pwc.co.nz

Indicative Business Case for Wellington Bus Rapid Transit

A report for the NZ Transport Agency, GWRC and WCC

July 2015

BRT – Indicative Business Case

July 2015

pwc

Strictly confidential

Strictly confidential

Chrissie Little
Project Manager, Bus Rapid Transit
New Zealand Transport Agency
Private Bag 6995
Wellington 6141

22 July 2015

Indicative Business Case for Wellington Bus Rapid Transit

Dear Chrissie,

We are pleased to provide our report setting out the indicative business case for Bus Rapid Transit in Wellington.

This report is provided in accordance with the terms of our engagement letter dated 29 May 2014 and the change of scope letter dated 17 February 2015, and is subject to the restrictions set out in Appendix E of this report.

If you have any queries please do not hesitate to contact us.

Yours sincerely

Bruce Wattie
Partner
bruce.wattie@nz.pwc.com
04 462 7001

Craig Rice
Partner
craig.rice@nz.pwc.com
09 355 8641

Table of contents

Glossary

AML	Average minutes late
BCR	Benefit-cost ratio
BP	Bus priority
BRT	Bus Rapid Transit
CBA	Cost benefit analysis
CSF	Critical success factor
D&C	Design and construct
DBB	Design, bid and build
DBC	Detailed Business Case
DCM	Design, construct and maintain
ECI	Early contractor involvement
EEM	The Transport Agency's Economic Evaluation Manual
EL	Equivalent time to a minute late
GPS	Government Policy Statement on Land Transport Funding
GT	General traffic
GWRC	Greater Wellington Regional Council
IBC	Indicative Business Case
ILM	Investment logic mapping
KPI	Key performance indicator
LRT	Light Rail Transit
LTP	Long-Term Plan
MCA	Multi-criteria analysis
N2A Plan	Ngauranga to Wellington Airport Corridor Plan 2008
N2A Strategy	Ngauranga to Wellington Airport Corridor Strategy
NLTF	National Land Transport Fund
NLTP	National Land Transport Programme
NPV	Net present value
O&M	Operations and maintenance

PPP	Public-private partnership
PT	Public transport
PTOM	Public Transport Operating Model
PTSS	Wellington Public Transport Spine Study
RLTP	Wellington Regional Land Transport Plan 2015
RLTS	Wellington Regional Land Transport Strategy 2010-40
RONS	Roads of National Significance
RPTP	Wellington Regional Public Transport Plan 2014
SH1	State Highway 1
The Transport Agency	New Zealand Transport Agency
VKT	Vehicle kilometres travelled
VOC	Vehicle operating costs
VoT	Value of time
WCC	Wellington City Council

Executive summary

This business case assesses the case for a proposed investment in Bus Rapid Transit (BRT) in Wellington City.

BRT in its most comprehensive form is a high-quality, high capacity bus system that improves upon traditional bus systems. Modern, comfortable, high-capacity buses travel in dedicated lanes, separated from general traffic, parking, turning traffic and other impediments. Passengers board from raised platforms (slightly higher than street level), having paid their fares electronically.

BRT is the proposed solution to improving public transport (PT) through the PT Spine, from the Railway Station to Newtown and Kilbirnie. In its entirety, BRT will involve increasing the amount of roadspace dedicated to buses, increased intersection priority for buses, using high-capacity buses and delivering operational and user improvements. This business case focuses on BRT infrastructure only that will provide dedicated roadspace and intersection priority for buses.

This business case follows the New Zealand Transport Agency (the Transport Agency) business case approach. This approach is based on the Treasury Better Business Cases guidelines, which are organised around the five case model designed to systematically test whether an investment proposal:

- is supported by a robust case for change – the ‘strategic case’
- will deliver optimal value for money – the ‘economic case’
- is commercially viable – the ‘commercial case’
- is financially affordable – the ‘financial case’, and
- is achievable – the ‘management case’.

This document is an **Indicative Business Case** (IBC). Its objectives are to confirm the preferred way forward for the proposal and to develop a short-list of options for further detailed analysis. It focuses on developing the strategic and economic cases for the project and includes an outline of the financial, commercial and management cases.

It is anticipated that this IBC will be followed by a Detailed Business Case (DBC), which will develop the preferred BRT option in detail, including detailed design and a detailed economic evaluation, as well as detailed consideration of financial, commercial and management aspects.

The IBC has been developed collaboratively between three partner organisations – the Transport Agency, Greater Wellington Regional Council (GWRC) and Wellington City Council (WCC).

Strategic Case

Background

The Ngauranga to Wellington Airport Corridor Plan 2008 (N2A Plan), developed by GWRC in collaboration with WCC and the Transport Agency and now included in the Regional Land Transport Plan 2015 (RLTP), outlined a multi-modal strategic plan to improve the way people travel around Wellington City and their access to key destinations and amenities.

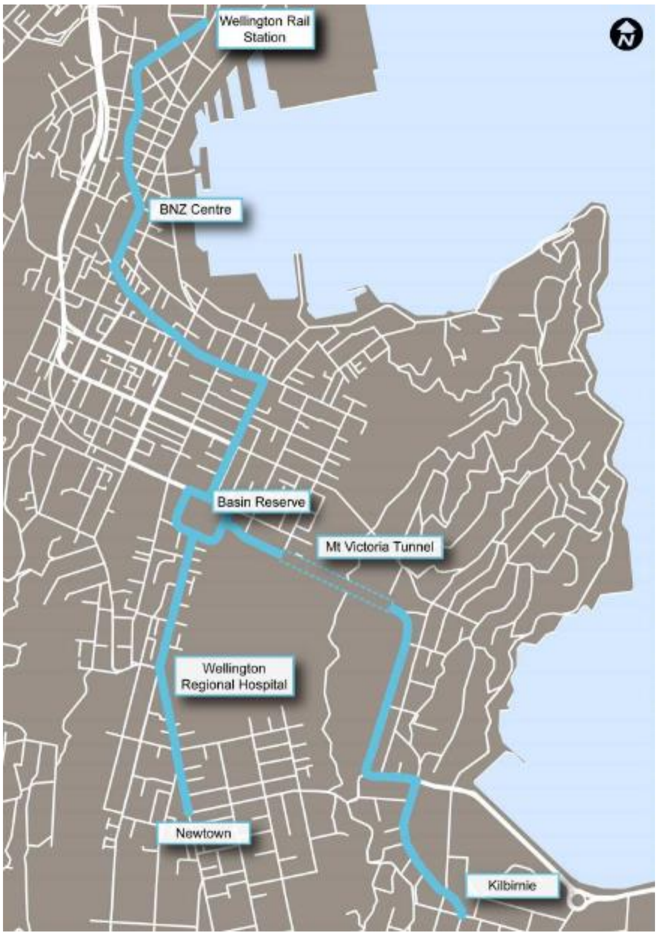
The Wellington Public Transport Spine Study (PTSS) was a key action arising from the N2A Plan. The PTSS investigated the feasibility of a large number of different options for creating a high-quality ‘PT spine’, arriving at a short-list of three options: bus priority, BRT and Light Rail Transit.

BRT was identified as the preferred option. Following community consultation in March 2014, the Regional Transport Committee agreed to progress BRT detailed planning and design, and to enable its implementation to be included in the 2015 RLTP[1]. GWRC, WCC and the Transport Agency agreed to work together to develop an IBC for BRT to provide clarity on the option to be taken forward for detailed design.

The BRT solution proposed for Wellington, developed for Wellington's unique context, involves:

- running of low-emission high-capacity buses:
    - along dedicated bus lanes, separate from general traffic (at grade, and using the same intersections)
    - between the Railway Station and Newtown/Kilbirnie (see Figure 1 below)
    - at a frequency sufficient to cater for demand and growth
- signal priority for buses at intersections (where deemed feasible)
- improved stop and station facilities
- integration with the new simpler and more efficient bus network for Wellington City
- a number of operational improvements, including integrated fares and ticketing, the development of mobile timetables and improvements in the provision of real-time bus location information.

Figure 1. Proposed BRT route



Source: PTSS presentation to stakeholders and interest groups (August 2013)

[1] Greater Wellington Regional Council (13 May 2014), Minutes of the Regional Transport Committee, 4 March 2014; minute 3.2.b.

This business case is for one part of this BRT solution – the physical infrastructure (roadspace and intersection priority, and stop/station infrastructure). The other elements of the BRT solution are currently undergoing their own assessment processes. For example, a business case for integrated fares and ticketing has been recently prepared.

The physical BRT infrastructure is a key element of the wider solution, as it is the part that enables faster and more reliable PT journeys. However, it is only one element – it needs to be considered as part of the full BRT solution. The full benefits of the physical infrastructure can only be achieved with the implementation of all the other parts of BRT.

In addition, the BRT solution is itself just one part of a wider transport solution planned for the Ngauranga to Airport corridor. Other aspects of this transport solution include state highway improvements, cycling infrastructure improvements, and addressing conflicting traffic demands at key locations.

The case for change

People travelling in Wellington consistently experience congestion, particularly at peak periods and at key network bottlenecks. The PT Spine corridor is particularly congested.

Bus users who travel along the PT Spine currently experience longer journey times compared to private vehicles. Bus services can also be unreliable. This is primarily a result of congestion along the PT Spine and buses having to compete with general traffic (and other buses) along the majority of the route. This limits the attractiveness of PT services to Wellington commuters. It restricts the ability for PT to attract new users and to shift private vehicle users to PT.

Together, these issues harm productivity – both for commuters who spend longer getting to and from work, and for organisations for which moving from place to place is a key part of their business. Congestion also impacts on freight movements. This limits Wellington's economic growth potential.

Giving buses priority both over roadspace and at intersections will enable faster and more reliable PT journeys. This will help make bus travel more attractive relative to private vehicles, which will remain in general traffic congestion. Because buses can carry far more people than private vehicles, giving them priority increases the carrying capacity of the whole corridor, and allows more people to travel along the PT Spine at peak periods.

Faster and more reliable journeys via BRT will drive improvements in the productivity of workers and businesses, and drive increases in Wellington's economic growth. Empirical evidence suggests that the economic benefits from even relatively small improvements to speed and reliability could be substantial, particularly for individual businesses[2].

Relatively slow and unreliable PT services, and the lack of a coherent and permanent PT Spine, has not helped the development potential of land around the PT Spine for higher-value uses, which is part of WCC's land-use plans. Consequently, Wellington is not maximising the potential land-use along the PT Spine corridor.

There are benefits to acting now. Congestion is already heavy at peak times and is limiting productivity and economic growth. Future population and economic growth will exacerbate it, but the problem exists today. Furthermore, PT patronage has begun to plateau.

However, one of the key benefits of BRT as a PT initiative is that it can be implemented incrementally. There may be merit in staging the implementation, or altering the timing to coordinate with other transport projects.

---

[2] See for example: Eddington, R. (December 2006), The Eddington Transport Study: Main report: Transport's role in sustaining the UK's productivity and competitiveness.

Implementation of BRT, along with other planned PT initiatives, has the potential to create a major step-change in the delivery of PT in Wellington. PT will become increasingly attractive and competitive with private vehicle travel, allowing more people to travel along the PT Spine corridor at peak times, with many achieving much faster and more reliable journeys, as well as freeing up road space on other corridors.

As an example of the impact that investment in PT can have, significant recent investment in Wellington's rail network has seen corresponding increases in patronage, as potential users respond to improved levels of service.

If Wellington wants to be a 21st century city, it needs to have a 21st century transport network, of which a 21st century PT network is a vital component. Wellingtonians and their goods need to be able to move around the city quickly, reliably, comfortably, and in large numbers. This is how Wellington can continue to grow, while still providing a high quality of life for its residents.

Strategic context

BRT is consistent with the strategic direction set by Central Government, the Transport Agency, GWRC and WCC, as outlined in the relevant strategic and planning documents. It is consistent with the plans for increasing PT mode share, and it will help alleviate congestion and improve productivity and economic growth. The relevant strategic and planning documents include:

- The Government Policy Statement on Land Transport Funding (GPS)
- The Transport Agency Statement of Intent 2014-18
- The Wellington Regional Land Transport Plan 2015 (RLTP)
- The Wellington Regional Public Transport Plan 2014 (RPTP)
- WCC's 2015-25 Long-Term Plan (LTP)
- WCC's draft Urban Growth Plan.

The GPS has increasing economic growth and improving productivity as the primary objectives for land transport expenditure. The expectation is that land transport funding will be directed into high-quality projects and activities that will support this objective. Consistent with this, economic growth is a key objective in the RLTP.

The RLTP notes a number of regional pressures, including traffic congestion and network capacity constraints, reliability of the transport network, and PT capacity and mode share.

Making quality investments in the area of public transport is highlighted in the GPS as an important strategic response to the goals of improved productivity and economic growth. Increasing peak period PT mode share is stated as a key outcome desired by the RLTP, as is reducing severe road congestion.

The N2A Plan is now included as a chapter in the RLTP, titled the Ngauranga to Airport Corridor Strategy (N2A Strategy). One of the seven strategic responses set out in the N2A Strategy is "developing a high quality and frequency PT priority 'spine'". Other strategic responses relate to capacity improvements on State Highway 1 (SH1) and addressing conflicting transport demands at the Basin Reserve.

The RPTP sets out the current programme for improvements to Wellington's PT services over the next 10 years. The PT Spine, from the Railway Station to Newtown and Kilbirnie, is central to the delivery of the overall plan. Implementing BRT along the PT Spine is considered the "immediate priority" for the Ngauranga to Airport corridor, alongside addressing conflicting transport demands around the Basin Reserve.

While BRT is clearly well-aligned with the relevant strategic documents, a key issue is the alignment and dependencies with the Transport Agency's Roads of National Significance (RONS) programme – in particular, the Basin Bridge and Mt Victoria tunnel duplication projects. These projects are another part of the response to the N2A Strategy.

The PTSS assumed that both of these projects would occur before BRT was implemented and the BRT option was assessed as such. However, resource consent for the Basin Bridge has since been declined (this is currently under appeal), and this has led to the Transport Agency re-evaluating the Mt Victoria tunnel duplication (this process is ongoing). In the economic case, we consider options that allow for a BRT solution without these RONS projects.

Key findings

There is a demonstrable problem with the current PT network along the PT Spine.

- The corridor is congested, particularly at peak times and this is forecast to worsen.
- It is difficult to increase PT patronage and mode share under the current circumstances. Buses are not segregated from general traffic. Wellington's bus services are perceived by the public as being less attractive and less reliable than private vehicle journeys.
- The issues with PT are restricting envisaged redevelopment of land around the southern and eastern ends of the PT Spine into higher-value uses, and limiting the potential economic activity in these areas.

A BRT solution can help address these problems. BRT can:

- provide faster and more reliable bus journeys along the PT Spine
- increase the corridor carrying capacity along the route
- help improve the bus user experience
- contribute to increasing PT patronage and PT mode share along the PT Spine
- help grow the total number of people able to travel along the PT Spine during peak periods.

This will help drive Wellington's economic and productivity growth. It will also encourage greater economic activity in the areas surrounding the PT Spine.

BRT is consistent with the strategic direction set out by Central Government, GWRC and WCC. It is a key initiative in terms of implementing Central Government's focus on improving productivity and economic growth. BRT will also help achieve a number of GWRC's and WCC's objectives, in particular economic growth, urban regeneration and improved accessibility. BRT along the PT Spine is the most important and most beneficial PT project currently being considered for Wellington, and is a key element of all current transport plans for the Wellington region.

Economic Case

This economic case is based on a best practice decision making approach for infrastructure projects and the level of detail appropriate for an IBC. A small set of options have been developed, differing across the key areas of material difference. These options are subjected to two types of economic assessment:

1. A qualitative assessment against a set of agreed criteria, typically referred to as a multi-criteria analysis (MCA).
2. A quantitative assessment, involving the development of benefit-cost ratios for the options. For a transport project such as this, this assessment is undertaken with reference to the Transport Agency's Economic Evaluation Manual (EEM).[3]

---

3 NZ Transport Agency (1 July 2013), Economic evaluation manual.

Options considered

The reference case

In the economic assessment, all options are assessed relative to a 'base case' scenario. This represents what is expected to happen if the project does not go ahead. The costs and benefits of the BRT options are determined relative to this reference case.

The reference case is not a 'do nothing'. It is a 'do minimum', and includes other projects along the PT Spine and ongoing maintenance spending for example.

The reference case for BRT includes or assumes:

- the current network of bus lanes and bus priority across Wellington City
- currently planned roading improvements. In particular:
  - The Basin Bridge and associated improvements; or another grade separated solution
  - Mt Victoria tunnel duplication, and associated improvements to Ruahine Street
  - All other Wellington RONS
- changes to Wellington bus services as a result of the Wellington City Bus Review, including:
  - Revisions to bus network running patterns
  - Optimisation of bus stops locations
  - Other user improvements
- the complete implementation of the Public Transport Operating Model (PTOM) contracts
- the introduction of integrated fares and ticketing (as currently envisaged by that project's business case)
- the use of high-capacity buses (eg double-decker) on some Wellington City bus routes, where warranted by demand
- buses will run at a frequency necessary to cater for demand and growth.

The BRT options

The Working Group considered that the most material features of the options, and hence those where different variants should be considered, were the degree of dedication of the bus lanes and the degree of intersection priority given to buses.

The BRT option in the PTSS assumed complete dedication and intersection priority, such that buses could essentially move freely throughout the route without congestion. The Working Group wanted to consider some variants of this BRT solution that involved lower degrees of dedication and priority. In effect, the Working Group wanted to assess options that spanned a continuum from the PTSS BRT option to the PTSS Bus Priority option.

Four distinct options were developed to reflect this continuum:

- Physically separated bus lanes along the full route, operating at all times (in effect, the PTSS BRT option)
- Bus lanes along the full route, operating at all times
- Bus lanes along selected parts of the route to target key congestion areas, operating at all times

- Bus lanes along the full route, but only operating at peak times.

In addition, a separate option was considered, based on a detailed possible plan recently developed by WCC, for bus priority improvements along the Central and Newtown branches.

Table 1 sets out the type of roadspace and intersection priority assumed for each of the core options.

Table 1. Key elements of core options

Option #	Type of roadspace dedication	Level of intersection priority
1	Improved bus priority	Limited priority
2	Bus lanes, along the whole route, at peak periods	Limited priority
3	Bus lanes in targeted locations, 24/7	Limited priority
4	Bus lanes, along the whole route, 24/7	Full priority
5	Physically separated bus lanes, along the whole route, 24/7	Full priority

BCR and MCA results

Table 2 presents the estimated benefits, costs and the benefit-cost ratios (BCRs) for the core BRT options. All dollar values shown are net present values over 40 years. Table 3 shows the MCA scores for the core options.

Table 2. Costs, benefits and BCRs – core BRT options

$m NPV	1	2	3	4	5
Benefits:					
Travel time benefits	5.9	15.3	19.0	28.1	32.9
Additional PT user benefits	0.0	0.0	0.0	5.8	6.0
Reliability benefits	5.9	15.3	19.0	28.1	32.9
Walking benefits	0.1	0.3	0.3	16.4	17.1
Emissions reductions benefits	0.1	0.3	0.3	0.3	0.4
Agglomeration benefits	0.9	2.3	2.8	4.2	4.9
Decongestion (dis)benefits	(4.9)	(4.4)	(4.3)	(4.0)	(3.7)
Reduction in vehicle operating cost benefits	3.8	10.7	11.0	13.3	17.5
Total benefits	**11.8**	**39.7**	**48.0**	**92.2**	**108.1**
Costs:					
Capex	24.3	72.1	43.4	97.2	132.9
Opex (savings)	(2.4)	(20.8)	(22.8)	(36.8)	(45.4)
Total costs	**21.9**	**51.3**	**20.6**	**60.4**	**87.5**
Benefit-cost ratio (benefits/costs)	**0.5**	**0.8**	**2.3**	**1.5**	**1.2**

Table 3. Results of multi-criteria analysis – core BRT options

	Ref case	1	2	3	4	5
1. Increased economic activity	● (grey)	● (light green)	● (green)	● (dark green)	● (dark green)	● (dark green)
2. Improved multi-modal network efficiency	● (grey)	● (light green)	● (green)	● (green)	● (green)	● (green)
3. Improved accessibility	● (grey)	● (light green)	● (green)	● (dark green)	● (dark green)	● (dark green)
4. Increased PT patronage	● (grey)	● (light green)	● (green)	● (dark green)	● (dark green)	● (dark green)
5. Improved PT user experience	● (grey)	● (grey)	● (light green)	● (light green)	● (dark green)	● (dark green)
6. Minimise emissions	● (grey)	● (grey)	● (light green)	● (light green)	● (green)	● (green)
7. Minimise impacts on physical environment / amenity	● (grey)	● (grey)	● (grey)	● (grey)	● (yellow)	● (yellow)
8. Affordable / value for money	● (grey)	● (grey)	● (light green)	● (light green)	● (light green)	● (light green)
9. Alignment / integration with other infrastructure & services	● (grey)	● (yellow)	● (green)	● (green)	● (green)	● (green)

Negative effects ● (red) ● (orange) ● (yellow) ● (grey) ● (light green) ● (green) ● (dark green) **Positive effects**

Discussion of trade-offs

The options involve a range of different types of BRT solution, each with different pros and cons.

Wellington can have the highest quality BRT system considered (Option 5), but this comes at a cost. The analysis of the intermediate options shows that there is an opportunity for Wellington to achieve a significant proportion of the benefits of a high-quality solution for a much lower cost.

For example, Option 4 is cheaper than Option 5, but still enables significant benefits to be achieved through having dedicated bus lanes along the full BRT route. Option 3 is considerably cheaper still, but still enables a considerable improvement over the reference case in terms of the ability to move people around the city.

All the options move people along the PT Spine faster and more reliably, to varying levels, than is currently the case. But they vary quite a lot according to the other objectives and strategic goals they satisfy.

Option 3 enables considerable improvements in moving people around the network. However, the discontinuous nature of the bus lanes means that it is unlikely to have the type of transformational effect that Option 5, and to a lesser extent Option 4, would have. Options 4 and 5 could provide a material step-change in Wellington's PT infrastructure.

BRT can be implemented incrementally. Instead of a one-off transformational step-change, incremental improvements could be made over time. For example, it is possible to deliver Option 3 now and then further develop the infrastructure by effectively moving to Option 4 or 5 at a later date.

As well as significant financial implications, high-quality BRT solutions also have costs in terms of their effects on other road users. As more dedication and priority is allocated to PT, more of the roadspace must be taken away from general traffic and/or parking (or the road is widened, with consequent environmental effects).

Finding a solution to conflicting transport demands at the Basin Reserve is critical to implementing a high-quality BRT system. Without such a solution, the Transport Agency will not duplicate the Mt Victoria tunnel and the Kilbirnie branch of the proposed BRT solution will not be able to proceed.

The BCRs for the option variants without the Kilbirnie branch are substantially lower than those that include it. Also, the option variants without the Kilbirnie branch are likely to overstate the true BCR of implementing BRT in the absence of the RONS – without the Basin Bridge (or a solution of similar effectiveness), the actual traffic outcomes for trips from Newtown will likely be inferior to those modelled.

Preferred options

The preferred options from the economic analysis are Options 3 and 4.

The PTSS envisaged a BRT solution with physically separated lanes along the full route from the Railway Station to Newtown and Kilbirnie. However, the economic analysis has demonstrated that this is not the only sensible approach to implementing a BRT solution.

The majority of the travel time benefits can be achieved by providing additional priority to buses at and around key intersections along the route. The economic analysis has shown that a targeted approach to BRT could provide a cost effective improvement to bus services along the PT Spine.

Option 3 will deliver a very good outcome in terms of moving people around Wellington City faster and more reliably, for an up-front capital investment of $59m (compared to $174m for Option 5). It also has lower adverse impacts on traffic and parking than Options 4 and 5.

Options 3 and 4 have indicative benefit-cost ratios of 2.3 and 1.5 respectively. These are relatively high for a PT project. The roadspace dedication of Option 3 could also be combined with the intersection priority of Option 4 to deliver even greater benefits.

The economic analysis suggests that Options 3 and 4, or a combination of them, are appropriate options for further consideration. Option 3 appears the best value-for-money approach – a good outcome for a relatively low cost. But if a high-quality, more transformational, outcome is desired, Option 4 appears the best approach – this is a lower cost version of Option 5, achieving a large proportion of the benefits.

Wellington can have the highest quality BRT solution possible (Option 5) if it desires. However, it will cost a lot more than Options 3 and 4 and involve more substantial effects on other road users and the physical environment. The economic analysis suggests that Option 5 may not be the best use of resources.

Options 3 and 4 have been identified as the preferred options on the basis that they deliver much of the benefits of Option 5 but with a more efficient use of resources.

These options also do not preclude upgrades to a higher-quality solution in the future. If Option 3 is chosen today, Options 4 or 5 could still be implemented at a later date if warranted.

It is also recommended that, if physically possible, only options that include the Kilbirnie branch are considered further. A key result from the consideration of the different option variants is that the Kilbirnie branch is essential to the viability of a BRT solution. This helps to partially illustrate the effect of complete transport networks. Designing a network as a whole enables optimisation across the PT network, as well as other road users.

Financial Case

Expected costs

BRT is expected to involve a capital investment of between $31m and $174m, depending on the option chosen. This may be spread over time, depending on the form and timing of the implementation.

Assuming the current funding arrangements for PT in Wellington are retained, the Transport Agency will fund 51% of BRT, with the remainder to be funded by GWRC and WCC. It is expected that WCC will fund the majority of this remainder, as current arrangements involve WCC funding road-related infrastructure, which comprises most of the expected capital cost.

In addition, operating savings are expected from BRT due to more efficient bus operations. These savings will benefit GWRC, as the funder of bus operations.

Current funding status

The National Land Transport Programme (NLTP) sets out the items to be funded by the Transport Agency via the National Land Transport Fund (NLTF) for a 3-year period, based on the programmes and activities submitted through RLTPs. This is set every 3 years, but can be varied during that period. The NLTP 2015-18 includes two BRT related activities: GWRC's Bus Rapid Transit Implementation Plan 2015-18 (intended for DBC phase, total cost approximately $3m) and WCC Wellington City BRT Infrastructure Improvements (total cost $60m). Both activities have 'proposed' status, which means that funding approval may be given when an application is made in 2015-18 provided further evidence is required to confirm the assessment profile and provide confidence in the funding priority and availability of funds.

The DBC phase will provide further certainty about the total cost of BRT implementation. To ensure enough local share is available for BRT implementation, WCC and GWRC will need to continue to factor the results of the IBC and future DBC phase into their respective annual and long term planning processes.

Commercial Case

There is a range of possible procurement models across a spectrum of public and private sector participation with associated risk transfer. These models include: traditional models, relationship based models, privately financed models, and managing contractor procurement models.

The most appropriate procurement model for BRT will be determined in the detailed business case. Factors that will impact the assessment of the procurement approach will include:

- Implementing BRT could be relatively straight forward with well-defined objectives and tangible outcomes. There might be few identifiable factors that would of themselves suggest a change from a traditional procurement model.
- The BRT project is likely to be funded through standard methods by the Project Partners.
- The BRT project is not overly complex. Costs, risks and scope can be well defined. Traditional models fare better in these situations, and there are not likely to be factors which would prohibit traditional models from being applied.
- There are three Project Partners. However, this can be well managed as roles and responsibilities are clearly defined, for example continuing existing policy delineating local roads, state highways and PT operations. The BRT project should be able to follow existing policy.
- The cost of designing and constructing the BRT infrastructure will vary considerably depending on the preferred option chosen. Option 3 is a low cost for an infrastructure project. Option 5 is far more substantial.
- The practicalities, or otherwise, of bundling the design and construction of the BRT infrastructure with the delivery of BRT services (and allied services as appropriate).

Management Case

There are a number of projects along the PT Spine and wider Ngauranga to Airport corridor that the BRT project needs to coordinate with. A separate workstream is currently underway, developing a sequencing and programming plan for all the corridor projects. At the moment, it makes sense for the BRT project team to continue to be a part of that workstream. However during any subsequent DBC the specifics around timing and integration with other projects will need to be determined.

The physical BRT infrastructure could be delivered as a single project or in multiple stages. It could also be combined with the delivery of other projects in the same location, including potentially combining consenting processes.

There are a number of project risks, many of which could lead to BRT not being fully delivered. However, these should be able to be adequately managed.

There is nothing in terms of delivery which, at this stage, appears prohibitively difficult or likely to suggest that this project should not proceed. There is nothing in the management case that suggests that the next stage of more detailed assessment should not be undertaken.

The next step in the assessment process is a DBC. Key items not undertaken at the IBC stage are: detailed design and optimisation of BRT options; detailed transport modelling of all options; fully quantifying all the costs and benefits for all options; and detailed development of the financial requirements, and the funding, procurement and management plans. These will all be part of a DBC.

A key decision to be made before any DBC begins is whether the different elements of the detailed assessment are to be undertaken together or separately. The entire DBC, including all the design work, could be procured and undertaken as one project. Alternatively, it could be split into multiple pieces and undertaken in stages.

Recommendations

This IBC provides support for more detailed analysis of BRT to be undertaken in a DBC. The economic analysis suggests that the options that are most appropriate for further consideration are Options 3 and 4.

Furthermore, nothing in the financial, commercial or management cases has indicated that a DBC should not proceed. There are a number of items that will need to be addressed at that stage, such as approval of funding, determining the appropriate sequencing and coordination with other projects and determining a procurement strategy. However none of these are sufficiently problematic that a DBC should not proceed.

Finding a solution to conflicting transport demands at the Basin Reserve is critical to the ability to implement a high-quality BRT system. Without such a solution, the economic viability of the BRT project is reduced considerably. We understand that the Transport Agency is committed to finding such a solution and it is recommended that the BRT project continue to proceed on that basis (with additional consideration given during a DBC).

A DBC for BRT is recommended – of Options 3 and 4, or a combination of both, or Option 3 moving to Option 4 at a later date.

The Indicative Business Case

What is an IBC?

The role of the IBC is to identify the preferred way forward for an investment proposal. It is used to provide evidence of reducing a long list of investment options to a short list, ensuring that only investment options which present a compelling case are investigated further. In doing so, the IBC attempts to avoid significant time and expense being dedicated to options which should not proceed.

The IBC re-confirms the preferred option's (from previous analysis, in this case the PTSS) alignment with the strategic context of the organisation(s), confirming the case for change and the need for the investment. It demonstrates the effectiveness of the proposed investment in and indicates the efficiency of the proposal.

Furthermore, a feature of the IBC is that key issues and risks are highlighted at an early stage. This can help to identify options which should not proceed or to frame detailed analysis at the DBC stage. In addition, it can guide stakeholder engagement after issues have been highlighted.

An IBC does not investigate each option in the level of detail necessary to approve implementation. That will occur at the subsequent DBC stage. The IBC involves an indicative assessment only, whereas a DBC will analysis the effects of the options in much more detail.

What does this IBC aim to do?

BRT was the option preferred by the PTSS for improving PT along the PT Spine corridor from the Railway Station to Newtown and Kilbirnie.

This IBC for a BRT solution recommends a preferred way forward for further investigation. It considers a set of possible options, and recommends an approach for detailed analysis which justifies the time and expense of the investigation. Analysis is at a broad level for each of the options, recognising the work that has been previously completed and the value of the potential investment.

In particular, this IBC aims to:

- re-confirm the strategic context and BRT's role within the strategic context (in the strategic case)
- confirm the rationale for BRT and the case for change (in the strategic case)
- recommend the preferred options for further analysis (in the economic case)
- demonstrate the effectiveness of the options (in the strategic case and the economic case)
- show the indicative costs, benefits and disbenefits of the options, thereby demonstrating the potential efficiency of the options (in the economic case)
- highlight risks and trade-offs of the BRT options (in the economic case).

Information base

To determine the costs and the transport effects of the options considered, we have relied on analysis undertaken for the PTSS. We have not undertaken additional analysis of costs or transport effects in this regard. The PTSS evidence was considered suitable for an IBC. This information:

- was peer reviewed as part of the PTSS
- was obtained relatively recently, and within a timeframe where traffic patterns may have changed but are not likely to have changed significantly as to materially affect the validity of the IBC conclusions

- is detailed enough to allow analysis at an IBC, including interpolations for different options.

We note that the options considered in this IBC are slightly different from the options considered in the PTSS. We have used professional judgement, tested with relevant experts including GWRC's transport modelling team, to make assumptions and interpolations to derive estimates for our options from the PTSS information.

This evidence was considered sufficiently robust to undertake an indicative assessment of the options. A more detailed evidence base will be required to consider any options in detail as part of any subsequent DBC.

The Better Business Case approach

The business case approach, following Treasury's Better Business Case guidelines, is relatively new. Less than a handful of IBCs have been completed to date, and benchmarks for the level of the analysis and the level of the evidence base required have not yet been determined.

While this IBC was being developed, the Transport Agency released the 2015-18 NLTP Investment Assessment Framework, which includes updated expectations regarding the preparation of IBCs. The broad framework for investment decisions under an IBC is the same as we previously understood it to be. Identifying the strategic fit of the problem, the issue or opportunity to be solved, the effectiveness and economic efficiency of the proposed solution, to drive value for money investments, remain key elements of the investment assessment framework.

The analysis in this IBC supports the decision making process under the 2015-18 NLTP Investment Assessment Framework. The final decision for funding will not take place until after a DBC is prepared.

How does this IBC align with the new IBC guidelines?

The aim of the IBC is to recommend the preferred way forward for further investigation – this has not changed. However, the expectations of the IBC have been clarified. These expectations, and the extent to which this IBC aligns with them, are outlined below.

The size of the report commensurate with the complexity of the exercise

Implementing BRT is likely to be a relatively simple transport project, with clear roles and responsibilities for the Project Partners, following existing policy. There is not significant scope for novelty, in terms of the options developed or the procurement process. The level of funding is toward the low end of the scale of transport projects subjected to the business case process.

This IBC takes an approach for preparing analysis commensurate with the level of complexity, ensuring that the analysis is fit for purpose.

Continue the progressive case and include a clear line of sight to support evidence collected

This IBC documents the re-confirmed alignment to strategic objectives, and confirms the problem identified and the case for change. It was determined that the PTSS evidence was appropriate to use as a basis for this IBC, with additional information provided by GWRC's transport modelling team as appropriate. We note that it could be considered that more detailed evidence, particularly for the 'intermediate' options, than that collected for this IBC would better satisfy these new expectations.

