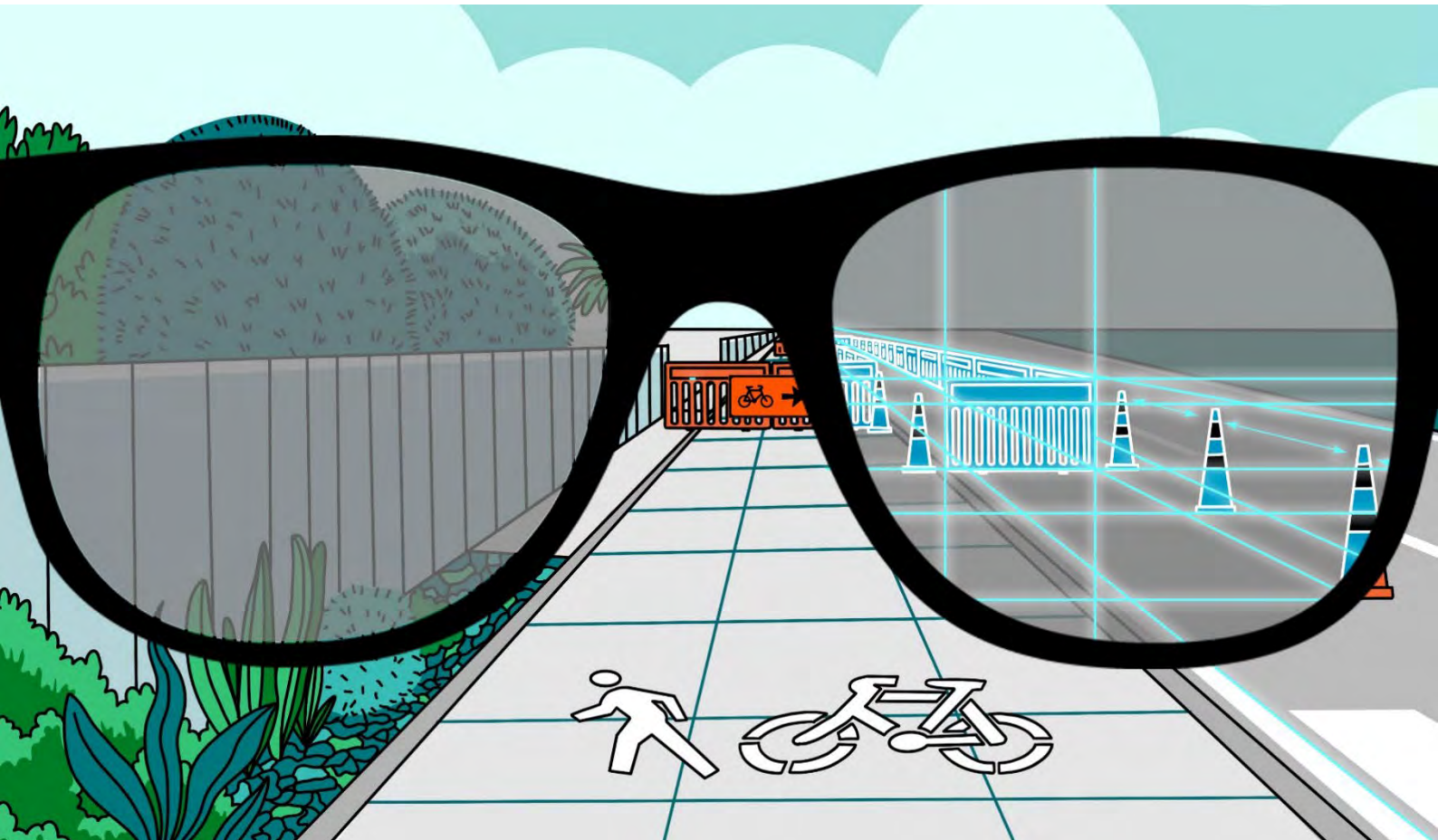
Part D: For TTM Designers

This part is for those designing TTM environments that affect Vulnerable Road Users.

This part includes processes for designing TMPs involving Vulnerable Road Users and a catalogue of how they can be safely managed through different arrangements of TTM equipment and the safe selection of that equipment.

This part includes the following guidance:

The following appendices are relevant to this part:



Part D: For TTM Designers

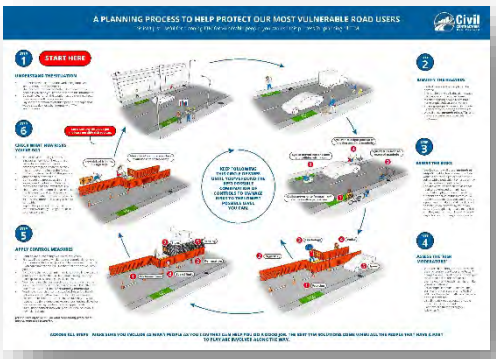
TTM Designers MUST:

- Conduct thorough risk assessments considering all risks associated with all those who are affected by the activity[25, Section 44(4)(d)(e)].
- Apply control measures that result in risks being managed as low as reasonably practicable[24, Section 6].
- Utilise the **hierarchy of controls** in designing traffic management plans to mitigate risks to VRUs effectively[24, Section 6].
- Ensure TTM designs comply with other legislative measures such as the TCD Rule, Setting of Speed Limits Rule, and Road User Rule.

TTM Designers SHOULD:

- Strive for continuous improvement by staying updated on new industry standards, technologies, and best practices in TTM design.
- Encourage a peer review process of your TMPs to ensure a well-rounded and effective solution for managing risk[86].
- Engage with communities and groups of vulnerable road users to better understand their needs and incorporate their feedback into TMPs.
- Establish a feedback loop with STMS staff to monitor the effectiveness of your TMPs so you can make future ones even better.

A risk assessment and treatment process for Vulnerable Road Users in TTM



Appendix D A3 poster of the planning process used in this practice note.

The primary task for TTM designers is to assess and manage risk **as low as reasonably practicable** in TTM environments and produce a TTM design that reflects this.

A structured approach is needed to assess and treat risk with the best solutions.

This part of the guidance outlines a process for TTM designers to follow that encourages thinking deeply about the needs of vulnerable road users in TTM environments.

Appendix D provides an A3 poster to help designers practice this planning process and become familiar with the steps.

This planning process does not just work for Vulnerable Road User safety – it can be used for all TTM.

Figure 4 summarises the planning process provided as part of this guidance. Each step is explained individually – with thorough explorations of what that step means and how it works.

Remember – this process is a guide only. There is more than one 'right answer', and no recipe can be applied to all situations. **Each situation should be evaluated site-specifically.**

A planning process to help protect our most vulnerable road users

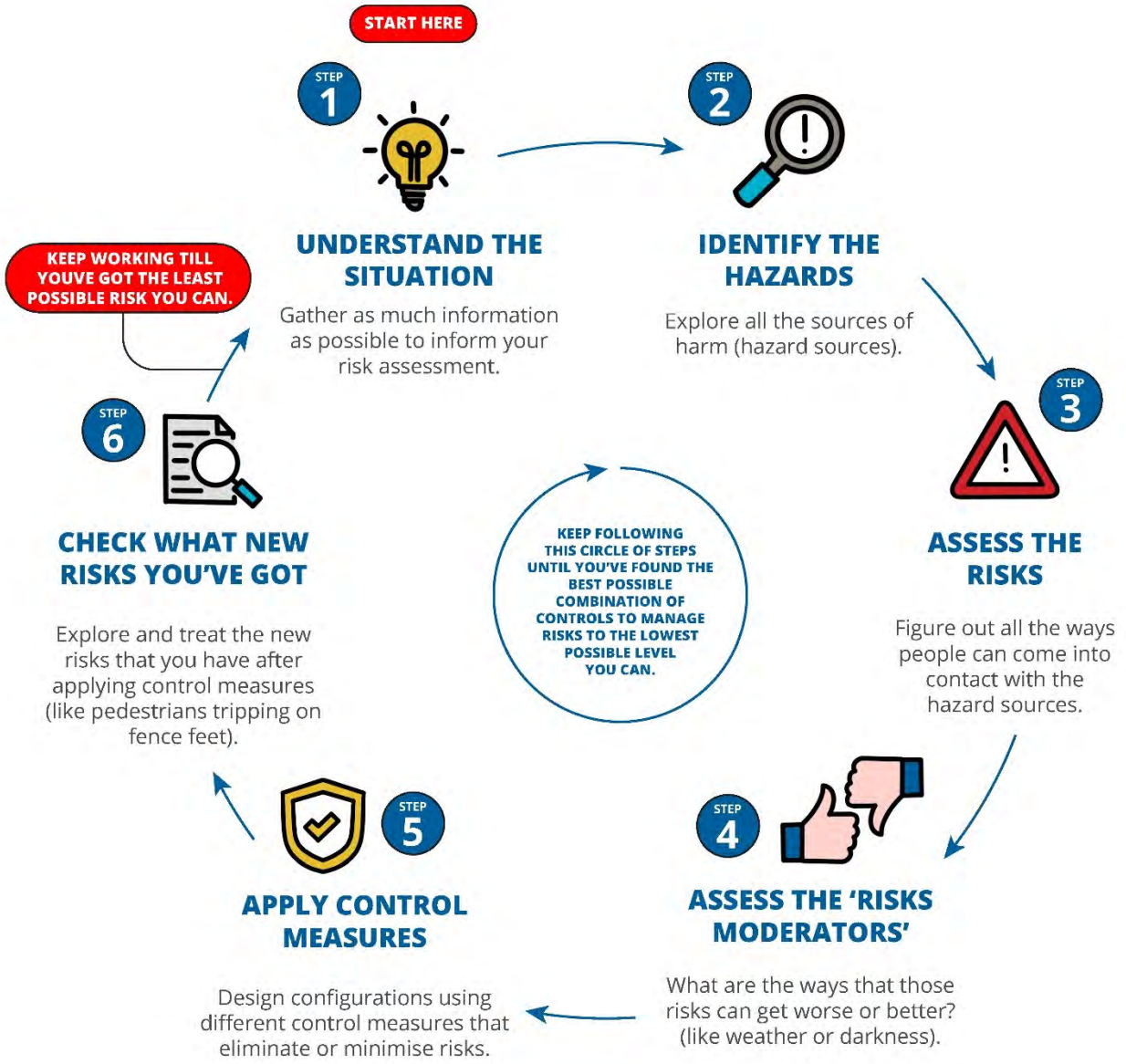


Figure 4 - Planning Process for protecting vulnerable road users in TTM

This guidance lays out a **6-step planning process** to help you shape your Traffic Management (TTM) designs to make the roads safe for everyone.

This process is not a one-time task **but a cycle that you will go through repeatedly**, refining your designs each time as every change brings new factors into play.

These steps are **grounded in well-established risk management practices** and have been tried and tested in other fields, ensuring a reliable framework for making informed decisions in traffic management planning.

It is designed to help you **think through and tackle all the factors that come into play** in making our roads safer, ensuring your TTM designs are well-rounded and well-thought-out.

This guidance explores each of the six steps in its own heading.

Step 1: Understand the situation

This step helps you know what you are working with so you can make **smart decisions** to create traffic management plans that **fit well with the site's needs and challenges**. It is about **collecting detailed information** on the site and the activity you will be doing there.

Do TTM planning alongside activity planning. Begin your traffic management planning alongside the construction planning phase, not after it. This coordination ensures that the methodologies adopted are safe and efficient from the start and that there are no missed opportunities to optimise the activity.

Thorough site reconnaissance. Conduct a thorough examination of the site. Check where people walk or cycle and note anything that might be affected by the work, like footpaths, cycle lanes, or nearby shops and schools. Do not just gather information related to **when you visited** – gather information about **all the conditions** that will be present for the entire activity. Remember, conditions are different at different times of the day and week. Also, **liaise with the RCA** for information that may be relevant.

Capture everything that is there. Thoroughly document existing infrastructure. This sets a baseline to understand how your activity might interact with the existing setup. Also, explore the surrounding area to identify common pedestrian origins and destinations like homes, stores, parks, and schools, along with alternate routes and established “short-cut” routes or 'desire lines' chosen by people walking and cycling to better anticipate movement patterns around the work zone.

Thoroughly Understand the Activity. Delve deeply into the specifics of the work activity that will be happening. This includes understanding the stages, machinery, delivery schedules, worker movement, and other aspects affecting traffic or pedestrian flow. Also, get a clear picture of the timelines involved - when will work start each day, when will it end, and will there be weekend or night-time activity?

Consider whether community engagement is necessary and worthwhile. Consider engagement with residents, business owners, and local stakeholders to gather insights. Their feedback can provide invaluable information about how the area functions daily and how your work might impact them. They might also provide suggestions or highlight concerns that you had not considered.

Detailed assessment of specific areas. For example, in areas with high pedestrian traffic, ensure that detours are wide enough to allow for several people walking or riding, including overtaking and travelling in both directions. Also, look for areas that might have informal use for VRUs, like worn grass pathways.

Do not stop there. The process of understanding the site should not stop after the initial assessment. Keep going throughout the planning process so that you are always looking to learn more and use that new learning and information to feed better TTM design.

Step 2: Identify the hazards

In this step, designers need to identify hazards, which are things that could cause harm.

These hazards can come from:

- The activity that makes the TTM necessary, in the first place, is construction work or road repairs.
- They can also come from the road environment, such as a sharp curve or a busy intersection.

It is important to note that the TTM measures you put in place, like signs or barriers, can also introduce new hazards. However, these will be evaluated later in the process.

The goal here is to spot these potential sources of harm so you can plan how to manage them.

Hazards can also be divided into static (stationary) and dynamic (moving) hazards.

	Static (not moving)	Dynamic (moving)
Environment Hazards	Hazards that are part of the **environment** (present before you even get there) that are **not moving** – like furniture, trees, surfaces, parked vehicles, etc.	Hazards that are part of the **environment** (present before you even get there) are **moving** – like motor vehicles, other vulnerable road users, public transport, etc.
Activity Hazards	Hazards introduced by the **activity** (not the TTM, that comes later) that **are not moving**- like materials, static equipment, excavations, etc.	Hazards introduced by the **activity** (not the TTM, that comes later) that are **moving** – like workers, moving plant or equipment, falling objects, etc.

Figure 5 (next page) provides a simple approach for identifying hazard sources that might cause harm to vulnerable road users.

This is not a complete list – there are always other sources of harm, as **each situation is different.**

Ensure you explore further than the list in Figure 5 (but use it as a guide).

Each hazard source in Figure 5 is explored briefly in further headings.

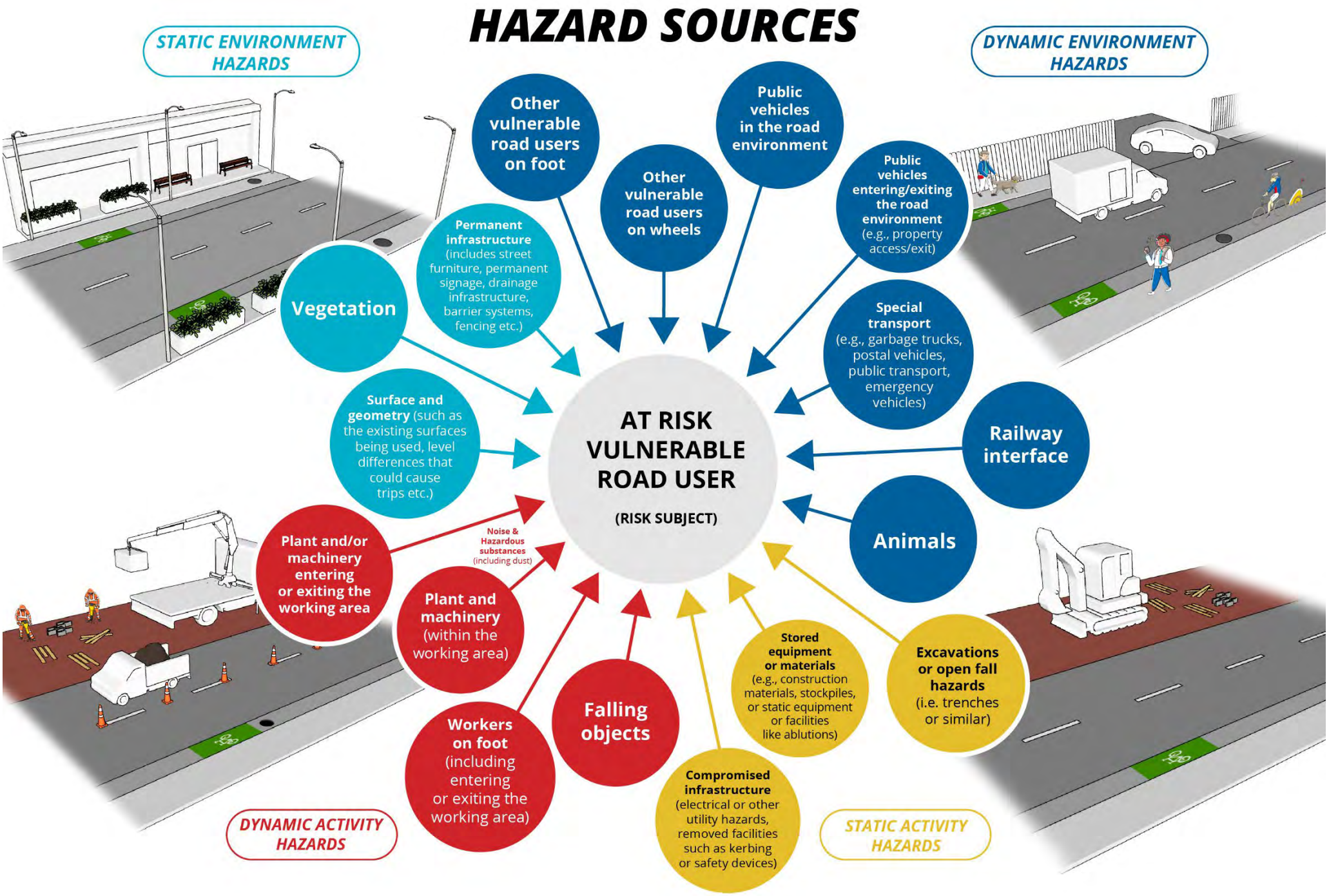


Figure 5 - Hazard sources for Vulnerable Road Users in TTM environments

Static Environment Hazards

They are **stationary (not moving) and could cause harm** to vulnerable road users, such as trees, bus stop shelters, or even a trip hazard in an uneven footpath.

