DRAFT

STANDARD SAFETY INTERVENTION TOOLKIT

Version 1 – February 2019

NZ TRANSPORT AGENCY
WAKA KOTAHI

New Zealand Government

CONTENTS

NZ Transport Agency
Published February 2019
NZBN: 9429041910085
ISBN xxxx-xxxx (online)
19-010

More information
If you have further queries, call our contact centre on 0800 699 000 or write to us:
NZ Transport Agency
Private Bag 6995
Wellington 6141
This document is available on the NZ Transport Agency's website at www.nzta.govt.nz/safenetwork

1. INTRODUCTION

The NZ Transport Agency is guided by the four themes in Government Policy Statement (GPS 2018), which outlines the Government's strategic priorities for the land transport system. Safety is one of these key priorities.

The Government will invest $4.3 billion over the next three years to manage and improve deaths and serious injuries on New Zealand roads through the 2018–21 National Land Transport Programme (NLTP).

Annual road deaths in New Zealand increased from 253 just a few years ago in 2013, to 378 last year (2017). The number of serious injuries increased from 2,788 to 3,264 per year over the same period.

To achieve significant and sustained reductions in deaths and serious injuries requires a joint effort and collaboration between NZ Transport Agency and local authority partners.

FIGURE 1 New Strategic Direction: GPS 2018

1.1 | RESPONDING TO GOVERNMENT PRIORITIES

Reversing New Zealand's current trauma trends requires a transport system that is designed and operated for people, and one that considers their safety as the top priority.

The GPS 2018 reflects a significant lift in ambition for improving the safety of the land transport system. The NLTP responds to this by proposing a programme of initiatives.

- Targeted to the most significant risks: Investment will focus on reducing the risk of head-on crashes, targeting high-risk intersections, making roads and roadsides more forgiving in the event of human error or mechanical fault, and protecting vulnerable users such as pedestrians, cyclists and motorcyclists.
- Can be delivered swiftly: A focus on highest-value interventions that can be delivered within the next three years and immediately deliver significant safety benefits. For safety interventions that may take more time to design and deliver, the Transport Agency is investigating procurement approaches to expedite delivery as much as possible.

1.2 | SAFER JOURNEYS AND THE SAFE SYSTEM

Safer Journeys is the government's strategy to guide improvements in road safety over the period 2010 to 2020. The strategy's vision is a safe road system increasingly free of death and serious injury and introduces the Safe System approach to New Zealand. In May 2016 the third and final Safer Journeys action plan 2016–2020 was released.

The safe system approach recognises that people make mistakes and are vulnerable in a crash. It reduces the price paid for a mistake, so crashes don't result in loss of life or limb. Mistakes are inevitable, however deaths and serious injuries from road crashes should not be.

Significant progress has been made under the two previous action plans across all key areas of the Safe System.

The third action plan has a renewed focus on areas of greatest risk and disproportionate harm, and present opportunities for the use of current and emerging technologies.

This includes investment in primary Safe System treatments that reduce the risk of:

- head-on and run-off road crashes (such as through the installation of median and side barriers)
- urban and rural intersection crashes (such as through the installation of roundabouts or speed management devices), and
- harm to vulnerable road users, including pedestrians, cyclists, mobility impaired (such as through segregated facilities, markings or speed management devices, including raised platforms at roundabouts, traffic signals, and pedestrian facilities)

1.3 | LOCAL GOVERNMENT ROAD SAFETY SUMMIT

The Associate Minister of Transport, Hon Julie Anne Genter held the Local Government Road Safety Summit in Wellington on 9 April 2018. Over 100 senior Local Government representatives, including 18 Mayors or Deputy Mayors, with around 20 senior representatives from central government took part in the all-day event.

The draft GPS, which was made available prior to the Local Government Road Safety Summit, included proposals to increase funding for walking and cycling initiatives. It also gave a clear priority for road safety projects and increased funding for local roads.

The summit enabled a high level of engagement with a very active and worthwhile discussion about how to improve road safety in New Zealand. Key actions from the summit were:

- That the government review the incentives, processes and funding arrangement for investing in safety initiatives by local government to ensure that safety on local roads is being improved.
- That the Associate Minister of Transport write to the Board of the NZ Transport Agency and asked that it review the Agency's processes around local government access to NLTP investment for interventions that will improve road safety, including capacity building and project delivery.
- For NZ Transport Agency staff to work with local authorities to provide additional support, including with applications for funding and for the deployment of the Speed Management Guide.
- For the Ministry of Transport to improve the setting of safe and appropriate speed limits in New Zealand by reviewing the barriers to acceleration of the implementation of the new Speed Management Guide approach. In particular, the current requirements to set speed limits by making a bylaw, and whether trials of temporary speed limits should be allowed while consultation on changes are occurring, including speed limits outside of schools and the use of technology to support speed enforcement.

In direct response to the key actions from the summit the NZ Transport Agency has progressed a number of streamlined investment measures including a suite of standard safety interventions, as outlined herein, to ensure that barriers are removed for our partners when delivering safety focussed projects that reduce the trauma on our roads.

1.4 | DELIVERING ON ROAD SAFETY

Partnership approach

To achieve significant and sustained reductions in deaths and serious injuries requires a joint effort and collaboration between NZ Transport Agency and local authority partners.

Through partnership and implementing a programme that is targeted to the highest risk urban, rural corridors and intersections we will achieve fewer deaths and serious injuries.

Safe Network Programme

Is a balanced targeted $1.85 billion programme of road safety improvements through top down evidence-based infrastructure risk assessment across local roads and state highways, including consideration of the top 10% identified for speed management, with the potential to save 160 -190 DSI per annum

The estimated total cost of the Safe Networks Programme is $1.85 billion, of which $1.3 to 1.4 billion is affordable in the National Land Transport Programme 2018-2021.

The Safe Network Programme will be implemented in partnership with local government.

Safe Network Regional Plans

The NZ Transport Agency will be working in partnership with local authorities to develop regional safe network implementation plans. These plans will provide a cornerstone for delivery of targeted road safety programmes focussed on high risk intersections and corridors. The plans will include a high-level assessment of regional road safety problems, treatment philosophy, appropriate safe system countermeasures (e.g. standard safety intervention) and guidance on appropriate investment pathways

Standard Safety Interventions Toolkit

This Standard Safety Interventions Toolkit is intended to provide guidance for road practitioners of all types and levels of professional experience, including: road safety and transport engineers, asset managers, town planners, civil designers and community road safety officers. It is relevant to both state highway and local authority networks.

The standard safety intervention toolkit is not design guidance or a specification; it is a tool to assist project managers in demonstrating value for money to support investment decisions on projects or activities that meet the required criteria at a programme level.

Standard Safety Interventions

The standard safety interventions included within the toolkit are proven road safety countermeasures that deliver the beneficial safety outcomes by improving the existing road network; it is not intended to be used for offline or new road corridors.

Further work is continuing assessing other infrastructure interventions for standard safety interventions, once they have been approved they will included in future updates of the documents.

Implementation guidance and investment assurance criteria have been developed for each standard safety intervention to support the project manager with optioneering and intervention selection.

Streamlined Investment Pathway

A streamlined investment pathway has been developed for projects and activities (value between $1 million and $50 million) that form part of the Safe Network Programme or other approved programme.

This streamlined investment pathway can only be used for standard safety Interventions that meet the applicable cost ranges and investment assurance criteria as detailed in the next section.

2. STANDARD SAFETY INTERVENTION TOOLKIT

This Standard Safety Interventions Toolkit is intended to provide guidance for road practitioners of all types and levels of professional experience, including: road safety and transport engineers, asset managers, town planners, civil designers and community road safety officers. It is relevant to both state highway and local authority networks.

The Toolkit has been developed progressively since 2018 and is a 'living' document. It is intended to be maintained and updated regularly, so that new standard safety interventions can be captured and disseminated to practitioners.

The Toolkit is not intended to replace any Transport Agency's and/or Austroad's road safety publications as a source of in-depth technical information.

Further information to support this section is available in other NZ Transport Agency documents such as the Transport Agency's High Risk Rural Roads Guide and High Risk Intersections Guide.

Although the primary objective of this Toolkit is to focus on engineering-based treatments, it is expected that the user takes a holistic view on road safety, identifying issues such as enforcement, road user education and media campaigns.

The Toolkit provides photographic examples of individual standard safety interventions and, for most treatments, there are technical references provided, some with links to internet sites containing relevant documents.

2.1 | PROJECT DEVELOPMENT

Suitably trained and qualified practitioners need to engage in a critical assessment of the road safety issues on the corridor and/or intersection and the appropriate safe system interventions to address them.

In some situations, such interventions will not be feasible due to project constraints dictated by budget, site, conflicting road user needs, or the environment. If so, the next safest project-feasible solution needs to be identified.

However, in accordance with the GPS value for money must also be demonstrated and as such primary safe system infrastructure interventions may not be affordable and supporting safe system treatments may be appropriate. The reasons why options have been or not been selected should be documented.

2.2 | SAFE AND APPROPRIATE SPEEDS

Establishing the safe and appropriate speed should be the starting point for determining appropriate actions going forward.

As outlined in the Setting of Speed Limits Rule 2017 – Section 2.7(4), if a road controlling authority decides that the existing speed limit is not safe and appropriate for a particular road, it must either:

(a) set a new speed limit that the road controlling authority considers to be safe and appropriate for that road; or

(b) take other measures to achieve travel speeds that are safe and appropriate on that road.

The Speed Management Guide – First Edition (2016) should be used to assist with decisions on treatment approaches which may include a mix of infrastructure and / or speed management.