Detail the long list of options, ensuring a wide range of options has been considered

We outline the list of options considered in the economic case. The long list of options was developed by the project Working Group and takes into consideration a range of quality levels for BRT (ie the degree of intersection and road priority), with variants based on a range of possible timings.

Show that the options optimise value for money

The indicative economic efficiency of the options is shown in the cost-benefit analysis. The cost-benefit analysis was taken a step further than the PTSS economic evaluation, assessing a broader range of benefit categories where this has been possible.

Justify how the short listed options were selected and why the other options were rejected

The five cases document the process that was undertaken to select the preferred option. The MCA and the CBA, within the economic case, provided the primary information used to consider the relative merits of the options. The discussion and conclusions sections set out the rationale for the options considered to be worth further analysis.

Demonstrate the short list of options aligns with the other elements of the programme within the programme business case as well as within the overall case for change

The preferred options identified align strongly to the strategic context and propose a value for money solution to the problem identified. This is set out in the strategic case, as well as the discussion of the trade-offs between options.

A collaborative, no surprises approach

The project Steering Group and Working Group, made up of officials from the Project Partners, met regularly while developing the IBC. The IBC was developed in a collaborative manner, with input from the Project Partners.

Introduction

This business case assesses the case for a proposed investment in BRT in Wellington City.

This business case follows the Transport Agency business case approach. This approach is based on the Treasury Better Business Cases guidelines, which are organised around the five case model designed to systematically test whether an investment proposal:

- is supported by a robust case for change – the 'strategic case'
- will deliver optimal value for money – the 'economic case'
- is commercially viable – the 'commercial case'
- is financially affordable – the 'financial case', and
- is achievable – the 'management case'.

This document is an **Indicative Business Case**. Its objectives are to confirm the preferred way forward for the proposal and to develop a short-list of options for further detailed analysis. It focuses on developing the strategic and economic cases for the project and includes an outline of the financial, commercial and management cases.

It is anticipated that this IBC will be followed by a DBC, which will develop the preferred BRT option in detail, including detailed design and a detailed economic evaluation, as well as detailed consideration of financial, commercial and management aspects.

1. Strategic case

1.1 Background

This section provides background information on the business case. It sets out what we mean by BRT in the context of this IBC, the process that has led to an IBC for BRT being undertaken, and the organisations leading the development of the business case.

1.1.1 What do we mean by 'BRT'?

Bus Rapid Transit in its most comprehensive form is a high-quality, high capacity bus system that improves upon traditional bus systems. Modern, comfortable, high-capacity buses travel in dedicated lanes, separated from general traffic, parking, turning traffic and other impediments. Passengers board from raised platforms (slightly higher than street level), having paid their fares electronically.

Standards have been developed to assess how close a given BRT system is to the above ideal. The Institute for Transportation and Development Policy assigns gold, silver and bronze rankings, depending on the quality of a BRT system. Many cities have started with an existing bus system and developed a customised BRT version that fits with the city's specific circumstances.

A specific BRT solution has been proposed for Wellington's context. It involves elements of the above ideal standard, tailored to suit the constraints of the PT Spine corridor.

1.1.2 The Wellington context

Ngauranga to Airport Corridor Plan

The N2A Plan, developed by GWRC in collaboration with WCC and the Transport Agency, outlined a multi-modal strategic plan to improve the way people travel around Wellington City and their access to key destinations and amenities.

The N2A Plan has been updated and included as a chapter within the RLTP, now entitled the N2A Strategy. Consistent with the N2A Plan, it includes a package of seven measures or strategic responses from across all transport modes and networks. The strategic responses are:

- Developing a high quality and high frequency PT priority 'spine'.
- Implementing safety and capacity improvements to SH1.
- Addressing conflicting transport demands at the Basin Reserve.
- Reallocating traffic between Ngauranga and the CBD.
- Improving key walking and cycling routes.
- Continuing a programme of travel demand management measures.
- Identifying and addressing network vulnerabilities.

Integration with other Ngauranga to Airport and PT transformation activities will be critical to the success of BRT in Wellington.

Wellington Public Transport Spine Study

One of the recommendations of the 2008 N2A Plan was to undertake a feasibility study for a high-quality PT system. This resulted in the PTSS.

A BRT solution for Wellington was the preferred option in the PTSS, finalised in 2013. The BRT solution proposed for Wellington, developed for Wellington's unique context, involves:

- running of low-emission high-capacity buses
    - along dedicated bus lanes, separate from general traffic (at grade, and using the same intersections)
    - between the Railway Station and Newtown/Kilbirnie (although most services would run beyond the area of the BRT infrastructure)
    - at a frequency sufficient to cater for demand and growth
- signal priority for buses at intersections (where deemed feasible)
- improved stop and station facilities
- integration with the new simpler and more efficient bus network for the whole of Wellington City
- a number of operational improvements, including integrated fares and ticketing, the development of mobile timetables and improvements in the provision of real-time bus location information.

In March 2014, following community consultation, the Regional Transport Committee agreed to progress BRT detailed planning and design, and to enable its implementation to be included in the 2015 RLTP. GWRC, WCC and the Transport Agency set up a joint project team to work on the detailed design and planning of the BRT spine corridor. This IBC is a component of the work being undertaken by the joint project team.

Indicative Business Case content

The BRT solution and the associated detailed design and planning have been split into a number of different elements for assessment and implementation. This IBC only relates to the physical infrastructure for BRT – the creation/extension of dedicated bus lanes and intersection priority, as well as any additional or improved stop/station infrastructure.

These are critical elements of BRT, particularly the roadspace allocation changes and intersection priority. They are the parts that make it 'rapid',[4] as well as reliable and will drive improvements in accessibility and network efficiency.

Elements of the BRT solution that are being assessed and implemented separately are:

- the use of high-capacity buses
- integrated fares and ticketing
- operational and user technology improvements
- the Basin Bridge, Mt Victoria tunnel duplication, and other roading improvements that will be integral to implementing the BRT.

These elements together with the physical infrastructure addressed in this IBC form the comprehensive BRT solution. The full benefits of each element will be achieved with the full implementation of all the other parts an in integrated manner.

A key dependency for part of the BRT solution is the Basin Reserve roading improvements. Finding a workable solution to conflicting transport demands through the Basin Reserve area is necessary to maximise the benefits of BRT. Most notably, implementing BRT from the Basin Reserve to Kilbirnie is only possible with a duplicate Mt Victoria tunnel. That will only occur if the associated Basin Reserve improvements are made.

---

4 We note that in Wellington's context this does not conflict with the speed limits on the roads along the BRT route. Rather it means the ability for buses to travel along the route with minimal delays.

Another key part of the wider BRT project is optimisation of the bus network. Following the 2011 Wellington City Bus Review, a new bus network is proposed to begin operating in Wellington City in mid-2017. The new network will change the services and routes currently used, providing the same level of service with fewer buses. This will reduce the number of buses travelling along the PT Spine, particularly the Golden Mile, helping to alleviate the congestion caused by multiple buses trying to use the same lane at the same time.

1.1.3 The Indicative Business Case stage

This IBC is an important step in the assessment process for BRT. Consistent with the decision of the Regional Transport Committee, it is focussed solely on BRT solutions, as opposed to the wider range of solutions considered in the PTSS.

The IBC is not intended as the only step between the PTSS (and the Regional Transport Committee decision) and implementation of a BRT solution. It is an IBC only, which is anticipated to be followed by a DBC, as per the Transport Agency's business case approval process (based on the Treasury's Better Business Cases), and an implementation plan.

The role of the IBC is to identify and evaluate all reasonably feasible BRT solutions and narrow the scope of high net value options down to a few that can be subject to detailed design, costing and analysis in the DBC, which is the next step in the assessment process after the IBC. A possible scope for a DBC is outlined in the management case.

This two stage IBC then DBC process recognises that there are a number of options for how BRT could be configured and the outcomes delivered. It is necessary to evaluate all feasible options to identify the option that will deliver the best value for money for Wellington.

1.1.4 The project partners

This IBC is a collaborative exercise across three partner organisations – GWRC, WCC and the Transport Agency. A joint project team has been established to develop the IBC.

Greater Wellington Regional Council

GWRC is the organisation primarily responsible for overall regional planning, including land-use, land transport and PT planning. GWRC is also responsible for the PT network and delivering PT services across Wellington. It undertakes asset management planning, including for new works, manages the operation of the network, and is responsible for arranging funding and contracts for service delivery.

GWRC led the development of the PTSS, with support from WCC and the Transport Agency.

Wellington City Council

WCC is the Road Controlling Authority for the majority of the roads forming the BRT corridor and has responsibility for planning, operations, management and maintenance of these roads.

WCC is also responsible for land-use planning in Wellington City. It prepares and updates various area plans, to give effect to the relevant strategic directions for transport planning for the city. WCC has provided advice throughout the business case process regarding the consistency of planned land use and the transport investments proposed.

New Zealand Transport Agency

The Transport Agency is the crown entity responsible for planning and investing in land transport networks, managing the state highway network and providing access to, and use of, the land transport system.

The Transport Agency is the host government agency for the development of the IBC. Under current NLTF investment criteria, it might fund approximately 50% of the capital cost of BRT implementation and approximately 50% of the cost of operating the BRT.

In its role as manager of the state highway network, the Transport Agency is leading and funding the Wellington Northern Corridor RONS programme. Elements of the BRT are dependent on the construction of the Basin Bridge, Mt Victoria tunnel duplication and Ruahine Street improvement projects.

Other stakeholders

There are a number of additional stakeholders which will likely have influence on the eventual project outcomes. These include:

- Wellington Inner City Residents and Business Association
- Wellington City Council Accessibility Advisory Group
- Wellington Civic Trust
- Retail NZ
- Public Transport Voice
- Wellington Property Council
- Bus operators and the Bus and Coach Association.

These organisations were all involved in the development of the PTSS.

1.2 Why is BRT important for Wellington?

A 21st century city

21st century cities are proactive rather than reactive. They stay ahead of the demand curve rather than struggle to keep pace with demand. They offer attractive places in which to live, work and do business.

21st century cities have 21st century infrastructure networks. Strong infrastructure, including transport infrastructure, enables vibrant city life and a prosperous economy. It transforms prosperity into social enrichment and a higher quality of life. The importance of infrastructure to modern civilisation cannot be overstated. It allows large groups of people to occupy small spaces. Modern cities could not have evolved without it.[5]

To be a 21st century city, Wellington needs to have a 21st century transport network, of which PT is a vital component.

A successful PT network

A successful PT network is one that:

- has sufficient capacity to safely move large numbers of people at any one time
- moves them quickly and reliably
- can attract new users from existing car users (thereby reducing congestion)
- offers a competitive alternative to private transport
- improves accessibility to key employment destinations and amenities
- maximises land use and development by encouraging people to live and work in new areas.

This is the type of PT network that drives productivity improvements and economic growth. It can greatly assist in development of areas in need of revitalisation. It gives more options to more people – about how

---

5 PwC (February 2014), Cities of Opportunity: Towards Auckland's future.

to travel, where to live, where to work, and where to play. It allows greater numbers of people to work in a given area, driving agglomeration and knowledge transfer.

There is a well proven direct relationship between development of transport networks and economic growth and prosperity. Rapid growth in the scale of transport networks and improvement in their cost and economic efficiency has been one of the major drivers of economic advancement through the 19th and 20th centuries.[6]

The relationship between transport and economic growth for a city like Wellington remains relevant and important notwithstanding it has a mature economy and existing transport networks. However, the focus should be on maximising the efficiency and performance of the existing networks and infrastructure rather than looking for transformational change through investment in new networks.

Removing bottlenecks and constraints so that transport networks can move people efficiently, reliably, safely, comfortably and with minimal environmental impacts will continue to underpin economic success and prosperity. It will ensure that people are efficiently connected to their work, that they are able to make the best use of their work and leisure time (less time commuting and more effective planning facilitated by reliable services), businesses can cluster and goods can be transported more efficiently so reducing costs for businesses.

BRT in Wellington fits exactly with the principle of making existing networks more efficient and effective. Users of BRT and other users of the road space are expected to benefit from considerably reduced travel times and greatly enhanced travel time reliability. As well as reducing bus congestion, BRT is expected to grow PT patronage, which will assist in moderating the growth in demand for road space by non-PT vehicles, and help alleviate congestion.

Cities of opportunities report

Periodically, PwC produces a global report entitled 'Cities of Opportunity. It assesses a number of global cities' social and economic performance against a set of key indicators. This assessment has been used to gain insight into how cities around the world are performing and what we can learn from them.

PwC has not assessed Wellington to date, but Auckland has been assessed. In 2012, Auckland scored a creditable 16th place against 28 cities, across all variables. However, for transport Auckland ranked 27 out of 28. In particular, Auckland achieved low results in the areas of mass transit coverage and cost of public transport.[7]

We don't know where Wellington would be placed in these rankings. However, investment in a high-quality PT system could ensure Wellington is comparable with the more successful 21st century cities – the ones with the best quality transport networks and thriving city economies.

---

6 See for example: Eddington, R. (December 2006), The Eddington Transport Study: Main report: Transport's role in sustaining the UK's productivity and competitiveness.

7 PwC (February 2014), Cities of Opportunity: Towards Auckland's future.

1.3 The case for change

This section sets out the case for change. It considers the nature of the problem, the benefits of investing in BRT, and the merits of investing now.

The question at hand is whether Wellington's current PT system provides the right quality of service or whether it need to be improved, and if the latter whether the incremental benefit is worth the cost of doing so.

The underlying problem is that buses compete with general traffic (and other buses) along a congested corridor. This makes bus journeys slow and unreliable. Consequently, use of buses is not maximised. BRT will improve PT journey times and reliability for existing users, help attract more users, and thus improve the carrying capacity of the corridor and address network congestion for all users, particularly at peak periods.

1.3.1 The problem

A facilitated investment logic mapping (ILM) workshop was held on 30 March 2015 with representatives from the project partners and selected key stakeholders. The Investment Logic Map is included in Appendix A. The group identified the following three underlying problems:

1. Congestion, within the constrained PT Spine corridor, will continue to adversely impact levels of service
2. A failure to grow bus patronage, due to unattractive and unreliable PT services compared to private vehicles
3. A failure to maximise the capacity of the PT Spine corridor is restricting Wellington's economic potential.

These problems are current issues that will be exacerbated by Wellington's forecast population and economic growth.

The RLTP includes a number of targets for PT patronage, mode share and journey times. In addition, WCC has various land-use plans and objectives. The three problems are currently impacting on the ability to achieve those targets and objectives.

Problem 1: Congestion, within the constrained PT Spine corridor, will continue to adversely impact levels of service

Demand for travel along the PT Spine is such that this corridor can be heavily congested, particularly at peak times. The heaviest congestion typically occurs along the Golden Mile and around the Basin Reserve and Mt Victoria tunnel areas.

Congestion along the PT Spine corridor leads to longer, less reliable journeys for both general traffic and PT. This has a number of adverse effects.

Congestion is resulting in journey times that are longer than they could be

Congestion makes journey times significantly longer than they would otherwise be. In the case of the PT Spine, this is not just a future problem – it is significantly congested today.

Table 4 shows the current average peak journey times to the CBD from Newtown and Kilbirnie, for both PT and private vehicles. It also shows PT journey times if there was no congestion.

Current congestion levels add significant time to the average journey to the CBD, particularly for PT users and particularly from Kilbirnie. Bus users from Kilbirnie could halve the length of their trip if there was no congestion.

There can also be significant congestion during weekends. The much more varied nature of weekend journeys (compared to the weekday peaks) can cause capacity issues on certain parts of the road network.

Table 4. Average journey times to the CBD (Willis St) (2011, morning peak)

	Public transport		Private vehicle		PT without congestion
	Time	Speed	Time	Speed	Time
From Newtown	17 min	12 kph	9 min	21 kph	8 min
From Kilbirnie	18 min	15 kph	14 min	32 kph	10 min

Sources: (1) 2011 times: PTSS Short List Evaluation Modelling Report; (2) PT without congestion times: based on BRT travel times, PTSS Option Evaluation Report.
Note: We understand that current PT journey times are around the same average level as those in 2011.

Table 5 illustrates forecast travel times, in relation to the extent of the congestion problem expected by 2031. Again, it shows that bus journeys along the PT Spine could be considerably quicker if there was no congestion. In particular, trips from Kilbirnie could take only around half the time if there was no congestion.

Table 5. Forecast average bus travel times along PT Spine corridor (2031, morning peak)

Minutes	Travel time from Newtown			Travel time from Kilbirnie		
	With forecast congestion	No congestion	% difference	With forecast congestion	No congestion	% difference
to Elizabeth Street				13.9	6.3	-55%
to the Basin Reserve	5.1	3.4	-33%			
to Courtenay Place	8.5	5.2	-39%	14.7	6.6	-55%
to Willis Street	13.1	8.4	-36%	19.3	9.8	-49%
to the Railway Station	18.3	11.9	-35%	24.5	13.3	-46%

Source: PTSS Option Evaluation Report
Notes: (1) The 'No congestion' times are those forecast to occur with BRT, which assumed no bus congestion along the entire route.
(2) Trips from Kilbirnie do not currently go past the Basin Reserve, and so Elizabeth Street is used as alternative reference point for that route.
(3) The journey times assume the completion of Basin Reserve roading improvements and a duplicate Mt Victoria tunnel.

Longer travel times directly impact the time available to individuals to do other things. Every extra minute spent commuting is a minute not spent either working or in some leisure activity.

Longer travel times also affect productivity. In addition to reducing the amount of time available for commuters to work, it also means longer journey times for freight and commercial trips that rely on travelling through the PT Spine and the CBD. Longer journey times also reduce the accessibility and connectedness of businesses within the city. Traffic congestion restricts Wellington's ability to achieve the level of economic growth that it is otherwise capable of.

Congestion also has adverse environmental impacts. Longer journey times, and more time spent idling, increases emissions, resulting in localised air impacts as well as contributing to global problems.

Journeys are unreliable

Congestion not only makes travel slower, it also makes it less reliable. Table 6 shows the proportion of current bus trips that are considered on-time (for all trips operated by NZ Bus, who operate the majority of services that use the PT Spine).

This data shows that while most buses start on time, a significant number run either early or late.

Table 6. Reliability of routes operated by NZ Bus (year to June 2014)

	Start of route	End of route	All stops
On time	91%	45%	69%

Source: Greater Wellington Regional Council

Reliability is also a key factor in the decisions of travellers about whether to take the bus or use a private vehicle.[8] Poor reliability is a key driver of the inability to increase PT patronage, as discussed further below and reliability is a key driver of customer satisfaction. Customer satisfaction surveys suggest that improved reliability of services is highly desired by customers.[9]

There are currently a high number of commuter trips along the PT Spine corridor

Wellington residents from the southern and eastern areas travel along the PT Spine into the CBD. Over 14,000 trips are made from southern and eastern areas to the CBD along the PT Spine during every morning peak period. Around 31% of these trips are on buses.[10]

At peak times, between 110 and 135 buses per hour currently travel along the Golden Mile in each direction. This is a large number of buses, and often leads to significant bus-on-bus congestion, even in areas where bus lanes exist.

By way of comparison, Auckland's two main bus entry routes to its CBD are Symonds St and Fanshawe St. These currently carry around 140 and 120 buses per hour respectively during the morning peak. These are considered very congested routes, and Auckland Transport is currently considering options for increasing the capacity of these corridors.

One of the outcomes of the 2011 Wellington City Bus Review was a programme to better optimise the current route network to provide the same level of service with fewer buses. This will reduce the number of bus services travelling along the PT Spine, and in particular the Golden Mile, helping address the current bus-on-bus congestion.

---

8 Gravitas (19 September 2014), 2013/14 Public Transport Passenger Satisfaction Survey, Research report prepared for Greater Wellington Regional Council.

9 Ibid.

10 PTSS Short List Evaluation Modelling Report.

Figure 2. Bus congestion on Courtenay Place

Source: GWRC

Buses can sometimes run at capacity

Some specific bus services currently run at close to or in excess of capacity at peak times and so leave people behind at stops.

The optimisation of the network following the Wellington City Bus Review and the introduction of high-capacity buses on some routes are designed to help address these capacity issues.

Problem 2: A failure to grow bus patronage, due to unattractive and unreliable PT services compared to private vehicles

Wellington's bus network is considered to be relatively unattractive compared to private vehicles to the average commuter. This is due to a number of issues, including:

- longer average travel times than corresponding car journeys (the biggest difference is for outlying suburbs such as Miramar and Island Bay)
- unreliable wait times and journey times
- a lack of capacity to carry more passengers in the peak, due to bus size constraints and an inability to effectively add additional peak services to already congested bus corridors
- some perceived stigma around buses and PT in general
- relatively inexpensive car-parking available to many commuters.

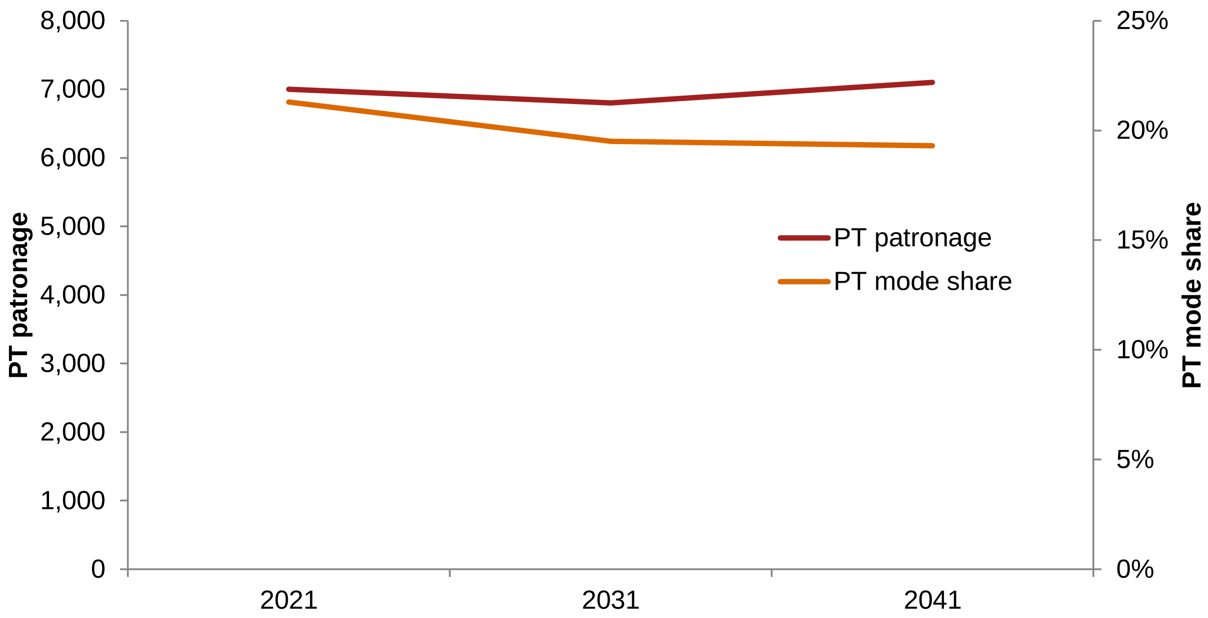
The recent increases in rail patronage following investment in the network shows that investment in improving PT services can lead provide incentives for users to switch from private vehicles to PT.

Bus mode share is relatively low along the PT Spine

Around 31% of peak trips from the southern and eastern suburbs to the CBD are via a bus. This is a relatively low PT mode share for such a key urban commuter route. PT mode share is higher for trips from Northern and Western suburbs. As another comparison, around 45% of peak time trips to Auckland's CBD are via PT (including trips from distant areas and from areas without good access to PT).[11]

In addition, bus patronage has begun to plateau, and bus mode share is forecast to decrease (see Figure 3 below).

Figure 3. Forecast bus trips from southern and eastern suburbs to CBD without BRT (morning peak)



Source: PTSS Option Evaluation Report

[11] Auckland Transport, City Centre Future Access Study (2012), Supporting Report: Sections 2-6, para 68.

Increasing public transport mode share is challenging

Congestion could be partly alleviated by shifting private vehicle users onto PT, particularly during peak periods. Buses have a much larger corridor-carrying capacity than cars so increasing PT mode share would allow more people to travel along the PT Spine at a given time, and could reduce average journey times. However, there are barriers to achieving this.

The lack of current separation between buses and general traffic along the PT Spine means buses encounter the same congestion as other traffic, making all journeys slower and less reliable. This limits the opportunity to switch private vehicle users onto buses, since there is no time-based incentive to change modes.

Problem 3: A failure to maximise the capacity of the PT Spine corridor is restricting Wellington's economic potential

WCC's future land-use plans include redevelopment of much of the land surrounding the southern and eastern ends of the PT Spine, to higher-value uses.

A key element of these plans is improving PT through the redevelopment areas and to the CBD, consistent with standard planning practice for intensification of cities, along with improvements to walking and cycling. Since the surrounding roads are already congested, the best method of providing transport for denser developments is through the provision of high-quality PT and improved walking and cycling facilities.

However, the current PT options add to challenges involved in redeveloping these areas. Simply, the current state of the PT network is not of sufficient quality to help encourage more dense residential and commercial development in these areas.

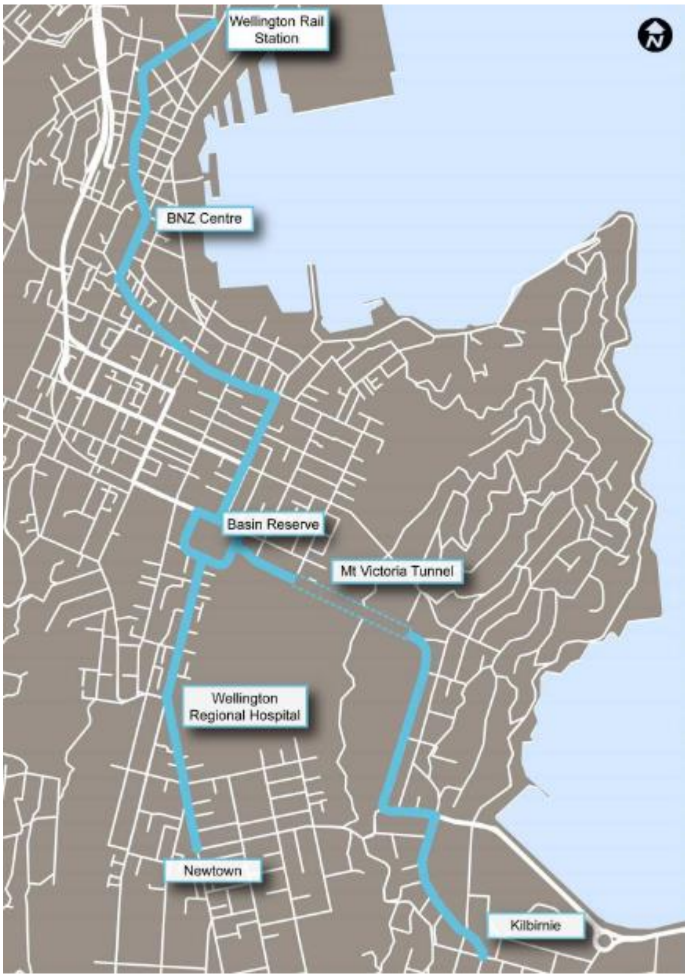
There are examples from other locations of improved PT driving urban redevelopment and higher property values. In Auckland's Britomart precinct, the extended rail line and new station has been the catalyst for significant redevelopment of the area. Auckland's Northern Busway has also led to significant increases in land values in the areas around the stations.

1.3.2 The proposed investment

The BRT solution proposed for Wellington, developed for Wellington's unique context, involves:

- the running of low-emission high-capacity buses
- along dedicated bus lanes, separate from general traffic (at grade, and using the same intersections as general traffic)
- between the Railway Station and Newtown/Kilbirnie (see Figure 4 below)
- at a frequency that caters for current demand and can be refined to accommodate growth
- buses given signal priority at intersections
- improved stop, station and interchange facilities that accommodate feeder services
- integration with the new simpler and more efficient bus network for the whole of Wellington City
- a number of operational improvements, including integrated fares & ticketing, electronic off-bus ticketing, and improvements in the provision of real-time bus location information.

Figure 4. Proposed BRT route



Source: PTSS presentation to stakeholders and interest groups

Much work has already been progressed on elements of the BRT system, such as operational improvements and integrated ticketing. These elements are not included in this IBC.

This IBC evaluates the merits of a number of options for the physical infrastructure component of the BRT solution (roadspace and intersection priority, and improved stop/station/interchange infrastructure). Parallel processes are being undertaken to assess the other elements of the BRT solution.

The physical infrastructure is a key element of the full BRT solution. It is the component that contributes the most to enabling faster and more reliable PT journeys. However, it is one of a number of components that together represent the comprehensive BRT solution. The full benefits of the physical infrastructure can only be achieved with the implementation of all the other parts of BRT.

BRT is itself one part of a wider Regional PT Plan and the Ngauranga to Airport corridor Strategy. Other aspects of this transport solution include state highway improvements, cycling infrastructure improvements and addressing conflicting traffic demands at key locations.

1.3.3 Benefits of Bus Rapid Transit in Wellington

The ILM workshop identified the following four key benefits of implementing BRT along the PT Spine:

1. Improved road and PT network efficiency
2. Increased bus patronage
3. Improved bus user experience
4. Increased economic activity in proximity to the PT Spine.

In general, these benefits will accrue directly to PT users, car drivers and passengers and freight and commercial businesses with vehicles travelling along the PT Spine corridor, as well as businesses and other parties owning or occupying land located along the corridor. The benefits experienced by these parties will flow through to the Wellington economy.

Benefit 1: Improved road and PT network efficiency

Faster and more reliable public transport journey times

BRT will reduce travel along the PT Spine corridor by physically separating buses from general traffic. Table 5 showed that journey times could be reduced significantly if there is no congestion. For example, trips from Kilbirnie could take only around half the time if there were no congestion constraints.

The journey times in Table 5 assume buses do not experience any congestion. Therefore, these journey times represent the best possible outcome of implementing BRT to remove congestion and are consistent with the highest-quality option considered in the economic case. If a lower quality BRT solution is adopted (for example, with less roadspace or intersection priority), buses would continue to experience some congestion, although less than current levels, and the travel time savings and travel time reliability improvements will not be as great.

Productivity improvements and economic growth

Faster journeys have significant benefits for the productivity of workers and businesses. The time saved becomes available for doing things that could not be done whilst travelling, increasing the output of workers and businesses and/or decreasing their costs. Businesses can also move goods around faster, enabling more goods to be moved by less people and less vehicles.

For many businesses, transport is necessary to their operations and can have a disproportionate impact on profitability. Reducing travel times, even by small amounts, can have significant benefits for individual firms.

Reliability is also very important to workers and businesses. Evidence suggests that the benefits from making journeys more reliable can be much greater than those from making the journeys quicker, and that this is even more so in the case of PT networks.[12] It is also a conventional benefit of transport investments under the EEM.

Faster and more reliable journeys also result in improved accessibility between Wellington locations, producing agglomeration benefits. Improved transport accessibility broadens firms' potential labour pools, enabling firms to reach more skilled workers, over a wider base. Improved transport accessibility also facilitates business-to-business interactions, be it improved supply chains or knowledge sharing and transfer mechanisms. The result of improved accessibility is productivity improvements for businesses in Wellington, driving GDP growth.

[12] See for example: Eddington, R. (December 2006), The Eddington Transport Study: Main report: Transport's role in sustaining the UK's productivity and competitiveness.

Faster and more reliable journeys via BRT are expected to drive improvements in the productivity of workers and businesses, and drive increases in Wellington's economic growth. Empirical evidence suggests that the economic benefits from even relatively small improvements to speed and reliability could be substantial, particularly for individual businesses.[13]

Improved commute times to and from the CBD

As well as allowing existing commuters to get their place of work faster, reduced journey times expands the area which is within a 30-minute commute of the CBD (sometimes considered a proxy for a reasonable commuting distance). This effectively increases the potential pool of CBD workers and allows people to live further away but still get to work in a reasonable time.

In particular, the current 25 minute journey time from Kilbirnie to the CBD means that the majority of households east of the airport are outside a 30-minute commute. Reducing the time from Kilbirnie to 13 minutes will make commuting from these suburbs to the CBD much more efficient than it is now. It also makes these PT journeys quicker relative to private vehicle trips from the same locations.

Increased carrying capacity along the PT Spine via a higher capacity mode

Making more of the existing road space available to buses through the use of dedicated bus lanes will increase the carrying capacity of the corridor. Since buses have a much greater corridor-carrying capacity than private vehicles, allowing buses to travel faster along the PT Spine, and shifting private users onto those buses, increases the number of people who can travel along the PT Spine at any given time.

The use of larger buses will further increase the carrying capacity of the corridor, and address any crowding issues. This will be particularly beneficial during peak periods.

Benefit 2: Increased bus patronage

BRT will involve faster, more reliable bus journeys, on new, larger, and less crowded buses. The overall experience for users will be considerably improved. This will provide incentives for commuters to use the bus rather than other transport modes and so is expected to drive increases in PT patronage and mode share.

BRT also integrates very well with the rest of the PT network. In particular, buses can travel on both the BRT route and other parts of the bus network, meaning passengers do not have to transfer between BRT and non-BRT services (except where they are transferring from/to rail). This was a key benefit of BRT over Light Rail in the PTSS, and is expected to help increase patronage and mode share growth.

Table 7 shows the increases in PT patronage expected if a high-quality BRT solution is implemented.