Remember, these hazard sources are not all there is. Look further than these examples for additional things in the environment that could cause harm to vulnerable road users.

Hazard Source	Explanation	Example
Permanent Infrastructure *Includes street furniture, permanent signage, drainage infrastructure, barrier systems, etc.*	Features like street furniture, permanent signs, and barriers that can obstruct or confuse vulnerable road users, for example, a bench on a footpath or a street light pole. What you should be asking here: ***What are all the permanent infrastructure features in this environment that could harm vulnerable road users?***	 *Image Credit ix: Waka Kotahi*
Vegetation	Trees, bushes, or other plant life can obscure vision or create tripping risks; for instance, an overgrown hedge blocking the view of an upcoming pedestrian crossing or an overhanging tree into a cycle lane. You should be asking: What are all the vulnerable road users in this environment? ***Where are they going, and how are they moving?***	 *Image Credit x: Waipa District Council*
Surface and Geometry	The physical characteristics of the road, including its material and shape, such as a steep incline that makes it difficult for wheelchair users to navigate safely, a sunken footpath with a trip hazard, or even just the kerb itself. What you should be asking here: ***What are the conditions of the environment, like surface and geometry, that can impact vulnerable road users?***	 *Image Credit xi: Wikimedia Commons*

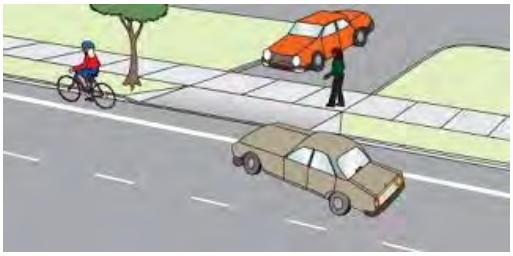
Dynamic Environment Hazards

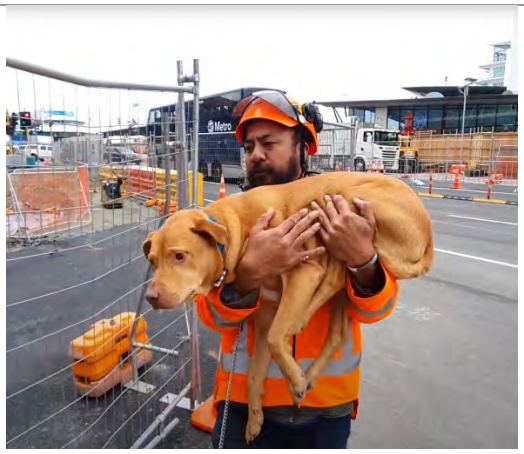
They are **dynamic (moving) and could cause harm** to vulnerable road users such as motor vehicles or trains, public transport, other vulnerable road users, vehicles entering or exiting, and even animals.

Remember, these hazard sources are not all there is. Look further than these examples for additional things moving around in the environment that could cause harm to Vulnerable Road Users.

That does not mean checking once – different hazards are present at different times. Make sure you evaluate the site at different times to get the best picture of the moving hazards that might be there during the activity you are planning.

Hazard Source	Explanation	Example
Public Vehicles in the Road Environment	Moving motor vehicles that use the road can pose a risk to vulnerable road users; for example, vehicles in the main traffic lanes of the road or vehicles turning into or out of side roads. What you should be asking here: ***What public motor vehicles are present in the environment, how many, and where are they going from and to?***	 *Image Credit xii: Parallaxx*
Other Vulnerable Road Users on Foot	Pedestrians who move or stop create hazards, such as a child running into a bike lane or someone with a child stroller using a narrow footpath with other pedestrians. What you should be asking here: ***What are all the potentially vulnerable road users on foot in this environment? Where are they going, and how are they moving?***	 *Image Credit xiii: Parallaxx*

Hazard Source	Explanation	Example
Other Vulnerable Road Users on Wheels	Cyclists, skateboarders, or scooter users who share the path and whose movements can be unpredictable; for instance, a skateboarder swerving into the path of a pedestrian. You should be asking: What are all the potentially vulnerable road users on wheels in this environment? W***here are they going, and how are they moving?***	 *Image Credit xiv: Mellissa Ramsay*
Public Vehicles Entering or Exiting the Road Environment *Such as properties or driveways*	Vehicles turning into or out of driveways or other entrances pose a risk to those on footpaths or in cycle lanes; for example, a car exiting a driveway without noticing a passing pedestrian. What you should be asking here: ***What are all the entry and exit points to the road for motor vehicles, how often and in what way are they used?***	 *Image Credit xv: Pedbiksafe.org*
Special Transport *Such as rubbish collection vehicles, postal vehicles, public transport, and emergency services.*	Vehicles with unique movement patterns or stops, such as rubbish trucks or emergency vehicles; for instance, a postal vehicle that stops frequently, requiring cyclists to overtake. What you should be asking here: ***What are all the special vehicles that do or might use the environment, in what way, at what times, and where?***	 *Image Credit xvi: Transport for London*

Hazard Source	Explanation	Example
Railway Interface	Points where the road crosses a railway pose unique risks, such as a cyclist getting a tire stuck in the railway tracks. What you should be asking here: ***If there are any railway interfaces in the environment, what are the vulnerable road user interactions with those railways? (crossings, walkways, etc.)***	 *Image Credit xvii: Kiwirail / Waka Kotahi*
Animals	Domestic or wild animals can enter the road and create unpredictable hazards; for example, a dog running into the street, causing cyclists to swerve. What you should be asking here: ***Where might there be animals in the environment, where might they come into contact with vulnerable road users, and in what ways?***	 *Image Credit xviii: Parallaxx*

Remember – do not stop there!

Keep looking for more moving hazards in the environment.

Look at different times and on different days – ask, ***"What else could be different if I were to come back tomorrow?"***

Static Activity Hazards

They are things that are stationary (not moving) and are being introduced by the work that is going to be done that could cause harm to Vulnerable Road Users, such as excavations, stored materials, or cables running across a footpath.

Remember, these hazard sources are not all there is. Keep asking questions of those who will do the work, like *"Does the pipe you are installing also need to be onsite at the start?"* or *"Will you have more than one hole open at a time?"*

Hazard Source	Explanation	Example
Excavations or open fall hazards *Such as trenches or pits or even water catchments that the depth is unknown*	Features like trenches, pits, or unknown-depth water catchments that pose a risk of falling, for example, a trench near a pedestrian pathway. What you should be asking here: ***What hazards could vulnerable road users fall into, when, how, and where?***	 *Excavations present hazards to vulnerable road users. Image Credit xix: Golden Valley Construction*
Stored equipment or materials *Such as construction materials, stockpiles, static machines or even site toilet facilities*	Items like construction materials, stockpiles, or static machines that can obstruct or pose risks, such as a pile of bricks left unsecured near a bike lane. What you should be asking here: ***Where are materials or plant going to be stored during this activity, where, for how long, and how would vulnerable road users be harmed?***	 *Materials sitting in the path of vulnerable road users. Image Credit xx: Niska & Eriksson (Sweden)*
Compromised infrastructure *Such as electrical or other utility hazards, removed kerbs or safety devices.*	Hazards arise from altered or damaged utilities, kerbs, or safety devices; for instance, a removed kerb that makes the boundary between pedestrian and vehicular traffic unclear. What you should be asking here: ***Where are changes to permanent infrastructure that could harm vulnerable road users?***	 *Long-term worksite showing reduced road surface standard and removed pathways and cycleway/traffic lane separation. Image Credit xxi: Chris Harmer.*

Dynamic Activity Hazards

They are things that are dynamic (moving) and are being introduced by the work that is going to be done that could cause harm to Vulnerable Road Users, such as moving plant or people, entering and existing work vehicles, or even falling objects.

Remember, these hazard sources are not all there is. Ask questions about those who will do the work, like ***"Will these vehicles be present the whole time, or will they come and go?"*** or ***"Does that excavator need to load a truck, or will it only move material within the working space?"***

Look further than these examples for additional things that the activity will introduce that are moving around and could cause harm to Vulnerable Road Users.

That does not mean checking once – different hazards are present at different times. Ensure you explore the entire work lifecycle from the first task to the last one. For example – chip sealing a road has multiple phases to line marking the road at the end. Each phase has different dynamic activity hazards. This might require **multiple TTM configurations** (including multiple ones within the same day).

Hazard Source	Explanation	Example
Plant or machinery *Within the working space*	Heavy machinery operating within the work zone can pose immediate threats to vulnerable road users, for example, a crane swinging its load close to a pedestrian pathway. What you should be asking here: ***Where is there moving plant and machinery involved in this activity that could harm vulnerable road users?***	 *Truck outrigger in footpath.* *Image Credit xxii: Kouchy & Partners (Sweden)*
Plant or machinery *Entering and exiting the working area*	Machinery moving in and out of the work zone can create hazards, such as an entering truck crossing a bike lane. What you should ask here: ***How will plant and machinery enter and exit the activity area, which could interact with and harm vulnerable road users?***	 *Activity vehicles entering and exiting often have to cross the path of vulnerable road users. Image Credit xxiii: Parallaxx.*

Hazard Source	Explanation	Example
Workers on Foot *Including entering or exiting the activity area*	Workers walking within or into the work zone can interact with vulnerable road users; for instance, a worker stepping into a cyclist's path. What you should be asking here: ***How are workers moving around the worksite (including entry and exit) where they could interact with vulnerable road users?***	 *Workers moving around, with or without equipment, present a hazard to road users (as road users also present a hazard to workers). Image Credit xxiv: Mellissa Ramsay*
Falling Objects	Objects falling from height within the work zone can pose a direct risk, for example, a tool falling off scaffolding and onto a pedestrian walkway. What you should be asking here: ***Where are hazards above (or close to above) that could fall on vulnerable road users?***	 *Falling objects (either from slung loads or work above) present risks to those below. Image Credit xxv: RCS Safety (California)*
Noise and Hazardous Substances *Including dust and biological hazards*	Loud noises can disorient vulnerable road users, and hazardous substances like dust can impair vision; for example, construction dust obscures pedestrians' and drivers' view of a footpath. What you should be asking: ***What could produce noise or hazardous substances (including dust) from the activity that could harm, impact or impede vulnerable road users?***	 *Noise and dust from worksites present hazards to road users, especially on foot or wheels, as they have no protection. Image Credit xxvi: NBM Media*

What if the working area is not in one spot (i.e. a mobile work task)?

Your TTM will move with the work, and the hazards will change significantly.

If this is the case – the following considerations are essential:

Consideration	Explanation	Example
Static Environment hazards will change.	As the work area moves, the static elements like permanent infrastructure and vegetation that pose a hazard in one location may not be a concern in another. For example, a street lamp that was an obstruction at the first site may not be present at the next. New hazards may arrive, like a curve in the road restricting the visibility of approaching cyclists.	 *Doing mobile TTM along this road would present different static environment hazards as the operation progressed. Image Credit xxvii: Greater Auckland.*
Dynamic Environment hazards will change.	The flow of traffic and pedestrian activity will vary as the work area moves, affecting the types of dynamic environmental hazards present. For instance, an intersection will have different hazards to vulnerable road users compared to a mid-block section without side roads.	 *Dynamic hazards, including cyclists, pedestrians, or intersection movements, will come and go as operations move along the road. Image Credit xxviii: Kaipara City Council.*
Dynamic activity hazards will change.	The nature of the work activity itself may change as the work area moves, altering the types of machinery or plant in use. For example, a mower will, in certain places, have to work closer or further away from the edge of the lane (which gets closer or further away from cyclists on the edge of the road)	 *As operations move along the road, their hazards change as well – the activity requires different tasks at different times, adding to the dynamic nature of a mobile operation. Image Credit xxix: Transport British Columbia.*

Especially with moving operations, control measures MUST be reviewed to ensure they are effective and working.[24, Section 8]

Step 3: Assess the Risks

Now, you have a complete list of all the things that can cause harm to vulnerable road users.

You now need to figure out **how that harm might happen.** This means exploring how these Vulnerable Road Users might be **exposed** to those hazards.

Exposure happens when those Vulnerable Road Users are in the same place and time as a hazard and have **conflict**.

What we are doing here is identifying and assessing risks. To simplify it, we will call these risk **methods of conflict**.

Can I just use a risk matrix?

A risk matrix is a standard method to assess risk in TTM and is used by many organisations.

This is where a table is used to assign how **likely** and how **serious** a risk might be, and it usually results in a list of risks that are deemed 'low' or 'medium' or 'high' (or some other classification system).

Risk matrices can sometimes result in a lack of depth of risk assessment and are often just a **tick-box exercise** for some people[10].

Risk assessment is critical when dealing with vulnerable road users and must be done thoroughly. This means we need a better approach than a risk matrix.

Workers MUST comply with reasonable instructions from their employer (the PCBU) about Health and Safety[25, Section 45]. That includes policies or specific procedures (such as risk matrices) if they are related to compliance with the Health and Safety at Work Act 2015.
Before using the risk assessment process in this guide, ensure it does not conflict with an organisation's (PCBU) instructions related to Health and Safety.

What is another method to assess risks?

Failure Modes Effects Analysis (FMEA) is a tool used to spot possible ways things can go wrong (failure modes) in a process, product, or system and then to understand the impact of these failures[59]. By doing this, you can figure out how to **prevent these failures or reduce their effects.**

In our approach – we will call these failures **Methods of Conflict.** This is a simple way to understand that when two things (a **risk subject** (someone whom you want to protect from harm) and a **hazard come together – conflict (harm) can occur**. This is a **system failure** – and our design needs to **remove these potential failures (conflicts) from happening.**

Conflict, in this case, means places where **different road users or activities could interfere with each other** in a way that could cause harm. This could be, for example, where a new pedestrian route crosses a busy driveway.

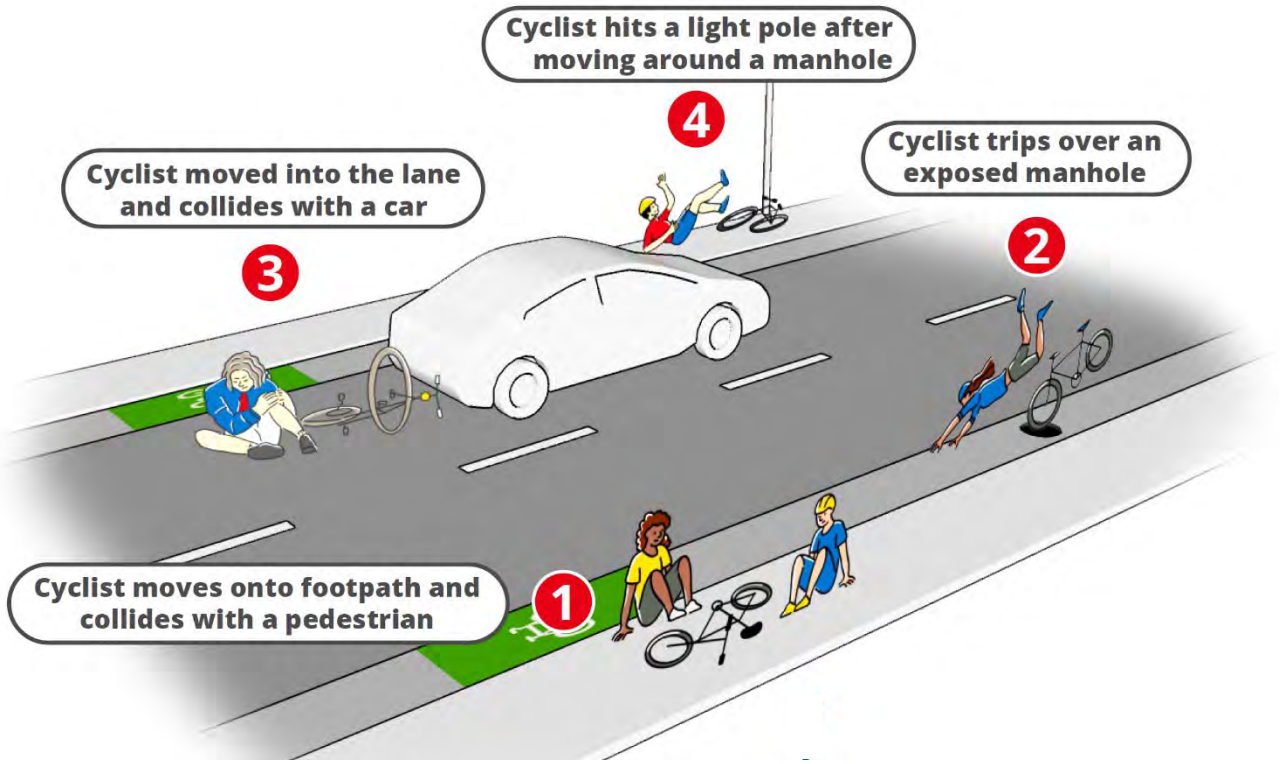


Figure 6 - Explaining Methods of Conflict for Vulnerable Road Users in TTM environments

These methods are important because they help to prevent problems before they happen. They let you plan your TTM in a way that avoids trouble, keeps people safe, and allows traffic, both motor vehicles and people walking, to flow smoothly. By looking at Figure 6, you can see examples of how methods of conflict are used to plan better TTM setups.