2.3 | SAFE SYSTEM IMPLEMENTATION HIERARCHY

The selection of treatment measures should start with the objective of aiming to achieve a Safe System by first considering interventions that are most likely to eliminate the occurrence of fatal and serious injuries. Often there is a suite of measures that can be implemented to manage a particular risk, with some measures typically being more effective than others.

On corridors where Safe System transformation cannot be achieved, interventions should provide the highest safety performance possible whilst being supportive of, and acting as a stepping stone towards, future achievement of Safe System transformation. For example:

- A wide central painted median with audio-tactile lines may be installed with adequate width to allow for future installation of a central median barrier, whilst also allowing for further widening of the road cross-section in the future; whereas,
- Long continuous lengths of roadside barrier installed in the short-term may need to be removed and/or relocated in the longer term in order to allow for a median barrier and/or additional widening.

2.4 | SAFE SYSTEM TREATMENT PHILOSOPHY

The safe system treatment philosophy gives the indicative level of infrastructure change and investment required to be the most cost-effective treatments. Note that, within the treatment philosophy diagram below, some measures will cross boundaries.

Also note that this is a guide to the types of treatments that are the most appropriate for the level or risk. It does not mean discount all options and treatments when determining the best measures for the corridor or intersection.

It is important that safety improvements implemented on all New Zealand roads are consistent along the corridors as much as possible, and consistent with the Safe Roads and Roadsides infrastructure objectives.

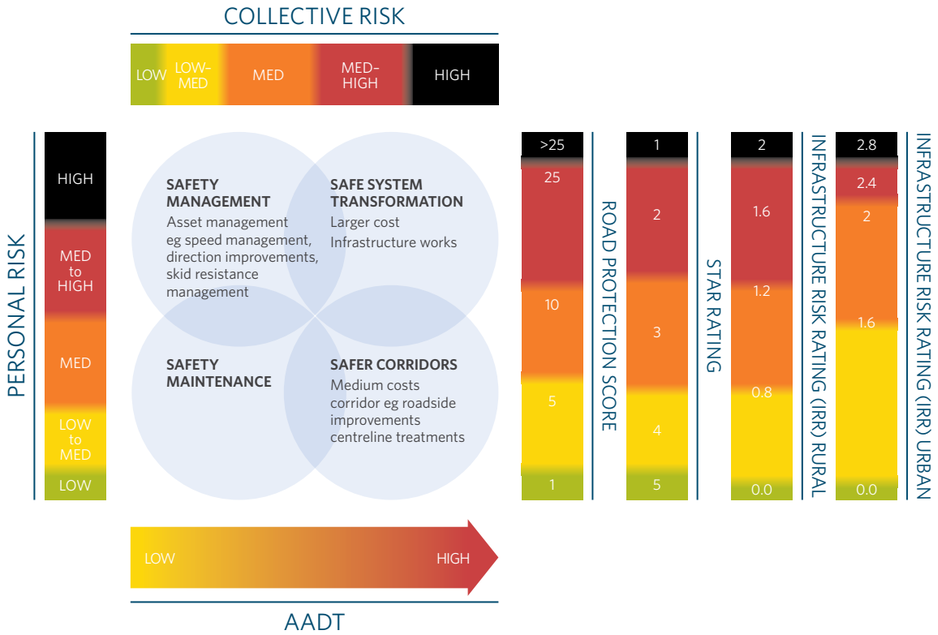


FIGURE 2 Safe System Treatment Philosophy

The treatment philosophy is considered as a level of safety service indicator that is particularly useful for identifying sites that, although lower risk, are performing worse than would be expected. Having identified an intersection or corridor with potential safety improvement benefit, the crashes must be investigated to identify the crash and risk issues that must be addressed. While the focus is on high-risk intersections and corridors, (those typically located in the upper and right sides of figure 2) it is important to remember low-cost safety management treatments may still apply to the bottom left quadrant.

As intersections or corridors may not feature in the upper and right-hand side portions of figure 2, it does not preclude them being implemented, just that these improvements should be proportional to the problem.

Intervention selection

The interventions outlined in the table below are linked to the key crash types that account for the majority of serious trauma. These are presented in the order of Safe System alignment. Further information regarding specific interventions can be found in the Transport Agency's High Risk Rural Roads Guide and High Risk Intersection Guide.

Safe System transformation interventions (such as median barriers and roundabouts) are generally higher cost infrastructure measures that offer the highest road safety performance.

Safer Corridors and Safer Intersection interventions (such as wide centrelines and traffic signals) generally offer medium to low road safety performance for medium to low cost.

Safety Management interventions are lower-cost measures (such as ATP markings and warning signs) and are most appropriate on lower-volume roads and intersections where higher-cost infrastructure measures such as solid median barriers and grade-separated intersections are not justified.

	KEY CRASH TYPE			
PHILOSOPHY	**HEAD-ON**	**RUNOFF ROAD**	**INTERSECTIONS**	**VULNERABLE ROAD USERS**
Recommended safe system treatments	• Median barriers (solid/semi-rigid and flexible) • Safe and appropriate speeds	• Roadside barriers • Safe and appropriate speeds	• Grade-separated interchanges or overpasses • Roundabouts • Signalised roundabouts • Safe and appropriate speeds	• Separated off-road facilities • Safe and appropriate speeds
Recommended safer corridor and safer intersection treatments	• Wide central/ median treatments • Safe and appropriate speeds	• Wider shoulders • ATP markings • Safe and appropriate speeds • Skid resistance	• Wider shoulders • Separate turning facilities • Skid resistance • Improved delineation • Active signs • Safe and appropriate speeds	• Improved sight visibility through various treatment • Safe and appropriate speeds
Recommended safety management treatments	• ATP markings • Improved delineation (signs and markings) • Active signs • Separated off-road facilities • Safe and appropriate speeds	• Wider shoulders • Improve delineation • Active signs • Safe and appropriate speeds	• Skid resistance • Improved sight visibility through various treatment	• Improved sight visibility • Reduce pinch points • Maintain consistent shoulder width • Maintain surface quality

3. STREAMLINED INVESTMENT PATHWAY

The process for applying for funding approval for standard safety interventions on projects valued between $1 million and $50 million is explained, however this is not a step by step instruction on how to use SAP or Transport Investment Online (TIO).

The project manager/programme manager will need to determine the appropriate investment pathway for the implementation of their perspective projects and submit the appropriate documentation for funding approval.

3.1 | EXCLUSIONS

Projects or activities that are considered complex or high risk will generally be required to proceed through the single stage business case pathway. However, as the business case process is scalable, the level of effort and deliverables required to develop the investment case should be appropriate to the size and risk of the problem and the proposed investment.

Projects or activities that are deemed to be complex or high risk, taking into consideration factors unique to the corridor or intersection, will generally include, but are not limited to, the following:

- The project requires complex solutions due to difficult engineering issues;
- The total project cost will exceed $50 million;
- The project has multiple outcomes that requires careful consideration of each outcome;
- The project is located within a high-risk sensitive receiving environment (environmental, social, cultural or historical);
- The project does not comply with the NZ Transport Agency standards, specifications, guidelines or professional services specialist recommendations.

Each project or activity should also be assessed with reference to the problems and benefits of the individual project in the context of its contribution to programme level investment objectives.

Projects or activities that have a total project cost less than $1 million can be considered as a low cost, low risk improvement. Instructions for the application and process for low cost, low risk improvements can be found on the NZ Transport Agency website (updated annually).

SM018 Annual plan instructions (capital) 2019/20

https://www.nzta.govt.nz/roads-and-rail/highways-information-portal/processes/strategic-activity-management/annual-planning/

3.2 | FUNDING APPROVAL

Projects that are likely to meet the criteria of the streamlined investment pathway, should use the standard safety intervention BCR as investment decisions are to be made at a programme level rather than individual project or activity level.

All applications for Standard Safety Interventions will require:

- An individual application form (see application template form in appendix)

Applications should be submitted via the Safe Networks Programme Manager to the regional Partnership Investments, Investment Advisor for review. Applications will then be recommended for the funding approval and release by the appropriate delegation depending on the scale and cost of the project or activity.

- General Manager Investment and Finance
- Senior Manager, Operational Policy, Planning and Performance
- Safe Network Governance Group
- Safe Network Programme Director

4. STANDARD SAFETY INTERVENTIONS

The standard safety interventions included within the toolkit are proven road safety countermeasures that deliver the beneficial safety outcomes by improving the existing road network; it is not intended to be used for offline or new road corridors.

Intervention implementation guidelines

Implementation guidelines have been developed to assist designers/project managers in ensuring the proposed standard safety intervention/s are appropriate for the site/corridor being addressed.

These guidelines do not provide an exhaustive list of possible safety interventions and thus suitably trained and qualified practitioners will need to engage in a critical assessment of the site/corridor to ensure that the road safety issues identified are being treated appropriately.

Safe system treatment philosophy

Each standard safety intervention has an associated safe system treatment philosophy, which gives an indicative type of intervention and appropriate level of investment to address the level of risk at the site/corridor.

Investment assurance criteria

The investment assurance criteria presented under each Standard Safety Intervention and represents the criteria used to evaluate the appropriateness of funding through streamlined investment pathway.

Intervention cost ranges

For each intervention there is an assumed low to high cost range, which is a best effort at determining the appropriate design and construction cost based on past experiences.

Costs at the low-cost end of the stated range typically apply when the intervention can be implemented with little or no supporting infrastructure changes, such as widening the road cross-section. Conversely, high costs are generally associated with substantial supporting infrastructure changes, typically to meet more conservative or desirable practices and standards.

Projects that exceed the cost ranges will generally not qualify for the streamlined investment pathway, unless a specific exception is granted.

Assessed economics – deaths and serious injuries (DSIs)

For the economics and effectiveness of the interventions is all referred to as deaths and serious injuries (DSIs).