Table 7. Forecast PT patronage (morning peak)

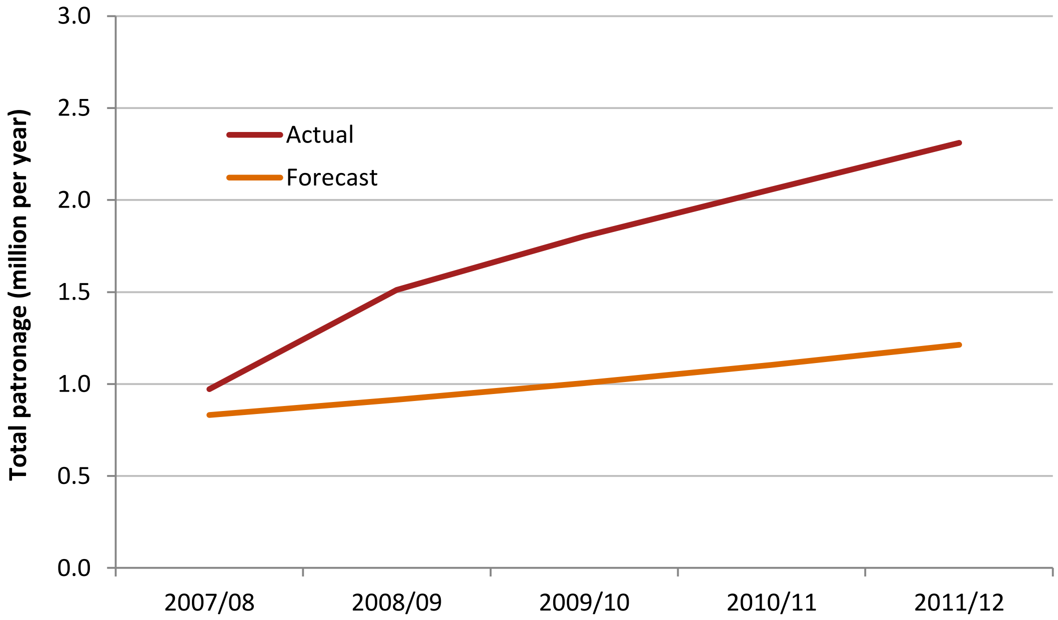
	Wellington region			Trips from southern and eastern suburbs to CBD		
	Without BRT	With BRT	% increase	Without BRT	With BRT	% increase
2021	35,600	36,300	2%	7,000	7,400	6%
2031	34,000	34,800	2%	6,800	7,270	7%
2041	35,200	36,100	3%	7,100	7,650	8%

Source: PTSS Option Evaluation Report

13 Eddington, R. (December 2006), The Eddington Transport Study: Main report: Transport's role in sustaining the UK's productivity and competitiveness.

With a high-quality BRT system, it is possible that future patronage could exceed the levels shown in Table 7. The best example of BRT in New Zealand is Auckland's Northern Busway. Figure 5 shows that since it opened in 2008, its patronage has exceeded official projects by a considerable amount (over 1 million extra passengers annually). We note however that BRT along the PT Spine and Northern Busway are not entirely like-for-like examples – the Northern Busway involves physical separation to a degree not even considered for Wellington, while surrounding population growth and existing PT mode share also differ.

Figure 5. Auckland's Northern Busway – actual patronage vs pre-construction forecast



Source: Auckland Transport; Parliamentary Question #1239, 27 February 2008.
Note: Actual values only include buses which travel between the CBD and the busway stations. They do not include buses which travel to other locations on the North Shore.

A BRT solution along the PT Spine is expected to not only increase patronage from the southern and eastern suburbs, but also increase patronage from other areas. This is an example of the network benefits of investing in improved PT infrastructure – the improved user experience in one location drives increases in usage across a much wider area of the network.

If patronage can be increased, and the average number of passengers per bus increased, this will improve operating efficiency and reduce per-unit costs. This will allow farebox recovery to be improved.

Benefit 3: Improved bus user experience

BRT will increase the attractiveness of the bus network along the Spine. In particular, BRT will:

- reduce bus journey times
- improve the reliability of bus journeys and reduce wait times
- enable increased frequencies (where warranted by demand)
- utilise larger high-capacity buses
- utilise new larger high-capacity and better quality buses
- include improvements to infrastructure at bus stops and interchanges
- include improvements to ticketing, real-time information, and other user services.

All of these items will improve the user experience and make bus travel a more attractive alternative to private cars.

Some of the benefits are appropriately attributed to elements of the BRT solution not considered in this IBC, for example the benefits of integrated ticketing. The economic case of this IBC only includes benefits attributable to the physical BRT infrastructure.

Benefit 4: Increased economic activity in the proximity of the PT Spine

There is substantial evidence that the provision of high-quality PT increases land values in the areas alongside PT corridors[14]. The higher values encourage conversion of property to higher-value uses.

This effect along the PT Spine corridor will be particularly beneficial in its southern and eastern ends where WCC is encouraging redevelopment of the current relatively low-value land uses into more high-value activities. In some areas, such as around Adelaide Road, WCC has developed plans for a denser area of residential and mixed-use developments, to replace the existing light industrial and low-intensity residential uses. The improved PT provided by BRT will encourage this redevelopment, which is currently not occurring in part due to perceived poor quality PT.

Other benefits

BRT will increase the number of viable transport choices available to potential users. This option value is beneficial regardless of whether or not they use BRT. Implementing BRT and achieving the various benefits set out in this section, will significantly improve the quality of the PT services along the PT Spine corridor. This is expected to increase the attractiveness of buses as an alternative to car travel.

Increased PT mode share along the PT Spine will help limit the number of car trips to and from the suburbs to the south and east. This can help improve amenity and create more liveable communities in those areas. More liveable, pedestrian-friendly neighbourhoods are particularly important when areas are being intensified and denser residential development is occurring.

Importance of enabling roading projects

The RONS projects through the Basin Reserve and Mt Victoria areas are key enablers of elements of BRT. Without them, the magnitude of the benefits from implementing BRT will be constrained. The integration of BRT with these projects is discussed in more detail in the next section.

1.3.4 When is the right time to invest?

There are benefits to acting now

The three problems identified are current issues, which will be exacerbated by future growth:

- There is already heavy congestion along the PT Spine, and in Wellington generally, at peak times.
- Bus patronage is static and bus mode share is expected to decline without improvements in services (see Figure 3 above).
- Plans to redevelop urban areas are not supported by the current PT network.

The sooner BRT is implemented, the sooner these issues can be addressed and the consequential economic and quality of life benefits achieved.

The longer the timeframe for implementing BRT the more difficult it will be to encourage people to switch to PT. The forecast decrease in PT mode share is partly the result of current and planned investments in road and cycling infrastructure without corresponding investments in improving PT. There is a risk that,

---

[14] See for example: Jones Lang LaSalle (January 2015), *CrossRail: Identifying opportunities*; Grimes A. & Liang Y. (May 2008), *Bridge to Somewhere: The Value of Auckland's Motorway Extensions*.

without a signal that PT improvements will come soon, many travellers may switch from buses to cars and the use of cars as opposed to PT could become further ingrained.

A key benefit of BRT is that it can be implemented incrementally

BRT does not need to be implemented all at once. It would be possible to construct the physical infrastructure in stages. For example, the Golden Mile improvements could be made first, with the rest following at later dates. Bus users would still benefit from the faster journeys in this part of the corridor. In fact, this approach would be consistent with targeting improvements to the more heavily congested parts of the corridor first with the remaining parts of the corridor being developed as they become more heavily congested in the future.

Also, the construction of the physical infrastructure does not necessarily have not occur at the same time as the implementation of other parts of the full BRT solution – such as integrated ticketing, or high-capacity buses. While the full benefits of the individual components of the full BRT solution will not be achieved until all elements are in place, some benefits will be available as each part of the solution is introduced.

In the economic case, different timing and staging of the options is considered. In addition, the management case discusses the Ngauranga to Airport corridor programming and sequencing workstream that this BRT project is a part of, which is considering key dependency issues between the different parts of the wider Ngauranga to Airport corridor transport solution.

1.3.5 The existing evidence base

In general, the current problem and the likely benefits of a high-quality BRT solution are well defined.

The evidence on current transport conditions, such as patronage and journey times, is very good. This is based on robust data about actual PT trips in Wellington. The forecasts of future transport conditions are based on the transport modelling undertaken for the PTSS. This modelling was detailed and robust.

However, the PTSS only modelled one BRT option and one bus priority option. A number of different variants of BRT are evaluated in this IBC. These variants essentially form a continuum between the bus priority and BRT options used in the PTSS. Additional transport modelling has not been undertaken for this IBC and so it has been necessary to make assumptions about the likely transport effects for the intermediate options. We note that this type of detailed modelling will be a key component of any subsequent DBC.

In addition, the PTSS BRT option assumed the successful completion of the Basin Bridge and Mt Victoria tunnel duplication projects prior to BRT implementation, and the transport modelling was undertaken on that basis. As discussed in the next section, this is not guaranteed. The economic case makes assumptions about how the modelled transport effects would change if BRT was implemented without these roading projects.

Connections between businesses and their employees and between businesses are a key economic growth factor. There is extensive literature that addresses the importance of these connections and the vital role transport networks play in this context.

Estimating the magnitude of the impact transport networks have on connecting people and businesses is difficult and is dependent on the context, although the impacts are likely to be significant. Monetary values of the likely impacts are considered in the economic case.

1.4 Strategic context

This section considers the alignment of BRT with Wellington's strategic direction and relevant planning documents.

BRT is a key initiative in terms of implementing the high-level strategic direction of Central Government as this relates to the Wellington Region. The clear focus of the GPS is improving productivity and economic growth. Some of the key benefits of BRT are helping alleviate congestion, reducing PT journey times, increasing transport capacity and encouraging urban redevelopment. All of these impacts will contribute to improved productivity across the region.

BRT will also help achieve a number of GWRC's and WCC's objectives, in particular economic growth, urban regeneration and improved accessibility. BRT, and PT services in general, can play an important city-shaping role to help WCC achieve its plans for redevelopment and changes in land-use.

The comprehensive BRT solution is also an important part of the suite of transport improvement projects currently taking place and planned for the Wellington region in the near future – including the RONS projects, the implementation of the new bus network for Wellington City and implementation of new PT operator contracts. BRT is important to realising the full benefits from these projects.

As is recognised in a number of GWRC and WCC land transport plans, BRT along the PT Spine is the most important and most beneficial PT project currently being considered for Wellington.

1.4.1 Alignment of BRT with relevant organisational strategies and objectives

The overriding purpose of any investment in BRT, in addition to addressing the problems identified earlier, must be to help the project partners implement their strategic objectives. The alignment of BRT to the relevant strategic and planning documents is outlined below.

Central Government and the Ministry of Transport

Central Government and the Ministry of Transport set the high-level strategic direction of land transport investment in New Zealand.

The GPS sets out the government's priorities for expenditure from the NLTF over the next 10 years. The GPS is informed by the National Infrastructure Plan and sets out how funding is allocated between activities such as road safety policing, State Highways, local roads and PT.

The current GPS was released in December 2014 and comes into effect in July 2015. It supersedes the 2012 version, which was current at the time the PTSS was undertaken.

The 2015 GPS continues and reinforces the Government's focus on increasing economic growth and productivity as the primary objective for land transport expenditure. The expectation is that land transport funding will be directed into high-quality projects and activities that will support improved productivity and economic growth.

Making quality investments in the area of PT is highlighted in the GPS as an important strategic response to the goals of economic growth and productivity.

The National Infrastructure Plan sets out seven specific goals for transport infrastructure, including the achievement of "a public transport system that is robust and effective and offers a range of user options that will attract a greater percentage of long term users."

As one of New Zealand's larger cities, Wellington receives a significant share of NLTF funding. Local organisations play a key role in ensuring that this funding is directed into activities that will support the GPS priorities of productivity and economic growth.

BRT is a key initiative in terms of implementing the high-level strategic direction of Central Government. Key benefits of BRT, reducing PT journey times, increasing transport capacity and encouraging urban redevelopment, will contribute to improved productivity across the region and so support the GPS focus on improving productivity and economic growth.

New Zealand Transport Agency

The Transport Agency is responsible for implementing the strategic direction set out in the GPS. It administers the NLTF, is responsible for planning and funding of the State Highway network and provides funding to local and regional authorities for approved transport projects.

Consistent with the GPS, the strategic focus of the Transport Agency (as set out in its Statement of Intent) is on delivering improved transport services that contribute to economic and productivity growth.

One of the Transport Agency's five short-term strategic priorities is "making the most of urban network capacity". This is seen as an important step in making transport networks more efficient, for the benefit of the economy. PT improvements are seen as an important part of achieving this objective.

With its ability to significantly increase the corridor carrying capacity of the PT Spine, BRT is a key initiative in terms of better utilising Wellington's current urban road and PT network.

Greater Wellington Regional Council

Economic development is the overarching objective of the Wellington Regional Strategy, developed by GWRC in 2012. Improving the quality of infrastructure, including transport, is an important enabler that will assist the Region achieve its economic growth potential.

The 2015 RLTP (and its predecessor the 2010 RLTS) provides an overall context for investment in Wellington's transport network over the next 10-30 years. The RLTP notes a number of regional pressures, including traffic congestion and network capacity constraints, reliability of the transport network, and PT capacity and mode share. It also sets out a number of objectives for land transport including economic growth, consistent with the GPS direction, but also wider objectives such as improved safety, resilience and liveability.

Increased PT use, and improved PT journey times and reliability, are stated as being key outcomes that GWRC will seek to achieve over the next 30 years. Other key outcomes include reducing severe road congestion and improving land use and transport integration.

The N2A Plan, now incorporated into the RLTP, supports the development of a high quality PT spine through central Wellington as a priority project. Implementing BRT along the PT Spine is considered the "immediate priority" for the Ngauranga to Airport corridor, alongside addressing conflicting transport demands around the Basin Reserve.

The 2014 RPTP sets out the blueprint for investments in PT in the region over the next 10 years. It gives effect to the components of the RLTS, and aims to deliver an effective, efficient and integrated PT network for the people of Wellington.

Wellington City Council

The key focus of WCC's draft 2015-25 LTP is economic growth. It asks Wellingtonians to make a choice between "unlocking Wellington's economic potential" and a path of lower economic growth.

A key initiative in the draft LTP to promote economic growth is inner city regeneration. Improving PT is stated as being a critical element of this. Another of the draft LTP's initiatives is providing "real transport choices". Implementing a high-frequency bus service along the PT Spine, improving connectivity between the CBD and the southern and eastern suburbs, is stated as a critical part of these initiatives.

The LTP identifies the proposed redevelopment of the area around Adelaide Road as an important regeneration project. WCC has also developed an 'Adelaide Road Framework' that sets out its vision for redevelopment over the next 10-20 years of the area into a more intensive area of residential and mixed-use developments.

The Wellington Urban Growth Plan 2014-43 lists implementing a high-frequency bus service along the PT Spine as a key transport project to be delivered over this period, in order to allow the City to grow and accommodate the forecast increases in population.

BRT will help achieve a number of WCC's objectives – in particular, economic growth, urban regeneration and improved accessibility. BRT, and PT services in general, can play an important city-shaping role to help the council achieve the redevelopment and land-use patterns that it envisages.

1.4.2 Integration of BRT with related projects

As discussed above (and in the management case), BRT is part of a wider set of projects along the Ngauranga to Airport corridor. Integration with these activities will be critical to the success of implementing BRT in Wellington. Further details about selected specific projects are discussed below.

Roads of National Significance

The proposed BRT route, as identified in the PTSS, includes two roading projects which are part of the Transport Agency's RONS programme of works:

- The Basin Bridge project involves grade separation of Buckle Street on the northern side of the Basin Reserve, to separate north-south movements along Cambridge/Kent terrace and Adelaide Road and east-west movements along Buckle and Patterson Streets.
- The Mt Victoria tunnel duplication project involves the creation of a new tunnel through Mt Victoria parallel and adjacent to the existing general traffic tunnel. It also includes widening of Ruahine St.

The PTSS assumed that both of these projects would be completed before BRT was implemented, and the BRT option was assessed in the PTSS on this basis. However, since the PTSS was completed, resource consent has been declined for the Basin Bridge. This decision is currently under appeal. This has also led to the Transport Agency re-evaluating the tunnel duplication project.

Finding a solution to conflicting transport demands at the Basin Reserve is critical to the ability to implement a high-quality BRT system. Without such a solution, the Transport Agency will not duplicate the Mt Victoria tunnel, and the Kilbirnie branch of the proposed BRT solution will not be able to proceed. Furthermore, the benefits of delivering BRT along the Newtown branch would be limited since buses would continue to be held up in congestion around the Basin Reserve.

This IBC assumes that there will be a solution at the Basin Reserve (either the Basin Bridge or a solution of similar effectiveness), and that the Mt Victoria tunnel duplication will proceed. However, the economic case also considers each BRT option without the Kilbirnie branch, a proxy for how the options would proceed in the absence of the RONS projects being completed. As the economic case shows, the benefits of BRT are severely limited if an adequate solution is not found for the Basin Reserve.

We also note that advancing the planning and design of a BRT solution along the PT Spine may assist with the consenting of the Basin Bridge and other inner city RONS, given the comments by the Board of Inquiry around the lack of integration with other modes and projects.

Cycling infrastructure

There is a potential for a number of upgrades to cycling infrastructure along and around the PT Spine between now and when BRT is implemented. WCC is currently in the process of developing a Cycling Framework and Network Plan. This includes a cycleway from Island Bay to the CBD, through elements of the PT Spine along Adelaide Road and Kent and Cambridge Terraces.

Implementing a BRT solution will not inhibit the provision of additional cycling infrastructure or the upgrade of existing cycle lanes. However, the allocation of available roadspace between competing uses (general traffic, PT, cycling, parking) is an important component of any ultimate transport solution along the PT Spine and will need to be carefully considered.

There is also the potential for BRT and cycling infrastructure to be designed together, to create a more effective integrated solution, including the development of joint BRT/cycling facilities. Integrated construction may also be an efficient approach to implementation.

The design of the street layouts should consider the potential for upgrading cycling infrastructure at the same time as BRT implementation, or at least allow for the implementation of additional cycling infrastructure at a later date. These details will be considered during any subsequent DBC. In the management case, we discuss integration with other components of the Ngauranga to Airport corridor transport programme.

High capacity buses

Use of high capacity buses as part of the BRT solution is being assessed under a separate process, and is not part of this IBC.

As part of the outcomes of the 2011 Wellington City Bus Review and the PTSS, GWRC has resolved to introduce high capacity buses on some routes independent of any decision around the provision of physical BRT infrastructure. It is expected that many of the selected routes will coincide with the PT Spine or points of it.

The benefits from the increased corridor carrying capacity of high capacity buses make them worth the investment even with the current levels of bus priority along the PT Spine. However, there are clearly even more benefits available if the high capacity buses can travel along dedicated lanes free of congestion and benefit from priority measures at intersections. Without BRT, the full extent of the potential benefits of high capacity buses will not be realised.

Operational improvements to bus services

There are a number of operational PT improvements occurring and proposed to occur over the same broad time period as BRT, and that are part of the wider BRT solution. These include route optimisations and service improvements resulting from the Wellington City Bus Review, the introduction of integrated fares and ticketing across the region, as well as revised PTOM contracts for the bus operators.

These operational improvements will lead to better outcomes from the provision of the physical BRT infrastructure. More importantly, the full benefit of these operational improvements can only be achieved with the implementation of the physical infrastructure.

1.5 Conclusions

There is a demonstrable problem with the current PT network along the PT Spine.

- The corridor is congested, particularly at peak times. This is limiting Wellington's economic growth potential, as well as having other wider impacts.
- It is difficult to increase PT patronage and mode share under the current bus service offering. Buses are not segregated from general traffic, which means that they get caught in the same congestion as private vehicles.
- Wellington's bus services are perceived as being less attractive and less reliable than private vehicle journeys, and for the majority of people buses are not the preferred way to get around Wellington City.
- The issues with PT are restricting envisaged redevelopment of land around the southern and eastern ends of the PT Spine into higher-value uses, and limiting the potential economic activity in these areas.

These are current problems which will be exacerbated by future growth.

A BRT solution can help address these problems. BRT can provide faster and more reliable journeys along the PT Spine, and help improve the bus user experience. This can create incentives for private vehicle users to shift to buses, contributing to increasing PT patronage and PT mode share along the route. BRT can also increase the corridor carrying capacity along the route, enabling more people to travel along the PT Spine during peak periods.

Together, BRT will enable more people to travel along the PT Spine, faster, more reliably, and in greater comfort. This is likely to have a significant impact on the productivity of Wellington's workers and businesses, and help drive future economic growth. It will also encourage greater economic activity in the areas surrounding the PT Spine.

BRT is consistent with the strategic direction set out by Central Government, GWRC and WCC. It is a key initiative in terms of implementing Central Government's focus on improving productivity and economic growth. BRT will also help achieve a number of GWRC's and WCC's objectives, in particular economic growth, urban regeneration and improved accessibility. BRT along the PT Spine is the most important and most beneficial PT project currently being considered for Wellington, and is a key element of all current transport plans for the Wellington region.

This IBC only relates to the physical BRT infrastructure, not the various other elements of the BRT solution. If the other elements are introduced but not the physical infrastructure, the full benefits of the elements adopted will not be realised. The benefits of bigger buses, better ticketing, and operational improvements will be limited if the part of BRT which leads to faster more reliable journeys is not adopted.

In addition, the ability to achieve the full benefits of BRT is contingent on finding, and implementing, an adequate solution to conflicting transport demands around the Basin Reserve. Without this, the benefits of BRT are considerably reduced.

2. Economic case

2.1 Process for economic assessment

2.1.1 Two types of economic assessment are undertaken

This economic case is based on a best practice decision making approach for infrastructure projects and the level of detail appropriate for an IBC. A small set of options have been developed, differing across the key areas of material difference. These options are subjected to two types of economic assessment:

1. A qualitative assessment against a set of agreed criteria, typically referred to as an MCA.
2. A quantitative assessment, involving the development of benefit-cost ratios for the options. For a transport project such as this, this assessment is undertaken with reference to the EEM.

The use of both types of assessment together is very important for an IBC. Ideally, a quantitative assessment of an option's benefit and costs should provide decision makers with a clear view of the best value for money option. Decision makers should be able to clearly evaluate options across quality, quantity, timeliness and cost dimensions. Invariably, however, a quantifiable approach either does not pick up, or not fully quantify, all aspects of an option that are relevant to the decision that needs to be made. Moreover, fully quantifying all costs and benefits across all options is only undertaken at the DBC stage. The qualitative assessment allows a more rounded assessment of the options across a scope of measures that are important to decision makers.

2.1.2 Other economic assessments of BRT

An economic assessment of a BRT solution was undertaken as part of the PTSS. In the PTSS, MCA was used to reduce a long list of options to a shortlist of three. Then those three options were subjected to a quantitative assessment, and the BCRs developed were a key component of the ultimate conclusion that BRT was the best of the three options.

In this economic case, we consider a number of different BRT solutions, one of which is essentially the same as the PTSS BRT option while the others differ in small but important ways.

If the project proceeds to DBC stage, a more detailed economic assessment will be undertaken at that point. The BRT solution will be able to be optimised to a much greater degree of detail than is possible or appropriate in this IBC, and all costs and benefits will be quantified (where possible). The DBC economic assessment will be quantitative – we do not expect a MCA to be used as well.

2.2 Options considered

2.2.1 Approach to specifying the options

The specification of the different options needs to be closely aligned with the purpose of the IBC. In particular it needs to be:

- broad enough in scope so as to demonstrate that a genuine assessment of the range of potential approaches to solving the problem is being undertaken
- at a level of detail that allows meaningful comparison on the material differences in option outcomes, without expending significant time and resource on a comprehensive and detailed design.

The last point is critical. Detailed design and costing will be undertaken as part of any subsequent DBC stage. At the DBC stage, a great deal can be done on specific options to optimise both costs and benefits. The goal of the options design and specification in the IBC is to undertake a 'like for like' comparison of options at a higher level to understand substantive differences between costs and benefits.

With this IBC, the project starts from the basis that BRT has been identified as the preferred strategic response to the problem. In other words, the option specification is not revisiting other approaches to solving the problem.

The options used in this IBC differ across the quality and extent of the BRT solution, and different staging of implementation over time.

2.2.2 The reference case

In the economic assessment, all options are assessed relative to a 'base case' scenario. This represents what is expected to happen if the project does not go ahead. The costs and benefits of the BRT options are determined relative to this reference case.

The use of a reference case also allows consideration of whether implementing BRT is better than not doing so (not just consideration of which option is best).

The reference case is not a 'do nothing'. It is a 'do minimum', and includes other projects along the PT Spine and ongoing maintenance spending for example.

The reference case for BRT includes or assumes:

- the current network of bus lanes and bus priority across Wellington City
- currently planned roading improvements, in particular:
  - the Basin Bridge and associated improvements; or another grade separated solution
  - Mt Victoria tunnel duplication, and associated improvements to Ruahine Street
  - all other RONS in Wellington City
- changes to Wellington bus services as a result of the Wellington City Bus Review, including:
  - revisions to bus network running patterns
  - optimisation of bus stops locations
  - other user improvements
- the complete implementation of the PTOM contracts

- the introduction of integrated fares and ticketing (as currently envisaged by that project's business case)
- the use of high-capacity buses (eg double-decker) on some Wellington City bus routes, where demand warrants it
- buses will run at a frequency necessary to cater for demand and growth.

We note that this is very similar to the reference case used in the PTSS. The only material difference relates to the treatment of high-capacity buses. The PTSS did not include high-capacity buses in the reference case – their costs and benefits were instead included in the PTSS BRT option. But the introduction of these buses is not being considered separately, and is likely to occur regardless of whether physical BRT infrastructure is constructed. Therefore, the costs and benefits of high-capacity buses are excluded from the BRT options set out below.

2.2.3 *The BRT options*

Approach to developing the BRT options

The options considered in this IBC were developed by the Working Group (which was established to develop the IBC). The Working Group considered that the most material features of options, and hence those where different variants should be considered, were the degree of dedication of the bus lanes and the degree of intersection priority given to buses.

The BRT option in the PTSS assumed complete dedication and intersection priority, such that buses could essentially move freely throughout the route without congestion. The Working Group wanted to consider some variants of this BRT solution that involved lower degrees of dedication and priority. In effect, the Working Group wanted to assess options that spanned a continuum from the PTSS BRT option to the PTSS Bus Priority option.

Four distinct options were developed to reflect this continuum:

- Physically separated bus lanes along the full route, operating at all times (in effect, the PTSS BRT option)
- Bus lanes along the full route, operating at all times
- Bus lanes along selected parts of the route to target key congestion areas, operating at all times
- Bus lanes along the full route, but only operating at peak times.

In addition, a separate option was considered, based on a detailed possible plan recently developed by WCC, for bus priority improvements along the Central and Newtown branches.

The Working Group also wanted to consider some variants of these options, based on:

- the timing of construction and implementation
- a lower-quality solution, or no solution at all, for the 'Kilbirnie branch'.

The options are described in the sub-sections below. In addition, Appendix B provides a more detailed description of each option.

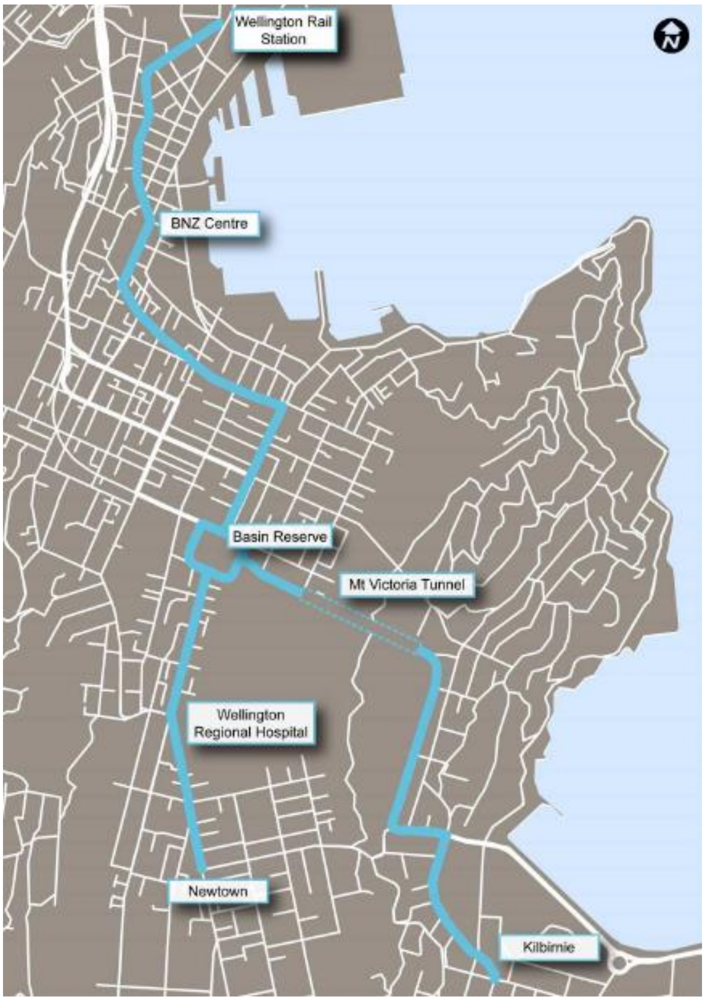
The BRT route

The proposed route for BRT is shown in Figure 6. For ease of description, we have split the route into three 'branches'.

- **The Central spine**: From the Railway Station, the route follows Lambton Quay, Manners St, Courtenay Place, and Cambridge and Kent Terraces to the Basin Reserve.
- **The Newtown branch**: From the Basin Reserve, the route continues south along Adelaide Road and Riddiford St to the corner of Constable Street.
- **The Kilbirnie branch**: From the Basin Reserve, the route continues east through the Mt Victoria tunnels, along Ruahine Street, Wellington Road and Kilbirnie Crescent.

All options follow this same route. However some options have different levels of priority, or different implementation timings, for different branches.

Figure 6. Proposed BRT route



Source: PTSS presentation to stakeholders and interest groups (August 2013)

Summary of the options

There are five core options considered in this economic case. Table 8 sets out the type of roadspace and intersection priority assumed for each options – the key components of the options. Each option, and the types of priority, are described in more detail further below.

Table 8. Key elements of core options

Option	Type of roadspace dedication	Level of intersection priority
1	Improved bus priority	Limited priority
2	Bus lanes, along the whole route, at peak periods	Limited priority
3	Bus lanes, in targeted locations, 24/7	Limited priority
4	Bus lanes, along the whole route, 24/7	Full priority
5	Physically separated bus lanes, along the whole route, 24/7	Full priority

Option 1 – Improved bus priority and other modes improvement

This option is based on a detailed possible plan recently developed by WCC, for bus priority improvements along the Central spine and Newtown branch.

It provides for additional bus lanes between the Railway Station and Newtown, in certain locations where none currently exist. It also provides for bus signal priority at a greater number of intersections along the route, using the 'B phase' method.

Some of these bus lanes will only operate at certain periods, depending on inter-peak congestion levels.

Improvements are also made to cycle infrastructure, along Adelaide Road, through the Basin Reserve and along Kent and Cambridge Terraces.

This option assumes there is no construction of the Basin Bridge, or any solution of similar effectiveness. It includes dedicated bus lanes and cycle infrastructure through the Basin Reserve area that are incompatible with the Basin Bridge proposal. As currently designed, this option cannot be implemented if the Basin Bridge, or another solution of similar effectiveness through the area, is constructed.

Option 2 – Peak bus lanes and limited priority

Continuous bus lanes are provided along the Central spine, and the Newtown and Kilbirnie branches. These lanes would **only operate at peak periods**.

Buses will get signal priority at intersections, using the **'B phase' method**.

Where no bus lane currently exists, general traffic lanes or parking spaces will be converted to bus lanes during peak periods.

Option 3 – Targeted bus lanes and limited priority

Bus lanes, and possibly other bus priority measures, are provided **in selected areas** along the Central spine, and the Newtown and Kilbirnie branches. The areas and measures selected will be based on **targeting key congestion areas and key intersections**.

The exact location of the new bus lanes and priority measures will be determined at a later date, but key areas include the Golden Mile, the intersection of Manners St, Courtenay Place and Taranaki St, the intersection of Kent/Cambridge Terrace with Vivian St, the south and eastern entries to the Basin Reserve, the intersection of Adelaide Road and John St, Ruahine St, and the intersection of Wellington St and Kilbirnie Crescent.

Buses will get signal priority at intersections, using the **'B phase' method**, where there is a bus lane immediately prior to the intersection.

Where no bus lane currently exists, general traffic lanes or parking spaces will be converted to bus lanes.

Option 4 – Bus lanes and full priority

Continuous bus lanes are provided along the Central spine, and the Newtown and Kilbirnie branches. These lanes would **operate at all times**.

Buses will get signal priority at intersections. This includes both **pre-emption of signals** before the bus arrives at the intersection, and the **extension of phases**, where feasible.[15]

Where no bus lane currently exists, general traffic lanes or parking spaces will be converted to bus lanes.

Option 5 – Physically separated bus lanes and full priority

This option is designed to be, in effect, the PTSS BRT option.

Continuous bus lanes, physically separated from general traffic, are provided along the Central spine, and the Newtown and Kilbirnie branches. These lanes would **operate at all times**. (Note that the bus lanes in Options 2, 3 and 4 are not physically separated from general traffic.)

Buses will get signal priority at intersections. This includes both **pre-emption of signals** before the bus arrives at the intersection, and the **extension of phases**, where feasible.

Where no bus lane currently exists, general traffic lanes or parking spaces will be converted to bus lanes.

Timing of construction assumed in core options

Table 9 presents the timing of construction assumed in our core options. In each case, the Central spine is implemented as soon as possible (following the completion of the assessment and consenting processes). The Newtown and Kilbirnie branches are constructed as soon as the RONS projects (Basin Bridge and Mt Victoria tunnel duplication) are completed.

Table 9. Timing of construction assumed for core options

	Central spine	Newtown branch	Kilbirnie branch
Option 1	Immediately	To coincide with the completion of the RONS	n/a
Options 2-5	Immediately	To coincide with the completion of the RONS	To coincide with the completion of the RONS

Note: (1) 'Immediately' assumes it is completed prior to 2019. (2) The RONS (Basin Bridge and Mt Victoria tunnel duplication) are assumed to be completed prior to 2025.

Timing variants for Options 2, 3, 4 and 5

Multiple variants of options 2-5 are considered in addition to the core options. They include the following variations:

---

[15] 'Pre-emption' means the ability for the bus' signal to turn green before the bus arrives at the intersection, so that it does not need to stop at the intersection. 'Phase extension' means the ability for a green signal phase to be extended, so that a bus can pass through before the signal turns red. Both have been successfully implemented in a number of cities worldwide, including Brisbane, Cleveland and Chicago.

- delaying implementation of the Central spine, so that it is constructed at the same time as the branches (variant 'a')
- not building any physical BRT infrastructure along the Kilbirnie branch (variant 'b')
- only constructing bus lanes in targeted locations (ie Option 3) along the Kilbirnie branch.

The combinations considered are set out in Table 10.

