



City Rail Link

Business Case 2015

This document is AT's internal business case to facilitate the Gateway Review process prior to letting contracts for enabling works construction.

It is not a joint business case with government.



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Executive Summary

The City Rail Link (CRL) is Council's top priority project to help achieve the Government's aims for higher economic productivity and the Auckland Plan vision of Auckland being the world's most liveable city. It is a 3.45km rail link, largely in tunnel, from the current Britomart Transport Centre to the North Auckland (Western) Line at a redeveloped Mt Eden Station. It includes two new underground stations at Aotea and Karangahape Road.

Doubling rail capacity into the City Centre and providing two new stations in the heart of Auckland's economic hub, the CRL will enable the economic potential of the city to be released through ensuring access to employment/labour improves, will drive the productivity increases that New Zealand requires and will help shape its dominant city for a more sustainable future. It will close a significant gap in customer service levels - better matching public transport demand and supply. A core strategy for Auckland to address road congestion is to ensure growth in use of public transport meets or exceeds the travel needs of the underlying growth in population. The CRL will help achieve this by addressing a major capacity constraint in the Public Transport network allowing 20,000 more passengers to conveniently access the City Centre in one hour than would otherwise be possible.

The CRL will assist in achieving Government and Council objectives for the economy, and also for housing – by providing enhanced access to the Special Housing Areas (SHAs) and making affordable housing in outer areas more viable by providing effective transport options. The CRL is needed as Auckland's rapid population growth sees it increasing from some 1.5 million people to between 2.2 and 2.5 million in about 30 years. The CRL will be a section of the metro rail system where high capacity trains – Electric Multiple Units – can provide the means to move the large volumes of passengers associated with a city of this size.

Auckland's population growth will be partially met through development of dedicated new housing areas on the current fringes of the city. This will require public infrastructure estimated at over \$13 billion over the next 30 years. The CRL will facilitate significant transport oriented development, both planned (as in the development proposed around Mt Eden Station) and market-led as has occurred in Auckland as in other jurisdictions. This has the potential to mitigate some development on the city fringe in favour of more intensive development within the existing city.

The new central city station at Aotea will generate uplift in activity in that area - as Britomart has, closer to the waterfront. New and redeveloped stations at Karangahape Road and Mt Eden will support the economic and land-use changes planned in those areas. Significant development is expected in all the station precincts, valued in total at some \$1.2 – \$1.4b, adding patronage as well as possible income for the Council where the development occurs on its land holdings, a form of direct value capture.

The CRL is part of an integrated transport and land-use plan for Auckland alongside major investments that have occurred in motorway and arterial roads over recent decades. CRL builds on investments in rail upgrades that have seen patronage increases averaging 18% year-on-year for 12 years.

While further investment in the rail system will be needed beyond the CRL to maintain the growth and provide a truly world class railway, the CRL will provide a massive step change in removing a dead-end terminus at Britomart, where trains have to enter and reverse out on the only two tracks available – and similarly will remove the need for western line trains reversing at the second busiest station, Newmarket.

The rail service will be further integrated into the overall public transport system with bus routes re-worked to act as feeder services at suburban stations, reducing the numbers of buses in the City Centre from directions such as the west – and therefore allowing more bus services from other locations, including the north, that are not currently served by rail. In this way the CRL will provide indirect benefits to a wider area of Auckland than just the immediate rail catchments.

The CRL has an estimated benefit cost ratio (BCR) of 1.6 to 1.7, including wider economic benefits (WEBs) that relate to the expected economic uplift. The range using a variety of standard sensitivity tests for discount rate and evaluation periods is 1.2 to 3.3. If allowance were made for the desirable land-use changes that the CRL will catalyse (as is permitted in some Australian jurisdictions, for example), the monetised benefits would increase still further. The BCR is more than comparable to that achieved by similar city-shaping transport projects across Australasia – road and rail – using equivalent methodologies and economic parameters. Costs of these projects are typically high owing to the need for tunnelling to avoid unacceptable environmental damage. The BCR is equally robust against a cost range of +/- 20 per cent, which is appropriate for the current stage of development, giving a BCR lying between 1.3 and 1.9.

Given the CRL's relatively high costs as it is almost entirely underground, including the two new stations, the BCR demonstrates the high value of the benefits.

The escalated (dollars-of-the-day) capital (and property) cost of the CRL is \$2.5b. The operating and maintenance costs for the new tunnel and stations are estimated at \$50m per annum. It is anticipated that \$20m will be generated from fare revenue and that Council and the New Zealand Transport Agency (the Transport Agency) will jointly fund the remaining operating subsidy. As the CRL allows a major productivity benefit from shortening the route from the west to Britomart, additional EMUs are not immediately required for the CRL opening services. The shorter route means that the overall operating cost for the rail services should reduce.

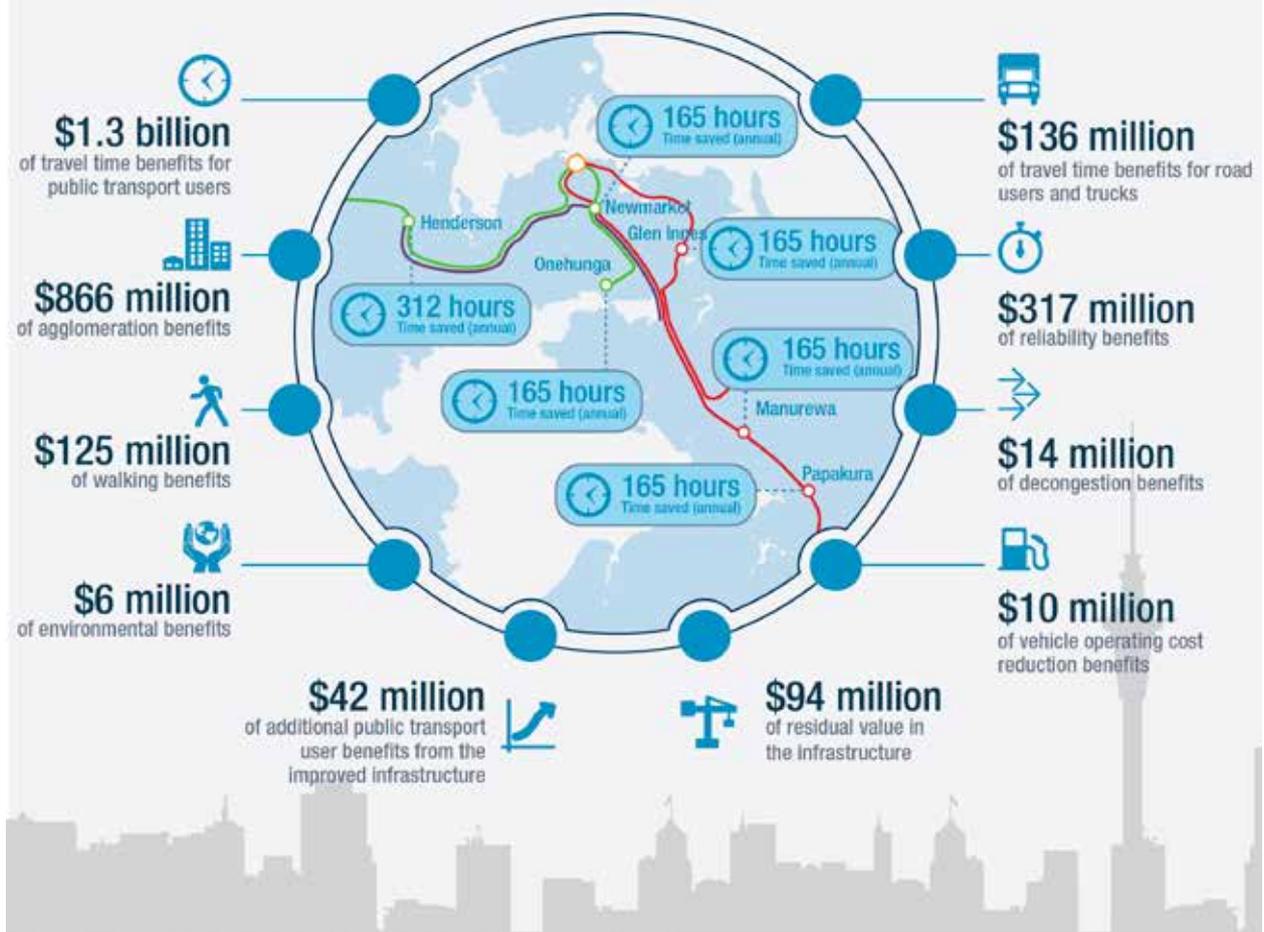
The project is rated High for Strategic Fit and High for Effectiveness in the AT Integrated Transport Programme prioritisation calculator, based on the Transport Agency ratings. EMU's services are unaffected by on-road congestion.

The CRL is the product of multiple studies and analyses that have consistently shown that it is the optimal investment to enhance access to the City Centre. Non-infrastructure options were explored and found not to be capable of providing the required economic and access benefits. Metro rail has the latent capacity required for a rapidly growing Auckland and its City Centre. The CRL will release that capacity. The route and design have been progressively refined to enhance value-for-money, while maintaining a customer focus.

Council's Long-term Plan provides certainty of Council funding, with a Government commitment for funding from 2020 - or earlier if certain conditions are met.

The City Centre Future Access Study (CCFAS) effectively constituted the indicative business case for the CRL with its thorough examination of options. Since its completion the pressure for the CRL has only increased with the very high rate of growth in rail patronage and with growing commitment to major development from the private sector which needs certainty on CRL construction and timing, including Precinct Properties' Downtown tower (which will build the CRL tunnel under its building) and a variety of other major developments planned adjacent to the route.

The City Rail Link is expected to deliver:



Annualised travel time savings for person trips from each representative station to Aotea Station.

1 Introduction

This document is a detailed business case for the CRL. It contains, at different stages of development, all five 'cases' in terms of the New Zealand Government Better Business Cases model¹. It also covers the requirements of the Transport Agency.

The five cases are:

- The strategic case – responding to the major economic and transport challenges for Auckland and showing the way that the CRL has a strategic fit with Government objectives and those of Auckland
- The economic case – describing the project and the extensive options analyses that have determined that the present solution is optimal. It includes the demand analysis and demonstrates the project is economically sound
- The financial case – giving the costs and confirming the funding for the project which is sufficient for decisions prior to Enabling Works contract awards
- The commercial case – largely procurement² relating to the Enabling Works and signalling future development for the main works
- The management case – demonstrating that there is strong governance and project management in place.

Finally the business case includes information on the consultation processes for the CRL – including with Mana whenua, and the CRL's role in helping to achieve greater sustainability.

1.1 CRL timeline

1.1.1 Initiation

In 2008, Auckland City Council made the Government aware of the intended redevelopment of the Downtown Shopping Centre by Westfield that would preclude the extension of the metro rail from its terminus at Britomart to the North Auckland Line as was contemplated in Auckland's formal transport planning documents.

In response, the then Minister of Finance, Hon Dr Michael Cullen, wrote to the Chair of the New Zealand Railways Corporation stating that it "was in the long term public interest to secure and protect the CBD tunnel route even though construction may not take place for many years" and advising that it was "appropriate for ONTRACK to assist in the protection of the CBD tunnel route by acting to protect the route at the earliest appropriate opportunity."

1 Infrastructure.govt.nz/publications/betterbusinesscases accessed 23 December 2014

2 At this time the section includes the indicative procurement strategy plus detail of the Enabling Works. Further development of the approach for the main works is programmed for the end of 2015

1.1.2 Preliminary Business Case

In 2009, the Auckland Regional Transport Authority (ARTA) and KiwiRail (KRG) (previously ONTRACK) commenced an investigation to designate a route for the CRL for inclusion in Auckland's District Plan.

A consortium of AECOM, Parsons Brinckerhoff and Beca (APB&B) was appointed by KRG and ARTA to identify the preferred route, prepare the concept design for the preferred option together with a business case to support the Notice of Requirement (NOR), and prepare the NOR documentation. A preferred option for the route was identified in early 2010 and approved by KRG and ARTA. This preferred option was endorsed by the Auckland Regional Council, Auckland City Council, and the Auckland Regional Transport Committee.

In November 2010, AT, Council and KRG released the findings of this work (the Initial Business Case) and forwarded these findings to the Government for its consideration.

1.1.3 Review of the Initial Business Case

The Minister of Transport asked the Ministry of Transport, (MoT) and Treasury, in conjunction with the Transport Agency, to review the Initial Business Case (the Review). The purpose of the Review was to formally assess the Initial Business Case and provide advice on the merits of the CRL as a transport and economic investment, and when the project might be required. The Review was also intended to assist in determining if, how and when to progress with the CRL. Management from AT and Council participated in the analysis undertaken for the Review, supported by APB&B and other advisors.

That Review was undertaken from December 2010 through to May 2011 with the report released on 31 May 2011. In the Review the MoT concluded that "there was a strategic case for lodging a notice of requirement and it would make good sense to proceed with it".

At the same time AT, Council and their advisers undertook a review of the economic evaluation of the project, concluding that "taking into account the wider transport policy initiatives which are planned, the City Rail Link would deliver overall benefits exceeding overall costs, with the benefit cost ratio ranging from 1.1 to 2.3." (Auckland City Rail Link Updated Economic Evaluation 20 May 2011, Auckland Transport/ Auckland Council May 2011).

On 28 June 2011 the Governing Body of Council resolved (Resolution number GB/2011/144):

- That the Council directs Auckland Transport to seek a designation for the City Rail Link.
- That the Council confirms Auckland Transport's financial responsibility for the Project, subject to Council funding being approved and available for any local share of the Project.
- That the Council and Auckland Transport will prepare draft agreed terms for a Heads of Agreement between Auckland Council and Auckland Transport, which sets out the basis upon which Auckland Transport will have financial responsibility for the Project.

1.1.4 Further investigations

On 20 July 2011, the Mayor of Auckland received a letter from the Minister of Transport, the Hon Steven Joyce, which requested a further CRL Review [to] include:

- "finalisation of the spatial plan and master plan including establishing achievable growth projections for the CBD
- demonstration of commitment to resolving current CBD access issues, for example by improving bus operations and addressing capacity issues
- evidence of rail patronage increases, particularly in the morning peak, residential intensification and CBD regeneration as a result of current investment
- beginning implementation of large scale residential developments along the rail corridors
- implementation of additional park and ride sites, and changes to bus feeder services."

A project team was formally established to progress the CRL on 1 November 2011. The Programme included progressing:

- The designation process
- Responding to the Minister's Letter

1.1.5 City Centre Future Access Study

The City Centre Future Access Study (CCFAS) was the agreed process across Auckland and government agencies to:

"Develop a robust and achievable multi-modal programme for transport into the Auckland City Centre, which considers a thorough analysis of alternatives and identifies the optimal mix of modes to meet demand. This should include consideration of the prioritisation and sequencing of projects".

In February 2012, new Minister of Transport, Hon Gerry Brownlee confirmed his comfort with the scope of the study and appreciated the close engagement of government officials whilst expressing some reservations as to the proposed time-line.

The study reported in December 2012. It established that the CRL was the optimal "headline" project, and that additional surface bus improvements were required.

CCFAS was effectively an indicative business case in terms of the Better Business Case stages. Whilst it included economic appraisal, the BCRs were relative not absolutes.

In July 2013, Minister Brownlee wrote to Auckland Mayor Len Brown, confirming that "government has committed to a joint business case for the City Rail Link with Auckland Council in 2017, and to providing its share of funding for a construction start in 2020." The letter also raised matters relating to future governance, determining of funding shares and circumstances that could trigger an earlier business case:

- Auckland city centre employment increases by 25% over current levels
- Annual rail patronage is on track to hit 20 million trips well before 2020.

1.1.6 Designation process

The requested designation process has proceeded. The NORs were lodged in August 2012, notified in January 2013 with hearings in August that year. The designation is now confirmed after appeal in 2015. Contracts for detailed design for the area from Britomart to Wyndham Street were let in mid-2015 and construction funding for this part of the project was approved by Council in its Long-term Plan (LTP). A start is scheduled before the end of the year.

1.1.7 Current business case

The current business case has been prepared to bring together the previous work with comprehensive Strategic and Economic cases that take full account of the changes that have occurred since earlier versions were prepared, notably the rapid increase in rail patronage and increased pressure for development in the City Centre. The initial Financial and Commercial cases are sufficiently developed for the immediate requirement of letting Council-funded construction contracts for enabling works and which will be further developed including a Gateway process ahead of the main works contracts.

1.1.8 Next steps

Further development of the business case, including the Commercial case with a focus on procurement of the main works will be carried out in 2015/16 including market sounding. The Financial case will also be developed further, including greater consideration of value capture opportunities.

1.2 Expert Advisors

In advancing and developing the CRL, AT has ensured that it has been advised and supported by expert consultancies. They include the Project's Principal Technical Advisor, a consortium involving Aurecon and Mott McDonald for the engineering design and Jasmac and Grimshaw for the architectural design. This consortium has been engaged by AT since early 2012. Through the course of the developing design, independent reviews have been undertaken by selected international experts. These have included geotechnical and construction reviews of proposed construction methodologies, strategic planning and delivery experts from Australian transport agencies. These inputs have helped influence the developing design to-date, and will continue at appropriate points through the programme.

Cost advisors RLB are leading a team for international rail cost experts in the management of the project costing activity. This work has been reviewed by construction programme cost experts Bond CM.

In the development of the business case, PwC and Melbourne Wider Economic Benefits specialists, SGS Economics and Planning, have advised on the Economics and Financial cases which have been peer reviewed by Mr Alex Sundakov. EY led the initial considerations of the procurement strategy, including drawing on their experience in Australia on such major rail projects as the North West Rail Link in Sydney.

1.3 Achievement of project objectives

Objectives for the CRL were adopted by the AT Board in 2012. The table below shows how the CRL achieves the objectives.

Figure 1- Achievement of project objectives

	Objective	Expected achievement
1.	<p>Improve transport access in and around the city for a rapidly growing Auckland</p> <p>a. Future proof for expected growth</p>	<p>By constructing the CRL, access to the City Centre will be greatly improved with 20,000 more trips able conveniently to reach the central area in one hour, than could otherwise have been achieved. Access times by rail improve dramatically from the west with the new direct route available via Mt Eden, Karangahape and Aotea stations to Britomart. All rail routes benefit from the better penetration of the City Centre and the enhanced frequencies and capacity possible. These increases are required to cater for Auckland's rapid growth.</p> <p>CRL will provide enhanced accessibility particularly for outer areas of Auckland where the higher speeds available from the additional metro rail services will generate large travel time benefits.</p> <p>Travel will be improved for rail trips that do not go to or from the City Centre, as higher rail frequencies will benefit all trips, including more convenient interchange with other modes, as envisaged in AT's Regional Public Transport Plan (RPTP).</p> <p>Not only can existing lines have higher service frequencies than would be possible without the CRL, but services for future network extensions can be accommodated.</p> <p>Enhanced post-CRL rail services will directly support the development of the strategic SHAs at locations such as New Lynn and Otahuhu Coast³ (while other areas will benefit from the integrated approach to transport and land-use of which the CRL is a part).</p> <p>Aotea Station is being designed to allow a potential future North Shore line to be accommodated with sufficient capacity for additional passengers both interchanging between lines and entering and leaving the station.</p>

³<http://www.aucklandcouncil.govt.nz/EN/ratesbuildingproperty/housingsupply/Pages/specialhousingareas.aspx> accessed 12 December 2014

2.	<p>Improve the efficiency and resilience of the transport network of urban Auckland</p> <p>a. Improve journey time, frequency and reliability of all transport modes</p> <p>b. Maximise the benefits of existing and proposed investment in transport</p> <p>c. Release the rail capacity constraint at Britomart</p>	<p>The CRL is a very effective productivity improvement for Auckland's transport network. The service efficiency will greatly improve by reducing the distance trains have to travel to serve the City Centre from the west and avoiding the highly inefficient reversing movement at Newmarket. As a result of the higher productivity of the rolling-stock, more services for more passengers can be provided without increasing the number of EMUs at CRL opening.</p> <p>The resilience of the system will increase by eliminating the high exposure to a single, terminating station at Britomart, as well as the rail system as a whole being a more reliable option for Aucklanders.</p> <p>Journey time will decrease and reliability increase on the rail system post-CRL, with flow-on effects to bus services some of which can become feeders for the trains. These changes avoid the need for the buses to be affected by congested inner Auckland and City Centre roads. The bus services that remain – for example those from the North Shore - will benefit from the road capacity released in the centre.</p> <p>A reduction in use of the roads by general traffic is expected, as some drivers elect to switch to public transport as it becomes faster and more reliable. Given the high level of congestion expected with Auckland's growing population, the expected reduction will provide significant travel time savings to continuing public transport users, those who change to become public transport users and to those who remain on the road network (including commercial vehicles). The latter save some 60 million hours of travel time over the 40 year assessment period.</p> <p>Pedestrians and cyclists will benefit from the better access to rail services and the opportunities that exist once the CRL is in operation, for example, to introduce the Victoria Street Linear Park and similar enhancements set out in the City Centre Masterplan. These measures are not possible without the higher capacity for travel post-CRL that allows road space to be reallocated away from general traffic.</p> <p>The CRL is particularly aligned to the objective of leveraging-off existing investment. As a result of recent and current investment by Government and Auckland's past and present councils in partnership, including double-tracking and electrification, the rail network has the potential to take on more of the transport 'heavy lifting' – provided the current limitations centred on Britomart are addressed. Rail is the only major mode with capacity actually or potentially available to better serve the growth in the City Centre, partly by increasing the productivity of the EMU services.</p> <p>The CRL, as designed, successfully releases the latent capacity at Britomart with an increase in service potential from a maximum of 20 inbound services per hour to 48 or ultimately even 60 with advanced systems – given that with the CRL services can be 'inbound' from two directions.</p>
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3.	<p>Significantly contribute to lifting and shaping Auckland's economic growth</p> <p>a. Support economic development opportunities</p> <p>b. Provide the greatest amount of benefit for cost</p> <p>c. Enable a more productive and efficient City Centre</p>	<p>The CRL is essentially an economic enabler providing the accessibility needed for Auckland's primary economic engine – the City Centre – to grow. The estimated Wider Economic Benefits (WEBs) equal some \$866m (NPV) – the quantified assessment of the agglomeration benefits generated by the CRL.</p> <p>The CRL is particularly able to lift economic activity as the underlying conditions for growth of the centre – a high level of demand, a supportive planning regime and local government at the appropriate scale⁴, are in place.</p> <p>The project is also expected to catalyse economic development at sites adjacent to the stations, in the same way that the Britomart Transport Centre has transformed the neighbouring area.</p> <p>The current assessed benefit-cost ratio for the CRL is in the range 1.6 to 1.7. In developing the project, multiple options have been considered both of different modes and alignments and station choices. Successive studies, including the City Centre Future Access Study (CCFAS), have shown that "a" city rail link offers the highest return of any option.</p> <p>Work to optimise the project has increased the benefits and lowered the costs compared to where they would otherwise be. Replacing the Newton Station with a redevelopment of Mt Eden Station is one major example of the multiple value enhancements introduced.</p> <p>The increased economic productivity that will result from the CRL is calculated in the WEBs; less tangible factors that will further lift productivity include all the public domain enhancements set out in the City Centre Masterplan, many of which are dependent on the transport network changes possible with the CRL.</p> <p>The increased efficiency of the City Centre is a direct result of the improvements in travel times and accessibility.</p>
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⁴Rudiger Ahrend (rudiger.ahrend@oecd.org), Emily Farchy, Ioannis Kaplanis and Alexander Lembcke, *What Makes Cities More Productive? Evidence on the Role of Urban Governance from Five OECD Countries, No 2014/5*, OECD Regional Development Working Papers from OECD Publishing. The paper finds that "cities with fragmented governance structures tend to have lower levels of productivity. For a given population size, a metropolitan area with twice the number of municipalities is associated with around six percent lower productivity; an effect that is mitigated by almost half by the existence of a governance body at the metropolitan level."

4.	<p>Provide a sustainable transport solution that minimises environmental impacts</p> <p>a. Limit visual, air quality and noise effects</p> <p>b. Contribute to the country's carbon emission targets</p>	<p>With an underground route from Britomart to Mt Eden, the direct environmental impact of the CRL is very low, especially for a project of its scale. Where there are impacts, they have been minimised through design and in accordance with the Notices of Requirements conditions. The visual impact of the stations relates to the entrances which are anticipated to enhance their urban settings with designs that reflect their locations and Mana whenua values.</p> <p>The electric trains which will use the CRL are significantly more sustainable, with lower carbon emissions than other potential solutions to the problem of restricted City Centre access.</p> <p>Attracting drivers from cars to public transport should also help to reduce carbon emissions. A further benefit is expected to come from increasing the proportion of residential development in townhouses and apartments close to stations as the improved rail travel accessibility makes such locations more desirable and therefore supportive of these more energy efficient, and therefore less carbon intensive, building forms.</p> <p>The project is targeted for an Excellent rating in the Infrastructure Sustainability Council of Australia (ISCA) rating scheme for the Design and As-Built certification phases.</p>
5.	<p>Contribute positively to a liveable, vibrant and safe city</p> <p>a. Enhance the attractiveness of the city as a place to live, work and visit</p> <p>b. Protect our cultural and historic heritage for future generations</p> <p>c. Help safeguard the city and community against rising transport cost</p>	<p>The CRL will help achieve a more liveable, vibrant and safe city directly through contributing to increased activity and through the opportunities provided for the City Centre Masterplan enhancements. Design elements at the stations are being planned to enhance the streetscape directly. Reinstatement of the public realm to a high standard following construction to improve the amenity is a requirement of the Notices of Requirement conditions, which will also contribute to the attractiveness of the city.</p> <p>Having an effective high capacity transport mode will assist in the success of special events in the city that draw large crowds.</p> <p>The project is being designed to take full account of, and to protect, the local historic features including the heritage bluestone wall and Martha's corner on Albert Street and the former Chief Post Office. Maori culture and heritage are being addressed through working with AT's Mana whenua group.</p> <p>The calculated benefits of the CRL demonstrate the scale of the savings for the community – valued at over \$3.1b, NPV.</p>

2 The Strategic Case – the problems and major challenges

2.1 The economic challenge

Relative to its OECD comparator countries, New Zealand has performed poorly economically for multiple decades. The economic performance, as defined, for example, by GDP per capita, is the major reason why New Zealand does not quite reach the top of the various inter-country comparisons (e.g. see Appendix 1 where New Zealand's ranking in the Global Competitiveness Report is summarised).

The recently published Thirty Year New Zealand Infrastructure Plan is focussed on the way that infrastructure can help address what it calls the "persistent productivity gap" (see Section 3.3).

Treasury, in its briefing to the incoming Government in October 2014⁵ (BIM), commented that: "New Zealand economy has performed well since the GFC and is currently experiencing strong growth. Despite this, New Zealand has experienced several decades of relative economic decline and a substantial income gap has opened up with other comparable countries. Much of this gap appears to be because New Zealand is uniquely small and remote. While it is important (and necessary) to get the fundamentals right, e.g. fiscal, macro, monetary, regulatory policy, this will not be sufficient to close the gap.

"A number of challenges will need to be overcome to achieve a successful economy in 2025, such as:

- Deeper connections into international flows of people capital ideas and trade
- A more knowledge-intensive economy and export mix
- Greater business expenditure on R&D
- Stronger environmental performance by our businesses, e.g. primary sector
- Improved outcomes for those currently underachieving, particularly Maori and Pasifika".

Treasury also provided a briefing document on what it saw as the medium-term opportunities and challenges for New Zealand's economic performance⁶. It states on page (iii) that:

"The key strategic challenge to increasing our prosperity is connecting internationally. The far-reaching economic reforms of the mid-to-late 1980s and the early 1990s have provided a strong foundation for economic growth. While New Zealand has significantly improved its economic performance since the early 1990s, income per person still lags behind the better performing advanced economies. Narrowing this gap will depend on boosting productivity and international connections – which are intertwined. A productive economy attracts international flows of goods and services, people, capital and ideas, and international connections boost productivity by bringing scale, competition, investment and ideas."

"In terms of sustainability, we see the key strategic challenge as moving towards the export and investment-led economic growth that would underpin living standards in the long-term. Continued improvements in the management of New Zealand's natural resources are important for the sustainability of our economic performance. While there is more to be done, the most pressing challenge to the sustainability of New Zealand's economic performance comes from the composition of economic growth."

5 Briefings to Incoming Ministers Information Release, Release Document November 2014 The Treasury 2014, page 5

6 Holding On And Letting Go - Opportunities and challenges for New Zealand's economic performance - A perspective from the Treasury, 2014

With respect to Auckland the paper states⁷:

“The advent of cheaper transport and communication technology has not meant the death of distance. Instead evidence suggests there may be increasing productivity benefits – known as agglomeration – from the concentration of economic activity in particular locations. This means that, as New Zealand’s international gateway and only global city, Auckland has particular importance for our international connections and productivity performance. Auckland provides transport and logistics links to the rest of the world, and has tertiary institutions, researchers, businesses and innovators linking New Zealand to global knowledge. The city is also home to a high percentage of overseas-born residents and a large number of companies (both domestic and foreign-owned) doing business internationally. While many of these features are not unique to Auckland, their role is likely to be enhanced if Auckland’s scale and density generate agglomeration benefits over time.”

2.1.1 Productivity

The Treasury message about poor productivity is supported by studies by the Productivity Commission⁸. The Commission’s research finding is of a generally poor productivity performance – both at the economy-wide and industry levels which is stated to underscore “the need for New Zealand’s policy environment to be strongly supportive of productivity growth and for firms to have a clear focus on improving productivity”⁹.

The research found that New Zealand is unique among OECD countries as both having weak productivity and not catching-up with its peers. The norm is that if productivity is poor there is ample scope to improve so some improvement over-time should be expected.

New Zealand does not match the paradigm.

Figure 2 – Aggregate labour productivity levels and growth rates compared



7 Ibid page 16
 8 Productivity by the numbers: The New Zealand experience Commission Research Paper 2013/01, September 2013
 9 Ibid, page 1

2.1.2 The economic potential of Auckland

Labour productivity in the Auckland region is estimated to have a premium of 30 to 50 per cent relative to the rest of New Zealand, with average labour productivity in Auckland's City Centre at least twice that of the rest of New Zealand (excluding the Auckland Region)¹⁰.

The expectation based on the literature is that a city of the scale of Auckland would demonstrate significantly higher incomes than other areas of the country and would effectively drive the national economy. While the former phenomenon applies, Auckland is not as dominant as would be expected – partly because the most productive area in the country, the City Centre is relatively small¹¹. A critical factor in allowing the City Centre to grow is access.

The CRL, in part therefore constitutes a response to the long history of concern that the Auckland region does not perform as well as it might as New Zealand's largest city and one of comparable scale to Australia's secondary cities of Brisbane, Perth and Adelaide (and which might also be expected to compete with Sydney and Melbourne in some areas). Auckland's economy needs to perform better if New Zealand's economy is to grow strongly and consistently.

Concerns with regard to the scale and performance of the Auckland economy are explicitly recognised in the Auckland Plan; see Section 3.5.

Further discussion in relation to Auckland's economy is included in Appendix 1.

¹⁰ Population and Growth: why bigger can be better, Rachael Logie – Senior Economist, Auckland Council, Auckland, Economic Quarterly, January 2013 – citing Maré, D C. : Labour Productivity in Auckland Firms, Motu Working Paper 08 - 12 (and MED Occasional paper

¹¹ Auckland Plan, page 80

2.2 Auckland’s transport challenges

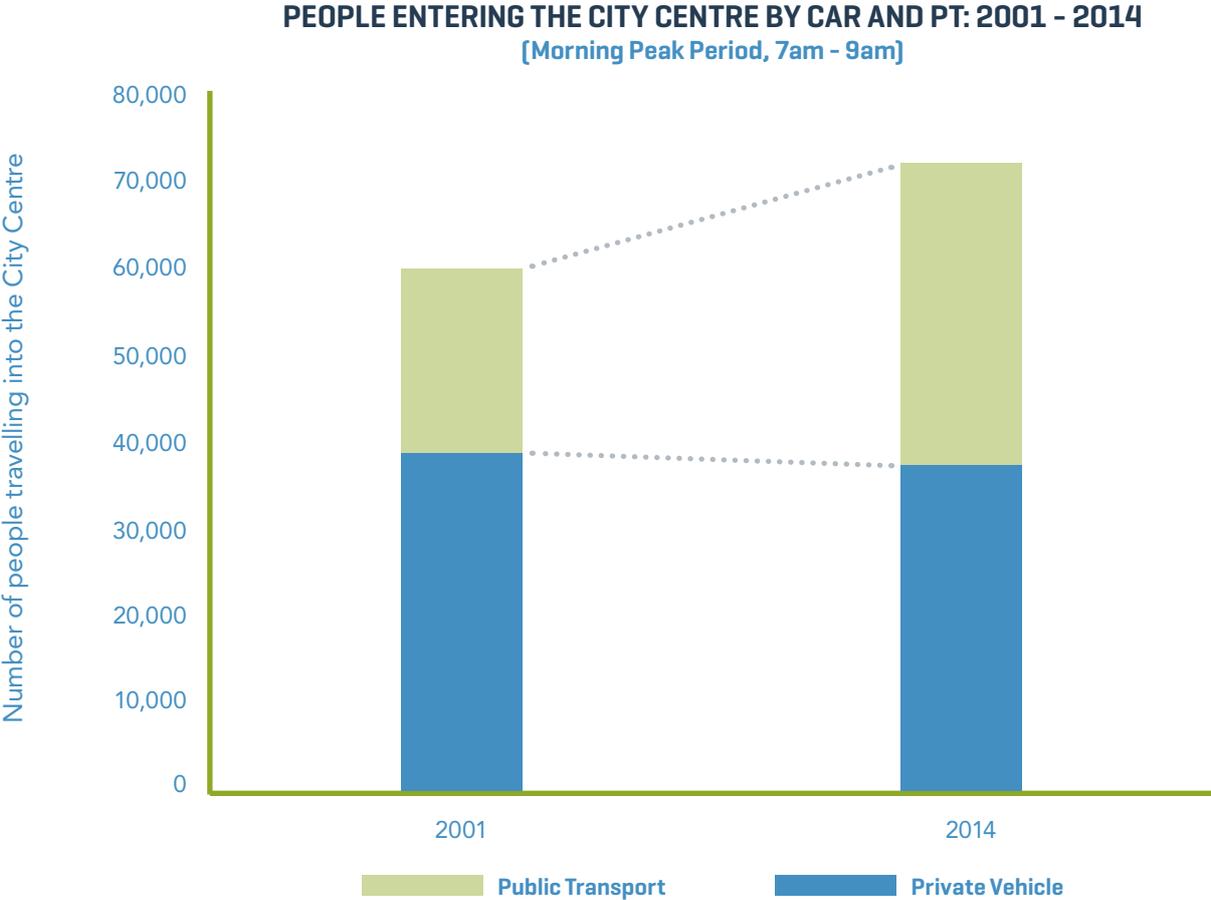
The needs and expectations of the transport system in Auckland have been assessed in multiple studies. A thorough strategic review was carried out for the initial Integrated Transport Programme¹¹ (ITP), prepared jointly by AT and the New Zealand Transport Agency (Transport Agency) in 2012 with input and support from Council. The ITP’s purpose is to coordinate the investment and other activities of the transport network providers.

The analysis for the ITP showed that from 2021, congestion in Auckland is expected to significantly worsen, as road capacity increase slows and population growth starts to outpace infrastructure investment. With Auckland’s rapidly growing population, the demand for travel over the next 30 years is expected to increase by around 50 per cent, for person trips, while numbers of freight and commercial trips are expected to more than double.

The ITP identified that despite network improvements underway, average variability in journey times would still be significantly higher in Auckland than in any of the five big Australian cities. Auckland compared well on inter-peak congestion but peak congestion levels were shown to be on a par with Sydney and Melbourne which have populations over four million.

A core strategy for Auckland to address road congestion is to ensure growth in use of public transport meets or exceeds the demands from underlying growth in population. The CRL will help achieve this by addressing a major capacity constraint in the Public Transport (PT) network. The approach has been successful in the past in increasing the numbers entering the City Centre – with a flat-line in numbers of cars far more than compensated for by an increase in public transport use.