The assumed cost per DSI for rural environments is $1.4 million and for urban environments is $1.1 million.

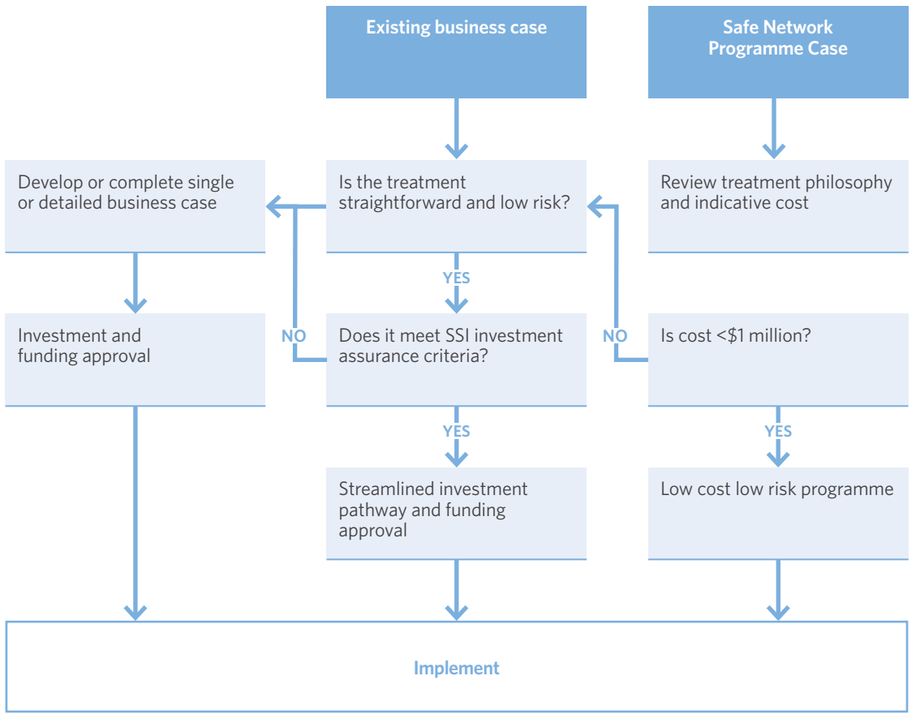
Assessed economics – benefit cost ratio (BCR)

A full BCR range has been calculated for each intervention based on the Safe and Appropriate Speed as 'Do Minimum' approach, with inclusion of travel time disbenefit and vehicle operating costs.

For standard safety interventions where the BCR range is less than zero, the Programme Development Manager/Area Programme Manager/Project Manager will need to determine the appropriate investment pathway for the implementation of their respective projects and submit the appropriate documentation for funding approval.

A whole of life cost factor has been used and is based on past experiences eg Safe Roads Alliance projects. It allows for the detailed design, site supervision and discounted maintenance costs over a 40-year project life.

Projects which have a higher multiplicative factor are those which have elements that require more frequent renewal. For example, flexible barriers have regular (sometimes monthly) strikes which require regular repair and renewal throughout the project life or; road markings which may be remarked every year during a 40-year economic life. Projects which use more structural elements, such as widening or installation of a roundabout, will have a longer design life and therefore require less maintenance in proportion to the initial capital works cost.



4.1 | CONTINUOUS 3-BARRIER (MEDIAN AND ROADSIDE BARRIER)

ASSESSED ECONOMICS FOR STREAMLINED INVESTMENT PATHWAY

Applicable cost range:
$2m to $4m per km

Assumed DSI reduction:
75%

BCR range:
Between 0.9 and 1.8

FIGURE 4 Example of continuous 3-barrier treatment

Continuous 3 barrier is a continuous central and roadside barrier system installed along a corridor, which provides separation between opposing traffic lanes and protection from roadside hazards and furniture.

3 barriers can be effectively retrofitted on two-way two-lane roads, 2+1 and dual lane carriageways. In most cases this will require widening of the carriageway.

Implementation needs to consider a good standard of turnarounds, provision of roundabouts at major intersections, passing/overtaking opportunities and audio tactile pavement marking.

Safe system treatment philosophy

Safe system transformation

Investment assurance criteria

For the project to meet the criteria for the streamlined investment pathway, the total project cost must fall between the applicable cost range and the meet criteria below:

- Annual average daily traffic (AADT) is greater than 10,000 vehicles per day.
- Collective risk is medium-high risk or higher or predictive collective risk is medium-high or higher.
- Posted speed limit or mean speed is 80km/h or higher.

The applicable cost range reflects the installation of the 3-barrier intervention on an existing corridor and includes professional services fees, construction costs (establishment, traffic management etc.), pavement widening, audio tactile pavement markings, signage, drainage, full roundabouts, turnarounds and rural intersection activated warning signs (RIAWS). The cost range does not allow for passing lanes, land acquisition and whole of life costs.

Intervention implementation guidelines

To assist designers/project managers with the selection of suitable sites for 3 barriers, the following guidelines have been developed:

- A relatively high AADT typically greater than 10,000 vehicles per day, although corridors with lower AADT may still be considered.
- Does the corridor have a collective risk of medium-high or higher?
- Is there evidence of runoff road and head-on type reported crash types (crash codes BA – BO, CA – CO, DA and/or DB)?
- Are there significant roadside hazards that require continuous protection?
- Is the posted speed limit or measured mean speed 80km/h or higher on the corridor?
- Is the One Network Road Classification (ONRC) classification regional or higher?

Other considerations

While road safety barriers can be installed over shorter lengths, they are most effective when installed over longer lengths of a corridor. This is to minimise the number of terminal ends and potential conflicts as they can pose a greater risk if struck by an errant vehicle.

On national (HV) and regional ONRC corridors, which are identified and agreed as overdimension load routes, an appropriate offset of roadside objects should be considered as per the Transport Agency guidance. Roadside objects include street lights, signage and vegetation.

The sealed shoulder width will need to accommodate cyclists if the corridor is part of the identified cycle network according to Transport Agency guidance. However, on other corridors, narrower shoulders can be treated to provide a continuous treatment. Careful consideration of cyclist requirements (including consultation) should be carried out.

Audio tactile profiled (ATP) markings should be installed on/adjacent to the white edge line and centreline unless there are practical reasons they cannot be installed. The installation of ATP markings may also reduce the amount of nuisance strikes.

The designer must consider the appropriate offset location of roadside barriers opposite and either side of intersections, access ways and/or entranceways to ensure safe ingress and egress.

The designer must also consider ongoing maintenance activities, including signage, lighting, drainage and vegetation. The designer may need to consider pull-over areas and breaks in the barrier to allow access for appropriate maintenance vehicles, police vehicles etc.

References and guidelines

www.nzta.govt.nz/resources/road-safety-barrier-systems/

4.2 | MEDIAN BARRIER

ASSESSED ECONOMICS FOR STREAMLINED INVESTMENT PATHWAY

Applicable cost range:
Between $1m to $3m per km

Assumed DSI reduction:
65%

BCR range:
Between 0.9 and 2.8

FIGURE 5 State Highway 1 Centennial Highway, Wellington – median barrier treatment

A median barrier consists of a continuous central barrier system installed along a corridor. Median barriers are generally either a rigid or flexible road safety barrier system.

A median barrier is most effective at reducing the number and injuries severity of crashes that would have resulted in head-on type (cross centreline) crashes involving two vehicles. The median is also effective at reducing the severity of single vehicle loss of control crashes to the right, which may have started as a lane departure to left followed by an overcorrection travelling over the centreline.

As such, a median barrier is the preferred safe system intervention treatment, where continuous 3 barriers cannot be installed, and roadside safety barriers are being considered.

Safe system treatment philosophy

Safe system transformation and/or safer corridors

Investment assurance criteria

For the project to meet the criteria for the streamlined investment pathway, the total project cost must fall between the applicable cost range and the meet criteria below:

- AADT is greater than 6000 vehicles per day.
- Collective risk is medium-high risk or higher or predictive collective risk medium-high or greater.
- Posted speed limit or mean speed is 80km/h or higher.

The applicable cost range reflects the installation of the median barrier intervention on an existing corridor and includes professional services fees, construction costs including establishment and traffic management, pavement widening of up to 1.5 metres on both sides, audio tactile pavement markings, signage, drainage, compact roundabouts, turnarounds and RIAWS. The cost range does not allow for passing lanes, land acquisition and whole of life costs.

Implementation guidelines

To assist designers/project managers with the selection of suitable sites for median barriers, the following guidelines have been developed:

- Does the corridor have a collective risk of medium-high or higher?
- Is there evidence of runoff road or head-on type reported crash types (crash codes BA – BO, CA – CO, DA and/or DB)?
- Is the posted speed limit or measured mean speed 80km/h or higher on the corridor?
- An AADT count typically greater than 7500 vehicles per day, although corridors with lower AADT may still be considered.
- Is the ONRC classification regional or higher?

Other considerations

While median barriers can be installed over shorter lengths, they are most effective when installed over longer lengths of a corridor. This is to minimise the number of terminal ends and potential conflicts as they can pose a greater risk if struck by an errant vehicle.

On national heavy vehicle (HV) and regional ONRC corridors, which are identified and agreed as overdimension load routes, an appropriate offset of roadside objects should be considered in accordance with Transport Agency guidance. Roadside objects include street lights, signage and vegetation.

Audio tactile profiled (ATP) markings should be installed on/adjacent to the white edge line and centreline unless there are practical reasons they cannot be installed. The installation of ATP markings may also reduce the amount of nuisance strikes.

The sealed shoulder width will need to accommodate cyclists if the corridor is part of the identified cycle network in accordance with Transport Agency guidance. However, on other corridors, narrower shoulders can be treated to provide a continuous treatment. Careful consideration of cyclist requirements (including consultation) should be carried out.

