



ACCIDENT RESEARCH CENTRE

GUIDELINES FOR ENSURING THE SAFETY OF ROADWORKERS

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6 August 2003

Prepared for the Australian Workers Union

INTRODUCTION

BACKGROUND

The Australian Workers Union (AWU) has asked Monash University Accident Research Centre (MUARC) to prepare guidelines for ensuring the safety of roadworkers. The AWU considers that the current levels of safety are inadequate and would like to have guidelines that can be incorporated into industrial agreements and contracts.

A set of guidelines was prepared for assessing and managing risks at roadworks sites based on general principles for ensuring roadworks safety. Following this, a simplified system of risk controls was developed by merging similar types of worksites. After discussion with the AWU, a number of issues of implementation were identified and are described at the conclusion of the report.

GENERAL PRINCIPLES UNDERLYING THE GUIDELINES

The following general principles underlie the guidelines:

1. In the long term, roadworks are vital to maintaining and improving the level of safety and amenity for all road users.
2. Roadworks can pose a safety risk to both roadworkers and other road users.
3. Roadworkers are road users and have the same level of vulnerability to impact as other road users.
4. The aim of risk control programs should be to reduce the level of risk to any road user group (including roadworkers) to what it would be at that site in the absence of works.
5. If vehicles travel faster, crashes will be more likely and injuries will be more severe.
6. Risk control measures should be considered in a hierarchical manner, with the highest and most effective level being separation of workers from traffic and the lowest level (and least effective) being ensuring the visibility of workers.

These general principles are discussed in more detail in the remainder of this section.

1. Roadworks are vital to maintaining and improving the level of safety for all road users

Roadworks are a necessary part of maintaining and improving the safety and amenity of the road system for all road users. Especially in rural areas, improvements to the road system are vitally important in achieving a safer road system. However, in the short-term, roadworks cause disruptions to the level of safety and amenity of the road system in proximity to the work site.

2. Roadworks can pose a safety risk to both other road users and roadworkers

The safety of both the road workers who are carrying out the work and road users travelling the section of road is potentially at risk. Controls need to be put in place to reduce the safety risks to both workers and other road users. Many of the controls to improve worker safety also improve the safety of other road users.

Some plant may provide a lower level of protection to workers in the event of a crash than would a passenger vehicle. In addition, items of plant and trucks etc used in roadworks can pose a risk to other road users.

3. Roadworkers are road users and have the same level of vulnerability to impact as other road users

Empirical data has shown that the risk of death to a pedestrian rises very steeply for impact speeds above 40 km/h. This suggests that roadworks speed limits of 60 km/h may be too high to ensure the safety of workers on foot. When roadworkers are pedestrians, there may be a need for lower travel speeds than when roadworkers are vehicle occupants (e.g. driving machinery).

4. Risk control programs should aim to reduce the level of risk to any road user group (including roadworkers) to what it would be at that site in the absence of the works

If there were 10 casualty crashes per month on a section of road in the absence of the works, the risk controls should ensure that this is not exceeded during the works, even though the works may introduce pedestrian workers who would not be there otherwise. In other words, if there are no pedestrian casualties in the absence of works there should be none during the presence of works.

5. If vehicles travel faster, crashes will be more likely and injuries will be more severe

Lower travel speeds through worksites will reduce the likelihood and severity of injury to both workers and other road users. One of the general principles of road safety is therefore that the speed of travel needs to be matched to the safety of the road environment at that point.

6. Risk control measures should be considered in a hierarchical manner

A hierarchy of controls to reduce the risk of workers working on or near the roadway was produced in an earlier MUARC report for VicRoads. The main classes of risk controls that can be implemented to prevent motorists colliding with workers who are working on or near the roadway involve:

1. reducing the exposure of workers to passing traffic
2. ensuring a safe distance between workers and passing traffic
3. ensuring that passing traffic is travelling at a safe speed
4. ensuring that worksites can be seen by motorists
5. ensuring that workers can be seen by motorists.

