New Zealand guide to temporary traffic management

All workers and road users
go home safe every day

WAKA KOTAHI
NZ TRANSPORT
AGENCY

Waka Kotahi NZ Transport Agency

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While all care has been taken to ensure all the figures and information in this publication are correct, there may be some errors or omissions in the detail.

Purpose of this guide

The New Zealand guide to temporary traffic management (NZGTTM) supports system level changes needed to achieve the Road to Zero New Zealand road safety strategy. The guide has been developed for use by Waka Kotahi, its partners and the sector.

The NZGTTM is designed to aid all organisations involved in temporary traffic management (TTM) to meet their legislative obligations. The foundation to success is consultation, collaboration and coordination with all organisations necessary. The NZGTTM sets out our principles and is only a guide. This is deliberate. The NZGTTM does not detail TTM solutions as there are too many variables that mean each site must be assessed individually. This applies for generic activities and unique activities, both planned or reactive. It is wise to never assume a generic approach to TTM will be fit for purpose for any site – always ask 'how can I do this more safely?'.

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Disclaimer

The purpose of this guide is to help the TTM industry make decisions about what safe temporary traffic management looks like and suggests what may be considered reasonably practicable steps towards ensuring that risk is minimised for those working in and using road corridors. The TTM industry is encouraged to make decisions as they see fit and to obtain their own advice.

Waka Kotahi has endeavoured to ensure material in this document is technically accurate and reflects legal requirements. However, the document does not override governing legislation and Waka Kotahi is not liable for any consequences arising from the use of this document. If you are unsure whether the material is correct, you should refer directly to the relevant legislation and contact Waka Kotahi.

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Foreword

Waka Kotahi NZ Transport Agency is committed to Road to Zero – a safer Aotearoa New Zealand where no one is killed or seriously injured on our roads.

This vision extends to the importance of keeping our road workers and road users safe when temporary traffic management is required. We support an approach that considers, on each temporary traffic management site, the risks to people and how they could be kept safe.

We believe every road worker should go home safely. That's why we've been actively working with the sector, from construction and maintenance companies to roading providers and regulators WorkSafe New Zealand, on a joined-up approach to make a difference to road worker safety.

The emphasis on a risk-based approach clearly places people at the heart of how we manage temporary traffic. It will be useful for construction and maintenance programmes, events, emergency response and primary industry activities or any activity where a temporary road design is required. While proven principles underpin the guide, the key benefit in moving to a risk-based approach is providing more freedom to focus on managing safety risks. At the same time the guide makes decision making and accountability clearer.

The guide's risk-based approach will require a new way of thinking and new way of doing things to keep everyone safe on our roads. It's going to take time to embed this new way of working and Waka Kotahi, as a sector leader and as a road controlling authority, is committed to helping you through the changes.

Waka Kotahi is working with its partners to implement the new approach to TTM across our network to support the transition from a government-led compliance-based model to an industry-led risk-based model. We also welcome the wider industry to work together to support the transition to the new guidance to improve road worker safety.

I look forward to working with you on this journey.

V C Browne

Vanessa Browne
National Manager Programme and Standards
Transport Services
Waka Kotahi NZ Transport Agency

Using this guide

This is a best practice guide to aid with securing the safety of those using and working in a road corridor.

While not a mandatory code of practice, this guide is intended for use by persons conducting a business or undertaking (PCBUs) that fund, plan, or engage in activities on or near roads in Aotearoa New Zealand.

Use this guide alongside the WorkSafe *Keeping healthy and safe while working on the road or roadside Good Practice Guide (2022)*. Further background reading includes the Health and Safety at Work Act 2015, Land Transport Management Act 2003, Local Government Act 2002 and the Road to Zero strategy, Ministry of Transport. Links to these resources are included in this guide.

Use of 'must', 'should', and 'could'

The words 'must', 'should', and 'could' indicate whether an action is required by law or is a recommended practice or approach.

Term	Definition
Must	Legal requirement that has to be complied with
Should/could	Recommended practice or approach

Who should read this guide?

This guide is for any PCBU and transport practitioner who is involved in road or roadside activity at any point in the contracting chain, for example:

- a PCBU that has workers working on a road or roadside
- a PCBU that has control of a road or roadside and contracts work to be done on that road or roadside
- a PCBU that subcontracts other PCBUs to do work on a road or roadside
- a PCBU that is responsible for designing or implementing temporary traffic management plans for road or roadside work.

This guide is written to facilitate the wide range of knowledge and experience of PCBUs and transport practitioners that may refer to it. In some instances, PCBUs and transport practitioners may need to refer to relevant experts for further guidance on how to implement or execute recommended practices.

This guide may also be useful for health and safety professionals when providing health and safety advice to PCBUs and transport practitioners who are involved with road or roadside work, or those who are part of the contracting chain.

Guide structure

New Zealand guide to temporary traffic management		
Main document	**Additional guidance and resources**	**Applying the guide - the TTM library**
Part 1 Introduction Part 2 TTM system Part 3 The toolbox Part 4 Glossary	Guidance notes, supporting information and resources have been provided by Waka Kotahi and the TTM industry as a starting point to support the publication of Version 1 of the NZGTTM: Lowest total risk Activity and environment information Identification of TTM risks Design guide diagrams Example forms Operational practice note Quality, assurance and control Basis of dimensions Note: These will evolve over time and additional resources will be added to the TTM library.	We're working with TTM industry to support the development of the TTM library which will act as a central hub for guidance notes, supporting information and resources. Everyone across the TTM industry can create resources and contribute to the library.

Document	**Part 1** **Introduction**	**Part 2** **TTM system**	**Part 3** **The toolbox**
Description	Overview of the purpose and use of the NZGTTM including references to relevant legislation	Details and guidance on the operational workflow for temporary traffic management	TTM engineering guidance for geometrics, design principles, equipment, and specialist projects

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Why we implement temporary traffic management

Part 1 sets out why we have TTM and provides information about the purpose of the NZGTTM. This includes references to relevant legislation, strategy and guides.

Who should read this?

- Senior leaders* responsible for organisational systems and processes.
- Temporary Traffic Management Planner (TTMP).
- Site Traffic Management Supervisor (STMS).
- Road workers.
- Department managers.
- Corridor manager.
- Traffic management managers.
- Project managers.
- Contract managers.

* Senior leaders include anyone typically in roles like CEO, GM or Regional Manager.

Contents

Introduction

How this guide fits into the bigger picture

In terms of transport and road safety, this guide is aligned with government priorities and direction. In this section you'll find information on how national legislation, strategies and guidance provide the context for this guide.

Many of us know of a time where a worker or member of the public has died or been seriously injured at a worksite. We must all do **everything we can** to eliminate and reduce the risk of death and serious harm.

In Aotearoa New Zealand, legislation along with national strategy and guidance documents, requires that persons conducting a business or undertaking (PCBU) **must** do all things reasonably practicable to keep workers and road users safe.

Safety is our number one priority – convenience comes second.

Legislation

Health and Safety at Work Act 2015 (HSWA)

legislation.govt.nz/act/public/2015/0070/latest/DLM5976660.html

What HSWA sets out to do

Everyone must have the best protection possible from workplace health and safety risks, as is reasonably practicable.

A good health and safety system relies on participation, leadership, and accountability from businesses, workers, and government. Everyone needs to work together.

HSWA sets out the principles, duties, and rights in relation to workplace health and safety.

What does this mean?

Everyone is responsible for safety and health

HSWA makes everyone's roles and responsibilities clear.

PCBUs are responsible for the health and safety of their workers and any other workers they influence or direct. They're also responsible for the health and safety of people at risk from the work they're doing. In relation to TTM, a PCBU is any entity that is controlling or impacting road workers and users.

If you create the risk, you manage the risk

Work-related health and safety risks must be identified and managed, so everyone is kept safe and healthy. This means looking for potential for work-related health conditions as well as the injuries that could occur.

Everybody involved must proactively do everything they can to identify risks and put in place controls to eliminate or minimise the risks to workers and road users such as drivers, passengers, pedestrians, and cyclists.

What this means for the temporary traffic management industry

- All parties are responsible, whether they are the client, designer, or contractor – from Director to CEO to manager to worker.
- Everyone has obligations to both workers and road users.
- Everyone gets the highest level of protection reasonably practicable.
- Everyone needs to proactively identify risk and put in place controls to eliminate or minimise the risks as far as reasonably practicable.

Local Government Act 2002 and 1974 (LGA)

2002 – legislation.govt.nz/act/public/2002/0084/latest/DLM170873.html

1974 – legislation.govt.nz/act/public/1974/0066/latest/DLM415532.html

The LGA provides for democratic and effective local government that recognises the diversity of communities in Aotearoa New Zealand.

The LGA:

- states the purpose of local government
- provides a framework and powers for local authorities to decide which activities they undertake and how they'll do them
- promotes the accountability of local authorities to their communities
- provides for local authorities to promote the social, economic, environmental, and cultural well-being of their communities, using a sustainable development approach.

Local government has a responsibility to protect and promote the safety of the community.

Section 145 of the LGA 2002 states:

145. General bylaw-making power for territorial authorities

A territorial authority may make bylaws for its district for one or more of the following purposes:

a. protecting the public from nuisance:

b. protecting, promoting, and maintaining public health and safety:

c. minimising the potential for offensive behaviour in public places.

Section 353 of the LGA 1974 states:

353. General safety provisions as to roads

The council shall take all sufficient precautions for the general safety of the public and traffic and workmen employed on or near any road, and in particular shall—

a. take all reasonable precautions to prevent accidents during the construction or repair by the council of any road, or when any opening is made therein by the council for the repair of drains or gas pipes or for any other purpose, and require other persons doing such work to take such precautions, by erecting barriers, devices to cause traffic to slow down, or fences across any such road or around any dangerous place therein, or otherwise, and shall cause, and require other persons doing such work to cause, any such dangerous place to be sufficiently lighted by night; and any person removing any such protective work, or removing or extinguishing any such light, without the authority of the council, commits an offence:

b. require the owner or occupier of any land upon which there is any hole, well, excavation, or other place dangerous to persons passing along any road forthwith to fill in, cover, or enclose the same:

c. whenever the public safety or convenience renders it expedient, require the owner or occupier of any land not separated from a road by a sufficient fence to enclose the same by a fence to the satisfaction of the council.

What this means for the temporary traffic management industry

- Local government has responsibilities to the communities they serve
- These responsibilities include protecting, promoting, and maintaining public health and safety during road construction or repair.

Land Transport Management Act 2003 (LTMA)

legislation.govt.nz/act/public/2003/0118/latest/DLM226230.html

The purpose of the LTMA

The LTMA contributes to the aim of achieving an affordable, integrated, safe, responsive, and sustainable land transport system.

The LTMA covers things like:

- planning and investment in land transport
- social and environmental outcomes
- funding mechanisms.

What this means for the temporary traffic management industry

The TTM system is used by those who work on land transport funded projects to:

- contribute to a safer land transport system
- deliver projects that improve the safety of the transport system
- deliver projects in a safe manner.

Other Acts

There are other acts relevant to TTM, including the:

- Railways Act 2005 legislation.govt.nz/act/public/2005/0037/latest/DLM341568.html
- Civil Defence Emergency Management Act 2002 legislation.govt.nz/act/public/2002/0033/51.0/DLM149789.html
- Fire and Emergency New Zealand Act 2017 legislation.govt.nz/act/public/2017/0017/latest/DLM6712701.html
- Policing Act 2008 legislation.govt.nz/act/public/2008/0072/latest/whole.html
- Utilities Access Act 2010 legislation.govt.nz/act/public/2010/0098/latest/whole.html

These acts require organisations operating on or next to roads to meet obligations that include safety, access, prevention or reduction of harm and damage, and civil rights.

While organisations have many different obligations relating to the operation of roads, the safety of people and managing risk is common to all.

National strategy

Road to Zero, New Zealand's road safety strategy 2020–2030

transport.govt.nz/assets/Uploads/Report/Road-to-Zero-strategy_final.pdf

Road to Zero places human wellbeing at the heart of our road transport planning. It outlines a road safety system that supports and expects road users to make good choices but acknowledges that we can all make mistakes. It values every life and the liveability of our communities, and it upholds the right of all of us to feel safe and arrive safely on our journeys across Aotearoa.

Our vision

An Aotearoa where no one is killed or seriously injured in road crashes. This means that no death or serious injury while travelling on our roads is acceptable.

Seven guiding principles support this vision:

- We promote good choices but plan for mistakes.
- We design for human vulnerability.
- We strengthen all parts of the road transport system.
- We have a shared responsibility for improving road safety.
- Our actions are grounded in evidence and evaluated.
- Our road safety actions support health, wellbeing, and liveable places.
- We make safety a critical decision-making priority.

Of these seven principles, three are important to TTM:

We promote good choices but plan for mistakes

We expect everyone to follow the rules and make good choices when they use the roads. Most serious crashes are not caused on purpose. Some people will take risks, but usually a crash is caused by a momentary lapse or error in judgement. Most crashes happen when someone makes a mistake. These mistakes should not end in serious injury or death.

We design for human vulnerability

In a crash, there's only so much force our bodies can take before we're injured. Our chances of survival or avoiding serious injury drops rapidly the faster we go. For a pedestrian, wheeled pedestrian, cyclist, or motorcyclist hit by a car, the limit is 30 km/h. In a side impact collision of two cars, it's 50 km/h and in a head-on crash of two cars, it's 70 km/h.

Children, the elderly, and people with disabilities are more vulnerable. With people getting older and more people walking, cycling, scootering, and using mobility aids, there are likely to be more vulnerable people using our transport network. Our road system design must recognise our vulnerabilities and plan for mistakes, so that a crash doesn't end in serious injuries or death.

We make safety a critical decision-making priority

Safety is as important as public health and sustainability. It must be given the same priority in our investment and regulatory frameworks. It is not optional or a nice-to-have add-on. This means that other objectives, such as increased efficiency, need to be achieved in a way that improves safety.

What this means for the temporary traffic management industry

- Safety is a key focus for the transport system.
- An Aotearoa where nobody is killed or seriously injured in road crashes.
- Plan for mistakes and human vulnerability.

The Road to Zero strategy shifts our focus to designing for human error and vulnerability. Everyone must consider what might happen if somebody doesn't follow the TTM on a site. We need to make sure everyone is safe.

One Network Framework

The One Network Framework is our national classification system for roads and streets and is based on a movement and place framework. It's a tool to help establish transport network function and inform decision making and potential interventions for each road and street type. The framework also introduces classifications for different modes of transport, recognising that our roads and streets have different functions for different modes. Streets not only keep people and goods moving, but they're also places for people to live, work and enjoy. Other words for the function of a road and streets are purpose or role. Examples of the function of roads can be to:

- move freight – lots of heavy vehicles
- allow access to private property or businesses
- facilitate travel between towns
- move buses
- allow pedestrians or cyclists safe passage
- allow people space to spend time socialising or shopping.

Go to nzta.govt.nz/onf for more information.

What this means for the temporary traffic management industry

- Roads and streets are for people to use, our TTM response needs to be consistent with the needs of users.
- We no longer solely focus on traffic volume to inform decision making.
- We acknowledge all modes of transport – walking, cycling, public transport, general vehicles and freight.
- We acknowledge roads and streets provide a place function – a place where people live, work, shop, play, meet and gather with others.
- Temporary traffic management applied to the network should consider the function that a road or street performs, as well as the modes of transport, and the people that use them.

National guidance

WorkSafe Good Practice Guideline: Keeping healthy and safe while working on the road and roadside

The WorkSafe Good Practice Guideline has advice on how to manage the health and safety risks road and roadside workers are exposed to while at work. They can help PCBUs to meet their duties under the Health and Safety at Work Act 2015 (HSWA).

worksafe.govt.nz/topic-and-industry/road-and-roadside/keeping-healthy-safe-working-road-or-roadside

Examples of road and roadside work are shown in Figure 1.

