Land Transport Benefits Framework measures manual







Te Kāwanatanga o Aotearoa New Zealand Government

Land Transport Benefits Framework measures manual

February 2024 Version 2.1

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More information

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This document is available on the Waka Kotahi website at <u>https://www.nzta.govt.nz/resources/land-transport-benefits-framework-measures-manual</u>

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Introduction

Purpose of this manual

The purpose of this manual is to guide how benefits are measured and used in benefits realisation, and how benefits are measured in investment decision making. It provides details about benefits measures – what they are and how to use them.

The measures are quantitative (number based) and qualitative (description based).

The manual provides guidance about the measures and how to apply them in transport planning, including:

- definitions
- relationships with other measures
- how to forecast quantitative measures (where available)
- how to provide a value scale to qualitative measures (where available)
- where to find centralised data for quantitative measures (where available).

The information in this manual can be used in multiple stages of the Investment Decision-Making Framework. Initially, it can support the identification of benefits and investment objectives as part of the strategic case. Second, data sources and definitions within this manual can help shape options assessment within the economic case. Benefits, including monetised benefits and quantitative and qualitative benefit measures, should be reported within the <u>appraisal summary table</u> (AST). Third, benefits management provides guidance for benefits management planning within the management case. This manual will be regularly updated as further details or information becomes available.

Recent updates to this manual (version 2) improve how we plan for and realise the benefits of our investments to meet enduring and emerging priorities such as improving our response and adaptation to climate change, reducing deaths and serious injuries, improving mode choice and improving the efficient movement of freight.

We have also changed the name of this manual (from *Non-monetised benefits manual: quantitative and qualitative measures*) to better reflect the content and purpose of this manual.

This manual should be read in conjunction with the <u>benefits management guidance</u>, which provides a broad overview of the <u>Land Transport Benefits Framework</u> and its application, and the <u>Monetised</u> <u>benefits and costs manual</u> (MBCM), which provides details about the monetisation of benefits in the benefits framework.

Who this manual is for

This guide is for:

- business case writers, reviewers and owners
- people who carry out economic evaluation or cost-benefit analysis
- transport planning practitioners
- measurement specialists
- benefit management practitioners
- other stakeholders interested in land transport decision making.

Navigating around the manual

Links are provided throughout this PDF to allow you to navigate between sections. Where you see a '>>' or an underlined heading, click on the >> or underlined heading to go to that area of the document.

Overview of benefits management and the benefits framework

What is benefits management?

Benefits management is a generic term used to describe any and all activity associated with benefits. In this manual and <u>associated guidance</u>, it is used to generally describe the act of understanding and managing benefits from investment.

What is a benefit?

A benefit is a measurable change resulting from an investment. It could be either an advantage (positive/benefit) or disadvantage (negative/disbenefit) by one or more stakeholders. In this document, 'benefit' is used as an overarching term for both benefits and disbenefits.

The term 'impact' is also used widely in the benefits framework as a substitute for the term 'benefit' to allow for benefits and disbenefits.

What is the benefits framework?

The benefits framework is the structure that outlines and organises types of benefits. The benefits framework provides a common list of all transport benefits currently recognised by Waka Kotahi. It includes monetised benefits and associated qualitative and quantitative measures. See <u>Appendix 2</u> for an overview table of the benefits framework and the <u>benefits management guidance</u> on our website for description of each of the components of the benefits framework.

How we use the benefits framework to manage benefits

We apply the benefits framework to National Land Transport Programme (NLTP) processes for the identification, analysis, planning, realisation and reporting of benefits. This includes business case development, investment decision making and monitoring and reporting on the realisation of benefits.

Introduction to benefit measures

What is the difference between benefit measures and monetised benefits?

Monetised benefits are the benefits with standardised monetary values (in NZ dollar terms), as described in the <u>Monetised benefits and costs manual</u>. Monetised benefits are used in the calculation of benefit–cost ratios (BCRs) as the primary measure of economic efficiency, within cost–benefit analysis (CBA).

Benefit measures consider the impact of an investment from a quantitative or qualitative perspective. The qualitative measures are necessary where benefits cannot be easily monetised, for example improvements to social cohesion or biodiversity. These measures are associated with all of the benefits included in the benefits framework, except wider economic impacts, regardless of whether or not they can be monetised.

The benefit measures provide information sources for understanding impacts, associated with both on-the-ground impacts, such as counting the number of kilometres of road impacted by an intervention, and the next level of impacts such as the impact of the intervention on people's ability to get to their closest supermarket. These two levels of measures are referred to in these benefits guides and manuals as either 'output' or 'outcome' measures.

What is the difference between quantitative and qualitative measures?

A quantitative measure is concerned with a quantity. It is often based on a number or percentage. It measures an impact you can count. A quantitative measure in this manual is identified with a number (#) icon.

A qualitative measure is concerned with a quality. It is often descriptive. It measures an impact you can describe. A qualitative measure in this manual is identified with a pen icon.

How are quantitative and qualitative measures used in benefits management?

Benefit measures – the quantitative and qualitative measures – are included across the breadth of the NLTP process, from regional land transport plans (RLTPs), through to activity management plans (AMPs), business case development, investment decision making, into benefits realisation monitoring and reporting.

The <u>benefits management guidance</u> provides information about how benefits and their associated measures are applied in various plans and processes. This manual describes in more detail the instances in which measures can be used and gives instruction for applying the measures.

Any measure in this manual can be used as evidence for any benefit, if it is appropriate. The details provided here, including the relationships between measures, can assist in the selection of the measure that provides the best observed or reported evidence of the benefit for a particular investment.

It is expected that measures will be selected for benefits, whether or not those benefits can be monetised. In addition to monetised benefits, measures are used in the economic evaluation of the investment. Benefit measures are also used in the development of plans and business cases and in ongoing monitoring and evaluation of the investment.

Including standardised benefit measures (quantitative and qualitative) at all stages of the NLTP enables better and more transparent consideration of benefits into Waka Kotahi investment decision making, including assessment. For example, the <u>appraisal summary table</u> (AST) will

reflect both measures and monetised benefits information, allowing for a more comprehensive view of the impact of an investment and the ability to track progress against those impacts over time (benefits realisation).

A further feature is the availability of centralised measures information. The centralised measures data held in the Benefits Data Tool on StoryMaps about the quantitative benefit measures provides evidence to inform early thinking and transport planning. The data in StoryMaps also feeds into baseline setting and monitoring of those measures. Links to the tool are provided in the relevant measure descriptions in this manual. Note, however, that the StoryMaps tool is not a comprehensive source of data.

How are quantitative measures described in this manual?

There is a standard format used to describe and provide instructions for using the quantitative measures.

Measure description

- At the top of each measure, the number and short name of the measure is provided. A circle to the far right also provides the number of the measure. To the left of the circle there is an 'icon bar' that summarises the attributes of the measure. The icons identify the type of measure (quantitative or qualitative), its scope (whether it can be used at project level or can be rolled up to a geographical area or to a programme level), and the data and spatial information centrally available for the measure. When the icon bar is blue, detailed information or instructions are not yet included in the manual for the measure. See the key to the icons.
- The first four rows of the table provide the measure number, name, description and type.
- The next section describes the **intent** (that is, for which types of investments or programmes this measure might be used) and the **scope** (whether the measure is best suited at project level and/or can be rolled up) of the measure.
- The **relationship map** shows the relationships between this measure and other measures in the framework. Three types of relationships are included:
 - **Companion** measures can be used in conjunction with each other to complete the evidence for a particular impact or investment.
 - **Cause/effect** improving the result for one measure leads to improvement of the results for another measure.
 - **Conflict** to be balanced against each other to avoid unintended consequences.

Measure information and data

- The **measure equation** field details the data components of the measure. With both a description and the equation provided where possible, this information is intended to help users pull together reporting on the measure from centralised or local data sources.
- The unit of measure is the form in which the measure is reported for example number of kilometres or percentage of population.
- The **definition of terms** section outlines specific meanings or boundaries that are relevant to fully understand and apply the measure.
- The **information available** area provides a brief description and overview of any centrally held information/data, along with links to the StoryMaps tool that holds the information/data. The tool provides spatial information via maps and/or downloadable data. Whether complete or partial spatial information/data is held is also specified here. Where no centralised data is held, or only partial data is available, the type of localised data that might be used for this measure is considered when appropriate. The **information items** further describe content in the StoryMaps tool.

How to calculate baseline/monitoring data

A common step across a number of NLTP processes is to identify a baseline to define the situation before the change for each quantitative measure selected. Baseline data will be required to build a model that reflects the current situation (it can also be a point of time in the past). We can then

compare the performance of an activity before and after implementation using data to model impacts. In some cases, baseline data can be sourced through centrally held information. In those cases, the approach for determining the baseline is outlined in this section. Where there is currently only partial datasets or no centrally held data, potential methods for determining a baseline from localised data is discussed.

Waka Kotahi continues to develop tools and data to improve the ease of baseline setting and ongoing monitoring.

Forecasting methodology

Forecasting the desired level of performance for a specific benefit using the target measure is the other piece of information that needs to be presented in the benefits management section of the business case. The baseline and forecasted target are required for building a benefit profile. The timeframes for achieving the targets should be realistic and consistent with the scale of the initiative.¹

Where available, a centralised forecasting methodology will be included in the manual for each of the quantitative measures. The centralised forecasting methodology project will feed a handful of new forecasting methodologies into this manual each quarter.

In the interim, forecasts should be developed by approved organisations using existing local methodologies.

Benefits realisation

Where available, further information and guidance is provided around the ongoing monitoring and realisation of each measure.

How are qualitative measures described in this manual?

Qualitative measures are usually for those benefits or parts of benefits that don't yet have quantitative measures developed for them or for which quantitative measurement or monetisation alone is not appropriate. In the full list of measures at Appendix 1, the qualitative measures are those that include 'user to describe' in their description.

There is a standard format used to describe and provide instructions for using the qualitative measures. The first section is largely the same as for quantitative measures, with some small differences.

Measure description

- At the top of each measure, the number and short name of the measure is provided. A circle to the far right also provides the number of the measure. To the left of the circle there is an 'icon bar' that summarises the attributes of the measure. The icons identify the type of measure (quantitative or qualitative), its scope (whether it can be used at project level or can be rolled up), and the method by which the measure can be analysed (narratives, thresholds and ranking; scoring; rich narrative; user to define). When the icon bar is blue, detailed information or instructions are not yet included in the manual for the measure. See the key to the icons.
- The first four rows of the table provide the measure number, name, description and type.
- The next section describes the **intent** (that is, for which types of investments or programmes this measure might be used) and the **scope** (whether the measure is best suited at project level and/or can be rolled up) of the measure.
- The **relationship map** shows the relationships between this measure and other measures in the framework. Three types of relationships are included in the map:

¹ The timeframe is set for the purpose of benefits realisation, and could also be included in the appraisal summary table as part of the economic analysis results and does not have to be consistent with the analysis period in the benefit–cost ratio calculation.

- **Companion** measures can be used in conjunction with each other to complete the evidence for a particular impact or investment.
- **Cause/effect** improving the result for one measure leads to improvement of the results for another measure.
- **Conflict** to be balanced against each other to avoid unintended consequences.

Measure information

- The **definition of terms** section outlines specific meanings or boundaries that are relevant to fully understand and apply the measure.
- The information sources section references the original source of the methodologies or approaches used to develop the qualitative methodology
- The methodology section outlines, at a high level, which of the four methodologies in <u>Figure 1</u> can be applied to develop the qualitative description, baseline and forecast (direction/scale).
- A description of the methodology for each is then provided, which may include things like descriptions of the elements valued in the measure, the method to appraise the features of the site, the impact of the investment and/or the determination of the overall measurement score. Detail of the steps of the scoring methodology are outlined at <u>Figure 2</u>.

How to calculate baseline/monitoring data

Where available, the description of the methodology will outline how to fully describe the qualitative measure and the baseline before investment. In the 'scoring methodology', this occurs at steps 2 and 3. This information is required in some NLTP processes, as outlined in our <u>benefits</u> <u>management guidance</u>. When required in Transport Investment Online (TIO), this information is to be included in the '**input measure baseline'** field.

Forecasting methodology

Where available, the description of the qualitative methodology will outline how to forecast the impact of investment on the measure. In the 'scoring methodology' this occurs at step 5. This information is required in some NLTP processes, as outlined in our <u>benefits management</u> <u>guidance</u>. When required in TIO, this information is to be included in the 'input measure direction/scale' field.

Benefits realisation

Where available, further information and guidance is provided around the ongoing monitoring and realisation of each measure.

Figure 1: The four qualitative benefit measure methodologies

Narratives, thresholds and ranking

This method uses the approach taken in economic analysis to developing narratives. To do this, a narrative can be written collaboratively by the appropriate experts or separate narratives can be developed that are then pulled together by the group. Within the narrative approach, the idea of thresholds is sometimes used to provide a more nuanced level of value judgement. For instance, a rank of heritage sites could be classified as either of 'national significance' as the top threshold, or of a lower tier of 'regional or local significance'.

Rich narrative

A rich narrative involves engagement with a broader range of people and does not rely solely on experts. This allows a narrative that acknowledges the plurality of understandings of intangibles within communities and recognises local voices rather than imposing external ones. This approach may take more effort than an expert-led narrative, but carries the advantage of describing the impacts of investment proposals in a way that documents the values identified and recognised by the community, including groups within the community, in addition to subject matter experts. This method requires that the communities who value and benefit from the place or environment are involved in their management and conservation.

Scoring

This method brings together quantitative and qualitative approaches, allowing for a structured appraisal of a qualitative description and forecast. It also allows for comparability across different sites, values or benefits, which is lacking from a purely narrative approach, and for the concept of natural capital to be included in the appraisal of benefits. Site- or location-specific attributes that have certain qualities or functions that are valued by the community and/or at the local, regional, national and international level are central to this method. Measurement is based on the impact of investment on these attributes. The attributes contain a series of features and this manual provides a list of features unique to each measure. The scoping method can be applied at different stages of the investment process, using the level of detail appropriate to the stage, and for ongoing monitoring of the impact of the investment. Sensitivity testing is encouraged as part of this method, with any assumptions clearly stated. Increasing confidence can be placed in the result as greater detail is included. This method can also be applied more deeply beyond the needs of scoring for the purposes of measurement to further understand the impact of the investment. The steps suggested to use this method are outlined at Figure 2.

User to define

For qualitative measures that are tangible or have not had methodology detailed in this manual, a locally determined narrative or a pre-existing local quantitative measure can be used

Figure 2: Steps of the scoring methodology

Scope and identify study area

This step mirrors the first step of an environmental impact assessment, where each measure being considered should be scoped separately. The study area being scoped is the geographical area of the investment, including the area of impact. The scope and study area should be appropriate to the investment and its proposed impact, with impacts that are expected to be minimal scoped out at this early stage. As with the environmental impact assessment, it may be appropriate to discuss the scope of the study area with your Waka Kotahi adviser. During the scoping step, information should be obtained relating to the potential impacts of the investment and the features or elements that may be impacted. Potential impacts and the investment's zone of influence is likely to vary from one qualitative measure to another.



Identify key attributes and their features

Key attributes and their features (or elements) are to be clearly identified and described at this step. They should be identified based on the coherence of character within each feature or element and distinctiveness of character across them. A set of features is suggested for each measure in this manual, with descriptions. This set of features should be reviewed and added to in this step. The resulting description can be summarised and provide the **description of the measure**.



Set baseline of the features

In this step, a series of indicators are provided to appraise the features defined in step 2 to understand their current state, which is considered their baseline state. The indicators help understand and record the value of the features and consider scale, significance and rarity. This step assesses what matters and why at present. The resulting description can be summarised to provide the qualitative **benefit measure baseline**.



Describe the forecast impact of investment

In this step, the impact of the investment on the baseline features is described. This description seeks to understand the scale and seriousness of the impact and whether the impact is primary and immediate or secondary (cumulative), such as gradual degradation over time as a result of the investment. This is also where planned mitigations or ameliorations of negative impacts of the investment are considered.

Score the forecast impact of investment

Using the description of impact from step 4, this step uses a table of impacts to 'score' the forecast impact for each measure. The potential 'scores' include 'Large beneficial (positive) effect', 'Moderate beneficial (positive) effect', 'Slight beneficial (positive) effect', 'Slight adverse (negative) effect', 'Moderate adverse (negative) effect', 'Large adverse (negative) effect'. This score can be provided as the **qualitative measure direction/scale**.

Measure attributes - icon key

Throughout the manual, a standard set of icons is used in the 'icon bar' at the top right of each of each new measure. The icons describe some of the key attributes of each measure in shorthand.

Measure attributes

manual

A blue box means there is currently no

detailed information provided in the

The key for the contents is explained below.

Measure number

1.1.1

= the measure number (in the benefits framework)

Level of detail provided

Measure attributes

A clear box means there is measures information available in the manual

Types of measure



Quantitative measure - data availability



Ωů

= full centralised data available

Quantitative measure - spatial information availability



= full centralised spatial information (map) available

Qualitative measure - method



Scope of measure



= measure can be rolled up (used at a higher geographical area, for a number of projects, or nationally)

= measure can be used at project level

Measure relationships



>> Return to quantitative measures section

>> Return to qualitative measures section

Overview of the Land Transport Benefits Framework

Healthy and safe people			Resilience and security	Ecor	nomic prosperity
 1. Changes in user safety 1.1 Impact on social cost of deaths and serious injuries ≥> 1.2 Impact on a safe system ≥> 	 2. Changes in perceptions of safety 2.1 Impact on perceptions of safety and security >> 	 3. Changes in human health 3.1 Impact of mode on physical and mental health ≥≥ 3.2 Impact of air emissions on health ≥≥ 3.3. Impact of noise and vibration on health ≥≥ 	 4. Changes in impact of unplanned disruptive events on access to social and economic opportunities 4.1 Impact on system vulnerabilities and redundancies ≥> 	 5. Changes in transport costs 5.1 Impact on system reliability set 5.2 Impact on network productivity and utilisation set 	 6. Wider economic impact (WEI) 6.1 Wider economic benefit (productivity) 6.2 Wider economic benefit (employment impact) 6.3 Wider economic benefit (imperfect competition) 6.4 Wider economic benefit (regional economic development)
7. Changes in natural environment 7.1 Impact on water >> 7.2 Impact on land and biodiversity >>	 Environmental sustainability 8. Changes in climate 8.1 Impact on greenhouse gas emissions (GHG) >> 		10. Changes in access social and economic opportunities 10.1 Impact on user experience of the transport system >> 10.2 Impact on mode ch >> 10.3 Impact on access to opportunities >> 10.4 Impact on communicies >>	Inclusive accesss to11. Changes in liveability of plat 11.1 Impact on heritage and cult value $\geq \geq$ 11.2 Impact on landscape $\geq \geq$ 11.3 Impact on townscape $\geq \geq$	aces tural 12. Changes in te ao Māori 12.1 Impact on te ao Māori ≥≥

Healthy and safe people

This transport outcome is about protecting people from transportrelated injuries and harmful pollution, and making active travel an attractive option.

1. Changes in user safety

This benefit cluster focuses on the actual safety of users of the transport system. It includes two benefits about the social cost and incidence of crashes and the creation and operation of a safe transport system.

1.1 Impact on social cost of deaths and serious injuries

This benefit is about the social cost of crashes on individuals and groups and the incidence of crashes, including the number and nature of them.

A full description of this benefit is available on our website: <u>1.1 Impact on social cost of deaths and serious injuries</u>.

The measures listed below have been associated with this benefit for ease of reference, but they can also be applied to other benefits as appropriate.

Quantitative measures			
No.	Name		Description #
1.1.1	Collective risk (crash density)	<u>>></u>	Average annual fatal and serious injury crashes per kilometre of road section
1.1.2	Crashes by severity	>>	Number of crashes by severity
1.1.3	Deaths and serious injuries	<u>>></u>	Number of deaths and serious injuries
1.1.4	Personal risk (crash rate)	<u>>></u>	Average annual fatal and serious injury crashes per 100 million vehicle- kilometres
Qualitati	ive measures		
N/A			

>> Return to Land Transport Benefits Framework overview

1.1



1.1.1 Collective risk (crash density)

Measure description

Measure attributes	
	1.1.1

Measure no:	1.1.1
Measure name:	Collective risk (crash density)
Measure description:	Average annual fatal and serious injury crashes per kilometre of road section
Measure type:	Quantitative measure
Intent	This measure can be used for any safety-related investments and programmes, particularly those targeting areas with high rates of deaths and serious injuries .
Scope	This measure can be applied at the project level and can also be rolled up for geographical areas or programmes.
Measure relationships	This measure has companion and cause–effect relationships with other measures in the benefits framework. The relationship map below shows these relationships and can be used to help you select further measures to support this measure.



Measure equation	Description:
	From geospatial point 'a' to geospatial point 'b', the annual no. of fatal and serious injury crashes divided by days of the year divided by no. of km between 'a' and 'b'.
	Equation:
	$n = \left(\frac{FSI}{365}\right)/km$
	Where <i>FSI</i> is the annual number of fatal and serious injury crashes between geospatial point 'a' and geospatial point 'b'
	Where <i>km</i> is the number of kilometres between ' <i>a</i> ' and ' <i>b</i> '

1.1.1

	This data is translated into a rating through the Mega Maps tool, using the DSI casualty equivalent methodology.		
Unit of measure	Rating – low,	low medium, medium high, high	
Definition of terms	This measure uses the estimated DSI casualty equivalent methodology. This methodology utilises crash causes to identify crashes with similar characteristics, although outcomes may vary, to calculate collective risk. A link to further definition is available inside the StoryMaps tool.		
Information available	Centralised in	nformation is available (since August 2019).	
	Map (no data	a). Map-based information is available for all roads in New Zealand.	
	Link to benef	its StoryMap (information)	
	Scroll down to navigate around all benefits and measures in the Healthy and Safe People outcome area. To view the collective risk information, click the link to Mega Maps in the left-hand column and the layers selected as per the instructions in the StoryMap.		
	lf you do not	have access to view the information, please request from	
	investment.b	enefits@nzta.govt.nz	
	This measure is viewed through Mega Maps, which has additional access requirements.		
Information items	Map/data item name	Description	
	Мар	A number of related maps are available in the StoryMap. The interactive maps allow users to view the rating on specific pieces of state highway and local roads.	

How to calculate baseline/monitoring data

Define geospatial area of measure	As part of your project/programme definition in TIO, you will be required to enter the geospatial coordinates of your investment. In the case of this measure, you may measure the geospatial coordinates of this investment or the entire corridor, if more appropriate.
Use the StoryMaps tool to manually calculate the baseline result	Using the instructions provided in StoryMaps tool, go to Mega Maps and select the section of road to be measured.
Enter into baseline field in TIO	Enter rating associated with that piece of road into appropriate field in TIO.

Forecasting methodology

Centralised methodology is not yet available. Local forecast is to be developed as appropriate and documentation about the methodology used to be included in business case documentation.

Benefits realisation

Waka Kotahi will continue to regularly update information and any improvements will result in a change to this measure definition. Ongoing monitoring of this measure will utilise the same steps as in the baseline/monitoring data section.

>>Return to 1.1 Impact on social cost of death and serious

1.1.2 Crashes by severity

Measure description



Measure no:	1.1.2
Measure name:	Crashes by severity
Measure description:	Number of crashes by severity
Measure type:	Quantitative measure
Intent	This measure can be used for any safety-related investments and programme benefits, particularly those targeting areas with high crash rates resulting in injuries .
	The severity information is based on injury and allows for investment to be targeted at areas/corridors where the most harm is experienced.
Scope	This measure can be applied at the project level and can also be rolled up for geographical areas or programmes.
Measure relationships	This measure has companion and cause–effect relationships with other measures in the benefits framework. The relationship map below shows these relationships and can be used to help you select further measures to support this measure.



Measure equation	Description:
	From geospatial point 'a' to geospatial point 'b', the annual actual number of crashes for the last calendar year, described by severity of injury (minor injury, serious injury and fatal)
	Equations:
	mi = t - (si + f)
	si = t - (mi + f)
	$f = t - (mi \ si)$
	Where <i>mi</i> equals crashes resulting in minor injuries, <i>si</i> equals crashes resulting in serious injuries, <i>f</i> equals crashes resulting in fatalities and <i>t</i> equals total crashes between points a and b.
Unit of measure	Number



Definition of terms	The severity I Serious (S) in medical treatr death. All severity let	evel of crashes included in the map are minor injury, serious injury and fatal. jury includes a fracture, concussion, severe cuts or other injury requiring ment or removal to and retention in hospital. Fatal (F) is where injury results in vels of crashes are included in the data, including non-injury.
Information available	Centralised in Map. Map-bas crashes inclue Data. Data in crashes are ir <u>Link to benefi</u> Scroll down to outcome area If you do not h investment.be	formation is available (since August 2019). sed information is available for all roads in New Zealand. The severity level of ded in the map are minor injury, serious injury and fatal. different formats is available through the open data portal. All severity levels of necluded in the data, including non-injury. ts StoryMap (information) o navigate around all benefits and measures in the Healthy and Safe People a. have access to view the information, please request from enefits@nzta.govt.nz
Information items	Map/data item name Map Data	Description A number of related maps are available in the StoryMap. The interactive maps allow users to view colour-coded severity mapping by geographical location. Data is available in a number of formats and the link in the StoryMap will take users through to the open data portal.

How to calculate project baseline/monitoring data

Defining geospatial area of measure	As part of your project definition in TIO, you will be required to enter the geospatial coordinates of your investment. In the case of this measure, you may measure to the geospatial coordinates of this investment or the entire corridor or area, if more appropriate.
Use the StoryMaps tool to manually calculate your project baseline result	 The map in the right panel of the StoryMap shows all crashes on record from 2000. To see greater detail, open the CAS map in a new tab. Open the Layer List tool. Tick on and off crash types as you want them to appear. These layers are only visible when you zoom in. Open the Summary tool. This will return counts of the crashes you see on screen as you pan and zoom the map. Dates of crashes can be found by clicking on the crash indicator on the map.
Enter into 'baseline' field in TIO	Enter the numbers for minor injury, serious injury and fatal injury, separated by commas into the baseline field.

Forecasting methodology

A standardised forecasting methodology is not yet available for this measure. A local forecast is to be developed as appropriate. Documentation about the methodology used should be included in business case documentation as appropriate.

Benefits realisation

Waka Kotahi will continue to update information on a regular basis and any improvements will result in a change to this measure definition. Benefits realisation monitoring will require the replay of the steps to the baseline with more current data.

>>Go back to 1.1 Impact on social cost of deaths and serious injuries

1.1.3

1.1.3 Deaths and serious injuries

Measure description

Measure no:	1.1.3
Measure name:	Deaths and serious injuries
Measure description:	Number of deaths and serious injuries
Measure type:	Quantitative
Intent	This measure can be used for any safety-related investment and programme benefits, particularly those targeting high death and serious injury rates .
Scope	This measure can be applied at the project level and can also be rolled up for geographical areas or programmes.
Measure relationships	This measure has companion and cause–effect relationships with other measures in the benefits framework. The relationship map below shows these relationships and can be used to help you select further measures to support this measure.

Measure attributes

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Measure equation	Description:
	From geospatial point 'a' to geospatial point 'b', the number of deaths and serious injuries resulting from land transport-related crashes in the last year (generally calculated as a rolling average of the last 5 to 10 years, depending on the application).
Unit of measure	Number
Definition of terms	Serious (S) injury includes a fracture, concussion, severe cuts or other injury requiring medical treatment or removal to and retention in hospital. Fatal (F) is where injury results in death.
	The data for this measure may settle over time as the nature of an injury may change over time.
Information available	Centralised information is available (since August 2019).
	Map. Map-based information is available for all roads in New Zealand with data between 2013 and 2019.

	Data. Data is Link to Story Scroll down to outcome area	available through a link to the CAS (Crash Analysis System). <u>Aap (information)</u> to navigate around all benefits and measures in the <i>Healthy and safe people</i> a.
	panel to acce	ss detailed information.
	If you do not h investment.be	nave access to view the information, please request from enefits@nzta.govt.nz
Information items	Map/data item name	Description
	Мар	A number of related maps are available in the StoryMap. The interactive maps allow users to view colour-coded severity mapping by geographical location.
	Data	Data is available in a number of formats and the link in the StoryMap will take users through to the Crash Analysis System, open data portal.

How to calculate project baseline/monitoring data

A method to calculate a baseline/monitoring data will be provided in a future update.

Forecasting methodology

A local forecast is to be developed as appropriate. Forecasting methodologies and tools for this measure are available in the 'Tools and resources' section of the <u>Land Transport Benefits</u> <u>Framework measures manual</u> page on our website. Which methodology you use will depend on whether safety is the primary outcome, whether the investment is about infrastructure, and whether it is a national or regional intervention. Documentation about the methodology used should be included in business case documentation as appropriate.

Benefits realisation

Waka Kotahi will continue to update information on a regular basis and any improvements will result in a change to this measure definition. Benefits realisation monitoring will require the replay of the steps to the baseline with more current data.

>>Return to 1.1 Impact on social cost of deaths and serious injuries

1.1.3 page >>

1.1.4 Personal risk (crash rate)

Ме

_

Measure attributes



Measure equation	Description: Average annual fatal and serious injury crashes per 100 million vehicle-kilometres
Unit of measure	Low, low medium, medium high, high
Definition of terms	Serious (S) injury includes a fracture, concussion, severe cuts or other injury requiring medical treatment or removal to and retention in hospital. Fatal (F) is where injury results in death. The data for this measure may settle over time as the nature of an injury may chan time.
Information available	Partial centralised information is available (since August 2019)Map: Information is available for deaths and serious injuries through the Mega Maps portal.Personal risk is calculated in the map in the relevant layer.