What is the outcome of exploring the Methods of Conflict?

You should now have a list, a diagram, or multiples of both, of all the methods of conflict in your situation.

If you have listed them – they might be something like *"a person on foot walks under a suspended load from a crane, and the load falls, harming the pedestrian"* or *"a person on a bicycle approaches from the side street and strikes a person on foot"*.

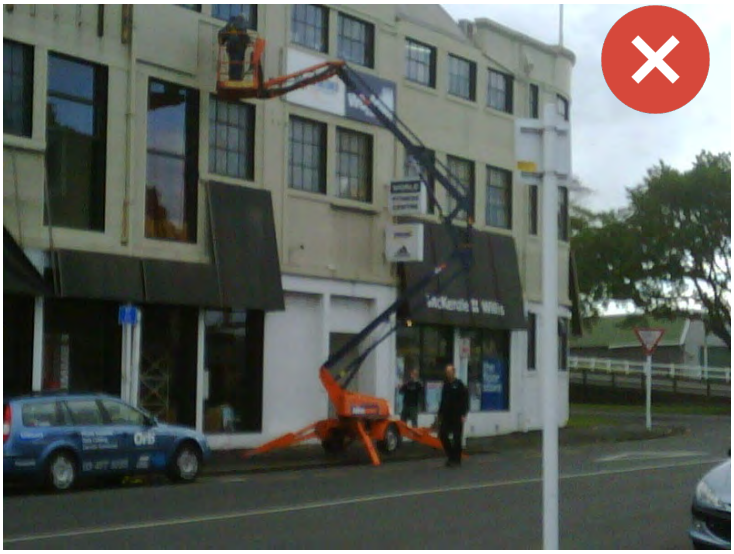
If you have used a diagram, you might have sketches and notes showing all the conflict areas and where they are. Using diagrams and sketches is a great way to get lots of detail and make it easier for others you are working with to understand.

Remember – we **have not applied any control measures** yet – so these methods of conflict just represent a **picture of what you are dealing with** and what **needs to be treated** (with control measures).

Case Study A: Distinguishing between hazards, risk events[60]

When setting up temporary traffic management around construction sites, keeping pedestrians safe is vital.

This means listing potential dangers and **fully understanding them to create effective safety measures.**



The person working on the elevated work platform has tools and materials that may fall onto the walkway below. The EWP is blocking the footpath. Image Credit xxx: Peter Graham.

Situation

A person is working on an elevated work platform (EWP) with tools, materials, and materials above a footpath. It is obvious there is a risk, but what exactly could happen?

Hazard Identified

Work with equipment and materials is occurring over the walkway.

Potential Risks

1. A pedestrian might walk beneath just as some equipment or material falls, causing injury.
2. Someone might tire of waiting and recklessly cross the road, risking collision with a vehicle.
3. The activity might distract someone, and they collide with street furniture, the EWP, or other people.

We must apply control measures addressing the immediate danger and possible human reactions to prevent these risks from becoming a reality.

The detailed steps required

1. **Identify the Hazard:** Recognise and describe the potential source of harm clearly.
2. **Define Risk Events:** Envision different scenarios that could result from the hazard.
3. **Evaluate Likelihood:** How likely is it that these events will occur?
4. **Assess Consequence:** What could be the outcome if these events happen?

Applying Control Measures

Now, treat the risks (apply control measures). Control measures typically apply to one of the four areas above:

Can you eliminate or minimise the hazard itself?	Can you eliminate or minimise the risk event from occurring? (this can also be exposure to the hazard)	Can you eliminate or minimise the likelihood of the risk event?	Can you eliminate or minimise the consequence (if it were to occur)?

Assessing risk moderators

A risk moderator can **increase or decrease the impact or likelihood of a risk**, even though it is not a risk by itself.

For example, while rainy weather is not a risk on its own, it can amplify the risk of slipping on a wet road.

Step 4: Assess the risk moderators

In this step, we look at how risk moderators change the risks or conflict methods we found in Step 3.

Risk moderators are not risks themselves but can make a risk bigger or smaller when they are present.

We have picked some risk moderators for this guidance, but many others are out there. The ones we picked are a good starting point, but always watch for more as you work on your design.

Figure 7 shows the risk moderators we will discuss in this guidance. You can make better and safer traffic management plans by understanding these moderators.

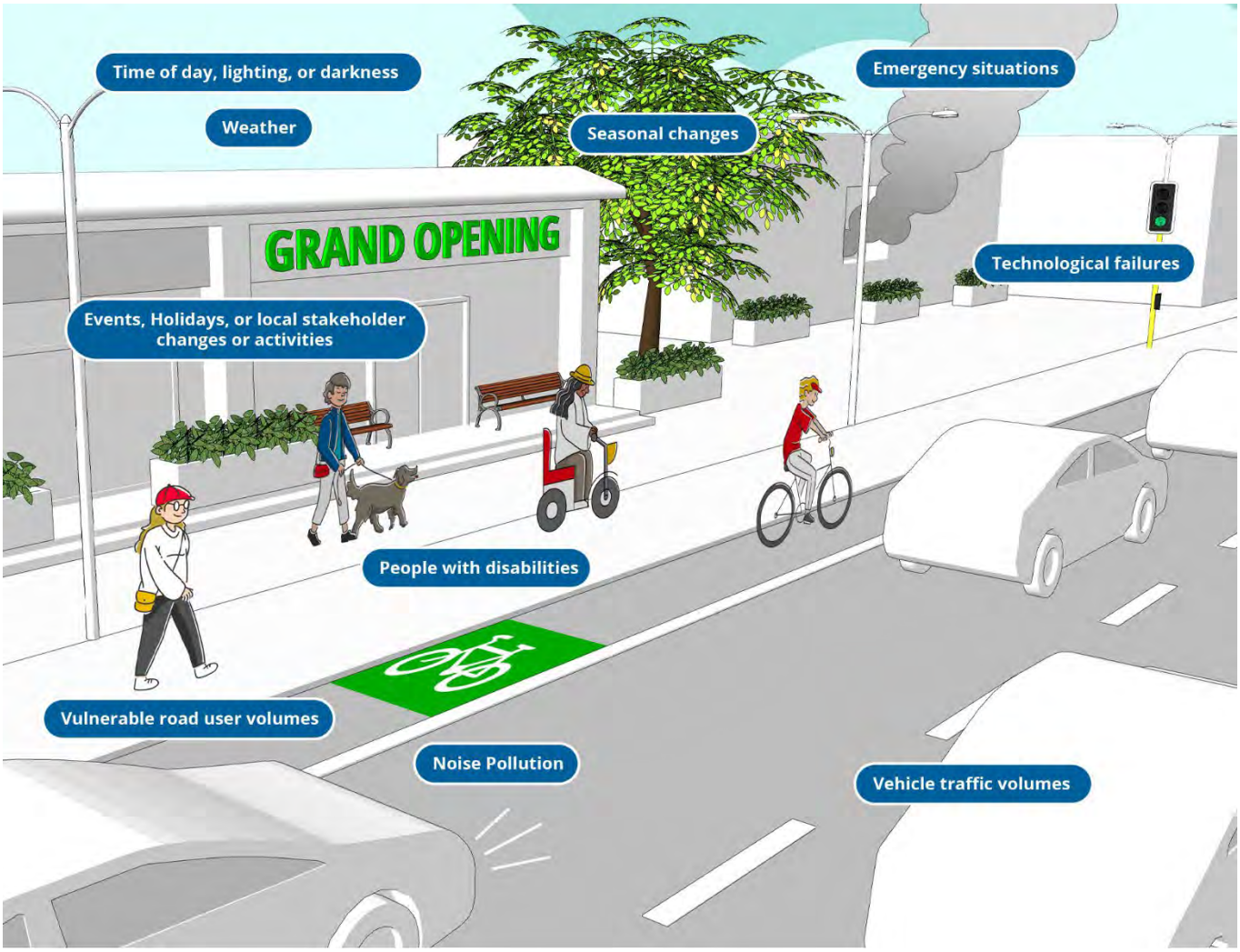


Figure 7 - Example risk moderators that might impact Vulnerable Road Users in TTM environments

Risk Moderator	Explanation
Weather	Adverse weather conditions such as rain, snow, or strong winds can alter the physical environment of a TTM zone. Rain can create slippery surfaces, reducing traction for motor vehicles and people walking. Snow and ice can obscure road markings and signage, making it difficult for all road users to navigate safely. On the other hand, dry and calm weather conditions can enhance the effectiveness of TTM measures, providing clear visibility and stable conditions. Sun glare can also cause visibility challenges at sunset and sunrise.  *Image Credit xxxi: Betty Mitrova*
Time of Day, Lighting, or Darkness	The risks within a TTM zone can vary considerably depending on the time of day and the lighting conditions. For instance, darkness or poor lighting can drastically reduce visibility for drivers and vulnerable road users, making it difficult to see and respond to TTM controls and other road users. Headlights often used by cyclists are not sufficiently powerful enough to illuminate signs to the same degree that vehicle headlights can, possibly reducing the effectiveness of TTM signs for these users[44]. During daylight hours, the clarity and visibility of TTM measures are enhanced, potentially reducing the likelihood of incidents.  *Image Credit xxxii: Parallaxx*

Risk Moderator	Explanation
Vehicle Traffic Volumes and Types	Higher motor vehicle traffic volumes (or different vehicle types, such as heavy vehicles) can increase the complexity and risk of managing a TTM zone. The more vehicles there are, the higher the likelihood of conflicts between vehicles and VRUs (although sufficient congestion can lead to slower traffic speeds that reduce the likely severity of any incidents). High traffic volumes may also reduce the effectiveness of TTM measures due to the increased complexity of managing multiple road users. Conversely, lower traffic volumes can reduce the likelihood of conflict between hazards and the level of exposure – reducing risk.  *Image Credit xxxiii: Parallaxx*

Case Study B: Vulnerable road user safety and freight vehicles: A case study in North Carolina and Tennessee[80]

As online shopping has become more popular, the number of trucks delivering goods in cities has grown rapidly.

This increase in urban freight traffic is important for TTM zones because trucks, cars, bicycles, and pedestrians often share these areas.

A case study from North Carolina and Tennessee shows that the more trucks there are, the higher the chance of accidents happening, especially those involving people not in cars, like pedestrians and cyclists.

Image Credit xxxiv: Transport and Environment (Europe)

Between 2009 and 2015, there was a notable rise in the number of injuries and deaths from crashes involving freight vehicles in urban areas.

These accidents tend to happen on local roads rather than highways, which is concerning because local roads are where people often walk or cycle.

This study also found that these accidents usually involve older people and happen more often at night or when drivers have been drinking alcohol.

Trucks with trailers are hazardous, as they are big and challenging to manoeuvre.

Another key point is that accidents involving trucks and VRUs are more likely to cause serious harm.

This is because trucks have blind spots and are heavy, which makes crashes more dangerous.

Lastly, the study shows that accidents often occur when trucks are reversing or parking, especially in busy urban areas where parking is scarce.

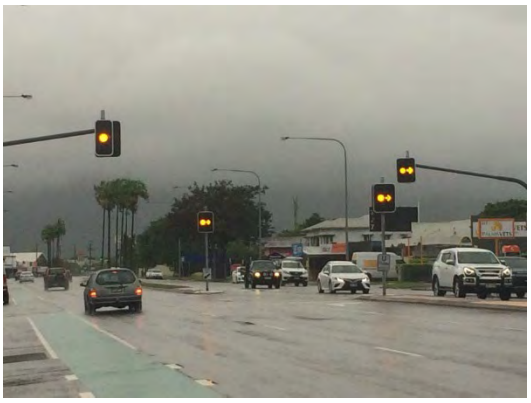
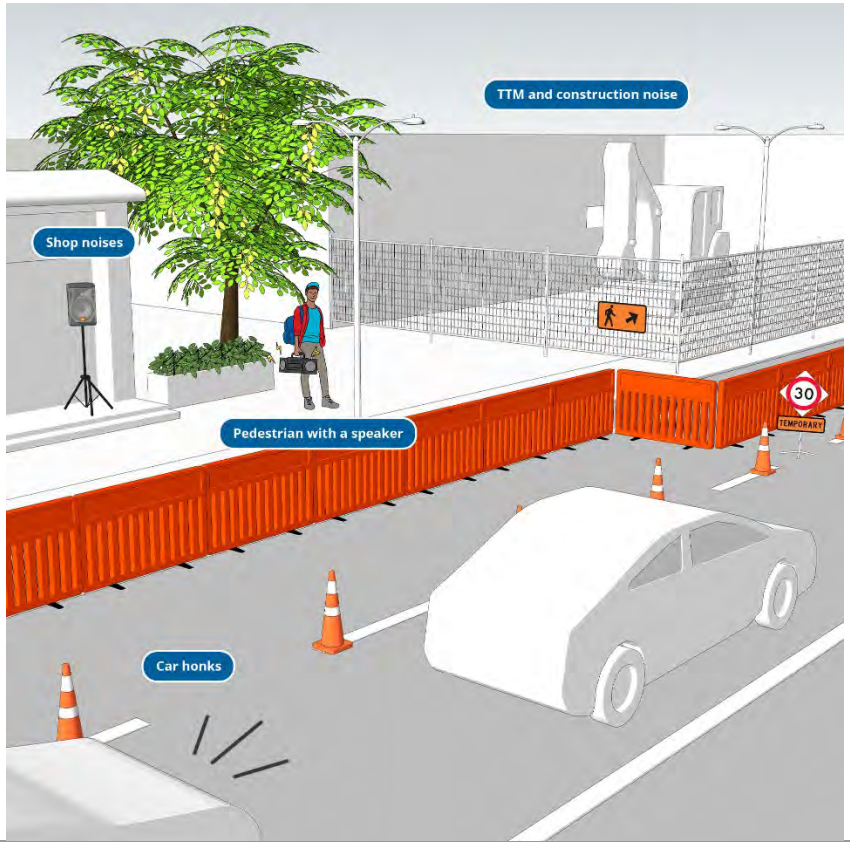
This is a big challenge for safety because trucks have many blind spots that make it difficult to see people or other vehicles when moving backward or parking.

The findings from this study can help us understand the risks that freight traffic brings to TTM zones. They suggest that TTM plans should account for the type and amount of freight traffic, especially in urban areas.

Planners might need to think about creating specific loading zones or using technology to help truck drivers see better around their vehicles to make these areas safer for everyone.

Risk Moderator	Explanation
Vulnerable Road User Volumes	The volume of VRUs may differ significantly from motor vehicle traffic peaks. Recognising and planning for these varying VRU volumes is crucial in TTM to ensure safe and effective traffic management for all road users. Also consider major public transport transit areas which can result in a high volume of people on foot or cycling.  *Image Credit xxxv: Ben Gracewood*
Seasonal Changes	Different seasons bring about varying weather conditions and daylight hours, affecting the risks within a TTM zone. For instance, autumn may bring wet leaves onto pathways, creating slip hazards. During summer, longer daylight hours can enhance the visibility of TTM measures, potentially reducing the risk of incidents.  *Image Credit xxxvi: Highway Traffic Control (New Jersey)*

Events, Holidays, or Local stakeholder changes or activities	Local events, holidays, or changes in local stakeholder activities can lead to sudden or significant changes in traffic and VRU volumes. For example, a local market might drastically increase pedestrian traffic, altering the risk profile of the TTM zone. Conversely, during holiday periods, reduced traffic and VRU volumes may simplify the risks present.  *Image Credit xxxvii: Parallaxx*
Emergency Situations	Emergencies such as accidents, fires, or medical incidents can significantly disrupt the planned TTM arrangements. They require quick and unobstructed access for emergency responders, which TTM measures might hinder. Moreover, emergency vehicles can further complicate traffic and TTM management, increasing the risk of collisions or other incidents. **For more information on managing emergencies – refer to the contingency plans section.**  *Image Credit xxxviii: Monterey County Fire Training Officers Association*

Technological Failures	Technological systems like traffic lights, electronic signage, or communication devices are crucial in managing TTM zones. A failure in any of these systems can lead to confusion, miscommunication, or loss of control over the TTM control measures. For instance, a malfunctioning traffic light could lead to confusion and potential collisions.  *Image Credit xxxix: Queensland Police*
Noise Pollution	High levels of noise pollution can create a distracting or disorienting environment within a TTM zone. Excessive noise might prevent VRUs and workers from hearing crucial auditory cues like horns, warning shouts, or emergency sirens. Conversely, quieter conditions can enhance the ability of individuals to communicate and perceive auditory warnings, potentially reducing the risk of incidents. 

Methods for mitigating risks to Vulnerable Road Users in TTM environments

Step 5: Apply Control Measures

Applying control measures is about putting the **right actions in place to handle the risks we have found.**

These measures **eliminate** or **minimise** risk, keeping **everyone in the TTM zone safe.**

We look at this in two parts. First, we see how different **controls work together** to make a safe system (Step 5A).

Then, we look at **each control itself (Step 5B)**. We explore the purpose and value of the more common individual controls in **Part F of this guidance** so designers can understand each of them.

Hierarchy of Controls

The hierarchy of controls is a system that **prioritises the complete removal of risks** as the most effective means of protection.

It guides using less effective controls only when higher strategies are not reasonably practicable.