All of this needs to occur without increasing the risk to other road users.

Reducing exposure is almost always the most effective form of risk control. The exposure of workers to traffic can be reduced by working when there is less traffic, blocking off traffic, or doing the job without getting out of a vehicle. What constitutes a safe distance between workers and passing traffic depends on the speed of the passing traffic. Therefore this class of risk controls complements those risk controls that affect the speed of passing traffic. If passing traffic is travelling at a safe speed, both the likelihood and severity of impact with workers working on or near the roadway is reduced. Ensuring that worksites can be seen by motorists should contribute to reductions in the speed of passing traffic and to increases in the distance between worksites (and workers) and passing traffic. Ensuring that workers can be seen by motorists should be considered a “last line of defence” in terms of classes of risk controls.

KEY OPERATIONAL PRINCIPLES

1. The behaviour of road users is affected by their perception of the level of risk at roadworks
2. Enforcement is often needed to bring travel speeds down to roadworks speed limits
3. Implementing risk controls is sometimes risky
4. Many factors determine what is a safe distance between workers and passing traffic

1. The behaviour of road users is affected by their perception of the level of risk at roadworks

It is plausible that road users' responses to roadworks ahead are affected by their perception of the overall level of risk. This is made up of the risk of damage to their vehicle (e.g. from loose stones or discontinuities in the road surface), the risk of collision or loss of control (related to road width, obstructions, road surface etc.) and the risk that they may collide with a worker. For the same worksite, road users will judge the overall level of risk to be lower if they cannot see workers (whether this is a correct perception or not) than if they can see workers. Thus the visibility of worksites and workers (while not a strong direct factor in risk reduction) is a crucial contributor to road user responses such as speed reductions.

2. Enforcement is needed to bring travel speeds down to roadworks speed limits

Roadworks speed signs generally result in about half of the drivers slowing down and measured mean speeds are often markedly greater than the signed speed limit (Haworth et al., 2002). Vehicle speeds are reduced significantly by roadworks speed signage, but only the presence of flagmen brings speeds down to or below the roadworks speed limits.

Police presence and enforcement of speed limits in work zones both achieve a reduction in speeds. Variable message signs and speed feedback appear to produce speed reductions similar to those of a Police presence. There is potential for automated enforcement or for wider use of variable message signs to provide speed feedback. One option to reduce costs would be to have automated enforcement (speed cameras on roadworks signs) at a changing sample of worksites to deter motorists from speeding (similar to the practice with red light cameras).

Enforcement will likely reduce not only the average speeds but also dramatically reduce the proportion of road users travelling vastly in excess of the roadworks speed limit.

It is likely that effective enforcement of roadworks speed limits will be more publicly acceptable if it is well signed and the speed limit relates to the current level of risk present (this suggests that speed limits might be lower when workers are present than when they are not present).

3. Implementing risk controls is sometimes risky

The very act of placing the signs on the side of the road increases the amount of time the worker is exposed to traffic, and this period may be more dangerous than the time spent completing the task; especially if the task can be undertaken using the works truck as a traffic shield and the speed restriction signs have to be placed on both sides of the road and for both approaches.

4. Many factors determine what is a safe distance between workers and passing traffic

The concept of a safe distance between workers and passing traffic is commonly thought of in terms of the need to provide sufficient recovery space such that an errant vehicle does not collide with workers. It is also important to consider the safety of other road users and what is a safe distance between other road users and obstructions, including plant and equipment.

In general, the required safe distance increases with travel speed and is higher for pedestrian roadworkers than for roadworkers who are vehicle occupants. For the combination of high travel speeds and pedestrian roadworkers, it may be that the required safe distance would not be feasible and therefore separation by means of barriers would be needed.

DEVELOPING CATEGORIES OF WORKSITES

The AWU has requested that MUARC develop a very small number of sets of guidelines (3 to 5) that relate to particular categories of worksites. One idea expressed was that prescriptive guidelines be developed for “green”, “orange” and “red” worksites. However interpreted, the approach assumes that worksites can be categorised into groups for which particular sets of guidelines are appropriate.

