Road to Zero Speed and Infrastructure Programme Design Framework

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WAKA KOTAHI
NZ TRANSPORT AGENCY

New Zealand Government

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More information

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Contents

Introduction

The purpose of the Road to Zero Speed and Infrastructure Programme (SIP) “design framework” is to outline the Safe System philosophy for Waka Kotahi NZ Transport Agency and Local Authority transport infrastructure programmes and projects. These guidelines are intended for, but not limited to, all the corridors and sites that form part of the Road to Zero Speed and Infrastructure Programme.

This document outlines the design principles, standards and guidance to support the scoping and designing of projects within the Road to Zero Speed and Infrastructure Programme. This is to ensure that each project is contributing sufficiently to the outcomes sought by the programme.

The purpose is to ensure that Safe System outcomes are being optimised whilst guiding considerations and decisions that may lead to compromise on the grounds of project specific constraints.

The intent of the design framework is to embed Safe System principles at the forefront of all projects to ensure that every effort is taken to achieve the greatest Safe System alignment possible as part of the development and implementation of speed and infrastructure interventions on the transport network.

The key to the design principles is context sensitive design, this encourages flexibility, to ensure that designers investigate and adopt criteria considered appropriate and tailored to the corridor or site. These Safe System design principles for the Road to Zero Speed and Infrastructure Programme requires consideration of design criteria that may, in some cases, be outside of the normally accepted range to support the goal of optimising safe system outcomes.

The guiding philosophy should be to maximise alignment with Safe System Transformation as much as possible and wherever possible throughout project development.

Road to Zero Strategy and Action Plan

Road to Zero is New Zealand’s road safety strategy to significantly reduce road trauma over the period 2020 to 2030. The strategy’s vision is an Aotearoa New Zealand where:

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

The strategy puts in place an ambitious target of reducing deaths and serious injuries on our roads by 40 percent over the next 10 years. A series of action plans that outline the priority actions required to help us reach this target will be released over this 10-year period. The first action plan was released at the same time as the strategy and covers the three years from 2020-2022.

Road to Zero commits Waka Kotahi to Vision Zero and is underpinned by the Safe System approach.

Vision Zero acknowledges human error and fragility but doesn’t accept that death or serious injury should be an inevitable or acceptable outcome of travelling on our roads, streets, cycleways and footpaths. Adopting Vision Zero means committing to safety as a critical priority for investment and decision-making, and a greater focus on system changes rather than on addressing human error alone.

Underpinning this vision is the Safe System approach, which acknowledges that we all make mistakes on our roads but that these mistakes should not cost us our lives.

The Safe System approach aims to provide a more forgiving transport system that acknowledges people make mistakes and are vulnerable in a crash. It aims to provide a system that reduces the price paid for a mistake, so crashes don’t result in loss of life or limb. Mistakes (such as errors in judgement or lapses in attention) are inevitable; however, deaths and serious injuries from road crashes should not be. By designing all aspects of the transport system to protect people from death or serious injury when they are involved in a crash, we can make progress towards zero deaths and serious injuries on our roads.

The Safe System approach is guided by four principles, that acknowledge:

1. People make mistakes - We need to recognise that people make mistakes and some crashes are inevitable.
2. People are vulnerable - Our bodies have a limited ability to withstand crash forces without being seriously injured or killed.
3. We need to share responsibility - Those who design the road system and those who use the roads must all share responsibility for creating a road system where crash forces don't result in death or serious injury.
4. We need to strengthen all parts of the system - We need to improve the safety of all parts of the system - roads and roadsides, speeds, vehicles, and road use - so that if one part fails, other parts will still protect the people involved.

Adopting the Road to Zero vision represents an ambitious commitment to making some transformative changes, such as stronger leadership, committing to safety as a critical priority for investment and decision-making, and a greater focus on system changes rather than on addressing human error alone. It requires us to set clear goals and measure our progress against them.

To help us realise this vision, *Road to Zero* has seven guiding principles. The first four principles are grounded in and build on the Safe System principles while the last three are guiding principles to support the Safe System. The principles for *Road to Zero* are:

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

Road to Zero Speed and Infrastructure Programme Business Case

Speed Management and Infrastructure Strategic Model

Approximately half of the 40% national DSI target (approx. 600-650 DSIs saved) needs to be achieved through infrastructure and speed management. It is estimated that this will require an investment of approximately $5bn over the 10-year period.

The Road to Zero Strategic Speed and Infrastructure Programme outlines an optimised programme of individual elements (projects) prioritised based on DSi saved per $100m.

- More than 2,300 primary and supporting safe system intersection treatments.
- 1,000 km of median barriers on rural corridors and roadside barrier where practicable.
- More than 7,000 km of roads with a lower speed limit.

The strategic programme has been developed to determine the level of investment necessary to achieve this level of DSI reduction. By assessing the corridors and intersection level of risk and assigning an optimised treatment philosophy and an indicative level of investment.

As the strategic programme has been developed at a strategic level to provide indicative interventions and estimates. The project team are required to ground truth this to establish the deliverability of the interventions and costs within the programme.

- Safe System Transformation – this intervention assumes a central wire rope median barrier system with side barrier where practicable. This is known as a ‘Primary’ Safe System treatment.
- Supporting Safe System Treatment (medium cost) – this intervention covers a range of measures that move a corridor towards a safe system environment, such as wide centreline

treatment, carriageway widening, roadside hazard removal/protection etc. This is known as a ‘Supporting’ Treatment, which moves towards better Safe System alignment and is compatible with the future implementation of Primary Safe System Treatments.

- Supporting Safe System Treatment (low cost) – this intervention covers a range of measures that improve safety outcomes but do not materially change the IRR / Star Rating of the corridor. Interventions include measures such as audio tactile paving (ATP), enhanced delineation, improved surface friction etc. This is known as a ‘Supporting’ Treatment, which does not affect the future implementation of Primary Safe System Treatments.
- Rural Safe System Transformation – this intervention involves the upgrade of a priority-controlled intersection to a roundabout. This is known as a ‘Primary’ Safe System treatment.
- Rural Supporting Safe System Treatment (medium cost) – this intervention is based on safety improvements to existing roundabouts achieved through design enhancements or speed management measures, such as raised platforms. This is known as a ‘Supporting’ Treatment, which does not affect the future implementation of Primary Safe System Treatments.
- Rural Supporting Safe System Treatment (low cost) – this intervention is based on treatments such as RIAWS, Vehicle Activated Stop Signs, provision of turning bays, improved visibility etc. This is known as a ‘Supporting’ Treatment, which does not affect the future implementation of Primary Safe System Treatments.

TREATMENT PHILOSOPHY	DSi EFFECTIVENESS	INDICATIVE COSTS
Safe System Transformation	65% DSi reduction	$2.6m per km including maintenance costs
Supporting Safe System Treatment (medium cost)	30% DSi reduction	$1.25m per km including maintenance costs
Supporting Safe System Treatment (low cost)	15% DSi reduction	$0.4m per km including maintenance costs
Intersection Rural Safe System Transformation	70% DSi reduction	$3.3m per site including maintenance costs
Rural Supporting Safe System Treatment (medium cost)	40% DSi reduction	$0.5m per site including maintenance costs
Rural Supporting Safe System Treatment (low cost)	35% DSi reduction	$0.33m per site including maintenance costs

*Indicative cost and effectiveness of each Safe System treatment philosophy category as assumed in the Strategic Model (and Programme Business Case).

Development of the 10 Year Road to Zero Speed and Infrastructure Programme

To ensure that the speed and infrastructure outcomes sought by the GPS, Road to Zero Strategy and Action Plan are met, Waka Kotahi has led the development and approval of a single Road to Zero Speed and Infrastructure Programme Business Case for Local Roads and State Highways. This enables locally developed, agreed and prioritised activities to be implemented without further business cases for the 2021-24 NLTP period.

The Road to Zero Speed and Infrastructure Programme Team are responsible for the development, approval and implementation of the Road to Zero Speed and Infrastructure Programme.

As part of the annual reviews or by exception (e.g. an emerging road safety issue on a corridor or intersection), Waka Kotahi staff must engage with the Road to Zero Speed and Infrastructure Programme Development Team and Activity Class Manager to discuss the project scope and outcomes alignment with Road to Zero.

Commitment to the 10 Year Road to Zero Speed and Infrastructure Programme

To meet the Government's expectations on delivering the Road to Zero Strategy the programme has been developed as a 10-year programme running on three-year funding cycles.

Waka Kotahi Board endorsement

Road to Zero Speed and Infrastructure Programme Business Case was submitted and endorsed by the Waka Kotahi Board at the Meeting on Wednesday 24th February 2021.

Endorsement of the 10 Year Speed and Infrastructure programme by the Waka Kotahi Board provides Waka Kotahi staff, local authority partners, communities and the sector with a clear signal of the importance of the programme, which will ensure delivery momentum and eliminate any potential relitigating of the programme's outcomes and investment priority.