Figure 3 Mode for entry into the City Centre, 2001 and 2014

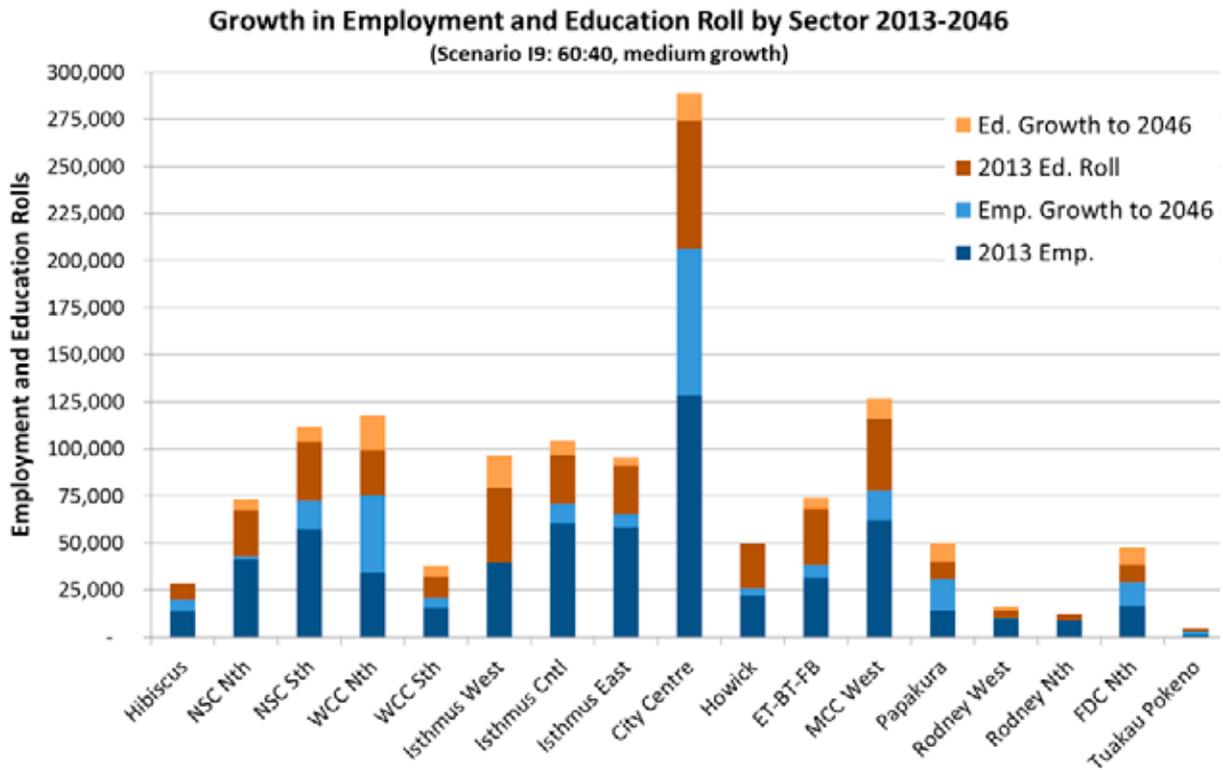


12 2012 – 2041 Integrated Transport Programme AT, June 2012

2.2.1 Growth trends

Figure 4 shows the anticipated growth in education and employment. Of particular note is the increase in the numbers in the City Centre, showing its expected increasing importance.

Figure 4 Growth in employment and education 2013-2046



2.2.2 Public transport

Auckland’s public transport network was shown in the ITP to have substantial shortcomings. The Rapid Transport Network (RTN) was identified as being limited by the capacity of Britomart station and the wider rail network and the limited extent of the Northern Busway. The existing network of bus routes was seen to be overly complex with a number of routes operating at too low a frequency to be attractive to customers. The New Network¹³ is now addressing this deficiency of the bus network.

13 <https://at.govt.nz/projects-roadworks/new-public-transport-network/>

2.2.3 City Centre issues

A deficiency analysis was undertaken for the joint Government/AT City Centre Future Access Study (CCFAS)¹⁴. This analysis identified shortfalls in transport network capacity when compared to demand on the network.

The deficiency analysis focused on the extent to which planned transport infrastructure developments both to public transport services and highway capacity, would cater for land use growth with the aim of identifying the particular issues or opportunities relating to the City Centre that would need to be addressed through a project such as CRL, or alternatives.

Balanced reference case¹⁵ model outputs were used as the basis of the deficiency analysis as they represented the best estimate of the state of public transport and highway systems in Auckland in future years, without any of the possible options being studied in the CCFAS itself. The deficiency analysis identified that demand for public transport services would exceed capacity by a significant degree for both 2021 and 2041.

Appendix 1 contains additional details of the analysis and findings.

2.2.4 Rail network – constraints and opportunities

The fundamental constraint that applies to the Auckland rail network is the maximum train frequency at the Britomart Transport Centre (BTC). With only two lines feeding the five platforms in this terminal station the maximum planning capacity is 20 trains per hour¹⁶. With six trains on each of the main lines in the peak – southern, eastern and western – and two trains per hour on the Onehunga line, the peak period capacity is fully taken up without the CRL.

Further constraints on the rail network at critical junctions and between Wiri and Westfield are planned to be addressed in parallel with CRL construction. These are identified within the Regional Land Transport Plan (RLTP) although funding remains uncertain.

AT with KRG prepared an initial Auckland Rail Development Implementation Pathway (Pathway) in 2014 which identified a long term capital programme to improve network capacity, performance and resilience. The Pathway was submitted to the AT Board in September 2014. The Pathway is currently being refined and developed by AT and KRG to provide a long term plan for rail in Auckland. One of the key drivers for the plan is to ensure that there is integration with CRL works and to ensure that the entire rail network is capable of reliably supporting the CRL and planned freight service levels.

Rail patronage has been growing rapidly in recent years. If the trend were to continue the rail network could be carrying 20m passengers per annum – which the Government has identified as one trigger for investing in the CRL¹⁷ – as soon as 2017.

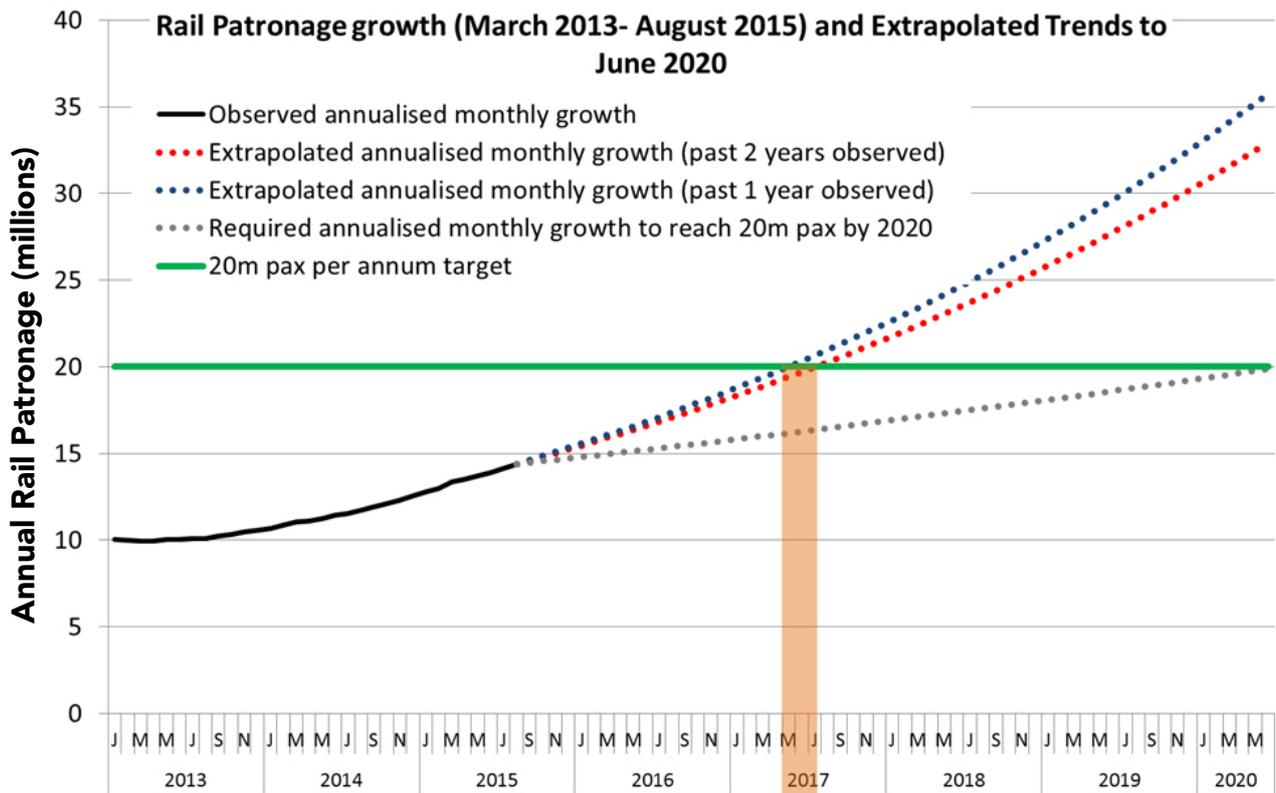
14 City Centre Future Access Study (CCFAS), Auckland Transport December 2012

15 The balanced reference case was developed following the deficiency analysis to provide a more “realistic” reference point than the initial reference case, based on bus volumes that could be provided without the need for large-scale infrastructure within the City Centre. It contained significantly greater improvements to the regional transport network than would normally be included in a traditional “base case”.

16 CCFAS, op cit

17 <http://www.transport.govt.nz/assets/Uploads/Rail/annex-a-city-rail-link-monitoring-report.pdf>

Figure 5 Rail Patronage growth



Once the principal constraint has been addressed, with the CRL turning Britomart into a through station, it will be possible to run up to 24 services per hour, each way, through the Link, with initial plans for 18 services per hour in the peaks. Ultimately, advanced systems and further investment might see that figure rise to 30 services per hour. This means that the expected rapid increase in patronage as the railway progressively takes a greater share of demand with other modes being highly constrained, can be responded to with additional train services.

The Auckland Plan identifies the desirable rail network extensions¹⁸. It sets out a decade by decade programme of transport improvements, with further major rail proposals, aside from CRL, such as to the Airport and North Shore.

¹⁸ Auckland Plan, op cit, Chapter 13,

2.3 Auckland Transport strategic themes

Auckland Transport has developed five strategic themes to drive the delivery of the transport components of the Auckland Plan. The themes are:

- Prioritise rapid, high frequency public transport to achieve the Auckland Plan outcome of moving to outstanding public transport.
- Transform and elevate customer focus and experience by delivering road, public transport, cycling and walking services which are user friendly, customer oriented, and meet the needs of the people of Auckland.
- Build network optimisation and resilience to get better value out of our existing services and assets and be resilient against future shocks (e.g. oil price changes), changing travel patterns and demands and natural events (e.g. flooding).
- Ensure a sustainable funding model to create certainty for maintaining and renewing our assets, improving service levels incrementally and adding additional capacity to the transport system to meet the needs of future growth.
- Develop creative, adaptive, innovative implementation of AT's services, programmes and new projects.

AT's strategic themes (see Figure 6 below) align with Auckland Plan transport outcomes as shown in Figure 7 following. The CRL strongly supports the themes.

Figure 6- Auckland Transport's strategic themes and the Auckland Plan strategic directions

Auckland Plan strategic directions					
	Increased access to a wider range of quality, affordable transport choices	Auckland's transport system moves people and goods efficiently	Auckland's transport system enables growth in a way that supports communities and a high-quality urban form	Reduce adverse effects from Auckland's transport system	Better use of transport investment
Prioritise rapid, high frequency public transport	Strong	Moderate	Moderate	Minor	Strong
Transform and elevate customer focus and experience	Strong	Minor	Moderate	Strong	
Build network optimisation and resilience	Moderate	Strong	Minor		Minor
Ensure a sustainable funding model					Strong
Implement accelerated, adaptive, innovative solutions	Strong	Moderate	Moderate	Strong	Moderate

Figure 7- AT's strategic themes to implement the Auckland Plan



Strategic Themes to implement the Auckland Plan

STRATEGIC THEMES

Prioritise rapid, high frequency public transport

- RTN and FTN routes/innovation
- LRT Programme
- Road hierarchy programme
- Integrate active modes

STRATEGIC THEMES

Transform and elevate customer experience

- Branded services
- Customer centric culture
- Digital information
- Way-finding
- Facilities and place making
- Model choices
- Integration of transport for customer experience
- HOP entertainment
- Loyal by recognition

STRATEGIC THEMES

Build network optimisation and resilience

- One network/system
- Commercial Productivity
- Route optimisation
- Network options
- Transport development
- Real time information
- Congestion management
- Network resilience/feasibility
- Integrate active transport

STRATEGIC THEMES

Ensure a sustainable funding model

- Commercial partnering
- Business improvements
- Diversified revenue sources
- Asset optimisation/AMP
- Disposal/usage/development of surplus assets
- Internal costing
- Procurement models
- Legislative issues

STRATEGIC THEMES

Develop creative, adaptive, innovative implementation

- Technology partnerships
- Digital data experience
- Shared facility plan
- Innovation HUB
- Academic partners
- Innovative

3 The Strategic Case

– consistency with adopted strategies

3.1 National and Auckland strategies

This section looks first at the national level strategies, for building economic productivity, infrastructure and transport. The discussion shows that the CRL is either part of the national level strategy or supports it very well.

The second area reviewed is the degree to which Auckland-specific strategy has been established and the importance of the CRL for Auckland. Auckland has planned its strategy carefully in the form of the statutory Auckland Plan linking planning for the economy, environment and social development. The CRL is a core project in the Plan and is identified as a critical enabler of economic growth for Auckland and the nation.

The CRL is an integral component of two specific subject-related plans, the City Centre Masterplan and the Regional Public Transport Plan (RPTP).

Additional information relating to the strategies and how CRL relates to them are contained in Appendix 2.

3.2 The Government's Business Growth Agenda

The Business Growth Agenda (BGA) is central to the Government's plan to help achieve a more competitive and productive economy. The 2014 report¹⁹ is the most recent update. It states that "the Government has set four key priorities to deliver a stronger and more prosperous New Zealand...lifting productivity and competitiveness is critical to creating business opportunities, more jobs and higher wages, and ultimately the higher living standards to which New Zealanders aspire". (p. 9).

Under the Building Infrastructure heading, the BGA notes that "efficient rail hubs, air and sea ports play a key role as part of an integrated transport network. This includes making a commitment to a joint business case for the Auckland City Rail Link in 2017 and providing our share of funding for a construction start in 2020." (p. 108).

3.3 The Thirty Year New Zealand Infrastructure Plan (Thirty Year Plan)

The Government's third iteration of an Infrastructure Plan²⁰ was published in August 2015 by the Treasury's Infrastructure Unit, on behalf of the Government. In his Introduction, Minister of Finance, Hon Bill English, states (p.4): "the Plan reaffirms the Government's long-term vision that New Zealand's infrastructure is resilient and coordinated and contributes to a strong economy and high living standards".

Like other Government documents, the Thirty Year Plan emphasises the need to support a higher level of productivity: "we need to address a persistent productivity gap to make sure our businesses remain competitive on the world stage. Infrastructure will play a key role in lifting productivity and ensuring we can take advantage of opportunities in the global economy" (p. 7). It cites projections of economic growth with a lower rate of productivity growth so that "we will need larger productivity gains which more effective infrastructure can contribute towards" (p. 15).

19 The Business Growth Agenda: Future Direction 2014, New Zealand Government

20 The Thirty Year New Zealand Infrastructure Plan, New Zealand Government, 2015

The Thirty Year Plan also identifies that the growing economy will create pinch-points, stating that “between now and 2045 the pinch-points of growth will be felt most predominantly in Auckland which is forecast to grow by another 716,000 people over this time” (p. 7). In the Section “Focus on Auckland” (p. 41), the CRL is included as a major public transport improvement project to support future growth.

Analysis of CRL’s compatibility with the more extensive 2011 National Infrastructure Plan is contained in Appendix 2.

3.4 Alignment of CRL with NZ Government transport strategies

This section highlights the aspects of the Government transport strategies that are most relevant for the CRL and this business case and how the CRL is expected to perform against the Government’s stated objectives and policies.

3.4.1 Connecting New Zealand

Connecting New Zealand²¹ is a summary statement of the Government’s policy direction. It includes the Government’s overall objective:

3.4.2 Government’s overall objective for transport

“The government is seeking an effective, efficient, safe, secure, accessible and resilient transport system that supports the growth of our country’s economy, in order to deliver greater prosperity, security and opportunities for all New Zealanders.”

CRL contribution

The CRL is expected to be a major contributor to economic growth in Auckland - and New Zealand more generally. It will contribute to an effective and efficient transport system for Auckland – effective, in that it will help provide necessary transport capacity into the City Centre and efficient, as it will make use of latent capacity on the rail network with benefits exceeding the costs.

Further assessment is again in Appendix 2.

3.4.3 Government Policy Statement on Land Transport

The Government Policy Statement on Land Transport Funding²² (GPS) expands on the content of Connecting New Zealand. The December 2014 document (which took effect from 1 July 2015) specifies the Government’s Strategic Direction and National Land Transport Objectives and Results.

3.4.4 Strategic direction

The GPS specifies the Government’s Strategic Direction as “To drive improved performance from the land transport system by focussing on:

- economic growth and productivity
- road safety
- value for money.”

3.4.5 Economic growth and productivity

The GPS states that it maintains the direction of putting “wealth generating capacity of our economy at the top of the agenda” and will do so by “continuing the focus on lead investments that will materially reduce the cost of doing business”.

21 Connecting New Zealand – A summary of the government’s policy direction for transport, Ministry of Transport 2011

22 Government Policy Statement on Land Transport 2015/16-2024/25 December 2014

CRL alignment

The CRL is very much a “lead investment”. As demonstrated in this business case the major purpose of the CRL is as an economic intervention, providing transport capacity to enable the top wealth creating location in New Zealand to grow.²³

3.4.6 Road safety

Road safety remains a priority for the Government.

CRL contribution

The CRL has a role in assisting road safety through providing an alternate mode that will attract some traffic from the roads. With limited opportunity to expand road capacity into the City Centre the CRL provides additional capacity on a mode with generally good safety records.

3.4.7 Value for money

The funds available need to be used in a way that deliver the best possible value to New Zealanders.

CRL alignment

The CRL is shown to provide benefits that significantly outweigh the costs including appreciable Wider Economic Benefits.

The CRL will take advantage of the potential capacity in the rail network now available after with electrification (including the introduction of new electric trains), and which is currently limited by Britomart. Compared to other theoretical ways to increase capacity into the City Centre, the CRL will not require substantial additional complementary network changes as would an attempted bus-based solution, for example.

The options analyses discussed in Section 4 provide more detail of the alternatives examined.

The CRL is a priority in Auckland, as it could be for New Zealand, owing to its substantial economic facilitation role.

3.4.8 Auckland

The GPS specifically refers to Auckland growth and requirements²⁴:

Much of New Zealand’s population growth is likely to continue to be centred in Auckland. Achieving an effective and efficient transport system for Auckland is central to improving the city’s contribution to the national economy.

23. Since 2009, the Government has undertaken a major programme of investment in Auckland’s transport infrastructure. This investment is delivering significant results, helping to hold congestion steady despite population growth.

24. Over the next 20 years, Auckland’s population is expected to increase by 480,000, an amount roughly equal to the current population of Wellington. The additional demand for travel from this growth will put even more pressure on Auckland’s transport network. Sound land use policy, public transport investment and demand management will play a role in shaping demand. Private vehicle travel is still expected to account for around three-quarters of peak period trips.²⁴

25. Further increases in the capacity and productivity of the Auckland roading network, particularly those sections currently experiencing severe delays, will therefore remain a priority. This will involve ongoing investment in State highway and local road productivity across the network. This will need to be complemented by significant investments in public transport. Initially this would help unlock the potential created by recent initiatives. Later, further investment will be needed to provide additional capacity on corridors serving our main business and education centres at peak periods.

23 Ibid, page 15

24 Ibid page 7

CRL approach

The CRL is an integral element of the Auckland Plan (the spatial plan) and of the ITP. These documents allow for investment both in highways and public transport. The CRL is an example of a required “significant investment in public transport” that will build on the opportunity provided by the recent initiatives, such as electrification and double-tracking.

3.5 The Auckland planning framework

Figure 8 - The Auckland Planning framework



Auckland has a comprehensive planning framework with the statutory Auckland Plan²⁵ at its apex. The CRL is also important for the Masterplan, the ITP and the statutory RPTP and RLTP. Detailed information on CRL and its importance to the Auckland Plan, the Masterplan, ITP, RPTP and RLTP is provided in Appendix 2. The structure is shown in Figure 8.

The inclusion of the CRL in Council's Long-term Plan (LTP) is covered in the Finance Section 10 and the Benefit Realisation Section 18.

3.6 The Auckland Plan and economic development

3.6.1 Economic development

The Auckland Plan takes as a given that a strong economy that delivers opportunities and prosperity for everyone results in a better quality of life for all and that continuing disparities and high unemployment inflict huge personal cost on those who are disadvantaged and on society as a whole²⁶.

The Plan emphasises required improvements in accessibility to the City Centre, as Auckland's largest economic hub, particularly through public transport²⁷.

3.7 The Auckland Plan - Transport

3.7.1 CRL in the Auckland Plan

The Auckland Plan specifies the CRL as "the top priority transport project for Auckland, with a targeted date to become operational in 2021."²⁸

The Auckland Plan nevertheless states that the "planning of major projects requires rigorous analysis of all costs and benefits. Projects will only proceed if they demonstrate value for money and contribute to the outcomes sought for Auckland and/or New Zealand. This process will also help prioritise the timing of the projects²⁹". This business case represents that rigorous analysis for the CRL.

3.7.2 The City Centre Masterplan

The Masterplan³⁰ is a non-statutory supporting document to the Auckland Plan setting out the preferred direction and priorities for the City Centre. The Masterplan states that the top public transport priority is the CRL as it is "vital to transform the City Centre and support growth of organisations such as the universities"... "and will be implemented in a way that encourages city centre development in the right place at the right time".

"The City Rail Link is our opportunity to create highly accessible city precincts – or growth nodes – around the existing and new (Aotea, Karangahape Road and Newton³¹) City Rail Link stations."

Appendix 2 provides additional discussion of the Masterplan and the expected benefits of the CRL and its new stations.

25 The Auckland Plan, Auckland Council, March 2012

26 Ibid, page 80

27 Ibid, page 120

28 Ibid, page 324

29 Ibid, page 332

30 City Centre Masterplan, Auckland Council, 2012

31 Now Mt Eden

3.8 The Auckland Regional Public Transport Plan

The Auckland RPTP 2013³², prepared by AT, is a statutory document that describes the public transport network that AT proposes for the region, identifies the services that are integral to that network over the next 10 years, and sets out the policies and procedures that apply to those services.

The RPTP states that the priority investment for the first decade is the CRL as it will provide a dramatic increase in the capacity and effectiveness of the public transport system³³. It notes that the CRL will result in a more cost-effective use of the whole rail network by removing the bottleneck at Britomart, in the same way that investments in the motorway network have progressively removed bottlenecks and increased the efficiency of the state highway network.

As noted in the RPTP, its creation was subject to extensive consultation with public feedback being 'overwhelmingly positive'³⁴.

The RPTP had a limited update in 2015 in relation to the potential introduction of Light Rail Transit and integrated zonal fares.

3.8.1 The Auckland Regional Land Transport Plan 2015-2025

The RLTP notes that "The City Rail Link will commence in the first three years of this plan" and that it is "an example of the sort of bold project needed to unlock Auckland's potential"³⁵.

3.9 Special Housing Areas

Council and the Government have been working closely together to advance the availability of housing in Auckland. The Special Housing Areas (SHAs) include some 14,000 potential sites³⁶ that are adjacent to the rail network (either in walkable distance or with convenient park-and-ride), and for which the CRL will allow enhanced service.

Council and the Government want more homes to be delivered faster³⁷. New housing legislation (Housing Accords and Special Housing Areas Act) is in place to allow the Council to identify SHAs to quickly free up land in existing urban areas and new areas for homes. Development of new sites and homes in these areas will be 'fast-tracked' through the planning process.

SHAs aim to:

- ensure that critical infrastructure, such as water, stormwater, wastewater and transport, is planned and delivered in the same place at the same time
- deliver more homes and require more affordable homes for Auckland families and first-time buyers without compromising quality
- fast-track consents and plan changes
- contribute to achieving the target of 39,000 new homes or new sites to be consented over the next three years.

Enhanced post-CRL rail services will directly support the development of the strategic SHAs at locations such as New Lynn and Otahuhu Coast (while other areas will benefit from the integrated approach to transport and land-use of which the CRL is a part).

32 Auckland Regional Public Transport Plan 2013, AT, adopted November, 2013

33 Ibid, page 27

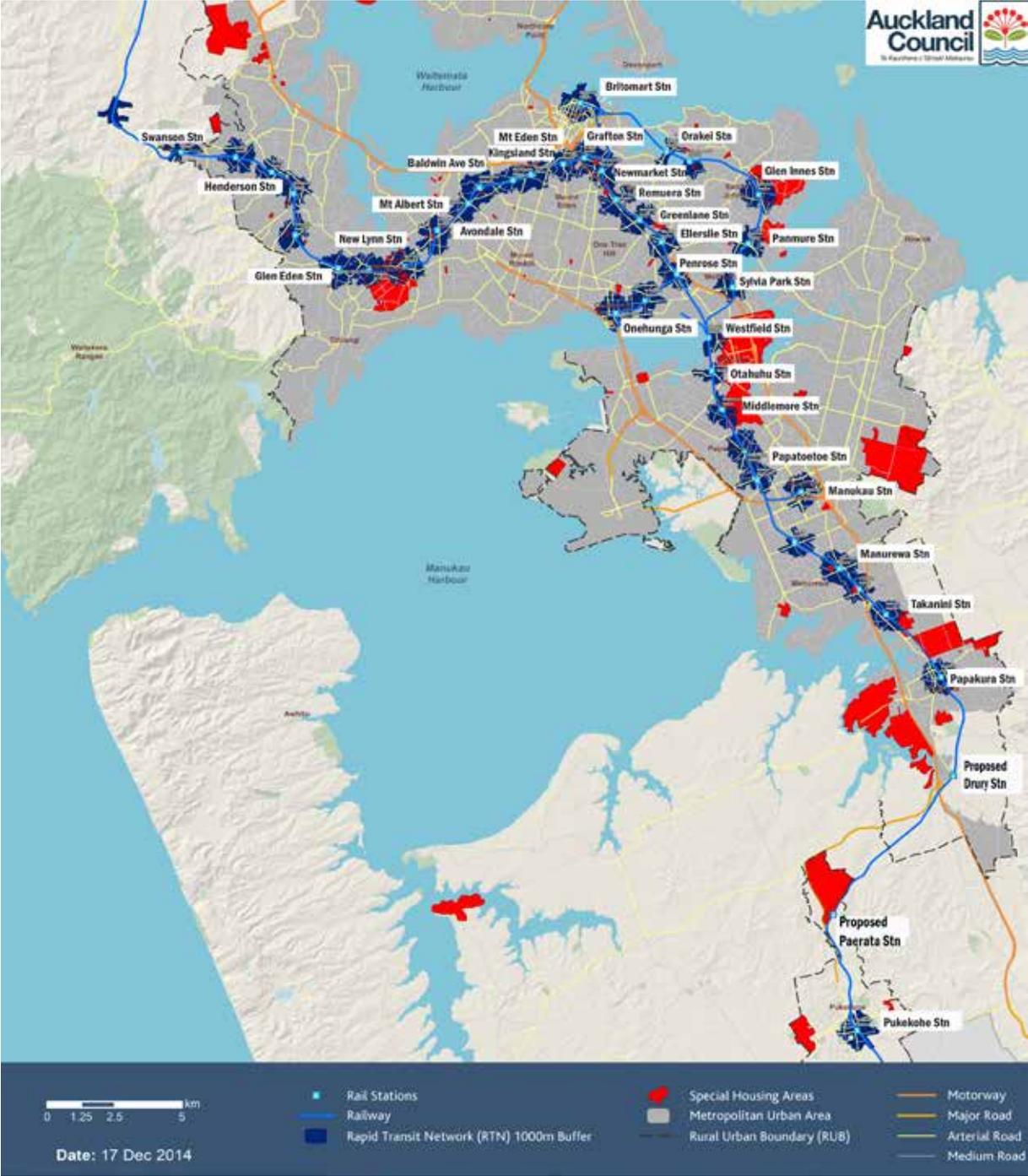
34 Ibid, page iv

35 Auckland Regional Land Transport Plan (RLTP), 2015 - 2025, Auckland Transport, August 2015, page 8

36 Council calculations

37 Special Housing Areas fact sheet, Council, undated

Figure 9- Special Housing Areas



The CRL will also help to serve the Spatial Priority Areas³⁸ that are designated for development and intensification, most of which straddle the rail corridors.

38 RLTP, op cit, pages 79, 80

4 The Economic Case - strategic options analysis

4.1 Developing the CRL as part of the metro rail system

Whilst the idea of a high quality rail system for Auckland has existed for many years, the precise form has only been established through progressive study and evaluation of options. Auckland has been consistent in pursuing a package approach of a more intensified urban form and a boost to public transport, as the repeated technical assessments have shown that only such a package can hope to achieve balanced economic, environmental and social goals.

The regional land transport strategies from 1995³⁹ and 1999⁴⁰ confirmed rail as a core mode for Auckland. In 2003 a consortium of the Auckland Regional Council, Auckland Regional Transport Network Ltd (ARTNL) and Infrastructure Auckland developed the Auckland Passenger Rail Upgrade Project draft business plan⁴¹. The business plan made the case for an improved, sustainable regional metro rail system as part of a transport network that included road-based public transport and ferry services.

4.2 Determining the preferred rail mode

The 2003 study determined the preferred rail mode for the public transport spine south of the Waitemata Harbour. It looked at a variety of 'rail' modes, including metro rail (either EMU or Diesel Multiple Units (DMUs), light rail (LRT) and busway. It confirmed metro rail (EMUs) as the preferred mode taking account of fit with regional growth objectives, societal objectives, economic attractiveness and risk.

In 2006 the Auckland Regional Transport Authority (ARTA) developed a business case to look at the preferred form of rapid transit for Auckland⁴². The business case re-tested various forms of rail development varying by target frequency, different power (diesel or electric) and suburban or city centre-focused intensification. The study also considered the option of a 'do minimum', i.e. retaining the rail system largely as it was or exiting rail with the introduction of greater bus priority and additional busways to replace the trains.

Projects such as 'the Britomart CBD loop tunnel' were considered to be potential longer-term enhancements to be considered at an indicative level and in sensitivity testing.

The business case, which confirmed the case for electrification, was the subject of rigorous examination in conjunction with central Government – the Auckland Transport Strategic Alignment Project (ATSAP)⁴³.

39 Auckland Regional Land Transport Strategy, Auckland Regional Council, 1995

40 Auckland Regional Land Transport Strategy, Auckland Regional Council, 1999

41 Auckland Passenger Rail Upgrade Project draft Business Plan, The Boston Consulting Group, May 2003

42 Core Network Upgrade Development Plan Technical Papers Volume 1 Business Case, Auckland Regional Transport Authority, August 2006

43 <http://www.treasury.govt.nz/publications/media-speeches/media/20apr07-at>

4.3 Confirmation of the CRL within the rail strategy and programme

The Auckland Regional Land Transport Strategy 2010⁴⁴ specifically included constructing the CRL by 2021 and further increasing frequencies and capacity.

ARTA included the CRL as a priority in the Regional Land Transport Programme:

“CBD Rail Tunnel - the decision to electrify the rail network has allowed work to begin on protecting and constructing the CBD rail tunnel. Once completed, the CBD rail tunnel will allow higher train frequencies across the entire rail network, as well as providing new stations in the heart of the CBD and facilitate future rail extensions, such as to the airport. Overall, this project will increase the accessibility of the CBD, New Zealand’s largest concentration of economic activity, to more than half a million people within 30 minutes’ travel time by rail, which is completely free of road congestion.”

4.4 CRL in the 2012-2041 Integrated Transport Programme

The Integrated Transport Programme (ITP) was prepared in 2012 by AT to coordinate the investment and other activities of transport network providers to ensure they respond effectively and efficiently to the strategic vision, outcomes and targets of the Auckland Plan, and to the Government’s wider transport policies.

The ITP states that the “CRL will allow more cost-effective use of the whole rail network by removing the bottleneck at its centre (Britomart), in the same way that the investments in the Central Motorway Junction, the Victoria Park Tunnel and the Waterview Connection have been progressively removing bottlenecks and increasing the efficiency of the state highway network. This key project will enable a dramatic increase in the rail network’s capacity, reach and service frequency during the second decade of the plan period, and make the use of public transport a more viable choice for greater numbers of customers”.

The ITP states that the CRL is the key transport project within the City Centre⁴⁵ - whilst acknowledging that it also unlocks the potential of the entire region’s public transport system. The ITP comments that the increased investment, particularly the CRL, gives public transport the ability to carry far more people.

The CRL is rated High for Strategic Fit and High for Effectiveness in the Integrated Transport Programme prioritisation calculator, based on the Transport Agency ratings.

The Transport Agency Board, at its meeting on 3 May 2013, resolved to support the Auckland Integrated Transport Programme (AITP) as a strategy, and noted that the critical packages align with its strategic fit and investment outcomes also with a profile of HH.

44 Auckland Regional Land Transport Strategy 2010 – 2040 , Auckland Regional Council, April, 2010

45 Integrated Transport Programme (ITP), Auckland Transport, 2013, page 45

4.5 Option assessment – detailed studies

As with the more strategic options analyses there have been multiple studies into the preferred mode and route. In the APB & B Study of 2010⁴⁶ four potential transport investment alternatives were analysed on a qualitative basis:

- on-surface bus capacity improvements
- a central area bus tunnel with three stations
- an expanded Britomart rail station
- a City Centre rail tunnel with three stations (CRL).

Multi-criteria analysis was used to reduce the list of four alternatives down to two options capable of providing the capacity, reliability and robustness to deliver the transport outcomes sought. The City Centre of 2041 was anticipated to need a solution that could provide additional transport capacity without causing congestion and other environmental externalities.

The two higher scoring options were the CRL with three stations and the Central Area Bus tunnel with three stations with the former preferred for its higher cost effectiveness.

4.6 Further mode choice option analysis: City Centre Future Access Study

The CCFAS was designed to develop a robust and achievable multimodal programme for transport into the City Centre. It was a comprehensive joint study between AT and Government further re-visiting the options available to improve public transport access into the City Centre.

The study focused on multimodal transport options based around a series of “headline” public transport modes. These were:

- underground rail infrastructure
- surface bus infrastructure
- underground bus infrastructure.

Each headline mode was developed as part of a suite of multimodal measures - including considering the role of private vehicles. The main objectives in developing each option were to design a programme that:

- provided for future City Centre growth and employment, recognising that the City Centre is a critical part of the Auckland and New Zealand economy
- would support regional growth objectives by providing access for targeted residential growth areas
- would deliver benefits for all transport users including private motor vehicles, commercial vehicles and freight.

Each option was considered in detail to establish its practicality. This included such issues as bus capacity with one or two bus lanes in each direction, intersection operation, lay-over and stabling for each mode, dwell times, park and ride provision and service patterns to ensure a thorough understanding of the options and to provide a robust basis for the assessment.

The CRL option produced the highest benefits but also had the highest costs. It provided the greatest multimodal capacity to get people into the City Centre, resulted in the highest road network speeds within the City Centre and was the longest-lasting solution in terms of capacity.

Appendix 2 summarises the CCFAS approach and findings.

⁴⁶ Business Case, Auckland CBD Rail Link, prepared for KiwiRail and ARTA by APB&B, November 2010

4.7 Alignment and station options

The alignment options for a possible link west from the Britomart Station to 'the Western Rail Line' were studied in 2004 by consultants⁴⁷ for the Auckland City Council. The study concluded that the extension was technically feasible and the risks manageable and that through operation of Britomart Station would offer operational efficiencies for the Auckland rail network. The preferred alignment had twin tunnels connecting Britomart Station (Platforms 1 and 5) heading westward under Albert Street/Pitt Street/Upper Queen Street to the Western Rail line.

As an element of the 2009/10 APB&B CBD Rail Link Study, the possible alignments and station locations were again studied in some considerable detail⁴⁸. As noted in the report, the main constraint for the alignment remained the steep topography, the maximum gradient climbable by the electric passenger trains and the need to safely pass under the motorways in the vicinity of the Central Motorway Junction.

4.8 Option evaluation review

After AT assumed responsibility for the project on 28 June 2011, a further review was initiated of the 2010 Option Evaluation Report and the concept design prepared previously for KiwiRail and ARTA. This review was to determine whether any additional work would be required to support route protection to enable the construction, operation and maintenance of the CRL. Section 171(1)(b) of the Resource Management ACT 1991 (RMA) requires consideration of alternative sites, routes or methods of undertaking the work.

Further investigations, option evaluations and technical assessments determined an alignment, revised station footprints and prudent effects assessments, which in turn determined the land required to give effect to the project objectives. It also confirmed the CRL and designation are 'reasonably necessary' to meet the objectives of AT .

As a result of all these studies AT was able to confirm the choice of route, proceed to consenting and undertake reference design using international engineering consultants with expertise in underground railway development – Aurecon and Mott McDonald supported by architects Grimshaw and Jasmx. Beca assisted with the land designation process given their expertise in RMA processes.

47 Final Report, Britomart West Rail extension Study, URS and GHD for the Auckland City Rapid Transport Group, January 2004

48 Auckland CBD Rail Link Study – Options Evaluation Report – prepared for ONTRACK and ARTA, APB&B, December 2009

5 *The Economic Case: the preferred option – the City Rail Link*

5.1 Coverage

This section provides brief information on the physical CRL project. Appendix 3 addresses the 'product' particularly from a customer perspective. Appendix 4 describes the physical project.