In accord with general principle 2. “roadworks can pose a safety risk to both roadworkers and other road users”, it was decided to categorise groups of worksites according to the level of safety risk to roadworkers and according to the level of safety risk to other road users, **if no risk controls were implemented**. Each of these risks was classified into low, medium and high levels.

The higher the level of risk to either roadworkers or other road users, the more likely it is that risk controls from higher in the hierarchy of risk controls (general principle 6.) will need to be used. For example, a high risk site is much more likely to require physical separation to achieve an outcome consistent with general principle 4. “risk control programs should aim to reduce the level of risk to any road user group (including roadworkers) to what it would be at that site before works commenced”. For a low risk site, measures to improve the conspicuity of the worksite and workers may be all that is necessary.

Figure 1 shows that the levels of risk to roadworkers and other road users at a particular worksite may differ. If, for example, footpaths were being reconstructed near a school on a street with no vehicles travelling in excess of 60 km/h, the level of risk to roadworkers might be judged to be low (since they are not on the roadway most of the time) but the level of risk to the children walking to school might be judged to be medium or high if they were required to (or were likely to) walk on the roadway.

		Level of risk to other road users		
		Low	Medium	High
Level of risk to roadworkers	Low			
	Medium			
	High			

Figure 1. Categorisation of groups of worksites according to the level of safety risk to roadworkers and road users.

As shown in Figure 1, worksites that are judged to pose low levels of risk to both roadworkers and other road users, if no risk controls were implemented, will be categorised as “green”. Worksites that are judged to pose medium levels of risk to either roadworkers or other road users, if no risk controls were implemented, will be categorised as “orange”. Worksites that are judged to pose high levels of risk to either roadworkers or other road users, if no risk controls were implemented, will be categorised as “red”.

The types of risk controls that would need to be implemented to achieve general principle 4. “risk control programs should aim to reduce the level of risk to any road user group (including roadworkers) to what it would be at that site before works commenced” are likely to be different for worksites that have high levels of risk to roadworkers only, compared to those that have high levels of risk to other road users only.

DECIDING WHICH CATEGORY A JOB FITS INTO

An attempt was made to generate risk categories based on:

- pre-existing travel speeds at the site
- location of the workers in relation to passing vehicles
- whether workers are pedestrians or vehicle occupants

Categorising a job requires answering three questions:

1. Before the works, are 95% or more of the vehicles travelling at less than 60 km/h?
2. Will roadworkers be on the roadway or within 3 metres of the travel lane on foot?
3. Will there be no, some or a large increase in the risk to other road users (either unprotected or protected)?

The criteria and categories to which they apply are summarised in Table 1. The controls relevant to each category are summarised in Table 2.

Speed measurements should be taken in an unobtrusive manner at the proposed worksite at times that reflect the traffic conditions under which work will take place (e.g. at night if work will only occur at night). If measured speeds reflect all vehicles (including those not travelling at free speeds), then median and 95th percentile speeds should be recorded. If speed measurements are not available, then the guidelines assume that the 95th percentile speed is greater than 60 km/h.

There is an inbuilt assumption that vehicle speeds will be the same or lower during roadworks, compared to before works commence. Thus, if speed profiles prior to work are considered appropriate, there is not a need to monitor or reduce them during work.

Alternative sets of controls were developed for those situations where travel speed is required to be maintained during the works.

CATEGORIES OF WORKSITES AND THE CONTROLS TO BE IMPLEMENTED

CATEGORY 1 “GREEN” WORKSITES

These comprise worksites where:

- 95th percentile of pre-existing vehicle speeds is less than 60 km/h
- workers are vehicle occupants or pedestrian workers are not on the road (even if they are within 3m of travel lane)
- works do not create safety issues for unprotected road users (pedestrians, cyclists and motorcyclists)

Controls required:

Since speed and separation are appropriate, the focus should be on ensuring site and worker visibility by appropriate signage and protective clothing.

