

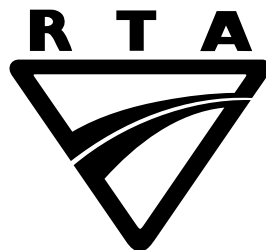


Traffic control at work sites

RTA
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CONTROLLER

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Traffic Control at Work Sites





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Foreword

The *Occupational Health and Safety Act 2000* requires that an employer must ensure the health, safety and welfare of its employees, contractors, visitors and the public at its work sites. The application of the principles outlined in this *Traffic Control at Work Sites* manual will ensure that road users will be able to travel through, past or around road and bridge work sites in safety. Adherence to the manual will also ensure that the workforce is able to work safely in the vicinity of road users and their vehicles and work site plant.

This is the fourth version of the manual and its release has been made following the revision Australian Standard 1742, *Manual of uniform traffic control devices*, Part 3, *Traffic control devices for works on roads* and to bring it up to date with developments made in traffic control practice since the release of the third version in 2003.

This manual must be used on all RTA road and bridge sites for work being undertaken by the RTA's own work force, RTA contractors or local government and public utility bodies undertaking work on behalf of the RTA. Use of the manual, however, is commended to all practitioners who are responsible for the control of traffic at work sites, on non-RTA sites.



Acknowledgement

The review of this manual has been undertaken by staff from RTA's Traffic Management Branch on behalf of the Network Management Directorate of the RTA. This review, however, could not have been undertaken without regular and considerable input from a wide range of areas both within and outside the RTA.

To those many contributors sincere appreciation is given for all your efforts.

Note regarding authorities and responsibilities

This fourth version of the *Traffic Control at Work Sites* manual continues the practice of adopting the levels of delegated authority as they are generally used within the RTA. These authority levels are as follows:-

- Team Leader (RTA Delegation Level 6/7)
- Works Supervisor (RTA Delegation Level 5/6)
- Project Manager (previously engineer, RTA Delegation Level 5)
- Manager (RTA Delegation Level 4)
- Branch Manager

The scope of this fourth version of the manual includes contractors, local government and public utility bodies undertaking work on behalf of the RTA. Because of the diversity of operations of such organisations it is not possible to define the positions in those organisations where specific authorities lie. It is the responsibility of those organisations to determine and assign the authorities and responsibilities detailed in this manual at appropriate levels within their own structures.

Practitioners undertaking works not on behalf of the RTA may follow the principles of this manual to assign authorities and responsibilities within their own organisations.



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Amendment record

Please note that this Manual is Version 4 dated June 2010 and all pages in this manual are marked Issue 1, dated June 2010. Each time amendments are made to any part of the manual the details of the amendments made will be recorded on this form.

It is the responsibility of owners of the manual to ensure that they have up to date copies of all pages of the Manual by printing from the web site as amendments are made.

As changes are made to pages of the manual the footer on the page will be updated to show the issue number of that page and its issue date.

Issue No	Page	Description	Issued
1	All	Original Issue	June 2010
2	2-3 7-6 9-19 & 9-20 App D E-14 & E-15	Definition for 'D' replaced by 'Determination of D' Table 7.6 amended Section 9.6.2 updated Location checklist amended TCPs 41, 43, 46, 61, 77, 90, 93, 94, 96 & 114 amended Format problem with titles corrected	July 2010



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The Roads and Traffic Authority NSW has both a moral and legal responsibility for the safety of all persons at RTA work sites. This includes RTA's own staff, its contractors and members of the public.

Of paramount importance in ensuring the safety of people at work sites is the need to provide a high standard of traffic control around, past or through those work sites. This can only be undertaken by a systematic consideration of the conditions to be encountered at each site and selecting or designing a specific plan for the control of traffic.

This Manual must be used on all RTA road and bridge work sites.

The manual contains a large number of standard traffic control plans (TCPs) which can be selected and implemented at work sites for which the plan meets all requirements. Where a standard plan does not meet the traffic control needs of a particular site the manual provides procedures for the design of a new or site specific plan. These procedures must be followed. Compliance with traffic control plans is to take precedence over operational expediency in all situations.

The design, selection and implementation of traffic control measures detailed in this manual are based on Australian Standard 1742.3, *Traffic control devices for works on roads*. If this manual does not contain advice on a particular aspect of traffic control then AS 1742.3 must be consulted and, its advice adopted, if such advice exists.

Traffic control and the selection or design of TCPs shall only be undertaken by persons who are qualified, authorised and have passed RTA approved training courses. The training of personnel will be an integral part of the implementation of this policy.

Local government, contractors and public utility authorities are required to adopt the manual for works undertaken on RTA controlled roads and are encouraged to adopt the manual for works on roads outside the control of the RTA.



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2.1 Purpose and scope

This manual is for personnel responsible for road and bridge work sites. It contains standard traffic control plans (TCPs) for a range of work activities, instructions on how to select a standard TCP for a specific work activity, instructions on how to design new TCPs and guidance for traffic control in a number of specific situations.

The purpose of this manual is to maximise safety by ensuring that traffic control at work sites consistently complies with best practice. It is also intended to help personnel to comply with the Occupational Health and Safety Act, 2000 and the Occupational Health and Safety Regulation, 2001.

For works conducted by contract, the manual complements RTA specifications G10, *Control of Traffic* and G11, *Road Occupancy Provisions*.

The principles outlined in this Manual detail the minimum treatments required. Additional signs or devices may from time to time be required at specific sites to ensure the maximum guidance possible. Extreme care is required to ensure that the inclusion of additional signs and devices improves and does not detract from the safety of a work site.

Any variations below the requirements of this manual shall only be made on the basis of a documented risk assessment.

2.2 Application

This manual shall be used on all RTA road and bridge works.

Appendix D, *Traffic control plans*, contains standard TCPs covering many work activities. Where a standard TCP does not exist for the work activity planned then an existing TCP may be modified within strict limits (see Section 4.5, *Minor modifications to TCPs*) or a new TCP is to be designed.

Not all TCPs in this manual will be applicable in every area of the State.

See Section 9, *Specific situations*, for further guidance.

In this Manual the term “Standard TCP” refers either to any TCP contained in this Manual (all of which are authorised) or a TCP, duly authorised, and contained in the Local Office Manual. The term “New TCP” refers to a TCP which does not exist as a standard TCP and which cannot be produced by minor modification of a standard TCP and will need to be designed by a person with a Design and Inspect Traffic Control Plans Certificate and, once authorised, may become a Standard TCP.

2.3 Definitions

85th percentile speed (V_{85}) – the speed at or below which 85% of vehicles are observed to travel under free flowing conditions past a nominated point.

AADT (annual average daily traffic) – the total traffic volume over the whole year, divided by the number of days in the year.

Adjacent to traffic - work which is not undertaken on trafficked lanes but immediately to the side of them and at locations where traffic from time to time might be expected to be found. For instance on shoulders, footpaths or medians.

ADT (average daily traffic) – the total traffic volume during a stated period, divided by the number of days in that period.

Advance warning signs – roadwork warning signs which have a general message, used in advance of other roadwork signs with a more specific message.

Advance warning vehicle – a vehicle used well in advance of mobile works to provide advance warning of those works, to following traffic.

Approach speed – the speed of traffic approaching the work site measured in km/h and may be the speed limit applying to the road.

Around, past and through – traffic will move either around, past or through work areas:-

Around – a work area with traffic on a detour, side track or different carriageway

Past – a work area with traffic on the same carriageway as the work area, to the side of, and not directly over the area being worked on

Through – a work area with traffic over the area being worked on with or without a pilot vehicle and may intermingle with workers or plant.

Built-up area – roadside development comprising property accesses at spacings averaging less than 100 m over distances of at least 500 m.

Competent person – a person who has, through a combination of training, qualification and experience, acquired knowledge and skills to enable that person to perform specified tasks.

Condition signs – temporary signs indicating the condition of the road surface through the work area.

Containment fencing - a physical barrier (not a safety barrier) sufficient to provide separation between the travelled path of pedestrians and the work area, but not so rigid as to become a hazard if struck by vehicles.

Clear of traffic and plant - a location where traffic and plant would not normally be expected.

Crossover (roadworks) – used where one carriageway of a divided road is closed to traffic and the traffic is transferred to the other carriageway which then operates as a two way road.

Crossover (emergency vehicles) – used to allow access from one carriageway to the adjacent carriageway for emergency vehicles (Police, Ambulance, Fire etc) and roadwork vehicles but not private vehicles.

Delineation – a general term for treatments which enhance the information needed to select the appropriate path and speed, or position, to allow a manoeuvre to be carried out safely and efficiently. In this manual, delineation refers to devices such as line marking, raised pavement markers, traffic cones, bollards and post mounted reflectors.

Determination of D – based on the speed of traffic approaching the *work site* in km/h or the speed limit applying to the road.

Device – see definition for *traffic control device*.

Dimension D – a distance expressed in metres and used for the positioning of advance signs and related purposes.

Engineer – see definition for *Project Manager*.

Footpath – the paved area in a footway.

Footway – a public way largely reserved for the movement of pedestrians.

Independent person – a person, with respect to safety inspections, who is not directly a member of a work crew undertaking short term or long term work.

Intermittent work – work which is undertaken on travel lanes, in gaps in traffic, without obstructing traffic and without compromising the safety of workers. Intermittent work may be either planned or unplanned.

Lead vehicle - a vehicle used at the head of mobile works on two way roads to give advance warning of the works to traffic approaching from the opposite direction and to enable the driver to alert following workers of any impending hazard.

Legibility distance – the maximum distance that the various types of traffic control signs or devices are clearly seen under normal operating conditions and where there is no restriction to the line of sight.

Long-term work – work requiring traffic control and taking **longer** than one work shift and where some form of traffic control must remain when the site is left unattended and may need to operate both day and night.

Maintenance Engineer – see definition for *Project Manager*.

May – indicates the existence of an option.

Mobile work – work which entails work vehicles moving continuously along the *roadway* at speeds significantly lower than other traffic. All signs and devices are either vehicle mounted or are regularly moved along the road.

Open road area – roadside development less frequent than that specified for a *built-up area*.

Past – see definition for *Around, past and through*.

Pedestrian Movement Plan (PMP) – A diagram showing the allocated travel paths for workers or pedestrians around or through a work site. The plan shall show all associated signs and devices used to guide the workers or pedestrians. A PMP may be combined with or superimposed on a TCP.

Physical works – the visible on-site activity of workers, plant or trucks.

Project Manager – the officer responsible for the selection, design, approval and implementation of the traffic control to apply on site. It may include the Engineer, Asset Engineer, Maintenance Engineer, Roadworks Engineer, Surveyor, Supervising Geotechnical Scientist or other positions usually at RTA Unit Manager level.

Remote location – a location that is generally clear of traffic but may include plant items or tip trucks. Examples of such locations are gravel pits and stockpile sites. Whilst traffic would not generally be expected at these locations care shall be taken as access to traffic may not be denied.

Road occupancy – consists of any activity likely to impact on the operational efficiency of the road network, in other words, an activity that requires the road to be used in such a way as to affect traffic flow, or an off road activity that affects traffic flow. A road occupancy may involve closure of a traffic lane or traffic lanes.

Road Occupancy Licence (ROL) – allows a proponent to use a specified road space at approved times, but does not imply permission or approval for the actual works being undertaken. For all occupancies on classified (state) roads applications are to be made to the Planned Incident Unit of the RTA's Transport Management Centre. For occupancies that impact solely on unclassified (council) roads applications are to be made to the relevant local council authority.

Road user – any driver, rider, passenger or pedestrian using the road.

Roadside - that area between the reserve boundary and the nearest road shoulder.

Roadway – that portion of the road devoted to the use of vehicles, inclusive of shoulders and any auxiliary lanes.

RTA work site – a *work site* under the control either of RTA or its contractors.

Running lane – a portion of the roadway allotted for a single line of moving vehicles.

Safety barrier - a physical barrier separating the work area and the travelled way, designed to resist penetration by an errant vehicle and as far as practicable, to redirect errant vehicles back into the travelled path.

Shadow vehicle - a vehicle which provides close up protection to the rear of workers on foot.

Shall - understood to be mandatory.

Should - understood to be non-mandatory, i.e. advisory or recommended.

Short-term work – work requiring traffic control during work taking **less** than or equal to one work shift and where traffic control is not required when the work is complete and where road conditions are returned to normal when the shift ends.

Sight distance – the distance between the point at which an approaching driver first sees the whole of an object (in the context of this manual the object is the traffic control sign or device) and the object itself. The desirable sight distance is sufficient to enable a driver to see, perceive, respond and react, and is usually approximately equal to 8 – 10 seconds of travel or about $2.5D$ where D is the approach speed in km/h.

Signals Technician – see definition for *Technician*.

Site Supervisor – see definition for *Technician*, for traffic signals work and *Works Supervisor* for road and bridge works.

Spotter – a person whose sole responsibility is to watch out for and warn workers of approaching traffic.

Tail vehicle - a vehicle used at the tail of mobile works to provide advance warning of the works to following traffic, to divert traffic around the works and to enable the driver to alert workers ahead of any danger.

TCP – see definition for *traffic control plan*.

Team Leader – the person on-site full time who directly manages the other workers. This includes the leader of a survey party.

Technician – a person with electrical qualifications, holding either a current Qualified Supervisor Certificate endorsed “Electrician” or an Individual Contractor Licence endorsed “Q” for electrical work, issued under the provisions of the Building Services Corporation Act 1989. A traffic signal technician is one who has the above qualifications and has had training in traffic signals operation.

Through – see definition for *Around, past and through*.

Traffic – all vehicles, persons or animals travelling on a road.

Traffic control – guidance given to road users using any signs, devices, pavement markings, signals or directions from a traffic controller to regulate, warn or guide road users.

Traffic control device – any sign, signal, pavement marking or other installation placed or erected by a public authority, authorised agent or contractor to regulate, warn or guide traffic.

Traffic Control Plan (TCP) – a diagram showing signs and devices arranged to warn traffic and guide it around, past or, if necessary through a work site or temporary hazard. The TCP shall detail the location, spacing and sizes of all signs and devices, the location and lengths of tapers, all pavement markings and delineators, any containment or safety fencing, flashing arrow signs, portable traffic signals, variable message signs, roadwork speed zones and, if necessary, pedestrian routes.

Traffic controller - a trained person whose duty it is to control traffic at a work site. This control is normally exercised by the use of STOP/SLOW bats, but may be by manual control of traffic signals or other devices.

Traffic Management Plan (TMP) – a plan detailing work to be undertaken and describing its impact on the general area, especially its impact on public transport and passengers, cyclists, pedestrians, motorists and commercial operations. It also describes how these impacts are being addressed. May also contain detailed TCPs and VMPs.

Travelled path – that part of the roadway which is available to vehicles and which may consist of one or more running lanes.

Variable message sign – an electronic sign that displays electronically generated messages on a screen. They provide road users with information about road and traffic conditions.

Vehicle Movement Plan (VMP) – a diagram showing the preferred travel paths for vehicles associated with a work site entering, leaving or crossing the through traffic stream. A VMP should also show travel paths for trucks at key points on routes remote from the work site such as places to turn around, accesses, ramps and side roads. A VMP may be combined with or superimposed on a TCP.

Vehicles per hour (vph) – the number of vehicles in any particular hour. This can be determined from an actual hourly count or counting the vehicles during a short period (say 6 minutes) and then multiplying to make the hour (by 10 for a 6 minute count). Alternatively, if the ADT is known, experience has shown that dividing the ADT by 16 gives a useable vph. (See Section 9.14, *Vehicle inspections*, Table 9.2, Estimating ADT.)

VMP – see definition for *vehicle movement plan*.

Work area – the specific area on the road or bridge or within the road reserve where the construction or maintenance work is being undertaken.

Work site – an area of road or bridge or road reserve which includes the work area or areas and any additional length of road or bridge required for traffic control such as signs and tapers.

Work vehicle - in mobile works this is the vehicle or plant item immediately proceeding the work area and undertaking the work (such as a linemarking machine) or supporting the workers on foot behind it. For static sites it is positioned to best suit the work being undertaken.

Works Supervisor – the first person in line management who directly supervises teams of field personnel.

2.4 Training

2.4.1 General

The success of a system of traffic control at a work site depends on the knowledge, skills, cooperation and efforts of all the people with a responsibility for traffic control at the work site.

Training shall therefore be provided to all personnel with a responsibility for traffic control at work sites.

This training shall be provided to personnel who:-

- ◆ control traffic with a STOP/SLOW bat
- ◆ set up and work with TCPs
- ◆ select and make minor modifications to TCPs
- ◆ design new TCPs or inspect TCPs on any site.

Training courses have been developed as shown below. Before undertaking any of the courses it is essential that the relevance of the course to the person nominated is confirmed and that any pre-requisites have been met.

- **Traffic Controllers - *Duration 1 day***

This course provides training for staff required to control traffic at a work site, by using **STOP/SLOW** (R6-8/T7-1) bats.

This course *qualifies* the participant to control traffic, it **does not authorise** the participant to control traffic nor to set up or work with traffic control plans. The participant must ensure they are authorised to control traffic by the relevant roads authority pursuant to Roads Regulation 2008.

- **Apply Traffic Control Plans - *Duration 1 day***

This course provides training for staff required to set up and work with Traffic Control Plans (TCPs) issued to them.

It **does not** qualify the participant to control traffic with a STOP/SLOW bat nor to select or modify existing TCPs.

- **Select/Modify Traffic Control Plans - *Duration 2 days***

This course provides training for staff required to select and make minor modifications to standard Traffic Control Plans to suit work locations.

It **does not** qualify the participant to control traffic with a STOP/SLOW bat, set up or work with traffic control plans, design a new traffic control plan or to inspect traffic control plans on any work site except for routine inspections of any site for which the participant is responsible.

- **Design and Inspect Traffic Control Plans - *Duration 1 Day***

This course provides training for staff required to design new Traffic Control Plans or produce major modifications to standard plans. It also qualifies staff to inspect and report on traffic control plans on **any** work site, especially those for which they have no responsibility. (See Section, 2.5, *Traffic control safety inspections*.)

2.4.2 Audit of training effectiveness

The RTA training packages on traffic control at work sites shall be supplemented with an auditing process to ensure that managers and field staff:-

- possess a consistent level of knowledge of and commitment to safe work practices in relation to traffic control
- are aware of their responsibilities under OH&S legislation
- are aware of their responsibilities under this manual
- know that field personnel are required to select, install, maintain and remove signs and other devices on the basis of TCPs
- are aware of the procedure for modifying standard TCPs
- are utilising the training received.

2.5 Traffic control safety inspections

A traffic control safety inspection is a structured procedure whereby an independent and suitably qualified person uses a checklist to determine the level of compliance at work sites with the practices and requirements of this manual.

The overriding objectives of a traffic control safety inspection are:-

- to ensure that the work site is operating safely
- to ensure that, if required, a TCP has been provided and is on site, has been approved and has been implemented as approved
- to ensure any variations to the TCP (for instance in sign location due to shade, parked vehicles etc) are recorded on the TCP
- to highlight discrepancies and, if appropriate, make recommendations.

All work sites are subject to traffic control safety inspections.

An example of a Traffic Control at Work Sites Safety Inspection Checklist is included in Appendix E. Whilst independent inspections are to be undertaken the checklist can also be used by suitably qualified members of crews involved in any work as a further means of ensuring safe working conditions.

2.6 Liaising with external organisations

RTA will endeavour to keep its standard TCPs current by liaising with:-

- overseas road and traffic agencies (the formal liaison with the United States Highways Research Program is an example)
- other road agencies in Australia and New Zealand through the AUSTROADS liaison groups
- Local Government (Councils) and WorkCover in NSW
- Relevant Australian Standards Committees.

When new information becomes available and new techniques are developed, they will be assessed and if suitable incorporated into this manual. Any amendments to the manual will be made available on the RTA web site.

2.7 Improving public awareness

2.7.1 Aim

The aim is to improve the recognition and response of drivers to roadworks traffic control devices and Traffic Controllers at work sites.

2.7.2 Drivers' perspective

Problems in public awareness at work sites include:-

- road users may not understand the devices, particularly newer devices
- drivers do not appreciate the dangers to workers and road users if traffic control devices are not given adequate respect, attention and appropriate response, and
- drivers lose respect for signs, which are used incorrectly.

For example, if the traffic controller (symbolic) sign is displayed while there is no traffic controller present, then drivers may interpret this sign as meaning there **may** be a traffic controller ahead. This could lead to a lessening of the impact of the sign when next encountered by the drivers.

2.7.3 Methods

The following may be used to raise public awareness of work sites:-

- erecting special signs informing the public of traffic guidance schemes
- advertising on television and radio
- advertising in local newspapers and magazines
- including suitable material in RTA's *Road Users' Handbook*

- conducting campaigns with the Police to reinforce responsible behaviour on the roads especially at work sites
- presenting road safety videos and posters in public areas of RTA offices, particularly Motor Registries
- presenting training kits on road safety in schools
- including brochures with registration and licence renewals
- handing out brochures at public events such as shows.

2.7.4 Topics

The public needs to be educated in the following topics:-

- what traffic controllers do and understanding their instructions
- the meaning of advance warning signs
- the meaning of symbolic signs such as traffic controller (T1-34, T1-200-2 and T1-200-3), workers (T1-5) and lane status (T2-6)
- work zone speed limits and compliance
- longitudinal line marking operations
- night work, particularly in urban areas.

2.7.5 Ongoing advice

The media should be encouraged to advise on current and planned roadworks on an ongoing basis, providing information on the:-

- extent of the work
- location of the work
- likely delays to traffic
- need to take care in the light of changed road and traffic conditions.

2.8 Evaluation and review

Implementation of this manual will be evaluated as part of RTA's overall program of evaluations and assessment audits.

A Traffic Control at Work Sites Committee exists to assist in the review of this manual on a regular basis. Factors taken into account in these reviews include the circumstances of incidents and accidents at work sites and the results of safety audits and inspections. Feedback on the manual is welcome and encouraged and should be forwarded to the General Manager, Traffic Management Branch.

The Committee is also responsible for:-

- evaluating and approving new standard TCPs, signs and devices
- developing strategies to improve safe systems of work
- evaluating training and accreditation issues
- the consideration of work site OH&S issues.

The Committee has representatives from most areas of the RTA.

The basic criteria for the evaluation and acceptance of a new sign, device or standard TCP for general use throughout NSW are:-

- it conforms with the principles in Section 3, *General procedures* and Section 5, *Designing new TCPs*
- it has application in more than one area of the State
- other standard signs, devices or TCPs are not suitable or not effective.

2.9 Exclusions from this manual

As well as following the principles contained in this manual, some work groups may have separate documented procedures by which they operate. Such groups include the RTA Traffic Emergency Patrollers (TEPs). These separate procedures have not been included in the Manual because of the specialist activities of these groups.

2.10 Risk management

It is essential that risk management is undertaken on works to identify and analyse all hazards likely to arise during the planning, setting up, operating, changing and dismantling of a traffic control plan, followed by the determination of appropriate measures to mitigate those risks. This risk assessment process is required to be undertaken for minor routine works, mobile works and more extensive works.

The process to be followed is a four part one as detailed below.

Step 1 Identify and list the hazards to health and safety

On any work site there are potential hazards. Some examples are moving traffic, reversing plant, overhead power lines etc.

Step 2 Assess the risks arising from the hazards.

The risk of a hazard is related to the severity of a single incident, and the frequency and duration of exposure. Also, the risk is increased when more hazards are identified at a site.

The risk assessment reckoner below is used to determine the of action required by first determining the severity of the hazard (K, S, M or F) and

then the likelihood of it occurring (VL, L, U or VU). The corresponding value indicates the risk rating as follows:-

- 1 **High risk** – take immediate action
- 2 **Significant risk** – do something as soon as possible
- 3 **Medium risk** – risk control measures are required
- 4 **Low risk** – manage by routine procedures.

Severity	Likelihood			
	Very likely VL	Likely L	Unlikely U	Very unlikely VU
Death/permanent disability K	1	1	2	3
Long term illness or serious injury S	1	2	3	4
Medical and time off work M	2	3	4	5
First aid F	3	4	5	6

Step 3 Assessment of risk control or reduction measures

Having determined the risks and severity it is necessary to consider and decide on the risk control measures to be implemented based on the following hierarchy of controls:-

Elimination of the hazard

This could be undertaken by not proceeding with the work, through a traffic diversion by means of a detour or sidetrack, stopping traffic for short periods using portable traffic signals in preference to traffic controllers

Engineering to minimise the risk

This could involve the use of safety barriers, lane closures, portable traffic signals, crash attenuators, increased separation etc.

Administrative or behavioural measures to minimise the risk

This could involve speed reduction, warning signs, variable message signs, police enforcement, delineation etc.

Step 4 Monitor and review

Review the traffic control measures in place to determine whether or not they were effective.

2.1.1 Dimension D (AS 4.1.5)

Dimension D is related to the speed of traffic and is defined as a distance expressed in metres. It is used for positioning of advance signs and related purposes. The signs shall be placed at specific distances apart so that road users have sufficient time to read and absorb their messages or instructions.

See also Section 3.2.3, *Advance warning sign distances*.

Determination of the value of D

Case (a) No roadwork speed zone or speed zone change

Where there is no roadwork speed zone in place or no change in the pre-existing posted speed zone the value of D will be based on the pre-existing speed of traffic which will be the greater of:-

- (i) the posted speed limit in metres; or
- (ii) the estimated approach speed of traffic in metres if it is greater than (+10%) of the posted speed limit.

For instance:-

- ♦ if the posted speed limit is 60 km/h and traffic is generally travelling at about 65 km/h or less then D = 60 metres;
- ♦ however, if the speed limit is 80 km/h and traffic is generally travelling at about 90 km/h then D = 90 metres.

Case (b) 40 km/h or 60 km/h roadwork speed zones located 100 metres before start of work

Where a 40 km/h or 60 km/h roadwork speed zone begins 100 metres in advance of the work (in accordance with Section 8.2.4 (b)) then the value of D shall be based on the pre-existing speed of traffic as in Case (a) above.

The start of the work shall be the start of transition area, traffic diversion or traffic control position.

Case (c) A posted roadwork speed zone or speed zone change

Where there is a roadwork speed zone in place or a change in the pre-existing posted speed zone the value of D shall be based on the speed of the traffic in Zone X where the speed zone change is less than 200 metres from the first advance warning sign after the speed zone sign.

This is shown in Figure 2.1.

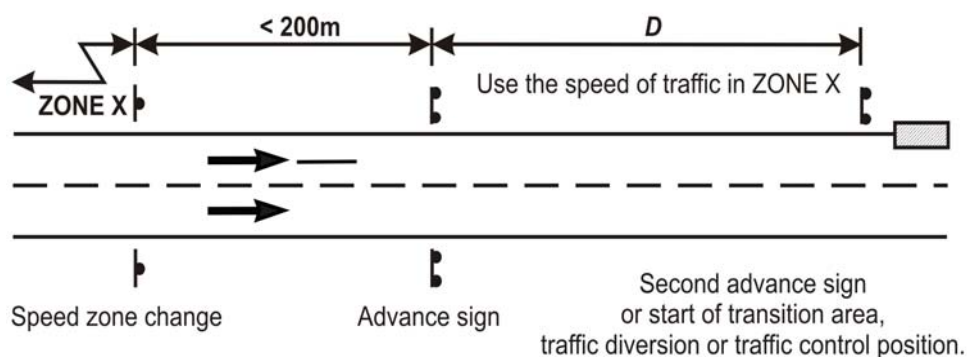


FIGURE 2.1 When the distance between the speed zone change and the advance sign is less than 200 metres, use the speed of traffic in Zone X.

Case (d) A posted roadwork speed zone or speed zone change

Where there is a roadwork speed zone in place or a change in the pre-existing posted speed zone the value of D shall be based on the speed of the traffic in Zone Y where the speed zone change is greater than 200 metres from the first advance warning sign after the speed zone sign.

This is shown in Figure 2.2.

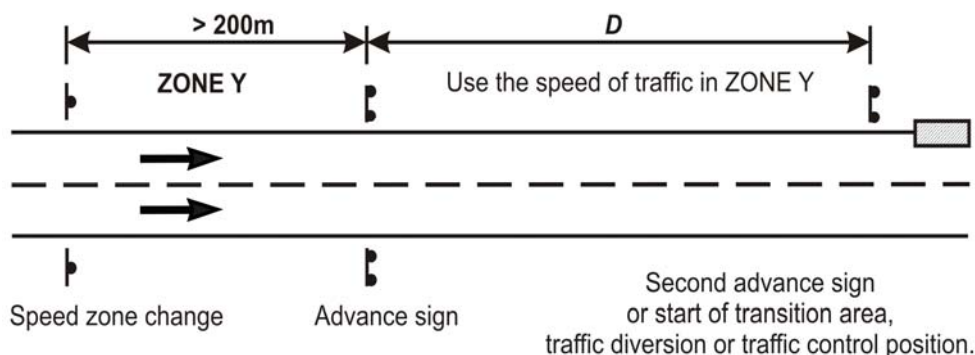


FIGURE 2.2 When the distance between the speed zone change and the advance sign is greater than 200 metres, use the speed of traffic in Zone Y.

NOTE: Having determined the values of D, based on the speed of approaching traffic above, this value shall be used to determine the any cone spacings or taper lengths as shown in Tables 5.1 and 5.2 respectively.

3.1 Introduction

3.1.1 General (AS 1.5 & 2.1)

Work shall be arranged so that workers are able to work safely and are separated from road users wherever possible.

All personnel working in or adjacent to traffic shall wear high visibility clothing in accordance with the RTA's OH&S Policy.

In setting up traffic control measures at work sites the following broad principles shall be complied with:-

Signs and devices:-

- shall be placed before work begins and be removed as soon as they are no longer required
- shall be regularly checked to ensure they are still relevant, in good mechanical condition, clean, not faded and have good night-time visibility, if necessary
- shall be inspected to ensure they remain clearly visible to road users and are not obscured by vegetation, vehicles, plant or other signs and devices and are displayed in the correct sequence

Traffic controllers:-

- shall be qualified, having passed the RTA approved Traffic Controllers training course, and shall be authorised
- shall be used if road users are to be directed to disobey a traffic regulation, such as crossing a barrier line (portable traffic signals may also be used to direct road users across barrier lines)

Work sites:-

- shall be selected so that the minimum length and width of a road is closed at each stage to ensure minimum disruption and inconvenience to road users whilst maintaining working efficiency
- shall be staged to ensure minimum disruption to traffic especially at peak times, nights, weekends, holiday periods and during special events
- shall be monitored and action taken if excessive lengths of queues or delays occur

3.1.2 Around, past or through a work site

Around (AS 2.3.5 & 4.14) - where traffic is moved on a detour using existing roads or a specially built side track or different carriageway using a cross over. See Section 9.19, *Detours, sidetracks and crossovers*.

Past (AS 2.3.4) - where traffic is diverted to the side of a work area and does not travel over the work area. On multi lane roads traffic stays within its own carriageway.

Through (AS 2.3.3) - passage of traffic through a work area shall only be permitted where both the traffic and the work can be adequately controlled. Traffic controllers or traffic signals shall be used as necessary to slow traffic on the approach to a work area, to stop traffic for short periods when required or to control single line flow. A pilot vehicle may be used to lead traffic along the desired path and to control its speed. Traffic controllers may also be needed to control the movement of plant within the trafficable area.

3.1.3 Short-term and long-term work (AS 1.4.15 & 1.4.5)

Short term work - work requiring traffic control but taking less than or equal to one shift and where roadway conditions are returned to normal, with no traffic control, after the shift or part shift. An example is the maintenance of freeway safety barriers over a period of days, where the adjacent lane is closed during the shift. At the end of each shift the lane is opened to traffic and no further traffic control is required whilst personnel are not in attendance.

Long-term work - work requiring traffic control but taking more than one work shift where some form of traffic control must remain in place when the site is unattended. Traffic control is required where road conditions are different to normal and may take the form of lane closures, roadwork speed zones, no linemarking, detours, shoulder closures etc.

An example of **long-term** work would be a series of heavy patches along a length of road where, even though personnel are not in attendance after the shift, ongoing traffic control would be required in the form of speed restriction signs, signs indicating a loose surface or signs advising of no lines marked.

3.2 Traffic control signs

3.2.1 Types of signs

Roadworks and bridgeworks traffic control signs are grouped into a number of broad categories. Some examples of signs to be found in those categories are those that are used:-

- **at work site approaches and departures (AS 3.4).** Examples are **ROADWORK AHEAD** (T1-1), **BRIDGEWORK AHEAD** (T1-2), **GRADER AHEAD** (T1-4) and **END ROADWORK** (T2-16).
- **for regulatory control of traffic (AS 3.5).** Examples are speed restriction signs (R4-1), roadwork speed restriction signs (R4-212), **STOP/SLOW** bats (R6-8 and T7-1), **PREPARE TO STOP** (T1-18) and **STOP HERE ON RED SIGNAL** (R6-6).
- **at detours (AS 3.6).** Examples are **DETOUR** (T5-1, L or R), two way traffic (W4-11 or T2-24) and detour marker (T5-6).
- **to indicate road conditions (AS 3.7).** Examples are **ROUGH SURFACE** (T3-7), **GRAVEL ROAD** (T3-13), loose stones (T3-9) and **NEW WORK NO LINES MARKED** (T3-11). On long work sites these signs may need to be repeated at intervals of not more than 500 metres.
- **at lane and road closures (AS 3.8).** Examples are lane status signs such as (T2-6-1) and **ROAD CLOSED** (T2-4).
- **at blasting works (AS 3.13.2).** Examples are T4-7 and T4-3.
- **as pedestrian control signs (AS 3.14).** -Indicating the paths pedestrians are required to take such as **PEDESTRIANS** (T8-2, L or R) and **USE OTHER FOOTPATH** (T8-3).
- **as vehicle height and mass restriction signs (AS 3.15).** Used to indicate height or mass limits such as **LOW CLEARANCE X.Xm** (R6-11) and **BRIDGE LOAD LIMIT Xt GROSS** (R6-3).
- **or other signs (AS 3.16).** Including **TRAFFIC HAZARD AHEAD** (T1-10) and trucks (T2-25).

Signs shall be designed and manufactured in accordance with AS 1743. Details of each letter shall be as shown in AS 1742.2. The retroreflective material used on signs shall be Class I material complying with AS 1906.1. **(AS 3.2.2).**

3.2.2 Sign sizes (AS 3.2.3)

Standard signs shall be used wherever one suitable for the purpose exists. Individual signs may be available in 2 different sizes described as (A) or (B). (For signs used on mobile work vehicles see Sections 3.3.9, *Vehicle mounted signs and devices* and 9.17.2, *Mobile work*). Each category of sign shall be used under the following conditions:-

A size

- (a) at traffic speeds up to 90km/h where lateral offset of the sign from the travel path is not more than 8 metres; or
- (b) at traffic speeds up to 110km/h where the offset is not more than 4.5 metres; or
- (c) signs directed at pedestrians.

B size

- (i) where the conditions for A size signs are exceeded; or
- (ii) on expressway type roads for added emphasis of the onset of works, detours or closures; or
- (iii) other critical safety messages; or
- (iv) where traffic speeds exceed 70 km/h and the relevant A size sign is less than 1 m² in area.

C and D size

Larger signs may be used where there is considered to be a need to emphasise the message or there is excessive lateral offset of the sign.

The works supervisor is responsible for selecting sign sizes and for ensuring that they are shown on the TCP.

NOTE: Details of standard sign sizes are contained in:-

AS 1742.1, General introduction and index of signs

RTA's electronic Traffic Signs Register.

3.2.3 Advance warning sign distances (AS 4.7.4)

Local constraints may not allow signs and devices to be placed exactly in accordance with the relevant TCP. Judgement will therefore be necessary to place signs and devices as close as possible to the spacings indicated. Should variations to the recommended spacing be required then it is generally preferable to increase the spacing slightly.

Any sign location changes are to be marked and initialled on the TCP held on site, with the name of the person making the changes clearly shown.

Advance warning signs are not required **(AS 4.7.1)**:-

- (a) where the work is sufficiently remote from a roadway that no action is required of road users
- (b) where the work is undertaken in gaps in traffic (see Section 9.1.2, *Intermittent work*) in either open road or built-up areas or takes less than 5 minutes (see Section 9.1.4, *Short term work in traffic – open road areas*)
- (c) if the effects of the works are confined to one direction of travel and no extra vigilance is required of road users travelling in the other direction
- (d) on unsealed roads (see Section 9.20.3, *Short term partial road closures*).

The following distances, measured from the beginning of the taper area or beginning of a diversion associated with the work site, shall be used when placing advance warning signs **(AS 4.7.4)**:-

- (i) where there is only one advance sign, it shall be placed at 2D from the work area for approach speeds of 65 km/h or more, or D for approach speeds less than 65 km/h.
- (ii) where there is more than one advance sign position, the advance signs nearest the work area shall be placed D from the beginning of the taper area or diversion and other advance sign positions at successive spacings of D further in advance of the work area.

For frequently changing work sites (see Sections 9.1.5, *Frequently changing work areas – open road areas* and 9.1.9, *Shoulder grading and mowing on sealed roads – open road areas*) **(AS 4.3.4 & 4.3.5)** (during minor pavement maintenance, shoulder grading, longitudinal survey work etc), where the work is continually progressing along the route, advance signs may be placed up to 2 km in advance of the work provided the **NEXT 2KM** (T1-28) is displayed. This may be increased to 10 km for shoulder grading and verge mowing in open road areas and for maintenance grading on unsealed roads (see Section 9.20, *Works on unsealed roads*) **(AS 4.5.2)**.

For the purposes of sign spacing the value of D shall be as determined by Section 2.11, *Dimension D*.

3.2.4 Duplication of signs

As detailed below, the works supervisor shall arrange for duplication of signs, where practical, on both sides of the roadway for undivided roads or on the left hand side and on the median for divided roads with medians of sufficient width:-

- on multilane roads (**AS 2.5.2**) with volumes of 10,000 vpd or greater
- for lane status signs(T2-6-1, T2-6-2 etc) regardless of vpd (**AS 3.8.2**)
- on the outside of left hand curves where the sign is seen on approach to the work site
- on medians of dual carriageways where parked vehicles or other objects would obscure kerb side/footpath signs
- at other locations where conditions are such that duplicate signs would improve safety and guidance.

Duplication of signs may be dispensed with where it is impracticable (ie where it would be necessary to cross the road on foot carrying signs, the shoulder is too narrow to position the signs or to park the work vehicle etc) or where the duplicated signs might have too large a lateral offset as to not be obvious to motorists (ie on a six lane, two way undivided road).

On multi-lane roads where there is no room for duplicate signs on medians, consider placing supplementary signs on the left hand side, particularly workers (symbolic) (T1-5), and traffic controller (symbolic) signs (T1-34, T1-200-2 or T1-200-3).

3.2.5 Erection of signs on display for longer than 2 weeks (AS 4.7.5)

Signs continuously required for works, which will be in progress for longer than 2 weeks, should, where appropriate, be erected in a permanent manner on posts sunk into the ground (**AS 4.7.5**). Permanent installation, however, may not be possible or appropriate in narrow cuttings, where underground utilities may be located, behind safety barriers where off-sets might be too great or where it is undesirable to be making holes.

Signs required for works which will be in progress for less than 2 weeks may also be erected in a permanent manner if it is considered to be justified. Otherwise less permanent mountings shall be used.

Workers shall not cross roads or carriageways on foot when erecting or removing signs.

3.2.6 Multiple sign displays (AS 3.3.2)

Where two signs are to be displayed together at the one position (i.e. a worker symbolic and authorised speed restriction sign) they may be displayed on the same mounting, either side by side or one above the other. The sign sizes may be slightly reduced to suit the mounting, provided that the size of legend, size of symbol or area occupied by the legend is unchanged from the approved sign.

A maximum of three signs may be displayed together (ie worker symbolic, roadwork speed zone and **ROADWORK AHEAD**) if there is sufficient space available. Roadwork speed zone signs shall be erected a minimum of 600 mm above the ground to the under side of the sign and placed on the frame so that they are closest to the traffic. However, use of a multiple sign may not be appropriate where the speed of passing traffic is high or the lateral offset of the sign is near acceptable limits. In such situations there may be insufficient time for drivers to fully read and comprehend the message being given. The use of irrelevant messages shall be avoided.

Also, where it is proposed to display the traffic controller symbolic and **PREPARE TO STOP** signs together a second **PREPARE TO STOP** sign shall be displayed in advance of the multiple sign to give advance warning.

3.2.7 Sign mountings (AS 3.3.1)

If used sign mountings shall:-

- be quick and easy to install
- provide secure sign attachment
- be stable in windy conditions and from the effects of passing traffic
- be suitable for both gravel and bitumen surfaces
- be able to accommodate various sign sizes
- be easy to handle, transport and store
- not be a hazard if struck in their normal upright position or after being knocked over.

Signs may also be mounted by alternative means, for instance on posts or on guide posts. Where holes are to be dug the locations of any underground utilities shall be determined.

3.2.8 Sign positions (AS 2.5.2)

Signs and devices shall be positioned and erected so that they:-

- (a) are properly displayed and securely mounted (see Section 3.2.7)
- (b) are within the line of sight of the intended road user ie at approximately 90 degrees to the line of sight
- (c) cannot be obscured from view (e.g. by vegetation or parked cars)
- (d) do not obscure other devices from the line of sight of road users
- (e) do not become a possible hazard to workers, pedestrians or vehicles
- (f) do not deflect traffic into an undesirable path
- (g) do not restrict sight distance for drivers entering from side roads or streets, or private driveways
- (h) are not installed using supports that could be a hazard if struck by a vehicle.

Delineating devices (e.g. traffic cones, bollards, post mounted delineators) should be placed in accordance with Section 3.3.11, *Edge clearances*.

Consideration shall be given for signs for works planned to take longer than two weeks to be mounted on posts, after considering Section 3.2.5 above.

Open road areas – signs on posts

In open road areas and on unkerbed roads in built-up areas where signs are to be mounted on posts, they should normally be placed clear of the outer edge of shoulder and, where possible, at least 2 m clear of the travelled way, whichever is the greater clearance. They should be erected 1.5 m minimum above the level of the nearest edge of the travelled path to the underside of the sign.

Built-up areas – signs on posts

On kerbed roads in built-up areas where signs are mounted on posts adjacent to a footpath or where vehicle parking may occur, they should be placed a minimum of 300 mm clear distance behind the kerb and erected a minimum of 2.2 m above the level of the kerb or footpath to the underside of the sign, to reduce interference from parked vehicles.

Where neither pedestrians nor parked vehicles have to be considered, e.g. on a traffic island or median, a mounting height of 1.5 m may be more appropriate.

Portable supports (short term works)

Signs mounted on portable supports used for short-term operation (see Section 3.2.7) should generally be located as follows:-

(i) In open road areas

On the road shoulder a minimum of 1 m clear of the travelled way, where possible.

(ii) In built-up areas

Behind the kerb if visible to oncoming traffic and not obstructing pedestrians, otherwise on the pavement as near as practicable to the kerb without the sign becoming obscured and without obstructing moving traffic.

Where a regulatory or detour sign and a road condition sign would normally be required at the same location, the former shall take precedence and the latter should be positioned at the best alternative location.

Mountings for short-term operation shall be arranged so that the signs are prominently displayed to traffic and will command attention.

Ideally the minimum height to the lower edge of the sign should be 200 mm **(AS 3.3.1)** but signs may be placed on the surface subject to them being clearly visible to traffic and not be obscured by vegetation.

For roadwork speed zone signs the minimum height to the lower edge of the sign shall be 600 mm.

The visibility of a sign can be affected by deep shade, the direction of the sunlight, background conditions (including lighting) and oncoming headlights. These factors should be considered when signs and devices are erected to ensure that they can be clearly seen at all times.

Signs shall face towards approaching traffic approximately at right angles to the line of sight from drivers to the sign and on curves shall be placed approximately 50 metres in advance of drivers.

3.2.9 Variable message signs (portable) (AS 3.16.6)

Where variable message signs are to be used at or near a work site to carry warning or other messages relating to the works, the following requirements shall apply:-

- (i)) Legends shall comprise not more than four words or numbers on any one screen.
- (ii)) Letter forms and legend height shall be adequate to be comfortably read by drivers at the prevailing approach speed of traffic.
- (iii)) There shall not be more than two separate screens in any alternating series of screens.
- (iv)) Where there are alternating screens the "on" time of each screen shall be 0.6 ± 0.1 second per word or number and the total time required to read the message on both screens shall be taken into account when determining message length and letter height.

NOTE: A procedure for determining letter sizes for signs is given in AS 1742.2. The letter series which most nearly matches the on-screen fonts should be used in the calculations. It is recommended that the calculated letter height be doubled for this purpose.

- (v)) Symbols shall not be used unless they have been tested for comprehension in their on-screen format (i.e. taking into account distortions due to pixel size limitations).
- (vi)) Messages shall be relevant to the nature and phase of the work in progress and shall be changed or switched off when they are not relevant.
- (vii)) Messages shall be additional to and not substituted for any sign, or warning or delineating device required by this Manual. The nature and positioning of the messages shall not detract from those signs or devices. Variable message signs near roadworks sites displaying unrelated messages shall be switched off.

Variable message signs shall not be used to set speed limits, but they may be used as a reminder of any set speed limit.

3.2.10 Portable traffic signals (AS 4.11)

Instructions on the use of portable traffic signals are given in Section 10, *Portable traffic signals*.

Sight distance on the approach to traffic signals shall be 150 m to the primary signal face and the approach speed of traffic shall be no higher than 60 km/h. In open road areas where traffic signals might not be expected consideration should be given to erecting the signal ahead (W3-3) sign with a 500 m (W8-5) sign to give long distance warning.

3.2.11 Illuminated flashing arrow signs (AS 3.12.2)

Illuminated flashing arrow signs shall comply with the relevant Australian Standards, where they exist, and RTA specification FAS/5 or FAS/4 Parts A and B. The relevant Australian Standards are listed in FAS/5 and FAS/4. General operating instructions are given in Section 11, *Illuminated flashing arrow signs*.

In addition to the above, only equipment that has been type approved by the RTA is to be used. Testing of equipment is to be undertaken by the RTA's Manager, Traffic Equipment and Standards. After type approval has been issued the Manufacturer or Selling Agent shall affix, to the equipment, a durable marking plate in the following format:-

This equipment conforms to RTA – NSW TYPE APPROVAL No.
--

The number shown on the marking plate shall be that shown on the Type Approval Certificate issued by the RTA Manager, Traffic Equipment and Standards.

The following three size designations are used:-

- Type A - 1260mm by 650mm for roof mounting on light vehicles
- Type B - 1500mm by 770mm for cab mounting on trucks
- Type C - 2400mm by 1200mm for trailer mounting and using its own power source or cab mounting on a truck.

High intensity flashing lamps may be used in conjunction with this sign provided that the lamps are either appropriately shielded or laterally or vertically displaced from the edge of the sign to avoid visually corrupting the arrow shape or its directional effect.

Requirements for the flashing of different patterns of the lights are:-

- (i) When traffic is expected to pass the sign on a particular side and can do so in safety, i.e. it is not required to seek a gap in oncoming traffic, the bar of the arrow and the barb directing traffic to that side shall be flashed.

- (ii) When the sign is used to give a general warning of works activity ahead including mobile works, but either the sign is located clear of the traffic path or the display of an arrow would not be appropriate for some other reason, the four corner lights at the extremities of the barbs shall be flashed with diagonal pairs being be flashed alternately.

3.3 Traffic control and delineation devices

3.3.1 Barrier boards (AS 3.8.3 (a))

Barrier boards shall comply with RTA QA Specification 3385.

Barrier boards shall:-

- be used to prohibit access to the ends of work (where they may have flashing yellow lights mounted on them)
- be used to prevent use of a traffic lane
- be placed at right angles to traffic flow at a maximum spacing of 100m.

They shall NOT:-

- be used as delineation devices but may be used on footpaths for the guidance of pedestrians
- be placed parallel to the direction of traffic flow as they will be difficult to see and may act like spears if hit by traffic.

Trestles supporting the barrier boards may be manufactured of timber, metal or other suitable, approved material and shall be yellow. The trestles shall provide firm supports for the barrier board and be kept in place by filled sand bags or other acceptable devices. The bases of the trestles shall not protrude beyond the ends of the boards.

3.3.2 Plastic containment fences (AS 3.10.1)

Containment fences may be used to provide visible separation between pedestrians and the travelled way or the work area, in situations where physical protection by use of a safety barrier is not warranted.

All types of containment fencing shall be supported by posts at not more than 5 m centres and shall not have horizontal deflections greater than 0.5m from the nominal line of the fencing.

Containment tapes may be used to contain workers on foot and plant within the safe workplace boundary established at the particular work site. Tapes should be 100 mm wide with alternate stripes of contrasting colour and supported on posts approximately 1 m high such that the height of the tape above the ground is never less than 800 mm.

Tapes shall not be used for pedestrian containment adjacent to traffic.

Plastic mesh fencing shall be used for excluding pedestrians from a work area and for the containment of workers on foot and plant as for containment tape. It shall comprise a flexible orange mesh approximately 1 m high such that the height of the tape above the ground is never less than 800 mm.

When used for containment from the travelled way the clearance requirements of Section 3.6, *Safe clearances between workers and through traffic at static work sites* shall be met.

Plastic containment tapes and fences are not to be used as safety barriers and when used adjacent to traffic are not to act as delineation. Delineation shall be achieved using reflectors on the supporting posts or using appropriately placed cones or bollards.

Containment fences should be used behind safety barriers to prevent workers entering the area of deflection of the safety barrier.

3.3.3 Cones and bollards (AS 3.9.1)

Traffic cones shall comply with RTA QA Specification RTA 3352 and be used on short-term works under the following conditions:-

Small size cones 450mm high - most low speed urban and rural applications including footpaths, shared paths and bicycle paths where traffic speeds do not exceed 70 km/h

Standard size cones 700mm or higher – all other road applications where traffic speeds exceed 70 km/h. May also be used on lower speed roads.

NOTE: Cones smaller than 450mm would not normally be used.

Temporary bollards shall be at least 750 mm high and 100 mm in diameter and made from fluorescent red/orange material and be resilient to impact.

Cones and bollards shall be used on works to define the traffic path past or through the work area. At no time shall they be used as a substitute for barrier boards and signs at either end of the work. When used at night they shall have a white horizontal retroreflective band of Class I material 150mm wide on the small cones and 250mm wide on the standard cone and bollards.

They should only be used while work is in progress (day or night) where employees are in attendance to reinstate any of the cones and bollards dislodged by traffic or wind. However, they may be used on long-term unattended works if they are securely fixed to the pavement or weighted to provide adequate stability.

Recommended spacing of cones is given in Table 5.1.

3.3.4 Roadworks delineators (“guideposts”) (AS 3.9.2)

Roadworks delineators shall be used as follows:-

- (a) For delineation of the travel path through or past the work site as an alternative to traffic cones or bollards with yellow delineators on both sides of the roadway.
- (b) For delineation of the roadway on detours and side-tracks with red delineators on the left side and white on the right (two-way roadway) or yellow on the right (one-way roadway).

Delineators used at or near works on roads shall meet the requirements of AS/NZS 1906.2 for either the sheeting or discrete device type. Delineators made from orientation-sensitive material shall be made and installed at the manufacturer’s recommended orientation for optimum performance.

Delineators should be erected 1 m minimum from the edge of the travelled path and at a uniform height of approximately 1 m above the road surface. Delineator posts should be frangible or otherwise non-hazardous and be installed to provide a single continuous line defining the travelled path. The spacing of delineators shall be as follows:-

- (i) Immediately adjacent to or through work areas:-
 - (A) 24 m maximum at traffic speeds up to 70 km/h;
 - (B) 60 m maximum at higher traffic speeds.
- (ii) On side tracks and detours as specified in Section 9.19, *Detours, sidetracks and crossovers* (AS 4.14.6).

3.3.5 Traffic warning (roadwork) lamps –flashing yellow lamps (AS 3.11)

Traffic warning lamps shall comply with MR 1027.

There are two types of lamps used on temporary work sites as follows:-

unidirectional flashing yellow lamps (AS 3.11) - these may be used to draw attention to a particular sign (**AS 4.7.5**) and shall be mounted above the sign or may be mounted on barrier boards indicating the ends of work sites. They shall not be used to delineate a path through a work site because of the confusing light pattern which a series of such lamps may produce. They may also be used to highlight safety barrier end treatments.

rotating or flashing yellow lamps (AS 3.12.1) – shall be used to draw attention to work vehicles and plant to which they are attached or to draw attention to signs in difficult light conditions or in high volume locations.

Strobe lamps (AS 3.12.1 (b) NOTE) may be permitted if it can be shown that their on-time performance in each flash cycle is equal to or longer than that of the rotating or flashing lamp.

3.3.6 Temporary pavement markings and markers (AS 3.9.4 & 3.9.5)

Pavement markings and markers used at temporary work sites generally comprise:-

- (a) barrier, lane and edge lines
- (b) turning arrows
- (c) raised retroreflective pavement markers.

All pavement markings shall be reflectorised and be in accordance with the relevant RTA specifications for Pavement Markings.

The pavement markings on temporary roadways and detours shall be of a similar standard to that in use at either end of the adjoining existing roadway and where the adjoining roadway is edgelined, temporary roadworks shall be similarly edgelined.

Where temporary linemarking (ie linemarking not in its final location) is required on the final wearing surface, or adjacent pavement, only approved pavement marking tape shall be used.

Where it is determined that the temporary pavement **linemarking** has become ineffective, remarking shall be undertaken within forty-eight hours.

Where **raised pavement markers** have been dislodged or become ineffective, they shall be replaced within twenty-four hours.

Where a single carriageway is opened adjacent to or used in lieu of an existing dual carriageway length, pavement arrows (in tape if they are required to be removed from a final wearing surface) indicating the direction of flow of traffic shall be placed as directed with the maximum allowable spacing being 500 m. The arrows shall be removed if the section is then reincorporated as dual carriageway.

All redundant pavement markings shall be immediately obliterated or removed in such a way as to leave a clean, undamaged pavement with a surface texture, reflectivity characteristics and colour comparable to the adjacent pavement surface. **Blacking out shall not be permitted.**

All redundant raised pavement markers shall be immediately removed from the pavement.

Where existing pavement markings are to be removed and replaced by other pavement markings, removal shall not begin until adequate provisions have been made to complete the installation of the replacement markings. Pavement markings shall be removed in such order that the markings remaining in place at any time will not be in a pattern that will mislead or misdirect road users.

The markings shall be removed so that the surface is in proper condition for adequate bonding of the new markings. Any material deposited on the pavement as a result of removing pavement markings shall be promptly removed as the work progresses by acceptable methods.

When these operations are completed, the pavement surface shall be clear of any residue or debris. A minimum of ninety (90) percent of the total area of the existing pavement markings shall be removed to uniformly expose the existing pavement surface.

Any damage to the pavement, pavement joint materials or the pavement surface caused by the removal of pavement markings shall be repaired. The pavement surface shall be left in a condition that will not mislead or misdirect road users.

On long-term works raised retroreflective pavement markers complying with AS1906.3 may be used in conjunction with temporary pavement markings. The spacing and application shall be as specified in AS1742.2.

3.3.7 Longitudinal channelising barricades (AS 3.10.2)

Plastic water filled devices that have not satisfied the requirements of NCHRP 350 (or equivalent) as a safety barrier shall only be used as a containment fence for workers or pedestrians or as delineation devices in situations where a road safety barrier system is not required. These devices will not contain a vehicle and might present a hazard to personnel if struck and displaced by a vehicle.

Typical uses include placement in a work area behind safety barriers to prevent workers from entering the area of deflection of the safety barrier. They may also be used to guide pedestrians and cyclists through or past work areas (subject to the restriction of item (i) below).

These units:-

- (i) shall satisfy impact tests 70 and 71 of NCHRP 350 for work zone traffic control devices
- (ii) shall not be used at locations where a safety barrier is required as indicated by this manual
- (iii) shall each be marked as shown below in letters at least 50 mm high:-

NOT A SAFETY BARRIER

- (iv) for night use, each unit shall be fitted with a reflector visible to approaching traffic, and where used to channel pedestrians away from a pre-existing route, lighting shall be provided to the same level as the pre-existing pedestrian route
- (v) shall be filled with sufficient water (or sand) to provide the mass to resist displacement or overturning from expected wind conditions, air turbulence from passing traffic and minor vehicle impacts
- (vi) shall be placed at the appropriate edge clearance as shown in Section 3.3.11 **(AS 4.13.4 (a))**

3.3.8 Unacceptable traffic control devices

The following shall not be used as traffic control devices, as they can be hazardous to personnel if hit by vehicles:-

- (i) steel drums
- (ii) isolated or non-continuous safety barrier units
- (iii) barrier boards parallel to the direction of traffic flow.

3.3.9 Vehicle mounted signs and devices (AS 3.12.1)

Vehicle mounted warning devices shall be displayed as follows:-

- (a) a single rotating or flashing yellow lamp for emergency or other infrequent use on a vehicle not normally used for roadworks purposes, or for use on a plant item or an inspection vehicle operating in accordance with Section 9.1.3, *Mobile inspections – open road areas*.
- (b) a pair of rotating or flashing yellow lamps for use on vehicles (e.g. patrol trucks) so that at least one and preferably both lamps are visible from any direction.
- (c) an illuminated flashing arrow sign as specified in Section 3.2.11 for any work and for mobile works where indicated in Section 9.17, *Mobile works*.

Strobe lamps shall be permitted if it can be shown that their on-time performance in each flash cycle is equal to or longer than the rotating or flashing lamp.

In addition to the above, Workers (symbolic) signs (T1-5) shall be displayed on all vehicles in a mobile works convoy where workers are working on foot and shall be displayed on vehicles other than mobile works where workers are working. For linemarking operations vehicles shall display **LINE MARKING AHEAD** (T1-15) or **WET PAINT ON ROAD** (T2-237) signs on the appropriate convoy vehicle.

The symbol size or legend size for these signs shall not be less than as specified for the A or B sign as required in accordance with Section 3.2.2, *Sign sizes*. The sign background, however, may be varied to suit mounting conditions.

3.3.10 Truck mounted attenuators (TMAs) (AS 3.12.5)

Consideration should be given to installing truck mounted attenuators on vehicles, such as those used to effect lane closures on multilane roads or used as shadow vehicles on mobile works.

3.3.11 Edge clearances (AS 4.13.4 & Appendix D)

Clearance between edge of traffic lane and delineating devices or road safety barrier system shall be as below. This clearance shall be measured to the traffic-side edge of delineating devices or barrier. This edge shall also be the line from which clearances to the work area are measured for the purpose of determining treatments in Section 3.6, *Safe clearance between workers and through traffic at static work sites*.

- (a) Edge of traffic lane to line of traffic cones, bollards or longitudinal channelising barricades:-
 - (i) 0.5 m for traffic speeds up to 60 km/h
 - (ii) 1.0 m for traffic speeds above 60 km/h.
- (b) Edge of traffic lane to roadworks delineators or temporary hazard markers—1.0 m.
- (c) Edge of traffic lane to road safety barrier system:-
 - (i) 0.3 m for traffic speeds 40 km/h or less
 - (ii) 0.5 m for traffic speeds 41 to 60 km/h
 - (iii) 1.0 m for traffic speeds 61 to 80 km/h
 - (iv) 2.0 m for traffic speeds greater than 80 km/h.

If the edge of the traffic lane is kerbed, delineation devices shall be placed 0.3 to 0.5 m clear behind the face of kerb.

NOTE: Road safety barriers should not be placed behind kerbs on high speed roads (above 70 km/h). However, where it is proposed to use them behind kerbs the effectiveness of the barrier positioning with respect to the kerb-barrier combination shall be considered.

Containment fences marking the limit of work area shall be placed as specified in Section 3.6.

If site conditions are such that it is not possible to provide the edge clearances listed above for the appropriate traffic then alternative treatments shall be adopted based on a documented risk assessment. (See Section 2.1, *Purpose and scope*).

3.4 Sequence for erection and removal of signs and devices (AS 2.5.3)

3.4.1 Sequence of erection

Before work commences, signs and devices at approaches to the work site shall be erected in accordance with the adopted TCP, in the following order:-

- advance warning and regulatory signs
- all intermediate advance warning and regulatory signs and devices required in advance of the taper or start of the work area
- all delineating devices required to form a taper including flashing arrow signs or temporary hazard markers where required
- delineation of the work area or side track
- all other warning and regulatory signs, including termination and end of temporary speed zone signs.

Delineation devices such as cones and bollards shall be placed in the same sequence, i.e. those furthest in advance of the work placed first.

Where a work area is moving progressively along the road, relocation of the signs ahead should take place in the above sequence. Those behind should be relocated in the reverse sequence.

Signs and devices that are erected before they are required shall be covered by a suitable, opaque material and, if necessary, inspected at night to ensure they do not give conflicting messages. The cover shall be removed immediately prior to the commencement of work.

3.4.2 Erection of signs and devices

Always travel in the direction of normal traffic flow.

A work vehicle with a flashing arrow or rotating or flashing light(s) shall be positioned between the workers and approaching traffic during placement of traffic control devices.

Workers shall not cross roads or carriageways on foot when erecting or removing signs.

Long-term or recurring short-term sites:- Consider marking the desired location of each sign or device on the road for easy placement.



Multi-lane roads:- the placement of traffic control signs and devices on central medians or concrete barriers on multi lane roads requires special consideration (i.e. a site specific TCP, or use of a mobile convoy etc).

3.4.3 Removal of signs and devices

Removal of traffic control signs and devices should be undertaken in the reverse order of erection, progressing from the work area out toward the approaches.

Workers shall not cross roads or carriageways on foot when erecting or removing signs.

Lane closures delineated by cones and bollards:- a work vehicle shall be positioned between the workers and approaching traffic and should generally slowly reverse along the closed roadway allowing workers to remove the traffic control devices. However, subject to the approval of the works supervisor, the work vehicle may proceed in a forward direction towards approaching traffic along the closed roadway, provided that this does not create motorist confusion or distraction, such as headlight glare at night.

Lane closures using barrier boards:- an “advanced warning vehicle” placed between the workers and approaching traffic should be considered as an option when removing barrier boards from lane and road closures.

Once the lane closure traffic control devices have been removed, the work vehicle should return to the approaches to the work area and, subject to the vehicle being able to move clear of the travel lane, remove all signs in the reverse sequence they were erected before the commencement of work. Special consideration shall be given for the removal of signs on central medians and barriers on multi lane divided carriageways.

3.4.4 Difficult sites

At sites where it is difficult to install and remove control signs and devices due to traffic conditions, volumes, shoulder width or road alignment, special arrangements (incorporating a site specific TCP and appropriate safe procedures) to compliment the above general principles shall be adopted to maintain worker safety. This may mean that signs are removed in the same order that they were erected to allow the work vehicle to move in the direction of normal traffic flow when use of the travel lane is the only alternative.

3.5 Broad safety principles

3.5.1 Advertising in advance of works

Advertising of proposed roadworks and any expected delays shall always be considered. This could be undertaken through:-

- media advertising (press, television, radio, internet etc)
- specially erected signs on the approaches to the proposed work
- letter box drops and personal contact.

3.5.2 Instruct and guide road users

Where standard TCPs are not appropriate new ones need to be carefully designed to adequately instruct and guide road users safely around, past or through the work site, giving particular attention to:-

- preparing a separate TCP for each stage of the work
- separating the work area from the route of vehicles wherever possible
- the need for using traffic controllers or portable traffic signals to regulate traffic conflicts and to slow and stop traffic if necessary.

3.5.3 Maintaining temporary signs and devices

Work sites need to be carefully maintained with particular attention to:-

- checking that the signs and devices displayed remain appropriate for changing circumstances during the work
- regularly checking that signs and devices are always maintained in good condition
- replacing signs damaged or disfigured in the work environment especially if the warnings displayed are not clear
- removing or covering the signs and devices as soon as they are not needed, for instance when the work is completed, or at the end of the day or when there is no site activity, i.e. during meal breaks.

3.5.4 Special safety guidelines

The following special safety guidelines shall be considered at work sites:-

- **(AS 4.14.8)** where at a detour or crossover or other location, traffic is required to travel temporarily in the wrong direction special safety requirements may be needed for pedestrians. See Section 9.3.3, *Pedestrians, Reversed traffic direction*.
- keep pedestrians clear of work sites. This can be achieved by erecting containment fencing around the work site. See Section 9.3, *Pedestrians*.
- some drivers may take longer to react to changed circumstances in the road environment
- when a detour requires traffic to travel in the wrong direction on an existing carriageway, the trailing ends of existing safety barriers will become the leading ends and may require modification
- the use on RTA works of reverse coloured signs (yellow on black) for night-time works. See Section 9.2.8, *Signs for night work*
- visibility to the end of a queue that may develop and extend from a temporary closure or delay to traffic. Use additional signs (such as **PREPARE TO STOP** (T1-18)) and warning devices where queues or delays are long (see Section 3.5.7, *Avoiding end of queue collisions*)
- avoid undue delay to traffic as this may result in drivers speeding or taking unnecessary risks to make up time in the rest of their journey
- the use of truck mounted attenuators on work vehicles protecting workers in exposed situations.

3.5.5 Traffic signal site issues

Consider the following when making traffic control arrangements at work sites with traffic signals:-

- adjust the operation of adjacent traffic signals where necessary during roadworks
- maintain effective traffic signal operation and coordination with other traffic signals, if traffic signals are part of a coordinated signal system
- if turn restrictions are necessary, check that alternative routes are available and satisfactory

- seek Police assistance at difficult work sites
- inform road users in advance of proposed works by advertising i.e. roadside advertising, letter drops or press releases
- ensure that adequate provision is made for pedestrians if it is necessary to turn off pedestrian signals or the pedestrian mode of traffic signals.

3.5.6 Emergency incidents (AS Appendix B)

Emergency incidents may occur during or outside normal working hours. It is essential that personnel be trained in the procedures to be followed at such incidents and that emergency service organisations are given contacts details to enable RTA resources to be deployed as quickly as possible. Emergency incidents may involve minor partial road closures, major partial road closures or complete road closures, due to accidents, oil spillages from vehicles, fallen trees etc. When encountering such conditions the following general procedure is to be adopted:-

- initially stop the crew truck in the travel lane with **ALL flashing lights on AND** immediately begin warning (with safety) approaching traffic to slow down. Where possible the crew truck and workers should be located to achieve a minimum sight distance of 2.5D to approaching traffic.
- set up appropriate TCP to use traffic controllers to stop traffic (advance signs to be carried to appropriate locations).
- set up advanced warning signs (i.e. **TRAFFIC ACCIDENT AHEAD, PREPARE TO STOP, TRAFFIC HAZARD**) in advance of the anticipated end of the traffic queues, to provide adequate warning to approaching traffic that a traffic queue ahead may exist. The length of the traffic queue and the location of appropriate warning signs will require periodic monitoring.

3.5.7 Avoiding end of queue collisions (AS 4.7.8)

(a) General

At an active traffic control position, under conditions of heavy traffic or lengthy delays, or a combination of the two, long queues may form. This may result in an increased risk of rear end collisions occurring.

These collisions may occur:-

- where queues are unexpected and may be short, for instance on rural highways, and may be due to the inattention of road users
- where queue lengths are long and may vary considerably, for instance in built-up areas, and may be due to queue ends extending beyond advance warning signs and devices.

Depending on speed of traffic and sight distance to the end of a queue, additional advance warning may be required to be given to advancing motorists to avoid end-of-queue collisions. **This may include extending the length of a sign posted roadwork speed zone where the queue length extends beyond the originally established zone.**

(The principles outlined in this Section may also be applied at the approach to a roadwork speed zone. See Section 8.2, *Roadwork speed zones*.)

Devices or techniques which may assist in this and which should be considered include:-

- additional and/or oversized signs
- variable message signs
- narrowing of lanes using bollards or cones
- chicanes
- electronic speed display signs
- flashing lights on signs
- thermoplastic tape or similar laid either longitudinally in zig zags or transversely to act as gentle “speed humps”.

At the present time portable speed humps, which are usually supplied with a rise of 70mm or greater, are not considered satisfactory where the speed of approaching traffic exceeds 50 km/h, as they could be hazardous to motor cycles and the method of fixing might cause damage to road pavements. Their use, however, is being examined further and recent trials of a device that does not require road fixing have proven to be positive.

(b) Assessment of expected queue length

Whilst it may not be possible to determine accurately the queue lengths expected, consideration of the relevant factors should give a close approximation.

These factors include:-

- the expected hourly traffic volumes at the time of the work
- the expected delays at each phase of the work
- the number of traffic lanes closed or affected
- the percentage of heavy vehicles
- the terrain at the site
- the site alignment, horizontal and vertical

At all times during the course of the work traffic queues shall be monitored to ensure that queue lengths do not extend back beyond the limits of the advance warning signs. Where this occurs use the procedure outlined in 3.5.7 (c) below.

At work sites where longer than normal delays may be expected (such as the laying of bridge beams which may delay traffic for 20 or more minutes) extra planning may be required which is beyond the scope of this Manual.

(c) Procedure for reducing end of queue collisions

End-of-queue protection shall be provided whenever a queue is likely to extend to a point less than D beyond the **PREPARE TO STOP** sign associated with the active control and either or both of the following apply:-

- (a) Approach speeds are greater than 70 km/h
- (b) Sight distance to the end of the queue for approaching traffic is likely to be less than $2D$ (open road areas) or $1.5D$ (built-up areas).

The following are recommended options for providing end-of-queue protection where significant queues will form:-

- (i) Where the maximum queue length can be predicted in advance, the primary **PREPARE TO STOP** sign shall be located so that the distance from this sign to the end of the queue is never likely to be less than D , see Figure 3.1. The B size **PREPARE TO STOP** sign should be used in this application.

The distance may need to be adjusted if the queue length proves to have been underestimated. If the primary **PREPARE TO STOP** sign needs to be placed more than $4D$ (approximately 15 seconds of travel time) from the control point, repeater **PREPARE TO STOP** signs at intervals of not more than $4D$ should be provided between that point and the control point to provide for conditions after the queue has dispersed.

In any relocation of the primary **PREPARE TO STOP** sign the distance D to the **ROADWORK AHEAD** sign shall be maintained.

- (ii) A second traffic controller may be employed to move the **PREPARE TO STOP** sign and the **ROADWORK AHEAD** sign as necessary to maintain their minimum required distance in advance of the end of queue. The traffic controller may also display the **SLOW** bat at each location in which case a 60 km/h temporary speed zone shall be extended to cover that position.
- (iii) Distant advance warning using variable message signs should also be used where practicable.
- (iv) All other advance and position signs required for the work shall be located at the distances otherwise specified from the start of the work area.

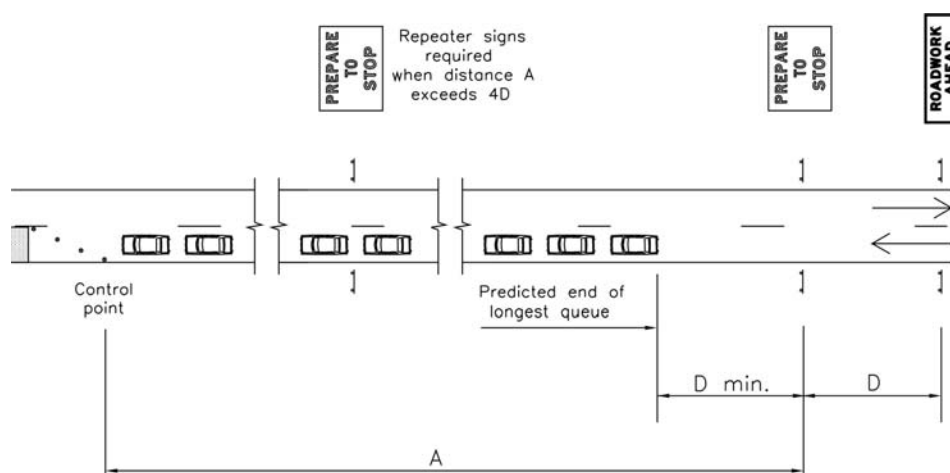


Figure 3.1 Avoiding end of queue collisions

A distant advance warning using a variable message sign should also be used where practicable.

3.5.8 Tolerances on positioning of signs and devices (AS 4.1.6)

Where this Manual gives a specific distance for the longitudinal positioning of signs or devices with respect to other items or features, for the spacing of delineating devices or for the length of tapers or markings, the following tolerances may be applied: -

(a) Positioning of signs, length of tapers or markings:

- (i) Minimum, 10% less than the distances or lengths given.
- (ii) Maximum, 25% more than the distances or lengths given.

(b) Spacing of delineating devices:

- (i) Maximum, 10% more than the spacing shown.
- (ii) No minimum.

These tolerances shall not apply where a distance, length or spacing is already given in the text or a figure as a maximum, a minimum or a range. They may need to be exceeded where road features such as intersections or median openings intervene.

3.6 Safe clearances between workers and through traffic at static work sites (AS 4.2)

This Section sets out requirements for protecting workers from oncoming or passing traffic, and road users from hazards within the site at a static work site. Intermittent and low-impact works permitted under Section 9.1 and mobile works permitted under Section 9.17 are exempted from these requirements and recommendations provided that the requirements of those Sections are observed.

The clearances to edge of work area in the following Items shall be measured from the traffic-side edge of the line of delineating devices or barriers as specified in Section 3.3.11.

There is an obligation on both organizations and contractors carrying out works on roads together with supervisory personnel at all levels, to maintain a safe workplace. This entails the prevention of injury to workers due to hazards within the works site, the protection of workers from oncoming or passing traffic, and the protection of road users from hazards within the work site.

Requirements and recommendations for protecting workers from oncoming or passing traffic and road users from hazards within the site at a static works site are as shown below. Short-term and low-impact works and mobile works are exempted from these requirements.

The requirements applying to pedestrians affected by works are included in Section 9.3, *Pedestrians*.

3.6.1 Work area 6 m or more clear of traffic

If the entire work area including all vehicles and plant is located a minimum of 6 m from the nearest edge of a lane carrying traffic, no traffic delineation of the work area or temporary speed limit will be required but a Workers (symbolic) (T1-5) sign should be placed on the left side of the roadway in advance of the work area if workers or plant are visible to passing traffic.

3.6.2 Work area 3 m to 6 m clear of traffic

If the entire work area including all vehicles and plant is located a minimum of 3 m from the nearest edge of a lane carrying traffic, no traffic delineation of the work area will be required but the following shall be provided:-

- (i) A Workers (symbolic) (T1-5) sign in advance of the work area when workers or small items of plant are present on the site.
- (ii) A vehicle mounted warning device (see Section 3.3.9).
- (iii) In speed zones higher than 80 km/h, a temporary speed limit of 80 km/h or other measures resulting in the reduction of traffic speeds past the work area to 80 km/h where the traffic volume exceeds 10 000 vpd.

The minimum length of an 80 km/h temporary speed zone should be 500 m.

A containment fence (see Section 3.3.2) should be used to delineate the clearance line for workers if the work area clearance is close to the 3 m minimum.

On expressway type roads, signs other than speed restriction signs at the start and end of a speed zone shall be placed on the left side of the roadway only.

3.6.3 Work area closer than 3 m to traffic

If the clearance between the work area and the nearest edge of a lane carrying traffic is less than 3 m one or other of the following options shall be used:

(i) Protection by safety barrier system

If the work area is protected by a road safety barrier system (see Section 9.6), there will be no requirement to reduce traffic speeds for the protection of workers. However, if the safety barrier system is rated to a speed less than that of passing traffic then the speed of passing traffic shall be reduced to the rated speed.

Advance signing and delineation, including Workers (symbolic) (T1-5) signs when workers are on site, are required, and temporary speed zoning may be required for the safety of traffic negotiating the site outside the barrier. Steps should be taken to ensure that workers and plant will remain within the protection of the barrier. A containment fence behind the barrier as recommended in Section 3.3.2 or Section 3.3.7 should also be used.

(ii) Clearance to traffic between 1.2 m and 3 m

If there is no road safety barrier system between the edge of the work area and the nearest edge of a lane carrying traffic, but the clearance between the two is from 1.2 m to less than 3 m, the following are required when workers or small items of plant are on site, in addition to the requirements for other work site management devices specified in this Manual:-

- (A) A Workers (symbolic) (T1-5) sign in advance of the work area.
- (B) Delineation of the edge of the traffic lane by cones, bollards or similar means, see Clause 4.13.4.
- (C) Separate delineation of the edge of the work area by means of a containment fence (see Clause 3.10.1) if there is a risk of workers or small items of plant infringing the clearance area.
- (D) The speed of passing traffic shall be reduced to 60 km/h through:-
 - (1) the use of appropriate traffic control devices such as signs, flashing lights, traffic controllers and tapers; or
 - (2) imposing a temporary road work speed zone; or
 - (3) a combination of the above.

This action is not required if traffic speeds past the site are already 60 km/h or less.

A temporary 60 km/h speed zone shall be at least 150 m long.

3.6.4 Work area closer than 1.2 m to traffic

If the clearance requirement of 1.2 m in Section 3.6.3 (ii) above cannot be achieved, all of the requirements of Section 3.6.3 (ii) shall apply except that traffic speeds shall be reduced to 40 km/h or less using the methods specified in Section 3.6.3 (ii) (D). Use of a containment fence may be omitted if there is insufficient space to place it.

3.6.5 Protection of traffic controller

Traffic controllers are not subject to the requirements of Section 3.6.3 above, but shall be allowed to operate only in an area where traffic speeds have been reduced to 60 km/h or less as set out in Section 3.6.3 (ii) (D).

3.6.6 Speed control at hazardous sites

Where any one or more of the following conditions apply at a static site, the traffic speed shall be reduced to a value less than 40 km/h using the methods specified in Item (c)(ii)(D) together with traffic controllers or pilot vehicles (see Section 5.2.7) as needed:-

- (i) An unusually high level of hazard for workers on foot within 1.2 m of moving traffic or other road users as a consequence of the work area.
- (ii) It is impracticable to separate pedestrians or cyclists from vehicular traffic in the work area.
- (iii) The works do NOT involve any of the following:-
 - (A) Works being undertaken using large item of plant exclusively.
 - (B) Workers and road work delineation which are separated from moving traffic by at least 1.2 m.
 - (C) Grading or mowing on a median or verge which does not encroach onto a moving traffic lane.
 - (D) Works on a residential street where the speed limit is 40 km/h or less.

If traffic speeds are to be reduced by means of a temporary speed zone to less than 40 km/h, the length of the zone shall not exceed 200 m nor be less than 100 m.

3.6.7 Clearance requirements shown on TCPs

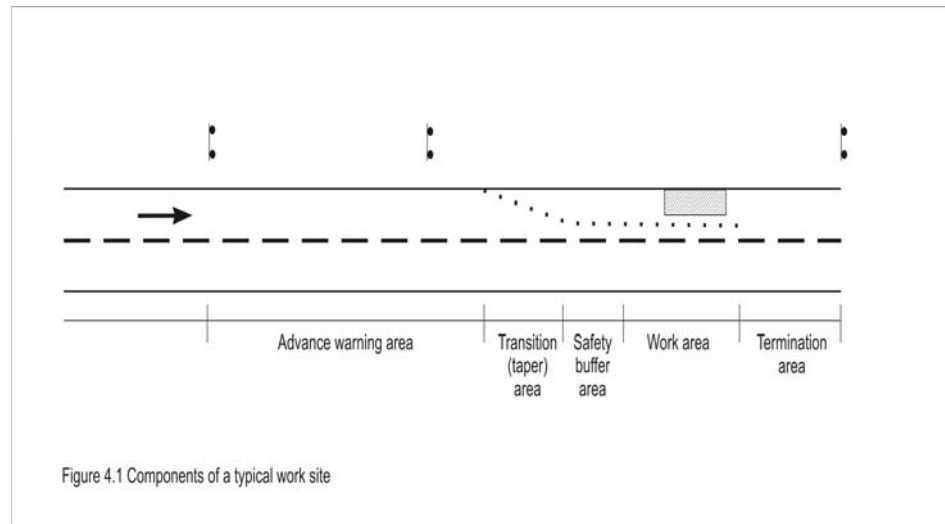
It is essential when selecting or modifying standard TCPs or designing new ones that the clearance requirements, including the positioning of any road work speed signs, are clearly shown on the TCPs.



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4.1 Components of the work site (AS 4.1.4)

The work site is that length of road or bridge which includes the area where the work is being undertaken and any additional length of road or bridge required for traffic control including signs, tapers, traffic lights and other devices. This work site is made up of five smaller areas as shown in Figure 4.1:-



Descriptions and requirements for each of the areas are as follows:-

- **advance warning area** - where the advance warning sign or signs are erected to warn and inform of changes to traffic conditions ahead and to give motorists time to adjust their driving patterns
- **transition (taper) area** - where traffic is positioned, usually by means of cones or bollards set out in a taper, to move safely past the work area
- **safety buffer area** - the **unoccupied** space between the transition and work areas to allow for an out of control vehicle to pull up before reaching the work area. A length of 20 to 30 metres is sufficient. Access to the work area is permitted through the safety buffer area.
- **work area** - where the work is being undertaken and is closed to through traffic and occupied by workers, plant and materials
- **termination area** - where traffic has cleared the work area and where normal traffic conditions resume.

These areas can be clearly seen in TCPs such as 83, 84 and 101.

4.2 Dimension D (AS 4.1.5)

Dimension D is related to the speed of traffic and is defined as a distance expressed in metres and is used for positioning of advance signs and related purposes. The signs shall be placed at specific distances apart so that road users have sufficient time to read and absorb the message or instructions on the signs. (See Section 2.11, *Dimension D*.)

4.3 Selecting standard TCPs

4.3.1 Standard TCPs

Selection

- tables are provided in Appendix A, *Typical uses of TCPs*, to assist in selecting a suitable TCP.
- standard TCPs are located in Appendix D, *Traffic control plans*. If adopted without modification these TCPs are already approved.
- these approved TCPs are baseline TCPs and modifications may need to be made to them to ensure that site conditions such as approach speed, length of work, the existence of intersections etc are accurately recorded on the TCP.
- minor modification of a standard TCP, as detailed in Section 4.5, *Minor modifications to TCPs*, shall only be made by personnel who have successfully completed the Select/Modify Traffic Control Plans training course. Modified TCPs shall be approved.
- if a new TCP is required it can only be designed by personnel who have successfully completed the Design & Inspect Traffic Control Plans training course and by referring to Section 5, *Designing new TCPs*.

4.3.2 What the works supervisor shall do

Before works requiring traffic control begin the works supervisor shall:-

- determine the category of the work to be undertaken
- refer to Appendix A, *Typical uses of TCPs*, to select the appropriate standard TCP detailed in Appendix D, *Traffic control plans*, with minor modifications if necessary
- refer to the local office manual to select the appropriate standard/approved TCP
- if the standard TCP has been modified seek approval for it
- consult with the project manager, if necessary, to confirm that the proposed TCP is appropriate.

NOTE: The requirements in this Section relate generally to situations where works supervisors have frequent contact with work crews. Where the works supervisor is not available, perhaps because of the remoteness of sites, personnel (i.e. team leaders, site supervisors (technicians) and others) who have successfully undertaken the Select/Modify Traffic Control Plans training course may be authorised to select and implement standard TCPs.

4.3.3 What the project manager shall do

The project manager shall:-

- when requested by the works supervisor determine whether the TCP proposed by the works supervisor is appropriate, or is the most appropriate TCP, with or without minor modification
- determine whether it is necessary to design a new TCP (i.e. if the standard ones are inappropriate)
- ensure that new TCPs are designed in accordance with Section 5, *Designing new TCPs*.

4.3.4 Verification

The choice of TCP to be used shall be signed and recorded by the works supervisor.

4.4 Implementing TCPs

4.4.1 What the works supervisor shall do

Before work begins, the works supervisor shall:-

- determine sign sizes and whether duplication of signs is required
- ensure that all signs and devices required by the TCP are available and are in good condition
- ensure that the locations and types of devices are recorded in the diary
- ensure that authorisations have been given for the use of any roadwork speed zones or portable traffic signals
- ensure that, where flashing arrow signs are specified, only type-approved equipment complying with Specifications FAS/4 or FAS/5 is used in accordance with Section 11, *Illuminated flashing arrow signs*
- ensure that the TCP is implemented as approved and a copy is available on site.

4.4.2 What the team leader shall do

The team leader shall implement the approved TCP before physical work commences and ensure that a copy of the TCP is kept on site. The team leader shall also drive through the site before work begins to ensure that the TCP has been implemented correctly and that it will warn, instruct and guide road users as designed. Any variations made to the plan must be marked on the plan and initialled by the team leader.

The team leader shall ensure that, in conforming to the approved TCP, by way of initial and regular inspections:-

- there are no contradictory signs
- there are no surplus, obstructing or distracting signs
- the TCP fits with other traffic control in the area which may or may not be under the control of the one organisation
- signs are suitably placed, by considering:-
 - ◆ line of sight and sight distances
 - ◆ road user approach speeds
 - ◆ expected queue lengths
 - ◆ visibility, shady or high glare areas
 - ◆ the effects of sun rise and sun set
- only trained, certified and authorised Traffic Controllers are used and are suitably positioned
- signs and devices are in place at appropriate times, **and removed or covered when not needed**
- covered signs are inspected during windy periods to ensure that the covering has not been disturbed
- damaged or defective signs are replaced or repaired as soon as practicable
- signs required for night guidance are inspected at night and are as specified in Section 9.2.8, *Signs for night work*
- a trafficable travel path for vehicles is maintained and clearly defined.

The team leader shall also report any anomalies or inconsistencies found in the TCPs being used.

4.4.3 What the project manager shall do

For contracts where Specification RTA G10 is applicable:-

- submit to the Principal a Traffic Management Plan in accordance with RTA G10 and this Manual, including the relevant TCP's.
- submit to the Principal a request for approval for the use of regulatory traffic control devices.

- ensure approval has been given for the Traffic Management Plan and traffic control devices before the relevant work commences and ensure they are implemented.

For contracts where Specification RTA G11 is applicable:-

- submit to the Principal a Traffic Management and Safety Plan and new TCP's in accordance with RTA G11 and this Manual.
- submit to the Principal a request for approval for the use of regulatory traffic control devices
- ensure approval has been given for the new TCP's and traffic control devices before the relevant work commences and ensure they and the Traffic Management and Safety Plan are implemented.

For road and bridge work the project manager shall also:-

- if required by the TCP, seek or ensure that authorisation for a roadwork speed zone has been given in accordance with Section 8.2, *Roadwork speed zones*, and provide a copy of the authorisation to the works supervisor
- if the speed limit is not approved, reconsider the TCP
- ensure that where portable traffic signals are specified authorisation is obtained from the relevant RTA office or Local Council for their installation, and that only type-approved equipment complying with Specification PTS/3A is used in accordance with Section 10, *Portable traffic signals* and provide a copy of the authorisation to the works supervisor
- if the use of portable traffic signals is not approved, reconsider the TCP.

For longer duration works:-

- personally inspect the traffic control arrangements at least once every four weeks and record the date and time, any deficiencies noted and any corrective action taken or specified
- give a signed copy of the inspection report to the Works Supervisor.

For all road and bridge works, the Project manager shall ensure that a system is in place and operating to:-

- arrange advice through local media of the works in progress or planned, where required in accordance with local procedures
- advise the Police of the traffic arrangements including any expected delays or extended times of work
- advise the emergency services of any major disruptions or special circumstances.

4.5 Minor modifications to TCPs

If a standard TCP does not exist for the work being planned, a decision will need to be made if minor modification of a standard TCP, using the principles listed below, will produce a TCP to suit the work being planned.

Only personnel who have successfully completed the Select/Modify Traffic Control Plans training course can make minor modifications to TCPs. The Location Risk Assessment attached to Appendix D is to be completed at the time of TCP modification.

Minor modification of standard TCPs would include the following:-

- the inclusion of any road work speed zones
- varying the size of signs in accordance with Section 3.2.2, *Advance warning sign distances*
- varying the spacing of signs and including additional signs in accordance with Section 3.2.3, *Spacing between signs*
- duplicating signs in accordance with Section 3.2.4, *Duplication of signs*
- including any variable message signs used in addition to all other signs shown on the TCP
- placing additional signs if it is felt that expected queue lengths might require them in accordance with Section 3.5.7, *Avoiding end of queue collisions*
- varying the positioning of signs and devices in accordance with Section 3.5.8, *Tolerances on positioning of signs and devices*
- detailing the location of signs required for a roadwork speed zone in accordance with Section 8.2, *Roadwork speed zones* and TCP 57
- including the location of signs indicating workers are on site for TCPs showing traffic arrangements when workers are not on site
- adding additional signs where it is considered they are required for safety reasons i.e. on the approaches to crests or sharp bends
- adding additional signs where a minor side street joins a work site.

Care needs to be exercised to ensure that any additional signs are only included on a needs basis as it is possible to place too many signs in a scheme such that they become ineffective.

Any TCPs modified using the principles above shall be authorised and marked or numbered to show that they are a modification and which standard TCP they are a modification of. It is not acceptable to modify a previously modified TCP.

4.6 General notes on TCPs in Appendix D

- Where Traffic Controllers or portable traffic signals are used, approach speeds of traffic shall be reduced to a maximum of 60 km/h. The TCPs in Appendix D do not generally, for clarity, detail the signs required for posted roadwork speed zones. If it is intended to install a roadwork speed zone then the relevant TCP shall be modified to incorporate the principles of Section 2.11, *Dimension D*, Section 8.2, *Roadwork speed zones* and TCP 57.
- Traffic Controller (symbolic) (T1-34) signs shall be used for daylight work. Sign (T1-200-2) shall be used on RTA works where a work activity is undertaken in both day and night conditions. Sign (T1-200-3) shall be used on RTA works where work is undertaken at night only.
- **ROADWORK AHEAD** (T1-1) signs may be used for some short term works. For clarity these have not been shown on the TCPs in Appendix D.

4.7 New TCPs or major modifications to standard TCPs

If a standard TCP does not exist for the work being planned, and it is not possible to make minor modifications to a standard TCP to suit the work being planned, then either a standard TCP will need to receive major modifications or a new TCP will need to be designed for the work. (Modifications to a TCP in areas outside those listed in Section 4.5 are considered to be major modifications.)

Only people who have successfully completed the Design and Inspect Traffic Control Plans course are able to design new TCPs or make major modifications to standard TCPs. Hand drawn TCPs are acceptable provided they are well drawn, clear and contain all the information required to set out the site.



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5.1 New TCPs

5.1.1 What the works supervisor shall do

Having determined that a standard TCP does not exist for the work proposed and that minor modification of a standard TCP will not suit the work, or having some doubt about the appropriateness of a standard TCP, the works supervisor shall consult with the project manager.

5.1.2 What the project manager shall do

When consulted the project manager shall:-

- determine the appropriateness of the standard TCP and arrange modification if necessary by a person who has successfully completed the Select/Modify Traffic Control Plans training course
- if a new TCP is required use a person who has successfully completed the Design and Inspect Traffic Control Plans training course and by referring to Section 5, *Designing new TCPs*:
 - ◆ have a new TCP designed and added to the list of local TCPs and, if considered desirable, submit the new TCP to the General Manager, Traffic Management Branch for possible inclusion in this manual
 - ◆ have a site specific TCP designed
 - ◆ ensure the new TCP is signed by the designer, lists the designer's certificate number, has been given an identifying number and is dated
- approve or seek approval for the modified or new TCP before issue and use, preferably by a person holding Design and Inspect Traffic Control Plans qualifications, but not the designer of the TCP
- give a dated copy of the approved TCP to the works supervisor for implementation in accordance with Section 4.4, *Implementing TCPs*.

5.1.3 Approval

The project manager can give approval only if all the guidance in Section 5.2, *Principles for designing TCPs*, has been observed. The project manager shall seek approval from the relevant Manager if the TCP:-

- includes a non-standard or unapproved sign or device
- contravenes one or more of the principles in Section 5.2
- is for carrying out work using Specification G10 or G11.

5.2 Principles for designing TCPs

5.2.1 General

The TCP shall be designed on the basis that:-

- as much protection as practicable shall be given to all people on the work site, consistent with minimising disruption and risk to road users and minimising the number of signs and devices used to achieve this
- only approved signs and devices shall be used
- fixed work areas shall be marked by barrier boards or delineation devices spaced appropriately
- the use of a pilot vehicle shall be considered, to lead and control the speed of vehicle platoons, if traffic speed through a work site needs to be very carefully controlled
- condition signs shall be used where the road surface at the work area is sufficiently different from the approach roads as to be hazardous to traffic
- the needs of all non-vehicular users (pedestrians, cyclists, school children etc) are provided for
- the TCP is to be implemented in accordance with Section 4.4, *Implementing TCPs*.

5.2.2 Spacing of signs, cones and bollards (AS 3.9.1)

Signs shall be spaced in accordance with the broad principles of Section 3.2.3, *Advance warning sign distances*.

Cones and bollards are used to define the traffic path past or through work areas and shall have retroreflective bands if required for night use. The following types of approach tapers may be used:

- *traffic control at beginning of tapers* - used where there is a traffic controller or portable traffic signals just prior to a single lane. Cones or bollards may be placed at 4 metres spacing along the centreline in advance of the taper
- *lateral shift taper* - where traffic is required to shift laterally without conflict with another traffic stream (see TCP 41)
- *merge taper* - where one lane of traffic is required to merge into another (see TCP 91).

Recommended maximum spacing of cones and bollards is shown in Table 5.1, *Recommended maximum spacing of cones and bollards*. Where traffic volumes are high or other conditions warrant it, consideration should be given to reducing the spacing of cones to as little as 1m to prevent traffic taking a wrong turn or opening through cones or bollards,

Purpose and usage	Approach speed of traffic km/h ***	Recommended maximum spacing, m
All purposes	≤ 50	4
Centre-line on approach to a traffic controller position	All cases	4
Outer edge of traffic lane - i.e. works on shoulder or parking lane	51 - 70	18
	> 70	24*
Separating opposing traffic on 2-lane 2-way road – ie partial or complete lane closure	51 - 70	12
	> 70 km/h	18
Separating opposing traffic on a multilane undivided road – ie as part of a lane closure	51 - 70	12
	> 70	18
Adjacent to a closed lane on a multilane undivided road	51 - 70	18
	> 70	24
Merge tapers	51 - 70	9
	> 70	12
Lateral shift tapers	51 - 70	12
	> 70	18
Protecting freshly painted lines	51 – 70	24
	>70	60**

Table 5.1, Recommended maximum spacing of cones and bollards

* This spacing may be extended to 60 m where the length of the line of cones or bollards exceeds 1 km but not adjacent to locations where there are workers on foot.

** This spacing may need to be reduced on curves or crests, or if the row of cones is not clearly defined at night.

*** The approach speed of traffic adopted shall be as determined in Section 2.11, *Dimension D*.

Recommended taper lengths are shown in Table 5.2, *Recommended taper lengths*. Taper lengths should be increased where warranted such as locations with poor sight distances or in foggy areas.

Approximate speed of traffic km/h	Recommended taper length, m		
	Traffic control at beginning of taper	Lateral shift taper	Merge taper
45 or less	15	0	15
46 - 55	15	15	30
56 – 65	30	30	60
66 - 75	N/A	70	115
76 - 85	N/A	80	130
86 – 95	N/A	90	145
96 – 105	N/A	100	160
Greater than 105	N/A	110	180

Table 5.2, Recommended taper lengths

NOTE:-

- (a) Speed of traffic is the mid-point of each tabulated range
- (b) The speed of traffic adopted shall be as determined in Section 2.11, *Dimension D*.

5.2.3 Requirements for specific signs

The following signs are to be used where the stated conditions apply.

- **ROADWORK AHEAD (T1-1) (AS 3.4.2 & 4.7.2 (b))** or **BRIDGEWORK AHEAD (T1-2) (AS 3.4.3 & 4.7.2 (c))** signs shall be used at:-
 - ♦ all long-term road and bridge work sites
 - ♦ a diversion of traffic along a side track or detour
 - ♦ unexpected conditions such as loose stones or the absence of linemarking
 - ♦ short-term works where additional advance warning is warranted.
- **ROADWORK X KM AHEAD (T1-16) (AS 3.4.2)** or **BRIDGEWORK X KM AHEAD (T1-29) (AS 3.4.3)** signs shall be used X km in advance of road or bridge works where additional advance warning is considered to be necessary, where one or more of the following occur:-
 - ♦ the approach speed exceeds 80 km/h
 - ♦ sight distance is less than 150 metres

The siting of these signs needs careful consideration to ensure that any road users entering from side roads are given adequate warning.