Table 10. Variants of core options considered

	Delay the Central Spine	No Kilbirnie branch	Targeted Kilbirnie branch	Delay the Central spine, AND targeted Kilbirnie branch
Option 1	-	-	-	-
Option 2	✓ Option 2a	✓ Option 2b	-	-
Option 3	✓ Option 3a	✓ Option 3b	-	-
Option 4	✓ Option 4a	✓ Option 4b	✓ Option 4c	✓ Option 4ac
Option 5	✓ Option 5a	✓ Option 5b	✓ Option 5c	✓ Option 5ac

2.3 Approach to cost benefit analysis

The cost-benefit analysis was conducted alongside the MCA to provide a monetised assessment of the net-benefits of the options. It is consistent with current applied best practice transport economic evaluation procedures, including the EEM.

Broadly, the approach to evaluate the standard transport benefits of BRT requires several steps:

1. Identify and describe the options to be evaluated, including a do-minimum and the options
2. Define the transport modelling process
3. Identify the streams of economic impacts accruing from the project and define the calculations that must be completed in order to value them. The economic impact includes nationwide benefits and costs, not just the core funding costs. Appendix C provides more detail regarding the procedures for conducting the core transport evaluation.
4. Identify any qualitative, or non-transport assessments that are required, including significant non-monetised impacts and national strategic factors.
5. Calculate economic efficiency and sensitivity test the results.

The economic evaluation of transport services, such as BRT, should focus on the transport benefits alone. The aim of this evaluation is to produce a benefit-cost ratio (BCR) that compares the transport benefits of the project with the project costs to determine its overall economic efficiency. Table 11 describes the types of costs and benefits which were included in this evaluation, where data permitted.

Table 11: Costs and benefits included in the economic evaluation

Costs	Benefits
• **Construction costs** • **Operating costs**	• **Transport service user benefits** (for both new and existing users) including: o Travel time benefits o Additional PT user benefits o Reliability benefits o Walking benefits • **Road traffic reduction benefits** (vehicle operating cost (VOC) savings and travel time cost savings) • **Environmental benefits** • **Agglomeration benefits**

Where the BRT options create adverse effects, these are accounted for as negative benefits, rather than costs, as per EEM guidelines.

In line with the EEM, our main analysis covers a 40 year evaluation period and uses a 6% discount rate. Sensitivity testing is performed using (i) a 30 year, 8% discount rate scenario, and (ii) a 60 year, 4% discount rate scenario.

2.3.1 Key inputs and assumptions

Our core information base was the outputs from the transport modelling undertaken for the PTSS by GWRC. We did not undertake any additional modelling of transport effects as part of this IBC.

Our Option 5 is designed to match the PTSS BRT option, and hence we applied the PTSS BRT modelling to it. In addition, we assumed that the transport effects (eg journey times) of Option 1 are materially similar to the PTSS Bus Priority option (minus the Kilbirnie branch). The reference case was also assumed to be the same for both the PTSS and this analysis.[16]

The use of the PTSS outputs for Options 1 and 5 represented the 'bookends' of our analysis. The transport effects of Options 2 through 4 were determined by interpolation, using methods developed in conjunction with GWRC.

The key metrics from the transport models were for the two hour am peak period in 2031, and covered travel time savings and patronage from Kilbirnie and Newtown to the CBD, in the reference case, and the bus priority and BRT options.

Table 12 below shows the PTSS patronage forecasts. Table 13 and Table 14 show the PTSS travel time savings, relative to the reference case.

Table 12: Local growth in patronage to the CBD (2031 am peak period)

Area	Reference case	Bus Priority	BRT
Miramar	1320	+ 60	+ 170
Kilbirnie Lyall	680	+ 40	+ 80
Mt Victoria/ Hataitai	790	+ 20	- 50
Island Bay	1,140	+ 20	+ 100
Newtown	790	+ 30	+ 90
Total	**4,710**	**+ 170**	**+ 400**

Source: PTSS Option Evaluation Report

Table 13: Travel time savings from Kilbirnie relative to the reference case (2031 am peak period, minutes)

Kilbirnie to	Reference case	Bus Priority	BRT
Elizabeth St	13.9	- 1.1	- 7.6
Courtenay Pl	14.7	- 1.1	- 8.1
Willis St	19.3	- 1.5	- 9.5
Rail Station	24.5	- 2.7	- 11.2

Source: PTSS Option Evaluation Report

---

[16] As discussed above, the key difference is the inclusion in our reference case of high-capacity. The cost and benefit values were adjusted to exclude the effects of the larger buses in our options.

Table 14: Travel time savings from Newtown relative to the reference case (2031 am peak period, minutes)

Newtown to	Reference case	Bus Priority	BRT
Basin	5.1	- 1.4	- 1.7
Courtenay Pl	8.5	- 1.4	- 3.3
Willis St	13.1	- 1.8	- 4.7
Rail Station	18.3	- 3.0	- 6.4

Source: PTSS Option Evaluation Report

For the intermediate options, GWRC determined an interpolation method based on the relativity of expected travel time savings between the options. This method was used to determine the values for travel time savings, patronage, operating costs and car vehicle kilometres travelled. The method identified key intersections and the impact of the level of bus priority and dedication measures on travel time savings, for each option. Appendix C includes further details.

2.3.2 Key modelling results

Average travel times for Options 1 and 5

The PTSS data included different journey times to different parts of the CBD. The approach to our analysis was to use a weighted average method, based on the proportion of travellers expected to travel from Newtown and Kilbirnie to the specific destinations along the routes.

We assumed the patronage weights shown in Table 15 for travellers from Newtown and Kilbirnie to the CBD to generate the weighted average travel time along the routes. We assumed that the demand breakdown for Newtown and Kilbirnie travellers is the same across all the options, based on forecast patronage values from the PTSS.

Table 15. Weights for travellers along the Newtown and Kilbirnie routes by destination

Newtown to	Per cent of travellers	Kilbirnie to	Per cent of travellers
Basin	10%	**Elizabeth St**	10%
Courtenay Pl	10%	**Courtenay Pl**	10%
Willis St	40%	**Willis St**	40%
Rail Station	40%	**Rail Station**	40%

The PTSS disaggregation of travel times into segment allowed the travel time savings for the variants without the Kilbirnie branch to be derived. We assumed that the buses travelling from Kilbirnie will be able to benefit from the infrastructure when travelling along the Central spine when this infrastructure is completed.

The weighted average travel time savings for Options 1 and 5 are shown in Table 11.

Table 16. Weighted average travel time savings (2031 am peak, min)

Travel segment	Option 1	Option 5
Newtown to CBD	2.2	4.9
Kilbirnie to CBD	1.9	9.5

Interpolation approach for intermediate options

For the intermediate options, we interpolated the travel time savings shown above using an allocation method based on the expected impact on easing congestion, relative to the PTSS BRT option. GWRC identified key intersections and the impact of the level of bus priority and dedication measures on travel time savings, for each option. Appendix C has further details.

Table 17 below shows the weighted average travel time savings for the core options considered.

Table 17. Weighted average travel time savings for the core BRT options (2031 am peak, mins)

	1	2	3	4	5
Time savings (mins)	1.4	4.3	4.5	6.5	7.6

Figures for patronage were interpolated using the same method as the travel time savings. Table 18 below shows the additional patronage for the core BRT options.

Table 18. Additional PT patronage for core BRT options (2031)

	1	2	3	4	5
Additional patronage	50	146	162	272	390

2.3.3 *Calculation of costs*

Capital and operating cost values are also sourced from the PTSS work. These were developed by Davis Langdon, and peer reviewed. As with the transport effects, we apply the PTSS Bus Priority and BRT costs to Options 1 and 5, and then interpolate to develop the costs for the other options.

Capital expenditure

Table 19 below shows the indicative costs of the bus priority and BRT options from the PTSS work.

Table 19: Capital expenditure of construction ($2013 m)

	Bus Priority	BRT [2]
Central spine	16.1	79.8
Newtown branch	5.9	29.4
Kilbirnie branch	14.1 [1]	25.6
General allowances	5.0	9.8
Design and construction contingencies (20%)	9.8	32.2
Total construction cost	**58.6** [3]	**173.5**

Source: Wellington Public Transport Spine Study Appendix E Option Cost Methodology
Note: (1) Option 1 does not include the Kilbirnie branch. However we use the PTSS value for this part of the route to help interpolate the values for other options. (2) The BRT values exclude the amount included in the PTSS for high-capacity buses, since these are part of the reference case for our analysis. (3) The Bus Priority values exclude amounts for the Constable St part of the route, since this is not part of any BRT option.

The interpolation method used for capital costs differed to that applied to journey times, given the different drivers of the values. Our method uses professional judgement to determine the relative costs of each option compared to the 'bookends'. The approach used a different relative allocation for road infrastructure and signalling and telemetry. Table 20 and Table 21 set out the approach used to interpolate the capital costs.

Table 20: Infrastructure cost allocation

Option 1	Option 2	Option 3	Option 4	Option 5
Bus Priority costs	Midway between BP and BRT costs	BP costs plus 25%	Midway between BP and BRT costs	**BRT costs**

Table 21: Signalling cost allocation

Option 1	Option 2	Option 3	Option 4	Option 5
Bus Priority costs	Same as BP costs	Same as BP costs	Same as BRT costs	**BRT costs**

Further detail is contained in Appendix C

Operating expenditure

The PTSS assumed savings in operating costs for both the bus priority and BRT options, relative to the reference case. The operating costs relate to the bus operations (eg fuel, vehicle maintenance etc) and a 10% contingency has been applied to the total regional cost of providing public transport services. The PTSS did not specifically include costs for maintenance of the new infrastructure. We have assumed that the maintenance costs of the whole roadway are materially similar as the do-minimum scenario, on the basis that the segment of the road would need to be maintained anyway. For example, if kerb-side parking is removed and converted to a bus-lane, the existing renewals budget would have some proportion allocated to the road segment anyway.

For the intermediate options, opex savings are allocated proportionate to the travel time savings.

2.4 Cost benefit analysis results

This section presents the results of the CBA, using the approach discussed in the previous section.

All costs and benefit figures are present values. This allows a like-for-like comparison between costs and benefits that have different timings. But, notably, the cost figures shown here are lower than the actual cost that will eventually be incurred – which is presented in the financial case.

2.4.1 The core options

Table 22 presents the estimated benefits, costs and the benefit-cost ratios for the core BRT options. All dollar values shown are net present values over 40 years.

Table 22. Costs, benefits and BCRs – core BRT options

$m NPV	1	2	3	4	5
Benefits:					
Travel time benefits	$ 5.9	$ 15.3	$ 19.0	$ 28.1	$ 32.9
Additional PT user benefits	$ 0.0	$ 0.0	$ 0.0	$ 5.8	$ 6.0
Reliability benefits	$ 5.9	$ 15.3	$ 19.0	$ 28.1	$ 32.9
Walking benefits	$ 0.1	$ 0.3	$ 0.3	$ 16.4	$ 17.1
Emissions reductions benefits	$ 0.1	$ 0.3	$ 0.3	$ 0.3	$ 0.4
Agglomeration benefits	$ 0.9	$ 2.3	$ 2.8	$ 4.2	$ 4.9
Decongestion (dis)benefits	-$ 4.9	-$ 4.4	-$4.3	-$ 4.0	-$ 3.7
Reduction in vehicle operating cost benefits	$ 3.8	$ 10.7	$ 11.0	$ 13.3	$ 17.5
Total benefits	**$ 11.8**	**$ 39.7**	**$ 48.0**	**$ 92.2**	**$ 108.1**
Costs:					
Capex	$ 24.3	$ 72.1	$ 43.4	$ 97.2	$ 132.9
Opex (savings)	-$ 2.4	-$ 20.8	-$ 22.8	-$ 36.8	-$ 45.4
Total costs	**$ 21.9**	**$51.3**	**$ 20.6**	**$ 60.4**	**$ 87.5**
Benefit-cost ratio	**0.5**	**0.8**	**2.3**	**1.5**	**1.2**

2.4.2 Sensitivity analysis

We have performed sensitivity testing on three key assumptions: construction cost, the value of time and the value of the agglomeration benefits, in three individual sensitivity tests. We applied an extra 20% to costs, an extra 25% to the value of time for PT users and changed the agglomeration benefit calculation to 25% of all other benefits (to match the PTSS economic evaluation).

As a result of the suggestions from the peer-review, we also performed sensitivity testing on the reliability benefits and walking benefits to ensure that the overall BCR results were not unduly influenced by these two benefit categories. For the reliability benefits, we reduced the value of the benefits by 69%.[17] For the walking benefits, for the sensitivity test we only included the walking benefits to new PT users and excluded the theoretical benefits to existing PT users who walk further due to the stops being further apart.

The overall results are robust to the sensitivity tests and the key results remain valid. One result in particular stands out. When the construction costs are an additional 20% higher (ie with the contingencies that are an additional 40% above the PTSS point estimates), options 3 and 4 retain BCRs above 1, indicating the strength of these two options. The extra reliability and walking sensitivity tests do not change the overall outcome for these options, either as individual sensitivity tests or combined as an overall sensitivity test of conservative assumptions (BCRs 1.7 and 1.0 respectively).[18]

Further details are in Appendix C.

2.4.3 Variants of core options

The results for the variants of the core options are presented in Appendix C. There are two key results.

The options which did not include the Kilbirnie branch had significantly lower BCRs than the core options. The Kilbirnie branch is a very important part of the BRT solution, most notably through the significant reduction in travel times from eastern suburbs that can be achieved with additional BRT infrastructure along that part of the route.

The options which involved a delay in the construction of the Central spine had higher BCRs than the corresponding core options. While this might suggest that delaying construction has merit, we note that this result should be viewed with caution. This type of result, where delay to the implementation of a project increases the BCR, is not uncommon across economic cost-benefit analysis.

---

[17] As indicated in Table 6, the reliability of buses along all stops is 69%, and therefore 31% of buses are not on time. Therefore, we applied a factor of 0.31 to the reliability NPV for all the options as a sensitivity test.

[18] Conservative assumptions refers to conservative values for costs (extra 20%), reliability benefits (factored down by 69%) and walking benefits (benefits only accrue to new PT users).

2.5 Approach to multi criteria analysis

This section sets out the approach used to undertake the MCA.

The MCA has two stages.

- Firstly, options are assessed against a set of critical success factors (CSFs) – things that an option *must* have if it is to be considered further.
- Secondly, those options which meet the CSFs are then scores against a set of evaluative criteria.

2.5.1 Critical success factors

Table 23 shows the CSFs determined for BRT. These were developed by the Working Group.

Table 23. Critical success factors

A reduction in bus-on-bus congestion
A reduction in PT journey times along the PT Spine
An increase in reliability of PT journeys along the PT Spine
An increase in PT patronage in Wellington city
An increase in PT Spine corridor carrying capacity

It was considered that all of the options, and the variants of each, meet each of these CSFs. Therefore, all options described earlier are subjected to the full economic assessment.

2.5.2 The MCA evaluation framework

Project objectives and criteria

Nine 'project objectives' were developed by the Working Group, to use as a basis for the MCA. Each option is assessed against each of the objectives.

These objectives were developed by the Working Group, initially at the ILM workshop and then at a subsequent workshop. They were deemed to cover the key problems identified, and attempting to be addressed, and the key areas which were relevant to a decision to invest.

To help the scoring process, a number of more specific criteria were developed for each objective. Each option is scored against each criterion. Then the scores for the criteria are averaged to derive the scores for each objective (the criteria for each objective are unweighted).

Table 24 presents the nine project objectives and the criteria for each.

Table 24. Multi-criteria analysis evaluation framework – project objectives and criteria

Objective	Criteria
1. Increased economic activity	• 1.1 PT Spine corridor throughput • 1.2 Ability to drive intensification of development and economic activity • 1.3 Increase in the value of land use along the PT Spine • 1.4 Increase in residential population along the PT Spine
2. Improved multi-modal network efficiency	• 2.1 Reduction in PT journey times • 2.2 Increased reliability of PT journeys • 2.3 Reduction in vehicle operating costs • 2.4 Improvement in ability to move goods and services around the city • 2.5 Operational resilience (level of interaction with other modes)
3. Improved accessibility	• 3.1 Increase in PT Spine corridor carrying capacity • 3.2 Improved options for mode choice • 3.3 Reduction in bus-on-bus congestion • 3.4 Reduction in PT journey times
4. Increased PT patronage	• 4.1 Increase in PT patronage in Wellington city • 4.2 Increase in PT mode share in Wellington city
5. Improved PT user experience	• 5.1 Increase in PT user satisfaction • 5.2 Increase in ease of use of PT
6. Minimise emissions	• 6.1 Assessment of emissions (buses) • 6.2 Assessment of emissions (mode shift)
7. Minimise impacts on physical environment / amenity	• 7.1 Land take • 7.2 Construction effects • 7.3 Visual effects • 7.4 Noise effects • 7.5 Heritage effects • 7.6 Loss of town belt • 7.7 Ecological effects • 7.8 Safety impacts • 7.9 Impacts on residential amenity • 7.10 Localised urban centre commercial impacts • 7.11 Loss of parking • 7.12 Traffic and transport effects
8. Affordable / value for money	• 8.1 Benefits • 8.2 Capex • 8.3 Opex & maintenance • 8.4 Rates impact
9. Alignment / integration with other infrastructure & services	• 9.1 Alignment with strategic documents (eg GOS, RLTP, LTP, Urban Growth Plan) • 9.2 Alignment with specific projects (eg RONS, cycling)

Scoring system

Each criterion, and objective, was scored against the 7-point scoring system presented in Table 25.

A 7-point scale was preferred by the Working Group to the 5-point scale used in the PTSS. It was considered that 3 levels of positive effects would allow a better discrimination between the options.

Table 25. Scores used for multi-criteria analysis

	Numerical score	Colour used to present results
Significant positive effects (or alignment)	+3	
Some positive effects (or alignment)	+2	
Minor positive effects (or alignment)	+1	
Neutral	0	
Minor negative effects (or alignment)	-1	
Some negative effects (or alignment)	-2	
Significant negative effects (or alignment)	-3	

2.6 *Multi criteria analysis results*

This section presents the results of the MCA, using the framework discussed in the previous section. This section just presents the results for each objective, and only for the core options. The actual numerical scores, the underlying results for the individual criteria, and their rationale, and the scores for the option variants, are all presented in Appendix D.

Table 26 shows the MCA scores for the core BRT options.

Table 26. Results of multi-criteria analysis – core BRT options

	Ref case	1	2	3	4	5
1. Increased economic activity	● (grey)	● (light green)	● (green)	● (dark green)	● (dark green)	● (dark green)
2. Improved multi-modal network efficiency	● (grey)	● (light green)	● (green)	● (green)	● (green)	● (green)
3. Improved accessibility	● (grey)	● (light green)	● (green)	● (dark green)	● (dark green)	● (dark green)
4. Increased PT patronage	● (grey)	● (light green)	● (green)	● (dark green)	● (dark green)	● (dark green)
5. Improved PT user experience	● (grey)	● (grey)	● (light green)	● (light green)	● (dark green)	● (dark green)
6. Minimise emissions	● (grey)	● (grey)	● (light green)	● (light green)	● (green)	● (green)
7. Minimise impacts on physical environment / amenity	● (grey)	● (grey)	● (grey)	● (grey)	● (yellow)	● (yellow)
8. Affordable / value for money	● (grey)	● (grey)	● (light green)	● (light green)	● (light green)	● (light green)
9. Alignment / integration with other infrastructure & services	● (grey)	● (yellow)	● (green)	● (green)	● (green)	● (green)
Negative effects ● (red) ● (orange) ● (yellow) ● (grey) ● (light green) ● (green) ● (dark green) **Positive effects**						

Considering the scores separately by objective allows the differences between each option to be better understood. However, the scores can be aggregated, to derive one score for each option. Table 27 presents the aggregate scores, if all objectives are given the same weights.

Table 27. Unweighted aggregate MCA scores – core BRT options

	Ref case	1	2	3	4	5
Unweighted score	● (grey)	● (grey)	● (light green)	● (green)	● (green)	● (green)
Negative effects ● (red) ● (orange) ● (yellow) ● (grey) ● (light green) ● (green) ● (dark green) **Positive effects**						

Unweighted scores can be misleading however. They implicitly assume that all objectives are of equal importance, which is rarely the case. In the case of BRT, the first five objectives were identified during the ILM workshop as of the greatest importance. The Working Group considered that giving these objectives, collectively, double the weighting of the other four objectives was a reasonable way of accounting for this.

Table 28 presents the aggregate scores, if the objectives 1-5 are collectively given double the weight of objectives 6-9.

Table 28. Weighted aggregate MCA scores – core BRT options

	Base case	1	2	3	4	5
Weighted score	● (grey)	● (grey)	● (light green)	● (green)	● (green)	● (green)

Negative effects	● (red)	● (orange)	● (yellow)	● (grey)	● (light green)	● (green)	● (dark green)	**Positive effects**

We note that these are same as the unweighted aggregate scores. We have tested the sensitivity of the scores to different weightings, and have concluded that the scores (in particular, the differences between options) are relatively robust to changes in the weights of the objectives.

2.7 Discussion of trade-offs

The options involve a range of different types of BRT solution, each with different pros and cons. In this section we discuss the trade-offs between *what* the options deliver and *how* they deliver them.

The cost vs quality trade-off

Wellington can have the highest quality BRT system considered (Option 5), but this comes at a cost.

Option 5, effectively the BRT solution envisaged in the PTSS, provides a very high-quality bus system. Buses are physically separated from general traffic, and have full priority over general traffic at intersections. However, not unexpectedly, Option 5 is also the most expensive of those considered.

Our analysis of intermediate options shows that there is an opportunity for Wellington to achieve a significant proportion of the benefits of a high-quality solution for a much lower cost.

For example, Option 4 is cheaper than Option 5, but still enables significant benefits to be achieved through having dedicated bus lanes along the full BRT route. Option 3 is considerably cheaper still, but still enables a considerable improvement in terms of the ability to move people around the city over the reference case.

The transformational approach vs cost efficient approach

All the options move people along the PT Spine faster and more reliably, to varying levels, than is currently the case. But they vary quite a lot according to the other objectives and strategic goals they satisfy.

Option 3 enables considerable improvements in moving people around the network. However, the discontinuous nature of the bus lanes means that it is unlikely to have the type of transformational effect that Option 5, and to a lesser extent Option 4, would have.

Options 4 and 5 could provide a material step-change in Wellington's PT infrastructure. With dedicated lanes along 100% of the route, the look and feel of these solutions would be quite different to Option 3. These highest quality options are more likely to lead to significant shifts in land use along the corridor, and drive intensification and increase economic activity around the PT Spine.

However, BRT can be implemented incrementally. Instead of a one-off transformational step-change, incremental improvements could be made over time. For example, it is possible to deliver Option 3 now, and then further develop the infrastructure by effectively moving to Option 4 or 5 at a later date.

The road space allocation trade-off

As well as significant financial implications, high-quality BRT solutions also have costs in terms of their effects on other road users. As more dedication and priority is allocated to PT, more of the roadspace must be taken away from general traffic and/or parking (or the road is widened, with consequent environmental effects).

Dedicated bus lanes along the full route will almost certainly involve the removal of some sections of general traffic lanes (eg Ruahine St, Kent and Cambridge Terraces), and the removal of some kerb-side parking (eg Courtenay Place, Adelaide Road). They would also make it more difficult to introduce separately cycle lanes within the existing roadspace.

Furthermore, if buses are given complete priority at intersections, this could have a significant impact on other road users. Indicative network modelling undertaken for the PTSS suggests that the potential overall impact of fully-separated BRT on the wider transport network is moderate but manageable. This is equivalent to Option 5 – a BRT solution providing a lower level of dedication could result in significantly reduced impacts on other road users. This analysis, however, has highlighted a number of critical intersections where affording priority to buses would provide significant benefits but might also result in adverse impacts for other road users. These intersections are likely to be the focus of design efforts during any subsequent DBC phase.

Option 2, in an attempt to improve peak period mobility while retaining kerbside carparking during the interpeak and off-peak periods, does not appear to provide an efficient use of resources. The cost of putting in the infrastructure does not appear to be justified on the basis of the peak-period benefits.

It is important to note that the PT users and private vehicle users are not necessarily two distinct groups of people – the majority of PT users also travel via car for some trips. High-quality public transport provides options and viable choices to all travellers, so that they choose the best mode for each particular trip.

The timing trade-off

The analysis shows that the option variants in which construction is delayed to match the timing of the RONS projects, have higher BCRs than the core options, in which the Central Spine segment is constructed earlier. This highlights a classic timing trade-off found with cost-benefit analysis. It is not uncommon for delaying construction to increase a BCR, due to the discounting process of large capital costs.

Constructing BRT early has tangible advantages not included in the narrow scope of the cost-benefit analysis. For example, construction demonstrates commitment to developing the network infrastructure and could encourage earlier mode shift to PT.

The impact of the RONS projects

As discussed in the strategic case, finding a solution to conflicting transport demands at the Basin Reserve is critical to implementing a high-quality BRT system. Without such a solution, the benefits yielded from duplicating the Mt Victoria tunnel will likely be considerably lower, and the Kilbirnie branch of the proposed BRT solution will not be able to offer the same benefits as envisaged with the RONS projects in place.

The option variants which do not include the Kilbirnie branch illustrate the best the BRT could offer without the RONS. The BCRs for these variants are substantially lower than those for the core options. In many cases, these BCRs are below one. This illustrates how important this part of the route is to achieving the full benefits from BRT.

Furthermore, the BCRs for the option variants without the Kilbirnie branch likely overstate the true BCR of implementing BRT in the absence of the RONS – the modelled benefits overstate the likely benefits in such a situation. Without the Basin Bridge (or a solution of similar effectiveness), the actual traffic outcomes for trips from Newtown will likely be inferior to those modelled.

2.8 *Preferred options for Detailed Business Case*

The preferred options from the economic analysis are Options 3 and 4.

Pragmatic value-for-money options are preferred

The PTSS envisaged a BRT solution with physically separated lanes along the full route from the Railway Station to Newtown and Kilbirnie. However, the economic analysis has demonstrated that this is not the only sensible approach to implementing a BRT solution.

The majority of the travel time benefits can be achieved by providing additional priority to buses at and around key intersections along the route. The economic analysis has shown that a more targeted approach to BRT could provide a more cost effective improvement to bus services along the PT Spine.

Option 3 will deliver a very good outcome in terms of moving people around Wellington City faster and more reliably, for an up-front capital investment of $59m (compared to $174m for Option 5). It also has lower adverse impacts on traffic and parking than Options 4 and 5.

Options 3 and 4 have indicative benefit-cost ratios of 2.3 and 1.5. These are relatively high for a PT project. The roadspace dedication of Option 3 could also be combined with the intersection priority of Option 4 to deliver even greater benefits.

The economic analysis suggests that Options 3 and 4, or a combination of them, are appropriate options for further consideration. Option 3 appears the best value-for-money approach – a good outcome for a relatively low cost. But if a high-quality, more transformational, outcome is desired, Option 4 appears the best approach – this is a lower cost version of Option 5, achieving a large proportion of the benefits. It would also be possible to implement Option 3 initially and progress to Option 4 over time.

Table 29 and Table 30 summarise the MCA scores and BCRs for Options 3 and 4.

Table 29. Multi-criteria analysis scores for the preferred options

	Base case	3	4
1. Increased economic activity	Grey	Dark green	Dark green
2. Improved multi-modal network efficiency	Grey	Green	Green
3. Improved accessibility	Grey	Dark green	Dark green
4. Increased PT patronage	Grey	Dark green	Dark green
5. Improved PT user experience	Grey	Light green	Dark green
6. Minimise emissions	Grey	Light green	Green
7. Minimise impacts on physical environment / amenity	Grey	Grey	Grey
8. Affordable / value for money	Grey	Light green	Light green
9. Alignment / integration with other infrastructure & services	Grey	Green	Green

Negative effects (Red, Orange, Yellow, Grey, Light green, Green, Dark green) **Positive effects**

Table 30. Benefit-cost ratios of the preferred options

Option	3	4
BCR	2.3	1.5

Wellington can have the highest quality BRT solution possible (Option 5) if it desires. However, it will be cost a lot more than Options 3 and 4 and involve some more substantial effects on other road users and the physical environment. The economic analysis suggests that Option 5 may not be the best use of resources.

Options 3 and 4 have been identified as the preferred options on the basis that they deliver much of the benefits of Option 5, but with a more efficient use of resources.

These options also do not preclude upgrades to a higher-quality solution in the future. In Option 3 is chosen today, Options 4 or 5 could still be implemented at a later date if warranted.

The Kilbirnie branch is very important

A key result from the consideration of the option variants within the economic analysis is that the Kilbirnie branch is essential to the viability of a BRT solution. This helps to partially illustrate the effect of complete transport networks. Designing a network as a whole enables optimisation across the PT network, as well as with other road users.

It is therefore recommended that, if physically possible, only options that include the Kilbirnie branch are considered further.

3. Financial case

The financial case covers the detailed financial costing, including both capital and operating expenditure. It discusses funding implications, including the extent to which funding for BRT is currently included in council LTPs.

3.1 Implementation costs

Table 31 shows the expected total capital expenditure for implementing each of the core BRT options identified in Section 2.2. These amounts are specified in 2015 dollars. The capital expenditure will increase with inflation over time. Inflation has not been included but would need to be taken into account when using these values for budgeting purposes.

Table 31 also shows the expected savings in operating expenditure. As discussed in the economic case, it is expected that BRT would lead to reduced operating costs for buses, largely due to reductions in journey times. These operating cost savings are expected to increase over time. The savings expected in 2031 are included in Table 31. These are also expressed in real 2015 dollar terms. The operating costs exclude any specific allocation for maintenance of the BRT infrastructure. We note that some maintenance costs will already be included in the do-minimum (eg the costs of maintaining the section of a road which is currently kerb-side parking but converted to a bus lane should be similar). We have assumed that the operating costs for the BRT infrastructure are not materially different to the do-minimum scenario. This can be investigated in greater detail in the DBC stage.

The cost amounts in the table are consistent with those used in the economic case. As discussed in that case, they are sourced from the PTSS, with assumptions made for the intermediate options.

Table 31. Expected total capital expenditure and annual operating expenditure savings for each core BRT option ($2013 m)

Option	Total capital expenditure ($m)	Annual operating expenditure savings in 2031 ($m)
1	30.9	0.3
2	95.7	2.6
3	58.8	2.9
4	127.2	4.6
5	173.5	5.7

Capital expenditure components

There are different components of the capital expenditure that may be subject to different funding arrangements.

Table 32 presents the capital expenditure values for key components, for the core options.[19]

[19] Note that any costs of projects included in the Reference Case are not included in this table. For example, the costs of duplicating the Mt Victoria tunnel and associated widening of Ruahine Street are not included. These costs relate to the incremental costs of implementing BRT, over and above the costs incurred in the Reference Case.

Table 32. Capital costs for the core BRT options, disaggregated into key components ($2013 m)

Option	1	2	3	4	5
Site Preparation Works (Within Existing Carriageway)	0	3.2	0	3.2	6.4
Traffic Management, Road Alterations	10.5	27.8	16.0	27.8	42.8
Signalling/Controls	3.6	3.6	11.7	43.2	43.2
Stations/Ticketing and Fare Collection Systems	1.3	1.5	1.8	1.5	1.5
General Allowances	14.9	43.1	27	43.1	64.5
Other	0.6	8.4	2.2	8.4	15.1
Total	**30.9**	**97.5**	**58.8**	**127.2**	**173.5**

Time profile of capital costs

Table 33 shows the time profile of capital expenditure for the core BRT options.

The core options focus on a staged approach to construction. Each of these options are assumed to be implemented in stages – the Central branch immediately, and then the Newtown and (except for Option 1) the Kilbirnie branch once the RONS projects are complete. There is considerably uncertainty over the possible completion date of the RONS projects, and hence the expenditure profiles need to be viewed with caution.

Table 33. Time series of capital costs for the core options ($2013 m)

Option	1	2	3	4	5
2016	-	-	-	-	-
2017	-	-	-	-	-
2018	22.6	51.0	27.0	74.2	102.8
2019	-	-	-	-	-
2020	-	-	-	-	-
2021	-	-	-	-	-
2022	-	-	-	-	-
2023	-	-	-	-	-
2024	8.3	47.4	31.8	53.0	70.7
2025	-	-	-	-	-

This IBC does not include likely depreciation profiles of the assets. We note that the depreciation levels will be important if the funding organisations intend to fund future renewals by funding depreciation over time. This work will be undertaken in any subsequent DBC, for the option(s) considered in that phase.

Cost uncertainty

The capital cost values shown above are based on the estimates developed for the PTSS. They include an amount for contingencies, equal to 20% of the other costs. The operating costs also have a contingency factor applied. A contingency of 10% has been applied to the total regional cost of providing public transport services.

There is inherent uncertainty over the potential capital costs for investments like this. Business cases often express the capital expenditure values as a probability range. This is not undertaken in this IBC. The PTSS expenditure values that are the basis of our analysis were not determined with a range (only a central estimate), and hence considering higher percentiles is not possible.

We have used other mechanisms to consider the effect of uncertainty. As per the approach in the PTSS, the cost estimates used for our main BCRs include an amount for contingencies (20% of other costs). We have also undertaken sensitivity testing of these cost values in the economic case. We have tested the suitability of this approach to considering cost uncertainty in an IBC with the Transport Agency.

While the capital cost estimates are adequate for providing guidance on the relative cost of the options for the purpose of this IBC, they will need to be updated in detail for the DBC.

3.2 Funding sources

Assuming the current funding arrangements for PT in Wellington are retained, BRT will be jointly funded by the Transport Agency, GWRC and WCC. Table 34 and Table 35 show each organisation's share of the required funding, for the core BRT options5, assuming these funding arrangements continue. It shows total capital cost, and the annual opex in 2031. As with previous tables, these are in real 2015 dollars and so do not include the effects of future inflation. .

We understand that there is some ambiguity over the future funding arrangements for stop and station infrastructure. However, under current and historical funding arrangements, it is assumed that GWRC will fund the remainder of the cost that the Transport Agency will not.

It is also possible that alternatives to the current PT funding arrangements could be considered for BRT, particularly if some of the options considered in a DBC have different capex/opex ratios.