CATEGORY 2 “ORANGE” WORKSITES

Orange worksites can be subdivided into:

- ORANGE1 Low risk to roadworkers, medium risk to other road users
- ORANGE2 Medium risk to roadworkers, low risk to other road users
- ORANGE3 Medium risk to roadworkers, medium risk to other road users

ORANGE1 Low risk to roadworkers, medium risk to other road users

These comprise worksites where:

- 95th percentile of pre-existing vehicle speeds is less than 60 km/h
- workers are vehicle occupants or pedestrian workers are not on the road (even if they are within 3m of travel lane)
- works create some safety issues for unprotected road users (pedestrians, cyclists and motorcyclists)

Controls required:

Since speed and separation of workers from traffic are appropriate, the focus should be on ensuring visibility of workers and the worksite by appropriate signage and protective clothing. The safety of unprotected road users should be addressed by signage for cyclists and motorcyclists, and physical separation or traffic control workers should be introduced if there are hazards to pedestrians.

ORANGE2 Medium risk to roadworkers, low risk to other road users

These comprise worksites where:

- 95th percentile of pre-existing vehicle speeds is less than 60 km/h
- pedestrian workers are on the road
- works do not create safety issues for unprotected road users (pedestrians, cyclists and motorcyclists)

Controls required:

Roadworks speed limit signs and speed feedback signs should be used to keep 95th percentile speed down to 40 km/h when pedestrian workers are on the road. If these procedures do not result in the required reduction in 95th percentile speeds, then enforcement by fixed speed cameras or other technology should be introduced. Given that the works do not create safety issues for unprotected road users, the speed reduction is required only while pedestrian workers are on the road.

ORANGE3 Medium risk to roadworkers, medium risk to other road users

These comprise worksites where:

- 95th percentile of pre-existing vehicle speeds is less than 60 km/h
- pedestrian workers are on the road
- works create some safety issues for protected or unprotected road users (pedestrians, cyclists and motorcyclists)

Controls required:

Roadworks speed limit signs and speed feedback signs should be used to keep 95th percentile speed down to 40 km/h (even when pedestrian workers are not on the road). If these procedures do not result in the required reduction in 95th percentile speeds, then enforcement by fixed speed cameras or other technology should be introduced.

CATEGORY 3 “RED” WORKSITES

Red worksites can be subdivided into:

- RED1 Low risk to roadworkers, high risk to other road users
- RED2 Medium risk to roadworkers, high risk to other road users
- RED3 High risk to roadworkers, low risk to other road users
- RED4 High risk to roadworkers, medium risk to other road users
- RED5 High risk to roadworkers, high risk to other road users

RED1 Low risk to roadworkers, high risk to other road users

These comprise worksites where:

- 95th percentile of pre-existing vehicle speeds is greater than or equal to 60 km/h
- workers are vehicle occupants or pedestrian workers are not within 3 metres of the travel lane
- works create a high level of danger to protected or unprotected road users (pedestrians, cyclists and motorcyclists)

Controls required:

Given the high risk to other road users, the preferred approach is to close the road while works occur. If this approach is not taken, roadworks speed limit signs and speed feedback signs should be used to keep 95th percentile speed down to 60 km/h at all times. If these procedures do not result in the required reduction in 95th percentile speeds, then enforcement by fixed speed cameras or other technology should be introduced.

RED2 Medium risk to roadworkers, high risk to other road users

These comprise worksites where:

- 95th percentile of pre-existing vehicle speeds is greater than or equal to 60 km/h
- workers are vehicle occupants or pedestrian workers are not within 3 metres of the travel lane
- works create a high level of danger to protected or unprotected road users (pedestrians, cyclists and motorcyclists)

Controls required:

Given the high risk to other road users, the preferred approach is to close the road while works occur. If this approach is not taken, roadworks speed limit signs and speed feedback signs to keep 95th percentile speed down to 60 km/h at all times. If these procedures do not result in the required reduction in 95th percentile speeds, then enforcement by fixed speed cameras or other technology should be introduced.