The designer must also consider ongoing maintenance activities including signage, lighting, drainage and vegetation. The designer may need to consider pull-over areas and breaks in the barrier to allow access for appropriate maintenance vehicles, eg police vehicles.

References and guidelines

https://www.nzta.govt.nz/resources/road-safety-barrier-systems/

4.3 | ROADSIDE SAFETY BARRIER AT HIGH-RISK LOCATIONS

ASSESSED ECONOMICS FOR STREAMLINED INVESTMENT PATHWAY

Applicable cost range:
Between $0.1m to $0.4m per km

Assumed DSI reduction:
30%

BCR range:
Between 1.9 and 7.6

FIGURE 6 Examples of different roadside safety barriers

Traditionally, safety barriers have been developed for speed environments over 70km/h to reduce the severity of crashes involving errant vehicles leaving the road and colliding with more severe roadside hazards.

Roadside safety barriers include flexible barriers (wire rope), semi-rigid barriers (typically steel beam) and rigid barriers (concrete).

Safe system treatment philosophy

Safer corridors

Investment assurance criteria

For the project to meet the criteria for the streamlined investment pathway, the total project cost must fall between the applicable cost range and the meet criteria below:

- AADT is greater than 1000 vehicles per day.
- Collective risk is medium risk or higher or predictive collective risk medium or greater.
- Posted speed limit or mean speed is 80km/h or higher.
- ONRC classification - all.

The applicable cost range reflects the installation of the roadside barrier at high-risk locations intervention on an existing corridor and includes professional service fees, construction costs (establishment, traffic management etc), some pavement widening, ATP markings and signage. The cost range does not allow for land acquisition, service relocations and whole of life costs.

Implementation guidelines

To assist designers/project managers with the selection of suitable sites for roadside barriers at high-risk locations, the following guidelines have been developed.

- Does the corridor have a collective risk of medium or higher?
- Is there evidence of runoff road reported crash types (crash codes CA – CO, DA and/or DB)?
- Are there significant roadside hazards that require continuous protection?
- Is the posted speed limit or measured mean speed 80km/h or higher on the corridor?
- Is the ONRC classification arterial or higher?

Other considerations

ATP markings should be installed on/adjacent to the white edge line unless there are practical reasons they cannot be installed. The installation of ATP markings may also reduce the amount of nuisance strikes.

Shoulder widening must be completed to achieve the desired layout, if the minimum sealed width cannot be achieved.

The sealed shoulder width will need to accommodate cyclists if the corridor is part of the identified cycle network in accordance with Transport Agency guidance. However, on other corridors, narrower shoulders can be treated to provide a continuous treatment but careful consideration of cyclist requirements (including consultation) should be carried out.

The designer will need to allow for pull-over areas at regular intervals for heavy vehicles, maintenance vehicles and slower vehicles.

The designer must consider the appropriate offset location of roadside barriers opposite and either side of intersections, access ways and/or entranceways to ensure safe ingress and egress.

The designer must also consider ongoing maintenance activities, eg signage, lighting, drainage and vegetation. The designer may need to consider pull-over areas and breaks in the barrier to allow access for appropriate maintenance vehicles, eg police vehicles.

References and guidelines

https://www.nzta.govt.nz/resources/road-safety-barrier-systems/

4.4 | WIDE CENTRELINE

ASSESSED ECONOMICS FOR STREAMLINED INVESTMENT PATHWAY

Applicable cost range:
Between $0.25m to $01.7m per km

Assumed DSI reduction:
35%

BCR range:
Between 0.5 and 3.1

FIGURE 7 Examples of different wide centreline marking configurations

Wide (spaced) centrelines consist of two lines marked in the centre of the road which provide greater separation for opposing traffic than standard centreline markings.

This separation helps reduce the likelihood of head-on crashes and are typically used on rural roads where 'crossing the centreline' type crashes either exist or there is potential risk of them occurring.

Wide centrelines are appropriate where traffic volumes may not yet warrant a central median barrier. However, the design should allow for the future proofing of the installation of a median barrier to allow for changes in traffic growth and/or crash risk.

Wide spaced centrelines can be used where space between lanes is not intended to be used for turning traffic and must be marked with two approximately parallel lines spaced not less than 0.5 metres and not more than 1.5 metres apart.

Safe system treatment philosophy

Safer corridors, but may also be a valid treatment on safe system transformation corridors where it is not possible, practical or economic to install a primary safe system treatment such as a median barrier.

Investment assurance criteria

For the project to meet the criteria for the streamlined investment pathway, the total project cost must fall between the applicable cost range and the meet criteria below:

- AADT is between 1000 and 12,000 vehicles per day.
- Collective risk is medium risk or higher or predictive collective risk is medium or higher.
- Posted speed limit or mean speed 80km/h or higher.
- ONRC classification - all.

The applicable cost range reflects the installation of the wide centreline intervention on an existing corridor and includes professional service fees, construction costs including establishment, traffic management, some pavement widening, drainage, pavement marking changes, ATP markings and signage. The cost range does not allow for passing lanes, land acquisition and whole of life costs.

Implementation guidelines

To assist designers/project managers with the selection of suitable sites for wide centreline, the following guidelines have been developed:

- Does the corridor have a collective risk of medium or higher?
- Is there evidence of head-on type reported crash types (crash codes BA – BO)?
- Is the posted speed limit or measured mean speed 80km/h or higher on the corridor?
- Is the ADDT greater than 3000 vehicles per day?
- Is the ONRC classification arterial or higher?

Other considerations

Wide centreline pavement markings must be designed and installed in accordance with the draft Transport Agency Traffic control devices manual: Part 5 – Traffic control devices for general use – between intersections.

ATP markings should be installed on/adjacent to the white edge line and within the wide spaced centreline markings in accordance with the draft Transport Agency Traffic control devices manual: Part 5 – Traffic control devices for general use – between intersections.

The sealed shoulder width will need to accommodate cyclists if the corridor is part of the identified cycle network in accordance with Transport Agency guidance. However, narrower shoulders can be treated to provide a continuous treatment. Careful consideration of cyclist requirements (including consultation) should be carried out.

The designer/project manager must consider future traffic growth to ensure that the design of the wide centreline intervention could accommodate the future installation of a median barrier.

References and guidelines

https://www.nzta.govt.nz/assets/resources/wide-centreline-trial/docs/wide-centreline-trial-infosheet.pdf

https://www.nzta.govt.nz/assets/resources/audio-tactile-profiled-roadmarkings-guidelines/docs/atp-guidelines.pdf

https://www.nzta.govt.nz/resources/traffic-control-devices-manual/

4.5 | SHOULDER WIDENING AT HIGH-RISK LOCATIONS

ASSESSED ECONOMICS FOR STREAMLINED INVESTMENT PATHWAY

Applicable cost range:
$0.2m-$0.45m per site (approx. 250 metre length)

Assumed DSI reduction:
10%

BCR range:
Between 1.4 and 3.1

A sealed shoulder provides drivers with an appropriate surface on which to regain control of an errant vehicle.

FIGURE 8 Widened shoulder on a rural road

Safe system treatment philosophy

Safer corridors

Investment assurance criteria

For the project to meet the criteria for the streamlined investment pathway, the total project cost must fall between the applicable cost range and the meet criteria below:

- AADT is greater than 1000 vehicles per day.
- Collective risk is medium risk or higher or predictive collective risk medium or greater.
- Posted speed limit or mean speed 80km/h or higher.
- ONRC classification of arterial or higher.

The applicable cost range reflects the installation of the shoulder widening at high-risk locations on an existing corridor and includes design fees, construction costs (eg establishment, traffic management), pavement widening of up to 1.5 metres on one side of the road up to a length of 250 metres. The cost range does not allow for land acquisition and whole of life costs.

Implementation guidelines

To assist designers/project managers with the selection of suitable sites for shoulder widening at high-risk locations, the following guidelines have been developed:

- Does the corridor have a collective risk of medium or higher?
- Is there evidence of runoff road reported crash types (crash codes CA – CO, DA and/or DB)?
- Is there evidence of edge break or vehicle tracking over the edge of sealed shoulder?
- Are there out of context curves or curves with a radius less than 450m with below the desirable shoulder width?
- Is the posted speed limit or measured mean speed 80km/h or higher on the corridor?
- Is the ONRC classification arterial or higher?

Other considerations

On curves, the vertical and horizontal geometry should be reviewed and appropriate design vehicles used to determine the extent of appropriate shoulder widening.

Shoulder widening should not exceed 2 metres, as drivers may use them as an additional lane.

Shoulder widening should be initially prioritised to the outside of curves (up to 2.0 metres) as this gives the greatest crash benefits.

Shoulder widening on the inside of curves or on straight sections of a corridor to achieve a total seal width of 1.0 metre will provide good benefits, any widening beyond the 1.0 metre only deliver small incremental benefits unless there is an identified need/warrant for additional shoulder widening width.

References and guidelines

https://www.nzta.govt.nz/assets/resources/state-highway-geometric-design-manual/docs/shgdm-part-6.pdf

4.6 | AUDIO TACTILE PAVEMENT (ATP) MARKINGS

ASSESSED ECONOMICS FOR STREAMLINED INVESTMENT PATHWAY

Applicable cost range:
$0.01m and $0.05m per km

Assumed DSI reduction:
20%

BCR range:
Between 2.3 and 11.4

ATP markings can be provided along the edgeline and/or centreline of a roadway and provide audio and tactile feedback to road users. They may replace or supplement standard edgeline markings on sections of road.