- the **Workers (symbolic) (T1-5) (AS 3.4.4 & 4.7.2(a))** sign shall be used to give warning of personnel engaged in short-term works not involving the diversion of traffic along a detour or side track and at long-term works during all periods and at all locations where workers are actually working on or adjacent to the traffic path or are visible to oncoming traffic, or both. These signs shall be covered or removed when workers are no longer on site or are not visible to road users such as during meal breaks. The sign shall be used with the **NEXT 2km (T1-28)** sign at frequently changing work areas (see Section 9.1.5).
- the **PREPARE TO STOP (T1-18) (AS 3.5.2 & 4.7.3 (d))** sign shall be used to give advance warning where traffic may be required to stop in compliance with portable or temporary traffic signals, or the directions of a Traffic Controller. The sign shall be used with the signals ahead (T1-30 or W3-3) (**AS 3.5.4 (c)**) or the traffic controller (T1-34 or T1-200-2/3 for RTA works) (**AS 3.5.2(b)**) signs.
- an **END ROADWORK (T2-16) (AS 3.4.8)** sign shall be used when **ROADWORK AHEAD (T1-1)** and **ROADWORK X KM AHEAD (T1-16) (AS 3.4.2)** signs are specified and is used to indicate that normal traffic conditions have resumed. They shall be placed a distance D downstream from the last point on the roadway affected by the works (**AS 4.7.9**). **END ROADWORK** signs should be placed beyond the end of any temporary speed zone ie after any signs indicating the reinstatement of a pre-existing limit (**AS 4.9.7**).
- the **NEXT 2km (T1-28) (AS 3.4.7)** sign shall be used in conjunction with the **Workers (symbolic) (T1-5)**, the **ROAD PLANT AHEAD (T1-3-1 or T1-3-2)** or the **GRADER AHEAD (T1-4)** signs where they are used to warn of frequently changing work areas (Sections 9.1.5 and 9.1.6, *Frequently changing work areas- open road and built up areas*, respectively). The distance may be increased to 10 km for shoulder grading and mowing in open road areas (Section 9.1.9) and for maintenance grading on unsealed roads (see Section 9.20.2(ii)(A), *Maintenance grading and resheeting*).
- the **TRAFFIC HAZARD AHEAD (T1-10) (AS 3.16.5)** sign shall only be used in emergencies and for a maximum of 24 hours.
- where the TCP involves closing a traffic lane, a minimum of two **temporary hazard markers (T5-4 or T5-5) (AS 3.9.3)** per closed lane shall be used, in addition to cones, bollards etc, if traffic is to be merged into an adjacent lane, or directed by a Traffic Controller or traffic signals around the work area. If temporary delineation is required on both sides of the vehicle path at a taper, hazard markers shall only be used on the side primarily guiding traffic away from the obstruction as use on both sides of a traffic path may cause confusing patterns of delineation. Cones or bollards should be used on the other side. **On high speed roads consideration shall be given to using a flashing arrow sign with or in place of the temporary hazard markers.**

- the Trucks (W5-22, long term) and Trucks (T2-25) signs shall be used in accordance with Section 7.7, *Signs for depots, stockpiles, quarries, gravel pits etc.* **(AS 3.16.2)**
- signs such as slippery (symbolic) (T3-3), **SOFT EDGES** (T3-6), **ROUGH SURFACE** (T3-7), **GRAVEL ROAD** (T3-13), loose stones (T3-9) and **LOOSE SURFACE** (T3-14) and **NEW WORK NO LINES MARKED** (T3-11) shall be erected to warn motorists of conditions which render a roadway surface temporarily hazardous. On long work sites these signs may need to be repeated at intervals of not more than 500 metres. **(AS 3.7.2.)**
- the **NEW WORK NO LINES MARKED** sign (T3-11) shall be erected in locations such as multilane or one-way roads where there is no overtaking risk from oncoming vehicles. The **NO LINES DO NOT OVERTAKE UNLESS SAFE** sign (T3-12) shall be erected where barrier lines would normally be installed and should be used in any situation where there will be overtaking in an oncoming traffic lane. **(AS 3.7.4)**
- the **GIVE WAY** (R1-2) **(AS 3.5.3)** and **ONE LANE** (R9-9) sign assembly shall be used to assign priority to one direction of travel past the work area where the travelled way is reduced to less than that required for two lanes of traffic. It is appropriate for works when:-
 - (i) the traffic volume is 1500 vpd or less and the traffic speed is 70 km/h or less
 - (ii) each entry to the work area is visible from the other
 - (iii) the work area is less than 100m long
 - (iv) there is sight distance to opposing traffic of at least 200m beyond the far end of the work area for traffic facing the **GIVE WAY/ONE LANE** assembly sign.
- the give way sign ahead (W3-2) sign shall be used with the R1-2 and R9 -9 signs where advance warning is required.
- the **NO OVERTAKING OR PASSING** sign shall be erected at the start of the single lane for traffic in the opposite direction.

5.2.4 Traffic controllers (AS 3.5.2 & App C)

When a Traffic Controller is required:-

- traffic controller (symbolic) (T1- 34) (or T200-2/3 on RTA sites) and **PREPARE TO STOP** (T1-18) signs shall be used
- where possible the **PREPARE TO STOP** (T1-18) sign should also be visible to the Traffic Controller
- a Traffic Controller should only manage traffic in one lane and in one direction (except as described in Section 8.1.3, *How many traffic controllers*)

- Traffic Controllers shall only be used where approach speeds of traffic are reduced to a maximum of 60km/h through the use of appropriate devices and signs including, as necessary, a road work speed limit (**AS 4.10.4**)
- in conjunction with the above point consider using a rotating or flashing yellow light adjacent to the **PREPARE TO STOP** (T1–18) sign especially on high volume, high speed roads.

5.2.5 Stopping or merging traffic

If it is planned to stop traffic, the TCP designer shall:-

- assess the likely queue length through a consideration of expected delay in minutes, hourly traffic volumes at the time of the work and the type or mix of traffic i.e. allow more queue length for heavy vehicles
- ensure that signs and spacings specified on the TCP are appropriate for all queue lengths up to the maximum design queue length plus 10% to allow for some greater demand. Road users will generally need 2D sight distance to the end of expected queues in open road areas and 1.5D in built-up areas. See Section 3.5.7, *Avoiding end of queue collisions*.

5.2.6 Mobile works (AS 4.6)

Where continuously or progressively moving vehicles or plant are used, signs and devices shall be mounted on the vehicles or road plant so that they are visible and conspicuous at all times. See to Section 9.17, *Mobile work*.

5.2.7 Pilot vehicle (AS 4.12)

A pilot vehicle may be used to guide traffic through a work site when:-

- for any reason traffic fails to maintain safe speeds through the work
- part of the length of the work site is out of view of the supervisor, work gang and the traffic controller
- the hazard to workers (Section 3.6.6) requires the traffic speed to be reduced to less than 40 km/h
- traffic speed is required to be kept low to minimise damage to the work i.e. a newly laid seal
- traffic needs to follow a particular path through the site which may not be obvious without a pilot vehicle.

The pilot vehicle shall display at least one rotating or flashing yellow lamp and may also display a special sign instructing traffic to follow it but not pass it. It may also be necessary to advise road users orally to follow but not pass the pilot vehicle. Care shall also be exercised to ensure that the pilot vehicle is not obscured by large trucks to the extent that other road users have difficulty following the pilot vehicle. In such cases it may be necessary to use more than one pilot vehicle.

5.2.8 Works in built-up areas

Where the work site is in a built-up area the TCP shall accommodate local traffic, cyclists, pedestrians, local businesses, parking and driveway access.

Pedestrians - In relation to pedestrians, refer to Section 9.3, *Pedestrians*.

Local streets - only detour traffic via local streets as a last resort, and with the concurrence of the Local Council and Police. Local residents shall be informed beforehand of a detour proposal.

Closing the road - when a temporary road closure is necessary, careful pre-planning is necessary involving consultation with the Local Council and Police.

5.2.9 Dual carriageway and multilane roads

Generally, where workers are on foot and are working on a central lane an adjacent lane should also be closed.

Where a traffic lane is to be closed, the TCP shall specify:-

- that appropriate lane status (T2-6-1 or T2-6-2) signs shall be used
- a minimum of two temporary hazard markers (T5-4 or T5-5) or a flashing arrow sign shall be used if traffic is merged into an adjacent lane without a Traffic Controller.

Where work is undertaken on a dual carriageway:-

- signs and devices (except pavement arrows) shall be placed on both sides of the carriageway in accordance with Section 3.2.4, *Duplication of signs*
- if that carriageway has three or more lanes and two lanes are to be closed then this should be done one lane at a time, with the distance between tapers at least 1.5D (**AS 4.8.2**).

5.2.10 Night works

See Section 9.2, *Working at night*.

The TCP shall specify that:-

- **NIGHT ROADWORK AHEAD** (T1-223), workers (symbolic) (T1-224) and traffic controller (symbolic) (T1-200-3) are used instead of the day time (T1-1), (T1-5) and (T1-34 or T1-200-2 (RTA works)) signs. Where it is known that work will span **both** day and night the T1-200-2 shall be used.
- all personnel on the site wear approved high visibility clothing
- the work site has appropriate flood lighting, Section 9.2.5, *Lighting*
- additional signs and devices may be used where there is reduced visibility.

5.3 Checklist for new signs, devices and TCPs

Proposals for new or modified signs, devices and standard TCPs should include consideration of:-

- **feasibility** – the level of technology involved
- **useability** – the ease of use by workers
- **applicability** – how well they address the problems
- **effectiveness** – the ability to mitigate injuries and deaths of workers and lessen the hazard and inconvenience to road users
- **trade-offs** – the level of undesirable side effects produced
- **cost** – life-cycle cost including development, fabrication and maintenance.

5.4 New signs, devices and TCPs

Any proposal for a new sign, device or TCP for inclusion in this manual is to be submitted, in the first instance, to the RTA's General Manager, Traffic Management Branch. Proposals will be evaluated in a consultative manner as described in Section 2.8, *Evaluation and review*. Where RTA favours a new sign, device or TCP which departs significantly from AS 1742.3, Standards Australia will be consulted and efforts made to introduce the practice on a broader basis.

In some cases, it may be necessary to limit the initial use of new signs and devices to enable field assessment or trials before they can be adopted for general use. It is essential that any such trials be fully documented and that the requirements of RTA publication *Management of Innovative Technologies*, RNIM-TP4-007 be followed.



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6.1 Inspections and record keeping

In addition to traffic control safety inspections (see Section 2.5) formal and documented daily (short term) and weekly (long term) inspections shall be undertaken at work sites. Examples of typical checklists are included in Appendix E, *Inspection checklists and forms*.

6.1.1 What the works supervisor shall do

For all long-term work sites the works supervisor shall:-

- inspect the traffic control layout on the day before the work begins and at least once per week during the duration of the work
- inspect the traffic control layout between shifts at least once during the first week and at least once every two months for the duration of work
- provide after hours contact to local police for the duration of the work
- inspect the site on the final day to ensure that unnecessary signs and devices are removed
- record results of these inspections noting date, time, deficiencies and any corrective action taken or specified
- ensure that any corrective action specified is taken.

6.1.2 What the team leader shall do

For all works, the team leader (or site supervisor) shall:-

- if the works supervisor is not available inspect the site on the final day to ensure that unnecessary signs and devices are removed
- keep a record of the TCP that was used
- have on site a copy of the TCP used
- record start and finish times and location of the works
- carry out inspections before work starts, during the works and pre-closedown of the site using the nominated checklist, noting:-
 - ◆ date and time of inspection
 - ◆ deficiencies identified and corrective action taken
 - ◆ changes or modifications made to the site
- periodically check that all signs and devices are satisfactory and in their correct position
- make these records available to authorised staff.

6.1.3 What the project manager shall do

The project manager shall:-

- ensure that a traffic control safety inspection (reference Section 2.5) is carried out at least once per month on a selected short-term and long-term work site under his or her control and that the date, time and deficiencies are recorded
- ensure that any corrective action specified is taken and recorded.

This information may be critical should legal proceedings follow an accident.

Note: In the case of accidents, either witnessed or reported, involving the public or from which legal proceedings might arise, the actual type, size and location of signs, and devices in use at the time of the accident should be recorded and the sign arrangement photographed for subsequent reporting. The actual travelled path width and condition and weather conditions should also be recorded, as well as personal injury, extent of vehicle damage and vehicle details such as registration.

6.2 Reporting incidents to WorkCover

6.2.1 What to report

By law employers and/or occupiers are required to report work-related incidents to WorkCover NSW and/or the relevant workers compensation insurers.

An occupier (of premises or workplace) is someone who manages or has responsibility for a workplace or a particular operation at a workplace, even though they may not be the employer.

Serious incidents shall be notified to WorkCover NSW immediately as an urgent investigation may need to be undertaken. Serious incidents include:-

- an incident where there has been a fatality
- an incident where there has been a serious injury or illness such as when a person:-
 - ◆ is placed on a life support system
 - ◆ loses consciousness
 - ◆ is trapped in machinery or a confined space
 - ◆ has serious burns
- an incident where there is an immediate threat to life such as major damage to machinery or buildings.

Up to 36 hours after the serious incident has been reported, the immediate area around the incident must not be disturbed, except to assist any injured persons and to avoid further injuries and problems, or where WorkCover has authorised work to continue.



6.2.2 Reporting procedure for RTA staff

The following reporting procedure is to be followed by RTA staff on RTA works.

- **Incidents involving RTA employees.**

All workplace incidents and near misses shall be reported immediately to the workplace supervisor who is responsible for investigating the incident. The incident and investigation must also be recorded in the RTA's incident reporting system, EnSafe. Contact the EnSafe Helpdesk on 1300 131 469 for assistance.

- **Incidents involving non-RTA employees on RTA works.**

All workplace incidents that involve a non-RTA employee including contractors, visitors and members of the public shall be reported immediately to the RTA workplace supervisor, who is responsible for investigating the incident. The incident and investigation shall also be recorded in the RTA's incident reporting system, EnSafe. Contact the EnSafe Helpdesk on 1300 131 469 for assistance.

6.2.3 Reporting procedure for non-RTA works

For other organisations undertaking works and using this Manual the WorkCover reporting procedures must be followed. It is suggested that those in positions of responsibility should make themselves aware of those procedures.

Serious incidents as defined in Section 6.2.1 to non-RTA employees shall be reported immediately to the RTA workplace supervisor. The incident and investigation shall also be recorded in the RTA's incident reporting system, EnSafe. Contact the EnSafe Helpdesk on 1300 131 469 for assistance.



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7.1 Responsibilities of drivers

Drivers of vehicles at work sites are responsible for driving safely and in accordance with the road rules, exercising care and working in accordance with Vehicle Movement Plans (VMPs) where they are provided.

Special driving care is necessary when entering and leaving traffic streams and turning at work sites. This is even more important for loaded trucks because, compared with lighter vehicles, longer time and distance is needed to accelerate and decelerate.

All trucks used on work sites shall have fitted and maintained both reversing alarms and reversing lights. Procedures shall be put into place to warn all workers of the potential hazard of reversing vehicles and to establish appropriate on site traffic control procedures. Such procedures could include the requirement for truck drivers to report to a suitably signposted area on the work site and for a designated worker to walk beside the reversing truck to act as an observer to ensure all workers are clear of the reversing vehicle. (See Section 9.23, *Working on foot near plant*).

Contractors and agents to the RTA are strongly encouraged to adopt the principles contained in the RTA's *Safe Driving Policy*, as contained in the RTA's Occupational Health and Safety Manual.

7.2 Site entry and exit

When entering or leaving work areas trucks shall be able to decelerate and accelerate outside the through traffic lanes, i.e. under traffic control or on shoulder areas. Under motorway conditions deceleration and acceleration lanes shall be provided. Under all other conditions if the sight distance is less than 500 m, then deceleration and acceleration lanes shall be considered or the entry and exit points relocated.

7.3 Hazardous movements

U–turns – single movement U–turns are not to be made across lanes carrying traffic, without traffic control by Traffic Controllers or traffic signals, unless clear sight distance in both directions exceeds 2D (6D for 3–point U–turns). U–turns on divided roads from one carriageway to the other are to be made only at established median crossovers (see Section 7.8, *Median crossovers*) or in accordance with an approved TCP or VMP. Note, U–turns are illegal across unbroken centrelines (barrier line or painted median).

Reversing movements – there is to be no reversing, including 3–point U–turns, in lanes carrying traffic unless traffic is being controlled by Traffic Controllers or traffic signals, or approach sight distance exceeds 6D (20 seconds of travel time). Vehicles reversing in the work area are subject to the conditions outlined in Section 7.1, *Responsibilities of drivers*.

Stopping – work vehicles shall not remain stationary in lanes carrying through traffic unless broken down, in a traffic queue, or protected by Traffic Controllers or traffic signals.

7.4 Planning for movements of work vehicles

When planning works, attention shall be given to ensure that traffic associated with the works can safely manoeuvre to and from traffic streams, turn at work areas, depots, stockpile sites, quarries, gravel pits, etc and turn around. This includes:-

- trucks delivering materials or equipment
- trucks taking materials or equipment from the work area and associated depots, storage areas, gravel pits, etc
- gang trucks
- works supervisors' vehicles, etc.

The standard TCPs in this manual show arrangements necessary to ensure that the general public can travel safely around, past or through work sites.

It is also essential that satisfactory arrangements are planned and implemented for vehicles associated with works. This mainly involves entering and leaving the traffic stream at work areas, accesses and side roads, or turning around.



Locations for turning across lanes carrying traffic and for entry and exit to and from work areas for vehicles associated with the work shall be restricted to well defined points selected after considering relevant factors including sight distance, grades, volumes and approach speeds of through traffic, areas clear of traffic lanes for accelerating and decelerating, etc.

7.5 Vehicle movement plans

On roads with approach speeds of 100 km/h or more work vehicles should normally enter and leave the through traffic stream using the same ramps or side roads as the travelling public. Where this cannot be reasonably achieved, refer to Tables 7.1 and 7.2 to determine the type of treatment to be adopted, based on ADT, truck movements per shift and sight distance.

On roads with approach speeds of less than 100 km/h but more than 80 km/h refer to Tables 7.3 and 7.4 to determine the type of treatment to be adopted and for approach speeds between 80 km/h and 60 km/h inclusive refer to Tables 7.5 and 7.6.

For a particular work site, more than one VMP may be necessary to reflect changes in preferred routes as the work progresses.

ADT	300 – 1,500		More than 1,500	
Number of truck movements per shift	≤ 20	>20	≤ 20	>20
TCP with Traffic Controllers or traffic signals		Yes ^α	Yes ^α	Yes ^α
VMP required	Yes ^α	Yes ^α	Yes ^α	Yes ^α
Warning signs required during shifts (TCP 195)		Yes ^α		Yes ^α

Table 7.1 Providing for truck movements where approach speed is 100 km/h or more and sight distance is LESS than 2D

^α Under these conditions every effort should be made to choose turning locations where sight distance exceeds 2D.

ADT	300 – 1,500		More than 1,500	
Number of truck movements per shift	≤ 20	>20	≤ 20	>20
TCP with Traffic Controllers or traffic signals		Yes	Yes	If acceleration and deceleration cannot occur on shoulders
VMP required		Yes		Yes
Warning signs required during shifts (TCP 195)		If sight distance is less than 6D		If sight distance is less than 6D

Table 7.2 Providing for truck movements where approach speed is 100 km/h or more and sight distance is MORE than 2D

ADT	300 – 1,500		More than 1,500	
Number of truck movements per shift	≤ 20	>20	≤ 20	>20
TCP with Traffic Controllers or traffic signals		Yes	Yes	Yes
VMP required	Yes	Yes	Yes	Yes
Warning signs required during shifts (TCP 195)		Yes		Yes

Table 7.3 Providing for truck movements where approach speed is less than 100 km/h but more than 80 km/h and sight distance is LESS than 2D in built-up areas

ADT	300 – 1,500		More than 1,500	
Number of truck movements per shift	≤ 20	>20	≤ 20	>20
TCP with Traffic Controllers or traffic signals		Yes		Yes
VMP required		Yes		Yes
Warning signs required during shifts (TCP 195)		If sight distance is less than 6D		If sight distance is less than 6D

Table 7.4 Providing for truck movements where approach speed is less than 100 km/h but more than 80 km/h and sight distance is MORE than 2D including built-up areas

ADT	300 – 1,500		More than 1,500	
Number of truck movements per shift	≤ 20	>20	≤ 20	>20
TCP with Traffic Controllers or traffic signals		Yes	Yes	Yes
VMP required		Yes		Yes
Warning signs required during shifts (TCP 195)		Yes		Yes

Table 7.5 Providing for truck movements where approach speed is between 60 km/h and 80 km/h and sight distance is LESS than 2D including built-up areas

ADT	300 – 1,500		More than 1,500	
Number of truck movements per shift	≤ 20	>20	≤ 20	>20
TCP with Traffic Controllers or traffic signals		Yes		Yes
VMP required		Yes		Yes
Warning signs required during shifts (TCP 195)		Yes		Yes

Table 7.6 Providing for truck movements where approach speed is between 60 km/h and 80 km/h and sight distance is MORE than 2D including built-up areas

In any instance where the use of Tables 7.1 to 7.6 indicates that a traffic controller or portable traffic signals shall be used then the approach speed of traffic is to be reduced to at least 60 km/h.

7.6 Responsibilities

The **project manager** is responsible for:-

- ensuring that satisfactory arrangements are planned and implemented for vehicles associated with works
- considering the need for VMPs at work sites and truck turning areas as indicated by Tables 7.1 to 7.6 or other extenuating circumstances
- where a VMP is required, approving it and making it available before work begins.

The **works supervisor** is responsible for:-

- planning arrangements for vehicles associated with works, and
- where a written VMP is required by Tables 7.1 to 7.6, or as specified by the project manager, confirming that the VMP is relevant for the work and the site.



The **team leader** is responsible for:

- ensuring that drivers of work vehicles are familiar with arrangements for traffic control, and
- ensuring that RTA's *Safe Driving Policy*, Section 7.1, *Responsibilities of drivers*, Section 7.2, *Site entry and exit* and Section 7.3, *Hazardous movements* are available to drivers
- instructing drivers how to enter and exit work sites safely and the routes to follow between work sites and depots, material sources etc
- implementing written VMPs where they are provided.

7.7 Signs for depots, stockpiles, quarries, gravel pits, etc (AS 3.16.2)

Where roadworks generate truck turning movements remote from work sites, temporary warning signs are to be considered at the approaches to the points of access on through roads. This is particularly important where there may be little or no other indication of likely vehicle turning movements, i.e. at roadside stockpile sites or accesses to private property.

The appropriate signs are trucks (W5-22, long term) or (T2-25, short term). These signs may be used in conjunction with **TRUCKS TURNING** (W5-205) and **xx m ON LEFT/RIGHT** (W8-207 (L) or (R) signs. A typical arrangement is shown in TCP 195. All signs shall be displayed before the haulage operation begins, and removed or covered at the end of each shift.

7.8 Median crossovers

The main purpose of median crossovers on Freeways and similar high speed divided roads is to allow access for emergency vehicles (i.e. Police Service, Ambulance Service and Fire Brigade) and roadworks vehicles. Other drivers on these roads are mostly unaware of median crossovers and do not expect to encounter turning traffic.

Emergency vehicles are generally more recognisable than roadworks vehicles. Drivers respond more defensively in the vicinity of emergency vehicles than roadworks vehicles.

The location of vehicle crossovers is therefore critical. In planning works on Freeways and other high speed roads, it is necessary to check median crossovers likely to be used by works vehicles.

The relevant requirements are:-

- the desirable minimum sight distance to a median crossover is 1km
- the absolute minimum sight distance to a median crossover is 500m
- median crossovers should be located well clear of entry and exit ramps to ensure short weaving manoeuvres do not occur
- motorists shall not be required to stop or slow or swerve for roadworks vehicles using the crossovers
- having regard to the point above, at each crossover determine whether roadworks vehicles are to join the fast lane and accelerate or to cross the carriageway to the slow lane and accelerate.

Where these requirements cannot be met, either provide for turning movements at a different location, or use a TCP to close one or more lanes so that deceleration, turning and acceleration takes place outside the traffic stream.

See Section 7.7, *Signs for depots, stockpiles, quarries, gravel pits, etc* to determine the need for signs.

7.9 Haul roads crossing public roads

Special care is necessary in designing traffic control where haul roads cross public roads. Traffic control may take the form either of Traffic Controllers, **STOP** (R1-1) signs or traffic signals depending upon sight distances and traffic volume.

Traffic signals at haul road crossings may be:-

- temporary, i.e. fixed signals designed in accordance with current RTA specifications, or
- portable (with one or two sets), in accordance with Section 10 of this manual.

A typical arrangement using traffic signals is shown in TCP 44.

Care shall also be taken when vehicles are leaving work areas to ensure that gravel or mud is not deposited on the through road. If conditions on the work area are such that this might happen then consideration shall be given to the use of rumble grids and coarse gravel layers or hosing clean the vehicles before they enter or cross the through road.

8.1 Traffic Controllers

8.1.1 General (AS 4.10.2)

(a) Equipment

Traffic controllers shall wear approved high visibility clothing and shall control traffic using a **STOP/SLOW** bat (**AS 3.5.2 (c)**) or the **STOP** sign mounted on a boom. The traffic controller (symbolic) (T1-34 or T1-200-2/3 on RTA works) sign shall be used to give advance warning of the presence of a traffic controller and the **PREPARE TO STOP** (T1-18) sign shall be used if traffic may be required to stop at the traffic controller location. Traffic controllers are responsible for setting up and removing or covering these two signs and relieving traffic controllers are to check to ensure that the signs are installed correctly.

(b) Training

Traffic Controllers shall be appropriately trained in their duties and certified as competent. The minimum requirement is to have satisfactorily completed RTA's training course – *Traffic Controllers*.

(c) Authorisation

RTA Traffic Controllers, or Traffic Controllers working for RTA contractors, shall wear approved yellow high visibility safety clothing displaying either the RTA logo or the letters "RTA" and the words "Authorised Traffic Controller". Local Government Traffic Controllers or Traffic Controllers working for Local Government contractors shall wear high visibility clothing meeting the requirements of AS4602, displaying the logo or name of the Local Government organisation and the words "Authorised Traffic Controller".

(d) Approach speed (AS 4.10.4)

Where Traffic Controllers are used, approach speeds of traffic shall be restricted to 60 km/h or less through the use of appropriate devices and signs including, as necessary, a roadwork speed limit.

(e) Visibility (AS 4.10.3)

Traffic Controllers shall **not** be located in positions where the sight distance between them and oncoming traffic is less than 1.5D.

(f) Positioning

A Traffic Controller's normal duty is to remain at the head of the traffic queue while traffic is stopped. If there is a possibility of vehicles colliding with the end of the queue because of restricted sight distance, or of drivers queue jumping because they cannot see the Traffic Controller at the head of the queue, then an additional Traffic Controller and/or additional

warning signs shall be placed at the end of the queue or other appropriate location. (See Section 3.5.7, *Avoiding end of queue collisions*.)

(g) Communication

Where Traffic Controllers cannot see or hear each other, additional Traffic Controllers, placed within sight of the original Traffic Controllers, or portable two-way radios shall be used for communication between them. Additional radios in the middle of the work or with the site workers may be useful to ensure that the control is suitable for the work situation.

(h) Period of duty (AS 4.10.5)

Traffic Controllers shall be relieved after two hours work and may be either rested or placed on other duties for a period of at least 15 minutes before being returned to traffic control duties.

8.1.2 Where are Traffic Controllers required

Traffic Controllers are required on both short- and long-term work where traffic needs to be periodically stopped in approach to the work site.

Traffic Controllers may also be necessary in some circumstances on mobile work on single carriageway roads (2 lane/2 way and 3 lane/2 way), particularly for mobile work with a slow rate of progression along the road. Refer to Standard TCP 71

A Traffic Controller can control traffic in only one lane and, usually (see Section 8.1.3, *How many traffic controllers*) in only one direction at a time. When manual traffic control is required on multi-lane carriageways, a merge or merges shall be introduced upstream of the Traffic Controller so that the Traffic Controller is managing one lane.

8.1.3 How many traffic controllers

For manual traffic control using **STOP/SLOW** signs with traffic flow in opposite directions, either one Traffic Controller shall assess gaps in oncoming traffic or two Traffic Controllers are required – one on each approach to the work area.

Suitable gaps are likely to be too infrequent where the ADT exceeds 1,500 vehicles per day. To assess gaps in oncoming traffic, a Traffic Controller shall be able to see at least 300 m (400 m where pre-existing approach speeds exceed 100 km/h) or, for long work areas, 250 m (350 m where pre-existing approach speeds exceed 100 km/h) plus the length of the work area. This is illustrated in Figure 8.1. **Traffic speeds shall be reduced to comply with the clearance to workers requirements of Section 3.6, *Safe clearances between workers and through traffic at static work sites*.**

Clear sight distance for a Traffic Controller may be restricted by road curvature, crests, roadside vegetation, road plant etc. Sight distance may also be restricted by conditions such as fog, rain, or mirages in hot weather on even grades.

For work at night see Sections 8.1.5, *Night work* and 9.2, *Working at night*.

A Traffic Controller shall also be required on the other approach if:-

- the Traffic Controller shown in Figure 8.1 cannot see clearly the minimum distance shown to oncoming traffic, or
- length of work area L (Figure 8.1 and Table 8.1) is greater than 250 m, or
- ADT exceeds 1,500 vehicles per day.

2 lane/2 way roads

One Traffic Controller is required where it is necessary to periodically stop traffic in one direction provided traffic in the opposing direction is not affected. **Traffic speeds shall be reduced to comply with the clearance to workers requirements of Section 3.6, *Safe clearances between workers and through traffic at static work sites*.**

Where the work closes or restricts one travel lane, and both directions of traffic use the other travel lane which remains unobstructed:

- No Traffic Controllers are required where:
 - ◆ ADT is less than 100 vehicles per day, and
 - ◆ each entry to the work site is visible from the other end, and
 - ◆ the work area is shorter than 100 m.
- One Traffic Controller is required where:
 - ◆ ADT is 1,500 vehicles or less, and
 - ◆ sight distance from the Traffic Controller exceeds the minimum in Table 8.1.

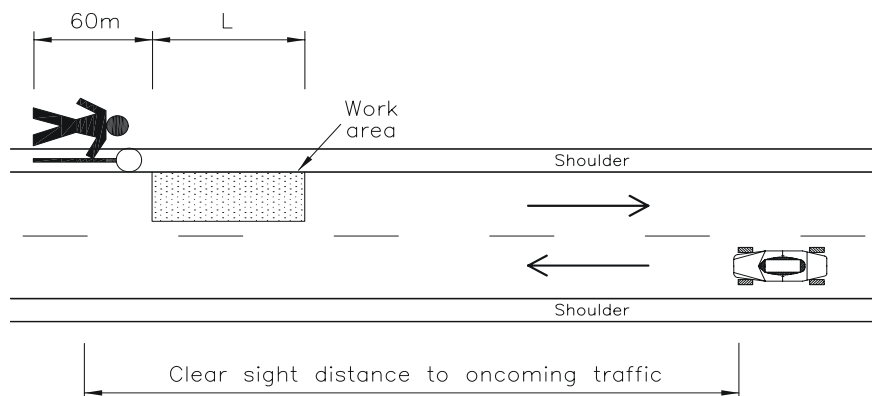


Figure 8.1 Traffic Controller minimum sight distance

Approach Speed (prior to 60 km/h zone)	Length of Work Area (L)	Minimum clear sight distance to oncoming traffic
Up to 100 km/h	Less than 60 m	300 m
	60 m to 250 m	L + 250 m
More than 100 km/h	Less than 60 m	400 m
	60 m to 250 m	L + 350 m

Table 8.1 Traffic Controller minimum sight distance

- Two Traffic Controllers are required where:
 - ♦ ADT is greater than 1,500 vehicles per day, or
 - ♦ the work area is longer than 250 m, or
 - ♦ sight distance from the Traffic Controller in the obstructed lane to the other approach is less than the minimum in Table 8.1.

3 lane/2 way roads

Where the work closes or restricts one of the lanes in the direction with two lanes, a choice is available depending on the circumstances of the site and the work. Either all traffic in that direction can be channelled to the unaffected lane or both lanes can be closed. See TCP 80.

Where the work closes or restricts both lanes in the direction with two lanes, so that both directions of traffic use the single lane, the requirements are the same as for a 2 lane/2 way road. See TCP 90.

Where traffic is stopped intermittently in the single lane and allowed to proceed in the same lane, and the opposing 2 lane flow is not affected, one Traffic Controller is required. See TCP 71.

Where the work closes or restricts the single travel lane, and the centre lane remains unobstructed and available to both directions of traffic, the requirements are:

- One Traffic Controller is required where:
 - ♦ ADT is less than 1,500 vehicles per day, and
 - ♦ sight distance from the Traffic Controller exceeds the minimum in Table 8.1.

- Two Traffic Controllers are required and the slow lane closed where:
 - ♦ ADT is greater than 1,500 vehicles per day, or
 - ♦ the work area is longer than 250 m, or
 - ♦ sight distance from the Traffic Controller in the obstructed lane to the other approach is less than the minimum in Table 8.1.

This arrangement is shown in TCP 91.

Roads with 4 or more lanes

On single carriageway roads with 4 or more lanes and on divided roads, lane closures can usually be set up so that Traffic Controllers are not required during the work. However a Traffic Controller will be required where intermittent closure of a lane is necessary, for example to allow plant to manoeuvre or to enable trucks to deliver materials. See Section 7, *Providing for works traffic*. Remember that a Traffic Controller shall control only one lane, and merges upstream of the work area may be necessary.

A typical situation with a Traffic Controllers on a divided road is shown in standard TCP 82.

8.1.4 Instructions for traffic controllers

A Traffic Controller shall:-

- wear the approved high visibility external clothing at all times
- ensure that **PREPARE TO STOP** (T1-18) and traffic controller symbolic (T1-34 or T1 -200-2 and T1-200-3 signs on RTA work) signs are in place and located in accordance with the TCP
- stand, if possible, where he or she can see the end of the work and any other Traffic Controller and where the sight distance to oncoming traffic is at least 1.5D. Traffic Controllers shall ensure that they are able to signal each other either directly or by using two way radios, an intermediate person or other means. All radios shall be confirmed to be in working order before going to the work site. **Radios shall not be used at blasting works.**
- stand facing the traffic, but just outside the travel path so that he or she can be seen for a minimum of 1.5D in advance by oncoming traffic
- not obstruct the motorists view of other signs and devices or be hidden by them
- **always stand so that a clear escape path is available**
- once the first vehicle has stopped, change position if necessary, in order to be clearly visible to following traffic. The Traffic Controller shall stay at the head of the traffic queue and stand alone, never permitting people to group around.

- give definite and clear signals to:-
 - stop traffic** – turn the **STOP/SLOW** bat (R6-8/T7-1) to **STOP** and raise the free arm into the stop signal position with the palm of the hand towards the traffic
 - allow traffic to proceed** – check that all traffic from the other end of the work site has passed, then turn the **STOP/SLOW** bat to **SLOW** and with the other hand give the **GO** signal
 - slow traffic** – show the **SLOW** side of the **STOP/SLOW** bat, extend the free arm and wave arm up and down.
- stand clear of traffic when allowing it to proceed
- not leave his or her post until directed by the Works Supervisor or Team Leader, or relieved by another Traffic Controller
- be courteous at all times in dealing with the public. If requested, inform the driver of the reason for, and possible length of the delay, but be brief. If provoked by unreasonable behaviour, exercise restraint.
- remove or cover the **PREPARE TO STOP** (T1-18) and traffic controller symbolic (T1-34, T1-200-2 or T1-200-3) signs when traffic control is discontinued or during brief breaks such as lunch
- report irresponsible motorists immediately. The Police will deal with them if you can report quickly.

NOTE:

There are three types of traffic controller ahead signs, namely:

- **day use only** (T1-34) – black symbol on fluorescent/retroreflective red background
- **day and night use** (T1-200-2) – black symbol and border on Class I reflectorised yellow background for works which continue day and night
- **night use only** (T1-200-3) – Class I reflectorised yellow symbol and border on black background.

8.1.5 Night work

See Section 9.2, *Working at night*. Be sure to:-

- wear approved, high visibility garments such as white overalls with reflective tapes
- consider use of an illuminated wand to supplement the **STOP/SLOW** bat
- try to position the traffic controller at a location on the road that is lit. For planned night work there should be good light on the traffic controllers.
- use two way radio control. It is desirable in most cases and essential if clear sight between operators is not available.



8.2 Roadwork (temporary) speed zones (AS 4.9)

It is essential that:-

- the procedures outlined in this Section are followed to provide consistency of roadwork speed zone operations in NSW
- all speed zone signs are adequately covered or removed from site when not required
- pre-existing speed zones are reinstated as soon as possible after passing the work site.

Failure to follow these three basic principles will lessen the credibility of roadwork speed zones and may lead to motorists not obeying signs correctly displayed. This will increase the risks to both workers and road users.

Consideration may also be given on the approach to a roadwork speed zone to providing additional advance warning of the zone by using the techniques mentioned in Section 3.5.7, *Avoiding end of queue collisions*.

8.2.1 General

Temporary speed zones may be implemented to assist in controlling the speed of traffic through roadwork sites. In general, the installation of temporary warning signs, lights and other devices have been more effective than speed limit signs in drawing attention to the need for caution at work sites. Furthermore, experience has shown that temporary speed zones at work sites will be significantly more effective if they appear reasonable to drivers.

Roadwork speed zones:-

- (i) shall only be used where they are self-enforcing or will be enforced
- (ii) shall not be used alone but used with other signs or devices required by the site specific conditions
- (iii) are not to be used in the place of more effective means of traffic control, but to compliment such controls
- (iv) shall only be used while work is being undertaken or temporary road conditions exist which are prejudicial to safety.

8.2.2 Location

Roadwork speed zones may be used where:-

- (i) there is an accident or an emergency
- (ii) traffic travels through the work site

- (iii) workers are endangered by high speed traffic
- (iv) dust or smoke reduces visibility
- (v) loose material or stones are on the road surface (i.e. during spray sealing works)
- (vi) there is a reduction at the work site in road surface condition or vertical or horizontal alignment which is inconsistent with the adjacent length of road
- (vii) detours or sidetracks are of a lower standard than the approaches
- (viii) excavations are adjacent to the travel path of vehicles
- (ix) bridges, which for reasons of structural safety, require a reduction in the impact loading caused by traffic
- (x) traffic is diverted onto the opposing travel lanes or carriageway.

8.2.3 Speed limit selection

The speed limit selected shall not exceed the maximum safe speed of travel for that work area. This safe speed is dependent on the degree of vehicular and pedestrian conflicts, the type and extent of the work in progress, the characteristics of the road and the proximity of workers to passing traffic. The speed of passing traffic shall be reduced to the following speeds, using appropriate signs and devices together with, if considered necessary, an authorised roadwork speed limit :-

a) 80km/h:

- (i) where workers on foot or operating plant are between 3 and 6 metres of traffic with no intervening physical barrier and traffic volumes exceed 10,000 vpd
- (ii) where there are changed traffic conditions on the site such as high speed, high standard detours, reduction in the number of lanes, varying surfaces
- (iii) where there are work vehicles entering or leaving the carriageway
- (iv) as a transition zone in 110km/h zones where a 60 or a 40km/h roadwork speed zone is required at the site of the work and the use of a 60 or 40km/h ahead sign is considered inadequate

b) 60 km/h:

- (i) where workers on foot or operating plant are within 1.2 to 3 metres of traffic with no intervening physical barrier
- (ii) on approach to a traffic controller
- (iii) on approaches to temporary or portable traffic signals
- (iv) there is significant interaction between work vehicles and through traffic

- (v) there is a reduced standard of alignment due to the works
- (vi) there is a loose surface such as gravel or a newly sprayed bitumen seal
- (vii) plant is operating near through traffic
- (viii) dust or smoke may reduce visibility
- (ix) traffic is adjacent to an excavation.

c) 40 km/h:

- (i) where workers on foot or operating plant are within 1.2 metres of traffic with no intervening physical barrier or are working within the trafficked area
- (ii) there is a severe change in the alignment considering the surrounding speed environment
- (iii) on bridges where the deck has an inconsistent surface or there might be structural damage to the bridge by vehicles travelling at higher speeds.

NOTE: for bridges where the impact loading caused by traffic threatens the structural safety of the bridge the temporary speed limit, as determined by the project manager, may be set lower than 40 km/h. Consideration should also be given to erecting bridge load limit signs (R6-3).

d) Less than 40 km/h (AS 4.2(e))

Refer to Section 3.6.6, *Speed control at hazardous sites*.

8.2.4 Procedures

(a) Duration

Signs showing roadwork speed limits (R4-212) shall be displayed only while the restriction applies and for the duration of the need. Hence the signs may be displayed on a:-

- (i) full-time basis for the duration of the roadworks or;
- (ii) part-time basis only while workers and plant are working, and a higher speed limit is more suitable between work shifts. The higher limit may be the normal speed limit or a different roadwork speed limit.

(b) Minimum length of zones

Roadwork speed zones shall be the minimum length required for the protection of workers and the travelling public. **Drivers will not adhere to limits where there are no obvious roadworks or bridgework activity.**

40km/h and 60km/h roadwork speed zones shall be located so that the zone commences no closer than 100m before the start of the work, which is the start of transition area or traffic diversion or the traffic control position. In general 40km/h zones are only to be erected over the length where people are working or the other conditions listed in 8.2.3(c) exist. The roadwork speed zone shall end at least 50m past the site where people are working.

The desirable lengths of roadworks speed zones are:-

	minimum	maximum
40km/h	not specified	500m
(The maximum length of 500m above is for worker safety but the actual length shall be restricted to areas adjacent to where people are actually working and visible to road users .)		
60km/h	150m	not specified
80km/h	500m	not specified
80km/h transition zones	300m	not specified

(For traffic safety there is no maximum length specified above (ie for long lengths of reseals etc) but physical restraint to traffic speed shall be considered (ie pilot vehicles etc.) for longer lengths.)

Roadworks speed zones may be staggered so that there is a different speed restriction for opposing directions of traffic. Staggering may be applicable:-

- (i) to reduce the length of speed restriction to traffic leaving the work site
- (ii) where a speed zone is extended to protect the end of a queue
- (iii) on a divided road where roadworks affect traffic conditions on one side of the median only
- (iv) where a roadworks speed zone is used in a transition zone to reduce traffic speeds in approach to a traffic controller but is not required for traffic flow in the opposite direction
- (v) where work is underway on the shoulder and does not affect traffic in the opposing traffic lane.

8.2.5 Signposting

(a) Speed restriction ahead signs

Speed Restriction Ahead signs (G9-79) shall be erected where the speed of traffic on the approach to the temporary speed zone is 30 km/h or more higher than the temporary limit. They shall **also** be considered for use:-

- where there is insufficient sight distance
- on downhill approaches
- where, under normal driving expectations, the change in speed zone may not be apparent to road users.

The Speed Restriction Ahead (G9-79) signs shall be located 2D in advance of the roadworks speed zone.

At the start of zones

At the start of a roadworks speed zone the Roadwork Speed Limit (R4-212) signs shall be erected on both sides of the carriageway. Where this is not possible a second sign is to be erected 0.5 D from the start of the zone.

Repeater signs

Repeater signs (R4-212) shall be erected on the left side of the carriageway at a maximum spacing of 500 m. They are also required where traffic enters from a side road within a roadworks speed zone.

End of Zone

At the end of the roadworks speed zone, a speed restriction sign shall be erected showing the speed limit applying beyond the roadworks zone.

Conflict with other signs

When a roadworks speed zone is introduced, speed restriction signs or markings and advisory speed signs in the zone which show conflicting speeds shall be covered or removed.

(b) Sign Size

Speed restriction signs used on all roads where the existing limit is 60km/h or more are to be at least "B" size. On freeways and other higher speed roads "C" size signs may be erected.

(c) Erection of signs

Roadwork speed restriction signs shall be erected:-

- (i) within 5m of the edge of the outer travel lane
- (ii) a minimum of 600mm above the ground to the underside of the sign
- (iii) to be clearly visible to traffic. In urban areas the location of the zone may be adjusted so that signs can be erected clear of parked vehicles, other signs or obstructions.

(d) Multiple work crews

Where there are multiple work crews within a job site or over a length of road, separate zones may be required for each work area in order to avoid an excessively long and restrictive speed zone. The minimum lengths stated in 8.2.4(b) may be used as a guide when designing the TCP in this instance.

(e) Speed Restriction Road Pavement Markings

For long-term work the existing speed limit pavement numerals shall be obliterated or ground off i.e. usually removing the first numeral will suffice '1' for 100 km/h, '8' for 80 km/h. It is not normally necessary to provide pavement markings for roadworks speed zones.

(f) ROADWORK SPEED LIMITS ENFORCED signs

On long-term roadwork sites where a speed restriction is to be used for an extended period (in excess of 4 weeks) and compliance with the roadwork speed restriction is expected to be a problem, **ROADWORK SPEED LIMITS ENFORCED** (T4-216) signs shall be erected.

If used, these signs shall be located:-

- 100m after each roadwork speed limit sign for speed limits of 60km/h or less
- 125m for speed limits greater than 60km/h.

These signs may also be used if compliance becomes a problem during shorter periods of work.

(g) Seeking Police co-operation

It is desirable to advise local police of the installation of any temporary speed zones and to seek police co-operation to enforce those zones. In this regard consideration shall be given to the use of police speed enforcement/presence as part of the risk management process during the development, construction and maintenance stages of projects.

Potential projects requiring police involvement include:-

- (i) long term works on high volume and/or high speed roads
- (ii) short term work where traffic barriers cannot be employed to protect workers.

Procedures for involving police in enforcement or presence on roadworks are contained in RTA Technical Direction, TDT 2009/07, *Police Speed Enforcement or Presence on RTA Work Sites*.

8.2.6 Delegations and documentation

(a) RTA works on Classified Roads

Authorisation by a Unit Manager (RTA Delegation Level 5 Officer) who holds a current Design and Inspect Traffic Control Plans card (orange card) is required before a roadwork speed limit sign can be installed, displayed, altered or removed on any Classified Road.

Completion is required of an appropriate form (see end of this Section) to cover a roadwork speed restriction that may be applied for any section of any Classified Road. Copies of the forms shall be forwarded to the police station nearest to the appropriate sections of road.

A copy of this authorisation shall be kept on site and will enable the erection of roadwork speed limit signs (R4-212) at the specified location(s).

Records shall be kept detailing the date and time, the speed displayed and the location of speed zone signs, repeater signs, advanced warning signs and any other relevant information. Such information shall be kept for at least seven years, as it may be required as evidence for litigation purposes including speeding prosecutions or accident compensation claims.

For work undertaken on Classified Roads, councils (whether Single Invitee Contractors (SIC) or not) and private contractors shall seek the authorisation of the RTA to erect roadwork speed limit (R4-212) signs.

(b) Works on Unclassified roads

Authorisation shall be carried out in accordance with Item 13 of the RTA's *Delegation to Councils – Regulation of Traffic* (dated 23 February 2009).

“When the installation period for a ‘Roadwork Speed Limit’ (R4-212) sign is to be for 6 working days or less:-

- (i) authorisation of the use of the ‘Roadwork Speed Limit’ (R4-212) sign must be carried out by council or a sub-delegate who holds a current Select/Modify Traffic Control Plans certificate issued by the Authority ; and
- (ii) the nearest office of the Authority is to be notified in writing of council's intention to implement a roadwork speed limit prior to works commencing; and
- (iii) the nearest Police Station is to be notified in writing of Council's intention to implement a roadwork speed limit prior to works commencing.”

“When the installation period for a ‘Roadwork Speed Limit’ (R4-212) sign is to be for more than 6 working days:-

- (i) authorisation of the use of the ‘Roadwork Speed Limit’ (R4-212) sign must be carried out by council or a sub-delegate who holds a current Select/Modify Traffic Control plans Certificate issued by the Authority ; and
- (ii) the nearest office of the Authority is to be notified in writing of council's intention to implement a roadwork speed limit 7 days prior to works commencing; and
- (iii) the nearest Police Station is to be notified in writing of Council's intention to implement a roadwork speed limit 7 days prior to works commencing.”

8.2.7 Records

Records shall be maintained of all roadwork speed zones. Records shall include:-

- (i) RTA's or council's (or its sub-delegate's) written authorisation of the installation. [The sub-delegate's Select/Modify Traffic Control Plans Certificate number shall be shown.]
- (ii) the location
- (iii) the installation time and date, and
- (iv) the removal time and date

The 'Roadwork Speed Limit' (R4-212) sign is to be removed as soon as practicable after the roadworks have been completed.

Roadwork speed limit Authorisation and Notification forms are included at the end of this Section.

All records shall be kept for a minimum of 7 years.

8.2.8 Inspection

The team leader or appropriate person is to ensure that speed restriction signs are properly erected, conflicting signs are covered and advance signs are in place when inspecting the traffic control on the site. Consideration should also be given to keeping photographic records of signs and their locations.

Roadwork speed zones are to be inspected and associated documentation examined on a regular basis.

8.2.9 Mobile speed zones

The issue of the legality of mobile speed zones in New South Wales is one that has yet to be resolved. In the meantime it is acceptable to display non-regulatory (black on white) speed restriction signs on mobile works vehicles.

ROADWORKS SPEED ZONE SIGN AUTHORISATION FORM

RTA/Council Ref No _____

Authorisation is given in accordance with the RTA Delegation Manual to install, display, alter or remove a _____ km/h roadworks speed limit sign as described below.

Location

Road No & Name _____

Town/Suburb
(where applicable) _____

Start Point _____

End Point _____

Commencement

Date _____ Time _____

Signed _____ Date _____

Name _____

Designation _____

Traffic Control at
Work Sites Certificate No _____

Councils

This form should be faxed to the nearest Regional Office of the RTA and the nearest Police Station as required under clause 13 of the *Delegations to Councils Regulation of Traffic* document.

ROADWORKS SPEED ZONE SIGN NOTIFICATION FORM

Council Ref No _____

_____ Council intends to install a _____ km/h
roadworks speed limit sign as described below.

Location

Road No & Name _____

Town/Suburb
(where applicable) _____

Start Point _____

End Point _____

Proposed Commencement **Date** _____ **Time** _____

Proposed Completion **Date** _____ **Time** _____

Daily Operating Times **Date** _____ **Time** _____
(where applicable)

Signed _____ Date _____

Name _____

Designation _____

Traffic Control at
Work Sites Certificate No _____

This form should be faxed to the nearest Regional Office of the RTA and the nearest Police Station as required under clause 13 of the *Delegations to Councils Regulation of Traffic* document.

9.1 Intermittent work and low impact works

9.1.1 General (AS 4.4.1)

The treatments in this Section are permitted in recognition of the need to allow certain short-term low impact works to be carried out without the use of fully protected static work sites or mobile works convoys which could otherwise lead to significant work inefficiencies. Since they could be seen as a partial relaxation of safety standards, it is vital that a risk assessment (see Section 2.10, *Risk management*) be made of the proposed adoption of these treatments in particular environments taking account of factors such as traffic volume and speed, road geometry and width and the general behaviour of road users. If the risk cannot be tolerated, a fully protected static work site (Section 3.6) or mobile works (Section 9.17) convoy will be required.

Regardless of any risk assessment, where the speed limit, traffic volume, traffic separation or occupation time constraints specified below cannot be met, a static or mobile work site shall be used.

The speed limits specified are existing permanent speed limits. Temporary speed limits shall not be used unless a static site as specified in this manual is to be set up.

9.1.2 Intermittent work (AS 4.3.2 and 4.4.6)

(a) Planned

Work is classified as intermittent if it is undertaken within gaps in traffic without obstructing traffic and without compromising the safety of workers. It may be planned, unplanned or emergency work and may involve frequently changing work sites. Some examples of work included under this category are pot hole patching, edge repair, seal or patch spotting, road inspections, removal of dead animals or debris, litter collection etc. For this type of work advance warning signs and delineation may be omitted provided the following conditions are met:-

- approved high visibility external clothing, as specified in AS 4602, *High visibility safety garments* or the RTA's *Occupational Health and Safety Policy Manual, Wearing of High Visibility Vests and Garments* is worn by all workers
- a contingency plan is in place so that work in progress can be abandoned immediately without risk to workers or traffic
- where a spotter is used the person shall have good eyesight and be fully instructed in the spotter's duties

- where a spotter is used, there is no approaching traffic for at least a minimum distance as shown in Table 9.1 for the designated approach speed (approximately equivalent to 10 seconds travel time or 3D)
- where used the spotter shall remain within sight and hearing distance of the worker(s) (generally within 2 metres), and an advance spotter may be required if the distances shown in Table 9.1 cannot be achieved. This advance spotter should be within sight distance of the first spotter or within radio contact if sight distance is not possible.
- where a spotter is not used, there is no approaching traffic for at least a minimum distance as shown in Table 9.1 for the designated approach speed (approximately equivalent to 20 seconds travel time or 6D) and the work shall be expected to be completed in less than 10 seconds
- there is at least one operating rotating or flashing yellow light on the work vehicle when parked adjacent to the carriageway.
- where the work is repetitive and is undertaken within a designated length of up to 2km, signs such as workers (symbolic) (T1-5) with **NEXT 2KM** (T1-28) or similar shall be placed in advance of the work. Where this work is undertaken as a frequently changing work area the advance signs shall be progressively relocated so that for opposing directions they are never more than 2 km apart.

(b) Unplanned

Where the work is unplanned or is an emergency the use of signs as detailed above may be omitted. However, it is essential that personnel are able to substantiate that the work was unplanned and required urgently.

Approach speed (D) km/h	Minimum sight distance (m)	
	With a spotter	Without a spotter
10 & 20	60	120
30	90	180
40	120	240
50	150	300
60	180	360
70	210	420
80	240	480
90	270	540
100	300	600
110	330	660

Table 9.1 Safe traffic gaps for intermittent work



If vehicles in the traffic stream are randomly distributed and with a volume not exceeding 100 per hour, suitable gaps will occur every minute. However, in many places factors like traffic signals and slow vehicles often bundle traffic into platoons, and suitable gaps may occur more frequently.

9.1.3 Mobile inspections (AS 4.3.6) – open road areas

Where it is necessary for work vehicles (other than vehicles engaged in mobile works, see Section 9.1.7, *Mobile work*) to travel at speeds below that of other traffic, such as during routine patrol works or mobile inspections, they shall only travel at or above the minimum slow speed shown in Table 9.2 and ensure the following conditions are met:-

- (a) vehicles shall travel wholly within the traffic lane provided:-
 - (i) travel speed is less than 20 km/h below the speed limit
 - (ii) travel speed is at least 25 km/h on roads with less than 200 vpd
- (b) vehicles have at least one rotating or flashing yellow light operating and visible to traffic following the vehicle
- (c) vehicles may travel at speeds greater than 20 km/h below the speed limit if they travel on the road shoulder or verge using gaps in traffic to pass obstructions and shall not straddle the edge line
- (d) where fitted, flashing arrow signs are only used to direct traffic to one side of the vehicle if it is safe to do so. In situations where it is not safe to pass or overtake the work vehicle only the warning mode of the arrow shall be flashed
- (e) if vehicles travel at speeds below that shown in (a) above it shall operate as a mobile work.

Normal traffic speed	Minimum slow speed
60 km/h	40 km/h
70 km/h	50 km/h
80 km/h	60 km/h
90 km/h	70 km/h
100 km/h	80 km/h
110 km/h	90 km/h

Table 9.2 Slow speed range for work vehicles

9.1.4 Short term work in traffic (AS 4.3.3) – open road areas

Workers with a vehicle or item of plant equipped with a vehicle-mounted warning device may work on the roadway or within 1.2 m of moving traffic without the use of advance signs provided the roadway at any one work site is not occupied for more than 5 minutes and the conditions listed below are applied. The period may be increased to 20 minutes for works within 3 metres but more than 1.2 metres.

Sight distance to the vehicle-mounted warning device for approaching drivers shall be:-

- (a) greater than 150 m in a 60 km/h or lower speed zone; or
- (b) greater than 250 m elsewhere; and

The vehicle-mounted device shall not be obscured, e.g. by overhanging vegetation or a raised truck body.

The work shall not reduce the:-

- (i) overall width to less than that required for safe passage for two-way traffic (or one way traffic if the volume is less than 50 vpd); or
- (ii) the lane width adjacent to a barrier line to less than that needed for vehicles to proceed without crossing the line.

A spotter shall be posted to warn workers on foot of the approach of any vehicles whose speed or size might constitute a safety threat. If two or more locations within a space of 2 km or less are to be worked as above, the site shall be treated as a frequently changing work area (refer Section 9.1.5, *Frequently changing work areas – open road* and Section 9.1.6, *Frequently changing work areas – built up areas*).

9.1.5 Frequently changing work areas (AS 4.3.4) – open road areas

For activities such as minor maintenance on the pavement or shoulder, including road furniture maintenance and longitudinal survey work at successive locations less than 2 km apart, the frequently changing work area treatment may be applied. If it is applied the treatment shall be subject to the following requirements:-

- (a) In all cases the following requirements of Section 9.1.4 shall be observed:-
 - (i) work vehicle positioning and length of occupation at any one site (5 minutes maximum)
 - (ii) display of the vehicle mounted warning device
 - (iii) sight distance to the work vehicle for approaching traffic
 - (iv) the need for a spotter to warn workers on foot on the roadway of approaching traffic.
- (b) Signs up to 2 km in advance of each work position or item of moving plant shall be displayed. The distance between advance signs for opposing directions of travel shall not exceed 2 km at any time and the location of such signs shall be progressively changed to ensure the maximum separation is not exceeded as the work progresses along the road.
- (c) At each advance sign location the following signs shall be used:-
 - (i) Workers (symbolic) (T1-5) where there are workers on foot; or

- (ii) **ROAD PLANT AHEAD (T1-3-1)** where moving road plant only will be encountered.

The sign **NEXT 2 KM (T1-28)** shall be placed beside whichever of the above signs is used.

- (d) If any of the requirements of Item (a) cannot be met at a particular location, i.e. sight distance is substandard, that site shall be set up as a fully protected static work site with advance signs as required.

9.1.6 Frequently changing work areas (AS 4.4) – built up areas

A-Work not within a traffic lane (AS 4.4.2)

The work shall be carried out with a vehicle equipped with a vehicle mounted warning device parked on a shoulder or parking lane or elsewhere where parking is permitted adjacent to moving traffic. The vehicle shall shadow the work area at all times, either to the front or back of it. The limitations that shall apply are:-

- (a) speed limit—70 km/h or less; and
- (b) minimum sight distance to oncoming traffic—50 m; and
- (c) maximum work period at any one location—
 - (i) 20 min at any traffic volume; or
 - (ii) 40 min at traffic volumes 150 vph or less; or
 - (iii) 1 hour at traffic volumes 40 vph or less.

The work area may move frequently between successive locations.

The following are examples of short-term works appropriate for this treatment when they do not require encroachment onto a moving traffic lane:-

- (A) Pit cleaning or repair.
- (B) Litter collection.
- (C) Tree pruning or planting.
- (D) Road signs or street furniture maintenance.
- (E) Street light maintenance.

NOTE: A static work site is required if these conditions cannot be met.

B-Work within a traffic lane (AS 4.4.3)

The work shall be carried out using a work vehicle or large plant item, and a shadow vehicle, both equipped with a vehicle mounted warning device.

If work is being carried out by a large plant item and there are no workers on foot or small plant items present, the shadow vehicle shall follow the plant item 15 m to 30 m behind it, either in the lane or shoulder to the left of the work lane if free, or otherwise, within the work lane.

If the work is being carried out by workers on foot or small items of plant, even though large plant items may also be present, the shadow vehicle shall travel in the same lane as the work area, 20 m to 40 m behind the work vehicle.

The following limitations apply:-

- (a) Speed limit—60 km/h or less.
- (b) Maximum work period at any one location, large item of plant, no workers on foot:-
 - (i) 20 min at any traffic volume; and
 - (ii) 1 hour at traffic volumes up to 40 vph.
- (c) Maximum work period at any one location, workers on foot—1 hour at traffic volumes up to 40 vph.

The shadow vehicle may be dispensed with at volumes less than 60 vph provided sight distance to oncoming traffic is at least 50 m or 2D, whichever is the greater.

The work may be moved frequently between successive locations.

Examples of work appropriate for this treatment are:-

- (A) pavement marker laying (other than on dividing lines);
- (B) pavement testing; and
- (C) any of the items listed in Section 9.1.6 A where encroachment onto a traffic lane is likely to occur.

NOTE: A static or mobile work site will be required if these conditions cannot be met,

9.1.7 Works on medians, verges and footpaths (AS 4.4.4) – built up areas

Access to medians is potentially hazardous because it is likely to involve unexpected manoeuvres to and from a fast lane. Therefore, work vehicles (including those driven by works supervisors) are to use deceleration bays, median crossovers and any other wide areas of pavement for access to and from medians.

Refer Section 7.8, *Median crossovers*, for detailed requirements.

The following works may be carried out without any support vehicle on the roadway, subject to the work duration being limited to a single shift and to the conditions listed in Items (i) and (ii) being met:-

- (a) median and verge mowing, and related activities such as tilling, seeding and weed spraying.
- (b) works on a footpath.
- (c) garden maintenance.

The following conditions shall be met:-

(i) Large plant items only (see Note to Section 9.1.6 B)

Where there are no workers on foot, the relationship between speed limit and clearance to edge of traffic lane shall be as follows:-

- (A) Speed limit 90 km/h or more—clearance shall be greater than 1.2 m.
- (B) Speed limit 80 km/h or less—clearance may be less than 1.2 m but plant items shall not encroach onto the traffic lane.

(ii) Workers on foot or small items of plant

Where there are workers on foot or small items of plant, or both, the work method shall be restricted to one of the following:-

- (A) the speed limit is 60 km/h or less and the work area does not encroach onto a moving traffic lane
- (B) the speed limit is 80 km/h or less and the clearance to edge of a moving traffic lane is 1.2 m or more.
- (C) The entire work area is 3 m or more clear of a moving traffic lane.

The workers (symbolic) (TI-5) sign or **ROAD PLANT AHEAD** (TI-3) sign shall be displayed respectively, when either workers on foot or plant items alone are present and working less than 3 m to a moving traffic lane.

Wherever there are workers on foot or small items of plant working 3 m or less clear of a moving traffic lane, cones or bollards, in accordance with Section 5.2.2 shall be placed along the kerb line or edge of traffic lane if no kerb.

NOTE: A static or mobile work site will be required if these conditions cannot be met.

9.1.8 Street sweeping and garbage collection (AS 4.4.5) – built up areas

Street sweeping and garbage collection operations which do not involve workers on foot working closer than 1.2 m to the edge of a moving traffic lane may be carried out under the following conditions:-

- (a) vehicle to be equipped with a vehicle mounted warning device
- (b) speed limit 70 km/h or less generally, or 80 km/h or less if the work vehicle can operate at least 1.2 m clear of the edge of nearest running lane.
- (c) the minimum sight distance for following traffic is 1.5D.

9.1.9 Shoulder grading and mowing on sealed roads (AS 4.3.5) – open road areas

Shoulder grading and mowing on sealed roads with traffic volumes less than 1500 vpd may be undertaken in bounds of up to 10 km in length under the following conditions:-

- (a) If sight distance to the vehicle mounted warning sign on the grader or mower is at least 250 m throughout the section of road being worked on, advance signs **ROAD WORK NEXT 10 km** (T1-24) shall be placed at each end of the section. Loose stones (symbolic) (T3-9) or similar signs may be needed at the beginning and along the section.
- (b) If the sight distance falls to less than 250 m at some locations, **GRADER AHEAD** (T1-4) or **ROAD PLANT AHEAD** (T1-3-1) together with **NEXT 2 KM** (T1-28) shall be used on each approach to the section covering the location of diminished sight distance. A 60 km/h temporary speed zone (see Section 8.2) will be required if the speed of traffic is 80 km/h or more.
- (c) Subsections of 2 km or less in length created as in Item (b) shall be completed and signs including if used, speed zone signs, shall be relocated before proceeding with the next section. If there is difficulty turning a grader around at the end of a 2 km section it may be extended to the next available turning point but not to more than 6 km in total length.

Where traffic volumes are greater than 1500 vpd the works shall be undertaken either as a mobile work (see Section 9.17) or as static work site (see Section 3.6).

9.1.10 Slow moving plant

Plant items may be travelled on the road provided that the travel speeds indicated in Table 9.2 are complied with. The plant items shall have (where they are fitted) headlights and tail lights switched on and shall have at least one rotating or flashing yellow light operating. Plant items shall travel wholly within the traffic lane and shall not straddle lane or edge lines. They shall also pull over from time to time to allow traffic to pass.

Where plant items are not capable of travelling at the minimum speeds shown in Table 9.2 one of the following actions shall be taken in order to travel plant on the carriageway:-

- put in place a TCP to stop traffic whilst the plant is moved. It would normally be necessary to stop traffic only in the direction the plant item is travelling.
- use an escort vehicle or vehicles in accordance with Section 9.1.11.
- travel the plant item on the road shoulder or verge using gaps in traffic to pass obstructions and shall not straddle the edge line.
- float the plant item from site to site.

9.1.1.1 Escorting plant items

At times it may be necessary to escort slow moving plant items travelling on the road. The following procedure shall be used:-

- at least one escort vehicle shall travel behind the plant item.
- at locations where a minimum sight distance of 2D is available the escort is to travel at the same speed as the plant item, at a distance of approximately 2D behind the plant item.
- where sight distance is less than 2D the escort is to stop on the shoulder, off the travel lane until the plant item has moved a maximum of 6D ahead. The escort is then to travel at normal speeds to a point near the plant item and stop on the shoulder again.
- where sight distance is less than 1D a second escort vehicle shall be used, travelling at varying distances behind the plant item. The second vehicle will vary speed to ensure as far as possible that maximum sight distance is maintained for traffic approaching from behind. For example, the escort would travel more quickly through a bend and then slow down on a straight where sight distance is increased. This vehicle should occasionally pull over to allow traffic to pass. The first escort vehicle shall continue to operate as in the point above.
- all escort vehicles shall be equipped with at least one operating rotating or flashing yellow light and a sign **ROAD PLANT AHEAD**. Similarly all the plant items shall be equipped with at least one operating rotating or flashing yellow light. The escort vehicles and the plant items shall have (where they are fitted) headlights and tail lights switched on. Escort vehicles and at least one of the plant items shall be equipped with effective two-way radios.
- the plant items shall pull over periodically to allow traffic to pass so that the queue of traffic following generally does not exceed 12 vehicles.
- escort vehicles may be cars, utilities or trucks, provided that trucks used as escorts shall not be heavily loaded and are not towing trailers.
- up to three plant items may be escorted in the one group using one or two escort vehicles as prescribed above. In this case a distance of 60 m to 80 m shall be maintained between the plant items.

9.2 Working at night

9.2.1 General

As well as during night work the requirements of this Section should be considered when working in any poorly lit situations such as during periods of fog or working in tunnels.

9.2.2 Clothing

All personnel working at night, not just Traffic Controllers, are to wear approved high visibility external clothing in accordance with RTA's current occupational health and safety policies, and are to keep all night gear clean and bright. Wet weather clothing requirements are also described in RTA's current occupational health and safety policies.

Note that these requirements are based on considerations of traffic safety. Other requirements for personal protection equipment such as hearing protectors (earmuffs, ear plugs, etc.) and safety footwear are also described in RTA's current occupational health and safety policies.

9.2.3 Cones and bollards

Take special care in placing and maintaining cones and bollards. In particular:-

- consider decreasing their spacing from that shown in Table 5.1 if this will improve their visibility
- ensure they have retroreflective bands or sleeves of Class I material
- ensure employees are on site to reinstate any dislodged devices.

9.2.4 Flashing arrow signs

They are essential at night for lane closures on "high" volume and "high" speed roads and on busy roads in built-up areas. Care needs to be taken to ensure that the dimming facility is operating correctly at night. It is very desirable that back-up units are available on critical works.

Only type approved flashing arrow signs shall be used in New South Wales. For information and approval requirements see Section 11.2, *Approvals and specifications*. A list of type approvals is maintained by RTA, Engineering Technology Branch, Parramatta.

9.2.5 Lighting

Where possible the work site is to be fully lit by floodlighting. If power is not available use portable generators. Floodlighting of night work is particularly necessary in rural areas where there is no street lighting.

Traffic Controllers and their STOP/SLOW signs at the approaches to a night time work area shall be clearly visible to road users. Where it is not practical to floodlight the whole work site consider floodlighting the Traffic Controllers and the STOP/SLOW signs.

The works supervisor is to check floodlighting at work sites to ensure that floodlights do not adversely affect road users or adjacent dwellings or businesses. These checks shall be made by driving around, past or through the work site in all directions of travel. On divided carriageway roads, these checks are necessary from all carriageways, even if the work area is only on one carriageway.

Any floodlighting or security lighting at depots or compounds is also to be inspected to ensure that it does not adversely affect road users or adjacent dwellings or businesses.

9.2.6 Motorists behaviour

Important points to remember at night are:-

- motorists tend to drive with vehicles further apart
- obstacles are less conspicuous and peripheral vision is reduced
- motorists tend to drive faster on major arterial roads
- motorists may be more fatigued or alcohol-impaired
- sight distance is significantly reduced even on high beam and on low beam is only of the order of 100 m.

9.2.7 Pavement markings

Line marking is generally not visible on lit roads on wet nights and on dry nights is not as conspicuous as during normal daytime even with streetlights or floodlights.

Raised reflective pavement markers can be used to assist delineation through work sites.

In some circumstances cones with retroreflective bands can provide the continuity to guide motorists through the work site effectively. Delineators on guide posts or temporary stakes are useful, and care is needed to achieve standard spacings particularly on winding rural roads.

9.2.8 Signs for night work

Signs at the work site are essential and advance signs are also required. These RTA signs are **NIGHT ROADWORK AHEAD** (T1-223), workers (symbolic) (T1-224) and traffic controller (symbolic) (T1-200-3).

These signs are used in lieu of **ROADWORK AHEAD** (T1-1), workers (symbolic) (T1-5) and traffic controller (symbolic) (T1-34 or T1-200-2(RTA works)) signs.

They shall be made of Class 1 (retroreflective) yellow sheeting on a Class 2 (non-retroreflective) black background.

Other matters to consider are:-

- yellow is better than red at night
- externally lit signs are preferred to unlit retroreflective signs
- messages on signs should be brief and clear
- use standard signs and avoid *home-made* signs

- use standard sizes of signs for ease of storage and installation
- ensure that accurate records of the locations and types of devices displayed are entered in the works supervisor's diary, as detailed in Section 4.4, *Implementing TCPs*.

9.3 Pedestrians

9.3.1 General

In planning temporary arrangements for pedestrians consider:-

- the pedestrian and road environment
- the pedestrian accident history
- the surrounding land use
- the expected numbers of pedestrians
- where they will want to travel from and to (e.g. desire lines; key routes; attractors; destinations; linked trips)
- the needs of older pedestrians and pedestrians with impairments such as vision impairment; hearing impairment or physical impairment (e.g. of needs: personal space envelopes; wheelchairs [non-motorised or motorised]; walking frames; ramps)
- the need for a road safety audit
- the needs of school children and others who may be temporarily impaired such as those with shopping trolleys or prams
- the need for extra signage, guidance (e.g. pedestrian fencing) and protection (e.g. crash barriers; crash cushions).

The safety and convenience of pedestrians requires paths and crossings locations to be maintained in an acceptable and hazard free condition at all times of the day. Apart from concern for safety of the community, attention to this matter is essential to protect the organisation from injury or damage claims arising from accidents to pedestrians occurring as a result of the temporary arrangements.

Pedestrians shall be separated from any trenches cut into paths or the trenches covered with steel plates until backfilled.

9.3.2 Defining the work area

It is essential that the work area is clearly defined by using:-

- generally, plastic pedestrian fencing to the standard described in Section 3.3.2, *Plastic containment fences*, or
- in very busy urban areas, such as shopping areas, more substantial fencing such as rolled-top "weldmesh" or pool fencing.

Where pedestrians have been diverted onto an existing roadway the pedestrian path may be separated from vehicular traffic by a mesh fence provided that:-

- (i) the clearance to the delineated edge of the traffic lane is at least 1.2m and the speed of traffic is 60 km/h or less; or
- (ii) the clearance to the delineated edge of traffic is less than 1.2m and the speed of traffic is 40 km/h or less
- (iii) sufficient width for the anticipated pedestrian volumes, storage and flow directions.

Where these conditions cannot be met a safety barrier shall be provided or an alternative pedestrian path provided or the worksite redesigned to pass a road safety audit based on pedestrians.

9.3.3 Reversed traffic direction (AS 4.14.8 (c))

Where, at a detour or crossover or other location, traffic is required to travel temporarily in the wrong direction special safety requirements may be needed for pedestrians. In particular:-

1. containment fences may be required to control the crossing point
2. personnel may need to be positioned to guide and assist the pedestrians
3. **LOOK BOTH WAYS, TWO-WAY TRAFFIC** (T8-5) signs may be required, especially where one carriageway of a divided road is closed. The signs shall be placed on both sides of the open carriageway facing pedestrians about to cross.

9.3.4 Footpaths

Temporary footpaths shall provide a clear path of travel and need to be:-

- adequately signposted to indicate the direction of the footway
- of all weather standard including ramps over gutters that may have water velocities above 1m/s
- of equivalent material and performance to the adjacent footpaths and not pose a trip hazard for the range of pedestrians
- at local constrictions not be less than 1m width. Elsewhere a width of at least 2m shall be provided and any additional width to aid stopping sight distance to all road users.

Give care to maintaining good conditions and widths at points of concentration of pedestrians such as in front of shops, schools at bus stops, mono rail stops, storage islands, medians and refuges.

9.3.5 Pedestrian crossings

Give special care to maintaining pedestrian crossing facilities and associated signs during the works. If access to existing crossings cannot be provided, provide alternative facilities as near as possible to the established crossing and at least the same standard. In some cases, on long-term works, grade separated structures such as pedestrian bridges or subways that “span” both the work area and the travel lanes may be appropriate.

Pedestrians shall be prevented from crossing, where:-

- traffic is flowing temporarily in the opposite direction from normal
- medians, refuges or other physical devices separate lanes of traffic flowing in the same direction
- traffic speeds are higher or the drivers will not be alerted to pedestrians
- there is insufficient safe congregation space
- stopping sight distance is not available to all road users.

In these circumstances active control is necessary by:-

- pedestrian actuated traffic signals, or
- supervisors (eg. Traffic Controllers, Police Officers or Civilian School Crossing Supervisors) or
- at the least, directing pedestrians in a chicane so that they face the direction of oncoming traffic with the required stopping sight distance before stepping on to the traffic lanes.

9.3.6 Monitoring pedestrian movements

At work sites where it has been necessary to introduce temporary arrangements for pedestrians, it is essential, especially during the first week, to observe movement patterns of pedestrians and make any changes necessary to ensure that pedestrians are able to move safely. Any observations should cover both day and night conditions as required by the road safety audit process and amendments made to the approved traffic management plan.

9.3.7 Street lighting

Where it is necessary to temporarily divert pedestrians, the works supervisor is:-

- to ensure the temporary pedestrian route is at least as well lit as the permanent route
- to floodlight pedestrian crossings, especially those replacing permanent crossings that are or were lit
- to provide street lighting to aid security for pedestrians in otherwise dark areas.

9.3.8 Security guards or cameras

Where it is necessary to temporarily divert pedestrians, the works supervisor is to aid security and safety for pedestrians:-

- in otherwise dark areas
- in areas that may shield offenders
- in storage areas that may be at a height that if unstable may be a hazard.

9.4 Cyclists

9.4.1 Policy

Recognising the considerable environmental benefits, the RTA is committed to the use of cycling as a transport mode and to the provision of safe and convenient cycling facilities.

9.4.2 ADT less than 3,000

On roads with ADT less than 3,000 vehicles, motor vehicles and cyclists can be expected to share the available road space through work sites.

9.4.3 ADT more than 3,000

For works affecting a cycle route and/or on roads with ADT more than 3,000 vehicles, temporary arrangements will be necessary for cyclists, unless a Traffic Controller is on duty for the duration of the works. Where a Traffic Controller is on duty cyclists may share traffic lanes with motor vehicles, without the need for any special provision.

Where there is no Traffic Controller, the arrangement will depend on the:-

- existing usage (the number of cyclists)
- available width and alignments
- traffic speeds and volumes
- duration of work
- surface material and condition
- environmental impacts
- costs.

As a principle objective of provision for cyclists adjacent to the work site, the pavement surface should be maintained in a clean, smooth state. This may necessitate sweeping of the riding surface regularly.

At work sites without a Traffic Controller (eg. between shifts at long term works), consider the circumstances and provide one of the following:-

- separate bicycle paths, 1.2 m wide for one-way and 2 m wide for two-way flow
- paths shared with pedestrians, 2.0 m wide for one-way and 3.0m wide for two-way flow
- a smooth shoulder, minimum width 1.2 m (2 m required if adjacent to traffic lane with speeds above 60 km/h).

9.4.4 Grooved roads

Milling of roads prior to re-surfacing may present a hazard for cyclists. Where road surfaces are grooved, cyclists should be warned by the display of **CYCLE HAZARD GROOVED ROAD (T2-207)** signs on all approaches.

9.4.5 Lighting of work sites

Where works affecting cycleways are carried out for a period exceeding one day, the works should be made sufficiently visible for night time travel. That is, cyclists shall be able to observe site conditions under low ambient light, including temporary access paths, and take appropriate action.

In addition, as a general principle, lighting on temporary access paths should not be less than the existing level on the original path.

9.4.6 Broad principles

For works affecting cyclists consider also the following:-

- on down grades cyclists may travel at speeds of up to 50 km/h and surfaces shall be able to be ridden on safely at this speed
- many cycles have no suspension making rough surfaces unpleasant and potentially dangerous to travel on
- provision should be made to “feather” the edges of temporary surfaces to remove any hazardous edges
- roadworks signs should be placed above the head height of cyclists
- barrier boards and signs should not be placed such that they force cyclists away from space allocated to cyclists
- **do not place roadworks signs so that they block cycle ways.**



9.5 Working adjacent to traffic

9.5.1 General

This Section is to be read in conjunction with Section 3.6, *Safe clearances between workers and through traffic at static work sites*

Consider the following safety factors where work is being carried out on areas adjacent to or close to traffic:-

- the type of traffic, its speed and volume
- mutual sighting between the workers and road users
- the duration and extent of the work
- the proximity of the work area to moving traffic.

9.5.2 Clearances

It is a requirement to reduce the speed of passing traffic to the following speeds, using appropriate signs, techniques, devices and temporary roadwork speed zones, where there are no intervening physical barriers between workers and traffic:-

- 80 km/h for workers between 6 and 3 metres of traffic (where traffic volumes exceed 10,000 vpd)
- 60 km/h for workers between 3 and 1.2 metres of traffic
- 40 km/h for workers within 1.2 metres of traffic.

Suitable signs, techniques and devices to be considered include:-

- portable traffic signals
- additional traffic controllers
- stopping all traffic
- narrowing lanes
- directing traffic onto sealed shoulders
- pilot vehicles
- plastic barriers to exaggerate narrowing of lanes
- chicanes.

If it is considered that a roadwork speed zone should be installed, refer to Section 8.2, *Roadwork speed zones*.

9.5.3 Principles

For **intermittent work** see Section 9.1.2, *Intermittent work*, for sight distance requirements to check whether a spotter will be required.

For **short-term work**, Traffic Controllers and associated signs are usually adequate to ensure that traffic proceeds slowly around, past or through the work area.

For **long-term work**, where the work area is adjacent to the edgeline or travel path of vehicles and personnel are working (unless having any other protection, such as safety barriers or operating major plant items), plastic mesh fencing supported on posts with delineators should be used to define the work area. The clearance between this fencing and the edge of the adjacent traffic lane should be at least 1.2 m.

In general, a safety barrier should be considered for isolating a work area if one or more of the following apply:-

- the requirements of Section 3.6, *Safe clearances between workers and through traffic*, cannot be met
- the location will continue to be a work area for longer than two weeks
- traffic speeds are likely to be greater than 80 km/h or
- ADT exceeds 10,000 vehicles (or 5,000 vehicles for the carriageway nearer the work area) or
- personnel do not have other protection, such as operating plant.

It is also essential to ensure that if used the safety barrier does not create greater additional hazards, such as presenting unprotected ends, unacceptably narrow travel path, etc.

9.6 Safety barriers

9.6.1 General

Safety barriers, such as precast concrete barriers, some water filled plastic barriers (see Section 3.3.7, *Longitudinal channelizing barriers*) and steel guardfence, are used at work sites to prevent vehicles encroaching on work areas and to ensure the safety of the workers. They shall conform to the requirements of AS3845.

Safety barriers may be required where:-

- (a) protection is required for workers and plant items (refer Section 3.6.3 (i), *Protection by safety barrier system*)
- (b) it is necessary to separate opposing traffic streams where there are potentially hazardous conflicts, such as the risk of head-on collisions

- (c) there are excavations or hazardous fixed objects close to the travelled way
- (d) there is inadequate separation from temporary foot paths or bicycle paths (refer Section 9.3.2, *Defining the work area*).

However, barriers at work sites can present many problems including:-

- sight distance restrictions
- end treatment requirements
- night or adverse weather visibility problems
- the need to provide gaps for local access and access for road plant etc.

Sight distance restrictions may occur where safety barriers or end treatments obstruct the vision of motorists entering the main road from a side road, perpendicular to the safety barrier. The requirements of the work area often prevent the barrier from being tapered away from the main road in the vicinity of a driveway access or a side road intersection. Sight restrictions also occur when barriers are erected on sections of road with tight horizontal curves and the barrier needs to be located close to traffic lanes.

Driveways, intersections and crossovers greatly increase the exposure of barrier ends in most urban areas. In high speed zones where there are limitations on methods of end treatment that protect both motorists and workers, consider imposing a lower speed limit and utilising an end treatment suitable for that lower speed.

Flashing lights may be used to highlight barrier end treatments.

Care is necessary to install and maintain the correct coloured reflectors and lights on barriers so that they can be seen at night. In adverse weather both barriers and reflectors need cleaning so that dirt accumulations do not negate their delineating effect.

9.6.2 Safety barrier systems for temporary works

RTA's Road Design Guide, Section 6 - Safety Barriers for Roads and Bridges, gives details of the attributes of all currently approved barrier systems and terminal treatments. Safety barrier styles are classified as rigid, and non-rigid. See Section 9.6.4, *Warrants*.

The following temporary safety barrier systems are currently approved for use:-

- BARRIERGUARD 800 Steel Safety Barrier
- GUARDLINER Plastic Safety Barrier
- IRONMAN BARRIER Steel Rail Safety Barrier
- J-J HOOKS CONCRETE BARRIER Concrete Safety Barrier

- ROADLINER 2000S Plastic Safety Barrier
- SAFEGUARD LINK Steel Safety Barrier
- T_LOK F-TYPE BARRIER Concrete Safety barrier
- Type F Concrete Safety Barrier
- Triton TL2 Plastic Barrier System
- Triton TL3 Plastic Barrier System

NOTE: This list may change from time to time. Therefore the latest approved barriers should always be checked at:
www.rta.nsw.gov.au/doingbusinesswithus/designdocuments/safety_barriers.html

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9.6.3 Side tracks and detours

The appropriate safety barriers shall be considered on all temporary embankments on side tracks or detours where the vertical height between the edge of the shoulder and the intersection of the batter and the existing surface exceeds 2 m.

9.6.4 Warrants

The types of safety barriers listed in Section 9.6.2, *Safety barrier systems for temporary works*, are systems or devices which have passed crash testing to NCHRP 350 (or equivalent) and are classified as operational in their country of origin. Other systems can only be regarded as delineation fences defining the work areas and not as safety barriers.

Safety barriers are an expensive means of protection for temporary works. Risk analysis techniques shall be used as the basis for making decisions on the use of safety barriers unless required by other sections of this manual. RTA's *Road Design Guide*, Section 6, *Safety Barriers for Roads and Bridges* gives detailed guidelines for analysing risks, severity and design of safety barriers on temporary roads and detours as well as for the protection of workers in defined work areas adjacent to traffic.

9.6.5 Working behind safety barriers

Of the two types of safety barrier systems, rigid and non-rigid, the non-rigid barriers are designed to deflect significantly during a vehicle impact. For a given safety barrier the amount of deflection depends on the speed and angle of impact and the mass of the errant vehicle. This may be a significant aspect in choosing a safety barrier for a work site, and the Project Manager should refer to RTA's *Road Design Guide*, Section 6, *Safety Barriers for Roads and Bridges* which gives details of predicted deflections for approved barrier types. (Refer Section 3.3.7, *Longitudinal channelising barricades*). **(AS 3.10.2).**

9.7 Access to adjoining properties

9.7.1 General

It is highly desirable to maintain both pedestrian and vehicle access to adjoining properties at all times. This not only helps to maintain good relations with property owners, lessees and the residents in the area but is essential for safety reasons in the case of urgent access such as a medical emergency. Pedestrian and vehicle access shall therefore be continuously available unless clear agreement has been reached with the occupants for a temporary restriction.

9.7.2 Standard of access

Temporary access to adjacent side streets and properties shall be trafficable under all normal weather conditions and shall be constructed to reasonable standards matching the side streets and property driveways.

9.7.3 Communication

Effective communication with residents is essential for the work to be carried out safely and efficiently. Changes to access arrangements during works are best advised in writing in the first instance with follow up action in person if possible before the changes are introduced. Written notices may need to be prepared in a number of languages.

9.8 Working at intersections

9.8.1 General

Intersections vary greatly in type, number of legs, number of traffic lanes and forms of traffic control. For this reason, it is difficult to cover all situations in this Manual. Therefore, most roadworks at intersections require a site specific TCP to be designed.

Where there is sufficient distance between intersections, use standard treatments for the signs and tapers on the approaches. Within the intersection the work usually needs to be staged so that sufficient lanes are kept open to handle the traffic flows. Very clearly define these stages of the work using closely spaced traffic cones or temporary barriers.

9.8.2 Principles

The following principles are important when working at intersections:-

- ensure there is sufficient capacity and delays are kept to acceptable levels (avoid excess capacity which may encourage high speeds)
- avoid blockages at the intersection or from downstream queuing as much as possible
- maintain effective control using signs, Traffic Controllers or signals
- make provision for alternative routes if right hand turns or other movements are temporarily banned at the intersection
- clearly define work areas so that road users can easily identify paths available for traffic within the intersection
- ensure that guide signs are clearly visible and not obstructed by road plant or temporary signs (if necessary relocate)
- restrict work to periods outside peak traffic flows if the intersection is a critical one within the road network.



9.8.3 Examples

For the reasons given in Section 9.8.1, *General*, it is difficult to provide standard TCPs at intersections. One such example for long-term work is given in this manual as standard TCP 60.

More examples will be considered for inclusion in later revisions of this manual but working at intersections will always require some additional specification at least in the form of individual job instructions. Traffic control at traffic signals is specifically covered in Section 9.9, *Working at traffic signals*.

9.9 Working at traffic signals

9.9.1 General

This section deals with how traffic should be controlled in the vicinity of traffic signals whilst maintenance or re-construction work is in progress. In most cases, traffic signals work involves only short duration traffic controls that can be quickly set up and dismantled, but are still effective in directing traffic around work areas.

At certain defined sites police control is essential or may be desirable and arrangements should be made with the relevant police station in advance.

9.9.2 Procedures to be followed

When closing off a lane, always work in the direction of traffic flow, starting at the farthest point from the job. Where possible, the vehicle (with warning lights and hazard flashers operating) should be stopped at the start of the layout (i.e. beginning of the taper). Both the vehicle and the person placing the layout can then move cautiously in the direction of traffic flow until the taper is completed.

The taper is the most important part of any layout and care should be taken when placing it. For work carried out clear of traffic the length of tapers should be 30 m for 60 km/h zones and 50 m for 80 km/h zones. Where possible for installation of a new site or major reconstruction the lengths should be increased to D m (i.e. 60 m for the former and 80 m for the latter) if plant or labour is required to work on the roadway. The cones should be spaced 3 – 5 m apart.

If the work area is beyond a crest or curve with limited visibility to the approaching motorist (less than 100 m) then the layout should be extended in advance of the crest or curve, if possible.

While work is proceeding, the work vehicle should be parked between the layout and the job where possible, with hazard warning lights operating at all times. This is to prevent injury to personnel if a vehicle runs through the layout.

If a work vehicle is not parked in the closed-off lane, an extra (approximately 10 m to 15 m) length should be added between the end of the taper and the work area. Cones should be placed on the lane line between the end of the taper and the work area.

The layout should be dismantled only after all materials and equipment have been removed, so that the lane can be re-opened quickly (i.e. the layout should not be removed before the vehicle is ready to move). The layout should be picked up by personnel walking against the traffic flow. Two persons should remove the taper, one picking up the cones and the other picking up the signs and guiding the traffic. Vehicles should not be driven against the flow of traffic when picking up layout equipment.

Care should always be taken with pedestrian traffic. Sufficient clear space should be provided during the work to permit pedestrians to cross safely. Where excavations are left unattended, sufficient barriers and warning lights shall be provided so that the area is safe for both vehicles and pedestrians.

It is important to check the site at the end of the work to ensure that no potential hazards to pedestrians and vehicles remain.

9.9.3 Examples

Standard TCP 60 is a general TCP which shows some of the controls that can be used at urban intersections for long-term work such as a new site or major reconstruction.

Standard TCPs covering typical situations are described in Table A-15, *TCPs for traffic signal works* (Appendix A) and Appendix D, *Traffic control plans*. These standard TCPs show traffic control devices close to the work. If further advance warning is required then such signs should be erected in accordance with standard TCP 60. It should be noted that it is very difficult to cover all possible situations. The standard TCPs should be used to formulate layouts for other situations. In this regard the good judgement of the site supervisor will be invaluable.

9.9.4 Signs and warning devices

The following are special signs which may be used in conjunction with other warning signs to highlight the work:-

- **SIGNALS OUT OF SERVICE** (T1-220)
- **MERGE** (T1-221)

Measures may need to be taken to prevent vehicles parking in the kerbside lane where other lane/s are blocked.

All signs and warning devices shall be checked regularly to ensure they remain in their correct positions and that flashing lamps (if used) are operating.



9.10 Working on roadsides (AS 4.3.7)

Although work on roadsides means that the work area is clear of traffic, workers shall realise that they may still be working close to traffic and adjacent to shoulders or parking lanes. Take the following precautions when attending parked work vehicles:-

- take all tools and stores from the side of the vehicle further away from traffic (and/or the rear if there is no risk of errant vehicles impacting on the rear of the vehicle)
- where possible, park work vehicles to shield workers from the path of errant vehicles.

See Sections 3.6.1, 3.6.2 and 9.5 for guidance when working on roadsides.

For long term work, where personnel are working close to the edgeline or travel path of vehicles (unless they have other protection, such as operating major plant items) plastic mesh fencing supported on posts with delineators should be used to define the work area. This fencing should be located such that the clearance between it and the edge of the adjacent traffic lane is at least 1.2 metres.

In general, a safety barrier should be considered if any of the conditions exist as described in Section 9.5.3.

9.11 Excavations

Special consideration of the safety of both workers and traffic is needed while traffic flow is adjacent to excavations. Any safety barriers installed will be in addition to any barriers required for excavation fall protection of workers and pedestrians. In planning and carrying out works, priority is to be given to backfilling all excavations near traffic.

Excavations shallower than 0.5 m and within 3 m of the travel path or edgeline should be defined by plastic mesh fencing, barrier boards perpendicular to the traffic flow, cones, bollards or similar delineation while the adjacent lane is not under traffic control.

A safety barrier shall be erected where traffic flows without a Traffic Controller beside an open excavation, deeper than 0.5 m and within 3 m of the travel path or edgeline.

An appropriate safety barrier shall be used for isolating work areas with excavations where the excavation depth exceeds 200 mm if:-

- the excavation remains open longer than two weeks, and
- the distance of the excavation to the travel path or edgeline is less than
 - 3 m for 60 km/h approach speed
 - 6 m for 80 km/h approach speed
 - 9 m for 100 km/h or faster approach speed.

If the Project Manager considers that compliance with these requirements is not practical or warranted, a more thorough risk analysis should be made based on RTA's *Road Design Guide*, Section 6, *Safety Barriers for Roads and Bridges*.

9.12 Bituminous works

Bituminous works or other pavement surfacing works may be conducted under traffic or the work area may be clear of traffic. In most cases there will be some interruption to traffic either from the work or from plant and vehicles associated with the work. Keep this interruption to traffic to a minimum by careful planning and execution of the work. Such planning and control of the work will also assist in the safe completion of the work.

It is good practice to advise the local community in advance of planned bitumen sealing works especially on busy roads.

The Project Manager shall ensure that risks in the bituminous works are taken into account in planning the work so that traffic delay does not exceed a maximum of 15 minutes. This suggests an operations cycle of not longer than 10 minutes, and involves determining the following:-

- widths and lengths of area to be treated
- timing to avoid peak traffic periods
- whether to introduce side tracks or detours
- temporary closure of intersecting roads.

In the case of bituminous spraying works take care to ensure that wet bitumen or loose stones do not cause a hazard to traffic. For this reason, monitor the works for some days, and adjust signs or temporary speed zones to suit the road conditions.

For signs at sprayed sealing works, the four stages to consider are:-

- before sealing begins
- during the sealing operations
- until the last loose stones are removed
- until the appropriate line marking and road markings are fully restored.

Where sealing works are undertaken in areas where the posted speed limit is greater than 60 km/h then a 60 km/h roadwork speed zone shall be installed and shall remain in place until the number of loose aggregate particles remaining in place falls to the specified level.

Where road condition signs (such as slippery surface (T3-3), **LOOSE STONES** (T3-9) etc) are installed they shall remain in place until the above requirements, regarding loose aggregate particles, are met. **(AS 3.7.2)** Signs warning of the absence of linemarking are not to be removed until all linemarking is reinstated (see Section 5.2.3, *Requirements for specific signs*). **(AS 3.7.4)**



9.13 Surveying

The Survey Party Leader is responsible for the safety of the survey party.

The traffic control arrangements for long-term work (such as construction sites) should have been put in place by the personnel responsible for the work. If so, the Survey Party Leader will:-

- determine who is the Works Supervisor
- satisfy himself or herself that the procedures in place have been approved
- satisfy himself or herself that the procedures will accommodate the type of survey work that the party intends to do
- discuss with the works supervisor any changes considered essential and ensure that approval to the changes is obtained.

Where there is no TCP in place, the Survey Party Leader will choose and implement or ensure that a trained person chooses and implements the plan which best fits the work site.

Thus in applying relevant sections of this manual, the Survey Party Leader selects competent people to assume the responsibilities of both the team leader and the works supervisor.

Survey work can be mobile, intermittent or short-term work, depending on the circumstances. Traffic control requirements should be assessed accordingly.

Survey work in travelled lanes can be performed as planned intermittent work or under lane closure using the appropriate TCP.

For survey work on the roadside, that is areas between the reserve boundary and the nearest road shoulder, all survey party members shall wear high visibility garments in accordance with RTA Policy contained in the OH&S Manual. Roadside signs will not generally be required for such work, but if movements from one side of the road to the other are required these shall be undertaken with extreme caution.

Surveying on a busy urban road at an approach to traffic signals while traffic is stopped for a red signal is acceptable as intermittent work provided a spotter is on duty to observe signals and traffic while accompanying the person carrying the survey reflector.

9.14 Vehicle inspections

9.14.1 General

RTA Inspector Vehicle Regulation (IVRs) carries out inspections of vehicles to determine compliance with the various Acts and Regulations administered by the RTA.

The objectives of inspections are to ensure that:-

- vehicles are roadworthy
- vehicles are not overloaded
- loads are properly secured
- vehicles are within vehicle construction limits
- vehicles are registered.

Drivers of heavy vehicles shall also be properly licenced and not exceed driving hour limits.

The objectives of the checks are road safety, asset protection and regulatory compliance.

9.14.2 Stopping vehicles

Inspector Vehicle Regulation carries out inspections on vehicles by day and night. These inspections are carried out at:-

- **Fixed Sites** are specially designed facilities constructed off the carriageway to undertake all or some Vehicle Regulation tasks. In most cases the site has permanently fixed signage identifying RTA inspection facility however portable signage is acceptable. Normal traffic goes around sites and the site is located off the carriageway and the maximum approach speed is 80km/h and at times speed restrictions apply. Some permanent fixed sites may be used for other activities such as driver reviver when not used for inspection purposes. Many sites have lighting and other facilities such as toilets. TCPs VR101 &102 refer.
- **Planned Sites** are not specifically constructed for Vehicle Regulation tasks and are often identified to passing traffic via portable traffic control devices. Normally, traffic goes around sites and the site is located off the carriageway. Principally, planned sites are used for static intercepts and are suitable for all or some Vehicle Regulation tasks. Some planned sites are used for other activities such as driver reviver when not used for inspection purposes. TCPs VR201 &202 refer.
- **Mobile Intercept Sites** are used where there are concerns about the target vehicle. Often there is limited or no advanced warning to other traffic and normal traffic may pass through or around the site. The RTA and target vehicles are mobile prior to interception and often the site is not selected by the intercepting officer. Limited Vehicle Regulation tasks are conducted according to TCP activity checklist and minimal time spent on site. It may be necessary to redirect the target vehicle to a more appropriate site if tasks other than those identified prior to intercept are to be conducted. Tasks are restricted to a single vehicle. TCP VR401 refers.



