTION ZONE BEGINS sign must be installed at the beginning of the construction zone and the Rb-90B (formerly TC-41B) CONSTRUCTION ZONE ENDS sign must be installed at the end of the construction zone. These signs are required on projects for which the Ministry or municipal by-law and associated road authority procedures has established a construction speed zone.

YIELD Sign (Ra-2) (not shown)

YIELD AHEAD Sign

Wb-1A	**75 cm x 75 cm**
Font	**N/A**
Colour	**Arrow & Border – Black** **Yield Symbol – Red Reflective and White Reflective** **Background – Yellow Reflective**
Minimum Sheeting	**Type I, engineering grade**

The use of the YIELD sign for control of normal road traffic is described in Book 5 (Regulatory Signs).

If it is considered necessary or desirable to advise drivers of construction vehicles exiting from work areas into travelled traffic lanes that they must yield to traffic in those lanes, the YIELD sign may be used for this purpose. The YIELD TO ONCOMING TRAFFIC sign (Rb-91) must not be used for this purpose.

The use of the YIELD AHEAD sign for control of traffic is described in Book 6 (Warning Signs)

A Wb-1a sign should be used in conjunction with the Rb-91 sign (formerly TC-43 sign) where traffic is approaching at high speed and an advance warning for the one lane traffic control is considered essential.

YIELD TO ONCOMING TRAFFIC Sign (formerly TC-43)

Rb-91	**90 cm x 120 cm**
Font	**Highway Gothic C**
Colour	**Legend & Border – Black** **Yield Symbol – Red Reflective and White Reflective** **Background – White Reflective**
Minimum Sheeting	**Type III, high intensity**

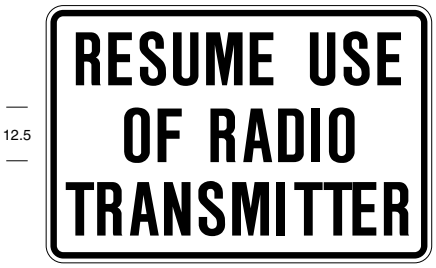
The Rb-91 (formerly TC-43) YIELD TO ONCOMING TRAFFIC sign must be used only on two-lane, two-way roadways, where only one lane is available for traffic and the traffic volume is too low to warrant the installation of portable traffic control signals or temporary traffic control signals or the use of a TCP on duty for 24 hours a day. See Book 5 (Regulatory Signs). The sign must be installed in the direction of the closed lane only and located at a distance in advance of the lane closure specified in the appropriate Table (A or B). The sign must be covered or removed when the TCP is on duty.

In some situations, partial lane shifts (See Section 1.9 and Figures TL-9 and TL-10 in Section 8) may be used as an alternative to this form of traffic control.

DO NOT USE RADIO TRANSMITTER Sign

TC-44	**60 cm x 90 cm**
Font	**Helvetica Bold Condensed**
Colour	**Legend & Border – Black** **Background – White Reflective**
Minimum Sheeting	**Type I, engineering grade**

RESUME USE OF RADIO TRANSMITTER Sign



TC-45	**60 cm x 90 cm**
Font	**Helvetica Bold Condensed**
Colour	**Legend & Border – Black** **Background – White Reflective**
Minimum Sheeting	**Type I, engineering grade**

The TC-44 sign must be installed where blasting is being done, whenever an electrical detonating system is in use adjacent to the highway. The sign must be installed 1 km in advance of the blasting area.

The TC-45 sign must be installed in conjunction with the TC-44 DO NOT USE RADIO TRANSMITTER sign where blasting is being done, whenever an electrical detonating system is in use adjacent to the highway. The sign must be installed 1 km past the end of the blasting area.

ROAD CLOSED Sign (formerly TC-46)

Rb-92	**90 cm x 120 cm**
Font	**Highway Gothic E**
Colour	**Legend & Border – Black** **Do Not Enter Symbol – Red Reflective and White Reflective** **Background – White Reflective**
Minimum Sheeting	**Type III, high intensity**

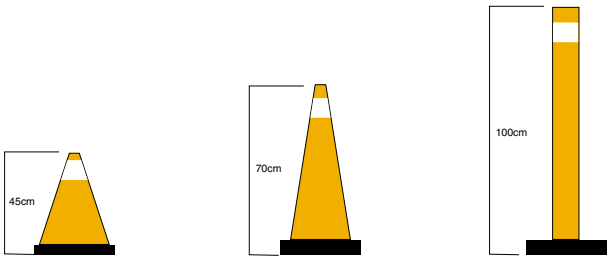
The Rb-92 (formerlyTC-46) ROAD CLOSED sign must be used where, due to construction activities, a roadway must be temporarily closed. See Book 5 (Regulatory Signs). **Note**: See Subsection 28(3) of the Public Transportation and Highway Improvement Act R.S. O. 1990.

Table E.1 in Section 8 illustrates the typical usage of signs through a temporary work zone.

6.2 Channelizing Devices, Barricades and Barriers

Table E.2 (Section 8) provides general guidelines for the use of cones, markers, barricades, and barriers.

Traffic Cones



TC-51A TC-51B TC-51C

Traffic Cones may be used to delineate and to channelize traffic along a specified route. This marker may be placed at the edge of the closed lane and spaced in accordance with details given in the appropriate Table (A, B or C).

The TC-51A cone (45 cm) may be used only for zone painting, and must have a white reflective collar. For all other uses of cones, the TC-51B (70 cm) with a white reflective collar is the standard cone (with the TC-51C, with white reflective collar as an acceptable alternate).

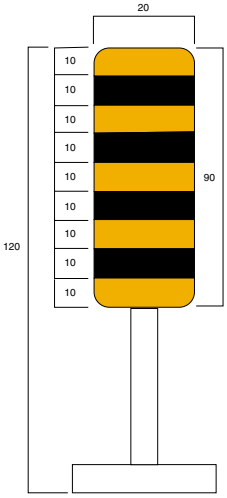
The white reflective cone collar must be 10 cm to 15 cm wide, mounted on the upper one-third of the cone taper, 10 cm below the top of the cone or marker (Type III or IV, high intensity reflective sheeting).

Any cones used at night must have a reflective collar as described. As of January 1, 2002, all cones will require reflective collars.

Reflectorized TC-52s or TC-54s may be used, and in some cases must be used, as alternatives to cones. See the sections below on these devices.

Cones are easily blown over or displaced unless their bases are ballasted or enlarged to increase stability. The ballast must not present a hazard if the cone is struck. Suggested means of ballasting include doubling the cones, using heavier weighted cones, using special weighted bases, or using masses such as sandbag rings or ballast rings made out of recycled tires.

Construction Marker



TC-52	**20 cm x 90 cm, top edge mounted 120 cm above ground level**
Font	**N/A**
Colour	**Alternating black and reflective horizontal orange bands, 10 cm wide**
Minimum Sheeting	**Type III, high intensity**

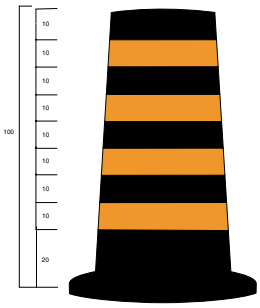
The TC -52 marker may be used to delineate diversions and closed lanes, channelize traffic through a construction area, mark channelizing tapers in advance of closed lanes and generally provide separation between construction work site and the flow of traffic.

The markers shall be placed at the edge of closed lanes and spaced in accordance with speed related distances detailed in the appropriate Table (A, B or C).

Consideration should be given to other channelizing devices (e.g., TC-54) for high speed, high volume areas. See Table E.2 in Section 8.

Appropriate bases and uprights (as approved by the road authority) are necessary to ensure the stability of the sign and driver safety in both rural or urban areas.

Flexible Drum (Barrel)



TC-54	**Approximately 100 cm high, base diameter 55 cm minimum, top diameter 33 cm minimum**
Font	**N/A**
Colour	**Circumferential horizontal alternating black and reflective orange bands, 10 cm wide**
Minimum Sheeting	**Type III, high intensity**

The TC-54 flexible drum (barrel) may be used to delineate diversions and closed lanes, channelize traffic through a construction area, mark channelizing tapers in advance of closed lanes and generally provide separation between construction work site and the flow of traffic.

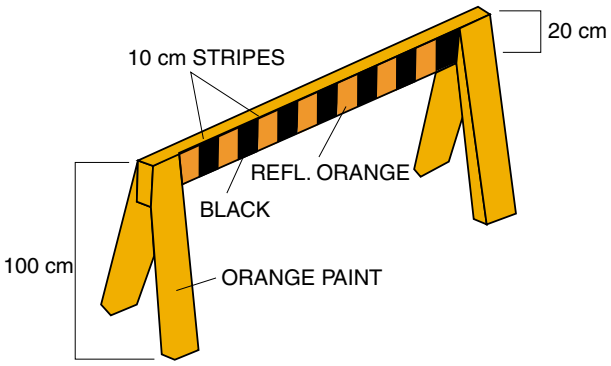
When located near traffic lanes, drums may reduce capacity. Drums should be placed with care to reduce the likelihood of impact.

Where space permits, TC-54s should be used on freeways and other high speed, high volume roads, rather than TC-52s.

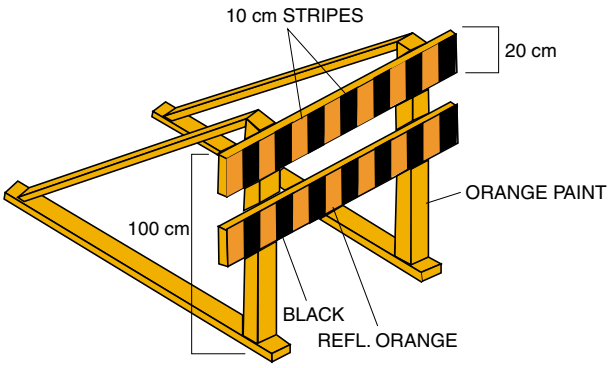
Flexible Drums must be approximately 100 cm in height and a minimum of 55 cm in diameter at the base and 33 cm at the top. The markings of the flexible drums must be horizontal, circumferential, alternating black and reflectorized orange stripes (four bands of approximately 10 cm each).

The drum must be manufactured to include an anti-roll device in case of impact and should not be of a construction which creates a hazard to vehicles. The drum must be ballasted in such a manner as to not be a hazard to motorists or workers. Suggested means of ballasting include ballast rings of recycled tires or loose sand placed at the bottom (not more than 25 kg). Drums should not be ballasted with rocks, chunks of concrete, or similar objects. Ballast should not be placed at the top of the drums.

Barricades



TC-53A	**One horizontal cross bar, 20 cm x variable length, top edge mounted 100 cm above ground level**
Font	**N/A**
Colour	**Alternating black and reflective vertical orange bands, 10 cm wide; orange bases/supports**
Minimum Sheeting	**Type III, high intensity on horizontal bars; bases/supports may be painted**



TC-53B	**Two horizontal cross bars, 20 cm x variable length, top edge of top bar mounted 100 cm above ground level**
Font	**N/A**
Colour	**Alternating black and reflective vertical orange bands, 10 cm wide; orange bases/supports**
Minimum Sheeting	**Type III, high intensity on horizontal bars; bases/supports may be painted**

The TC-53A or TC-53B barricades must be used primarily for blocking off road excavation sites or other work site hazards and to prevent vehicular traffic from penetrating into work areas. They may also be used for short-term road closures. The use of the light or heavier barricades depends on approach speed of traffic and the nature and severity of hazards for which these devices provide protection.

The TC-53A or TC-53B must not be used as a channelizing device.

Temporary Concrete Barriers

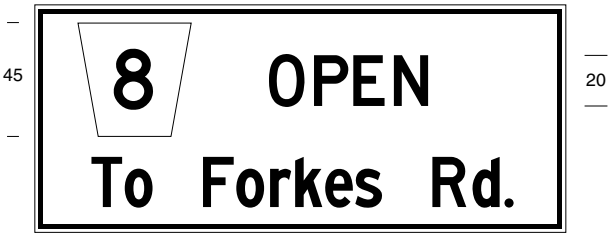
On long-term freeway construction projects the function of preventing vehicular penetration into the work areas must be carried out by temporary concrete barrier walls or equivalents. They may also be used to positively separate two-way, high-speed/high-volume traffic flows.

Although barrier walls may serve the additional function of channelizing traffic their use should be determined by the protective requirements of the location rather than the channelizing needs. Approved reflective devices are required on temporary concrete barriers at spacings to be determined by the road authority.

Information regarding standards and specifications for temporary concrete barriers including installation details, means of reflectorization, end treatment and other particulars are available from the Highway Design Office of the Ministry of Transportation.

6.3 Information and Directional Guide Signs

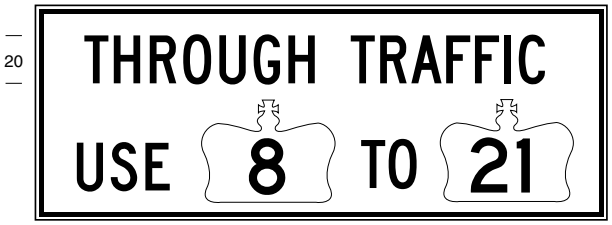
NEW ROADWAY OPEN Sign



TC-61	**120 cm x 210 cm**
Font	**Highway Gothic D**
Colour	**Legend & Border – Black**
	Background – White Reflective
Minimum Sheeting	**Type I, engineering grade**

The TC-61 sign, when used, must be installed approximately 1 km in advance of the best alternative route and 1 km in advance of the beginning of the new section of highway. This sign is to be used to inform potential users that a new road is open. The sign is to be removed one year after it is installed.

ALTERNATE HIGHWAY ROUTE Sign



TC-62	**120 cm x 240 cm**
Font	**Highway Gothic C**
Colour	**Legend & Border – Black**
	Background – White Reflective
Minimum Sheeting	**Type I, engineering grade**

The TC-62 sign, when used, must be installed 100 m beyond the TC-66 HIGHWAY SECTION CLOSED sign to indicate the alternate route around the closed area of a through highway.

ROAD CLOSING/RESTRICTION NOTICE Sign (Full-Time)

TC-64	**120 cm x 240 cm**
Font	**Highway Gothic D**
Colour	**Legend & Border – Black**
	Background – White Reflective
Minimum Sheeting	**Type I, engineering grade**

The TC-64 sign must be installed in advance of an interchange which is to be closed or restricted, at least one week prior to the actual closing date of the ramp.

This sign is to be located in advance of the first guide sign pertaining to the interchange so as not to interfere with the existing guide signs and is to be removed immediately after the closing of the ramp.

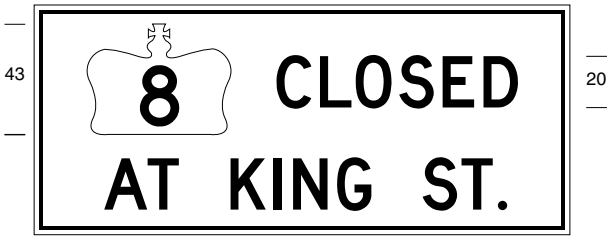
The regulations concerning road closings by the Ontario Municipal Board must be precisely followed and where these exist, full information should be obtained from the appropriate traffic authority.

ROAD CLOSING NOTICE Sign

TC-65	**120 cm x 120 cm**
Font	**Highway Gothic D**
Colour	**Legend & Border – Black** **Background – White Reflective**
Minimum Sheeting	**Type I, engineering grade**

The TC-65 sign must be installed at strategically selected locations of the street at least one week prior to the actual closing date of the street. It must be removed immediately after the street has been closed.

HIGHWAY SECTION CLOSED Sign



TC-66	**120 cm x 210 cm**
Font	**Highway Gothic D**
Colour	**Legend & Border – Black** **Background – White Reflective**
Minimum Sheeting	**Type I, engineering grade**

The TC-66 sign must be installed to inform the motorist of a section of through highway that is closed. This sign must be installed 1 km in advance of the best detour route.

In urban areas, a reduced size sign may be desirable.

STREET SECTION CLOSED Sign

20

TC-67	**120 cm x 210 cm**
Font	**Highway Gothic C**
Colour	**Legend & Border – Black** **Background – White Reflective**
Minimum Sheeting	**Type I, engineering grade**

The TC-67 sign must be installed to inform motorists that a street on which they are driving will be closed at its junction with a designated sideroad. This sign must be installed 1 km in advance of the signed detour turn off.

In urban areas, a reduced size sign may be desirable.

CONTRACT IDENTIFICATION Sign (ROAD AUTHORITY) (not shown)

TC-71	**Variable**
Font	**Variable**
Colour	**Legend & Border – Black** **Background – Orange Relfective**
Minimum Sheeting	**Type I, engineering grade**

The TC-71 is a generic sign number reserved for contract identification signs installed by the road authority to identify a road construction project, its length, and the road authority responsible. This sign is not shown as its design may vary from road authority to road authority.

CONTRACT IDENTIFICATION Sign (JOINT PROJECT)

10

TC-72A	**120 cm x 210 cm**
Font	**Helvetica Medium**
Colour	**Legend & Border – Blue** **Background – White**
Minimum Sheeting	**None; painted sign**

CONTRACT IDENTIFICATION Sign (JOINT PROJECT)

TC-72B	**120 cm x 210 cm**
Font	**Helvetica Medium**
Colour	**Legend & Border – Blue** **Background – White**
Minimum Sheeting	**None; painted sign**

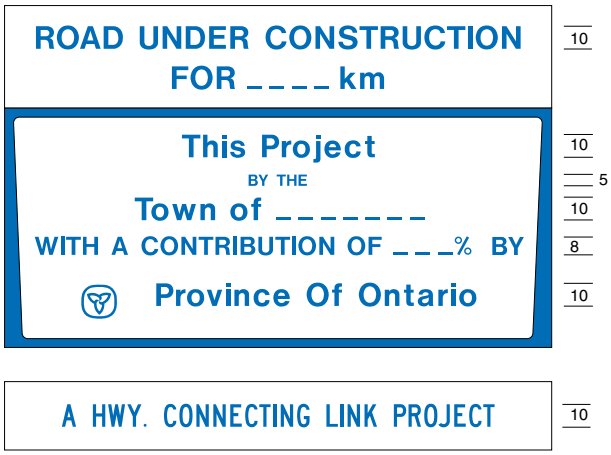
The TC-72A and TC-72B signs must be installed on projects for road-rail grade separations when a successful application has been made under Part 11 of Bill C-27 of the Railway Relocation and Crossing Act. This sign must show specifically the extent of financial involvement of each of the participants.

On municipal projects where Transport Canada, the Province of Ontario, a municipality and railway are involved, the TC-72A sign must be installed.

On Provincial projects where only Transport Canada, the Province of Ontario and the railway are involved, the TC-72B sign must be installed.

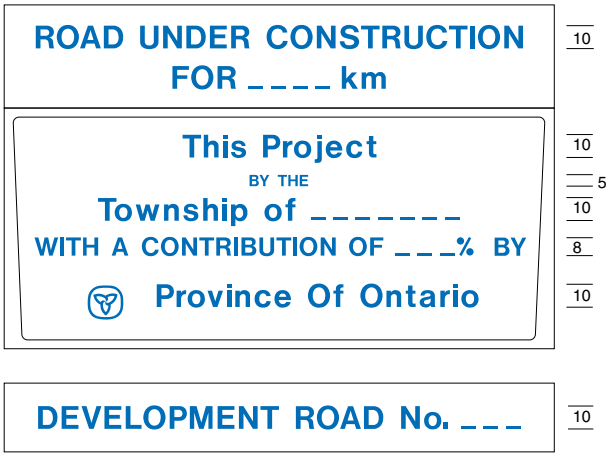
The TC-72A and B signs must be installed in advance of the CONSTRUCTION AHEAD sign closest to the construction site at the distance specified in the appropriate Table (A, B, or C).

CONTRACT IDENTIFICATION Sign (CONNECTING LINK PROJECT)



TC-73A	**150 cm x 240 cm**
Font	**Helvetica Medium and Highway Gothic C**
Colour	**Legend & Border – Blue** **Background – White**
Minimum Sheeting	**None; painted sign**

CONTRACT IDENTIFICATION Sign (DEVELOPMENT ROAD PROJECT)



TC-73B	**150 cm x 240 cm**
Font	**Helvetica Medium**
Colour	**Legend & Border – Blue** **Background – White**
Minimum Sheeting	**None; painted sign**

The TC-73A CONTRACT IDENTIFICATION (Connecting Link Projects) sign must be installed to identify construction projects on connecting links for which cost sharing has been provided by the Ministry of Transportation. The TC-73B CONTRACT IDENTIFICATION (Development Road) sign must be installed to identify construction projects on development roads for which cost sharing has been provided by the Ministry of Transportation. The sign must be installed only if the municipality or township has no objections to the installation of such a sign.

On railroad grade separation projects, the standard TC-72A or B CONTRACT IDENTIFICATION (Joint Project) sign should be used instead of the TC-73A or B signs. For connecting link projects which are administered by the Ministry of Transportation, the standard TC-71 Contract Identification will be used instead of the TC-73A sign.

Two signs will normally be required for each project, one at each end of the section under construction. The TC-73B sign must be installed in advance of the CONSTRUCTION AHEAD sign closest to the construction site at the distance specified in the appropriate Table (A, B, or C).

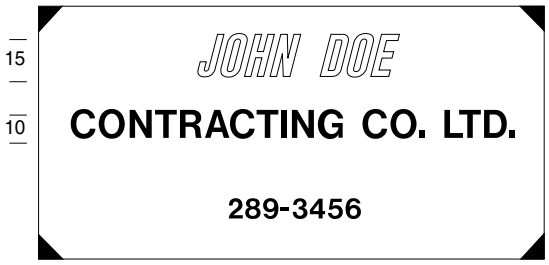
CONTRACT IDENTIFICATION Sign (MUNICIPAL PROJECT)

TC-74	**120 cm x 180 cm**
Font	**Highway Gothic C**
Colour	**Legend & Border – Blue** **Background – White**
Minimum Sheeting	**None; painted sign**

The TC-74 sign is to be installed in advance of a construction area to indicate that the following construction is being done by the municipality under the contract number shown as part of the sign.

Two signs will normally be required for each project, one at each end of the section under construction. The TC-74 sign must be installed in advance of the "Construction Ahead" sign closest to the construction site at the distance specified in the appropriate Table (A, B or C).

CONTRACTOR'S IDENTIFICATION Sign



TC-75	**Variable; max. of 90 cm x 180 cm**
Font	**Helvetica Bold Condensed**
Colour	**Legend & Border – Black** **Background – White**
Minimum Sheeting	**None; painted sign**

The TC-75 sign may be erected by the contractor either directly beside the TC-71, TC-73, TC-74 signs or, in the case of insufficient space, just past the CONTRACT IDENTIFICATION sign. This sign shall be restricted to a size of not larger than 90 cm x 180 cm. If it is installed, it should give the contractor's name and telephone number only.

The background colour shall not be red, yellow or orange and the sign may be non-reflectorized.

7. Traffic Control Devices: Quality Replacement Guidelines

Introduction

Traffic control devices in work zones must be maintained in good condition. Section 25 (1) (b) of the OHSA places responsibility on employers to ensure that equipment, materials, and protective devices provided by them are maintained in good condition.

Traffic control in work zones depends upon good visibility and legibility of the devices used. By the very nature of temporary conditions, involving storage, transport, installation, removal, and relocation, traffic control devices in work zones are often subjected to hard use, wear, and damage. This may result in loss of effectiveness due to soiling, deformation, gashes, other breakage, and loss of or damage to reflective sheeting, text, or symbols. A certain amount of wear degradation of devices can be accommodated without significant loss of effectiveness, and it is not practical to require new devices at all times. Yet a certain standard of quality must be maintained. Traffic control devices must be evaluated, and quality replacement guidelines are needed to provide guidance as to when used devices need to be replaced to assure continued effectiveness. The purpose of this section is to provide illustrative guidelines of this type, to enhance effectiveness and safety for motorists and workers.

Device quality should be evaluated at various stages, including storage, preparation for drop off at the work zone, installation, and regularly during the course of the work. Good quality control throughout the stages of the work will reduce costs and minimize the need for replacement on-site.

Although the principal responsibility for ensuring that traffic control equipment, materials and protective devices are maintained in good condition rests with the contractor, it is also important that there be periodic monitoring of contractor compliance by the road authority in order for the outlined quality guidelines to be effective. If monitoring of compliance is not done, or not effectively and consistently done, quality will slip. If road authorities do not require, and monitor to ensure, the installation of quality devices, they are inviting contractors not to do so. If contractors believe that monitoring is likely to be weak, they will have little incentive to install good quality devices or to base their bid on the supply of good quality devices.

The material in this section is based on concepts outlined in the American Traffic Safety Services Association's (ATSSA) "Quality Standards for Work Zone Traffic Control Devices," but has been modified for purposes of this manual and its application in Ontario.

The quality of work zone devices has been divided into three categories: acceptable, marginally acceptable, and unacceptable.

Acceptable devices meet the quality requirements outlined herein and all design, size, and colour requirements, and may be used on highway construction, maintenance and utility projects. The percentage of acceptable devices on a work project should be at least 50%, at any time, or as contained in the contract specifications or road authority requirements.

Marginally acceptable devices are at or near the lower end of acceptability. Such devices may be used until they become unacceptable. The percentage of marginally acceptable devices on a work project should not exceed 50% at any time, and if used, should be interspersed with acceptable devices so that a sizeable length of a work zone is not all marginally acceptable.

Unacceptable devices should not be delivered to the work site, or used on a work project, and should be replaced or repaired within 12 hours of notification, or as contained in the contract specifications or road authority requirements. Where 10% or more of the surface of a traffic control device, or 20% of the retroreflective material on the traffic control device is damaged or missing, the device is unacceptable and should be removed from service.

The 50% acceptability criterion outlined above applies to each traffic control device type taken by itself.

Figures 7 to 10, illustrating selected traffic control devices, together with the accompanying description, should be used as a guide to determine whether the device is acceptable, marginally acceptable, or unacceptable. Such assessments are somewhat subjective, and devices can be worn or damaged in a wide variety of ways. All such worn or damaged states cannot practicably be depicted.

Quality Guidelines

All traffic control devices used in work zones must conform to the requirements of Book 7 and contract documents with regard to size, shape, colour, placement, and legend. Sign positioning at the work zone should be determined based on site conditions. Signs should be as near vertical as practicable. Barrels (Flexible Drums) that are dented severely enough to affect their overall dimensions or contain fractures that affect their stability or ability to retain the reflective sheeting are unacceptable.

Any situation where there are more than two adjacent channelizing devices missing or substantially out of alignment will cause an unacceptable situation.

Persons engaged in traffic control should routinely inspect their equipment at night to assure that the level of retroreflectivity is adequate and the devices are clearly visible and legible.

Evaluation Guide

Work Zone Signs (Figures 7 and 8)

- **Acceptable**: Minor abrasions, no loss of lettering. The message is legible per design criteria of Book 1b.
- **Marginally acceptable**: Many surface abrasions, including individual letters of message. Sign surface is free of residue. Background colour and reflectivity are still apparent at night. The message is legible per design criteria of Book 1b.
- **Unacceptable**: Many abrasions and/or splatter; significant loss of letters or colour fading. The message is partly missing or illegible per design criteria of Book 1b.

Note: All TC-21 STOP/SLOW signs and TC-22 Paddles in use must meet the "acceptable" criterion.

Flexible Drums (TC-54 Barrels) (Figure 9)

- **Acceptable**: Minor tears and scratches on sheeting. Any dents do not seriously reduce reflectivity. Intended original shape is maintained.
- **Marginally acceptable**: Numerous tears and scratches, but free of large areas of residue or missing or damaged reflective material. Intended original shape and strength are maintained.

- **Unacceptable**: Large areas of missing or damaged reflective material, or significant splatter residue. If 20% of the retroreflective material is damaged or missing, the device is unacceptable and should be removed from service. Substantial deformation alone may render a drum unacceptable.

Cones (Figure 10)

- **Acceptable**: Clearly identifiable conical shape, free standing in its original position. Surface is free of punctures and abrasions, splatter or residue, and is washable. Reflective bands have little or no loss of reflectivity, with only minor tears and scratches.

- **Marginally acceptable**: Some splatter, difficult to clean, minor discoloration. Reflective bands have tears and scratches, but are free of large areas of residue or missing material.

- **Unacceptable**: Punctures, large areas of splatter residue, large areas of missing or stained reflective material.

TC-12 Flashing Arrow Boards

- **Acceptable**: Flashing arrow mode: Not more than one lamp out in stem and none out in arrow head, and dimming properly. Bar mode: Four or more lamps operating and dimming properly.

- **Marginally acceptable**: Flashing arrow mode: Two or fewer lamps in stem out, none out in arrow head, and dimming properly. Bar mode: Minimum of four lamps functioning, dimming properly.

- **Unacceptable**: Flashing arrow mode: Any lamp out in the arrow head, or three or more lamps out in the stem, or arrow panel not dimming properly.

  Note: any operating lamp which is out of alignment will be considered "not functioning". Bar mode: Fewer than four lamps functioning, or not dimming properly. The sign fails to meet the visibility distance criterion outlined in Section 3.2.

Variable Message Signs

- **Acceptable**: 90% or more of the pixels per character module are operating properly.

- **Unacceptable**: Fewer than 90% of the pixels per character module are operating properly, or not performing within the criteria of the OTM Book 10 (Dynamic Message Signs), or message clarity is significantly impacted.

Pavement Tape and Paint

- **Acceptable**: All pavement marking tape or paint required (solid lines and skip lines) is in place and meets all material specifications.

- **Marginally acceptable**: No more than 10% of all tape, paint, message, or symbol, or no more than two consecutive skip lines, or no more than 15 continuous metres of solid line is missing.

- **Unacceptable**: More than 10% of all tape, paint, message, or symbol, more than two consecutive skip lines, or more than 15 continuous metres of solid line is missing.

Temporary Raised Pavement Markers (TRPMs)

- **Acceptable**: All TRPMs required are in place and meet all material specifications.

- **Marginally acceptable**: No more than 10% of the total TRPMs or no more than three consecutive TRPMs are missing.

- **Unacceptable**: More than 10% of the total TRPMs or more than three consecutive TRPMs are missing.

Figure 7 – Sign Quality Illustration (1)

Acceptable Marginal Unacceptable

Figure 8 – Sign Quality Illustration (2)

Acceptable Unacceptable

Figure 9 – Barrel Quality Illustration

Acceptable Marginal Unacceptable Unacceptable

Figure 10 – Traffic Cone Quality Illustration

Acceptable Marginal Unacceptable Unacceptable

8. Typical Layouts for Signing Temporary Work Zone Situations

The material in this section is organized as follows:

General Notes to the Typical Layouts

(1) For work zone advisory signing for Construction Zones: Refer to Figure TL-1 or Figure TL-2.

(2) For mobile zone painting operations, refer to Figures TL-67 and TL-68.

(3) Paving operations, using a paving machine, included in mobile operations by the Ministry of Labour, are treated as stationary operations for purposes of traffic control. Typical layouts labelled "Mobile Operations" do not apply to paving operations.

For paving operations on freeways, an 80 km/h regulatory (black/white) speed limit must be used, enforced by police or pace vehicles, at times when work is being performed. The reduced speed limit signs must be covered when no work is being performed. Portable variable message signs may be placed on one or both sides of the roadway, 500 m in advance of the work zone to warn motorists of the reduced speed (supplementing Figure TL-4). PVMSs advising of a lane closure should be positioned upstream of expected ends of queues.

To enhance visibility for motorists, machinery used in paving operations should have conspicuity tape appropriately applied.

(4) For Short Duration Nighttime requirements, see Section 1.8.

(5) The 1 km and 2 km advance construction signs (TC-1A and TC-1B) and TC-1 are required on all long duration freeway construction work zones. Note that additional provisions apply to long duration freeway construction work zones if the work duration is longer than five days (see Note 14). On the typical layouts, where either the TC-2B or TC-1 is shown, the TC-1 is shown as a requirement for long duration, even though the same sign is also shown on Figures TL-1 and TL-2. The TC-2B (or TC-2A), shown as required for short duration work, is also to be used for local actual work areas within a long duration work zone, when work is being performed.

Sign sizes shown on the typical layouts are usually standard sizes. On multi-lane roads, 70 km/h or higher, oversize TC-101, TC-101A, TC-101B, TC-103, TC-104 and TC-105 signs are minimum requirements, where space permits.

(6) On multi-lane roads, left-side signing is not required if the road is not divided, or if it is not practicable. See Table 2 in Section 3.

(7) Figure TL-3 represents the signing of a construction speed zone of 60 km/h on a two-lane highway with a normal regulatory speed limit of 80 km/h. Similarly, Figure TL-4 represents the signing of a construction speed zone of 80 km/h on a multi-lane road with a normal regulatory speed limit of 100 km/h. The "km/h" should be displayed on the speed limit signs unless the road authority has a policy that this units information is not required.

If a construction speed zone is established and the reduced speed limit is to be enforced by the police, the maximum speed signs must be regulatory (black and white); otherwise they must be advisory (black and orange). See also Section 1.11.

All existing regulatory speed limit signs (Rb-1) in a construction speed zone must be covered or removed in the zone indicated whenever a

reduced regulatory speed limit is in effect. This will eliminate confusion resulting from conflicting speed limit signs in the same area.

(8) Partial Lane Shifts may be used on two-lane roads:

- 60 km/h or lower (low- and high-volume roads);
- 70 km/h or higher (low-volume roads only)

Partial Lane Shifts (TL-9 and TL-10) must not be used where posted speeds are 90 km/h or higher, or on multi-lane roads. For high speed multi-lane roads, use Narrow Lanes (TL-17).

(9) Refer to Table E.1 for guidelines on the typical usage of signs in a work zone and to Table E.2 for guidelines on the use of channelizing devices, barricades, and barriers.

(10) **LBA** Longitudinal Buffer Area (dimension 2* on Typical Layouts) (Tables A, B, C, D)

BV Buffer Vehicle = BT or CT

BT Blocker Truck (no TMA), with TC-12 (and four-way flashers)

CT Crash Truck (equipped with TMA, TC-12 and four-way flashers)

TMA Truck-mounted Attenuator

WV Work Vehicle

LIDG Lateral Intrusion Deterrence Gap (Table D)

IV Incoming Vehicle

(11) In **stationary work zones** with lane closures and with normal posted regulatory speeds:

- 60 km/h or lower: An LBA or BV is not required, but should be considered where space permits and other concerns exist;

- 70 km/h or higher:

  - Non-freeways
    For work in closed traffic lanes, an LBA is required for full lane closures, but not for partial lane shifts, or where traffic is controlled by a Traffic Control Person, a Remote Control Device, or a Traffic Control Signal, or intersection work where an LBA is not shown on typical layouts. This means that an LBA will generally not be required for two-lane roads, but will be required for multi-lane non-freeways. A buffer vehicle is not required but may be considered for multi-lane non-freeways. If a buffer vehicle is used, it must be used with an LBA and an LIDG, as shown for freeways. (For work on shoulders, neither an LBA nor a BV is a standard requirement.) LBA lengths are shown as dimension 2* in Tables A, B, and C and in column 2 in Table D. For long duration, a TC-12 or TC-7 is required at the end of the taper. For short duration, a TC-12 is required at night, and may replace the TC-3 and TC-4 in the daytime.

  - Freeways
    For work in closed traffic lanes or on shoulders, an LBA plus a BV plus an LIDG must be used. (For Very Short Duration work on shoulders, a vehicle with 360 degree beacon and four-way flashers must be used, but neither an LBA nor a BV is a standard requirement.) LBA lengths are shown as dimension 2* in Tables A, B, and C and in column 2 in Table D. BVs must be used with their associated LBA and LIDG as

shown in Table D. A TC-12 is required at the end of the taper, and the BV at the end of the LBA must have a TC-12 in bar mode. A buffer vehicle should not be positioned at the end of the taper; it should be positioned at least the LBA distance downstream from the end of the taper. If the work area moves within the closed lane, the buffer vehicle should move with it, maintaining a distance LIDG upstream of the work area and at least the LBA distance downstream from the end of the taper.

For both non-freeways and freeways, neither an LBA nor a buffer vehicle is required if the work area is separated from a live lane of traffic by a minimum lateral clearance of at least 3 m.

A BV with tandem rear axles must have both axles braked when parked. At least two-thirds of the BV mass should be over the rear axle(s).

A BV used in a stationary work zone should be unoccupied (except when being moved), to remove the driver from risk of injury.

Where an LBA is used, but not a BV, one or two cones or barrels should be placed at the downstream end of the LBA to mark its limit.

For paving operations, where a milling operation is under way downstream from the paving machine by a distance greater than LIDG, one buffer vehicle should be positioned upstream of the milling operation and another buffer vehicle should be positioned upstream of the paving operation.

(12) For **mobile work operations**, including zone painting (LBAs are not applicable):

- Shoulder operations or road-edge operations: a BV is not required on non-freeways. A BV is required on freeways, except for intermittent stops of only a few minutes in duration.

- Operations in traffic lanes, with lane closures, for normal regulatory posted speeds:

  - 60 km/h or lower: A BV is not required.

  - 70 km/h or higher:

    - Non-freeways
      A BV is not required on two-lane roads, or on multi-lane roads, except as noted for zone painting on Figures TL-67 and TL-68. BVs should be used with associated gaps between vehicles as shown in Table D, Mobile Work Operations, and for zone painting, as noted on Figures TL-67 and TL-68.

    - Freeways
      A BV is required. For zone painting operations, see Figure TL-68. BVs should be used with associated gaps between vehicles as shown in Table D, Mobile Work Operations, and for zone painting, as noted on Figure TL-68.

(13) As required by OHSA and its regulations, Temporary Concrete Barriers (TCBs) must be used for stationary operations on freeways, where practicable, to separate workers from traffic, where the duration of the work is longer than five days. Barrier-mounted delineators should be used with TCBs. Where TCBs are not practicable on freeways and a minimum lateral clearance from a live lane of traffic cannot be achieved (see Note 11), an LBA plus BV plus LIDG must be used. TCBs should also be

considered for use on non-freeways where the duration is longer than five days, to separate workers from traffic or to separate opposing traffic on multi-lane undivided roads.

(14) Narrow lanes on multi-lane roads: With reference to Figure TL-17, the arrangement shown may be used where traffic volumes require that two lanes remain open to traffic. The signing and channelization for this situation can be used only if the remaining lane widths are 3 m or greater (3.5 m preferable on freeways), otherwise a full lane closure is required.

The existing pavement markings, where they may cause driver confusion, should be removed and replaced by temporary pavement markings. Solid edge lines and lane lines should be used through diversion areas (ramps excepted). Figure TL-17 applies to both divided and undivided roads.

(15) Where a TC-7 sign is shown in intersection typical layouts, the flashing amber light on the TC-7 must only be used if the intersection is not signalized.

(16) Many surveying operations do not require workers on the roadway (that is, they are on the shoulder or beyond the shoulder). Often, if workers are on the roadway, it is only for a few seconds at a time. Where survey crews must perform surveying operations on the roadway, appropriate typical layouts for roadside work or for full lane closures must be used, as applicable. In addition to the specific surveying Figures TL-73A to TL-76, it may be necessary to use Figures TL-11, 20A, 20B, 25, 26, 28 or 29, as noted in Table F.

Pre-engineering activities, including surveying, will require the selection of those typical layouts appropriate to the work activity on the road. TL-73A to TL-76 apply specifically to surveying, but survey operations and other pre-engineering activities may also require the use of other typical layouts, for example, where a lane closure is required.

(17) A sign truck is a vehicle with a truck-mounted or trailer-mounted TC-12 flashing arrow board. On TL-77 to TL-82, a vehicle shown as a sign truck may start out with a TC-12, but may leave the TC-12 at the end of the taper. From then on, the vehicle is technically no longer a sign truck, but is shown as such for purposes of continuity.

(18) For freeway ramps, the appropriate Typical Layout is chosen to suit the specific conditions including speeds, geometrics, and volumes.

Table A – Work Zone Component Dimensions: Short Duration Work (Non-freeways)

Normal Regulatory Speed Limit						
*	**Dimension**	**50 km/h or lower**	**60 km/h**	**70 km/h**	**80 km/h**	**90 km/h**
1a	Taper length for full lane closure (m)	10 – 15	20 – 30	30 – 40	50 – 60	70 – 80
1b	Taper length for roadside work (m)	3 – 5	5 – 7	7 – 10	10 – 12	15 – 20
2	Longitudinal Buffer Area (LBA) (m)**	(30)	(40)	50	60	75
3	Maximum distance between markers (m)***	4 – 6 (use at least 4 markers)	4 – 6 (use at least 4 markers)	8 – 10 (use at least 4 markers)	8 – 10 (use at least 4 markers)	10 – 12 (use at least 4 markers)
4	Minimum tangent between tapers (m)	30	30	60	60	80
5	Distance between construction signs (m)	20 – 30	20 – 30	50 – 60	50 – 60	70 – 80
6	**Condition**	**TC-2B or TC-2A Required?**				
	Visibility less than 150 m	Yes	Yes	Yes	Yes	Yes
	Visibility 150 m or greater	No	No	No, if a TC-12 is used	Yes	Yes

Notes:

* When the 85th percentile speed is known, it may be used instead of the normal regulatory speed limit. Table A distances are based on good visibility, and should be increased if visibility is poor. Cones require reflective collars for nighttime operations, and for daytime or nighttime after January 1, 2002.

Roadside work includes shoulder work and roadway edge work.

** Buffer Vehicles are not required on non-freeways. For application of LBA on non-freeways, see General Notes to Typical Layouts, Table D, and Section 5. LBAs are not a requirement at speeds of 60 km/h or lower, but should be considered if safety concerns exist.

*** Markers are channelizing devices. Application guidelines are shown in Table E.2. Cones may be used for daytime or nighttime operations on non-freeways.

Table B – Work Zone Component Dimensions: Long Duration Work (Non-freeways)

Normal Regulatory Speed Limit						
*	**Dimension**	**50 km/h or lower**	**60 km/h**	**70 km/h**	**80 km/h**	**90 km/h**
1a	Taper length for full lane closure (m)	LV: 15 – 25 HV: 30 – 50	40 – 60	60 – 80	100 – 120	140 – 160
1b	Taper length for roadside work (m)	LV: 5 – 8 HV: 9 – 15	10 – 14	14 – 20	20 – 24	30 – 40
2	Longitudinal Buffer Area (LBA) (m)**	(30)	(40)	50	60	75
3	Maximum distance between markers (m)***	6 – 8 (use at least 4 markers)	8 – 10 (use at least 4 markers)	8 – 10 (use at least 4 markers)	10 – 12 (use at least 4 markers)	12 – 14 (use at least 4 markers)
4	Minimum tangent between tapers (m)	55	100	120	140	160
5	Distance between construction signs (m)	40 – 50	90 – 100	110 – 120	130 – 140	150

Notes:

When the 85th percentile speed is known, it may be used instead of the normal regulatory speed limit. Table B distances are based on good visibility, and should be increased if visibility is poor.

Roadside work includes shoulder work and roadway edge work.

** Buffer Vehicles are not required on non-freeways. For application of LBA on non-freeways, see General Notes to Typical Layouts, Table D, and Section 5. LBAs are not a requirement at speeds of 60 km/h or lower, but should be considered if safety concerns exist.

*** Markers are channelizing devices. Application guidelines are shown in Table E.2. Cones may be used for daytime operations, however, construction markers or flexible drums must be used for nighttime operations.

LV = Low Volume

HV = High Volume

Low volume is defined as an average daily traffic volume less than 3,000 vehicles per day (combined traffic for both directions). This figure can be obtained from the local road authority or can be estimated by counting the number of vehicles passing the work site in 3 minutes and multiplying this figure by 300. The count may be taken in off-peak or peak traffic periods, corresponding to the period during which the work operations will be carried out.

Example: 20 cars in 3 minutes x 300 = 6,000 vehicles per day. (This would be a high-volume road.)

Table C – Work Zone Component Dimensions: Freeways

Normal Regulatory Speed Limit				
*	**Dimension**	**80 km/h**	**90 km/h**	**100 km/h**
1a	Taper length for full lane closure (m)	220	250	300
1b	Taper length for roadside work (m)	20 – 25	30 – 40	40 – 50
2	Longitudinal Buffer Area (LBA) (m)**	60	75	95
3	Maximum distance between markers (m)***	10 – 14	18 – 24	18 – 24
4	Minimum tangent between tapers (m)	220	250	300
5	Distance between construction signs (m)	160	180	200

Notes:

When the 85th percentile speed is known, it may be used instead of the normal regulatory speed limit. Table C distances are based on good visibility, and should be increased if visibility is poor.

Roadside work includes shoulder work and roadway edge work.

** For application of LBA and Buffer Vehicles (BVs), see General Notes to Typical Layouts, Table D and Section 5.

*** Markers are channelizing devices. Application guidelines are shown in Table E.2. Cones may be used for daytime very short duration or short duration operations only. Construction markers or flexible drums must be used for all other conditions.

Table D – Application of Longitudinal Buffer Area and Buffer Vehicles

Stationary Work Operations Required Protection (Freeways): LBA + Buffer Vehicle + LIDG Required Protection (Non-freeways): LBA only		
(1) **Normal Regulatory Speed Limit (km/h)**	**(2)** **Longitudinal Buffer Area (LBA) (m)**	**(3)** **Lateral Intrusion Deterrence Gap (LIDG) (m)**
50	(30)	(35)
60	(40)	(40)
70	50	50
80	60	60
90	75	65
100	95	70

Mobile Work Operations	
(1) **Normal Regulatory Speed Limit (km/h)**	**(2)** **Lateral Intrusion Deterrence Gap (LIDG) (m)**
70	35
80	45
90	50
100	55

Notes:

1. See also Section 5 and General Notes to Typical Layouts.

Table E.1 – Typical Usage of Signs through a Temporary Work Zone

Sign No.	Sign Name	Advance Warning Area	Approach Area	Transition Area	Longitudinal Buffer Area	Work Area	Termination Area
TC-1	Construction Ahead	X					
TC-1A	Construction 1 km Ahead	X					
TC-1B	Construction 2 km Ahead	X					
TC-2A	Road Work (square)	X				X	
TC-2B	Road Work (diamond)	X				X	
Rb-90A	Construction Zone Begins	X					
Rb-90B	Construction Zone Ends						X
Rb-1	Maximum Speed (regulatory)	X				X	
Rb-31	Do Not Pass	X			X	X	
TC-3	Lane Closed Ahead		X				
TC-4	Lane Closure Arrow		X				
TC-5	Detour Ahead	X					
TC-5A	Detour 1 km Ahead	X					
TC-5B	Detour 2 km Ahead	X					
TC-7	Detour-Turn Off/Diversion		X	X			
TC-7tA	Road Closed Tab		X	X			
TC-7tB	Local Traffic Only Tab		X	X			
TC-9	Roadside Diversion Warning	X					
TC-10	Detour Markers	X					
TC-11	Narrow Lanes	X				X	
TC-12	Flashing Arrow Board		X	X			
TC-12A	Flashing Arrow Board (striper)					X	
TC-13	Pavement Ends	X	Discouraged		X	X	X
TC-14	Bump Ahead	X	Discouraged		X	X	X
TC-15	Bump	X	Discouraged		X	X	X

Table E.1 – Typical Usage of Signs through a Temporary Work Zone (cont'd)

Sign No.	Sign Name	Advance Warning Area	Approach Area	Transition Area	Longitudinal Buffer Area	Work Area	Termination Area
TC-16	Turn & Curve	X	Discouraged		X	X	X
TC-17t	Advisory Speed Tab	X	Discouraged		X	X	X
TC-18	Chevron Alignmnent		X	X			
TC-19	Grooved Pavement	X	Discouraged		X	X	X
TC-20	Prepare to Stop	X	Discouraged		X	X	X
TC-21	Traffic Control Person Ahead		X				
TC-22	Traffic Control (STOP/SLOW) Paddle		X				
Wb-1A	Yield Ahead	X					
Rb-91	Yield to Oncoming Traffic		X				
TC-23	Signals Ahead		X				
TC-23A	Remote Control Device Ahead		X				
TC-24	Uneven Lanes	X	Discouraged		X	X	X
TC-27	Do Not Pass When Flashing (mobile)		X	X	X	X	X
TC-31	Truck Entrance				X	X	X
TC-32	Temporary Bridge	X	Discouraged		X	X	X
TC-33	Low Bridge Ahead	X	Discouraged		X	X	X
TC-34	Two Way Traffic	X	Discouraged		X	X	X
TC-35	Ramp Closed Ahead	X	Discouraged		X	X	X
TC-36	Maximum Speed (advisory)	X				X	
TC-37	Soft Shoulders	X	Discouraged		X	X	X
TC-39	No Exit	Used on side roads where no exit					
TC-40	Pedestrian Direction	May be used off road in all areas					
TC-44	Do Not Use Radio Transmitter	X					
TC-45	Resume Use of Radio Transmitter						X
Rb-92	Road Closed					X	
	Portable Variable Message Signs	X					
TC-61 to TC-75	Guide and Information Signs	X					

Table E.2 – Usage of Channelizing Devices, Barricades and Barriers

Road Type or Operation	Device				
	TC-51A (45 cm) **Cones****	**TC-51B (70 cm) TC-51C (100 cm)** **Cones****	**TC-52 Markers TC-54 Flexible Drums** **Markers Barrels**	**TC-53A TC-53B** **Barricades**	**TCB** **Temporary Concrete Barriers**
Zone Painting	VSD, SD	Option	Not required	Not required	Not required
Two-lane Roads	No	VSD, SD	LD*	LD	Not required
Multi-lane Roads (Non-freeways)	No	VSD, SD	LD*	LD	Not required
Freeways	No	VSD, SD (daytime only)	VSD, SD (nighttime), LD****	LD	LD more than 5 days***

Notes:

* may also be used for VSD or SD, in place of TC-51B or TC-51C, if space permits.