Table 34. Funding required for the core BRT Options 1 - 3 ($2013 m)

Option	1				2				3			
	Total	NZTA cost	GWRC cost	WCC cost	Total	NZTA cost	GWRC cost	WCC cost	Total	NZTA cost	GWRC cost	WCC cost
Capex												
Road alterations	**10.5**	5.4		5.2	**31.0**	15.8		15.2	**16.0**	8.2		7.8
Signalling / controls	**3.6**	1.8		1.8	**11.7**	6.0		5.7	**11.7**	6.0		5.7
Stations/ticketing and fare collection systems	**1.3**	0.7	0.6		**1.5**	0.8	0.7		**1.8**	0.9	0.9	
Other	**15.5**	7.9		7.6	**51.5**	26.3		25.2	**29.3**	14.9		14.4
Capex total	**30.9**	**15.8**	**0.6**	**14.5**	**95.7**	**48.8**	**01.7**	**46.2**	**58.8**	**30.0**	**0.9**	**27.9**
Opex (2031)	**-0.3**		**-0.3**		**-2.6**		**-2.6**		**-2.9**		**-2.9**	

Note: Totals may not add due to rounding.

Table 35. Funding required for the core BRT Options 4 and 5 ($2013 m)

Option	4				5			
	Total	NZTA cost	GWRC cost	WCC cost	**Total**	NZTA cost	GWRC cost	WCC cost
Capex								
Road alterations	**31.0**	15.8		15.2	**49.2**	25.1		24.1
Signalling / controls	**43.2**	22.0		21.2	**43.2**	22.0		21.2
Stations/ticketing and fare collection systems	**1.5**	0.8	0.7		**1.5**	0.8	0.8	
Other	**51.5**	26.3		25.2	**79.6**	40.6		39
Capex total	**127.2**	**64.9**	**0.7**	**61.6**	**173.5**	**88.5**	**0.8**	**84.3**
Opex (2031)	**-4.6**				**-5.7**		**-5.7**	

Note: Totals may not add due to rounding.

3.3 Current funding status

If BRT is to be delivered, the three funding organisations will need to allocate the required funding in their respective plans and budgets.

The NLTP sets out the items to be funded by the Transport Agency via the NLTF for a 3-year period, based on the programmes and activities submitted through RLTPs. This is set every 3 years, but can be varied during that period. The NLTP 2015-18 includes two BRT related activities: GWRC's Bus Rapid Transit Implementation Plan 2015-18 (intended for DBC phase, total cost approximately $3m) and WCC Wellington City BRT Infrastructure Improvements (total cost $60m). Both activities have 'proposed' status, which means that funding approval may be given when an application is made in 2015-18 provided further evidence is required to confirm the assessment profile and provide confidence in the funding priority and availability of funds.

The DBC phase will provide further certainty about the total cost of BRT implementation. To ensure enough local share is available for BRT implementation, WCC and GWRC will need to continue to factor the results of the IBC and future DBC phase into their respective annual and long term planning processes.

4. Commercial case

The Commercial Case presents a range of approaches to the procurement of the BRT options, sets out the pros and cons of each, and provides an indicative assessment of the most suitable options. Any subsequent DBC will have a more detailed assessment, and a preferred option will be selected.

As with the rest of this IBC, the commercial case is focused on procurement of just the physical BRT infrastructure, not the other elements of the wider BRT solution (eg high-capacity buses). However, the management case considers options for procuring this BRT infrastructure together with new cycling infrastructure, roading improvements, or other physical changes to the roadspace. We also consider the potential of the procurement options to work with an integrated provision approach.

The indicative assessment of procurement options in this section focuses on a number of qualitative factors, particularly:

- cost competitiveness, and the ability of the different models to ensure strong market tension
- the ability of the procurement model to meet construction deadlines
- the effectiveness of the procurement model at transferring risk from the project sponsors over its design, construction and building life, enabling greater certainty of costs
- the ability of the model to accommodate unexpected changes to scope or original specification during procurement and construction due to potential changes in the Wellington transport network over the analysis period (eg uncertainty around the timing of the Basin bridge)
- the procurement model's ability to deliver innovation in asset design, construction and management, achieving lower whole-of-life project costs.

This commercial case also discusses opportunities for commercial development.

4.1 Procurement strategy

Below we outline possible strategies for the procurement of the design, construction, ongoing maintenance and operations of the physical BRT infrastructure.

Our approach to this analysis is as follows:

- **Procurement models**: An overview of the characteristics of potential procurement options.
- **Project components and application to the BRT options**: An outline of the different components of each procurement model and how the different procurement options might be applied in the context of this project. This allows us to consider the pros and cons of different procurement approaches at a more granular level; in particular, the policy implications associated with different risk allocation and the transfer of rights.
- **Preliminary evaluation and recommendations**: We consider the merits of each option with respect to the BRT context, and provide indicative recommendations for the option(s) which are likely to be most suitable.

4.1.1 Defining procurement models

There is a range of possible procurement models across a spectrum of public and private sector participation with associated risk transfer. These models include:

- **Traditional models**: The Project Partners would individually enter into contracts with an expressly identified risk allocation. The effectiveness of these arrangements tends to rely on the ability of the Project Partners to define their performance requirements prior to tendering and to have a clear identification, understanding and quantification of risks.

- **Relationship based models**: The Project Partners would enter into a collaborative relationship agreement with appropriate parties to define requirements, understand risks and undertake the works. These approaches generally collectively share risk on a 'no fault, no blame' basis with incentives built in to equitably share additional or reduced value to the Project Partners by outcomes actually achieved, thereby encouraging enhanced performance. Such approaches include the (Early Contractor Involvement) ECI model and Alliance contracting.
- **Privately financed models**: The Project Partners would enter into contracts with a fixed risk allocation on a whole-of-life basis, such as public-private partnership (PPP) models.
- **Managing contractor procurement models**: The Project Partners would appoint a Managing Contractor as the head contractor who would engage subcontractors on behalf of the Project Partners to deliver the works and would typically be paid a management fee and incentive payments for achieving target price, schedule and other key parameters.

Table 36 provides a high level summary of the key characteristics of different examples of these models and how they could be applied in the BRT context. All of these models have been applied to infrastructure procurement in Australasia and internationally.

Table 36. Characteristics of different procurement models and application to the BRT options

Model description	Project Partners' risks	Contractor's risks	Payment mechanism	Use
Design then construct/ design bid build (DBB) The Project Partners individually contract with separate entities for the design and construction phases of the project for the segments they are responsible for.	• Scope does not meet needs • Scope changes • Site conditions • Whole-of-life asset ownership risks • Operational risks • Disputes between design and general contractor over responsibility for issues cause delays and/or mean some contractor risk is pushed back to the Project Partners • Separate design and construction contracts may lead to a design that is not buildable or that is not cost effective from a construction perspective. • Lack of clarity over roles and responsibilities between Project Partners	• Design does not meet brief (though there is risk to the Project Partners that this is disputed between design and construction contractors) • Construction timetable breaches • Cost of works (except for agreed variations).	• Fixed price (though subject to disputes, claims and variations) • Progress payments based on milestones or cost of work completed • Whole-of-life, maintenance and lifecycle type costs are retained by the Project Partners (though may be separately contracted out).	Best suited to projects where: • Each Project Partner's specifications can be clearly articulated before tender • Specifications are unlikely to change and where each Project Partner is best placed to manage non-construction project risks • Design is relatively uncomplicated, where the key procurement objective is ensuring a strongly competitive construction tender • One design is repeated over • Relationship with design team may be more interactive, which can reduce specification risks; however, it can also be harder to manage scope • Operational risks best managed separately • No upfront funding constraints • Low scope for innovation.

Model description	Project Partners' risks	Contractor's risks	Payment mechanism	Use
Design and construct (D&C) The Project Partners seeks tenders to provide a (typically) fixed price for design and construction.	• Similar to DBB approach but risk of disputes between design and construction contractors is addressed • May increase risk that scope does not meet needs as there is generally greater separation between the client and the design team • Assumes the Project Partners can specify required outcomes clearly at the outset.	• Constructed design does not meet brief • Construction timetable breaches • Cost of works (except for agreed variations).	As per DBB.	Similar to DBB but tends to be a quicker process as there is one tender process and D&C can overlap. Relative to DBB, it is better suited to more complex designs where there is a need for a closer relationship between the design and construction teams.
Design, construct and maintain (DCM) Contractor retains responsibility for maintenance, but typically these models do not extend beyond the first major lifecycle phase (5 to 7 years, depending on the project).	Similar to the DBB approach: • Scope definition • Scope changes • Site conditions • Cultural and heritage risks • Operational risks • Residual ownership and asset performance risks beyond the term and scope of the maintenance contract.	As per the D&C model, and also maintenance risk for the term and scope of the maintenance contract. Effective risk transfer can be limited by the lack of private finance at risk.	• As per D&C • Maintenance costs are paid periodically by WCC and/or GWRC. Incentive arrangements and competitive tensions during the original bid phase can drive the DCM contractor to provide some reduced maintenance costs, although this will depend on the relative value of the maintenance works and the D&C component.	DCM contractor retains responsibility for some lifecycle maintenance, so these models suit projects where there is: • Opportunity to introduce D&C innovation on a whole-of-life basis • Need to create longer term alignment of interests between the contractor and the owner • Desire for a different risk allocation.

Model description	Project Partners' risks	Contractor's risks	Payment mechanism	Use
Early Contractor Involvement (ECI) Typically, the preferred contractor (ECI contractor) is selected under open competition for a whole of project contract (ie including design development, design and construction). Typically, agreements are staged, and a D&C contract is entered into with the ECI contractor following the detailed definition phase. A further contract would likely then be entered into to provide maintenance and (potentially) operations services.	• All risks retained exclusively by the Project Partners during development and definition phase • When the ECI converts to a D&C, the risk allocation profile is as per the D&C contract, including whole-of-life ownership and operational risks • However, these risks would likely be lower as major D&C risks should have been dealt with during the development and definition phase.	D&C types of risks accepted by ECI contractor following agreement on D&C.	• During the design development phase, the ECI contractor is reimbursed at agreed rates on a time basis. • Based on preliminary design and draft construction contract, the contractor prepares a fixed price to undertake construction. Price is prepared on an open book basis utilising standard rates and margins originally bid by the contractor. This price may then be market tested. • The Project Partners would engage an external auditor to verify the price prepared prior to fixing in the D&C contract. Payments are made similar to the D&C arrangement.	• The ECI model has been used when cost, risks and scope cannot be sufficiently defined upfront and where there are opportunities to access contractor innovation in design and development. • ECI should reduce opportunity for successful claims and variations compared with D&C only if the risk allocation of the underlying D&C is different. This reflects the ECI's involvement during development, better understanding of the Project Partners' requirements and project risks and more clearly defined allocation of responsibilities and risks.

Model description	Project Partners' risks	Contractor's risks	Payment mechanism	Use
Alliance An Alliance relationship is formed between key project participants, which include the Project Partners and non-owner participants (eg designer, constructor, other key stakeholders, etc). The relationship must be collaborative for the Alliance to be effective. Options are available to develop the Target Outturn Cost (TOC) in a competitive environment. However, most alliances have tended to use a single party to develop the TOC. This relies on the owner implementing approaches that create appropriate cost, quality and scope tensions, and the right level of expertise to critically validate the TOC, including risk quantification. A further contract would likely then be entered into to provide maintenance and (potentially) operations services. A key feature of Alliances is the gain share pain share incentive mechanism.	• Alliances are predicated on 'no blame' and collective assumption of all project risk basis (ie parties share 'pain'). • The Project Partners share the risks during the D&C phase with the Alliance participants. The extent of the Alliance participants' financial exposure to adverse risk outcomes depends on specified sharing arrangements but is generally limited to their margin (corporate overhead and profit). The Project Partners remain fully exposed to the underlying project procurement costs, including the resultant costs of the occurrence of all project risks. • All asset ownership and whole of life risks are retained by the Project Partners. • Operational risks are retained by the Project Partners.		• Non-owner parties are typically guaranteed reimbursement of their direct project costs and payment of corporate overheads in an open-book arrangement. • Targets for cost, schedule and other key result areas are developed jointly during pre-construction phase. If actual delivery is better than agreed targets all participants share reward ('gain-share'). If delivery does not meet agreed targets, a pre-agreed 'pain-share' formula applies (where the margins of non-owner participants will be at risk). • Construction and other costs are paid over the course of the construction period on the basis of reimbursement of cost incurred (monthly).	• Typically used in high risk projects where it is difficult to effectively define and transfer risk and there is uncertainty around scope definition, design complexity, delivery complexity, and complex interfaces which will influence design and construction outcomes. • The model provides early collaboration of the designer and contractor in the project, providing opportunities to access construction expertise in the development of the design, definition and construction programming.

Model description	Project Partners' risks	Contractor's risks	Payment mechanism	Use
Public Private Partnership (PPP) Generally, a private sector contractor (or contractor consortium) is responsible for the design, construction, operation, maintenance and finance of the infrastructure over an extended period (typically 25-30 years). This is a typical long-term, whole-of-life approach to infrastructure delivery. Risk allocation is determined up front for the period of the contract, including maintaining the infrastructure and providing the services to a pre agreed condition for the duration of the concession. Risk transfer, bundling of whole-of-life costs and incentives from having private finance at risk can drive increased innovation.	Some risks are common to the DBB/D&C models including: • site conditions (possibly) • cultural and heritage. Additional risks include: • transfer back risk • market changes that cannot be adapted to due to the long term PPP contract. The Project Partners will only bear the risk that is specifically allocated to the individual organisation. This means that all unspecified risks are borne by the private sector consortium.	• Majority of D&C and maintenance risks on a whole-of-life basis are transferred to a private sector consortium, which has full ownership risk over the assets. (No service, no payment; substandard service, reduced payment). • Private sector consortium has full exposure (of all its capital invested) to consequences of design, construction and maintenance judgments and trade-offs over the life of the project.	• The Project Partners make service payments once the project delivers the services at the required standard (ie post commissioning). Consortium pays D&C sub-contractors during construction through private financing, which is subsequently repaid to consortium from the Project Partners' service payments over the term of the contract. • The payment mechanism links with a key performance indicator (KPI) and service specifications regime and provides for reduced payments for poor performance or lack of availability during the concession. • In theory, the PPP model could involve the consortium assuming patronage risk (eg having payments linked to the number of PT users). However, there is currently limited appetite from private sector financiers to take 'patronage risk' and it is	• Where there is a clear measurable service output against which performance can be measured. • Where there are opportunities for significant effective risk transfer to the private sector (including D&C and whole-of-life risks). • Where there is opportunity for private sector innovation in any or all aspects of the project (D&C, finance, O&M) to add value. • Where benefits can be realised through a whole-of-life approach to design and costing, ie there is a strong connection between the specific design, construction materials and the level and type of maintenance costs.

Model description	Project Partners' risks	Contractor's risks	Payment mechanism	Use
			even less likely in the context of GWRC managing the public transport services.	
Privatisation Full transfer of rights to the private sector through sale.	Control over the infrastructure or land transferred to the private sector. Ability to ensure quality of service over the long-term could be challenging.	All risks rest with private party.	Negotiated through the sale process.	• May be applicable to certain small components of the project only (eg redevelopment of land surrounding new stations, if this is currently owned). • Funds from any sale could be used to offset the costs of any of the other procurement methods.
Public provision This would involve direct provision from the Project Partners.	All risks reside with the individual Project Partners for the segments they are responsible for.	N/A	N/A, as there is no contractual party	Not suitable as a full procurement option, but may be used in conjunction with another method.

4.1.2 Components of providing the BRT infrastructure

Different procurement options are applicable to different elements of the project, and/or have a different scope in terms of what is actually being procured. Table 37 outlines the key components of the project and where decisions in relation to procurement need to be considered. We then consider how the different procurement options could be applied, in the context of these project components.

Table 37. Project components

Component	Description / considerations
Financing	Mixture of debt and equity Public sector or private finance Cost of funds versus risk transferred
Design: • concept designs and project briefs • detailed design	Development of fully documented designs for the BRT routes and stations • preliminary design to the point where the BRT options could be traditionally tendered • full design required to enable the BRT option to be constructed
Construction	The main construction contract for the BRT option
Facilities management services including for example: • asset maintenance • cleaning	• Maintenance and renewals of BRT infrastructure (eg kerbs, road space, traffic lights, signage) • Maintenance and renewals of the stops and/or stations • Day to day cleaning of the stops and/or stations
Ownership	While underlying ownership is not being 'procured' it is included here as a component of the BRT project that may be subject to a transfer of rights or obligations. This includes underlying land ownership and any BRT stations developed etc.

4.1.3 How the procurement models might work in the context of BRT infrastructure

Having introduced the various procurement models, and outlined the various project components, we consider options for how the project might be procured by deploying a specific option or combination of options.

For simplicity and pragmatism this is not an exhaustive list. We have outlined the likely combinations, and benefits and issues with their application. We have also assumed for the moment that:

- the primary client/contracting party would be the Project Partners (either as individual organisations or a joint working group of the Project Partners with requisite delegated authorities)
- post construction ownership of the BRT infrastructure would sit with the public sector
- where the procurement model involves retention of management by one of the Project Partners, this may be provided by a wholly owned and independently managed company or subsidiary organisation

- the procurement relates only to the physical assets of the BRT options and excludes the purchase of the high capacity buses.

Table 38. Option 1 – DBB based procurement

Core components covered	Detailed design and construction, but under separate, consecutive contracts
Financing	Public sector debt via normal public sector processes/channels
Concept design and project brief	Separate contracts between the Project Partners and professional service advisors (architects, quantity surveyors, engineering etc)
Facilities management	Facilities management provided via the relevant Project Partner
Underlying ownership	The relevant Project Partner(s)
Comments	This is a traditional (and generally the default) procurement approach. Specialist design and construction contracts are awarded sequentially. The design team is able to offer advice to the client that is independent from the construction contractor, and may enable a more competitive construction tender process as design documentation is complete. However, there are increased risks that the Project Partners have to absorb risks of disputes between the design and construction contractors. The sequential nature of the procurement means it is typically more time consuming relative to a D&C contract. Separation of design from construction contracts may enable the Project Partners to have greater interface in the design process putting less pressure on a locked-down design specification. However, this would likely push costs into the design process, and the design team may be removed from the latest construction costs and develop designs that are not cost effective. As the management responsibilities are separated from design and construction, there is very limited opportunity to incentivise the management of whole-of-life project risks or to spur additional innovation.

Table 39. Option 2 – D&C based procurement

Core components covered	Detailed D&C
Financing	Public sector debt via normal public sector processes/channels
Concept design and project brief	Separate contracts between the Project Partners and professional service advisors (architects, quantity surveyors, engineering etc)
Facilities management	Facilities management provided via the relevant Project Partner(s)
Underlying ownership	The relevant Project Partner(s)
Comments	This is a traditional procurement approach. Specialist expertise is deployed for the various components of the project separately. As the management responsibilities are separated from D&C and finance, there is very limited opportunity to incentivise the management of whole-of-life project risks, optimise risk transfer or to spur innovation.

Table 40. Option 3 – DCM based procurement

Core components covered	Detailed D&C and asset maintenance for 5-7 years
Financing	As for D&C
Concept design and project brief	As for D&C
Facilities management	Asset management service provided under core contract for 5-7 years.
Underlying ownership	The relevant Project Partner(s)
Comments	Similar to the D&C contract but with maintenance arrangements (for a period) included. This shifts some maintenance risks to the contractor, providing some incentive to D&C assets with lower whole-of-life costs. However, the relatively short timeframe of the maintenance contract limits these risks. In addition, the contractor's risk is essentially limited to the value of the maintenance contract, meaning they may walk away from a more serious failure in the asset's performance.

Table 41. Option 4 – ECI based procurement

Core components covered	Concept design, detailed design and construction
Financing	As for D&C
Facilities management	As for D&C
Underlying ownership	The relevant Project Partner(s)
Comments	Relative to the D&C model, the ECI model enables more upfront involvement by the contractor in the design specification process. This can help in accessing contractor innovation in design and development. This model is generally suited to complex projects where the cost, risks and scope are difficult to define upfront, making a standard construction tender process difficult. This is unlikely to be the case in respect of the construction components of the BRT project. Because of this, it is unlikely that any advantages from early involvement in design would outweigh the loss in competitive tension associated with the construction contract. This model may also result in a different risk allocation if the contractor, by being involved during the development stage, is in a better position to understand the Project Partners' requirements and the project risks. As a consequence, this model can also reduce the opportunity for successful claims and variations compared with D&C only

Table 42. Option 5 – Alliance based procurement

Core components covered	Concept design, detailed design and construction
Financing	As for D&C
Facilities management	As for D&C

Underlying ownership	The relevant Project Partner(s)
Comments	Similar to the ECI model, the Alliance model involves upfront involvement by the contractor in the design specification process. Under this model a total cost is determined and agreed upfront, and risks of construction cost overruns (or savings) are shared between the Project Partners and the contractor on an agreed (pain/gain) basis. This model is also suited to complex projects where the cost, risks and scope are difficult to define upfront, making a standard construction tender process difficult. This includes projects such as large mass rapid transit with significant tunnelling components, where the client either can't specify what it wants or there are certain risks (technology, underground conditions) that no one can really understand until they commence the project. This is unlikely to be the case in respect of the construction components of the BRT project. Alliance can be an expensive form of procurement with a low level of cost control. In an Alliance, the client is agreeing to share construction risk with the contractor. It is difficult to see why that might be appropriate in this case, where the project is relatively simple and the Project Partners can get a fixed price, turn-key contract.

Table 43. Option 6 – Availability PPP based procurement

Core components covered	Financing, detailed design, construction, facilities and asset management services including asset maintenance and cleaning services over a 25 year period
Financing	Financing capital and facilities management cost is the responsibility of the PPP consortium
Facilities management	Primarily the responsibility of the PPP consortium
Underlying ownership	The relevant Project Partner(s), though the asset is essentially transferred to a PPP consortium via a lease or license for 25 years
Comments	Supplementary income for a PPP consortium, from associated commercial opportunities, is highly unlikely to be sufficient to fully fund the BRT project. This means any PPP consortium would need to be paid an annual fee of some kind to provide services, subject to them being provided to some agreed standard. This approach has the advantage of shifting risk for asset maintenance and renewals to the same private sector party responsible for the asset's D&C. This incentivises the consortium to apply a whole-of-life cost approach to D&C. It also encourages innovation that will drive cost effectiveness, as the consortium will share in these benefits. With financial penalties for non-performance and the equity and debt investment at stake, there is also significant incentive to meet performance standards. The PPP consortium takes D&C, maintenance and lifecycle risks for the life of the project. Maintenance and lifecycle costs are significant costs that can be difficult to predict, and can drive cost issues for a significant number of projects. In addition, as the Project Partners specify outcomes or outputs, the PPP consortium takes D&C risk based on this specification rather than a design put forth by the Project Partners. So, for instance, if it turns out that some key performance metric is not met, then the Project Partner(s) can reduce

payments until such time as it has been remedied. This could mean that the consortium would need to invest additional funds for which they will not be repaid. The opposite applies under a traditional procurement ECI and Alliance models.

Finally, the consortium takes all risks of cost overruns. Given the amount of their debt and equity in the project they will be incentivised to scope and manage the project to ensure it is on time and on budget.

Private sector cost of capital will be higher than public sector cost of capital as it will be based on the risk profile of the investment rather than on government or council borrowing rates. There will also be PPP specific costs. PPP seeks to offset this higher cost via savings achieved through innovation and allocating risks to the party best placed to manage them.

While a PPP might have a number of advantages, its applicability as a procurement option for the BRT project is questionable. A PPP is a complex procurement method. It can take longer to implement than a D&C approach and involve significant transaction costs for the private sector bidders and the procuring agency.

4.1.4 Procurement model evaluation and discussion

Table 44 summarises the suitability of each of the procurement options considered above.

Table 44. Feasibility and suitability of different procurement options

Option	Comment	Feasibility / suitability
DBB	Traditional procurement model. Widely recognised and understood. Commonly used for this type of project.	Yes
D&C	Traditional procurement model. Widely recognised and understood. Commonly used for this type of project.	Yes
DCM	Less common than above models, but still well understood and applicable to this type of construction project.	Yes
ECI	Generally suited to complex projects where the cost, risks and scope are difficult to define upfront, making a standard construction tender process difficult. This is a reasonably standard construction project, meaning ECI is unlikely to be suitable for the construction components of this proposal.	Unlikely
Alliance	Suited to complex projects where the cost, risks and scope are difficult to define upfront, making a standard construction tender process difficult. This is a reasonably standard construction project meaning Alliance is unlikely to be suitable for the construction components of this proposal.	Unlikely
Availability PPP	This procurement method is being established in the New Zealand market. BRT will be a relatively small and reasonably uncomplicated construction project. The value of using PPP procurement for BRT will need careful consideration.	Unlikely

The most appropriate procurement model for BRT will be determined in the detailed business case. Factors that will impact the assessment of the procurement approach will include:

- Implementing BRT could be relatively straight forward with well-defined objectives and tangible outcomes. There might be few identifiable factors that would of themselves suggest a change from a traditional procurement model.
- The BRT project is likely to be funded through standard methods by the Project Partners.
- The BRT project is not overly complex. Costs, risks and scope can be well defined. Traditional models fare better in these situations, and there are not likely to be factors which would prohibit traditional models from being applied.
- There are three Project Partners. However, this can be well managed as roles and responsibilities are clearly defined, for example continuing existing policy delineating local roads, state highways and PT operations. The BRT project should be able to follow existing policy.
- The cost of designing and constructing the BRT infrastructure will vary considerably depending on the preferred option chosen. Option 3 is a low cost for an infrastructure project. Option 5 is far more substantial and expensive.
- The practicalities, or otherwise, of bundling the design and construction of the BRT infrastructure with the delivery of BRT services (and allied services as appropriate).

4.1.5 Evaluation criteria

Table 45 sets out a range of evaluation criteria which are typically used when selecting a procurement model and could be applied in any subsequent DBC. We would expect that a working group could determine if weights are appropriate for the criteria and the value of the weights.

Table 45. Possible evaluation criteria for procurement options in a DBC

Criteria	Comments	Rationale
Cost competitiveness/ Value-for-Money	Ensuring achievement of efficient pricing through a competitive procurement process, but also maximising the chances of private finance	Ensuring tension in the market, given the predicted resource scarcity in the medium term
Time and establishment	Ability of procurement model to meet construction deadlines.	Need to provide a strong and early market signal of progress
Flexibility/ control	Ability to deliver a project that will meet the need for a design that integrates with the surrounding areas	Ensuring the project is completed on time but dynamic as the situation and scenario may change (eg timeframe for the Basin development is not confirmed at this stage)
Risk transfer and cost certainty	Ability to deliver a project that will meet public transport objectives	
Innovation/ opportunity	Effectiveness of model at transferring risk from the Project Partners, through design, construction and building life, enabling greater certainty of costs	Ensuring the BRT project is funded and the likelihood of cost overruns is minimised

4.2 Commercial development opportunities

There is the opportunity to develop BRT station infrastructure along the Central spine, Newtown and/or Kilbirnie branches and recover costs from the project from future developments.

New BRT infrastructure can be aligned to a broader urban redevelopment programme. Capital injected into a new, high quality BRT station can spur a wider programme of urban development on the land surrounding the station, with new retail and commercial space being developed (privately). A key driver of this activity is the increased foot-traffic around the station. Retailers meet the needs of users of the BRT stops and as a result, there can be increased commercial activity in the area. Britomart station, in Auckland, is an example, albeit at a different scale. The land surrounding Britomart station has been extensively redeveloped into a vibrant centre over the last decade, since the station opened.

Two areas are prime targets for redevelopment along the proposed BRT route. The existing Wellington Railway Station and Kilbirnie town centre, and the surrounding local areas, have been identified as areas for revitalisation and redevelopment. This could occur after leading BRT infrastructure is put in place.

There are opportunities to recover some of the BRT infrastructure costs via future activity around the station (eg air rights, targeted rates) as businesses will benefit from the increase in pedestrian activity in the area. This could be one way to bridge the funding gap.

5. Management case

5.1 Integration with other corridor projects

As discussed in the strategic case, the physical BRT infrastructure considered in this IBC is just one element of the full BRT solution proposed for Wellington's PT Spine. The other elements include:

- the introduction of high-capacity buses (including the removal of trolley buses)
- integrated fares and ticketing
- operational and user technology improvements
- roading improvements that BRT will leverage off, such as the Basin Bridge and Mt Victoria tunnel duplication.

These other elements are currently subject to their own assessment and implementation processes.

In addition, there are a number of other projects proposed for the PT Spine, and the wider Ngauranga to Airport corridor. These include:

- other roading improvements
- the addition of new of cycle infrastructure, and enhancement of existing infrastructure, including along Adelaide Road and Kent and Cambridge Terraces
- possible stormwater improvements along Kent and Cambridge Terraces.

5.1.1 Sequencing and programming

There are a number of important dependencies amongst these projects. Furthermore, in some cases multiple projects involve physical works on the same piece of road. In order to ensure the most efficient delivery and implementation of these projects, it will be important to ensure that there is effective coordination between the various project teams. The project teams will need to work together to develop an optimal approach to sequencing and integrating the implementation of this suite of projects.

To this end, GWRC, WCC and the Transport Agency have recently appointed an external consultant to lead a coordination workstream for the Ngauranga to Airport corridor projects. The purpose of the workstream is to develop a plan for sequencing and programming the implementation of each project, and ensuring good coordination between the teams where appropriate. Representatives from the BRT project are part of this workstream.

At the moment, it is sufficient for BRT to be part of this sequencing and programming workstream. However the exact sequencing of BRT with other projects, and any coordination of delivery, will need to be determined during any subsequent DBC.

We note that some elements of the physical BRT infrastructure are dependent on the RONS projects. In particular, the Kilbirnie branch of BRT cannot be constructed without the successful duplication of the Mt Victoria tunnel (and associated widening of Ruahine St), and that tunnel duplication will not occur without the Basin Bridge or a solution of similar effectiveness. In addition, while the Newtown branch can be implemented without the RONS, journey time savings will only be maximised when travel around the Basin Reserve can occur without material congestion.

5.1.2 Coordination of delivery

Aside for the sequencing issues discussed above, it is possible for the physical BRT infrastructure to be delivered separately of the other projects, or combined with others. Below we set out three possible approaches to delivering BRT with and without other projects. In our view, all of these approaches are possible in practice.

The preferred approach will be selected during the DBC. We expect that the merits of each approach may depend on the outcomes of the sequencing and programming workstream discussed above. In particular, whether it makes sense to combine delivery of BRT with another project is likely to be dependent on what other projects are being delivered at around the same time.

Note that we do not consider it appropriate to split up the design of the BRT solution, only the delivery. It seems preferable to design the full BRT solution together, regardless of how it is delivered. We also note that integrated designs for all models along a particular part of the route may be the most effective approach. For example, designing BRT and cycling improvements along Kent and Cambridge Terraces seems likely to be more effective than designing them in isolation.

1. Deliver BRT all together in one go by itself

This the simplest approach. The physical BRT infrastructure is consented in one go. It is then procured and delivered in one go, with no explicit integration of delivery with other projects.

2. Deliver BRT in separate pieces

This approach is useful if staging the implementation of the physical BRT infrastructure is desired – eg to do the most congested areas first, or to do the areas not dependent on the RONS projects first.

The physical BRT infrastructure would be delivered in stages. For example, the Golden Mile could be delivered first, then Kent and Cambridge Terraces, and the Newtown and Kilbirnie branches at later dates. The separate stages would be separately procured and delivered.

The consenting could still all be done in one go, as in approach #1. Alternatively, separate consents could be obtained for each stage.

3. Deliver BRT in separate pieces, with some pieces combined with other projects

As in approach #2, BRT could be delivered in stages. But under this approach, some elements of the BRT infrastructure are procured and delivered with other projects.

For example, the implementation of dedicated bus lanes along Kent and Cambridge Terraces could be done at the same time as additional cycling infrastructure is added. Both involve physical changes to the road, and it may be more efficient to deliver both sets of changes together. At this early stage, combining the delivery of BRT with the delivery of cycling infrastructure seems like a very useful idea. They are complementary projects, and could involve the efficient delivery of a multi-modal improvement to large parts of the BRT route.

Another possibility is combining the widening of Ruahine St, to be undertaken as part of the RONS project, with the creation of dedicated bus lanes.

The consents for each project could be obtained separately. Alternatively the consenting processes for each project could be combined.

5.2 Next steps for delivery of BRT

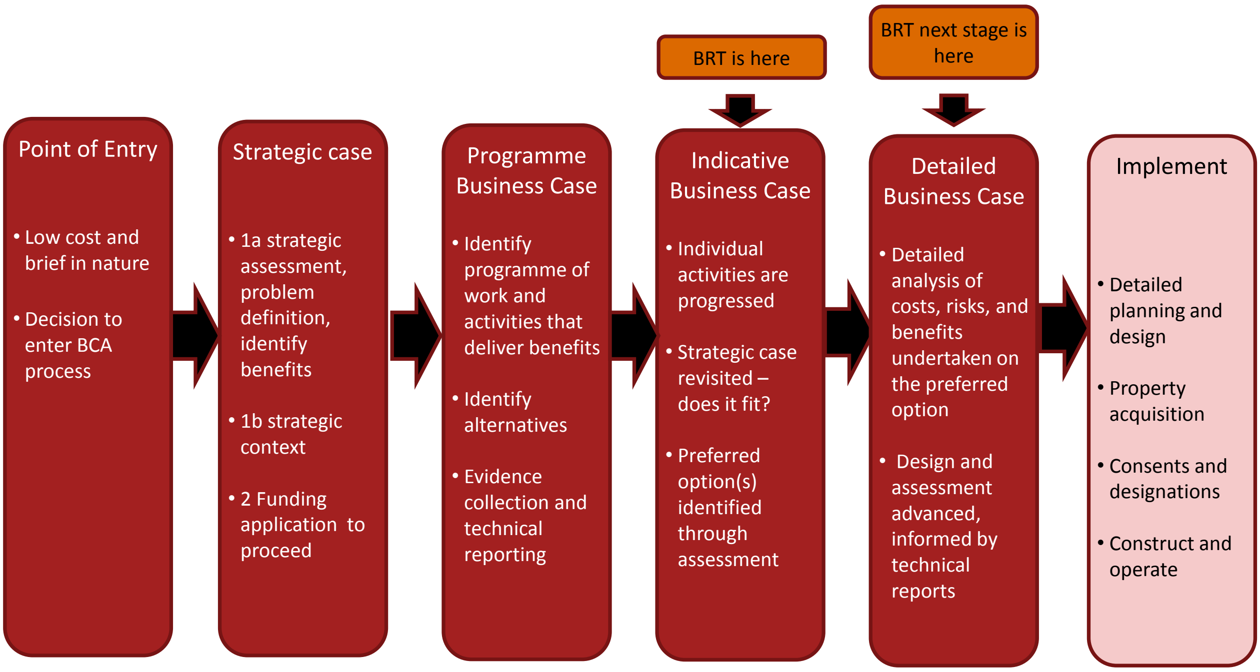
5.2.1 Next assessment phase

Detailed business case phase

As discussed in the strategic case, this IBC is one stage in the assessment process for BRT. In particular, the key roles of the IBC are to provide the strategic rationale for BRT, and an *indicative* assessment of the economics of a range of options. The aim is to reduce the number of options, so that the more detailed work can concentrate on a smaller set of possible options.