5.2 Overall alignment

The CRL rail tunnels comprise a 3.45km extension from Britomart Station to the Western or North Auckland Line (NAL) near Mt Eden with an additional 0.725km for the east-facing connection and 1.33km of modifications to the NAL itself. The CRL rail tunnels will follow the alignment, below:

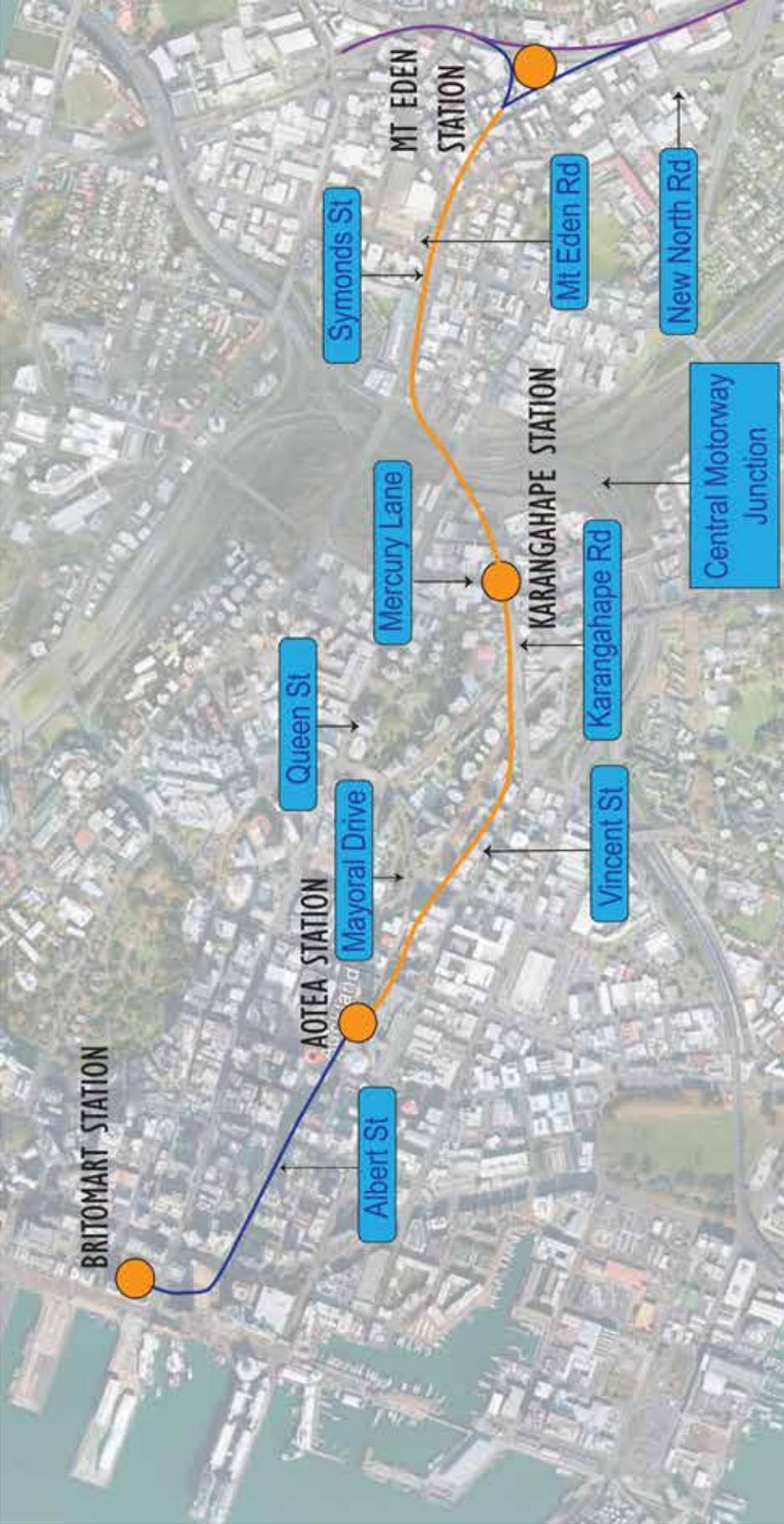
- extend underground into Lower Queen Street via existing Platforms 1 and 5 at Britomart Station
- turn south along Albert Street through the current Downtown Shopping Centre site
- Arrive at Aotea Station located beneath Albert Street between Victoria Street and Wellesley Street
- follow Mayoral Drive and Vincent Street under the existing road
- separate at the southern end of Vincent Street and approach Karangahape Station beneath Pitt Street
- arrive at Karangahape Station located along Pitt Street and Mercury Lane
- extend under the Central Motorway Junction (CMJ) and move east to run parallel with Symonds Street
- separate between New North Road and Mt Eden station with the east facing connection grade separated from the west facing connection
- the east facing connection joining with the NAL east of the existing Mt Eden Station
- the west facing connection incorporating a new platform at Mt Eden with an interchange between the NAL and CRL lines, before joining the NAL west of the existing Mt Eden Station.

5.3 Design of stations

Station entrances have been designed to address the needs of each station in terms of function, performance and personality, as well as the needs of their particular urban context. Placement and configuration of the above-ground components of the station entries and other station components have been designed to maximise local benefits. This included consideration of:

- potential for architectural treatments and materiality
- scale, massing and form
- activation of street frontages and oversite development opportunities
- preserving important heritage structures
- potential to explore inclusion of Iwi cultural landscape and design themes.

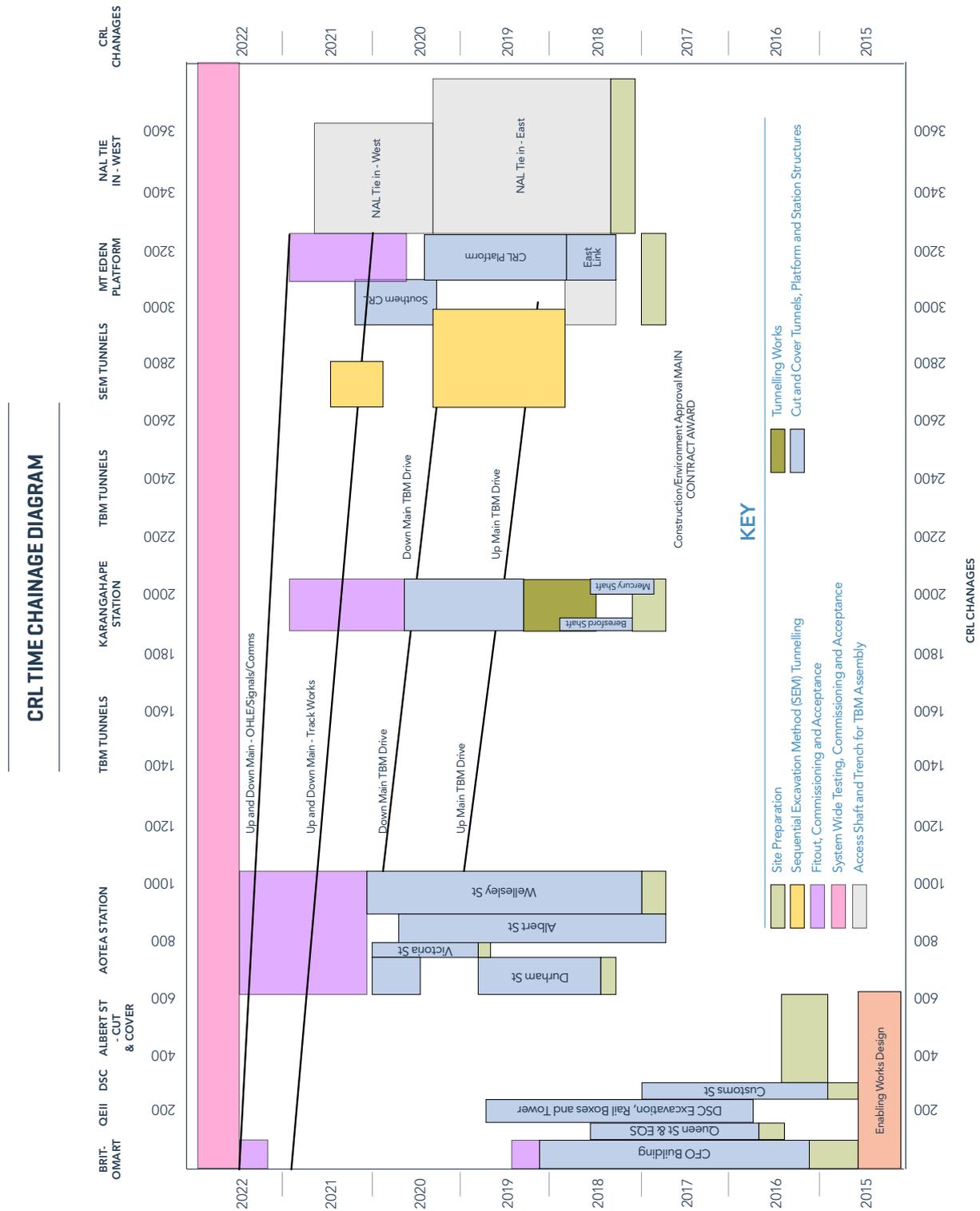
Figure 10 Map of alignment



5.4 Construction programme

An indicative construction programme is set out below. It is based on the indicated construction methodology for each work site. This indicative construction programme is suitable for commonly-adopted procurement methods.

Figure 11- CRL time chainage diagram



5.5 Enabling works

In 2014 AT resolved that an enabling works package should be used to address the conflicting and compounding needs of the large number of capital works projects within the lower City Centre area that are programmed for construction at approximately the same time – around 2016.

These projects include:

- an upgrade of Customs and Fanshawe St
- an upgrade of Quay St including the Seawall
- the redevelopment of the downtown Bus Interchange
- the reconstruction of the Downtown Shopping Centre (DSC)

A clash with these projects would be likely to comprise:

- competition for road closures
- inefficiencies from competing interests and requirements
- increased construction costs
- increased community disruption.

It is preferable that construction of the CRL within this area should precede these other projects.

The purpose of the enabling works is therefore to facilitate the efficient construction of other projects in the downtown area. By completing the CRL activities required in this area, the other projects will be able to progress as planned and not be disrupted by late CRL construction works.

5.6 Design and optimisation

The concept design phase was completed in mid-2012 to support the Notices of Requirement (see 5.7) and land designation process. The design was then further developed through a 'value management' process, in which the scope of the project was reviewed and alternative design elements were developed and assessed. This work continues.

5.7 Operating principles

5.7.1 Focus of the principles

The operating principles for the CRL are based on delivering customer requirements to travel safely, reliably and efficiently on the Auckland Rail Network, and specifically on the CRL.

The operating principles focus on:

- safety and security
- the customer
- responding to travel demand
- contingency and emergency plans to be prepared to cope effectively with disruption, major events or genuine emergencies
- cleanliness
- clear customer information
- effective control and high levels of performance
- reliability
- enabling ticketing and control of fare evasion to be effective.

5.7.2 Enabling methods

The principles will be achieved by:

- AT having plans to ensure facilities are provided on the wider Auckland Rail Network to meet growth in terms of trains, track layouts, maintenance and train stabling facilities
- producing Train Plans and outline timetables for a range of future growth scenarios up to 2041. These will be subject to timetable /layout and system modelling validation
- monitoring train loadings to ensure they remain acceptable and within agreed standards
- ensuring facilities use capital efficiently and use assets to best advantage by planning for high levels of train and staff use and optimising operating costs
- using New Zealand rail and international best practice operating and design standards
- ensuring new and redeveloped stations on the CRL and elsewhere are safe and that fire and evacuation requirements are thoroughly addressed especially at sub-surface and underground stations
- ensuring operating and technical standards, procedures, rules and instructions are fit-for-purpose and that staff using them are trained and competent
- having a robust testing and commissioning regime at the end of construction and systems installation encompassing people, process, facilities and equipment
- testing that the design is capable of operating under failure conditions and is capable of “graceful” degraded mode operation. This means an ability to operate trains, the CRL railway and stations with reduced functionality but maintaining critical safety requirements and an ability to move passengers as efficiently as possible under identified and credible failure modes. The principle is to avoid absolute failure by design and operating procedures wherever possible.

5.7.3 Interface with existing rules and standards

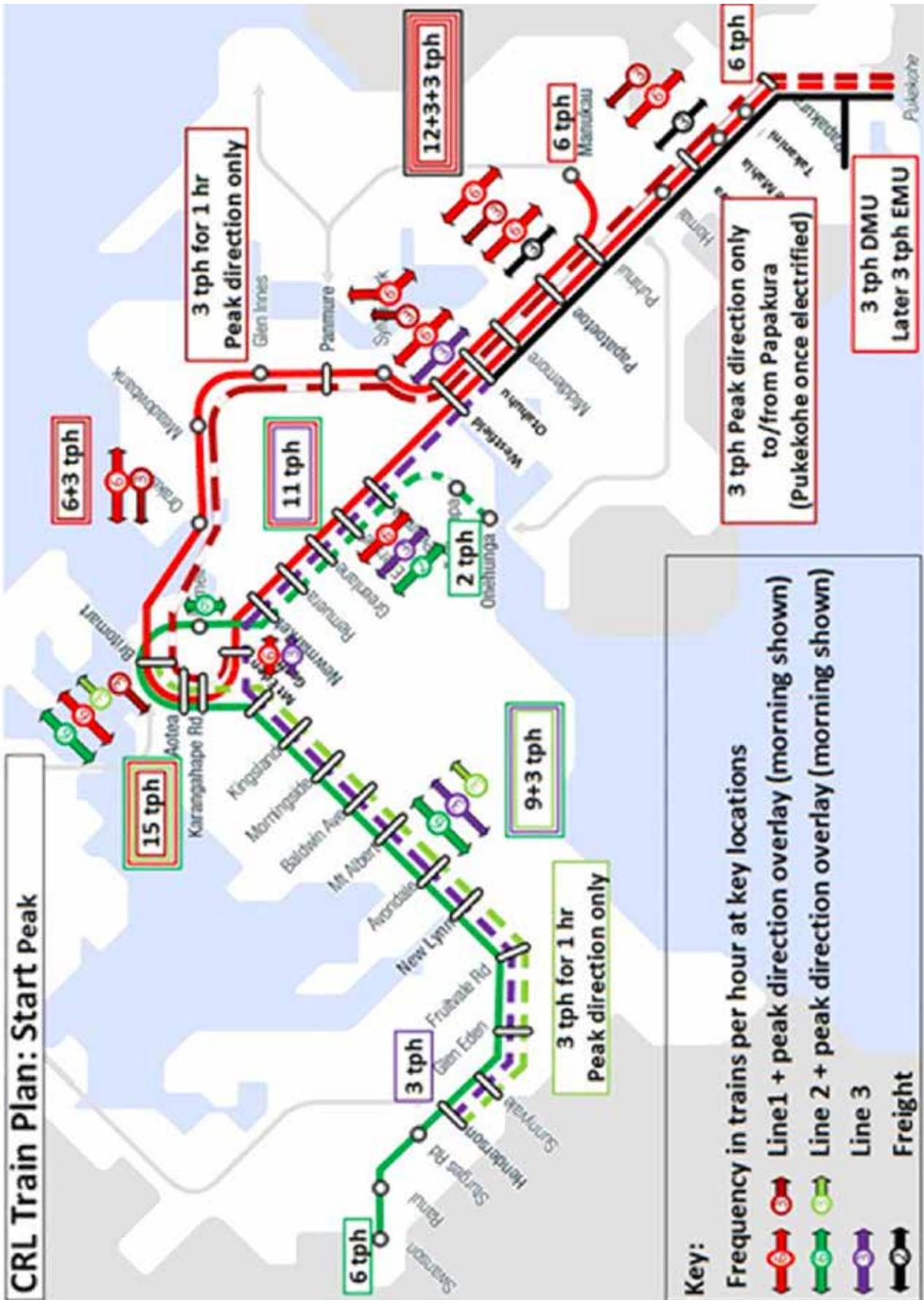
The CRL will be part of the Auckland Network and have some specific requirements and features which are unique because of the nature of an underground railway with underground and sub-surface passenger stations, but will otherwise be consistent and conform to existing railway rules and codes under NRSS.

5.8 Train planning

This section describes the proposed CRL train plans.

Whilst the actual train plan to operate can be confirmed much closer to the opening date, it was important for planning and modelling purposes to identify a potential train plan that can operate reliably, and which takes account not only of the opportunity of the CRL but of the constraints as they may be on the wider network, for example to accommodate freight paths.

Figure 12- Train Plan – Start Peak

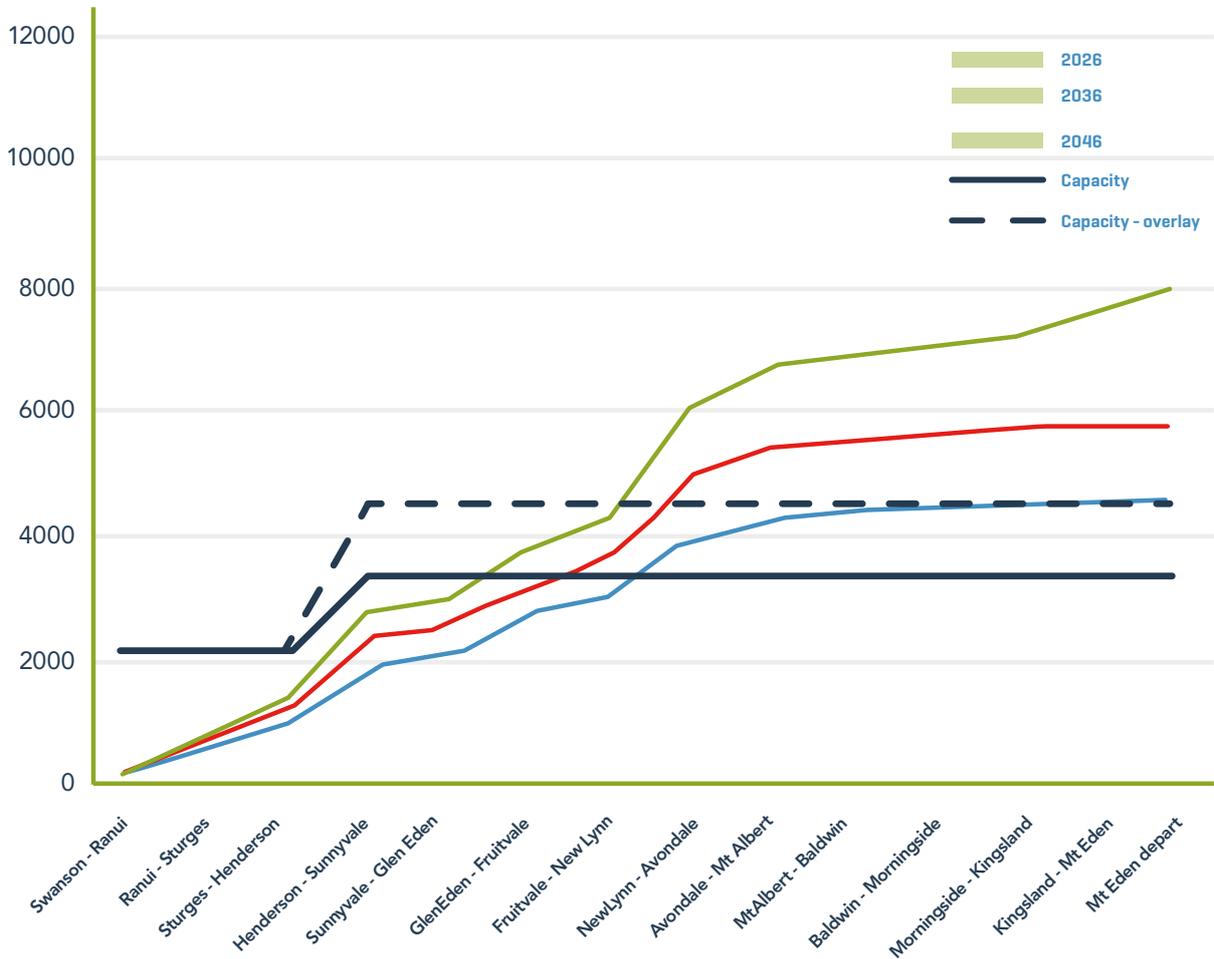


The patronage estimates were based on the JMAC APT3 demand model (see Section 7), with values every decade split by line.

- Capacity and demand were compared using the assumption that each 3 car EMU would hold no more than 375 passengers – a load factor of slightly more than 1.6 passengers per seat
- Figure 13 below shows as an example how train capacity was matched against predicted demand by decade by line, in this case the Western Line for 2023. The capacity line represents 6 tph x 3 car service starting from Swanson, 3 tph x 3 car service starting from Henderson and a 3 tph x 3 car peak overlay starting from Henderson. Similar analysis was carried out for other lines and decades.

If the need is to operate at a 6 tph base peak pattern, because that is consistent with what has happened pre CRL, and yet there is a need to minimise the number of services on the western line in the peak to mitigate level crossing impacts, then a service like that shown below could be operated. This is operating almost the same number of trains past level crossings on the Western Line as the pattern above, for almost the same capacity. Until sufficient level crossings are addressed on the western line, a Henderson – Otahuhu service has no capacity to operate.

Figure 13 - Western demand at 2023 being met



- Over time, as demand increases, as the fleet size is increased, an increasing number of trains can be lengthened to 6 car operation, and the span of operation of the peak overlay can increase from 1 hour to 3.

6 Property and Planning

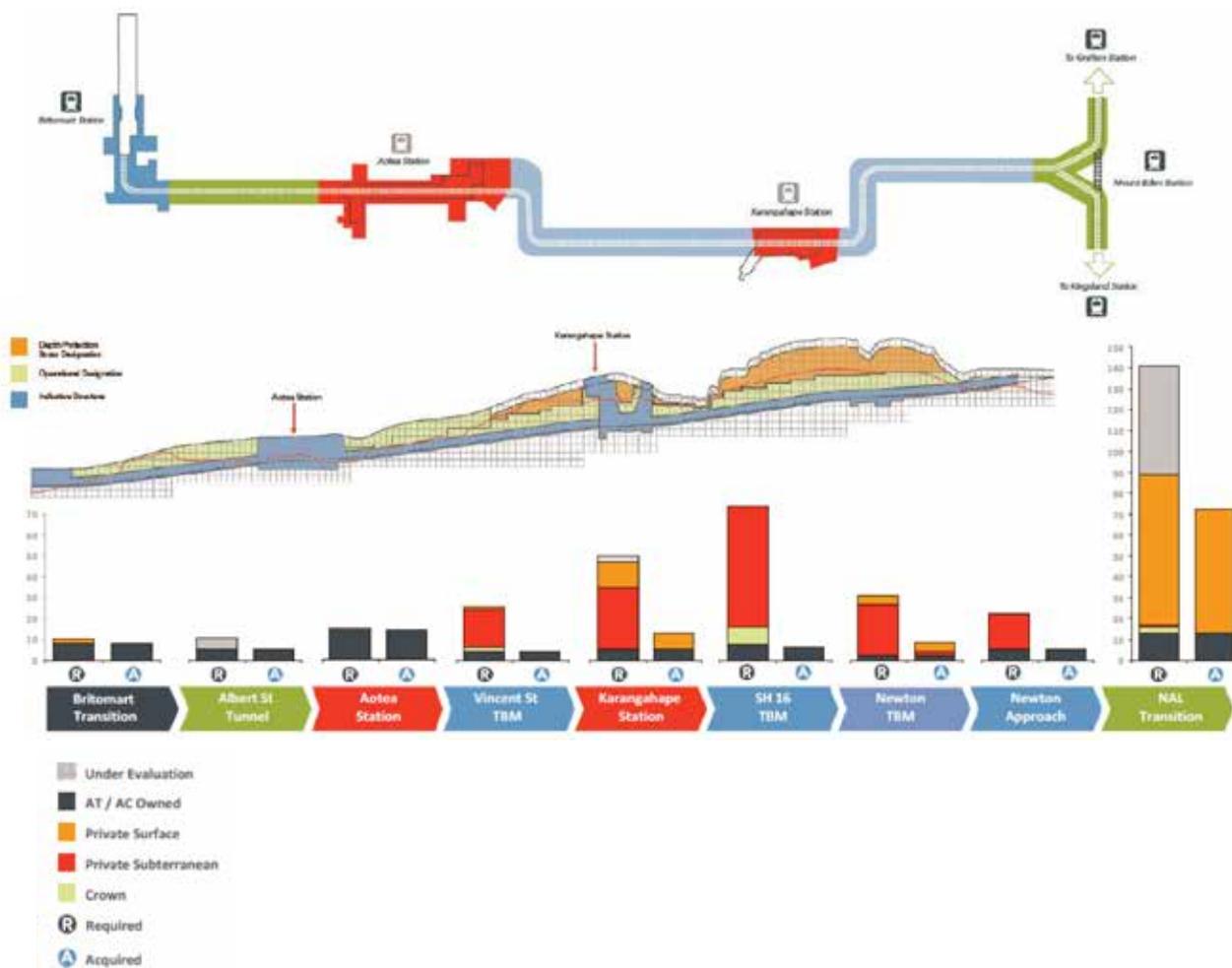
6.1 Property acquisition strategy and programme

6.1.1 Property to be acquired

Much of the land required for the Project is located within the road corridor which is already under the control and management of AT, or is Council land. This ownership has limited the land take requirements and the direct impact on private property. The balance of the land required for the project is either privately owned land at some depth beneath the surface, or is part or all of privately owned property at the surface.

Detailed land requirement plans and related property schedules are contained within the six Notices of Requirement (NOR). A profile of the property interests being acquired is shown below.

Figure 14 - Locator Diagram showing acquisition requirements and progress as at Sept 2015



6.1.2 How property is being acquired

AT has developed a land acquisition and interim property management process in conjunction with Council which is implemented within statutory and wider council organisational frameworks. The approach enabled acquisition and interim property management to be structured around timeframes that support project delivery whilst at the same time ensuring that a landowner has a reasonable opportunity to engage in good faith negotiations.

AT began a phased approach to consultation with directly affected landowners in early July 2012 prior to lodgement of the Notices of Requirement (NOR) under the RMA NOR with Council.

In September 2012, following meetings with individual owners, the Project Director wrote to owners addressing issues they raised. The Project Director also wrote to all owners explaining the feedback from information sessions and providing an update on the project together with information relating to land purchase. The letter advised that AT expected to commence property negotiations from mid-2013.

Subsequent to the information sessions in 2012 and from mid-2012, AT entered into discussions with owners, as a result of which as at September 2015 significant progress had been made on surface acquisition, see Figure 15, below. AT initiated negotiations are in progress for complex leasehold relocations and planning is underway to confirm the acquisition levels for subterranean strata.

Figure 15 - Negotiation progress as at September 2015

Acquisition Progress as at Oct 2014	Acquired	Under Negotiation	Evaluating Basis of Acquisition
Commercial properties	38	3	0
Undeveloped property	2	0	0
Residential properties	25	0	0
Subterranean land	3	0	71
Lease Interest	11	6	0
Totals	79	9	71

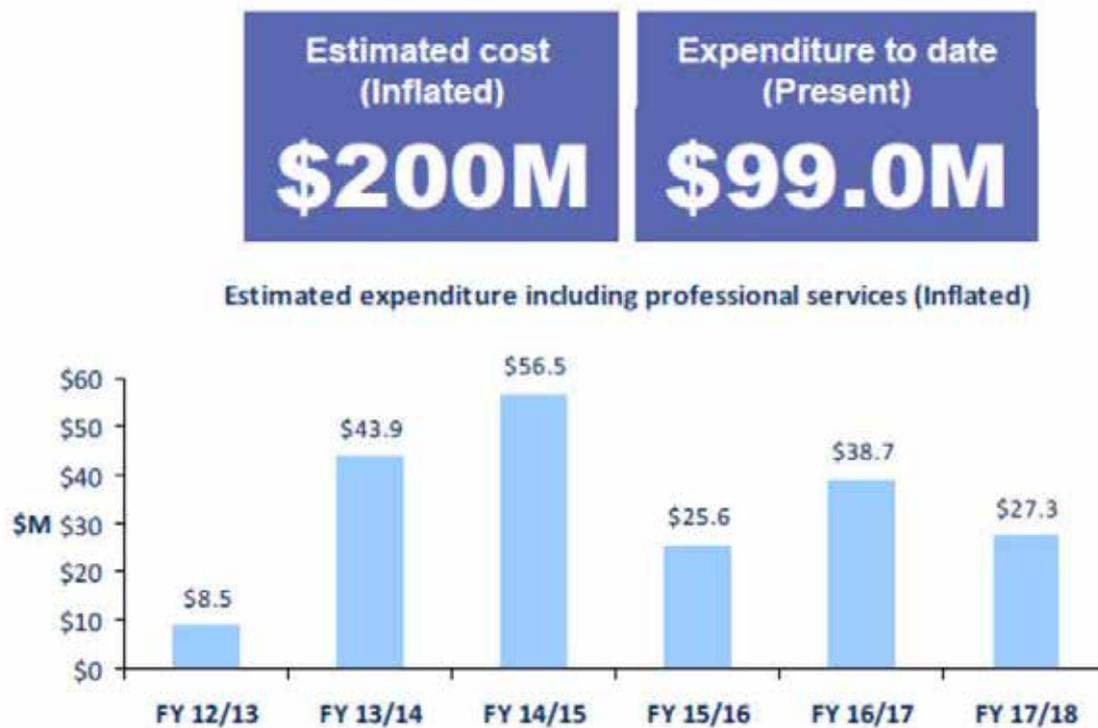
6.1.3 When property is being acquired

The Project land acquisition programme was well-defined with \$245m identified for property acquisition under the Council Long-term Plan (2012-2022) and allocated over the period 1 July 2013 to 30 June 2015, with the ability to bring forward funding.

On current programme all property acquisition is scheduled for completion by mid-2017 to coincide with the earthworks season and possible construction start date of mid-2017.

A snapshot of the programme progress as at September 2015 is shown in Figure 16 below:

Figure 16 - Property expenditure

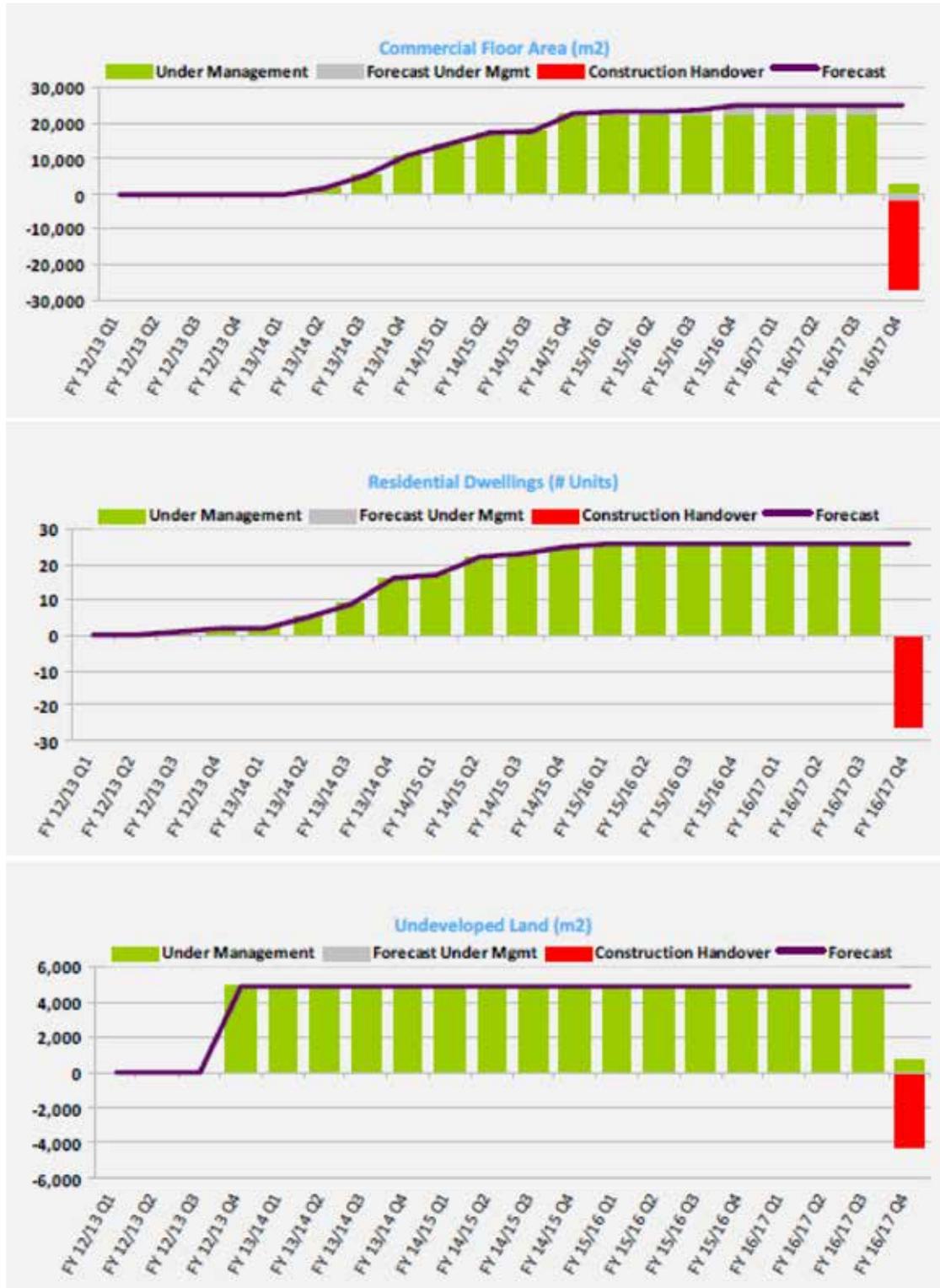


6.1.4 Interim Property Management

During the period between acquisition and demolition and construction, the project portfolio is being managed to maintain activation and avoid blight in a way that does not prevent or hinder the project nor adversely change the character, intensity or scale of existing use of the land.

As at September 2015 the majority of surface property has been acquired and is under management. A forecast through to construction handover is provided in Figure 17.

Figure 17- CRL Property management floor area forecast through to construction handover



6.1.5 Property Management Strategy

Work is currently underway to formally document a Property Management Strategy (Strategy) to provide a framework for the interim management of the project portfolio. The purpose of the Strategy is to provide guidance to AT as Requiring Authority and Panuku Development Auckland as the property manager responsible for the day to day management of the portfolio. The intention is that the Strategy will provide confidence to occupants, adjoining property owners, the community and other stakeholders that the properties are managed responsibly pending construction.

6.1.6 Master planning

In terms of the future use of the land following project completion, the Auckland Plan, City Centre Masterplan, and precinct plans under development by Council will provide strategic direction for redevelopment of the land within the project footprint.

Master planning work undertaken as part of the project will provide for integration of the underground stations, and tunnel infrastructure into the above ground and surrounding public realm, and the remediation of land disturbed in the course of construction, guided by the CRL urban design framework.

6.2 Planning consents

6.2.1 Consenting framework

The overarching statutory framework for planning and environmental approval governing the CRL is the RMA. The consenting pathway for the construction, operation and maintenance for CRL has been sought via a Notice of Requirement (NOR 1-6) under Part 8 of the RMA. Once confirmed the NOR is designated in the relevant district plan for the purpose of construction, operation and maintenance. Regional consents are also required prior to construction and will be applied for once further design detail is complete.

The consenting pathway for CRL was determined by the following factors:

- size, scale, complexity of the project
- the current zoning of the land required for the project
- previous work undertaken through feasibility and scheme assessments
- timing for construction or operation
- costs
- mechanisms to achieve approval to carry out the work under the RMA
- legal implications
- public perception of the project.

The RMA sets out the statutory tests that must be met to confirm a designation.

These include:

- identifying the sites to which the designation applies
- the nature of the proposed works
- the nature of any proposed conditions that would apply
- the effects that the proposed work would have on the environment and the ways in which any adverse effects will be mitigated
- alternative sites and methods considered

- why the proposed work is reasonably necessary
- other consents that are required (may be applied for at a later date)
- consultation undertaken
- any information required by the district plan, regional plan or any other regulations under the RMA
- the lapse period sought.

The benefits of designation include the ability to apply for a longer lapse period than resource consent. Longer lapse periods are generally required on large scale projects due to significant project planning, on-going design phases and changes (within the scope of the designation) and lengthy procurements for construction. Other benefits include providing certainty to directly affected landowners and occupiers, those in proximity, iwi, stakeholders (including network utility operators) and the community as to the extent and location of designation (for construction, operation and maintenance) and the nature of any restrictions on the land.

6.2.2 CRL Designation

In April 2014, AT issued a decision to confirm the CRL designations with some modifications to the conditions. Six Environment Court appeals were received. Five of the appeals were resolved between the parties supported by reasonable and appropriate amendments to conditions and draft Consent Orders to be sealed by the Environment Court.

One appeal was heard by the Environment Court related to NOR 6. On 21 August 2015 AT received a decision from the Environment Court to refuse the appeal and the expectation by the Court to confirm the designation subject to the finalising of appropriate conditions listed in the decision.

The designation restricts anyone, other than AT from carrying out work on the land set out in the notice that will prevent, or hinder the project, or work to which the project relates, without obtaining AT's prior consent.

6.2.3 Alterations to Designation

CRL Designations

Alterations to the CRL designation boundary are to provide for design elements which have progressed since the original concept design was developed in 2012 which supported the NOR footprint for NORs 1-6. Planning approvals for CRL are also required for works to be undertaken within KiwiRail's Designation H13-09 located at the North Auckland Line (NAL).

The alterations required include:

- Changes to provide for the relocation of ventilation equipment at Aotea Station to Kingston Street and the associated relocation of the Bluestone Wall (approximately 3m to east)
- Changes proposed to the designation where the CRL ties into the existing North Auckland Line
- Changes to both the surface and substrata boundaries to include parts of the design that are required outside the designation footprint.

These alterations will be packaged into four (potentially five) separate applications and lodged in stages. The programme for delivery is to lodge the alterations no later than 31 March 2016.

Britomart Transport Centre Designation

The Britomart Station designation will be altered to include the construction, ongoing operation and maintenance associated with the tie in of CRL to the Britomart Transport Centre. The designation will enable the construction of the tunnels to the existing rail platforms within the Britomart Transport Centre underneath the Chief Post Office (CPO) connecting to the CRL designation in Lower Queen Street. It will also include the temporary station structure required at the rear of the CPO to ensure on-going rail services during construction.

The Britomart Station designation was lodged with Council on 28 May 2015, with a hearing expected in mid-November 2015.

6.2.4 Resource Consents

The necessary resource consents for CRL are pursuant to sections 9, 14, and 15 of the RMA. The consents have been applied for in a staged approach in order to respond to the CRL design progress (i.e. level of information and design available for certain sections of the CRL route) and construction programme requirements.

The staged process is summarised in the table below.