Data: Vehicle-kilometres travelled (VKT) is not yet available for separate release here, although personal injury risk rating is provided that integrates the calculation of VKT. Link to benefits StoryMap (information) Scroll down to navigate around all benefits and measures in the Healthy and Safe People outcome area. To view the personal risk information, click the link to Mega Maps in the left-hand column and select the appropriate layers as per the instructions in the StoryMap. If you do not have access to view the information, please request from investment.benefits@nzta.govt.nz This measure is viewed through Mega Maps, which has additional access requirements. Information items Map/data item name Map A number of DSI related maps are available in the StoryMap. The interactive				
Link to benefits StoryMap (information) Scroll down to navigate around all benefits and measures in the Healthy and Safe People outcome area. To view the personal risk information, click the link to Mega Maps in the left-hand column and select the appropriate layers as per the instructions in the StoryMap. If you do not have access to view the information, please request from investment.benefits@nzta.govt.nz This measure is viewed through Mega Maps, which has additional access requirements. Information items Map/data item name Map A number of DSI related maps are available in the StoryMap. The interactive		Data: Vehicle although pers	e-kilometres travelled (VKT) is not yet available for separate release here, sonal injury risk rating is provided that integrates the calculation of VKT.	
Scroll down to navigate around all benefits and measures in the Healthy and Safe People outcome area. To view the personal risk information, click the link to Mega Maps in the left-hand column and select the appropriate layers as per the instructions in the StoryMap. If you do not have access to view the information, please request from investment.benefits@nzta.govt.nz This measure is viewed through Mega Maps, which has additional access requirements. Information items Map/data item name Map A number of DSI related maps are available in the StoryMap. The interactive		Link to benefi	its StoryMap (information)	
To view the personal risk information, click the link to Mega Maps in the left-hand column and select the appropriate layers as per the instructions in the StoryMap. If you do not have access to view the information, please request from investment.benefits@nzta.govt.nz This measure is viewed through Mega Maps, which has additional access requirements. Information items Map/data item name Map A number of DSI related maps are available in the StoryMap. The interactive		Scroll down to outcome area	o navigate around all benefits and measures in the Healthy and Safe People a.	
If you do not have access to view the information, please request from investment.benefits@nzta.govt.nz This measure is viewed through Mega Maps, which has additional access requirements. Information items Map/data item name Map A number of DSI related maps are available in the Ston/Map. The interactive		To view the pears and select the	ersonal risk information, click the link to Mega Maps in the left-hand column e appropriate layers as per the instructions in the StoryMap.	
investment.benefits@nzta.govt.nz This measure is viewed through Mega Maps, which has additional access requirements. Information items Map/data item name Map A number of DSI related maps are available in the Ston/Map. The interactive		If you do not h	have access to view the information, please request from	
This measure is viewed through Mega Maps, which has additional access requirements. Information items Map/data item name Description Map A number of DSI related maps are available in the Ston/Map. The interactive		investment.benefits@nzta.govt.nz		
Information items Map/data Description item name A number of DSI related maps are available in the Ston/Map. The interactive		This measure	e is viewed through Mega Maps, which has additional access requirements.	
Man A number of DSI related mans are available in the Ston/Man. The interactive	Information items	Map/data item name	Description	
maps allow users to view colour-coded severity mapping by geographical location.		Мар	A number of DSI related maps are available in the StoryMap. The interactive maps allow users to view colour-coded severity mapping by geographical location.	
Data DSI data is available in a number of formats and the link in the StoryMap will take users through to the Crash Analysis System, open data portal.		Data	DSI data is available in a number of formats and the link in the StoryMap will take users through to the Crash Analysis System, open data portal.	

How to calculate project baseline/monitoring data

Defining geospatial area of measure	As part of your project definition in TIO, you will be required to enter the geospatial coordinates of your investment. In the case of this measure, you may measure the geospatial coordinates of this investment or the entire corridor, if more appropriate.
Use the StoryMaps tool to manually calculate your project baseline result	Following the instructions in the StoryMap, open Mega Maps and select the personal risk layer. Click on the local road or state highway.
Enter into 'baseline' field in TIO	Input the rating (low, medium low, medium, medium high, high).

Forecasting methodology

A standardised forecasting methodology is not yet available for this measure. A local forecast is to be developed as appropriate. Documentation about the methodology used should be included in business case documentation as appropriate.

Benefits realisation

Waka Kotahi will continue to update information on a regular basis and any improvements, such as the provision of underlying data, will result in a change to this measure definition. Benefits realisation monitoring will require the replay of the steps to the baseline with more current data.

>>Return to 1.1 Impact on social cost of deaths and serious injuries

1.2 Impact on a safe system

1.2

This benefit focuses on safety of the system for all transport users and includes behaviour-focused activities within its scope. Alongside system-wide infrastructure investment, the benefit also covers the regulation and policing of the transport system for safety.

A full description of this benefit is available on our website: 1.2 Impact on a safe system

The measures listed below have been associated with this benefit for ease of reference, but they can also be applied to other benefits as appropriate.

Quantita	Quantitative measures			
No.	Name		Description #	
1.2.1	Road assessment rating – roads	<u>>></u>	Infrastructure risk rating	
1.2.2	Road assessment rating – state highways	<u>>></u>	KiwiRoad Assessment Programme (KiwiRAP) star rating (for state highways)	
1.2.3	Travel speed gap	>>	Difference between safe and appropriate speed, and actual speed	
Qualitative measures			(sca)	
N/A				

>> Return to Land Transport Benefits Framework overview

1.2.1 Road assessment rating - roads



Measure description

Measure no:	1.2.1
Measure name:	Road assessment rating – roads
Measure description:	Infrastructure risk rating
Measure type:	Quantitative measure
Intent	This measure can be used for any safety-related investment benefits, particularly those that target road infrastructure to improve safety.
Scope	This measure can be applied at the project level and can also be rolled up for geographical areas or programmes. It is a good measure for rural road sections of around 5km, with sections between 3–7km acceptable. It is not a suitable measure for shorter sections (<3km) or for urban roads, intersections, roundabouts or other points. As the measure is reported in 'bands', significant level of change may be required to move sections of road from one band to another.
Measure relationships	This measure has companion and cause–effect relationships with other measures in the benefits framework. The relationship map below shows these relationships and can be used to help you select further measures to support this measure.





Measure equation	Description: Infrastructure risk rating	
Unit of measure	 The infrastructure risk rating (IRR) band is the unit of measure for this measure. A 5-band risk rating system is adopted based on the IRR score, with separate thresholds for rural and urban land use classification. The bands are: low (green) low-medium (yellow) medium (orange) medium-high (red), and high (black). 	
Definition of terms	Investment risk rating (IRR) is developed through the characteristics of the road and its environment rather than only crash history. A link to further information defining infrastructure risk rating is available in the StoryMap. The IRR score is calculated using several automated processes, including considerations of land use, road stereotype, alignment, average annual daily traffic (AADT), intersection density, land and shoulder width, roadside hazards and access density.	
Information available	Partial centralised information is available (since August 2019). (The information is considered partial because a map is provided without data, not that there are gaps in the coverage of the map). Map-based information is available for all roads in New Zealand. Link to benefits StoryMap (information) Scroll down to navigate around all benefits and measures in the Healthy and Safe People outcome area. If you do not have access to view the information, please request from investment.benefits@nzta.govt.nz This measure is viewed through Mega Maps, which has additional access requirements.	
Information items	Map/data Description item name	



Мар	A colour-coded risk rating map is available through the links in the StoryMap. Click on the section of road to view relevant data on that section, including the IRR score and band.
	the IRR score and band.

How to calculate baseline/monitoring data

Defining geospatial area of measure	As part of your project/programme definition in TIO, you will be required to enter the geospatial coordinates of your investment. In the case of this measure, it is possible to identify specific pieces of road.
Use the StoryMaps tool to manually calculate your project baseline result	Click on the section of road in the map provided through the StoryMap and identify the current IRR band.
Enter into baseline field in TIO	Enter current IRR band into 'baseline' field in TIO.

Forecasting methodology

A standardised forecasting methodology is not yet available for this measure. A local forecast is to be developed as appropriate. Documentation about the methodology used should be included in business case documentation as appropriate.

Benefits realisation

Waka Kotahi will continue to update information on a regular basis and any improvements, such as the provision of underlying data, will result in a change to this measure definition. Benefits realisation monitoring will require the replay of the steps to the baseline with more current data.

>> Return to 1.2 Impact on a safe system

1.2.2 Road assessment rating – state highways

Measure description

Measure attributes	
	1.2.2

Measure no:	1.2.2
Measure name:	Road assessment rating – state highways
Measure description:	New Zealand Road Assessment Programme (KiwiRAP) star rating (for state highways)
Measure type:	Quantitative measure
Intent	This measure can be used for safety-related investments focused on improving the safety rating of state highway infrastructure
Scope	This measure can be applied at the project level and can also be rolled up for geographical areas or programmes.
Measure relationships	This measure has companion and cause–effect relationships with other measures in the benefits framework. The relationship map below shows these relationships and can be used to help you select further measures to support this measure.



Measure equation	Description: Star rating as defined by KiwiRAP process.
Unit of measure	 Rating of between 1 and 5 stars, with 5 being the highest. 1 star (black) 2 star (red) 3 star (orange) 4 star (yellow) 5 star (green) No data (grey)
Definition of terms	KiwiRAP: KiwiRAP is the New Zealand Road Assessment Programme and is a partnership between



	the NZ Auton ACC and NZ	nobile Association, Waka Kotahi NZ Transport Agency, Ministry of Transport, Police. It analyses the road safety of the state highway network.	
	The degree of risk, or just how safe a road is, depends to an extent on whether built-in safety features have been incorporated into the road's design. These include wide lanes, shoulders, and safety barriers which are known to reduce the impact and severity of a crash.		
	The safest roads are likely to be straight, divided, have good line-markings, wide lanes and sealed shoulders. Roadsides with no trees or ditches, and roads with few, if any, intersections are also deemed safer.		
	Comparatively, single or narrow lanes, undivided roads and unsealed shoulders are deemed the least safe. Tight curves in mountainous terrain, poor line markings and unforgiving roadside features such as trees, power poles and ditches also affect the safety rating.		
	Based on ins the impact ar	pection of various design elements, the Star Rating provides an evaluation of ad severity those elements would have in a crash scenario.	
Information available	 Full information available (from October 2019) Information is from 2012 Map and data available for all state highways in New Zealand. Link to benefits StoryMap (information) Scroll down to navigate around all benefits and measures in the Healthy and Safe People outcome area. 		
	If you do not investment.b	have access to view the information, please request from enefits@nzta.govt.nz	
Information items	Map/data item name	Description	
	Мар	Maps of safety of entire state highway network, released in 2012.	
	Data	ESRI file geodatabase and ESRI shapefile, released in 2012.	

How to calculate baseline/monitoring data

Defining geospatial area of measure	As part of your project/programme definition in TIO, you will be required to enter the geospatial coordinates of your investment. In the case of this measure, it is possible to identify specific pieces of road.
Use the StoryMaps tool to manually calculate your project baseline result	Click on the section of road in the map provided through the StoryMap and identify the current KiwiRAP star rating.
Enter into baseline field in TIO	Enter latest KiwiRAP star rating into 'baseline' field in TIO.

Forecasting methodology

A standardised forecasting methodology is not yet available for this measure. A local forecast is to be developed as appropriate. Documentation about the methodology used should be included in business case documentation as appropriate.

Benefits realisation

Waka Kotahi will continue to update information on a regular basis and any improvements, such as the provision of underlying data, will result in a change to this measure definition. Benefits realisation monitoring will require the replay of the steps to the baseline with more current data.

>> Return to 1.2 Impact on a safe system

1.2.3 Travel speed gap



Measure description

Measure no:	1.2.3
Measure name:	Travel speed gap
Measure description:	Difference between safe and appropriate speed (SAAS), and actual speed
Measure type:	Quantitative measure
Intent	This measure can be used for any safety-related investment benefits, particularly those targeting areas with high risk in relation to speed limits.
Scope	This measure can be applied at the project level and can also be rolled up for geographical areas or programmes.
Measure relationships	This measure has companion and cause–effect relationships with other measures in the benefits framework. The relationship map below shows these relationships and can be used to help you select further measures to support this measure.



Measure equation	Description:
	For the section of road between point 'a' and point 'b' being measured.
	n = os - saas
	Where 'os' is the operating speed or average speed travelled on the section of road and 'saas' is safe and appropriate speed
Unit of measure	Kilometres per hour (speed)
Definition of terms	The safe and appropriate speed (SAAS) is the travel speed that is determined to be safe

Information available

1.2.3
for a road segment based on the road function, design, safety and use. It is determined based on tables 2.1 and 2.2 of the <u>Speed management guide</u>
The operating speed is calculated by determining the average free-flow speed on that piece of road.
Partial centralised information is available (since August 2019) through the Mega Maps section of the Waka Kotahi website. Additional access is sometimes required to see this information.
The operating speed and the safe and appropriate speeds are available in maps for state highways and local roads, but the difference between the two is not yet available in a map form. Users will need to calculate this themselves.

	Link to Story	Link to StoryMap (information)		
	Scroll down	Scroll down to navigate around all benefits and measures in the Healthy and Safe People outcome area.		
	If you do not	If you do not have access to view the information, please request from		
	investment.benefits@nzta.govt.nz This measure is viewed through Mega Maps, which has additional access requirements.			
Information items	Map/data item name	Description		
	Мар	Separate interrogatable layers are available in the StoryMap for operating speed and safe and appropriate speeds.		

How to calculate baseline/monitoring data

Defining geospatial area of measure	As part of your project/programme definition in TIO, you will be required to enter the geospatial coordinates of your investment. In the case of this measure, it is possible to identify specific pieces of road.
Using the StoryMaps tool to manually calculate your project baseline result	Partial information (map only) is available in the StoryMaps tool. For the specific piece of road to be measured, the safe and appropriate speed and the operating speed need to be individually taken from the tool and the difference between them calculated manually.
Enter into baseline field in TIO	Enter speed into 'baseline' field in TIO.

Forecasting methodology

A standardised forecasting methodology is not yet available for this measure. A local forecast is to be developed as appropriate. Documentation about the methodology used should be included in business case documentation as appropriate.

Benefits realisation

Waka Kotahi will continue to update information on a regular basis and any improvements, such as the provision of underlying data, will result in a change to this measure definition. Benefits realisation monitoring will require the replay of the steps to the baseline with more current data.

>> Return to 1.2 Impact on a safe system

2.1

2. Changes in perceptions of safety

This benefit cluster focuses on interventions that change how people feel about their safety and security when using the transport system.

2.1 Impact on perceptions of safety and security

This benefit is about user experience and perception of the system, particularly relating to safety and security.

A full description of this benefit is available on our website: 2.1 Impact on perceptions of safety and security

The measure listed below has been associated with this benefit for ease of reference, but it can also be applied to other benefits as appropriate.

Quantita	tive measures			(#)
No.	Name		Description	
2.1.1	Access – perception	>>	Perception of safety and ease of walking and cycling	
Qualitative measures				(are)
N/A				U

>> Return to Land Transport Benefits Framework overview

2.1.1 Access - perception

Me

Measure description	
Measure no:	2.1.1
Measure name:	Access – perception
Measure description:	Perception of safety and ease of walking and cycling
Measure type:	Quantitative measure
Intent	Use this measure when investment is focused on encouraging walking and cycling modes or improving the safety or accessibility of walking and cycling.
Scope	This measure can be applied at an overall national level or for those towns and cities with an appropriate sample size.
Measure relationships	This measure has companion and cause–effect relationships with other measures in the benefits framework. The relationship map below shows these relationships and can be used to help you select further measures to support this measure.



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Healthy and safe people > 2. Changes in perceptions of safety



Measure equation	Description:	
	The proportion of people surveyed that agreed they felt safe the last time they cycled or walked (through Waka Kotahi perception of walking and cycling survey).	
	Equation:	
	Where ' <i>positive responses</i> ' refers to responses that select 'agree' or above for the questions:	
	% agreed they don't feel safe walking in the day	
	% agreed they don't feel safe walking in the dark	
	% agreed they don't feel safe walking because of how people drive	
	% who said they feel safe or extremely safe riding a bicycle	
	% agreed it has become more safe to cycle on the road	
	% agreed they don't feel safe cycling because of how people drive	
	% agreed they don't feel safe cycling in the dark	
Unit of measure	Percentage	
Definition of terms	Percention of safety and ease: self-reported sense of safety or ease associated with	
Deminion of terms	walking and cycling transport modes.	
Demition of terms	walking and cycling transport modes. Locations: the survey has been designed to understand safety perceptions at a national level. There is some geographic component to responses, but it is not at an appropriate level to develop detailed maps.	
Deminion or terms	 walking and cycling transport modes. Locations: the survey has been designed to understand safety perceptions at a national level. There is some geographic component to responses, but it is not at an appropriate level to develop detailed maps. The survey has been run annually in the past and is now a continuous surveying n=175 per month so users could back-cast data as far back is reasonable to obtain a decent sample size for their city. 	
Deminion or terms	 walking and cycling transport modes. Locations: the survey has been designed to understand safety perceptions at a national level. There is some geographic component to responses, but it is not at an appropriate level to develop detailed maps. The survey has been run annually in the past and is now a continuous surveying n=175 per month so users could back-cast data as far back is reasonable to obtain a decent sample size for their city. It should be noted that across the year the sample is ONLY available as follows: 	
	 walking and cycling transport modes. Locations: the survey has been designed to understand safety perceptions at a national level. There is some geographic component to responses, but it is not at an appropriate level to develop detailed maps. The survey has been run annually in the past and is now a continuous surveying n=175 per month so users could back-cast data as far back is reasonable to obtain a decent sample size for their city. It should be noted that across the year the sample is ONLY available as follows: 500 Auckland per year 	
	 walking and cycling transport modes. Locations: the survey has been designed to understand safety perceptions at a national level. There is some geographic component to responses, but it is not at an appropriate level to develop detailed maps. The survey has been run annually in the past and is now a continuous surveying n=175 per month so users could back-cast data as far back is reasonable to obtain a decent sample size for their city. It should be noted that across the year the sample is ONLY available as follows: 500 Auckland per year 500 Wellington per year 	
	 walking and cycling transport modes. Locations: the survey has been designed to understand safety perceptions at a national level. There is some geographic component to responses, but it is not at an appropriate level to develop detailed maps. The survey has been run annually in the past and is now a continuous surveying n=175 per month so users could back-cast data as far back is reasonable to obtain a decent sample size for their city. It should be noted that across the year the sample is ONLY available as follows: 500 Auckland per year 500 Christchurch per year 	
	200 Tauranga per year	
-----------------------	--	--
	200 Dunedin per year	
Information available	Not currently available on the StoryMaps tool.	
	Partial data r Kotahi annua	nay be available through MOT GPS reporting and as a number in the Waka al report.
Information items	Map/data item name	Description
	Cycling chart	Not yet available
	Walking chart	Not yet available

How to calculate baseline/monitoring data

Defining geospatial area of measure	This is currently reported as a single number in published documents, although only cities listed above are surveyed.
Using any available data to develop baseline.	View Waka Kotahi annual reports or GPS data to select appropriate baseline percentage.
Enter into baseline field in TIO	Enter into appropriate field in TIO

If alternative data source is used, note source in business case.

Forecasting methodology

Centralised methodology not yet available. A local forecast to be developed as appropriate.

Benefits realisation

Waka Kotahi will continue to update annual reporting information on an annual basis and any improvements, such as the provision of data in the StoryMaps tool, will result in a change to this measure definition.

>>Return to 2.1 Impact on perceptions of safety

3. Changes in human health

This benefit cluster is comprised of three benefits relating to mode of transport, air emissions and noise. From the personal decision of whether to cycle or drive to the supermarket to the ongoing impact of operations of arterial routes on people living or working close to them, this cluster is about how transport impacts on the health of people who use or are affected by others' use of the transport system.

3.1 Impact of mode on physical and mental health

This benefit relates to the impact of mode choice on transport users' physical and mental health. This benefit is often framed in relation to physical and mental health benefits associated with uptake of active modes.

A full description of this benefit is available on our website: <u>3.1 Impact of mode on physical and</u> <u>mental health</u>

The measure listed below has been associated with this benefit for ease of reference, but it can also be applied to other benefits as appropriate.

Quantitative measures			(#)	
No.	Name		Description	0
N/A				
Qualitative measures				(ma)
3.1.1	Physical health benefits from active modes	>>	User to describe	0

>> Return to Land Transport Benefits Framework overview

3.1.1 Physical health benefits from active modes



Measure description

Measure no:	3.1.1
Measure name:	Physical health benefits from active modes
Measure description:	User to describe
Measure type:	Qualitative measure
Intent	Use this measure when investment is likely to result in increase or decrease of active modes
Scope	This measure is currently best used for large investments/programmes or across large geographical areas.
Measure relationships	This measure has companion and cause–effect relationships with other measures in the benefits framework. The relationship map below shows these relationships and can be used to help you select further measures to support this measure. The physical health benefits are directly monetised using procedures in the <u>Monetised benefits and cost</u> <u>manual</u> , but those procedures do not include identification of the individual health impacts.

3.1



Measure information

Definition of terms	Physical health benefits include those identified by WHO. Physical activity acts as a protective factor against diseases such as heart disease, stroke diabetes and some cancers, as well being associated with improved mental health, the delay of onset of dementia and improved quality of life and wellbeing (<u>WHO Global action plan on physical activity</u> , 2018).
Information sources	To be confirmed
Methodology	Narratives, thresholds and ranking. Detailed instructions for this methodology are to be provided in future re-release of manual. Local descriptions or quantitative data can be used as evidence against this measure.
Direction/scaling	To be provided in future re-release of manual.

How to calculate baseline/monitoring data

Calculations using the 'narratives, thresholds and ranking' methodology to be provided in a future re-release of manual.

If local description or quantitative measure is used, apply appropriate calculation to determine current state or data for the measure.

Forecasting methodology

A centralised methodology is not yet available. A local forecast to be developed as appropriate.

Benefits realisation

Waka Kotahi will continue to update annual reporting information on an annual basis and any improvements, such as the provision of data in the StoryMaps tool, will result in a change to this measure definition.

>>Return to 3.1 Impact of mode on physical and mental health

3.2 Impact of air emissions on health

This benefit covers land transport air emissions that impact on human health, limited to those arising from roads and rail. There are a range of pollutant sources that contribute to poor air quality, of which land transport is one. Land transport air emissions are a complex mixture of gases and particles, with pollutants typically split into harmful air pollutants that cause adverse health effects and impact locally (this benefit), and pollutants which cause global impacts (benefit 8.1 Impact on greenhouse gas emissions).

A full description of this benefit is available on our website: <u>3.2 Impact of air emissions on health</u>

The measures listed below have been associated with this benefit for ease of reference, but they can also be applied to other benefits as appropriate.

Quantitative measures				
No.	Name		Description	(#)
3.2.1	Ambient air quality – NO ₂	<u>>></u>	Concentration of NO ₂ in µg/m ³	Ŭ
3.2.2	Ambient air quality – PM ₁₀	<u>>></u>	Concentration of PM_{10} in $\mu g/m^3$	
Qualitati	ve measures			(454)
N/A				igsim

>> Return to the Land Transport Benefits Framework overview



3.2.1 Ambient air quality - NO₂

Measure description

Measure no:	3.2.1
Measure name:	Ambient air quality – NO ₂
Measure description:	Concentration of NO ₂ in µg/m ³
Measure type:	Quantitative measure
Intent	Use this measure when investment delivers lowered or maintained NO ₂ or focuses on the impact of NO ₂ on people close to infrastructure that can lead to exposure to elevated concentrations of the gas.
Scope	This measure can be applied to specific investments or rolled up to geographical areas or programmes. To understand the attribution of investment to the overall nitrogen dioxide levels measured, this data should be presented in the context of vehicle emissions data.
Measure relationships	This measure has companion and cause–effect relationships with other measures in the benefits framework. The relationship map below shows these relationships and can be used to help you select further measures to support this measure.

3.2



Measure equation	The micrograms of nitrogen dioxide present in ambient air at monitoring site at the time the record was taken.		
Unit of measure	µg/m³		
Definition of terms	NO ₂ : nitroger µg/m ³ : micro	n dioxide gram per cubic metre	
Information available	 Partial information available (since November 2019) Concentration contour maps are being developed, and the measure of levels of 'exposure' of populations to harmful exposure is also being developed. At this stage NO₂ data is based on the monitoring site data from the national NO₂ diffusion tube network. Vehicle NO₂ emissions data is provided for all roads from the Waka Kotahi Vehicle Emission Mapping Tool, which is a suitable proxy for attributing transport's contribution to ambient NO₂ levels measured at the monitoring sites. Link to benefits StoryMap (information) Scroll down to navigate around all benefits and measures in the Healthy and Safe People outcome area. If you do not have access to view the information, please request from 		
Information items	Map/data item name	Description	
	Мар	Map shows monitoring site data for New Zealand's national NO ₂ diffusion tube network. Vehicle emissions of NO ₂ (modelled) are provided as context.	
	Data	Monitoring site data for concentrations of NO ₂ measured by New Zealand's national diffusion tube network. Summarised NO ₂ vehicle emissions data.	



How to calculate baseline/monitoring data and forecasting methodology

The baseline and forecasting methodology should be consistent with the approach developed for *8.1.3 Light vehicle use impacts*. There are likely to be efficiencies in undertaking an integrated analysis to develop a cohesive investment story of multiple benefits consistent with national benchmarks.

Independent modelling may be more efficient in certain circumstances, such as for investments to improve amenity where health impacts are more sensitive (for example anaerobic exercise areas) or where low speeds in decongested areas are a key characteristic of the study area (a limitation of the VEPM model).

Benefits realisation

Waka Kotahi will continue to update annual reporting information on an annual basis and any improvements, such as the provision of data in the StoryMaps tool, will result in a change to this measure definition.

>>Return to 3.2 Impact on air emissions on health

3.2.2 Ambient air quality – PM₁₀

Measure description

Measure attributes	
	3.2.2

Measure no:	3.2.2
Measure name:	Ambient air quality – PM ₁₀
Measure description:	Concentration of PM ₁₀ in µg/m ³
Measure type:	Quantitative measure
Intent	Use this measure when investment delivers lowered or maintained particulate matter or focuses on the impact of particulate matter on people close to infrastructure that can lead to exposure to elevated concentrations of the harmful matter.
Scope	This measure can be applied to specific investments or rolled up to geographical areas or programmes. To understand the attribution of investment to the overall particulate matter levels measured, this data should be presented in the context of vehicle emissions data.
Measure relationships	This measure has companion and cause–effect relationships with other measures in the benefits framework. The relationship map below shows these relationships and can be used to help you select further measures to support this measure.



Measure equation	The micrograms of particulate matter ₁₀ present in ambient air at monitoring site at the time the record was taken.
Unit of measure	μg/m³
Definition of terms	PM_{10} : particulate matter (particles with a diameter less than 10 micrometres). Exposure to particulate matter can contribute to heart and lung diseases and can lead to hospitalisation and premature death. Most PM_{10} health impacts are associated with long-term exposure. $\mu g/m^3$: microgram per cubic metre
Information available	Partial information available (November 2019) Concentration contour maps are being developed for PM ₁₀ . The measure of levels of 'exposure' of populations to harmful exposure is also being developed.



	At this stage PM_{10} data is based on the monitoring site data from the regional council monitoring network and is provided as an annual average.		
	Vehicle PM_{10} emissions data is provided for all roads from the Waka Kotahi Vehicle Emission Mapping Tool, which is a suitable proxy for understanding variations in concentrations due to vehicle emissions.		
	Link to benef	fits StoryMap (information)	
	Scroll down to navigate around all benefits and measures in the Healthy and Safe People outcome area.		
	If you do not have access to view the information, please request from investment.benefits@nzta.govt.nz		
Information items	Map/data item name	Description	
	Мар	Vehicle emissions of PM_{10} (modelled) is provided. Concentration contour maps should be available in 2020.	
	Data	Summarised PM ₁₀ concentration data.	

How to calculate baseline/monitoring data

To be provided in future re-release of manual.

Forecasting methodology

A centralised methodology is not yet available for this measure. A local forecast should be developed as appropriate.

Benefits realisation

Waka Kotahi will continue to update annual reporting information on an annual basis and any improvements, such as the provision of data in the StoryMaps tool, will result in a change to this measure definition.

>>Return to 3.2 Impact on air emissions on health

3.3

3.3 Impact of noise and vibration on health

This benefit covers land transport noise and vibration that impacts on human health. Noise and vibration can come from construction, operation, maintenance and use of land transport infrastructure.

A full description of this benefit is available on our website: <u>3.3 Impact of noise and vibration on health</u>

The measure listed below has been associated with this benefit for ease of reference, but it can also be applied to other benefits as appropriate.

Quantitative measures				(#)
No.	Name		Description	
3.3.1	Noise level	>>	Noise level in dB Laeq(24h)	\frown
Qualitati	ve measures			(ALCO)
N/A				V

>> Return to Land Transport Benefits Framework overview



Measure attributes

Measure description

Measure no:	3.3.1
Measure name:	Noise level
Measure description:	Noise level in dB Laeq(24h)
Measure type:	Quantitative measure
Intent	Use this measure when investment delivers lowered or maintained noise levels or focuses on the impact of noise on people exposed to high levels of noise.
Scope	This measure can be applied to specific investments or rolled up to geographical areas or programmes. To understand the impact on people, this data should be presented in the context of the numbers of people exposed to noise.
Measure relationships	This measure has companion relationships with other measures in the benefits framework. The relationship map below shows these relationships and can be used to help you select further measures to support this measure.