** all cones require white reflective cone collars for nighttime operations, and for daytime or nighttime after January 1, 2002.

*** TCBs required if practicable. If not practicable, an LBA (if physically possible) and buffer vehicle(s) are required.

**** Where space permits, TC-54s should be used on freeways rather than TC-52s.

VSD = Very Short Duration

SD = Short Duration

LD = Long Duration

TCB = Temporary Concrete Barrier

No = Must not be used

Table F – Decision Matrix: Typical Layouts

Type of Activity	Type of Work							
	Mobile Operations (continuously moving)		**Very Short Duration** (30 minutes or less, including set up/take down time)		**Short Duration** (more than 30 minutes, up to 24 hours)[1]		**Long Duration** (more than 24 hours)	
	Undivided	Divided	Undivided	Divided	Undivided	Divided	Undivided	Divided
1. Construction zone advisory signing							TL-1 2-lane and ML non-Fwy	TL-2 (non-Fwy & Fwy)
2. Speed zone signing							TL-3 2-lane and ML non-Fwy	TL-4 (non-Fwy & Fwy)
3. Shoulder and roadway edge work on a two-lane road								
Right shoulder work	TL-5		TL-5		TL-6		TL-6	
Encroachment in right lane (remaining lane 3 m wide or more)	TL-7		TL-7		TL-8		TL-8	
Partial lane shift (remaining lane less than 3 m wide) No parking lanes present			TL-9		TL-9			
Partial lane shift (remaining lane less than 3 m wide) Parking lane present			TL-10		TL-10			
4. Shoulder and roadway edge work on a multi-lane road								
Right shoulder work (non-freeway undivided) Right or left shoulder work (non-freeway divided)	TL-5	TL-5	TL-5	TL-5	TL-6	TL-6	TL-6	TL-6
Right or left shoulder work (freeway) (left lane is mirror image of right)		TL-11		TL-11		TL-12		TL-12
Work in median (non-freeway)		TL-5		TL-5		TL-6		TL-6
Work in median (freeway)		TL-11		TL-11		TL-12		TL-12

Table F – Decision Matrix: Typical Layouts (cont'd)

Type of Activity	Type of Work							
	Mobile Operations (continuously moving)		**Very Short Duration** (30 minutes or less, including set up/take down time)		**Short Duration** (more than 30 minutes, up to 24 hours)[1]		**Long Duration** (more than 24 hours)	
	Undivided	Divided	Undivided	Divided	Undivided	Divided	Undivided	Divided
4. Shoulder and roadway edge work on a multi-lane road (cont'd)								
Encroachment in right lane (non-freeway & freeway) (left lane is mirror image of right, for divided road only)	TL-13	TL-13	TL-13	TL-13	TL-14	TL-14 (non-Fwy) TL-15 (Fwy)	TL-14	TL-14 (non-Fwy) TL-15 (Fwy)
Parking lane occupied (non-freeway)			TL-16		TL-16		TL-16	
Passing & truck-climbing lane sections	TL-5		TL-5		TL-6		TL-6	
Narrow lanes (non-freeway & freeway)							TL-17	TL-17
5. Single lane closed								
Two-lane road – lane closed	TL-18		TL-18					
(i) Yield to oncoming traffic (low volume)					TL-19		TL-19	
(ii) Traffic control persons (TCPs)			TL-20A		TL-20A or TL-20B		TL-20A or TL-20B	
(iii) Portable or temporary traffic control signals (high volume)					TL-21		TL-21	
Multi-lane road – right lane closed (non-freeway) (left lane is mirror image of right for divided highway only)	TL-22	TL-22	TL-22	TL-22	TL-23	TL-23	TL-24	TL-24

Table F – Decision Matrix: Typical Layouts (cont'd)

Type of Activity	Type of Work							
	Mobile Operations (continuously moving)		**Very Short Duration** (30 minutes or less, including set up/take down time)		**Short Duration** (more than 30 minutes, up to 24 hours)[1]		**Long Duration** (more than 24 hours)	
	Undivided	**Divided**	**Undivided**	**Divided**	**Undivided**	**Divided**	**Undivided**	**Divided**
5. Single lane closed (cont'd)								
Multi-lane road – left lane closed (non-freeway)	TL-25	TL-22 or TL-25 depending on median width	TL-25	TL-22 or TL-25 depending on median width	TL-26	TL-23	TL-27	TL-24
Multi-lane road – right or left lane closed (freeway) (left lane is mirror image of right)		TL-28		TL-28		TL-29		TL-29
Multi-lane road (centre lane closed) (not a two-way left-turn lane) (non-freeway or freeway)	See "Two lanes closed" in Activity Type 6							
Five-lane road – left through lane closed	TL-25		TL-25		TL-26		TL-27	
Five-lane road – two-way left-turn lane closed					TL-30		TL-30	
Passing & truck-climbing lanes								
Upbound right lane (Two-lane direction)	TL-22		TL-22		TL-23		TL-24	
Downbound lane (Single-lane direction)	TL-18				TL-31		TL-31	
Centre lane	TL-25				TL-32		TL-32	

Table F – Decision Matrix: Typical Layouts (cont'd)

Type of Activity	Type of Work							
	Mobile Operations (continuously moving)		**Very Short Duration** (30 minutes or less, including set up/take down time)		**Short Duration** (more than 30 minutes, up to 24 hours)[1]		**Long Duration** (more than 24 hours)	
	Undivided	Divided	Undivided	Divided	Undivided	Divided	Undivided	Divided
6. Two lanes closed								
Four-lane road – two lanes closed (non-freeway undivided)					TL-33		TL-33	
Four-lane road – two lanes closed (non-freeway divided or freeway) (median crossover)								TL-34A & TL-34B
Five-lane road – two through lanes closed (non-freeway)					TL-35		TL-35	
Five-lane road – two-way left-turn lane & left through lane closed (non-freeway)					TL-36		TL-36	
Six-lane road – one (centre) or two left lanes closed (non-freeway) (two right lanes closed is mirror image of two left lanes closed)					TL-37	TL-37	TL-37	TL-37
Six-lane road – one (centre) or two right lanes closed (freeway) (two left lanes closed is mirror image of two right lanes closed)						TL-38		TL-38
7. Median crossover								
Mid-block location (non-freeway & freeway) (near-side and far-side)						TL-34A & TL-34B		TL-34A & TL-34B
Intersection approach closed (work in intersection)						TL-39		TL-39

Table F – Decision Matrix: Typical Layouts (cont'd)

Type of Activity	Type of Work							
	Mobile Operations (continuously moving)		**Very Short Duration** (30 minutes or less, including set up/take down time)		**Short Duration** (more than 30 minutes, up to 24 hours)[1]		**Long Duration** (more than 24 hours)	
	Undivided	Divided	Undivided	Divided	Undivided	Divided	Undivided	Divided
8. Detour								
Roadway diversion (two-lane road)							TL-40	
Lane realignment (multi-lane road)							TL-41	TL-41
Route detour (alternative roads)					TL-42A & TL-42B	TL-42A & TL-42B	TL-42A & TL-42B	TL-42A & TL-42B
9. Ramps								
Lane closed at exit ramp					TL-43	TL-43	TL-43	TL-43
Lane closed at entrance ramp					TL-44	TL-44	TL-44	TL-44
Ramp closure					TL-45	TL-45	TL-45	TL-45
10. Intersection lane closed on two-lane road								
Near-side lane closed (TCP or detour)			TL-46		TL-46		TL-47	
Far-side lane closed (TCP or detour)			TL-48		TL-48		TL-49	
Work in intersection (TCP or detour)			TL-50		TL-50		TL-47	
11. Intersection near-side lane closed on multi-lane road								
Left lane closed (right lane closed is mirror image)			TL-51	TL-51	TL-51	TL-51	TL-51	TL-51
Right-turn lane closed			TL-52	TL-52	TL-52	TL-52	TL-52	TL-52
Left-turn lane closed			TL-53	TL-53	TL-53	TL-53	TL-53	TL-53
Right-turn lane open and adjacent through lane closed			TL-54	TL-54	TL-54	TL-54	TL-54	TL-54

Table F – Decision Matrix: Typical Layouts (cont'd)

Type of Activity	Type of Work							
	Mobile Operations (continuously moving)		**Very Short Duration** (30 minutes or less, including set up/take down time)		**Short Duration** (more than 30 minutes, up to 24 hours)[1]		**Long Duration** (more than 24 hours)	
	Undivided	Divided	Undivided	Divided	Undivided	Divided	Undivided	Divided
11. Intersection near-side lane closed on multi-lane road (cont'd)								
Left-turn lane open and adjacent through lane closed					TL-55	TL-55	TL-55	TL-55
Right-turn lane and adjacent through lane closed			TL-56	TL-56	TL-56	TL-56	TL-56	TL-56
Left-turn lane and adjacent through lane closed			TL-57	TL-57	TL-57	TL-57	TL-57	TL-57
Work in intersection: right lane closed					TL-58	TL-58	TL-58	TL-58
Work in intersection: left lane closed					TL-59	TL-59	TL-59	TL-59
Work in intersection: two lanes closed (detour)					TL-60A or TL-60B	TL-60A or TL-39	TL-60A or TL-60B	TL-60A or TL-39
12. Intersection far-side lane closed on multi-lane road								
Left lane closed (right lane closed is mirror image)			TL-61	TL-61	TL-61	TL-61	TL-61	TL-61
Right lane closed (near-side right-turn lane open)			TL-62	TL-62	TL-62	TL-62	TL-62	TL-62
Left lane closed (near-side left-turn lane open)					TL-63	TL-63	TL-63	TL-63
13. Pedestrian considerations – sidewalk detour onto roadway								
Mid-block location					TL-64	TL-64	TL-64	TL-64
Approaching an intersection					TL-65	TL-65	TL-65	TL-65
Vehicle encroachment on road/sidewalk			TL-66	TL-66	TL-66	TL-66		

Table F – Decision Matrix: Typical Layouts (cont'd)

Type of Activity	Type of Work							
	Mobile Operations (continuously moving)		**Very Short Duration** (30 minutes or less, including set up/take down time)		**Short Duration** (more than 30 minutes, up to 24 hours)[1]		**Long Duration** (more than 24 hours)	
	Undivided	Divided	Undivided	Divided	Undivided	Divided	Undivided	Divided
14. Zone painting operations								
Mobile operations – non-coning paint – two-lane road	TL-67							
Mobile operations – non-coning paint – multi-lane road	TL-68	TL-68						
Intersections – turn arrows			TL-69	TL-69	TL-69	TL-69		
Intersections – stop-lines and crosswalks			TL-70	TL-70	TL-70	TL-70		
Intersections – left lanes closed			TL-71	TL-71	TL-71	TL-71		
Intersections – right lanes closed			TL-72	TL-72	TL-72	TL-72		
15. Survey operations								
Survey work on two-lane road			TL-20A, TL-73A, B, TL-74, TL-75		TL-20A, B TL-73A, B, TL-74, TL-75			
Instrument on centreline			TL-73A, TL-74,		TL-73A, TL-74			
Survey work in intersection			TL-75	TL-75	TL-75	TL-75		
Survey work on multi-lane road (non-freeway)			TL-11, TL-25, TL-76	TL-11, TL-25, TL-76	TL-11, TL-26, TL-76	TL-11, TL-26, TL-76		
Survey work on multi-lane road (freeway)				TL-11, TL-28, TL-29		TL-11, TL-28, TL-29		

Table F – Decision Matrix: Typical Layouts (cont'd)

Type of Activity	Type of Work							
	Mobile Operations (continuously moving)		**Very Short Duration** (30 minutes or less, including set up/take down time)		**Short Duration** (more than 30 minutes, up to 24 hours)[1]		**Long Duration** (more than 24 hours)	
	Undivided	Divided	Undivided	Divided	Undivided	Divided	Undivided	Divided
16. Lane closure set-up procedures (freeway)								
Right or left lane (with shoulders)						TL-77A, B, C		
Two right or left lanes (with shoulders) (six-lane freeway) (two left lanes closure is mirror image of two right lanes closure)						TL-78A, B, C, D		
Two left or right lanes (no shoulders) (six-lane freeway) (two right lanes closure is mirror image of two left lanes closure)						TL-79A, B, C, D, E		
17. Lane closure removal (take-down) procedures (freeway)								
Right or left lane (with shoulders)						TL-80A, B, C		
Two right or left lanes (with shoulders) (six-lane freeway) (two left lanes closure take-down is mirror image of two right lanes closure take-down)						TL-81A, B, C, D		
Two left or right lanes (no shoulders) (six-lane freeway) (two right lanes closure take-down is mirror image of two left lanes closure take-down)						TL-82A, B, C, D		

Notes:

1. Short Duration: Operations taking more than 30 minutes, up to 24 hours in duration. Conditions apply for nighttime work and for repeated, non-continuous operations at a given site.
2. If no typical layout is shown for Very Short Duration work, move to Short Duration and use the typical layout shown there.
3. Installer familiarity with the relevant typical layouts, especially TL-77 through TL-82, is essential before going out on the road.

Legend of Symbols Used in the Typical Layouts

LEGEND	
●	CONE, TC-52, OR TC-54
▬	SIGN
	TRAFFIC CONTROL PERSON (TCP)
	WORK VEHICLE, SIGN TRUCK, BLOCKER TRUCK,OR CRASH TRUCK
	FLASHING AMBER LIGHT
	AMBER 360^{O} BEACON
	WORK AREA
	PORTABLE TRAFFIC CONTROL SIGNAL
X—X	TC-53A, TC-53B (BARRICADES) OR TEMPORARY CONCRETE BARRIER
	REMOTE CONTROL DEVICE
	TC-12 ARROW MODE
	TC-12 BAR MODE

Figure 1 – Component Areas of a Temporary Work Zone

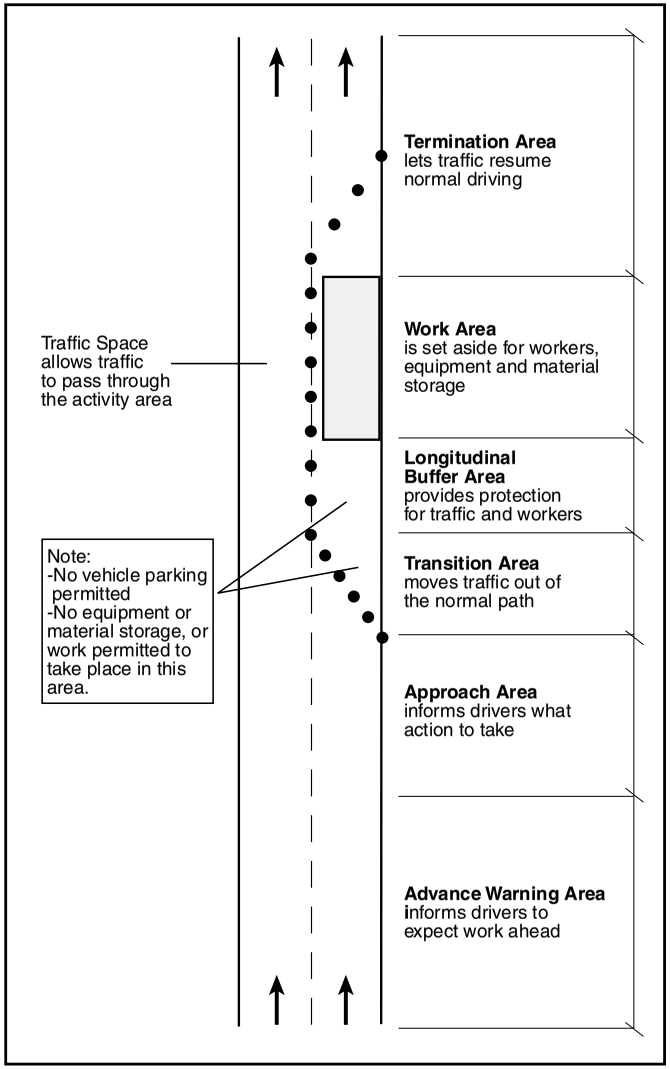


Figure A1 – Frequently used Traffic Control Devices

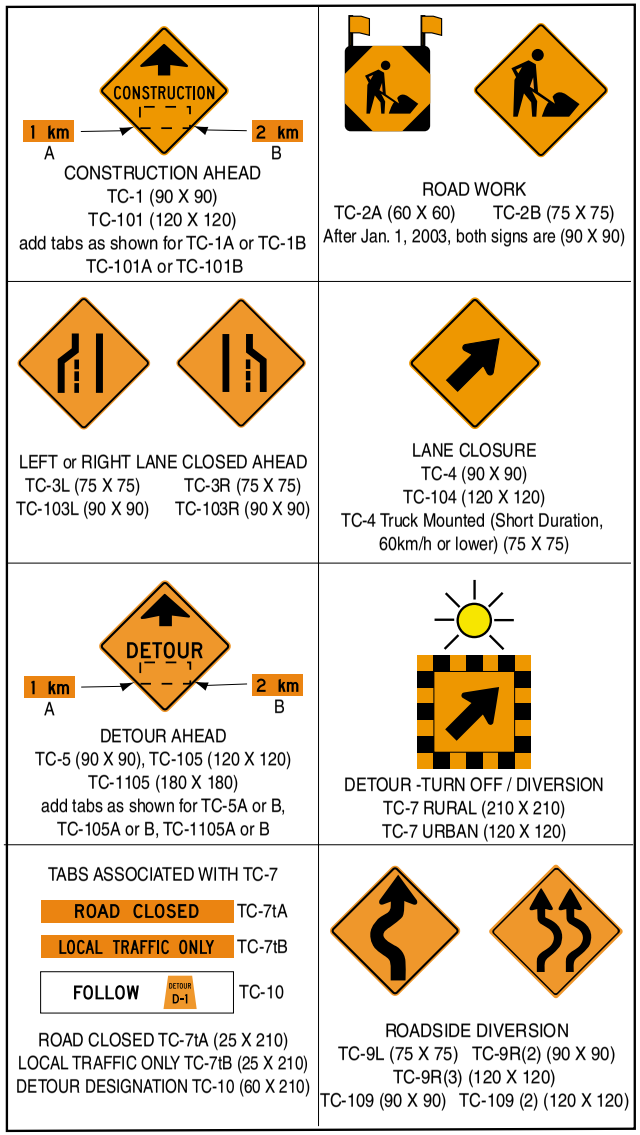


Figure A2 – Frequently used Traffic Control Devices

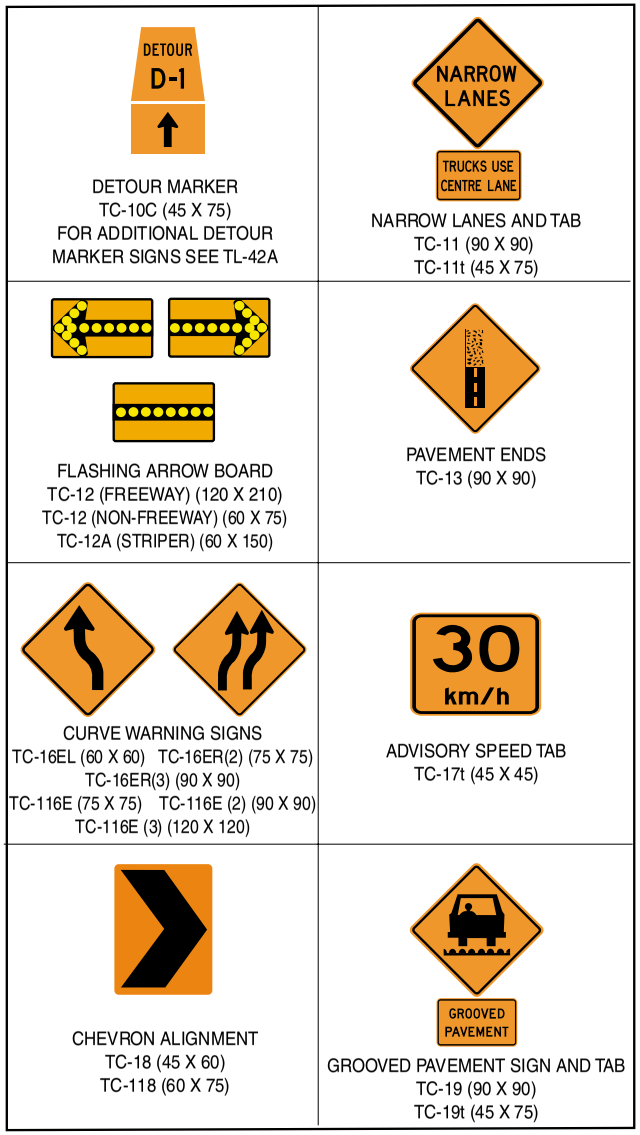


Figure A3 – Frequently used Traffic Control Devices

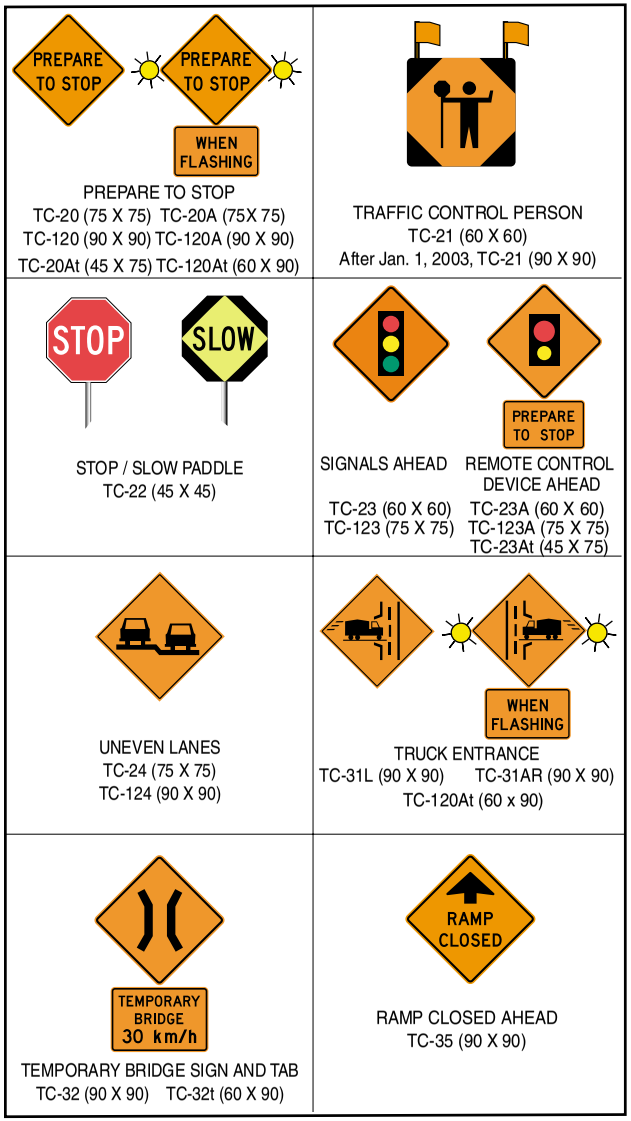


Figure A4 – Frequently used Traffic Control Devices

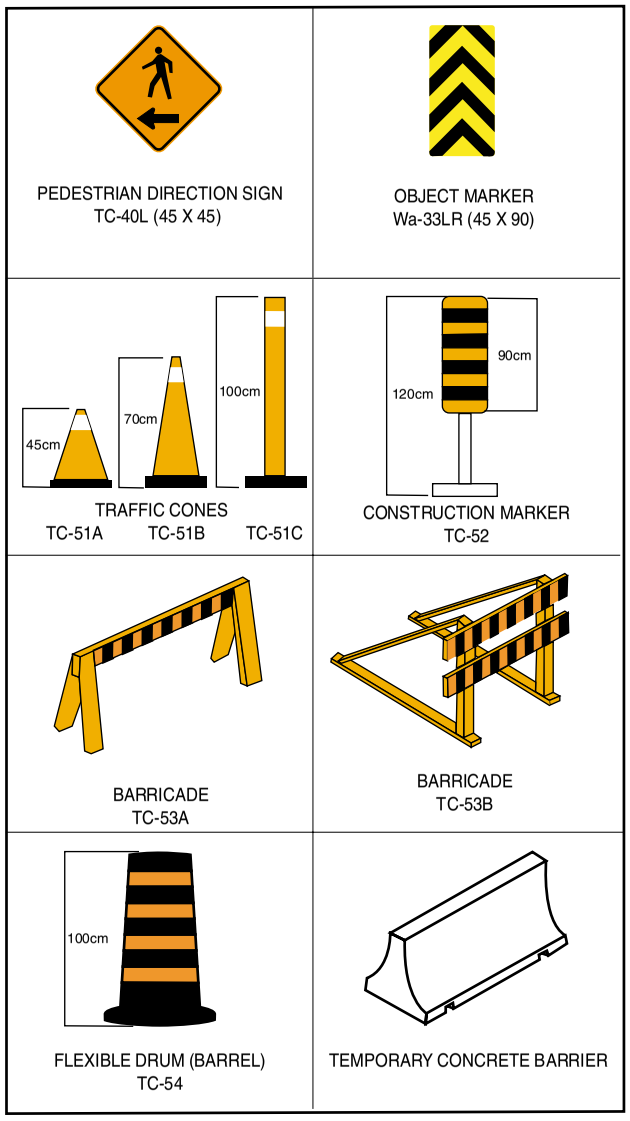
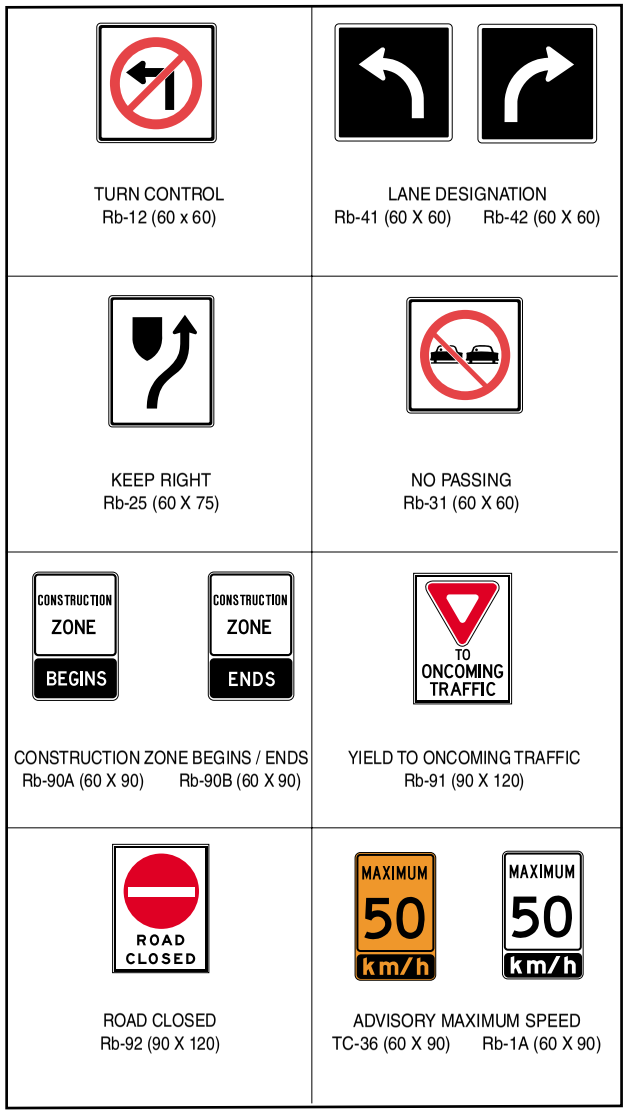
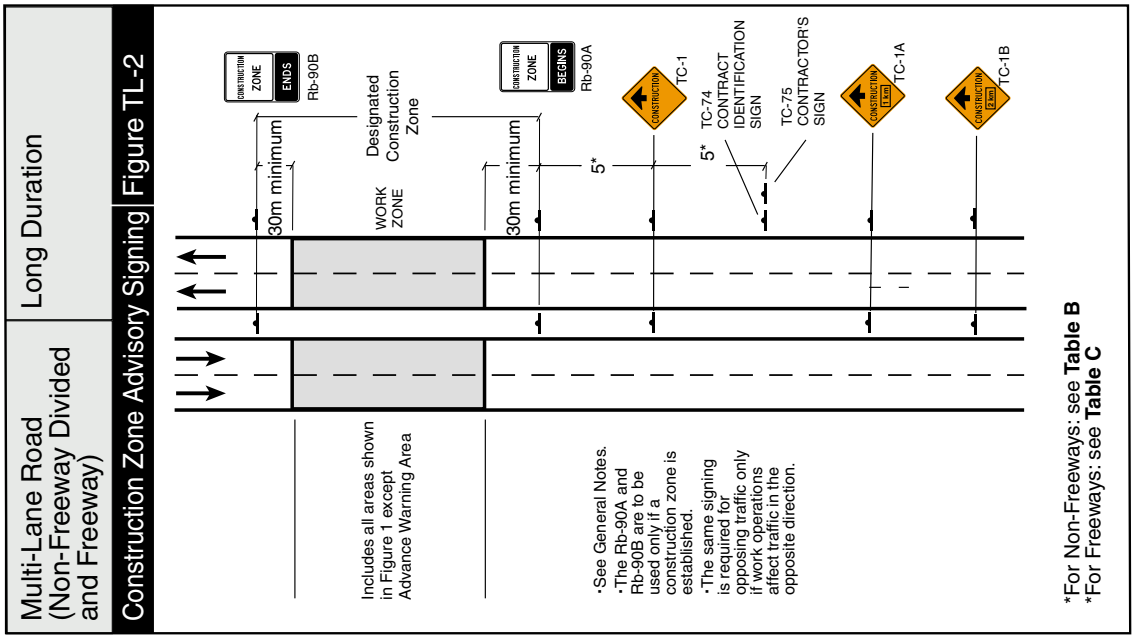
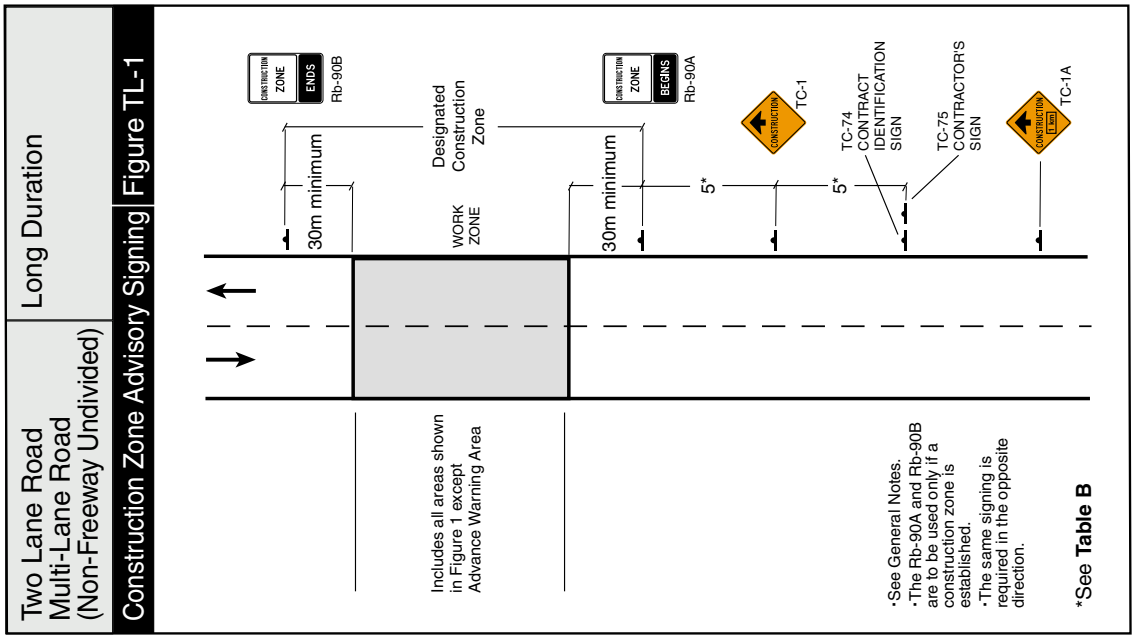
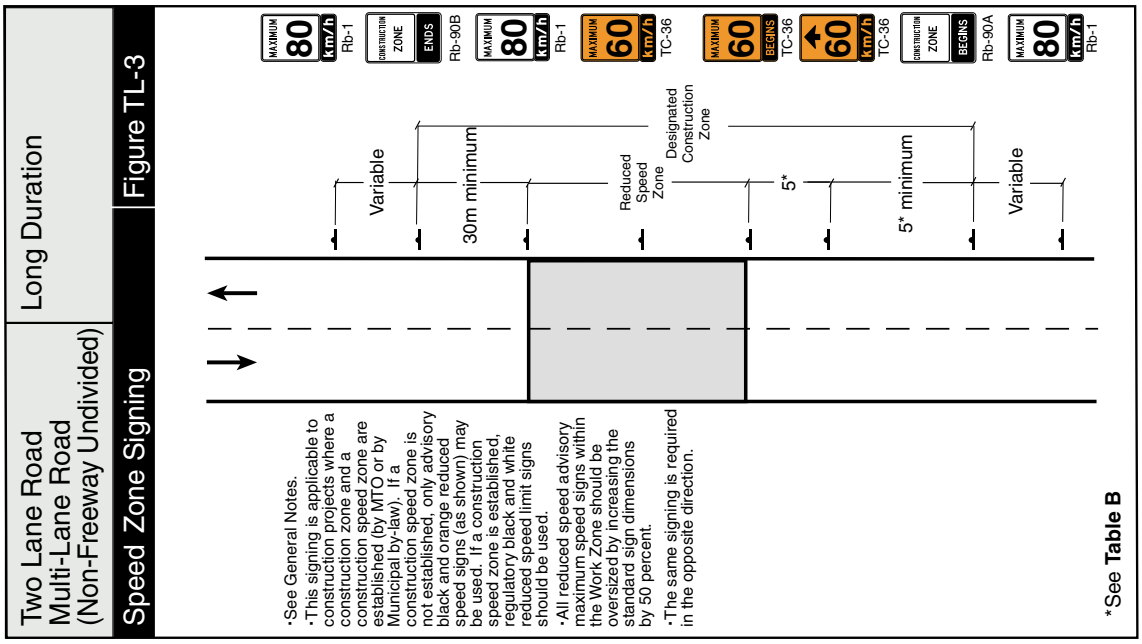


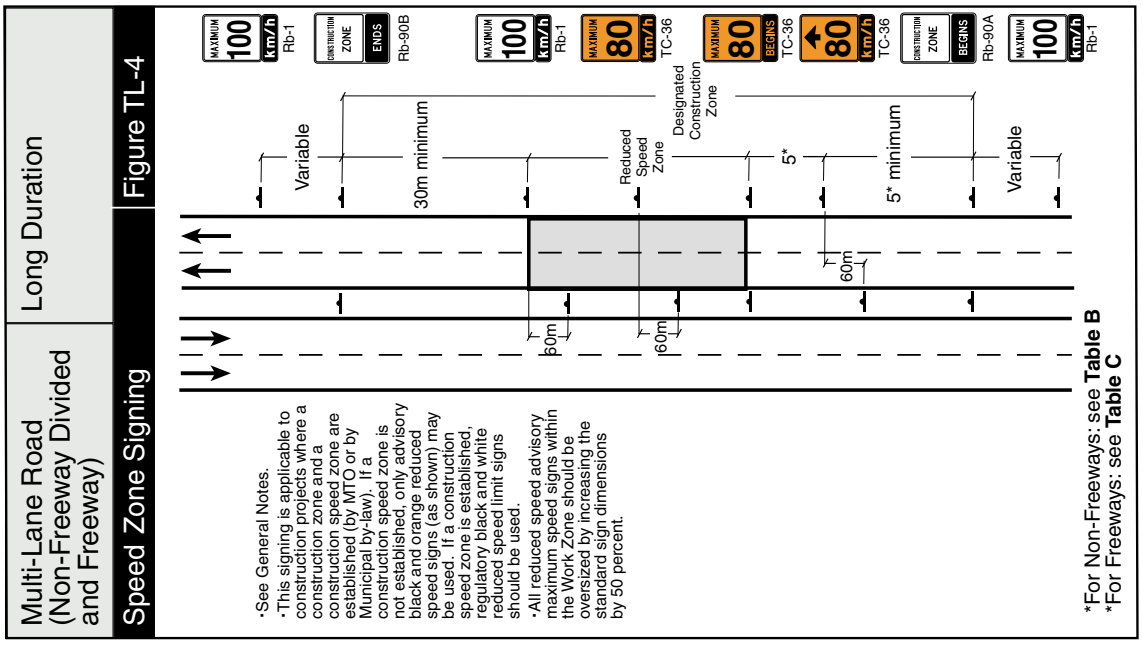
Figure A5 – Frequently used Traffic Control Devices

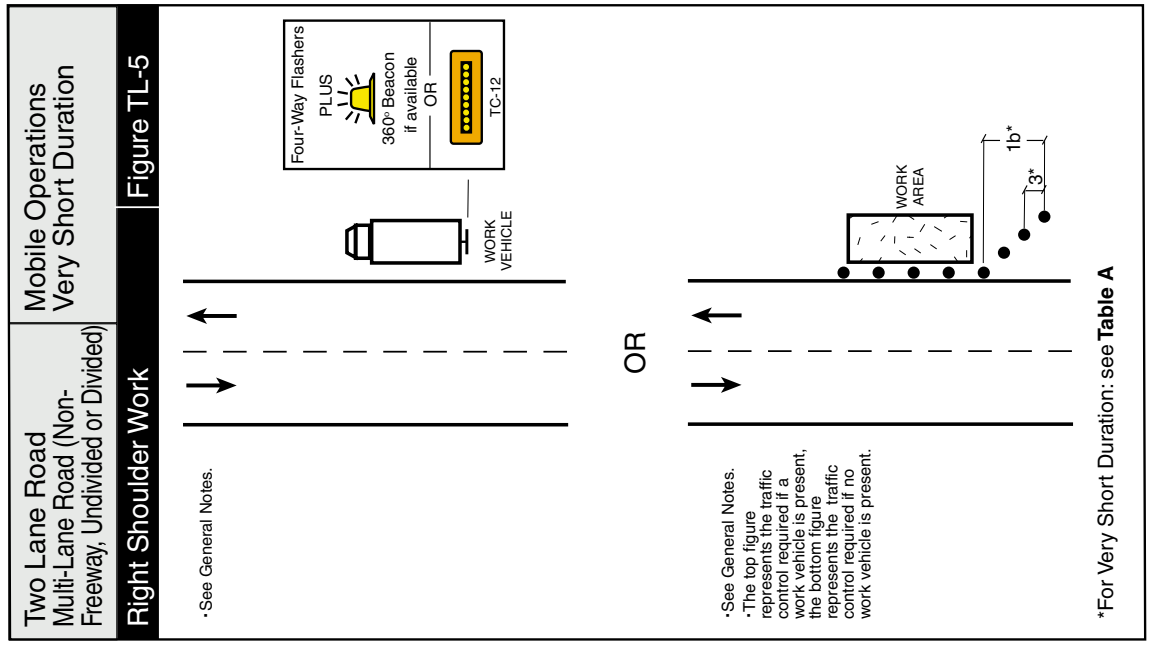


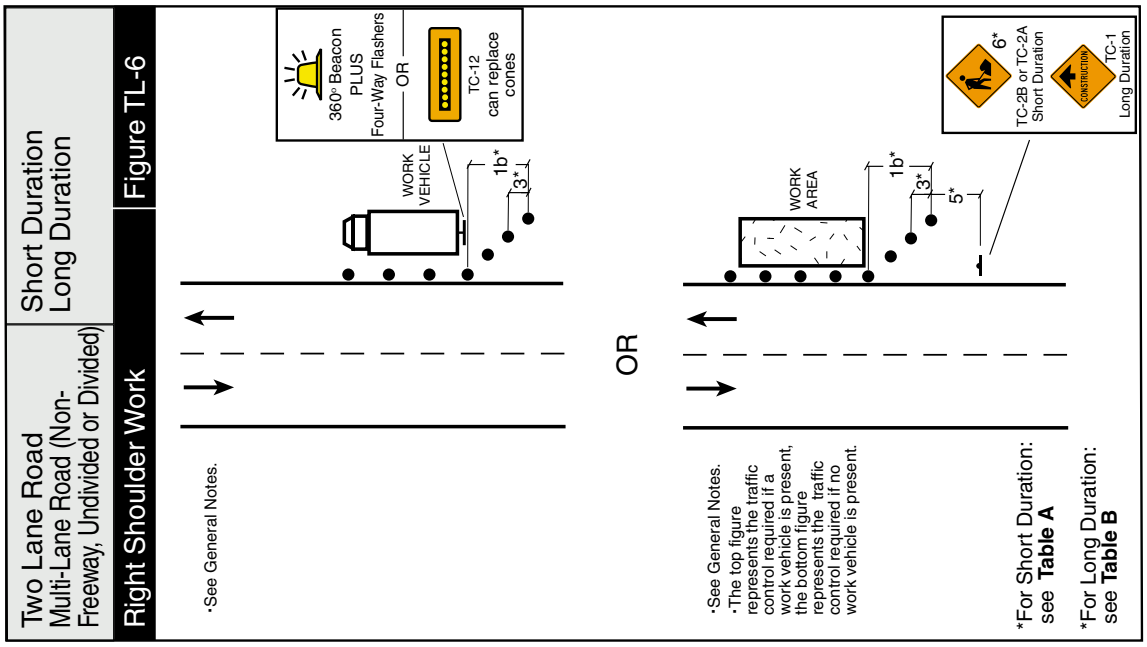

Multi-Lane Road
(Non-Freeway Divided
and Freeway)
Long Duration
Construction Zone Advisory Signing
Figure TL-2
CONSTRUCTION ZONE ENDS
Rb-90B
30m minimum
Designated
Construction
Zone
WORK
ZONE
30m minimum
CONSTRUCTION ZONE BEGINS
Rb-90A
5*
CONSTRUCTION
TC-1
5*
TC-74
CONTRACT
IDENTIFICATION
SIGN
TC-75
CONTRACTOR'S
SIGN
CONSTRUCTION 1 km
TC-1A
CONSTRUCTION 2 km
TC-1B
Includes all areas shown
in Figure 1 except
Advance Warning Area
•See General Notes.
•The Rb-90A and
Rb-90B are to be
used only if a
construction zone is
established.
•The same signing
is required for
opposing traffic only
if work operations
affect traffic in the
opposite direction.
*For Non-Freeways: see Table B
*For Freeways: see Table C

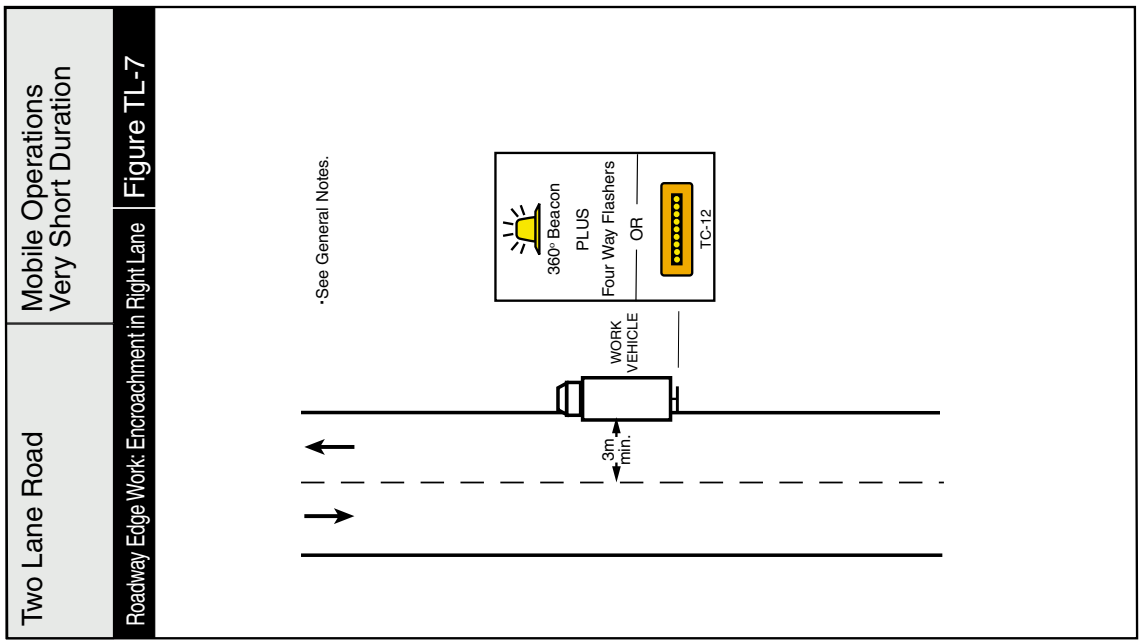

Two Lane Road
Multi-Lane Road
(Non-Freeway Undivided)
Long Duration
Construction Zone Advisory Signing
Figure TL-1
CONSTRUCTION ZONE ENDS
Rb-90B
30m minimum
Designated
Construction
Zone
WORK
ZONE
30m minimum
CONSTRUCTION ZONE BEGINS
Rb-90A
5*
CONSTRUCTION
TC-1
5*
TC-74
CONTRACT
IDENTIFICATION
SIGN
TC-75
CONTRACTOR'S
SIGN
CONSTRUCTION 1 km
TC-1A
Includes all areas shown
in Figure 1 except
Advance Warning Area
•See General Notes.
•The Rb-90A and Rb-90B
are to be used only if a
construction zone is
established.
•The same signing is
required in the opposite
direction.
*See Table B