- **Static Intercept** is only conducted at a Fixed, Planned or Temporary site where traffic can pass through the work site without crossing the adjacent traffic lane. The enforcement vehicle is stationary and the target vehicle is mobile. There is limited or no advance warning to traffic. The intercepting officer directs the driver of the target vehicle with an approved sign and shall stand in the marked safe work zone as outlined in the site vehicle movement plan. Vehicle Regulation tasks are conducted according to TCP activity check list. TCP VR402 refers.
- **Temporary Site** is often used where there are immediate road safety concerns in respect of the target vehicle. These sites are only used where no Fixed or Planned sites are available or target vehicle movement is impractical. The target vehicle may be redirected from an intercept site to a temporary site where limited checks can be carried out. Temporary sites are selected by the intercepting officer and there is limited or no advance warning to other traffic. Tasks are restricted to a single target vehicle and are conducted according to TCP activity list. Temporary sites can be used for conducting inspections during Authorised Inspection Station Audits and Authorised Unregistered Vehicle Inspection Station Audits. Normal traffic may pass through or around the site. TCPs VR301 - 311 refer.
- **Accident/Incident Sites** are where one or more damaged vehicles and or debris are on the site. The site is normally under the control of a site commander, often from another agency. Due to the nature of the work limited or no advanced warning is given to other traffic and advanced warning may be removed when other agency personnel depart site. The site is never chosen by the IVR and normal traffic may pass through or around the site. Detailed inspections and observations are often carried out on site however it is preferred that the vehicle is recovered and transported to a secure facility for inspection. Incident observations often occur outside controlled areas. A safe work method statement identifies critical steps and potential risks.

9.14.3 Site risk assessment

To determine the appropriate TCP, an assessment shall be made to determine the average daily traffic flow (ADT) for all Temporary Sites.

Fixed and Planned Sites will be determined by annual average daily traffic AADT figures as these activities may be carried out over one or more days.

Any TCP implemented shall cater for the greatest traffic volume likely.

To determine an appropriate TCP for Temporary Sites the following steps shall be used, in order of preference:-

1. Use Table 9.3 to estimate current traffic flow by counting traffic passing in both directions for five minutes and converting this data to approximate the ADT. In practice, most traffic is within the period of 6:00am to 10:00pm, a 16 hour period. Hence a 5 minute count of 5 vehicles may better equate to the following calculation of 16 hrs x 60 vehicles = ADT 960.
2. If no Traffic Volume Data is available and there is insufficient time to do the 5 minute count – an ADT figure of > 1500 shall be used in TCP determinations.
3. Determine the appropriate TCP from the *Traffic Control at Vehicle Regulation Work Sites Manual*.

NUMBER OF VEHICLES PASSING IN 5 MINUTES	CALCULATION	ESTIMATED ADT
8 or more vehicles	16hrs x 96 vehicles = 1536	> 1500
7 vehicles	16hrs x 84 vehicles = 1344	> 1000 but ≤ 1500
6 vehicles	16hrs x 72 vehicles = 1152	> 1000 but ≤ 1500
5 vehicles	16hrs x 60 vehicles = 960	> 300 but ≤ 1000
4 vehicles	16hrs x 48 vehicles = 768	> 300 but ≤ 1000
3 vehicles	16hrs x 36 vehicles = 576	> 300 but ≤ 1000
2 vehicles	16hrs x 24 vehicles = 384	> 300 but ≤ 1000
≤ 1 vehicle	16hrs x 12 vehicles = 192	< 300

Table 9.2 Estimating ADT

NOTE: Traffic shall be counted in both directions to determine the total traffic volume per 5 minutes

9.15 Traffic counting

9.15.1 Training

Field traffic counting involves the recording of road traffic volume. Road-side recorders receive signals from road-mounted sensors. Sensors are often rubber tubes that vehicles tyres create a pressure pulse in, recorded as being the axle of a passing vehicle. Only officers trained in traffic control and safe-working shall undertake such activities related to traffic counting.

Safe work instructions and guidance in the use of the safety equipment shall be provided to all Traffic Counting Officers (TCOs) by the immediate Supervisor. Location specific on-site instruction shall be given to minimise the risk to personnel and traffic.

A period of guidance shall be provided by experienced TCOs working alongside new personnel. Insight shall be given into the nature of vehicular traffic and identifiable risks, allowing the development of skills required for safe working.

9.15.2 Selecting a traffic counting site

Selecting an appropriate site to install counting sensors or tubes is the first step in reducing the risk to staff. A site that is safe will also be more likely to yield quality traffic counting data.

The location is usually designated by road name, compass direction and distance from a cross street or other feature. Apply the following criteria when selecting sites to install counting sensors:-

- **sight distance** – if all other factors are satisfied by more than one site, choose the site with the best sight distance
- **traffic speed** – select a site within the lowest speed zone such as a 60 km/h zone instead of an 80 km/h zone
- **proximity to speed reduction facility** – select a site downstream of a set of traffic signals or a roundabout for example. Such a feature can also create breaks in the traffic flow to facilitate safe installation and servicing of traffic counting equipment.
- **number of lanes** – select a site with more than one lane or a wide shoulder in the direction of traffic flow. This enables traffic to be channelled around the work site instead of being stopped. Consider also sites with fewer lanes to reduce road exposure to flaps, nails and the like.
- **road surface** – select road surfaces free from wheel ruts and surface irregularities in the area where sensor tubes are to be placed.
- **roadside furniture/objects** – ensure the site has a pole or tree to secure the recording equipment. In urban areas, proximity to a street light is desirable.
- **parking** – in built-up areas exclude sites with on-street parking so that traffic safely flows around the work area. The quality of the recorded data will also be improved.

9.15.3 Weather conditions

During times of wet weather extra care needs to be taken. Longer sight distances are required and work should not be undertaken where fog exists unless the appropriate sight distance is clear. Where weather conditions create a hazard the TCO shall defer the work until the weather clears. Alternatively they shall seek support from a district office or works depot for the purposes of positive traffic control thereby reducing the work hazard. In the case of contract work such arrangements shall be made with the RTA representative supervising the contract.

9.15.4 Time of day

Work is to be planned for predominantly during normal working hours. However, for sites with high traffic flows arrangements should be made to work during times of low traffic flow.

Night-time work necessitates that adequate street lighting is provided. Approved night-time high visibility clothing is to be worn, as defined out in the RTA *Occupational Health and Safety Manual*, Section 5.4, *Wearing of High Visibility Vests and Garments*.

In built up areas where traffic standing restrictions apply, work during the restricted hours shall not proceed that would obstruct traffic.

9.15.5 Intermittent work

Refer to Section 9.1.2, *Intermittent work*.

Traffic surveying equipment may be installed as intermittent work on travel lanes without using temporary advance signs where the following conditions apply:-

- staff shall wear approved high visibility external clothing, and
- the work shall be abandoned immediately where risk to staff or traffic is evident
- the work vehicle shall be parked on the road-side prior to the work location. The vehicle shall have hazard lights operating , a rotating or flashing yellow light on the roof or raised boot lid (whichever is higher) switched on, and a double sided, vehicle mounted sign displaying work information
- sight distance meets the criteria in Table 9.1, depending on whether a spotter is available. Otherwise, work shall be abandoned and personnel shall leave the road when approaching traffic is within these distances of the work area.

The minimum acceptable sight distance should be determined according to the estimated approach speed of vehicles. Traffic control devices such as traffic signals or roundabouts slow the traffic. In open areas traffic may be well above the speed limit.

The TCO shall assess the traffic conditions and observe whether gaps in the traffic are large enough to carry out the activity. The assessment of a suitable gap is based on the time it would take to carry out the planned activity and return to the road-side. Sight distance is the criterion to use in this situation as it may be difficult to estimate the time it takes for an approaching vehicle to reach the work area.



9.15.6 Responsibilities

The TCO is responsible for assessing the safe location and timing of traffic counting operations. Training is to be supplemented with field experience to allow development in staff of the necessary skills to make such assessments.

Prior to undertaking physical work within travel lanes, the TCO shall first determine if acceptable sight distance exists and whether gaps between vehicles are available. Consideration should also be given to selecting days and times of minimum traffic flow.

Minimum sight distances shall be selected from those listed in Table 9.1 no matter whether a TCO is operating alone or with a spotter. Where acceptable sight distance or traffic gaps are not available, the TCO shall request a higher level of traffic control. This may include the presence of one or more spotters suitably positioned to provide the required 10 seconds warning.

Equipment such as two-way radios can assist in effective communication between spotters and TCOs. Where radio communication is not available, Traffic Controllers may be needed to control traffic during the work.

If any of the responsibilities noted here conditions cannot be met then arrangements shall be made with the district office or works depot to provide full traffic control, or in the case of contract work, with the RTA representative supervising the contract.

9.16 Testing road condition

9.16.1 General

This section covers traffic control for some of the more common forms of condition testing and monitoring of roads under traffic. Two distinct work crews often work together when testing work is being carried out, with one crew responsible for the testing and another for traffic control. It is essential that:-

- all members of the testing crew clearly understand who is responsible for traffic control, and
- all members of the traffic control crew are familiar with the testing process.

9.16.2 Benkelman Beam

Benkelman Beam tests give an indication of pavement strength. The test comprises a rigid truck with standard load and tyres on the rear axle, and a Benkelman Beam apparatus placed on the road immediately behind the rear axle of the truck. The truck driver remains in the truck which moves slowly forward 9 m for each test and then proceeds to the next test site. Test sites are typically 10 m to 50 m apart.

Typically the average speed of progression for Benkelman Beam testing is unlikely to exceed about 3 km/h, and the operation is virtually stationary. One or more testing operators walk behind the truck taking readings and carrying the apparatus forward from one test site to the next.

Traffic control for Benkelman Beam testing may be set up either as short-term work or mobile work, depending on the number of lanes available for traffic and the spacing between tests.

As short-term work, the traffic control system consists of roadside signs and, if necessary, Traffic Controllers. As mobile work, the traffic control system comprises a Shadow Vehicle and an Advance Warning Vehicle, with traffic control devices mounted on these vehicles.

On divided roads and undivided roads with 4 or more lanes, a mobile arrangement will generally be more suitable.

Table A–8, *TCPs for Benkelman Beam testing* (Appendix A), shows a number of standard TCPs which should be considered when planning Benkelman Beam testing. Standard TCPs 104 and 453 have been prepared specifically for Benkelman Beam testing. They show a Work Vehicle which is the truck with the standard axle load. The Benkelman Beam and operator will be immediately behind the Work Vehicle. The other TCPs mentioned in Table A–8, *TCPs for Benkelman Beam testing* (Appendix A) have been prepared for a wider range of work and show a work area distinct from the Work Vehicle. When these TCPs are used for traffic control for Benkelman Beam testing, the Work Vehicle and the work area are at the same location.

9.16.3 Deflectograph

A Deflectograph gives an indication of pavement strength by measuring the deflection of a pavement under a standard load. It is mounted on a rigid truck which has two crew members – the driver and the operator. The driver occupies the normal driving position, and the operator occupies a separate cabin behind the driver.

During testing, the truck moves at a very low uniform speed (typically up to 4 km/h), pulling a sled along the pavement beneath the truck and within the wheelbase area. There are no workers outside the vehicle.

Traffic control for Deflectograph testing should be set up as mobile work with an Advance Warning Vehicle and where necessary a Lead Vehicle and Traffic Controllers. A Shadow Vehicle is not required.

At traffic signals the Deflectograph stops when it arrives at the stop line and moves forward at the start of the next green phase, ensuring that it does not get caught within an intersection against a red signal.

Table A–10, *TCPs for Deflectograph and Falling Weight Deflectometer (FWD) testing* (Appendix A) shows the TCPs for Deflectograph testing. These TCPs are also suitable for other forms of testing where all testing personnel remain inside vehicles during the work, and the work progresses slowly along a traffic lane.



9.16.4 Profilometer

A profilometer is generally used to measure the longitudinal and transverse profile of a pavement. The host vehicle is mounted with a bank of lasers and a data recording system inside the vehicle. There are two crew members – a driver and an operator. The driver occupies the normal driving position, and the operator occupies the front passenger seat during testing.

Testing is conducted at speeds between 20 km/h and 100 km/h, depending on the speed limit at the test site. Speed may vary during the testing, and generally the test vehicle travels with the traffic flow. There are no workers outside the vehicle.

The driver is able to pay full attention to and respond to normal traffic conditions without affecting the testing process. If necessary the driver can readily take evasive action in an emergency, aborting the testing process. The testing normally presents no obstruction to traffic. The only forms of traffic control necessary are a rotating or flashing yellow light and a warning sign mounted on the road testing vehicle, and clearly visible from the rear.

Where traffic conditions do not allow operation at speeds between 20 km/h and 100 km/h (eg., at busy intersections and pedestrian areas), separate traffic control will be necessary possibly using a site specific TCP or arranging with traffic signals staff to modify signal operation temporarily. The officer responsible for organising the testing should seek advice or assistance from the local road maintenance works supervisor in this regard.

9.16.5 NAASRA Roughness Vehicle

A NAASRA Roughness Vehicle is used to test the riding quality of a pavement. It consists of a station wagon (eg. Holden Commodore) with a device known as a NAASRA Roughness Tower connected to the rear axle and a data recording system which measures the roughness value of the road. The roughness device and the data recording system are inside the vehicle.

There are normally two crew members – a driver and an operator. The driver occupies the normal driving position, and the operator occupies the front passenger seat during testing.

Testing is conducted at either of the two standard speeds – 50 km/h and 80 km/h, depending on the speed limit at the test site. There are no workers outside the vehicle.

The driver is able to pay full attention to traffic conditions without affecting the testing process, and the testing normally presents no obstruction to traffic. If necessary the driver can readily take evasive action in an emergency, aborting the testing process.

The only forms of traffic control necessary are a rotating or flashing yellow light and a warning sign mounted on the vehicle, and clearly visible from the rear.

Where traffic conditions do not allow operation at a constant standard speed of 50 km/h or 80 km/h (eg., at busy intersections and pedestrian areas), and a continuous survey is required through an intersection a separate traffic control may be necessary possibly using a site specific TCP or arranging with traffic signals staff to modify phasing temporarily. The officer responsible for organising the testing should seek advice or assistance from the local road maintenance works supervisor in this regard.

9.16.6 SCRIM

A SCRIM measures the skid resistance of a pavement at constant speeds. It is self contained and consists of a tank to hold water to wet the pavement, and equipment capable of measuring and recording the skid resistance. There are two crew members – a driver and an operator. The driver occupies the normal driving position, and the operator occupies the front passenger seat during testing.

During testing, the road in front of the test wheels is kept wet by a regulated flow of water from the tank and the vehicle travels at a constant speed of 50 km/h. Alternative speeds can be used for specific sites such as roundabouts. There are no workers outside the vehicle.

The driver is able to pay full attention to traffic conditions without affecting the testing process and the testing normally presents no obstruction to traffic. If necessary the driver can readily take evasive action in an emergency, aborting the testing process. The only forms of traffic devices necessary are a rotating or flashing yellow light and a warning sign mounted on the vehicle, and clearly visible from the rear.

Where traffic conditions do not allow operation at a constant standard speed of 50 km/h or the alternative speed of 20 km/h, (eg., at busy intersections and pedestrian areas), and a continuous survey is required through an intersection, a separate traffic control may be necessary, possibly using a site specific TCP or arranging with traffic signals staff to modify phasing temporarily. The officer responsible for organising the testing should seek advice or assistance from the local road maintenance works supervisor in this regard.

9.16.7 Falling Weight Deflectometer

A Falling Weight Deflectometer (FWD) is a trailer mounted device for measuring pavement strength. During transport between sites it is towed behind a light commercial vehicle, and can travel at normal road speeds. Typically there is one crew member – a driver/operator. There are no workers outside the vehicle.

During a test the FWD is stationary. A test takes about a minute (from 45 seconds to 1 minute 30 seconds), and the spacing of tests varies typically from 20 m to 100 m. During testing the FWD progresses at an average rate of between 0.5 km/h and 3 km/h. The speed of progression for 50 m test spacing is about 2 km/h.

Traffic control for FWD testing should normally be set up as mobile work with an Advance Warning Vehicle and where necessary a Lead Vehicle and Traffic Controllers. A Shadow Vehicle is not needed for FWD testing. Traffic control as short term work may be suitable in some circumstances.

Refer Table A-10, *TCPs for Deflectograph and FWD testing* (Appendix A).

9.16.8 ROADCRACK™

The ROADCRACK™ equipment detects, measures, and classifies road cracking in real time and at highway speeds of up to 100 km / h.. The equipment consists of specialised digital image technology which is mounted on a truck. There are two crew members – a driver and an operator. The driver occupies the normal driving position, and the operator occupies the front passenger seat during testing.

Testing is conducted at speeds of up to 100 km/h, depending on the speed limit at the test site. Speed may vary during the testing, and generally the test vehicle travels with the traffic flow. There are no workers outside the vehicle.

The driver is able to pay full attention to and respond to normal traffic conditions without affecting the testing process. If necessary the driver can readily take evasive action in an emergency, aborting the testing process. The testing normally presents no obstruction to traffic.

The only forms of traffic control necessary are a rotating or flashing yellow light and a warning sign mounted on the road testing vehicle, and clearly visible from the rear.

9.16.9 GIPSICAM

The GIPSICAM van is a special-purpose vehicle for taking road survey videos whilst measuring position and geometry as it drives along the road at speeds up to 80 km/h. It is a light van fitted with special equipment within the van and on the roof.

There are two crew members, driver and operator. The driver occupies the normal driving position, and the operator occupies the front passenger seat during surveys. Setting up for a survey run is done at a safe parked position, at which the driver and operator shall wear approved high visibility external clothing whilst working outside of the van in the vicinity of traffic.

Surveys are conducted at speeds of up to 80 km/h, subject to the local speed limits. Speed may vary during the survey, but the van generally travels with the traffic flow up to 80 km/h. There are no workers outside the vehicle during a survey run.

The driver is able to pay full attention to and respond to normal traffic conditions without affecting the surveying operation. If necessary the driver can readily take evasive action in an emergency, which may involve aborting the survey. Safety overrides technical operation at all times and the driver is fully responsible in this regard.

The surveys normally present no obstruction to traffic, but the van will pull over if there is any unreasonable impediment to other road users. The only forms of traffic control necessary are rotating or flashing yellow lights and warning signs mounted on the van, and clearly visible from the rear. The rear facing signs are “CAUTION – ROAD SURVEY VEHICLE” (black on red), “CAUTION VAN MAY SLOW” (black on red) and “PASS WHEN SAFE” (black on yellow).

9.16.10 ROCOND

Road condition (ROCOND) monitoring (also known as ROCOND rating) is a manual method of assessing and recording the overall condition at a point in time of a section of road.

ROCOND monitoring is carried out by visual observation of road features. ROCOND rating involves two people (ROCOND raters) travelling in a light vehicle and stopping intermittently to walk on the road.

Only one of the ROCOND raters is to be on the road pavement when outside their vehicle. The other ROCOND rater is to act as a lookout. The spotter is to be positioned off the pavement adjacent to the rater who is on the pavement.

For traffic control purposes, ROCOND rating is usually intermittent work, as described in Section 9.1, *Intermittent work, Planned work, where a spotter shall be used.* Where requirements for planned intermittent work cannot be met, then work is to be abandoned and a mobile work traffic control system put in place.

in a mobile work traffic control system Shadow Vehicles and Advance Warning Vehicles are necessary. A Lead Vehicle may also be necessary on a two-way carriageway. The raters light vehicle may be used as the Shadow Vehicle provided it is fitted with appropriate signs.

9.17 Mobile work

Mobile work is defined as work which entails vehicles moving along the roadway continually and at a speed significantly lower than other traffic and obstructing or partially obstructing traffic lanes. Direction of travel is the same as normal traffic flow. All signs and warning devices shall be mounted on moving vehicles in the convoy. All vehicles and plant items in the mobile works convoy, other than minor plant items, shall have fitted a flashing arrow sign.

Examples of mobile works are linemarking, placing of raised pavement markers and pavement testing. The following sections describe the vehicles used for mobile work, their purpose and positioning.

9.17.1 Work convoy arrangements (AS4.6.2)

A mobile works convoy shall be made up of the following vehicles as required for the relevant road situation:-

A **Lead Vehicle** is required on two-way roadways when working on the dividing line. It precedes a work area and has three main purposes:-

- it warns oncoming road users of the work
- the driver can alert following workers early to any impending danger from oncoming traffic
- it can shield workers from approaching traffic.

A **Work Vehicle** is the vehicle or item of plant which undertakes the work (eg a linemarking machine) or supports the workers on foot behind it.

A **Shadow Vehicle** follows closely behind the work area as the work progresses. Its main purpose is to shield from traffic those workers who are not in vehicles but are working on foot behind the work vehicle. This vehicle shall travel a clear distance of 20 to 40 metres behind the Work Vehicle and consideration should be given to fitting the vehicle with a truck-mounted crash attenuator when it is protecting workers in a traffic lane.

A **Tail Vehicle** follows some distance behind the work area. The main purposes of a Tail Vehicle are:-

- to warn following road users of the work
- to divert traffic around the work area
- to enable the driver to alert workers of any impending danger.

An **Advance Warning Vehicle** is positioned about 1 km behind the work convoy to give advance warning to following road users.

9.17.2 Operating principles (AS 4.6.3)

Advance warning (AS 4.6.3 (f))

Vehicles providing advance warning shall travel at the following convoy spacings:-

- I. Where sight distance is good:-
 - a. Lead vehicles travel 200 m to 400 m in open road areas or 30 m to 100 m in built-up areas in advance of the work vehicle
 - b. Tail vehicles travel 300 m to 500 m in open road areas or 200 m to 300 m in built up areas behind the work vehicle or shadow vehicle if one is being used. This vehicle may be dispensed with if the speed limit is 60 km/h or less.

II. Where sight distance is poor:-

- a. The lead vehicle shall move as necessary beyond the distances given in (i) above to a point where good sight distance is regained, and remain there until the work vehicle catches up.
- b. The tail vehicle shall hold at a position of good sight distance until the work vehicle has progressed to a point where the tail vehicle can move through the section with restricted sight to a point where good sight distance is regained.

Work on two way roads (AS 4.6.3 (e))

- (i) Wherever practicable, following traffic shall be directed to pass to the left of the work convoy by flashing the left barb of the flashing arrow sign.
- (ii) Where it is not possible for traffic to pass to the left and opportunities to pass to the right do not exist the work shall be stopped periodically by pulling off the traffic lane and allowing following traffic to pass.
- (iii) Traffic shall not be directed to completely cross a dividing line into the path of oncoming traffic nor to cross a freshly marked line if that would result in the marking being damaged.

Work on freeways (AS 4.6.3 (i))

A second tail vehicle shall be provided for work on freeways. The two vehicles shall be arranged to form a mobile taper with the first vehicle travelling to the left or the right of the occupied lane and the second (closer to the work vehicle) travelling in the occupied lane.

Supplementary vehicle-mounted signs (AS 3.12.3)

Additional signs, such as Workers (symbolic) (T1-5), where workers are on foot, **WET PAINT ON ROAD** (T2- 237) or **ROAD PLANT AHEAD** (T1-3-2), may be used on vehicles displaying a flashing arrow sign. Sign sizes shall be in accordance with Section 3.2.2.

9.17.3 Workers on foot

To give maximum protection to workers on foot, work vehicles and shadow vehicles should be positioned in line with the right or left boundary of work area, depending on which is more exposed to traffic. In some cases the lead vehicle or shadow vehicle or both may be partly within the lane of oncoming traffic.

Advance warning Vehicles should mostly be positioned in the same lane or straddle the same line as the work vehicle. However for work near the centre of a multi-lane undivided road and near the median on a divided road, the Advance Warning Vehicle should be to the right of the carriageway to divert traffic around the left of the work area.



When using Flashing Arrow Signs in conjunction with works on two lane, two way roads, or in short overtaking or climbing lanes ensure that the arrow is turned off and that the warning mode is turned on. On multilane roads the arrow can be flashed to the direction where it is safe to pass.

A 40 km/h speed zone shall be installed where workers are within 1.2 metres of moving traffic. For mobile work speed zones see Section 8.2.9, *Mobile speed zones*.

9.18 Working in the vicinity of railway lines

To ensure compliance with Rail Safety Act 2003 and duty of care under the Occupational Health and Safety Act 2000. The safety procedures outlined here shall be applied whenever work is carried out in the Rail Corridor.

9.18.1 Definitions

- **Rail track owner** - The owner and maintainer of the rail network.
- **Rail Corridor** - The area within rail boundary fence lines, or if there are no fences, everywhere within 15 metres of the outer most rails.
- **Rail traffic** - Trains and all other on-track vehicles.
- **Personal Protective Equipment** – Equipment worn by workers to reduce their exposure to hazards. The colour of safety vests when working in rail corridors is determined by the rail track owner.
- **Protection Officer (Rail)**- The authorised qualified worker responsible for protection and management of the safe interaction of work at the site, and the rail network.
- **Danger Zone** - Everywhere within 3 metres horizontally from the nearest rail and any distance above or below these 3 metres.

9.18.2 Working within the rail corridor

If the situation is such that either employees, contractors, plant, equipment or materials are located within or are likely to be within the Rail Corridor then the manager authorising the work is responsible for ensuring that:-

- the rail track owner is advised
- arrangements are made for the rail track owner to provide a Protection Officer (Rail) to ensure the safe interaction between the work and the rail network

The site supervisor understands that where a Protection Officer (Rail) is provided:-

- they shall follow the instructions of the Protection Officer (Rail), and
- work is not to be carried out if the Protection Officer (Rail) is off-site.

The supervisor in charge of the site is responsible for ensuring that:-

- all persons (RTA staff and contractors) on-site understand the need to follow instructions of the Protection Officer (Rail) All persons (RTA staff and contractors) on-site shall wear approved rail standard safety vests and other Personal Protective Equipment
- where required, arrangements are made with the Rail Track owner to provide persons with rail safety awareness training
- all persons comply with the instructions of the Protection Officer (Rail)
- work is not carried out within the Danger Zone when the Protection Officer (Rail) is off-site.

The workers on-site (whether RTA, council, contractors, public utility bodies) are responsible for:-

- working in accordance with instructions of the Protection Officer (Rail), and
- not entering the Danger Zone when the Protection Officer (Rail) is not present on-site.

9.18.3 Separated by physical barriers.

Notwithstanding the fact that the manager authorising the work may be satisfied that there is a physical barrier of solid construction that prevents persons or their equipment from coming into contact with rail traffic or overhead wiring, the manager shall still notify the rail track owner of the work and comply with the owner's requirements.

The supervisor in charge of the worksite is responsible for ensuring that the requirements set out in Section 9.18.2 are applied prior to commencement of work. In the event that the physical barrier becomes dismantled or damaged in such a way as to allow the possibility of persons coming into contact with rail traffic or overhead wiring then the supervisor shall stop all work on-site and notify the rail track owner so that the barrier can be re-established or the situation reviewed.

Persons on site are not to damage or attempt in any way to overcome a physical barrier.

9.18.4 Work outside the rail corridor

Where work is situated outside the Rail Corridor as defined in Section 9.18.1, and the manager authorising the work is satisfied that persons, plant, equipment and material will not intrude into the Rail Corridor, then there is no need to notify the rail track owner. However, if the work may effect the strength of the railway line or rail structures then the rail track owner shall be notified.



9.19 Detours, sidetracks and crossovers (AS 4.14)

Where it is not possible to move traffic past or through a work area the following forms of traffic detours should be considered:-

Sidetrack - a temporary roadway constructed near the existing roadway and may cater for one or both directions of travel

Detours – where existing roads are used and may cater for one or both directions of travel

crossovers - used with divided roads where one carriageway is converted to a two way road

detours for heavy or over-dimensional vehicles - shall be able to cater for heavy, high or long vehicles

exit closures on motorway/freeway type roads – advice in advance of a closed exit is to be provided if a previous exit or succeeding exit is to be used.

In choosing the type of treatment to use the following points need to be considered:-

- approval shall be sought from the maintaining authority to use any detours
- the pavement on detours shall be of sufficient structural strength to carry the loads and traffic volumes expected
- the pavement on detours shall be monitored to ensure that any damage is quickly rectified
- the width of a detour and its alignment shall be adequate for the expected traffic types and volumes
- provision shall be made for pedestrians, bicycles, wheelchairs and public transport
- access shall be provided for local traffic
- adequate delineation shall be provided on sidetracks as follows
(AS 4.14.6(b)(i)):-
 - (i) 20 m spacing on straights and curves greater than 200m radius
 - (ii) 6 m and 12 m on the outside and inside respectively of curves up to 200 m radius
 - (iii) on roads with volumes of 1500 vpd or less
 - A up to 100 m on long flat straights
 - B up to 50 m on short and undulating straights
 - C up to 25 m on curves greater than 200 m radius.
- delineation on detours using existing roads may require upgrading

- signposting shall be clear and adequate
- **DETOUR AHEAD (T1-6)** signs shall be used to give advance warning of any detours.

NOTE: The establishment of long-term sidetracks would normally require detailed design input.

9.20 Works on unsealed roads (AS 4.5)

9.20.1 General (AS 4.5.1)

The following treatments are permitted on unsealed roads in recognition of the generally lower volumes and traffic speeds encountered on those roads than on sealed roads and the need to be economical in the expenditure of resources on these low usage facilities. Since they could be seen as a partial relaxation of safety standards, it is vital that a risk assessment be made of the proposed adoption of these treatments in particular environments taking account of factors such as traffic volume and speed, road geometry, width and surface condition, and the general behaviour of road users.

The treatments shall not be applied to any road which would normally be sealed but has been left unsealed either temporarily or permanently due to, for example, economic or climatic factors or is in the process of construction or reconstruction as a sealed road.

9.20.2 Maintenance grading and resheeting (AS 4.5.2)

Maintenance grading and resheeting may be carried out either with or without leaving a windrow as indicated below. Work done without leaving a windrow normally involves use of either a windrow eliminator or a second grader in tandem.

Wherever practicable, grading on the right side of the road against oncoming traffic should be avoided.

(a) Maintenance grading shall be undertaken as follows:-

- (i) If the grader is always to operate leaving room for opposing traffic to pass it without driving off the roadway and the sight distance to the grader's vehicle mounted warning device is at least 250 m throughout the entire section of road being worked on, no advance warning signs for either direction of travel are required.
- (ii) If the operating conditions in Item (i) cannot be met, the work shall be carried out as follows:-
 - (A) The work shall be undertaken in bounds of not more than 10 km in length. The sign **ROADWORK NEXT 10 km (T1-24)** shall be placed at each end of the section being worked on.



(B) Where sight distance falls to less than 250 m the sign **GRADER AHEAD** (T1-4) or **ROAD PLANT AHEAD** (T1-3-1) together with **NEXT 2 km** (T1-28) shall be used at each end of each subsection with reduced sight distance of up to 2 km in length. The signs shall be placed at least 100 m in advance of the start of any windrow.

(C) Subsections of 2 km or less in length created as in Item (B) shall be completed and signs including (if used) speed zone and end of zone signs, shall be relocated before proceeding with the next section, which may be a further sight distance deficient sub-section or the remaining whole section.

If there is difficulty turning a grader around at the end of a 2 km section it may be extended to the next available turning point but not to more than 6 km in total length.

(iii) Road condition signs shall be placed at various locations if the freshly graded surface has loose material that may be a hazard. One or more of the following may be required depending on the nature of the hazard:-

(A) Slippery (symbolic (T3-3))

(B) Loose Stones (symbolic (T3-9))

(C) **LOOSE SURFACE** (T3-14).

NOTE: Where graded or resheeting material cannot be traversed by traffic, in order to allow traffic to overtake the grader, the grader driver should be instructed to raise the blade from time to time and move forward a short distance to allow that traffic to pass.

(b) Maintenance resheeting

Maintenance resheeting shall be undertaken in accordance with Items (a)(ii) and (a)(iii) above

9.20.3 Short term partial road closures

The following apply to the treatment of short term partial road closures:-

(a) Omission of advance signs

Advance signs may be omitted provided that:-

(i) the vehicle mounted warning device on the work vehicle can be seen by approaching traffic for at least 250 m;

(ii) no traffic controller is required and

(iii) either:-

(A) traffic volumes are 20 vpd or less; or

(B) there is room for two-way traffic past the work area, or both.

(b) Using a single traffic controller

Traffic control is required and may be performed by a single traffic controller under the following conditions:-

- (i) there is a single lane section not exceeding 50 m in length.
- (ii) traffic volumes are not more than 20 vph.
- (iii) the traffic controller has a good view of traffic approaching from both directions when stationed at one end of the job.

(c) Other cases

Situations not meeting the conditions set out in Items (a) or (b) shall be treated in the same way as sealed roads.

9.21 Motorcyclists

9.21.1 General

Motorcycles travelling through work sites require additional consideration, particularly in terms of the road surface provided. Motorcycles do not handle the same as cars and they are less stable than other vehicles on loose and slippery surfaces. They are also unable to brake heavily on curves.

Signage for the site should adequately identify road surfaces that are different to that on the approach. Particular hazards to motorcyclists include unsealed surfaces, unexpected sections of wet roads and loose gravel, especially in areas where braking and turning is required.

9.21.2 Road surfaces

Surface changes can be critical to motorcycle stability and it is essential that the changes be signposted well in advance so that the motorcyclist is not forced to take rapid or unexpected evasive action.

Where sections of sealed roads are temporarily reduced to gravel the warning sign **GRAVEL ROAD** (T3-13) shall be erected where sight distance to the change in surface is less than 1D or where the surface is unusually rough or loose. Similarly, where it is necessary to water the surface of the road the road condition sign "Slippery" (T3-3) shall be erected where sight distance to the wet surface is less than 1D.

9.21.3 Grooved roads

Milling of roads prior to resurfacing may present a hazard to motorcyclists. Where road surfaces are grooved warning signs **CYCLE HAZARD GROOVED ROAD** (T2-207) shall be erected on all approaches. Where grooving is carried out on roads with curved alignments it may be necessary to impose roadwork speed zones to help improve motorcycle safety.

9.21.4 Steel plates

Steel plates used to cover excavations shall be coated with a skid resistant treatment. The plates shall be of sufficient thickness to not deflect significantly under the weight of fully loaded trucks. The plates shall also overlap excavations by at least 400mm on each side.

9.21.5 Drainage

Care shall be given to the drainage of roadworks such that water does not run across traffic lanes to a depth greater than 5mm.

9.22 Repair and servicing of plant

9.22.1 General

The purpose of this Section is to provide guidelines for safe working practices for personnel when they are repairing, servicing, transporting, testing or refuelling plant or vehicles in the field in close proximity to traffic or mobile plant.

9.22.2 Principles

Personnel listed above shall remember that it is not their primary function to be traffic controllers. If the repair or servicing of plant or vehicles requires traffic control then this should be requested from and provided by the operations organisation responsible, in the form of fully qualified controllers using approved traffic control plans.

As a general principle plant personnel shall:-

- wear approved high visibility protective clothing
- turn on flashing yellow lights where fitted to the repairers' vehicle and item being repaired.
- ensure a suitable site is used (i.e. the site is level or if not then the plant or vehicle is immobilised by the use of park brake and chocks).

9.22.3 Work locations

The repair, servicing, testing or refuelling of plant or vehicles is generally required at one or more of the following locations. The procedures detailed shall be followed at those locations or the plant or vehicles moved to a more suitable location.

(a) Workshop

Where plant or vehicles are being repaired or serviced in designated workshops no specific procedures need be followed regarding working near traffic or mobile plant.

Care shall, however, be taken in moving the items into and out of the workshop and the procedures and safety guidelines applying to that workshop shall be fully complied with.

(b) Depots and sub-depots

Where plant or vehicles are being repaired or serviced in designated depots or sub-depots where other plant items or vehicles may be given access then the following procedures shall be followed:-

- the item being worked on is to be moved to a separate part of the depot or sub-depot as directed by the site supervisor
- if it is not possible to move the item the site supervisor will arrange to protect the area around the worksite using the repairers' vehicle, barrier boards or other means. Plastic containment fencing may also be used to exclude pedestrians. (See Figure 9.1)

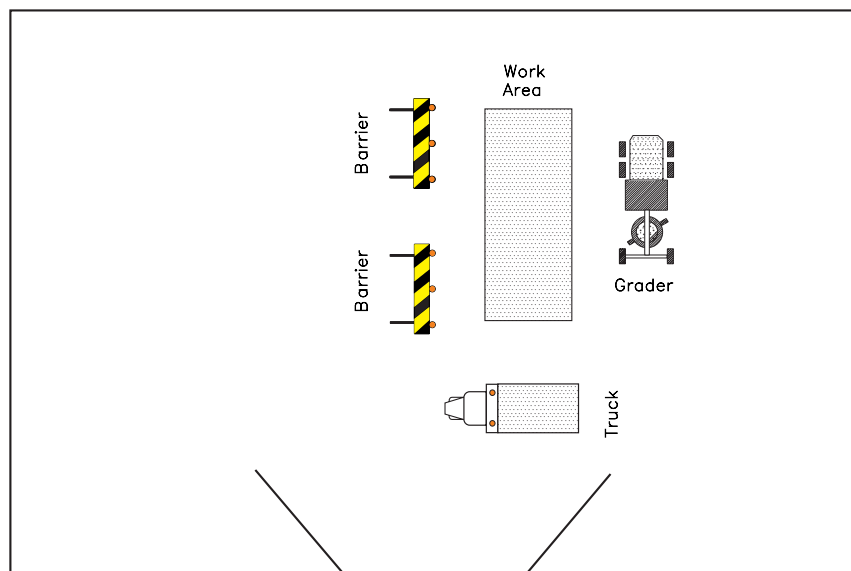


Figure 9.1 – Method of worker protection when repairing plant in depots

(c) Remote locations

Where plant or vehicles are being repaired or serviced at remote locations, such as gravel pits or stockpile sites, that are being worked then principles stated for depots and sub-depots are to be used.

If the location is not currently being worked then the following procedures need to be employed:-

- be on the alert for errant vehicles entering the site
- close and, if possible, lock any gates or booms
- park the repairers vehicle in such a way as to provide the most protection to the workers.

(d) Locations clear of through traffic

Where plant or vehicles are being repaired or serviced at locations such as rest areas where other plant items or vehicles may have access then the following procedures shall be followed:-

- the item being worked on is to be moved to a part of the site as directed by the site supervisor who will arrange any other traffic control precautions as deemed necessary
- if it is not possible to move the item the site supervisor will arrange to protect the area around the worksite using the repairers' vehicle, barrier boards or other means. Plastic containment fencing may also be used to exclude pedestrians. (See Figure 9.1 for general principles.)

(e) Road shoulders or breakdown lanes

Extreme caution shall be exercised when attending to plant items or vehicles on road shoulders or breakdown lanes. If items are capable of being moved they shall be moved to locations that are at least 3 metres clear of the through traffic. If the items are not capable of being moved then Table 9.3 gives advice, based on the distance from passing traffic and the speed of that traffic.

Approach speed of traffic km/h	Distance from edge of trafficked lane in metres		
	0 – 1.2	1.2 – 3.0	>3.0
110	TC	10 minutes	Nil
100	TC	10 minutes	Nil
90	TC	10 minutes	Nil
80	TC	10 minutes	Nil
70	TC	10 minutes	Nil
60 or less	10 minutes	Nil	Nil

Table 9.3 Conditions for work on road shoulders or breakdown lanes

Note: Visibility and conditions should be taken into consideration when using the table above.

TC Work may only proceed if a full and approved traffic control plan is implemented by trained traffic controllers, including decreasing the speed of passing traffic to 60 km/h or less.

Minutes Indicates the maximum number of minutes that may be worked under the existing conditions to effect emergency repairs

Nil No extra precautions are required under these conditions.

(f) Traffic lanes

If a plant item or vehicle has broken down in a trafficked lane and cannot be moved then repairs can only be undertaken if full traffic control is provided by qualified traffic controllers.

However, if the lane blockage is such that it presents a danger to other road users, for instance if it occurs around a bend with poor visibility, some action shall be undertaken. This is dealt with in Section 9.22.3 (h), *Dangerous situations*.

(g) Construction sites

When repairing or servicing plant on construction sites you shall always report initially to the site supervisor. If it is your first visit to the site you will be given a site induction.

The site supervisor will provide assistance to ensure that the item of plant is either:-

- removed to a location clear of other mobile plant or vehicles
- or protected by using barrier boards or similar devices. Plastic containment fencing may be used to exclude pedestrians from the area. (See Figure 9.2 for general principles.)

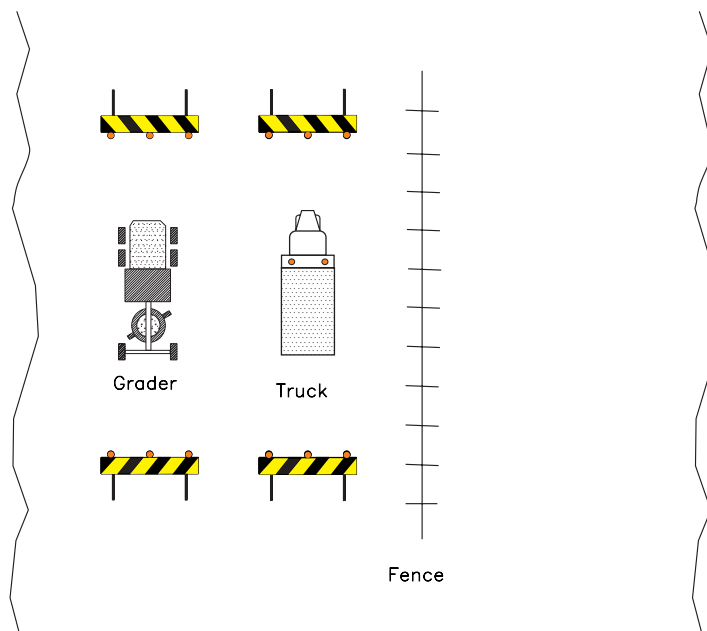


Figure 9.2 – Method of worker protection when repairing plant on construction sites.



(h) Dangerous situations

Emergency situations may arise not only as a result of lane blockages by broken down plant items or vehicles but blockages due to accidents, oil spillages from vehicles, fallen trees etc. Bearing in mind the limited traffic warning devices that you are likely to be carrying when encountering such conditions the following general procedure is to be adopted:-

- offer assistance to the person in control of the situation and follow all reasonable requests bearing in mind the level of qualification you might have in controlling traffic
- if you are the first on the scene stop your vehicle in the travel lane with all flashing lights on and immediately begin warning traffic approaching to slow down. Where possible you and your vehicle should be located to achieve a minimum sight distance to approaching traffic of 2.5 times the approach speed of the traffic in metres (2.5D)
- call for support from the appropriate operations area
- set up warning signs (eg. **TRAFFIC ACCIDENT AHEAD, PREPARE TO STOP**) in advance of the anticipated end of the traffic queues, to provide adequate warning to approaching traffic that a traffic queue ahead may exist. The length of the traffic queue and the location of appropriate warning signs will require periodic monitoring.

You shall exercise extreme caution during any of these activities.

Section 9.23 Working on foot near plant

This Traffic Control at Work Sites Manual gives guidance on the selection, design and implementation of the following traffic control measures which, respectively, cater for traffic movements around work sites or entering and leaving work sites:-

Traffic control plans – these are generally in diagram form and shown the location of temporary signs and devices arranged to warn traffic and guide it around, past or through work sites.

Vehicle movement plans – these are generally diagrams showing the preferred travel paths for vehicles associated with a work site entering, leaving or crossing the through traffic stream.

Of equal importance is the safety of personnel working within the work site close to mobile plant or vehicles and remote from other road users vehicles. The principles outlined in this Section will provide guidance on the implementation of safe working practices within work sites.

9.23.1 General

Before any road or bridge work is undertaken its impact on road users is assessed and if required a Traffic Control Plan is selected or designed and then implemented. This applies equally to major and minor works.

At the time of considering the need for a TCP any specific risks within the work site should be identified, bearing in mind the nature of the work to be undertaken, and safety measures adopted to eliminate or minimise those risks. For the purposes of this section “plant” also includes trucks.

Risks that may be identified include:-

- The possibility that site personnel and/or contractors may be injured
- the possibility of unauthorised persons entering the work site
- the proximity of people to mobile plant
- vehicles being loaded or unloaded
- plant being operated in reverse – where unavoidable reversing lengths occur they should be kept to a minimum
- working close to the edge of embankments or cuttings
- working below plant operating close to the edge of or on embankments or cuttings
- the proximity of people to revolving plant such as excavators
- trenching operations
- high speed plant such as dump trucks
- noisy work locations masking the sound of approaching plant
- inappropriate location of compounds or site amenities
- the lack of adequately defined and safe crossing points
- working at night
- limited sight distances
- intermittent crews visiting and being unfamiliar with the site
- working beneath power lines
- working beneath overhead activities ie bridge sites, steel erection
- the servicing and/or floating of plant items
- parking plant items or vehicles in inappropriate locations ie too close to moving plant or in blind spots
- workers jumping onto plant
- workers, other than operators of plant, riding on plant
- intensity, speed and acceptable clearance to any adjacent traffic

A site **Vehicle Movement Plan** is to be prepared for vehicle movements within the work site where:-

- there are repetitive movements of plant (> 20 per day), or
- plant on site is travelling at faster than 40 km/h, or
- plant is reversing long distances (>100 m) or
- there are other specific hazards to pedestrians on site from plant carrying out the work.

Throughout this document it is mentioned that workers are not to work within 3 metres of moving plant or within the area of influence of revolving plant. These are general requirements as there will be many instances where workers have to work within these limits and when they do so it is essential that they be properly trained and that all operators are informed of the proximity of the workers.

Caution shall be exercised when delivering or moving materials and personnel are to be aware of the effects that any additional or unplanned movement of those materials may have ie rolling pipes, spillage of aggregate etc.

Furthermore, sites shall be assessed to determine if extra precautions should be taken for the protection of open excavations, the use of traffic controllers within the site and the security of sites after hours.

Site Induction shall be given to all visitors to any site. At the time of the agreed site visit visitors shall:-

- locate and report to the person in charge of the site who will advise who will provide the site induction
- confirm the reason for their presence on site
- secure any site resources that have been agreed upon
- follow all relevant site procedures and all reasonable requests of the supervisor, including vehicle movement procedures

9.23.2 Heavy patching and excavation under traffic

Heavy patching works on trafficked roads will generally require some traffic control. Workers on foot during heavy patching works can face other hazards and the following procedures shall be adopted to minimise risks:-

Reversing plant

- ensure that plant items are fitted with an automatically activated, clearly audible and working reversing alarm and lights
- do not have workers working within 3 metres of moving plant such as rollers, graders water carts etc
- use a spotter when plant is reversing near workers.

Delivery vehicles

- ensure that all delivery vehicles report to a designated location or person
- ensure that all delivery vehicles are fitted with working reversing alarms and lights
- if delivery vehicles are required to reverse near people ensure that a spotter is used.

Revolving plant

- ensure that workers are not working close to plant like excavators such that they can be hit when the plant item revolves.

9.23.3 Clearing and grubbing

The nature of this work might be quite hazardous to workers on foot from both plant and falling trees or limbs. Signs are to be erected warning of the work in progress. Workers on foot during clearing works may be at risk and the following procedures shall be adopted to minimise those risks:-

Reversing plant

- ensure that plant items are fitted with an automatically activated, clearly audible and working reversing alarm and lights
- do not have workers working within 3 metres of moving plant
- use a spotter when plant is reversing near workers.

Revolving plant

- ensure that workers are not working close to plant like excavators such that they can be hit when the plant item revolves.

Other plant

- ensure that workers are not working within the area of influence of other plant items ie not working within the fall area of trees being pushed over by plant.

9.23.4 Earthworks

The risks to workers on foot, during excavation work, are similar to those that might be encountered in heavy patching and the following procedures shall be adopted to minimise those risks:-

Reversing plant

- ensure that plant items are fitted with an automatically activated, clearly audible and working reversing alarm and lights
- do not have workers working within 3 metres of moving plant such as rollers, graders, water carts etc
- use a spotter when plant is reversing near workers.

Delivery vehicles

- ensure that all vehicles report to a designated location or person
- ensure that all delivery vehicles are fitted with working reversing alarms and lights
- if delivery vehicles are required to reverse near people ensure that a spotter is used.

Revolving plant

- ensure that workers are not working close to plant like excavators such that they can be hit when the plant item revolves.

9.23.5 Delivery vehicles

It should be clear to drivers of vehicles delivering to work sites to whom and where they should report. The following procedures shall be adopted:-

- if required to reverse near people ensure delivery vehicles are fitted with clearly audible and working reversing alarm and lights, are accompanied by a spotter or that there are no unauthorised workers on foot within the unloading area
- ensure that where rigid, articulated and vehicles with dog trailers are tipping the ground is firm and relatively flat and there are no overhead powerlines that could contact with the tray of the vehicle
- ensure that people are well clear of tipping vehicles
- ensure there is a safe area where delivery vehicles may wait before delivery or clean down after delivery
- where vehicles are being unloaded by crane ensure that workers not involved in the unloading are not within 3 metres of the area, there are no overhead powerlines that could contact the jib and a spotter is used when the crane is reversing.

9.23.6 Haulage

Haulage routes should be clearly defined and all workers shall be advised of their location. Workers on foot shall not be allowed to work on haulage routes. If workers are working near haulage routes, but not closer than 3 metres, one or more of the following procedures shall be considered:-

- imposing a reduced speed limit on the route
- installing designated crossing points and ensuring their location is advised to all workers and operators
- varying the haulage route to move it away from the workers
- clearly delineating the work area using barrier boards, plastic mesh fencing or similar and notifying the location of the workers to each driver of a haulage vehicle.

9.23.7 Testing, surveying etc.

Work is often required to be undertaken by other visiting technical personnel on construction and maintenance sites where there is moving plant. Examples of these other activities include, but are not limited to, surveying, sampling in quarries, material testing and sampling and site inspection. All such visits to sites shall be made with reference to the person responsible for the work at the site to ensure safety and that the planned visit will not unduly interfere with work activities. For instance, it would be unacceptable to visit a site unannounced and expect full traffic control for work to be undertaken. Procedures to follow with the person responsible are:-

- determine a mutually acceptable date and time for the visit
- agree on the nature of the work required and the exact location
- indicate what if any site resources are required ie traffic controllers.

At the time of the agreed site visit do the following:-

- locate and report to the person in charge of the site who will advise who will provide the site induction
- confirm the reason for your presence on site
- secure any site resources that have been agreed upon
- follow all relevant site procedures and all reasonable requests of the supervisor, including vehicle movement procedures.

9.23.8 Asphalt paving and milling

AC paving works involve the use of many reversing vehicles and plant items. The following procedures shall be adopted to ensure minimisation of risk:-

- ensure that plant items are fitted with an automatically activated, clearly audible and working reversing alarm and lights
- ensure that all delivery vehicles report to a designated location and person
- when delivery vehicles are required to reverse near people ensure that a spotter is used
- when existing roads are paved and there is the expectation that public pedestrians might be in the area attention shall be paid to ensure that the pedestrians do not enter the work site from adjacent properties or footpaths. This can be done through the use of containment fencing, barrier boards, pedestrian signposting etc. In some locations it may also be necessary to post employees to act as control officers or guides. (This area requires careful planning where long lengths of paving are expected.)
- ensure adequate procedures are employed during night works especially relating to “spot” lights on plant

9.23.9 Bitumen sealing

Bitumen sealing works involve the use of many reversing vehicles and plant items. The following procedures shall be adopted to ensure the minimisation of risk:-

- ensure that plant items are fitted with an automatically activated, clearly audible and working reversing alarm and lights
- ensure that all delivery vehicles report to a designated location or person
- when delivery vehicles are required to reverse near people ensure that a spotter is used
- ensure that cockerel operators are properly trained
- where it is necessary for workers to be walking within 3 metres of moving plant, for instance for the checking of application rates, the pathway shall be inspected and cleared of obstacles before the work begins
- when existing roads are sealed and there is the expectation that public pedestrians might be in the area attention shall be paid to ensure that the pedestrians do not enter the work site from adjacent properties or footpaths. This can be done through the use of containment fencing, barrier boards, pedestrian signposting etc. In some locations it may also be necessary to post employees to act as control officers or guides.
- ensure adequate procedures are employed during night works, especially relating to “spot” lights on plant

9.23.10 Concrete paving

Concrete paving works involve the use of reversing trucks and require workers to work close to plant. The following procedures shall be adopted to ensure the minimisation of risk:-

ensure that all delivery vehicles report to a designated location or person

when delivery vehicles are required to reverse near people ensure that they are fitted with an automatically activated, clearly audible and working working alarm and lights and a spotter is used

ensure that all workers associated with the paver are fully trained for the work they are undertaking.

9.23.11 Kerb and gutter extrusion

Extrusion works involve the reversing of concrete delivery trucks. Ensure that a spotter is used and that workers are aware of the reversing vehicle. The reversing vehicles should be fitted with working reversing alarms and lights.

9.23.12 Miscellaneous works

There are numerous activities that may be undertaken at a work site.

Examples are:-

- concrete work
- headwall construction
- signposting
- subsoil drainage construction
- pipe laying
- gabion basket and reno mattress work.

These activities may be carried out:-

- within 3 metres of mobile plant performing other work
- or with plant helping with the work.

In the first case:-

- protect the workers with use of barrier boards, plastic mesh, tape or similar such that the work location is highly visible to plant and vehicle operators.

In the second case:-

- ensure that all delivery vehicles report to a designated location or person
- when delivery vehicles are required to reverse near people ensure that they are fitted with an automatically activated, clearly audible and working reversing alarm and lights and a spotter is used
- ensure that workers are not working within the area of influence of revolving plant like excavators such that they can be hit when the plant item revolves
- when using elevating platform vehicles ensure that the operator is qualified to use the item, it is supported on stable ground and there are no overhead power cables that could come into contact with the operator or platform
- when using skid steer loaders and similar machines around workers ensure that all workers are aware of the fact and that one of the workers is appointed to direct the activities of the machine. Because of the potential for conflict with workers on foot and skid steer loader operations operators of these machines shall be given extra training in operating procedures near people on foot.

9.23.13 Stabilising

Stabilising works can involve the use of many items of plant and the following procedures shall be adopted to ensure the minimisation of risk:-

Reversing plant

- ensure that plant items are fitted with working reversing alarms and lights
- some workers are required to follow within 3 metres of the mixer to monitor moisture levels etc. In this case a second worker is to accompany the monitoring person to act as spotter
- use a spotter when plant is reversing near people

Delivery vehicles

- ensure that all delivery vehicles report to a designated location and person
- ensure that plant items are fitted with an automatically activated, clearly audible and working reversing alarm and lights
- if delivery vehicles are required to reverse near people ensure that a spotter is used.

Hazard	Precautions to be taken	Work activity involved
Reversing plant	- ensure that plant items are fitted with an automatically activated, clearly audible and working reversing alarm and lights - preferably do not have workers working within 3 metres of moving plant such as rollers - if the proximity of people to plant is unavoidable use a spotter when the plant is reversing (the spotter might be supplied with a whistle to attract attention of workers)	Heavy patching Excavation under traffic Clearing and grubbing Earthworks Testing, surveying etc AC paving Bitumen sealing Concrete paving Kerb and gutter extrusion Stabilising
Revolving plant	ensure that workers are not working close to plant like excavators such that they can be hit when the plant item revolves.	Heavy patching Excavation under traffic Clearing and grubbing Earthworks Stockpiles
Delivery vehicles	- ensure that all delivery vehicles report to a designated location or person - if delivery vehicles are required to reverse near people ensure that they are fitted with working reversing alarms and lights and a spotter is used.	Heavy patching Excavation under traffic Earthworks AC paving Bitumen sealing Concrete paving Kerb and gutter extrusion Stabilising
Haulage vehicles (dump trucks, scrapers etc)	- consider imposing a speed limit where workers are working near haulage routes - if required designated crossing points shall be installed and all workers and operators advised of their locations - the haulage route is to be varied to move it away from the workers - the work location is to be clearly delineated using barrier boards, plastic mesh fencing or similar and the location of workers advised to each driver of a haulage vehicle.	Haulage works Earthworks

Table 9.4 Summary table of hazards and precautions to be taken when working on foot near moving plant

10.1 Introduction

This section provides the basic information to effectively use portable traffic signals (PTS) to control traffic. It applies equally to both RTA and other bodies working on roads such as Councils, contractors and public utility authorities. It gives a description of the operational features of the equipment including details for the selection of appropriate signal timings and model situation diagrams showing the required signposting and site layout for the signals.

Portable signals are only intended for traffic control applications lasting up to three or four weeks maximum. For sites where work will continue for longer periods, without the location of the work site changing, consideration should be given to the installation of temporary traffic signals rather than using portable signals.

10.2 Requirements and legislation

Within the RTA a person at or above the level of Section Manager has the delegated authority to authorise the installation of traffic control signals.

Councils have been given delegated authority to use portable traffic signals for some purposes.

No other authority or person has been given such a direction. This means that public utility authorities and contractors working on public streets have no delegated authority in themselves to use portable traffic signals and will need to apply to the relevant Regional Manager of the RTA for authorisation to do so.

A general condition applying to all delegations will be that portable traffic signal equipment used shall comply with Specification PTS/3A.

Specification PTS/3A requires that each set of type approved signals has a durable marking plate indicating that type approval has been obtained. A list of type approvals is held by RTA's Manager, Traffic Equipment and Standards. In addition, the equipment is to be operated in accordance with this section and the manufacturer's instructions. A record (refer to Table 10.7) must be kept of the approval and the period of operation of the traffic signals and may be required in Court in case of an accident or traffic infringement.

Temporary traffic signal installations, using fixed equipment and cables, are not covered by these arrangements and will need to be authorised and inspected in the same manner as permanent installations.

10.3 Specifications

The Equipment Specification PTS/3 for PTS portable traffic signals is:-

- PART A – General Requirements (Revision 1) Originally issued August 1990. Revision 1 issued April 1992.
- PART B – Special Requirements (Issued October 1990).

Part A of Specification PTS/3 covers the minimum requirements for traffic control and safety and apply to any user within NSW. Part B covers additional requirements for PTS used by the RTA's own personnel.

Requests for copies of Specification No. PTS/3, a list of type approved equipment, and arrangements for type approval of equipment should be directed to:-

Manager, Traffic Equipment and Standards
Roads and Traffic Authority NSW
99 Phillip Street
PARRAMATTA NSW 2150
Telephone (02) 8837 0116
Facsimile (02) 8837 0056

10.4 Definition of terms

See also, Section 2.3, *Definitions*.

Actuation – the electrical action produced by a vehicle (by means of a vehicle detector) to enable the controller to recognise its presence.

All-red – a period of time for the clearance of traffic within the controlled areas, during which red displays are shown to all approaches.

Aspect – a single optical system of a signal lantern (i.e. a three-aspect lantern has a red aspect uppermost, a yellow aspect below it and a green aspect at the bottom).

Controller – the device which regulates the order and duration of the displays of the signal lanterns.

Controlled area – the area of roadway shared by conflicting traffic streams controlled by traffic signals.



Cycle Length – the time interval between the start of the green display on two successive cycles of the same phase.

Demand – the request for a green signal by traffic on a phase which has a red signal display (ie. which does not have right-of-way on arrival).

Display – an aspect which is illuminated/

Extension – the additional green time allocated to a vehicle actuating the detector during the green period.

Gap – the time interval between the detection of two successive vehicles in a traffic stream.

Maximum green period – the maximum time that a green display can show for one phase when a demand has been made for another phase.

Minimum green period – the shortest time for which the green display shows following the all-red period. No change of vehicle displays can occur during the Minimum Green Period.

Phase – an interval which permits a particular traffic movement or combination of compatible movements.

Portable traffic light signals – traffic light signals and associated equipment used at work sites and operated in one of the following modes:-

- **Manually Operated Mode (MAN)** – in which the duration and the sequence of displays, are varied by an operator manually controlling the signals. MAN/1 refers to one-way or shuttle manual control and MAN/2 refers to two-way manual control.
- **Vehicle-actuated mode (VA)** – in which the duration and the sequence of displays vary automatically in relation to the traffic flow into the controlled section
- **Fixed-time mode (FT)** – in which the duration and the sequence of displays are preset and do not vary with traffic flow.

Shuttle working – the traffic arrangement used where a portion of the roadway is closed, such that a single lane must be used alternately by traffic from opposite directions.

Signal lantern – an assembly of one or more signal aspects.

Vehicle detector – the equipment which senses the presence or passage of vehicles.

10.5 Approvals

Before using portable traffic signals on a job, two approvals are required:-

- type approval of the equipment to RTA Specification PTS/3 Part A, General Requirements (Revision 1) See Section 10.3.
- project approval for use on each job, see Table 10.7.

10.6 General description of system

Each set of equipment will normally comprise:-

- two signal stands, incorporating signal lanterns, vehicle detectors and control equipment
- power pack of batteries and/or generator
- operational spares, i.e. chassis and plug panel sub-assembly; controller module; lamp switch module; radio module; signal lantern assembly; lamps and fuses; target board assembly; and microwave detector
- detector checking unit, and
- remote manual control box.

10.6.1 Shuttle operation (AS 4.11.2 (a))

For shuttle working on a two lane two-way road, one set of portable traffic signals is required.

The normal mode of operation is vehicle-actuated using microwave detectors mounted above and integrally with the vehicle signal lanterns. It is also possible to use the signal equipment in either manual control mode (shuttle operation) or fixed-time cycle mode, without the use of the detectors. Under shuttle operation, the operator determines which direction of traffic flows at any time. One direction faces a green display whilst the other faces a red display.

10.6.2 Heavy machinery crossing

For heavy machinery crossing applications, one set of portable signals is required. This set is used to control traffic on the public road (one set of lanterns on each approach). Traffic on the haul road is not usually directly controlled.

Manual operation is safer and more effective in preventing delays to both public road traffic and haul vehicles. Under manual control (two-way operation), the operator determines when the public road traffic needs to stop to allow the haul vehicles to cross. Both directions face the same display, either green or red.

If aspects are required to be displayed to haul traffic, then a second set of signals is necessary which are linked to the public road signals. These signals will be arranged to display red when the other set is green and vice versa.

10.7 Signposting and traffic arrangements

10.7.1 General

TCP's 43 and 44 illustrate the use of portable traffic signals.

Since the use of portable traffic signals may require a large proportion of vehicles to either stop or slow considerably, it is critical that the correct signs be erected in the correct sequence. Signs should be located in clear view of approaching drivers, generally on the left side of the road.

However, on winding alignment it may also be necessary to erect a sign or signs on the right hand side. Consider pairs of signs, one on each side of the road, when a driver's view may be obscured by alignment, buildings or traffic. Consider the use of larger signs for high approach speeds.

For shuttle working, the signal stands should normally be located on the shoulder at the start of the taper or at least 30 metres clear of the full lane closure. They should be in clear view of approaching drivers, as shown in TCP 43. However, if it is found that vehicles in the non-barricaded approach lane are disregarding the signals or are travelling too fast through the work site, then consideration may be given to installing a chicane arrangement in this lane in order to slow approaching traffic as well as allowing conspicuous positioning of the signal lanterns. TCP 59 shows a layout for the chicane arrangement. The dimensions should be selected to suit site conditions, such as the prevailing road geometry, sight distance and vehicle speed. However, it should be noted that the use of the chicane arrangement substantially increases the length of the controlled area, and hence imposes the penalty of longer all-red clearance times (and hence increased traffic delays).

10.7.2 Temporary speed limits (AS 4.11.3)

A roadwork speed limit of no higher than 60 km/h shall be imposed if the signals would otherwise be in a higher speed limit zone. Roadwork speed limits require the approval of an RTA Section Manager (RTA Delegation Level 5 officer) who holds a current Design and Inspect Traffic Control Plans card. See Section 8.2, *Roadwork speed zones*.

10.7.3 Sight distance (AS 4.11.3)

Sight distance on the approach to portable or temporary traffic signals shall be a minimum of 150 metres.

10.8 Equipment installation

10.8.1 Signal lanterns

Normally one signal lantern is used on each approach, thereby requiring only one set of equipment for effective working on one road. Portable traffic signals complying with specification PTS/3 have a facility to connect a second lantern assembly. This would be useful on a wide carriageway.

The lantern must be placed so as to give approaching drivers a conspicuous signal and also to be clearly visible to drivers stopped behind the stop line. The signal aspects should be aimed towards the vehicular traffic: vertical adjustment is by adjusting the lantern on the stand, horizontal adjustment is arranged by positioning the stand itself on the ground. In practice, the aiming of the vehicle detectors (located on top of the lanterns) is more critical than the lanterns, so the main emphasis of the aiming operation should be as detailed in Section 10.8.5, *Vehicle detectors*.

Generally, the signal unit should be positioned so as to be as nearly as possible in the driver's line of sight. It is essential to locate signals so the driver has sufficient sight distance to stop on a red display. The minimum sight distance to the signal lantern required for stopping depends mainly on the vehicle type and vehicle speed in the approach to the work area. Table 10.1 provides a guide to stopping sight distances on level bituminous or concrete surfaces.

Vehicle speed (km/h)	Stopping sight distance (m)	
	Cars	Trucks
50	60	80
60	80	100
70	100	130
80	120	160
90	140	190
100	170	230
110	210	270

Table 10.1 – Stopping Sight Distances for Cars and Laden Trucks on Level Pavements

Increase the stopping sight distance by 2% for each 1% of downgrade.
Decrease the stopping sight distance by 2% for each 1% of upgrade.

10.8.2 Signal stands

The signal stands must be securely erected and anchored to prevent excess movement or interference by vandals.

10.8.3 Controller

The controllers allow for two-phase operation only. Each stand has a control module, one of which must be switched to “master” operation, the other to “slave” operation. To provide remote manual operation a special box is connected by cable to the “master” unit.

The controller is provided with manual controls (switches) for selecting:-

- power: ON/OFF
- master/slave selection
- mode selection:-
 - ◆ manual (shuttle operation)
 - ◆ manual (two way operation)
 - ◆ fixed-time/vehicle-actuated

- manual advance: for manual selection of phases
- yellow time: pre-select 4 or 5 seconds
- all-red time: pre-select in the range 2 to 100 seconds for fixed-time and vehicle-actuated operation
- maximum green time: pre-select in the range 20 to 150 seconds for fixed-time and vehicle-actuated operation. The minimum green time is fixed at 15 seconds.

The control equipment provides that in the event of internal failure, a loss in radio communications or low battery voltage, the signals revert to flashing yellow.

10.8.4 Communication

The two signal stands, incorporating the signal lanterns and detectors, are linked either by radio or cable control.

10.8.5 Vehicle detectors

Vehicle detectors are used to relay an electrical impulse to the controller when a vehicle approaches. One detector per approach is required.

Microwave detectors may be located on top of the traffic signal lantern and the beam from the transmitter is reflected back to its receiver by the approaching vehicle. The microwave detector will only detect objects moving towards it. Care must be taken to ensure that unwanted vehicles (eg. construction vehicles) do not actuate the detector.

Response of the microwave detector will be dependant upon the speed of movement and the size of the target object. In general terms the unit, when positioned to “look” at an approach, should detect:-

- a motorbike moving within the range, 20 m to 5 m from the unit
- other larger motor vehicles moving within the range, 30 m to 5 m from the unit.

This is assuming that the detector is mounted at a height of between 2.5 m and 3 m and the object being detected is moving at a speed of greater than 5 km/h.

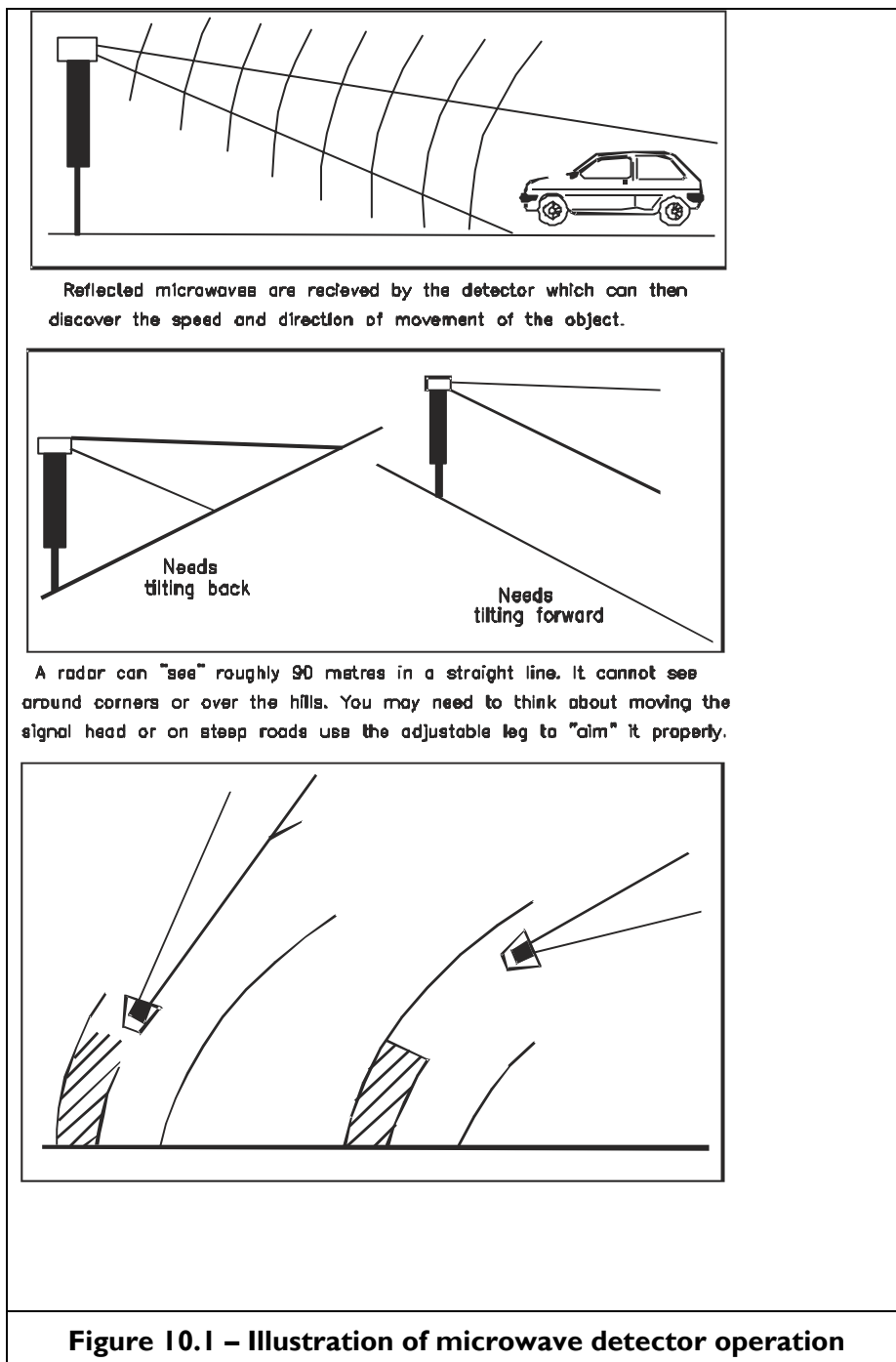
It must be emphasised that the detector should be positioned in such a way that its beam axis is pointed at the centre of the target area and at a distance of approximately 25 m to 35 m ahead of the unit.



For single lane approaches it is suggested that the unit be aimed more towards the road edge. This will result in an increased “sensitivity” to the desired vehicular movements but at the same time decrease the sensitivity to vehicles travelling away (on the departure side of the street). Although the departing vehicle will not produce a detection output, it can cause a “swamping” or masking of a signal being reflected by an approaching vehicle.

In practice, aiming of the microwave detector is achieved by moving the complete stand (adjustment in the horizontal plane) and by tilting the lantern by the adjustment at the top of the stand (adjustment in the vertical plane). A visual indicator built into the rear of the detector case assists in the aiming operation. Vehicles should be able to be detected (as indicated by the visual monitor) at a distance of 5 m to 30 m ahead of the signal stand.

An illustration of how the detectors work is given in Figure 10.1.



10.9 Manufacturer's instructions

Operators should familiarise themselves with the manufacturer's Instructions. Section 10.10, *Performance*, discusses the appropriate traffic conditions and performance for the four possible operating modes.

Field service usually covers:-

- simple fault diagnosis and associated replacement of the faulty modules
- routine maintenance, including replacement of lamps and other expendable components.

Note that this section does not replace the field service manual and operating instructions accompanying each set of equipment. It is most important that operators make themselves fully acquainted with the manufacturer's instructions and recommendations before attempting to operate the equipment.

10.10 Performance

For manual operation, a remote control box would generally be connected by cable to the “master” unit, although the equipment can be manually operated at the “master” stand (note that either unit will operate as a “master” or “slave”). Use of a cable enables the operator to be located safely away from the road in a position where both approaches to the work area are visible. The “master” unit should then be selected on the basis that the connecting cable should not cross the roadway. For automatic operation, there is no need for a full-time operator. The operator fixes the initial settings and then only needs to monitor performance intermittently.

10.10.1 Manual Mode (Shuttle Operation) (MAN/I)

With manual mode (shuttle operation), the operator controls the sequence in which green aspects are displayed, and also the “all-red” and “green” times. The “minimum green” time cannot be varied by the operator and is fixed at 15 seconds. The “yellow” time is pre-selected, as appropriate, to 4 or 5 seconds. The “all-red” time has a minimum value of 2 seconds but the termination of this period is controlled by the operator. The length of the “all-red” period should be kept to a minimum consistent with the need to clear the controlled area of opposing traffic.

Manual shuttle operation is applicable when:-

- a) movement of works traffic prevents the effective use of vehicle-actuated or fixed-time operation, or
- b) a detector fails, when using the vehicle-actuated mode and it is not desired to use fixed-time mode.

10.10.2 Manual Mode (Two-way operation) (MAN/2) (AS 4.11.2 (c))

With manual mode (two-way) operation the duration and sequence of displays is determined as in Section 10.10.1. The length of the “all-red” period should be kept to a minimum consistent with the need to provide for movement of road machinery without interference from normal traffic.

Manual two way operation is applicable when:-

- a) all traffic needs to be stopped to allow the passage of traffic on a haul road
- b) traffic must be kept out of the work area for an extended period, eg. during blasting, priming or full width bitumen sealing.

10.10.3 Vehicle-actuated operation (VA) (AS 4.11.2 (a))

This mode of operation allows the signals to operate automatically in response to vehicle demands. The signals will change in response to a demand registered by vehicles as they actuate a vehicle detector and the cycle length is adjusted automatically to suit traffic flows.

Vehicle-actuated operation is applicable when:-

- a) automatic control is required during working hours – this allows the signals to operate unattended while still being responsive to changes in traffic flows, or
- b) traffic control is required outside working hours – the signals can operate unattended provided the power supply is maintained.

The signals must be inspected by the operator at least once per day to ensure that the detectors are functioning correctly and that there are no burnt out lamps and to arrange the daily change of batteries or other servicing. This is particularly important if the site is unattended, as on weekends. On weekdays, the signals should be checked immediately prior to start and completion of work.

If a detector malfunction is found, the equipment should be switched to fixed-time operation or if an operator is available, to manual operation.

Following the initial switch on and “master/slave” selection, the operation is as follows:-

- a) initially red is displayed on all approaches for a period of at least 10 seconds then each approach in turn receives a green display for its selected “maximum green” time with a “yellow” display and “all-red” display between each green display.

If the signals are switched from the “manual” or “fixed-time” modes of operation to the “vehicle-actuated” mode, the control equipment will automatically register an artificial demand for each phase for the first cycle.

- b) after all phases have been called automatically for the first cycle, the signals will change only in response to vehicle demands
- c) if vehicles approach consistently from only one direction, the controller holds the green display on that approach
- d) when a vehicle is detected on another approach, the signals can change in one of two ways:-
 - i) when vehicles approach the first phase as a steady stream, the phase holds for the “maximum green” time before changing to the new approach, or
 - ii) when the gap between vehicles approaching the first phase is greater than 5 seconds, the signals will change to the new phase, subject to the limitations of the 15 second “minimum green” time, and after the selected yellow and all-red times.
- e) In the absence of any demand, the signals will revert to “all-red” until a vehicle is detected. This feature ensures that the signals are then able to give right-of-way to the first approaching vehicle with minimum delay.

If the phase changes at the “maximum green” time, a new demand is automatically entered for the terminated phase when the phase changes. This ensures that approaching vehicles stopped by the red display will be cleared at an early time. Otherwise, new demands for the terminated phase will only be registered when the arrival of an additional vehicle actuates the detector of that phase.

As a safety feature, when using microwave detectors, an automatic demand will be introduced for any (phase) approach which has not received a detector actuation for approximately 200 seconds.

10.10.4 Fixed-time operation (FT) (AS 4.11.2 (b))

As this form of control does not allow for any response to short-term variations in traffic flow, vehicles may be delayed for no apparent reason when the road is clear. Unattended sites should not be left in FT mode.

FT operation is an automatic mode which is not responsive to vehicle demands. The green time is selected by the “maximum green” switch, and the all-red time is selected by the “All-Red” switch for each phase. The signals will then cycle in a predetermined order at the times selected. Cycle times can only be varied by manual adjustment of the controller.

Fixed-time is most applicable when there is a relatively constant flow of traffic on both approaches. It is also applicable when failure of the vehicle detectors prevents use of the vehicle-actuated mode and/or when a full-time operator is not available.

10.10.5 Limitations on use of microwave detectors

Microwave detectors will only register moving vehicles and so, if for any reason a demand is lost, stationary vehicles waiting at the lights may be ignored by the equipment.

A demand can be lost if vehicles are unable to move off a green display. If vehicles do not start to move within 15 seconds of receiving a green display the controller will terminate the phase and will ignore the waiting vehicles.

To clear these vehicles it is necessary to either:-

- a) wait until a new vehicle joins the queue and actuates the detector, or
- b) change to manual operation (once traffic is running again, the controller can be returned to vehicle-actuated operation), or
- c) wait until the controller (or detector) puts in an artificial demand (it is programmed to place such an artificial demand approximately 200 seconds after the phase was last demanded).

10.10.6 Flashing yellow feature

The control equipment automatically switches all yellow aspects to “flashing yellow” within 0.5 seconds when any hazardous or incompatible conditions occur in the operation of the equipment, as required by RTA Specification PTS/3 – Part A.

In the “flashing yellow” mode, the red and green aspects remain blacked out, and all yellow aspects flash at a rate between 60 and 80 flashes per minute.

If the equipment is allowed to operate for a prolonged period on flashing yellow without a battery change, the signals will eventually turn off.

10.11 Operation

10.11.1 Control modes

Although the layout and switch configuration may differ, all controllers have basically the same functions.

All Red	All displays red. Any running sequence is cleared first.
Manual (MAN)	Control over green displays is via switches or push buttons on the controller. Control can be passed from one phase to another.
Fixed Time (FT)	Control transfers from one phase to the next in a cyclical manner. Each phase receives the green display regardless of traffic flow.
Vehicle Actuated (VA)	The controller responds to signals from the vehicle detectors. With no demands present the signals will rest in the all red period.

The mode of operation (ie. manual, vehicle actuated or fixed time) should be selected having regard to the operating conditions of the particular site as discussed in more detail in Section 10.10, *Performance*.

10.11.2 Time settings

General

These are shown in Table 10.2.

Mode	All red	Minimum green	Maximum green	Yellow
MAN/1	M	F	M	S
MAN/2	M	F	M	S
FT	S	F	S	S
VA	S	F	S	S
F Fixed at 15 seconds				
M Set the manual control switch each cycle				
S Needs to be selected and pre-set by the operator for each site				
Table 10.2 – General time settings				

Yellow time

Estimate the 85% percentile approach speed. Select the yellow time from Table 10.3.

Approach speed	Yellow time
Below 70 km/h	4 seconds
Above 70 km/h	5 seconds
Table 10.3 – Yellow time settings	

All red time

Measure the distance between the stop lines at each traffic signal. Select an appropriate all red time from Table 10.4 or Table 10.5 depending if the minimum clearance speed is 20 km/h or 40 km/h respectively.

Maximum green time

Select a maximum green time from Table 10.4 or Table 10.5 depending on the minimum clearance speed. In FT mode, adjust the maximum green times by allowing 3 seconds for each vehicle queued at the end of the all-red period on each approach. Note that the minimum setting is 20 seconds.

In VA mode the green time will gap off when traffic clears and only run to the maximum if there is no demand for the other phase. If long queues are regularly occurring in one approach, try increasing the maximum green time on that approach only.

Distance between stop lines at traffic signals (m)	All red period* (seconds)	Max. green period (seconds)
0 – 30	2	30
30 – 45	5	35
45 – 75	10	35
75 – 105	15	40
105 – 135	20	40
135 – 165	25	45
165 – 195	30	45
195 – 250	40	50
250 – 310	50	50
310 – 365	60	60
365 – 415	70	70
415 – 465	80	80
465 – 525	90	90
525 – 575	100	100
Table 10.4 – Initial signal time settings (low speed)		

* based on a minimum clearance speed of about 20 km/h

Distance between stop lines at traffic signals (m)	All red period* (seconds)	Max. green period (seconds)
0 – 50	2	30
50 – 90	5	35
90 – 150	10	35
150 – 210	15	40
210 – 270	20	40
270 – 330	25	45
330 – 390	30	45
390 – 500	40	50
500 – 620	50	50
620 – 730	60	60
730 – 830	70	70
830 – 930	80	80
930 – 1050	90	90
1050 – 1150	100	100
Table 10.5 – Initial signal time settings (high speed)		

* based on a minimum clearance speed of about 40 km/h

10.11.3 Setting up

- Set up stands with signal aspects facing oncoming traffic.
- Connect controller to the generator and start generator
DO NOT SWITCH CONTROLLER ON.
- Set red & green times as required.
- Select mode switch.
- Ensure that the shuttle lane or haul road is clear and then switch on controller.
- Controller will serve each phase in turn, clearing the initial demand.

Note: Waving a hand smartly toward the detector should place a call on each side for checking VA mode if selected. This will verify that signals are operating properly in this mode even in the absence of traffic.



10.11.4 Trouble shooting in VA mode

Details are shown in Table 10.6

Problem	Possible cause	Remedy
Long queues	1. Green setting too short. 2. Detector fault. 3. Road capacity exceeded.	1. Increase setting. 2. Call service. 3. Call Supervisor.
Signals do change after one stream has stopped even though traffic is waiting.	Detector fault.	Call service. Operate signals in manual or FT mode until service arrives.
Green period always same length.	1. Detector fault. 2. Green setting too short. 3. Traffic flow very light. 4. Traffic flow too heavy.	1. Call service. 2. Increase green time setting. 3. No action. 4. Call Supervisor.
Traffic still in shuttle lane at start of opposite green.	1. Traffic running the red light. 2. All-red setting too short.	1. Call police. 2. Increase all-red setting.
Long gap between last vehicle clearing shuttle lane & start of next green.	1. All-red setting too long. 2. Detector fault.	1. Decrease all-red setting. 2. Call service.
Signals do not remain on red in absence of traffic.	Detector fault.	Call service.
Table 10.6– Trouble shooting in VA mode		

10.11.5 Examples

Site Details

Work area 100m long, rural highway situation:-

- approach speeds 80 km/h
- distance between stop lines 160 metres
- minimum clearance speed 20 km/h



Figure 10.2 – Illustration of site layout

a) Example of selecting times for “Fixed-Time” operation

(i) From Time Setting Instructions 10.11.2 and Tables 10.3 and 10.4 select initial controller settings:-

- Yellow 5 seconds
 - All-red 25 seconds
 - Max. green
- Phase 1 45 seconds
- Phase 2 45 seconds

(ii) Switch on and observe for three cycles:-

- If all vehicles clear the work area during the all-red period do not adjust “all-red” setting. If vehicles do not clear the work area extend the “all-red” period.
- Count the number of vehicles queued at the end of the all-red period on each approach. Assume the following vehicles queued at the end of the red period:-

	Phase 1	Phase 2
First Cycle	10	1
Second Cycle	15	6
Third Cycle	9	4
Max queued vehicles in any one cycle	15	6



- Adjust “max. green” times for the two phases:-
 Phase 1 – $15 \times 3 = 45$ sec
 Phase 2 – $6 \times 3 = 18$ sec (use the minimum setting of 20 sec)
- Check regularly that vehicles are not experiencing unnecessary delays due to incorrect settings.

b) Example of selecting times for “Vehicle Actuated” operation

- From Time Setting Instructions 10.11.2 and Tables 10.3 and 10.4 select initial controller settings as for FT operation.
- Switch on and observe for three cycles:-
 - Check all-red setting as for FT operation.
 - Time the green period for each phase using a stop watch. Assume the following green times were measured.

	Phase 1	Phase 2
First Cycle	45	25
Second Cycle	45	35
Third Cycle	45	30

- Try extending the max. green time for phase 1 by 5 to 10 seconds.
- If Phase 1 is still running to its maximum green setting repeat Step iii.
- Check regularly that vehicles are not experiencing unnecessary delays due to incorrect settings.

10.12 Maintenance

10.12.1 General

The equipment should be maintained in good working condition and expendable items such as traffic signal lamps replaced immediately after they fail. If faults develop the signals should be taken out of service and alternative traffic control arrangements made. The signals should not be returned to service until the faults have been rectified.

10.12.2 RTA equipment

Maintenance of the various items of RTA plant, i.e.:-

- signal stands, incorporating signal lanterns, vehicle detectors and control equipment
- battery packs
- battery charger.

This is to be dealt with under established practice for major plant items. Signal lanterns, vehicle detectors and controllers are to be returned for repair with associated operation/maintenance manuals and wiring diagrams to the RTA's Works Centre as follows:-

The Works Supervisor
Roads and Traffic Authority
Traffic Workshop
129A Orchardleigh Street
Yennora 2161
Telephone (02) 9794 4747

Equipment problems such as faulty wiring that can be corrected in the field may be rectified by a qualified electrician or radio serviceman. Expendable items such as traffic signal lamps and fuses should be replaced in the field and small stocks of such items should be kept in field offices.

Note that the signal lamps are a special type with quartz envelopes. These quartz envelopes should never be touched with bare hands as they are easily damaged. The lamps should always be held by the metal bases and fitted using cotton gloves.



Portable Traffic Signals Record of Approval and Use				
Approval: (To be completed by a person with delegated authority) Approval is given to the use of portable traffic signals (which have been separately type approved to RTA specification, PTS/3– Part A, as revised 4/92) as detailed hereunder.				
Owner:..... User:..... Project:.....		Signed: Title: Date:.....		
Use: (To be completed by the Users representative) Job location:				
Portable signals in service				
Date	Time (24 hour)	Supervisors name, please print	Initials	Mode* of operation
This completed schedule should be kept by the relevant approving authority for a period of 2 years as a record of the display. Note * MAN/1 – Manual Shuttle Operation MAN/2 – Manual Two Way Operation VA – Vehicle Activated Shuttle Operation FT – Fixed Time Shuttle Operation				
Table 10.7 – Portable traffic signals, record of approval and use				



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11.1 Introduction (AS 3.12.2)

This section provides the basic information to effectively use illuminated flashing arrow signs. These signs comprise a matrix of lamps or LED aspects in the form of an arrow that is flashed in a cyclic manner to either the left or right, indicating the direction in which approaching vehicles are to pass.

The equipment is to be operated in accordance with this section and with the manufacturer's instructions. As part of the daily routine tasks and record keeping, a log must be kept of the location and the period of display of the signs. This documentation may be required in Court in case of an accident or other incident such as a traffic infringement. Other bodies working on public roads are encouraged to follow these practices where they are applicable. Refer to Section 6, *Record keeping and reporting*, for more information.

Flashing arrow signs are intended to be applied primarily where a lane is closed or a diversion of traffic is required, typically on a multilane carriageway. They may also be adapted for mobile plant operation where only part of the road is blocked by the road plant but a clear direction to traffic is required as to which side of the plant traffic should pass through the mobile work site. An example of this is longitudinal linemarking.

Note that this section does not replace the field service manual and operating instructions for each set of equipment. It is important that operators make themselves fully acquainted with the manufacturer's instructions and recommendations before attempting to operate the equipment.

11.2 Approvals and specifications

Illuminated flashing arrow signs shall comply with the relevant Australian Standards, where they exist, and RTA specifications FAS/5 or FAS/4 Part A. The relevant Australian Standards are listed in FAS/5 and FAS/4. General operating instructions are given in this section.

In addition to the above, only equipment that has been type approved by the RTA is to be used. Testing of equipment is to be undertaken by the

RTA's Manager, Traffic Equipment and Standards. After type approval has been issued the Manufacturer or Selling Agent shall affix, to the equipment, a durable marking plate in the following format:-

This equipment conforms to
RTA – NSW TYPE APPROVAL
No.

The number shown on the marking plate shall be that shown on the Type Approval Certificate issued by the RTA Manager, Traffic Equipment and Standards.

Requests for copies of Specification No. FAS/5, FAS/4 Part A or a list of type approved equipment, and arrangements for type approval of equipment should be directed to:-

Manager, Traffic Equipment and Standards
Roads and Traffic Authority NSW
Level 5 Pod D
99 Phillip Street PARRAMATTA NSW 2150
Telephone (02) 8837 0116
Facsimile (02) 8837 0025

11.3 Definitions

These definitions are specific to this section, see also, Section 2.3, *Definitions*.

Aiming distance – the distance between the flashing arrow sign and the eye of an approaching driver.

Cycle length – the time interval between the start of the lamps being switched on and off and then on again to give a complete sequence of displays.

Flashing arrow signs – flashing electronic traffic control signs and associated equipment used at work sites and operated in one of the following modes:-

Arrow right mode (AR) – the lamps are energised to display an arrow which directs traffic to move or merge to the right.

Arrow left mode (AL) – the lamps are energised to display an arrow which directs traffic to move or merge to the left.



Double headed arrow mode (DA) – the lamps are energised to display an arrow which directs traffic to move or merge both to the left and to the right. It is usually used where the centre lane of a three lane carriageway is closed to traffic and generally in an emergency situation

Warning mode (W) – a pair of opposite diagonal lamps flash to give a strong warning or caution to approaching traffic.

Lamp matrix – an arrangement of lamps that display a message or symbol when a set or pattern of lamps is turned on or flashed.

Monitoring lamps – a set of two lamps at the rear of the sign which displays the mode of operation to the workers. Monitoring lamps are only provided on the Type C sign.

Off-time – the period of cycle time all the lamps are off. This is usually 50 to 40 percent of the cycle time.

On-time – the period of cycle time specific lamps are on. This is usually 50 to 60 percent of the cycle time.

Visibility distance – the maximum unobstructed distance the flashing displays are clearly seen under bright, daylight conditions with the specified lamps fully energised.

Visors – cylindrical matt black sleeves that are fitted around each lamp to shield them from incident light and reduce sun phantom effects.

11.4 General description of system

11.4.1 Illuminated flashing arrow sign equipment

The following three size designations are used.

Type A and Type B signs are suitable for mounting permanently on the rear of a road construction vehicle (fixed sign arrangement) or on the cab of a truck or utility vehicle (adjustable sign arrangement). Cab-mounted signs can be rotated to face either the front or the rear of the vehicle. The sign can also be rotated and locked in the face-down position for transport when the sign is not in use. They may be powered from the vehicle's electrical system or from a separate power source.

Type C signs are trailer mounted with integral generator, back-up battery supply and control equipment. Provision is made for the sign to be lowered, rotated and locked for transport or when the sign is not in use.

All signs can operate in one of four modes as detailed in Table 11.1.

Mode	Rear monitoring for Type C	Flashing lamps
Arrow right (AR)	-----■	Shaft and the right side arrow head.
Arrow left (AL)	■-----	Shaft and the left side arrow head.
Double arrow (DA)	■-----■ synchronised flash	Shaft and both the left and the right side arrow heads.
Warning (W)	■-----■ alternating flash	Pairs of diagonally opposite lamps. Gives a general message of caution or draws attention to an important traffic control sign.
Note: Lamp off ■ Lamp on		
Table 11.1 – Modes of operation		

11.4.2 Vehicle-mounted signs

Type A signs are suitable for attachment to light vehicles such as cars, panel vans or utilities or small plant items. Type B signs are suitable for attachment to heavy vehicles such as trucks and large plant items.

They are generally used on mobile works such as longitudinal linemarking, mobile survey vehicles, patrol vehicles and on shadow trucks protecting groups of workers.

11.4.3 Trailer-mounted signs

Type C signs are self contained trailer mounted units particularly designed for use on high speed roads such as rural divided roads where driver expectations are high.

They are generally used at short term or long term lane closures for work requiring one or more lanes to be closed for one or more shifts. Where

the flashing arrow signs are to operate overnight or over weekends the associated signs and devices need to be either reflectorised or lit.

11.4.4 Associated signposting and traffic arrangements

Any additional or associated signposting or traffic arrangements that may be required to be used with flashing arrow signs is to conform to the requirements of this manual.

Using flashing arrow signs tends to downgrade the effectiveness of other devices at the work site so it is essential that the associated signs and devices be in very good condition and special care be taken in their erection. The visibility distance for Type A, B and C flashing arrow signs is 500, 1000 and 1500 metres respectively. Associated signs should be located in clear view of approaching drivers, generally on the left side of the road. However, on winding alignment it may also be necessary to erect a sign or signs on the right hand side for clear viewing. Duplicate signs, on the right hand side of the road, may be considered when a driver's view may be obscured by alignment, buildings or heavy traffic. The use of larger signs may be considered for high approach speeds.

11.5 Equipment installation

11.5.1 Lamps

The brightness of the lamps is adjusted by an automatic dimming control which dims the light output for night conditions. A photocell detects the ambient light conditions that triggers the dimming facilities.

The flash rate for flashing arrow displays (AL, AR, DA) can vary from 50 to 60 percent on-time and 50 to 40 percent off-time. For diagonal flashing displays (W) the on-time and off-time is the same. The repetition rate for all modes is between 35 and 40 cycles per minute.

Two monitoring lamps are provided at the rear of the Type C sign to allow workers to monitor the mode of operation. These lamps flash as shown in Table 11.1.

11.5.2 Sign boards

Generally, the flashing arrow sign unit should be positioned so as to be as near as possible in the driver's line of sight. It is important to always locate signs to give the driver maximum visibility and hence time to understand

and react to the sign message. The visibility distance of the sign (ie. the distance at which the motorist can first become aware of the flashing arrow) varies as shown in Table 11.2. The minimum sight distance that should be provided to the flashing arrow sign depends both on the vehicle type and vehicle speed in the approach to the work area.

Table 11.2 provides a guide to the sight distances appropriate for the three types of sign. On high speed roads, every effort should be made to position the sign to achieve the desirable minimum sight distance.

Sign type	Visibility distance (m)	Sight distance	
		Desirable minimum	Absolute minimum
A	500	250	150
B	1000	500	300
C	1500	750	450
Note: Increase the sight distance by 2% for each 1% of downgrade. Decrease the sight distance by 2% for each 1% of upgrade.			
Table 11.2 – Typical sight distances for placement of flashing arrow signs			

The signs must be securely erected and anchored to prevent wind movement or interference by vandals. This is especially true for Type C signs as these are intended to be operated unattended.

The signs must also be aimed carefully to direct their display to the approaching vehicles. It is important that the sign be aimed to vehicles within the “critical zone” which covers the distances where drivers have time to react to the message and change lanes or stop if necessary. This is particularly important if the approach alignment of the road is not straight.

Sighting is usually done by means of a “sighting” device which facilitates aiming of the sign display. Such an aiming device must be substantially free of parallax error and must make allowance for the inherent downcast in the sealed-beam lamps. In the absence of a “sighting” device fitted to the sign, aiming needs to be undertaken by “trial and error”.

Table 11.3 lists the recommended aiming distances from the sign near the start of the taper defining the lane closure.