Measure information and data

Measure equation	The noise produced by transport between point 'a' and point 'b' of a state highway or local road.		
Unit of measure	dB Laeq(24h)		
Definition of terms	dB: decibel: the unit of sound level (the higher the decibel, the louder the sound) Laeq(24h): Measure of the time-averaged, A-weighted sound level measured in dB Research document – <u>community noise and the effects of noise</u> Online – <u>noise metric tool</u>		
Information available	 Full information available (since November 2019). <u>Link to benefits StoryMap (information)</u> Scroll down to navigate around all benefits and measures in the Healthy and Safe People outcome area. If you do not have access to view the information, please request from investment.benefits@nzta.govt.nz 		
Information items	Map/data item name	Description	
	Мар	Number of people exposed to noise within each region or main urban area. Noise contour mapping shows noise levels in association with the state highway and local road transport network (focusing on roads over a certain threshold of traffic volume) (the subject of this measure).	
	Data	Noise contours	

How to calculate baseline/monitoring data

Defining geospatial area of measure	As part of your project/programme definition in TIO, you will be required to enter the geospatial coordinates of your investment. In the case of this measure, it is possible to identify specific pieces of road for measurement.
Use the StoryMaps tool to manually calculate your project baseline result	The contextual information of people in the area exposed to different noise levels is shown in the map at a high level. Zoom into the piece of road being measured in the map to see the contour information, ie the amount of noise produced by the road, to determine the baseline of the measure.
Enter into baseline field in TIO	Enter the baseline information into the appropriate field.

Forecasting methodology

A centralised methodology is not yet available for this measure. A local forecast should be developed as appropriate.

Benefits realisation

Waka Kotahi will continue to update annual reporting information on an annual basis and any improvements, such as the provision of data in the StoryMaps tool, will result in a change to this measure definition.

>>Return to 3.3 Impact of noise and vibration on health

4.1

Resilience and security > 4. Changes in impact of unplanned disruptive events on access to social and economic opportunities

Resilience and security

This transport outcome is about minimising and managing the risks from natural and human-made hazards, anticipating and adapting to emerging threats, and recovering effectively from disruptive events.

4. Changes in impact of unplanned disruptive events on access to social and economic opportunities

This benefit cluster is formed with one benefit and primarily covers the resilience component of the transport outcomes framework (with security covered off in benefit 2.1 Impact on perceptions of safety and security).



With the release of the national adaptation plan² in 2022 work is underway across a number of agencies that is expected to require updates to this manual. In the interim the current measures focus on redundancy and qualitative descriptions of level of service risk. Future changes will focus on incorporating specific measures to address climate change impacts on system resilience.

4.1 Impact on system vulnerabilities and redundancies

This benefit is about reducing the risk of communities not being able to access social and economic opportunities due to unexpected outages. This may be achieved through more options in the system (or redundancies) or reduction of vulnerabilities.

A full description of this benefit is available on our website: <u>4.1 Impact on system vulnerabilities and</u> redundancies

The measures listed below have been associated with this benefit for ease of reference, but they can also be applied to other benefits as appropriate.

Quantitative measures				#
No.	Name		Description	
4.1.1	Availability of a viable alternative to high- risk and high-impact route	<u>>></u>	Percentage of high-risk, high-impact routes with a viable alternative	
Qualitative measures				AST)
4.1.2	Level of service and risk	<u>>></u>	Resilience risk category (calculated using National Resilience Programme Business Case methodology)	

>> Return to Land Transport Benefits Framework overview



² <u>Urutau, ka taurikura: kia tū pakari a Aotearoa i ngā huringa āhuarangi – adapt and thrive: building a climate-</u> resilient New Zealand – New Zealand's first national adaptation plan

Resilience and security > 4. Changes in impact of unplanned disruptive events on access to social and economic opportunities

4.1.1 Availability of a viable alternative to high-risk and high-impact route



Measure description

Measure no:	4.1.1		
Measure name:	Availability of a viable alternative to high-risk and high-impact route		
Measure description:	Percentage of high-risk, high-impact routes with a viable alternative		
Measure type:	Quantitative measure		
Intent	This measure can be used for any investment that focuses on maintaining or increasing the resilience of the transport network, particularly enabling alternative viable routes.		
Scope	This measure is applied at a national level, but can be used for large geographical areas, such as regions.		
Measure relationships	This measure has companion and cause–effect relationships with other measures in the benefits framework. The relationship map below shows these relationships and can be used to help you select further measures to support this measure.		



Measure equation	Description:
Unit of measure	Percentage %
Definition of terms	High-risk routes are those that may be disrupted or impacted by significant events (including earthquakes, storms, volcanos and tsunamis).
	High-impact routes are those that are of high importance for social and economic activities.
	Viable alternative routes are those that can carry the same or similar traffic types and levels.
	Opportunity cost is the sunk cost of investment in a high-risk route and can also include on- going costs relating to higher maintenance. The impact of lost future opportunities to invest in alternative options due to investment lock-in may be considered within economic appraisal.
Information available	Partial information is available (since August 2019).
	For state highways, a map of high-risk routes is available.
	An interactive <u>detour map</u> is available.
	Link to benefits StoryMap (information)
	Scroll down to navigate through the benefit and measures in the Resilience and Security outcome.

	If you do not have access to view the information, please request from		
	investment.benefits@nzta.govt.nz		
	Coastal effects assessment guideline for transportation infrastructure		
	Uneconomic Transport Infrastructure Policy		
Information items	Map/data item name	Description	
	Мар	Interrogatable spatial map detailing resilience risk rating for state highways.	
	wap	interrogatable spatial map detailing resilience risk rating for state highways.	

How to calculate baseline/monitoring data

Baseline data can be obtained from StoryMap.

Forecasting methodology

A centralised methodology is not yet available for this measure. A local forecast should be developed as appropriate.

An interactive <u>detour map</u> is available which can (with a few clicks) identify pre-agreed alternate routes, comparative distance and travel times, which vehicle types each route is suitable for, and other key pieces of information.

High-risk routes can be identified using the methodology described in 4.1.2 (level of service and risk). Smaller-scale projects may use real option analysis and larger-scale programmes may use adaptive decision-making approaches such as dynamic adaptive pathways. The 2022 report <u>'Climate change adaptation and investment decision making</u>' may be useful to understand how adaptive decision making can be supported by economic appraisal.

Benefits realisation

Waka Kotahi will continue to update annual reporting information on an annual basis and any improvements, such as the provision of data in the StoryMaps tool, will result in a change to this measure definition.

>>Return to 4.1 Impact on system vulnerabilities and redundancies

Resilience and security > 4. Changes in impact of unplanned disruptive events on access to social and economic opportunities

4.1.2 Level of service and risk

Measure attributes (All 2) (

Measure description

Measure no:	4.1.2
Measure name:	Level of service and risk
Measure description:	Resilience risk category (calculated using National Resilience Programme Business Case methodology)
Measure type:	Qualitative measure
Intent	The intent of this measure is to allow for description and measurement of the risk to level of service by unplanned disruption (including earthquakes, storms, volcanos and tsunamis). This measure can be used for any investment that focuses on maintaining or increasing the resilience of the transport network.
Scope	This measure can be applied to specific investments or rolled up to geographical areas or programmes. When rolled up, the measure can be used quantitatively by including the percentage of the network in each risk category.
Measure relationships	This measure has companion and cause–effect relationships with other measures in the benefits framework. The relationship map below shows these relationships and can be used to help you select further measures to support this measure.



Measure information

Definition of terms	Level of service is the expected experience and quality that can be expected in relation to use of transport service or infrastructure. One Network Framework (ONF) has a defined level of service for unplanned disruptions which vary by ONF class.
Information sources	Refer to the ONF <u>level of service gap tool</u> on our website. For state highways, a StoryMap including a range of resilience information (including earthquakes, storms, volcanos and tsunamis) is available: <u>State highway resilience StoryMap</u> . The information on risk rating for state highways is contained in the Waka Kotahi <u>National Resilience</u> <u>Programme Business Case</u> .
Direction/scaling	To be provided in future re-release of manual.

How to calculate baseline/monitoring data

Resilience and security > 4. Changes in impact of unplanned disruptive events on access to social and economic opportunities

4.1.2

For state highways and urban arterials, baseline level of service data can be establish using the <u>ONF level of service tool</u> and <u>State highway resilience StoryMap</u>. These sources will be updated over time.

Local descriptions or quantitative data can be used as evidence to develop this measure for local roads and other transport network elements.

If local description or quantitative measure is used, apply appropriate calculation to determine current state or data for the measure.

Forecasting methodology

A centralised methodology for calculation of risk rating for elements of the network is available. It utilises the methodology outlined in the <u>National Resilience Programme Business Case</u> (appendix G).

This uses the following risk assessment methodology:



Based on the input variables, the resulting risk is categorised as minor, moderate, major or extreme.

The full version of this methodology and tools for this measure are available on the 'Tools and Resources' section of the <u>Land Transport Benefits Framework measures manual</u> page on our website.

Benefits realisation

Waka Kotahi will continue to update reporting information on an annual basis and any improvements, such as the provision of data in the StoryMaps tool, will result in a change to this measure definition. Centralised data is currently available on the Waka Kotahi website for the state highway network. While there is currently no centralised data or information for the local road network, this will be developed over time, and ongoing monitoring of the measure will be required at the local level.

>>Return to 4.1 Impact on system vulnerabilities and redundancies

Economic prosperity

local, regional, and international connections, with efficient movements of people and products.

This transport outcome is about supporting economic activity via

5. Changes in transport costs

This benefit cluster comprises two benefits about system reliability and network productivity and utilisation. These factors are important to supporting economic activity and connections.

5.1 Impact on system reliability

Transport system reliability is about the user being able to count on a similar travel experience on the transport system when travelling under the same conditions (for example at the same time with the same mode). This includes knowing that a bus will arrive at the time scheduled or knowing it will take a certain amount of time to drive to a destination at the same time of the day. Reliability means the journey is as expected, taking known normal variations into account, such as expecting a trip to normally take longer in peak than off-peak periods.

A full description of this benefit is available on our website: 5.1 Impact on system reliability

The measures listed below have been associated with this benefit for ease of reference, but they can also be applied to other benefits as appropriate.

Quantitative measures				
No.	Name		Description	
5.1.1	Punctuality – public transport	<u>>></u>	Percentage of scheduled service trips between 59 seconds before and 4 minutes 59 seconds after the scheduled departure time of selected point	
5.1.2	Travel time reliability – motor vehicles	<u>>></u>	Coefficient of variation; standard deviation of travel time DIVIDED BY average minutes travel time (as per Austroads)	
5.1.3	Travel time delay	<u>>></u>	Difference between average travel time A and average travel time B in minutes per kilometre	
5.1.4	Temporal availability – road	<u>>></u>	Number and duration of resolved road closures: urban >=2 hours; rural >=12 hours	
Qualitati	ve measures		(ALA)	
N/A				

>> Return to Land Transport Benefits Framework overview

5.1.1 Punctuality – public transport

Measure description



Measure no:	5.1.1
Measure name:	Punctuality – public transport
Measure description:	Percentage of scheduled service trips between 59 seconds before and 4 minutes 59 seconds after the scheduled departure time of selected point
Measure type:	Quantitative measure
Intent	To be provided in future re-release of the manual
Scope	To be provided in future re-release of the manual
Measure relationships	To be provided in future re-release of the manual

KEY





Measure information and data

Measure equation	To be provided in future re-release of the manual.		
Unit of measure	Percentage %		
Definition of terms	To be provided in future re-release of the manual.		
Information available	Centralised information is not currently available for this measure.		
Information items	Map/data item name	Description	
		To be provided in future re-release of the manual.	

How to calculate baseline/monitoring data

To be provided in future re-release of the manual.

Forecasting methodology

To be provided in future re-release of the manual.

Benefits realisation

To be provided in future re-release of the manual.

>> Return to 5.1 Impact on system reliability

5.1.2 Travel time reliability – motor vehicles

Measure description



Measure no:	5.1.2
Measure name:	Travel time reliability – motor vehicles
Measure description:	Coefficient of variation; standard deviation of travel time DIVIDED BY average minutes travel time (as per Austroads).
Measure type:	Quantitative
Intent	Use this measure when investment intends to deliver more reliable travel on roads, such as improving resilience or infrastructure.
Scope	This measure can be applied at rural and urban journey level or at a specific piece of road.
Measure relationships	This measure has companion relationships with other measures in the benefits framework. The relationship map below shows these relationships and can be used to help you select further measures to support this measure.



Measure equation	Description: Standard deviation of travel time DIVIDED BY average minutes travel time	
	standard derivation of travel time	
	$n = \frac{\text{standard derivation of charge time}}{\text{average minutes travel time}}$	
	The final result is presented as a percentage in the StoryMaps tool.	
Unit of measure	Rate (Low <30%, Medium 30-60%, High >60%)	
Definition of terms	Coefficient of variation is also known as relative standard deviation. This is a probability theory and statistical term and is a measure of variation in relation to the mean. Motor vehicles: covers all motor vehicles, including cars, buses, electric cars and buses, motor cycles and trucks.	
	This measure is currently limited to state highways and urban arterials, due to availability of data	
	For more information on Austroads National Performance Indicators, see: https://austroads.com.au/publications/traffic-management/ap-r305-07	
Information available	Partial information available (since October 2019).	



atial maps a	are provided, but data is not available due to licensing conditions.	
Spatial maps are provided, but data is not available due to licensing conditions. Link to StoryMaps (information)		
Scroll down to navigate around the benefits and measures in the Economic Prosperity outcome.		
ou do not h estment.bei	ave access to view the information, please request from nefits@nzta.govt.nz	
p/data n name	Description	
o	Travel time reliability for state highways and urban arterials has been mapped for the period July 2018–June 2019. Maps are provided for:	
	 key journeys – rural key journeys – urban AM (7am–9am) key journeys – urban interpeak (10am–2pm) key journeys – urban PM (4pm–6pm) 	
	bil down to come. bu do not h estment.be b/data n name	

How to calculate baseline/monitoring data

Defining geospatial area of measure	As part of your project/programme definition in TIO, you will be required to enter the geospatial coordinates of your investment. In the case of this measure, it is possible to identify specific pieces of road.
Use the StoryMaps tool to manually calculate your project baseline result	Partial information (map only) is available in the StoryMaps tool. Select the appropriate type of journey and period and zoom into the appropriate journey/road. Identify the rate. If you can't use StoryMaps, travel time data will need to be observed and used to directly calculate the average travel time and standard deviation.
Enter into baseline field in TIO	Enter rate into appropriate 'baseline' field in TIO.

Forecasting methodology

A standardised forecasting methodology is not yet available for this measure, however, a method using volume/capacity relationships.is currently being considered. A local forecast is to be developed as appropriate. Documentation about the methodology used should be included in business case documentation as appropriate.

Benefits realisation

Waka Kotahi will continue to update information on a regular basis and any improvements, such as the provision of underlying data, will result in a change to this measure definition. Benefits realisation monitoring will require the replay of the steps to develop the baseline with more current data.

>> Return to 5.1 Impact on system reliability

5.1.3 Travel time delay

Measure description



Measure no:	5.1.3
Measure name:	Travel time delay
Measure description:	Difference between average travel time A and average travel time B in minutes per kilometre.
Measure type:	Quantitative measure
Intent	This measure can be used for generic projects where a quick assessment of travel time benefits is desired that can produce an order of magnitude effect.
Scope	This measure can be used at a project level.
Measure relationships	This measure has companion and cause–effect relationships with other measures in the benefits framework. The relationship map below shows these relationships and can be used to help you select further measures to support this measure.





Measure information and data

Measure equation	From geospa	From geospatial point 'a' to geospatial point 'b'.		
Unit of measure	Percentage %			
Definition of terms	Average travel time is the average length of time in minutes to travel from geospatial point 'a' to geospatial point 'b' by using the transport network (that is, not as the crow flies).			
Information available	Centralised information includes methodology and tools developed by Infometrics.			
Information items	Map/data item name	Description		
	Tools and information	See the 'Tools and resources' area on the <u>Land Transport Benefits</u> <u>Framework measures manual</u> page on our website, and the report ' <u>Modelling</u> <u>travel time and travel time delay</u> '.		

How to calculate baseline/monitoring data

Baseline data can be calculated based on observed data or based on speed and distance assumptions where appropriate (for example, cycling and walking).

Forecasting methodology

A forecasting methodology and tools for this measure are available in the 'Tools and resources' area on the Land Transport Benefits Framework measures manual page on our website.

Where possible, a local approach to forecasting of changes in travel time is to be developed, following the Waka Kotahi <u>Transport model development guidelines</u>. The model developed should provide a forecast of travel time for transport modes relevant to the project for the do-minimum and the preferred option.

Without detailed modelling of the road segment in question, or for small network areas, simplified methodologies and tools are provided for:

- light vehicles (based on volume/capacity relationships)
- pedestrians (based on delay calculations for both controlled and uncontrolled crossings)
- cyclists (at this stage the above approach has not been agreed to by members of the Benefits Forecasting Technical Advisory Group, and so no spreadsheet tool has yet been developed; however, the pedestrian tool is readily applicable to cyclists.)

Benefits realisation

To be provided in future re-release of the manual.

>> Return to 5.1 Impact on system reliability

5.1.4 Temporal availability - road

Measure description

Measure attributes	
	5.1.4

Measure no:	5.1.4		
Measure name:	Temporal availability – road		
Measure description:	Number and duration of resolved road closures: urban >=2 hours; rural >=12 hours		
Measure type:	Quantitative measure		
Intent	This measure can be used for any investment that focuses on maintaining or increasing the resilience of the transport network and responding to unplanned closures.		
Scope	This measure can be used for individual investments or rolled up to geographical area or programme.		
Measure relationships	This measure has companion and cause–effect relationships with other measures in the benefits framework. The relationship map below shows these relationships and can be used to help you select further measures to support this measure.		



Measure equation	Description:		
	From points ' 12 hours (rur	a' to 'b', the annual number of closures with durations over 2 hours (urban) or al).	
	Equation:		
		n = closure > 2hours (urban) + closure > 12 hours (rural)	
Unit of measure	Number		
Definition of terms	Only unplanned road closures are included in this measure		
Information available	Partial information is available (August 2019).		
	Information a	bout unplanned closures is available for state highways and urban arterials.	
	Link to StoryMaps (information)		
	Scroll down to navigate around the benefits and measures in the Economic Prosperity		
	outcome.		
	If you do not have access to view the information, please request from		
	investment.benefits@nzta.govt.nz		
Information items	Map/data item name	Description	
	Мар	Interrogatable spatial map detailing with unplanned closures colour coding.	
	Data	ESRI data files are available.	





How to calculate baseline/monitoring data

Defining geospatial area of measure	As part of project/programme definition in TIO, you will be required to enter the geospatial coordinates for your investment. In the case of this measure, it is possible to identify specific pieces of road.
Use the StoryMaps tool to manually calculate your project baseline result	Data should be gathered for the latest year available in the StoryMaps tool and the average number and duration of outages (over 2 hours in urban and over 12 hours in rural) calculated for the section of road.
Enter into baseline field in TIO	Enter number of outages over the thresholds into appropriate baseline field.

Forecasting methodology

A standardised forecasting methodology is not yet available for this measure. A local forecast is to be developed as appropriate. Documentation about the methodology used should be included in business case documentation as appropriate.

Benefits realisation

Waka Kotahi will continue to update information on a regular basis and any improvements, such as the provision of underlying data, will result in a change to this measure definition. Benefits realisation monitoring will require the replay of the steps to develop the baseline with more current data.

>> Return to 5.1 Impact on system reliability

5.2 Impact on network productivity and utilisation

Network productivity and utilisation is about efficient use of the land transport network. This benefit is about optimising our part of the broader economic/social system to allow broader benefits to be gained.

A full description of this benefit is available on our website: <u>5.2 Impact on network productivity and utilisation</u>

The measures listed below have been associated with this benefit for ease of reference, but they can also be applied to other benefits as appropriate.

			\sim
Quantita	tive measures		(#)
No.	Name		Description
5.2.1	Spatial coverage – freight	<u>>></u>	Percentage completion of the strategic high productivity motor vehicle freight network
5.2.2	Freight – mode share value	<u>>></u>	Number of vehicles TIMES average load per vehicle in NZD, expressed as percentages
5.2.3	Freight – mode share weight	<u>>></u>	Number of vehicles TIMES average load per vehicle in tonnes, expressed as percentages
5.2.4	Freight – throughput value	<u>>></u>	Number of vehicles TIMES average load per vehicle in NZD
5.2.5	Freight – throughput weight	<u>>></u>	Number of vehicles TIMES average load per vehicle in tonnes
5.2.6	Access to key economic destinations (all modes)	>>	Proportion of population living within travel threshold (15 minutes, 30 minutes or 45 minutes) of key economic opportunities (including work) by different modes (walking, cycling, public transport, private motor vehicle) in the morning peak
Qualitati	ve measures		
N/A			

>> Return to Land Transport Benefits Framework overview

5.2.1 Spatial coverage – freight

Measure description



Measure no:	5.2.1		
Measure name:	Spatial coverage – freight		
Measure description:	Percentage completion of the strategic high productivity motor vehicle freight network		
Measure type:	Quantitative measure		
Intent	Use this measure when investment will impact on the high productivity motor vehicle freight network.		
Scope	This measure is best used at a national level.		
Measure relationships	This measure has companion relationships with other measures in the Benefits Framework. The relationship map below shows these relationships and can be used to help you select further measures to support this measure.		



Measure information and data

Macoura equation	Description			
Measure equation	Description.			
	Percentage of	Percentage completion of the strategic high productivity motor vehicle freight network		
Definition of terms	High productivity motor vehicles (HPMV) including 50MAX are trucks that are able to operate above the current 44 tonne weight limit under permit.			
Information available	Partial centralised information is available (since August 2019).			
	A map of HPMV routes is available and the data is currently in the process of being released.			
	Link to benef	its StoryMap (information)		
	Scroll down t	to navigate around the benefits and measures in the Economic Prosperity		
	outcome. If you do not have access to view the information, please request from			
Information items	Map/data item name	Description		
	HPMV map	The full HPMV network map shows the routes that are suitable for HPMVs carrying the maximum loads available under a permit.		
		The map is intended to give operators guidance on where bridges can safely support full HPMV mass limits. It does not mean that HPMVs cannot travel under a permit on roads that are not on the map, but the permit may specify lower mass limits for these roads.		
		The full HPMV network map differs from the 50MAX network map, which is also provided for context.		

How to calculate baseline/monitoring data

Defining geospatial area of measure	As part of project/programme definition in TIO, you will be required to enter the geospatial coordinates for your investment. In the case of this measure, it is possible to identify specific pieces of road.
Use the StoryMaps tool to manually calculate your project baseline result	The StoryMaps tool cannot be currently used to determine the percentage of the HPMV completed but can be used to determine if the specific piece of road is suitable for HPMV. To be provided in future re-release of the manual.
Enter into baseline field in TIO	



Forecasting methodology

A centralised methodology is not yet available. A local forecast to be developed as appropriate.

Benefits realisation

Waka Kotahi will continue to update annual reporting information on an annual basis and any improvements, such as the provision of data in the StoryMaps tool, will result in a change to this measure definition. While there is no centralised data or information, ongoing monitoring of the measure will be required at the local level.

>> Return to 5.2 Impact on network productivity and utilisation

5.2.2 Freight – mode share value

Measure description



Measure no:	5.2.2		
Measure name:	Freight – mode share value		
Measure description:	Number of vehicles TIMES average load per vehicle in NZD, expressed as percentages		
Measure type:	Quantitative		
Intent	Use this measure when investment will impact on commercial freight activity.		
Scope	This measure can be used at an investment level or can be rolled up for a geographical area or programme.		
Measure relationships	This measure has companion and cause–effect relationships with other measures in the benefits framework. The relationship map below shows these relationships and can be used to help you select further measures to support this measure.		



Measure equation	Description: Number of vehicles TIMES value of the average load per vehicle in NZD, expressed as percentages (by mode). Equation: $n = (Vh) x \left(\frac{total NZD}{Vh}\right)$ Where Vh is the total number of vehicles and total NZD is the total value of all of the loads added together. To be repeated for each mode and total value of freight from all modes to be represented as percentage of total value.	
Unit of measure	Percentage of value for each mode (rail, road, coastal)	
Definition of terms	Heavy road vehicles of all types are included in this data set. Light vehicles are excluded. AADT (in the map) = annual average daily traffic	
Information available	Partial centralised information is available (from August 2019).	

	 Data about the number of freight road vehicles (heavy vehicles) is centrally available. Data for other modes is not currently available. Dollar value of average loads is not currently available centrally. <u>Link to benefits StoryMap (information)</u> Scroll down to navigate around the benefits and measures in the Economic Prosperity outcome. 		
	If you do not have access to view the information, please request from		
	investment.benefits@nzta.govt.nz This measure is viewed through Mega Maps, which has additional access requirements.		
Information items	Map/data item name	Description	
	Мар	A centralised map with the number of freight vehicles is available for state highways and local roads.	
	Data	A centralised data set for the number of freight vehicles is available for state highways and local roads.	

How to calculate project baseline/monitoring data

Not enough centralised data is available to enable a project baseline to be fully developed. Local data should be used in association with centralised data to determine baseline.

Forecasting methodology

A centralised methodology is not yet available. A local forecast to be developed as appropriate.

Benefits realisation

Waka Kotahi will continue to update annual reporting information on an annual basis and any improvements, such as the provision of data in the StoryMaps tool, will result in a change to this measure definition. While there is no centralised data or information, ongoing monitoring of the measure will be required at the local level.

>> Return to 5.2 Impact on network productivity and utilisation

5.2.3 Freight – mode share weight

Measure description



Measure no:	5.2.3		
Measure name:	Freight – mode share weight		
Measure description:	Number of vehicles TIMES average load per vehicle in tonnes, expressed as percentages		
Measure type:	Quantitative		
Intent	Use this measure when investment will impact on commercial freight activity.		
Scope	This measure can be used at an investment level or can be rolled up for a geographical area or programme.		
Measure relationships	This measure has companion and cause–effect relationships with other measures in the benefits framework. The relationship map below shows these relationships and can be used to help you select further measures to support this measure.		



Measure equation	Description: Number of vehicles TIMES weight of the average load per vehicle in tonnes, expressed as percentages (by mode).	
	Equation:	
	$n = (Vh) x \left(\frac{total T}{Vh}\right)$	
	Where <i>Vh</i> is the total number of vehicles and <i>total T</i> is the total weight of all of the loads added together in tonnes. To be repeated for each mode. Total tonnage of freight from all modes to be represented as percentage of total tonnage.	
Unit of measure	Percentage of weight for each mode (rail, road, coastal shipping)	
Definition of terms	Heavy vehicles of all types are included in this data set. Light vehicles are excluded.	

5.2.3

	AADT (in the map) = annual average daily traffic		
Information available	Partial centralised information is available (from August 2019). Data about the number of freight road vehicles (heavy vehicles) is centrally available. Data for other modes is not currently available.		
	Weight of ave	rage loads is not currently available centrally.	
	Link to benefi	ts StoryMap (information)	
	Scroll down to navigate around the benefits and measures in the Economic Prosperity		
	outcome.		
	If you do not have access to view the information, please request from		
	investment.benefits@nzta.govt.nz		
	This measure is viewed through Mega Maps, which has additional access requirements.		
Information items	Map/data item name	Description	
	Мар	A centralised map with the number of freight vehicles is available for state highways and local roads.	
	Data	A centralised data set for the number of freight vehicles is available for state highways and local roads.	

How to calculate project baseline/monitoring data

Not enough centralised data is available to enable a project baseline to be fully developed. Local data should be used in association with centralised data to determine baseline.

Forecasting methodology

A centralised methodology is not yet available. A local forecast to be developed as appropriate.

Benefits realisation

Waka Kotahi will continue to update annual reporting information on an annual basis and any improvements, such as the provision of data in the StoryMaps tool, will result in a change to this measure definition. While there is no centralised data or information, ongoing monitoring of the measure will be required at the local level.

>> Return to 5.2 Impact on network productivity and utilisation

5.2.4 Freight – throughput value

Measure description



Measure no:	5.2.4		
Measure name:	Freight – throughput value		
Measure description:	Number of vehicles TIMES average load per vehicle in NZ dollars		
Measure type:	Quantitative		
Intent	Use this measure when investment will impact on commercial freight activity.		
Scope	This measure can be used at an investment level or can be rolled up for a geographical area or programme.		
Measure relationships	This measure has companion and cause–effect relationships with other measures in the benefits framework. The relationship map below shows these relationships and can be used to belo you select further measures to support this measure		



Measure equation	Description: Number of vehicles TIMES average value of load per vehicle in NZ dollars		
	Equation:		
	$n = Vh \ x \ (\frac{total \ V}{Vh})$		
	Where <i>Vh</i> is the total number of vehicles and <i>total V</i> is the total value of all of the loads added together in New Zealand dollars.		
Unit of measure	Dollar value		
Definition of terms	Heavy vehicles of all types are included in this data set. Light vehicles are excluded.		
	AADT (in the map) = annual average daily traffic		
Information available	Partial centralised information is available (from August 2019).		



	Data about the number of freight road vehicles is centrally available. Data for other modes is not available.		
	Dollar value of average loads is not currently available centrally.		
	Link to benefits StoryMap (information)		
	Scroll down to navigate around the benefits and measures in the Economic Prosperity outcome.		
	If you do not have access to view the information, please request from		
	investment.benefits@nzta.govt.nz		
Information items	Map/data item name	Description	
	Мар	A centralised map with the number of freight vehicles is available for state highways and local roads.	
	Data	A centralised data set for the number of freight vehicles is available for state highways and local roads.	

