ARUP

Preliminary Construction Transport Management Plan

Austral Public School

School Infrastructure NSW

14 February 2025

NSW GOVERNMENT | Education

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Document control

Consultant	Arup
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Distribution	CTPG: Rocco Bombardiere, Sophia Palmer SINSW: Zeeshan Ijaz Arup: Tessa Knox-Grant, James Turner, Annabel Kerr, Henry Zheng

Contents

1. Introduction

Introduction

Construction Traffic Management Plan for Austral Public School

This Preliminary Construction Traffic Management Plan has been prepared to support a Review of Environmental Factors (REF) for the Department of Education (DoE) for the upgrade of Austral Public School (APS) (the activity). The purpose of the REF is to assess the potential environmental impacts of the activity prescribed by *State Environmental Planning Policy (Transport and Infrastructure) 2021* (T&I SEPP) as “development permitted without consent” on land carried out by or on behalf of a public authority under Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The activity is to be undertaken pursuant to Chapter 3, Part 3.4, Section 3.37 of the T&I SEPP.

The proposed activity is for the upgrades to the existing APS at 205 Edmondson Avenue, Austral, NSW, 2179 (the site).

The purpose of this report is to outline the construction activities required for the Austral Public School and ensure they are safely delivered using a robust set of methodologies with no unplanned disruption to surrounding services.

Introduction

Traffic management objectives

The key aim of the Preliminary Construction Traffic Management Plan (PCTMP) is to ensure safe access to the school, and to minimise impacts to the surrounding transport network during construction. This report is subject to contractor development prior to construction.

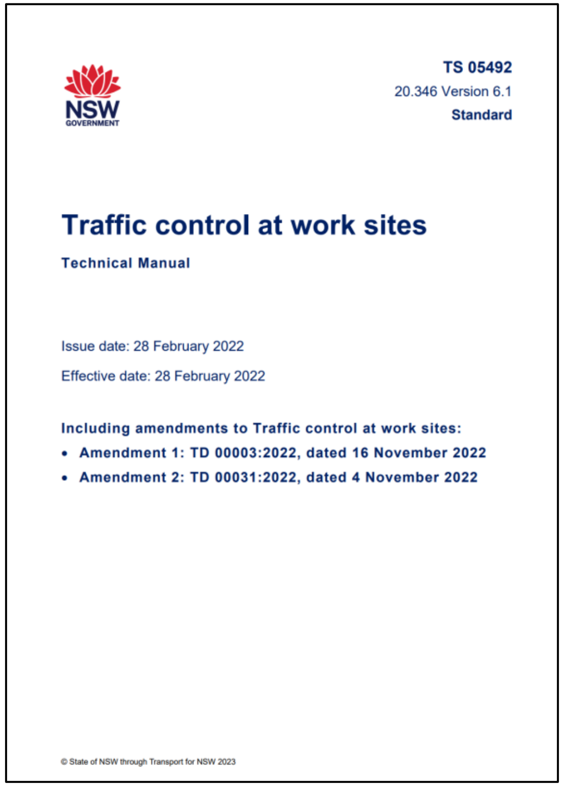
The following objectives have been developed in order to support the overarching aim of the PCTMP:

- Separate construction activities from public activities
- Ensure safety of pupils, staff and visitors of school, pedestrians, cyclists, construction workers, road users and the local community
- Minimise the overall impacts to all road users and conflict with construction vehicle. Assessment of traffic control plans
- Ensure minimal disruptions to public transport operations, including schedules, stop location and routes
- Minimise vehicle movements and arrange parking of work vehicles
- Minimise disruption to existing road furniture and kerbside provisions including existing bus stops, cycleways and on-street parking
- Maintain access for existing road users, including the local community, public transport operators, pedestrians and cyclists
- Ensure disruption to school and residents are minimised including appropriate consultation. Community notification process indicating impact of activity
- Comply with all relevant legislation and other requirements specified by relevant authorities

Introduction

Policies

- Traffic Control at Work Sites Manual (Transport for NSW, 2022)
- Australian Standard AS 1742.3 Manual of uniform traffic control devices Traffic control for works on roads (Standards Australia, 2019)
- Hoarding and Tower Crane Standard (Liverpool City Council, 2023)



TS 05492
20.346 Version 6.1
Standard

Traffic control at work sites

Technical Manual

Issue date: 28 February 2022

Effective date: 28 February 2022

Including amendments to Traffic control at work sites:

- **Amendment 1: TD 00003:2022, dated 16 November 2022**
- **Amendment 2: TD 00031:2022, dated 4 November 2022**

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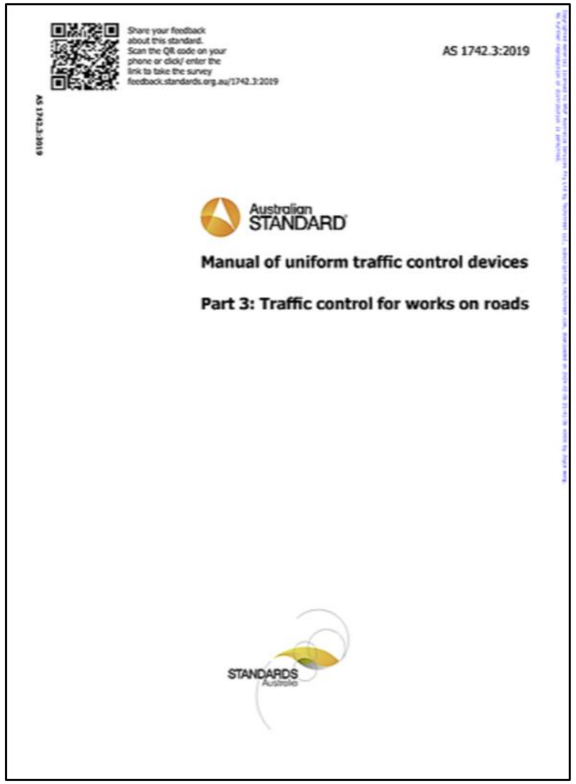


Share your feedback about this standard. Scan the QR code on your phone or click/ enter the link to take the survey feedback.standards.org.au/1742.3:2019

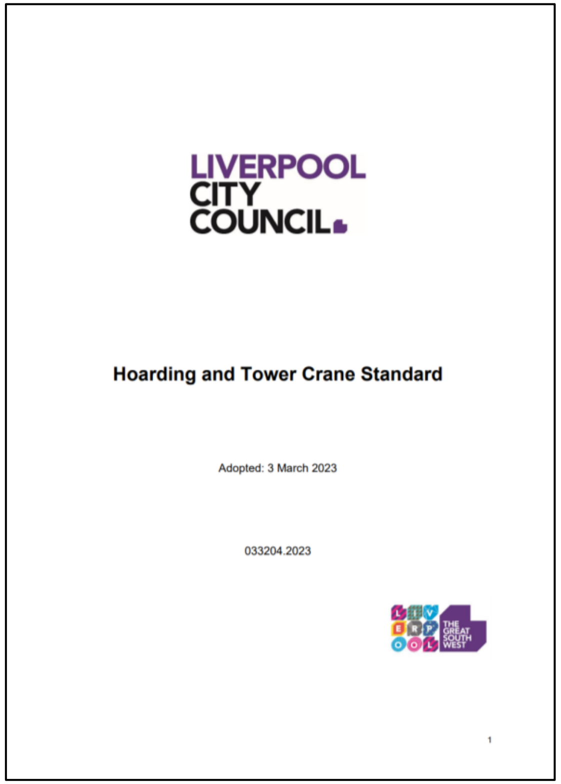
AS 1742.3:2019

Australian STANDARD

Manual of uniform traffic control devices

Part 3: Traffic control for works on roads

STANDARDS Australia



LIVERPOOL CITY COUNCIL

Hoarding and Tower Crane Standard

Adopted: 3 March 2023

033204.2023

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2. Existing site conditions

Site description

APS is located at 205 Edmondson Avenue, Austral on the south-eastern corner of the intersection between Edmondson Avenue and Tenth Avenue. The site has an area of 2.986 ha and comprises of 6 allotments, legally described as:

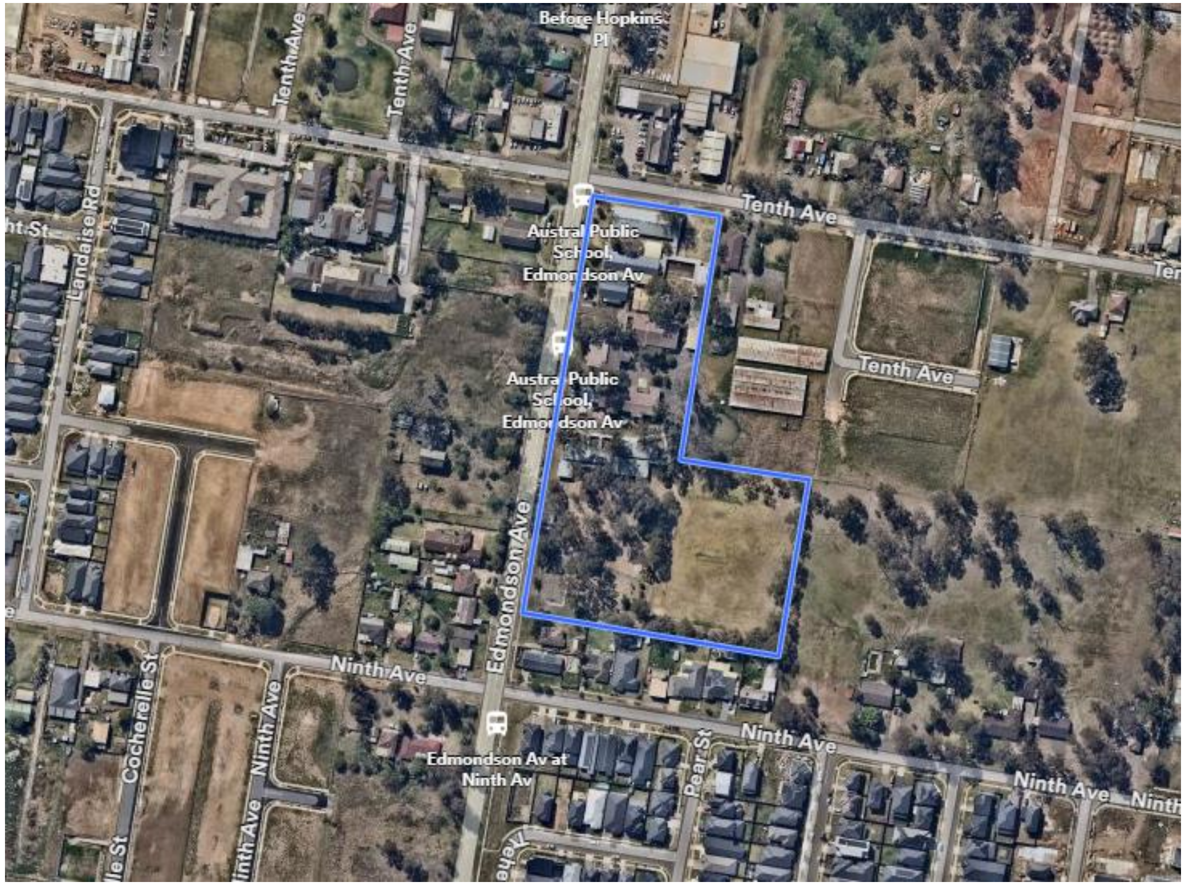
- Lot 1 DP 398105
- Lot 1 DP 398106
- Lot 1 DP 509613
- Lot 1 DP 512119
- Lot 2 DP 509613
- Lot 865 DP2475

The site currently comprises an existing co-educational primary (K-6) public school with:

- 8 permanent buildings;
- 14 demountable structures;
- interconnected paths;
- covered walkways;
- play areas: and
- at-grade parking.

The Austral Community Pre-school is also located within the site.

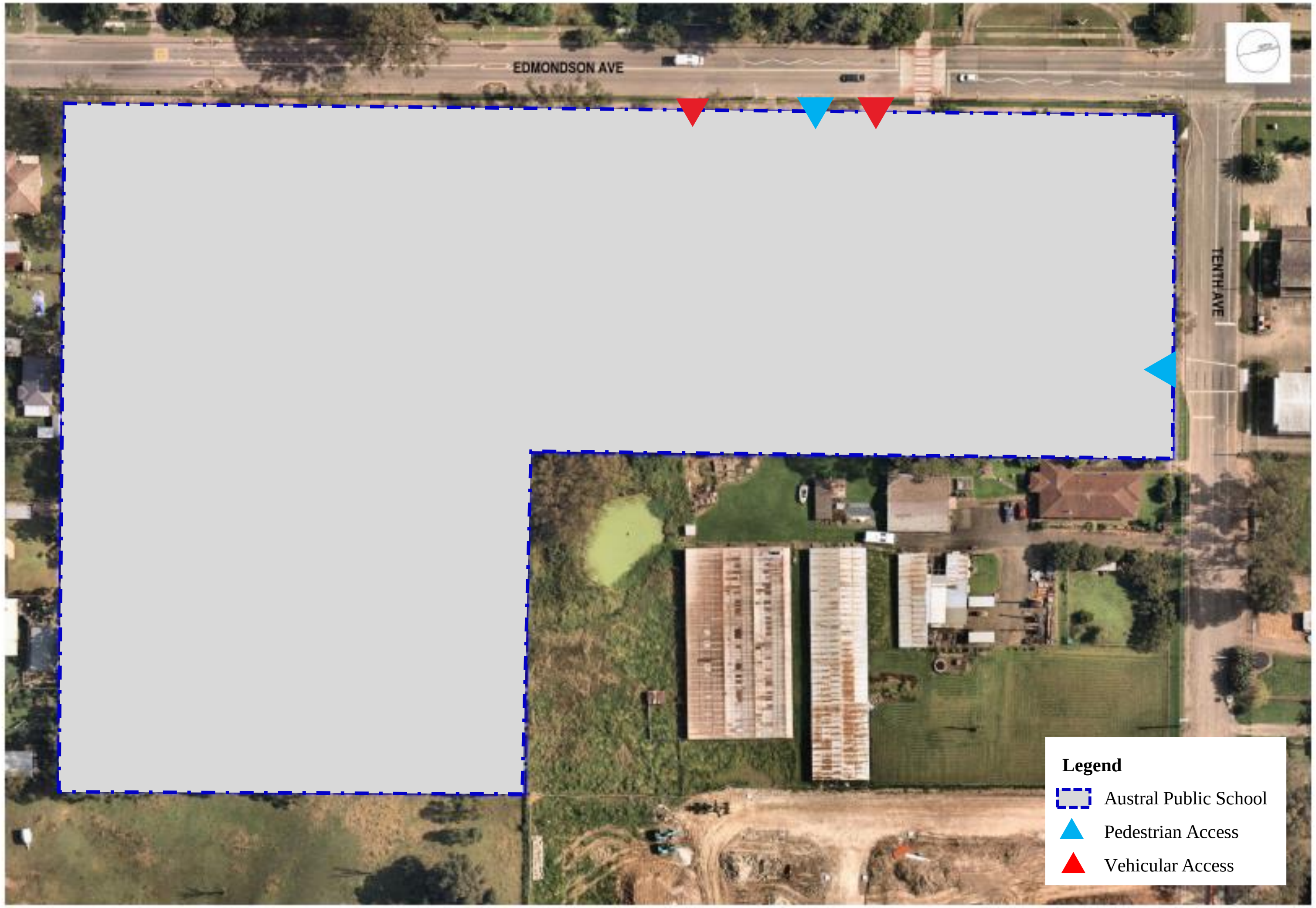
The existing buildings are clustered in the northern part of the site, ranging between 1 to 2 storeys in height. There is a sports oval in the south-eastern portion of the site, and a densely vegetated informal play area located in the south-western portion of the site.



Aerial image of site (source: NearMap, taken 7 Sept 2023)

Existing site conditions

School footprint and location



Existing site plan

Location
205 Edmondson Avenue, Austral NSW
Site area: 2.986 hectares

Site operation
OSHC AM: 06:30 – 08:45
School hours: 09:05 – 15:05
OSHC PM: 15:05 – 18:30

Current staff and pupil numbers
Staff: 40 full time and 23 part time
Pre-school: 30 pupils
Primary school: 681 pupils

3. Description of proposed works

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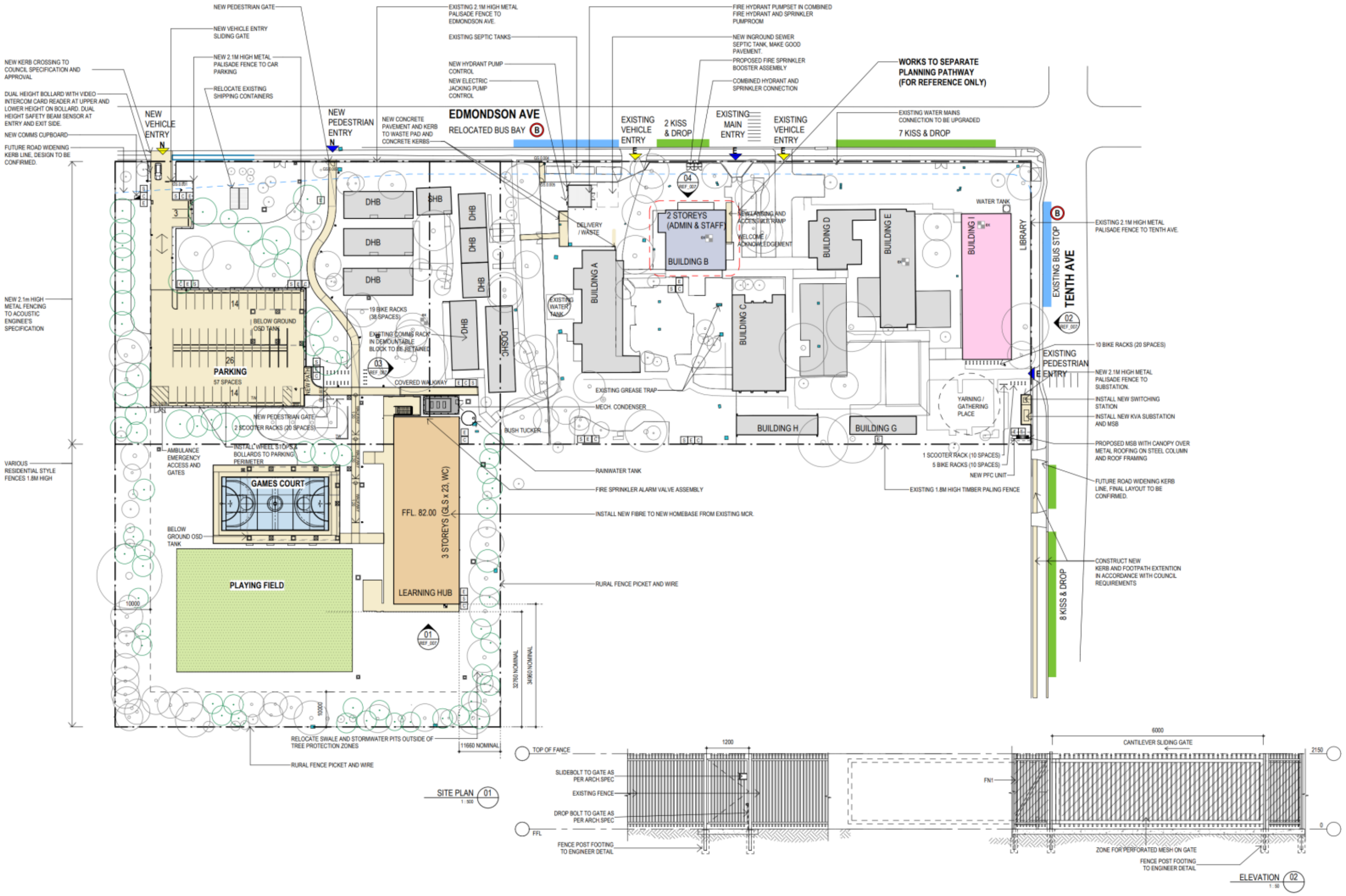
Proposed activity description

Proposed activity

The proposed activity involves alterations and additions to the existing APS, including the following:

- Demolition of existing structures and removal of trees, as well as other site preparation works;
- The erection of a new 3-storey building comprising teaching spaces that includes 20 permanent teaching spaces and 3 support teaching spaces;
- Refurbishment and change of school function of Building I from classrooms to a Library;
- At-grade parking (57 new spaces, including 1 accessible space);
- New driveway and access gate from Edmondson Road;
- Erection of a substation within the site on the northern boundary;
- Upgrade of the sports field;
- Internal pathways, fencing, utility upgrades and associated works; and
- Off-site public domain improvements including retention and upgrading of the Kiss & Drop area and a temporary pedestrian road crossing on Tenth Avenue.

The intent of the activity is to allow for upgrades to APS that will provide a CORE 35 primary school compliant with the EFSG. The works will increase the capacity of the school from 681 students and 40 FTE teachers to 734 students and 64 FTE teachers, respectively. Furthermore, provision within the expanded 734 student capacity will be made for the creation of 30 support class students places.



Proposed Site Plan (Source: Pedavoli Architects, Overall Site Plan Revision D)

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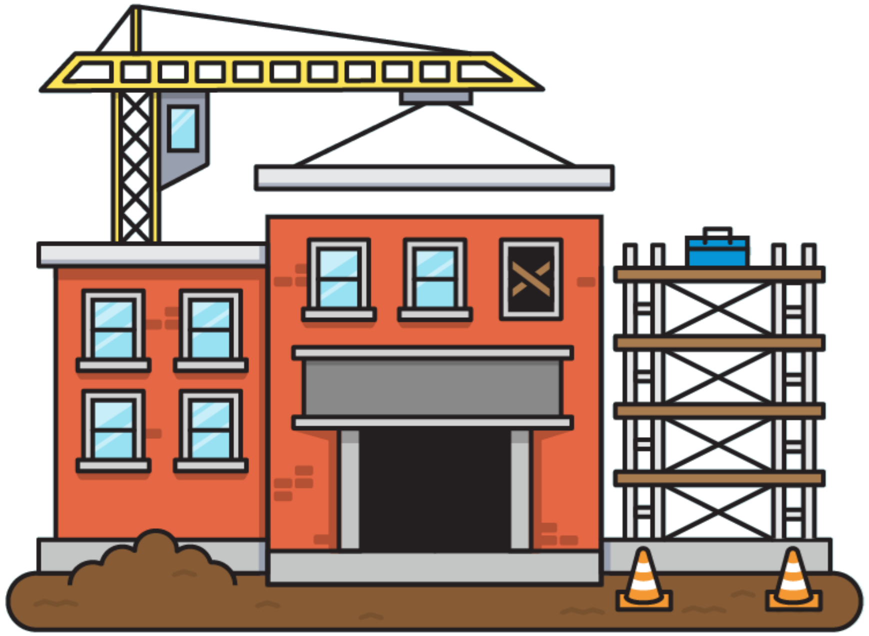
Description of proposed works

Peak construction movements

Construction vehicle volumes at similar construction sites

Project	Peak vehicles per day	Maximum vehicle size
Pendle Hill High School	32	19m
John Palmer Public School	20	19m
Fort Street Public School	50	13.6m
Average	34	12m
Maximum	50	19m



It is assumed that the average volume of construction vehicle traffic to and from the site would be consistent with other similar SINSW projects. More accurate data would be provided by an appointed contractor in a detailed Construction Traffic Management Plan prior to commencement of construction.

The contractor will be required to coordinate deliveries with the school and ensure pedestrian activity is minimised and controlled at delivery sites.

Maximum size of vehicle expected during peak construction:

19m semi-trailer

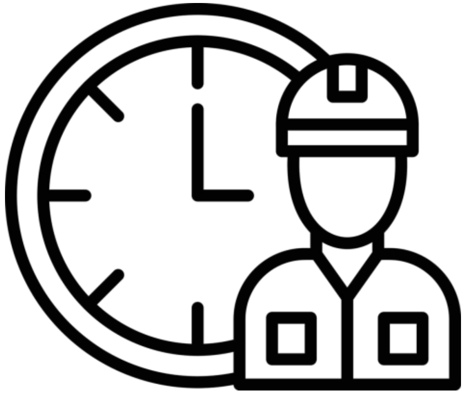
Larger vehicles may be subject to separate approval

Description of proposed works

Work hours

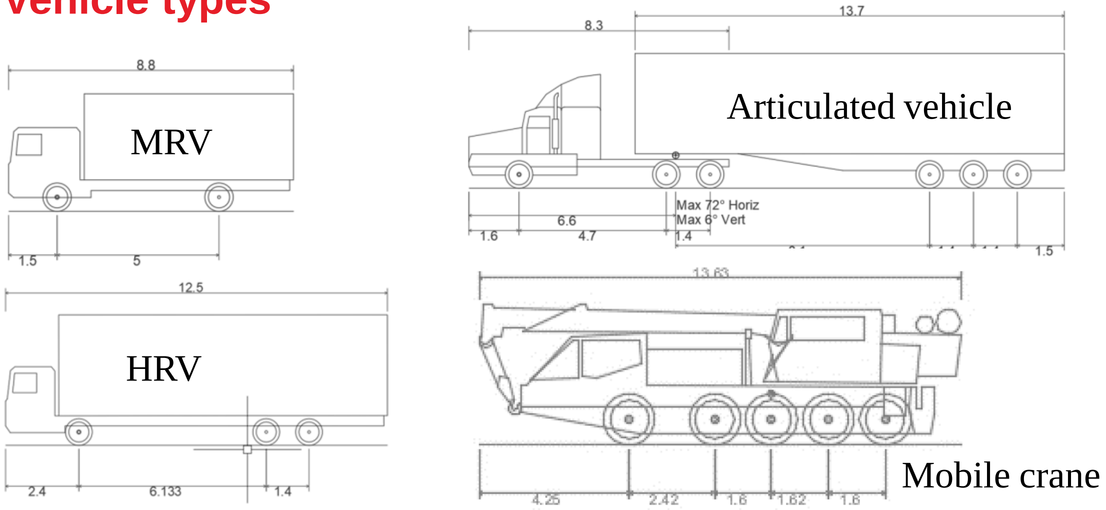
Demolition, excavation, and construction works, including the delivery of materials, will be undertaken in accordance with the conditions of approval for the REF and will generally be undertaken during the work hours below in line with Liverpool Council requirements:

- Monday to Friday: 7am to 6pm
- Saturday: 8am to 1pm
- Sunday and public holidays: No work permitted



All heavy goods such as machinery plants should be delivered outside of school pick up and drop off times, allowing a 30-minute buffer either side to minimise impact to pupils and school operation.

Vehicle types



The construction vehicles accessing the site will mainly comprise of Medium and Heavy Rigid vehicles (MRVs and HRVs).

It is expected that a one-off event with a 100-tonne mobile crane entering at the start of the construction and existing at the end of construction will be required.

During certain stages of construction, an articulated vehicle will also be used onsite.

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Description of proposed works

Construction methods

The new hub building located adjacent to games court will be built using methods of modern construction including a kit-of-parts. All elements are made off site and installed in tranches using a crane.

Link to SINSW website https://www.schoolinfrastructure.nsw.gov.au/what-we-do/we-build-schools/modern-construction-methods.html#content_3

Hoarding and fencing

During site establishment and construction of APS, the project is expected to use Type A hoarding in order to secure the boundary of the site.

The extents of the hoarding and fences will be within the project site and so, no impact is expected on Council roads.

Hoarding and fencing will be provided according to Liverpool City Council Hoarding and Tower Crane Standard. Hoardings will be used to secure the perimeter of the site from access.

Type A Hoarding means a site fence which encloses or isolates a development site from public areas primarily to restrict access from the public.

4. Project conditions and access

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Project conditions and access

Edmondson Avenue

Construction recommendations

- Deliveries to the school will need to be conducted **outside of peak school peak hours (08:00-09:30 and 14:30-16:00)** in order to minimise impact to pupils travelling to school and reduce the impact on the surrounding road network.
- **Traffic controllers will be required** for larger vehicles to ensure the safety and minimise pedestrian-vehicle conflicts along Edmondson Avenue.
- **Ensure public transport services would not be affected** by the works during school peak hours.
- Provide **dust monitoring** to minimise dust to protect the amenity of the school.

Project conditions and access

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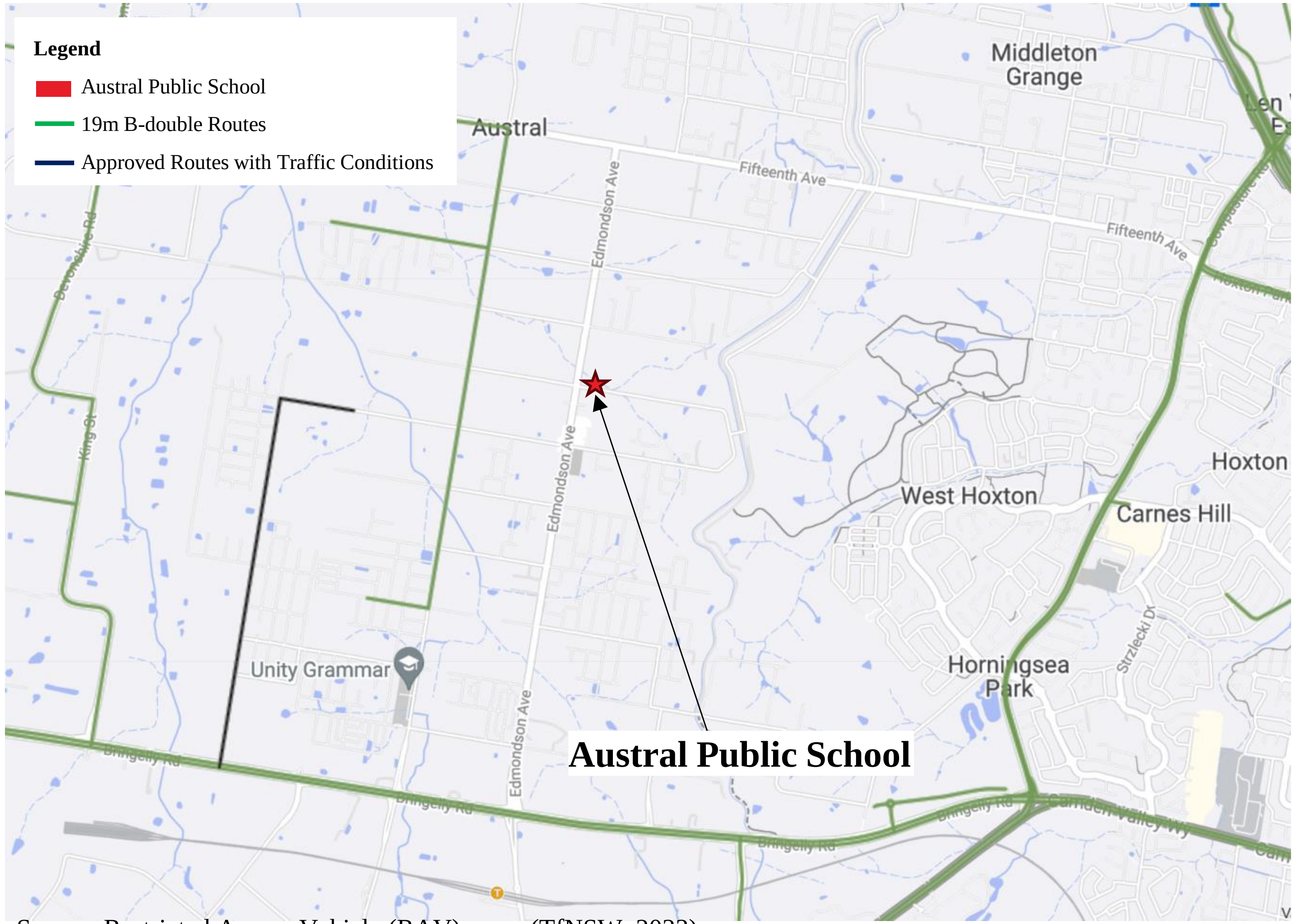
Heavy goods vehicles road hierarchy

To guide the appointed construction contractor(s), the figures below indicate appropriate haulage routes which consist of arterial roads and the Safety, Productivity and Environment Construction Transport Scheme (SPECTS) network.



Source: Restricted Access Vehicle (RAV) maps (TfNSW, 2023)

According to the RAV map on the left, Fifteenth Avenue, Fourth Avenue, Devonshire Road and Bringelly Road are classified as 19m B-double routes.

The proposed haulage routes during construction will mainly travel on the above 19m B-double routes and major roads in the area.

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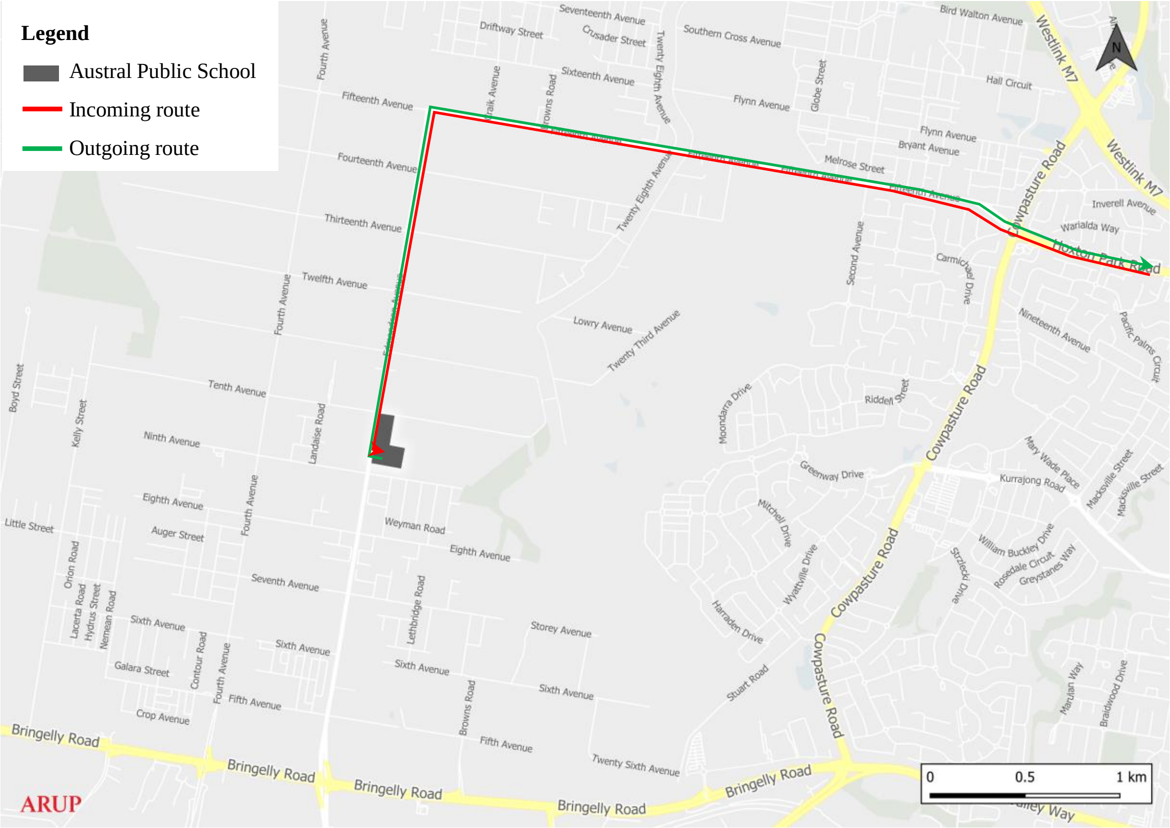
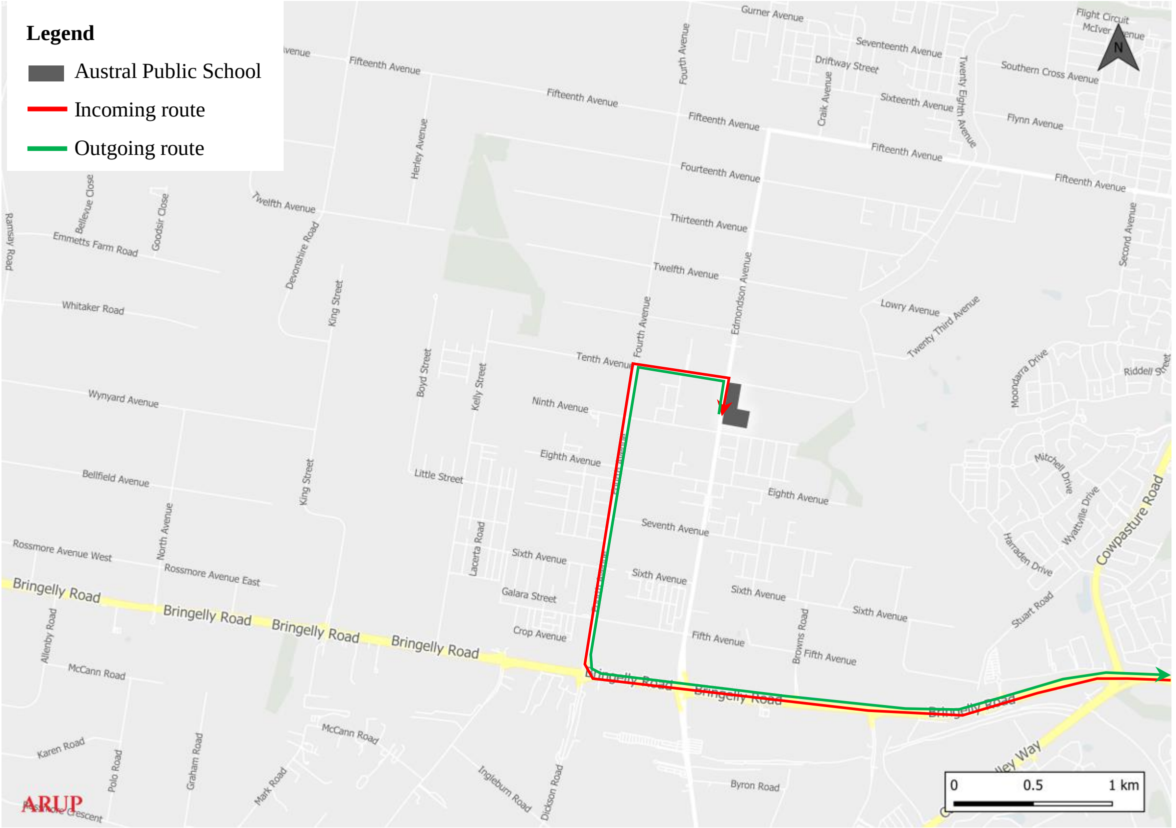
Project conditions and access

Construction vehicle routes



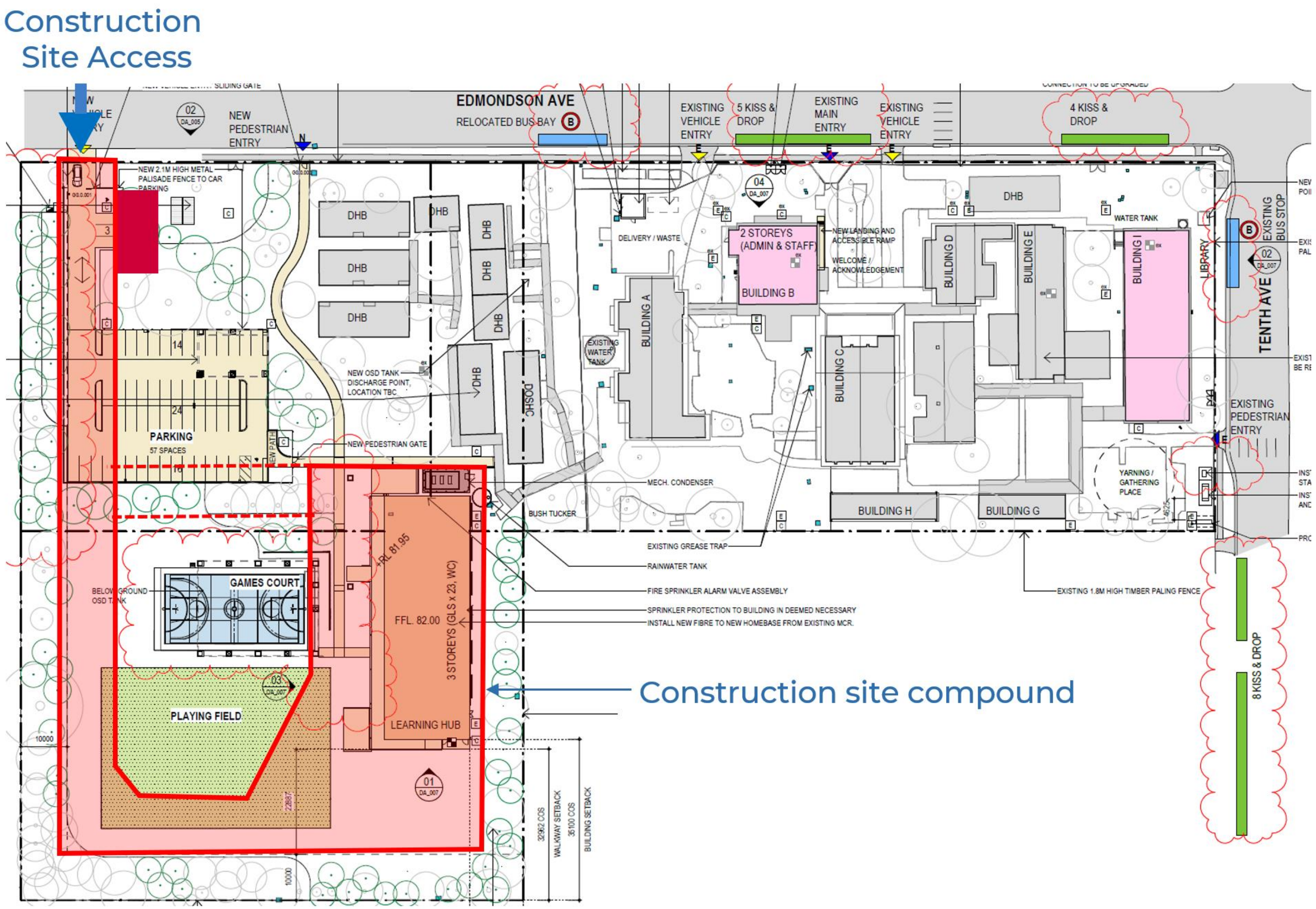
Typical routes



During Edmondson Avenue Upgrade Works (Stage 1)

Project conditions and access

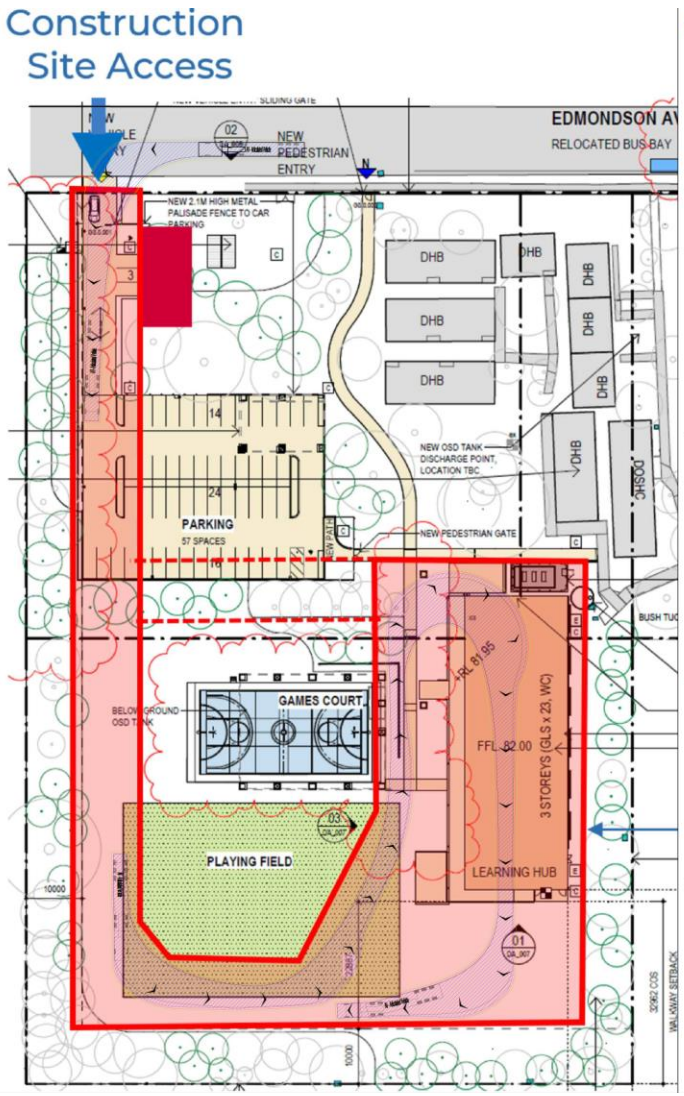
Preliminary vehicle access (subject to change)

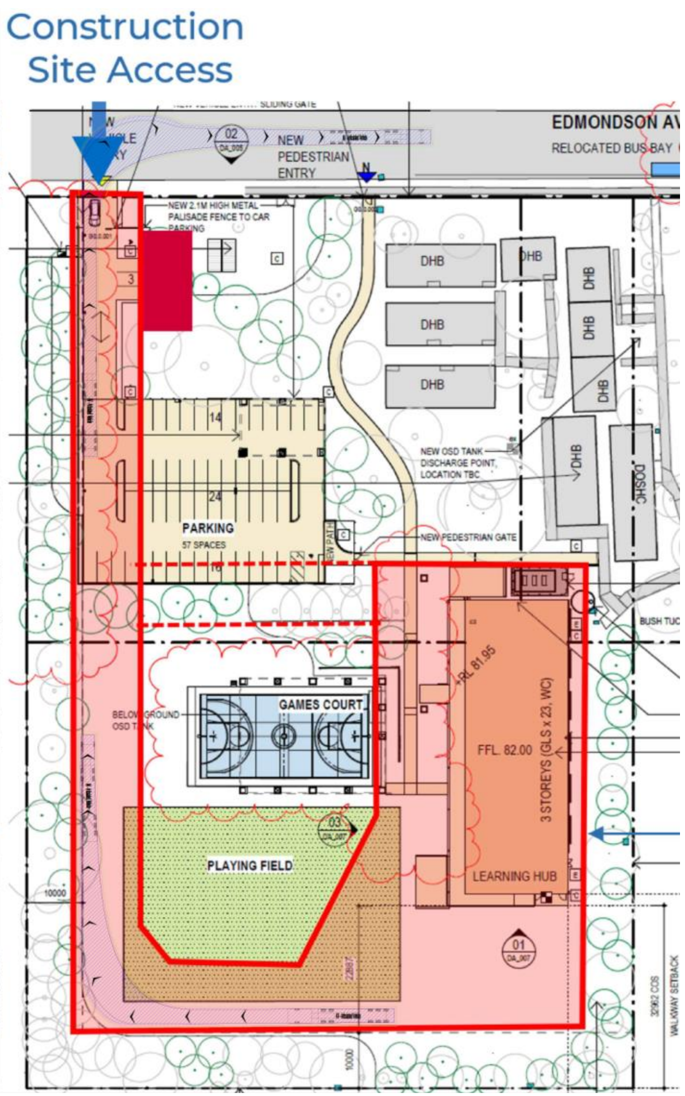


- The existing general vehicle access will be retained and not affected during school peak times between:
  - 8:00 – 9:30am
  - 2:30 – 4:00pm
- All heavy goods such as machinery plants should be delivered outside of school peak times listed above.
- The contractor will be required to coordinate deliveries with the school and ensure pedestrian activity is minimised and controlled at delivery sites.
- For site compounds which are expected to generate heavy vehicle movements, a designated area for unloading and pickup will be available within each work site. The contractor will implement traffic and pedestrian management at the site access via a designated operator.
- The proposed construction vehicle access routes do not travel on Tenth Avenue and will not interact with bus stops used for school coaches on Tenth Avenue.

Project conditions and access

Swept path analysis

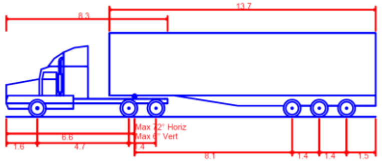




Legend

- Body Envelope
- 300mm Envelope
- 600mm Envelope
- Wheel Envelope

Design Vehicle(s)



AV - Articulated Vehicle

Overall Length	19.000m
Overall Width	2.500m
Overall Body Height	4.301m
Min Body Ground Clearance	0.418m
Track Width	2.500m
Lock to Lock Time	6.00 sec
Curb to Curb Turning Radius	12.500m

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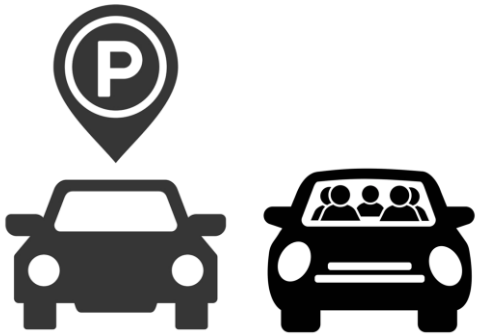
Project conditions and access

Worker access



The number of construction staff is yet to be agreed by the contractor as part of their detailed Construction Traffic Management Plan, as well as outlining avoiding interference with neighbours.

No parking will be allowed within the site for workers. The surrounding roads offer unrestricted on-street parking where parking is available. These spaces could be used by construction workers. Workers choosing to travel by car shall be responsible for finding their own parking and are to park in accordance with all signposted parking restrictions.

During construction of Edmondson Avenue immediate outside the school, workers will be encouraged to utilise public transport to and from the site. The site is within 2 mins walking distance of public bus stops along Edmondson Avenue which are serviced by the 855 and 861 bus routes, providing connectivity to Carnes Hill and Liverpool CBD. Leppington Train Station, which connects to Parramatta and Sydney CBD is located 2.3km south of the school, accessed by 855 bus route.

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Project conditions and access

Impacts to pedestrians and cyclists

Where work sites Avenue an impact on footpaths and shared paths, consideration must be given to the requirements of all pedestrians and cyclists, especially where there is the potential for vulnerable road users, such as school children, elderly people and mobility impaired users. The following measures will be considered to minimise impact to pedestrians and cyclists. The appointed design and construction contractor will determine the necessity of setting out demarcated work zones.

Carry out condition surveys of affected footpaths, including an assessment of the paving and lighting to ensure that they are suitable and appropriate for use.

Accredited traffic controllers will be required to ensure the safety and minimisation of pedestrian-vehicle conflicts along Edmondson Avenue (including driveways) and pedestrians on footpaths.

Hoardings or fences between public paths and where work is being undertaken, protecting pupils from accessing hazardous zones (likely to be type A)

Safety training to workers to ensure they are aware of all the traffic management strategies and controls.

Clear signage and entry points with lighting in accordance with current standards, and restricted access for construction workers only.

Communication with school to minimise heavy machinery noise and operation during school hours to minimise disruption to learning activities.

Travel coordinator will liaise with contractors, schools, parents and carers groups and develop a suitable travel plan during the construction.

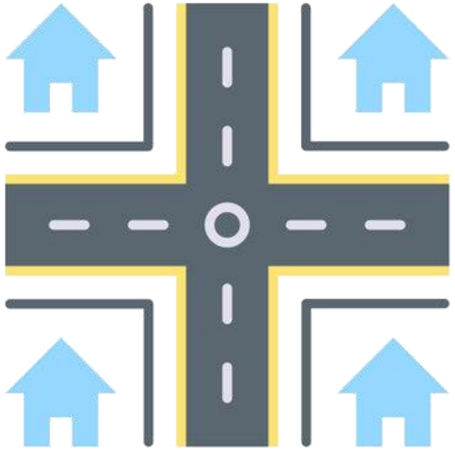
Project conditions and access

Impacts to public transport and road network

Public Transport

- There shall be no changes to local public transport routes and services because of construction of Austral Public School. Public transport may be affected as a result of the construction of Edmondson Avenue, subject to discussions with Council and Transport for NSW.

Road Network



- Given that construction workers are expected be on site by 7am, peak private vehicle arrivals are expected to be before the AM and school peak hours, minimising impact on the surrounding road network. The anticipated peak construction vehicle volumes are therefore unlikely to impact the surrounding transport network.
- It is likely that the increased traffic associated with the construction activities will have minimal impact on the existing road network, although the estimated average construction traffic volumes will be confirmed by the contractor as part of the detailed Construction Traffic Management Plan.
- The majority of the works will be carried out within the compounds of the school, minimising disruption to the external roads. The works will be undertaken outside of school term wherever possible to minimise impact to pupils and staff on site.
- Traffic controllers will also direct vehicles, when necessary, in and out of the site access.
- Emergency vehicle access to the school will be need to be provided via the existing servicing and delivery access off Edmondson Avenue.

5. Cumulative Impact Assessment

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Cumulative Impact Assessment

Cumulative Impact Assessment

Located in the South-West Growth Area (SWGA), the site and surrounding areas are poised for substantial growth and densification. Austral is undergoing significant change and transition following recent rezoning by the NSW Government. Numerous residential subdivisions in both the immediate and broader vicinity are set to reshape the area, further contributing to the evolving landscape. The impact of this population uplift on the surrounding transport and traffic network is considered in combination to the operation of the school.

Impact	Description
Queuing from construction vehicle traffic	• Road and intersection delays and queuing from construction vehicle movements. • Workers traveling by passenger vehicle will present as additional strain on the local road network.
Overflow parking onto surrounding streets	• No parking will be provided on site for construction workers. Vehicle parking demand from construction workers will reduce available street parking.
Obstruction of footpath and cycleways	• Hoarding may reduce the effective width of footpaths and disrupt the operation of cycleways and shared paths. Temporary traffic controls such as boom gates and traffic management to accommodate construction vehicle movements may also restrict pedestrian and cyclist movement.
Increased patronage on public transport	• Workers will present as additional strain on the public transport network.
Construction and demolition waste removal requires additional vehicle navigating local roads	• Waste from demolition and construction work will accumulate on site and overflow without management strategy.
High levels of noise produced by construction activity	• Noise pollution will disrupt student learning and the neighbourhood.

6. Mitigation Measures

Management measures

Management measures for drivers

Technology

Heavy vehicles equipped with safety technology and equipment to improve vehicle safety, visibility and the detection of vulnerable road users. Safety, Productivity and Environment Construction Transport provides further information on appropriate safety devices.

Training

Mandatory completion of heavy vehicle driver introduction training prior to accessing any work sites to ensure they are aware of all the traffic management strategies and controls. This may include haulage routes, potential changes, common road users and hazards / risks along the routes, entry and exit points, turning restrictions, unloading / pick up locations and any other onsite heavy vehicle requirements.

Information

The construction contractor(s) is to ensure that drivers are informed of any changes which may impact their route or access to a work site, particularly during the construction of Edmondson Avenue.

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Management measures

Traffic Control Plans

- The use of traffic controllers to control traffic at worksites may be required at the school to manage vehicles and pedestrian access points and should be in accordance with the Traffic Control at Work Sites Manual (TfNSW). Traffic controllers are accredited through Safe Work NSW.

- Variable message signs (VMS) and or signage may be used to inform drivers, where necessary, to avoid particular roads or areas where activities associated with the project would cause disruption. Where these are used, it is to be in accordance with documented Austroads Guidelines, TfNSW supplements, procedures, guidance and approval of the road authority. The placement of temporary VMS must consider pedestrian safety and disabled access needs when placed on footpaths VMS placement should conform to Austroads Guidelines, TfNSW supplementary material and approval processes of the road authority.
- Signage may be required is extended closure or timing is required.

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Mitigation Measures

Mitigation	Aspect	Mitigation measure	Reason for mitigation measure
Construction traffic management strategy	General measures to be determined prior to commencement of construction work	Vehicle movements will be organised to avoid peak hour and school times. The estimated average construction traffic volume will be confirmed by the contractor as part of the detailed Construction Traffic Management Plan. A form of materials booking system could be developed by the appointed contractor to assist with vehicle arrival and departure scheduling. This could be used as part of a strategy within the Construction Traffic Management Plan to avoid blockages and queuing at access points.	To reduce impact of construction vehicles on the road network.
Public transport guide	Prior to commencement of construction	Workers arriving by car should be encouraged to use public transport options and be provided information on various accessibility options available including the public transport options that connect to the site.	Encourage public transport use to reduce strain on on-street parking and road network.
Footpath condition surveys	Prior to and during Construction	Carry out a dilapidation survey and monitor the changes to footpath conditions to ensure footpaths continue to meet required standards.	Observe the condition of footpaths to correct damages.

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Mitigation Measures

Mitigation	Aspect	Mitigation measure	Reason for mitigation measure
Traffic management and engineering controls	Prior to and during construction	Traffic management controls are to be adopted to manage safety and interruption to pedestrians, vehicles and cyclists at the entrance to the site.	Control obstructions and minimise interference to paths, pedestrians and cyclists.
Construction and demolition waste management notifications	Prior to commencement of construction	Waste and contamination to be managed by the contractor, consolidated on site and notified to the RMS Traffic Management Centre so that waste vehicle transportation route from the site is planned prior to the commencement of waste and contaminated material removal.	Allows for the cataloguing, preparation and transportation of waste with appropriate materials handling.
Work zone identification	Prior to and during construction	The appointed design and construction contractor will determine the necessity of setting out demarcated work zones with clearly marked boundaries and signage.	Work zones would provide efficient and safe operation of construction activity with clear separation of construction activity and public use spaces.

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Supplementary details

Appendix A – Traffic Control at Work Sites

TS 05492

20.346 Version 6.1

Standard

Traffic control at work sites

Technical Manual

Issue date: 28 February 2022

Effective date: 28 February 2022

Including amendments to Traffic control at work sites:

- **Amendment 1: TD 00003:2022, dated 16 November 2022**
- **Amendment 2: TD 00031:2022, dated 4 November 2022**

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www.transport.nsw.gov.au

Technical Direction – TD 00003:2022

Issue date: 16 November 2022

Effective date: 16 November 2022

Title: Traffic control at work sites

This technical direction is issued by the Asset Management Branch (AMB), formerly known as the Asset Standards Authority (ASA), as an update to *Traffic control at work sites*, version 6.1.

The update includes amendments to the following provisions:

- providing for pedestrians
- sign posting traffic hazards before rectification works can take place
- sequence for installation and removal of signs and devices:
    - use of automated work vehicles as work site plant, including automatic cone placement trucks
    - motorways and other high-risk, multi-lane environments
- projected pavement arrows
- minor change to table caption
- traffic guidance scheme approval personnel.

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1 Amendment to *Traffic control at work sites, v6.1*

The following sections in *Traffic control at work sites* are to be amended as follows:

Section 4.4.2 Pedestrians

Replace the Requirement column for Footpaths in Table 4–4 as follows:

Table 4–4 – Planning considerations for pedestrians

Consideration	Requirement
Footpaths	Temporary footpaths must provide a clear path of travel and must be: • Adequately and clearly signposted to support pedestrian wayfinding to /from the existing pedestrian facilities. • Of all weather standard including ramps over gutters that can have water velocities above 1 m/s. • Of equivalent material, surface condition and performance to the adjacent footpaths and not pose a trip hazard for the range of pedestrians. • At local constrictions, not less than 1 m width. Elsewhere a width of at least 2 m must be provided and any additional width to aid stopping sight distance to all road users. Additional width should be provided where this is a point of concentration or peak flows of pedestrians, such as in front of shops and schools, at bus and light-rail stops, railway stations and at pedestrian crossing points in medians. TTM signs and devices must not obstruct or reduce the width of an existing or temporary footpath to less than 1 m wide unless an alternative facility is provided for pedestrians.

Section 4.4.4 Motorcyclists

Replace the requirement for road surfaces, grooved roads and other hazards in their entirety with the following:

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Table 4–6 – Considerations when planning for works impacting motorcycles

Consideration	Requirement
Road surfaces	Surface changes can be critical to motorcycle stability and so, surface changes must be signposted well in advance so that a motorcyclist is not forced to take rapid or unexpected evasive action. This may include: • Use of the GRAVEL ROAD (T3-13) sign where sections of sealed roads are temporarily reduced to gravel. • Use of other surface condition signs such as ROUGH SURFACE (T3-7), Loose stones symbolic (T3-9), LOOSE SURFACE (T3-14) or POTHOLES symbolic (T3-219n). • Use of the SLIPPERY symbolic (T3-3) sign to indicate a wet surface. • Use of TRAFFIC HAZARD (T1-10) sign when there is no other more relevant sign. • Use of appropriate warning signage prior to and after the hazard, such the TRAFFIC HAZARD AHEAD (T1-10-1n) sign and the END TRAFFIC HAZARD (T1-10-2n) sign. • Use of appropriate signage, such as Temporary Portable Rumble Strip Ahead symbolic (T5-210n) sign or Boom Barrier AHEAD (T1-272n) sign to warn of specific traffic management changes.
Grooved roads	Milling of roads prior to resurfacing can present a hazard to motorcyclists. Where road surfaces are grooved, CYCLE HAZARD GROOVED ROAD (T2-207n) signs must 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.
Other hazards	• Materials, installation and maintenance of steel plates (road plates) used to cover excavations must comply with the QA Specification M209. • Water which drains from roadworks, should not run across traffic lanes to a depth greater than 5 mm.

Section 6.4 Sequence for installation and removal of signs and devices

Replace the contents of Section 6.4 in their entirety with the following:

Section 6.4.1 General

The sequence for installation and removal of signs and devices must be considered in the TMP and documented in the TGS or another site document such as a SWMS. The installation and removal of signs and devices must:

- Be undertaken in accordance with the procedures, sequence, signs and devices shown on the relevant TGS or detailed in the SWMS.
- Be carried out in a forward direction in the advance warning area, starting on the approaches to the work site and progressing towards the work area, unless shown otherwise on the TGS or documented in the SWMS.

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- Not require workers to cross roads or multiple travel lanes on foot.
- Be undertaken with a work vehicle with a flashing arrow or rotating/flashing light(s) positioned between the workers and approaching traffic.
- Not commence until there has been an onsite (pre-start) review of the risk assessment and verification by the ITCP or PWZTMP qualified person that the TGS is still appropriate to implement.

The *hierarchy of controls* framework for risk management must be considered and applied for the installation and removal of TTM devices. Where appropriate, this includes the prioritised use of:

1. automated work vehicles (see Section 6.4.2)
2. pod-trucks that eliminate or reduce the need for worker/s on foot
3. worker/s on foot with a spotter.

Section 6.4.2 Use of automated work vehicles as work site plant

Automated work vehicles, such as automated cone placement trucks, may be used for the installation and removal of traffic control devices, where considered appropriate to safely undertake the works, such as at high risk sites.

Automated work vehicles can reduce or eliminate risk to workers who may be otherwise exposed to live traffic.

However, their use must be:

- risk assessed
- documented in the TMP
- included in the relevant TGS.

The use of automated work vehicles must be considered in the work site SWMS. The SWMS must include the risks introduced and proposed mitigation measures (such as, a tail vehicle to prevent traffic overtaking where the cone grabber arm encroaches into a live traffic lane) as well as the risks intended to be eliminated or substituted through the use of the plant.

Section 6.4.3 Installation

Section 6.4.3.1 General

Before work commences, the installation of signs and devices at the work site must be safely sequenced. Section 6.4.3.2 to Section 6.4.3.4. provide the general procedures for the installation of TTM signs and devices.

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Section 6.4.3.2 Two-lane, two-way roads

For two-lane, two-way roads, installation should be carried out in the following order:

1. Install termination signs and devices (affected direction and side streets).
2. Install remaining signs and devices on side streets if applicable.
3. Install signs and devices in the non-working lane (unaffected direction).
4. Install signs and devices in the working lane (affected direction).

The sequence of installation should be as illustrated in Figure 6-3 in the following order:

1. Circled numeral 1: Install the termination signs when initially leaving work area, 'End Road Work/speed reinstatement' (affected direction).
2. Circled numeral 2: Use the existing road network to turn where safe to do so.
3. Circled numerals 3 to 7: Place approach signs in unaffected direction, including the PTCD (traffic controller to remain with the PTCD).
4. Circled numeral 8: Install 'End Road Work/speed reinstatement' (unaffected direction).
5. Circled numeral 9: Use the existing road network to turn where safe to do so.
6. Circled numerals 10 to 14: Place approach signs in the affected direction, including the PTCD (traffic controller to remain with PTCD).
7. Circled numerals 15 and 16: Traffic controller/s to stop traffic and taper/lane closure delineation implemented.
8. Circled numeral 17: ITCP qualified person completes drive around to confirm TGS is installed as designed.

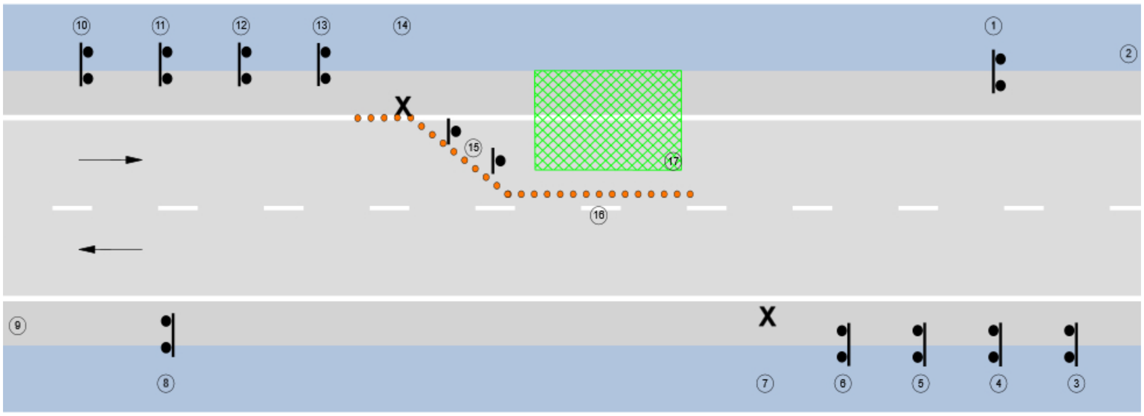

Figure 6-3 Example sign installation sequence for a two-lane, two-way road

Section 6.4.3.3 Multi-lane roads

For multi-lane roads, installation should occur in the following order:

1. Install signs and devices for the non-working lane (unaffected lane).

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2. Install signs and devices for the working lane (affected lane).

The installation of signs on central medians of multi-lane divided carriageways increases the risk profile of the activity. In such cases, a site-specific TGS with either static work or a dynamic works convoy must be used.

The sequence of installation should be as illustrated in Figure 6-4 in the following order:

1. Circled numeral 1: Locate advance warning vehicle and TMA to shadow sign installation vehicle.
2. Circled numerals 2 to 5: Install advance warning signs in unaffected lane.
3. Circled numeral 6: Install 'End Roadwork'/speed reinstatement.
4. Circled numeral 7: Use the existing road network to turn where safe to do so.
5. Circled numeral 8: Locate advance warning vehicle and TMA to shadow sign installation vehicle.
6. Circled numerals 9 to 12: Install advance warning signs in obstructed (affected) lane.
7. Circled numeral 13: Install 'Flashing Arrow' and delineation devices on approach to start of taper.
8. Circled numeral 14: Position TMA in travel lane to shadow installation of taper.
9. Circled numerals 14 and 15: Install taper and delineation devices to form taper, safety buffer and past work area.
10. Circled numeral 16: Install 'End Roadwork'/speed reinstatement.
11. Circled numeral 17: Use the existing road network to turn where safe to do so.
12. Circled numeral 18: TMA positioned to shadow work area.
13. Circled numeral 19: ITCP qualified person completes drive around to confirm TGS is installed as designed.

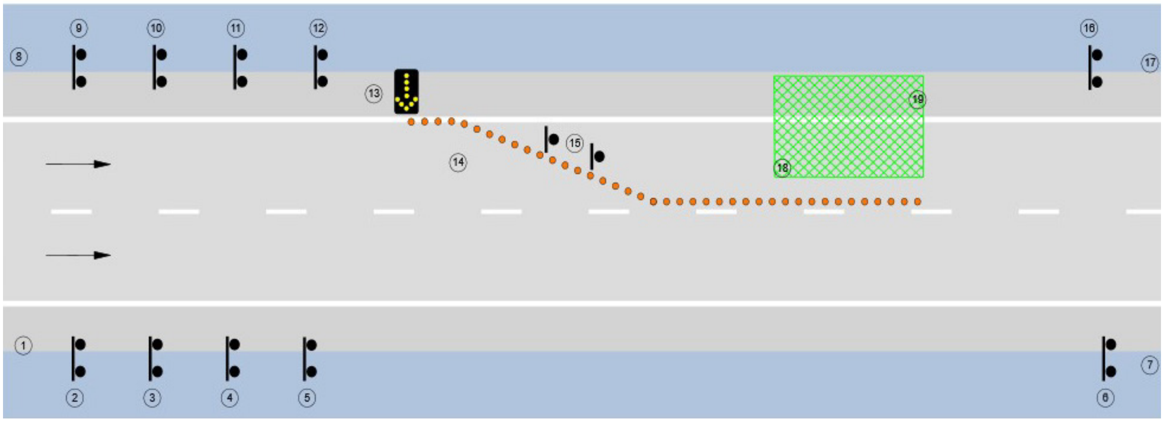

Figure 6-4 Example sign installation sequence for a multi-lane road

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Where a work area is moving progressively along the road, relocation of the signs and devices located in advance of the work area should take place in accordance with the sequence described in this Section.

For long-term or recurring short-term sites, consideration should be given to the use of VMS for displaying static images that need to be repeatedly displayed during work hours and removed at the end of each shift, see Section 6.9.1.2. If static signs are used, they should be installed on posts or their location should be marked for easy placement.

Section 6.4.3.4 Motorways and other high-risk multi-lane environments

The requirements in this Section must be applied when installing signs and devices on any part of the designated roads listed in Table 6-20. These requirements should also be applied to roads not included on Table 6-20, but meet all of the following high-risk multi-lane road criteria:

- multi-lane road
- posted speed limit greater than 85 km/h
- greater than 10,000 vpd.

As part of the risk assessment process, consideration should still be given to applying these requirements on other high speed multi-lane roads even though the road may not meet the above traffic volume criteria.

The planning requirements and recommendations provided in Table 6-4 apply to the installation of signs and devices.

Table 6–4 – Planning requirements and recommendations for installation

Item	Provision/s
Risk assessment	A site-specific risk assessment must consider the risks involved in each stage of the installation process and identify the controls necessary to eliminate or minimise those risks.
TGS and documentation	A site-specific process for installation of signs and devices must be shown on the static works TGS or on a supplementary TGS by providing a numbered sequence for installation of the signs and devices. A SWMS or other generic document that applies to any location does not meet the above requirement for documenting how the static works TGS will be installed.
TGS design and approval	Both the primary TGS and (where used) the supplementary TGS for the installation of primary TGS must be approved and verified in accordance with Section 7.9.

Item	Provision/s
Co-ordination	There must be full co-ordination of any Intelligent Transport Systems (ITS) infrastructure that may assist with the TGS installation, and must be documented on the TGS. For example, this may involve the placement of advance warning messages on permanent variable message signs and/or a reduction of the speed limit where variable speed limit signs (VSLS) are provided.

The operational requirements and recommendations provided in Table 6-5 apply to the installation of signs and devices.

Table 6–5 Operational requirements and recommendations for installation

Item	Provision/s
Advance warning vehicle	At least one advanced warning vehicle must precede the TMA (acting as shadow vehicle). The advance warning vehicle must be fitted with a VMS. The VMS size must be in accordance with Section 6.5.3. During installation of the taper, or when the TMA is otherwise occupying an open trafficable lane, the advance warning vehicle should regularly communicate with heavy vehicle drivers via UHF radio and provide verbal advance warning of the TTM operation. The advanced warning vehicle must be in the road shoulder, offset from the travel lane edge line by at least 2.0 m. Offsets from the travel lane edge line of less than 2.0 m may be used, provided an additional TMA is used as the advance warning vehicle.
Shadow vehicle	A TMA must be used to shadow the traffic control vehicle and workers on foot. A TMA must not be located in the travel lane, unless: • the TMA is protecting TTM personnel who are in the process of placing signs and devices to form the taper • the TMA is located inside the lane closure (behind the taper) • the installation activity is carried out using a dynamic (mobile) works convoy in accordance with Section 7.8.4.4.
Number of vehicles	Additional, suitably sized vehicles must be in place if gaps in traffic are insufficient for the TMA to appropriately shadow the traffic control vehicle and workers on foot continually.
Duplication of signs	As part of the risk assessment process, consideration must be given to whether it is appropriate to duplicate key signs (that is, lane status, speed limit, road work ahead and so on) on the median or on the shoulder.

The installation of signs and devices on central medians on motorways and other high risk multi-lane environments increases the risk profile of the activity. In such cases, a site-specific TGS with either static work or a dynamic works convoy must be used.

The following process details the stages and steps that should be followed to install and remove a static lane closure on a motorway or other high-risk multi-lane environment. For clarity, the process, steps and diagrams have been simplified by only explaining one possible lane closure scenario, omitting some of the required signs and assuming that signs are not duplicated in the median. Other scenarios such as a right lane closure, multiple lane closures or the duplication of signs in the median will require a modified process.

The four defined stages of the installation of TGS (in order of installation) are:

1. Stage 1 – Advance warning area
2. Stage 2 – Arrow board and pre-taper
3. Stage 3 – Taper and lane closure
4. Stage 4 – Lane closure and end of road work signs

Stage 1 – Advance warning area

The following steps must be undertaken for Stage 1 – Advance warning area as indicated by the circled numerals in Figure 6-5:

1. The advance warning vehicle must be positioned at least 2.0 m from the travel lane edge line. The advance warning vehicle must remain at a nominated location, with its VMS switched to Roadwork Ahead sign and work site speed zone sign to indicate commencement of the advance warning area.
2. The TMA must be positioned clear of the travel lane edge line, acting as a shadow vehicle for traffic control vehicle and workers on foot during sign and device installation. The TMA must be located no closer than 30 m from the installation activity.
3. The traffic control vehicle must be positioned no closer than 0.5 m from the travel lane edge line.
4. As the installation progresses, the TMA may leapfrog installed signs and devices provided there is adequate sight distance and gaps in traffic.
5. An additional, suitably sized vehicle must be in place if gaps in traffic are insufficient for the TMA to appropriately shadow the traffic control vehicle and workers on foot continually. Consideration should be given to using a second TMA as this additional vehicle.

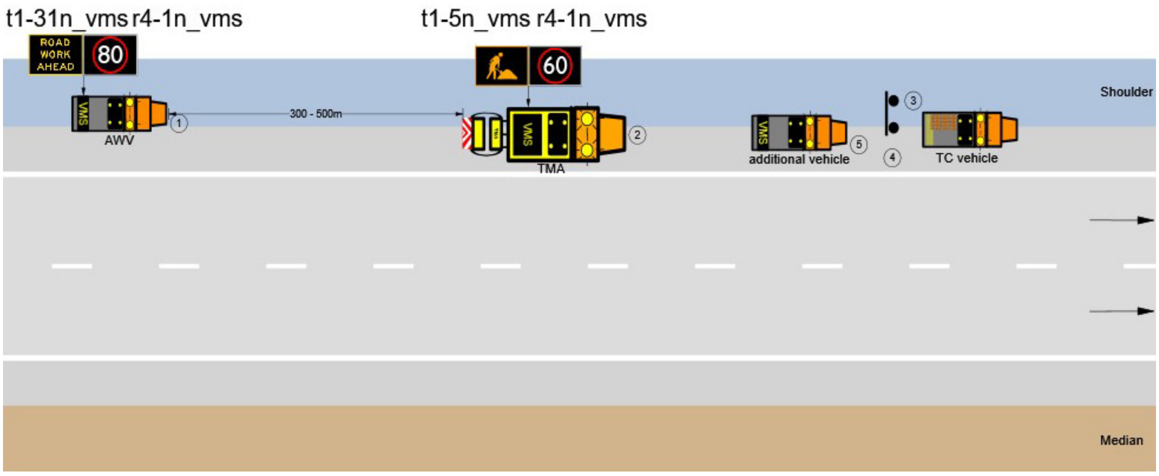

Figure 6–5 – Installation Stage 1: Advance warning area

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Stage 2 – Arrow board and pre-taper

The following steps must be undertaken for Stage 2 – Arrow board and pre-taper as indicated by the circled numerals in Figure 6-6:

1. The advance warning vehicle must remain in its position at the commencement of the advance warning area* and be positioned at least 2.0 m from the travel lane edge line. As soon as the traffic control vehicle reaches the arrow board position, the advance warning vehicle must switch its VMS to the Roadwork 1km Ahead sign and work site speed zone sign.
2. The final Lane Status sign(s) must be located not closer than D from the commencement of the taper.
3. At *TMA position 1*, the TMA must shadow the traffic control vehicle and workers on foot as the arrow board sign is installed (this includes shadowing their exit from/entry to the traffic control vehicle).
4. The arrow board sign is installed and four cones at 12 m spacing, placed outside the edge line in advance of the taper.
5. At *TMA position 2*, the TMA must then move into the nearest travel lane to shadow the traffic control vehicle and workers on foot as they install the taper, from (6). See Section 6.4.1 for hierarchy of controls.

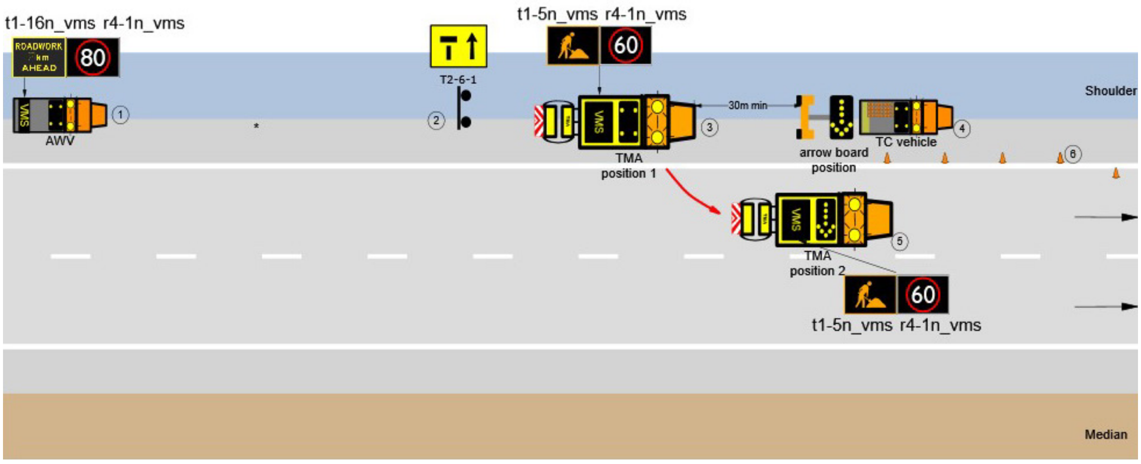

Figure 6–6 – Installation Stage 2: Arrow board and pre-taper

Stage 3 – Taper and lane closure

The following steps must be undertaken for Stage 3 – Taper and lane closure as indicated by the circled numerals in Figure 6-7:

1. The advance warning vehicle must remain in its position at the commencement of the advance warning area*, be positioned at least 2.0 m from the travel lane edge line and continue to display the Roadwork 1km Ahead sign and work site speed zone sign on its VMS.
2. The arrow board must clearly display the required merging movement.

3. At *TMA position 2*, the TMA must remain in the nearest travel lane to shadow the traffic control vehicle and workers on foot as the taper length is installed in accordance with Section 7.6.2.2, with the first cone (of the taper) placed 12 m from the last advance taper cone.

4. Appropriately spaced Hazard Warning Marker signs must also be installed.

5. After the taper is installed, the TMA must then move into *TMA position 3* via the shoulder.

6. The TMA must then remain as a shadow vehicle to the traffic control vehicle and workers on foot as the sign and device installation activity progresses in the partially closed lane. The TMA must not be located closer than 30 m from the installation activity.

7. The traffic control vehicle and workers on foot move along the partially closed lane and install delineation devices next to the lane line.

   Note: For a closure of more than one lane and the installation of additional tapers, an additional arrow board and TMA must be used. Steps 2 to 6 above are repeated.

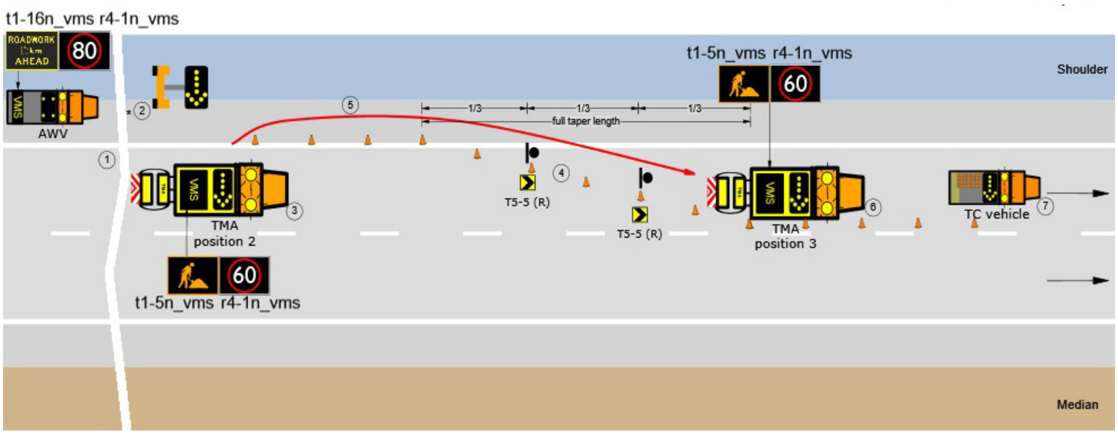

Figure 6–7 Installation Stage 3: Taper and lane closure

Stage 4 - Lane closure and end road work

The following steps must be undertaken for Stage 4 - Lane closure and end road works as indicated by the circled numerals in Figure 6-8:

1. The advance warning vehicle must remain in its position at the commencement of the advance warning area*, be positioned at least 2.0 m from the travel lane edge line, and continue to display the Roadwork 1km Ahead sign and work site speed zone sign on its VMS.

2. The arrow board must remain in its position at the start of the taper and clearly display the required merging movement. The taper length must be installed in accordance with Section 7.6.2.2.

3. To indicate the lane closure, barrier boards must be installed at a maximum spacing of 100 m.

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4. The TMA must remain as a shadow vehicle to the traffic control vehicle and workers on foot as the sign and device installation activity progresses at (5). The TMA must not be located closer than 30 m from the installation activity.
5. The traffic control vehicle and workers on foot move along the partially closed lane and install delineation devices next to the lane line.
6. The End Roadwork sign must then be installed accompanied by the reinstated speed limit sign no further than D metres from the farthest worker on foot or plant item.
7. The TMA must remain as a shadow vehicle for the work area. The TMA must not be located closer than 30 m from the work area.

ITCP qualified person must then complete a drive around to confirm that the TGS is installed as designed.

The advance warning vehicle must remain in place for the duration of the road work operations and during the removal sequence.

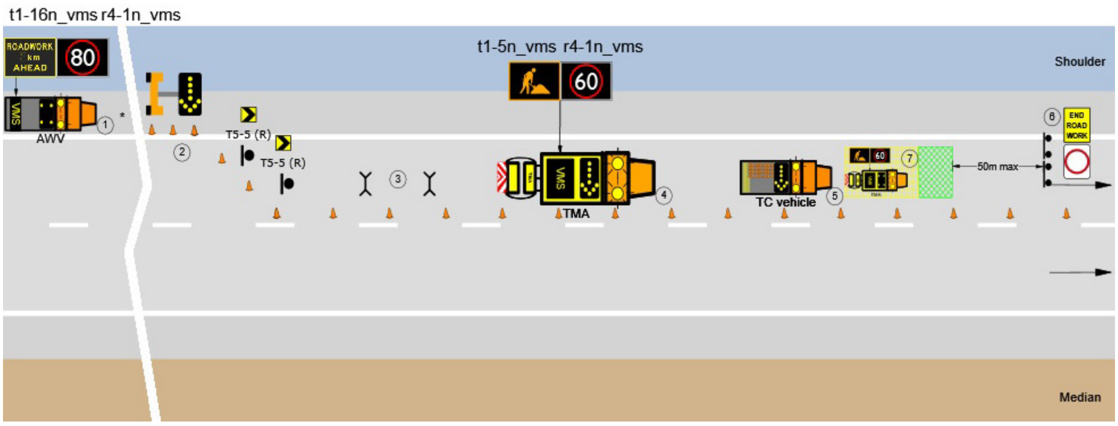

Figure 6-8 Installation Stage 4: Lane closure and end roadworks

Section 6.4.4 Removal

Section 6.4.4.1 General

When work is complete, the removal of signs and devices at the work site must be safely sequenced. Section 6.4.4.2 and Section 6.4.4.3 provide the general procedures for the removal of TTM signs and devices.

Section 6.4.4.2 Non-motorway and other non-high risk multi-lane environments

The following general requirements and recommendations apply to the removal of signs and devices on non-motorway and other non-high-risk multi-lane environments (such as two-lane, two-way roads or low risk multi-lane roads):

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- Unless shown otherwise on the TGS or documented in the SWMS, the removal of devices should be undertaken in the reverse order of installation, progressing from the work area out toward the approaches.
- When removing delineation devices, such as cones, bollards or barrier boards used to close a lane:
  - a work vehicle must also be positioned between the workers and approaching traffic
  - an advanced warning vehicle should be used to warn road users of workers on foot
- A work vehicle must only proceed in a forward direction towards approaching traffic along the closed roadway if it is determined by the PWZTMP qualified person that it is safe to do so. This must not occur at night time where it may create motorist confusion or distraction, such as headlight glare.
- The removal of signs on central medians of multi-lane divided carriageways increases the risk profile of the activity. In such cases, a site-specific TGS with either static work or a dynamic works convoy must be used.

Section 6.4.4.3 Motorways and other high-risk multi-lane environments

The requirements in this section must be applied when removing signs and devices from any part of the roads listed in Table 6-20. These requirements should also be applied to roads not listed in Table 6-20, but meet all of the following high-risk multi-lane road criteria:

- multi-lane road
- posted speed limit greater than 85 km/h
- greater than 10,000 vpd.

As part of the risk assessment process, consideration should still be given to applying these requirements on other high speed multi-lane roads even though the road may not meet the above traffic volume criteria.

On motorways and other high-risk multi-lane environments, the removal of signs in reverse order (progressing out from the work site area toward the approaches) can be difficult due to higher speeds and distances between devices. As such, delineation devices must be removed in the reverse order back to the commencement of the taper. The signs in the advance warning area must be removed in the same order that they were installed.

The removal of the signs in the advance warning area must be carried out using the same method that was applied for their installation. An advance warning vehicle must be in place at an appropriate location and a TMA used to shadow the traffic control vehicle and the workers on foot.

The planning requirements and recommendations provided in Table 6-6 apply to the removal of signs and devices.

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Table 6–6 Planning requirements and recommendations for removal

Item	Provision/s
Risk assessment	A site-specific risk assessment must consider the risks involved in each stage of the removal process and identify the controls necessary to eliminate or minimise those risks.
TGS and documentation	A site-specific process for the removal of signs and devices must be shown on the static works TGS or on a supplementary TGS by providing a numbered sequence for removal of the signs and devices. A SWMS or other generic document that applies to any location does not meet the above requirement for documenting how the static works TGS will be removed.
TGS design and approval	Both the primary TGS and (where used) the supplementary TGS for how it will be removed must be approved and verified in accordance with Section 7.9.
Co-ordination	There must be full co-ordination of any ITS infrastructure that may assist with the TGS removal, and this must be documented on the TGS. For example, this may involve the placement of advance warning messages on permanent variable message signs and/or a reduction of the speed limit where variable speed limit signs (VSLS) are provided.

The operational requirements and recommendations provided in Table 6-7 apply to the removal of signs and devices.