Figure 18 - Resource Consent Packages

Resource Consent Packages	Location	Approvals
Consents for pump tests to allow for collection of data for subsequent regional consents applications	Along the route between Albert Street and North Auckland Line	Approved by Auckland Council
Albert Street Stormwater Pipe Re-alignment	Albert Street	Approved by Auckland Council
Regional Consents Package 1	Britomart Station to Wyndham Street	Approved by Auckland Council (appeal period closes 22 September 2015)
Regional Consents Package 2	Aotea Station to the North Auckland Line (including all CRL operational requirements for the entire route covered by Package 1 and 2)	To be lodged end Q3 of 2015/2016 Financial year

The regional consents for package one were applied for as a bundled application and publicly notified due to the size and scale of the project and the public nature of the project and the affected/interested parties. Package two will also be applied for as a bundled application and publically notified. The consents are primarily associated with construction works, including consents for the following activities:

- Land disturbance (earthworks)
- Water permits for the temporary and permanent diversion of groundwater
- Discharges of dust and air pollutants
- Discharges from contaminated land
- Stormwater and wastewater discharges and diversion
- Other utility diversions.

7 The Economic Case: demand forecasts

7.1 Demand Forecasts

This section describes the modelling tools used in the design and assessment of the CRL and the resulting forecast for demand.

7.2 Transport models

The demand forecasting used four models operated by JMAC , Auckland Spatial Planning (ASP), Auckland Regional Transport Model, (ART), the Auckland Passenger Transport model (APT) and the City Centre SATURN model ("SATURN") which is a traffic assignment model.

- The ASP model produces land use inputs to the ART3 model.
- The ART model is a region-wide strategic model that covers travel by all modes – car, commercial vehicles, public transport, cycling and walking (active mode travel is based on a series of assumptions) – and for different trip purposes. The version of ART used for this project was ART3.
- The APT model is a strategic region-wide, passenger transport model that is specifically aimed at public transport travel – rail, ferry, and bus – but which does not distinguish between different trip purposes. Inputs to APT come from ART, in terms of the public transport trip matrix. The version of APT used for this project was APT3. The model was subject to substantial validation and calibration with an independent peer review. The APT model includes a crowding module, which means that PT service capacity constraints are able to be incorporated.
- The peer-reviewed City Centre SATURN model provides a more detailed resolution of the transport network within the City Centre. The extent of the model is the City Centre within the motorway ring and it extends as far as Ponsonby and Parnell/Newmarket. It is an assignment model only and provides a more detailed way of assessing the impacts on vehicle travel within the City Centre and city Fringe area.
- The interaction between the models was reviewed and improved following the CCFAS. An Assumptions Report provides detail of the models and their inputs.

7.3 Land-use

The Scenario I land use scenario, version 8B, was used as the central scenario as it represents the Auckland Plan land-use, with realistic rates of growth in employment and population in the Auckland City Centre (as agreed with Government officials). It is a medium growth scenario. An alternative scenario was also modelled which has slightly higher population and employment forecasts and an alternative underlying spatial land use pattern. Monitoring suggests that Auckland growth is trending above the medium growth.

Both of the growth scenarios are modelled in the 2026 and 2036 forecast years, but only the medium growth scenario is modelled in 2046.

7.4 The Do Minimum

The transport network in the Do Minimum was the ITP Basic Transport Network (see Section 2.2) with the exclusion of certain projects that did not meet the criterion as specified in the Transport Agency's Economic Evaluation Manual of having committed funding and design. The most prominent projects not included are the Alternative Waitemata Harbour Crossing and East West Connections.

The Do Minimum included rail electrification – Swanson to Papakura, the New Network (bus and ferry) and integrated zonal fares as in the RPTP and the Fanshawe Street dedicated busway. The Third Main between Wiri and Westfield was also assumed to be in place as it is included in the ITP. Further detail is included in the CRL Assumptions Report.

7.5 The Do Something

In addition to the core project from Britomart to the North Auckland Line as described in Section 5, a group of additional works is included in the project scope (and therefore in the costs) in order to facilitate the train plan as shown in Section 5.8.

They are:

- Henderson, third platform
- Newmarket, four crossovers
- Crossover at Strand
- Through siding at Quay Park
- Otahuhu, third platform.

7.6 Forecasts

The model years used in the assessment of the CRL are 2016, 2026, 2036 and 2046. These years are used for the economic assessment with interpolation between them. The modelling years are used for the do minimum, core option and sensitivity tests. While outputs from all three models (ART, APT and SATURN) are used in the economic assessment, public transport patronage forecasts are taken from APT.

7.6.1 Do Minimum forecasts

In 2026 without the CRL it is estimated that some 13,200 passengers will pass through Britomart in the two hour morning peak period, with 84% (11,100) of these alighting here to access the City Centre. Over the following 20 years, the number of passengers using Britomart is expected to increase by 33% to 17,600. This represents annual growth of approximately 1.7% per year. Figure 19 below shows the growth in rail passengers using Britomart over the three forecast years.

Figure 19 - Do minimum city centre rail passengers (2 hours morning period, medium growth scenario)

	2026	2036	2046
City Centre passengers	13,200	15,100	17,600

Figure 20 summarises the overall rail network patronage in the do minimum for both land use scenarios for the 2 hour morning period.

Figure 20 – Do minimum rail patronage (2 hour morning period)

Overall rail network	2026	2036	2046
Medium growth scenario	24,600	28,100	32,700
Alternative growth scenario	26,300	30,300	n/a

The total number of passengers on the rail network in the 2026 morning period is estimated at 24,600, growing to 32,700 by 2046. This represents a 33% increase, or 1.7% growth per year, similar to the growth experienced at Britomart. At these levels there is a high degree of crowding on the rail network, with passengers still using the trains owing to the corresponding crowding on the buses and congestion on the roads. The capacity constraint of Britomart means that no additional train services can be added to cope with growing demand and this essentially caps the number of people that are able to travel by rail.

Figure 21 and Figure 22 show the PT patronage plots for the 2 hour morning peak for 2026 and 2046 respectively. The blue lines represent rail patronage, with bus patronage shown in green. The thickness of the line is proportional to the number of passengers on that part of the service.

Figure 21 – Do minimum PT patronage, 2026 (2 hour morning period)



Figure 22 - Do minimum PT patronage, 2046 (2 hour morning period)



Modest growth is shown on the rail network and the thick green bars in the City Centre highlight the high volumes of bus passengers that are accessing the City Centre via the main bus corridors of Symonds Street, Wellesley Street and Fanshawe Street from the North Shore. The highest volumes of rail passengers occur on the approach to Britomart as the two rail lines (eastern line and Newmarket branch line) come together to enter the station.

7.6.2 Do Something forecasts

With the CRL in place the potential of the rail network is unlocked and there are three main drivers behind the significant increase in rail patronage compared to the do minimum.

The first is the increase in capacity that is enabled by being able to run additional services. This means that more people are able to travel and the trains are less crowded which creates a more pleasurable experience.

The second is the increased accessibility of the City Centre due to the new stations at Aotea and Karangahape Road. These new stations mean that virtually the entire City Centre is accessible to and from the rail network within a 5-10 minute walk. This attracts more people to rail as a mode of transport as they are now able to get to more locations.

The third main reason for the increase in rail patronage is the improved travel times, particularly for those people coming from the western line. These passengers now have a much more direct route into the City Centre, with the travel time to Britomart station reducing by at least 7 minutes. This improved travel time, combined with the increased accessibility and additional services means significantly higher savings to other areas of the City Centre.

With the two new stations in the City Centre, it is estimated that some 24,100 passengers will pass through the three City Centre rail stations in the two hour morning peak period, with 85% (20,600) of these alighting here to access the City Centre. This is the same proportion of boarding/alighting as in the do minimum, but the numbers of passengers have increased dramatically. Over the following 20 years, the number of passengers using the City Centre stations is expected to increase by 42% to 34,100. This represents annual growth of approximately 2.1% per year. Figure 23 shows the growth in rail passengers using the City Centre rail stations over the three forecast years for the do minimum and CRL option.

Figure 23 - City Centre rail passengers (2 hour morning period, medium growth scenario)

	2026	2036	2046
City Centre passengers (Britomart) – Do minimum	13,200	15,100	17,600
City Centre passengers (Britomart, Aotea, K Rd) – with CRL	24,100 (+10,900)	29,100 (+14,000)	34,100 (+16,500)

With the CRL in place, there are similar numbers of passengers at Aotea and Britomart stations (40% each) with approximately 20% of the passengers using the Karangahape Road station.

Figure 24 summarises the overall rail network patronage with the CRL in place for both land use scenarios for the 2 hour morning period. The increase relative to the do minimum is also shown in brackets.

Figure 24 - Do something network rail patronage (2 hour morning period)

Overall rail network	2026	2036	2046
Medium growth scenario	34,500 (+9,900)	41,500 (+13,400)	49,500 (+16,800)
Alternative growth scenario	37,100 (+10,800)	45,400 (+15,100)	n/a

The total number of passengers on the rail network in the 2026 morning period is estimated at 34,500, growing to 49,500 by 2046. This represents a 43% increase, or 2.2% growth per year, similar to the growth experienced at the City Centre rail stations. With the increase in rail service capacity enabled by CRL, the demand even out to 2046 is able to be catered for on the rail network, providing an efficient way for people to travel not only to the City Centre but all around the region, on a mode that is unaffected by congestion.

For the additional rail patronage associated with the CRL, there are three sources:

- Passengers previously travelling by car (ex-car)
- Passengers previously travelling by bus (ex-bus)
- Passengers who were previously not travelling at all (new)

Figure 25 and figure 26 summarise the analysis of where the additional rail passengers have come from in the medium and alternative growth scenarios. Note that the differences in the totals arise from rounding and slight differences in car occupancy assumptions.

Figure 25 - Medium growth scenario additional rail passengers (2 hour morning period)

Year	Ex-car trips	Ex-bus trips	New trips	Total
2026	1,355	4,049	4,260	9,665
2036	1,876	4,698	6,640	13,214
2046	2,517	5,459	8,665	16,641

Figure 26- Alternative growth scenario additional rail passengers

Year	Ex-car trips	Ex-bus trips	New trips	Total
2026	1,537	4,023	4,989	10,549
2036	2,261	4,564	8,015	14,840
2046	Not modelled			

Just under half (45%) the additional passengers are completely new, and were previously not able to travel in the morning period. The overall improvement in rail travel experience (capacity, accessibility and travel time) has been sufficient to allow these customers to travel.

For 40% of the additional passengers, there has been a shift in mode from bus to rail. The way in which trips are modelled in APT means that these passengers could either be completely switching from bus to rail, or now travelling by rail for part of their journey – perhaps transferring from a feeder bus at one of the rail stations. Again, the combination of factors that have improved the overall rail system is attracting these people to the rail network for some or all of their journey.

The final 15% of the additional passengers were previously travelling by car, but are now converted to become rail passengers because they can either get to their destination faster, more reliably, easier or more comfortably (less rail crowding). By attracting people from their cars, the associated reduction in car travel means less congestion on the road network for those trips which are occurring, such as business, freight, servicing or private vehicle trips.

Figure 27 shows the PT patronage plots for the 2 hour morning peak for 2026 with the CRL in place. The blue lines represent rail patronage, with bus patronage shown in green. The thickness of the line is proportional to the number of passengers on that part of the service.

Figure 27- Do something PT patronage, 2026 (2 hour morning period)



Figure 28 shows a patronage difference plot of the PT network with CRL in place compared to the do minimum for the 2 hour morning period in 2026. Green represents an increase and red represents a

Figure 28 - PT patronage difference plot (CRL vs do minimum 2026).



There are widespread small decreases on the bus network, but significant increases on the rail lines due to the introduction of the CRL. The additional passengers on each of the lines are approximately:

- 3,100 on the western line
- 600 on southern line (south of Newmarket)
- 2,700 on the eastern line

There is a reduction between Newmarket and Britomart via Parnell because the train operating patterns are different and many of the southern rail line services are routed via Grafton and the CRL on their inbound journeys with the CRL in place.

The same plots are repeated below for 2046, with Figure 29 showing the overall PT patronage with the CRL in place and Figure 30 showing the difference in patronage between the CRL and the do minimum.

Figure 29 - So something PT patronage, 2046 (2 hour morning period) decrease.

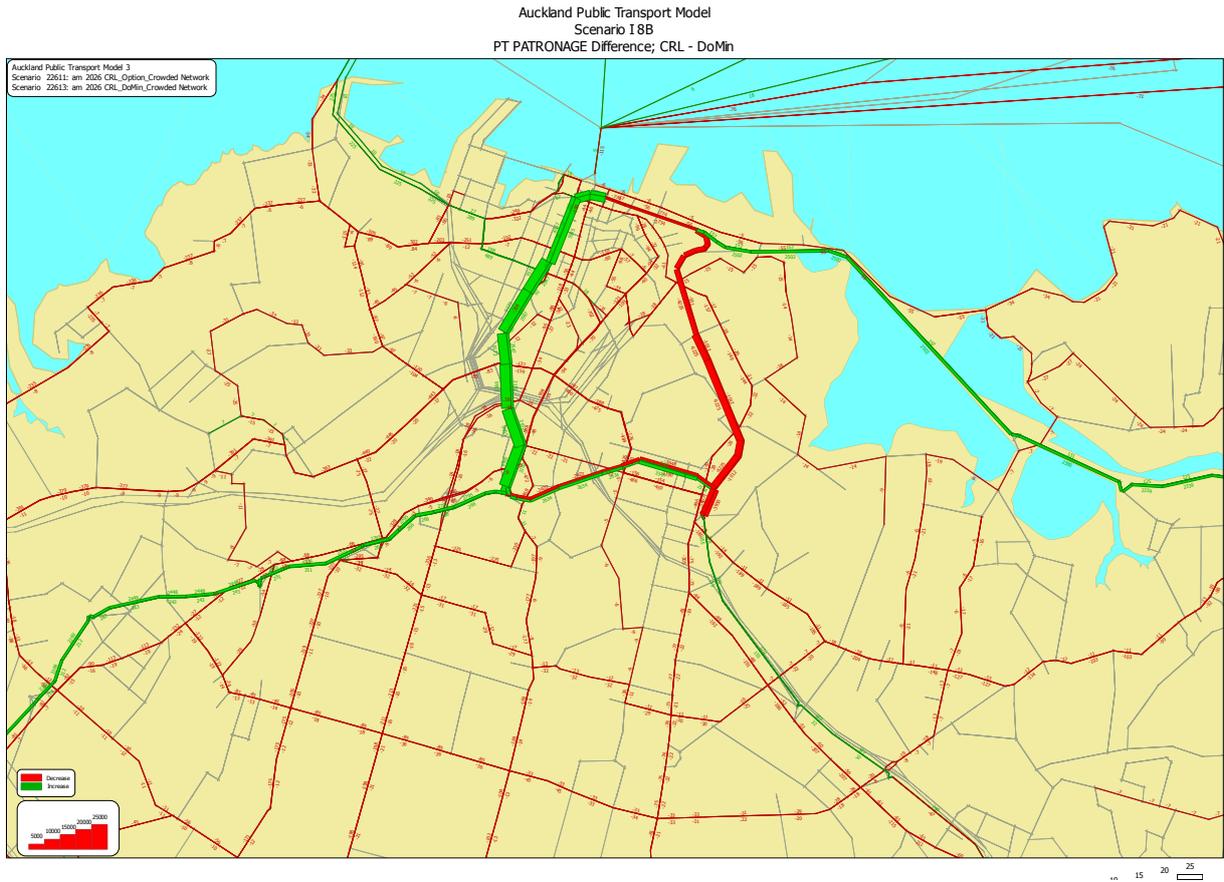
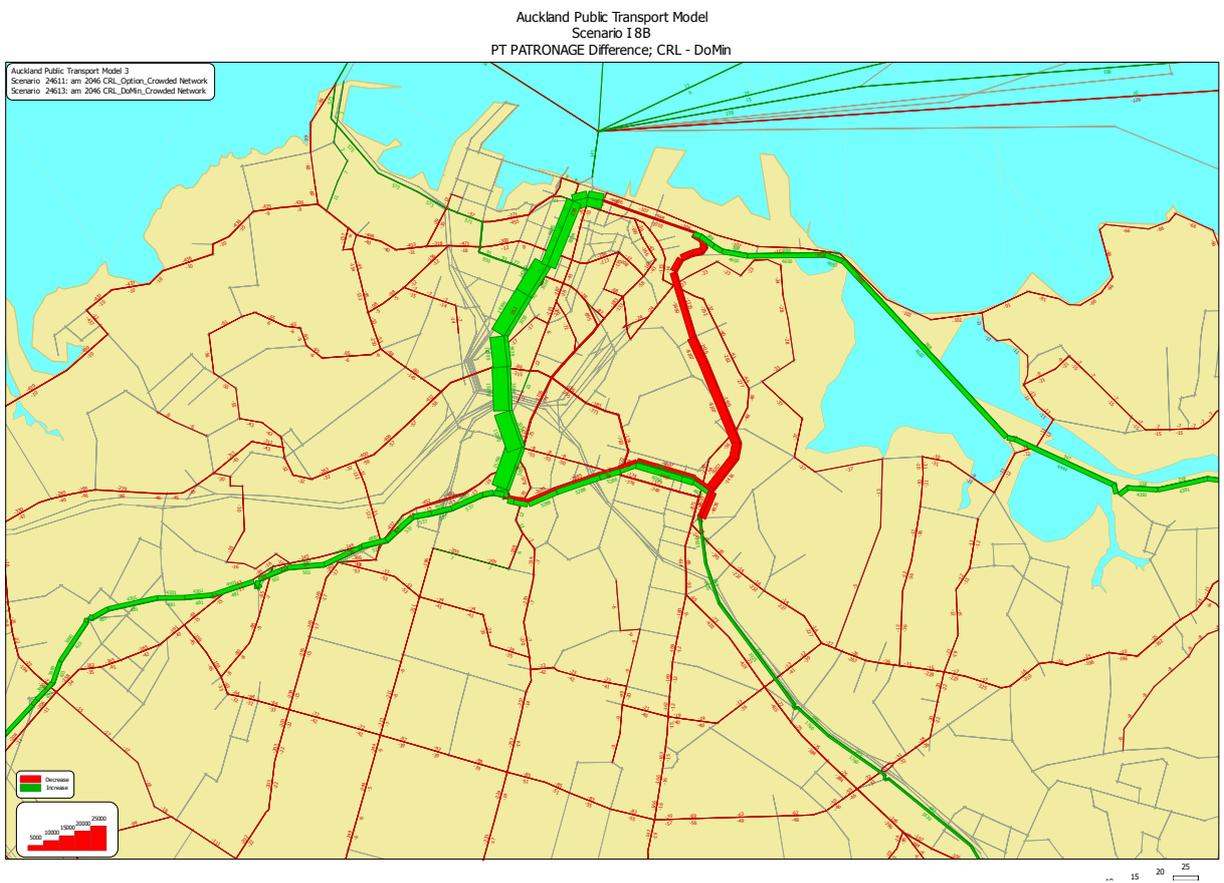


Figure 30 - PT patronage difference plot (CRL vs do minimum) 2046 (2 hour morning period)



In 2046, the patterns are very similar to 2026. The additional passengers on each of the lines are approximately:

- 5,400 on the western line
- 2,500 on southern line (south of Newmarket)
- 5,000 on the eastern line

The increases on all the rail lines highlight the positive impact that the CRL has on the whole network, not just on the western line as a result of travel time savings for those passengers. The overall increase in capacity and improved service frequency coupled with the accessibility improved related to the two new stations means that the CRL benefits all rail passengers.

7.7 Travel times

As a result of the CRL there will be some dramatic changes in train travel times – particularly from the western line and to the mid-town and up-town areas of the City Centre through having the new stations at Aotea and Karangahape Road. Locations along the western line will benefit greatly from the direct route via Karangahape Road and Aotea to Britomart, no longer having to carry out the reverse manoeuvre from Newmarket. It is not just the western line passengers who experience the travel time savings, as passengers on all lines will gain through the ability to run more services and the better penetration of the City Centre.

The scale of the time savings – allowing for both the improved rail time and reduction in walking time in the City Centre due to the new stations is illustrated in the table below:

Figure 31 - Travel time changes

TRAVEL TIME TO CITY RAIL LINK STATION					
From:	To:	Travel by train/bus (minutes)			% improvement in travel time
		Current	Future	Difference	
Papakura	Aotea Station	66	57	9	14%
Manurewa	Aotea Station	56	47	9	16%
Papatoetoe	Karangahape Station	52	34	18	35%
Swanson	Karangahape Station	71	40	31	44%
Henderson	Aotea Station	52	35	17	33%
New Lynn	Britomart Station	33	26	7	21%
Manukau	Karangahape Station	55	43	12	22%
Panmure	Karangahape Station	35	23	12	34%
Glen Innes	Aotea Station	27	18	9	33%
Onehunga	Aotea Station	40	31	9	23%
Ellerslie	Karangahape Station	35	17	18	51%
Newmarket	Aotea Station	20	11	9	45%
Karangahape Station	Britomart	18	6	12	67%

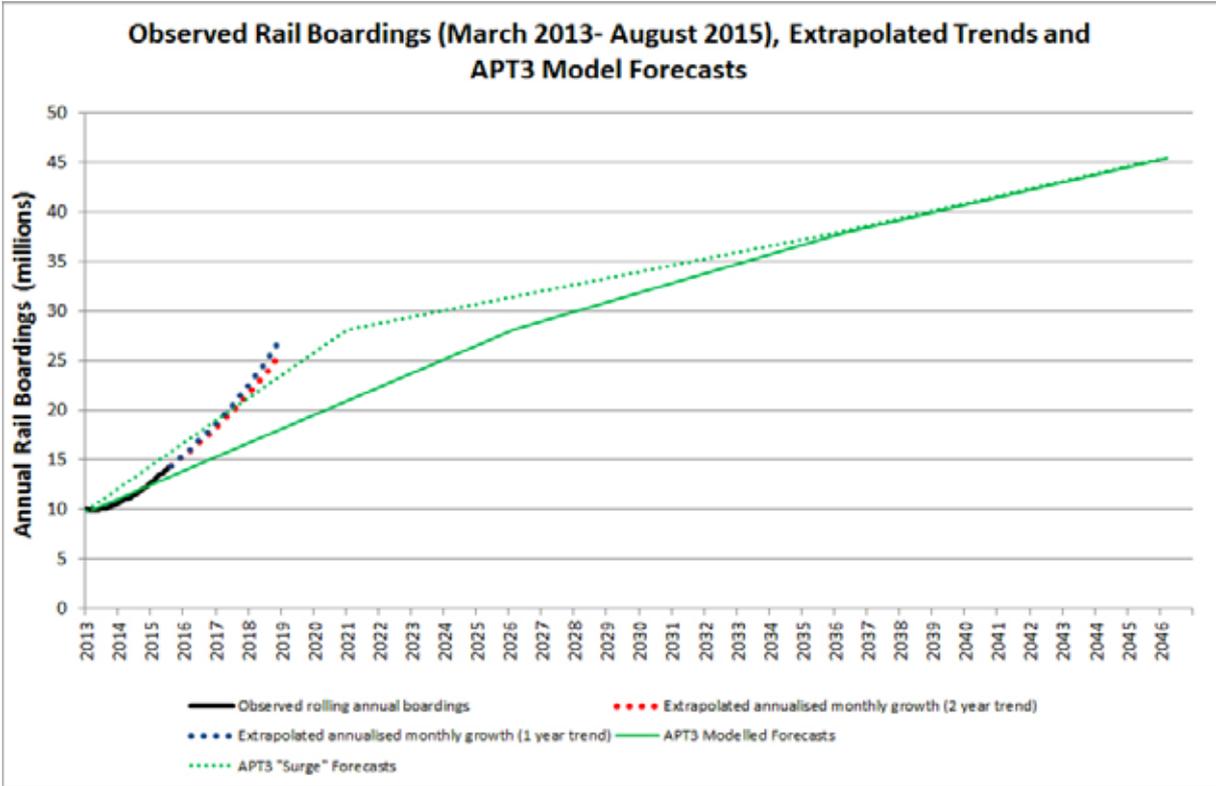
7.8 Correction to recognise recent very high rail patronage growth

The APT3 patronage forecasts are based on model parameters that were estimated to align modelled public transport patronage with that observed in March 2013. Since this time there has been very high growth in rail patronage. There is little robust explanatory evidence to explain the recent high growth in rail patronage as some has occurred even where “the sparks effect” of electrification and new EMUs had not applied, but it is considered by JMAC that this is not well represented in the base 2013 APT3 model.

The CRL modelling forecasts were developed using the base 2013 validated model parameters. In order to make allowance for the recent surge in rail patronage it was decided that the short term forecasts should be increased to replicate the reality. This was achieved in the CRL economic analysis by applying the 2026 patronage forecasts to 2021, in accordance with the projection. Due to the uncertainty around the causes of the recent high growth, it was decided that long term patronage forecasts should remain at the level predicted by the APT3 model, and as such the 2036 and 2046 forecasts were retained for the economic analysis. This assumption is considered to be conservative, making some allowance for recent high growth, but not assuming the trend will simply continue long term.

Figure 32 below overlays observed annual rail boardings from March 2013 to August 2015, extrapolated one and two year trends, and the annualised APT3 forecasts. The forecasts used for the CRL economic analysis are shown with the dotted green line. These forecasts represent an initial surge in patronage consistent with current observation, but flattens out over time. It is clear that this is highly conservative in comparison to the extrapolated trends. It is considered that the economic analysis based on this forecast is therefore conservative in this regard.

Figure 32 - Observed rail boardings (March 2013 – August 2015), Extrapolated Trends and APT3 Model Forecasts



8 The Economic Case: land-use changes

8.1 Land-use changes

The construction of the CRL will provide a station within a 10 minutes' walk of anywhere in the City Centre. It will double the number of people within 30 minutes train travel of a City Centre rail station. This change will create the targeted connections and accessibility within Auckland sought in the Auckland Plan and provide the spur for increased development around stations.

8.2 Station investment areas

Through improving the accessibility of the centre, the CRL will act as an economic and urban redevelopment catalyst, stimulating investment in the City Centre and Fringe locations such as Midtown, Karangahape Road and Newton. It will expedite major redevelopment above and adjacent to stations areas and also within the wider walkable catchments. The CRL assessment recognises the relationship between delivering a rail project to increase transport capacity and the city-wide place-making opportunity. The project provides the opportunity to encourage private investment while creating a lasting enhancement of Auckland.

In planning for such development, the importance of high quality station design and integrating the station with the urban fabric cannot be overemphasised. Station buildings are the "front doors" to passenger rail transport and play an important role in improving the passenger experience and increasing patronage. The station buildings and surrounding station precincts also have a role to play in achieving the Council's aspirations for a 21st century city and high quality of life. Each station must be integrated into its surrounding context and make a positive contribution to the unique local cultural and physical context and opportunity. The station buildings will introduce a new typology to the existing rail network - a new generation of civic buildings. The design of the station precincts will be guided by the Urban Design Framework which incorporates Mana whenua design principles. Design will be carefully managed to provide a well-balanced outcome considering multiple functions, from providing efficient public transport and a great customer experience and amenity to providing good access, including to new commercial buildings above or adjacent to the station entry.

International case studies of station precincts highlight a strong link between the provision of new rail stations and significant increases in property values in the surrounding area, which can be in the order of 33 per cent, whilst providing the confidence needed for redevelopment of surrounding areas. This is because rail infrastructure represents permanent capital investment with new rail stations acting as powerful economic drivers. There is also evidence internationally that the economic impact of property values within 500m of a new station is two to three times the cost, which, if translated to the CRL, would mean each new station area's surrounding property values could have \$1b uplift in value.⁴⁹

8.2.1 Demand side research

Real estate market research and investigations relating to the City Centre and Fringe has given an understanding of demand and supply across all market segments including rental rates, tenancy trends and vacancy rates, as well as the major tenants, investors, development companies, development pipeline and vacant site capacity. This research has informed the highest and best use development concepts and associated financial feasibility models for Transport Oriented Development (TOD) across the proposed CRL stations.

49 Steer Davies Gleave – The Value of Station Investment, November 2011

8.2.2 Delivery

Through the rail infrastructure design process, the project has future proofed above ground development identified through the master planning process. This allows the project to create and capture value within the project footprint. These opportunities include commercial and high density residential development (Transport Oriented Communities (TOCs) and TODs).

The grant of above station development rights to investors/developers will enable TOD opportunities to be realised.

8.3 Investment around individual CRL stations

Investment in quality rail station infrastructure, that is well designed and constructed, has been shown to be a means of accelerating private investment in broader regeneration projects and in some cases is critical to encouraging further development. This phenomenon is seen as a 'ripple effect' whereby station investment gives investors confidence, substantially increasing the level of economic activity in the surrounding area. Britomart Station is a good example of how investment in a new rail station transformed a very rundown central city precinct into a very successful commercial hub and destination, which continues to grow and mature as a premium commercial property location. CRL will provide better regional access to Britomart, making the location even more attractive, which in turn will help the area reach its full development potential. Similar responses are expected at the new stations at Aotea, Karangahape Road and Mt Eden where new stations will make the areas more attractive to quality businesses and tenants to locate⁵⁰).

AT will coordinate and integrate above-ground development opportunities and public spaces with below-ground station areas, through an individual station area master plan. Such a plan is imperative to achieve a quality and consistent design outcome, ensure a world-class passenger experience and provide for effective public realm development integration. It is also very important to identify and conceptualise the commercial development opportunities and property value add of the station areas early, while the design process still has flexibility to accommodate changes. This upfront planning and design coordination will ensure the underground stations are well-designed, integrated transport facilities supporting above-ground development opportunities.

8.3.1 The Opportunity

The refurbishment of the existing Britomart Station, construction of a new station at Aotea (under Albert Street between Wellesley and Victoria Streets) and Karangahape (under the intersection of Pitt Street and Karangahape Road), redevelopment of the existing Mt Eden station provide a significant opportunity to deliver new and upgraded stations. The aim will be to:

- maximise the benefits of the proposed CRL investment, including facilitating patronage and the important 'place shaping' role of the CRL
- create a unique environment that supports patronage, encourages dwell time and that creates a sense of place
- integrate with the core transport functions of the rail stations
- provide a compelling and balanced retail offering
- be design led and based on sustainable design principles
- respond to the environment and individual characteristics of each CRL station site; which are vibrant, people oriented and safe
- attract non-rail users, peak and non-peak users
- be conscious of economic and market context, and ensuring attractiveness to developers and investors is maximised
- optimise returns
- be completed within a reasonable time frame.

50 Drivers of Business Location in the Auckland CBD, Research Report Prepared for Council, Gravitas November 2011

Figure 33- Britomart Station



Britomart Station, which is situated within the AT owned Chief Post Office Building (CPO), will undergo a redevelopment to turn the station into a through running station.

A site-specific retail vision has been developed to ensure a cohesive retail solution is achieved throughout the station once construction is complete. This supports the customer experience strategy by providing retail, convenience, and amenity.

Over station development and value capture opportunity behind the Britomart CPO building is currently being assessed.

8.3.2 Aotea Station

For the Aotea Station, the CRL project requires surface and subterranean property (road reserve and council owned property) for construction.

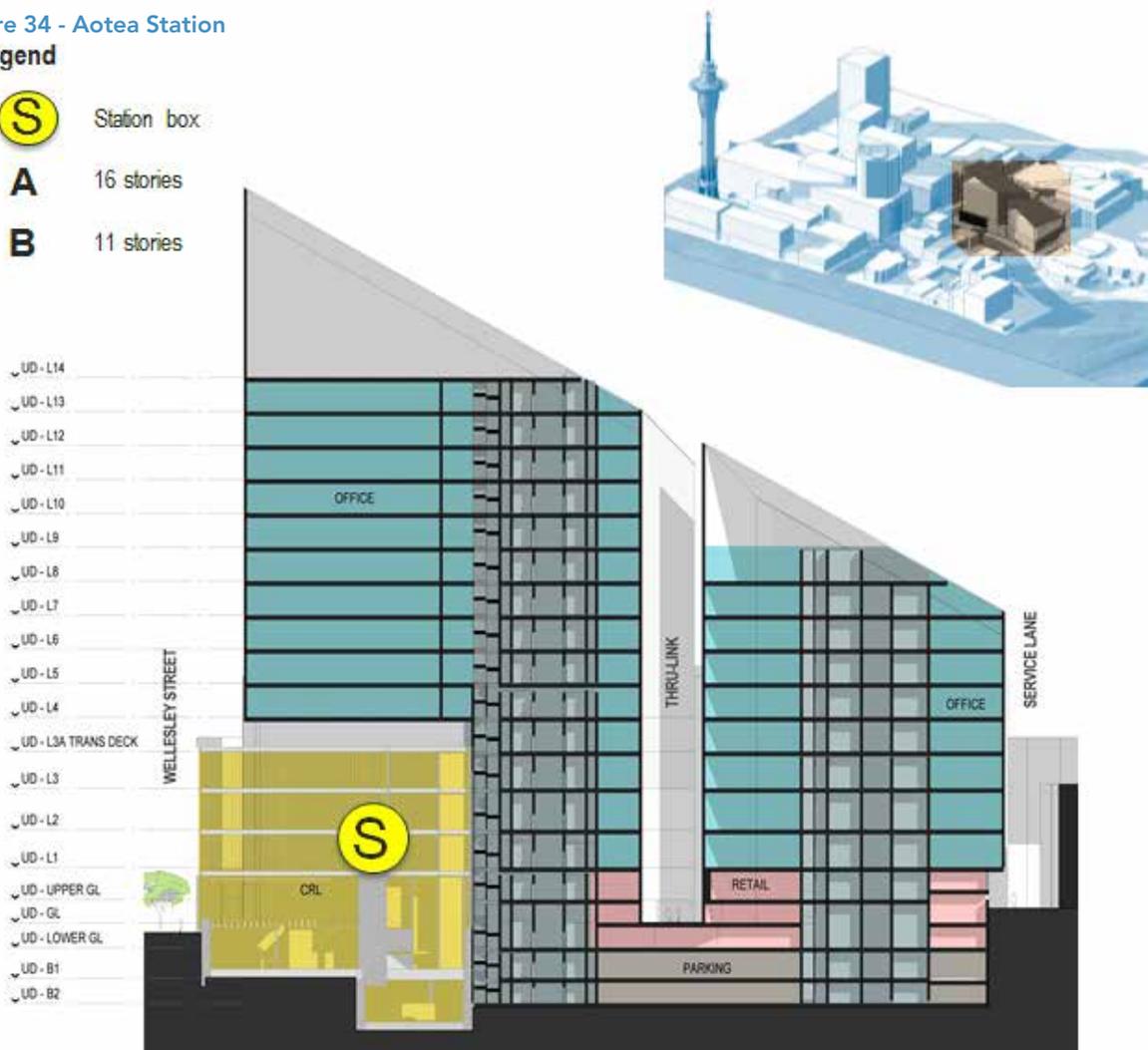
A prominent southern entrance and above station development will be located on the corner of Wellesley Street and Mayoral Drive and two northern entrances are proposed on the eastern and western sides of Victoria Street which intersects with Albert Street.

Council has developed the Aotea Station Gateway Development Framework (ASGDF). The ASGDF includes initial schemes that seek to integrate the station entry with a multi-storey commercial office and retail development across the site which embodies Council's urban design ambitions.

Figure 34 - Aotea Station

Legend

- S** Station box
- A** 16 stories
- B** 11 stories



The CRL Project has undertaken a concept study of the development opportunity at this location. It builds upon the ASGDF and considered the controls relating to the Operative District Plan (ODP) and the Proposed Auckland Unitary Plan (PAUP).

Development potential under the ODP and PAUP is summarised below:

Figure 35 - ODP and PAUP development potential

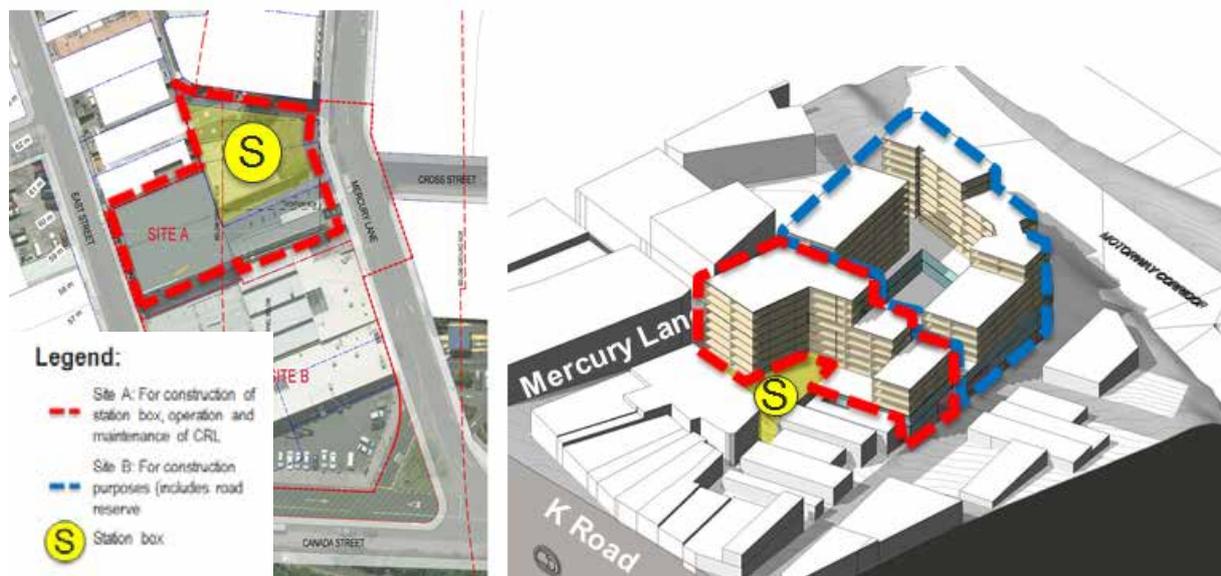
Aotea Development Potential	
Development lot size (land sqm)	4,645sqm
Maximum total floor area sqm (10:1 MTFAR)	46,450sqm
Development potential under the ODP (requires resource consent)	
Developed Value	\$310,000,000
Additional Workers	2,700
Development potential under the PAUP (sqm)	
Developed Value	\$230,000,000
Additional Workers	2,000

8.3.3 Karangahape

At Karangahape the project envisaged a main station entrance at Beresford Square and a second entrance opposite the junction of Cross Road and Mercury Lane. The rail platform will be approximately 33m below ground level at Beresford Square and 26m below at Mercury Lane.