How to calculate project baseline/monitoring data

Not enough centralised data is available to enable a project baseline to be fully developed. Local data should be used in association with centralised data to determine baseline.

Forecasting methodology

A centralised methodology is not yet available. A local forecast is to be developed as appropriate.

Benefits realisation

Waka Kotahi will continue to update annual reporting information on an annual basis and any improvements, such as the provision of data in the StoryMaps tool, will result in a change to this measure definition. While there is no centralised data or information, ongoing monitoring of the measure will be required at the local level.

>> Return to 5.2 Impact on network productivity and utilisation

5.2.5 Freight – throughput weight

Measure description

Measure attributes	
	5.2.5

Measure no:	5.2.5		
Measure name:	Freight – throughput weight		
Measure description:	Number of vehicles TIMES average load per vehicle in tonnes		
Measure type:	Quantitative		
Intent	Use this measure when investment will impact on commercial freight activity.		
Scope	This measure can be used at an investment level or can be rolled up for a geographical area or programme.		
Measure relationships	This measure has companion and cause–effect relationships with other measures in the benefits framework. The relationship map below shows these relationships and can be used to help you select further measures to support this measure.		



Description:			
Number of vehicles TIMES average weight of load per vehicle in tonnes Equation: $n = Vh \ x \ (\frac{total \ W}{Vh})$			
			Where <i>Vh</i> is the total number of vehicles and <i>total W</i> is the total weight of all of the loads added together in tonnes.
			Total tonnage
Heavy vehicles of all types are included in this data set. Light vehicles are excluded.			
Partial centralised information is available (from August 2019)			



	Data about the number of freight road vehicles is centrally available. Data about other modes is not available.		
	Dollar value of average loads is not currently available centrally.		
	Link to benefits StoryMap (information) Scroll down to navigate around the benefits and measures in the Economic Prosperity outcome. If you do not have access to view the information, please request from investment.benefits@nzta.govt.nz		
	This measure is viewed through Mega Maps, which has additional access requirements.		
Information items	Map/data item name	Description	
	Мар	A centralised map with the number of freight vehicles is available for state highways and local roads.	
	Data	A centralised data set for the number of freight vehicles is available for state highways and local roads.	

How to calculate project baseline/monitoring data

Not enough centralised data is available to enable a project baseline to be fully developed. Local data should be used in association with centralised data to determine baseline.

Forecasting methodology

A centralised methodology is not yet available. A local forecast is to be developed as appropriate.

Benefits realisation

Waka Kotahi will continue to update annual reporting information on an annual basis and any improvements, such as the provision of data in the StoryMaps tool, will result in a change to this measure definition. While there is no centralised data or information, ongoing monitoring of the measure will be required at the local level.

>> Return to 5.2 Impact on network productivity and utilisation

5.2.6 Access to key economic destinations (all modes)

Measure description



Measure no:	5.2.6		
Measure name:	Access to key economic destinations (all modes)		
Measure description:	Proportion of population living within travel threshold (15 minutes, 30 minutes or 45 minutes) of key economic opportunities (including work) by different modes (walking, cycling, public transport, private motor vehicle) in the morning peak		
Measure type:	Quantitative measure		
Intent	Use this measure when investment is focused on providing infrastructure for walking, cycling or public transport or where mode shift or uptake of active modes/public transport is driving investment; or where improving access to social and economic opportunities by road vehicle (particularly in rural areas).		
Scope	This measure can be applied at investment level or can be rolled up by geographical area or programme. It is best used to measure the catchment of the destinations focused on in the measure (such as jobs).		
Measure relationships	This measure has companion and cause–effect relationships with other measures in the benefits framework. The relationship map below shows these relationships and can be used to help you select further measures to support this measure.		



5.2.6

Measure equation	Description:			
	Proportion of population living within travel threshold (15 minutes, 30 minutes or 45 minutes) of key economic opportunities (including work) by different modes (walking, cycling, public transport, private motor vehicle) in the morning peak.			
	 The following focuses on the 'work' component of this measure. This measure uses the centroid of each NZ meshblock (48,000) as its origin and jobs as the destination. It maps jobs that would take 45 minutes to reach by car, public transport, walking, and cycling (note that 30 minutes' drive time is used for modelling, but this assumes it takes an average of 15 minutes to get to/from car and to park car). The number of jobs reachable is then determined for each meshblock – and for each region a proportion is calculated to show how many 'reachable jobs' there are within the region and within the threshold. The basic formula is: 			
	Equation:			
	No. of jobs reached within each threshold catchment			
	Total no. of jobs			
	More detailed formula (without population weighting is): $\sum_{n=1}^{n} total_{jobs_{ri}}$			
	$ave_access_r = \frac{2i}{cnt} \frac{sum_reg_Job_r}{sum_reg_Job_r}$			
	Where:			
	ave_access_r is the percentage of average accessibility of a meshblock in the region r			
	<i>total_jobs</i> _{ri} is the total number of jobs available for meshblock <i>i</i> in the region r			
	$sum_reg_job_r$ is the total number of jobs available in the region r			
	$cnt_meshblock_r$ is the total num	$cnt_meshblock_r$ is the total number of meshblocks in the region r		
	n is the total number of meshblocks in the region r			
	When calculating a national figure, each region's share of national jobs is used to weight the region (otherwise each region would be equal to one, eg Auckland would be weighted the same as West Coast).			
	This measure is reported in the Waka Kotahi annual report with one national proportion (number), but localised web maps are available for all four modes.			
	The number of minutes travel is calculated based on traffic and routes at morning weekday peak period (8:15am) on a Tuesday in March based upon the TomTom network.			
	A linked General Transit Feed Specification (GTFS) file was created for public transport modelling (based upon GTFS files around March 2019). For walking and cycling Open Street Maps was used.			
	Data source for jobs is the LEED (Linked Employer-Employee Data) from Stats NZ that is based on business demography data.			
Measurement unit	Percentage (of jobs that can be	accessed from origin point)		
Definition of terms	Travel threshold: the time taken	to reach a given destination by each mode.		
Information available	Full information available (since	October 2019).		
	Link to benefits StoryMap (information)			
	Scroll down to navigate around the benefits and measures in the Economic Prosperity outcome.			
	If you do not have access to view the information, please request from investment.benefits@nzta.govt.nz			
Information items	Map/data item name	Description		
	Graph	For an infometric of national summary data of access to social destinations refer to the measure 'Access to social and economic opportunities by mode' in the relevant Waka		
		Kotahi NZ Transport Agency annual report.		
5.2.6

Map of access to employment	Map based on proximity of population to job centres by mode.
Maps of access to other social opportunities, includ schools, supermarkets, general practitioners (GPs) hospitals, work and income centres	Maps based on proximity of social destination to population.
Data	ESRI file geodatabase and ESRI Shapefile for employment and social destinations.

How to calculate baseline/monitoring data

Defining geospatial area of measure	As part of your project/programme definition in TIO, you will be required to enter the geospatial coordinates of your investment. In the case of this measure, it is suggested that the catchment area of the impact of the investment be used to determine the geospatial area.
Use the StoryMaps tool to manually calculate your project baseline result	If national, select relevant number from the Waka Kotahi annual report. If focused on a smaller area, zoom in the StoryMaps tool to the appropriate scale to determine the proportion of the population within 45 minutes of work by each mode.
Enter into baseline field in TIO	Enter percentage and mode into 'baseline' field in TIO.

Forecasting methodology

A standardised forecasting methodology is not yet available for this measure. A local forecast is to be developed as appropriate.

Benefits realisation

Waka Kotahi will continue to update information on a regular basis and any improvements, such as the provision of underlying data, will result in a change to this measure definition. Benefits realisation monitoring will require the replay of the steps to the baseline with more current data.

>> Return to 5.2 Impact on network productivity and utilisation

6. Wider economic impact

In addition to, or in some cases as a consequence of, direct impacts there can be indirect impacts on the economy. These may cause a redistribution or reallocation of resources or may cause the entry or exit of firms. These are wider economic impacts and can include:

- agglomeration or specialisation of economic activity arising from improved transport that can encourage economies of scale
- mitigating existing market failures by improving accessibility and therefore competition between markets
- increased output in imperfectly competitive markets by diminishing persistent externalities
- technology and knowledge transfer by connecting people and places and increasing the interaction between economic actors
- increased activity through changes in development patterns and activity that are enabled through transport system changes.

There are no qualitative or quantitative measures associated with this benefits cluster as many of the potential measures are represented elsewhere.

More detail about this benefit cluster is available on our website: 6. Wider economic impact

Environmental sustainability

This transport outcome is about transitioning to net zero carbon emissions, and maintaining or improving biodiversity, water quality, and air quality

7. Changes in natural environment

The natural environment benefits cluster is comprised of benefits relating to water, land and biodiversity. Changes to the natural environment result from the development, use, operation and maintenance of the land transport system. This benefits cluster may therefore be applied to a wide range of investment.

Water, land and biodiversity have value in and of themselves as fundamental building blocks of Aotearoa New Zealand's natural environmental system. They support our way of life and have intergenerational benefits.

This benefit cluster is related to benefit cluster 12 Changes to te ao Māori due to the importance of the environment in te ao Māori.

7.1 Impact on water

The land transport system can impact on water quality and flow during the operation, maintenance and construction of transport infrastructure. Effects can be short term or long term.

Potential impacts include surface water pollution from surface run-off or spray and accidental spillage, and ground water pollution from soakaways discharge or disturbance of contaminated ground.

A full description of this benefit is available on our website: 7.1 Impact on water

The measure listed below has been associated with this benefit for ease of reference, but it can also be applied to other benefits as appropriate.

Quantita	tive measures			(#)
No.	Name		Description	Ű
N/A				\frown
Qualitati	ve measures			(Arch)
7.1.1	Water quality	<u>>></u>	User to describe	

>> Return to Land Transport Benefits Framework overview



7.1

7.1.1 Water quality

Measure description



Measure no:	7.1.1
Measure name:	Water quality
Measure description:	User to describe
Measure type:	Qualitative measure
Intent	Use this measure when investment may impact on water quality in the short (such as during construction) or long term (such as modification of water courses).
Scope	This measure can be rolled up by geographical area or programme but is best used to measure the catchment of the investment.
Measure relationships	This measure has companion and cause–effect relationships with other measures in the benefits framework. The relationship map below shows these relationships and can be used to help you select further measures to support this measure.



Measure information

Definition of terms	To be provided in future re-release of the manual.	
Information sources	To be confirmed.	
Methodology	Scoring. Detailed instructions for this methodology are to be provided in future re-release of the manual. Local descriptions or quantitative data can be used as evidence against this measure.	
Direction/scaling	To be provided in future re-release of the manual.	

How to calculate baseline/monitoring data

Calculations using the 'scoring methodology' to be provided in a future re-release of the manual.

If local description or quantitative measure is used, apply appropriate calculation to determine current state or data for the measure.

Forecasting methodology

A centralised methodology is not yet available. A local forecast to be developed as appropriate.

Benefits realisation

Waka Kotahi will continue to update annual reporting information on an annual basis and any improvements, such as the provision of data in the StoryMaps tool, will result in a change to this measure definition. While there is no centralised data or information, ongoing monitoring of the measure will be required at the local level.

>> Return to 7.1 Impact on water

7.2

7.2 Impact on land and biodiversity

This benefit, which is largely focused on biodiversity, is concerned primarily with indigenous vegetation, ecosystems, and habitats for indigenous species. With 52,000 species found only in Aotearoa New Zealand, our indigenous biodiversity is significant internationally as a 'biodiversity hot spot'.

A full description of this benefit is available on our website: 7.2 Impact on land and biodiversity

The measures listed below have been associated with this benefit for ease of reference, but they can also be applied to other benefits as appropriate.

Quantitative measures				(#)
No.	Name		Description	
N/A				
Qualitative measures				(ASCA)
7.2.1	Biodiversity	>>	User to describe	
7.2.2	Productive land	<u>>></u>	User to describe	

>> Return to Land Transport Benefits Framework overview



7.2.1 Biodiversity

Measure description

Measure no:	7.2.1
Measure name:	Biodiversity
Measure description:	User to describe
Measure type:	Qualitative measure
Intent	Use this measure when investment may impact on biodiversity in the short or long term.
Scope	This measure can be rolled up by geographical area or programme, but is best used to measure the area directly impacted by investment.
Measure relationships	This measure has companion and cause–effect relationships with other measures in the benefits framework. The relationship map below shows these relationships and can be used to help you select further measures to support this measure.



7.2.1

Measure information

Definition of terms	To be provided in future re-release of the manual.
Information sources	To be confirmed.
Methodology	Scoring. Detailed instructions for this methodology are to be provided in future re-release of the manual. Local descriptions or quantitative data can be used as evidence against this measure.
Direction/scaling	To be provided in future re-release of the manual.

How to calculate baseline/monitoring data

Calculations using the 'scoring methodology' to be provided in a future re-release of the manual.

If local description or quantitative measure is used, apply appropriate calculation to determine current state or data for the measure.

Forecasting methodology

A centralised methodology is not yet available. A local forecast is to be developed as appropriate.

Benefits realisation

Waka Kotahi will continue to update annual reporting information on an annual basis and any improvements, such as the provision of data in the StoryMaps tool, will result in a change to this measure definition. While there is no centralised data or information, ongoing monitoring of the measure will be required at the local level.

>> Return to 7.2 Impact on land and biodiversity

7.2.2 Productive land

Measure description



Measure no:	7.2.2
Measure name:	Productive land
Measure description:	User to describe
Measure type:	Qualitative measure
Intent	Use this measure when investment may impact on productive land in the short or long term.
Scope	This measure can be rolled up by geographical area or programme and can be used to measure the area directly impacted by investment.
Measure relationships	This measure has companion and cause–effect relationships with other measures in the benefits framework. The relationship map below shows these relationships and can be used to help you select further measures to support this measure.



Measure information

Definition of terms	To be provided in future re-release of the manual.
Information sources	To be confirmed.
Methodology	Scoring. Detailed instructions for this methodology are to be provided in future re-release of the manual. Local descriptions or quantitative data can be used as evidence against this measure.
Direction/scaling	To be provided in future re-release of the manual.

How to calculate baseline/monitoring data

Calculations using the 'scoring methodology' to be provided in a future re-release of the manual.

If local description or quantitative measure is used, apply appropriate calculation to determine current state or data for the measure.

Forecasting methodology

A centralised methodology is not yet available. A local forecast is to be developed as appropriate.

Benefits realisation

Waka Kotahi will continue to update annual reporting information on an annual basis and any improvements, such as the provision of data in the StoryMaps tool, will result in a change to this measure definition. While there is no centralised data or information, ongoing monitoring of the measure will be required at the local level.

>> Return to 7.2 Impact on land and biodiversity

8. Changes in climate

The 2022 emissions reduction plan (ERP)³ outlines how the land transport system can reduce emissions from transport in line with the government's carbon budgets. This benefit cluster consists of benefits that will help to mitigate climate change by reducing greenhouse gas emissions.

8.1 Impact on greenhouse gas emissions

In 2019, land transport contributed 17 percent of greenhouse gas emissions in New Zealand.⁴ The government's priority is to reduce vehicle kilometres travelled (VKT) by light vehicles by 20 percent and freight emissions by 35 per cent during three emissions budget periods by 2035 (ERP 2022) as part of the plan to reduce emissions from transport.

The primary greenhouse gas produced by the transport sector is carbon dioxide (CO₂), however other emissions such as methane (CH₄) and nitrous oxide (N₂O) contribute to anthropogenic (human-created) climate change. The combined impact of greenhouse gases is measured through carbon dioxide equivalence, or CO₂-e.⁵

A full description of this benefit is available on our website: <u>8.1 Impact on greenhouse gas</u> emissions

The measures listed below have been associated with this benefit for ease of reference, but they can also be applied to other benefits as appropriate.

The addition, in 2023, of measures for light VKT (8.1.3) and freight emissions (8.1.4) respond to national ERP targets in these factors. Policy is emerging rapidly in this field and future revisions will build on emerging policy and practice in relation to VKT reduction planning. The government has prioritised planning in our fastest growing (Tier 1 and Tier 2) cities and towns.

In time, VKT-reduction programmes are expected to play a greater role in investment decision making. While VKT-reduction planning is underway in our growing urban centres an interim approach is outlined for use throughout New Zealand. This interim approach relies on existing practice in transport demand modelling. Forecasting will report on the direct impacts of a proposal to support future benefits management so that informed decisions can be made at a programme level. There is scope for larger proposals to consider indirect impacts.

Quantitative measures (#)				
No.	Name		Description	
8.1.1	Greenhouse gas emissions (all vehicles)	<u>>></u>	Tonnes of CO ₂ equivalents emitted by all vehicles	
8.1.3	Light vehicle use impacts	>>	Light vehicle kilometres travelled (light VKT)	
8.1.4	Freight transport impact on greenhouse gas emissions	<u>>></u>	Tonnes of CO ₂ equivalents emitted by trucks, rail and ships used for freight (excludes light commercial vehicles and aviation)	
Qualitative measures				
8.1.2	Mode shift from single occupancy private vehicle	>>	User to describe	

Understanding the interactions of different investment options between benefits clusters will help tell a cohesive investment story, for example:

- embodied emissions within land transport infrastructure are considered in benefit 9.1 Impact on resource efficiency
- air pollutants that impact human health, such as oxides of nitrogen (NOx), are considered in benefits in *3. Changes in human health* benefit cluster
- the relationship of light VKT reductions to mode shift is considered in 10. Changes to access to social and economic opportunities benefit cluster

8.1

³ <u>Te hau mārohi ki anamata: towards a productive, sustainable and inclusive economy: Aotearoa New</u> <u>Zealand's first emissions reduction plan</u>

New Zealand's Greenhouse Gas Inventory 1990–2020

⁵ Quantified through Global Warming Potentials, which represent the radiative forcing effect of each gas. See https://www.epa.gov/ghgemissions/understanding-global-warming-potentials

• preparation and adaptation for climate change is reflected in the *Resilience and security* transport outcome.

>> Return to Land Transport Benefits Framework overview

Measure attributes

8.1.1 Greenhouse gas emissions (all vehicles)

Measure description

Measure no:	8.1.1
Measure name:	Greenhouse gas emissions (all vehicles)
Measure description:	Tonnes of CO ₂ equivalents emitted (CO ₂ -e)
Measure type:	Quantitative measure
Intent	Use this measure when investment impacts on CO_2 -e emissions from vehicles using the transport network.
Scope	This measure can be applied at investment level or can be rolled up by geographical area or programme.
Measure relationships	The inputs used to forecast emissions for all vehicles are likely to be developed in the same model used to measure light VKT impacts in <i>8.1.3 Light vehicle use impacts</i> .
	This measure has other companion and cause–effect relationships with other measures in the benefits framework. The relationship map below shows these relationships and can be used to help you select further measures to support this measure.



Measure information and data

Measure equation	Description:				
	Carbon dioxide emissions from all vehicle types				
Unit of measure	Tonnes				
Definition of terms	CO ₂ -e: carbon dioxide equivalent emissions				
Information available	Full information available (since October 2019).				
	Modelled emissions from vehicles are presented in spatial and data form.				
	National Vehicle Emissions Dataset – emission estimates for all public roads taking account of traffic count, fleet profile, speed and gradient.				
	Vehicle Emissions Prediction Model (VEPM)				
	Link to benefits StoryMap (information)				
	Scroll down to navigate through the benefits and measures included in the Environmental Sustainability outcome.				
	If you do not have access to view the information, please request from				
	investment.benefits@nzta.govt.nz				
Information items	Map/data item name	Description			
	Мар	Vehicle emissions – CO ₂ -e:			
		Predicted CO ₂ -e vehicle emissions for all roads from the Waka Kotahi <u>Vehicle Emission Mapping Tool</u> .			
	Data Summarised vehicle CO ₂ -e emissions (tonnes).				

Forecasting methodology

The output from suitable traffic modelling undertaken to determine the changes in VKT (8.1.3 Light vehicle use impacts) can be used to estimate emissions. Forecast changes in emissions should be calculated by applying the Waka Kotahi <u>Vehicle Emissions Prediction Model (VEPM)</u> to the output from the traffic model, where the traffic model provides a forecast of kilometres travelled by all vehicles, and speed of each vehicle type, for the do-minimum and the preferred option scenario.

The approach should follow Waka Kotahi guidance, including the <u>Traffic Model Emissions Tool</u> and current good practice. Documentation about the methodology used, and assumptions made, should be included in business case documentation as appropriate.

Enter into baseline field in TIO	Total emissions at start of investment (when preferred option not in place)	
Enter in forecast range for 'do- minimum' in TIO	Emissions forecast for do-minimum (at forecast year)	
Enter in forecast range for 'preferred option' in TIO	Emissions forecast for preferred option (at forecast year)	

VEPM is an average speed emissions model, and may not accurately estimate changes in greenhouse gas emissions in low-speed areas. Waka Kotahi does not recommend using VEPM to estimate any change in greenhouse gas emissions for smaller interventions, where the main impact is a change to the expected average vehicle speed under or equal to 60km/h in urban locations (for example installing/removing a traffic calming measure or lowering/raising a speed limit around a school). In these situations, a qualitative description of the impacts will be appropriate. VEPM can be used to estimate the impact of speed changes on greenhouse gas emissions on roads with average speeds above 60km/h and in wider scale interventions, supported by traffic modelling. See the research note <u>'Effect of speed on greenhouse gas emissions from road transport – a review</u>' for more detail.

Once the CO₂-e emissions (for all vehicles) have been forecast, this can then be monetised using the approach outlined in section 3.4 of the <u>Monetised benefits and costs manual</u>, utilising the

shadow price path of carbon. Economic appraisal may use a longer period of impact than the data available from the traffic modelling.

Cross checks on CO₂-e emissions should be made using the <u>Project Emissions Estimation Tool</u> (<u>PEET</u>) and the <u>Climate Assessment of Transport Investment (CATI)</u> tool during option development to help inform and refine the options.

Benefits realisation

Waka Kotahi will continue to update information on a regular basis and any improvements, such as the provision of underlying data, will result in a change to this measure definition. Benefits realisation monitoring will require the replay of the steps to the baseline with more current data.

>> Return to 8.1 Impact on greenhouse gas emissions

8.1.2 Mode shift from single occupancy private vehicle

Measure description



Measure no:	8.1.2			
Measure name:	Mode shift from single occupancy private vehicle			
Measure description:	User to describe			
Measure type:	Qualitative measure			
Intent	Use this measure when investment may impact on mode shift from a single occupancy vehicle in the short or long term.			
Scope	This measure can be rolled up by geographical area or programme, and can be used to measure the area directly impacted by investment.			
Measure relationships	This measure has companion and cause–effect relationships with other measures in the benefits framework. The relationship map below shows these relationships and can be used to help you select further measures to support this measure.			



KEY



Measure information

Definition of terms	To be provided in future re-release of the manual.		
Information sources	To be confirmed.		
Methodology	User to describe. Local descriptions or quantitative data can be used as evidence against this measure.		
Direction/scaling	To be provided in future re-release of the manual.		

How to calculate baseline/monitoring data

If local description or quantitative measure is used, apply appropriate calculation to determine current state or data for the measure.

Forecasting methodology

A centralised methodology is not yet available. A local forecast is to be developed as appropriate.

Benefits realisation

Waka Kotahi will continue to update annual reporting information on an annual basis and any improvements, such as the provision of data in the StoryMaps tool, will result in a change to this measure definition. While there is no centralised data or information, ongoing monitoring of the measure will be required at the local level.

>> Return to 8.1 Impact on greenhouse gas emissions

8.1.3 Light vehicle use impacts

Measure description



Measure no:	8.1.3
Measure name:	Light vehicle use impacts
Measure description:	Light vehicle kilometres travelled (light VKT)
Measure type:	Quantitative measure
Intent	All investment proposals must demonstrate their impact on light vehicle kilometres travelled to demonstrate how a project contributes to targets in the ERP.
	ERP. This target is approximately that amount of light VKT observed nationally in 2019, not accounting for expected population and economic growth. Sub national targets are being set for major urban areas (Tier 1 and 2) to support planning in our fastest growing urban centres."
Scope	Activity-level investment appraisal will focus on direct impacts on VKT of an intervention. The indirect impacts of the activity are only expected to be reported qualitatively at an activity level (to understand how an option contributes to a broader programme and sub- national VKT reduction targets). The broader programme of activities will consider all expected impacts, direct and indirect and may be reported as a range to reflect the uncertainty.
Geographic	This measure can be rolled up by geographical area or programme and can be used to measure the area directly impacted by investment. VKT impacts will need to be assessed at a territorial local authority level and include all activities that will combine to deliver a system-wide impact.
	Activity-level assessments of VKT impacts are those directly attributable to the proposed option. Any activity-level assessment will need to consider the broader regional impacts of system response, for example traffic displacement or induced traffic and potential for land-use changes. For Tier 1 and Tier 2 urban areas the geographical scope should consider impacts within the territorial local authority boundary
Measure relationships	This measure has companion and cause–effect relationships with other measures in the benefits framework. The relationship map below shows these relationships and can be used to help you select further measures to assess.



Measure information

Definition of terms	To be provided in future release of the manual.	
Information sources	<u>'VKT and GHG emissions baseline report – a research note</u> ' contains relevant tables for Tier 1 and 2 urban centres and transport model development that provide useful context for assessing the significance of a project in relation to sub-national targets in lieu of a detailed regional VKT reduction plan.	
	Waka Kotahi guidance on transport model development should be followed to develop VKT forecasts – see the <u>Transport model development. guidelines</u> .	
	A <u>site for technical users to dive deeper into the body of evidence</u> has been developed. (Note: this will require setting up a login).	

How to calculate project baseline/monitoring data

A locally determined method is expected to be developed to support VKT reduction planning. This should utilise the parameters of the national VKT baseline data used to set the national and subnational VKT reduction targets.

National VKT baseline data

A national VKT baseline has been developed to support local and central government planning for VKT reduction (refer to <u>'VKT and GHG emissions baseline report – a research note</u>'). This includes data tables outlining expected VKT at the community level for urban environments in New Zealand. The largest urban centres are expected to do the heavy lifting to meet the national VKT reduction and freight emissions targets.

The national VKT baseline data is a business-as-usual transport scenario against which progress against the ERP targets will be measured. It does not consider permitted or planned changes to land use and transport systems, nor how other policies may work together to change travel behaviour. It is therefore not suited for activity-level assessment of light VKT changes and does not represent the baseline from which forecasts should be developed for traffic modelling. However, it can support transport model development and option analysis and support programme level and regional assessments, by:

- informing the design of parameters used in the development of a transport or integrated models for VKT reduction programmes
- acting as a comparator to support assessment of alternative transport models or descriptions of the counterfactual
- providing scenario analysis at larger scales where the national baseline data increases in relevance.

Forecasting methodology

A local approach to forecasting of changes in VKT is to be developed, following the Waka Kotahi <u>*Transport model development guidelines*</u>. The traffic model developed should provide a forecast of kilometres travelled by all transport modes and vehicle types relevant to the project for the dominimum and the preferred option.

The modelling should utilise parameters consistent with the national VKT baseline data. User to define:

- scale of transport/traffic modelling undertaken, aligning with territorial local authority and census modelling standards
- description of the counterfactual (the do-minimum), including only funded activities
- forecast light VKT projections for do-minimum and preferred option (note that it is likely that any existing transport model will report the VKT for light and heavy vehicles combined, and that this measure requires the determination of light VKT only)
- scenario development to understand significance of the project towards sub-national VKT reduction targets
- other assumptions.

In some special cases, where anticipated VKT changes are more easily understood (and explainable) through first principles, then a simplified spreadsheet-based analysis may suffice. For example, the VKT reduction from light vehicle trips changing to public transport (or other modes) can be estimated by calculating the likely change in





public transport demand to a proposed intervention using elasticities (for example <u>MBCM</u> table 81), and then applying light vehicle diversion rates and average public transport trip lengths by city/region (for example using <u>MBCM</u> tables 41 and 42 values) to estimate the resulting change in light VKT.

Activity and programme level assessments

Indirect impacts should only be included in programme assessments, or for sufficiently large projects with appropriate research methods (using the <u>Business Case Approach</u>). For smaller projects prone to optimism bias, indirect impacts should not be included in the forecast, and instead summarised qualitatively (or according to any bespoke approach defined at a programme level). When considering indirect impacts, how an option supports (or works against) broader VKT reduction efforts that are in place (either funded or unfunded) will determine how the initiative's efficacy may change when delivered alongside other initiatives, at least within the same programme. This may include accelerated changes to land use, supporting the uptake of electric vehicles or ride share programmes or other network wide impacts that the activity may be a small, but contributing factor.

Documenting these matters will support future programme level decisions by better understanding how the activity performs as a standalone intervention and how it interacts with other activities within a programme or portfolio.

For most projects a VKT forecast of 25 to 30 years will suffice. It must be recognised that forecasting to this horizon will include a large degree of uncertainty. Impacts and benefits beyond that period will be even less certain. However, this does not mean that the modelling cannot be used for economic analysis beyond that time scale. It is recommended that scenario analysis is carried out to understand the implication of a sensible range of future conditions.

Output requirements of any modelling that are to be submitted

Details about the methodology used must be included in business case documentation, including information on how the model responds to the following matters that are likely to be considered when the baseline, do-minimum and forecast data is quality assessed:

- For larger and more complex proposals supported by robust research, how land-use change assumptions and other elasticities are factored into modelling.
- What assumptions are made about the impact of complementary or conflicting proposals– consistent with the requirement for the do-minimum analysis to only include funded commitments.
- How the activity aligns with the relevant subnational VKT reduction target and any emergent VKT reduction programme.