Approach speed (km/h)	Aiming distance (m)		
	Sign type		
	A	B	C
< 60	60	120	180
60	100	200	300
80	140	280	420
100	200	400	600
> 100	260	520	780
Notes: The aiming distance should not exceed the sight distance. The recommended aiming distances for the Type A sign is based on the stopping distance PLUS the reaction distance for 2.5 seconds of travel PLUS an allowance of 30 metres for siting the sign past the start of the taper. The aiming distances for Type B and C signs are two and three times those for the Type A sign to take advantage of their greater size and visibility. Type C signs not usually used on low speed roads.			
Table 11.3 – Aiming distances for various approach speeds			

Figure 11.1, *Illustration of aiming and sight distance*, shows the relationship between these two distances used when setting up flashing arrow signs.

11.5.3 Controls

The controls available are:-

- Power: On/Off
- Mode selection
- Mode monitoring (Type C signs only).

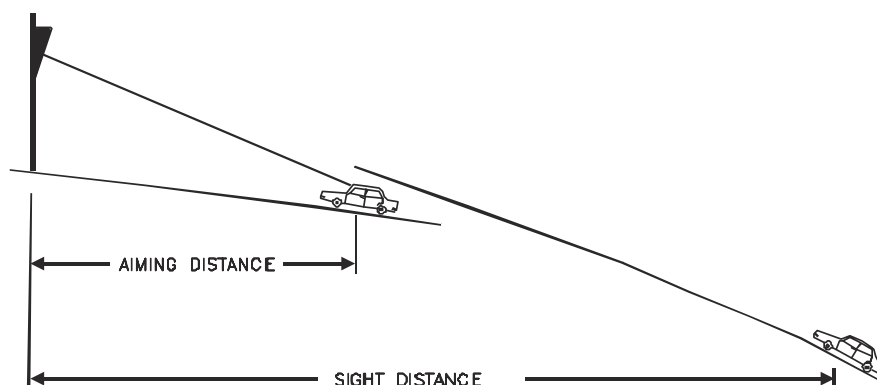


Figure 11.1 – Illustration of aiming and sight distance

11.6 Operation

11.6.1 Control modes

Although the layout and switch configuration may differ, all controls have basically the same functions, namely:-

- Arrow Right (AR)
- Arrow Left (AL)
- Double Arrow (DA)
- Warning (W).

11.6.2 Flash rate

The flash rate is fixed to the levels given in the Specifications and cannot be varied. It is important to check that all lamps are functioning to give the correct display selected by the controls.

11.6.3 Dimming

The dimming facilities are automatic but care should be taken that any incident light (from street lighting and/or vehicle headlights) falling on the photocell does not adversely interfere with the operation of the dimming feature. The photocell should be occasionally cleaned, since if it is dirty or obstructed, the lamps will not be as bright as they should be.



11.6.4 Setting up

The equipment should be set up to the Manufacturer's Instructions with particular care to the siting and aiming of the signs to suit the layout arrangement being used and the geometry of the road approach to the sign.

11.6.5 Trouble shooting

The monitoring lamps should be regularly observed to confirm that the sign is operating in the appropriate mode for the work site. It is also necessary to regularly inspect the front panel of the sign to ensure that all lamps are clean and alive.

If one lamp is not operating then check it and if it is blown replace with a new lamp. If all lamps are out or all lamps are too dim for the conditions then check the battery or generator for charge. If the charge is satisfactory but the lamps are still too dim for the conditions then check that the photocell is not being blocked from reading the true ambient light level.

11.7 Maintenance

11.7.1 Field service

Operators should familiarise themselves with the manufacturer's instructions. A high level of field service is essential to maintain the sign in good condition to provide an effective warning to motorists at all times.

Field service usually covers:-

- simple fault diagnosis and associated replacement of the faulty modules;
- routine maintenance and servicing, including replacement of lamps and other consumable components;
- keeping the equipment clean and tidy.

These requirements are detailed in the manufacturer's instructions.

11.7.2 Major repairs

If care is taken with the field service, the equipment should remain in good working condition between major service inspections and overhauls. If major faults develop the sign should be taken out of service and alternative



traffic control arrangements made. The sign should not be returned to service until the faults have been rectified.

11.7.3 Administration procedures

Refer to local office procedures in respect of administration, costing and maintenance of flashing arrow signs as an item of small plant.

A.1 Introduction

This Appendix contains more than 100 standard TCPs and it will help you select the most appropriate standard TCP for your circumstances. The standard TCP will show what type of traffic control is necessary for your work situation, and what devices and signs to use as a minimum.

There are standard TCPs for short term, long term and mobile work. There are no TCPs for intermittent work. Section 9.1, *Intermittent work and low impact works*, describes the relevant requirements.

A.2 Finding a suitable standard TCP

Some TCPs are specifically intended for particular work situations such as line marking, shoulder grading, weed spraying, bitumen surfacing, etc. However the following tables do not name every work activity, and judgement will be necessary in selecting the most appropriate TCP.

Selecting a standard TCP will be easier if the following is available:-

- the type of work being planned
- the number of lanes the road has at the work area
- whether the road is divided or a single carriageway
- the ADT
- the approach speed of and clearance to passing traffic
- whether it is best to divert traffic around, past or through the work
- whether the work is short term, long term or mobile.

The following information will be useful in choosing a standard TCP:-

- Section 4.3, *Selecting standard TCPs*, gives guidance on responsibilities.
- Table A-1 is an index of work situations. It indicates either the relevant standard TCP or the next table to examine.
- Tables A-2 to A-17 show which standard TCPs to use for a range of work types and activities. In these tables, the types of work shown are examples of typical applications for the standard TCPs.

- If Tables A–I to A–17 do not mention your work, use Table A–18 to select a suitable standard TCP by matching the details of your work situation with those on the TCPs in Appendix D.

If none of the standard TCPs is suitable, refer to Section 5, *Designing new TCPs* and Section 9, *Specific situations*.

Abbreviation	Meaning
A	Traffic goes Around the work area
AV	Advance warning Vehicle
Div	Divided carriageway
L	Long term work
LV	Lead Vehicle
M	Mobile work
P	Traffic goes Past the work area
Na	Not applicable
S	Short term work
SV	Shadow Vehicle
T	Traffic goes Through the work area
TC	Traffic Controller(s)
TCS	Traffic Control Signals
Un	Undivided carriageway

Figure A–I – List of abbreviations used in this Appendix

Note:

Refer to Section 2.3, *Definitions*, for additional information if necessary.

Work	Reference	
Access to depots, stockpiles, quarries, gravel pits etc.	Appendix D	TCP 195
Batter maintenance	Appendix A	Table A-14
Benkelman Beam testing	Appendix A	Table A-8
Bituminous surfacing	Appendix A	Table A-9
Blasting	Appendix D	TCP 47
Bridge joints – repair – see <i>Lane closures</i>	Appendix A	Tables A-2 & A-3
Deflectograph and FWD testing	Appendix A	Table A-10
Drainage maintenance	Appendix A	Table A-7
Formation grading	Appendix D	TCP 105
Footway work – short term work	Appendix D	TCP 61
Footway work – long term work	Appendix D	TCP 109
Full road closure	Appendix D	TCP 47
Grading – formation	Appendix D	TCP 105
Grading – shoulder	Appendix D	TCP 99
Guardfence – repair and installation	Appendix A	Tables A-2, A-3 & A-14
Guideposts	Appendix A	Tables A-2, A-4 & A-14
Hand patching	Appendix A	Table A-6
Haul road	Appendix D	TCP 44
Height restriction	Appendix D	TCP 48
Kerb and gutter works	Appendix A	Table A-12
Lane closure – mobile work	Appendix A	Table A-4
Lane closure – long term work	Appendix A	Table A-3
Lane closure – short term work	Appendix A	Table A-2
Line marking	Appendix A	Table A-13
Machine patching, see <i>Short term lane closure</i>	Appendix A	Table A-2

Table A-1 Typical work activities and situations



Work	Reference	
Mechanical testing – Deflectograph and FWD	Appendix A	Table A-10
Mowing – ADT less than 1500	Appendix D	TCP 97
Patching, hand	Appendix A	Table A-6
Patching, machine – see <i>Short term lane closures</i>	Appendix A	Table A-2
Pavement marking – installation / removal	Appendix A	Table A-2
Raised pavement markers	Appendix A	Table A-11
Reconstruction	Appendix A	Table A-5
Restoration	Appendix A	Table A-5
Roundabouts	Appendix A	Table A-17
Safety barriers	Appendix A	Table A-14
Services adjustment – see <i>Drainage maintenance</i>	Appendix A	Table A-7
Shoulder grading	Appendix D	TCP 99
Shoulder work – miscellaneous	Appendix A	Table A-14
Sign work (roadside)	Appendix A	Table A-14
Snow clearing	Appendix D	TCP 67
Speed zoning at road works	Appendix D	TCP 57
Spotting	Appendix A	Table A-11
Surveying	Appendix A	Table A-16
Test holes, see <i>Short term lane closures</i>	Appendix A	Table A-2
Testing – mechanical	Appendix A	Table A-10
Testing – Benkelman Beam	Appendix A	Table A-8
Traffic signal works	Appendix A	Table A-15
Weed spraying	Appendix D	TCP 76
Weight restriction	Appendix D	TCP 49

Table A-1 Typical work activities and situations (continued)

Lane	2 lane 2 way	3 lane 2 way	4 or more lanes undivided	4 or more lanes divided
Left	43 Temporary traffic signals 47 Full road closure - blasting 77 Up to 5 mins, ADT > 3,000 78 Up to 5 mins, ADT < 3,000 83 ADT > 1,500 84 ADT < 6,000 95 Bitumen sealing in one lane 104 Benkelman Beam 108 ADT < 1,500 437 ADT ≥ 1500 440 Traffic through work area 831 Intermittent	<i>In direction with one lane:</i> 81 Traffic through work area 91 Traffic using opposing lane 826 Traffic using opposing fast lane <i>In direction with two lanes:</i> 86 No delay in fast lane 88 Occasional delay in fast lane	101 Slow lane	92 No delay in fast lane 93 Occasional delay in fast lane
Middle				100 Traffic around work area
Fast		89 Chicane 90 Traffic Controllers	102 Chicane 103 Both fast lanes	94 Traffic around work area

Table A-2 TCPs for short term lane closures



Lane	2 lane 2 way	3 lane 2 way	4 or more lanes undivided	4 or more lanes divided
Left	43 Temporary traffic signals 45 Traffic diverted to shoulder 48 High vehicle detour 49 Heavy vehicle detour 50 One lane side track 51 Two lane side track 53 Urban 1 lane detour 54 Urban 2 lane detour 60 At urban intersection 353 Sealing – full width 439 Give way signs 440 Traffic in work area		46 Temporary shift of centre line 60 At urban intersection	52 Carriageway closed, side track across median 96 Bitumen sealing in one lane
Middle				52 Carriageway closed
Fast		89 Chicane		52 Carriageway closed

Table A-3 TCPs for long term lane closures

Lane	2 lane 2 way	3 lane 2 way	4 or more lanes undivided	4 or more lanes divided
Left	67 Snow clearing 76 Weed spraying 451 Testing	<i>In direction with one lane:</i> 71 General work 452 Testing <i>In direction with two lanes:</i> 69 General work 450 Testing	74 General work 445 Testing	62 Pavement markers 72 General work 448 Testing
Middle				107 General work 446 Testing
Fast		70 General work, without Traffic Controller 116 General work, with Traffic Controller 449 Testing	447 Testing	63 Pavement markers 73 General work wide median 75 General work narrow median 444 Testing

Table A-4 TCPs for mobile lane closures



Lane	2 lane 2 way	3 lane 2 way	4 or more lanes undivided	4 or more lanes divided
Left	43 L Temporary traffic signals 45 L Traffic diverted to shoulder 50 L One lane side track 51 L Two lane side track 53 L One direction urban detour 54 L All traffic detour – urban 60 L At urban intersection 439 L Give way signs 440 S/L Traffic in work area		46 L Shift centre line	52 L Carriageway closed – side track crosses median
Middle			46 L Shift centre line	52 L Carriageway closed, side track crosses median
Fast		89 S/L Chicane		52 L Carriageway closed, side track crosses median

Table A–5 TCPs for restoration and reconstruction

Note(s):

Use TCP 57 for roadwork speed limits.
 Use TCP 195 for access to depots, gravel pits, etc.

Lane	2 lane 2 way	3 lane 2 way	4 or more lanes undivided	4 or more lanes divided
Left	41 S D < 60 km/h 77 S ADT > 3,000, up to 5 mins 78 S ADT < 3,000 108 S ADT < 1,500 437 S ADT ≥ 1500 Over 5 mins 83 I Intermittent work	<i>In direction with one lane:</i> 71 M General work with TC 81 S Traffic through work area 91 S Traffic around work area <i>In direction with two lanes:</i> 69 M No delay in fast lane 86 S No delay in fast lane 88 S Occasional delay in fast lane	74 M No delay in fast lane	72 M General work 92 S No delay in fast lane
Middle				107 M General work
Fast		70 M General work without TC 80 S Traffic Controller 89 S/L Chicane		82 S ADT < 10,000, up to 5 mins 94 S Over 5 mins 73 M Wide median 75 M Narrow median

Table A-6 TCPs for hand patching

Lane	2 lane 2 way	3 lane 2 way	4 or more lanes undivided	4 or more lanes divided
Left	41 S D < 60 km/h 61 S Footway closed 83 S ADT > 1,500 84 S ADT < 6,000 108 S ADT < 1,500 42 L Shoulder closed 45 L Lane closed 50 L Side track 51 L Side track 60 L At intersection 109 L Footway closed 40 M Clear of traffic	<i>In direction with one lane:</i> 91 S Traffic around work area <i>In direction with two lanes:</i> 86 S No delay in fast lane 88 S Occasional delay in fast lane	46 L Shift centre line 101 S Slow lane work	92 S No delay in fast lane 93 S Occasional delay in fast lane 52 L Carriageway closed
Middle				100 S Traffic around work area 52 L Carriageway closed
Fast		90 S Traffic Controllers 89 S/L Chicane	102 S Chicane 103 S Both fast lanes	94 S Traffic around work area 52 L Carriageway closed

Table A-7 TCPs for drainage maintenance

Lane	2 lane 2 way	3 lane 2 way	4 or more lanes undivided	4 or more lanes divided
Left	104 S	<i>In direction with one lane:</i> 91 S <i>In direction with two lanes:</i> 86 S 69 M 450 M	101 S 74 M	92 S 72 M
Middle				100 S 107 M
Fast		89 S 70 M	102 S Chicane 103 S 453 M	94 S 73 M

Table A-8 TCPs for Benkelman Beam testing



Width	2 lane 2 way	3 lane 2 way	4 or more lanes undivided	4 or more lanes divided
One lane	95 S D ≤ 60 km/h			96 L All speeds, minor delay
Full width	56 L ADT < 5,000 and D < 60 km/h 353 L ADT > 5,000 and D > 80 km/h			

Table A-9 TCPs for bituminous surfacing

Lane	2 lane 2 way	3 lane 2 way	4 or more lanes undivided	4 or more lanes divided
Left	451	<i>In direction with one lane:</i> 452 <i>In direction with two lanes:</i> 450	445	448
Middle				446
Fast		449	447	444

Table A-10 TCPs for Deflectograph and FWD testing

Line	2 lane 2 way	3 lane 2 way	4 or more lanes undivided	4 or more lanes divided
Left edge	77 S ADT $\geq$ 3,000 78 S ADT < 3,000 79 M	<i>In direction with one lane:</i> 81 S 71 M <i>In direction with two lanes:</i> 80 S 69 M	74 M	62 M
Right edge				82 S 63 M
Centre	108 S ADT < 1,500 437 S ADT > 1,500 106 M	116 M		
Lane		70 M 80 S		62 M 75 M 107 M 82 S

Table A-11 TCPs for raised pavement markers and spotting

Location	TCP
Left side	42 L Shoulder closed 45 L Kerbside lane closed 53 L Detour 60 L At intersection 61 S Footway closed 109 L Footway closed
Median	94 Fast lane closed

Table A-12 TCPs for kerb & gutter works

Line	2 lane 2 way	3 lane 2 way	4 or more lanes undivided	4 or more lanes divided
Left edge	64	111	114	114
Right edge				115
Centre	66	110	113	
Lane		438	58	65

Table A-13 TCPs for line marking

Work type	TCP
Short term	41 D < 60 km/h 77 Minor traffic delay, ADT ≥ 3,000 78 Minor traffic delay, ADT < 3,000 97 Mowing 99 Grading shoulders 101 Lane closed, high speed road, flashing arrow 440 Lane closed, Traffic Controllers
Long term	42 Shoulder closed 43 Lane closed, temporary traffic signals 45 Lane and shoulder closed 439 Lane closed, give way signs 440 Lane closed, Traffic Controllers
Mobile	40 Clear of road

Table A-14 TCPs for shoulder work

Note(s):

Typical uses of this table include: signs, guideposts, safety barriers, batters, grading, mowing, etc.



Location	TCP
Footway/Closed kerbside lane	802 Blacked out site, all work done on footway > 80 minutes 812 Work on tertiary post with blocked lane, > 80 minutes 820 Kerbside lane closed < 80 minutes 821 Kerbside lane closed > 80 minutes 822 Short term/routine maintenance, no lane blocked 822A Short term emergency maintenance 822B Short term/routine maintenance, no lane blocked
Road	804 Loop cutting – 2 lane/2 way intersection 805 Loop cutting – 2 approach lanes with median 805A Loop cutting – 2 approach lanes no median 806 Loop cutting – right turn bay 807 Loop cutting – 4 approach lanes 814 Loop cutting – centre lane of 3 approach lanes
Median	803 Blacked out site, with right turn bay > 80 minutes 816 2 lane approach < 80 minutes 817 2 lane approach with right turn bay <80 minutes 818 2 lane approach > 80 minutes 819 2 lane approach with right turn bay > 80 minutes 822 Short term/routine maintenance, no lane blocked 822A Short term emergency maintenance 822B Short term/routine maintenance, no lane blocked
Overhead	809 2 lane approach – kerbside lanes < 80 minutes 810 3 lane approach – centre lane < 80 minutes 811 Multilane approach < 80 minutes 812 2 lane departure > 80 minutes 813 2 lane approach > 80 minutes 814 3 lane approach – centre lane > 80 minutes 815 Multilane approach – medianside lane > 80 minutes

Table A-15 TCPs for traffic signal works

Notes:

- I. If Police on point duty wish to modify the layout, act accordingly. Record the request in the diary with details, eg date/time/location/name of Police making request. Advise Supervisor when return to depot.

Traffic Control at Work Sites

2. Pedestrian crossings should not be blocked. If necessary, provide alternative crossing or assistance.
3. For loop marking, use of a shadow vehicle with flashing lights ON to protect staff marking out loop is considered adequate.
4. Reduced size signs will be used.
5. TCP809-811, 816, 817, 820, 822 (< 80min work)
If staff feel that it is unsafe to proceed as shown in the TCP after an on-site risk assessment, the appropriate one for work > 80min should be used instead.

Location	Traffic Control
Shoulder (lip and kerb)	459 2 way road
Travel lanes	Intermittent work or lane closure. See Section 9.1, Table A-2, or Table A-4
Medians	463 1 way carriageway
Narrow medians	Intermittent work or lane closure. See Section 9.1, Table A-2, or Table A-4
Roadside	Not required if work area is more than 3 metres from the nearest edge of a traffic lane

Table A-16 TCPs for surveying

Location	Traffic Control
Kerb side lane	827 S 4 lane/2 way
Median lane	828 S 4 lane/2 way
Single lane approach	829 S up to 10 minutes delay
Multilane approach	830 S roundabout lane closure

Table A-17 TCPs for roundabouts



TCP	Lanes	Div or Un	ADT ^α	Where on the road is the work area?	Short or long term, or mobile work?	Around, past or through the work area?	Main type of traffic control ^β
40	2	Un	No limits	Clear of travel lanes	M	A	Signs
41	2	Un	No limits and D<60 km/h	Shoulder	S	A	Signs
42	2	Un	No limits	Shoulder	L	A	Signs
43	2	Un	No limits	In lane	S & L	A	TCS
44	2	Na	No limits	Haul road access	L	T	TC or TCS
45	2	Un	No limits	In lane	L	A	Signs
46	6	Un	No limits	In kerbside and middle lanes	L	A	Signs
47	2	Na	No limits	Full road closure	S	T	TC
48	2	Na	No limits	Height restriction	L	na	Signs
49	2	Na	No limits	Weight restriction	L	na	Signs
50	2	Un	No limits	One lane	L	P	Signs
51	2	Un	No limits	Full width	L	P	Signs
52	4	Div	No limits	Full width of one carriageway	L	P	Signs
53	2	Un	No limits	Half width of road	L	P	Signs
54	2	Un	No limits	Full width of road	L	P	Signs
56	2	Un	< 5,000	Full width	L	T	TC
57	2	Un	No limits	Various	S & L	T	Speed Zone

Table A-18 Main features of standard TCPs

Note(s):

^α Lane closures and similar temporary arrangements may reduce the capacity of the road, and the Site Supervisor shall make all necessary arrangements to compensate for reduced capacity.

^β The type of traffic control may depend on circumstances at the site such as available sight distance and traffic volumes. This column mentions only the dominant type of traffic control shown on each standard TCP.

TCP	Lanes	Div or Un	ADT ^α	Where on the road is the work area?	Short or long term, or mobile work?	Around, past or through the work area?	Main type of traffic control ^β
58	4	Un	No limits	Lane line	M	A	LV & AV
60	2	Un	No limits	Kerbside lane at intersection	L	A	Signs
61	2	Un	No limits	On footway	S	A	Signs
62	4	Div	No limits	On lane line and left edge line	M	A	SV & AV
63	4	Div	No limits	On right edge line	M	A	SV & AV
64	2	Un	No limits	Left edge line	M	A	AV
65	4	Div	No limits	Lane line	M	A	AV
66	2	Un	No limits	Centre line	M	A	LV & AV
67	2	Un	No limits	Full width	M	A	Signs
69	3	Un	No limits	Edge line adjacent to slow lane	M	A	SV & AV
70	3	Un	No limits	Central lane. lane line	M	A	SV & AV
71	3	Un	No limits	Edge line adjacent to single lane	M	T	TC & AV
72	4	Div	No limits	Left lane	M	A	SV & AV
73	4	Div ^χ	No limits	Right lane	M	A	SV & AV

Table A-18 Main features of standard TCPs (continued)

Note(s):

- ^α Lane closures and similar temporary arrangements may reduce the capacity of the road, and the Site Supervisor shall make all necessary arrangements to compensate for reduced capacity.
- ^β The type of traffic control may depend on circumstances at the site such as available sight distance and traffic volumes. This column mentions only the dominant type of traffic control shown on each standard TCP.
- ^χ Median wider than 3 m.



TCP	Lanes	Div or Un	ADT ^α	Where on the road is the work area?	Short or long term, or mobile work?	Around, past or through the work area?	Main type of traffic control ^β
74	4	Un	No limits	In left lane or on left edge line	M	A	SV & AV
75	4	Un ^δ	No limits	In right lane or on right edge line	M	A	SV & AV
76	2	Un	No limits	Shoulders and verges	M	A	Signs or AV
77	2	Un	> 3,000	In lane, or edge line or on shoulder	S	T	TC
78	2	Un	< 3,000	In lane, or edge line or on shoulder	S	T	TC
79	2	Un	No limits	In lane	M	A	SV & AV
80	3	Un	No limits	Fast lane	S	T	TC
81	3	Un	No limits	Single lane	S	T	TC
82	4	Div	< 10,000	Fast lane, lane line, right edge line	S	T	TC
83	2	Un	> 1,500	In lane	S	A	TC
84	2	Un	< 6,000	In lane	S	A	TC
86	3	Un	No limits	In slow lane	S	A	Signs
88	3	Un	No limits	In slow lane with plant or personnel occasionally moving in and out of fast lane	S	A	TC
89	3	Un	No limits	In fast lane	S & L	A	Signs

Table A-18 Main features of standard TCPs (continued)

Note(s):

^α Lane closures and similar temporary arrangements may reduce the capacity of the road, and the Site Supervisor shall make all necessary arrangements to compensate for reduced capacity.

^β The type of traffic control may depend on circumstances at the site such as available sight distance and traffic volumes. This column mentions only the dominant type of traffic control shown on each standard TCP.

^δ Median narrower than 3 m.

TCP	Lanes	Div or Un	ADT ^α	Where on the road is the work area?	Short or long term, or mobile work?	Around, past or through the work area?	Main type of traffic control ^β
90	3	Un	No limits	In fast lane with plant or personnel moving regularly in and out of slow lane	S	A	TC
91	3	Un	No limits	In single lane	S	A	TC
92	4	Div	No limits	In slow lane	S	A	Signs
93	4	Div	No limits	In slow lane with plant and personnel moving regularly in and out of fast lane	S	A	TC
94	4	Div	No limits	Fast lane, with plant and personnel wholly in fast lane	S	A	Signs
95	2	Un	No limits	Half width – in one lane only	S	A	TC
96	4	Div	No limits	In slow lane	L	A	TC
97	Na	Na	< 1500	Mowing, shoulders and verges	S	A	Signs
99	2	Un	No limits	Shoulders and earth drains	S	A	Signs
100	6	Un	No limits	In middle lane	S	A	Signs

Table A–18 Main features of standard TCPs (continued)

Note(s):

^α Lane closures and similar temporary arrangements may reduce the capacity of the road, and the Site Supervisor shall make all necessary arrangements to compensate for reduced capacity.

^β The type of traffic control may depend on circumstances at the site such as available sight distance and traffic volumes. This column mentions only the dominant type of traffic control shown on each standard TCP.

TCP	Lanes	Div or Un	ADT ^α	Where on the road is the work area?	Short or long term, or mobile work?	Around, past or through the work area?	Main type of traffic control ^β
101	4	Un	No limits	In slow lane	S	A	Signs
102	4	Un	No limits	In fast lane	S	A	Signs
103	4	Un	No limits	In fast lane	S	A	Signs
104	2	Un	No limits	In lane	S	A	TC
105	2	Un	No limits	Whole carriageway	S	T	Signs
106	2	Un	No limits	On centre line	M	A	TC & AV TC, LV & AV
107	6	Div	No limits	Kerb lane restricted and middle lane closed	M	A	AV & SV
108	2	Un	< 1,500	In lane	S	A	TC
109	All roads	Na	No limits	Footway	L	A	Signs
110	3	Un	No limits	Centre line	M	A	LV & AV
111	3	Un	No limits	Edge line adjacent to slow lane	M	A	AV
113	4	Un	No limits	Centre line	M	A	LV & AV
114	4	Div & Un	No limits	Left edge line	M	A	AV
115	4	Div	No limits	Right edge line	M	A	AV

Table A-18 Main features of standard TCPs (continued)

Note(s):

^α Lane closures and similar temporary arrangements may reduce the capacity of the road, and the Site Supervisor shall make all necessary arrangements to compensate for reduced capacity.

^β The type of traffic control may depend on circumstances at the site such as available sight distance and traffic volumes. This column mentions only the dominant type of traffic control shown on each standard TCP.

TCP	Lanes	Div or Un	ADT ^α	Where on the road is the work area?	Short or long term, or mobile work?	Around, past or through the work area?	Main type of traffic control ^β
116	3	Un	No limits	Centre line, fast lane	M	A	AV, TC & SV
195	na	Na	No limits	Work vehicles turning on and off	S & L	na	Signs
353	2	Un	≥ 5,000 & D > 80 km/h	Full width of road	L	T	TC
437	2	Un	No limits	Left lane	S	A	TC
438	3	Un	No limits	Left lane	M	A	AV & LV
439	2	Un	< 1,500	Left lane	L	A	Give way signs
440	2	Un	No limits	Left lane	S & L	A	TC
444	4	Div	No limits	Fast lane	M	A	AV

Table A-18 Main features of standard TCPs (continued)

Note(s):

- ^α Lane closures and similar temporary arrangements may reduce the capacity of the road, and the Site Supervisor shall make all necessary arrangements to compensate for reduced capacity.
- ^β The type of traffic control may depend on circumstances at the site such as available sight distance and traffic volumes. This column mentions only the dominant type of traffic control shown on each standard TCP.

TCP	Lanes	Div or Un	ADT ^α	Where on the road is the work area?	Short or long term, or mobile work?	Around, past or through the work area?	Main type of traffic control ^β
445	4	Un	No limits	Slow lane	M	A	AV
446	6	Div	No limits	Middle lane	M	A	AV
447	4	Un	No limits	Fast lane	M	A	AV
448	4	Div	No limits	Slow lane	M	A	AV
449	3	Un	No limits	Overtaking lane	M	A	AV
450	3	Un	No limits	Slow lane	M	A	AV
451	2	Un	No limits	Left lane	M	A	LV, AV & TC
452	3	Un	No limits	Single lane	M	A	LV, AV & TC
453	4	Div & Un	No limits	Fast lane	M	A	AV & SV
459	na	Un	< 10,000	Both shoulders	M	A	Signs
463	na	Div	No limits	Shoulder and median	M	A	Signs
802	6	Div	No limits	Footpath	S	P	Signs & cones
803	5	Div	No limits	Median	S	P	Signs & cones
804	2	Un	No limits	Kerbside lane - loop cutting	S	T	TC
805	4	Div	No limits	Both approach lanes - loop cutting	S	P	Flashing arrow & lamps or signs, & cones

Table A-18 Main features of standard TCPs (continued)

Note(s):

^α Lane closures and similar temporary arrangements may reduce the capacity of the road, and the Site Supervisor shall make all necessary arrangements to compensate for reduced capacity.

^β The type of traffic control may depend on circumstances at the site such as available sight distance and traffic volumes. This column mentions only the dominant type of traffic control shown on each standard TCP.

TCP	Lanes	Div or Un	ADT^α	Where on the road is the work area?	Short or long term, or mobile work?	Around, past or through the work area?	Main type of traffic control^β
805A	4	Un	No limits	Both approach lanes - loop cutting	S	P	Flashing arrow & lamps or signs, & cones
806	4	Div	No limits	Right turn bay - loop cutting	S	P	Flashing arrow & lamps, signs & cones
807	8	Div	No limits	4 approach lanes - loop cutting	S	P	Flashing arrow & lamps or signs, & cones
809	4	Div	No limits	Kerbside lane - overhead signal	S	P	Flashing arrow & lamps
810	6	Div	No limits	Centre lane – overhead signal	S	P	Flashing arrow & lamps
811	8	Div	No limits	Median lane - overhead signals	S	P	Flashing arrow & lamps
812	4	Div	No limits	Kerbside departure lane - overhead signals	S	P	Flashing arrow & lamps, signs and cones
812A	4	Div	No limits	Kerbside departure lane - overhead signals	S	P	Flashing arrow & lamps, signs and cones
813	4	Div	No limits	Kerbside lane – overhead signal	S	P	Flashing arrow & lamps, signs & cones

Table A-18 Main features of standard TCPs (continued)

Note(s):

^α Lane closures and similar temporary arrangements may reduce the capacity of the road, and the Site Supervisor shall make all necessary arrangements to compensate for reduced capacity.

^β The type of traffic control may depend on circumstances at the site such as available sight distance and traffic volumes. This column mentions only the dominant type of traffic control shown on each standard TCP.

TCP	Lanes	Div or Un	ADT ^α	Where on the road is the work area?	Short or long term, or mobile work?	Around, past or through the work area?	Main type of traffic control ^β
814	6	Div	No limits	Centre lane – overhead signal	S	P	Flashing arrow & lamps, signs & cones
814A	6	Div	No limits	Centre lane – overhead signal	S	P	Flashing arrow & lamps, signs & cones
815	8	Div	No limits	Median lane - overhead signals	S	P	Flashing arrow & lamps, signs & cones
816	4	Div	No limits	Median lane - ladder	S	P	Flashing arrow, lamps & cones
817	5	Div	No limits	Right turn bay - ladder	S	P	Flashing arrow, lamps & cones
818	4	Div	No limits	Median lane - ladder	S	P	Flashing arrow & lamps, signs & cones
819	5	Div	No limits	Right turn bay - ladder	S	P	Flashing arrow & lamps, signs & cones
820	4	Div	No limits	Kerbside lane - ladder	S	P	Flashing arrow & lamps
821	4	Div	No limits	Kerbside lane - ladder	S	P	Flashing arrow & lamps, signs & cones
822	5	Div	No limits	Work on median or footpath	S	P	Cones and signs

Table A-18 Main features of standard TCPs (continued)

Note(s):

^α Lane closures and similar temporary arrangements may reduce the capacity of the road, and the Site Supervisor shall make all necessary arrangements to compensate for reduced capacity.

^β The type of traffic control may depend on circumstances at the site such as available sight distance and traffic volumes. This column mentions only the dominant type of traffic control shown on each standard TCP.

TCP	Lanes	Div or Un	ADT^α	Where on the road is the work area?	Short or long term, or mobile work?	Around, past or through the work area?	Main type of traffic control^β
822A	5	Div	No limits	Work on median or footpath	S	P	Cones
822B	5	Div	No limits	Work on median or footpath	S	P	Cones and signs
826	3	Un	No limits	In the single lane	S	P	Signs and cones
827	4	Un	No limits	Kerbside lane – roundabout	S	P	Flashing arrow, signs & cones
828	4	Un	No limits	Median lane – roundabout	S	P	Flashing arrow, signs & cones
829	2	Un	No limits	Single lane – roundabout	S	P	TC, signs & cones
830	4	Un	No limits	Roundabout lane	S	P	Signs & cones
831	2	Un	No limits	Intermittent work	S	T	Signs and spotter

Table A–18 Main features of standard TCPs (continued)

Note(s):

^α Lane closures and similar temporary arrangements may reduce the capacity of the road, and the Site Supervisor shall make all necessary arrangements to compensate for reduced capacity.

^β The type of traffic control may depend on circumstances at the site such as available sight distance and traffic volumes. This column mentions only the dominant type of traffic control shown on each standard TCP.



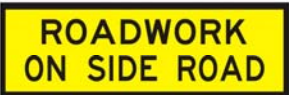
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For sign sizes and layouts refer to:-

- ◆ **The RTA website Traffic Signs Register**
- ◆ **ASI 743**
- ◆ **The relevant Table in ASI 742.3, as shown at the foot of the following pages**

References under the REMARKS column on the following pages refer to the relevant Section(s) in this Manual or the Clause in AS 1742.3.

SIGN	NUMBER	REMARKS
	T1-1	5.2.3 (AS 3.4.2)
	T1-31	5.2.3 Use where space is restricted (AS 3.4.2)
	T1-16	5.2.3 May also specify 2km AHEAD (AS 3.4.2)
	T1-2	5.2.3 (AS 3.4.3)
	T1-29	May also specify 2km AHEAD (AS 3.4.3)
	T1-5	5.2.3 Daytime use (AS 3.4.4)
	T1-5*	5.2.14; 9.2.8 For use when RTA work is undertaken during both day and night time.
	T1-224*	Class 1 Yellow border and symbol with black background. For use on RTA night works.
*Not Australian Standard (RTA NSW sign)		
SIGNS FOR WORK SITE APPROACHES AND DEPARTURES (AS TABLE 3.1)		

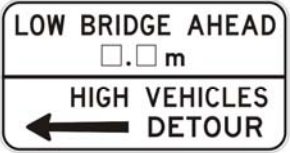
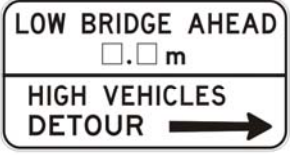
SIGN	NUMBER	REMARKS
	T1-3-1	5.2.3; 9.1.5 (AS 3.4.5)
	T1-3-2	(AS 3.4.5)
	T1-4	(AS 3.4.5)
	T1-25	(AS 3.4.6)
	T1-27	(AS 3.4.6)
	T1-32	(AS 3.4.6)
	T1-28	5.2.3; 9.1.2 (AS 3.4.7)
	T2-16	5.2.3 (AS 3.4.8)
SIGNS FOR WORK SITE APPROACHES AND DEPARTURES (AS TABLE 3.1)		

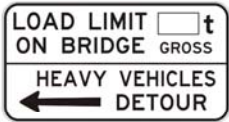
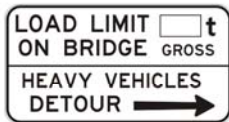
SIGN	NUMBER	REMARKS
	T1-223*	5.2.10; 9.2.8 Class 1 Yellow border and letters on black ground for RTA works.
	T2-19	
	T2-20	
	T2-21-1	
*Not Australian Standard (RTA NSW sign)		
SIGNS FOR WORK SITE APPROACHES AND DEPARTURES (AS TABLE 3.1)		

SIGN	NUMBER	REMARKS
	T1-18	5.2.3 (AS 3.5.2a)
	T1-34	Day time (AS 3.5.2b)
	T1-200-2*	5.2.10; 9.2.8 For use where RTA work is undertaken during both day and night time.
	T1-200-3*	5.2.10; 9.2.8 Class 1 Yellow border and symbol on black background. RTA night works.
 	R6-8(STOP) T7-1(SLOW)	5.2.4; 8.1.1 (AS 3.5.2c)
	R1-2	5.2.3 (AS 3.5.3a)
	W3-2	5.2.3
*Not Australian Standard (RTA NSW sign)		
SIGNS FOR REGULATORY CONTROL OF TRAFFIC (AS TABLE 3.2)		

SIGN	NUMBER	REMARKS
	R9-9	5.2.3 Used with the R1-2 sign (AS 3.5.3a)
	R6-11	5.2.3 Used with R1-2 and R9-9 (AS 3.5.3b)
	W3-3	T1-30 not used in NSW (AS 3.5.4c)
	R6-6	(AS 3.5.4d)
	T1-220*	9.9.4
	T1-221*	9.9.4
	R4-1-100	8.2 (AS 3.5.5a)
	R4-1-60	8.2 (AS 3.5.5a)
*Not Australian Standard (RTA NSW sign)		
SIGNS FOR REGULATORY CONTROL OF TRAFFIC (AS TABLE 3.2)		

SIGN	NUMBER	REMARKS
	R4-3	8.2 (AS 3.5.5b)
	R4-212*	8.2 Sign is hinged to be lockable in both positions. The selected speed limit is inserted in the circle. All sizes are available.
	G9-79	8.2 (AS 3.5.5d)
	T4-216*	8.2.5(f)
*Not Australian Standard (RTA NSW sign)		
SIGNS FOR REGULATORY CONTROL OF TRAFFIC (AS TABLE 3.2)		

SIGN	NUMBER	REMARKS
	T1-6	9.19 (AS 3.6.2)
	T2-23	9.19 (AS 3.6.3)
	T5-1(L)	9.19 (AS 3.6.4)
	T5-1(R)	9.19 (AS 3.6.4)
	T5-6	(AS 3.6.5)
	G9-3(L)	(AS 3.6.6)
	G9-3(R)	(AS 3.6.6)
SIGNS FOR DETOURS (AS TABLE 3.3)		

SIGN	NUMBER	REMARKS
	G9-4(L)	(AS 3.6.6)
	G9-4(R)	(AS 3.6.6)
	G9-5-1(L)	(AS 3.6.7)
	G9-5-1(R)	(AS 3.6.7)
	G9-5-2(L)	(AS 3.6.7)
	G9-5-2(R)	(AS 3.6.7)
	G9-47-2*	
*Not Australian Standard (RTA NSW sign)		
SIGNS FOR DETOURS (AS TABLE 3.3)		

SIGN	NUMBER	REMARKS
	G9-232*	
	G9-233*	
	G9-260*	
	G9-262*	
	G9-263*	
	G9-265*	
*Not Australian Standard (RTA NSW sign)		
SIGNS FOR DETOURS (AS TABLE 3.3)		

SIGN	NUMBER	REMARKS
	W4-11	(AS 3.6.8)
	T2-24	(AS 3.6.8)
	R2-14(L)	(AS 3.6.9)
	R2-14(R)	(AS 3.6.9)
SIGNS FOR DETOURS (AS TABLE 3.3)		

SIGN	NUMBER	REMARKS
	T1-15	
	T2-13	
	T2-207*	
	T2-237*	9.17.2
	T3-3	5.2.3; 9.12 (AS 3.7.2)
	T3-6	5.2.3 (AS 3.7.2)
	T3-7	5.2.3 (AS 3.7.2)
	T3-9	5.2.3; 9.12 (AS 3.7.2)
*Not Australian Standard (RTA NSW sign)		
SIGNS FOR ROAD CONDITIONS (AS TABLE 3.4)		

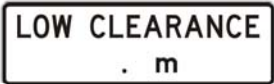
SIGN	NUMBER	REMARKS
	T3-11	5.2.3 (AS 3.7.4)
	T3-12	5.2.3 (AS 3.7.4)
	T3-13	5.2.3 (AS 3.7.2)
	T3-14	5.2.3 (AS 3.7.2)
	T3-16-1	(AS 3.7.3)
	T3-16-2	(AS 3.7.3)
	T3-216*	9.12
	T3-217*	9.12
*Not Australian Standard (RTA NSW sign)		
SIGNS FOR ROAD CONDITIONS (AS TABLE 3.4)		

SIGN	NUMBER	REMARKS
	T4-4	
	T4-5	(AS 3.16.3)
	T4-6	
	T4-214*	
	T4-215*	
	T6-201*	
	T6-207*	
	T6-233*	
*Not Australian Standard (RTA NSW sign)		
SIGNS FOR ROAD CONDITIONS (AS TABLE 3.4)		

SIGN	NUMBER	REMARKS
	T2-4	(AS 3.8.2b)
	T2-5	
	T2-6-1	(AS 3.8.2a)
	T2-6-2	(AS 3.8.2a)
		More complex (AS 3.8.2a)
		More complex (AS 3.8.2a)
SIGNS FOR LANE AND ROAD CLOSURES (AS TABLE 3.5)		

SIGN	NUMBER	REMARKS
	T5-4	5.2.3 (AS 3.9.3)
	T5-5	5.2.3 (AS 3.9.3)
	T2-235(L)*	
	T2-235(R)*	
	T6-1(L)*	9.17.2
	T6-1(R)*	9.17.2
	T1-15	Appendix D
*Not Australian Standard (RTA NSW sign)		
SIGNS FOR DELINEATING AND INDICATING THE TRAVELLED PATH (AS REFERENCE 3.9.3)		

SIGN	NUMBER	REMARKS
	T4-1	
	T4-3	(AS 3.13.3)
	T4-7	(AS 3.13.2)
	T8-1	(AS 3.14.2)
	T8-2(L)	(AS 3.14.3)
	T8-2(R)	(AS 3.14.3)
	T8-3	(AS 3.14.4)
	T8-4	(AS 3.14.4)
	T8-5	(AS 3.14.5)
SIGNS FOR BLASTING AND PEDESTRIAN CONTROL (AS TABLES 3.8 AND 3.9)		

SIGN	NUMBER	REMARKS
	R6-3	(AS 3.15.2)
	R6-11	(AS 3.15.3)
	R6-12	(AS 3.15.4)
	W4-8	(AS 3.15.5)
SIGNS FOR VEHICLE HEIGHT AND MASS RESTRICTIONS (AS TABLE 3.10)		

SIGN	NUMBER	REMARKS
	T1-10	(AS 3.16.5)
	T1-11*	
	T2-25	(AS 3.16.2)
	W5-22	(AS 3.16.2)
	W5-205*	7.7
	W8-5	
	W8-207(L)*	7.7
	W8-207(R)*	7.7
	R1-1	
	R1-4*	
*Not Australian Standard (RTA NSW sign)		
OTHER SIGNS (AS TABLE 3.11)		



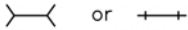
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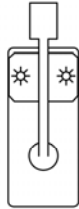


	Flashing Arrow Sign (Left)
	Flashing Arrow Sign (Right)
	Separation Line
	Single Barrier Line – (BS)
	Double Barrier Line – (BB)
	Edge Line
	Traffic Cones
	Delineators
	Grader or Snow Plough (with flashing yellow lamps)
	Work Vehicle and Trailer (with flashing yellow lamps)
	Linemaker (with flashing yellow lamps)
	Tractor with Mower (with flashing yellow lamps)
	Work Vehicle or Truck (with flashing yellow lamps)
	Work Area
LIST OF STANDARD SYMBOLS SHEET 1 OF 2	
T000358	

T000358

	Antiglare screen
 or 	Barrier Board Position
	Barrier Board
	Daytime Strobe
	Flashing Yellow Lamps (for sign mounting)
	Rotating Flashing Yellow Lamps (for vehicle mounting)
	Traffic Controller
 or 	Sign – single sided
 or 	Sign – double sided
	Traffic Signal Position
	Traffic Signal Display
	Pedestrian Containment Fencing
LIST OF STANDARD SYMBOLS SHEET 2 OF 2	
T000359	

T000359



EPV



Ladder



Mastarm with Lantern

LIST OF STANDARD SYMBOLS
SHEET 3 OF 3

T000823

T000823



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**Traffic Control at Work Sites
Location Checklist**

Road No: Location:

Type of Work:

Date: Time: Completed by:

The following checklist shall be completed on site with the approved TCP for the work being undertaken, prior to TCP implementation.

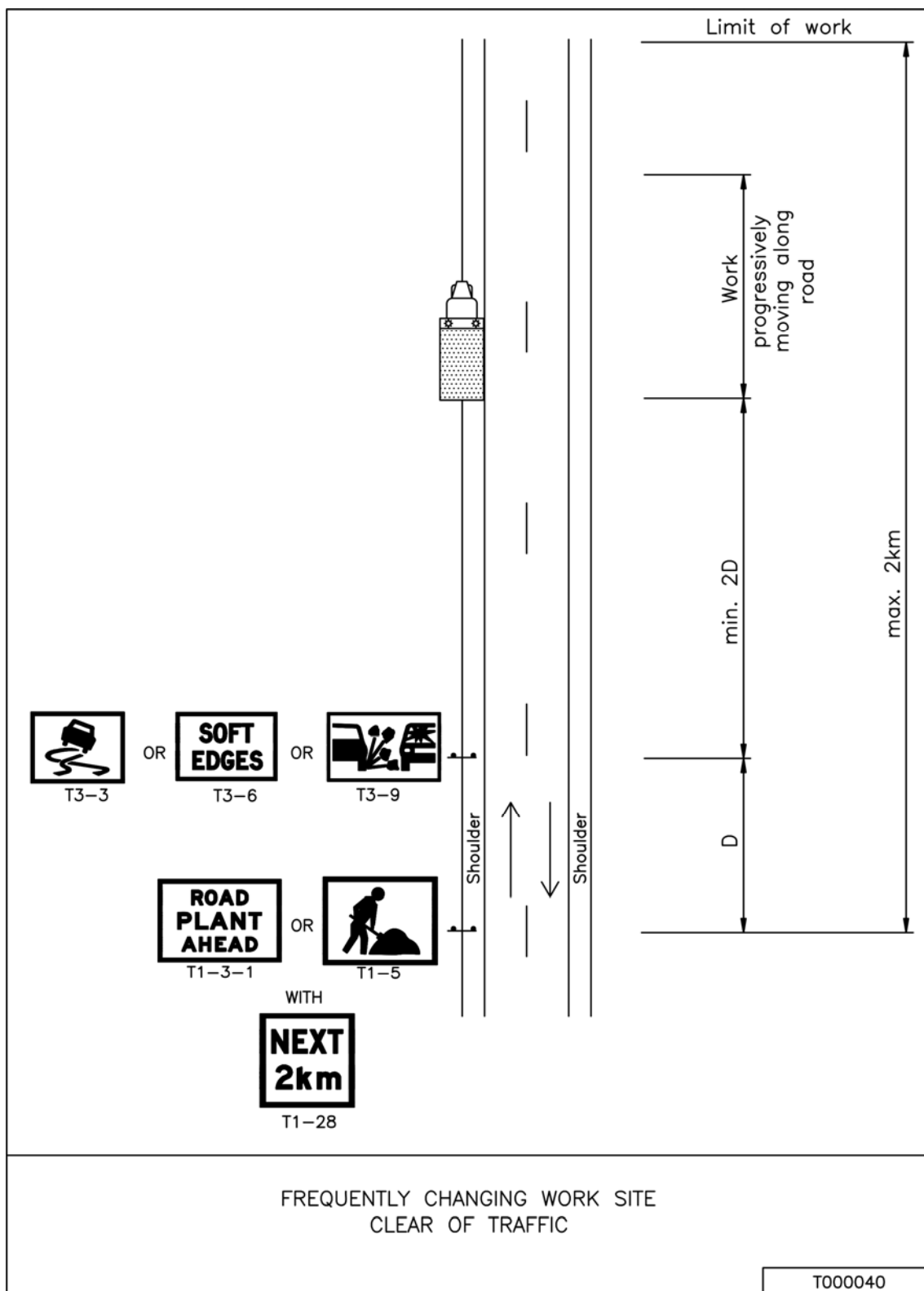
1	Has provision been made for any intersections, on-loading or off-loading ramps within the worksite ?	Yes/No/NA
2	Will vehicles be entering or leaving the worksite from private or commercial driveways ? Has provision been made for those vehicles ?	Yes/No Yes/No/NA
3	Is there adequate sight distance for road users to signs and traffic controllers ?	Yes/No
4	Will control measures be safe for the approach speeds of traffic ?	Yes/No
5	Has consideration been given to traffic volumes expected ?	Yes/No
6	Has provision been made for bus stops (including school) ?	Yes/No/NA
7	Has provision been made for pedestrians including those with impairments ?	Yes/No/NA
8	Has provision been made for cyclists ?	Yes/No/NA
9	Are there any overhead power lines that might be a risk to construction vehicles and plant ?	Yes/No
10	Has the time of day been adequately considered (ie night work, low setting sun) ?	Yes/No

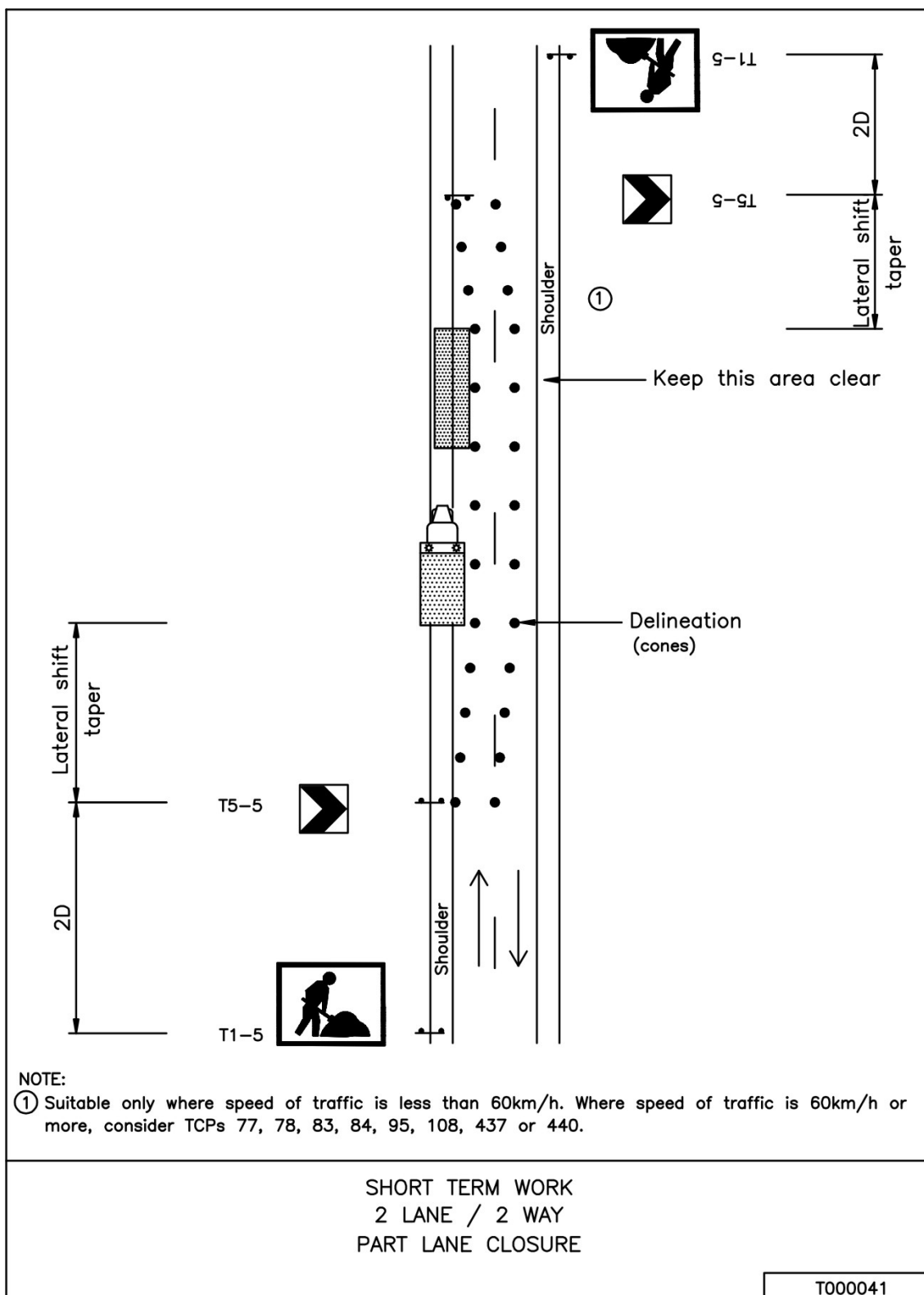
Item No	Action taken.

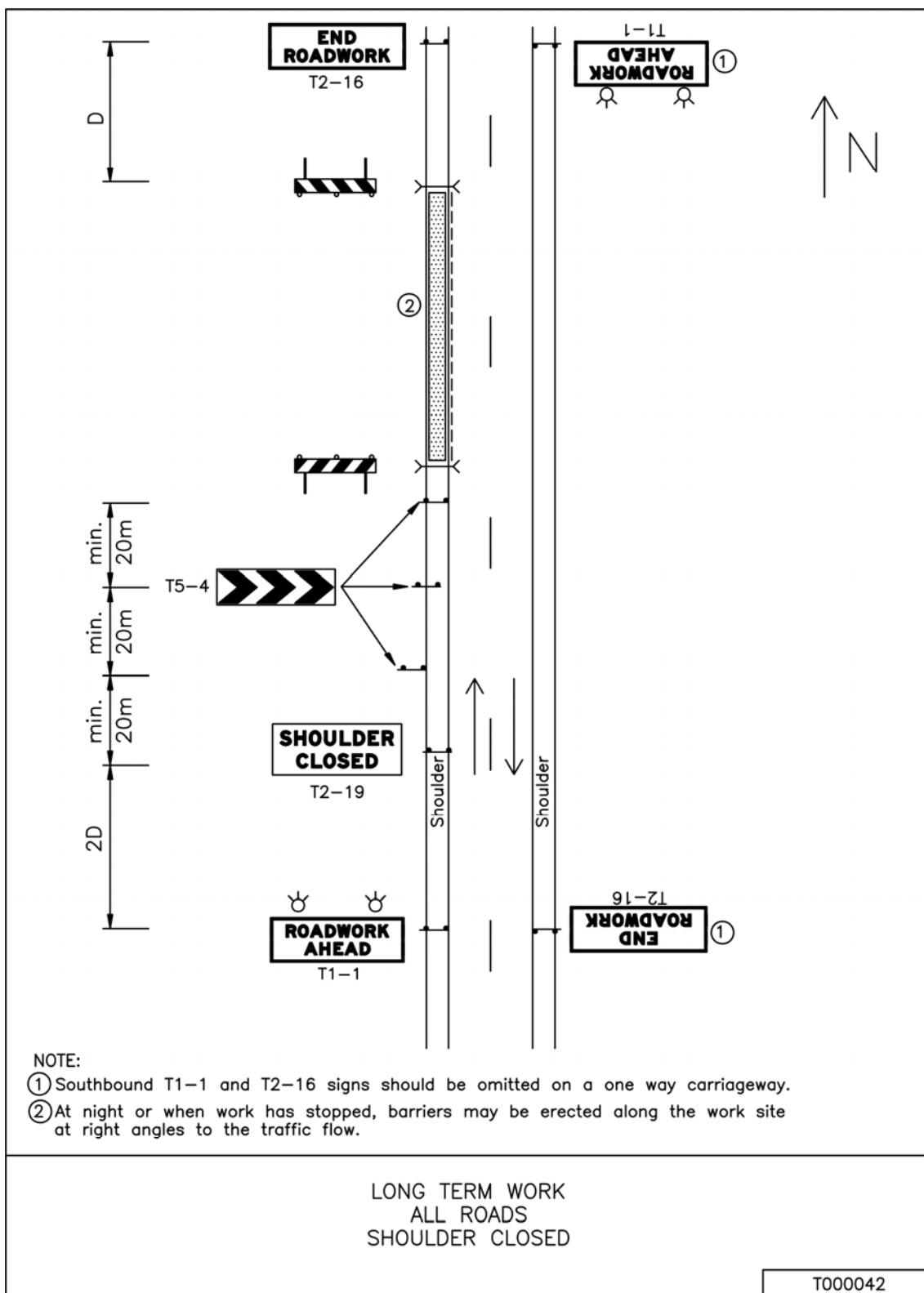
Use of opposite checklist

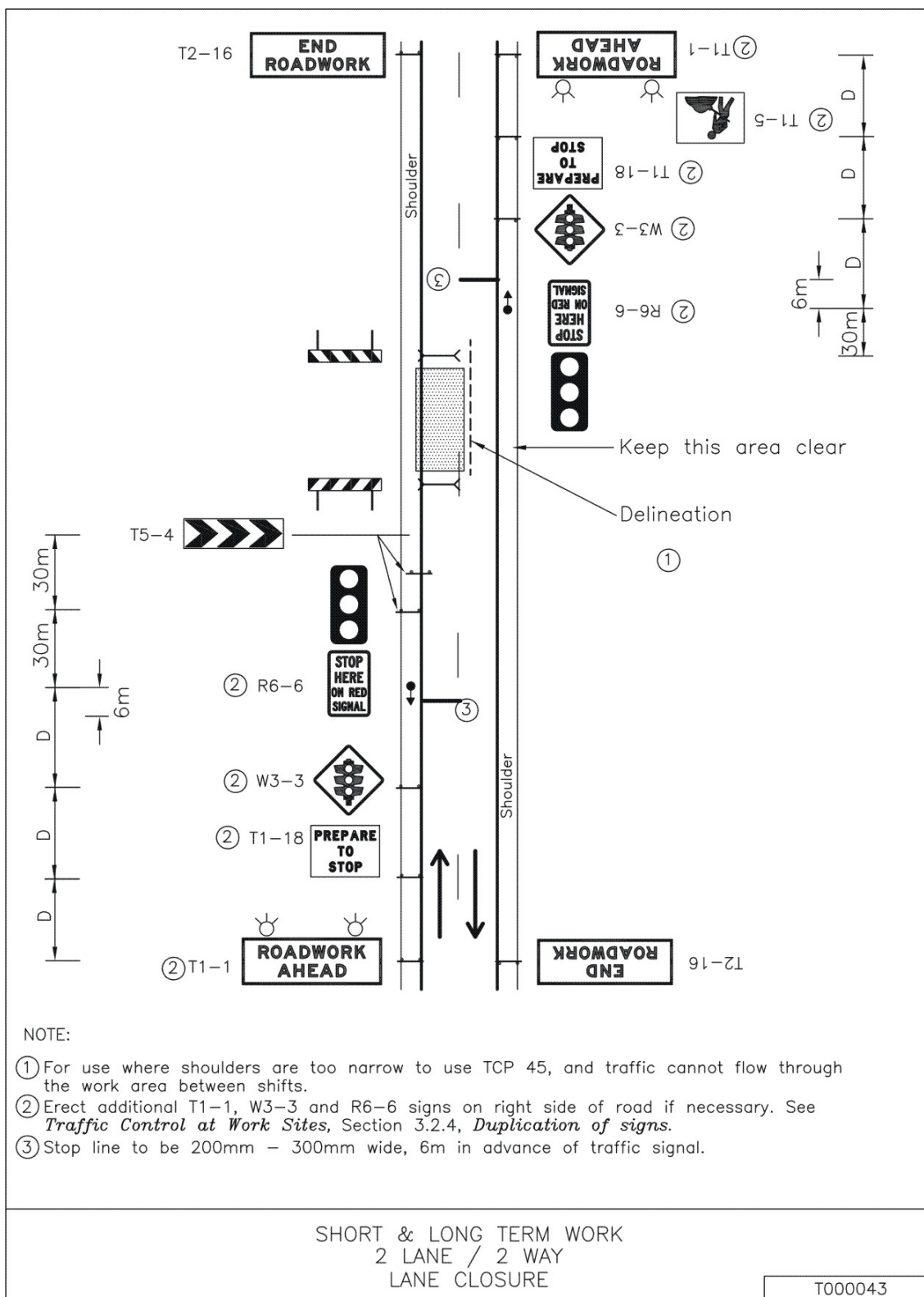
To assist in the assessment of risk at traffic control work sites the checklist opposite has been devised and is to be used as follows:-

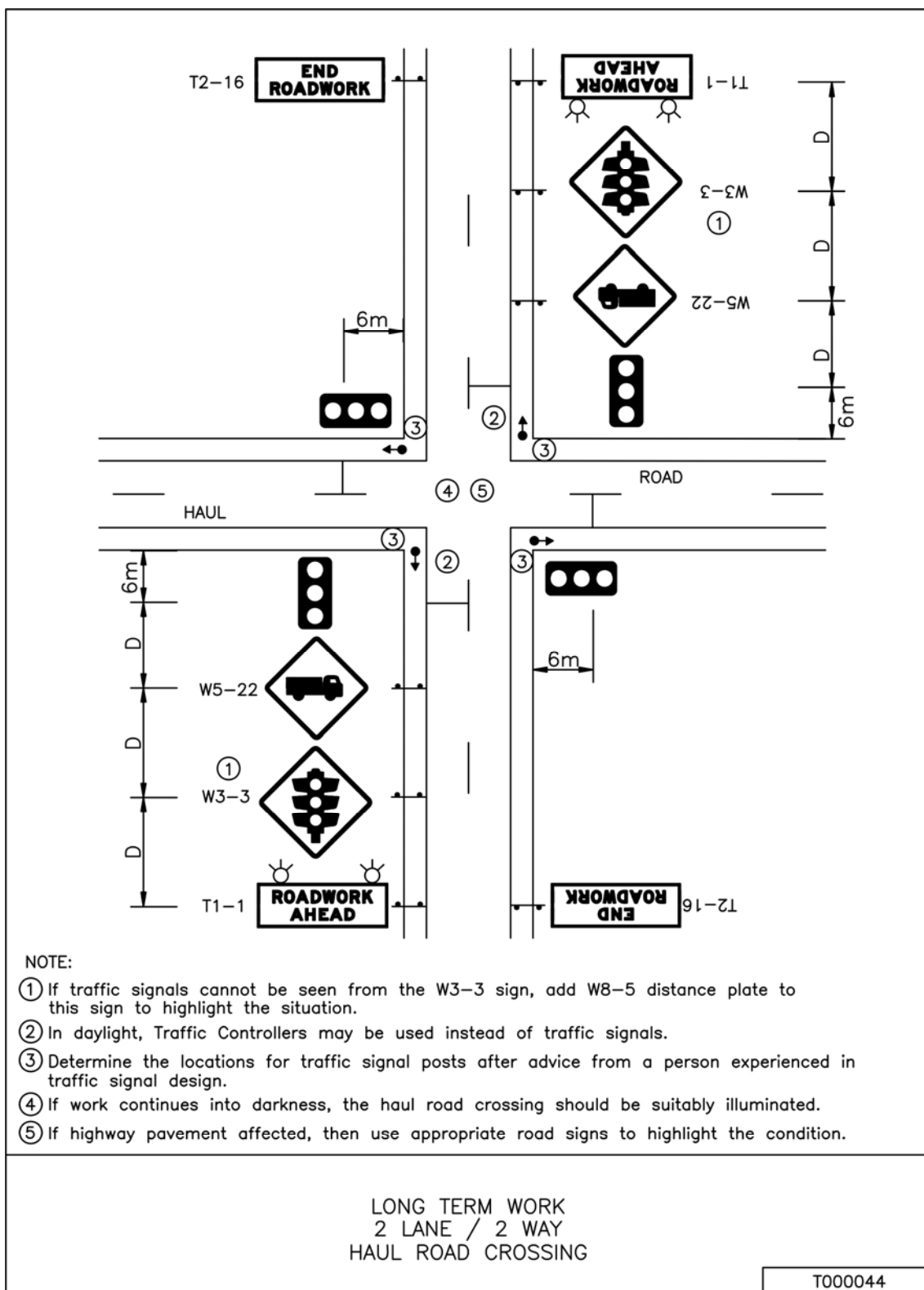
- a standard TCP is to be selected or a new TCP designed for the work to be undertaken
- the checklist opposite is then to be photocopied onto the back of or fixed to the TCP
- the TCP and checklist are to be taken to the work site where the checklist is to be completed
- any action considered necessary as a result of the use of the checklist is to be taken and recorded in the bottom box
- the checklist is to be signed and dated by the person responsible for making the minor modifications
- any minor modifications made are to be shown on the TCP and initialled by the person responsible for making the changes.