RED3 High risk to roadworkers, low risk to other road users

These comprise worksites where:

- 95th percentile of pre-existing vehicle speeds is greater than or equal to 60 km/h
- pedestrian workers are on the road or within 3 metres of the travel lane
- works do not create safety issues for protected or unprotected road users (pedestrians, cyclists and motorcyclists)

Controls required:

Given the high risk to roadworkers, the preferred approach is to close the road while works occur. If this approach is not taken, then Alternative 1 focuses on reducing speed, while Alternative 2 focuses on ensuring adequate separation.

Alternative 1

Roadworks speed limit signs and speed feedback signs should be used to keep 95th percentile speed down to 40 km/h when pedestrian workers are on the road or down to 60 km/h when pedestrian workers are not on the road but within 3 metres of the travel lane. Enforcement by fixed speed cameras or other technology should be introduced if the speed limit has been reduced to 40 km/h or if the 60 km/h speed limit does not result in the required reduction in 95th percentile speeds. Given that the works do not create safety issues for protected or unprotected road users, the speed reduction is required only while pedestrian workers are on the road. Traffic control workers are needed if pedestrian workers are on the road.

Alternative 2

Use barriers to separate traffic from pedestrian roadworkers. Speed reductions may be necessary if the barriers create safety problems for other road users.

RED4 High risk to roadworkers, medium risk to other road users

These comprise worksites where:

- 95th percentile of pre-existing vehicle speeds is greater than or equal to 60 km/h
- pedestrian workers are on the road or within 3 metres of the travel lane
- works create safety issues for protected or unprotected road users (pedestrians, cyclists and motorcyclists)

Controls required:

Given the high risk to roadworkers, the preferred approach is to close the road while works occur. If this approach is not taken, then Alternative 1 focuses on reducing speed, while Alternative 2 focuses on ensuring adequate separation.

Alternative 1

Roadworks speed limit signs and speed feedback signs should be used to keep 95th percentile speed down to 40 km/h when pedestrian workers are on the road or 60 km/h at all other times. If these procedures do not result in the required reduction in 95th percentile speeds, then enforcement by fixed speed cameras or other technology should be introduced. Traffic control workers are needed if pedestrian workers are on the road.

Alternative 2

Use barriers to separate traffic from pedestrian roadworkers and introduce speed reductions to the extent needed to improve the safety of other road users.

RED5 High risk to roadworkers, high risk to other road users

These comprise worksites where:

- 95th percentile of pre-existing vehicle speeds is greater than or equal to 60 km/h
- pedestrian workers are on the road or within 3 metres of the travel lane
- works create a high level of danger to protected or unprotected road users (pedestrians, cyclists and motorcyclists)

Controls required:

The preferred approach is to separate workers and other road users by closing the road when work is being undertaken.

Alternative 1: Use roadworks speed limit signs and speed feedback signs to keep 95th percentile speed down to 40 km/h at all times (even when pedestrian workers are not on the road). The speed limit should be enforced by fixed speed cameras or other methods.

Alternative 2: Use barriers to separate traffic from roadworkers and introduce speed reductions to the extent needed to improve the safety of other road users. The speed limit should be enforced by fixed speed cameras or other methods if more than 5% of vehicles exceed the posted limit.

SIMPLIFIED CATEGORIES FOR ASSIGNING CONTROLS

Following feedback that the matrix of controls was overly complex, an attempt was made to merge categories in terms of the controls appropriate. This reduced the number of Orange categories from 3 to 2 and the number of Red categories from 5 to 2 (see Table 3). Overall, there are 5 categories in the simplified system. The presentation was also modified so that preferred approaches and each alternative were in separate columns.