Table 6–7 Operational requirements and recommendations for removal

Item	Provision/s
Advance warning vehicle	At least one advanced warning vehicle must precede the TMA (acting as shadow vehicle). The advance warning vehicle must be fitted with a VMS that is sized in accordance with Section 6.5.3. During the removal of taper, or when the TMA is otherwise occupying an open trafficable lane, the advance warning vehicle should regularly communicate with heavy vehicle drivers via UHF radio and provide verbal advance warning of the TTM operation. The advanced warning vehicle must be in the road shoulder, offset from the travel lane edge line by at least 2.0 m. Offsets from the travel lane edge line of less than 2.0 m may be used, provided an additional TMA is used as the advance warning vehicle.
Shadow vehicle	A TMA must be used to shadow the traffic control vehicle and workers on foot. A TMA must not be located in the travel lane, unless: • the TMA is protecting TTM personnel who are in the process of removing signs and devices of the taper • the TMA is located inside the lane closure (behind the taper) • the removal activity is carried out using a dynamic (mobile) works convoy in accordance with Section 7.8.4.4.

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Item	Provision/s
Number of vehicles	Additional, suitably sized vehicles must be in place if gaps in traffic are insufficient for the TMA to appropriately shadow the traffic control vehicle and workers on foot continually. For multi-lane closures involving more than one taper, two TMAs should be considered.

The removal of signs on central medians on motorways and other high risk multi-lane environments increases the risk profile of the activity. In such cases, a site-specific TGS with either static work or a dynamic work convoy must be considered.

The following process details the stages and steps that must be taken to remove a lane closure on a motorway or other high-risk multi-lane environments. For the purpose of simplicity and clarity of the process, it does not detail all the signs and devices to be removed and assumes that signs have not been duplicated in the median. Other scenarios such as a right lane closure or multiple lane closures will require a modified process.

The following are four defined stages removal of the TGS (in order of removal):

1. Stage 1 – Lane closure
2. Stage 2 – Taper area
3. Stage 3 – Advance warning area
4. Stage 4 – Arrow board.

Stage 1 – Lane closure

The following steps must be undertaken as indicated by the circled numerals in Figure 6-9:

1. The advance warning vehicle must be positioned at least 2.0 m from the travel lane edge line. The advance warning vehicle must remain at a nominated location, with the VMS switched to the Roadwork 1km Ahead sign and work site speed zone sign to indicate commencement of the advance warning area.
2. Relevant advanced warning signage must still be installed. The arrow board must be positioned such that it clearly displays the required merging movement, and the relevant taper length must still be installed.
3. Before removal commences, all workers and plant must be cleared from the work area.
4. The TMA must then raise the attenuator and reverse to an agreed point within the lane closure area. The attenuator must then be lowered, as such becoming the shadow vehicle. The traffic control vehicle and workers on foot may then remove relevant signs and devices within the lane closure area beginning with the End Roadwork and speed reinstatement signs and moving backwards. This step is repeated until the TMA is positioned at the commencement of the lane closure. During this process, the TMA must be no closer than 30 m from the removal activity.

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5. When the TMA reaches the end of taper and all signs and devices in advance of the taper are removed, the TMA and traffic control vehicle must be then repositioned to the advance warning area. For efficiency a second TMA may be employed.

6. Having been repositioned and with the TMA now positioned in the lane in front of the taper, the traffic control vehicle and workers on foot are ready to commence removal of the taper.

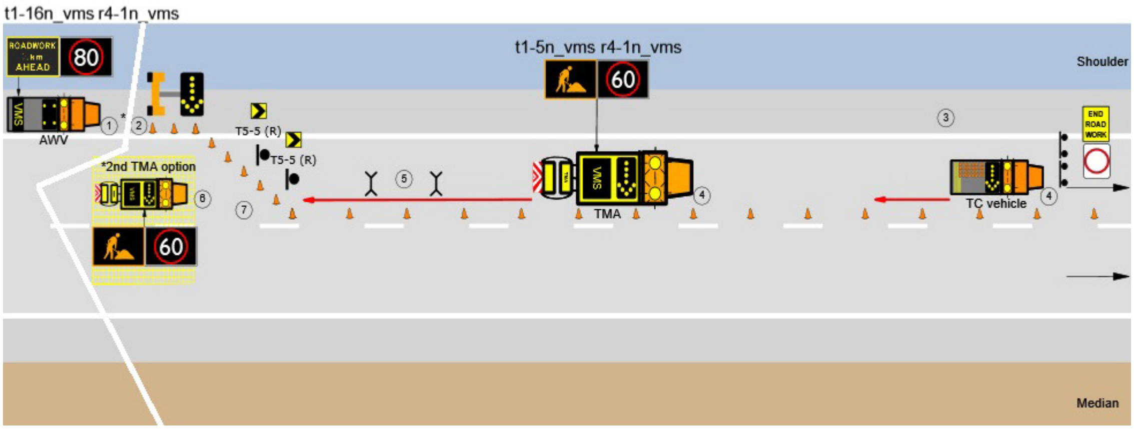

Figure 6–9 Removal stage 1: Lane closure

Stage 2 – Taper area

The following steps must be undertaken as indicated by the circled numerals in Figure 6-10:

1. The advance warning vehicle must be positioned at least 2.0 m from the travel lane edge line. The advance warning vehicle must remain at a nominated location, with the VMS switched to Roadwork 1km Ahead sign and work site speed zone sign to indicate commencement of the advance warning area.

2. Relevant advanced warning signage must still be installed. The arrow board must still be positioned such that it clearly displays the required merging movement, and the relevant taper length must still be installed.

3. With the TMA now positioned in the lane, in front of the taper, the traffic control vehicle and workers on foot may commence removal of the taper in reverse order from (5). The TMA must be no closer than 30 m from the removal activity.

4. An additional, suitably sized vehicle may be employed to provide additional cover on the shoulder.

5. The traffic control vehicle and workers on foot move in the reverse direction to remove the taper delineation devices.

6. After the taper has been removed, the TMA and traffic control vehicle must then be repositioned to the start of the advance warning area to commence the removal of the advance warning signage.

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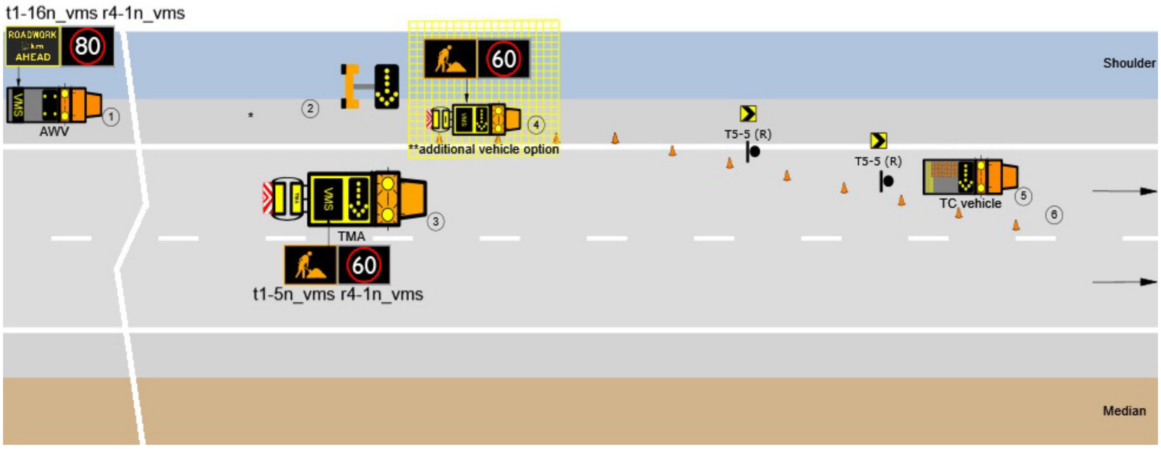

Figure 6–10 Removal stage 2: Taper area

Stage 3 – Advance warning area

The following steps must be undertaken as indicated by the circled numerals in Figure 6-11:

1. The advance warning vehicle must be positioned at least 2.0 m from the travel lane edge line. The advance warning vehicle must remain in advance of the TGS advance warning area and display on the VMS the Roadwork Ahead sign and work site speed zone sign.
2. The TMA must be positioned clear of the travel lane edge line, acting as a shadow vehicle for traffic control vehicle and workers on foot during removal of advance warning signs and devices. The TMA must be no closer than 30 m from the removal activity.
3. Beginning with the first sign/device after the advance warning vehicle, the traffic control vehicle and workers on foot may then remove subsequent signs and devices in a forward direction. The traffic control vehicle must remain positioned no closer than 0.5 m from the travel lane edge line.
4. The advance warning vehicle and TMA may then progress along the shoulder with the traffic control vehicle during the removal process.

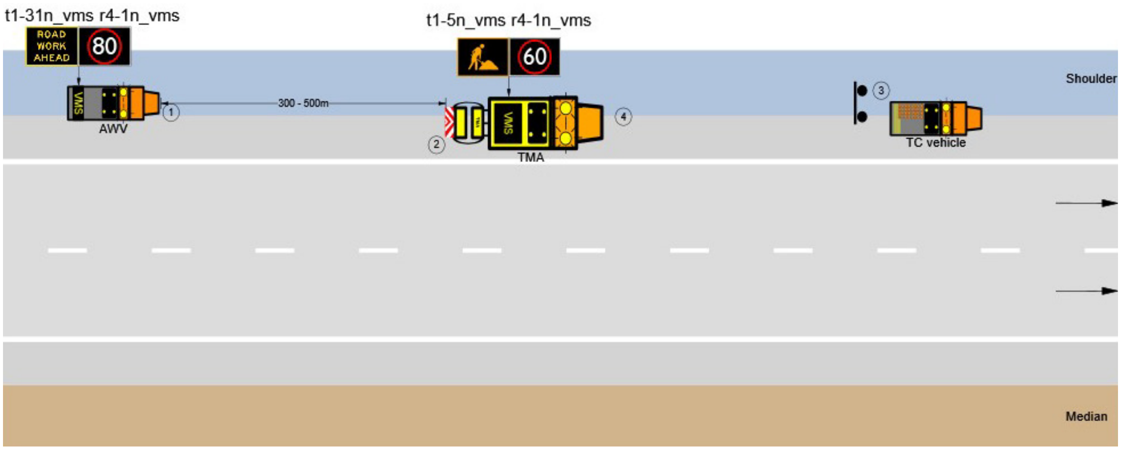

Figure 6–11 Removal stage 3: Advance warning area

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Stage 4 - Advance warning area and arrow board

The following steps must be undertaken as indicated by the circled numerals in Figure 6-12:

1. The advance warning vehicle must be positioned at least 2.0 m from the travel lane edge line, with the VMS displaying the Roadwork Ahead sign and work site speed zone sign. The advance warning vehicle moves along with the TMA and traffic control vehicle during the removal process.
2. The TMA must be positioned clear of the travel lane edge line, acting as a shadow vehicle for workers on foot during removal of arrow board and cones. The TMA must be no closer than 30 m from the removal activity.
3. The traffic control vehicle must be positioned at least 0.5 m clear of the edge line and remove the arrow board and three remaining cones in advance of the taper.
4. All vehicles must then accelerate in shoulder and re-join traffic, de-activate warning beacons once they reach a speed of not less than 20 km/h below the posted speed limit.

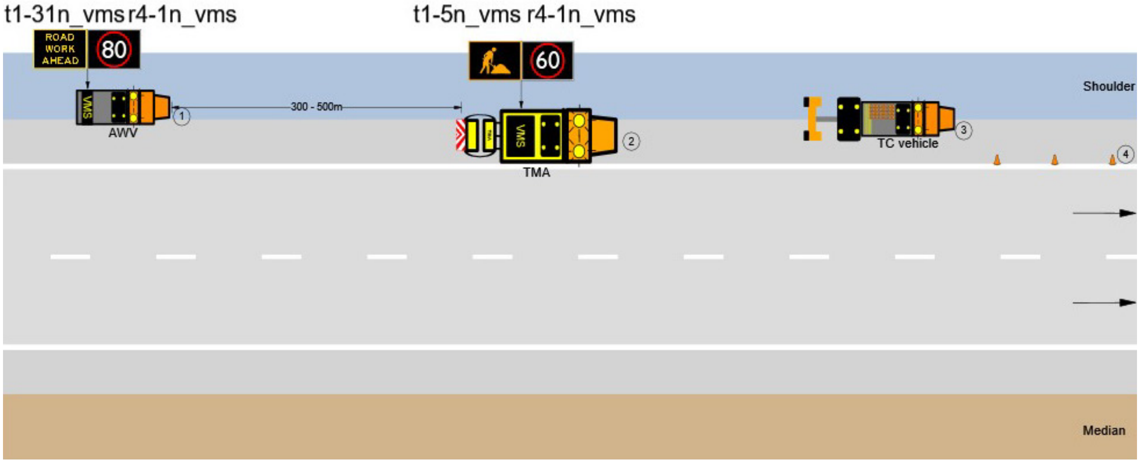

Figure 6–12 Removal stage 4: Advance warning area and arrow board

Section 6.5.2 Types of signs

Replace Table 6-5 in its entirety with the following:

Table 6-5 Examples of signs for a typical category

Category	Example signs	Sign number
Road hazard approaches and departure	TRAFFIC HAZARD AHEAD END TRAFFIC HAZARD	T1-10-1n T1-10-2n
Work site approaches and departures	ROADWORK AHEAD GRADER AHEAD END ROADWORK	T1-1 T1-4 T2-16

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Category	Example signs	Sign number
Regulatory control of traffic	Speed limit ROADWORK PREPARE TO STOP STOP HERE ON RED SIGNAL	R4-212n T1-18 R6-6
Detours	DETOUR One lane each way symbolic Arrow marker symbolic	T5-1 T2-24 T5-6
To indicate road conditions	SLIPPERY symbolic SOFT EDGES ROUGH SURFACE POTHOLES GRAVEL ROAD Loose stones symbolic LOOSE SURFACE NEW WORK NO LINES MARKED	T3-3 T3-6 T3-7 T3-219n T3-13 T3-9 T3-14 T3-11
Lane and road closures	Lane closed symbolic ROAD CLOSED	T2-6-1 T2-4
Pedestrian control signs	PEDESTRIANS USE OTHER FOOTPATH LOOK BOTH WAYS TWO WAY TRAFFIC	T8-2 T8-3 T8-5
Vehicle height and mass restriction signs	LOW CLEARANCE X.Xm BRIDGE LOAD LIMIT Xt GROSS	R6-11 R6-3

Section 6.5.9 Requirements for specific signs

Replace Table 6–11 in its entirety with the following:

Table 6–11 Requirements and conditions of use for specific TTM signs

Sign	Conditions	Notes
ROADWORK AHEAD (T1–1) or (T1-31) BRIDGEWORK AHEAD (T1-2)	Must be used at: • Long-term road or bridge work sites. • A diversion of traffic along a side track or detour. • Unexpected conditions, such as loose stones or the absence of linemarking.	The signs may be used: • With the NEXT 2km (T1-28) sign for frequently changing work areas. • Short-term works where additional advance warning is warranted.

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Sign	Conditions	Notes
ROADWORK X km AHEAD (T1–16) BRIDGEWORK X km AHEAD (T1-29)	Must be used where: • The approach speed is greater than 85 km/h. • Relevant sight distance is less than 150 m (to work area/end of queue etc).	This sign to be positioned X km from: • The start of the taper area. • The traffic diversion. • The traffic control position.
ROADWORK ON SIDE ROAD (T1-25)	Must be used in advance of an intersection to warn of the relevant activities on the side road where there is insufficient distance on that road to provide the required warning.	
SIDE ROAD CLOSED (T1-32)	Must be used in advance of an intersection where the side road is closed to all traffic.	
TRAFFIC HAZARD AHEAD (T1-10-1n)	Must be used to provide advance warning of a traffic hazard where: • The approach speed is greater than 65 km/h. • Relevant sight distance is less than 150 m (to the hazard). This sign must be placed a minimum of distance D from the start of the traffic hazard.	
END TRAFFIC HAZARD (T1-10-2n)	Must be: • Used in conjunction with the TRAFFIC HAZARD AHEAD (T1-10-1n) sign. • Placed at a distance D from the end of the hazard to indicate that normal traffic conditions have resumed.	• Signs reinstating the existing permanent speed limit should be placed adjacent to this sign.
STOP HERE ON RED SIGNAL (R6-6)	Must be used: • Where traffic is required to stop in compliance with a PTS (placed 6 m in advance of the PTS). • With the SIGNALS AHEAD (T1-30 or W3-3) sign.	

Sign	Conditions	Notes
END ROADWORK (T2–16) or (T2-17)	Must be: • Placed at a distance D from the work site to indicate that normal traffic conditions have resumed when ROADWORK AHEAD (T1-1) or ROADWORK X KM AHEAD (T1-16) signs are used • Placed adjacent to or after any signs indicating the reinstatement of an existing permanent speed limit.	The T2-16 sign is preferred wherever space is available as the site allows it to be used.
SLIPPERY SYMBOLIC (T3-3) SOFT EDGES (T3-6) ROUGH SURFACE (T3-7) POTHOLES (T3-219n) GRAVEL ROAD (T3-13) LOOSE STONES SYMBOLIC (T3-9) LOOSE SURFACE (T3-14)	Must be installed to warn motorists of conditions which make a roadway surface temporarily hazardous.	On long work sites these signs should be repeated at intervals of not more than 500 m.
TRAFFIC HAZARD (T1–10)	Must be used only when a more relevant sign is not available.	
REDUCE SPEED (T1-278n)	Must be used in conjunction with one of the above road conditions signs or another sign describing the hazard.	
NO LINES DO NOT OVERTAKE UNLESS SAFE (T3-12) NO LINES DO NOT OVERTAKE (TM3-12-1n)	Must be used in a two-lane, two-way road when: • Lines have been removed. • A new seal has been installed.	• T3-12 may be used where overtaking would normally be permitted in an oncoming traffic lane. • TM3-12-1n must be used where barrier lines would normally be installed and overtaking is not permitted.
NEW WORK NO LINES MARKED (T3-11)	Must be used on a multilane road when: • Lines have been removed. • A new seal has been installed.	Must not be used where there is an unacceptable risk of collision due to oncoming traffic. In such cases, T3-12 or TM3-12n as applicable must be used.

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Section 6.8.7 Temporary pavement markings and markers

Replace the contents of Section 6.4 in their entirety with the following:

Pavement markings on temporary roadways and detours must be of a similar standard to that in use at either end of the adjoining sections of road. Where the adjoining road is delineated with edge lines, temporary roadworks must be similarly marked with an edge line.

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

- barrier, lane and edge lines
- turning arrows
- raised retroreflective pavement markers (temporary or permanent)
- projected pavement arrows (that is, pavement arrow images projected onto pavement surface by a road image projector).

Where, during or at the conclusion of pavement-surfacing works, a section of roadway is to be left for a period of time without linemarking, temporary raised pavement markers should be used to provide delineation at the dividing or lane lines. Application of the pavement markings must take place as soon as practicable.

Where temporary linemarking, that is, linemarking not in its final location, is required on the final wearing surface, or adjacent pavement, pavement marking tape should be used. Where used, pavement marking tape must meet the performance requirements of QA Specification R145.

Where it is determined that any temporary pavement marking or marker has become ineffective, remarking and/or replacement must be undertaken as soon as practicable.

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 must be placed as directed with the maximum allowable spacing being 500 m. The arrows must be removed if the section is then reincorporated as dual carriageway.

Where appropriate as part of static night works, ‘projected pavement arrows’ may be used to supplement existing traffic control measures, such as in advance of a merge taper or truck mounted attenuator (TMA). Projected pavement arrows must be dimensionally representative of those within AS 1742.2 with no distortion when projected. The use of projected pavement arrows must be documented as part of the TMP and the relevant TGS by a PWZTMP qualified person.

Where existing pavement markings are required after the temporary works, these may be masked over with suitable black tapes where they exhibit similar characteristics to the existing pavement colour and surface finish, during the works period. This may be a suitable consideration where limited traffic impact is expected, to limit the chance of dislodgement by

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traffic. Otherwise, permanent removal must be undertaken and agreement must be received from the asset owner in accordance with Section **Error! Reference source not found.**.

On long-term works raised retroreflective pavement markers complying with QA Specification R142 may be used in conjunction with temporary pavement markings. The spacing and application must be as specified in QA Specification R142.

Pavement markings and retroreflective markers should be considered in conjunction with the placement of other delineation devices and must be used where temporary safety barriers are used, to ensure road users are safely directed through the site without conflicting messages.

With the exception of projected pavement arrows, all pavement markings must be retroreflective in accordance with QA Specification R145. Where projected pavement arrows are used, illumination must be such that the projected image is clearly visible to approaching road users.

Section 7.6.2.2 Tapers

Replace caption of Table 7–4 with the following:

Minimum spacing between tapers

Add the following new section after Section 7.7.5

Section 7.7.6 Signposting traffic hazards

Plans must be in place to ensure that drivers are alerted to hazards that have been identified on the road carriageway, such as pavement damage or failure, prior to road works commencing to remediate the hazard. Until works can be undertaken to remediate the hazard, signposting and/or delineation can be used to mitigate the risk to road users. This signposting and/or delineation should alert road users to the hazard and clearly communicate the nature of the hazard and the actions that road users should take.

Signposting a traffic hazard does not remove or reduce the requirement to rectify the hazard as soon as practicable and should only be implemented until such time that works can take place to remediate the hazard.

An appropriate TGS must be implemented as soon as practicable after identifying the hazard until the traffic management is established for the road works. The TGS may involve advance warning signage prior to the hazard, sign posting at the hazard and other mitigation measures such as a speed limit reduction and/ or delineation devices to guide traffic around, past or through the hazard.

Given that traffic hazards can occur at any time, generic TGSs should be developed so that an appropriate TGS can be implemented immediately when responding to hazards arising from traffic incidents, natural disasters or other unplanned events.

Any generic or site-specific TGS for managing a traffic hazard must be designed and implemented in accordance with *Section 7.0 Traffic guidance schemes* and the following applicable provisions (see Figure 7–15a for an example layout):

- The TGS must include details of how traffic and if applicable other road users (that is, pedestrians, cyclists and so on) will be managed around, past or through the hazard site at all times until the traffic management is implemented for the road works that will repair the damage or remove the hazard. This includes the removal or covering of any signs that may no longer be applicable, particularly permanent speed limits.
- Unless the risk assessment of the hazard site indicates otherwise, the speed limit should remain unchanged if safe or, if not appropriate, should be no more than 20 km/h below the existing permanent speed limit, having regard to the identified site conditions (for example, pavement condition, damaged safety barrier), expected weather conditions and road characteristics such as traffic volumes, heavy vehicles, urban versus rural road environment.
- Inspections of the site should be undertaken in accordance with *Section 8.1 Work site inspections, reviews, and audits*.

As part of preparing the site to be left unattended, the actions shown in Table 7–6a should be taken.

Table 7‑6a Considerations and actions

Considerations	Actions
Size of site	Minimise the length of the site as much as possible by providing minimum spacings to signage before and after the hazard(s) unless determined otherwise by the risk assessment.
Temporary speed limits	If the risk assessment has determined that a reduced speed limit should be installed, the design should consider minimising the length of the reduced speed zone (any changes to a speed limit must be approved).
Unsafe conditions and sign selection	Identify the hazard, such as loose material on the road surface, road erosion, a depression or hollow in the road surface and select the appropriate sign to warn road users accordingly.
Signs	Implement appropriate advance warning and road conditions signs – see Table 6-5 for sign options and spacing. TTM signs need to remain in place and serviceable while the site is not attended. Check that all signs are ballasted for windy conditions, reasonably level, mounted at the correct height and positioned correctly.
Delineation	Check that all delineation devices are clean, positioned correctly and adequately ballasted, for example, double weighed bollards.

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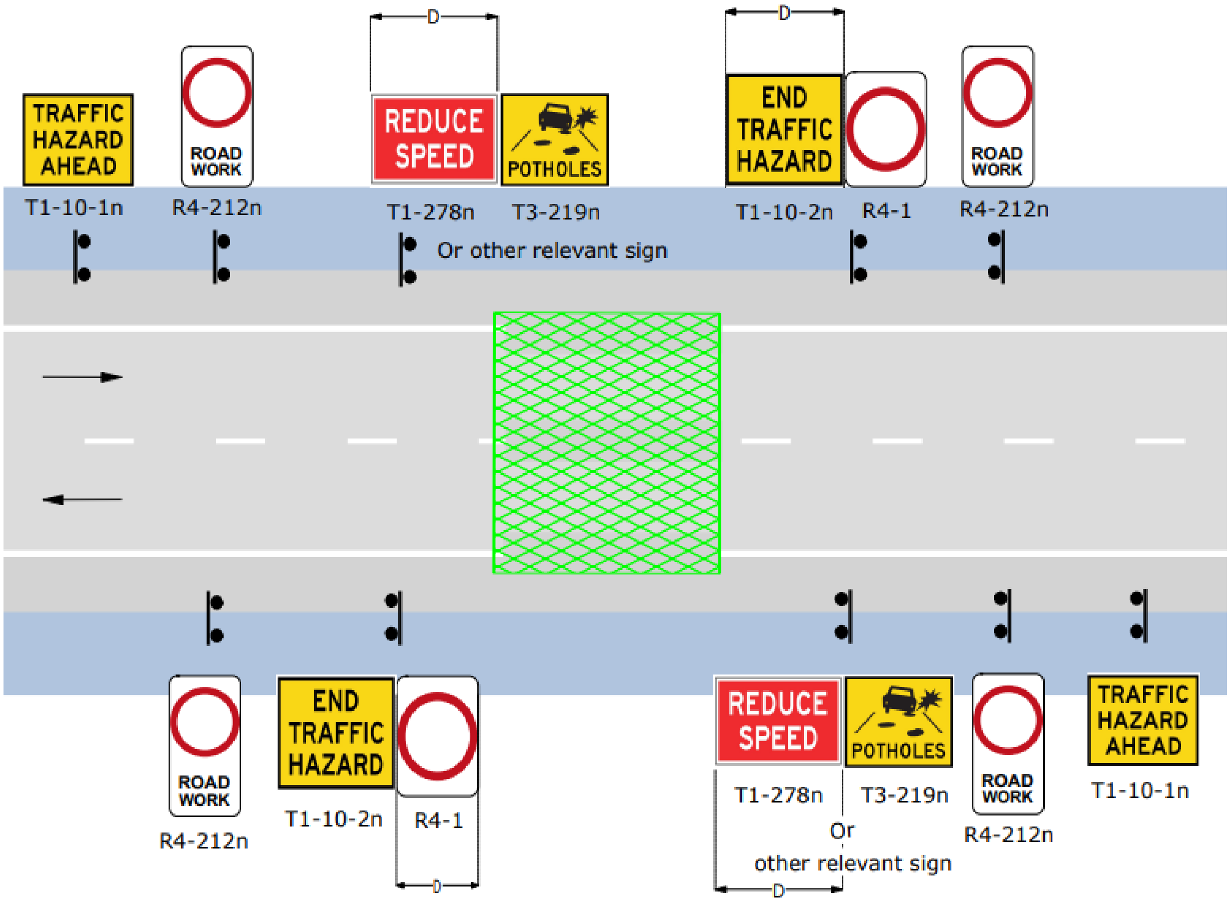

Figure 7–15a Example layout – sign posting a traffic hazard

Section 7.9 TGS approval and verification

Replace the contents of Section 7.9 in their entirety with the following:

Section 7.9.1 TGS approval

After the PWZTMP qualified person has designed or modified a TGS, the TGS must be reviewed and approved for use by a second PWZTMP qualified person, who is not the designer or modifier. The purpose of the approval is to ensure that the TGS:

- Has been designed in response to the risks and hazards identified in the relevant TMP, risk assessment and associated TTM specific documentation.
- Has been designed in accordance with the requirements of this document.
- Contains the relevant information for the ITCP qualified person to safely implement onsite including additional support vehicle/s and sequencing.

Any departures to the requirements of this document, including non-standard signs and devices proposed by the TGS must be appropriately approved in accordance with Section 2.8. Additionally, the use of a manual traffic controller as part of the TGS must be undertaken in accordance with Section 5.4.

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The TGS must include separate sign-off sections for the designer and approver. The sign-off sections must include the relevant persons:

- Full name
- Role
- Division/organisation
- SafeWork NSW card number
- Signature
- Date.

Section 7.9.2 TGS verification

After a TGS is selected or designed and approved, it must be verified as being appropriate for use at the work site, via the completion of the TGS verification.

A TGS verification must be undertaken to confirm the selected or designed TGS is fit for purpose. A TGS verification must be completed in accordance with Section 8.1.2 by an ITCP or PWZTMP qualified person. TGS verification must include an inspection of the work site where the TGS will be implemented.

Authorisation:

Approved by	Director Corridor Infrastructure and Engineering Asset Management Safety, Environment and Regulation

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Technical Direction – TD 00031:2022

Issue date: 04 November 2022

Effective date: 04 November 2022

Title: Traffic control at work sites

This technical direction is issued by the Asset Management Branch (AMB) as an update to *Traffic control at work sites*, Issue 6.1.

The update includes an amendment to G9-79 sign in Table 6-12.

1 Amendment to *Traffic control at work sites, Issue 6.1*

Section 6.5.10 in *Traffic control at work sites* is amended as follows:

Section 6.5.10 Signposting of roadwork speed zones

Replace only the Conditions column for Speed limit AHEAD (G9-79) sign in Table 6-12 as follows:

Table 6-12 Requirements and conditions of use of specific signs

Sign	Conditions
Speed limit AHEAD (G9-79) sign	Speed Limit AHEAD signs must be erected where the speed of traffic on the approach to the temporary speed zone is 35 km/h or more than the temporary limit. The Speed Limit AHEAD signs must be located 2D in advance of the initial roadworks speed zone (R4-212n) signs.

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Authorisation:

Approved by	Director Roads & Traffic Engineering Technical Services Infrastructure and Place

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Transport for NSW

Traffic control at work sites

Technical Manual

Trial undertaken on Newell Highway, Peak Hill, NSW

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About this release

Title:	Traffic control at work sites
Document Number:	20.346
Author:	Senior Temporary Works Interface Manager, Technical Services, Infrastructure & Place
Authorised by:	Director Corridor Infrastructure & Engineering, Asset Management, Safety, Environment & Regulation

Issue	Date	Revision description
6.0	14 September 2020	Manual Update
6.1	28 February 2022	Minor Revision

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Foreword

This Technical Manual has been developed by Transport and must be applied to the following:

- Transport work sites requiring temporary traffic management (TTM); and
- Works involving temporary traffic management being undertaken for or on behalf of Transport (by contractors, local government and public utility bodies or similar).

This is the sixth issue of the Technical Manual and its release seeks to harmonise Transport practice with National practice where practicable.

This Technical Manual is to be read and used by personnel responsible for designing, implementing, operating and inspecting temporary traffic management at Transport work sites relating to construction or maintenance activities.

Where this Technical Manual refers to a Transport roadwork site, it includes any Transport construction or maintenance work that impacts on the road network, this could include rail or maritime infrastructure projects.

The information in this Technical Manual is provided to assist Transport in meeting its obligations under the *NSW Work Health and Safety Act 2011* (WHS Act). This Act places a positive duty of care on persons conducting a business or undertaking (PCBU) to ensure the health and safety at work, so far as is reasonably practicable (SFAIRP), of:

- Workers they engage or cause to be engaged; and
- Workers whose work activities they influence.

Transport must also ensure, SFAIRP, that the health and safety of other persons is not put at risk from work carried out as part of the conduct of their business or undertaking.

The *NSW Work Health and Safety Regulation 2017* (WHS Regulation) prescribes the risk management approach that duty holders of a PCBU must apply. This includes:

- Identifying all reasonably foreseeable hazards that could give rise to health and safety risks;
- Assessing these risks; and
- Managing the risks to health and safety by eliminating them, or, where this is not reasonably practicable, minimising them.

The WHS Regulation describes the hierarchy of control measures that duty holders must implement if it is not reasonably practicable to eliminate risks to health and safety.

The Technical Manual does not provide an exhaustive list of controls and does not displace Transport's duties under the *WHS Act* (2011) and *WHS Regulation* (2017).

Compliance with the requirements of this Technical Manual by itself is not sufficient to ensure satisfactory outcomes for traffic management. Transport expects that professional judgement be used by competent personnel when performing TTM to ensure such outcomes.

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Amendment Record

This amendment record references the changes made against Version 6.0 (dated 14 September 2020)

Version	Section	Sub Section	Amendment	Issued
6.0	NA	NA	Issue 6: New edition, completely rewritten. Descriptions of changes to previous versions are no longer relevant, and are not listed.	14 September 2020
6.1	Throughout	Throughout	Corrections, minor amendments and internal consistency changes.	28 February 2022
	2	2.4.2	Removal of the requirement for Transport for NSW-specific refresher training for temporary traffic management qualifications.	
	4	4.3.3	Revision of the concept of “clear zones” in line with the Austroads *Guide to Road Design*.	
	6	6.9.1.2	Inclusion of a set of static signs that are permitted for display on a variable message sign (VMS).	
	6	6.9.2	Inclusion of new guidance material on the use of variable speed limit signs (VSLS).	
	7	7.7.3.2	Additional requirements for closing a lane on motorways or other multi lane roads.	

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1 Introduction

1.1 Purpose and scope

This Technical Manual is to be read and used by personnel responsible for designing, implementing, operating, reviewing and inspecting temporary traffic management (TTM) at Transport construction or maintenance work sites.

Where this Technical Manual refers to a Transport roadwork site, it includes any Transport construction or maintenance work that impacts on the road network, this could include rail or maritime infrastructure projects.

In the context of TTM, the Technical Manual contains instructions for the following:

- Manage risks associated with TTM;
- Develop a traffic management plan (TMP);
- Design, select, obtain approval, record and store a traffic guidance scheme (TGS); and
- Undertake traffic management in a number of specific situations.

The purpose of this Technical Manual is to ensure that traffic control at Transport work sites continually strives for best practice. It is also intended to help personnel understand their obligations under the *Work Health and Safety Act 2011* and the *Work Health and Safety Regulation 2017*.

For works conducted by contract, this Technical Manual complements the following Transport specifications:

- G10 (Traffic Management);
- D&C G10 (Traffic Management);
- G10M (Traffic Management (Maintenance Works);
- G22 (WHS Construction Work); and
- D&C G22 (WHS Construction Work).

Appendices of this Technical Manual noted as *mandatory* are key to the application of the Technical Manual. Appendices noted as *informational* are optional, and have been provided to assist practitioners with application.

Variations to and departures from the requirements of this Technical Manual must be in accordance with the departure process described in *Section 2.8 Departures from this Technical Manual.*

1.2 Exclusions, evaluation and review

1.2.1 Exclusions

The requirements of this Technical Manual do not apply to ‘standard work activities’ outside the scope of construction or maintenance of a Transport managed road. Activities considered to be ‘standard work activities’ and excluded from the requirements of this Technical Manual include, but are not limited to:

- Transport Traffic Emergency Patrol work;
- School Crossing Supervisors;
- Emergency service related work including the use of crossovers as permitted/intended by their provision;

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- Inspections that do not require traffic to be managed, or where traffic is not affected by the inspection;
- Heavy vehicle inspection conducted by Compliance Operations Inspectors; and
- Speed camera certifications and maintenance activities.

Standard work activities such as those listed above should be managed in line with divisional requirements and through the development of localised risk assessment and procedures to manage the risk associated with these works.

Unless specifically determined by the relevant division, any procedures that are developed for these activities need not adhere to this Technical Manual or prepared by a TTM qualified person, however, this Technical Manual may be used as a point of reference.

Readers are advised to consult the Transport website for additional information, guidance and requirements for these specialist activities.

1.2.2 Evaluation and review

Implementation of this Technical Manual will be evaluated as part of Transport's program of audits.

A Transport Traffic Control at Work Sites committee exists to assist in the review of this Technical Manual on a regular basis. Factors taken into account in these reviews include the circumstances of incidents at work sites and the results of safety audits and inspections.

The committee is also responsible for:

- Developing strategies to improve safe systems of work; and
- Providing input into traffic management innovation and new technology.

Feedback on the Technical Manual is encouraged and can be forwarded to the Director, Roads and Traffic Engineering via standards@transport.nsw.gov.au. When new information becomes available and new techniques are developed, they will be assessed and if suitable, will be incorporated into this Technical Manual. Amendments to the Technical Manual will be published on the Transport website.

1.3 Terms and definitions

For the purposes of this Technical Manual the terms and definitions provided in *Table 1-1* apply.

Table 1-1. Terms and definitions

Term	Definition
85th percentile speed	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)	total traffic volume over the whole year, divided by the number of days in the year
ADT (average daily traffic)	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 and used in advance of other roadwork signs with a more specific message

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Term	Definition
advance warning vehicle	vehicle used in advance of dynamic works to provide advance warning of those works
alternate flow	see shuttle flow entry
approach speed	speed of traffic approaching the work site measured in km/h and may be the speed limit applying to the road
built-up area	In relation to a length of road, an area in which either is present for a distance of at least 500 m or, if the length of road is shorter than 500m, for the whole road: • buildings, not over 100m apart, on land next to the road • street lights not over 100m apart • with or without kerb and channel
carriageway	portion of a road or bridge devoted particularly to the use of vehicles, inclusive of shoulders and auxiliary lanes
competent person	any 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
consequence	effect such as illness, injury, loss of life or property damage resulting from a hazardous event occurring or a risk being realised
containment fencing	physical barrier that provides separation between pedestrians or cyclists and the work area, or between separate work areas, but not so rigid as to become a hazard if struck by a vehicle
controlled area	area of a roadway where temporary traffic management is in place, i.e. between the first advance warning sign and where normal traffic arrangement resume
contraflow	when a 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
controller	device which regulates the order and duration of the displays of the signal lanterns
crossover	access point from one carriageway to the adjacent carriageway for emergency vehicles (e.g. police, ambulance, fire etc.)
date of publication	date Issue 6.1 of the Traffic Control at Work Sites Technical Manual is made available on the Transport for NSW website
delineation	general term for treatments which regulate, warn or provide tracking information and guidance to drivers (e.g. linemarking, raised pavement markers, traffic cones, bollards and post-mounted reflectors are delineation devices)
dimension D	distance expressed in metres for the positioning of TTM signs, devices and determining other TTM related factors
escort vehicle	vehicle used under the Heavy Vehicle National Law to escort an Oversize Overmass vehicle on the road network

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Term	Definition
footpath	paved area in a footway
footway	public way largely reserved for the movement of pedestrians
hazard	situation, condition or source that has the potential to lead to negative consequences, harm or loss, but not the negative outcome itself
high risk pedestrian	subgroup of pedestrians at greater risk to hazard such as persons with a disability, the elderly and children
high speed road	road which is posted at speeds greater than 85 km/h
high volume road	road which has traffic volumes greater than 20,000 vpd
implement traffic control plan (ITCP)	SafeWork NSW qualification principally concerned with the competency of implementing a work zone traffic management plan (TMP)
intermittent work	work which is undertaken on travel lanes, in gaps in traffic, without obstructing traffic and without compromising the safety of road workers
lead vehicle	vehicle used at the head of a work convoy on two-way roads (e.g. to give advance warning of the works to traffic approaching from the opposite direction and/or to enable the driver to alert following road workers of any impending hazard)
long-term work	work requiring traffic control for longer than one work shift and where some form of traffic control remains when the site is left unattended
lookout person	any person whose sole responsibility is to watch out for and warn road workers of approaching traffic
may	indicates permission or an option, often accompanied by one or more conditions
modification	with reference to a TGS and the positioning of signs and devices, any change which exceeds a permitted tolerance
motorway	motorway is used but not defined in roads or road transport legislation. A motorway is a divided highway for through traffic with no access for traffic between interchanges and with grade separation at some interchanges. Certain activities (such as the carriage of dangerous goods) may be restricted or prohibited by legislation. Includes tollways.
must	indicates a mandatory requirement
open road area	roadside development less frequent than that specified for a built-up area
pedestrian movement plan (PMP)	diagram showing the allocated travel paths for road workers and/or pedestrians around, past or through a work site
pilot vehicle	vehicle used to guide traffic by controlling the desired path and to manage speed through the work site

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Term	Definition
portable traffic control device (PTCD)	portable device that removes the need for manual traffic control or allows traffic controllers to perform their roles at a safe distance from traffic (e.g. type 2 (automatic) portable traffic signals, type 1 (manual) portable traffic signals and portable boom barriers)
portable traffic signal (PTS)	approved traffic signals that are transportable and not permanently installed
prepare work zone traffic management plan (PWZTMP)	SafeWork NSW qualification principally concerned with the competency of developing or modifying a work zone traffic management plan (TMP) and/or a traffic guidance scheme (TGS)
prescribed traffic control device	sign, signal, marking, structure or other device to direct or warn traffic on a road (or part of a road)
Regional Road	see Schedule of Classified Roads and State and Regional Roads publication. See also Portal for State Roads
risk	possibility of suffering harm or loss
road	defined in the Road Transport Act 2013 as 'an area that is open to or used by the public and is developed for, or has as one of its main uses, the driving of motor vehicles'. Roads include bridges and tunnels.
road designer	an engineering practitioner approved by Transport, with at least 5 years of recent experience in designing roads to Transport standards
road occupancy	consists of any activity likely to affect the operational efficiency of the road network (e.g. an activity that requires the road to be used in such a way as to affect traffic flow)
road occupancy licence (ROL)	permit which conditionally allows the holder to use or occupy a specified road space at approved times
road user	any driver, rider, passenger or pedestrian using the road
roadside	area between the reserve boundary and the nearest road shoulder
roadway	portion of the road devoted to the use of vehicles, inclusive of shoulders and any auxiliary lanes
roadwork site	works that are conducted on a road, including bridge or light rail works that impact a road
safety barrier	physical barrier designed to resist penetration by an errant vehicle and as far as practicable, to redirect errant vehicles back into the travelled path
shadow vehicle	vehicle which provides close up protection to the rear of road workers on foot
short-term work	work requiring traffic control taking less than or equal to one work shift and where road conditions are returned to normal when the shift ends

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Term	Definition
should	indicates a non-mandatory recommendation
shuttle flow (aka alternate flow)	where a single lane is used alternately by both directions of traffic (e.g. where insufficient width is available for a lane to be provided in each direction)
sight distance	distance between the point at which an approaching driver first sees the whole of an object and the object itself (in the context of this Technical Manual the object is the traffic control sign or device)
so far as is reasonably practicable (SFAIRP)	see WHS Act, Section 18
State Road	see Schedule of Classified Roads and State and Regional Roads publication. See also Portal for State Roads
tail vehicle	vehicle used in a dynamic work convoy to provide advance warning of the works and protection
temporary traffic management (TTM)	the organisation, arrangement, guidance and control of both stationary and moving traffic, including pedestrians, cyclists and all types of vehicles, around a hazard or work site for the safety of both road workers and road users
traffic control	direction of traffic around, past or through a roadwork site, accident or other disruption
traffic controller	person holding a SafeWork NSW qualification principally concerned with the competency of directing traffic in accordance with a work zone traffic management plan
traffic gap	time interval between the detection of two successive vehicles in a traffic stream
traffic guidance scheme (TGS)	diagram showing signs and devices arranged to warn traffic and guide it around, past or, if necessary through a work site or temporary hazard ***Note to entry:*** *Traffic guidance scheme (TGS) was previously referred to as traffic control plan (TCP)*
traffic management plan (TMP)	document detailing work to be undertaken, identifying associated risks and the accepted control measures to reduce risks by describing its effect on the general area, especially its effect on public transport, cyclists, pedestrians, motorists and commercial operations with required approvals from road authorities
traffic management strategy	document containing work related conditions and constraints to assist the development of a traffic management plan
traffic staging plan	road design drawings that show how traffic passes safely around, past or through the work area during various stages of a roadwork project
travelled path	part of the roadway which is available to vehicles and consisting of one or more running lanes

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Term	Definition
vehicle movement plan (VMP)	diagram showing the preferred travel paths for vehicles associated with a work site entering, leaving or crossing the through traffic stream
vehicles per day (vpd)	number of vehicles observed passing a point on a road in both directions in a 24 hour period
vehicles per hour (vph)	number of vehicles observed passing a point on a road in both directions in a given hour
vulnerable road user	subgroup of road user including pedestrians, cyclists, motorcyclists, scooter users
work area	area on the road or within the road reserve where the construction or maintenance work is being undertaken
work site	an area of road or road reserve which includes the work area or areas and any additional length of road required for traffic control such as signs and tapers
work vehicle	vehicle or item of plant which undertakes the work and supports the road workers on foot within the work area

1.4 References

The following documents, provided in *Table 1-2*, are referred to in the text in such a way that some or all of their content constitutes requirements, recommendations or informative elements of this document.

Table 1-2. References

Document	Publisher
AS 1742.1, Manual of uniform traffic control devices, Part 1: General introduction and index of signs	*Standards Australia*
AS 1742.2, Manual of uniform traffic control devices, Part 2: Traffic control devices for general use	*Standards Australia*
AS 1742.3, Manual of uniform traffic control devices, Part 3: Traffic control for works on roads	*Standards Australia*
AS 1743, Road signs – Specifications	*Standards Australia*
AS 2700, Colour standards for general purposes	*Standards Australia*
AS 4852.2, Variable Message Signs, Part 2: Portable Signs	*Standards Australia*
AS/NZS 1906.1, Retroreflective materials and devices for road traffic control purposes, Part 1: Retro-reflective sheeting	*Standards Australia*
AS/NZS 1906.2, Retroreflective materials and devices for road traffic control purposes, Part 2: Retro-reflective devices (non-pavement application)	*Standards Australia*
AS/NZS 3845, Road safety barrier systems and devices	*Standards Australia*
Delineation guide	*Transport for NSW*
Guide to Road Design	*Austroads*

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Document	Publisher
Guide to Temporary Traffic Management	*Austroads*
Guide to Traffic Management	*Austroads*
IC-QA-G10, Traffic Management	*Transport for NSW*
IC-DC-G10, Traffic Management	*Transport for NSW*
IC-QA-G10M, Traffic Management (Maintenance Works)	*Transport for NSW*
IC-QA-G22, Work Health and Safety (Construction Work)	*Transport for NSW*
IC-DC-G22, Work Health and Safety (Construction Work)	*Transport for NSW*
QA Specification R145, Pavement Marking (Performance Based)	*Transport for NSW*
QA Specification 3352, Fluorescent Plastic Traffic Cones	*Transport for NSW*
QA Specification 3385, Barrier Boards	*Transport for NSW*
QA Specification M209, Road Openings and Restorations	*Transport for NSW*
Schedule of Classified Roads and State and Regional Roads	*Transport for NSW*
Traffic Signs Register	*Transport for NSW*
TS200, Register of ITS Field Equipment	*Transport for NSW*
TSI-SP-049, Traffic Signal Systems	*Transport for NSW*
TSI-SP-059, Type 1 Portable Traffic Signals	*Transport for NSW*
TSI-SP-060, Illuminated Flashing Arrow Signs	*Transport for NSW*
TSI-SP-081, Type 1 Portable Traffic Signals with Boom Barrier	*Transport for NSW*

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2 Temporary traffic management policies

2.1 General

Transport has a primary duty of care to ensure the health and safety of all persons at Transport work sites. This extends to its employees, its contractors and members of the public.

To ensure the safety of people at work sites, a high standard of temporary traffic management and traffic control around, past or through those work sites must be provided. A site-specific plan for the management of traffic can be developed by considering the conditions that may be encountered at each site.

The design, selection and implementation of traffic control measures detailed in this Technical Manual are based on AS 1742.3, *Manual of uniform traffic control devices*, Part 3: *Traffic control for works on roads* and the Austroads *Guide to Temporary Traffic Management* (AGTTM). If this Technical Manual does not contain advice on a particular aspect of traffic control then the latest version AS 1742.3 and the relevant Part of the AGTTM applies, if the required information is available.

This Section details the key policies that Transport applies to temporary traffic management on work sites.

2.2 Traffic management plan

The purpose of a TMP is to assist in providing a safe work environment while maintaining a safe and efficient journey for all road users.

In accordance with *Section 3 Traffic management planning process,* a traffic management plan (TMP) must be developed for all temporary traffic management (TTM) works on Transport work sites, including maintenance work sites.

A TMP may be developed that applies to either of the following, depending on the nature of work to be completed, its risk profile and location:

- A specific road corridor; or
- A project or activity.

A TMP must ensure that works are arranged such that:

- Road workers are able to work safely;
- Road users are able to travel around, past or through the work site safely;
- Road workers and road users are separated wherever possible; and
- It does not impact or cause delay to road users or, if not reasonably practicable, it is minimised.

The TMP templates provided in *Appendix A – Traffic management planning templates and tools* can be used to assist in the collection of data and inform the development of TMP.

2.3 Traffic guidance scheme

In accordance with *Section 7 Traffic guidance schemes (TGS)*, a TGS must be developed where the road environment is temporarily changed and the road users may be impacted. A TGS is a detailed layout of temporary signs and devices that communicate the TTM arrangement to guide traffic around, past or through a work site or temporary hazard. For the purposes of this document, a TGS is classified as one of the following:

- Generic;
- Site Suitable; or

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- Site Specific.

Each TGS must be checked against risks identified in the TMP to ensure that the means of controlling or reducing these risks are in place.

This Technical Manual contains example work site layouts as diagrams throughout and in *Appendix D – Work type layout examples*.

***Note**: These diagrams outline the types of controls that may be applied in a particular situation and do not include all signs/devices required. The diagrams are intended only to assist in the design of TGSs.*

2.4 Personnel

2.4.1 General

The development, design and implementation of TMPs and associated TGSs must be undertaken by authorised and competent persons who are fit for duty in accordance with this Section.

2.4.2 Training

Personnel undertaking TTM in NSW must hold a valid traffic control qualification relevant to the type of work they are undertaking.

As of 1 July 2020, traffic control training in NSW is prescribed under the WHS Regulation 2017 and is managed by SafeWork NSW. As a requirement of the WHS Regulation 2017, a person undertaking traffic control work must hold the relevant qualification for the work they are performing. The three qualifications outlined in the WHS Regulation 2017 are as follows:

- Traffic Control (TC);
- Implement Traffic Control Plans (ITCP); and
- Prepare Work Zone Traffic Management Plans (PWZTMP).

For a list of SafeWork NSW approved training providers see the Service NSW Public Register of Training Providers.

In this Technical Manual, all references to the training certification titled Implement Traffic Control Plans refers to the qualification currently recognised in NSW for implementing traffic guidance schemes.

Table 2-1 provides a summary of the three traffic control training qualifications with requirements and restrictions for each of the qualifications.

As required by the WHS Regulation 2017, Transport as a PCBU must ensure that any persons undertaking traffic control work have either completed the Safework NSW training for that type of traffic control work in the preceding 2 years, or have been carrying out that type of traffic control work in preceding 2 years.

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Table 2-1. Traffic control training qualifications, requirements and restrictions

Qualification	Requirements	Restrictions
Traffic Controller This qualification provides the necessary certification to control traffic with a prescribed traffic control device.	Persons holding this qualification are permitted or required to: • Stop or direct road users using a STOP/SLOW bat or other accepted traffic control device; • Maintain traffic incident reports; • Operate a 2-way radio; • Understand the TGSs for the site; • Check traffic control signs are installed in accordance with the relevant TGS; • Assess and respond to changes in the environment, e.g. traffic volumes, weather conditions, road conditions, WHS and operational requirements; and • Carry out risk assessments for personal safety.	Persons holding this qualification must not: • Select or adjust a site suitable TGS; • Implement a TGS; • Modify a TGS; or • Design a TGS.
Implement Traffic Control Plans This qualification allows for qualified personnel to set up and work with TGSs at a work site and complete safety inspections.	Persons holding this qualification are permitted to: • Set up, monitor, and close down traffic control devices according to nominated TGS; • Identify safety implications of traffic control at roadworks; • Check, clean and store equipment on completion of work and close down a TGS; • Select an approved TGS to suit site conditions, traffic volumes and work activities; • Make adjustments to an existing TGS within the tolerances specified in *Section 7.10.3 Tolerances on positioning of signs and devices;* • Conduct an onsite check of a TGS to identify risks and hazards; • Ensure spacing between signs and traffic control devices is in line with a TGS; • Maintain traffic incident reports; and • Monitor traffic controllers.	Persons holding this qualification must not: • Control traffic with a STOP/SLOW bat or other traffic control device; • Make adjustments to an existing TGS which exceeds the tolerances specified in *Section 7.10.3 Tolerances on positioning of signs and devices;* or • Design a TGS.
Prepare Work Zone Traffic Management Plan This qualification allows for qualified personnel to design and modify Traffic Management Plans (TMPs), Vehicle Movement Plans (VMPs) and traffic guidance schemes (TGSs).	Persons holding this qualification are permitted to: • Prepare a Work Zone TMP; • Collect all required information about a given roadwork project to enable the preparation of a TGS; • Design a TGS, based on risk assessment, statutory and regulatory requirements, standards, road authority requirements and project brief; • Select and modify a TGS based on risk assessment, statutory and regulatory requirements, standards, road authority requirements and project brief; • Determine the recommended spacing between signs and traffic control devices in line with standards, measure width of trafficable surface and calculate edge clearances to barriers, cones and clearance to work personnel;	Persons holding this qualification must not: • Control traffic with a STOP/SLOW bat or other traffic control device; or • Implement a TGS.

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Qualification	Requirements	Restrictions
	• Undertake safety inspections/checks on the effectiveness of TMPs and TGSs; • Conduct an onsite check and inspection of the plan and to identify any hazards or risks; and • Seek approvals required for a TMP and TGS	

2.4.3 Fitness for duty

Workers performing TTM must be fit for duty when reporting for work and during working hours (including breaks and travel time). This includes being free from the adverse effect of prescribed, over-the-counter and alternative medication which might negatively affect the ability to perform duties and/or pose a risk to the safety of workers and/or others.

Alcohol or prohibited drugs must not be consumed on a Transport work site or workplace at any time. Refer to the Transport Drugs and alcohol procedure for more information. All workers when undertaking work for, or on behalf of Transport, must comply with this procedure at a minimum. If work is being undertaken on a site that is under the control of a Principle Contractor, the Drug and Alcohol requirements of that Principle Contractor prevail only if the standard exceeds that required by Transport.

Workers should inform their manager where there is reasonable suspicion that anyone working on a roadwork site may be under the influence of drugs or alcohol.

2.4.4 Personal Protective Equipment (PPE)

Workers performing TTM must wear approved high-visibility clothing, including wet weather clothing where appropriate, in accordance with Transport’s current Personal Protective Equipment Procedure. PPE must be clean, bright and not obscured by or covered with other clothing.

Additional PPE such as hearing, eye and foot protection must also be worn as required by the relevant Safe Work Method Statement (SWMS) and in accordance with Transport’s current Personal Protective Equipment Procedure.

2.5 Traffic control

Traffic control is any direction of traffic around, past or through a roadwork site, accident, hazard or other disruption. A summary of the key policies contained in *Section 5.4 Traffic control* are as follows:

- Traffic control must be used if road users are to be directed to deviate from a traffic regulation, such as crossing a barrier line;
- The implementation of traffic control must be conducted in line with the hierarchy of controls with the elimination of harm to workers and the travelling public considered in the first instance;
- Where traffic control is required, a portable traffic control device (PTCD) must be used rather than using a manual traffic controller when the existing permanent speed limit is greater than 45 km/h, see *Section 5.4.2 Traffic control types.* *Section 5.4 Traffic control* provides the conditions under which a manual traffic controller may be used;
- Where PTCDs or traffic controllers are used, approach speeds of traffic must be reduced to less than 65 km/h; and
- All persons operating a portable traffic control device or performing manual traffic control must be:
    - Qualified with ‘Traffic Control’ training; and

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  - Authorised by the relevant road authority.

Section 5.4 Traffic control permits the use of a manual traffic controller provided all of the following conditions are met:

- The use of a PTCD is demonstrated to not achieve the safest outcome;
- The decision to use a manual traffic controller instead of a PTCD is documented; and
- Approval is granted by the one-up manager of the PWZTMP qualified person or the nominated divisional representative.

Additionally, a manual traffic controller may be used in instances of emergency response.

If a manual traffic controller has been justified and approved in the TMP, the manual traffic controller must have four (4) cones placed at 4 m spacing at a safe location immediately preceding the location of the traffic controller on the edge line, centre line or both, and the appropriate signage in accordance with *Section 5.4 Traffic control*.

2.6 Signs and devices

Signage must be installed in accordance with *Section 6 Signs and devices*. When using signs they must be:

- Placed before the roadwork begins and be removed as soon as they are no longer required;
- Regularly checked to ensure they are still relevant, in good mechanical condition, have not moved, rotated or blown over, are clean, not faded and have good night-time visibility as necessary; and
- Inspected to ensure they remain clearly visible and command attention to road users and are not obscured by vegetation, vehicles, plant or other signs and devices, and are displayed in the correct sequence.

2.7 Work sites

The work site is the length of road which includes the area where the work is being undertaken and any additional length of road used for traffic control including signs, tapers, traffic lights and other devices. The work site is made up of five smaller areas detailed in *Section 7.6.2 Components of the work site*.

A work area is a component of a work site and is occupied by workers, plant and materials. Work areas must be:

- Designed so that the minimum length and width of a road is closed at each stage to minimise disruption and inconvenience to road users while maintaining work site safety and efficiency;
- Staged to ensure minimum disruption to traffic especially at peak times, nights, weekends, holiday periods and during special events; and
- Monitored with action taken if lengths of traffic queues or delays occur which are greater than those predicted and allowed for.

2.8 Departures from this Technical Manual

2.8.1 General

It is acknowledged that during the planning or implementation of TTM, there might be instances where the mandatory, minimum requirements contained in this Technical Manual are not achievable, or are not achieving the required level of risk management. In these instances, a variation to a requirement or a

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departure developed and approved in accordance with this Section, may provide a better outcome. The rationale for all such decisions must be documented.

There are three broad categories of departures shown in *Table 2-2*. Departures must be managed according to the processes within the relevant category to allow for the effective management of risk.

None of the processes contained within this Section enable departures from Road Occupancy Licence (ROL) requirements.

Table 2-2. Departure categories

Departure	Examples	Section
Use of unapproved signs – includes variation to existing sign designs or the introduction of a sign that is not contained with the Traffic Signs Register	• Modification of an existing sign design within the Traffic Signs Register; or • Development of a new sign specific to site activity	Section 2.8.2 Use of unapproved signs
Use of unaccepted device – includes the introduction of a device or innovative process that is not already accepted for use via this Technical Manual	• Use of a new or varied device for controlling traffic; or • Use of new or varied to delineation method	Section 2.8.3 Use of unaccepted devices
General departures – refers to a variation to a mandatory requirement in this Technical Manual that does not fall into a ‘sign’ or ‘device’ category	• Variation to the approved minimum lane width; or • Variation to the approved minimum edge clearance/shoulder width	Section 2.8.4 General departures

The requirements of this Section apply to all TTM planning or implementation being undertaken for or on behalf of Transport, including works managed by a Principal Contractor or Industry Partner, in consultation with the relevant Transport representative for the project.

2.8.2 Use of unapproved signs

All signs used to direct or warn traffic at a roadwork site must be approved, designed and used in accordance with this Technical Manual and the Transport electronic Traffic Signs Register.

When it is determined that a work site requires a new sign, or modification to a standard sign, an Innovative/Non Standard Sign Design Request must be completed and submitted to standards@transport.nsw.gov.au.

Design and approval of a non-standard sign are undertaken by the Guidance and Delineation team within Road Specialists.

If a sign design is determined to be of benefit to Transport on an ongoing basis, it may be considered for inclusion on the Traffic Signs Register.

2.8.3 Use of unaccepted devices

Under the Road Transport Act 2013, a prescribed traffic control device must not be installed, displayed on, above or near a road without appropriate authority. Devices detailed in this Technical Manual and the

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relevant specifications where required, provide the authorisation and conditions for use by which those devices may be installed on a Transport work site.

All traffic control devices, including road markings, traffic signals, or any other device used to direct or warn traffic at a roadwork site must be accepted for use in accordance with this Technical Manual or another Transport standard, Technical Manual or specification.

Any device that is not approved for use by Transport must not be used without the appropriate written authorisation as per the Roads Transport Act 2013.

Written authorisation for the conditional use of a device for the purposes of TTM may be granted by the Director, Roads and Traffic Engineering via an application to standards@transport.nsw.gov.au.

Once submitted, the Traffic Engineering team will review the application and make an assessment for use considering:

- Existing standards and approvals required;
- Alternative solutions available;
- Safety and operational benefits;
- Constraints and risks; and
- Justification for its use.

In some cases, for authorisation to be granted, a field trial may be requested prior to or during its use as described in the application.

Any such trial will be requested by the Director, Roads and Traffic Engineering in consultation with the applicant. The purpose of the trial is to determine the safety, efficacy, operational requirements and suitability of the device for its use in this and other similar applications. The outcomes of trials may result in the integration of the device into this Technical Manual or other relevant documentation.

2.8.4 General departures

Where a mandatory requirement of this Technical Manual cannot be achieved or does not achieve an acceptable level of risk management, the following process must be followed:

1. Following the framework of *Section 3.3.4 Risk assessment,* the PWZTMP qualified person must undertake a risk assessment which includes:
    a. Description of the work where departure is required;
    b. Mandatory requirement not being met with detailed description why it cannot be met;
    c. Options investigated
    d. Proposed variation to the requirement, including if the variation is:
        - Aligned with an accepted and existing national practice document, such as AS 1742.3 or the AGTTM;
        - Aligned with an accepted and published standard of another Australian road authority; or
        - A risk based departure with no alignment to another standard or practice.
    e. Risks introduced as a result of the proposed variation;
    f. Additional controls needed to manage the introduced risks; and
    g. The residual risk after the proposed variation and mitigation measures are applied.

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2. Based on the anticipated residual risk and proposed standard applied, the PWZTMP qualified person must seek approval for the variation from the relevant Transport representative. Where the residual risk is determined to be:
   a. **Low to Medium** – a Transport representative with authority at least Delegation 5 or higher (4, 3, 2 or 1) is required to approve the variation;
   b. **High** – a Transport representative with authority at least Delegation 4 or higher (3, 2 or 1) is required to approve the variation.
3. After approval, the PWZTMP qualified person must update the TMP and other relevant documents such as traffic staging drawings and TGS in accordance with *Section 8.2 Record keeping of TTM documentation*. The TMP must include:
   a. A copy of the approved risk assessment;
   b. A summary of the departure including:
      i. Description of the work where departure is required;
      ii. Mandatory requirement not being met;
      iii. Detailed reason for the requirement not being met;
      iv. Options investigated;
      v. Approved variation;
   c. Minimum controls needed to manage the introduced risks; and
   d. Supporting information such as drawings and correspondence etc.

Throughout the process, consultation should be undertaken with relevant subject matter experts where required, such as Traffic Engineering, Road Design or other specialists. Any changes to the TMP must be approved in accordance with *Section 3.3.6 TMP approval and review scheduling*.

Appendix A – Traffic management planning templates and tools contains a template that may be used to capture this information for inclusion in the TMP.

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3 Traffic management planning process

3.1 General

Temporary traffic management (TTM) is one of the highest risk activities on a roadwork site. As such, TTM planning, in accordance with this Technical Manual, must be undertaken to assist with meeting work health and safety requirements and to provide a safe work environment while maintaining road user safety and network efficiency.

Traffic management planning is a risk management process that requires the input of relevant stakeholders to eliminate or manage risk to workers and all road users so far as is reasonably practicable (SFAIRP). The purpose of TTM planning is to:

- Establish the context of the road network, work activity and work environment;
- Assess the risk to road workers and road users by identifying, analysing and evaluating all actual and potential risks;
- Develop a strategy for traffic management based on the context and risks, which determines if traffic is required to be directed 'around', 'past' or 'through' the work site or temporary hazard;
- Develop and implement controls specifically related to the traffic management strategy. This includes design of site specific TMP, traffic guidance scheme/s (TGS) and obtaining required approvals; and
- Establish effective monitoring and review processes to ensure ongoing effectiveness of the process.

The TTM planning process, shown in *Figure 3-1* involves the development of a:

- Traffic Management Strategy; and
- Traffic Management Plan (TMP).

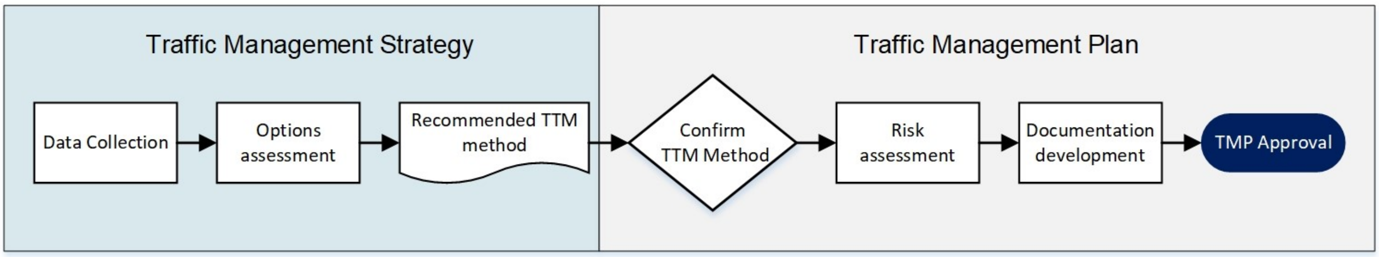

Figure 3-1. Overview of the traffic management planning process

A traffic management strategy and TMP must be developed for all roadworks. A TMP may be developed that applies to either of the following, depending on the nature of work to be completed, its risk profile and location:

- A specific road corridor; or
- A project or activity.

For example, for maintenance of a section of road, it might be more practical to develop a single traffic management strategy and TMP that is applicable to all maintenance work within a specified boundary.

Alternatively, for a project that involves a series of activities completed within a defined timeframe, a traffic management strategy and TMP for the project would be more appropriate.

An iterative process should be adopted in collaboration with relevant stakeholders to adopt the most appropriate traffic management approach and develop the associated documents for the work. For the purposes of Section 3:

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- *Client* – refers to the person or team within Transport requesting or commissioning the works. The Client has the ability to access and provide relevant information about the work required and road environment. It does not strictly refer to the people funding the work.
- *Delivery partner* – refers to the team or business engaged to undertake the works. The delivery partner is responsible for making the final determination on the selected traffic management method and managing the development of site specific requirements such as a risk assessment and TGSs.

Table 3-1 provides some examples of client and delivery partner entities for different scenarios, however it is important to note that the client and delivery partner might be different for each activity.

Table 3-1. Example client and delivery partner entities

Example	Client	Delivery Partner
When maintenance works are completed internally	Transport Infrastructure Services	Transport Regional Maintenance
When maintenance works are completed externally	Transport Regional Maintenance Delivery	Principal Contractor
For road maintenance council contract (RMCC) works	Transport Delivery Strategy/Transport Infrastructure Services (or equivalent)	Local Council
For Transport Major Projects	Transport Regional Project Delivery	Principal Contractor
For Survey Works	Transport Major Project Office or Transport Regional Maintenance Delivery	Transport Engineering Services – Survey and contracted traffic control company

3.1.1 Traffic management method

A considered and consultative approach to traffic management planning allocates appropriate time and provides enough information to determine and apply the safest traffic management method. A traffic management strategy, completed early in the design safety lifecycle supports the appropriate allocation of time, funds and resources, and allows for consultation in determining the safest and most efficient way for road users to interact with the work site. In accordance with the hierarchy of controls, the three overarching TTM methods are described in *Table 3-2*.

Table 3-2. Traffic management methods

Traffic management method	Description	Examples
***Around** (elimination)	An around method is where traffic is completely separated from the work area. An around method is the preferred TTM method where achievable, as a majority of risks associated with TTM are eliminated and it generally provides the lowest overall net risk option. This method must be considered as the first option, however if it cannot be achieved, justification must be provided in the TMP.	Examples of around methods include: • A road closure requiring a detour of all traffic. • Construction of a sidetrack. • Contraflow of traffic via a separated median.

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Traffic management method	Description	Examples
Past (isolation or engineering)	A past method is where substitution, isolation and engineering controls are used to guide traffic along an adjacent path to the work area. A past method includes the use of a barrier or shifting of traffic to provide complete separation of workers and traffic.	Examples of past methods include: • Contraflow without a separated median. • A lateral shift taper. • Use of an accepted temporary barrier system.
Through (administration and PPE)	A through method relies on administrative, training and PPE controls only. A through method does not provide separation of traffic to the work area and requires the passage of traffic through the work area. A through method must only be considered when around and past strategies are not achievable or the risk generated by installing those options outweigh the safety benefit.	Examples of through method include: • Directing road users immediately over the work area. • Separation only achieved by use of cones or bollards. • Pilot vehicle used to platoon road users.

Note* to Table 3-2: *It is acknowledged that the adoption of an 'around' traffic management method might require additional time, budget, area and community consultation. The earlier these are considered in project development, the greater the ability to incorporate into a TMP.*

3.2 Developing a traffic management strategy

3.2.1 General

To effectively manage the risk associated with TTM, it is important that the conditions and constraints associated with the works are understood. When commissioning or ordering works to be completed, the client must ensure that sufficient resourcing, including time, funds and information have been provided to the delivery partner to enable effective planning of works.

For this to be achieved, the client must develop a traffic management strategy through the collection of relevant data and information and provide this to the delivery partner. A person developing the traffic management strategy does not require any formal TTM qualifications; however experience and knowledge in TTM, or an ability to consult those with the relevant experience is recommended. A traffic management strategy is comprised of three elements:

- Data collection;
- Options assessment; and
- Recommendation.

Data collection, further detailed in *Section 3.2.2* is the minimum mandatory information that must be provided by the client to the delivery partner within the traffic management strategy.

The 'options assessment' described in *Section 3.2.3* and the 'recommendation' described in *Section 3.2.4* should also be developed and provided by the client, however these are not mandatory. If they are not provided by the client, then they may be generated by the delivery partner during the development of the TMP.

Additionally, for more complex works, a draft TMP should be developed by the client to demonstrate feasibility of the works. During project development, the draft TMP should be provided to relevant stakeholders for consideration, such as survey and geotechnical, to support traffic management investigations.

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In alignment with the Transport Design safety lifecycle management framework, the information needed by the client is best collected and assessed early in the project cycle; ideally during the strategic phase, prior to the environmental impact statement or project boundaries being determined. This information should be completed and consulted as part of the Health and Safety in Design process to ensure the considerations of constructability are also factored into the options.

For works requested by a client outside of the Design safety lifecycle management framework, consultation with the relevant subject matter expert must be undertaken.

Appendix A – Traffic management planning templates and tools provides a template that may be used to facilitate development of a traffic management strategy.

3.2.2 Data collection

Data must be collected to inform the delivery partner about the way work will be undertaken and details of the work location. This information is fundamental to informing the TMP and the work specific risk assessment that is completed prior to the design of TGSs.

The client must provide the following information, where relevant, to the delivery partner in order to facilitate the development of the TMP:

Site related information

- Name of the project;
- Activity/work to be performed;
- Details of intersections impacted by the project length;
- Location of the work; and
- Details of the project phase for which the strategy is being developed.

Relevant site related data

- Cross section including description of unique features in cross section, and photo/aerial of the location of works;
- If the work location is in an urban or rural setting;
- Existing permanent and operating speed limits of all roads in work sites;
- Traffic volumes and composition in average daily traffic (ADT) and annual average daily traffic (AADT), if available, and AM and PM peak times;
- Details of heavy vehicle access requirements including vehicle types, e.g. restricted access vehicle (RAV) and over-size, over mass (OSOM) vehicles, and where available indication of length, mass, width, and heights of vehicles and percentage of types;
- Details of crash history;
- Details of intersections impacted by the project length; and
- Details of vulnerable road users and other facilities, including but not limited to:
  - On-street parking;
  - Transport facilities and infrastructure such as bus stops, train stations and tram stops;
  - Clearways;
  - Cycle ways; or
  - Footways.

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Constraints

- Road environment constraints such as heritage considerations, utilities, cuttings, significant cut/fills, bridges, guardrails, limited shoulders and other environmental constraints like threatened species; and
- Details of significant traffic generators including their location, duration/time restrictions and other impacts. Examples of significant traffic generators are:
  - Local centres;
  - Retail, business, entertainment and community facilities;
  - Events;
  - Schools; and
  - Mines.

In addition to the above, any other relevant considerations should be provided to the delivery partner as part of the traffic management strategy.

3.2.3 Options assessment

After the work and site related information has been collected, the client should assess, detail and document the options available relating to the TTM methods detailed in *Table 3-2*. The purpose of the options assessment is to provide the delivery partner with an understanding of the suitability and availability of ways in which traffic can be managed to enable the highest level of controls for road workers to be implemented. As such, when undertaking the options assessment, at least one *around* option should be considered and detailed.

It is acknowledged that information required to undertake an options assessment might not be readily accessible to the client, and in these instances, consultation should be undertaken with the delivery partner. The options assessment should provide detail of the multiple options assessed, and in particular, give information relating to both of the following traffic management methods:

- Around – the client should determine options available for around. It is recognised that there will be instances where an around option is not feasible, and in such cases, the reason for non-feasibility can be stated in the options assessment. When investigating suitability for around options the client should provide information to the delivery partner regarding:
  - A detailed description of the *around* route including any detours;
  - The duration that the *around* method will be in place, in either days, weeks or months;
  - The hours of operation of the *around* method, whether day and/or night and where known, the hours of operation;
  - Details of the benefits of the option in terms of cost and/or time;
  - Details of any constraints that will apply to the *around* method;
  - The estimated total cost to implement the *around* method, including route upgrades or infrastructure requirements;
  - Other considerations such as works traffic impacts, e.g. access and egress;
  - Stakeholder consultations required to ensure method is implemented successfully and that any affected residents or businesses have been notified; and
  - Approvals required to implement the *around* method.

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- Past – the client should determine and provide information to the delivery partner regarding:
    - A description of the *past* method;
    - The anticipated duration that the *past* method will be in place, in either days, weeks or months;
    - The hours of operation of the *past* method, whether day and/or night and where known, the hours of operation;
    - The type of temporary traffic management that will be required to facilitate the *past* option;
    - Details of the benefits of the option in terms of cost and/or time;
    - Details of any constraints that will apply to the *past* method;
    - Other considerations such as works traffic impacts, e.g. access and egress;
    - Stakeholder consultations required to ensure method is implemented successfully;
    - Approvals required to implement the *past* method; and
    - Provision of clear access for emergency vehicles.

When developed by the client, the option of through does not need to be considered as this option is managed by the delivery partner. When developed, the options assessment must also be provided to the delivery partner.

3.2.4 Recommendation

After data collection as per *Section 3.2.2 Data collection*, and available methods for *around* and *past* traffic management have been identified in accordance with *Section 3.2.3 Options assessment*, a recommendation can then be made to the delivery partner on the preferred method.

Where a recommendation is made to the delivery partner, the recommendation should consist of:

- A preferred method;

  Note: *A combination of two or more methods may be suitable.*

- A justification for the recommendation;
- A description of the critical risks and other considerations that the delivery partner is to be aware of; and
- Any additional comments.

Following the options assessment and where an *around* or *past* option is not recommended, the client then acknowledges that a *through* method is the only remaining alternative.

The final decision relating to around, past or through is the responsibility of the delivery partner and is determined following the provision of the above information with sufficient time for the TMP to be developed.

3.3 Developing a traffic management plan

3.3.1 General

A TMP shows how site specific works are integrated into the operation of the road network and additionally provides for the safety of workers and road users while maintaining the service provided by the road network. Management of work on roads must balance the need to protect road workers from traffic, while maintaining a safe and efficient road network for road users including vulnerable road users. The process of developing a TMP must be monitored and reviewed to ensure it is completed effectively.

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All resources and documentation for a TMP must be stored in a records management system, to enable and support audit and review during the life of the project and after the project is complete. See *Section 8.2 Record keeping of TTM documentation.*

After receiving all information needed to develop a TMP, including the traffic management strategy, the PWZTMP qualified person must develop and verify the TMP for the works. The TMP must contain at a minimum:

- A summary of information provided by the client in the form of a template provided by the client;
- An options assessment if not completed by the client in the traffic management strategy;
- Details of the traffic management method selected, including the decision and justification;
- A risk assessment for the works undertaken;
- Site specific documentation including relevant site specific TGS, Vehicle Movement Plans, Safe Work Method Statements (SWMS), Road Occupancy Licence and Speed Zone Authorisation; and
- Approvals, including formal acceptance of the TMP, TGSs and monitoring and review strategies.

Appendix A – Traffic management planning templates and tools provides a template that may be used to facilitate development of a traffic management plan.

3.3.2 Verification of traffic management strategy

As there can be a significant amount of time between the completion of the traffic management strategy and development of the TMP, verification of the information provided in the traffic management strategy must be undertaken. This includes:

- Verifying if all relevant information is provided and if not, the person developing the TMP must obtain the information from the client representative prior to completing the TMP;
- Verifying the accuracy of all previously collated data;
- Identifying any other work or site considerations that may have arisen since the completion of the traffic management strategy;
- Listing the details of any changes which impact the options identified in the traffic management strategy; and
- Listing additional options that may be available, and not identified in the traffic management strategy.

3.3.3 Decision of TTM method

After the information described in *Section 3.2 Developing a traffic management strategy* has been provided by the client and a verification of the information has been completed, the delivery partner must determine the TTM method, or combination of methods, required to safely perform the work or activity. When deciding the TTM method the following should be considered:

- *Detour options*:
  - Does the length and route of the detours proposed by the client introduce a disproportionate amount of disruption to the road users?
  - Does the detour introduce unacceptable impact/s on surrounding areas or unacceptable delays, resulting in undesired road user behaviour?
  - Is the cost of upgrading the route or intersections prohibitive when compared to the project value and duration?

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- *Site location*:
    - Does the site of the works contain curves, crests, vegetation, existing signage or infrastructure that may obstruct signs and devices needed for certain strategies?
- *Work area*:
    - Does the area needed to safely perform the work justify the full closure of sections of road?
- *Vulnerable road users*:
    - Do desire lines of pedestrians, cyclists, motorcyclists and users of scooters impact on works or create undesired interaction between these road users and traffic?
- *Community facilities and needs*:
    - Does the presence of schools, hospitals, retail outlets, public transport routes or other facilities create conflict with the work?

After considering the above factors, a decision regarding the TTM method must be made. If the method that is selected differs from that recommended by the client, the reasons for the departure to this recommendation must be documented in the TMP and advice provided back to the client. The feedback to the client is critical in ensuring the client is informed of site specific considerations for future reference.

The decision to place traffic around, past or through must be documented with a justification of the decision made in the TMP.

3.3.4 Risk assessment

3.3.4.1 General

After a TTM method has been determined, the delivery partner must then identify the hazards and risks associated with the works through the development of a risk assessment. The purpose of this risk assessment is to determine the controls required for the protection of the road workers and road users.

A risk assessment is generally completed in accordance with the divisional requirements; however, it must comply with the requirements of the Transport procedure for WHS Risk Management (PN066P02) at a minimum. The information and data collected during development of the TTM strategy will need to be considered.

3.3.4.2 Hazard and risk identification

The types of information that should be reviewed and engagement activities that may assist in preparing and identifying hazards includes:

- An examination of the site layout (ideally a site visit should be undertaken);
- Road network maps, including heavy vehicle route maps;
- Traffic volume viewer;
- Consultation with workers and other relevant stakeholders;
- Risk registers, including risk registers from work sites that perform similar activities;
- Operational requirements and constraints; and
- Australian Standards and other Codes of Practice.

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Hazards and risks that may be identified include, but are not limited to those listed in *Table 3-3*

Table 3-3. Hazards and risks

Hazards and risks	
Moving traffic	Traffic generating special events
Queued traffic	Non-compliance with temporary speed limits
High volume traffic	Reduced lane and shoulder widths
High vulnerable road user activity	Compromised access points
Other construction activity or roadworks in close proximity to proposed work site	Emergency vehicle access
Rising and setting of the sun	Overhead power lines or other utilities
Traffic speed and compliance behaviour	Horizontal (curves) and vertical (crests/sags) alignment
Traffic composition	Crash history
Number and location of traffic control points	Site vehicle access and egress points
Exposure and proximity of workers to live traffic	Topographical constraints
Length of delays for road users	

3.3.4.3 Risk analysis

After the hazards have been identified, a risk analysis must be carried out using the divisional framework or framework provided in *Figure 3-2* and *Table 3-4*. The risk analysis is used to identify the likelihood of harm or damage caused by exposure to the hazard and the consequences of that risk occurring. This analysis must be based on all standard treatments for those risks being in place, with their established degree of effectiveness.

Figure 3-2 provides the framework for the analysis of risk in the development of a TMP.

Risk evaluation matrix

Risk ratings:
Very high **VH**
High **H**
Medium **M**
Low **L**

Likelihood		Consequence: Insignificant C6	Minor C5	Moderate C4	Major C3	Severe C2	Catastrophic C1
Almost certain	L1	M	H	H	VH	VH	VH
Very likely	L2	M	M	H	H	VH	VH
Likely	L3	L	M	M	H	H	VH
Unlikely	L4	L	L	M	M	H	H
Very unlikely	L5	L	L	L	M	M	H
Almost unprecedented	L6	L	L	L	L	M	M

Figure 3-2. Risk evaluation matrix

Table 3-4 provides the consequence and likelihood measures for the risk analysis.

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Table 3-4. Likelihood and consequence measures

Consequence measures		Likelihood measures	
Rating	**Description**	**Rating**	**Description**
Insignificant	Illness, first aid or injury not requiring medical treatment. No lost time	Almost certain	• Expected to occur multiple times (10 or more times) during any given year • Expected to occur at least 1 in every 4 times the event or action occurs (more than 25% chance of occurrence) • This risk is known to occur frequently.
Minor	Minor injury or illness requiring medical treatment No lost time post medical treatment	Very likely	• Expected to occur occasionally (1 to 10 times) during any given year. • Expected to occur between 1 in 4 and 1 in 10 times the event or action occurs (10 to 25% chance of occurrence). • This risk is known to occur often.
Moderate	Minor injuries or illnesses resulting in lost time	Likely	• Expected to occur once during any given year. • Expected to occur between 1 in 10 and 1 in 100 times the event or action occurs (1 to 10% chance of occurrence). • This risk is known to have occurred on occasions.
Major	1 to 10 serious injuries or illnesses* resulting in lost time or potential permanent impairment	Unlikely	• Expected to occur once every 1 to10 years. • Expected to occur between 1 in 100 and 1 in 1,000 times the event or action occurs (0.1 to 1.0% chance of occurrence). • This risk could occur but not often.
Severe	Single fatality and/or 11 to 20 serious injuries or illnesses* resulting in lost time or potential permanent impairment	Very unlikely	• Expected to occur once every 10 to100 years. • Expected to occur between 1 in 1,000 and 1 in 10,000 times the event or action occurs (0.01 to 0.1% chance of occurrence). • It is unusual that this risk occurs but it has happened.
Catastrophic	Multiple fatalities and/or more than 20 serious injuries or illnesses* resulting in lost time or potential permanent impairment	Almost unprecedented	• Not expected to occur in the next 100 years (less than once every 100 years). • Expected to occur less than 1 in 10,000 times (if ever) the event or action occurs (less than 0.01% chance of occurrence). • Any risk can occur but it is very improbable that this risk will occur within the large number of events.

Note* to Table 3-4: *serious injury or illness is defined by the WHS Act section 36*

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For additional information relating to analysing risk as part of a risk assessment, refer to the Transport procedure for WHS Risk Management (PN066P02).

3.3.4.4 Risk control

In order to decide the controls that are reasonably practicable, the person developing the TMP must consider the following principles:

- Severity of the risk/s mitigated by that option;
- Knowledge of that risk;
- Perceived benefit of the option;
- Nature of the works;
- Practicality of the option proposed; and
- Cost of removing or mitigating that risk.

All possible control measures must be considered, and a decision made on the control measures that are most effective and reasonably practicable.

The controls selected must prioritise the safety of workers and road users, while minimising the delay to traffic and costs associated with treatments.

For each of the risks identified, the WHS Risk Management process must be applied to ensure risks are managed using the hierarchy of controls framework.

The factors that must be considered in the selection of controls are provided in *Table 3-5*.

Table 3-5. Factors for selection of temporary traffic controls

Key factor	Explanation
Application of minimum Standards	The cumulative impact of applying multiple minimum standards and the potential for an unsatisfactory outcome to occur as a result of the combination.
Contingency planning	Determine the way traffic will be managed in the instance that work cannot be completed as planned. This is particularly important for work that is not fully protected by temporary safety barriers. Contingency measures that can be implemented immediately should be employed.
Method and location of traffic control	Determine the way traffic will be controlled and the locations control is required. Possible control methods include: • Type 2 (automatic) Portable Traffic Signal (PTS) – fixed time operation (no traffic controller); • Temporary PTS (Type 1) – manual operation (traffic controller positioned remotely); • Boom barriers – manual operation (traffic controller positioned remotely); or • STOP/SLOW bat – manual operation (traffic controller exposed to traffic). Where traffic control has been identified as necessary, it must meet the requirements of *Section 5.4 Traffic control* and the relevant approvals must be sought for the use of a manual traffic controller.
Speed management	• Only credible speed limits should be implemented that will be self-enforcing. • Reduced speed zones must not be used in the place of more effective means of traffic control, but to complement such controls.

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Key factor	Explanation
	• The reduced speed zone must only be used when work is being undertaken or when otherwise needed. • 40 km/h speed zones should only be used when workers are on foot and the site is active. • 30 km/h (see *Section 4.5 Speed zones*). • Engage with NSW Police Traffic and Highway Patrol Command to determine if enforcement activities will be required to assist with compliance.
Aftercare provisions	• Provision for night work traffic controls must made where works will be undertaken during hours of darkness. • Roadwork sites, whether in operation or shutdown during the hours of darkness, must continue to be managed appropriately.
Emergency access	Provision for emergency services access through a roadworks site to another location to access the site in the event of an emergency on site during the works must be made.
End-of-queue management strategy	Where applicable, control measures must be implemented to stop or reduce the speed of traffic and result in either a static queue or slow moving queue (i.e. 20 km/h below the normal travel speed) in accordance with *Section 4.6 End-of-queue management*.

3.3.5 Site-specific documentation

The site-specific documentation that must be developed after finalisation of the TMP and risk assessment includes:

- A TGS which shows the placement of all temporary signs and devices. TGSs must be clear and show all traffic controls for each stage of the works;
- Road occupancy licences;
- Plans showing access to local properties and side roads affected by temporary works;
- WHS documentation including SWMSs and strategies for dealing with unplanned events or incidents;
- Emergency Management Plan to manage incidents within the traffic controlled area (vehicle break down, vehicle fires, pedestrians hit, car crash etc.);
- Approved list of TTM personnel and contacts;
- Vehicle Movement Plans showing mandated travel paths for vehicles to enter, leave or cross through traffic;
- Traffic incident plan; and
- Design drawings for temporary roadways and detour upgrades where applicable to the TTM strategy.

Other documentation that may be developed or included within the TMP includes:

- Speed zone authorisations;
- Traffic staging arrangements including Traffic Staging Plans and the time periods during which staging will be in operation;
- Traffic switches, which are often high risk activities that must have a detailed program of critical activities involved during the time of the switch;

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- Pedestrian and cyclist movement plans showing allocated travel paths around, past or through the work site or temporary hazard. This should include provision for safe and unhindered access to public transport services; and
- Records of consultation with public transport operators.

3.3.6 TMP approval and review scheduling

The final step of developing a TMP must detail the approval, monitoring and review requirements of the TMP as provided in *Table 3-6.*

Table 3-6. TMP approval, monitoring and review

Key factor	Requirements
Approval	The TMP must be reviewed and endorsed by the designer's one-up manager or other nominated person as determined by the divisional requirements. The one-up manager or nominated person must hold a current Prepare Works Zone Traffic Management Plan qualification. This approved TMP must be used to inform the development of all TGSs for the work as described in *Section 7 Traffic guidance schemes (TGS).*
Monitoring	Monitoring and review is important throughout the TMP process to ensure that the TMP remains current and addresses all risks at the work site for the duration of the project or activity. To ensure that the TMP is kept up to date, details of the process to facilitate review and continuous improvement must be detailed in the TMP. This may include audits and inspections as per *Section 8 Work site inspections, recording and reporting.*
Review	After the TMP has been implemented, TTM reviews must be undertaken in accordance with *Section 8.1 Work site inspections, reviews and audits*. Other TMP reviews must be completed as required by the G10 Specification, where applicable. Where G10 Specification is not applicable, a TMP review must occur at least every 12 months or where any on-site or works changes occur. All relevant changes must be considered and recorded in the TMP with any changes made by an appropriately qualified person. A copy of all documentation relating to the endorsement of the changes must be available to be accessed, either electronically or in hard copy, by the person responsible for the works.