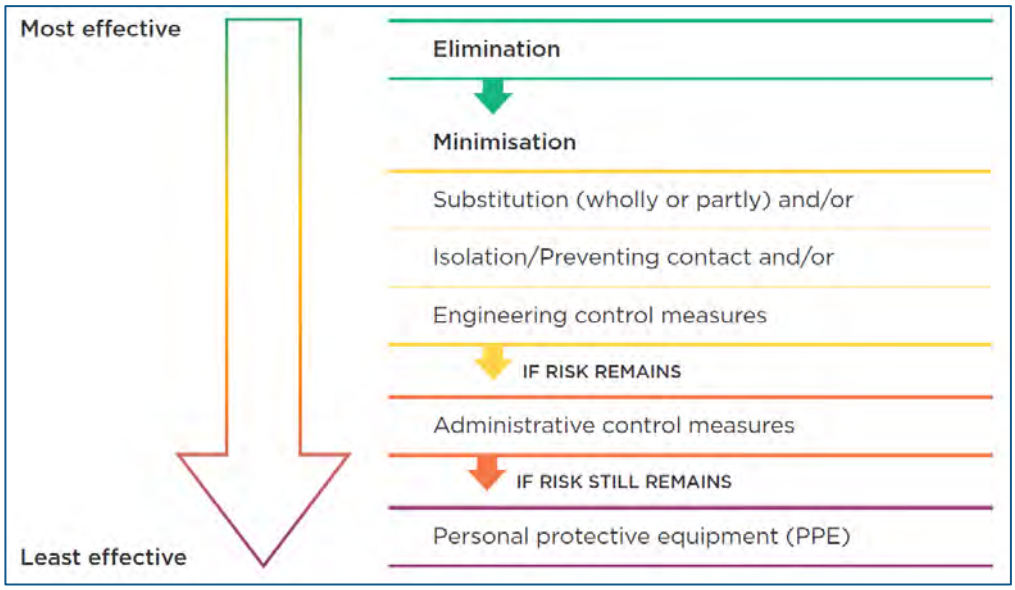


Figure 8 - Hierarchy of Controls diagram published by WorkSafe New Zealand [82]

You MUST follow the hierarchy of controls when selecting control measures to apply to risks[24].
You MUST select the best possible control and only move to a lesser control if the better one is not reasonably practicable[24].

List every possible control measure to keep people safe before picking the best ones. This ensures you think of new ideas and do not just go with what you always do.

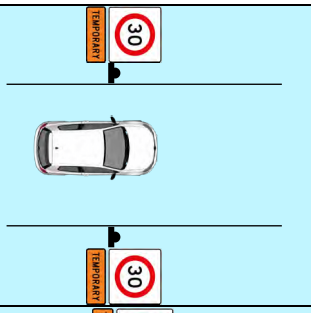
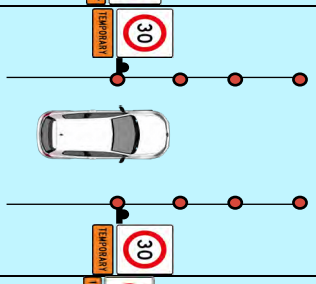
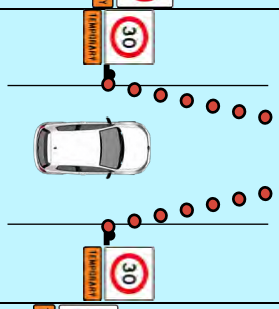
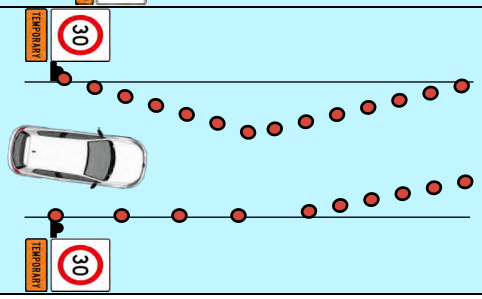
Explaining the Hierarchy of Controls

Preference	Explanation	Example
Must be considered first **ELIMINATION**	This control completely removes the hazard, thus nullifying the risk. For example, an unattended excavator on a footpath represents a significant risk that can be eliminated by removing the excavator entirely.	
Must be considered next **SUBSTITUTION**	This involves replacing a hazard with something less risky. Continuing from the previous example, replacing the excavator with a manual hand excavation reduces the risk by substituting the heavy plant with a less hazardous operation.	
ENGINEERING	These are physical modifications to reduce risk. Creating an exclusion zone for the excavator, meaning any incursions had room to be absorbed, would be an engineering control (if combined with fencing).	
ISOLATION	This involves creating a barrier between the hazard and people. Erecting a fence around the excavator isolates the risk, preventing pedestrian access. The effectiveness varies: fences provide a more substantial barrier than cones or cone bars, which are more easily moved.	
Must be considered next **ADMINISTRATION**	These rely on human actions and decisions, like obeying signage or speed limits. Their effectiveness depends on compliance and can be bolstered by physical measures to encourage or enforce adherence.	
Must be considered last **PERSONAL PROTECTIVE EQUIPMENT (PPE)**	The least effective control in the hierarchy. In TTM, reliance on PPE, such as high-visibility clothing or helmets, is insufficient for significant risk mitigation, particularly concerning VRUs. PPE should be a last resort after all other controls have been considered.	

Case Study C: Engineering, Isolation, and Administrative Controls as a system

In TTM, the distinction between administrative and engineering controls is not a clear boundary but a **range that blends the two.** Administrative controls, such as Temporary Speed Limits (TSLs), are at one end of this range, relying on drivers' choices for effectiveness. On the other end are engineering controls that physically alter driving conditions to force compliance.

The following 4-step sequence explains how more 'engineering' can be introduced to a TSL to take it from a simple administrative control – towards a more engineered one. The hierarchy of controls requires you to seek engineering first – so methods that do not simply rely on a road user's decision (in this case, to follow a TSL) must be considered first.

Starting with a TSL sign, its effectiveness depends on individual adherence, placing it firmly within the administrative domain. This is a regulatory measure.	
Adding cones along the roadside introduces a physical measure that encourages drivers to slow down, not through direct enforcement but through psychological influence, nudging the control slightly towards the engineering side of the range.	
Narrowing these cones and decreasing their spacing compresses travel lanes, which compels drivers to reduce speed more significantly. This further amplifies the physical measures to control motor vehicle speeds.	
The installation of a chicane is an even more 'engineered' control. It forces drivers to reduce speed due to the physical changes in the roadway, positioning this control towards the engineering end of the range.	

This progression illustrates how the nature of controls can evolve from relying on driver decision-making to dictating driver behaviour through design, enhancing the overall effectiveness of the risk management strategy.

While the TSL is an administrative control, it can be enhanced through other 'more engineered' measures to generate more effective risk management. This highlights that the combination of controls often generates effectiveness – not each control by itself.

Step 5A: Selecting Temporary Traffic Management Methods

A 'Temporary Traffic Management Method' is a planned setup using various items like cones, signs, and fencing arranged in a particular way to **safely guide people through or around an activity in the road reserve.**

For example, a **footpath diversion** is a specific arrangement of these items to create a new path for pedestrians.

It is important to **figure out the general TTM method** before selecting individual controls – as all the individual controls should work together as part of a system.

It is good practice to design your control measures for vulnerable road users before you design for motor vehicle traffic.

Decide what the system will look like first (looking at space, time, activity, geometry, etc.) – then the individual control measures needed to achieve that will be clearer later.

Control measures have to work together. They can easily be ineffective in isolation (like the photo example shown).

You should ensure the individual control measures you choose **work together – to create a safety system.**

The next part of the guidance lays out **12 different TTM methods for managing VRUs safely using TTM.**

The 12 options are sequenced (generally) **in order of preference**, but in some cases, the order (of preference) may change depending on the site and activity conditions and your risk assessment.

Signs have been used to close this crossing however there are no other supporting control measures, the tactile paving is still in place which means visually impaired users are likely to still be at risk. Image Credit xl: Betty Mitrova.

This order of preference is important – it gives a clear sequence of choices, and **you should not move on to the next choice until you have verified if a more preferred option is possible.** This supports the required approach to managing risk – by choosing the option that is the safest (and still reasonably practicable) first.

Some methods apply to **those on foot**, some apply to **those on wheels,** and some apply to both. **With all methods, do not forget that speed management is an effective way to generate safe environments for people walking and cycling.**

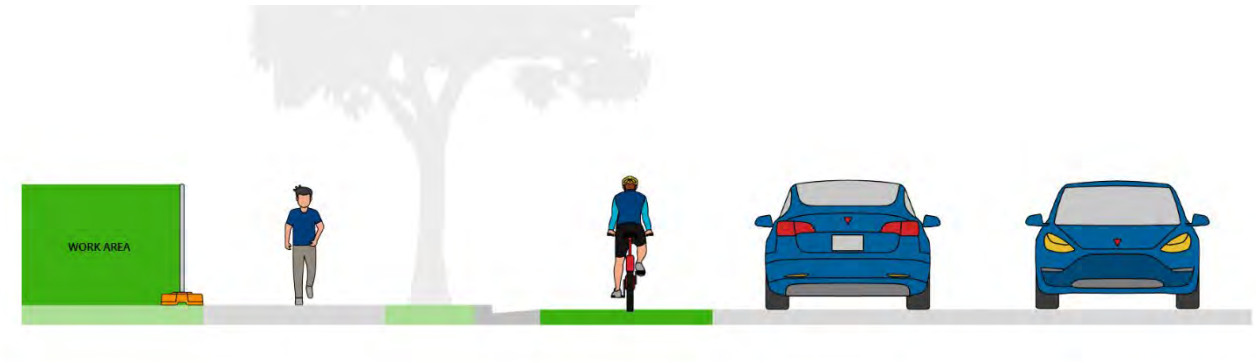
Each of the 12 explored methods is not isolated – they can be combined. Many sites may use multiple methods – as the risks at different places or times call for a different approach depending on the situation.

Refer to Appendix E for a Vulnerable Road User TTM Methodology selection tool.

Exploring 12 different Temporary Traffic Management Methods for managing vulnerable road users safely

Keep existing facilities

Maintain the usability of existing facilities like footpaths, cycle lanes, and crossings while designing the activity methodology.

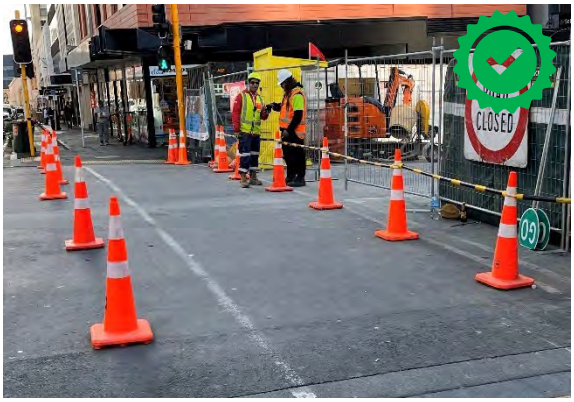


Considerations

Activity Methodology: Assess how the work activity is planned and executed to ensure safe entry and exit to the work area. Determine if temporary stoppage of VRU paths (see separation by time method) is necessary for safe entry and exit to the work area.

Work Duration: Evaluate if constraining to a tight space could prolong the activity, extending the overall exposure to risk for different people and outweighing the benefits of utilising existing facilities.

Safety of Work Activity: Determine if the tight space compromises the safety of the work activity itself. Evaluate if the constrained space could lead to hazardous situations for workers and vulnerable road users. A method of segregating (i.e. fencing) space between the activity and vulnerable road users is still likely to be required.



Existing pedestrian crossing maintained with full width and enhanced by some adjacent cones for clarity. Image Credit xli: Betty Mitrova.

Impact on vulnerable road users: Assess the impact on VRU flow and whether the existing facilities can accommodate the VRUs safely alongside the work activity. Evaluate if there are any specific times during the day when VRU flow is higher and if adjustments in the work schedule could alleviate risks.

Quality of Existing Facilities: Assess the quality and condition of existing facilities to ensure they are up to standard for safe use by vulnerable road users. Evaluate if any temporary enhancements or repairs are necessary to uphold safety standards.

Communication: Ensure clear communication with vulnerable road users about the activity – sometimes, just the presence of work activity (even if there is little impact) can make people stay at home or take alternative, less safe routes.

Separation by time

This is about timing our work so it does not clash with the movement of vulnerable road users. Sometimes, we can pause the activity, letting people pass safely before we continue. Other times, we might need to control traffic, stopping it briefly to let people cross or move through.

Example of a stop/go operation having a specific phase for cyclists – separating their safe travel in a single lane environment by time (from vehicles). Image Credit xlii: Betty Mitrova.

Considerations

Vulnerable road user flow: Analyse the volume of VRUs during different times of the day to identify appropriate work stoppage intervals and times.

Work Stoppage Impact: Assess the feasibility of halting and restarting work, considering the nature of the activity and the impact on the overall project timeline. Evaluating whether elongated work duration due to frequent stoppages could escalate the total risk.

Noise Pollution: Recognise the challenge of communicating effectively with workers and the public during noisy work. Considering noise-reducing measures or alternative communication methods to ensure clear instructions.

Holding Time Tolerance: Recognising the patience threshold of vulnerable road users, particularly in holding areas, and understanding that prolonged waiting could deter compliance or prompt unsafe behaviour. Acknowledge that cyclists may have a lower tolerance for waiting and planning for shorter holding durations.

Visibility of Approaching Vulnerable Road Users: Ensure a clear line of sight or employ monitoring systems to detect approaching users in time to halt work or guide them to safe holding areas.

Possible Control Measures

Traffic Management Workers: Employing traffic/footpath controllers to manage the movement and coordination of different users.

Signs: Implementing signs (like Figure 9) to guide vulnerable road users and inform them of procedures. Such signs alone will be insufficient to manage risk as visually impaired users cannot rely on signs for safety.

Figure 9: Such a sign (with custom wording) would be permitted under the Land Transport Rule: Traffic Control Devices 2004 Section 4.4(1), and corresponding sign W7-8 under Schedule 1 provided it is approved by the Road Controlling Authority prior to use (Section 3.2(2)).

Communication Systems: Establish communication between traffic controllers and work crews to signal approaching vulnerable road users and coordinate work stoppages. Consider using alert systems, like bells or lights, to notify workers of approaching users.

Designated Holding Areas: Creating safe and marked holding areas for vulnerable road users to wait during work activity, ensuring they are protected from other hazards.

Narrowing of existing facilities

Narrowing Existing Facilities means that while we keep footpaths, cycle lanes, or crossings open for use, we make them narrower to accommodate our work area. It is like squeezing the space a bit but ensuring people can still pass through safely while we undertake the work activity.

This example shows a narrowed existing path with a method to prevent access to the hazard area and directional signage. One improvement would be ensuring the method preventing access is particularly clear at the entry points (closest to the camera) to make sure pedestrians can't get through, especially at the point of the change in their direction. Image Credit xliii: Traffic Management Hawkes Bay.

Considerations

Pedestrian Congestion: When we narrow down spaces, it can get more crowded, especially during busy hours. This can tempt people to step onto the road or take a different, less-safe route.

Sight Lines: With a narrower space, seeing what is coming for workers and VRUs might be more challenging.

Narrowed Length: Shorter, narrow lengths may require limited other controls, while longer lengths may need other controls.

Existing Obstructions: Things like benches or lamp posts could become bigger hurdles with less room to manoeuvre around them.

Width Requirements: Even if it is narrower, the space **should still be wide enough for everyone, including people with wheelchairs and allow for people to pass each other.**

Narrowed cycle path separated by delineation. Image Credit xliv: Downer NZ.

Straight Path: Keeping the path as straight as possible helps everyone know where to go and makes the journey smoother, sticking to the **smooth and stable** principle.

Possible Control Measures

A mechanism for preventing access: Something solid and clear to show where people should not go, keeping them away from hazards.

Directional Information: Signs or other control measures showing which way to go can help keep things orderly and clear.

Passing Bays: In spots where it gets tight, a wider section at regular intervals can let people pass each other safely whilst still resulting in the least possible disruption to users.

Visible Markings: Clear markings on the ground can help guide the way, ensuring everyone knows where to go, even if it is narrower than usual.

Monitoring: A staff member keeping an eye on things, especially during busy times, can help manage the flow and spot any issues before they become problems.

Temporary Diverted Pedestrian Route (Temporary Footpath)

This is both a methodology and explored as a control measure (outlined in Part F). This method directs pedestrians to a different nearby path when their usual footpath is not usable due to our work. This change in route is only for a short time and is nearby, without making them cross other roads or go far out of their way.

***Priority 3 is into the edge of the roadway (in a separated space) and in this case would see the rearrangement of the cycle lane as well if present.**

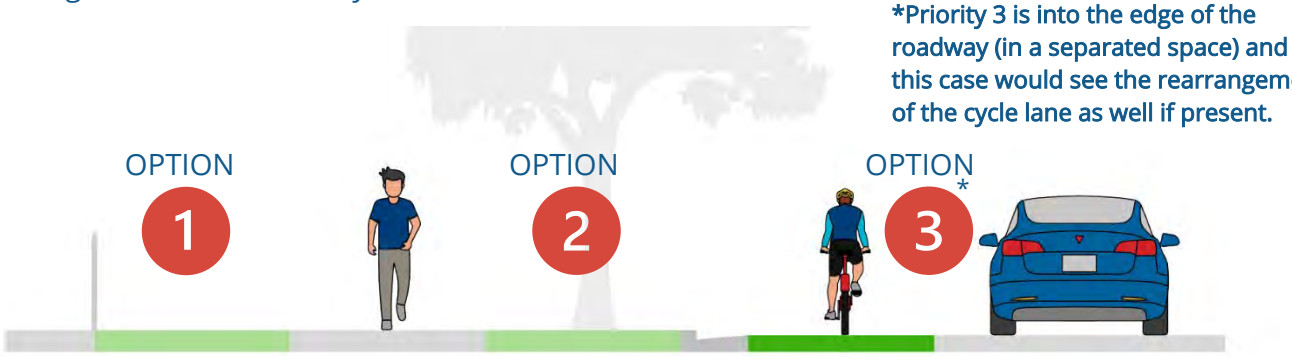


Figure 10 - Cross section of order of preference for pedestrian diversion options

Considerations

The first important consideration is where to divert pedestrians. The cross-section above (Figure 10) shows the **preferred order**. Any selection of an option that is lower in the preferred order should be evidenced by **why a higher option cannot be done** (use a risk assessment process; do not just jump to a lesser option without documenting why more preferred options will not work).