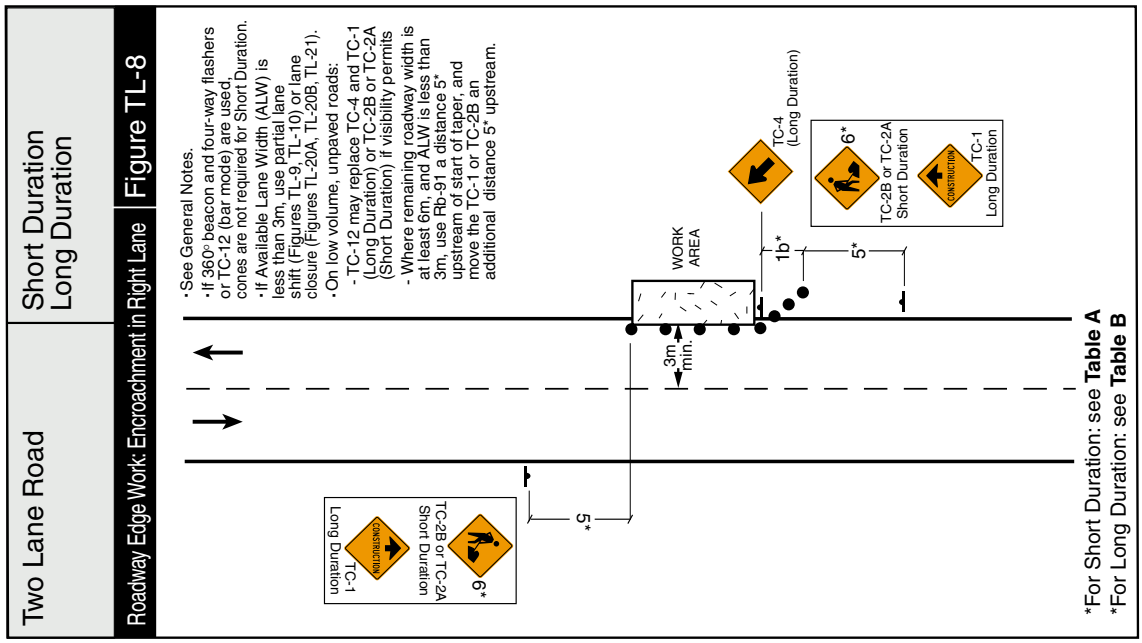

Two Lane Road
Multi-Lane Road
(Non-Freeway Undivided)
Long Duration
Speed Zone Signing
Figure TL-3
•See General Notes.
•This signing is applicable to construction projects where a construction zone and a construction speed zone are established (by MTO or by Municipal by-law). If a construction speed zone is not established, only advisory black and orange reduced speed signs (as shown) may be used. If a construction speed zone is established, regulatory black and white reduced speed limit signs should be used.
•All reduced speed advisory maximum speed signs within the Work Zone should be oversized by increasing the standard sign dimensions by 50 percent.
•The same signing is required in the opposite direction.
*See Table B
MAXIMUM 80 km/h Rb-1
CONSTRUCTION ZONE ENDS Rb-90B
MAXIMUM 80 km/h Rb-1
MAXIMUM 60 km/h TC-36
MAXIMUM 60 BEGINS TC-36
60 km/h TC-36
CONSTRUCTION ZONE BEGINS Rb-90A
MAXIMUM 80 km/h Rb-1
Variable
30m minimum
Reduced Speed Zone
Designated Construction Zone
5*
5* minimum
Variable

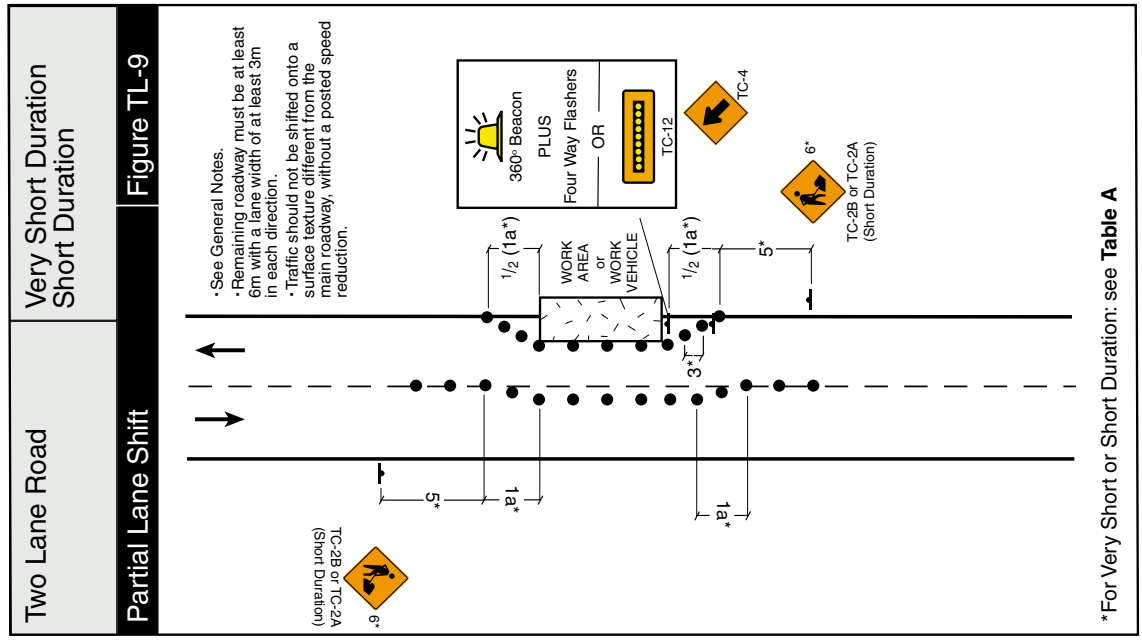

Multi-Lane Road
(Non-Freeway Divided
and Freeway)
Long Duration
Speed Zone Signing
Figure TL-4
•See General Notes.
•This signing is applicable to construction projects where a construction zone and a construction speed zone are established (by MTO or by Municipal by-law). If a construction speed zone is not established, only advisory black and orange reduced speed signs (as shown) may be used. If a construction speed zone is established, regulatory black and white reduced speed limit signs should be used.
•All reduced speed advisory maximum speed signs within the Work Zone should be oversized by increasing the standard sign dimensions by 50 percent.
*For Non-Freeways: see Table B
*For Freeways: see Table C
MAXIMUM 100 km/h Rb-1
CONSTRUCTION ZONE ENDS Rb-90B
MAXIMUM 100 km/h Rb-1
MAXIMUM 80 km/h TC-36
MAXIMUM 80 BEGINS TC-36
80 km/h TC-36
CONSTRUCTION ZONE BEGINS Rb-90A
MAXIMUM 100 km/h Rb-1
Variable
30m minimum
60m
Reduced Speed Zone
60m
Designated Construction Zone
5*
60m
5* minimum
Variable

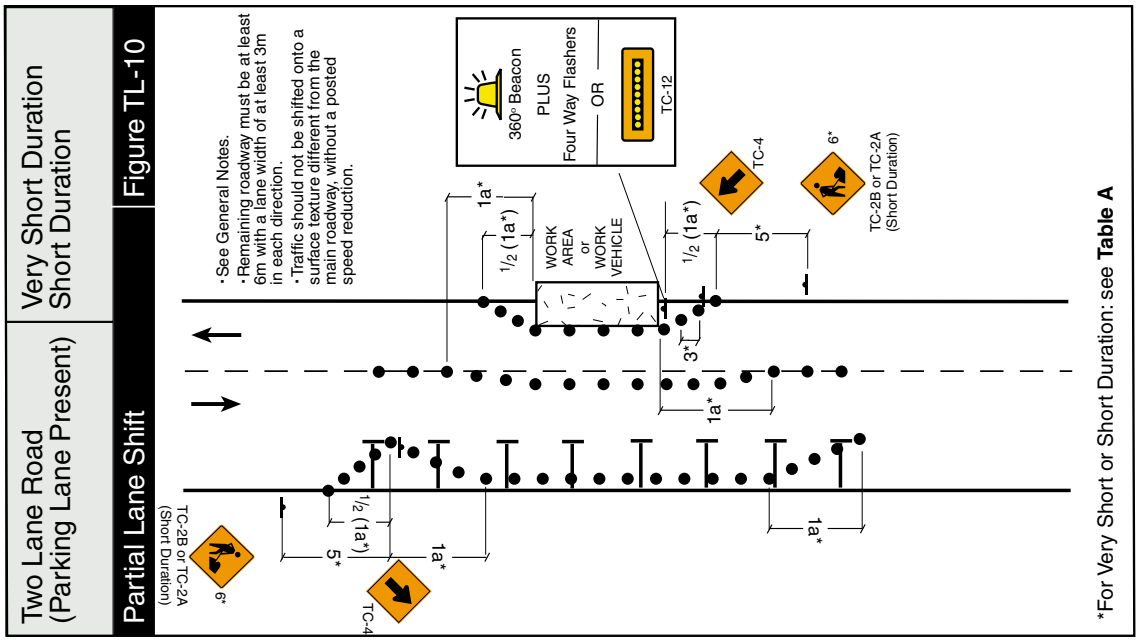

Two Lane Road
Multi-Lane Road (Non-Freeway, Undivided or Divided)
Mobile Operations
Very Short Duration
Right Shoulder Work
Figure TL-5
•See General Notes.
Four-Way Flashers
PLUS
360° Beacon if available
OR
TC-12
WORK VEHICLE
OR
WORK AREA
1b*
3*
•See General Notes.
•The top figure represents the traffic control required if a work vehicle is present, the bottom figure represents the traffic control required if no work vehicle is present.
*For Very Short Duration: see Table A


Two Lane Road
Multi-Lane Road (Non-Freeway, Undivided or Divided)
Short Duration
Long Duration
Right Shoulder Work
Figure TL-6
•See General Notes.
360° Beacon
PLUS
Four-Way Flashers
OR
TC-12
can replace cones
WORK VEHICLE
1b*
3*
OR
WORK AREA
1b*
3*
5*
6*
TC-2B or TC-2A
Short Duration
TC-1
Long Duration
•See General Notes.
•The top figure represents the traffic control required if a work vehicle is present, the bottom figure represents the traffic control required if no work vehicle is present.
*For Short Duration: see Table A
*For Long Duration: see Table B

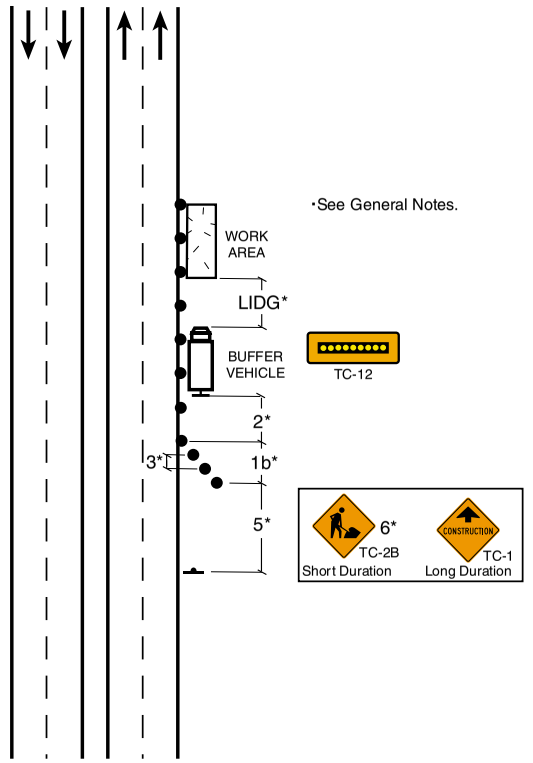

Two Lane Road
Mobile Operations
Very Short Duration
Roadway Edge Work: Encroachment in Right Lane
Figure TL-7
•See General Notes.
360° Beacon
PLUS
Four Way Flashers
OR
TC-12
WORK
VEHICLE
3m
min.


Two Lane Road
Short Duration
Long Duration
Roadway Edge Work: Encroachment in Right Lane
Figure TL-8
• See General Notes.
• If 360° beacon and four-way flashers or TC-12 (bar mode) are used, cones are not required for Short Duration.
• If Available Lane Width (ALW) is less than 3m, use partial lane shift (Figures TL-9, TL-10) or lane closure (Figures TL-20A, TL-20B, TL-21).
• On low volume, unpaved roads:
- TC-12 may replace TC-4 and TC-1 (Long Duration) or TC-2B or TC-2A (Short Duration) if visibility permits
- Where remaining roadway width is at least 6m, and ALW is less than 3m, use Rb-91 a distance 5* upstream of start of taper, and move the TC-1 or TC-2B an additional distance 5* upstream.
TC-1
Long Duration
TC-2B or TC-2A
Short Duration
6*
5*
WORK
AREA
3m
min.
1b*
5*
TC-4
(Long Duration)
6*
TC-2B or TC-2A
Short Duration
TC-1
Long Duration
*For Short Duration: see Table A
*For Long Duration: see Table B


Two Lane Road
Very Short Duration
Short Duration
Partial Lane Shift
Figure TL-9
•See General Notes.
•Remaining roadway must be at least 6m with a lane width of at least 3m in each direction.
•Traffic should not be shifted onto a surface texture different from the main roadway, without a posted speed reduction.
360° Beacon
PLUS
Four Way Flashers
OR
TC-12
TC-4
TC-2B or TC-2A (Short Duration)
WORK AREA or WORK VEHICLE
½ (1a*)
1a*
5*
3*
6*
*For Very Short or Short Duration: see Table A

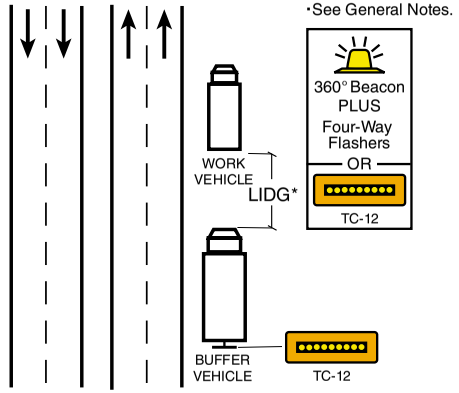

Two Lane Road
(Parking Lane Present)
Very Short Duration
Short Duration
Partial Lane Shift
Figure TL-10
•See General Notes.
•Remaining roadway must be at least 6m with a lane width of at least 3m in each direction.
•Traffic should not be shifted onto a surface texture different from the main roadway, without a posted speed reduction.
360° Beacon
PLUS
Four Way Flashers
OR
TC-12
TC-4
TC-2B or TC-2A (Short Duration)
WORK AREA or WORK VEHICLE
½ (1a*)
1a*
5*
3*
6*
*For Very Short or Short Duration: see Table A

Multi-Lane Road (Freeway)	Short Duration Long Duration
Right or Left Shoulder Work	Figure TL-12

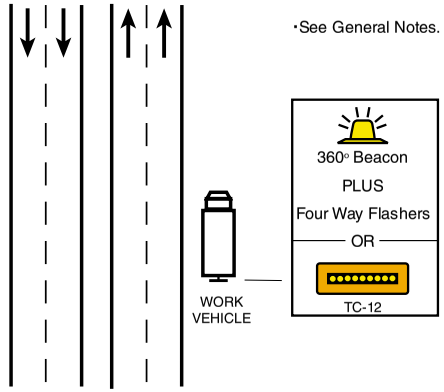


*For Freeways: see **Table C**
For Lateral Intrusion Deterrence Gap (LIDG): see **Table D**

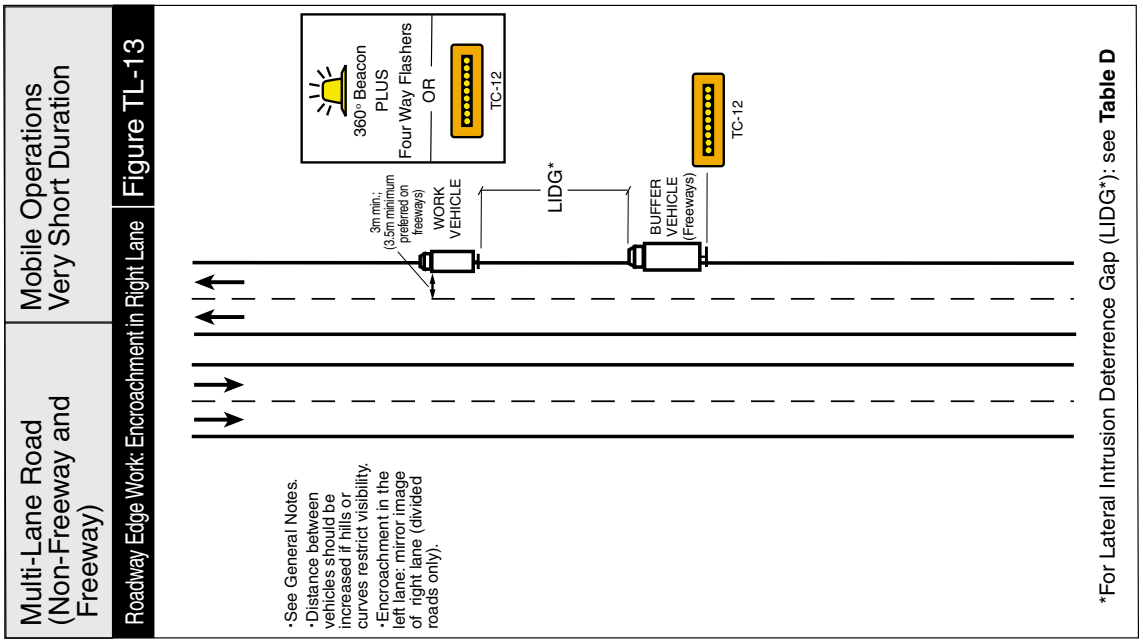
Multi-Lane Road (Freeway)	Mobile Operations Very Short Duration
Right or Left Shoulder Work	Figure TL-11

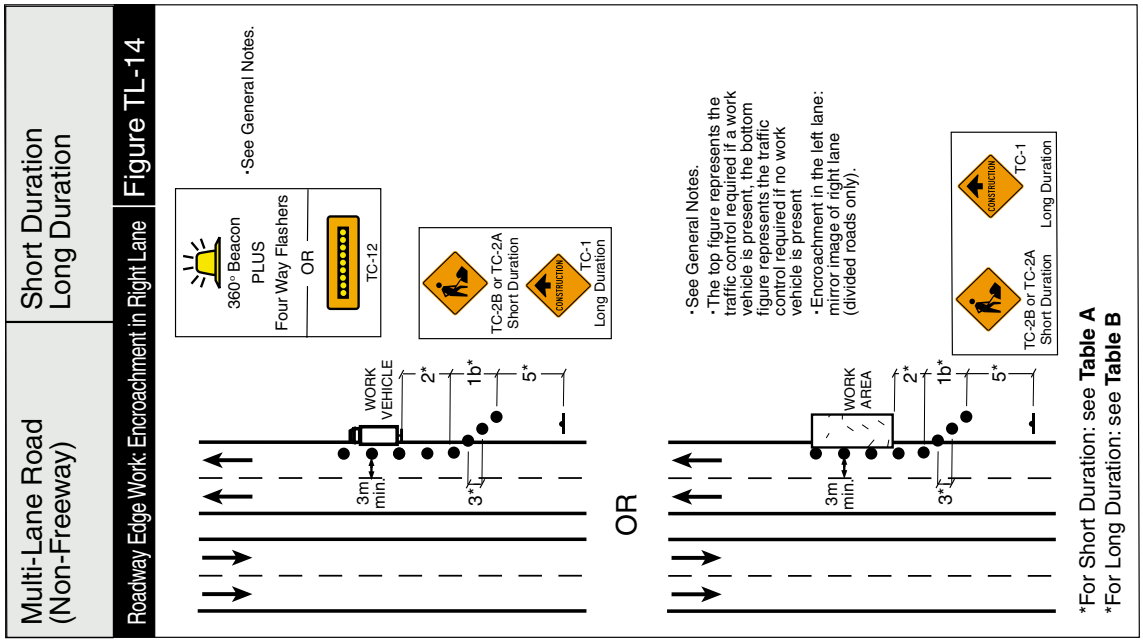


For Mobile Operations
For Lateral Intrusion Deterrence Gap (LIDG) : see **Table D**



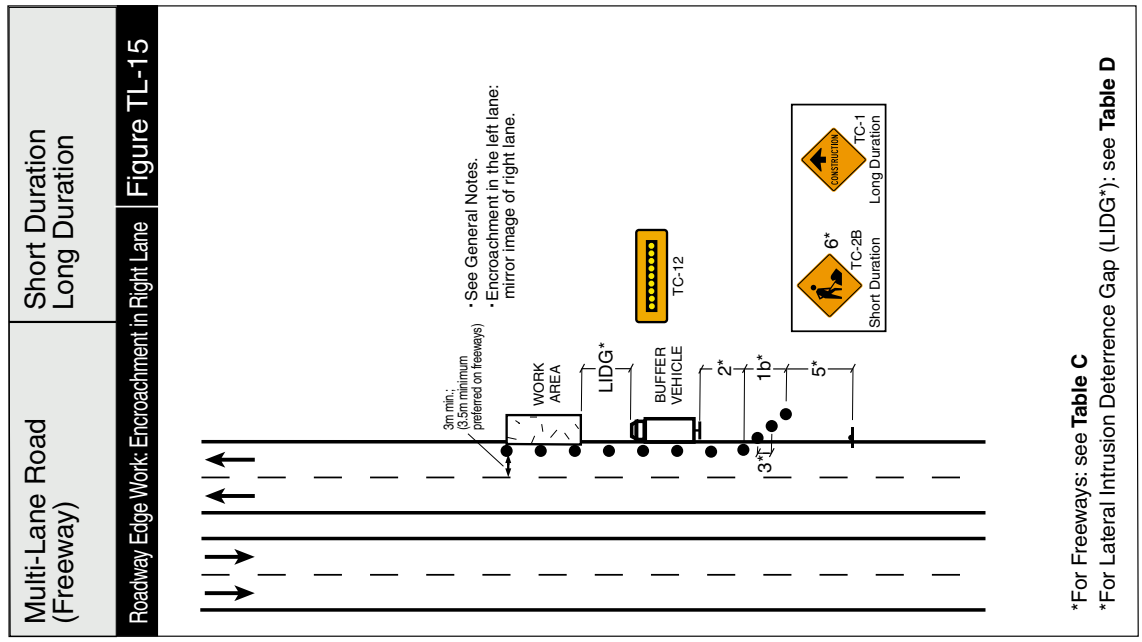
For Very Short Duration


Multi-Lane Road (Non-Freeway and Freeway)
Mobile Operations Very Short Duration
Roadway Edge Work: Encroachment in Right Lane
Figure TL-13
•See General Notes.
•Distance between vehicles should be increased if hills or curves restrict visibility.
•Encroachment in the left lane: mirror image of right lane (divided roads only).
3m min.; (3.5m minimum preferred on freeways)
WORK VEHICLE
LIDG*
BUFFER VEHICLE (Freeways)
360° Beacon
PLUS
Four Way Flashers
OR
TC-12
TC-12
For Lateral Intrusion Deterrence Gap (LIDG): see Table D


Multi-Lane Road (Non-Freeway)
Short Duration Long Duration
Roadway Edge Work: Encroachment in Right Lane
Figure TL-14
360° Beacon
PLUS
Four Way Flashers
OR
TC-12
•See General Notes.
3m min.
WORK VEHICLE
2*
1b*
3*
5*
TC-2B or TC-2A Short Duration
CONSTRUCTION
TC-1 Long Duration
OR
•See General Notes.
•The top figure represents the traffic control required if a work vehicle is present; the bottom figure represents the traffic control required if no work vehicle is present
•Encroachment in the left lane: mirror image of right lane (divided roads only).
3m min.
WORK AREA
2*
1b*
3*
5*
TC-2B or TC-2A Short Duration
CONSTRUCTION
TC-1 Long Duration
*For Short Duration: see Table A
*For Long Duration: see Table B

Multi-Lane Road (Freeway) | Short Duration Long Duration

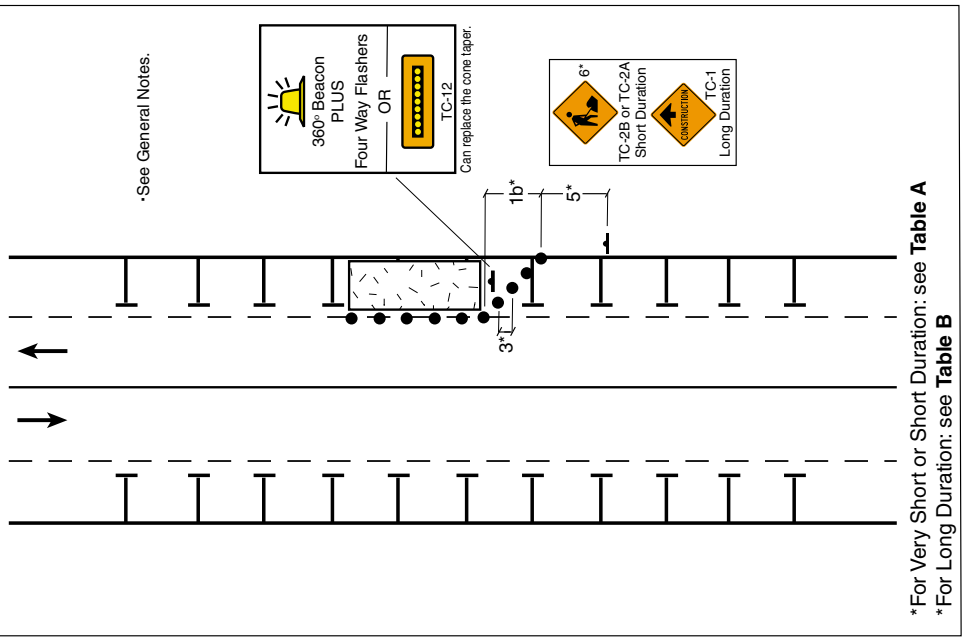
Roadway Edge Work: Encroachment in Right Lane | Figure TL-15



*For Freeways: see **Table C**
For Lateral Intrusion Deterrence Gap (LIDG): see **Table D**

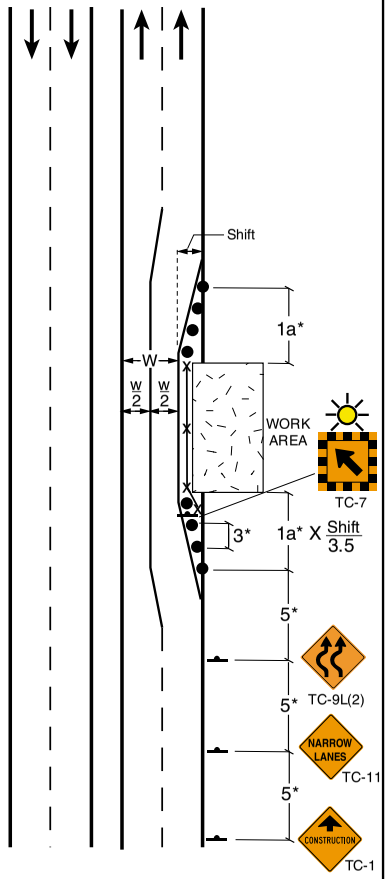
Multi-Lane Road (Non-Freeway) (Parking Lane Present) | Very Short Duration Short Duration Long Duration

Parking Lane Occupied | Figure TL-16



*For Very Short or Short Duration: see **Table A**
*For Long Duration: see **Table B**

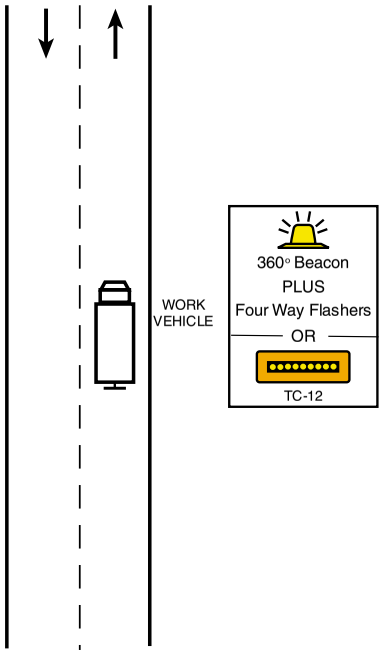
Multi-Lane Road (Non-Freeway or Freeway)	Long Duration
Narrow Lanes	Figure TL-17



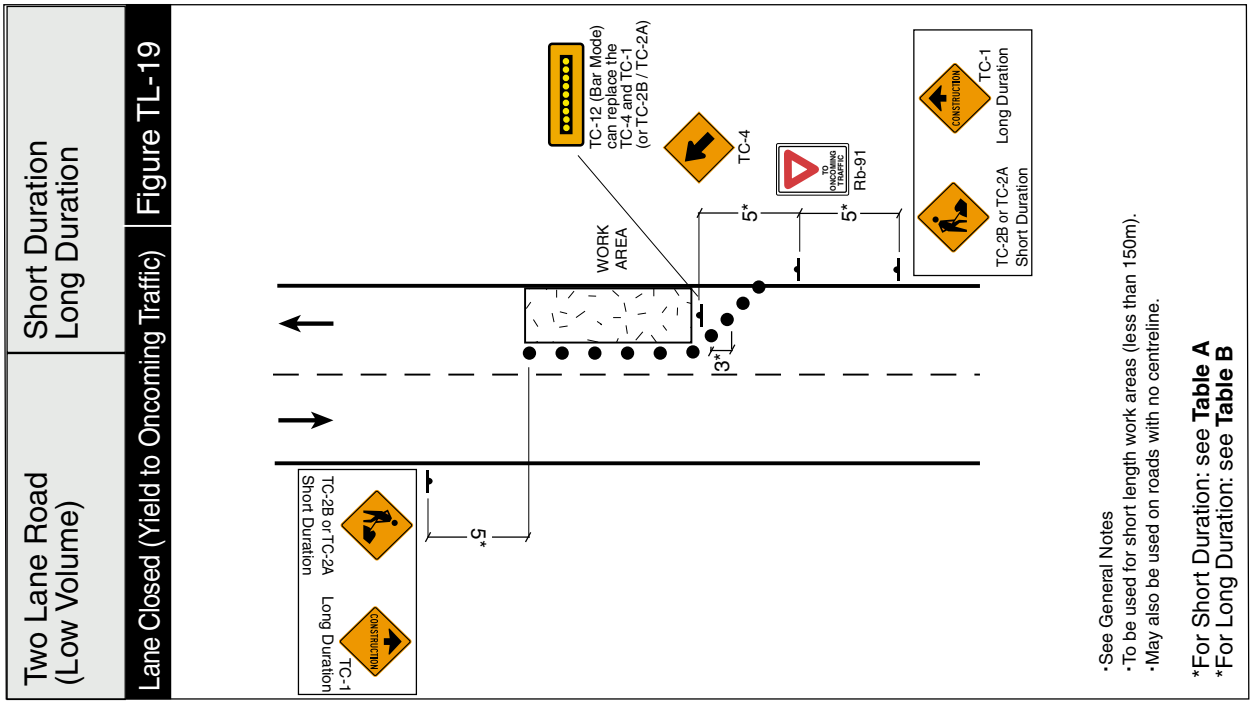
- See General Notes.
- This Typical applies to both divided and undivided roads.
- $\frac{W}{2}$ = 3m minimum (3.5m preferred on Freeways)

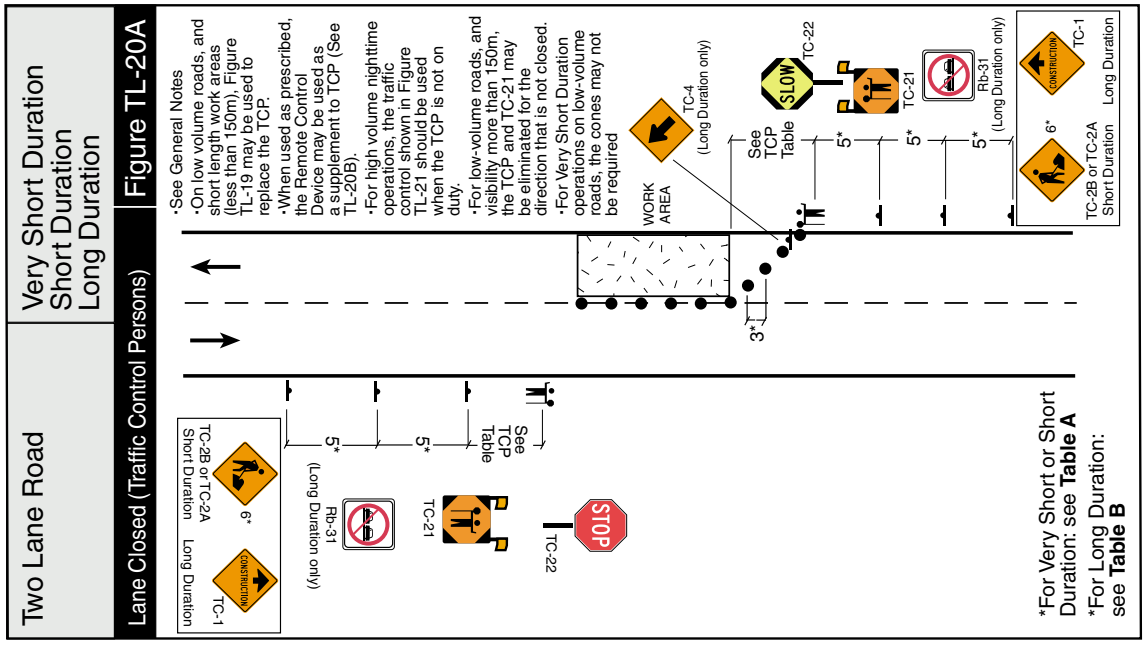
*For Long Duration (Non-Freeway): see **Table B**
*For Freeways: see **Table C**

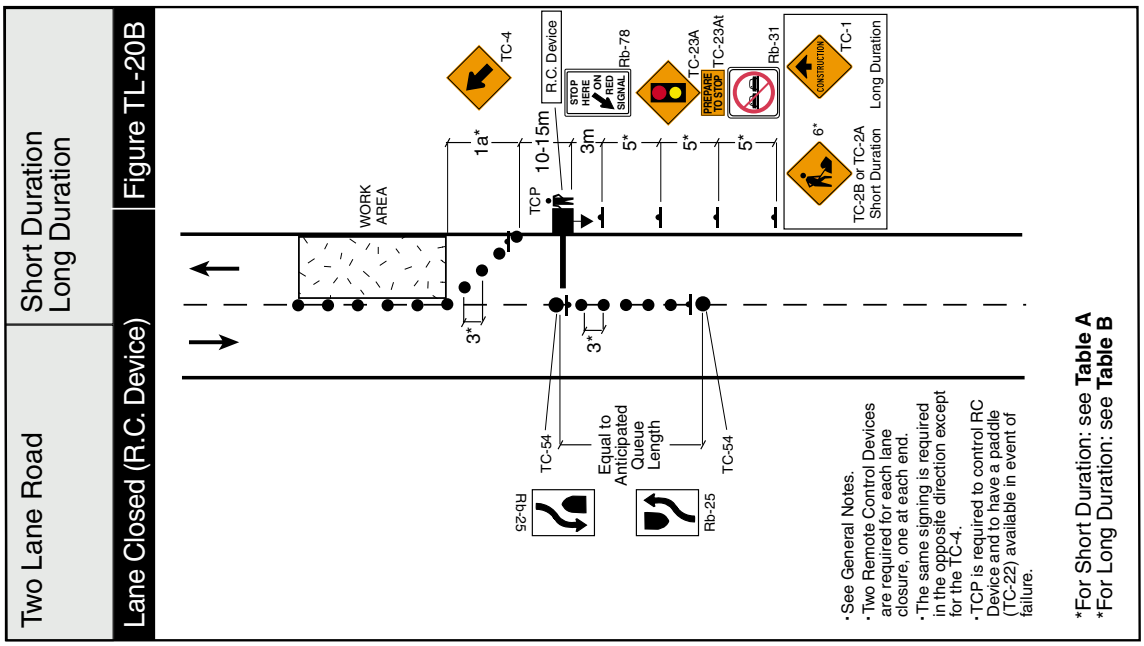
Two Lane Road	Mobile Operations Very Short Duration
Lane Closed	Figure TL-18

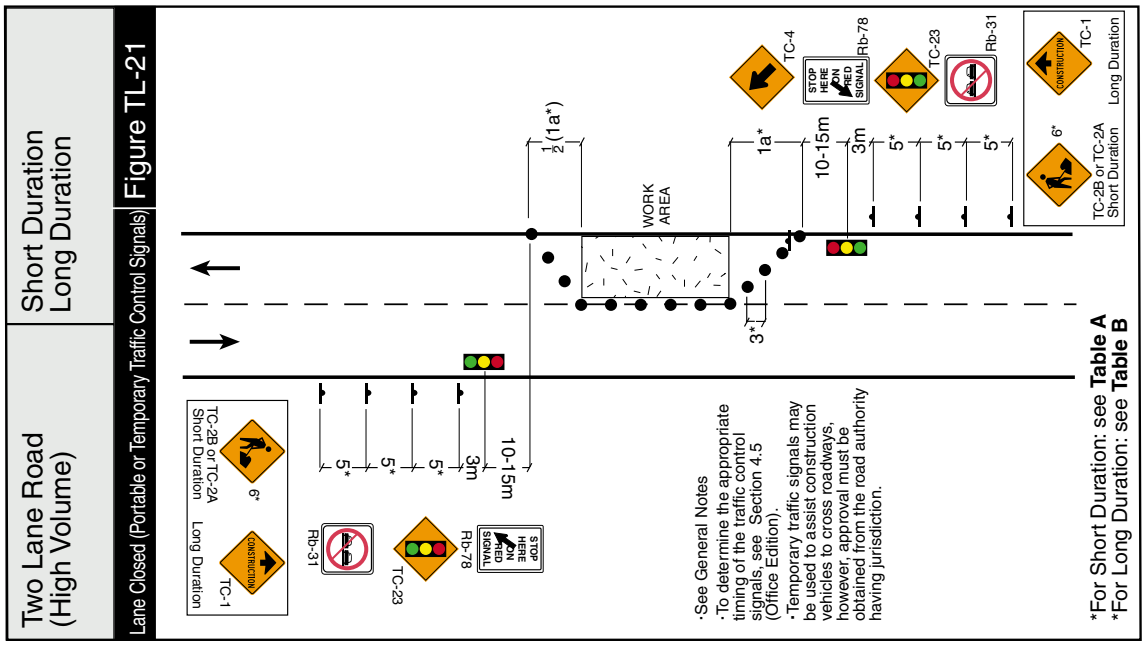


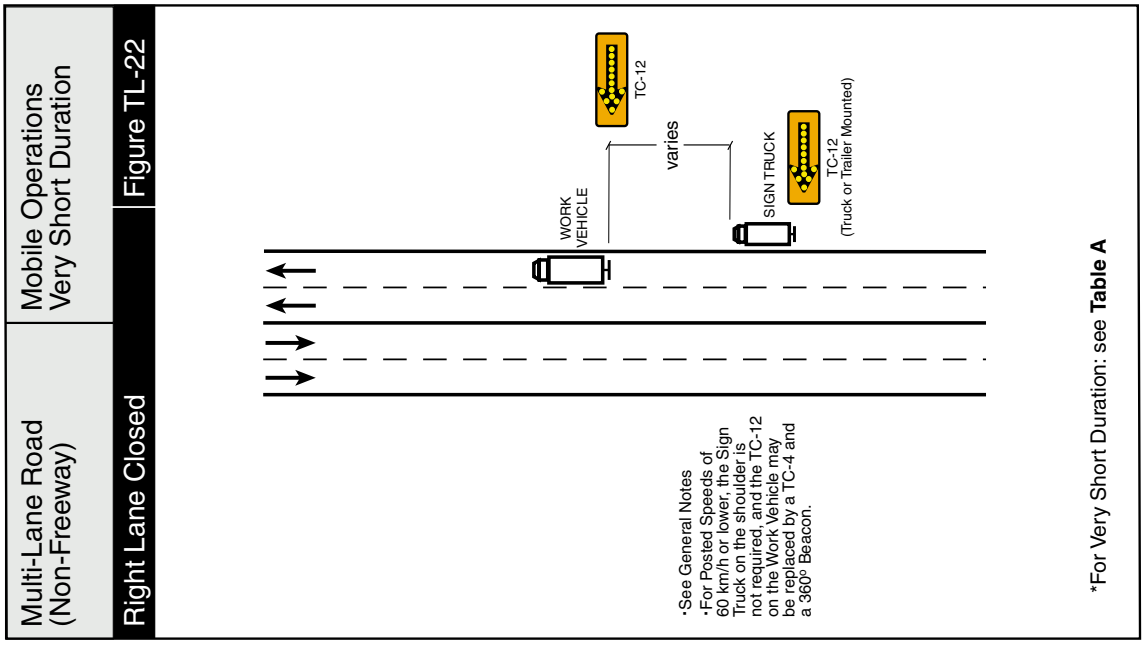
- See General Notes.
- Where high speeds, high volume, and/or poor visibility may result in safety or traffic congestion problems, consider other options such as using TL-19 or TL-20A, or working at less congested times.

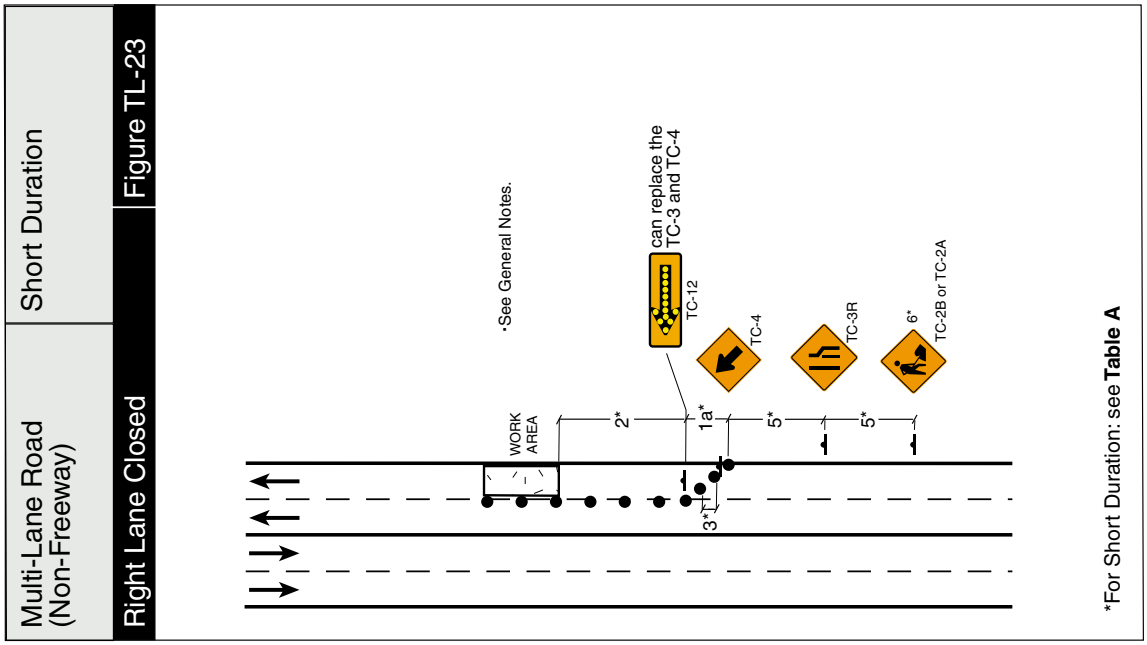

Two Lane Road
(Low Volume)
Short Duration
Long Duration
Lane Closed (Yield to Oncoming Traffic)
Figure TL-19
TC-2B or TC-2A
Short Duration
Long Duration
TC-1
CONSTRUCTION
5*
WORK
AREA
TC-12 (Bar Mode)
can replace the
TC-4 and TC-1
(or TC-2B / TC-2A)
TC-4
TO
ONCOMING
TRAFFIC
Rb-91
5*
5*
3*
TC-2B or TC-2A
Short Duration
Long Duration
TC-1
CONSTRUCTION
·See General Notes
·To be used for short length work areas (less than 150m).
·May also be used on roads with no centreline.
*For Short Duration: see Table A
*For Long Duration: see Table B

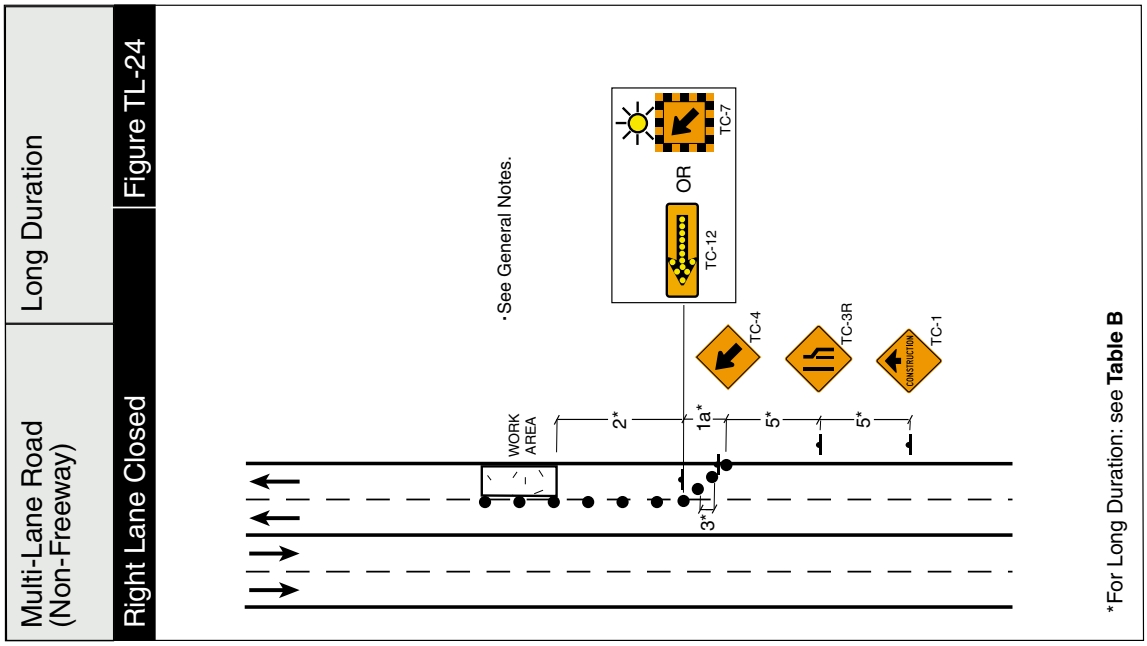

Two Lane Road
Very Short Duration
Short Duration
Long Duration
Lane Closed (Traffic Control Persons)
Figure TL-20A
TC-2B or TC-2A
Short Duration
Long Duration
TC-1
6*
5*
5*
(Long Duration only)
Rb-31
TC-21
See TCP Table
TC-22
STOP
WORK AREA
TC-4
(Long Duration only)
3*
SLOW
*For Very Short or Short Duration: see Table A
*For Long Duration: see Table B
•See General Notes
•On low volume roads, and short length work areas (less than 150m), Figure TL-19 may be used to replace the TCP.
•When used as prescribed, the Remote Control Device may be used as a supplement to TCP (See TL-20B).
•For high volume nighttime operations, the traffic control shown in Figure TL-21 should be used when the TCP is not on duty.
•For low-volume roads, and visibility more than 150m, the TCP and TC-21 may be eliminated for the direction that is not closed.
•For Very Short Duration operations on low-volume roads, the cones may not be required


Two Lane Road
Short Duration
Long Duration
Lane Closed (R.C. Device)
Figure TL-20B
WORK AREA
3*
1a*
TCP
10-15m
3m
5*
5*
5*
TC-4
R.C. Device
STOP HERE ON RED SIGNAL
Rb-78
TC-23A
TC-23At
PREPARE TO STOP
Rb-31
TC-1
CONSTRUCTION
6*
TC-2B or TC-2A
Short Duration
Long Duration
TC-54
Equal to Anticipated Queue Length
TC-54
Rb-25
*For Short Duration: see Table A
*For Long Duration: see Table B
•See General Notes.
•Two Remote Control Devices are required for each lane closure, one at each end.
•The same signing is required in the opposite direction except for the TC-4.
•TCP is required to control RC Device and to have a paddle (TC-22) available in event of failure.