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4 Inputs to a traffic management plan

4.1 General

When developing a traffic management plan, the following principles must be taken into account to ensure the safety of road workers and road users:

- Type of work being performed;
- Temporary works design principles;
- Providing for specific road users;
- Speed zones;
- End-of-queue management; and
- Credibility of work sites.

Detailed considerations of these principles when developing a TMP are provided in the following Sections.

4.2 Types of work

4.2.1 General

In this Technical Manual, work is classified by duration and activity. The terms used in this Technical Manual to classify work by duration are short-term work and long-term work. The terms used in this Technical Manual to classify work by activity are static work and dynamic work.

Table 4-1 provides a summary of the permitted relationships between static, dynamic, short and long term work.

Table 4-1. Relationships between work types

	Short term	Long term
Static work	✓	✓
Dynamic work	✓	✗

4.2.2 Short-term work

Short-term work applies to traffic management when work does not exceed the duration of a single shift and the work site is continuously attended. Examples include activities such as maintenance of freeway safety barriers, linemarking or installation of treatments such as raised pavement markers or audio tactile linemarking.

With all short-term work, roadway conditions must be returned to normal, without traffic control or after-care provisions, when work has been completed.

Short term work must be performed as either static work or dynamic work.

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4.2.3 Long-term work

Long-term work applies when work is performed over a duration greater than one shift and traffic management is used between shifts. For long-term work, a traffic guidance scheme might need to operate both day and night with the work site left unattended. Long-term work must be arranged and undertaken in accordance with the relevant requirements of static work.

Long term work must only be performed as static work.

4.2.4 Static work

Static work is classified as work that is completed at a fixed site for a period of time with TTM. Static work sites may involve complex traffic arrangements and are often established so that a site can be left unattended during or between work shifts. The use of a static work site must be a risk based decision, where the risk of setting up static controls is considered against the protection provided by those controls.

Static work might include the use of lane closures, roadwork speed zones, changes to linemarking, detours, shoulder closures etc. and often with some form of traffic control.

The length of a static work site may range from 100 m to many kilometres of work area. If traffic is to be stopped for any duration at a static work site, then the length of the work site should be considered in the TMP in relation to risk (particularly end-of-queue).

Static work must be performed as either short-term work or long-term work. For information on designing a TGS for static work see *Section 7.7 Designing a TGS: Static work*.

4.2.5 Dynamic work

Dynamic work is classified as work that is short in duration and moves along a length of roadway. Dynamic work is classified into three sub-categories:

- *Frequently changing work* – regularly moves between successive locations, either in or outside of a traffic lane where minimal warning is required to advise road users of the presence of workers;
- *Continuous work (previously known as mobile work)* – progressively moving in vehicles along the roadway; or
- *Intermittent work* – work which is undertaken on travel lanes, in gaps in traffic, and requires no adjustment that affects road users on the roadway.

Dynamic work may be completed:

- In a lane, on an edge line or on a shoulder; or
- On a verge, median or footpath.

Depending on the activity, dynamic work may involve:

- Workers only;
- Plant only; or
- A combination of both.

See *Section 7.8 Designing a TGS: Dynamic work* for examples and further details of dynamic work.

Dynamic work must be performed as short-term work only. For information on designing a TGS for dynamic work see *Section 7.8 Designing a TGS: Dynamic work.*

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4.2.6 Risk Management through work type selection

In all instances, the work type that enables the highest order control through the hierarchy of controls must be selected. Most often for long term works, this is the selection of a static site protected by a detour or safety barriers. It is recognised however that the selection and set up of static methods for short term work can in itself generate an increased level of risk (e.g. by exposing workers to traffic for longer periods during the setup of the site than the time required to perform the work). In these instances, a dynamic work method may be selected, however the worker protection must always be prioritised in accordance with the hierarchy of controls framework shown in *Figure 4-1*.

Figure 4-1. Hierarchy of controls framework

4.3 Temporary works design principles

4.3.1 General

When designing a TMP, appropriate temporary design principles must be used to ensure a safe road environment for road workers and road users. In some instances, these principles will align with the permanent road design standards.

4.3.2 Lane widths

The minimum width for lanes carrying traffic around, past or through a work site must be in accordance with *Table 4-2*. Lane widths should also consider accommodating the turn paths of large vehicles expected to negotiate the work site.

Table 4-2. Minimum lane widths

Speed of traffic (km/h)	Minimum lane width (m)
Less than 65 km/h	3.0
Greater than 65 km/h	3.5
Curve with radius less than 250 m	Curve widening of 0.5 m per lane
Shuttle flow with active control	3.5

Note to Table 4-2*: Where existing lane widths are narrower than those specified in the table above, the lane widths may be maintained. However the TMP must document provisions for turning paths, sight distances and vulnerable road users.*

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Where fixed vertical obstructions such as fences or safety barriers are restricting the available shoulder width, consideration should be given to increasing lane widths to accommodate larger vehicles.

See *Section 4.4.5 Heavy vehicles* for additional information regarding lane width considerations for heavy vehicles.

4.3.3 Roadside design

Roadside design aims to provide the safest transport network for all users by minimising the likelihood and severity of vehicles colliding with other road users, objects or other hazards within available funding constraints. It involves the consideration of the existing roadside environment and the future environment after the temporary traffic management measures have been implemented.

Previously, the clear zone concept was used to define a specific area beside the road to be evaluated for roadside safety and it was considered that hazards outside the clear zone were acceptable. This is no longer appropriate as the risks and hazards cannot be eliminated no matter how wide the clear zone is.

All hazards in the road reserve, both adjacent to the road shoulder (or kerb) and within median, must be considered in terms of the level of risk they pose and whether appropriate mitigation measures should be implemented.

A clear area on the roadside is one of several possible mitigation measures. Other examples include:

- Improving the delineation of the road;
- Changing the cross-section (including the use of wide medians and median barriers);
- Installing temporary safety barriers;
- Removing the hazard;
- Relocating the hazard to a position where it is less likely to be struck;
- Reducing the impact severity posed by the hazard; and
- Accepting the risk of the untreated hazard where the frequency of hitting the hazard and severity are both low. In this case, the risk should be monitored.

The most appropriate solution for a work site, which might be a combination of options listed above, must be determined based on a documented risk assessment and detailed in the TMP.

4.3.4 Minimum clearances of workers to traffic

Work must be planned and designed to provide maximum achievable clearances to workers on foot and plant.

When performing static or dynamic work, the minimum allowable clearance of 1.5 m must be maintained between workers on foot, plant and traffic, unless the following is demonstrated:

- A site or activity specific risk assessment must be completed, demonstrating that the hierarchy of controls is applied and all higher order controls have been considered;
- Site specific controls for works, including the minimum controls detailed in *Section 4.3.5 Protection of work area,* have been determined and detailed in the traffic management plan; and
- Work specific minimum controls, detailed in *Section 7.8 Designing a TGS: Dynamic work* have been determined and detailed in the traffic management plan.

4.3.5 Protection of work area

In accordance with *Section 4.3.4 Minimum clearances of workers to traffic*, all work areas should be distanced as far away from through traffic as possible via the use of *around* or *past* traffic management

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methods. Where work is required to be performed near traffic, *Table 4-3* provides the mandatory controls and additional recommended controls for the protection of a work area.

Table 4-3. Mandatory and recommended controls for protection of a work area

Distance of work area to traffic	Mandatory and recommended controls			
	Mandatory/ recommended	Static work		Dynamic work
		Work duration greater than 4 weeks	Work duration less than 4 weeks including short-term work	*Continuous and frequently changing work
Closer than 1.5 m	Mandatory controls	• Temporary safety barrier	• Delineation of work area • Speed zone of 45 km/h or less	• Speed zone of 45 km/h or less • Shadow vehicle
	Recommended controls	• Speed zone of 85 km/h or less	• Speed zone of 35 km/h or less • Temporary safety barrier	• Delineation of work area • Speed zone of 35 km/h or less
Between 1.5 m and 3 m	Mandatory controls	• Temporary safety barrier where speed zone is greater than 75 km/h • Speed zone of 65 km/h or less where no temporary safety barrier is used	• Delineation of work area • Speed zone of 65 km/h or less	• Speed zone of 65 km/h or less • Shadow vehicle
	Recommended controls	• Delineation of work area • Temporary safety barrier where speed zone 85 km/hr or less	• Temporary safety barrier	• Delineation of work area • Speed zone of 55 km/h or less
Between 3 m and 6 m	Mandatory controls	• Speed zone of 85 km/h or less where there is no safety barrier	• Delineation of work area • Speed zone of 85 km/h or less where there is no safety barrier	• Speed zone of 85 km/h or less
	Recommended controls	• Temporary safety barriers	• Temporary safety barrier	• Delineation of work area • Speed zone of 65 km/h or less
Greater than 6m	Mandatory controls	• Worker symbolic (T1-5) sign when workers are visible to road users	• Worker symbolic (T1-5) sign when workers are visible to road users	• As per *Section 7.8* .
	Recommended controls	• Delineation of work area • Temporary safety barriers	• Delineation of work area	• Delineation of work site

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Notes* to Table 4-3:

1. *Minimum controls for intermittent work are provided in Section 7.8.5.1 Minimum controls for intermittent work*.
2. *All work sites protected by an approved temporary safety barrier must meet the requirements of Section 6.7 Temporary safety barriers*.
3. *Where a temporary safety barrier is not installed, work site delineation should be provided by way of cones, bollards or similar in accordance with Section 6.8 Traffic guidance and delineation devices.*
4. *Where a temporary safety barrier has been installed as a recommended control, the mandatory speed zone reduction may be re-assessed in accordance with the acceptance conditions provided on the Transport Safety Barrier Products website.*
5. *If there is a risk of workers, plant or equipment encroaching into the through lane of traffic, containment fencing in accordance with Table 6-13 should be installed.*
6. *In addition to the controls detailed in Table 4-3, signage must be installed for the relevant works in accordance with Section 6 Signs and devices.*

When determining the distance between a work area and traffic, the distance must be based on the location of the closest workers or object to the edge of a travel lane (the lane line), including bicycle lanes.

The edge of the traffic lane is the outside limit of the traffic lane, usually defined by an edge line or the kerb. If there is no edge line or kerb on the road (i.e. such as a rural road) then the edge of the traffic lane would be edge of the sealed pavement for a sealed road or the drainage swale for an unsealed road.

4.3.6 Sight distances

Suitable sight distances enable road users to perceive and react to a hazardous situation on the road ahead resulting in safer and more efficient traffic management. When designing a TMP, the PWZTMP qualified person must ensure adequate sight distance is maintained at all times along the alignment including at intersections and accesses. The following sight distance checks should be considered:

- Stopping Sight Distance (SSD);
- Safe Intersection Sight Distance (SISD);
- Overtaking Sight Distance;
- Intermediate Sight Distance;
- Approach Sight Distance (ASD); and
- Pedestrian Sight Distance.

Detailed steps and calculations associated with assigning appropriate sight distances are described in detail in Austroads *Guide to Road Design Part 3 and Part 4a* and Transport Supplement to AGRD Part 3 and Part 4a. Advice on sight distance can also be provided by Road Design and Traffic Engineering.

Sight distances must be maintained to all safety elements of the work site including but not limited to:

- Traffic control devices;
- Queued vehicles;
- Signs and delineation;
- Site access and egress points;
- Intersections;

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- Private and commercial accesses;
- Merge tapers;
- Work vehicles; and
- Pedestrian, cyclist and other vulnerable road user paths and crossing points.

Best practice is to provide as much sight distance as possible, while considering drivers perception of the upcoming hazards, however it is often restricted by the following:

- Road geometry including horizontal and vertical curves in road;
- Environmental factors such as:
    - Weather;
    - Vegetation; and
    - Time of day.
- Road user factors including:
    - Traffic queues;
    - Types of road users; e.g. over-dimensional vehicles, motorcyclists; and
    - Road user behaviour such as vehicles closely following each other.
- Local site features, both temporary and permanent, including the presence of the following located in the median or on the roadside:
    - Safety barriers and kerbs;
    - Signs;
    - Street furniture, including landscaping and fencing;
    - Steep cuttings;
    - Parked vehicles;
    - Railway crossings; and
    - Bridges.

It is important to note that stopping sight distance for heavy vehicles varies from that of other vehicles. Information regarding stopping sight distance for heavy vehicles can be found in the Performance-Based Standards Scheme – Network Classification Guidelines.

Additional sight distance requirements are provided in *Section 7.8.5.2 Sight distances for intermittent work.*

4.3.7 Traffic staging plans

Traffic staging plans (TSPs) are typically road design drawings that show how traffic passes safely around, past or through the work area during various stages of a roadwork project.

A road designer must design the horizontal and vertical alignment of the temporary roadway. In addition and where detailed, a PWZTMP qualified person must design the layout for the temporary signage and delineation. These activities may be completed by two people or one person with both qualifications. Accordingly, the alignment and layout must be signed off under road designer and PWZTMP competencies.

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The TSP and any supporting TGS must show the alignment, signage and delineation, and allow for easy installation and checking. As such, it may be necessary that the TSP be separated from other staging plans, such as a construction staging drawings.

A TSP must show the following details (where applicable):

- Lane configurations on existing and new (temporary and permanent) pavements;
- Intersection layouts and temporary traffic signals arrangements;
- All existing and temporary traffic signage, delineation and pavement markings;
- Footways and cycle ways;
- Bus stop locations;
- Work areas;
- Construction site ingress and egress locations including acceleration and deceleration lanes (or shoulders);
- Access to local properties and side roads;
- Temporary street lighting;
- Temporary barriers; and
- Chainages.

Other factors that should be considered (that may form part of a staging construction design) when designing the TSP include:

- Temporary pavement design;
- Temporary drainage design, including erosion and sedimentation control;
- Longitudinal and cross-section plans of temporary alignment;
- Utilities and their impact on staging; and
- Temporary retaining structures.

4.3.8 Detours

A detour must be carefully planned at the TMP stage such that:

- The alternative route is capable of accommodating all classes of vehicles that are to be detoured in terms of mass, height or width limits of any structures;
- Stakeholders, such as the local council and police, are informed and concur with the proposed detour;
- Local residents are consulted and informed in a timely manner; and
- Consent is obtained for local and regional roads from the relevant local council in accordance with the Heavy Vehicle National Laws.

The following additional aspects should be considered when planning a detour:

- Lane widths;

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- Geometric design of intersections and their capability to accommodate the vehicles that are being detoured (for example, B-double sweep paths and small roundabouts);
- Existing intersection controls and priority relative to the proposed route (i.e. will Give Way or Stop sign control be in conflict with the detour route);
- Existing traffic flows and turning movements;
- Vulnerable road user movements and existing facilities;
- Land use along the detour route and the need to manage any environmental impact (i.e. noise); and
- Sensitive land uses along the detour route. For example, aged care facilities, child care centres etc.

Further information regarding TGS design considerations for detours is contained in *Section 7.7.2.3 Detours.*

4.4 Providing for specific road users

4.4.1 General

During the development of a TMP, the needs of specific road users must be understood and managed for the extent of the works. The locations of need, travel paths and desire lines must be factored into the development of the TMP to ensure safety and access is maintained.

Specific groups to be assessed include:

- Vulnerable road users including:
    - Pedestrians;
    - Cyclists;
    - Motorcyclists; and
    - Users of scooters and other similar devices/vehicles.
- Heavy vehicles, including oversize overmass vehicles.

When it is identified that TTM arrangements may affect any of the above groups, paths and routes must be maintained in an acceptable and hazard-free condition at all times. Restriction or closure of routes, accesses or desire lines must be determined via appropriate consultation and approval.

4.4.2 Pedestrians

It is essential to understand the type, need and access required for pedestrians affected by the works. Pedestrians include high risk pedestrians which are at greater risk to hazard such as persons with a disability, the elderly and children.

Information that should be obtained includes:

- Existing pedestrian paths within and adjacent to the project boundaries, e.g. desire lines, key routes, attractors, destinations or linked trips;
- Pedestrian accident history;
- Surrounding land use, including access needs to businesses, schools, pubs or community facilities;
- Expected numbers and types of pedestrians; and
- Pedestrian accessibility requirements e.g. shopping trolleys, prams, motorised or non-motorised wheelchairs or walking frames.

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The TMP must ensure pedestrian needs are addressed, including:

- Specific requirements for high risk pedestrians e.g. persons with a disability (particularly with vision or hearing impairment), children or elderly; and
- Provision of additional signage, guidance (e.g. pedestrian fencing) and protection (e.g. crash barriers and crash cushions) in high risk locations.

Additionally, the TMP must determine the need for a road safety audit.

Generally, pedestrians will take the most direct route possible. At work sites where it has been necessary to introduce temporary arrangements for pedestrians, movement patterns of pedestrians must be observed, especially during the first week, and necessary changes made to ensure that pedestrians are able to move safely. Observations should cover both day and night conditions as required by the road safety audit process, and any amendments should be made to the approved TMP.

Key considerations when planning for pedestrians are provided in *Table 4-4*.

Table 4-4. Planning considerations for pedestrians

Consideration	Requirement
Defining the work area	The work area must be clearly defined by using an appropriate fencing. Where pedestrians have been diverted onto an existing roadway, the pedestrian path must be separated from vehicular traffic by a mesh fence at a minimum, provided that there is sufficient width for the anticipated pedestrian volumes, storage and flow directions. Where these conditions cannot be met, a safety barrier or an alternative pedestrian path must be provided or the work site redesigned to pass a road safety audit based on pedestrian access. Pedestrians must be separated from any trenches or the trenches covered with appropriate plates until backfilled.
Reversed traffic direction	Special safety requirements may be needed where traffic is required to travel temporarily in the wrong direction, at a detour, crossover or other location. In particular: • Containment fences may be required to control the crossing point; • Personnel may need to be positioned to guide and assist the pedestrians; or • LOOK BOTH WAYS, TWO-WAY TRAFFIC (T8-5) signs may be required, especially where one carriageway of a divided road is closed. The signs must be placed on both sides of the open carriageway facing pedestrians.
Footpaths	Temporary footpaths must provide a clear path of travel and must be: • Adequately signposted to indicate the direction of the footway; • Of all weather standard including ramps over gutters that can have water velocities above 1 m/s; • Of equivalent material and performance to the adjacent footpaths and not pose a trip hazard for the range of pedestrians; and • At local constrictions, not less than 1 m width. Elsewhere a width of at least 2 m must be provided and any additional width to aid stopping sight distance to all road users. Care should be given to maintain good conditions and widths at points of concentration of pedestrians, such as in front of shops, schools at bus stops, light-rail stops, storage islands, medians and refuges.

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<table>
<tr><th>Consideration</th><th>Requirement</th></tr>
<tr><td>Pedestrian crossings</td><td>Care should be given to maintaining pedestrian crossing facilities and associated signs during the works. If access to existing crossings cannot be maintained, alternative facilities as near as possible to the established crossing and (to at least the same standard) must be provided. 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 must be prevented from crossing, where:
• 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; or
• Stopping sight distance is not available to all road users.
In these circumstances active control must be implemented, using one of the following:
• Pedestrian-actuated traffic signals;
• Use of portable traffic control device; or
• Direct pedestrians through a chicane so that they face the direction of oncoming traffic with the required stopping sight distance before stepping on to the traffic lanes.</td></tr>
<tr><td>Lighting and security</td><td>Where it is necessary to temporarily divert pedestrians, the path must:
• Have lighting provided for pedestrian crossings; and
• Have all security risk areas identified and controls implemented to manage this risk. This may include provision of additional lighting, security cameras or change of design to eliminate high potential locations.</td></tr>
</table>

4.4.3 Cyclists

Transport is committed to the use of cycling as a transport mode, and to the provision of safe and convenient cycling facilities. Therefore, ongoing provisions for cyclists for the duration of the works must be identified and determined during development of the TMP. The following items should be considered when making this determination:

- Existing volumes of cyclists;
- Existing cyclist facilities;
- Available width and alignments;
- Traffic speeds and volumes;
- Duration of work;
- Surface material and condition;
- Environmental effects; and
- Costs.

Following the determination to provide for cyclists, and documented in the TMP, a smooth shoulder, with a minimum width of 1.2 m (2 m required if adjacent to traffic lane with speeds above 60 km/h) and regular sweeping of the riding surface must be provided. Consideration should be given to increasing the width of the cycle path if site based factors such as steep grades or vegetation are present.

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Cyclists will take the most direct route possible. At work sites where it has been necessary to introduce temporary arrangements for cyclists, movement patterns of cyclists must be observed, especially during the first week, and necessary changes made to ensure that cyclists are able to move safely. Observations should cover both day and night conditions as required by the road safety audit process, and any amendments should be made to the approved TMP.

Table 4-5 provides considerations that should be applied when planning for works in relation to cyclists.

Table 4-5. Considerations when planning for works impacting cyclists

Type	Considerations
General principles	• On down-grades, cyclists can travel at speeds of up to 50 km/h and surfaces must 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; and • Signs and devices should be placed so that they do not force cyclists away from safe travel paths.
Grooved roads	Milling of roads prior to re-surfacing can present a hazard for cyclists. Where road surfaces are grooved, cyclists should be warned by the display of CYCLE HAZARD GROOVED ROAD (T2–207n) signs on all approaches.
Lighting of work sites	Where works affecting cycle ways are carried out for a period exceeding one day, the works must be made sufficiently visible for night time travel. That is, cyclists must 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.

4.4.4 Motorcyclists

Motorcycles (and mopeds) travelling through work sites require additional consideration, particularly in terms of the road surface provided. When designing a TMP, it should be considered that motorcycles do not handle in the same way as cars, they are less stable than other vehicles on loose and slippery surfaces and are unable to brake heavily on curves.

Signage for the site must adequately identify road surfaces that are different to that on the approach. Particular hazards to motorcyclists include unsealed surfaces, some painted road markings when wet, unexpected sections of wet roads and loose gravel, especially in areas where braking and turning is required.

Table 4-6 provides considerations that should be applied when planning for works in relation to motorcyclists.

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Table 4-6. Considerations when planning for works impacting motorcyclists

Consideration	Requirement
Road surfaces	Surface changes can be critical to motorcycle stability and so, surface changes must be signposted well in advance so that a motorcyclist is not forced to take rapid or unexpected evasive action. This may include: • Use of the GRAVEL ROAD (T3-13) sign where sections of sealed roads are temporarily reduced to gravel; • Use of the SLIPPERY symbolic (T3-3) sign to indicate a wet surface; or • Use of appropriate signage, such as Temporary Portable Rumble Strip Ahead Symbolic (T5-210n) sign or Boom Barrier AHEAD (T1-272n) sign to warn of specific changes.
Grooved roads	Milling of roads prior to resurfacing can present a hazard to motorcyclists. Where road surfaces are grooved, CYCLE HAZARD GROOVED ROAD (T2-207n) signs must 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.
Other hazards	• Materials, installation and maintenance of steel plates used to cover excavations must comply with Transport QA Specification M209, Road Openings and Restoration. • Water which drains from roadworks, should not run across traffic lanes to a depth greater than 5 mm.

4.4.5 Heavy vehicles

Transport is committed to providing safe and efficient access for heavy vehicle operation in delivering freight.

OSOM loads may travel on the road network under Notice with a gross mass up to 115 tonne and dimensions up to 5 m wide, 5 m high and 30 m long. OSOM vehicles may have a trailer axle ground contact width up to 4.6 m. Transport has no visibility of when, where or the frequency of vehicles operating under Notice, so work sites must cater for these dimensions at a minimum if work is carried out on an identified heavy vehicle route (see NSW OSOM Load Carrying Vehicles Network Map). Vehicles that exceed any of the above mass or dimension limits are required to obtain a permit via the National Heavy Vehicle Regulator.

When developing a TMP, the considerations provided in *Table 4-7* for heavy vehicles such as OSOM and Restricted Access Vehicles (RAV) accessing the network under notice or permit, must be identified and detailed in the TMP.

Table 4-7. Heavy vehicle TMP provisions

Consideration	Detail
Number and type of vehicles	Number and percentage of different types of heavy vehicles, time of day access requirements.
Vehicle clearances	• Length, mass, height and width of vehicles expected to pass through the site; • Minimum ground contact height required for vehicles; and • Turning path and sight distance requirements.

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Consideration	Detail
Access through site	• Identification of alternate routes around work site nominated if vehicle cannot be accommodated through the site; • Works designed so that the installation of temporary barriers, contra flow arrangements and falsework structures do not significantly affect the movement of heavy vehicles; and • Location and placement for emergency stopping/pull over bays within long work sites that will accommodate long vehicles.
For higher volumes of OSOM vehicles	• Ensure Livetraffic.com.au is updated to show the works and any relevant information relating to OSOM access; • Provide a site contact name and contact details to the Transport Road Access Management unit to assist OSOM operators in negotiating the work site; • Where high volumes of heavy vehicles are expected, additional safety measures such as traffic control and VMS boards should be provided to give advanced warning to OSOM loads of the upcoming works; and • Provision of OSOM pullover areas prior to the works.

Heavy vehicles between 3.5 m to 6 m wide are accompanied by at least one escort vehicle. Escort vehicles function as a warning to other road users of an approaching oversize load. Loads in excess of 6 m wide and/or 40 m long are accompanied by NSW Police escorts.

Escort drivers must not conduct traffic management functions (aside from leading or following their OSOM vehicle) while travelling through a work site that is under independent traffic management and control. As such escort vehicle drivers must not assist in managing other road users to facilitate access of an OSOM load through a work site. This requirement does not apply to Police when acting as an escort.

Pilot vehicles which are operating in accordance with the TMP for the particular work site are permitted to manage other road users to facilitate access of an OSOM load through the particular work site.

When developing a TMP, the project location should be identified on the Restricted Vehicle Access Maps and Lists to determine if the project will be within any approved routes and network restrictions for use by heavy vehicles. The interactive RAV maps provide details on the roads and zones approved for the following heavy vehicle combinations when selecting the corresponding option, including:

- 4.6 m high vehicle routes;
- B-doubles routes; and
- Road Train Routes.

The published maps are the legally enforceable network in NSW. Freight Branch (email freight@transport.nsw.gov.au) can provide support and advice regarding types of vehicles under Notice or permits to access the network.

Where a work site impacts on the dimensions of the existing road environment, by reducing lane width or introducing temporary safety barriers, Live Traffic must be used to notify road users, including heavy vehicle operators, of the work sites. At a minimum the information on Live Traffic should include details of any OSOM restrictions and a site contact and all information provided should be clear, concise and relevant.

For assistance of advice regarding OSOM routes, site provisions or to assist in sending communications about works to the heavy vehicle industry, the Transport OSOM Access Manager can be contacted on 1300 656 371.

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4.5 Speed zones

4.5.1 General

Roadwork speed zones are used to assist in managing the risk to road workers or road users in case of a hazard on or surrounding the road. This may include, but is not limited to the following:

- Where traffic travels past or through a work site or where workers are undertaking activities in or adjacent to the roadway;
- During an accident or an emergency;
- During situations of reduced visibility;
- Where loose material or stones are on the road surface, e.g. during spray sealing works;
- Where there is a reduction in quality of the road surface condition, including where vertical or horizontal alignment is inconsistent with the adjacent length of road;
- When traffic is diverted onto an opposing carriageway, detour or side-track;
- When controlling traffic in accordance with *Section 5.4 Traffic control;*
- Where road users are required to travel adjacent to excavations; and
- On bridges, where a reduction in the impact loading caused by traffic is required for structural safety.

4.5.2 Selection

When determining the need for a roadwork speed zone, the PWZTMP qualified person must ensure the selected speed zone is:

- Credible;
- Placed in accordance with the requirements of this Section;
- Placed to maximise the effectiveness of the road environment, i.e. topography and geometry;
- Not used alone, but used with other signs or devices as dictated by and in response to the site-specific conditions;
- Within the minimum length needed for the protection of workers and the travelling public;
- Not used in the place of more effective means of traffic control, but to complement such controls; and
- Only used for the duration of the need, and not used while work is not being undertaken or when road conditions have resumed to their normal operation.

The following factors should be considered when selecting the roadwork speed limit:

- Number and degree of vehicular and pedestrian and other vulnerable road user conflicts;
- Type and extent of the work in progress;
- Characteristics of the road;
- Proximity of workers to passing traffic; and
- Number and type of work vehicles entering or leaving the road.

Roadwork speed zones must be selected in accordance with the conditions provided below, and can be supported by using appropriate signs and devices according to the criteria provided in *Table 4-8*.

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Table 4-8. Selection criteria of roadwork speed zones

Speed zone	Selection Criteria
80 km/h	The speed limit must be reduced to 80 km/h where: • Workers on foot, or operating plant, are between 3 m and 6 m of a traffic lane with no intervening physical barrier; • There are changed traffic conditions on the site such as, reduction in the number or width of lanes and varying surfaces; or • A transition zone is required in 110 km/h zones where a 60 km/h or a 40 km/h roadwork speed zone is used and the use of a Speed Limit AHEAD (G9-79) sign is considered inadequate.
70 km/h	The speed limit may be reduced to 70 km/h where: • Variable Speed Limit Signage is in place; • Integrated Speed Limit and Lane Use Signs (ISLUS) are in place; or • VMS are used to display regulatory speed zone signage.
60 km/h	The speed limit must be reduced to 60 km/h where: • Workers on foot, or operating plant, are between 1.5 m and 3 m of traffic with no intervening physical barrier; • Traffic control is used; • There is frequent interaction between work vehicles and through traffic; • There is a reduced standard of alignment due to the works; or • There is a loose surface such as gravel or a newly sprayed bitumen seal.
40 km/h	The speed limit must be reduced to 40 km/h where: • Workers on foot, or operating plant, are closer than 1.5 m to traffic with no intervening physical barrier; • There is a severe change in the alignment considering the surrounding speed environment; or • A bridge deck has an inconsistent surface or there might be structural damage to the bridge by vehicles travelling at higher speeds.
30 km/h*	Traffic should be reduced to 30 km/h where: • Workers on foot, or operating plant, are closer than 1.5 m to traffic with no intervening physical barrier; • The existing posted speed limit of a road is 45 km/h or less; or • It has been identified by divisional procedures.

Note* to Table 4-8: *refer to Section 4.5.3 for 30km/h speed zone conditions of use.*

4.5.3 Criteria for use

Priority must be given to providing safe clearances between workers and traffic through the use of other controls, rather than installing a speed limit of less than 45 km/h.

A 40 km/h roadwork speed zone should not be left in place for extended periods of aftercare, such as over a weekend. The extended use of 40 km/h roadwork zones when the work site is clear of active workers diminishes the credibility of work sites, leading to increased rates of non-compliance.

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A 40km/h speed zone may be implemented at an unattended work site for more than 24 hours, provided the one-up manager to the PWZTMP qualified person or Project Manager has reviewed and approved the plan to do so. This approval must be specifically documented in the relevant TMP and TGS. Otherwise, a 40 km/h must not remain in place when the work site is not active or unattended.

A 30 km/h temporary speed zone is an additional measure to protect workers on foot in close proximity to live traffic only, and must not be used as a justification to reduce any other TTM requirement that is stipulated in this Technical Manual. As such, all temporary traffic management must be designed to comply with a temporary speed limit of 40 km/h or above.

The following conditions must be met prior to approval and implementation of a 30 km/h speed zone:

- The length of zone must not be less than 100 m or exceed 200 m;
- The speed zone must only be implemented while workers on foot or plant are active within 1.5 m and clearly visible to road users; and
- A higher temporary speed must be reinstated during any period of inactivity, such as during lunch or other breaks.

A 30km/h speed zone must not be left in place for any period of aftercare.

It is critical for these requirements to be met, to maintain the credibility of work sites and to support the effectiveness of this additional measure for protecting workers on foot. It is recognised that the slower the speed limit, the less compliant road users often become unless an immediate risk is obvious. See *Section 4.7 Credibility of work sites.*

4.5.4 Duration

Signs showing roadwork speed limits (such as R4-212n) must only be displayed when the speed zone authorisation (SZA) applies and for the duration of the need. The duration of need is typically:

- While active works are underway and the site is attended; or
- While warranted by changed road conditions.

Outside of restriction and need, roadwork speed limit signs must be removed or covered appropriately.

4.5.5 Implementation

When implementing a temporary speed zone, the conditions in *Table 4-9* must be met:

Table 4-9. Speed zone implementation conditions

Aspect	Condition
At the start of zones	Roadwork Speed Limit (R4-212n) signs are to be erected on both sides of the carriageway. Where this is not possible a second sign is to be erected 0.5D from the start of the zone.
Repeater signs	Repeater signs (R4-212n) must be erected 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 a distance no greater than D from the work area, a Speed Limit (R4-1) sign must be installed showing the pre-existing speed limit prior to or adjacent to the End Roadwork (T2-16 or T2-17) sign.
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, must be covered or removed.

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Aspect	Condition
Sign size	Roadwork Speed Limit (such as R4-212n) signs used on all roads where the existing limit is 60 km/h or more must be at least ‘B’ size.
Erection of signs	Roadwork speed restriction signs must be erected: • Static signs – within 5 m of the edge of the outer travel lane; and • VSLS signs – within 10 m of the edge of the outer travel lane. The position of speed restriction signs must be visible to traffic, with adequate sight distance provided.

Note to Table 4-9: *Requirements for the use of portable VSLS as speed restriction signs are provided in Section 6.9.2 Variable speed limit signs (portable).*

Roadwork speed zones less than 65 km/h must be located such that the zone commences no closer than 100 m before the start of the work at:

- The start of the taper area;
- The traffic diversion; or
- The traffic control position (see *Figure 4-2*).

Where 100 m cannot be achieved, a roadwork Speed Limit AHEAD (G9-79) sign must be installed 2D in advance of the initial roadwork speed zone to advise road users of speed reduction and allow sufficient time for speed to be reduced before the reduced speed limit.

Speed zones of less than 45 km/h must be restricted to an area or areas immediately adjacent to road workers. The roadwork speed zone must end at least 50 m past the site where people are working and must not extend greater than 500 m (see *Figure 4-3*).

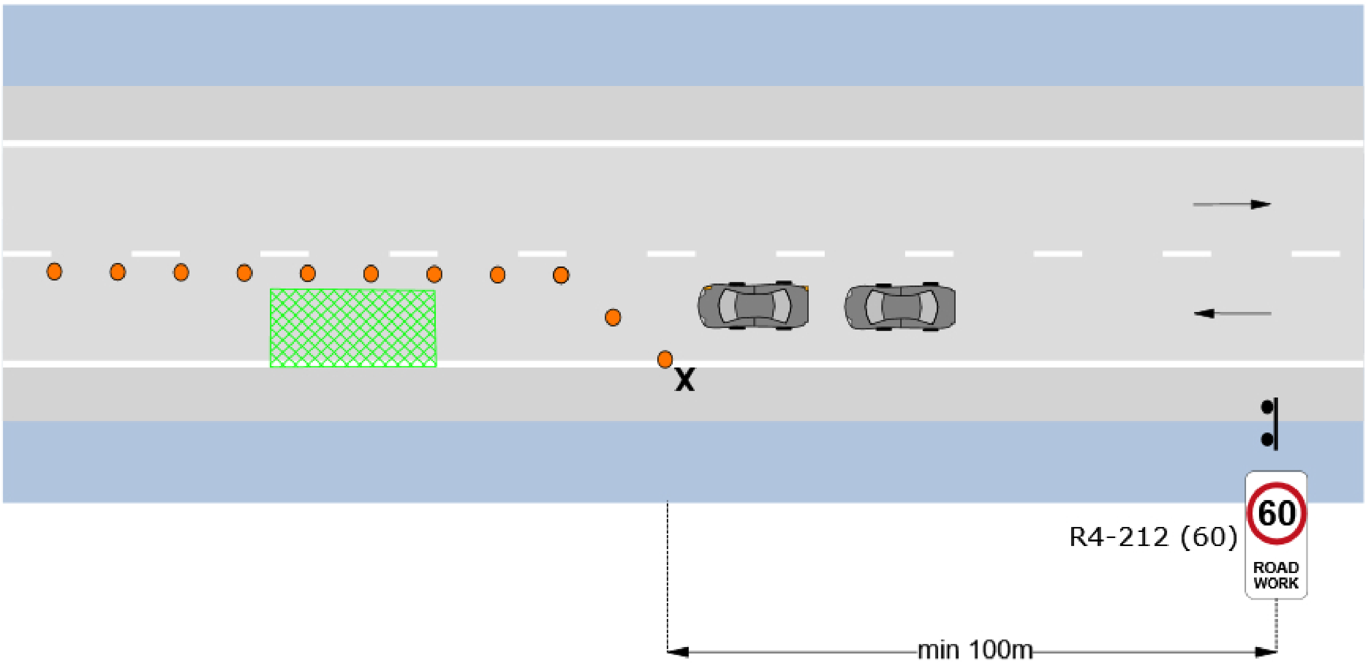

Figure 4-2. Speed zone commencement location

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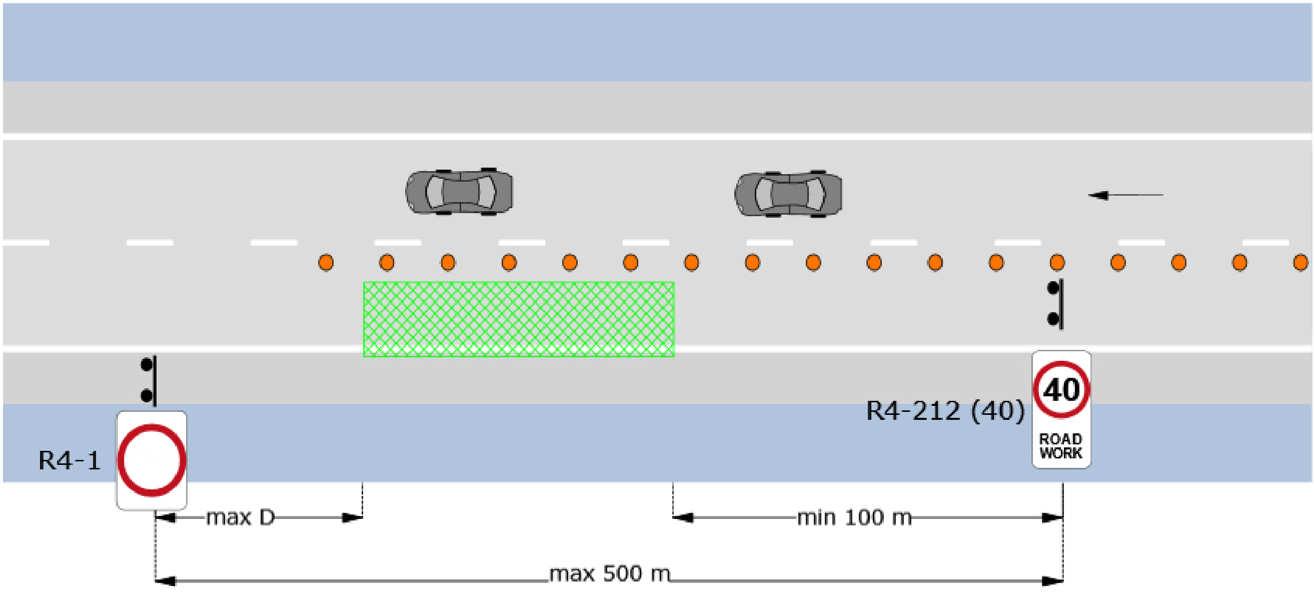

Figure 4-3. Minimum length zones

***Note to Figure 4-3**: In urban areas the location of the roadwork speed zone may be adjusted so that signs can be erected clear of parked vehicles, other signs or obstructions.*

Roadworks speed zones may be offset so that there is a different speed restriction for opposing directions of traffic. An offset speed zone may be used:

- To reduce the length of speed restriction leaving the work site;
- Where a speed zone is extended in one direction to protect the end of a queue;
- On a divided road where roadworks affect traffic conditions on one side of the median only;
- Where a roadworks speed zone is used in a transition zone to reduce traffic speeds on approach to a changed traffic condition, but is not needed for traffic flow in the opposite direction; or
- Where work is underway on the shoulder which does not affect traffic in the opposing traffic lane.

4.5.6 Minimum length zones

Temporary speed zones at work sites are significantly more effective if they appear reasonable to drivers (see also *Section 4.7 Credibility of work sites*). The lengths of roadworks speed zones must be in accordance with *Table 4-10*.

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Table 4-10. Length of roadworks speed zones

Roadwork Speed Zone	Minimum length	Maximum length
less than 35 km/h	100 m	200 m
40 km/h	150 m	500 m
60 km/h	150 m	Not specified*
70 km/h transition zone	200 m	Not specified*
80 km/h	500 m	Not specified*
80 km/h transition zones	300 m	Not specified*

Note* to Table 4-10: *For traffic safety, there is no maximum length specified however for longer lengths, additional controls to manage traffic speed should be considered, for example use of pilot vehicles.*

It must be noted that increasing the length of reduced temporary speed zone without reason may cause adverse road user behaviours, as drivers may return to the normal speed limit if they see no reason to slow down.

4.5.7 Strategies for achieving speed zone compliance

In addition to a reduced speed limit, the following devices or techniques should be considered to assist with driver speed compliance:

- PTCDs;
- Pilot vehicles;
- Additional or oversized signs;
- Duplication of signs;
- Variable message signs;
- Electronic speed display signs (such as a variable speed limit sign (VSLS) or radar assisted speed sign (RASS);
- Narrowing of lanes using bollards or cones;
- Chicanes;
- Temporary portable rumble strips (TPRS);
- Flashing lights on signs;
- Thermoplastic tape or similar laid either longitudinally in zig zags or transversely to act as gentle ‘speed humps’; or
- VMS advance warning vehicle.

4.5.8 Approval of roadwork speed zones

Authorisation must be provided by an appropriately delegated officer under item 1.30 of the Transport Regulatory Delegations, Part 2 Road Network and Operations Delegations, before a speed limit sign is installed, displayed, altered or removed on any State road.

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For work undertaken on State roads, councils and private contractors must seek the authorisation of Transport to erect roadwork speed limit (R4-212n) signs.

For work undertaken on regional roads, before a speed limit sign is installed, displayed, altered or removed, authorisation must be carried out in accordance with Item 13 of Transport's Delegation to Councils – Regulation of Traffic (dated 31 October 2011), which states the following:

When the installation period for a 'Roadwork Speed Limit' (R4-212n) sign is to be for six working days or less:

- *Authorisation of the use of the 'Roadwork Speed Limit' (R4-212n) sign must be carried out by council or a sub-delegate holding a current Prepare Work Zone Traffic Management Plan accreditation issued by the Authority*
- *The nearest Transport office is to be notified in writing of council's intention to implement a roadwork speed limit prior to works commencing.*
- *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' (R4-212n) sign is to be for more than six working days:

- *Authorisation of the use of the 'Roadwork Speed Limit' (R4-212n) sign must be carried out by council or a sub-delegate holding a current Prepare Work Zone Traffic Management Plan accreditation issued by the Authority*
- *The nearest Transport office is to be notified in writing of council's intention to implement a roadwork speed limit seven days prior to works commencing*
- *The nearest police station is to be notified in writing of council's intention to implement a roadwork speed limit seven days prior to works commencing.*

4.5.9 Speed enforcement at roadwork sites

4.5.9.1 General

Compliance with roadwork speed limits is critical to effectively managing the safety of road workers and road users at roadwork sites. Police speed enforcement is a method that may be used to improve compliance.

Early communications and planning with police is crucial to providing an environment conducive to safe and effective police speed enforcement operations. As such, provision of suitable areas for police operations should be considered during the development and construction phases of projects and when planning maintenance activities.

During the development, delivery and maintenance stages of a project, the project team must consider the use of police speed enforcement as part of their risk management approach.

The planning of police speed enforcement is typically split in to three phases:

- *Phase 1* – early site investigation;
- *Phase 2* – planning for police speed enforcement; and
- *Phase 3* – operational engagement of police.

4.5.9.2 Phase 1: Early site investigation

The risks presented by speeding drivers to the safety of road workers and road users on the roadwork site must be assessed for all roadwork projects during TMP development.

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The traffic speed and crash history data obtained as part of the development of the TTM strategy and plan must be reviewed to determine if there are any existing speed related issues within the project area. This data forms a basis for early police engagement and highlight high risk areas to be dealt through appropriate TTM planning.

Potential projects requiring police involvement include:

- Long-term work located on high volume and/or high speed traffic routes;
- High-risk short-term work such as:
  - Where traffic barriers cannot be used to separate workers from adjacent traffic and work site safety depends on a lateral separation distance and reduced traffic speed; or
  - Where there is limited sight distance, complex traffic arrangements, or other factors requiring a high level of speed compliance.

When it has been identified that there is the potential for non-compliance with roadworks speed zones, which presents an unacceptable risk to the safety of road workers and road users, the project representative must begin planning for police speed enforcement.

4.5.9.3 Phase 2: Planning for police speed enforcement

The objectives of Phase 2 are to:

- Raise awareness of the project and the potential need for police assistance;
- Ensure the work site can accommodate police enforcement operations in a safe and effective manner; and
- Ensure that the work site speed zones are lawful and enforceable.

This phase should normally occur during the development stage of a project and involves initial engagement with police, review ongoing data collection to monitor speed compliance and the identification of the work site requirements to support police enforcement.

Initial police engagement

The project representative must engage the police to alert them of the safety risk of road workers and road users as identified in the early site investigation. The appropriate contact details to be used for police engagement should be determined by contacting the Manager, Regional Operations (in the respective region).

Police are most likely to provide speed enforcement operations if they are confident it will be effective, the speed zone is appropriately sign posted and lawfully enforceable and the operation can be carried out within a safe operating environment that complies with their standard operating procedures.

Engaging the police early in the project is important as it creates an opportunity to:

- Describe the project and any existing conditions that affect speed compliance and safety;
- Identify and plan the work site to accommodate police speed enforcement;
- Identify data collection parameters to support a request for police involvement;
- Identify site conditions that can impact on their operations; and
- Alert them to the potential need for police speed enforcement.

Police may not commit to speed enforcement at this stage; however, this consultation can be used to obtain an in-principle agreement with the police for speed enforcement during the project delivery when the need arises, provided the work site can provide sufficient supporting data.

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The type and quantity of supporting data to be collected should be confirmed with police during the initial engagement process.

Work site requirements

To enable police to undertake speed enforcement on roadwork sites, project teams must ensure that:

- Roadwork speed zones are implemented in accordance with this document;
- Speed Zone Authorisation (SZA) has been issued for the speed zone in operation and the documentation is available to police;
- Location reference points of start and end of roadwork speed zones are documented; and
- Roadwork speed zones are long enough for practical enforcement.

The following considerations must be implemented in each stage of the traffic management plan in order to create an environment for safe and effective police speed enforcement:

- Appropriately sized areas for positioning police vehicles, for example, wide shoulders or breakdown bays or pull-over bays for OSOM vehicles;
- Appropriately located areas for positioning police vehicles with unobscured line of sight to approaching traffic which allow safe departure and acceleration when conducting mobile intercept operations;
- Ability for police to pull over offending vehicles with sufficient length to accommodate the longest vehicle type (access under Notice) that police may pull over. This may include provision of:
    - Sufficient shoulder width; or
    - Regular (every 500 m) breakdown bays.
- Suitable shoulder and breakdown bay surfaces.

These considerations along with any other work site requirements should be confirmed with police during the initial engagement process.

4.5.9.4 Phase 3: Operational engagement of police

Police engagement for speed enforcement

The appropriate contact details to be used for police engagement should be determined by contacting the Manager, Regional Operations (in the respective region).

At the site meeting between the project representative and police, the project representative must:

- Provide an overview of the project;
- Provide a copy of the SZA for the speed zone;
- Provide details of speed zone locations, dates and start and end times of speed zones;
- Provide evidence of speed non-compliance and any other supporting data requested during the initial engagement;
- Request confirmation of the type and quantity of data to be collected to support enforcement activities;
- Demonstrate that any work site requirements for police speed enforcement have been met;
- Provide information about activities that can impact on police operations, for example, construction vehicle movements; and

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- Maintain a record of the meeting.

The project representative must then request for speed enforcement operations to be undertaken within the work site on an agreed schedule. In certain situations a 'user pays' arrangement in accordance with NSW Police Force User Pays Policing Services guidelines may need to be agreed upon.

As police speed enforcement operations are not always available for the entire time road workers are on-site, police enforcement then becomes an additional control to complement existing control measures determined through risk assessment and the application of the hierarchy of controls framework.

Ongoing data collection

Police speed enforcement data must be continuously collected throughout the duration of the project to monitor the effectiveness of the traffic management plan and the police speed enforcement when in place. This data allows police to focus their enforcement operation around the particular times of day/s of the week when the risk to road workers and road users is most significant.

This data may be used to monitor speed compliance and can be used as evidence when deciding if ongoing police speed enforcement will be requested in future discussions with police.

Ongoing communications with police

Regular communication (such as a recurring meeting) between project representatives and police must be scheduled throughout the delivery and/or maintenance stage of the project to keep police informed. The meetings must:

- Discuss site conditions that impact police operations;
- Provide a project schedule of works to police informing them of planned changes to the road configuration that affect their speed enforcement operations;
- Discuss user pays arrangements where applicable;
- Discuss the outcomes from the previous police speed enforcement operations;
- Discuss the data that has been collected and determine if police speed enforcement is still warranted; and
- Agree on a future police speed enforcement schedule.

Responsibilities

While Transport project representatives work with police to design site conditions conducive to police speed enforcement/presence, police are responsible for their own management of risks associated with their activities. The method of police speed enforcement is to be determined by the police.

4.5.10 Records and inspections

Records must be maintained of all roadwork speed zones. Records must include:

- Written authorisation of the installation from Transport, or council or its sub-delegate. The sub-delegate's Prepare a Work Zone Traffic Management Plan certificate number must be shown;
- Reference points or location of the roadwork speed zone;
- The installation time and date;
- The speed displayed;
- Location of repeater signs;

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- Location of advanced warning signs; and
- The removal time and date.

This information must be kept for at least seven years as it can be required as evidence for litigation purposes including speeding prosecutions or accident compensation claims.

Application and completion for roadwork speed limit authorisation and occupancy licences must be lodged via Transports Road Occupancy Licence website.

For long term projects, copies of the approved forms can be forwarded to the police station nearest to the appropriate sections of road by the project manager and a record of this should be kept on site.

Roadwork speed zones must be regularly inspected as part of daily inspections carried out by an Implement Traffic Control Plans or Prepare Work Zone TMP qualified person who was not involved in the physical implementation of the signage. These inspections should be carried out before work starts, during the works and pre-closedown of the site and completed in accordance with *Section 8.1 Work site inspections, reviews and audits*.

In accordance with *Section 8.2 Record keeping of TTM documentation*, roadwork speed zones must be inspected and associated documentation examined on a regular basis. The ITCP qualified person must 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 be given to keeping photographic records of signs and their locations. Any issues or breaches should be recorded in daily diaries.

4.6 End-of-queue management

4.6.1 General

End-of-queue management strategies must be provided when:

- Traffic is planned to be stopped;
- Queues are expected to be generated; or
- The TMP or risk assessment identifies there is a potential for end-of-queue collisions.

Wherever traffic is required to slow significantly or stop, particularly at active traffic control positions, long queues can form, depending on traffic volumes and the length of delay. This can result in an increased risk of rear end collisions occurring.

The risk of end-of-queue collisions is increased:

- Where 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);
- Where queues are unexpected, for instance on rural highways, and can be due to the lack of attention of road users or fatigue;
- Where queue lengths are long and can vary considerably, for instance in built-up areas, and can be due to queue ends extending beyond advance warning signs and devices;
- On high speed roads such as motorways, particularly when lane closures are introduced; and
- At night or in adverse weather conditions.

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4.6.2 Assessment of expected queue length

Anticipated queue lengths must be estimated and documented prior to stopping traffic. Factors that influence queue lengths include:

- Expected hourly traffic volumes at the time of the work;
- Expected delays at each phase of the work;
- Number of traffic lanes closed or affected;
- Traffic composition, such as percentage of heavy vehicles;
- Predicted distances or gaps between stopped vehicles – drivers in rural areas tend to leave greater gaps than those in urban environments;
- Known special events;
- Terrain at the site; and
- Road alignment (horizontal and vertical).

Traffic queues must be monitored at all times to ensure that queue lengths do not extend back beyond the limits of the advance warning signs.

At work sites where longer than normal delays can be expected, such as the laying of bridge beams, additional planning may be required which is beyond the scope of this Technical Manual. When required, this additional planning must be included in the preparation of the TMP and site-specific or activity-specific risk assessment to identify the risks associated with such long delays, and be completed in consultation with relevant divisions of Transport, emergency services and other relevant stakeholders.

4.6.3 Procedure for reducing end-of-queue collisions

As required by *Section 5.4 Traffic control*, when traffic is being controlled, a PREPARE TO STOP (T1-18) sign must be installed and the traffic controller operating the PTCD or STOP/SLOW bat or an observer with the ability to communicate to the traffic controller, must be able to maintain visibility to the end of the queue.

Additional advance warning or other mitigation measures should be implemented, depending on the speed of traffic and sight distance to the end of the queue, to alert road users of the changed road conditions and to avoid end-of-queue collisions. Where applicable, this may include extending the length of a sign posted roadwork speed zone, where the queue length extends beyond the originally established zone, and provided the zone is self-regulating.

The use of such devices and techniques must be documented in the TMP or risk assessment and included on the approved TGS.

Where significant queues are expected to form, active monitoring of the queue must be undertaken as the primary control. In addition, at least one the following end-of-queue protection strategies must be used:

- Where the maximum queue length can be predicted in advance, the primary PREPARE TO STOP sign must be located such that the distance from this sign to the end of the queue is not less than D, see *Figure 4-4*. 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 be 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 must be maintained.

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- Under the immediate direction of an ITCP qualified person, a traffic controller may be employed to move the PREPARE TO STOP (T1-18) sign and the ROADWORK AHEAD (T1-1) sign as necessary to maintain their minimum required distance in advance of the end-of-queue.
- A portable traffic signal (flashing amber) may also be added, at each location of the PREPARE TO STOP sign to alert road users of the approaching work site.

Provided the conditions of *Section 5.4.2 Traffic control types* are met and a temporary speed zone of less than 65 km/h is implemented, a traffic controller displaying the SLOW sign at each location of the PREPARE TO STOP sign, may be substituted for a portable traffic signal.

All other advance and position signs required for the work must be located at the distances shown in *Figure 4-4* from the start of the work area.

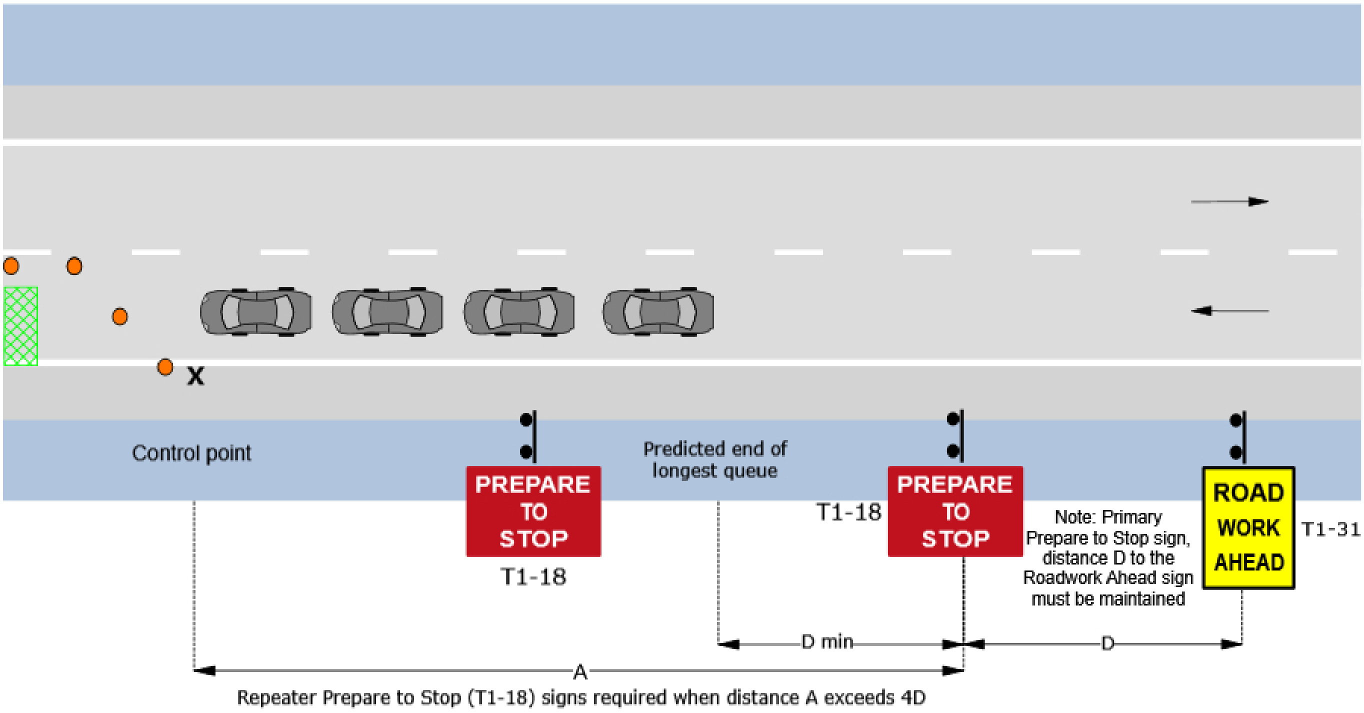

Figure 4-4. Avoiding end-of-queue collisions example

4.7 Credibility of work sites

4.7.1 General

Research has shown that drivers do not perceive roadwork zones as hazardous unless they can see active workers or machinery. In a survey undertaken by the Centre for Accident Research and Road Safety, Queensland, road users stated that the credibility of work zones is undermined by the lack of activity drivers see, particularly when a speed reduction is in place, or having to slow for a speed reduction that is perceived to be unrealistic. It was reported that not only may this lead to speed limit non-compliance, driver frustration may result in other unsafe behaviour, such as tailgating, which generates risk for the road workers and road users.

It has also been demonstrated that drivers become complacent to roadwork signage when it is misused, left out or not appropriate for the works. This includes irrelevant roadwork signage left out during aftercare or the use of PREPARE TO STOP (T1-18) or traffic controller symbolic (T1-34) sign while the traffic control is not present. Not only does this affect the credibility of the work site, it can lessen the effectiveness of the signs when next encountered by the drivers.

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4.7.2 Enhancing work site credibility

The study reported that controls most likely to affect driving speed through a work zone were visibility of police, presence of workers on the road and protection of workers by barriers. To ensure credibility of Transport roadwork sites, it is important to consider the following in the TTM planning phase:

- Only reduce speed limits where required to ensure worker or road user safety;
- Reinstate speed limits when work is not occurring;
- Minimise delays to road users;
- Ensure temporary signage and road marking are clear and do not cause confusion;
- Remove or cover temporary signs that are not relevant;
- Provide ongoing road user information and education programs; and
- Engage with police to develop an enforcement strategy through the site.

4.7.3 Improving public awareness

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

- Transport for NSW website;
- Approved social media;
- Community consultation sessions;
- Conducting campaigns with the police to reinforce responsible behaviour on the roads especially at work sites;
- Additional VMS / static signs near work sites;
- Presenting road safety visuals and posters in public Transport offices, particularly Service NSW centres;
- Advertising the times and duration of planned works on various mediums e.g. such as radio or newspaper;
- Explaining detour options;
- Signs that thank drivers for their cooperation; and
- Communication about the road user or community safety benefits of the work being completed and contact details for enquiries or feedback.

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5 Providing for works

5.1 General

When developing a TMP, it is important to consider the impact of the works and its management within the road corridor. This includes the operation of traffic control and works vehicles and activity specific considerations that need to be made.

5.2 Providing safe movements for works traffic

5.2.1 General

In addition to the requirements outlined in, *Section 4 Inputs to a Traffic Management Plan* planning must also be undertaken to determine the management of works traffic within and around the work site. In particular, the vehicle entry to and exit from the site, and their movements on the road network surrounding the work site, to ensure the safety of workers and road users while maintaining the service provided by the road network.

For the purposes of this document, works traffic is any light or heavy vehicle associated with the undertaking of the work being performed, and includes, but is not limited to:

- Work vehicles carrying crews, signage or equipment;
- Haulage trucks delivering or receiving plant, materials or goods; and
- Any light vehicle attending site that is associated with the work.

When planning and designing for works traffic the following core principles must be considered and applied:

- ***Safety*** – providing safe movements within and around site for construction works vehicles while not increasing the risk to the general traffic.
- ***Efficiency*** – ensuring access to construction sites does not impede traffic flows and is designed and managed to minimise impact on traffic efficiency.
- ***Consistency*** – ensuring consistent and uniform access treatments are applied, so that the message conveyed to road users is consistent.

Safe movement for works traffic must be provided such that vehicles can safely manoeuvre:

- ***To and from the site*** – ensuring safe access and egress from or into live lanes of traffic; and
- ***Around the site*** – ensuring safe travel paths are available for access to ancillary and off site work areas such as depots, stockpile sites, quarries and gravel pits.

The impact of works traffic or any associated TTM measures on general road users must be considered.

All vehicles on a work site must have the ability to warn workers of the potential hazard of reversing vehicles. This includes clearly audible and working reversing alarm and lights.

5.2.2 Vehicle movement plans

A vehicle movement plan (VMP) is a document or diagram showing the safe travel paths for works traffic and may include details of safe entry, drive through, exit or navigation around the site. A VMP must be developed if any of the following applies:

- Vehicles will be entering or leaving from a high speed road with an existing permanent speed limit of greater than 75 km/h;

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- Vehicles will be entering or leaving from a divided carriageway;
- Where site access constraints require complex manoeuvres on-site;
- Where site access constraints require off-site location movements to turn around;
- Where repetitive movements of plant (greater than 20 per day) are present;
- Where plant on-site may travel faster than 35 km/h;
- Where plant may reverse long distances (greater than 100 m) without the protection of temporary safety barriers; or
- Where specific hazards to vulnerable road users are identified from plant carrying out the work on-site.

A VMP should be developed using the considerations provided in *Table 5-1.*

Table 5-1. Key considerations for the movement of vehicles

Key consideration	Details
Existing traffic conditions	Hourly traffic flows (including peak hour), traffic speed (85th percentile) and traffic composition (i.e. light vs heavy) will influence the road capacity to accommodate works vehicle movements. Possible source of data is the Transport Traffic Volume Viewer.
Site access	The site environment and constraints will influence the type of access that can be provided and the vehicle movements that can be accommodated.
Expected works traffic movements	The number of works vehicle movements, class of works vehicles (light vs heavy vehicles) and the origin/ destination of works vehicles.
Speed zone	The roadwork speed zone will influence the type and design of the site access and whether additional control measures are required to operate the access. Consideration needs to be given to balancing site access requirements for works traffic with the need to minimise the delay for to general traffic.

When developing works traffic VMP, the project manager or other person as nominated by divisional requirements must:

- Ensure that satisfactory arrangements are planned and implemented for vehicles associated with works;
- Ensure a VMP is developed that provides for safe access to, from and around the worksite; and
- Approve and make available a VMP before work begins.

Where a VMP identifies the installation of additional TTM on the road network, a PWZTMP qualified person must approve the relevant VMP and supporting TGSs.

For long-term, high risk or complex works, multiple VMPs may be needed for a project, and should reflect project staging and work areas. Preparation of a VMP must consider the whole of route for significant suppliers and haul requirements (i.e. from quarries, or through town sites for girder delivery, for example). Subject matter experts in road design or traffic engineering should be consulted to determine the safest and most appropriate treatments.

All 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 VMPs. Care must be taken by all drivers at work sites when entering and leaving traffic streams and turning at work sites. Contractors and agents of Transport should adopt the principles contained in Transport's Safe Driving Policy.

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Although this Section of the Technical Manual details the requirements for VMPs associated with access *to* and *around* a work site, it does not specify the requirement for the development of a VMP *through* a work site to ensure the separation of workers and plant. For information relating to the management of the risk of workers on foot and separation of plant and workers see the Transport WHS procedures for Working with Mobile Plant.

5.2.3 Access *to* and *from* the work site

5.2.3.1 General

When developing a TMP, site accesses must be identified and designed in accordance with Austroads *Guide to Road Design* and Austroads *Guide to Traffic Management*. Work sites may be accessed through the options provided in *Table 5-2*, depending on the location of the works.

Table 5-2. Site access options

Access type	Description
Access via local roads	The use of the existing road network to access construction site off local roads, where generally the safety and traffic risks are lower. A safety assessment of the proposed route should be undertaken as upgrade work and stakeholder consultation may be required.
Left in/left out only	Utilising existing road treatments (roundabout, U-turn bay, alternate route) or designated acceleration and deceleration lanes to provide left only movements to and from site. This requires planning for works vehicles to turn around, when on the road network. This option minimises impact to existing traffic flow while also minimising the safety risks for turning construction vehicles. This may require widening of existing pavement, utilising existing shoulders, narrowing of the existing travel lane, or a combination of these. The design should be prepared in accordance with normal design practice and subject to a Road Safety Audit.
Restricted / separated access	To maintain safe and efficient access, turn movements may be separated or restricted (e.g. no right turn out movements).
Full access	All movements in and out of the site are provided at one intersection. The safety and efficiency impacts should be considered.
Dedicated access	Dedicated work site accesses, such as auxiliary lanes, must be designed by a road designer. Auxiliary lanes are also used to eliminate the need to stop traffic for work site vehicles to enter or exit the site, thus removing the need for traffic controllers and reducing the risk of rear end collisions. Dedicated work site accesses should always be located and designed using the same principles and technical guidance as a permanent treatment.

When planning and designing a work site access, *Table 5-3* must be referenced as part of the traffic management planning and risk assessment process.

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Table 5-3. Planning and designing for work site access

Consideration	Detail
Existing traffic conditions	Review TMP data or collect recent data to understand existing traffic conditions and to support evidence based decision making. Data may include: • Traffic volumes (daily and hourly peak) including the number of heavy vehicles; • Speed data; • Crash history; • Vulnerable road user volumes and desire lines; and • Public transport (i.e. bus routes and frequency).
Site environment/constraints	Consider site specific constraints such as: • Existing lane widths; • Shoulder widths; • Horizontal and vertical alignment; • Existing road intersections and private property accesses; • Pavement type and condition; and • Road furniture (e.g. barriers, poles, gantries).
Construction traffic	Estimated construction traffic movements into and out of the work site (light and heavy vehicles). Origin and destinations of these vehicles and the turning movements at each access point should also be considered.
Speed zone	The roadwork speed zone will influence the type and design of the site access based on fundamental design considerations. When determining whether a reduced speed zone is required consideration needs to be given to balancing the site access requirements with the need to minimise the delay/increased travel time to non-construction traffic.
Positioning of site access gates	Positioned along the road length where sight distance is adequate and can operate unattended without the need for traffic controllers. See *Section 4.3.6 Sight distances*
Design vehicles	Appropriate turn paths, lane widths and auxiliary lane lengths must be provided as the size and type of work traffic will influence the access design.
Median crossovers	Median crossovers must only be used by work traffic as a predetermined work site access point when the sight distances detailed in *Section 4.3.6 Sight distances* are met. Any use of a median crossover for median work site access must be consulted with the relevant traffic management centre and be documented as part of the work site TMP, TGS and VMP.

As part of the risk assessment and design process, additional site specific risks may be identified that warrant the provision of auxiliary lanes beyond the normal design requirements.

5.2.3.2 Designing site access on multi-lane roads or high speed environments

Work site vehicles entering and leaving through traffic lanes from a multi-lane road can represent a significant hazard for both road workers and road users, particularly in a high speed, high traffic volume road environment. To mitigate this potential risk, Transport has developed a standard all work site access treatment to be adopted for work sites on motorways which provides a clear and consistent message for road users driving through roadwork sites in NSW. The treatment may be adapted for access in the near or offside shoulders.

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The delineation and sign posting of the standard work site treatment shown in *Figure 5-1* must be adopted at the roads and localities given in *Table 5-4* and designed in accordance with this Technical Manual, with reference to AS 1742.2, the Transport *Delineation guide* and relevant linemarking specifications.

Table 5-4. Road names and route numbers for applicable to auxiliary lane provisions

State road name	Route number	Locality
Pacific Motorway	M1	Wahroonga to Beresfield
Princes Motorway	M1	Waterfall to Yallah
Eastern Distributor	M1	Entire
Western Distributor	A4	Entire
Hume Motorway	M31	Casula to Federal Highway Interchange
Hunter Expressway	M15	Entire
Westlink	M7	Entire
Western Motorway	M4	Entire
The Hills Motorway	M2	Entire
South Western Motorway	M5	Entire
NorthConnex	No route number	Entire
WestConnex	M8, M5, M4	Entire
Lane Cove Tunnel	A1, M2	Entire
Sydney Harbour Tunnel	M1	Entire
Sydney Harbour Bridge	No route number	Entire

The work site access treatment shown in *Figure 5-1* should also be adopted on high speed, high volume roads. The treatment may also be used in other situations where the road environment and/or other site-specific risks require a higher level of site access control.

When designing these accesses, clear and uninterrupted travel lanes should be maintained for motorists travelling past the work site. As such, retroreflective markers should not be used in the shoulders for the specific use of guiding work vehicles into or out of a work site. All work site acceleration and deceleration lanes must be designed by a road designer in accordance with Austroads *Guide to Road Design*, unless specific requirements or distances are specified in this Technical Manual.

When used, the following provisions apply:

- All yellow linemarking and diagonal chevron markings must:
    - Be Golden Yellow colour Y14 in accordance with QA Specification R145 Pavement Marking (Performance Based) and AS 2700;
    - Not have any retroreflective pavement markers; and
    - Have dimensions, spacing and angles in accordance with *Figure 5-2.*
- For the ingress, a Yellow C1 (broken) linemarking should be installed on the outside of an edge line to delineate the diverge area of the travel lane and where vehicles enter the work site (i.e. work site deceleration lane). Refer to *Table 5-5* for the length of the C1 line;
- The Golden Yellow (Y14) diagonal markings are an alternative delineation method and a higher control to a Yellow C1 line. The diagonal markings should be used when:

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  - The pavement surface in this location is not the permanent pavement surface after the works are completed; and
  - An unacceptable risk is present for public vehicles to enter the work site, or a high risk of vehicles stopping or in the shoulder. Increased risk occurs in poor vertical or horizontal alignment, high speed road, road furniture and vegetation, etc.

    Note: *In such cases, Golden Yellow (Y14) diagonal markings in the shoulder should be installed for a length of at least the diverge length and may extend further. Refer to Table 5-5 for minimum length of diagonal markings.*

- For the egress, a white continuity C1 (broken) line must be installed where the merge taper is located on the work site acceleration lane, to delineate for vehicles exiting the lane to merge and give way to through traffic. Refer to *Table 5-5* for length of C1 line;
- A minimum of three (3) yellow angled pavement arrow markings (ARU5), spaced in accordance with *Table 5-5*, must be placed in merge taper of the work site access acceleration lane, to indicate to road users of merging works traffic. The middle arrow must be located at the commencement of the C1 line;
- A NO ENTRY (R2-4n) sign with a CONSTRUCTION VEHICLES EXCEPTED (R9-203-1) supplementary plate must be installed at the commencement of the work site deceleration lane diverge taper;
- A Trucks symbolic (W5–22 or T2-25) sign must be installed at D and 2D in advance of the commencement of the work site deceleration lane diverge taper. A supplementary plate '___m ON RIGHT (or LEFT)' (W8-207n) must accompany the first sign at 2D; and
- A Trucks symbolic (W5–22 or T2-25) sign must be installed with relevant supplementary plates 'MERGING' at D and '___m ON RIGHT (or LEFT)' (W8-207n) at 2D in advance of the commencement of the work site diverge area (white C1 line). The spacing of these may be lengthened to suit any existing or temporary barriers or road furniture.

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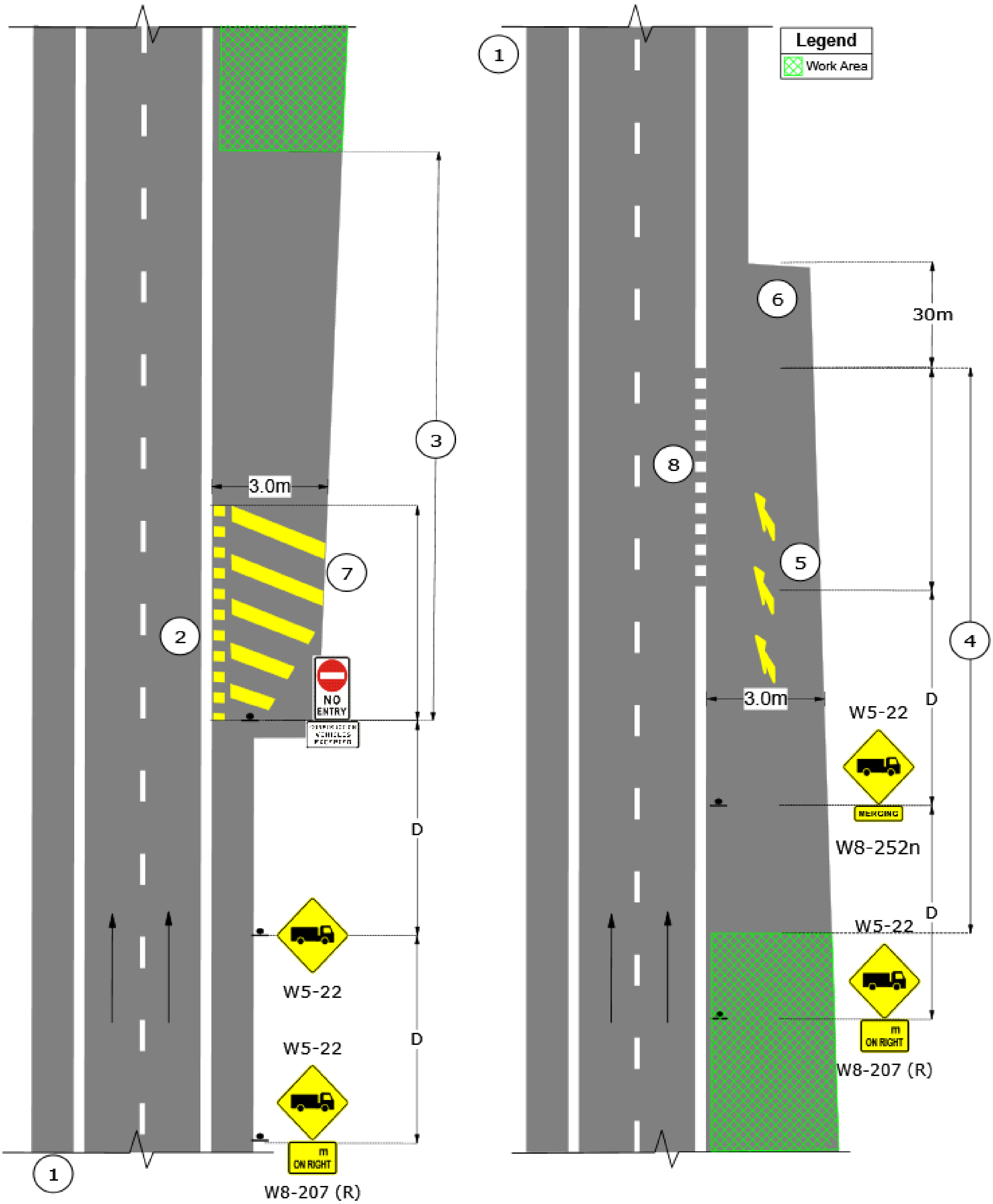

Figure 5-1. Concept layout for a deceleration and acceleration lane into/from a work area located in an 80 km/h zone in the median of a dual carriageway

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Notes to Figure 5-1:

1. *Additional temporary traffic management signage may be required subject to the risk assessment;*
2. *Length of yellow C1 (broken) line is as per Table 5-5;*
3. *Deceleration length (or diverge length) of work site access deceleration lane to be designed in accordance with Austroads Guide to Road Design Part 4a by a road designer;*
4. *Length of acceleration lane for work site access to be designed in accordance with Austroads Guide to Road Design Part 4a by road designer;*
5. *Yellow angled pavement arrow markings (ARU5) spaced in accordance with as per Figure 5-2 with middle arrow placed at start of C1 line.*
6. *Run off area of 30 m x 3 m at end of work site acceleration merge must be included;*
7. *Yellow (Y14) diagonal markings are an alternate treatment option and higher order control to the yellow C1 (broken line. The dimensions, spacing and width of the diagonal are shown in Figure 5-2 and Table 5-5;*
8. *White C1 (broken) line is as per Table 5-5*

Table 5-5. Lengths of C1 line and spacing of angled arrow pavement markings

D	Length of Yellow C1 line and diagonal markings (min.)	Length of white C1 line	Spacing of angled arrow pavement markings
60	40 m	138 m	30 m
80	50 m	175 m	40 m
100	62 m	212 m	60 m

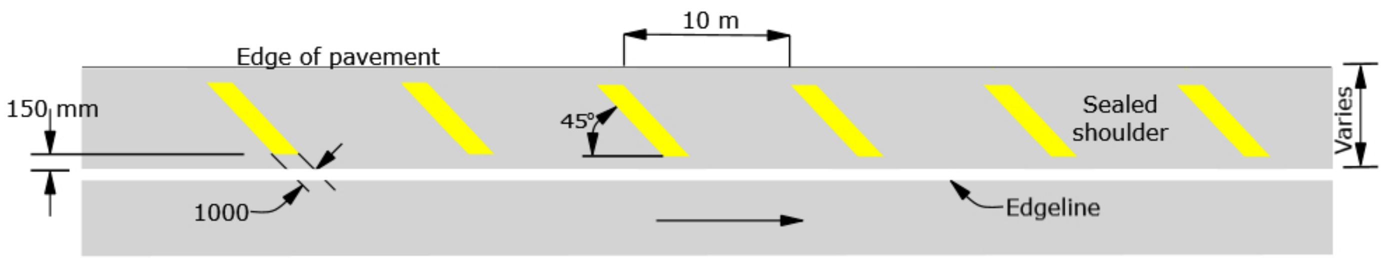

Figure 5-2. Required yellow linemarking and diagonal marking dimensions, spacing and angles

5.2.3.3 Providing for truck movements

Providing for truck movements includes any instance where trucks will be crossing or using a road to access or leave site.

Care must be exercised when designing traffic control for haul roads that cross roads. Traffic control for haul roads must be one of the following:

- PTCD;
- Traffic controllers; or
- STOP (R1–1) signs;

Where sight distance is less than 2D, *Table 5-6* must be used for determining controls for managing truck movements where auxiliary lanes are not provided, depending on traffic volumes, sight distance, number of truck movements and traffic speed. Where sight distance is greater than 2D, *Table 5-7* must be used.

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Table 5-6. Providing for truck movements where sight distance is less than 2D

ADT	300 – 1500		More than 1500	
Number of truck movements per shift	less than or equal to 20	greater than 20	less than or equal to 20	greater than 20
Traffic control required		Yes	Yes	Yes
VMP required	Yes	Yes	Yes	Yes
Warning signs required during shifts		Yes	Yes Note 2*	Yes

Note 1 to Table 5-6: *Where approach speed is greater than 95 km/h every effort should be made to choose turning locations where sight distance exceeds 2D.*

Note 2* to Table 5-6: *Not required when approach speed is less than 85 km/h.*

Table 5-7. Providing for truck movements where sight distance is greater than 2D

ADT	300 – 1500		More than 1500	
Number of truck movements per shift	less than or equal to 20	greater than 20	less than or equal to 20	greater than 20
TGS with traffic control		Yes	Yes Note 1#	Yes Note 2*
VMP required		Yes		Yes
Warning signs required during shifts		Yes		Yes

Note 1# to Table 5-7: *where approach speed is greater than 95 km/h.*

Note 2* to Table 5-7: *If acceleration and deceleration cannot occur on shoulders.*

In any instance where traffic control is required, then the approach speed of traffic must be reduced to 65 km/h or less as per *Section 5.4 Traffic control.*

Care must also be taken when vehicles are leaving work areas, to ensure that gravel or mud is not deposited on the through road. The respective environment representative should be consulted for advice regarding management of this risk. Consideration therefore should be given to the use of rumble grids and coarse gravel layers or hosing to clean the vehicles before they enter or cross the through road.

5.2.4 Access *around* the site

Locations for turning vehicles associated with the work across lanes carrying traffic, must be restricted to predetermined locations. The following relevant factors should be considered when selecting these locations:

- Sight distance;
- Grades;

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- Volumes and approach speeds of through traffic; and
- Areas clear of traffic lanes for accelerating and decelerating.

Where roadworks generate truck turning movements remote from work sites, temporary warning signs should be used at the approaches to the points of access on through roads. This is particularly important where there might be little or no other indication of likely vehicle turning movements, for example at roadside stockpile sites or via accesses to private property. Where this occurs, the Trucks symbolic (W5–22 or T2-25) sign should be used, which may be supplemented by the ON LEFT/RIGHT (W8-207) (L) or (R) signs.

If installed, all signs must be displayed before the haulage operations begin, and removed or covered at the end of each shift.

When planning for movement of work traffic, the movements described in *Table 5-8* are restricted.

Table 5-8. Work site vehicle restricted movements

Movement	Conditions
U-turns	Work vehicles must not perform single movement U-turn across lanes carrying traffic, unless documented in the TMP, site specific risk assessment and detailed on the relevant TGS and: • Safe intersection sight distance is achieved. The safe intersection sight distance must be determined in consultation with a technical specialist from Traffic Engineering or Road Design and based on the principles of the Austroads *Guide to Road Design*; or • Traffic is being controlled. The above permissions do not apply for illegal manoeuvres, such as U-turns across unbroken centre-lines.
Median crossovers	Median crossovers are designed for the purpose of providing access from one carriageway to another under specific controlled conditions*. For Transport work site related vehicles, median crossovers must not be used as a point of U-turn unless the following conditions are met: • A risk assessment has been completed for each cross over; • Sight distances detailed in *Section 4.3.6 Sight distances are achieved;* and • Use has been consulted with the relevant traffic management centre and is documented as part of the work site TMP, TGS and VMP. Where it is determined that crossovers provide a safe alternative to work site manoeuvres for a particular corridor, this must be risk assessed and documented in accordance with *Section 2.8 Departures from this Technical Manual.*
Reversing movements	Work vehicles must not reverse (including 3-point U-turns) in lanes carrying traffic, unless: • Traffic is being controlled by a PTCD or traffic controllers; or • The approach sight distance exceeds 6D i.e. 20 seconds of travel time.

Note* to Table 5-8: *Emergency vehicles such as police service, ambulance service and fire brigade as well as NRMA and nominated Transport emergency response vehicles are permitted to use the median crossover to make a U-turn, provided it is performed in accordance with the relevant organisational safety requirements.*

5.2.5 Access to adjoining properties

Pedestrian and vehicle access to adjoining properties must be maintained, unless clear agreement has been reached with the occupants for a temporary restriction. Effective communication with residents must be conducted for the work to be carried out safely and efficiently.

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Temporary access to adjacent side streets and properties must be trafficable under all expected weather conditions and must be constructed to reasonable standards matching the side streets and property driveways. If conditions of access cannot be maintained other arrangements must be made for those forms of movement (i.e. wheelchair, bicycle, etc.).

5.3 Work site specific requirements

5.3.1 Traffic incident management

A TMP must include a traffic incident plan. The following is a list of recommended inclusions in a traffic incident plan:

- Names and contact details of nominated personnel responsible for dealing with traffic incidents occurring at the work site;
- Contact details of the person responsible for the works, TMC operation representative, police, and emergency services representatives (where appropriate);
- Procedure to be followed in the event of a traffic incident at the site;
- List of plant that will be available for moving portable concrete safety barriers (if in use on-site);
- Inventory of safety barriers, signs etc. and their storage location(s) that will be available to replace damaged barriers in event of a traffic accident (if in use on-site);
- Procedure for carrying out investigations of traffic incidents involving members of the public or workers. This should include:
  - Checking that the traffic control measures in place are in accordance with the TMP and its component plans, and ROL conditions;
  - Carrying out a “drive through” and video recording of the roadway, including the location where the incident has taken place;
- Information required for initial notification to the person responsible for the works, and where necessary, other relevant authorities; and
- Format for reporting and communication of the results of traffic incident investigations, and lessons learned.

5.3.2 Working at intersections

Intersections vary greatly in type, number of legs, number of traffic lanes and forms of traffic control. Due to the complex nature of working at intersections, the following principles should be considered when developing a TMP that requires work at these locations:

- Sufficient capacity should be maintained, and delays should be kept to acceptable levels, for example, excess capacity should be avoided which encourages high speeds;
- Blockages at the intersection from downstream queuing should be avoided;
- Provision for alternative routes should be made if right hand turns or other movements are temporarily prohibited at the intersection;
- Work periods should be restricted to outside peak traffic flows if the intersection is a critical one within the road network;
- Work areas should be clearly defined so that road users can easily identify paths available for traffic within the intersection;

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- Guide signs should be clearly visible and not obstructed by road plant or temporary signs. If necessary they should be relocated; and
- Effective control using signs, traffic signal or controllers, linemarking and delineation should be maintained.

Where distance between intersections is sufficient, standard treatments for the signs and tapers on the approaches must be used. Within the intersection, the work usually needs to be staged so that sufficient lanes are kept open to handle the traffic flows. These stages of the work must be clearly defined using closely spaced traffic cones or temporary barriers. An audit should be undertaken on all temporary works arrangements, prior to a traffic switch or similar being implemented at intersections. If the works are to be in place during night hours, the audit should also be done at night to ensure appropriate delineation is in place.

5.3.3 Working at or close to traffic signals

A need to work at or near traffic signals may arise for a variety of reasons including operation and maintenance of equipment, emergency fault repairs, pavement resurfacing or linemarking.

When planning works that involve or impact traffic signals the following should be considered:

- Consultation with police where major or complex traffic signals will need to be flashed yellow or blacked out;
- Where permanent traffic signals are still in operation, alternative traffic control arrangements, such as a PTCD or a traffic controller with a manual STOP/SLOW bat must not be used to control traffic;
- Determine if turn restrictions or detours are necessary and:
  - Check that alternative routes are available and satisfactory for all classes of vehicle being detoured;
  - Consider the impact that additional traffic will have on the operation (phasing) of any traffic signals on the alternative route;
  - Consider the impact that any lane closures, particularly turn lanes will have on signal operation (phasing) and intersection efficiency.
- Where there are likely to be significant impacts on the operation of traffic signals or coordination between signals engage with Transport Network Operations for advice and mitigation measures;
- Notification to road users in advance of proposed works of impact to the signals. This may be by way of advertising, for example using VMS roadside noticeboard advertising, letter drops or press releases; and
- Ensure that adequate provision is made for pedestrians and mobility aid users if it is necessary to turn off pedestrian signals or close a pedestrian crossing at intersection traffic signals.

This variety of works means that the scale and complexity of the TTM required to facilitate the work activities will also vary significantly. When determining TGS requirements, *Section 7.7.4.2 Working at traffic signals* must be followed.

5.3.4 Working in the vicinity of railway lines

The safety procedures provided in this Section must be applied whenever work is carried out in or adjacent to the rail corridor (refer to the Rail Safety National Law National Regulations and the Work Health and Safety Act 2011 for additional requirements).

For the purposes of this Section, the terms and definitions of *Table 5-9* apply.

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Table 5-9. Terms and definitions applicable to working in the vicinity of railway lines

Term	Definition
danger zone	everywhere within 3 m horizontally from the nearest rail and any distance above or below these 3 m
protection officer	authorised qualified worker responsible for managing the rail safety component of work site protection
rail corridor	area within rail boundary fence lines, or if there are no fences, everywhere within 15 m of the outer most rails and includes rail tracks, rail junctions, level crossings, station buildings, platforms, signal boxes, tunnels, bridges and other associated structures
rail infrastructure manager	owner and maintainer of the rail network
rail traffic	trains and all other on-track vehicles

When working in or adjacent to the rail corridor, the rail owner and the relevant rail infrastructure manager should be consulted early during development of the TMP and risk assessment, to ensure all constraints, risks and requirements are identified and mitigated. This includes the completion of an Access Application Form (and requires at least 20 working days for processing).