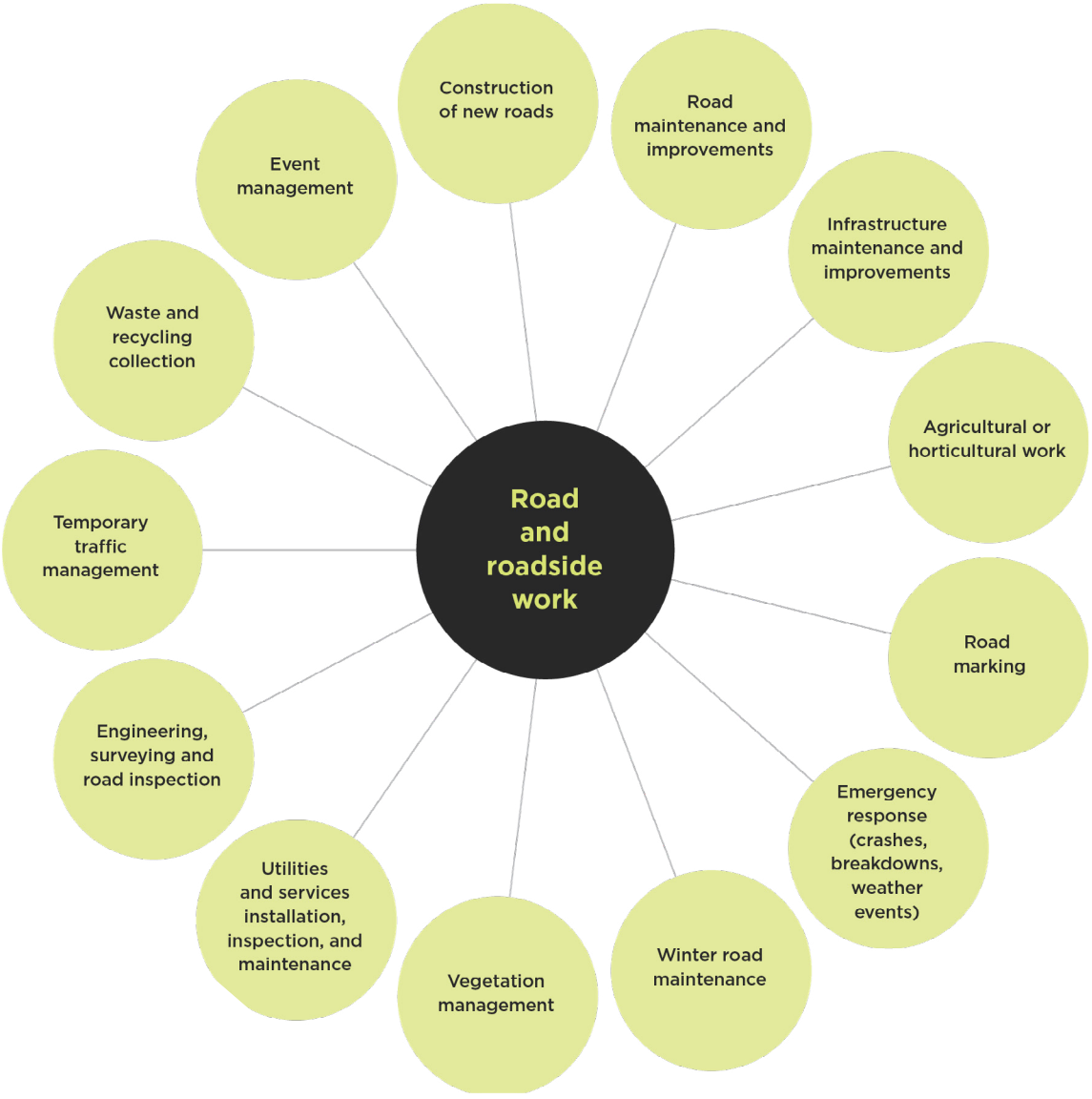

Figure 1 Examples of Road and Roadside Work.
Image credit: WorkSafe

The WorkSafe Good Practice Guideline covers all work being done on a road or roadside. In these environments the worker and work activity create risk to the road user and the road user creates risk to the worker as shown in Figure 2.

Figure 2 Risk relationship between worker/work activity and road users.
Image credit: WorkSafe

Road and roadside workers can be exposed to many risks to their health and safety. All PCBUs involved with road and roadside activities have a duty to keep everyone safe when working on or near roads.

What this means for the temporary traffic management industry

- All parties have obligations – client, designer, and contractor from CEO to worker level.
- All parties have obligations to both workers and road users.
- You need to give the highest level of protection, as is reasonably practical.
- You need to proactively identify risk and controls to eliminate or minimise the risks as far as reasonably practical.

Top tip: Managing risk of harmful interactions
Unfortunately, harmful interactions to road workers are on the rise, especially from road users affected by road or roadside work. Useful guidance on how to manage the risk from harmful interactions can be found at: worksafe.govt.nz/topic-and-industry/road-and-roadside/keeping-healthy-safe-working-road-or-roadside/part-b/15-0-mental-wellbeing

Everybody involved must proactively do all things reasonably practicable to identify risks and controls to eliminate or minimise the risks to workers and road users.

Why we need TTM

Workers and road users need to be protected from the hazards created by a work site. A good TTM plan can achieve this by following the key principles in figure 3.

Everybody – everybody involved has responsibilities for safety.

Safety – safety of everyone in the transport system.

Risk – we must proactively identify risks and work to eliminate or minimise these risks.

Mistakes – people make mistakes or take risks.

Vulnerability – people should not pay for mistakes with their lives.

Figure 3 TTM key responsibilities

All workers and road users go home safe every day


STOP

2

The temporary traffic management system

Part 2 covers how we do TTM. We look at the risk-based approach of the TTM system and the processes behind planning, implementation, maintenance and uplift.

Who should read this?

- Practitioners planning and preparing for temporary traffic management activity.
- Temporary Traffic Management Planner (TTMP).
- Department managers.
- Corridor manager.
- Traffic management managers.
- Project managers.
- Contract managers.

Contents

Risk management for TTM

This section introduces the risk-based approach to TTM and outlines risk concepts and principles.

If, when assessing risk, you become unsure how to proceed, this simple explanation may help you figure out how to move forward.

This section is not complete risk management training. If you're unclear on risk management processes, you should seek advice and training.

What is risk?

Before getting into the planning process, you need to understand risk and how to identify it. Risk is the combination of a hazard and a person interacting with or being exposed to that hazard.

- **Hazard** – something that can cause harm
- **Exposure** – to cause harm, somebody must interact with the hazard
- **Risk** – chance or probability that the hazard will cause harm and the severity of the harm

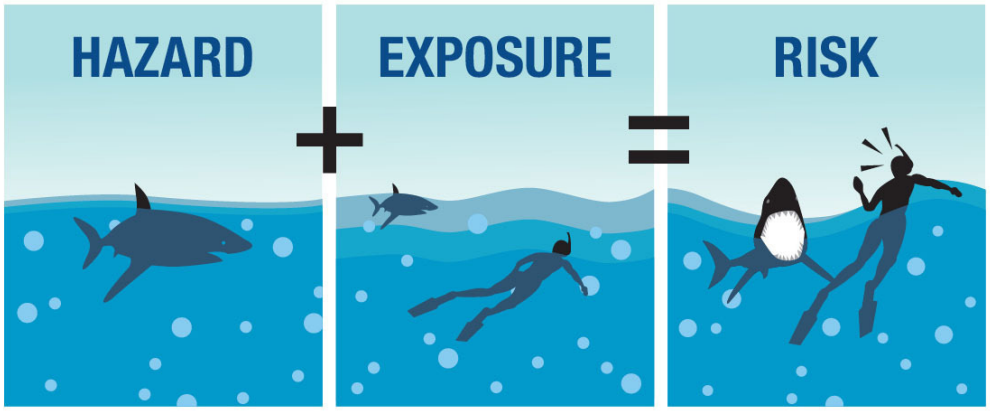

Figure 1: Visualisation of hazard, exposure, and risk. Image credit: Exponent

If we apply this to a TTM example:

- A washout on the shoulder of a road is a **hazard**
- If people travel down the road, they'll interact with the washout – **exposure**
- There's a **risk** of possible harm to some people

Figure 2: Advanced warning of hazard.

Describing risk

You'll need to identify, describe, and assess risk carefully, otherwise you could choose the wrong control and end up increasing the risk.

Start by describing the:

- hazards which are the source of the risk
- event that could result from the identified hazard
- consequences or impacts of that event.

Risk assessment

A traditional way to work out the overall risk rating is to use a risk matrix that considers both probability and consequence of a hazard causing harm. A risk matrix is only one of many methods.

It's up to the company or organisation doing the risks assessment to decide the best method for assessing the risks. TTM staff should check with their company's health and safety leaders for their companies preferred risk assessment method.

Things to consider when doing a risk assessment:

- **Experience** – a person with one day of experience will make different decisions from a person with 5 years. A person with 25 years of experience will make different decisions again. More experience may increase knowledge and ability, but more experience may also result in complacency or learned habits that no longer apply.
- **Personal bias** – a person's point of view and experiences affects their response to new information. This can influence their decision-making process.
- **Group decisions** – a single person will have a different perspective from a team of people. We don't all perceive hazards and probability in the same way.

For many situations, you can form a group consisting of people from the:

- works crew
- TTM staff
- client.

For more complex situations, the group members should represent all stakeholders, such as:

- works crew/event participants
- TTM staff
- client
- community – typically those nearby the site
- road users that would pass through the site such as light and heavy vehicle drivers, pedestrians, cyclists, public transport users, blind and low vision, mobility impaired.

TTM framework

For the TTM system to be successful there are four core elements – people, processes, equipment, and contracts. Each of these elements are important to achieving our collective vision:

> All workers and road users go home safe every day.

Under each of the four elements are examples of activities we do. All organisations are encouraged to contribute to the development of people, processes and guides, equipment and contracts.

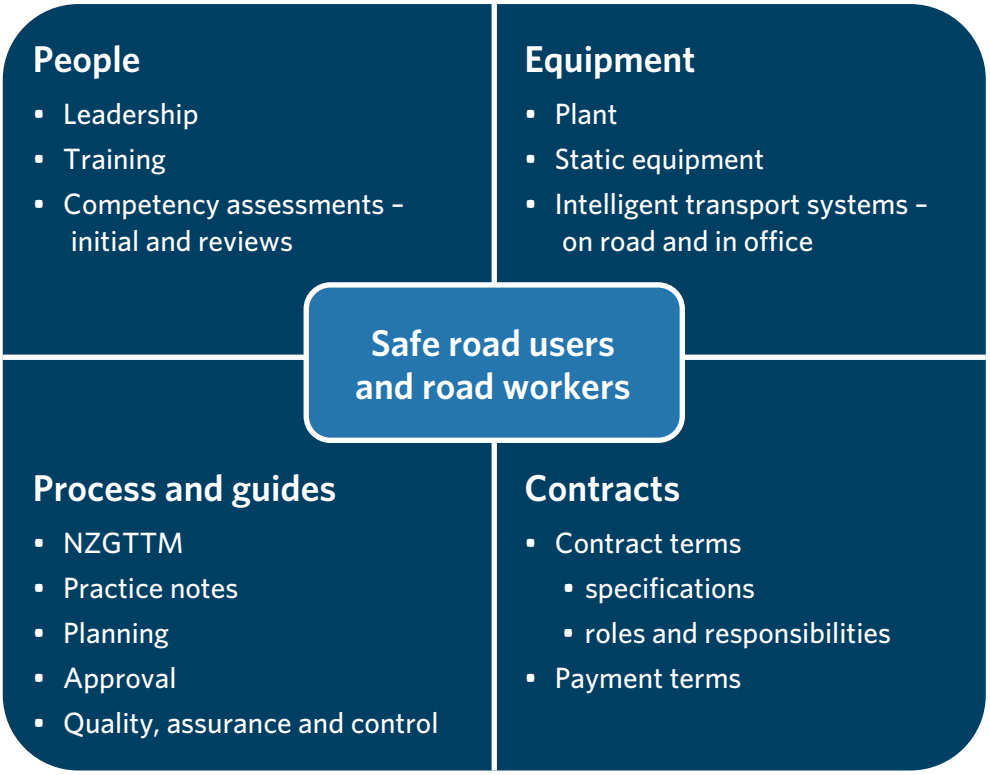

Figure 4 TTM Framework

TTM organisational responsibilities

Duty of care

Any person conducting a business or undertaking (PCBU) has a **duty of care** to ensure the health and safety of workers and others, so far as is reasonably practicable.

You can find out more about PCBUs in the *Road and Roadside Workers Health and Safety Good Practice Guide* produced by WorkSafe.

With the move to a risk-based approach, there's a fundamental shift of focus in roles and responsibilities:

- If you create the risk, you manage the risk
- Everyone in the contracting chain is responsible for safety and health

WorkSafe's good practice guide *PCBUs working together – advice when contracting* highlights the following key points:

- You must **consult**, **cooperate**, and **coordinate** with other PCBUs when working as part of a contracting chain or in a shared workspace.
- You can't contract out of health and safety duties and responsibilities.
- PCBUs in the contracting chain do not all have the same duties. See the WorkSafe good practice guide for more detail.

worksafe.govt.nz/managing-health-and-safety/getting-started/understanding-the-law/overlapping-duties/pcbus-working-together-advice-when-contracting

Contracting chain

Contracting is when the contracting PCBU hires another PCBU, called a contractor PCBU, to carry out work for them. A contractor PCBU may also hire a subcontractor PCBU. This is known as a contracting chain and is the most common business model used in road and roadside work.

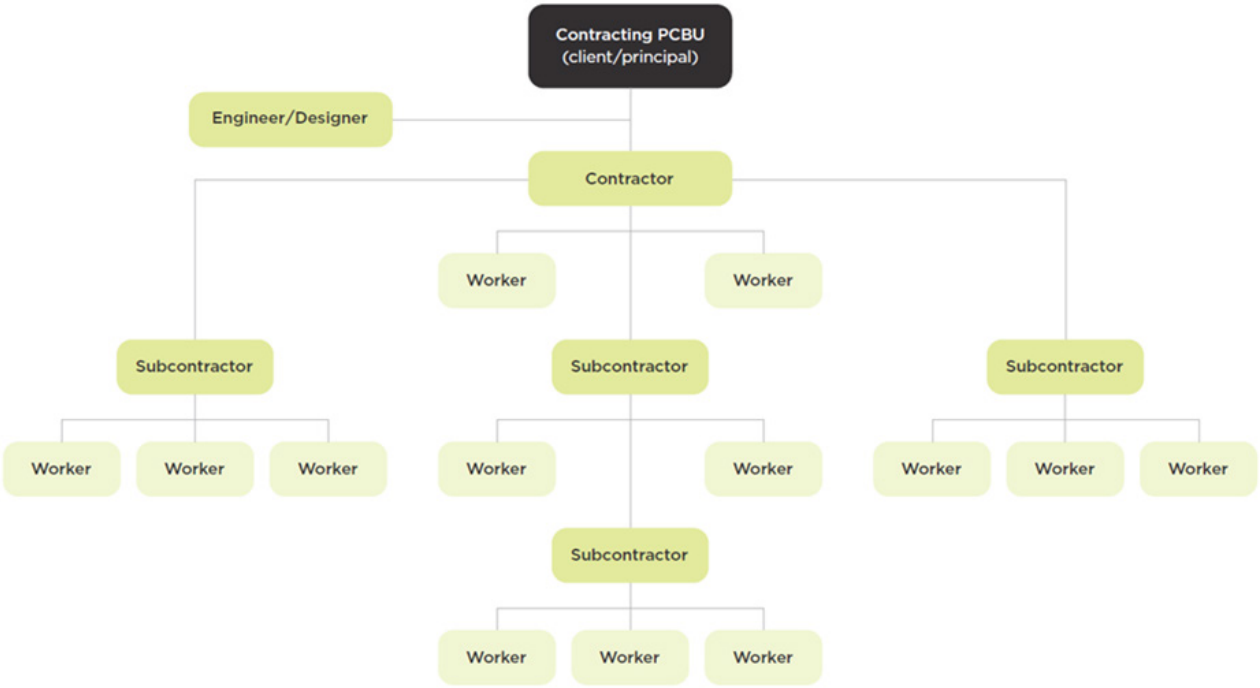

Figure 3: Example of a contracting chain. Image credit: WorkSafe

Keeping healthy and safe while working on the road or roadside Good Practice Guidelines (GPG), part A, section 3 Managing risk throughout the contracting chain, is highly recommended reading for the TTM sector and is one of the foundation documents for the NZGTTM. The GPG Part A, Section 3 contains additional information on:

- overlapping duties in the contracting chain
- expectations for contracting PCBUs
- expectations for contractor PCBUs
- expectations for sub-contractor PCBUs
- other PCBUs in the contracting chain
- good contracting principles and health and safety standards.

The more influence and control a business has over a health and safety matter, the more responsibility it is likely to have.

Road construction activities

The Road Controlling Authority (RCA) and contracting PCBU will generally be the same for road construction and maintenance work activities. Sometimes the RCA may be represented by a third party administering the duties on behalf of the RCA.

In these cases, there are two organisations responsible for safety outcomes:

- Councils/Waka Kotahi – both client and RCA functions
  - Contracting PCBU
  - RCA
- Contractor PCBU

Non-road construction activities

For non-road construction activities, the contracting PCBU is usually not the RCA. This means there are now three organisations responsible for the safety being:

- Contracting PCBU – event or works client
- Contractor PCBU
- RCA

Non-road construction activities include activities such as:

- events – hikoi, sporting, motorsport, concerts, parades, markets, local community events
- security
  - cordons to keep the public out (fire, flooding, earthquakes), likely Civil Defence would be the client
  - cordons to protect people from malicious acts, likely the police or Ministry of Justice would be the client.
- primary industry – forestry, agriculture
- vertical construction – building construction
- non-road infrastructure construction – rail, water, power, gas or telecommunication services etc
- services – breakdown, waste collection.