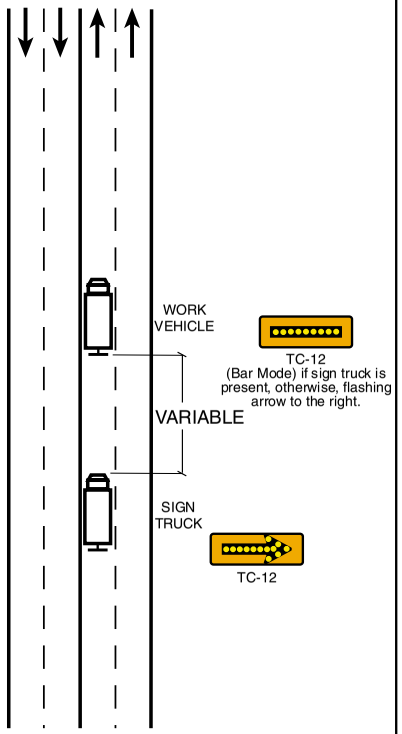

Two Lane Road
(High Volume)
Short Duration
Long Duration
Lane Closed (Portable or Temporary Traffic Control Signals)
Figure TL-21
TC-2B or TC-2A
Short Duration
Long Duration
TC-1
6*
5*
5*
5*
3m
10-15m
Rb-31
TC-23
Rb-78
STOP HERE ON RED SIGNAL
WORK AREA
1/2(1a*)
3*
1a*
10-15m
3m
5*
5*
5*
TC-4
Rb-78
TC-23
Rb-31
TC-2B or TC-2A
Short Duration
6*
TC-1
Long Duration
·See General Notes
·To determine the appropriate timing of the traffic control signals, see Section 4.5 (Office Edition).
·Temporary traffic signals may be used to assist construction vehicles to cross roadways, however, approval must be obtained from the road authority having jurisdiction.
*For Short Duration: see Table A
*For Long Duration: see Table B


Multi-Lane Road
(Non-Freeway)
Mobile Operations
Very Short Duration
Right Lane Closed
Figure TL-22
WORK VEHICLE
TC-12
varies
SIGN TRUCK
TC-12
(Truck or Trailer Mounted)
·See General Notes
·For Posted Speeds of 60 km/h or lower, the Sign Truck on the shoulder is not required, and the TC-12 on the Work Vehicle may be replaced by a TC-4 and a 360° Beacon.
*For Very Short Duration: see Table A


Multi-Lane Road (Non-Freeway)
Short Duration
Right Lane Closed
Figure TL-23
•See General Notes.
WORK AREA
2*
1a*
3*
5*
5*
6*
TC-12
can replace the TC-3 and TC-4
TC-4
TC-3R
TC-2B or TC-2A
*For Short Duration: see Table A


Multi-Lane Road (Non-Freeway)
Long Duration
Right Lane Closed
Figure TL-24
•See General Notes.
WORK AREA
2*
1a*
3*
5*
5*
TC-12
OR
TC-7
TC-4
TC-3R
TC-1
CONSTRUCTION
*For Long Duration: see Table B

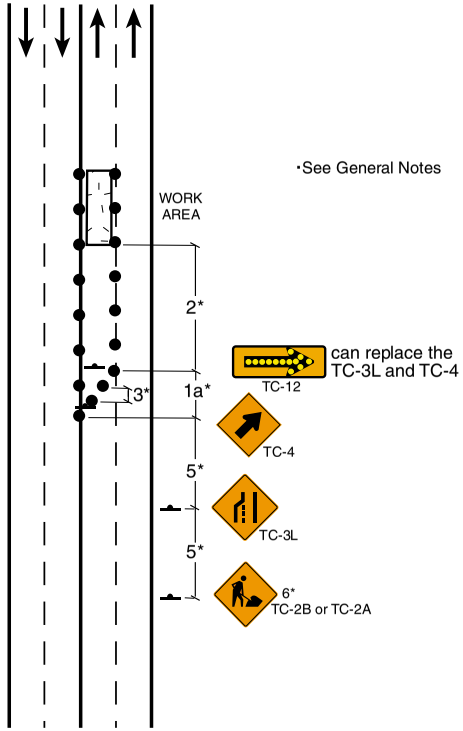
Multi-Lane Road (Non-Freeway)	Mobile Operations Very Short Duration
Left Lane Closed	Figure TL-25



.See General Notes.

• For Posted Speeds of 60 km/h or lower, the Sign Truck is not required and the TC-12 on the Work Vehicle may be replaced by a TC-4 and a 360° Beacon.

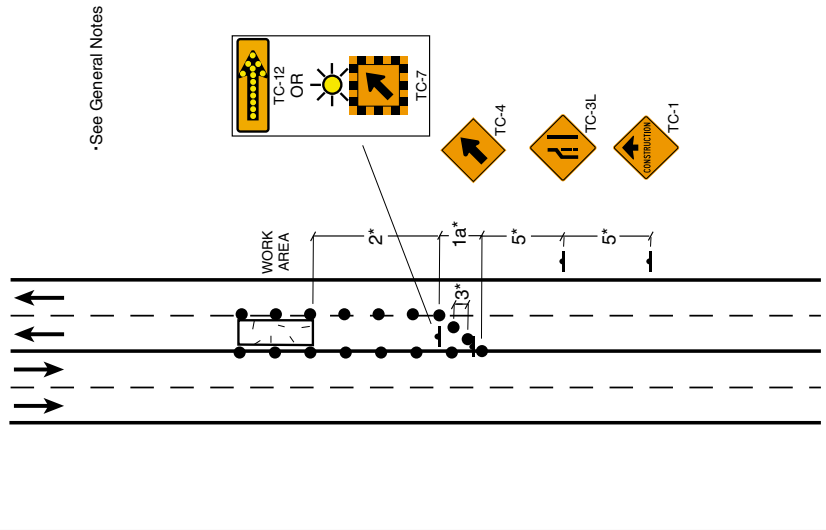
Multi-Lane Road (Non-Freeway)	Short Duration
Left Lane Closed	Figure TL-26



*For Short Duration: see **Table A**

Multi-Lane Road (Non-Freeway) | Long Duration

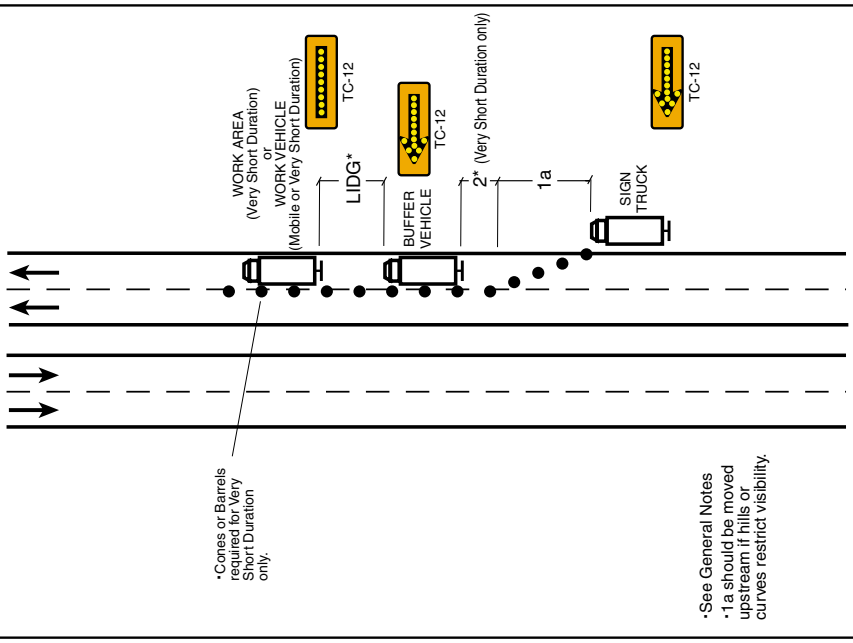
Left Lane Closed | Figure TL-27



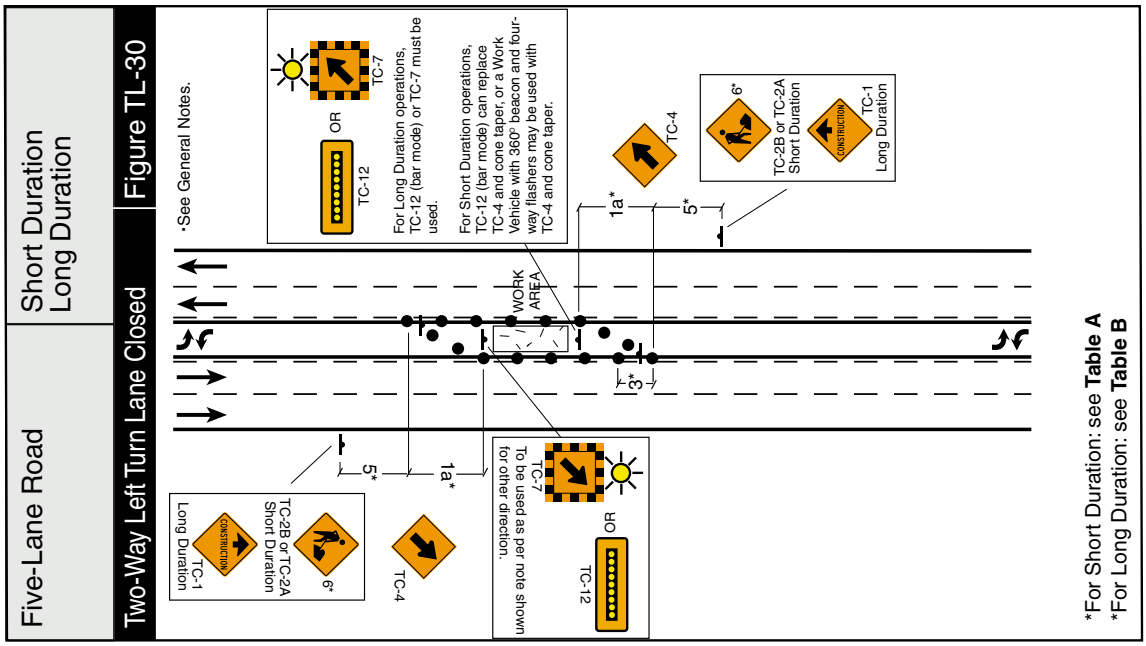
*For Long Duration: see **Table B**

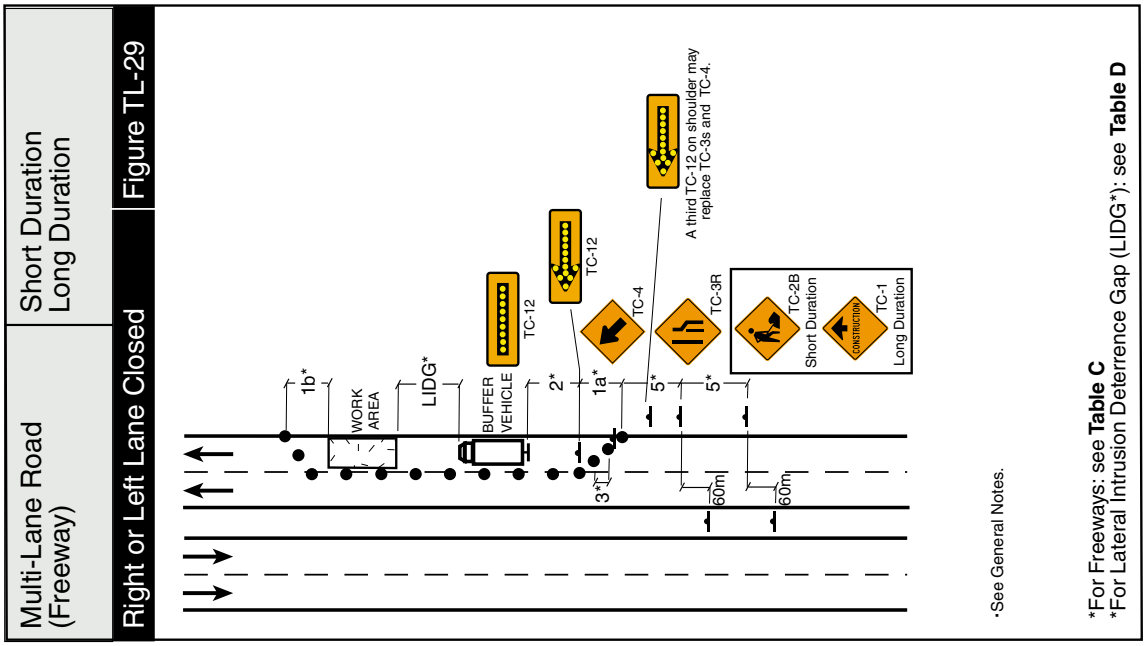
Multi-Lane Road (Freeway) | Mobile Operations Very Short Duration

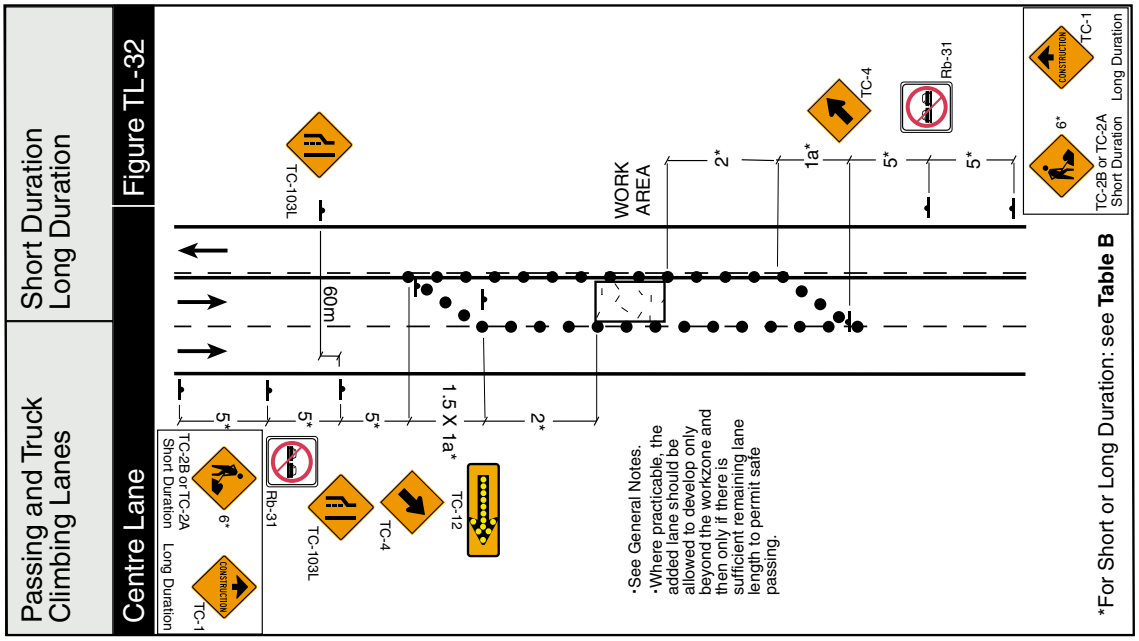
Right or Left Lane Closed | Figure TL-28

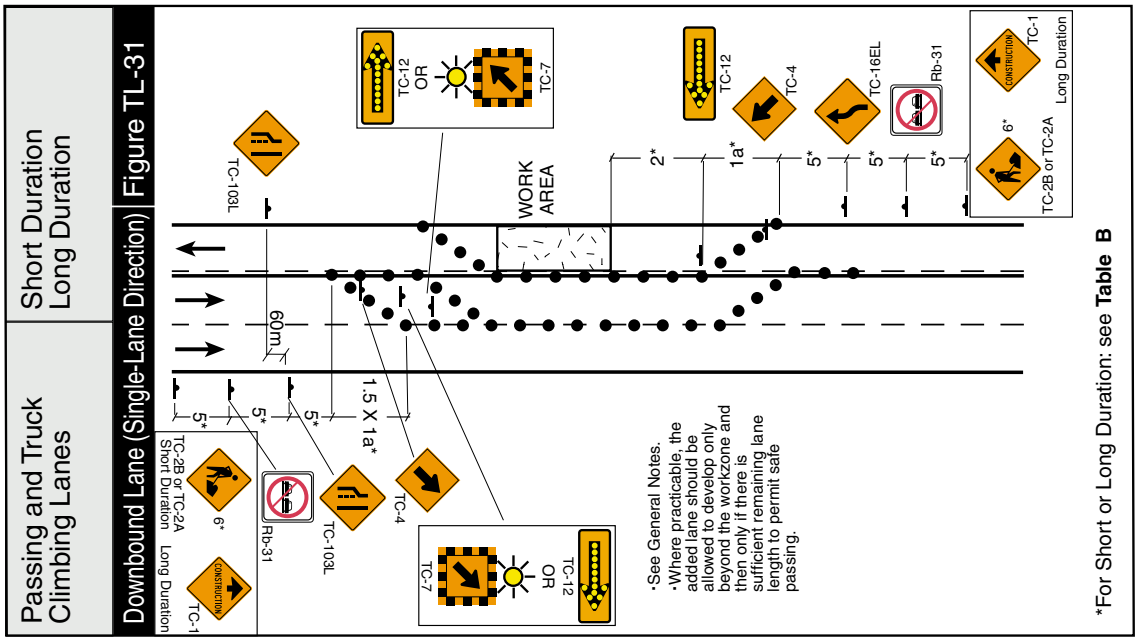


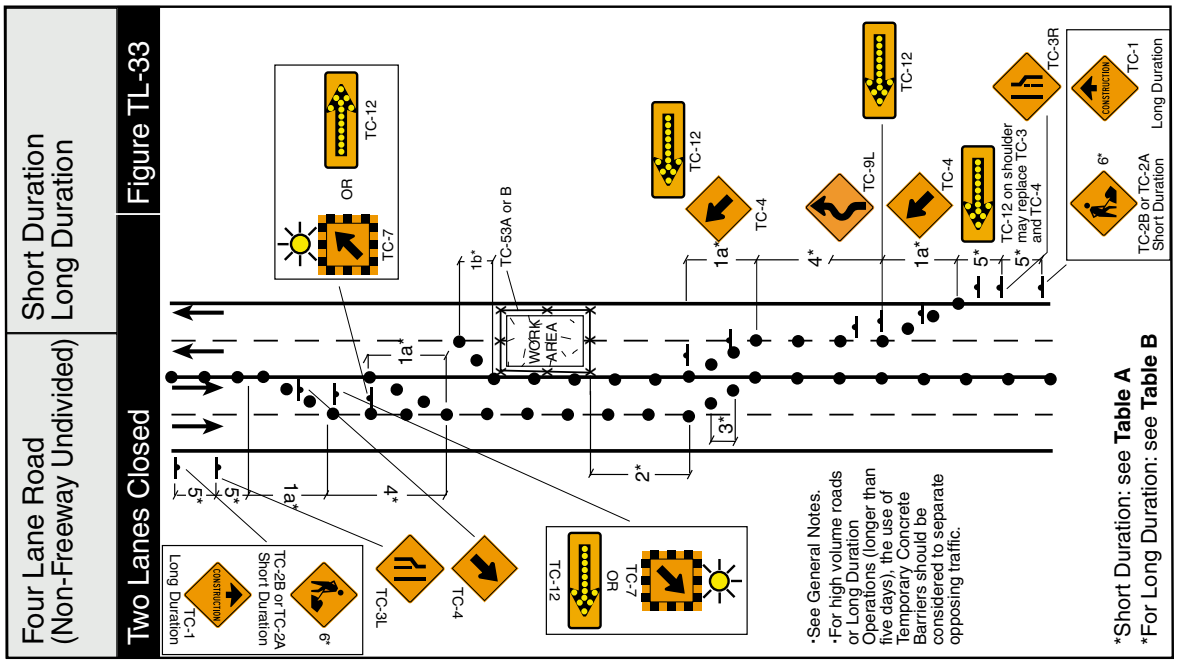
*For Freeways: see **Table C**
For Lateral Intrusion Deterrence Gap (LIDG): see **Table D**

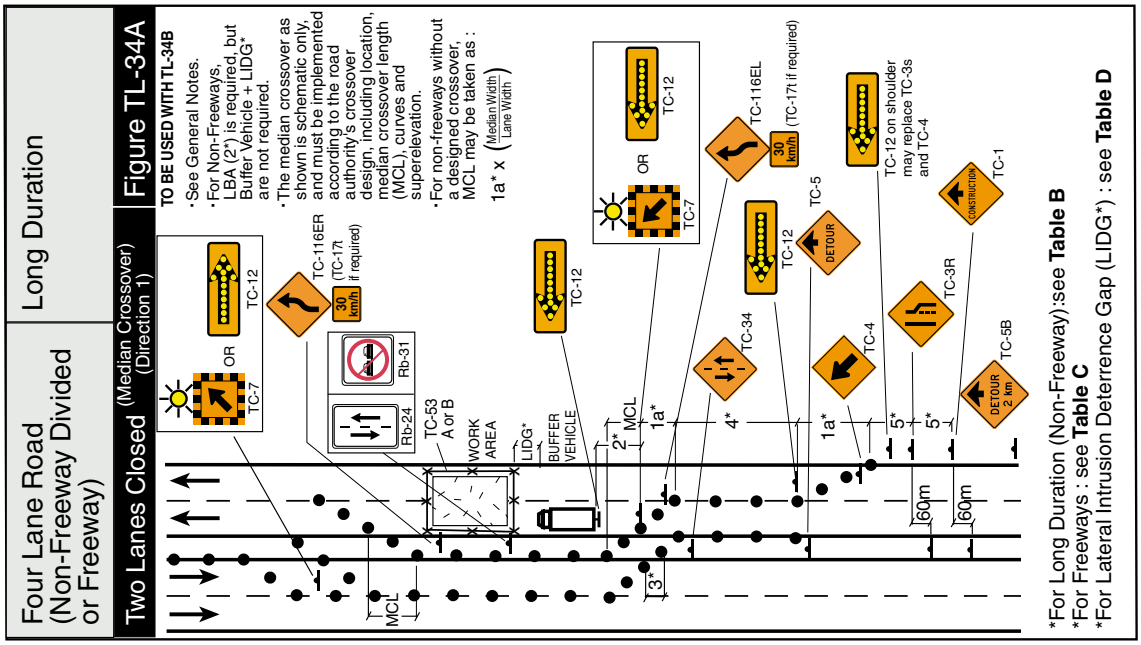

Five-Lane Road
Short Duration
Long Duration
Two-Way Left Turn Lane Closed
Figure TL-30
•See General Notes.
TC-7
OR
TC-12
For Long Duration operations, TC-12 (bar mode) or TC-7 must be used.
For Short Duration operations, TC-12 (bar mode) can replace TC-4 and cone taper, or a Work Vehicle with 360° beacon and four-way flashers may be used with TC-4 and cone taper.
TC-4
1a*
5*
6*
TC-2B or TC-2A
Short Duration
TC-1
Long Duration
CONSTRUCTION
WORK AREA
3*
TC-1
Long Duration
TC-2B or TC-2A
Short Duration
TC-4
1a*
5*
TC-7
To be used as per note shown for other direction.
OR
TC-12
*For Short Duration: see Table A
*For Long Duration: see Table B

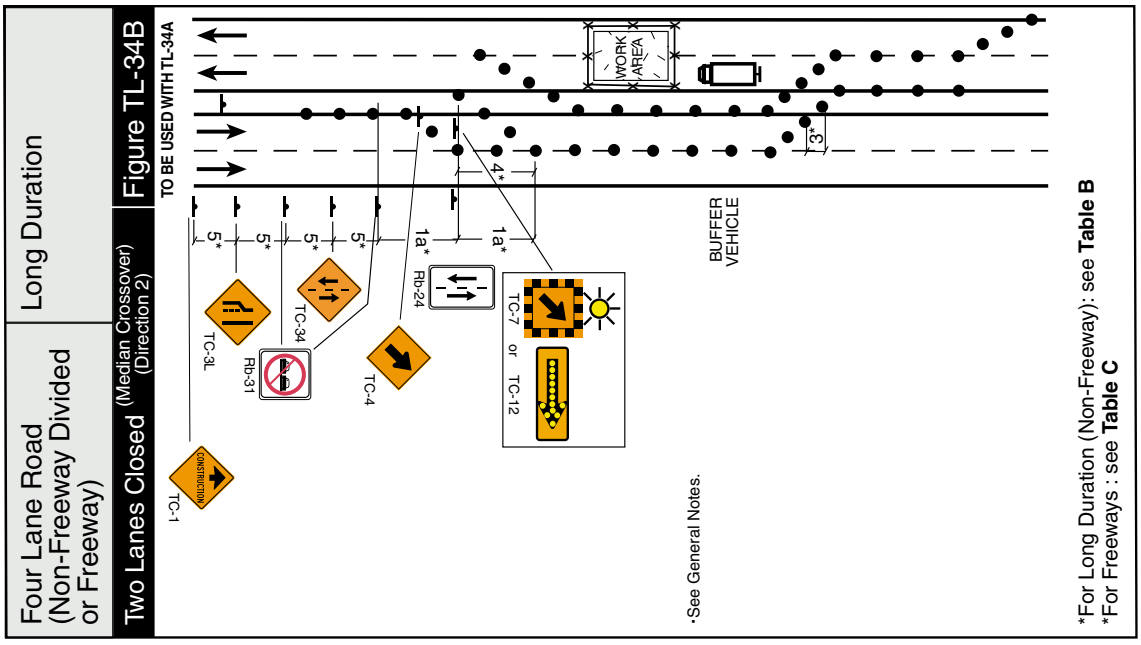

Multi-Lane Road
(Freeway)
Short Duration
Long Duration
Right or Left Lane Closed
Figure TL-29
1b*
WORK AREA
LIDG*
BUFFER VEHICLE
TC-12
2*
1a*
TC-4
5*
TC-3R
5*
A third TC-12 on shoulder may replace TC-3s and TC-4.
TC-12
TC-2B
Short Duration
TC-1
Long Duration
CONSTRUCTION
3*
60m
60m
•See General Notes.
*For Freeways: see Table C
For Lateral Intrusion Deterrence Gap (LIDG): see Table D

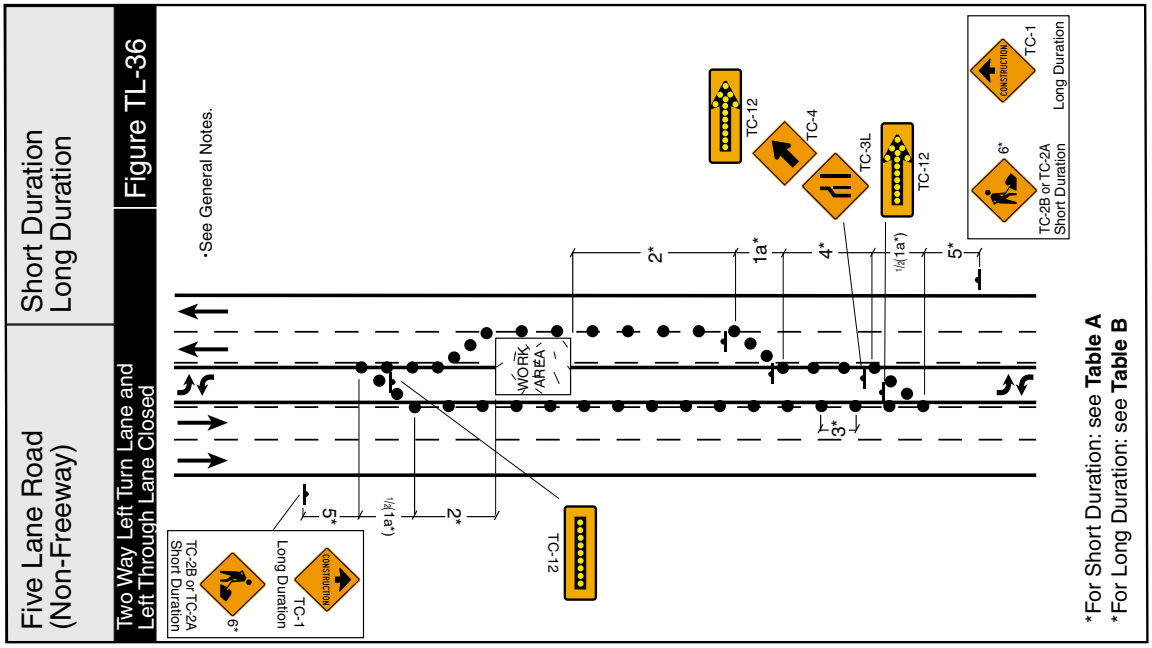

Passing and Truck Climbing Lanes
Short Duration Long Duration
Centre Lane
Figure TL-32
TC-103L
60m
5*
5*
5*
1.5 X 1a*
2*
WORK AREA
2*
1a*
5*
5*
TC-4
Rb-31
TC-12
TC-2B or TC-2A Short Duration
6*
TC-1 CONSTRUCTION Long Duration
·See General Notes.
·Where practicable, the added lane should be allowed to develop only beyond the workzone and then only if there is sufficient remaining lane length to permit safe passing.
*For Short or Long Duration: see Table B

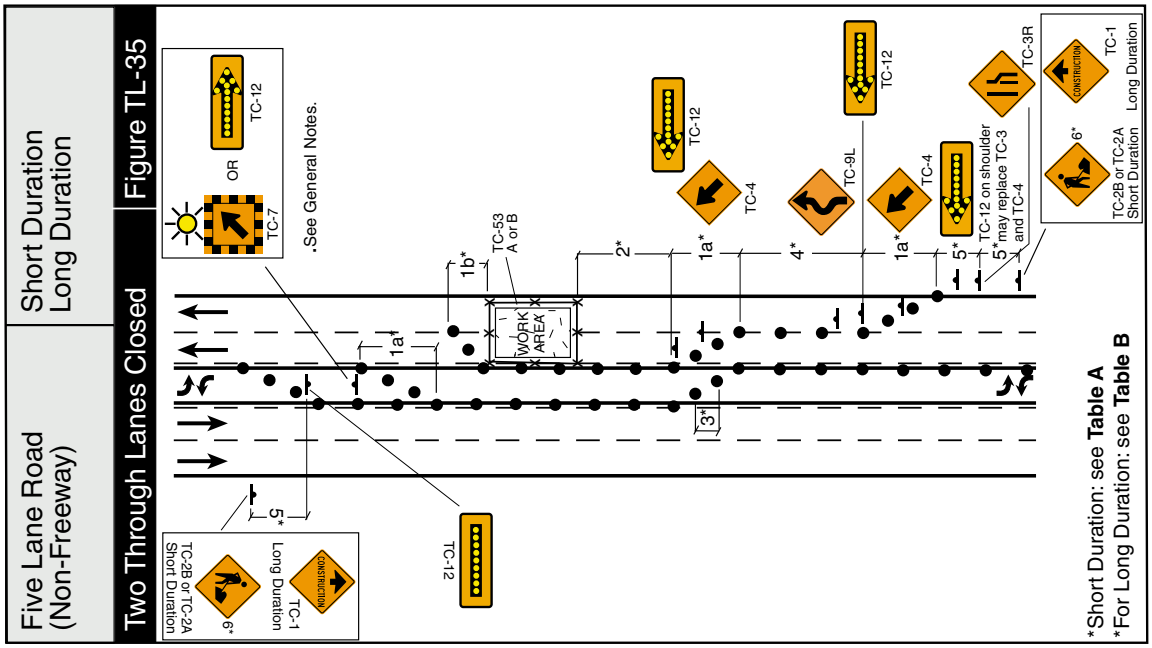

Passing and Truck Climbing Lanes
Short Duration Long Duration
Downbound Lane (Single-Lane Direction)
Figure TL-31
TC-103L
60m
5*
5*
5*
1.5 X 1a*
TC-12 OR TC-7
WORK AREA
2*
1a*
5*
5*
5*
TC-12
TC-4
TC-16EL
Rb-31
TC-2B or TC-2A Short Duration
6*
TC-1 CONSTRUCTION Long Duration
·See General Notes.
·Where practicable, the added lane should be allowed to develop only beyond the workzone and then only if there is sufficient remaining lane length to permit safe passing.
*For Short or Long Duration: see Table B

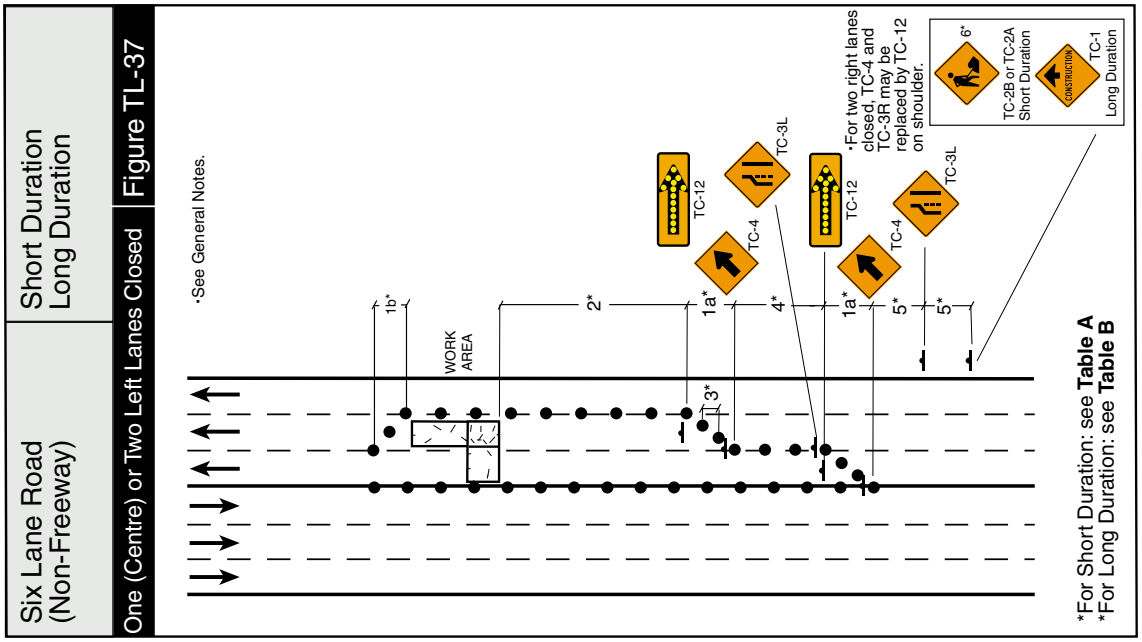

Four Lane Road
(Non-Freeway Undivided)
Short Duration
Long Duration
Two Lanes Closed
Figure TL-33
TC-1
Long Duration
TC-2B or TC-2A
Short Duration
6*
TC-3L
TC-4
TC-12
OR
TC-7
TC-53A or B
WORK AREA
TC-9L
TC-3R
TC-12 on shoulder may replace TC-3 and TC-4
5*
4*
3*
2*
1a*
1b*
1
•See General Notes.
•For high volume roads or Long Duration Operations (longer than five days), the use of Temporary Concrete Barriers should be considered to separate opposing traffic.
*Short Duration: see Table A
*For Long Duration: see Table B

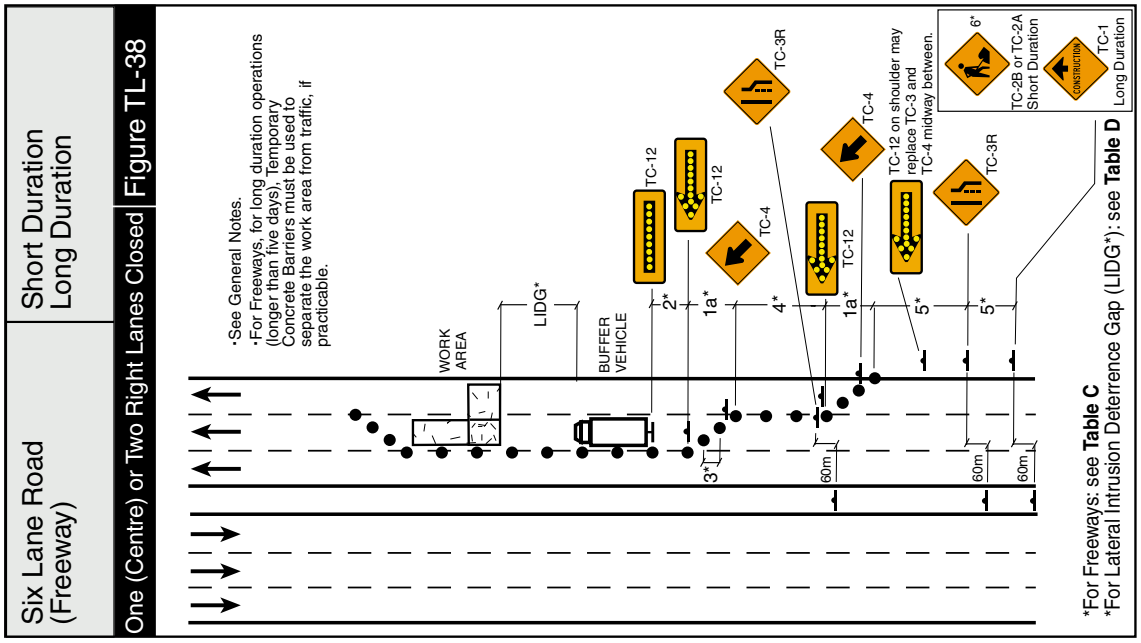

Four Lane Road (Non-Freeway Divided or Freeway)
Long Duration
Two Lanes Closed (Median Crossover (Direction 1)
Figure TL-34A
TO BE USED WITH TL-34B
•See General Notes.
•For Non-Freeways, LBA (2*) is required, but Buffer Vehicle + LIDG* are not required.
•The median crossover as shown is schematic only, and must be implemented according to the road authority's crossover design, including location, median crossover length (MCL), curves and superelevation.
•For non-freeways without a designed crossover, MCL may be taken as :
1a* x (Median Width / Lane Width)
TC-12
OR
TC-7
TC-116ER
30 km/h
(TC-17t if required)
Rb-31
Rb-24
TC-53 A or B
WORK AREA
LIDG*
BUFFER VEHICLE
MCL
2*
3*
1a*
4*
TC-34
TC-116EL
30 km/h
(TC-17t if required)
TC-12
TC-5
DETOUR
TC-4
TC-12 on shoulder may replace TC-3s and TC-4
5*
TC-3R
60m
DETOUR 2 km
TC-5B
CONSTRUCTION
TC-1
*For Long Duration (Non-Freeway):see Table B
*For Freeways : see Table C
For Lateral Intrusion Deterrence Gap (LIDG) : see Table D

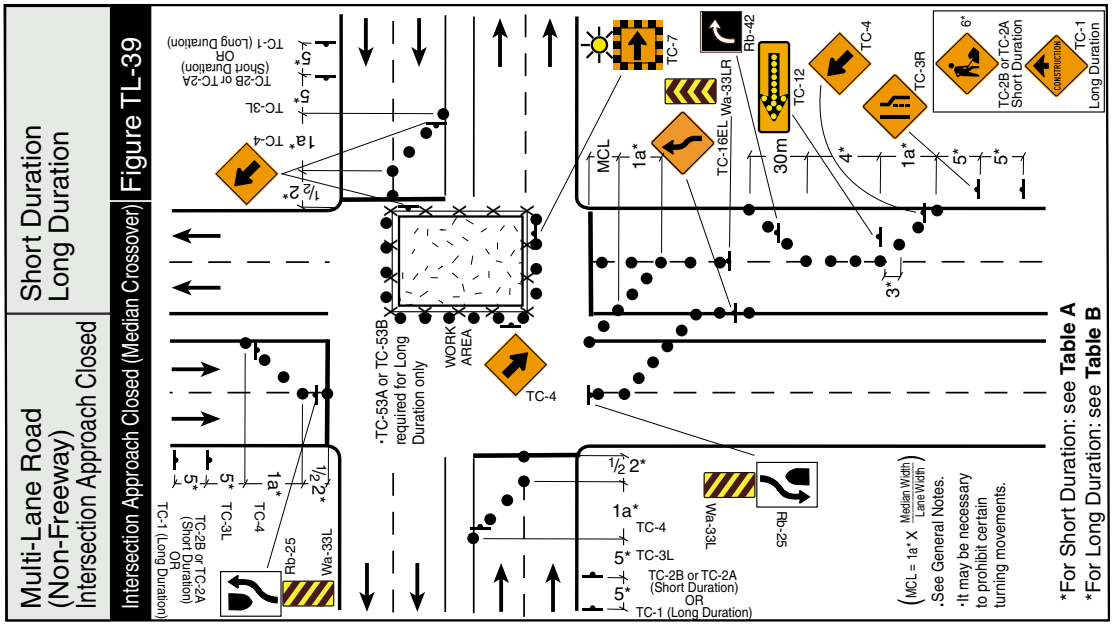

Four Lane Road (Non-Freeway Divided or Freeway)
Long Duration
Two Lanes Closed (Median Crossover (Direction 2)
Figure TL-34B
TO BE USED WITH TL-34A
TC-1
CONSTRUCTION
TC-3L
Rb-13
TC-34
TC-4
Rb-24
1a*
5*
4*
TC-7 or TC-12
WORK AREA
BUFFER VEHICLE
3*
•See General Notes.
*For Long Duration (Non-Freeway): see Table B
*For Freeways : see Table C


Five Lane Road
(Non-Freeway)
Short Duration
Long Duration
Figure TL-36
Two Way Left Turn Lane and
Left Through Lane Closed
•See General Notes.
TC-2B or TC-2A
Short Duration
Long Duration
TC-1
CONSTRUCTION
6*
5*
1/4(1a*)
2*
TL-12
WORK AREA
TC-12
TC-4
TC-3L
1a*
4*
3*
1/4(1a*)
5*
*For Short Duration: see Table A
*For Long Duration: see Table B

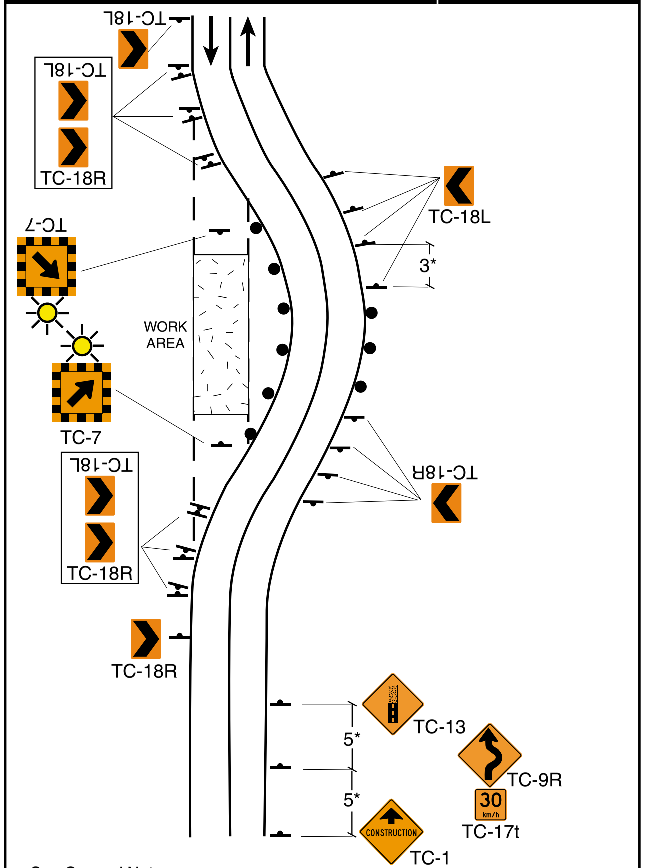

Five Lane Road
(Non-Freeway)
Short Duration
Long Duration
Figure TL-35
Two Through Lanes Closed
.See General Notes.
TC-2B or TC-2A
Short Duration
Long Duration
TC-1
CONSTRUCTION
6*
5*
OR
TC-12
TC-7
TC-12
1a*
1b*
TC-53
A or B
WORK AREA
2*
1a*
4*
1a*
5*
3*
TC-12
TC-4
TC-4
TC-9L
TC-12
TC-12 on shoulder
5* may replace TC-3
and TC-4
TC-3R
*Short Duration: see Table A
*For Long Duration: see Table B


Six Lane Road (Non-Freeway)
Short Duration Long Duration
One (Centre) or Two Left Lanes Closed
Figure TL-37
•See General Notes.
WORK AREA
1b*
2*
3*
1a*
4*
5*
TC-12
TC-4
TC-3L
•For two right lanes closed, TC-4 and TC-3R may be replaced by TC-12 on shoulder.
6*
TC-2B or TC-2A Short Duration
CONSTRUCTION
TC-1 Long Duration
*For Short Duration: see Table A
*For Long Duration: see Table B


Six Lane Road (Freeway)
Short Duration Long Duration
One (Centre) or Two Right Lanes Closed
Figure TL-38
•See General Notes.
•For Freeways, for long duration operations (longer than five days), Temporary Concrete Barriers must be used to separate the work area from traffic, if practicable.
WORK AREA
LIDG*
BUFFER VEHICLE
2*
3*
1a*
4*
5*
TC-12
TC-4
TC-3R
60m
TC-12 on shoulder may replace TC-3 and TC-4 midway between.
6*
TC-2B or TC-2A Short Duration
CONSTRUCTION
TC-1 Long Duration
*For Freeways: see Table C
For Lateral Intrusion Deterrence Gap (LIDG): see Table D


Multi-Lane Road
(Non-Freeway)
Intersection Approach Closed
Short Duration
Long Duration
Intersection Approach Closed (Median Crossover)
Figure TL-39
TC-1 (Long Duration)
OR
TC-2B or TC-2A
(Short Duration)
TC-3L
TC-4
TC-2B or TC-2A
(Short Duration)
OR
TC-1 (Long Duration)
Rb-25
Wa-33L
TC-53A or TC-53B
required for Long
Duration only
WORK
AREA
TC-4
TC-7
Rb-42
TC-16EL
Wa-33LR
TC-12
TC-4
TC-3R
TC-2B or TC-2A
Short Duration
TC-1
Long Duration
MCL
30m
3*
4*
5*
1a*
1/2 2*
5*
(MCL = 1a* X Median Width / Lane Width)
.See General Notes.
.It may be necessary
to prohibit certain
turning movements.
*For Short Duration: see Table A
*For Long Duration: see Table B

Two Lane Road	Long Duration
Roadside Diversion	**Figure TL-40**



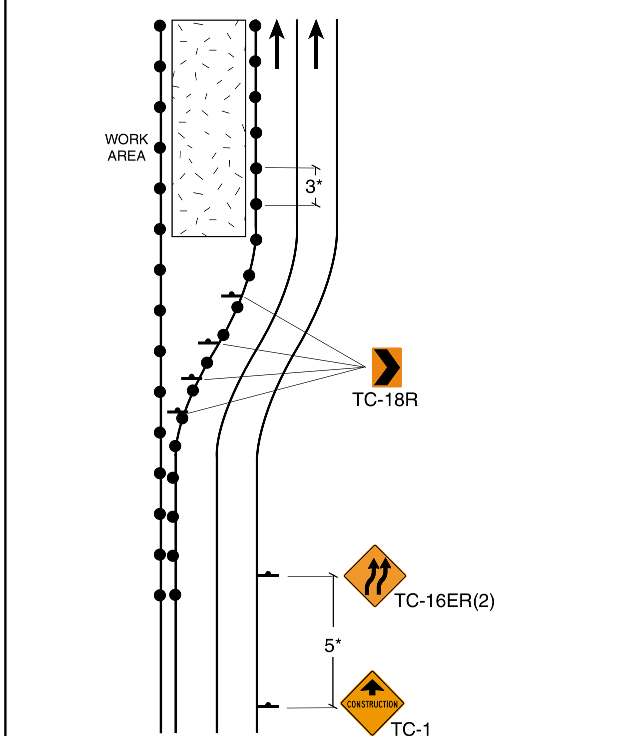
•See General Notes.

•If the diversion is paved, temporary pavement markings are required, including edgelines and TC-13 should not be used.

•The same advance signing is required for the opposing direction.

*For Long Duration: see **Table B**

Multi-Lane Road (Non-Freeway or Freeway)	Long Duration
Lane Realignment	**Figure TL-41**



•See General Notes.

*For Long Duration (Non-Freeways): see **Table B**
*For Freeways: see **Table C**

Detour (Non-Freeway)	Short Duration Long Duration

Route Detour (Alternative Roads) | Figure TL-42A

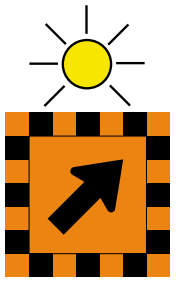
•The following signs are to be used in the layout for Route Detours (see TL-42B).