FIGURE 9 Centre and edge line audio tactile pavement markings

Safe system treatment philosophy

Safer corridors and/or safety management

Investment assurance criteria

For the project to meet the criteria for the streamlined investment pathway, the total project cost must fall between the applicable cost range and the meet criteria below:

- AADT is greater than 1000 vehicles per day.
- Posted speed limit or mean speed is 80km/h or higher.
- ONRC classification of arterial or higher.

The applicable cost range reflects the installation of the audio tactile pavement marking intervention on an existing corridor and includes professional service fees, construction costs (establishment, traffic management etc), ATP markings including RRPMS and pavement marking removal. The cost range does not allow for whole of life costs.

Implementation guidelines

To assist designers/project managers with the selection of suitable sites for ATP marking intervention, the following guidelines have been developed:

- Does the corridor have a collective risk of low-medium or higher?
- Is there evidence of runoff road or head-on type reported crash types (crash codes BA – BO, CA – CO, DA and/or DB)?
- Is there evidence of crashes where fatigue or driver distraction may have been a contributing factor?
- Are there specific site problems such as poor visibility, frequent or heavy rain, or night-time crash history?
- Is the posted speed limit or measured mean speed 80km/h or higher on the corridor?
- Is the ADDT greater than 1000 vehicles per day?
- Is the ONRC classification arterial or higher?
- Will the installation of ATP markings unduly affect nearby residents?

Other considerations

ATP markings should be used as a continuous treatment system rather than as a series of 'spot' treatments at high crash risk locations.

ATP markings must be installed in accordance with Transport Agency's *Traffic control devices manual*.

ATP markings should be omitted from major access ways and intersections but continuous across minor entrances unless noise is a problem for residents.

References and guidelines

https://www.nzta.govt.nz/resources/audio-tactile-profiled-roadmarkings/

https://www.nzta.govt.nz/assets/resources/audio-tactile-profiled-roadmarkings-guidelines/docs/atp-guidelines.pdf

https://www.nzta.govt.nz/assets/resources/audio-tactile-profiled-roadmarkings/docs/audio-tactile-profiled-roadmarkings-notes.pdf

https://www.nzta.govt.nz/resources/traffic-control-devices-manual/

4.7 | RURAL INTERSECTION ACTIVATED WARNING SIGNS (RIAWS)

ASSESSED ECONOMICS FOR STREAMLINED INVESTMENT PATHWAY

Applicable cost range:
Up to $0.3m per site

Assumed DSI reduction:
35%

BCR range:
Up to 0.1

FIGURE 10 State Highway 1 Himatangi Beach intersection

RIAWS are installed on the major approaches to the intersection and are activated by a turning vehicle or an approaching vehicle on the minor leg of the intersection.

Rural intersection crashes mostly involve turning and crossing vehicles colliding with high speed through-traffic. By reducing the speed of the vehicles on the through road at the intersection, it can reduce the number and severity of crashes at rural intersections.

RIAWS reduce speeds and raise awareness of an intersection with deficiencies or crash problems where transformational works are not appropriate or possible.

Safe system treatment philosophy

Safer intersection, although they may still be a viable solution for safe system transformation intersection sites if primary safe system solutions are not possible.

Investment assurance criteria

For the project to meet the criteria for the streamlined investment pathway, the total project cost must fall between the applicable cost range and the meet criteria below:

- Collective risk or personal risk is medium-high or greater.
- 3 or more fatal and serious injury crashes.
- Posted speed limit or mean speed 80km/h or higher.
- ONRC classification of high volume, national, regional and arterial.

The applicable cost range reflects the installation of the RIAWS intervention at an existing intersection and includes professional service fees, construction costs (establishment, traffic management etc) electronic sign infrastructure, poles, detector system, power and communications. The cost range does not allow land acquisition and whole of life costs.

Implementation guidelines

To assist designers/project managers with the selection of suitable sites for RIAWS intervention, the following guidelines have been developed:

- Does the intersection have a high-risk rating?
  - Have there been 3 or more fatal or serious crashes over a 5-year period, or
  - 2 or more DSI equivalents (estimated from all injury crashes), or
  - Medium-high collective or personal risk or higher.
- Is there evidence of reported crossing and turning crash types (crash codes HA, JA, KA and KB)?
- Is the posted speed limit or measured mean speed 80km/h or higher on the through road of the intersection?
- Is the traffic volume proportionally higher on the through route than the side road traffic volume lower, but not so low that exposure is minimal? Initial evaluation advice from Sweden was that the optimum traffic volumes would be approximately 10,000 vehicles per day on the through road and 2000 vehicles per day on the side road. However, we have sites well above that, even if the higher the crossing/turning volumes, the more often the lower speed limit is activated.
- Does the intersection have approach visibility issues (too little or too much)?
- Does the intersection have relatively simple geometry (T or X), without complicating factors such as multiple lanes on through road (accepting that many intersections have acceleration lanes and right turn bays)?

Other considerations

The project team needs to fully understand and consider if there are regional site works planned for the intersection over the short to medium term.

RIAWS can be considered an appropriate interim safety solution where a longer term safe system transformational project is planned or being considered.

References and guidelines

https://www.nzta.govt.nz/assets/network/operating/safely/doc/riaws-info-sheet.pdf

https://www.nzta.govt.nz/assets/planning-and-investment/knowledge-base/Uploads/Documents/Speed-Management-Toolbox-and-Appendices-combined-Final-July-2016.pdf

https://www.nzta.govt.nz/resources/traffic-control-devices-manual/

4.8 | RURAL ROUNDABOUT

ASSESSED ECONOMICS FOR STREAMLINED INVESTMENT PATHWAY

Applicable cost range:
$2m-$5m per site

Assumed DSI reduction:
60%

BCR range:
Less than 0

FIGURE 11 Rural roundabout

Roundabouts are an effective method of reducing both the number and severity of injury crashes. This is due to the reduced number of conflict points, lower relative impact speeds and more favourable impact angles when compared with other layouts.

In many situations roundabouts provide a similar capacity to signals, but may operate with lower delays and better safety, particularly in off-peak periods.

Where additional capacity is required, or the minor flows are suffering significant delays, partial or full signalisation of the roundabout should be considered.

Signalised roundabouts have been shown to have an even better safety performance than unsignalised roundabouts and improve safety for vulnerable road users.

Safe system treatment philosophy

Safe system intersection transformation

Investment assurance criteria

For the project to meet the criteria for the streamlined investment pathway, the total project cost must fall between the applicable cost range and the meet criteria below:

- Intersection collective risk medium-high or greater.
- 3 or more G,H,J,K,L,N injury crash types.
- Speed limit 80km/h and above.

The applicable cost range reflects the installation of the rural roundabout intervention on an existing intersection and includes professional service fees, construction costs (establishment, traffic management etc), pavement widening, lighting, signage, pavement markings and drainage. The cost range does not allow for land acquisition and whole of life costs.

Implementation guidelines

To assist designers/project managers with the selection of suitable sites for a rural roundabout intervention, the following guidelines have been developed:

- Does the intersection have a collective risk rating of medium-high risk or higher?
- Is there evidence of crossing/turning type crashes?

Other considerations

Speeds and collision angles need to be managed down on the approaches, so as not to result in unacceptably high entry speed onto the circulating carriageway.

Two thirds of DSIs at rural roundabouts involve loss of control or colliding with roadside objects downstream of the exit. So clear zones in these areas are crucial.

Ensuring optimum visibility on the approach to the roundabout – excessive visibility particularly to the right – has been shown to result in early decision making and high entry speeds.

Visibility should (both around the circulatory and on approach to) also be even to avoid differential speeds.

Optimum deflection should also be applied – too much can result in collision with the central island or cutting across adjacent lanes resulting in side swipe collisions and too little results in high entry speeds resulting in loss of control type crashes.

Where there is insufficient exit deflection to adequately manage vehicle speeds, raised speed platforms on the approaches could be considered as an alternative solution. However, while being trialled overseas, the concept is new to New Zealand and should be discussed with the Transport Agency Intersection Working Group.

The exit radius should also be easier than entry to reduce likelihood of vehicles losing control.

Multiple approach lanes can result in vehicles straight lining the roundabout and losing control on exit. For example, islands to separate the left turn lane can reduce this likelihood.

4.9 | URBAN ROUNDABOUT

ASSESSED ECONOMICS FOR STREAMLINED INVESTMENT PATHWAY

Applicable cost range:
$0.5m-$2m

Assumed DSI reduction:
60%

BCR range:
Less than 0

FIGURE 12 Urban roundabout

A roundabout is a safer form of intersection control compared to most other types. They provide smoother traffic flow and fewer delays for drivers in off-peak periods and can mean less delay for pedestrians.

A well-designed roundabout could have an advantage over traffic signals in reducing right-turn opposed type crashes and overall delays. Smaller (mini) roundabouts may be installed using simple markings or raised islands but are best applied in conjunction with plantings that beautify the street and the surrounding neighbourhood. Careful attention should be paid to the available lane width and turning radius used with traffic circles.

Safe system treatment philosophy

Safe system intersection transformation and/or safer intersection

Investment assurance criteria

For the project to meet the criteria for the streamlined investment pathway, the total project cost must fall between the applicable cost range and the meet criteria below:

- Intersection collective risk medium-high or greater or predicative intersection collective risk medium-high or greater.
- 3 or more G,H,J,K,L,N injury crash types.
- Speed limit 60km/h and below.

The applicable cost range reflects the installation of the urban roundabout intervention at an existing intersection and includes professional service fees, construction costs (establishment, traffic management etc.), pavement widening, lighting, signage, pavement markings and drainage. The cost range does not allow for land acquisition and whole of life costs.

Implementation guidelines

To assist designers/project managers with the selection of suitable sites for an urban roundabout intervention, the following guidelines have been developed:

- Does the intersection have risk rating of medium or higher?
- Is there evidence of turning/crossing type reported crash types and/or crashes involving vulnerable road users?
- Is the posted speed limit or measured mean speed 60km/h or less on the corridor?