Note: For this measure, the baseline and change in light VKT is to be reported with supporting evidence. Whole fleet VKT output from the traffic model should be used to quantify the emissions for measure 8.1.1 and (where appropriate) 8.1.4.

Enter into baseline field in TIO	Light VKT at start of investment (when preferred option not in place)	
Enter in Forecast range for 'do-minimum' in TIO	Light VKT forecast for do-minimum (at forecast year)	
Enter in Forecast range for 'preferred option' in TIO	Light VKT forecast for preferred option (at forecast year)	

Benefits realisation

Waka Kotahi will continue to update annual reporting information on an annual basis and any improvements, such as the provision of baseline data, or insights from national VKT reduction planning will result in a change to this measure definition. While there is no centralised data or information, ongoing monitoring of the measure will be required at the programme level.

>> Return to 8.1 Impact on greenhouse gas emissions

8.1.4 Freight transport impact on greenhouse gas emissions



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Measure description

Measure no:	8.1.4			
Measure name:	Freight transport impact on greenhouse gas emissions			
Measure description:	Tonnes of CO_2 equivalents emitted by trucks, rail and ships used for freight (excludes light vehicles and aviation)			
Measure type:	Quantitative measure			
Intent	Use this measure when investment delivers impacts on CO ₂ -equivalent emissions from freight in a way consistent with the target in the ERP to reduce emissions from freight transport by 35% (of 2019 levels) by 2035.			
Scope	This measure can be applied at investment level and should only consider the regional or national level, with a focus on direct impacts from targeted investment.			
	Projects not targeting freight efficiency improvements are expected to deliver negligible or negative indirect impacts and are excluded from the scope. This is because reductions of heavy vehicle kilometres travelled in one area are likely to result in an increase in another area without a comprehensive freight demand management plan, which are uncommon at smaller scales.			
	Indirect impacts, such as land-use changes that improve the efficiency of freight movement (agglomeration effects), would require fewer journeys for the same or greater freight task and, as a result, could count as a beneficial reduction in emissions. These are likely to be part of larger spatial studies and would benefit from robust research and modelling.			
Measure relationships	This measure has companion and cause–effect relationships with other measures in the benefits framework. The relationship map below shows these relationships and can be used to help you select further measures to support this measure.			



Measure information and data

Measure equation	Description: Carbon dioxide emissions from vehicles			
Unit of measure	Tonnes			
Definition of terms	CO ₂ -e: Carbon dioxide equivalents			
Information available	National Vehicle Emissions Dataset – emission estimates for all public roads taking account of traffic count, fleet profile, speed and gradient. National Freight Demand Study 2017/18, Te Manatū Waka Ministry of Transport			

	Modelled emissions from vehicles are presented in spatial and data form. Link to benefits StoryMap (information) Scroll down to navigate through the benefits and measures included in the Environmental Sustainability outcome. If you do not have access to view the information, please request from investment.benefits@nzta.govt.nz		
Information items	Map/data item name	Description	
	Мар	Vehicle emissions – CO ₂ -e: Predicted CO ₂ -e vehicle emissions for all roads from the Waka Kotahi Vehicle Emission Mapping Tool.	
	Data	Summarised vehicle CO ₂ -e emissions (tonnes).	

Direct investment in freight emissions reduction

It is expected that more sustainable energy use (such as switching the fleet to bio-fuel, hydrogen or electric heavy vehicles) will play a key role in reducing freight emissions. Improving the efficiency of freight movement without increasing emissions will be a key challenge for projects.

Te Manatū Waka Ministry of Transport is developing a National Freight and Supply Chain Strategy. This 30-year view will outline what government and industry want the freight and supply-chain systems to achieve, pathways and priority actions, and how government and industry will work together to reduce emissions, improve resilience, boost productivity and innovation in the sector and transition in a way that improves safety and equity outcomes. The approach outlined will be reviewed upon release of this strategy. Coastal and rail shipping will continue to play a vital role in the movement of goods, with volumes increasing as demand grows (depending on commodity). Freight ports and hubs will enable swift transfer and integration between transport modes. Urban freight initiatives are one area where innovation and technology are expected to reduce emissions and improve freight efficiency. The role of freight hubs, digital connectivity, embedded sensors, and artificial intelligence are examples of the type of infrastructure that will support the transformation of urban freight delivery in New Zealand.

How to calculate baseline/monitoring data

Baselining of data should focus on demand by sector, and anticipated growth should be consistent with a local freight plan, recognising that observed fleet data is available using the National Vehicle Emissions Dataset.

Defining geospatial area of measure	The geographical area should be defined in a freight study or similar plan. The larger the geographic area the more useful observed aggregated freight data becomes.
	to displacement effects. Transport model calibration will need to consider at least the regional scale.
Enter into baseline field in TIO	Enter tonnes of equivalent carbon emissions into 'baseline' field in TIO.

Forecasting methodology

A standardised forecasting methodology is not yet available for this measure. A local forecast is to be developed as appropriate using freight demand modelling at the appropriate scale, likely at a regional or national level. VEPM can be used to quantify the changes in emissions from heavy vehicles, similar to the approach taken for 8.1.1. Documentation about the methodology used should be included in business case documentation as appropriate.

Benefits realisation

The freight sector is working collaboratively with local government, Waka Kotahi and Te Manatū Waka Ministry of Transport to reduce emissions and the role of public infrastructure investment is expected to leverage private investment to improve the sustainability of the fleet or prepare the network for future private investment.



Waka Kotahi will continue to update information on a regular basis and any improvements, such as the provision of underlying data, will result in a change to this measure definition. Benefits realisation monitoring will require the replay of the steps to the baseline with more current data.

>> Return to 8.1 Impact on greenhouse gas emissions

9. Changes in resource efficiency

Using resources in efficient and sustainable ways can reduce environmental impacts, relieve demand for new raw materials, reduce waste and costs. This benefit cluster consists of one benefit about the impact on resource efficiency.

9.1 Impact on resource efficiency

This benefit is about the sustainable use of resources and materials and the reduction of environmental harm. It includes:

- sustainable sourcing and use of materials, such as aggregate and recycled materials
- waste minimisation, such as reducing waste sent to landfill and clean-fill, and designing out waste, and
- reduced embodied carbon and energy use, within the materials and energy used to build, operate and maintain transport infrastructure.

A full description of this benefit is available on our website: <u>9.1 Impact on resource efficiency</u>

The measures listed below have been associated with this benefit for ease of reference but they can also be applied to other benefits as appropriate.

Quantita	tive measures			
No.	Name		Description	
9.1.2	Embodied carbon	>>	Tonnes of CO ₂ equivalents emitted	•
Qualitative measures				
9.1.1	Resource efficiency	>>	User to describe	\mathbf{O}
9.1.3	Energy use	>>	User to describe	

>> Return to Land Transport Benefits Framework overview



9.1.1 Resource efficiency

Measure	description
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Measure no:	9.1.1
Measure name:	Resource efficiency
Measure description:	User to describe
Measure type:	Qualitative measure
Intent	Use this measure when investment may impact on resource use in the short or long term.
Scope	This measure can be rolled up by geographical area or programme and can be used to measure the area directly impacted by investment.
Measure relationships	This measure has companion and cause–effect relationships with other measures in the benefits framework. The relationship map below shows these relationships and can be used to help you select further measures to support this measure.

9.1

9.1.1



Measure information

Definition of terms	To be provided in future re-release of the manual.		
Information sources	To be confirmed.		
Methodology	The Waka Kotahi <u>Resource Efficiency Policy</u> and <u>Resource efficiency guideline for</u> <u>infrastructure delivery and maintenance</u> set out resource efficiency requirements for all Waka Kotahi projects.		
	Local descriptions can be used as evidence against this measure. Two frameworks for managing construction waste and sustainable sourcing that may be applicable are the Waka Kotahi Resource Efficiency Policy requirements, and the <u>ISC sustainability rating</u> <u>scheme</u> methodology for high-value projects.		
Direction/scaling	To be provided in future re-release of the manual.		

How to calculate baseline/monitoring data

If local description is used, describe current state or data for the measure.

Forecasting methodology

A centralised methodology is not yet available. A local forecast is to be developed as appropriate.

Benefits realisation

For Waka Kotahi projects, information on resource efficiency measures will be gathered as a requirement of the Resource Efficiency Policy.

For non Waka Kotahi projects, there is no centralised data or annual reporting requirement yet developed for this measure. Any future improvements such as the provision of data in the StoryMaps tool, may result in a change to this measure definition

>> Return to 9.1 Impact of resource efficiency

9.1.2 Embodied carbon

Measure description



Measure no:	9.1.2			
Measure name:	Embodied carbon			
Measure description:	Tonnes of CO ₂ equivalents emitted			
Measure type:	Quantitative measure			
Intent	Use this measure to calculate the carbon embodied in the infrastructure (during construction, operation and maintenance) across the whole life of the asset.			
Scope	This measure can be rolled up by geographical area or programme and can be used to measure the area directly impacted by investment. It includes projected carbon emissions for the construction, operation, maintenance and disposal of assets.			
	(Projected vehicle emissions are considered separately under 8.1.1 Greenhouse gas emissions (all vehicles) and (where appropriate) 8.1.4 Freight transport impact on greenhouse gas emissions.)			
	Embodied carbon analysis has high levels of uncertainty at early stages of a business case but provides indications of emissions and allows comparison between options. In the programme business case phase it may be more appropriate to use the qualitative measure <i>9.1.1 Resource efficiency</i> .			
Measure relationships	This measure has companion and cause–effect relationships with other measures in the benefits framework. The relationship map below shows these relationships and can be used to help you select further measures to support this measure.			



Measure information

Definition of terms	To be provided in future re-release of the manual.
Information sources	To be confirmed.
Methodology	Waka Kotahi guidance on the estimation of embodied emissions associated with infrastructure projects should be followed. To quantify emissions in the early business case stages, Waka Kotahi has developed the <u>Project Emissions Estimation Tool (PEET)</u> . It allows a high-level estimate of the embodied GHG emissions through the life of the project to be calculated, using standard design examples for state highways and local roads and using emissions factors that are appropriate for New Zealand. Alternative models or tools can be used in consultation with Waka Kotahi.
Direction/scaling	To be provided in future re-release of the manual.

How to calculate baseline/monitoring data

Apply appropriate Waka Kotahi guidance to determine current state or data for the measure.



Forecasting methodology

Apply appropriate Waka Kotahi guidance to forecast the expected embodied emissions associated with the infrastructure.

Benefits realisation

For Waka Kotahi projects, ex-post embodied emissions data will be collected as a requirement of the Resource Efficiency Policy. This data will be reported annually by Waka Kotahi to meet obligations under the Carbon Neutral Government Programme.

For non Waka Kotahi projects, there is no centralised data or annual reporting requirement yet developed for this measure. Any future improvements such as the provision of data in the StoryMaps tool, may result in a change to this measure definition.

>> Return to 9.1 Impact of resource efficiency

9.1.3 Energy use

Measure description



Measure no:	9.1.3
Measure name:	Energy use
Measure description:	User to describe
Measure type:	Qualitative measure
Intent	Use this measure when investment may impact on energy use in the short or long term.
Scope	This measure can be rolled up by geographical area or programme, and can be used to measure the area directly impacted by investment.
Measure relationships	This measure has companion and cause–effect relationships with other measures in the benefits framework. The relationship map below shows these relationships and can be used to help you select further measures to support this measure.



Measure information

Definition of terms	To be provided in future re-release of the manual.
Information sources	To be confirmed.
Methodology	Narratives, thresholds and ranking. Local descriptions or quantitative data can also be used as evidence against this measure. Waka Kotahi guidance is available on the estimation of energy use, which is considered as part of application of the <u>Resource Efficiency Policy</u> .
Direction/scaling	To be provided in future re-release of the manual.

How to calculate baseline/monitoring data

If local description or quantitative measure is used, apply appropriate Waka Kotahi guidance to determine current state or data for the measure.

Forecasting methodology

A centralised methodology is not yet available. For quantitative measures, apply Waka Kotahi guidance to develop a local forecast as appropriate.

Benefits realisation

For Waka Kotahi projects, ex-post energy use data will be collected as a requirement of the Resource Efficiency Policy.

For non-Waka Kotahi projects, there is no centralised data or annual reporting requirement yet developed for this measure. Any future improvements such as the provision of data in the StoryMaps tool, may result in a change to this measure definition and to reporting.

10.1

Inclusive access

This transport outcome is about enabling all people to participate in society through access to social and economic opportunities, such as work, education and health care.

10. Changes in access to social and economic opportunities

An important way people obtain access to social and economic opportunities is through fair and equitable access to the transport system alongside other equitable access methods, including proximity and virtual access. That is, regardless of age, ability or socio-economic status, people can

get where they need to be to participate in society and live fulfilling lives. Social and economic opportunities include access to education, work, essential health and shopping services and community. The focus on people, proximity and destinations is a distinctive feature of this benefit cluster. The benefit cluster also focuses on how users experience the land transport system, the modes available for people to choose from and the impact of the transport system on social cohesion.

10.1 Impact on user experience of the land transport system

User experience of the land transport system is a wide-ranging benefit. It considers how all people experience the transport system, including people with disabilities, school children and the elderly, and how different modes are experienced.

Perceptions of safety also impacts on user experience, with some overlap between this benefit and benefit 2.1 Impact on perceptions of safety and security.

Experience might include comfort, ease, convenience, crowding, how long it takes to travel and network condition.

A full description of this benefit is available on our website: <u>10.1 Impact on user experience of the</u> <u>land transport system</u>

The measures listed below have been associated with this benefit for ease of reference, but they can also be applied to other benefits as appropriate.

Quantitative measures (#)			
No.	Name		Description
10.1.1	People – throughput of pedestrians, cyclists and public transport boardings	<u>>></u>	Number of pedestrians, cyclists and public transport boardings
10.1.2	Pedestrian delay	>>	Pedestrian time lost due to intersection delay
10.1.3	Ease of getting on/off public transport services	>>	Percentage of low floor and wheelchair accessible services
10.1.4	Network condition – cycling	<u>>></u>	Percentage travel on cycle network classified as complying with defined level of service (facility type)
10.1.5	Network condition – road	<u>>></u>	Percentage travel on road network classified as smooth as per defined level of service
10.1.6	People – throughput	>>	Number of pedestrians, cyclists, public transport boardings and motor vehicles (excl. public transport) TIMES average number of people per vehicle
10.1.7	People – throughput (UCP)	<u>>></u>	Number of pedestrians and cyclists



10.1.1

10.1.8	Traffic – throughput	>>	Number of pedestrians, cyclists and motor vehicles by vehicle type
10.1.9	Travel time	<u>>></u>	Average travel time in minutes
Qualitative me	asures		(aco)
N/A			

Measure attributes

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>> Return to Land Transport Benefits Framework overview

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10.1.1 People – throughput of pedestrians, cyclists and public transport boardings

Measure description

Measure no:	10.1.1
Measure name:	People – throughput of pedestrians, cyclists and public transport boardings
Measure description:	Number of pedestrians, cyclists and public transport boardings
Measure type:	Quantitative
Intent	Use this measure when investment is focused on providing infrastructure for walking, cycling or public transport or where mode shift or uptake of active modes/public transport is driving investment.
Scope	This measure is best used rolled up across geographical areas or programmes but can also be used for individual investments.
Measure relationships	This measure has companion relationships with other measures in the benefits framework. The relationship map below shows these relationships and can be used to help you select further measures to support this measure.



Conflict

Measure information and data

Measure equation	Number of pedestrians, cyclists and public transport boardings		
Unit of measure	Number		
Definition of terms	Public transport boardings are: counted as individual boardings on public transport vehicles. Single journeys may consist of more than one boarding (eg getting on a bus to the train station and then getting on a train would count as two boardings).		
Information available	Partial information is available (November 2019) using annually reported data for cycling and public transport boardings.		
	Interactive da	eractive data maps for walking and cycling are being investigated.	
	Link to benefi	ts StoryMap (information)	
	Scroll down to	o navigate the benefits and measures in the Inclusive Access outcome.	
	If you do not have access to view the information, please request from investment.benefits@nzta.govt.nz		
	This measure	is viewed through Mega Maps, which has additional access requirements.	
Information items	Map/data item name	Description	
	Chart	Cycling cordon count data is from the three main New Zealand centres – Auckland, Wellington and Christchurch – and consists of cordon count data provided annually by councils.	
	Мар	The locations of cordons used for the annual count are mapped.	
	Chart	Public transport boardings.	

How to calculate project baseline/monitoring data

Defining geospatial area of measure	Limited centralised data is available for specific geospatial areas (Christchurch, Wellington, Auckland)
Use the StoryMaps tool to manually calculate your project baseline result	Using the StoryMaps tool, refer to graphs to find most recent information for public transport boardings and cycle cordon counts. If centralised data is not available, use local data source.
Enter into 'baseline' field in TIO	Enter appropriate information into 'baseline' field in TIO.

Forecasting methodology

A centralised methodology is not yet available. A local forecast is to be developed as appropriate.

Benefits realisation

Waka Kotahi will continue to update annual reporting information on an annual basis and any improvements, such as the provision of data in the StoryMaps tool, will result in a change to this measure definition. Where there is no centralised data or information, ongoing monitoring of the measure will be required at the local level.

10.1.2 Pedestrian delay

Measure description



Measure no:	10.1.2		
Measure name:	Pedestrian delay		
Measure description:	Pedestrian time lost due to intersection delay		
Measure type:	Quantitative measure		
Intent	This measure can be used for generic projects where a quick assessment of pedestrian travel time benefits is desired that can produce an order of magnitude effect.		
Scope	This measure can be used at a project level.		
Measure relationships	This measure has companion and cause–effect relationships with other measures in the benefits framework. The relationship map below shows these relationships and can be used to help you select further measures to support this measure.		

KEY



Measure information and data

Measure equation	From geospatial point 'a' to geospatial point 'b'.			
Unit of measure	Percentage ^o	Percentage %		
Definition of terms	Pedestrian time is the average length of time in minutes to travel on foot from geospatial point 'a' to geospatial point 'b' by using the transport network (that is, not as the crow flies).			
Information available	Centralised information includes methodology and tools developed by Infometrics.			
Information items	Map/data item name	Description		
	Tools and information	See the 'Tools and resources' area on the <u>Land Transport Benefits</u> <u>Framework measures manual</u> page on our website, and the report ' <u>Modelling</u> <u>travel time and travel time delay</u> '.		

How to calculate baseline/monitoring data

If local data is used, apply appropriate calculation to determine current state or data for the measure.

Forecasting methodology

A forecasting methodology and tools for this measure are available in the 'Tools and resources' area on the Land Transport Benefits Framework measures manual page on our website.

Without detailed modelling of the road segment in question, or for small network areas, simplified methodologies and tools are provided for pedestrians (based on delay calculations for both controlled and uncontrolled crossings).

Benefits realisation

To be provided in future re-release of the manual.

10.1.3 Ease of getting on/off public transport services

Measure description



Measure no:	10.1.3		
Measure name:	Ease of getting on/off public transport services		
Measure description:	Percentage of low floor and wheelchair accessible services		
Measure type:	Quantitative measure		
Intent	To be provided in future re-release of the manual.		
Scope	To be provided in future re-release of the manual.		
Measure relationships	To be provided in future re-release of the manual.		

KEY



Measure information and data

Measure equation	To be provid	To be provided in future re-release of the manual.		
Unit of measure	To be provid	To be provided in future re-release of the manual.		
Definition of terms	To be provid	To be provided in future re-release of the manual.		
Information available	No centralise	No centralised data is currently available for this measure. Local data sources can be used.		
Information items	Map/data item name	Description		
		To be provided in future re-release of the manual.		

How to calculate baseline/monitoring data

If local data is used, apply appropriate calculation to determine current state or data for the measure.

Forecasting methodology

A centralised methodology is not yet available. A local forecast is to be developed as appropriate.

Benefits realisation

While there is no centralised data or information, ongoing monitoring of the measure will be required at the local level.

10.1.4 Network condition – cycling

Measure description



Measure no:	10.1.4			
Measure name:	Network condition – cycling			
Measure description:	Percentage travel on cycle network classified as complying with defined level of service (facility type)			
Measure type:	Quantitative measure			
Intent	To be provided in future re-release of the manual.			
Scope	To be provided in future re-release of the manual.			
Measure relationships	To be provided in future re-release of the manual.			

KEY



Measure information and data

Measure equation	To be provided in future re-release of the manual.		
Unit of measure	Percentage %		
Definition of terms	To be provided in future re-release of the manual.		
Information available	No centralised data is currently available for this measure. Local data sources can be used.		
Information items	Map/data item name	Description	
		To be provided in future re-release of the manual.	

How to calculate baseline/monitoring data

If local data is used, apply appropriate calculation to determine current state or data for the measure.

Forecasting methodology

A centralised methodology is not yet available. A local forecast is to be developed as appropriate.

Benefits realisation

While there is no centralised data or information, ongoing monitoring of the measure will be required at the local level.

10.1.5 Network condition - road

Measure description



Measure no:	10.1.5		
Measure name:	Network condition – road		
Measure description:	Percentage travel on road network classified as smooth as per defined level of service		
Measure type:	Quantitative measure		
Intent	To be provided in future re-release of the manual		
Scope	To be provided in future re-release of the manual		
Measure relationships	To be provided in future re-release of the manual		

KEY



Measure information and data

Measure equation	To be provided in future re-release of the manual.		
Unit of measure	Percentage %		
Definition of terms	To be provided in future re-release of the manual.		
Information available	No centralised data is currently available for this measure in the benefits StoryMap, but it may be available through RAMM.		
Information items	Map/data item name	Description	
		To be provided in future re-release of the manual.	

How to calculate baseline/monitoring data

If local data is used, apply appropriate calculation to determine current state or data for the measure.

Forecasting methodology

A centralised methodology is not yet available. A local forecast is to be developed as appropriate.

Benefits realisation

While there is no centralised data or information, ongoing monitoring of the measure will be required at the local level.

10.1.6 People – throughput

Measure attributes

Measure description

Measure no:	10.1.6		
Measure name:	People – throughput		
Measure description:	Number of pedestrians, cyclists, public transport boardings and motor vehicles (excl. public transport) TIMES average number of people per vehicle		
Measure type:	Quantitative measure		
Intent	To be provided in future re-release of the manual.		
Scope	To be provided in future re-release of the manual.		
Measure relationships	To be provided in future re-release of the manual.		

KEY



Measure information and data

Measure equation	To be provided in future re-release of the manual.			
Unit of measure	Number	Number		
Definition of terms	To be provid	To be provided in future re-release of the manual.		
Information available	No centralise	No centralised data is currently available for this measure. Local data sources can be used.		
Information items	Map/data item name	Description		
		To be provided in future re-release of the manual.		

How to calculate baseline/monitoring data

If local data is used, apply appropriate calculation to determine current state or data for the measure.

Forecasting methodology

A centralised methodology is not yet available. A local forecast is to be developed as appropriate.

Benefits realisation

While there is no centralised data or information, ongoing monitoring of the measure will be required at the local level.

10.1.7 People – throughput (UCP)

Measure description



Measure no:	10.1.7		
Measure name:	People – throughput (UCP)		
Measure description:	Number of pedestrians and cyclists		
Measure type:	Quantitative measure		
Intent	To be provided in future re-release of the manual.		
Scope	To be provided in future re-release of the manual.		
Measure relationships	To be provided in future re-release of the manual.		

KEY



10.1.7 People – throughput (UCP)

Measure information and data

Measure equation	To be provided in future re-release of the manual.			
Unit of measure	Number	Number		
Definition of terms	UCP – Urban Cycleways Programme			
	To be provid	To be provided in future re-release of the manual.		
Information available	No centralised data is currently available for this measure. Local data sources can be used.			
Information items	Map/data Description item name			
		To be provided in future re-release of the manual.		

How to calculate baseline/monitoring data

If local data is used, apply appropriate calculation to determine current state or data for the measure.

Forecasting methodology

A centralised methodology is not yet available. A local forecast is to be developed as appropriate.

Benefits realisation

While there is no centralised data or information, ongoing monitoring of the measure will be required at the local level.

10.1.8 Traffic – throughput

Measure description

Measure attributes	
	10.1.8

Measure no:	10.1.8
Measure name:	Traffic – throughput
Measure description:	Number of pedestrians, cyclists and motor vehicles by vehicle type
Measure type:	Quantitative
Intent	This measure can be used for any investment that focuses on mode, congestion or access.
Scope	
Measure relationships	This measure has companion relationships with other measures in the benefits framework. The relationship map below shows these relationships and can be used to help you select further measures to support this measure.



Measure information and data

Measure equation	Number of pedestrians, cyclists and motor vehicles by vehicle type		
Unit of measure	Number		
Definition of terms	 The vehicle types reported are: all vehicles heavy vehicles (heavy trucks, including heavy trailers, and heavy buses). 		
Information available	Partial information is available (August 2019).		
	For state highways, a vehicle count is available in map form, with detailed data available for road controlling authorities that have signed a data sharing agreement.		
	The vehicle types reported are:		
	all vehicles		
	 heavy vehicles (heavy trucks, including heavy trailers, and heavy buses). 		
	No data is provided for pedestrians or cyclists.		
	Link to benefits StoryMap (information)		
	Scroll down to navigate benefits and measures included in the Inclusive Access outcome.		
	If you do not have access to view the information, please request from		
	investment.benefits@nzta.govt.nz		
Information items	Map/data item name	Description	
	Мар	Interrogatable spatial map detailing information provided by road controlling authorities on vehicle counts.	
	Data – state highway	Detailed data available for road controlling authorities that have signed a data sharing agreement. Permission is required to access this data.	

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10.1.8

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vehicle	
count	

How to calculate project baseline/monitoring data

Defining geospatial area of measure	Limited centralised data is available for vehicles.
Use the StoryMaps tool to manually calculate your project baseline result	Using the StoryMaps tool, refer to maps and data to find most recent information for all vehicles or heavy vehicles. If centralised data is not available, use local data source.
Enter into 'baseline' field in TIO	Enter appropriate information into 'baseline' field in TIO.

Forecasting methodology

A centralised methodology is not yet available. A local forecast is to be developed as appropriate.

Benefits realisation

Waka Kotahi will continue to update information on an annual basis and any improvements, such as the provision of data in the StoryMaps tool, will result in a change to this measure definition. Where there is no centralised data or information, ongoing monitoring of the measure will be required at the local level.

10.1.9 Travel time

Measure description



Measure no:	10.1.9
Measure name:	Travel time
Measure description:	Average travel time in minutes
Measure type:	Quantitative measure
Intent	This measure can be used for generic projects where a quick assessment of travel time benefits is desired that can produce an order of magnitude effect.
Scope	This measure can be used at a project level.
Measure relationships	This measure has companion and cause–effect relationships with other measures in the benefits framework. The relationship map below shows these relationships and can be used to help you select further measures to support this measure



Measure information and data

Measure equation	From geospatial point 'a' to geospatial point 'b'.	
Unit of measure	Time in minutes	
Definition of terms	Average travel time is the average length of time in minutes to travel from geospatial point 'a' to geospatial point 'b' by using the transport network (that is, not as the crow flies).	
Information available	Centralised information includes methodology and tools developed by Infometrics.	
Information items	Map/data item name	Description
	Tools and information	See the 'Tools and resources' area on the <u>Land Transport Benefits</u> <u>Framework measures manual</u> page on our website, and the report ' <u>Modelling travel time and travel time delay</u> '.

How to calculate baseline/monitoring data

Baseline data can be calculated based on observed data or based on speed and distance assumptions where appropriate (for example, cycling and walking). If local data is used, apply appropriate calculation to determine current state or data for the measure.

Forecasting methodology

A forecasting methodology and tools for this measure are available in the 'Tools and resources' area on the Land Transport Benefits Framework measures manual page on our website.
Where possible, a local approach to forecasting travel time is to be developed, following the Waka Kotahi <u>Transport model development guidelines</u>. The model developed should provide a forecast of travel time for transport modes relevant to the project for the do-minimum and the preferred option.

Without detailed modelling of the road segment in question, or for small network areas, simplified methodologies and tools are provided for:

- light vehicles (based on volume/capacity relationships)
- pedestrians (based on calculations for both controlled and uncontrolled crossings)
- cyclists (at this stage the above approach has not been agreed to by members of the Benefits Forecasting Technical Advisory Group, and so no spreadsheet tool has yet been developed; however, the pedestrian tool is readily applicable to cyclists.)

Benefits realisation

To be provided in future re-release of the manual.

>> Return to 10.1 Impact on user experience of the land transport system

10.2 Impact on mode choice

This benefit is focused on the way that people make journeys, including the start and end of a person's journey, and the options they have open to them. It can also include freight mode choice.

This benefit is about the things that may encourage/dissuade someone to select a particular mode, which is different to the focus on destination in *10.3 impact on access to opportunities*. For example, barriers to mode choice may include availability (infrastructure, service), viability (of provision), affordability to user, frequency, reliability and comfort. Some of these factors are also relevant to *10.1 impact on user experience*.

A full description of this benefit is available on our website: 10.2 Impact on mode choice

The measures listed below have been associated with this benefit for ease of reference, but they can also be applied to other benefits as appropriate.