The BRT IBC is midway through the Transport Agency's Business Case Approach, as shown in Figure 7.

Figure 7. Transport Agency business case approach



Key items not undertaken at the IBC stage, that must be completed in the DBC phase, are:

- concept and preliminary design and optimisation of BRT options
- detailed transport modelling, and identification of wider effects, of BRT options
- fully quantifying all the costs and benefits of the BRT options
- detailed development of the financial requirements, the funding, procurement and management plans, and the consenting and property strategies.

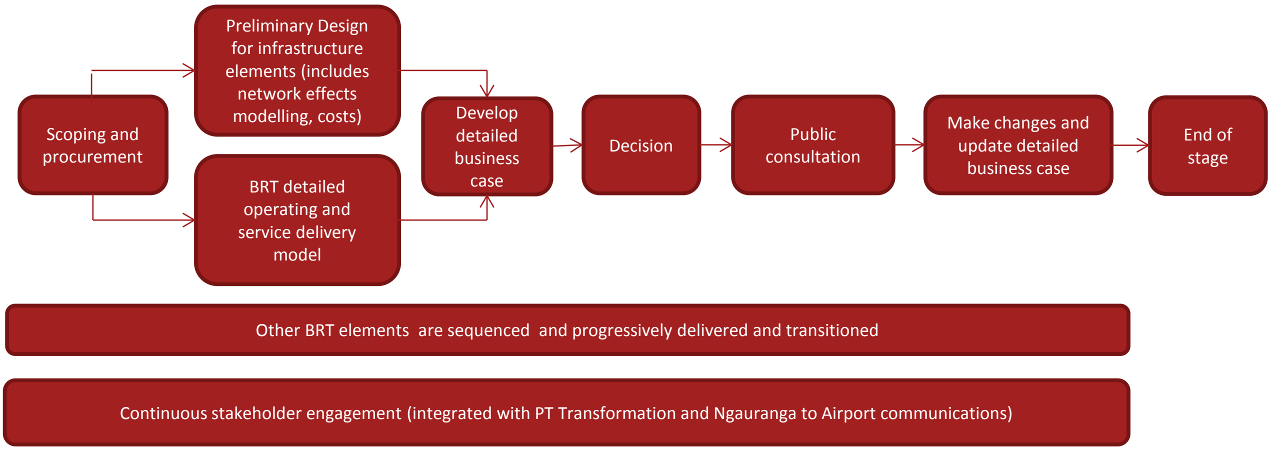
The Transport Agency's business case approval process (based on the Treasury's Better Business Cases) requires a DBC to be undertaken, after this IBC, before any funding can be approved.

A key decision is whether the different elements of the detailed assessment should be undertaken together or separately. The entire DBC, including all the design work and estimation of effects, could be procured and undertaken as one project. This would likely require a consortium of providers, to fully cover all the required capabilities. Alternatively, it could be split into multiple pieces and undertaken in stages using specialist resources as needed – the detailed design of options could be undertaken as a first step, followed by detailed transport modelling and effects estimation of those options, and then finally the DBC document itself could be developed using the outcomes of the first two steps as inputs to the business case development process.

It is recommended that a staged delivery model, but one which encompasses or references as much of the wider BRT solution as possible to maintain integration of all the elements that make up the BRT solution.

The DBC stage will follow a series of steps. Figure 8 shows two key inputs into a DBC and what subsequent steps the stage will cover after that. The DBC phase will be complete once public consultation feedback has been collated, reviewed and incorporated, and final approvals complete.

Figure 8. Potential stages for a detailed business case phase



The following deliverables are in-scope for the detailed business case phase.

- a detailed scoping step
- a physical solution design (for one or more preferred roading options) and costs for road layout, stop/stations/interchanges
- detailed network effects traffic and intersection modelling to support option selection
- preferred intersection priorities
- detailed Impacts identified and assessed including any land requirements confirmed, detailed impacts on general traffic, impact on parking, impact on walking
- safety requirements and assessment
- a wrap-around detailed business case, updated again after formal public consultation,
- a BRT operating and service delivery model, detailed business requirements
- continuous stakeholder engagement and communications
- formal public consultation
- approvals
- consenting strategy confirmed, delivery strategy, next steps
- construction sequencing within wider transports activities.

It is estimated that the DBC phase could take up to approximately 12-15 months, and cost in the order of $1.5m. A high-level breakdown of costs is shown in Table 46. This price includes costs for carrying out one geometric design, on options 3 and 4, as the roading design is the same on both options, but with network traffic modelling and detailed economic modelling undertaken for variants of both options. A detailed scoping step at the beginning of the phase will refine the detailed scope.

Table 46. Potential cost of a detailed business case phase

	Work unit / activity	Potential cost ($)
1	Problem definition and option development. Includes: detailed scoping, procurement, transport assessments modelling and economic assessments, model interpretations and reporting, peer review.	750,000
2	Readiness and assurance. Includes: stakeholder engagement and public consultation, business case development, peer reviewing, delivery stage planning.	750,000
	Total cost	**1,500,000**

Governance arrangements

This project comes under the wider scope of the Ngauranga to Airport corridor programme, and its governance arrangements. These arrangements have worked well to date. This IBC is being jointly run by the Project Partners, with the Transport Agency acting as the host agency. Representatives from each organisation have been part of the BRT Working Group established to develop the IBC.

At this time, we see no reason to change these governance arrangements for any subsequent stage in the assessment process. We consider that the only reason why a change should be considered is if there are changes to the overarching Ngauranga to Airport corridor programme governance, and that this makes the current arrangements difficult to continue.

5.2.2 Implementation

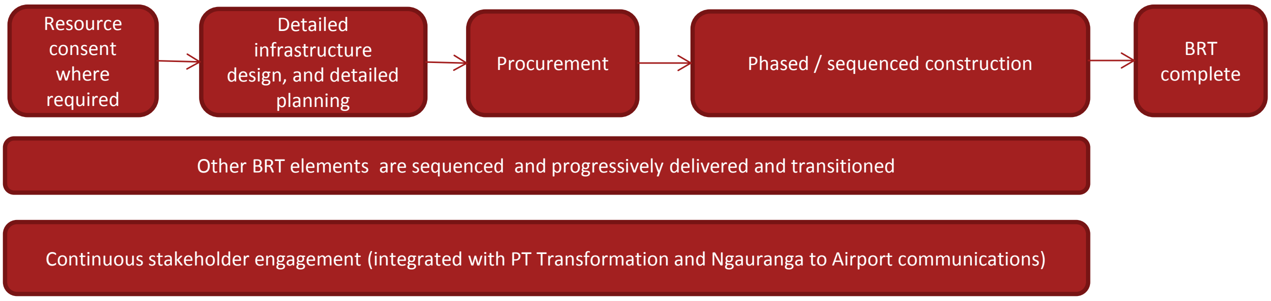
The DBC management case will develop a detailed plan for implementing BRT. In addition to the potential coordination with other projects discussed above, this plan will need to include details regarding consenting, timing, procurement, and construction/delivery.

This plan will also need to address resourcing. We recommend that a project implementation team be established, either within one of the project partners or as a multi-entity team, and tasked with ensuring the successful delivery of the physical BRT infrastructure (including integration with other elements of the wider BRT solution). The DBC will develop the details of what that team should look like. Responsibility for ongoing maintenance of the infrastructure will also need to be determined.

After the DBC is confirmed the project would then move into the consenting phase for which detailed designs would be drawn up. These would also inform construction stages. These stages are often called pre-implementation and implementation phases and come after the detailed business case phase.

Figure 9 below shows future phases once the detailed business case is confirmed. The process starts at the resource consenting step and once complete moves through to detailed design. Traditionally procurement and construction follow. Once all pieces are implemented the BRT solution is complete. A sequenced and integrated approach to implementation is likely.

Figure 9. Potential phases following a detailed business case phase



5.2.3 *Important dates*

It is too early to develop even an indicative timeline for delivery of a BRT solution. In particular, the timing will depend on (i) the option (including delivery timing) which is ultimately chosen during any subsequent DBC, and (ii) the outcomes of the Ngauranga to Airport corridor programming and sequencing workstream.

Key dates of the delivery of the DBC are:

- Q1 FY16 – Q1 FY17: BRT Detailed Business Case phase.
- Q1 FY17: BRT Detailed Business Case presented to the Transport Agency, GWRC, and WCC for approval/support and agreement to proceed to pre-implementation/implementation.

Other dates and time periods which will be important will become apparent when the timeline is determined during any subsequent DBC. These include the following:

- As discussed above, we expect that any subsequent DBC would take approximately 12-15 months. There would be an approval process for each of the funding organisations immediately afterwards, the length for which is difficult to predict.
- As discussed above, elements of the project are dependent on successful completion of the RONS projects in the Basin Reserve and Mt Victoria areas. The ultimate timing for the construction of the Newtown and Kilbirnie branches will be dependent on the timing of the RONS.
- As discussed in the financial case, the NLTP 2015-18 includes two BRT related activities, including a BRT implementation plan beginning 2015-18 (intended to provide for the DBC phase).

5.3 *Project risks*

Table 47 sets out an initial risk assessment for implementing BRT.

Table 47. Initial assessment of project risks

Risk description	Mitigation activity
Approval phase	
• Failure to provide a convincing business case for a BRT solution	• Development of a robust IBC and DBC, including independent quality assurance • Robust identification of key network effects • Development and delivery of a stakeholder engagement and communication plan
• Failure to convince the Wellington public of the need for BRT	
• Lack of political alignment and governance	
• Failure to secure Transport Agency funding /	

approval from councils	
• Failure to get resource and other consents as necessary	
• Failure to adequately identify important effects (eg traffic, transport, network)	
Delivery phase	
• Inability to physically implement the option chosen	• Physical constraints of specific options identified during detailed design stage • Preferred option(s) optimised at DBC to ensure deliverability
• Inability to achieve sufficient land take without resorting to compulsory acquisition	
• Insufficient management capability to deliver the project	• Current project team to ensure management capability is retained for subsequent processes

Many of these risks could lead to BRT not being fully delivered. However, in our view these should be able to be adequately managed.

We do not consider that any of these risks should stop BRT proceeding to a DBC phase. However, ensuring these (and any other identified) risks remain sufficiently mitigated will be a key component of the DBC management case.

5.4 Monitoring achievement of benefits

The ILM workshop developed a number of KPIs for BRT. The intention is that KPIs will be used, following the implementation of BRT, to assess whether BRT is achieving the desired benefits.

The KPIs developed at the workshop have been further refined to make them more specific to the BRT investment. These KPIs are set out in Figure 10 below. These KPIs will be refined during any subsequent DBC.

These KPIs can all provide reasonable evidence for whether the benefits are being achieved. They are all readily measurable. In most cases they are also able to be measured such that the results can be largely attributed to BRT. However, for the last two KPIs, it will difficult to completely attribute changes in land use and population to PT improvements, given the various other developments which will occur along the PT Spine over the same time period.

Figure 10 also shows the expected level of benefit from Options 3 and 4, for each KPI. For some KPIs, we have information from the PTSS and the economic case which allows us to state the expected benefit from these options. For others, we expect some benefit, but sufficient analysis has not been undertaken to be able to articulate the magnitude of that benefit – this will occur at a DBC phase.

During a DBC phase, we expect that targets and baseline levels would be developed for each KPI. The measures used would also be specified at a more detailed level. The expected levels of benefit, which will be re-estimated at a DBC phase, would likely inform the choice of target.

Figure 10. Possible KPIs, and expected outcomes for Options 3 and 4

Benefit	Possible KPI	Measure	Anticipated level of benefit from Options 3 and 4
Improved road and PT network efficiency	Improved PT travel time and travel time reliability along the PT Spine	Bus travel time data	Average bus travel time savings, for peak trips from Newtown and Kilbirnie, of 4.5 mins (Option 3) to 6.5 mins (Option 4); Significant reduction in variability of bus travel times
	Increased corridor carrying capacity in peak periods along the PT Spine	Bus and private vehicle capacity analysis	Material increase in corridor carrying capacity
Increased bus patronage	Higher PT mode share along the PT Spine	Bus passenger, private vehicle, and active travel counts	Increase in PT mode share, for peak trips from Southern & Eastern suburbs, of 1%-2%
	Reduced PT operating cost per passenger, for PT services along the PT Spine	Bus operating costs	Reduction in annual bus operating costs in 2031 of $2.9m (Option 3) to $4.6m (Option 4)
Improved bus user experience	Increase in customer satisfaction for existing users of bus routes along the PT Spine	Customer survey responses	Material improvement in satisfaction
	Increase in the ease of use of bus services	Customer survey responses	Material improvement in ease of use
Increased economic activity in proximity to the PT Spine	Higher value land-use along the PT Spine corridor	Market land values; type of land use	Material increase in land values; change in land use to alternative uses
	Increased residential population along the PT Spine corridor	Census population counts, and other population estimates	Material increase in population

In general, Options 3 and 4 (those considered most appropriate for further consideration) are expected to address the current problems with Wellington's transport network, where buses compete with general traffic and other buses along already congested corridors. Options 3 and 4 are expected to provide faster bus travel times, improve travel time reliability, and increase the corridor carrying capacity along the PT Spine by dedicating more road space to buses. Improved PT travel speeds and reliability will encourage more people onto PT, helping grow patronage and increasing PT mode share. Options 3 and 4 are also expected to improve PT customer satisfaction, primarily through improvements in reliability.

Options 3 and 4 are also expected to induce land use change along the PT Spine corridor. Improved accessibility between Newtown and the CBD, as well as Kilbirnie and the CBD, is likely to draw people and businesses to the area and along the PT Spine corridor. Options 3 and 4 would likely produce a smaller effect than option 5 in this respect, but some change is expected.

5.5 Conclusions

There are a number of projects along the PT Spine and wider Ngauranga to Airport corridor that the BRT project needs to coordinate and integrate with. A separate workstream is currently underway, developing a sequencing and programming plan for all the corridor projects. At the moment, it makes sense for the BRT project team to continue to report through to this programme. However during any subsequent DBC the specifics around timing and integration with other projects will need to be determined.

The physical BRT infrastructure could be delivered as a single project or in multiple stages. It could also be combined with the delivery of other projects in the same location, including potentially combining the consenting processes. There are a number of potential benefits from both staging the implementation and combining it with other projects.

There are a number of project risks, many of which could lead to BRT not being fully delivered. However, these should be able to be adequately managed.

There is nothing in terms of delivery which, at this stage, appears prohibitively difficult or likely to suggest that this project should not proceed. There is nothing in this management case which suggests that the next stage of more detailed assessment should not be undertaken.

The next step in the assessment process is a DBC. Key items not undertaken at the IBC stage include: detailed design and optimisation of BRT options; detailed transport modelling of all options; fully quantifying all the costs and benefits for all options (including peer review); and detailed development of the financial requirements, and the funding, procurement and management plans. These will all be part of a DBC.

A key decision to be made before any DBC begins is whether the different elements of the detailed assessment are to be undertaken together or separately. The entire DBC, including all the design work, could be procured and undertaken as one project. Alternatively, it could be split into multiple pieces and undertaken in stages.

Next steps

This IBC provides support for more detailed analysis of BRT to be undertaken in a detailed business case. The economic analysis suggests that the options which are most appropriate for further consideration are Options 3 and 4.

- The majority of the travel time benefits can be achieved by providing additional priority to buses at and around key intersections along the route. The economic analysis has shown that a more targeted approach to BRT, than envisaged by the PTSS, could provide a more cost effective improvement to bus services along the PT Spine.
- Options 3 and 4 have indicative BCRs of 2.3 and 1.5. These are relatively high for a PT project. The roadspace dedication of Option 3 could also be combined with the intersection priority of Option 4 to deliver even greater benefits.
- It is possible to ultimately implement a solution which has elements of both Options 3 and 4. It is also possible to implement Option 3 initially, and then move towards Option 4 over time.

Furthermore, nothing in the financial, commercial or management cases has indicated that a DBC should not proceed. There are a number of items that will need to be addressed at that stage, such as approval of funding, determining the appropriate sequencing and coordination with other projects, and determining a procurement strategy. However none of these are sufficiently problematic that a DBC should not proceed.

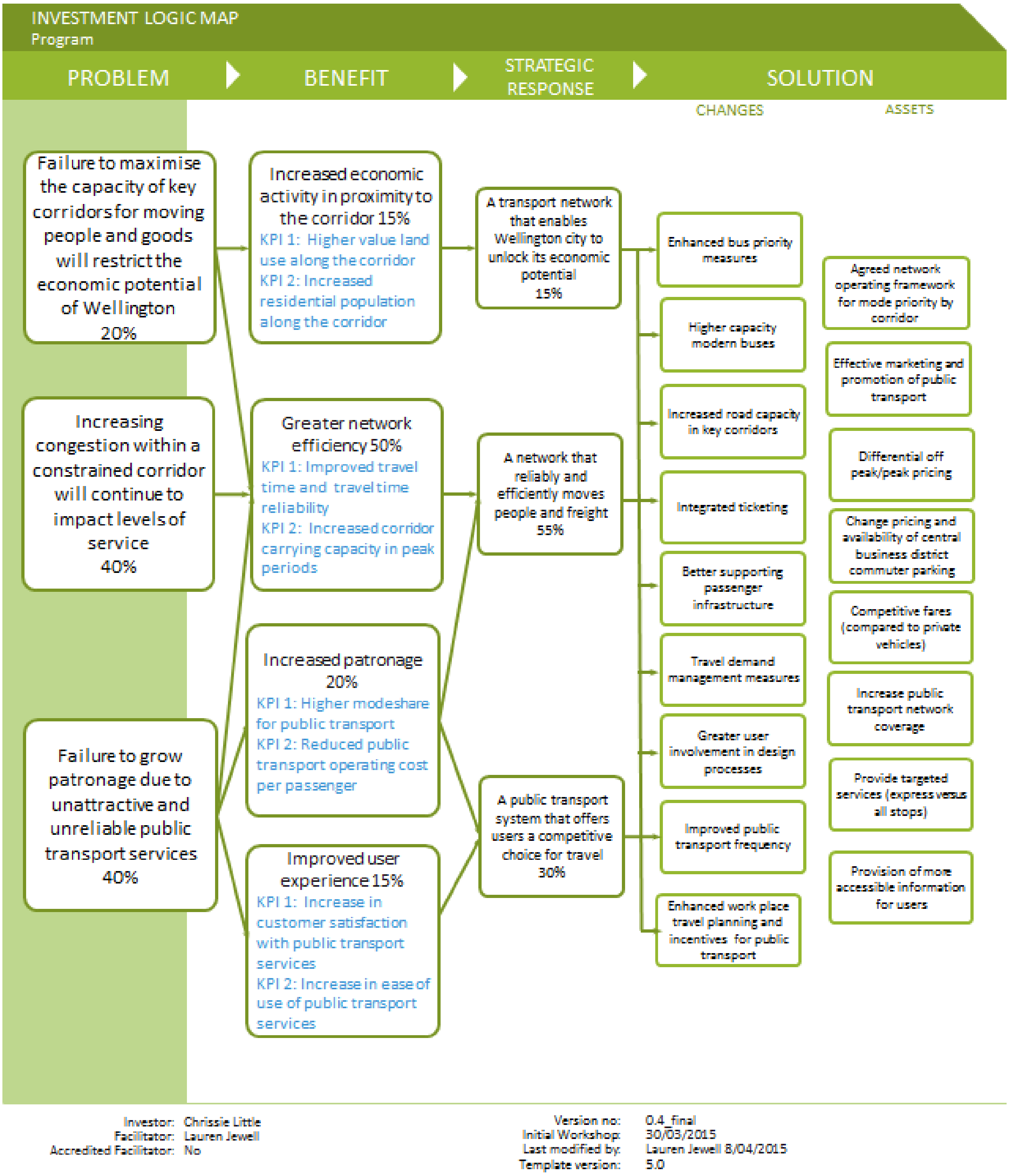
Finding a solution to conflicting transport demands at the Basin Reserve is critical to the ability to implement a high-quality BRT system. Without such a solution, the benefits yielded from duplicating the Mt Victoria tunnel will likely be considerably lower, and the Kilbirnie branch of the proposed BRT solution will not be able to offer the same benefits as envisaged with the RONS projects in place – and this reduces the economic viability of the project considerably. We understand that the Transport Agency is committed to finding such a solution, and it is recommended that the BRT project continue to proceed on that basis (with additional consideration given during a DBC).

A DBC for BRT is recommended – of Options 3 and 4, or a combination of both, or Option 3 moving to Option 4 at a later date.

Appendix A Investment Logic Map

Figure 11 presents the ILM map from the ILM workshop held on 30 March 2015. This workshop was used to develop the problem definitions, the desired benefits of BRT, and possible KPIs for the investment, as discussed above in the Case for change section.

Figure 11. ILM map



Appendix B Options description

This appendix provides a detailed description of the options.

Option 1 – Improved bus priority and other modes improvement

Description of option

This option is based on a detailed possible plan recently developed by WCC, for bus priority improvements along the Central and Newtown branches.

Key points

- Provides for additional bus lanes along the Central spine and Newtown branch. No additional bus lanes are developed along the Kilbirnie branch.
- Provides signal priority for buses at a greater number of intersections along the route. Priority will occur through the 'B phase' method.
- Improvements are also made to cycle infrastructure along the route.

Specific details

- Where no bus lane currently exists, either general traffic lanes or on-street parking will be converted to bus lanes.
- Additional bus lanes will be located on the outside of the roadway.
- Specifics for each road section:
    - Railway Station to Courtenay Place:
        - shared bus lanes (both directions)
        - no general traffic lanes along southern Lambton Quay, Willis St and Manners St
        - some removal of parking on Courtenay Place
    - Kent/Cambridge Terraces:
        - dedicated bus lanes (both directions)
        - additional cycling infrastructure on median
    - Basin Reserve:
        - dedicated bus lanes (both directions)
        - assumes no Basin Bridge or similar RONS solution
        - additional cycling infrastructure through Basin Reserve
    - Adelaide Rd to Riddiford St:
        - dedicated bus lanes (both directions)
        - separated cycle lanes (both directions)

Other features

- Cycles and taxis will be able to use some of the bus lanes, with details to be determined on a road-by-road basis later.
- Some additional lanes will only operate at certain periods, depending on inter-peak congestion levels.
- High-capacity buses will run at a frequency necessary to cater for demand and growth, as assumed in the reference case.
- Bus services can continue to other destinations on local roads.
- Additional lanes implemented immediately (currently modelled as 2019).

Variants

As this option is designed to reflect a possible option developed by WCC, no alternative variants are considered.

Option 2 – Bus lanes along the whole route, at peak periods, with limited intersection priority

Key points

- Provides for dedicated bus lanes along the Central spine, and Newtown and Kilbirnie branches. These lanes would only operate at peak periods.
- Buses will get signal priority over general traffic at intersections at peak periods. This will occur through the 'B phase' method.

Specific details

- Where no dedicated bus lane currently exists, either general traffic lanes or on-street parking space will be converted to bus lanes at peak periods.
- Exact location of lanes within the roadspace to be determined at a later date. But given only peak usage, likely to be on the outside of the roadway.
- Possible specifics for each road section:
  - Railway Station to Courtenay Place:
    - dedicated bus lanes (both directions) at peak times
    - no general traffic lanes along southern Lambton Quay, Willis St and Manners St; these bus lanes operate 24/7
    - some removal of peak time parking on Courtenay Place
  - Kent/Cambridge Terraces:
    - dedicated bus lanes (both directions) at peak times
    - some removal of peak time parking
  - Basin Reserve:
    - assumes Basin Bridge or similar RONS solution (as per do minimum)
  - Adelaide Rd to Riddiford St:
    - dedicated bus lanes (both directions)

    - some removal of peak time parking
  - Mt Victoria tunnel to Kilbirnie:
    - buses mix with general traffic in duplicate Mt Vic tunnel
    - dedicated bus lanes (both directions) at peak times, on Ruahine St; which is already widened through the RONS work
    - dedicated bus lanes (both directions) at peak times, on Kilbirnie Cres

Other features

- Cycles and taxis may be able to use some of the bus lanes, with details to be determined on a road-by-road basis later.
- High-capacity buses will run at a frequency necessary to cater for demand and growth, as assumed in the reference case.
- Bus services can continue to other destinations on local roads.

Variants based on timing

Along with the core option, 2 additional variants of this option are assessed, based on different timing of implementation for each branch. These are shown in Table 48.

Table 48. Variants for Option 2

Assumed timing	Core option	Option 2a	Option 2b
Central spine	Immediately	To coincide with completion of RONS	Immediately
Newtown branch	To coincide with completion of RONS	To coincide with completion of RONS	To coincide with completion of RONS
Kilbirnie branch	To coincide with completion of RONS	To coincide with completion of RONS	Never

Note: (1) 'Immediately' assumes it is completed prior to 2019. (2) The RONS are assumed to be completed prior to 2025.

Option 3 – Bus lanes in targeted locations, 24/7, with full intersection priority

Key points

- Provides for some dedicated bus lanes in selected areas along the Central spine, and Newtown and Kilbirnie branches. The areas selected will be based on targeting key congestion areas and key intersections.
- The specific areas for dedicated lanes will be determined later are detailed investigation of how congestion varies along the route. Buses may mix with general traffic in other areas.
- Buses will get signal priority over general traffic at intersections, except at intersections where there is no dedicated lane immediately prior to the intersection. This will occur through the 'B phase' method.

Specific details

- Where no dedicated bus lane currently exists, general traffic lanes will be converted to bus lanes.

- Exact location of any dedicated lanes within the roadspace to be determined at a later date.
- The exact location of the new bus lanes will be determined at a later date. But possible specifics for each road section are:
  - Railway Station to Courtenay Place:
    - dedicated bus lanes (both directions)
    - no general traffic lanes along southern Lambton Quay, Willis St and Manners St
    - some removal of peak time parking on Courtenay Place
  - Kent/Cambridge Terraces:
    - dedicated bus lanes (both directions) either side of Vivian St intersection
    - some removal of parking around Vivian St
  - Basin Reserve:
    - assumes Basin Bridge or similar RONS solution (as per do minimum)
    - dedicated bus lanes, with signal priority, at entrances from Adelaide Road and the Mt Victoria tunnel
  - Adelaide Rd to Riddiford St:
    - dedicated bus lanes (both directions) either side of the John St intersection
    - some removal of parking around John St
  - Mt Victoria tunnel to Kilbirnie:
    - buses mix with general traffic in duplicate Mt Vic tunnel
    - dedicated bus lanes (both directions) at peak times, on Ruahine St; which is already widened through the RONS work
    - restricted general traffic turning movements at Wellington St / Kilbirnie Cres intersection
    - no bus lanes on Kilbirnie Cres

Other features

- Cycles and taxis may be able to use some of the bus lanes, with details to be determined on a road-by-road basis later.
- Dedicated lanes could potentially only operate during the day. This can be determined at a later date.
- High-capacity buses will run at a frequency necessary to cater for demand and growth, as assumed in the reference case.
- Bus services can continue to other destinations on local roads.

Variants based on timing

Along with the core option, 2 additional variants of this option are assessed, based on different timing of implementation for each branch. These are shown in Table 49.

Table 49. Variants for Option 3

Assumed timing	Core option	Option 3a	Option 3b
Central spine	Immediately	To coincide with completion of RONS	Immediately
Newtown branch	To coincide with completion of RONS	To coincide with completion of RONS	To coincide with completion of RONS
Kilbirnie branch	To coincide with completion of RONS	To coincide with completion of RONS	Never

Note: (1) 'Immediately' assumes it is completed prior to 2019. (2) The RONS are assumed to be completed prior to 2025.

Option 4 – Bus lanes along the whole route, 24/7, with full intersection priority

Key points

- Provides for dedicated bus lanes along the Central spine, and Newtown and Kilbirnie branches. These lanes would operate at all times.
- Buses will get signal priority at intersections. This includes both pre-emption of signals before the bus arrives at the intersection, and the extension of phases.

Specific details

- Exact location of lanes within the roadspace to be determined at a later date.
- Where no dedicated bus lane currently exists, general traffic lanes will be converted to bus lanes.
- Possible specifics for each road section:
    - Railway Station to Courtenay Place:
        - dedicated bus lanes (both directions)
        - no general traffic lanes along southern Lambton Quay, Willis St and Manners St
        - some removal of peak time parking on Courtenay Place
    - Kent/Cambridge Terraces:
        - dedicated bus lanes (both directions)
        - some removal of parking
    - Basin Reserve:
        - assumes Basin Bridge or similar RONS solution (as per do minimum)
    - Adelaide Rd to Riddiford St:
        - dedicated bus lanes (both directions)
        - some removal of parking
    - Mt Victoria tunnel to Kilbirnie:

- buses mix with general traffic in duplicate Mt Vic tunnel
- dedicated bus lanes (both directions) at peak times, on Ruahine St; which is already widened through the RONS work
- dedicated bus lanes (both directions) at peak times, on Kilbirnie Cres

Other features

- Cycles and taxis may be able to use some of the bus lanes, with details to be determined on a road-by-road basis later.
- Dedicated lanes could potentially only operate during the day. This can be determined at a later date.
- High-capacity buses will run at a frequency necessary to cater for demand and growth, as assumed in the reference case.
- Bus services can continue to other destinations on local roads.

Variants based on timing

Along with the core option, 4 additional variants of this option are assessed, based on different timing of implementation for each branch. These are shown in Table 50.

Table 50. Variants for Option 4

Assumed timing	Option 4	Option 4a	Option 4b	Option 4c	Option 4ac
Central spine	Immediately	To coincide with completion of RONS	Immediately	Immediately	To coincide with completion of RONS
Newtown branch	To coincide with completion of RONS	To coincide with completion of RONS	To coincide with completion of RONS	To coincide with completion of RONS	To coincide with completion of RONS
Kilbirnie branch	To coincide with completion of RONS	To coincide with completion of RONS	Never	To coincide with completion of RONS	To coincide with completion of RONS

Note: (1) 'Immediately' assumes it is completed prior to 2019. (2) The RONS are assumed to be completed prior to 2025.

Option 5 – Physically separated bus lanes along the whole route, 24/7, with full intersection priority

This option is designed to be, in effect, the PTSS BRT option.

Key points

- Provides for dedicated bus lanes, physically separated from general traffic lanes, along the Central spine, and Newtown and Kilbirnie branches. These lanes would operate at all times. Physical separation will be through a small curb or median.
- Buses will get signal priority at intersections. This includes both pre-emption of signals before the bus arrives at the intersection, and the extension of phases.

Specific details

- Exact location of lanes within the roadspace to be determined at a later date.
- Where no dedicated bus lane currently exists, general traffic lanes will be converted to bus lanes.
- Possible specifics for each road section:
    - Railway Station to Courtenay Place:
        - separated bus lanes (both directions)
        - no general traffic lanes along southern Lambton Quay, Willis St and Manners St
        - some removal of peak time parking on Courtenay Place
    - Kent/Cambridge Terraces:
        - separated bus lanes (both directions)
        - some removal of parking
    - Basin Reserve:
        - assumes Basin Bridge or similar RONS solution (as per do minimum)
    - Adelaide Rd to Riddiford St:
        - separated bus lanes (both directions)
        - some removal of parking
    - Mt Victoria tunnel to Kilbirnie:
        - buses mix with general traffic in duplicate Mt Vic tunnel
        - separated bus lanes (both directions) at peak times, on Ruahine St; which is already widened through the RONS work
        - separated bus lanes (both directions) at peak times, on Kilbirnie Cres

Other features

- Only buses can use the dedicated lanes.
- High-capacity buses will run at a frequency necessary to cater for demand and growth, as assumed in the do-minimum.
- Bus services can continue to other destinations on local roads.

Variants based on timing

Along with the core option, 4 additional variants of this option are assessed, based on different timing of implementation for each branch. These are shown in Table 51.

Table 51. Variants for Option 5

Assumed timing	Option 5	Option 5a	Option 5b	Option 5c	Option 5ac
Central spine	Immediately	To coincide with completion of RONS	Immediately	Immediately	To coincide with completion of RONS
Newtown branch	To coincide with completion of RONS	To coincide with completion of RONS	To coincide with completion of RONS	To coincide with completion of RONS	To coincide with completion of RONS
Kilbirnie branch	To coincide with completion of RONS	To coincide with completion of RONS	Never	To coincide with completion of RONS	To coincide with completion of RONS

Note: (1) 'Immediately' assumes it is completed prior to 2019. (2) The RONS are assumed to be completed prior to 2025.

Appendix C Cost benefit analysis technical appendix

Objectives of the economic evaluation

The Transport Agency's chief objective for BRT's economic case is to produce a robust and comprehensive economic appraisal that includes sensitivity testing, in line with the EEM. The economic case in any business case is about achieving two key outputs:

1. Assessing measurable economic returns that can be used to inform a wider discussion (linked to strategic, commercial and financial analysis) on the viability of the project.
2. Assessing the best option or configuration of options: that is, to assess from a suite of possible approaches, the one that generates the highest economic benefit compared to cost.

In considering these two objectives, it is critical not to view them in isolation of the other components of the business case. For example, the ability to fund a project is a critical part of the business case, and sometimes trade-offs need to be made between optimal economic performance (ie high net public benefits) and budget constraints. Similarly, the interface between the economic case and the strategic case are critical. An economic case may give an optimal economic timing for a project (often driven by discount rates etc) that is later than wider strategic drivers, which are not fully monetised in the economic evaluation procedures.

The scope of this economic evaluation is to identify and monetise the economic benefits and economic costs of the BRT options, delivering an overall assessment of each options' net benefits.

This report documents the assumptions and method for the economic evaluation of the BRT and demonstrates the evaluation's alignment with EEM procedures.