Non-road construction activities have some unique features to consider:

- The contracting PCBU is sometimes less familiar with their obligations. They may not have the skills, systems, or processes to deliver best practice safety within a road environment.
- Participants at a concert, parade, or sporting event often aren't trained at occupying road space. They might not follow traditional road rules such as stopping or giving way at an intersection, one lane bridge or pedestrian crossing – racing or large crowd behaviour.
- Specific needs, such as a security cordon to protect the public from harmful criminal drivers. This may include tools to deliberately damage and disable a vehicle, known as hostile vehicle mitigation devices.
- Often the footprint of the activity is large or has a big impact on the transport system, for example a marathon route covering 20+ km of network or concert requiring closure of major intersections to allow for pedestrian volumes.

The NZGTTM content applies to these activities, as the risk-based approach allows you to identify unique or unusual risks and controls that apply to the activity. Also, design principles, equipment and plant used will usually be the same, except for unusual circumstances such as hostile vehicle mitigation or national emergency disaster management.

Key points

The contractor PCBU must make sure the contracting PCBU receives professional, robust, and thorough advice on the risks, controls, and implementation requirements. When less experienced PCBU are involved, this increases the obligation on others in the contracting chain to ensure everyone is safe.

Experienced organisations must provide professional, robust, and thourough advice to less experienced organisations.

For example, a contracting PCBU may want to use volunteer labour from their club or another volunteer group. This may be acceptable for straight forward low risk activities such as guiding runners and cyclists. However, where there's an interaction with public using the road, such as staff at a closure point or manual traffic control, these staff must have appropriate capability and training. You can find out more about capability and training on page 64.

TTM responsibilities model

The following is an overview of the typical roles and responsibilities of each organisation. All organisations must consult, coordinate and cooperate.

Contracting PCBU – client

- Must ensure safety in design is considered. A contracting PCBU must ensure a project can be delivered, maintained, and operated safely.
- Use procurement practices that promote safety and health outcomes.
- Where others are required to be onsite, the contracting PCBU must ensure their safety, either directly or through consultation, cooperation, and coordination with other contracting PCBUs.

Contractor PCBU

- Prepares site risk assessments.
- Prepares TMPs, consulting, coordinating, and cooperating with other PCBUs.
- Approves the TMP.

Subcontractor PCBU

- Contributes to the design of the TMP to make sure their needs and risks are covered.

Transport Authority Organisations (TAO)

This includes Road Controlling Authority (RCA), Rail Access Authority (RAA), Public Transport Authority (PTA) or other authority.

- Peer reviews risk assessments to make sure the needs of the parties they represent are recognised and addressed.
- Coordinates the combination of contracting PCBUs wanting to occupy the network.
- Regulatory duties are complied with such as authorising use of traffic control devices, temporary speed limits, road closures etc.
- Has veto rights and can stop a TMP from being implemented if they consider it too risky for road users.

In this model the duties and responsibilities of each group overlap. For example, the contractor PCBU is responsible for the safety of the public and workers onsite, while at the same time, the TAO is responsible for safety of road users. All organisations must work together to make sure the site is safe, but they can't tell each other how to manage their responsibilities (HSWA 2015 and LGA 1974/2002).

TTM planning process

This section applies the risk-based approach to the planning process for TTM controls to support proposed activities.

Figure 5 summarises a typical operational workflow – from consideration of the proposed activity and environment to an approved plan for implementation. It also includes the parties likely be involved in each of the steps.

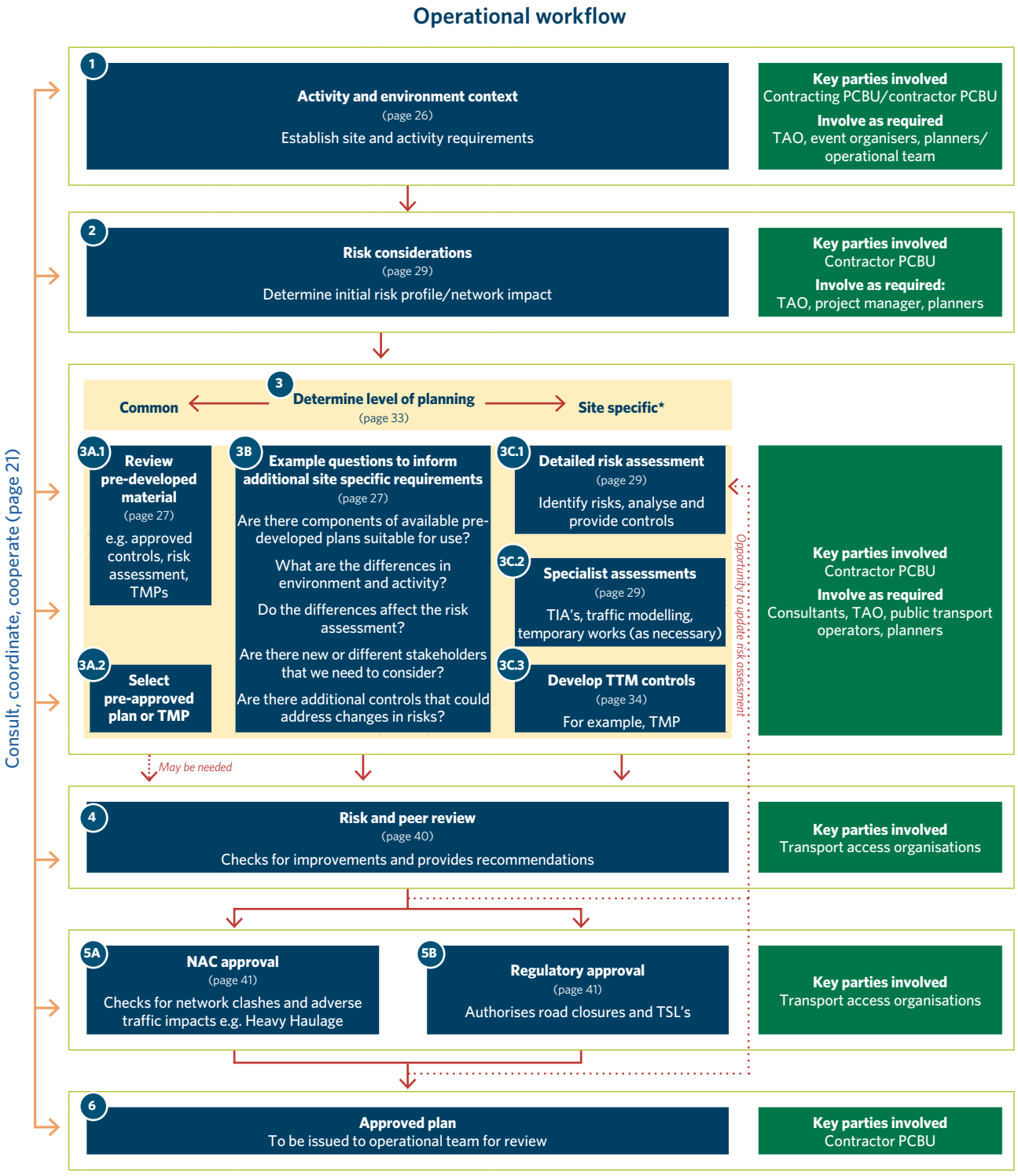

Figure 5: Operational workflow for NZGTTM

*TTM documentation is covered on page 38. This covers risk register, TMP documents, other TTM delivery documents and practice notes.

Activity and environment context

The first step in the site planning process is to clearly understand the proposed activity and its environment. This provides important context information in the assessment of risks and risk mitigation controls.

Activity context

The TTM industry allows its clients to safely go about their activities on the transport system. Understanding the client's activity, intentions and goals is important to support the safety of workers or event participants and transport system users. Activity context information is central to risk assessment and TMP design. Categories, sources of information and examples can be found in the activity and environment information guidance note.

Environmental context

The environmental context for the activity also needs to be clarified and understood. Environmental context can be summarised by the following categories:

- **Transport corridor** – what are the transport operations that will be affected by the proposed activity such as vehicle lanes, bus lanes, cycle lanes, footpaths, intersections, traffic signals, streel lighting.
- **Programme** – what are the days and times of the proposed activity?
- **Network uses** – who are the network users that may be affected by the proposed activity? This includes all modes of transport and representative groups such as the Automobile Association, Transporting New Zealand, National Road Carriers, Heavy Haulage Association, Bus and Coach association, Cycle Advocacy Network.
- **Neighbours** – owners and users of property affected by the activity.
- **Natural environment** – what are the natural environmental features that may be affected or may affect the proposed activity such as weather or natural hazards like cliff faces.

Contractor PCBUs need to describe the environmental context alongside the proposed activities in order to carry out risk considerations – page 29.

Determine level of planning

Traffic related harm to both workers and road users is one of the highest risks on a road work site, and some sites are more complex than others. The level of effort in the planning phase needs to be consistent with the level of risk – more risk means more planning effort. This is shown in step 3, figure 5, which has lower risk sites on the left-hand side, and higher risk more complicated sites on the right-hand side. A key step to this process is the risk considerations on page 29.

Common

Sites on the far left of the step 3 scale in Figure 5, are likely to be tasks that may already have pre-approved reusable schemes and risk assessments. Maintenance activities are one of the most common forms of repeated activity where pre-approved plans may be suitable. Other common activities could include certain emergency tasks.

Common scenarios still require a risk assessment, traffic management plan and diagrams to be completed. These plans are produced and approved by the Contractor PCBU who must consult, cooperate and collaborate with the Contracting PCBU and TAO. The deployment of these plans is subject to a check that the risk assessment is applicable to the activity and the environmental context. If a plan doesn't fit, don't use it.

Site specific

Sites on the far right of the scale require site-specific planning. This involves a detailed risk assessment – page 28. Specialist assessments may be required, such as traffic impact assessments, which could include traffic modelling, and road safety audits, or temporary works such as a retaining wall, barrier system, and detailed geometric design.

The production and approval of the plan is the responsibility of the contractor PCBU who must consult, cooperate and collaborate with the contracting PCBU, and TAO.

In-between common and site specific

The middle of the scale may be situations where a site-specific risk assessment is carried out, with a mix of site-specific plans and pre-approved reusable schemes. In some situations, a pre-approved reusable scheme may be appropriate with the addition of an updated job safety analysis (JSA). Ask the following:

- Are there components of pre-approved schemes suitable for use?
- What are the differences in environment and activity?
- Do the differences affect the risk assessment?
- Are there new or different stakeholders that we need to consider?
- Are there additional controls that could address changes in risks? For example, JSAs.

Risk assessment process

This section outlines key steps to consider and do during the risk assessment. This involves determining critical risks at the risk consideration stage – page 29, through to a detailed risk assessment – page 31. Fundamental TTM methodologies are outlined on page 34. The risk review process is detailed on page 40.

A risk assessment focus is essential in enabling the vision that the NZGTTM is based on:

> All workers and road users go home safe every day

Risk management process

The basis for risk management process in New Zealand is the Risk Management Standard AS NZS ISO 31000:2018. From this, WorkSafe have adopted the Plan-Do-Check-Act cycle.

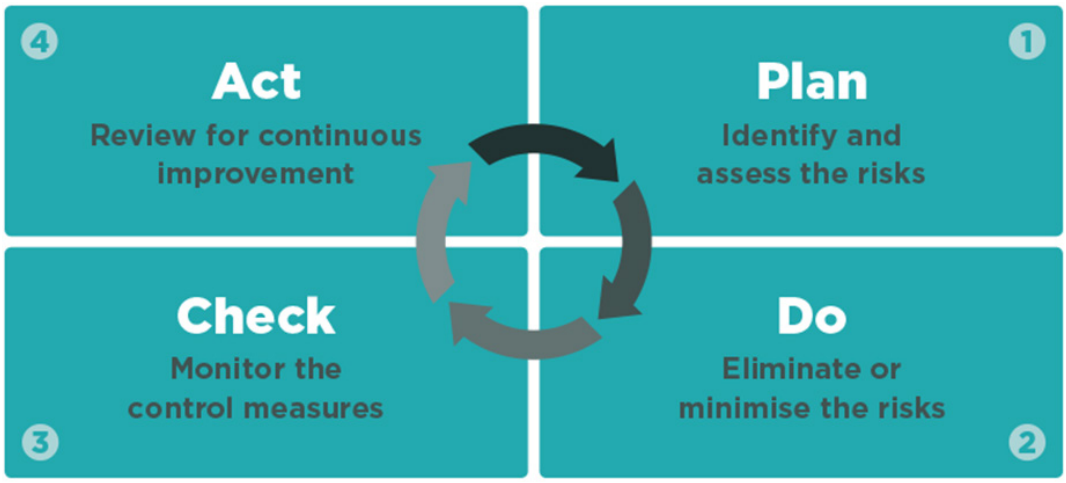

Figure 6: Image showing the cyclic nature of the risk assessment process. Image credit: WorkSafe

Go to worksafe.govt.nz/managing-health-and-safety/managing-risks/how-to-manage-work-risks for more information.

Key point

The key aspect of this process is that it is cyclic – plan, do, check, act, then back to the start. It's through thinking, acting, learning, and rethinking that you improve your ability to eliminate or minimise the risks.

> It's very rare to have a perfect set of controls for every scenario, so you must apply a plan-do-check-act approach to each scenario.

Risk assessments

Completing a risk assessment involves working through the following steps:

- Identify risks.
- Analyse the risks.
- Identify control options.
- Assess control options, residual risks and identify the lowest total risk option.
- Prepare the TMP.

Identifying risks

The range of risks to be considered vary from site to site.

Start by describing the:

- hazards which are the source of the risk
- event that could result from the identified hazard
- consequences or impacts of that event.

All relevant risk types should be included but remember that safety is the main focus. Examples of common risks as well as identification of risks guidance is included in the identification of TTM risks guidance note.

Types of risk

There are many types of risk, including:

- Safety – potential for impacts on a person's safety.
- Security – potential for malicious intentional acts to impact on a person's safety directly or indirectly.
- Health – potential for impacts on a person's health and wellbeing.
- Environmental – potential for environmental harm.
- Legal – potential for prosecution.
- Quality – potential for quality to be reduced/of poor standard.
- Property – potential for property, public or private, to be damaged.
- Reputation – potential for bad publicity for an organisation.
- Financial – potential for cost increase or revenue loss.

Workers and others must be given the highest level of protection from workplace health and safety risks as is reasonably practicable.

In TTM the focus is on health and safety risk. The contracting PCBU must do everything reasonably practicable to eliminate or minimise the health and safety risks.

An emerging risk type is security for events with crowds of people. This is the potential for intentional malicious acts to impact on a person's safety directly or indirectly. In the context of TTM, a security risk is the same as a safety risk. Use the NZ Police self-assessment tool to determine level of security risk for events.

police.govt.nz/advice-services/protecting-crowded-places-attack/prepare-your-crowded-place

In designing the TTM Controls, the TTM sector should acknowledge the limits of our capabilities and plan for human error, so that the impact of a collision does not cause fatal or serious injuries.

Not all safety risks are the same. The TTM sector should never tolerate risks of fatal or serious injury, but the sector may need to tolerate a risk of minor injury or property damage to reduce the risk of a fatal or serious injury.

For example, using a truck mounted attenuator (TMA) at a worksite will reduce the risk of a fatal crash, however there's still a risk of injury if a car crashes into the TMA. Another example is installing a road safety barrier system to prevent a fatal crash though it may damage cars and cause minor injury if drivers crash.

Who's at risk?

Risks are created any time an activity changes the way the road normally operates. Because risks are created when somebody is exposed to a hazard, many different groups of people are affected.

Therefore, when identifying risk, the contractor PCBU must identify everyone affected by the activity. The contractor PCBU is to consult, cooperate and coordinate with other relevant organisations to ensure all people exposed to risk are identified. Everybody has the same right to be safe, including:

- Work crews
- TTM crews
- Vehicle drivers
  - Private car drivers
  - Heavy vehicle drivers
  - Motorcyclists
  - Bus drivers
- Vehicle passengers
  - Public transport users
  - Passengers in private vehicles
- Cyclists
  - Commuters
  - Racing/training cyclists
  - Mountain bikers
- Pedestrians
  - Commuters
  - Those less able – take extra care when a site is near schools, hospitals, rest homes etc
  - Runners and walkers seeking exercise or training.
- Special vehicle operators
  - Mobility scooters
  - Over dimension vehicles
  - Over-weight vehicles
  - Agricultural vehicles
  - Forestry vehicles

The contractor PCBU needs to recognise that people have different reasons for being on the transport system. This influences the mindset of the road users such as level of awareness, focus on travelling vs distractions, and time pressure.

Reasons for being on the transport system may include:

- travelling to or from work
- transporting goods
- work in, on or beside the road
- participating in an event
- travelling to or from recreational activities
- travelling to or from school
- travelling to or from shops
- travelling to or from friends and family.

Creating TTM solutions for urban areas is often more complicated than for rural areas as there are generally more user types, all doing different things.

Analyse the risks

Once the contractor PCBU has identified the risks each risk must be assessed. This is so the risks can be compared, with the highest ranked risks being prioritised for elimination or the development of mitigation controls to minimise the risk.

It's the responsibility of the contracting PCBU to decide the best way to assess the risks and make sure the risk assessment team is made up of an appropriately diverse group of people.