Quantitative measures			
No.	Name		Description
10.2.1	People – mode share	<u>>></u>	Number of pedestrians, cyclists, public transport boardings, and motor vehicles (excl. public transport) TIMES number of people per vehicle, expressed as percentages
10.2.2	Accessibility – public transport facilities	<u>>></u>	Number of bus or train stops that are fully accessible
10.2.3	Spatial coverage – cycle lanes and paths	>>	Percentage completion of the strategic cycle network
10.2.4	Spatial coverage – cycling facilities	<u>>></u>	Number of people living within 500m of a high-quality cycling facility
10.2.5	Spatial coverage – public transport – employees	<u>>></u>	Number of employees within 500m of a bus stop or 1km from a rail or bus rapid transit station
10.2.6	Spatial coverage – public transport – resident population	<u>>></u>	Number of people within 500m of a bus stop or 1km from a rail or bus rapid transit station
10.2.6a	Spatial coverage – public transport – new residential dwellings	>>	% of recently built residential dwellings with access to public transport services (subset of number of people living within 500m of a bus stop or 1km from a rail or bus rapid transit station)
10.2.7	Temporal availability – public transport	<u>>></u>	Public transport frequency per hour weighted by percentage of the population living within 500m of a bus stop or 1km from a rail or bus rapid transit station
10.2.10	Traffic – mode share (number)	<u>>></u>	Number of transport users by mode pedestrians, cyclists and motor vehicles by vehicle class, expressed as percentages
10.2.10b	Traffic – mode share (distance)	<u>>></u>	Average trip distance per person in urban areas by mode
Qualitative measures			
10.2.8	Cost of access to key destinations – all modes	<u>>></u>	User to describe
10.2.9	Pricing – more efficient	<u>>></u>	User to describe

>> Return to Land Transport Benefits Framework overview

10.2

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10.2.1 People – mode share

Measure description



Measure no:	10.2.1
Measure name:	People – mode share
Measure description:	Number of pedestrians, cyclists, public transport boardings, and motor vehicles (excl. public transport) TIMES number of people per vehicle, expressed as percentages
Measure type:	Quantitative measure
Intent	To be provided in future re-release of the manual.
Scope	To be provided in future re-release of the manual.
Measure relationships	To be provided in future re-release of the manual.

KEY



10.2.1 People – mode	
share	

Measure information and data

Measure equation	To be provided in future re-release of the manual.		
Unit of measure	Number		
Definition of terms	To be provided in future re-release of the manual.		
Information available	No centralised data is currently available for this measure. Local data sources can be used.		
Information items	Map/data item name	Description	
		To be provided in future re-release of the manual.	

How to calculate baseline/monitoring data

If local data is used, apply appropriate calculation to determine current state or data for the measure.

Forecasting methodology

A centralised methodology is not yet available. A local forecast is to be developed as appropriate.

Benefits realisation

While there is no centralised data or information, ongoing monitoring of the measure will be required at the local level.

Measure attributes

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10.2.2 Accessibility – public transport facilities

Measure no:	10.2.2
Measure name:	Accessibility – public transport facilities
Measure description:	Number of bus or train stops that are fully accessible
Measure type:	Quantitative measure
Intent	To be provided in future re-release of the manual.
Scope	To be provided in future re-release of the manual.
Measure relationships	To be provided in future re-release of the manual.

KEY

Companion	10.2.2 Accessibility
Cause-effect	public transport
Conflict	Identites

Measure information and data

Measure equation	To be provided in future re-release of the manual.		
Unit of measure	Number		
Definition of terms	To be provided in future re-release of the manual.		
Information available	No centralised data is currently available for this measure. Local data sources can be used.		
Information items	Map/data item name	Description	
		To be provided in future re-release of the manual.	

How to calculate baseline/monitoring data

If local data is used, apply appropriate calculation to determine current state or data for the measure.

Forecasting methodology

A centralised methodology is not yet available. A local forecast is to be developed as appropriate.

Benefits realisation

While there is no centralised data or information, ongoing monitoring of the measure will be required at the local level.

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Inclusive access > 10. Changes in access to social and economic opportunities

10.2.3 Spatial coverage – cycle lanes and paths

Measure description

Measure no:	10.2.3
Measure name:	Spatial coverage – cycle lanes and paths
Measure description:	Percentage completion of the strategic cycle network
Measure type:	Quantitative
Intent	This measure can be used for active mode investments, particularly those targeting development of cycling infrastructure.
Scope	This measure can be used at investment level and rolled up for geographical area or programme.
Measure relationships	This measure has companion and cause–effect relationships with other measures in the benefits framework. The relationship map below shows these relationships and can be used to help you select further measures to support this measure.

Measure attributes

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Measure information and data

Measure equation	Description: Percentage completion of the strategic cycle network
Unit of measure	Percentage %
Definition of terms	Cycle lanes and paths include New Zealand cycle trails, urban cycle ways and Urban Cycleways Programme-funded cycleways.
Information available	Partial centralised information is available (since August 2019). Information is currently available for New Zealand Cycle trails. Information for other cycle lanes and paths is not yet centrally available. <u>Link to benefits StoryMap (information)</u> Scroll down to navigate benefits and measures included in the Inclusive Access outcome.

10.2.3

	If you do not have access to view the information, please request from investment.benefits@nzta.govt.nz	
Information items	Map/data item name	Description
	Мар	Interrogatable national map of cycleways.

How to calculate project baseline/monitoring data

Defining geospatial area of measure	Limited centralised data is available for New Zealand Cycle trails. Select area relevant to investment or impact area of investment.
Use the StoryMaps tool to manually calculate your project baseline result	Using the StoryMaps tool, refer to maps and data to find most recent information. If centralised data is not available, use local data source.
Enter into 'baseline' field in TIO	Enter appropriate information into 'baseline' field in TIO.

Forecasting methodology

A centralised methodology is not yet available. A local forecast is to be developed as appropriate.

Benefits realisation

Waka Kotahi will continue to update information on an annual basis and any improvements, such as the provision of data in the StoryMaps tool, will result in a change to this measure definition. Where there is no centralised data or information, ongoing monitoring of the measure will be required at the local level.

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10.2.4 Spatial coverage – cycling facilities

Measure description



Measure no:	10.2.4
Measure name:	Spatial coverage – cycling facilities
Measure description:	Number of people living within 500m of a high-quality cycling facility
Measure type:	Quantitative measure
Intent	To be provided in future re-release of the manual.
Scope	To be provided in future re-release of the manual.
Measure relationships	To be provided in future re-release of the manual.

KEY



Measure information and data

Measure equation	To be provid	To be provided in future re-release of the manual.	
Unit of measure	Number	Number	
Definition of terms	To be provid	To be provided in future re-release of the manual.	
Information available	No centralise	No centralised data is currently available for this measure. Local data sources can be used.	
Information items	Map/data item name	Description	
		To be provided in future re-release of the manual.	

How to calculate baseline/monitoring data

If local data is used, apply appropriate calculation to determine current state or data for the measure.

Forecasting methodology

A centralised methodology is not yet available. A local forecast is to be developed as appropriate.

Benefits realisation

While there is no centralised data or information, ongoing monitoring of the measure will be required at the local level.

Measure attributes

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10.2.5 Spatial coverage – public transport – employees

Measure description

Measure no:	10.2.5
Measure name:	Spatial coverage – public transport – employees
Measure description:	Number of employees within 500m of a bus stop or 1km from a rail or bus rapid transit station
Measure type:	Quantitative measure
Intent	To be provided in future re-release of the manual.
Scope	To be provided in future re-release of the manual.
Measure relationships	To be provided in future re-release of the manual.

KEY



Measure information and data

Measure equation	To be provided in future re-release of the manual.	
Unit of measure	Number	
Definition of terms	To be provided in future re-release of the manual.	
Information available	No centralised data is currently available for this measure. Local data sources can be used.	
Information items	Map/data item name	Description
		To be provided in future re-release of the manual.

How to calculate baseline/monitoring data

If local data is used, apply appropriate calculation to determine current state or data for the measure.

Forecasting methodology

A centralised methodology is not yet available. A local forecast is to be developed as appropriate.

Benefits realisation

While there is no centralised data or information, ongoing monitoring of the measure will be required at the local level.

Measure attributes

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10.2.6 Spatial coverage – public transport – resident population

Measure description

•	
Measure no:	10.2.6
Measure name:	Spatial coverage – public transport – resident population
Measure description:	Number of people within 500m of a bus stop or 1km from a rail or bus rapid transit station
Measure type:	Quantitative measure
Intent	To be provided in future re-release of the manual.
Scope	To be provided in future re-release of the manual.
Measure relationships	To be provided in future re-release of the manual.

KEY

Companion
Cause-effect
Conflict

Measure information and data

Measure equation	To be provided in future re-release of the manual.	
Unit of measure	Number	
Definition of terms	To be provided in future re-release of the manual.	
Information available	No centralised data is currently available for this measure. Local data sources can be used.	
Information items	Map/data item name	Description
		To be provided in future re-release of the manual.

How to calculate baseline/monitoring data

If local data is used, apply appropriate calculation to determine current state or data for the measure.

Forecasting methodology

A centralised methodology is not yet available. A local forecast is to be developed as appropriate.

Benefits realisation

While there is no centralised data or information, ongoing monitoring of the measure will be required at the local level.

10.2.6a Spatial coverage – public transport – new residential dwellings



Measure description

Measure no:	10.2.6a
Measure name:	Spatial coverage – public transport – new residential dwellings
Measure description:	% of recently built residential dwellings with access to public transport services (subset of number of people living within 500m of a bus stop or 1km from a rail or bus rapid transit station)
Measure type:	Quantitative measure
Intent	To be provided in future re-release of the manual.
Scope	To be provided in future re-release of the manual.
Measure relationships	To be provided in future re-release of the manual.

KEY





Measure information and data

Measure equation	To be provided in future re-release of the manual.	
Unit of measure	Percentage %	
Definition of terms	To be provided in future re-release of the manual.	
Information available	No centralised data is currently available for this measure. Local data sources can be used.	
Information items	Map/data item name	Description
		To be provided in future re-release of the manual.

How to calculate baseline/monitoring data

If local data is used, apply appropriate calculation to determine current state or data for the measure.

Forecasting methodology

A centralised methodology is not yet available. A local forecast is to be developed as appropriate.

Benefits realisation

While there is no centralised data or information, ongoing monitoring of the measure will be required at the local level.

Inclusive access > 10. Changes in access to social and economic opportunities

10.2.7 Temporal availability – public transport

Measure description

Measure attributes	
	10.2.7

Measure no:	10.2.7
Measure name:	Temporal availability – public transport
Measure description:	Public transport frequency per hour weighted by percentage of the population living within 500m of a bus stop or 1km from a rail or bus rapid transit station
Measure type:	Quantitative measure
Intent	Use this measure when investment is focused on uptake of public transport or improving public transport services.
Scope	This measure can be used at investment level and rolled up for geographical area or programme.
Measure relationships	This measure has companion relationships with other measures in the benefits framework. The relationship map below shows these relationships and can be used to help you select further measures to support this measure.



Measure information and data

Measure equation	Description: Public transport frequency per hour weighted by percentage of the population living within 500m of a bus stop or 1km from a rail or bus rapid transit station.
Definition of terms	Public transport: bus, train, ferry, rapid transit. High frequency: public transport scheduled at least every 15 minutes. Maps are based on scheduled public transport in the morning peak (7am – 9am).
Information available	Partial information available (since October 2019). Population weighting is not available. <u>Link to benefits StoryMap (information)</u> Scroll down to navigate benefits and measures included in the Inclusive Access outcome.

	If you do not investment.b	If you do not have access to view the information, please request from investment.benefits@nzta.govt.nz	
Information items	Map/data item name	Description	
	Maps	Access to public transport (within 500m of stop with transport that runs every 30 minutes – 2018). Access to high frequency public transport (within 500m of stop with transport that runs every 15 minutes – 2018).	
	Data	ESRI file geodatabase ESRI Shapefile	

How to calculate project baseline/monitoring data

Defining geospatial area of measure	Select area relevant to investment or impact area of investment.
Use the StoryMaps tool to manually calculate your project baseline result	Using the StoryMaps tool, refer to maps and data to find most recent information. If centralised data is not available, use local data source.
Enter into 'baseline' field in TIO	Enter appropriate information into 'baseline' field in TIO.

Forecasting methodology

A centralised methodology is not yet available. A local forecast is to be developed as appropriate.

Benefits realisation

Waka Kotahi will continue to update information on an annual basis and any improvements, such as the provision of data in the StoryMaps tool, will result in a change to this measure definition. Where there is no centralised data or information, ongoing monitoring of the measure will be required at the local level.

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10.2.8 Cost of access to key destinations – all modes

Measure description

Measure no:	10.2.8
Measure name:	Cost of access to key destinations – all modes
Measure description:	User to describe
Measure type:	Qualitative measure
Intent	To be provided in future re-release of the manual.
Scope	To be provided in future re-release of the manual.
Measure relationships	To be provided in future re-release of the manual.

Measure attributes

KEY

Companion	10.2.8 Cost of access to key
Cause-effect	destinations – all modes
Conflict	

Measure information

Definition of terms	To be provided in future re-release of the manual.
Information sources	To be confirmed.
Methodology	User to define. Local descriptions or quantitative data can be used as evidence against this measure.
Direction/scaling	To be provided in future re-release of the manual.

How to calculate baseline/monitoring data

If local description or quantitative measure is used, apply appropriate calculation to determine current state or data for the measure.

Forecasting methodology

A centralised methodology is not yet available. A local forecast is to be developed as appropriate.

Benefits realisation

Waka Kotahi will continue to update annual reporting information on an annual basis and any improvements, such as the provision of data in the StoryMaps tool, will result in a change to this measure definition. While there is no centralised data or information, ongoing monitoring of the measure will be required at the local level.

Inclusive access > 10. Changes in access to social and economic opportunities

10.2.9 Pricing – more efficient

Measure description



Measure no:	10.2.9
Measure name:	Pricing – more efficient
Measure description:	User to describe
Measure type:	Qualitative measure
Intent	To be provided in future re-release of the manual
Scope	To be provided in future re-release of the manual
Measure relationships	To be provided in future re-release of the manual

KEY



10.2.9 Pricing – more efficient

Measure information

Definition of terms	To be provided in future re-release of the manual.
Information sources	To be confirmed.
Methodology	User to define. Local descriptions or quantitative data can be used as evidence against this measure.
Direction/scaling	To be provided in future re-release of the manual.

How to calculate baseline/monitoring data

If local description or quantitative measure is used, apply appropriate calculation to determine current state or data for the measure.

Forecasting methodology

A centralised methodology is not yet available. A local forecast is to be developed as appropriate.

Benefits realisation

Waka Kotahi will continue to update annual reporting information on an annual basis and any improvements, such as the provision of data in the StoryMaps tool, will result in a change to this measure definition. While there is no centralised data or information, ongoing monitoring of the measure will be required at the local level.

Inclusive access > 10. Changes in access to social and economic opportunities

10.2.10 Traffic – mode share (number)

Measure description

Measure attributes	
	10.2. 10

Measure no:	10.2.10
Measure name:	Traffic – mode share (number)
Measure description:	Number of transport users by mode pedestrians, cyclists and motor vehicles by vehicle class, expressed as percentages
Measure type:	Quantitative
Intent	This measure can be used for any investment that focuses on mode.
Scope	This measure is best used for rolled-up geographical areas and programmes, but can also be used at investment level.
Measure relationships	This measure has companion relationships with other measures in the benefits framework. The relationship map below shows these relationships and can be used to help you select further measures to support this measure.



Measure information and data

Measure equation	Description: Number of transport users by mode pedestrians, cyclists and motor vehicles by vehicle class, expressed as percentages
Unit of measure	Percentage
Definition of terms	 Modes included in the modeshare maps: PT: bus, train, ferry Private vehicle: car/van (driver or passenger), motor cyclist and taxi passenger Cycling: cyclist (by electric or non-e) Walking: pedestrian
Information available	Two forms of data are available (since August 2019). One data set is highly detailed and based on 2013 Census data. The other data set is based on the Household travel survey run by the Ministry of Transport (MoT) and annual data must be rolled up to a three-year data set to allow regional breakdowns. This is the data source that Waka Kotahi uses in its annual reporting. Both maps and data are available for both data sources. Link to benefits StoryMap (information) Scroll down to navigate benefits and measures included in the Inclusive Access outcome.

	If you do not have acces investment.benefits@nz	ta to view the information, please request from ta.govt.nz
Information items	Map/data item name	Description
	Map – Census	2013 Census data mapped to interrogate at granular geographical areas
	Data – Census	2013 Census data
	Map – Household travel survey	2015-18 MoT Household travel survey data (three years of data rolled up) to interrogate at broad geographical areas
	Data – Household travel survey	2018-18 MoT Household travel survey

How to calculate baseline/monitoring data

Defining geospatial area of measure	Select area relevant to investment or impact area of investment.
Use the StoryMaps tool to manually calculate your project baseline result	Use the household travel survey data for baseline and ongoing monitoring.
Enter into 'baseline' field in TIO	Enter appropriate mode name and percentages into 'baseline' field.

Forecasting methodology

A centralised methodology is not yet available. A local forecast is to be developed as appropriate.

Benefits realisation

Waka Kotahi will continue to update information on an annual basis and any improvements, such as the provision of data in the StoryMaps tool, will result in a change to this measure definition. Where there is no centralised data or information, ongoing monitoring of the measure will be required at the local level.

Inclusive access > 10. Changes in access to social and economic opportunities

10.2.10b Traffic – mode share (distance)

Measure description

Measure attributes	
	10.2. 10b

Measure no:	10.2.10b
Measure name:	Traffic – mode share (distance)
Measure description:	Average trip distance per person in urban areas by mode
Measure type:	Quantitative
Intent	This measure can be used for any investment that focuses on mode.
Scope	This measure is best used for rolled-up geographical areas and programmes, but can also be used at investment level
Measure relationships	This measure has companion relationships with other measures in the benefits framework. The relationship map below shows these relationships and can be used to help you select further measures to support this measure.



Measure information and data

Measure equation		
Unit of measure	Distance	
Definition of terms	 Modes included in the m PT: bus, train, ferry private vehicle: car/ cycling: cyclist (by e walking: pedestrian. 	odeshare maps: van (driver or passenger), motor cyclist and taxi passenger lectric or non-e)
Information available	 Waiking: pedestrian. Two forms of data are available (August 2019). One data set is highly detailed and based on 2013 Census data. The other data set is based on the Household travel survey run by the Ministry of Transport (MoT) and annual data must be rolled up to a three-year data set to allow regional breakdowns. This is the data source Waka Kotahi uses in its annual reporting. Both maps and data are available for both data sources. Link to StoryMaps (information) Scroll down to navigate benefits and measures included in the <i>Inclusive Access</i> outcome. If you do not have access to view the information, please request from 	
Information items	Map/data item name	Description

10.2.	
10b	

Map – Census	2013 Census data mapped to interrogate at granular geographical areas
Data – Census	2013 Census data
Map – Household travel survey	2015–18 MoT Household travel survey data (three years of data rolled up) to interrogate at broad geographical areas
Data – Household travel survey	2018–18 MoT Household travel survey

How to calculate baseline/monitoring data

Defining geospatial area of measure	Select area relevant to investment or impact area of investment.
Use the StoryMaps tool to manually calculate your project baseline result	Use the household travel survey data for baseline and ongoing monitoring.
Enter into 'baseline' field in TIO	Enter appropriate mode name and percentages into 'baseline' field.

Forecasting methodology

A centralised methodology is not yet available. A local forecast is to be developed as appropriate.

Benefits realisation

Waka Kotahi will continue to update information on an annual basis and any improvements, such as the provision of data in the StoryMaps tool, will result in a change to this measure definition. Where there is no centralised data or information, ongoing monitoring of the measure will be required at the local level.

10.3 Impact on access to opportunities

This benefit concentrates on transport as an enabler and the integration of land use and transport. It focuses on the importance of destinations and the services/activities that can be equitably accessed through transport to enable economic and community participation. This benefit is of particular relevance for people or groups who experience transport disadvantage.

The social and economic benefits of equitable access to transport are part of this benefit, with participation in employment, volunteer work and social and leisure activities improving the overall wellbeing of our community as a whole. The beneficiaries of this benefit are therefore all current and future users of the transport system for whom access to the system allows them to fully participate in life and their community.

A full description of this benefit is available on our website: <u>10.3 Impact on access to opportunities</u>

The measure listed below has been associated with this benefit for ease of reference, but it can also be applied to other benefits as appropriate.

Quantita	tive measures		(#)
No.	Name		Description
10.3.1	Access to key social destinations (all modes)	>>	Proportion of population living within travel threshold (15 minutes, 30 minutes or 45 minutes) of key social opportunities (including education, health care, supermarkets) by different modes (walking, cycling, public transport, private motor vehicle) in the morning peak
Qualitative measures			(Arros)
N/A			

Measure attributes

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>> Return to Land Transport Benefits Framework overview

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10.3.1 Access to key social destinations (all modes)

Measure description

Measure no:	10.3.1
Measure name:	Access to key social destinations (all modes)
Measure description:	Proportion of population living within travel threshold (15 minutes, 30 minutes or 45 minutes) of key social opportunities (including education, health care, supermarkets) by different modes (walking, cycling, public transport, private motor vehicle) in the morning peak
Measure type:	Quantitative measure
Intent	Use this measure when investment is focused on providing infrastructure for walking, cycling or public transport or where mode shift or uptake of active modes/public transport is driving investment.
Scope	This measure is best used for the area impacted by investment and can be rolled up to geographical area and programme.
Measure relationships	This measure has companion and cause–effect relationships with other measures in the benefits framework. The relationship map below shows these relationships and can be used to help you select further measures to support this measure.

10.3.1

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Inclusive access > 10. Changes in access to social and economic opportunities



Measure information and data

Measure equation	Description: Proportion of population living within travel threshold (15 minutes, 30 minutes or 45 minutes) of key social opportunities (including education, health care, supermarkets) by different modes (walking, cycling, public transport, private motor vehicle) in the morning peak			
Definition of terms	Travel threshold: the time taken	to reach a given destination		
Information available	Full information available (since October 2019) Link to benefits StoryMap (information) Scroll down to navigate benefits and measures included in the Inclusive Access outcome. If you do not have access to view the information, please request from investment.benefits@nzta.govt.nz			
Information items	Map/data item name	Description		
	Graph	Infometric of national summary data of access to social destinations from the 2018/19 Waka Kotahi annual report (page 17)		
	Maps of access to other social opportunities, including schools, supermarkets, general practitioners (GPs), hospitals, work and income centres	Maps based on proximity of social destination to population by mode		
	Data	ESRI file geodatabase and ESRI Shapefile for employment and social destinations		

How to calculate baseline/monitoring data

Defining geospatial area of measure	Select area relevant to investment or impact area of investment.
Use the StoryMaps tool to manually calculate your project baseline result	Zoom into area in map or access data to determine the times to specific destinations by mode.
Enter into 'baseline' field in TIO	Enter appropriate destination, mode and time into baseline field.

Forecasting methodology

A centralised methodology is not yet available. A local forecast is to be developed as appropriate.

Benefits realisation

Waka Kotahi will continue to update information on an annual basis and any improvements, such as the provision of data in the StoryMaps tool, will result in a change to this measure definition. Where there is no centralised data or information, ongoing monitoring of the measure will be required at the local level.

>> <u>Return to 10.3. Impact on access to opportunities</u>

10.4

10.4.1

10.4 Impact on community cohesion

The community cohesion benefit is about the transport system's role in enabling and maintaining the normal functions of a community. While resilience focuses on short term community cohesion at a more individual level as well as at community level as a result of unexpected disruption, this benefit is about the long-term resilience and connectedness of communities, rather than individuals.

A full description of this benefit is available on our website: 10.4 Impact on community cohesion

The measures listed below have been associated with this benefit for ease of reference, but they can also be applied to other benefits as appropriate.

Quantitative measures			(#)	
No.	Name		Description	
N/A				\frown
Qualitati	ve measures			
10.4.1	Social connectedness	>>	User to describe	igsim
10.4.2	Severance	>>	User to describe	
10.4.3	Isolation	>>	User to describe	

>> Return to Land Transport Benefits Framework overview

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Measure attributes

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10.4.1 Social connectedness

Measure description

Measure no:	10.4.1
Measure name:	Social connectedness
Measure description:	User to describe
Measure type:	Qualitative measure
Intent	Use this measure when investment may impact on social connectedness in the short or long term.
Scope	This measure can be rolled up by geographical area or programme but is best used to measure the area directly impacted by investment.
Measure relationships	This measure has companion and cause–effect relationships with other measures in the benefits framework. To be provided in future re-release of the manual.

KEY



10.4.1 Social connectedness

Measure information

Definition of terms	To be provided in future re-release of the manual.
Information sources	To be confirmed.
Methodology	Scoring. Detailed instructions for this methodology are to be provided in future re-release of the manual. Local descriptions or quantitative data can be used as evidence against this measure.
Direction/scaling	To be provided in future re-release of the manual.

How to calculate baseline/monitoring data

Calculations using the 'scoring methodology' to be provided in a future re-release of the manual.

If local description or quantitative measure is used, apply appropriate calculation to determine current state or data for the measure.

Forecasting methodology

A centralised methodology is not yet available. A local forecast is to be developed as appropriate.

Benefits realisation

Waka Kotahi will continue to update annual reporting information on an annual basis and any improvements, such as the provision of data in the StoryMaps tool, will result in a change to this measure definition. While there is no centralised data or information, ongoing monitoring of the measure will be required at the local level.

>>Return to 10.4 Impact on community cohesion



10.4.2 Severance

Measure description

Measure no:	10.4.1
Measure name:	Severance
Measure description:	User to describe
Measure type:	Qualitative measure
Intent	Use this measure when investment may impact on social connectedness in the short or long term.
Scope	This measure can be rolled up by geographical area or programme but is best used to measure the area directly impacted by investment.
Measure relationships	This measure has companion and cause–effect relationships with other measures in the benefits framework. To be provided in future re-release of the manual.



KEY

Companion
Cause-effect
Conflict

Measure information

Definition of terms	To be provided in future re-release of the manual.
Information sources	To be confirmed.
Methodology	Scoring. Detailed instructions for this methodology are to be provided in future re-release of the manual. Local descriptions or quantitative data can be used as evidence against this measure.
Direction/scaling	To be provided in future re-release of the manual.

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How to calculate baseline/monitoring data

Calculations using the 'scoring methodology' to be provided in a future re-release of the manual.

If local description or quantitative measure is used, apply appropriate calculation to determine current state or data for the measure.

Forecasting methodology

A centralised methodology is not yet available. A local forecast is to be developed as appropriate.

Benefits realisation

Waka Kotahi will continue to update annual reporting information on an annual basis and any improvements, such as the provision of data in the StoryMaps tool, will result in a change to this measure definition. While there is no centralised data or information, ongoing monitoring of the measure will be required at the local level.

>> Return to 10.4 Impact on community cohesion

Inclusive access > 10. Changes in access to social and economic opportunities

10.4.3 Isolation

Measure description



Measure no:	10.4.3
Measure name:	Isolation
Measure description:	User to describe
Measure type:	Qualitative measure
Intent	Use this measure when investment may impact on social connectedness in the short or long term.
Scope	This measure can be rolled up by geographical area or programme but is best used to measure the area directly impacted by investment.
Measure relationships	This measure has companion and cause–effect relationships with other measures in the benefits framework. To be provided in future re-release of the manual.

KEY

Companion		
Cause-effect)	10.4.3 Isolation
Conflict		

Measure information

Definition of terms	To be provided in future re-release of the manual.
Information sources	To be confirmed.
Methodology	Scoring. Detailed instructions for this methodology are to be provided in future re-release of the manual. Local descriptions or quantitative data can be used as evidence against this measure.
Direction/scaling	To be provided in future re-release of the manual.

How to calculate baseline/monitoring data

Calculations using the 'scoring methodology' to be provided in a future re-release of the manual.

If local description or quantitative measure is used, apply appropriate calculation to determine current state or data for the measure.

Forecasting methodology

A centralised methodology is not yet available. A local forecast is to be developed as appropriate.

Benefits realisation

Waka Kotahi will continue to update annual reporting information on an annual basis and any improvements, such as the provision of data in the StoryMaps tool, will result in a change to this measure definition. While there is no centralised data or information, ongoing monitoring of the measure will be required at the local level.

>> Return to 10.4 Impact on community cohesion

11.1

11. Changes in liveability of places

Liveability extends far beyond the transport system and includes a wide range of factors, many of which are not related to the benefits framework. However, the transport system does have a significant impact on liveability and can either improve or detract from the quality of 'place'.

The liveability of a place can relate to its form, character, amenity, convenience and proximity to other places valued by locals and visitors. Liveability of place includes how we plan, manage and grow our towns and cities, particularly in relation to transport – how people move through places to reach the destinations that matter to them. It is about how well the attributes of a location enhance the wellbeing of the people who live, work or visit there. When the liveability of a place changes, it can be due to local context change (the location reflects the diversity of the population), the value individuals place on the location, the number of people there and the variety of needs and preferences of people that are met there.

11.1 Impact on heritage and cultural values

This benefit is about both cultural values and heritage. This benefit reflects the diverse cultures that make up New Zealand's population. Cultural values can be closely intertwined with heritage. Spiritual and/or cultural values are a deeper experience of the place that transcends amenity associations and are distinct from commemorative associations.

Values associated with te ao Māori are strongly related to heritage and cultural values. These have to be valued in partnership with Māori as discussed separately in benefit cluster 12.

A full description of this benefit is available on our website: <u>11.1 Impact on heritage and cultural</u> <u>values</u>

The measures listed below have been associated with this benefit for ease of reference, but they can also be applied to other benefits as appropriate.