ISSUES OF IMPLEMENTATION

SHORT-TERM WORKS

Short-term works are often defined as works that will be completed within a day. This may involve short jobs at discrete locations or moving worksites (e.g. patching). In addition, there are some works where the workgroup may only be contacted the previous day. In these circumstances, the criteria for classifying worksites and the controls may need to be adapted. However, it is important to ensure that workers on short jobs are still provided with the same level of protection as workers on longer jobs.

Where works have to commence at short notice and travel speed information is not available, the safest approach is to assume that 5% of the vehicles will be exceeding the speed limit before the works and to classify the site in one of the Red categories. A less safe alternative would be to replace travel speeds in the criteria with the pre-works speed limit. Thus, sites with a speed limit of less than 60 km/h would fall into the Green or Orange categories and sites with a speed limit of 60 km/h or more would fall into one of the Red categories.

Where worksites are moving, setting out and removing signs and cones may be time-consuming and potentially dangerous and closing the road is rarely considered. Slowing traffic appears to be a useful approach here. Where the control matrices for Red sites specify a speed reduction, then providing signage on the vehicle and speed measurement and enforcement technology on the vehicle would enable this to occur without having to move signs. Requiring that motorists cannot pass an appropriately signed roadworks vehicle at greater than 40 km/h when workers are on the road (similar to school buses in NSW) is recommended.

RISK MANAGEMENT FRAMEWORK OR BLANKET SPEED LIMIT

This project set out to develop a framework for assessing and managing the risks associated with roadworks. The aim was to produce a framework that was as simple as possible. The level of success of success of the framework will depend on its practicality in implementation, how well the principles and practices are understood and can be implemented.

Members of the Working Party for this project have suggested that a simpler alternative would be implementation of a blanket 40 km/h speed limit where there is a “roadworks” sign and a 25 km/h speed limit if a worker is on the road on foot. This proposal is consistent with general principle 2 that lower travel speeds through worksites will reduce the likelihood and severity of injury to both workers and other road users. Indeed, the framework requires 40 km/h roadworks speed limits

- Where 95th percentile of pre-existing vehicle speeds is less than 60 km/h and pedestrian workers are on the road (Orange2/3)
- Where 95th percentile of pre-existing vehicle speeds is greater than or equal to 60 km/h and pedestrian workers are on the road or within 3 metres of the travel lane (Red 3/4/5) if physical separation (barriers) are not used

It may be that these conditions are true for a large proportion of roadworks sites and therefore application of the framework would result in 40 km/h speed limits at a large proportion of roadworks sites.

However, it should be noted that it is the actual travel speed (and particularly of the fastest vehicles), not the speed limit that affect the likelihood and severity of crashes. For these blanket speed limits to be effective, the extent of motorist compliance would need to increase markedly. An increase in levels of speed enforcement (whether manual or electronic) would probably be necessary for this to occur.

It is also important that the blanket speed limit not become a substitute for other risk control measures, such as physical separation.

The framework does not mention 25 km/h roadworks speed limits. A 25 km/h limit is probably justified if traffic very close to workers on foot (say less than 1.2 m).

SUMMARY AND FUTURE DIRECTIONS

This document has developed draft guidelines for ensuring the safety of roadworkers from a set of general principles underpinning the safety of roadworks. It sets out basic requirements without specifying details of implementation such as dimensions.

The original 9 categories deal with low, medium and high risk to roadworkers and other road users. A simplified version with 5 categories for implementation of risk controls has been developed. If either framework proceeds to implementation, there is a need to trial the useability and reliability of the framework. How easy is the framework for site personnel to use? Do different personnel agree on what category a certain site falls into?

Adaptations of the categorisation of sites and implementations of risk controls were suggested for short-term and moving worksites. While modifications to the methods currently used will improve safety at the majority of sites, it should be realised that some current practices are unacceptable from a safety point of view and this may need rethinking of how to do the task or decisions to close the road while work is underway.