Refer to Figure 11 for a range of considerations for this footpath methodology (when diverted into the edge of the carriageway. Many of the same considerations apply to other diversion locations as well.

An example of a temporary diverted pedestrian route into a closed road space. One improvement is a few trip hazards that are visible. Image Credit xlv: Parallaxx.

Possible Control Measures

Possible control measures are also provided in Figure 11 (next page). Additional potential control measures include:

- temporary lighting (if the visibility of the path or transition points is compromised),
- passing bays (if the width does not allow continuous two-way space)
- audible messaging (to enhance directional information for the hearing impaired)
- temporary marking (to provide supporting directional information as well as signs)

For Dimensional information refer to Appendix F

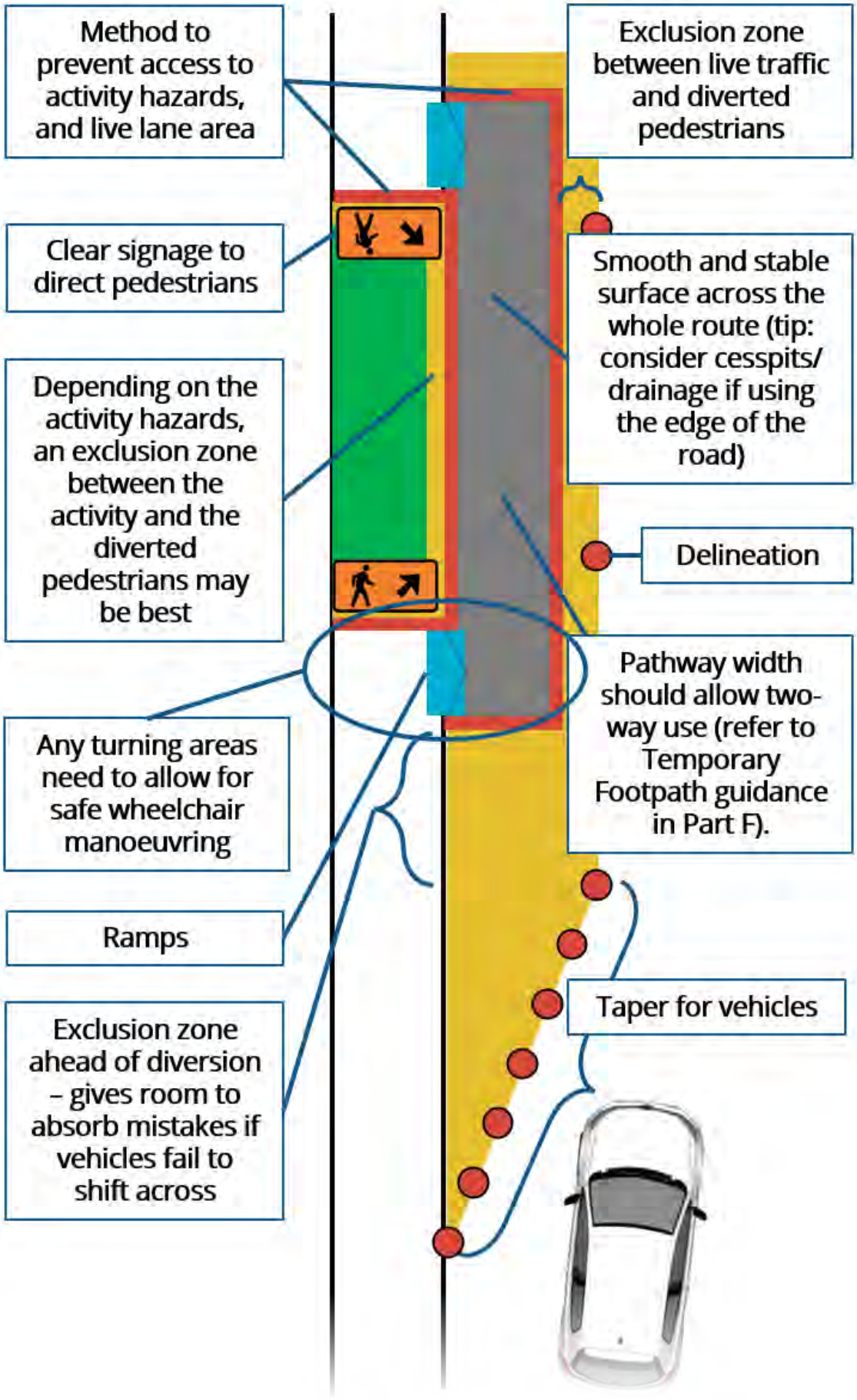


Figure 11 - Considerations for the temporary diversion of pedestrians towards or into the carriageway

Temporary Separated Cycleway

This is both a methodology and explored as a control measure (outlined in Part F). A temporarily separated cycle lane is established when work activities impede the existing cycle lane. Cyclists are redirected to a nearby or adjacent route designated temporarily.

This method maintains a **separated** cycle lane that is not merged with motor vehicles (for that method, see **Shared Cyclist Facility with Vehicles).**

This example shows a clear and well aligned temporary cycle lane diversion. One improvement would be adding a method to prevent cyclists riding through the cones (especially at the diversion location). Image Credit xlvi: Whites Traffic Management.

Considerations

Cyclists MUST not be directed to ride on footpaths or grass berms[29, Section 11.11(1)]4.

Refer to Figure 12 for a range of considerations for this cycle lane methodology (when diverted into the carriageway. Additional considerations include:

- Whether the impacted cycle lane carries one-way or two-way cycle traffic will impact the width and design of the transition areas (refer to **Temporary Cycleways in Part F**).
- aim to keep the route as direct as possible (straight).
- Visibility for cyclists around obstacles or activity hazards, especially at transition areas.
- Any level differences between existing and temporary cycleway locations.
- temporary marking (to provide supporting directional information as well as signs)
- adjacent speed of motor vehicles. This will impact the width of the exclusion zones provided as well.

Possible Control Measures

Possible control measures are also provided in Figure 12 (next page). Additional potential control measures include:

- Temporary lighting (if the visibility of the path or transition points is compromised),
- Cyclist chicane arrangements to ensure appropriate speeds of cyclists using the diversion.
- Deliberate selection of control measures to prevent access. Cones will not prevent access, cone bars can be effective but deteriorate quickly, and fencing (particularly if used for channelling in a taper) can cause harm to cyclists if they strike it.
- Temporary marking (to provide supporting directional information as well as signs)

[4] It may be appropriate to convert a short section of footpath to be a shared path, however appropriate regulatory signage must be used to do this (i.e. R4-11 sign)

For Dimensional information refer to Appendix F

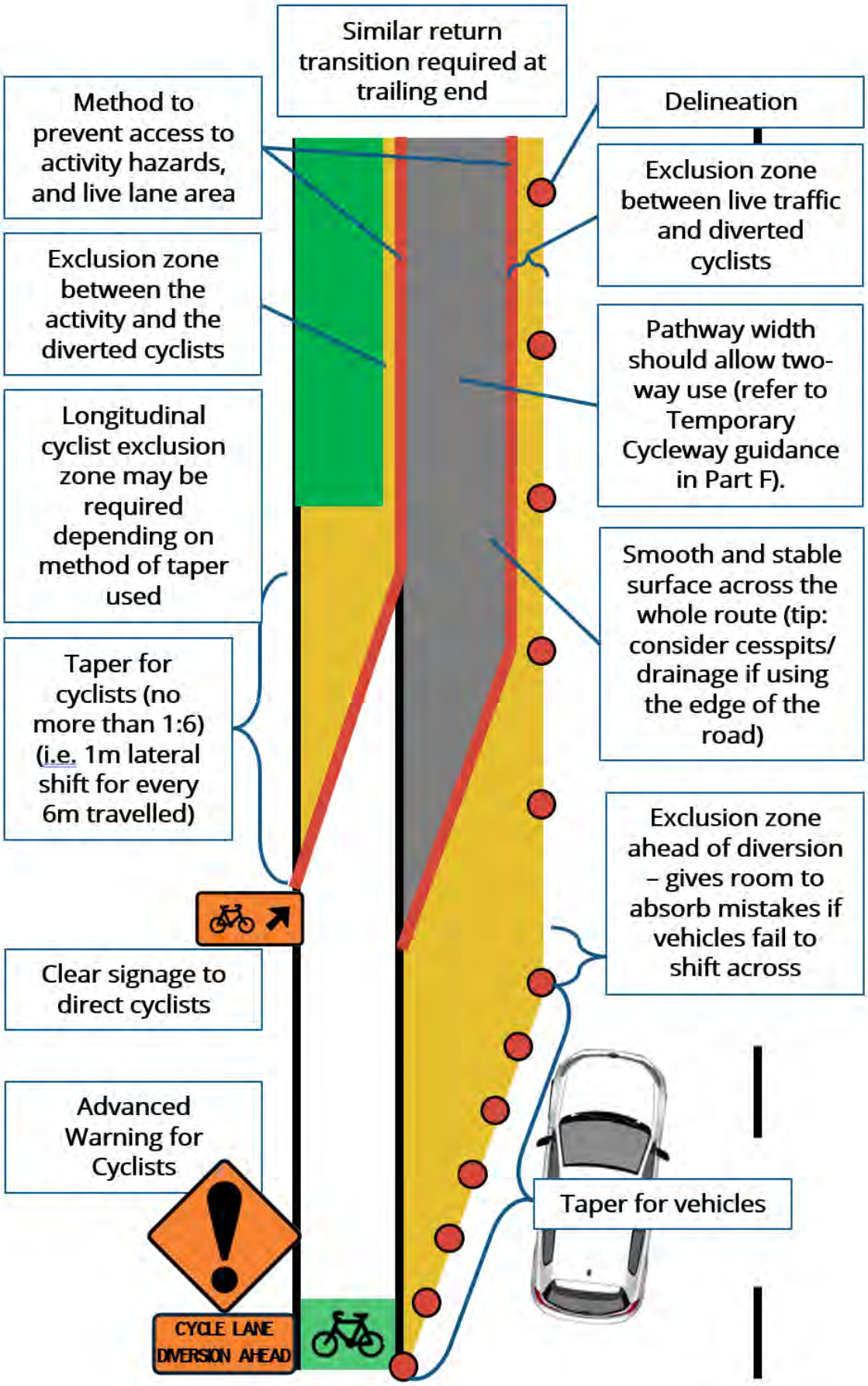


Figure 12 - Considerations for the temporary diversion of cyclists into the carriageway. The custom advanced warning sign text is permitted in accordance with the Land Transport Rule: Traffic Control Devices 2004 Section 4.4(1), and corresponding sign W7-8 under Schedule 1 provided it is approved by the Road Controlling Authority prior to use (Section 3.2(2)).

Shared Vulnerable Road User Facility (Those on Foot and on Wheels together)

A Shared Vulnerable Road User Facility, often referred to as a **shared path**, is a designated route meant for use by pedestrians and cyclists, mobility devices, and wheeled recreational devices[70].

This facility aims to provide a safe space for different user groups to travel alongside each other. **Remember, it is still best to separate people riding bicycles from pedestrians wherever possible.**

An example of a permanent shared path using pavement marking to provide directional guidance (keep left). Image Credit xlvii: Waka Kotahi[70]

Considerations

Path Width: It is crucial to ensure the path is wide enough to accommodate different users safely; **refer to Appendix F for dimensional guidance.**

User Volumes: High user volumes may necessitate a more structured approach to separation or segregation to prevent conflicts.

Surface Quality: The surface should be smooth and well-maintained to cater to the different needs of users.

Visibility: Adequate visibility is crucial for all users, particularly at intersections and crossings.

Directional Signs and Markings: These help guide users, promote predictable behaviour, and are especially effective in shared path environments[57].

Possible Control Measures

Signage and Markings: Shared paths occupy a unique legal category[5] and require specific signage as ordinarily, cyclists and pedestrians do not occupy the same facilities.

Figure 13 - R4-11 sign used to mark the start of a shared path.

Signs (like the one shown in Figure 13) are **required** at the start of the shared path[32, Section 11.4(1)(a)(i)]. This specific sign is not mandatory; any sign that appropriately indicates it is a shared environment would be acceptable – provided it complies with the Traffic Control Devices Rule 2004.

Directional Separation: Employ centrelines for directional separation when the path width permits.

[5] Land Transport Rule: Traffic Control Devices 2004, Section 11.4.

concept entails a part of the road where motor vehicles and cyclists coexist. This arrangement is typically seen where separate cycle lanes are not provided or a cycle facility needs to be closed for activity.

The lane width majorly influences the dynamics between people who cycle and motor vehicles.

A sufficient lane width allows a **lateral coexistence between people and motor vehicles** (the lane is ≥4.25m wide), enabling them to move side by side.

SHOULD	**People who cycle and motor vehicles SHOULD NOT be asked to coexist where the shared lane between cyclists and motor vehicles is between 3.25m and 4.25m. Vehicles may be confident to pass – however, there is not enough space to do so safely.**

In the case of a narrower lane (≤3.25m), a "take the lane" approach is advocated for, where cyclists occupy the middle of the lane, and motor vehicles follow. Figure 14 shows these lane width considerations.

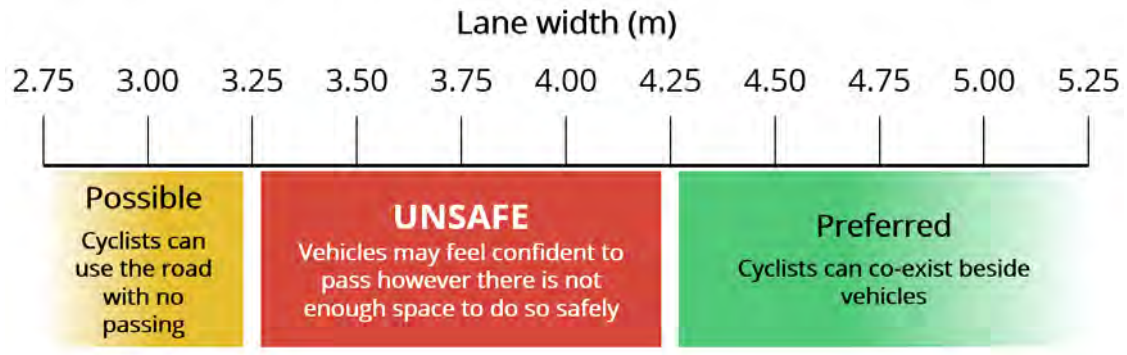


Figure 14 - Lane width guidance for cyclists sharing the carriageway. Adapted from Transport for London[63]

Considerations

Considerations and control measures for lateral coexistence (preferred):

Lane Width: An adequate lane width of 4.25m or more is important for lateral coexistence.

Signage and Markings: Clear signage and possibly road markings are important for road users and cyclists to warn of the upcoming shared environment (and the transition to and from that environment of cyclists are to join the carriageway from a separate space temporarily). Refer to Figure 19 for additional concepts.

Speed: Temporary speed limits should help make a safer environment for people who cycle and motor vehicles to coexist. Lower speed limits are preferred, especially in urban settings, to minimise the risk of accidents. Traffic calming measures could also be deployed to encourage speed limits.

Parking Management: Managing on-street parking is crucial to prevent obstruction and maintain the lane width for shared use. This might include no-parking zones.

Considerations and control measures for the "Take the Lane" approach:

Lane Width: In situations where the lane width is narrowed to 3.25 metres or less, the "take the lane" approach is **possible**. A concept layout of this approach is shown in Figure 20.

This necessitates a single-file approach, emphasising the importance of speed parity between people who cycle and motor vehicles to prevent unsafe overtaking attempts.

Speed Management: A speed limit of 30 km/h is recommended to maintain speed parity, making it safe for cyclists to take the lane without impeding traffic flow significantly and reducing the chance of more severe consequences if something goes wrong.

Lane width is the most effective way to manage safe speeds for sharing the road. Be careful to consider uphill and downhill impacts on people cycling as well.

Signs and Markings: Few temporary measures are aligned closely with the "take the lane" cycling approach; however, some permanent measures such as sharrows (road marking) (Figure 15) are possible, as well as the use of signs approved within the Traffic Control Devices Rule 2004 (examples below):

Figure 15 - Sharrow marking indicate a shared lane for both cyclists and motorists, helping position cyclists safely on the road while reminding all road users to share the space responsibly.[57]

Figure 16 - A43-7 Sign

Figure 17 - W5-8.13 Sign

Figure 18 - A43-1 Sign

Considerations and control measures for closing a cycle lane and diverting cyclists into the lane:

Where there is an existing cycle lane, and it is required to be closed, with cyclists needing to be redirected to merge with traffic, the following considerations are important:

- Exclusion zones at the transition area ensure that mistakes by people who cycle or motor vehicle drivers do not have catastrophic consequences.
- A clear warning to people who cycle and motor vehicles that the merging operation is ahead.
- Reduction of motor vehicle speed to allow safer coexistence with cyclists.
- Straight alignment of cyclists and vehicles at the merge point (i.e. they are both pointing in the same direction).