Road to Zero Speed and Infrastructure Programme Outcomes

To ensure that the speed and infrastructure outcomes sought by the GPS, Road to Zero Strategy and Action Plan are met, the following overarching programme outcomes have been developed and endorsed:

1. Waka Kotahi is committed under Road to Zero to work towards a future aspiration of Vision Zero, which will require Waka Kotahi, over time, to create a Safe System;
2. Safe System Principle #2 (People are vulnerable - Our bodies have a limited ability to withstand crash forces without being seriously injured or killed.) specifies a range of evidence-based injury tolerance limits (shown as survivable impact speed thresholds) to guide system design and prevention of exposure to key serious injury crash types: head-on (70km/h); intersection (50km/h); run-off-road (40km/h); and vulnerable user (30km/h) crashes;
3. The Road to Zero Action Plan (Page 12) calls for implementation of Primary Safe System treatments, i.e. those most closely aligned to Safe System principles, wherever possible.
4. The Road to Zero SIP programme sets the scale of implementation required from speed and infrastructure measures to achieve the interim 40% reduction in DSIs by 2030, working in harmony with other Safe System interventions and representing a significant contribution towards the longer-term Vision Zero aspiration;
5. The Road to Zero SIP Programme also sets out the level of investment and level of affordability achievable over the next 10 years to 2030, i.e. what can be achieved as a step towards Vision Zero and a Safe System;
6. SIP is focussed primarily on retrofitting safety measures to the existing road network, but the programme design principles should also be applied to other programmes;
7. Waka Kotahi should continually seek innovation to achieve greater outcomes and / or greater cost efficiency across the programme/s.

Safe System Boundary Conditions

As the programme seeks alignment to safe system outcomes, a simple test to check the alignment is for each project that is development under the programme to answer all the following Safe System boundary principles during the project development phase:

1) Is it possible to have a head-on crash at a speed greater than 70 km/h?
2) Is it possible to have an intersection (right-angle) crash at a speed greater than 50 km/h?
3) Is it possible to have a run-off-road (side impact with a rigid object) crash at a speed greater than 40 km/h?
4) Is it possible to have a crash involving vulnerable people (e.g. pedestrian, cyclist and motorcyclist) at a speed greater than 30 km/h?

Answering “yes” to any of these questions requires consideration of the most effective measures that can be implemented to achieve the best possible alignment with safe system principles.

Project Development

The challenge is to provide a solution that minimises harm and attempts to cater for all outcomes in a pragmatic and affordable compromise that aligns with Road to Zero principles.

Project Scope

For each project the treatment philosophy, level of intervention and an indicative cost has been determined from the development of the programme.

As the programme has been modelled to optimise our DSI savings for the dollars we are investing. This means that we can’t deliver the intervention at any cost as this will have significant impact on the programme performance, effectiveness and ability to deliver the programme outcomes.

Where there is a major departure from the intended scope of the project this must be escalated to the programme team and/or SIP Escalation Group (in some instances) for consideration and decision.

A major departure could include:

- The option no longer aligns with the project scope and treatment philosophy
- The option exceeds the intended cost expectation and exceeds the SSI cost range
- The option cannot be delivered within the intended timeframe
- The option is not aligned with the design principles unless prior agreement in the briefing document.
- A technical design departure that requires changes to the scope or adds costs to the project

A key project documentation is the design philosophy statement which should capture all the decisions for design etc and should be included as part of the brief.

Technical Design Departures

A technical design departure is defined as design criteria being considered or adopted outside of current Waka Kotahi design standard or guidance, unless it has been superseded by guidance contained within the design framework e.g. minimal seal cross section for median barrier and/or roadside barrier installations.

Technical design departures are not changes to project scope. Any changes related to the programme, project or activities treatment philosophy, intervention and design scope will need to be agreed to by the programme team and may require escalation to the SIP Escalation Group.

Specific technical design departures will be considered on a case by case basis by the relevant Waka Kotahi Programme and Standards Lead Advisor - Subject Matter Expert.

Early engagement with the appropriate Lead Advisor, programme safety representative and regional safety SME is required to determine if there is a requirement for a departure from standards and/or specifications or if it is a scope/design philosophy change.

Whole of Life Responsibilities

Consideration of whole of life cost (versus benefit) in decision-making can lead to improved planning and outcomes for operational and maintenance costs, when the project (and assets) are handed over for system management.

There is a need to ensure whole of life consideration in design have been optimised and:

- Projects are safe to operate and maintain (using a hierarchy of risk control approach)
- The impact of the design on corridor maintenance operations should be considered and minimised wherever practicable
- Decisions on scope are well-informed and made for the right reasons

It is expected that adherence to existing good practice for safety in design, maintenance in design and whole of life cost (versus benefit) through-out project lifecycle will capture these considerations and mitigate accordingly to a reasonably practicable level.

Road to Zero Speed and Infrastructure Programme Design Principles

The key to the design principles is context sensitive design, this encourages flexibility, to ensure that designers investigate and adopt criteria considered appropriate and tailored to the corridor or site that enables alignment to safe system with the implementation of primary safe system interventions.

These design principles for the Road to Zero Speed and Infrastructure Programme requires consideration of design criteria that may, in some cases, be outside of the normally accepted range to support the goal of optimising safe system outcomes.

There should be not relitigating of the treatment and/or intervention options as defined in the programme business case, SSI application and/or design brief.

The following six key (6) design principles are to be applied across the Road to Zero Speed and Infrastructure Programme to support the optimisation of road safety outcomes:

Principle 1 – Installation of median barriers should be on all roads satisfying the following conditions:

- **a posted speed limit of 90km/h or 100km/h and traffic volumes above 6,000 vehicles per day and**
- **a posted speed limit of 80 km/h and traffic volumes above 10,000 vehicles per day**

The objective of this principle is to optimise the degree of Safe System Transformation across the road network. It is acknowledged that this may not always be possible and that the level of investment assumed for individual projects across the programme will need to be considered. However, if a median barrier cannot be achieved then this should be supported with a documented justification.

In some cases, if the practical distance between turnarounds is excessive it may be necessary to simply provide a gap in the median. This option should only be considered when all other options have been ruled out. Ideally the number of accesses and turning movements in these cases would be low.

Where it is difficult or not possible to extend the median barrier past a driveway, or series of driveways, every effort should still be made to maximise the extent of median barrier installation over the length of the corridor. The overall objective should be to optimise the extent of median barrier installed along the corridor, noting that it may be necessary to leave gaps where all other options have been exhausted.

1. Under a Safe System, road users must be protected from head-on collisions above 70km/h, requiring us to progressively move the rural network towards physical separation (median barrier) or energy management (lower rural speeds - 80km/h, ideally supported by safety cameras);
2. Median barriers are a Primary Safe System measure to address head-on crashes, whilst also addressing around 40-50% of run-off-road crashes;
3. Corridors identified for Safe System Transformation should be treated with continuous median and roadside barriers. However, in many cases this will not be achievable in the short to medium term, requiring progressive improvements and further transformation over time;
    a. Where this cannot be achieved, the next step down in treatment type should be to treat with median barrier only. Where possible the median barrier should be supported by roadside barriers at high-risk locations;
4. Desirable values for cross-section components should be considered to accommodate median barriers but will ultimately be subject to affordability.

   a. If this cannot be achieved, then narrower (minimum) cross-sections must be considered to accommodate median barrier installation;

5. Cross-sections as narrow as 10m (without roadside barrier) should be accompanied by appropriate justification (and documentation) including design details, whole of life and management considerations e.g. pull-off areas, and an operational plan to be a shared with maintenance and first responders.
6. Cross-sections as narrow as 10m should be investigated before any decision is made to progress a Safe System Transformation corridor without a median barrier (which would in most cases require reducing the speed limit to 80km/h and also need to be supported by a Safe System Assessment report);
7. If roadside barriers are also to be installed then the minimum offset between median and roadside barrier should be 6.5m. Reductions in offset may be acceptable over short lengths, subject to approval;
8. Roadside barriers, which would generally be at high risk locations, may be set back from the pavement edge when a narrow cross-section is adopted to minimise pavement widening and so as not to affect the operation of the shoulder e.g. to provide shy distance for cyclists.
9. Median barrier should also be installed on roads identified for a Safer Corridor treatment philosophy where this can be achieved cost-effectively, i.e. achieving greater safety outcomes for the same investment.

Principle 2: Interventions should be designed to minimise earthworks and land purchase

The objective should be to maximise the safety outcome (Safe System alignment) within the most cost-effective cross-section or design criteria wherever possible. Every effort should be taken to minimise the amount or negate the need of land purchase, earthworks and pavement construction required.

Where all other options have been exhausted and land purchase becomes an important enabler for the project scope, it is an important to consideration reputational, legal, programme and cost risks.

In relation to State Highway projects, all property acquisition or agreements are undertaken through the Legal and Transport Property teams. Agreements with landowner shall not be undertaken without the direct input and approval of the Legal and Transport Property teams.