Key points

- Not all risks are equal.
- The goal is to identify the risks with the highest risk rating, so the highest ranked risks can be focused on first.
- Consider both the absolute risk rating as well as the relative differences between risks.

TTM Risk Assessment Framework

At the time of writing, New Zealand does not have a detailed TTM specific risk assessment framework. If a company needs an example framework, the risk assessment framework in the Austroads Guide to Temporary Traffic Management, part 10 is suggested. This is not a mandatory framework within New Zealand.

austroads.com.au/publications/temporary-traffic-management/agttm-set

Downer New Zealand, as part of an Executive Undertaking, is developing a TTM risk assessment framework which will be included in a subsequent revision of the NZGTTM.

Risk control concepts

Risk controls

Once the contracting PCBU has identified the risks, decisions need to be made about how to eliminate or minimise the risks. Choosing the mitigation measures, also called risk controls, is as important as identifying and assessing risks. Not all risk controls are as effective as each other. Health and Safety at Work Regulations 2016 Section 6 Hierarchy of control measures, describes the priority order that must be applied in the selection of controls. The contracting PCBU must work to do everything reasonably practicable to eliminate or minimise health and safety risks.

Most effective control  **Least effective control**	**Preferred**	**Eliminate the risk**	Eliminate risks to health and safety, so far as is reasonably practicable;
	Second choice	**Substituting** **Isolating** **Engineering**	Minimise risks to health and safety, so far as is reasonably practicable, by taking one or more of these actions that are the most appropriate and effective, taking into account the nature of the risk
	Least preferred	**Administrative**	If a risk then remains, you must minimise the remaining risk as far as reasonably practical
		Personal protective equipment	If a risk then remains, you must minimise the remaining risk using PPE

Table 1: Hierarchy of Controls

Lowest total risk

Sometimes a control for one risk may increase or transfer risk to another group of people or it may introduce another risk. This is where the concept of lowest total risk applies.

Assessing the total risk is very important in transport because many different people can be affected by the same risk. Solving a risk to the workers, such as closing the road to control the risk of a worker being hurt, may result in road users being detoured on a much less safe road. This is unlikely to reduce the total risk as one group has risk increased while another group has risk decreased. Examples to help explain lowest total risk can be found in the lowest total risk guidance note.

Control selection guidance

For some risks, some control types may not be available, practicable or feasible. For other risks combinations of control types may achieve the best result. Different control types may be selected for different parts of a project or at different times within a worksite.

The contractor PCBU must consult, cooperate and coordinate with the contracting PCBU, especially if controls can't be identified for very high or high rated risks. This is because the client can't contract out of risk management and must contribute to risk reduction. This may include changing the project specification, contract terms or other aspects to enhance safety.

For each risk there are some things to consider when selecting a control type:

- Severity of the risk – does the control match the risk level?
- Effectiveness of the control – does it eliminate or minimise the risk consistently? Is the residual risk after the control is implemented noticeably less? Is the control easy or complicated to implement correctly? If the control is complicated to implement, will it be effective if not implemented correctly?
- Introduced risks - what are the new risks created by the control? Solving one risk but introducing another risk needs be very carefully considered. If the new risk is substantially lower than the original, it may be appropriate.
- Most appropriate control – there's more than one way to manage traffic at a worksite. The most suitable option may not be clear until the risk assessment and option selection process is done.
- It's unethical and it's inconsistent with HSWA 2015 to transfer risk from one group to another, for example from workers to the public. Refer to lowest total risk above.
- All options for all work stages need to be evaluated. This will inform the selection of TTM staging, which may be consistent across multiple stages or may vary within a stage.
- Evaluate the suitability of the control options for each of the different groups impacted, for example, workers, athletes, public transport, pedestrians, motorists, cyclists, and local business owners.
- Planners selecting the risk controls need to be clear in their reasoning for the TTM control selection and document their rationale to the contractor PCBU, contracting PCBU and TAO. If the reasoning cannot clearly be explained, then the planning process has failed. This may result in injury or death and prosecution.

Once the set of controls is selected, review both the reductions for each individual risk and the lowest total risk. If the initial risks are not eliminated or minimised sufficiently, or lowest total risk test fails, go through the risk control selection process again.

Develop TTM controls

It is recommended that the risk control concepts section above is read before reading this section.

The design guide diagrams guidance can assist with risk identification and control design. These diagrams are provided as prompts.

Fundamental TTM methodologies

Fundamental TTM methodologies have been identified by applying the hierarchy of controls concepts to TTM. These cover most situations, but there may be other control options.

1. **Remove need to do work** – if the need for the work can be removed then there will no longer be any risk to road workers and road users. This is the preferred control for both road workers and road users. However, most times the work needs to happen, or the event has social, environmental, financial or cultural benefits that means it is beneficial that the event proceed.
2. **Go around the site** – this is the preferred TTM control to minimise risk to the workers as traffic is removed from the site. However, care must be taken not to increase risk to road users such as detouring them onto a less safe route without putting in place appropriate risk controls. There are two sub-options in this category:
   - Detour – sends traffic onto other roads in the road network, ensuring there's no traffic in the worksite. Be sure to consider the practicality of this approach for pedestrians and cyclists.
   - Temporary road – a specially built section of road to divert traffic, eliminating the risk to workers. Again, take care of the needs of cyclists and pedestrians.
3. **Go through the site** – this is the second level of TTM control. By temporarily closing a road, workers can operate without exposure to traffic. The activity is then periodically paused, the site made safe, and workers moved to safety. The traffic is then released to travel through the site safely. Risks to road users as they travel through the site must be addressed. There are two sub-options in this category:
   - Portable traffic control device – equipment operated stop/stop and stop/go periods. Note using a replaceable device is preferable than exposing a worker to risk.
   - Manual traffic control – human operated stop/stop and stop/go periods.
4. **Go past the site** – this is the third level of TTM control. There are three sub-options, which can be combined, in this category:
   - Separation of traffic and workers by a physical barrier or exclusion zone space.
   - Isolating workers in space by using a truck mounted attenuator
   - Isolating workers in time using manual traffic control or portable devices for stop/go periods.
5. **In the gaps** – this is the lowest form of TTM control. This form involves workers entering lanes in the gaps between approaching vehicles. This form of control relies on ability of workers to leave the road safely before the next vehicle arrives. The road must also be left safe with no additional risk to road users when the worker leaves the road. A critical component to this control is contingency planning ie what would the risk be if a worker does not leave the road or the work is not finished before the next vehicle arrives. Also, it relies heavily on lowest total risk concept, that is, if doing something else would increase the risk to the workers or road users. There are two sub-options, which can be combined, in this category:
   - Safe work method statements.
   - Detailed training and instruction with close supervision.

Other key points to note when selecting a TTM control:

- **Minimise the length of road and paths where traffic management is placed** – long sites where it isn't obvious why drivers are being delayed often leads to non-compliance with speed controls. If the site is long, reduce speeds only for the parts of the site where it's necessary.
- **Consider the timing** – when working on the road, choose times with less traffic to reduce risk to road workers and road users. Chose a time based on actual hourly traffic counts. If something happens, such as a crash, and traffic is still heavy later than normal, delay setting up the site until traffic has cleared.
- **Minimise the time the road or path is blocked (exposure reduction)** – to minimise the risk to road users, set up the TTM right before the activity starts and pack up as soon as it's complete. Consider whether the TTM needs to be set up for the entire length of the job. For example, at a vertical build site outside the road, set up the lane drop for deliveries only when needed, don't block the lane and create unnecessary risk.
- **Minimise blocked lanes and paths** – consider whether there is a need to block a traffic lane to work on the footpath or verge. Can work vehicles stop on the shoulder or verge rather than blocking a lane?
- **Have realistic options for all modes of transport** – for example a pedestrian or cyclist diversion taking them a long way around a site is unlikely to be used.
- **Coordination** – consider coordinating with other works being done nearby or at the same location.

Not all risks are the same – never tolerate risks of fatal or serious injury. Property damage or minor injury risks may need to be tolerated in order to control the risk of a fatal or serious injury.

The options chosen must be the highest practicable level of protection and safety to achieve the lowest total risk. Before choosing a treatment option, consult with those who will be implementing the measures, undertaking the works and groups representing road users.

Traffic management diagrams

Traffic management diagrams (TMDs) are used to show the location of TTM equipment for the site – the site's vertical and horizontal geometric design.

Geometric design makes sure the shape of a road is appropriate for the way in which it's being used. Measurements used are typically time (seconds) and distance (meters), and human factors such as detection, decision making and reaction times as well as physics such as breaking forces (energy and friction) and cornering forces (radial acceleration and friction) are included.

TTM is simply permanent design delivered temporarily, so TTM should align with permanent design guides. This includes things like taper lengths, curve radii, safe stopping distances and speed limits.

Contractor PCBUs also need to do traffic engineering assessments for the design and to reconfirm risk assessments. For example, calculating queue lengths to work out the correct spacing of advanced warning signs. If sign spacing is based only on safe stopping distances and the queue is long, then there's no advanced warning of the stopped queue, which then becomes an uncontrolled risk.

All equipment to be used onsite must be:

- legal signs and markings as defined in the Traffic Control Devices rule
- compliant with current standards and fit for purpose
- where necessary, specifically designed to minimise a unique risk at the site (only for exceptional circumstances).

For more detail on geometric design, traffic engineering, and equipment refer to NZGTTM Part 3: The toolbox.

Clarifications

There are several topics in the *Code of Practice for Temporary Traffic Management* (CoPTTM) not included in the NZGTTM risk management controls sections. This is because in moving to a risk-based approach, they are no longer appropriate:

- Mobile, semi static, or static sites
  - These definitions are about how the TTM equipment such as signs, cones, and plant are used. The risk management approach requires that the contractor PCBUs decide on the most appropriate equipment for each site based on its unique situation.
- Generic plans
  - A pre-approved scheme is the name for both a pre-draw layout and risk assessment that has been pre-approved.
  - In a risk management approach, the contractor PCBU decide if the pre-approved scheme is suitable. Never assume they are applicable for any individual situation.
- Road levels
  - Road levels were a simplified risk assessment. By undertaking a risk assessment for each site, road levels are no longer necessary.
  - Make sure the different functions of roads are well understood, see the One Network Framework at nzta.govt.nz/onf.

    Note the ONF is not a risk assessment tool, it helps the TMP designer understand that not all roads have the same purpose. TTM should consider the function that a road or street performs, including the users and their modes of transport during the planning/ design stages.


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TTM documentation

Documentation of information enables the TTM sector to function. It enables clear communication between the PCBUs in the contracting chain, with the TAOs, between planners and STMS, between STMS and assurance staff. Documents enable communication with investigators such as Police, WorkSafe, the Transport Accident Investigation Commission, the Coroner.

This section describes typical TTM documentation. PCBUs are encouraged to develop additional material should it improve safety of road workers and road users.

Risk register

A risk register is used to document the steps of the risk assessment process and enable communication with all necessary parties. It is important to note that not everybody will have the same perspective nor agree on the levels of the assessed risks. This is natural which is why the risk register is a critical document to enable structured consultation, communication, and collaboration.

Each company will have its own risk assessment processes for health and safety, budget, and other risks. This process can be applied to TTM but will likely need to be adapted for TTM topics and the lowest total risk concept.

The risk register should contain the following:

- Risks identified – the hazard, the event from exposure to the hazard, and the consequences of the event.
- Assessment of the risks – a ranking of the level of risk.
- Possible control options – applying the fundamental TTM controls in preferred order.
- Residual risks if the control options were implemented – what risk is left after the controls if the controls were implemented.
- An assessment of lowest total risk for each of the control options – how do the controls work for road users and road workers.
- Adopted control options – the control options to be implemented during the delivery phase.

Feedback and decisions from the peer review process should also be included, such as feedback from the contractor PCBU project manager, the contracting PCBU and the TAOs. This could include:

- Peer reviewer description
- Peer reviewer feedback
- Contractor PCBU's response
- Independent advice, if required. This might be specialist advice on safety, transport impact assessments, equipment compliance with legislative rules, independent risk assessments, and communications advice.
- Contractor PCBU's decision – noting that the contractor PCBU approves the TMP.

It's important that a document capturing the choice of fundamental TTM controls and any reviews is prepared. The documented decision is a critical record should the worst happen and somebody gets hurt.

TMP documents

The risk assessment, fundamental TTM controls, and the detailed site design should be documented. This creates a record that allows communication with the contracting PCBU, TAO, STMS, work crews and assurer. The most important person to communicate the risks and the site design to is the STMS, because they set up the site and manage the real world risks to workers and road users.

As the TMP has several audiences, it needs to include:

- traffic management plan reference
- traffic management plan approval
- organisations involved
- contact information
- project overview – activity and environment context
- risk register – including controls and residual risks
- consultation – record of who was consulted
- communication – the communication plan
- proposed TTM details – a description of time, location, plant, and equipment

- contingency plans – if something changes or goes wrong what is the alternate plan?
- quality, assurance and control – how will the quality of TMP and its delivery be assured?
- peer reviews – who, when and recommendations
- diagrams – geometric design information

An example TMP form has been included in the example forms guidance. It is not mandatory. A PCBU is encouraged to consider their needs and whether their own form is required.

It's important that a document capturing of the operational decisions and activities is prepared. The documented decision is a critical record should the worst happen, and somebody get hurt.

Other TTM delivery documents

A contractor PCBU may determine it appropriate to record additional information. The following list is additional documents that a contractor PCBU may wish to prepare. Note that these documents allow a contractor PCBU to respond easily to questions and investigations during and after delivery of the activity.

- crew briefing plans and pre-start records
- TMP variation register
- incident reports
- site inspection records
- temporary speed limit record of implementation – note this record is critical to enable Police to prosecute speeding offences through temporary speed limits
- consultation log
- complaints register

Some example forms have been included in the example forms guidance note, however they are not mandatory. A PCBU is encouraged to consider their needs and whether their own form is required.

TTM library

The TTM library has guidance notes, supporting information and resources to help the industry to put the guide into practice. Waka Kotahi and our industry partners have provided some resources as a starting point, and as more are developed by the TTM industry these will be added to the TTM library.

There are a range of audiences that will find resources in the TTM library to help with risk and risk review processes, engineering, operations, and other functions.

The TTM library includes:

- Guidance notes:
  - Description: following the TTM principles introduced in the guide, these notes outline how these principles can be applied in practice. The notes will also include guidance on how to manage unusual circumstances using the principles of the guide.
  - Examples: risk management practice, geometric design information, extreme weather event, for example cyclone Gabrielle.
  - Lead: Waka Kotahi, TTM industry steering group, transport authority organisations.
- Operational practice notes:
  - Description: risks and considerations of control measures that the contracting PCBU would determine are appropriate for regularly repeated specific activities. Operational practice notes are foundational to TMP's for site specific and pre-approved reusable schemes.
  - Examples: a framework for operational practice will be developed by the TTM industry steering group, however it is expected to cover situations such as mobile operations, static sites, events.
  - Lead: Contractor PCBU/TTM industry steering group.
- Administrative notes:
  - Description: various administrative and process requirements to bring life to the TTM system principles including:
    - forms and documentation that are relevant while preparing or implementing a TMP
    - audit forms
    - on site record forms.
  - Examples: access permit red alert, a RCA's Christmas holidays, forms and processes for planning, quality assurance and control, operational practice.
  - Lead: Transport authority organisations.

Peer review system

The peer review system happens throughout the planning stages as well as during the implementation and operational phases. The main peer reviews during the planning stages are the risk reviews, network access coordination approval and regulatory approval. It's important that everyone in the process consults, co-ordinates and co-operates to make sure no risks are missed. Peer reviews during the implementation and operational stages are covered in more detail from page 44.

Overview

The peer review system includes multiple people and stages. There are people who propose ideas, review the ideas, deliver the ideas and check that everything is done correctly.

Planning reviews

There are three different functions required to complete a robust peer review in the planning stages:

- Risk review – page 40
- Network access coordination – page 41
- Regulatory functions – page 41

Note - asset management, that is making sure road and rail assets are left in suitable condition at the end of the activity, is not covered here as it is covered by the National Code of Practice for Utility Operators' Access to Transport Corridors, enabled by the Utilities Access Act 2010.

Delivery reviews

Peer reviews during delivery are just as important as those during the planning phase. Once the site is established there are two groups of reviews:

- Checks that the risks identified in the planning phase are consistent with the actual risks onsite and that the fundamental control is appropriate.
- Checks that the risk controls designed during the planning phase are implemented as designed.

These reviews are covered in Quality assurance and control – page 52.

Risk review

The risk review process is meant to make sure the risk management process is robust and hasn't overlooked any critical risks. This includes risks from combining multiple sites and security risks where appropriate. The risk reviewer doesn't approve the risk assessment but provides improvement recommendations to the contractor PCBU. This is an important shift away from the historic CoPTTM approver function. The TAO peer reviewer should not approve the design and detail of the TMP.