For Dimensional information refer to Appendix F

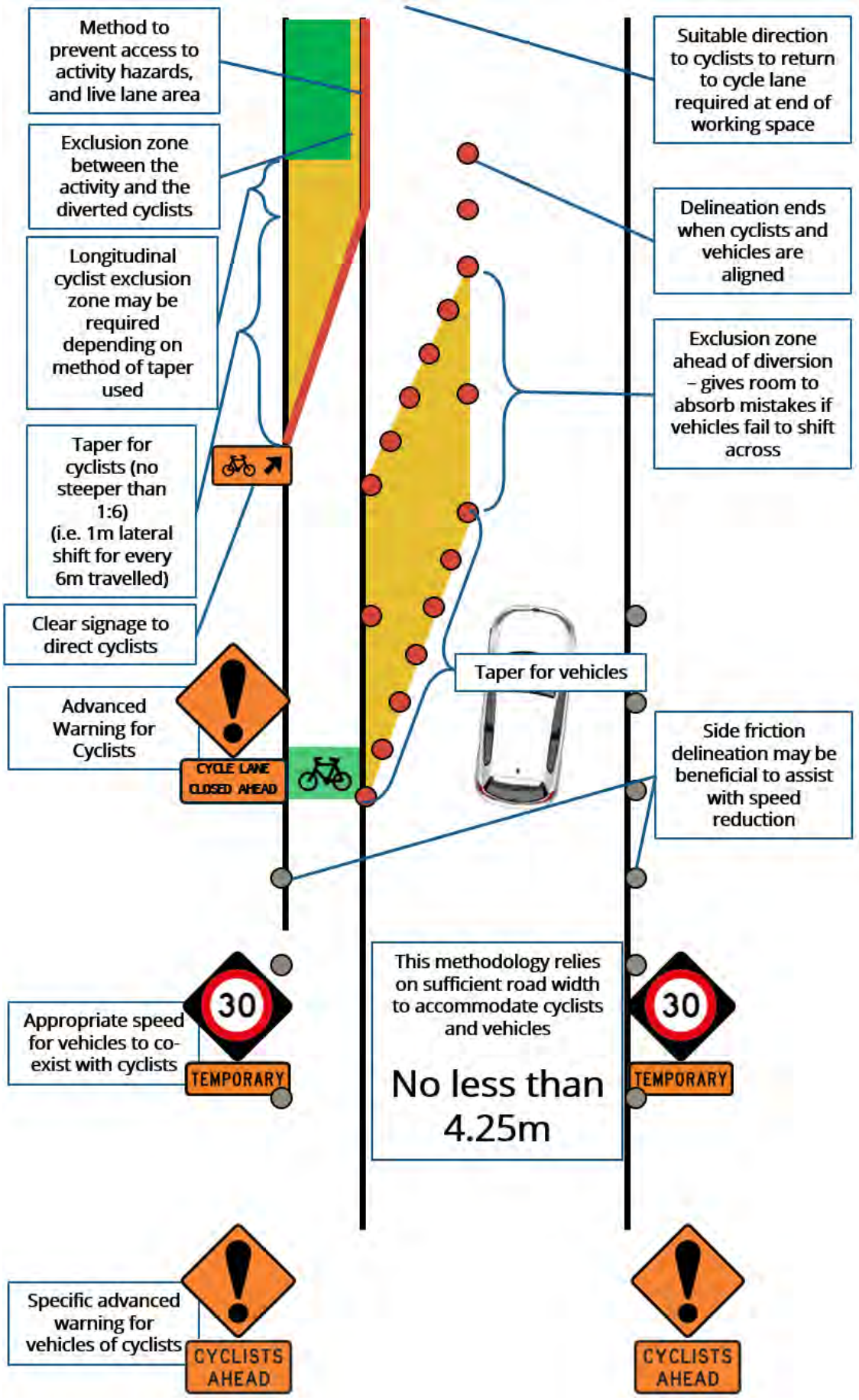


*Figure 19 - Considerations for the temporary diversion of cyclists into the carriageway to share the road with vehicles where there is **sufficient lane width for passing.***

For Dimensional information refer to Appendix F

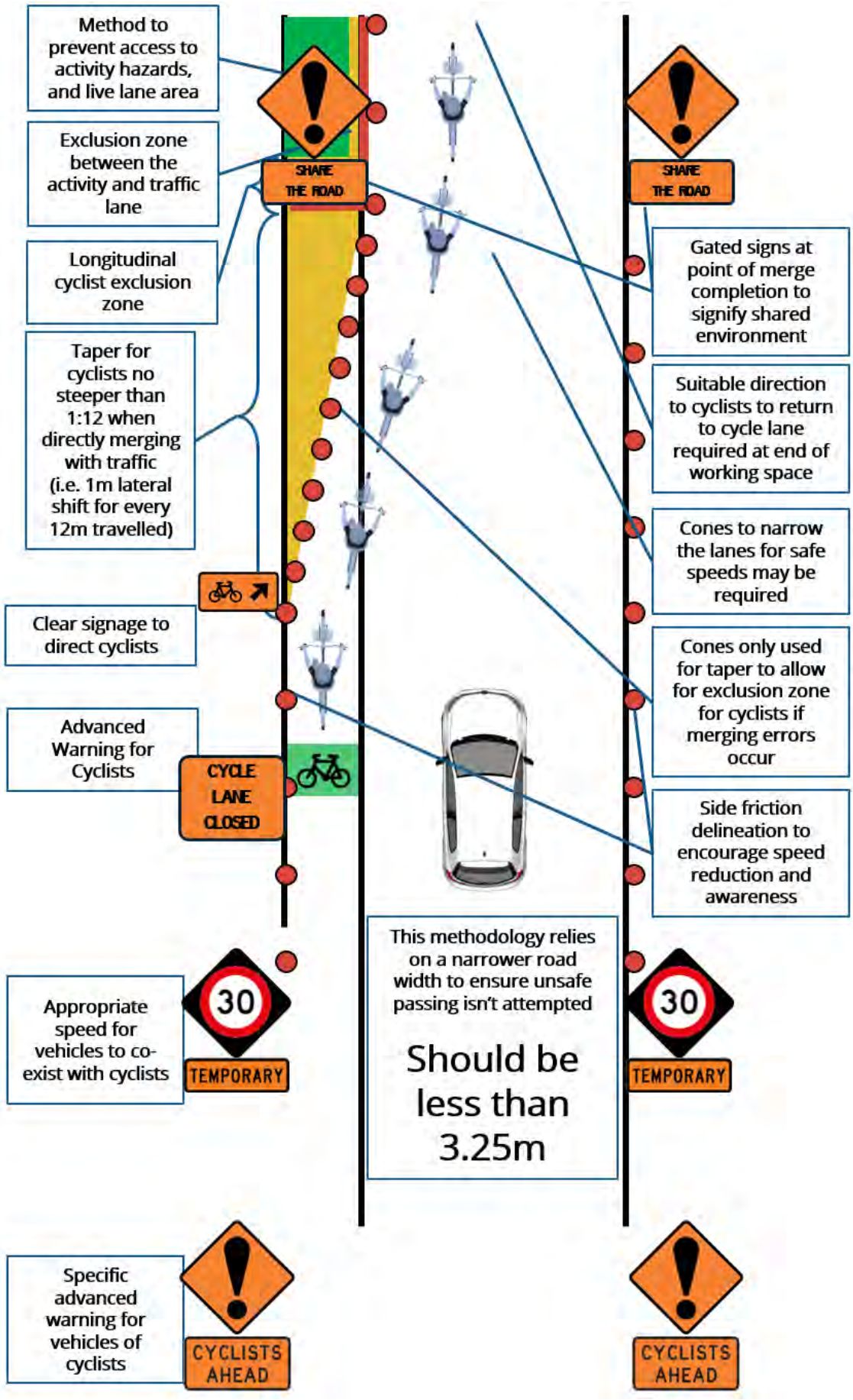


*Figure 20 - Considerations for the temporary diversion of cyclists into the carriageway to share the road with vehicles where there is **insufficient lane width for passing.***

Parallel Alternative Pedestrian Route (Use the other side of the road)

This method refers to redirecting pedestrians to use the **footpath on the opposite side of the road** when the usual footpath is unavailable. This requires crossing the road and possibly re-crossing it further along to resume the original path.

SHOULD

Diverting pedestrians to a footpath on the other side of the road should only be considered after all other preferred options have been ruled out. Compliance with this method is proven to be low[3; 42; 47; 64], resulting in ineffective risk management.

Considerations

Route Deviation: Significant deviations from existing paths can lead to misunderstanding and unsafe pedestrian movements as individuals may attempt to enter the carriageway to bypass the site.

Footpath closure at signalised crossing to allow safe controlled crossing of the road for footpath users. Image Credit xlviii: Danny Wood.

Controlled Crossing Facilities: Providing controlled temporary crossing facilities can ensure safe crossing to the alternative footpath, especially on roads with high traffic volumes. Existing controlled crossing points may be utilised if they do not divert pedestrians excessively or unintuitively.

Alternate route quality: The path quality where people are being diverted should be of equal or better standard.

Sight Distance: The sight distance at crossing points needs to be sufficient to allow for safe crossing (Refer to Appendix F). This is crucial for pedestrians and oncoming traffic to have adequate visibility to react to each other.

Access to Properties: If there are properties within closed sections of footpath, this could create confusion and result in unsafe pedestrian movements. Arrangements should be clear and well-communicated for continued access.

Possible Control Measures

Temporary Tactile Pavers: Utilise temporary tactile pavers to assist visually impaired individuals in identifying the crossing points.

Example of footpath closure (suing other side) utilising an existing pedestrian refuge. Image Credit xlix: Danny Wood.

Pedestrian Refuge: In cases where the road is wider than 10 metres and may be challenging to cross in one go[68], a temporary pedestrian refuge in the middle of the road can provide a safe waiting area for a multi-stage crossing (**refer to this detail in Appendix F).**

Dedicated Site Personnel: Positioning dedicated site personnel at closure or crossing points to assist and guide pedestrians, especially those requiring assistance or reassurance.

Detours for People who are walking

This refers to guiding pedestrians along a different path when their typical route is temporarily inaccessible.

Such detours can be longer and may deviate significantly from the original or desired route.

While detours are **typically the last resort** due to their potential to cause confusion or non-compliance, they might be the only viable option to maintain pedestrian safety and accommodate necessary work activities in certain exceptional circumstances.

Example of a pedestrian detour plan. The length of the detour may be a challenge for those with disabilities and could encourage unsafe behaviour. Control measures should be considered if non-compliance is a risk. Image Credit l: Parallaxx.

Considerations

Understanding and Compliance: Detours that oppose usual routes or desired lines are often misunderstood, leading to unsafe pedestrian movements. The further a detour deviates from the original path, the lower the likelihood of compliance, especially if it significantly increases the travel distance[67]. It is essential to ensure that the use of the original (closed) route is prevented through engineering controls if it is unsafe.

Vulnerable Pedestrians: People who are blind or with low vision or other disabilities are more likely to face challenges with detours, especially those with multiple crossing points or unclear directions.

Early Planning: The planning for detours should be integrated into the initial stages of construction planning to ensure they maximise opportunities for extensive public communication and optimal use of routes (which might include private property).

Route Quality: Detours should aim to maintain or even improve the quality of the original route in terms of surface material, facility width, and signalised crossings.

Possible Control Measures

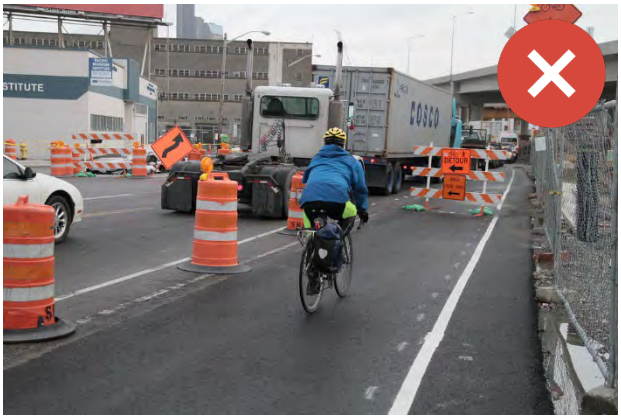
Dedicated TTM workers: Positioning dedicated TTM workers throughout the detour route to mitigate the risk of misunderstandings regarding the change of direction and to ensure that vulnerable pedestrians can be fully escorted through the route.

Clear and Concise Signage: Utilising clear and concise signage to guide pedestrians effectively along the detour route, indicating the direction and any crossing points.

Utilisation of Signalised Crossings: Incorporating signalised crossing points with longer crossing phases to facilitate safe crossings, especially at busy intersections or high-traffic areas.

Detours for people who cycle

This refers to redirecting cyclists from their usual path to an alternative route due to temporary obstructions. Unlike pedestrians, cyclists cover distances faster and may be more willing to take detours if well-planned and clearly marked. The aim is to provide a safe, clear, and reasonably direct alternative to the usual cycle route.



Cyclist detour with no clear safe arrangement with the nearest traffic lane at the point of detour. Image Credit li: Washington State Department of Transportation.

Considerations

Route Directness: Cyclists prefer direct routes to minimise travel time[44; 57]. Detours that significantly lengthen the trip may lead to non-compliance, with cyclists potentially finding alternative routes that might be unsafe or choosing to dismount and become pedestrians.

Surface Quality: The surface quality of the detour route is crucial, as uneven or rough surfaces can be hazardous for cyclists. The surface of any detour should be checked thoroughly for cyclist safety before use and checked regularly for any deterioration.

Signage and Markings: Clear signage and markings are vital to guide cyclists along the detour route, indicating the direction, potential hazards, and the distance to the destination.

Crossing Points: Safe crossing points are essential, especially at busy intersections or high-traffic areas. Signalised crossings or designated cycle crossings are preferred.

Width and Capacity: The width of the detour route should be sufficient to accommodate cyclists safely, allowing for overtaking where necessary. Refer to Appendix F.

Possible Control Measures

Advanced Warning Signs: Positioning advanced warning signs to inform cyclists of the upcoming detour well in advance, allowing them to make informed decisions.

Temporary Cycle Lanes: Establishing temporary cycle lanes on the detour route can provide a designated space for cyclists, enhancing their safety, especially on roads with mixed traffic.

Lighting and Visibility: To prevent accidents, ensure good lighting and visibility along the detour route, especially at night or during adverse weather conditions.

Route Monitoring: Monitoring the detour route to promptly identify and address any issues, ensuring it remains safe and clear of obstructions.

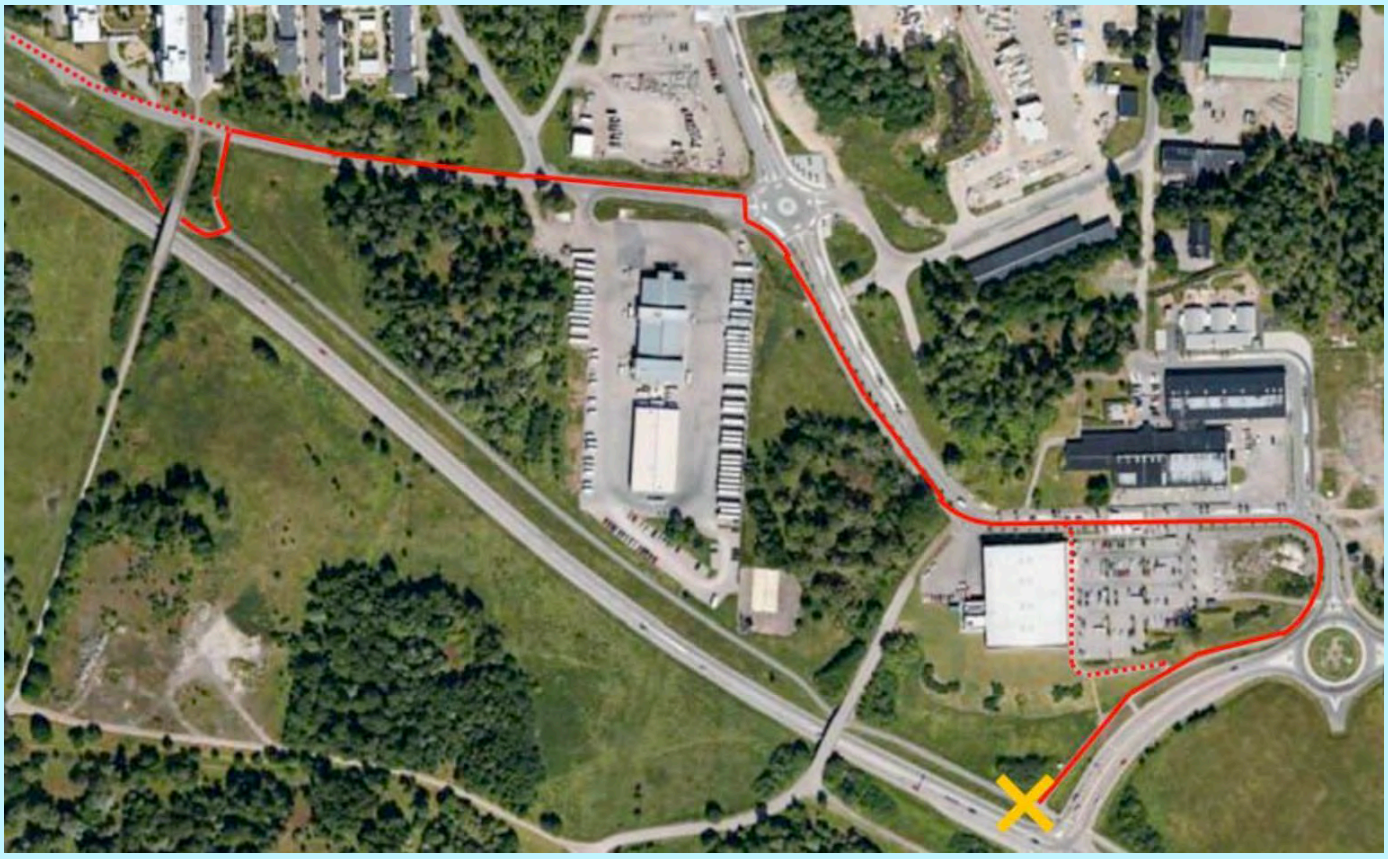
Public Communication: Publicising the detour through various channels, including online platforms, to inform cyclists in advance and allow them to plan their routes accordingly.