Principle 3: Single-lane roundabouts are considered as the most cost-effective Safe System intersection treatment

The objective is to optimise the implementation of single laned roundabouts as the preferred Safe System solution for at-grade intersections and accommodating turnaround manoeuvres. The design of and implementation of single lane roundabouts must be considered and investigated within the existing property boundaries. This will minimise costs and time delays without compromising the desired safety outcome and supports the Road to Zero Programme Outcomes.

Considerations associated with single lane roundabouts:

- for intersections with major corridor traffic volumes up to 20,000vpd;
- Roundabout size will be a balance between land requirement and compromises to desirable design values; influenced by available land and deliverability e.g. extent of complex traffic management;
- Supporting speed management interventions, such as vertical deflections, may be necessary to support safer speeds on roundabout approaches, particularly with smaller diameter roundabouts designed to fit within land constraints or in situations where adequate horizontal deflection or appropriate readability cannot be achieved.

Principle 4: Turnaround facilities should be corridor-specific

For each corridor, consideration will need to be given to the specific design of turnaround facilities that are aligned with Safe System principles and based on agreed design vehicles with flexibility around separation distances between facilities to accommodate corridor-specific conditions. Generally, designs should aim to:

- Prioritise turnaround facilities at intersections where desirable visibility and sight distances are achieved;
- Achieve a typical spacing of approximately 3 - 5 km.
- Preference would be installing compact roundabouts at existing intersections.

Consideration should also be given to coordinating the location of turnaround facilities with maintenance and stopping bays where appropriate to reduce additional widening and associated works.

The assessment of turnaround facilities (type and location) will largely be dependent on corridor-specific conditions, such as:

- Locations where desirable sight distance criteria are achieved (including, but not limited to intersections)
- Type (tracking and swept path analyses) and number of vehicles that need to be accommodated;
- Capacity – vehicle stacking requirement where there are nearby businesses, which generate large turning traffic movements in a short period;
- Locations where the road corridor has sufficient width or land may be able to be purchased.

An important aspect when considering turnaround type, location and design is obtaining a clear understanding of the local access requirements. Of particular note is the need to understand any times of concentrated use such as shift changes for businesses, unusual vehicle movement such as over-dimension vehicles or vehicles with unusual tracking characteristics such as farm machinery. Also, it is important to understand the frequency of these movements so that a reasonable level of service is provided and to avoid over investment in servicing an infrequent movement or vehicle type where a longer diversion is considered reasonable.

While the disbenefits of additional travel time and distance to individual users is acknowledged, it is highlighted that the turnaround facilities will provide for much safer right turning access off and onto the road for residents. Specifically, they can:

- Remove the need for drivers to simultaneously negotiate two directions of traffic when turning right onto the highway.
- Remove the risk of exposure to a rear end collision when turning right from the major road.
- Consolidate accessways and turning points at a safe point on the road.

Principle 5: Minimise impact on nearby or associated structures

The design of each corridor or intersection needs to minimise and mitigate any impacts on nearby or associated structures (bridges, retaining wall, culverts etc). For example, where the corridor treatment includes the installation of a median barrier, the implications for that treatment to continue over any corridor structures should be assessed but it is expected that in many cases it will be necessary to simply provide a gap in the median.

Specific design consideration should be given to how and where the median barrier starts and stops to ensure manoeuvrability for over-dimension vehicles (i.e. transitioning from bridge structure back to the traffic lane) and other considerations such as preventing informal U-turn spots.

This principle does not preclude roadside safety barriers from being investigated and implemented, when applicable and appropriate as defined in the project scope (i.e. roadside barrier at high risk locations).

Principle 6: Passing facilities should be retained wherever practicable

Safe system transformation projects quite often involve costly widening to create the additional space needed to accommodate median barrier.

The principles of narrower cross-sections should also be considered on passing lane sections, noting that passing lanes should generally be retained wherever practicable, subject to detailed and specific consideration.

This principle is further expanded in the supporting guidance. It does not preclude an existing passing opportunity being repurposed to a more appropriate arrangement, (i.e. a passing lane being converted to a slow vehicle lane) to best balance the overall traffic operations and the outcomes of the programme.

Within the programme there is also a need to ensure the projects minimise costs whilst still achieving a Safe System outcome. To achieve the Road to Zero targets, the safety investment needs to prioritise the investment of the safety dollar as wisely as possible.

Road to Zero Speed and Infrastructure Programme Design Standards and Guidance

While this section should be considered in the context of other Waka Kotahi design guidance (such as Cycling and Pedestrian network guidance) however the design standards and guidance contained within the design framework supplements other Waka Kotahi design standards and guidance in the context of the Speed and Infrastructure programme projects

This supplementary guidance is required because Waka Kotahi and Austroads guidance is not currently sufficiently aligned to safe system outcomes and simply applying or achieving guidance/standards will not be sufficient to achieve the outcomes sought by Road to Zero Strategy or the Speed and Infrastructure Programme.

Minimum Cross Sections

The following cross sections show the different scenarios for shoulder and median width based on the agreed minimum seal width; these are based on an assumption that the desirable lane width is 3.5m.

The following cross sections and associated seal widths have been agreed between SH&E Senior Manager, Road Safety and Transport Services National Manager Programme and Standards and supersedes other Waka Kotahi design guidance.

However, even these parameters may be varied for short lengths along a corridor to balance outcomes where local constraints require. For example, the median width may be incrementally reduced to a minimum of 1.0m in order to maintain lane and minimum shoulder widths; lane widths may be increased on tighter radius curves (<500m R) to accommodate truck/trailer off-tracking and simulation modelling should be used to determine the additional width required.

It should be noted that these widths are intended to guide designers where compromises could be considered mid-block down to the agreed minimum cross section. It is important that, when considering improvements on corridors including intersections that close attention is given to the operating dimensions and requirements to accommodate the appropriate design vehicles and all modes negotiating the intersection; both turning and through movements.

- Aim to achieve the desirable median width of 1.5 m as a priority.
- Depending on the existing pavement/seal width, adjust shoulder widths accordingly.
- On median width of 1.5m and less supporting measures such as ATP markings should be incorporated to minimise nuisance hits.
- Wide centreline widths – if a median barrier cannot be installed a wide centreline should be between 0.6m and 1.5m
- General consideration / evaluation of likely maintenance implications

National Cycle Routes

An effective shoulder width of 1.0 is desirable to accommodate cyclists in a rural location. Greater widths may be required where Cyclist numbers are significant or National Cycle Routes require a higher level of service and coincide with the corridor, even for a limited length.

SafetyNET contains a list of routes regarded to be part of the National Cycling Routes, some of it is not in the published cycling routes as they don't yet meet the design criteria.

https://www.nzta.govt.nz/walking-cycling-and-public-transport/cycling/cycling-in-new-zealand/cycle-touring/

Median Barrier with Continuous Roadside Safety Barriers

The minimum cross-section width for corridors with continuous median and roadside barriers should be 13.0 metres. This is to allow sufficient physical width of at least 6.5m between median and roadside barriers for two vehicles to pass in the event that one is broken-down or stopped. On an over-dimension route the desirable offset between median barrier and roadside obstructions (not including roadside barrier) is between 7.25 and 9.5m.

This does not require the total cross-section width to be sealed (as shown in the table below) as this would require costly widening of the existing carriageway. If widening of the pavement is required to meet the minimum seal width requirements (as shown in the table below) this needs to be critically assessed and carefully considered in respect of the cost effectiveness and constructability.

Roadside barrier should be offset as much as possible to achieve the 6.5m offset, this may require roadside barriers located with grass berms, or unsealed shoulders.

A reduced seal width cross section (less than 13.0 metres) maybe considered on lengths less than 500 metres where the increased in costs to project is not acceptable and a minimum offset of 6.25 metres between barriers is appropriate.

	Unsealed Shoulder Width /Berm (to barrier face)	Sealed Shoulder Width (min)	Traffic Lane Width	Central Median Width	Total Seal Width (min)	Total width between barriers (min)
Scenario 1	1.5m*	0.75m*	3.5m	1.5m	10.0m	13.0m
Scenario 2 (sections of less than 500m)	1.5m	0.75m	3.5m	1.0m	9.5m	12.5m
Scenario 3 Passing Lane	1.0m	0.75m	3.5m	1.5m	13.5m	15.5m

* For instances where road widening is required to achieve the total seal width, it is expected that the sealed shoulder width and unsealed shoulder width are interdependent of one another (i.e. if one is increased, the other decreases) and this needs to be critically assessed and carefully considered in respect of the cost effectiveness and constructability. Where side barriers are not installed, this dimension may be reduced to 0.5m to maintain pavement stability (see table below).

Median Barrier with No Roadside Barrier

The minimum seal width for a corridor fitted with a median barrier (no roadside barrier) is 10.0 metres; comprising a 1.5m median, 3.5m lanes and 0.75m sealed shoulders.

If widening of the pavement is required, this needs to be critically assessed and carefully considered in respect of the cost effectiveness, constructability and impact on the programme.

A reduced seal width cross section (less than 10.0 metres) maybe considered on lengths less than 500 metres where the increased in costs to project is not acceptable.