DETOUR D-1 Other tabs may be used with the DETOUR D-1 sign as follows:

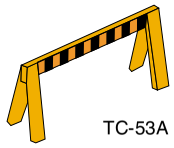
TC-39

TC-5

Rb-92



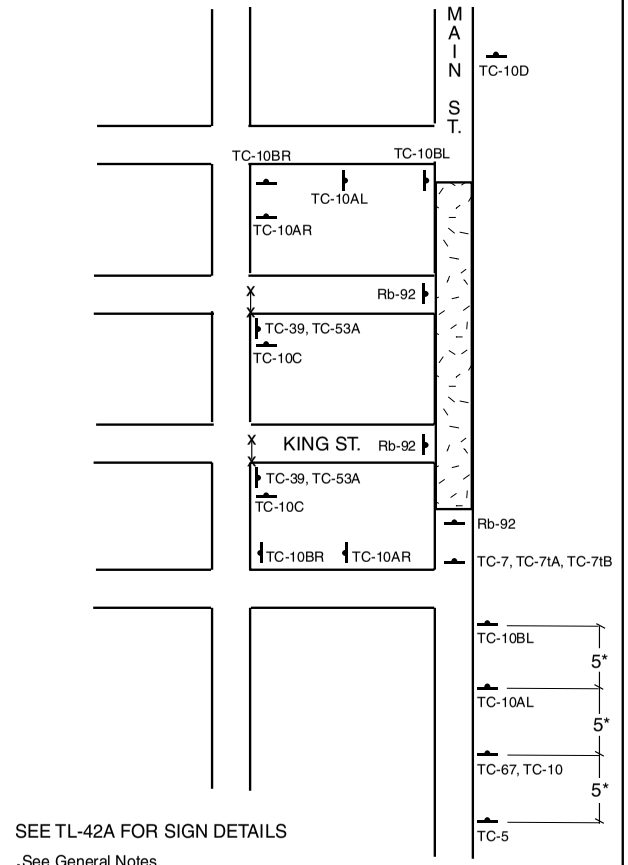
TC-7
TC-7tA
TC-7tB


TC-53A

TC-67
TC-10

Detour (Non-Freeway)	Short Duration Long Duration

Route Detour (Alternative Roads) | Figure TL-42B



SEE TL-42A FOR SIGN DETAILS

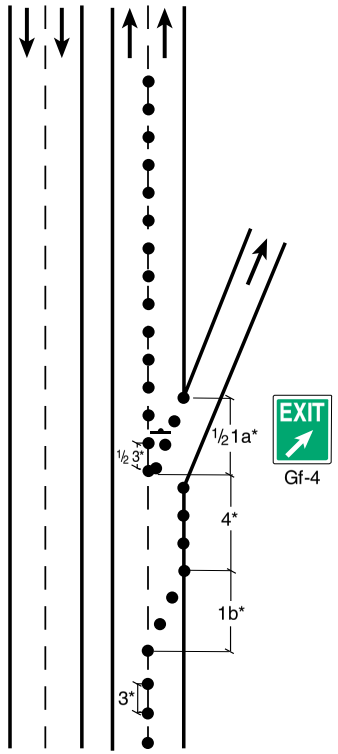
.See General Notes.

•The same approach to signing is required in the opposite direction.

*For Short Duration: see **Table A**

*For Long Duration: see **Table B**

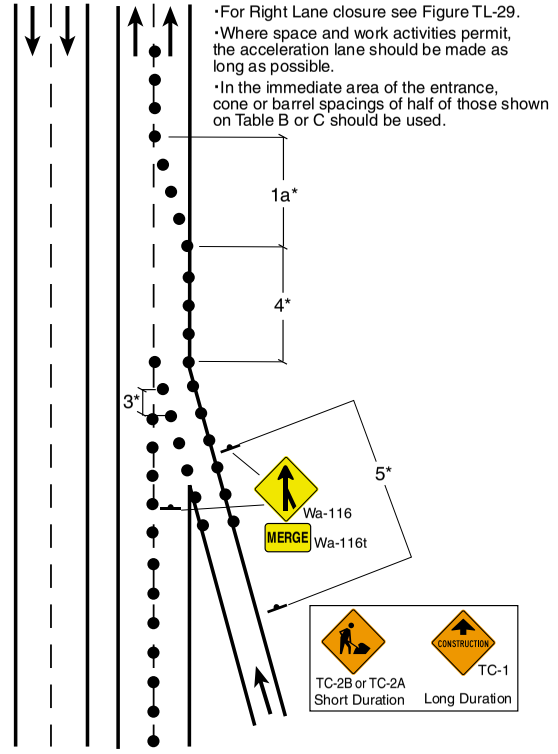
Ramp (Non-Freeway and Freeway)	Short Duration Long Duration
Lane Closed at Exit Ramp	Figure TL-43



•See General Notes
•In the immediate area of the exit, cone or barrel spacings of half of those shown on Table B or C should be used.
•For Right Lane closure see Figure TL-29.

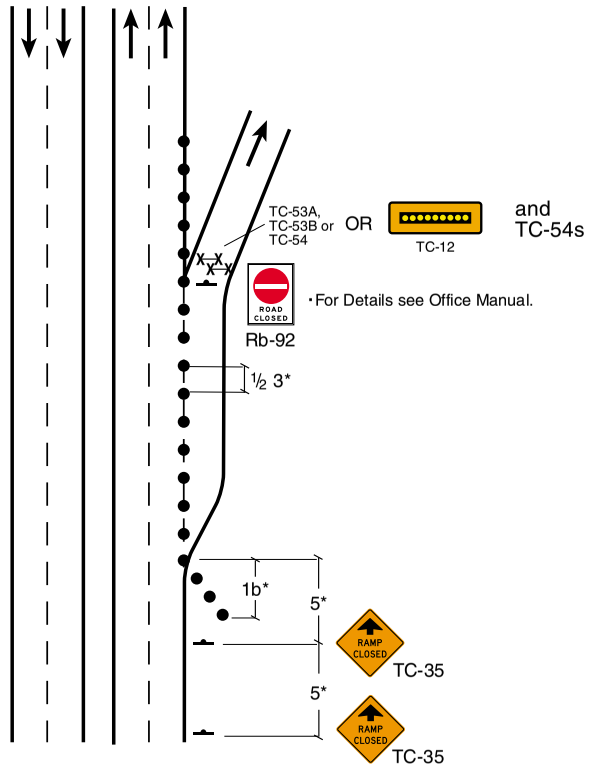
*For Short or Long Duration Exit Ramp from Non-Freeway: see **Table B**
*For Exit Ramp from Freeway: see **Table C**

Ramp (Non-Freeway and Freeway)	Short Duration Long Duration
Lane Closed at Entrance Ramp	Figure TL-44



*For Short or Long Duration Entrance Ramp onto Non-Freeway: see **Table B**
*For Entrance Ramp onto Freeway: see **Table C**

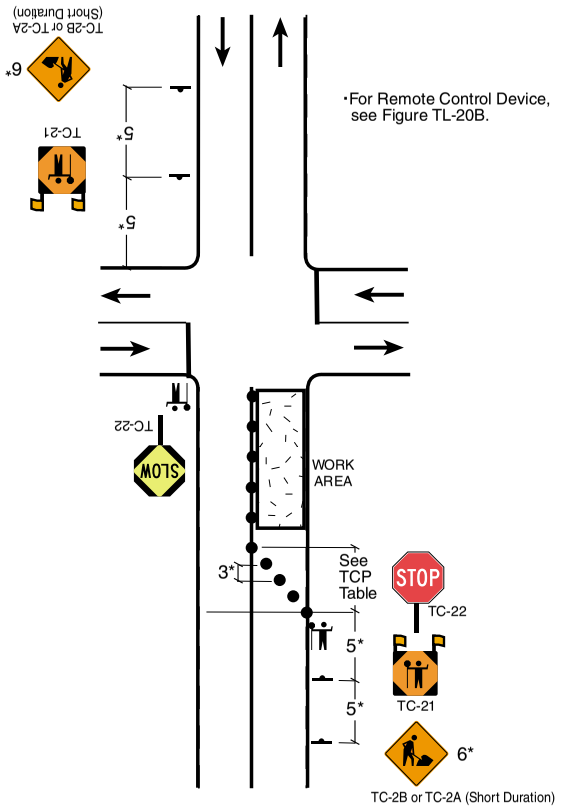
Ramp (Non-Freeway and Freeway)	Short Duration Long Duration
Ramp Closure	**Figure TL-45**



•See General Notes.
•"Closed" sign on Directional Guide Signs to be used for Long Duration only.
•Consideration should be given to the use of a TC-64 sign.

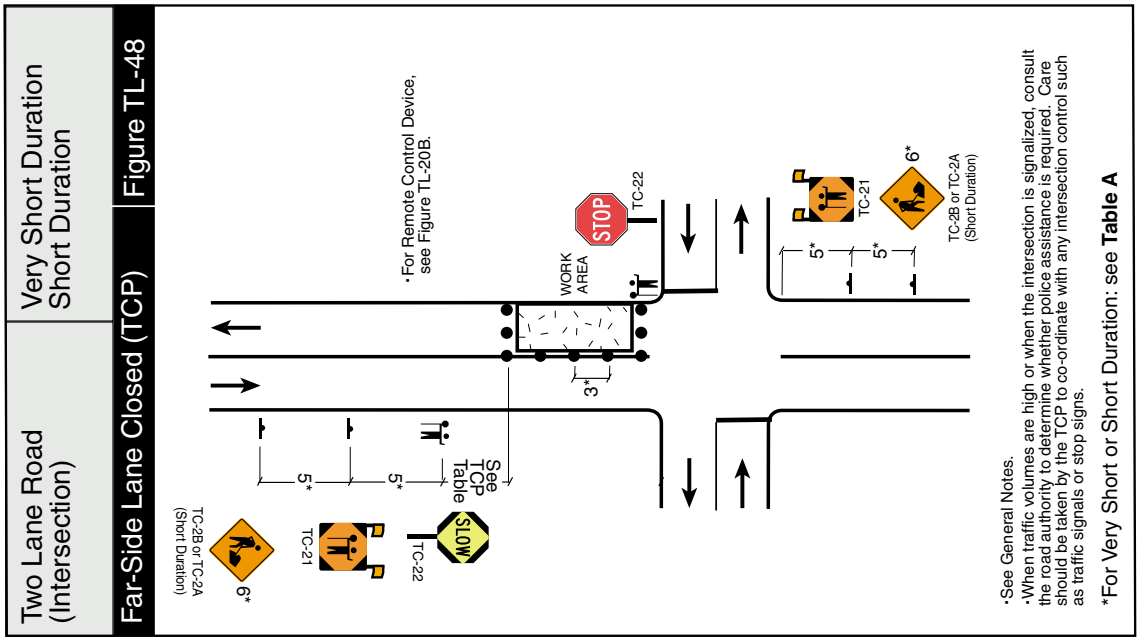
*For Short or Long Duration (Ramp from Non-Freeway): see **Table B**
*For Ramp from Freeway: see **Table C**

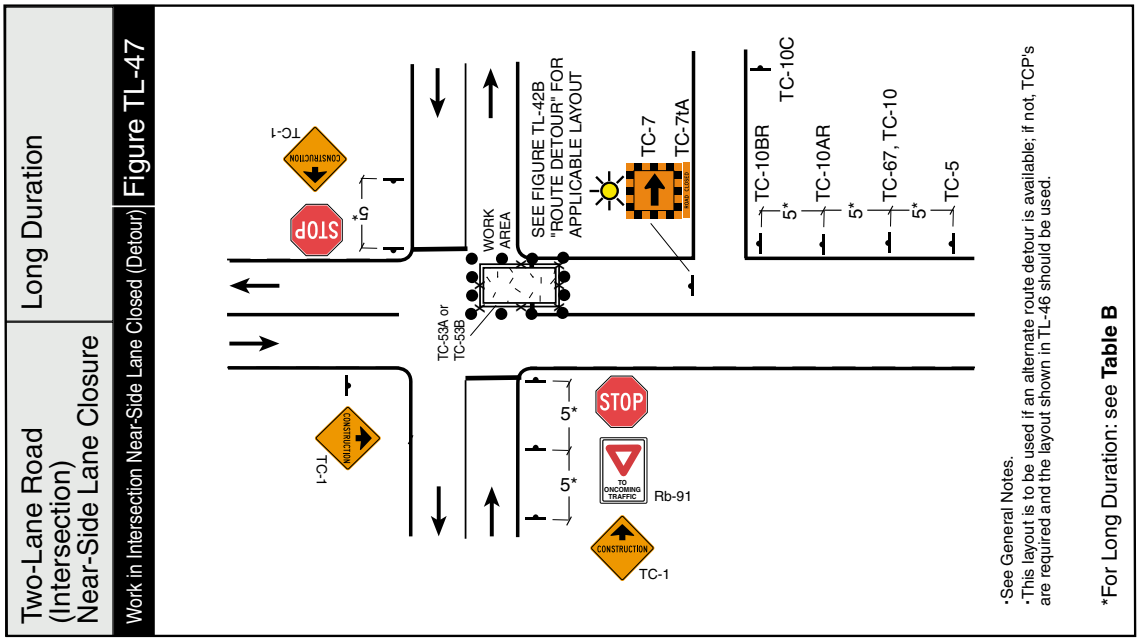
Two Lane Road (Intersection)	Very Short Duration Short Duration
Near-Side Lane Closed (TCP)	**Figure TL-46**

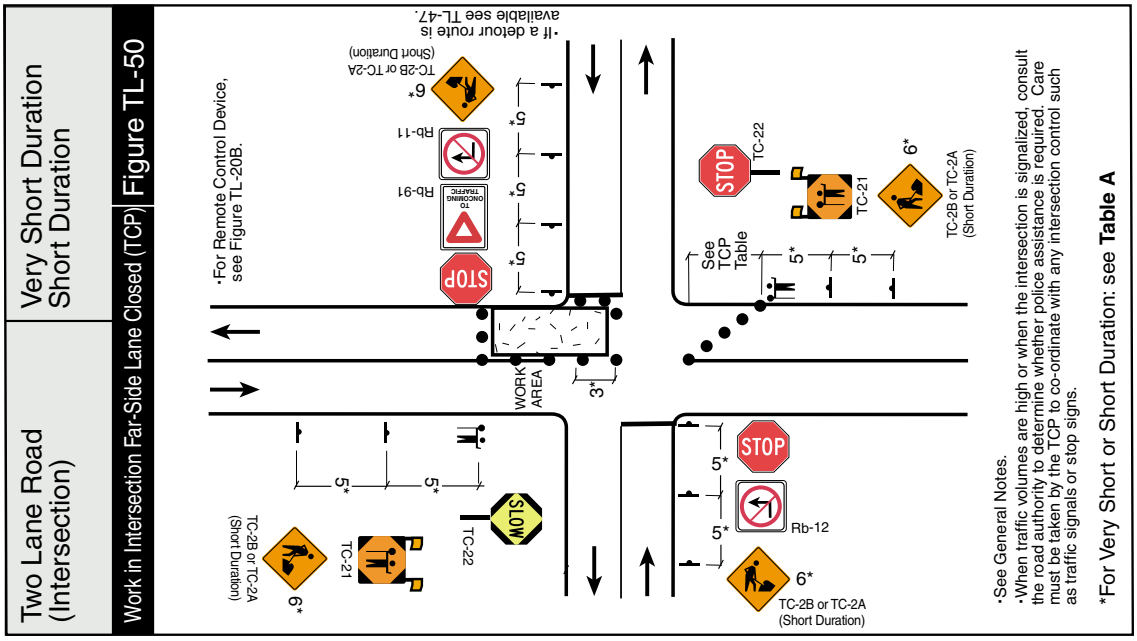


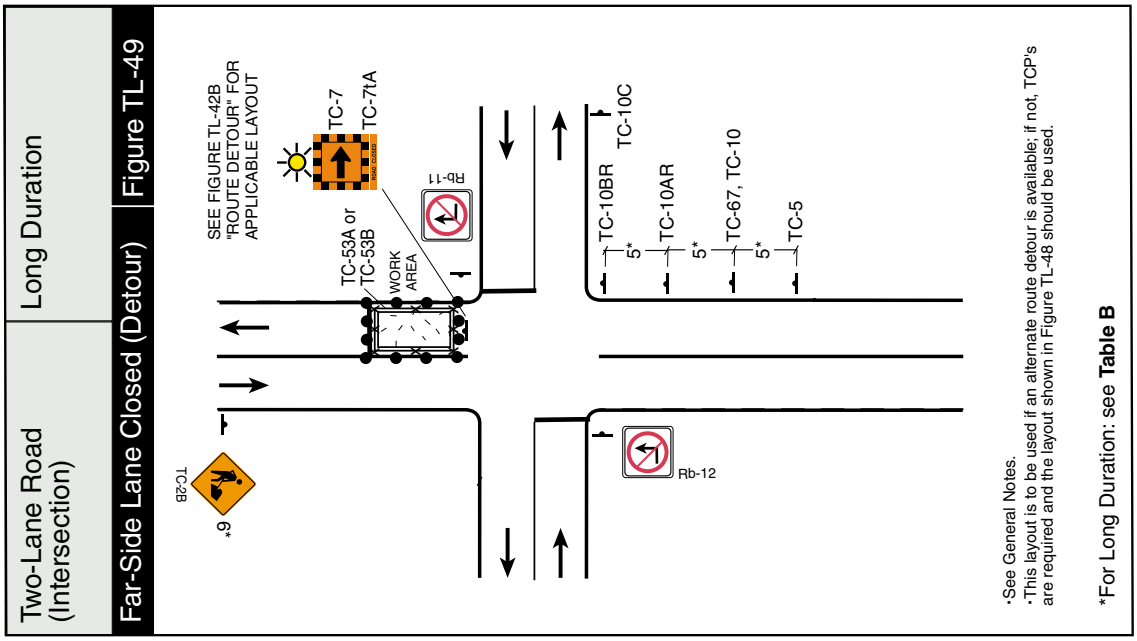
•See General Notes.
•When traffic volumes are high or when the intersection is signalized, consult the road authority to determine whether police assistance is required. Care should be taken by the TCP to co-ordinate with any intersection control such as traffic signals or stop signs.

*For Very Short or Short Duration: see **Table A**

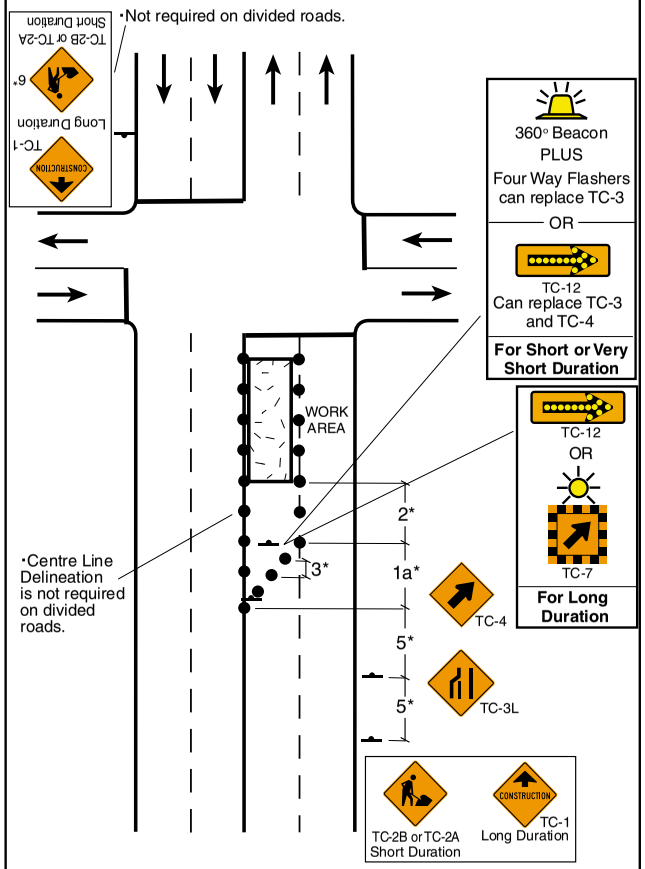

Two Lane Road
(Intersection)
Very Short Duration
Short Duration
Far-Side Lane Closed (TCP)
Figure TL-48
TC-2B or TC-2A
(Short Duration)
6*
TC-21
TC-22
5*
5*
See
TCP
Table
SLOW
For Remote Control Device,
see Figure TL-20B.
WORK
AREA
3*
STOP
TC-22
5*
5*
TC-21
6*
TC-2B or TC-2A
(Short Duration)
See General Notes.
When traffic volumes are high or when the intersection is signalized, consult the road authority to determine whether police assistance is required. Care should be taken by the TCP to co-ordinate with any intersection control such as traffic signals or stop signs.
*For Very Short or Short Duration: see Table A


Two-Lane Road
(Intersection)
Near-Side Lane Closure
Long Duration
Work in Intersection Near-Side Lane Closed (Detour)
Figure TL-47
TC-1
CONSTRUCTION
STOP
TC-1
5*
WORK
AREA
TC-53A or
TC-53B
SEE FIGURE TL-42B
"ROUTE DETOUR" FOR
APPLICABLE LAYOUT
TC-7
TC-7tA
5*
5*
STOP
TO
ONCOMING
TRAFFIC
Rb-91
CONSTRUCTION
TC-1
TC-10BR
TC-10C
5*
TC-10AR
5*
TC-67, TC-10
5*
TC-5
See General Notes.
This layout is to be used if an alternate route detour is available; if not, TCP's are required and the layout shown in TL-46 should be used.
*For Long Duration: see Table B


Two Lane Road
(Intersection)
Very Short Duration
Short Duration
Work in Intersection Far-Side Lane Closed (TCP)
Figure TL-50
•For Remote Control Device, see Figure TL-20B.
•If a detour route is available see TL-47.
STOP
Rb-91
TO ONCOMING TRAFFIC
Rb-11
6*
TC-2B or TC-2A (Short Duration)
WORK AREA
3*
5*
See TCP Table
TC-22
TC-21
TC-2B or TC-2A (Short Duration)
SLOW
TC-22
TC-21
6*
TC-2B or TC-2A (Short Duration)
STOP
Rb-12
•See General Notes.
•When traffic volumes are high or when the intersection is signalized, consult the road authority to determine whether police assistance is required. Care must be taken by the TCP to co-ordinate with any intersection control such as traffic signals or stop signs.
*For Very Short or Short Duration: see Table A


Two-Lane Road
(Intersection)
Long Duration
Far-Side Lane Closed (Detour)
Figure TL-49
SEE FIGURE TL-42B "ROUTE DETOUR" FOR APPLICABLE LAYOUT
TC-7
TC-7tA
TC-53A or TC-53B
WORK AREA
Rb-11
TC-10BR
TC-10C
TC-10AR
TC-67, TC-10
TC-5
5*
6*
TC-2B
Rb-12
•See General Notes.
•This layout is to be used if an alternate route detour is available; if not, TCP's are required and the layout shown in Figure TL-48 should be used.
*For Long Duration: see Table B

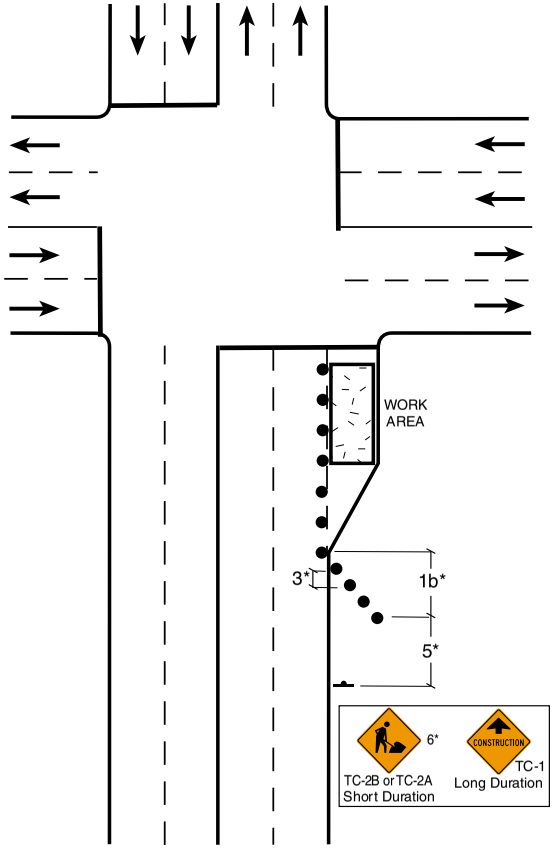
Multi-Lane Road (Intersection) Near-Side Lane Closure	Very Short Duration Short Duration Long Duration
Left Lane Closed	Figure TL-51



•See General Notes.
•Right lane closed is mirror image.

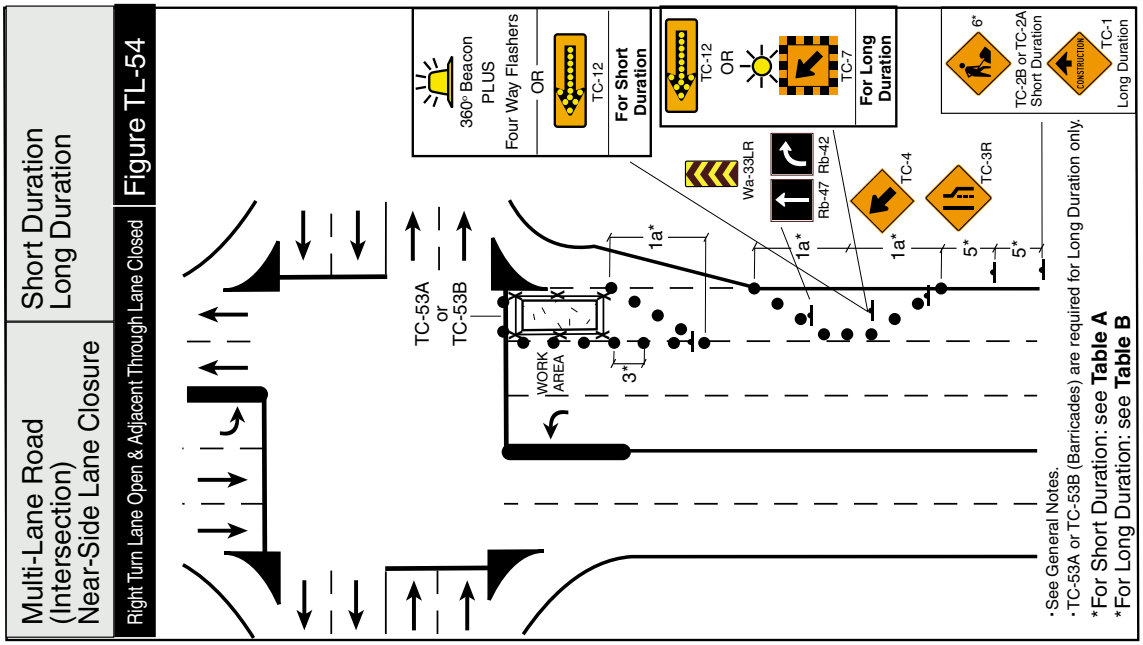
*For Very Short or Short Duration: see **Table A**
*For Long Duration: see **Table B**

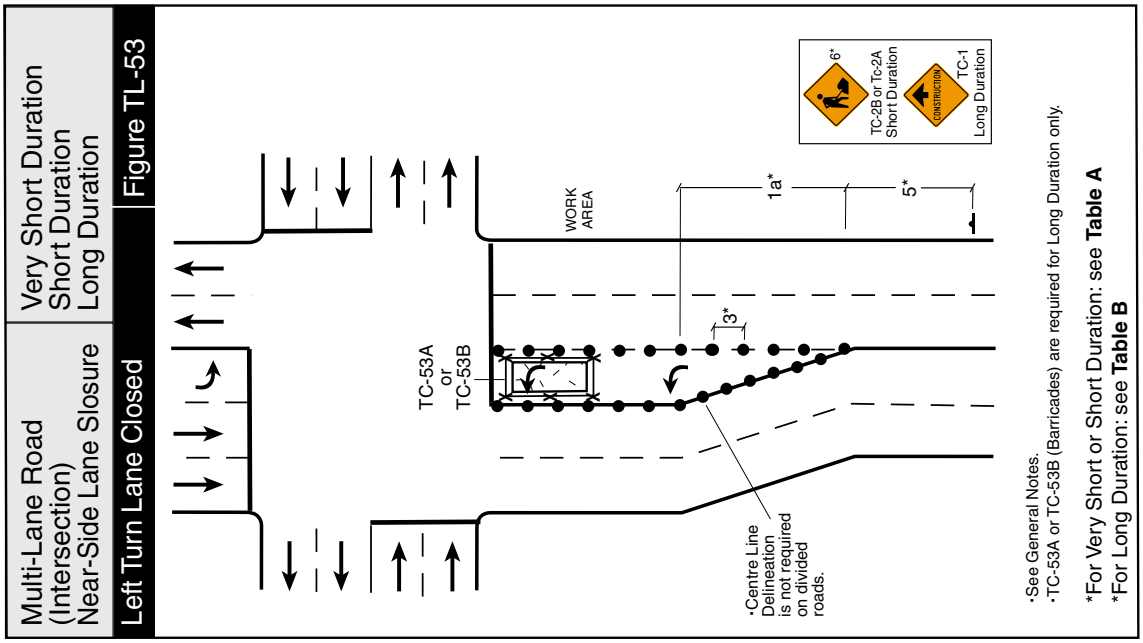
Multi-Lane Road (Intersection) Near-Side Lane Closure	Very Short Duration Short Duration Long Duration
Right Turn Lane Closed	Figure TL-52

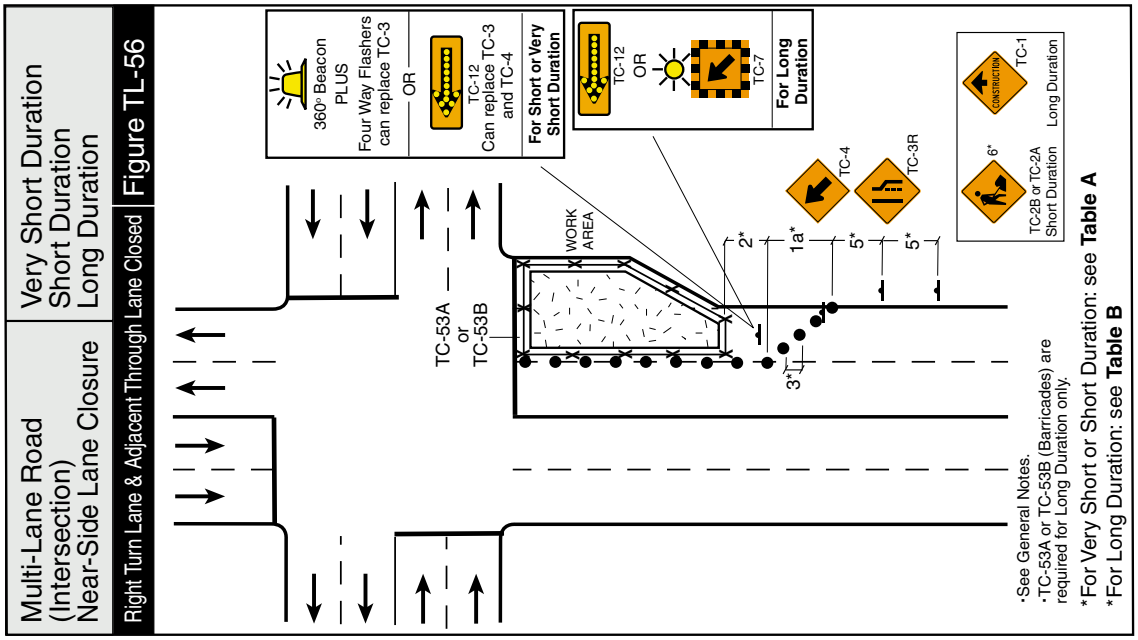


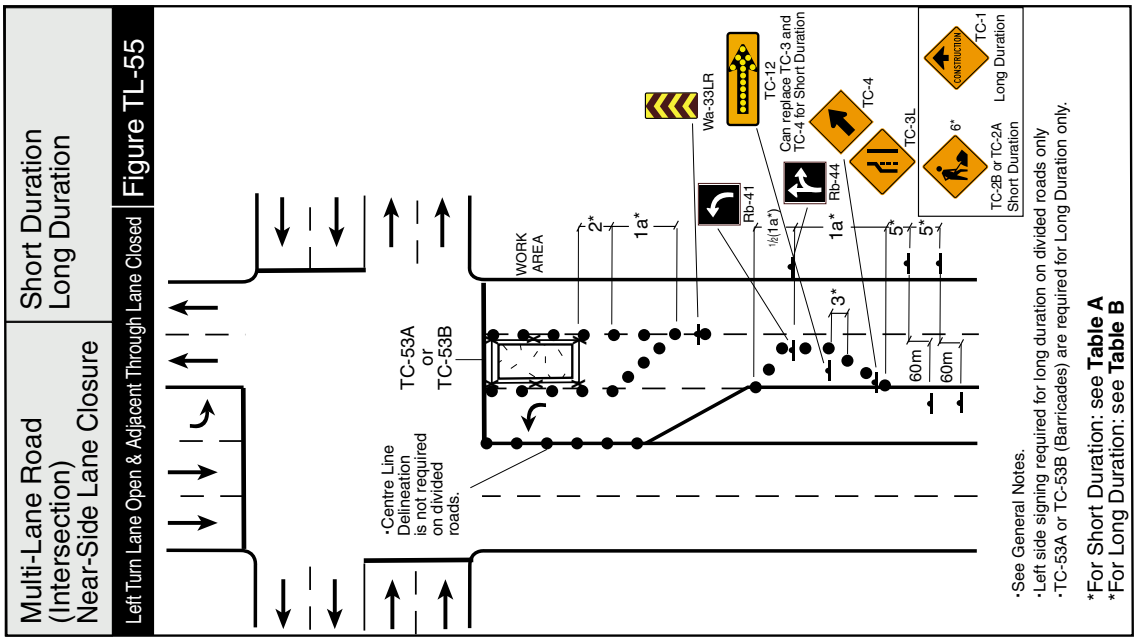
•See General Notes.

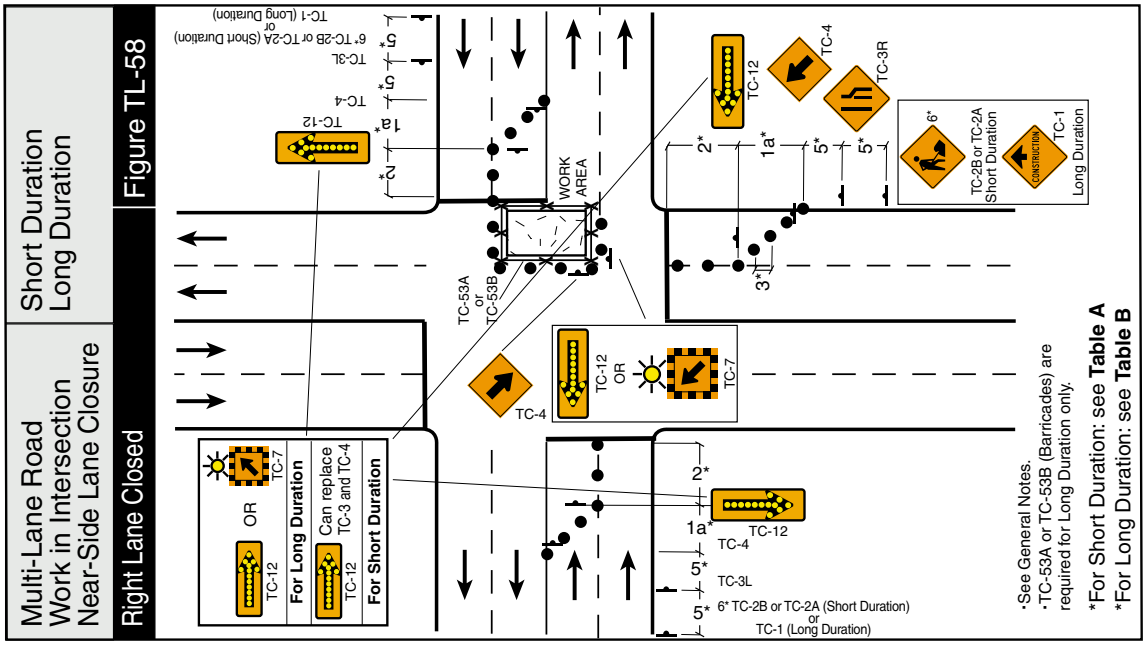
*For Very Short or Short Duration: see **Table A**
*For Long Duration: see **Table B**

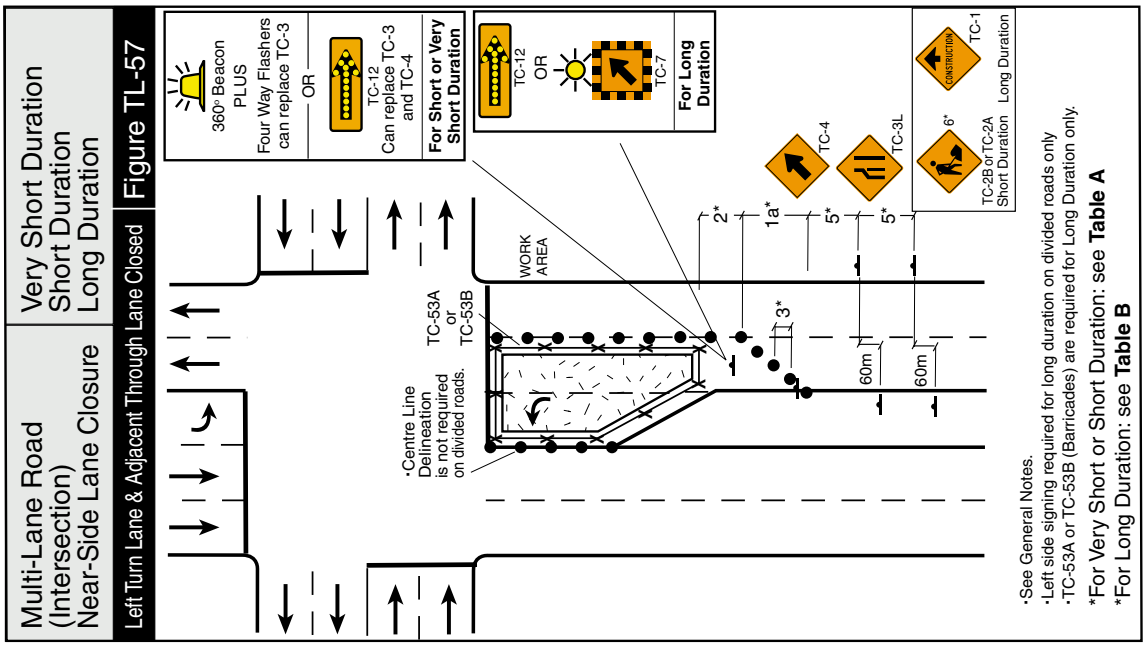

Multi-Lane Road (Intersection) Near-Side Lane Closure
Short Duration Long Duration
Right Turn Lane Open & Adjacent Through Lane Closed
Figure TL-54
TC-53A or TC-53B
WORK AREA
3*
1a*
360° Beacon PLUS Four Way Flashers
OR
TC-12
For Short Duration
TC-12 OR
TC-7
For Long Duration
Wa-33LR
Rb-47
Rb-42
TC-4
TC-3R
6*
TC-2B or TC-2A Short Duration
CONSTRUCTION
TC-1 Long Duration
•See General Notes.
•TC-53A or TC-53B (Barricades) are required for Long Duration only.
*For Short Duration: see Table A
*For Long Duration: see Table B

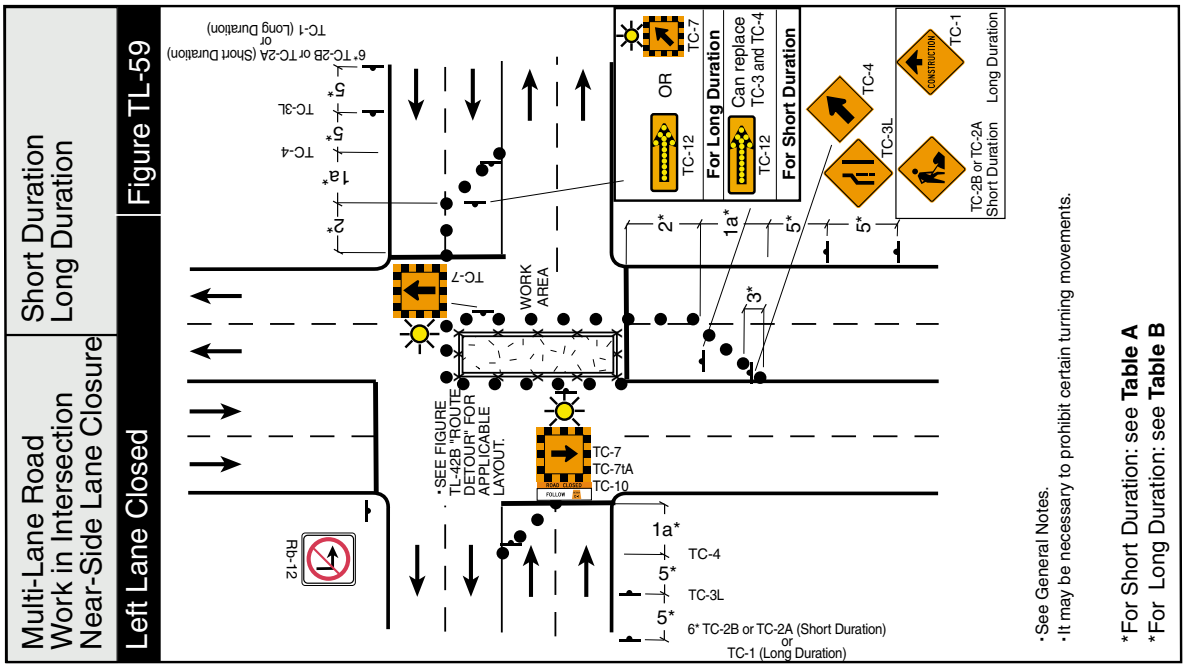

Multi-Lane Road (Intersection) Near-Side Lane Slosure
Very Short Duration Short Duration Long Duration
Left Turn Lane Closed
Figure TL-53
TC-53A or TC-53B
WORK AREA
3*
1a*
5*
6*
TC-2B or Tc-2A Short Duration
CONSTRUCTION
TC-1 Long Duration
•Centre Line Delineation is not required on divided roads.
•See General Notes.
•TC-53A or TC-53B (Barricades) are required for Long Duration only.
*For Very Short or Short Duration: see Table A
*For Long Duration: see Table B

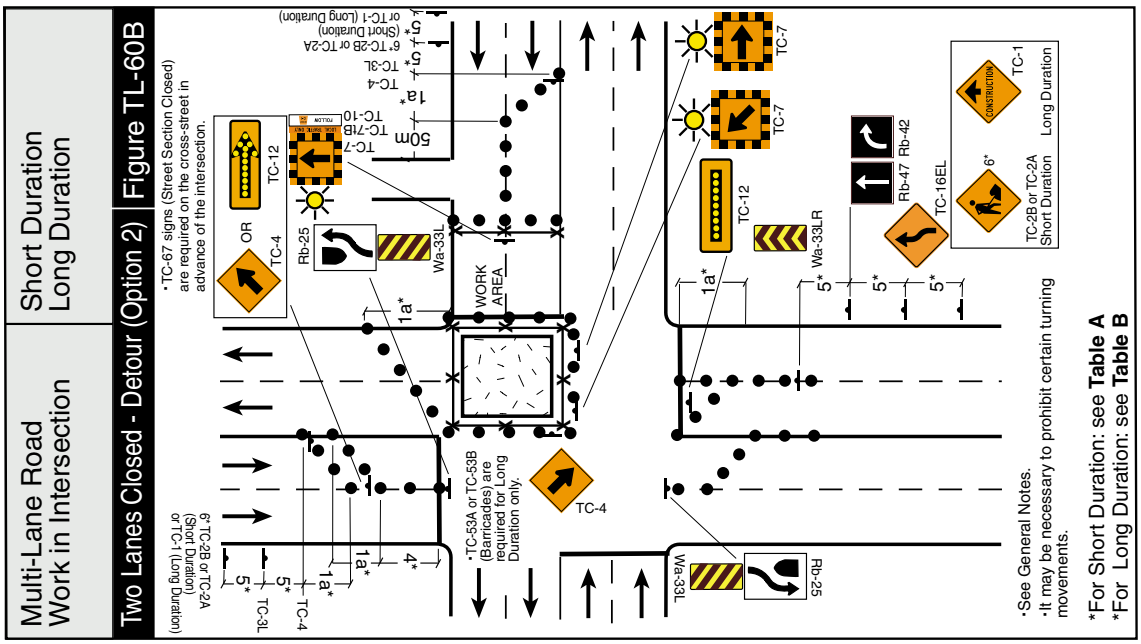

Multi-Lane Road
(Intersection)
Near-Side Lane Closure
Very Short Duration
Short Duration
Long Duration
Right Turn Lane & Adjacent Through Lane Closed
Figure TL-56
360° Beacon
PLUS
Four Way Flashers
can replace TC-3
OR
TC-12
Can replace TC-3
and TC-4
For Short or Very
Short Duration
TC-12
OR
TC-7
For Long
Duration
TC-53A
or
TC-53B
WORK
AREA
2*
1a*
3*
TC-4
TC-3R
5*
5*
6*
TC-2B or TC-2A
Short Duration
CONSTRUCTION
TC-1
Long Duration
•See General Notes.
•TC-53A or TC-53B (Barricades) are
required for Long Duration only.
*For Very Short or Short Duration: see Table A
*For Long Duration: see Table B

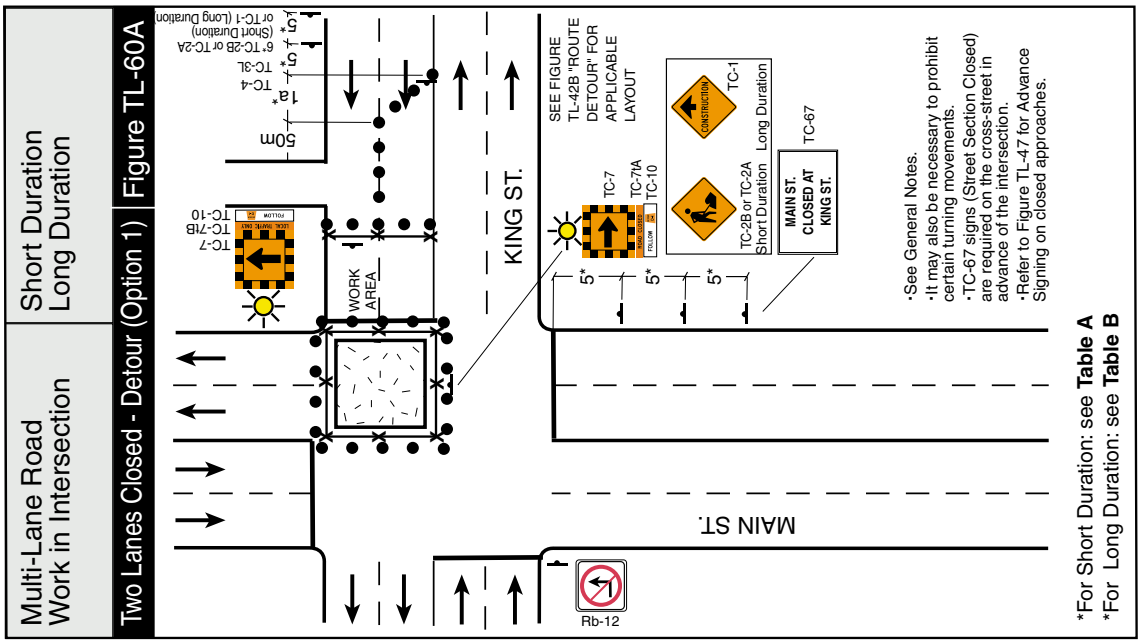

Multi-Lane Road
(Intersection)
Near-Side Lane Closure
Short Duration
Long Duration
Left Turn Lane Open & Adjacent Through Lane Closed
Figure TL-55
•Centre Line
Delineation
is not required
on divided
roads.
TC-53A
or
TC-53B
WORK
AREA
2*
1a*
Wa-33LR
Rb-41
½(1a*)
TC-12
Can replace TC-3 and
TC-4 for Short Duration
Rb-44
1a*
3*
TC-4
TC-3L
5*
5*
60m
60m
6*
TC-2B or TC-2A
Short Duration
CONSTRUCTION
TC-1
Long Duration
•See General Notes.
•Left side signing required for long duration on divided roads only
•TC-53A or TC-53B (Barricades) are required for Long Duration only.
*For Short Duration: see Table A
*For Long Duration: see Table B