If the situation is such that any person, plant or equipment are required to be within the rail corridor, then the manager authorising the work must ensure that the rail infrastructure manager is advised and arrangements are made for the provision of a protection officer to ensure the safe interaction between the work and the rail network. The rail infrastructure manager must also be notified if the work affects or has the potential to impact the railway line or rail structures. This includes travel to and from the work site within the rail corridor ensuring vehicle and personnel remain outside the danger zone.

When performing work where a protection officer is required, all workers must follow the instructions of the protection officer and work must not be carried out without the presence of the protection officer.

The supervisor in charge of the site must ensure that:

- All workers understand the requirement to follow instructions of the protection officer;
- All workers must wear approved rail standard safety vests and other personal protective equipment as required by the rail infrastructure manager;
- Where required, arrangements are made with the rail infrastructure manager to provide persons with applicable rail safety awareness training; and
- Work is not carried out within the rail corridor, including travel to and from the work site when the protection officer is off-site.

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 must still notify the rail infrastructure manager of the work and comply with the its requirements.

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 must stop all work on-site and notify the rail infrastructure manager so that the barrier can be re-established or the situation reviewed.

Persons on-site must not damage or attempt in any way to overcome a physical barrier.

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5.3.5 Working at night or in low visibility

When working in any poorly lit situations, such as during periods of fog or working in tunnels, a TGS must specify the requirements and details provided in *Table 5-10*. For night works in particular, it should be noted that;

- Obstacles are less conspicuous and peripheral vision is reduced; and
- There is a higher risk of motorists being fatigued, alcohol-impaired or driving at higher speeds.

Table 5-10. TGS requirements for sites with poor visibility

Requirement	Details
The work site has appropriate flood lighting	PTCDs or traffic controllers with STOP/SLOW bats at the approaches to a night time work area must be clearly visible to road users. This may require additional lighting. The ITCP, works supervisor or team leader must check floodlighting at work sites to ensure that floodlights do not adversely affect road users, adjacent dwellings or businesses. These checks must be made by driving around, past and through the work site in all directions of travel. On divided carriageway roads, these checks must be carried out from all carriageways, even if the work area is only on one carriageway.
Additional signs and devices	On high speed, high volume roads and on busy roads in built-up areas, flashing arrow signs must be used at night. Care must be taken to ensure that the dimming facility is operating correctly. It is recommended that back–up units are made available on critical works. Only type-approved flashing arrow signs must be used in NSW. For information and approval requirements, see *Section 6.9.2 Illuminated flashing arrow signs.*
Delineation in accordance with AS 1742.3.	The standard ROADWORK AHEAD (T1-1), Worker symbolic (T1-5) and Traffic Controller symbolic (T1-34) signs must be used for night works. All signs must be manufactured with Class 400 or Class 400T (retroreflective) yellow sheeting. As of 30 June 2020 the NIGHT ROADWORK AHEAD (T1- 223), Worker symbolic (T1-224 and T1-5-2) and Traffic Controller symbolic (T1-200-2 and T1-200-3) must not be used.
All personnel on the site wear approved high visibility clothing	In addition to traffic controllers, all personnel working at night must wear approved high-visibility external clothing, including wet weather clothing, in accordance with Transport's current Personal Protective Equipment Procedure. PPE must be clean and bright. Additional PPE such as hearing, eye and foot protection must also be worn as required by the relevant SWMS and in accordance with Transport's current Personal Protective Equipment Procedure.

5.4 Traffic control

5.4.1 General

Traffic control must be used if road users will be directed to disobey a traffic regulation, such as crossing a barrier line (traffic control does not override requirements for road users to obey traffic signals).

In instances of inclement weather where visibility and skid resistance is compromised, traffic control should not be used. However, if this is not practical additional controls must be implemented to ensure the safety of road workers and road users. Prior to installation of traffic control, a contingency plan should be developed to determine the actions and controls that are required in the instance of inclement weather, such as rain.

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At any point of traffic control, four cones must be placed at 4 m spacing on the centre line, edge line or both, prior to the traffic control point. Traffic cones are used to highlight the traffic control position, where vehicles are to stop and for traffic management purposes.

5.4.2 Traffic control types

For all work sites requiring traffic control, a PTCD must be used when the existing permanent speed limit is above 45 km/h. This requirement is not applicable to instances and environments of emergency response.

A manual traffic controller may be used provided all of the following conditions are met:

- The use of a PTCD is demonstrated to not achieve the safest outcome;
- The decision to use a manual traffic controller instead of a PTCD is documented in the TMP or supporting risk assessment; and
- Approval is granted by the one-up manager of the PWZTMP qualified person responsible for the works relevant TMP.

Under the Road Transport Act 2013 a person must not install or display a prescribed traffic control device on, above or near a road without appropriate authority. All traffic control devices, including road markings, traffic signals, or any other device used to direct or warn traffic at a roadwork site must be accepted for use in accordance with this Technical Manual.

Devices detailed in this Technical Manual and the relevant specifications where required, provide the authorisation and conditions for use by which those devices can be installed on a Transport work site. Only approved PTCDs detailed in *Section 6.6 Portable traffic control devices (PTCDs)* must be used.

Any device that is not accepted for use in this Technical Manual must not be used unless the conditions in *Section 2.8.3 Use of unaccepted devices* have been met or approval has been obtained by a person with appropriate authority under Part 11 of the Transport Delegations.

5.4.3 Requirements for traffic controllers

Table 5-11 provides the general requirements that must be applied when a traffic controller is used, including the use of a PTCD.

Table 5-11. General requirements for the use of a traffic controller

Aspect	Requirements
Training	Traffic controllers must be trained in their duties and verified as competent. At a minimum, traffic controllers must have the 'Traffic Controller' qualification and be deemed competent in the use of the relevant PTCD or STOP/SLOW bat.
Identification	All traffic controllers performing traffic control work must be identified as such. This must be by wearing a badge or other distinguishing mark clearly stating "traffic controller". Reference to Transport (or RMS/RTA) is not permitted unless the traffic controller is an employee of Transport.
Fitness for duty	Traffic controllers must be fit for duty when reporting for work and remain so during working hours (including breaks and travel time). Traffic controllers must comply with the drug and alcohol procedure in place at their work site. See *Section 2.4.3* for further information.
Equipment	Traffic controllers must only control traffic using an accepted traffic control device as per this Technical Manual.

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Aspect	Requirements
Approach speed	Where traffic control is used, the speed limit applied to approaching traffic must be reduced to less than 65 km/h. Additionally, a speed zone of less than 65 km/h must commence more than 100 m from the traffic control position, in accordance with *Section 4.5.5 Implementation*.
Visibility	Traffic controllers must be located in a position where the sight distance between them and oncoming traffic is a minimum of 1.5D, unless: • A site specific risk assessment has been undertaken; • Additional control measures identified in the site specific risk assessment are in place; and • It has been documented in the relevant TMP and TGS.
Positioning	A traffic controller must be positioned: • Outside the travel path of traffic; • Facing the traffic; • Where a clear and safe escape path is available; • So their body is adequately illuminated by installed lighting when working at night or in low visibility; and • Such that they do not obstruct motorists' view of other signs and devices, or be hidden by them. A traffic controller must not leave their position (control point) unless directed by the ITCP qualified person, equivalent person responsible for site, or upon relief by another traffic controller.
Communication	Traffic controllers must ensure that they are able to communicate effectively to other nominated members of the work crew, such as other traffic controllers or plant operators. Communication may be via: • Direct verbal communication; • Verbal communication via a two way radio; or • Through an intermediate person. The use of verbal communication either directly or via a two way radio is the preferred means of communication between traffic controllers. The use of a two way radio is essential if clear sight between operators is not available, are located an extended distance apart, or they are working at night.
Signage	A PTCD sign relevant to the device used, such as Boom Barrier symbolic (T1-272n) or Signals symbolic sign (T1-30), or a Traffic Controller symbolic sign (T1-34) must be used to give advance warning of the presence of traffic control. A PREPARE TO STOP (T1-18) sign must also be used when traffic is required to stop at the traffic control location. The above signs must only be used when the traffic control is in operation and must be removed or covered up when traffic control is discontinued or during breaks, such as lunch.
Period of duty	Traffic controllers must be relieved every two hours of work. They may return to traffic control duties after a minimum of 15 minutes of rest or alternative duties. This also applies to traffic controllers operating a PTCD.
PPE	Traffic controllers must wear all relevant PPE for their works as required by their employer. At a minimum, these requirements must meet the standard set by the Transport Personal Protective Equipment Procedure PN066P19

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Aspect	Requirements
Performing duties	When performing their duties traffic controllers must: • Check that the appropriate signage has been installed or uncovered by the ITCP qualified person, prior to undertaking traffic control duties; • Remain focussed on their traffic control duties and be aware of the roadworks; • Report adverse driving behaviour from motorists in accordance with *Section 8.3 Reporting work site incidents*; and • Remain courteous at all times in dealing with the public. Traffic controllers must not: • Use any electronic device, including a mobile phone, unless required for communication with other traffic controllers or their team supervisor; or • Allow persons to stand near or gather around the PTCD or STOP/SLOW bat, which can cause distraction or create confusion for the travelling public.

5.4.4 Additional requirements for the use of a STOP/SLOW bat

If a manual traffic controller has been justified and approved in the TMP, the manual traffic controller must only be in place when traffic speeds have been reduced to less than 65 km/h in accordance with *Section 5.4 Traffic control.* A traffic controller must:

- Only use approved hand signals shown in *Table 5-12* to direct traffic when using a STOP/SLOW bat;
- Only control one lane of traffic, and usually only in one direction;
- Be clearly visible to traffic at all times. This may require the traffic controller to reposition after the first vehicle has stopped in order to be visible to queuing traffic;
- Stay at the head of the traffic queue at a safe distance from the opposing traffic lane; and
- Stand clear of traffic when allowing it to proceed.

An illuminated wand may be used to supplement the STOP/SLOW bat during night works or when visibility is limited.

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Table 5-12. Traffic controller hand signals

Traffic direction	Action	Illustration
From Slow to Stop: stop traffic	1. Choose a gap in the traffic flow and/or most appropriate vehicle to stop; 2. Turn the STOP/SLOW bat to STOP; 3. Raise the free arm into the stop signal position with the palm of the hand towards the traffic.	
From Stop to Slow: allow traffic to proceed	1. Check that all traffic from the other end of the work area has passed; 2. Turn the STOP/SLOW bat to SLOW; 3. Give the proceed signal with a sweeping motion.	
Slow traffic	1. When the STOP/SLOW bat is showing SLOW extend the free arm to the side and wave hand up and down.	

5.4.5 Traffic control locations

The traffic control locations must be considered as part of the development of the TMP. When determining the traffic control locations needed for a work site, the following must be considered:

- Type of temporary traffic management;
- Number of approaches to be controlled;
- The way in which traffic is being controlled, including the use of a PTCD;

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- Sight distances and factors that impact on this including road geometry and vegetation;
- Expected duration of traffic control;
- Infrastructure such as transit stops, assessed queue lengths for planned stopping duration; and
- Weather conditions (i.e. adverse weather such as extreme heat).

Once the traffic control locations have been determined, the number of traffic controllers required to operate the traffic control devices, or STOP/SLOW bats can be determined.

To determine the number of traffic controllers for operating a traffic control device, see *Section 6.6 Portable traffic control devices (PTCDs)*.

When a traffic controller is utilised for operation of a PTCD or a STOP/SLOW bat, a sight distance of 1.5D must be allowed for.

A traffic controller is not required where all of the following conditions are met, otherwise at least one traffic controller must be in place (see *Figure 5-3*):

- ADT is less than 100 vehicles per day;
- Each entry to the work site is visible from the other end; and
- The work area is shorter than 100 m.

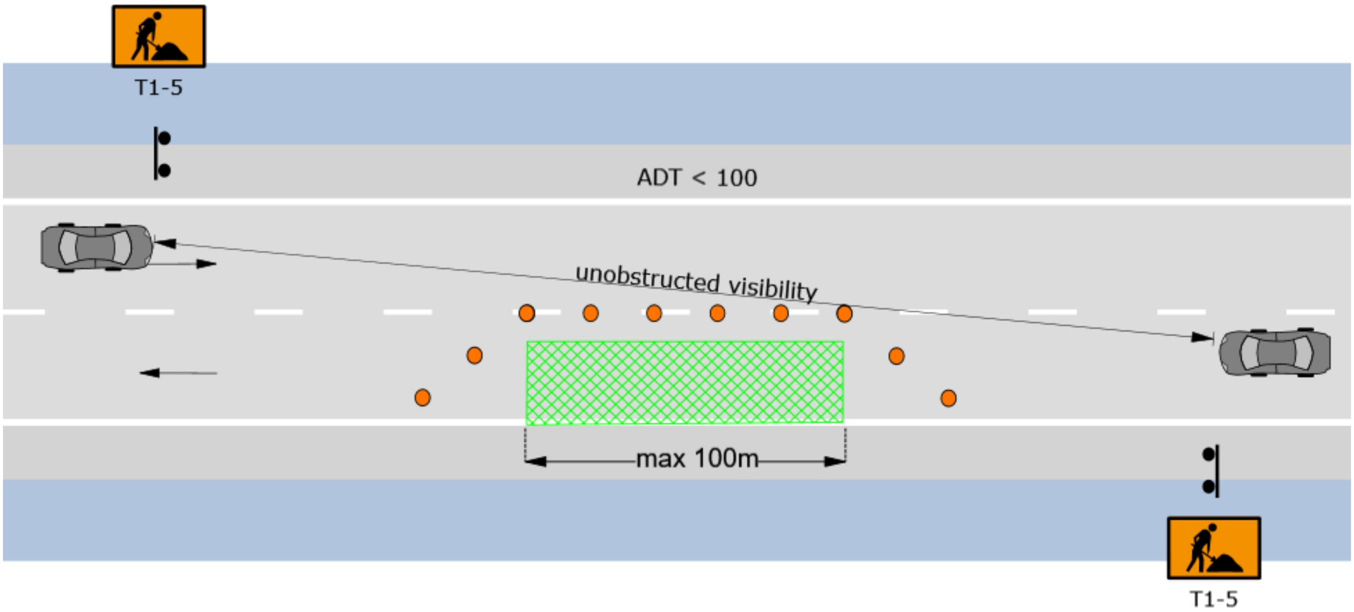

Figure 5-3. No traffic controller required

One traffic controller may be in place where:

- ADT is 500 vehicles or less; and
- Sight distance from the traffic controller exceeds the minimum in *Table 5-13*.

Two traffic controllers must be in place where:

- ADT is greater than 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 provided in *Table 5-13*.

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Table 5-13. Traffic controller minimum sight distances

Existing permanent speed km/h	Length of Work Area (L)	Minimum clear sight distance to oncoming traffic
less than 105	less than 60 m	300 m
less than 105	greater than or equal to 60 m	L + 250 m
greater than 105	less than 60 m	400 m
greater than 105	greater than or equal to 60 m	L + 350 m

When traffic control is being used for a multi-lane carriageway, a merge or merges must be introduced upstream of the traffic control position so that only one lane is managed at a time as per *Figure 5-4*.

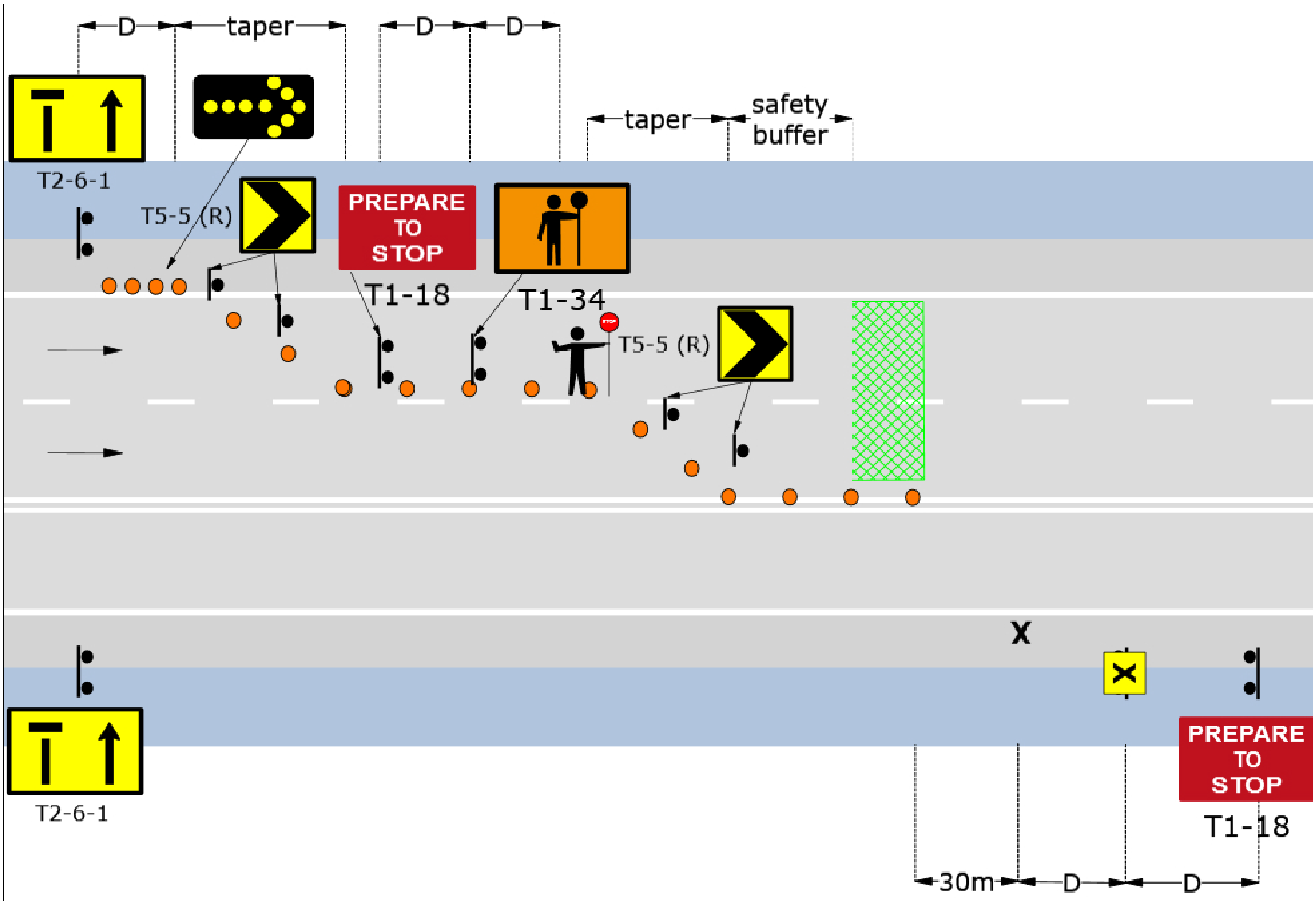

Figure 5-4. Manual traffic controller for multi-lane carriageway

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6 Signs and devices

6.1 General

This Section must be used to determine the use and placement of TTM signs and devices at Transport work sites by persons qualified with PWZTMP or ITCP as applicable. The Section includes defining the clearances and spacing for signs and devices as well as the sequence of installation and removal.

The devices in this Section include:

- Portable traffic control devices (PTCDs);
- Safety barriers;
- Traffic guidance and delineation devices; and
- Other safety devices.

In relation to this Section the following must not be used:

- Isolated or non-continuous safety barrier units;
- Barrier boards parallel to the direction of traffic flow;
- Any other traffic control device that is not authorised for use.

For authorising the use of an unaccepted traffic control device see *Section 2.8 Departures from this Technical Manual.*

6.2 Clearances and spacing of signs and devices

6.2.1 Edge clearances for delineating devices and temporary safety barriers

Clearances between the edge of traffic lane and delineating devices or a road safety barrier system must be in accordance with in *Table 6-1*, unless alternatives have been determined based on a documented risk assessment and detailed in the TMP as per *Section 2.8 Departures from this Technical Manual*.

Clearances must be measured to the traffic side edge of delineating devices or barrier. This edge must also be the line from which clearances to the work area are measured for the purpose of determining treatments.

Where barrier shape includes feet, the clearance must be measured from the edge of the foot on the traffic side. Containment fences marking the limit of work area must be placed as specified in *Section 6.8.3 Plastic containment tapes and fences.*

See *Figure 6-1* and *Figure 6-2* for further information.

Table 6-1. Edge clearances

Edge of traffic lane to:	Edge clearances
Line of traffic cones or bollards	• 0.5 m for traffic speeds less than 65 km/h • 1.0 m for traffic speeds greater than 65 km/h

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Edge of traffic lane to:	Edge clearances
Barrier boards, temporary guide posts or temporary hazard markers	1.0 m
Road safety barrier system	• 0.3 m for traffic speeds less than 45 km/h • 0.5 m for traffic speeds 45 to 65 km/h • 1.0 m for traffic speeds 65 to 85 km/h • 2.0 m for traffic speeds greater than 85 km/h

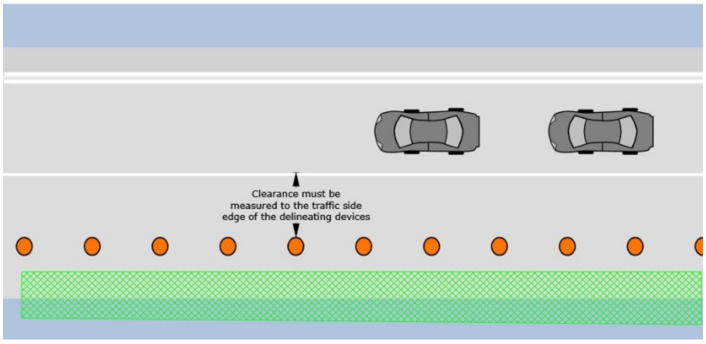

Figure 6-1. Clearance measurement from delineating device (cones)

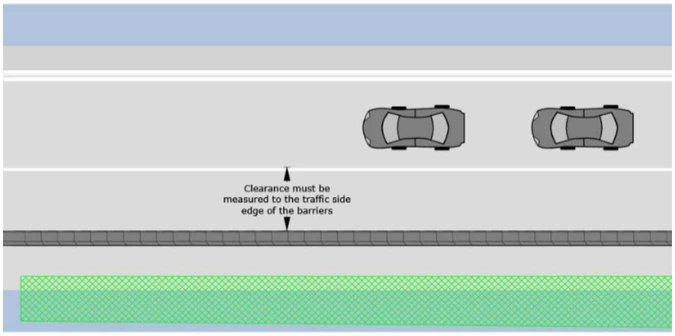

Figure 6-2. Clearance measurement from delineating device (barrier)

6.2.2 Use of delineating devices on kerbs

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

Temporary kerbing used for delineation of the roadway on detours and side-tracks must be clearly delineated with red delineators on the left side and white on the right (two-way roadway) or yellow on the right (one-way roadway). Additional information relating to the use of temporary kerbing can be found in *Section 6.8.5 Temporary kerbs*.

6.2.3 Use of temporary safety barriers on kerbs

When an errant vehicle traverses a kerb directly prior to impact with a temporary safety barrier, roll and pitch are developed which affect the interaction of the vehicle with the barrier, increasing the risk of the vehicle mounting the barrier.

Where installation of a temporary safety barrier is required behind a kerb the barrier must be installed either:

- Greater than 1.5 m behind the kerb, to allow an errant vehicle to stabilise before striking the barrier; or
- Within 0.2 m of the kerb so that an errant vehicle has not had adequate time to develop significant pitch and/or roll.

Where temporary safety barriers are required to be installed behind kerbs on roads with a posted speed limit of greater than 75 km/h, a risk assessment must be performed to determine the most appropriate barrier position and detailed within the TMP.

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6.2.4 Placement and clearances of registered plant or devices

This Section applies to registered plant or trailer mounted devices that are left unattended for a period of time on the road-side during roadworks, such as lighting towers and VMS. The plant and devices captured within this section generally have a physical size and mass such that they are not frangible and if positioned inappropriately can pose a potential road safety hazard.

Prior to placement of the plant or device, a site-specific risk assessment must be undertaken by the persons responsible for the work site to identify, assess and manage the risks associated with deployment. The risk assessment should consider:

- Location of specific hazards such as traffic, utilities, culverts, medians or embankments;
- Risks introduced as a result of the placement or operation of the device;
- Parking and removal of plant or device; and
- If the items are to be unloaded and loaded onto floats or rigid trucks.

When determining the placement and clearances, the plant or device must be located:

- In a lawful parking location i.e. not on a footpath;
- Behind a Transport accepted safety barrier;
- No less than the appropriate sight distance from an intersection, merge point, exit ramp, traffic control signal or sharp curves;
- In a position where road user sight lines are not obstructed;
- To provide for the safe movements of all road users, including cyclists, pedestrians (inclusive of mobility and vision impaired pedestrians) and heavy vehicles including wide loads;
- Where safe stopping sight distance to pedestrians at crossing points (e.g. refuges, pedestrian crossings, signalised intersections) are not obstructed; and
- Where adequate delineation can be provided such as bollards, traffic cones or temporary linemarking so that road users can perceive the location of the device at night or in low visibility.

When a device cannot be protected by a barrier, the devices or vehicle must be positioned as far away from the edge of the traffic lane as is practical in a position determined suitable based on a documented risk assessment and detailed in the TMP. For more information refer to Austroads *Guide to Road Design* Part 6: *Roadside Design, Safety and Barriers*.

Additional issues that should be considered when locating plant or devices include:

- Positioning relative to curves – avoid locating the device, plant item or other vehicle on the outside a curve;
- Avoid locating where vehicles are laterally moving or weaving across traffic lanes (i.e. at the end of merge or in the merge run out area); and
- The deflection zone of the relevant barrier systems
- When a device, plant item or other vehicle is being located behind a crash barrier. Adequate lateral separation should be provided between the back of the barrier and the device, plant item or vehicle to ensure that the performance of the system is not compromised.

Additional information specific to the placement of Variable Message Signs is contained in *Section 6.9.1 Variable message signs (portable).*

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6.2.5 Spacing of cones and bollards

Cones and bollards are used to define the traffic path past or through work areas (refer to *Section 6.8 Traffic guidance and delineation devices* for further information on types, sizes and uses of cones and bollards).

Maximum spacing of cones and bollards must be in accordance with *Table 6-2*. Where traffic volumes are high or other conditions warrant it, consideration should be given to reducing the spacing of cones to as close as 1 m to prevent traffic taking a wrong turn through cones or bollards.

Table 6-2. Required maximum spacing of cones and bollards

Purpose and usage	Speed zone of device location km/h	Maximum spacing m
On approach to a traffic control position (centreline or edge line)	All cases	4
Merge tapers	55 to 75 greater than 75	9 12
Lateral shift tapers	55 to 75 greater than 75	12 18
Protecting freshly painted lines	55 to 75 greater than 75	24 60*
All other purposes	less than 55 55 to 75 greater than 75	4 12 18

Note* to Table 6-2: *This spacing should be reduced on curves or crests or if the row of cones is not clearly defined at night.*

6.2.6 Spacing of signs

Signs must be spaced in accordance with *Table 6-3*. The value of 'Dimension D' is used to determine the placement of signs, see *Section 7.3 Dimension D* for determining 'Dimension D'.

Table 6-3. Sign spacing requirements

Number of signs	Approach speed	
	less than 65 km/h	65 km/h or greater
One advanced sign	D	2D
Multiple advanced signs	D	D

Where there is more than one advance sign position, the advance sign nearest the work area must be placed D from the beginning of the taper area or diversion and other advance sign positions at successive spacing of D further in advance of the work area.

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Tolerances for positioning on signs and devices is detailed in *Section 7.10.3 Tolerances on positioning of signs and devices.*

6.3 Maintaining temporary signs and devices

Work site temporary signs and devices need to be consistently maintained with particular attention given to the following:

- Signs and devices displayed must remain appropriate for changing circumstances during the work;
- Signs which are not required between shifts must be covered;
- Sign placement, including covers must be checked after weather events;
- Signs and devices must be in good condition;
- Damaged or disfigured signs in the work environment must be replaced as soon as possible, especially if the warnings displayed are not clear;
- Signs and devices erected before they are required must be covered by a suitable, opaque material in accordance with AS 1742.3. A suitable material may be WF 200 woven polypropylene material. The cover must be removed immediately prior to the commencement of work;

  Note: *Covering signs with hessian material does not sufficiently inhibit the sign's retroreflective performance and should not be used. Additionally, dark coloured and plastic materials may cause overheating or excessive moisture build-up and therefore damage to the sign.*

- If used at night, signs and devices must be inspected at night (*see Appendix E – Inspection checklists and tools*).
- Signs must not display conflicting messages; and
- Temporary signs displays must not be altered or changed by adhering non-approved materials to the sign face. For example, roadwork speed zones must not be altered by using tape or any other similar material.

The condition of signs must be checked prior to installation and as a part of regular TTM inspections. See *Section 8.1 Work site inspections, reviews and audits*.

6.4 Sequence for installation and removal of signs and devices

6.4.1 General

The sequence for installation and removal of signs and devices must be considered in the TMP and documented on the TGS or another site document such as a SWMS. The installation and removal of signs and devices must:

- Be undertaken in accordance with the procedures shown on the TGS or other document;
- Be planned to be in the direction of normal traffic flow;
- Not require workers to cross roads or carriageways on foot; and
- Be undertaken with a work vehicle showing a flashing arrow or rotating/flashing light(s) positioned between the workers and approaching traffic.

Special consideration must be given for the removal of signs on central medians and barriers on multi-lane divided carriageways, i.e. a site-specific TGS or use of a work convoy etc.

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6.4.2 Installation

Before work commences, signs and devices at the work site must be installed in a sequence that is safe and efficient. After the work area has been located, via the use of a GPS, survey, landmarks, side streets or chainage, setting up a site to install signs and devices should be in accordance with the general procedures described below:

Two-lane, two-way roads

For two-lane, two-way roads, installation should occur in the following order:

1. Install termination signs (if no side roads).
2. Install on side streets.
3. Install in the non-working lane (unaffected direction).
4. Install in the working lane (affected direction).

Figure 6-3 provides an example sign installation sequence for a two-lane, two-way road.

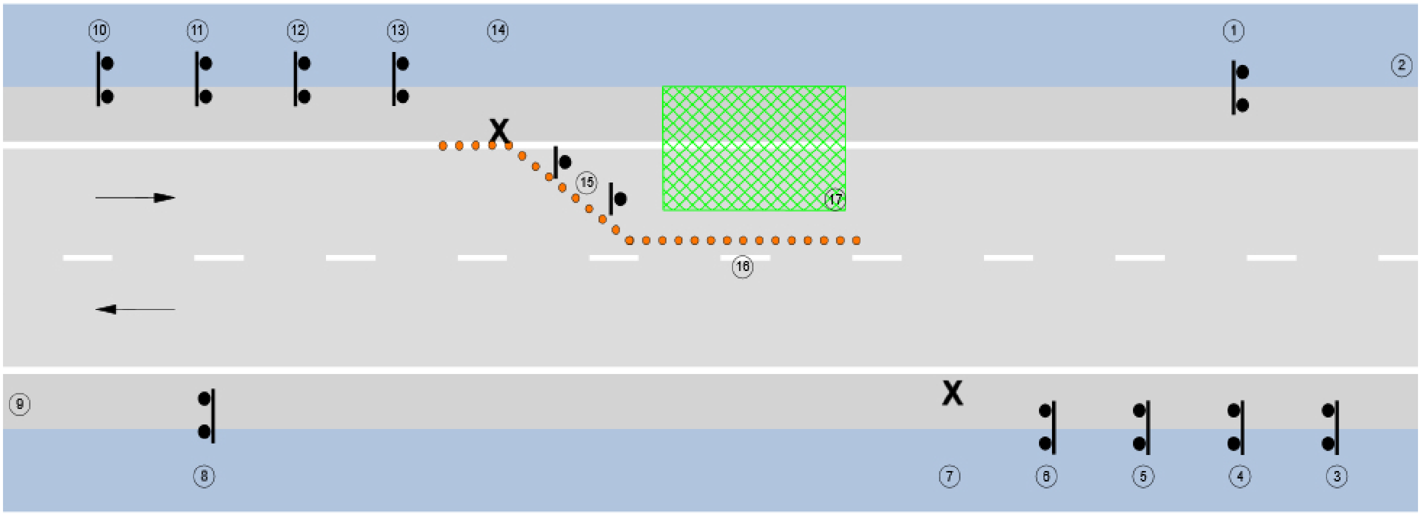

Figure 6-3. Example sign installation sequence for a two-lane, two-way road

Multi-lane roads

For multi-lane roads, installation should occur in the following order:

1. Install signs and devices for the non-working lane (un-affected direction).
2. Install signs and devices for the working lane (affected direction).

Special consideration must be given to the installation of signs on central medians and barriers on multi-lane divided carriageways. In such cases, a site-specific TGS or use of a convoy may be required.

Figure 6-4 provides an example sign installation sequence for a multi-lane road.

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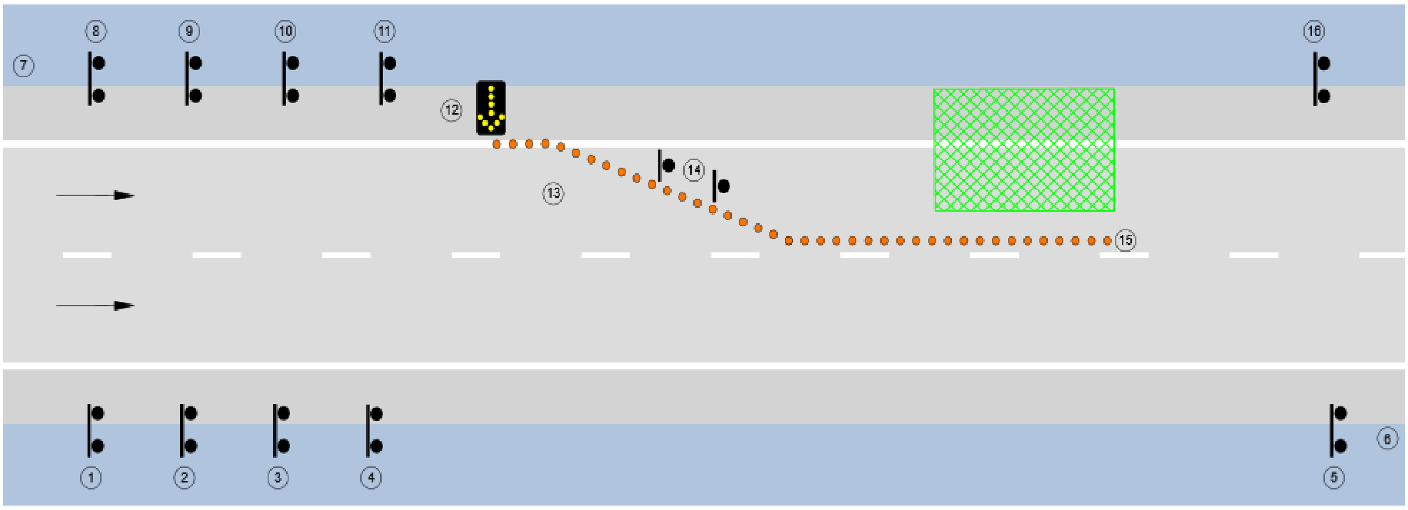

Figure 6-4. Example sign installation sequence for a multi-lane road

A different implementation sequence may needed for site specific circumstances, e.g. install End Roadwork and reinstate the existing permanent speed limit first.

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

For long-term or recurring short-term sites, consideration should be given to marking the desired location of each sign or device on the road for easy placement.

6.4.3 Removal

Removal of traffic control signs and devices should be undertaken in the reverse order of installation, progressing from the work area out toward the approaches. On motorway type carriageways, the removal of signs can be difficult in this sequence, in which case, signs should be removed in the same order that they were installed. The work vehicle should be positioned between the workers and approaching traffic when removing signs in this manner.

When removing delineation devices, such as cones, bollards or barrier boards used to close a lane, an advanced warning vehicle should be used to warn road users of workers on foot and a work vehicle must also be positioned between the workers and approaching traffic.

A work vehicle must only proceed in a forward direction towards approaching traffic along the closed roadway if it is determined by the PWZTMP or ITCP qualified person that it is safe to do so. This should not occur at night time where it may create motorist confusion or distraction, such as headlight glare.

6.4.4 High risk sites

At sites where it is deemed too difficult or unsafe to install and remove control signs and devices in accordance with the above general principles, special arrangements to complement the above general principles must be adopted to maintain worker safety. These arrangements must be documented as part of the TMP and the relevant TGS or SWMS, and mitigation measures incorporated into the work practice that is adopted. This may mean that signs are removed in the same order that they were erected to allow the work vehicle with a rotating or flashing light(s) to move in the direction of normal traffic flow when use of the travel lane is the only alternative.

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6.5 Traffic control signs

6.5.1 General

Standard TTM signs must be used wherever one suitable for the purpose exists. All existing signs can be found in the Traffic Signs Register. Where a suitable standard traffic sign does not exist, the process detailed in *Section 2.8.2 Use of unapproved signs* must be followed.

Signs referred to in this Technical Manual follow the naming and numbering conventions of AS 1742.1, which is summarised in *Table 6-4*.

Table 6-4. Sign naming and numbering convention

Class	Function in TTM	TTM Sign example
Regulatory sign (R)	To regulate the movement of traffic by indicating when or where a legal requirement applies, failure to comply constitutes an offence.	STOP HERE ON RED SIGNAL (R6-6)
Warning sign (W)	To warn road users of unexpected or hazardous conditions on or adjacent to the road.	Traffic Lights symbolic (W3-3)
Direction sign (G)	To inform and advise road users of directions or non-regulatory traffic instructions.	Speed limit AHEAD sign (G9-79)
Temporary signs (T)	To control, warn and guide road users safely through, around or past work sites on roads and footpaths and to warn and advise of other temporary hazardous conditions that could endanger road users.	ROADWORK AHEAD (T1–1)

Where, due to regulatory requirements, NSW adopt a variation to the design of an Australian Standard sign, an ‘n’ following the sign number is included. Examples include:

- Speed Limit ROADWORK (R4-212n) sign;
- SHOULDER CLOSED (T2-19n) sign; and
- ONE LANE (R9-9n) sign.

6.5.2 Types of signs

Examples of traffic control signs grouped into broad categories, are provided in *Table 6-5*.

Table 6-5. Examples of signs used for a typical category

Category	Example signs	Sign number
Work site approaches and departures	ROADWORK AHEAD GRADER AHEAD END ROADWORK	T1-1 T1-4 T2-16
Regulatory control of traffic	Speed limit ROADWORK PREPARE TO STOP STOP HERE ON RED SIGNAL	R4-212n T1-18 R6-6

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Category	Example signs	Sign number
Detours	DETOUR One lane each way symbolic Arrow marker symbolic	T5-1 T2-24 T5-6
To indicate road conditions	GRAVEL ROAD Loose stones symbolic NEW WORK NO LINES MARKED	T3-13 T3-9 T3-11
Lane and road closures	Lane closed symbolic ROAD CLOSED	T2-6-1 T2-4
Pedestrian control signs	PEDESTRIANS USE OTHER FOOTPATH LOOK BOTH WAYS TWO WAY TRAFFIC	T8-2 T8-3 T8-5
Vehicle height and mass restriction signs	LOW CLEARANCE X.Xm BRIDGE LOAD LIMIT Xt GROSS	R6-11 R6-3

Signs must be designed and manufactured in accordance with AS 1743. Details of each letter must be as shown in AS 1742.2. The retroreflective material used on signs must be Class 400 or Class 400T material complying with AS 1906.1.

6.5.3 Sign sizes

Signs are generally available in four increasing size classes: A, B, C and D. A size and B size are the most commonly used. The dimensions of the sign sizes vary depending on the sign.

Conditions for use of the different sign sizes are provided in *Table 6-6*. The TGS designer is responsible for selecting sign sizes and therefore must ensure that they are shown on the TGS.

Table 6-6. Sign size conditions of use

Sign Size	Requirement
A size	Must be used when any of the following conditions are met: • Directed at pedestrians or cyclists; • The lateral offset of the sign from the travel path is less than 4.5 m; or • The lateral offset of the sign from the travel path is between 4.5 m and 8 m and the posted speed is less than 95 km/h.
B size	Must be used when any of the following conditions are met: • The conditions for *A size* signs are exceeded; • The sign is a roadwork speed zone sign used on roads where the existing permanent speed limit is greater than 55 km/h; • The relevant *A size* sign is less than 1 m² in area and traffic speeds are greater than 65 km/h; • On motorway type roads for added emphasis of the onset of works, detours or closures; or • For display of any other critical safety messages

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Sign Size	Requirement
C size and D size	Must be used when any of the following conditions are met: • The sign is a roadwork speed zone sign used on motorway type roads, multi-lane roads, or higher speed roads; • There is considered to be a need to emphasise the message; or • There is excessive lateral offset of the sign.

Note: *Details of standard sign sizes are contained in Transport electronic Traffic Signs Register and AS 1742.1.*

6.5.4 Sign mounting

The method of mounting signs must consider the duration of display, the placement location and frequency of removal or covering. Signs may be mounted in frames or on posts; however at all times the mounting method must:

- 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; and
- Not be a hazard if struck in their normal upright position or after being knocked over.

For ease of installation and removal, signs mounted in frames are the preference for works taking less than two weeks. Signs required for works which will be in progress for less than two weeks may be erected in a permanent manner if it is considered to be justified.

Signs continuously required for works, which will be in progress for longer than two weeks, should be installed on posts in a permanent manner.

Table 6-7 provides the requirements for frame and post mounted signs.

Table 6-7. Frame and post-mounted sign requirements

Sign mount	Requirement
Signs mounted in frames	When using frames to mount signs they must be quick and easy to install as well as easy to handle, transport and store. When in a frame, the minimum height to the lower edge of the sign should be 200 mm. For requirements specifically associated with frame mountings of multi-message signage, see *Section 6.5.8 Multi-message signs.*
Signs mounted on posts	When signs are mounted on posts, the locations of any underground utilities must be determined prior to installation. The ability to install signs on posts may be restricted: • In narrow cuttings; • Where underground utilities are located; • Behind safety barriers where off-sets might be too great; or • Where it is undesirable to damage the asset for installing. When installed in open road situations, the underside of the sign must be at least 1.5 m above the level of the nearest edge of the travelled path. When installed on a kerb or footpath, the underside of the sign must be at least 2.2 m above the level of the nearest edge of the travelled path to reduce impact on vulnerable road users or interference from parked vehicles.

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6.5.5 Sign placement

Placement of signs must be arranged so that they are prominently displayed to traffic and will command attention. Signs must be properly displayed at all times and within the line of sight of the intended road user. Regulatory and detour signs must be located nearest to the travel edge of the lane. Signs must not:

- Be obscured from view such as vegetation or parked cars;
- Obscure other devices from the line of sight of road users;
- Create a hazard to road workers and road users (see *Section 4.4 Providing for specific road users* for additional provisions for specific road users);
- Be a hazard that deflects traffic into an undesirable path; or
- Restrict sight distance for drivers entering from side roads or streets, or private driveways.

The visibility of a sign can be affected by shade, the direction of the sunlight, and background conditions including lighting and oncoming headlights.

Where installed, signs must be oriented to ensure adequate line of sight for approaching road users (see *Figure 6-5*):

- On the outside of a curve, the sign face must be at 0 degrees, or “normal to traffic”;
- On a straight, the sign face must be angled at approximately 5 degrees normal to oncoming traffic; and
- On the inside of a curve, the sign face must be angled at approximately 5 degrees normal to oncoming traffic at 200 m preceding the sign.

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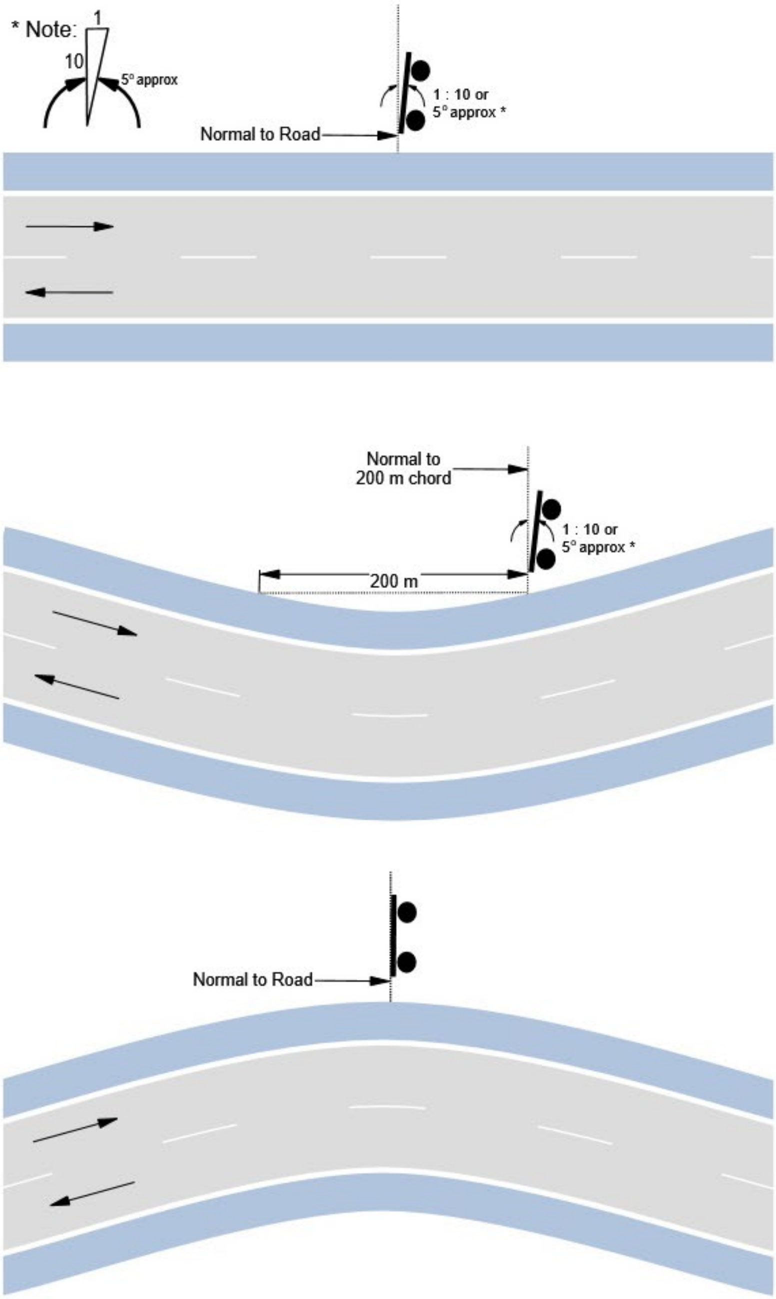

Figure 6-5. Orientations of signs

Signs must be placed in accordance with *Table 6-8*.

Table 6-8. Sign placement provisions

Placement of signs	Provision
For short term works	Signs mounted on portable supports used for short-term operation must be located as follows: • ***In open road areas*** – on the road shoulder a minimum of 1 m clear of, and not more than 5 m from the travelled way. • ***In built up areas*** – behind the kerb if visible to oncoming traffic and not obstructing vulnerable road users or on the pavement, as near as practicable to the kerb, provided the sign is not obscured by parked vehicles and without obstructing moving traffic.

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Placement of signs	Provision
For long term works	Signs mounted on posts used for long-term operation must be located as follows: • ***In open road areas or roads without kerbing*** – signs should be placed clear of the outer edge of the shoulder and, where possible, at least 2 m clear of the travelled way, whichever is the greater clearance. • ***In built up areas or roads with kerbing*** – signs should be placed at a minimum of 300 mm clear distance behind the kerb. All signs mounted on posts should be mounted at heights specified in *Section 6.5.4 Sign mounting.*

6.5.6 Duplication of signs

Consideration should be given to duplicating signs as a measure to improve worker and road user safety when developing a TMP and TGS. Where practical, signs should be located on both sides of the roadway for undivided roads, or on the left hand side and on the median for divided roads where there is sufficient median width.

Signs should be duplicated:

- On multilane roads with volumes of 10,000 vpd or greater;
- For lane status signs (T2-6-1, T2-6-2 etc.) regardless of vpd;
- On the outside of left hand curves where the sign is seen on approach to the work area;
- On medians of dual carriageways where parked vehicles or other objects obscure kerb side/footpath signs; and
- At other locations where conditions are such that duplicate signs improve safety and guidance as identified in the TMP or risk assessment.

Duplication of signs should not be used, where:

- It will introduce potential safety risks during installation;
- It will 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; or
- The duplicated signs have too large a lateral offset as to not be obvious to motorists e.g. on a six lane, two-way undivided road.

The decision to not duplicate signs in accordance with the above provisions must be documented in the TMP.

On multi-lane roads where there is no room for duplicate signs on medians, consideration should be given to placing supplementary signs on the left hand side.

Details of duplication of speed zone signs are contained within the speed zones *Section 4.5.5 Implementation.*

6.5.7 Dual sign arrangements

Dual sign arrangements are two independent signs displayed together at one position either side by side, as shown in *Figure 6-6* or ‘stacked’, as shown in *Figure 6-7*. Dual sign arrangements may be used, provided all of the following conditions are met:

- The size of both signs, including the legend, size of symbol or area occupied by the legend is unchanged from the standard sign;

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- The lateral offset meets the requirements of *Section 6.2.6 Spacing of signs;* and
- Where used in a dual sign arrangement, regulatory or detour signs must be located nearest to the travel edge of the lane.

Figure 6-6. Side-by-side dual sign arrangements

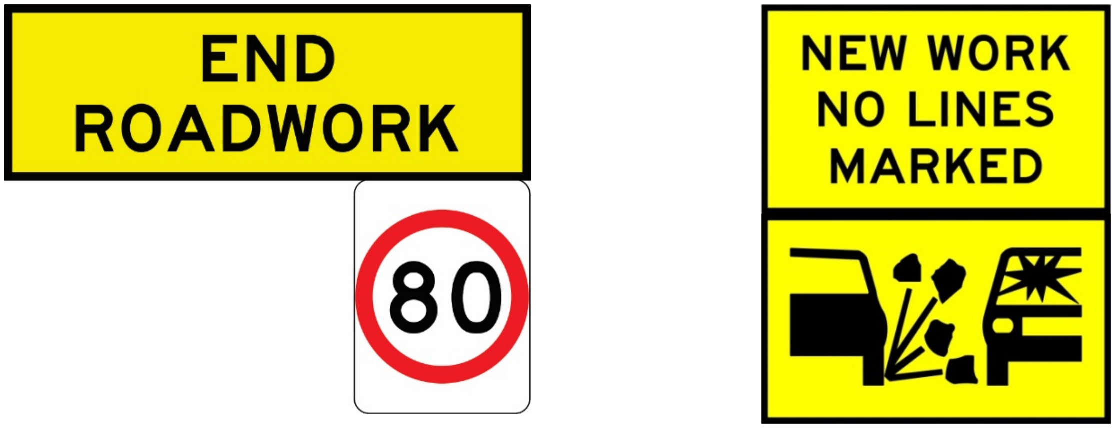

Figure 6-7. Stacked dual sign arrangements

6.5.8 Multi-message signs

6.5.8.1 General

Multi-message signs (MMS) are two or more logically related signs displayed within one mounting frame. For Transport roadwork, MMS may be used, provided both of the following conditions are met:

- The existing permanent speed limit is less than 65 km/h; and
- The MMS frame has the dimensions shown in either *Figure 6-10* or *Figure 6-11*.

Additionally, an MMS must not:

- Be used on multi-lane carriageways;
- Contain messages that are not relevant to the works being performed; or
- Contain empty panels (empty voids).

MMS should not be used where the lateral offset of the sign is close to maximum allowable limits, due to insufficient time for drivers to fully read and comprehend the message being displayed. Examples of typical MMS use and layouts are contained in *Figure 6-8* and *Figure 6-9*.

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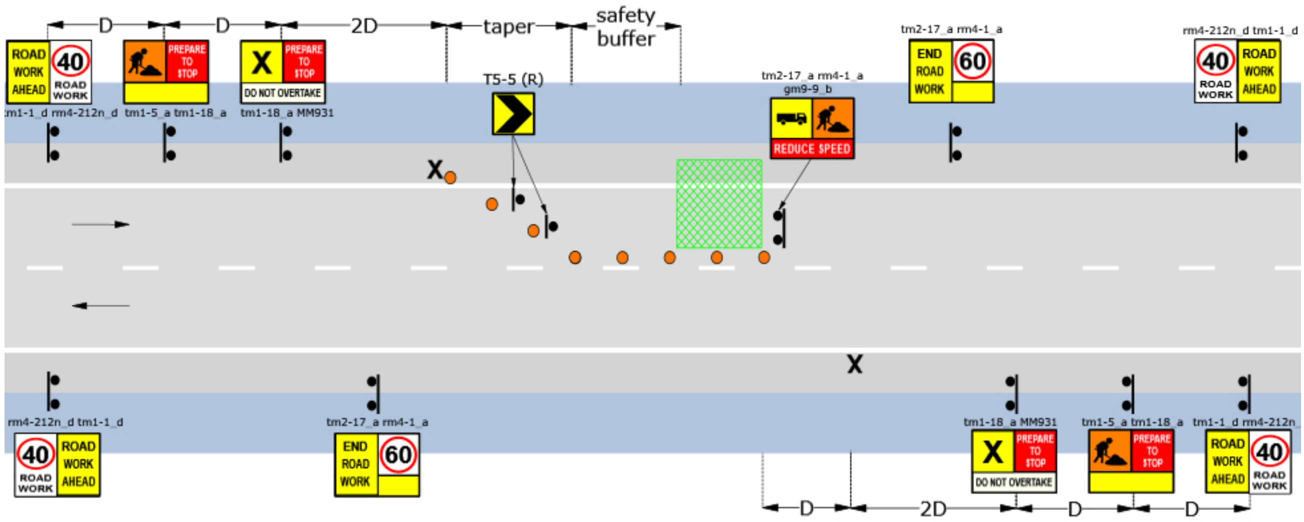

Figure 6-8. Typical MMS layout – carriageway

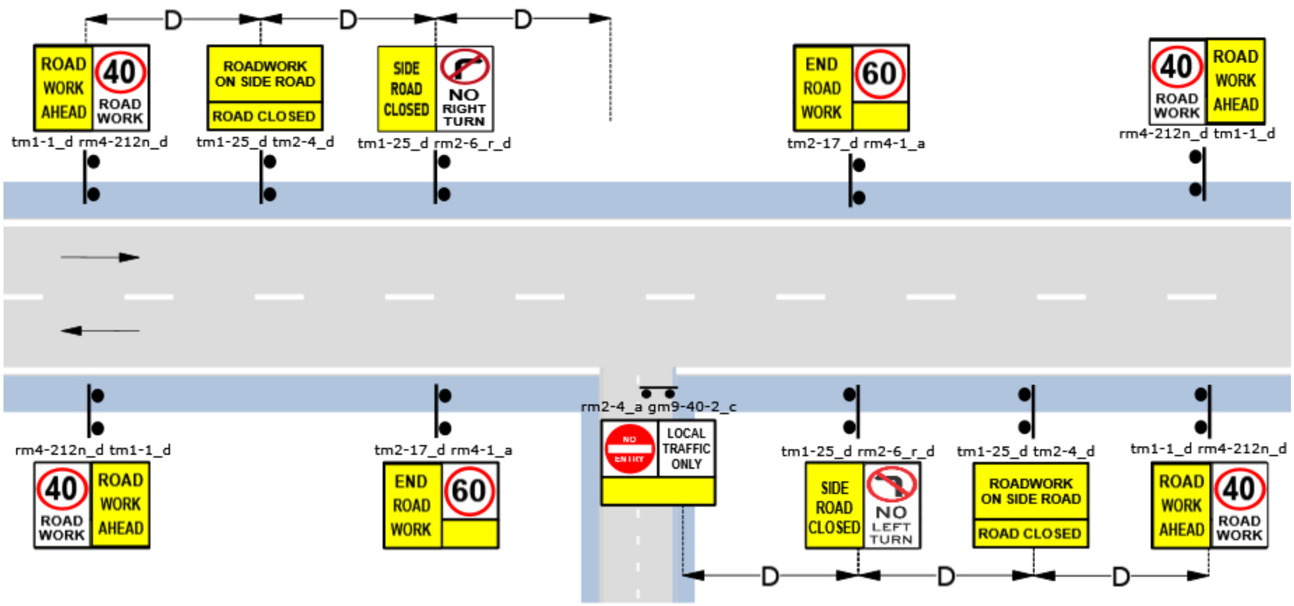

Figure 6-9. Typical MMS layout – side road closed

6.5.8.2 Frame and sign sizes

Figure 6-10 and *Figure 6-11* show the two permitted sizes of multi message sign frames.

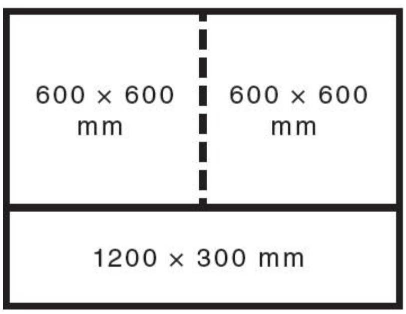

Figure 6-10. Three sign or stacked dual sign MMS frame

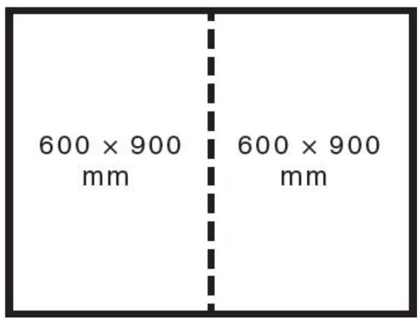

Figure 6-11. Side-by-side dual sign MMS frame

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Table 6-9 shows the permitted MMS dimensions and sizes.

Table 6-9. Permitted MMS sign dimensions and sizes

Sign dimension (mm)	Sign Size
600 x 600	M-A
1200 x 300	M-B
1200 x 600 (used in a stacked dual sign MMS frame)	M-C
600 x 900	M-D

6.5.8.3 Combinations

When determining the combination of signs to be used in an MMS frame, the following conditions must be met:

- No more than one regulatory sign is used per MMS frame;
- The regulatory sign must be located in the top position of the frame, closest to the traffic;
- There must not be more than two signs consisting of words only;
- When using two 600 mm x 600 mm signs, at least one 600 mm x 600 mm panel must contain a symbolic sign;
- All signs are placed horizontally;
- A blank retroreflective yellow panel must be placed within any unused panel of the frame; and
- Signs that are not published in the Traffic Signs Register for MMS use must not be used.

Figure 6-12 to *Figure 6-26* are examples of possible MMS combinations.

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Figure 6-12. Sign numbers: TM1 and GM9-79

Figure 6-13. Sign numbers: TM1-1 and RM4-212n

Figure 6-14. Sign numbers: TM1-32 and RM2-66n-L

Figure 6-15. Sign numbers: RM2-66n-R and TM1-32

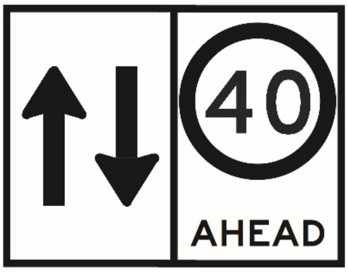

Figure 6-16. Sign numbers: RM2-11 and GM9-79

Figure 6-17. Sign numbers: RM2-7 and GM9-79

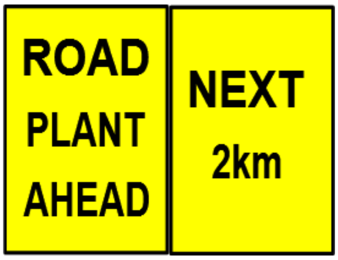

Figure 6-18. Sign numbers: TM1-3-1and TM1-28

Figure 6-19. Sign numbers: TM2-17 and RM4-1

Figure 6-20. Sign numbers: TM1-5, TM1-18 and TM1-100

Figure 6-21. Sign numbers: TM1-5, TM1-3-1 and TM1-100

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Figure 6-22. Sign numbers: TM1-5, TM2-25 and TM1-1

Figure 6-23. Sign numbers: TM1-47 , TM1-46 and TM1-18

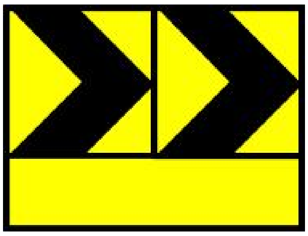

Figure 6-24. Sign numbers: TM5-5 and TM1-100

Figure 6-25. Sign numbers: TM1-100, TM1-30 and TM1-18

Figure 6-26. Sign numbers: TM1-30, TM1-18 and TM1-100

6.5.9 Requirements for specific signs

Table 6-10 provides the requirements and conditions of use of specific TTM signs. During aftercare arrangements, when not in use, or the relevant work is not being performed, the signs must be covered or removed.

Table 6-10. Requirements and conditions of use for specific TTM signs

Sign	Conditions	Notes
Workers symbolic (T1-5)	Must be used where worker on foot will be visibly working adjacent to traffic.	The sign must be: • Covered or removed where there are no workers on foot; and • Used with the NEXT 2km (T1-28) sign at frequently changing work areas.
PREPARE TO STOP (T1-18)	Must be used where traffic is required to stop at a PTCD or traffic controller.	The sign must be used with the relevant PTCD warning sign or traffic control sign.
Trucks symbolic (W5-22) Trucks symbolic (T2-25)	Must be used where roadworks generate greater than 20 truck turning movements per day.	The sign (T2-25) is restricted to short term work only. These signs may be used in conjunction with __ m ON LEFT/RIGHT (W8-207).

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Sign	Conditions	Notes
ROAD PLANT AHEAD (T1-3-1) GRADER AHEAD (T1-4)	Must be used to give warning of frequently changing work areas.	The sign must be used with the NEXT 2km (T1-28) sign for frequently changing work areas. 2 km may be increased to 10 km for shoulder grading and mowing in open road areas and for maintenance grading on unsealed roads.

Table 6-11 provides the requirements and conditions of use of specific TTM signs that may remain uncovered during aftercare arrangements. The signs must be used where the stated conditions apply.

Table 6-11. Requirements and conditions of use for specific aftercare TTM signs

Sign	Conditions	Notes
ROADWORK AHEAD (T1–1) or (T1-31) BRIDGEWORK AHEAD (T1-2)	Must be used at: • Long-term road or bridge work sites; • A diversion of traffic along a side track or detour; or • Unexpected conditions, such as loose stones or the absence of linemarking.	The signs may be used: • With the NEXT 2km (T1-28) sign for frequently changing work areas; and • Short-term works where additional advance warning is warranted.
ROADWORK X km AHEAD (T1–16) BRIDGEWORK X km AHEAD (T1-29)	Must be used where: • The approach speed is greater than 85 km/h; or • Relevant sight distance is less than 150 m (to work area/end of queue etc)	This sign to be positioned X km from: • The start of the taper area; • The traffic diversion; or • The traffic control position.
ROADWORK ON SIDE ROAD (T1-25)	Must be used in advance of an intersection to warn of the relevant activities on the side road where there is insufficient distance on that road to provide the required warning.	
SIDE ROAD CLOSED (T1-32)	Must be used in advance of an intersection where the side road is closed to all traffic.	
TRAFFIC HAZARD (T1–10)	Must be used only for emergencies and for a maximum of 24 hours.	
STOP HERE ON RED SIGNAL (R6-6)	Must be used: • Where traffic is required to stop in compliance with a PTS (placed 6 m in advance of the PTS); and • With the SIGNALS AHEAD (T1-30 or W3-3) sign.	

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Sign	Conditions	Notes
END ROADWORK (T2–16) or (T2-17)	Must be: • Placed at a distance D from the work site to indicate that normal traffic conditions have resumed when ROADWORK AHEAD (T1-1) or ROADWORK X KM AHEAD (T1-16) signs are used; and • Placed adjacent to or after any signs indicating the reinstatement of an existing permanent speed limit.	The T2-16 sign is preferred wherever space is available as the site allows it to be used
Slippery symbolic (T3-3) SOFT EDGES (T3-6) ROUGH SURFACE (T3-7) GRAVEL ROAD (T3-13) Loose stones symbolic (T3-9) LOOSE SURFACE (T3-14)	Must be installed to warn motorists of conditions which make a roadway surface temporarily hazardous.	On long work sites these signs should be repeated at intervals of not more than 500 m
NO LINES DO NOT OVERTAKE UNLESS SAFE (T3-12) NO LINES DO NOT OVERTAKE (TM3-12-1n)	Must be used in a two-lane, two-way road when: • Lines have been removed; or • A new seal has been installed.	• T3-12 may be used where overtaking would normally be permitted in an oncoming traffic lane. • TM3-12-1n must be used where barrier lines would normally be installed and overtaking is not permitted.
NEW WORK NO LINES MARKED (T3-11)	Must be used on a multilane road when: • Lines have been removed or • A new seal has been installed.	Must not be used where there is an unacceptable risk of collision due to oncoming traffic. In such cases, T3-12 or TM3-12n as applicable must be used.

6.5.10 Signposting of roadwork speed zones

In accordance with *Section 4.5 Speed zones*, roadwork speed zones must be implemented to assist in managing the risk to road users or road workers where there is a hazard on or surrounding the road. When designing a TGS that includes a roadworks speed zone the following requirements apply:

- Roadworks speed zone signs used on roads where the existing permanent speed limit is greater than 55 km/h, must be at least ‘B’ size. On motorway type roads, multi-lane roads, or higher speed roads, ‘C’ size signs may be erected;

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- When a roadworks speed zone is introduced, speed limit signs or markings (see requirements below) and advisory speed limit signs in the zone which show conflicting speeds, must be covered or removed;
- When erected, roadwork speed limit restriction signs must be:
  - Located within 5 m of the edge of the outer travel lane; and
  - Clearly visible to traffic. In urban areas the location of the sign may be adjusted to avoid parked vehicles, other signs or obstructions.
- Where there are multiple work crews within a job site or over a length of road, separate zones may be needed for each work area in order to avoid an excessively long and restrictive speed zone. This will be relevant where 30 km/h speed zones have been installed to support the safety of workers on foot in a particular location within a work site. The minimum lengths stated in *Section 4.5.6 Minimum length zones* may be used as a guide when designing the TGS in this instance; and
- For long-term work, in place for longer than four weeks, the existing speed limit pavement numerals should be removed in accordance with *Section 6.8.8 Removal of pavement markings and markers*. Pavement markings for roadworks speed zones are typically not installed.

Table 6-12 provides the requirements and conditions for use of specific roadwork speed limit signs that must be used in accordance with the stated conditions.

Table 6-12. Requirements and conditions of use of specific roadwork signs

Sign	Conditions	Notes
Speed limit AHEAD (G9-79) sign	Speed Limit AHEAD signs must be erected where the speed of traffic on the approach to the temporary speed zone is 30 km/h or more than the temporary limit. The Speed Limit AHEAD signs must be located 2D in advance of the initial roadworks speed zone (R4-212n) signs.	Speed limit ahead signs should only be used when it is essential to provide motorists with information that is not otherwise evident, or where the reduction in speed is significant. Speed Limit AHEAD signs should also be considered for use: • Where there is insufficient sight distance; • On downhill approaches; • Where, under normal driving expectations, the change in speed zone is not apparent to road users; and • In complex roadside environments where there is competing signage or factors such that the speed zone change might not be apparent to road users
Speed Limit ROADWORK (R4-212n) sign	At the start of a roadworks speed zone, Speed Limit ROADWORK signs must be erected on both sides of the carriageway. Repeater signs must be erected on the left side of the carriageway at a maximum spacing of 500 m. They must also be erected where traffic enters from a side road within a roadworks speed zone.	Where this is not possible a second sign must be erected 0.5D from the start of the zone.

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Sign	Conditions	Notes
ROADWORK SPEED LIMITS ENFORCED (T4-216)	ROADWORK SPEED LIMITS ENFORCED signs should be erected on long-term roadwork sites where a speed restriction is used for an extended period, for example in excess of four weeks, and compliance with the roadwork speed restriction is expected to be challenging. If used, these signs must be located D metres after the first roadwork speed limit sign. Additional ROADWORK SPEED LIMITS ENFORCED signs may be used at 500 m intervals thereafter or where the designer considers most appropriate for speed compliance.	These signs may also be used if compliance becomes difficult during shorter periods of work These signs do not need to be applied when utilising buffer roadwork speed limits.

6.6 Portable traffic control devices

6.6.1 General

A portable traffic control device (PTCD) is a device designed to manually control traffic. A PTCD is designed to reduce risk to traffic control personnel by enabling use and control of the device remotely so that the operator can be located outside of the live lane of traffic. PTCDs may include but are not limited to PTS and boom barriers.

In accordance with *Section 5.4 Traffic control*, a PTCD must be used instead of a manual traffic controller for all work sites under traffic control when the existing permanent speed limit is above 45km/h, unless the decision to not use a PTCD has been documented in the TMP and considered in the associated risk assessment.

When developing a TMP, or selecting or designing a TGS for the use of a PTCD, the relevant qualified person must consider:

- Queue length estimates;
- Expected traffic flows;
- Operational efficiency of the device and the expected delay and queue lengths; and
- Any lost time associated with use for e.g. lowering of boom.

Appendix B – Device use requirements provides additional requirements in relation to the use, installation, operation and removal of accepted PTCD types. The requirements provided for these devices must be read in conjunction with relevant specifications and manufacturer's instructions.

6.6.2 Delegation and approval

6.6.2.1 Type 2 (automatic) portable traffic signal (PTS) system

Prior to the use of a Type 2 (automatic) portable traffic signal (PTS) system, the following approvals must be sought and granted:

- Type approval of the equipment as per the relevant Usage Procedure for the PTS device; and
- Approval from the relevant delegated representative.

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Within Transport, a person at or above the level of section manager within Transport has the delegated authority to approve the installation of the PTS.

Other Road Authorities in NSW (i.e. Councils) have delegated authority to use PTS in specific situations.

No other delegated authority has been given to other agencies or persons. This means that public utility authorities and contractors working on public streets have no delegated authority to use PTS and will need to apply to Transport for authorisation to do so.

6.6.2.2 Type 1 (manual) portable traffic signal (PTS) systems

No delegation is required for the installation of a Type 1 (manual) portable traffic signal (PTS) system, however before use, two approvals are required:

- A type approval as per the relevant Usage Procedure for the device; and
- Project approval for use on each job.

6.6.2.3 Portable boom barriers

No delegation is required for the installation of a portable boom barrier, however before using a portable boom barrier, two approvals are required:

- A Transport type approval as per the relevant Usage Procedure for the device; and
- Project approval for use on each job.

Note: *The 'Portaboom' device was accepted for use under the Transport Infrastructure Product Evaluation Scheme (TIPES) certificate number 16/0001, which is deemed to be equivalent to a Transport type approval. No other devices are accepted under TIPES.*

6.6.3 Type 2 (automatic) portable traffic signal (PTS) systems

The type 2 PTS, also known as automatic PTS can be controlled under vehicle actuated or fixed time operational modes. A type 2 (automatic) PTS can also be controlled manually by a traffic controller using a remote control. An example of a type 2 PTS setup on-site is shown in Figure 6-27.

Figure 6-27. Type 2 PTS

Type 2 PTS may be used for traffic control applications lasting up to three months. For sites where work will continue for longer periods, without the location of the work site changing, a risk assessment and feasibility analysis must be carried out to determine whether the extended use of portable signals is acceptable or whether a temporary signal installation should be provided. This risk assessment and feasibility analysis must be submitted to Traffic Engineering for review and the concurrence of the Director, Roads and Traffic Engineering obtained for the use of the portable signals for an extended period.

A type 2 PTS must be used in accordance with Appendix B.2 Usage procedure: Type 2 (automatic) portable traffic signal systems.

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6.6.4 Type 1 (manual) portable traffic signal (PTS) systems

The Type 1 PTS is a compact portable system that is manually controlled by a traffic controller using a remote control. A Type 1 PTS may be used with or without the addition of a boom arm. Where used:

- Type 1 (manual) PTS devices must have type approval in accordance with Transport Specification TSI-SP-059 Type 1 Portable Traffic Signals.
- Type 1 (manual) PTS devices with a boom arm (Type 1 PTS-B) must have type approval in accordance with Transport Specification TSI-SP-081 Type 1 Portable Traffic Signal with Boom Barrier.

Type 1 PTS or Type 1 PTS-B may be used when controlling a single-lane of traffic where either shuttle flow or plant crossing control is required.

Type 1 PTS and Type 1 PTS-B must not be installed on multi-lane carriageways unless a merge or merges have been installed upstream of the traffic control position such that the device is managing only one lane.

Type 1 PTS and Type 1 PTS-B must not be installed for work sites where the traffic speed in the work zone is greater than 65 km/h.

An example of a type 1 PTS setup on-site is shown in *Figure 6-28.*

Figure 6-28. Type 1 PTS

All Type 1 PTS and Type 1 PTS-B must be used in accordance with *Appendix B.3 Usage procedure: Type 1 (manual) portable traffic signal systems.*

6.6.5 Portable boom barriers

A portable boom barrier is controlled by a traffic controller using a remote control. A portable boom barrier is an alternative to other devices such as PTS. Portable boom barriers must have a Transport type approval and project approval in accordance with *Section 6.6.2.3 Portable boom barriers*. At the time of publication of this Technical Manual, a Transport specification for portable boom barriers is not available.

Portable boom barriers are not suitable in all traffic environments, but may be suitable for locations where there are sufficient gaps in traffic to safely lower the boom.

Portable boom barriers may be installed when controlling a single-lane of traffic in a single direction.

Note: *Two portable boom barriers may be used when controlling a single-lane in opposite directions for either shuttle flow or plant crossing control situations.*

Portable boom barriers must not:

- Be installed on multi-lane carriageways; or
- Be installed for work sites where the traffic speed in the work zone is greater than 65 km/h.

A portable boom barrier must be used in accordance with *Appendix B.4 Usage procedure: portable boom barriers.*

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6.7 Temporary safety barriers

6.7.1 General

Work zone temporary safety barriers are used at work sites to prevent vehicles encroaching on work areas and to ensure the safety of the workers from errant vehicles.

Work zone temporary safety barrier products must be accepted for use by Transport. Accepted safety barriers have been assessed and conform to the requirements of AS 3845. Unless the barrier, including attachment, has been tested and accepted, devices such as signage, lighting posts, screens or work platforms must not be attached to temporary safety barriers.

The use of safety barriers during temporary works should be considered as part of the project TMP and risk assessment. The Austroads *Guide to Road Design Part 6: Roadside Design, Safety and Barriers* and Transport *Supplement to AGRD Part 6* provides 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.

It should be noted that barriers are an introduced obstruction. When the reason for their inclusion in the road side environment no longer exists, the barriers should be removed as soon as practicable. Barriers must only be used for their intended purpose, since they can present a hazard in the work area or work site if used otherwise. If temporary safety barriers are proposed to be used such that they are not placed parallel to traffic, Road Design must be consulted to determine minimum lengths and placement angle in relation to passing traffic so that the risk of injury is minimised if the barrier is inadvertently struck.

For long-term, complex or high risk projects, advice should be sought from Road Design for barrier selection and design.

6.7.2 Use of temporary safety barriers

Work zone temporary safety barriers must be installed in accordance with their Transport acceptance conditions and manufacturer's requirements. This ensures in-field performance during impact is as expected based on crash testing undertaken. The list of Transport-accepted work zone temporary safety barriers systems and their acceptance conditions can be found on the Transport Safety Barrier Products website.

Additional information is provided in *Section 6.2.1 Edge clearances for delineating devices and temporary safety barriers* for clearance requirements and restrictions on installing safety barriers on kerbs.

Temporary safety barriers may be used:

- To separate opposing traffic streams where there are potentially hazardous conflicts, such as the risk of head-on collisions;
- Where there are excavations or hazardous fixed objects close to the travelled way;
- Where there is inadequate separation from temporary foot paths or bicycle paths; or
- Where there are embankments within the vicinity of works.

Temporary safety barriers are not delineation devices and therefore must not be used alone for the purposes of delineation. However, they may be used to assist delineation, provided other signs and devices, such as cones or bollards are also in place.

When determining the appropriate temporary safety barrier for use, the dynamic deflection and working width relevant to the barrier type must be considered, and an exclusion zone delineated to ensure workers do not access these areas.

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Dynamic deflection is the largest transverse deflection of a road safety barrier system during an actual crash or during a full-scale impact test (i.e. the amount the road safety barrier deflects from its initial position during impact (see *Figure 6-29*)).

An exclusion zone is the area behind the barriers that must be maintained as being clear of materials, workers or plant considerate of the dynamic deflection.

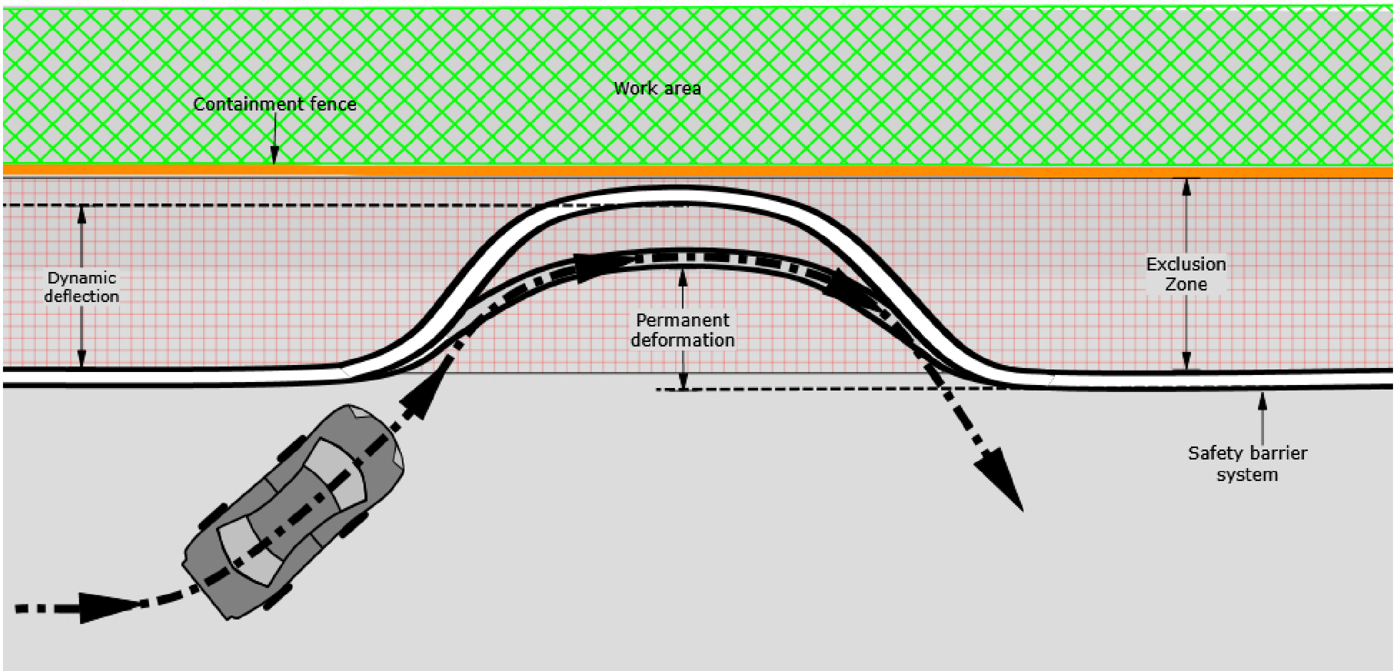

Figure 6-29. Dynamic deflection and exclusion zone

See *Section 6.2.1 Edge clearances for delineating devices and temporary safety barriers* for details on clearances, placement and location of barriers.

Where work zone temporary safety barriers are designed for use as part of a work site, a Temporary Safety Barrier Design Statement should be completed and included in the TMP. A Temporary Safety Barrier Design Statement should include:

- Location and direction barriers;
- Barrier type and specific design requirements;
- Terminals required;
- Transitions, including overlap requirements of different systems;
- Installation sequence; and
- Any relevant diagrams to assist the installation of the design.

The Temporary Barrier Design Statement should also include the ability for persons installing or inspecting to sign off that the barrier system is in accordance with the Design Statement. A Temporary Barrier Design Statement template is provided in *Appendix A.2.4 Temporary barrier design statement* for this purpose.

6.7.3 Mobile safety barriers

Mobile safety barriers are a portable barrier system attached to a prime mover and are designed to provide protection to workers in both static and dynamic work environments.

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A barrier trailer, when deployed correctly, aims to absorb the impact and deflect a vehicle which has left the intended path and entered the work site. The purpose of the mobile barrier is to protect the road workers behind it whilst maintaining the safety of the road user.

In a static environment, mobile safety barriers provide an additional form of work site protection.

When used for dynamic work, the portable temporary barrier system is designed to take the place of the work vehicle and the shadow vehicle within the work convoy (see *Figure 6-30*).

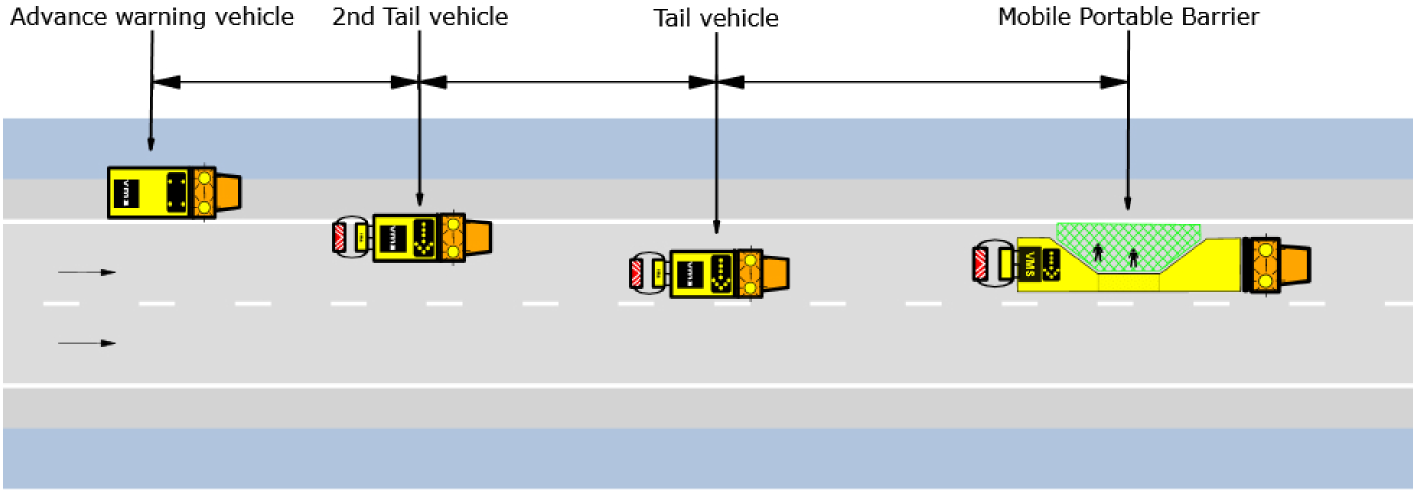

Figure 6-30. Example of a mobile safety barrier

Mobile safety barriers must only be used when all of the following conditions are met:

- The mobile safety barrier is accepted for use by Transport;

  Note: *At the time of publication of this Technical Manual, the only accepted mobile safety barrier is "Mobile Barrier Truck – MBT-1".*

- The temporary speed limit is less than 85 km/h;
- The exclusion zone behind the barrier is a minimum of 0.4 m;
- When deployed parallel to direction of traffic; and
- When a crash tested truck-mounted attenuator (TMA) is used as a tail vehicle.

Mobile safety barriers must not be used:

- As a work platform or with attachments such as lifting equipment or working platform; or
- With any additional attachments for the purpose of undertaking work on a work site.

Mobile safety barriers must comply with Transport Specification R132 and with Transport's Acceptance Conditions – Mobile Barriers MBT-1.

Example of work site layout for use in static and dynamic work sites are provided in *Appendix D – Work type layout examples*.

6.8 Traffic guidance and delineation devices

6.8.1 General

Delineators used at or near works on roads must meet the requirements of AS/NZS 1906.2 for either the sheeting or discrete device type. Delineators made from orientation-sensitive material must be made and installed in accordance with the manufacturer's recommended orientation for optimum performance. Delineators must be used in accordance with AS 1742.2 and Delineation guide.

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6.8.2 Barrier boards

For use as traffic guidance devices, barrier boards must:

- Comply with Transport QA Specification 3385;
- Alternate diagonal stripes of black and retroreflective yellow, terminating in yellow at each end as illustrated in *Figure 6-31*;
- Have diagonal stripes aligned to face down (see *Figure 6-31*);
- Be placed at right angles to traffic flow;
- Be placed at a maximum spacing of 100 m; and
- Be secured so that they are not moved or blown over by winds or pressure from heavy vehicles.

Where barrier boards are placed facing traffic, the bars need to be consistently pointing in the same direction. The bars on the barrier board must point down toward the side that vehicles are required to pass. For example, traffic is required to pass to the right of the barrier board as shown in *Figure 6-31*.

Barrier boards must not:

- Be used as delineation devices;
- Be placed parallel to the direction of traffic flow. This ensures maximum visibility of the barrier board and prevents it from becoming a spearing hazard if struck by an out-of-control vehicle; and
- Be used adjacent to a pedestrian or cyclist path of travel so as to not become a tripping or falling hazard.

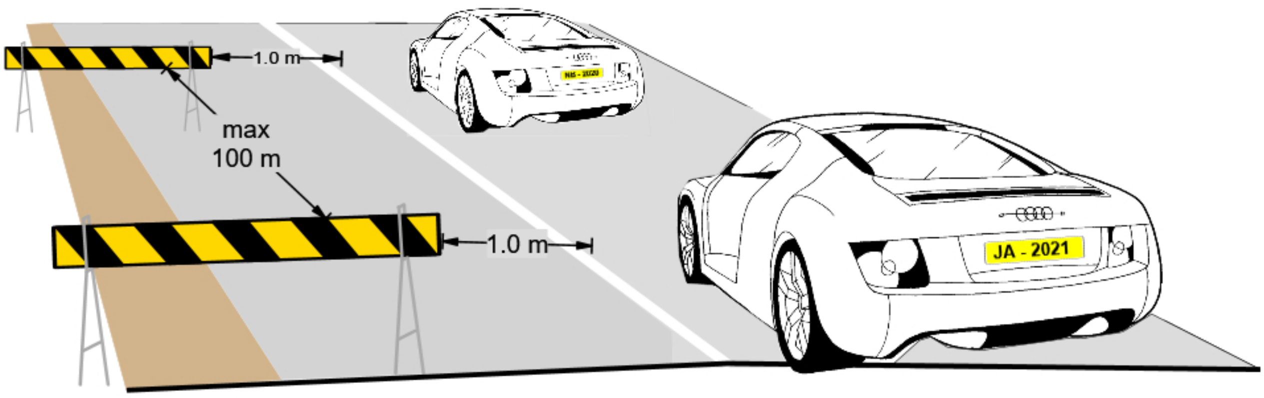

Figure 6-31. Typical example of a barrier board

6.8.3 Plastic containment tapes and fences

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

When installed, containment tape and fencing must:

- Be supported by posts;
- Have posts installed at maximum spacing of 5 m;
- Ensure horizontal deflection of the tape or fence material does not exceed 0.5 m from the nominal line of the tape or fencing as a result of wind, air turbulence from passing traffic or minor impacts; and
- Be monitored and maintained as they can become a hazard to traffic if poorly maintained, especially in windy conditions.

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Plastic containment tapes and fences must not:

- Be used as temporary safety barriers; or
- Act as delineation devices when used adjacent to traffic.

Containment fences or delineation should be used behind safety barriers to delineate and prevent workers entering the exclusion zone behind the temporary safety barrier. See *Section 6.7 Temporary safety barriers* for further information.

Additional conditions of use of containment tapes and fences are provided in *Table 6-13*.