	Unsealed Shoulder Width/Berm*	Sealed Shoulder Width (min)	Traffic Lane Width (min)	Central Median Width (min)	Total Seal Width (min)
Scenario 1	0.5m	0.75m	3.5m	1.5m	10.0m
Scenario 2 (sections less than 500m)	0.5m	0.75m	3.5m	1.0m	9.5m
Scenario 3 Passing Lane	0.5m	0.75m	3.5m	1.5m	13.5m

* Where side barriers are not installed, a 0.5m unsealed shoulder or berm should be installed to maintain pavement stability.

Maintenance and Emergency Stopping Management

Provision for stopping includes non-discretionary and elective stopping to allow safe pull over in the event of an emergency or voluntary scenario. Opportunities for stopping, including existing features such as driveways or level areas, traversable unsealed shoulders, as well as designed stopping bays or widen sections of shoulder can be provided at least every 3km - 4km. But this will largely be dependent on corridor-specific conditions, alternative traffic management solutions and project justification.

Turnaround areas can also provide an alternative location for vehicles to safely stop such for maintenance and in an emergency. Additional width to allow for stopping may be necessary to accommodate these activities.

Moving Crown

In many cases it is more economic and practical to achieve the required carriageway width by widening on one side of the carriageway only. This results in a situation where, assuming symmetrical cross fall, the crown of the widened road is no longer on the centreline.

If the crown moves towards the centre of the traffic lane this can pose safety issues for motorcycles and to a lesser extent cars, which may encounter stability issues as they move from straddling the crown to traversing the crown.

If the carriageway is being widened to accommodate a wide centreline or central median possibly with a central barrier, and the new crown lies within the median there is not really a problem.

If, however, the crown moves into the lane, this is when safety issues may arisee, and a departure is required, which must include a location specific risk assessment and cost implications. Based on the following considerations:

- Noting that wheel tracks are generally 250mm inside the lane line, where the wheel path lies in relation to the crown
- Whether the crown is parallel to the median lines and varying in offset
- How any transitions back to normal symmetrical cross fall are managed to ensure that the crown does not move to the wheel paths
- Widening both sides.
- Shape correction to reinstate the crown to the centreline.

Road Safety Barrier Systems

Flexible systems are preferred where possible, as these barrier types have the higher energy absorption qualities to lower impact severity and greatest potential to reduce occupant injury.

If the cross section is minimal and cost-effective widening or changes to the road layout are not possible, priority should be given to the installation of the median barrier over roadside barrier.

Barrier systems shall be designed by a suitable qualified designer (NZTA Barrier design course or equivalent) and must be designed in accordance with NZTA M/23 Specification and supporting appendices.

Roadside Safety Barrier Systems

The key feature associated with the placement of a roadside safety barrier system is the ‘effective shoulder width’. This will vary according to the anticipated usage, particularly where the corridor forms part of a strategic cycle network.

The desirable offset to a roadside safety barrier system from the back of the ‘effective shoulder’ is 0.5m.

This provides sufficient ‘shy distance’ from the barrier so that its intended purpose is not compromised. The strip of verge between the back of the effective shoulder and the safety barrier system does not need to be sealed and should slope at the same rate as the adjacent lane or shoulder. The whole of life responsibilities (and costs) should be considered when the placement of the roadside safety barrier will result in an unsealed shoulder width greater than 0.5m, and a median barrier is present.

Structured, High Performance or Audio Tactile Profiled Marking (ATPM)

This section does not supersede existing guidelines and standards on these type of road markings. It is setting the boundary conditions as to what is applicable in context to infrastructure projects from SIP.

The minimum standard of road marking that should be considered in a safe system transformation or safer corridor is ATPM.

- In the median, this should be included everywhere without exception, unless agreed.
- On the edge-line it may be considered appropriate to not install ATPM where the edge-line is within 200m of a dwelling. In which case, the marking should be structured high performance long-life markings.

Nearby existing ATPM that is at its end of life should be considered and included in work where applicable.

Turnaround Facilities

The development of turnaround facilities should be aligned to safe system principles.

Further design guidance is being developed for turnaround facilities. Where justified based on vehicle movements, installing compact roundabouts is the ideal Safe System turnaround solution at existing at-grade intersections and are the preferred method. These are most likely to be able to be justified when consolidated with one or a number of side roads and a turnaround. Where roundabouts cannot be justified then there is a hierarchy of options.

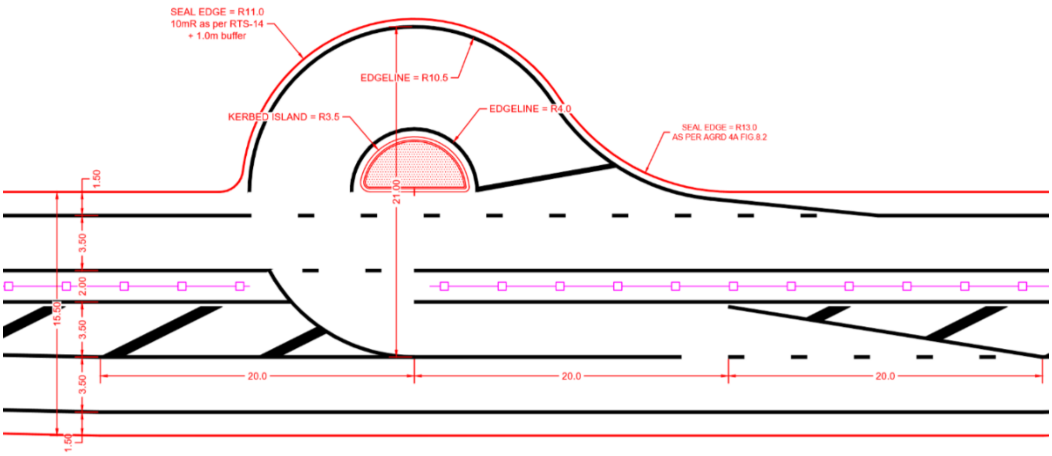
For each corridor, consideration will need to be given to the specific design of turnaround facilities and separation distances between facilities to accommodate corridor-specific conditions. In practice a combination of turnaround methods on each project is more likely.

The primary purpose of providing turnaround facilities is to support the installation median barrier and ensure the median barrier is optimised and as effective as possible.

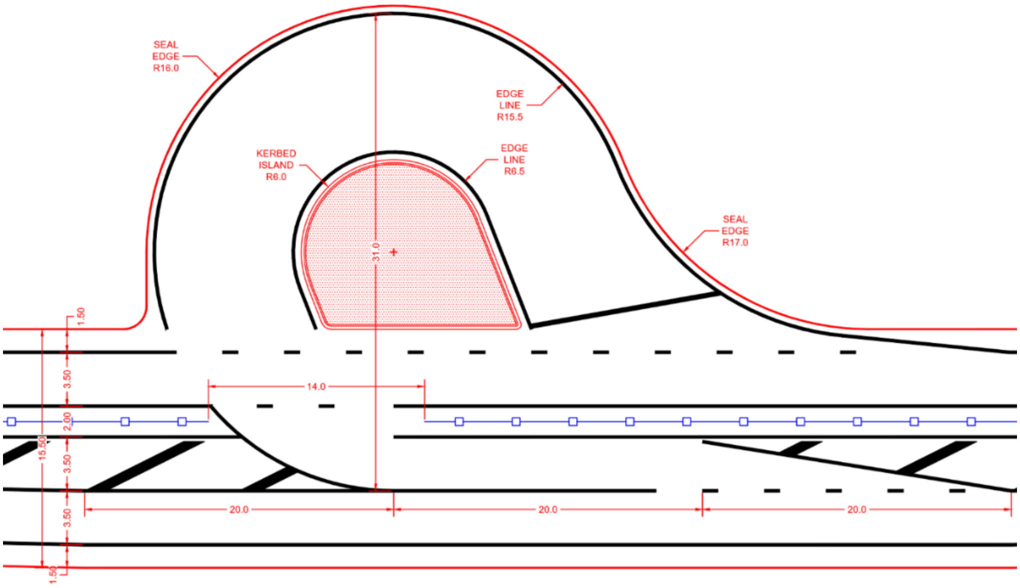
When looking to provide access arrangements following the introduction of a median barrier there is a hierarchy of options. At one end of the scale there is the provision of grade separated facilities or well-spaced roundabouts with full turning capability while at the other end there would be simple median breaks serving a single access, or no access at all. In between we have a range of options from full size jug handles capable of accommodating a quad axle semi, through to smaller jug handles for emergency services and 8m single units.

In exceptional circumstances where there are isolated accesses, or it is either impossible or uneconomical to secure the land required for a turnaround facility then a simple barrier gap may be considered. In these cases, it is important to ensure that as much safety as built into the arrangement as possible including ensuring adequate sight lines are available through the central barrier and consideration is given to providing widening opposite the access.

The following indicative 'Jug Handle' turnaround facilities have been developed. These are draft layouts and not to scale and cater for different vehicle tracking. Although the default design vehicle for the State Highway network is the 18m quad-axle semi-trailer, this should not be the default design vehicle for turnaround facilities. The designer should consider the generation of vehicles that would need to use these facilities and select a design vehicle accordingly.