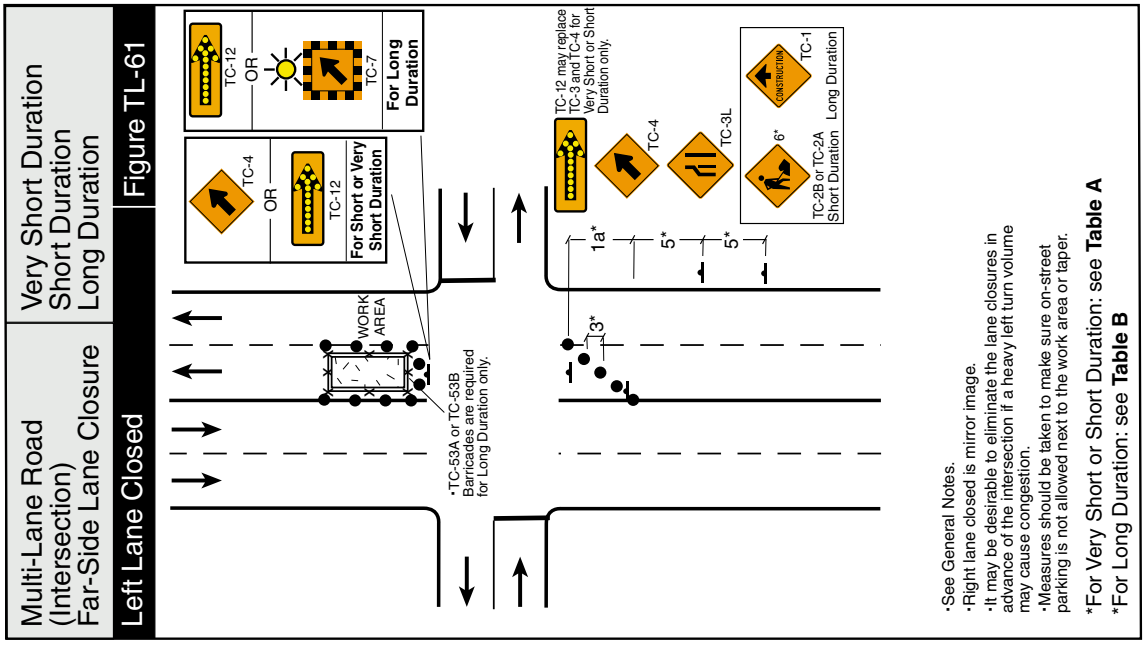

Multi-Lane Road
Work in Intersection
Near-Side Lane Closure
Short Duration
Long Duration
Right Lane Closed
Figure TL-58
TC-12
OR
TC-7
For Long Duration
Can replace TC-3 and TC-4
For Short Duration
TC-53A or TC-53B
WORK AREA
TC-4
TC-12
TC-3L
TC-3R
TC-2B or TC-2A Short Duration
TC-1 Long Duration
6* TC-2B or TC-2A (Short Duration) or TC-1 (Long Duration)
•See General Notes.
•TC-53A or TC-53B (Barricades) are required for Long Duration only.
*For Short Duration: see Table A
*For Long Duration: see Table B

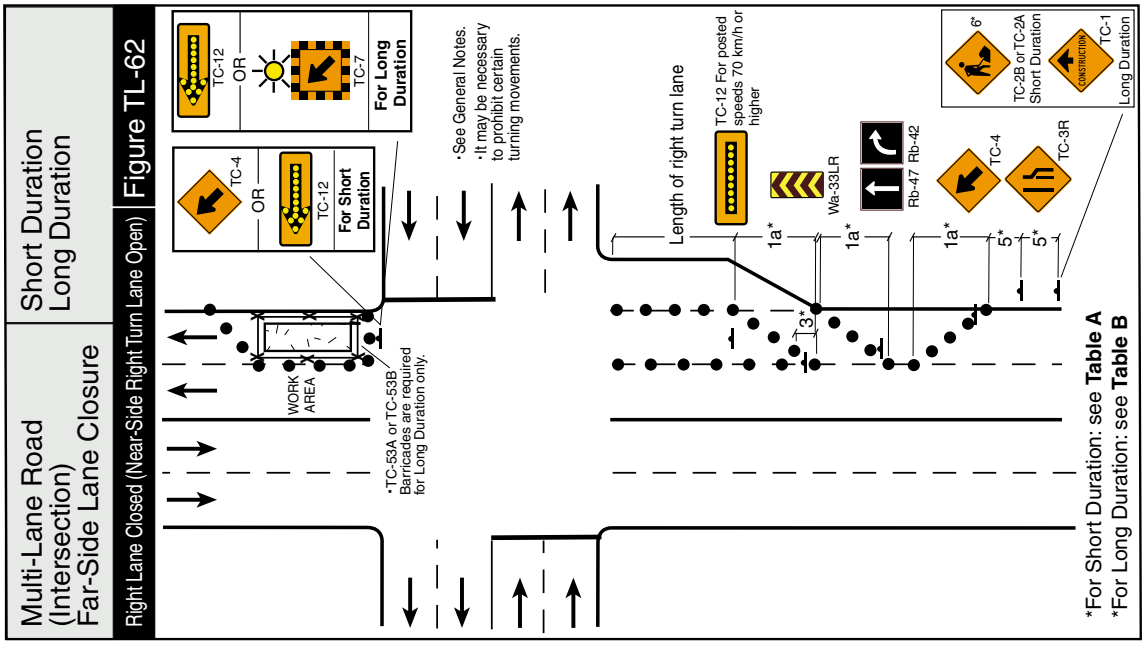

Multi-Lane Road
(Intersection)
Near-Side Lane Closure
Very Short Duration
Short Duration
Long Duration
Left Turn Lane & Adjacent Through Lane Closed
Figure TL-57
360° Beacon
PLUS
Four Way Flashers
can replace TC-3
OR
TC-12
Can replace TC-3 and TC-4
For Short or Very Short Duration
TC-12
OR
TC-7
For Long Duration
TC-53A or TC-53B
WORK AREA
•Centre Line Delineation is not required on divided roads.
TC-4
TC-3L
60m
TC-2B or TC-2A
Short Duration
Long Duration
TC-1
•See General Notes.
•Left side signing required for long duration on divided roads only
•TC-53A or TC-53B (Barricades) are required for Long Duration only.
*For Very Short or Short Duration: see Table A
*For Long Duration: see Table B

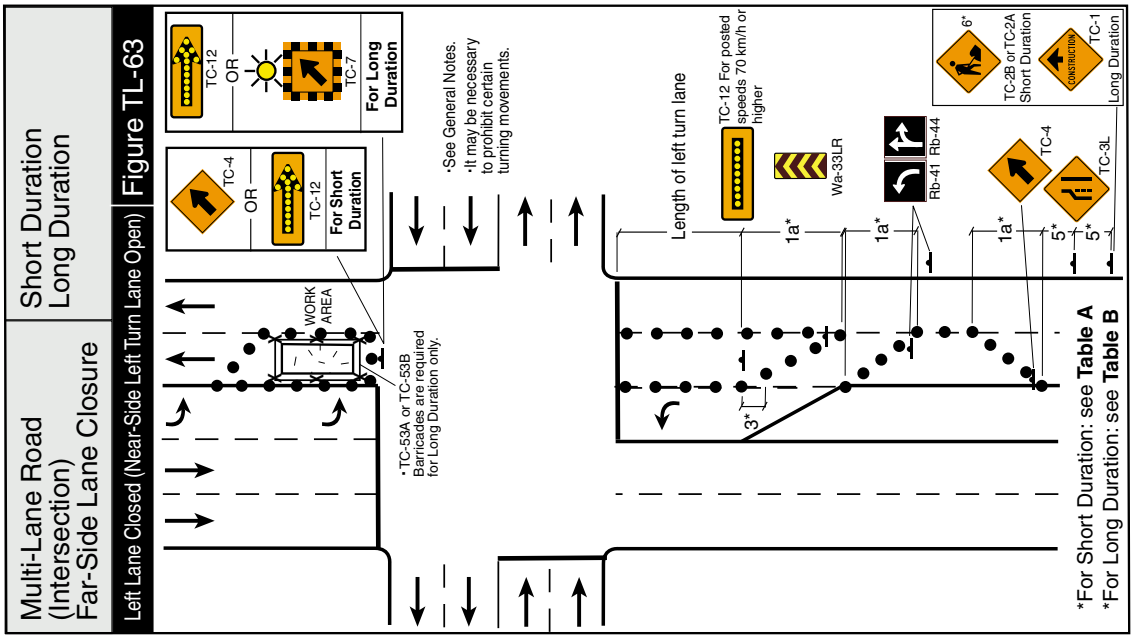

Multi-Lane Road
Work in Intersection
Near-Side Lane Closure
Short Duration
Long Duration
Left Lane Closed
Figure TL-59
6* TC-2B or TC-2A (Short Duration)
or
TC-1 (Long Duration)
TC-3L
TC-4
TC-7
WORK AREA
SEE FIGURE TL-42B "ROUTE DETOUR" FOR APPLICABLE LAYOUT.
TC-7
TC-7tA
TC-10
Rb-12
1a*
5*
TC-4
5*
TC-3L
5*
6* TC-2B or TC-2A (Short Duration)
or
TC-1 (Long Duration)
OR
TC-12
For Long Duration
Can replace TC-3 and TC-4
TC-12
For Short Duration
TC-4
TC-3L
TC-2B or TC-2A
Short Duration
TC-1
Long Duration
CONSTRUCTION
2*
1a*
5*
5*
3*
• See General Notes.
• It may be necessary to prohibit certain turning movements.
*For Short Duration: see Table A
*For Long Duration: see Table B

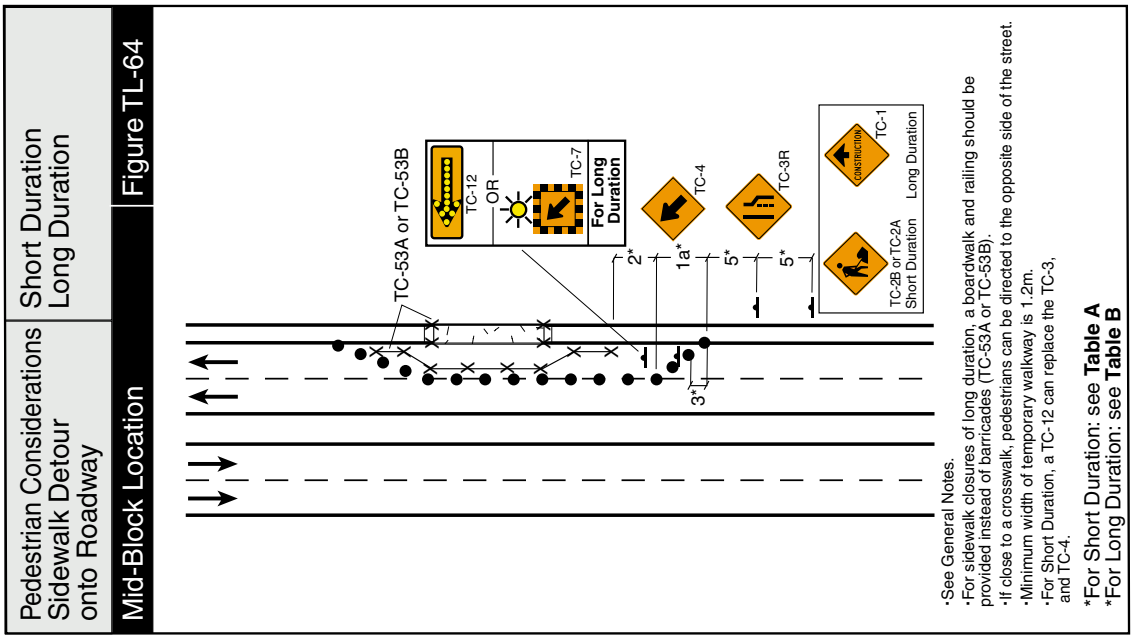

Multi-Lane Road
Work in Intersection
Short Duration
Long Duration
Two Lanes Closed - Detour (Option 2)
Figure TL-60B
•TC-67 signs (Street Section Closed) are required on the cross-street in advance of the intersection.
6* TC-2B or TC-2A (Short Duration) or TC-1 (Long Duration)
TC-3L
TC-4
TC-12
OR
TC-4
Rb-25
Wa-33L
50m
TC-7
TC-7B
TC-10
1a*
5*
WORK AREA
•TC-53A or TC-53B (Barricades) are required for Long Duration only.
TC-4
Wa-33L
Rb-25
TC-7
TC-12
Wa-33LR
Rb-47
Rb-42
TC-16EL
TC-2B or TC-2A
Short Duration
Long Duration
TC-1
•See General Notes.
•It may be necessary to prohibit certain turning movements.
*For Short Duration: see Table A
*For Long Duration: see Table B

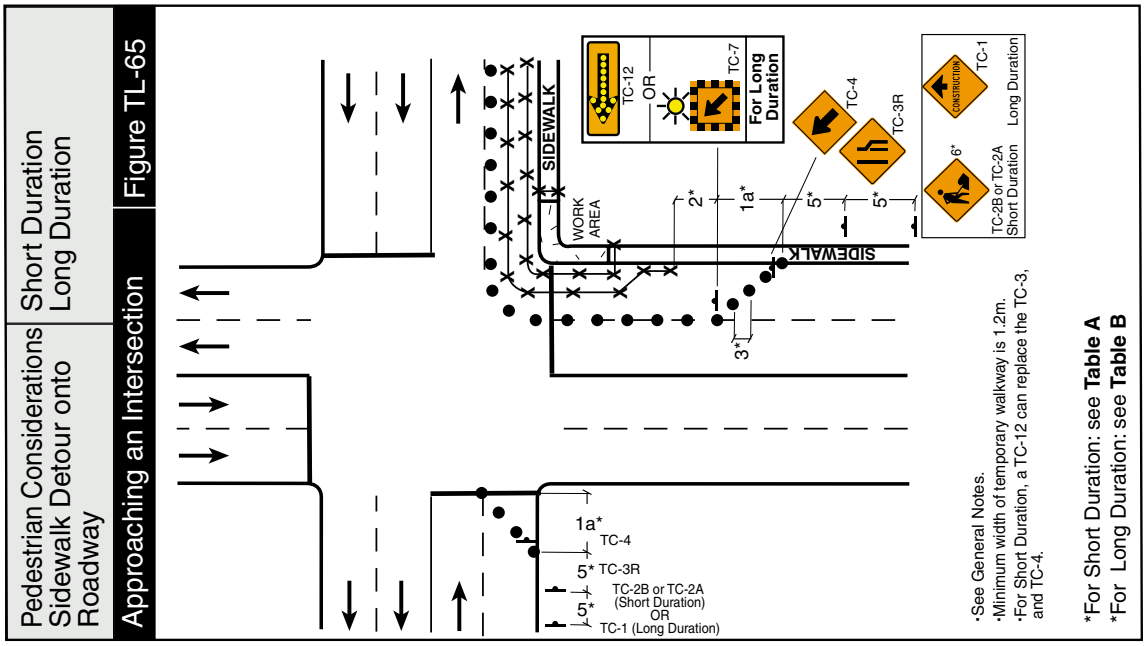

Multi-Lane Road
Work in Intersection
Short Duration
Long Duration
Two Lanes Closed - Detour (Option 1)
Figure TL-60A
6* TC-2B or TC-2A (Short Duration) or TC-1 (Long Duration)
TC-3L
TC-4
50m
TC-7
TC-7B
TC-10
WORK AREA
KING ST.
SEE FIGURE TL-42B "ROUTE DETOUR" FOR APPLICABLE LAYOUT
TC-7
TC-7A
TC-10
TC-2B or TC-2A
Short Duration
Long Duration
TC-1
MAIN ST. CLOSED AT KING ST.
TC-67
MAIN ST.
Rb-12
•See General Notes.
•It may also be necessary to prohibit certain turning movements.
•TC-67 signs (Street Section Closed) are required on the cross-street in advance of the intersection.
•Refer to Figure TL-47 for Advance Signing on closed approaches.
*For Short Duration: see Table A
*For Long Duration: see Table B

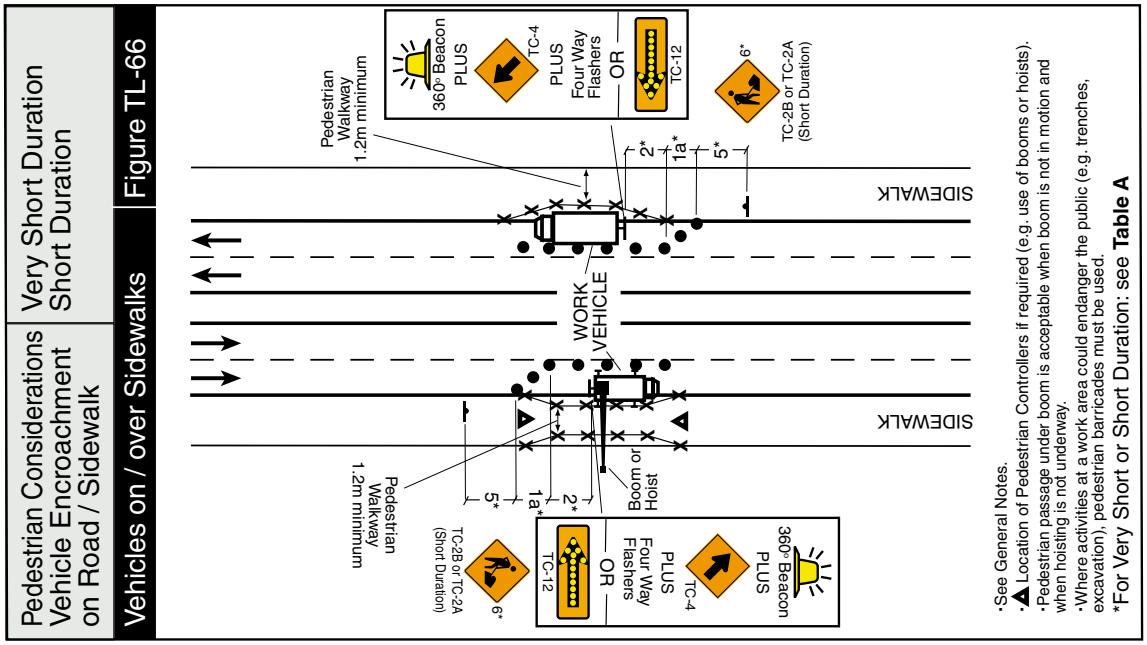

Multi-Lane Road (Intersection) Far-Side Lane Closure
Very Short Duration
Short Duration
Long Duration
Left Lane Closed
Figure TL-61
TC-12
OR
TC-4
TC-12
For Short or Very Short Duration
TC-7
For Long Duration
WORK AREA
•TC-53A or TC-53B Barricades are required for Long Duration only.
TC-12 may replace TC-3 and TC-4 for Very Short or Short Duration only.
TC-4
TC-3L
6*
TC-2B or TC-2A Short Duration
CONSTRUCTION
TC-1 Long Duration
1a*
5*
3*
•See General Notes.
•Right lane closed is mirror image.
•It may be desirable to eliminate the lane closures in advance of the intersection if a heavy left turn volume may cause congestion.
•Measures should be taken to make sure on-street parking is not allowed next to the work area or taper.
*For Very Short or Short Duration: see Table A
*For Long Duration: see Table B

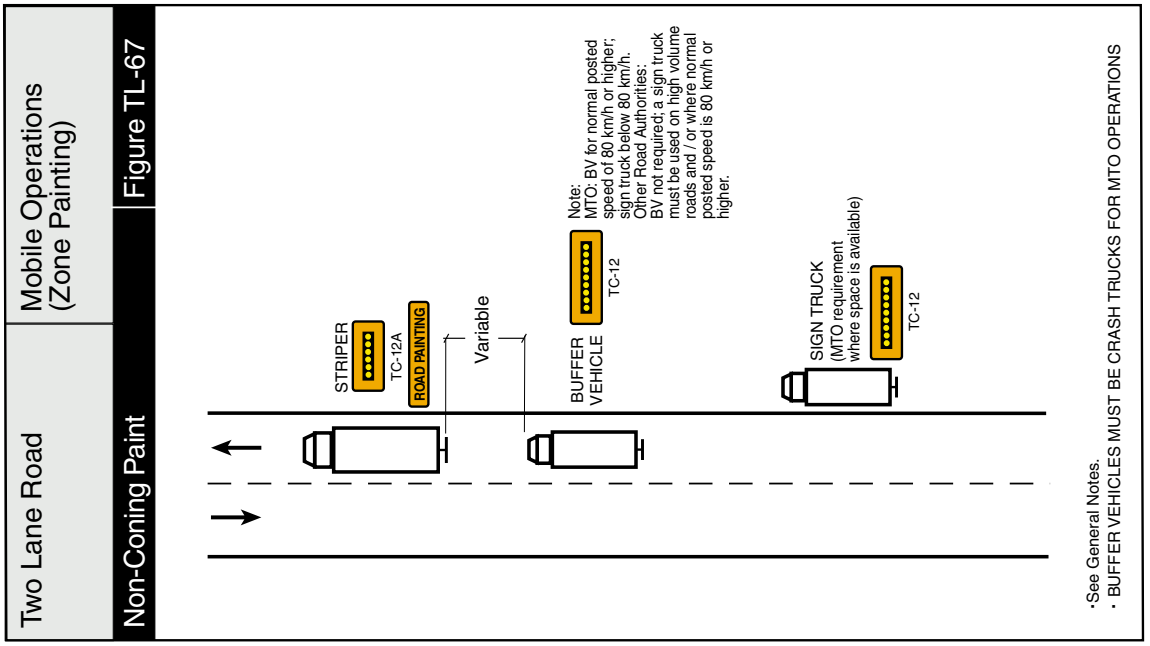

Multi-Lane Road (Intersection) Far-Side Lane Closure
Short Duration
Long Duration
Right Lane Closed (Near-Side Right Turn Lane Open)
Figure TL-62
TC-12
OR
TC-4
TC-12
For Short Duration
TC-7
For Long Duration
WORK AREA
•TC-53A or TC-53B Barricades are required for Long Duration only.
•See General Notes.
•It may be necessary to prohibit certain turning movements.
Length of right turn lane
TC-12 For posted speeds 70 km/h or higher
Wa-33LR
Rb-47
Rb-42
TC-4
TC-3R
6*
TC-2B or TC-2A Short Duration
CONSTRUCTION
TC-1 Long Duration
1a*
5*
3*
*For Short Duration: see Table A
*For Long Duration: see Table B


Multi-Lane Road (Intersection) Far-Side Lane Closure
Short Duration Long Duration
Left Lane Closed (Near-Side Left Turn Lane Open)
Figure TL-63
TC-4
OR
TC-12
For Short Duration
TC-12
OR
TC-7
For Long Duration
WORK AREA
•TC-53A or TC-53B Barricades are required for Long Duration only.
•See General Notes.
•It may be necessary to prohibit certain turning movements.
Length of left turn lane
TC-12 For posted speeds 70 km/h or higher
Wa-33LR
Rb-41 Rb-44
TC-4
TC-3L
6*
TC-2B or TC-2A Short Duration
TC-1
Long Duration
1a*
3*
5*
*For Short Duration: see Table A
*For Long Duration: see Table B


Pedestrian Considerations Sidewalk Detour onto Roadway
Short Duration Long Duration
Mid-Block Location
Figure TL-64
TC-53A or TC-53B
TC-12
OR
TC-7
For Long Duration
TC-4
TC-3R
TC-2B or TC-2A Short Duration
TC-1
Long Duration
2*
1a*
3*
5*
•See General Notes.
•For sidewalk closures of long duration, a boardwalk and railing should be provided instead of barricades (TC-53A or TC-53B).
•If close to a crosswalk, pedestrians can be directed to the opposite side of the street.
•Minimum width of temporary walkway is 1.2m.
•For Short Duration, a TC-12 can replace the TC-3, and TC-4.
*For Short Duration: see Table A
*For Long Duration: see Table B


Pedestrian Considerations
Sidewalk Detour onto Roadway
Short Duration
Long Duration
Approaching an Intersection
Figure TL-65
SIDEWALK
WORK AREA
SIDEWALK
TC-12
OR
TC-7
For Long Duration
TC-4
TC-3R
CONSTRUCTION
TC-1
TC-2B or TC-2A
Short Duration
Long Duration
1a*
TC-4
5* TC-3R
5*
TC-2B or TC-2A
(Short Duration)
OR
TC-1 (Long Duration)
2*
1a*
5*
3*
•See General Notes.
•Minimum width of temporary walkway is 1.2m.
•For Short Duration, a TC-12 can replace the TC-3, and TC-4.
*For Short Duration: see Table A
*For Long Duration: see Table B


Pedestrian Considerations
Vehicle Encroachment on Road / Sidewalk
Very Short Duration
Short Duration
Vehicles on / over Sidewalks
Figure TL-66
Pedestrian Walkway 1.2m minimum
360° Beacon
PLUS
TC-4
PLUS
Four Way Flashers
OR
TC-12
6*
TC-2B or TC-2A (Short Duration)
2*
1a*
5*
SIDEWALK
WORK VEHICLE
SIDEWALK
Boom or Hoist
Pedestrian Walkway 1.2m minimum
5*
1a*
2*
6*
TC-2B or TC-2A (Short Duration)
TC-12
OR
Four Way Flashers
PLUS
TC-4
360° Beacon
PLUS
•See General Notes.
•▲ Location of Pedestrian Controllers if required (e.g. use of booms or hoists).
•Pedestrian passage under boom is acceptable when boom is not in motion and when hoisting is not underway.
•Where activities at a work area could endanger the public (e.g. trenches, excavation), pedestrian barricades must be used.
*For Very Short or Short Duration: see Table A


Multi-Lane Roads (Non-Freeway and Freeway)
Mobile Operations (Zone Painting)
Right or Left Lane Closed (Non-Coning Paint)
Figure TL-68
Additional Signs on Rear of Vehicles (MTO) (Applies to both left and right lane operations)
ROAD PAINTING
ROAD PAINTING AHEAD
ROAD PAINTING AHEAD
ROAD PAINTING RIGHT LANE CLOSED FOR X km
Tab Optional
STRIPER
TC-12A
LIDG*
For Non-Freeways with posted speeds 80km/h or lower, BUFFER VEHICLE a Sign Truck may be used instead.
3
TC-12
LIDG* (Buffering) or 100-300m (MTO requirement for buffering and paint drying)
BUFFER VEHICLE 2 (Freeways)
TC-12
300-600m
BUFFER VEHICLE 1 (MTO requirement on Freeways for paint drying.
TC-12
Variable
Sign Truck (MTO requirement on Freeways)
TC-12
For MTO Freeways, add two vehicles as shown in opposite direction
TC-12
BUFFER VEHICLE 2 (Freeways)
LIDG* or 100-300m (as per route shown for other direction)
TC-12
BUFFER VEHICLE 3
LIDG*
TC-12A
STRIPER
•See General Notes.
• BUFFER VEHICLES MUST BE CRASH TRUCKS FOR MTO OPERATIONS
For Lateral Intrusion Deterrence Gap (LIDG): see Table D

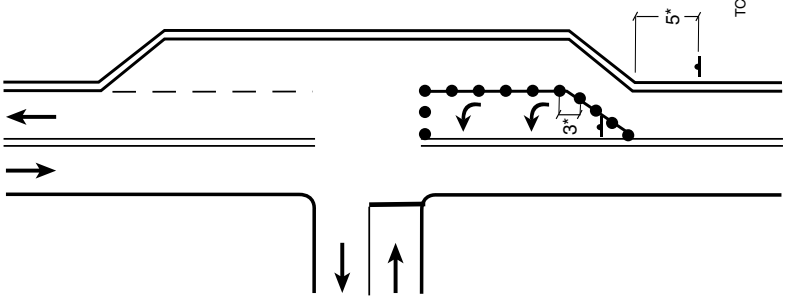
Two Lane Road
Mobile Operations (Zone Painting)
Non-Coning Paint
Figure TL-67
STRIPER
TC-12A
ROAD PAINTING
Variable
BUFFER VEHICLE
TC-12
Note:
MTO: BV for normal posted speed of 80 km/h or higher; sign truck below 80 km/h.
Other Road Authorities:
BV not required; a sign truck must be used on high volume roads and / or where normal posted speed is 80 km/h or higher.
SIGN TRUCK
(MTO requirement where space is available)
TC-12
•See General Notes.
• BUFFER VEHICLES MUST BE CRASH TRUCKS FOR MTO OPERATIONS

Zone Painting Operations Intersections

Very Short Duration Short Duration

Turn Arrows

Figure TL-69



·See General Notes.
·The signs can be removed when the painting operation is complete and no workers are present, the cones remain until the paint has dried.
·A vehicle with a 360° beacon can replace the TC-2B or TC-2A on the approach where the 360° beacon is visible.
·A TC-12 and a 360° beacon may replace the TC-2B or TC-2A and the TC-4.

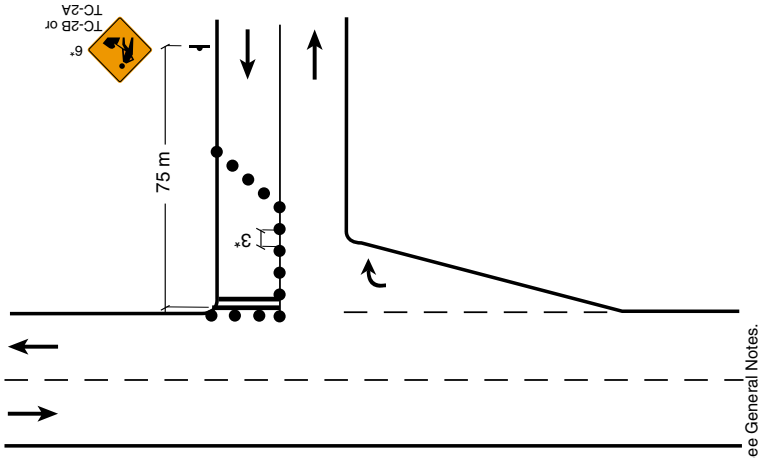
*For Very Short or Short Duration: see **Table A**

Zone Painting Operations Intersections

Very Short Duration Short Duration

Stoplines and Crosswalks

Figure TL-70



·See General Notes.
·It may be necessary to paint the stopline and crosswalks in sections to maintain traffic flow.
·The signs can be removed when the painting operation is complete and no workers are present, the cones remain until the paint has dried.
·A vehicle with a 360° beacon can replace the TC-2B or TC-2A on the approach where the 360° beacon is visible.

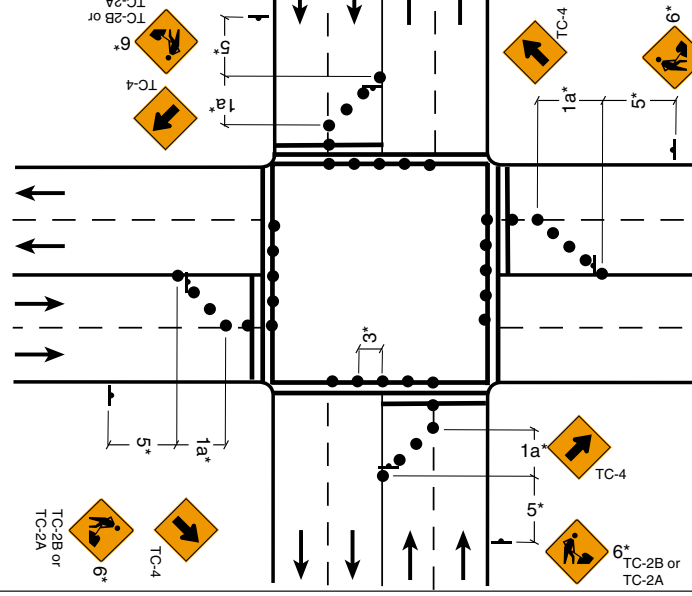
*For Very Short or Short Duration: see **Table A**

Zone Painting Operations Intersections

Very Short Duration Short Duration

Left Lanes Closed

Figure TL-71



·See General Notes
·The signs can be removed when the painting operation is complete and no workers are present, the cones remain until the paint has dried.
·A vehicle with a 360° beacon can replace the TC-2B or TC-2A on the approach where the 360° beacon is visible.
·A TC-12 and a 360° beacon may replace the TC-2B or TC-2A and the TC-4.

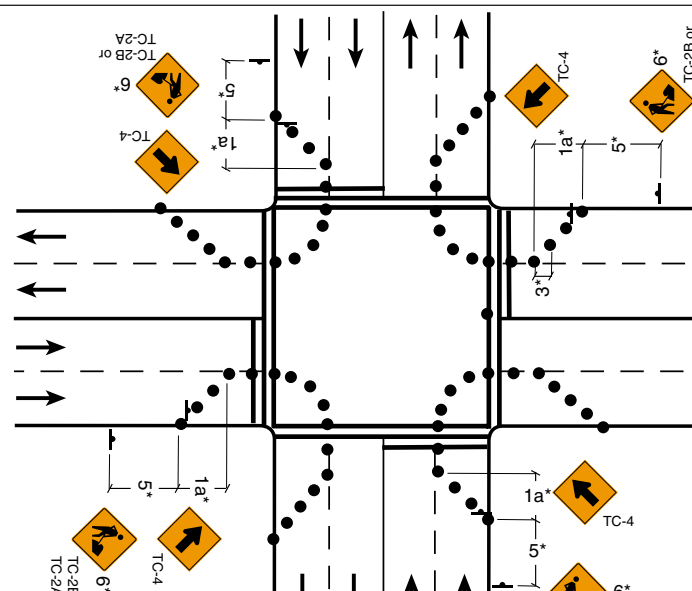
*For Very Short or Short Duration: see **Table A**

Zone Painting Operations Intersections

Very Short Duration Short Duration

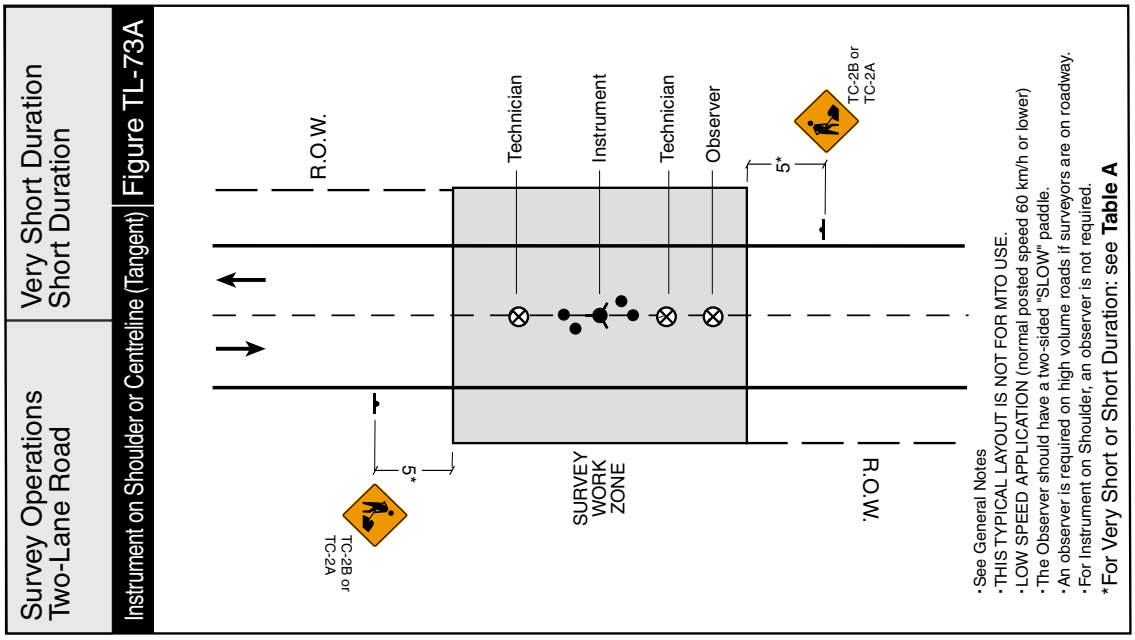
Right Lanes Closed

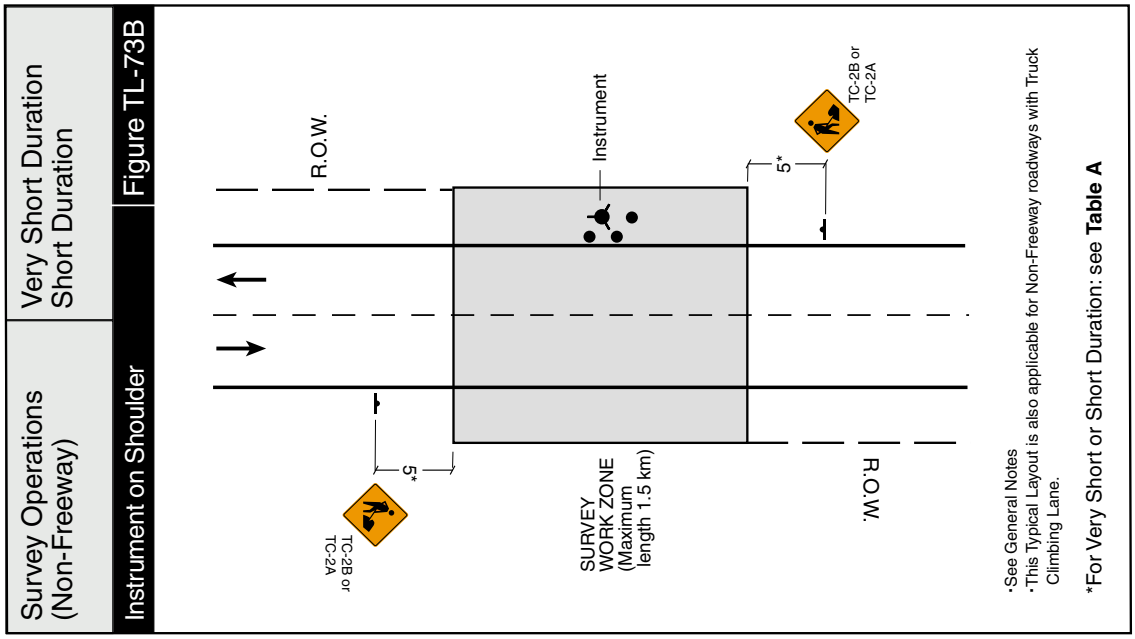
Figure TL-72



·See General Notes
·The signs can be removed when the painting operation is complete and no workers are present, the cones remain until the paint has dried.
·A vehicle with a 360° beacon can replace the TC-2B or TC-2A on the approach where the 360° beacon is visible.
·A TC-12 and a 360° beacon may replace the TC-2B or TC-2A and the TC-4.

*For Very Short or Short Duration: see **Table A**

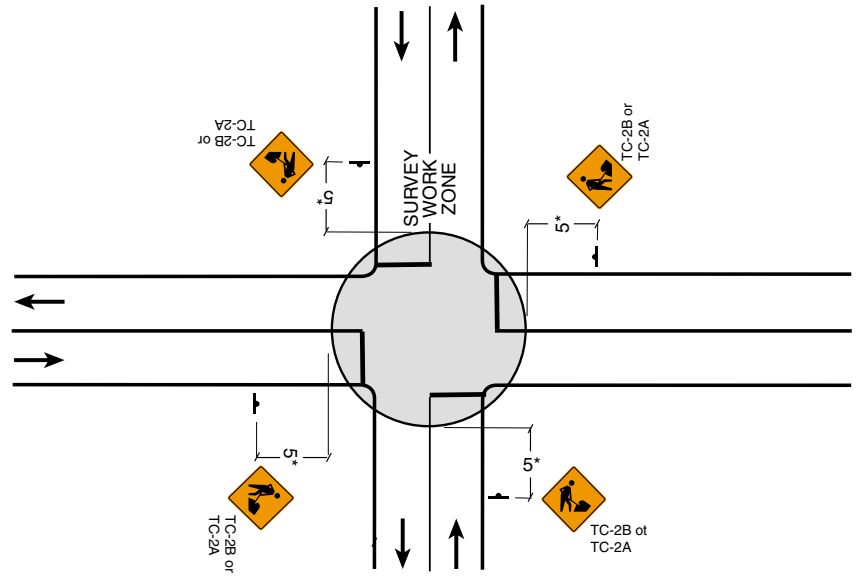

Survey Operations
Two-Lane Road
Very Short Duration
Short Duration
Instrument on Shoulder or Centreline (Tangent)
Figure TL-73A
R.O.W.
Technician
Instrument
Technician
Observer
5*
TC-2B or
TC-2A
SURVEY
WORK
ZONE
R.O.W.
·See General Notes
·THIS TYPICAL LAYOUT IS NOT FOR MTO USE.
·LOW SPEED APPLICATION (normal posted speed 60 km/h or lower)
·The Observer should have a two-sided "SLOW" paddle.
·An observer is required on high volume roads if surveyors are on roadway.
·For Instrument on Shoulder, an observer is not required.
*For Very Short or Short Duration: see Table A


Survey Operations
(Non-Freeway)
Very Short Duration
Short Duration
Instrument on Shoulder
Figure TL-73B
R.O.W.
Instrument
5*
TC-2B or
TC-2A
SURVEY
WORK ZONE
(Maximum
length 1.5 km)
R.O.W.
·See General Notes
·This Typical Layout is also applicable for Non-Freeway roadways with Truck Climbing Lane.
*For Very Short or Short Duration: see Table A

Survey Operations
Two-Lane Road

Very Short Duration
Short Duration

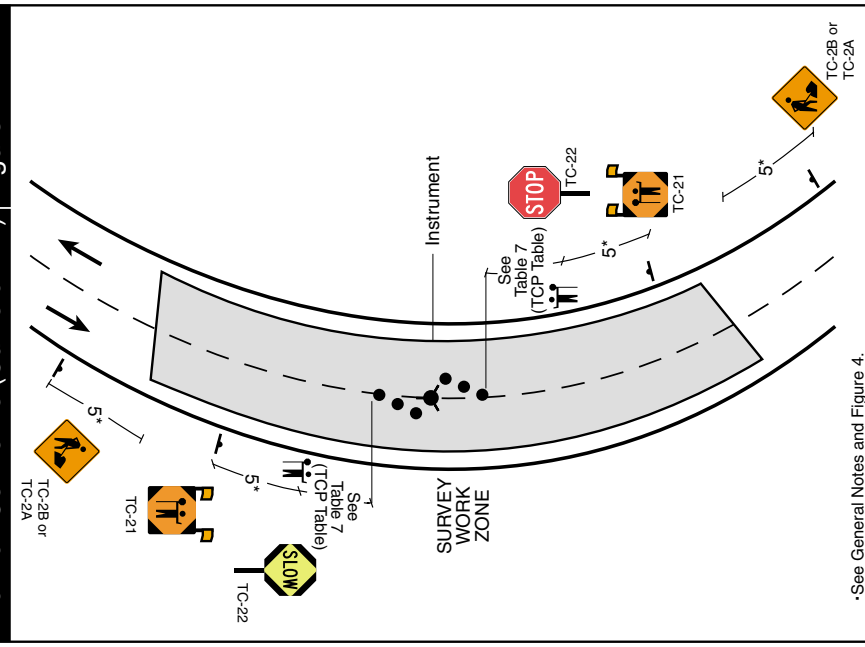
Work in Intersection | Figure TL-75



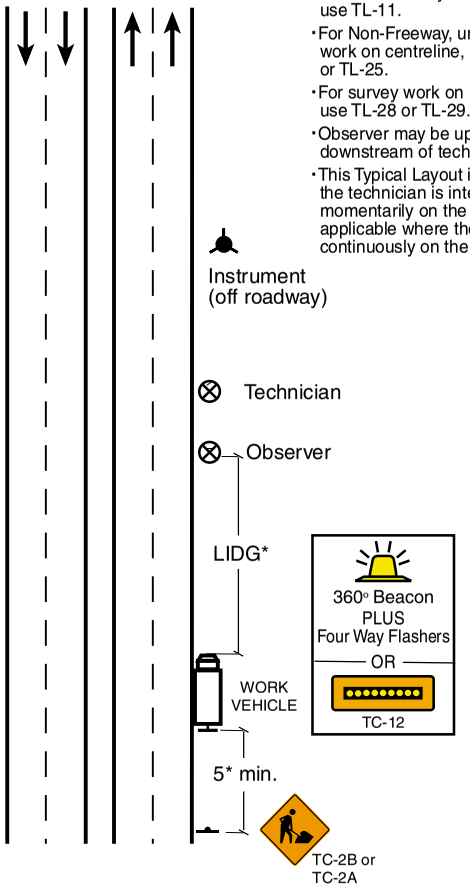
Survey Operations
Two-Lane Road

Very Short Duration
Short Duration

Work on Centreline (Curve or Hill) | Figure TL-74



Survey Operations Multi-Lane Road (Non-Freeway)	Very Short Duration Short Duration
Work on Pavement Edge or Lane Line	Figure TL-76

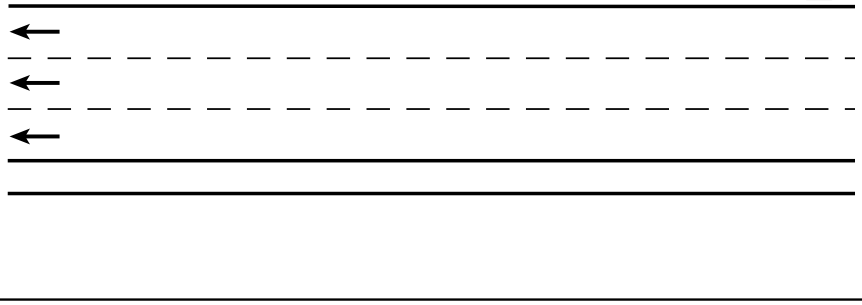


- See General Notes.
- For Survey Work off roadway, on Non-Freeways or Freeways, use TL-11.
- For Non-Freeway, undivided, work on centreline, use TL-26 or TL-25.
- For survey work on freeways, use TL-28 or TL-29.
- Observer may be upstream or downstream of technician.
- This Typical Layout is applicable where the technician is intermittently and momentarily on the roadway; not applicable where the technician is continuously on the roadway.