A value engineering exercise resulted in a change to the original vision set out in the NOR. Mercury Lane is now intended as the main station entrance. Beresford Square will be future proofed for possible construction at a later date.

Figure 36 - Karangahape Station



The main development opportunity relates to the remediation of the construction site, station entrance and above tunnel development in the lower part of Mercury lane.

AT has undertaken a study to inform reference design and to future proof transport orientated development above and around the station.

The most likely redevelopment scenario for this site is a mixed use development including ground floor retail (or other active use consistent with the 'fine grained' character of Karangahape Road), and residential with the option for a small amount of commercial office activities above.

The CRL Urban Product study breaks the potential development site into two study areas - sites 'A' to the north and 'B' to the south.

Site 'A' is required for the construction and eventual operation of the proposed Mercury Lane entrance. The study considered residential development within site 'A' above the station box which extends from East to West between Mercury Lane and East Street, basement car parking at the East end of the residential development with an entrance from East Street, and a newly created lane adjoining the residential development which dissects site 'A' and 'B'. The lane looks to improve access to the station by connecting East Street and Mercury Lane, provides retail opportunities at grade and critical fire egress from the station.

Site 'B' is required for construction of the Mercury Lane Station, CRL tunnels and other transport infrastructure. The study considered a mixed use development on site 'B' with two levels of basement car parking, retail to the perimeter of the site at grade as well as the new lane, two levels of commercial offices with multi storey residential apartments above.

Both sites have significant development potential, which if developed appropriately could unlock significant development value, assist in substantially improving the area and support rail patronage.

Figure 37 - Karangahape Station



Development potential within the project footprint

Figure 38 - Development potential within the project footprint

Concept Scheme Developed Potential (requires resource consent)	
Site Area	6,860sqm
Site A GFA	12,000sqm
Site B GFA	29,000sqm
Total FAR 5.4:1	41,000⁴ sqm
Developed Value	\$180,000,000 ²⁰
Additional Residents	500
Additional Workers	400
Additional Dwellings	250

Compliant scheme under the ODP	
Site Area	6,860sqm
Site A GFA	7,000sqm
Site B GFA	20,000sqm
Total Maximum floor area (3:1 MTFAR)	27,000sqm
Developed Value	\$95,000,000
Additional Residents	180
Additional Workers	400
Additional Dwellings	90

Compliant Scheme Under the PAUP	
Site Area	6,860sqm
Site A GFA	9,000sqm
Site B GFA	24,000sqm
Total Maximum floor area (4:1 MTFAR)	33,000sqm
Developed Value	\$130,000,000
Additional Residents	320
Additional Workers	400
Additional Dwellings	160

Council supports a higher density than shown above under the ODP and PAUP. It recognises the need to increase the PAUP density in the lower Mercury Lane area and will pursue a plan change which is aligned to the CRL concept scheme above.

8.3.4 Mt Eden

The land required for the CRL Project at Mt Eden comprises road reserve and property purchased for the main construction yard and for the station and trenches.

The NOR conditions require the remediation of the construction site guided by the Urban Design Framework.

The upgraded Mt Eden Station will be located 500m to the south of the Newton Town Centre and incorporates an upgraded station incorporating platforms constructed within a partial trench and, a new station building. The amended location is to the north of the existing NAL line and is partly over the existing KiwiRail designation.

Under the PAUP, the proposed station location and the construction yard (i.e. within the NOR boundaries) is zoned mixed use. The adjacent areas on the Symonds Street frontage, New North Road frontage, Mt Eden Road frontages are zoned Town Centre.

The mixed use zone permits a wide range of land use activities including residential and smaller scale commercial activity.

Figure 39 - Mt Eden redevelopment potential

Legend:

Development potential inside Mt Eden construction yard

Rail infrastructure

Development potential mostly outside the project footprint under the PAUP (mixed use zone)

Development potential mostly outside project footprint under PAUP (town centre zone)



This is the largest continuous development opportunity for the CRL. The capital investment in CRL provides a significant regeneration opportunity for the area. It has the ability to change the local area in the manner that development has changed the Britomart area. The area could become a dense village with many apartments, shared open spaces and associated amenity services which are significantly different to the uses currently in the area.

A summary of the development potential both within the construction yard (conceptual development planning has been undertaken), and outside the construction yard (conceptual development planning yet to have been carried out), are shown in figure 40, following.

Figure 40 - Mt Eden redevelopment area

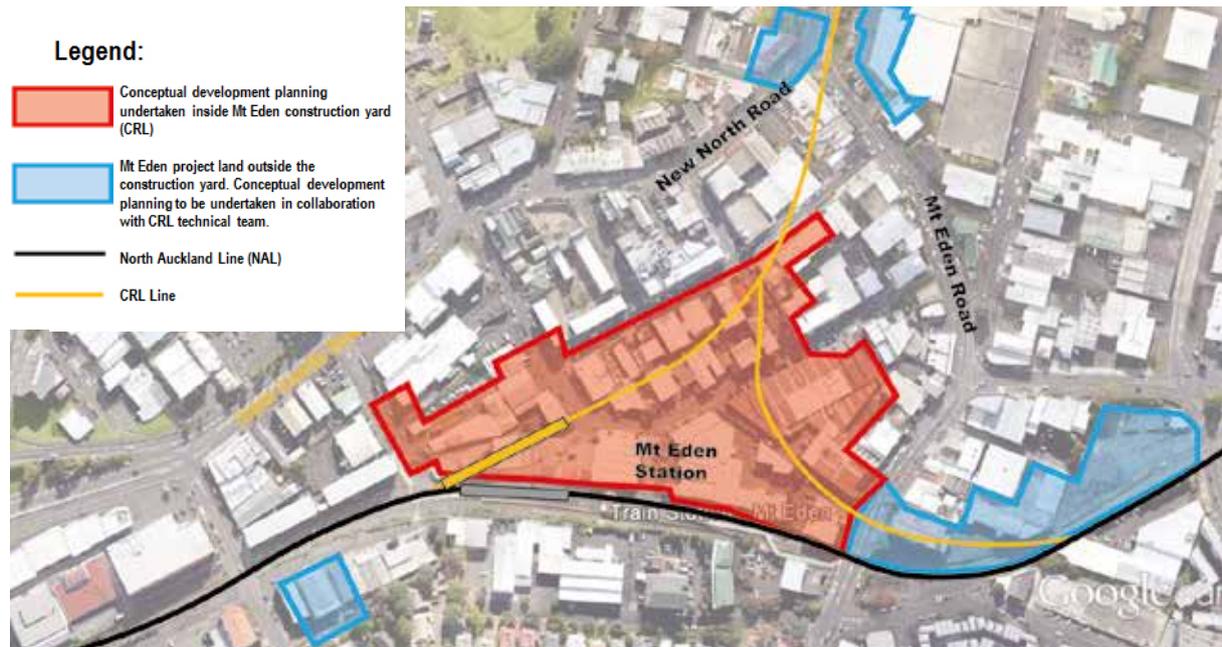


Figure 41 - Mt Eden development potential

Development Potential	
Land acquired at Mt Eden	45,747sqm
Council owned car park land area (marked 16)	1,871sqm

Figure 42 - Area within the construction yard

Area within the construction yard	
Total development gross floor area	70,000sqm – 93,000sqm
Developed value	\$470,000,000 – \$630,000,000
Additional Workers	500 - 600
Additional Residents	1,584 - 2,132
Additional Dwellings	792 - 1,066

Figure 43 - Area outside construction yard

Area outside the construction yard	
Total development gross floor area	58,000sqm – 71,000sqm
Developed value	\$360,000,000 – \$455,000,000
Additional Residents	1,492 - 1,836
Additional Dwellings	746 - 918

The range shown above reflects the opportunity to explore a refined block structure within the footprint which maximises the development density through the development planning process. Further master planning and development capacity analysis will be undertaken in collaboration with the CRL design team in the second half of 2015 to confirm the precise rail alignment and station design.

8.4 Likely effect of CRL in enhancing development around non-City Centre stations

To assist in understanding the potential for additional or earlier residential development to be stimulated by the CRL around the metro rail network's non-City Centre stations, a specialist's report was commissioned from urban planners Jasmox supported by urban economics expertise from MRCagney.⁵¹

The assessment related to potential development outcomes – particularly for more intense building typologies - within the walkable station catchments.

8.4.1 Headline results

The development feasibility modelling suggested that the accessibility and accompanying property value benefits of the CRL could increase the number of dwellings currently feasible for development within station catchments by 41 per cent, from approximately 40,000 dwellings to some 57,000 dwellings.

The impact of the CRL project on development feasibility varied substantially between stations catchments across the network.

The model used four key variables to estimate development outcomes:

- Accessibility change resulting from the CRL (number of additional jobs accessible within 30 minute and 45 minute commute times from stations)
- Underlying property values for parcels within station catchments
- Planning zones applied to property parcels within station catchments
- Estimated property value uplift resulting from the accessibility benefits of the CRL.

The model suggested that increased residential development feasibility resulting from the CRL will generally be greater in station catchments that have significant accessibility benefits from the project, and where supportive zoning and underlying property values support intensive residential development.

Advice suggests that there are inevitable caveats to these results and that they should not be treated as forecasts of actual levels of future development. The amount of development that will actually take place is dependent on a whole range of market factors that are difficult to forecast, and only partially captured by the model. The reported figures represent what development is feasible given 2014 property sales values and development costs. Future inflation in property sales values and development costs will change the level of feasibility over time – and at different rates for different stations. The impact of the CRL may be best considered as accelerating or bringing forward residential development around particular stations.

Nevertheless the report provides expert opinion on the likely scale of change, taking account of realistic take-up of development opportunities and the economics of differing property types as they are affected by access.

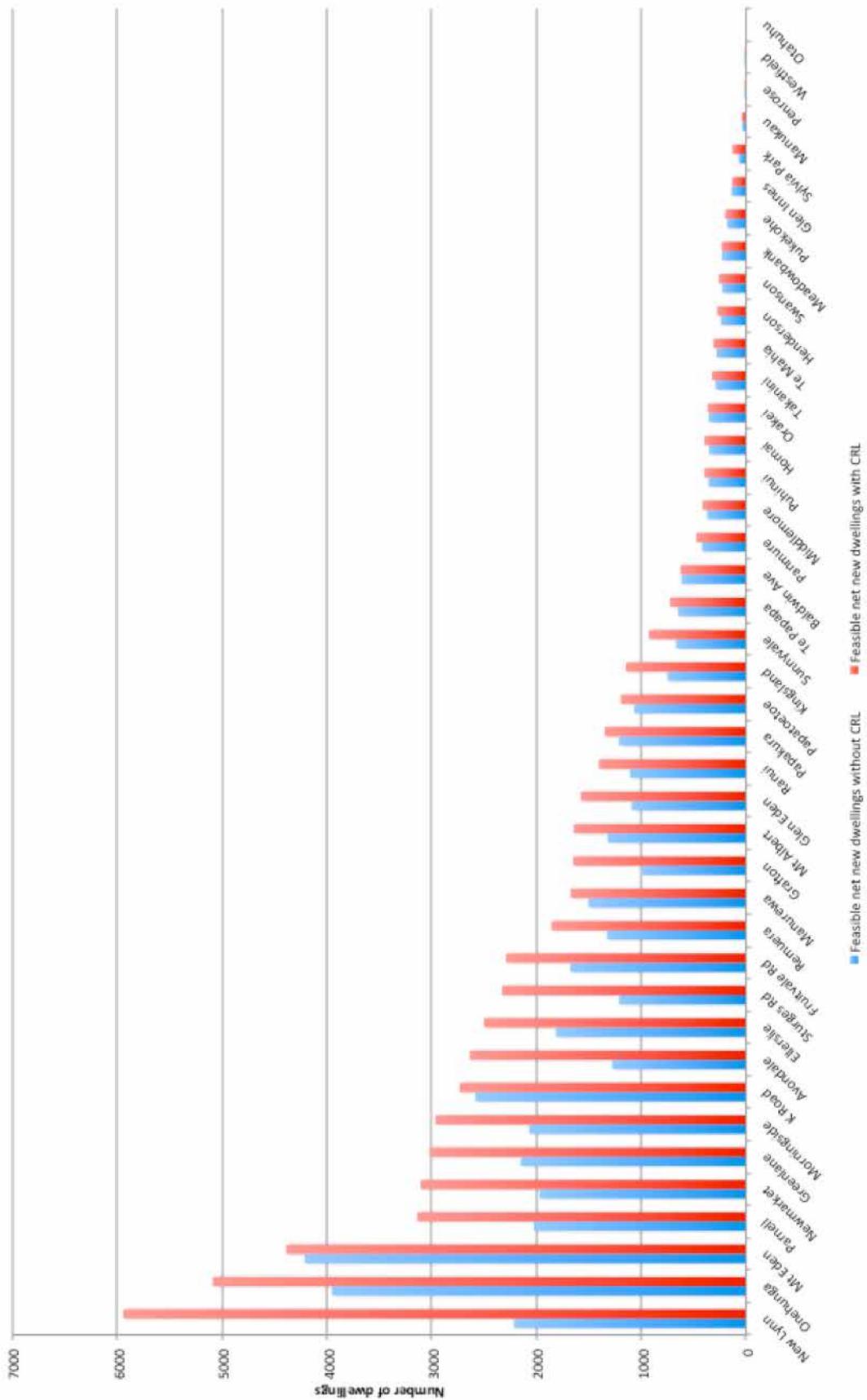
8.4.2 Results across station catchments

The results by catchment are very variable. Many station catchments contain small areas of land zoned for residential intensification, with larger areas of sites falling under the "Single House Zone" of the PAUP, notified 30th September 2013. Other station catchments contain large areas of land zoned for intensification, but are already significantly developed. While other station catchments contain areas of land that are not feasible for development, either with or without the CRL project.

A summary of results is shown in Figure 44. Note that the estimate for Mt Eden excludes the consideration of additional land that will become available for development after CRL construction. Neither does it include the potential impacts of urban amenity improvements associated with new station construction that may further catalyse new development.

⁵¹ Estimating the impact of the Auckland City Rail Link (CRL) on residential development in station catchments across the rail network, 11th August 2015, Jasmox and, MRCagney, for AT

Figure 44 - Residential development feasibility in Auckland rail station walkable catchments, 2014, with and without the CRL



9 The Economic Case: economic appraisal

9.1 Introduction

This section presents the results of the economic appraisal. It is supported by Appendix 6 which is the report from PwC on standard transport benefits and Wider Economic Benefits (WEBs) in accordance with the Transport Agency's EEM. It also includes the specialist report on WEBs from Australian urban economics experts, SGS Economics and Planning, who are recognised leaders in the discipline with methodologies adopted and applied by the Victorian and other Australian state governments.

The SGS report not only covers the theory of WEBs and the calculations for the CRL, but provides evidence of how they have been generated by a similar project that has been in operation for some thirty years – the Melbourne City Loop.

In this report the calculations are attributed to the consultant as they are the source of the calculations. In some cases there are differences between the estimates produced by the two consultants owing to their differing methodologies. Attribution shows where these differences arise.

AT has separately assessed the calculations and adopted the results for this business case.

The economic analysis approach and findings have been peer reviewed by Mr Alex Sundakov, of Castalia Strategic Advisors. He confirmed: "In my view, the PwC report provides a sensible and coherent calculation of the conventional benefits using the New Zealand Transport Agency's Economic Evaluation Manual. It also appropriately incorporates the SGS material, which I have reviewed previously." Dr Sundakov's peer review letter is included in Appendix 5.

The conventional transport benefit categories associated with the CRL that have been included in the evaluation are:

- Travel time benefits (for both public transport and general road users)
- Decongestion benefits
- Vehicle operating cost reduction benefits
- Additional public transport user benefits
- Reliability improvement benefits
- Health benefits from walking
- Emission reduction benefits
- Residual value of the infrastructure.

In addition to the conventional transport benefits, the wider economic benefits associated with agglomeration have also been estimated. The agglomeration benefits capture the effects that large transport infrastructure projects can have on the economy by improving economic productivity. This improvement is enabled by increased density of employment and improved accessibility, particularly to areas of employment. The CRL encourages intensification of businesses and people around areas which become more accessible – the City Centre and Fringe and areas along the rail line.

9.2 Results

Figure 45 below summarises the total undiscounted and discounted benefits of the CRL using the standard EEM discount rate of 6% and evaluation period of 40 years and alternative scenarios.

Figure 45 - Benefit cost ratios

Aotea Development Potential	4% 40 years	6% 40 years	8% 40 years	4% 60 years
Medium growth scenario				
Benefits	\$4,602m	\$2,889m	\$1,882m	\$6,850m
Costs	\$2,223m	\$1,853m	\$1,576m	\$2,345m
BCR	2.1	1.6	1.2	2.9
Alternative growth scenario				
Benefits	\$5,031m	\$3,147m	\$2,043m	\$7,717m
Costs	\$2,223m	\$1,853m	\$1,576m	\$2,345m
BCR	2.3	1.7	1.3	3.3

Cost Sensitivity Testing

In addition to the sensitivity tests above, two further sensitivity tests were undertaken relating to the costs of the project. To account for the potential uncertainty in both capex and opex costs. These were two sensitivity tests where the costs are increased or decreased by 10 per cent and 20 per cent.

Figure 46 below presents the BCRs for the cost sensitivity tests undertaken.

Figure 46 – Cost sensitivity testing

Standard	Capex changes				Opex changes				
		Decrease by 20%	Decrease by 10%	Increase by 10%	Increase by 20%	Decrease by 20%	Decrease by 10%	Increase by 10%	Increase by 20%
Medium growth scenario									
Benefits	\$2,889m	\$2,889m	\$2,889m	\$2,889m	\$2,889m	\$2,889m	\$2,889m	\$2,889m	\$2,889m
Costs									
Capex	1,513m	1,211m	1,362m	1,665m	1,816m	1,513m	1,513m	1,513m	1,513m
Opex	340m	340m	340m	340m	340m	272m	306m	374m	408m
Total	\$1,853m	1,551m	1,702m	2,005m	2,156m	1,785m	1,819m	1,887m	1,922m
BCR	1.6	1.9	1.7	1.4	1.3	1.6	1.6	1.5	1.5

PwC and SGS calculations

As observed in figure 45 the BCR for the CRL is 1.6 (medium growth, EEM specified 6% discount rate and 40 year evaluation period).

Under the alternative growth scenario, the BCR increases to 1.7. This could be considered to be slightly conservative, as the agglomeration benefits may increase further in this scenario but have not been explicitly calculated.

The sensitivity testing on the discount rate shows that the BCR is greater than 1.0 in all scenarios with a range of 1.2 – 3.3. It is also robust against the appropriate cost sensitivities for this stage of development with a range of 1.3 to 1.9.

9.3 Wider Economic Benefits

Wider Economic Benefits are an intrinsic element of the evaluation and are particularly important for a city- shaping public transport project such as the CRL. As SGS comment:

“The City Rail Link will do more than add a tunnel between Britomart and Mount Eden. It will increase the range of transport options for people across the city, improving access and connectivity. The impacts of improved access and connectivity are more widespread than simply lower travel times. Improved access and connectivity can multiply the effectiveness of cities, by improving the agglomeration economies that make cities work.

“Agglomeration economies have been well documented over the past century. The continuing intensification of cities proves the increasing relevance of agglomeration economies in the 21st Century. Agglomeration economies flow from business being able to interact easily with each other. They learn from each other and innovate to develop new products and open up new export markets. Workers presented with a large pool of jobs should be better matched to their roles and hence become more productive. There will be informal transfer of knowledge between skilled workers further boosting innovation and productivity in the long run.

“As the economy of Auckland becomes more and more ‘knowledge-intensive,’ agglomeration economies should become increasingly important. The CBD is the preferred location of these knowledge-intensive industries. Effectively, growing the Auckland CBD will help generate more income for businesses located there and more taxation revenue for Central Government. Estimating the agglomeration benefit from the CRL helps to quantify how great the uplift in income and taxation will be, which industries will benefit the most and which parts of Auckland will benefit the most from the project.

“Using generalised costs for car travel and composite costs for public transport travel as modelling inputs, SGS Economics and Planning estimates that the City Rail Link will lift economic output in 2026 by \$48.8 million (a 0.04% uplift to Auckland’s GDP) and 2046 by over \$173.1 million (a 0.08% uplift to Auckland’s GDP). This calculation is based on estimates of agglomeration economies and will be explained in depth in the following sections. This outcome is in line with international projects of a similar scale.

“Industries which cluster in the CBD will be ‘winners’ from the City Rail Link, but the largest single beneficiary is Central Government. Over the 40 year period, Central Government would collect around \$1.4 billion (in undiscounted terms) in taxation revenue as a result of the City Rail Link.”

The value of the agglomeration benefits calculated by SGS, over 40 years, discounted at 6% is \$866m. The PwC calculation using the EEM approach is close to that value, at \$742m giving confidence in the estimation.

9.4 Standard Transport Benefits

The economic evaluation was performed on an incremental basis, i.e. the CRL option relative to the do-minimum scenario. Therefore benefits are estimated relative to do-minimum and costs are incremental costs over and above what would be spent in the do-minimum.

9.4.1 Core assumptions

Core assumptions are outlined in Figure 47 following, with additional assumptions included below.

Figure 47 - Core assumptions for economic evaluation

Assumption	Value
Year of construction	2015 to 2022
Year CRL opens and benefits begin	2023
Discount rate	6%
Evaluation period	40 years
Time zero	2013

Time zero for the economic analysis is 2013, which is the year of first significant expenditure. Expenditure on land purchases were first made in 2013.

9.4.2 Land use scenarios

Two land use scenarios were modelled by JMAC. The medium growth scenario (I8b) is the standard scenario as shown in the figure below which compares Statistics New Zealand forecasts from 2006 on which the modelling is based with the 2013 version⁵². The alternative growth scenario (H7b) was also modelled as Statistics NZ data show that growth in Auckland is tracking above the medium scenario.

The alternative scenario contains more people and households than the medium growth scenario, and represents an underlying spatial land use pattern that may be closer to that represented in the PAUP.

9.4.3 Annualisation

The standard transport model data and outputs were provided by JMAC for the 2 hour AM peak period for ART and APT and the 1 hour AM peak period for SATURN. The annualisation factors used are shown in Figure 48.

Figure 48 - Annualisation factors

Model	Measure	Annualisation factor	Used for:
APT	Overall annualisation factor	1,100	Estimating annual benefits for all time periods
ART	Road user benefit annualisation factor	950	Travel time savings, VOC savings, CO2 emission reduction benefits
ART	Decongestion benefit annualisation factor	500	Reduced congested travel benefits (CRV)
SATURN	Overall annualisation factor	1,445	Overall benefits
SATURN	Decongestion benefit annualisation factor	850	Reduced congested travel benefits

⁵² http://www.stats.govt.nz/browse_for_stats/population/estimates_and_projections/SubnationalPopulationEstimates_HOTPA30Jun14.aspx

9.4.4 Results - non-monetised

The results from the APT model are shown in Figure 49 (medium growth scenario) and Figure 50 (alternative growth scenario). The values are the overall travel time savings across the Auckland region, aggregated for all journeys occurring in the 2 hour am peak period.

Figure 49 - Regional APT travel time savings (2 hour am peak period)

	2026	2036	2046
New users (mins)	49,507	78,986	89,456
Existing users (min)	392,348	582,623	779,790

Figure 50 - Regional APT travel time savings, alternative growth scenario (2 hour am peak period)

	2026	2036	2046
New users (mins)	56,848	95,913	N/A
Existing users (min)	454,199	690,605	N/A

9.4.5 Value of time

Weighted average values of time for public transport and private vehicles were developed, using the EEM. All values were updated to 1 July 2014 using the benefit update factor for the travel time cost savings.⁵³

Figure 51 - Value of time by model (2014\$/hr)

Model (Vehicle type, trip purpose)	Value of time	Resource cost correction on value of time	CRV
ART			
Car, Work	\$32.95	\$0.00	\$4.15
Car, Commute	\$10.28	\$1.34	\$4.15
Car, Other	\$9.11	\$1.19	\$3.62
HCV, All	\$26.73	\$0.40	\$4.44
APT			
Public transport, all	\$14.26	N/A	N/A
SATURN			
All vehicles, all trips	\$21.48	N/A	\$5.51

9.5 Results - monetised

This section gives the economic value of the standard transport benefits.

9.5.1 Travel time savings benefits

The travel time reduction benefits are based directly from the transport model outputs.

⁵³ Available at <http://www.nzta.govt.nz/resources/economic-evaluation-manual/economic-evaluation-manual/eem/>

Figure 52 - Total travel time savings benefits (annual undiscounted values)

Model/area		2026	2036	2046
APT	New users	\$12.9m	\$20.7m	\$23.4m
	Existing users	\$102.6m	\$152.3m	\$203.9m
ART (outside SATURN)	All trip purposes	\$8.9m	\$14.6m	\$26.6m
SATURN	All trip purposes	\$1.5m	\$2.7m	\$3.0m

Figure 53 - Total travel time savings benefits, alternative growth scenario (annual undiscounted values)

Model/area		2026	2036	2046
APT	New users	\$14.9m	\$25.1m	N/A
	Existing users	\$118.8m	\$180.6m	N/A
ART (outside SATURN)	All trip purposes	\$5.1m	\$6.0m	N/A
SATURN	All trip purposes	\$2.0m	\$3.5m	N/A

9.5.2 Decongestion benefits

The decongestion benefits are the additional travel time savings under congested conditions⁵⁶.

Figure 54 - Total decongestion benefits (annual undiscounted values)

Model/area		2026	2036	2046
ART	All trip purposes	\$0.8m	\$1.5m	\$2.9m
SATURN	All trip purposes	\$0.2m	\$0.4m	\$0.4m

Figure 55 - Total decongestion benefits, alternative growth scenario (annual undiscounted values)

Model/area		2026	2036	2046
ART (outside SATURN)	All trip purposes	\$0.4m	\$0.4m	N/A
SATURN	All trip purposes	\$0.2m	\$0.4m	N/A

9.5.3 Vehicle operating cost reduction benefits

The vehicle operating cost reduction benefits are typically derived from the improvements in travel speeds (for vehicles on the road) and fewer vehicles on the roads (due to mode shift to mass transit).

Figure 56 - Total vehicle operating cost reduction benefits (annual undiscounted values)

Model/area		2026	2036	2046
ART (outside SATURN)	All trip purposes	\$0.5m	\$1.5m	\$1.6m
SATURN	All trip purposes	\$0.2m	\$0.2m	\$0.1m

Figure 57 - Total vehicle operating cost reduction benefits, alternative growth scenario (annual undiscounted values)

Model/area		2026	2036	2046
ART (outside SATURN)	All trip purposes	\$0.4m	\$0.9m	N/A
SATURN	All trip purposes	\$0.1m	\$0.2m	N/A

9.5.4 Additional PT user benefits

Section A18 of the EEM gives the benefits associated with improving PT infrastructure and services.

Figure 58 - Additional PT user benefits (annual undiscounted values)

	2026	2036	2046
PT user benefits	\$4.3m	\$5.6m	\$6.8m

Figure 59 - Additional PT user benefits, alternative growth scenario (annual undiscounted values)

	2026	2036	2046
PT user benefits	\$4.5m	\$5.9m	N/A

9.5.5 Reliability improvement benefits

Reliability benefits are generated from reduced variability in travel times (in vehicle) and departure times. The analysis assumed that reliability benefits arise for the new rail passengers, owing to the physical separation from general traffic which allows passengers on trains to travel reliably, unaffected by road congestion.

The EEM reliability benefit calculation requires an estimate of the change in the average minutes late for the affected passengers. The current bus travel time variability is 6 minutes. For rail a 2 minute variance from timetabled travel times was allowed.

Figure 60 - Total reliability improvement benefits (annual undiscounted values)

	2026	2036	2046
Reliability improvement benefits	\$34.6m	\$40.2m	\$46.7m

Figure 61 - Total reliability improvement benefits, alternative growth scenario (annual undiscounted values)

	2026	2036	2046
Reliability improvement benefits	\$34.4m	\$39.0m	N/A

9.5.6 Health benefits from walking

The health benefits from walking are included for the additional rail passengers. Completely new rail passengers and those ex-car passengers gain health benefits from walking to and from the train stations. There is also likely to be an incremental health benefit to those ex-bus passengers, as the rail stations are spaced further apart than bus stops which will lead to longer walk distances in most cases.

Figure 62 - Total health benefits from walking for additional rail passengers (annual undiscounted values)

	2026	2036	2046
Health benefits from walking	\$11.6m	\$16.8m	\$21.7m

Figure 63 - Total health benefits from walking for additional rail passengers, alternative growth scenario (annual undiscounted values)

	2026	2036	2046
Health benefits from walking	\$13.1m	\$19.7m	N/A

9.5.7 Emissions reduction benefits

The environmental benefits from emissions reductions of carbon dioxide (CO₂), particulate matter (PM₁₀) and mono-nitrogen oxides (NO_x) are included due to the faster travel times and mode shift. The volume of emissions of CO₂, PM₁₀ and NO_x were modelled by the ART transport model for the CRL and do-minimum scenarios for each day. The ART transport model also produced the volume of volatile organic compound emissions, but no reliable figure to monetise the benefit of its reduction was found.

Figure 64 - Total emissions reductions benefits (annual undiscounted values)

Emission type	2026	2036	2046
CO2	\$203k	\$218k	\$535k
PM10	\$261k	\$342k	\$418k
NOx	\$68k	\$74k	\$106k
Total	\$532k	\$635k	\$1.1m

Figure 65 - Total emissions reductions benefits, alternative growth scenario (annual undiscounted values)

Emission type	2026	2036	2046
CO2	\$169k	-\$39k	N/A
PM10	\$7k	\$3k	N/A
NOx	\$77k	\$22k	N/A
Total	\$253k	-\$14k	N/A

9.5.8 Residual value of the project

Rail infrastructure tends to have a very long operating life, with tunnels in particular being recognised as having a useful life well in excess of 75 years⁵⁴. The residual value of the infrastructure associated with the CRL has been included as it is a significant economic investment and it will have a significantly longer life than the 40 year evaluation period.

The residual value was calculated as 50% of the infrastructure cost, discounted to the 40th year of the evaluation period. For the CRL, the residual value used in the economic evaluation is \$967m (before discounting to the current value).

9.5.9 Standard Transport Benefit summary

Figure 66 presents the benefits under the medium growth scenario with the total undiscounted and discounted benefits over 40 years

Figure 66 - Benefits for modelling outputs from the medium growth scenario over 40 years

Benefit category	Undiscounted	Present Value (6% discount rate)
Travel time		
PT users	\$5,405.4m	\$1,278.9m
Road users	\$623.8m	\$136.4m
Decongestion benefits	\$67.5m	\$14.3m
Vehicle operating cost reduction benefits	\$40.9m	\$9.6m
Additional PT user benefits	\$171.8m	\$42.4m
Reliability benefits	\$1,242.7m	\$317.0m
Health benefits from walking	\$523.4m	\$125.0m
Emissions reduction benefits	\$23.9m	\$5.6m
Residual value	\$967.1m	\$94.0m
Total conventional benefits	\$9,066.3m	\$2,023.3m

PwC analysis

54 KiwiRail (2013) Annual Report 2013, 19pp. Accessed 27 July 2015. [http://www.kiwirail.co.nz/uploads/Publications/2013%20Annual%20Report%20\(NZRC\).pdf](http://www.kiwirail.co.nz/uploads/Publications/2013%20Annual%20Report%20(NZRC).pdf)

Figure 67 represents the benefits under the alternative growth scenario with the total undiscounted and discounted benefits over 40 years.

Figure 67 - Benefits for modelling outputs from the alternative growth scenario over 40 years

Benefit category	Undiscounted	Present Value (6% discount rate)
Travel time		
PT users	\$6,983.7m	\$1,589.0m
Road users	\$293.2m	\$71.8m
Decongestion benefits	\$25.8m	\$6.3m
Vehicle operating cost reduction benefits	\$36.3m	\$7.9m
Additional PT user benefits	\$194.3m	\$46.7m
Reliability benefits	\$1,222.6m	\$312.3m
Health benefits from walking	\$666.7m	\$152.8m
Emissions reduction benefits	\$2.0m	\$1.0m
Residual value	\$967.1m	\$94.0m
Total conventional benefits	\$10,391.6m	\$2,281.6m

9.6 Wider Economic Benefits

In the EEM guidelines, the main wider economic benefits to be incorporated in analysis of transport projects in New Zealand are:

- Agglomeration benefits – the productivity improvements due to increased density of employment opportunities
- Imperfect competition – the additional output an economy produces, due to reducing transport costs into imperfect markets
- Increased labour supply – the additional tax revenue generated by new workers entering the labour force as a result of reduced transport costs.

Of these, the agglomeration benefits are often the most significant in value.⁵⁵ The mechanism for agglomeration benefits to occur, the analytical method and estimates of the CRL’s agglomeration benefit, are outlined in the following section.

9.6.1 Agglomeration benefits

Transport infrastructure has the ability to change the spatial concentration of economic activity in the city. The CRL encourages intensification of businesses and people around areas which become more accessible – the City Centre, City Centre Fringe and areas along the rail line. There is broad consensus in the literature that increased density is associated with improved productivity with estimates of the elasticity of productivity of increasing urban concentration between 0.01 and 0.2, though this relationship is dependent on the industry.⁵⁶

⁵⁵ See Figure 13.1 (page 76) of Kernohan and Rognlien (2011) for an assessment of the wider economic benefits of projects, primarily in the UK and Figure 19.1 (page 103) for an assessment of the wider economic impacts of the Additional Waitemata Harbour Crossing. These tables show the agglomeration benefits are typically far in excess of the labour supply and imperfect competition benefits for individual projects.

⁵⁶ For example, Rosenthal and Strange (2004) estimate that a doubling of city size increases productivity by between 3% and 8%. Melo et al (2012) find that a doubling of employment density leads to an increase in average wages of 4.3% in the US. Local research also suggests a strong positive relationship between density and productivity measures. Williamson et al (2008) suggest that doubling employment density is associated with an increase in average wages of 9.9% and Mare (2008) suggests a smaller relationship on productivity of 5.4%.

9.6.2 CRL agglomeration benefit estimates

The method used by SGS is broadly in line with the EEM. Each method estimates effective job density (EJD) and uses the difference in EJD between the CRL and do minimum scenario as the basis for the change in productivity. Appendix 5 gives the detailed analyses used.

Figure 68 below shows the present value (PV) of the agglomeration benefits over a 40 year period. The standard 6% discount rate over 40 years scenario is presented, along with a range of typical NZTA EEM sensitivity tests.

Figure 68 - SGS estimates of the agglomeration benefits

	4% 40 years	6% 40 years	8% 40 years	4% 60 years
Present value of agglomeration benefits	\$1,399m	\$866m	\$555m	\$2,399m

Source: SGS calculations

SGS's estimate of the agglomeration benefit suggests that the CRL will provide additional benefits of \$866m over 40 years, not accounted for in the assessment of traditional benefits. This represents the potential economic output that can be produced by improved labour productivity.