Other considerations

Single lane roundabouts are safer for all road users, particularly vulnerable road users and should be used where possible.

On-road cyclists can use roundabouts safely enough if vehicle speeds are managed to 30 km/h or less, and road crossings for cycle paths can be used at/near roundabouts.

Installation of raised zebra crossings clarify where pedestrians should cross and that they have priority of approaching vehicles.

4.10 | RAISED SAFETY PLATFORMS

ASSESSED ECONOMICS FOR STREAMLINED INVESTMENT PATHWAY

Applicable cost range:
$0.15m-$0.75m per site

Assumed DSI reduction:
40%

BCR range:
Less than 0

FIGURE 13 Raised safety platform

Raised safety platforms create a safe, slow-speed crossing and public space at minor intersections.

They can be described as either an approach platform located on the approach to an intersection or a raised intersection by raising the entire intersection so that motorists ascend on the approach to, and descend on the departure from, the intersection.

Similar to speed humps and other vertical speed control elements, they reinforce slow speeds and encourage motorists to yield to pedestrians at the crosswalk.

Raised intersections are to be flush with the adjacent footpath to ensure that drivers traverse the crossing slowly.

NOTE
NEW INITIATIVE
The use of approach platforms is a new initiative for New Zealand and is currently under trial. If a road controlling authority wants to implement an approach platform it will need to be approved by the Safe Intersections Working Group, made up of representatives from local authorities and the Transport Agency.

Safe system treatment philosophy

Safe system intersection transformation and/or safer intersection

Investment assurance criteria

For the project to meet the criteria for the streamlined investment pathway, the total project cost must fall between the applicable cost range and the meet criteria below:

- Intersection collective risk medium-high or greater or predicative intersection collective risk medium-high or greater.
- 3 or more injury crash types.
- Speed limit 60km/h and below.

The applicable cost range reflects the installation of the raised intersection platforms intervention at an existing intersection and includes professional service fees, construction costs including establishment and traffic management, pavement construction, signage, pavement markings and drainage. The cost range does not allow for land acquisition, lighting and whole of life costs.

Implementation guidelines

To assist designers/project managers with the selection of suitable sites for raised intersection platforms, the following guidelines have been developed:

- Does the intersection have risk rating of medium or higher?
- Is the posted speed limit or measured mean speed 60km/h or less on the corridor?
- Is there evidence of turning/crossing type reported crash types and/or crashes involving vulnerable road users?

Other considerations

Where two one-way streets intersect, there will be two corners around which no drivers turn. This can be designed with the smallest constructible radius.

References and guidelines

https://www.vicroads.vic.gov.au/-/media/files/technical-documents-new/road-design-notes/road-design-note-0307-raised-safety-platforms-rsp-oct-2018.ashx

https://www.nzta.govt.nz/resources/traffic-notes/traffic-notes/

4.11 | UPGRADE OF SIGNALISED INTERSECTION

ASSESSED ECONOMICS FOR STREAMLINED INVESTMENT PATHWAY

Applicable cost range:
$0.1m-$0.3m per site

Assumed DSI reduction:
25%

BCR range:
Less than 0

FIGURE 14 State Highway 6 and Queen Street intersection, Nelson - separate right turn phase

Upgrading of existing signalised intersections will generally be to fully control the right turn phases to eliminate right turn filtering and/or removal of shared straight through and turning lanes.

A separate turn phase reduces conflict between turning vehicles and vehicles travelling through the intersection. It also reduces the conflict between right turning vehicles and pedestrians crossing the intersecting road.

Safe system treatment philosophy

Safer intersection

Investment assurance criteria

For the project to meet the criteria for the streamlined investment pathway, the total project cost must fall between the applicable cost range and the meet criteria below:

- 3 or more L and/or N type injury crash types

The applicable cost range reflects the installation of the upgrade of signalised intersection intervention on an existing corridor and includes professional service fees, construction costs including establishment and traffic management, and additional signal aspects, right turn arrows, protected pedestrian phases, advance cycle stop box, splitter islands, high friction surfacing and lighting. The cost range does not allow for land acquisition and whole of life costs.

Implementation guidelines

To assist designers/project managers with the selection of suitable sites for signalised intersection upgrades, the following guidelines have been developed:

- Is there filtered turn with no separate right turn phase resulting in conflict?
- Are there short cycle times leading to frustration, short inter-green times and excessive approach speed all leading to red light running?
- Is there evidence of turning/crossing type reported crash types and/or turning crashes involving vulnerable road users?
- Where opposing multi-lane approaches conflict with right turning vehicles, the signalised intersection must have separate right turn phasing.

Other considerations

Drivers that are attempting to turn right, are often not looking for and fail to see approaching cyclists and motorcyclists and fail to give way to them resulting in high severity injury crashes. Exclusive right turn phases are particularly beneficial to motorcyclists and cyclists.

Protected right turn phases may result in excessive delays to pedestrians waiting to cross and increase the number of pedestrians crossing against the lights. Signal timings should be reviewed and optimised so pedestrians are not frustrated at the delay and cross against a red signal.

References and guidelines

https://www.nzta.govt.nz/resources/traffic-notes/traffic-notes/

4.12 | SIGNALISED INTERSECTION – FROM UNCONTROLLED/GIVE WAY

ASSESSED ECONOMICS FOR STREAMLINED INVESTMENT PATHWAY

Applicable cost range:
$0.25m-$0.5m

Assumed DSI reduction:
25%

BCR range:
Less than 0

FIGURE 15 Signalised intersection

Upgrading an uncontrolled or priority (give way or stop) intersection to traffic signals can be considered a safety improvement only if potential conflicts are managed to a minimum and to an appropriate safe speed. Vulnerable road users require appropriate phasing/protection to minimise or remove their exposure to vehicle conflicts.

At crossroads in urban locations and at T-junctions, signals can be used to manage vehicular, pedestrian and cycle modes.

Safe system treatment philosophy

Safe system intersection transformation and/or safer intersection

Investment assurance criteria

For the project to meet the criteria for the streamlined investment pathway, the total project cost must fall between the applicable cost range and the meet criteria below:

- Intersection collective risk medium-high or greater or predicative intersection collective risk medium-high or greater.
- 3 or more G,H,J,K,L,N injury crash types.
- Speed limit is between 40km/h and 80km/h.

The applicable cost range reflects the installation of the signalised intersection – from uncontrolled/give way intervention at an existing intersection and includes professional service fees, construction costs including establishment, and traffic management, signal aspects, cabling and advance cycle stop box, splitter islands, high friction surfacing and lighting. The cost range does not allow for land acquisition and whole of life costs.

Implementation guidelines

To assist designers/project managers with the selection of suitable sites for signalised intersection intervention, the following guidelines have been developed:

- Is there evidence of turning/crossing type reported crash types and/or turning crashes involving vulnerable road users?

Other considerations

Requires careful consideration of layout and phasing, including particular attention to opposing right turns, cycle and pedestrian facilities. Conflict between turning vehicles and pedestrians requires careful phasing. Right turn against crashes on multi-lane roads requires exclusive turn phases.

As both cyclists and motorcyclists are often not noticed by other drivers that fail to give way, typically when drivers are turning right, exclusive right turn phases are particularly beneficial to motorcyclists and cyclists.

Speed management must be considered and can be effectively managed by the installation raised platforms.

References and guidelines

https://www.nzta.govt.nz/resources/traffic-notes/traffic-notes/

4.13 | MID-BLOCK RAISED PEDESTRIAN CROSSING

ASSESSED ECONOMICS FOR STREAMLINED INVESTMENT PATHWAY

Applicable cost range:
$0.12m-$0.4m

Assumed DSI reduction:
40%

BCR range:
0.7–2.3

FIGURE 16 Mid-block raised pedestrian crossing

Mid-block crossings facilitate movement between places that people want to go, but that are not well served by the existing traffic network. The pedestrian crossing can either be priority controlled or signalised depending on the volume of pedestrian and vehicles.

These pedestrian crossings, which commonly occur at schools, parks, museums, waterfronts and other destinations, have historically been overlooked or difficult to access, creating unsafe or unpredictable situations for both pedestrians and vehicles.

Safe system treatment philosophy

Safe system transformation and/or safer corridors

Investment assurance criteria

For the project to meet the criteria for the streamlined investment pathway, the total project cost must fall between the applicable cost range and the meet criteria below:

- Pedestrian crossing.
- Speed limit or mean speed is 60km/h and below.
- Land use commercial strip shopping, mixed use arterials, schools.
- ONRC classification - all.

The applicable cost range reflects the installation of the mid-block raised pedestrian crossing intervention on an existing corridor and includes professional service fees, construction costs including establishment and traffic management, pavement construction, signage, pavement markings and drainage. The cost range does not allow for land acquisition, lighting and whole of life costs.

Implementation guidelines

To assist designers/project managers with the selection of suitable sites for mid-block raised pedestrian crossing intervention, the following guidelines have been developed:

- Is there is a need for a priority pedestrian crossing?
- Speed limit or average speed is 60km/h or less.
- Is there evidence of pedestrian related crashes or near misses?

Other considerations

The use of the mid-block raised pedestrian crossings can be applied to locations where there is existing crossing infrastructure including zebra crossing, and central refuge islands.

Parked vehicles, street furniture and/or vegetation in advance of a crossing needs to be removed to ensure pedestrians are more visible to motorists and cars more visible to pedestrians. This may be accomplished by restricting parking and/or installing a curb extension.

At key access points to parks, schools and waterfronts, and at intersections with local streets, raised crossings increase visibility, driver stopping behaviour, and create a safer pedestrian crossing environment.