Some TMPs may require multiple risk reviews. When an activity impacts multiple transport systems such as road, rail, public transport, airport and port, the contractor PCBU will need to consult, coordinate, and cooperate with appropriate organisations. Potential risk review organisations may include:

- Road controlling authorities such as Waka Kotahi, councils, DOC, airports, and ports.
- Rail access authorities such as KiwiRail or local railway network operators. Note KiwiRail is not the only rail network operator in Aotearoa New Zealand.
- Public transport authorities such as councils and regional councils.
- Police and other security specialists.

If the transport authority organisation risk reviewer does not believe the risk assessment is fit for purpose, they have the right to stop the lead contractor from proceeding under their relevant legislation.

Network access co-ordination (NAC) approval

There are two parts to the network access coordination functions:

Space and time coordination

This function makes sure the section of road where the activity is proposed doesn't clash with another activity, unless both activities can happen safely at the same time. This includes ensuring a detour does not travel through another road closure.

Transport impacts review

This function is more complicated and will require traffic engineering knowledge.

This review includes assessing the transport impacts for individual and multiple sites in an area. This cannot be prepared by any one contracting PCBU as they will not have information for all sites. Often assessment of the impact can be done using first principles, however in complex situations, specialist traffic modelling may be needed.

The impacts are subject to the type of transport system, for example a grid network (Christchurch), rooms and corridors (Wellington), or a combination of both (Auckland).

Note - safety comes first, delay is secondary. However excessive delays will often result in poor safety outcomes as road users make poor decisions such as U-turns at inappropriate locations or taking small gaps in opposing traffic that result in crashes.

Regulatory approval

The powers of Transport Authority Organisations come from various pieces of legislation.

Below is a list of common regulatory functions, there may also be local bylaws that apply:

Authorise installation and operation of traffic control devices

The Traffic Control Devices Rule 2004 section 2.1(1) requires that a Road Controlling Authority authorise installation of traffic control devices:

a. authorise and, as appropriate, install or operate traffic control devices:
- **i.** if required by or under this rule or other enactment; or
- **ii.** to instruct road users of a prohibition or requirement that it has made concerning traffic on a road under its control; or
- **iii.** to warn road users of a hazard; and

d. remove a traffic control device if required by or under this rule or other enactment.

Authorise road closures

Waka Kotahi NZ Transport Agency is granted powers:

- to stop, divert, or otherwise control the traffic upon any state highway temporarily while any work or investigation is being undertaken or for the structural protection of any part of the state highway – Government Roading Powers Act 1989, section 61, clause 4(h).
- to close to traffic any state highway, or any part of it, for such period as Waka Kotahi considers necessary to execute repairs or to remove any obstruction – Government Roading Powers Act 1989, section 61, clause 4(i).
- For the purpose of holding on any road any vehicle races or trials, or any processions, carnivals, celebrations, sporting events, or other special events, the controlling authority may, subject to the provisions of these regulations, close the road to ordinary vehicular traffic for a period or series of periods of not more than 12 hours each in any consecutive 24 hours – Transport (Vehicular Traffic Road Closure) Regulations 1965, section 3.

Councils are granted powers by the Local Governmant Act 1974:

- The council may, in the manner provided in Schedule 10 –

  (b) close any road to traffic or any specified type of traffic (including pedestrian traffic) on a temporary basis in accordance with that schedule and impose or permit the imposition of charges as provided for in that schedule – Local Government Act 1974 section 342, clause 1.

- The council may, subject to such conditions as it thinks fit (including the imposition of a reasonable bond), and after consultation with the Police and Waka Kotahi, close any road or part of a road to all traffic or any specified type of traffic (including pedestrian traffic) —

  (a) while the road, or any drain, water race, pipe, or apparatus under, upon, or over the road is being constructed or repaired; or

  (b) where, in order to resolve problems associated with traffic operations on a road network, experimental diversions of traffic are required; or

  (c) during a period when public disorder exists or is anticipated; or

  (d) when for any reason it is considered desirable that traffic should be temporarily diverted to other roads; or

  (e) for a period or periods not exceeding in the aggregate 31 days in any year for any exhibition, fair, show, market, concert, film-making, race or other sporting event, or public function:provided that no road may be closed for any purpose specified in paragraph (e) if that closure would, in the opinion of the council, be likely to impede traffic unreasonably.

Local Government Act 1974 Schedule 10, Temporary prohibition of traffic, clause 11.

In terms of TTM, this means that Waka Kotahi and councils hold the legal function to approve a road closure. However, the legal function to close a road is not the same as the decision-making process which must be guided by HSWA 2015.

Approver of temporary speed limits

A temporary speed limit is set by getting approval from the Road Controlling Authority and installing the signs. Waka Kotahi and councils must approve temporary speed limits in writing and this may be done as part of a TMP approval process. For more information see section 7 of the Setting of Speed Limits Rule 2022.

Access to railway by easements or for works

Regardless of any other Act, Section 75 of the Railways Act 2005 requires written permission from the licenced access provider or railway access owner before a person:

- exercises a right under an easement
- constructs or carries out work on, over, or under any railway infrastructure or railway premises.

TMP implementation, maintenance, and uplift

TTM implementation basics

At all sites where TTM is in place it needs to:

- ensure safety and minimise risk
- have a traffic management plan (TMP) and traffic management diagrams (TMDs) for all activities and they must be suitable for the nature and duration of the work
- give clear and positive guidance for road users, including
  - protection for pedestrians, cyclists and other vulnerable road users
  - providing an alternative route when signs or devices obstruct a road or path
  - appropriate warning of changes in surface condition
  - appropriate warning of the presence of people or plant working on the road.
- protect people onsite, such as workers or event participants.

During the installation phase, the TMP needs to:

- clearly show the peer reviewed site layout design to the STMS
- be used to record any changes made onsite.

If anybody is hurt, the TMP, with any amendments, will be used in Court to show how the site was set out.

At every site the contractor PCBU needs to:

- monitor the TTM performance for effectiveness, for example, when managing traffic queues, delays, make sure drivers know what is expected and that there is compliance with speed limits. This is the check and act part of the Plan, Do, Check, Act cycle
- make sure signs and devices are installed by a competent person with the necessary training, skills, and experience
- make sure signs and devices are consistent with the TMP
- install signs and devices just before a site becomes active and remove as soon as they are no longer needed
- keep appropriate signs, including any aftercare signs, in place until all work has been completed
- regularly check signs and devices to make sure they're still relevant, in good condition, clean, not faded and have good low light visibility and reflectivity
- regularly check signs and devices to make sure they're displayed in the right order and are clearly visible to road users. They must not be blocked by vegetation, vehicles, plant or other signs and devices
- keep records of all signage and delineation
- if the TMP requires it, cover permanent regulatory traffic control equipment that is inconsistent with the TMP. If not identified on the TMP, the STMS should get authorisation before regulatory signs are covered or moved.

Implementation roles and responsibilities

Contractor PCBU TTM responsibilities

- Hold briefings to make sure everyone onsite understands the risks, controls, and residual risks.
- Make sure everyone is supported when it comes to safety, for example, production and financial pressures must not compromise safety.
- Make sure everyone working in traffic management operations is qualified and competent.
- Manage unsafe workers as appropriate.
- Follow traffic regulations and the requirements of the TMP.
- Make sure the site layout and worksite conditions are in line with the approved TMPs.
- Report on incidents and crashes at worksites.
- Make sure correct authorisations have been obtained to carry out work or activities within the road reserve or affecting the road reserve. This may include approvals such as:
  - a Work Access Permit - see the Utilities Code
  - an event permit
  - approval to install hoardings, containers, fencing or other semi-permanent structure in the road reserve
  - approval to occupy paid parking spaces.

Site traffic management supervisor (STMS)

The STMS has three primary functions:

- Establish the site so it is consistent with the TMP.
- Monitor the site.
- Uplift the site.

Make sure to check and act if there are issues with the site at any time. This is the check and act part of the Plan, Do, Check, Act cycle – Risk assessment process page 34.

The STMS needs to:

- make sure the approved TMP is right for the worksite, and if it isn't, contact the TTM planner to update the TMP
- set up the approved TMP, including driving, walking, and cycling checks to make sure the site is consistent with the TMP
- if a new risk is identified, change the site as necessary. Changes should be reviewed by a qualified person, preferably the TTM planner. If the STMS believes the TMP needs to be changed they should contact the TTM planner or suitability qualified person to check the proposed changes. If they are unable to do this the STMS can use their knowledge of the NZGTTM to make the best decision possible and document any changes. The STMS is responsible for the TTM on site and must do everything they can to ensure the safety of workers and the public
- make sure a copy of the approved TMP is always available on-site
- make sure people entering the worksite attend an induction about the TTM risks and controls

- lead the TTM team and make sure TTM workers
  - have been briefed
  - are wearing appropriate PPE
  - know what their tasks are and monitor that they are completed
  - make sure all workers and TTM staff comply with all traffic controls and best practice for worksites.
- provide leadership for TTM matters during an incident
- manage fatigue and staffing breaks
- always be contactable by mobile phone so the TAO, workers, TTM team and others may make contact
- complete worksite inspections to make sure
  - there are no contradictory signs or markings
  - there are no surplus, obstructing or distracting signs or markings
  - the TMP fits with other traffic control devices in the area, such as permanent signs or other TTM, including those put in place by another STMS
  - devices are in place at the right times and removed or covered when not needed
  - damaged or defective signs, cones or other equipment are replaced or repaired as soon as possible
  - signs, cones and other guidance equipment are inspected in low light conditions if deployed in these conditions.
- safely and quickly put in place any TTM changes instructed by an authorised person, for example Police, a WorkSafe representative, or other qualified person. These changes must be recorded and signed on the TMP/TMD by the requesting person. The TTM planner must also be told as soon as possible.

Interactions between the lead contractor, subcontractors and the STMS

- The STMS should contribute to toolbox talks with information on the peer reviewed TTM at least daily, and at each change of a TMD.
- The STMS shall record and alert the contractor PCBU of
  - all incidents at the worksite – supply a crash report where needed
  - any assurance assessments completed by 3rd parties
  - any complaints about the TTM.

Other TTM workers

To reduce the risk of misunderstanding and to support the STMS, all other TTM workers should be qualified. If the lead contractor decides to use un-qualified, un-trained or volunteer workers, they need to manage any risks associated with this, for example extra trained STMS to provide leadership.

The STMS has the right to ask workers to leave the site if their actions are putting themselves or others at risk.

TTM implementation risk management

Even with the controls identified by the TTM planner, there will be residual risks. These are the risks that exist even with the controls in place. This means the residual risks are known and accepted and the controls address these risks at an acceptable and practicable level.

The TTM planner must give the risk register to the STMS so they are aware of the residual risks and can brief everyone onsite about them. It also helps the STMS understand why the controls were selected and helps them make an informed decision on changing any controls.

Pre-start

Before starting works, the STMS needs to peer review the site's risk register to make sure nothing has been overlooked during planning. Using the site risk register complete the following:

- Risk identification review
  - Have all risks been identified? Are any risks missing from the TMP documents?
  - Add any additional risks into the risk register.
  - If any additional risks are identified, seek input from a TTM planner. If input from another person is not obtained it will undermine the peer review process and possibly create more risk. All decisions and actions must be recorded.

To check the risks, an STMS could review matters such as:

- The volume of traffic, measuring a 5-minute count of traffic should give a good estimate.
- The speed of the traffic – observation using known distances (such as painted centre line dashes or edge marker posts) and a stopwatch. Speeds can be estimated from the following:
  - 100kph = 100m in 3.6s
  - 80kph = 80m in 3.6s
  - 50kph = 50m in 3.6s
  - 30kph = 30m in 3.6s.
- The duration of work – confirm with the lead contractor.
- The location of work.
- The weather conditions.
- Types of businesses or private property near the site.

Site inductions

Everyone onsite, including temporary or casual visitors, needs to be inducted and regularly briefed by the STMS. The STMS needs to keep a log of these inductions with the site records. The site inductions should cover:

- identified risks for the site
- the controls for the site including the fundamental controls, detailed controls, and residual risks
- the key aspects of the TMP, such as
  - around, through, past or administration/PPE fundamental control chosen
  - TTM equipment
  - exclusion zones
  - the worksite hazards
  - site driving and parking requirements
  - entering and leaving the worksite
  - clearances to live traffic.

Site installation

The TTM measures for the site can be installed in a planned and safe manner once the pre-start activities have been completed. The installation process should be included in the TMP and be risk assessed in the same way as the TTM for the active site.

It's important the site is installed and maintained according to the risk management concepts in the TMP. If a different approach is taken the controls may not be as effective as planned, such as a TMA not positioned to protect workers or a barrier missing its end treatment.

Positioning devices

Refer to part 3: The toolbox for guidance on how devices should be positioned. Any changes must be marked on the TMP so it remains an accurate record of the site. Seek support from the TTM planner if there are any concerns or issues during site set up.

Site maintenance and operation

Once the TTM worksite is set up, the STMS monitors its effectiveness:

- Drive, walk, and cycle through the site regularly to make sure it's operating as expected.
- Check the risk controls are operating as expected and there aren't any unexpected risks.
- Make sure the activity is in line with what was requested during the planning stage.

The STMS's primary duty of care is to ensure the safety of the workers and public. Nothing is to distract the STMS from this purpose. If the activity changes, the STMS is to speak with the TTM planner about updating the risk assessment and TMP.

Active site hours

At the start and regularly during each shift, the STMS should check:

- the positioning of signs and cones continues to be correct
- all signs continue to be securely installed
- all signs remain observable from appropriate sight distance by the road user
- dynamic operations such as manually operated controls and ITS devices continue to be consistent with other signage
- barriers continue to meet manufacturers specifications
- TMA and arrow boards continue to function as intended, such as visual cues and crash energy reduction.

The STMS should seek support from the TTM planner if there are any concerns or issues with the TMP and risk controls during maintenance of the site.

Inactive site hours

Controls for inactive site hours should be included in the TMP. There may need to be changes made to prepare for inactive site hours, such as removing signs, uncovering of permanent signs, or installing different signs.

All installed devices and operations must continue to operate as designed during inactive hours. The controls must continue to reduce risk as planned. Because there are no workers onsite, the risk profile is different, so the controls will be different from the active hour's controls.

The process for checking and remedying any issues should be identified by the STMS and TTM planner during the planning phase. High pedestrian areas or conditions such as high wind or winter snows may need checks more often. Control failure will increase risk, so it's important the controls always function.

Record keeping

Keep detailed records and update them every day. The level of detail should allow the STMS to easily recreate the site in the future, which could be a couple of years later. They may also be used in legal proceedings.

It's up to the contracting PCBU to decide how these records will be kept, such as paper, secure digital, or video. For records of how the site is setup, a video recording is recommended. The records need to show:

- STMS details.
- Date.
- Location.
- Identification of job, including any reference numbers.
- Time of inspection.
- Detail of any adjustments and modifications.
- Name of person who made the changes.
- Name of person authorising the changes.
- Comments.
- Reference number of traffic management plan or traffic guidance scheme.
- Hand over procedures at shift change or moving from active to inactive.
- Weather conditions.
- Check all devices onsite are functioning. A video is the best way to show how a site was set up. Checks should include:
  - signs are upright, clean, visible, and correctly spaced
  - taper lengths are correct
  - dynamic operations (either manual or ITS) are working correctly
  - pedestrians and cyclists are provided for
  - lane widths are adequate
  - vehicle queue lengths are acceptable
  - road surface condition is adequate
  - installation and removal times are recorded.

Incidents

Incidents, such as crashes or collisions, either witnessed or reported, involving the public or from which legal proceedings might arise, should be documented for reporting. Record and photograph the actual TTM arrangements in use at the time of the incident. This includes spacings, widths, positioning, dynamic operations – all the TTM and permanent controls in place.

Details of weather, surfacing condition, activity details, traffic conditions, the type of crash, vehicles involved, and their drivers, should also be recorded.

This information may be important if legal proceedings result from an incident. Tampering with evidence by shifting signs and devices is a criminal activity.

If a fatal or serious injury happens, evidence of all aspects of the site and the incident must be preserved until police are able to complete a forensic examination. Changes to the site must only be done to assist the injured, or to make the site safe or minimise the risk of further incidents. The site must not be cleaned or tampered with, including all traffic management devices. Except for the reasons above, leave crash debris in place until police or WorkSafe arrive. Preserving evidence is more important than traffic access, so additional lane closures or complete road closures may be needed to achieve this. Guidance on partially or fully closing a site to traffic should be sought from the TMP contingency plan specific for the site.

For detailed information on notifiable incidents as required by HSWA go to What must a PCBU do if a notifiable event occurs? worksafe.govt.nz/notifications/notifiable-event/what-is-a-notifiable-event

Make sure controls are not excessive

For controls to remain effective, the public must trust that the controls are in place for a reason. Using controls excessively, such as deploying them early or leaving them installed when the site is completed, will undermine the public's trust. Making sure there are no excessive controls is the responsibility of the contractor PCBU.

If the public aren't paying attention to the TTM equipment, it becomes ineffective at managing risk and the safety of current and future workers and the public is weakened.