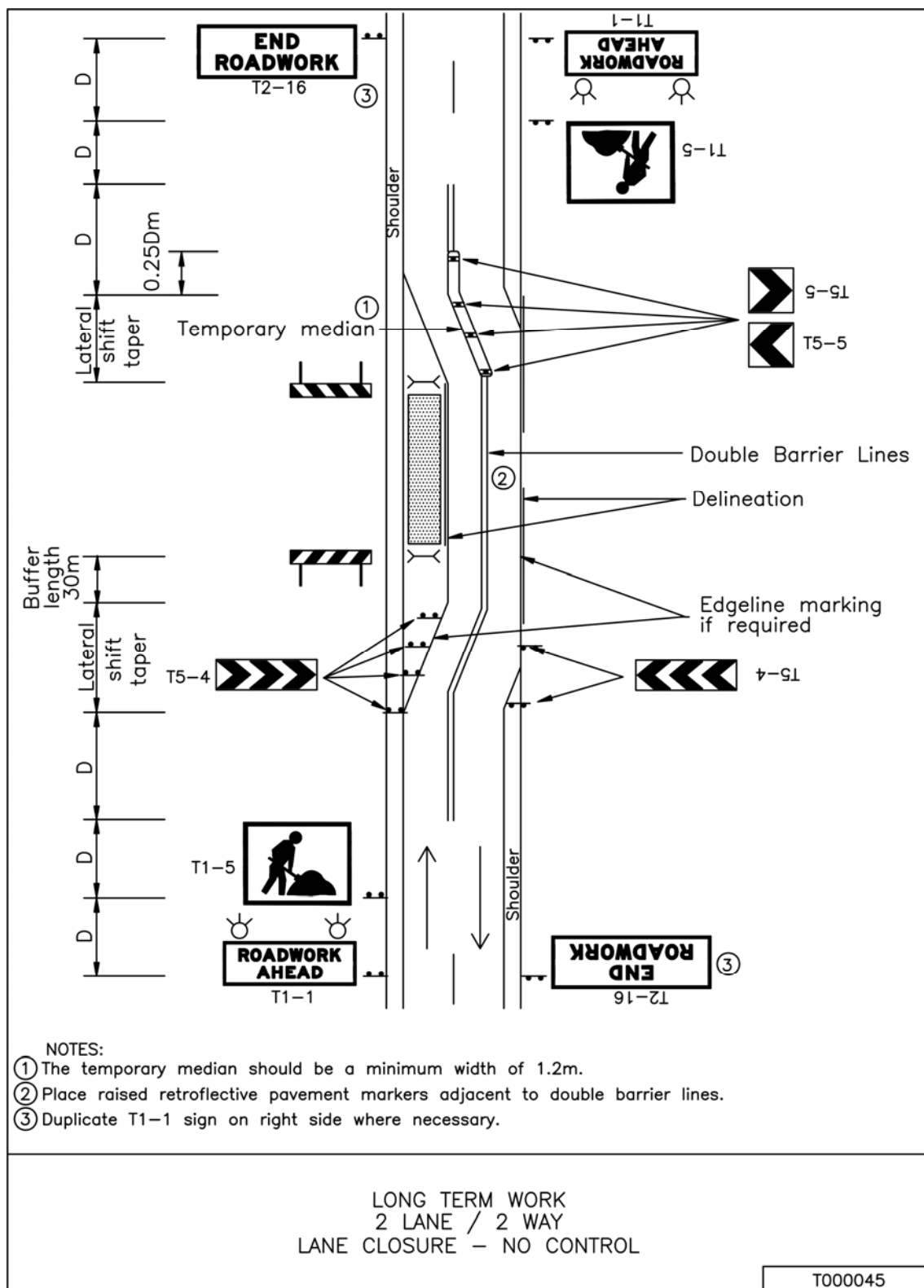


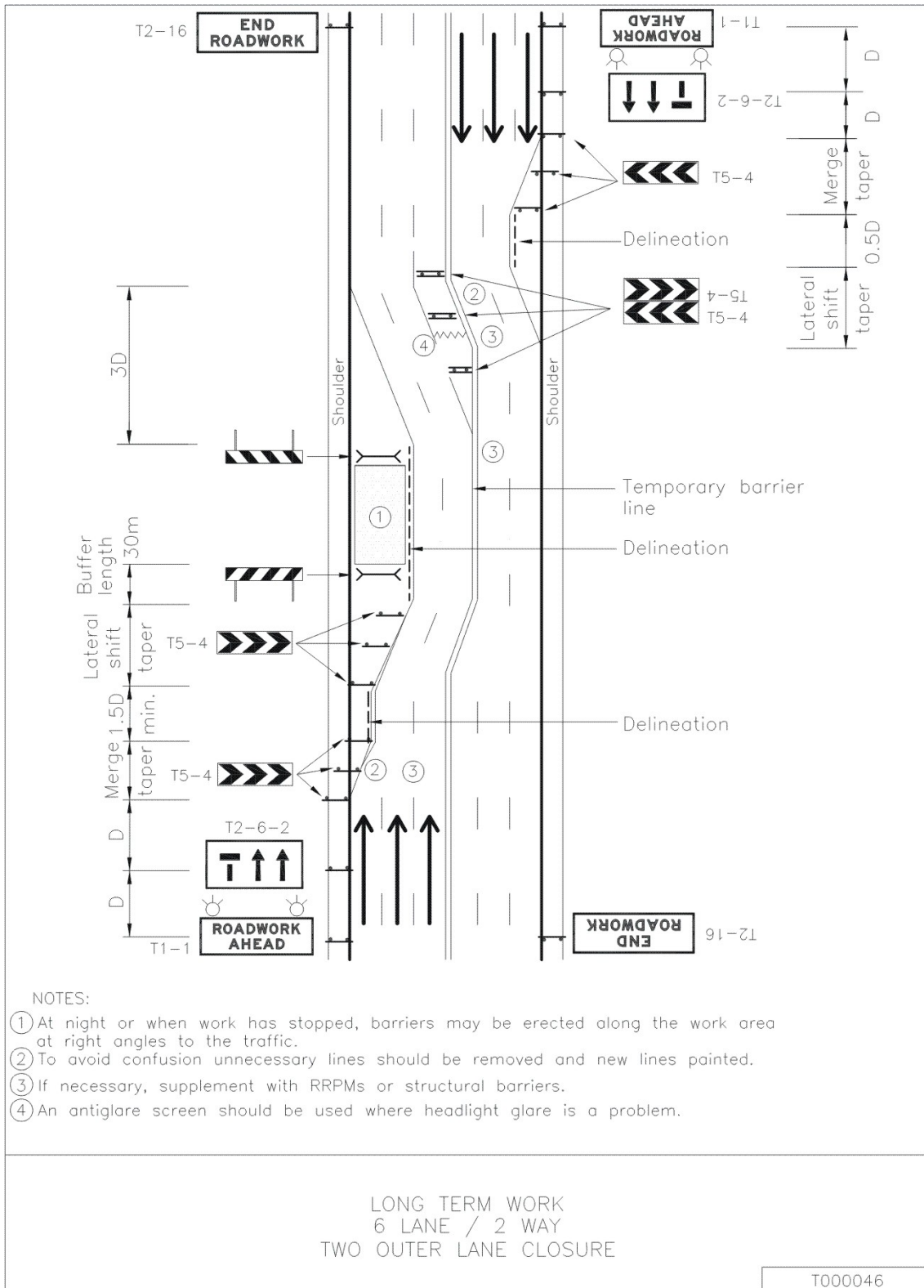




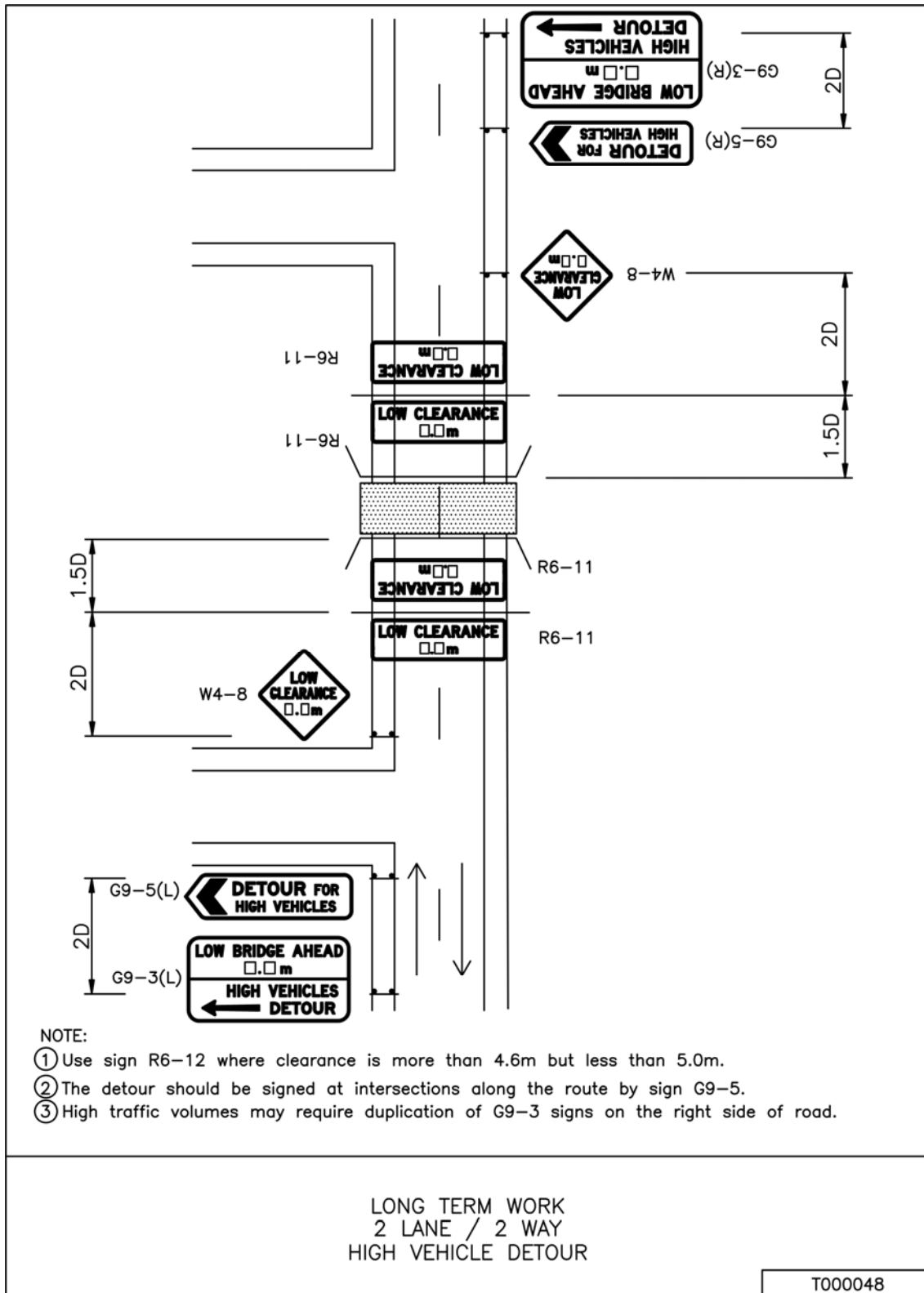


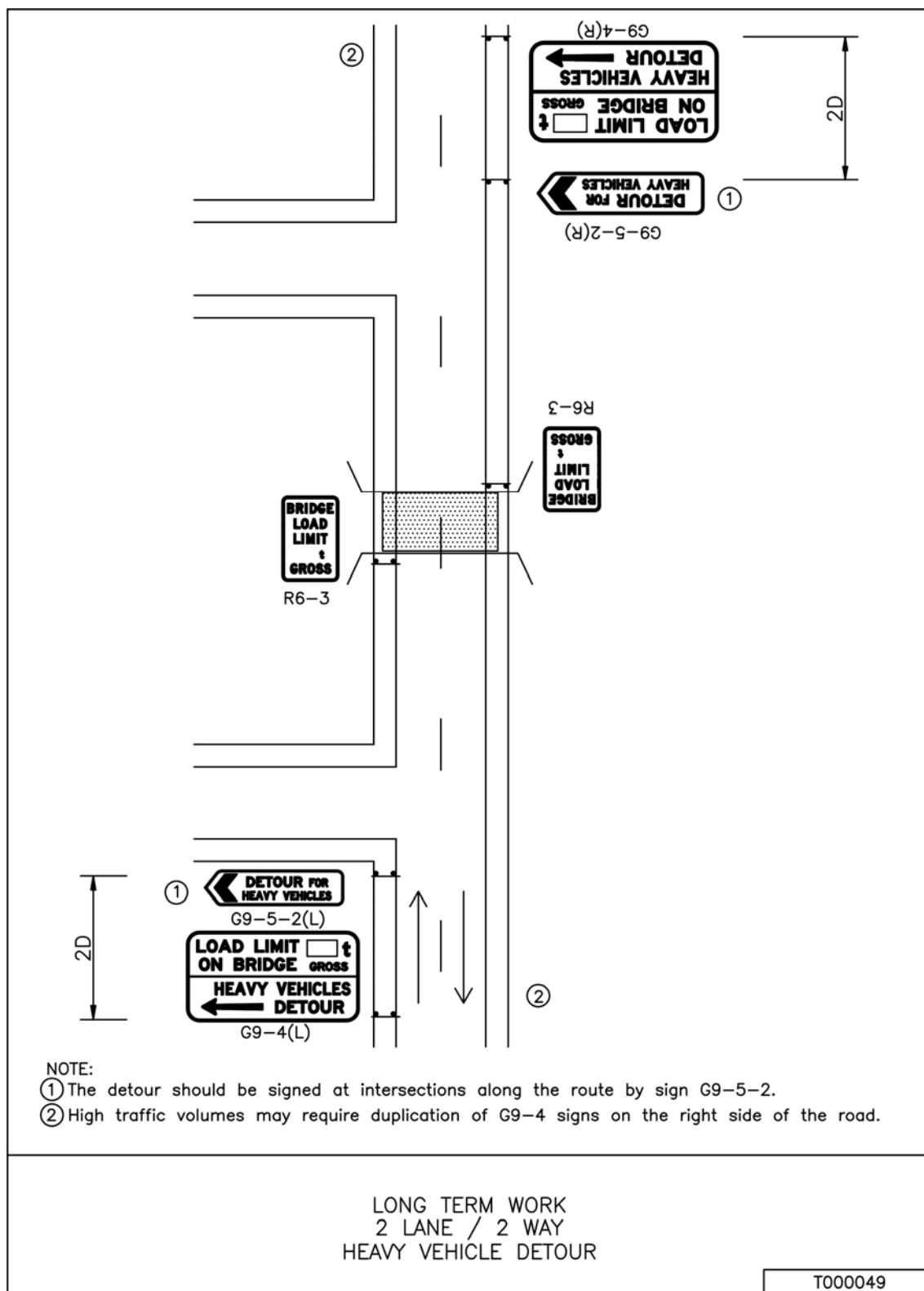


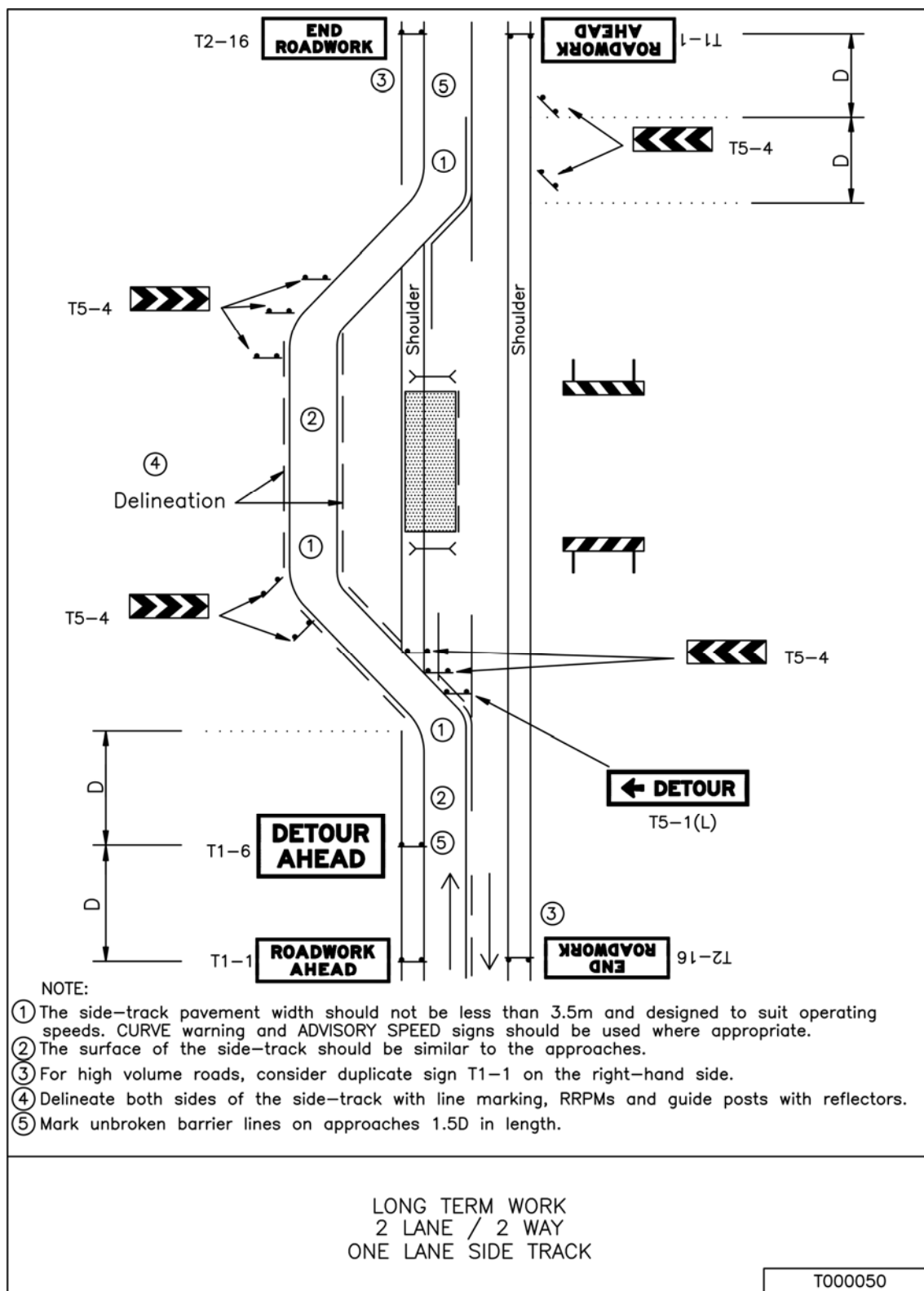


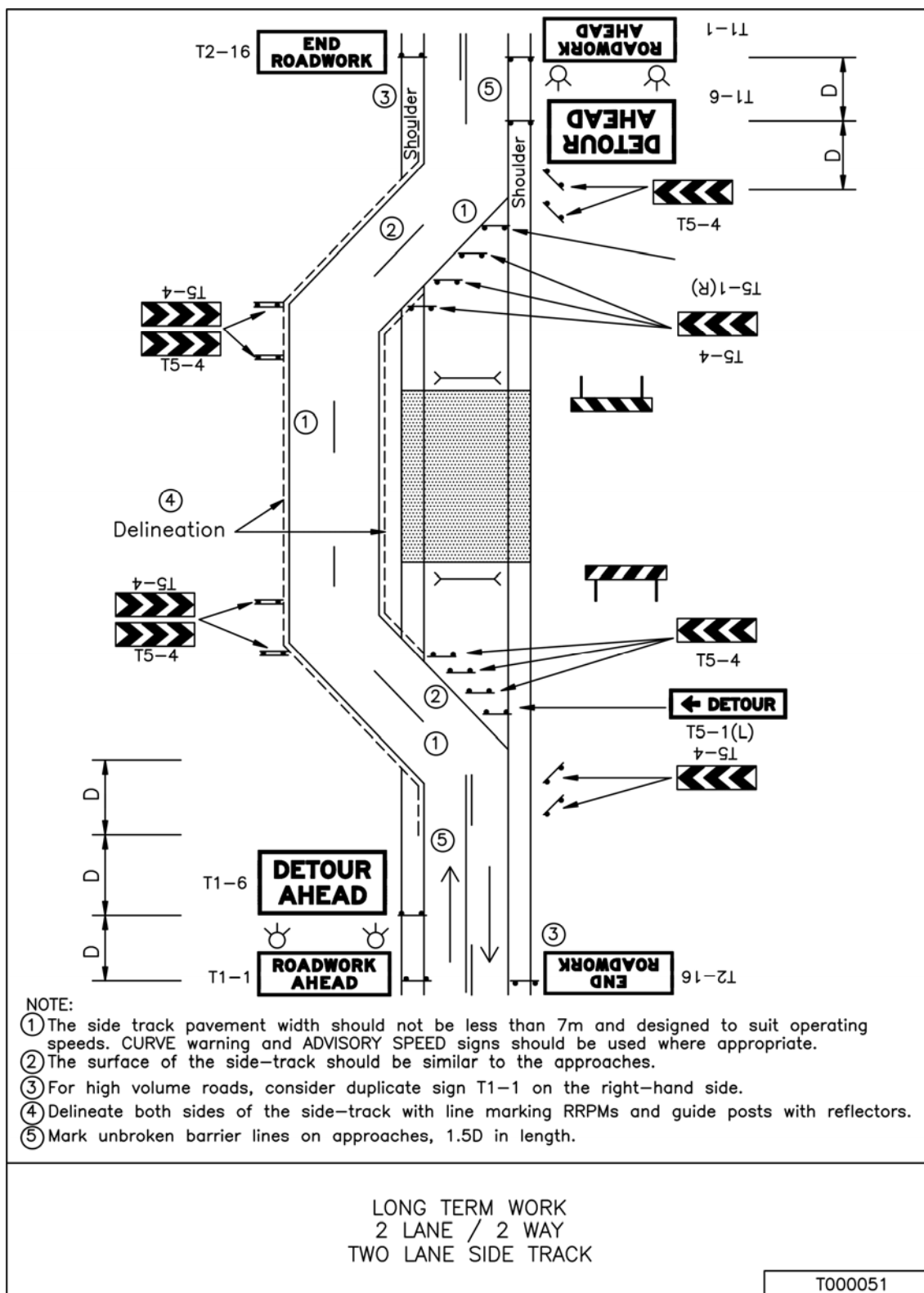


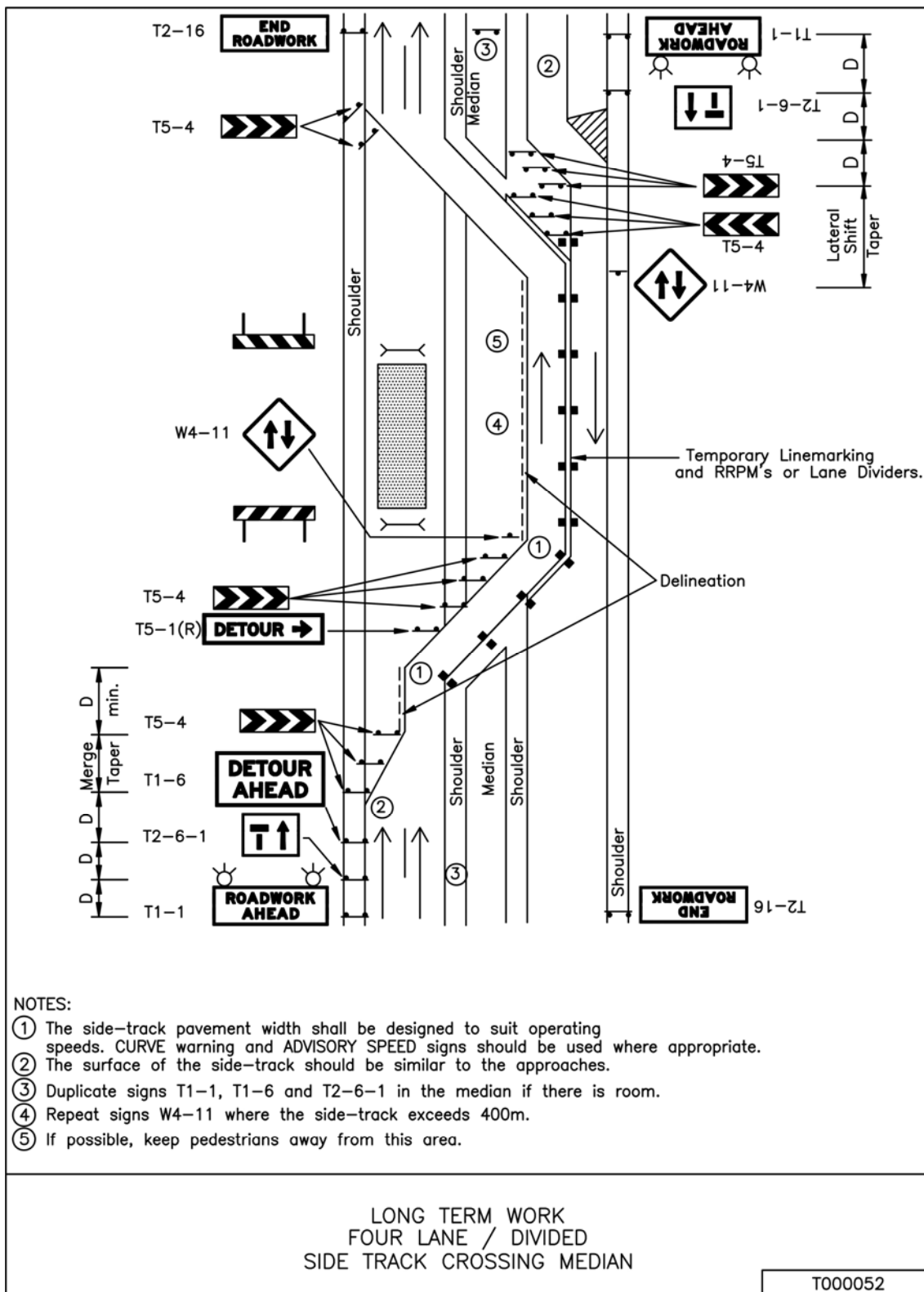


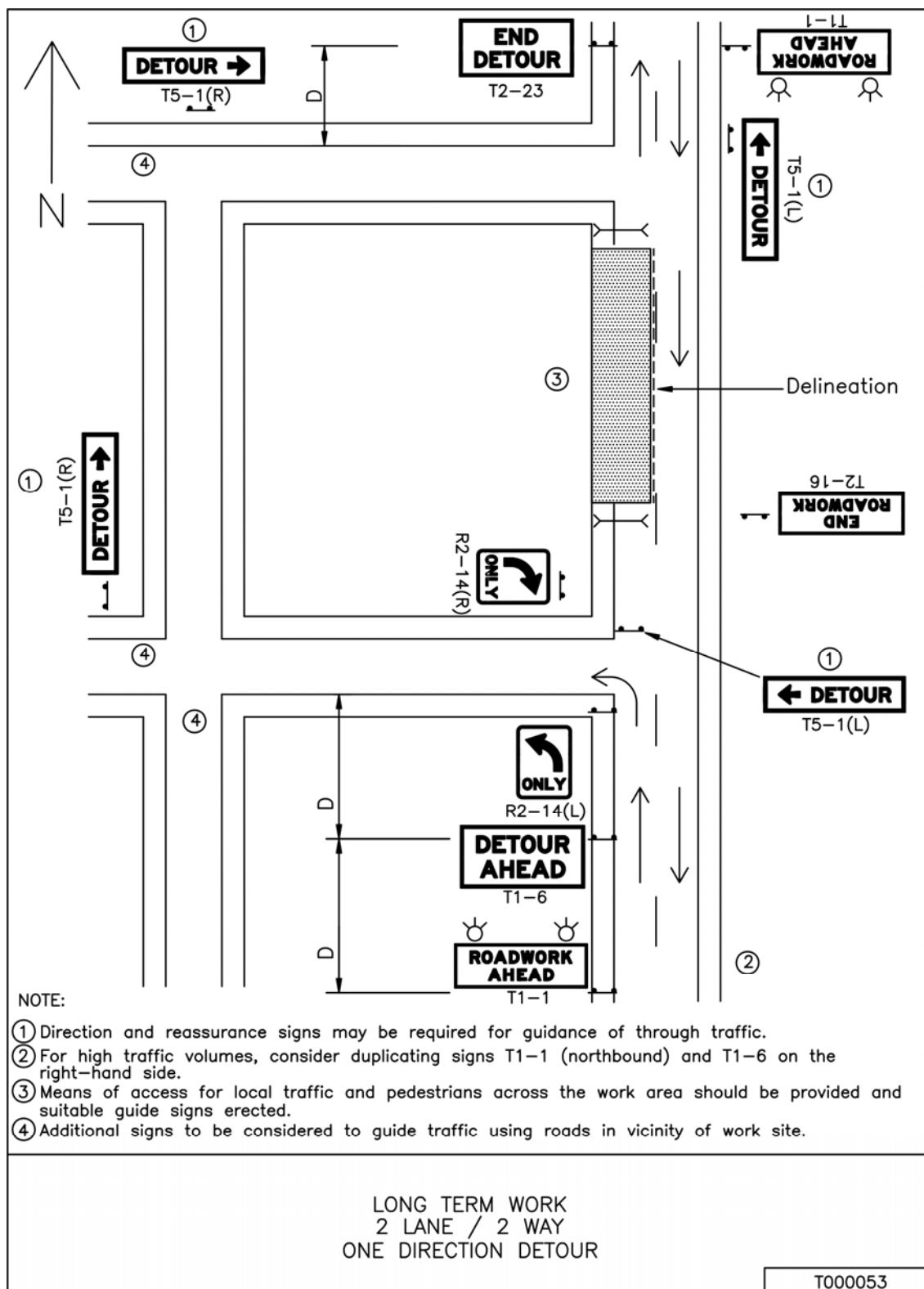


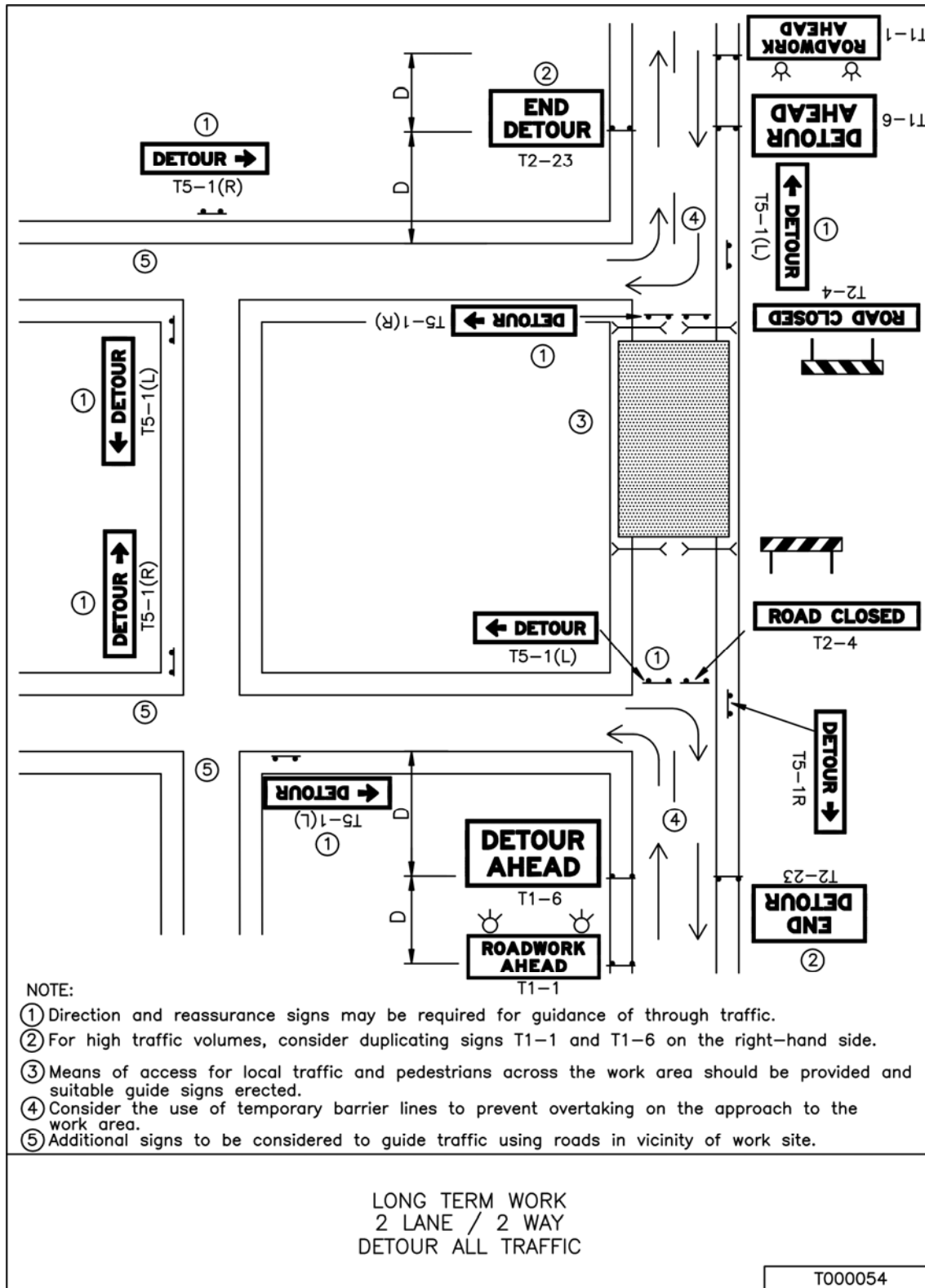






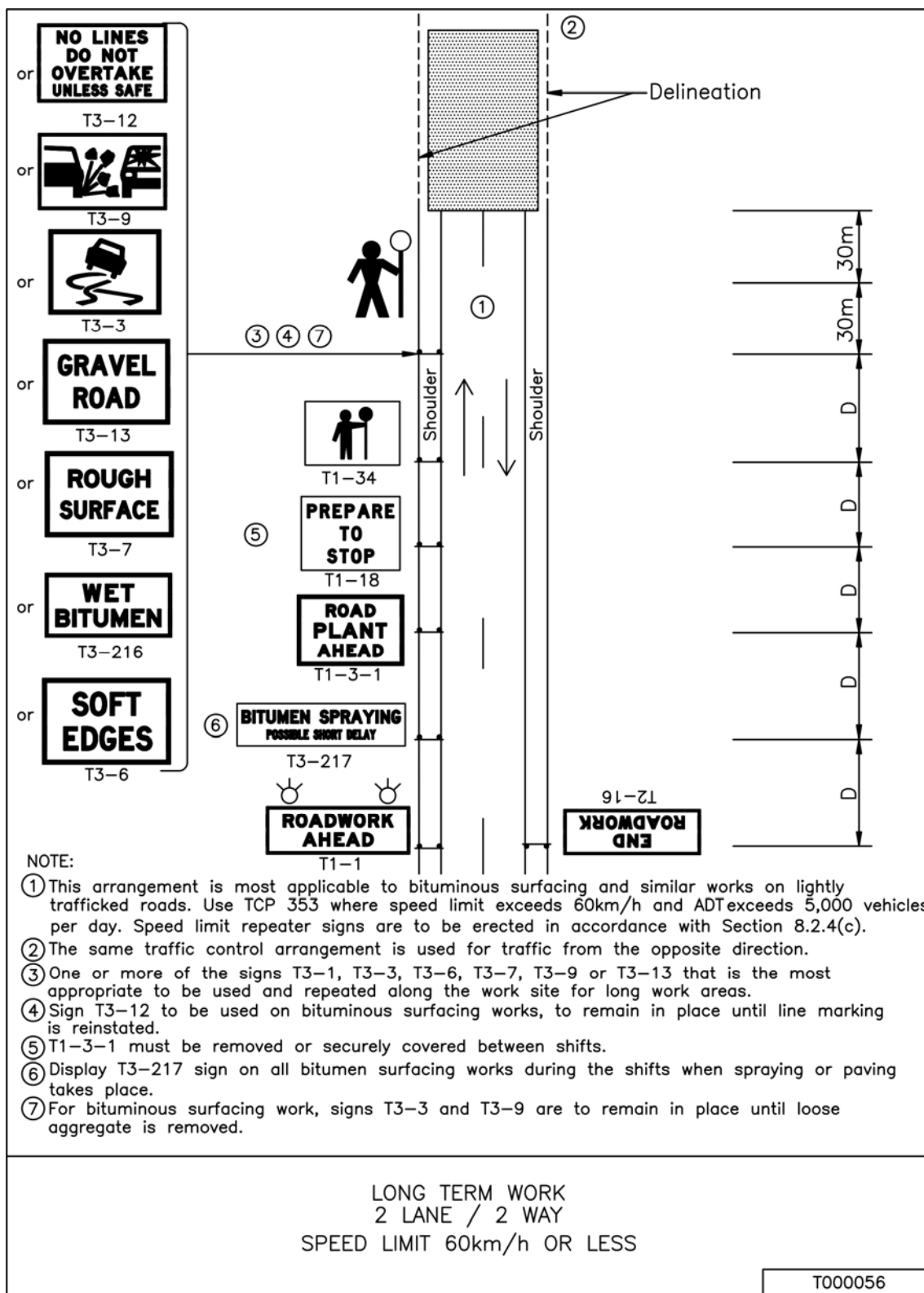


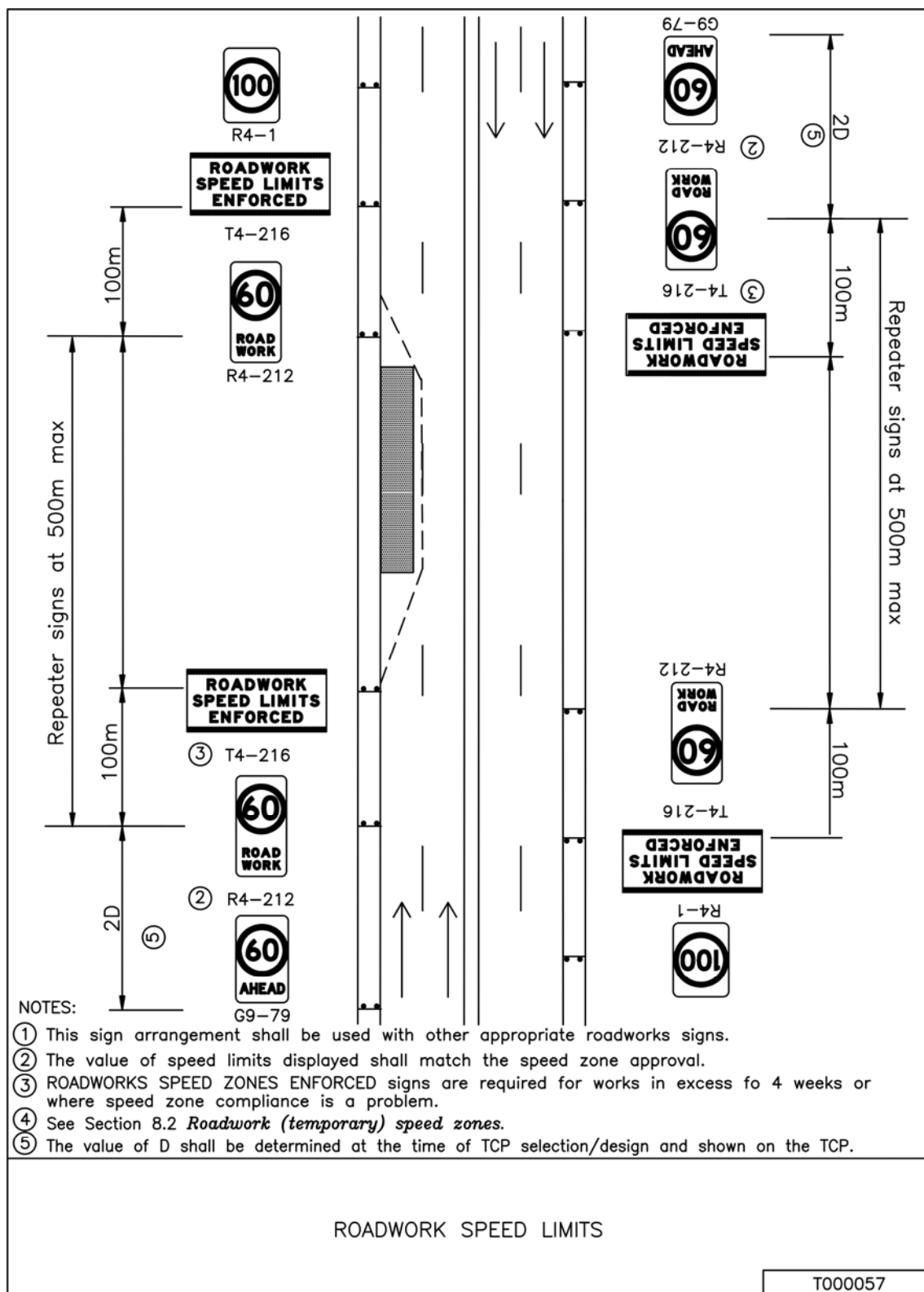


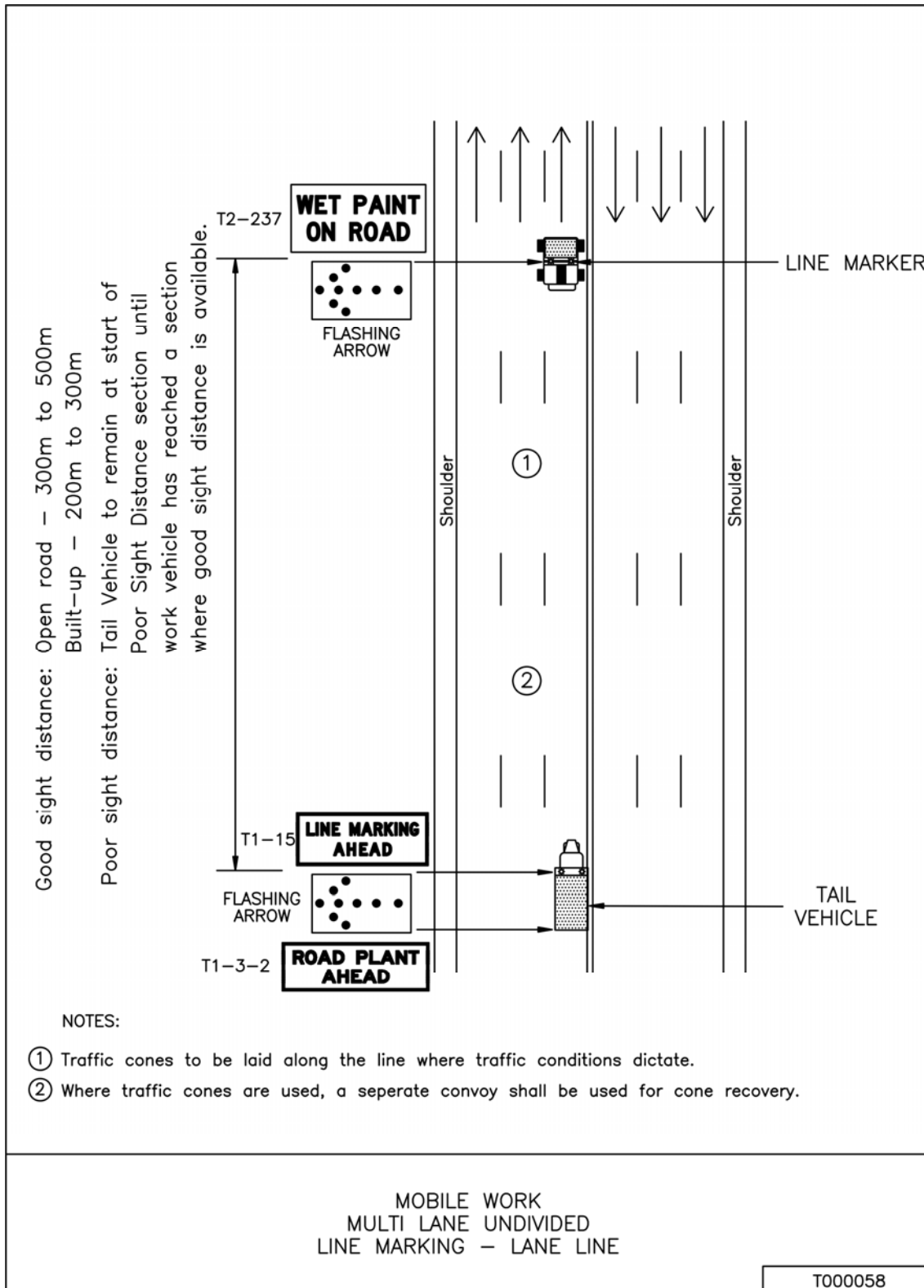




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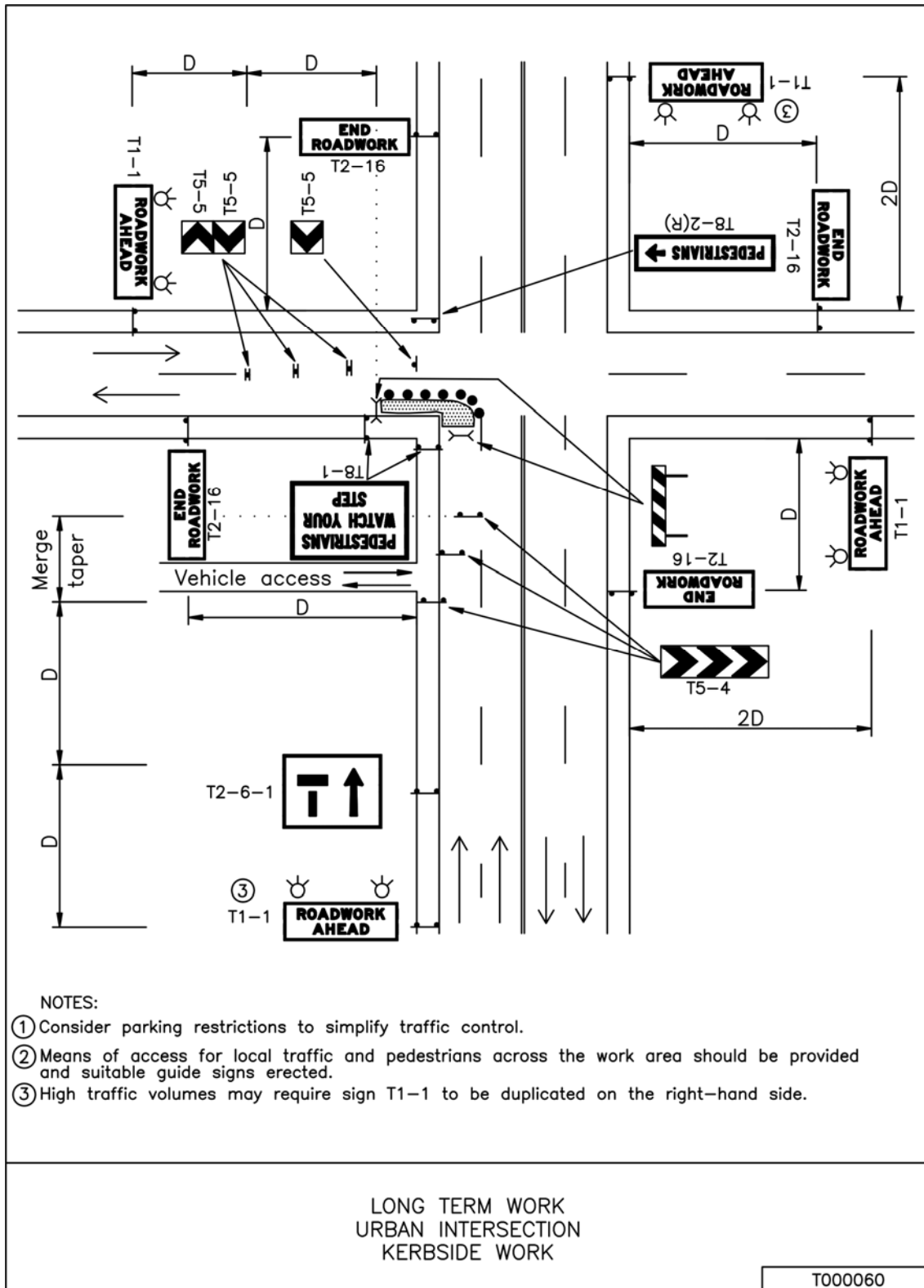


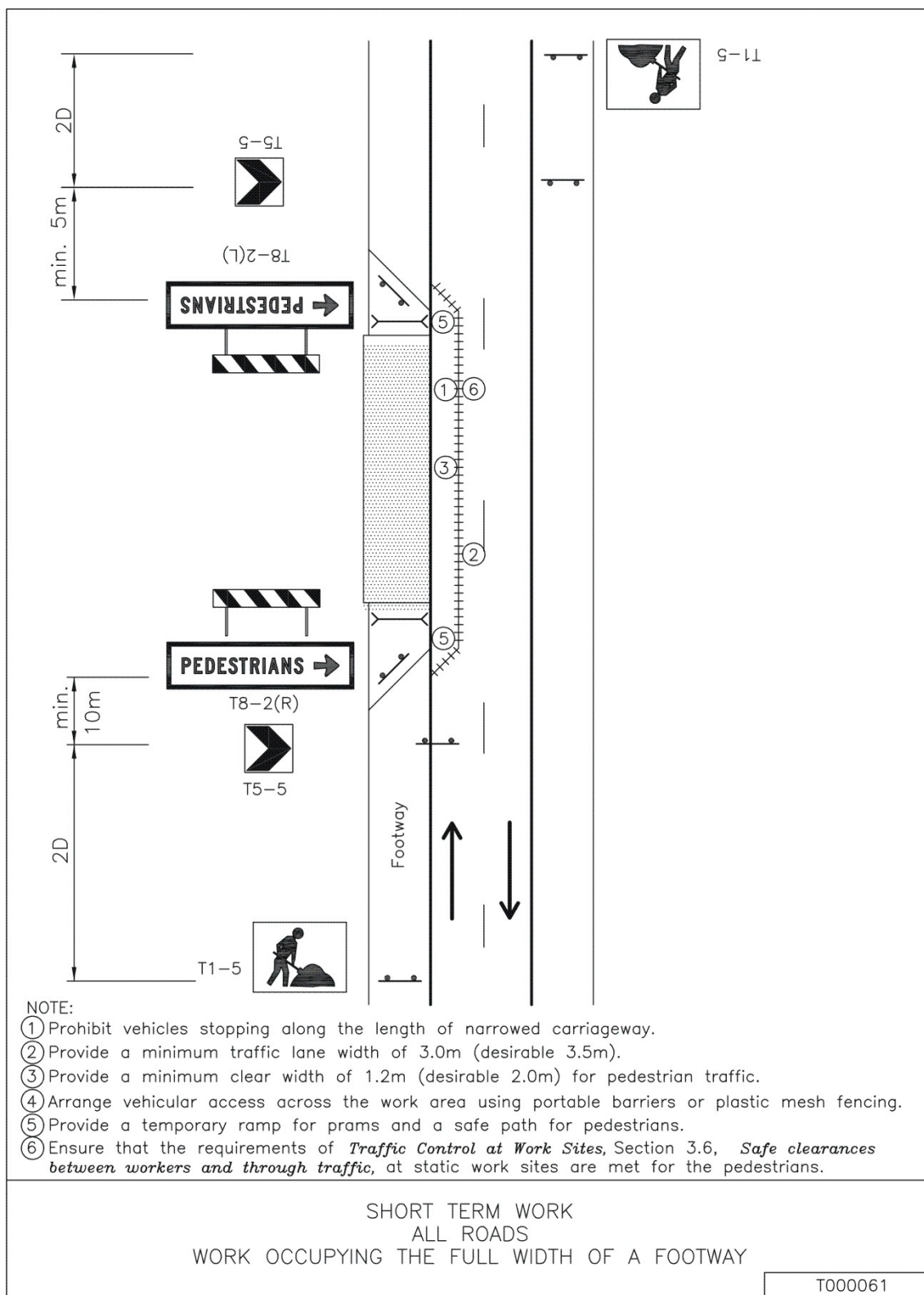


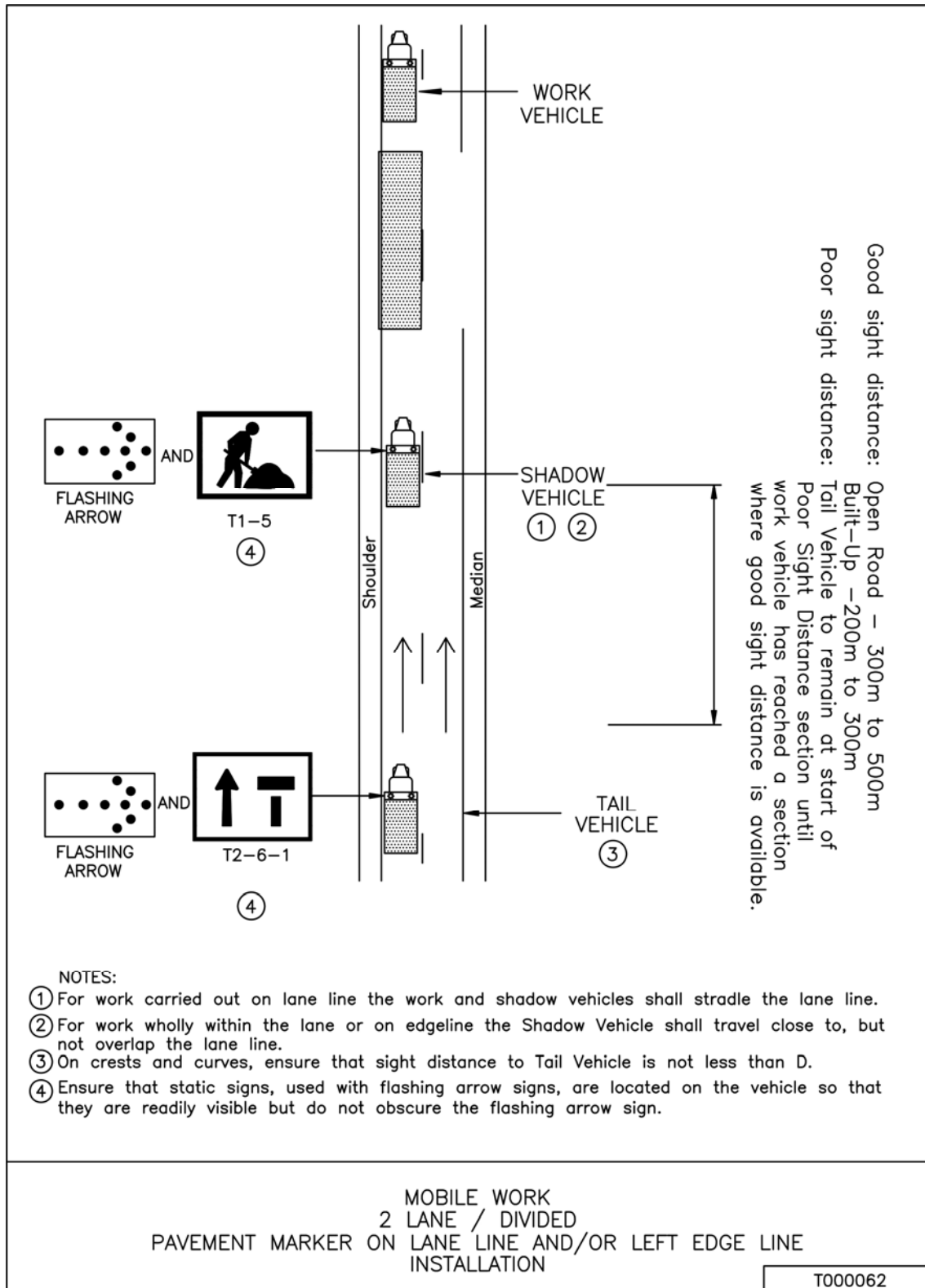




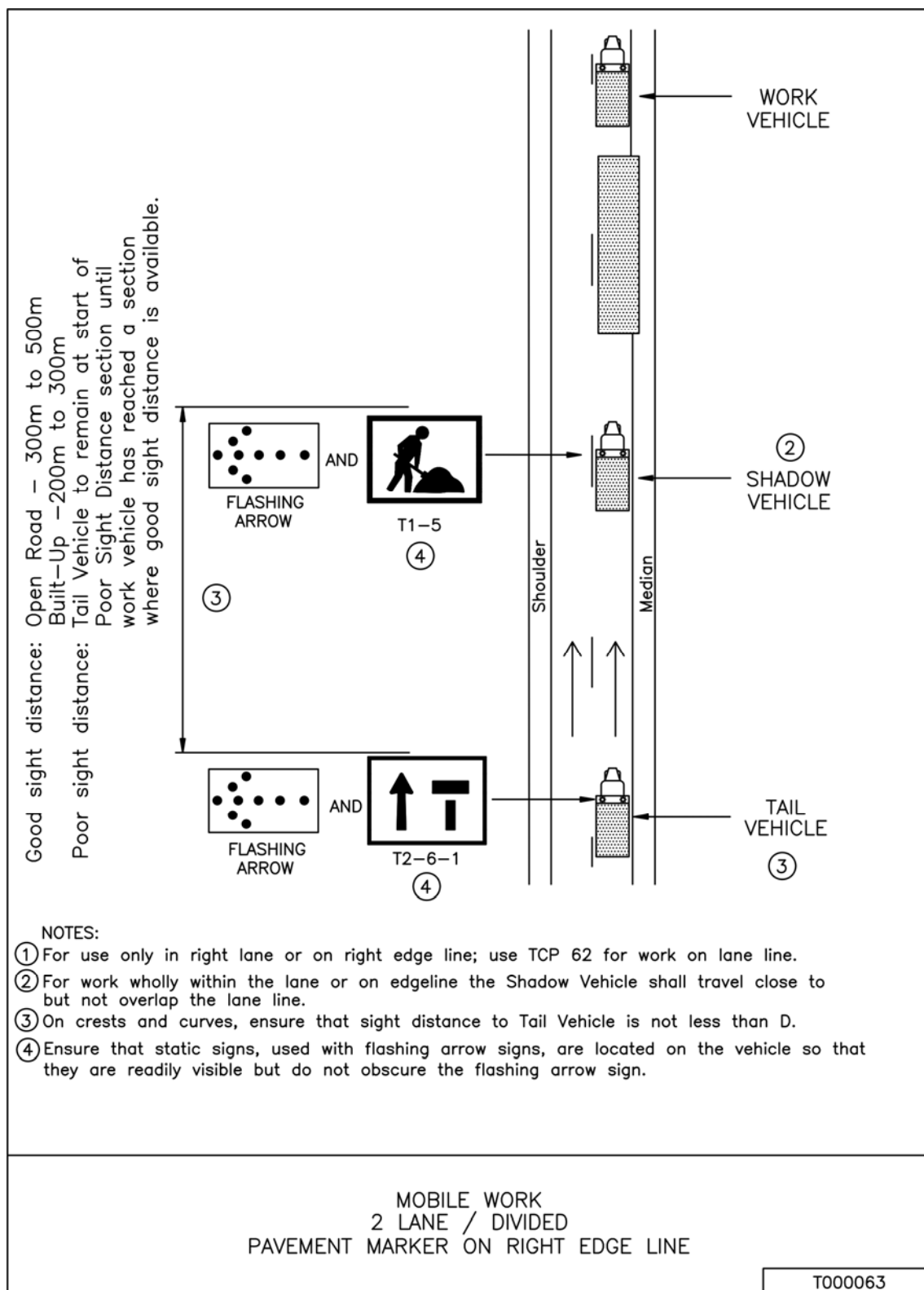
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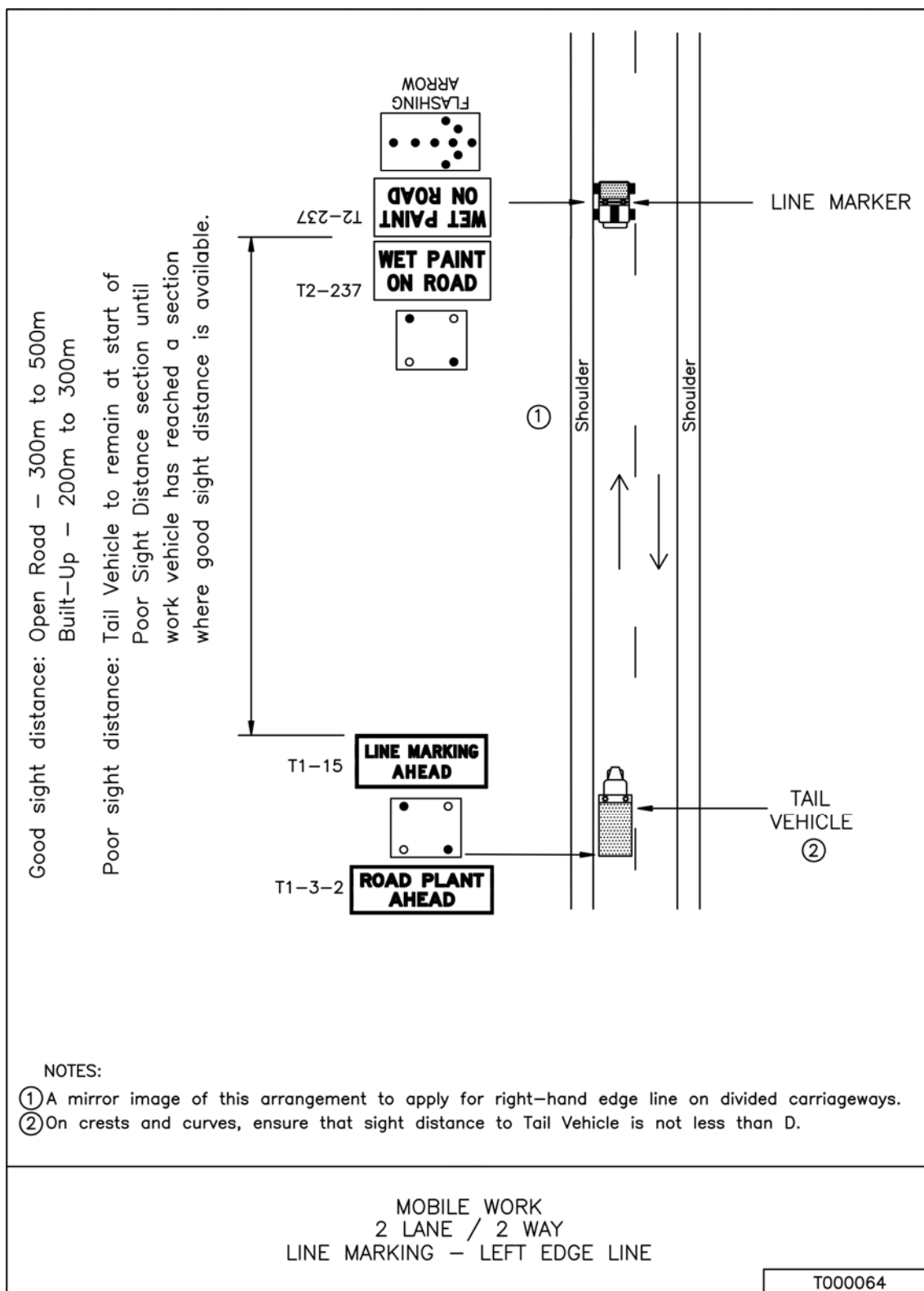


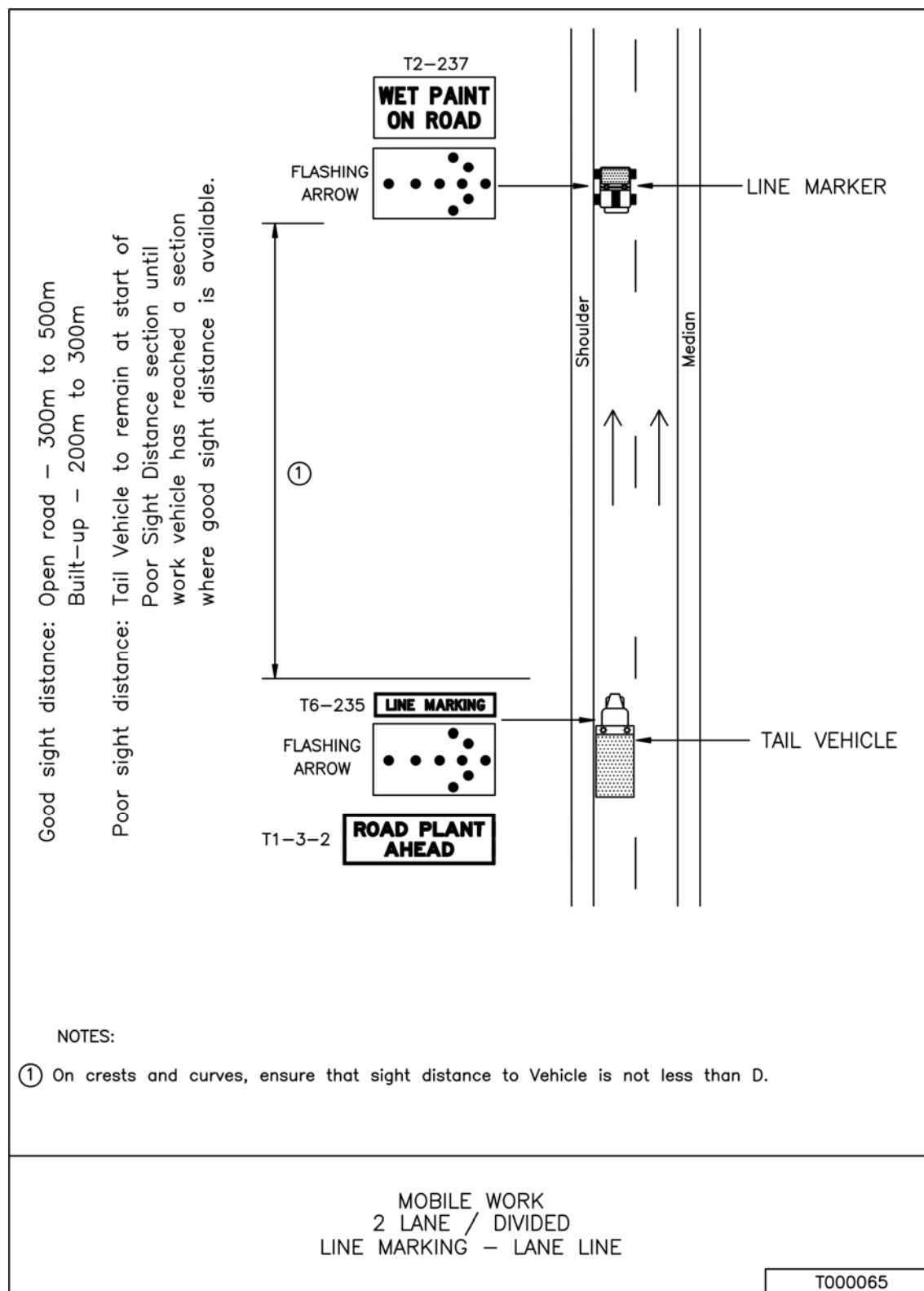


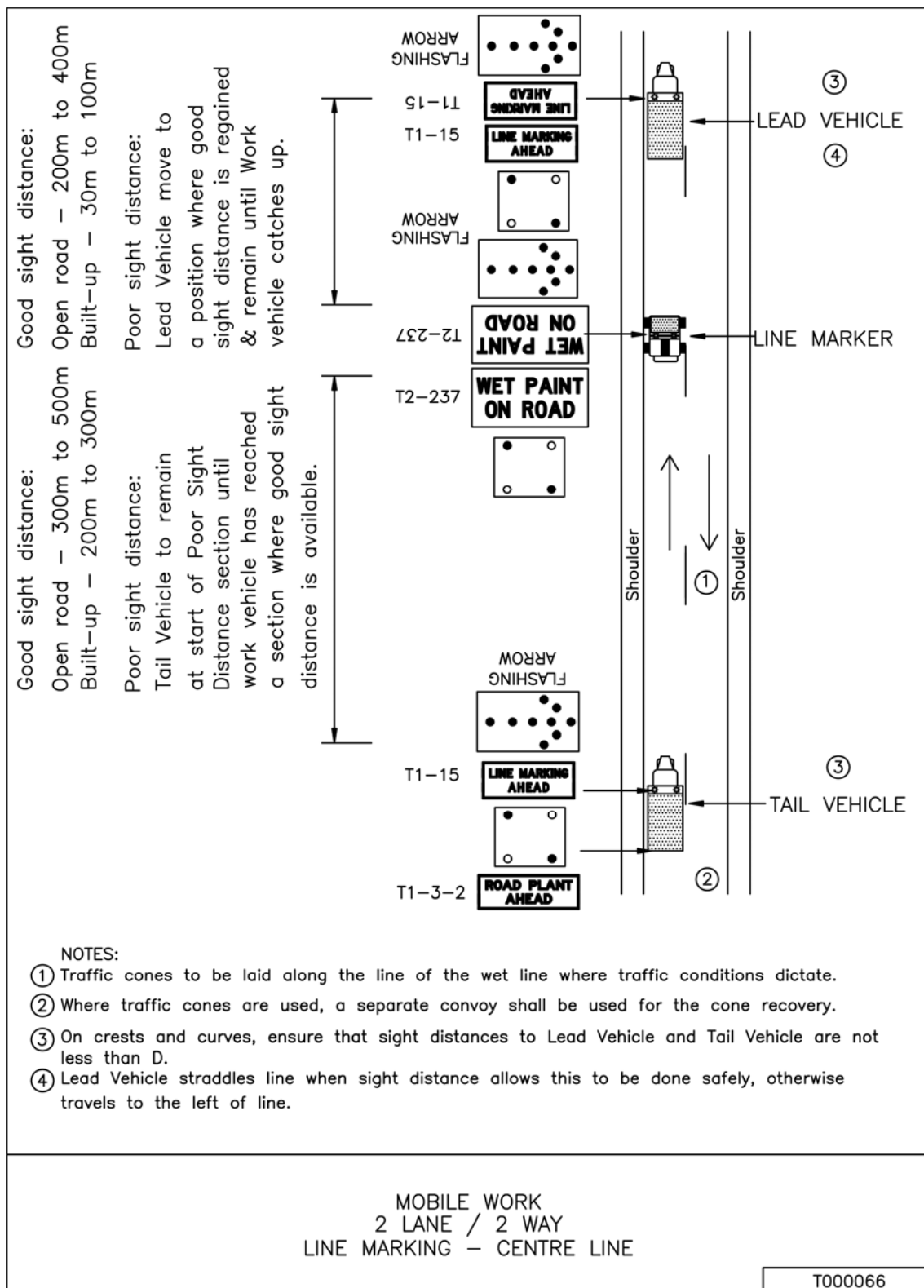


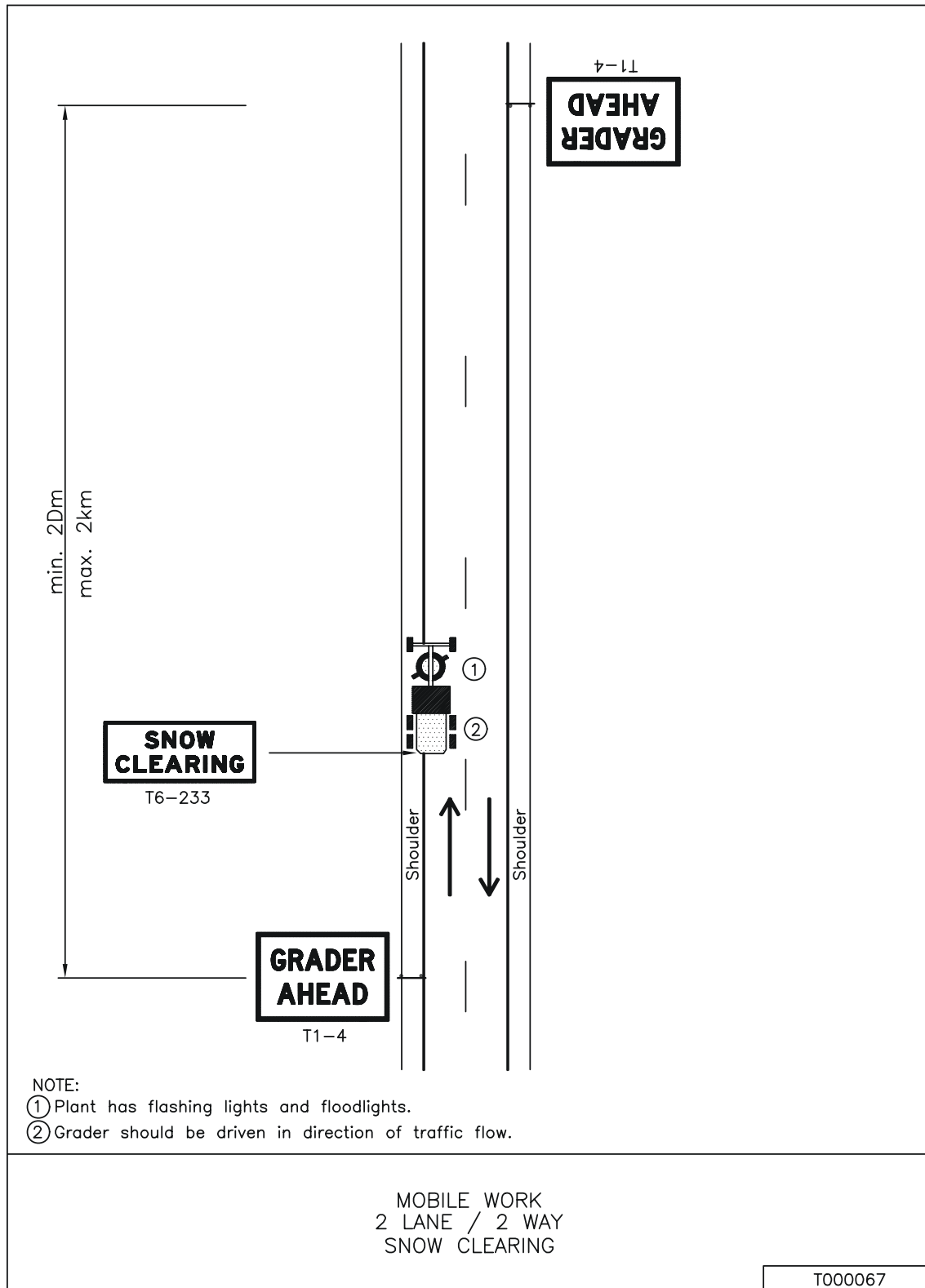
TCP 62





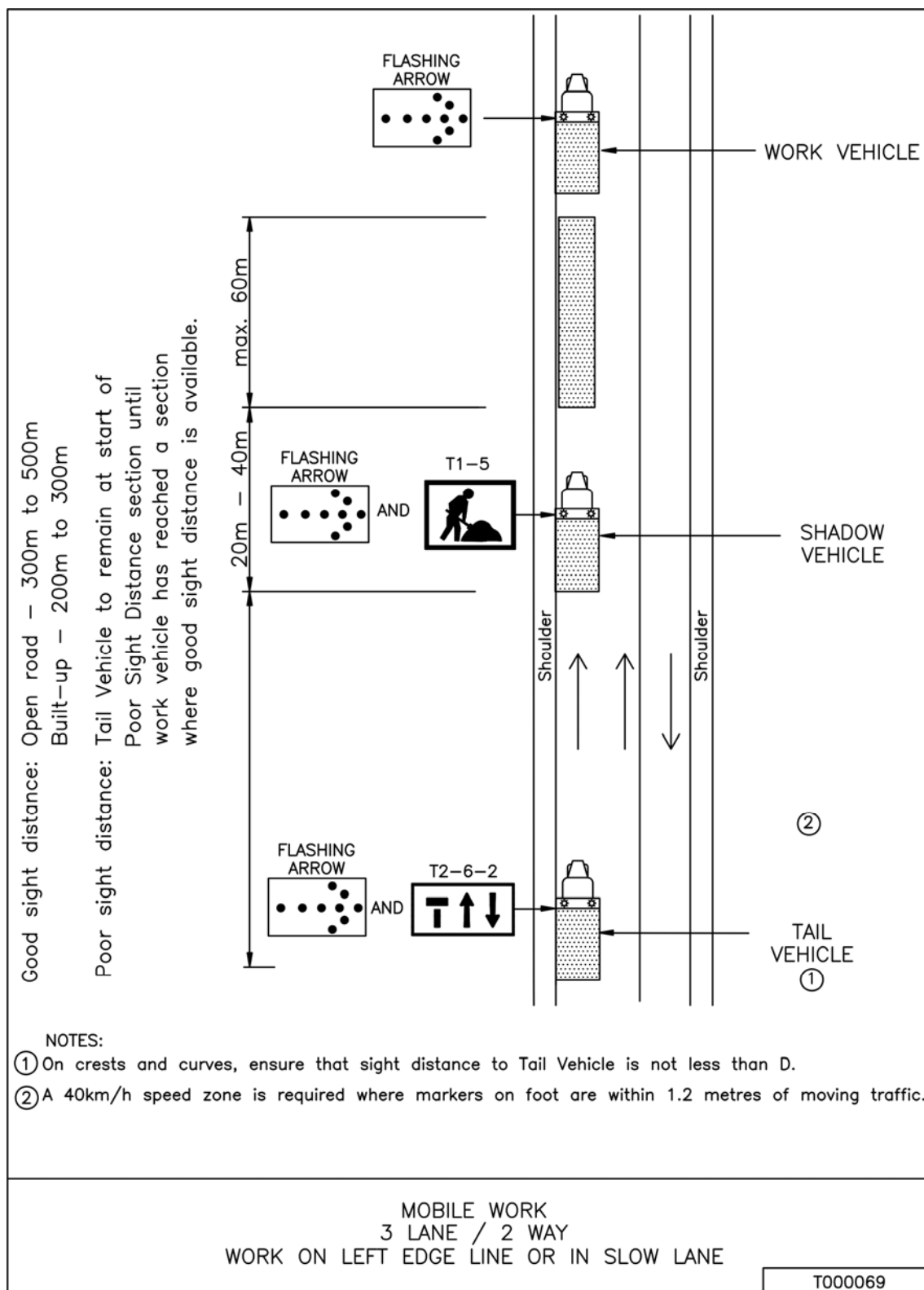


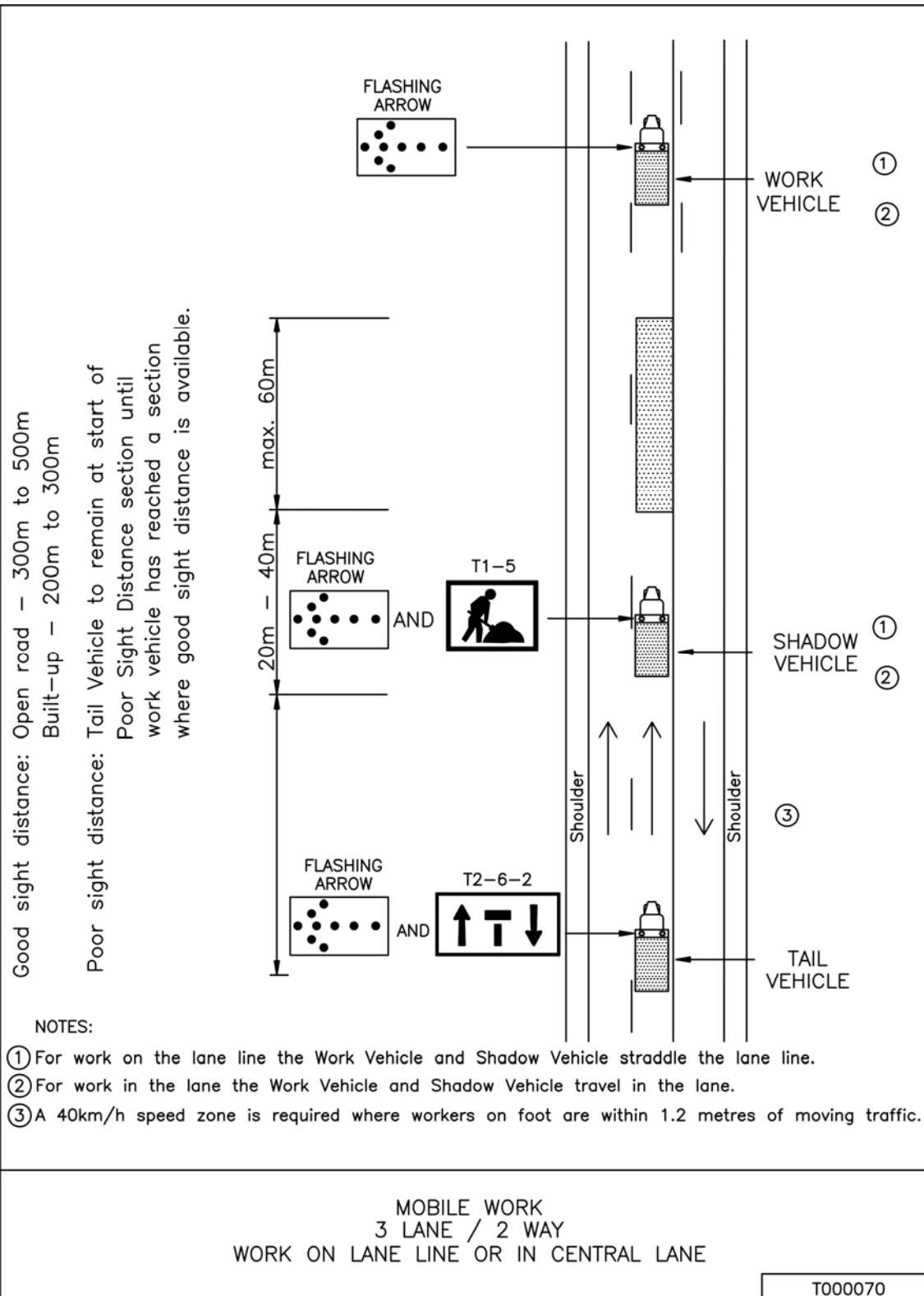


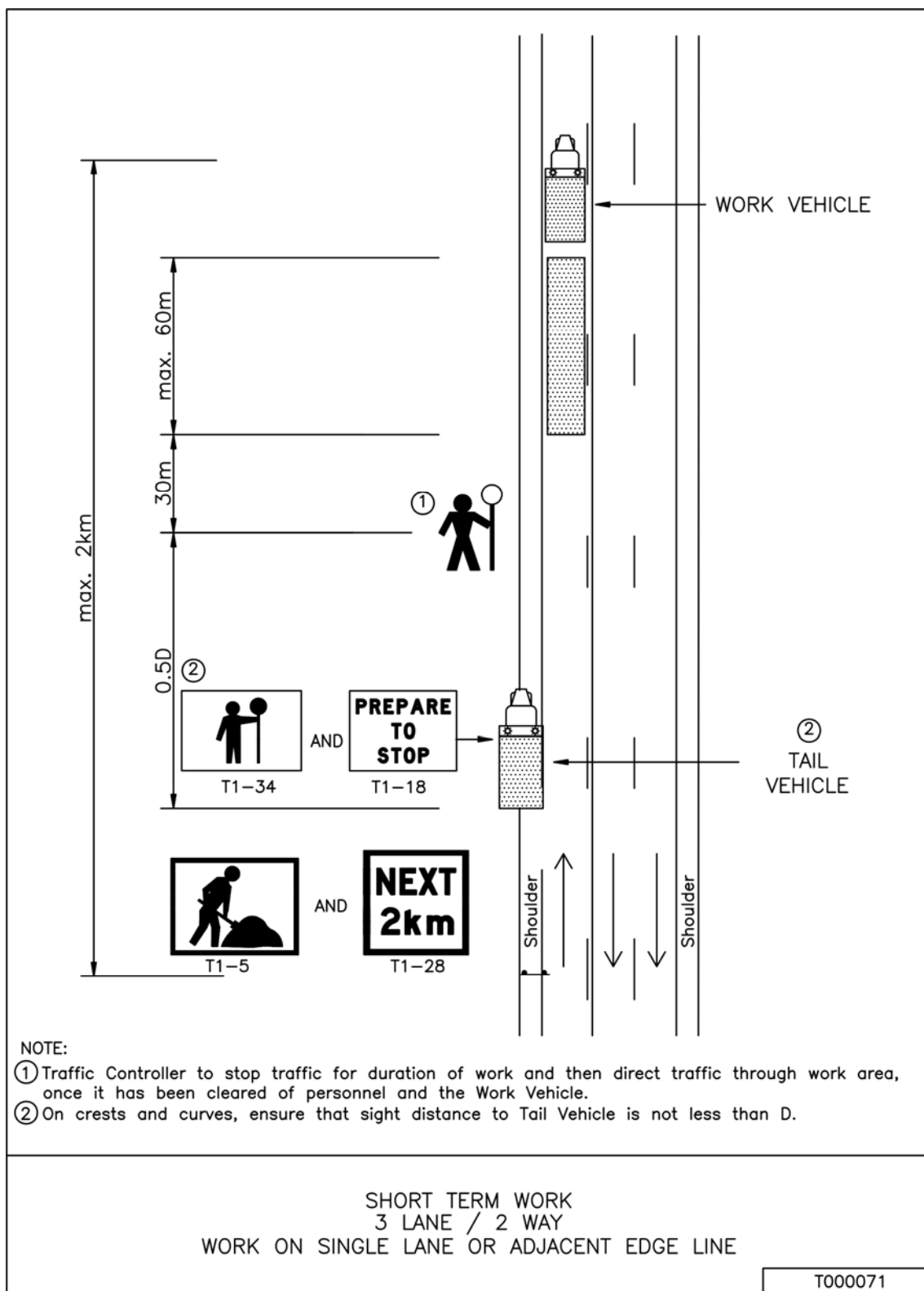


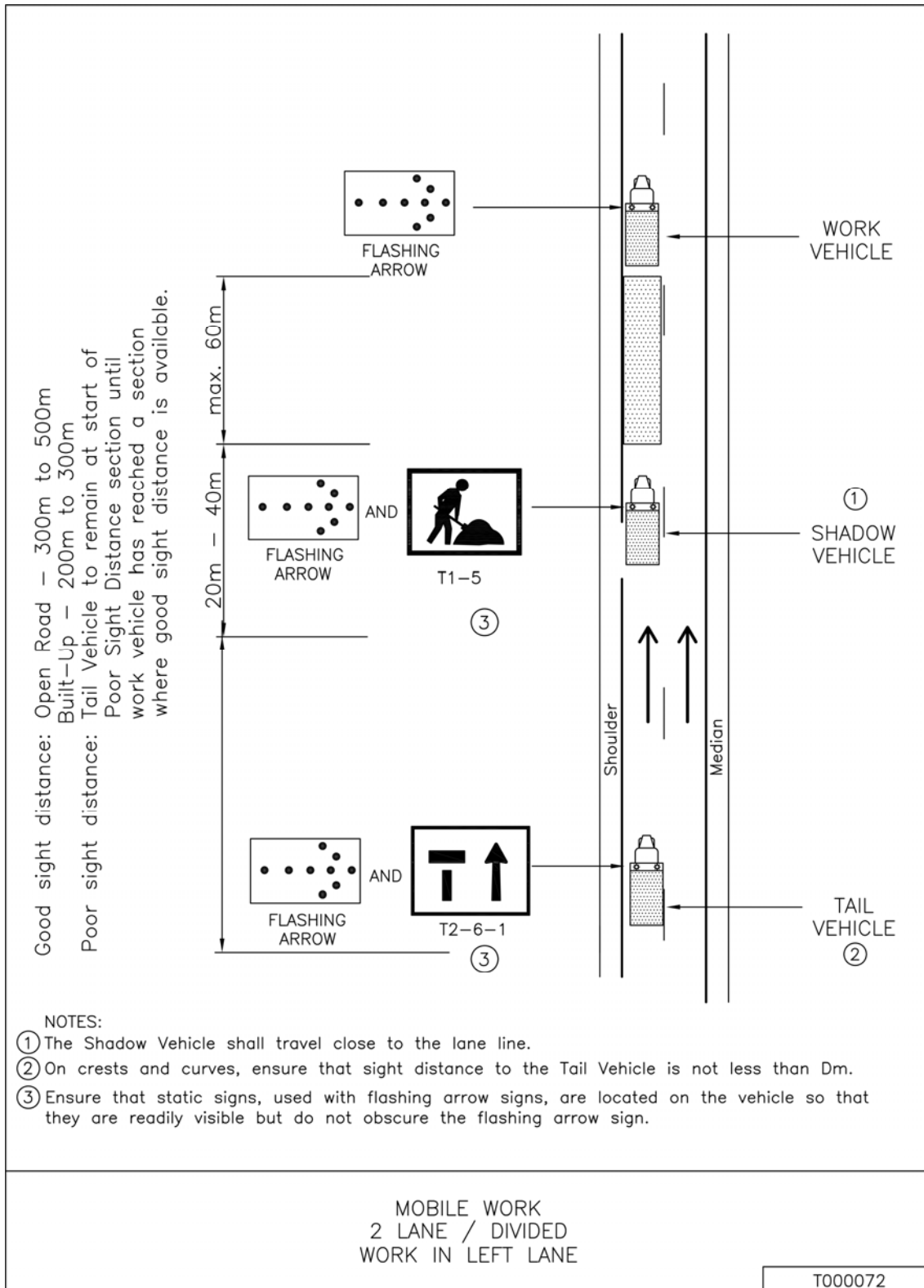


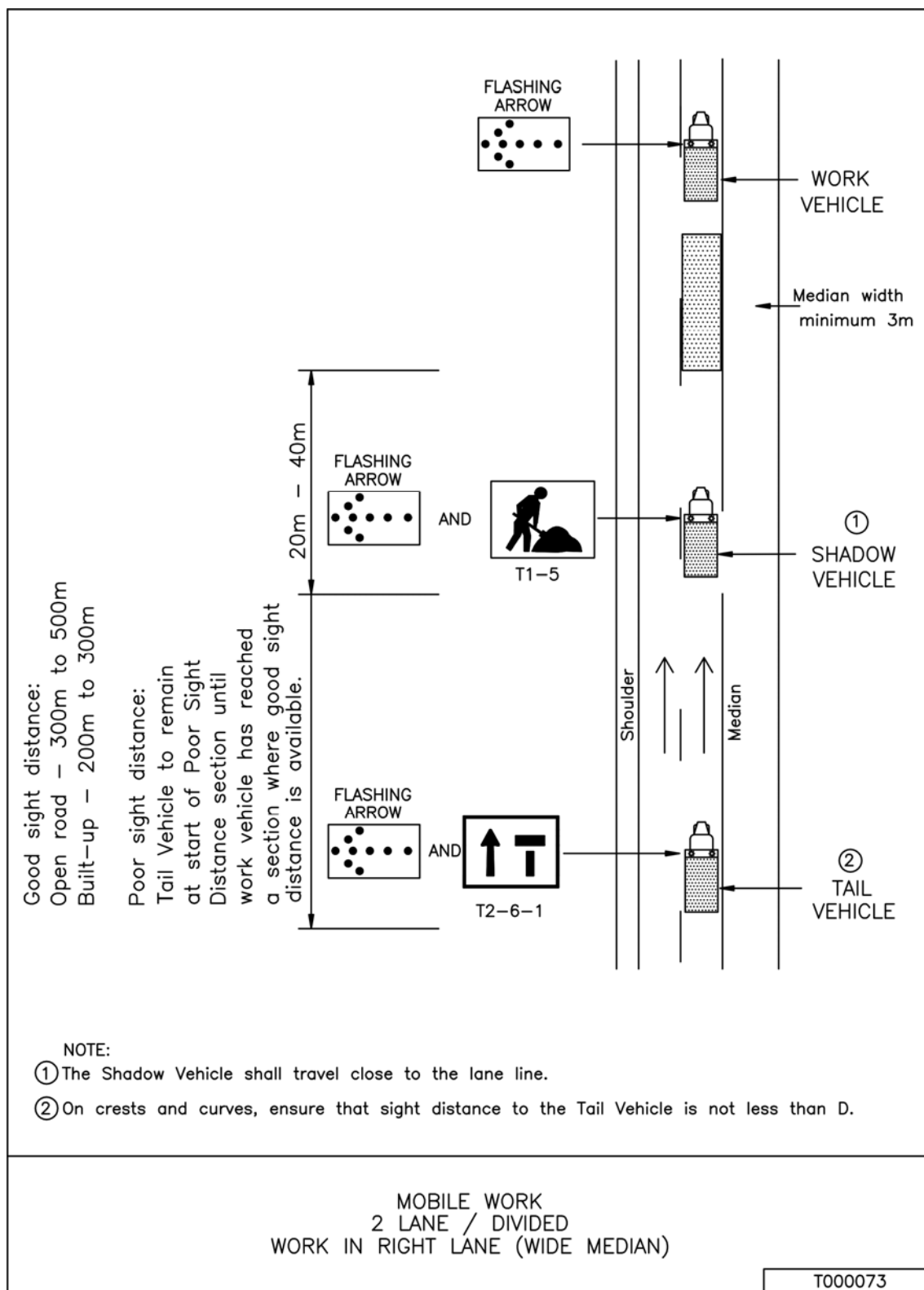
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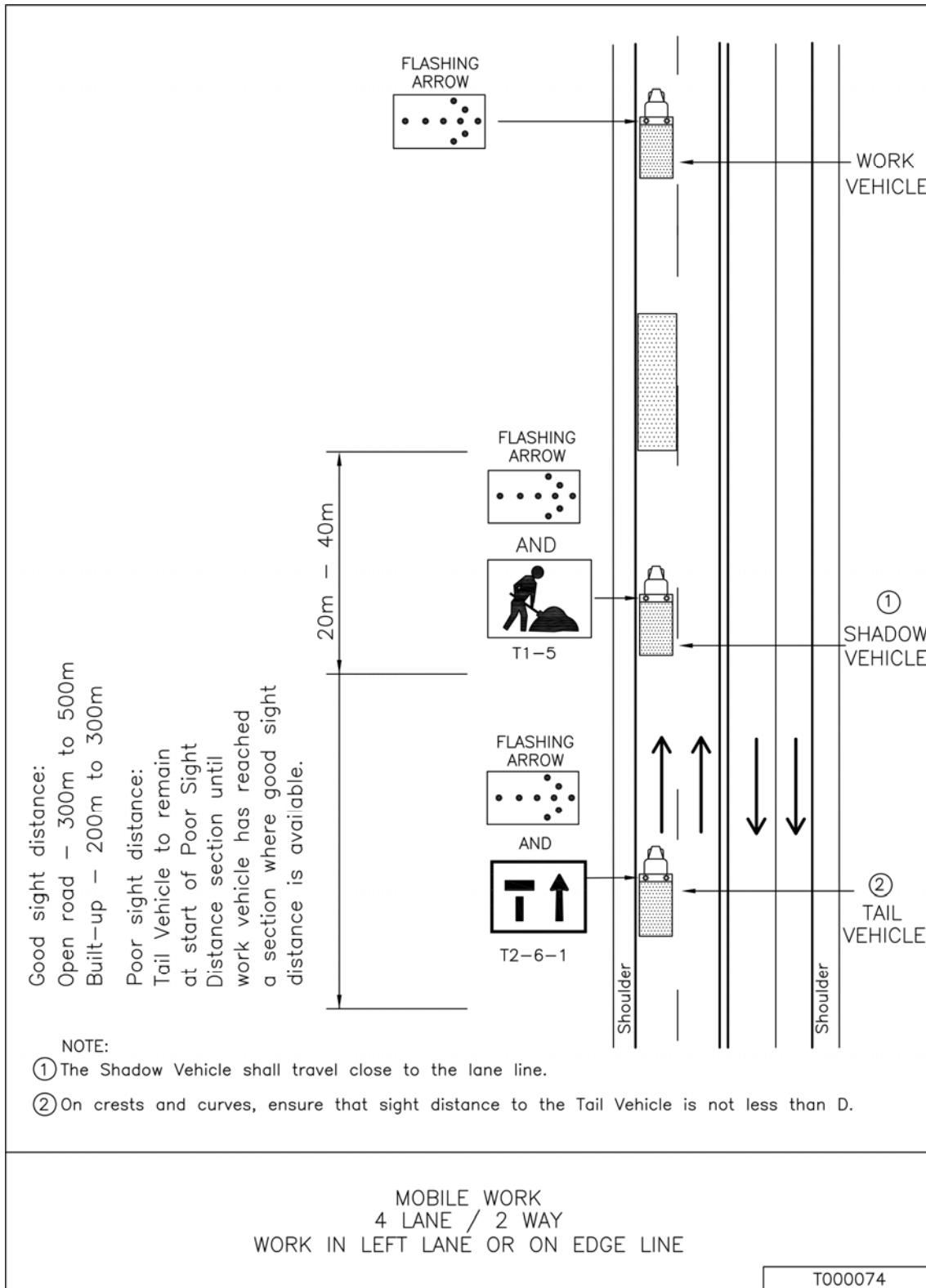