Approach to cost benefit analysis

Method

The economic evaluation of the BRT options have been based on procedures and parameters that represent good practice and are defined in the EEM. The relevant procedure in the EEM for evaluating public transport infrastructure and services is contained in Section 4.4 of the EEM.

There are five broad stages of analysis required, with several required steps at each stage:

1. Identify and describe the options to be evaluated, including a do-minimum and a preferred option.
2. Define the transport modelling process, including model inputs such as land use scenarios and required model outputs.
3. Identify the streams of economic impacts accruing from the project and define the calculations that must be completed in order to value them. The report defines in detail procedures for conducting the core transport evaluation and discusses the integration with the wider economic benefits and sustainability benefits valuations.
4. Identify any qualitative, or non-transport assessments that are required, including significant non-monetised impacts and national strategic factors.
5. Calculate economic efficiency and how results will be reported for use in decision-making.

The scope of the BRT IBC involved no new transport modelling. As such, the transport model analysis from the PTSS provided the base data for the economic analysis. Therefore we deviated slightly from the stages of the analysis prescribed in the EEM but not in the application of assessing the benefits and costs.

The economic evaluation was performed on an incremental basis, ie relative to the do-minimum. Therefore benefits are estimated relative to the status quo in the do-minimum and costs are incremental costs over and above what would be spent in the do-minimum.

Key assumptions

The analysis has been limited to transport model data already conducted as part of the PTSS. We have assumed that the Bus Priority option, in the PTSS is broadly equivalent to Option 1 (without the Kilbirnie branch) and the BRT option in the PTSS is broadly equivalent to Option 5.

Our key assumptions used in the analysis are outlined in Table 52 below.

Table 52. Key assumptions for the economic evaluation

Assumption	Value
Year of construction	
- **Central Spine**	2018 (or 2024 for option a)
- **Newtown branch**	2024
- **Kilbirnie branch (if relevant)**	2024
Year benefits begin	
- **Central Spine**	2019 (or 2025 for option a)
- **Newtown branch**	2025
- **Kilbirnie branch (if relevant)**	2025
Discount rate	6%
Cost escalation	Yes – refer schedule in Table 94
Year zero	2015

Key data

The key data for our economic evaluation is from the transport modelling completed for the PTSS. The key data which underpins much of the economic analysis is outlined in this section.

Travel time savings

Travel time savings data is a key input to our analysis. The raw data from the analysis is from the PTSS Option Evaluation Results Technical Note report. Table 53 and Table 54 below show the travel time savings along BRT routes.

Table 53. Travel time savings from Kilbirnie to the CBD (2031 am peak, min)

From Kilbirnie to:	Reference case	BP	BRT
Elizabeth St	13.9	-1.1	-7.6
Courtenay Pl	14.7	-1.1	-8.1
Willis St	19.3	-1.5	-9.5

Rail Station	24.5	-2.7	-11.2

Source: PTSS Option Evaluation Results Technical Note

Table 54. Travel time savings from Newtown to the CBD (2031 am peak, min)

From Newtown to:	Reference case	BP	BRT
Elizabeth St	5.1	-1.4	-1.7
Courtenay Pl	8.5	-1.4	-3.3
Willis St	13.1	-1.8	-4.7
Rail Station	18.3	-3.0	-6.4

Source: PTSS Option Evaluation Results Technical Note

We converted the information as travel time savings per segment travelled, along the Newtown and Kilbirnie branches and along the Golden Mile, as shown in Table 55 and Table 56 below.

Table 55. Travel time savings along the Kilbirnie route (2031 am peak, min)

	Bus Priority		BRT	
	From Elizabeth St to:	From Kilbirnie to:	From Elizabeth St to:	From Kilbirnie to:
Elizabeth St	N/A	1.1	N/A	7.6
Courtenay Pl	0	1.1	0.5	8.1
Willis St	0.4	1.5	0.9	9.5
Rail Station	1.6	2.7	3.6	11.2

PwC calculations

Table 56. Travel time savings along the Newtown route (2031 am peak, min)

	Bus Priority		BRT	
	From Basin to:	From Newtown to:	From Basin to:	From Newtown to:
Basin	N/A	1.4	N/A	1.7
Courtenay Pl	0	1.4	1.6	3.3
Willis St	0.4	1.8	3.0	4.7
Rail Station	1.6	3.0	4.7	6.4

PwC calculations

To further facilitate the analysis, we made assumptions on the percentage of travellers from Newtown and Kilbirnie alighting at different segments along the routes to generate the weighted average travel time saved per route. This is because we did not believe that all travellers would be on the bus the entire length of the journey to the Railway Station. Our demand weighting assumptions is listed in Table 57 below.

Table 57. Weights for travellers along the Newtown and Kilbirnie routes by destination

Newtown to	Per cent of travellers	Kilbirnie to	Per cent of travellers
Basin	10%	**Elizabeth St**	10%
Courtenay Pl	10%	**Courtenay Pl**	10%
Willis St	40%	**Willis St**	40%
Rail Station	40%	**Rail Station**	40%

This enabled us to generate weighted average travel time savings for Option 1 and Option 5 as outlined in Table 58 below.

Table 58. Weighted average travel time savings (2031 am peak, min)

Travel segment	Option 1	Option 5
Newtown to CBD	2.2	4.9
Kilbirnie to CBD	1.9	9.5

Patronage

We also relied upon the patronage forecasts from the PTSS, outlined in Table 59 below.

Table 59. Local growth patronage to the CBD (2031 am peak)

Area	Reference case	Bus Priority	BRT
Miramar	1,320	+60	+170
Kilbirnie Lyall	680	+40	+80
Mt Vic/Hataitai	790	+20	-50
Island Bay	1,140	+20	+100
Newtown	790	+30	+90
Total	4,710	+170	+400

Source: PTSS Option Evaluation Results Technical Note

The transport modelling for the PTSS also modelled regional patronage in 2021, 2031 and 2041, which was used as a basis to generate a time series of patronage along the Newtown and Kilbirnie routes. The growth rate in regional patronage was used as a proxy growth rate for the Newtown and Kilbirnie routes.

Table 60. Changes in regional patronage during morning peak

Year	Reference case	Bus Priority	BRT
2021 (regional)	35,600	+200 = 35,800	+700 = 36,300
2031 (regional)	34,000	+300 = 34,300	+800 = 34,800
2041 (regional)	35,200	+300 = 35,500	+900 = 36,100

Source: PTSS Option Evaluation Results Technical Note

Table 61 below shows the patronage figures converted to growth rates during the decade (not annual averages).

Table 61. Decade growth rates in patronage

Growth rate	2021 to 2031	2031 to 2041
Reference case	-4.5%	3.5%
Bus Priority	-4.2%	3.5%
BRT	-4.1%	3.7%

PwC calculations

Note that the forecast regional PT patronage is expected to increase sharply in 2021 then decline slightly in 2031 and increase again in 2041.

Interpolation method for intermediate options

The travel time savings data and patronage figures for options 1 and 5 have been identified using the PTSS modelling for the BP and BRT options. In order to determine the travel time savings and patronage figures for the intermediate options, an allocation method was determined by GWRC using data from the Saturn model. We have relied on this interpolation method to determine the intermediate options.

The primary assumption for the analysis was that Option 5 incurs no delays and assumes that the do-minimum option incurs 100% of delays. The intermediate options incur a proportion of delays on certain links / at certain intersections, dependent on the level of bus priority, signal pre-emption and segregation being proposed. Each key intersection-option combination was given a factor between 1 = no improvement on congested travel speeds and 0 = equivalent to free flowing travel speeds.

High-level assumptions and results

Table 62 captures the assumed level of priority at four key intersections and the assumed factor impact on travel speeds at the intersections is captured in Table 63. A full list is GWRC's assumptions by intersection is captured afterwards.

Table 62. Intersection priority assumed at key intersections

Key intersection	Reference case	1	2	3	4ac	4 (except 4ac)	5ac	5 (except 5ac)
Basin entry from Mt Vic	Nothing	Bus lane but not to stop line, buses mix with GT[20] turning left, no B phase	Bus lane to stop line, B phase	Bus lane to stop line, B phase	Bus lane to stop line, B phase	Bus lane to stop line, pre-emption	Bus lane to stop line, pre-emption	Segregated bus lane to stop line, pre-emption
Basin entry from Newtown	Nothing	Bus lane but not to stop line, buses mix with GT turning left, no B phase	Bus lane to stop line, B phase	Bus lane to stop line, B phase	Bus lane to stop line, pre-emption	Bus lane to stop line, pre-emption	Segregated bus lane to stop line, pre-emption	Segregated bus lane to stop line, pre-emption
Vivian Street description	Nothing	Bus lanes to stop line, no B phase, no pre-emption	Bus lanes to stop line, no B phase, no pre-emption	Bus lane to stop line, B phase	Bus lane to stop line, pre-emption	Bus lane to stop line, pre-emption	Segregated bus lane to stop line, pre-emption	Segregated bus lane to stop line, pre-emption
Adelaide / John Street description	Nothing	Bus lane but not to stop line, buses mix with GT turning left, no B phase	Bus lane but not to stop line, buses mix with GT turning left, no B phase	Bus lane to stop line, B phase	Bus lane to stop line, pre-emption	Bus lane to stop line, pre-emption	Segregated bus lane to stop line, pre-emption	Segregated bus lane to stop line, pre-emption

Source: GWRC

[20] General Traffic (GT)

Table 63. Key intersections along the Newtown and Kilbirnie routes and assumed impact of the option on the delay at the intersection

Intersection	Ref case	1	2	3	4ac	4 (except 4ac)	5ac	5 (except 5ac)
Basin Reserve approach	1	0.8	0.4	0.4	0.4	0.2	0.2	0
Adelaide / John Street	1	0.8	0.8	0.6	0.2	0.2	0	0
Basin approach (other side)	1	0.6	0.4	0.4	0.2	0.2	0	0
Vivian Street	1	0.6	0.6	0.4	0.2	0.2	0	0

Source: GWRC

Following this, the factors were applied to existing Saturn travel time modelling output at the intersections for each option and then aggregated across the whole route.

Table 64. Example calculation for Adelaide/John St

	Ref case	1	2	3	4ac	4 (except 4ac)	5ac	5 (except 5ac)
Improvement factor	N/A	1	0.8	0.8	0.6	0.2	0.2	0
Average delay (sec)	**56**	56	44.8	44.8	33.6	11.2	11.2	0

Source: GWRC, PwC example calculations

As this was done for each option and at key intersections, the relative change in travel time savings could be estimated between the options, benchmarked to Option 1 and 5.

The Saturn modelling output and interpolation method generated an alternative set of travel times for the Newtown and Kilbirnie routes. After discussion with GWRC, it was considered that the PTSS transport modelling was considered more accurate and more complete than the estimates for option 1. Therefore the travel time estimates for BP and BRT were retained and set as the bookends. The additional Saturn modelling output was only used to determine the interpolation percentages.

Table 65 below shows the percentage change improvements over the whole route.

Table 65. Travel time savings for intermediate options, relative to Option 5

Route	Ref case	1	2	3	4ac	4 (except 4ac)	5ac	5 (except 5ac)
Newtown	0%	35%	47%	55%	80%	80%	100%	100%
Kilbirnie	0%	12%	40%	42%	46%	80%	83%	100%
Golden Mile	0%	18%	50%	50%	94%	94%	100%	100%

Source: GWRC

The method identified by GWRC was to use the percentages in Table 65 and apply them to the PTSS travel time savings between BP and BRT, ie Option 2 provides 47% of the benefits of Option 5.

We calculated an overall weighted average for each option, based on the relative PT demand between the Newtown and Kilbirnie branches. Table 66 and Table 67 below show the weighted average travel time savings for the core options, and the ‘a’ and ‘b’ variants (the other variants are combinations of these).

Table 66. Weighted average travel time savings for core options and “a” variant (2031 am peak, mins)

	1	2 / 2a	3 / 3a	4 /4a	5 /5a
Time savings (mins)	1.4	4.3	4.5	6.5	7.6

Source: GWRC data, PwC calculations

Table 67. Weighted average travel time savings for "b" BRT options (2031 am peak, mins)

	2b	3b	4b	5b
Time savings (mins)	2.2	2.3	2.9	3.1

Source: GWRC data, PwC calculations

Figures for patronage were interpolated using the same method as the travel time savings. Table 68 and Table 69 below show the additional patronage for the core options and the 'a' and 'b' variants.

Table 68. Additional PT patronage for core options and "a" variant (2031)

	1	2/2a	3 / 3a	4 / 4a	5 / 5a
Additional patronage	50	146	162	272	390

Source: GWRC data, PwC calculations

Table 69. Additional PT patronage for "b" BRT options (2031)

	2b	3b	4b	5b
Additional patronage	65	77	112	190

Source: GWRC data, PwC calculations

Detailed assumptions about level of priority at key intersections

Table 70. GWRC assumptions on level of priority for the options at key intersections

Key intersection	Reference case	1	2	3	4ac	4 (except 4ac)	5ac	5 (except 5ac)
Kilbirnie to SH1	Nothing	Nothing	Peak bus lanes	Turn priority into / out of KBC from SH1 but no pre-emption, no bus lanes on KBC, priority around Kilbirnie TC	Turn priority into / out of KBC from SH1 but no pre-emption, no bus lanes on KBC, priority around Kilbirnie TC	Turn priority into / out of KBC from SH1 with pre-emption, no bus lanes on KBC, priority around Kilbirnie TC	Turn priority into / out of KBC from SH1 with pre-emption, no bus lanes on KBC, priority around Kilbirnie TC	Segregation, full priority, pre-emption, no GT in bus lanes
SH1 to Basin	Nothing	Nothing	Bus lanes on Ruahine, no pre-emption	Bus lanes on Ruahine, no pre-emption	Bus lanes on Ruahine, no pre-emption	Bus lanes on Ruahine, plus pre-emption	Bus lanes on Ruahine, plus pre-emption	Segregation, full priority, pre-emption, no GT in bus lanes
Newtown to Basin	Nothing	Bus lanes to stop line, no B phase	Bus lanes to stop line plus B phase	Bus lanes to stop line plus B phase	Bus lanes to stop line plus pre-emption	Bus lanes to stop line plus pre-emption	Segregation, full priority, pre-emption, no GT in bus lanes	Segregation, full priority, pre-emption, no GT in bus lanes
Basin	Bus lanes	Bus lanes to stop line, no B phase	Bus lanes to stop line plus B phase	Bus lanes to stop line plus B phase	Bus lanes to stop line plus pre-emption	Bus lanes to stop line plus pre-emption	Segregation, full priority, pre-emption, no GT in bus lanes	Segregation, full priority, pre-emption, no GT in bus lanes
Kent Cambridge	As current	Bus lanes to stop line, no B phase	Bus lanes to stop line plus B phase	Bus lanes to stop line plus B phase	Bus lanes to stop line plus pre-emption	Bus lanes to stop line plus pre-emption	Segregation, full priority, pre-emption, no GT in bus lanes	Segregation, full priority, pre-emption, no GT in bus lanes

Key intersection	Reference case	1	2	3	4ac	4 (except 4ac)	5ac	5 (except 5ac)
Courtenay Place to Taranaki Street	As current	Improved bus lanes including some removal of parking, some B phase, GT allowed	Improved bus lanes including some removal of parking, some B phase, no GT at peak times	Improved bus lanes including some removal of parking, some B phase, no GT at peak times	Improved bus lanes, removal of most parking and access restrictions, pre-emption, no GT allowed	Improved bus lanes, removal of most parking and access restrictions, pre-emption, no GT allowed	Segregation, full priority, pre-emption, no GT	Segregation, full priority, pre-emption, no GT
Taranaki Street to Willis Street	As current (effectively bus only) with no signal priority / pre-emption	As current (effectively bus only) with no signal priority / pre-emption	As current (effectively bus only) with no signal priority / pre-emption	As current (effectively bus only) with no signal priority / pre-emption	Improved bus lanes, pre-emption, no GT, effectively fully segregated	Improved bus lanes, pre-emption, no GT, effectively fully segregated	Improved bus lanes, pre-emption, no GT, effectively fully segregated	Improved bus lanes, pre-emption, no GT, effectively fully segregated
Willis Street	As current	As current	No GT at peak times, no pre-emption	No GT at peak times, no pre-emption	No GT 24/7, pre-emption, effectively fully segregated	No GT 24/7, pre-emption, effectively fully segregated	No GT 24/7, pre-emption, effectively fully segregated	No GT 24/7, pre-emption, effectively fully segregated
Lambton Quay to Wellington bus station	As current	General traffic restrictions at peak times, shared bus lanes, some b phase	No GT at peak times, no pre-emption	No GT at peak times, no pre-emption	No GT 24/7, pre-emption, effectively fully segregated	No GT 24/7, pre-emption, effectively fully segregated	No GT 24/7, pre-emption, effectively fully segregated	No GT 24/7, pre-emption, effectively fully segregated

Key intersection	Reference case	1	2	3	4ac	4 (except 4ac)	5ac	5 (except 5ac)
Basin entry from Mt Vic	Nothing	Bus lane but not to stop line, buses mix with GT turning left, no B phase	Bus lane to stop line, B phase	Bus lane to stop line, B phase	Bus lane to stop line, B phase	Bus lane to stop line, pre-emption	Bus lane to stop line, pre-emption	Segregated bus lane to stop line, pre-emption
Basin entry from Newtown	Nothing	Bus lane but not to stop line, buses mix with GT turning left, no B phase	Bus lane to stop line, B phase	Bus lane to stop line, B phase	Bus lane to stop line, pre-emption	Bus lane to stop line, pre-emption	Segregated bus lane to stop line, pre-emption	Segregated bus lane to stop line, pre-emption
Vivian Street description	Nothing	Bus lanes to stop line, no B phase, no pre-emption	Bus lanes to stop line, no B phase, no pre-emption	Bus lane to stop line, B phase	Bus lane to stop line, pre-emption	Bus lane to stop line, pre-emption	Segregated bus lane to stop line, pre-emption	Segregated bus lane to stop line, pre-emption
Adelaide / John Street description	Nothing	Bus lane but not to stop line, buses mix with GT turning left, no B phase	Bus lane but not to stop line, buses mix with GT turning left, no B phase	Bus lane to stop line, B phase	Bus lane to stop line, pre-emption	Bus lane to stop line, pre-emption	Segregated bus lane to stop line, pre-emption	Segregated bus lane to stop line, pre-emption

Source: GWRC (direct correspondence)

Table 71. GWRC factor assumptions on level of priority for the options at key intersections

Intersection	Ref case	1	2	3	4ac	4 (except 4ac)	5ac	5 (except 5ac)
Bay Road / Onepu	1	1	0.8	0.8	0.8	0.2	0.2	0
Bay Road / Kilbirnie Crescent	1	1	0.8	0.8	0.8	0.2	0.2	0
Kilbirnie Crescent / Wellington Road	1	1	0.6	0.6	0.6	0.2	0.2	0
Wellington Road / Ruahine Street	1	1	0.6	0.6	0.6	0.2	0.2	0
Wellington Road / Ruahine Street	1	1	0.6	0.6	0.6	0.2	0.2	0
Basin Reserve approach	1	0.8	0.4	0.4	0.4	0.2	0.2	0
Hospital	1	0.6	0.4	0.4	0.2	0.2	0	0
Adelaide / John Street	1	0.8	0.8	0.6	0.2	0.2	0	0
Hospital Road	1	0.6	0.4	0.4	0.2	0.2	0	0
Ped Xing	1	0.6	0.4	0.4	0.2	0.2	0	0
Basin approach	1	0.6	0.4	0.4	0.2	0.2	0	0
Basin exit	1	0.6	0.4	0.4	0.2	0.2	0	0
Vivian Street	1	0.6	0.6	0.4	0.2	0.2	0	0

Intersection	Ref case	1	2	3	4ac	4 (except 4ac)	5ac	5 (except 5ac)
Elizabeth Street	1	0.6	0.4	0.4	0.2	0.2	0	0
GM Ped Xing	1	0.6	0.4	0.4	0.2	0.2	0	0
Tory Street	1	0.7	0.4	0.4	0.2	0.2	0	0
Taranaki Street	1	0.7	0.4	0.4	0.2	0.2	0	0
Cuba Street	1	1	1	1	0	0	0	0
Victoria Street	1	1	1	1	0	0	0	0
Willis Street / Boulcott	1	1	0.4	0.4	0	0	0	0
Willis / BNZ	1	1	0.4	0.4	0	0	0	0
Lambton Quay Signals 1	1	0.7	0.4	0.4	0	0	0	0
Lambton Quay Signals 2	1	0.7	0.4	0.4	0	0	0	0
Lambton / Bowen	1	0.7	0.4	0.4	0	0	0	0

Source: GWRC

Value of time assumptions

A weighted average PT value of time was estimated based on EEM values of time and a trip breakdown from GWRC, based off survey data. The weighted average was composed of three types of trip purposes: work travel, commuting and other purposes (eg education, shopping) and was calculated to estimate the value of time for the "average" PT user along the Central Spine.

Table 72. Values of time for seated bus and train passengers ($/hour, all road categories, all time periods)

Trip purpose	2002 $/hr	% of Wellington PT trips	Resource cost correction factor	Weighted average value of time (2002 $/hr)	Weighted average value of time (2014 $/hr)
Work travel purpose	21.70	4%	1.00	$5.74	$8.15
Commuting	4.70	73%	1.15		
Other purposes	3.05	23%	1.15		

Source: EEM, PwC calculations

The EEM values for traffic composition and travel purpose breakdown along urban arterial roads were used to determine the value of time for car passengers, along the Central Spine, Newtown and Kilbirnie branches. A weighted average value of time was estimated, for the 'average' car passenger along the Spine Study routes.

Table 73 a). Value of time calculations for car passengers

					Travel purpose		
Time period	**Road type**	**Vehicle type and occupant**	**Traffic composition**	**Vehicle occupancy**	**Work**	**Commute**	**Other**
AM peak	Urban arterial	Car	85%	1.4	10%	50%	40%
		Car passenger			10%	50%	40%
		LCV	10%	1.4	65%	20%	15%
		LCV passenger			65%	20%	15%
		MCV	2%	1.2	90%	5%	5%
		HCVI	1%	1.2	90%	5%	5%
		HCVII	2%	1.2	90%	5%	5%

Source: EEM, PwC calculations

Table 75 b). Value of time calculations for car passengers

						VoT by vehicle class and travel purpose (2002 $/hr)		
Time period	Road type	Vehicle type and occupant	ART3 model output category	Person composition	... by vehicle class	Work	Commute	Other
AM peak	Urban arterial	Car	Cars	61.2%	64%	$23.21	$7.24	$6.41
		Car passenger		24.5%	26%			
		LCV		7.2%	8%			
		LCV passenger		2.9%	3%			
		MCV	HCVs	1.7%	40.0%		$18.83	
		HCVI		0.9%	20.0%			
		HCVII		1.7%	40.0%			

Source: EEM, PwC calculations

The overall weighted average value of time for car passengers was $12.08 per hour (in 2014 dollars).

Annualisation factors

The modelling data was for the two hour AM peak period, therefore annualisation factors were used to scale up the benefits to an annual figure.

Table 74. Annualisation factors

	Value	Source
Highway	490	AECOM (2013)
PT	583	AECOM (2013)
PT – peak only	500	Assumption based on 250 working days per year and 2 peak periods per day
Bus (for bus VKT)	595	Estimating using data from GWRC

Standard benefits

Travel time savings benefits

The patronage and weighted average travel time were used as the basis for the travel time savings benefits. As the modelling outputs were for the 2031 year, additional assumptions were required to determine the profile of travel time savings and patronage over time.

As outlined earlier, regional BP and BRT patronage growth rates were used to proxy the profile of the number of bus users long the Newtown and Kilbirnie routes over time. The travel time savings, over the do-minimum, were not expected to stay constant over time. The do-minimum is expected to worsen over time, so the travel time savings relative to the do-minimum is expected to increase over time.

A factor of 0.8 was applied to 2031 travel time savings to generate travel time savings in 2021. A factor of 1.2 was applied to travel time savings in 2031 to generate travel time savings in 2041. Travel time savings were assumed to be constant after 2041. The rule of half was applied to new PT users.

Table 75 shows the NPV of the travel time savings over 40 years for all BRT options.

Table 75 a). Travel time savings for core BRT options (NPV, 40 years)

	1	2	3	4	5
Existing users	$5.9m	$15.1m	$18.7m	$27.3m	$31.7m
New users	$44.1k	$228.4k	$306.2k	$737.3k	$1.2m
Total	$5.9m	$15.3m	$19.0m	$28.1m	$32.9m

PwC calculations

Table 77 b). Travel time savings for BRT options (NPV, 40 years)

	2a	2b	3a	3b	4a	4b
Existing users	$14.0m	$8.5m	$17.5m	$10.5m	$25.5m	$13.6m
New users	$214.6k	$87.8k	$289.1k	$127.0k	$695.9k	$230.7k
Total	$14.2m	$8.6m	$17.7m	$10.6m	$26.2m	$13.8m

PwC calculations

Table 77 c). Travel time savings for BRT options (NPV, 40 years)

	4c	4ac	5a	5b	5c	5ac
Existing users	$21.2m	$19.1m	$30.0m	$14.7m	$28.3m	$26.5m
New users	$318.4k	$290.4k	$1.2m	$427.5k	$504.6k	$477.1k
Total	$21.5m	$19.4m	$31.2m	$15.1m	$28.8m	$27.0m

PwC calculations

Additional PT user benefits

Section A18 of the EEM identifies benefits associated with improving PT infrastructure and services. The higher quality PT options, in terms of more priority, were also assumed to have better quality infrastructure. We assumed that Options 3, 4 and 5 generated additional PT user benefits from the BRT infrastructure, with attributes according to the following table, taken from EEM Table A18.5:

Table 76. Value of benefit for PT infrastructure

Attribute	Sub-attribute	Value of benefit (IVT min)
Stop	Condition	0.1
	Size	0.1
	Seating	0.1
	Cleanliness	0.1
	Litter	0.2
	Type	0.2
Ticketing	Roadside	0.1
	Availability	0.2
Security	Security point	0.3
	CCTV	0.3
	Lighting	0.1
Information	Terminals	0.1
	Realtime	0.8
	Clock	0.1
	Contact number	0.1
	Timetable	0.4
Total		3.3
Factored down by 50% (per EEM procedures)		**1.65**

Source: EEM table A18.5

The total value is factored down by 50% to account for multiple features. We assumed that the benefits only accrue in the second phase of construction, after the Basin Bridge is completed. Therefore the core options and "a" options are equivalent.

Table 77 below shows the NPV of the additional PT user benefits over 40 years. The full value is applied to existing PT users (who are assumed to benefit from the new infrastructure in its entirety as the infrastructure is new) and the rule of a half is applied to new PT users.

Table 77 a). Additional PT user benefits for BRT options (NPV, 40 years)

	1	2	3	4	5
Additional PT user benefits	-	-	-	$5.8m	$6.0m

PwC calculations

Table 79 b). Additional PT user benefits for BRT options (NPV, 40 years)

	2a	2b	3a	3b	4a	4b
Additional PT user benefits	-	-	-	-	$6.1m	$2.4m

PwC calculations

Table 79 c). Additional PT user benefits for BRT options (NPV, 40 years)

	4c	4ac	5a	5b	5c	5ac
Additional PT user benefits	$2.4m	$2.5m	$6.3m	$2.5m	$2.4m	$2.5m

PwC calculations

Reliability benefits

Reliability is a major issue for passengers, who value certainty about their trip. Section A18 of the EEM outlines the calculation to determine the benefit associated with improved journey time reliability. Reliability benefits are directly estimated, rather than relying on a rule of thumb.

Table A18.1 of the EEM provides the equivalent time to a minute late (EL) ratio for bus travellers. The combined delay of 4.1 EL was used. The base vehicle travel time was taken from Table A4.2 of the EEM and updated to 2014 dollars, the vehicle travel time is $24.28 per hour.

GWRC data on the average "lateness" of all Wellington bus services showed that the Island Bay to Wellington Station route (which includes the Newtown to Wellington Station route) was on average 3.8 minutes late. Whereas the Karori to Courtenay Place route (covers the Kilbirnie branch) was on average 3.4 minutes late. The average across all routes was 3.5 minutes late.

We used this as a benchmark to determine the reliability benefits of the BRT options. Option 5 was assumed to eliminate variability in travel times due to congestion reduced by the signal priority and the segregated corridor. That is, we assumed that the reduction in average minutes late (AML) for Option 5 was 3.5 minutes. The intermediate options were also interpolated using the same method as the travel time savings. Table 78 shows the average reduction in minutes late across the BRT options.

Table 78. Assumptions on average reduction in minutes late for BRT options.

	1	2b	2 / 2a	3c	3 / 3a	4c / 4ac	4b / 4 / 4a	5c / 5ac	5/5a/5b
AML	.5	1.4	1.3	1.6	1.4	1.8	2.4	2.7	3.5

Source: GWRC data, PwC calculations

The rule of half was applied to new PT users.

As noted in section 18.1 in the EEM, trip reliability benefits cannot exceed the travel time savings. The calculated journey reliability benefits exceeded the travel time savings for each option, so the value used in the CBA was the value attributed the travel time savings.

Health benefits

Health benefits arise from walking to PT stops and section A20.3 of the EEM outlines the procedure for evaluating the economic benefits. We have assumed that new PT users shift travel mode from private vehicle so walk the average distance from their homes to PT stops. Existing PT users also benefit from walking further, in options3,4 and 5, as there are fewer BRT stops with wider spacing between them.

Table 79 outlines the key assumptions for the walk analysis.

Table 79. Key walking and bus stop assumptions

	Bus Priority	BRT
Distance along Kilbirnie route	6km	6km
Distance along Newtown route	5km	5km
Number of stops (Kilbirnie route)	17	8
Number of stops (Newtown route)	14	8
Average distance between stops (Kilbirnie route)	350m	750m
Average distance between stops (Newtown route)	350m	625m
BRT stop catchment size	400m	800m
Average walk distance to stop (existing stops)	0.2km	N/A
Extra walk to BRT stations	0.4km	0.2km
Walking benefits $ (2014) per pedestrian km	$3.08/km	$3.08/km
Year benefits begin	2025	2025

We assumed BP stop distances for core Options 1 to 3 and BRT style stations for Options 4 and 5, with the combination options a blend of BP and BRT station distances for the Newtown and Kilbirnie branches as per option definitions. We also assume that the new stations along the Newtown and Kilbirnie branches do not get constructed until after the Basin development, so benefits only accrue to PT users from 2025 onwards.

We assumed a grid road layout and estimated Manhattan distances for the average walk distances, as illustrated in Figure 12 below. The Manhattan distance is based on horizontal and vertical path, ie the distance 175m + 359m below. The average distance is half the Manhattan distance ie 267m.

In order to present a conservative value, in line with our broad approach to the analysis, we factored the walking distances down by 25%.

Figure 12. Example walking distance calculation for the BRT options

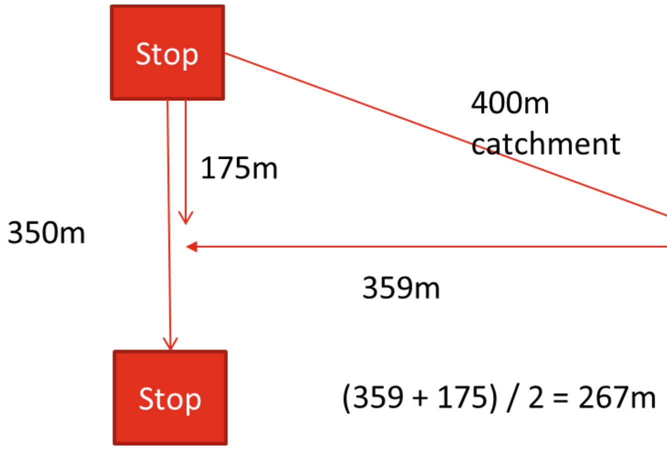


Table 80 shows the estimated walking benefits for the BRT options over 40 years.

Table 80 a). Value of walking benefits for BRT options (NPV, 40 years)

	1	2	3	4	5
Walking benefits	$94k	$286k	$317k	$16.4m	$17.1m

PwC calculations

Table 82 b). Value of walking benefits for BRT options (NPV, 40 years)

	2a	2b	3a	3b	4a	4b
Walking benefits	$67k	$128k	$76k	$151k	$17.3m	$6.7m

PwC calculations

Table 82 c). Value of walking benefits for BRT options (NPV, 40 years)

	4c	4ac	5a	5b	5c	5ac
Walking benefits	$6.8m	$7.1m	$18.1m	$7.2m	$6.9m	$7.3m

PwC calculations

Emissions

The reduced frequency and improved travel times along the BRT routes result in fewer vehicle kilometres travelled by the buses servicing these lines. The economic benefits associated with reducing bus emissions have been included in our analysis.

We assumed that the type of buses is constant over all options, as high capacity buses are part of the do-minimum. Therefore the source of the emissions benefits is due to the reduction in vehicle km travelled for buses, rather than a change to the bus fleet configuration. We have assumed that the new buses will be of a Euro 5 standard.

The energy efficiency of Euro 5 buses has been taken from previous analysis for GWRC.

Table 81. Bus type assumptions for BRT options

Bus type	MJ/100km	kg Co2 / MJ
Euro 5	1200	0.07325

GWRC estimated the bus vehicle km travelled (VKT) in 2031, using assumed headways and route lengths. Table 82 shows the key data from GWRC on VKT in the am peak period in 2031.

Table 82. Data on bus frequencies and VKT for BRT options

	Frequency (minutes per bus)	Number of buses required (Kilbirnie)	Number of buses required (Newtown)	Kilbirnie VKT	Newtown VKT
Reference	2	30	23	360	360
BP	3	18	14	240	240
BRT	4	9	8	180	180

Source: GWRC

We interpolated the VKT across the options per the schedule in Table 83 below.

Table 83. VKT assumptions for BRT options

	1	2	3	Combination of 3 and 4	4	Combination of 3 and 5	5
VKT assumptions	As per BP	Same as 1	Same as 1	Midway between 3 and 4	Same as 5	Midway between 4 and 5	As per BRT

In addition, we have assumed that bus VKT is constant over time. This implicitly assumes that when the BRT begins there is sufficient passenger capacity to capture the growth in demand.