Case Study D: Cyclist detour compliance in Sweden

The longer cycle detours are, the more deviation from the original path, the less compliant cyclists will follow the detour.

This means that cyclists are still likely to try and use the existing route (which is now unsafe) or may try and ride with motor vehicle traffic, which is unsafe without appropriate controls.

The following cyclist detour was set up in Gothenburg, Sweden. Observations showed that 12 out of 15 cyclists (80%) ignored the detour and cycled on the traffic lanes instead[23].



Rerouting of cycle traffic when the cycle path is closed (yellow cross) due to roadworks. The solid red line shows the route the cyclists are directed to, while the dotted lines show their chosen route. Image Credit lii: www.eniro.se

This case study highlights that deploying TTM methods to manage the safety of vulnerable road users must account for the level of compliance with the chosen controls. If the method is ineffective, then adjustments or alternatives must be actioned.

Cyclists Dismount

This method is deployed in scenarios deemed hazardous or impractical for cyclists to continue riding.

This typically occurs in Very constrained activity areas, heavily congested areas, or where roadway widths are notably restricted.

The directive compels cyclists to dismount and proceed on foot, essentially transitioning them temporarily into pedestrians.

However, this measure is often seen as disruptive and less favourable among cyclists due to the inconvenience it imposes, and thus, it **is recommended to be a last resort.**

Figure 21 - This sign combination uses a W5-8.12 cyclist directional sign, with a custom sign under W8-8 from the Traffic Control Devices Rule 2004.

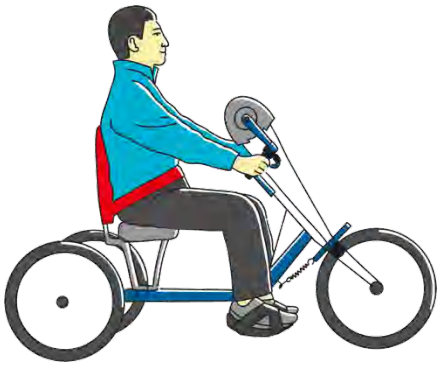
Considerations

Make it clear why they are dismounting: The reason must be immediately apparent to cyclists. Compliance rates will likely plummet without a clear and visible rationale [17].

Short Distance: The directive should span a short distance, ideally not exceeding 50 metres[7]. This minimises inconvenience and increases the likelihood of compliance.

Alternative Routes: Before resorting to a "Cyclists Dismount" directive, all alternative routes and configurations should be explored to retain space for cycling. This directive should be employed only in extreme circumstances where alternative routes are impractical or unsafe.

Impact on Disabled Cyclists: Not all cyclists can easily dismount and proceed on foot, especially those using cycles as mobility aids. The process could potentially cause accidental injury and significant inconvenience to these individuals.



Possible Control Measures

Signage Clarity: Ensure the signage is clear, visible, and placed well in advance to provide ample reaction time for cyclists.

Marshals: In situations where dismounting is unavoidable, having marshals on site to assist cyclists, particularly disabled people, could enhance compliance and safety. These marshals should ideally receive specific training to assist disabled cyclists better.

Public Communication: Broadcasting the "Cyclists Dismount" directive and its reasons on various platforms, including online and local signage, can help inform cyclists in advance and possibly lead to better compliance.

Shuttle Transport

Shuttle transport emerges as a contingency measure when accommodating vulnerable road users within or around a work zone becomes unfeasible. This mechanism is triggered in scenarios where the construction of temporary walkways or bike paths is impracticable, often during substantial infrastructural overhauls like bridge replacements or complete closures such as a railway crossing upgrade. The primary goal is to ensure safe and accessible passage for pedestrians and cyclists around the construction site, albeit in motorised transport, deviating from the typical self-propelled travel mode.

This method may also be suitable in rural areas where an extended length of the road is reduced to a single lane with alternating flow. It may be undesirable for people cycling to travel with the motor vehicle traffic due to the time taken to negotiate the single-lane section.

Considerations

Only used if you have to: It is advised that shuttle services be considered less preferred than other measures with less disruption to users. It may not be a 'last resort' – as the activity and site conditions may mean shuttle transport is the only realistic option.

Image Credit liii: Bike Ventures (Bulgaria)

Capacity and Accessibility: Ensuring the shuttle service is accessible to all, including individuals with disabilities, is paramount. A standard capacity should include space for at least two disabled passengers in powered chairs alongside a maximum of ten non-disabled individuals[1].

Volume-Based Service: The frequency and operation of the shuttle service could be determined based on the pedestrian and cyclist volumes. High volumes may necessitate on-site shuttles, while on-call services could serve low volumes.

Cost-Effectiveness and Practicality: Exploring partnerships with local public transit systems might present a cost-effective and practical solution, especially in urban settings with robust systems.

Possible Control Measures

Clear Signage, Information, and Communication: Display clear signage and provide information on the shuttle service's availability, location, and schedule well before the construction site. Communicate the availability and operational details of the shuttle service through various channels, including online platforms, to ensure maximum awareness among the affected VRUs.

Collaboration with Local Transit Operators: Engage with local public transit authorities to explore the possibility of bolstering existing transit services to accommodate the detour needs of VRUs.

Appropriate parking and waiting areas: Ensure safe locations for vulnerable road users to wait and safe pick-up and drop-off areas clear of the road.

Contingency Plans

The primary aim of a contingency plan is to ensure the continuous safety and accessibility of traffic spaces for vulnerable road users, even in the face of unforeseen circumstances.

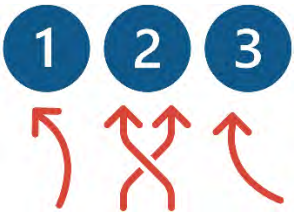
Preparing for various scenarios enhances the robustness and flexibility of the TMP, making it resilient to change and uncertainties. **The value of effective contingency planning is in:**

Proactive Risk Management: Anticipating problems before they occur is at the heart of risk management. Contingency plans provide a structured response to potential issues, minimising the possibility of less effective ad-hoc decisions when things change.

Enhanced Safety: The dynamic nature of traffic and construction environments necessitates a buffer against potential hazards. Contingency plans offer this buffer, ensuring that safety standards are maintained even when the primary traffic management methodology faces challenges.

Operational Efficiency: With well-structured contingency plans, field staff can quickly adapt to changing conditions without requiring extensive re-design or delay, thus maintaining the operational flow.

Every contingency plan should:



Be scenario-specific: Each contingency plan should be tailored to address a specific event or scenario. This narrows the focus and ensures the response is precise and effective.

Have defined trigger points: Establish clear, measurable trigger points that signal the activation of a contingency plan. These trigger points should be identified far enough in advance to provide adequate time to implement the contingency measures.

Be feasible and resourced: Ensure each contingency plan is feasible with the available or easily accessible resources. This includes human resources, equipment, and other logistical arrangements necessary to enact the plan.

Be communicated: Develop clear communication channels to promptly relay the activation of contingency plans to all relevant stakeholders. This includes field staff, other road users, and the VRUs affected by the change.

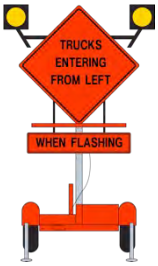
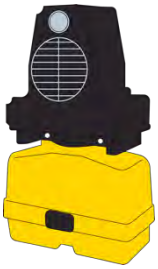
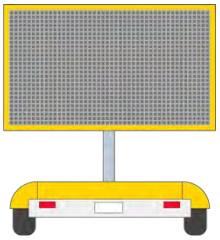
Have associated training: Field staff should be adequately trained and familiarised with the contingency plans to ensure swift and correct implementation when needed.

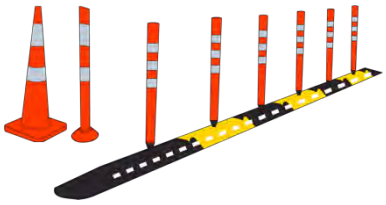
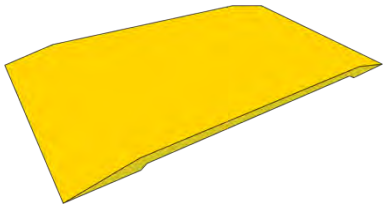
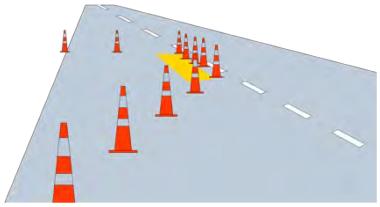
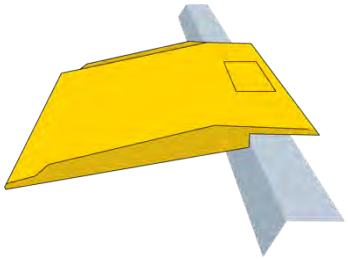
Control Measures that are used for Vulnerable Road Users

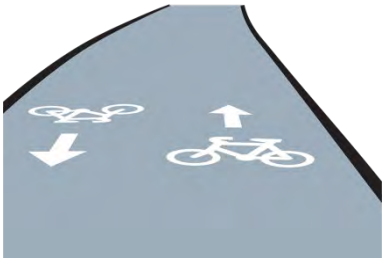
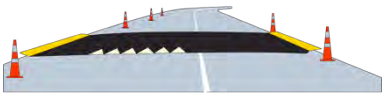
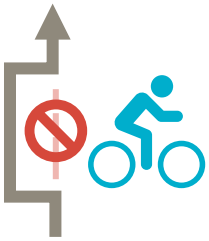
Step 5B: Select Individual Control Measures

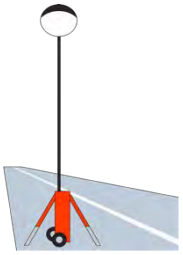
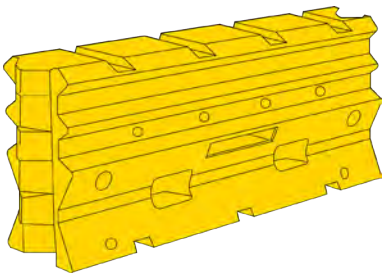
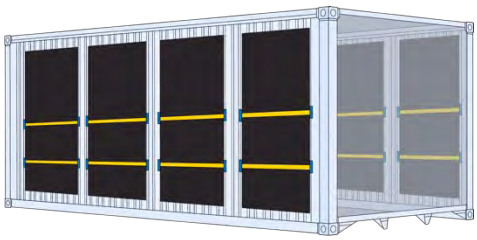
The individual control measures should be selected to achieve the overall traffic management method in Step 5A. This requires a deep and thorough understanding of the individual controls used in TTM for the safety of vulnerable road users and how they work.

Individual control measures are provided alphabetically and summarised in the following table. Refer to Part F of this guidance for a full exploration of each control measure (in the same order as this table).

Control measure	Explanation	Graphic
Advanced Technologies *Page F2*	Uses modern technology like sensors to detect and protect vulnerable road users. For example, a sensor could alert approaching cyclists of a motor vehicle in a blind spot.	
Advanced Warning *Page F3*	Gives early warning about upcoming hazards (for either vulnerable road users or drivers), such as warning of a narrow path for cyclists.	
Audible Messaging *Page F3*	Uses sound to guide or warn vulnerable road users. For example, a beep to indicate a safe time to cross the road or a speaker sharing safe directions (particularly for visually impaired road users).	
Communications with the Public *Page F4*	Keeps people informed about what is happening and why. For example, a community notice about roadwork dates or a variable message sign (VMS).	
Cone Bars *Page F6*	Used to create quick, visible separation between areas. For example, separating a pedestrian path from a work zone.	

Control measure	Explanation	Graphic
Delineation *Cones* *Tubular Delineators* *Flexible Traffic Separators* *Page F7*	Marks out boundaries between areas and provides channelling for road users. For example, cones are set up to channel road users away from a road shoulder to give room for cyclists.	
Escorting Vulnerable Road Users *Footpath Controllers* *Page F8*	Guiding vulnerable users safely through the work zone. For example, a worker helps an older person cross the road.	
Excavation Covers *Trench Covers* *Page F9*	Covers up holes or trenches to make them safe to walk or ride over. For example, a sturdy cover over a dug-up part of a sidewalk.	
Exclusion Zones *Safety Zones* *Page F10*	Areas that provide buffer zones between hazards and those that can be harmed (providing space to absorb errors or mistakes). For example, a space between a fence and an excavation so the fence does not fall in the hole if struck.	
Fencing *Page F11*	Physical devices that prevent access to an area and channel road users. For example, a fence guiding pedestrians towards a safe crossing point.	
Kerb Ramps *Page F12*	Creates step-free access between levels. For example, a ramp at a crossing for wheelchair users.	

Control measure	Explanation	Graphic
Markings *Temporary Marking* *Road Marking* *Page F14*	Paint or tape on the ground to guide or warn. For example, LOOK LEFT is painted on the ground at a crossing point for pedestrians.	
Signs *Directional Signs* *Regulatory Signs* *Page F15*	Provides information or instructions. For example, a sign indicating a direction for cyclists to travel in.	
Temporary Bus Stops *Page F16*	A short-term bus stop when the usual one is unavailable. For example, a sign and marked area a few metres away from a closed bus stop.	
Temporary Crossings *Page F17*	Short-term safe places to cross the road. For example, a signposted safe crossing using temporary traffic signals.	
Temporary Cycleways *Page F18*	A designated, temporary route for cyclists to ensure their safe passage through or adjacent to a work zone.	
Temporary Footpaths *Page F20*	A designated, temporary route for footpath users to ensure their safe passage through or adjacent to a work zone.	

Control measure	Explanation	Graphic
Temporary Lighting *Page F20*	Extra lights for safety and visibility. For example, floodlights illuminate a temporary footpath that is still required at night.	
Temporary Road Safety Barrier System (TRSBS) *Page F23*	Barriers to redirect or capture motor vehicles that leave the road so motor vehicle occupants do not get hurt may also provide valuable protection for vulnerable road users in certain situations.	
Temporary Speed Limits *Page F23*	Reduced speed zones near work areas. For example, a 30km/h limit where people who cycle and motor vehicles use the same road space.	
Temporary Walkway Bridges *Page F25*	Paths over obstacles or hazards. For example, a footbridge over a dug-up section of road.	
Vehicle fitted with a Truck Mounted Attenuator (TMA) *Page F25*	A vehicle equipped with an impact-absorbing device to reduce the severity of collisions. For example, a truck with an attenuator positioned at the start of a pedestrian diversion to protect people walking who are being diverted close to vehicles.	
Walkway Covering *Page F26*	Covers to protect or guide pedestrians. For example, a covered walkway shields people from falling objects.	

Check what new risks you have introduced

Implementing control measures to manage risks can occasionally introduce new hazards or escalate existing ones.

Step 6: Check what new risks you have got

Some potential introduced risks are summarised alphabetically in the following table. This list is not exhaustive. You should always look for new risks from using other control measures.

Control measure	Explanation
Control measure deterioration, variability, or redundancy *Page D53*	Over time, controls like fencing or signs might no longer serve their intended purpose, thus becoming obstacles that could be hit or block pathways. A continuous evaluation of control measures to ensure they are still needed and effective is required.
Loss or impact to access for properties *Page D55*	Implementing control measures might alter people's movement patterns in the vicinity, negatively affecting access to businesses or residences. Such changes could spawn new hazards or challenges, like altered parking, delivery, or emergency service access.
Sign Placement *Page D56*	While signs need to be prominently placed to ensure visibility, their placement can encroach upon spaces needed by vulnerable road users or their safe use of those spaces.
Site Access or Exit *Page D57*	Work activity vehicles' entry and exit points may shift as the site progresses, possibly intersecting with paths vulnerable road users use unexpectedly. These changing patterns can lead to unfamiliar crossover points, increasing the risk of accidents.
Surface Condition *Page D58*	Temporary relocation of pedestrian or cyclist paths can result in inferior surface conditions. Using these temporary environments may present new risks like uneven or slippery surfaces, which did not exist before.
Visibility *Page D60*	Altering pedestrian or cycle routes changes sight lines, while introducing plant, machinery, and materials to the environment may obstruct previously clear visibility. These changes can heighten the risk of collisions or other accidents.
Water pooling or drainage *Page D61*	Changes brought about by control measures, like the placement of devices, alterations to permanent infrastructure like kerbs, or the placement of kerb ramps, can affect water movement and drainage. These changes can cause water to pool in areas where the environment's geometry is not equipped to handle it, creating unsafe surfaces or areas where water depth is difficult to ascertain.

Control measure deterioration, variability, or redundancy

Any temporary sign MUST be removed as soon as the need for it has ended[32, Section 4.2(7)].

Description:

Over time, or due to changing site conditions, control measures like delineation or ground surfaces may degrade, lose effectiveness, or no longer serve their intended purpose. They become hazardous or obstacles that could hit or block pathways, endangering the safety of vulnerable road users.

For instance, a ramp initially placed to aid pedestrian access might become worn and uneven, posing a tripping hazard. Similarly, faded paint or line marking can lead to unclear path demarcation, creating confusion for VRUs.

When the access gate is open on this site, the pedestrian signage directs users to walk into the site entry point. Image Credit liv: Parallaxx.

How would this risk arise?

These risks can come from a lack of meticulous attention during the planning stages, where control measures remain unchanged across different phases of the job despite the evolving nature of site risks.

The risk becomes more likely when insufficient checking and correction has occurred on-site, allowing for degraded or misaligned control measures to remain unaddressed.

Additionally, when the primary focus is on managing motor vehicle-based risks, the effect of control measures may be overlooked, making some controls redundant or hazardous for those who are vulnerable.