Priority controlled crossings should be highlighted using additional warning signage, high visibility lighting and markings and traffic calming features, such as build outs and mid-block curb extensions.

To achieve the safety benefits of the raised platforms they need to be installed at a minimum height of 75mm and between 100mm. The length of the ramp on the approach and departure side of the table will determine the ride quality.

Where mid-block pedestrian crossings are in a low volume downtown commercial or neighbourhood residential area, a designer may consider the application of a shared street treatment. Specific street design including street furniture and landscaping may be required to make the street self-explaining and manage speeds to below 30km/h.

Walking speeds should always be estimated conservatively with additional allowances where needed:

- Some pedestrians, notably the elderly, who can take up to 1.5 seconds longer to start crossing.
- People at the back of a large group of pedestrians, who will take some time to enter the crossing.
- If the crossing is narrow, there may be obstructions and delays between pedestrians walking in opposite directions.

References and guidelines

https://www.nzta.govt.nz/assets/resources/pedestrian-planning-guide/docs/pedestrian-planning-guide.pdf

https://austroads.com.au/network-operations/network-management/pedestrian-facility-selection-tool

https://www.nzta.govt.nz/resources/traffic-control-devices-manual/

4.14 | SKID RESISTANCE AT HIGH-RISK LOCATIONS

ASSESSED ECONOMICS FOR STREAMLINED INVESTMENT PATHWAY

Applicable cost range:
$0.03m-$0.3m per site

Assumed DSI reduction:
20%

BCR range:
Between 0.7 and 7.1

FIGURE 17 Skid resistance

Skid resistance is a very complex issue that includes factors such as speed, water and/or detritus, macro and micro texture and stone shape. There are strong proven relationships between skid resistance values and crash rates in both wet and dry conditions.

Enhancement to the skid resistance at high-risk locations may include, but not be limited to, the approaches to railway level crossings, traffic signals, pedestrian crossings, one lane bridges and rural high-risk curves (out of context) and/or curves that are less than 250m radius and up to 400m radius.

Safe system treatment philosophy

Safety management and/or safer corridors

Investment assurance criteria

For the project to meet the criteria for the streamlined investment pathway, the total project cost must fall between the applicable cost range and the meet criteria below:

- 2 or more skid related crashes.
- Speed limit 50km/h and above.
- High-risk curves (out of context) or curves less than 250m and up to 400m radius where the speed limit is 80km/h.
- ONRC Classification - all.

The applicable cost range reflects the installation of improved skid resistance at high-risk locations on an existing corridor or site and includes professional service fees, construction costs including establishment and traffic management, high friction surface and pavement markings. The cost range does not allow for pavement or surfacing defects and whole of life costs.

Implementation guidelines

Skid resistance levels and requirements can be determined in variety of ways. These include regular network surveys, such as the annual SCRIM survey that is undertaken on the state highway network, high-risk site surveys using smaller trailer type devices or the British pendulum meter.

Desired minimum levels of skid resistance for various situations can be found in the Transport Agency's T10 specification, however providing even higher levels of skid resistance at high-risk sites is often very beneficial and cost effective.

Methods for improving skid resistance include water blasting (temporary), scabbling, resurfacing with higher polished stone value aggregates, melter slag, or specific manufactured products such as calcium bauxite.

To assist designers/project managers with the selection of suitable sites for skid resistance at high-risk locations intervention, the following guidelines have been developed:

- Is there evidence of crashes or near misses related to the poor skid performance on bends, approaches to intersections, crossing etc.?
- Where improved skid resistance will reduce stopping distances and likelihood of crashes.

However, implementation should not be restricted to these situations. It should be considered at high-risk locations referred to above where improved skid resistance and shortened stopping distances will reduce the likelihood and/or severity or crashes, as similar BCRs are likely to be achieved.

Other considerations

Ensure that the surface drainage is appropriate as it will lead to increased water depths on the road surface. Attention should be given to crossfall, grades, moving crowns and similar surface features.

Consider the surface contaminants that affect the skid resistance such as bitumen, oil, grease, tyre rubber, mud, clay and organic (plant) matter.

Consideration needs to be given to the pavement construction and condition, as well as the sub-surface as this needs to be good condition when considering high friction surfacing types. Poor pavement or exiting surface condition can lead to premature failure of high friction surfacing.

Consider what the treatment life will be and what crash migration might occur when high skid resistance treatments are used at some sites, but not adjacent to similar situations.

Skid resistance will continue to deteriorate over time, especially in high demand, high volume sites.

References and guidelines

https://www.nzta.govt.nz/assets/resources/skid-resistance-investigation-treatment-selection/docs/T10-skid-resistance-investigation-treatment-selection-201306.pdf

https://www.nzta.govt.nz/assets/resources/skid-resistance-investigation-treatment-selection/docs/T10-Notes-to-specification-for-highway-skid-resistance-management-201306.pdf

4.15 | SIGNS AND MARKING DELINEATION UPGRADES

ASSESSED ECONOMICS FOR STREAMLINED INVESTMENT PATHWAY

Applicable cost range:
Up to $0.1m per km

Assumed DSI reduction:
5%

BCR range:
Up to 4.7

Signs and marking delineation upgrades may include but are not limited to the installation and/or upgrading of a number of traffic control devices, centreline, edge lines, reflective raised pavement markers (RRPMS), edge marker posts and curve warning signage.

FIGURE 18 Signs and markings delineation upgrades

Safe system treatment philosophy

Safety management and/or safer corridors

Investment assurance criteria

For the project to meet the criteria for the streamlined investment pathway, the total project cost must fall between the applicable cost range and the meet criteria below:

- AADT is greater than 800 vehicles per day.
- Posted speed limit or mean speed is 80km/h or higher.
- Collective risk of low-medium or higher.

The applicable cost range reflects the installation of the signs and marking delineation upgrades intervention on an existing corridor and includes professional service fees, construction costs including establishment and traffic management, installation of high performance pavement markings including RRPMS, edge marker posts and signage. The cost range does not allow for audio tactile pavement markings or whole of life costs.

Implementation guidelines/site selection

To assist designers/project managers with the selection of suitable sites for signs and marking delineation upgrades, the following guidelines have been developed:

- Edge marker post delineation upgrades on roads with typically greater than 500 vehicles per day.
- On corridors where there are inconsistences of the delineation.
- Evidence of loss of control and night-time type of crashes.

Other considerations

Edge lines can reduce shoulder damage, reducing maintenance costs and aid in curve negotiation.

Edge marker posts (EMPs) should be used where other sources of delineation (such as line marking) are not sufficient and cannot be correctly placed.

Any gaps in the sequence of EMPs reduces the overall effectiveness of the delineation.

Visibility of the chevron signs in both directions needs to be considered and a sign for one direction should not be visible to traffic travelling in the opposite direction.

References and guidelines

https://www.nzta.govt.nz/resources/motsam/part-1/

https://www.nzta.govt.nz/resources/motsam/part-2/

https://www.nzta.govt.nz/resources/traffic-control-devices-manual/index.html

https://www.nzta.govt.nz/resources/traffic-notes/traffic-notes/

5. SUMMARY OF ASSESSED ECONOMICS

STANDARD SAFETY INTERVENTION	INVESTMENT ASSURANCE CRITERIA FOR STREAMLINED INVESTMENT PATHWAY	LOW COST	MEDIUM COST	HIGH COST
Continuous 3 barriers	• AADT 10,000 or greater • Actual collective risk medium-high or greater or predictive collective risk medium-high or greater • Speed limit 80km/h and above • ONRC classification - all	$2 million per km BCR 1.8	$3 million per km BCR 1.2	$4 million per km BCR 0.9
Median barrier	• AADT 6000 or greater • Collective risk medium-high or greater or predictive collective risk medium-high or greater • Speed limit 80km/h and above • ONRC classification - all	$1 million per km BCR 2.8	$2 million per km BCR 1.4	$3 million per km BCR 0.9
Wide centreline	• AADT 3000 or greater • Collective risk medium-high or greater or predictive collective risk medium-high or greater • Speed limit 80km/h and above	$250,000 per km BCR 3.1	$700,000 per km BCR 1.1	$1.7 million per km BCR 0.5
Roadside barrier at high-risk locations	• AADT 1000 or greater • Collective risk medium-high or greater or predictive collective risk medium-high or greater • Speed limit 70km/h and above • ONRC classification - all	$100,000 per km BCR 7.6	$250,000 per km BCR 3.0	$400,000 per km BCR 1.9
Audio tactile pavement (ATP) marking	• AADT 1000 or greater • Speed limit 80km/h and above • ONRC classification - all except access	$10,000 per km BCR 11.4	$15,000 per km BCR 7.6	$50,000 per km BCR 2.3
Shoulder widening at high-risk locations	• AADT 1000 or greater • Collective risk high risk or predictive collective risk high • Speed limit 70km/h and above • ONRC classification - all	$200,000 per site BCR 3.1	$325,000 per site BCR 1.9	$450,000 per site BCR 1.4
Rural roundabout	• Intersection collective risk medium-high or greater • 3 or more G,H,J,K,L,N crash types • Speed limit 80km/h and above	$2 million per site BCR less than 0	$3 million per site BCR less than 0	$5 million per site BCR less than 0
Urban roundabout	• Intersection collective risk medium-high or greater • 3 or more H,J,K,L,N injury crash types • Speed limit 70km/h and below	$500,000 per site BCR less than 0	$1.5 million per site BCR less than 0	$2 million per site BCR less than 0
Raised safety platforms	• Intersection collective risk medium-high or greater • 3 or more injury crash types • Speed limit 60km/h and below	$150,000 per site BCR less than 0	$200,000 per site BCR less than 0	$300,000 per site BCR less than 0
Upgrade of signalised intersection (eg right turn filter bans)	• 3 or more L,N injury crash types • Speed limit 50km/h and above	$100,000 per site BCR less than 0	$200,000 per site BCR less than 0	$300,000 per site BCR less than 0