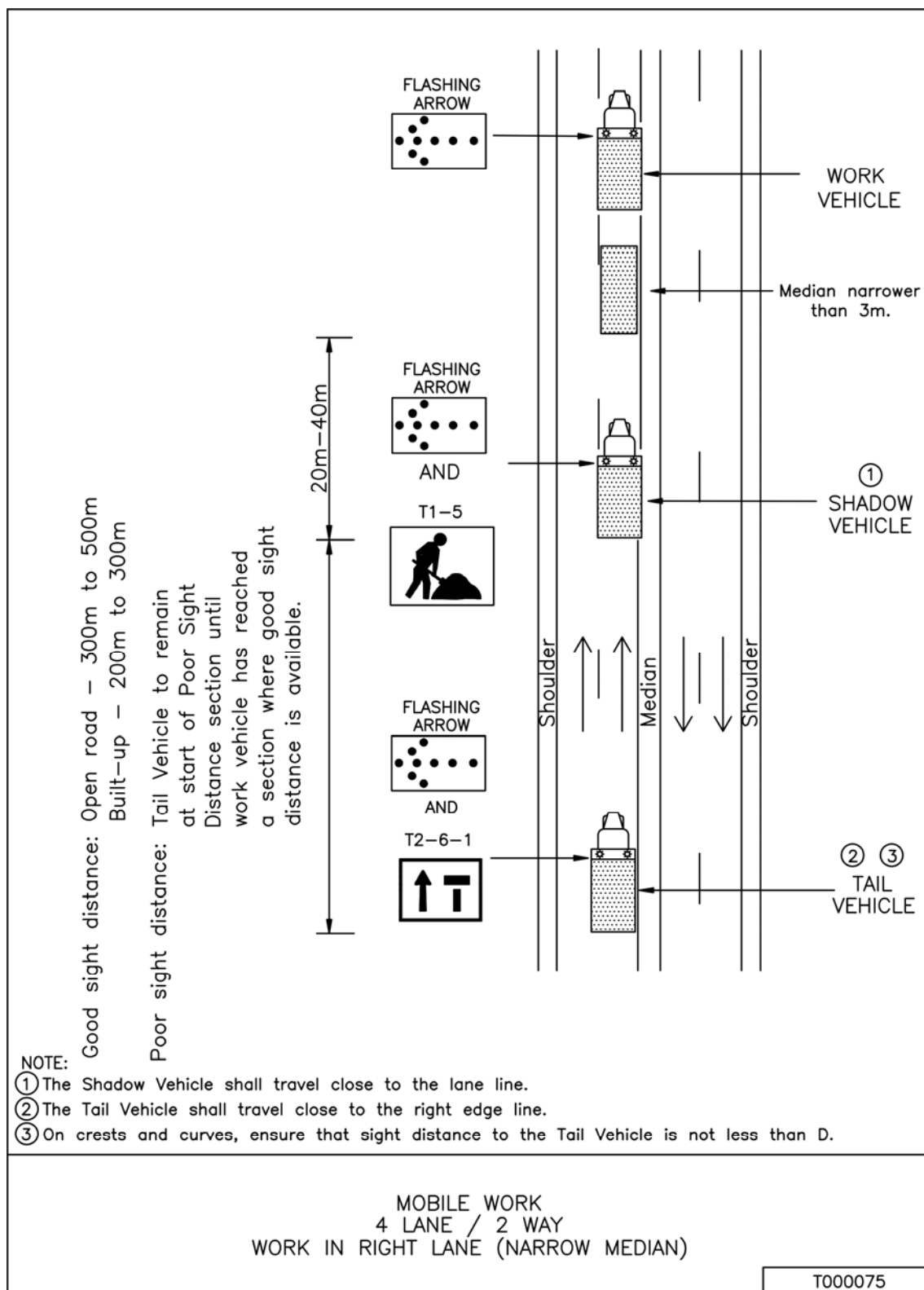


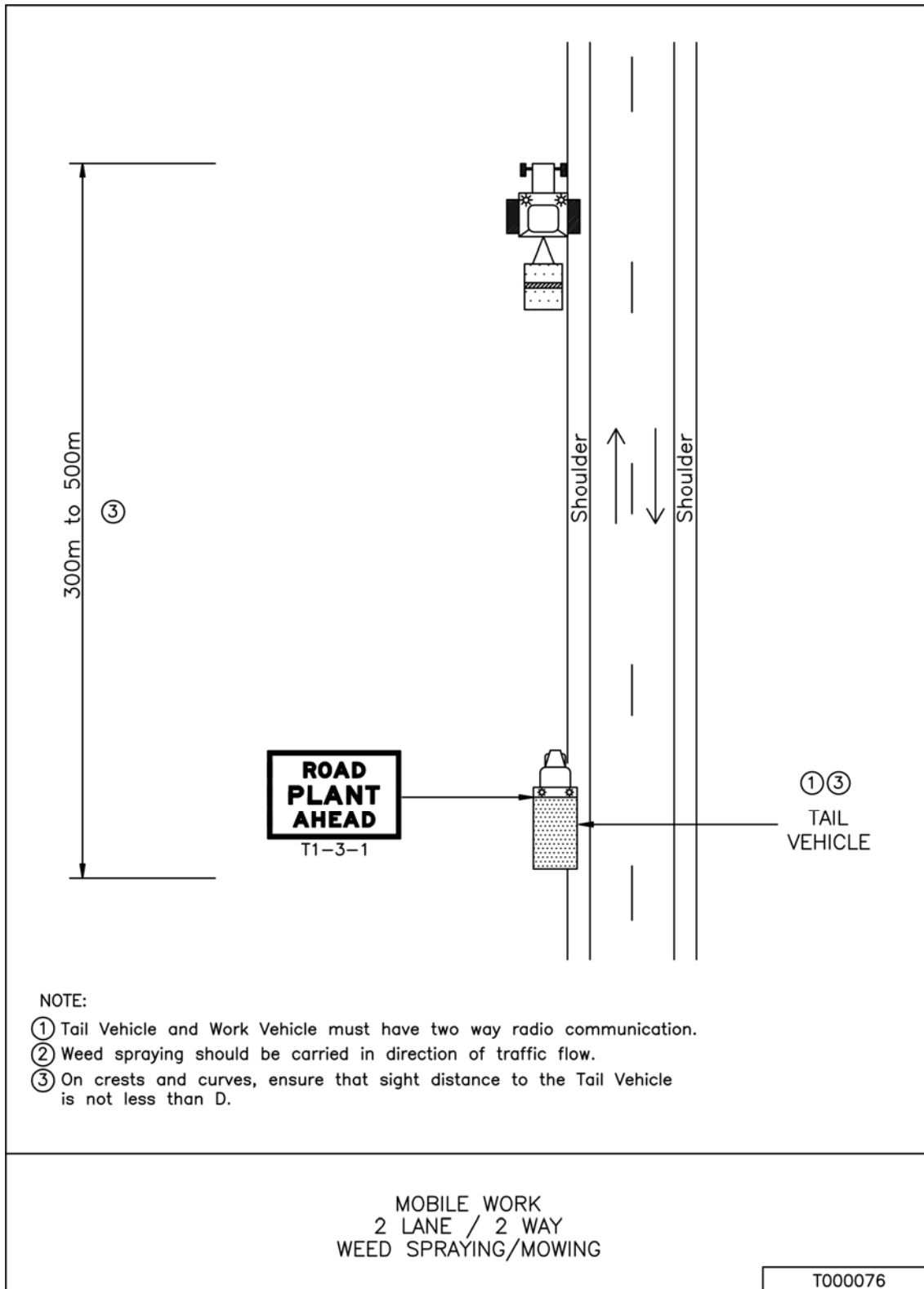


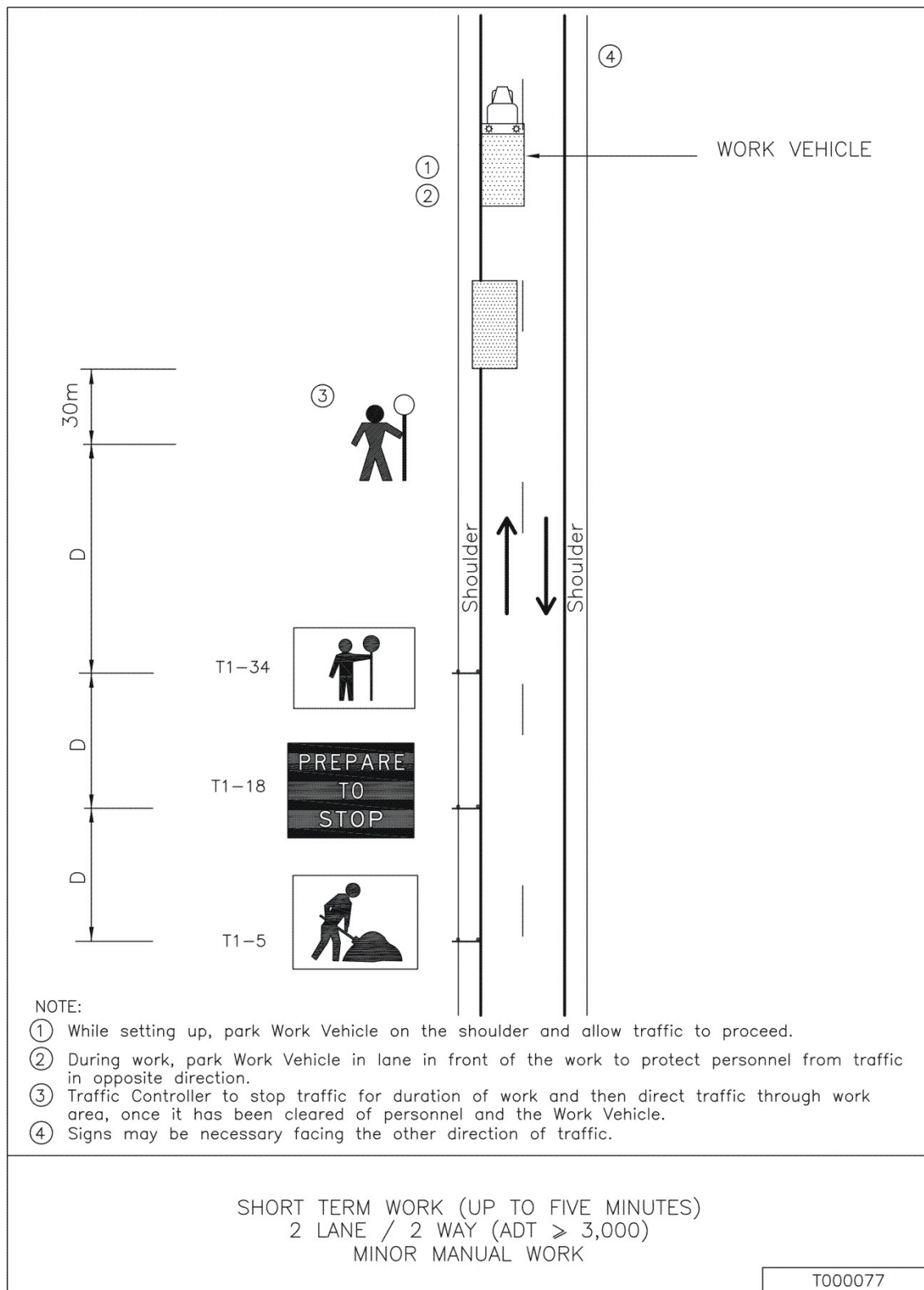


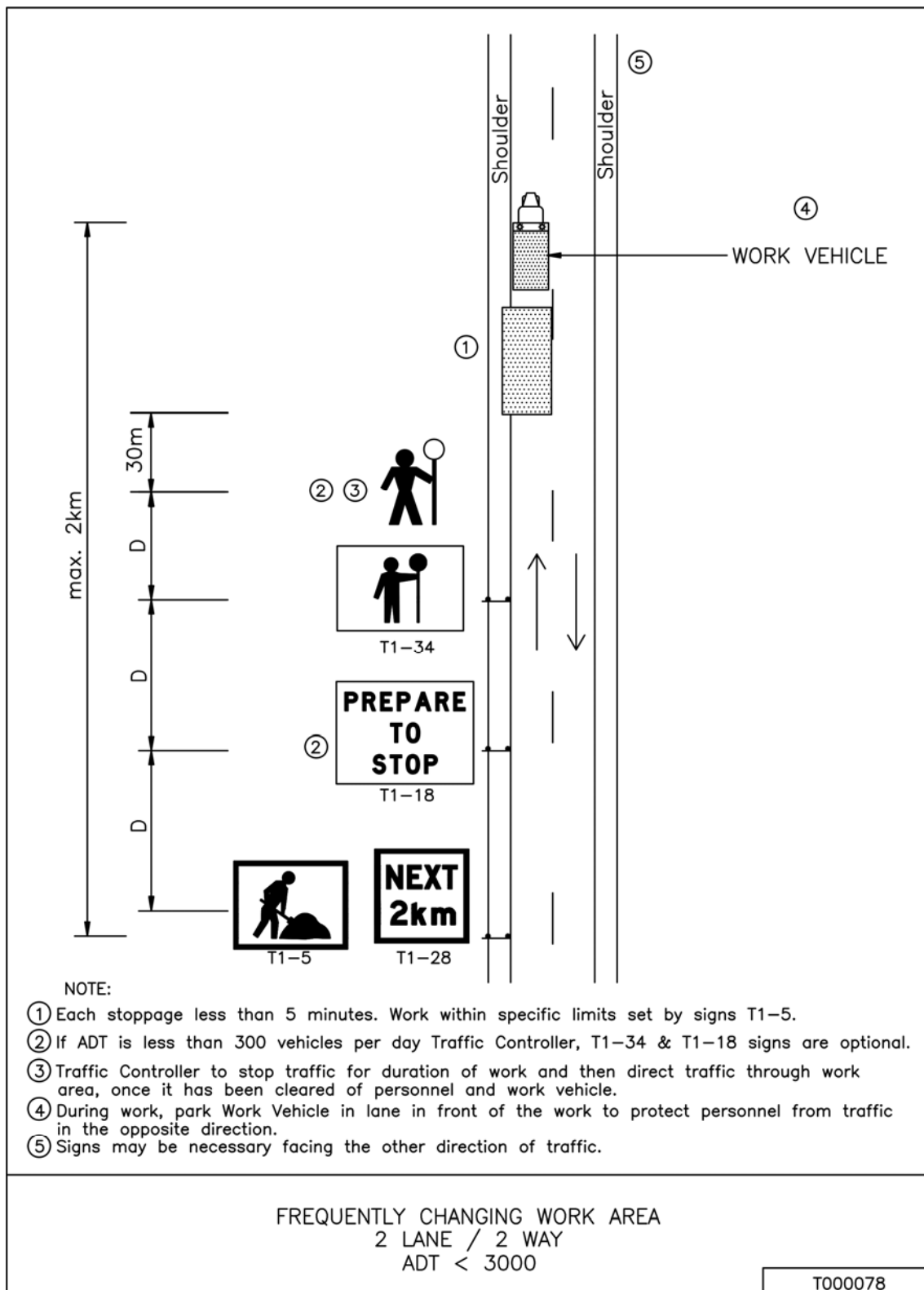


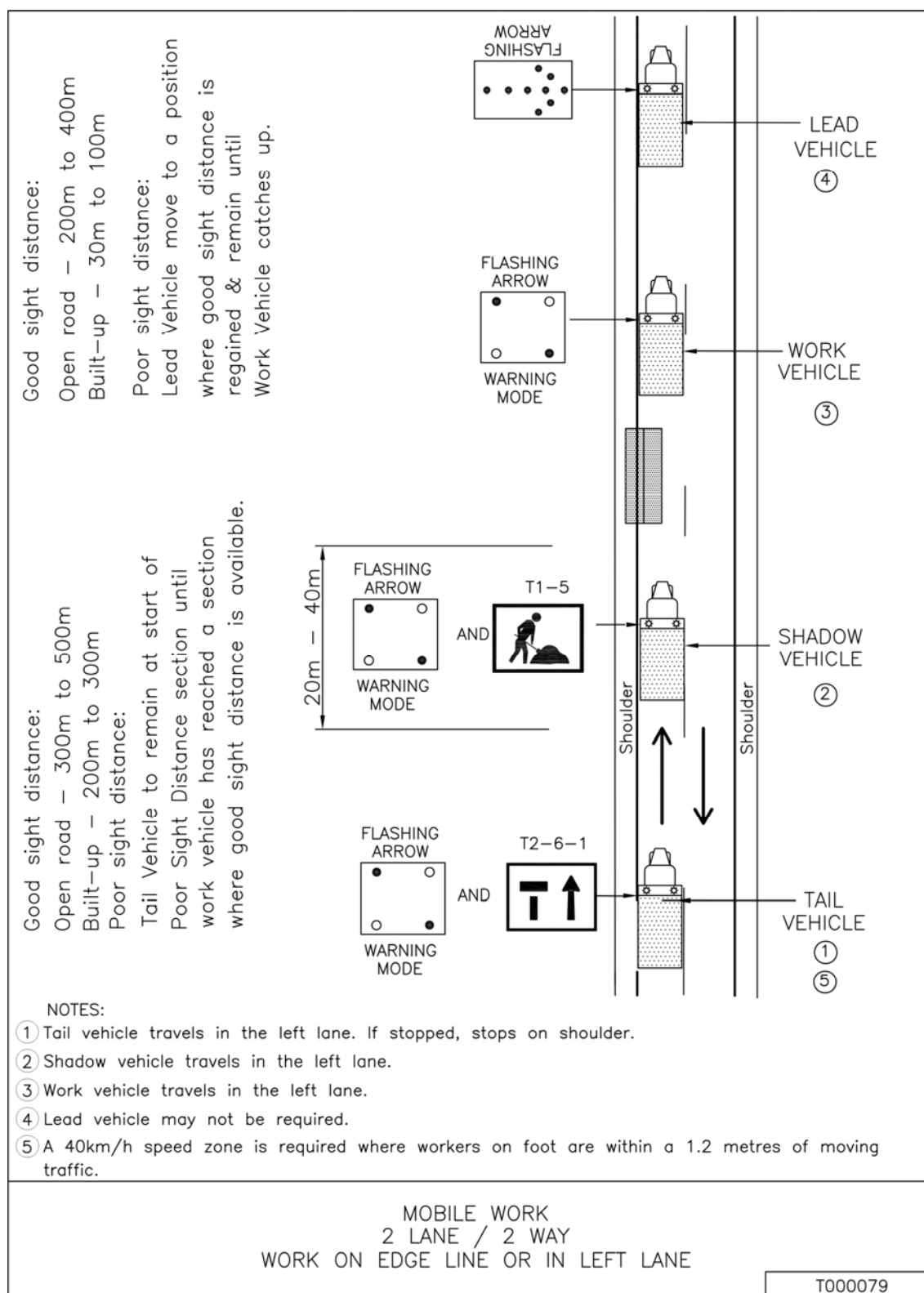


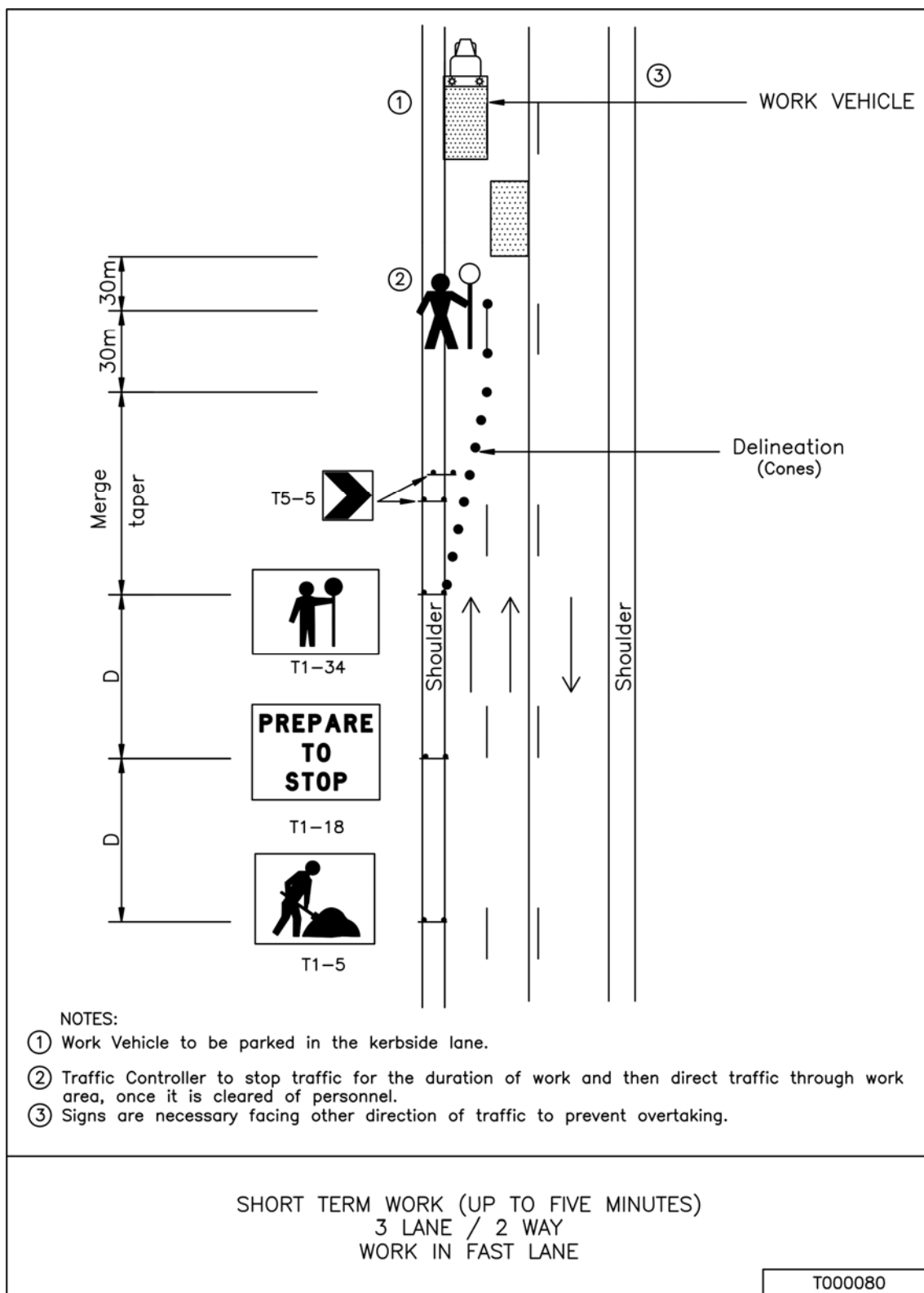




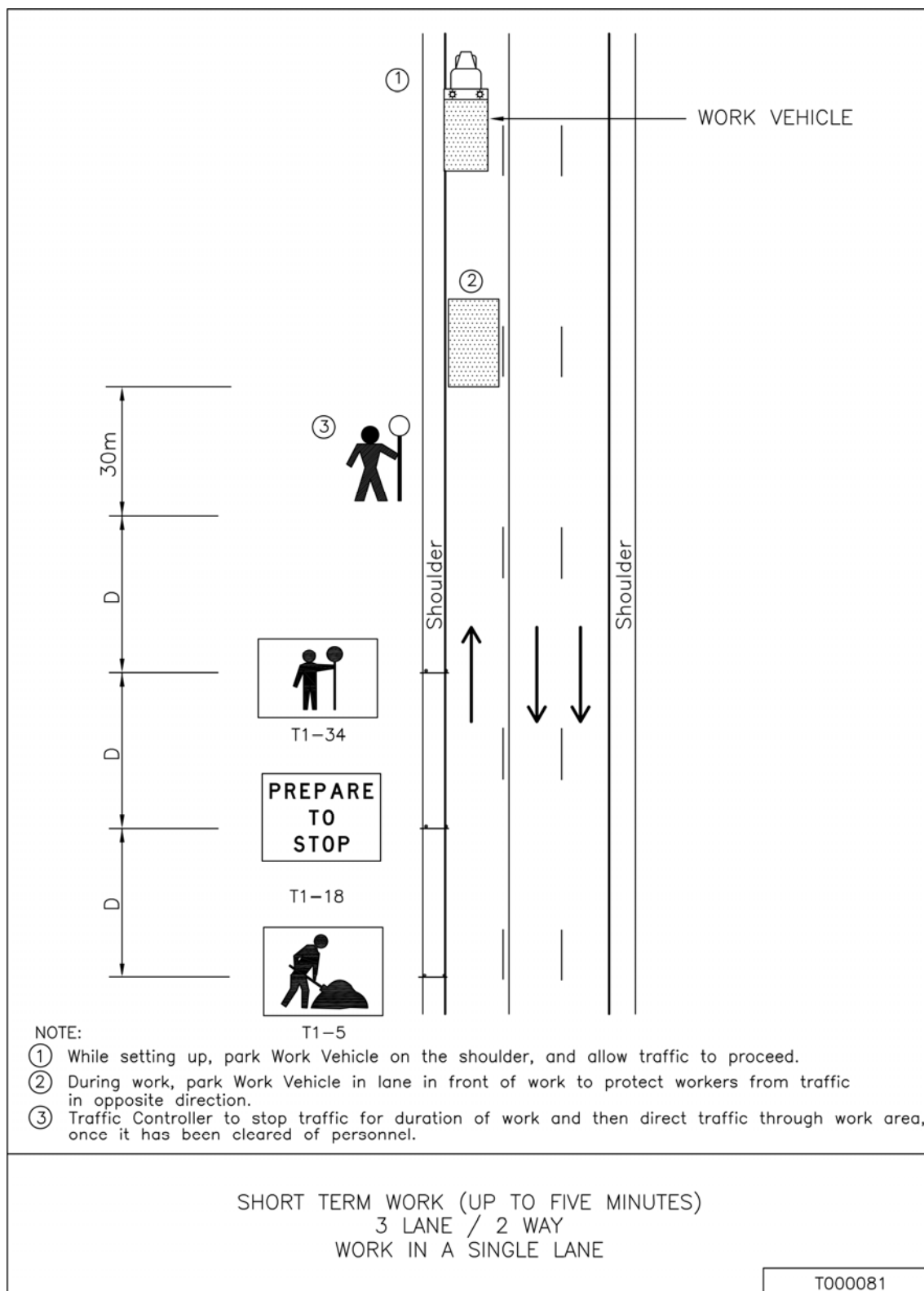


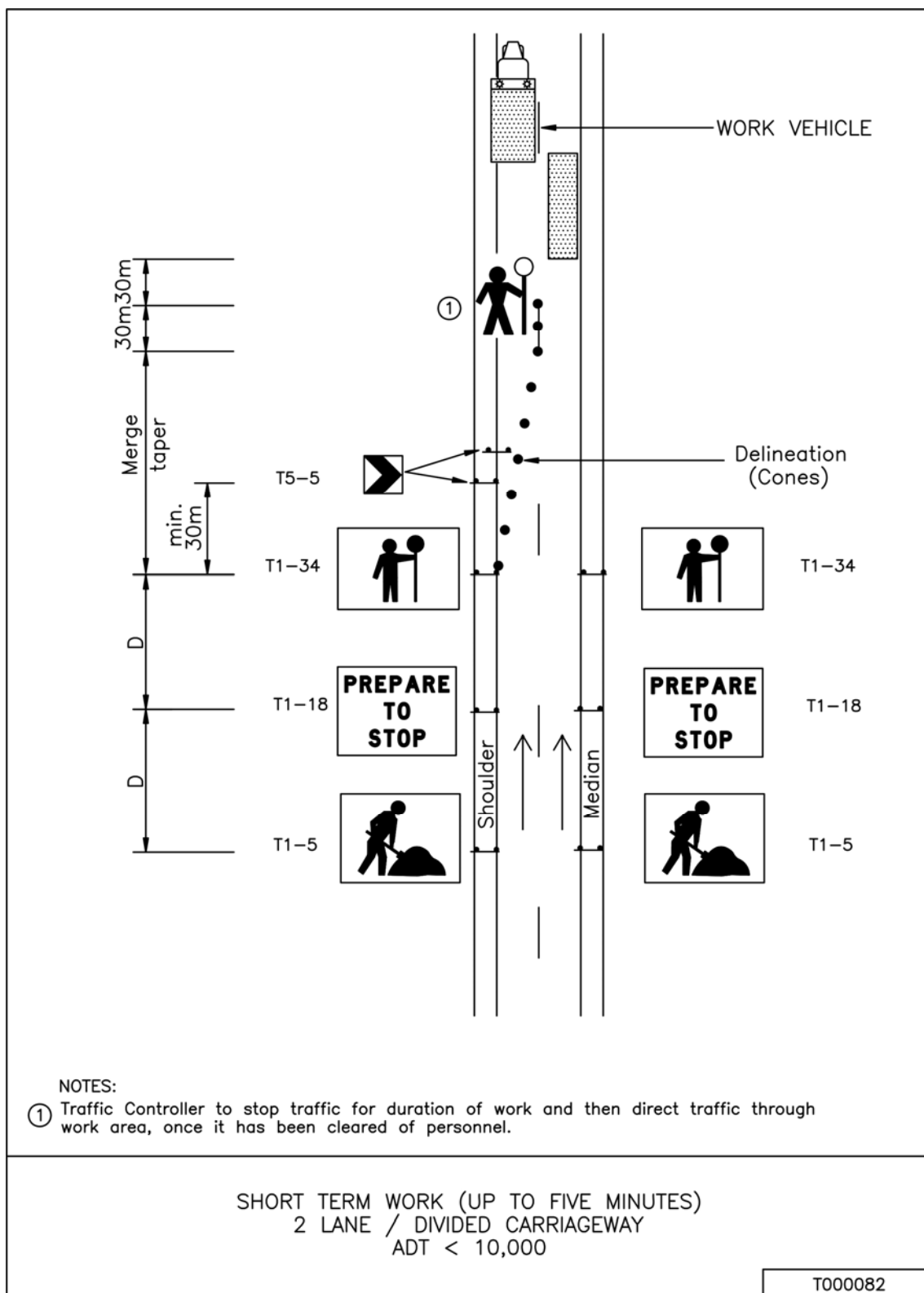


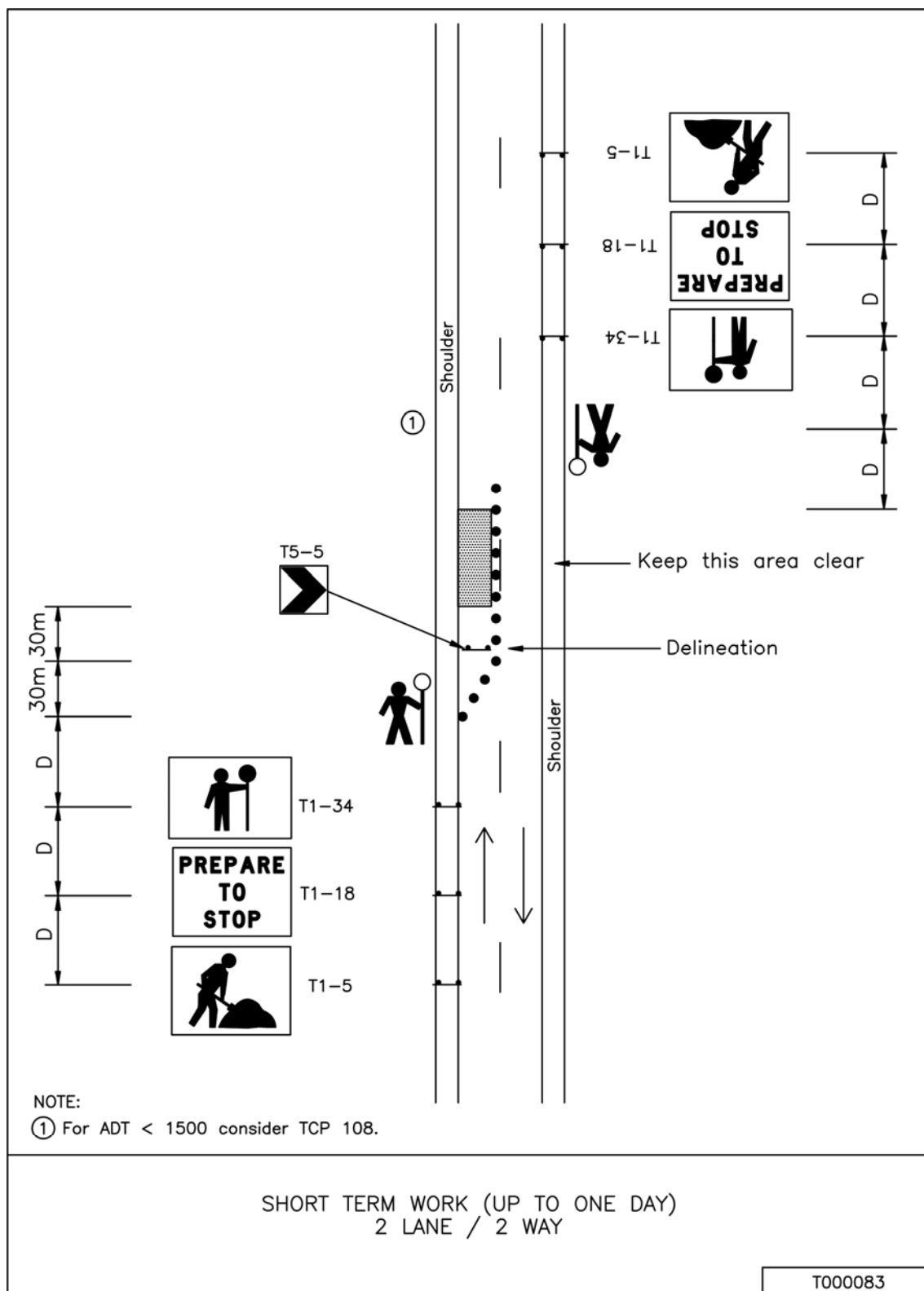


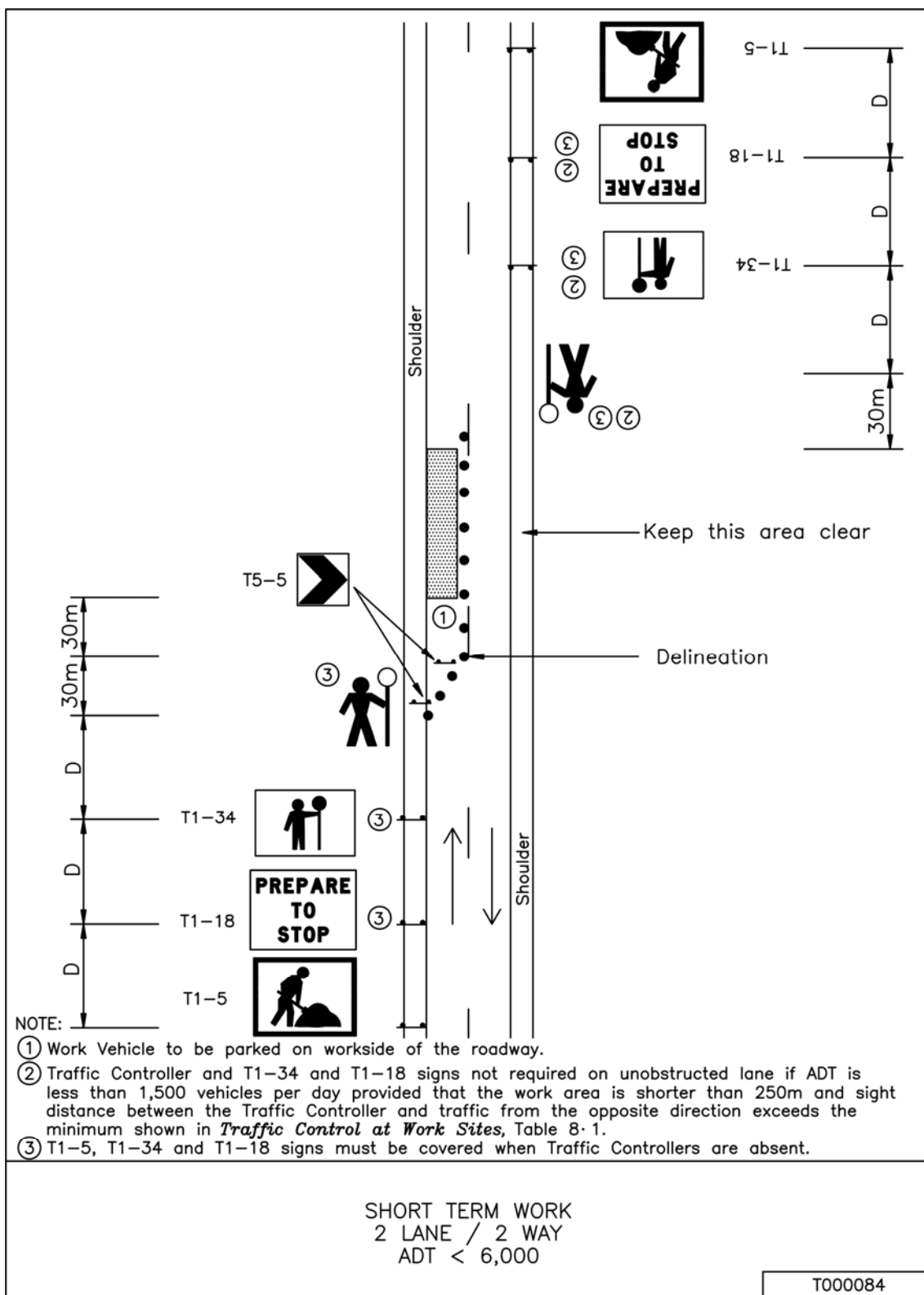


TCP 80



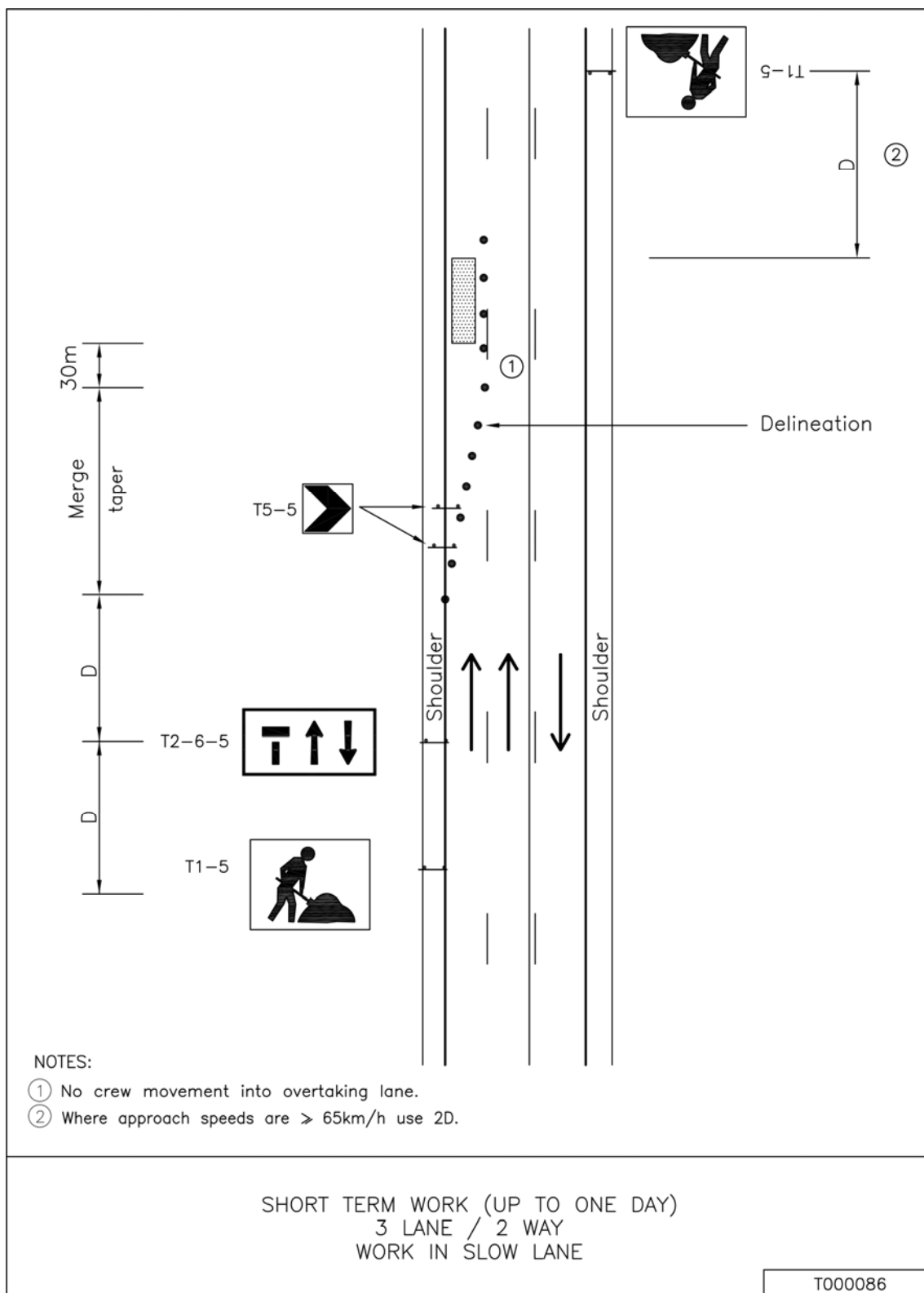






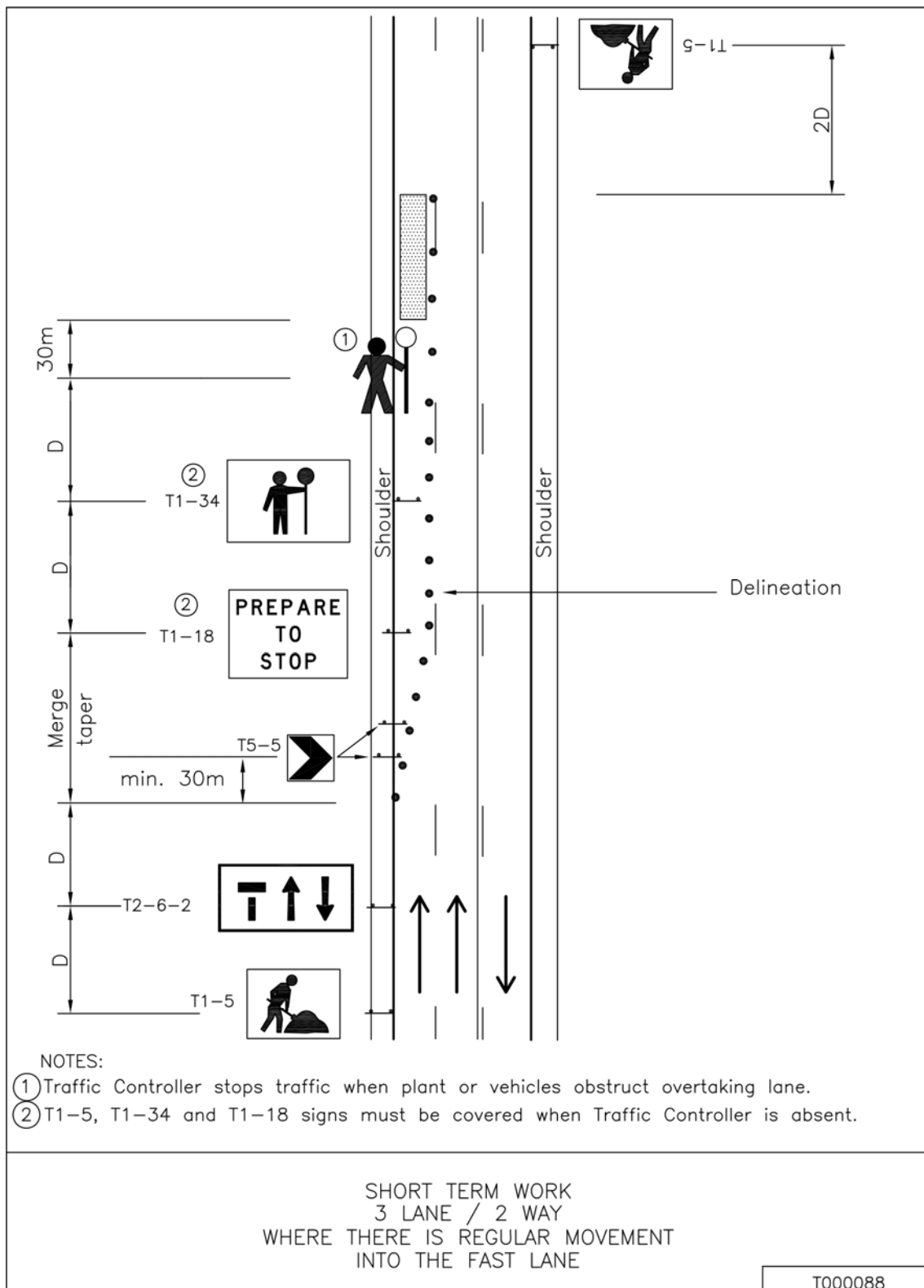


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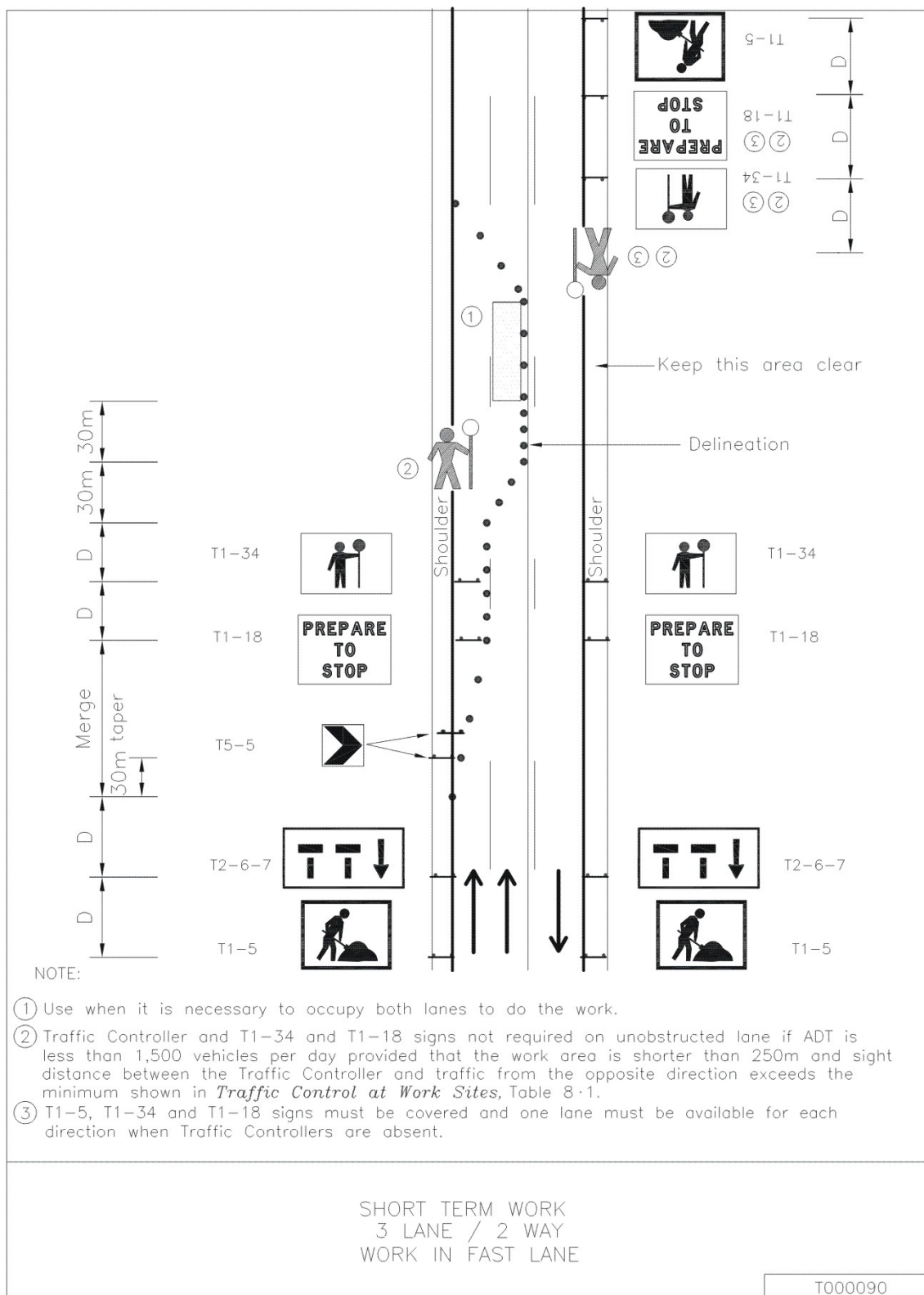


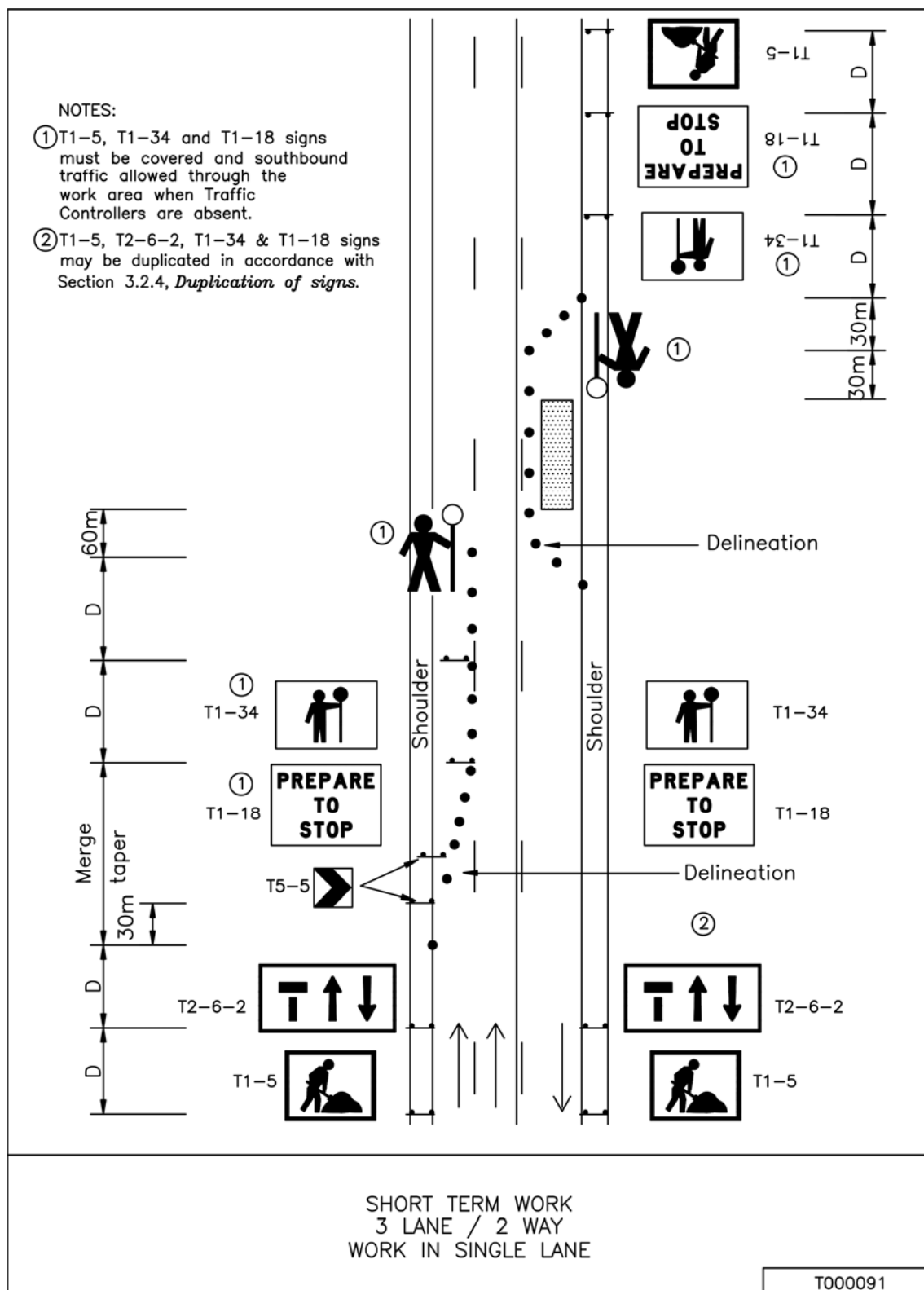
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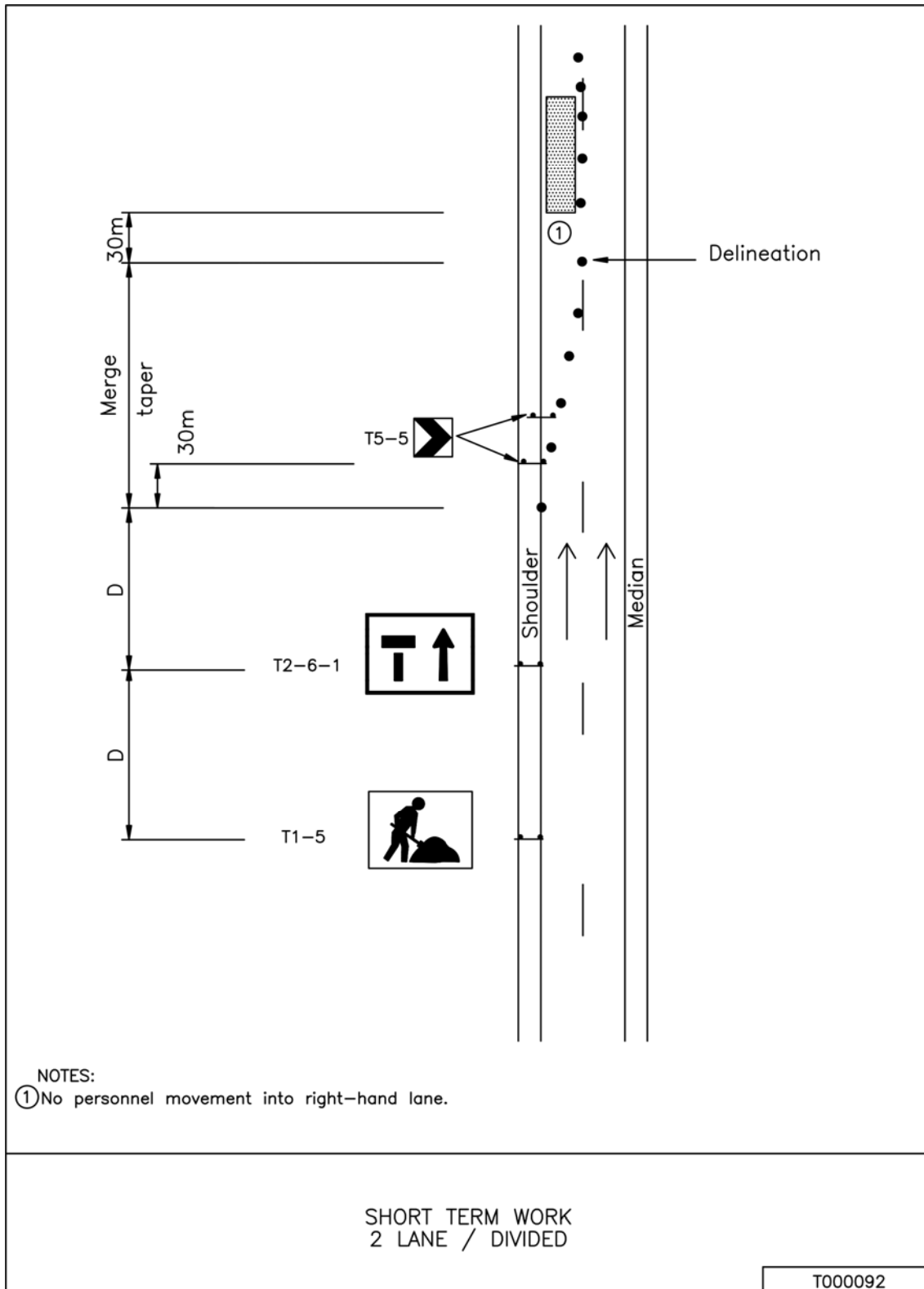


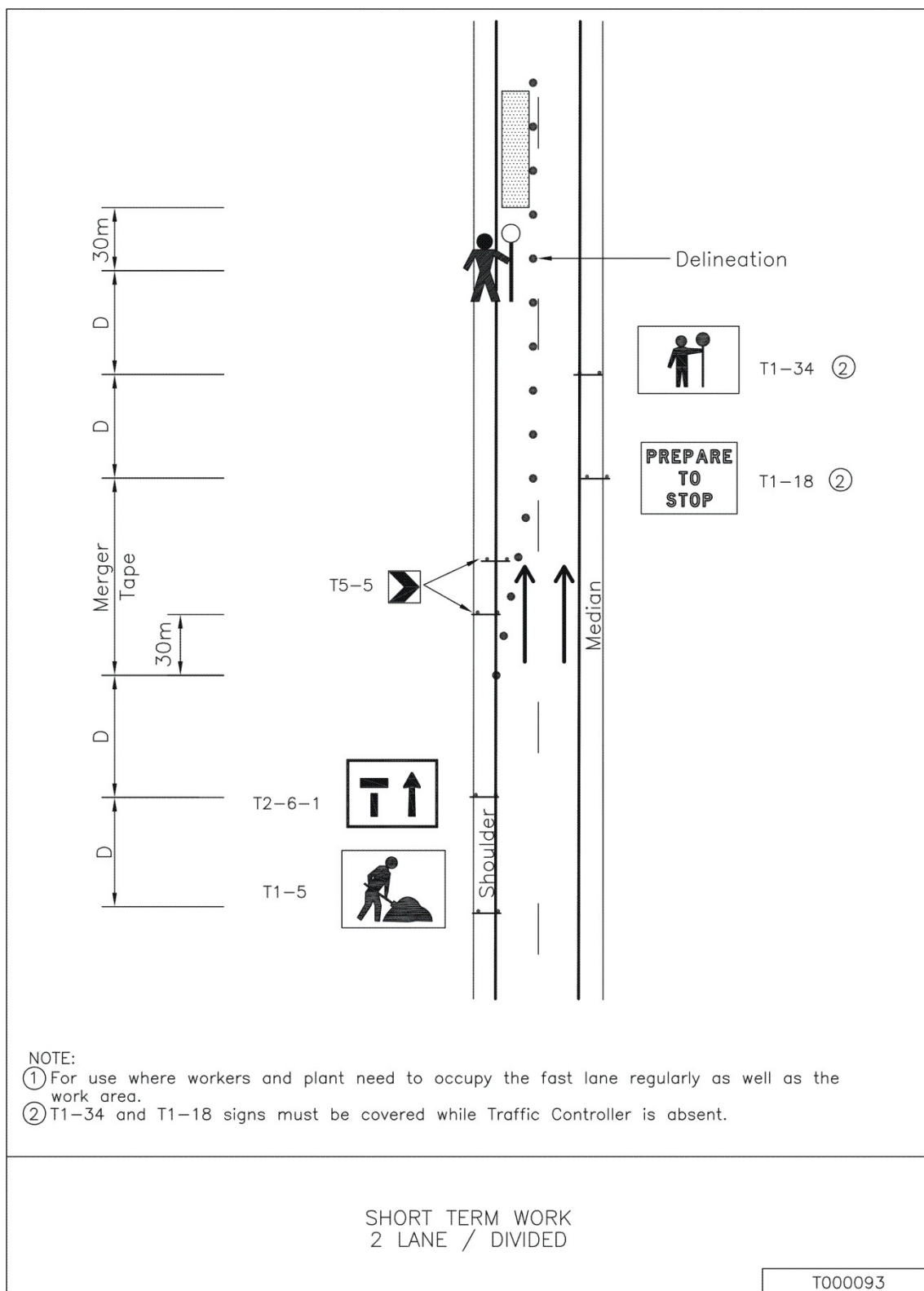
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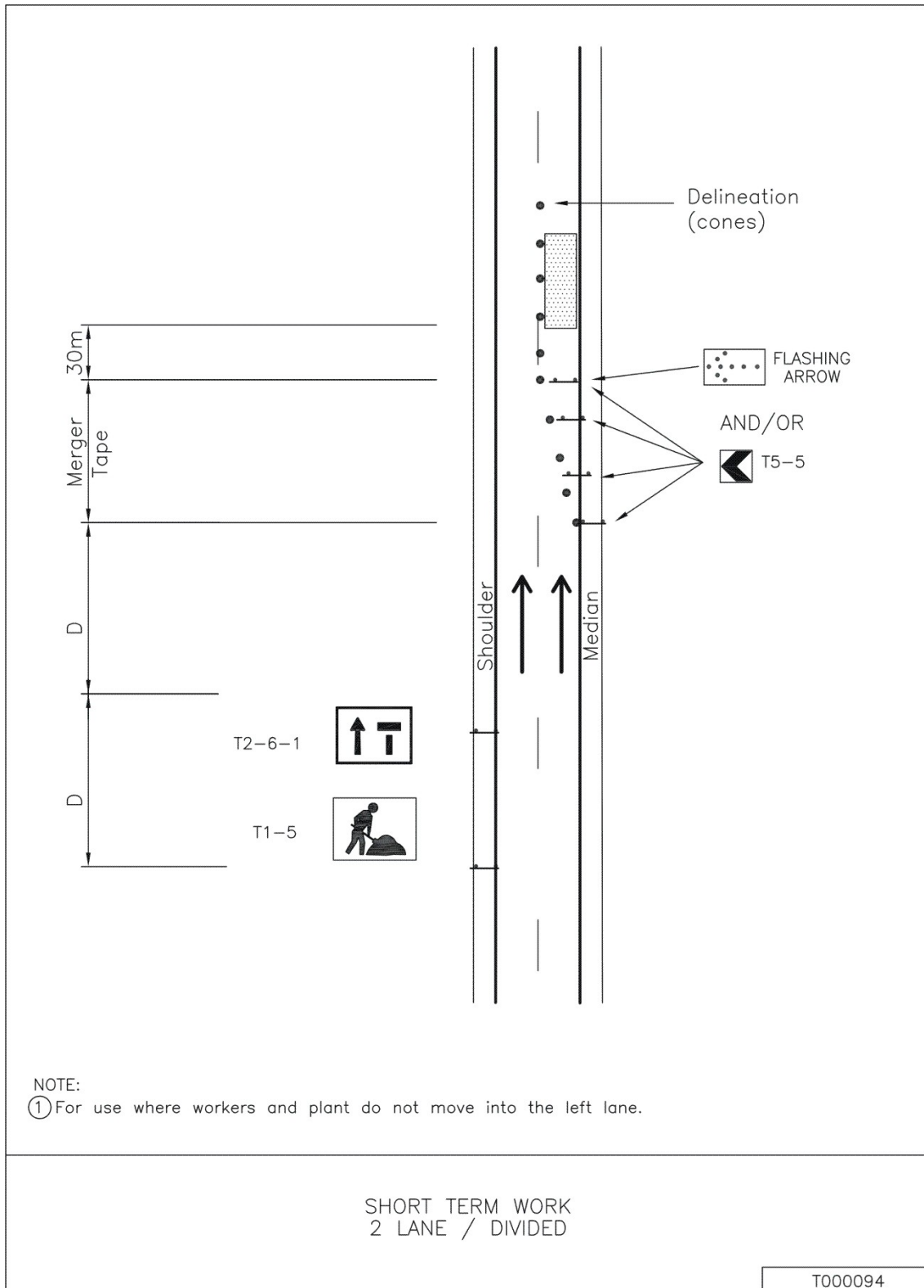


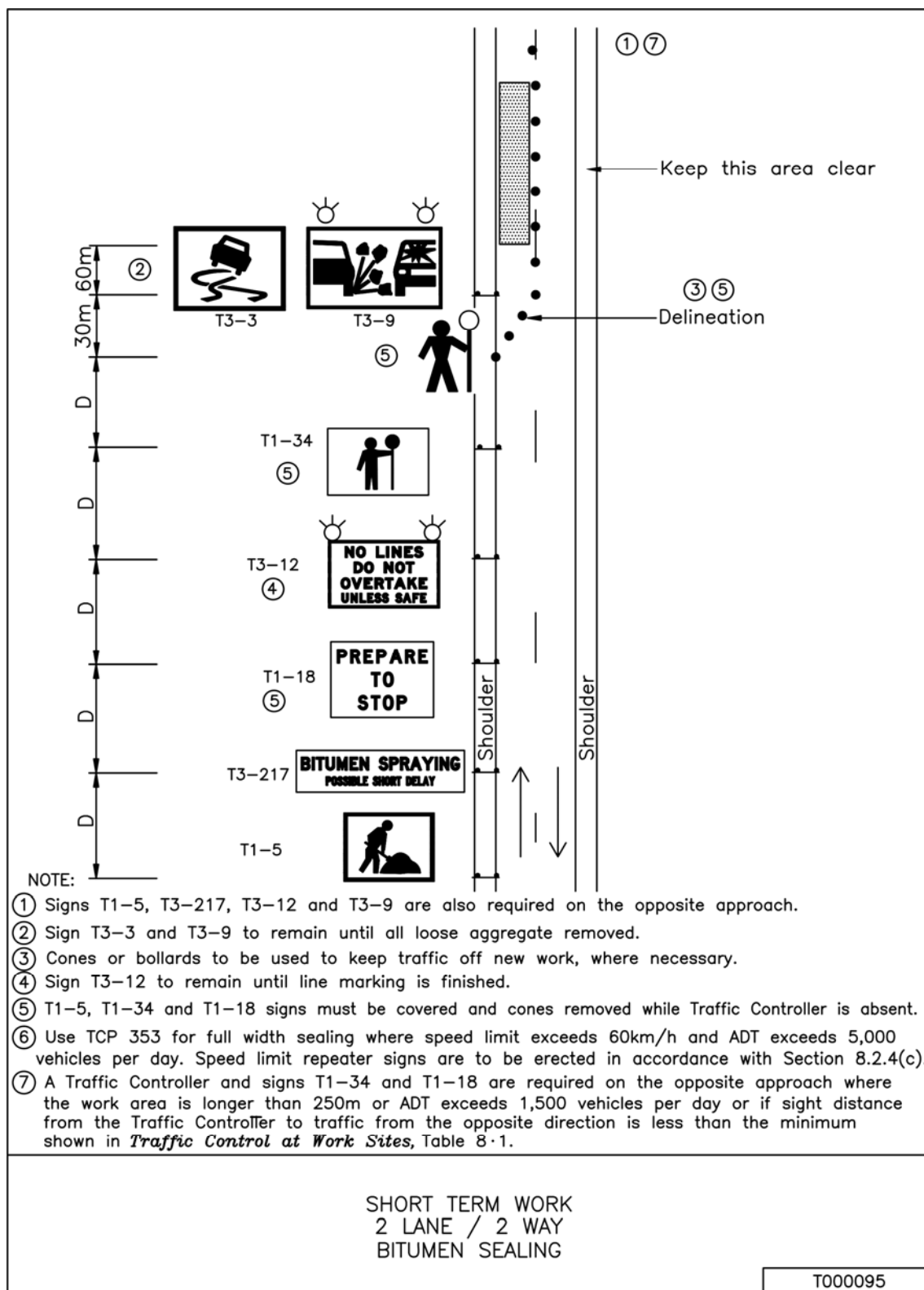


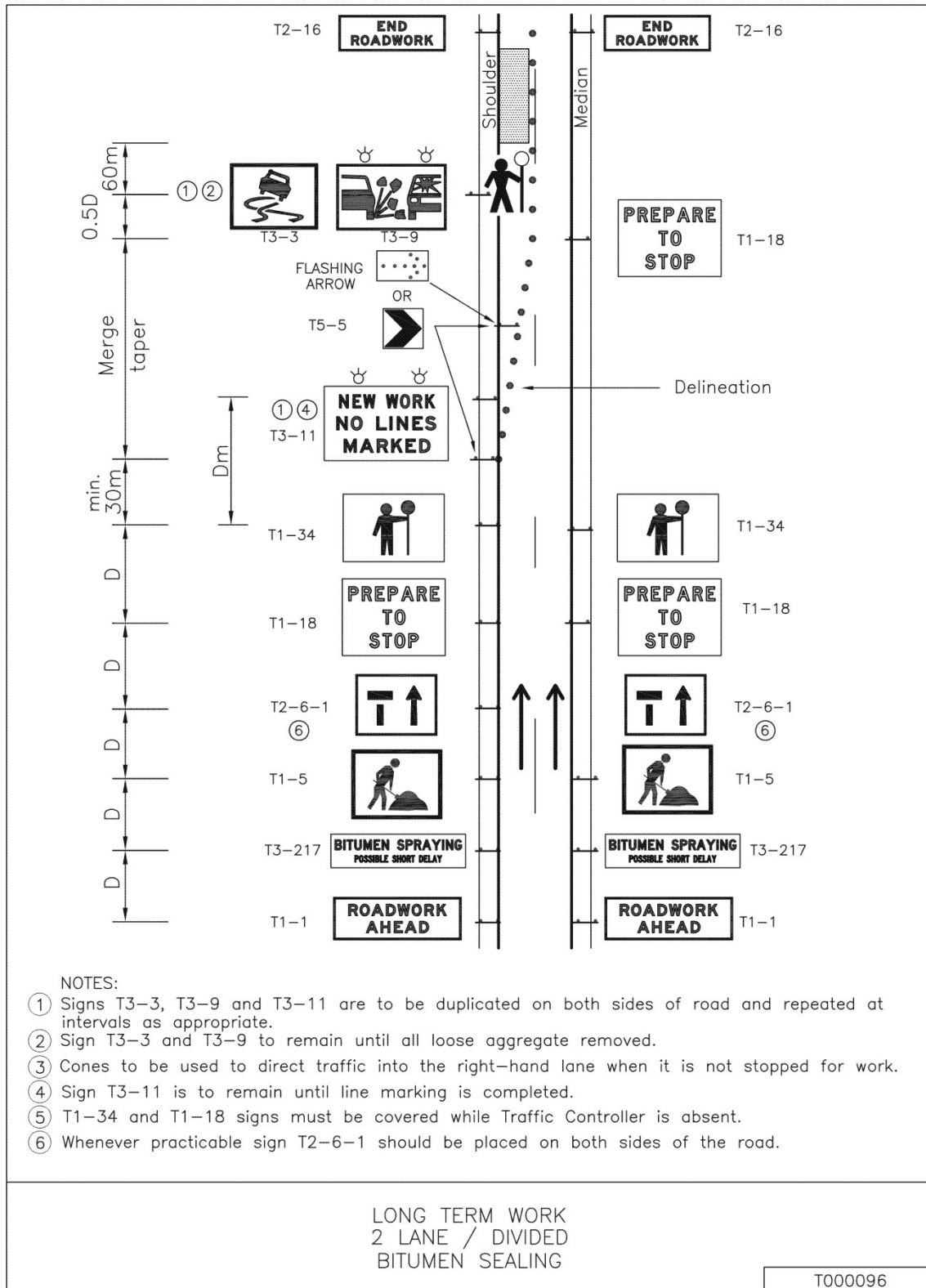


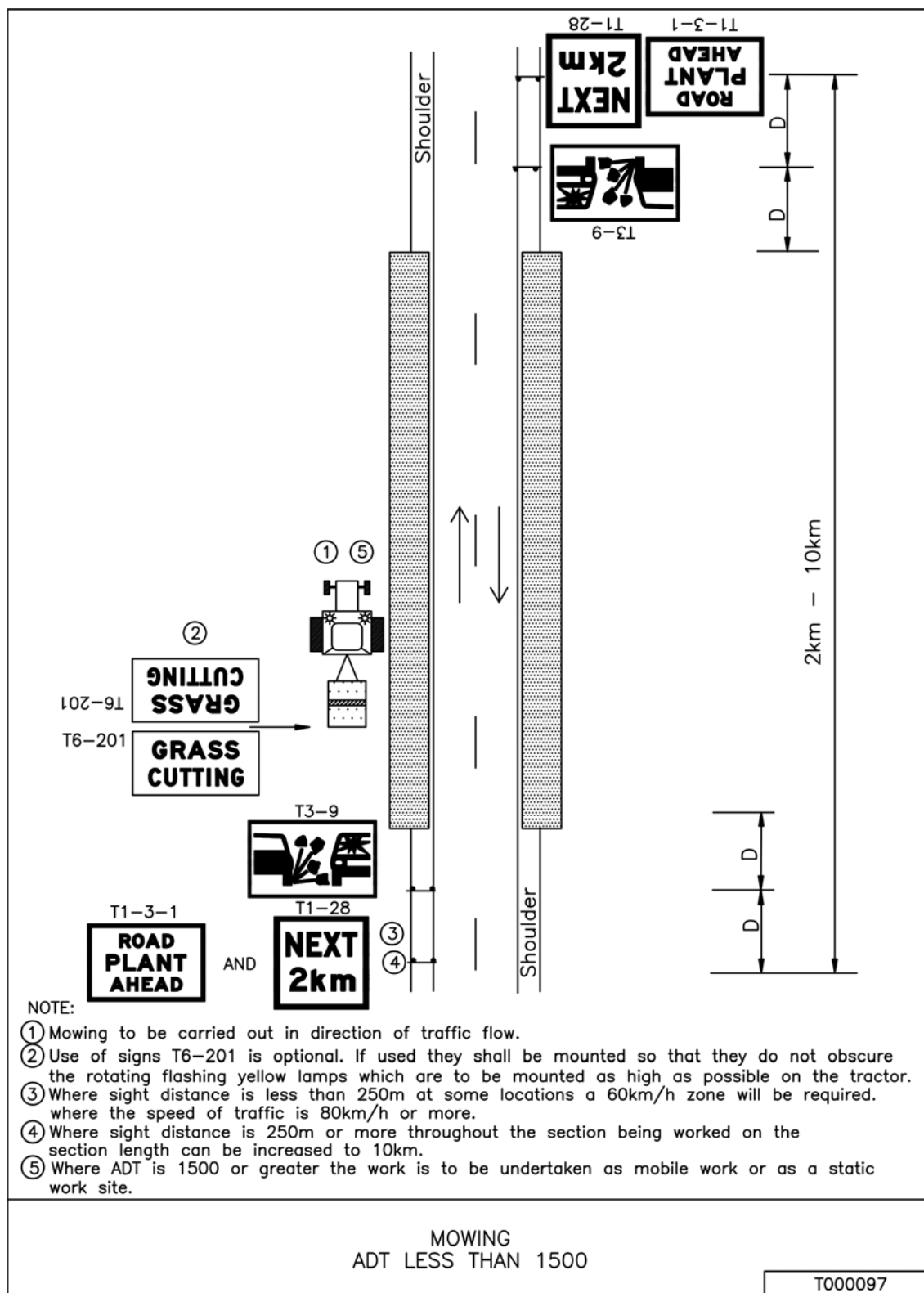






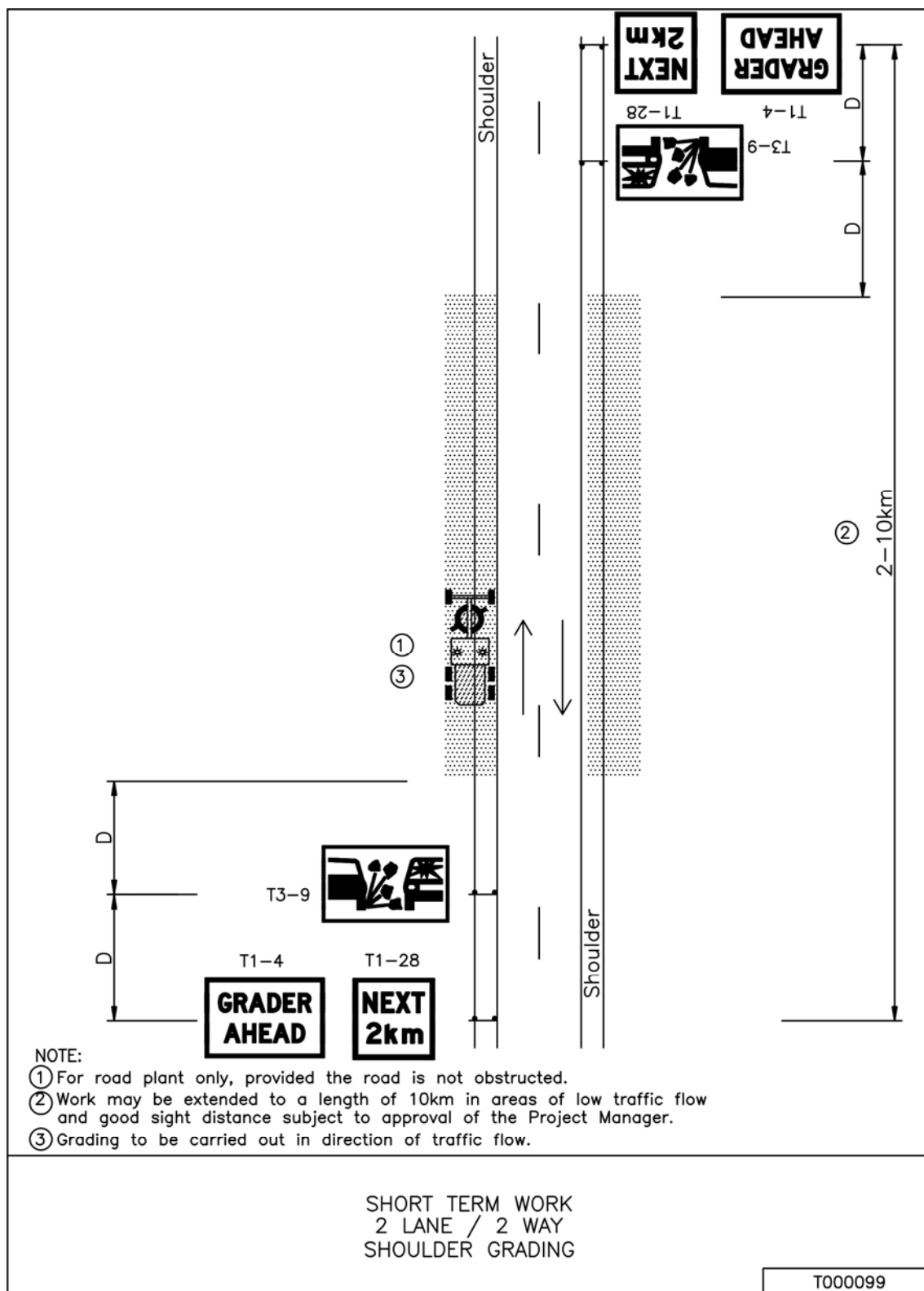


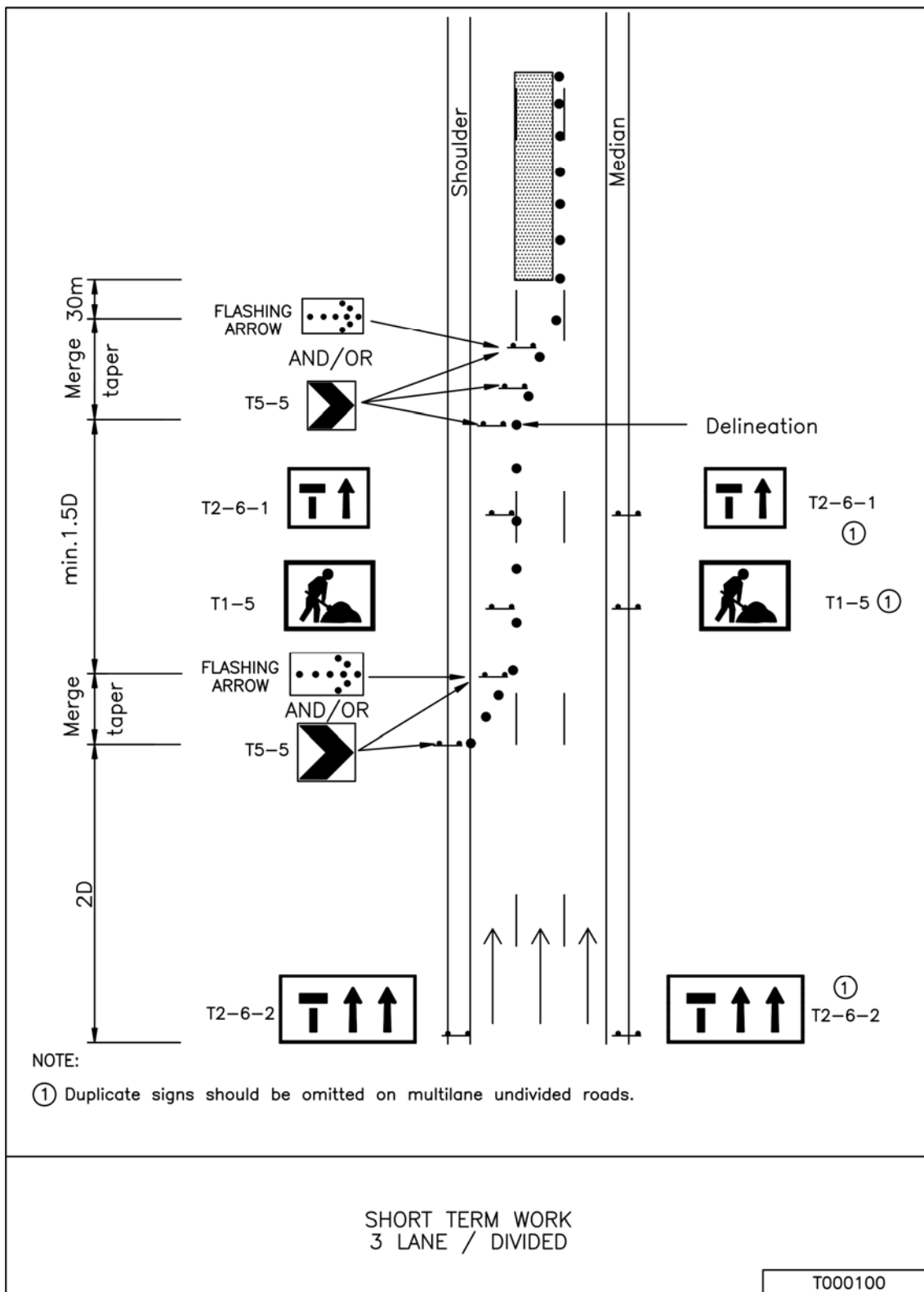


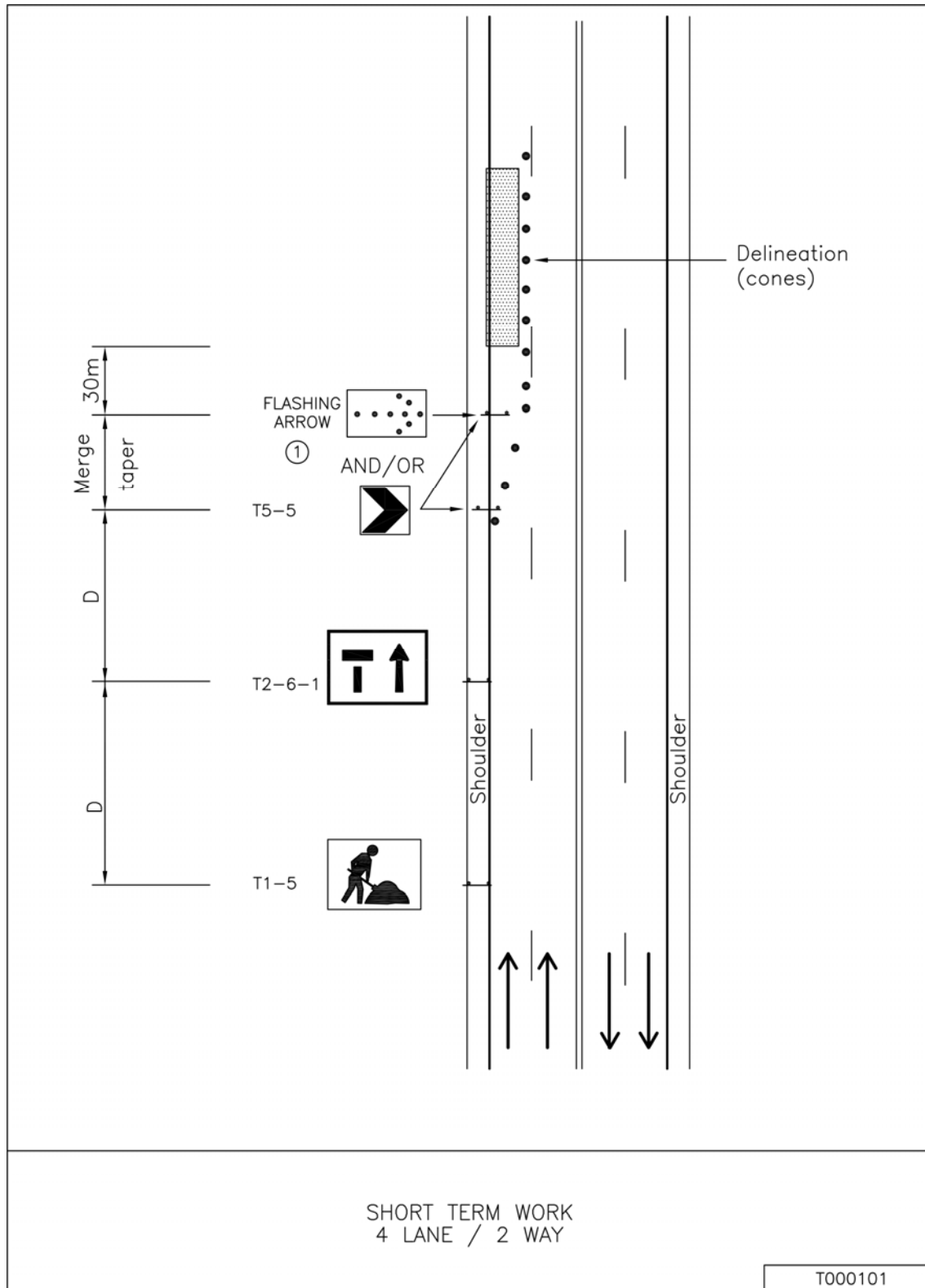


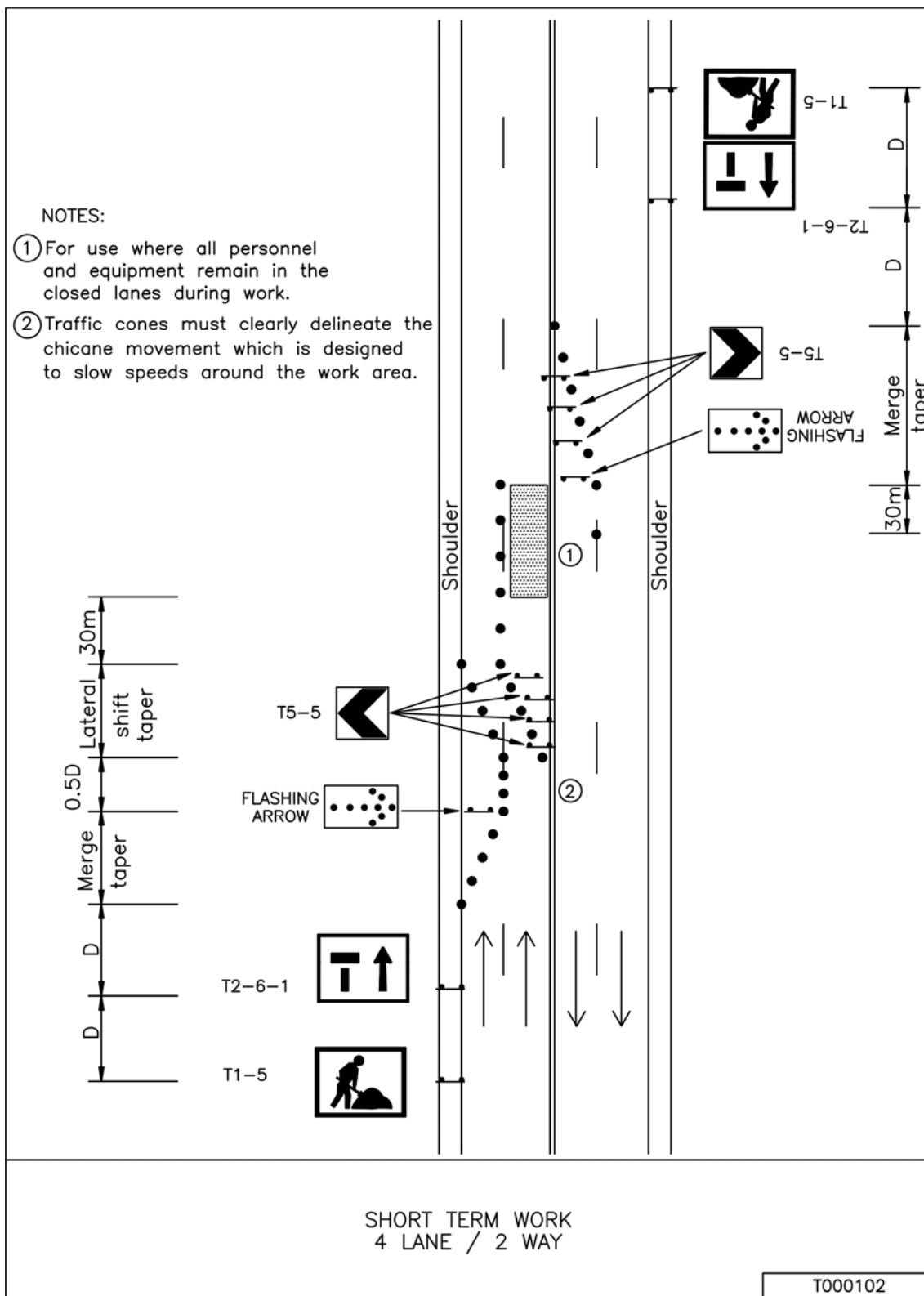


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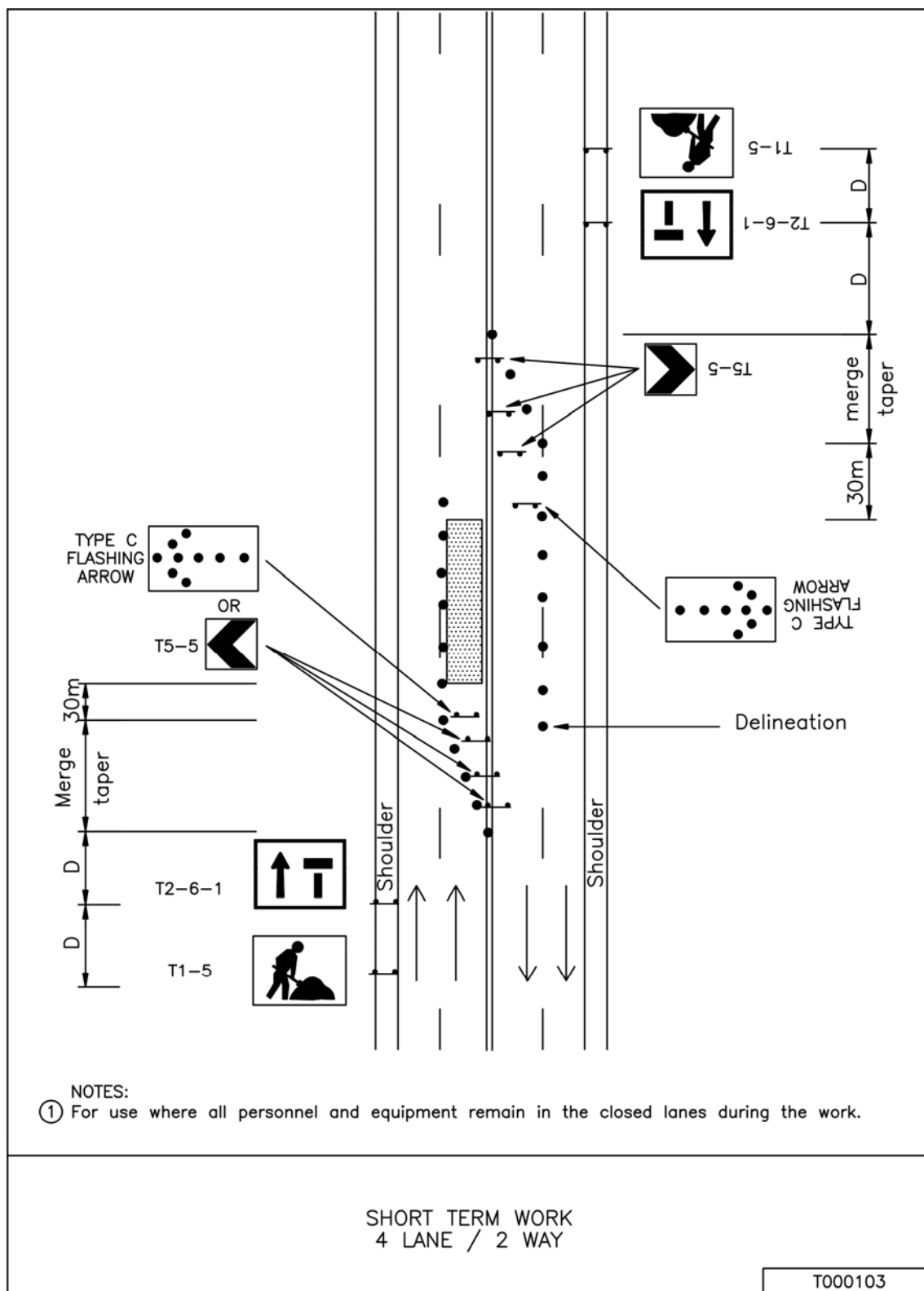


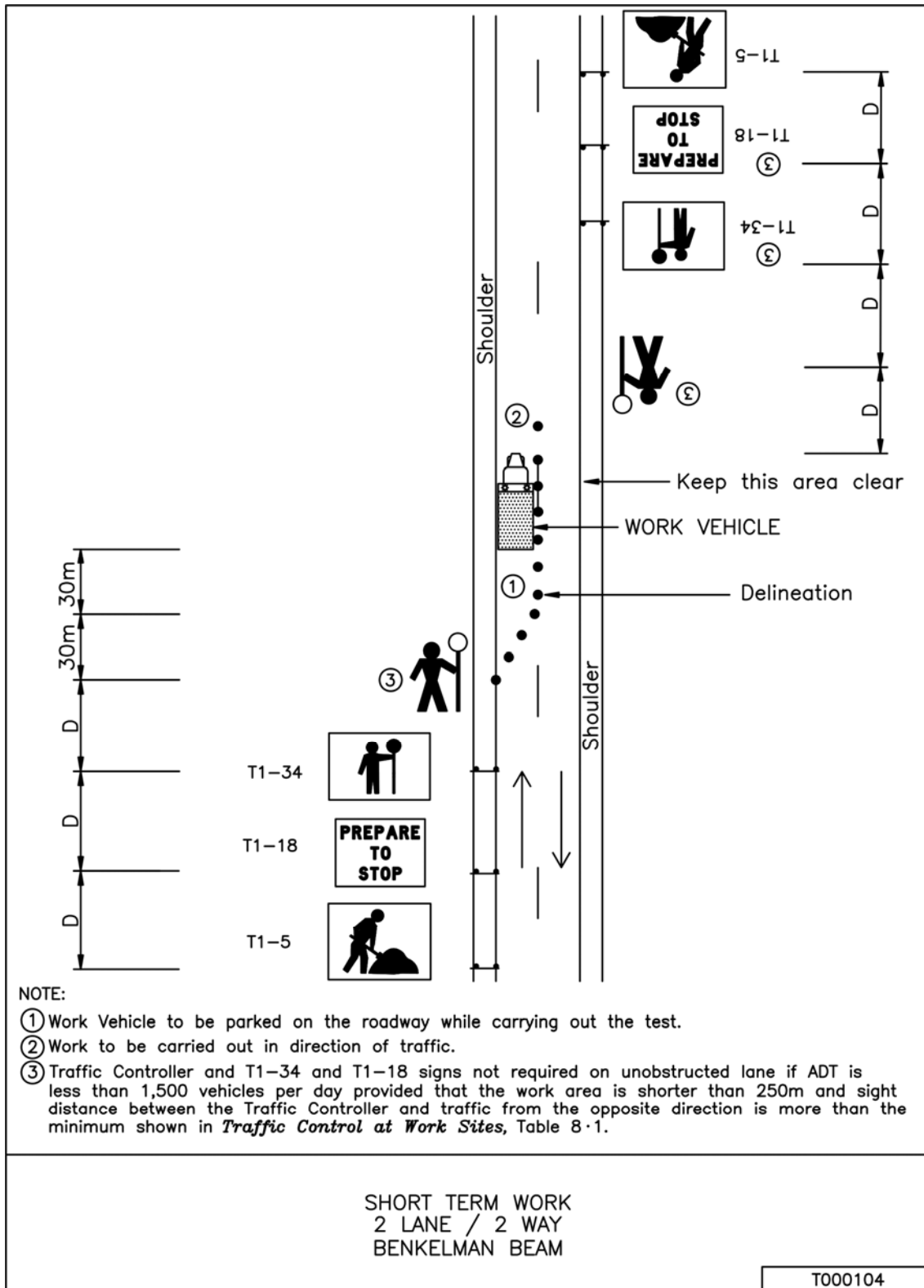


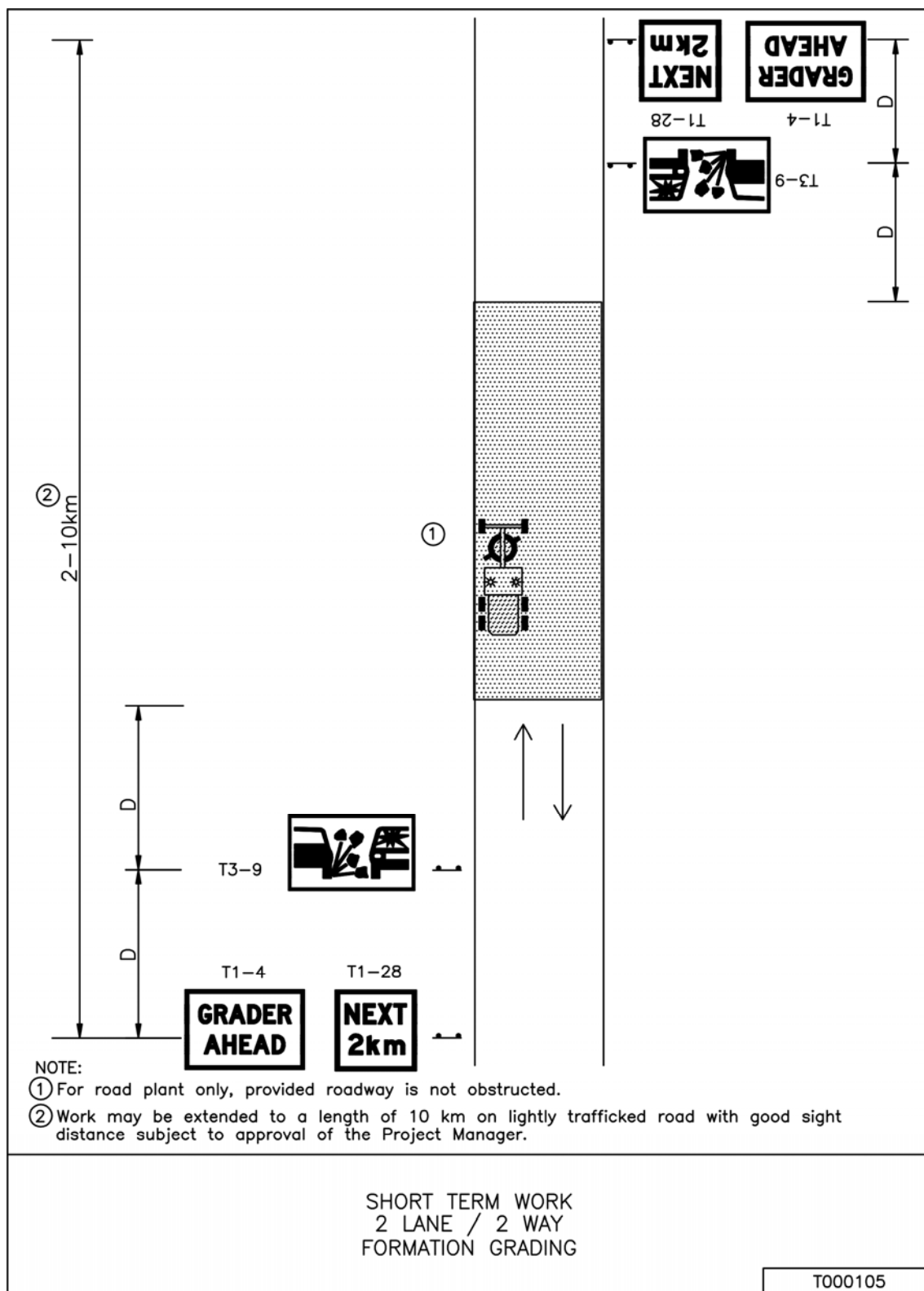


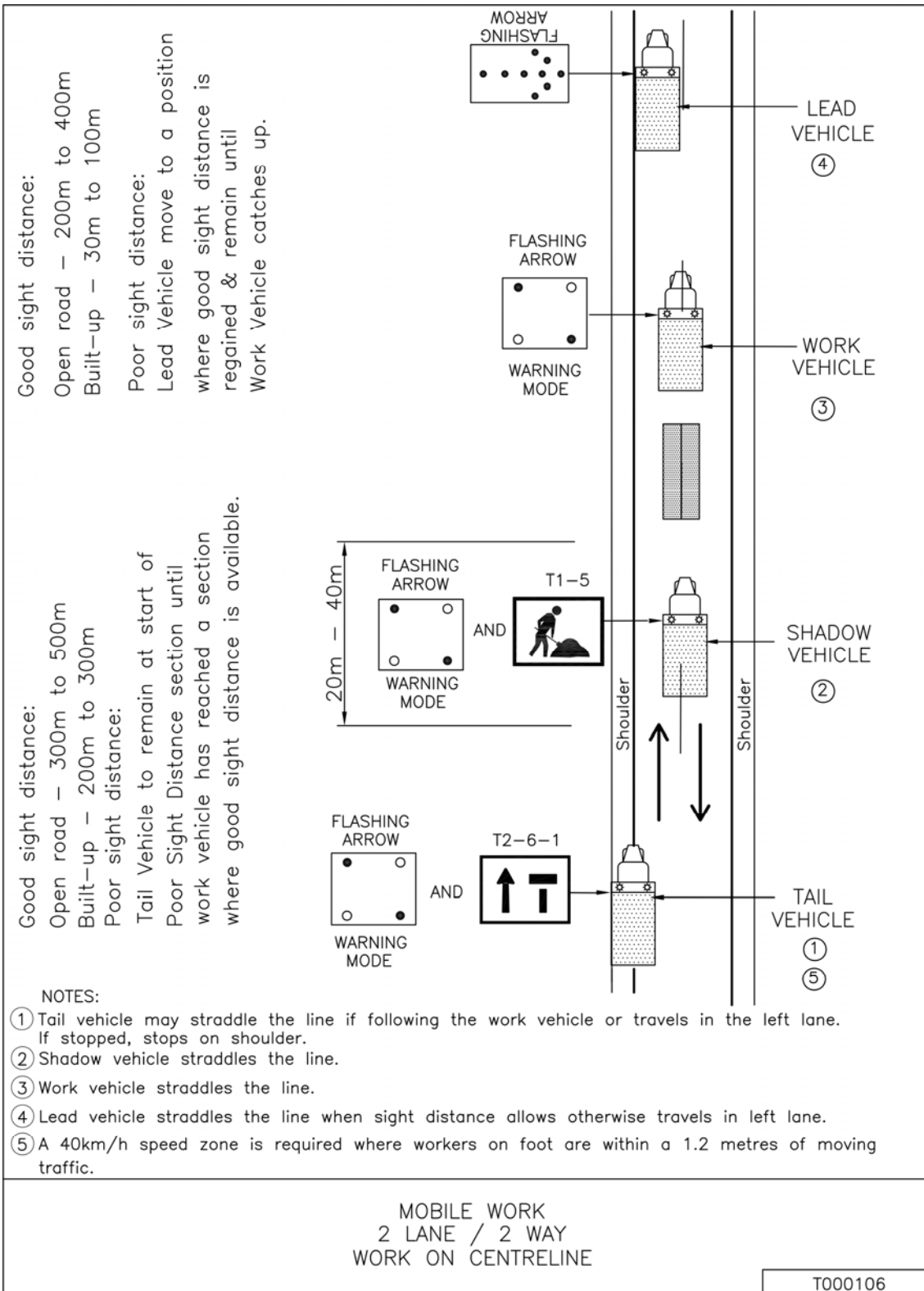


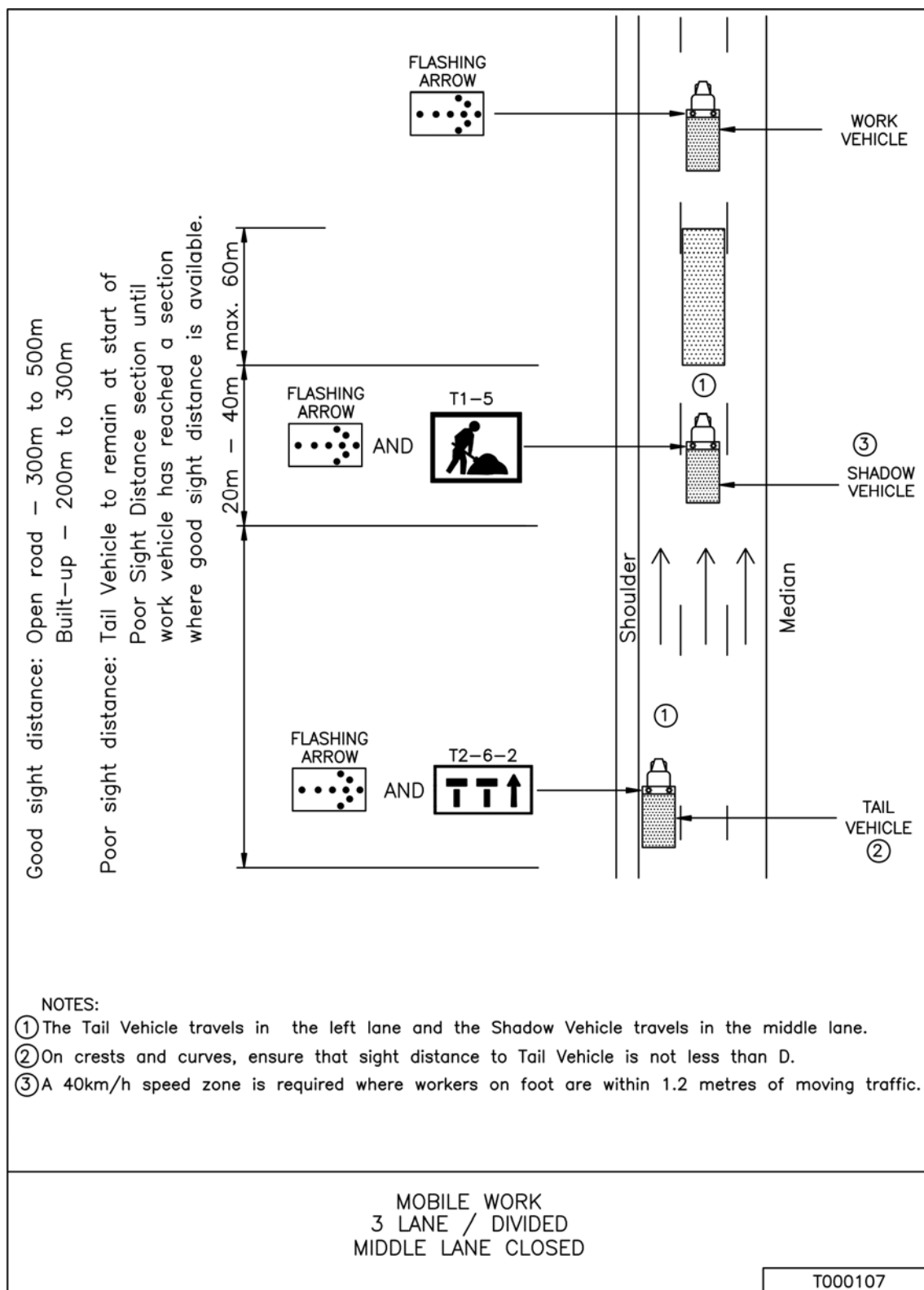
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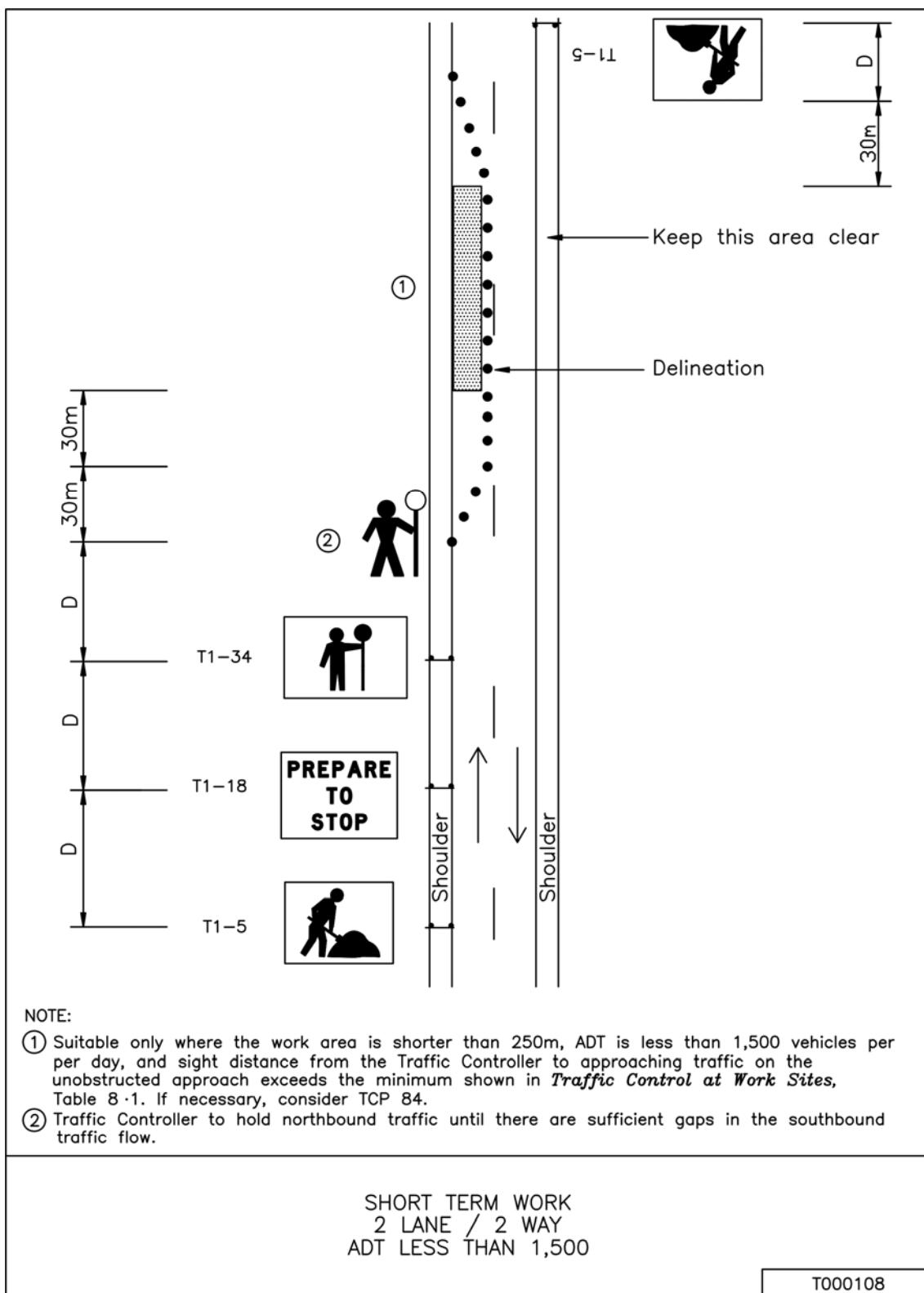




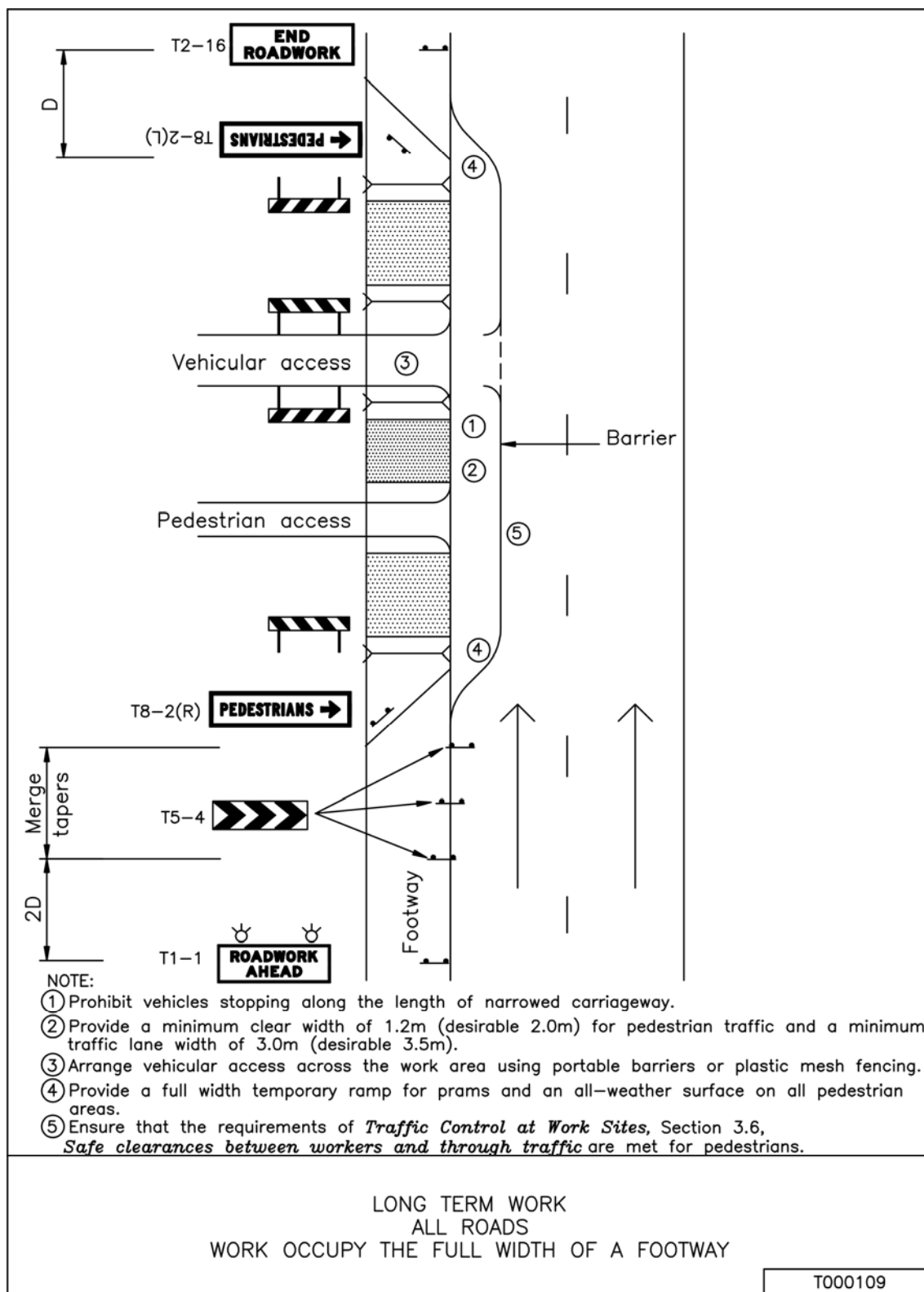


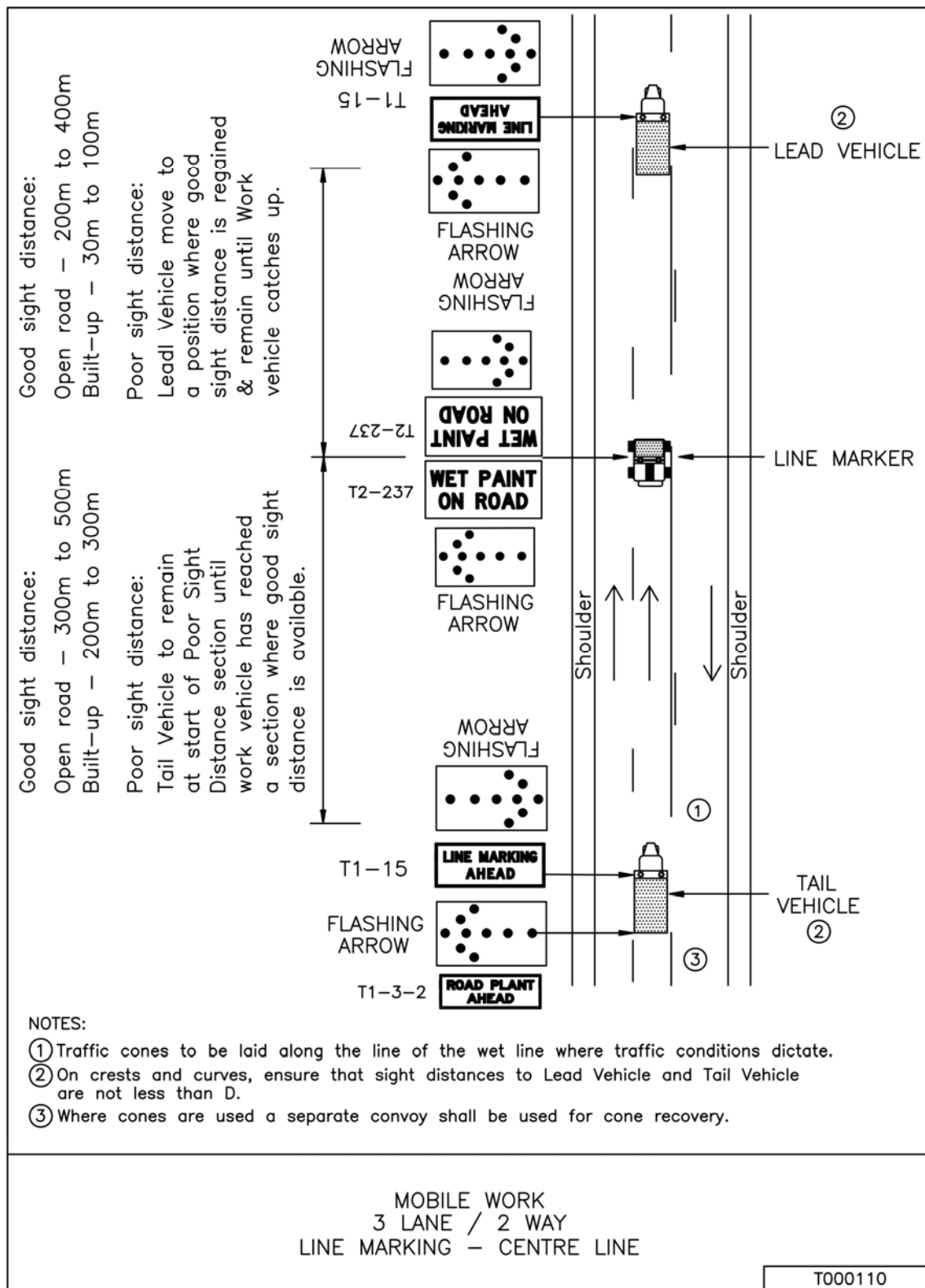






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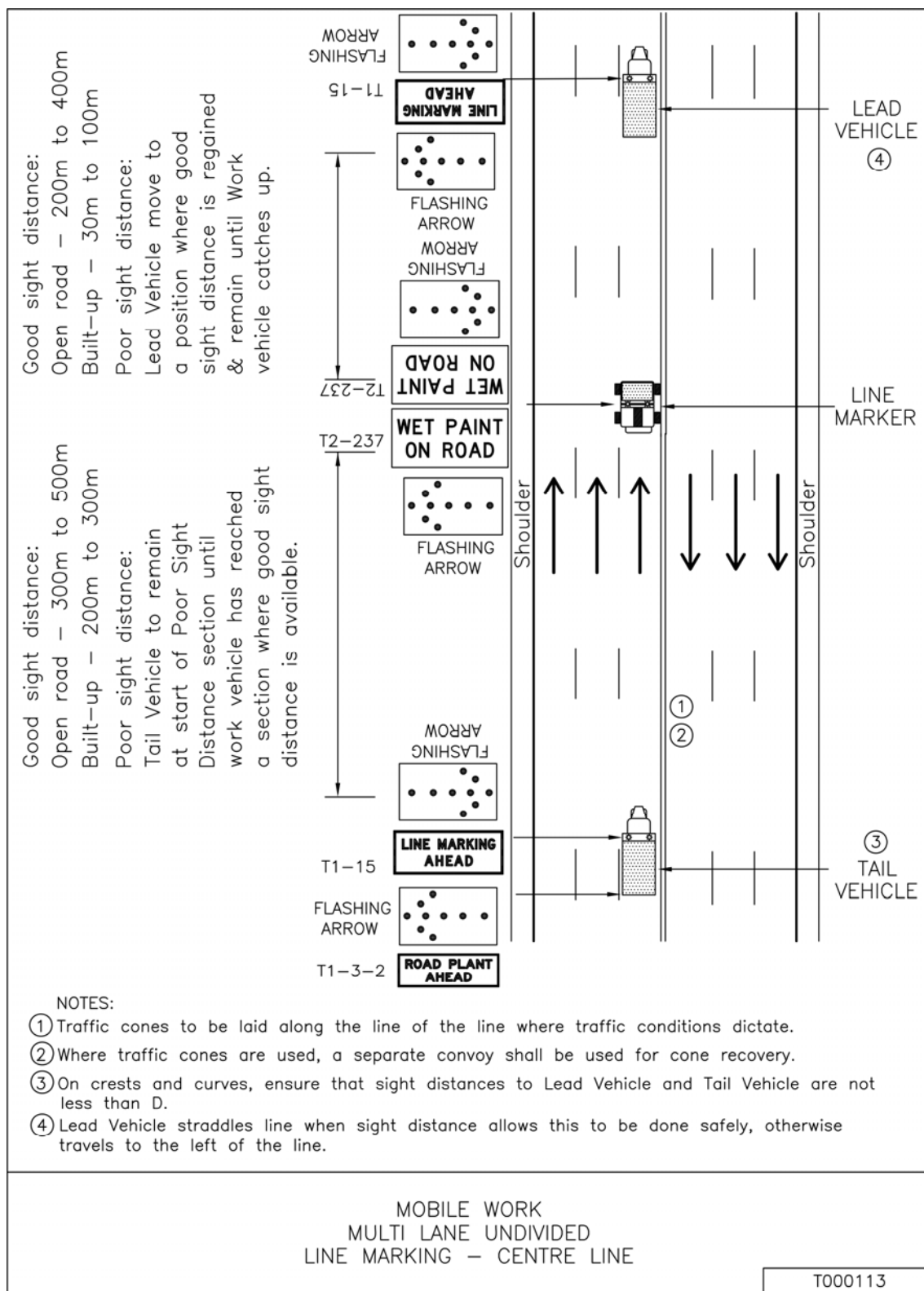