Figure 69 - EJD with CRL

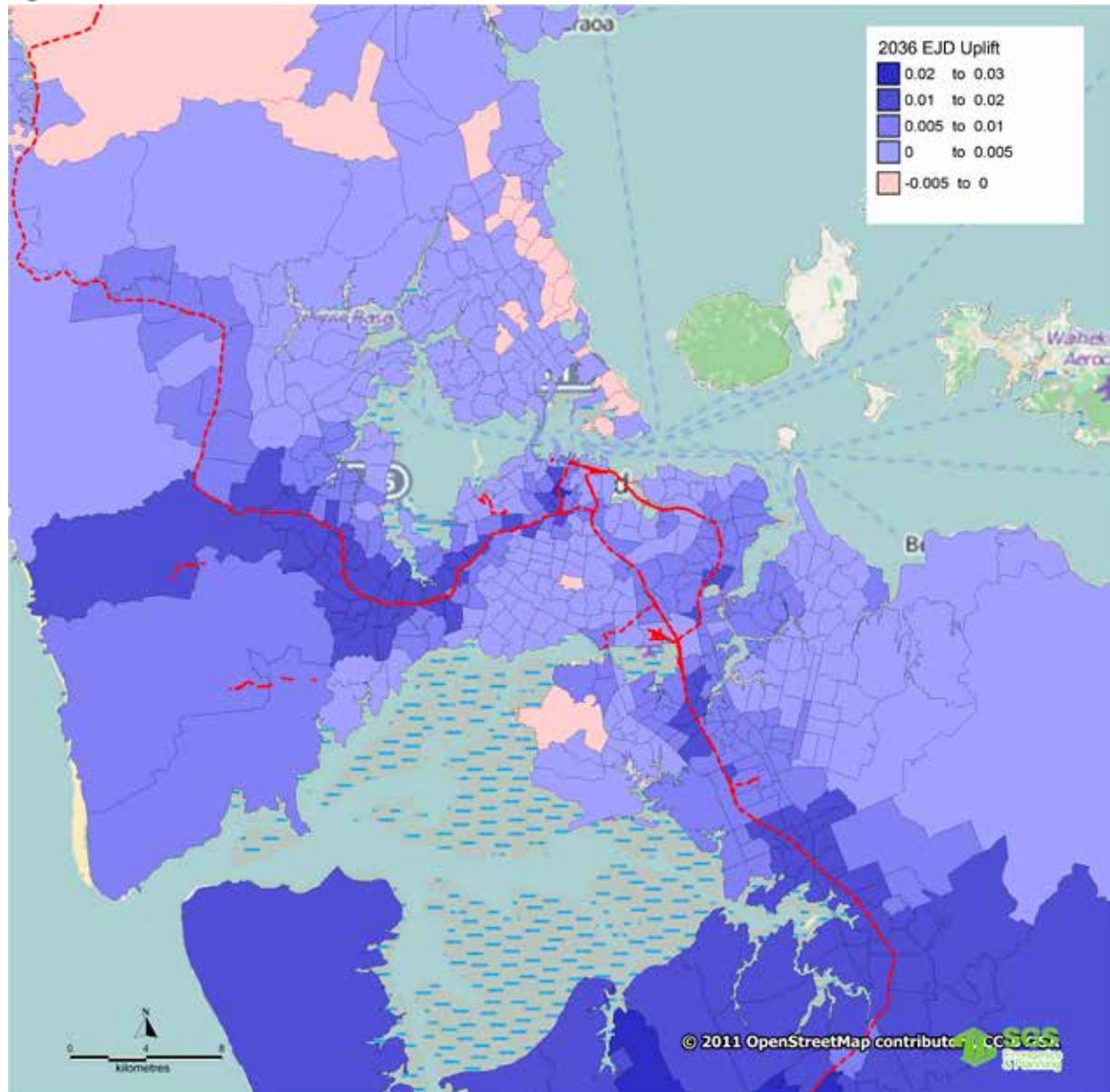


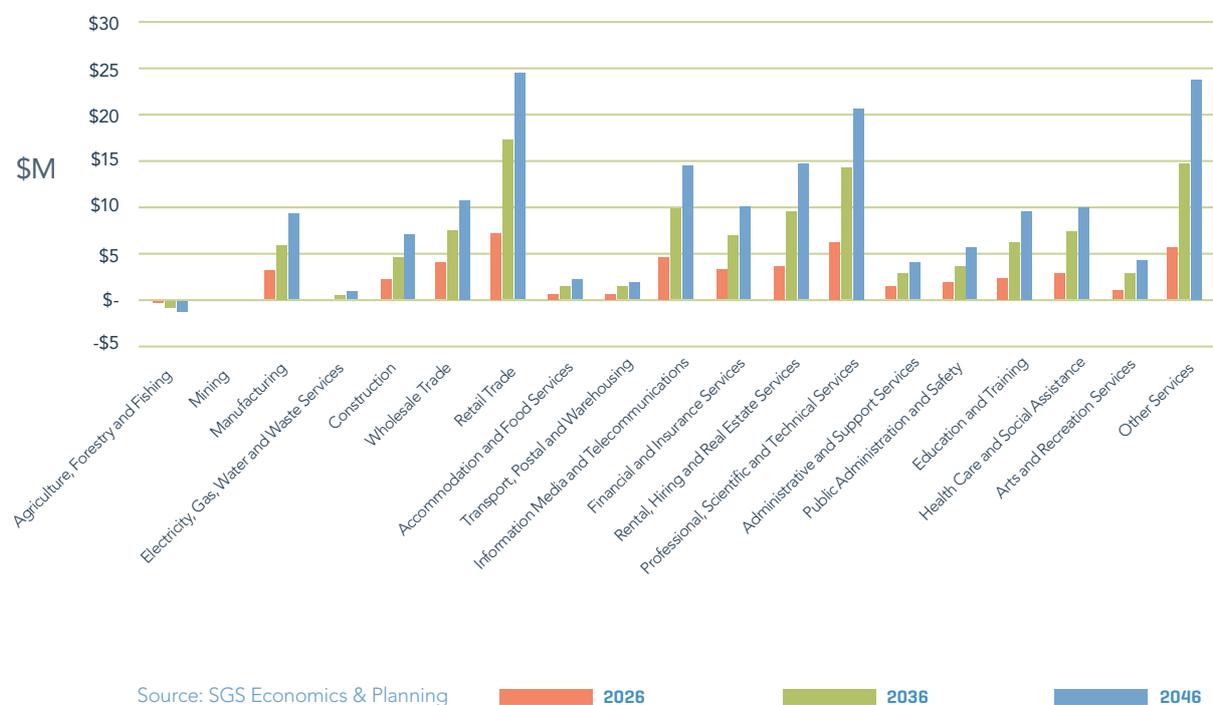
Figure 69 previous page shows the change (proportional) in EJD that would result under the CRL scenario.

The analysis creates an estimated uplift in value added for each of 19 industry categories in the 557 transport zones within Auckland, for 2026, 2036 and 2046. The results were aggregated across the areas to estimate the industry-by-industry effects.

Sectors with the biggest uplifts in value added include sectors likely to locate in the inner city of Auckland such as:

- Central Government – via increased income, GST and companies taxes.
- Retail trade – as a result of greater concentration of customers and hence increase demand for goods.
- Professional services – due to improved access to labour and interaction with customers and other suppliers.
- Information & media – due to greater interaction with customers and other suppliers.
- Real estate services – larger economic mass creating increased demand for development.
- Financial services – due to improved access to labour and interaction with customers.

Figure 70 - Increased employment sectors within CBD



PwC produced an alternative estimate of the agglomeration using the method prescribed by the EEM. There are a few differences between the two methods, including:

- Different cost variable used for public transport
- Different agglomeration elasticities
- Different allocation from transport model zones to small area units
- Different calculation method for the effective job density
- Different calculation for overall economic output change.

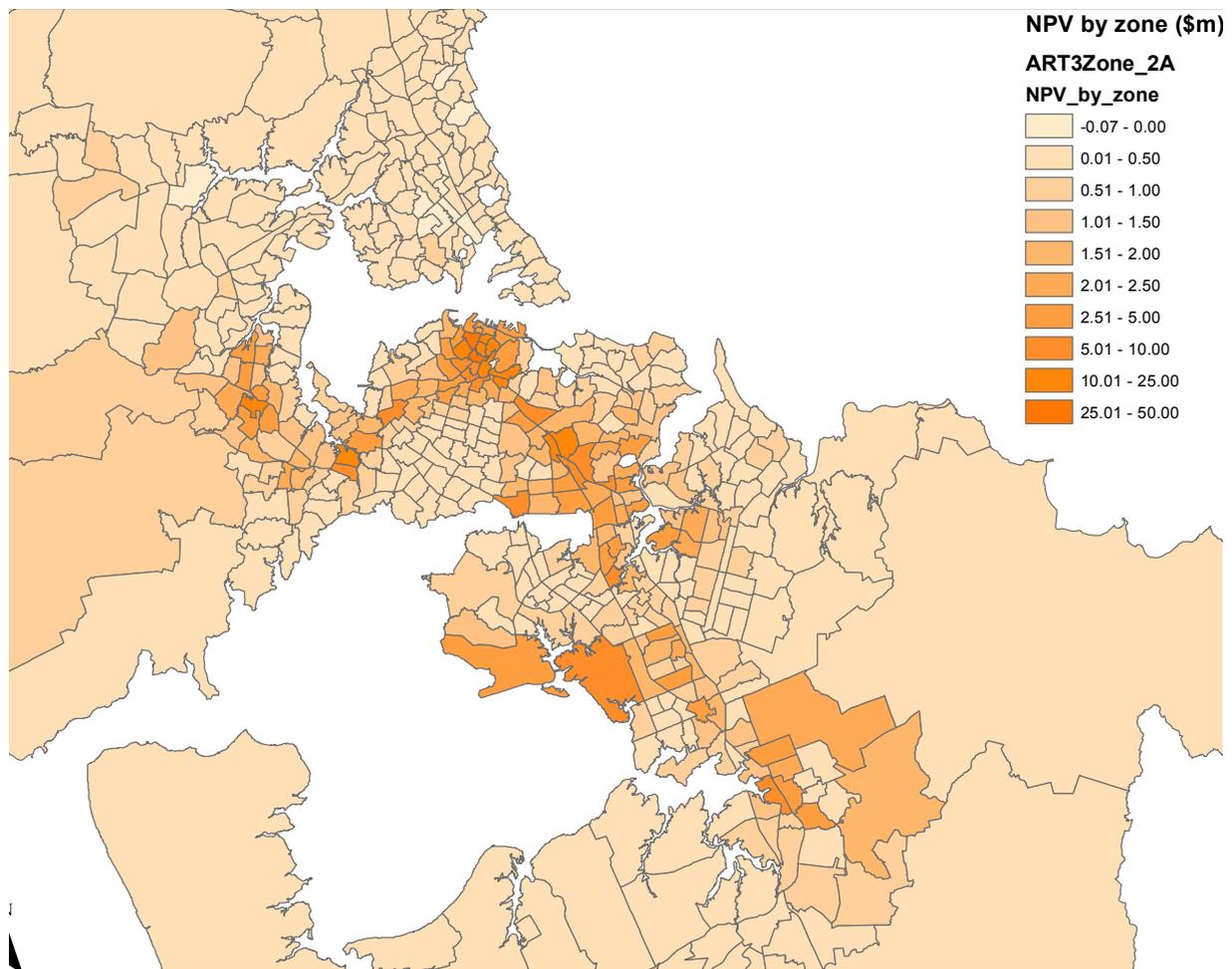
Figure 71 - CRL agglomeration estimates using NZTA's EEM procedure

	Undiscounted total, 40 years	4% 40 years	6% 40 years	8% 40 years	4% 60 years
Present value of agglomeration benefits	\$3,226m	\$1,169m	\$742m	\$487m	\$1,744m
% of conventional transport benefits	35.6%	36.5%	36.7%	36.7%	39.2%

Source: PwC calculations

Figure 72 below shows the geographic distribution of the agglomeration benefits, derived from the EEM. The agglomeration benefits of the CRL are concentrated in the city centre and along the rail lines, a feature which is expected owing to the improved accessibility to these areas.

Figure 72 - Breakdown of the present value of agglomeration benefits by zone (\$m, EEM method)



Source: PwC calculations

The SGS method and the EEM prescribed method produce a range for the agglomeration benefits as shown below.

Figure 73 - Present value of agglomeration benefits using SGS’s method and the EEM procedure

	4% 40 years	6% 40 years	8% 40 years	4% 60 years
SGS method	\$1,399m	\$866m	\$555m	\$2,399m
EEM method	\$1,169m	\$742m	\$487m	\$1,744m
Midpoint	\$1,284m	\$804m	\$521m	\$2,072m

Source: SGS and PwC analysis

The two methods produce reasonably consistent values for the baseline scenario (6%, 40 year evaluation period). Across all scenarios, the EEM estimates are within 12% and 27% of SGS’s estimate.



10 The Financial Case

10.1 Capital costs

The CRL capital cost, including the net property cost, is \$2.5b, inflated to the expected 'dollars of the day.'

Figure 74 – Capital Costs

Costs	Totals (\$million)
Investigation and design	150
Construction - enabling works	302
Construction - main works	1,802
Gross land purchases (excluding land sales)	242
Maintenance unit and Operational Readiness	36
Wider Network Impact Project	114
Gross capex costs (excluding land sales)	2,646
Land sales	-116
Capex costs after land sales	2,531

Investigation and design relates to all activity delivered by AT and suppliers in preparation for the works including management, business case, transport planning, planning consent, communications, investigation and design, site survey and geotechnical investigation.

Construction costs relate to all contractor costs, client management costs, supplier project management and MQSA costs. This includes building consent levies, insurances and other client costs.

Enabling Works Construction contracts include:

- **Contract 1 Separable Portion 1** Britomart Works (Temporary accommodation, underpinning, excavation and running tunnels)
- **Contract 1 Separable Portion 2** Queen Street Works (Excavation and construction of running tunnels)
- **Contract 2 Separable Portion 1** Albert Street Cut and Cover Works (Customs Street to Wyndham Street)
- **Contract 2 Separable Portion 2** Albert Street Storm Water Main relocation (Pipe Jack)

Main Works Construction relates to:

- Aotea Station Construction (civils and fit-out)
- K' Rd Station Construction (civils and fit-out)
- Mt Eden Station Construction (civils and fit-out)
- Running Tunnel Construction (Tunnel Boring Machine, mined tunnels and portals)
- Rails Systems Installation (OHLE, traction power, signalling, trackform etc)
- North Auckland Line Works (All works related to connection of the CRL rail lines to the existing NAL rail lines including associated infrastructure)

Gross Land Sales relate to all the full title, partial title, substrata and lease interests required to build the CRL (Permanent and temporary construction purpose requirements). Costs include all acquisition costs as well as land lord fees, supplier fees, compensation payments and in some cases relocation payments. The great majority of this cost relates to full titles within the MT Eden area.

Maintenance Unit and Operation Readiness relate to the procurement of a rail based unit for tunnel maintenance purposes and the costs (operators, KiwiRail, AT and suppliers) associated with the support of the operational readiness period which includes familiarisation, testing and trail running.

Wider Network Impact Projects relate to projects in the wider network that are required to support efficient operation use of the CRL and associated timetable. Costs include works and management costs.

Land sales relates to the value of releasable (saleable) land post construction of the CRL.

10.1.1 Cost range

There are inevitable uncertainties relating to the costs which apply as a project is developed. AT has undertaken sensitivity testing relating to those uncertainties which are reported in Section 9 showing the robustness of the economic appraisal to a +/- 20% variation in costs. AT advisers have confirmed that the cost is likely to remain within this range. Close attention to potential scope creep will be applied.

Figure 75 – Financial information

\$million Year Ended 30 June	Prior Years	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Total
Capital Expenditure	164	114	157	125	216	314	470	502	374	71	0	2488
Government Contribution	0	0	0	0	249	157	223	203	184	23		1039
CRL related closing debt	172	292	463	611	608	798	1092	1456	1621	1642	1615	

10.2 Operating costs

The timeframe for the opex projection modelling for the CRL is 30 years - 2014 to 2043.

The cost model splits opex costs into major categories:

- rail and station infrastructure maintenance
- EMU maintenance
- station operations
- train operations
- control centre operations
- depreciation
- other items.

Projected CRL opex has been estimated using currently available information. The overall opex projection for CRL at start-up in 2023 is \$49m in 2023 dollars. Applying a 30 per cent uncertainty gives a range of \$35m to \$64m. Operating costs are divided between depreciation (\$29.14m in 2023) and operations and maintenance (\$20.41m in 2023). Farebox revenue in 2023 is expected to be \$20.41m, leaving net opex of \$28.9m to be funded jointly by Council and the Transport Agency.

10.3 Council financial provision

The financial provision for the CRL is included in Council's 2015 -2025 LTP. This provision includes:

- programmed spend for the next three financial years of \$400m initially funded by Council
- enabling works to commence in the 2015/16 financial year with completion in 2018/19
- main works contract commences in the 2018/19 financial year with completion in 2022/23
- investigation, design and procurement of the main works to proceed so that construction can commence in July 2018
- property purchase and enabling works extend into the 2018/19 financial year
- Government funding commences in 2018/19 financial year.

10.3.1 Assumptions

- Council proceeds with only investigation and design, land purchases and enablement works for the next three years (total \$400 million)
- Council initially funds the enabling works (about \$287m of the \$400m)
- Government contribution from 2018/2019
- Full construction starts 2018/2019.

10.3.2 Financial Impacts

The financial modelling for the CRL has been undertaken by Council. The Council's 2015-2025 LTP has confirmed the affordability of the CRL based on the assumptions set out in the previous section. Council has now confirmed funding for the CRL when adopting the LTP.

The financial impacts of the CRL have been further modelled for AT by PwC. The PwC model is based on, and is fully consistent with the Council's LTP inputs and assumptions, and provides a 30 year forecast of the core financial elements of the CRL, including expected:

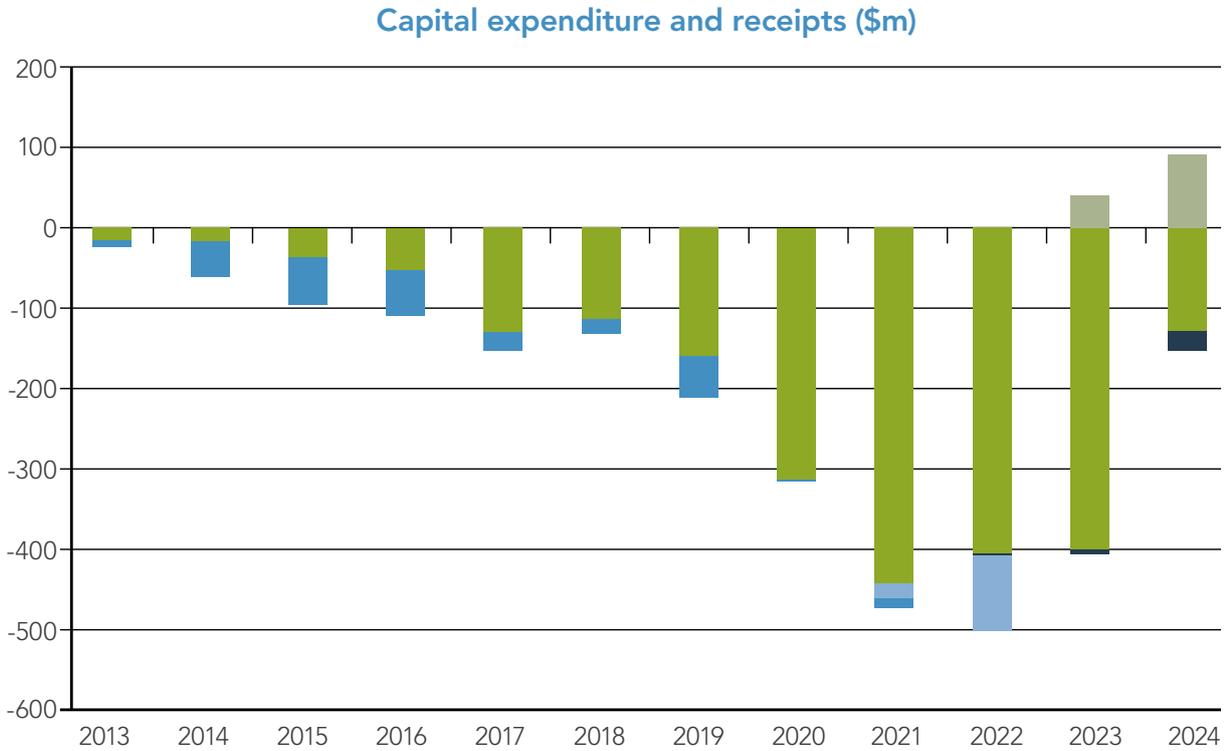
- capital costs, including for land, station development, new tracks, tunnels, and trains etc
- operating costs associated with new stations and services associated with the CRL
- fare box revenue
- other revenue such as property sales
- external funding
- residual funding required from Council.
- The model also provides information relating to the cashflow, balance sheet and profit and loss impacts of the project.

10.3.3 Capital costs

Figure 76 below shows that:

- expenditure peaks in 2022 at about \$500 million per annum
- there are capital receipts scheduled for 2023 and 2024, associated with the sale of surplus properties.

Figure 76 – Capital expenditure and receipts



Source: Council AT, PwC Analysis

- Financial Calculations
- Construction Costs
- Train Costs
- Additional Project Costs
- Land Purchases
- Land Sales

10.3.4 Operating costs

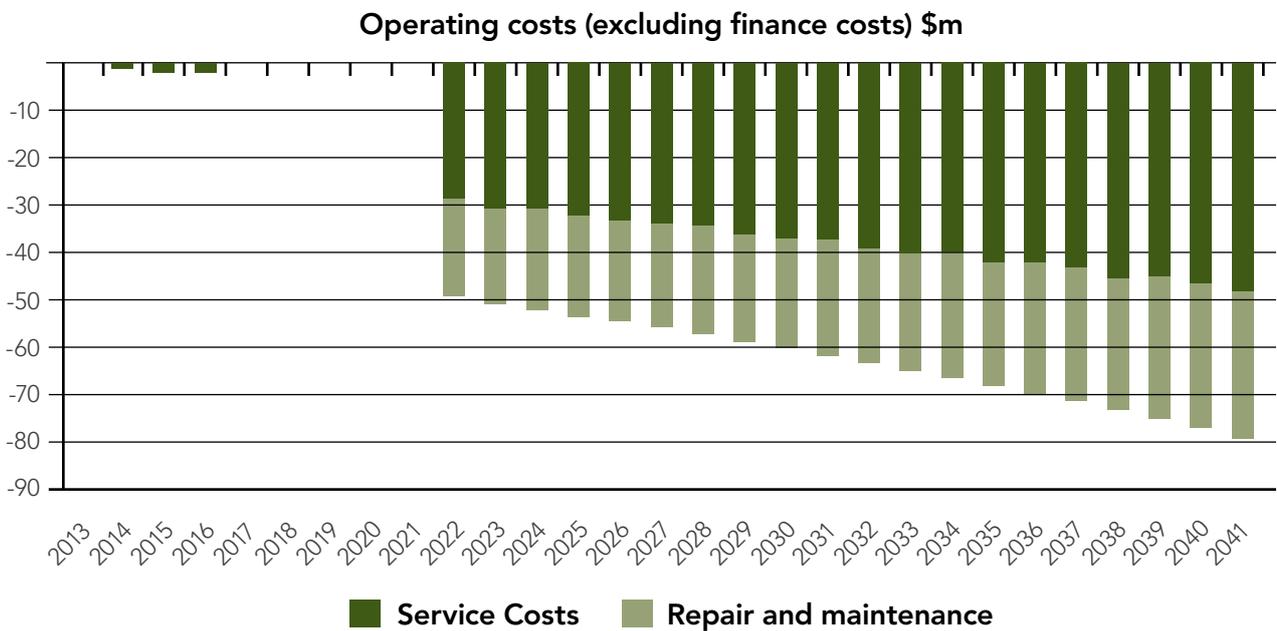
The CRL will create additional operating costs for AT as there is more infrastructure and additional assets to maintain. This is broadly split into two main categories - service costs, and costs associated with maintaining assets.

Maintenance cost estimates are based on engineering estimates of likely annual costs to maintain and renew the assets. Some of these costs could be considered capital in nature. They have, however, been included within this category for simplicity. The model separately provides for accounting depreciation, based on asset lives.

There is a small amount of operating expenditure prior to the CRL opening, which relates to maintenance of properties purchased for the CRL's construction. The ongoing operating costs from 2023 onwards are shown in the table below. These costs are relative to the do-minimum.

Over the evaluation period, the total operating costs are \$1,263m (undiscounted).

Figure 77 – Operating costs



Source: AT, PwC Analysis

10.4 Revenues

The CRL will generate several revenue streams (over and above the do minimum), including:

- farebox revenues from 2023 when the CRL is operational
- land rentals (associated with property held prior to construction)
- development contributions
- NZTA FAR subsidies.

Post-construction, revenues settle at around \$35m in current (2015) dollars. This includes:

Figure 78 – Operating revenues by category (excluding property rentals)

	Annual opex estimate (\$2015)
Maintenance and renewals	\$17m
CRL service costs	\$25m
Total annual operating costs	\$42m

Source: AT, PwC Analysis

10.5 Potential Value Capture

AT and Council are continuing to investigate value capture opportunities as part of the ongoing efforts to spread the funding burden and in particular attract contributions from those who benefit directly, as well as the development opportunities cited in Section 8.3.

10.6 Conclusion

The financial impacts of the CRL have been modelled extensively by Council over the past five years and in adopting the 2015-2025 Council confirmed that the CRL was affordable.

11 The Commercial Case

11.1 Procurement

This section covers the Commercial case as it has been developed for the current iteration of the business case prior to letting Enabling Works contracts. It therefore includes the framework for the analysis being carried out at a strategic level to ensure that the overall approach has been considered to provide the context for the Enabling Works contracts. An initial package of Enabling Works is planned to commence at the northern end of the project between Britomart west and the junction of Albert/ Wyndham streets, largely to mitigate excessive construction impacts in this part of the City Centre. As described, below further investigation of procurement methods for the main works has commenced. This section of the business case will be updated accordingly before they are procured in accordance with a finalised main works procurement strategy.

The following sections describe the methodology to be adopted in determining the procurement strategy for the main project works. It is programmed to be confirmed by the end of 2015.

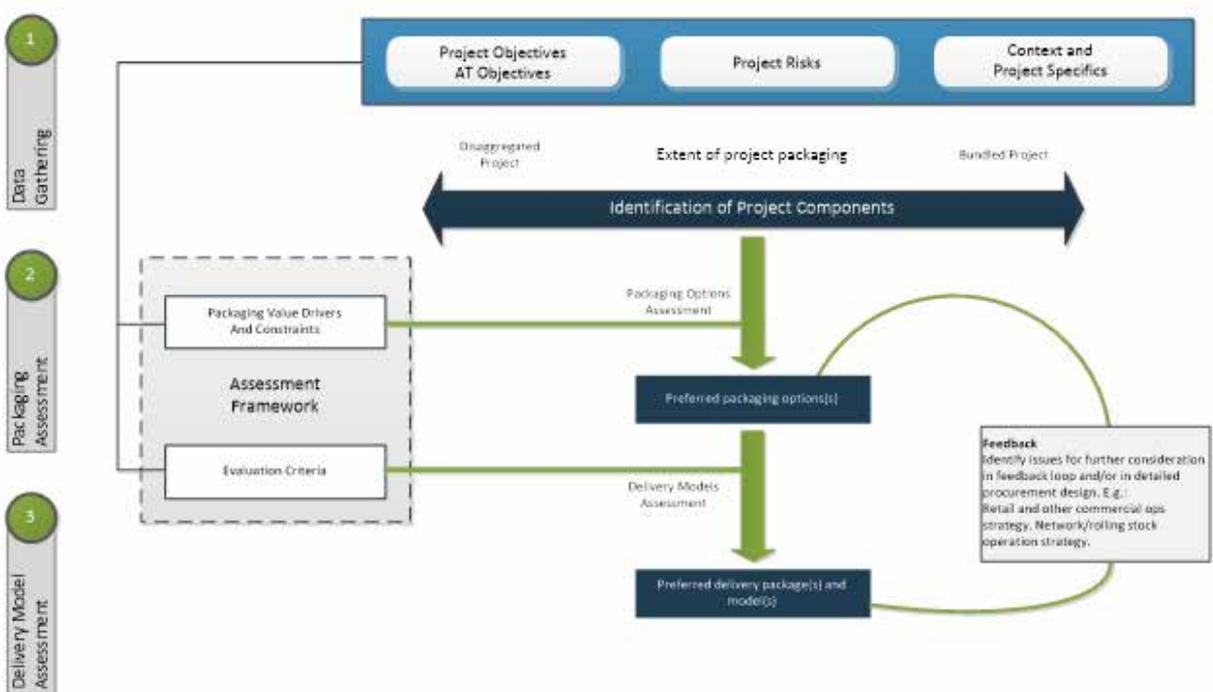
11.1.2 Methodology Overview

The approach to the procurement strategy development uses bottom up analysis based on unique project characteristics, constraints, risks and value drivers. This process draws on experiences from precedent procurements to inform and guide the development of the strategy and is aligned with the guidance provided in Better Business Cases.

The procurement strategy approach is guided by analysis carried out by EY.⁵⁷

The following chart summarises the process for developing the procurement strategy:

Figure 79 – Methodology



57 CRL Procurement Strategy, EY for Auckland Transport, October, 2014

The methodology includes the following three stages:

- i analysis of the project and its context in the broader network focused on understanding the project objectives, value drivers and constraints in order to build a robust assessment framework to be applied in each of the following two stages
- ii the packaging assessment considering how the CRL project components should be packaged in order to deliver optimal value through alignment with the key value drivers, whilst accommodating any project constraints (see Figure 80)
- iii the delivery model assessment considering which contractual framework will best deliver each package identified in stage two. For each contract package, a range of delivery models will be assessed against a set of agreed selection criteria (see Figure 81).

11.2 Assessment and findings

11.2.1 Assessment Framework

The following value drivers and constraints will be used for assessing and defining the preferred procurement packaging options:

Figure 80 – Value drivers and constraints

Interface and Synergies	<p>What synergies are there from bundling project components?</p> <p>Does the packaging approach create or mitigate significant interface risks between project components?</p> <p>Does the technical solution or do existing conditions create interfaces that have to exist or cannot be managed?</p>
Network effects	<p>Does the project element have an on-going impact on the operations of the wider network?</p> <p>Are there established protocols and processes which need to be considered?</p>
Innovation opportunities	<p>Does the packaging approach create or reduce opportunities for innovation in design, construction and/or a whole-of-life focus?</p> <p>Does the packaging approach allow or constrain innovation in delivering service outcomes?</p> <p>Does the technical solution or existing conditions impair innovation opportunities?</p>
Staging / delivery process	<p>Does the packaging approach provide opportunities for effective staging of project works and/or early works?</p> <p>Does the packaging of works increase or decrease time certainty (e.g. by creating critical path dependencies)?</p>
Market capacity and context	<p>Is there market appetite for the size and/or composition of the package?</p> <p>Does the size/composition of the package impact on the number of potential contractors?</p> <p>Does the size/composition of the package impact on the market financing capacity?</p> <p>Does the packaging approach impact on expected competitive tension and contestability?</p> <p>Does the packaging approach impact on future Government and market capabilities for other projects?</p>
Client capability and capacity	<p>Does the responsible body have the experience and internal capability to effectively manage the risks and interfaces between procurement packages?</p>

The following evaluation criteria and priorities were agreed for assessing the delivery models which could be applied to each contract package:

Figure 81 – Delivery Model Evaluation Criteria

Delivery Model Evaluation Criteria		Priority
Risk allocation	Extent to which the delivery model supports effective risk allocation and mitigation (targeting both the likelihood and consequences of risk).	High
Price	Extent to which the procurement approach supports the delivery of lowest whole-of-life cost on a risk adjusted basis (including maximising competitive tension).	Very High
Time to market	Extent to which the delivery model facilitates award of contract within Auckland Transport’s desired timetable.	Very High
Certainty (cost and time)	Extent to which the delivery model provides Auckland Transport with certainty regarding cost and time to completion.	High
Innovation	Extent to which the delivery model supports innovation in delivering the desired outcomes.	Medium
Outcomes	Extent to which the delivery model supports delivery of the required technical and performance outputs and the project objectives and project outcomes.	Very High
Interface with Operations	Extent to which the delivery model provides flexibility to manage over time the complex interfaces with operations and network.	High

11.2.2 Main Works Procurement

A study of more recent overseas procurement models has been undertaken with the intent to review the initial procurement strategy. The final procurement packaging has yet to be determined but the choice will be significantly influenced by the assessment of the placement of project risk by those best equipped to manage it. The review will largely follow the methodology outlined above and take account of the developments arising from the reference design, dependencies that have arisen from the further development and consideration of the lessons learnt from the study of recent overseas experience on projects of a similar nature. The review is planned to also incorporate a consultation period with the construction market to assist in finalising the procurement strategy.

11.2.3 Market for providers

An initial review of the contractor market was carried out to confirm the likelihood of there being sufficient market appetite for the scale and form of packages being considered. This very preliminary review covered New Zealand providers, Australian providers and those from further afield. It drew on experience with the Transmission Gully PPP, major works being carried out in Christchurch and Auckland and the level of interest and competition for such projects as North West Rail Link in New South Wales and Melbourne Metro in Victoria.

11.3 Application to Enabling Works

The Enabling Works were split into two contracts as the works are geographically separate (split by the zone of tunnel to be built by Precinct Properties Ltd during its redevelopment of the Downtown Shopping Centre), will require their own and separate works areas and have different methodology and distinct skillset requirements.

11.3.1 Early Contractor Involvement

An Early Contractor Involvement (ECI) contract has been adopted as best able to deliver on the key outcomes sought from the procurement of the Enabling Works contracts. These outcomes are:

- Conduct a competitive tender process that uses market tension to drive value for money outcomes
- Be in a position to commence Enabling Works on site as soon as consents and designation approvals are in place
- Complete an approved procurement process in a timeframe that allows Constructors input to the consenting process
- Allow for collaboration between AT, the Principal Technical Advisor and the Constructor such that the best outcomes for the CRL project are obtained
- Complete the procurement process in a timeframe that allows Constructor input to the design process for temporary works as well as constructability input into Permanent works (CPO and Running Tunnels)
- Provide a framework for effective risk management and risk allocation
- Deliver the Projects in a timely manner with minimum disruption and working collaboratively with stakeholders and the City Centre community.

11.3.2 Enabling Works procurement

To ensure a robust procurement process was followed, AT implemented the following in accordance with the principles of NZTA Procurement Manual:

- The procurement plan used a two stage procurement process with the first stage Registration of Interest (ROI) being publicly advertised through GETS, followed by a Request for Proposal (RFP) being made available to the successful proponents
- The ROI was evaluated by Pass/Fail for the Non-Price Attributes
- The RFP stage was evaluated using a Price Quality Method and included an extensive interactive programme with the proponents.
- The Tender Evaluation Team (TET) members and Non-Scoring Chair, and AT's Technical Advisors had significant experience with evaluating contracts of this scale and complexity and operating under the principles of the NZTA procurement guidelines
- A Risk Governance Panel (RGP) was established to provide advice to the TET where required, and to review and verify the recommendations of the TET
- An independent Probit Auditor was appointed to shadow the tender process to ensure a transparent procurement process, all parties were treated equitably, and potential third party risks were managed proactively.

12 Governance and management

12.1 Project management plan

The CRL project is managed through a Project Management Plan that is kept current as the project progresses⁶⁰. This document covers all the high-level actions necessary to define, prepare, integrate, and co-ordinate all the activities in undertaking the project. The current version focuses on activities for the future design and delivery stages of the project. It outlines the strategic objectives for the development programme, the scope of activities and the key deliverables and describes how the project is being managed and controlled to ensure the greatest likelihood of successful delivery.

12.2 Project principles

The plan specifies a set of guiding principles:

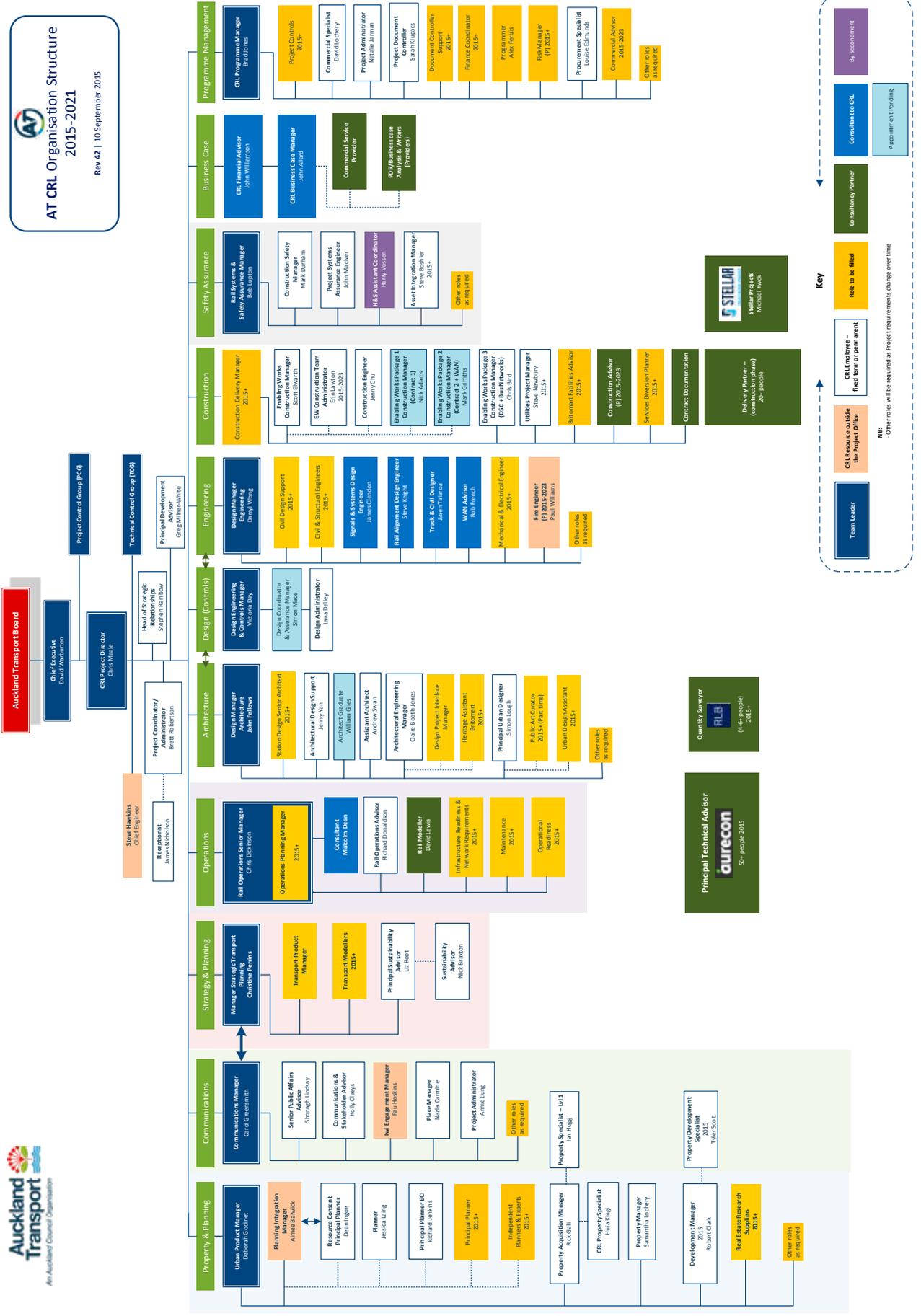
- ensure key target audiences and stakeholders have an accurate understanding of the project and its implications including how the project fits into the strategic regional development of transport infrastructure and contributes to the vision for Auckland as the world's most liveable city
- engage constructively with key stakeholders/target audiences
- provide consistent information across the project
- minimise uncertainty and dispel misinformation
- gather feedback on the option
- maintain and enhance existing relationships for ongoing constructive engagement
- enhance AT's reputation for quality delivery of transport projects and responsiveness to those affected
- manage risks to the project and to AT's reputation.
- Governance

Given the scale and social/economic impact the project will have on Auckland it is vital to ensure value is delivered through effective governance. The CRL project is an AT and Council collaboration with the overall accountability for delivering the project sitting with AT. The governance structure and resources required to meet the project deliverables are set out below.