'JUG HANDLE' TURNAROUND FACILITY
8m TRUCK AS PER RTS-18
SUITABLE FOR EMERGENCY VEHICLES.
SCALE 1:250 [A4]



'JUG HANDLE' TURNAROUND FACILITY
19m QUAD-AXLE SEMI AS PER RTS-18
SCALE 1:250 [A4]

Where possible and practicable a spacing 3 – 5 km between turnaround facilities should be adopted. This is considered a reasonable balance between the safety benefits gained and the access requirements for residential or business access for multiple trips on a daily basis.

It may be considered reasonable to have longer spacing of 5km+ to accommodate some larger vehicles. These may be service vehicles for residential properties which need access from time to time or for agricultural vehicles which may only need to be provided for on a more occasional basis.

Wayfinding is an important element for drivers to be able to quickly and easily identify and understand turnaround locations. The level of signage will be different for turnaround areas off the side road than those that are immediately adjacent to the highway which can be more readily identified. The signing options are currently being finalised but in the interim, there is agreement on using general advisory information (text) type sign (example site: SH1 Dome Valley).

Lighting, if applicable, is to be designed in accordance with layouts similar to AS/NZS 1158.

Raised Safety Platforms

Raised Safety Platforms (RSPs) are elevated sections of road that aim to manage vehicle speeds on the approach to areas of higher risk, such as an approach to an intersection or at a pedestrian crossing.

RSPs are speed management treatments capable of reducing the maximum comfortable operating speed for a vehicle, thus managing the speed of vehicles to match the required operating speed and help manage collision speeds within Safe System tolerances. RSPs may be designed for a range of vehicle speeds and types. Achieving operating speeds ≤ 50km/h are encouraged to reduce the side-impact severity for a vehicle to a survivable level. Achieving operating speeds ≤ 30km/h are encouraged to reduce the severity of any pedestrian or cyclist related crashes to a survivable level.

Waka Kotahi is currently drafting RSP design guidance until this has been completed it is advised to use the Vic Roads Design Guidance.

https://www.vicroads.vic.gov.au/-/media/files/technical-documents-new/road-design-notes/road-design-note-0307--raised-safety-platforms-rsp-version-c2.ashx

The implementation of RSPs typically involves the following:

At intersections:

- placing platforms on the approach to an intersection
- so that motorists ascend on the approach to, and descend on the departure from, the intersection

At mid-block locations:

- placing platforms mid-block as a traffic calming device or to improve safety at pedestrian crossings (suitable for local roads and low speed arterial roads)

Figure 1 Example of RSP's at a new signalised intersection (Thomas Road / Gordonton Road, Hamilton)

https://www.nzta.govt.nz/assets/Safety/docs/road-to-zero/case-study-raised-safety-platforms.pdf

The recommended approach ramp grades to achieve Safe System speeds are detailed in the table below. These grades are designed to optimise the likelihood of vehicles slowing to the desired speed when entering an intersection, while minimising undue occupant discomfort, risk of heavy braking or vehicle damage.

Easing of ramp grades below values listed in the table below may be considered to accommodate certain road users, such as heavy vehicles, emergency vehicles, buses, bicycles or low floor vehicles. This should be balanced against the extent of speed reduction required for the majority of road users and vehicle types – i.e. adopting a reduced grade to accommodate a particular user type may result in the majority of users being able to traverse the RSP relatively comfortably, thus reducing effectiveness.

Additional supporting treatments may also be necessary to achieve the desired operating speeds and alert drivers to the unique environment.

Platform Length (min)	Platform Height	Operating Speed (km/h)	Divided Carriageway			Undivided Carriageway	
			Approach Ramp Grade	Departure Ramp Grade	Advisory Speed (km/h)	Approach/ Departure Ramp Grade	Advisory Speed (km/h)
6 metres	100mm	50	1:15	1:35	30*	1:20	30*
		60	1:20		40	1:25	40
		70	1:25		50	1:25	50

*For use with priority pedestrian crossings

Every effort should be made to establish the operating speed of a corridor in order to select the most appropriate platform profile. However, in the absence of this information, and for the purposes of the interpreting the data above for urban roads the adoption of an operating speed equivalent to the posted speed limit is appropriate and for rural roads an operating speed of 10km/h greater than the posted speed limit should be adopted.

There are some notable characteristics to avoid for RSPs:

- Sites with notable horizontal or vertical curves that may impede sight lines to RSPs and associated signing
- Sites with vertical clearance restrictions e.g. overhead structures and/or overhead utility services.
- Sites that will not cause critical instability or truck roll over for minor errors.

Where there are heavy truck volumes or in highly populated areas, careful consideration should be given to the use of RSPs because of the related operating noise. However, consideration maybe given to reducing the approach gradients to mitigate adverse effects before discounting the installation..

Other road users such as emergency services, buses, motorcyclists, cyclists, visually impaired, etc. should be considered in the project risk assessment based on the individual merits and context of the project, in determining the feasibility of the site selected for treatment. If the proposal presents an unacceptable risk for other road users, the treatment should not be considered further.

RSP's that are improving pedestrian crossings or providing a new crossing opportunity, should be considered (and designed) in conjunction with the relevant pedestrian planning and design guide (Pedestrian planning and design guide | Waka Kotahi NZ Transport Agency (nzta.govt.nz)).

RSP's can be constructed out of concrete, asphalt or a combination of the two. Asphalt has a shorter design life than concrete, however, is considerably cheaper than concrete due to the reduced construction timeframe and materials and should be the preference in most cases. Quality assurances checks and robust construction methodology is required to ensure that the desired ramp profile is achieved through the construction process.

Compact Roundabouts

Waka Kotahi is in the process of formalising design advice for compact roundabouts, for inclusion in the design framework.

Compact roundabouts for rural high-speed environments are a relatively recent treatment option and while they have not been widely implemented, they show potential to achieve high safety benefit at generally lower cost than more conventional roundabout layouts.

A compact roundabout is a roundabout intersection treatment that comprises a non-mountable central island with a diameter smaller than conventional roundabouts noted in AGRD Part 4B. They may utilise a concrete apron in order to accommodate the required design vehicle while minimising land-take. However, it is still important for the central island to provide target value for drivers to facilitate awareness and readability of the intersection.

Where there is an identified speed management concern then this should be assessed and confirmed (and monitored as appropriate) before considering design modifications. Entry speed concerns are commonly the result of a lack of awareness and readability of the layout for drivers. Depending on the speed environment of the approach, visual cues e.g. deflection, conspicuity (target value) of the central island, increase in chevron sign sizes should be applied and observed for a period after opening. If the entry speeds remain unacceptably high, then raised safety platforms may be installed on individual legs to appropriately manage entry speeds of vehicles to safely match the operating speed of the circulating carriageway.

The size of the central island is larger than that of a 'mini roundabout' (which have a maximum central island diameter size of 4m and are generally used in low-speed environments). Compact roundabouts should be designed to conform to the overarching principles of roundabout design described in AGRD Part 4B so that they provide consistency and achieve comparable safety benefits.

A number of methods exist to reduce (or encourage drivers to reduce) approach speeds. These include:

- Central Island and splitter island features
- Perceptual line marking

- Advance warning signs
- Raised safety platforms

It should be noted that pedestrian crossings, or combined pedestrian and cycle crossings, at roundabouts should always be placed on a raised safety platform to increase its effectiveness. These should be placed between 6m and 12m from the circulatory carriageway.

A variety of approach platform configurations are possible when the risk of a higher than desirable approach speed has been identified, for example:

- the roundabout itself is raised and a platform is provided in advance to gradually reduce motorist speeds on the approach.
- a single RSP is provided on the approach to the roundabout at a point at which the management of approach vehicle speed is critical to managing the entry speed into the roundabout

Consideration needs to be given to heavy vehicles at compact roundabouts. The size of the central island, circulating carriageway and apron (if required) will all be determined based on the swept path and turning speed of the design and checking vehicles. This should be an iterative process using constraint points at the site to inform the design.

A compact roundabout design will require the careful consideration of the design vehicle than provided for in a conventional roundabout design (i.e. a single unit truck/bus or a service vehicle rather than a semi-trailer truck). As such, when considering adoption of a compact roundabout, it is important to note that the general design vehicle for the state highway network and therefore the default design vehicle is the quad-axle semi-trailer. The design vehicle for other roads should be informed by a good understanding of the type and number of vehicles that will be using the roundabout, including their OD patterns through the roundabout.

The appropriate design vehicle should be able to negotiate the intersection without encroaching onto areas behind the kerb or conflicting with other movements.

The checking vehicle may have to negotiate the intersection in a less desirable way, such as at the absolute minimum speed (generally the stop condition) or by encroaching onto areas behind the kerb. This is considered acceptable due to the infrequency of these movements. However, this may influence design elements including the location of signs, the kerb profile (1V:3H) and the provision of additional paved areas (e.g. behind kerbs, or aprons at the corners of the intersection to cater for left turn movements).