Table 6-13. Conditions of use of containment tapes and fences

Containment type	Conditions of use
Containment tapes	Containment tapes may be used to contain workers on foot and plant within the safe workplace boundary established at the particular work site. Where used, tapes must 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 must not be used for pedestrian containment adjacent to traffic.
Plastic mesh fencing	Plastic mesh fencing may be used for excluding pedestrians from a work area and for the containment of workers on foot and plant. When in use, plastic mesh fencing must comprise a flexible orange mesh approximately 1 m high. When in use, the top of the fence must not be less than 800 mm above the ground. When used for containment from the travelled way, the clearance requirements of *Section 4.3.4 Minimum clearances of workers to traffic* must be met.

6.8.4 Traffic cones and temporary bollards

Traffic cones and temporary bollards may be used to define the traffic path *past* or *through* the work area. Cones and temporary bollards must not be used as a substitute for barrier boards and signs at either end of the work.

Traffic cones and temporary bollards must comply with Transport QA Specification 3352 Fluorescent Plastic Traffic Cones. Traffic cones and temporary bollards must have a white horizontal retroreflective band of Class 400 material that are:

- 150 mm wide on 450 mm height traffic cones; or
- 250 mm wide on the traffic cones and temporary bollards higher than 450 mm.

Traffic cones and temporary bollards must be used on works in accordance with the conditions provided in *Table 6-14*.

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Table 6-14. Traffic cone and temporary bollard conditions of use

Cone or bollard size (height)	Conditions of use
General	Cones and bollards must only be used while work is in progress (day or night) where workers are in attendance to reinstate any of the cones and bollards dislodged by traffic or wind. Cones or bollards may be used on long-term unattended works provided they are securely fixed to the pavement or weighted to provide adequate stability. The requirements for spacing of cones and bollards are provided in *Table 6-2*.
300 mm cones	300 mm traffic cones must not be used.
Small (450 mm) cones	450 mm traffic cones may be used for most built-up and open road applications including footpaths, shared paths and bicycle paths provided traffic speeds are less than 75 km/h.
Standard (700 mm) cones	700 mm traffic cones must be used in locations where traffic speeds are greater than 75 km/h. ***Note**: 700 mm traffic cones may also be used on lower speed roads.*
Large (900 mm) cones	900 mm traffic cones may be used: • On high speed, high volume roads instead of standard size cones, e.g. expressway type roads; or • On any work site where increased visibility is required or as a means to provide additional delineation. ***Note**: 900 mm traffic cones may also be used on lower speed roads.*
Temporary bollards (min 900 mm)	Temporary bollards must be: • At least 900 mm high and 100 mm in diameter; • Made from fluorescent red or orange material; and • Resilient to impact. ***Note**: Temporary bollards may also be used on any speed roads*.

6.8.5 Temporary kerbs

Temporary kerbing may be used to form temporary medians, traffic islands, pavement edges, or as a temporary lane divider in appropriate situations during long term works.

When used temporary kerbing must be:

- Yellow in colour;
- Not greater than 150 mm in height;
- Secured to the pavement;
- A continuous line at least 150 mm wide as seen by approaching traffic; and
- Clearly delineated in accordance with *Section 6.2.2 Use of delineating devices on kerbs*.

6.8.6 Roadworks temporary guideposts

Roadworks temporary guideposts with delineators may be installed to provide a single continuous line defining the travelled path.

Where used for delineation and at a minimum, roadworks temporary guideposts must be used as follows:

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

Roadworks temporary guideposts with delineators must be installed in accordance with AS 1742.2.

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

6.8.7 Temporary pavement markings and markers

Pavement markings on temporary roadways and detours must be of a similar standard to that in use at either end of the adjoining sections of road. Where the adjoining road is delineated with edge lines, temporary roadworks must be similarly marked with an edge line.

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

- Barrier, lane and edge lines;
- Turning arrows; and
- Raised retroreflective pavement markers (temporary or permanent).

Where, during or at the conclusion of pavement-surfacing works, a section of roadway is to be left for a period of time without linemarking, temporary raised pavement markers should be used to provide delineation at the dividing or lane lines. Application of the pavement markings must take place as soon as practicable.

Where temporary linemarking, i.e. linemarking not in its final location, is required on the final wearing surface, or adjacent pavement, pavement marking tape should be used. Where used pavement marking tape must meet the performance requirements of Transport QA Specification R145 *Pavement Marking (Performance Based)*.

Where it is determined that any temporary pavement marking or marker has become ineffective, remarking and/or replacement must be undertaken as soon as practicable.

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 must be placed as directed with the maximum allowable spacing being 500 m. The arrows must be removed if the section is then reincorporated as dual carriageway.

Where existing pavement markings are required after the temporary works, these may be masked over with suitable black tapes where they exhibit similar characteristics to the existing pavement colour and surface finish, during the works period. This may be a suitable consideration where limited traffic impact is expected, to limit the chance of dislodgement by traffic. Otherwise, permanent removal must be undertaken and agreement must be received from the asset owner in accordance with *Section 6.8.8 Removal of pavement markings and markers*.

On long-term works raised retroreflective pavement markers complying with Transport QA Specification R142 *Retroreflective Raised Pavement Markers,* may be used in conjunction with temporary pavement markings. The spacing and application must be as specified in Transport QA Specification R142 *Retroreflective Raised Pavement Markers*.

Pavement markings and retroreflective markers should be considered in conjunction with the placement of other delineation devices, and must be used where temporary safety barriers are used, to ensure road users are safely directed through the site without conflicting messages.

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All pavement markings must be retroreflective in accordance with [Transport QA Specification R145 *Pavement Marking (Performance Based).*](#)

6.8.8 Removal of pavement markings and markers

All redundant pavement markings and raised pavement markers that will not be required must be immediately 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 of redundant pavement markings with paint is not permitted and must not occur.

Where existing pavement markings are to be removed and replaced by other pavement markings, removal must not begin until adequate provisions have been made to complete the installation of the replacement markings. Pavement markings must be removed so that the markings that remain in place at any time will not be in a pattern that will mislead or misdirect road users. Reinstatement of the pavement markings must take place as soon as possible.

The markings must 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 must be promptly removed as the work progresses by acceptable methods.

When these operations are completed, the pavement surface must be clear of any residue or debris. A minimum of 90 percent of the total area of the existing pavement markings must 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 must be repaired. The pavement surface must be left in a condition that will not mislead or misdirect road users.

6.9 Illuminated warning devices

6.9.1 Variable message signs (portable)

6.9.1.1 General

A portable variable message sign (VMS) is an electronically powered on-road sign used for traffic management or driver information applications. All portable VMS used on a Transport work site must meet the requirements of AS 4852.2 *Variable Message Signs, Part 2 Portable Signs*. Where portable VMS are to be used at or near a work site to carry warning or other messages relating to the works, this Section must be applied. If a conflict exists between requirements in this Section and AS 4852.2, then AS 4852.2 must be applied.

Where a VMS is used, the rationale for use must be documented in the TMP and/or risk assessment. The risk assessment should:

- Include identification, assessment and management of risks introduced to road users and the workers who install and maintain the VMS; and
- Consider the risks associated with the proposed VMS location such as proximity to traffic, overhead electricity lines, and positioning them near culverts, medians or steep embankments.

The inclusion of VMS at a work site must be shown on the approved TGS.

Table 6-15 provides the conditions of use that apply in relation to the display of portable VMSs.

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Table 6-15. Conditions of use of portable VMS displays

Display type	Conditions of use
General	When a VMS is used, it must meet the following conditions: • The VMS display must be levelled; • The visual lighting intensity of the VMS display must not generate a distraction or blinding risk for road users, particularly at night; • Complementary messages must only be placed on a VMS when a flashing arrow sign is utilised; • When on-site, the VMS display must always be displaying a sign or message. Where there is no relevant sign or message to be displayed, the messages shown “*Report Traffic Incident*” with “131 700” as alternating messages as shown in *Figure 6-32* should be used as the default messages. Otherwise, the VMS must be switched off; and • If there is a malfunction with the VMS the display must be rotated at 90 degrees or folded down until such time as it can be removed. In these circumstances, consideration should be given to placing additional delineation to highlight the presence of the out of service VMS.
Displaying messages	• The content of new and revised messages must be approved in accordance with standard procedures for each road authority. Refer to Austroads *Guide to Traffic Management (AGTM) Part 10: Traffic Control and Communication Devices* and Transport Supplement to AGTM Part 10; • Messages must comprise not more than four words or numbers on any one screen; • Letter forms and legend height must be adequate to be comfortably read by drivers at the prevailing approach speed of traffic; • There must not be more than two separate screens in any alternating series of screens; • Where there are alternating screens, the ‘on’ time of each screen must be 0.6 + 0.1 second per word or number, and the total time required to read the message on both screens must be taken into account when determining message length and letter height; ***Note:*** *A procedure for determining letter sizes for signs is provided in AS 1742.2. The letter series which most nearly match the on-screen fonts should be used in the calculations. It is recommended that the calculated letter height be doubled for this purpose.* • Symbols must not be used unless they replicate an existing static sign or have been tested for comprehension in their on-screen format, i.e. taking into account distortions due to pixel size limitations; • Messages must be relevant to the nature and phase of the work in progress and must be changed or switched off when they are not relevant; ***Note:*** *Other variable message signs near roadworks sites displaying unrelated messages must be switched off.* • Messages must be complementary to other signs, or warning or delineating devices required by this Technical Manual. The nature and positioning of the messages must not detract from those signs or devices.

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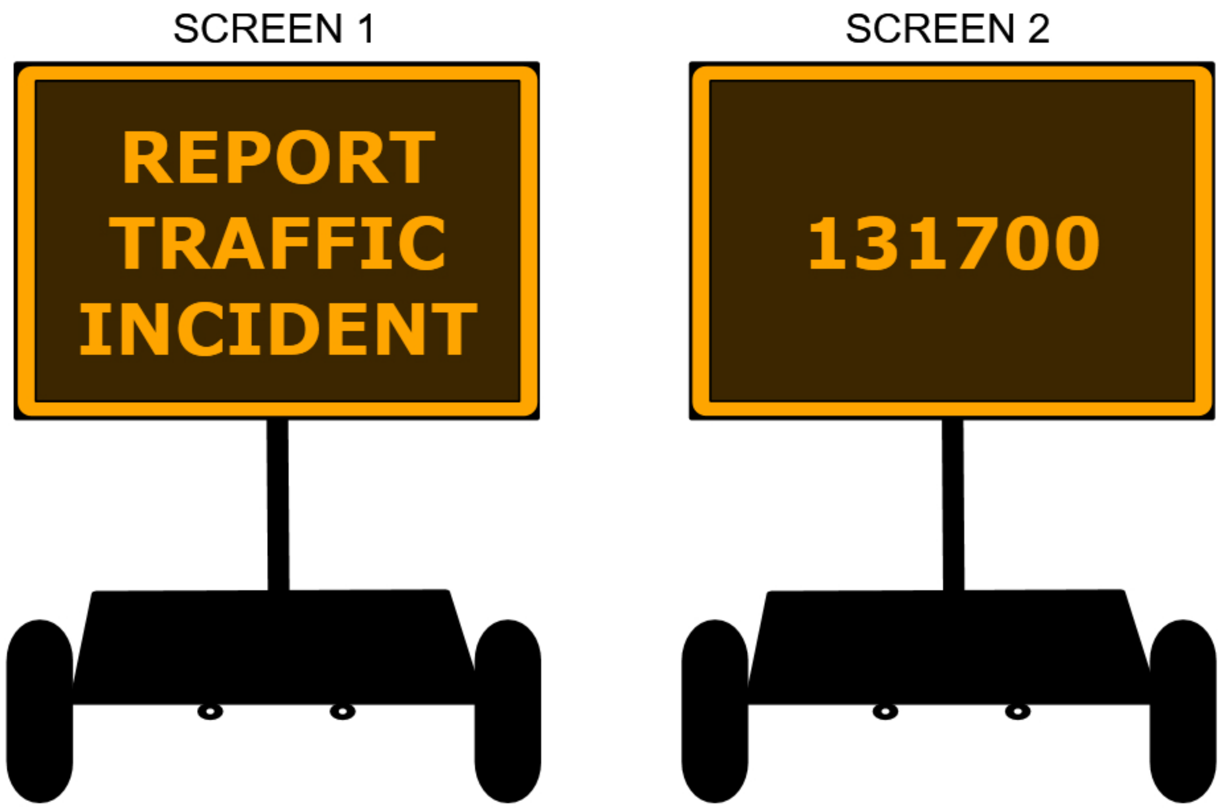

Figure 6-32. VMS default messages

All VMS must be located and installed in accordance with Section 6.2.4 Placement and clearances of registered plant or devices.

In addition to the requirements of *Section 6.2.4 Placement and clearances of registered plant or devices*, portable VMS must be:

- Placed on a road where there is adequate time for the driver to view and comprehend the message. A greater distance is required for multiple message screens and higher traffic speeds;
- Driven into position in the same direction as traffic, so that the trailer lights and reflectors are seen by on-coming vehicles;
- Placed at least 300 m from the nearest permanent VMS;
- Positioned so that the display is clear of the envelope of passing vehicles (particularly heavy vehicles);
- Be clearly visible at all times, with reflective material delineating the outer extremities;
- Anchored to prevent it moving under wind loading; and
- Risk assessed to determine if additional delineation is required, taking into account factors such as lateral offset from the edgeline, road alignment, horizontal and vertical, speed zone, road environment and the adequacy of the delineation on the trailer body/sign face.

The positioning of VMS must always be verified by the project team or delivery partner as being appropriate. *Appendix E – Inspection checklists and tools and forms* contains a checklist that is a broad summary of the major items for consideration in locating and placing of portable VMSs.

6.9.1.2 Displaying signs

A VMS may be used to display a static sign under the following conditions:

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- Where a VMS will display a sign detailed in the Traffic Signs Register, the VMS must:
    - Display a reasonable likeness to the static sign in accordance with the examples provided in the Traffic Signs Register; and
    - Be, at a minimum, displayed at the required size in accordance with this Technical Manual and the relevant Sign Design Plan provided in the Traffic Signs Register.
- Where a VMS is used to replace a regulatory sign or a lane status sign, the VMS must display the message continuously and not alternating with another message or flashing.

Table 6-16 provides a list of the static signs which are, at the time of publication, permitted for display on a VMS.

Table 6-16 Static signs for display on VMS

Sign code	Sign name	Pictorial example
R4-1n-VMS	Speed limit	
T1-16n-VMS	Roadwork X km ahead	
R4-212n-VMS	Speed limit and roadwork	
T1-34n-VMS	Traffic controller	
T1-23n-VMS	Changed traffic conditions	
T1-31n-VMS	Roadwork ahead	

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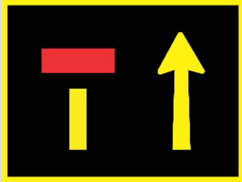
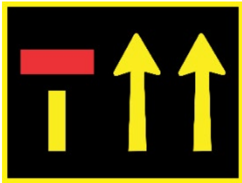
Sign code	Sign name	Pictorial example
T1-5n-VMS	Worker symbolic	
T2-6-1n-VMS	Left lane closed	
T2-6-2n-VMS	Left lane closed	
T2-17n-VMS	End roadwork	
T2-25n-VMS	Truck crossing/entering	
G9-9n-VMS	Reduce speed	

6.9.2 Variable speed limit signs (portable)

6.9.2.1 Description and general

This Section describes portable variable speed limit signs and additionally provides the requirements for their use to regulate speed as part of TTM.

A portable variable speed limit sign (VSLS) is an illuminated sign used for advising road users of a temporary change to the speed limit. The portable VSLS display is mounted on a re-locatable trailer and displays signs in the format and colours specified for speed limit signs in the NSW Road Rules. The displayed speed limits on the VSLS are capable of being changed by electronic means. Generally, VSLS are used as a series of signs along the length of a roadwork site, rather than a singular replacement for a static sign.

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All portable VSLS used on a Transport work site must meet the requirements of Intelligent Transport Systems (ITS) Specification no. TSI-SP-082 *Portable Variable Speed Limit Sign*.

The rationale for use of VSLS must be documented in the TMP and/or the supporting risk assessment. The TMP/risk assessment must:

- Include identification, assessment and management of risks introduced to road users and the workers who install and maintain the VSLS; and
- Consider the risks associated with the proposed VSLS location such as proximity to traffic, overhead electricity lines, culverts, medians or steep embankments.

The placement of VSLS, including the spacing of devices and the offset from the nearest traffic lane must be shown on the approved TGS.

Table 6-17 provides the principle conditions of use for portable VSLS.

Table 6-17. Conditions of use of portable VSLS

	Conditions of use
General	• The VSLS must be a Transport type approved device. • The VSLS display must be levelled. • The VSLS display must be a 'C' size speed limit sign as defined in AS 1743. • When on site, the VSLS should always display a speed limit image. • When the VSLS malfunctions, the display must be rotated 90 degrees until the device is repaired or replaced. As a result of the out-of-service VSLS, additional measures should be installed such as delineation around the device and a static speed sign.
Placement and Positioning	• The VSLS must be placed and positioned in accordance with the provisions of *Section 6.2.4 Placement and clearances of registered plant or devices*. • The VSLS must be duplicated at the start of the roadwork speed zone. Where this is not possible, a second VSLS must be erected 0.5D from the start of the zone. • As part of a series of signs, the VSLS must be repeated on the left hand side of the carriageway at a spacing of no greater than 750 m. A VSLS must also be placed between 50 m and 100 m both upstream and downstream of a junction to a side street/road to inform road users who have entered a roadwork speed zone from a side street/road. • Regardless of the use of VSLS, the normal speed limit must be reinstated at the extremities of the work site in accordance with the provisions of *Section 7.6.2.5 Termination area*.
Displaying signs	• The VSLS image must display a reasonable likeness to the static speed limit sign (R4-1) in accordance with the NSW Road Rules. • The VSLS image must be displayed in accordance with the size requirements in this Technical Manual and the relevant sign design plan provided in the Traffic Signs Register. • Roadwork speed zones must be selected in accordance with the provisions of Section 4.5 Speed zones.
Maintenance	• As part of the TMP/TGS development, an inspection and maintenance plan for routine preventive maintenance of VSLS must be prepared and implemented in order to proactively check the units for battery health and optimum working condition at regular intervals. • The inspection and maintenance plan must also detail the procedure for identifying, managing and repairing/replacing any faulty VSLS unit.

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6.9.2.2 Additional placement requirements

The following additional requirements apply to the placement of VSLS:

- The VSLS must be positioned so there is adequate time for the driver to view and comprehend the information contained within the sign.
- The VSLS must be orientated in the same direction as the flow of traffic, such that trailer lights and reflectors are visible to on-coming vehicles.
- The VSLS must be positioned so the display is clear of the envelope of passing vehicles (particularly heavy vehicles).
- The VSLS must be clearly visible at all times, with reflective material delineating the outer extremities.
- In strong wind areas, the VSLS must be anchored to prevent it moving under wind loading.

The risk assessment must consider whether additional delineation is required, taking into account factors such as lateral offset from the edge line of the nearest traffic lane, horizontal and vertical road alignment, speed zone, road environment and the adequacy of the delineation on the trailer body/sign face. The positioning of VSLS must always be verified by the project team or delivery partner as appropriate. *Appendix E - Inspection checklists and tools and forms* contains a checklist that may be used by project teams when locating and placing portable VMS/VSLS.

6.9.2.3 Accompanying static signs

The static sign IF VARIABLE SPEED LIMIT SIGN IS BLACKED OUT (G6-317n or G6-317-1n) must be installed at the extremities of a work site controlled by a series of portable VSLS to advise entering road users of the speed limit when the portable VSLS is blacked out, due to a malfunction or an operational need. G6-317n is the preferred method of display, however G6-317-1n may be selected where there are width limitations and other locality constraints (see Figure 6-33 and Table 6-18).

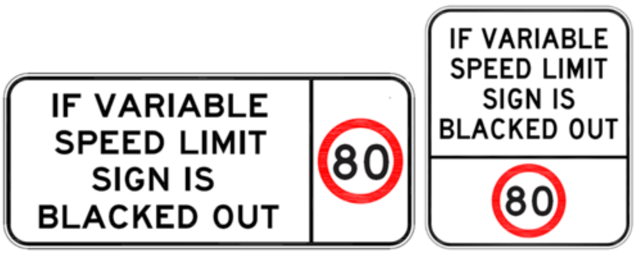

Figure 6-33 G6-317n and G6-317-1n

Table 6-18. Size requirements for G6-317n and G6-317-1n signs.

Road configuration	Approach speed	Sign size
Single carriageway	Less than 95 km/h	A size
	Greater than 95 km/h	B size
Dual carriageway and multilane roads	Less than 95 km/h	A size
	Greater than 95 km/h	B size

The G6-317n or G6-317-1n sign must be installed in the following locations:

- Prior to the first portable VSLS along the length of the work site in each direction (preferably at distance of D);
- 300 m after the first VSLS in each direction; and

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- Less than 50 m from a junction with a side road/street, both upstream and downstream, to inform road users who have entered a roadwork speed zone from a side street/road.

These signs should also be repeated at an appropriate spacing along the length of an extended roadwork site.

The default speed shown inside the red annulus of the G6-317n sign should be the speed limit applicable during aftercare arrangements. However, alternative speed limits may be used, provided an appropriate justification is given the TMP and/or supporting risk assessment.

6.9.3 Illuminated flashing arrow signs

Illuminated flashing arrow signs (FAS) are signs which 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. Flashing arrow signs are intended to be applied primarily where a lane is closed or a diversion of traffic is required, typically on a multi-lane carriageway.

Illuminated flashing arrow signs must comply with Transport Specification TSI-SP-060 Illuminated Flashing Arrow Signs and the relevant Australian Standards. General operating instructions are provided in this Section and *Appendix B*.

Illuminated FAS must only be vehicle-mounted (rear mounted or cab mounted), incorporated into VMS, or a stand-alone sign. *Appendix B.5 Usage procedure: illuminated flashing arrow signs* provides additional relevant requirements in relation to their use, installation, operation, signage and removal. The requirements provided for these devices must be read in conjunction with relevant specifications and manufacturer's instructions.

Additional vehicle mounted beacons or lamps that might cause a risk or confusion to road users whilst the flashing arrow sign is operating should be switched off.

6.9.4 Traffic warning (roadwork) lamps – flashing yellow lamps

Vehicle-mounted warning devices must be displayed as follows:

- A single (1) 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; or
- A pair (2) 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.

The conditions of use for flashing yellow lamps are provided in *Table 6-19*.

Table 6-19. Conditions of use of flashing yellow lamps

Display type	Conditions of use
Unidirectional flashing yellow lamps	Are used to draw attention to a particular sign. Where used, they must be mounted above the sign. They may be mounted on barrier boards indicating the ends of work areas. They must not be used to delineate a path through a work site because of the confusing light pattern which a series of such lamps can produce. They may also be used to highlight safety barrier end treatments.
Rotating or flashing yellow lamps	Must 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.
LED light bars or beacons	May be used 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.

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6.10 Truck and trailer-mounted attenuators

6.10.1 Description

A truck and trailer-mounted attenuator (TMA) is a combination of host vehicle and Impact Attenuator Unit (IAU), mounted on or towed by the host vehicle. The IAU is a mobile crash cushion safety device, used as an advance warning device on approach to work sites to provide for increased road user safety if struck. The primary purpose of an IAU is to reduce the impact for errant road users and should not be used as the sole protection method for work sites from unexpected vehicle impacts.

For use on Transport roads, TMAs must be assessed and accepted by Austroads Safety Barrier Assessment Panel in accordance with AS/NZS 3845.2:2017 and meet the requirements of this document..

6.10.2 Usage policy

TMAs must be used on the roads at the listed localities provided in *Table 6-20*. If a section of the road listed below, or work type on the section of road listed below does not have a risk profile that justifies the need for a TMA, this must be captured in the relevant TMP as a departure in accordance with *Section 2.8 Departures from this Technical Manual.*

Table 6-20. Roads at localities where TMAs are required

State road name	Route number	Locality
Pacific Motorway	M1	Wahroonga to Beresfield
Princes Motorway	M1	Waterfall to Yallah
Eastern Distributor	M1	Entire
Western Distributor	A4	Entire
Hume Motorway	M31	Casula to Federal Highway Interchange
Hunter Expressway	M15	Entire
Westlink	M7	Entire
Western Motorway	M4	Entire
The Hills Motorway	M2	Entire
South Western Motorway	M5	Entire
NorthConnex	No route number	Entire
WestConnex	M8, M5, M4	Entire
Lane Cove Tunnel	A1, M2	Entire
Sydney Harbour Tunnel	M1	Entire
Sydney Harbour Bridge	No route number	Entire

TMAs are not required where one or more of the following are in place:

- Road closure;
- Contraflow; or
- Work is behind temporary safety barriers.

TMAs are recommended to be used when the posted speed limit exceeds 85 km/h and traffic volumes exceed 20,000 vpd. Additionally, TMAs may also be used in other instances.

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The need for a TMA must be determined in the TMP and the site specific risk assessment. Factors that should be considered when determining if a TMA is required include:

- Work type and activity;
- Speed of approaching traffic;
- Location of work, including sight distances;
- Crash history at location of work;
- Posted and temporary speed limits;
- Number of carriageways;
- If the location is a nominated heavy vehicle route; and
- Volume of heavy vehicle movements.

6.10.3 Operation

The operational requirements of a TMA are as follows:

- The TMA must be set-up and installed, operated and disassembled in accordance with the manufacturer's instructions. The requirements of this document in relation to TMAs are additional to the manufacturer's instructions, and in the case of discrepancy, this document prevails;
- The host vehicle must be staffed by at least one qualified operator (*see Section 6.10.5 TMA Operator*);
- Original equipment manufacturer (OEM) seatbelts must be worn at all times. Where a harness is fitted to a host vehicle, the operator should be harnessed while the attenuator is lowered;
- The TMA must be located between 100 m and 200 m to the work area during dynamic work, including the roll ahead distance (see *Figure 6-34);*
- The TMA must not be lowered when people are in the immediate vicinity of the attenuator;
- When used as an advance warning vehicle (motorway application) and when in environments with narrow shoulders and reduced edge clearances (if the advance warning vehicle cannot achieve the required 0.5 m clearance from edge line), the TMA must be located outside the traffic lane;
- When used as a shadow vehicle (protected by the tail vehicle) for the protection of workers on foot or small plant items, must follow no less than 40 m behind in the work lane (see *Figure 6-35);* and
- Consideration should be given to switching off any vehicle mounted beacons that might cause a risk or confusion to road users whilst flashing arrow sign is operating.

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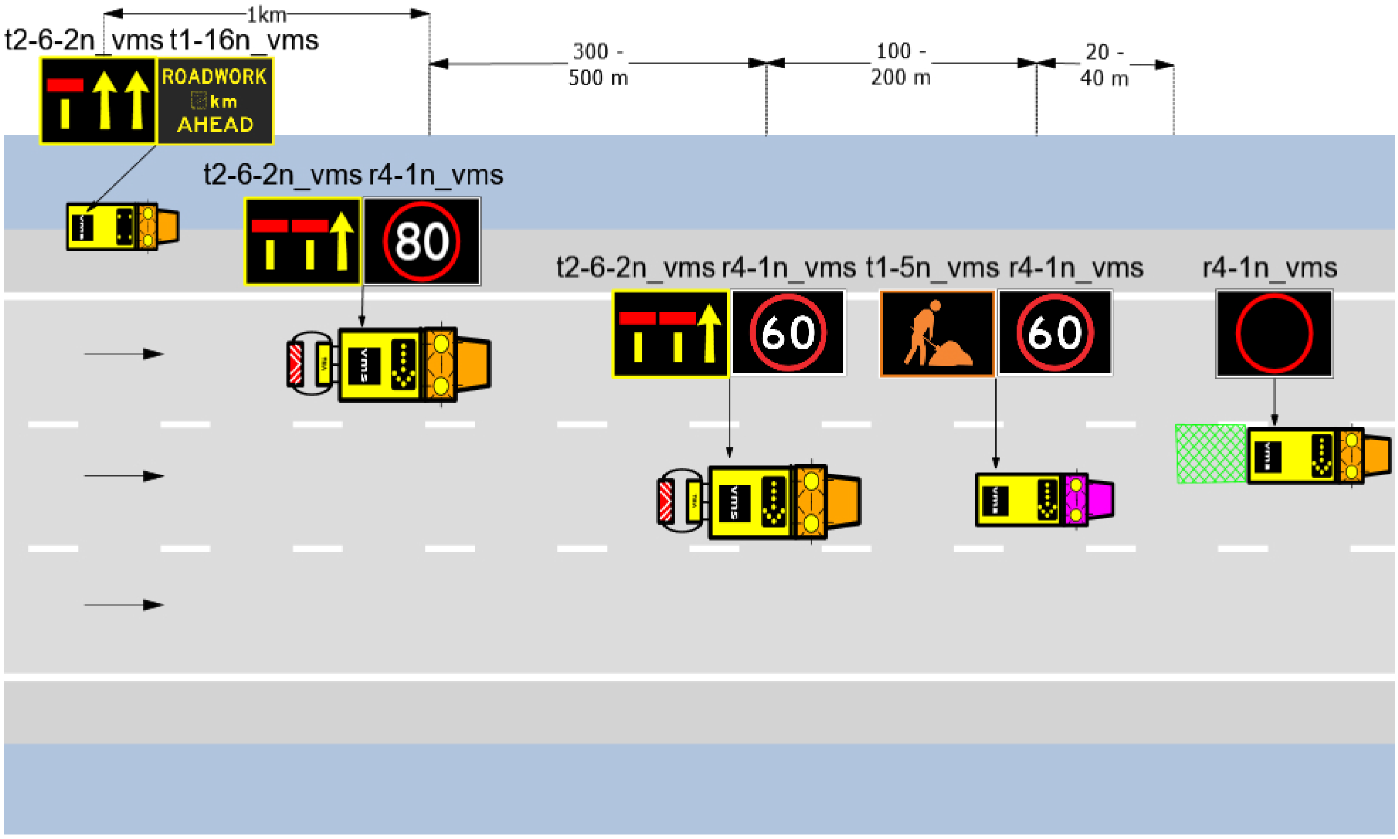

Figure 6-34. TMA layout – dynamic work

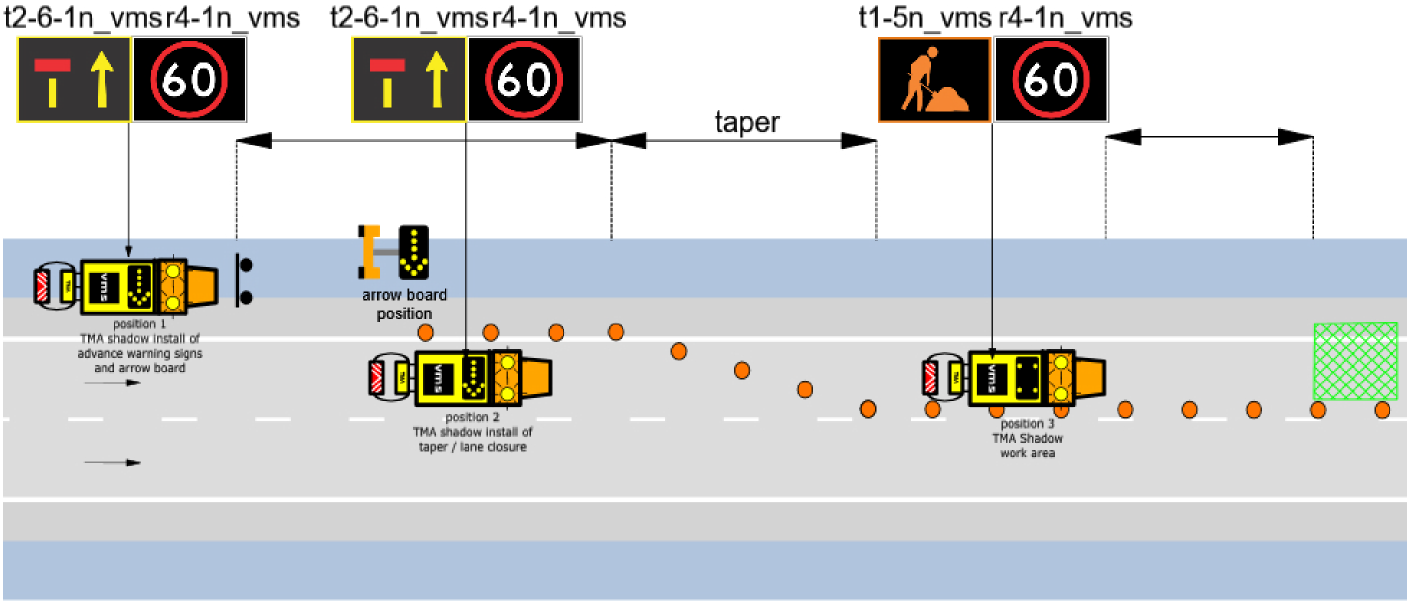

Figure 6-35. TMA layout – static work

6.10.4 Host vehicle features

The host vehicle must:

- Have at least two dedicated flashing warning lights, usually amber in colour;
- Have a rear overhang of 6.5 m maximum;

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- Be at least 15 tonnes GVM;
- Be a single cab truck, with automatic transmission;
- Be fitted with automatic impact brakes (AIB);
- Be fitted with a variable message sign (VMS);
- Be fitted with rear facing CCTV cameras; and
- Be fitted with a Type C flashing arrow board.

6.10.5 Signage

Signage on a VMS that is attached to a TMA must be in accordance with *Section 6.9.1 Variable message signs (portable)*.

Advance warning signage should follow the guidance provided in *Figure 6-34* and *Figure 6-35.*

For static work sites, advance warning signage must be installed on all approaches to the work area. For dynamic works, an advance warning vehicle must be in place on all approaches to the work area.

6.10.6 TMA Operator

The operator of the TMA must:

- Hold a current and valid heavy vehicle licence of suitable class to operate the TMA host vehicle;
- Hold a current Implement Traffic Control Plan qualification;
- Have successfully completed the national unit of competency RIIRTM301D (operate a truck or trailer-mounted attenuator) with evidence of completion;
- Have successfully completed training in the relevant business/divisional requirements; and
- Have been inducted into the relevant or site-specific SWMS for operation of TMAs at roadwork sites.

6.11 Temporary portable rumble strips

6.11.1 Description

Temporary portable rumble strips (TPRS) are portable traffic devices placed in a traffic lane perpendicular to the direction of travel. TPRS provide a visual, audible and tactile warning to alert road users of changed conditions.

When used in conjunction with other traffic control signs and devices, TPRS have been found to increase positive road user behaviour in terms of increased compliance at a work site.

The decision to use a TPRS must be considered as part of the risk assessment and documented in the TMP.

TPRS are not suitable in all traffic environments and the decision to use a TPRS must consider:

- Volumes and proportion of heavy vehicles which influence the lateral and rotational movement of the TPRS;
- Maintaining safe travel paths for vulnerable road users;
- Vertical (grade) and horizontal (curves) alignment of road which influence longitudinal, lateral and rotational movement of TPRS;
- Road alignment to ensure clear sight distance of D to the TPRS is maintained; and

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- Proximity of residential buildings or other noise sensitive land uses due to noise associated with the TPRS.

A TGS, which includes TPRS, must be designed in accordance with the above considerations.

Only TPRS products accepted by Transport products must be used. At the time of publication, this includes:

"RoadQuake Modular F1791001 or Folding F1791003"

TPRS from the above manufacturer must be yellow in colour.

Other TPRS devices not listed above may be used following approval from the Director, Roads and Traffic Engineering via standards@transport.nsw.gov.au.

6.11.2 Usage policy

TPRS may be installed in locations characterised by all of the following:

- Where the speed zone is less than 65 km/h; and
- On concrete, asphalt or sealed roads.

TRPS must not be installed:

- On multi-lane carriageways, except where all of the above conditions have been met;
- For work sites where the speed zone in the work zone is greater than 65 km/h; or
- On wet, unsealed, freshly sealed, or heavily rutted roads.

To protect oncoming traffic from the risk of swerving behaviour, TPRS must be placed in one of the following methods:

1. Where traffic is reduced to and controlled within a single lane (see *Figure 6-37*); or
2. On a two-lane two-way road a temporary median kerb with delineators is installed on the centreline for a minimum distance of D prior to the first strip in each array (see *Figure 6-38*).

Loose materials such as gravel and debris on the road surface must be removed prior to installation.

The carriageways near and around the work site that are being controlled by TPRS should remain clean and clear of dirt and construction debris. Debris and other construction waste that have dislodged from passing vehicles onto the carriageway/s should be regularly monitored and removed.

TPRS must be installed in the form of arrays. An array is a series of three rumble strips with 3 m spacing between each rumble strip as shown in *Figure 6-36*.

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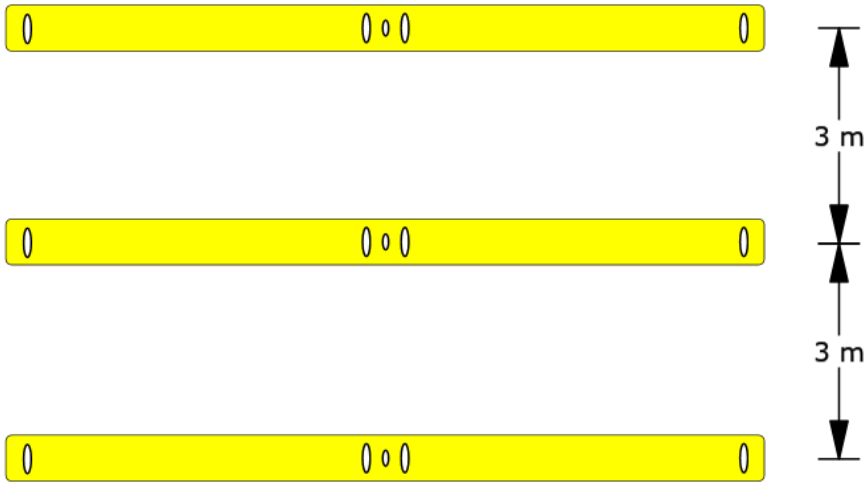

Figure 6-36. Temporary portable rumble strip (TPRS) typical array arrangement

TPRS must be used in accordance with *Appendix B.6 Usage procedure: temporary portable rumble strips*. The requirements provided for these devices must be read in conjunction with relevant specifications and manufacturer's instructions (see *Figure 6-37)*.

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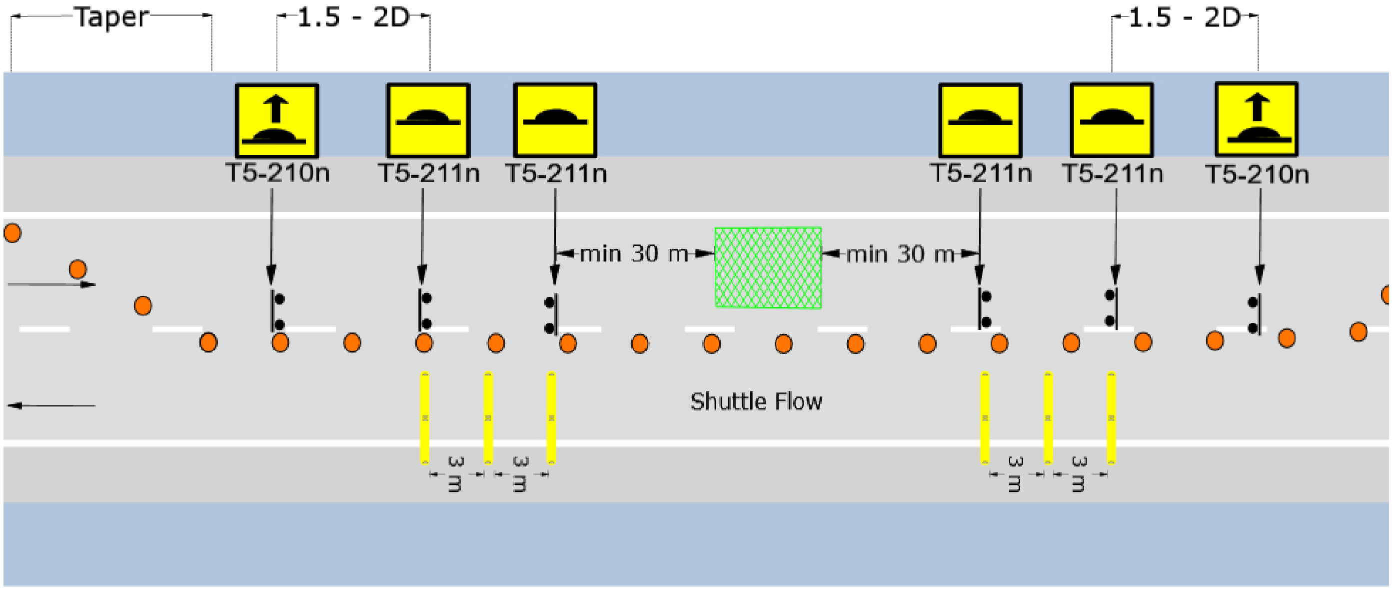

Figure 6-37. TPRS layout – single lane

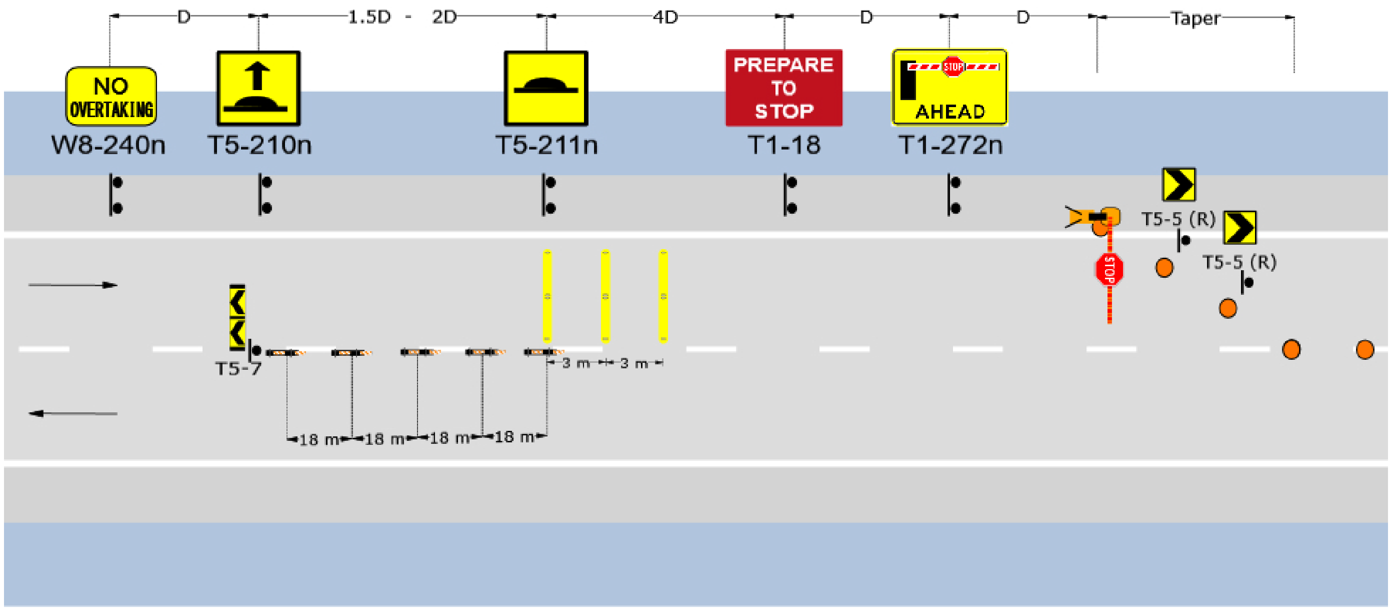

Figure 6-38. TPRS layout – boom barrier

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7 Traffic guidance schemes

7.1 General

This Section must be used by those with PWZTMP and ITCP qualifications to develop, select and implement a traffic guidance scheme (TGS). It covers:

- Principles of a TGS, including components of a work site and application of Dimension D;
- Selection, design and implementation of a TGS; and
- Finalisation and record keeping of a TGS.

Prior to the selection or development of a TGS, the person responsible for the works must confirm the type/s of TTM work to be undertaken safely. The two types of work are:

- Static work; and
- Dynamic work.

Often, a combination of work types may be needed. For example, a dynamic work TGS may be used to set up a static work site.

Factors that influence the work type selection include, but are not limited to:

- Duration of works;
- Location of works, e.g. in the traffic lane or shoulder;
- Clearances to traffic;
- Existing posted speed limits;
- Traffic volumes;
- Other nearby or associated works;
- Available sight distance; and
- Workers on foot requirements.

After the TTM work type/s has been established, the controls can be determined and a TGS selected or developed.

As detailed in *Section 7.5 Selecting a TGS*, a qualified person must determine if a suitable TGS for the TTM work exists in an approved TGS library. If no Generic TGSs can be made Site Suitable, a Site Specific TGS must be designed in accordance with Sections *7.6 Designing a TGS: General principles*, *7.7 Designing a TGS: Static work* or *7.8 Designing a TGS: Dynamic work.*

7.2 Types of TGS

A TGS, previously known as a traffic control plan (TCP), is a detailed layout of temporary signs and devices that communicate the TTM arrangement around, past or through a work site or temporary hazard. *Table 7-1* provides a description of the different types of TGS used in this document.

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Table 7-1. TGS types and descriptions

TGS type	Description
Generic	A Generic TGS is a TGS that has not been approved for use on-site and has no specific location information. A Generic TGS is a planning tool and should only exist within a TGS library (see *Section 7.12 TGS records)* held by a work group for their own operating environment and work activities (such as a District Works Depot). A series of generic TGSs may be included in a TGS library. A generic TGS must not be used and implemented unless a copy has been made and the copy has had appropriate details added and verified as Site Suitable or modified to be Site Specific (if required) and approved for use by an appropriately qualified person. See *Section 7.5 Selecting a TGS*. All Generic TGS must be designed by a PWZTMP qualified person and endorsed prior to being added to the TGS library. When designing a Generic TGS, the principles of this Technical Manual must be followed. The work type layouts provided in *Appendix D – Work type layout examples* are for information only and are not Generic TGS. They may be used to aid the design of Generic TGSs, but must not be selected and used at a work site without review and amendment.
Site Suitable	A Site Suitable TGS is a copy of a Generic TGS that has been determined suitable for a location and / or works. In order for a TGS to be considered Site Suitable, the following provisions apply: • The Generic TGS must have been selected by a PWZTMP or an ITCP qualified person using the defined selection procedure, see *Section 7.5 Selecting a TGS*; • A PWZTMP or ITCP qualified person must confirm the selected Generic TGS is appropriate for use for the road environment and the work activity at that site; and • The TGS to be specified does not require modifications beyond the tolerances detailed in *Section 7.10.3 Tolerances on positioning of signs and devices*. When a Site Suitable TGS is selected, a TGS verification of the site must be conducted by a PWZTMP or ITCP qualified person and mandatory information outlined in *Section 7.4 Information required on a TGS* must be added prior to the TGS being approved for use, see *Section 7.12 TGS records*. A Site Suitable TGS is only valid for the time period of works specified on the TGS.
Site Specific	A Site Specific TGS is produced by a PWZTMP qualified person and may be either: • A new TGS designed specifically for a project site location on the road and for a particular work activity; or • A copy of a Generic TGS that has been modified outside the tolerances of *Section 7.4 Information required on a TGS* to suit the specific location or work requirements. When a Site Specific TGS is designed, a TGS verification of the site must be conducted by a PWZTMP qualified person and mandatory information outlined in *Section 7.4 Information required on a TGS* must be added prior to the TGS being approved for use, see *Section 7.12 TGS records.* A Site Specific TGS is only valid for the time period of works specified on the TGS. A Site Specific TGS may be added to the TGS library as per *Section 7.12 TGS records*, if it is determined appropriate for future re-use activities.

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7.3 Dimension D

Dimension D is a measure of distance in metres. It is used to determine taper lengths, the position of signs and devices and for determining sight distances along the road so that road users have sufficient time to absorb the roadwork specific messages, understand the changed traffic conditions and take necessary actions.

Dimension D is calculated by expressing the speed in metres for the zone preceding to where the Dimension D will be applied, this may be either the existing posted speed or a reduced roadwork speed limit.

For example Dimension D in *Figure 7-1* below is:

- 110 m for the yellow shaded area;
- 80 m for the blue shaded area; and
- 60 m for the pink shaded area.

The existing posted speed limit may be used to determine Dimension D throughout the work site, provided the PWZTMP qualified person has determined that there is higher risk of poor driver compliance with speed zones and where space allows.

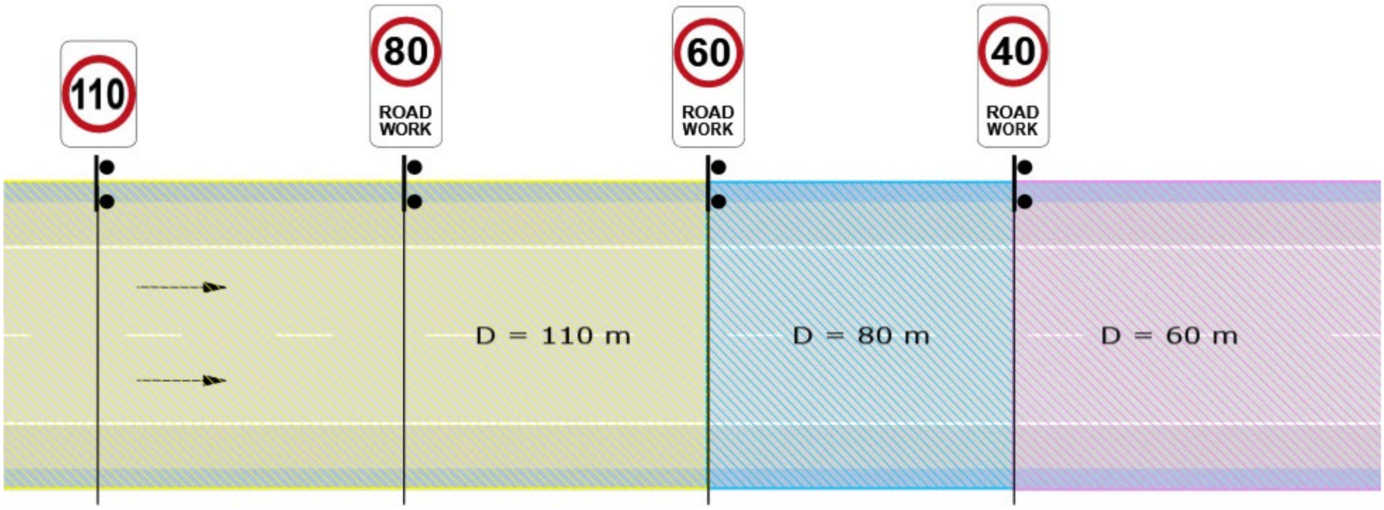

Figure 7-1. Example calculation of Dimension D

The Dimension D to be used on a work site must be determined by the PWZTMP qualified person and must be specified on the relevant TGS.

Where required by site-specific constraints, the application of Dimension D may be varied through the departures process provided in *Section 2.8 Departures from this Technical* Manual.

An example showing application of Dimension D in a 60 km/h roadwork zone with a preceding 80 km/h zone is given in *Table 7-2*.

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Table 7-2. Dimension D calculation based on speed zone

Scenario	Dimension D required	Dimension D
Dimension D	Dimension D calculated as	80 m
For determining sight distance to a PTCD or manual traffic controller	Traffic controller must be able to see 1.5 D or greater to the oncoming traffic	80 m x 1.5 1.5D = 120 m
For determining sight distance to end-of-queue	Sight distance to the end-of-queue for approaching traffic must be calculated at 2D for approach speeds greater than 65 km/h and 1.5D for approach speeds of less than 65 km/h	greater than 65 km/h 80 m x 2 2D = 160 m less than 65 km/h 80 m x 1.5 1.5D = 120 m
For determining sign spacing	Distance between signs must be calculated as follows: • **Single sign**: 2D for speeds greater than 65 km/h and 1D for speed zones of less than 65 km • **Multiple signs (such as dual sign arrangements or multi-message signs)**: 1D for all permitted speed zones	greater than 65 km/h 80 m x 2 2D = 160 m less than 65 km/h 80 m x 1 D = 80 m
For determining taper lengths	See *Section 7.6.2.2 Tapers*	
For distance between tapers on multi-lane roads	A distance of 1.5D should be applied	80 m x 1.5 1.5D = 120 m

7.4 Information required on a TGS

7.4.1 General

All TGS must include the following information:

- Project name and the time period that works will be performed;
- Types and location of permanent signs and traffic signals (where applicable);
- Types, locations and clearance requirements of all:
  - Temporary signs; and
  - Traffic control locations and devices including details of determined safe location and escape routes for traffic controllers, where applicable.
- Predicted end-of-queue lengths;
- Location and names of roads and intersecting roads;

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- Location reference markers, in order to assist recreating the layout in case of incident. Location reference markers must be recorded for temporary speed zone locations;
- Notes, as per *Section 7.4.2 Notes on a TGS*;
- Dimension D applied;
- Frequency of shift TTM inspections in accordance with *Section 8.1.4 Shift TTM inspections;* and
- Sign-off section for the designer and approver including an issue and review date.

Where applicable, the below details should also be included on the TGS:

- Installation and removal order of temporary signs and traffic control devices, (this may also be captured in relevant SWMSs).
- Locations of temporary safety barrier systems including terminals;
- Exclusion zone required for the temporary safety barrier system and details of delineation of zones and maintenance during works;
- Existing footways and cycle ways;
- Location of site access gates;
- Location and access provisions for local properties and/or car parking access;
- Temporary pavement markings and delineation devices required;
- Locations of temporary street lighting;
- Time and date, the designer completed the TGS verification as required by *Section 7.9.1 TGS verification*;
- Locations of emergency or breakdown lanes; and
- Existing pavement markings including a note of which require covering/removal.

This information must be included on, or attached to the TGS. This may be as information on the front of the TGS, as detail on the rear of the TGS, as an attachment to the TGS or a combination of methods. *Appendix C – Example TGS* provides an example of a completed TGS with details and notes as per this Section.

7.4.2 Notes on a TGS

Notes must be included on the approved site suitable or site specific TGSs, to detail any specific procedures that need to be communicated to the:

- *Implementer* – for installing or removing the TGS;
- *Person responsible* – for inspecting and monitoring the operation of the TGS;
- *Traffic controller* – for the operation of the TGS; or
- *Workers* – utilising the TGS.

Notes are created by either the PWZTMP or ITCP qualified person and provide additional information to the TGS or reinforcement of key critical safety messages.

The non-exhaustive list below provides some examples of notes that may be included on TGS:

- "*Shadow vehicle or TGS No xxx must be used to set out this TGS (installation/dismantle)*";
- "*Observer must be utilised when installing this TGS*";
- "*Ensure all radios are switched to the appropriate channel and frequency, and are in working order*";

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- "*Size X signs must be used*";
- "*Signs X must be duplicated*";
- "*Contradictory signs must be covered*";
- "*Where there is not enough lateral clearance, reduce speed to X km/h*";
- "*Access and exit points for site/delivery vehicles must be via X*";
- "*Containment fence or tape to be used to delineate exclusion zones*";
- "*All personnel, plant and equipment to maintain a minimum of X m from traffic*";
- "*A variable message sign (truck or trailer mounted) may replace 'Roadwork Ahead' or 'Roadwork Ahead 1 km sign/s (ensure clear of edge line)*"; or
- "*All signs that are no longer required must be covered or removed when not in use, e.g. between shifts or during meal breaks*".

7.5 Selecting a TGS

7.5.1 General

A Generic TGS that has been developed in accordance with *Section 7.6 Designing a TGS: General principles* and *7.7 Designing a TGS: Static work*, or *7.7.4 Through TTM methods*, may be selected by a person who is either PWZTMP or ITCP qualified (see *Figure 7-2*) to be site suitable. The qualified person must then assess whether the Generic TGS will:

- Be suitable for the road environment and TTM activity and if so, confirm the Generic TGS as a Site Suitable TGS in accordance with *Section 7.9 TGS confirmation and approval;* and
- Require modifications in excess of the tolerances detailed in *Section 7.10.3 Tolerances on positioning of signs and devices*.
- If modifications are required, then a PWZTMP qualified person must design a Site Specific TGS.

To appropriately select and assess a generic TGS the PWZTMP or ITCP qualified person must:

- Obtain a copy of the relevant TMP;
- Determine the category of work to be undertaken (short term / long term, static / dynamic);
- Use an approved selection procedure; and
- Identify, assess and mitigate site-specific conditions and risks within the parameters of the selection procedure and the tolerances outlined in *Section 7.10.3 Tolerances on positioning of signs and devices*.

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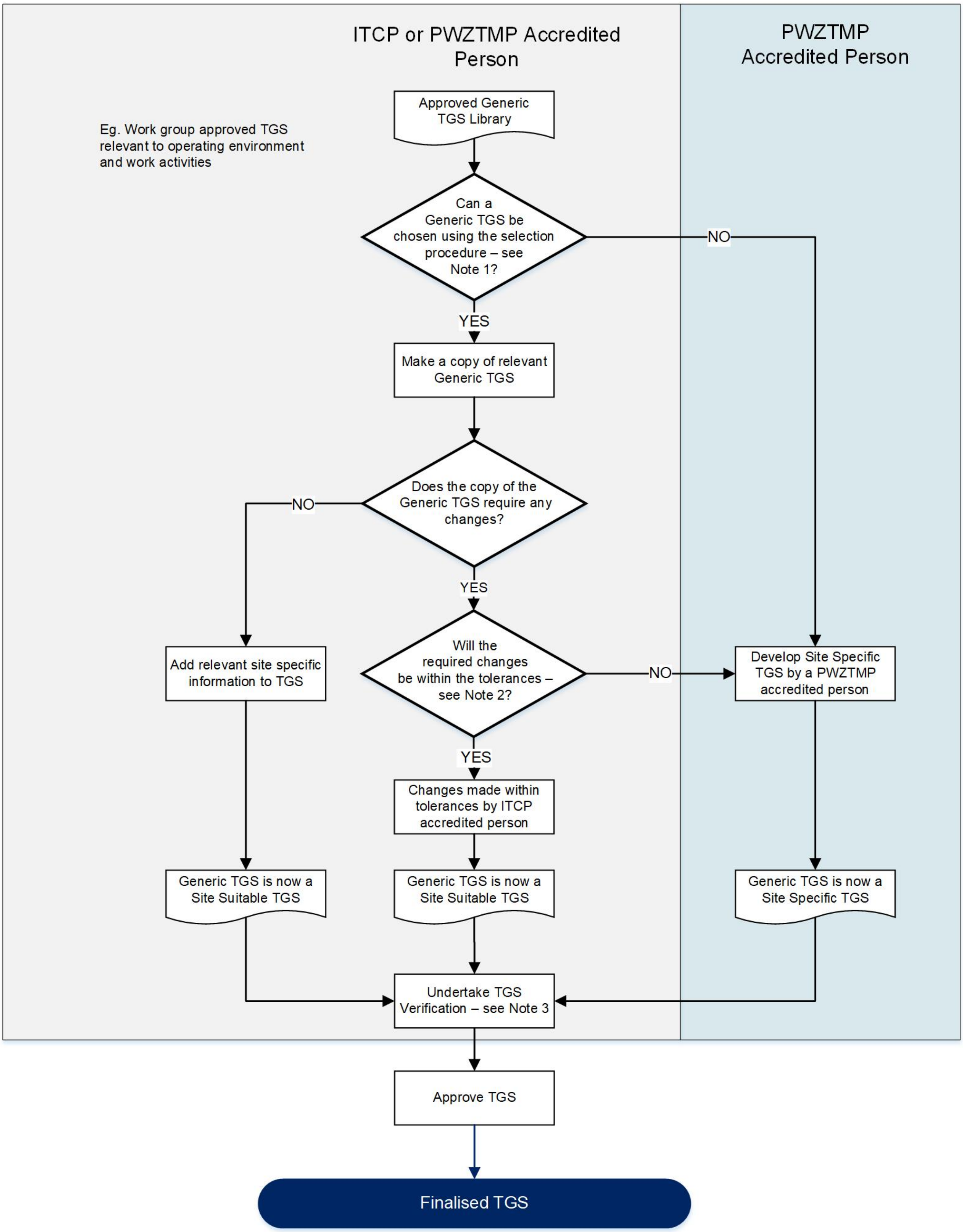

Figure 7-2. TGS selection flow chart

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Notes Figure 7-2:

1. *Selection procedure must be developed in accordance with Section 7.5.2 TGS Selection Procedure*
2. *Tolerances must be in accordance with Section 7.10.3 Tolerances on positioning of signs and devices*
3. *TGS Verification must be completed in accordance with Section 7.9 TGS confirmation and approval*

7.5.2 TGS Selection Procedure

A selection procedure must be prepared and endorsed by a PWZTMP qualified person to accompany a generic TGS Library. The selection procedure must define the factors or inputs to be used to determine whether a generic TGS is suitable or not. When using the generic TGS Library to select a site suitable TGS, the PWZTMP or ITCP qualified person must:

- Reference the TMP under which the TGS will be implemented; and
- Ensure that the generic TGS has been reviewed and approved within the previous 12-month period. See *Section 7.11.1 Generic TGS review* and *Section 7.9 TGS confirmation and approval* for review and approval of a TGS.

A selection procedure should consider factors such as the:

- Activity to be undertaken;
- Type of work being planned, i.e. static or dynamic work;
- Type of road i.e. a one-way or two-way road and single versus divided carriageway;
- Number of lanes;
- Road environment, for example rural/urban;
- Posted speed limit and approach speeds of traffic;
- Time of day, for example whether the TGS is suitable for day work, night work or both;
- Traffic volumes; and
- Where the work site is located within the road corridor, for example on shoulder or in lane.

If a TGS does not exist in the generic library that can be selected as Site Suitable, a Site Specific TGS must be designed in accordance with *Section 7.6 Designing a TGS: General principles* and *Section 7.7 Designing a TGS: Static work*, or Section *7.7.4 Through TTM methods*.

7.5.3 Confirming a Site Suitable TGS

After a Generic TGS has been identified as being suitable for the works using the selection procedure, the PWZTMP or ITCP qualified person must make a copy of the relevant Generic TGS. This copy will become the Site Suitable TGS after the below information has been added to it:

- Distance D;
- Details of modifications within the tolerances outlined in *Section 7.10.3 Tolerances on positioning of signs and devices;*
- Location information; and
- Signature and approval date of the selected TGS.

Once the site suitable TGS has been created, it must be confirmed and approved in accordance with *Section 7.9 TGS confirmation and approval* before it is implemented in the field.

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7.6 Designing a TGS: General principles

7.6.1 General

This Section provides the general principles for designing a TGS.

There are two types of TGS that may be designed by a PWZTMP qualified person. These include:

- Generic TGS; and
- Site Specific TGS.

All TGSs must be designed and approved by a PWZTMP qualified person and prepared in accordance with this manual. Key principles for designing a TGS include:

- Ensure the risks and controls detailed in the TMP are addressed;
- Eliminate risks SFAIRP;
- Provide protection SFAIRP to workers and the work site, including:
  - Separating the work area from the route of vehicles wherever possible; and
  - Prioritising the use of PTCDs rather than a manual traffic controller.
- The needs of all road users are provided for e.g. pedestrians, cyclists, school children etc., including:
  - Avoiding the need to slow and/or stop traffic wherever possible.
  - The use of a pilot vehicle is considered;
- Only accepted signs and devices are used, including condition signs where the road surface at the work area is sufficiently different from the approach roads and may be hazardous to traffic;
- Preparing a separate TGS for each stage of the work; and
- TGSs are drawn to scale to ensure geometric standards are achieved and implemented.

To ensure a TGS is easily understood, all TGSs should be produced electronically with hand drawn TGSs only produced in extenuating circumstances.

7.6.2 Components of the work site

The work site is the length of road, made up of five smaller areas as shown in *Figure 7-3* below, which includes the area where the work is being undertaken and any additional length of road used for traffic control including signs, tapers, traffic lights and other devices.

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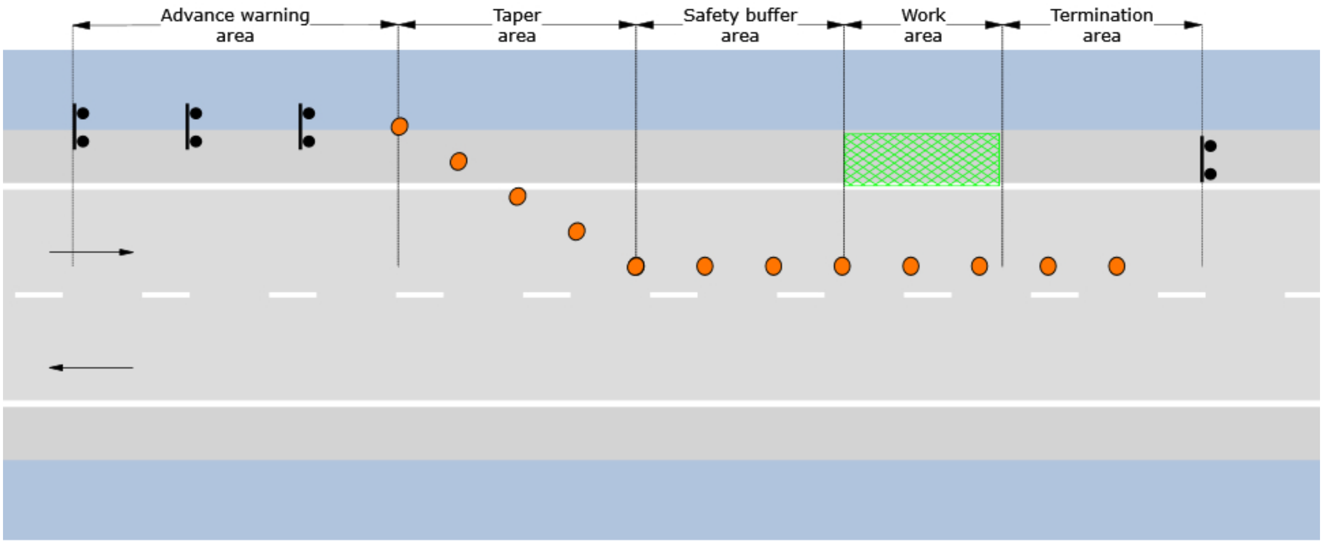

Figure 7-3. Components of a work site

***Note to Figure 7-3**: the five areas noted above are shown in the direction of an affected lane.*

7.6.2.1 Advanced warning

Advanced warning for work sites must be installed to communicate to road users that there are changes to the road conditions ahead. Advanced warning may be required to notify road users of:

- Traffic hazards;
- Speed reductions;
- Workers on foot;
- Stopped traffic; or
- Changes to lane configurations.

Most work sites will require advance warning signage to be included on the TGS with spacing in accordance with *Section 6.2.6 Spacing of signs*.

Advance warning signs are not required in the following situations:

- Where the work is sufficiently remote from a roadway that no action is required of road users;
- Where the work is undertaken as intermittent work i.e. in gaps in traffic, in either open road or built-up areas or takes less than five minutes;
- 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; or
- On unsealed roads.

7.6.2.2 Tapers

The following types of approach tapers may be used (see *Figure 7-4, Figure 7-5* and *Figure 7-6*):

- ***Traffic control taper*** — used immediately after the position of a PTCD or traffic controller, to guide road users past a roadwork site or temporary hazard.
- ***Lateral shift taper*** — where traffic is required to shift laterally without conflict with another traffic stream.
- ***Merge taper*** — where one lane of traffic is required to merge into another.

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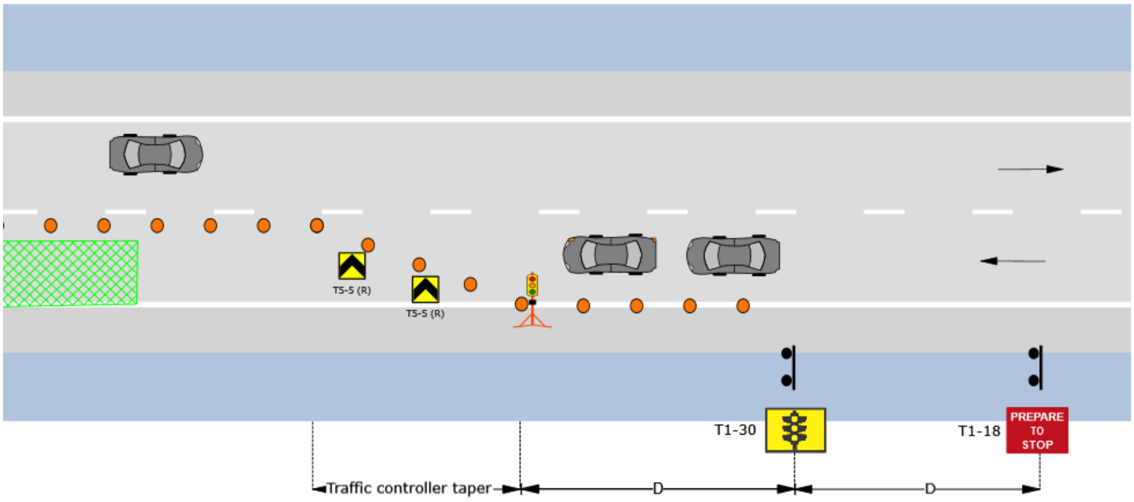

Figure 7-4. Traffic control taper with Type 1 PTS

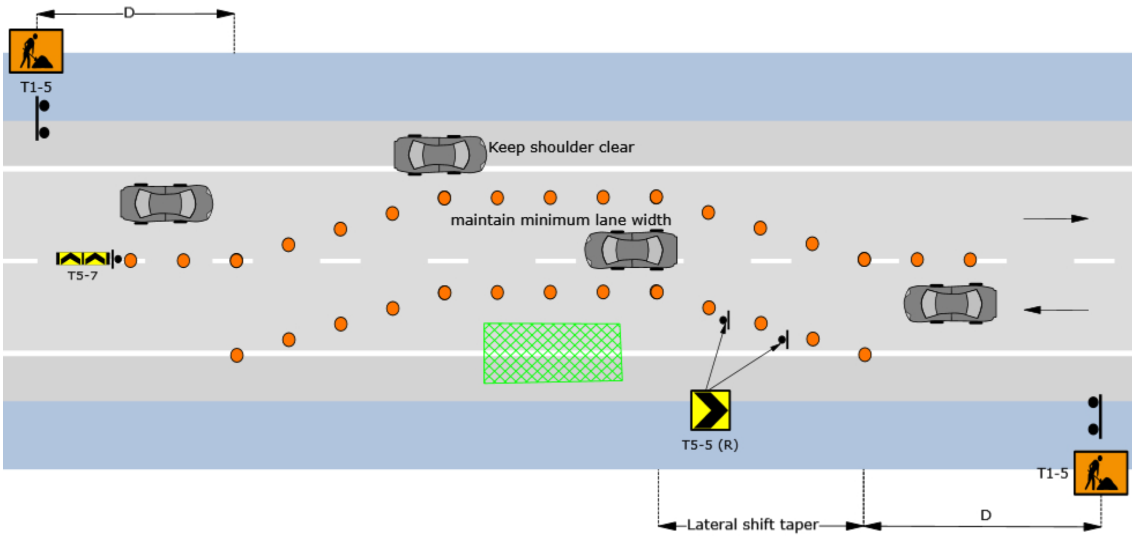

Figure 7-5. Lateral shift taper

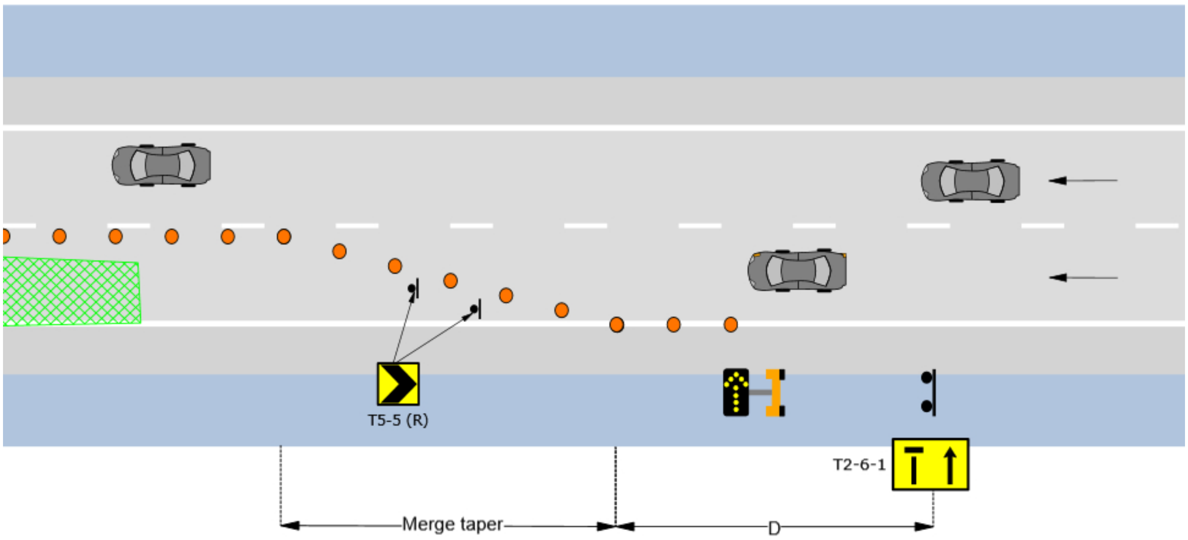

Figure 7-6. Merge taper

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Recommended taper lengths are provided in *Table 7-3*. Taper lengths should be increased at locations with poor sight distances or speed compliance, and supported by a site-specific risk assessment and documented in the TMP.

Table 7-3. Recommended taper lengths

	Recommended taper length (m)		
Speed (km/h)	Traffic control taper	Lateral shift taper	Merge taper
45 or less	15	15	15
46 to 55	15	15	30
56 to 65	30	30	60
66 to 75	N/A	70	115
76 to 85	N/A	80	130
86 to 95	N/A	90	145
96 to 105	N/A	100	160
Greater than 105	N/A	110	180

Note to Table 7-3*: Speed is defined as the speed (km/h) of traffic at a position in the TGS where a device is located (e.g. start of a taper). This should be one of the following, in order of preference:*

- *The measured speed;*
- *The predicted speed of traffic;*
- *The preceding roadwork speed zone in accordance with Section 7.3 Dimension D; or*
- *The existing posted speed limit.*

When installing multiple tapers, the distance between each taper must be in accordance with *Table 7-4*.

Table 7-4. Minimum taper lengths

Speed (km/h)	**Distance between tapers (m)**
45 or less	10
46 to 55	25
56 to 65	70
greater than 65	1.5 x Speed

Note to Table 7-4: *Speed is defined as the speed (km/h) of traffic at a position in the TGS where a device is located (e.g. start of a taper). This should be one of the following, in order of preference:*

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- *The measured speed;*
- *The predicted speed of traffic;*
- *The preceding roadwork speed zone in accordance with Section 7.3 Dimension D; or*
- *The existing posted speed limit.*

7.6.2.3 Safety buffer

A safety buffer is the unoccupied space between the taper and work areas, and allows for a driver of an errant vehicle to correct, slow or stop before entering the work area. When designing a TGS, a space of no less than 30 m must be provided prior to the work area for the safety buffer.

Safety buffers are not required on departure, however if road users are able approach the work area from either end, a safety buffer must be provided at both ends of the work area.

Roadworks and storage of vehicles, plant, equipment and stockpiled materials must not occur in safety buffers. Road workers must not occupy the safety buffer area except when accessing the work area.

7.6.2.4 Work areas

The work area is the space required for the immediate work to be competed. Work areas must be set up in accordance with this manual and, where possible, work vehicles within a work area must be parked so that:

- They are clear of the minimum clearances described in *Section 4.3.4 Minimum clearances of workers to* traffic and *Section 4.3.5 Protection of work area*;
- Workers are not required to enter the minimum clearances to access tools and stores from the side of the vehicle; and
- The work vehicle provides a shield to workers from the path of errant vehicles.

7.6.2.5 Termination area

Provision of appropriate termination signage is critical to ensure road users are aware that the roadwork or changed conditions are no longer present and normal road conditions are reinstated.

Where a ROADWORK AHEAD sign is installed, END ROADWORK (T2–16) or (T2-17) termination sign must be located D from the last point of the work area where people are working and displayed adjacent to or after any signs indicating the reinstatement of the existing permanent speed limit. The SPEED LIMIT (R4-1) symbolic sign must be placed no further than 50 m past the work area.

It is important to note that if the termination signs are placed at a distance too great from the work area, driver compliance may reduce and road user complacency for work sites may increase.

7.6.3 Traffic control types

Traffic control must be designed in accordance with *Section 5.4 Traffic control*. Portable traffic control devices (PTCDs) must be used when the existing permanent speed limit is above 45 km/h for all work sites under traffic control. This requirement is not applicable to instances and environments of emergency response.

A manual traffic controller may be used instead of a device provided all of the following conditions are met:

- The use of a PTCD does not provide the safest outcome, SFAIRP;
- The decision to use a manual traffic controller instead of a PTCD is documented as part of the TMP and site specific risk assessment; and
- Approval is granted by the one-up manager to the PWZTMP person approving the TMP.

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For all traffic control types, four cones placed at 4 m spacing must be located immediately preceding the location of the traffic control (see *Figure 7-4*).

7.6.4 End-of-queue

In addition to the TMP requirements provided in *Section 4.6 End-of-queue management*, if work is planned to stop traffic, the TGS designer must assess the likely maximum queue length, through a consideration of:

- Expected delay in minutes;
- Peak hourly traffic volumes at the time of the work;
- The type or mix of traffic; and

  Note: *Heavy vehicles are longer than light vehicles and therefore affect the calculation of maximum queue length.*
- The gap between stopped vehicles.

  Note: *In rural environments the gap is generally longer than that of an urban road environment.*

If the TGS is planned to stop traffic, the TGS designer must ensure that signs and spacing specified on the TGS are appropriate for all queue lengths up to the maximum design queue length plus thirty per cent (30%) to allow for anomalies, such as 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.

Expected queue lengths must be determined and detailed on the TGS. Procedures should be put in place where the predicted maximum queue length will be exceeded. This may include increasing gap between signs, extra signs or preparing to be able to release traffic to ease the congestion in the queue.

7.6.5 Pilot vehicles

A pilot vehicle is a work vehicle used to guide traffic by controlling the desired path and to manage speed through the work area. A pilot vehicle must:

- Be registered for road use in NSW;
- Only act as a pilot vehicle specifically for the function of the work site;
- Have its function documented in the TMP and the relevant TGS prior to operating on a work site;
- Be operated by a person as either Traffic Controller or Implement Traffic Control Plans and appropriately licenced to operate the relevant vehicle; and
- Be a car, utility or truck; however the vehicle must not be heavily loaded or towing;
- Have two rotating or flashing yellow lamps, an effective two-way radio, headlights and tail lights; and
- Have a PILOT VEHICLE DO NOT OVERTAKE (T6-5) sign instructing traffic to follow it but not pass it.

When in use, a PILOT VEHICLE IN USE (T6-6) sign must also be installed at an appropriate distance in advance of where the pilot vehicle operates.

A pilot vehicle should be used to guide traffic through a work area when:

- Traffic needs to follow a particular path through the site which might not be obvious to road users;
- There is low compliance with the reduced speed limit, for example, switching traffic onto a new carriageway or releasing traffic after a full closure;
- Part of the work area is out of view of the supervisor, work gang and the traffic controller;
- The traffic speed has been reduced to less than 45 km/h due to an increased risk to workers (see *Section 4.5 Speed zones*); or

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- Traffic speed is kept low to minimise damage to the work, i.e. a newly laid seal.

7.6.6 Workers on foot

When work activities require workers on foot, the minimum clearances outlined in *Section 4.3.4 Minimum clearances of workers to traffic* must be maintained at all times. In addition, in accordance with *Section 4.5 Speed zones,* a 30 km/h speed zone should be installed where workers are closer than 1.5 m to moving traffic.

Additionally, to give maximum protection to workers on foot where temporary safety barriers cannot be provided:

- Work area delineation should be provided where possible;
- Work vehicles should be placed to shield workers from the path of errant vehicles; and
- Work vehicles and shadow vehicles should be positioned in line with the boundary of work area which is more exposed to traffic;

When attending parked work vehicles, the vehicles may be accessed from the side or the rear if there is no risk of errant vehicles impacting on the rear of the vehicle further away from traffic.

7.7 Designing a TGS: Static work

7.7.1 General

When designing a TGS for static works, the size and position of the work area must enable the work site to be managed effectively for the safety of road workers and road users. The size and position might not be consistent for the whole duration of work depending on changes in project tasks or location. When designing a TGS for static works:

- Temporary speed limits must be in accordance with *Section 4.5 Speed zones* and be limited to the immediate times and locations required;
- Sign placement must be in accordance with *Section 6.5.5 Sign placement* with signs that are not immediately relevant, removed or covered;
- Lane widths must be in accordance with *Section 4.3.2 Lane widths*; and

Protection of the work area must be in accordance with *Section 4.3.5 Protection of work area.*

When designing a TGS for a static work site, the work area must be designed to provide for:

- Access and egress of workers, plant and equipment;
- Storage areas for materials and equipment;
- Safe sight distances for signage, traffic control devices and the work area; and
- Fixed work areas, which must be marked by barrier boards or delineation devices where applicable.

For a long term static work site, a number of TGS may be needed in addition to the use of staging plans.

7.7.2 *Around* TTM methods

7.7.2.1 General

Around traffic management strategies include detours, road closures or the use of crossovers protected by a separated median. Around TTM methods provide the highest level of worker protection as the risk of live traffic is removed. Around TTM strategies should be considered wherever possible. Prior to the

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implementation of any of these strategies, approvals must have been gained with appropriate road authority and emergency service consultation and notification prior to installing the treatment.

7.7.2.2 Road closures

A road closure involves the complete closure of all trafficable lanes to all road users to ensure the safety of road workers and road users whilst works are underway. For a full road closure to be undertaken, it must have been identified and approved as part of the TMP. When designing a TGS for a road closure:

- The ROAD CLOSED (T2-4) sign must be used in conjunction with barrier boards at the start of the site to prohibit general road user access;
- Speed zones must be reduced approaching the closure;
- The number of traffic lanes should be progressively reduced on approach to the closure. For example, on a two-lane one-way road, on approach to the closure, the left lane should be closed before the right lane;
- If an approach or exit lane is closed at an intersection, the corresponding approach or exit lane on the opposite side of the intersection must also be closed;
- Traffic control vehicles may be used to physically obstruct access to closed roads to supplement delineation devices if delineation devices alone are insufficient;
- If a motorway exit is temporarily closed, closure signs must be installed in advance of:
    - The previous exit if traffic is detoured through said previous exit; or
    - The closed exit if traffic is detoured through the next exit.
- Closures at on and off-ramps must be reinforced with a line of traffic cones at appropriate site distance from the work area. The traffic cones should be placed in a continuous line or chicaned to slow road users, assist in re-enforcing the closure and define work vehicle entry points. Traffic cones must be placed 1 m apart to stop road users from driving through, and advance warning signs are provided as detailed above.

Where access to properties is affected by the road closure, the following treatments should be considered:

- Provision of an alternative access point for residents and commercial businesses;
- Provision for local traffic to travel through the work area with a delineated path or guidance from a traffic controller. A LOCAL TRAFFIC ONLY sign should be erected beside the access point as applicable. Large gaps should not be left between delineation devices (e.g. traffic cones) at access points to avoid general traffic passing through by mistake or intentionally; or
- Allow pedestrian access only. Local residents will need to park elsewhere during this time.

Where road closures are utilised with detours required, detours should be installed in accordance with *Section 7.7.2.3 Detours*.

Figure 7-7 provides an example layout of a detour and full road closure scenario.

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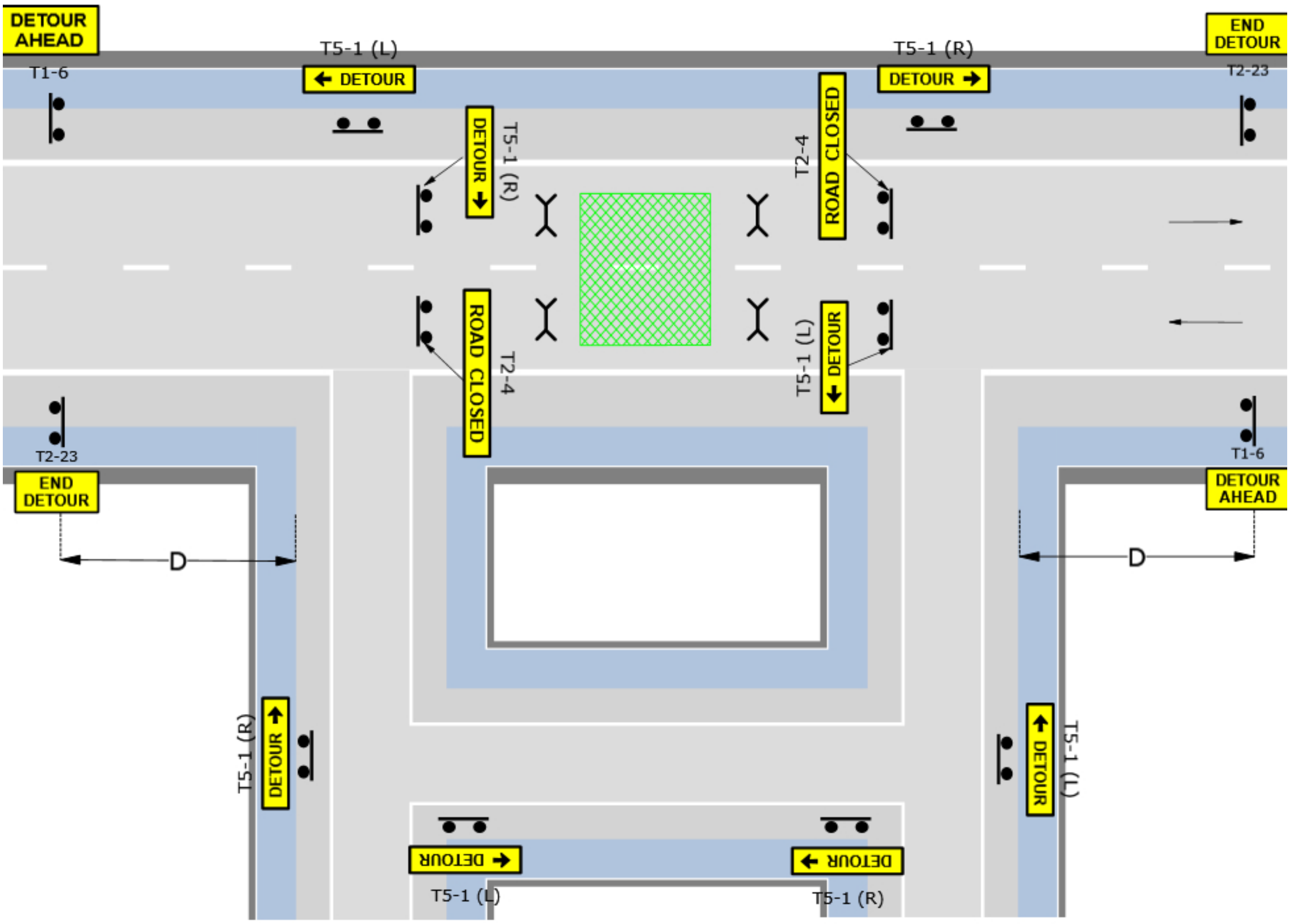

Figure 7-7. Example layout – detour

7.7.2.3 Detours

When designing a TGS for a static work site that utilises an around method, sufficient advanced warning signs and information to advise road users of the changed conditions must be provided. This includes the following:

- A Worker symbolic sign must be placed on the left side of the roadway in advance of the work area if road workers are visible to traffic; and
- A DETOUR AHEAD sign (or VMS) must be placed to give advance warning of an approaching route to detour around a work area. The first detour marker must be placed no more than 100 m past the DETOUR AHEAD sign (or VMS). Detour markers are mounted horizontally with the arrow either vertically upward, at 45 degrees upwards to the left or right, or horizontally to the left or right.