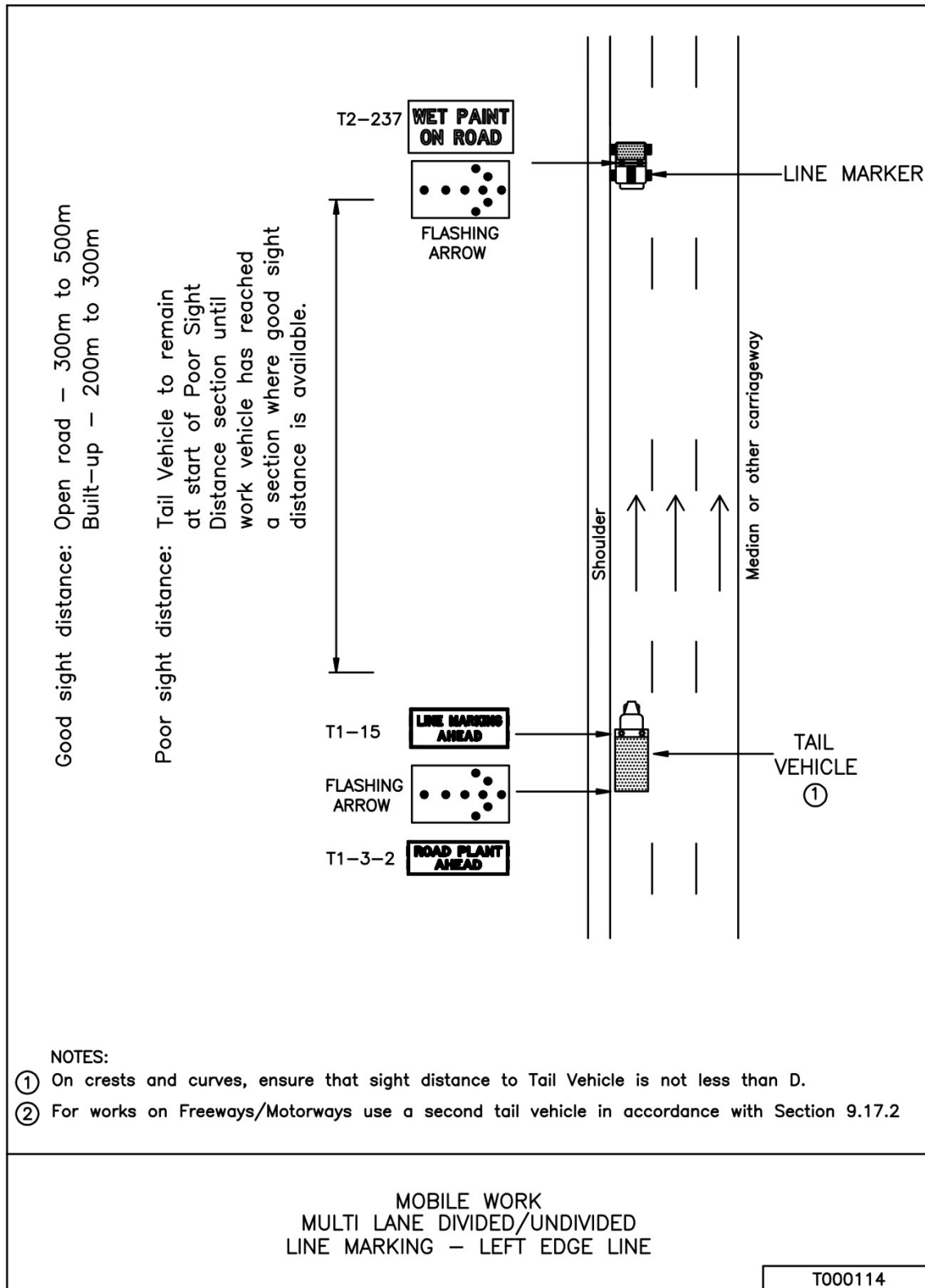


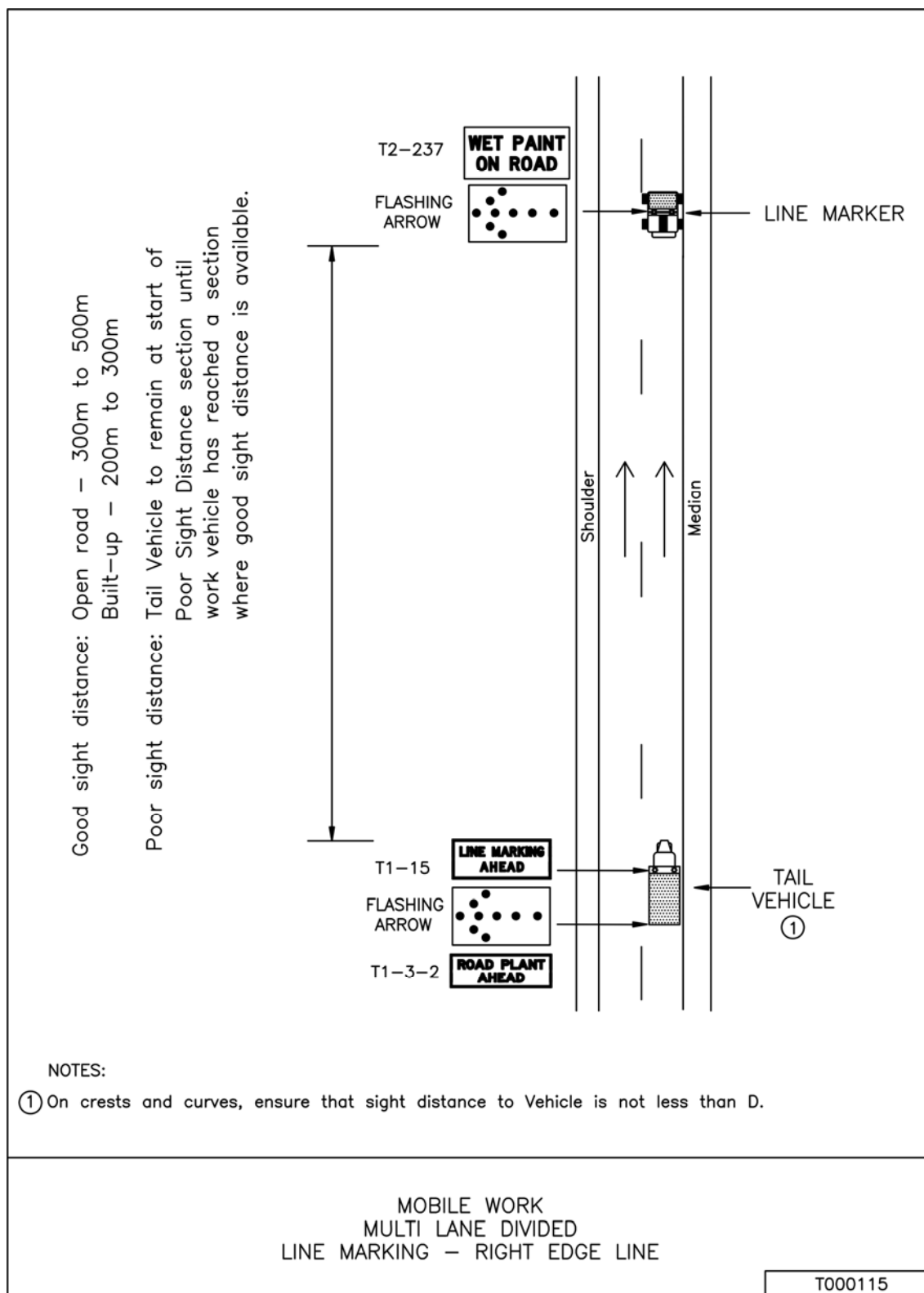


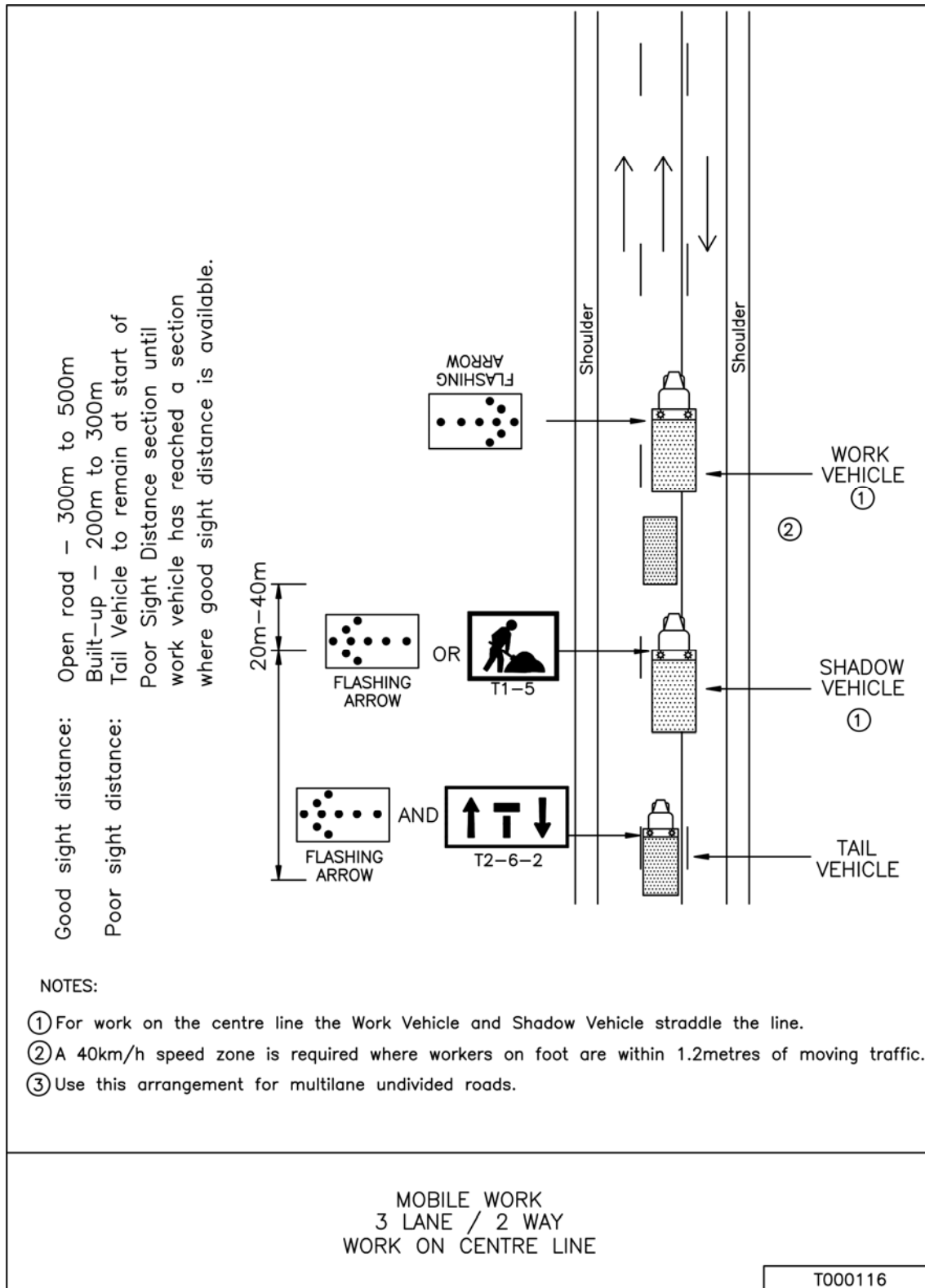


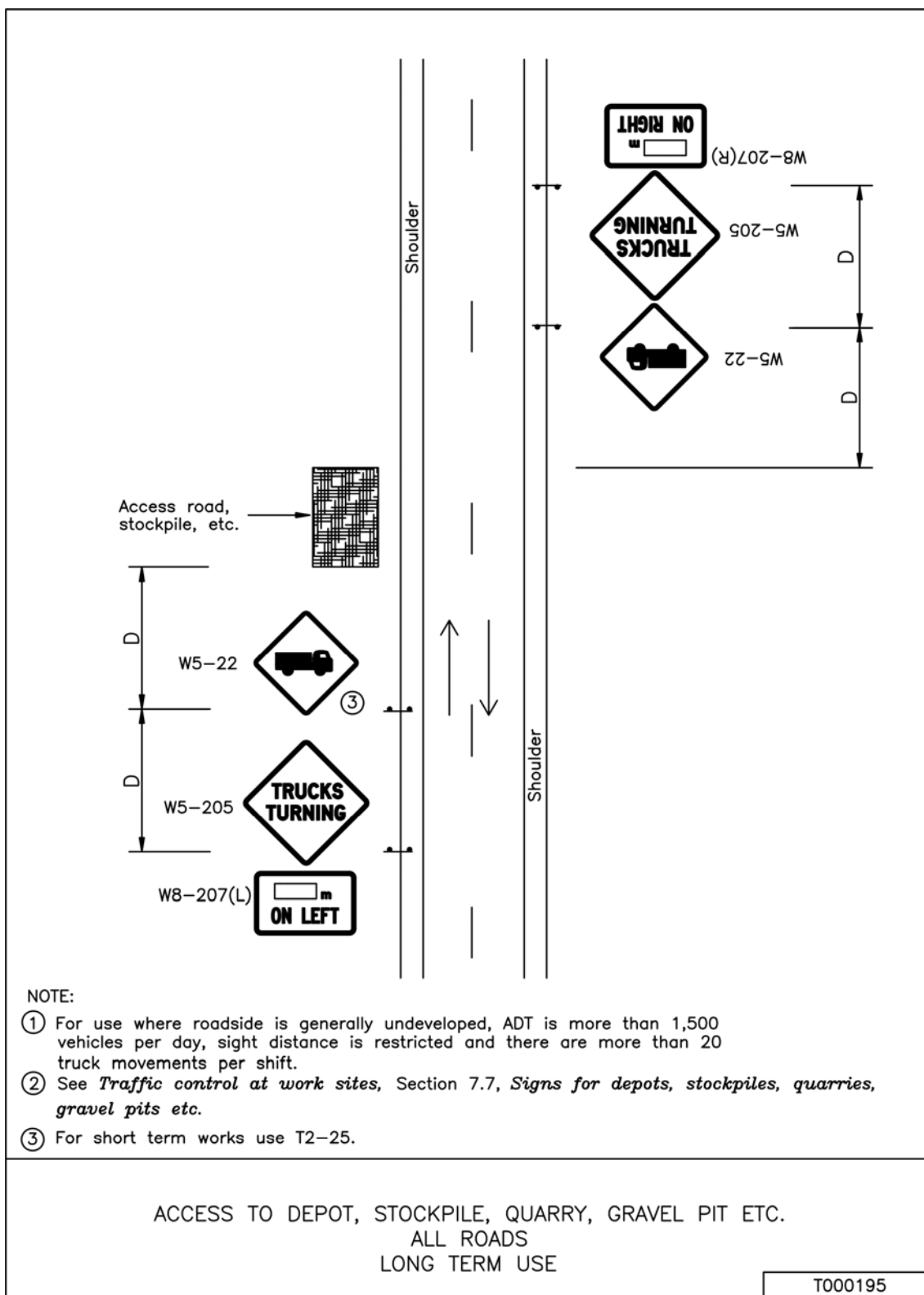
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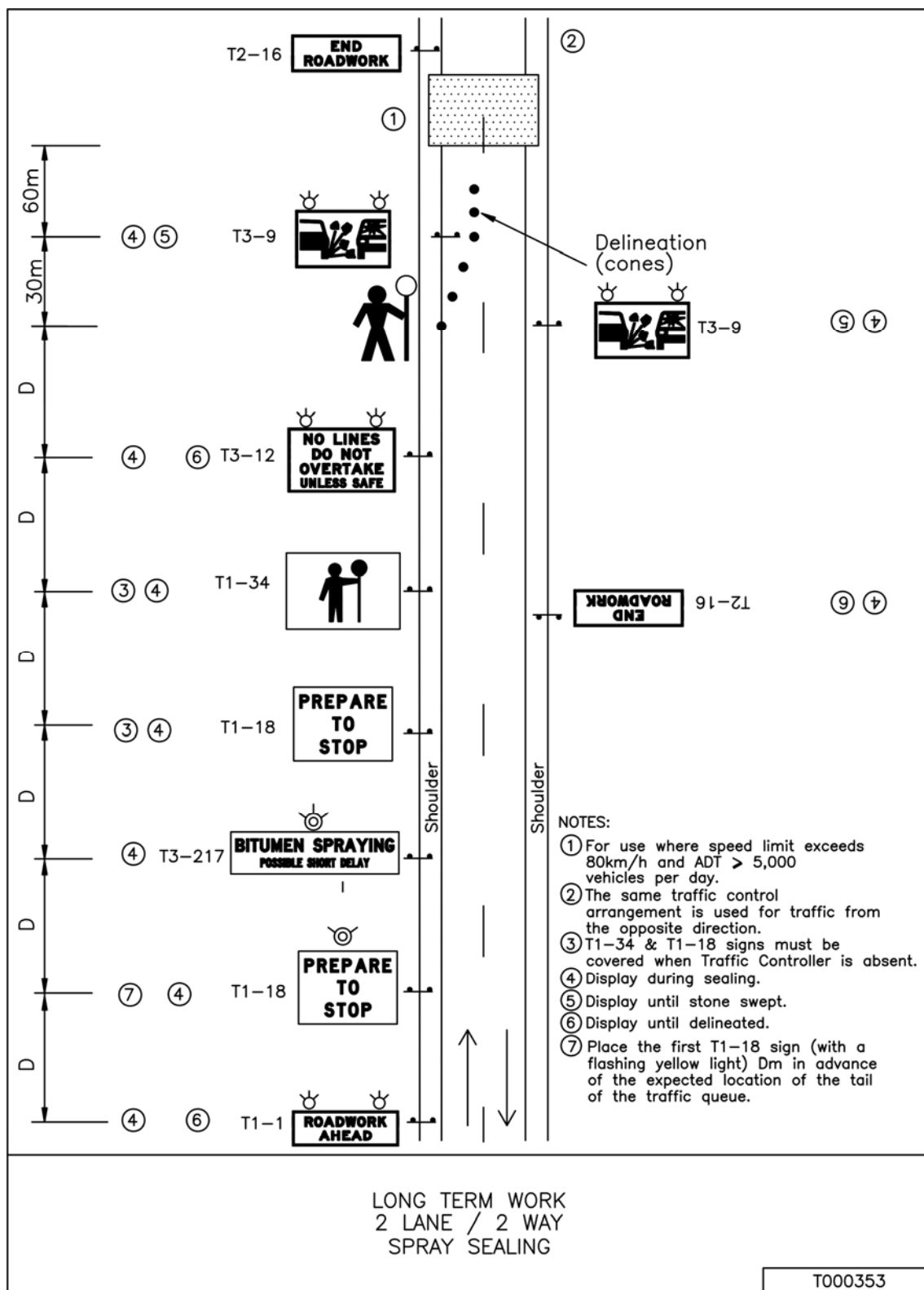






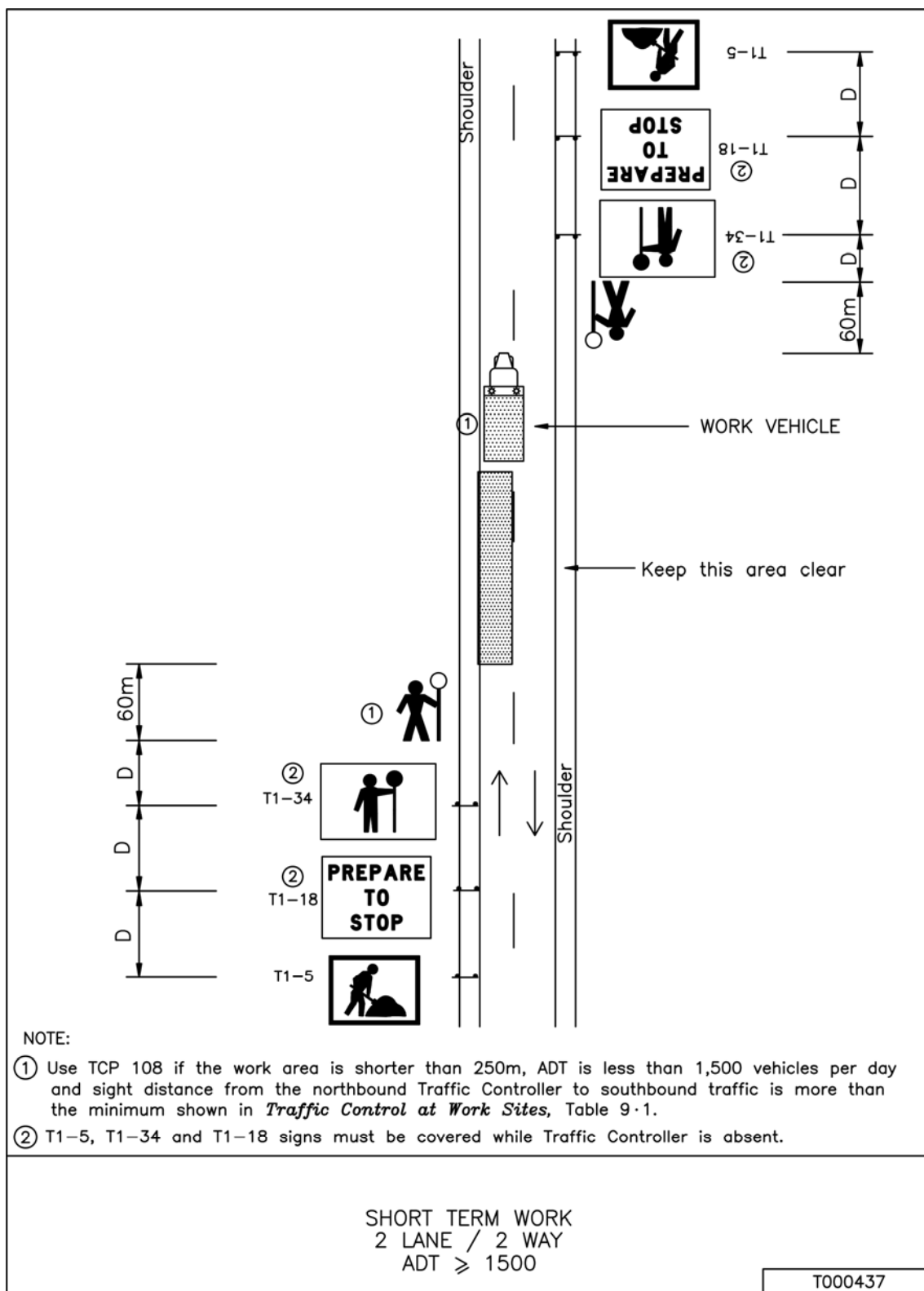


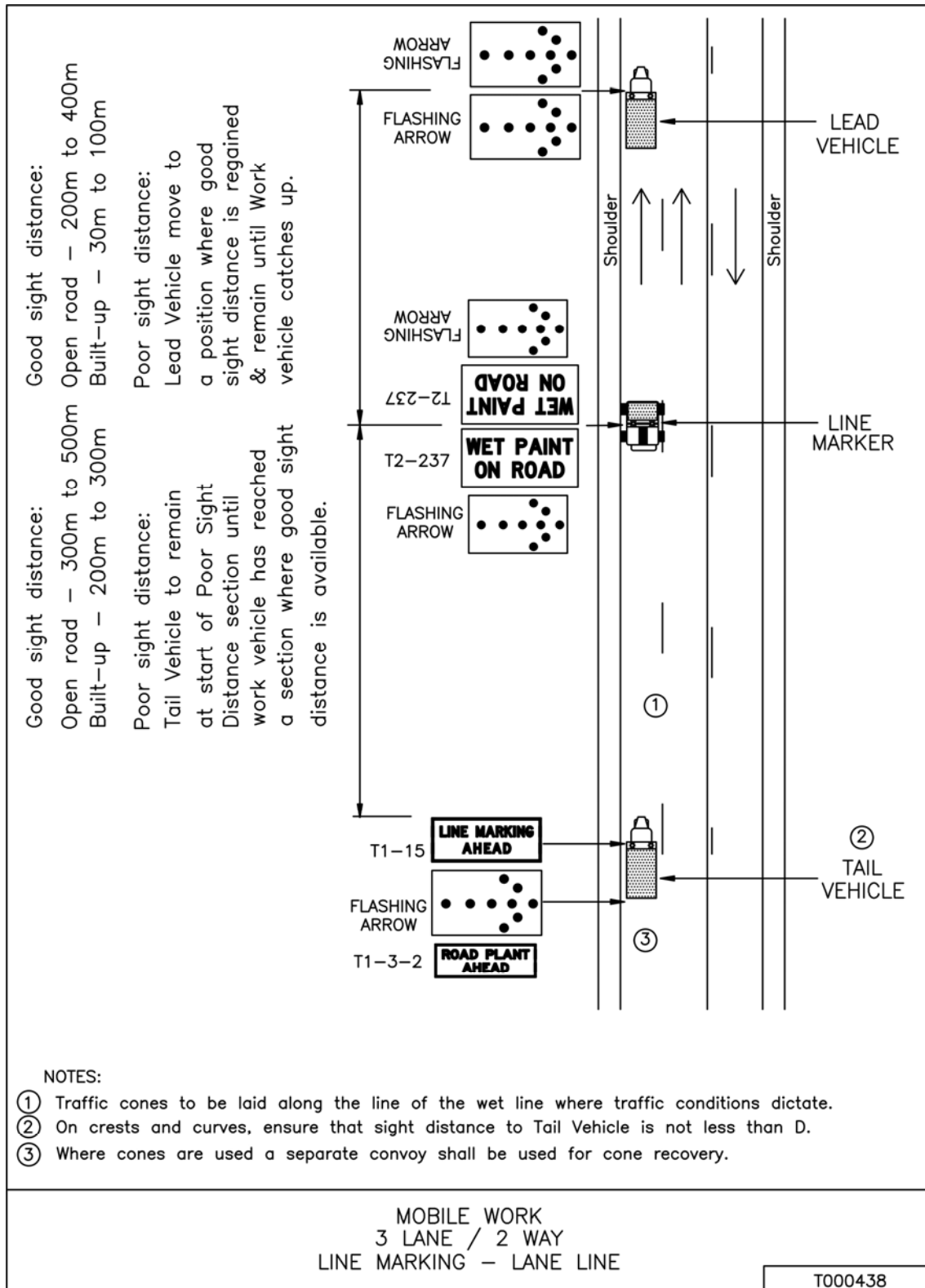
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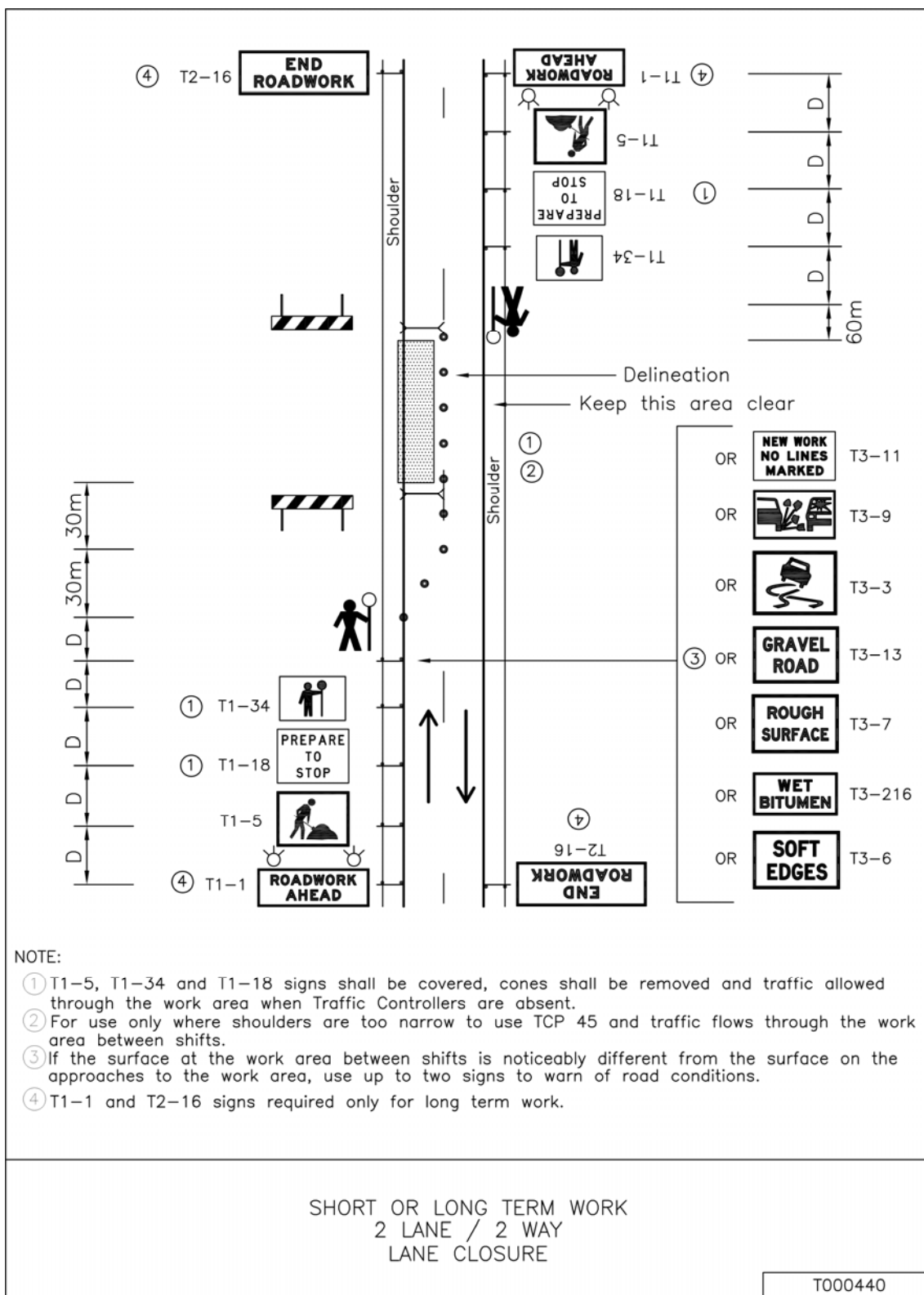


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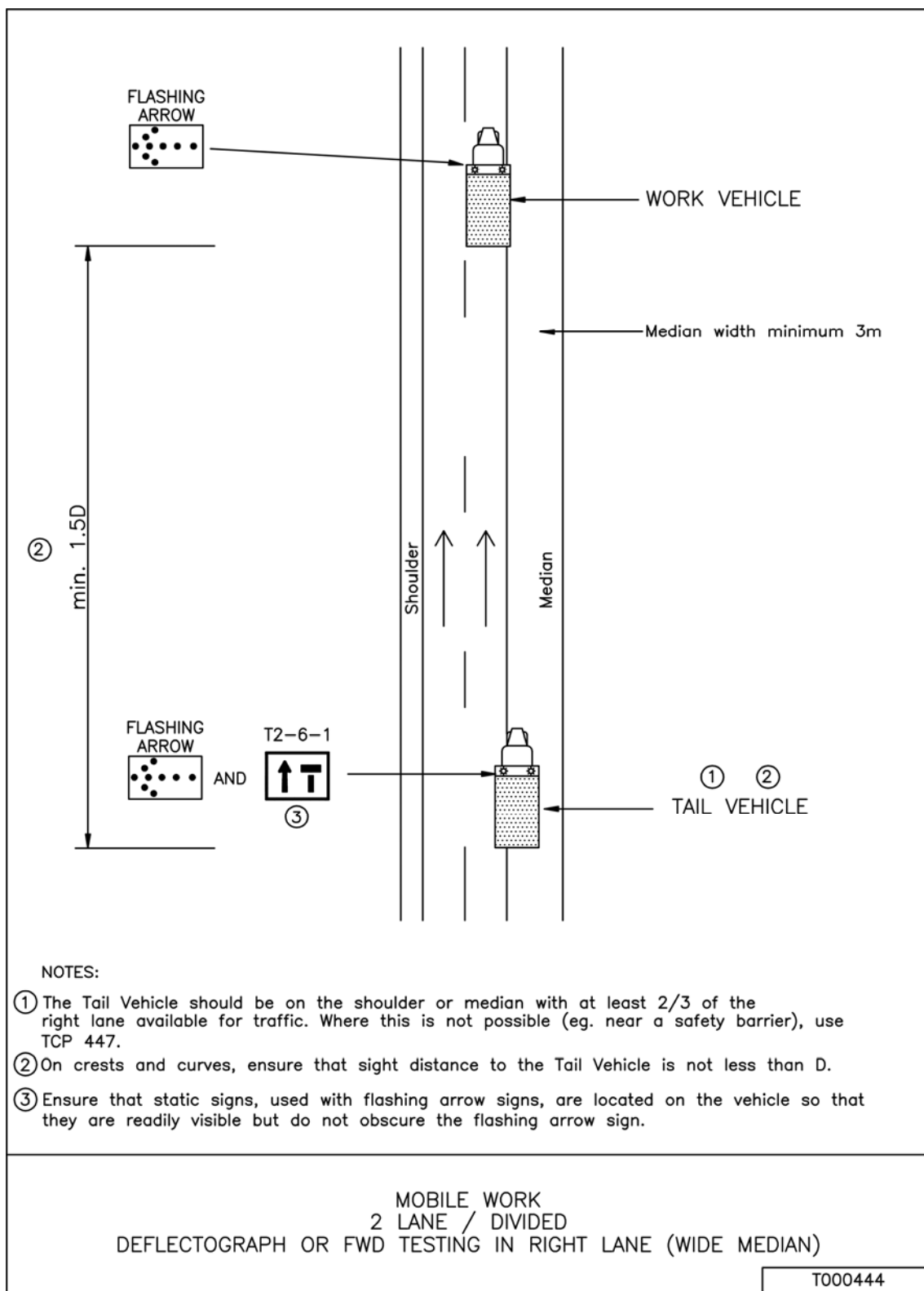




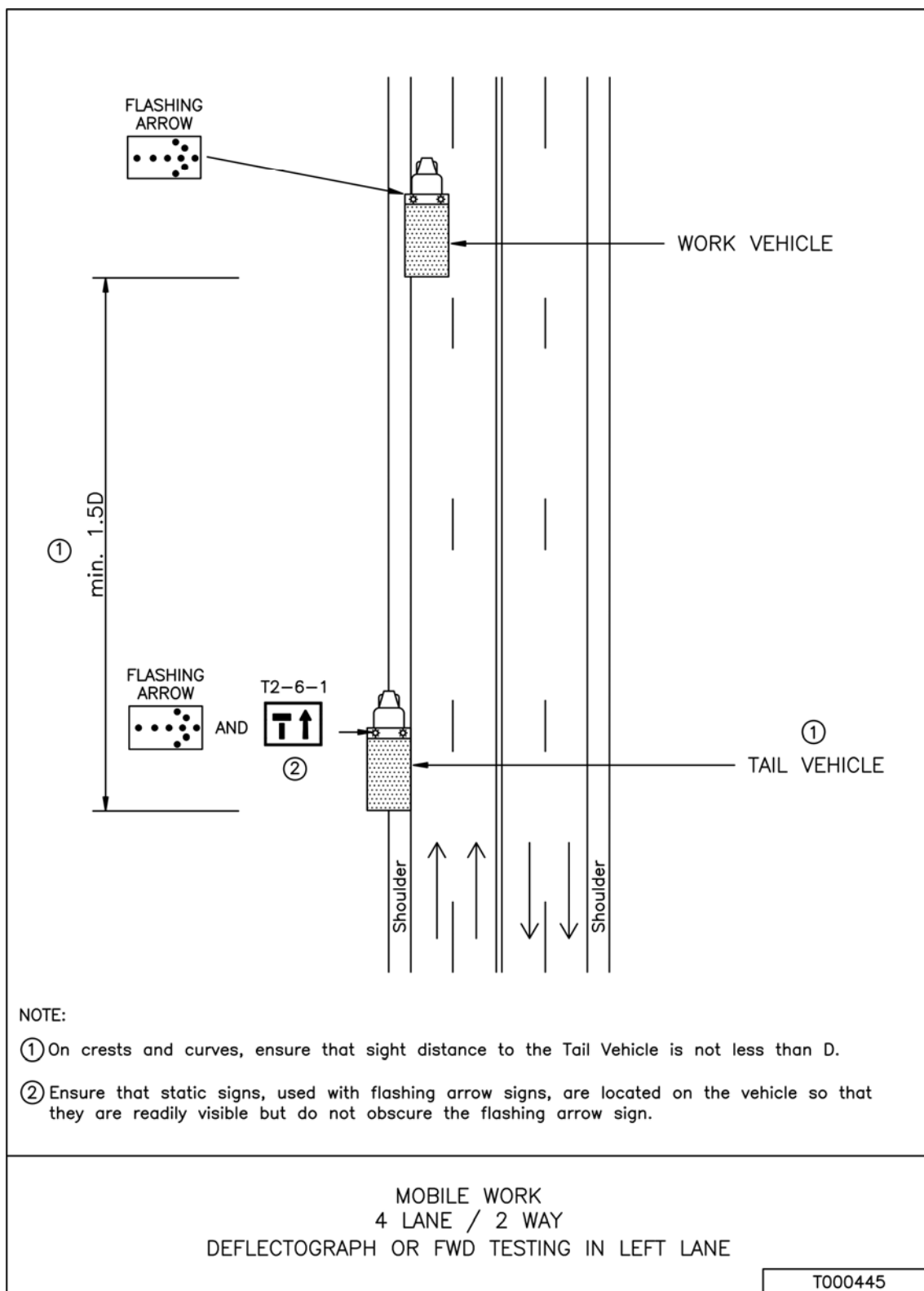


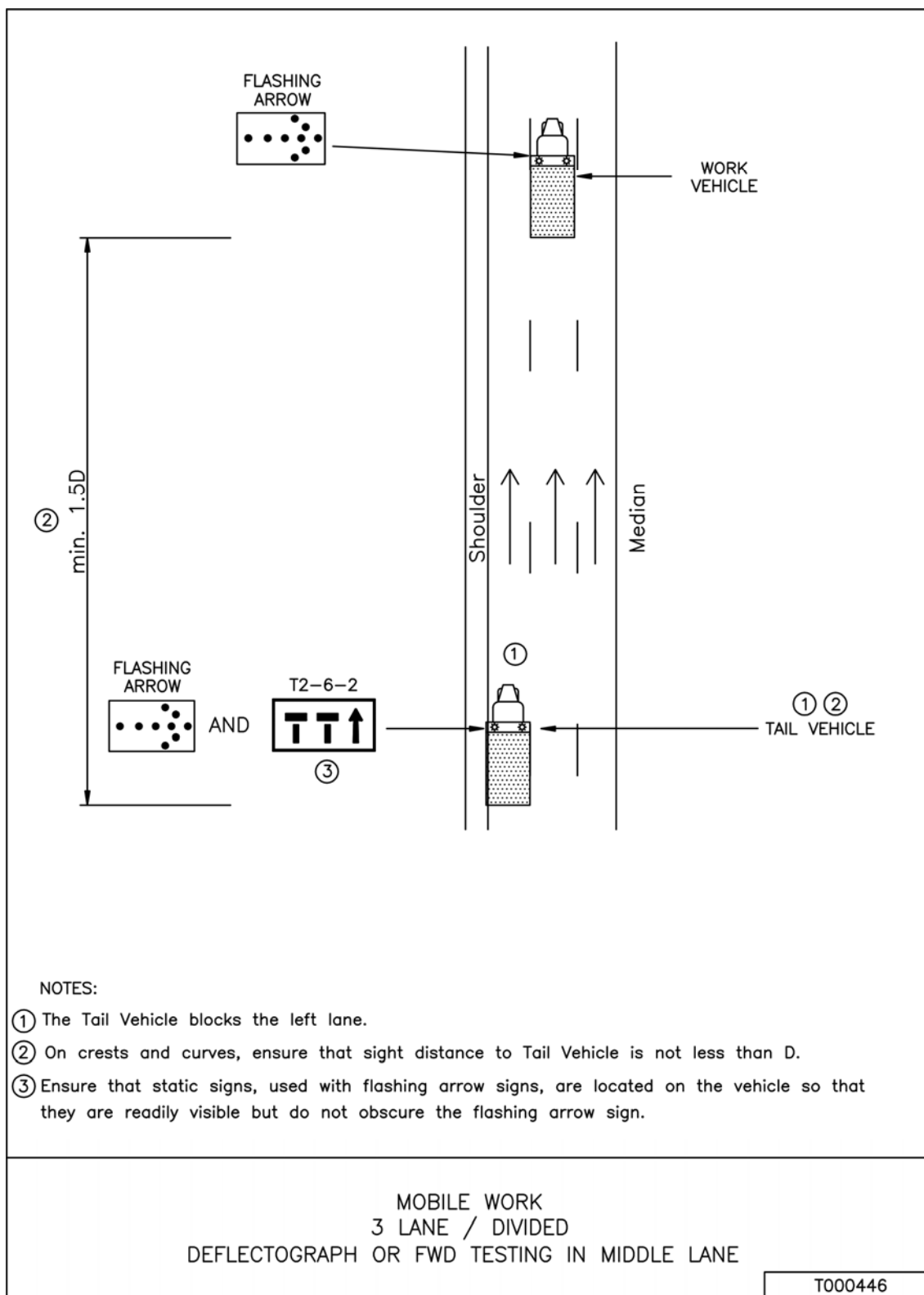


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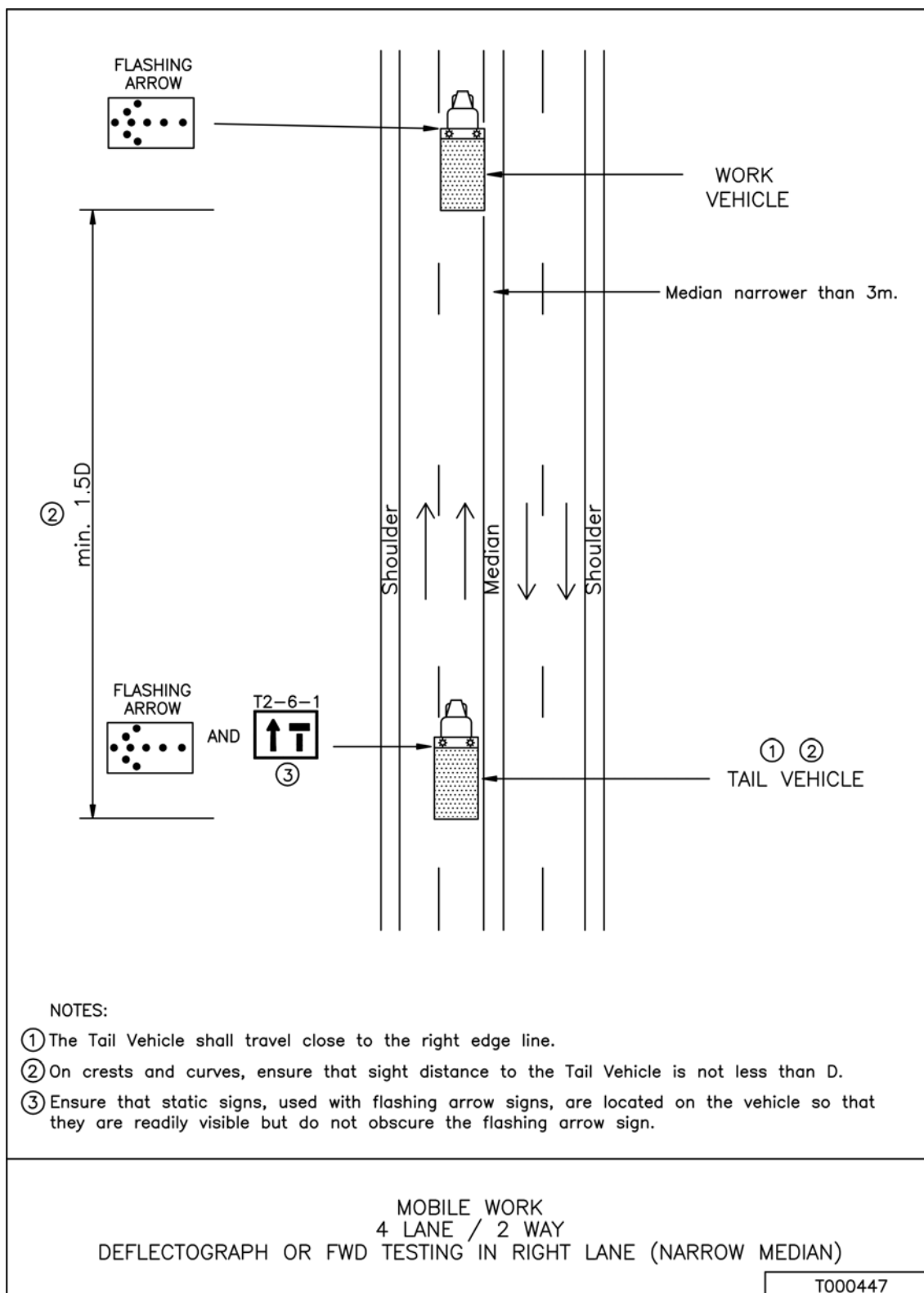


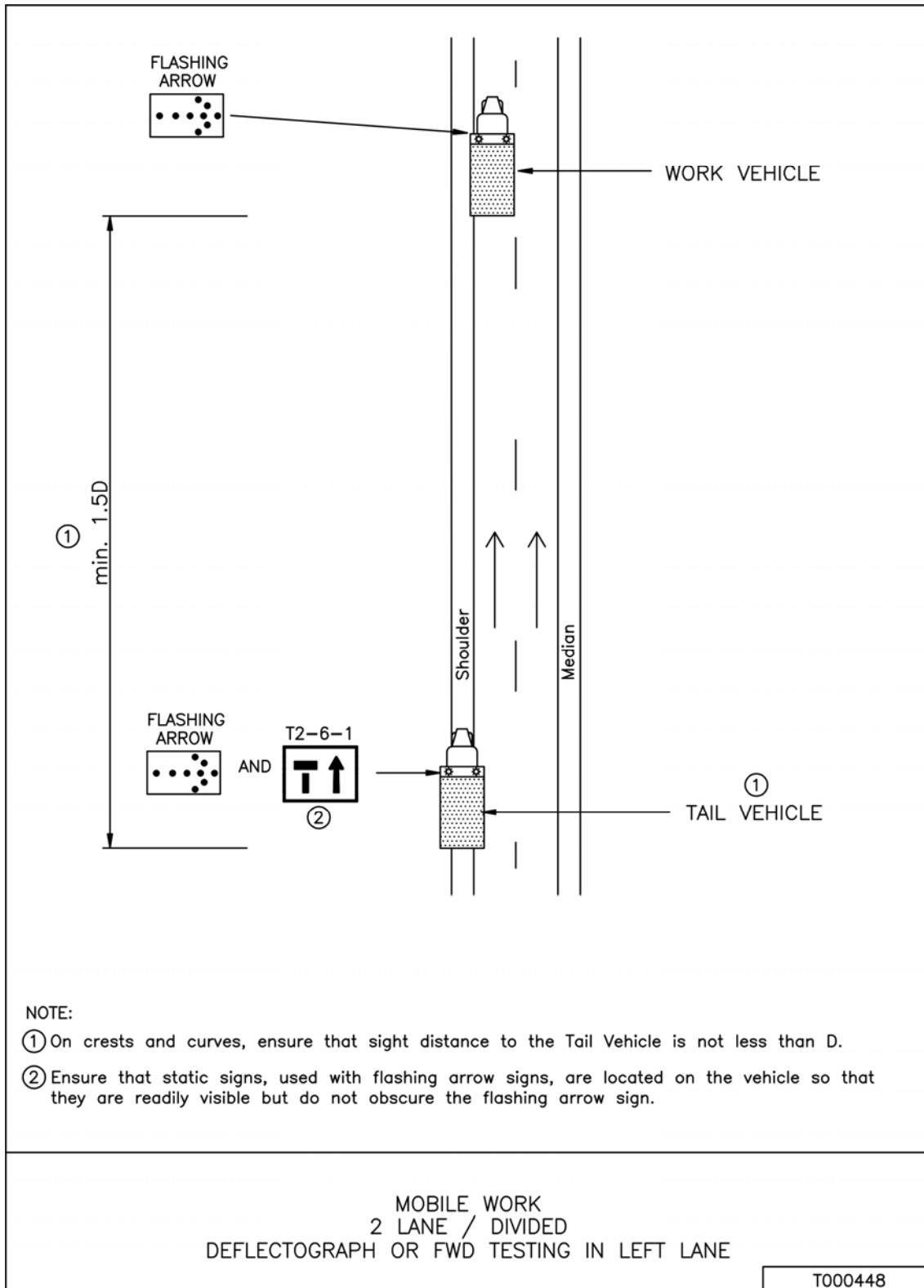
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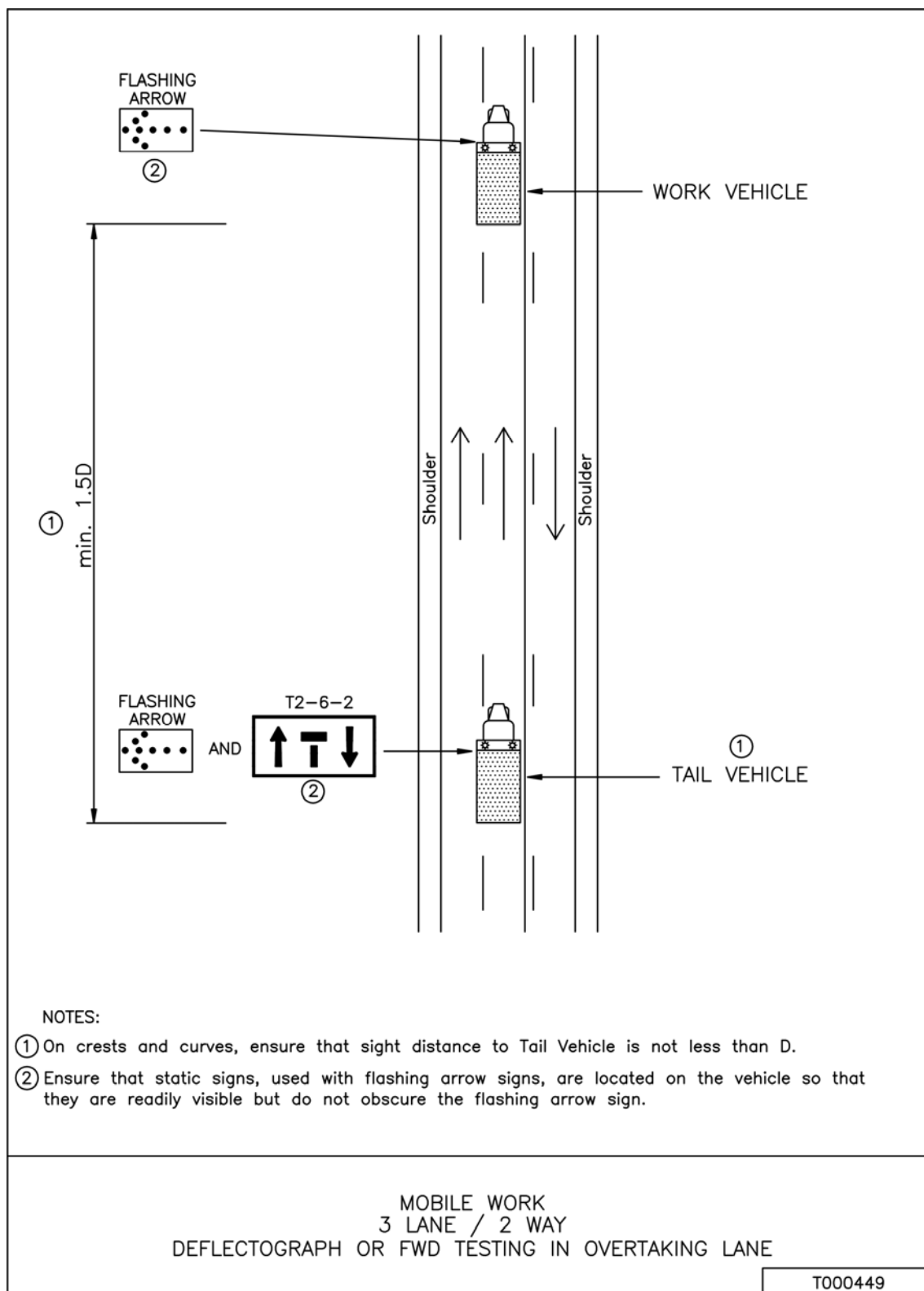


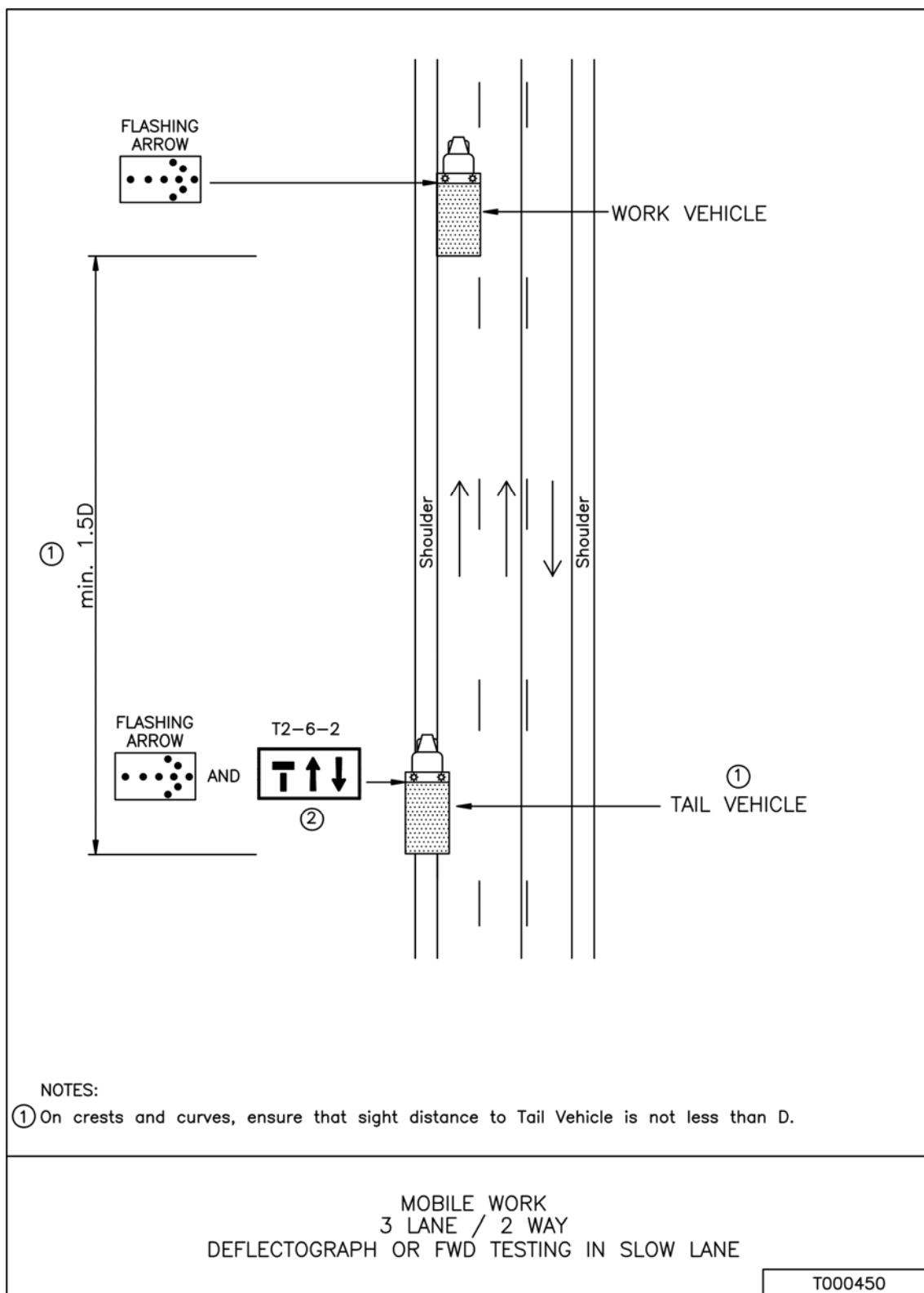


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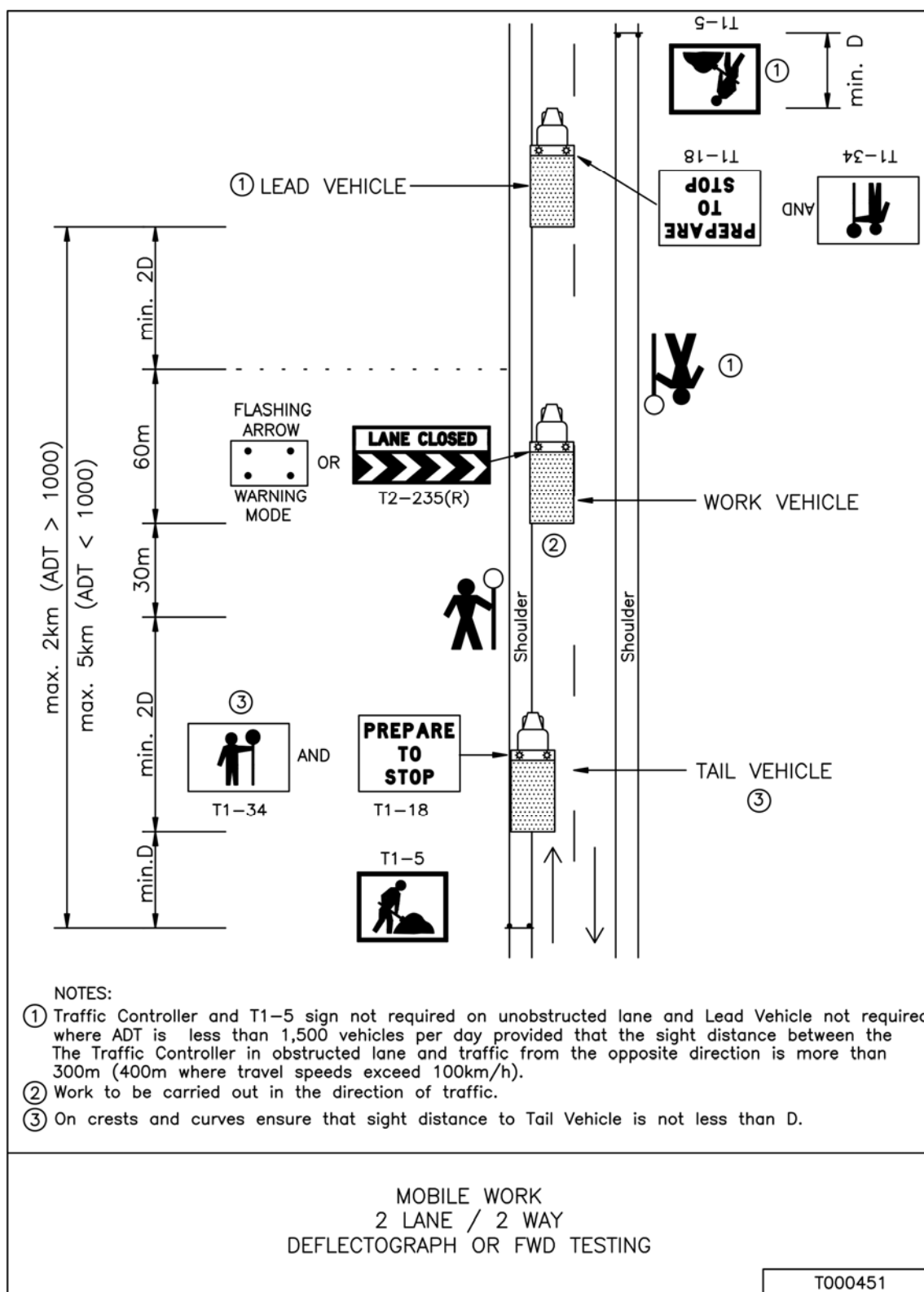


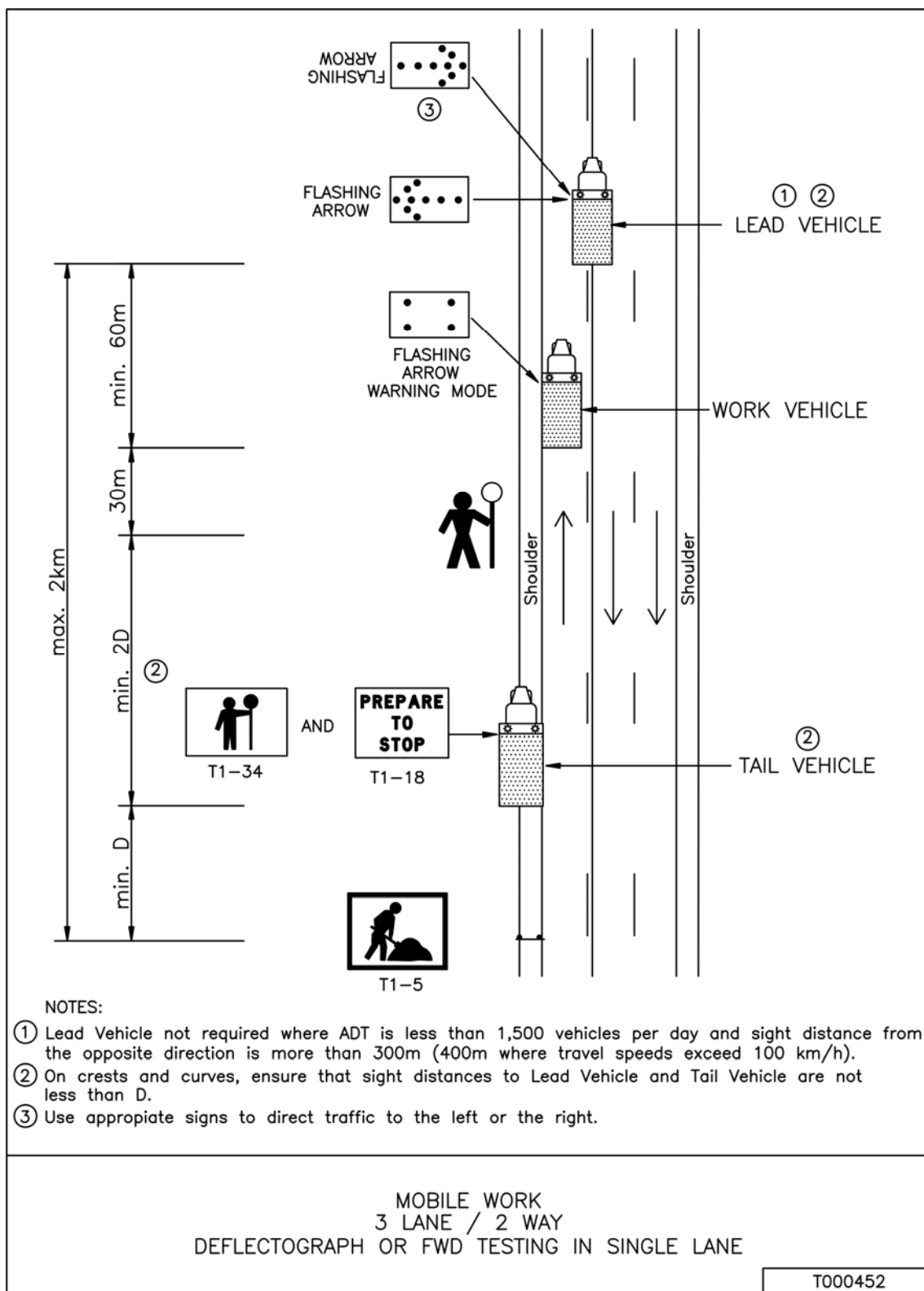


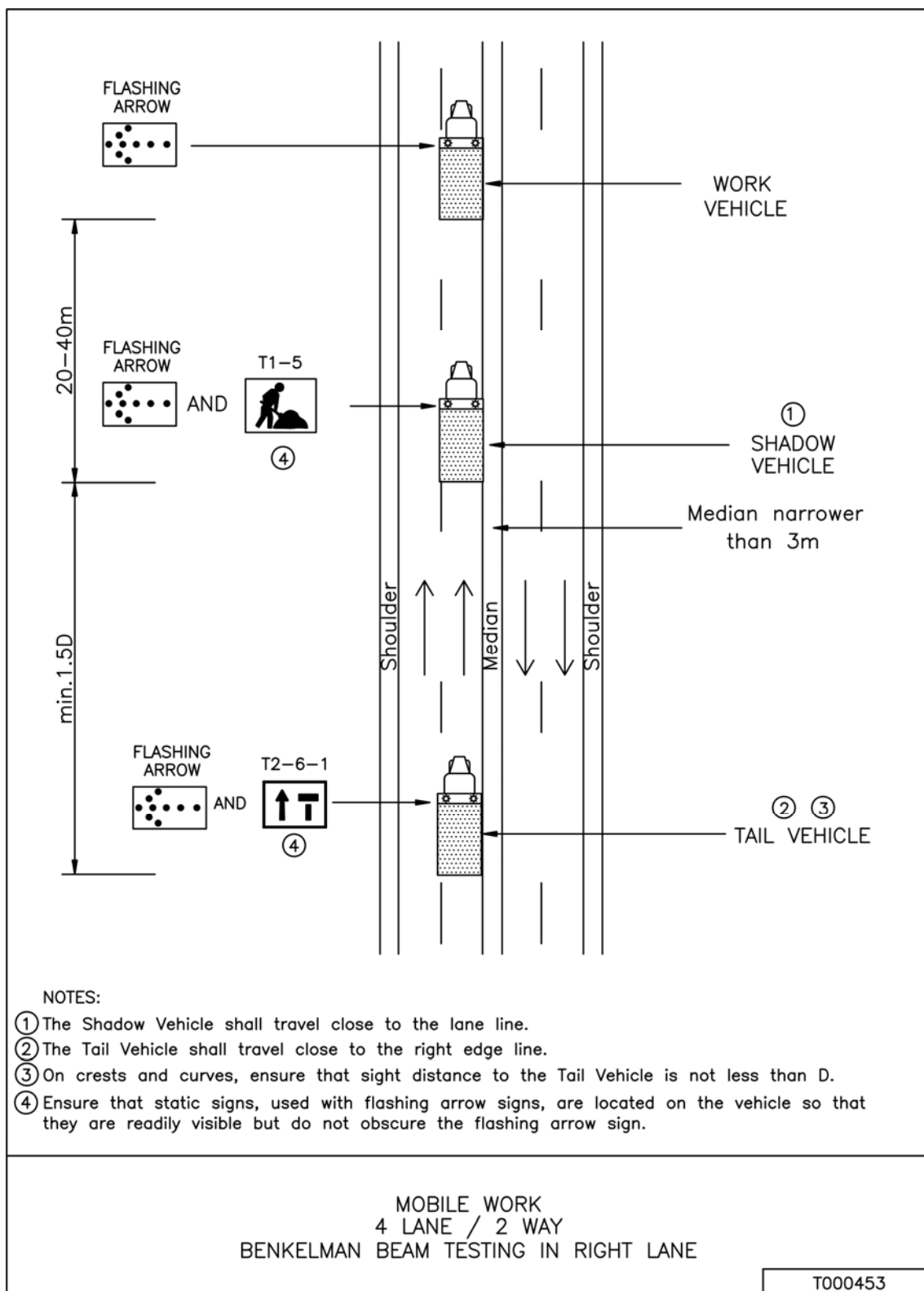




TCP 450

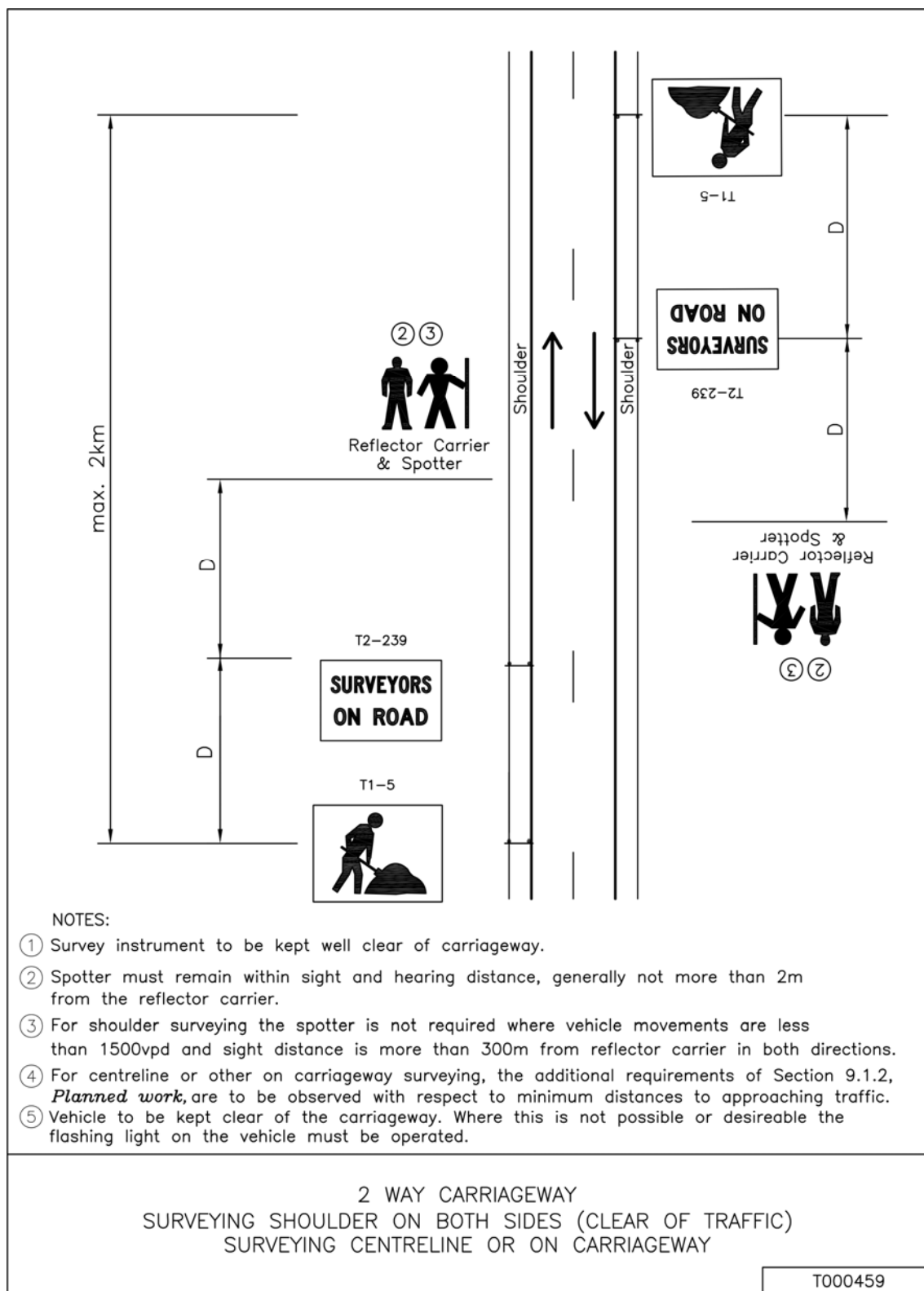






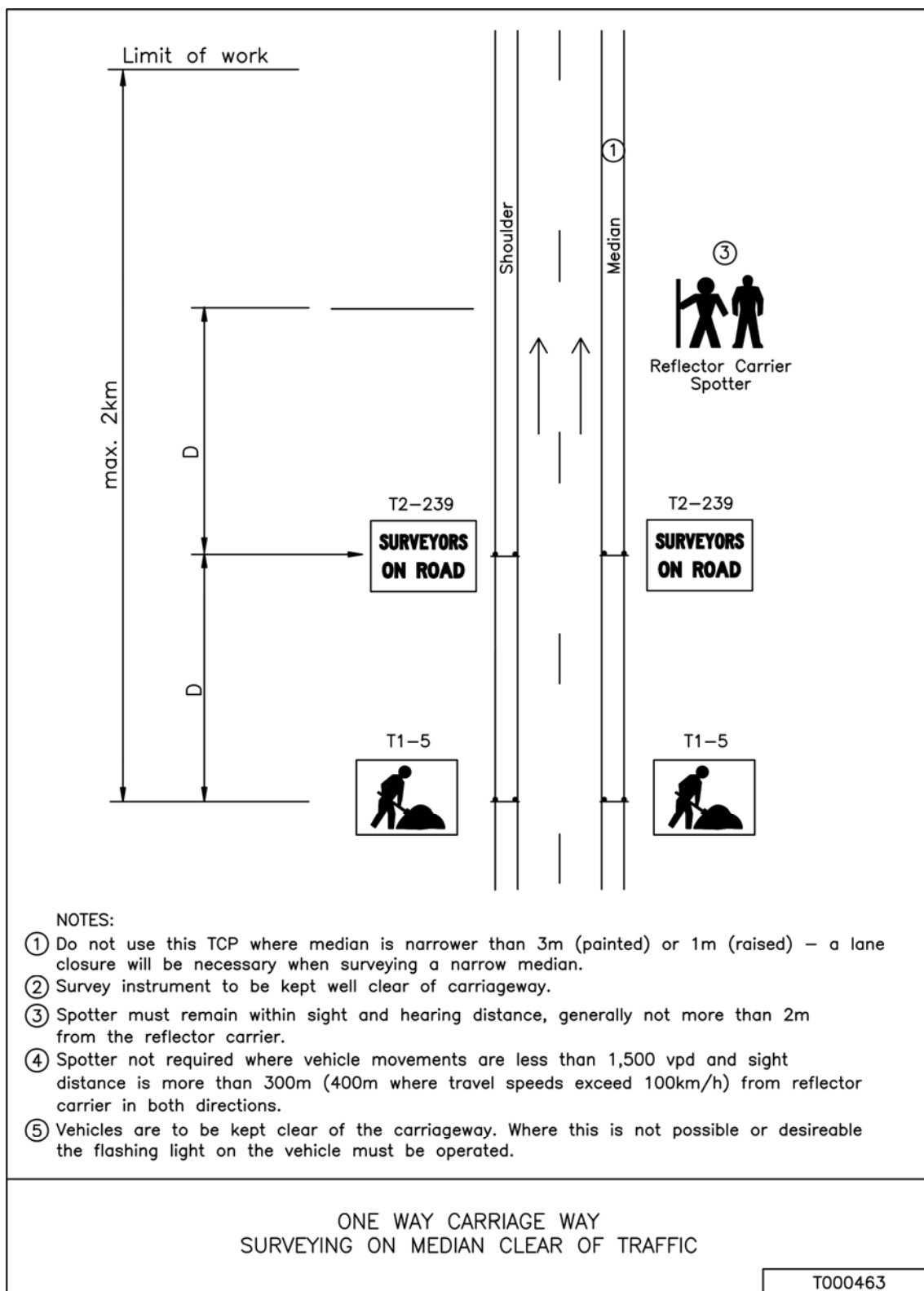


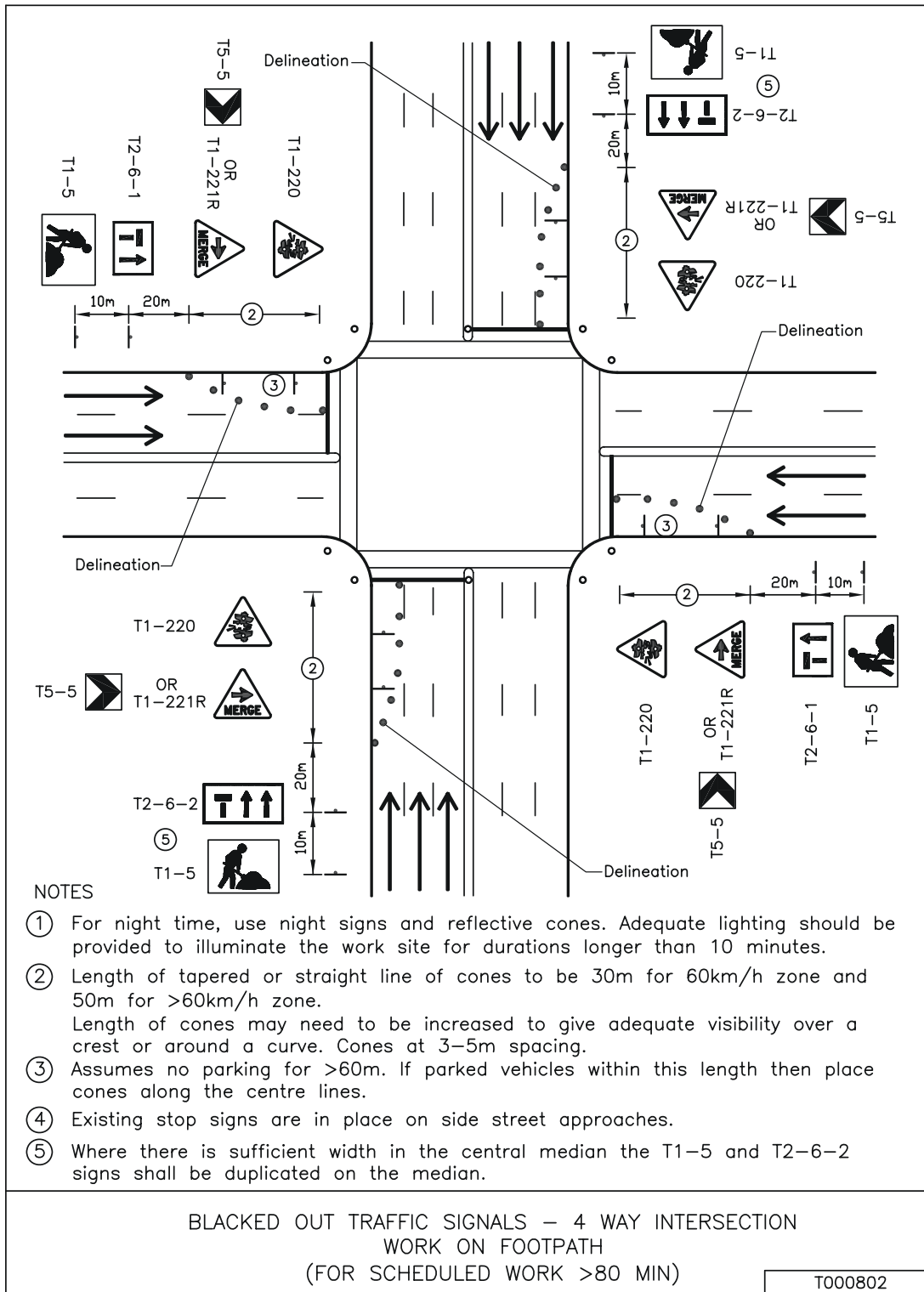
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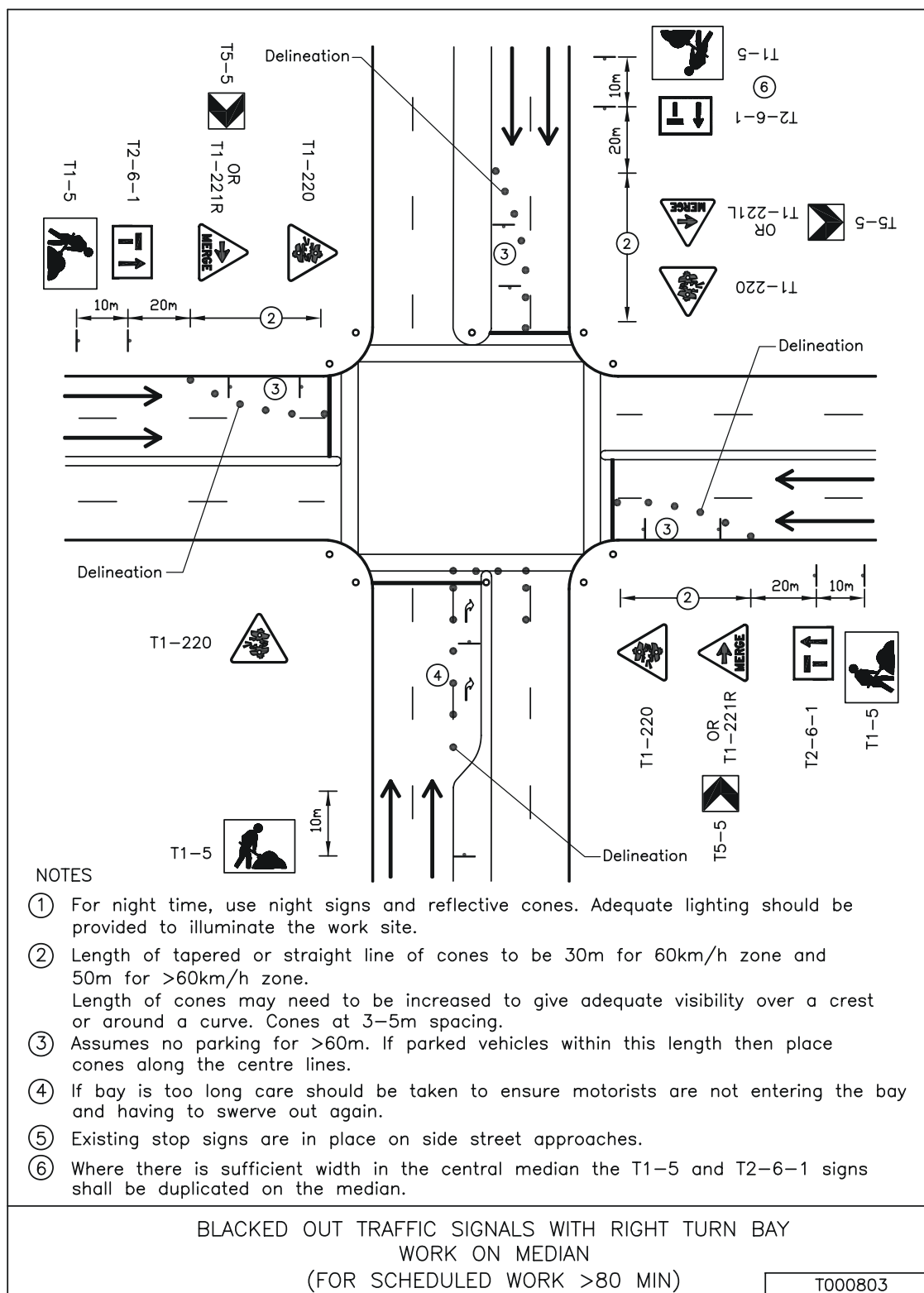




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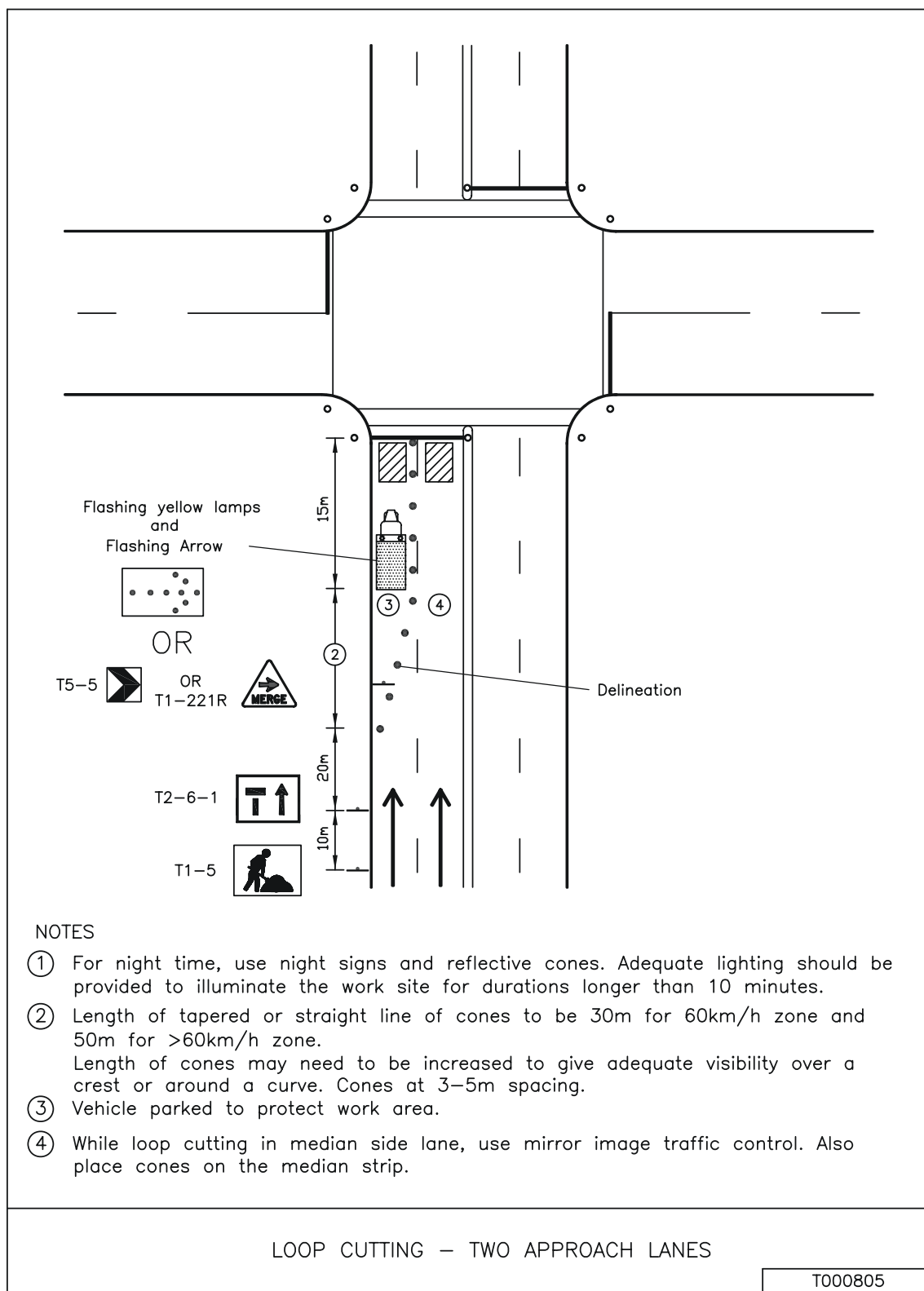


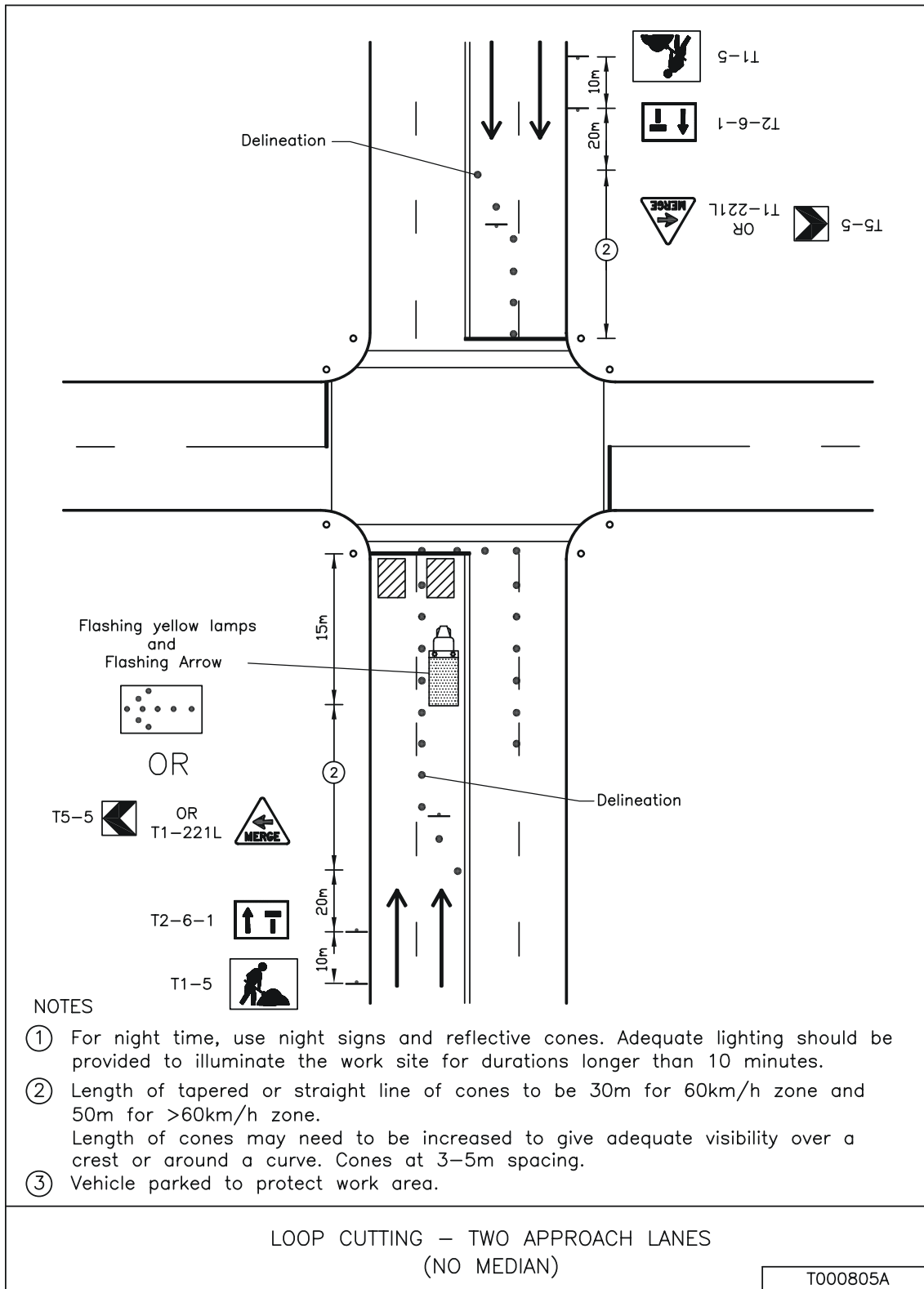


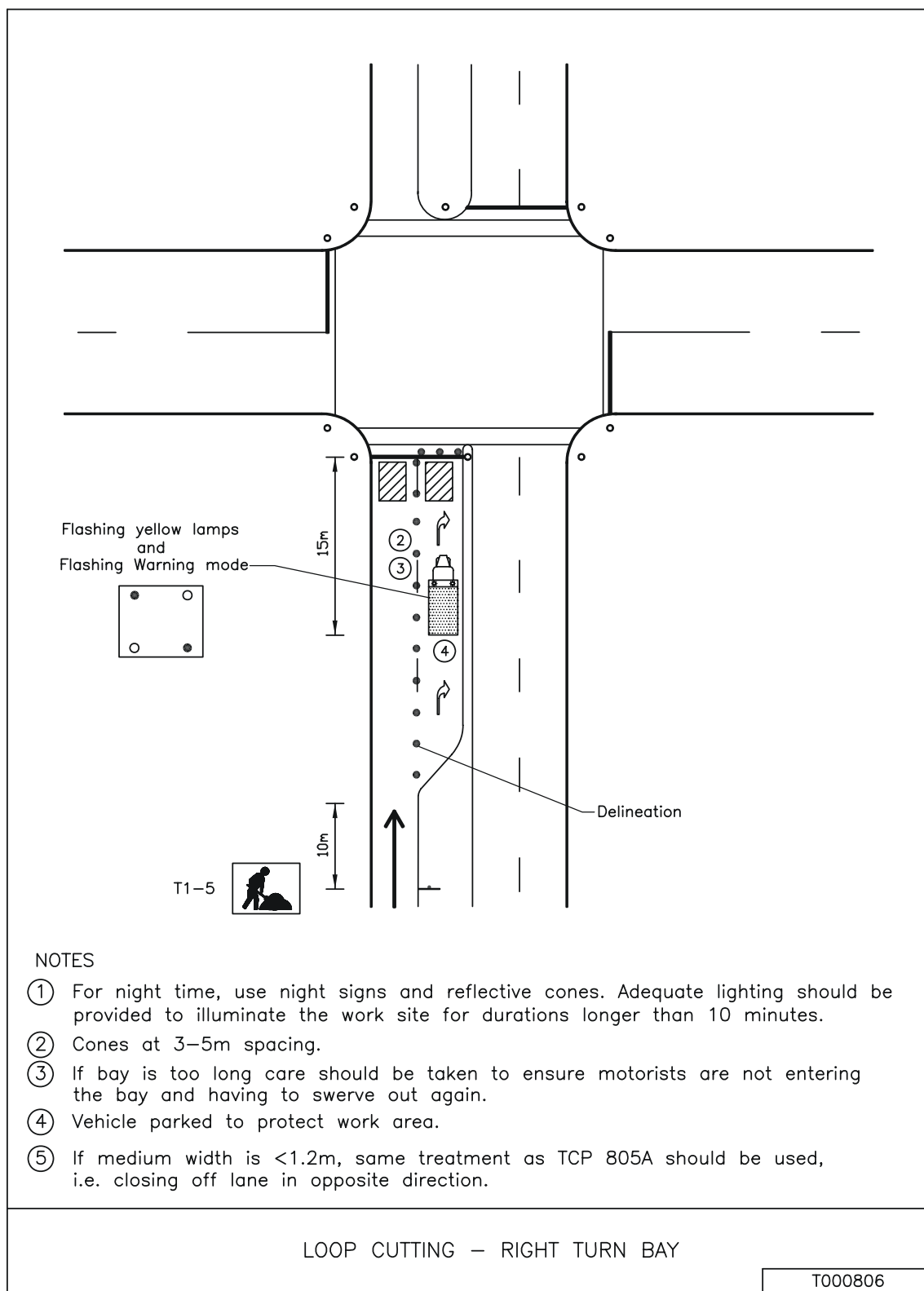
- ① For night time, use night signs and reflective cones. Adequate lighting should be provided to illuminate the work site for durations longer than 10 minutes.
- ② Work is carried out when the traffic light is red for approaching traffic.
- ③ Length of tapered or straight line of cones to be 30m for 60km/h zone and 50m for >60km/h zone.
Length of cones may need to be increased to give adequate visibility over a crest or around a curve. Cones at 3–5m spacing.
- ④ Traffic controller to monitor approaching vehicles and stop the first one at 15m from the stop line when traffic signal is red.
- ⑤ Work on site is not expected to exceed 60 minutes.
- ⑥ Traffic is allowed to go over the work site throughout this period.
- ⑦ Traffic controller to monitor queue length. If queue is long, allow vehicles through every cycle; else allow vehicles through every few cycles.