Passing (Overtaking) Facilities

More specific guidance is currently being developed but the purpose of this section is intended to provide an appropriate level of process with regard to the assessment and decision-making at passing facilities that are within scope of SIP. It also sets out a simplistic structure as to how the story can be articulated and explained.

If the SIP scoped treatment philosophy (and intervention/s) cannot practicably be achieved in the roads existing cross section, then there are two criteria's (in order) that should be considered if a passing facility is retained or repurposed/removed:

1. Safety performance

2. Efficiency and Effectiveness

User experience (perception of frustration) is also critical to understand at each particular site (or facility) but this aspect is intertwined in the above two criteria.

Safety Performance

In terms of safety, the recently completed Austroads projects (NTM 6025 and NTM6189) found that almost half of New Zealand passing lane installations resulted in an increase in crashes over the length from 2km upstream to 5 km downstream.

This being the case, it is worth determining whether the passing facility is considered to improve safety. Typical safety performance indicators, but not limited to, for a passing facility include;

- Length
- Speed limit and operating speed environment
- Speed differential between vehicles
- Volume of traffic and HCVs
- Appropriate diverge, merge or termination run out layout,
- Readability of termination e.g. ends over a crest or on a horizontal curve,
- Is immediately upstream of geometrically constrained alignments with posted curves
- Presence of intersections within the length, including tapers
- Number of accessways within the length, including tapers
- Opportunity for inappropriate speed

If one or more of the above safety indicators are present it is likely that either modification or repurposing may improve safety and overall performance of the passing opportunity.

As a do-minimum, modification (if required to fix a safety concern i.e. incorrect merge layout) should be investigated.

Passing lanes that are on flat terrain may encourage or even require overtaking drivers to exceed the posted speed limit in order to complete the passing manoeuvre and as a consequence are more likely to result in excessive downstream speeds which will impact safety as well.

Corridor Uniformity

The road corridor in and around passing lanes are often sections which experience greater constraints and the ability for additional widening can be challenging.

Removal of a passing facility to repurpose the road space, in these instances, will support median installation as well as maintain additional shoulder width for cyclists and vehicles. However, this improvement may only be over the relatively short length of the passing lane.

In these instances, it will be important to consider how the balance of the safety risks are affected by the passing lane and how this length relates to the cycle journey length and the context of the wider corridor being treated. i.e. If the passing lane length becomes the corridor constraint and there is either latent or observable cycle demand, then consideration should be given to either omit median barrier for the length of the passing lane, repurpose or to the removal of the passing lane.

If the shoulder on the rest of the route is similar or narrower, then the benefits of passing lane removal will be marginal.

Efficiency and Effectiveness

The bulk of the efficiency benefits accrue downstream of the passing lane. However, if the traffic re-forms platoons relatively quickly after the passing lanes, these benefits will be small or potentially non-existent.

It is also worth noting that the merge capacity at the end of a passing lane is invariably less than the adjacent sections of single carriageway, i.e. in the order of 1400-1600 vehicle per hour for the merge compared with 1800-2000 for a mid-block single lane. As a result, passing lanes can reduce the ultimate capacity of a highway corridor. This is the key reason for improving capacity by closing passing lanes during peak holiday periods.

Typical efficiency indicators, but not limited to, for a passing lane include;

- a lack of an intersection or geometric feature e.g. sharp curves or steep or long gradients that do not result in a speed differential,

- inadequate length so that relatively few vehicles can overtake relative to the demand for overtaking (also related to speed differential),
- Located on a route where traffic volumes in the direction of the passing lane often exceed 1400 vehicles per hour,
- Subject to higher volumes and downstream constraints so that traffic quickly re-forms platoons
- Immediately upstream of an urban area, development or major intersection which causes traffic to re-form platoons

If any of the above efficiency indicators are present it is likely that either repurposing the space will not significantly impact network performance.

Re-purposing of a passing facility could include:

- Re-marking to a slow vehicle lane
- Road width to be reallocated to shoulder and wide centreline widths (with median barrier)
- Provision of additional width to allow slower vehicles to pull-over or stop
- Provision of maintenance bays

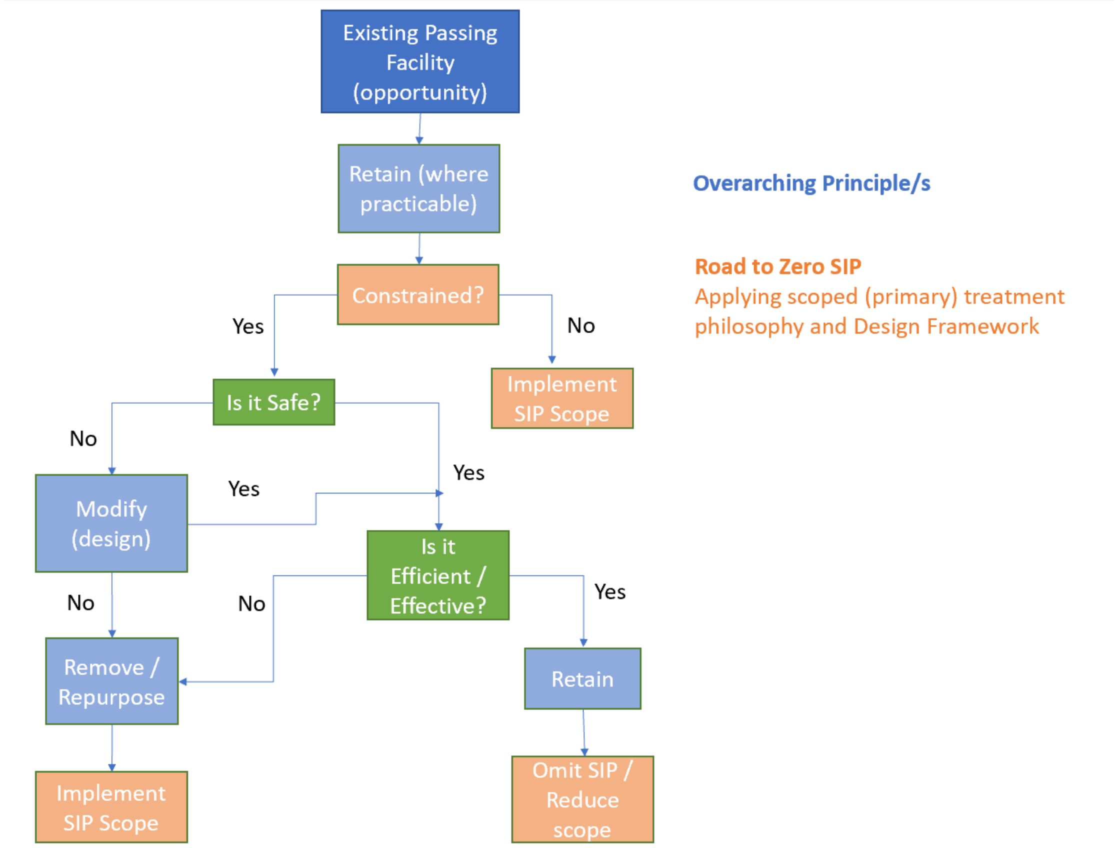
Open road speed limit changes

The implementation of the Speed Management Programme has resulted in some questioning the need to retain passing facilities when the posted limit has been reduced from 100km/h to 80km/h.

There is not a direct relationship with a change in speed management, and the typical considerations outlined above, will continue to apply equally i.e. analysis/assessment done of the impact from the speed limit change will have on the speed profile and operation of the passing facility.

Process in practice

The following assessment flow-chart has been developed as a guide to outline the type of considerations that should be made when considering the impacts of SIP scope on existing passing facilities (and opportunities).



Safe System Assessments and Road Safety Audits

A road safety audit will still be required at the various design phases to identify any safety issues and the associated risk profile of the proposed design.

https://www.nzta.govt.nz/resources/road-safety-audit-procedures/

A Safe System Assessment is to be conducted prior to the feasibility options being finalised. Once scope is confirmed during the Feasibility project phase a preliminary safety audit should be conducted on the preferred option.

A Road Safety Audit Exemption form will be required to be completed and signed for the concept road safety audit phases based on the condition that a safe system assessment has been carried out.

PROGRAMME DELIVERY PHASES	FEASIBILITY		DETAILED DESIGN	POST CONSTRUCTION
Road Safety Audit Phases	Concept (options)	Preliminary Design (preferred option)	Detailed Design	post construction*
Audit Type				
Safety Audit		√	√	√
Safe System Assessment	√			
Road Safety Audit Exemption Required	√			

- Note that a post construction audit normally takes place between 1 and 3 months of the removal of the temporary speed limits (TSL). This audit should be preceded by a pre-opening safety inspection by the regional safety team to assess whether the works are completed sufficiently to remove the TSLs.

Maintenance and Operations

The issues faced by the road maintenance industry as the shape and nature of our road corridors transition towards a Safe System environment. Inevitably this will culminate in increased amounts of road and roadside furniture that will not only require maintenance itself but also whose presence will require modifications to current maintenance practices.