Quantitative measures		(#)		
No.	Name		Description	\mathbf{O}
N/A				-
Qualitative m	easures			
11.1.1	Amenity value – natural and built environment	>>	User to describe	\mathbf{O}
11.1.2	Heritage and cultural values	>>	User to describe	

>> Return to Land Transport Benefits Framework overview

11.1.1 Amenity value – natural and built environment

Measure description



Measure no:	11.1.1
Measure name:	Amenity value – natural and built environment
Measure description:	User to describe
Measure type:	Qualitative measure
Intent	Use this measure when investment affects the visual attractiveness of an area with heritage, townscape or landscape value. This measure should not be used if the broader heritage (11.1.2) or landscape (11.1.3) measures are used, as amenity is a subset of the scoring process. It could be added to the townscape (11.3.1) measure, however, as it does not include amenity as a feature.
Scope	This measure can be applied at the project level and can also be rolled up for geographical areas or programmes.
Measure relationships	This measure has companion and cause–effect relationships with other measures in the benefits framework. The relationship map below shows these relationships and can be used to help you select further measures to support this measure.



Measure information

Definition of terms	Amenity is defined as visual attractiveness of an area with heritage and cultural values, a townscape precinct, or landscape and includes built or natural features or a combination of both.
Information sources	Historic heritage impact assessment guide for state highway projects (2015) (NZ Transport Agency) NZ Transport Agency Research Report 601 (2016)
Methodology	Scoring, 5 steps outlined at 11.1.2. Methodology worksheet at table 4. The methodology for this measure is a sub-component of the methodology described at 11.1.2. Apply the five steps for the 'amenity' feature only.
Direction/scaling	Large positive, moderate positive, slight positive, neutral, large negative, moderate negative and slight negative

>> Return to 11.1 Impact on heritage and cultural values

11.1.2 Heritage and cultural values

Measure description



Measure no:	11.1.2
Measure name:	Heritage and cultural values
Measure description:	User to describe
Measure type:	Qualitative
Intent	Use this measure when investment effects a heritage or cultural significance, including historic sites, structures, places and areas, archaeological sites and places of diverse cultural significance.
Scope	This measure is best applied at a project level, but can also be rolled up for larger geographical areas or programmes.
Measure relationships	This measure has companion and cause–effect relationships with other measures in the benefits framework. The relationship map below shows these relationships and can be used to help you select further measures to support this measure.
	As noted in the description of the benefit, this measure is closely aligned with 12.1.1 Te ao Māori, but does not overlap. Sites and features highly valued in te ao Māori should therefore be considered in 12.1.1 separately.



Measure information

Definition of terms	Includes natural and physical resources that contribute to an understanding and appreciation of New Zealand's history and cultures deriving from any of the following qualities: (i) archaeological (ii) architectural (iii) cultural (iv) historic (v) scientific
	(v) scientific (vii) technological
	It includes: historic sites, structures, places and areas, archaeological sites and places of diverse cultural significance (<u>Historic heritage impact assessment guide for state highway</u> projects (2015), page 12).
	Some examples of diverse New Zealand heritage and cultural values include:
	 archaeological sites relating to Māori occupation for over 800 years (pā, terraces, pits, midden) (to be covered by values identified in partnership with Māori, see 12.1.1)
	 places associated with 19th century European settlers (Dalmatians, Chinese, British as whalers, sealers, goldminers), and with 20th century settlers (Pacifica, Polish, Asian and many others), and

11.1.2

	• places that commemorate distinctive moments in New Zealand history (Waitangi, New Zealand Land wars, WWI and WWII, Suffragette movement, etc.).
Information sources	Historic heritage impact assessment guide for state highway projects (2015) (NZ Transport Agency NZ Transport Agency research report 601 (2016)
Methodology	Scoring, 5 steps (including features and indicators of value) outlined below. Methodology worksheet at table 4.
Direction/scaling	Large positive, moderate positive, slight positive, neutral, large negative, moderate negative and slight negative



Step 1: Scope and identify study area.

Identify and document the geographical area the measure will cover, noting heritage and cultural sites and potential impacts at a high level, scoping out those with minimal impact.

Step 2: Identify key heritage and cultural sites and describe their features.

Identify and record the key sites within the geographical area and describe the key features, using the list of potential features in table 1 below. The summary resulting from this step can be entered into the '**description of the measure**' field.

The features align to the value the site may be given by the community and are from <u>NZ Transport</u> <u>Agency research report 601 (2016)</u>.

Table 1: Features of New Zealand heritage and cultural sites

Heritage and cultural associated features	Value type	Definitions
Amenity	Intangible	The place/space/area is visually attractive and pleasant. The natural or physical qualities of an area that contribute to people's appreciation of its pleasantness and aesthetic coherence.
Spiritual/cultural	Intangible	Deeper experience of the place that transcends amenity association and is distinct from a commemorative association. This value is present when individuals or communities attach a deeper (eg ethical, philosophical or religious) meaning to a heritage site or area.
Bequest	Intangible	The 'bequest' value applies to heritage sites or areas that should be preserved for posterity. It is likely that sites with high bequest values are already listed as category 1 sites. The place is archaeologically or architecturally unique or represents a historic technological development that is not found elsewhere and needs to be preserved for future generations.
Historic education	Intangible	A heritage site or area has 'historic education' value when it has the potential to educate and raise awareness about aspects of New Zealand's culture and history. The place has the potential to be used for formal and informal educational purposes related to history, architecture, science, engineering, technology, or design.
Commemorative	Intangible	A 'commemorative' value stems from a site's association with historic events, processes or people that provides groups with a sense of identity and continuity.
Associative	Intangible	The place is an essential element of history and culture in wider heritage area. The 'associative' value is present when the degradation or loss of a heritage site diminishes intrinsic and intangible values of a wider heritage area.
Recreation	Tangible	Unpaid, intentional use of the place.
Tourism	Tangible	Paid, intentional use of the place.
Functional	Tangible	Paid, intentional use of the place that is not tourism.
Other economic	Tangible	Effects on the wider economy of heritage improvements and/or costs associated with demolition/disposal.

Source: NZ Transport Agency research report 601 (2016) pages 33-34.



How to calculate baseline



Step 3: Set the baseline of the features.

In this stage the sites and features are appraised, and their current state is described. This information can be summarised and included in the '**measure baseline**' field.

Table 2 provides descriptions of each of the three indicators of value that can be used at this step – scale it matters, significance and rarity. The depth of this appraisal should be appropriate to the investment or detail required. That is, the appraisal can be made at summary level, site level and/or feature level depending on the stage and complexity of the investment.

Each feature described above is to be identified as either low, medium and high for each of the indicators of value, as outlined on the worksheet at table 4.

Table 2: Heritage indicators or value

Indicators of value	Definitions
Scale it matters	The geographical scale at which the features matter to both policy makers at all levels, and to local stakeholders (residents, interest groups, businesses, etc.). It includes national, regional and local communities' levels.
Significance	How valuable is the heritage or cultural asset to current and future generations?
Rarity	The heritage and cultural features in terms of its representational value, eg some features are very rare either nationally or within their locality, others are relatively common and typical and so important characteristics of a period or region, etc.

Forecasting methodology



Step 4: Describe the forecast impact of the investment In this step, the impact of the investment on each of the sites of the study area is described.

It should provide an assessment of the scale and seriousness of the impact in specific terms. This should encompass incremental or secondary impacts, such as gradual degradation of context through noise or other pollution, and so on. The extent to which the identified significance will be either enhanced or compromised should be made clear, including the mitigating effects of any amelioration (avoided, remedied or mitigated) incorporated formally into the investment or allowed for as standard good practice.

All impacts on the key historic features, positive or negative, should be identified, along with their magnitude. The time period for consideration of impacts should include the worst case, whenever this would arise, and the situation in the final forecast year. There should also be consideration of the do-minimum impact, if the investment was to not go ahead, if required.





Step 5: Score the forecast impact of investment

This step uses the descriptions from step 4 to score the impact of the investment on the sites and features of the study area. It should summarise impact across all features and sites described and will be used for initial preferred option and dominimum forecast and will be reanalysed and rescored when doing ongoing monitoring for this measure. Resulting scores should be entered into the 'measure direction/scale', 'do-minumum forecast' or 'preferred option forecast' fields as appropriate.

The definitions provided in table 2 are based on the seven point scale for scoring of impact adopted and adapted from the <u>UK Department for Transport TAG Unit A3 Environmental Impact Appraisal</u>, with scores from large positive impact to large negative impact.

Use table 3 to identify which of the available scores are relevant to the features, values and impact descriptions developed in the earlier steps. For an investment to qualify for a particular score, most of the statements relating to that score must apply.

Table 3: Heritage and cultural value - forecast and actual impact scores and descriptions

Score	Comment
Large positive impact	 The investment: uses extensive early screening and survey tools to identify heritage resources within the project corridor and excellent planning and design to avoid damage to these resources extensively restores or reinstates heritage features to a place/site/building/structure, removing unsympathetic additions or features, reinstating or repairing heritage features consistent with a conservation plan, ICOMOS NZ Charter (2010), national heritage policies and guidelines significantly creates an awareness and understanding of a heritage place/site for educational and/or tourism purposes through interpretation or design strongly delivers on resource efficiency through the adaptive reuse of heritage asset(s), minimising waste of virgin resources and demolition waste to landfill.
Moderate positive impact	 The investment: provides for restoration of heritage character, features, setting or amenity through removal, relocation or mitigation of damaging or discordant existing impacts on heritage resources is consistent with regional and local policies for the protection or enhancement of heritage enhances existing historic landscape/townscape character through beneficial landscaping/mitigation and good design delivers resource efficiency through the planned adaptive reuse of heritage asset(s), the minimisation or waste of virgin resources and demolition waste to landfill.
Slight positive impact	 The investment: is consistent with national, regional or local policies for the protection of heritage restores or enhances the form, scale, pattern or sense of place of the heritage resource through good design and mitigation removes or mitigates visual intrusion (or other indirect impacts) into the context of locally or regionally significant heritage features, such that appreciation and understanding of them is improved considers minor resource efficiency opportunities through heritage resources.
Neutral impact	 The investment: is consistent with national, regional and local policies for the protection of heritage has no appreciable effects, either positive or negative, on known heritage values and amenity of individual heritage sites or resources does not result in severance or loss of place-making function, integrity, context or understanding of a heritage place or area is a combination of slight positive and negative impacts on locally significant aspects of heritage asset.
Slight negative impact	 The investment: conflicts with local policies for the protection of the local character of the heritage resource has a detrimental impact on the context of regionally or locally significant assets, such that their integrity is compromised and appreciation and understanding of them is diminished damages locally significant heritage features for which adequate mitigation can be specified

11.1.2

Score	Comment
	does little to consider resource efficiency gains through adaptive reuse of heritage or waste minimisation through avoidance of demolition and landfill waste.
Moderate negative impact	 The investment: is out of scale with, or at odds with the scale, pattern or form of the heritage resource is intrusive in the setting (context), and will adversely affect the appreciation and understanding of the character or amenity of the heritage resource is in conflict with local or regional policies for the protection of heritage is damaging to nationally significant heritage assets, resulting in loss of features such that their integrity is compromised, but not destroyed, and adequate mitigation has been specified has a major direct impact on regionally or locally significant heritage, resulting in loss of features such that their integrity is substantially compromised, but adequate mitigation can be specified.
Large negative impact	 The investment: has a major direct impact on nationally or regionally significant heritage resources, such that they are lost, or their authenticity or integrity is severely damaged, and no adequate mitigation can be specified is highly intrusive and would seriously damage the setting of nationally/regionally significant heritage resource(s), such that its context is seriously compromised and can no longer be appreciated or understood is in serious conflict with national, regional and local policies for the protection of heritage is strongly at variance with resource efficiency opportunities to avoid demolition waste of heritage assets to landfill, or consideration of adaptive reuse possibilities.

Table 4: worksheet for 11.1.2 Heritage and cultural values

Step 2		Step 3 (baseline)			Step 4 (preferred option, do- minimum, actual impact)
Feature	Description	Scale it matters	Significance	Rarity	Impact
Amenity					
Spiritual/cultural					
Bequest					
Historic education					
Commemorative					
Associative					
Recreation					
Tourism					
Functional					
Other economic					

Reference sources

Qualitative comments

Benefits realisation

Steps 4 and 5 can be repeated with a view to current impact of investment, rather than forecast impact, for ongoing monitoring of this measure.

>> Return to 11.1 Impact on heritage and cultural values



11.2

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11.2 Impact on landscape

This benefit is primarily about rural settings but can be relevant to some urban settings with the same characteristics as a rural area. Landscape means more than just 'a physical tract of land' or 'a view or scene'. Landscape can be explained as a reflection of the relationship between people and place. It is both the characteristics and perceptions of the land that give a 'sense of place' to people living in it or visiting it. The characteristics can be physical or cultural and can be unique to a place or can contribute to local distinctiveness and community perception of value.

A full description of this benefit is available on our website: <u>11.2 Impact on landscape</u>

The measure listed below has been associated with this benefit for ease of reference, but it can also be applied to other benefits as appropriate.

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	Description ► User to describe

>> Return to Land Transport Benefits Framework overview



11.2.1 Landscape

Measure description

Measure no:	11.2.1
Measure name:	Landscape
Measure description:	User to describe
Measure type:	Qualitative
Intent	Use this measure when investment affects landscape features. Landscape is comprised of biophysical features, patterns and processes; sensory qualities; and spiritual, cultural, and social associations, including both activities and meanings.
Scope	This measure can be applied at the project level and can also be rolled up for geographical areas or programmes.
Measure relationships	This measure has companion, cause–effect and conflict relationships with other measures in the benefits framework. The relationship map below shows these relationships and can be used to help you select further measures to support this measure.







Measure information

Definition of terms	 Landscape can be defined as the cumulative expression of natural and cultural features, patterns and processes in a geographical area, including human perceptions and associations. Landscape is comprised of geographic/biophysical features, patterns and processes; perceptual aspects and sensory qualities; and associative aspects of cultural and social associations, including both activities and meanings. The measure applies within rural landscapes, and coastal landscape settings, but can also be relevant to urban settings where landscape is a significant element to the sense of place. The types of considerations specific to the landscape are: the recognised matters of national importance in relation to landscape the character of the landscape – effects on the locally distinctive pattern of landscape elements the visual intrusiveness of the investment – potential for effects upon visual amenity within the study area, including effects on key views if appropriate the tolerance of the landscape being able to accommodate further change the cultural associations and sense of place and how amenity values can be
Information sources	<u>NZTA landscape and visual assessment guidelines</u> <u>Landscape assessment and sustainable management, New Zealand Institute of Landscape</u> Architects (NZILA) (2010)
Methodology	Scoring, 5 steps (including features and indicators of value) outlined below. Methodology worksheet at table 8.
Direction/scaling	Large positive, moderate positive, slight positive, neutral, large negative, moderate negative and slight negative



Step 1: Scope and identify study area.

Identify and document the geographical area the measure will cover, noting landscape sites and potential impacts at a high level, scoping out those with minimal impact.

Step 2: Identify key landscape sites and describe their features.

Identify and record the key sites within the geographical area and describe the key features, using the list of potential features in table 5 below. The summary resulting from this step can be entered into the 'description of the measure' field.

Given that 'landscape' is a complex mix of physical features and patterns, and cultural associations, the level of detail to which landscape character assessment and appraisal is

undertaken depends very much on the purpose of the exercise and the scale of the landscape in question.

Features, for the purposes of this guidance, are the summation of those attributes that most strongly define the landscape, and which are directly or indirectly affected by investment. Definitions of the features which combine to define landscape are given below.

Table 5: Features of New Zealand landscape

Landscape associated features	Definition
Natural character	The degree or level of natural elements, natural patterns and natural processes. 'Natural' means 'a product of nature' to highly modified and man-made, for example coastal environment (biophysical and perceptual), wetlands, and lakes and rivers.
Amenity and user experience	Amenity values are those natural or physical qualities and characteristics of an area that contribute to people's visual appreciation of its pleasantness and aesthetic coherence. Amenity value of landscape environments contribute to people's appreciation of the
	pleasantness and aesthetic coherence, including any recognised view shafts or protected views.
	User experience can influence behaviour by create clear and self-explaining environments. It is about the experience of people travelling in terms of amenity. Safety is the main element of user experience of the landscape environment. User experience considers travel as a window into our rural and urban landscapes that are enjoyed and valued by tourists and locals alike. Most overseas visitors experience New Zealand through transport and the protection and enhancement of amenity and scenic values (including high-value scenic routes). Recognising interesting landmarks and opportunities to enhance a journey contributes to this important component of our economy.
Public access	The maintenance and enhancement of public access to and along the coastal marine area, lakes, and rivers is a matter of national importance. 'Public' means the public in general, and not just a section of the public. Public access is also important to access recreation, cycling and walking trails, and public open space.
Landcover, ownership and use	The landcover, contour and vegetation, land tenure and ownership, and the way in which the land is used and managed contributes to the character of the landscape. It includes: vegetation (native and exotic), contour and soil patterns and geology and geomorphology, public, private or collective title, and the use and activities on the land.
	For example, intensively farmed lowland arable landscapes. The productive use or structural diversity provided by the presence of soils, vegetation and contour, and landscape management, should also be recorded here. For example: 'lowland forest is a scarce but important element, the remnant forest patches are large and act as ecological stepping stone across the pastoral productive landscape of the area, and framing views to the ranges and forest park.'
Associative aspects	This feature should cover descriptions of how landscape elements of a historic, traditional or cultural nature contribute to landscape character. These include, historical associations, , recreational use, emblematic aspects (eg an icon for an area) and tangata whenua associations (to be valued in partnership with Māori, see 12.1.1)
Summary of the landscape context	This should summarise and pull together the relationship between the primary features of the key landscape being appraised. More general observations on the existing landscape, its character and visual qualities, and degree of development should be made here. An overview of the cultural and community associations of the landscape should also be provided here including any specific areas. For example, a landscape will be considered outstanding if it is 'conspicuous, eminent, remarkable or iconic' within the context of the area concerned. These landscapes are often protected. The criteria for assessing whether a landscape is outstanding include:
11.2.1

 natural science factors (geological, topographical, ecological, and dynamic components of the landscape) aesthetic values (including memorability and naturalness)
 expressiveness or legibility (how obviously the landscape demonstrates the formative processes leading to it)
• transient values (occasional presence of wildlife or other values at certain times of the day or year)
 whether the values are shared and recognised value to tangata whenua (be valued in partnership with Māori, see 12.1.1) historical associations.
It is the protection of outstanding landscapes that is of national importance. It is not only nationally outstanding natural landscapes that are to be protected. They may therefore include sites or locations that are important for local communities.

How to calculate baseline and do-minimum impact forecast



Step 3: Set the baseline of the features

In this step the sites and features are appraised, and their current state is described. This information can be summarised and included in the **'measure baseline'** field as the baseline information and comprises the significance of the features that may be impacted.

Table 6 provides descriptions of each of the three indicators of value that can be used at this step – scale and magnitude, significance and importance. The depth of this appraisal should be appropriate to the investment or detail required. That is, the appraisal can be made at summary level, site level and/or feature level depending on the stage and complexity of the investment.

Each feature described above is to be identified as either low, medium and high for each of the indicators of value, as outlined in table 6 below, to be included in the worksheet at table 8.

Indicator of value	Definition
Scale and magnitude	The geographical scale at which the features matter to both policy makers at all levels and to iwi, national advocates, territorial authorities and local stakeholders (residents, interest groups, businesses, etc.).
Significance	Should be interpreted as to whether the landscape features being evaluated are commonplace to the locality, scarce or outstanding. Significance often relates directly to importance. Maintaining landscape can be as much about safeguarding and keeping the commonplace common as conserving and protecting the rare.
Importance	How important is this feature and at what level – for example, high, medium, or low and at national/regional/local level – and to whom. For example, an individual tree or group of trees may be of very high importance at the local level, but do not figure at a regional or national level.
	Assessing importance is straightforward where recognised policy judgements about the importance of features (and their associated elements) have been made. For example, it is recognised that while outstanding natural landscapes and features are reviewed regionally, they are of national importance. These are landscapes with a full range of particular qualities and characteristics that make them worthy of national designation, eg national parks and areas of outstanding natural landscapes (ONLs) and outstanding natural features (ONFs), coastal landscape and statutory designations. Assessing importance in the case of the everyday landscape will be both a matter for professional judgement and public perception.

Table 6: Landscape indicators of value

11.2.1

Forecasting methodology



Step 4: Describe the forecast impact of the investment In this step, the impact of the investment on each of the sites of the study area is described.

It should provide an assessment of the scale and seriousness of the impact in specific terms. This should encompass incremental or secondary impacts, such as gradual degradation of context through noise or other pollution, and so on. The extent to which the identified significance will be either enhanced or compromised should be made clear, including the mitigating effects of any amelioration (avoided, remedied or mitigated) incorporated formally into the investment or allowed for as standard good practice. All impacts on the key landscape features, either negative or positive, should be identified, along with their magnitude.

The publicly available information from the relevant authorities, statutory bodies, organisations and local residents should be brought to bear in deciding the extent and significance of the impacts on the character and quality of each landscape feature and its constituent elements. This will be easier where an environmental impact assessment has been carried out. Where such information does not exist, it should still be possible.

The time period for consideration of impacts should include the worst case, whenever this would arise, and the situation in the final forecast year. There should also be consideration of the dominimum impact, if the investment was to not go ahead, if required.



Step 5: Score the forecast impact of investment

This step uses the descriptions from step 4 to score the impact of the investment on the sites and features of the study area. It should summarise impact across all features and sites described and will be used for initial preferred option and dominimum forecast. It will be reanalysed and rescored when doing ongoing monitoring for this measure. Resulting scores should be entered into the **'measure direction/scale'**, **'do-minumum forecast'** or **'preferred option forecast'** fields as appropriate.

The definitions provided in table 6 are based on the seven point scale for scoring of impact adopted and adapted from the <u>UK Department for Transport TAG Unit A3 Environmental Impact Appraisal</u> with scores from large positive impact to large negative impact.

Use table 7 to identify which of the available scores are relevant to the features, values and impact descriptions developed in the earlier steps. For an investment to qualify for a particular score, most of the statements relating to that score must apply.

Table 7: Landscape – forecast and actual impact scores and descriptions

Score	Comment
Large positive impact	 The investment greatly enhances the landscape because: it greatly enhances the character (including quality and value) of the landscape it creates an iconic high-quality feature and/or series of elements it enables a connection to the environment, a sense of place, scale and quality to be restored in an area formerly of high landscape quality. Note that very few, if any, investments are likely to merit this score.
Moderate positive impact	 The investment enhances the landscape because: it fits very well with the scale, landform and pattern of the landscape there is potential, through environmental design measures, to enable the restoration of characteristics, partially lost or diminished as the result of changes resulting from intensive farming or inappropriate development it enables a connection to the environmental design measures, that is, characteristics are enhanced through the use of local materials and species used to fit the investment into the landscape

	 it enables some sense of quality to be restored or enhanced through beneficial landscaping and sensitive design in a landscape that is not of any formally recognised quality
	 it furthers government objectives to regenerate degraded environments it furthers partnership with iwi in recognising the cultural landscape
Slight positive	The investment:
impact	 fits well with the scale, landform and pattern of the landscape
	 incorporates environmental design measures to ensure they will blend in well with
	surrounding landscape
	will enable some sense of place and scale to be restored through well-designed planting
	and environmental design measures
	maintains or enhances existing landscape character in an area that is not a designated
	landscape, nor vulnerable to change
Noutralimpost	avoids conflict with government policy towards protection of the environment. The investment:
Neutrai impact	 complements the scale landform and pattern of the landscape
	 incorporates environmental design measures to ensure that the investment will blend in
	well with surrounding landscape characteristics and landscape elements
	 avoids being visually intrusive or having an adverse effect on the current landscape
	through which the investment passes
	• maintains existing landscape character in an area that is not a designated landscape, that
	is neither national nor local high quality, nor vulnerable to change
	avoids conflict with government policy towards protection of the countryside.
Slight negative	The investment:
impact	does not quite fit the landform and scale of the landscape
	 although not very visually intrusive, impacts on certain views into and across the area cappet be completely integrated because of the nature of the investment itself or the
	 callion be completely integrated because of the nature of the investment used of the character of the landscape through which it passes
	affects an area of recognised landscape quality
	 conflicts with local authority policies for protecting the local character of the landscape.
Moderate	The investment:
negative impact	is out of scale with the landscape, or at odds with the local pattern and landform
	 is visually intrusive and will adversely impact on the landscape
	• is not possible to fully integrate, that is, environmental design measures will not prevent
	the investment from scarring the landscape in the longer term as some feature of interest
	will be partiy destroyed or their setting reduced or removed
	 Thas an adverse impact on a landscape of recognised quality of on vulnerable and important characteristics or elements.
	 is in conflict with local and national policies to protect the environment, and recognised
	landscapes and/or landscape features.
Large negative	The investment is:
impact	at considerable variance with the landform, scale and pattern of the landscape
	 visually intrusive and disrupts valued views of the area
	degrades, diminishes or even destroys the integrity of a range of characteristics and
	elements and their setting
	 substantially damaging to a nigh quality of night vulnerable landscape and/or feature, causing it to change and he considerably diminiched in guality.
	 cannot be adequately integrated
	 in serious conflict with government policy for the protection of the environment, and
	recognised landscapes and/or landscape features.
Very large	The investment is:
negative impact	at complete variance with the landform, scale and pattern of the landscape
	highly visual and extremely intrusive, destroying fine and valued views both into and
	across the area
	 irrovocably damaging or dograding, hadly diminishing or over destroying the integrity of
	 irrevocably damaging or degrading, badly diminishing or even destroying the integrity of characteristics and elements and their setting
	 irrevocably damaging or degrading, badly diminishing or even destroying the integrity of characteristics and elements and their setting causing a very high quality or highly valued landscape to be irrevocably changed and its
	 irrevocably damaging or degrading, badly diminishing or even destroying the integrity of characteristics and elements and their setting causing a very high quality or highly valued landscape to be irrevocably changed and its guality very considerable diminished
	 irrevocably damaging or degrading, badly diminishing or even destroying the integrity of characteristics and elements and their setting causing a very high quality or highly valued landscape to be irrevocably changed and its quality very considerable diminished unable to be integrated: there are no environmental design measures that would protect or

11.2.1

•	cannot be reconciled with government policy for the protection of nationally recognised
	environment, and recognised landscapes and/or landscape features.

Table 8: worksheet for 11.2.1 Landscape

	Step 2		Step 3		Step 4
Features	Description	Scale and magnitude	Significance	Importance	Impact
Natural character					
Amenity					
User experience					
Public access					
Landcover, ownership and use					
Associative aspects					
Summary of the landscape context					

Reference sources

Step 5 – Summary assessment score

Qualitative comments

Benefits realisation

Steps 4 and 5 can be repeated with a view to current impact of investment, rather than forecast impact, for ongoing monitoring of this measure.

>> Return to 11.2 Impact on landscape

11.3

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11.3 Impact on townscape

This benefit is about the how the form and character of the built and non-built urban environment and their perception generates a 'sense of place' or identity. The continuing changes in the urban environment (urban morphology) is also included in this benefit. A townscape includes all aspects of the urban form, not just heritage or architecturally designed.

A full description of this benefit is available on our website: <u>11.3 Impact on townscape</u>

The measure listed below has been associated with this benefit for ease of reference, but it can also be applied to other benefits as appropriate.

Quantitative measures				
No.	Name		Description	-
N/A				
Qualitative me	easures			0
11.3.1	Townscape	>>	User to describe	

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11.3.1 Townscape

Measure description

Measure no:	11.3.1
Measure name:	Townscape
Measure description:	User to describe
Measure type:	Qualitative
Intent	Use this measure when investment affects townscape features. It includes all aspects related to the context, urban form (and urban development), character, place, amenity and quality of the built environment for people.
Scope	This measure can be applied at the project level and can also be rolled up for geographical areas or programmes.
Measure relationships	This measure has companion, cause–effect and conflict relationships with other measures in the benefits framework. The relationship map below shows these relationships and can be used to help you select further measures to support this measure.





Measure information

Definition of terms	The qualitative measure for townscape includes aspects of urban design as set out within the NZ Urban Design Protocol and summarised by the 7 Cs.			
	 Context: seeing buildings, places and spaces as part of whole towns and cities (included) 			
	Character: reflecting and enhancing the distinctive character, heritage and identity of our urban environment (included)			
	Choice: ensuring diversity and choice for people			
	Connections: enhancing how different networks link together for people (included)			
	Creativity: encouraging innovative and imaginative solutions			
	Custodianship: ensuring design is environmentally sustainable, safe and healthy			
	Collaboration: communicating and sharing knowledge across sectors, professions and with communities.			
Information sources	Ministry for the Environment, New Zealand Urban Design Protocol – the seven Cs NZTA landscape and visual assessment guidelines			
Methodology	Scoring, 5 steps outlined below (including features and indicators of value). Methodology worksheet at table 12.			
Direction/scaling	Large positive, moderate positive, slight positive, neutral, large negative, moderate negative and slight negative			



Step 1: Scope and identify study area.

Identify and document the geographical area the measure will cover, noting townscape sites and potential impacts at a high level (spatial extent) and low level (precinct, local area/ network and neighbourhood scale), scoping out those with minimal impact.



Step 2: Identify key townscape sites and describe their features.

Identify and record the key sites within the geographical area and describe the key features, using the list of potential features in table 9 below. The summary resulting from this step can be entered into the '**description of the measure**' field.

Given that 'townscape' is a complex mix of physical features and patterns, and cultural associations, the level of detail to which landscape character assessment and appraisal is undertaken depends very much on the purpose of the exercise and the scale of the landscape in question.

Features, for the purposes of this guidance, are the summation of those attributes that most strongly define the townscape, and which are directly or indirectly affected by investment. Definitions of the features that combine to define townscape are given below.