Site removal

Removing a site can often be high risk for TTM crews because of fatigue and being focused on getting home. Make sure the removal process is described in the TMP and risk assessed in the same way as the TTM for the active site. Additional controls may be required to manage risks during site removal. Pre-plan the site removal process, for example schedule a shift change with a new crew coming in and manage the length of shifts onsite.

A risk assessment for the site should be completed before starting the removal process. What has been happening on site should be also looked at, as it will show the type of road user behaviours seen in that location.

The assessment could include:

- duration of the site. Removal of a long-term site may confuse drivers and result in safety risks.
- length of the site
- complexity of the site
- permanent speed of the road
- speeds observed during road work
- time of day
- type of conditions such as weather or sun glare.

Quality, assurance, and control

Evidence suggests that many sites are unsafe before an onsite audit is even carried out, therefore reviews should be done before the site is installed. The NZGTTM requires a risk-based approach, which results in more reviews than previous processes.

Quality, assurance, and control system

TTM performance will be improved by putting a robust quality system in place. Assurance ensures quality during the planning stage, while control ensures quality during the delivery stage. Implementing a quality, assurance, and control system can bring the following benefits:

- Maintaining TTM services, plant, and equipment consistently and in compliance with applicable laws and regulations.
- Trend analysis of process, standards, and performance.
- Enhancing safety outcomes through facilitation of improvement opportunities.
- Analysing opportunities and risks.
- Demonstrating compliance with a contractor PCBU's quality management systems.

Swiss cheese concept

The quality, assurance and control system is a multi-layer system, shown as the Swiss Cheese Model – figure 8. Each layer in the system has strengths and weaknesses – holes in the slices of Swiss cheese. It's through multiple stages – layers of Swiss cheese – that creates the greatest opportunity for safe worksites.

The TTM quality, assurance, and control system includes the following six processes:

1. TMP Review (Risk assessment review).
2. STMS/contractor review.
3. G check/partial review.
4. Compliance based audit (existing).
5. Full risk-based review (similar to comprehensive road safety audit).
6. Systems audit (quality/process assurance).

The six processes apply to different sections of a projects time frame. Figure 9 shows the timeline for each section.

A detailed breakdown of the components of the model can be found in the quality, assurance and control guidance note.

Note – while the first five processes are for the TTM industry to do, the sixth process, systems audit is an ISO 9001 quality management system audit. Although companies can conduct systems audits, to achieve and maintain an ISO accreditation, an independent organisation must complete the process.

Each audit/review process within the system has its own unique strengths and weaknesses. By using multiple layers within the system, each risk is mitigated by a specific layer (or multiple layers) with the result being the greatest opportunity for zero harm work sites.

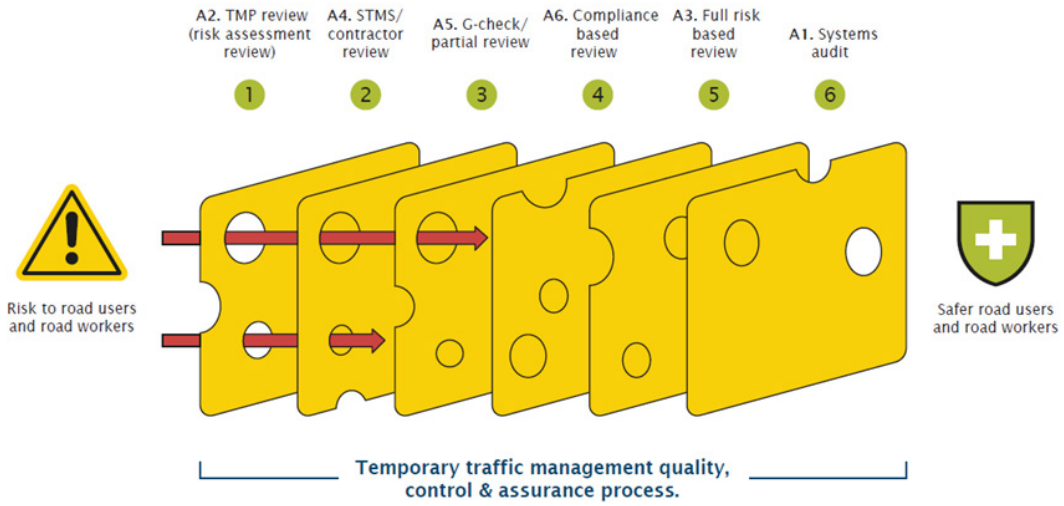


Figure 8: Quality, assurance and control process - Swiss Cheese Model
Image credit: Waka Kotahi

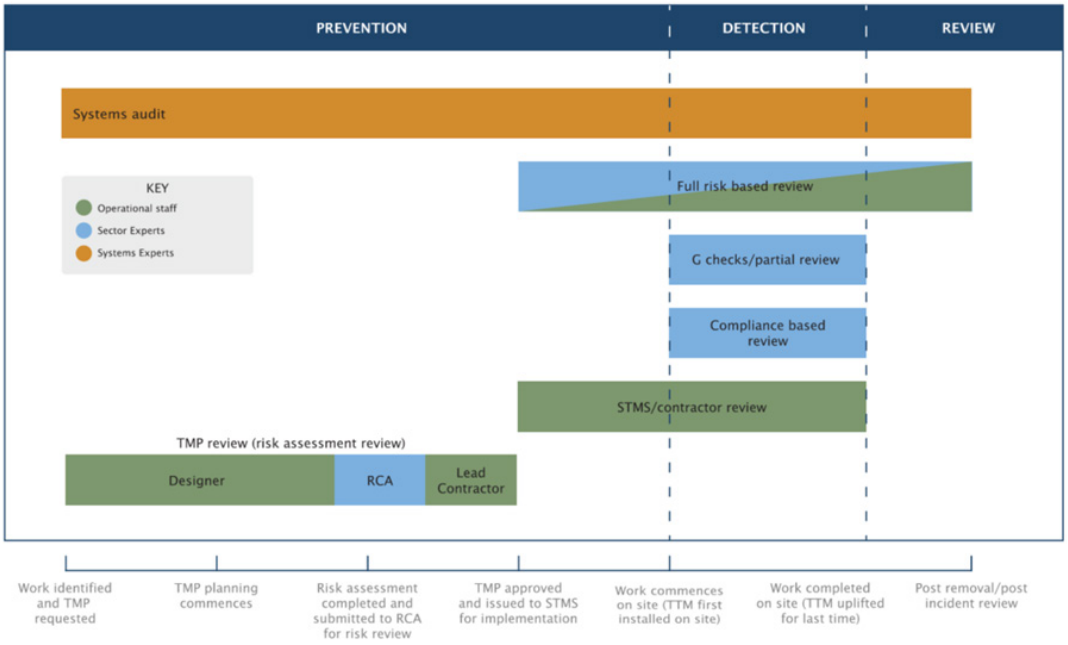


Figure 9: Quality, assurance and control process - TTM timeline
Image credit: Waka Kotahi

Emergency response

For workers attending emergency sites it's understood there may not have been a full risk assessment leading to a TMP, and it may not be possible to set up a TTM site that's consistent with a TMP or practice note. However, in an emergency PCBUs are still legally obliged to ensure the safety of workers and the public so far as reasonably practicable. This is consistent with HSWA 2015. This may mean using a different approach than for a planned site.

So, for emergency response situations our vision is changed to:

> Do the best you can with what you have, to ensure road workers and road users go home safe every day

Responders should cause no more harm, either from inaction or action. More death or serious injury from inaction is no different to more death or serious injury from action.

A contractor PCBU responding to incidents is encouraged to plan as much as possible, while acknowledging the specifics of each incident will be different.

If legal proceedings result from an accident, information about the site will be important and the TTM planner and lead contractors are likely to be asked for details of the site. It's important that good records are kept.

Situations which typically require an unplanned time critical reactive response include:

- vehicle crashes
- fires
- floods
- live power cables or gas leaks
- emergency repairs to roads and essential services
- large objects on a road.

This approach doesn't apply to non-time critical responses or activities that can be planned, such as general maintenance activities like streetlight replacement, which can be reasonably foreseen and therefore a TMP prepared.

After every unplanned emergency response, all PCBU and the TAO must consult, collaborate and cooperate to move as quickly as possible to a planned emergency response.

Emergency response can be broken into four phases of operation as described below:

- **Short term response** – the first hour where the response is reactive with limited resources.
- **Medium term response** – after the first hour until around three hours after the incident where the response is reactive, but more resources become available.
- **Long term response** – approximately three hours after the incident until it's stabilised. There is more leadership and oversight, and the response may be changed in a planned way.
- **Recovery period** – the incident is stabilised until return to normal. Operate as normal, with pre-planning and peer review of all activities.

Transition from one phase to the next is never obvious. It is important that everybody involved understands these transitions will happen and supports the changes. For some events, such as a vehicle crash with only minor injuries, the move from short term response to return to normal may be less than an hour. For other events such as a major fire or flooding the long-term response may be in place for days, with many updates to the long-term response plans. A major earthquake or storm may take months for the long-term response phase and years for the recovery phase. It is important that everybody proactively and positively supports the lifecycle of the emergency.

Further reading on the national approach to emergency management can be found on the National Emergency Management Agency (NEMA) website at civildefence.govt.nz/cdem-sector/the-4rs

Short term response

While emergency services may take initial measures, the primary traffic management of the site and the follow-up TTM control measures should be provided by the TTM industry who are better trained and equipped to ensure the safety of those onsite and the public. This allows emergency services to focus on the resolution of the incident rather than directing traffic. Think of this as working back-to-back with the emergency services – they focus inward on the incident and the TTM industry focuses outward on the traffic.

In the case of emergency response, the safety of emergency services and road workers is central and actions to achieve maximum safety are essential.

Organisations on standby for emergency response should develop efficient methods and operating procedures for attending emergencies. Emergencies often occur outside working hours with limited access to support. The teams assigned to short term response should be trained in the use of the specific emergency response procedures, including:

- Duties of workers attending the site.
- Modified duties where there aren't enough workers for ideal control of the site, for example, the need for a single manual traffic controller to control traffic from two directions.
- Procedures for contacting police, emergency services, back-up assistance and the contracting PCBU, as well as any other help needed, including contingency plans for when usual communication, such as a mobile phone, isn't available or working.
- Ensuring equipment is always ready on callout vehicles.

Moving from the short-term response to the medium-term response should be done as quickly as possible as the short-term response is often the highest risk phase. This means initial responders calling out additional on-site resources and alerting managers and professional support as soon as possible so they can start planning for the long-term response.

Medium term response

Additional resources will become available in the medium-term, but their use continues to be unplanned. Staff onsite continue to lead operations independently or with limited communication with emergency services, operational managers, planners etc. The focus is on further reducing risk and enhancing safety, using equipment as it becomes available. Safety continues to be the central focus and actions to achieve maximum safety for emergency services, road workers and road users are encouraged.

During the medium term response, planners and managers will start collecting information so that coordinated response plans can be developed, and resources prepared for implementation.

Planners and managers need to understand the risks and ensure appropriate controls are identified and communicated. This includes identifying the most appropriate fundamental TTM control that is reasonably practicable. This will continue to evolve as more resources and information becomes available.

Additional matters will start to become important during this time such as:

- Suitability of detours.
- Welfare, such as shelter and toilets, for staff and road users delayed by the road closure.

Long term response

All actions during the long-term response happen after event specific risk management planning. It will feel like normal planning, but the response is still focused on ensuring safety and stabilising the emergency. Follow the NZGTTM, including risk assessment for identifying fundamental TTM controls, TMP development, peer review and risk-based installation and removal.

Recovery period

During the recovery period all actions are planned, however the focus is on repair of the damage. Follow the NZGTTM, including risk assessment for identifying fundamental TTM controls, TMP development, peer review and risk-based installation and removal.

Innovation

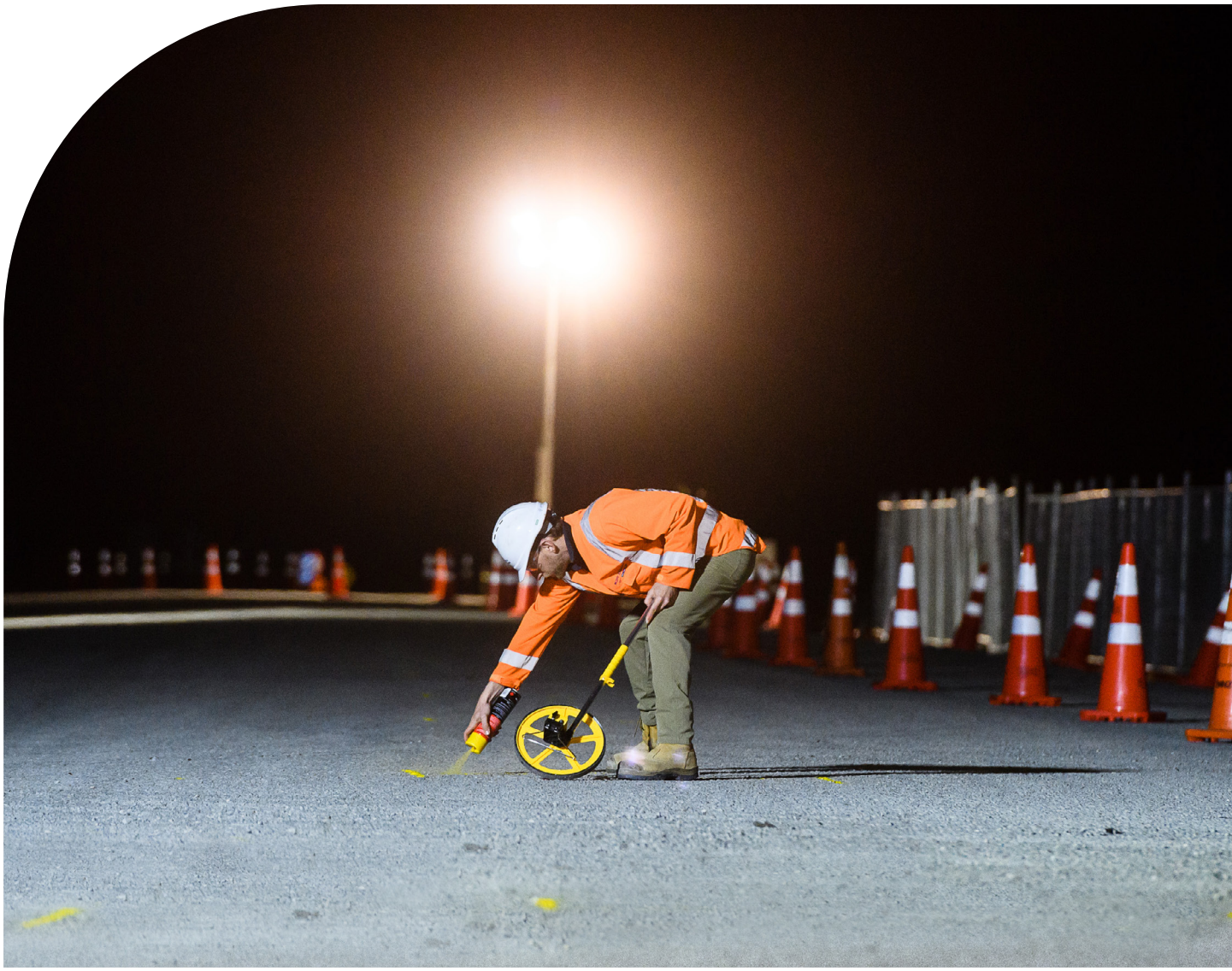
Innovation to reduce risk and improve safety outcomes is encouraged. Consider and apply the following as appropriate:

- Innovation through:
  - changing how we use existing materials and plant
  - introducing new plant, material, equipment, methodologies, systems, or processes.

Innovation must lead to an increase in total safety. Safety improvements for one group, such as workers, that introduces risk for another group, such as the public, are unacceptable.

Products must be approved by review of applicable standards or through a trial. Aotearoa New Zealand has laws and rules governing equipment that must be followed. Introducing new products without a review or trial is unacceptable. The Waka Kotahi TTM team will provide support through this process.

The Waka Kotahi Traffic Note 10 has more information on the trial process.
nzta.govt.nz/assets/resources/traffic-notes/docs/traffic-note-10-rev3.pdf



Capability and training

Background

All workers must have the appropriate training and credentials and be competent to do their work safely. Training requirements will depend on:

- the level of risk their job involves
- any industry or occupation specific training requirements and credentials, including licences required
- their knowledge, experience, and previous training.

PCBUs are responsible for making sure all workers, including subcontractors, have the appropriate training and certifications for the work they'll be doing. See HWSA 15 section 36(3) (f):

36 (3) . . . a PCBU must ensure, so far as is reasonably practicable, . . .

36 (3) (f) the provision of any information, training, instruction, or supervision that is necessary to protect all persons from risks to their health and safety arising from work carried out as part of the conduct of the business or undertaking. Examples of appropriate training may include:

- relevant TTM/STMS qualifications
- appropriate licences and training to operate specific types of plant
- industry specific health and safety training
- site access training.