While solutions to these issues will vary with region and practitioner, the intention is to provide a level of broad guidance to give the industry a way forward. With experience and knowledge sharing it is anticipated that practice will become more consistent and effective.

Innovation Opportunities

We have an opportunity to learn and share knowledge between regions that will have a positive impact on delivering our Road to Zero strategic outcomes.

This will be more challenging in some regions than others, as what is considered a change in maintenance and operational requirements in one region could be current practice for another region.

1. More works potentially carried out at night time, this reduces exposure with high traffic volumes for workers.
    a. Overnight maintenance work on State Highway 51 at the Hyderabad Road and Georges Drive intersection, and on State Highway 50 at the Prebensen Drive roundabout.
2. More road closures to carry out works, less overall impact on customers, more efficiency, eliminate exposure for workers, more work can be carried out a once.
    a. Remutaka Hill closures to carry out resurfacing and maintenance activities
    b. SH1 Wellington Tunnels Closure Programme
3. Less granular pavement overlays, more recycling, in-situ cement or foam bitumen stabilisation, this also reduces impact on customers.
4. Review KPI/OPI response times for barrier/road furniture replacement, programme repairs at an agreed timeframe to maximise traffic management.
    a. SH58 road closure from 9am-4pm for 3 consecutive days for essential maintenance. This maintenance includes drain works, guardrail repairs, sign repairs, weed spraying, and litter clearance.
5. Barrier installation innovations eliminating the need for solid concrete foundations in the pavement. This makes pavement rehabilitation easier.
    a. Driven socket post system methodology
6. Improved annual planning to capture costs associated with the removal and reinstatement of road safety barriers, audio tactile pavement markings and traffic management.

Temporary Traffic Management

It is acknowledged that the presence of different infrastructure assets within the road corridor will have an impact on how these and other assets are maintained, as it may in some cases make construction and maintenance activities more challenging.

The SIP infrastructure teams should engage the Maintenance and Operations teams and their respective NOCs to undertake more detailed planning to understand the risks and potential changes to maintenance and construction methodologies that should be captured within the Maintenance and Incident Management Plan (MMP) and Traffic Control Plan.

This will need to be reflected in the TTM practices of mobile operations, stop/go operations, sign placement, set up and set down procedures etc.

Waka Kotahi will work with industry to better understand what these challenges are so we can plan for it, acknowledge it within contracts and ensure that there is sufficient funding (annual plan) to carry out the works, in current and future NLTPs.

The risk of death or serious injury to workers working within the 'deflection zone' of a roadside safety barrier system is significantly reduced compared to that of unprotected workers.

Corridor Specific Road Closure Plans

As each Network Outcomes Contract (NOC) has been required to development an Emergency Procedures and Preparedness Plan and Traffic Control Plan many of the known issues should be documented and appropriate mitigation measures identified.

To support these contract plans development of specific road closure procedures document maybe required to supplement the EPPP to outline the required organisational responses to incidents causing partial or complete closures the state highway.

The Emergency Procedures and Preparedness Plan (EPPP) defines the roles, practices and procedures in preparation for and during an incident response event. The EPPP must be developed by the Contractor and agreed with the Principal and any other stakeholders the Principal may identify.

The Traffic Control Plan (TCP) establishes the practices for traffic management at a Network level, project level and customer level. All TMPs required to perform the Contract Works must be developed by the Contractor and accepted by the Principal.

Vehicle Breakdowns

In case of a breakdown, a width of 6.5m between barriers allows for 2.5m wide vehicles to pass with 0.5m to the barriers and 0.5m between them. As stated previously, for short sections, of less than 500 metres length, a width of 6.25 metres is acceptable

Inevitably, there will small inconveniences and they should be minimised as much as practicable e.g. periodic widening.

Opportunities for stopping, including emergency, non-discretionary and elective stopping, will be considered for narrow cross-section designs. This could include stopping bays or widened sections of shoulder at regular intervals of the order of every 3km-4km. These will vary as the corridor's characteristics allow and could include existing widened areas around accessways, berms, intersections or older, superseded (improved) sections of road The precise frequency should be determined with consideration of a corridor plan (including alternative traffic management solutions), minimising the cost of earthworks required, providing adequate sightlines, and targeting high risk stopping sites.

Maintenance and service authority access points should be strategically located to support maintenance activities, utilising existing driveways, sideroads and turnaround facilities.

Road safety barrier systems

Median Barriers

Regarding maintenance, Waka Kotahi has investigated variables that influence barrier strikes as well as the cost of associated collision maintenance. This information has been compiled into a predictive model which can be used to investigate the effect of barrier type and environmental factors such as median width and carriageway width on collision maintenance costs.

The tool is available for use to help better understand the potential maintenance costs from barrier strikes on median barriers.

https://www.nzta.govt.nz/resources/research/reports/580

https://www.nzta.govt.nz/assets/resources/research/reports/580/580-quantifying-the-likelihood-of-barrier-strike-maintenance.pdf

NZTA will be undertaking further research to better understand operational issues associated with narrow cross-sections. However, available evidence suggests maintenance is manageable and delays are no worse than for other types of roads on other parts of the network. [1]

[1] Bergh, T. et. al. (2016) 2+1-rpads Recent Swedish Capacity and Level-of-Service Experience. International Symposium on Enhancing Highway Performance (ISEHP 2016)

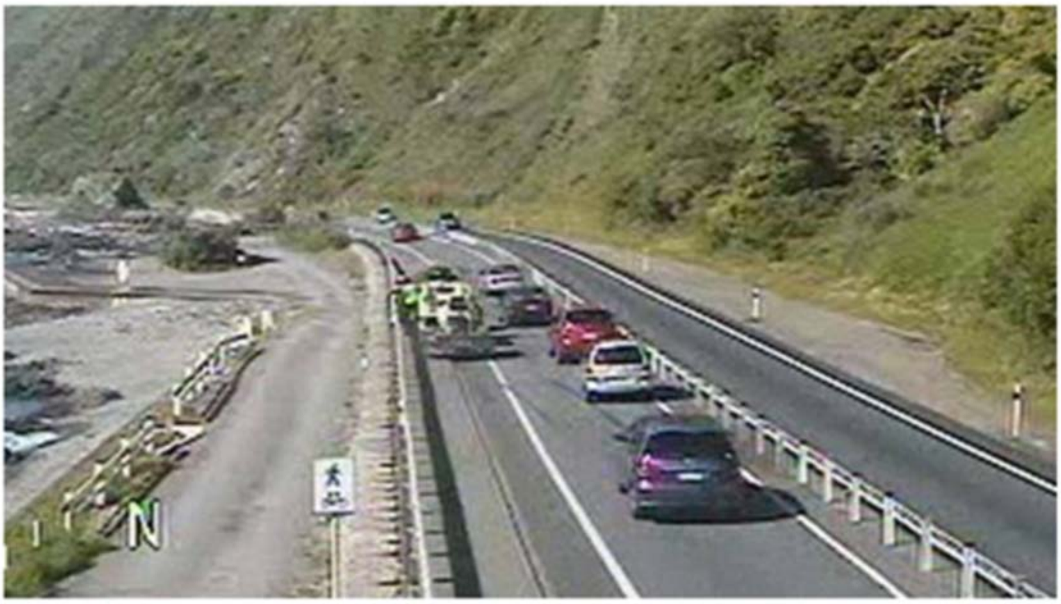


Figure 2 ***Operations on Centennial Highway showing reactions to a stopped vehicle***

Heavy Vehicles and Over-dimensional Vehicles

Corridors or sites that form part of an agreed over-dimensional route will need to follow the agreements that have been made at Waka Kotahi national level. Regional engagement with our heavy vehicle stakeholder should be carried out as early as practicable in the feasibility stage to inform them of the planned works and develop operational procedures. Any feedback, issues or concerns raised around these will need to brought to the attention of Waka Kotahi's Programme and Standards Lead Safety Advisor for resolution.

The installation of median barriers on designated or agreed over-dimension routes and corridors should not restrict the movement of over-dimension (OD) loads. However, it may impact on the operational requirements and operators will need to ensure they are operating safely for their staff and the general public.

Background

Most of the time, OD loads travel at night or early morning when traffic volumes are low.

It is a permit requirement that the operators undertake an appropriate risk-based assessment on the corridors that are attempting to travel through and ensuring their load sizes are appropriate, so they be manged/transported safely and not cause unnecessary damage to the surrounding environment.

If an operator does operate outside the bounds of safe traffic management practice, this should be escalated to the permitting office.

Damage caused by these types of operations is an unnecessary cost burden for Waka Kohati, local councils and for the general public.

Current National Standards

Corridors or sites that form part of an identified over-dimensional route will need to follow the guidelines that have been agreed between Waka Kohati and the Heavy Haulage Industry representatives at a national level. These include clearance requirements to roadside objects where median barriers are present.

Vertical and horizontal clearances at all overhead or adjacent obstructions shall conform with figure A4 within the Waka Kotahi Bridge Manual.