Table 9: Features of New Zealand townscape

Townscape features	Description
Context	In context, urban development, buildings, infrastructure, places and spaces are not seen as isolated elements but as part of the whole town or city. For example, a public transport station is connected to its street, the street to its neighbourhood, the neighbourhood to its city, and the city to its region. The spatial dimension forms relationships between buildings, places, spaces, activities and networks. The context feature recognises that towns and cities are part of a constantly evolving relationship between people, land/ urban development, culture and the wider environment and that these items all interrelate in well-functioning urban environments. Some examples of components of townscape's context feature are: • local and surrounding conditions

	 social, cultural and economic context as well as physical elements and relationships health of the population who live and work there, cultural identity and the heritage values of a place.
Character	 Character reflects and enhances the distinctive character and culture of an urban environment, and recognises that character is dynamic and evolving, not static. It ensures new development and spaces are unique, are appropriate to their location and complement their historic identity, adding value to our towns and cities by increasing tourism, investment and community pride. Some examples of components of townscape's character feature are: unique identity of each town, city and neighbourhood, and strengthens the positive characteristics that make each place distinctive distinctive landforms, water bodies and indigenous plants and animals locally appropriate and inspiring architecture, spaces and places appropriate and efficient use of available land and buildings that supports
Choice	 legibility and wayfinding. Choice fosters diversity and offers people choice in the urban form of our towns and cities, and choice in densities, mixed land use, building types, transport options, and activities. Flexible and adaptable design provides for unforeseen uses and creates resilient and robust towns and cities. Some examples of components of townscape's choice feature are: urban environments provide opportunities for all, especially the disadvantaged choice of different sustainable lifestyle options, locations, modes of transport, types of buildings and forms of tenure diversity of activities within urban centres, mixed-use developments and neighbourhoods.
Connections	Good connections enhance choice, support social cohesion, make places lively and safe, and facilitate contact among people. Severance can have the opposite effect. Quality connections recognise how all networks – roads, streets, railways, walking and cycling routes, services, infrastructure, and communication networks – connect and support healthy neighbourhoods, towns and cities. Places with good connections between activities and with careful placement of infrastructure and facilities benefit from reduced travel times and lower environmental impacts. Where urban form and physical layouts and activity patterns are easily understood, residents and visitors can navigate around the city or town easily. Some examples of components of townscape's connections feature are:
	 safety, attractiveness and security of pathways and links between centres, landmarks and neighbourhoods places a high priority on walking, cycling and public transport (alongside road space allocation for vehicles, freight and logistics and parking spaces, and right size for context) accessibility of the transport system to public services and facilities streets and other thoroughfares as positive spaces with multiple functions formal and informal opportunities for social and cultural interaction access to services and efficient movement of goods and people environments that encourage people to become more physically active
Creativity	Creativity encourages innovative approaches. Creativity adds richness and diversity and turns a functional place into a memorable place. Creativity facilitates new ways of thinking, and willingness to think through problems afresh, to experiment and rewrite rules, to harness new technology, and to visualise new futures. Creative proposals support a dynamic urban cultural life and foster strong urban identities and liveability. Some examples of components of townscape's creativity feature are: innovative and imaginative solutions public art and 'place making' that is integrated into a building, space or place strong and distinctive local identity new technology utilisation different cultural perspectives.
Custodianship	Custodianship reduces the environmental impacts of our towns and cities through environmentally sustainable and responsive design solutions. Custodianship



	 recognises the lifetime costs of buildings and infrastructure and aims to hand on places to the next generation in as good or better condition. Stewardship of our towns includes the concept of kaitiakitanga. It creates enjoyable, safe public spaces (crime prevention through environmental design – CPTED items), a quality environment that is cared for, and a sense of ownership and responsibility in all residents and visitors. Some examples of components of townscape's custodianship feature are: landscapes, ecological systems and cultural heritage values environmentally responsive and sustainable design solutions greenhouse gas emissions-based thinking creates buildings, spaces, places and transport networks that are safer, with less crime and fear of crime.
Collaboration	Towns and cities are designed incrementally as we make decisions on individual projects. Quality townscapes require good communication and coordinated actions from all decision makers: central government, local government, professionals, transport operators, developers and users. It is about a common vision for townscape that is achieved over time through collaboration between various parties, including communities.
Summary	This should summarise and pull together the relationship between the primary characteristics and features or attributes of the key townscape being appraised. More general observations on the townscape, its type and degree of development and change should be made here. Consider spatial scale, precinct or character area scale and local/ neighbourhood scale here.

How to calculate baseline and do-minimum impact forecast



Step 3: Set the baseline of the features and baseline changes

In this step, the sites and features are appraised, and their current state is described. This information can be summarised and included in the **'measure baseline'** field as the baseline information and comprises the significance of the features that may be impacted.

Table 10 provides descriptions of each of the three indicators of value that can be used at this step – scale, quality of place and importance. The depth of this appraisal should be appropriate to the investment or detail required. That is, the appraisal can be made at summary level, site level and/or feature level depending on the stage and complexity of the investment.

Table 10:	Townscape	indicators	of	value
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Indicator of value	Definition
Scale (fit for context)	The geographical scale at which the features matter to both policy makers at all levels and to local stakeholders (residents, interest groups, businesses, etc). It includes national, regional and local communities' levels.
Quality of place	Should be interpreted as to whether the townscape features being evaluated prior to impact appraisal are commonplace and if they contribute to the vitality of the locality or diminish the quality of the place. For example, quality and provision of public space for health and wellbeing. Maintaining the local character and sense of place can be as much about safeguarding and keeping the commonplace common as conserving and protecting the key urban features, consider the scale of change.
Importance	How important is this feature and at what level – for example, high, medium, or low and at national/regional/local level – and to whom. For example, an important street or precinct may be of very high importance at the local level, but does not figure at a regional or national level.
	Addresses whether these urban features and their constituent elements are replaceable or not within a given time frame. Support this with an appraisal of the temporary or short-term impacts/improvements and medium- to long-term impacts/improvements.



Forecasting methodology



Step 4: Describe the forecast impact of the investment In this step, the impact of the investment on each of the sites of the study area is described.

It should provide an assessment of the scale and seriousness of the impact in specific terms. This should encompass incremental or secondary impacts, such as gradual degradation of context through noise or other pollution, and so on. The extent to which the identified significance will be either enhanced or compromised should be made clear, including the mitigating effects of any amelioration (avoided, remedied or mitigated), incorporated formally into the investment or allowed for as standard good practice. All impacts on the key townscape features, either adverse or beneficial, should be identified, along with their magnitude.

The time period for consideration of impacts should include the worst case, whenever this would arise, and the situation in the final forecast year. There should also be consideration of the dominimum impact if the investment was to not go ahead, if required.



Step 5: Score the forecast impact of investment

This step uses the descriptions from step 4 to score the impact of the investment on the sites and features of the study area. It should summarise impact across all features and sites described and will be used for the initial preferred option and dominimum forecast. It will be reanalysed and rescored when doing ongoing monitoring for this measure. Resulting scores should be entered into the **'measure direction/scale'**, **'do-minimum forecast'** or **'preferred option forecast'** fields as appropriate.

The definitions provided in Table 11 are based on the seven point scale for scoring of impact adopted and adapted from the <u>UK Department for Transport TAG Unit A3 Environmental Impact</u> <u>Appraisal</u> with scores from large positive impact to large negative impact.

Use table 11 to identify which of the available scores are relevant to the features, values and impact descriptions developed in the earlier steps. For an investment to qualify for a particular score, most of the statements relating to that score must apply.

Score	Comment
Large beneficial (positive) effect	 The investment: enhances the urban form/layout, mix, scale, appearance, human interaction and cultural aspects of the townscape enables the restoration of the characteristic features of the townscape, changes resulting from inappropriate development are mitigated in a way provides enhancements enables a sense of place and scale to be restored through well-designed mitigation measures, characteristic features are enhanced through integrated urban design strategies, frameworks and proposals into the townscape enhances the character and vitality of the townscape through beneficial and sensitive design in a townscape which is not of any formally recognised quality is based on sound urban design principles and facilitates government and local authority policies' objectives for urban areas.
Moderate beneficial (positive) effect	 The investment: fits very well with the urban form and layout, mix, scale, appearance, human interaction and cultural aspects of the townscape has potential, through environmental design measures, to enable the restoration of characteristic features, and changes resulting from inappropriate development are mitigated enables a sense of place and scale to be restored through well-designed environmental design measures, that is, characteristic features are enhanced through the use of local materials to fit the proposal into the townscape enables some sense of quality to be restored or enhanced through beneficial and sensitive design in a townscape that is not of any formally recognised quality

Table 11: Townscape – forecast and actual impact scores and descriptions

	• integrates urban design considerations and furthers government objectives and local authority policies to regenerate degraded urban areas.
Slight beneficial (positive) effect	 The investment: fits well with the layout, mix, scale, appearance, human interaction and cultural aspects of the townscape incorporates environmental design measures for mitigation to ensure they will blend in well with surrounding townscape enables some sense of place and scale to be restored through well-designed environmental design measure maintains or enhances existing townscape character in an area that is not designated for the quality of its townscape, nor vulnerable to change applies urban design and avoids conflict with government policy and local authority policies of enhancing urban environments.
Neutral effect	 The investment: complements the layout, mix, scale, appearance, human interaction and cultural aspects of the townscape incorporates environmental design measures to ensure that the investment will blend in well with surrounding townscape characteristics and elements avoids being visually intrusive or having an adverse effect on the current level of tranquillity (where these exist) of the townscape through which the investment passes maintains existing townscape character, that is, not high quality, nor vulnerable to change avoids conflict with government policy and local authority policies towards enhancing urban environments.
Slight adverse (negative) effect	 The investment: does not quite fit the layout, mix, scale, appearance, human interaction and cultural aspects of the townscape although not very visually intrusive, will impact on certain views into and across the area cannot be completely integrated because of the nature of the investment itself or the character of the townscape through which it passes affects an area of recognised townscape quality conflicts with local authority policies for enhancing urban environments.
Moderate adverse (negative) effect	 The investment: is out of scale or at odds with the urban form and layout, mix, scale, appearance, human interaction and cultural aspects of the townscape is visually intrusive and will adversely impact on the townscape is not possible to fully integrate, that is, environmental design measures will not prevent the investment from scarring the townscape in the longer term, as some features of interest will be partly destroyed, or their setting reduced or removed will have an adverse impact on a townscape of recognised quality or on vulnerable and important characteristics or elements is in conflict with local and national policies and local authority policies to enhance the urban environment.
Large adverse (negative) effect	 The investment: impacts urban form and is at considerable variance with the layout, mix, scale, appearance, human interaction and cultural aspects of the townscape is visually intrusive and would disrupt fine and valued views of the area is likely to degrade, diminish or even destroy the integrity of a range of characteristic features and elements and their setting is substantially damaging to a high quality or highly vulnerable townscape, causing it to change and be considerably diminished in quality cannot be adequately integrated, has negative effects is in serous conflict with government policy and local authority policies for the enhancement of the urban environment.



Table 12: worksheet for 11.3.1 Townscape

	Step 2	Step 3			Step 4
Features	Description	Scale (fit for context)	Quality of place	Importance	Impact
Context					
Character					
Choice					
Connections					
Creativity					
Custodianship					
Collaboration					
Summary					
Reference sources					

Step 5 – Summary assessment score

Qualitative comments

Benefits realisation

Steps 4 and 5 can be repeated with a view to current impact of investment, rather than forecast impact, for ongoing monitoring of this measure.

>> Return to 11.3 Impact on townscape

12.1

12. Changes in te ao Māori values

This benefit cluster is about te ao Māori values (a Māori world view), which are intertwined with obligations under Te Tiriti o Waitangi (the Treaty of Waitangi). This benefit is important to Māori and incorporates both historical and contemporary evolving values that should be considered to understand the potential and realised benefits. It is about benefits realised due to integration of elements that respond to specific Māori concerns.

12.1 Impact on te ao Māori

This benefit is about the impacts of interventions on te ao Māori view. There is no 'one' te ao Māori view. While there are many common elements between different te ao Māori views, there are often variations between whānau (families), hapū (subtribes), and iwi (tribes). Te ao Māori views evolve with changes in circumstances and technology and reflect historical and contemporary influences. Decision makers should be aware of the views of tangata whenua (the iwi or hapū with customary authority over a particular area) as it relates to the location and influence that their programme or project may have.

A full description of this benefit is available on our website: 12.1 Impacts on te ao Māori

The measure listed below has been associated with this benefit for ease of reference, but it can also be applied to other benefits as appropriate.

Quantitative n	neasures		(#)
No.	Name	Description	
N/A			\frown
Qualitative me	easures		(
12.1.1	Te ao Māori 😕	User to describe	U

>> Return to Land Transport Benefits Framework overview



12.1.1 Te ao Māori

Measure no:	12.1.1					
Measure name:	Te ao Māori					
Measure description:	User to describe					
Measure type:	Qualitative measure					
Intent	 This measure should be used to consider the following Māori values: Rangatiratanga: The right to exercise authority and self-determination within one's own iwi and/or hapū realm. Manaakitanga: Hospitality, kindness, generosity; supports the process of showing respect, generosity and care for others. Kaitiakitanga: Guardianship, stewardship, trusteeship, trustee. Kaitiakitanga is an important Māori value that bestows an obligation of stewardship on Māori to care for the environment. Transport investments in infrastructure can ensure environmental sustainability and support Māori to exercise their environmental kaitiaki responsibilities. Kaitiakitanga also applies to caring for people. Iwi and hapū within their area of interest (rohe) have an obligation to ensure the safety and wellbeing of all people. This is applicable to safety-related investments. Whanaungatanga: Relationship, kinship, sense of family connection – a relationship through shared experiences and working together, which provides people with a sense of belonging. Wairuatanga: The immutable spiritual connection between people and their 					
	environments.Kotahitanga: Unity, cohesion and collaboration.					

	Mātauranga: Māori/mana whenua knowledge and understanding.
Scope	This measure can be applied at the project level and can also be rolled up for geographical areas or programmes.
Measure relationships	This measure has companion and cause–effect relationships with other measures in the benefits framework. The relationship map below shows these relationships and can be used to help you select further measures to support this measure.



KEY



Measure information

Definition of terms	This measure is about protecting, enhancing and maintaining the relationship of Māori with culture and traditions with their ancestral land, water, sites, wāhi tapu, and other taonga Many te ao Māori values are found elsewhere in the benefits framework. This measure provides focus to ensure that the holistic views of te ao Māori are considered in each of the other clusters. These impacts and benefits will at some point require clarification with relevant hapū and iwi.
Information sources	<u>Te ara kotahi – our Māori strategy</u> Hononga ki te iwi – our Māori engagement framework
Methodology	Rich narrative, engaging with iwi and hapū with mana whenua affected by infrastructure projects.

Iwi have a special relationship with the Crown as Treaty of Waitangi partners and therefore have a partnership role with Waka Kotahi. Iwi and hapū affected by transport investments are free to present the impacts on their wellbeing in a manner that is appropriate for them.

Considerations when working with Māori are:

- recognising and respecting Māori values
- working collaboratively and in a mana-enhancing way with Māori
- building strong, meaningful and enduring relationships to achieve mutually beneficial outcomes
- finding opportunities to support Māori aspirations through transport investments.

While the above provides a great starting point, it is critical you verify this information with your closest Waka Kotahi Pou Ārahi – Regional Māori Advisor.

>> Return to 12.1 Impact on te ao Māori

Appendix 1: Overview of Land Transport Benefits Framework with measures

Note that measures can be used as evidence for more than one benefit, not only for the primary association provided in this table. For more information about the Land Transport Benefits Framework, see <u>Benefits management guidance</u> on the Waka Kotahi website.

Transport outcome	Benefit cluster	Benefit Benefits marked ^{\$} are monetised. For more	Quantita Measures informatio	t ive and qualitative benefit n marked [#] are quantitative, and th n see the <u>Land Transport Benefits</u> .	Monetised benefits Value proxy and measure of changes in option compared to do-minimum	
	information see the <u>Monetised</u> <u>benefits and costs manual</u>	No.	Measure name	Measure		
Healthy and safe people	1. Changes in user safety	1.1 Impact on social cost of deaths and serious	1.1.1	Collective risk (crash density)#	Average annual fatal and serious injury crashes per kilometre of road section	<pre>\$ crash costs by crash type and severity</pre>
		injuries ^{\$}	1.1.2	Crashes by severity#	Number of crashes by severity	
			1.1.3	Deaths and serious injuries [#]	Number of deaths and serious injuries	
			1.1.4	Personal risk (crash rate) [#]	Average annual fatal and serious injury crashes per 100 million vehicle-kilometres	
		1.2 Impact on a safe system	1.2.1	Road assessment rating – roads [#]	Infrastructure risk rating	
			1.2.2	Road assessment rating – state highways [#]	KiwiRoad Assessment Programme (KiwiRAP) star rating (for state highways)	
			1.2.3	Travel speed gap [#]	Difference between safe and appropriate speed (SAAS), and actual speed (under development)	
	2. Changes in perceptions of safety	2.1 Impact on perceptions of safety and security	2.1.1	Access – perception#	Perception of safety and ease of walking and cycling	
	3. Changes in human health	3.1 Impact of mode on physical and mental health ^{\$}	3.1.1	Physical health benefits from active modes*	User to describe	 \$/pedestrian * 1km of a new facility \$/conventional cyclist *3km of a new facility \$/electric assisted cyclist *3km of a new facility
		3.2 Impact of air emissions	3.2.1	Ambient air quality – NO ₂ #	Concentration of NO ₂ in μ g/m ³	\$ damage cost/tonne of
		on health ^{\$}	3.2.2	Ambient air quality – PM ₁₀ #	Concentration of PM_{10} in $\mu g/m^3$	pollutant * number of people exposed
		3.3 Impact of noise and vibration on health ^{\$}	3.3.1	Noise level [⊭]	Noise level in dB L _{Aeq(24h)}	\$/dB noise level per household or person affected per year

Transport outcome	Benefit cluster	Benefit Benefits marked ^{\$} are	Quantitative and qualitative benefit measures (primary associations) Measures marked # are quantitative, and those marked * are qualitative. For more			Monetised benefits Value proxy and measure of	
		monetised. For more information see the <u>Monetised</u> <u>benefits and costs manual</u>	No.	n see the <u>Land Transport Benefits</u> Measure name	Framework measures manual Measure	changes in option compared to do-minimum	
Resilience and security	Resilience and security 4. Changes in impact of unplanned disruptive events on	Changes in pact of unplanned4.1 Impact on system vulnerabilities and redundancies	4.1.1	Availability of a viable alternative to high-risk and high-impact route [#]	Percentage of high-risk, high-impact routes with a viable alternative		
access to social and economic opportunities	access to social and economic opportunities		4.1.2	Level of service and risk *	Resilience risk category (calculated using National Resilience Programme Business Case methodology)		
Economic prosperity	Economic prosperity 5. Changes in transport costs	. Changes in ransport costs 5.1 Impact on system reliability ^{\$} 5.2 Impact on network productivity and utilisation ^{\$}	5.1.1	Punctuality – public transport [#]	Percentage of scheduled service trips between 59 seconds before and 4 minutes 59 seconds after the scheduled departure time of selected point	 \$/minutes PT vehicle travel time (VTT)* delay time (min)* number of passengers affected \$/h travel time value*changes in network variability* traffic volume*0.9 \$/h for person or vehicle travel time \$ Vehicle operating cost (VOC)/vehicle \$/minute vehicle occupant time for PT users \$ PT fares for users 	
			5.1.2	Travel time reliability – motor vehicles [#]	Coefficient of variation; standard deviation of travel time DIVIDED BY average minutes travel time (as per Austroads)		
			5.1.3	Travel time delay [#]	Difference between average travel time A and average travel time B in minutes per kilometre		
			5.1.4	Temporal availability - road [#]	Number and duration of resolved road closures: urban >=2 hours; rural >=12 hours		
			5.2.1	Spatial coverage – freight [#]	Percentage completion of the strategic high productivity motor vehicle freight network		
			5.2.2	Freight – mode share value#	Number of vehicles TIMES average load per vehicle in NZ\$, expressed as percentages		
			5.2.3	Freight – mode share weight [#]	Number of vehicles TIMES average load per vehicle in tonnes, expressed as percentages		
			5.2.4	Freight – throughput value [#]	Number of vehicles TIMES average load per vehicle in NZ\$		
			5.2.5	Freight – throughput weight [#]	Number of vehicles TIMES average load per vehicle in tonnes		
			5.2.6	Access to key economic destinations (all modes)#	Proportion of population living within travel threshold (15 minutes, 30 minutes or 45 minutes) of key economic opportunities (including work) by different modes (walking, cycling, public transport, private motor vehicle) in the morning peak		

Transport outcome	Benefit cluster	Benefit Benefits marked ^{\$} are monetised. For more information see the <u>Monetised</u> <u>benefits and costs manual</u>	Quantitative and qualitative benefit measures (primary associations) Measures marked # are quantitative, and those marked * are qualitative. For more information see the <u>Land Transport Benefits Framework measures manual</u>			Monetised benefits Value proxy and measure of changes in option compared
			No.	Measure name	Measure	to do-minimum
Economic prosperity (continued)	6. Wider economic impact	6.1 Wider economic benefit (productivity) ^{\$}				\$ productivity increase as the result of changes effective density
		6.2 Wider economic benefit (employment impact) ^{\$}				\$ tax wedge on additional labour income
		6.3 Wider economic benefit (imperfect competition) ^{\$}				\$ total conventional business user benefits * imperfect competition uplift
		6.4 Wider economic benefit (regional economic development) ^{\$}				\$ value added as the result of increased international visitor activity
Environmental	7. Changes in natural environment	7.1 Impact on water	7.1.1	Water quality*	User to describe	
sustainability		7.2 Impact on land and biodiversity	7.2.1	Biodiversity*	User to describe	
			7.2.2	Productive land*	User to describe	
	8. Changes in climate	8.1 Impact on greenhouse gas emissions ^{\$}	8.1.1	Greenhouse gasemissions (all vehicles)#	Tonnes of CO_2 equivalents emitted	damage cost/tonne of CO2 as a function of motor vehicle fuel consumption
			8.1.2	Mode shift from single occupancy private vehicle*	User to describe	
			8.1.3	Light vehicle use impacts [#]	Light vehicle kilometres travelled (light VKT)	
			8.1.4	Freight transport impact on greenhouse gas emissions#	Tonnes of CO ₂ equivalents emitted by trucks, rail and ships used for freight (excludes light commercial vehicles and aviation)	
	9. Changes in resource efficiency	9.1 Impact on resource efficiency	9.1.1	Resource efficiency*	User to describe	
			9.1.2	Embodied carbon [#]	Tonnes of CO_2 equivalents emitted	
			9.1.3	Energy use*	User to describe	

Transport outcome	Benefit cluster	Benefit Benefits marked ^{\$} are monetised. For more	Quantitat Measures information	t ive and qualitative benefit m marked [#] are quantitative, and th n see the <u>Land Transport Benefits I</u>	Monetised benefits Value proxy and measure of changes in option compared	
		information see the <u>Monetised</u> <u>benefits and costs manual</u>	No.	Measure name	Measure	to do-minimum
Inclusive access	10. Changes in access to social and economic opportunities	10.1 Impact on user experience of the transport system ^{\$}	10.1.1	People – throughput of pedestrians, cyclists and public transport boardings [#]	Number of pedestrians, cyclists and public transport boardings	 \$/vehicle per kilometre of constructed passing lane \$/vehicle per kilometre sealed roads. \$/minutes PT passengers in-vehicle time in relation to infrastructure and bus and train attributes \$/minutes PT passengers vehicle occupant time for probability of being left and proportion of standing passengers \$ relative value for different types of cycling facility's quality improvements minutes additional time someone would be willing to spend walking to obtain the improvement of different aspects of the pedestrian realm
			(Repeat) 2.1.1	Access - perception [#]	Perception of safety and ease of walking and cycling	
			10.1.2	Pedestrian delay [#]	Pedestrian time lost due to intersection delay	
			10.1.3	Ease of getting on/off public transport services [#]	Percentage of low floor and wheelchair accessible services	
			10.1.4	Network condition – cycling [#]	Percentage travel on cycle network classified as complying with defined level of service (facility type)	
			10.1.5	Network condition – road [#]	Percentage travel on road network classified as smooth as per defined level of service	
			10.1.6	People – throughput [#]	Number of pedestrians, cyclists, public transport boardings and motor vehicles (excl. public transport) TIMES average number of people per vehicle	
			10.1.7	People - throughput (UCP)#	Number of pedestrians and cyclists	
			10.1.8	Traffic – throughput#	Number of pedestrians, cyclists and motor vehicles by vehicle type	
			10.1.9	Travel time#	Average travel time in minutes	
		10.2 Impact on mode choice	10.2.1	People – mode share [#]	Number of pedestrians, cyclists, public transport boardings, and motor vehicles (excl. public transport) TIMES number of people per vehicle, expressed as percentages	
			(Repeat) 8.1.2	Mode shift from single occupancy private vehicle*	User to describe	
			10.2.2	Accessibility – public transport facilities [#]	Number of bus or train stops that are fully accessible	
			10.2.3	Spatial coverage – cycle lanes and paths [#]	Percentage completion of the strategic cycle network	

Transport outcome	Benefit cluster	Benefit Benefits marked ^{\$} are monetised. For more information see the <u>Monetised</u> <u>benefits and costs manual</u>	Quantitative and qualitative benefit measures (primary associations) Measures marked [#] are quantitative, and those marked * are qualitative. For more information see the <u>Land Transport Benefits Framework measures manual</u>			Monetised benefits Value proxy and measure of changes in option compared
			No.	Measure name	Measure	to do-minimum
Inclusive access (continued) 10. Char access t econom opportu (continu	10. Changes in access to social and economic opportunities (continued)	10.2 Impact on mode 10 (continued) 10 10 10	10.2.4	Spatial coverage – cycling facilities [#]	Number of people living within 500m of a high-quality cycling facility	
			10.2.5	Spatial coverage – public transport – employees [#]	Number of employees within 500m of a bus stop or 1km from a rail or bus rapid transit station	
			10.2.6	Spatial coverage – public transport – resident population#	Number of people within 500m of a bus stop or 1km from a rail or bus rapid transit station	
			10.2.6a	Spatial coverage – public transport – new residential dwellings#	% of recently built residential dwellings with access to public transport services (subset of 10.2.6)	
			10.2.7	Temporal availability – public transport [#]	Public transport frequency per hour weighted by percentage of the population living within 500m of a bus stop or 1km from a rail or bus rapid transit station	
			10.2.8	Cost of access to key destinations - all modes*	User to describe	
			10.2.9	Pricing - more efficient*	User to describe	
			10.2.10	Traffic – mode share (number)#	Number of transport users by mode pedestrians, cyclists and motor vehicles by vehicle class, expressed as percentages	
			10.2.10b	Traffic – mode share (distance)#	Average trip distance per person in urban areas by mode	
		10.3 Impact on access to opportunities	10.3.1	Access to key social destinations (all modes)#	Proportion of population living within travel threshold (15 minutes, 30 minutes or 45 minutes) of key social opportunities (including education, health care, supermarkets) by different modes (walking, cycling, public transport, private motor vehicle) in the morning peak	
		10.4 Impact on community cohesion	10.4.1	Social connectedness*	User to describe	
			10.4.2	Isolation*	User to describe	
			10.4.3	Severance*	User to describe	

Transport outcome	Benefit cluster	Benefit Benefits marked ^{\$} are monetised. For more information see the <u>Monetised</u> <u>benefits and costs manual</u>	Quantitative and qualitative benefit measures (primary associations) Measures marked [#] are quantitative, and those marked [*] are qualitative. For more information see the <u>Land Transport Benefits Framework measures manual</u>			Monetised benefits Value proxy and measure of changes in option compared
			110.			
Inclusive access (continued)	11. Changes in liveability of places	11.1 Impact on heritage and cultural values	11.1.1	Amenity value - natural and built environment*	User to describe	
			11.1.2	Heritage and cultural values*	User to describe	
		11.2 Impact on landscape	11.2.1	Landscape*	User to describe	
		11.3 Impact on townscape	11.3.1	Townscape*	User to describe	
	12. Changes in te ao Māori values	12.1 Impact on te ao Māori	12.1.1	Te ao Māori*	User to describe	

Appendix 2: Overview of methodologies applied to qualitative measures

Benefit	Measure	Qualitative method
3.1 Impact of mode on physical and mental health	3.1.1 Physical health benefits from active modes	Narratives, thresholds and ranking
4.1 Impact on system vulnerabilities and redundancies	4.1.2 Level of service and risk	Scoring
7.1 Impact on water	7.1.1 Water quality	Scoring
7.2 Impact on land and	7.2.1 Biodiversity	Scoring
biodiversity	7.2.2 Productive land	Scoring
8.1 Impact on greenhouse gas emissions	8.1.2 Mode shift from single occupancy private vehicle	User to describe
9.1 Impact on resource efficiency	9.1.1 Resource efficiency	Narratives, thresholds and ranking
	9.1.3 Energy use	Narratives, thresholds and ranking
10.2 Impact on mode choice	10.2.8 Cost of access to key destinations – all modes	User to describe
	10.2.9 Pricing – more efficient	User to describe
10.4 Impact on community	10.4.1 Social connectedness	Scoring
cohesion	10.4.2 Isolation	Scoring
	10.4.3 Severance	Scoring
11.1 Impact on heritage and cultural values	11.1.1 Amenity value – natural and built environment	Scoring
	11.1.2 Heritage and cultural values	Scoring
11.2 Impact on landscape	11.2.1 Landscape	Scoring
11.3 Impact on townscape	11.3.1 Townscape	Scoring
12.1 Impact on te ao Māori	12.1.1 Te ao Māori	Rich narrative

Please note that the description of each of these methodologies will be included in ongoing updates of the manual.