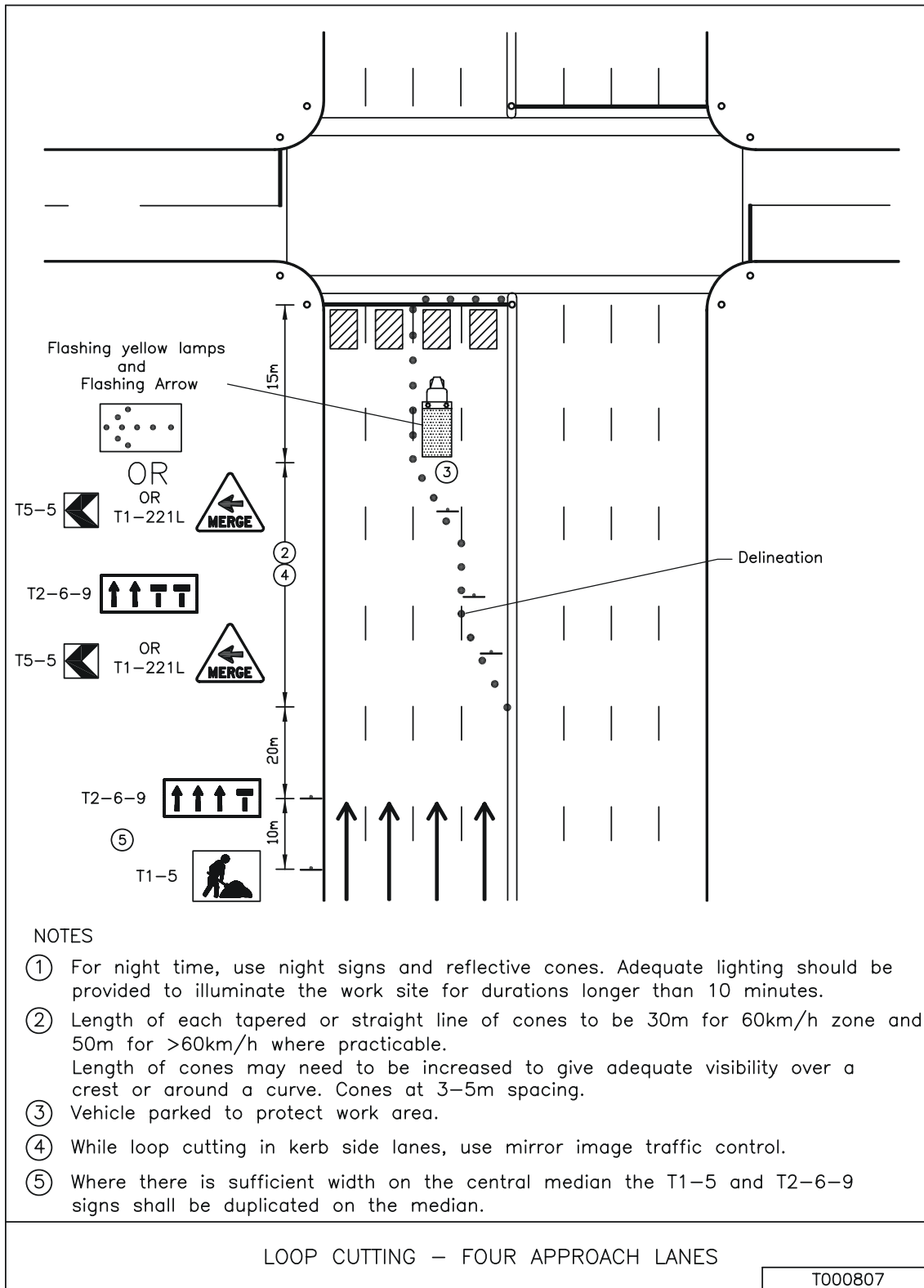
LOOP CUTTING – TWO LANE/TWO WAY INTERSECTION

T000804



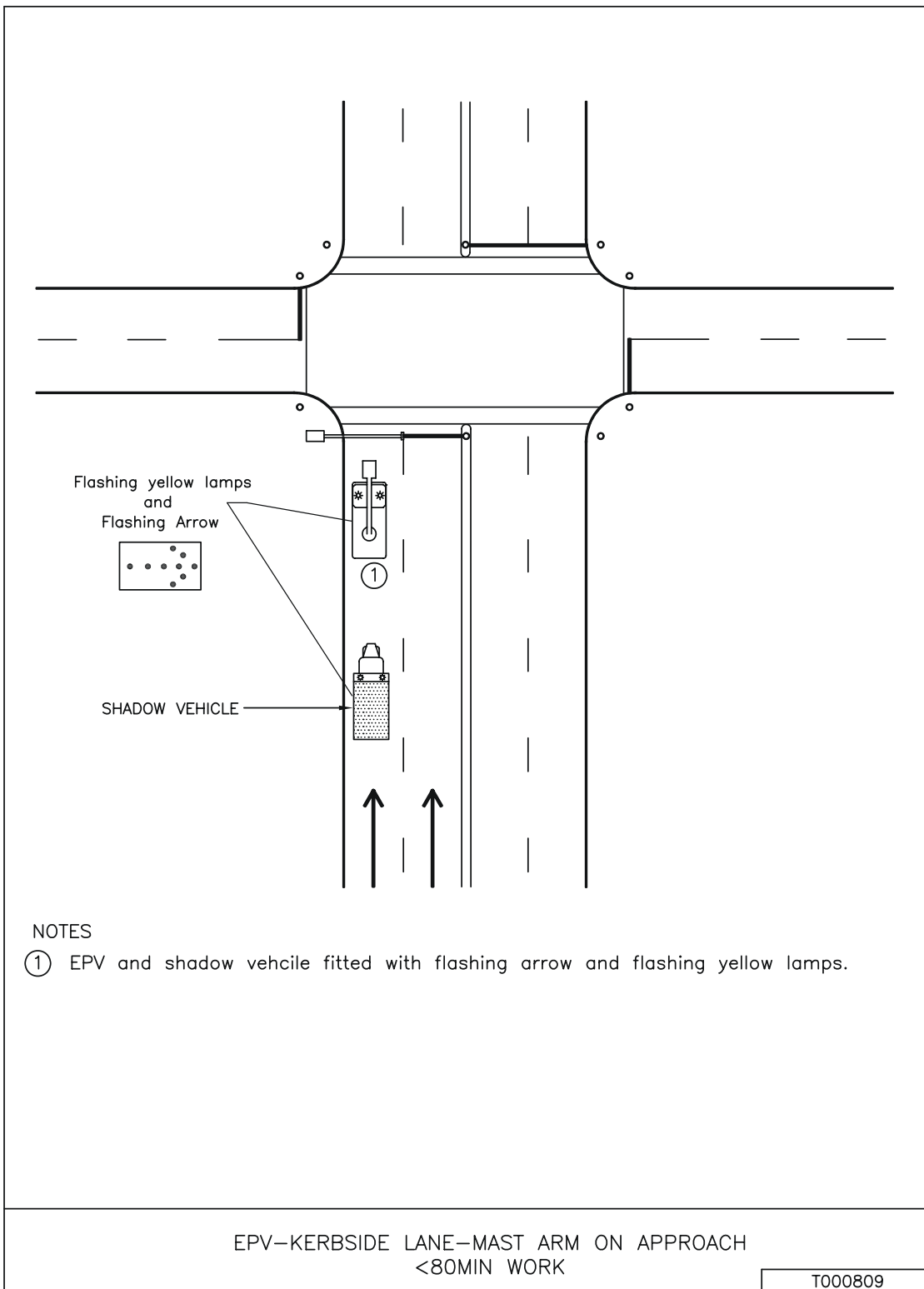


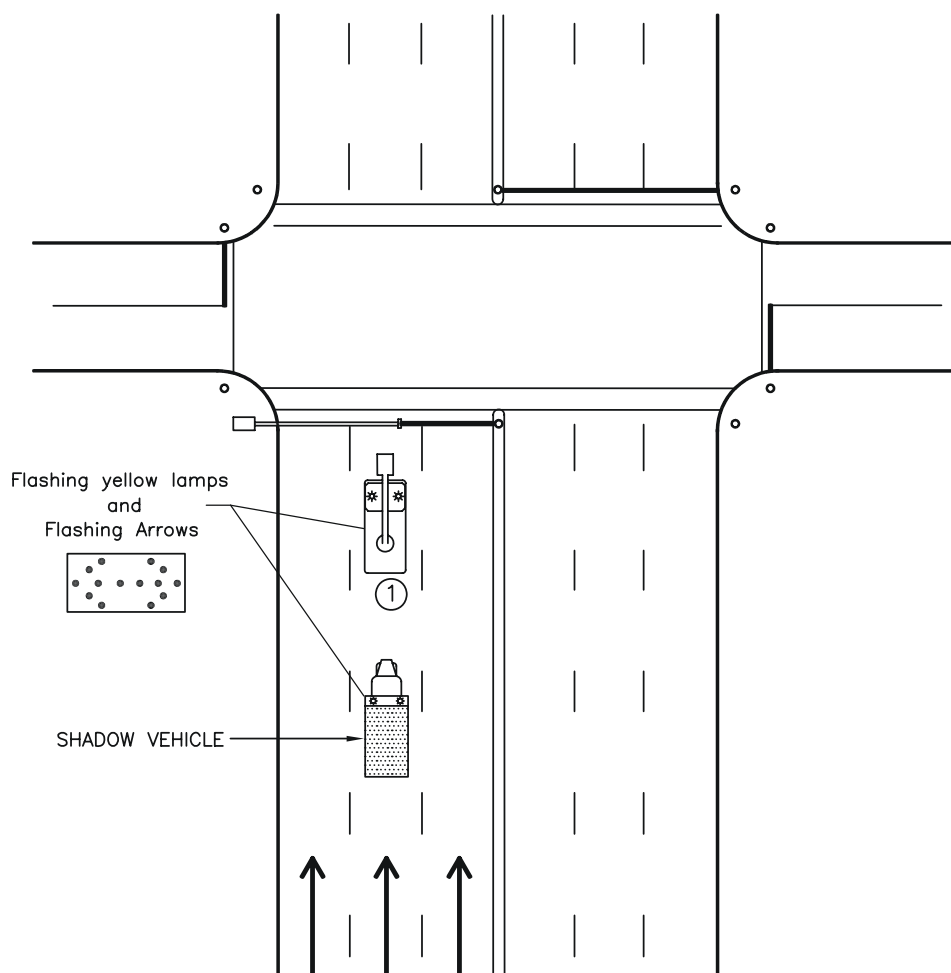






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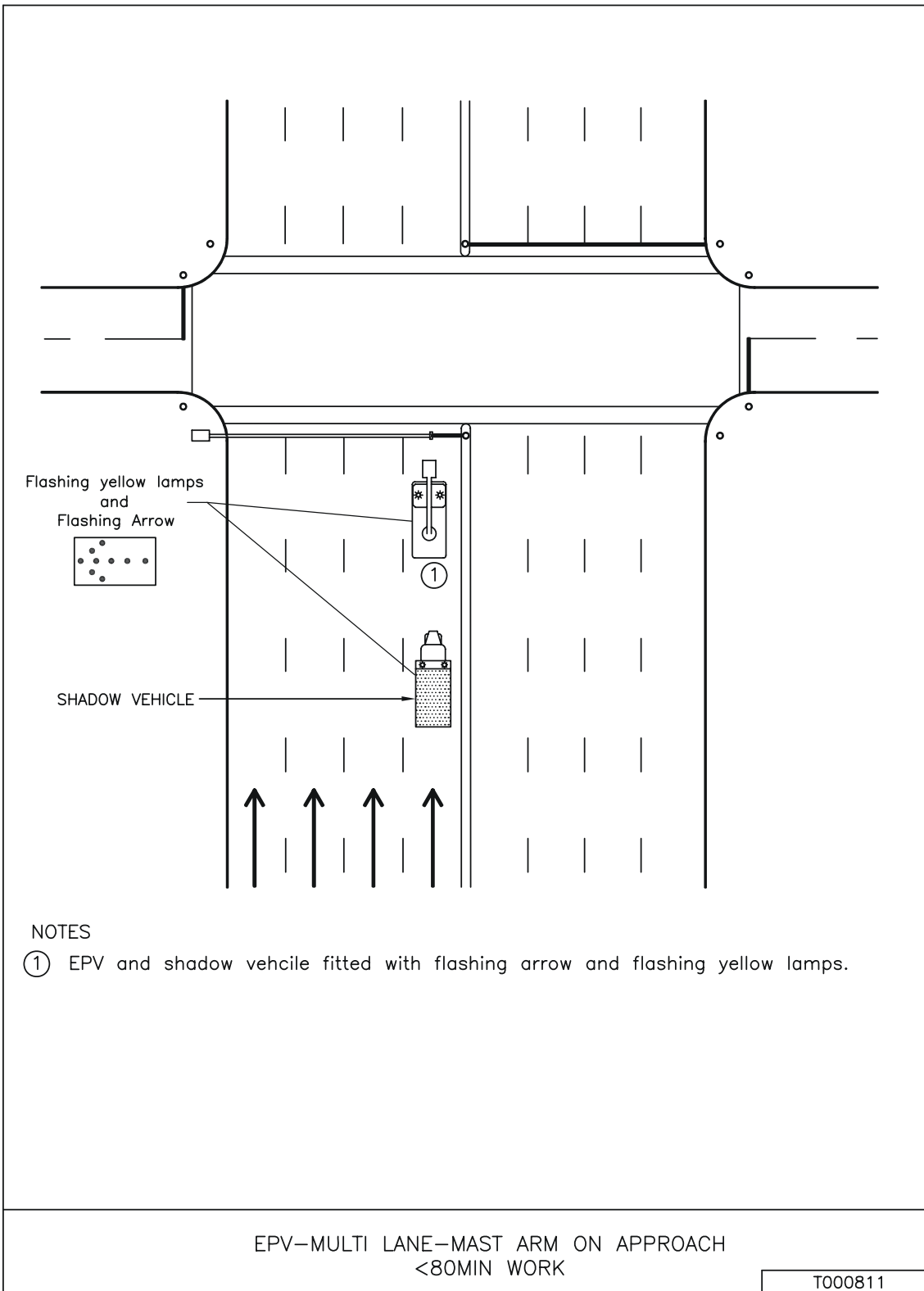
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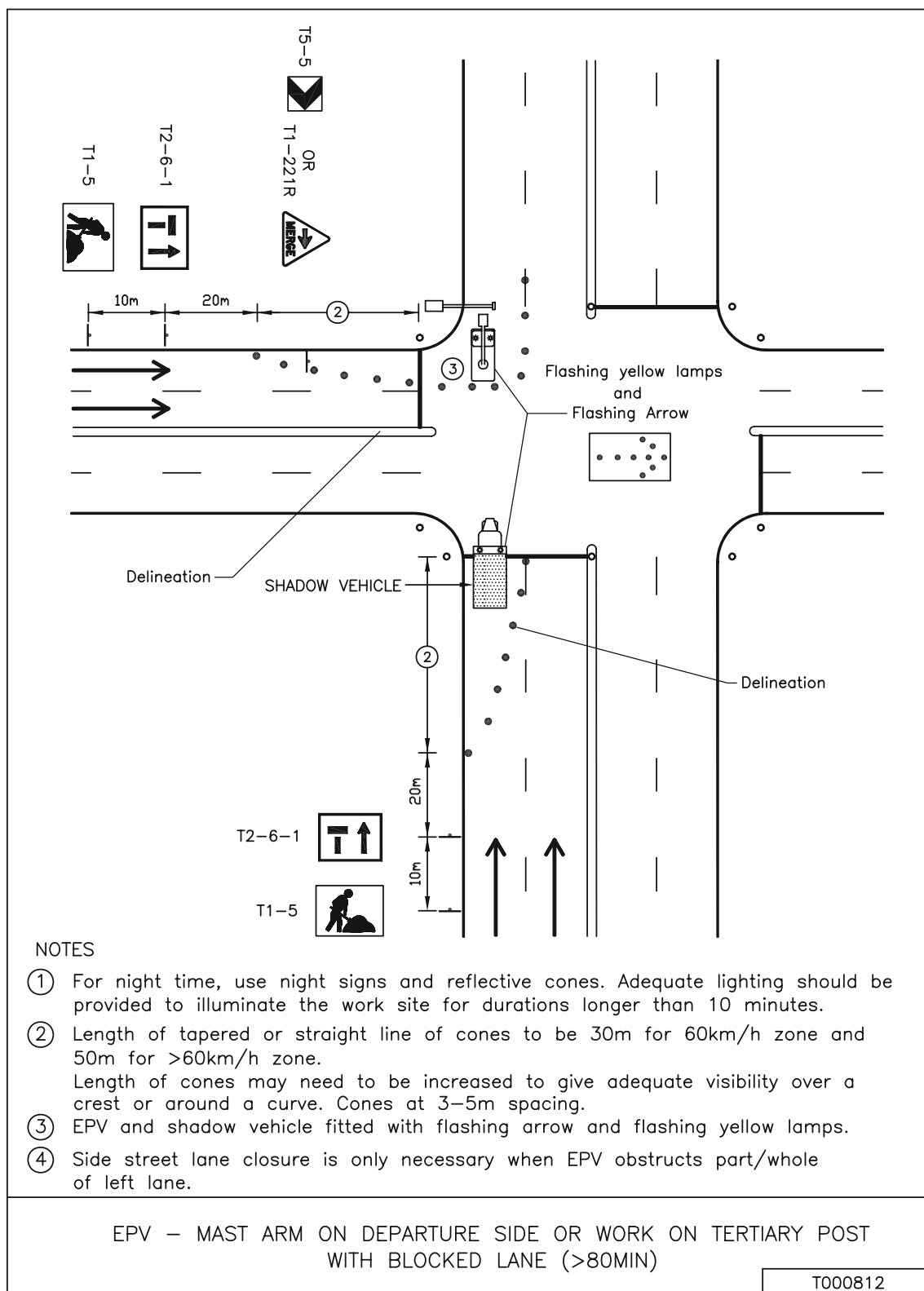
- ① EPV and shadow vehicle fitted with flashing arrows and flashing yellow lamps.

EPV—CENTRE LANE—MAST ARM ON APPROACH
<80MIN WORK

T000810

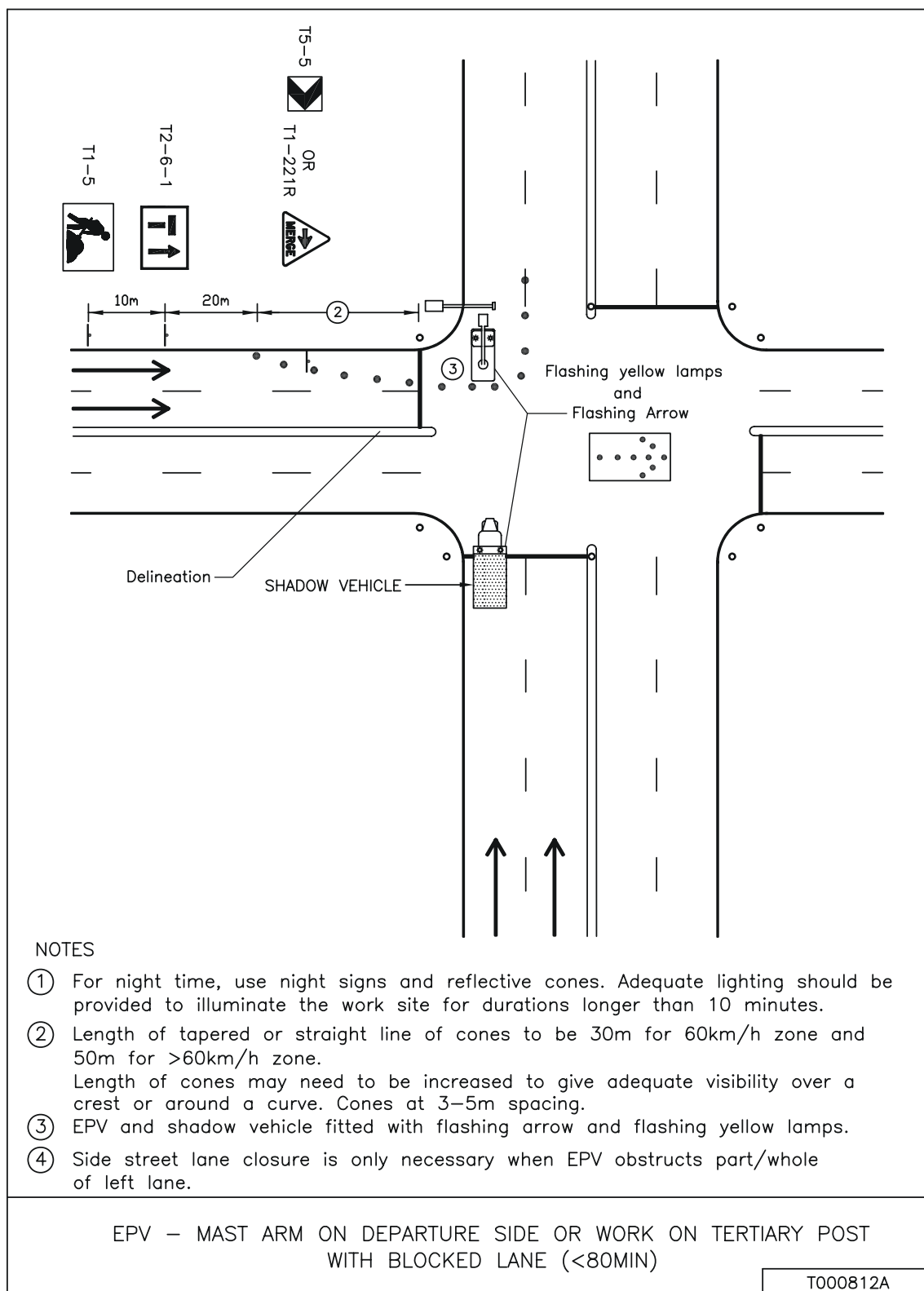
TCP 810



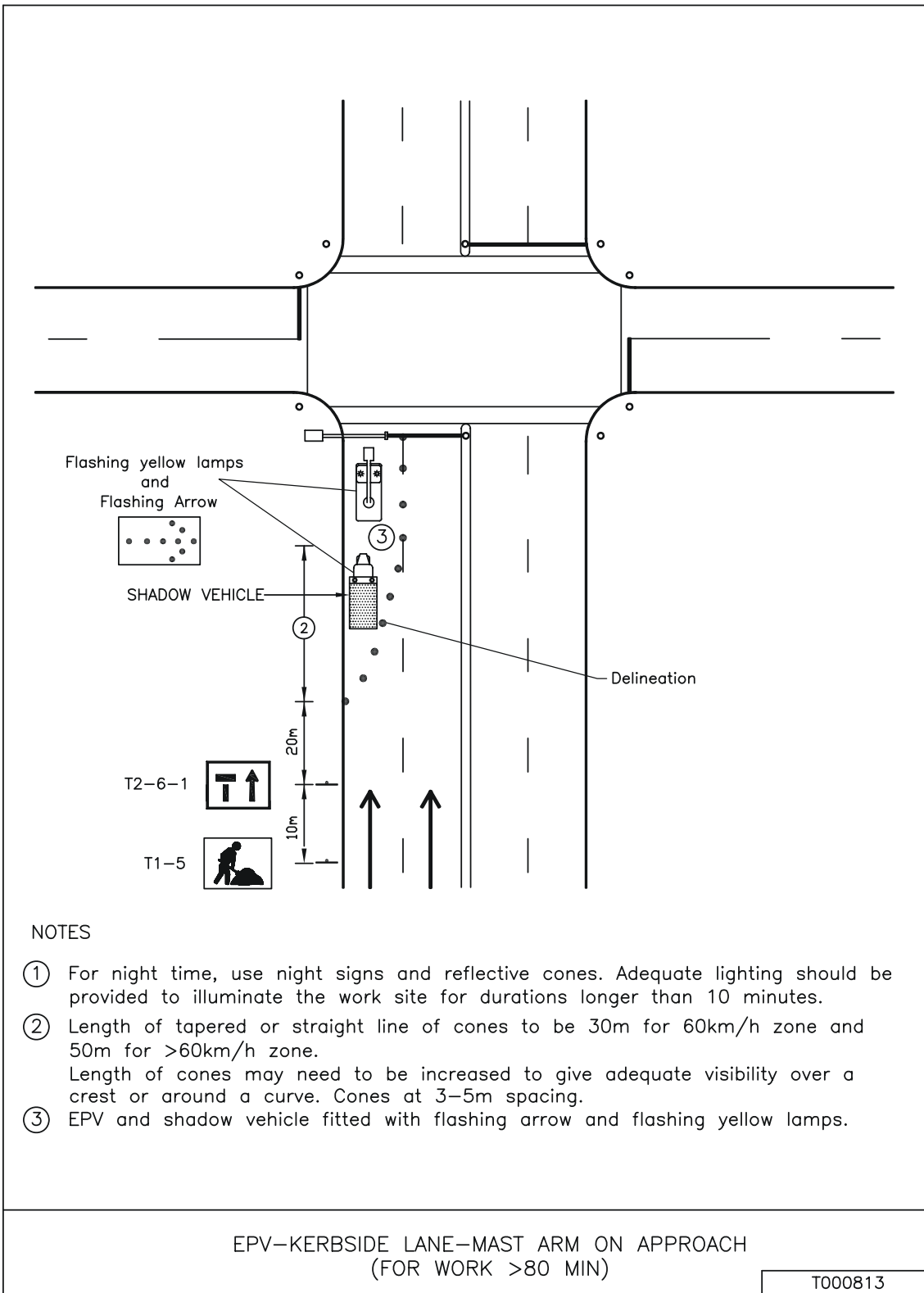


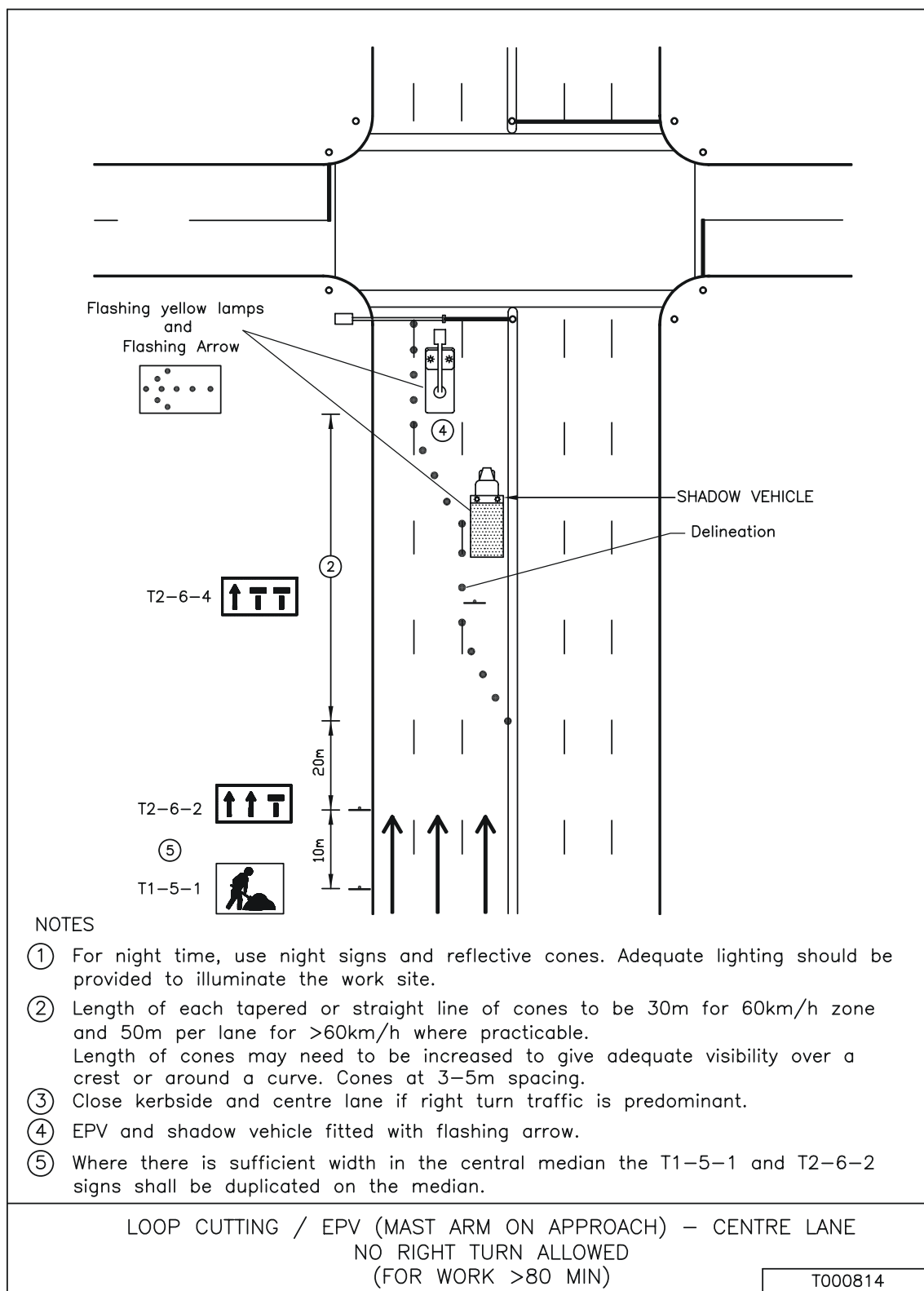


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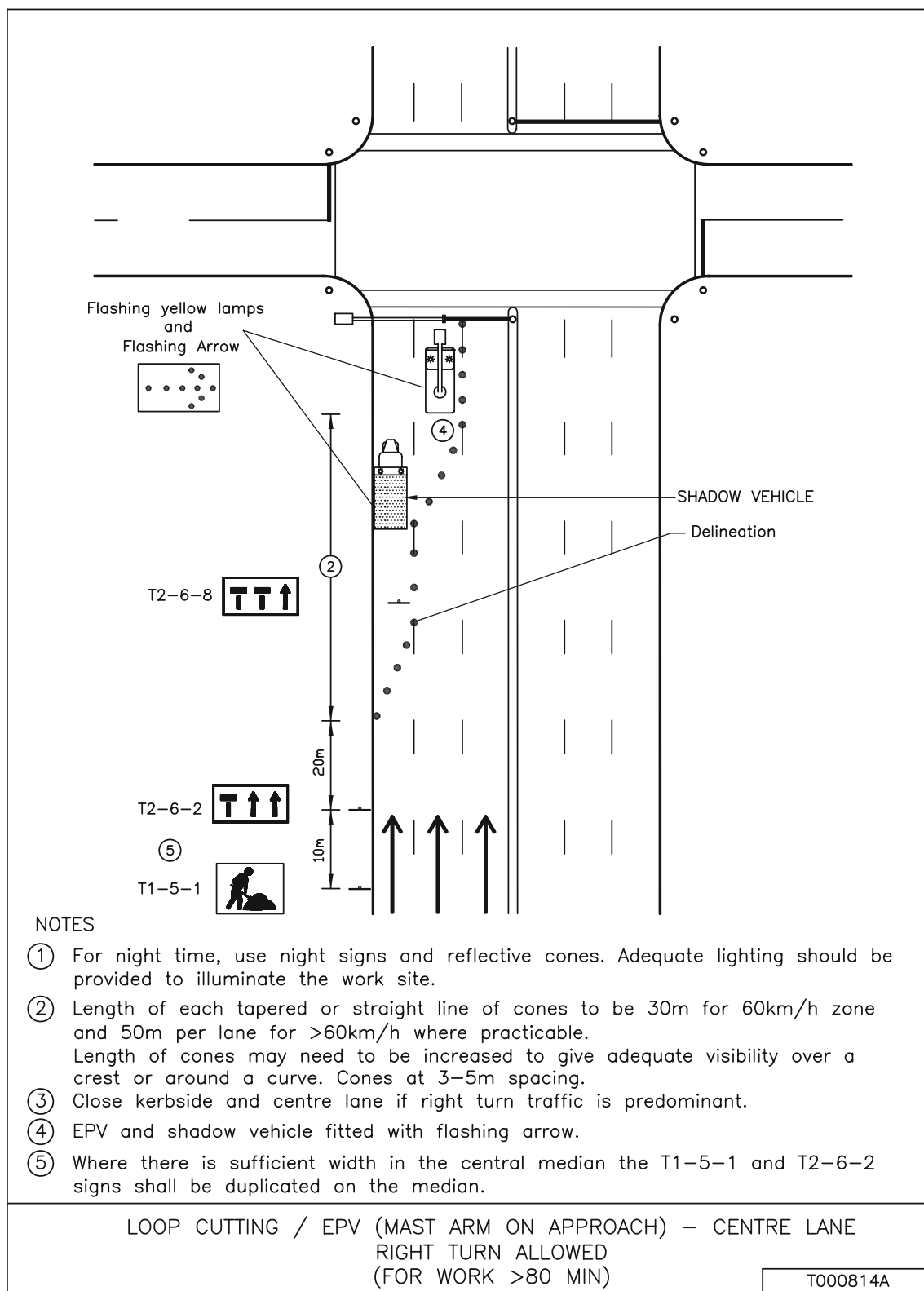
TCP 812A



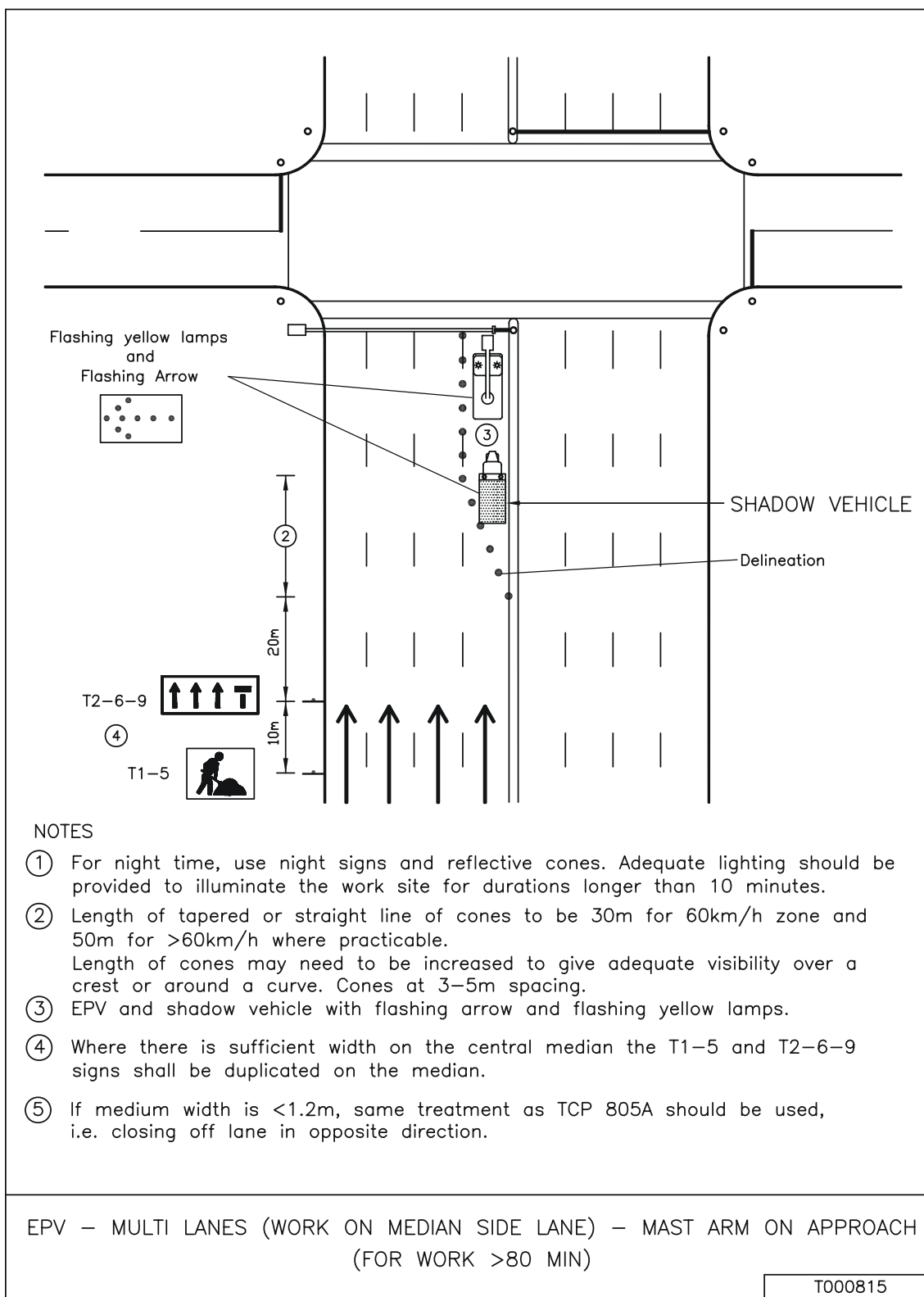




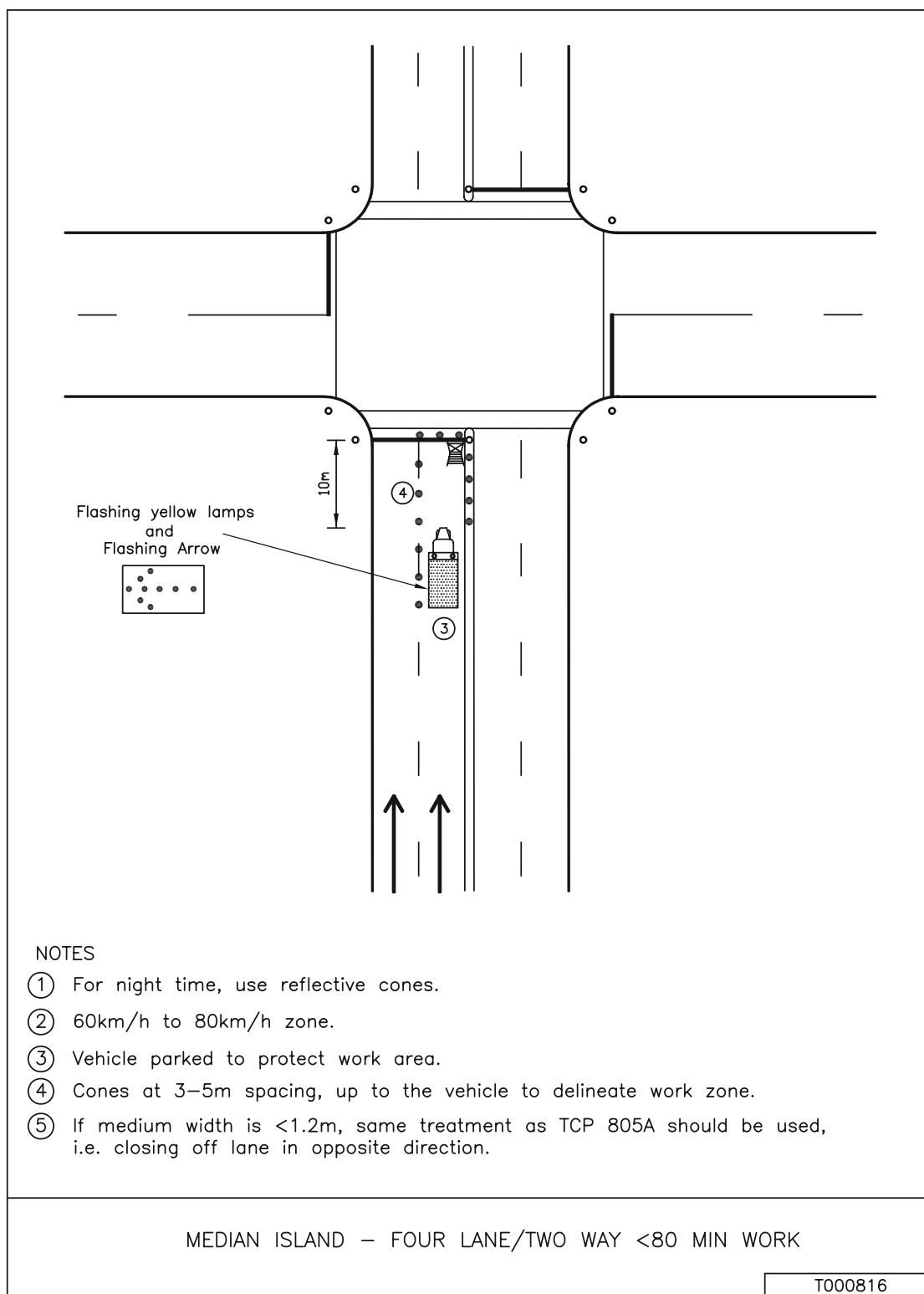
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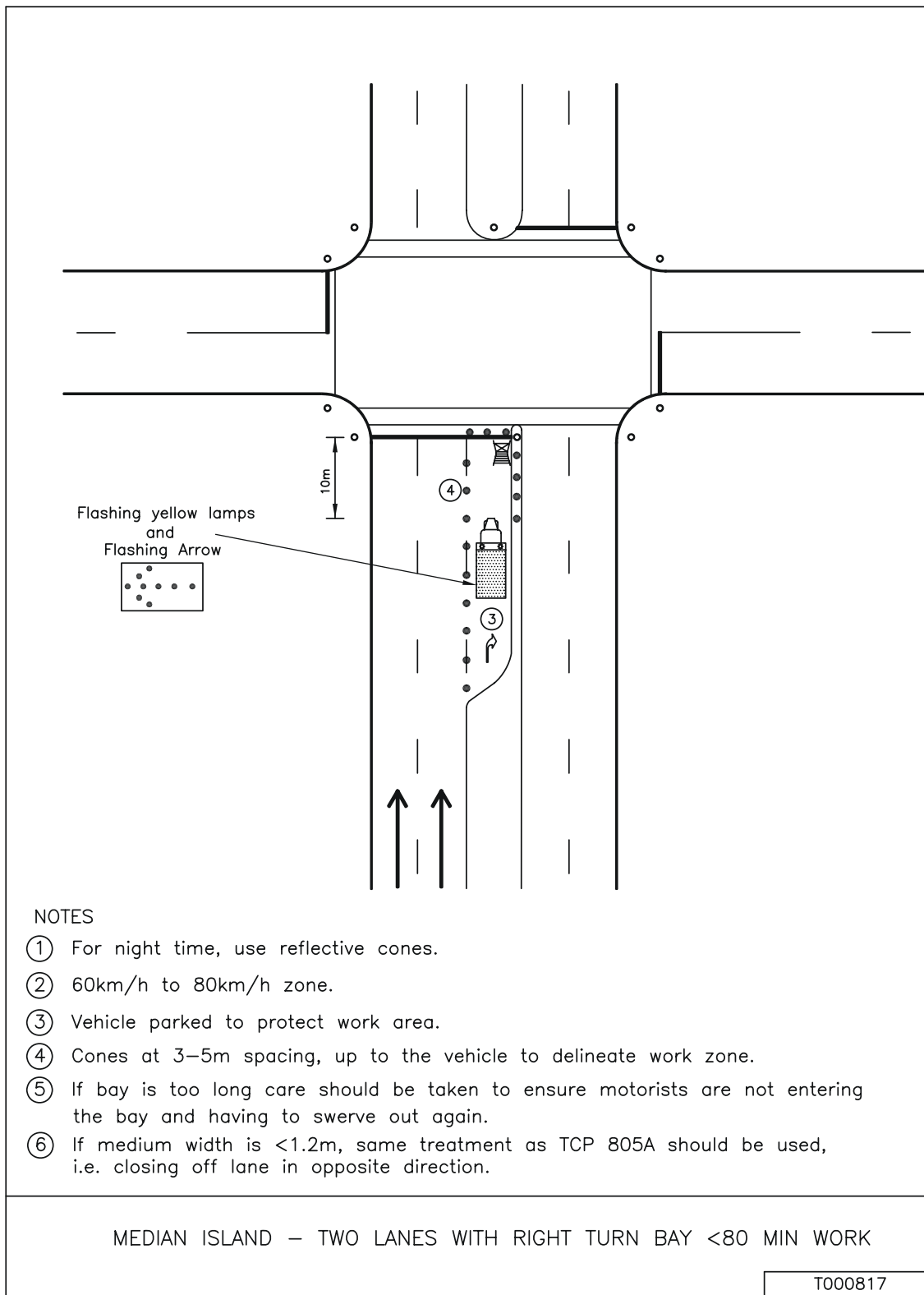


TCP 814A



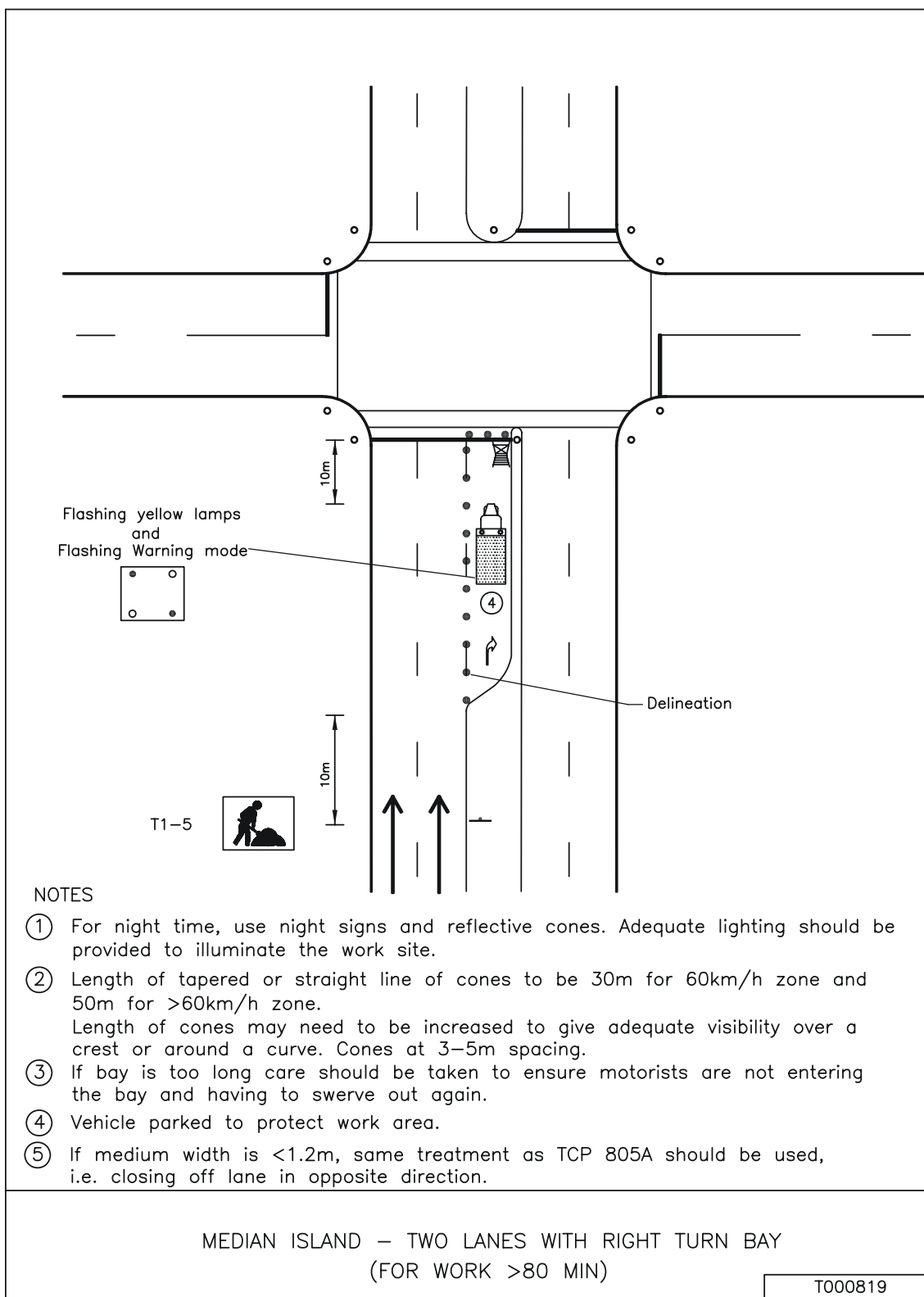
TCP 815



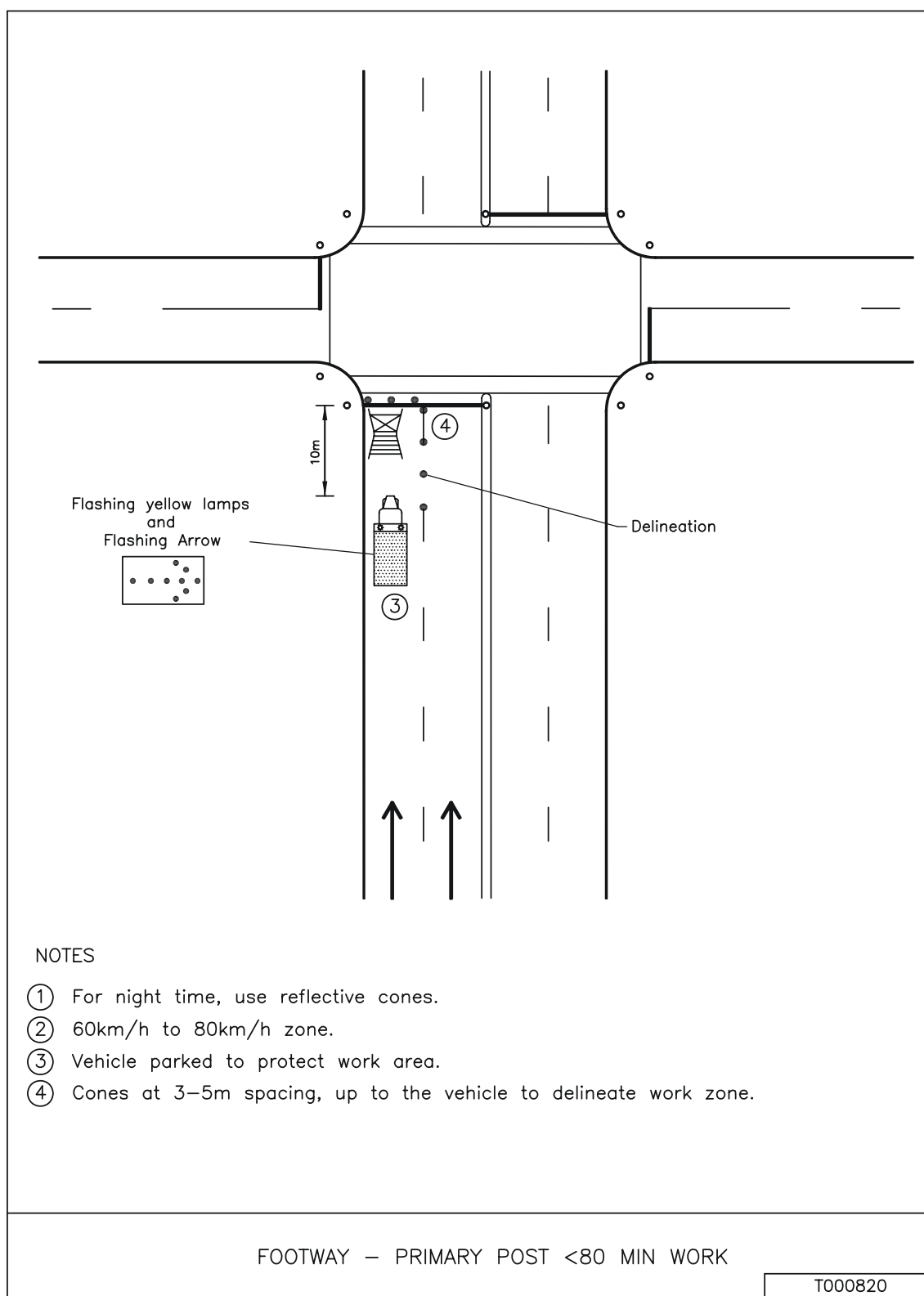


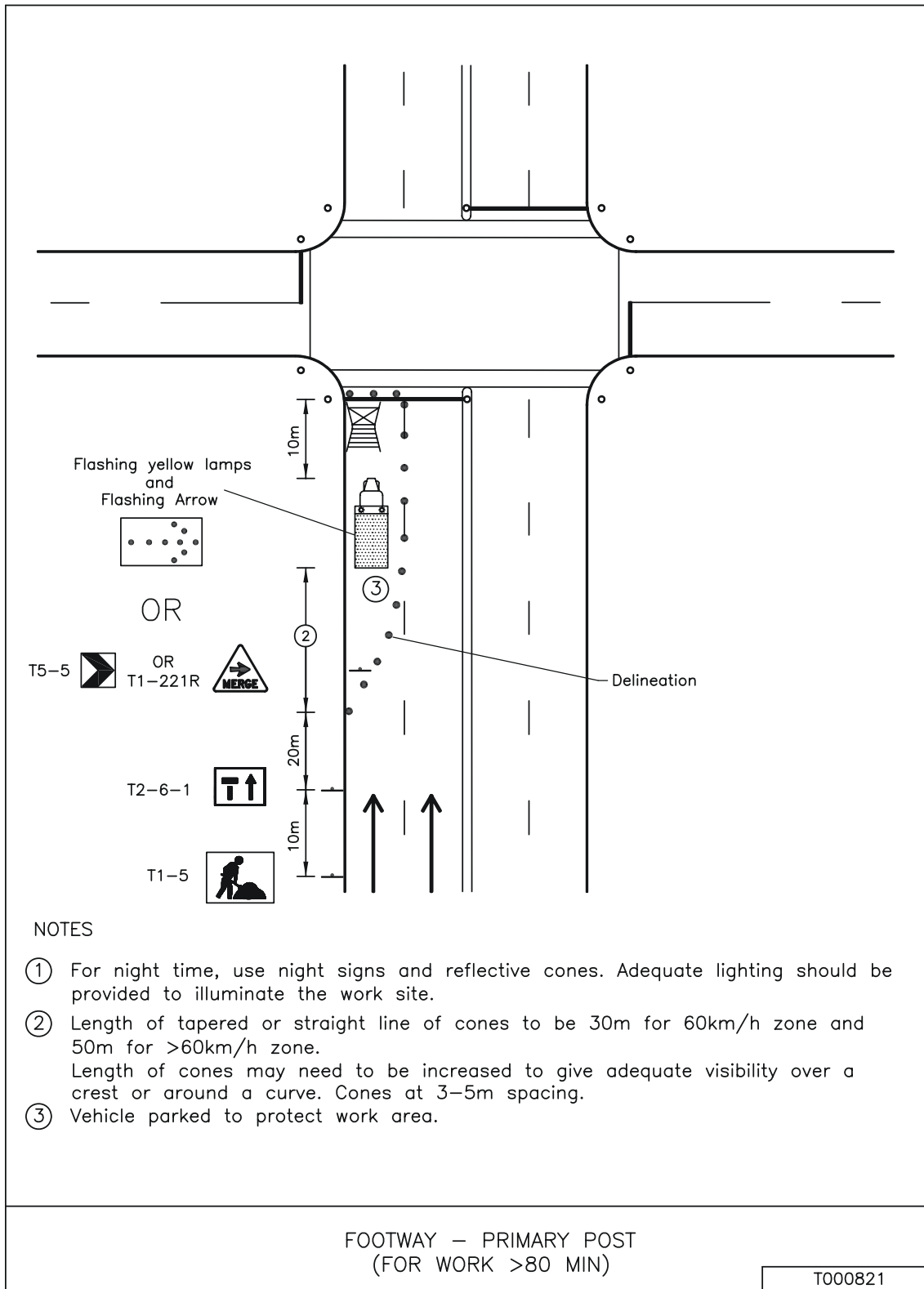
TCP 817

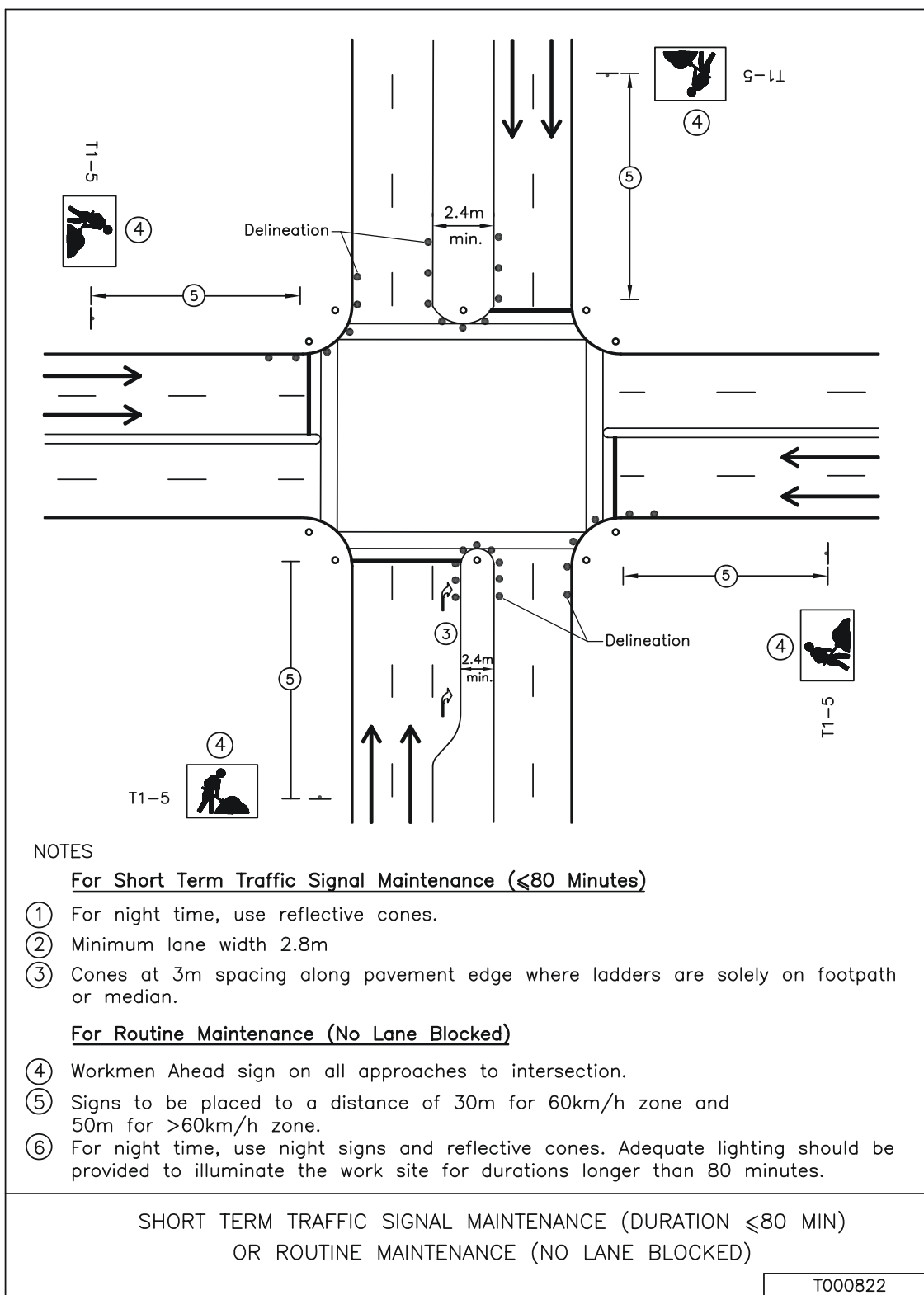


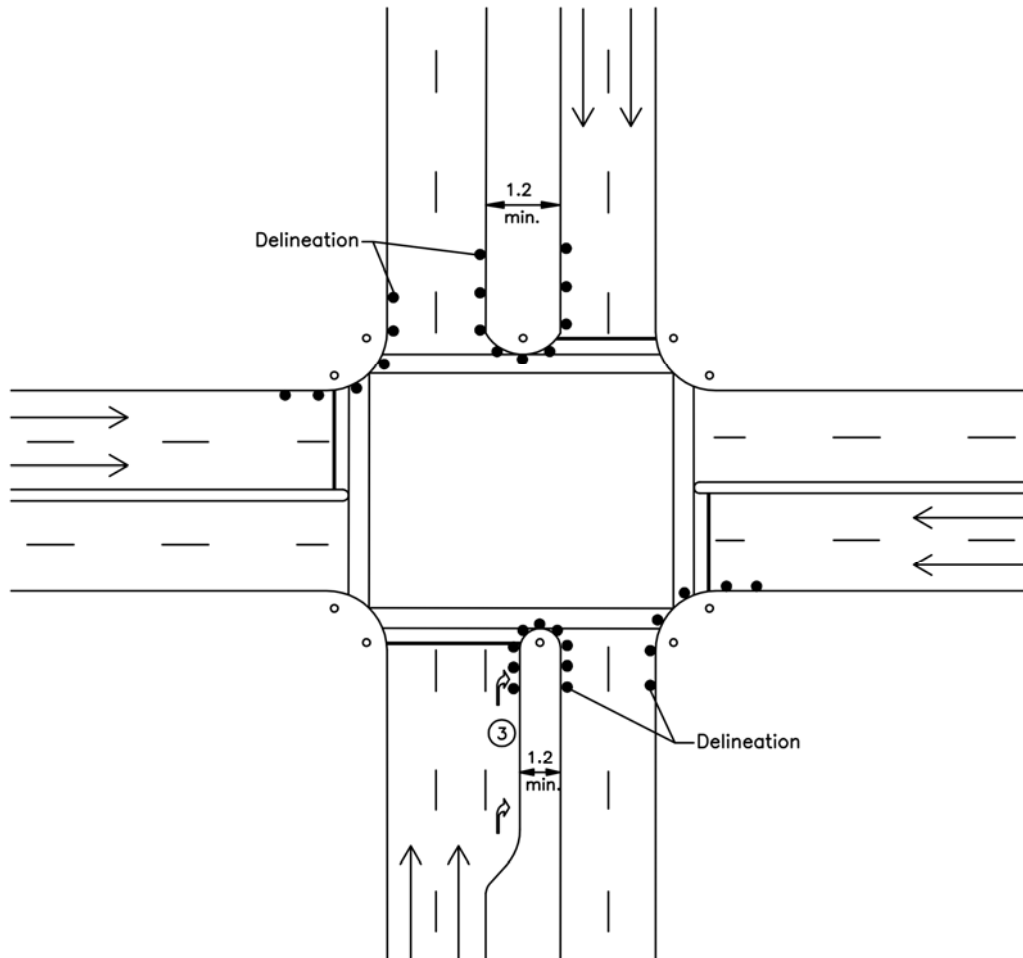


TCP 819









NOTES

For Short Term Traffic Signal Emergency Maintenance (≤ 10 Minutes)

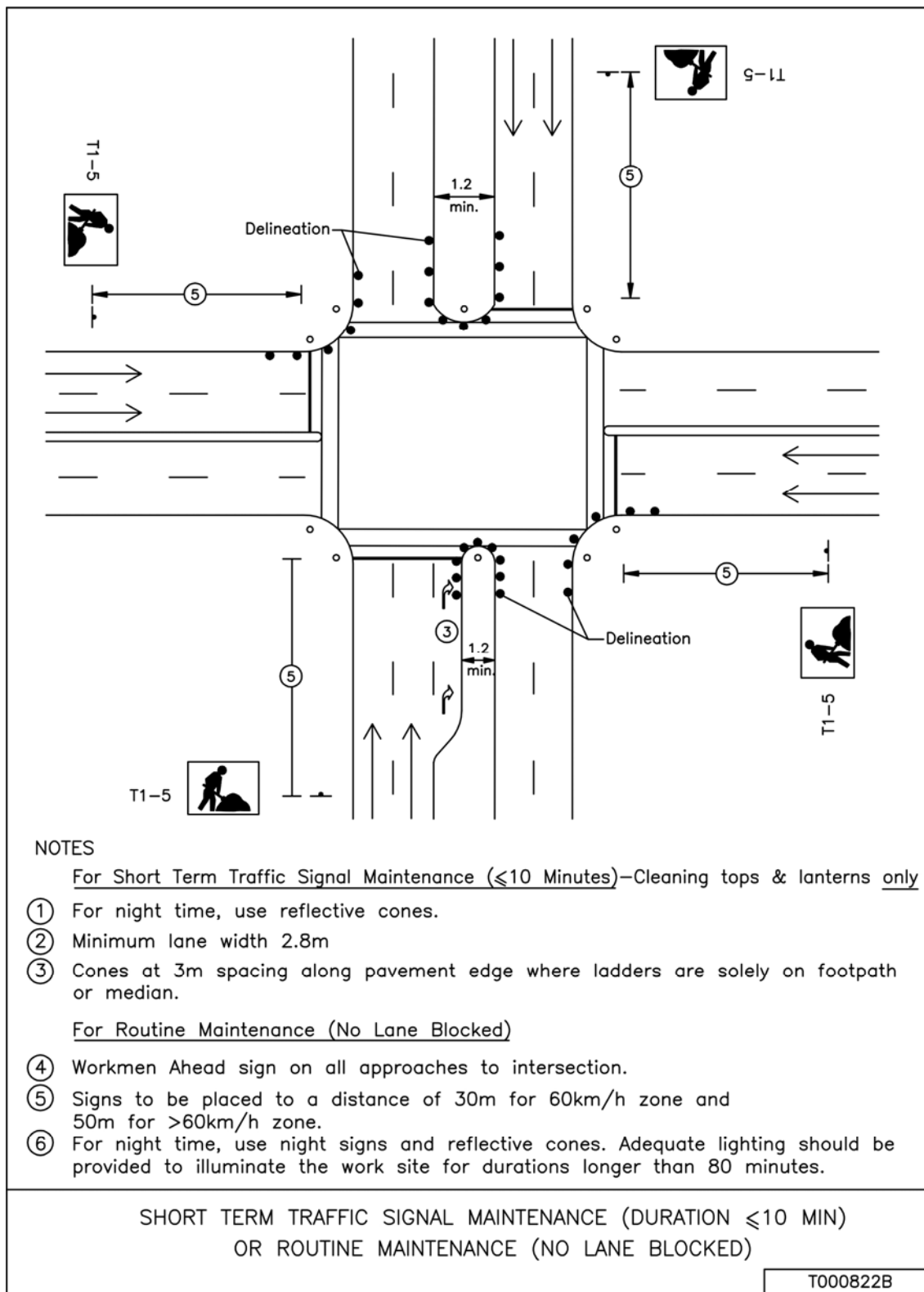
Single Lamp replacement/Push button repair/PT inspection

- ① For night time, use reflective cones.
- ② Minimum lane width 2.8m
- ③ Cones at 3m spacing along pavement edge where ladders are solely on footpath or median or where one foot of ladder is resting in travel lane.

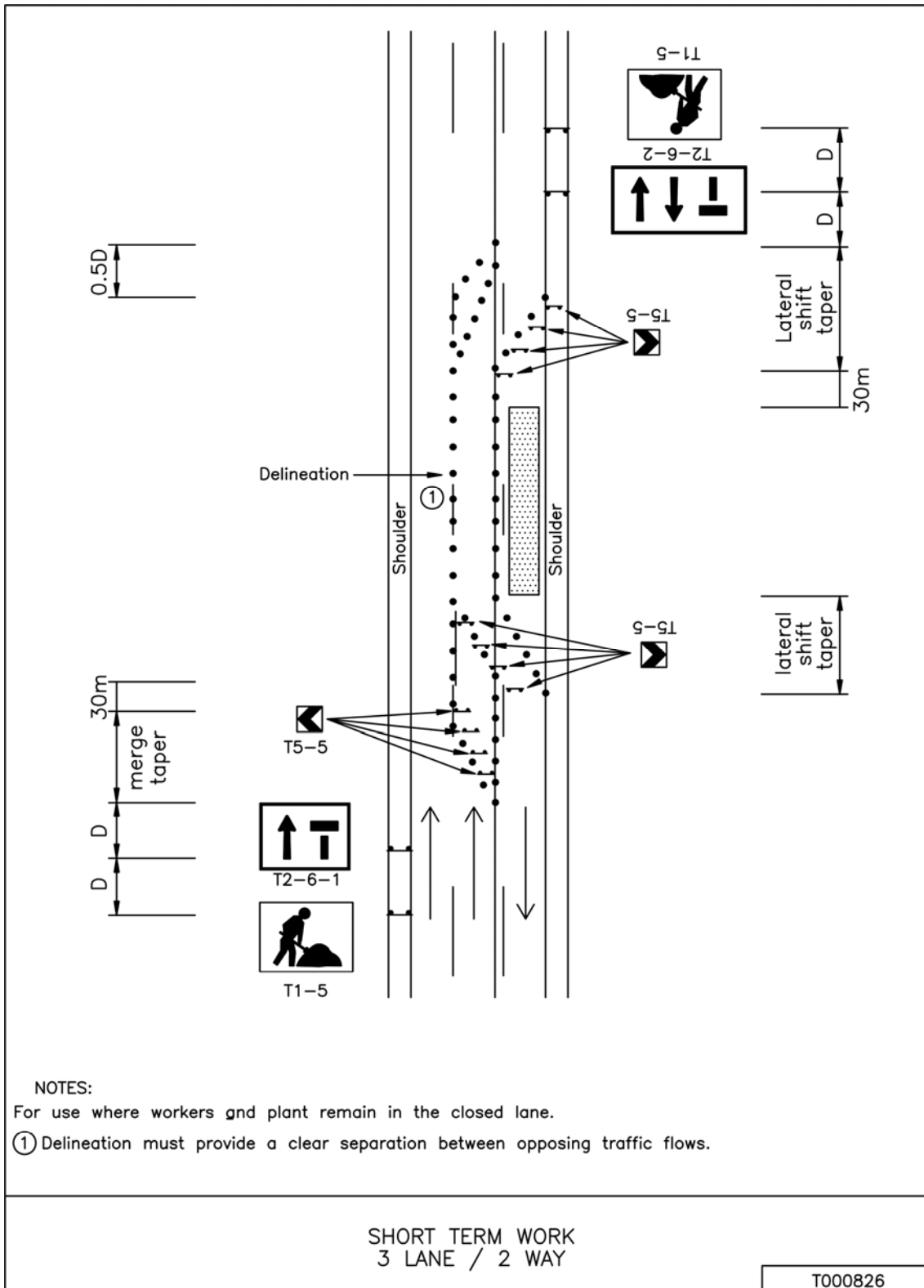
SHORT TERM TRAFFIC SIGNAL EMERGENCY MAINTENANCE (DURATION ≤ 10 MIN)

T000822A

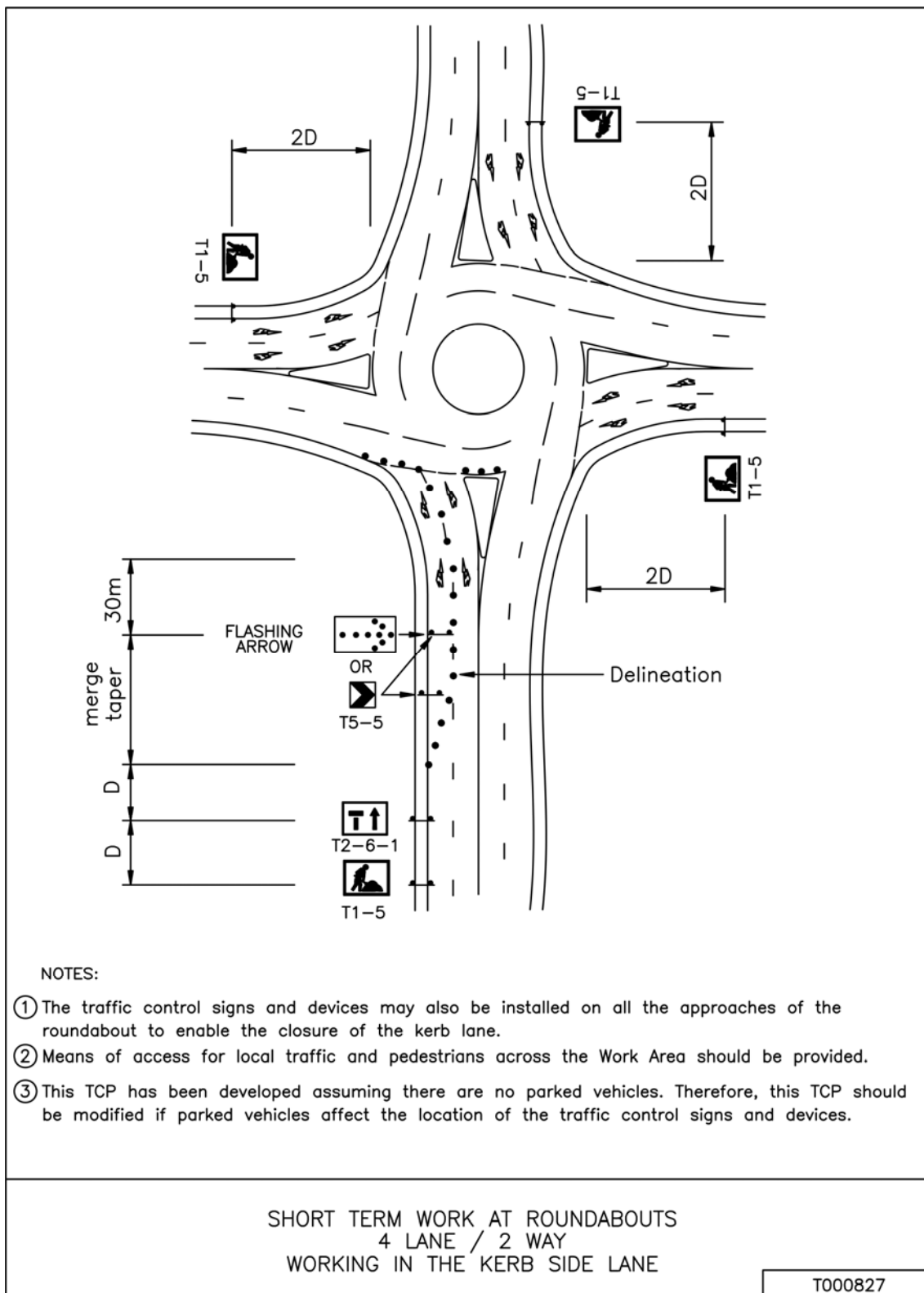
TCP 822A



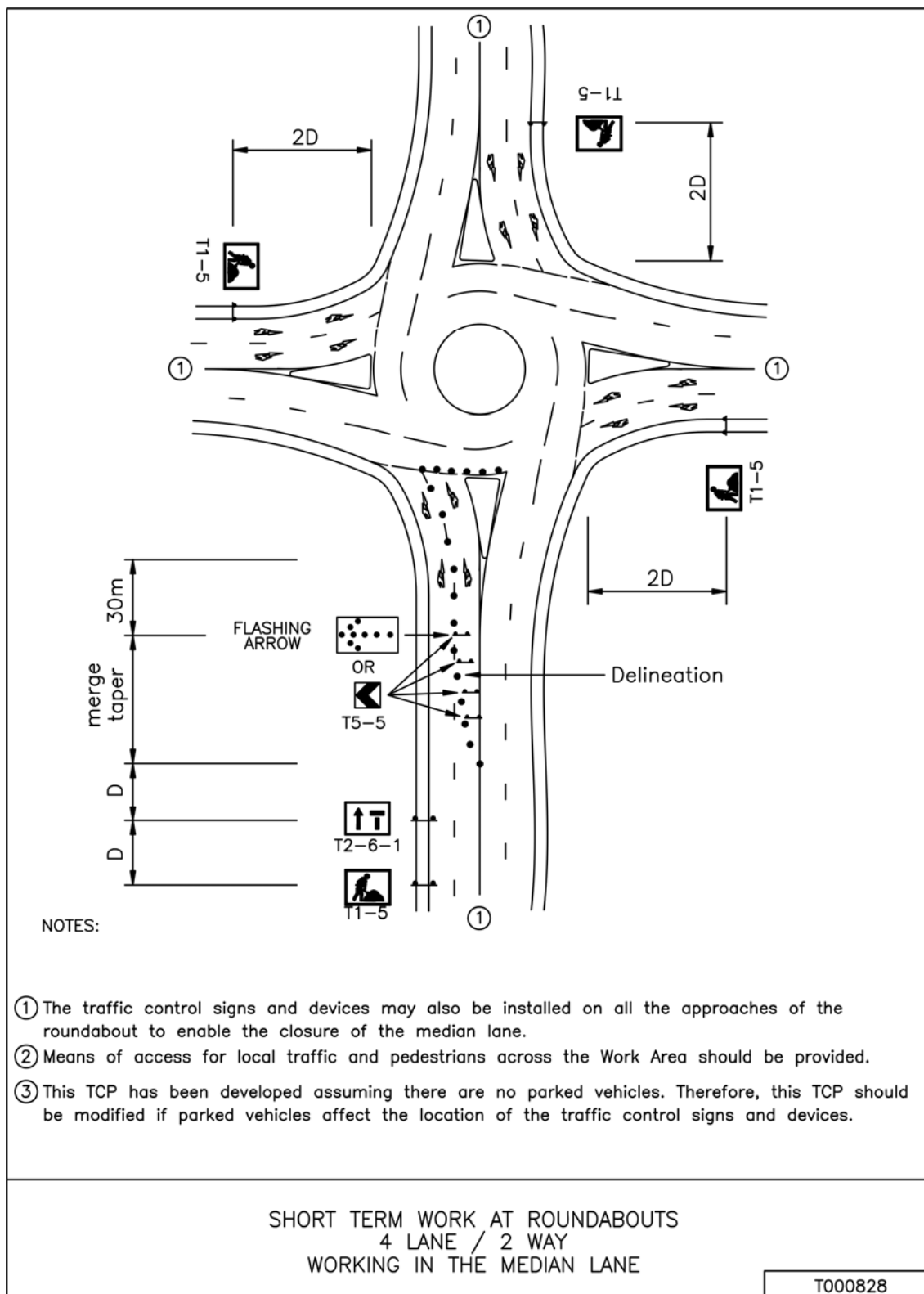
TCP 822B

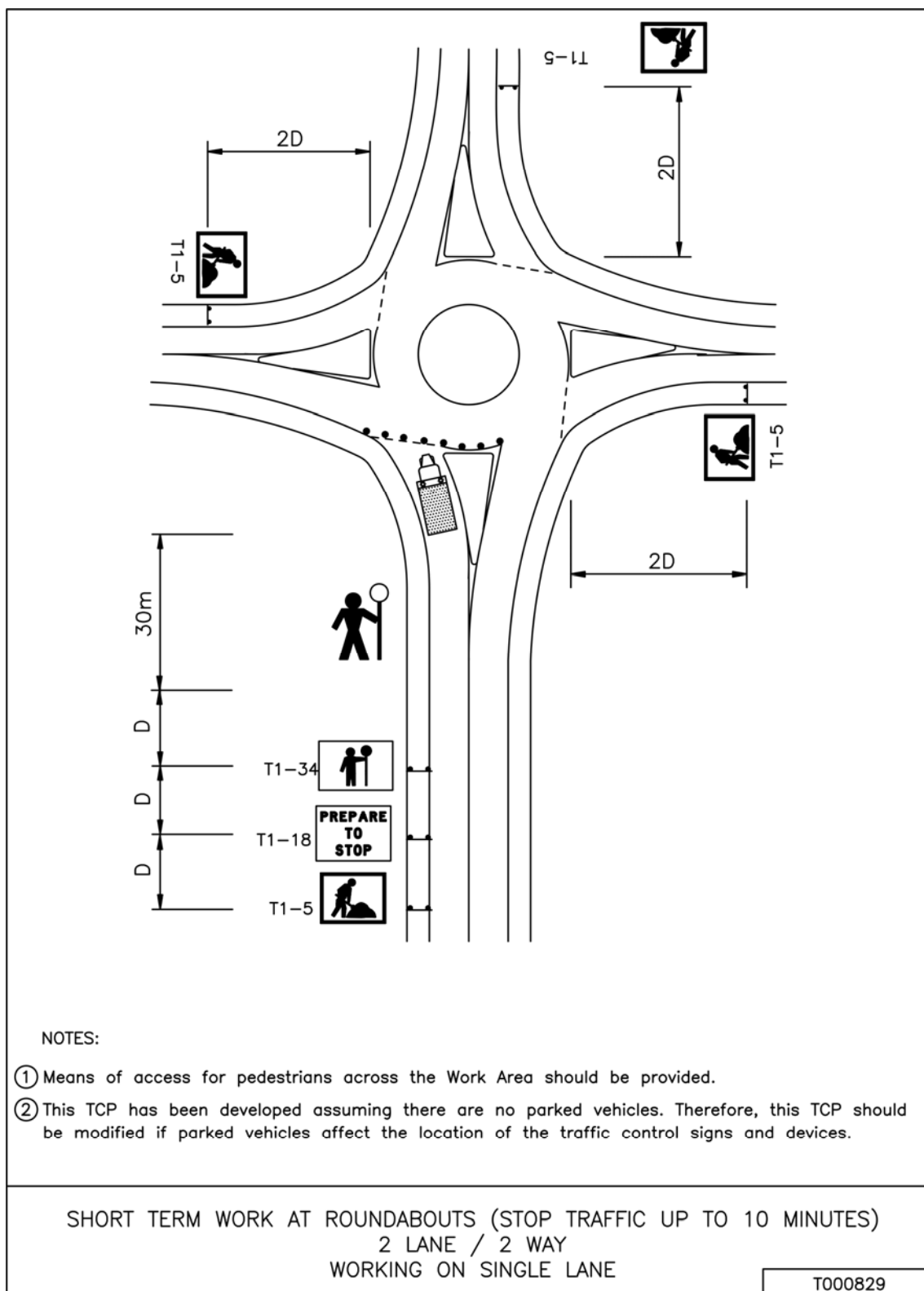


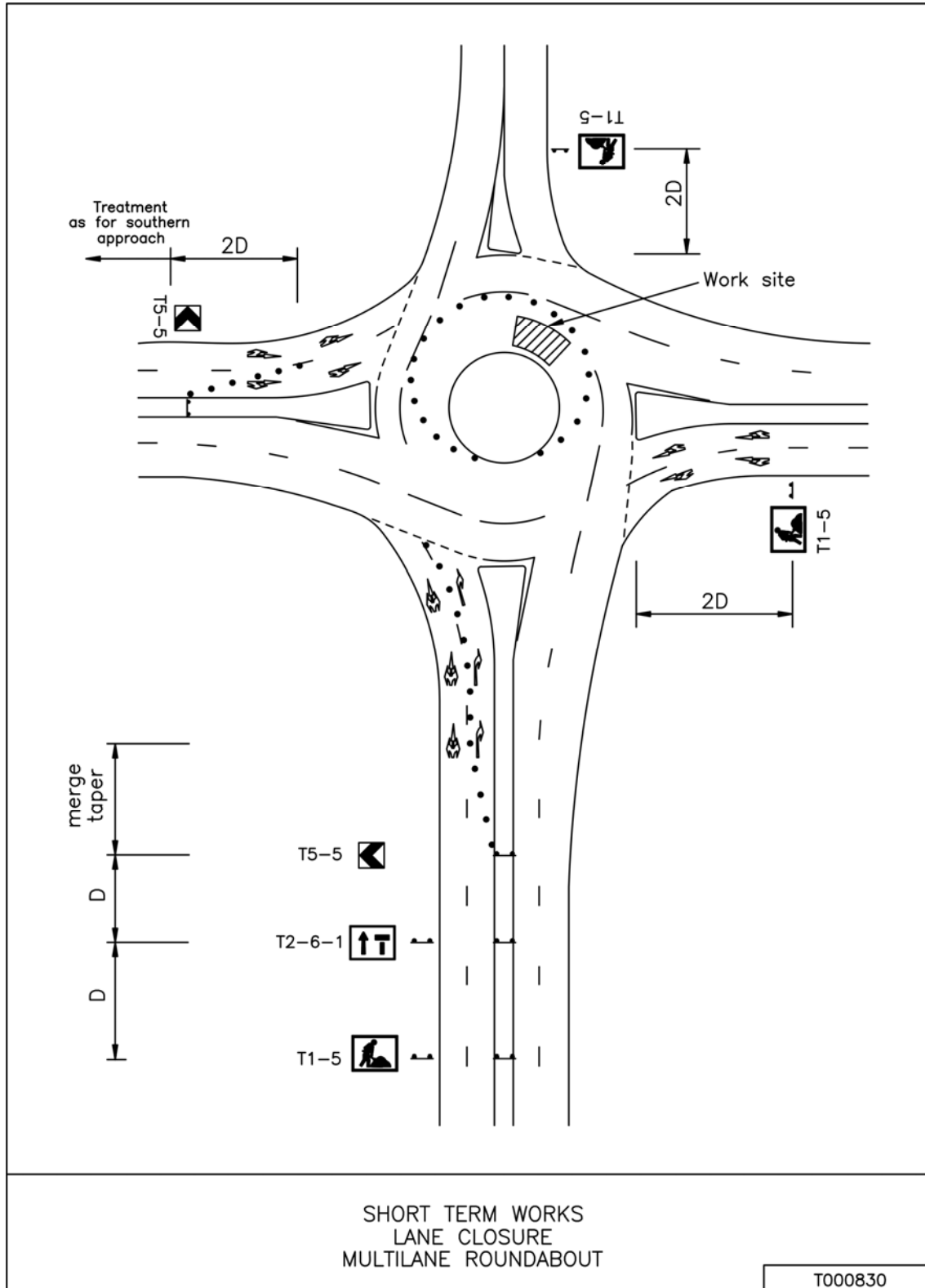
TCP 826



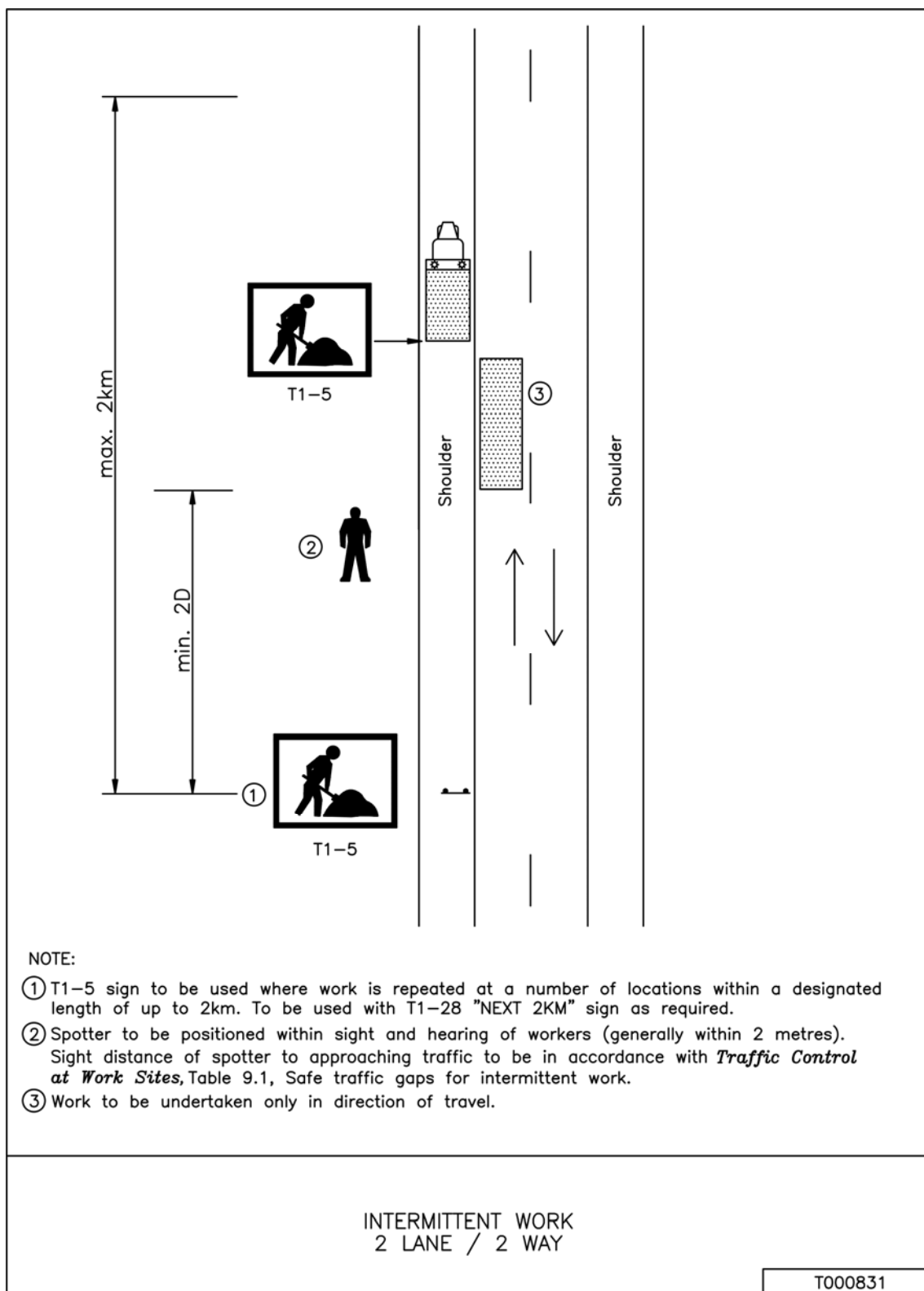
TCP 827







TCP 830





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Appendix E Inspection checklists and forms

This Appendix contains examples of inspection checklists and forms to be used at traffic control sites. The forms may be modified to suit local requirements provided that the basic information is retained.



TRAFFIC CONTROL AT WORK SITES SAFETY INSPECTION CHECKLIST		
Date:	Time:	
Inspector:	Design & Inspect TCPs Cert No	
RTA Office/Contractor:	Site Supervisor.	
TCP Number:	TCP Modified:	Y/N
Road/Bridge Name:	Location:	
Type of work:		
Duration of work:	days	Time/s of work:
Road configuration:		
Rate in the following manner:		
✓ Acceptable	X Not Acceptable	N/A Not Applicable

Guidance Notes:

1. Detailed Inspections using this checklist shall only be undertaken by personnel holding a current Design and Inspect Traffic Control Plans certificate.
2. Report to the Site Office or most senior person and attend site induction or be escorted.
3. Desk-top "Audit". Review paperwork and discuss site conditions, to complete Column 1. Check items against TCP and associated documents.
4. Site Inspection. Conduct site verification inspection, discussing issues with random site workers/ operators, to complete Column 2 – what you see on site.
5. Complete your report on site, where possible.
6. If you able to make a copy of the report on site, leave a copy with the supervisors.
7. Forward an additional copy to the engineer.
8. For contractor sites, forward an electronic copy to Manager Contractor Safety, RTA OHS Branch.

No	Conditions	TCWS Section	Rating	
			1	2
I	TCP			
I.1	Does the work require a:- A TMP ? A TCP ? A VMP ? (See I2 below.) A PMP ?	G10		
I.2	Are all required plans approved ?	4.3		
I.3	Is the approved TCP on site ?	4.4.1/.2		
I.4	Have signs and devices been set out as in the TCP ?	4.4.1/.2		
I.5	If modifications have been made are they approved and marked on the TCP ?	4.5		
I.6	Has a TCWS Appendix D Risk Assessment (RA) been done and been attached to the TCP ?	App D		
I.7	Does the RA cover the risks associated with the work site ?			
I.8	Does the RA cover current risks; including 'out of hours' work ?			
I.9	Is the TCP relevant for the works in progress ?	4.4.2		
I.10	Has a Road Occupancy Licence been issued and is it being complied with ?	G11		
I.11	Are the requirements implemented for safe clearances to workers and pedestrians and traffic approach speeds ?	3.6 9.3		
I.12	Other			
COMMENTS ITEM I				



2	Roadwork Speed Zones (RSZ)		Rating	
			1	2
2.1	Has the RSZ zone been authorised ?	8.2.6		
2.2	Is a copy of the SZA form held on site ?	8.2.6		
2.2	Has the SZA form been sent to local Police ?	8.2.6(a)		
2.3	Are records being kept of the times of RSZ installation ?	8.2.7		
2.4	Where a RSZ is in place, is the limit appropriate for the works being undertaken ?	8.2.3		
2.5	Is the speed limit/s operating within the approved times ?	8.2.6		
2.5	Is the length of the speed zone as per TCWS ?	8.2.4(b)		
2.6	Are Advanced Speed Warning Signs used appropriately ?	8.2.5(a)		
2.7	Are Speed signs duplicated at the start of the speed zone ?	8.2.5(a)		
2.8	Are speed signs the correct size ?	8.2.5(b)		
2.9	Are all signs installed at the correct spacing ?	8.2.5(a)		
2.10	Are all signs installed at the correct height ?	8.2.5(c)		
2.11	Have conflicting speed zone signs and pavement markings been covered/removed ?	8.2.5(e)		
2.12	Are repeater signs installed if required ?	8.2.5(a)		
2.13	Are "ENFORCED" signs required and installed ?	8.2.5(f)		
2.14	At the end of the work, has the pre-existing speed limit been reinstated ?	8.2		
2.15	Are signs covered adequately when not in use ?	3.4.1;8.2		
2.16	Other			
COMMENTS ITEM 2				

3	Record keeping		Rating	
			1	2
3.1	Are records being kept for roadwork speed zones?	8.2.6		
3.2	Are records kept as required in Appendix E?	6.1		
3.2.1	By the Works Supervisor?	6.1.1		
3.2.2	By the Team Leader?	6.1.2		
3.3	RA is available on site and being kept with TCP?	App D		
3.4	Where PTS are used, is the form <i>Record of Approval and Use</i> completed and retained?	T 10.7		
3.5	Other			
COMMENTS ITEM 3				

4	Traffic Controllers (TCs)		Rating	
			1	2
4.1	Are Traffic Controllers (TCs) being used ? (Night work - 4.13)	8.1		
4.2	Are the correct number of TCs being used ?	8.1.3		
4.3	Have TC Certificates been sighted and the No's recorded ?	G10		
4.4	Is TCs high visibility clothing in good repair ?	8.1.1(a)		
4.5	Are all TCs displaying the Road Authority's logo and <i>Authorised Traffic Controller</i> ?	8.1.1(c)		
4.6	Is the traffic speed restricted to a max of 60 km/h ?	8.1.1(d)		
4.7	Is the sight distance to approaching traffic 1.5D or greater?	8.1.1(e)		
4.8	Do TCs have a clear escape route ?	8.1.4		
4.9	Has provision been made to prevent end of queue accidents ?	8.1.1(e)		
4.10	Are TCs able to communicate with each other (line of sight, two way radios, additional TCs) ?	8.1.1(f) 3.5.7		
4.11	Are the PREPARE TO STOP (T1-18) and Traffic Controller Ahead (T1-34, T1-200-2/3) signs correctly displayed ?	8.1.1(a); 8.1.4		
4.12	Are the above signs covered or removed when not required?	8.1.4		



4	Traffic Controllers (TCs) (continued)		Rating	
			1	2
4.13	Are they controlling traffic in accordance with <i>Instructions to Traffic Controllers?</i>	8.1.4		
4.14	If TCs are being used for night work:- a. are they wearing approved clothing ? b. are they safely lit and visible ? c. do they have correct communication ? d. are they using lighted wands ?	8.1.5		
4.15	Other			
COMMENTS ITEM 4				
5	Portable Traffic Signals (PTS)		Rating	
			1	2
5.1	Are PTS being used ?			
5.2	Are the PTS formally approved for use ? (This may be included on the TCP approval.)	4.4.3, 10.5		
5.3	Are the PTS being used marked as complying with RTA Specification PTS/3?	10.2		
5.4	Are the PTS correctly registered ?			
5.5	Is the approach speed of traffic reduced to 60 km/h or less?	10.7.2		
5.6	Is minimum sight distance of 150 metres provided ?	10.7.3		
5.7	Are the PTS been correctly sighted and established ?	10.7.1		
5.8	Has a Holding Line been marked on the roadway ?	TCP43		
5.9	Are procedures in place to review the end-of-queue when PTS are operating?	3.5.7		
5.10	Have all signs associated with PTS been erected correctly ?	TCP43		
5.11	Other			
COMMENTS ITEM 5				

6	Flashing Arrow Sign (FAS)		Rating	
			1	2
6.1	Is a FAS being used ?			
6.2	Is the FAS being used marked as complying with RTA either Specification FAS/4 or FAS/5 ?	11.2		
6.3	Is it located correctly ?	11.4.4		
6.4	Is it the correct size sign ?	3.2.10; 11.4.1		
6.5	Is the correct Mode of Operation being used ?	Table 11.1		
6.6	If Lane Status signs (T2-6 series) are being used in conjunction with FAS, is the message to the motorist the same ?			
6.7	Other			
COMMENTS ITEM 6				
7	Variable Message Sign (VMS)		Rating	
			1	2
7.1	Is a variable message sign being used, as specified in TCWS ?	3.2.8		
7.2	Is the message related to the road or bridge works ?	3.2.8		
7.3	Are there less than 4 words per screen and no more than 2 screens on display ?	3.2.8		
7.4	Is the sign located in a safe position ?			
7.5	Is the VMS fitted with flashing blue and red lights ? If yes have them switched off/removed.			
7.6	Other			
COMMENTS ITEM 7				



7	Safety Barriers		Rating	
			1	2
8.1	Are safety barriers installed correctly ?	9.6		
8.2	Have the correct barriers been installed ?	9.6 & 3.3.7		
8.3	Where barrier sections are used as Safety Barriers, are they in compliance with AS3845 ?	9.6		
8.4	Where non rigid barrier systems are used as safety barriers, is work behind the barrier prohibited from the deflection zone ?	9.6.5		
8.5	Are water filled safety barrier elements full of water ?			
8.6	Is the safety barrier erected as designed (incorporating end protection) ?	9.6.1		
8.7	Has the approach speed of traffic been reduced to the barrier design rating ?			
8.8	Other			
COMMENTS ITEM 8				
9	Signs and Devices		Rating	
			1	2
9.1	Are all signs and devices in good condition ?	4.4.1		
9.2	Are the signs clearly visible and not affected by other signs, plant items, vegetation, shade, light glare etc ?	3.1.1		
9.3	Are sign faces in compliance with AS1742.3 and have Class I retroreflective material ?	3.2.1		
9.4	Are the correct sign sizes being used ?	3.2.2		
9.5	Are signs duplicated, where required ?	3.2.4		
9.6	Are signs erected at the correct height and position ?	3.2.8		
9.7	Are the signs erected to give the correct sight distance ?	3.2.8		
9.8	Are signs displayed on frangible mounts ?	3.2.7		
9.9	Are barrier boards sighted at right angles to the flow of traffic ?	3.3.1		

9	Signs and Devices (contined)		Rating	
			1	2
9.10	Are there any contradictory or superfluous signs, devices or markings?	4.3.2		
9.11	Have the needs of pedestrians been provided for ?	9.3		
9.12	Have the needs of cyclists been provided for ?	9.4		
9.13	Are all property accesses to the site controlled ?	9.7		
9.14	Are all cones and bollards installed at the correct spacing ?	5.2.2		
9.15	Are the correct sized cones and bollards being used ?	3.3.3		
9.16	Where tapers are used, have they been identified as <i>lateral shift</i> or <i>merge</i> tapers and are they the correct length ?	5.2 Table 5.2		
9.17	Where there are 3 lanes of traffic or more in one direction and two lanes are closed, are the separate merge tapers of the correct length ?	5.2.9		
9.18	Are the 2 tapers separated by at least 1.5 D ?	5.2.9		
9.19	Where work is beyond a crest or curve, has the taper been set up before the crest or curve ?			
9.20	Where temporary pavement marking and markers are used, do they comply with the requirements of TCWS Manual ?	3.3.6		
9.21	Other			
COMMENTS ITEM 9				



10	End-of Queue		Rating	
			1	2
10.1	Has the potential for end of queue accidents been considered and appropriate action taken ?	3.5.7(a)		
10.2	Has an assessment of expected queue length been undertaken/documented ?	3.5.7(b)		
10.3	Has protection been provided where the end-of-queue is likely to be within D of the first downstream PTS sign ?	3.5.7(c)		
10.4	Is a sight distance between approaching motorists and the end-of-queue, being maintained at greater than 2D (open road areas) and 1.5D (built up areas) ?	3.5.7(c)		
10.5	Where the first PTS sign is more than 4D from the control point, are <i>repeater signs</i> placed at intervals of not more than 4D ?	3.5.7(c)		
10.6	Is the traffic queue monitored at all times during the course of the work ?	3.5.7(b)		
10.7	Other.			
COMMENTS ITEM 10				



11	Workers on foot near plant		Rating	
			1	2
11.1	Have workers working within 3 metres of plant been trained/briefed/tool-boxed on requirements of TCWS and RTA TIP Sheet ?	9.23		
11.2	Where workers are working close to revolving plant, are satisfactory risk controls in place ?	9.23		
11.3	Has a VMP been developed where the conditions listed in TCWS occur on site ?	9.23.1		
11.4	Are spotters being used near reversing plant or delivery vehicles ?	9.23		
11.5	Other			
COMMENTS ITEM 11				



12	Works Traffic (VMPs)		Rating	
			1	2
12.1	Have acceleration and deceleration lanes been provided ?	7.2		
12.2	Are U turns being undertaken safely ?	7.3		
12.3	Are reversing movements being undertaken safely ?	7.3		
12.4	Are signs provided for stock pile sites etc ?	7.7		
12.5	Are median crossovers being used correctly ?	7.8		
12.6	Has a VMP been approved and provided ? Written VMP shall be prepared in 100km/h zones.	7.5;7.6 9.23.1		
12.7	Does the person authorising the VMP have traffic control qualifications ? If so, what qualifications ?			
12.8	Have access and egress to the site been safely provided ?	7.2		
12.9	Are delivery vehicles required to report to a designated location/person ? Is it happening on site ?	9.23		
12.10	Other			
COMMENTS ITEM 12				



13	Miscellaneous		Rating	
			1	2
13.1	For intermittent work are all requirements met ?	9.1.2		
13.2	Where a spotter is used, are all requirements being met ?	9.1.2		
13.3	For mobile work are all requirements being met ?	9.1.7		
13.4	If the work is conducted at night are all requirements being met ?	9.2		
13.5	Where travelling plant or vehicles travel slower than 20 km/h below the normal road speed limit, do they comply with the requirements of TCWS ?	9.1.3, 9.1.10		
13.6	Other			
COMMENTS ITEM 13				
ADDITIONAL COMMENTS				
Signed (Inspector).....				

**DAILY CHECKLIST – TRAFFIC CONTROL AT
SHORT TERM WORK SITES**



SITE SUPERVISOR: _____ **DATE:** _____

REPORTING OFFICE/COMPANY: _____

SITE:	1		2		3		4	
TCP No:								
INSPECTION:	Pre- Start	Pre- Close	Pre- Start	Pre- Close	Pre- Close	Pre- Start	Pre- Close	Pre- Start
TIME: (24 hrs)								
<i>All signs used during the work are to be recorded below, using the following codes: Y – signs and devices are in place during pre-start check and between shifts. N – signs and devices are no longer required at pre-close down check. X – signs and devices are damaged, vandalised or missing.</i>								
Signs and devices:								
Traffic Signals – time operational	To		To		To		To	
Appr No								
Temp Speed – time operational	To		To		To		To	
Appr No								
Speed (km/h)								
Supervisor's Initials:								

SITE 1

SITE 2

SITE 3

SITE 4

**WEEKLY CHECKLIST – TRAFFIC CONTROL
AT LONG TERM WORK SITES**



REPORTING OFFICE/COMPANY

COMMENTS:



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Index

Advertising	3.5.1
Apply TCPs course	2.4.1
Around - worksite	3.1.2
Asphalt	
Milling	9.24.8
Paving	9.24.8
Barrier boards	3.3.1
Barriers – safety	9.6
Benkelman beam	9.16.2
Bituminous works	9.12
Bitumen sealing	9.24.9
Bollards	3.3.3
Spacing	5.2.2
BRIDGEWORK AHEAD	5.2.3
Clearances	
Edge	3.3.11
Safe	3.6
Shown on TCPs	3.6.7
Concrete paving	9.24.10
Cones	3.3.3
Spacing	5.2.2
Night works	9.2.3
Containment fence	3.3.2
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