The agreed envelope on an undivided two-lane two-way corridor is 6.0 metres x 10 metres.

Where there are roadside and median barriers present there should be a minimum clear width of 6.25m provided between barrier systems

- Supports for roadside furniture e.g. traffic signs and traffic signals should be positioned 1.5m behind the barrier system.
- A minimum of 7.25m Separation shall be provided between median barrier system and any potential obstruction. E.g. light column, nearest edge of a road sign

In case of a breakdown, a minimum of 6.25 between barriers allows for 2.5m wide vehicles to pass with 0.5m to the barriers and 0.5m between them.

Where there is a median barrier present but no roadside barrier. There should be a minimum clear width of 7.25 metres between median barrier and roadside obstruction or furniture e.g. traffic signs, traffic signals and light columns. However, as over 80% of loads moved by the HHA are no greater than 8.0m, providing a clearance of 9.5m between the median barrier and any roadside obstruction would greatly increase both efficiency and safety of their operations.

It is therefore recommended that the project team investigate the occurrence of roadside furniture in the envelope between 7.25m and 9.5m from the median barrier position and viability of providing the desirable 9.5m. This will then frame the operating procedure required for the safe

passage of OD loads along the corridor. Note that the maximum offset to a road-sign from the edge-line is 5.0m.

Provision for stopping, including emergency, non-discretionary and elective (agricultural) stopping, should be considered where required on corridors where median barriers are proposed and will likely in result in stopping bays or widened sections of shoulder at regular intervals (2km – 3km spacings) along the corridor.

Stakeholder Engagement

The Waka Kotahi has committed with the Heavy Haulage Association (HHA) that project managers/designers will engage with them to establish the range of vehicles and loads that need to be taken into consideration during the design process. It is essential that this consultation is undertaken as early as practicable in the corridor programme. This will enable both parties to achieve a better understanding of the corridor's operational characteristics and how these can be achieved though smart design and tweaks to operating procedures.

At intersections, the HHA should provide the tracking and swept path envelope characteristics for the vehicle and loads that are likely to use the corridor. This should also be accompanied by a rough order of frequency of the journeys for each load and any other salient information that indicates the scale of importance of the route. Any changes in intersection design to accommodate a particular vehicle and load combination should give careful consideration to not only the cost and scale of the changes, but more importantly to the impact such changes will have on the safety or readability of the layout for the general travelling public.

Note that the HHA publish their own design specifications on their website http://www.hha.org.nz/for-engineers/design-specifications. However, this is not an agreed standard or specification and has not been supported or endorsed by Waka Kotahi. If during the regional consultation with our heavy vehicle stakeholders any feedback or concerns are raised that are not aligned with the national agreed clearance widths/envelopes these must be brought to the attention of Waka Kotahi's Programme and Standards Lead Safety Advisor for resolution.

This avoids regional variation of agreed national standards unless otherwise agreed by Waka Kotahi's Programme and Standards Lead Safety Advisor .

A decision will then be made by the SIP Safe System Lead with the advice from the Programme and Standards Lead Safety Advisor on whether the proposed design adjustments can be safely incorporated into the final design for projects that form part of the Speed and Infrastructure Programme,

Design Vehicle Selection TM – 2505 June 2019 (Draft) and

Designing for OD Vehicles TM – 2506 June 2021 (Draft)

The purpose of the Technical Memoranda is to provide detailed guidance to Project Managers and designers in the process of selecting an appropriate 'design vehicle' and 'check vehicle' for a project They also provide advice around the accommodation of abnormal or exceptional vehicles and loads as required. and meeting the expectations of the Heavy Haulage industry.

The way in which these vehicles' requirements are incorporated into the design will vary with context.

The current status of the Technical Memoranda is 'draft for comment'; it is still to be ratified.

Operation of over-dimensional vehicles on our network

There are many examples within New Zealand where OD vehicles can operate safely and efficiently on corridors with median barriers of varying widths.

If there are concerns on how OD vehicle operators are carrying out their operations on the network this needs to be escalated to the permitting office.

Operators are required to undertake safety risk assessments to ensure that they can move their loads within the design envelopes safely with the appropriate TTM, Health and Safety requirements on both state highway and local roads.

OD vehicles and loads need to follow additional requirements before travelling on our road and further guidance can be found on our website.

https://www.Waka Kotahi.govt.nz/commercial-driving/permits/OD-permits/

OD Permitting

OD vehicles use predetermined routes and are strictly controlled by permitting. When the permit is applied for this should be accompanied by a concept of operations for any route.

Permits issued to OD vehicles/loads may specify the following additional conditions:

- Restrictions on the vehicle's speed
- The route to be followed
- Pilots and pilot vehicles additional to those required by the rule
- Any additional conditions, under which the vehicle may be operated that the Transport Agency considers necessary.

Travel Restrictions for OD Vehicles

The document links below outline the time and day restrictions for different vehicle categories. Closedown times for OD loads are contained in the Land Transport Rule: Vehicle Dimensions and Mass 2016, Section 6.20

https://www.Waka Kotahi.govt.nz/assets/Commercial-Driving/docs/travel-restrictions-for-od-vehicles-2018.pdf

Examples of current route restrictions

https://www.Waka Kotahi.govt.nz/commercial-driving/permits/overweight-permits/driving-OD-vehicles/

In addition to these general restrictions, an OD vehicle must:

- use a route designated by a road controlling authority as suitable for OD vehicles, where available, and
- comply with the specific route restrictions listed below and any other route restrictions that apply to the route the vehicle takes.

Some road controlling authorities have bylaws that restrict the use of some roads by OD vehicles.

Auckland Harbour Bridge

Maximum height 4.8m. A vehicle exceeding 3.1m in width must contact the Traffic Operations Centre and may travel on this route provided it is accompanied by a Class 1 Pilot Vehicle as authorised by the Traffic Operations Centre.

Auckland motorways

No travel on Auckland motorways if the width exceeds 3.1m or the height exceeds 4.3m except for the following:

State Highway 1 between Ramarama Interchange (Ararimu Road Underpass) and the southern end of the Auckland Southern Motorway:

- may be used by vehicles that exceed 3.1m in width but are less than 4.8m in height, and
- may be used by vehicles that exceed 4.8m in height, if permission is first obtained from the Transport Agency.

State Highway 18 between the intersection with State Highway 16 and the Old Albany Highway:

- may be used by vehicles that exceed 3.1m in width but are less than 4.8m in height, and

- may be used by vehicles that exceed 4.8m in height, if permission is first obtained from the Transport Agency.

Auckland Northern Motorway between the Silverdale interchange and the northern end of the Northern Motorway:

- may be used by vehicles that exceed 3.1m in width but are less than 4.8m in height, and
- may be used by vehicles that exceed 4.8m in height, if permission is first obtained from the Transport Agency.

Wellington motorway

Maximum height 4.8m, maximum width 3.7m. However, an OD motor vehicle exceeding these dimensions may travel on the Wellington Motorway provided it complies with the Transport Agency's conditions.

Lyttelton Tunnel

Maximum height 4.27m, maximum width 2.6m, towing vehicle and semi-trailer maximum length 23m, 2m maximum for load overhanging front or rear of vehicle. However, OD vehicles exceeding the above maximums may travel if the following conditions are met:

- the operator of the OD vehicle must obtain permission from the Transport Agency (through Tunnel Control), and
- the operator of the OD vehicle must comply with any piloting or travel time restrictions required by Tunnel Control.

Toll routes

Loads that exceed 3.1m width or 4.3m height are not permitted to travel on any toll route unless the Transport Agency has provided explicit authority to do so. The operator of the OD vehicle must comply with any piloting or travel time restrictions required by the Transport Agency.

https://www.Waka Kotahi.govt.nz/assets/resources/vdam-permitting-manual/VDAM-Permitting-Manual-VOL-1-Part-C-OD.pdf

Waka Kotahi Factsheet links

Roles, responsibilities and permit requirements for OD loads

https://www.Waka Kotahi.govt.nz/assets/resources/factsheets/53b/docs/53b-OD-roles.pdf

This factsheet summarises the 'OD' requirements of the Land Transport Rule: Vehicle Dimensions and Mass 2016.

The rule sets out 3 key roles:

- Operator
- On-road supervisor (this is a new role in the 2016 rule)
- Pilots.

The rule also contains more specific detailed operational requirements associated with the load movement, such as lighting, use of lights, signs, and panels.

The responsibilities are in addition to any other roles and responsibilities that may apply under other acts, regulations and rules applicable to the load.

OD vehicles and loads

https://www.Waka Kotahi.govt.nz/assets/resources/factsheets/53/docs/53-OD.pdf

This factsheet summarises the 'OD' requirements of the Land Transport Rule: Vehicle Dimensions and Mass 2016.

Please refer to factsheet 13 to determine if your OD vehicle or load still requires an OD permit. If it does require a permit, follow the steps in this factsheet.

If the load is divisible and you are not over the width or height limits, you may be eligible for a high productivity motor vehicle permit; refer to factsheet 13g.