Comments are made on the proposal that roadworks safety be further simplified by blanket 40 km/h and 25 km/h limits. It may be that 40 km/h roadworks speed limits, while not scientifically justified, may have a greater chance of achieving better safety outcomes than a more risk-based approach.

TABLE 1. SUMMARY OF CRITERIA AND CATEGORIES TO WHICH THEY APPLY

CRITERIA	VALUE	CATEGORIES WHERE THEY APPLY								
		Green Low worker- Low other	Orange1 Low worker- Med other	Orange2 Med worker- Low other	Orange3 Med worker- Med other	Red1 Low worker- High other	Red2 Med worker- High other	Red3 High worker- Low other	Red4 High worker- Med other	Red5 High worker- High other
Speed (5% of vehicles exceeding this speed before works)	less than 60 km/h	✓	✓	✓	✓					
	greater than or equal to 60 km/h					✓	✓	✓	✓	✓
Worker location	on roadway as pedestrian			✓	✓			✓	✓	✓
	not on roadway but within 3m of travel lane as pedestrian	✓	✓					✓	✓	✓
	occupant of vehicle	✓	✓			✓	✓			
Other road user issues	Some risk to unprotected or protected road users		✓		✓				✓	
	high level of risk to protected or unprotected road users					✓	✓			✓

TABLE 2. SUMMARY OF CONTROLS AND CATEGORIES TO WHICH THEY APPLY

CONTROLS	CATEGORIES WHERE THEY APPLY								
	Green	Orange1	Orange2	Orange3	Red1	Red2	Red3	Red4	Red5
Ensuring site and worker visibility	✓	✓	✓	✓	✓	✓	✓	✓	✓
Traffic control workers/temporary signals		✓ If hazards to pedestrians					✓ Alt 1 - if ped workers on road	✓ Alt 1 - If ped workers on road	
Physical separation		✓ If hazards to pedestrians					✓ Alternative 2	✓ Alternative 2	✓ Alternative 2
40 km/h signing and feedback when workers present			✓ If ped workers on road				✓ Alt 1 – if ped workers on road		
Continuous 40 km/h signing and feedback				✓				✓ Alt 1 – if ped workers on road	✓ Alternative 1
60 km/h signing and feedback when workers present							✓ Alt 1 – if ped workers not on road but within 3m		
Continuous 60 km/h signing and feedback					✓ Alternative 1	✓ Alternative 1		✓ Alt 1 – if ped workers not on road	
Speed enforcement			✓ If >5% vehs over works speed limit	✓ If >5% vehs over works speed limit	✓ If >5% vehs over works speed limit	✓ If >5% vehs over works speed limit	✓ If 40 km/h limit or >5% vehs over works limit	✓ If 40 km/h limit or >5% vehs over works limit	✓ If 40 km/h limit or >5% vehs over works limit
Close the road					✓ Preferred	✓ Preferred	✓ Preferred	✓ Preferred	✓ Preferred

TABLE 3. SIMPLIFIED CONTROLS AND CATEGORIES TO WHICH THEY APPLY

CONTROLS	CATEGORIES WHERE THEY APPLY							
	Green	Orange1	Orange2/3	Red1/2		Red3/4/5		
				Preferred	Alternative 1	Preferred	Alternative 1	Alternative 2
Ensuring site and worker visibility	✓	✓	✓	✓	✓	✓	✓	✓
Traffic control workers/temporary signals		✓ If hazards to pedestrians	✓ If ped workers on road				✓ While ped workers on road	
40 km/h signing and feedback			✓ While ped workers on road OR continuous if risk to other road users				✓ While ped workers on road OR continuous if risk to other road users	
60 km/h signing and feedback					✓ Continuous		✓ While ped workers not on road but within 3m	
Speed enforcement			✓ If >5% vehs over workd speed limit		✓ If >5% vehs over workd speed limit		✓ If 40 km/h limit or >5% vehs over limit	
Physical separation		✓ If hazards to pedestrians						✓
Close the road				✓		✓		