The advance warning area is critical to the success of an *around* traffic management strategy to reduce the risk of confusion to road users. Repeated information may assist road users to navigate their way safely and effectively to their intended destinations.

7.7.2.4 Side tracks and crossovers

When designing a TGS that includes a sidetrack or a crossover the following provisions apply (see *Figure 7-8* for an example layout with side track):

- Approval must be sought from the maintaining authority to use any side track, cross over or detour;

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- The pavement must be of sufficient structural strength to carry the loads and traffic volumes expected;
- The pavement on detours must be monitored to ensure that any damage is quickly rectified;
- The width of a detour and its alignment must be adequate for the expected traffic types and volumes;
- Provision must be made for vulnerable road users and high risk pedestrians and public transport;
- Access must be provided for local traffic;
- Delineation must be provided on the alternate route as appropriate, and may include but is not limited to:
  - Linemarking;
  - Temporary guide posts;
  - Retro-reflective pavement markers (RRPMs), and
  - Signposting.
- Signposting must be clear and adequate; and
- DETOUR AHEAD (T1-6) signs must be used to give advance warning of any detours.

Additionally, the establishment of long-term sidetracks must undergo a detailed design and review process.

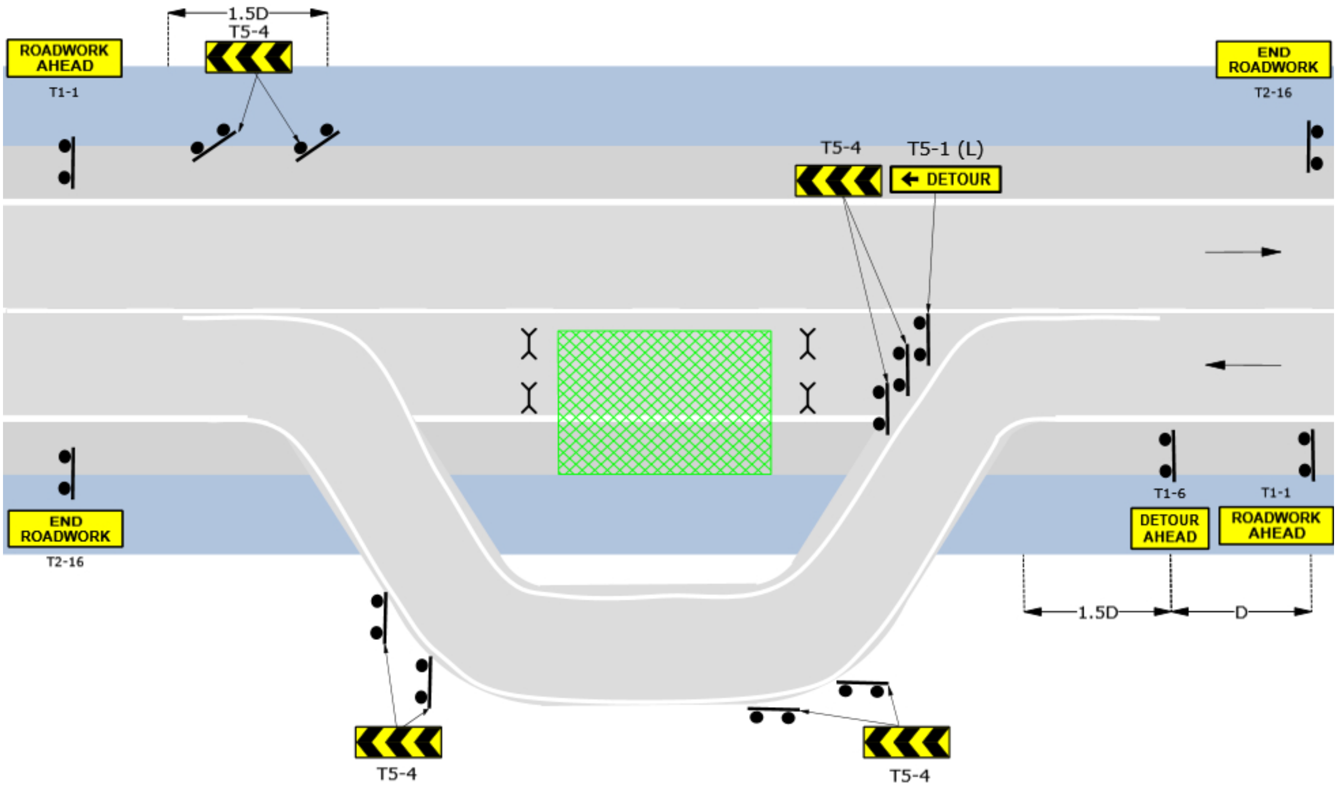

Figure 7-8. Example layout – side track

7.7.3 *Past* TTM methods

7.7.3.1 General

Where it is not possible to move traffic around a work area, the following forms of traffic past methods must be considered:

- Lane closure and lateral shift; or
- Protection of work site via accepted safety barriers as per *Section 6.7 Temporary safety barriers.*

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7.7.3.2 Closing a lane

Procedure

When closing a traffic lane, signs and devices should be installed and removed in accordance with *Section 6.4 Sequence for installation and removal of signs and devices*, see also *Figure 7-9*. When closing off a lane, work must progress in the direction of traffic flow, starting at the farthest point from the job. The vehicle housing the traffic cones, with warning lights and hazard lights operating, must commence at the start of the taper and progressively place the layout in the direction of traffic flow until the taper is completed. The vehicle, and any workers on foot, must be protected by a shadow vehicle during installation of the lane closure.

Minimum requirements for all roads

A minimum of two temporary hazard markers (T5-4 or T5-5) per closed lane must be installed. Cones or bollards must also be used to create a taper to close the lane and define the travel path if traffic is to be merged into an adjacent lane, shifted laterally or be directed by a PTCD or a traffic controller past the work area. When working in low light or restricted visibility conditions (e.g. at night), consideration must be given to using a flashing arrow sign in addition to, or in place of, the temporary hazard markers.

If temporary delineation is needed on both sides of the vehicle path at a taper, hazard markers must only be used on the side that is primarily guiding traffic away from the most significant obstruction or other hazard. Hazard markers on both sides of a traffic path must not be placed as this can cause confusing patterns of delineation. Cones should be placed on the lane line between the end of the taper and the work area and on the other side of the travel path in accordance with *Section 6.2.5 Spacing of cones and bollards* and *Section 7.6.2.2 Tapers*.

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.

Additional requirements for multi lane roads

On multi-lane roads with existing posted speed limit of less than 85 km/h and less than 20,000 vpd consideration must be given to using a flashing arrow sign in addition to, or in place of, the temporary hazard markers. The TGS must also include:

- Appropriate lane status (T2-6-1 or T2-6-2) signs; and
- Where required by *Section 6.10 Truck and trailer-mounted attenuators (TMA),* the location of the TMA as part of the lane closure.

Additional requirements for motorways or other multi lane roads

On the motorways listed in *Table 6-20* or other multi lane roads with an existing posted speed limit of greater than 85 km/h and traffic volumes greater than 20,000 vpd, a flashing arrow sign must be provided at each merge taper in addition to the two (minimum) temporary hazard markers (T5-4 or T5-5).

The flashing arrow sign and markers must remain in position and be clearly visible from the commencement of the taper installation, at all times during the operation of the TGS and until the taper is removed.

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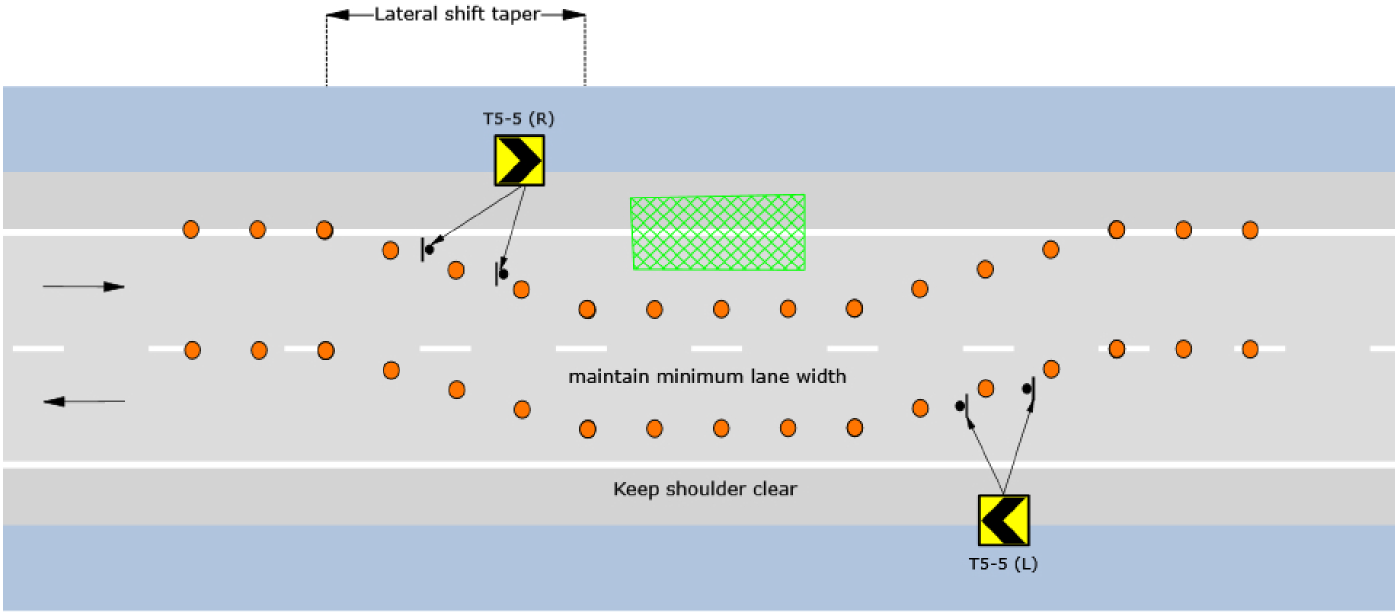

Figure 7-9. Example layout – static: lane closure, two-lane, two-way (formerly TCP 41)

Additional examples of lane closures are provided in *Appendix D – Work type layout examples.*

7.7.3.3 Closing a shoulder

When closing a shoulder, a temporary hazard marker shall be placed 20 m before the work area with at least one additional marker, at 20 m spacing, in advance. The hazard markers are to be no less than 1 m from the edge line. A barrier board should be placed at the beginning and end of the work area. In addition a SHOULDER CLOSED (T2-19n) must be placed D in advance of the first temporary hazard marker (T5-4 or T5-5), (see also *Figure 7-10*).

Consideration must be given to cyclists, buses, resident's vehicle, parking and any other road user that may utilise the shoulder in this area, see *Section 4.4 Providing for specific road users*.

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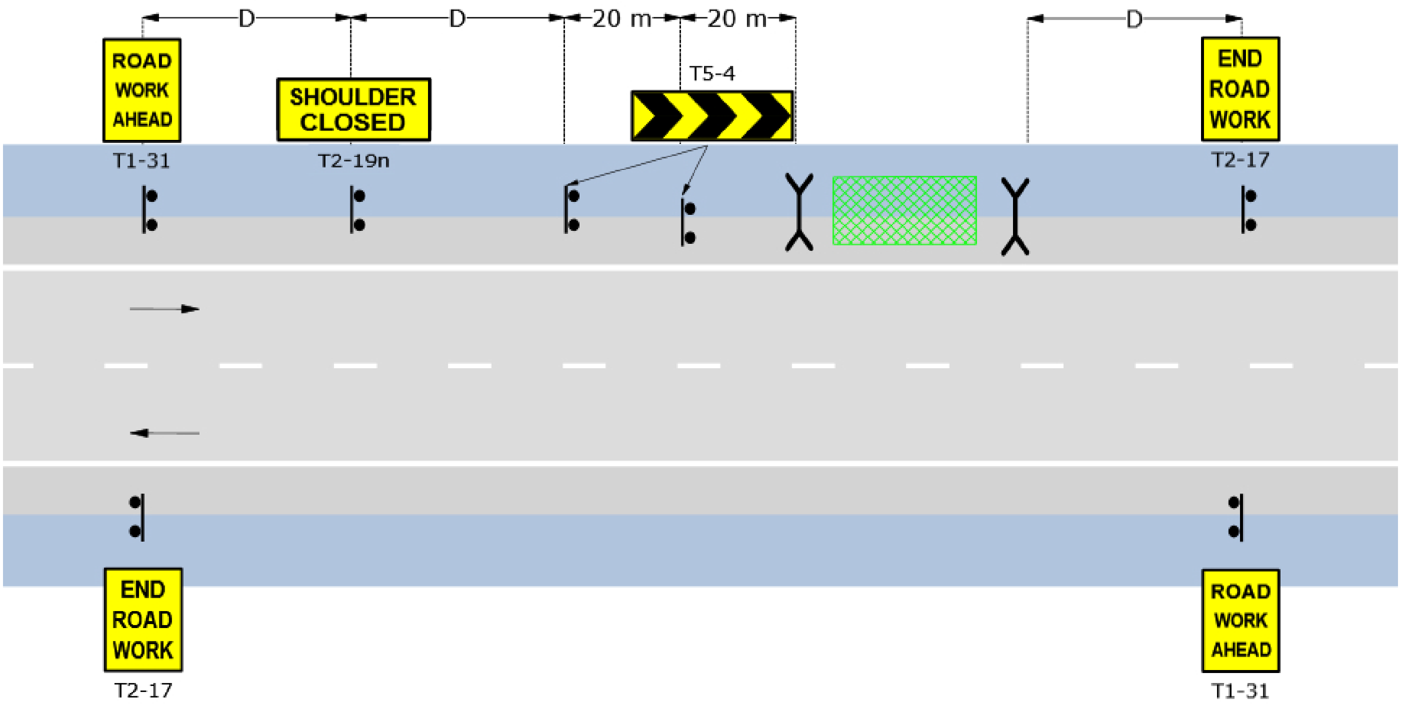

Figure 7-10. Example layout – shoulder closure

7.7.3.4 Single lane operation

Single lane operation may be used on two-way two-lane roads with a very low traffic volume and appropriate sight distance. GIVE WAY (R1-2) and ONE LANE (R9-9n) sign assembly must 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 and no traffic controller is provided (see *Figure 7-11*). This is appropriate for work when:

- The traffic volume is 100 vpd or less and the traffic speed is less than 75 km/h;
- Each entry to the work area is visible from the other;
- The work area is less than 100 m long; or
- There is sight distance to opposing traffic of at least 300 m beyond the far end of the work area for traffic facing the GIVE WAY/ONE LANE assembly sign.

NO OVERTAKING OR PASSING (R6-1) sign must be erected at the start of the single lane for traffic in the opposite direction. See also *Section 6.5.9 Requirements for specific signs*.

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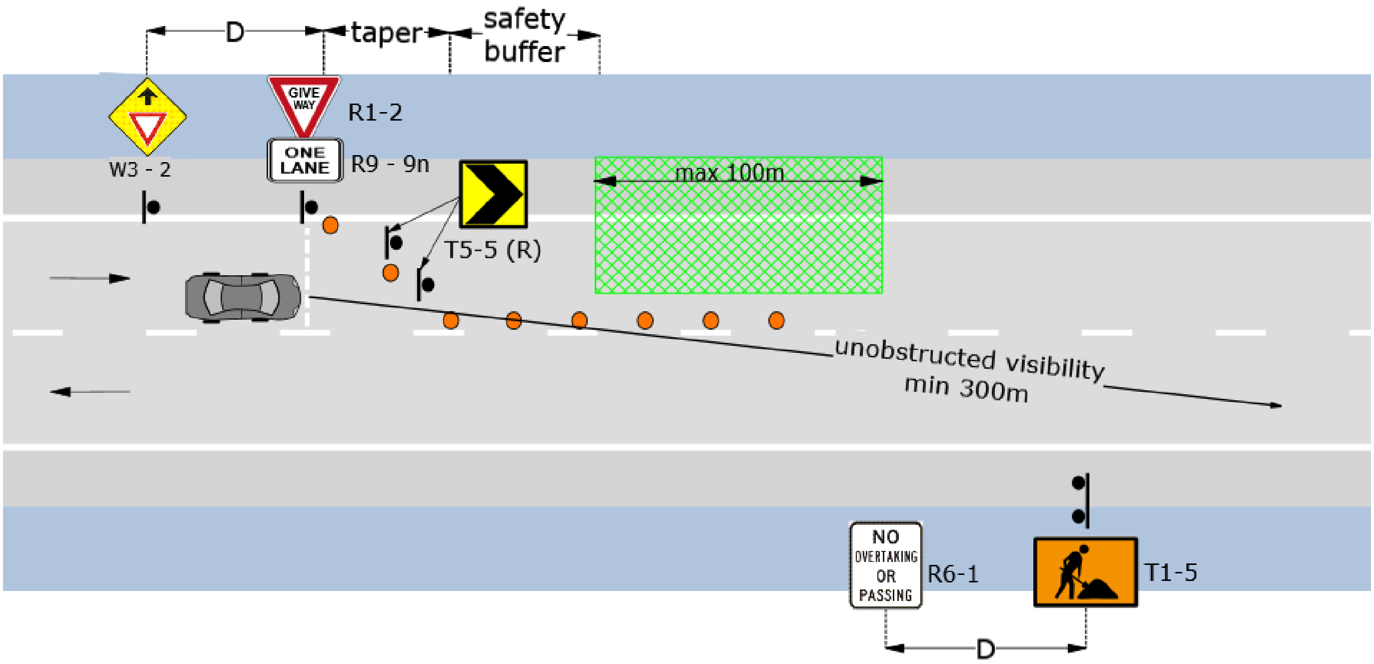

Figure 7-11. Example layout – single lane operation

7.7.3.5 Additional requirements for dual carriageway and multi-lane roads

When working on a central lane or in the median between carriageways there must be adequate lateral separation between workers on foot or plant from the opposing traffic flow. The lateral separation requirements in *Section 4.3.4 Minimum clearances of workers to traffic* should be applied at a minimum and in some situations an increased lateral separation may be required due to site-specific risks. The required lateral separation can be achieved by variety of means such as detouring the opposing traffic flow, providing a temporary barrier with a containment fence (for workers) or for shorter duration works by closing the opposing traffic lane.

Refer to *Section 7.7.3.2 Closing a lane* for the requirements for closing a lane on dual carriageway and multi-lane roads.

Where work is undertaken on a multi-lane dual carriageway:

- Signs and devices, excluding pavement arrows, must be placed on both sides of the carriageway, where practical, in accordance with *Section 6.5.6 Duplication of signs*.
- If the 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, see *Figure 7-12*; and
- Site access is established in accordance with *Section 5.2.3.2 Designing site access on multi-lane roads or high speed environments*, where required.

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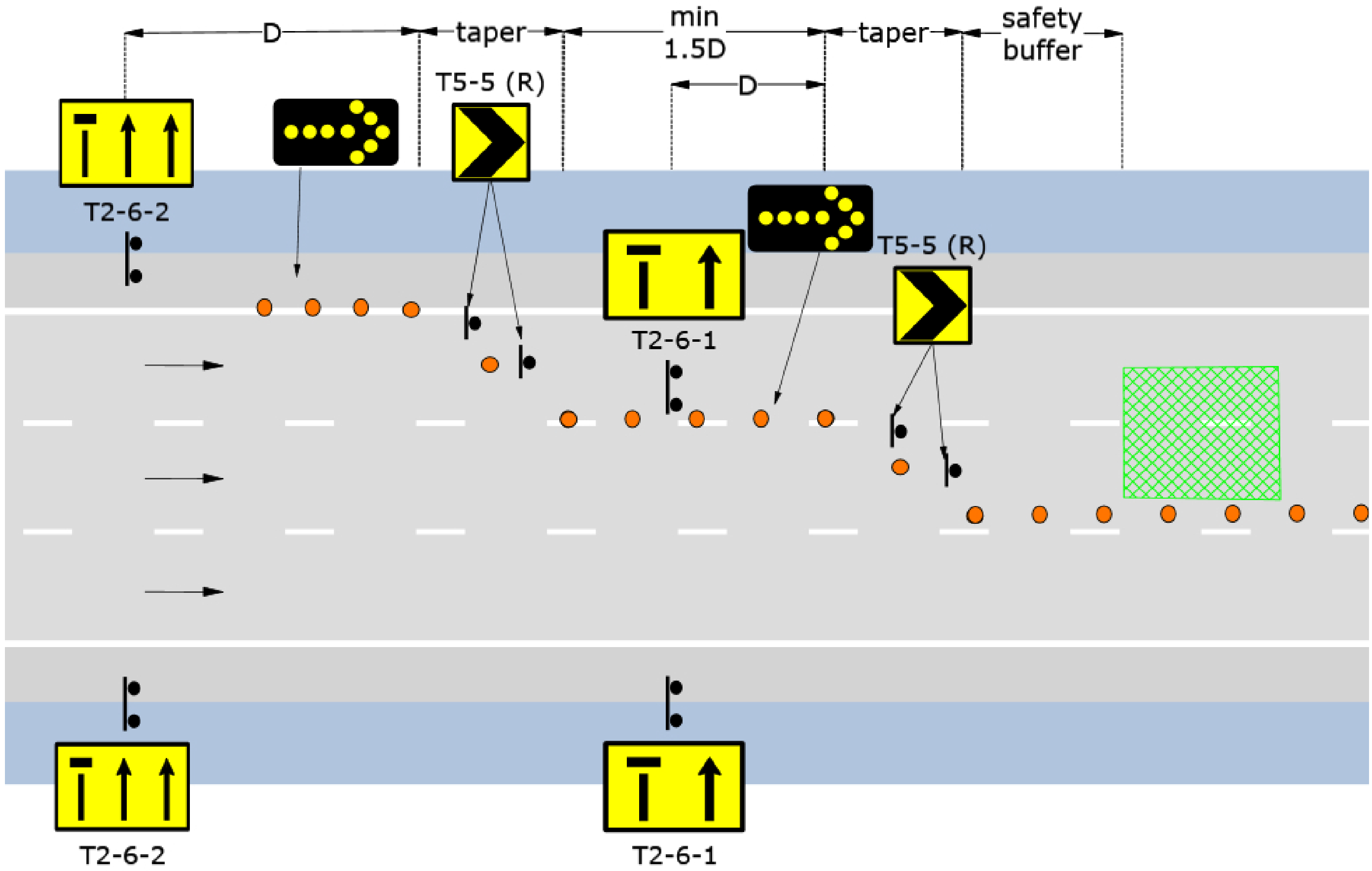

Figure 7-12. Example layout – static: lane closure, 3 lane

7.7.4 *Through* TTM methods

7.7.4.1 General

All static work sites that cannot have around or past controls applied must seek to ensure the highest order of available treatments are designed into the TGS, so as to reduce the potential for vehicles entering the work area erroneously. This should include speed reductions and delineation installed in accordance with *Section 4.3.5 Protection of work area* to reduce the risk of incidents between road workers and traffic.

7.7.4.2 Working at traffic signals

For short duration low impact works such as emergency fault repairs or routine maintenance, traffic controls need to be quickly set up and dismantled while still being effective in directing traffic past or through work areas. These types of works may be best managed by developing a suite of generic TGS that can be selected from, customised and implemented at various locations as site suitable TGS.

For the longer term or more major works such as pavement resurfacing, signal reconstructions or the construction of new traffic signals, site-specific TGS should be developed for each location and in some cases for each stage of work at the intersection.

In addition to the planning requirements in *Section 5.3.3 Working at or close to traffic signals* the following applies to designing a TGS for work at these locations:

- Any traffic control arrangements that will affect the operation of traffic signals or require them to be flashed yellow must be approved as part of the road occupancy licence. The Transport Management Centre (TMC) implements these approved changes to signal operation upon request during the implementation of the TGS;

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- If working at or in close proximity to signals and alternate traffic control is needed, the signals must be flashed yellow and traffic control implemented on all approaches of the intersection prior to the use of a PTCD or STOP/SLOW bat;
- If turn restrictions or detours are necessary, in addition to the requirements of *Section 7.7.2 Around TTM methods* the following must be considered:
  - The impact that additional traffic has on the operation (phasing) of any traffic signals on the alternative route; and
  - The impact that any lane closures, particularly turn lanes has on signal operation (phasing) and intersection efficiency.
- Contact the TMC if real-time adjustments are needed to the operation (phasing) of traffic signals or adjacent signals during roadworks;
- Inform road users in advance of proposed works by advertising, for example using VMS roadside noticeboard advertising, letter drops or press releases; and
- Ensure that adequate provision is made for pedestrians and mobility aid users if it is necessary to turn off pedestrian signals or close a pedestrian crossing at intersection traffic signals.

Where lane closures are needed, the requirements of *Section 7.7.3.2 Closing a lane* must be applied.

Figure 7-13 provides an example layout of working at traffic signals with lane closure.

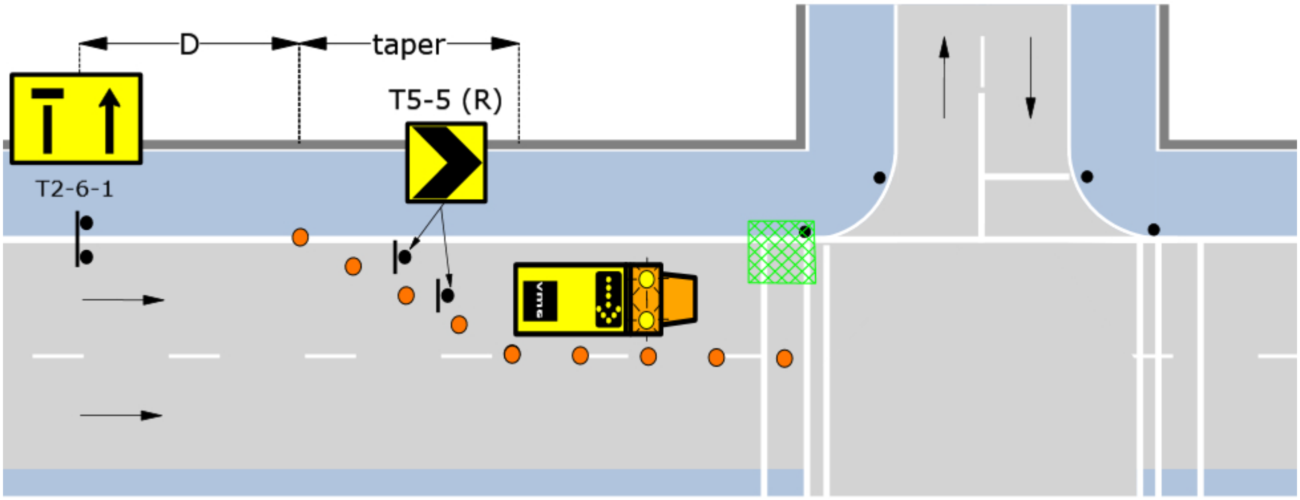

Figure 7-13. Example layout – work at traffic signals with lane closure

7.7.4.3 Excavations

Special consideration for the safety of both workers and traffic must be given while traffic flow is adjacent to excavations.

A temporary safety barrier must be installed where traffic travels beside an open excavation, deeper than 0.5 m and within 3 m of the travel path or edge line. When traffic is greater than 3 m from the excavation, the requirement for a temporary safety barrier should be considered during development of the TMP and risk assessment.

A temporary safety barrier must also be installed where the excavation depth exceeds 200 mm, and when the following applies:

- The excavation remains open longer than two weeks; and
- The distance of the excavation to the travel path or edge line is less than any of the following:
  - 3 m for 60 km/h approach speed;

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  - 6 m for 80 km/h approach speed; or
  - 9 m for 100 km/h or greater approach speed.

Temporary safety barriers installed must be in addition to barriers for excavation fall protection of road workers and road users.

When the adjacent lane is not under traffic control, excavations shallower than 0.5 m and within 3 m of the travel path or edge line must be defined by:

- Plastic mesh fencing;
- Barrier boards perpendicular to the traffic flow; or
- Cones, bollards or similar delineation.

Additional controls or mitigation measures as identified in the TMP or risk assessment must also be installed, e.g. temporary safety barriers.

If the project manager considers that compliance with these requirements is not practical or warranted, a more thorough risk analysis must be made, based on Austroads *Guide to Road Design Part 6: Roadside Design, Safety and Barriers* and Transport *Supplement to AGRD, Part 6*, and an application for a departure be submitted in accordance with *Section 2.8 Departures from this Technical Manual*.

In planning and carrying out works, priority must be given to backfilling all excavations near traffic as soon as practicable.

7.7.4.4 Bituminous works

Bituminous works or other pavement surfacing works may be conducted under active traffic conditions or when the work area has been cleared 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. This interruption to traffic should be kept to a minimum by careful planning and execution of the work. Such planning and control of the work also assists in the safe completion of the work.

The local community should be notified in advance of planned bitumen sealing works especially on busy roads.

The project manager must 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 no longer than 10 minutes. In such cases, the following should be determined:

- Widths and lengths of area to be treated;
- Timing to avoid peak traffic periods;
- Whether to introduce side tracks or detours; and
- Temporary closure of intersecting roads.

In the case of bituminous spraying works, care should be taken to ensure that wet bitumen or loose stones do not cause a hazard to traffic. For this reason, the works should be monitored for some days and adjustments made to signs or temporary speed zones to suit the road conditions.

For signs at sprayed sealing works, the four stages that should be considered are:

- Before sealing begins;
- During the sealing operations;
- Until the last loose stones are removed; and
- Until the appropriate linemarking and road markings are fully restored.

See *Figure 7-14* for signage examples.

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Where sealing works are undertaken in areas where the existing permanent speed limit is greater than 55 km/h, a 60 km/h roadwork speed zone must be installed and remain in place until the number of loose aggregate particles falls to the specified level.

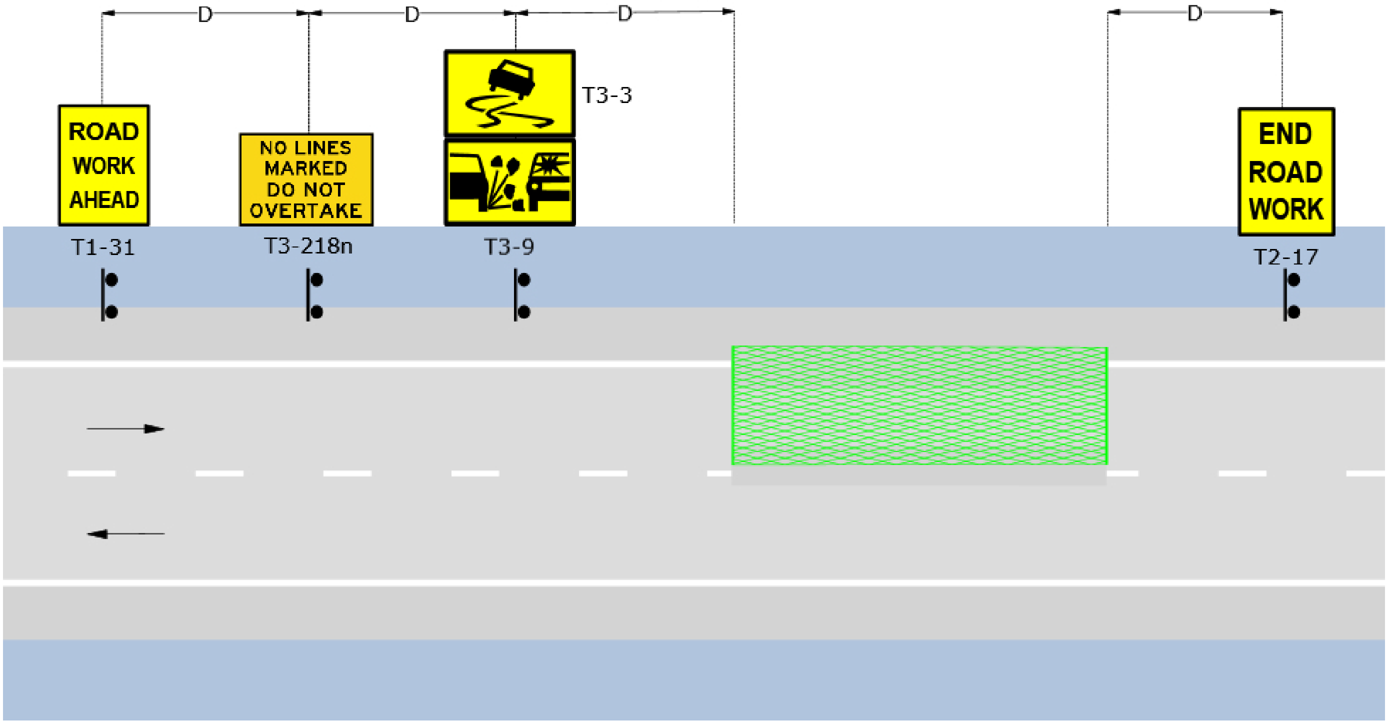

Figure 7-14. Example layout – bituminous works

7.7.5 Aftercare

Plans must be in place to ensure that traffic can proceed around, past or through a work site safely when workers are not present. This is typically referred to as *aftercare* traffic management. This includes periods outside normal working hours in either day or night when there are interruptions to the continuity of the work.

A separate TGS must be designed when aftercare is required at the work site, with the following applicable provisions (see *Figure 7-15* for an example layout):

- The TGS must include details of the requirements to manage traffic around, past or through the work site outside normal working hours or when workers are not present at the site. This includes the removal or covering of any signs that are not applicable, particularly temporary work site speed limits;
- Unless the risk assessment of the work site indicates otherwise, the work site speed limit should be returned to normal if safe or, if not possible, no more than 20 km/h below the existing permanent speed limit, having regard to the work site conditions (e.g. rough or slippery unsealed road surface, loose aggregate from bituminous works, or excavations close to the roadway); and
- Inspections of the site should be undertaken in accordance with *Section 8.1 Work site inspections, reviews and audits.*

As part of preparing the work site to be left unattended, the actions shown in *Table 7-5* should be considered.

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Table 7-5. Aftercare considerations and actions

Considerations	Actions
Size of site	Reduce the extents of the work site as much as possible by reducing the length of the work zone and removing/reducing any width restrictions.
Temporary speed limits	If temporary speed limits have been installed, the design should consider whether these need to remain in place or whether a higher speed zone or the existing permanent speed limit can be reinstated (any changes to a different temporary speed limit must be approved).
Unsafe conditions	Identification of potential unsafe conditions, e.g. loose material on the road surface, poor quality or confusing delineation, plant parked incorrectly, with mitigation measures implemented.
Signs	TTM signs need to remain in place and serviceable while the site is not attended. Check that all signs are ballasted for windy conditions, reasonably level, mounted at the correct height and positioned correctly.
Delineation	Check that all delineation devices are clean, positioned correctly, and adequately ballasted, e.g. double weighted bollards.

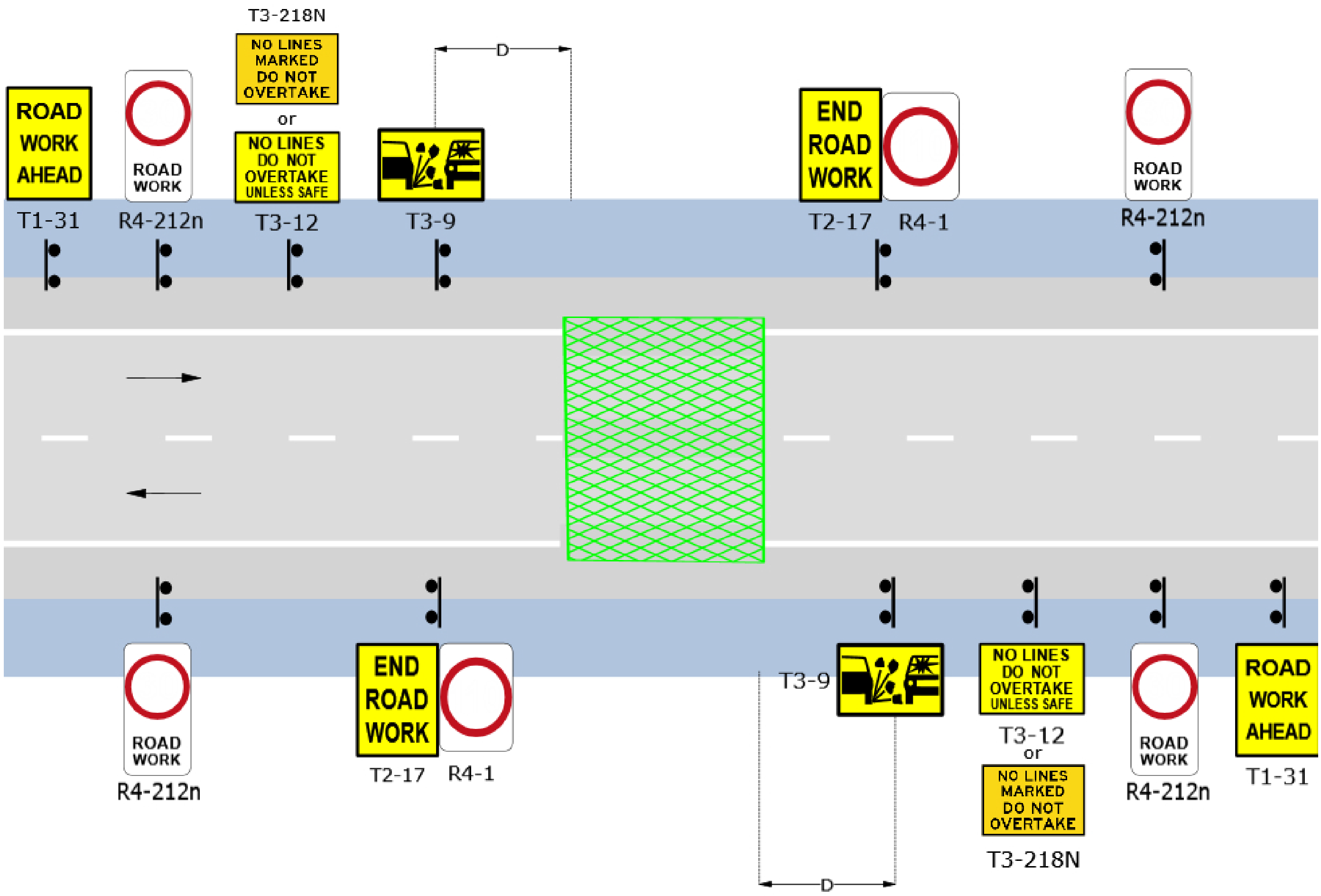

Figure 7-15. Example layout – aftercare

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7.8 Designing a TGS: Dynamic work

7.8.1 General

Dynamic work involves the carrying out of a work activity as one of the following:

- ***Frequently changing work*** – regularly moves between successive locations, either within or outside of a traffic lane where minimal warning is required to advise road users of the presence of workers;
- ***Continuous work*** – progressively moving vehicles along the roadway, often either wholly within, or wholly outside of a traffic lane; or
- ***Intermittent work*** – work which is undertaken on travel lanes, in gaps in traffic, and requires no adjustment that affects road users on the roadway.

The general principles that must be applied when developing a TGS for dynamic works are provided in *Table 7-6*.

Table 7-6. Principles for the design of a TGS for dynamic works

	TGS principles
Work site layout	• The work area should be designed to allow for movement of road workers, equipment, materials and vehicles, including sufficient waiting and storage space for TTM components. • The size and position of the work area should enable the work site to be managed effectively for the safety of road workers and road users. • The size and position may change during works depending on project tasks or location.
Sight distance	Sight distance allows a driver to see the work, react, and take required action to avoid a collision. Sight distance must: • Be determined in accordance with *Section 4.3.6 Sight distances*; and • Be appropriate for traffic composition (e.g. PBS vehicles see *Section 4.4.5 Heavy vehicles)*
Traffic volume	• Predicted end-of-queue lengths must be determined and a strategy must be documented in the TGS when higher than anticipated traffic volumes occur. • Unless unavoidable and essential, work should not be undertaken during peak times or special events that can influence traffic volumes.
Road users	When undertaking dynamic work, access provision must be maintained for impacted road users, e.g. users of foot paths or bicycle lanes must have access to safe alternatives
Speed	• The TGS must ensure that the appropriate speed zoning is in place for the dynamic work to be performed safely. • If speeding vehicles are predicted or noticed in the area, additional consideration should be given to advanced warning signs.
Vehicle placement	Dynamic works should be planned so that work vehicles do not need to straddle an edge line, and the placement of the work vehicles does not put at risk vulnerable road users. ***Note:*** *Some dynamic work such as linemarking or creation of a mobile taper may require lane straddling.*
Access to medians and verges	• Safe access and egress from medians and verges must be determined when planning dynamic work. • The road alignment and potential for vehicles to run-off onto median and verge should be considered when planning dynamic work in the median or verge.
Contingency	When performing dynamic work, a contingency plan must be developed if work cannot be completed as planned.

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7.8.2 Work convoys

Work convoys, as a whole or select convoy vehicles, might be required when undertaking dynamic work. The need for a convoy or otherwise is influenced by factors such as:

- Lane and shoulder widths;
- Geometric alignment – horizontal and vertical alignment;
- Sight distance;
- Grade of road;
- Traffic volumes;
- Speed of traffic;
- Number of traffic lanes;
- Traffic composition (i.e. proportion of heavy vehicles);
- Road user behaviour;
- Traffic movements – such as weaving traffic; and
- Workers on foot.

Where used, a works convoy must be made up of the vehicles in *Table 7-7*, as applicable, for the relevant road situation (*Figure 7-16* shows a typical layout of a works convoy).

Table 7-7. Vehicles and their function in a convoy

Vehicle	Role and function
Lead vehicle	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: • Warns oncoming road users of the work; • Alert following workers early to any impending danger from oncoming traffic; and • Shield workers and the work vehicle from approaching traffic.
Work vehicle	A '**work vehicle'** is the vehicle or item of plant which undertakes the work, e.g. a linemarking machine, or supports the workers on foot behind it.
Shadow vehicle	A '**shadow vehicle'** follows closely behind the work area as the work progresses. Its main purpose is to shield the work vehicle and/or workers on foot from traffic. This vehicle must travel at a clear distance of 20 m to 40 m 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.
Tail vehicle	A '**tail vehicle'** follows some distance behind the work area. The main functions of a tail vehicle are to: • Warn following road users of the work; • Divert traffic past the work area; and • Enable the driver to alert workers of any impending danger. ***Note***: *A second tail vehicle is required on motorway type roads.*
Advance warning vehicle	An **'advance warning vehicle'** should be positioned approximately 1 km behind the work convoy to give advance warning to following road users. • All signs and warning devices must be mounted on moving vehicles in the convoy; and • All vehicles and plant items in the works convoy, other than minor plant items, must have a flashing arrow sign fitted. An advance warning vehicle is not required for speed zones of less than 65 km/h with 2D sight distance.

Note to Table 7-7*: Additional requirements for vehicles in a convoy for motorway environments are provided in Section 7.8.4.4 Additional requirements: Work on motorway type roads.*

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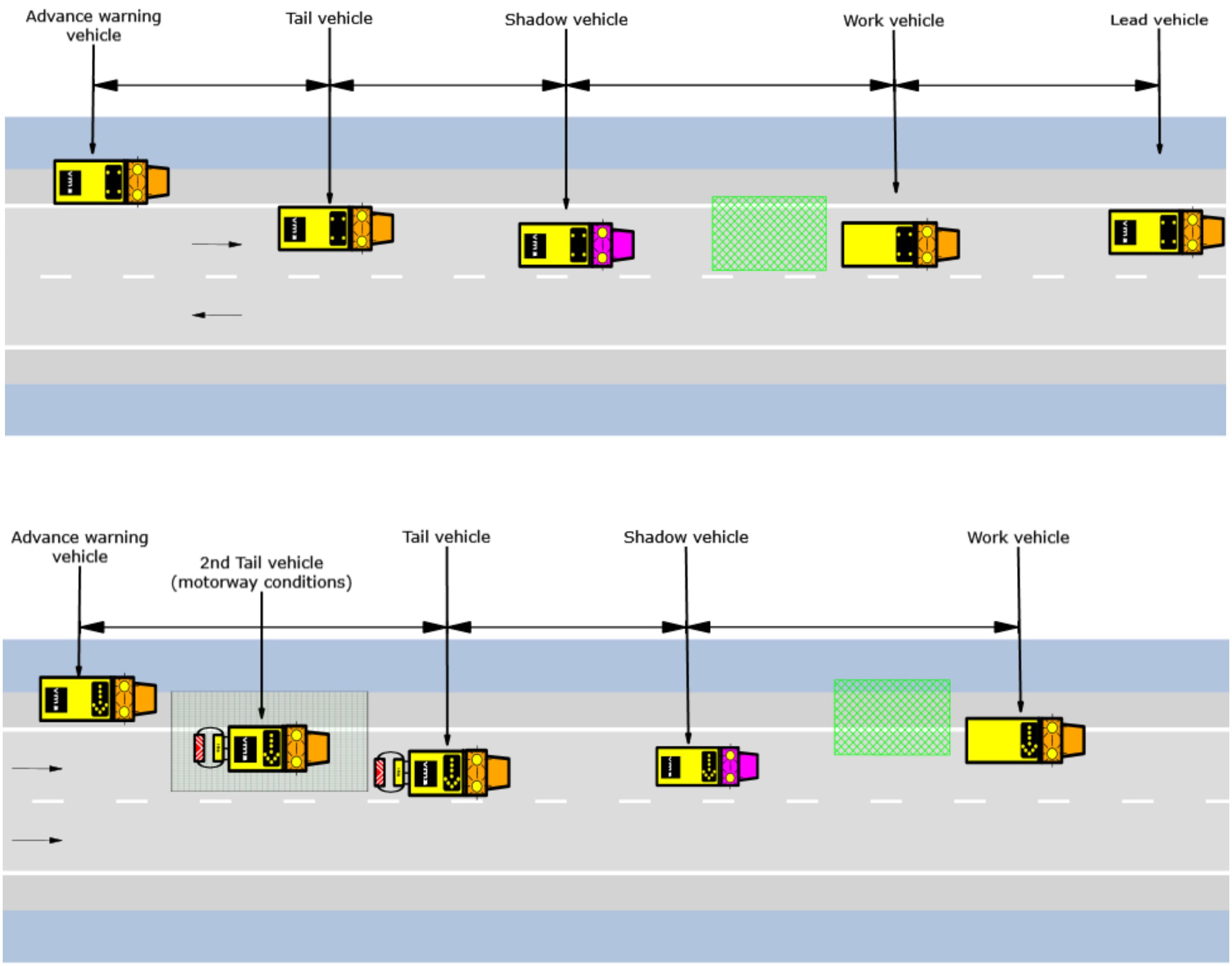

Figure 7-16. Works convoys – two-lane, two-way (top) and motorway conditions (bottom)

7.8.3 Frequently changing work

Frequently changing work involves regular movement between successive locations, either within or outside of a traffic lane where minimal warning is required to advise road users of the presence of workers. For frequently changing work to be conducted, the following criteria must be met:

- When conducted within a traffic lane:
  - Speed limit of less than 65 km/h; and
  - Maximum work period at any one location is 20 mins or up to 1 hour if traffic volumes are less than 40 vph.
- When conducted in a median or verge:
  - Sight distance that meets the criteria outlined in *Table 7-9* (or 50 m minimum sight distance to oncoming traffic not in adjacent traffic lane);
  - Speed limit of less than 75 km/h; and
  - Maximum work period at any one location with one of the following durations:
    - 1 hr at traffic volume less than 40 vph; or

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- 40 mins at traffic volume 40 to 150 vph; or
- 20 mins at traffic volume more than 150 vph.

Where the above criteria cannot be met the site must be set up as a static work site or completed as another suitable dynamic work type.

Frequently changing work may permit the short term partial closure of a road without advanced warning where all of the following conditions are met:

- The vehicle-mounted warning device on the work vehicle can be seen by approaching traffic for at least 250 m;
- No traffic control is required; and
- Traffic volumes are less than 20 vpd or there is room for two-way traffic past the work area.

Examples include:

Work outside a traffic lane	Work within a traffic lane
• Pit cleaning or repair; • Litter collection; • Tree pruning or planting; • Road signs or street furniture maintenance; or • Street light maintenance.	• Pavement marker laying other than on dividing lines; or • Pavement testing.

7.8.3.1 Minimum controls for frequently changing work

When undertaking frequently changing work the following minimum controls apply:

- A shadow vehicle or works convoy must be deployed to protect worker on foot or plant;
- All work vehicles must have at least one operating rotating or flashing yellow light on the work vehicle when work is being completed or the work vehicle is parked that is:
  - Not obscured by overhanging vegetation or a raised truck body; and
  - Visible for at least 150 m in a speed zone less than 65 km/h or 250 m elsewhere.
- Sight distance that meets the requirements of *Table 7-9;* and
- A contingency plan is in place so that work in progress can be abandoned immediately without risk to workers or traffic.

In addition, the following signage must be displayed:

- Signs up to 2 km in advance of each work position or item of moving plant. The distance between advance signs for opposing directions of travel must not exceed 2 km at any time and the location of such signs must be progressively changed to ensure the maximum separation is not exceeded as the work progresses along the road;
- At each advance sign location, either of the following signs must be used in conjunction with NEXT 2km (T1-28) and must be placed beside:
  - Workers symbolic (T1-5) where there are workers on foot; or
  - ROAD PLANT AHEAD (T1-3-1) where moving road plant only will be encountered.
- Where the work is repetitive and is undertaken within a designated length of up to 2 km, signs, such as WORKERS (symbolic) (T1-5) with NEXT 2KM (T1-28) or similar must be placed in advance of the work. Where this work is undertaken as a frequently changing work area, the advance signs must be progressively relocated so that in opposing directions they are never more than 2 km apart.

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Where signs and devices are mounted on the vehicles or road plant they must be visible and conspicuous to road users at all times, see also *Figure 7-17*.

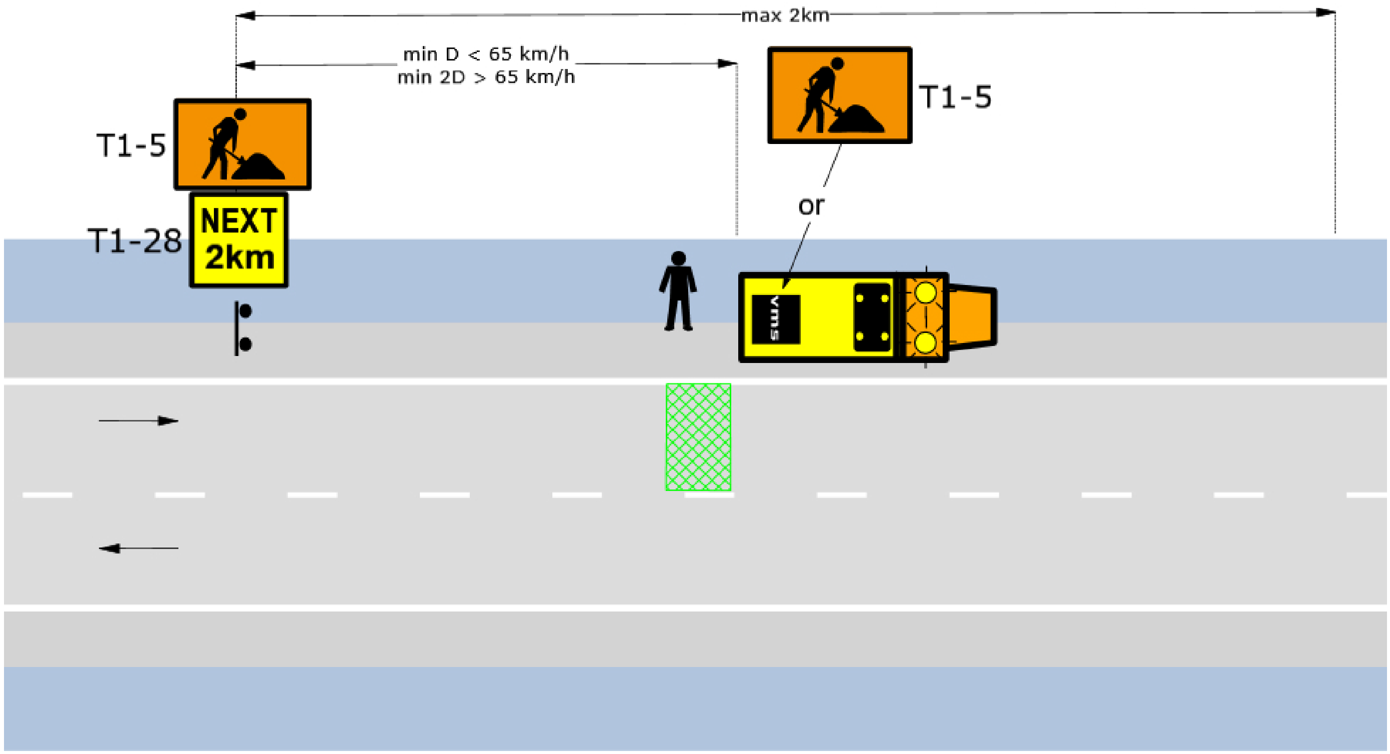

Figure 7-17. Example layout – frequently changing work

7.8.3.2 Additional requirements: Roads with less than 1500 vpd

Some works may be conducted as frequently changing work without the use of a works convoy or shadow vehicle provided all of the following conditions are met:

- Traffic volume is less than 1500 vpd;
- The minimum sight distance for following traffic is 1.5D;
- No more than two pieces of plant are operating within sight distance of each other;
- Posted speed limit is less than 85km/h; and
- At least 1.5m is maintained from live traffic.

Typically these activities include:

- Maintenance grading and resheeting of the traffic lanes on unsealed roads; or
- Shoulder grading on sealed or unsealed roads.

When undertaking frequently changing work without the use of a shadow vehicle, works may be undertaken within a road length of up to 10 km under the following conditions:

- Subsections of 2 km or less must be created and all signs must be installed 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;
- If sight distance to the vehicle-mounted warning sign on the works vehicle or plant is greater than 250 m throughout the section of road, ROADWORK NEXT __km (T1-24) must be placed at each end of the section.
- If the sight distance is less than 250 m at any point within the section:

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  - GRADER AHEAD (T1-4) or ROAD PLANT AHEAD (T1-3-1) together with NEXT 2km (T1-28) signs must be used on each approach to the section to cover the road length. These signs must be placed at least 100 m in advance of the start of any windrow; and
  - If the speed of traffic is greater than 75 km/h, a temporary speed zone of less than 65 km/h must also be implemented, see *Section 4.5 Speed zones*.
- Road condition signs must be placed at locations where the freshly graded surface has loose material that has become a hazard. Where required, one or more of the following must be installed depending on the nature of the hazard:
  - Slippery symbolic (T3-3);
  - SOFT EDGES (T3-6);
  - ROUGH SURFACE (T3-7);
  - GRAVEL ROAD (T3-13);
  - Loose stones symbolic (T3-9); or
  - LOOSE SURFACE (T3-14).

Additional information for specific activities are detailed in *Table 7-8*, see also *Figure 7-18.* Where traffic volumes are greater than 1500 vpd the works must be undertaken either as a continuously moving or static work.

Table 7-8. Additional information for specific activities

Activity	Additional information
Street sweeping	When undertaking works, the street sweeper must operate in a forward direction and not need to reverse for an extended distance. In addition, the sweeper may use a flashing arrow sign to direct traffic to one side of the vehicle if it is safe to do so.
Maintenance grading and resheeting	Wherever practicable, grading on the right side of the road against oncoming traffic should be avoided. Maintenance grading and resheeting may be carried out either with or without leaving a windrow. Work done without leaving a windrow normally involves use of either a windrow eliminator or a second grader in tandem. Where graded or resheeting material cannot be traversed by traffic, the grader blade should be raised from time to time to create a gap in the material or windrow so that traffic can overtake the grader.

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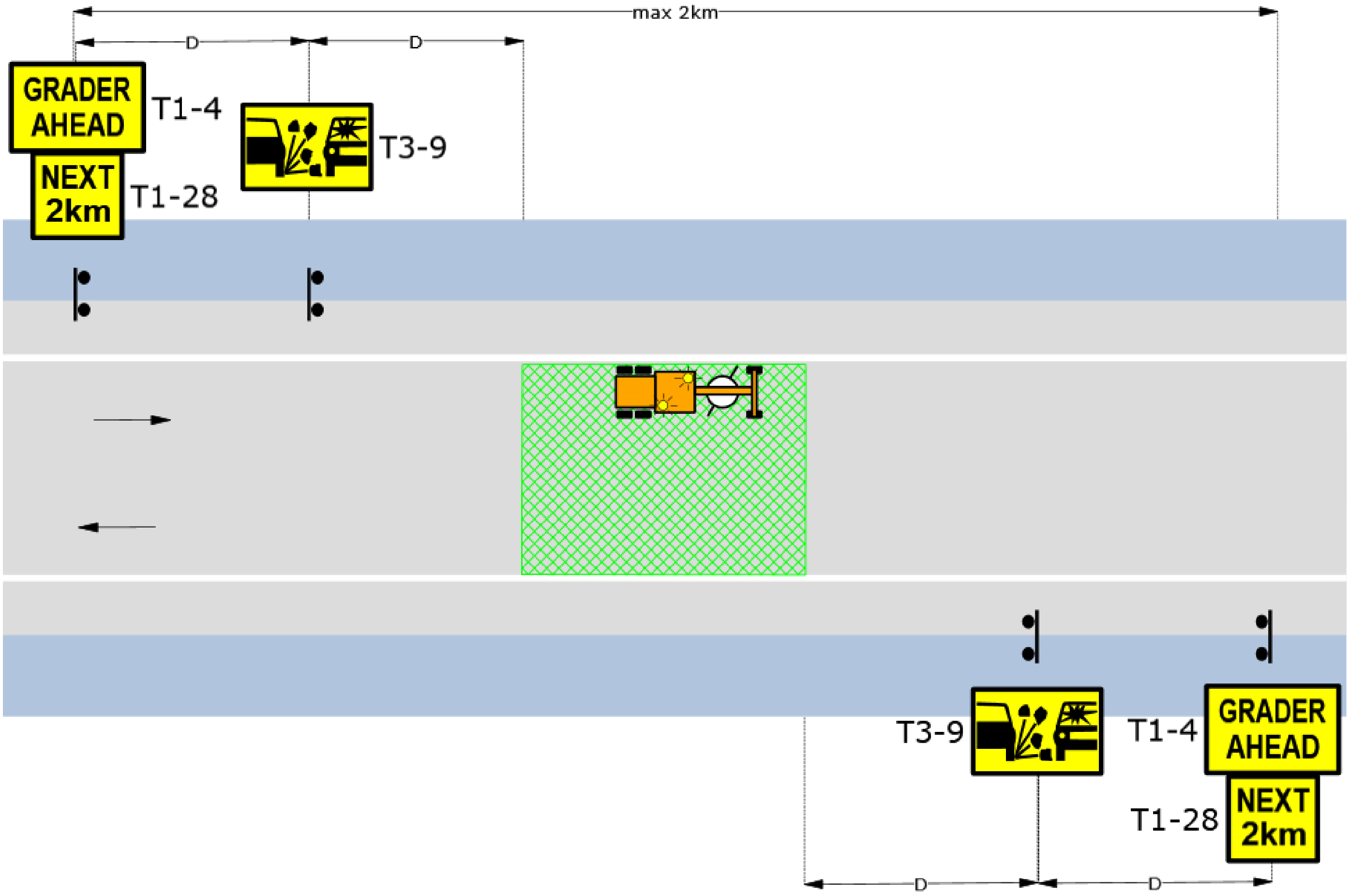

Figure 7-18. Example layout – grader ahead

7.8.3.3 Additional requirements: Work on a verge, median or footway

Access to verges, medians or footways must be carefully planned as it may involve works vehicles to manoeuvre in a manner that is unexpected by road users. Access to medians must be in accordance with *Section 5.2 Providing safe movements for works traffic*.

Median and verge mowing, tilling, seeding and weed spraying, works on a footpath and garden maintenance may be carried out without a shadow vehicle, subject to a risk assessment, provided the work is short term work and all of the listed conditions being met:

- Where there are no workers on foot, the relationship between speed limit and clearance to edge of traffic lane must be as follows:
  - Clearance of at least 1.5 m for speed limits greater than 85 km/h; or
  - Clearance of less than 1.5 m are permitted for speed limits less than 85 km/h, however plant items must not encroach onto the traffic lane.
- Where there are workers on foot:
  - The clearances detailed in *Section 4.3.4 Minimum clearances of workers to traffic* must be maintained; and
  - Where works will require workers on foot at one location for periods longer than 20mins, cones or bollards, must be placed along the kerb line or edge of traffic lane if no kerb exists.

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7.8.3.4 Additional requirements: Slow moving plant

Plant that moves along the roadway that cannot travel within 20 km/h of the posted speed limit may be moved using the principles of a 'frequently changing work site' in a traffic lane using one of the following actions:

- Put in place a TGS to stop traffic while the plant is moved. It would normally be necessary to stop traffic only in the direction the plant item is travelling;
- The plant item travels on the road shoulder or verge using gaps in traffic to pass obstructions and does not straddle the edge line; or
- Use a pilot vehicle or convoy of vehicles in accordance with the below.

Where required to pilot slow moving plant items travelling on the road, the following provisions apply:

- At least one pilot vehicle must travel behind the plant item;
- Up to three plant items may be guided in the one group using one or two pilot vehicles as prescribed above, provided a distance of 60 m to 80 m is maintained between the plant items;
- Where the sight distance is:
  - Less than 2D, the pilot must travel at the same speed as the plant item, and must be at a distance of approximately 2D behind the plant item;
  - Between 1D and 2D, the pilot must stop on the shoulder and must be completely clear of the travel lane until the plant item has moved a maximum of 6D ahead. The pilot may then travel at normal speeds to a point near the plant item and stop on the shoulder once again;
  - Less than 1D, a second pilot vehicle must 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 pilot 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 pilot vehicle must continue to operate as described above.
- The plant items must pull over periodically to allow traffic to pass so that the queue of traffic following does not exceed 12 vehicles.

In addition to the requirements of *Section 7.6.5 Pilot vehicles*, the PILOT VEHICLE DO NOT OVERTAKE (T6-5) sign must be replaced with ROAD PLANT AHEAD (T1-3-1) sign.

Where the above conditions cannot be met, plant should be floated between sites.

7.8.4 Continuous work

Continuous work is defined as work which entails vehicles moving along the roadway continually. Continuous work may be conducted with plant only, or with workers on foot, but must be completed either wholly within, or wholly outside of a traffic lane.

Examples include:

Plant only activities	Worker on foot activities
• Linemarking; • Pavement testing; • Pavement sweeping; • Low speed inspections • Snow clearing/spreading grit;	• Linemarking removal; • Pavement edge or pot hole patching; or • Raised pavement marker installations.

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Plant only activities	Worker on foot activities
• Grading - shoulder or unsealed road; or • Vegetation control.	

7.8.4.1 Minimum controls for continuous work

When undertaking continuous work (see *Figure 7-19*), the following minimum controls apply:

- All work vehicles must have at least one operating rotating or flashing yellow light on the work vehicle when work is being completed or the work vehicle is parked that is:
  - Not obscured by overhanging vegetation or a raised truck body; and
  - Visible for at least 150 m in a speed zone less than 65 km/h or 250 m elsewhere.
- All vehicles must stay wholly within or wholly outside of a travel lane; and
- If travelling more than 20 km/h below the posted speed limit, be protected by a works convoy as detailed in *Section 7.8.2 Work convoys*.

In addition, vehicles may:

- Use a flashing arrow sign to direct traffic to one side of the vehicle provided 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 must be flashed; and
- Require supplementary vehicle mounted signs such as:
  - WET PAINT ON ROAD (T2- 237n) or
  - ROAD PLANT AHEAD (T1-3-2).

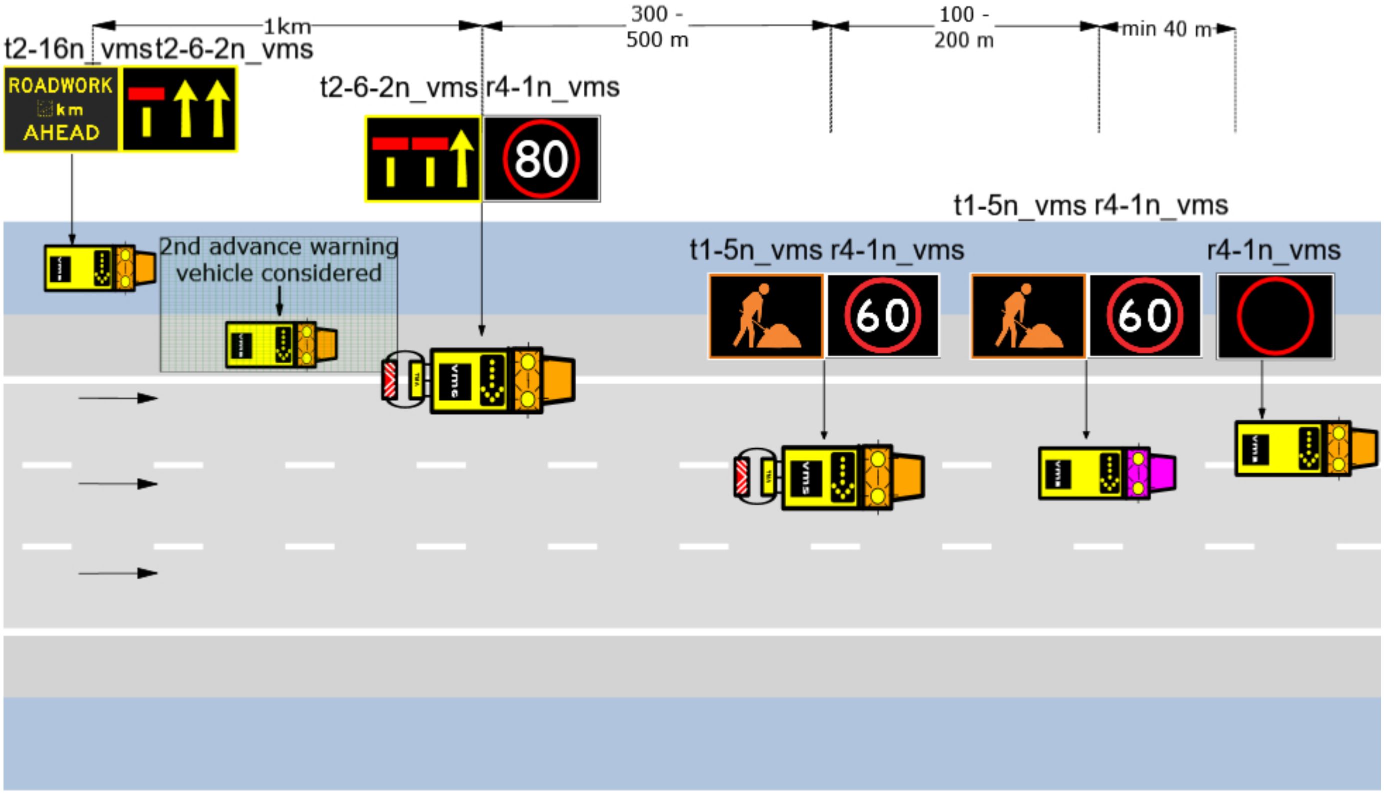

Figure 7-19. Example layout – continuous work

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7.8.4.2 Additional requirements: Advanced warning

Advance warning vehicles should be positioned in the same lane as the work vehicle. However, for work near the centre of a multi–lane undivided road or 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.

Vehicles providing advance warning must travel at the following convoy spacing:

- Where sight distance is greater than 2D:
  - 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; and
  - 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 less than 65 km/h.
- Where sight distance is less than 2D:
  - The lead vehicle must move as necessary beyond the distances given above to a point where sight distance of 2D is regained, and remain there until the work vehicle catches up; and
  - The tail vehicle must hold at a position of 2D 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 2D sight distance is regained.

7.8.4.3 Additional requirements: Work on two-way roads

Wherever practicable, following traffic must be directed to pass to the left of the work convoy by flashing the left barb of the flashing arrow sign.

Where it is not possible for traffic to pass to the left and opportunities to safely pass to the right do not exist the work must be stopped periodically by pulling off the traffic lane and allowing following traffic to pass.

Traffic must not be directed to completely cross a dividing line into the path of oncoming traffic. Additionally, traffic must not be directed to cross a freshly marked line if that would result in the marking being damaged.

7.8.4.4 Additional requirements: Work on motorway type roads

The shadow vehicle (second vehicle) in the convoy or any other vehicles occupying a travel lane (or part thereof) in a motorway environment must be fitted with a truck mounted crash attenuator (TMA), see *Figure 7-16* for further details. See *Section 6.10 Truck and trailer-mounted attenuators (TMA)* for specific requirements for the operation of a TMA.

A second tail vehicle must be provided for work on motorway type roads. The two vehicles must 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.

7.8.5 Intermittent work

Intermittent work does not require any adjustments that affect road users on the roadway. For intermittent work to be performed in a live traffic lane, work must be performed within safe gaps in traffic.

Intermittent work is only permitted as a work type when all of the following criteria are met:

- Sight distances in *Table 7-9* are achieved;
- Work can be performed within gaps in traffic; and
- Traffic is not obstructed.

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The duration of intermittent work must not exceed:

- ***5 minutes*** – if works are within 1.5 m of the live traffic lane;
- ***20 minutes*** – if works are in the shoulder or greater than 1.5 m from the live traffic lane; or
- ***60 minutes*** – if works are wholly within a verge, median or footway.

Intermittent work must not include:

- Speed limit changes;
- Tapers;
- Traffic control, i.e. use of traffic control devices or manual traffic controllers;
- Aftercare signs;
- Redirection of vulnerable road users; or
- Lane width or alignment adjustments.

Work must be treated as a frequently changing or static work areas where there will be two or more intermittent locations within a space of 2 km or less worked simultaneously.

Examples of intermittent work are pot hole patching, edge repair, seal or patch spotting, road inspections, removal of dead animals or debris, or litter collection etc., see *Figure 7-20*.

In addition to the TGS requirements in *Section 7.4 Information required on a TGS*, where applicable, when designing a TGS for intermittent work, the following information must be provided:

- A contingency plan so that work in progress can be abandoned immediately without risk to workers or traffic;
- Sight distances available for the work location; and
- Whether a lookout person is required to warn workers on foot of the approach of any vehicles whose speed or size might constitute a safety threat.

7.8.5.1 Minimum controls for intermittent work

When undertaking intermittent work, the following minimum controls apply:

- All work vehicles must have at least one operating rotating or flashing yellow light on the work vehicle when work is being completed or the work vehicle is parked that is:
  - Not obscured by overhanging vegetation or a raised truck body; and
  - Visible for at least 150 m in a speed zone less than 65 km/h or 250 m elsewhere.
- All road workers, materials and plant have the ability to quickly and safely move on or off the roadway in a short period;
- A contingency plan, so that work in progress can be abandoned immediately without risk to workers or traffic;
- Sight distances outlined in *Section 7.8.5.2 Sight distances for intermittent work;* and
- Where works involve workers on foot or small items of plant working within 3 m of a traffic lane, the Worker symbolic (T1-5) sign and/or ROAD PLANT AHEAD (T1-3-1) sign must be displayed.

When work is undertaken with a lookout person, the following provisions apply:

- There must be no approaching traffic for at least a minimum distance as shown in *Table 7-9* for the designated approach speed, i.e. approximately equivalent to 10 seconds travel time or 3D;
- The lookout person must have good eyesight and must be fully instructed in the lookout persons' duties; and

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- The lookout person must remain within sight and hearing distance of the worker(s) (generally within 2 m).

Where the distances shown in *Table 7-9* cannot be achieved, an advance lookout person should be used. This advance lookout person should be within sight distance of the first lookout person or within radio contact if sight distance is not possible.

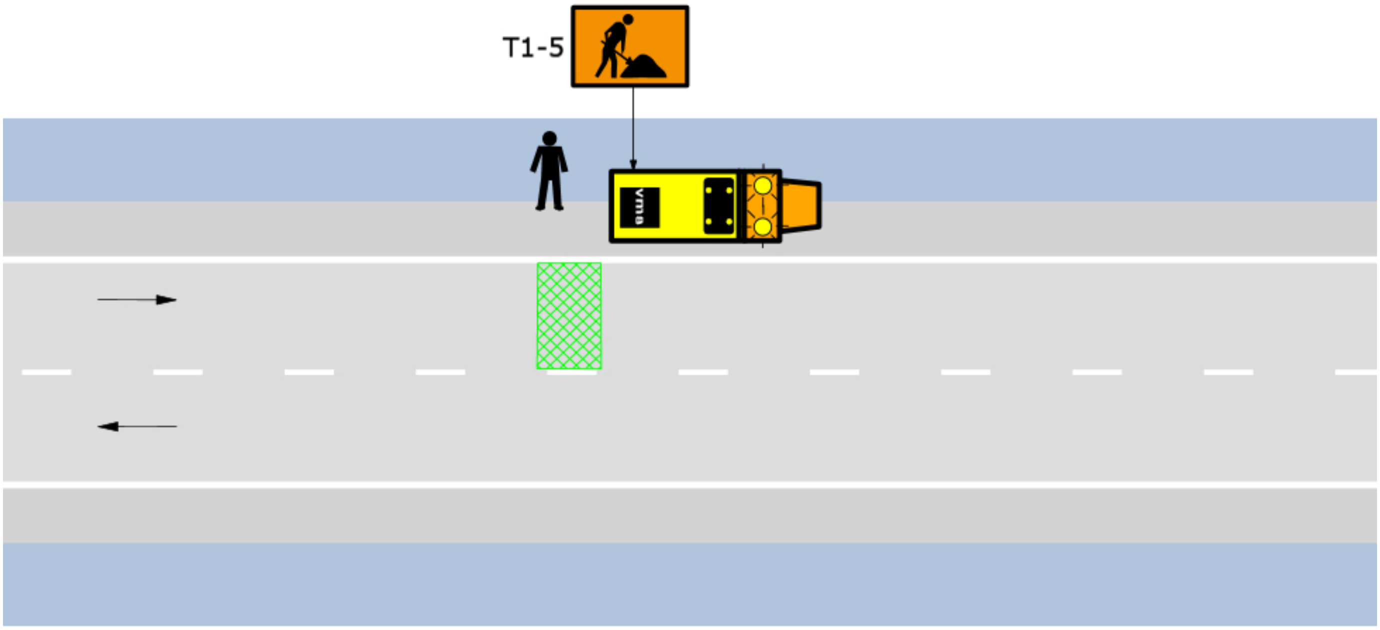

Figure 7-20. Intermittent work

7.8.5.2 Sight distances for intermittent work

When undertaking intermittent work, the need for a lookout person will be dependent on the sight distance available at the location. Sight distances, detailed in *Table 7-9* must be maintained at all times.

Table 7-9. Minimum sight distances for intermittent work

Approach speed (D) km/h	Minimum sight distance (m)	
	With a lookout person (3D)	Without a lookout person (6D)
20 or less	60	120
30	90	180
40	120	240
50	150	300
60	180	360
70	210	420

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Approach speed (D) km/h	Minimum sight distance (m)	
	With a lookout person (3D)	Without a lookout person (6D)
80	240	480
90	270	540
100	300	600
110	330	660

7.9 TGS confirmation and approval

7.9.1 TGS verification

After a TGS is selected or designed it must be approved as being appropriate for use at the work site. Site confirmation must be undertaken via the completion of the TGS verification.

A TGS verification must be undertaken to confirm the selected or designed TGS is fit for purpose. A TGS verification must be completed in accordance with *Section 8.1.2 TGS verification* by an ITCP or PWZTMP qualified person. TGS verification must include an inspection of the work site where the TGS will be implemented.

7.9.2 TGS approval

The PWZTMP qualified person who has designed or modified the relevant TGS must approve the TGS for use. Approval of the TGS must include:

- Review of the relevant TMP, risk assessment and associated TTM specific documentation;
- Design, redesign or modification of the TGS must be in accordance with the requirements of this Technical Manual; and
- Confirmation that the TGS provides the relevant information for the ITCP person to safely implement on-site.

The PWZTMP qualified person must seek approval from the one up manager if the TGS:

- Includes a non-standard or unaccepted sign or device;
- Includes any departures from the requirements of this manual; or
- If a manual traffic controller is proposed for use.

The TGS must include separate sign-off sections for the designer and approver. The sign-off sections must include the relevant persons:

- Full name;
- Role;
- Division / organisation;

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- Qualification number;
- Signature; and
- Date.

7.10 Implementing a TGS

7.10.1 General

A TGS must be installed, maintained and removed in a planned and safe manner. The implementation of a TGS must only be undertaken by an ITCP qualified person.

Before work begins, the ITCP qualified person must confirm that:

- The TGS has been selected, designed or modified and approved in accordance with this Technical Manual;
- Appropriate approvals have been given for road occupancy, speed zone authorisation, PTCD or use of manual traffic controllers;
- Copies of the relevant TMP, associated risks assessments and other relevant documents are obtained;
- Adequate materials (i.e. sign covers) are available to cover signs that are not needed; and
- All signs and devices on the TGS are available, are of correct size and are in good condition. Sufficient additional devices should be available to allow for any on-site adjustments, modifications and/or contingencies including:
    - Additional cones;
    - Repeater signs;
    - Additional signs for end-of-queue management;
    - Covering of existing conflicting signage;
    - Covering of signs not needed for aftercare TGS; and
    - Incident/emergency signage.

***Note**: Modifications and adjustments to a TGS must be undertaken by an appropriately qualified person and must be in accordance with this Technical Manual.*

7.10.2 Implementing a TGS

The sequence of implementation should be determined as part of the TMP, and detailed on the TGS or SWMS, rather than being determined on-site.

The general procedure for setting up a site should be in accordance with *Section 6.4 Sequence for installation and removal of signs and devices*. A different implementation sequence may need to be adopted to address any site specific circumstances.

The ITCP qualified person must ensure that the TGS is implemented as approved, with any minor adjustments completed in accordance with *Section 7.10.3 Tolerances on positioning of signs and devices*, are recorded on the TGS and a signed copy is available on-site.

Any anomalies or inconsistencies found in the TGS being used must be recorded and reported back to the TGS designer who is PWZTMP qualified.

If it is identified that risk will be generated through the implementation of a TGS that requires modification outside of the tolerances, then the site must be made safe and an updated TGS must be provided by a

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PWZTMP qualified person as soon as practicable. Where the TMP and TGS cannot be suitably adjusted or modified, the ITCP qualified person must advise the project manager that they are not appropriate and the works be postponed until a new site specific TGS is designed.

Once implemented, the appropriate inspection in accordance with *Section 8.1 Work site inspections, reviews and audits* must be completed.

7.10.3 Tolerances on positioning of signs and devices

Local constraints might not allow signs and devices to be placed exactly in accordance with the designed and approved TGS.

Where a specific distance is provided for the longitudinal positioning of signs or devices with respect to other items or features, the tolerances provided in *Table 7-10* may be applied.

Table 7-10. Permitted tolerances for positioning of signs and devices

Tolerance	Positioning of signs, length of tapers or markings	Spacing of delineating devices
Minimum	10% less than the distances or lengths given	Nil
Maximum	25% more than the distances or lengths given	10% more than the spacing shown

These tolerances must not be applied if a maximum, a minimum or a specific range has been specified on the TGS. They may need to be exceeded where road features such as intersections or median openings occur, provided approval is granted by the PWZTMP qualified TGS designer.

Any sign location changes must be marked and initialled on the TGS held on site, with the name of the person making the changes shown.

7.10.4 Modifying a TGS

Modifications to a Site Specific TGS must be approved by a person holding the PWZTMP qualification, and must be supported by a TMP or risk assessment to ensure all TGSs consider and mitigate identified site-specific conditions and risks.

The ITCP qualified person may vary the positioning of signs and devices provided the requirements of *Section 7.10.3 Tolerances on positioning of signs and devices* are met.

If it is identified that risk will be generated through the implementation of a TGS that requires modification outside of the tolerances, then works must be stopped (including the implementation of the TGS), the site must be made safe and an updated TGS must be provided by a PWZTMP qualified person prior to works recommencing.

7.10.5 Monitoring activities

In accordance with *Section 8.1 Work site inspections, reviews and audits*, initial and regular inspections must be completed.

Appendix E – Inspection checklists and tools, provides a checklist that may be appropriate for this purpose.

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7.11 TGS review

7.11.1 Generic TGS review

Generic TGSs must be reviewed by a PWZTMP qualified person every 12 months so that they remain appropriate. Once reviewed the date and details of the PWZTMP person must be updated on the TGS to ensure persons selecting can confirm currency.

7.11.2 Site Suitable and Site specific TGS review

All active Site Specific and Site Suitable TGSs must be reviewed as part of the weekly inspections detailed in *Section 8.1 Work site inspections, reviews and audits*.

A Site Specific or Site Suitable TGS must only be used for the duration of the work activity noted on the TGS. If the work activity is intended to be longer than 12 months, then the TGS must be formally reviewed by a PWZTMP qualified person at least every 12 months and issued with the review date and the details of the PWZTMP qualified person undertaking the review, and recorded on the TGS.

7.12 TGS records

All implemented TGSs must be recorded and stored in accordance with *Section 8.2 Record keeping of TTM documentation*.

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8 Work site inspections, recording and reporting

8.1 Work site inspections, reviews and audits

8.1.1 General

The inspection, review and audit of temporary traffic management (TTM) arrangements are critical to ensure that the work site is operating safely. As such, the structure, schedule and frequency of these activities must be considered and identified during the TTM planning phase. These aspects will vary depending on the size, complexity and duration of works.

There are two categories of monitoring activities that occur during TTM:

- ***Mandatory monitoring activities –*** these are required for all TTM arrangements (summarised in *Table 8-1*); and
- ***Additional monitoring activities*** – these are provided to assist the TTM application and may be prescribed as mandatory by Transport as divisional process in the relevant G10 specification or undertaken on behalf of client representatives as part of other functions (summarised in *Table 8-2*).

TTM monitoring activities must be undertaken in all instances where work is being performed or aftercare is in place. This includes during the day and at night times.

Table 8-1. Mandatory monitoring activities during TTM

Stage	Activity	Purpose	Qualification	Tools and checklists
Planning	TGS verification	To ensure that the TGS selected or designed is suitable for the works and location.	ITCP or PWZTMP	*Appendix E.2 TGS verification checklist*
During TTM	Weekly TTM inspections (includes preopening inspection)	To ensure that the TMP and relevant TGS are appropriate and operating safely, effectively and efficiently	PWZTMP	*Appendix E.3 Weekly TTM inspection checklist*
	Shift TTM inspections	To ensure that the TGS is implemented as designed. This includes at a minimum, twice per shift and when: • A TGS is installed, changed or updated; • At regular frequency after work commences, recommended every 2 hours; and • Once aftercare arrangements have been installed if required	ITCP or PWZTMP	*Appendix E.4 Shift / Daily TTM inspection checklist*
	TMP review	To ensure that TMP controls are achieving the required outcomes.	PWZTMP	Not provided
Post completion	Post-completion inspection	To ensure that the site has been demobilised as planned and is safe for opening to traffic	ITCP or PWZTMP	*Appendix E.5 Post completion inspection checklist*

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Table 8-2. Additional monitoring activities during TTM

Stage	Activity	Purpose	Qualification	Tools and checklists
During TTM	TTM Road Safety Audits	To identify road safety crash potential and areas of risk that could lead to traffic incidents in relation to the application of TTM. The aim of a road safety audit is undertake an objective assessment of crash risk.	Registered Road Safety Auditor **and** PWZTMP	Not provided
	Client inspections	Verification of TTM through the Transport Traffic Engineering, Work Health and Safety Branch, Surveillance Officers or other client representatives.	Divisionally determined	Not provided

8.1.2 TGS verification

In accordance with *Section 7.9 TGS confirmation and approval*, prior to use on site a TGS must be verified to ensure it is suitable for the works and the location. An example TGS verification checklist has been included in *Appendix E – Inspection checklists and tools* that may be suitable for this purpose.

Where a physical site inspection cannot be completed due to extenuating circumstances, such as emergency works or excessive distance, the TGS verification may be completed via the collection of the relevant information from other sources. Alternative sources of relevant information include aerial or street view images.

The purpose of the TGS verification is to ensure that the TGS selected or designed identifies and manages the site-specific risks associated with the location. As such the TGS verification must validate the accuracy of the data and information provided in the TMP and TGS, including but not limited to the existing permanent speed limits, and identifying any other items that may generate a risk or hazard during the works that have not already been considered, such as bus stops or parking.

Information that should be considered when undertaking a TGS verification includes:

- Shoulder widths;
- Sight distances;
- Existing permanent speed limit;
- Existing infrastructure such as signs, barriers, buildings and utilities;
- Transport services such as bus stops or parking facilities; and
- Other sources of risk for the works, such as community facilities.

Once completed, the TGS selector or designer, must ensure that all relevant supporting information, including records of verification, are included with the TGS for implementation.

8.1.3 Weekly TTM inspections

After a TMP and TGS have been approved and the TTM work site is established in accordance with this Section, a weekly TTM inspection must be completed prior to the initial opening of a work site, regardless of duration of work.

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***Note**: This means that the TTM has been installed, but the work intended to be protected by the TTM has not yet commenced.*

After the initial opening inspection, the same inspection must be completed on a weekly basis thereafter. *Appendix E – Inspection checklists and tools* provides a checklist that may be suitable for carrying out weekly TTM inspections.

The weekly TTM inspections must focus on effectiveness of the TMP in the context of the work being performed and that the TGS has been appropriately implemented.

The weekly TTM inspection must be:

- Undertaken by a person holding the PWZTMP qualification;
- Carried out from within the traffic stream at the normal traffic speed;
- Undertaken:
  - After the TGS has been implemented but prior to the work commencing on-site for the first time, known as a pre-opening inspection; and
  - At least once per week thereafter, known as a weekly inspection.

The pre-opening inspection must be carried out after the required TGS is installed but prior to the intended work activity commences or prior to opening a switch to traffic to ensure that:

- The work site is established in accordance with the TMP and relevant TGS;
- The TMP and relevant TGS are:
  - Provided and are on site;
  - Approved; and
  - Implemented as prescribed.
- Safe passage has been provided for all road users to travel around, past or through the work site;
- Signs and devices are in good condition and clearly visible to road users; and
- Any potential hazards are identified and addressed in the TMP and TGS prior to opening.

Thereafter, the weekly TTM inspection must ensure all of the above are maintained in addition to verifying:

- The work site is operating safely and as intended, including risk identification and mitigation;
- All incidents and near misses are reviewed; and
- Inspections are being completed.

When undertaking a pre-opening or weekly TTM inspection, the person completing the inspection should:

- Have a copy of the approved TMP and TGS used on-site;
- Ensure inspections are completed in day and/or night conditions as required; and
- If inspecting during low light, ensure low beam headlights are used for the inspection.

8.1.4 Shift TTM inspections

After the work site has been opened, shift TTM inspections, also known as 'daily' inspections, must be undertaken on a regular basis to confirm that the site traffic management:

- Has been implemented in accordance with the approved TGS;
- Is operating as intended; and

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- The controls implemented, are effective.

These shift TTM inspections ensure all road users are safely travelling around, past or through the work site. If vulnerable road user paths have been impacted, such as footways and cycle ways, the shift TTM inspection must include a walk-through or cycle-through as appropriate. The inspections must also include the surrounding road network if detour routes have been implemented.

The frequency of shift TTM inspections must be determined during the TGS development and approval phase by the PWZTMP qualified person, and recorded on the relevant TGS.

Shift TTM inspections must be completed at regular intervals throughout the work shift, at a minimum, shift TTM inspection must be completed twice per shift, however it is recommended that they be completed every two hours. TTM shift inspections must additionally be completed when:

- A TGS is installed, changed or updated; and
- Once aftercare arrangements have been installed, if required.

Shift TTM inspections must be undertaken by an ITCP or PWZTMP qualified person. When undertaking a shift TTM inspection, the person completing the inspection should:

- Have a copy of the TMP and TGS used on site;
- Carry out the inspection from within the traffic stream at the normal traffic speed;
- Ensure inspections are completed in day and/or night conditions as required; and
- If inspecting during low light, ensure low beam headlights are used for the inspection.