Temporary traffic management training

Training will be industry led and provided by vocational education organisations. For the purposes of Version 1 of the NZGTTM the current Training and Competency Model (V5.3 August 2019) from Waka Kotahi remains live and usable to support training requirements. Each PCBU must also consider where additional training requirements may be needed.

Training and competency is made up of standards, training, and assessment. Training may be formal or informal, theoretical, or practical.

The TTM industry/sector must have capability in the following functions:

- Planning
  - Risk assessment
  - Engineering (geometric design)
- Network access coordination
- Risk peer review
- Regulatory functions
- Operations
  - Operational leadership (STMS)
  - Operational team member
- Quality assurance

It's acknowledged that the TTM sector is made up of many sub-sectors and so it may be appropriate that different training units may be developed that fit within the overall framework outlined above.

The industry has formed a collective body in late 2022, to oversee the development and implementation of a training and competency system for their staff. Further information will be added future editions of the NZGTTM as the group progresses its work.

Waka Kotahi will support the transition from the historic warrant system to the industry led development and adoption of the new frameworks and models.

3

The toolbox

Part 3 sets out what we do to design a TTM site. It provides information about engineering design principles, geometrics, safety, traffic assessments, equipment, and specialist projects. This includes references to relevant design guides and standards.

Who should read this?

- Practitioners planning and preparing for temporary traffic management activity.
- Temporary Traffic Management Planner (TTMP).
- Site Traffic Management Supervisor (STMS).
- Corridor manager.
- Traffic management managers.
- Project managers.
- Contract managers.

Contents

TTM toolbox – what TTM engineering includes

Introduction

Structure

The toolbox has two main components:

- Design for TTM – the design section covers all engineering principles used to ensure the geometry, safety and traffic engineering are appropriate.
- Equipment for TTM – the equipment section covers equipment currently available for use on TTM sites. This includes both material and use specifications.

References and why we have them

This section of the NZGTTM includes references to several external documents. This is because:

- Most importantly, TTM is permanent road design delivered temporarily, so for geometric design and traffic engineering there's no need to develop TTM specific material.
- Many of the concepts of road safety are applicable to temporary traffic management.
- By referencing permanent design material, it's easier for a TTM planner to find what they need for complex TTM sites, for example major capital works projects with temporary road alignments. Note – common design information is included in the NZGTTM to assist with simple TTM sites.
- Design guidance is kept up to date with links to source documents for all reference information.

Professional advice

If at any time you are unsure how to proceed with the engineering of a TTM site, talk to a professional engineer. Note professional engineers often specialise in geometric design, safety or traffic engineering.

All major, and many smaller engineering consultancies have these skills. The key is knowing when professional expertise is required and when it's not. This skill set would be valuable to any major project such as construction of a new road or work on an arterial or state highway in a city. If in doubt, ask.

Design

Human behaviour guiding TTM design principles

Changing the permanent transport system using TTM measures influences human behaviour. Workers on the transport system are at risk of harm when exposed to many different hazards. The focus of the NZGTTM is on the risk from the interface between the activity and traffic. Whenever the permanent transport system is changed through a TTM site being installed, road users need to change their actions.

The users of the transport system are also at risk of harm when exposed to the hazards from a site – change in surface, geometry, roadside hazards such as trenches, plant, and partially completed guardrails, products such as bitumen, pedestrians exiting a concert, racing cyclists and more. These introduced and unexpected hazards pose a risk to road users.

The goal of any TTM measure is to aid road users to detect and navigate a TTM site in a manner that is both safe for them and safe for the worker. Road workers and road users are humans and humans all behave differently to what they see in front of them on a road. For comparison, water molecules in a pipe all behave the same for a given pressure and temperature. Humans, the workers and users of the transport system, all behave differently:

- Levels of comprehension or detection and reaction
  - "I didn't understand what the sign meant."
  - "I didn't know I wasn't allowed in the exclusion zone."
  - "What's an exclusion zone?"
- Risk tolerance
  - "I'm very nervous, I don't know how to drive on gravel."
  - "It's only a little snow, I have a 4wd, she'll be right."
  - "I can chuck some mix in the pothole in the gaps in traffic, stand back."
- Understanding of their rights of access to the transport system
  - "You can't stop me."
  - "Those are my car parks."
  - "I demand to drive down this closed street."
  - "I have an over dimension permit, get your TTM site out of my way."
  - "I have an approved TMP, you cannot come through here."
- Motivators/personal stress
  - "My business will fold if I can't deliver this product/get to this job today."
  - "My child is waiting for me at the school gate and very stressed."
  - "No worries I'll go another way."
  - "I've got to get this job done within the next 5 mins or we don't meet our contract KPI."

Providing for all the needs of those using the transport system is challenging, but Health and Safety at Work Act 2015 (HSWA 2015) requires that safety is prioritised above other risks.

From the seven guiding principles of Road to Zero, the following are key to TTM:

- We promote good choices but plan for mistakes.
- We design for human vulnerability.
- We make safety a critical decision-making priority.

Road design and safety are based on the concept of PIEV time, this is:

1. Perception – the time required for the sensations received by the eyes or ears and transmitted to the brain through the nervous system and spinal cord.
2. Intellection – the time required for understanding the situation. It's also the time required for comparing the different thoughts, regrouping, and registering new sensations.
3. Emotion – the time passed during emotional responses to the situation such as fear, anger, or even superstition. Therefore, the emotion time of a driver is likely to vary depending upon the problems involved.
4. Volition – the time taken for the final action.

PIEV time can also be described as the time between stimulus and response or just response time. This is the time from detecting something is different until the time the appropriate response is initiated.

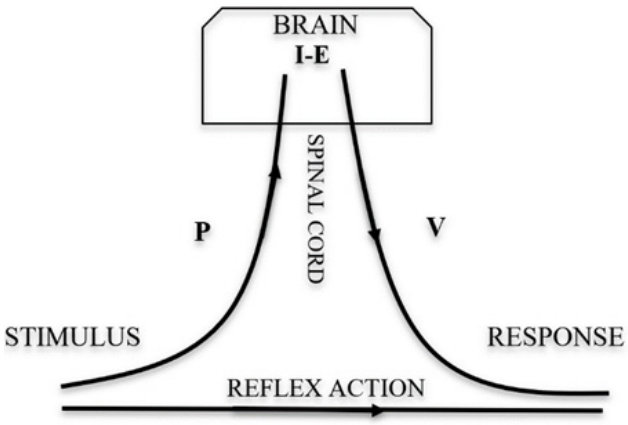


Figure 1 - PIEV time
Image credit: Civilease.com

Governing design principles

Given the PIEV time of humans, all design decisions need to communicate changes in transport system operating conditions to drivers, cyclists, pedestrians, and public transport users so they know what is expected of them and can safety use the changed transport system.

In designing a TTM site layout this means that we must provide clear:

- **Advanced warning** – make sure the public know there is a change to the road operating conditions ahead. This is typically the fact there is a TTM site ahead and the type of TTM site.
- **Guidance** – make sure the public know how to navigate the TTM site from advanced warning to return to normal.
- **Protection** – ensure protection from site hazards for the public or protection from traffic for workers.
- **Return to normal** – make sure the public know they have passed the TTM site and permanent road operating conditions and rules apply.

These are the most important principles for design of a site. If anything within the design section of the NZGTTM contradicts these principles, the governing design principles take precedence.

It is important to note that every change in road environment requires the drivers attention and has a prior PIEV time. For example, changes include a speed change, a lane shift/change, a loose surface, a stop/go operation, a follow me, or a works end sign.

A useful practical example is advanced warning sign spacing. Advanced warning must always be provided to allow time for drivers to take in the change in conditions and react appropriately in a time. If something changes such as queue lengths increase, the advanced warning signs must be relocated so they remain effective. This may happen when traffic flows increase beyond the capacity of a manual traffic control system. An advance warning sign that is midway along a stationary queue is no longer an advance warning sign.

Geometric design

Geometric design guides help us make sure the shape of a road is appropriate for the way it's being used. It's based on PIEV time as well as physics such as braking forces (kinetic energy and friction), and cornering forces (radial acceleration and friction). Dimensions used are usually time (seconds) and distance (meters).

Horizontal and vertical geometry

The traditional approach to permanent design is to consider both horizontal and vertical geometry and combine them into one complete three-dimensional design.

Horizontal geometric design is designing the straights, curves, cross-section widths and crossfall of roads. It deals with time and distance in 2 dimensions, along the road and across the road (coordinates).

Vertical geometric design is designing the gradients and crest and sag curves of roads. It deals with time and distance in one dimension, height or depth (levels).

It's very important horizontal and vertical geometry are considered when assessing required clearances, lane widths, taper rates and taper distances for a TTM layout. It's also very important they are reassessed when the layout has been installed on site. However, the majority of TTM layouts won't involve a change to the existing shape of the road surface, so where the lanes are temporarily moved (contra-flow, tapers, temporary curves) apply appropriate speed limits to make sure travel along the horizontal and vertical geometry of the existing road is safe.

Where this isn't appropriate, temporary changes to the road surface may be necessary. These changes must be removed when the temporary layout is no longer required.

Seek professional engineering advice if you're unfamiliar with these issues.

Design for users

Design decisions must consider all transport system users and make provision for them if they use the road network affected by the works or activity. Common transport system users can include:

- blind and low vision users
- mobility impaired
- pedestrians
- cyclists
- public transport
- light vehicles
- heavy vehicles
- over-dimension and over-mass vehicles.

Providing for these transport users, or any others identified, can be done through creating separated facilities, combined facilities, exclusion or redirection. Regardless of the approach, all user types identified must be considered and a decision made. It's unacceptable to ignore any user group.

Detailed design references

Below is a list of references to assist with design of TTM for TTM sites.

- Traffic Control Devices Manual part 1 2010 – nzta.govt.nz/resources/traffic-control-devices-manual/index.html
- Austroads Guide to Road Design part 3 2021 – austroads.com.au/safety-and-design/road-design/guide-to-road-design
- Waka Kotahi NZ Transport Agency Pedestrian Network Guidance (2021) – nzta.govt.nz/walking-cycling-and-public-transport/walking/walking-standards-and-guidelines/pedestrian-network-guidance
- Public transport design guidance – nzta.govt.nz/walking-cycling-and-public-transport/public-transport/public-transport-design-guidance
- Temporary bus stops - nzta.govt.nz/assets/resources/code-temp-traffic-management/docs/Section-I-13-bus-stops-copttm-4th-ed-may2016.pdf
- Cycling network design guidance – nzta.govt.nz/walking-cycling-and-public-transport/cycling/cycling-standards-and-guidance/cycling-network-guidance/designing-a-cycle-facility/#design-guidance
- Road safety barrier systems – nzta.govt.nz/assets/resources/road-safety-barrier-systems/docs/m23-road-safety-barrier-systems-appendix-c.pdf

Go to austroads.com.au/publications/road-design/agrd-set for the full ***Austroads Guide to Road Design***.

Specific references for various design elements are provided below.

Advanced warning

- Providing the appropriate information to all network users before they reach a change in the road operating conditions. This is to allow them to make an informed decision in a timely, safe manner.
- Visibility of devices due to both corners (horizontal geometry) and crests and dips (vertical geometry) – *Traffic Control Devices Manual* part 1, section 7.3 Location.

Guidance

Providing enough time for the public to identify the route including relocation to the correct lanes.

- Visibility of devices due to both corners (horizontal geometry) and crests & dips (vertical geometry) – *Traffic Control Devices Manual* part 1, section 7.3 Location.
- Advanced warning time (distance) should be longer than any traffic queue – see page 72 for more information on working out queue lengths.
- All horizontal and vertical design – *Austroads Guide to Road Design* part 3 (2020) and Waka Kotahi NZ Transport Agency Supplement TM-2501. This covers lateral shifts, curves, crossfall, and warp rates. Note temporary roads must have their geometry checked.

Lane dimensions to ensure all users have sufficient space.

- Traffic lane widths (horizontal geometry) – *Austroads Guide to Road Design* part 3 (2020), section 4.2.4
- Bus lane widths (horizontal geometry) – *Austroads Guide to Road Design* part 3 (2020), section 4.10.2
- Bus stops – Waka Kotahi public transport design guidance
- Cycle lane widths (horizontal geometry) – Waka Kotahi Cycling network design guidance
- Cyclists at intersections – Waka Kotahi Cycling network design guidance
- Footpath widths (horizontal geometry) – Waka Kotahi Pedestrian network guidance, Design
- Pedestrians at intersections – Waka Kotahi Pedestrian network guidance, Design

Safe and appropriate speed limits to ensure safety and compliance

Speed limit selection is subject to human body tolerances, vehicle technology and both horizontal and vertical geometry. There are two methods to determine an appropriate speed for a TTM site. It's recommended they're applied in the following order:

- **Human activity based** – the primary speed decision process. The human body can only withstand so much force before injuries become fatal. So, how humans are physically affected by motorised vehicles guides the selection of an appropriate speed limit. This is the best way choose a speed limit. The following table shows target speeds for different activities. These speeds have been taken from research by Wramborg, P. (2005) and later reviews.

Activity – sites with	**Target safe system speed**
possible crashes between motorised vehicles and: • workers on foot • pedestrians • cyclists • any other person affected and not protected by a vehicle.	30 km/h
possible side-on crashes between vehicles	50 km/h
possible head on crashes between vehicles	70 km/h

- **Environment based** – the secondary speed decision process. The speed should be appropriate for the road environment. In this situation the geometry (vertical and horizonal curves), roadside infrastructure, surfacing, weather etc are considered.

Environment – sites with	**Target safe system speed**
• significant loose material on surface (fresh chip seal or steel plates) • step in surface (pavement milled) • tight radius curves with no or adverse superelevation	30 km/h
• limited loose material on surface (pavement rebuilt but unsurfaced, recently swept chip seal, secured steel plates) • moderate radius curves with no or adverse superelevation	50 km/h
• small potholes – vehicle tyre does not drop into them, pavement cracking, pavement deformation • moderate radius curves with superelevation	70 km/h

Protection

Ensuring that those who do not observe the controls do not crash into queued traffic, people, or plant on the site:

- Safe stopping distances (subject to both horizontal and vertical geometry) – *Austroads Guide to Road Design* part 3 (2020), section 5.3
- Roadside safety space (for risk mitigation, recovery or stopping safely when lose control) – *Austroads Guide to Road Design* part 6 (2020), section 3.5
- Shy lines (the closet to an object that a driver feels comfortable driving) – *Austroads Guide to Road Design* part 6 (2020), table 5.4
- Crash protection systems – Waka Kotahi Specification M23 appendix C.

Return to normal

Providing enough time for the public to know they have left the TTM site and permanent road operating conditions resume:

- Visibility of devices due to both bends (horizontal geometry) and crests and dips (vertical geometry) – Traffic Control Devices Manual part 1, section 7.3 Location.

Common horizontal and vertical geometry information

As many of the sites TTM is prepared for are simple TTM sites, the following table is a summary of common geometric design information from the references above. The engineering detail for each of these dimensions can be found in the basis of dimensions guidance note. Values in Table 1 have been rounded.

The dimensions are given in both time and distance. It's expected that distance will used for planning, however both time and distance will be used for TTM site set-out. For example, when setting out a TTM site, the sign visibility distance of 3 seconds can be used to determine the location of an advanced warning sign. The STMS can do this by measuring the time from when they can first see a vehicle until it passes the point where the sign is proposed to be installed. This ties in with the operating speed rather than the permanent speed limit, creating a fit for purpose solution.

Note the separation from shadow vehicle to working vehicle distances. The separation needs to account for two risks:

- The roll forward risk – this is where a shadow vehicle rolls forward after being struck by an approaching road user and strikes a worker or the working vehicle.
- Lane re-entry risk – this is where a road user re-enters the lane between the shadow vehicle and the workers or the working vehicle.

If the shadow vehicle is too close to the workers or working vehicle, the roll forward risk could happen. If the shadow vehicle is too far away from the workers or working vehicle, the lane re-entry risk could happen. Unfortunately, the roll ahead distance is often longer than the lane re-entry distance. Waka Kotahi has commissioned expert advice on this matter and will update this section of the NZGTTM as soon as possible.