12.2.1 Principal elements

- the AT Board holds ultimate governance responsibility for the project
- a Steering Group (SG) has overall accountability for ensuring the project meets its objectives and delivers expected outputs
- a Project Control Group (PCG) is responsible for assurance and decision making for the project whilst providing independent infrastructure project expertise and advice
- a Project Sponsor is the AT owner ('Senior Responsible Officer') for the project providing strategic leadership and direction with responsibility for successful delivery and finance
- a Project Director has delegated authority to lead and manage the work, and is responsible for ensuring the project meets its objectives and delivers the expected outcomes
- project managers are responsible for delivery of the scope for their relevant workstream including contract and financial management
- a Technical Control Group (TCG) is responsible for technical decision making, project expertise and advice.

Figure 82 - CRL Organisation Chart



12.2.2 Steering Group

The Steering Group (SG), comprising the chief executives of AT and Council, has overall accountability for the ensuring the project meets its objectives and delivers expected outputs of securing required funding/properties and constructing the tunnel and stations. The SG meets as necessary and reports directly to the AT Board and the Council.

12.2.3 Project Control Group

The PCG is responsible for controlling decisions on scope, cost and programme within authority delegated by the AT Board, to ensure that the project is completed on time and within budget and to meet the specified product definition objectives.

The PCG acts as the focus of the project management by providing a forum for the rapid approval, or otherwise, of matters within its delegated authority, and for the endorsement, or otherwise, of proposals outside its delegated authority for referral to the AT Chief Executive or AT Board. It acts as the monitoring body with oversight of the project programme.

The PCG membership includes senior AT executives plus non-executive representatives with particular relevant skills and experience on similar major urban rail projects.

12.2.4 The Project Sponsor

The Project Sponsor is the senior management leader and champion for the project. Responsibilities of the Project Sponsor include being the cost centre manager for the project, the project governance framework and responsibilities, any significant legal issues and key stakeholder engagement.

The CRL Project Sponsor is the AT Chief Executive, Dr David Warburton.

12.2.5 The Project Director

The Project Director has day-to-day leadership of the project and is responsible for leading and managing the programme of work, managing and resolving project risks and issues, controlling the programme budget, managing the programme timeline, including coordination of workstream interdependencies and stakeholder management, in conjunction with the AT Key Relationships and Communications managers. The Project Director also manages all the commercial procurements and recruits the necessary resources with guidance/ assistance from the SG. The Project Director reports progress to the Project Sponsor and the governance forums.

The Project Director is Chris Meale. Chris has extensive experience in leading major infrastructure projects.

12.2.6 Project managers

Individual project managers are responsible for managing the particular workstream through to the delivery of the relevant outputs. All roles are currently filled by appropriately experienced individuals.

AT project manager meetings are used to update and discuss progress, issues, risks, and challenges. They are attended by the Project Sponsor, Project Director and the project managers responsible for engineering, property, NOR, transport planning, communications, funding and project controls.

12.2.7 Project controls

The Project controls team supports the Project Sponsor and Director and ensures the project is properly controlled. The team's responsibilities include monitoring and control of the overall project programme, finances and reporting, ensuring workstreams are managed following robust AT processes, risk management and ensuring procurement follows AT process and provides value for money.

12.2.8 Technical Control Group

A TCG of well-qualified technical experts from across AT supports the PCG by addressing and deciding on specialist topic areas.



13 The AT project management framework

13.1 Policies and procedures guide

AT has a project management framework based on PRINCE2 methodology and PMI standards which includes mandatory decision processes for Capital Development projects, including the CRL. It notes that project management is the discipline of planning, organising, securing, managing, leading and controlling resources to achieve specific goals.

13.2 The CRL Project Management System (PMS)

The CRL PMS sets out the project management processes to be applied throughout the delivery of the CRL project. The CRL project will comply with AT's Project Management Framework. The CRL PMS is complementary to this framework.

PCG has endorsed the approach and structure being implemented for the PMS.

The document, Project Management and Control, sets out the management processes and control function to be followed during the design, construction, testing and commissioning stages of the project. It describes the various processes which have been established to:

- ensure that decisions which affect the achievement of the project objectives are made at an appropriate level and are based on adequate political, financial, technical and operational knowledge
- ensure that problems are identified at an early stage so that appropriate management focus can be given to effective resolution
- ensure that an appropriate degree of cost and programme control is exercised at all stages of a project to achieve the objective of completion of the project within the approved budget and programme
- ensure that other commitments in areas such as health and safety, external stakeholders, people development, etc. are met.

83 - CRL Project Management System (Overview Structure)



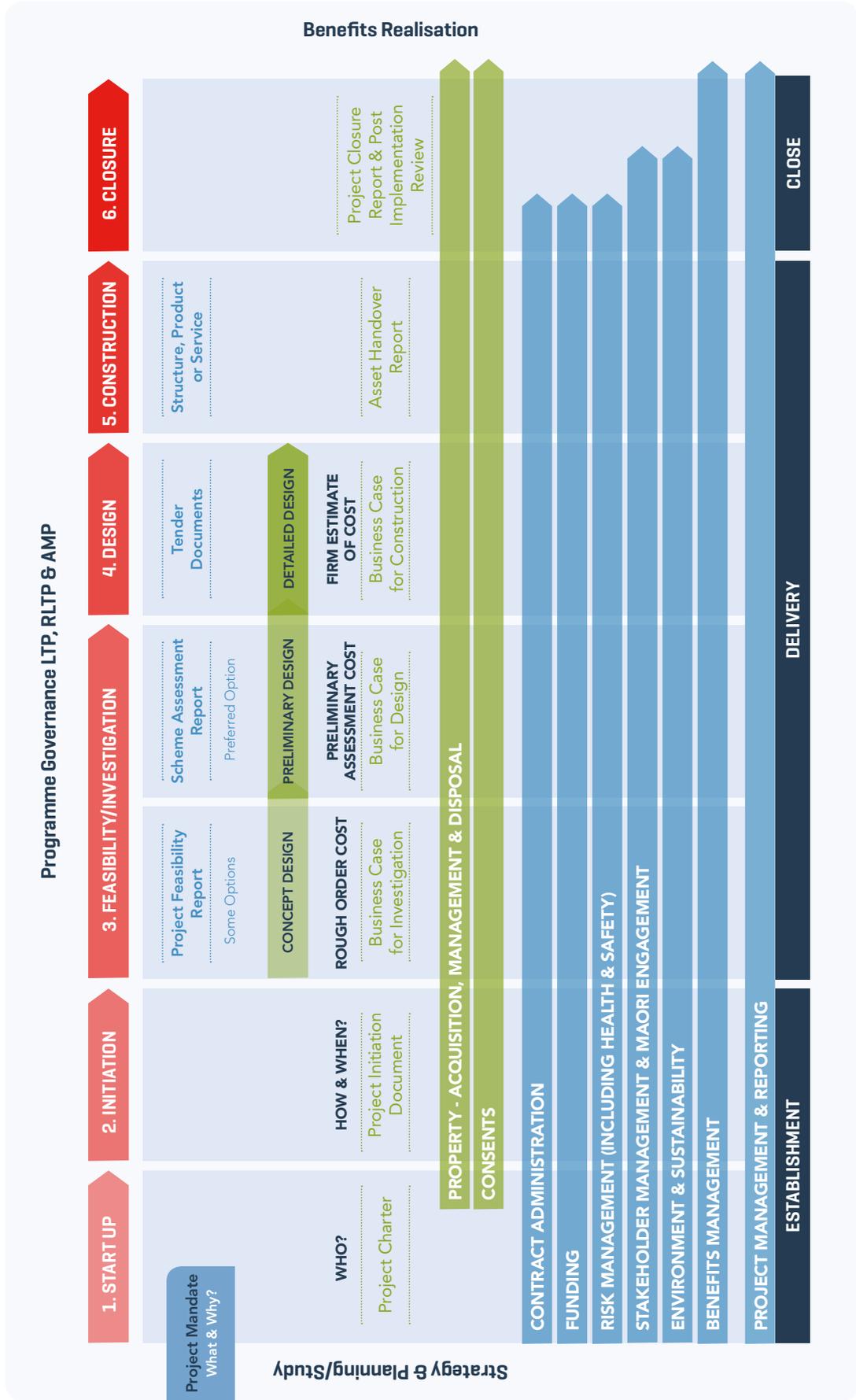
In the PMS:

- Tier 1 Documents define the overall policy statement and commitment relating to the application of a robust and auditable PMS
- Tier 2 Documents detail the objectives for both the project and the project management system.
- Tier 3 Documents define the individual PMS elements and requirements for implementation.

Tier 4 Documents provide further and finite details to the application of Tier 3 documents. For example, the Tier 3 Documents for

Tier 4 documentation is under continuous development during the project. Many records are allocated as Tier 4 documents. In terms of both internal and external process audit, Tiers 1, 2, and 3 provide the minimum information for process audit review whilst Tier 4 documents provide extended information.

Figure 80- AT Project stages



13.4 Project programme

An indicative project programme has been developed based on the current proposed construction methodology, factoring in assumptions and constraints.

A critical consideration is the requirement of a Tunnel Boring Machine (TBM) specific to the needs of this project. This machine would arrive on site approximately 18 months from order date and would require assembly and installation before being operational. Prior to the arrival and operation of the TBM, activities such as the preparation of access shafts for the tunnels, cut-and-cover construction, and temporary traffic diversions would commence.

Other items on the critical path are activities related to the detailed design of the project, Aotea Station construction, TBM drives and track works.

The overall timeframe for the indicative construction programme is approximately five and a half years. Therefore, should main construction commence in 2018 as planned, the CRL could be operational and helping to meet transport demand by 2023. Enabling Works are intended to commence in late 2015.

13.5 Construction programme

An indicative construction programme is set out in Appendix 4. It has been based on the proposed construction methodology for each work site. This indicative construction programme is suitable for commonly-adopted procurement methods.

The programme is indicative only, based on the high level of the design. Specific durations may vary, but the overall duration is a reliable indicator of project length. The contractor may also choose to reschedule non-critical activities to suit resource planning.

14 Quality assurance

14.1 Acceptance criteria

Each project manager is responsible for developing acceptance criteria for their principal deliverables. Acceptance criteria are approved by the Project Director who is responsible for checking that deliverables meet acceptance criteria and are in line with the quality assurance plan.

14.2 Quality assurance plan

Each workstream is responsible for establishing a quality assurance plan to ensure that the main deliverables meet relevant acceptance criteria. The quality plan specifies:

- the acceptance criteria definition for deliverables e.g. AT policies, NZTA policies, statutes.
- the approach to assessing whether the deliverables meet the quality expectations (i.e. the acceptance criteria)
- establishing systematic monitoring and control, and completing quality records
- responsibilities and approval delegations.

The quality assurance plans are reviewed and approved quarterly by the Project Director or under delegated authority.

The quality assurance plan is required to address work carried out internally and work carried out by external contractors or consultants. Each workstream is responsible for ensuring key deliverables produced as part of their work packages have been checked and verified prior to their use. A verification register is used to record (at a minimum) the author, checker, verifier and approver for each deliverable being produced.

14.2.1 Audits

Each workstream is required to undertake internal audits of its processes against the quality assurance plan at key stages of the project. Each project manager must develop a quality audit plan in line with AT's project management framework which includes:

- a suitable independent quality auditor
- timing and frequency of the audits
- scope of the audits.

Where the audit finds any issues they will be discussed with the project manager in the first instance, and if necessary with the Project Director.

14.3 Peer reviews and Gateway process

During the course of the CRL programme of work, peer reviews have ranged from internal peer reviews undertaken by the consultant delivering the work, through to review by the CRL Project Director and independent reviews by external reviewers.

A major review involving multiple international experts in the design of heavy rail projects, including tunnels, ("Challenge session") was undertaken between definition design phases one and two in January 2014 leading to significant project questioning and project optimisation.

14.4 Gateway reviews

AT has adopted the formal Gateway review practice as has the New Zealand Government through the State Services Commission (SSC) and Treasury. Each has a staged methodology with a gate at the time when a delivery strategy has been agreed, based on the business case, and the next gate when a contract could be signed to deliver the asset. The assumption in these processes is that the detailed design is carried out before the competitive procurement of the main construction works.

For CRL, a further gate is to be used. This will be a gate after the reference design is completed (in the second quarter of 2016) and another a year later before the construction tender is awarded. Taking this approach will ensure that the formal requirements of AT (and the Government) are covered and is appropriate for the scale, complexity and expected procurement method of the CRL. The SSC documentation explicitly provides for tailoring of the Gateway methodology.

A requirement for this additional step applies in the Gateway process for the Australian State of Victoria, which is widely recognised as being at the forefront in applying appropriate disciplines to project delivery. The Victorian practice is aligned with that in the UK, where much of the approach was developed, and has been adopted by the Australian Federal Government.

As with all the Gates, the membership of the review team will be related to the stage in developing the project. These reviews would therefore be weighted towards procurement and construction experts.

14.5 Additional peer review

A peer review will be undertaken for the Enabling Works contract following the principle of adding value and ensuring that leading practice is being followed. That review is programmed for first quarter 2016, prior to contract award. The reviewers will be experts in procurement and the types of construction methodologies envisaged.

15 Risk management

15.1 Approach

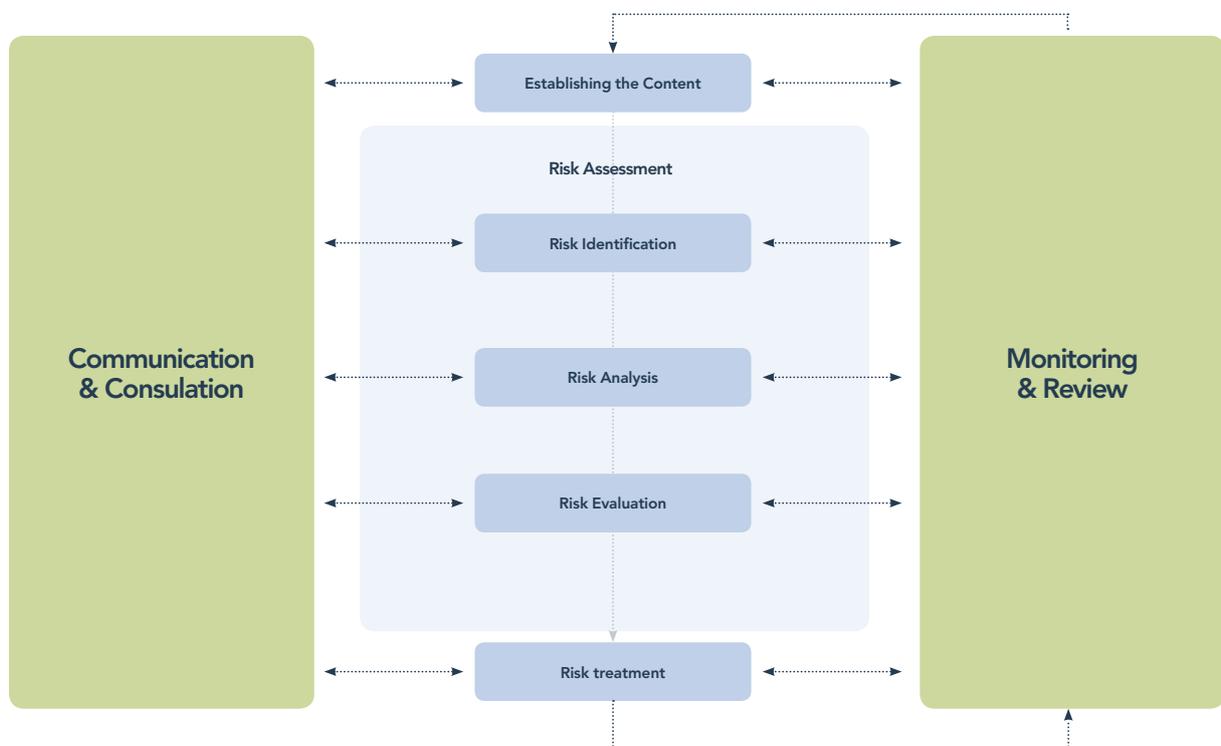
The approach to risk management for CRL follows AT's Risk Management Handbook.⁶¹

The risk management handbook expands on a framework of management policies, procedures and practices to be applied to the tasks of identifying, analysing, assessing, treating and monitoring risk. The purpose of the risk management handbook is to:

- Provide a reference for project managers and their team members by defining the aspects of project Risk Management that is accepted as good practice on most projects most of the time.
- Provide a methodology that guides consistent project Risk Management activities on all infrastructure projects within AT.
- Set the minimum standard for consistent risk analysis and management on AT projects depending on their size and complexity.
- Provide techniques, tools, and guidance for identifying, analysing, managing and responding to project risk over the entire project life cycle.

AT developed its risk management framework and the handbook to be consistent with the joint Australian New Zealand Standard – ISO 31000:2900 (Risk Management Principles and Guidelines) in order to ensure that risks generally throughout the business are managed and that risk management is performed on a consistent basis. The current governance structure provides a three-tiered protection to managing risks ensuring Auckland's social, economic, environmental, and cultural well-being. The five major steps of the risk management process for the CRL programme are shown below.

Figure 85 - AT risk management process



61 Project Risk Management Handbook, Addressing Uncertainty, Threats and Opportunities in Projects, Revised Edition, AT, August 2014

Significant risks may have multiple risk controls to provide an adequate level of confidence. Once risk controls are agreed, they are appropriately documented in the Risk Register and implemented in a systematic manner.

Risks which are outside CRL project control may require an action plan to manage the consequences of the risk occurring. The project team cannot reduce the causes of these risks but can attempt to minimise the impacts. Where these risks affect the realisation of the benefits, they will be managed accordingly.

15.2 Monitoring and review

Continual monitoring and review of the risks to the CRL programme is an important element of the risk management framework. It ensures new risks are detected and managed, and that action plans are implemented and progressed effectively. This takes the form of monthly reviews and updating of the Risk Register with project managers from each workstream and overall review by the Project Director and/or appropriate risk subject matter expert.

15.3 Principal technical risks

15.3.1 Settlement effects on existing buildings and infrastructure

The settlement effects on existing buildings and infrastructure is a risk on any underground construction project. The areas where these risks are most critical are:

- **Buildings:** Work has been undertaken to understand the potential impacts on the existing buildings from the construction and operation aspects of the project. This high-level assessment has highlighted the Eclipse Apartments, TV3 buildings, Sky City Grand Hotel, AA Building, Albert Plaza and Zurich Building as high-risk buildings that will potentially be susceptible to settlement and therefore could require some form of protection work before construction commences
- **Central Motorway Junction:** The cover to the driven tunnels will be lowest where they pass beneath the Central Motorway Junction. The current design has a cover of approximately 8m, measured from the tunnel crown to the road level of the eastbound and westbound legs of the SH16 motorway. As this section of motorway (SH1 and SH16) is the busiest in New Zealand, any potential effects from ground movement to the existing infrastructure during tunnelling must be further evaluated in the subsequent design stages.

Proposed mitigation: During subsequent stages of design further settlement assessments should be carried out to determine whether risk categories need to be amended. These assessments will use the latest design material and geotechnical data. Mitigation measures for the highest-risk buildings or infrastructure will be sought, in consultation with owners. More detailed assessments may be required, along with the development and implementation of a monitoring programme.

Appendix 5 shows the current Technical Risk Register for the higher risks and how they are being managed.

15.3.2 Utilities

Desktop study work has identified several major utility clashes. Two of the high risk constraints have been identified as the need to replace the major water line, Huia No. 2 Main, which may delay construction of CRL and the risk relating to damage to the Chorus cables and telecommunications manholes within the current Aotea Station extents. The water main is a particular risk as aspects of it are out of the immediate control of the project with reliance on Watercare. It is a long lead time activity and is quite important to the critical path for the core CRL works as construction around the south end of the job is key to the programme.

The current plan is that the water main will be relocated as part of the early works activity. Close liaison with Watercare regarding this diversion will therefore be essential.

Further detailed assessments and investigations may identify additional constraints.

Proposed mitigation: Continue liaison with the utility service providers, particularly Watercare and Chorus to seek agreement on the preferred approach for the two high risk areas mentioned above. In parallel, conduct intrusive site investigations to determine actual locations and any unforeseen utilities.

15.3.3 Construction below the CPO Building

To facilitate the rail alignment west of Britomart Station, construction will be required below the CPO building. This building has significant heritage value and has been restored. It now provides an entrance to Britomart Station and construction below the building could lead to damage.

Proposed mitigation: The current design solution uses the as-built drawings, as well as information from representatives involved in the restoration work during the Britomart Station development. Further design development will use this information. Controls will be put in place to monitor the effects on the building during construction.

15.4 Safe Design

15.4.1 General

Safe design is a process defined as the integration of hazard identification and risk assessment methods early in the design process, to eliminate or minimise the risks of injury throughout the life of the product being designed.

Legislation on Safe Design differs across the globe. The process followed during the project definition phase was based on best practice intended to comply with the 2011 Work Health & Safety Act in Australia and the relevant occupational health & safety legislation in New Zealand - the Health & Safety in Employment Act (1992) and relevant Health & Safety in Employment Regulations (1995).

15.4.2 Safe Design process on the CRL project

A Safe Design workshop was held in March 2013. As the CRL project was in concept development, the workshop focused on identifying and documenting the potential hazards to people during the construction, operation, and maintenance phases. The process was limited to identifying hazards associated with the current design concepts and the proposed construction methodologies.

As the CRL project moves into the next design phases, the focus will shift to analysing and evaluating, and then to eliminating and controlling, the potential hazards to people during the construction, operation, and maintenance phases. Hazards in the demolition phase will also be identified and recorded.

The hazards have been recorded in the Safe Design register and the Safe Design technical report. It is intended that the Safe Design register will be a live document throughout the CRL project.

16 Stakeholders and consultation

16.1 Consultation related to the designation

With local and central government agreeing on the need to protect a route via a designation and AT mandated to achieve it, a CRL team was established in late 2011 to progress the NOR to identify and designate the land needed to build and operate the CRL. A consultation and communication strategy was prepared to guide the engagement process for the CRL from early 2012 through to the securing of the designation.

Primary stakeholders identified were:

- landowners of directly affected properties within the designation
- occupiers of directly affected properties within the designation
- owners of properties in proximity to the designation
- iwi / hapu
- government and statutory agencies
- emergency services
- utility companies
- elected community representatives
- business associations
- the wider community.

A specific CRL website (www.cityrailink.co.nz), dedicated phone number and email (crlproject@aucklandtransport.govt.nz) were established. The website has been regularly updated with CRL information since it was established in early 2012.

Videos about the CRL have also been posted to the web and YouTube.

16.2 Stakeholder briefings

AT presented briefings on the CRL to stakeholder groups from 2011 to the present. Briefings on the details of the CRL were offered/provided to all 21 Council local boards.

A total of 17 iwi across wider Auckland were invited to participate in the CRL. Eight have since been actively working on the project.

16.2.1 Consultation with directly affected landowners within the designation footprint began on 2 July 2012.

Issues raised included:

- general overall support for the project
- uncertainty for people and their business
- the desire for a replacement property of similar standard, affordability and location
- potential reduction in the land supply and increased demand in the area
- the compensation process and its fairness
- maintaining property access during construction
- concern for existing tenants and their compensation
- expiring leases and likely difficulty in getting new tenants

- the time required to find a replacement property suitable for specialist businesses
- impact on heritage buildings.

Tenants of properties within the designation footprint were informed of the CRL via a letter which was either posted where addresses were held for the tenants or hand delivered.

Letters were sent in July 2012 to property owners whose properties are not within the designation footprint but who either bordered it or may be affected by being located in proximity, for example, from construction effects). They were invited to three group meetings on effects and their management.

Following notification of the NORs in January 2013, three public open days were held and information booths provided, at three major Auckland shopping centres adjacent to rail in February/March. More than 700 people were spoken to.

Briefings or meetings were also held with key corporate businesses and interests.

Since 2011, the CRL team has met regularly with central government, including representatives from the Ministry of Transport, Treasury, KiwiRail and the Transport Agency. The Auditor General's office was briefed in May 2013 and November 2014.

16.3 Briefing on optimisation, including replacing Newton station with Mt Eden

Major stakeholders affected by the proposed change from Newton to Mt Eden Station were confidentially briefed about the proposal prior to any decision being made. These included the Waitemataa and Albert Eden boards, the Uptown Business Association and the Ministry of Transport as well as relevant Council staff. All property owners affected by the proposed change were met or otherwise personally contacted and then sent follow up letters via post and email confirming the details. In addition, an advisory was sent to other stakeholders prior to the announcement. These stakeholders included iwi, MPs, business and property interest groups.

Information and images relating to the change were released to the media and provided on AT's CRL project website. Existing project collateral such as videos and images available on the web were revised to reflect the Mt Eden design change. Three open days held in late August/early September 2014 included information on the changes, the result of the NOR process and upcoming regional consents.

16.4 Specific stakeholder commitments

Regular discussions have taken place with Precinct Property Limited (PPL) which owns the Downtown Shopping Centre in Lower Queen Street as the property is within the proposed designation. An agreement has been reached which sees them build the CRL tunnels below and through their site when they redevelop it. A start is programmed for May 2016.

The land already designated for rail purposes and owned by KiwiRail was required for the construction and operation of the CRL and this has been purchased.

16.5 Strategies and options to capitalise on opportunities and manage issues

Communication and consultation with directly affected landowners, surface and subterranean, included:

- letters to all directly affected landowners
- ten landowner information sessions (with follow-up letters)
- individual meetings with landowners
- ongoing phone call, email and letter communications to directly answer queries

During the submission period for the project January-March 2013, AT held three public open days at locations close to the three new stations proposed for the CRL (Aotea, Karangahape Road and Newton) and therefore close to those directly affected by the proposed designation. Approximately 350 people took the opportunity to attend.

AT also staffed information booths at three shopping centres adjacent to railway stations. These were Lynnmall, Sylvia Park and Dressmart.

The AT blog widely discusses the CRL Project. The CRL Communications Manager made posts during the submissions period to clarify information and to encourage submissions.

Council, as the regulatory authority sent information to every directly affected party and others identified as being close to the areas subject to the designation footprint.

Submissions received on the CRL NORs totalled 263 with about 70 per cent in support.

The NORs were confirmed by AT in April 2014 and there were six appellants. Five of the appeals were resolved through negotiation and one dismissed by the Environment Court in August 2015.

Landowners have continued to be engaged with and updated regularly through the project email, phone, e- newsletter and meetings. Changes that affect them are communicated directly rather than through public channels as referred to in Section 18.2 above.

In August 2014 after the designation had been confirmed (subject to appeal), open days were held to demonstrate project progress and the outcome of the NOR submissions, reflected through the condition set. The various NOR reports and evidence are available on Council's website.

Pre Christmas 2014, bold red lines were painted across the footpath and road from Britomart Station through and across QEII square indicating the centre lines of the two CRL tunnels. They were accompanied by various messages in large text alerting Aucklanders to the project.

Over three months in early 2015, a CRL showcase was held in the inner city for five days and toured 13 Auckland suburbs presenting information on the project and its benefits, the station designs and upcoming early works. More than 1000 people visited the showcase.

A CRL Facebook page was established in March 2015 attracting 5000 likes in its first six months. The project has also been promoted through a large billboard at Britomart Station and through the placement of decals on the Albert St footpath in the city centre and at various train stations around Auckland, drawing attention to the project and promoting its website and Facebook page.

16.6 Avoiding disadvantage to stakeholders and addressing concerns

All landowners directly affected by the CRL were contacted individually by AT in 2012 and by Council in 2013. Tenants and owners of property in proximity to the project were also contacted as discussed above.

A range of opportunities for group or individual meetings was provided and taken-up. Information has been and continues to be supplied through various channels.

Meetings with landowners who have chosen to enter into property negotiation have been underway for some time. The Public Works Act (PWA) protects the rights of landowners affected by the project with property processes managed by an independent third party.

The CRL has designated project and media spokespeople and champions who are familiar with the project, including a communications and stakeholder manager for issues and media response.

16.7 On-going stakeholder construction period engagement and communications strategy

The CRL has an overarching communication and stakeholder strategy beneath which sit communication and stakeholder plans prepared for various aspects and phases of the project such as the NORs and property acquisition.

The final approved NOR conditions form the basis and minimum requirements during the construction phase. They include regular communication through various channels such as web, e-letter, and advertising as described earlier in this report, with owners, residents and businesses impacted by construction effects.

A Community Liaison Group (CLG) was established in early 2015 for the first phase of the project from Britomart to Wyndham Street in advance of the relevant NOR condition coming into effect. It has met regularly.

A draft communications plan covering both the pre-construction and construction periods was submitted as part of the NOR documentation. This has since been reviewed in preparation for a construction start with input from the CLG and from other stakeholders named within the conditions.

There will be significant project effects in areas of open surface construction such as Albert Street. The CRL communication effort will therefore prioritise working with property owners in these areas. This will include consideration of their needs as far as practicable when finalising the plans which govern construction - Construction Environment Management Plans.

Regardless of the CRL's ability to meet stakeholder preferences which are often conflicting (such as business and residents' desires for day or night construction), there will be a high priority on keeping people informed.

The CRL project team will provide advance information regarding the type and extent of work, likely noise and vibration impacts, and changes to access patterns.

A 24 hour freephone will operate to respond to inquiries and complaints.

There will also be regular briefings and updates to local boards, MPs, business associations, media and other stakeholders as the project progresses.

17 Sustainability

Sustainability is woven through the CRL Project Objectives, as well as the NOR conditions issued in April 2014.

Providing the CRL at the earliest opportunity (to specification and within budget) has the potential to provide the most substantial sustainability benefits for Auckland, attracting users away from their cars at an earlier date. Ensuring that the project provides a service that meets users' needs and expectations and provides welcoming and appealing facilities also has the potential to further enhance patronage and consequently the sustainability of the project.

17.1 Sustainability framework

AT's objective for the CRL project is to set the benchmark for designing, building and operating sustainable infrastructure in New Zealand.

The context for environmental and sustainability targets for the CRL has been established through a comprehensive review of local and national targets. In developing a framework appropriate for the project investigations have been undertaken into sustainability frameworks and rating tools used by other large infrastructure projects, internationally.

Specific sustainability-related focal areas for the project as a piece of infrastructure cover the carbon footprint, use of materials from sustainable sources, productive use of waste and its minimisation, avoidance of excessive environmental impacts during construction and the way that stations, in particular, can enhance community well-being, including through cultural awareness.

17.2 Sustainable development framework

A sustainability development framework (SDF) has been developed for the CRL. This framework is intended to guide the design and the delivery of the project and will also influence the governance in terms of having systems in place to ensure that the framework has a sufficient profile and is implemented effectively.

The following table shows the high level themes and objectives of the draft AT SDF.

17.3 Infrastructure sustainability rating

Figure 86 - Themes and Objectives of SDF

Climate Change	Minimise the project's direct impact on climate change
Resources	Minimise non-renewable natural resource depletion
Natural Environment	Minimise the negative impact of the project on the natural environment and enhance where practicable
Land Use Integration	Maximise integration with local businesses and community to encourage increased patronage and project value
Economic	Maintain economic advantage by minimising on-going costs and maximising operational availability and patronage Provide, enhance and protect the project economic benefits through efficient procurement and operation Maximise the social economic benefits that flow from the project and operation
Community Benefit	Make a tangible and significant positive contribution to community sustainability, health and well-being Minimise impact on the community during construction and operation
Governance	Ensure that the SDF is recognised and actioned to the maximum extent

The Infrastructure Sustainability Council of Australia's (ISCA) rating scheme closely aligns with the themes and objectives for the SDF detailed above.

Infrastructure Sustainability (IS) is a comprehensive rating system for evaluating sustainability across the design, construction and operation of infrastructure. It is a certification scheme that provides independent verification of sustainable outcomes. Targeting certification against this scheme requires the submission of documentary evidence to ISCA for independent verification. IS has six broad themes: Management and Governance; Using Resources; Emissions, Pollution and Waste; Ecology; People and Place and Innovation. The 15 categories that sit below these themes are shown in Figure 87.

Figure 87 - Sustainability categories

Themes	Categories	Score possible
Management and governance	Management systems	10.5
	Procurement and purchasing	5.0
	Climate change adaptation	5.0
Using resources	Energy and carbon	10.5
	Water	7.0
	Materials	7.0
Emissions, pollution and waste	Discharges to air, land and water	10.5
	Land	7.0
	Waste	7.0
Ecology	Ecology	10.5
People and place	Community health, well-being and safety	5.0
	Heritage	5.0
	Stakeholder participation	5.0
	Urban and landscape design	5.0
Innovation	Innovation	5.0

The IS rating has a 100 point scale plus five bonus points available for Innovation. There are three certified levels shown in the table below.

Figure 88 - IS rating level

Score	Rating Level
< 25	Not eligible to apply for a certified rating
25 - 49	Commended
50 - 74	Excellent
75 - 100	Leading

AT is targeting a certified Design and As-Built rating against the IS rating scheme for the CRL. The project is targeting the 'Excellent' rating level for each contract package with a goal of 65 points. AT has worked with ISCA to adapt IS to create a pilot rating scheme for the New Zealand context that can be applied to the CRL.

The following specific benefits and opportunities have been identified from adopting IS certification:

- the CRL Project, and hence AT, will be providing industry leadership through its involvement in the Pilot of IS and NZ tool development process
- requiring certification provides a level of assurance around project outcomes – requiring contractors to deliver a certified Excellent rating requires certain processes to be demonstrated and design attributes to be included within the delivered project
- IS provides a common language for sustainability in CRL that can be communicated across contract packages, can provide a vehicle for consistent application and evaluation of sustainability in tendering processes and acts as a discussion point in communications with external stakeholders and the wider public
- IS promotes whole of life thinking, resource efficiency and waste reduction, reducing costs
- IS promotes innovation and continuous improvement in the sustainability outcomes from infrastructure
- by targeting 65 points, not only is AT providing a buffer for achieving an Excellent certified rating level but in some areas will also introduce a safety margin between the project impacts and requirements of the consent conditions.

17.4 Zero waste to landfill

The project is supporting Council's adoption of an aspirational goal of Zero Waste with CRL striving for the achievement of zero waste to landfill through construction.

Contractors will be required to develop a Waste Management Plan that shares this goal and must incorporate:

- identification of likely waste streams and when they will arise
- strategies for implementing the waste management hierarchy: avoid – reduce – reuse – recycle – recover – treat – dispose
- systems to monitor and report on waste streams, quantities and diversion paths

17.5 Carbon budget

In support of the 'Climate Change' and 'Resources' themes of the SDF, as well as the 'Using Resources' category of IS, work is being undertaken to understand the carbon footprint of the project with the intention of producing a carbon budget for the CRL. It is anticipated that once set, the carbon budget will not be exceeded and that any proposed changes to the project that impact on the carbon budget will have their carbon footprint calculated to ensure that the carbon budget is not exceeded.

As the project moves into construction, where changes are proposed by the contractor, the contractor will be required to ensure that the carbon footprint for these changes is calculated in accordance with the methodology adopted for creating the original carbon budget

17.6 Progress to date

The two enabling works contracts for early contractor involvement (ECI) have the sustainability-related focus areas embedded in them, requiring the contractors to:

- contribute to and not hinder AT's ability to achieve an Excellent rating against the IS framework
- calculate the carbon footprint for any contractor-led changes
- target zero waste to landfill
- report monthly on energy and water use, and waste generation throughout the project.

Sustainability has been built into the contract key results areas that the contractors are measured against. During the ECI phase the specific key performance indicator (KPI) is the level of integration of sustainability objectives and targets into the construction methodology. During the construction phase the proposed KPIs cover waste management and IS certification.

Alongside the sustainability-related focus areas for the enabling works contractors, AT is currently working with Mana whenua to embed cultural values into their priority areas of the IS rating tool.

17.7 Future work

As well as the criteria developed for the enabling works, the following will be investigated for inclusion in the main works procurement:

- **Lean construction:** Lean Construction is a philosophy based on the concepts of lean manufacturing. It is about managing and improving the construction process to profitably deliver what the customer needs. Lean is about designing and operating the right process and having the right systems, resources and measures to deliver things right first time. Essential to this is the elimination of waste - activities and processes that absorb resources but create no value.
- **Mauri model (supported by Mana whenua):** The mauri model is a decision making framework that combines a stakeholder assessment of worldviews, with an impact assessment of indicators to determine sustainability and trends over time. This tool uses the concept of mauri as the measure of sustainability, in comparison to conventional monetary based assessment.
- Environmental requirements around materials selection

Social sustainability – the legacy of the project

- Apprenticeship opportunities
- Schools and youth engagement programmes
- Community programmes

18 Benefits delivery

18.1 Benefits realisation

18.1.1 Planning to ensure that the benefits are achieved

It is crucial for the success of any project that consideration is given during the planning stage to the various actions that are needed to make sure that the intended benefits are actually delivered. Some of the benefits are normally under the control of the project and its sponsoring organisation whilst others can be dependent on third parties.