We annualised the figures based on an estimated bus VKT annualisation factor of 595, using data from GWRC on total bus VKT travelled per year and bus VKT in the AM peak period. Table 84 below shows the monetised benefit for the reduction in bus VKT for the BRT options over 40 years, based on a cost of carbon emissions of $40/tonne (section A9.6 of the EEM).

Table 84 a). Emissions benefits for BRT options (NPV, 40 years)

	1	2	3	4	5
CO2 reduction benefit	$103k	$268k	$275k	$334k	$433k

PwC calculations

Table 86 b). Emissions benefits for BRT options (NPV, 40 years)

	2a	2b	3a	3b	4a	4b
CO2 reduction benefit	$238k	$137k	$245k	$143k	$297k	$167k

PwC calculations

Table 86 c). Emissions benefits for BRT options (NPV, 40 years)

	4c	4ac	5a	5b	5c	5ac
CO2 reduction benefit	$299k	$265k	$390k	$217k	$356k	$314k

PwC calculations

Car user travel time (dis)benefits

The BRT options impact on other road users, due to reduced road space for general traffic and some restrictions on turning (eg for options with physically separated bus lanes). The disbenefits to private vehicles are estimated, in terms of worsening travel times.

The key data to estimating the disbenefits to car users is from GWRC's modelling report for the PTSS. The key data we have relied on is in Table 85 below.

Table 85. Travel time savings by car to the CBD (am peak, 2031, in minutes)

	Reference travel time	BP change from reference	BRT change from reference
Miramar	26.6	-0.3	-0.9
Island Bay	23.9	0	+0.5
Newtown	21.6	+1	+0.8
Hataitai	20	-0.3	+0.5
Kilbirnie	22.6	+0.2	-0.1

Source: PTSS Short List Evaluation - Modelling Report

The car travel time changes for the intermediate options were interpolated using the bus travel time method.

Table 86. Overall car demand for selected Wellington origins

	Reference case	BP change in car demand from reference	BRT change in car demand from reference
Miramar	7502	-55	-121
Island Bay	4333	-22	-92
Newtown	4548	-30	-76
Mt Vic/Hataitai	3355	-20	37
Kilbirnie	4647	43	-77

Source: PTSS Short List Evaluation - Modelling Report

GWRC provided data on the percentage of trips to the CBD by origin, which was used to determine the number of trips to the CBD directly affected by the BRT options. Table 34 shows the number of trips to the CBD from each origin, which is the car demand in Table 33 multiplied by the percentage of trips to the CBD by origin.

Table 87. Car trips to the CBD

	% of trips to CBD by origin	Reference case	BP car trips to the CBD	BRT car trips to the CBD
Miramar	23%	1,725	1,713	1,698
Island Bay	35%	1,517	1,509	1,484
Newtown	64%	2,911	2,892	2,862
Mt Vic/Hataitai	47%	1,577	1,567	1,594
Kilbirnie	26%	1,208	1,219	1,188

Source: GWRC, PwC calculations

The overall change in time (change per trip multiplied by the number of trips) was aggregated and then annualised using an annualisation factor of 490.

To generate the profile over time, the travel times matched the expected change in travel times for buses (2021 car travel times were multiplied by a factor of 0.8 and 2041 car travel times were multiplied by a factor of 1.2 and were constant thereafter). Car demand over time was also based on PT regional patronage figures and the average vehicle occupancy of 1.4 persons per car.

Table 88 a). Car travel time disbenefits for BRT options (NPV, 40 years)

	1	2	3	4	5
Car travel time disbenefit	-$4.9m	-$4.4m	$4.3m	-$4.0m	-$3.7m

PwC calculations

Table 90 b). Car travel time disbenefits for BRT options (NPV, 40 years)

	2a	2b	3a	3b	4a	4b
Car travel time disbenefit	-$2.7m	-$5.0m	-$2.6m	-$5.1m	-$2.4m	-$5.1m

PwC calculations

Table 90 c). Car travel time disbenefits for BRT options (NPV, 40 years)

	4c	4ac	5a	5b	5c	5ac
Car travel time disbenefit	-$4.2m	-$2.5m	-$2.9m	-$5.2m	-$-3.8m	-$2.3m

PwC calculations

Vehicle operating cost reduction benefits

The vehicle operating cost (VOC) reduction benefits is inclusive of reduced VOC for cars (due to mode shift).

Table A5.1 gives the VOC (in cents per km) by speed and gradient. The road gradient was assumed to be 0%. A benefit update factor of 1.07 was used to convert the values from 2008 dollars to 2014 dollars.

Table 89 a). VOC reduction benefits for BRT options (NPV, 40 years)

	1	2	3	4	5
Car VOC reduction benefit	$3.8m	$10.7m	$11.0m	$13.3m	$17.5m

PwC calculations

Table 91 b). VOC reduction benefits for BRT options (NPV, 40 years)

	2a	2b	3a	3b	4a	4b
Car VOC reduction benefit	$11.2m	$5.5m	$11.6m	$5.7m	$14.0m	$6.6m

PwC calculations

Table 91 c). VOC reduction benefits for BRT options (NPV, 40 years)

	4c	4ac	5a	5b	5c	5ac
Car VOC reduction benefit	$11.9m	$12.5m	$18.5m	$8.8m	$14.0m	$14.8m

PwC calculations

Agglomeration benefits

The benefits associated with agglomeration economies have been assumed to be 15% of the travel time benefits and is in line with other economic appraisals of transport projects.[21] This is conservative but a realistic proposition for a city such as Wellington, in which much of the employment is already concentrated in the CBD.

Table 90 a). Agglomeration benefits for BRT options (NPV, 40 years)

	1	2	3	4	5
Agglomeration benefits	$0.9m	$2.3m	$2.8m	$4.2m	$4.9m

PwC calculations

Table 92 b). Agglomeration benefits for BRT options (NPV, 40 years)

	2a	2b	3a	3b	4a	4b
Agglomeration benefits	$2.1m	$1.3m	$2.7m	$1.6m	$3.9m	$2.1m

PwC calculations

Table 92 c). Agglomeration benefits for BRT options (NPV, 40 years)

	4c	4ac	5a	5b	5c	5ac
Agglomeration benefits	$3.2m	$2.9m	$4.7m	$2.3m	$4.3m	$4.0m

PwC calculations

Calculation of costs

Capital and operating cost values are also sourced from the PTSS. These were developed by AECOM and peer reviewed. As with the transport effects, we apply the PTSS BP and BRT costs to Options 1 and 5, and then interpolate to develop the costs for the other options.

Capital expenditure

Table 19 below shows the indicative costs of the bus priority and BRT options from the PTSS work.

Table 91: Capital expenditure of construction ($2013 m)

	Bus Priority	BRT [2]
Central spine	16.1	79.8
Newtown branch	5.9	29.4
Kilbirnie branch	14.1 [1]	25.6

[21] A summary of examples of wider economic impact assessments is contained in Kernohan and Rognlien (2011) *Wider economic impacts of transport investments in New Zealand*. Refer to Table 13.1. A 15% uplift sits comfortably within the range of agglomeration impacts for bus projects listed in the table.

General allowances	5.0	9.8
Design and construction contingencies (20%)	9.8	32.2
Total construction cost	**58.6** 3	**173.5**

Source: Wellington Public Transport Spine Study Appendix E Option Cost Methodology
Note: (1) Option 1 does not include the Kilbirnie branch. However we use the PTSS value for this part of the route to help interpolate the values for other options. (2) The BRT values exclude the amount included in the PTSS for high-capacity buses, since these are part of the reference case for our analysis. (3) The Bus Priority values exclude amounts for the Constable St part of the route, since this is not part of any BRT option.

The interpolation method used for capital costs differed to that applied to journey times, given the different drivers of the values. Our method uses professional judgement to determine the relative costs of each option compared to the 'bookends'. The approach used a different relative allocation for road infrastructure and signalling and telemetry.

Table 92 shows the approach to interpolate the infrastructure assets and Table 93 sets out the approach used to interpolate the signalling and telemetry costs.

Table 92: Infrastructure cost allocation

Option 1	Option 2	Option 3	Option 4c/4ac	Option 4	Option 5c/5ac	Option 5
BP costs	Midway between BP and BRT costs	BP costs plus 25%	Combination of Option 4 and Option 3 by route	Midway between BP and BRT costs	Combination of Option 5 and Option 3 by route	**BRT costs**

PwC assumptions

Table 93: Signalling cost allocation

Option 1	Option 2	Option 3	Option 4c/4ac	Option 4	Option 5c/5ac	Option 5
BP costs	Same as BP costs	Same as BP costs	Combination of Option 4 and Option 3 by route	Same as BRT costs	Combination of Option 5 and Option 3 by route	**BRT costs**

PwC assumptions

Cost escalation was applied to the capex figures. The 2013 dollar values from AECOM were inflated one year to generate 2014 dollars (to ensure the benefits and costs were aligned).

The values for the cost escalation were estimated using a combination of the forecast local government capital expenditure price index and long run consumer price index according to the following table:

Table 94. Cost escalation factors by year

Year	Local Government capex price index	% change p.a.	% change p.a. - LT CPI@2%	Annual cost escalation factor	Cumulative cost escalation factor
2014	1000	0.4%	-1.6%	0.9840	0.9840
2015	1021	2.1%	0.1%	1.0010	0.9850
2016	1045	2.4%	0.4%	1.0035	0.9885
2017	1072	2.6%	0.6%	1.0058	0.9942
2018	1100	2.6%	0.6%	1.0061	1.0003
2019	1130	2.7%	0.7%	1.0073	1.0076
2020	1161	2.7%	0.7%	1.0074	1.0151
2021	1196	3.0%	1.0%	1.0101	1.0254
2022	1233	3.1%	1.1%	1.0109	1.0366
2023	1273	3.2%	1.2%	1.0124	1.0495
2024	1317	3.5%	1.5%	1.0146	1.0648
2025	1366	3.7%	1.7%	1.0172	1.0831

Source: BERL, NZIER, PwC calculations

Operational expenditure

The annual operational expenditure was also sourced from AECOM work. Table 95 below shows the expected operational costs of the BP and BRT options. The operating costs relate to the bus operations (eg fuel, vehicle maintenance etc) only. The PTSS did not specifically include costs for maintenance of the new infrastructure. We have assumed that the maintenance costs of the whole roadway are materially similar as the do-minimum scenario, on the basis that the segment of the road would need to be maintained anyway. For example, if kerb-side parking is removed and converted to a bus-lane, the existing renewals budget would have some proportion allocated to the road segment anyway.

Table 95. Operational expenditure estimates

Option	$/annum	Change from reference case
Reference case	$88.3m	N/A
Bus Priority	$88.0m	-$0.3m
BRT	$82.6m	-$5.7m

Source: PTSS Option Evaluation Results

In the BP and BRT options, the operating costs are less than the operating costs in the do-minimum. Therefore, the BP and BRT options represent opex savings relative to the do-minimum.

We used the BP as the annual operating cost for Option 1 and BRT data for the annual operating costs for Option 5.

The operating costs for the intermediate options were also interpolating using the travel time percentage method.

We also applied cost escalation to operating costs. A long run forecast of the producer price index and long run forecast consumer price index were used to estimate a cost escalation factor for the operating costs. This was calculated as 0.2% per annum. The PTSS operating costs also included a 10% contingency on the total regional cost of providing public transport services.

Table 96 shows the expected total capex and annual opex (single year only) for each BRT option.

Table 96. Expected total capex and annual opex for each BRT option ($2013 m)

Option	Total capex	Additional opex in 2031
Core options		
1	30.9	- 0.3
2	95.7	- 2.6
3	58.8	- 2.9
4	127.2	- 4.6
5	173.5	- 5.7
Option variants:		
2a	95.7	- 2.6
2b	70.3	- 1.3
3a	58.8	- 2.9
3b	37.8	- 1.4
4a	127.2	- 4.6
4b	101.9	- 2.0
4c	121.3	- 3.5
4ac	121.3	- 3.5
5a	173.5	- 5.7
5b	139.7	- 2.4
5c	160.8	- 5.2
5ac	160.8	- 5.2

PwC calculations

Cost benefit analysis results

Core BRT options

Table 97 presents the estimated benefits, costs, and the benefit-cost ratios for the core BRT options. All dollar values shown are net present values over 40 years.

Table 97. Costs, benefits and BCRs – core BRT options

$m NPV	1	2	3	4	5
Benefits:					
Travel time benefits	$5.9m	$15.3m	$19.0m	$28.1m	$32.9m
Additional PT user benefits	$0.0m	$0.0m	$0.0m	$5.8m	$6.0m
Reliability benefits	$5.9m	$15.3m	$19.0m	$28.1m	$32.9m
Walking benefits	$0.1m	$0.3m	$0.3m	$16.4m	$17.9m
Emissions reductions benefits	$0.1m	$0.3m	$0.3m	$0.3m	$0.4m
Agglomeration benefits	$0.9m	$2.3m	$2.8m	$4.2m	$4.9m
Travel time (dis)benefits for car users	-$4.9m	-$4.4m	-$4.3m	-$4.0m	-$3.7m
Reduction in vehicle operating cost benefits	$3.8m	$10.7m	$11.0m	$13.3m	$17.5m
Total benefits	**$11.8m**	**$39.7m**	**$48.0m**	**$92.2m**	**$108.1m**
Costs:					
Capex	$24.3m	$72.1m	$43.4m	$97.2m	$132.9m
Opex (savings)	-$2.4m	-$20.8m	-$22.8m	-$36.8m	-$45.4m
Total costs	**$ 21.9m**	**$51.3m**	**$20.6m**	**$60.4m**	**$87.5m**
Benefit-cost ratio	**0.5**	**0.8**	**2.3**	**1.5**	**1.2**

PwC calculations

Other BRT variants

Table 98 presents the estimated benefits, costs, and the benefit-cost ratios for other BRT variants. All dollar values shown are net present values over 40 years.

Table 98a. Costs, benefits and BCRs – other BRT variants

$m NPV	2a	2b	3a	3b	4a	4b
Benefits:						
Travel time benefits	$14.2m	$8.6m	$17.7m	$10.6m	$26.2m	$13.8m
Additional PT user benefits	$0.0m	$0.0m	$0.0m	$0.0m	$6.1m	$2.4m
Reliability benefits	$14.2m	$8.6m	$17.7m	$10.6m	$26.2m	$13.8m
Walking benefits	$0.1m	$0.1m	$0.1m	$0.2m	$17.3m	$6.7m
Emissions reductions benefits	$0.2m	$0.1m	$0.2m	$0.1m	$0.3m	$0.2m
Agglomeration benefits	$2.1m	$1.3m	$2.7m	$1.6m	$3.9m	$2.1m
Travel time (dis)benefits for car users	-$2.7m	-$5.0m	-$2.6m	-$5.1m	-$2.4m	-$5.1m
Reduction in vehicle operating cost benefits	$11.2m	$5.5m	$11.6m	$5.7m	$14.0m	$6.6m
Total benefits	**$39.5m**	**$19.1m**	**$47.4m**	**$23.8m**	**$91.7m**	**$40.5m**
Costs:						
Capex	$61.2m	$55.9m	$37.6m	$30.0m	$81.4m	$81.1m
Opex (savings)	-$22.0m	-$10.0m	-$24.1m	-$11.4m	-$38.8m	-$15.5m
Total costs	**$39.2m**	**$45.9m**	**$13.5m**	**$ 18.6m**	**$42.5m**	**$65.6m**
Benefit-cost ratio	**1.0**	**0.4**	**3.5**	**1.3**	**2.2**	**0.6**

PwC calculations

Table 98b. Costs, benefits and BCRs other BRT variants

$m NPV	4c	4ac	5a	5b	5c	5ac
Benefits:						
Travel time benefits	$21.5m	$19.4m	$31.2m	$15.1m	$28.8m	$27.0m
Additional PT user benefits	$2.4m	$2.5m	$6.3m	$2.5m	$2.4m	$2.5m
Reliability benefits	$21.5m	$19.4m	$31.2m	$15.1m	$28.8m	$27.0m
Walking benefits	$6.8m	$7.1m	$18.1m	$7.2m	$6.9m	$7.2m
Emissions reductions benefits	$0.3m	$0.3m	$0.4m	$0.2m	$0.4m	$0.3m
Agglomeration benefits	$3.2m	$2.9m	$4.7m	$2.3m	$4.3m	$4.0m
Travel time (dis)benefits for car users	-$4.2m	-$2.5m	-$2.9m	-$5.2m	-$3.8m	-$2.3m
Reduction in vehicle operating cost benefits	$11.9m	$12.5m	$18.5m	$8.8m	$14.0m	$14.8m
Total benefits	**$63.4m**	**$61.6m**	**$107.4m**	**$46.1m**	**$81.8m**	**$80.5m**
Costs:						
Capex	$93.3m	$77.6m	$111.0m	$111.1m	$124.7m	$102.9m
Opex (savings)	-$28.2m	-$29.8m	-$47.9m	-$18.8m	-$41.2m	-$43.5m
Total costs	**$65.1m**	**$47.8m**	**$63.1m**	**$92.3m**	**$83.5m**	**$59.3m**
Benefit-cost ratio	**1.0**	**1.3**	**1.7**	**0.5**	**1.0**	**1.4**

PwC calculations

Sensitivity testing

Higher value of time

A higher value of time for PT users was used to lift the values of time more in line with those used in the PTSS economic evaluation, to make the results more comparable between studies. The values of time for PT users were increased by an additional 25% for the sensitivity testing, making the weighted average value of time for PT users $10.19 per hour.

Results presented below are for core BRT options only.

Table 99. Benefit-cost ratio for core BRT options with higher value of time

$m NPV	1	2	3	4	5
BCR – base case	**0.5**	**0.8**	**2.3**	**1.5**	**1.2**
BCR – higher value of time	**0.7**	**0.9**	**2.8**	**1.8**	**1.5**

PwC calculations

Higher construction costs

Higher capital costs (an extra 20%) were used to test the scenario in which construction costs are significantly higher than expected.

Table 100. Benefit-cost ratio for core BRT options with higher construction costs

$m NPV	1	2	3	4	5
BCR – base case	**0.5**	**0.8**	**2.3**	**1.5**	**1.2**
BCR – higher costs	**0.5**	**0.6**	**1.7**	**1.2**	**1.0**

PwC calculations

Higher agglomeration benefits

A higher uplift was used to determine the agglomeration benefits of the BRT options. The standard benefit ratio was 15% of travel time benefits, but 25% of all other benefits was used to align with the wider economic benefits in the PTSS economic evaluation.

Table 101. Benefit-cost ratio for core BRT options with higher agglomeration benefits

$m NPV	1	2	3	4	5
BCR – base case	**0.5**	**0.8**	**2.3**	**1.5**	**1.2**
BCR – higher agglomeration	**0.6**	**0.9**	**2.7**	**1.8**	**1.5**

PwC calculations

Reduced reliability benefits

A lower value for the reliability benefits was used for all the BRT options and variants in this sensitivity test. The standard reliability benefit was multiplied by a factor of 0.31 (ie the standard reliability benefits was reduced by 69%, reflecting the percentage of buses on time arriving at all stops). It is noted that in some circumstances, the EEM requirement to limit reliability benefits to be no greater than travel time benefits remains as a constraint. This suggests that the BRT options 3 and 4 are likely to improve PT reliability a great deal.

Table 102. Benefit-cost ratio for core BRT options with reduced reliability benefits

$m NPV	1	2	3	4	5
BCR – base case	**0.5**	**0.8**	**2.3**	**1.5**	**1.2**
BCR – reduced reliability	**0.4**	**0.8**	**2.3**	**1.5**	**1.2**

PwC calculations

Reduced walking benefits

A lower value for the walking benefits was used for all the BRT options and variants in this sensitivity test. The walking benefits for new PT users only was included in the sensitivity test, excluding the additional distance that existing PT users walk when bus stops have a greater distance between them.

Table 103. Benefit-cost ratio for core BRT options with reduced walking benefits

$m NPV	1	2	3	4	5
BCR – base case	**0.5**	**0.8**	**2.3**	**1.5**	**1.2**
BCR – reduced walking benefits	**0.5**	**0.8**	**2.3**	**1.3**	**1.1**

PwC calculations

Overall conservative sensitivity test

An overall sensitivity test combining the individual conservative sensitivity tests was used: including additional costs, reduced reliability and reduced walking benefits. As shown below, options 3 has a BCR greater than 1 and option 4 has a BCR equal to one.

Table 104. Benefit-cost ratio for core BRT options with reduced walking benefits

$m NPV	1	2	3	4	5
BCR – base case	**0.5**	**0.8**	**2.3**	**1.5**	**1.2**
BCR – conservative	**0.4**	**0.6**	**1.7**	**1.0**	**0.8**

PwC calculations

Appendix D Detailed multi-criteria analysis results

Scores for individual criteria

This section presents the scores for the individual MCA criteria, by objective. These scores were developed and agreed by the project Working Group.

1. Increased economic activity

This objective reflects the effect of BRT on economic productivity and growth in Wellington.

Table 105 presents the scores assessed for each of this objective's individual criteria.

Table 105. Scores for criteria for 'Increased economic activity'

	Ref case	1	2	3	4	5
1.1 PT Spine corridor throughput	0	1	2	3	3	3
1.2 Ability to drive intensification of development and economic activity	0	1	2	3	3	3
1.3 Increase in the value of land use along the PT Spine	0	1	2	3	3	3
1.4 Increase in residential population along the PT Spine	0	1	2	3	3	3

	2a	2b	3a	3b	4a	4b	4c	4ac	5a	5b	5c	5ac
1.1 PT Spine corridor throughput	2	1	3	2	3	2	3	3	3	2	3	3
1.2 Ability to drive intensification of development and economic activity	2	1	3	2	3	2	3	3	3	2	3	3
1.3 Increase in the value of land use along the PT Spine	2	1	3	2	3	2	3	3	3	2	3	3
1.4 Increase in residential population along the PT Spine	2	1	3	2	3	2	3	3	3	2	3	3

2. Improved multi-modal network efficiency

This objective reflects the effect of BRT on the efficiency of Wellington's transport network.

Table 106 presents the scores assessed for each of this objective's individual criteria.

Table 106. Scores for criteria for 'Improved multi-model network efficiency'

	Ref case	1	2	3	4	5
2.1 Reduction in PT journey times	0	1	2	3	3	3
2.2 Increased reliability of PT journeys	0	1	2	3	3	3
2.3 Reduction in vehicle operating costs	0	1	2	3	3	3
2.4 Improvement in ability to move goods and services around the city	0	1	2	3	3	3
2.5 Operational resilience (level of interaction with other modes)	0	0	0	0	0	-2

	2a	2b	3a	3b	4a	4b	4c	4ac	5a	5b	5c	5ac
2.1 Reduction in PT journey times	2	1	3	2	3	2	3	3	3	2	3	3
2.2 Increased reliability of PT journeys	2	1	3	2	3	2	3	3	3	2	3	3
2.3 Reduction in vehicle operating costs	2	1	3	2	3	2	3	3	3	2	3	3
2.4 Improvement in ability to move goods and services around the city	2	1	3	2	3	2	3	3	3	2	3	3
2.5 Operational resilience (level of interaction with other modes)	0	0	0	0	0	0	0	0	-2	-1	-1	-1

3. Improved accessibility

This objective reflects the effect of BRT on the ability for Wellingtonians to move around the city, and to access key destinations.

Table 107 presents the scores assessed for each of this objective's individual criteria.

Table 107. Scores for criteria for 'Improved accessibility'

	Ref case	1	2	3	4	5
3.1 Increase in PT Spine corridor carrying capacity	0	1	2	3	3	3
3.2 Improved options for mode choice	0	1	2	3	3	3
3.3 Reduction in bus-on-bus congestion	0	1	2	3	3	3
3.4 Reduction in PT journey times	0	1	2	3	3	3

	2a	2b	3a	3b	4a	4b	4c	4ac	5a	5b	5c	5ac
3.1 Increase in PT Spine corridor carrying capacity	2	1	3	2	3	2	3	3	3	2	3	3
3.2 Improved options for mode choice	2	1	3	2	3	2	3	3	3	2	3	3
3.3 Reduction in bus-on-bus congestion	2	1	3	2	3	2	3	3	3	2	3	3
3.4 Reduction in PT journey times	2	1	3	2	3	2	3	3	3	2	3	3

4. Increased PT patronage

This objective reflects the effect of BRT on the number of people using Wellington's PT system.

Table 108 presents the scores assessed for each of this objective's individual criteria.

Table 108. Scores for criteria for 'Increased PT patronage'

	Ref case	1	2	3	4	5
4.1 Increase in PT patronage in Wellington city	0	1	2	3	3	3
4.2 Increase in PT mode share in Wellington city	0	1	2	3	3	3

	2a	2b	3a	3b	4a	4b	4c	4ac	5a	5b	5c	5ac
4.1 Increase in PT patronage in Wellington city	2	1	3	2	3	2	3	3	3	2	3	3
4.2 Increase in PT mode share in Wellington city	2	1	3	2	3	2	3	3	3	2	3	3

5. Improved PT user experience

This objective reflects the effect of BRT on the user experience of PT users, and the perceived experience for potential users.

Table 109 presents the scores assessed for each of this objective's individual criteria.

Table 109. Scores for criteria for 'Improved PT user experience'

	Ref case	1	2	3	4	5
5.1 Increase in PT user satisfaction	0	0	1	1	3	3
5.2 Increase in ease of use of PT	0	0	1	1	3	3

	2a	2b	3a	3b	4a	4b	4c	4ac	5a	5b	5c	5ac
5.1 Increase in PT user satisfaction	1	1	1	1	3	1	3	3	3	1	3	3
5.2 Increase in ease of use of PT	1	1	1	1	3	1	3	3	3	1	3	3

6. Minimise emissions

This objective reflects the extent to which BRT affects the amount of emissions produced in Wellington.

Table 110 presents the scores assessed for each of this objective's individual criteria.

Table 110. Scores for criteria for 'Minimise emissions'

	Ref case	1	2	3	4	5
6.1 Assessment of emissions (buses)	0	0	0	2	2	2
6.2 Assessment of emissions (mode shift)	0	0	0	0	1	1

	2a	2b	3a	3b	4a	4b	4c	4ac	5a	5b	5c	5ac
6.1 Assessment of emissions (buses)	1	0	2	1	2	1	2	2	2	1	2	2
6.2 Assessment of emissions (mode shift)	0	0	0	0	1	0	1	1	1	0	1	1

7. Minimise impacts on physical environment / amenity

This objective reflects the extent to which BRT impacts amenity values or the physical environment.

Table 111 presents the scores assessed for each of this objective's individual criteria.

Table 111. Scores for criteria for 'Minimise impacts on physical environment / amenity'

	Ref case	1	2	3	4	5
7.1 Land take	0	0	0	0	0	0
7.2 Construction effects	0	0	-2	-2	-2	-3
7.3 Visual effects	0	0	0	0	0	-1
7.4 Noise effects	0	0	0	0	0	0
7.5 Heritage effects	0	0	0	0	0	0
7.6 Loss of town belt	0	0	0	-1	-2	-2
7.7 Ecological effects	0	0	0	0	0	0
7.8 Safety impacts	0	0	0	0	0	1
7.9 Impacts on residential amenity	0	0	0	0	0	-1
7.10 Localised urban centre commercial impacts	0	0	0	0	0	-1
7.11 Loss of parking	0	0	-1	-1	-2	-2
7.12 Traffic and transport effects	0	-1	0	-1	-1	-2

	2a	2b	3a	3b	4a	4b	4c	4ac	5a	5b	5c	5ac
7.1 Land take	0	0	0	0	0	0	0	0	0	0	0	0
7.2 Construction effects	-1	-1	-1	-1	-1	-1	-2	-1	-2	-2	-3	-2
7.3 Visual effects	0	0	0	0	0	0	0	0	-1	-1	-1	-1
7.4 Noise effects	0	0	0	0	0	0	0	0	0	0	0	0
7.5 Heritage effects	0	0	0	0	0	0	0	0	0	0	0	0
7.6 Loss of town belt	0	0	-1	0	-2	-1	-2	-2	-2	-1	-2	-2
7.7 Ecological effects	0	0	0	0	0	0	0	0	0	0	0	0
7.8 Safety impacts	0	0	0	0	0	0	0	0	1	1	1	1
7.9 Impacts on residential amenity	0	0	0	0	0	0	0	0	-1	-1	-1	-1
7.10 Localised urban centre commercial impacts	0	0	0	0	0	0	0	0	-1	-1	-1	-1
7.11 Loss of parking	-1	-1	-1	-1	-2	-2	-2	-2	-2	-2	-2	-2
7.12 Traffic and transport effects	0	0	-1	-1	-2	-1	-1	-2	-2	-2	-2	-2

8. Affordable / value for money

This objective reflects the cost of BRT, and the extent to which this is considered value for money.

Table 112 presents the scores assessed for each of this objective's individual criteria.

Table 112. Scores for criteria for 'Affordable / value for money'

	Ref case	1	2	3	4	5
8.1 Benefits	0	1	2	2	3	3
8.2 Capex	0	-1	-2	-1	-2	-3
8.3 Opex & maintenance	0	0	1	1	2	2
8.4 Rates impact	0	1	2	1	2	2

	2a	2b	3a	3b	4a	4b	4c	4ac	5a	5b	5c	5ac
8.1 Benefits	2	1	2	1	3	2	2	2	3	2	2	2
8.2 Capex	-2	-2	-1	-1	-2	-2	-2	-2	-3	-3	-3	-3
8.3 Opex & maintenance	1	1	1	1	2	1	1	1	2	1	2	2
8.4 Rates impact	2	2	1	1	2	2	2	2	2	2	2	2

9. Alignment / integration with other infrastructure & services

This objective reflects the extent to which BRT is aligned with the strategic plans and priorities of relevant councils and agencies, including other planned projects.

Table 113 presents the scores assessed for each of this objective's individual criteria.

Table 113. Scores for criteria for 'Alignment / integration with other infrastructure & services

	Ref case	1	2	3	4	5
9.1 Alignment with strategic documents (eg GOS, RLTP, LTP, Urban Growth Plan)	0	0	1	1	2	3
9.2 Alignment with specific projects (eg RONS, cycling)	0	-1	2	2	2	1

	2a	2b	3a	3b	4a	4b	4c	4ac	5a	5b	5c	5ac
9.1 Alignment with strategic documents (eg GOS, RLTP, LTP, Urban Growth Plan)	1	1	1	1	2	1	2	2	3	2	3	3
9.2 Alignment with specific projects (eg RONS, cycling)	2	2	2	2	2	2	2	2	1	1	1	1

Scores for each objective

The above scores are averaged for each objective, to derive scores for each objective.

Table 114 presents the scores for each objective.

Table 114. Scores for project objectives

	Ref case	1	2	3	4	5
1. Increased economic activity	0	1	2	3	3	3
2. Improved multi-modal network efficiency	0	0.8	1.6	2.4	2.4	2
3. Improved accessibility	0	1	2	3	3	3
4. Increased PT patronage	0	1	2	3	3	3
5. Improved PT user experience	0	0	1	1	3	3
6. Minimise emissions	0	0	0.5	1	1.5	1.5
7. Minimise impacts on physical environment / amenity	0	-0.1	-0.3	-0.4	-0.6	-0.9
8. Affordable / value for money	0	0.3	0.8	0.8	1.3	1
9. Alignment / integration with other infrastructure & services	0	-0.5	1.5	1.5	2	2

	2a	2b	3a	3b	4a	4b	4c	4ac	5a	5b	5c	5ac
1. Increased economic activity	2	1	3	2	3	2	3	3	3	2	3	3
2. Improved multi-modal network efficiency	1.6	0.8	2.4	1.6	2.4	1.6	2.4	2.4	2	1.4	2.2	2.2
3. Improved accessibility	2	1	3	2	3	2	3	3	3	2	3	3
4. Increased PT patronage	2	1	3	2	3	2	3	3	3	2	3	3
5. Improved PT user experience	1	1	1	1	3	1	3	3	3	1	3	3
6. Minimise emissions	0.5	0	1	0.5	1.5	0.5	1.5	1.5	1.5	0.5	1.5	1.5
7. Minimise impacts on physical environment / amenity	-0.2	-0.2	-0.3	-0.3	-0.5	-0.4	-0.6	-0.5	-0.8	-0.8	-0.9	-0.8
8. Affordable / value for money	0.8	0.5	0.8	0.5	1.3	0.8	0.8	0.8	1	0.5	0.8	0.8
9. Alignment / integration with other infrastructure & services	1.5	1.5	1.5	1.5	2	1.5	2	2	2	1.5	2	2

Appendix E Restrictions

This report has been prepared for the New Zealand Transport Agency (the Transport Agency), Greater Wellington Regional Council (GWRC) and Wellington City Council (WCC), to set out the indicative business case for Bus Rapid Transit in Wellington. This report has been prepared solely for this purpose and should not be relied upon for any other purpose. We accept no liability to any party should it used for any purpose other than that for which it was prepared.

This report has been prepared solely for use by the Transport Agency, GWRC and WCC and may not be copied or distributed to third parties without our prior written consent.

To the fullest extent permitted by law, PwC accepts no duty of care to any third party in connection with the provision of this report and/or any related information or explanation (together, the "Information"). Accordingly, regardless of the form of action, whether in contract, tort (including without limitation, negligence) or otherwise, and to the extent permitted by applicable law, PwC accepts no liability of any kind to any third party and disclaims all responsibility for the consequences of any third party acting or refraining to act in reliance on the Information.

We have not independently verified the accuracy of information provided to us, and have not conducted any form of audit in respect of the Transport Agency, GWRC and WCC. Accordingly, we express no opinion on the reliability, accuracy, or completeness of the information provided to us and upon which we have relied.

The statements and opinions expressed herein have been made in good faith, and on the basis that all information relied upon is true and accurate in all material respects, and not misleading by reason of omission or otherwise.

The statements and opinions expressed in this report are based on information available as at the date of the report.

We reserve the right, but will be under no obligation, to review or amend our report, if any additional information, which was in existence on the date of this report, was not brought to our attention, or subsequently comes to light.

We have relied on forecasts and assumptions prepared by the Transport Agency, GWRC and WCC about future events which, by their nature, are not able to be independently verified. Inevitably, some assumptions may not materialise and unanticipated events and circumstances are likely to occur. Therefore, actual results in the future will vary from the forecasts upon which we have relied. These variations may be material.

This report is issued pursuant to the terms and conditions applicable to our engagement letter dated 29 May 2014 and the change of scope letter dated 17 February 2015.