Where relevant, the shift TTM inspection must ensure that:

- Signs and devices:
  - Are installed and spaced in accordance with approved TGS;
  - Are in good condition, undamaged, in place and clearly visible to road users; and
  - Have been added, adjusted or moved in accordance with the approved TGS.
- There are no conflicting signs and devices;
- Delineation is clear and appropriate;
- Any variations, changes or departures to the TGS are recorded, approved and incorporated;
- Changed conditions do not impact on visibility of signs and devices (e.g. shade, parked vehicles etc.);
- There will be no drainage issues during a rain event from the positioning of signs or devices, or other safety issues arising from where traffic will be travelling through the work site;

In addition, a shift TTM inspection must be undertaken at least once for aftercare conditions to ensure:

- The relevant signs and devices have been covered and/or removed;
- The covers adequately cover the out-of-service sign;
- All covers are securely installed and will remain in place during windy conditions; and
- The appropriate speed limit is reinstated as per TMP & TGS.

A shift TTM inspection checklist is included in *Appendix E – Inspection checklists and tools* and may be used to keep a record of the inspection.

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8.1.5 TMP reviews

TMP reviews are undertaken to ensure TMP elements are implemented as designed and remain appropriate. The TMP review must be undertaken by PWZTMP qualified person, who is independent to the installation of the TTM, usually the relevant project manager.

The objectives of a TMP review are to:

- Ensure that due consideration has been given to traffic management planning, risk identification and mitigation;
- Ensure that the work site is operating safely;
- Assess site conditions to ensure implemented speed limit is appropriate;
- Ensure that the TGS has been provided, is available on the work site, has been approved and has been implemented as prescribed;
- Ensure any variations to the TGS (for example in sign location due to shade, parked vehicles) are in accordance with *Section 7.10.3 Tolerances on positioning of signs and devices*, recorded on the TGS and approved; and
- Record discrepancies and non-compliances and make recommendations for rectification.

Table 8-3 provides additional requirements in relation to TMP reviews.

Table 8-3. Additional requirements for TMP reviews

Type of TMP review	Frequency	Considerations
Scheduled	The scheduled TMP review must be undertaken every 6 months or as determined by the relevant G10 Specification or project specific plan (PSP).	The scheduled TMP review must consider the following: • TMP and TGS are approved; • Identify required variations to the TGS, and ensure that they are updated, recorded and approved; • Review any departures or variations to ensure they have been documented and approved; • Speed control effectiveness; and • Construction vehicle entry/egress suitability.
Change generated review	The change generated TMP review must be undertaken when implementing new traffic stages, switches or diversions.	The change generated TMP review must consider the following: • The work site is operating safely; • Delineation is effective with appropriate signage installed for changed conditions; • Safe passage is provided for all road users; • Road Safety Audits are arranged or confirmed as required by *Section 8.1.7 TTM road safety audits*; and • Accountability for approval and inspection is well understood and documented.
Post-incident or near miss	The post-incident or near miss TMP review must be undertaken following an incident or near miss.	The post incident or near miss TMP review must consider: • Causal factors; • Contributory factors or changes required; and • Identified changes to TGS are completed, approved, recorded and communicated.

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Type of TMP review	Frequency	Considerations
		For any incidents or near miss (where required) a safety alert must also be prepared and distributed by the Transport project manager to share learnings with other work sites.

8.1.6 Post completion inspection

A post completion inspection must be undertaken to ensure the site has been demobilised as planned and is safe for opening to traffic. This must be completed by an ITCP qualified person, to ensure:

- The road has been reinstated to the planned condition;
- All temporary speed limits have been removed;
- All signs and devices are removed from the site; and
- No hazards as a result of the work site are present.

If any issues are noted they must be rectified as soon as practical.

An example post completion inspection checklist is provided in *Appendix E – Inspection checklists and tools* and may be used to guide this inspection.

8.1.7 TTM road safety audits

A TTM road safety audit (RSA) is a formal technical assessment of a road construction project to identify crash potential and areas of risk that could lead to traffic incidents. The aim of a road safety audit is to undertake an objective assessment of crash risk and identify foreseeable hazards for all road users.

Transport works should develop an audit schedule in line with the relevant divisional quality management framework. The project manager is accountable and must be satisfied that RSAs are completed where required.

The requirement and frequency of an RSA will be specified in the works-relevant G10 or in divisional processes. Additionally, it may be beneficial to perform a pre-opening and finalisation RSA where the temporary or permanent traffic control devices cannot be completed or installed until traffic is switched onto the new alignment.

A TTM RSA must be conducted in accordance with the requirements in the Austroads *Guide to Road Safety Part 6: Managing Road Safety Audits* and must be conducted by an independent and qualified Road Safety Audit team, who must also hold a PWZTMP qualification. TTM RSAs may be completed either internally or externally. RSAs should be carried out during both day and night time to ensure appropriate delineation is in place to suit the conditions.

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8.1.8 Client inspections

Additional TTM inspections may be carried out by the client through the Transport Traffic Engineering, Work Health and Safety Branch, Surveillance Officers or other client representatives. Projects should make contact with their client to determine frequency and needed preparations for these inspections.

8.2 Record keeping of TTM documentation

8.2.1 General

Documentation and recording of information related to the TTM is an essential part of the process to ensure that the TTM has been implemented as designed and the controls are achieving the desired outcomes. As required by the State Records Act, records must be retained for seven years as this will also be required in case of an investigation relating to an incident or legal proceedings are commenced.

Records of TTM documentation must be kept and include at a minimum:

- The identification of the job;
- Reference number of the TMP or TGS;
- Date and location of the TTM;
- The name of the person keeping the record; and
- The name of the person responsible for the work.

TTM documentation produced as a result of site-specific works must be kept and include at a minimum:

- Approved TMP developed for the works;
- Completed risk assessments;
- Approved TGSs used, including versions where modifications or updates have been made;
- Other relevant documentation including staging plans;
- Completed inspection checklists that have been undertaken in accordance with *Section 8.1 Work site inspections, reviews and audits*;
- Records of traffic related incidents that occurred during the works;
- Any departures, and approvals of departures from this Technical Manual; and
- Any other relevant document generated by the process of completing the TTM works.

It is recommended that a folder system be developed to house all relevant TTM documentation for each activity. The format of the folder (e.g. paper based or electronic) and storage requirements will depend on the divisional record keeping requirements.

8.2.2 Generic TGS library

A TGS library is a series of generic TGSs that have been designed by a work group for use at particular locations or for specific work types. The TGS library makes relevant TGSs readily accessible for the person selecting a TGS for specific work activities.

For example, a works depot that is responsible for the regular maintenance of a particular section of the network may collate a series of generic TGSs, from which the nominated PWZTMP or ITCP qualified person can select.

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TGSs included in a TGS library must be approved by PWZTMP qualified person. When developing a TGS library, a TGS selection procedure must also be developed in accordance with *Section 7.5.2 TGS Selection Procedure,* to aid the effective selection of a generic TGS for use.

A process must be developed to ensure the TGSs in the library are:

- Stored appropriately;
- Easily identified and accessed;
- Secure, so that a generic TGS is not changed or removed without authority; and
- Identified as being an approved generic TGS.

A site-specific TGS may become part of the generic TGS library if it is suitable for ongoing use, provided it is approved by a PWZTMP qualified person and endorsed for inclusion in the library.

8.2.3 TTM inspection records

All TTM inspections must be completed in accordance with relevant requirements *Section 8.1 Work site inspections, reviews and audits*. A record of each TTM inspection must be kept and include the following:

- Reference to the TGS that was used and inspected;
- The start and finish times and location/s of the works;
- The date and time of the inspection;
- Any deficiencies identified and corrective action taken;
- Detail of adjustments and modifications made and by whom;
- Name of person authorising any modifications;
- Any near misses;
- Time of next shift TTM inspection;
- Name of the ITCP qualified person who implemented the TGS;
- Weather conditions and
- Details of on-site traffic controllers;

Daily records should be detailed enough to identify the site, signs and devices which were in place at a given time on a given day. This enables an external party (for example, a coronial request), to establish the conditions and TTM which existed at a specific point in time. Photo and/or video evidence should also be collected and stored in support of other forms of documentation such as checklists, TTM diaries and site registers.

All records of inspections must be made available to Transport personnel, or those working on behalf of Transport.

8.3 Reporting work site incidents

8.3.1 General

For all traffic related incidents, either witnessed or reported, involving the public or from which legal proceedings might arise, the following must be recorded and reported to Transport:

- Type, size and location of signs and devices in use at the time of incident;

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- Travel path width and road condition;
- Weather conditions;
- Witnesses present;
- Details of any personal injuries; and
- Extent of any vehicle damage and the vehicle details (e.g. registration).

8.3.2 Reporting procedure for Transport employees

The reporting process in *Table 8-4* must be followed by Transport staff performing work for Transport. The SRIMS Helpdesk can be contacted in 1300 131 469 or SRIMS mailbox SRIMS@transport.nsw.gov.au for assistance.

Table 8-4. Reporting requirements for Transport for NSW staff

Type incident	Requirements
Incidents involving Transport employees	All workplace incidents and near misses must be reported immediately to the workplace supervisor who is responsible for investigating the incident. The incident and investigation must also be recorded in Transport's incident reporting system, SRIMS.
Incidents involving non-Transport employees on Transport work sites	All workplace incidents that involve a non-Transport employee including contractors, visitors and members of the public must be reported immediately to the Transport workplace supervisor, who is to determine responsibility for investigating the incident. The incident and investigation must also be recorded in the incident reporting system of Transport, SRIMS.

8.3.3 Reporting to SafeWork NSW

By law, employers or occupiers must report work-related incidents to SafeWork NSW 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 if they are not the employer.

Serious incidents must be notified to SafeWork NSW immediately as an urgent investigation may need to be undertaken. For Transport internal work, the Work Health and Safety Branch is responsible for notifications to SafeWork NSW.

Serious incidents include where:

- There has been a fatality to an employee, contractor, visitor or member of the public;
- 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; or
    - Has serious burns.
- There is an immediate threat to life, such as major damage to machinery or buildings;
- It is highly visible to the public or has the potential for media interest.

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Further details on SafeWork NSW's reporting requirements can be found on the SafeWork NSW Incident Notification website.

After a serious incident has been reported the immediate area around the incident must not be disturbed (adhering to SafeWork NSW requirements), except where exemptions are provided for under the WHS Act 2011 which include to assist any injured persons, to avoid further injuries and issues or where SafeWork has authorised work to continue.

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Appendix A – Traffic management planning templates and tools

INFORMATIONAL APPENDIX

A.1 Scope

This Appendix provides a number of templates that may be used by project teams in relation to temporary traffic management planning. While every attempt has been made to align these templates with the requirements of this Technical Manual, the templates are examples only. The use of these templates might not necessarily fulfil all of the relevant requirements of this Technical Manual. And thus, pertaining to each work site, it remains the obligation of project teams to ensure all relevant requirements of this Technical Manual have been met regardless of the content of these example templates.

Additionally, this Appendix also provides a template that may be used by practitioners who wish to propose general departures to the requirements of this document.

A.2 TMP development templates

A.2.1 General

The templates provided in this Section may be used for temporary traffic management planning. The templates comprise:

- Temporary traffic management strategy template;
- Temporary traffic management plan and approval template; and
- Temporary barrier design statement template.

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A.2.2 Temporary traffic management strategy template

For the risk associated with temporary traffic management to be effectively managed, it is important that the conditions and constraints associated with the works are understood. For this to be achieved, the client must collect the relevant data and information and transfer this to the delivery partner to ensure an informed TMP is developed.

MANDATORY INFORMATION

An electronic version of this template is provided here.

Prepared by			
Name:		Role:	
Division:			
Signature:		Date:	
Persons consulted in the development of the traffic management strategy			
Name:		Role:	
Division:		Signature	
Name:		Role:	
Division:		Signature	
Name:		Role:	
Division:		Signature	

Site related information	
Project	
Activity / work	

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Site related information				
Location				
Current Project Phase	☐ Strategic design	☐ Concept Design	☐ Detailed Design	☐ Other ________

Site related data			
Attach a cross section and photo / aerial of location of works			
Cross section details	*Describe unique features of the cross section*		
Setting of works	☐ Urban	☐ Rural	
Existing speed limit/s	*(provide examples:* *Road name 1: limit* *Road name 2: limit)*		
Traffic volumes	Traffic volumes (ADT): _______	Traffic volumes (AADT): ________	
	Peak times AM: ____________	Peak times PM: ____________	
Traffic composition	☐ OSOM	☐ Heavy vehicles ________ (%)	☐ Permit vehicle routes
If yes provide details	Details		
Details of crash history at location	*Provide details of crash history and comment on any patterns of crashes*		

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Site related data			
Are intersections impacted by the project length?	☐ Yes ☐ No		
If yes provides details	Details		
Vulnerable road users and other facilities	☐ On-street parking	☐ Transport facilities (bus stops)	☐ Clearways
	☐ Cycle paths	☐ Pedestrian paths	☐ Other
If yes provides details	Details		

Constraints			
Significant traffic generators *If selected provide details*	☐ Community facilities	☐ Events	☐ Schools
	☐ Mines	☐ Other:	
	Location		
	Duration / time restrictions:		
	Impacts:		
Road environment constraints	*Heritage, utilities, cuttings, significant cut/fills, bridges, guardrails, limited shoulders, environmental constraints (threatened species)*		

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Other considerations or comments	
Other considerations	*Provide additional relevant information not included in the above*

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OPTIONAL INFORMATION

An electronic version of this template is provided here.

Options assessment						
Option 1:						
☐ **Around** ***An around should be considered as the first option.***		**Description:**	***Provide detail of around strategy, if none available this should also be detailed***			
Is this option feasible?		☐ **Yes** ☐ **No**	*If no, provide justification here* *If yes, complete information below to the best of your ability*			
Benefits			**Constraints**		**Estimated option cost**	
Include potential cost/time benefits						
Duration of works		**Hours of operation**		**Other considerations**		
	Days	*Day / night Or hours (if known)*		*Including provision for works traffic etc.*		
	Weeks					
	Months					
Consultation required				**Approvals required**		

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<table>
<tr><th colspan="6">Options assessment</th></tr>
<tr><td colspan="6">Option 2:</td></tr>
<tr><td colspan="2">☐ Around ☐ Past</td><td>Description:</td><td colspan="3">Provide detail of around strategy, if none available this should also be detailed</td></tr>
<tr><td colspan="2">Is this option feasible?</td><td>☐ Yes ☐ No</td><td colspan="3">If no, provide justification here

If yes, complete information below to the best of your ability</td></tr>
<tr><td colspan="3">Benefits</td><td colspan="2">Constraints</td><td>Estimated option cost</td></tr>
<tr><td colspan="3">Include potential cost/time benefits</td><td colspan="2"></td><td></td></tr>
<tr><td colspan="2">Duration of works</td><td colspan="2">Hours of operation</td><td colspan="2">Other considerations</td></tr>
<tr><td></td><td>Days</td><td colspan="2" rowspan="3">Day / night Or hours (if known)</td><td colspan="2" rowspan="3">Including provision for works traffic etc.</td></tr>
<tr><td></td><td>Weeks</td></tr>
<tr><td></td><td>Months</td></tr>
<tr><td colspan="4">Consultation required</td><td colspan="2">Approvals required</td></tr>
<tr><td colspan="4"></td><td colspan="2"></td></tr>
</table>

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<table>
<tr><td colspan="6">Options assessment</td></tr>
<tr><td colspan="6">Option 3:</td></tr>
<tr><td colspan="2">☐ Around ☐ Past</td><td>Description:</td><td colspan="3">Provide detail of around strategy, if none available this should also be detailed</td></tr>
<tr><td colspan="2">Is this option feasible?</td><td>☐ Yes ☐ No</td><td colspan="3">If no, provide justification here

If yes, complete information below to the best of your ability</td></tr>
<tr><td colspan="3">Benefits</td><td colspan="2">Constraints</td><td>Estimated option cost</td></tr>
<tr><td colspan="3">Include potential cost/time benefits</td><td colspan="2"></td><td></td></tr>
<tr><td colspan="2">Duration of works</td><td colspan="2">Hours of operation</td><td colspan="2">Other considerations</td></tr>
<tr><td></td><td>Days</td><td colspan="2" rowspan="3">Day / night Or hours (if known)</td><td colspan="2" rowspan="3">Including provision for works traffic etc.</td></tr>
<tr><td></td><td>Weeks</td></tr>
<tr><td></td><td>Months</td></tr>
<tr><td colspan="4">Consultation required</td><td colspan="2">Approvals required</td></tr>
<tr><td colspan="4"></td><td colspan="2"></td></tr>
</table>

If additional options are required use Options 2 and 3 as a template for completion

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Recommendation	
Recommended option	
Justification	
Critical risks and considerations	
Additional comments	

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A.2.3 Traffic management plan and approval template

Prepared by			
Name:		Role:	
Card number:		Organisation:	
Signature:		Date:	

Location of works	
Project	
Activity / work	
Location	
Dates relevant for TMP work	*DD/MM/YY – DD/MM/YY*

Traffic Management Strategy (TMS) Verification	
Has the TMS been received and attached to this TMP?	☐ Yes ☐ No *If "no" has been selected a TMP should not be developed until TMS information is obtained*
Provide updated information regarding TMS if required	
Current existing speed limit/s	*(Road name 1: limit* *Road name 2: limit)*

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Traffic Management Strategy (TMS) Verification			
Updated traffic data	Traffic volumes (ADT):		Traffic volumes (AADT): if available
	Hourly traffic volumes :		Operating speed
	Peak times AM:		Peak times PM:
Traffic composition	☐ OSOM	☐ Heavy vehicles ________ (%)	☐ Permit vehicle routes
If yes provide details	Details:		
Site and work specific considerations	*Additional to TMS, additional time, with environment or community concerns*		
Additional options available	*For additional options identified, the process of assessment outlined in the TMS must be completed*		

Decision point: Temporary Traffic Management Method	
Was an options assessment completed by the client?	☐ Yes ☐ No If yes, review and provide summary below If no, undertake an assessment
Summary of TMS options	
TTM method	☐ Around ☐ Past ☐ Through Option Selected: *nominate option selected from TMS*

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Decision point: Temporary Traffic Management Method	
Justification	

Traffic Management Planning				
TTM type	☐ Mobile	☐ Low impact	☐ Static	
Will lane or shoulder widths need to be modified?	☐ Yes		☐ No	
	If yes provide justifications and drawings:			
Specific road users impacted	☐ Pedestrians	☐ Cyclists	☐ Motorcyclist	☐ OSOM
	☐ Freight Industry	☐ Persons with disability, prams or children	☐ Public transport e.g. bus, tram.	☐ Other
	If one or more groups selected provide details of impacts and considerations:			
Additional location specific requirements to be considered?				

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Risk assessment				
Undertake and attach to this TMP a risk assessment of the proposed works with the determined strategy.				
List of sources of information used in risk assessment				
Has the risk assessment considered?	☐ Proximity of traffic	☐ Queued traffic	☐ High traffic volume	☐ Traffic speed and compliance behaviour
	☐ Traffic composition	☐ Exposure and proximity of workers to live traffic	☐ Length of delays for road users	☐ Traffic generating land use (hospital, mine, school)
	☐ Non-compliance with temporary speed limits	☐ Reduced lane and shoulder widths	☐ Compromised access points	☐ Site vehicle access and egress points
	☐ Horizontal (curves) and vertical (crests/sags) alignment	☐ Utilities including above and below services	☐ Crash history	☐ Topographical constraints
	☐ Sight distances	☐ Emergency services	☐ Car parking impacted	☐ Transport services (bus stops etc)
	☐ Access to private and commercial properties	☐ Local road access	☐ Special events or high risk venues	☐ Other ________________
Key risks identified as a result of works:				

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Risk assessment

Specific controls required:			
Protection of workers	☐ Barriers	☐ Delineation	☐ Other
	Provide details:		
Will a speed restriction be required?	☐ Yes	☐ No	
	If yes provide justifications and drawings:		
End queue management strategy:	*Provide details of:* *Calculated end-of-queue length* *Control required* *Sight distances*		
Delineation of site	*Detail how site must be delineated: e.g. reflectivity, non-contradictory signs, devices and delineation*		
Emergency service access and notification	*Provide details of emergency service strategy for site and who has been contacted*		

Relevant Documentation

Have the following ***mandatory*** documents been provided as part of the overall TMP?		
☐ All approved TGS required	☐ Road Occupancy Licence	☐ Plans showing access to local properties or side roads
☐ WHS documentation	☐ Approved list of TTM personnel and contacts	☐ Vehicle movement plans
☐ Traffic incident plans		
***STOP**: If one of the above documents has not been selected the TTMP cannot be approved*		

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Relevant Documentation	
Other documents provided	
☐ Traffic staging arrangements including Traffic Staging Plans	☐ Speed Zone Authorisation
☐ Design drawings	☐ Council permits
☐ Pedestrians and cyclists movement plans	☐ Consultation with public transport operator
☐ Other:	

Monitoring activities required			
Person responsible for monitoring *daily* TTM work activities			
Name:		Role:	
Unit:		Division:	
Qualification:		Card Number:	
Comments:			
Person responsible for TTM works			
Name:		Role:	
Unit:		Division:	
Qualification:		Card Number:	
Comments:			

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Review activities required			
Activity	**Required**		**Frequency or details**
Shift inspections	☐ Yes	☐ No	
Weekly Inspections	☐ Yes	☐ No	
TMP review	☐ Yes	☐ No	
Road safety audit	☐ Yes	☐ No	
Other:	☐ Yes	☐ No	
Other:	☐ Yes	☐ No	
Comments:			

Endorsed by (when a Principal Contractor undertaking the work)			
Name:			
Role:		Organisation	
Signature:		Date:	

Approval			
I have reviewed the relevant documents for the works and approve works to be completed in accordance with the TTM Plan.			
Name:			
Qualification:		Card Number:	
Unit:		Division:	
Signature:		Date:	

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A.2.4 Temporary barrier design statement

<table>
<tr><th colspan="4">Temporary safety barrier design statement template</th></tr>
<tr><td>TMP Reference #</td><td></td><td>TMD Reference #</td><td></td></tr>
<tr><td rowspan="2">Site Details</td><td>Location</td><td>Direction</td><td>Barrier Placement</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td rowspan="2">Risk/risk mitigation</td><td colspan="3">Description of the risk(s)</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td rowspan="6">Barrier systems

Hardware must be compliant with the Transport Specification R132</td><td>Barrier Type(s)</td><td colspan="2">Terminal(s)</td></tr>
<tr><td></td><td colspan="2"></td></tr>
<tr><td colspan="3">Transitions (including overlap of different systems)</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td colspan="3">Specific relevant considerations/restrictions</td></tr>
<tr><td colspan="3"></td></tr>
</table>

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Temporary safety barrier design statement template								
	Design requirements – multiple systems will require multiple copies of this table							
	System 1		System Deflection* (m)	Minimum Length (m)	Length of Need (LoN) (m)	MASH* Test Level (TL) (1-4)	Minimum Curve Radius	Clear Zone
	System name	Required Value *From manufacturer's information / R132*						
		Designed Value *What has been designed*						
	System 2		System Deflection* (m)	Minimum Length (m)	Length of Need (LoN) (m)	MASH* Test Level (TL) (1-4)	Minimum Curve Radius	Clear Zone
	System name	Required Value *From manufacturer's information / M23*						
		Designed Value *What has been designed*						
	**Where applicable – MASH test results must be used. If NCHRP-350 data is utilised (not yet approved under MASH) this must be stated. All devices deployed after 31st December 2020 must be MASH compliant.*							

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Temporary safety barrier design statement template

Design Variations					
Equipment and Hardware required *List the required hardware including terminal and barrier components*	**Hardware/Eqpt**	**Type/notes**			**Qty**
	Delineation (Barrier System)				
	Delineation (End Treatment)				
	Water (litres)				
Installation programme	**Sequence**				
	Installation/Removal				
Installation Designer Declaration	This design has been prepared in accordance with Transport QA Specification R132 Safety Barrier Systems and associated technical memoranda and standard drawings.				
Installation Designer					
	Name	*Date*	*Signature*	*Safety Barrier Qualification*	*Date of Qual*
Installed/ Inspected by					
	Name	*Date*	*Signature*	*Safety Barrier Qualification*	*Date of Qual*

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Temporary safety barrier design statement template	
Attachments	

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A.3 General departures template

Location of works	
Project	
Activity / work	
Location	
Dates relevant for TMP work	*DD/MM/YY – DD/MM/YY*

Step 1: Details of Departure and risk assessment			
Details of departure			
TCAWS requirement clause reference		Requirement summary	
Location requirement not suitable			
Why is the requirement not suitable?			
Proposed variation to the requirement			
Proposed mitigation measure/s			
Risks introduced as a result of the proposed variation			
Alternative options investigated			

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<table>
<tr><th colspan="4">Step 1: Details of Departure and risk assessment</th></tr>
<tr><td>Supporting Information such as drawings, correspondence etc.</td><td colspan="3">Describe and include attachments if required</td></tr>
<tr><td colspan="4">Risk assessment (to be attached to this form)</td></tr>
<tr><td>New standard being applied:</td><td colspan="3">☐ Alternate Standard / national Practice ☐ Risk Based determination</td></tr>
<tr><td>Standard applied</td><td></td><td>Details</td><td></td></tr>
<tr><td>Residual risk rating</td><td colspan="3"></td></tr>
<tr><td>Additional controls required</td><td colspan="3"></td></tr>
</table>

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Appendix B – Device use requirements

MANADATORY APPENDIX

B.1 Scope

This Appendix provides requirements, recommendations and information on the use, installation, operation and removal of some of the devices in *Section 6 Signs and devices*.

B.2 Usage procedure: Type 2 (automatic) portable traffic signal systems

B.2.1 Introduction

This Section supplements the requirements of *Section 6.6.3 Type 2 (automatic) portable traffic signal (PTS) systems* and provides basic information to effectively use portable traffic signals (PTS) to control traffic that have 'automatic' functionality. It applies equally to both Transport 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.

Type 2 PTS may be used for traffic control applications lasting up to three months. For sites where work will continue for longer periods, without the location of the work site changing, a risk assessment and feasibility analysis must be carried out to determine whether the extended use of portable signals is acceptable or whether a temporary signal installation should be provided. This risk assessment and feasibility analysis must be submitted to Traffic Engineering for review and the concurrence of the Director, Roads and Traffic Engineering obtained for the use of portable signals for longer than three months.

B.2.2 Specification and type approval

PTS systems with automatic functionality must be compliant to Transport Specification TSI-SP-049, Portable Traffic Signal Systems.

Testing of equipment is to be undertaken by the Transport's Intelligent Transport Systems Branch. After type approval has been issued, the manufacturer or selling agent must affix, to the equipment, a durable marking plate in the following format (*Figure B-1*):

This equipment conforms to

Transport for NSW

TYPE APPROVAL

No. ………………………..

Figure B-1. Marking plate

The number shown on the marking plate must match the number on the type approval certificate issued by the Transport's Intelligent Transport Systems Branch.

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Arrangement for copies of the TSI-SP-049 and type approval testing should be directed to:

- “Transport Traffic Equipment and Standards” at ITSHelpdesk@transport.nsw.gov.au;
- A list of current type approved equipment can be found in Transport specification TS200 (Register of ITS Field Equipment).

Type approved equipment is to be operated in accordance with this Section and the manufacturer's instructions. A record 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, see *Table B-1*.

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Table B-1. Portable traffic signals, record of approval and use

<table>
<tr><td colspan="5">Portable Traffic Signals

Record of Approval and Use</td></tr>
<tr><td colspan="5">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 Transport specification, TSI-SP-049 as detailed hereunder.</td></tr>
<tr><td colspan="3">Owner:</td><td colspan="2">Signed:</td></tr>
<tr><td colspan="3">User:</td><td colspan="2">Title:</td></tr>
<tr><td colspan="3">Project:</td><td colspan="2">Date:</td></tr>
<tr><td colspan="5">Use: (To be completed by the Users representative)</td></tr>
<tr><td colspan="5">Job location:</td></tr>
<tr><td colspan="5">Portable signals in service</td></tr>
<tr><td>Date</td><td>Time

(24 hour)</td><td>Supervisors name, please print</td><td>Initials</td><td>Mode* of operation</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="5">This completed schedule should be kept by the relevant approving authority for a period of two 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</td></tr>
</table>

Temporary traffic signal installations using fixed equipment and cables are not covered by this Section and will need to be authorised and inspected in the same manner as permanent installations.

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B.2.3 General description of system

Each set of PTS equipment with automatic functionality will normally comprise:

- Two signal stands, incorporating signal lanterns, vehicle detectors and control equipment;
- Power pack of batteries 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.

Shuttle flow

For shuttle flow on a two-lane, two-way road, one set of PTS 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 the direction of traffic flows at any time. One direction faces a green display while the other faces a red display.

Plant crossing control

For heavy machinery crossing applications, one set of portable signals is required. This set is used to control traffic on the road with 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 road traffic and haul vehicles. Under manual control i.e. two–way operation, the operator determines when the 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 road signals. These signals will be arranged to display red when the other set is green and vice versa.

B.2.4 Signposting and traffic arrangements

General

For shuttle flow, the signal stands should normally be located on the shoulder at the start of the taper or at least 30 m clear of the full lane closure. They should be in clear view of approaching drivers. 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. This should be documented in the site-specific TMP and risk assessment. 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 thus imposes the penalty of longer all–red clearance times and increased traffic delays.

Sight distance

Sight distance on the approach to portable or temporary traffic signals must be a minimum of 150 m.

In open road areas or higher speed environments where traffic signals might not be expected, a Traffic Lights symbolic (W3-3) sign with an __ m (W8-5) sign to indicate distance, should be provided to give advance warning. The position of these signs should take into account the expected queue length from

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traffic signals and the stopping distance required for heavy vehicles. Consideration should also be given to installing a portable VMS on each approach as an additional form of advance warning.

B.2.5 Equipment installation

Signal lanterns

Normally one signal lantern is used on each approach thereby requiring only one set of equipment for effective working on one road. PTS with automatic functionality complying with Transport Specification TSI-SP-049 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 whereby vertical adjustment is by adjusting the lantern on the stand and 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 *Vehicle detectors* below.

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 on the vehicle type and vehicle speed in the approach to the work area. *Table B-2* provides a guide to stopping sight distances on level bituminous or concrete surfaces.

Table B-2. Stopping sight distances for cars and laden trucks on level pavements

Vehicle speed (km/h	Stopping sight distance (m)	
	Cars	Trucks
50	*60*	*80*
60	*80*	*100*
70	*100*	*130*
80	*120*	*160*

Note to Table B-2. *Increase the stopping sight distance by 2% for each 1% of downgrade. Decrease the stopping sight distance by 2% for each 1% of upgrade.*

Signal stands

The signal stands must be securely erected and anchored to prevent excess movement or interference by vandals.

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;

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- 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 seconds or 5 seconds;
- All–red time: pre–select in the range 2 seconds to 100 seconds for fixed time and vehicle actuated operation;
- Maximum green time: pre–select in the range 20 seconds 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.

Communication

The two signal stands, incorporating the signal lanterns and detectors, are linked either by radio or cable control.

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 such as construction vehicles, do not actuate the detector.

Response of the microwave detector will depend on 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 20 m to 5 m range from the unit; and
- Other larger motor vehicles moving within the 30 m to 5 m range 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.

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An illustration of how the detectors work is given in *Figure B-2*.

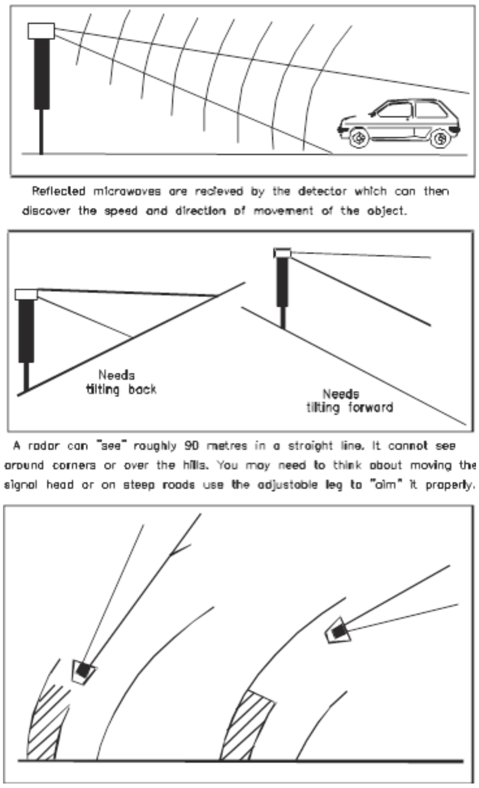

Figure B-2. Illustration of microwave detector operation

B.2.6 Manufacturer's instructions

Operators should familiarise themselves with the manufacturer's Instructions. 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: *This Section does not replace the field service manual and operating instructions accompanying each set of equipment. It is most important that operators are fully acquainted with the manufacturer's instructions and recommendations before attempting to operate the equipment.*

B.2.7 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: *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, a full–time operator is not required. The operator fixes the initial settings and then monitors the performance intermittently.

Manual mode (shuttle operation)

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.

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Manual shuttle operation is applicable when any of the following occur:

- A risk assessment has demonstrated that use of PTCD mitigates the risk associated with use of a manual traffic controller;
- Movement of works traffic prevents the effective use of vehicle actuated or fixed time operation; or
- A detector fails, when using the vehicle actuated mode and it is not desired to use fixed time mode.

Manual mode (two-way operation)

With manual mode (two-way operation), the duration and sequence of displays is determined as in Operation (Control modes). 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:

- All traffic needs to be stopped to allow the passage of traffic on a haul road;
- Traffic must be kept out of the work area for an extended period, such as during blasting, priming or full width bitumen sealing.

Vehicle-actuated operation

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 either of the following apply:

- Automatic control is required during working hours which allows the signals to operate unattended while still being responsive to changes in traffic flows; or
- Traffic control is required outside working hours so 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 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:

Step 1: 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.

Step 2: After all phases have been called automatically for the first cycle, the signals will change only in response to vehicle demands.

Step 3: If vehicles approach consistently from only one direction, the controller holds the green display on that approach.

Step 4: When a vehicle is detected on another approach, the signals can change in one of two ways:

- When vehicles approach the first phase as a steady stream, the phase holds for the 'maximum green' time before changing to the new approach.

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- 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.

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 or approach which has not received a detector actuation for approximately 200 seconds.

Fixed-time operation

As this form of control does not allow for any response to short–term variations in traffic flow, vehicles can be delayed for no apparent reason when the road is clear. Unattended sites should not be left in fixed time mode (FT).

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.

FT 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 or when a full time operator is not available.

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 can 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:

- Wait until a new vehicle joins the queue and actuates the detector;
- Change to manual operation (once traffic is running again, the controller can be returned to vehicle–actuated operation); or
- Wait until the controller (or detector) puts in an artificial demand i.e. it is programmed to place such an artificial demand approximately 200 seconds after the phase was last demanded.

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 Transport Specification TSI-SP-049.

In the 'flashing yellow' mode, the red and green aspects remain blacked out, and all yellow aspects flash at a rate between 55 and 65 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.

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B.2.8 Operation

Control modes

Although the layout and switch configuration can 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; and
- 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 (manual, vehicle actuated or fixed time) should be selected giving consideration to the operating conditions of the particular site as discussed in more detail in 'Performance'.

Time settings

General

These are shown in *Table B-3.*

Table B-3. General time setting

Mode	Operation	All red	Minimum green	Maximum green	Yellow
MAN/1	*Shuttle*	*M*	*F*	*M*	*S*
MAN/2	*Two-way*	*M*	*F*	*M*	*S*
FT	*Fixed Time*	*S*	*F*	*S*	*S*
VA	*Vehicle Activated*	*S*	*F*	*S*	*S*

Note to Table B-3: *The following abbreviations apply:*

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

Yellow time

Estimate approach speed. Select the yellow time from *Table B-4*

Table B-4. Yellow time setting

Approach speed	Yellow time
less than 75 km/h	4 seconds

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All red time

Measure the distance between the stop lines at each traffic signal. Select an appropriate all-red time from *Table B-5* or *Table B-6* depending on the minimum clearance speed is 20 km/h or 40 km/h respectively.

Maximum green time

Select a maximum green time from *Table B-5* or *Table B-6* 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: *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.

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Table B-5. Initial signal time settings (low speed)

Distance between stop lines at traffic signals (m)	All red period* (seconds)	Maximum green period (seconds)
0 to 30	2	30
30 to 45	5	35
45 to 75	10	35
75 to 105	15	40
105 to 135	20	40
135 to 165	25	45
165 to 195	30	45
195 to 250	40	50
250 to 310	50	50
310 to 365	60	60
365 to 415	70	70
415 to 465	80	80
465 to 525	90	90
525 to 575	100	100

Note* to Table B-5*: Based on a minimum clearance speed of about 20 km/h.*

Table B-6. Initial signal time settings (high speed)

Distance between stop lines at traffic signals (m)	All red period* (seconds)	Maximum green period (seconds)
0 to 50	2	30
50 to 90	5	35

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Distance between stop lines at traffic signals (m)	All red period* (seconds)	Maximum green period (seconds)
90 to 150	10	35
150 to 210	15	40
210 to 270	20	40
270 to 330	25	45
330 to 390	30	45
390 to 500	40	50
500 to 620	50	50
620 to 730	60	60
730 to 830	70	70
830 to 930	80	80
930 to 1050	90	90
1050 to 1150	100	100

Note* to Table B-6: Based on a minimum clearance speed of about 40 km/h.*

Setting up

The set-up steps given below must be followed and read in conjunction with the manufacturer's requirements:

1. Set up stands with signal aspects facing oncoming traffic
2. Connect controller to the generator and start generator
3. **DO NOT SWITCH CONTROLLER ON**
4. Set red and green times as required
5. Select mode switch
6. Ensure that the shuttle lane or haul road is clear and then switch on controller
7. 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.*

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Troubleshooting in VA mode

Details are shown in *Table B-7*.

Table B-7. Troubleshooting in VA mode

Problem	Possible cause	Remedy
Long queues	• Green setting too short • Detector fault • Road capacity exceeded	• Increase setting • Call service. • 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	• Detector fault • Green setting too short • Traffic flow very light • Traffic flow too heavy	• Call service • Increase green time setting • No action • Call supervisor
Traffic still in shuttle lane at start of opposite green	• Traffic running the red light • All–red setting too short	• Call police • Increase all–red setting
Long gap between last vehicle clearing shuttle lane and start of next green	• All–red setting too long • Detector fault	• Decrease all–red setting. • Call service
Signals do not remain on red in absence of traffic	• Detector fault	• Call service

Examples

Site details

Work area 100 m long in a rural highway situation (see *Figure B-3*):

- Approach speeds 80 km/h;
- Distance between stop lines 160 metres; and
- Minimum clearance speed 20 km/h.

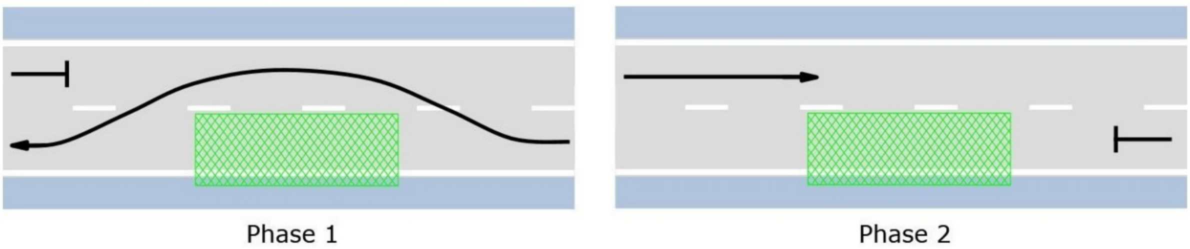

Figure B-3. Illustration of site layout

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Example of selecting times for "fixed time" operation

1. From time setting instructions in Maintenance (Transport equipment) and *Table B-4* and *Table B-5*, select initial controller settings:

Table B-8. Initial controller settings

Yellow	5 seconds
All-red	25 seconds
Max green:	
Phase 1	45 seconds
Phase 1	45 seconds

2. 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:

Table B-9. Number of vehicles queued

	Phase 1	Phase 2
First cycle	10	1
Second cycle	15	6
Third cycle	9	4
Max queued vehicles for three cycles	15	6

3. Adjust "maximum green" times for the two phases:

- Phase 1 – 15 x 3 = 45 seconds;
- Phase 2 – 6 x 3 = 18 seconds (use the minimum setting of 20 seconds).

4. Check regularly that vehicles are not experiencing unnecessary delays due to incorrect settings.

Example of selecting times for "vehicle-actuated" operation

1. From time setting instructions in *Table B-4* and *Table B-5*, select initial controller settings as for FT operation.
2. 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:

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Table B-10. Green times

	Phase 1	Phase 2
First cycle	45	45
Second cycle	45	35
Third cycle	45	30

3. Try extending the maximum green time for phase one by 5 to 10 seconds.
4. If phase one is still running to its maximum green setting, repeat Step 3.
5. Check regularly that vehicles are not experiencing unnecessary delays due to incorrect settings.

B.2.9 Maintenance

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.

Transport equipment

Maintenance is required on the various items of Transport plant, for example:

- Signal stands, incorporating signal lanterns, vehicle detectors and control equipment;
- Battery packs; or
- Battery charger.

This maintenance is to be addressed under established practice for major plant items. Signal lanterns, vehicle detectors and controllers are to be returned for repair with associated operation and/or maintenance manuals and wiring diagrams to Transport Works Centre as follows:

The Works Supervisor

Transport Services

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 service technician. 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: *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.*

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B.2.10 Signage

Sight distance on the approach to traffic signals must be 150 m to the primary signal face and the approach speed of traffic must be no higher than 60 km/h. In open road areas where traffic signals might not be expected, a Traffic light symbolic (W3-3) or (T1-30) sign with an __ m (W8-5) sign to indicate distance, should be provided to give advance warning. The position of these signs should take into account the expected queue length from traffic signals and the stopping distance required for heavy vehicles, with this information included in the TMP and/or risk assessment. The STOP HERE ON RED SIGNAL (R6-6) sign must be located 6 m in advance of the portable traffic signal and consideration given to the application of a solid white line (200-300 mm in width) adjacent to the R6-6 extending to the centre of the road. Consideration should also be given to installing a portable VMS on each approach as an additional form of advance warning. An example of a work site layout with PTS is provided in *Figure B-4.*

Additional instructions on the associated signs and use of portable traffic signals are given in *Section 6 Signs and devices*.

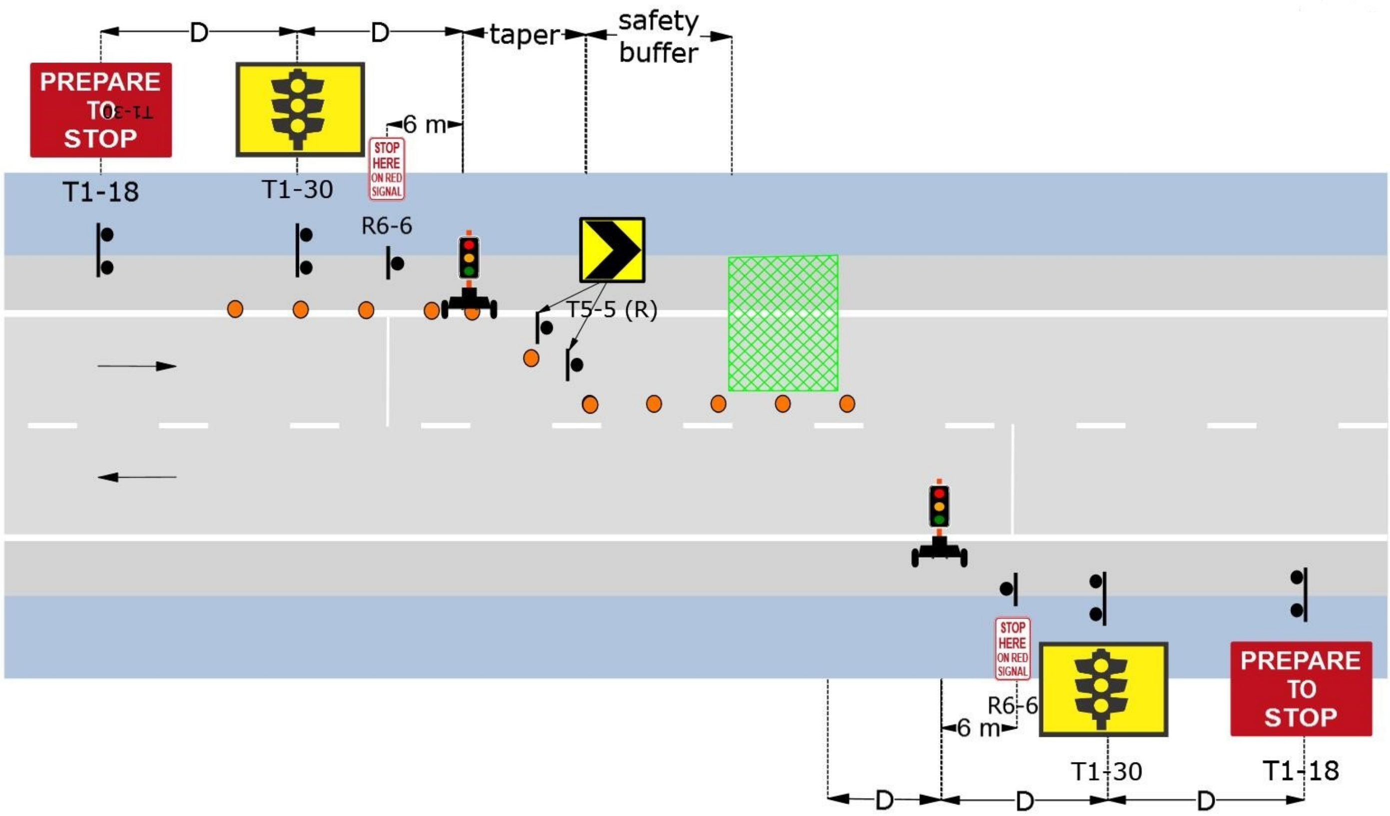

Figure B-4. Example work site layout with PTS

B.3 Usage procedure: Type 1 (manual) portable traffic signal systems

B.3.1 Purpose

This Section supplements the requirements of *Section 6.6.4 Type 1 (manual) portable traffic signal (PTS) systems* and provides the operational requirements for Type 1 (manual) PTS in NSW with or without the use of a boom arm. For the purposes of this manual:

- Type 1 (manual) PTS devices must be approved in accordance with Transport Specification No. TSI-SP-059 Type 1 Portable Traffic Signals.

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- Type 1 (manual) PTS devices with a boom arm (Type 1 PTS-B) must be approved in accordance with Transport Specification No. TSI-SP-081 Type 1 Portable Traffic Signals with Boom Barrier.

Reference to Type 1 PTS in this Section includes Type 1 (manual) PTS and Type 1 (manual) PTS-B. This Section must be read in conjunction with the Transport Specification TSI-SP-059 Type 1 Portable Traffic Signals.

B.3.2 Installation and operation

Installation and removal

When installed, Type 1 PTS must be:

- Located where there is a sight distance on the approach to the Type 1 PTS of at least 150m;

Note: *See Table B-2 which provides a guide to stopping sight distances on level bituminous or concrete surfaces.*

- Located in the line of sight of approaching road users, such that all lanterns are clearly visible and unobscured at all times;
- Installed such that they can be securely erected and anchored to prevent excess movement for all likely weather conditions;
- Located at a safe distance from the vehicle travel path, so that loads or turning vehicles will not impact the unit while remaining within the drivers' line of sight;
- Located such that its visibility is not diminished due to the proximity of other warning devices (such as flashing lights) or other plant and vehicles;
- Installed so that the top of the lantern, when erected, is between 2.5 m and 4 m from the surface of the road at the foot of the stand;
- Installed with target boards and visors fitted and in place during operation;
- Installed in accordance with the manufacturer's operation manual and guidelines; and
- Secured so as to not be at risk of being displaced as a result of wind or other disturbance.

When installing a Type 1 PTS, appropriate manual handling techniques should be used in the set-up, pack up and transportation of the device.

At the end of the work shift the Type 1 PTS must be removed from the traffic lane. The PTS must be stored behind Transport approved safety barriers or as far away from the edge of the traffic lane as is practical in a position determined suitable based on a documented risk assessment and detailed in the TMP. For more information refer to Austroads *Guide to Road Design* Part 6: *Roadside Design, Safety and Barriers*.

Operation

When installed, Type 1 PTS must be operated by an authorised traffic controller who is trained and competent in the operation of the product. The system must not be left unattended during operation. The authorised traffic controller must maintain direct control of the Type 1 PTS and must do so in accordance with the operating principles and procedures used by a manual traffic controller with a hand held STOP/SLOW bat in single lane operation.

During the operation of a Type 1 PTS:

- Queue lengths and driver behaviour must be regularly monitored and reviewed;
- If adverse driver behaviour is observed, such as swerving, "drive through on red" or end-of-queue incidents, additional control devices such as cones, temporary kerbing or bollards should be installed. These events and any additional controls implemented must be recorded;

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- If adverse driver behaviour continues to be observed, the Type 1 PTS must be replaced with an alternative form of traffic control and recorded;
- If two or more traffic controllers are required to operate the system, each traffic controller must be equipped with radio communication;
- Traffic controllers must not use STOP/SLOW signage that may conflict with the Type 1 PTS signage; and
- Items not directly related to the operation of the Type 1 PTS must not be attached to the unit (such as roadwork signage) unless they are in accordance with the relevant specification or approved by Traffic Engineering.

Low visibility and night time operation

When operating a Type 1 PTS in low visibility environments such as fog, low light or under night conditions, the area in which it is to be used must be sufficiently lit to ensure the lanterns on the Type 1 PTS do not negatively impact the night time vision of drivers.

When operating Type 1 PTS in night conditions, any potential impacts on night time vision and mitigation strategies must be documented in the Traffic Management Plan and associated risk assessments.

The risk of night time vision deterioration can be dependent on the:

- Exposure time experienced (e.g. short period just driving past or extended waiting for ability to proceed);
- Type of work that is being protected;
- Distances between the lights and the works; or
- Use and placement of other artificial lighting systems (e.g. lighting towers).

B.3.3 Traffic controller requirements

General

All requirements for traffic controllers provided in this document must be complied with.

Risk assessment

In relation to traffic controllers operating a Type 1 PTS, a risk assessment must be conducted to determine the number of traffic controllers to operate the Type 1 PTS.

The risk assessment must also be conducted to determine the safe location of the traffic controller/s in relation to their visual contact with the Type 1 PTS and traffic. See additional requirements below for the location of traffic controllers operating a Type 1 PTS.

Note: *One traffic controller may operate up to two Type 1 PTS devices.*

Location of traffic controllers

Traffic Controllers operating the Type 1 PTS must:

- Be located off the road pavement and out of the travel lane or path of vehicles;
- Have a clear and predetermined escape route;
- Maintain clear visibility of the Type 1 PTS and the front of traffic queues;
- Maintain clear visibility of both Type 1 PTSs and the front of traffic queues for each approach when one traffic controller is operating two barriers; and
- Be located behind a safety barrier where available.

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The risk assessment which determines the location of the traffic controller/s must also consider:

- Weather conditions, lighting, road geometry and roadside objects that may obstruct visibility or the escape route of the traffic controller/s;
- Roadside conditions such as long grass or vegetation, uneven and sloping surfaces or other hazards that may be a risk to workers on foot;
- Radio signal range between the PTS remote controls and the traffic signal lanterns; and
- Visual contact of traffic controllers with motorists to encourage compliance.

B.3.4 Signage

Advanced warning must be placed to alert motorists of the Type 1 PTS ahead. Details of the associated signs and use of portable traffic signals are given in *Section 6 Signs and devices*. When the device is not in operation, these signs must be covered or removed. A work type example for the use of a PTCD is provided in *Figure B-4*).

B.3.5 Critical faults

If a critical fault occurs, the Type 1 PTS revert to an all-red display on all lanterns within five seconds. When this occurs traffic controllers and STOP/SLOW bats must be available to perform traffic control for each Type 1 PTS. The traffic management plan must specify the management of equipment and traffic control failures to ensure the ongoing safety of workers and road users.

B.4 Usage procedure: portable boom barriers

This Section supplements the requirements in *Section 6.6.5 Portable boom barriers* and outlines the operational requirements for portable boom barriers in NSW. At the time of publication, there is no Transport specification for portable boom barriers.

B.4.1 Installation and operation

Installation and removal

When installed, portable boom barriers must be:

- Located where the sight distance between the device and oncoming traffic is at least 1.5D;

Note: *A distance of less than 1.5D may be used if a site-specific risk assessment has been undertaken, and documented in the TMP, and the departure is approved in accordance with Section 2.8 Departures from this Technical Manual, with additional measures adopted to ensure traffic controller safety.*

- Located clear of overhead hazards or obstructions;
- Located such that the end of the boom is 500 mm from the edge of the adjoining travel lane;
- Installed such that additional weight can be added to the stability legs via sandbags or other stabilisation methods, if winds greater 50 km/h are expected during operation;
- Installed when there are sufficient gaps in traffic to allow for the predictable and safe lowering of the boom without adversely affecting driver behaviour; and
- Installed in accordance with the manufacturer’s operation manual and guidelines.

When installing a portable boom barrier, appropriate manual handling techniques should be used in the set-up, pack up and transportation of the device.

At the end of the work shift, the portable boom barrier must be removed from the traffic lane. The barrier must be stored in a safe location behind Transport approved safety barriers or as far away from the edge of

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the traffic lane as is practical in a position determined suitable based on a documented risk assessment and detailed in the TMP. For more information refer to the Austroads *Guide to Road Design* Part 6: *Roadside Design, Safety and Barriers*.

Operation

When installed, portable boom barriers must be operated by an authorised traffic controller who is trained and competent in the operation of the specific proprietary product. The system must not be left unattended during operation. The authorised traffic controller must maintain direct control of the portable boom barrier and must do so in accordance with the operating principles and procedures used by a manual traffic controller with a hand held STOP/SLOW bat in single lane operation.

During the operation of a portable boom barrier:

- Queue lengths and driver behaviour must be regularly monitored and reviewed;
- If adverse driver behaviour is observed, such as swerving, adverse braking or end-of-queue incidents, additional control devices such as cones, temporary kerbing or bollards should be installed. These events and any additional controls implemented must be recorded;
- If adverse driver behaviour continues to be observed, the portable boom barrier must be replaced with an alternative form of traffic control and recorded;
- If two or more traffic controllers are required to operate the system, each traffic controller must be equipped with radio communication;
- Traffic controllers must not use STOP/SLOW signage that may conflict with the portable boom barrier signage; and
- Items not directly related to the operation of the portable boom barrier must not be attached to the unit (such as roadwork signage) unless it has been approved by Traffic Engineering.

Low visibility and night time operation

When operating a portable boom barrier in low visibility environments such as fog, low light or under night conditions, the area in which it is to be used must be sufficiently lit to ensure the visibility of the boom to road users.

B.4.2 Traffic controller requirements

General

All requirements for traffic controllers provided in this document must be complied with.

Risk assessment

In relation to traffic controllers operating portable boom barriers, a risk assessment must be conducted to determine the number of traffic controllers to operate the portable boom barriers.

The risk assessment must also be conducted to determine the safe location of the traffic controller/s in relation to their visual contact with the portable boom barriers and traffic. See additional requirements below for the location of traffic controllers operating a portable boom barrier.

Note: *One traffic controller may operate up to two portable boom barrier devices.*

Location of traffic controllers

Traffic controller/s operating the portable boom barriers, must:

- Be located off the road pavement and out of the travel lane or path of vehicles;
- Have a clear and predetermined escape route;

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- Maintain clear visibility of the portable boom barrier and the front of traffic queues;
- Maintain clear visibility of both barriers and the front of traffic queues for each approach when one traffic controller is operating two barriers; and
- Be located behind a safety barrier where available.

The risk assessment which determines the location of the traffic controller/s must also consider:

- Weather conditions, lighting, road geometry and roadside objects that may obstruct visual contact or the escape route of the traffic controller/s;
- Roadside conditions such as long grass or vegetation, uneven and sloping surfaces or other hazards that may be a risk to workers on foot;
- Radio signal range between the portable boom barrier and the remote controls; and
- Visual contact of traffic controllers with motorists to encourage compliance.

B.4.3 Signage

Advanced warning must be placed to alert motorists of the portable boom barrier ahead. The placing of the sign T1-272n (*Figure B-5* below) must be in accordance with this document. When the device is not in operation, these signs must be covered or removed.

Figure B-5. Portable boom barrier ahead sign (T1-272n)

The STOP sign (R1-1) must be fixed to the boom barrier (see *Figure B-6*), and positioned so that it is vertically and horizontally in the centre of the boom, and is clearly visible to approaching road users.

Figure B-6. Stop sign (R1-1)

Additional instructions on the associated signs and use of portable boom barriers are given in *Section 6 Signs and devices*.

A work type example for the use of a PTCD is provided in *D.4.4 Static: Dual lane closure for work in fast lane - 3 lane / 2 way (formerly TCP 90)*.

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B.4.4 Critical faults

If a critical fault occurs, traffic controllers with STOP/SLOW bats must be available to perform traffic control for each portable boom barrier.

The traffic management plan must specify the management of equipment and traffic control failures to ensure the ongoing safety of workers and road users.

B.5 Usage procedure: illuminated flashing arrow signs

B.5.1 Introduction

This Section supplements the requirements in *Section 6.9.2 Illuminated flashing arrow signs* and 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 maintained to record the location and 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 roads are encouraged to follow these practices where they are applicable. See *Section 8.2 Record keeping of TTM documentation*.

Flashing arrow signs are intended to be applied primarily where a lane is closed or a diversion of traffic is required, typically on a multi-lane 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 dynamic work site. An example of this is longitudinal linemarking.

Note: *This Section does not replace the field service manual and operating instructions for each set of equipment. It is important that operators are fully acquainted with the manufacturer's instructions and recommendations before attempting to operate the equipment.*

B.5.2 Approvals and specifications

Illuminated flashing arrow signs must comply with the relevant Australian Standards, where they exist, and Transport Specifications TSI-SP-060 Illuminated Flashing Arrow Signs. The relevant Australian Standards are listed in TSI-SP-060. General operating instructions are given in this Section.

Testing of equipment is to be undertaken by the Transport’s Intelligent Transport Systems Branch. After type approval has been issued, the manufacturer or selling agent must affix, to the equipment, a durable marking plate in the format provided in *Figure B-7*:

This equipment conforms to

Transport for NSW

TYPE APPROVAL

No. ………………………..

Figure B-7. Marking plate

The number shown on the marking plate must match the number on the type approval certificate issued by the Transport’s Intelligent Transport Systems Branch.

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Arrangement for copies of the TSI-SP-060 and type approval testing should be directed to:

- "Transport Traffic Equipment and Standards" at ITSHelpdesk@transport.nsw.gov.au;
- A list of current Type Approved equipment can be found in Transport specification TS200 (Register of ITS Field Equipment).

B.5.3 General description of system

Illuminated flashing arrow sign equipment

The following three size designations are used:

- Type A;
- Type B; and
- Type C.

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 B-11*:

Table B-11. Modes of operation

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.

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 dynamic works, such as longitudinal linemarking, mobile survey vehicles, patrol vehicles and on shadow trucks protecting groups of workers.

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.

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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 reflective or lit.

Associated signposting and traffic arrangements

Any additional or associated signposting or traffic arrangements that may be required to be used with flashing arrow signs must conform to the requirements of this Technical 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 are 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 m, 1000 m and 1500 m 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 can be obscured by alignment, buildings or heavy traffic. The use of larger signs may be considered for high approach speeds.

B.5.4 Equipment installation

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 trigger the dimming facilities.

The flash rate for flashing arrow displays (AL, AR, and DA) can vary from 50 to 60 per cent on–time and 50 to 40 per cent 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 B-11*.

Sign boards

Generally, the flashing arrow sign unit should be positioned 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 time to understand and react to the sign message. The visibility distance of the sign i.e. the distance at which the motorist can first become aware of the flashing arrow, varies as shown in *Table B-12*. 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 B-12 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:

Table B-12. Typical sight distance for placement of flashing arrow signs

Sign type	Visibility distance (m)	Sight distance	
		Desirable minimum	Absolute minimum
A	500	250	150
B	1000	500	300

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Sign type	Visibility distance (m)	Sight distance	
		Desirable minimum	Absolute minimum
C	1500	750	450

Note to Table B-12: *Increase the sight distance by 2% for each 1% of downgrade. Decrease the sight distance by 2% for each 1% of upgrade.*

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 B-13 lists the recommended aiming distances from the sign near the start of the taper defining the lane closure:

Table B-13. Aiming distances for various approach speeds

Approach	Aiming distance (m)		
speed (km/h)	sign type		
	A	B	C
less than 60	60	120	180
60	100	200	300
80	140	280	420
100	200	400	600
greater than 100	260	520	780

Note 1 to Table B-13: *The aiming distance should not exceed the sight distance.*

Note 2 to Table B-13: *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*

Note 3 to Table B-13: *The aiming distances for Type B and C signs are two and three times of those for the Type A sign to take advantage of their greater size and visibility*

Note 4 to Table B-13: *Type C signs are not usually used on low speed roads.*

Figure B-8 is an illustration of aiming and sight distance, showing the relationship between these two distances used when setting up flashing arrow signs.

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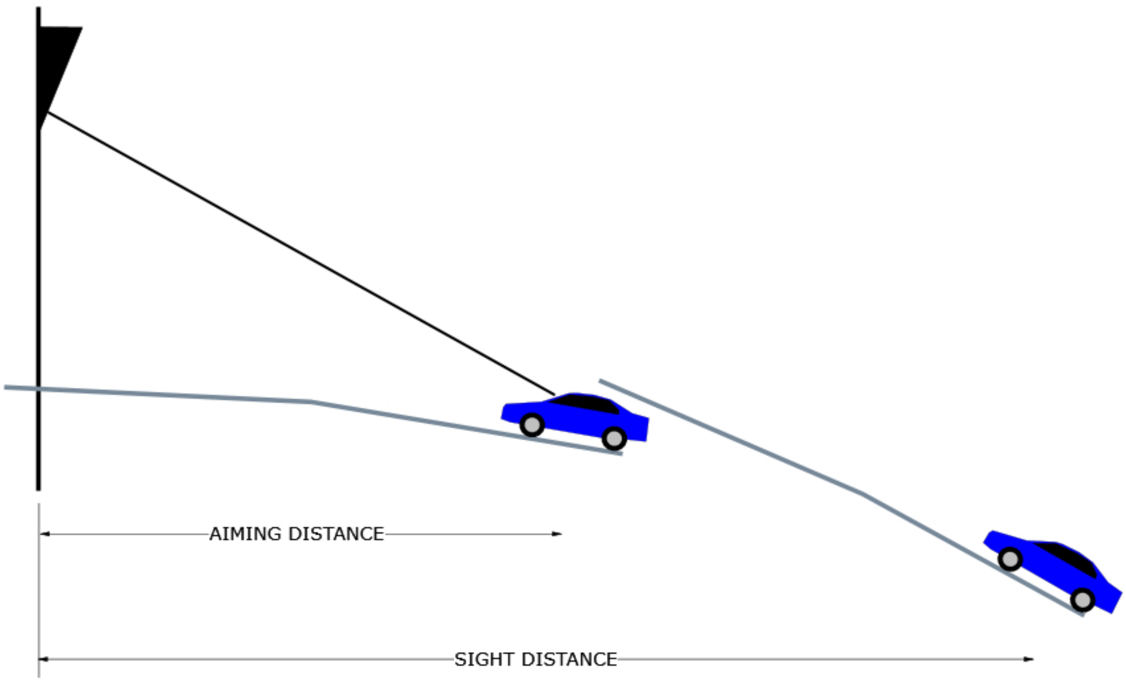

Figure B-8. Illustration of aiming and sight distance

Controls

The controls available are:

- Power: On/Off;
- Mode selection; and
- Mode monitoring (Type C signs only).

B.5.5 Operation

Control modes

Although the layout and switch configuration can differ, all controls have basically the same functions, namely:

- Arrow Right (AR);
- Arrow Left (AL);
- Double Arrow (DA); and
- Warning (W).

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.

Dimming

The dimming facilities are automatic, but care should be taken that any incident light from street lighting or vehicle headlights falling on the photocell does not adversely interfere with the operation of the dimming feature. The photocell should be occasionally cleaned to maintain brightness.

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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.

Troubleshooting

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, check it and if it is blown, replace it with a new lamp. If all lamps are out or all lamps are too dim for the conditions, check the battery or generator for charge. If the charge is satisfactory, but the lamps are still too dim for the conditions, check the photocell is not being blocked from reading the true ambient light level.

B.5.6 Maintenance

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; and;
- Keeping the equipment clean and tidy.

These requirements are detailed in the manufacturer's instructions.

Major repairs

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.

Administration procedures

See local office procedures in respect of administration, costing and maintenance of flashing arrow signs as an item of small plant.

B.5.7 Signage

Instructions on the use of illuminated flashing arrows are given in *Section 6.9.2 Illuminated flashing arrow signs.*

The following three sign size designations are used:

- Type A – 1260 mm by 650 mm for roof mounting on light vehicles;
- Type B – 1500 mm by 770 mm for cab mounting on trucks; and
- Type C – 2400 mm by 1200 mm 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.

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

- 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 must be flashed; and
- When the sign is used to give a general warning of works activity ahead, including dynamic 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 must be flashed with diagonal pairs flashing alternately.

Additional instructions on the associated signs and use of illuminated flashing arrows are given in *Section 6 Signs and devices*.

B.6 Usage procedure: temporary portable rumble strips

This Section supplements the requirements outlined in *Section 6.11 Temporary portable rumble strips (TPRS)* and details the operational requirements for temporary portable rumble strips (TPRS) in NSW. At the time of publication, there is no Transport specification for TPRS.

B.6.1 Installation and operation

Placement, installation and removal

To protect oncoming traffic from the risk of swerving behaviour TPRS must be placed in one of the following methods:

1. Where traffic is reduced to and controlled within a single lane; or
2. On a two-lane two-way road where a temporary median kerb with delineators is installed on the centreline for a distance of D prior to the first strip in each array.

Where placed on a two-lane two-way road, where a temporary median kerb with delineators, the median kerb delineators must be installed:

- Commencing immediately adjacent to the first TPRS;
- Extend a minimum distance of D prior to the TPRS; and
- Have spacing of not greater than 18 m between the centres of each section of kerb.

Example work site layouts for shuttle flow and merge lane closure scenarios using a TPRS are provided in *D.4.10 Static: Use of temporary portable rumble strips (shuttle flow)* and *D.4.11 Static: Use of temporary portable rumble strips (merge lane closure)*.

Additional examples of work site layouts for TPRS on approach to work area are provided in *Figure 6-34* and *Figure 6-35*.

When installed, TPRS must:

- Be located away from and not adjacent to, workers on foot;
- Be located at least four seconds of travel time after a driver decision point, driver action point or another TPRS array;
- Be located at least 30 m away from the work area;
- Be visible to an approaching road user for at least a distance of D metres; and
- Be installed in accordance with the manufacturers operation manual and guidelines, however, in case of a discrepancy, the requirements of this Technical Manual prevail.

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When located on a designated cycle path, a minimum 1 m shoulder adjacent to the TPRS must be provided. If this is not possible, other safe alternative provisions must be made.

If the length of the work area is greater than 200 m, or there is an interrupted line of sight between each end of the work area, then intermediate TPRS arrays and their associated signing should be installed at intervals of not less than 100 m.

When installing TPRS, appropriate manual handling techniques should be used in the set-up, pack up and transportation of the device.

When the work site is unattended or a speed limit of greater than 65 km/h is reinstated, TPRS must be removed and associated signs (T5-210, T5-211) removed or covered up.

Operation

During the operation of TPRS:

- Regular monitoring and review of the TPRS must be undertaken to monitor movement and driver behaviour;
- If adverse driver behaviour is observed, such as heavy braking or swerving on approach or around the TPRS, additional controls such as increasing the TPRS sign's advance warning distance should be implemented;
- In the event of swerving behaviour, the installation of additional control devices such as cones, temporary kerbing or bollards, should be implemented in consideration of OSOM vehicles; and
- If adverse driver behaviour continues to be observed, TPRS must be replaced with an alternative form of traffic control and recorded.

Low visibility and night time operation

When TPRS are operating in low visibility environments such as fog, low light or under night conditions, the area in which each array are being used must be sufficiently lit to ensure the visibility of the TPRS to road users.

Movement

TPRS are not secured to the road surface and as such, movement of the devices is possible. Factors influencing the degree of movement include:

- Type of road surface;
- Grade;
- Traffic composition; and
- Volume.

Regular inspections for TPRS movement must be carried out during operation.

Inspections should be completed more frequently when:

- Using TPRS at a work area for the first time;
- Used on grades;
- Used under high volumes of traffic; or
- Used under a higher proportion of heavy vehicles.

Maximum movement tolerances for TPRS are provided below in *Figure B-9* to *Figure B-11*, and if movement exceeds these tolerances, or if the TPRS becomes disconnected, it must be rectified immediately.

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To assist in identifying the extent of movement, a method of determining placement should be employed, such as using a chalk mark or aligning with a landmark to indicate where the TPRS were placed.

The frequency of remediation of displaced or disconnected strips must be monitored and risk-assessed. If it is determined that the frequency and risk of remediation exceeds the benefit gained by the use of the TPRS, the TPRS must be removed.

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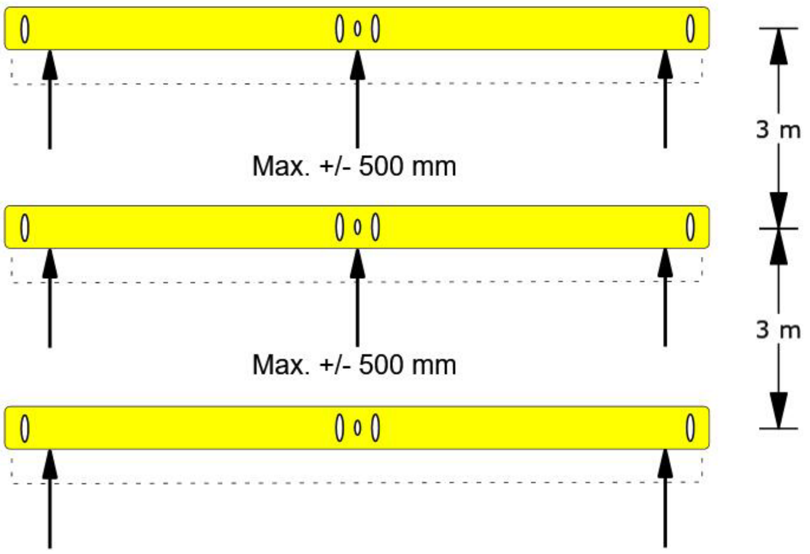

Figure B-9. Maximum movement tolerance for TPRS - Longitudinal movement

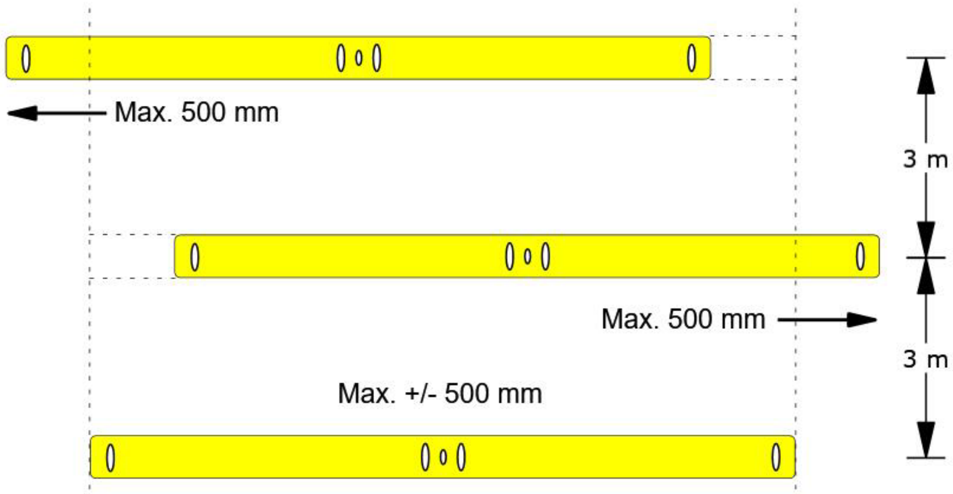

Figure B-10. Maximum movement tolerance for TPRS - Lateral movement, sideways

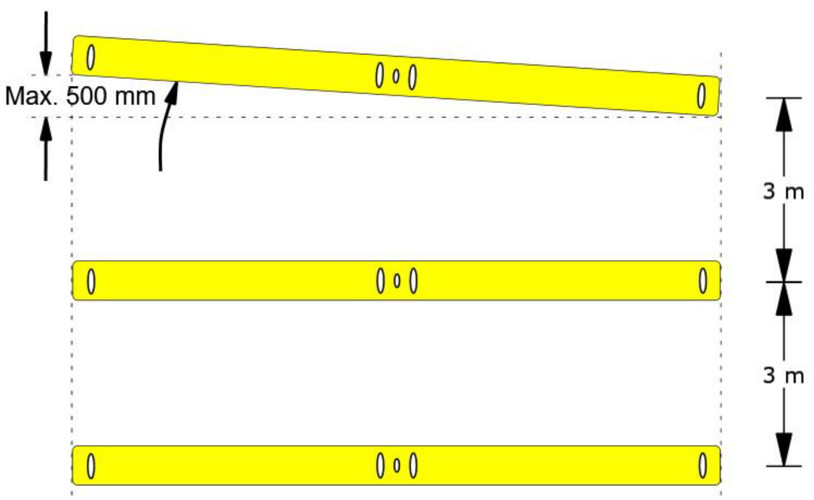

Figure B-11. Maximum movement tolerance for TPRS - Skewing / rotation

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B.6.2 Signage

Warning signs must be installed to alert drivers to the use of TPRS.

TPRS must be used with the following signage:

- A Speed hump ahead symbolic (*Figure B-12*) warning sign installed at distance D before the first rumble strip. The distance may be increased to 1.5D – 2D when there is poor compliance or adverse driver behaviours, such as excessive speed or harsh braking; and
- A Speed hump symbolic (*Figure B-13*) warning sign placed next to the first strip at a TPRS array.

When using TPRS with a temporary median kerb and delineators the following additional signage must be installed:

- A temporary collapsible chevron delineator (T5-7) on the first temporary median on approach to the TPRS (see *Figure B.14*); and
- A NO OVERTAKING sign (W8-240n) must be installed at distance 1.5D before the first rumble strip in advance of the temporary median (see *Figure B.15*).

Figure B-12. T5-210 Speed hump ahead sign

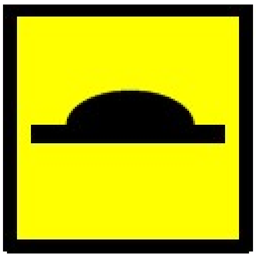

Figure B-13. T5-211 Speed hump sign

Figure B-14. T5-7 Chevron delineator

Figure B-15. W8-240n No Overtaking

When the work site is unattended or a speed limit of greater than 60 km/h is reinstated, TPRS must be removed and associated signs, (*Figure B-13*) and (*Figure B-12)* removed or covered up.

A Variable Message Sign (VMS) may be used to further alert drivers of TPRS if adverse driver behaviour is identified. The addition of VMS should be considered as part of the development of the TMP and included by the designer as part of the TGS.

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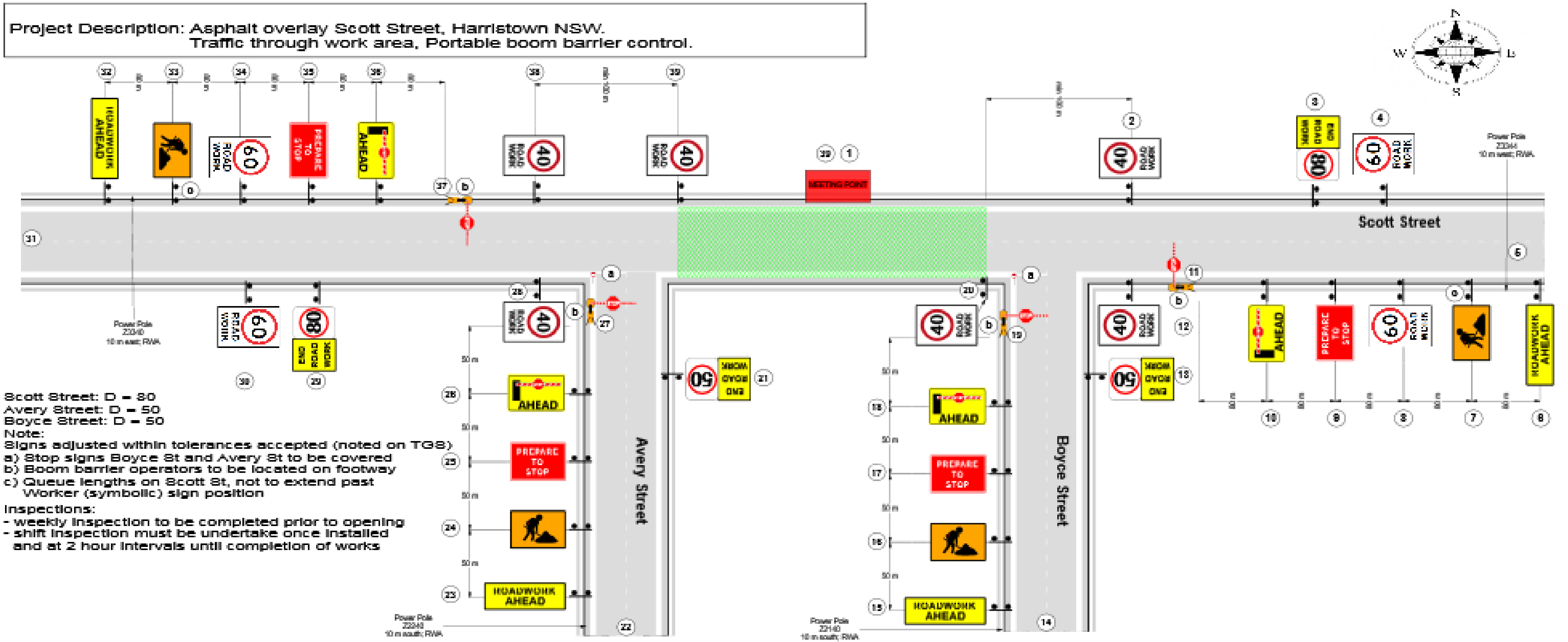
Appendix C – Example TGS

INFORMATIONAL APPENDIX



REVISIONS	REV	DESCRIPTION	Client:	Best Constructions	Duration:	Single shift	Commencement date:	20 / 05 / 2020
	00	sent to client	Road Name:	Scott Street	Road Configuration:	2 lane 2 way	Requested by:	R S Hammond
	01		Location of Works:	Between Boyce and Avery Streets	Speed Limit:	80 km/h & 50 km/h	Approved by:	T J Smith
	02		Suburb:	Harristown	ROL approved?	yes X no	Delegation:	Work Manager
	Designed by: M C Smith	Card #: 0000123456	Map Reference:	N/A	SZA approved?	yes X no	TGS PLAN REF No:	TGS-SC-0001 TGS: NTS

Figure E-1. Completed TGS

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REAR OF TGS:

The following must be applied when installing the attached TGS for Asphalt works to be completed on Scott Street; Harristown NSW (see *Figure E-1.)*

STEP	ACTION
1	Depart the meeting point
2/3/4	Install R4-212 (40), 'End Road Work/speed reinstatement' and install R4-212 (60) as the first sign when initially leaving work area.
5	Use the existing road network to turn where safe to do so
6/7/8/9/10/11	Then place approach signage signs, including the portable boom barrier in upright position (TC (b) to remain with boom barrier).
12/13	Then install R4-212 (40) turn left into Boyce Street, install 'End Road Work/speed reinstatement'
14	Use the existing road network to turn where safe to do so
15/16/17/18/19	Then place approach signage signs, including the portable boom barrier in upright position (TC (b) to remain with boom barrier).
20/21	Then turn left Scott St install R4-212 (40), then turn left Avery Street, install 'End Road Work/speed reinstatement'
22	Use the existing road network to turn where safe to do so
23/24/25/26/27	Then place approach signage signs, including the portable boom barrier in upright position (TC (b) to remain with boom barrier).
28/29/30	Then turn left Twice Road, install 'End Road Work/speed reinstatement' and install R4-212 (60)
31	Use the existing road network to turn where safe to do so
32/33/34/35/36/37	Then place approach signage signs, including the portable boom barrier in upright position (TC (b) to remain with boom barrier).
38/39	Then install both R4-212 (40).
40	Return to meeting point and confirm readiness with TCs

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Appendix D – Work type layout examples

INFORMATIONAL APPENDIX

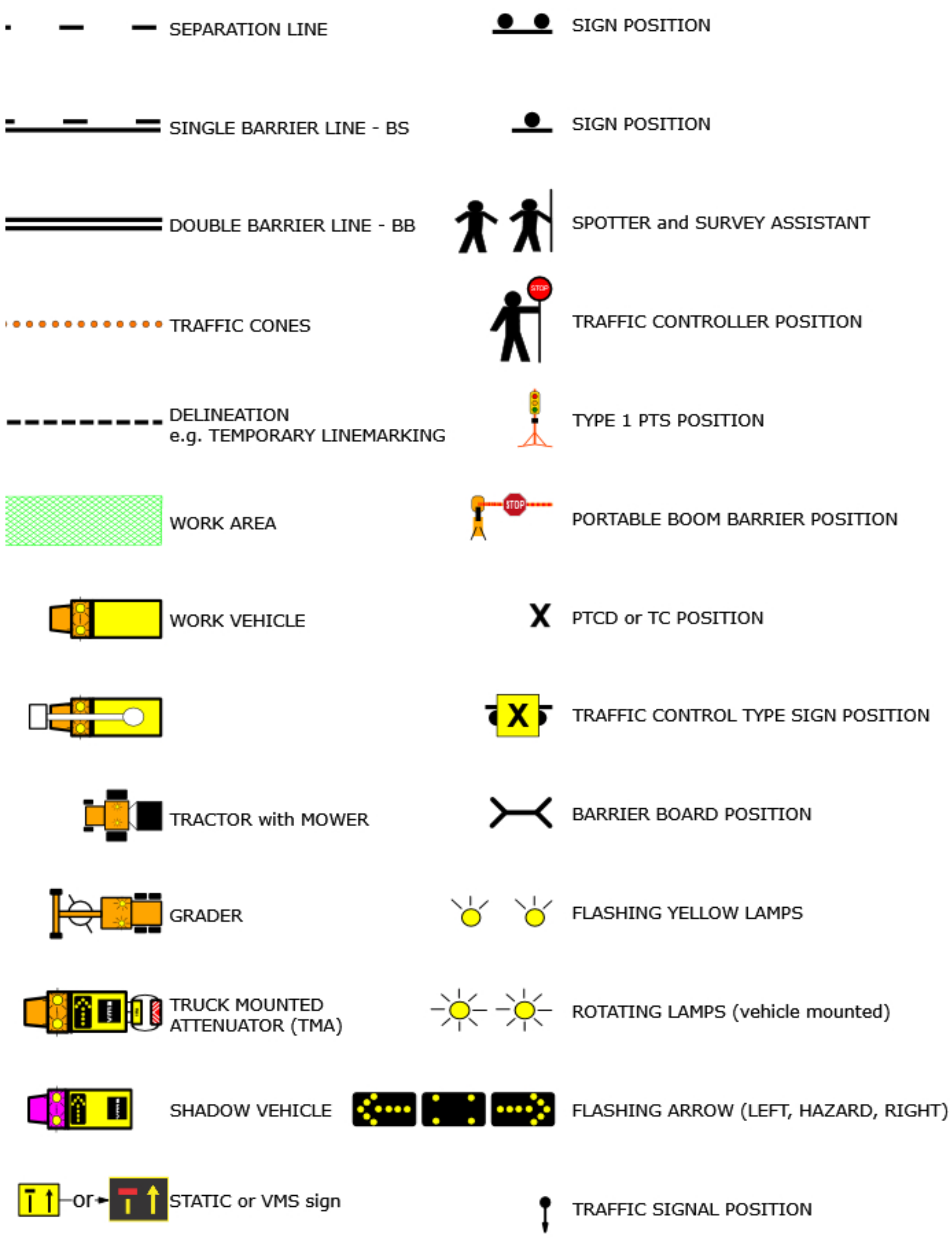
D.1 Scope

This Appendix provides various examples of work type layouts that may be referenced when developing traffic guidance schemes (TGSs). The requirements for preparing TGSs are provided in *Section 7 Traffic guidance schemes (TGS)*.

Note: *These examples reflect the minimum requirements, additional signage and advance warnings based on a risk assessment may be required.*

D.2 Standard symbols

The standard symbols used in the work type layouts are provided below.