RIAWS	• T or X type intersection • 3 or more H,J,K,L injury crash types • Speed limit 80km/h and above • Medium-high or greater intersection risk	Up to $300,000 per site BCR 0.1		
Signalised intersection	• Intersection collective risk medium-high or greater • Predicative intersection collective risk medium-high or greater • 3 or more G,H,J,K,L,N injury crash types • Speed limit between 40km/h and 80km/h	$250,000 per site BCR less than 0	$300,000 per site BCR less than 0	$500,000 per site BCR less than 0
Skid resistance at high-risk locations	• 2 or more wet skid crashes • Speed limit 50km/h and above • Curves less than 250m and up to 400m radius where the speed limit is 80km/h • Pedestrian crossing • Level crossing • ONRC classification - all	$30,000 per site BCR 7.1	$120,000 per site BCR 1.8	$300,000 per site BCR 0.7
Mid-block raised pedestrian crossing (priority and signalised)	• Pedestrian crossing • Speed limit 60km/h and below • Land use commercial strip shopping, mixed use arterials, schools • ONRC classification - all	$120,000 per site BCR 2.3	$160,000 per site BCR 1.7	$400,000 per site BCR 0.7
Signs and markings delineation upgrade	• AADT 1000 or greater • Speed limit 80km/h and above • ONRC classification - all except access	Up to $100,000 per km BCR 4.7		

6. SUMMARY OF DSI EFFECTIVENESS

STANDARD SAFETY INTERVENTION	DSI EFFECTIVENESS REFERENCES AND RESEARCH	SSI TOOLKIT ASSUMED DSI REDUCTION
Continuous 3 barriers	• 92% reduction in head-on DSI, 67% reduction in all DSI, 34% reduction in intersection and other: Safe Roads NZ rural SH mid-barrier site before/after study Feb 2018 • 60% reduction or more: IRAP safety toolkit • 70% – flexible median barriers (undivided rural highways): Austroads Road safety engineering toolkit • Transport Agency Crash estimation compendium	75%
Median barrier	• 92% reduction in head-on DSI, 67% reduction in all DSI: Safe Roads NZ rural SH mid-barrier site before/after study Feb 2018 • 60% reduction or more: IRAP safety toolkit • 70% - flexible median barriers (undivided rural highways): Austroad's Road safety engineering toolkit	65%
Wide centreline	• 50–80% reduction in head-on; 60% reduction in all crash types: Austroad's AP-R519 16 Guidance on median and centreline treatments to reduce head-on casualties. • 20–60% reduction in DSI: Transport Agency wide centreline trial • 10–25%: IRAP toolkit • 67% reduction in severe crashes Bruce Highway before/after study: TMR Queensland	35%
Roadside barrier at high-risk locations	• 45% reduction in runoff road injury crashes: HRRRG • 83–87% reduction in severe crashes: Austroad's AP-R498-15 Improving the performance of safe system infrastructure	30%
Audio tactile pavement (ATP) marking	• 30% reduction in runoff road crashes for edge line and 30% reduction in head-on crashes for centreline: Transport Agency Economic evaluation manual (EEM) crash compendium • Average 27% reduction in crashes, 32% reduction in runoff road crashes, 42% reduction in fatal crashes: HRRRG (The usability and safety of audio tactile profiled roads markings 2009 NZTA research report 365) • 10-25%: IRAP toolkit • 20% reduction for edge line and 15% for centrelines: Austroad's Road safety engineering toolkit	20%
Shoulder widening at high-risk locations	• 14–30% reduction in ROR crashes: HRRRG • 30% reduction in ROR casualty crashes - sealing existing unsealed shoulder (0.6-1.0 m): Austroad's Road safety engineering toolkit • 25–40% reduction: IRAP Toolkit	10%
Rural roundabout	• 90% reduction in serious and fatal crashes: HRIG • 70% for rural roundabout: Austroad's Road safety engineering toolkit • 60% or more 'roundabouts can virtually eliminate often severe right-angle, left-turn (or right-turn), and head-on collisions': RAP safety toolkit • 65% reduction in casualties: Austroad's AP-R556-17 Understanding and improving safe system intersection performance	60%

Urban roundabout	• 75% reduction in crashes: Austroad's AP-T330-17 Safe system infrastructure on mixed use arterials • 55% reduction for urban roundabouts: Austroad's toolkit • 90% reduction in fatal and serious crashes and 25-80% reduction in all crashes from uncontrolled intersections (urban/rural not defined): HRRRG	60%
Raised safety platforms	• 50% reduction in injury crashes: Bruce Corben (2014) Criteria for the use of elevated stop lines at traffic signals • 53% reduction in casualty crashes (urban roads): ARRB Criteria for the use of elevated stop lines at traffic signals • Reduction from 80km/h to 50km/h operating speed will reduce risk of fatal side impact crashes by 65% based on Nilsen curves • 40% decrease in fatal and serious crash risk Source: Jurewicz et al. (2016) based on Bahouth et al. (2014), Davis (2001)	40%
Upgrade of signalised intersection (eg right turn filter bans)	• 10–25% reduction for signalised turn lanes: IRAP toolkit • 25% reduction in crashes for improving signal conspicuity: HRIG • 27-35% reduction for right turn phases • 35% reduction in all casualty crashes for fully controlled right turn phase: Austroad's Road safety engineering toolkit	25%
RIAWS	• 35% reduction in crashes: *Transport Agency EEM crash compendium* • 35% reduction in crashes: HRIG	35%
Signalised intersection	• 25–40% reduction: IRAP toolkit • 15–30% reduction in all crashes from uncontrolled: HRIG	25%
Skid resistance at high-risk locations	• 40% wet road crashes (E&V) • 25–40% (IRAP toolkit) • 35% reduction on wet road and 20% in all crashes (HRRRG)	20%
Mid-block raised pedestrian crossing (priority and signalised)	• 40% reduction in casualty crashes & 45% reduction in vehicle-pedestrian crashes: Austroad's AP-T330-17 Safe system infrastructure on mixed use arterials • 50% reduction in fatal and serious (interpolated based on reducing impact speed from 60km/h to 40km/h): Source: Jurewicz et al. (2016) based on Bahouth et al. (2014), Davis (2001)	40%
Signs and markings delineation upgrade	• Install edge lines 10% reduction (assumes no edge line): T*ransport Agency EEM crash compendium* • Widened edge line (200mm) in high-risk locations have been shown to reduce crash rates: HRRRG • Statistically reliable improvement in drivers' lane keeping (reduction in instances of drivers crossing the centreline and edge line and an overall improvement in lane position: Transport Agency SWATT monitoring 2010. • 5% reduction in crashes for widened edge lines: Agent et al (survey of 43 US states) 2004 • 20-40% reduction in crashes from improved signage: HRRRG	5%

7. COMMUNITY ENGAGEMENT

As noted earlier, the 2018 Government Policy Statement (GPS) reflects a significant lift in ambition for improving the safety of the land transport system.

Local authorities are responsible to their communities and need to determine where road safety fits within the community's priorities and how best to address road safety challenges in the context of its statutory responsibilities.

Early engagement with key stakeholders and communities is vital to create a better understanding of road risk. The Transport Agency developed five principles for positive engagement based on a review of successful engagements in communities around New Zealand.

7.1 | LAY THE GROUNDWORK AND TAKE YOUR TIME

- Plan. Don't rush and you'll see the benefits.
- Think about who you need to speak with to make sure you connect with the right people right away.
- Map out your milestones. This will help you identify opportunities to engage and interact with your community, including local media.
- Anticipate your community's concerns before you engage. This will make it easier to respond in an open, clear and direct way.
- Be clear about why it's important to engage with your community, and how it can help.

7.2 | LISTEN, REALLY LISTEN

- Put your ear to the ground – find out what's going on in your organisation, analyse media coverage, conduct community research, and build an understanding of your community before you engage.
- Pay close attention to what your community is saying to better understand their concerns.
- Demonstrate you've really listened by adapting your programme to reflect their views and show them what you've done.

7.3 | ENGAGE MANY VOICES

- Generate interest and support for your proposal by sharing messages and communications widely and in a variety of ways.
- Identify and train your spokespeople to be 'advocates' for your programme.
- Try to be the first person to spread any news about your programme.

7.4 | GET OUT THERE AND TELL THE STORY

- Talk, and talk some more. Don't walk away from tough conversations.
- Help the media tell your story by working with, and regularly updating, them.
- Go where the people are and make it easy for them to come to you, eg hold community meetings, drop-in sessions or knock on doors.
- Connect in a way that is suitable for the audience you're trying to engage, eg social media for younger people, flyers at the library for older people.
- Tell the right story to the right audience in a timely way, eg if it's about a residential road, focus on the residents and give them time to think.
- Keep it simple: use clear messages, provide strong, neutral facts, use plain English to explain your proposals and steer clear of jargon.

7.5 | KEEP IT UP

- Engagement can be the difference between success and failure. So, start engaging well before you begin to consult, and keep it going throughout.
- Seek out and include a range of views. This could lead to solutions you might not otherwise consider.

For more information on how the Transport Agency engages visit **https://www.nzta.govt.nz/safety/speed-management-resources/**

If you have further queries, call our contact centre on 0800 699 000 or write to us:

NZ Transport Agency
Private Bag 6995
Wellington 6141

This publication is also available on NZ Transport Agency's website at **www.nzta.govt.nz**

NZ TRANSPORT AGENCY
WAKA KOTAHI

New Zealand Government

February 2019