The use of paper taped to a cone has meant the sign has deteriorated and hardly visible. The cone makes the ramp narrower which is particularly problematic for people using a wheelchair. Image Credit lv: Betty Mitrova.

Fences to prevent access to hazards but have fallen over, creating risk for vulnerable road users. Image Credit lvi: Sweden National Road and Transport Research Institute[44].

For instance, a row of cones moved by the public and left in disarray could obstruct pedestrian pathways and become tripping hazards.

Redundant or degraded controls mean the risk is going unmanaged (as those control measures were deployed for a reason and are no longer working/adding value). This means that someone has more risk than they should. Given that vulnerable road users have the highest risk of harm in most cases – ineffective controls have a greater impact on their safety than anyone else.

Mitigation strategies:

A well-structured plan that adapts to the changing risks on site is the cornerstone of mitigating these risks.

Such plans should delineate the evolution of control measures in tandem with the site's changing risk profile, enabling field staff to make necessary adjustments promptly.

A thorough onsite checking process is also crucial. This entails verifying the existing control measures and critically evaluating their relevance and effectiveness in the current site scenario.

For instance, asking, **"In what ways is this not currently working?"** can prompt a more detailed review.

Where longevity of control measures is concerned, utilizing more durable options like tubular delineators could significantly reduce maintenance requirements, thereby minimizing the risk of deterioration. However, weighing this against the increased time and risk involved in their installation and removal is essential, ensuring a balanced and well-assessed approach to risk management.

Equipment left in or adjacent to pedestrian routes that is unused only serves to add obstacles or hazards to users. Image Credit lvii: Betty Mitrova.

Loss or impact to access for properties

Description:

The risk of losing or affecting property access happens when traffic controls change how people usually move around, making it hard for them to get to certain places. This risk can **affect** customer visits to businesses, deliveries, emergency services, and the places' daily workings.

How would this risk arise?

This risk comes up when we put controls like fences, change traffic routes, or close paths to manage traffic or keep places safe during work. For instance, putting up a fence for a construction site might make people take a longer route, cross more driveways or change how they enter homes and businesses. Likewise, changing traffic routes may block regular entrances, affecting cars and people trying to access properties.

Mitigation strategies:

Engagement

Talk to property owners, business operators, and the community to understand their needs and concerns. Knowing what they require helps in planning and setting up controls properly.

Customised Planning

Plan traffic controls in a way that balances between managing traffic and keeping access to properties.

Consider the local setting, the type of properties affected, and what people expect.

Clear Signage and Communication

Put up clear signs to show any changes in routes or access points. Also, inform affected people about the changes, why they are happening, and how long they will last.

Information signage to inform pedestrians of local businesses being open. Image Credit lviii: Parallaxx.

Iterative Assessment

Regularly check the controls set up and be ready to make changes based on what is happening on the ground or feedback from the community.

Alternative Access Arrangements

Create temporary access points or paths to ensure people can still get to properties. This could include setting up delivery zones, temporary parking areas, or shuttle services for longer distances.

Coordination with Emergency Services

Work with local emergency responders to ensure they can still access properties in case of emergencies. Plan for emergency vehicle routes to keep the access clear. See contingency plans.

Sign Placement

Description:

The risk involves placing signs where vulnerable road users need safe movement. Misplaced signs could obstruct pathways or sightlines, introducing risks that outweigh the sign's benefit.

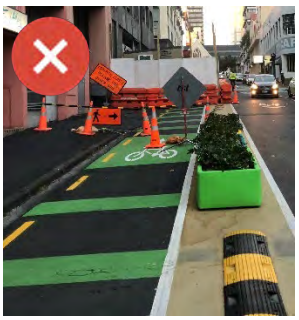


Image Credit lix: Parallaxx

Image Credit lx: Betty Mitrova

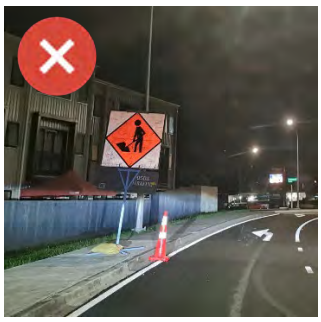


Image Credit lxi: Betty Mitrova

Image Credit lxii: Betty Mitrova

How would this risk arise?

This risk arises when signs are placed without considering the needs of all road users. For instance, a sign placed on a footpath may force pedestrians, especially those with mobility aids, onto the road.

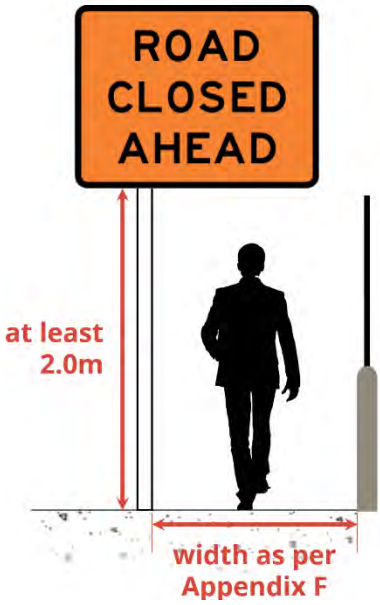


Figure 23 – Pedestrian or cycling box dimension requirements

Mitigation strategies:

Pedestrian or Cycling Box

For footpaths or cycle lanes, there should be no encroachment of signs into the full useable width of the space (as per widths outlined in Appendix F).

Therefore, any signs needing to be placed into walking or cycling space should be above 2.0m. This results in the pedestrian or cycling box concept (Figure 22 and Figure 23).

Figure 22: Depiction of the 'pedestrian box' concept[2]

Standard Sign Placement

When placing all standard signs (at normal height) – full footpath or cycle lane widths (as per Appendix F) should remain. Where any trip hazards (such as sign feet) are close to the travelled path of users – delineation should be placed (Figure 24).

Delineation placement adjacent to trip hazards is an important control for the visually impaired, who use canes to detect hazards or objects in their path.

Figure 24 - Sign placement adjacent to vulnerable road user paths.

Site Access or Exit

Description:

This introduced risk involves the potential hazards associated with entry and exit points of a construction or work site. Inadequate management of these points can lead to confusion, congestion, or accidents, particularly for vulnerable road users unfamiliar with temporary changes.

Site access and exit in this location would be very challenging. Pedestrians itneracting in the same place as entering vehicles and a blind corner of hoarding close to a live traffic lane. This location would require a number of control measures to ensure the safety of site entry and exit activity. Image Credit lxiii: Parallaxx.

How would this risk arise?

Site access or exit risks emerge when construction activities disrupt traffic flow and pedestrian or cyclist movement. This could occur if entry and exit points are poorly marked, insufficient space for motor vehicles and VRUs to navigate safely, or temporary changes are not communicated effectively to the public. There may also be risks associated with the visibility of gates or entering/exiting vehicles based on obstructions where there is limited space between the obstructions and where people travel.

Mitigation strategies:

Clear Demarcation

Ensure that entry and exit points are demarcated with appropriate signage visible from a distance to all road users, including pedestrians and cyclists.

Use TTM Workers or other Personnel

Employ personnel at key points to manage the flow of motor vehicles and VRUs, particularly during peak hours or when large vehicles enter or exit the site. This control can be added or removed as required – as the movement of vehicles into and out of a site is often infrequent.

Safe Crossing Points

Establish safe crossing points for VRUs with signage, markings, and fencing where necessary to guide them away from risks. Removing VRUs from the conflict points for entering/exiting vehicles can be the best way to eliminate the risk.

Regular Review

Conduct regular reviews of the access and exit arrangements, particularly in response to feedback from VRUs and changes in site activity, to ensure ongoing safety and efficiency.

Emergency Access

Maintain clear routes for emergency vehicles at all times, ensuring that any changes to access points are communicated to emergency services immediately.

Surface Condition

Description:

This risk relates to the safety concerns for pedestrians and cyclists when redirected onto alternate surfaces due to traffic management activities. These alternative pathways may have uneven, slippery, or unstable surfaces that could lead to trips, slips, or falls, especially for those with mobility impairments or when using assistive devices.

Slippery and uneven surfaces are not navigable for all people. One consequence of poor TTM is that some people give up trying to travel. We must ensure everyone can use walking and cycling facilities safely and comfortably.

How would this risk arise?

This risk materialises when temporary pathways are not adequately assessed for surface integrity and when changes in surface conditions are not addressed or communicated. For instance, pedestrians diverted onto gravel or lawns could encounter unstable footing, while cyclists redirected onto cobblestone areas might find the surface unsafe, particularly in wet conditions.

Whilst this grass area might be stable in good weather and with light use – that will quickly change after some use or rain, creating an unsafe surface for many users – especially those with mobility challenges. Image Credit lxiv: Betty Mitrova.

In this instance, high-contrast temporary non-slip covers have been used. These are helpful for people with visual impairments, but there is still a small trip hazard to watch out for. Image Credit lxv: Carina Duke.

Mitigation strategies:

Surface Assessment

Before redirecting traffic, thoroughly assess the alternate surface to ensure it is stable, even, and free of hazards.

Improvement Works

Carry out any necessary work to improve the surface condition, such as compacting loose gravel or covering uneven areas with temporary but stable platforms.

Signage and Warnings

Install clear signage to warn VRUs of the surface change, especially when transitioning from one type of surface to another.

Lighting

Ensure adequate lighting is provided where surface conditions may be less visible, such as during darkness hours or in shaded areas.

Accessibility Compliance

Make sure that any temporary surfaces comply with accessibility standards, providing a smooth transition for those with wheelchairs or other mobility aids.

Routine Inspections

Implement a schedule for regular inspections of the temporary surfaces to identify and rectify any emerging issues promptly.

Case Study E: Damaged footpath led to man's death[88]

Maintaining good surface conditions for footpaths is crucial for ensuring the safety and mobility of all pedestrians, especially disabled people.

Image Credit lxvi: Simon Maude

This case study revolves around the tragic incident where a 77-year-old man lost his life due to a fall from his mobility scooter, which was caused by a damaged section of the footpath.

This incident highlights the necessity of maintaining footpath integrity and showcases the legal and financial repercussions for failing to do so.

Some people depend on mobility aids with small wheels, and a footpath's condition directly impacts their ability to navigate the urban landscape safely.

In this case, the accident demonstrates the fatal consequences of neglecting this responsibility.

From a legal standpoint, the Health and Safety at Work Act 2015 imposes a duty on businesses to ensure their operations do not compromise the safety of others.

The failure of YSB Group Ltd to meet this requirement led to their conviction and subsequent fines totalling $200,000 for their role in the incident.

The legal records outline a series of shortcomings by YSB Group Ltd, from the lack of a proper risk assessment to inadequate pedestrian provisions and traffic management.

These failings exemplify a disregard for standard industry practices and the safety of vulnerable road users.

This case serves as a powerful reminder of the responsibilities of PCBUs to prioritise the safety of footpaths. This death was a preventable tragedy that has had lasting consequences for the victim's family and the companies involved.

This stark example highlights the importance of maintaining good surface conditions on footpaths, not only for compliance with safety regulations but also for safeguarding human life, particularly for disabled people who rely on these pathways for independence and well-being.

Visibility

Description:

These risk concerns arise when permanent sightlines are obstructed by traffic management setups, reducing the ability of road users to see each other or potential hazards. This can increase the likelihood of conflicts or collisions, as the ability to anticipate and react to others' movements is compromised.

How would this risk arise?

This issue can emerge when temporary fencing, signage, or construction equipment layout inadvertently blocks views, particularly at crossings, bends, or intersections. An example would be a site office that prevents drivers and pedestrians from seeing each other at a crossing point, increasing the risk of an accident.

Mitigation strategies:

Sightline Audits

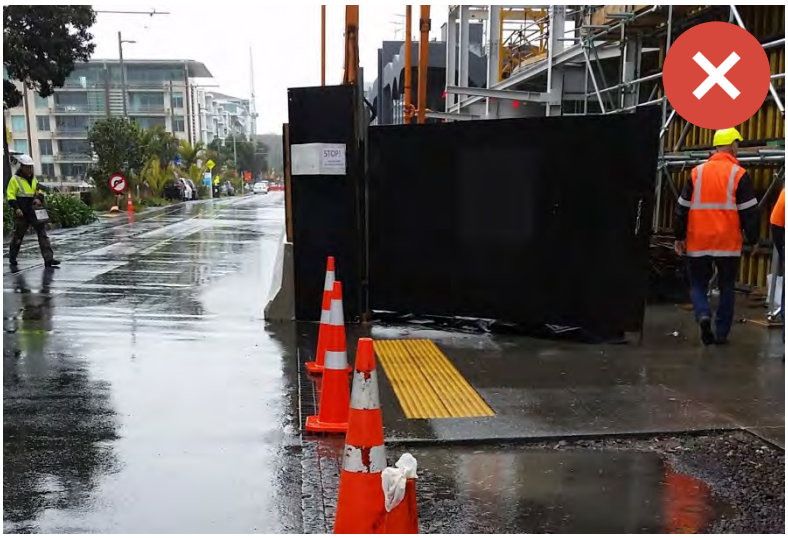
Perform regular checks to ensure all temporary structures do not interfere with sightlines for any users. Refer to Appendix F for dimensional guidance.

Strategic Placement

Place all necessary temporary structures carefully to maintain clear visibility across the site, especially around high-risk areas like intersections, crossings, or changes in direction.

Height Considerations

Ensure that the height of fencing and signage is appropriate so that they do not block eye-level visibility for users, including those in vehicles and on foot.



This crossing point is significantly compromised by the site hoarding, meaning anyone crossing from right to left (as viewed) would have no visibility of oncoming traffic. Image Credit lxvii: Parallaxx.

Mirrors and Supplementary Signage

Convex mirrors at strategic points can improve sightlines. Furthermore, warn of blind spots and use additional signage to alert users to potential visibility issues.

Lighting Enhancements

Increase lighting around areas where visibility is crucial, such as crossings and entry/exit points, to help illuminate potential hazards.

Water pooling or drainage

Description:

The risk of water pooling and drainage issues arises when modifications to road and footpath surfaces lead to inadequate drainage, causing water to accumulate. This can create hazards for all road users, especially vulnerable ones, making surfaces slippery and obscuring potential obstacles.

How would this risk arise?

Altering the surface levels for traffic management or installing barriers disrupting normal water flow can lead to water pooling. For example, a new temporary footpath might lack proper camber for drainage, resulting in standing water after rain.

Mitigation strategies:

Surface Assessment

Before implementing control measures, assess the existing drainage and predict how changes might affect water flow.

Proper Cambering

Ensure that temporary pathways have an adequate camber to facilitate water runoff and prevent pooling.

Drainage Plans

Incorporate additional drainage solutions into the TMP, such as temporary channels or strategically placed drainage mats.

Water can pool in various places, especially in construction environments where the topography has changed. This photo is an extreme version, but even a blocked drain due to construction debris can have an impact on the safety of vulnerable road users in a worksite. Image Credit lxviii: Campbell River Mirror.

Regular Monitoring

After rain or during wet conditions, inspect the site for water pooling and take immediate action to rectify any issues.

Non-slip Surfaces

Where water pooling cannot be avoided, use non-slip materials to reduce the risk of slips and falls.

Clear Markings

Mark areas prone to water pooling clearly so VRUs are aware and can navigate safely.

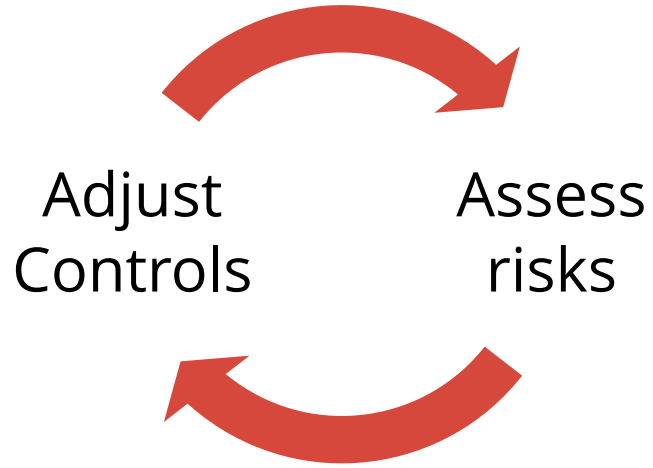
Responsive Maintenance

Set up a schedule to quickly address water pooling, promptly clearing blockages or other drainage issues.

Treat the new risks and look for new hazards

As you address identified risks within your TMP, remain vigilant for the **emergence of new hazards.**

This dynamic process requires a responsive and continual **cycle of evaluation, action, and re-evaluation** to ensure all risks are managed optimally.



This diagram to the right is simple, but it highlights that the risks change as soon as you adjust new controls, and you need to re-evaluate.

It is important to note that this diagram says 'adjust controls', not 'add controls'.

Sometimes, the risk change has come from the control you just added before, and the additional risk is because you have more than you started with.

This is the challenge with treating health and safety risks – sometimes your treatments make it worse, and you must keep revising until you have the risk as low as possible.

This becomes a process of **ever-decreasing risk** until you reach the **lowest possible risk level for the site.**

Peer Review / Risk Review

Peer review is essential in traffic management planning, offering an **independent check that strengthens safety measures.**

A peer reviewer spots oversights, bolstering the plan's thoroughness and safety.

This step is not about ticking boxes but fostering a **collaborative effort towards the best possible risk management**, ensuring the traffic management plan stands up to scrutiny and aligns with best practices.

In selecting a peer reviewer, prioritise expertise and impartiality[16]. The right reviewer engages as a partner, not just an approver, providing insightful feedback to refine the plan.

Their role is **to enhance**, not just endorse, driving the designer towards the **safest and most practical outcomes for all road users.**

Refer to Appendix G for a TTM Design peer/risk review tool.

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