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D.3 Table of examples

Reference	Work Type	Description
D.4.1	Static Work	Lane closure with chicane - 2 lane / divided (formerly TCP 94) – right to left merge
D.4.2	Static Work	Lane closure with double chicane – 2 lane/divided (formerly TCP 102) – left to right merge
D.4.3	Static Work	Dual lane closure - 3 lane / divided (formerly TCP 100
D.4.4	Static Work	Dual lane closure for work in fast lane - 3 lane / 2 way (formerly TCP 90)
D.4.5	Static Work	Use of truck-mounted attenuator to support installation of lane closure
D.4.6	Static Work	Road closure using multi message signs
D.4.7	Static Work	Access to depot, stockpile, quarry, gravel pit etc. all roads (formerly TCP 195)
D.4.8	Static Work	Bitumen sealing - 2 lane / 2 way (formerly TCP 95)
D.4.9	Static Work	Long term speed reduction (formerly TCP 57)
D.4.10	Static Work	Use of temporary portable rumble strips (shuttle flow)
D.4.11	Static Work	Use of temporary portable rumble strips (merge lane closure)
D.4.12	Dynamic Work	Continuous work - use of truck -mounted attenuator
D.4.13	Dynamic Work	Continuous work - multi lane (formerly TCP 62)
D.4.14	Dynamic Work	Continuous work in traffic - 3 lane / 2 way work (formerly TCP 70)
D.4.15	Dynamic Work	Continuous work - clear of traffic (formerly TCP 40)
D.4.16	Dynamic Work	Continuous work, grading - 2 lane / 2 way (formerly TCP 105)
D.4.17	Dynamic Work	Continuous work middle lane closed 3 lane / divided (formerly TCP 107)
D.4.18	Dynamic Work	Frequently changing work - 2 lane / 2 way for ADT < 1,500 (formerly TCP 77)
D.4.19	Dynamic Work	Frequently changing work in shoulder (formerly TCP 831)
D.4.20	Dynamic Work	Intermittent work, surveying (formerly TCP 459)

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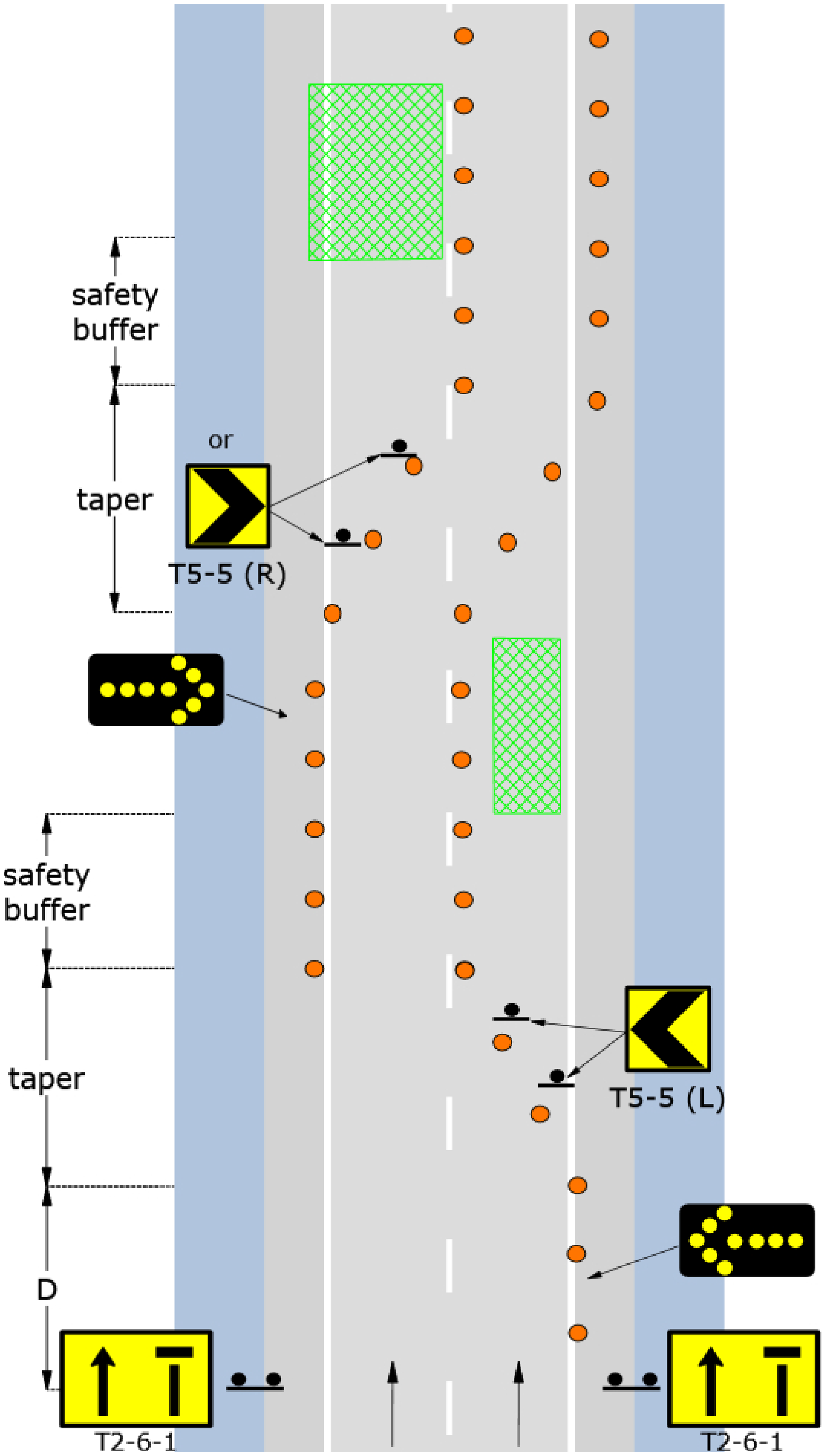
D.4 Work type examples

D.4.1 Static: Lane closure with chicane - 2 lane / divided (formerly TCP 94) – right to left merge



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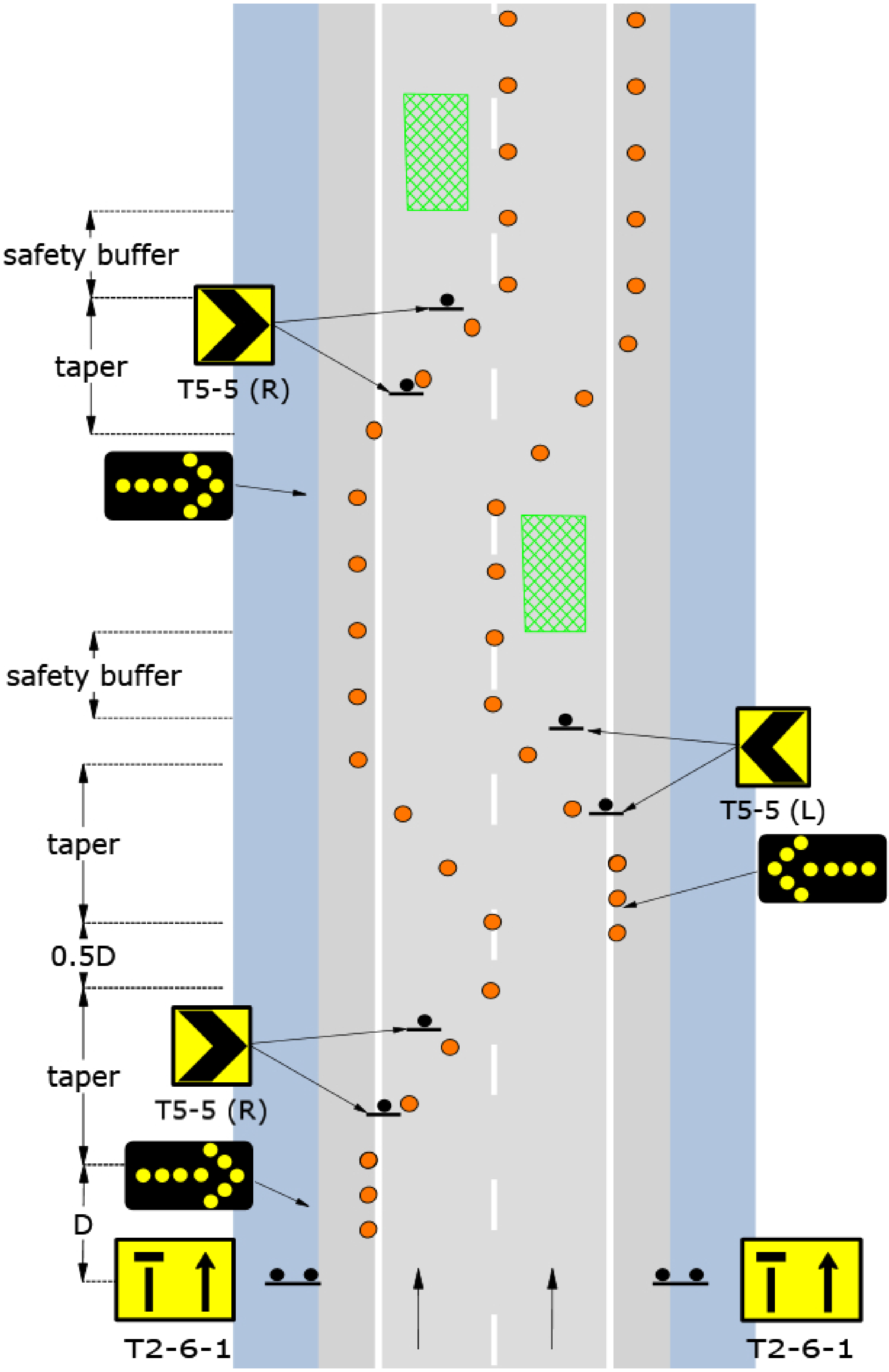
D.4.2 Static: Lane closure with double chicane – 2 lane/divided (formerly TCP 102) – left to right merge



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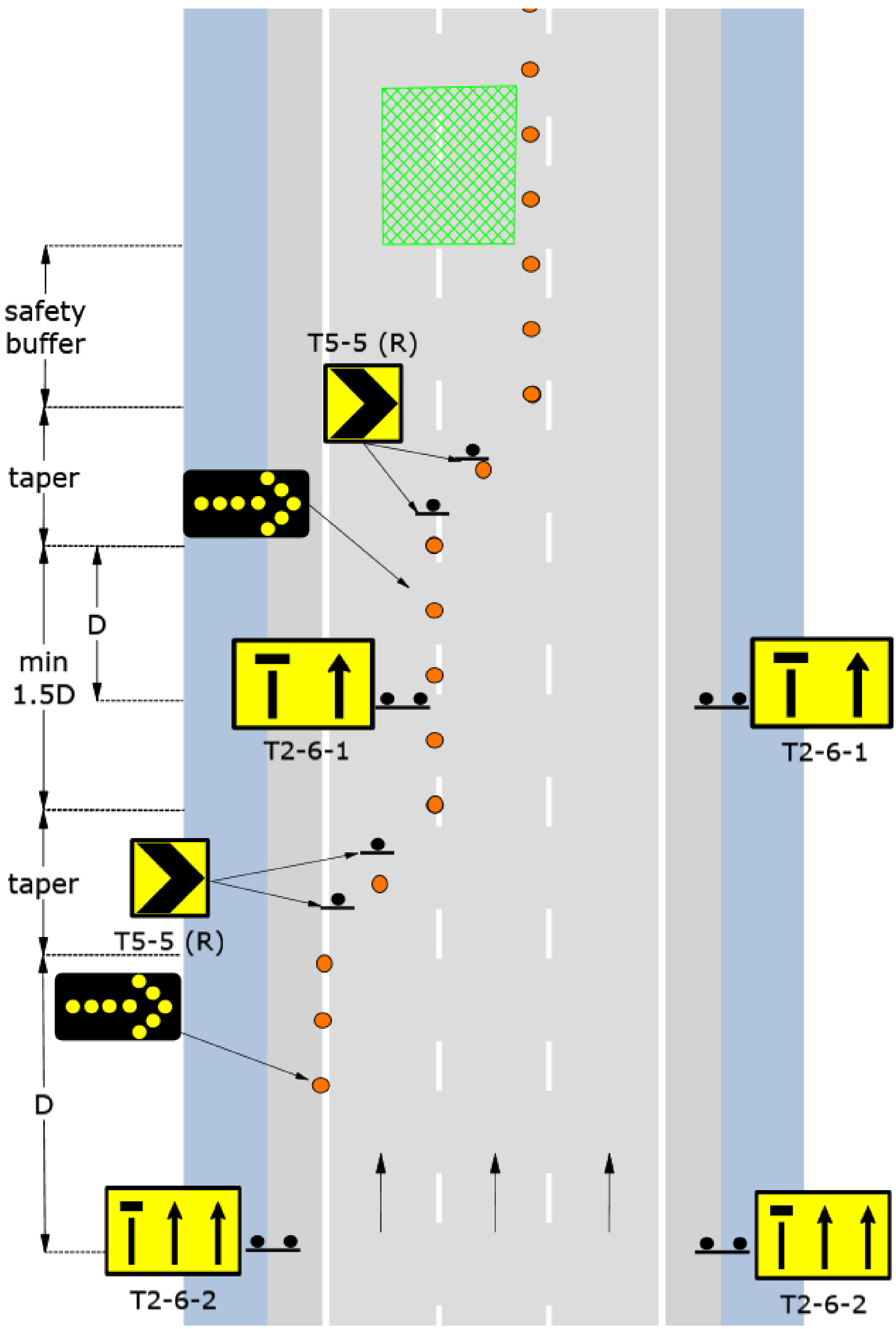
D.4.3 Static: Dual lane closure - 3 lane / divided (formerly TCP 100)



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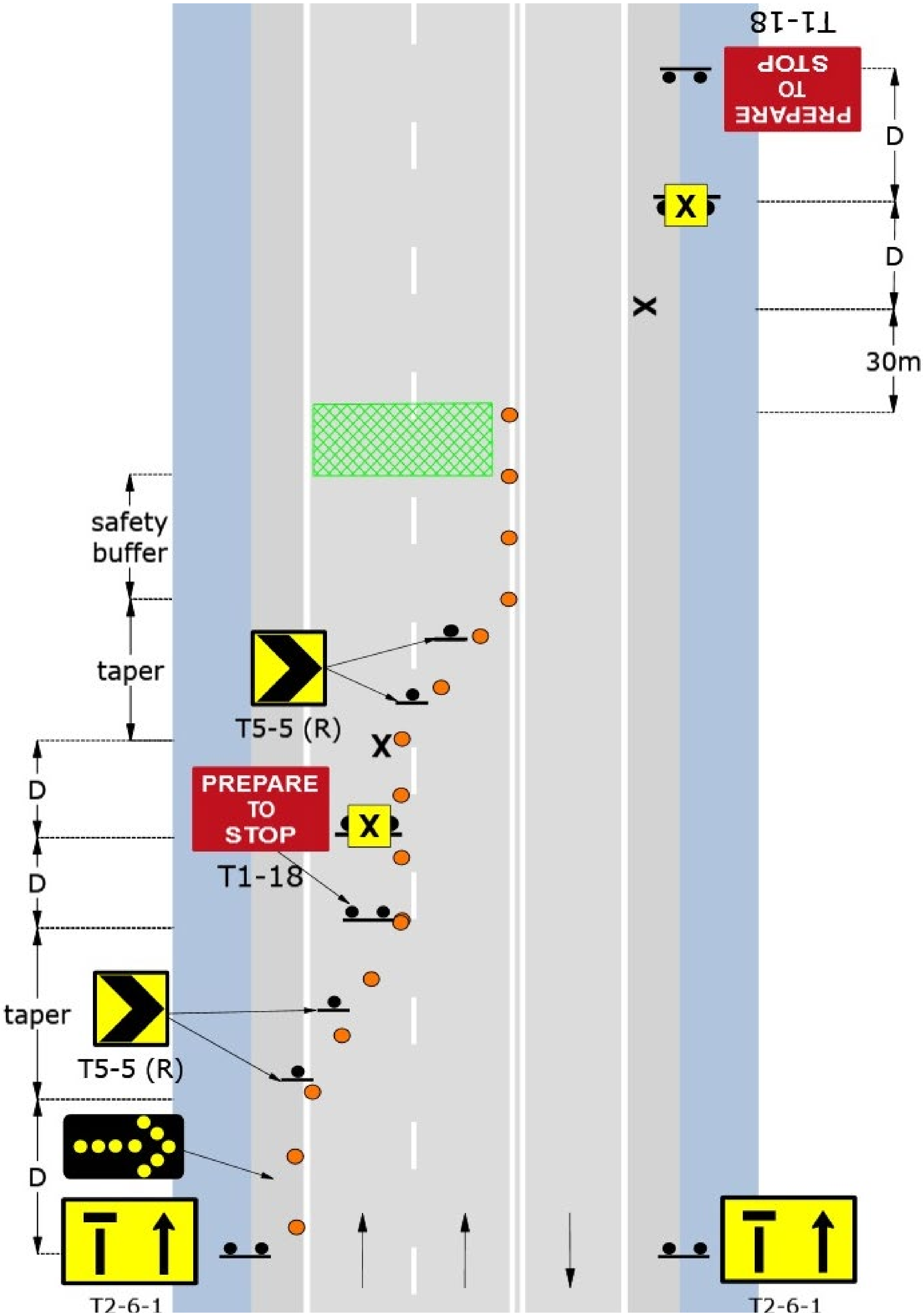
D.4.4 Static: Dual lane closure for work in fast lane - 3 lane / 2 way (formerly TCP 90)



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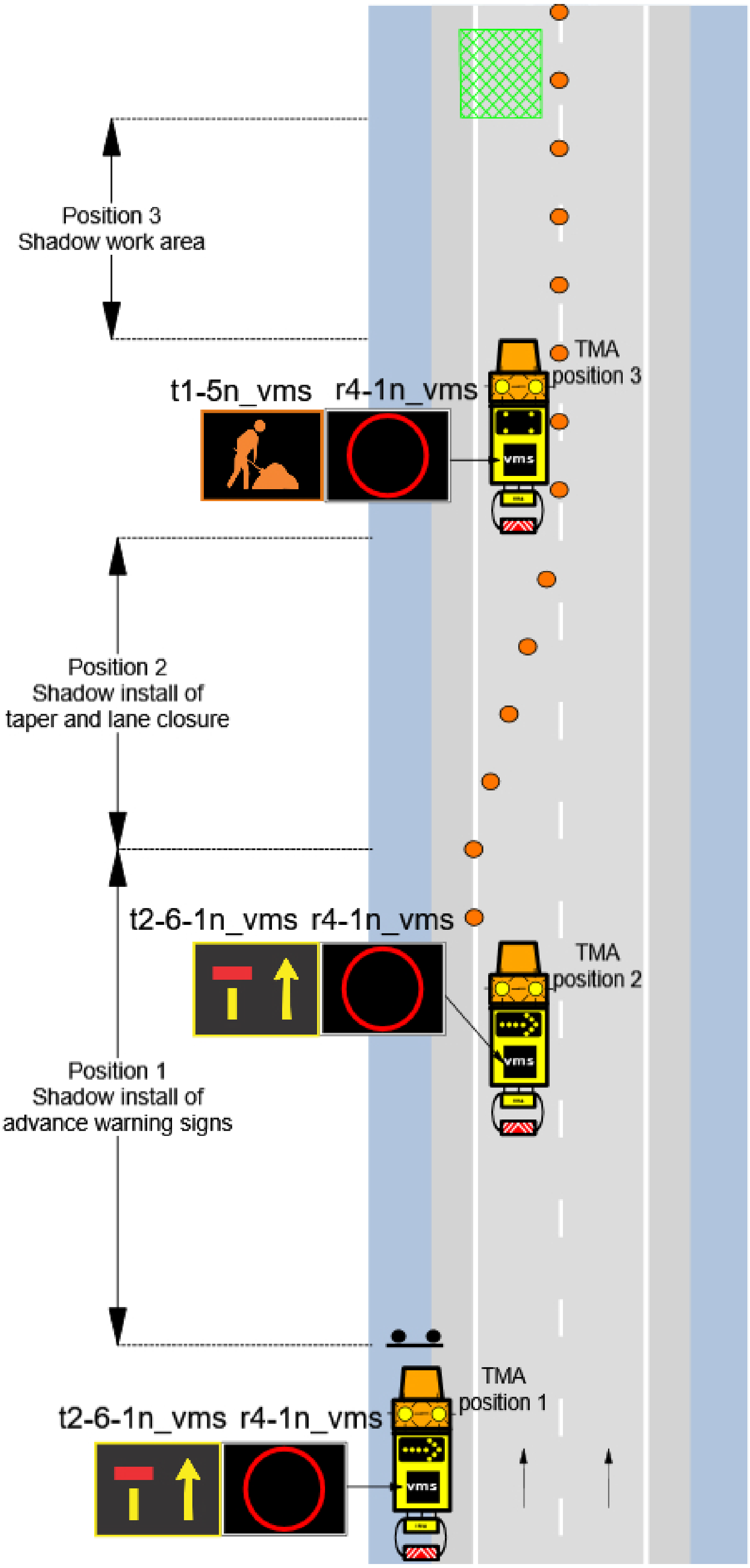
D.4.5 Static: Use of truck-mounted attenuator to support installation of lane closure



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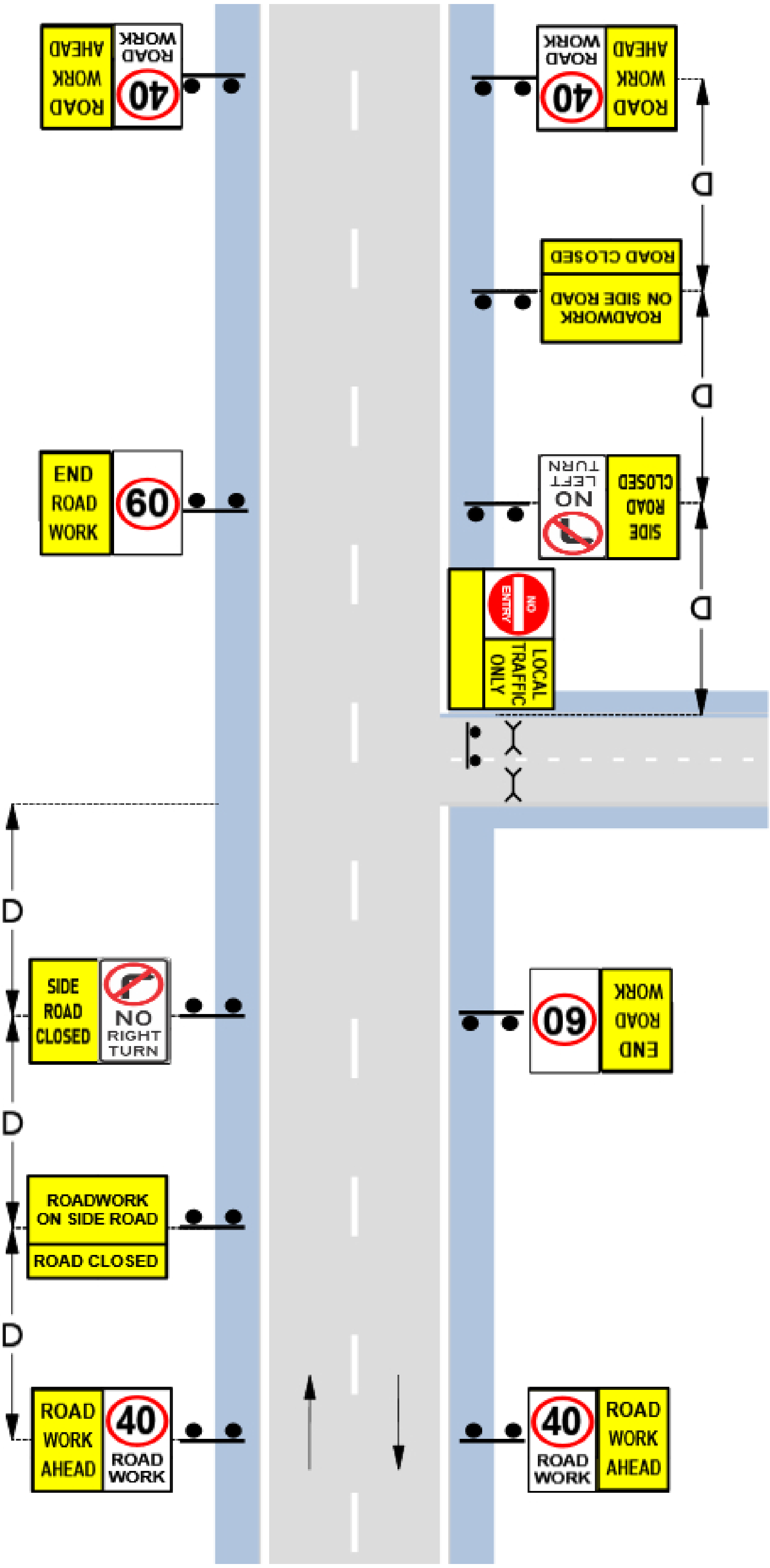
D.4.6 Static: Road closure using multi message signs



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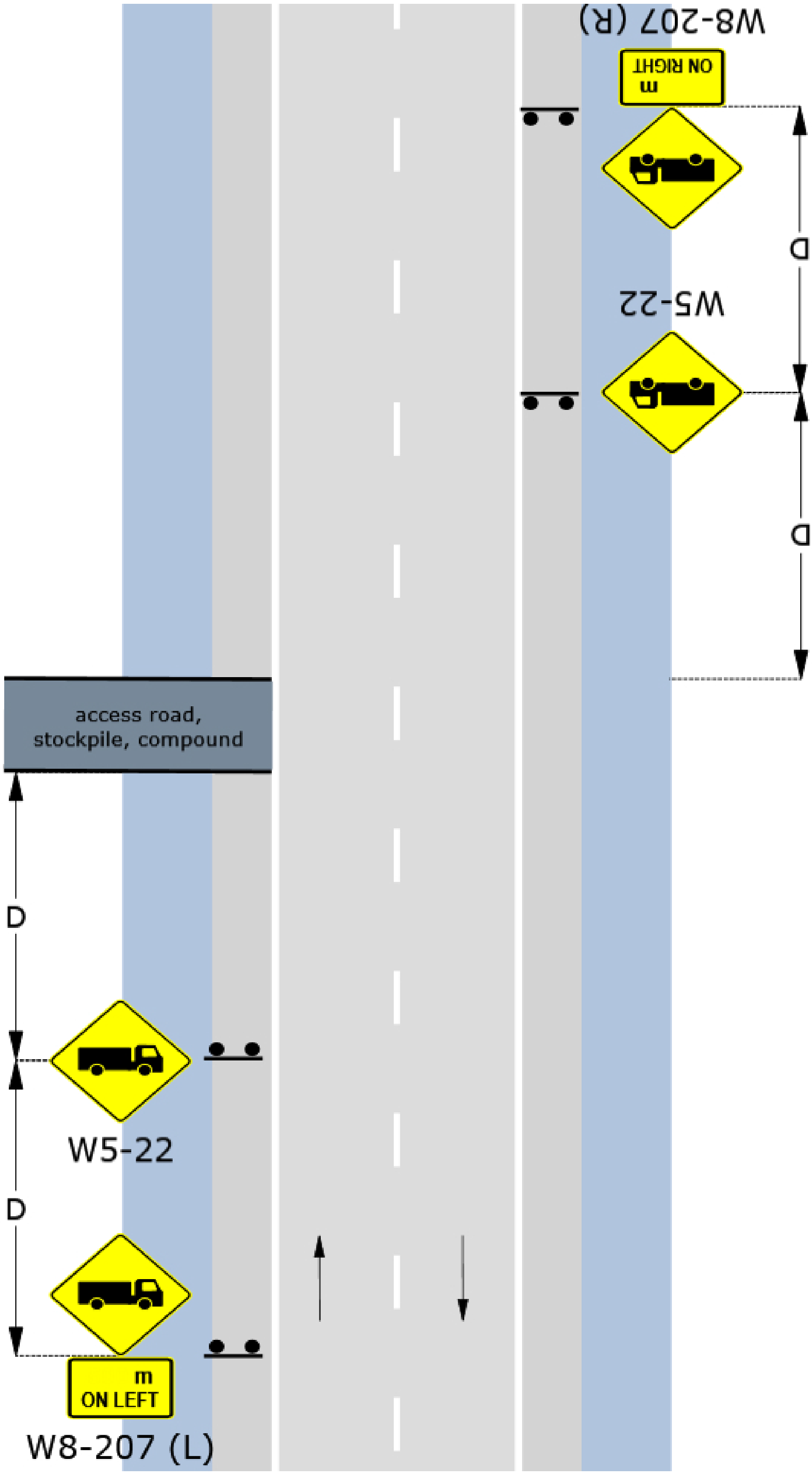
D.4.7 Static: Access to depot, stockpile, quarry, gravel pit etc. all roads (formerly TCP 195)



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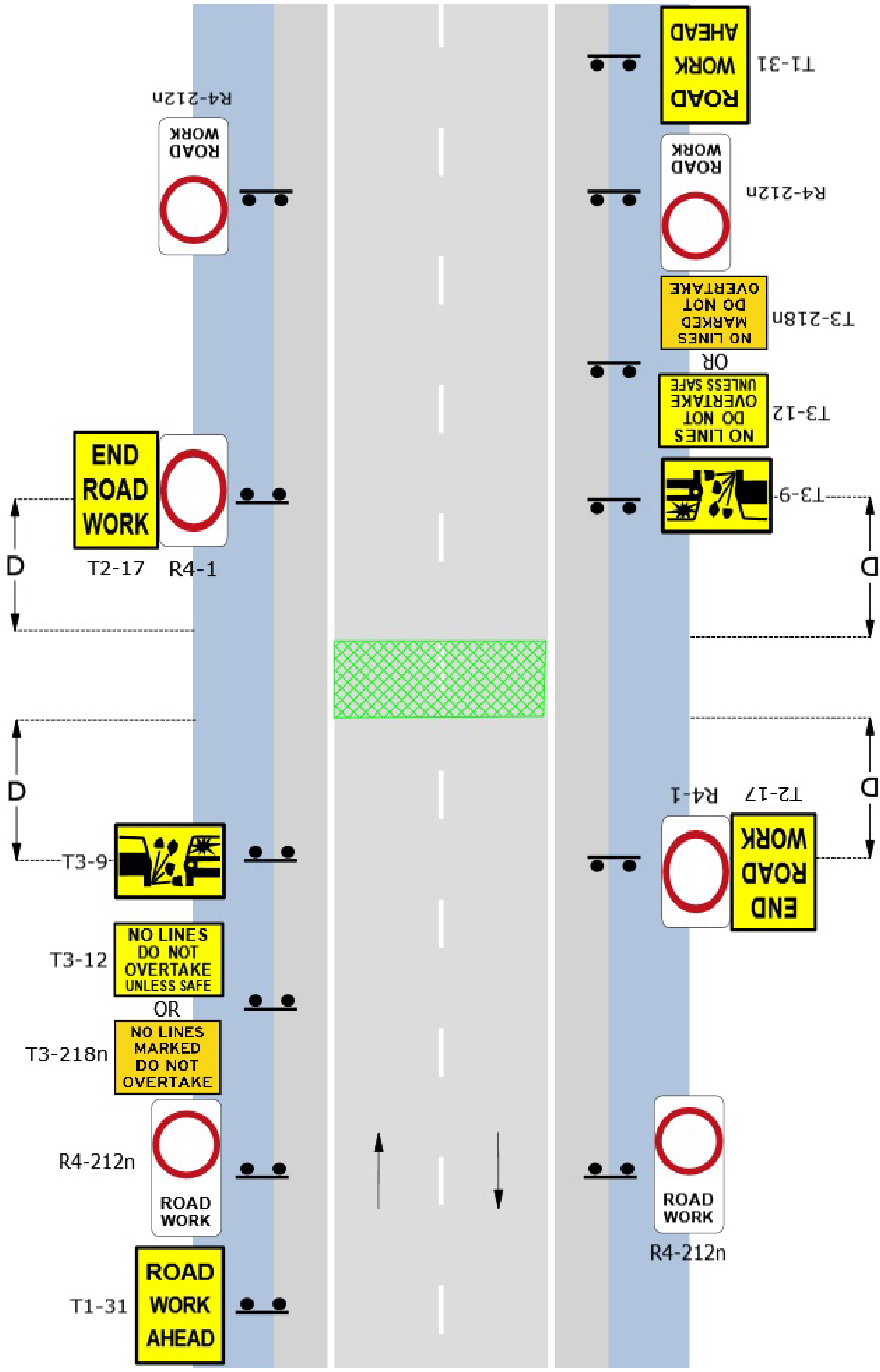
D.4.8 Static: Bitumen sealing - 2 lane / 2 way (formerly TCP 95)



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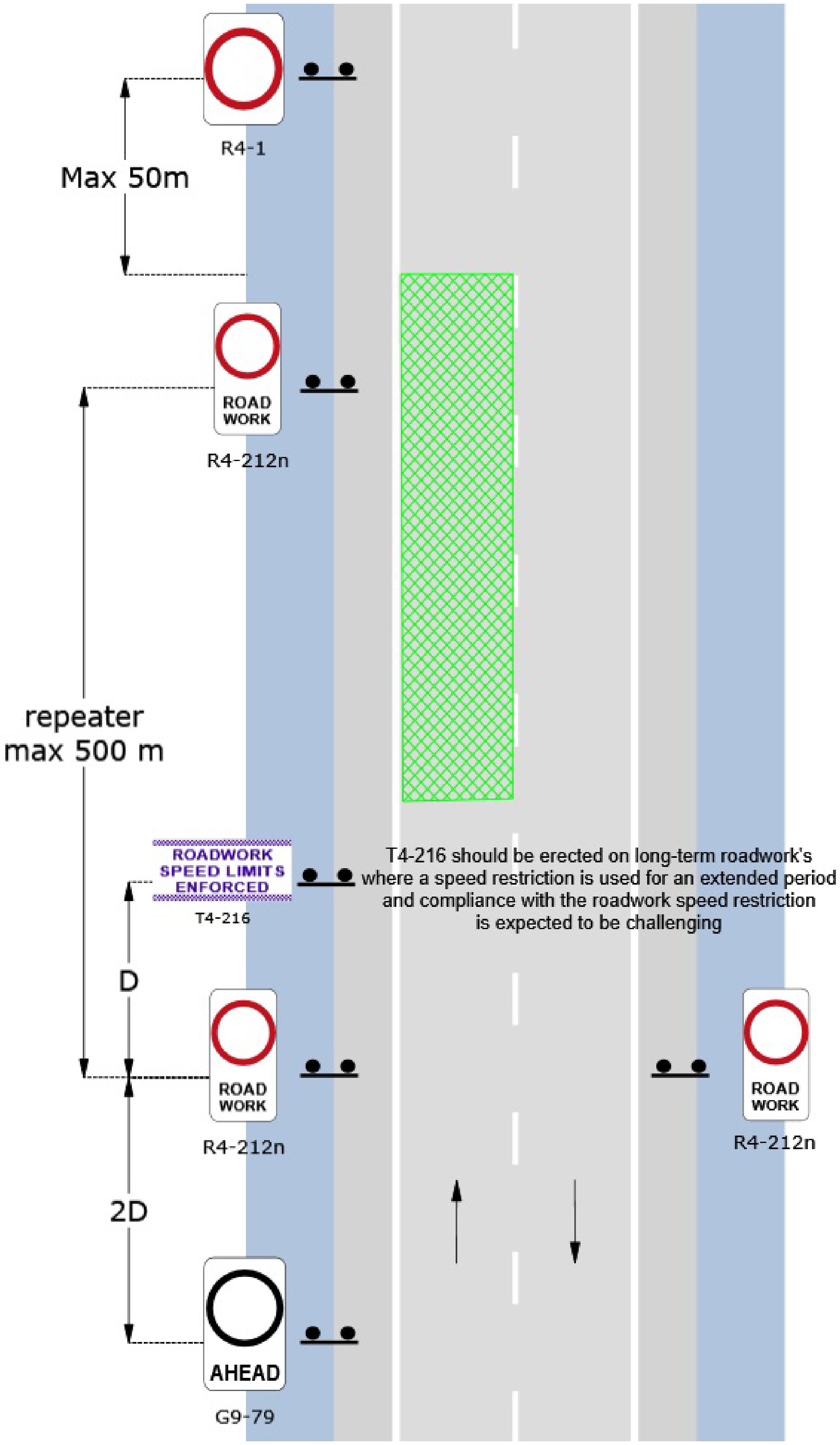
D.4.9 Static: Long Term speed reduction (formerly TCP 57)



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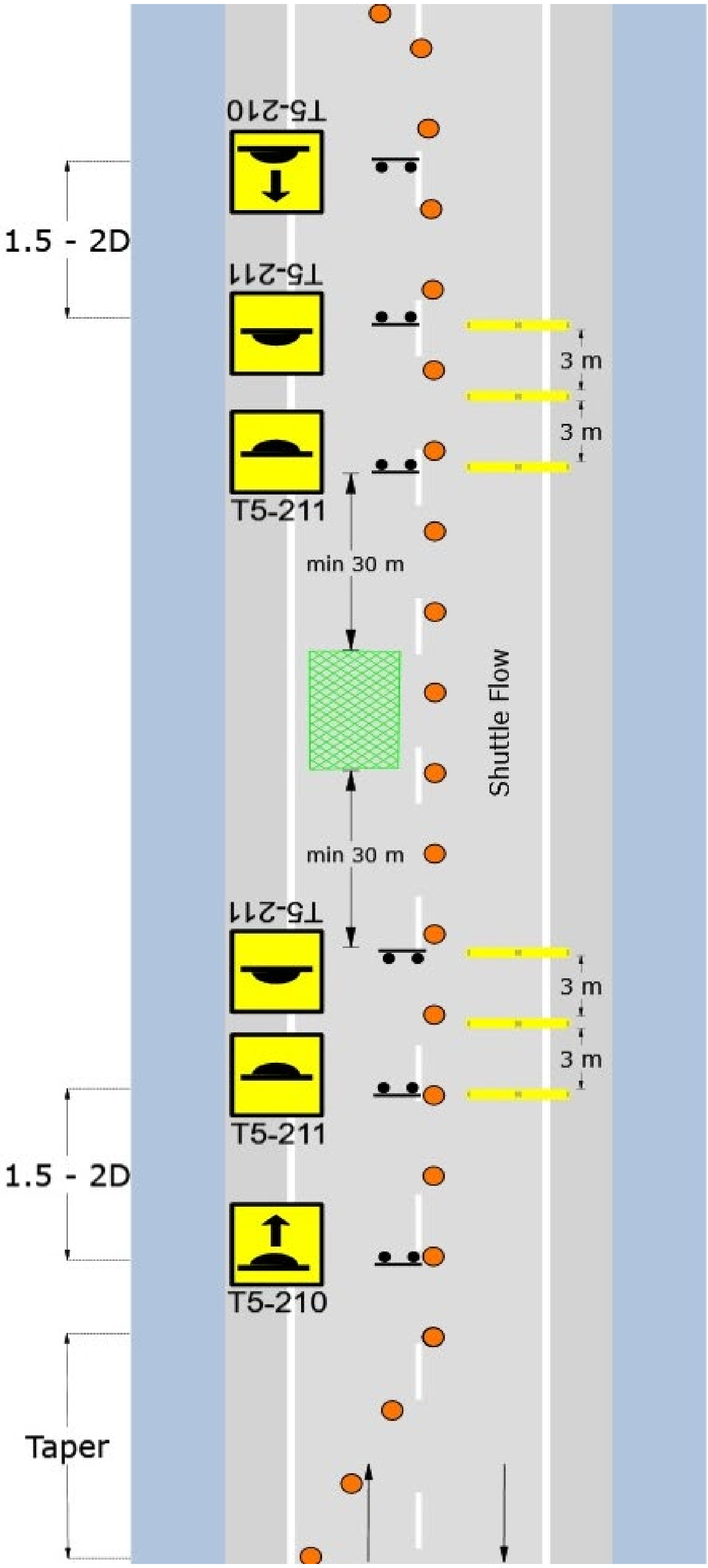
D.4.10 Static: Use of temporary portable rumble strips (shuttle flow)



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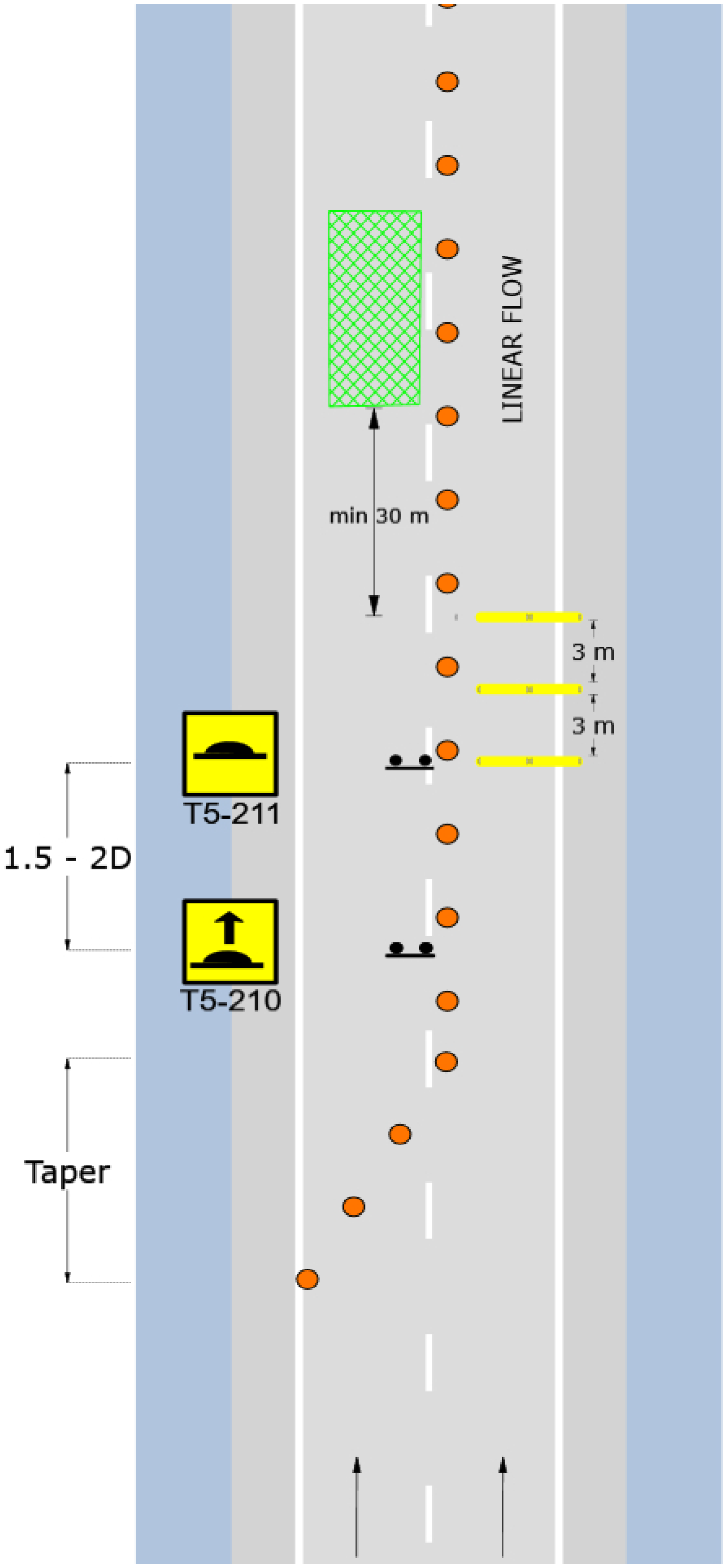
D.4.11 Static: Use of temporary portable rumble strips (merge lane closure)



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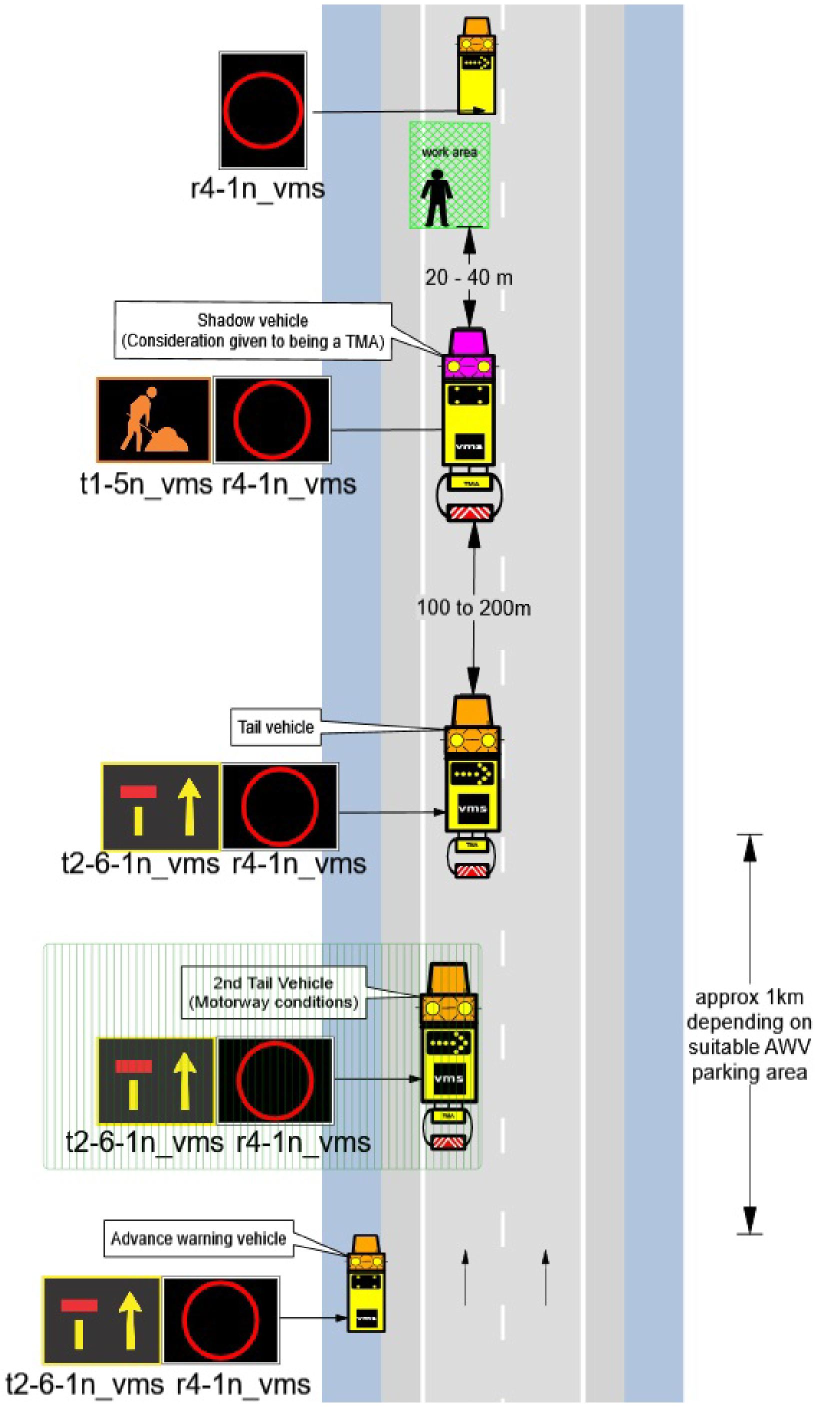
D.4.12 Dynamic: Continuous work - use of truck -mounted attenuator



Notes to Figure:

1. *Advance warning vehicle positioned greater than 500 mm inside the edge line and should include a VMS.*
2. *The TMA should be the first vehicle road users encounter in the lane, unless in motorway conditions, in which case the second tail vehicle will be encountered first, which straddles the edge line.*
3. *The tail vehicle TMA should be positioned within the travel lane.*
4. *The shadow vehicle should be positioned relative to worker on foot clearance requirements.*
5. *Vehicle spacing should be maintained; minimum sight distance to mounted warning devices should be 250 m.*
6. *Regulatory signs (e.g. speed signs) on a VMS must display continuously, and not alternate with another sign.*

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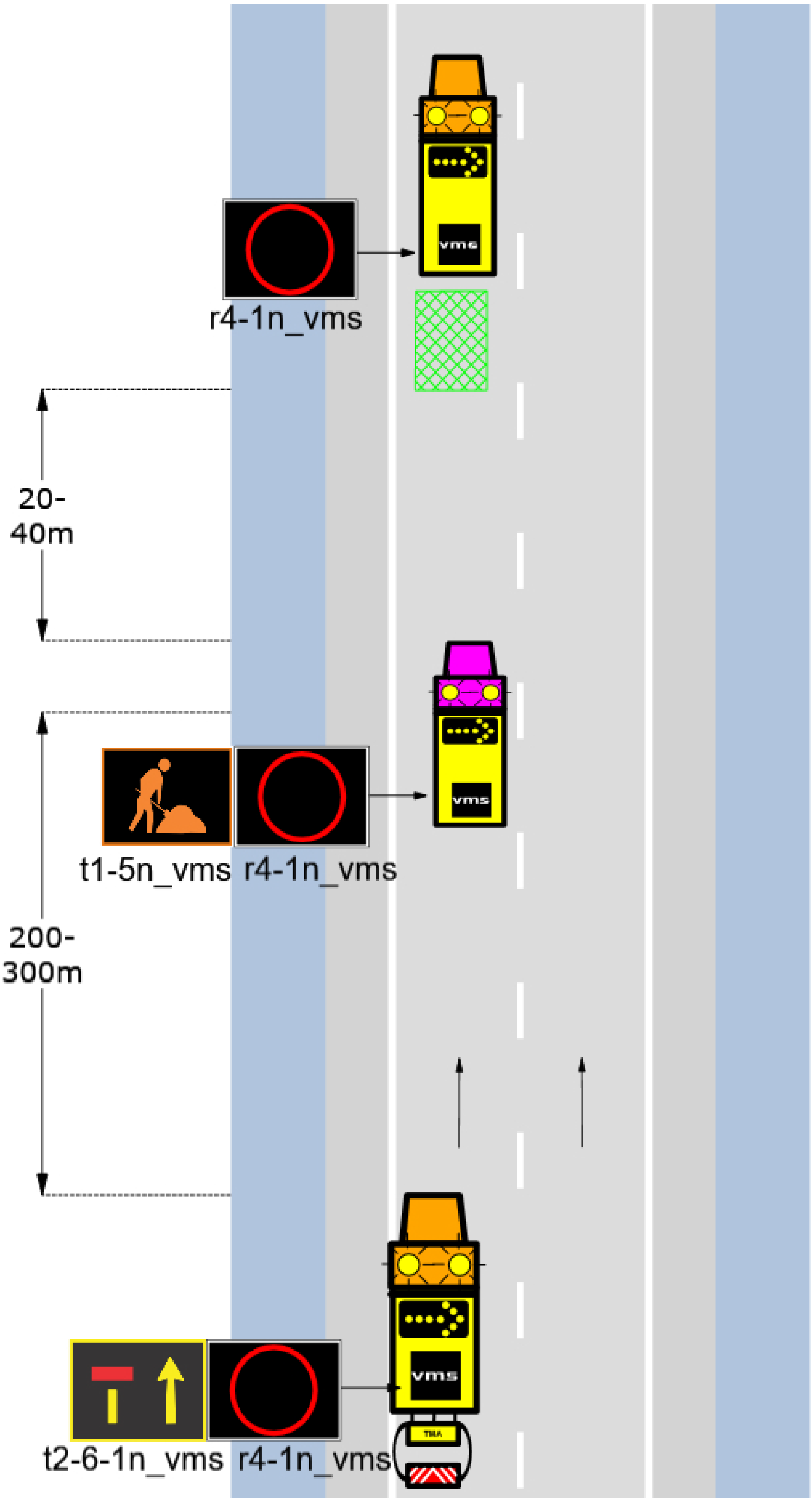
D.4.13 Dynamic: Continuous work - multi lane (formerly TCP 62)



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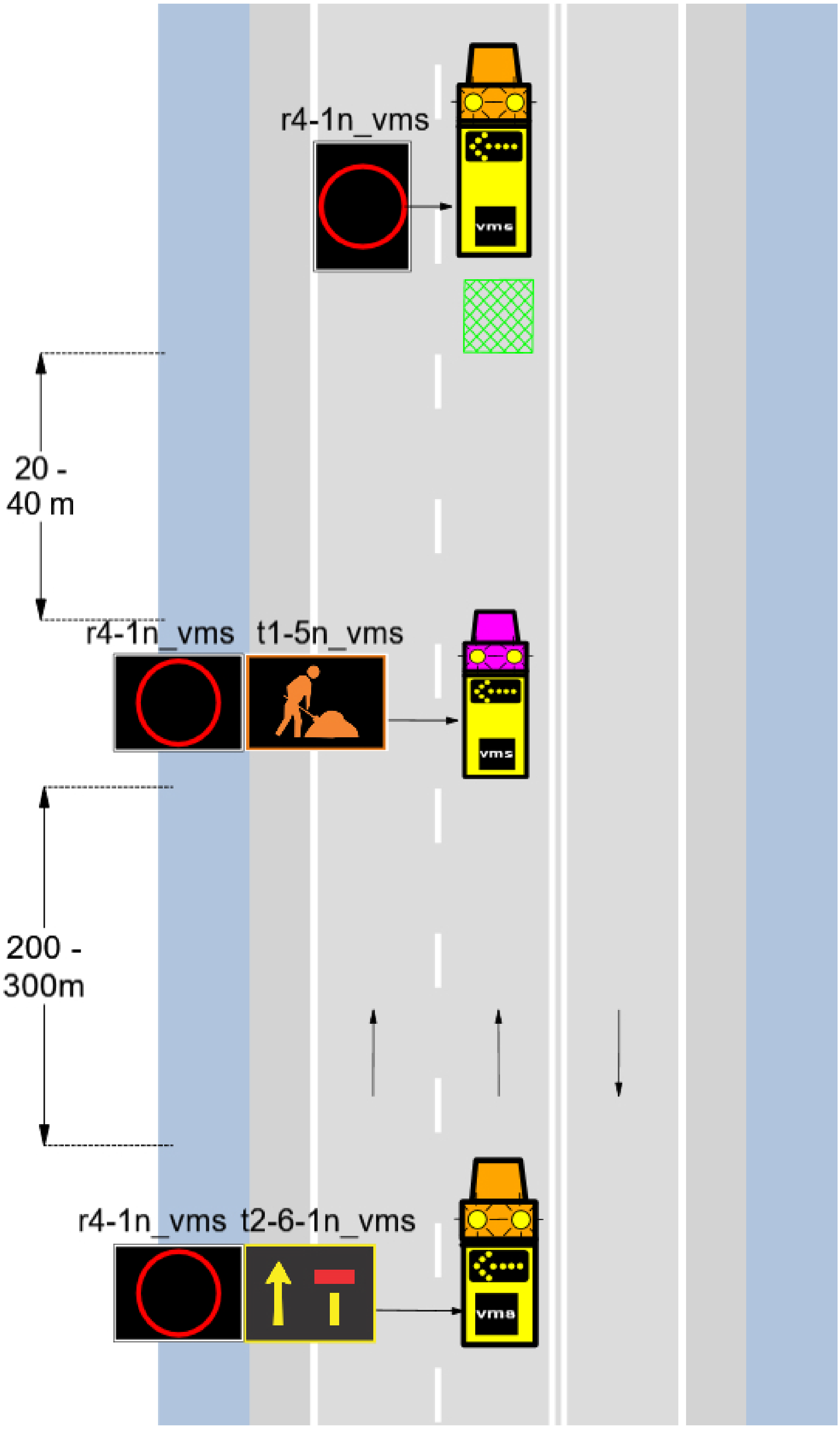
D.4.14 Dynamic: Continuous work in traffic - 3 lane / 2 way work (formerly TCP 70)



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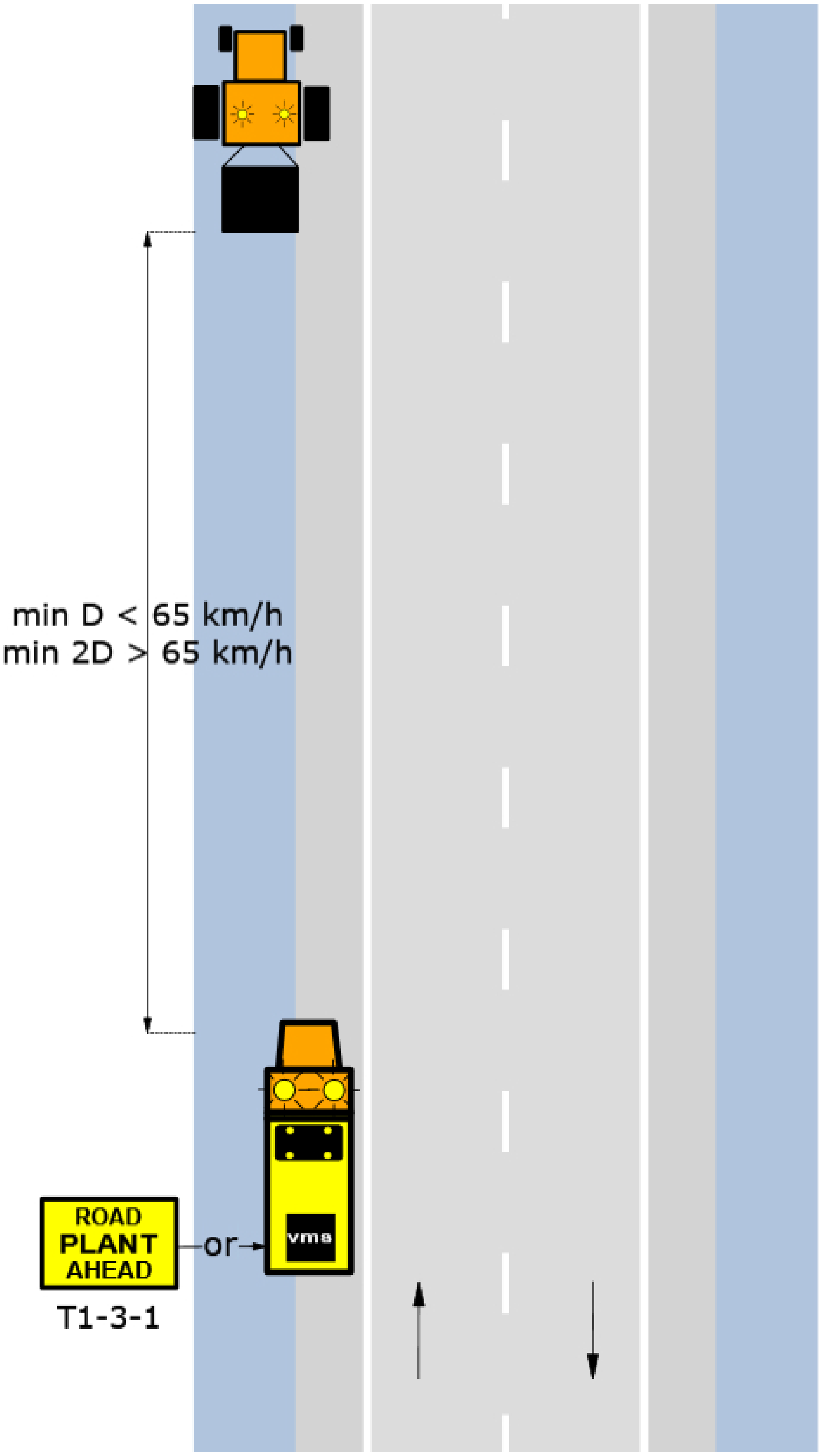
D.4.15 Dynamic: Continuous work - clear of traffic (formerly TCP 40)



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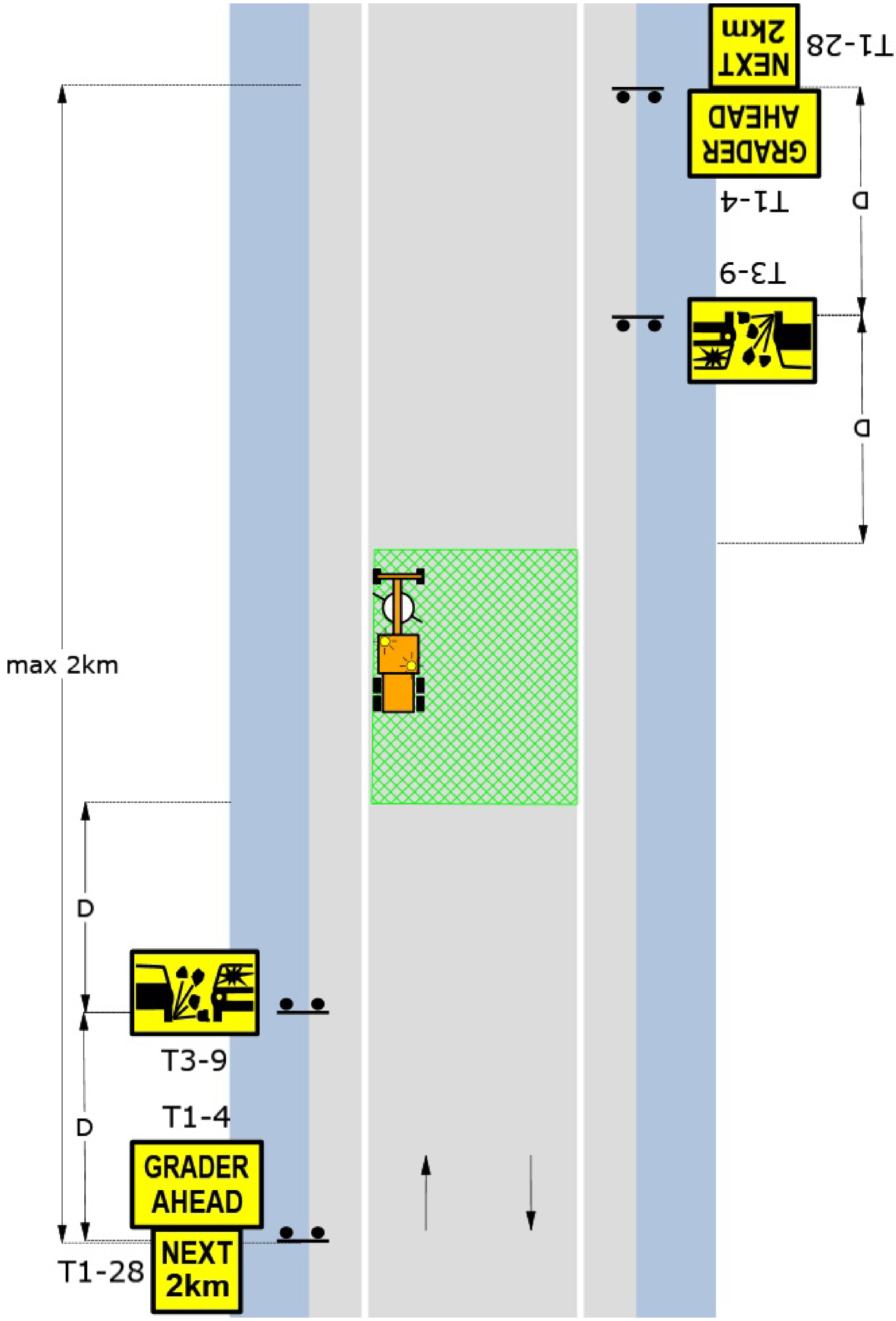
D.4.16 Dynamic: Continuous work, grading - 2 lane / 2 way (formerly TCP 105)



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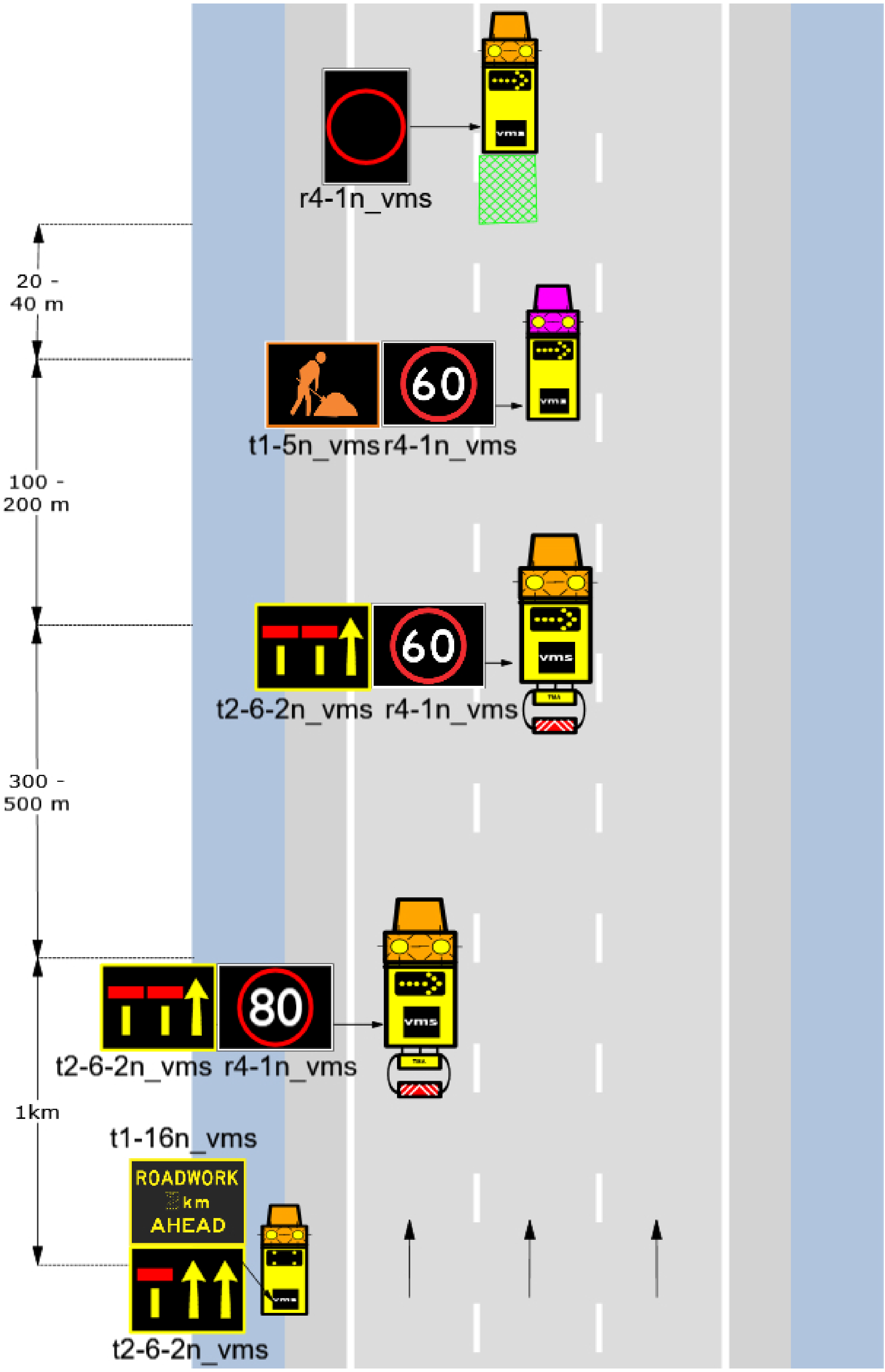
D.4.17 Dynamic: Continuous work middle lane closed 3 lane / divided (formerly TCP 107)



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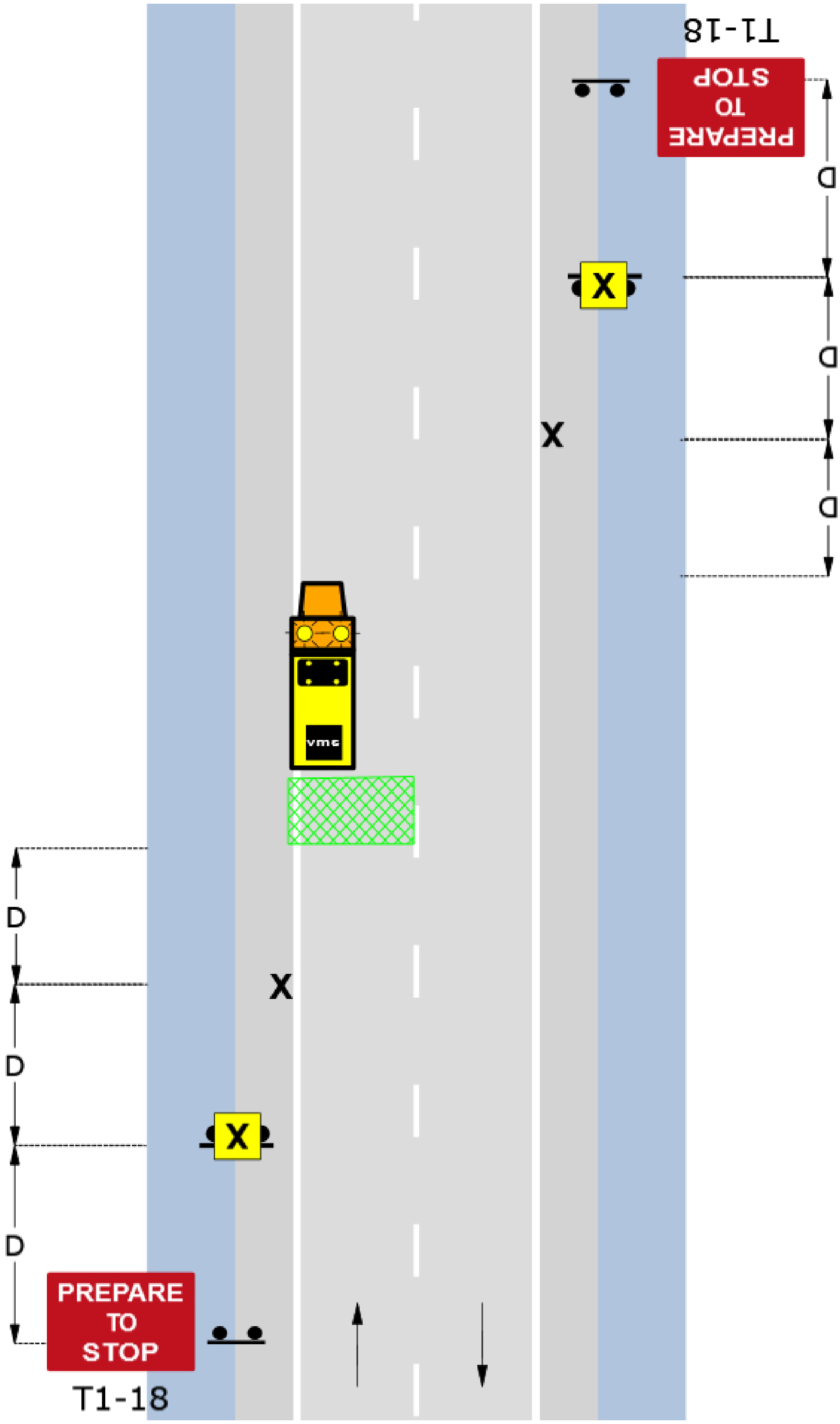
D.4.18 Dynamic: Frequently changing work - 2 lane / 2 way for ADT less than 1,500 (formerly TCP 77)



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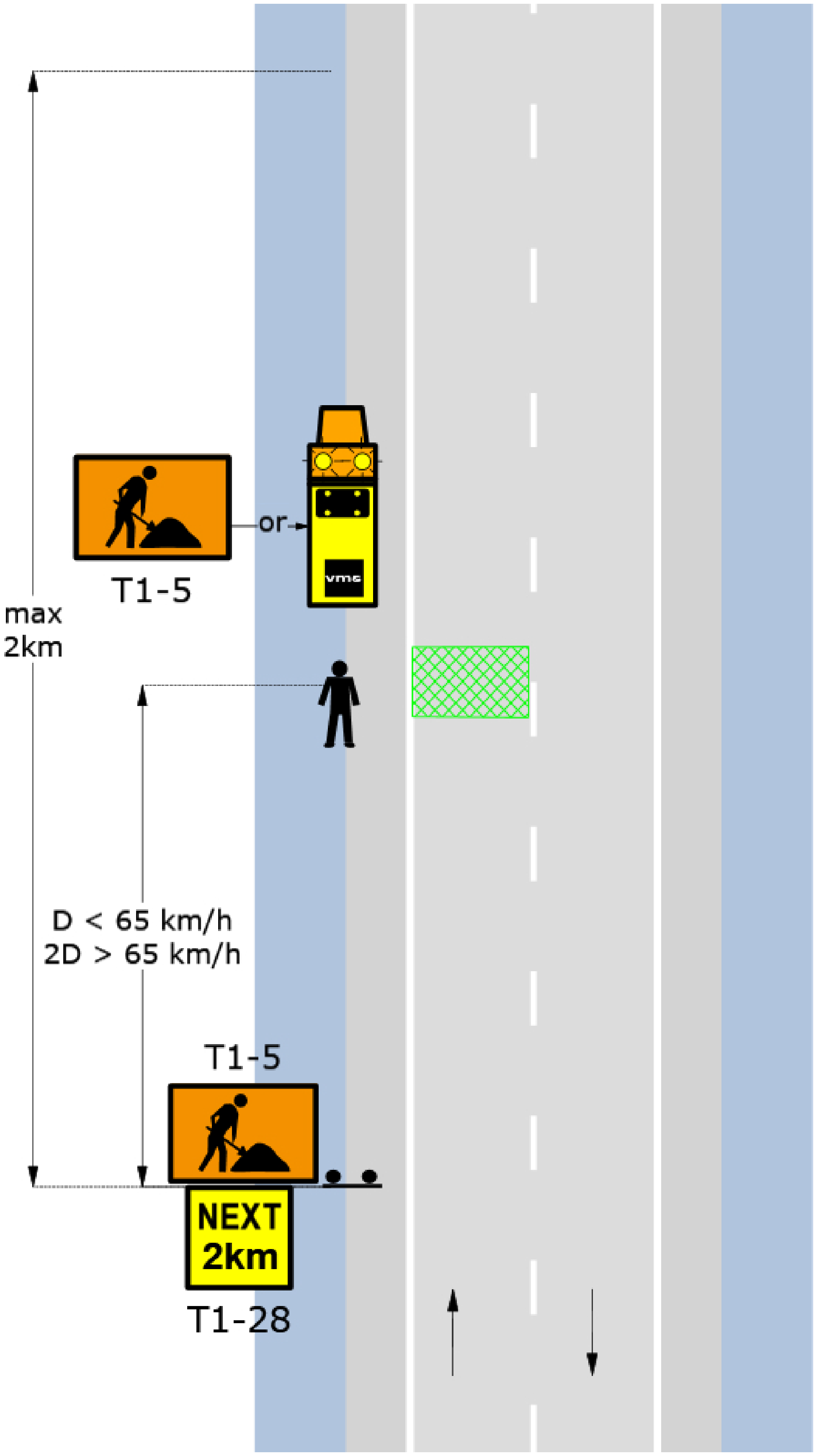
D.4.19 Dynamic: Frequently changing work in shoulder (formerly TCP 831)



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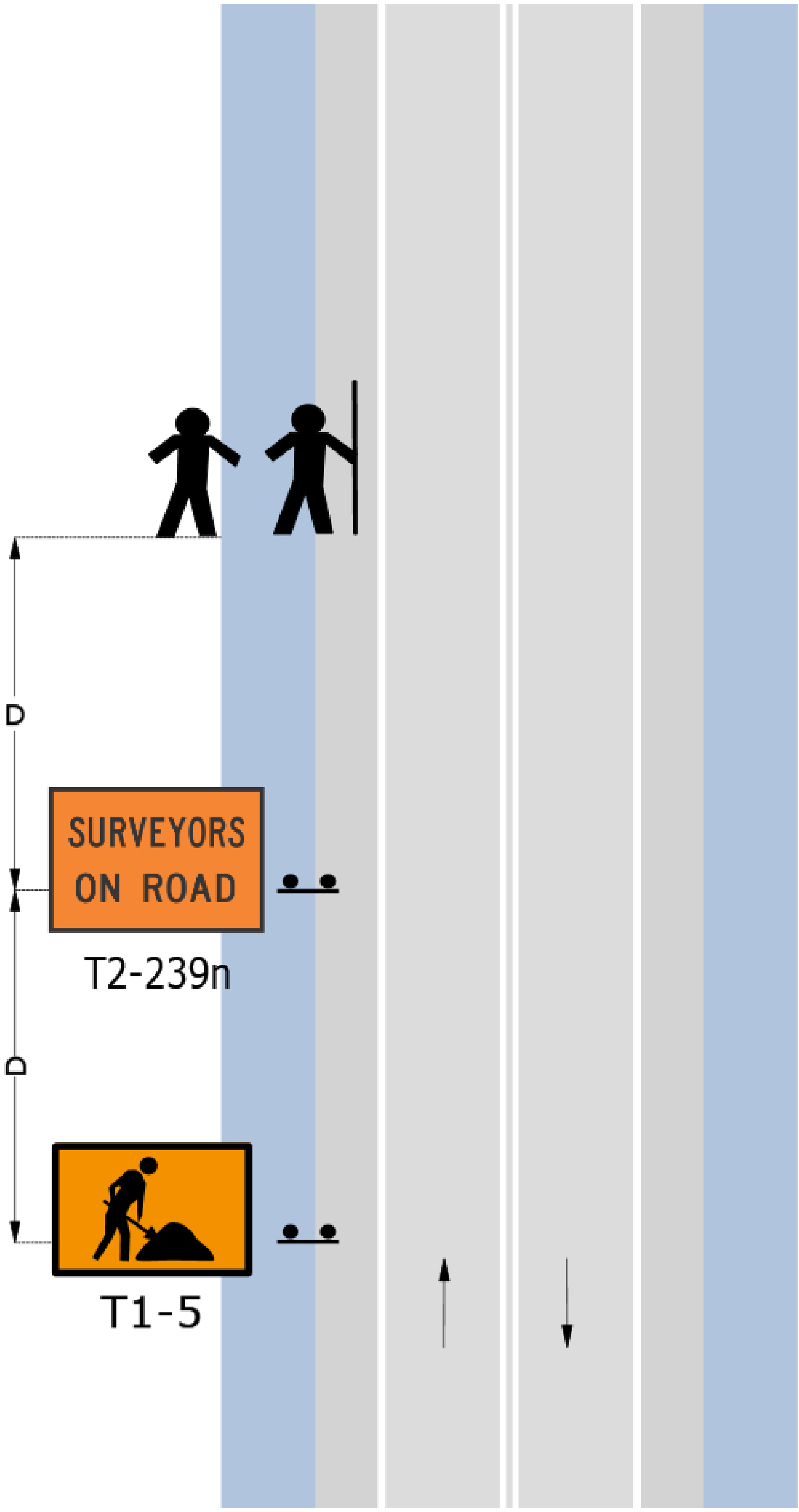
D.4.20 Dynamic: Intermittent work, surveying (formerly TCP 459)



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Appendix E – Inspection checklists and tools

INFORMATIONAL APPENDIX

E.1 Scope

This Appendix provides a number of checklists that may be used by project teams in relation to inspections. While every attempt has been made to align these checklists with the requirements of this Technical Manual, the checklists are examples only. Completion of these checklists might not necessarily fulfil all of the relevant requirements of this Technical Manual. And thus, pertaining to each work site, it remains the obligation of project teams to ensure all relevant requirements of this Technical Manual have been met regardless of the content of these example checklists.

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E.2 TGS verification checklist

TGS Verification must be undertaken after selecting or designing a TGS as a confirmation of appropriateness prior to approval for use. A PWZTMP or ITCP qualified person must undertake this verification.

Completed by:				
Name:		Signature:		
Qualification				
TGS details:				
TMP Reference:		TGS Reference:		
Date:		Review type	☐ Site Inspection	☐ Desktop review
Sources used for desktop review				
Site details				
Street name:		Confirmed posted speed limits:		
Street name:		Confirmed posted speed limits:		
Street name:		Confirmed posted speed limits:		
List unique site specific Hazards / Risks identified on site *E.g. utilities, infrastructure, vegetation, schools,*				

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TGS details					
Have the below been addressed on the TGS for this location?					
Traffic volumes	☐ Yes	☐ No	☐ N/A	Details	
Predicted queue length	☐ Yes	☐ No	☐ N/A	Details	
Shoulder widths	☐ Yes	☐ No	☐ N/A	Details	
Sight distances	☐ Yes	☐ No	☐ N/A	Details	
Existing infrastructure	☐ Yes	☐ No	☐ N/A	Details	
Transport services	☐ Yes	☐ No	☐ N/A	Details	
Pedestrian generators	☐ Yes	☐ No	☐ N/A	Details	
Appropriate site access	☐ Yes	☐ No	☐ N/A	Details	
Appropriate escape route for traffic controllers	☐ Yes	☐ No	☐ N/A	Details	

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Confirmation		
Does TGS require adjustments within tolerances? ***If yes provide details TGS must include these adjustments with justification.***		☐ Yes ☐ No
Comments or details of action taken:		
Does TGS require any additional changes or modifications? ***If yes provide details and return TGS to designer for additional changes or modifications***		☐ Yes ☐ No
Comments or details of action taken:		
Is TGS appropriate for use for works required at this location? ***If no provide details and, return TGS into file and select alternative, if design returned to designer for correction***		☐ Yes ☐ No
Comments or details of action taken:		
Have key TTM risks been addressed on site? ***If no, provide details and return TGS to designer for correction, review and approval***		☐ Yes ☐ No
Comments or details of action taken:		

Additional comments:

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E.3 Weekly TTM inspection checklist

Weekly inspections must only be carried out by a PWZTMP qualified person. Weekly inspections must be carried out when a site is first open and at least once every week thereafter.

Completed by:				
Name:		Signature:		
TMP Reference:		TGS Reference:		
Date:		Inspection type	☐ Pre-opening	☐ Weekly

Desktop review		
Is a copy of the location TMP and relevant TGS available? ***If no inspection must not be undertaken until documents are obtained***		☐ Yes ☐ No
Details of TMP and TGS:		
Are the location TMP and relevant TGS approved? ***If no, work must be stopped until documents are approved***		☐ Yes ☐ No
Comments or details of action taken:		

Site Inspection		
Inspection completed:	☐During the day ☐During the night	
Signs and devices positioned as prescribed and commanding attention? ***If no provide details and rectify signs***		☐ Yes ☐ No
Comments or details of action taken:		

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Site Inspection		
Sign sizes as prescribed? ***If no provide details and rectify signs***		☐ Yes ☐ No
Comments or details of action taken:		
Signs are mounted level and suitably clear of travel lanes? ***If no provide details and rectify signs***		☐ Yes ☐ No
Comments or details of action taken:		
Has temporary delineation been applied as prescribed, with permanent markings obliterated? ***If no provide details of action required to rectify delineation***		☐ Yes ☐ No
Comments or details of action taken:		
Are registered trailers i.e. VMS / light towers; suitably clear of travel lanes and delineated? ***If no provide details and rectify location***		☐ Yes ☐ No
Comments or details of action taken:		
Are temporary speed zones operating as prescribed? ***If no provide details and discuss with work supervisor***		☐ Yes ☐ No
Comments or details of action taken:		
Are PTCD positioned as prescribed in TGS? ***If no provide details of action required to rectify***		☐ Yes ☐ No
Comments or details of action taken:		

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Site Inspection		
Are manual traffic controllers clear of travel lane, have suitable escape route? ***If no provide details of action required to rectify***		☐ Yes ☐ No
Comments or details of action taken:		
Are site accesses and egresses well defined and safe for work vehicles? ***If no provide details of action required to rectify***		☐ Yes ☐ No
Comments or details of action taken:		
Termination signs are suitably located? i.e. D downstream of last activity. ***If no provide details of action required to rectify***		☐ Yes ☐ No
Comments or details of action taken:		

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Post site inspection confirmation		
Is worksite layout operating safely as intended? ***If no provide details and implement controls to rectify***		☐ Yes ☐ No
Comments or details of action taken:		
Has TMP identified and addressed key TTM risks? ***If no provide details and implement controls to rectify***		☐ Yes ☐ No
Comments or details of action taken:		
Have key TTM risks been addressed on site? ***If no provide details of additional hazards and controls required***		☐ Yes ☐ No
Comments or details of action taken:		
Have copies of Shift Inspections been sighted as completed as required? ***If no provide details and discuss with nominated rep completing Shift Inspections***		☐ Yes ☐ No ☐ N/A
Comments or details of action taken:		

Additional comments:

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E.4 Shift/Daily TTM inspection checklist

Shift inspections must be undertaken by a person holding the PWZTMP or ITCP qualification when a TGS is installed, changed or updated, to ensure the TGS is implemented as designed. This includes at a minimum, twice per shift (recommended every 2 hours). This form can also be used for inspecting 'Aftercare' arrangements.

Completed by:					
Name:		Signature:			
TMP Reference:		TGS Reference:			
Date:		Time/s	*Inspection 1*	*Inspection 2*	*Inspection 3*
			00-00	00-00	00-00

Drive through TGS inspection		*Inspection 1*	*Inspection 2*	*Inspection 3*
Have any adjustments been made to the approved TGS?		☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
If yes, provide details:	Are changes within tolerances? ***If no, TGS must be reviewed by a PWZTMP***	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
	Have changes been approved? ***If no, TGS must be approved***	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Comments or details of action taken:				
Have all signs and devices been installed in accordance with approved TGS? ***If no, provide detail of action taken***		☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Comments or details of action taken:				

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Drive through TGS inspection		*Inspection 1*	*Inspection 2*	*Inspection 3*
Are PTCD positioned as prescribed in TGS? ***If no, provide detail of action taken***		☐ Yes ☐ No ☐ N/A	☐ Yes ☐ No ☐ N/A	☐ Yes ☐ No ☐ N/A
Comments or details of action taken:				
Are manual traffic controllers clear of travel lane, have suitable escape route? ***If no, provide detail and reposition manual traffic controllers***		☐ Yes ☐ No ☐ N/A	☐ Yes ☐ No ☐ N/A	☐ Yes ☐ No ☐ N/A
Comments or details of action taken:				
Are sign and devices in good condition, clearly visible to road users? ***If no, provide detail of action taken***		☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Comments or details of action taken:				
Are all signs mounted level and suitably clear of travel lanes? ***If no, provide detail of action taken***		☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Comments or details of action taken:				
Are conflicting or non-applicable signs covered or removed? ***If no, provide detail and remove or cover signs***		☐ Yes ☐ No ☐ N/A	☐ Yes ☐ No ☐ N/A	☐ Yes ☐ No ☐ N/A
Comments or details of action taken:				

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Drive through TGS inspection		*Inspection 1*	*Inspection 2*	*Inspection 3*
Is temporary delineation installed as prescribed i.e. straight line forming taper? ***If no provide details and rectify delineation***		☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Comments or details of action taken:				
Have site conditions changed due to shade, park vehicles, glare etc. ***If yes provide details and note if action is required***		☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Comments or details of action taken:				
Are registered trailers i.e. VMS / light towers; suitably clear of travel lanes and delineated? ***If no provide details and rectify location***		☐ Yes ☐ No ☐ N/A	☐ Yes ☐ No ☐ N/A	☐ Yes ☐ No ☐ N/A
Comments or details of action taken:				
Are temporary speed zones operating as prescribed? ***If no provide details and discuss with work supervisor***		☐ Yes ☐ No ☐ N/A	☐ Yes ☐ No ☐ N/A	☐ Yes ☐ No ☐ N/A
Comments or details of action taken:				
Are workers on foot / plant clearances been applied / observed? ***If no provide details and implement controls to rectify***		☐ Yes ☐ No ☐ N/A	☐ Yes ☐ No ☐ N/A	☐ Yes ☐ No ☐ N/A
Comments or details of action taken:				

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Post drive through confirmation	*Inspection 1*	*Inspection 2*	*Inspection 3*
Is TGS valid for the site activity and operating safely as intended? ***If no provide details and implement controls to rectify***	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Comments or details of action taken:			
Is TGS is appropriate for the current traffic conditions? ***If no provide details and implement controls to rectify***	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Comments or details of action taken:			
Have potential hazards identified in TGS been addressed? i.e. end-of-queue management ***If no provide details of additional hazards and controls required***	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Comments or details of action taken:			

Additional comments:

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E.5 Post completion inspection checklist

Completed by:			
Name:		Road name/Staging Plan number:	
Signature:		Date / time:	
ITCP or PWZTMP card number			

Drive through post completed inspection		
Item		**Comments / Action**
Have all work activities been completed?	☐ Yes ☐ No	
Has all plant and equipment been removed?	☐ Yes ☐ No	
Have all TTM signs and devices been removed?	☐ Yes ☐ No	
Has all TTM linemarking been obliterated?	☐ Yes ☐ No	
Have existing permanent speed limits been reinstated?	☐ Yes ☐ No	
Have all TTM site hazards been removed?	☐ Yes ☐ No	
Other	☐ Yes ☐ No	

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Desktop post completion inspection		
Have all TGSs for completed tasks been retained?	☐ Yes ☐ No	
Have all TMP required documents been placed in relevant folders?	☐ Yes ☐ No	
Has TMP/TGS designer requested addition information post TTM removal?	☐ Yes ☐ No	
Is the road safe for opening to road users?	☐ Yes ☐ No	

Additional comments:

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E.6 Portable variable message sign (VMS)/variable speed limit sign (VSLS) location and placement checklist

Proposed site location	
Road Details /Intersections /property numbers	
Purpose of the VMS/VSLS	
Proposed period of use	
Is this integrated with TMC?	

Checklist details for VMS/VSLS location	Yes, No or N/A	Comments/reasons for non-compliance
Planning		
Will the location of the proposed VMS/VSLS be in the road reserve?		
Will the proposed VMS/VSLS be visible from a road or road related area?		
Is the proposed VMS/VSLS being used as part of a major event?		
Safety		
Will the proposed location allow safe and easy access to the site for deployment of the portable VMS/VSLS?		
Is the proposed site located near any utilities (overhead or underground)?		
Will the proposed site cause personnel to be unsafely exposed to traffic?		
Will traffic control be required to safely place or remove the portable VMS/VSLS?		

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Checklist details for VMS/VSLS location	Yes, No or N/A	Comments/reasons for non-compliance
Are there any other safety considerations at the proposed site? e.g. bore drains, culverts etc.		
Placement		
Is the proposed location likely to affect or change the patterns of any vulnerable road user movements?		
Is the proposed location likely to affect or change the pattern of cyclist movements?		
Will the proposed location be behind Transport approved safety barriers or as far away from the edge of the traffic lane as is practical in a position determined suitable based on a documented risk assessment and detailed in the TMP? For more information refer to Austroads *Guide to Road Design Part 6: Roadside Design, Safety and Barriers*.		
Is the proposed location at least 300m from the nearest permanent VMS?		
Is the proposed location at least 200-300m from significant static signs?		
Is the proposed location at least 200-300m from any signalised intersections?		
Will the proposed location cause driver distraction?		
Is the proposed location a suitable distance from any speed zoning signage?		
Is the proposed location in the direct run off carriageway path of a vehicle?		
Will the proposed location affect any residential or commercial properties?		

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Checklist details for VMS/VSLS location	Yes, No or N/A	Comments/reasons for non-compliance
Will the proposed location affect any accesses or legal rights of way?		
Is the proposed location within 200m of any intersection or merging lane?		

Structures		
Will the proposed location be behind guard rail?		
Will the proposed location be behind wire rope fence?		
Is the proposed location close to significant road side furniture?		

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