*For Very Short or Short Duration (Non-Freeway) see **Table A**
For Lateral Intrusion Deterrence Gap (LIDG) see **Table D**

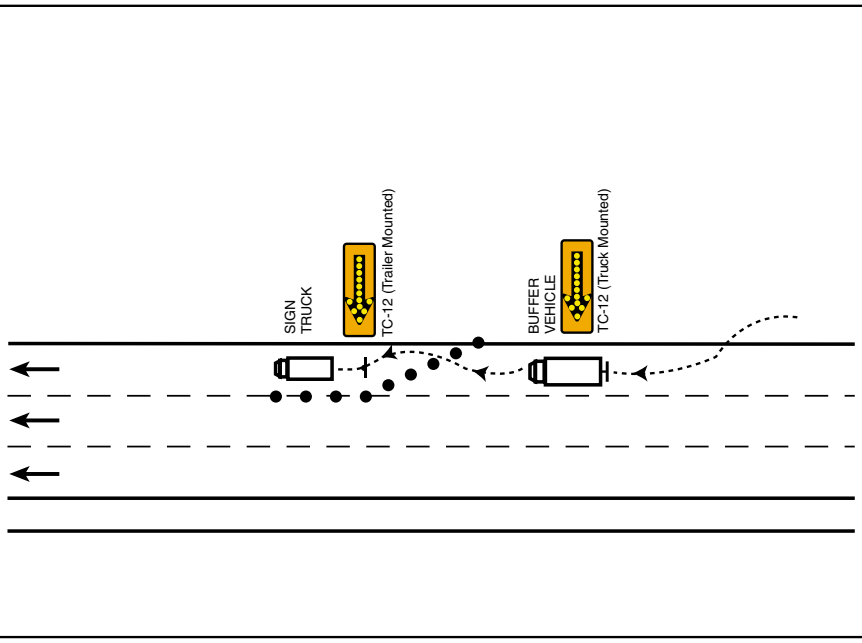
Lane Closure Set-Up Procedures (Freeway) | Short Duration

Right or Left Lane Closed (With Shoulders) | Figure TL-77A



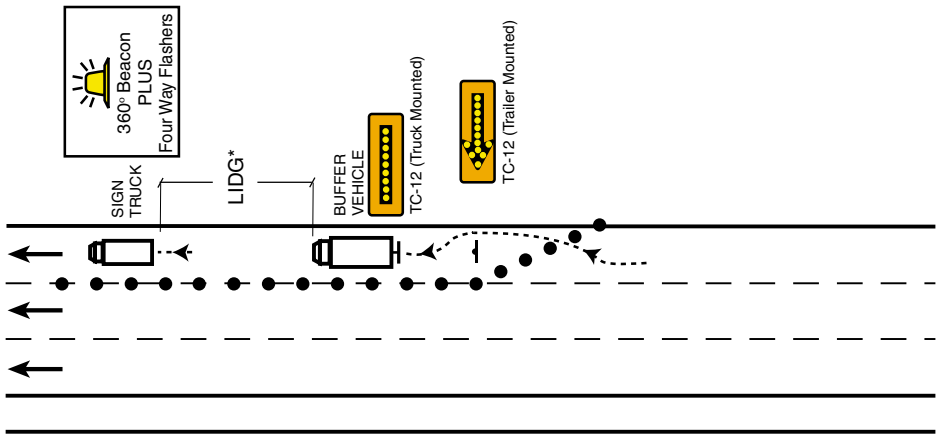
Lane Closure Set-Up Procedures (Freeway) | Short Duration

Right or Left Lane Closed (With Shoulders) | Figure TL-77B



Lane Closure Set-Up Procedures (Freeway) | Short Duration

Right or Left Lane Closed (With Shoulders) | Figure TL-77C

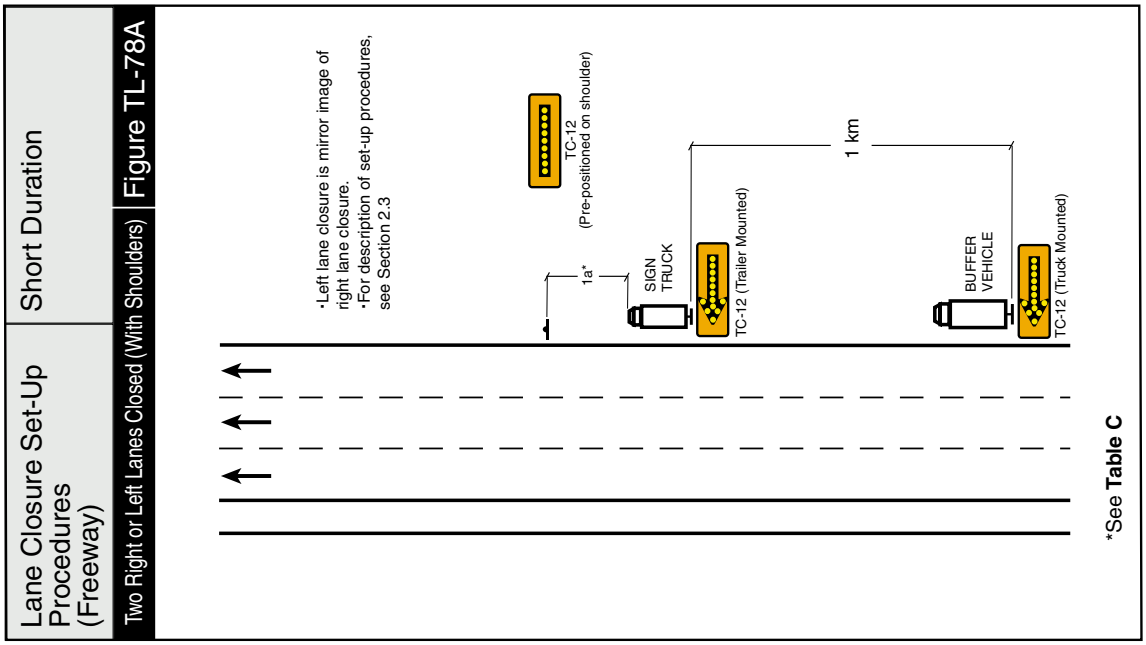


For Lateral Intrusion Deterrence Gap (LIDG): see **Table D**

Lane Closure Set-Up Procedures (Freeway)

Short Duration

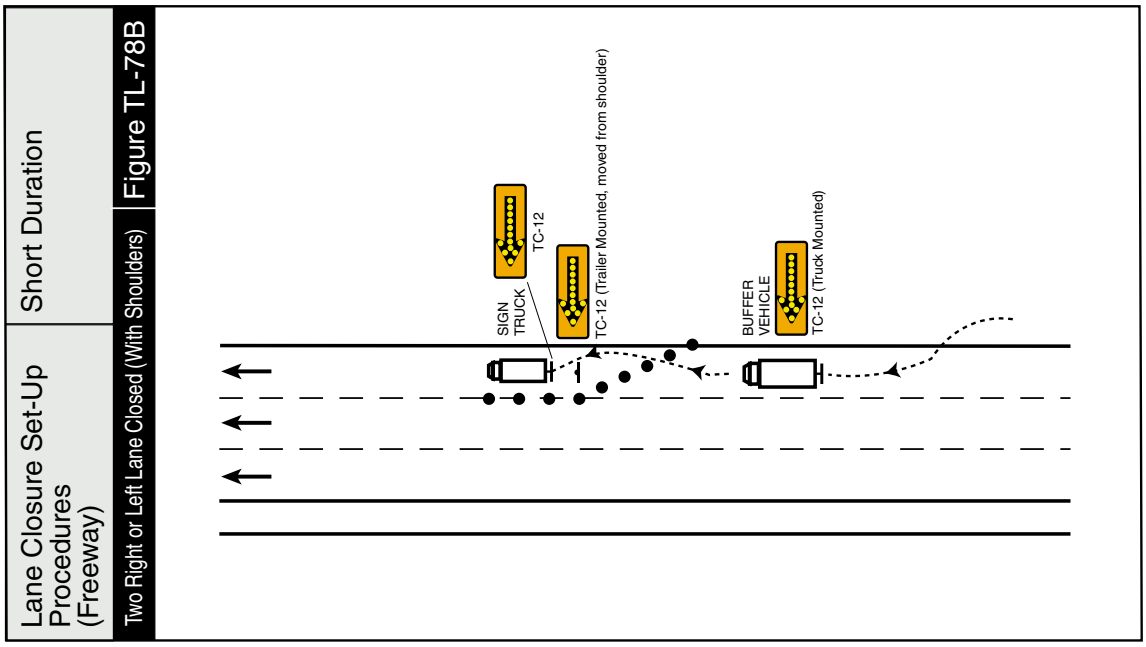
Two Right or Left Lanes Closed (With Shoulders) | Figure TL-78A



Lane Closure Set-Up Procedures (Freeway)

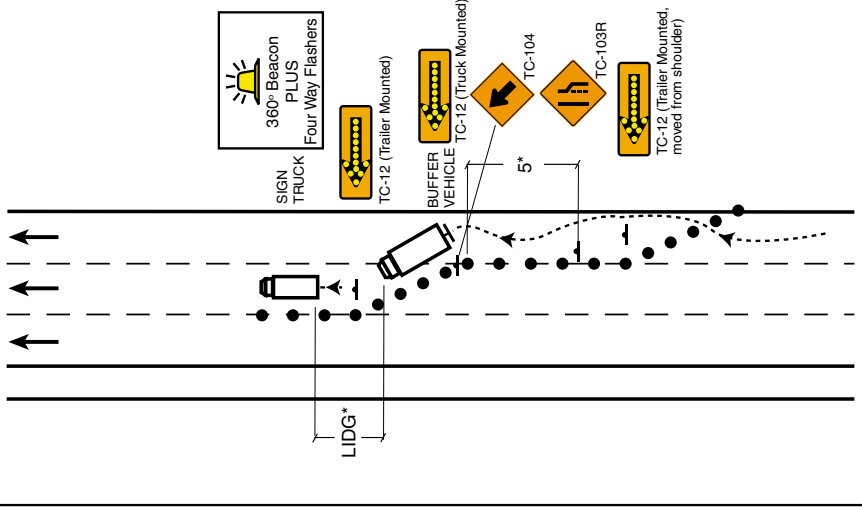
Short Duration

Two Right or Left Lane Closed (With Shoulders) | Figure TL-78B



Lane Closure Set-Up Procedures (Freeway) | Short Duration

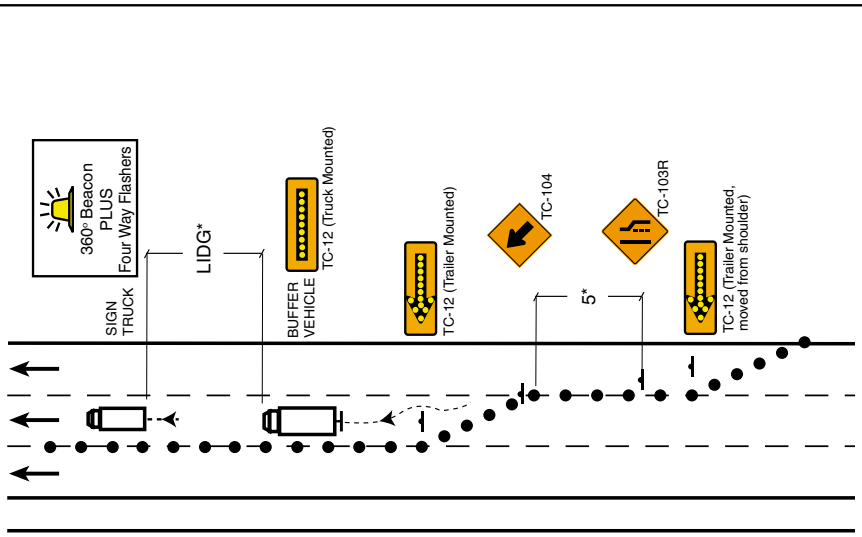
Two Right or Left Lanes Closed (With Shoulders) | Figure TL-78C



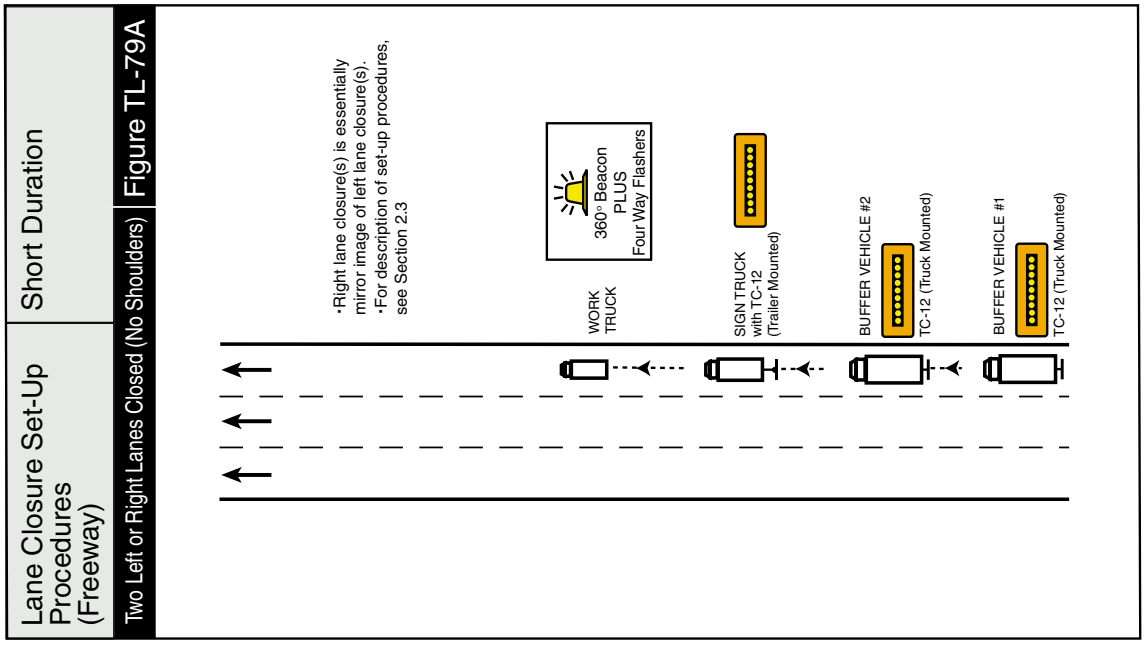
For Lateral Intrusion Deterrence Gap (LIDG): see **Table D**

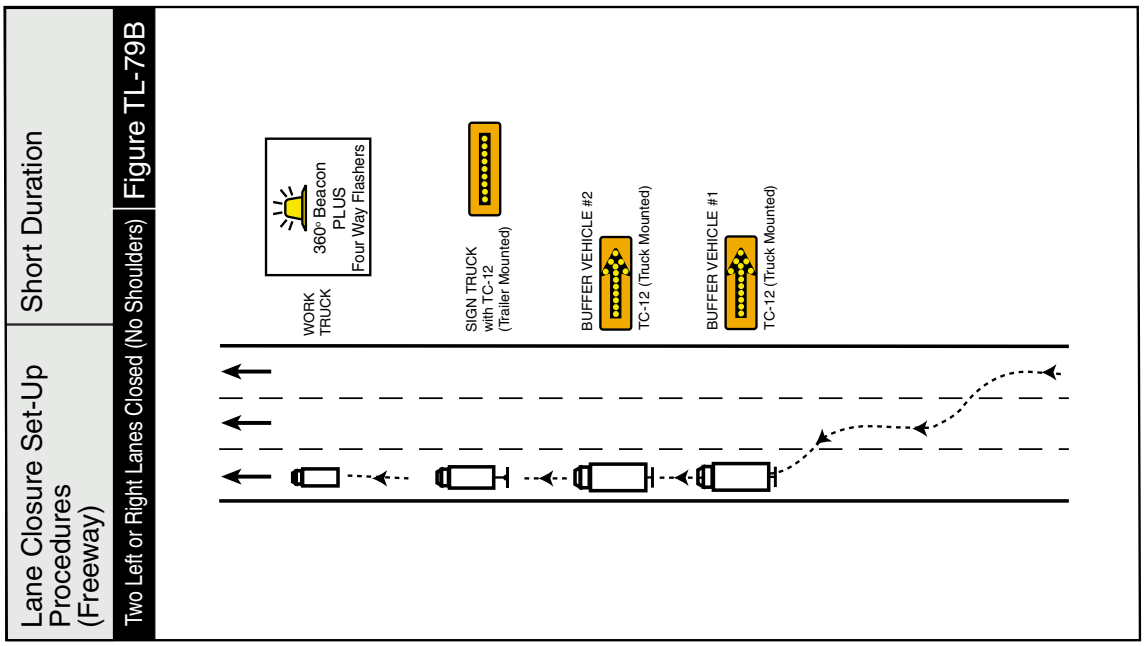
Lane Closure Set-Up Procedures (Freeway) | Short Duration

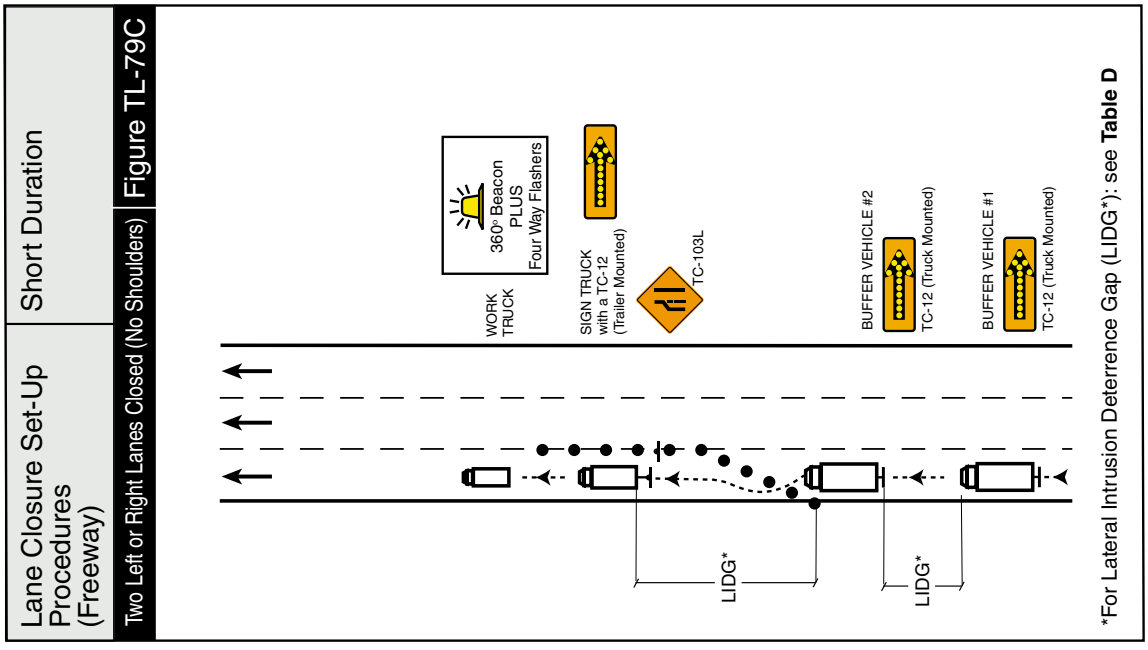
Two Right or Left Lanes Closed (With Shoulders) | Figure TL-78D

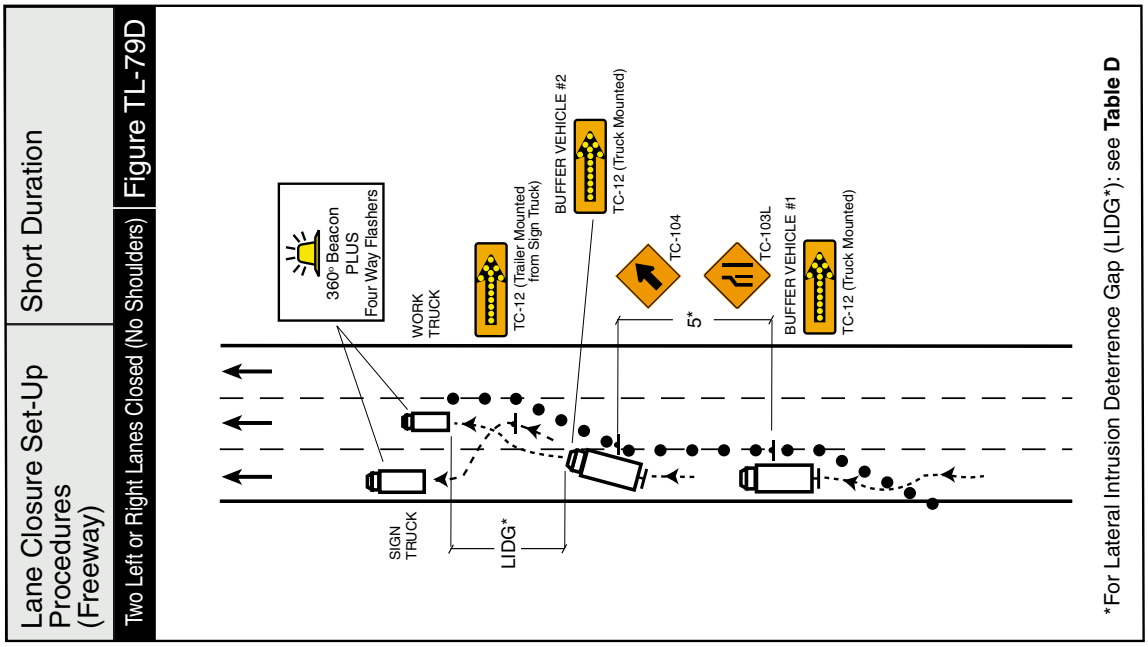


For Lateral Intrusion Deterrence Gap (LIDG): see **Table D**


Lane Closure Set-Up Procedures (Freeway)
Short Duration
Two Left or Right Lanes Closed (No Shoulders)
Figure TL-79A
•Right lane closure(s) is essentially mirror image of left lane closure(s).
•For description of set-up procedures, see Section 2.3
WORK TRUCK
360° Beacon PLUS Four Way Flashers
SIGN TRUCK with TC-12 (Trailer Mounted)
BUFFER VEHICLE #2
TC-12 (Truck Mounted)
BUFFER VEHICLE #1
TC-12 (Truck Mounted)

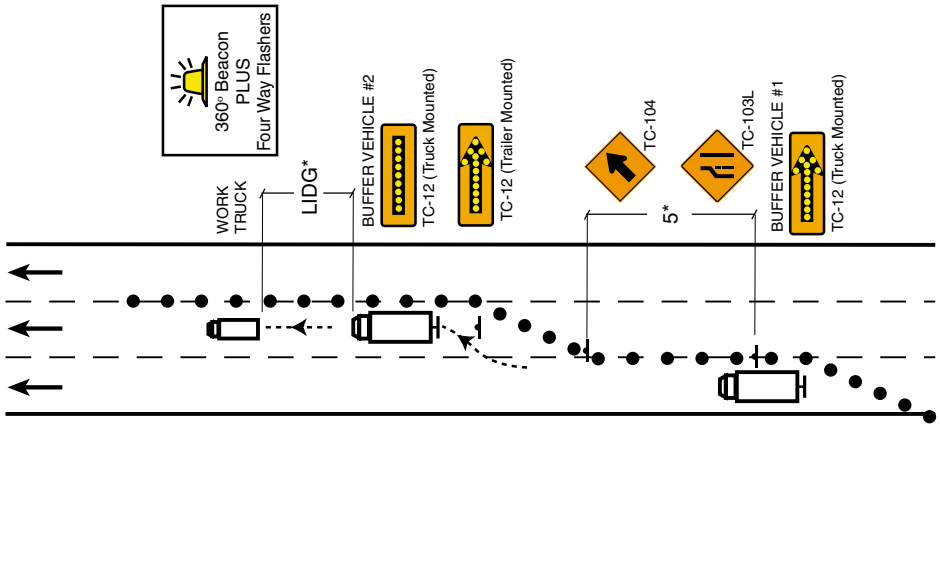

Lane Closure Set-Up Procedures (Freeway)
Short Duration
Two Left or Right Lanes Closed (No Shoulders)
Figure TL-79B
WORK TRUCK
360° Beacon PLUS Four Way Flashers
SIGN TRUCK with TC-12 (Trailer Mounted)
BUFFER VEHICLE #2
TC-12 (Truck Mounted)
BUFFER VEHICLE #1
TC-12 (Truck Mounted)


Lane Closure Set-Up Procedures (Freeway)
Short Duration
Two Left or Right Lanes Closed (No Shoulders)
Figure TL-79C
WORK TRUCK
360° Beacon PLUS Four Way Flashers
SIGN TRUCK with a TC-12 (Trailer Mounted)
TC-103L
BUFFER VEHICLE #2
TC-12 (Truck Mounted)
BUFFER VEHICLE #1
TC-12 (Truck Mounted)
LIDG*
LIDG*
For Lateral Intrusion Deterrence Gap (LIDG): see Table D

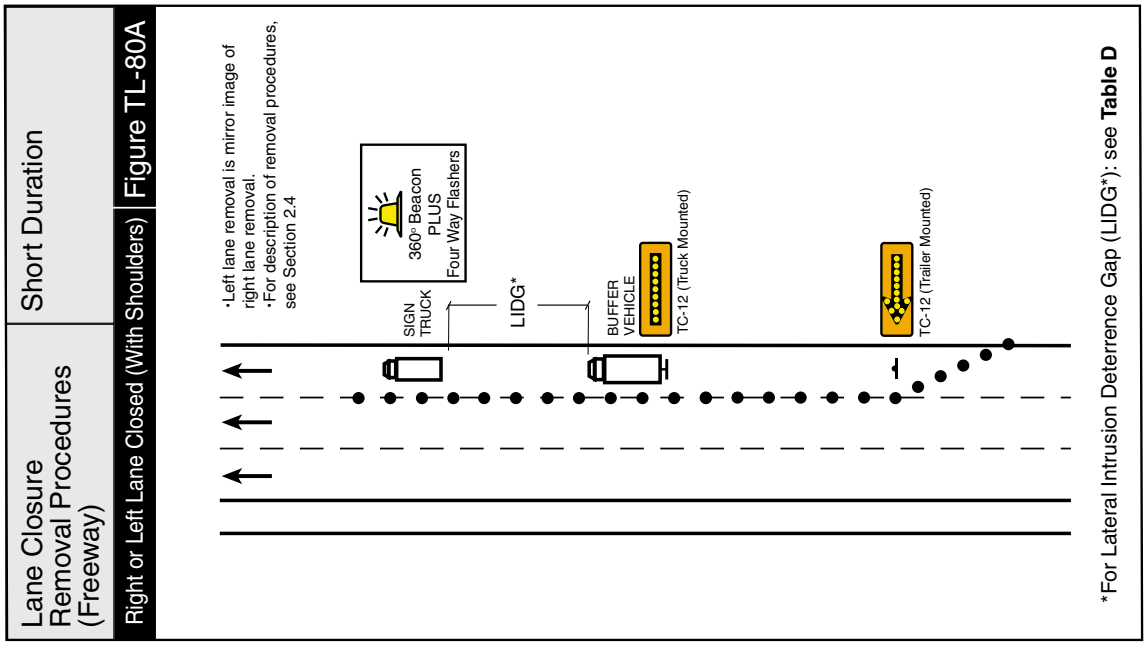

Lane Closure Set-Up Procedures (Freeway)
Short Duration
Two Left or Right Lanes Closed (No Shoulders)
Figure TL-79D
360° Beacon PLUS Four Way Flashers
WORK TRUCK
TC-12 (Trailer Mounted from Sign Truck)
BUFFER VEHICLE #2
TC-12 (Truck Mounted)
TC-104
5*
TC-103L
BUFFER VEHICLE #1
TC-12 (Truck Mounted)
SIGN TRUCK
LIDG*
For Lateral Intrusion Deterrence Gap (LIDG): see Table D

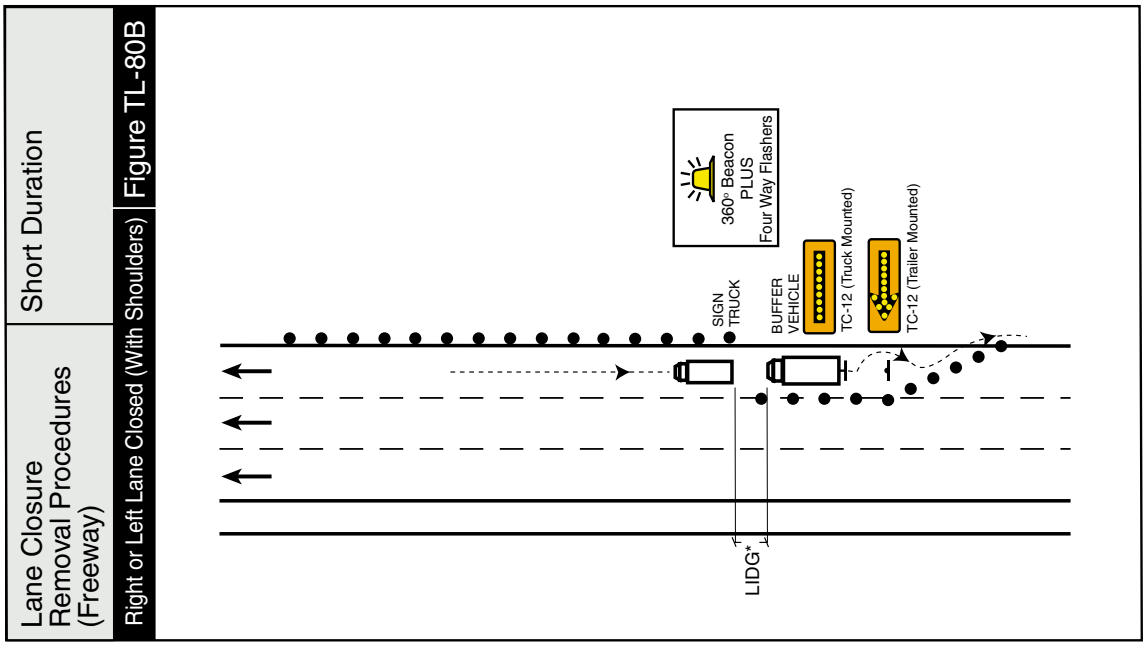
Lane Closure Set-Up Procedures (Freeway) | Short Duration

Two Left or Right Lanes Closed (No Shoulders) | Figure TL-79E



For Lateral Intrusion Deterrence Gap (LIDG): see **Table D**

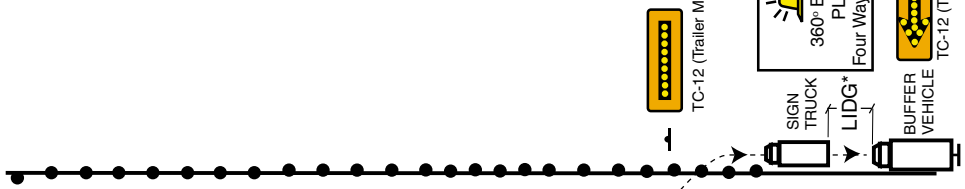

Lane Closure Removal Procedures (Freeway)
Short Duration
Right or Left Lane Closed (With Shoulders)
Figure TL-80A
•Left lane removal is mirror image of right lane removal.
•For description of removal procedures, see Section 2.4
SIGN TRUCK
360° Beacon PLUS Four Way Flashers
LIDG*
BUFFER VEHICLE
TC-12 (Truck Mounted)
TC-12 (Trailer Mounted)
For Lateral Intrusion Deterrence Gap (LIDG): see Table D


Lane Closure Removal Procedures (Freeway)
Short Duration
Right or Left Lane Closed (With Shoulders)
Figure TL-80B
SIGN TRUCK
360° Beacon PLUS Four Way Flashers
BUFFER VEHICLE
TC-12 (Truck Mounted)
TC-12 (Trailer Mounted)
LIDG*

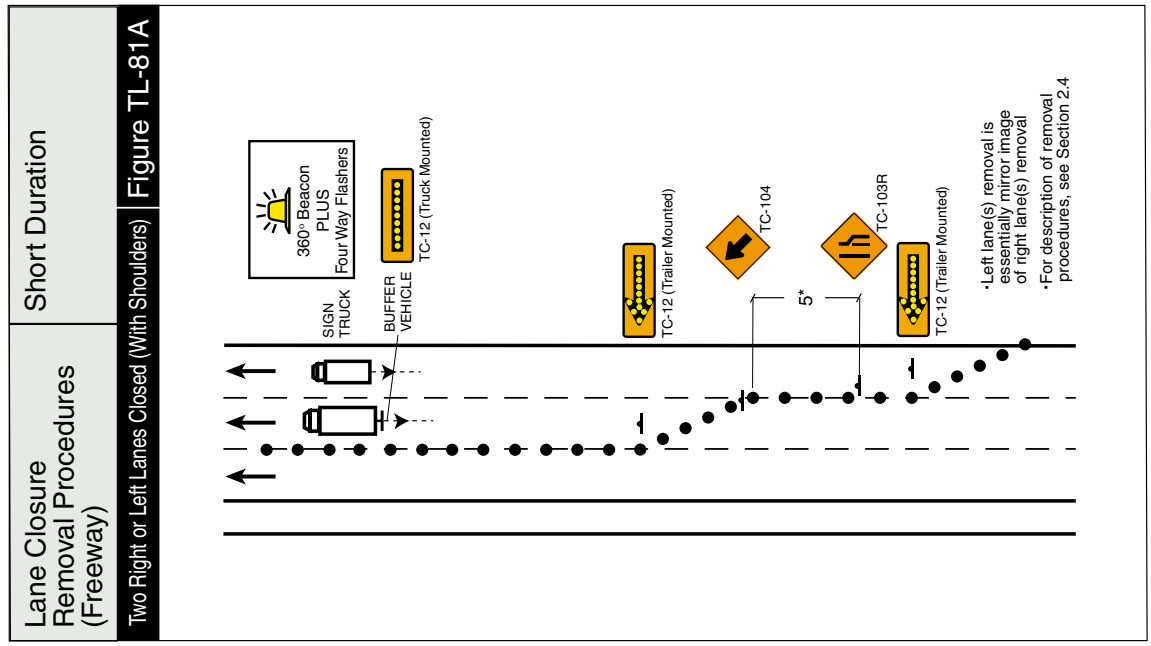
Lane Closure
Removal Procedures
(Freeway)

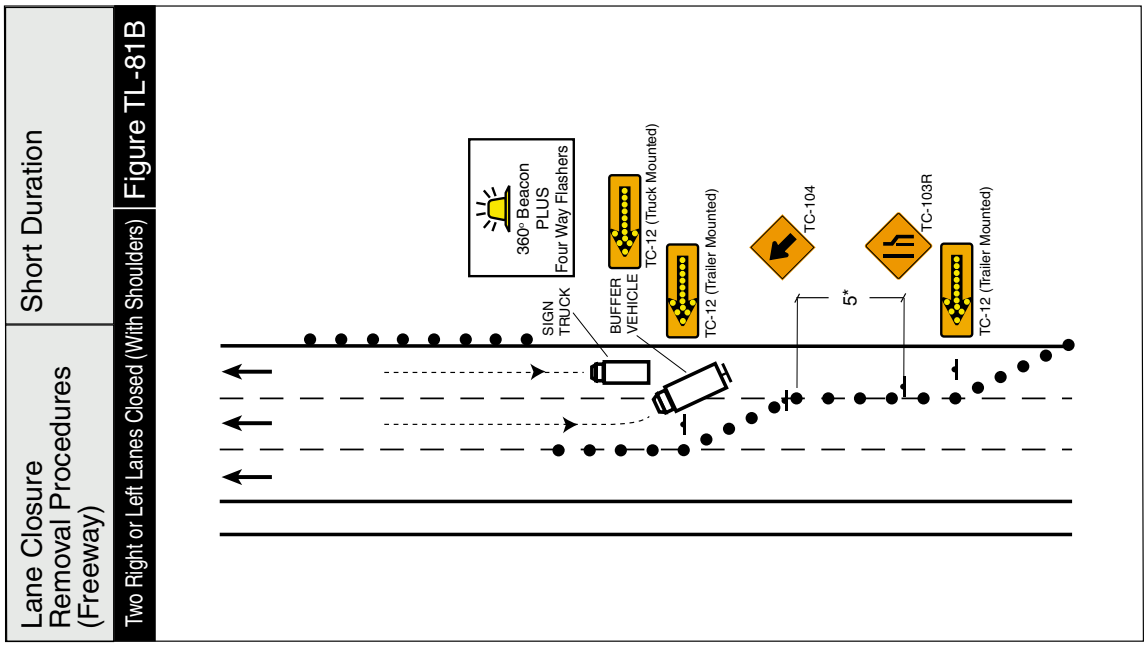
Short Duration

Right or Left Lane Closed (With Shoulders) Figure TL-80C



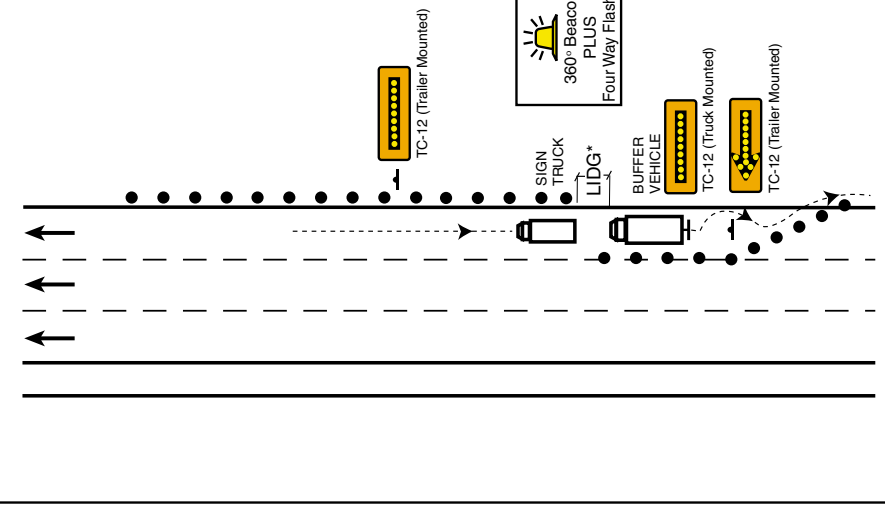
For Lateral Intrusion Deterrence Gap (LIDG): see **Table D**


Lane Closure
Removal Procedures
(Freeway)
Short Duration
Two Right or Left Lanes Closed (With Shoulders)
Figure TL-81A
360° Beacon
PLUS
Four Way Flashers
SIGN
TRUCK
BUFFER
VEHICLE
TC-12 (Truck Mounted)
TC-12 (Trailer Mounted)
TC-104
5*
TC-103R
TC-12 (Trailer Mounted)
•Left lane(s) removal is essentially mirror image of right lane(s) removal
•For description of removal procedures, see Section 2.4


Lane Closure
Removal Procedures
(Freeway)
Short Duration
Two Right or Left Lanes Closed (With Shoulders)
Figure TL-81B
360° Beacon
PLUS
Four Way Flashers
SIGN
TRUCK
BUFFER
VEHICLE
TC-12 (Truck Mounted)
TC-12 (Trailer Mounted)
TC-104
5*
TC-103R
TC-12 (Trailer Mounted)

Lane Closure Removal Procedures (Freeway) | Short Duration

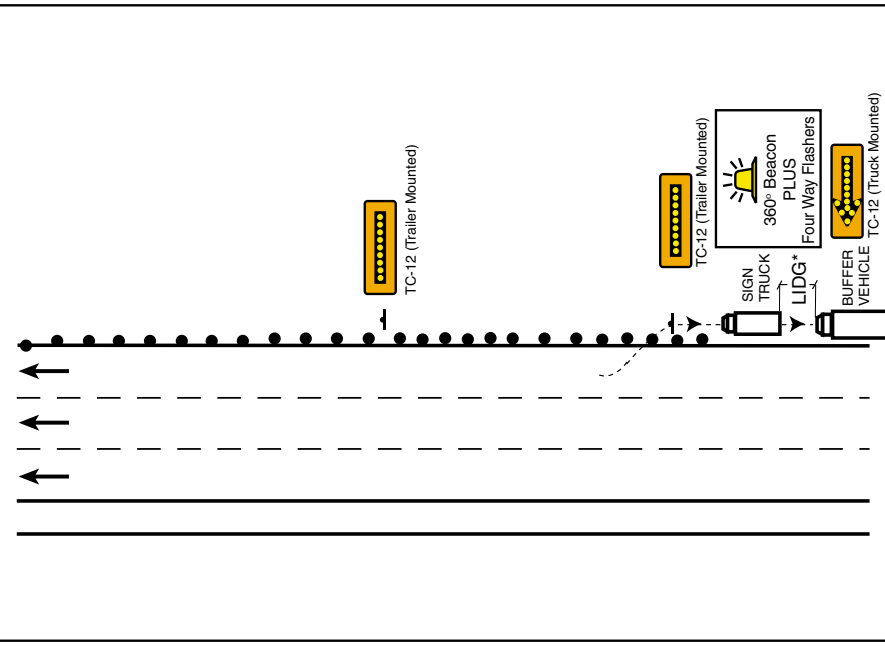
Two Right or Left Lanes Closed (With Shoulders) | Figure TL-81C



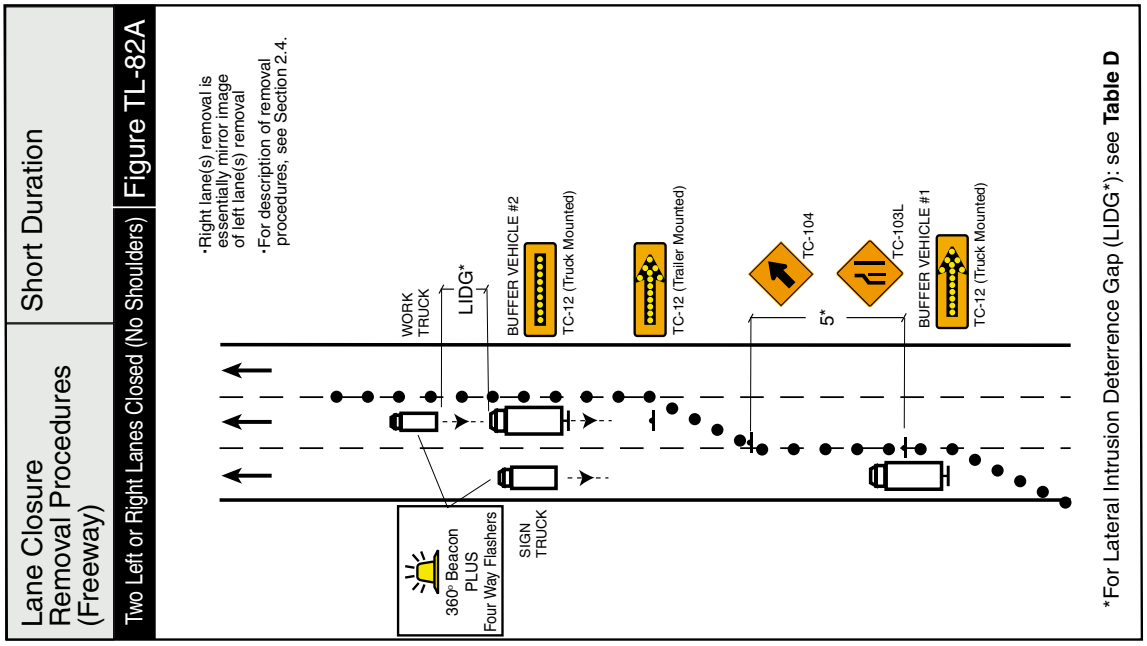
For Lateral Intrusion Deterrence Gap (LIDG): see **Table D**

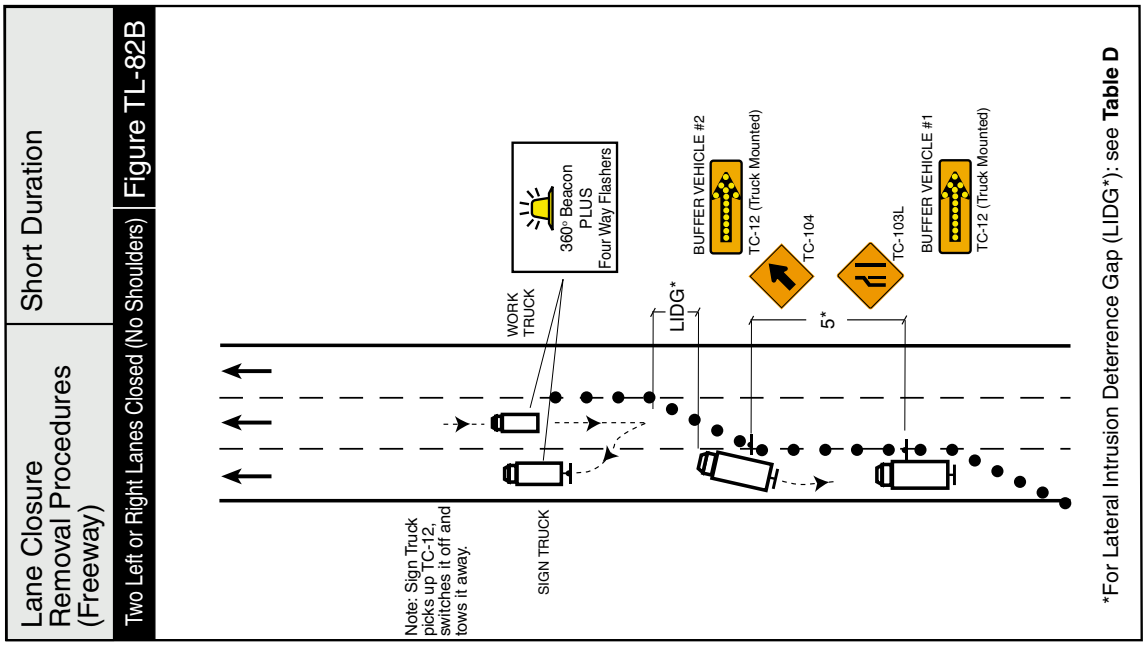
Lane Closure Removal Procedures (Freeway) | Short Duration

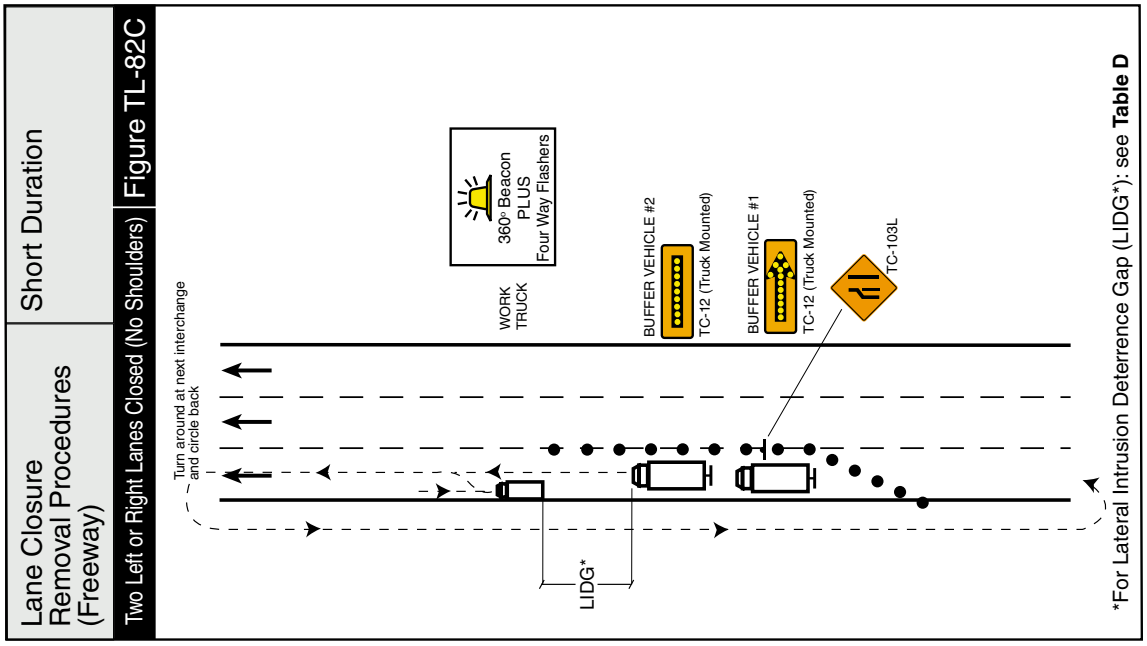
Two Right or Left Lanes Closed (With Shoulders) | Figure TL-81D

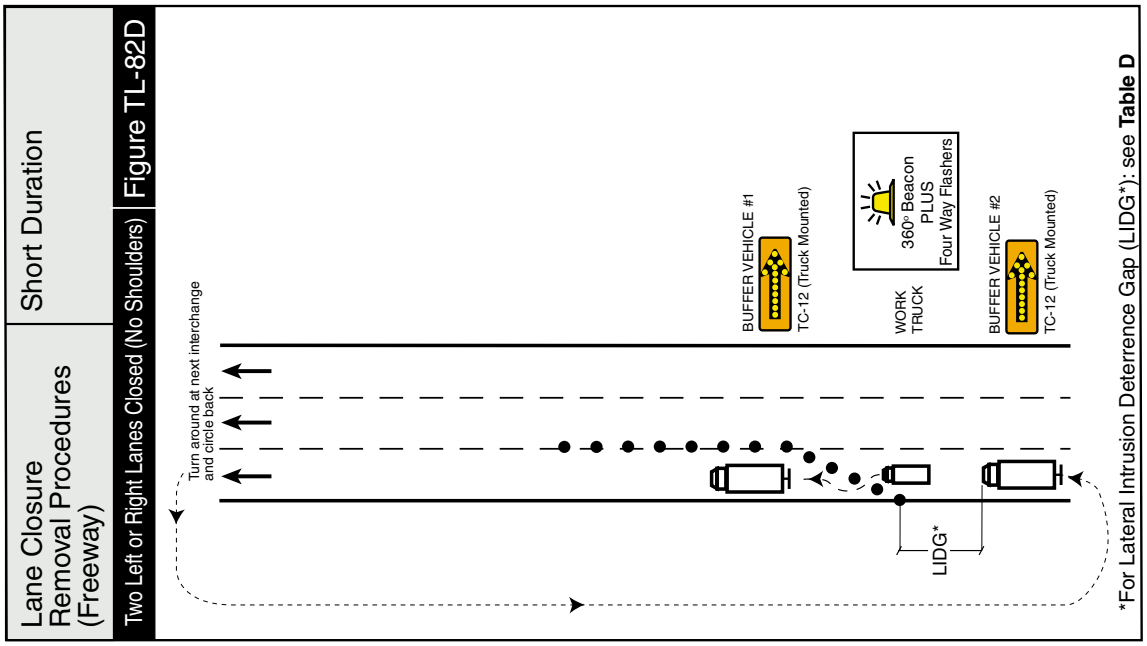


For Lateral Intrusion Deterrence Gap (LIDG): see **Table D**


Lane Closure Removal Procedures (Freeway)
Short Duration
Two Left or Right Lanes Closed (No Shoulders)
Figure TL-82A
•Right lane(s) removal is essentially mirror image of left lane(s) removal
•For description of removal procedures, see Section 2.4.
360° Beacon PLUS Four Way Flashers
SIGN TRUCK
WORK TRUCK
LIDG*
BUFFER VEHICLE #2
TC-12 (Truck Mounted)
TC-12 (Trailer Mounted)
TC-104
5*
TC-103L
BUFFER VEHICLE #1
TC-12 (Truck Mounted)
For Lateral Intrusion Deterrence Gap (LIDG): see Table D


Lane Closure Removal Procedures (Freeway)
Short Duration
Two Left or Right Lanes Closed (No Shoulders)
Figure TL-82B
Note: Sign Truck picks up TC-12, switches it off and tows it away.
SIGN TRUCK
WORK TRUCK
360° Beacon PLUS Four Way Flashers
LIDG*
BUFFER VEHICLE #2
TC-12 (Truck Mounted)
TC-104
5*
TC-103L
BUFFER VEHICLE #1
TC-12 (Truck Mounted)
For Lateral Intrusion Deterrence Gap (LIDG): see Table D


Lane Closure Removal Procedures (Freeway)
Short Duration
Two Left or Right Lanes Closed (No Shoulders)
Figure TL-82C
Turn around at next interchange and circle back
WORK TRUCK
360° Beacon PLUS Four Way Flashers
BUFFER VEHICLE #2
TC-12 (Truck Mounted)
BUFFER VEHICLE #1
TC-12 (Truck Mounted)
TC-103L
LIDG*
For Lateral Intrusion Deterrence Gap (LIDG): see Table D


Lane Closure Removal Procedures (Freeway)
Short Duration
Two Left or Right Lanes Closed (No Shoulders)
Figure TL-82D
Turn around at next interchange and circle back
BUFFER VEHICLE #1
TC-12 (Truck Mounted)
WORK TRUCK
360° Beacon PLUS Four Way Flashers
BUFFER VEHICLE #2
TC-12 (Truck Mounted)
LIDG*
For Lateral Intrusion Deterrence Gap (LIDG): see Table D

9. Manual Revisions Since Last Edition

Book 7 (Temporary Conditions) of the Ontario Traffic Manual replaces MUTCD Division A.5 (Temporary Conditions). Book 7 is a revision and expansion of MUTCD Part A, Division 5, with many changes, both major and minor.