Permanent speed limit or operating speed (km/h) where measured									
Parameter	**≤30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**
Traffic signs									
Sign visibility distance (m)	20	25	30	50	60	70	95	105	115
Sign visibility distance (sec)	2	2	2	3	3	3	4	4	4
Warning distance (m)	30	40	50	80	100	120	160	180	200
Warning distance (sec)	4	4	4	5	5	5	6	6	6
Sign spacing (m)	15	20	25	40	50	60	80	90	100
Sign spacing (sec)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Exclusion zones									
Longitudinal exclusion (m): Sealed	25	35	50	65	85	105	125	165	195
Longitudinal exclusion (sec): Sealed	3	3	4	4	4	5	5	6	6
Longitudinal exclusion (m): Unsealed	30	40	60	80	105	135	165	215	255
Longitudinal exclusion (sec): Unsealed	3	4	4	5	6	6	7	8	8
Lateral exclusion (m)	1	1	1	1.5	1.5	1.5	2	2	2
Lateral exclusion (sec)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tapers									
Taper length (m)	30	40	50	60	70	80	90	100	110
Taper length (sec)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Distance between tapers (m)	25	35	50	65	85	105	125	165	195
Distance between tapers (sec)	3	3	4	4	4	5	5	6	6
Lanes									
Temporary lane width (m)	2.75	2.75	3	3	3.25	3.25	3.5	3.5	3.5
Temporary lane width (sec)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Delineation spacing straights (m)	5	5	5	10	10	10	15	15	15
Delineation spacing straights (sec)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Delineation spacing curves and tapers (m)	2.5	2.5	2.5	5	5	5	10	10	10
Delineation spacing curves and tapers (sec)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Threshold length (m)*	10	10	10	20	20	20	40	40	40
Delineation spacing in threshold (m)*	2.5	2.5	2.5	5	5	5	10	10	10
Curve									
Min curve radius for generic design (m)	35	60	100	140	190	250	315	390	470
Min curve radius for generic design (sec)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Vehicle operations									
Clear sight distance (m)	100	135	165	200	235	265	300	335	365
Clear sight distance (sec)	12	12	12	12	12	12	12	12	12
Separation (min) from tail pilot to work vehicle (m)	25	35	45	65	75	85	120	130	150
Separation (min) from tail pilot to work vehicle (sec)	3	3	3	4	4	4	5	5	5
Separation (max) from tail pilot to work vehicle (m)	50	70	90	130	150	190	240	260	300
Separation (max) from tail pilot to work vehicle (sec)	6	6	6	8	8	8	10	10	10
Separation from shadow vehicle to work vehicle (m)**	15	20	25	30	35	40	45	50	55
Separation from shadow vehicle to work vehicle (sec)**	2	2	2	2	2	2	2	2	2
Separation (min) from work vehicle to lead pilot (m)	25	35	45	65	75	85	120	130	150
Separation (min) from work vehicle to lead pilot (sec)	3	3	3	4	4	4	5	5	5
Separation (max) from work vehicle to lead pilot (m)	50	70	90	130	150	190	240	260	300
Separation (max) from work vehicle to lead pilot (sec)	6	6	6	8	8	8	10	10	10

Table 1: Common geometric dimensions

* values additions since V1 of the table was released to the industry

** values subject to amendment based on further research being done

Safety assessment

The land transport system is made up of two main parts – intersections and links. This information will help with risk assessments, decisions around identifying the appropriate fundamental TTM controls and the detailed design of the TMP for the TTM site.

Waka Kotahi has more information on safety and identifying and assessing risk for rural roads and intersections:

- High Risk Rural Roads Guide - nzta.govt.nz/resources/high-risk-rural-roads-guide
- High Risk Intersections Guide - nzta.govt.nz/resources/high-risk-intersections-guide

Intersections

The fewer conflict points and the lower the speed, the lower the risk. In order of least safe to most safe, intersection forms are:

1. Uncontrolled intersections – no stop or give way sign .
2. Give way controlled intersection.
3. Stop controlled intersection.
4. Traffic signals.
5. Roundabout.
6. Grade separated interchange.

Additional information

a. Higher speed at an intersection = higher risk from higher probability and higher consequence.

b. More approaches (legs) = higher risk (greater probability and consequence). Crossroads (4-way) intersections are more dangerous than T intersections (3-way). This is because there are more conflict points, that is, points where paths of vehicles overlap. Figure 2 shows the conflict points of a four-way intersection.

c. Some crash types are higher consequence. Glancing crashes are generally safer than T-bone crashes. Roundabout crashes are usually glancing crashes rather than T-bone because of the curved travel path. Interchanges, while high speed, are low angle glancing crashes.

d. Y intersections have a higher probability of crashes than T intersections. This is because drivers must look over their shoulder and have trouble judging the speed of an approaching vehicle.

e. Property entranceways and site accesses are also intersections and must be considered when doing risk assessments.

Cycling and pedestrian movement through intersections follows the same principles regarding speed and conflict points. However, as cyclists and pedestrians travel at a different speeds to motorised vehicles this means the order of least safe to safest intersection types is different:

1. Interchange in high-speed environments.
2. Roundabouts in high-speed environments.
3. Roundabouts in low-speed environments.
4. Interchange in low-speed environments.
5. Uncontrolled intersections – no stop or give way sign.
6. Give way controlled intersection.
7. Stop controlled intersection.
8. Traffic signals.

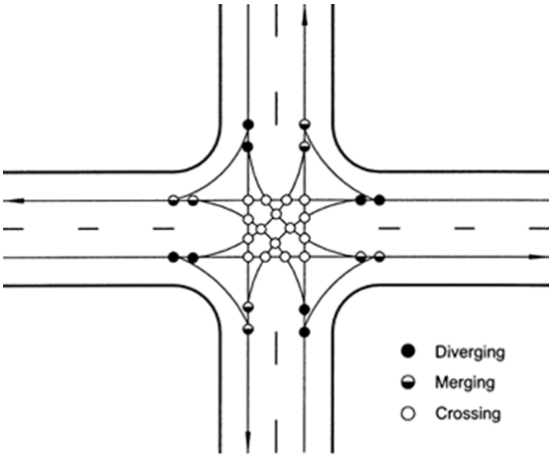


Figure 2 Four way intersection conflict points
Source: Federal Highway Administration Research and Technology

Links

A link, also known as mid-block links, is a section of road or path between intersections. The safety of a link is dependent on the cross section, speed, traffic volume, and any features that introduce vulnerable user crossings, such as pedestrian crossings and schools.

- Cross section
  - Where the cross section has many hazards such as poles, drainage ditches and headwalls, risk increases through higher probability of an out-of-control vehicle coming to an abrupt stop.
  - Where the sealed pavement is narrow, risk increases. This is because there is less space and time for drivers to correct steering errors, for example, an unsealed shoulder or no shoulder. A wide sealed shoulder is safer than an unsealed one, and an unsealed shoulder is safer than no shoulder.
  - Where there is no protection, such as guard rails, from roadside hazards or oncoming vehicle, the risk of a severe crash increases.
  - Where there is something on the surface that reduces skid resistance the risk of a loss of control crash increases. Examples include, gravel road, sealing chip, ice, snow, rain, flooding, mud from slips and soil tracked onto the road.
  - Where permanent delineation is poor or there is none, the risk of a run-off-road crash increases, especially in low light conditions. Examples include, no line marking, no raised reflective pavement markers, or no edge marker posts.
- Speed
  - Speed increases both probability and consequence of a crash. A higher speed means less time for drivers to correct errors and increases severity when something does go wrong.
- Volume of traffic
  - At high speeds, high volumes of traffic increase the probability of a crash. However, when congestion occurs, for example high volumes at low speeds, the volume no longer matters as low speed greatly reduces crash severity.

The information above will help with risk assessments, decisions around identifying the appropriate fundamental TTM controls and the detailed design of the TMP for the TTM site.

Traffic impact assessment

The priority of the TTM layout must always be the safety of road workers and the wider public network users. However, there may be occasions when alternative solutions provide an acceptable level of safety, while minimising disruption or delays to the network users.

Delay information will help with both risk assessment and design. Longer delays can increase the risk of drivers making poor choices due to frustration. Delays, specifically queue lengths, inform detailed design of the TMP for the TTM site.

For traffic impact assessment guidance the *CTOC Transport Efficiency and Impact Guide* is a suitable option found on the CCC Transport page. ccc.govt.nz/assets/Documents/Transport/CTOC/1804-CTOC-Transport-Efficiency-and-Impact-Guide.pdf

Note this was written during the rebuild of Christchurch and at a time when journey efficiency was as important as safety. This is no longer correct – safety has priority.

The following points are a summary of the key concepts:

- Delays are calculated for intersections and links separately and summed to determine the impact on a journey. There are several formulas to aid in both scenarios.
- Flow and speed are related through traffic density. As flow increases, speed slowly decreases, until capacity is reached – maximum density. At maximum density this is also maximum flow, any increase in flow will result in slowing of speed. This is called flow breakdown.
- Capacity of any lane is 1800 vehicles per hour (vph) because of the two second rule. The shortest distance between any two vehicles at maximum density is two seconds. As an hour is 3600 seconds, at two seconds between vehicles this results in 1800 vehicles per hour.

$$\frac{3600 \ \frac{\text{sec}}{\text{hr}}}{2 \ \frac{\text{sec}}{\text{veh}}} = 1800 \ \frac{\text{veh}}{\text{hr}}$$

- The 1800vph per lane is the basis, however it must be modified for various scenarios:
  - 30kph temporary speed limit has a capacity of 1500 vehicles per hour. If the front bumpers of two cars are two seconds apart at 30kph, the following car would crash into the car in front.
  - A merge at any speed has a capacity of 1300vph. This has been observed at many merges. It is because of the varying choices of drivers when merging – not all drivers merge like a zip.
  - Intersections lower capacity by reducing the time within an hour that movement can be made. For example, a traffic signal provides 65% of each cycle to the main road and 35% to the side road, so the capacity on each road is a percentage of the 1800 vehicles per hour. Main road capacity is.

    $$1800 \ \frac{\text{veh}}{\text{hr}} \times 0.65\% = 1170 \ \frac{\text{veh}}{\text{hr}}$$

    This is a great way to do a basic analysis of an intersection, but when there are right hand turn phases, uncontrolled movements, and random arrival of opposing traffic, it quickly becomes more complicated.
  - Stop/go or portable traffic signals are the same as traffic signals, only part of the hour is available to any one movement, so capacity is less than 1800vph. Stop/go is more complicated as the time it takes for the last car to enter and exit the TTM site must also be counted. At 30kph or 8.34 meters per second, it can take 18 seconds for a car to travel through a 150m TTM site.

- Queuing happens when traffic is stopped or when demand is higher than the capacity.
  - For stopped traffic such as stop/go, traffic signals, the queue length is determined by assessing the flow rate and the time of the stop. For example, if the flow rate is 1000vph and traffic is stopped for 40 seconds this leads to a queue length of:

$$40\text{sec} \times \frac{1000 \ \frac{\text{sec}}{\text{hr}}}{3600 \ \frac{\text{sec}}{\text{veh}}} \times 8 \ \frac{\text{m}}{\text{veh}} = 88.9\text{m}$$

  - When the traffic volume approaching a location is higher than the capacity, queueing will happen. For example, if there are 1500vph approaching a merge with 1300vph capacity, 200 vehicles will queue per hour.
  - Queues grow over time. Using the merging example, if a demand is 1500vph for two hours, there will be 200 vehicles queued at the end of the first hour and 400 vehicles queued at the end of the second hour.
  - Each vehicle takes up around 8m of space on average – some vehicles are shorter and others such as trucks are much longer. So, 400 queued vehicles will create a queue of around 3,200m (3.2km).

Equipment

General

All temporary traffic management equipment must be manufactured to comply with the relevant specifications and test protocol. Details of accepted equipment are in the Waka Kotahi M23: Specification and guidelines for road safety hardware and devices on our website at nzta.govt.nz/resources/road-safety-barrier-systems

Lightweight TTM equipment not requiring specific crash testing is listed in the M23 appendix F. This contains details relating to:

- delineation devices including cones, tubular delineators, barrels etc
- channelising devices including cone bars and traffic separators
- access prevention (fences)
- temporary traffic control systems
- beacons, arrow boards and light arrow systems
- advanced warning variable message systems (AWVMS)
- hazard covers
- temporary sign standards and supports
- traffic calming and arrest systems.

Further products will be added as they are submitted and assessed through the acceptance process outlined in the M23.

The M23 appendix F also contains relevant specification information relating to some TTM equipment that may be developed into standalone specification documents over time.

Heavy TTM equipment requires crashworthiness testing to an agreed international crash test protocol to ensure safe performance when correctly deployed. Currently Waka Kotahi uses the *AASHTO Manual for Assessing Safety Hardware (MASH)* protocol. Accepted equipment meeting the requirements of this protocol is listed in the M23 appendix C which covers:

- Temporary road safety barrier systems.
- End treatments to be used with the above barrier systems.
- Truck- and trailer-mounted attenuators.

Any equipment not covered by the specification or on the approved list must be submitted to the Waka Kotahi Programme and Standards Lead Safety Advisor for review and acceptance on a project or site-specific basis.
Email m23.queries@nzta.govt.nz

High visibility clothing

High visibility clothing is important at TTM sites, though as the hierarchy of controls shows, it's the least effective risk mitigation control.

Details of specifications for high visibility clothing for TTM purposes can be found in Waka Kotahi Specification E06 *Specification for the design and manufacture of high visibility safety garments for temporary traffic control purposes*.

Specialist projects

Where a project requires use of specialist equipment not listed in this toolbox, its use must be supported through a detailed risk assessment. Examples of this are as follows:

- Hostile vehicle mitigation
  Where there is a clear and present danger of someone using a vehicle to cause intentional harm, hardened devices such as concrete blocks or heavy plant may be used to stop the hostile vehicle. These devices will cause harm, so the lowest total risk assessment must be robust enough to support the use of this equipment.
- Race end gantry
  For the end of a race, a race end gantry may be used to signal to participants the end of a race and a shift in focus from racing to application of road rules.
- Banners/bunting
  To guide large crowds across roads to a large event.
- Portable lighting
  If the function of an intersection or crossing is changing either in purpose or volume of people using it, additional lighting may be necessary.

4

Glossary

Term	Definition
Activity	A planned event or operation done within the road reserve or affecting the normal use of the road reserve. An activity can be: • vertical and horizontal construction projects • vertical and horizontal maintenance activities • inspections and data collection – survey, asset investigation, traffic counting • on-road events and races – cycling, triathlon, running, motorsport • adjacent events – horse races, concerts, air shows • emergency services operations – FENZ, police, tow truck, civil defence • planned legal enforcement – police, MPI, Covid cordons • agricultural and forestry - stock crossing, stock droving and logging activities.
Advance warning	Equipment to ensure the public know there is a change to the road operating conditions ahead.
Exclusion zone	Positioned on the traffic side of the working space (or temporary pedestrian walkway) to separate workers, pedestrians, vehicles, plant, or materials from passing road users. These may be both parallel (lateral) or perpendicular (longitudinal).
Fundamental temporary traffic management controls controls	Around the site, through the site, past the site, in the gaps in this order. These controls are the temporary traffic management (TTM) description substitutes for the Health and Safety at Act 2015 hierarchy of controls.
Guidance	Equipment to ensure the public know how to navigate the site from advanced warning to return to normal.
Pre-approved reusable scheme (PARS)	A layout or set of layouts that have been pre-drawn and pre-approved. A risk assessment must be carried to determine if a PARS is suitable for any situation. It should never be assumed they are applicable for any situation.
Return to normal	Equipment to ensure the public know they have passed the site and permanent road operating conditions and rules apply.
Sign visibility distance	The minimum distance over which the driver of an approaching vehicle must be able to see the first advance warning sign. Where necessary, increase sign spacings to achieve visibility distance.
Site traffic management supervisor (STMS)	A qualified person who has specific responsibility for documentation and management of temporary traffic management (TTM). The STMS is the system installer, the person that installs a system designed by a designer.
Taper	A straight or smoothly curved row of delineation devices used to shift traffic laterally, for example, from a lane to the shoulder.

Term	Definition
Temporary speed limit (TSL)	A speed limit that is in force for a period of less than 12 months and is set under the Land Transport Rule: Setting of Speed Limits 2022 by the Road Controlling Authority (RCA).
Temporary traffic management (TTM)	Controls that are deployed on a site to mitigate risks to road workers and road users. The controls are identified via an assessment of risks to road workers and road users, and application of the hierarchy of controls, land transport rules and traffic engineering principles.
Traffic management diagram (TMD)	The TMD is a traffic management diagram within the traffic management plan (TMP). A TMP may have more than one TMD included as part of it.
Traffic management plan (TMP)	A document describing the design, implementation, maintenance, and removal of temporary traffic management (TTM) while the associated activity is being carried out within the road reserve or adjacent to and affecting the road reserve.
Transport Authority Organisations (TAO)	Collective term for organisations that control the land transport system. Includes: • Road Controlling Authorities (RCA) - any organisation that controls roads that members of the public can use such as Waka Kotahi, councils, DOC, Department of Corrections, airport organisations, port organisations. • Rail access authority - any organisation that controls a rail network. KiwiRail is one organisation however there are others. • Public transport authority - any organisation that operates scheduled public transport. Generally local or regional government.
TTM toolbox	It provides information about engineering design principals geometrics, safety, traffic assessments, equipment, and specialist projects. This includes references to relevant design guides and standards.
TTM zone	The section of road defined at each end by advance warning and end of works signs, or between vehicles in a mobile operation, including the vehicles themselves.
Warning distance	The minimum distance between the first advance warning sign and the start of the cone taper or the beginning of the closure or working space.
Work vehicle	In a mobile operation, a work vehicle is a vehicle carrying out activity adjacent to the road, or on the road carriageway, or supporting personnel on foot.
Work site	The area that is available for workers use to complete the activity.

Te Kāwanatanga o Aotearoa
New Zealand Government