Significant changes to Book 7 include:

Section 1.7	Six component areas of a Work Zone, including the Longitudinal Buffer Area (LBA)
Section 1.8	Four categories of Work Duration
Section 1.8	New definition of Short Duration Work, including nighttime work, and traffic control devices required
Section 1.9	Partial Lane Shifts
Section 1.12, 1.13	More treatment of pedestrians and cyclists
Section 2	Procedures for Temporary Work Zones (preparation, set up, and take down)
Section 2.6	Pilot Vehicle, Pace Vehicles, Rolling Closures
Section 3	New Table 2 (Work Zone Sign Sizes)
Section 3.1, 6.1	New reflectivity requirements
Section 3.2, 6.1	TC-12 Flashing Arrow Board requirements
Section 3.3	Portable variable message signs in work zones
Section 4.4	TCP clothing requirements
Section 4.4	Remote Control Device (Flagger)
Section 4.8	New technologies
Section 5	Application of Buffer Vehicles and the LBA
Section 6.1	New Signs
Section 6.1	New TCP Sign
Section 6.2	Barrier requirements
Section 6.2, 8	New Table E.2 (Usage of Channelizing Devices, Barricades, and Barriers)
Section 7	Traffic control devices: quality replacement guidelines
Section 8	Revisions to Tables A, B, and C
Section 8	New Table D (Buffer Vehicle Positioning)
Section 8	New Table E.1 (Typical Usage of Signs through a Temporary Work Zone)
Section 8	New Table F (Decision Matrix: Typical Layouts) and additional layouts
Training package	
Revised and re-formatted Book 7 Field Edition	

(Book 1 summarizes the manual revisions for each Book since that Book's last date of issue.)

10. Renumbered or Added Signs

In general, sign numbers used in Book 7 are consistent with those in the MUTCD. In a few instances, however, it was necessary to renumber signs or add new signs and sign numbers. Signs were renumbered or added for the following reasons:

- To accommodate new similar signs and to maintain consistency with other sign numbers.
- To accommodate changes in sign sub-classes, and to identify signs which, though used primarily for temporary conditions, are regulatory in nature.
- To accommodate signs from other sources, including municipalities and the Book 7 Technical Advisory Committee (TAC) and new sign designs.

Table 12 lists signs that have been renumbered. Table 13 lists added signs and new sign designs.

Table 12 – Renumbered Signs

New Number	Previous Number	Sign Name
TC-1B	TC-1A	CONSTRUCTION AHEAD 2 KM (Previously TC-1A included either the 1 km or the 2 km tab; now TC-1A refers to the sign with the 1 km tab; TC-1B to the sign with the 2 km tab)
TC-5A	TC-6	DETOUR AHEAD 1 KM
TC-5B	TC-6	DETOUR AHEAD 2 KM
TC-7tA	TC-7t	ROAD CLOSED Tab
TC-7tB	TC-8t	LOCAL TRAFFIC ONLY Tab
Rb-90A	TC-41A	CONSTRUCTION ZONE BEGINS (now also in Book 5)
Rb-90B	TC-41B	CONSTRUCTION ZONE ENDS (now also in Book 5)
Rb-91	TC-43	YIELD TO ONCOMING TRAFFIC (now also in Book 5)
Rb-92	TC-46	ROAD CLOSED (now also in Book 5)

Table 13 – Added Signs and New Sign Designs

Sign Number	Sign Name	Source/Comment
TC-3tA	300 M Tab	MUTCD
TC-9L (2)	ROADSIDE DIVERSION WARNING (left) (2 arrows)	New Design; MUTCDC
TC-9L (3)	ROADSIDE DIVERSION WARNING (left) (3 arrows)	New Design; MUTCDC
TC-9R (2)	ROADSIDE DIVERSION WARNING (right) (2 arrows)	New Design; MUTCDC
TC-9R (3)	ROADSIDE DIVERSION WARNING (right) (3 arrows)	New Design; MUTCDC
TC-10EL	DETOUR Marker	MTO
TC-10ER	DETOUR Marker	MTO
TC-10FL	DETOUR Marker	MTO
TC-10FR	DETOUR Marker	MTO
TC-11	NARROW LANES	New; Book 7 TAC
TC-11t	TRUCKS USE CENTRE LANE Tab	New; Book 7 TAC
TC-11tA	FOR XX KM Tab	MUTCD
TC-16E (L or R) (2)	LEFT REVERSE CURVE or RIGHT REVERSE CURVE (2 arrows)	New; Book 7 TAC
TC-16E (L or R) (3)	LEFT REVERSE CURVE or RIGHT REVERSE CURVE (3 arrows)	New; Book 7 TAC
TC-19	GROOVED PAVEMENT	New Design
TC-19t	GROOVED PAVEMENT Tab	MTO
TC-20	PREPARE TO STOP	Toronto
TC-20A	PREPARE TO STOP (with amber flashers)	Toronto, MTO
TC-20At	WHEN FLASHING Tab	Toronto, MTO
TC-23A	REMOTE CONTROL DEVICE AHEAD	New Design; MTO
TC-23At	PREPARE TO STOP Tab	MTO
TC-24	UNEVEN LANES	New; Book 7 TAC
TC-27	DO NOT PASS WHEN FLASHING	New Design; MTO
TC-31	TRUCK ENTRANCE	New Design
TC-31A	TRUCK ENTRANCE (with amber flashers)	New Design
TC-33A	LOW CLEARANCE AHEAD XX M	MUTCD
TC-33B	LOW CLEARANCE XX M	MUTCD
TC-35	RAMP CLOSED AHEAD	New Design
TC-40	PEDESTRIAN DIRECTION	Utilities

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LEFT LANE CLOSED AHEAD Sign (TC-3L), 6.1
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Appendix A • Definitions

A

AADT
Average Annual Daily Traffic

Acceleration Lane
A speed change lane for the purpose of:

(1) enabling a vehicle entering a roadway to increase its speed to a rate at which it can more safely merge with through traffic;

(2) providing the necessary merging distance; and

(3) giving the main road traffic the necessary time to make appropriate adjustments.

Advance Warning Area
The first component of a work zone, upstream of the approach area, used to alert drivers to road work ahead.

Advisory Speed
The speed, determined to the nearest 5 km/h, at which traffic may safely negotiate a potential hazard under favourable driving conditions.

All-red Interval Signal (Traffic Signal)
The time in seconds of a red indication for all intersection traffic. It is used following an Amber Clearance Interval to permit vehicles or pedestrians to clear the intersection before conflicting traffic receives a green indication. In Temporary Conditions, the All-red Interval is used to clear a one-lane section through a work site before opposing traffic receives a green indication.

Amber Clearance Interval (Traffic Signal)
The clearance interval in which the signal indication for that Phase is amber. A clearance interval to warn approaching traffic to clear the intersection before conflicting traffic receives a green indication.

Annual Average Daily Traffic (AADT)
The total yearly traffic volume on a given road divided by the number of days in the year.

Approach Area
The second component of a work zone, downstream of the advance warning area, and upstream of the transition area, in which the driver is informed of lane changes, speed reductions, passing restrictions and the like.

ASTM
American Society for Testing and Materials.

At-grade Intersection
An intersection of two roadways where there is no vertical separation between the two roadways at their point of intersection.

ATSSA
American Traffic Safety Services Association.

Average Daily Traffic (ADT)
The total volume during a given time period in whole days greater than one day and less than one year, divided by the number of days in that time period.

B

Barricade
A device which provides a visual indicator of a hazardous location or the desired path a motorist should take, but is not intended to contain or redirect a vehicle. A barricade is intended to provide separation or to inform of closure, or to provide

direction to pedestrians. A barricade is not a primary means of providing direction to motorists, but is supplemental to other traffic control devices providing delineation.

Barrier
A device which provides a physical limitation, through which a vehicle would not normally pass, and is intended to contain or redirect an errant vehicle of a particular size range, at a given speed and angle of impact.

Blocker Truck (BT)
A Buffer Vehicle (BV) not equipped with a Truck-mounted Attenuator.

Brightness
A term that refers to human perception of luminance. Whereas luminance is a photometrically measured quantity, brightness describes how intense a light source or lighted surface appears to the human eye.

Broken Line
A Pavement Marking consisting of a cycle of marking segments and gaps. Broken lines are permissive and inform drivers that they are permitted to cross a broken line (two-lane, two-way highways or multi-lane roadways) or that there is a change in use of a particular lane (continuity lines).

Buffer Vehicle (BV)
A truck positioned in a stationary work zone or in a mobile work operation to provide buffer protection for workers against errant vehicles intruding into a work zone or mobile work operation. The generic term Buffer Vehicle refers to either a Blocker Truck or a Crash Truck. As required by OHSA, a Buffer Vehicle must have a minimum mass of 6,800 kg, and must have a mounted TC-12 flashing arrow board and four-way flashers. After January 1, 2003, all Buffer Vehicles must be Crash Trucks. Before then, a Blocker Truck may be used only where the Annual Average Daily Traffic (AADT) is known to be less than 25,000 vehicles per day; otherwise a Crash Truck must be used. For MTO contracts, additional BV requirements apply.

Bull Nose
The area or point of divergence between two diverging roadways, such as between freeway mainline lanes and an exit ramp.

BV
Buffer Vehicle.

C

Capacity
The maximum number of vehicles which can pass over a given section of lane or a roadway in one direction, or in both directions for a two- or three-lane highway, during a given time period (usually one hour) under prevailing roadway and traffic conditions.

Centreline
See Directional Dividing Line.

CGSB
Canadian General Standards Board.

Changeable Message Sign
A Dynamic Message Sign which may display a limited number of fixed messages, any one of which may be displayed at any given time, or no message at all. It is an electrical, electro-optical, electro-mechanical, or mechanical sign which permits the sign message to be changed, either locally or remotely. See also Dynamic Message Sign and Variable Message Sign.

Channelization
The separation or regulation of traffic movements into definite paths of travel by use of Pavement Markings, raised islands, channelizing devices, or other suitable means to facilitate the safe and orderly movement of traffic, both vehicular and pedestrian.

Channelizing Devices
Cones, construction markers, flexible drums (barrels), pavement markings and any temporary barriers used to alert drivers to and direct traffic past hazards created by construction or maintenance activities.

Chevron Alignment Sign
A delineation sign used to delineate sharp roadway alignment changes. See also Books 6 and 11.

Closed Lane
A traffic lane on a roadway that has been closed off to traffic by either channelizing devices, signs, temporary concrete barriers, and/or TC-12 flashing arrow boards.

Collision
An incident resulting in property damage, personal injury or death and involving the loss of control and/or the striking of one or more vehicles with another vehicle, a person, an animal or an inanimate object.

Comprehension
The ability of drivers to understand the meaning of a sign message, including any symbols or abbreviations.

Cone of Vision
The small three-dimensional angle of vision, measured about the axis of the eye's pupil, and from the surface of the eye, within which angle maximum visual acuity is achieved.

Conspicuity
The ability of a traffic control device to attract or command attention, given the visual setting in which it is placed.

Construction
All work zone activities, including pre-engineering activities, relating to the building, capital maintenance, or rehabilitation of highways or utilities along or crossing highways.

Construction and Maintenance Signs
A group of Regulatory and Warning Signs used for the protection of public traffic and workers in the vicinity of a work area located on or near the roadway.

Construction Marker
A TC-52 Channelizing Device.

Construction Zone
One or more highway work zones located on or near the roadway. A construction zone must be designated and signed in order to have enforceable maximum speed limits.

Continuity Line
A lane line of reduced spacing and increased width, designed to alert road users to an impending change in lane function.

Continuous Wide Median
On a divided highway, a median that has a continuous width of 10 m or more. See also Divided Highway.

Contrast
Contrast refers to differences in colour or in brightness which allow a target, such as a sign message or symbol, to be seen against the sign background.

$$\text{Contrast} = \frac{R_L - R_B}{R_B}$$

$$\text{Contrast Ratio} = \frac{R_L}{R_B}$$

Where: R_L is Reflectance of Legend; and
R_B is Reflectance of Background.

For light-emitting dynamic message signs, the same relationships apply, except that reflectance is replaced by emitted light intensity, for both legend and background.

Controlled Access Rights-of-way
Control of access is the condition where the right of access to or from a highway, by owners or occupants of abutting land or by other persons, is fully or partially controlled by the road authority.

Crash
See Collision.

Crash Cushion
A traffic barrier used to safely shield fixed objects or other hazards from approximately head-on impacts by errant vehicles, consisting of energy-absorbing elements that are progressively deformed on impact.

Crash Truck (CT)
A Buffer Vehicle (BV) equipped with a Truck-mounted Attenuator meeting National Cooperative Highway Research Program Report NCHRP 350 requirements.

Curve
A horizontal or vertical deviation in the roadway. A horizontal curve appears as a bend in the roadway, requiring drivers to turn the steering wheel. A vertical curve appears either as a "crest" or a "sag" to provide for a change in gradient on the profile of the roadway.

Curve Sign
A Warning Sign used to inform drivers of an upcoming change in roadway alignment. In some cases, a reduction in speed is recommended.

Cyclist
A person riding a bicycle.

D

Deceleration Lane
A speed change lane for the purpose of enabling a vehicle that is to make an exit from a roadway to slow to the safe speed on the exit after it has left the main stream of traffic.

Delineation
One, or a combination of several types of devices (excluding Guide Signs) that regulate, warn, or provide tracking information and guidance to drivers.

Delineation Treatment
Refers to the higher-level decision process of designing delineation to be installed. Such issues such as use of raised pavement markers and post markers are part of delineation treatment.

Delineators
Small, Retroreflective devices erected in a series adjacent to the edge of a travelled portion of the roadway for the purpose of providing positive driver guidance.

Design Incoming Vehicle (DIV)
The selected vehicle or vehicles with the size and mass which correspond to a certain proportion of the vehicle population, or to a defined level of protection, used in the determination of Buffer Vehicle mass and Roll-ahead Distances for the design of construction and maintenance work zones.

Design Speed
A speed selected for purposes of design and correlation of those features of a highway, such as curvature, superelevation, and sight distance, upon which the safe operation of vehicles is dependent.

Detector
A device for indicating the presence or passage of vehicles, including sensor device, lead-in cable and detector sensor (amplifier) unit.

Detour
A diversion from the usual travelled roadway; either a crossover from one multi-lane roadway to another (within the highway right-of-way), or a Route Detour.

Detour Marker
A sign used to identify a Route Detour for detour route continuity, to assist driver navigation.

Device
See Traffic Control Device.

Diamond Grade Material
A non-metalized, high reflectivity micro-prismatic sign sheeting material. The material may be fluorescent or non-fluorescent.

Directional Dividing Line
A yellow Pavement Marking indicating the division of the roadway between traffic travelling in opposite directions.

Directional Guide Sign
A broad class of signs providing route-finding or operational guidance to road users, including direction to specific destinations.

Divided Highway
A multi-lane highway consisting of roadways for opposing traffic which are separated by an unpaved area or other physical barrier, including a curbed island. See also Continuous Wide Median.

Downstream
The direction that traffic is going to.

Driver
A person who operates a vehicle on a highway.

Driver Response
The driver action taken as a result of reading a traffic sign or encountering another traffic control device.

Duration
(1) The length of time for which a given state, conditon or phase exists.
(2) In Temporary Conditions, the length of time for specific construction, maintenance or utilitiy work activities to take place, and for which specific requirements and typical layouts apply. See Mobile Operations, Very Short Duration, Short Duration, and Long Duration.

Dynamic Message Sign
A sign that has the capability of displaying different messages to suit changing conditions on the roadway. A dynamic message sign may be a Changeable Message Sign (limited function) or a Variable Message Sign (full function).

E

Edge Line
A painted line marking the edge of the roadway.

Eighty-fifth (85th) Percentile Speed
The speed at, or below which, 85% of motorists are travelling.

Emergency
With regard to road works, an emergency is an unforeseen, unplanned combination of circumstances or the resulting situation that calls for immediate action in order to prevent or reduce damage or hazard to road users, workers, or infrastructure. In an emergency, short duration traffic control provisions should be implemented to the greatest extent practicable, including adequate reflectorization if at night, in order to avoid the creation of additional hazard.

Engineering Grade Material
A retroreflective sign sheeting material meeting ASTM Specification D-4956-95 for Type I material or CGSB Specification 62-GP-S 11M for Reflectivity Level II material.

Expectancy
Used in traffic engineering to describe a driver's anticipation of upcoming road design and traffic control conditions. Driver expectancy is usually affected by previous experience and the consistency and continuity of traffic control devices encountered. Violation of driver expectancy should be avoided whenever possible.

Expressway
A divided, multi-lane arterial highway for through traffic with full or partial control of access and generally with grade separations at major intersections. Some intersections may be at-grade.

F

f
Coefficient of friction; sometimes CoF is used.

Field Edition
The portable, abbreviated field edition of Book 7.

Fluorescence
The emission of light produced by certain substances when excited by an ultraviolet (UV) energy source. This emission ceases when the UV source is removed.

Fluorescent Orange and Yellow-Green
Fluorescent sign sheeting colours designed for high conspicuity in daytime. Fluorescent sign sheeting may be non-reflective (daytime use only) or reflective (daytime and nighttime use).

Freeway
A multi-lane Divided Highway with continuous dividing median, full control of access and interchanges in place of At-grade Intersections, and a posted speed of 90 km/h or greater. This term includes Toll Highways built to a freeway configuration.

G

Geometry
When referring to roadway design, geometry refers to the physical characteristics and dimensions of parts of the roadway.

Gore
The area between and immediately adjacent to two merging or diverging roadways; the area may be painted or unpainted.

Grade Crossing
A railroad crossing a highway at the same elevation (no vertical separation).

Grade Separation
The vertical separation of two or more intersecting roadways or a roadway and another transportation mode, e.g., railroad, thus permitting traffic on all roads to cross traffic on all other roads without interference.

Gross Vehicle Weight
The total weight in kilograms transmitted to the highway by a vehicle or combination of vehicle and load. This is not the same as the Registered Gross Vehicle Weight, which is a licensed measure.

Guide Rail
A fence or barrier to guide and help restrain vehicles from leaving the roadway.

Guide Sign
A Traffic Sign used to direct traffic along a route towards a destination.

Guideline
A recommended practice, method or value for a specific design feature or operating practice.

H

Hazard Marker
See Object Marker.

Headway
The spatial distance or time interval between the front ends of vehicles moving along the same lane or track in the same direction.

High Intensity Material
A retroreflective sign sheeting material meeting ASTM Specification D-4956-95 for Type III or IV or CGSB Specification 62-GP-11M for Reflectivity Level I material.

Highway
A general term denoting a public way for purposes of vehicular and pedestrian travel, including the area within the right-of-way. This includes King's Highways, regional and county roads, rural roads, municipal roads, and streets.

Highway Delineator
One of a series of short posts with reflective heads or chevrons, used to indicate horizontal alignment.

Highway Traffic Act (HTA)
The Ontario Highway Traffic Act.

Human Factors
The consideration of human physical, perceptual and mental limitations in engineering design, so as to optimize the relationship between people and things. The objective is to reduce error and increase user comfort.

I

Information Load
The amount of information presented to a driver by a sign or other traffic control device(s), which is a factor in determining the amount of time drivers require to read, comprehend, and act upon the message.

Installation
The process or act of placing, erecting, and/or connecting a traffic control device or system into its functional position and state of operational readiness.

Interchange
A system of interconnecting roadways in conjunction with one or more grade separations, providing for the interchange of traffic between two or more roadways on different levels.

Interdictory Symbol
An annular (circular) red band with a diagonal red stroke at 45 degrees, or as close to 45 degrees as practicable, signifying that whatever is depicted within the symbol is prohibited.

Intermittent
Not continuous. As used for traffic control devices, usually means regularly spaced either in time or space. Otherwise, may mean regularly or irregularly timed or spaced.

Intersection
The area embraced by the prolongation of lateral curb lines or, if none, of the rights-of-way of two or more highways that join one another at an angle, whether or not one highway crosses the other.

Intersection Approach
That part of an intersection leg used by traffic approaching the intersection.

Intersection Channelization
Raised or painted islands at an intersection that prevent specific movement(s) from being made or provide better definition of large uncontrolled areas of pavement.

Intersection Leg
That part of any one of the roadways radiating from the intersection which is close to the intersection but outside the area of the intersection proper.

J

Jurisdiction
A legal or other authority with responsibility and control for specific actions within a defined area.

K

Kilometre (km)
A measure of distance equal to 1000 m (0.622 miles).

King's Highway
A highway, including secondary and tertiary roads designated under the Public Transportation and Highway Improvement Act.

km
Abbreviation for kilometre.

L

Lane
A defined width of road intended to accommodate a single line of moving vehicles.

Lane Line
A Pavement Marking, other than a Directional Dividing Line, which separates two traffic lanes assigned to traffic moving in the same direction.

Large Arrow Sign
A Warning Sign intended to inform drivers of a sharp change in roadway alignment or of a need for a lane change. (See Book 6, Sign Wa-108, and Book 7, Signs TC-7 and TC-12).

Lateral Intrusion Deterrence Gap (LIDG)
The gap between a buffer vehicle and the work area to discourage lateral vehicle intrusions into a closed lane upstream of a stationary work area, or the gap between buffer vehicle and work vehicle (and between buffer vehicles) to discourage lateral vehicle intrusions into a lane in which mobile work operations are taking place.

LBA
See Longitudinal Buffer Area.

Leapfrogging
The practice of installing lane closures using two or more installers, whereby one installer installs barrels up to where the previous (second) installer started, then drives beyond (leapfrogs) the second installer, leaving a gap in the closure, to resume installation of the closure downstream. When the second installer reaches the point where the first installer resumed installation, he leapfrogs the first installer, and the process is repeated. This procedure should not be used.

Left-turn Lane
A lane reserved for left-turning vehicles and so designated by pavement markings and/or lane-use signs.

Legal Authority
The authority provided, by legislation and regulation, to a jurisdiction or enforcement body for the actions it takes.

Legibility Distance
The distance at which a sign can be read by a given driver under prevailing conditions.

Legibility Distance, Required
The distance at which a sign must be legible, based on the travel speed and the sum of Reading Time, Perception-reaction Time, and Manoeuvre Time.

Level of Service
A term which, broadly interpreted, denotes any one of an infinite number of differing combinations of operating conditions that may occur on a given lane or roadway when it is accommodating various traffic volumes. Level of service is a qualitative measure of the effect of a number of factors, which include speed and travel time, traffic interruptions, freedom to manoeuvre, safety, driving comfort and convenience, and operating costs. In practice, selected specific levels are defined in terms of particular limiting values of certain of these factors, as in levels A (free-flow) to F (stop and go) in the Highway Capacity Manual.

LIDG
See Lateral Intrusion Deterrence Gap.

Live Lane
A roadway lane open to traffic. It includes a traffic lane where vehicles, though they may be present, are being diverted away from a stationary or mobile work activity by work vehicles or Buffer Vehicles equipped with Traffic Control Devices, such as a TC-12.

Local Road
A street or road primarily for access to residence, business or other abutting property.

Long Duration (LD) Work
Stationary maintenance, construction, or utility activities which require a separate work space for longer than 24 hours. See also Short Duration (SD) and Very Short Duration (VSD) work.

Longitudinal Buffer Area (LBA)
The fourth component of a stationary work zone, downstream from the transition area and upstream of the work area, which provides protection for traffic and workers, by providing errant vehicles an opportunity to brake to a halt between the end of the transition area and the work space.

Low Volume/High Volume Road
For Temporary Conditions, low volume roads are defined as those with a combined traffic volume in both directions of less than 3,000 vehicles per day. Conversely, high volume roads are those with a combined traffic volume of 3000 vehicles per day or more.

Luminance
The luminous flux in a light ray, emanating from a surface or falling on a surface, in a given direction, per unit of projected area of the surface as viewed from that direction, per unit of solid angle. (Reflective light)

M

m
Abbreviation for metre.

Maintenance
The upkeep of highways, traffic control devices, other transportation facilities, property and/or equipment.

Major Road
The principal route of two roads at an intersection. Also called Main Road.

Manoeuvre Time
The time to complete any required manoeuvre before reaching a sign, other traffic control device, or decision point.

Marker
See Construction Marker, Detour Marker, Object Marker.

Marking (Pavement)
See Pavement Marking

Maximum Speed
The maximum speed drivers are permitted to travel. The maximum speed is imposed by the Highway Traffic Act, or municipal by-laws. See also Normal Posted Regulatory Speed.

May
Indicates a permissive condition. No requirement for design of application is intended. However, mandatory requirements apply to some specific options if and when they are selected.

Measure
A physical device, traffic control device, regulation or other action which affects the movement of motor vehicles, bicycles, and/or pedestrians.

Median
That portion of a divided highway separating the travelled ways for traffic in opposite directions.

Median Barrier
A raised island, wall or structure located on the Centreline of a roadway through an intersection or along a road, that prevents left turns or straight through movements from being made to and from a side street or private/commercial driveway.

Median Island
A zone or physical island constructed in the centre of a roadway to separate opposing directions of traffic.

Median Strip
An expanse of hard surface material separating opposing lanes on a highway. The hard surface is flush or nearly flush with the adjacent lanes.

Merging
The convergence of separate streams of traffic into a single stream.

Milling
The grinding off and removal of old asphalt for purposes of recycling and resurfacing. Milling may produce undesirable longitudinal grooves which affect behaviour of some vehicles.

Minimum Typical Guideline
Where so described, the guideline depicted in the typical layouts for Temporary Conditions represents the minimum requirements that must be achieved.

Ministry
Unless otherwise specified, the Ministry of Transportation Ontario (MTO). Where so specified, the Ministry means the Ontario Ministry of Labour (MOL).

Minor Road
The lesser of two roads at an intersection.

Mobile Operations
Work that is done while moving continuously, usually at low speeds, or intermittently, with periodic, brief stops related to the mobile operation, which do not exceed a few minutes in duration (e.g., centreline or edgeline zone painting operations). The advance warning area (where required) moves with the activity area.

MOL
The Ontario Ministry of Labour

Motor Vehicle
Includes an automobile, motorcycle, motor-assisted bicycle (moped), and any other vehicle propelled or driven other than with muscular power, but does not include a streetcar, or other vehicles designed to operate on rails, or a motorized snow vehicle, traction engine, farm tractor and implements of husbandry or road-building machine.

Motorist
See Driver.

MTO
The Ministry of Transportation Ontario.

Multi-lane Highway
A roadway with two or more travelled lanes carrying traffic in each direction.

Must
Indicates a mandatory condition. Where certain requirements in the design or application of the device are described with the "must" stipulation, it is mandatory that these requirements be met when an installation is made.

MUTCD
The Manual of Uniform Traffic Control Devices for Ontario, 1995, superseded over time by the Ontario Traffic Manual.

MUTCDC
The Manual of Uniform Traffic Control Devices for Canada, 1997.

MUTCD-US
The U.S. Manual of Uniform Traffic Control Devices for Canada, 1988 and (Part VI) 1993, and its subsequent revisions.

N

Narrow Lanes
Lanes in a work zone which are narrower than usual, as required by construction, maintenance, or utility operations. This may be done through partial lane shifting (See Partial Lane Shift) in Short Duration operations, or through barrels and/or temporary concrete barriers (or equivalent) in Long Duration operations, in which case existing pavement markings should be removed and replaced by temporary pavement markings.

NCHRP
National Cooperative Highway Research Program (U.S.)

Nighttime
The hours of darkness, taken as the time period from one-half hour before sunset to one-half hour after sunrise.

Nighttime Short Duration Provisions
Provisions required for nighttime short duration work, even though one or more may be shown as optional for the daytime short duration operations illustrated in the typical layouts. See Section 1.8. For nighttime work of any duration, traffic garments meeting OHSA requirements for nighttime work must be used.

Normal Regulatory Posted Speed
The regulatory maximum speed posted on a highway under normal conditions, that is, when no construction zone or work activity is present. Guideline provisions required in Book 7 are based on Normal Regulatory Posted Speed, not on temporarily reduced construction zone regulatory or advisory speeds.

O

Object Marker
A traffic sign mounted temporarily or permanently on an obstruction, within or adjacent to the roadway, to make the obstruction as highly visible as possible.

Occupational Health and Safety Act
The Ontario Occupational Health and Safety Act and Regulations for Construction Projects, of the Ontario Ministry of Labour.

Off-peak Period
The period of time, usually outside of the morning and afternoon Peak Periods. If there is a Midday Peak with traffic volumes equalling or approaching those in the A.M. or P.M. Periods, then this Midday Peak should be excluded from the off-peak period.

Official Sign
Any sign approved by the Ministry of Transportation Ontario.

OHSA
See Occupational Health and Safety Act.

Operating Speed
The speed at which the majority of vehicles are travelling, typically the 85th Percentile, regardless of the speed limit.

Oversize Sign
A Traffic Sign with greater proportional dimensions than the minimum dimensions specified in this Manual. Such signs are generally required on higher speed highways, or on other highways in special cases.

P

Partial Lane Shift
The temporary, partial shifting of travel lanes by demarcating them through use of cones or barrels, so that the lanes are squeezed while still maintaining usable lane widths of at least 3 m in each lane. See also Narrow Lanes and Roadside Diversions.

Pavement
That part of the roadway having a constructed hard surface for the facilitation of vehicular movement.

Pavement Marking
A coloured marking applied to the pavement to provide drivers with roadway alignment information.

Peak Hour
The one hour each day when traffic volumes are at their highest on a given road.

Peak Period(s)
The one or more periods each day, usually consisting of two or three hours, when traffic volumes are at their highest on a given road, usually corresponding to a morning "to work" period and an afternoon "from work" period.

Pedestrian
Any person who is on foot, not in or upon a vehicle, motorized or otherwise propelled, or riding upon an animal.

Perception-reaction Time
The time required to make a decision, after reading or encountering a traffic control device, and inititate a manoeuvre if required.

Permissive Symbol
An annular (circular) green band used on a sign to signify that whatever is depicted within the symbol is permitted.

Phase (Traffic Signal)
A part of a cycle where one or more traffic movements receive a green indication at the same time. Phase time is the time required from the start to the finish of the phase including Amber and All-red Interval times.

Portable Lane Control Signal
See Portable Traffic Control Signal.

Portable Traffic Control Signal
A portable traffic control signal may be used as an alternative to Traffic Control Persons and such signals are used only to stop vehicles intermittently when traffic must use a single lane in situations where the roadway is normally a two-way operation. Portable traffic control signals must comply in all respects with Regulation 606 of the Highway Traffic Act. (R.S.O. 1990), where they are referred to as Portable Lane Control Signals. (For details, see Book 7, Section 4.5, and Book 12 (Traffic Signals)).

Portable Variable Message Sign (PVMS)
A Variable Message Sign that may be moved from place to place to provide drivers information on conditions, usually work zone conditions, at the time and place where needed.

Positive Guidance
Provision to road users of the information they need to avoid hazards, when and where they need it, in a form they can best use it. See Book 1c (Positive Guidance Toolkit).

Posted Advisory Speed
The maximum advisory speed as indicated by appropriate Warning or Temporary Conditions Signs.

Posted Speed Zone
A section of highway upon which the maximum speed is indicated by appropriate Regulatory Signs.

Pre-engineering and Engineering Activities
Activities carried out in preparation for, during, or after completion of a construction project (e.g., surveying, geotechnical sampling or testing, pre-construction inspection). For purposes of Book 7 traffic control, pre-engineering activities are considered part of construction work activities.

Provincial Highway
Any public highway under the jurisdiction of the Ministry of Transportation of Ontario. See King's Highway.

Public Roadway
Any roadway under the jurisdiction of and maintained by a public authority and open to public travel.

Public Way
A sidewalk, street, highway, square, or other open space to which the public has access, as of right or by invitation, either express or implied.

R

Railroad Crossing
A location where one or more railroad tracks cross a public highway, road, street, or a private roadway, and includes sidewalks and pathways at or associated with the crossing.

Raised Pavement Marker
A ceramic, metal, glass or plastic marking device placed on or in the roadway to substitute for or act as a supplement to standard pavement markings. Raised pavement markers are comprised of a variety of configurations including retroreflective and non-retroreflective markers, and markers that employ prismatic retroreflection and those that employ spherical retroreflection.

Ramp
An interconnecting roadway of a traffic interchange, or any connection between highways at different levels or between parallel highways, on which the vehicles may enter or leave a designated roadway.

Reading Time
The time required to read a sign with a given message.

Reflectivity
A measure of the degree to which a surface reflects incident light. A related term, reflectance, is the amount of light reflected back from a sign, relative to the amount of light shining on the sign. See Retroreflectivity, Coefficient of (R)

Reflectorization
A method of incorporating light-reflective material on the approach face of a Traffic Sign so that the face will reflect light during the hours of darkness while retaining the same colours as by day.

Regulation
A prescribed rule, supported by legislation, such as any regulation made under the HTA or OHSA or municipal by-law. Regulations provide the legal basis for enforcement.

Regulatory Sign
A Traffic Sign advising drivers of action they should or must do (or not do), under a given set of circumstances. Disregard of a regulatory sign would usually constitute an offence.

Remote-control Device
An electro-mechanical device that is remotely controlled and performs the function of a Traffic Control Person (TCP), as controlled by a TCP.

Retroreflective Material
A type of material applied in either strips or sheets which reflects illumination back to its source.

Retroreflectivity, Coefficient of (R)
R indicates the proportion of light reflected back to the driver from a retroreflective sign surface, in candelas per lux per square metre. See Book 1b (Sign Design Principles), Section 9.1.

Right-of-way
(1) Allocation of right of movement to a road user, in preference over other road users.
(2) The width of the road allowance from the property line on one side to the property line on the opposite side of the roadway.

Road
See Highway.

Road Authority
The body (Municipal, Provincial, or private) that has legal jurisdiction over a roadway.

Road Closure
The closing of a highway to road users. Road closures are covered by Regulation 599 of the HTA.

Road Edge Work
Construction, maintenance, or utility work that encroaches on the edge of the road, with much of the work being done on the shoulder. Road edge work is not fully on the shoulder, nor does it result in a remaining travel lane width of less than 3.0 m (3.5 m on freeways), which would necessitate a lane closure or a Partial Lane Shift. See also Roadside Work.

Roadside Diversion
A deviation of the normal roadway, essentially within the highway right-of-way, where traffic is required to make a short diversion to bypass the work area. The diversion must be signed, using a TC-9, TC-16, and/or other appropriate signs.

Roadside Work
Construction, maintenance, or utility work that is done on the shoulder or on the edge of the road. Roadside Work includes both work on the shoulder and Road Edge Work.

Roadway
The part of the highway that is improved, designed or ordinarily used for vehicular traffic, but does not include the shoulder, and, where a highway includes two or more separate roadways, the term "roadway" refers to any one roadway separately and not to all of the roadways collectively.

Roadway Alignment Sign
A Warning Sign or Temporary Conditions Sign used to inform drivers of an upcoming change in roadway alignment, including turns and curves.

Roadway Edge Line
See Edge Line.

Route Detour
A detour where a driver is required to depart completely from the normal route and is directed to use an alternate route. The alternative route must be signed using a combination of the appropriate TC-10 directional signs. Prior to the closing of the roadway and the opening of a detour, a TC-65 "Road Closing Notice" sign must be erected at strategicially selected locations of the road at least one week in advance of the actual closing.

RPM
Raised Pavement Marker.

Rural Area
An area outside of the limits of any incorporated or unincorporated city, town, village, or any other designated residential or commercial area.

S

Safe Stopping Distance
The distance required to bring a vehicle completely and safely to rest with normal braking and road conditions.

Shall
Means the same as "must"

Short Duration (SD) Work
Stationary maintenance, construction, or utility activities which require a separate work space, which are continuously attended by workers, and which are more than 30 minutes and less than one 24-hour period in duration. Under certain conditions (see Section 1.8), work at the same location may be extended to more than one day, and still be considered SD work. See also Long Duration (LD) and Very Short Duration (VSD) Work.

Should
Indicates an advisory condition. Where the word "should" is used, the action is advised; recommended but not mandatory. This term is meant to suggest good practice in most situations but also to recognize that in some situations, for good reasons, the recommended action cannot or need not be followed.

Shoulder
The portion of a highway between the outer edge of the roadway and the curb, or point of intersection of the slope lines at the outer edge of the roadway and the fill, ditch, or median slope, for the accommodation of stopped vehicles, for emergency use, and for lateral support.

Sight Distance
The distance visible to the driver of a passenger vehicle, measured along the normal travel path of a roadway, to the roadway surface or to a specified height above the roadway, when the view is unobstructed by traffic.

Sign
A Traffic Control Device mounted on a fixed or portable support which conveys a specific message by means of symbols or words, and is officially installed for the purpose of regulating, warning, or guiding traffic.

Sign Assembly
Any Traffic Sign mounted and installed alone or in conjunction with any combination of associated Tab Signs.

Sign Blank Number
The number given to a given size of standard size blank (substrate), for purposes of identification, inventory and fabrication.

Sign Pattern
The full-size hard copy drawings or electronic images of individual signs, showing sufficient detail and dimensional accuracy for sign fabrication.

Sign Sheeting
The Retroreflective Material used on the surface of a Sign to provide good daytime and nighttime visibility.

Sign Support
The physical means of holding a sign in its intended position.

Sign Symbol
A pictogram, depiction, arrow, silhouette or figures, and/or Interdictory or Permissive Symbol, used to simplify or represent a word message on a sign.

Sign Truck
A vehicle that has:

(1) four-way flashers and a mounted flashing arrow board sign, or

(2) a portable trailer with a mounted flashing arrow board sign.

Signal Indication (Traffic Signal)
The illumination of one or more lenses in a signal head which conveys a message to traffic approaching the signal from one direction.

Signalized Control
The use of a traffic signal control device to control traffic on a road section or intersection.

Speed Change Lane
A tapered auxiliary traffic lane used by traffic entering or leaving a freeway or expressway for the purpose of acceleration or deceleration respectively.

Speed Limit
The maximum vehicular speed allowed within any given posted or unposted Speed Zone.

Speed Zone
A specific section of roadway upon which a maximum speed limit has been imposed. Such zones may be posted or unposted. A construction speed zone must be posted.

Standard
A rule, principle, pattern, or measure, which practice or theory has shown to be appropriate for a given set of conditions, and applicable, as the case may be, to planning, design, traffic control devices, operations, or maintenance.

Statutory Speed Limit
A maximum speed limit automatically in effect on all roads, unless otherwise signed. The statutory speed limit applies even where no maximum speed limits are signed.

Stopping Sight Distance
The distance required by a driver of a vehicle, travelling at a given speed, to bring the vehicle to a stop after an object on the roadway becomes visible. It includes the distance travelled during the Perception-reaction Time and the vehicle braking distance.

Street
An urban highway.

Striper
A self-contained marking system mounted on a truck chassis and used to apply Pavement Markings on the road.

Substrate
The surface to which the sign sheeting is applied.

T

Tab Sign
A sign smaller than the primary sign with which it is associated, and mounted below it. There are two types of tab signs:

(1) Supplementary Tab Sign – contains additional, related information;

(2) Educational Tab Sign – conveys the meaning of symbols during their introductory period.

Tangent Section
(1) A straight section of roadway between curves.

(2) In Temporary Conditions, the distance between the end of one taper and the beginning of the next taper, where more than one lane is being closed.

Taper
The gradual narrowing of a lane which is intended to safely guide drivers into the adjacent lane. The taper length is the length of the section of roadway required to achieve full lane closure (e.g., construction zone) or full lane transition.

TC
Abbreviation for Temporary Conditions.

Temporary Conditions
Roadway and traffic control conditions related to non-permanent construction, maintenance, and utility work on any highway open to the public.

Temporary Pavement Marking
A Pavement Marking intended to be used for Temporary Conditions.

Temporary Sign
A Regulatory, Warning, or Guide Sign, intended to be used for Temporary Conditions.

Temporary Traffic Control Signal
A temporary traffic control signal installed to control traffic at a crossing, such as a temporary roadway, a truck access route, pedestrian crossing, etc. A temporary traffic control signal must comply with Section 144(31) of the Highway Traffic Act. The design specifications for temporary signals, which require prior approval by the appropriate road authority, are those specifications which apply to permanent trafic control signals at signalized intersections (for details, see Book 7, Section 4.6, and Book 12 (Traffic Signals)).

Termination Area
The sixth and last component of a work zone, downstream of the work area, used for traffic to make the transition back to the normal path of the road. The termination area extends from the downstream end of the work area to the point where traffic is able to resume normal driving.

TMA
See Truck-mounted Attenuator.

Traffic Control Device
Any sign, signal, marking, or device placed upon, over or adjacent to a roadway by a public authority or official, or private road owner, having jurisdiction, for the purpose of regulating, warning, guiding or informing road users.

Traffic Control Installer
A person duly trained and authorized to install and remove Traffic Control Devices at a Work Zone.

Traffic Control Person (TCP)
A person duly trained and authorized to direct traffic at a work zone through the use of the Traffic Control Sign (STOP/SLOW Paddle).

Traffic Control Plan
A detailed plan for the control of traffic during construction, maintenance, or utility operations on a highway, taking into account the organized, systematic, safe conduct of the project, including, as applicable, detours, staging sequences, work vehicle access to and egress from work sites, temporary barriers, removal of old pavement markings and selection and planned implementation of appropriate typical layouts for traffic control.

Traffic Control Signal (Traffic Signal)
Any power-operated Traffic Control Device with at least three signal lenses, whether electrically or mechanically operated, by which traffic is alternately directed to stop and permitted to proceed. Traffic Signal:

(1) When used in general discussion, a traffic signal is a complete installation including signal heads, wiring, controller, poles and other appurtenances.

(2) When used specifically, the term refers to the signal head which conveys a message to the observer.

(3) That part of a traffic control signal system that consists of one set of no less than three coloured lenses, red, amber and green, mounted on a frame and commonly referred to as a signal head.

Traffic Count
A record of the number of vehicles or people aboard vehicles, or both, and pedestrians that pass a given checkpoint during a given time period.

Traffic Protection Plan
A plan required by the OHSA and its regulations for the protection of workers in a work zone. The plan must contain a written description of the traffic hazards to which workers may be exposed and measures used to protect them.

Traffic Sign
A device (other than Markings, Delineators and Traffic Control Signals) which may be installed beside or above a roadway for the purpose of regulating, warning, or guiding traffic.

Traffic Signal Control System
An area or corridor signal system under signalized control.

Transition Area
The third component of a work zone, downstream from the approach area, and upstream of the longitudinal buffer area, where traffic is channelled from the normal path to a new path required to move traffic past the work space. The transition area contains the tapers and parallel tangent sections (if more than one lane closed) that are used to close the lanes effectively.

Truck
A commercial vehicle exceeding a specified weight or length as defined by the Highway Traffic Act, municipal by-law, or toll agency.

Truck-mounted Attenuator (TMA)
An energy-absorbing device mounted on the rear of a truck, to deform on impact in a controlled manner, thereby reducing:

(1) the rate of deceleration (and associated injury) for the occupants of a vehicle striking the TMA from the rear; and

(2) the rate of acceleration (and associated injury) for the driver of the truck.

TMAs must satisfy the requirements of NCHRP 350 Level TL-2 (70 km/h) or TL-3 (100 km/h), and should be selected for the appropriate posted speed. After January 1, 2006, all TMAs used on freeways must satisfy the TMA TL-3 requirement (100 km/h).

Turn Lane
A lane designated to facilitate vehicular turn movements from the through roadway.

Turn Prohibition
A regulation prohibiting a straight-through movement or a left or right turn at an intersection. Turn prohibitions are sometimes used in association with barriers that physically prevent a turn from being made.

Two-lane Highway
An undivided two-way facility having one lane for traffic moving in each direction.

Two-way Left-turn Lane
The centre lane on some three, five, or seven lane sections of undivided highway which is designed to facilitate left turns from each direction.

U

Undivided Highway
A multi-lane highway with no continuous median, or with a paved flush dividing strip (including a Rumble Strip), or with a two-way left-turn lane.

Upstream
The direction that traffic is coming from.

V

Vehicle
Includes a motor vehicle, trailer, traction engine, farm tractor, road-building machine, bicycle, and any vehicle drawn, propelled or driven by any kind of power, including muscular power, but does not include a motorized snow vehicle or motorcycle sidecar.

Very Short Duration (VSD) Work
Any work activity which occupies a fixed location for up to 30 minutes duration, including set-up and takedown of the traffic control provisions (e.g., some utility work, minor road maintenance, stormwater catchbasin cleanout, etc.). The work site may be moved along the road and make frequent, short stops.

Volume
The number of vehicles or pedestrians that pass over a given section of a lane or a roadway or make a particular movement during a specific time period (such as one hour or 24 hours).

W

Warning Sign
A sign which indicates conditions on or adjacent to a highway or street that are actually or potentially hazardous to traffic operations.

Work Area
The fifth component of a work zone, downstream from the longitudinal buffer area and upstream of the termination area, where the work takes place. It is set aside for workers, equipment and material storage.

The work area may be in a fixed location or may move as work progresses. It may be defined by delineation devices. In a confined location, the work space may be shielded by barriers as an additional feature.

Work Site Identification
Visible identification of the work area by passive and/or active traffic control devices to show road users where work is taking place.

Work Zone
A section of highway or roadway where highway-related construction, maintenance, or utility work takes place. A work zone is usually made up of six component areas (See Figure 1), including the Work Area where the work takes place. A work zone can be in the travelled portion of the road or on the boulevard or shoulders and may be stationary or mobile. See Mobile Operations, Very Short Duration, Short Duration, and Long Duration Work.

Y

Yield
To cede the right-of-way.

Appendix B • References

Referenced Documents

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Specification D 4956-95; American Society for Testing and Materials, 1995

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Section U.D. 18 Urban Supplement to the Geometric Design Guide for Canadian Roads; Transportation Association of Canada, 1995

Transportation and Traffic Engineering Handbook; Institute of Transportation Engineers, 1999