18.1.2 Project delivery

As covered above, AT has responsibility for delivery of CRL. As discussed in the Governance and Management section earlier, a strong project management approach is being used with experienced expert staff and service providers. The project team regularly interacts with representatives of some of the larger transport projects recently delivered or in construction, including the teams for the Regional Rail Link in Melbourne, North West Rail Link in Sydney and Waterview in Auckland. These engagements ensure that the CRL team is fully up-to-date with latest thinking and development in project delivery, including of rail systems and tunnels.

While New Zealand does not have an underground rail section akin to the CRL at present, the project does not have any unusual or unique features that might challenge its delivery.

Considerations relating to the ability to deliver the core project do not therefore affect the likelihood of the benefits being delivered.

18.1.3 Independence from network changes

The essential features of the CRL which will provide the majority of the intended benefits is building a 'short-cut' from the North Auckland Line to Britomart, turning the cul-de-sac at Britomart into a through route and adding stations at Aotea and Karangahape Road. None of these features is dependent on any additional changes to the rail network. A small number of changes are planned outside the CRL alignment in order to allow additional services to run. These changes at Henderson, Newmarket, Otahuhu and for the Onehunga line are included as elements of the CRL, are fully-costed and funded as part of the project and provided for in the programme. No additional actions are therefore necessary to guarantee the delivery of the bulk of the transport benefits.

Over time, in order to run additional services to cater for Auckland's growth, further network changes - for example to eliminate more level crossings - and extensions such as to the airport or Mt Roskill are under consideration. The CRL benefits as quantified do not include the patronage from such network changes. They are the subject of separate business cases. The associated services could not, however, run without the CRL.

18.1.4 Reorganisation of bus services

As a consequence of the CRL, bus services can be rearranged so that fewer buses need to run to the City Centre, but can be redeployed to act as feeder services to the rail network, in particular to interchanges such as at Panmure and New Lynn. The CRL benefits include the benefits to the passengers from their quicker journey times and those accruing from having a less-congested City Centre.

As AT has the responsibility for the bus services through its planning in the RPTP and for contracting the services using the Transport Agency's PTOM approach, it is able to ensure that the reorganisation of the services takes place. The changes are already signalled in the RPTP.

18.1.5 TOD and City Centre developments

As set out in Section 8 a small proportion of the CRL's quantified benefits (additional benefits not in the core monetised value) is expected to come through land-use changes catalysed by the project along the rail lines. ToD benefits that arise through urban form that is more sustainable relate to improved health and reduced energy use, with saved infrastructure costs from avoiding urban Fringe development being an unquantified addition. These benefits are outside the direct control of AT – and of the Council unless their own sites are affected. The Council policies support such developments, however, with the PAUP allowing more intense development in appropriate locations close to stations and interchanges.

The private sector has been shown (e.g. Grimes⁵⁸) to respond to the improved accessibility of station locations. "Our estimates indicate that houses adjacent to a Waitakere City Western Line rail station rose in price on announcement of the upgrades in mid-2005, and that the magnitudes of the rises were sensitive to which station the houses were located nearest. Houses more distant from the rail track also rose, but by decreasing amounts up to a distance of around 8 kilometres from the station where no rise was apparent."(p. 23)

18.1.6 Rail operations

The benefits of the CRL to rail customers would not be fully delivered without effective rail operations. AT outsources the delivery of the rail services. A specific factor that AT is taking into account in procuring a future operator is their experience in operating railways that include underground stations and rail tunnels.

18.1.7 Inclusion in corporate plans

In the literature (e.g. NSW Treasury⁵⁹) it is established that the likelihood of a project succeeding and delivering the intended benefits is greatly enhanced if the project is a clear commitment of the organisation, for example in its Statement of Intent (Sol).

Not surprisingly as the Council's top priority project, the CRL is prominent in the successive Sols.

It is also, of course, included in the Council's Long-term Plan and the Auckland Plan as a top priority.

There is no doubt therefore of the strong commitment to the project, giving great confidence that the benefits will be realised.

18.1.8 Dependence on Government funding

The Council LTP notes that the Council anticipates funding for the CRL from Government, see Section 1.1.

18.2 Change management

18.2.1 Network implications

The introduction of the CRL into Auckland's transport network will have substantial impacts both on the rail system and other forms of transport, notably buses, but also the road network including cyclists and pedestrians. These modes (except state highways, which are relatively unaffected) are the responsibility of AT. Within AT, the Operations function has the day-to-day responsibility for all modes. The General Manager AT Metro is a member of the CRL PCG and can ensure that the practical impacts of the new link and stations is well-planned.

AT is well-advanced in preparing for the bus service changes needed during construction and that can take account of the CRL when it is in operation.

58 Anticipatory Effects of Rail Upgrades: Auckland's Western Line Arthur Grimes & Chris Young, Motu, 2010

59 Guidelines for Capital Business Cases Office Of Financial Management, Policy & Guidelines Paper, New South Wales Treasury, 2008

18.2.2 Rail operator

For the CRL to operate well, the rail operator, will need to take account of the CRL and plan for its considerable impact on patronage volumes and the way the rail system operates. The duration of the contract will cover the main construction period of the project and its likely first years of operation to maximise the opportunity for a smooth transition to the new services.

As part of the CRL team, a 'Shadow Operator' with experience of underground railways and stations is a member of the management group and has the responsibility for planning for the future operation not only of the CRL itself and its new stations but also for any consequential impact on the full Auckland network.

18.3 Monitoring and evaluation

18.3.1 Overview

Best practice for any major project is that a comprehensive monitoring system is in place to check that a project is delivering the benefits intended and to make adjustments to optimise the outcomes from having the new works. For the CRL, for example, one of the major opportunities identified is that the project is more successful than modelled in attracting patronage (as the Britomart Transport Interchange was) so that additional rolling stock is required earlier than currently planned. Early monitoring of patronage to pick-up this likelihood is needed given the lead time to procure additional EMUs.

Such monitoring is also useful in the planning of further transport enhancements.

18.3.2 Part of standard monitoring of patronage

AT has a programme to regularly measure and report on rail (and other public transport) patronage, now made particularly easy through the introduction of the HOP card. These statistics will provide the central information on the impact of the CRL on ridership. This monitoring is the responsibility of AT Operations and forms an element of AT reporting to Council against its Sol performance requirements.

18.3.3 Regular customer surveys

AT conducts six-monthly customer feedback attitude surveys. These surveys will provide useful before-and after information and give guidance on any areas that need to be fine-tuned or reviewed. These surveys are also for AT Operations and are regularly reported to the AT Board.

18.3.4 Operator KPIs

As part of the rail operator contract a series of KPIs are in place to monitor operator performance linked to incentivisation. Typical indicators include punctuality, reliability and safety. This regime will not only provide further monitoring information on the operation of the CRL, but also provides the mechanism to make adjustments as required, in conjunction with the operator.

18.3.5 Monitoring CRL's Influence on Growth

It is proposed to monitor the positive influence on development in areas close to the new CRL stations and the wider metro network. A 2015 baseline of development activity with walkable rail catchments prior to the CRL completion will be established and monitored after the CRL is operational on a five and ten yearly basis.

The study findings will enable an assessment of the role the CRL has played in influencing development investment decisions and supporting Auckland Plan outcomes.

Previous one-off studies such as those by Gravitas⁶⁰ have demonstrated the considerable success of the Britomart Transport Centre in transforming the surrounding precinct. Similar studies have been completed for the Crossrail project in the UK.

⁶⁰ Gravitas, November 2011, op cit

Council collects statistics on land-use changes across the city, for example from building and resource consents that can be reviewed to understand the linkage between development activity and the impact of the project. The private sector similarly monitors changes.

The baseline will be established within the CRL work programme and monitoring could be undertaken by Council's RIMU.⁶¹

18.3.6 Employment in the City Centre

As with land-use changes, regular surveys are carried out, which will demonstrate if the expected employment changes are being achieved.

More detailed information should be gained by having a focus on employment numbers within the surveys proposed on land-use changes.

⁶¹ RIMU: The Research, Investigations and Monitoring Unit, part of the Auckland Strategy and Research Department is Council's environmental, social, economic and cultural research centre.

Glossary

Acronym	Description
AEE	Assessment of Environmental Effects
AMETI	Auckland Manukau Eastern Transport Initiative
AP	Auckland Plan
APB&B	AECOM, Parsons Brinckerhoff and BECA
APT	Auckland Passenger Transport Model
ART	Auckland Regional Transport Model
ARTA	Auckland Regional Transport Authority
ARTNL	Auckland Regional Transport Network Ltd
ASGDF	Aotea Station Gateway Development Framework
ASP	Auckland Spatial Planning Model
AT	Auckland Transport
ATSAP	Auckland Transport Strategic Alignment Project
AWHC	Additional Waitemata Harbour Crossing
BCR	Benefit Cost Ratio
BGA	Business Growth Agenda
BIM	Briefing to the Incoming Minister
BTC	Britomart Transport Centre
CAF	Construcciones y Auxiliar de Ferrocarriles
CBD	Central Business District
CCFAS	City Centre Future Access Study
CCO	Council Controlled Organisation
CCTV	Closed Circuit Television
CEMP	Construction Environmental Management Plan
CLG	Community Liaison Group
CMJ	Central Motorway Junction
CO2	Carbon Dioxide
Council	Auckland Council
CPO	Chief Post Office
CRL	City Rail Link
D&C	Design and Construct
DBFM(O)	Design Build Finance Manage (Operate)
DDO	Definition Design Phase
DMU	Diesel Multiple Unit
DSC	Downtown Shopping Centre
DWP	Delivery Works Plan
ECBF	East Coast Bay Formation
ECCM	Energy and Climate Change Mitigation
ECI	Early Contractor Involvement
EEM	Economic Evaluation Manual
EJD	Effective job Density
EMF	Environmental Management Framework
EMU	Electric Multiple Units

EPB	Earth Pressure Balance
GDP	Gross Domestic Product
GETS	Government Electronic Tenders Service
GFA	Gross Floor Area
GFC	Global Financial Crisis
GHG	Greenhouse Gas
GPS	Government Policy Statement on Land Transport
GST	Goods and Services Tax
ILM	Investment Logic Map
IS	Infrastructure Sustainability
ISCA	Infrastructure Sustainability Council of Australia
ISO	International Organisation for Standardisation
ITC	Information, Communication & Technology
ITP	Integrated Transport Programme
JMAC	Joint Modelling Applications Centre
KPI	Key Performance Indicator
LRT	Light Rail Transit
LTP	Long term Plan under the Local Government Act
Masterplan	City Centre Masterplan
MSQA	Management Surveillance and Quality Assurance
MTFAR	Maximum Total Floor Area
NAL	North Auckland Line
NIP 2011	National Infrastructure Plan 2011
NOR	Notices of Requirement
NOx	Mono-nitrogen Oxide
NPV	Net Present Value
NRSS	National Rail System Standards
NSW	New South Wales
O&M	Operation and Maintenance
ODP	Operative District Plan
OECD	Organisation for Economic Cooperation and Development
OHLE	Overhead Line Equipment
PAUP	Proposed Auckland Unitary Plan
PCG	Project Control Group
PM10	Particulate Matter
PMS	Project Management Systems
PNTF	Passenger Network Transport Plan
PPL	Precinct Properties Limited
PPP	Private Public Partnership
PT	Public Transport
PTOM	Public Transport Operating Model
PV	Present Value
PWA	Public Works Act
PwC	Price Waterhouse Coopers
R&D	Research and Development
RAMS	Road Asset Management System

RFP	Request for Proposal
RGP	Risk Governance Panel
RIMU	Research Investigation and Monitoring Unit
RLTP	Regional Land Transport Plan
RMA	Resource Management Act
RMA	Resource Management Act 1991
ROI	Registration of Interest
RPTP	Regional Public Transport Plan
RTN	Rapid Transport Network
SATURN	A detailed assignment model
SCADA	Supervisory Controls and Data Acquisition System
SDF	Sustainability Development Framework
SG	Steering Group
SGS	SGC Economics and Planning of Melbourne
SH	State Highway
SHA	Special Housing Areas
SOI	Statement of Intent
SSC	State Services Commission
TBM	Tunnel Boring Machine
TET	Tender Evaluation Team
TOC	Transport Oriented Community
TOD	Transport Oriented Development

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Appendix 1

1 The Strategic Case: defining the problem – additional information

This appendix supports Section 2 of the business case.

It provides additional information on Auckland's economic and transport challenges.

1.1 The economic potential of Auckland highlighted for the Auckland Royal Commission

The evidence that Auckland could do better was one of the reasons that the Royal Commission on Auckland Governance was established.

Its Terms of Reference explicitly included consideration of:

“what ownership, governance, and institutional arrangements and funding responsibilities are required to ensure the effective, efficient, and sustainable provision of public infrastructure, services, and facilities to support and enhance—

- i. the current and future well-being of the Auckland region and its communities; and
- ii. the performance of the Auckland region as a growth engine in the New Zealand economy⁶⁶ and in its role as a key transport hub for New Zealand and the Pacific region; and
- iii. the ability of the Auckland region to compete internationally as a desirable place to live, work, invest, and do business; and
- iv. the ability of the Auckland region to respond to economic, environmental, cultural, and social challenges (for example, climate change).”

1.2 Submissions to the Royal Commission⁶² and targeted research

The Commissioners found that: most people felt that Auckland could do better economically and contribute more than it does now. For example, the New Zealand Council for Infrastructure Development suggested:

“Auckland could be the primary engine of growth for the NZ economy. It contains the largest agglomeration of people, businesses, education, health, and every other facet of life in New Zealand. In population terms, Auckland is the third-fastest growing city-region in Australasia. Auckland supports two-thirds of population in New Zealand and grows at double the national rate. However ... it only generates 35% of New Zealand's national income. It could, and should, do more.”[11259]

The commissioned research supported those views:

Our conclusion is that Auckland's economy does matter to the rest of New Zealand but that the evidence on domestic linkages does not suggest that it is currently acting as an engine of growth for the regions⁶³.

62 Auckland Governance, Volume 3: Summary of Submissions

63 A report prepared for the Royal Commission on Auckland Governance, Covec 2008

A second report suggested the way forward:

There is consequently a view that a step change is needed to get Auckland onto a new growth path. We fully endorse the desirability of such a change. It is most unlikely that any single project will be the catalyst for a new Auckland economy, but several projects could do so in combination. Some are already underway, such as addressing transport needs, and the Commission's own focus on governance issues. These projects are contextual, but critical."

The Commission researchers cited an OECD study of New Zealand's innovation system, which they had established was a key to sustainable economic growth. The research concluded that the system needed considerable work. Among other weaknesses, the OECD cited infrastructure weaknesses (including broadband, and Auckland's transport and electricity networks), lack of R&D investment incentives, barriers to business growth, and a dearth of relevant management skills.

1.3 Additional research on Auckland's economic performance

Market Economics found that Auckland ranked only 84th out of 116 metropolitan regions on GDP per capita, and sixth out of seven comparator cities (Brisbane, Melbourne, Adelaide, Seattle, Vancouver and Copenhagen). Auckland's household incomes were lower than all the comparator city-regions, with the exception of Adelaide. Auckland had a higher unemployment rate than other cities, with youth unemployment singled out as a 'significant problem' in Auckland, as were ethnic differences in Auckland's labour market participation rates.⁶⁴

The general conclusions noted in the study included:

- Auckland is sliding down the economic performance rankings for OECD cities.
- The workers that Auckland requires for productivity improvement are mobile and operate in a global marketplace. Auckland has a number of attractive features but also higher opportunity (i.e., lower incomes) and other costs (e.g., housing costs) compared with some international cities. It therefore risks losing skilled labour to other international cities.

A study by Grimes et al similarly concluded that New Zealand cities (including Auckland) are at risk of losing talented workforces to Australia.⁶⁵

2 Auckland's transport challenges – additional detail

2.1 Growth trends

The growth in demand discussed in Section 2.2 based on the ITP analysis is not confined to peak periods. The city's roads will need to provide for an additional 1.35 million trips during the inter-peak business hours.

⁶⁴ Market Economics, in: Improving our understanding of Auckland's competitiveness: Final Report A Synthesis of the Auckland Research Programme, Martin Jenkins, June 2011

⁶⁵ Grimes, Le Valliant and McCann, in: Improving our understanding of Auckland's competitiveness: Final Report A Synthesis of the Auckland Research Programme, Martin Jenkins, June 2011

Figure 89 - Transport network statistics – Transport network 2011 versus 2041

Transport Trip Statistics	2011	2041	% Change
Regional Road Network			
AM Vehicle Trips	505,000	740,000	47%
AM Average Vehicle Trip Time (mins)	13.4	18	34%
AM Average Vehicle Trip Speed (kph)	45.6	34.7	-24%
Road Length - Both Directions (km)	5,036	5,206	3%
Regional Freight			
AM Heavy Commercial Vehicle Trips	26,757	46,980	76%
Regional Public Transport Network			
AM Public Transport Trips	92,000	169,000	84%
AM Bus Service (km)	31,000	61,000	97%
AM Rail Service (km)	2,100	7,700	267%
AM Ferry Service (km)	700	1,500	114%
Regional Active Transport Network			
Daily Active Trips (cycling and walking)	507,000	1,011,000	99%

Core trip statistics for the regional networks are shown above.

The biggest percentage changes in trip making between 2011 and 2041 were projected for freight, public transport and active transport modes. The changes reflect the historical development of these transport networks and the projected increase resulting from more integrated planning and investment.

2.2 The main challenges

2.2.1 Roads

The main challenges acknowledged for the regional road network were:

- the state highway and arterial network are projected to experience significant increases in traffic growth, particularly people accessing the City Centre and its Fringes
- congestion is projected to worsen significantly in the second and third decade of the programme as the road network capacity is reached
- expanding the extent of the network will be difficult (and expensive) to achieve
- balancing the various competing demands for movement with the liveability needs of the main centres.

2.2.2 Freight

The main challenges for the strategic freight network were established to be:

- balancing the transport needs of the freight industry with those of other road and rail users
- aligning improvements to the freight network with business developments to maximise productivity gains and access to markets
- aligning the demand for land use between freight and other activities: freight routes are not considered to be desirable settings for residential intensification with reverse sensitivity issues resulting when these activities are in close proximity
- maintaining the ability of the freight network to offer convenient and reliable connections between business, industrial parks and ports owing to growing congestion on the arterial road network.

2.2.3 Public transport

Auckland's current public transport network was shown to have substantial shortcomings. The RTN was shown to be limited by the capacity of Britomart station and the wider rail network and the limited extent of the Northern Busway. The existing network of bus routes was seen to be overly complex with a number of routes operating at too low a frequency to be attractive to customers.

The major identified challenges for the existing public transport network were:

- the lack of an integrated and connected network, meaning that mode specific improvements were insufficient to achieve the major shift to public transport sought by the Auckland Plan
- public transport is currently far slower – in general - than driving owing to a combination of low frequency services, slow boarding times and stop-start travel on road corridors
- as traffic volumes grow, the ability of the public transport system to offer an attractive alternative to private vehicle travel can be compromised when services are affected by traffic congestion or constrained capacity on the rail network.

Achieving the Auckland Plan targets for public transport was identified as requiring continued investment in the proposed Rapid and Frequent public transport service networks to support the intensification of centres, corridors and future urban areas. Investment in public transport infrastructure, specifically quality interchanges and bus priority measures, was further shown to be required to gain the full benefits of the proposed services.

Differing levels of change were associated with a range of funding levels from that represented by the Auckland Plan down to "committed levels."

Figure 90 - 2026

Indicator	Description	Current	Full Funding - AP	Basic	Committed Funding
Public transport boardings	Number of annual public transport boardings (millions)	66	140	127	107
Public transport boardings per capita	Number of annual public transport boardings per capita (millions)	44	77	70	59
Public transport morning peak motorised mode share	Proportion of morning peak motorised trips (PT & Auto) into the CBD by public transport	46%	59%	57%	55%
Walking, cycling and public transport morning peak mode share	Proportion of morning peak trips that are made by walking, cycling or public transport	22%	28%	26%	25%
Greenhouse gas emissions	Greenhouse gas emissions from ground based transport	2013 (base)	16% increase	19% increase	18% increase
NOx emissions	Emissions of oxides of nitrogen, million tonnes per day	32	19	20	20
Morning peak, average vehicle	Travel speed, km/hr	47	43	42	43

2.2.4 City Centre issues

As part of the CCFAS, a deficiency analysis was undertaken. This analysis identified shortfalls in transport network capacity when compared to demand on the network. In terms of public transport, those shortfalls were expressed in terms of excess passenger demand above the carrying capacity of public transport services (based on service frequency and reliability, and vehicle capacity), while for roads the relationship was between vehicle volumes and road capacity.

The deficiency analysis focused on the extent to which planned transport infrastructure developments both to public transport services and highway capacity, would cater for land use growth (specifically as set out in the Auckland Plan) with the aim of identifying the particular issues or opportunities relating to the City Centre that would need to be addressed through a project such as CRL or alternatives.

Balanced reference case⁷² model outputs were used as the basis of the deficiency analysis as they represented the best estimate of the state of public transport and highway systems in Auckland in future years, without any of the possible options being studied in the CCFAS itself. The deficiency analysis was designed to identify both the location and scale of the problems that the future transport network would face.

2.2.5 Initial reference case definition

The reference case scenarios were developed based on known planning with regard to land-use and committed changes to public transport service provision and road transport network capacity. As well as the committed projects that would be included in a standard 'do minimum' or base case, the balanced reference case for the CCFAS study included additional less-certain projects such as the Additional Waitemata Harbour Crossing, AMETI later stages, the East West Connections and various unfunded state highway upgrades. The reference case therefore presented a 'best case' for the regional transport network.

2.2.6 CCFAS deficiency analysis findings

The deficiency analysis identified that demand for public transport services would exceed assumed capacity by a significant degree for both 2021 and 2041. The analysis indicated that demand for the network was forecast to be in excess of capacity on most corridors into the City Centre by this time.

A VCR of 1.0 meant that all the public transport services on a particular route were full. A VCR of 2.0 meant that the cumulative passenger demand forecast for all public transport services on a particular road or rail link was double the cumulative carrying capacity of services on that link.

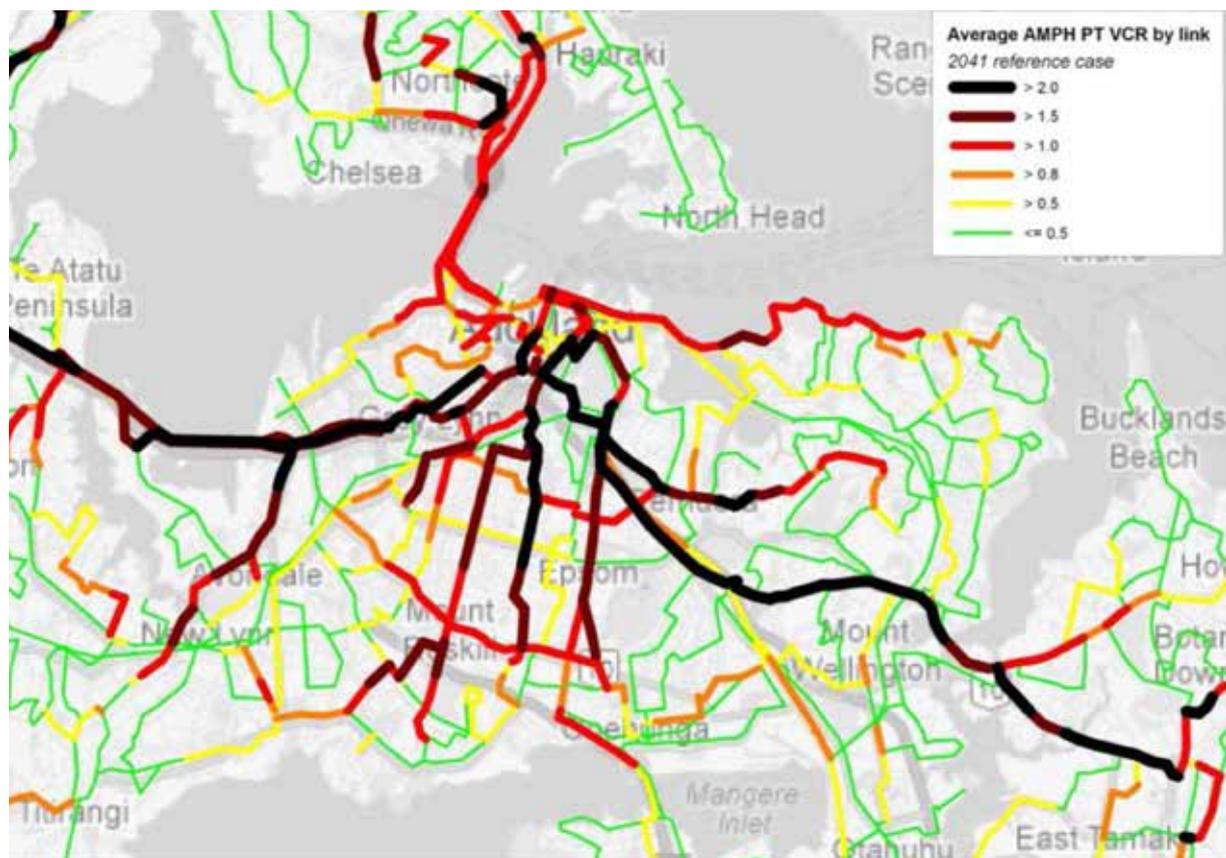
Estimated demand for services in the model was based on forecast land-use (expressed in terms of population and employment) and the generalised cost of different travel options, and was unconstrained by the capacity of public transport services, in order to demonstrate the demand.

2.2.7 Public transport - buses

By 2041, the situation on the public transport network was assessed to have worsened noticeably when compared with 2021, as shown in Figure 91. In particular, the following important corridors would not have sufficient capacity to meet demand for the service in the modelled years:

- Great South Road – VCR >2.0 in both 2021 and 2041
- Khyber Pass Road – VCR >2.0 in both 2021 and 2041
- Great North Road – VCR >1.5 in 2021 and >2 in 2041
- Mt Eden Road – VCR >1.5 in 2021 and >2.0 in 2041
- Dominion Road/Manukau Road – VCR >1.5 in 2041.

Figure 91 - Average morning peak hour public transport volume capacity ratio by link (2041 reference case)



The analysis of public transport VCRs also served to highlight issues in the City Centre, with buses on all approach roads except Quay Street, forecast to be over capacity in the 2021 reference case.

By 2041, demand for bus services on all approach roads into the City Centre, including Quay Street, was forecast to be in excess of capacity. The following locations were highlighted as particular concerns:

- Grafton Road – VCR >2.0 in both 2021 and 2041
- Grafton Bridge – VCR >1.5 in 2021, >2.0 in 2041
- Albert Street – VCR >2.0 in 2041
- Symonds Street / Karangahape Road – VCR >1.5 in 2041

The deficiency analysis also showed that increasing the frequency of bus services to meet forecast demand in the reference case would lead to significant operational issues on the high-frequency corridors. Research indicated that bus network performance deteriorated significantly when frequency exceeded 100 buses per hour using a single bus lane without indented bus stops. This threshold varied according to the nature of a specific site.

CCFAS identified that many bus corridors in Auckland were already operating at 80 to 100 buses per hour which resulted in the unstable flow and queuing seen on the inner city streets. Fanshawe, Customs, Wellesley, Albert and Symonds Streets were operating at the 80 to 100 bus level with unstable flow already apparent. Platooning or bunching of buses was common on high frequency routes like Dominion Road and Pakuranga Highway.

Increasing service frequency on such corridors to meet demand would further reduce network performance, and higher forecast demand for services, would also lead to increasing dwell times at stops as a result of more boarding and alighting activity, exacerbating the issue. Owing to additional boarding in the PM peak this issue would be expected to be worse in that period. Forecast increases in general traffic would also exacerbate delays and limit options for bus priority improvements.

By 2041, increasing demand for services would lead to a requirement for even higher frequencies. By this time, the majority of approaches into the City Centre would require over 100 buses per hour, with requirements on Fanshawe Street and Wellesley Street at approximately 190 buses per hour and on Symonds Street at over 250 buses per hour.

The deficiency analysis demonstrated that operating these required frequencies is not practical for the following reasons:

- operational constraints relating to service reliability and delays associated with operating high frequencies on key corridors
- physical road capacity and junction priority issues (both for bus and general traffic)
- impacts on environmental and streetscape amenity and road safety created by high frequency bus corridors
- few opportunities for route optimisation as a result of the limited number of bus access corridors to the City Centre.
- The CCFAS deficiency analysis also indicated that increasing the frequency of the bus network to meet demand was unlikely to be a feasible option even if the bus fleet in Auckland were upgraded to high capacity buses.
- The deficiency analysis supported the conclusions that demand in 2021 and 2041 would be too high to be addressed by adjusting service frequencies and vehicle capacities on the existing transport network, and that additional intervention would be required to increase capacity to the City Centre.

2.2.8 Bus network capacity

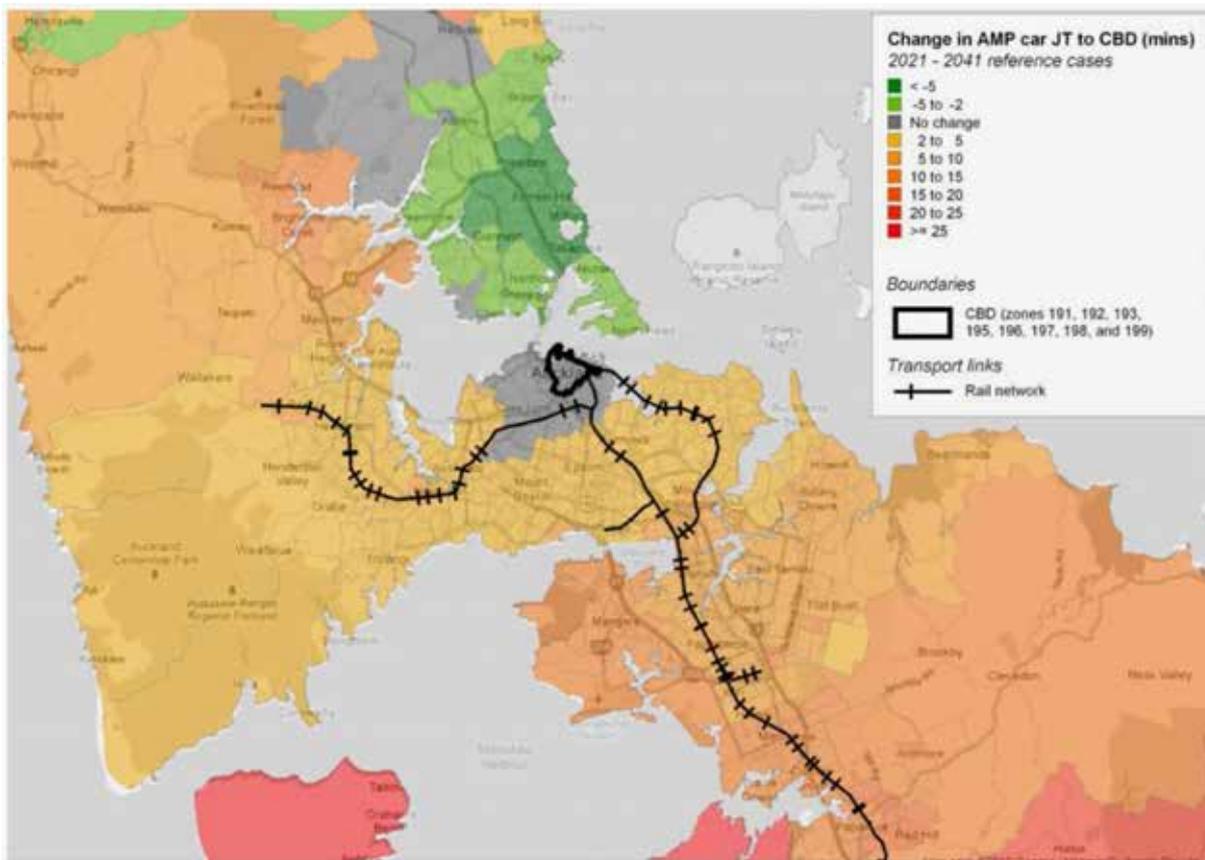
Further analysis of bus capacity was undertaken to identify critical services and corridors that would reach their capacity, and when this was likely to occur, assuming increased frequencies within the physical capacities of the current bus network.

The majority of services from the isthmus, north and east were estimated to reach their capacity by 2021 while services from the west would reach 80 per cent of their capacity in the 2030s. The limited opportunity to optimise further was unlikely to change the overall picture.

2.2.9 Future road conditions

The CCFAS assessment of road network VCRs and car journey times indicated that traffic congestion would be expected to be widespread across the network in future years, leading to deterioration in network conditions. This was shown by analysing the forecast changes in car journey times to the City Centre from 2021 to 2041. This change is summarised on the map below.

Figure 92 – Journey Times to City



The map indicates that journey times to the City Centre were forecast to increase from every part of the city except the North Shore, which benefited from the inclusion of the Additional Waitemata Harbour Crossing (AWHC) in the 2041 reference case model assumptions.

The increase in congestion was forecast to occur alongside the increase in demand for public transport services, suggesting that without additional capacity into the centre, the opportunities for optimising the bus network through the provision of more dedicated lanes and priority at signal junctions would become increasingly limited in future. In the modelling, the forecast number of morning peak car trips to the City Centre in 2041 was broadly similar to the forecast for 2021, suggesting that road network capacity constraints in the City Centre resulted in suppressed demand and some mode shift to public

transport. In contrast, car trip numbers outside the centre were forecast to increase between 2021 and 2041, adding to congestion on many links and worsening journey times to the City Centre.

Following the initial deficiency analysis, more detailed traffic modelling was undertaken for CCFAS using the City Centre SATURN model to understand the changes in levels of congestion within the central area. The analysis indicated that congestion within the City Centre would increase significantly making private and commercial vehicle access much more difficult. The SATURN model suggested that average speeds in the morning peak hour could drop from 16 kph in 2011 to 7 kph in 2021 and 5 kph in 2041.

2.2.11 Future rail capacity

The CCFAS findings also indicated that while there appeared to be spare capacity on the rail network coming into Britomart, there would be capacity issues on rail outside the City Centre, with volumes exceeding assessed capacity on the western line and links approaching Puhinui, Penrose and Newmarket stations from the south by 2041. A high level of alighting activity at Newmarket and Parnell stations reduced demand into Britomart itself.

2.2.12 Rail constraints at Britomart

On the rail network, the Britomart terminus and Quay Park junction (which is very close to Britomart) limit the number of train paths into and out of the City Centre. Further out, Newmarket constrains the frequency of trains that can be operated from the western and southern lines. The post-electrification peak period electric train timetable was for 20 trains per hour (tph) in and out of Britomart during peak periods, comprised of six tph on each of the Southern, Western and Eastern routes, together with two tph from Onehunga. At Newmarket, six tph would reverse going west and six tph reverse coming into the city as well as eight tph in each direction as through trains to and from the Southern and Onehunga lines.

The combination of the Newmarket constraint with Quay Park/Britomart effectively meant that, by 2015 all of the useable peak train paths into and out of Newmarket and Britomart would be in use, providing no room to add additional services.

Post-electrification, demand was not expected to exceed rail capacity in 2021 with the majority of the network able to operate within the seated capacity. This was because demand was constrained by the reach of the network and frequencies which could operate following electrification. The Western Line rail capacity would be exceeded sometime around 2030 with the post-electrification network and timetable. Seated capacity at the key load point on the Western Line was assessed to be reached prior to 2021.

2.3 Environmental requirements

2.3.1 Improving environmental well-being

The current operation of the transport system was identified in the ITP as a concern with diverse impacts ranging from those on public health, stormwater, climate change, biodiversity, habitat connectivity, and other impacts from noise, dust, and community severance, to waste production, and non-renewable resource use.

Growing recognition and evolving demand for improvement across a range of outcomes was argued to mean that a much more coordinated and collaborative approach was needed. The transport sector's contribution to reduce greenhouse gases to 40 per cent below 1990 levels by 2040 (49 per cent reduced from 2009) would be important to meet both Auckland's and central government greenhouse gas targets.

Appendix 2

1 The strategic context - additional information

1.1 Strategic alignment of the City Rail Link

This appendix supports Section 3 of the business case. It covers additional strategies and/or provides greater detail than the body of the business case.

1.2 National Infrastructure Plan 2011 - links to the CRL and support for it

In preparing the case for the CRL, AT has taken note of the National Infrastructure Plan, 2011 (NIP 2011).⁶⁶ In particular, the following matters considered in the Plan resonate with the strategic thinking and analysis supporting the project:

- Focus on Auckland
- Infrastructure challenges
- A growing New Zealand
- Economic performance
- Investment analysis
- Funding mechanisms.

1.3 Focus on Auckland

The NIP 2011 contains a reasonably extensive section focused on Auckland with transport featuring strongly. While recognising some of Auckland's strengths, the section also highlights two particular challenges - coordination and funding.

It is suggested in the NIP that the formation of the Council and the development of the Auckland Plan provide the opportunity to strengthen the coordination with land-use planning and that between central and local government priorities. AT is aligned with the direction signalled. Helping to deliver the Auckland Plan and its land use strategy is one of the most important goals for the transport investment.

Similarly, AT has acknowledged the Government's priority for economic development and has developed the CRL and associated transport upgrades (together with land-use changes facilitated by Council policies and investments) to maximise the economic return from the project. These benefits should come from the direct transport productivity changes as a result of the CRL and equally from the macroeconomic effects it will catalyse.

The NIP states that central government agencies will "consider the Auckland Plan and its land use, growth and infrastructure strategy in their own investment decisions and strategies."

⁶⁶ National Infrastructure Plan 2011 New Zealand Government, July 2011

1.4 Infrastructure challenges

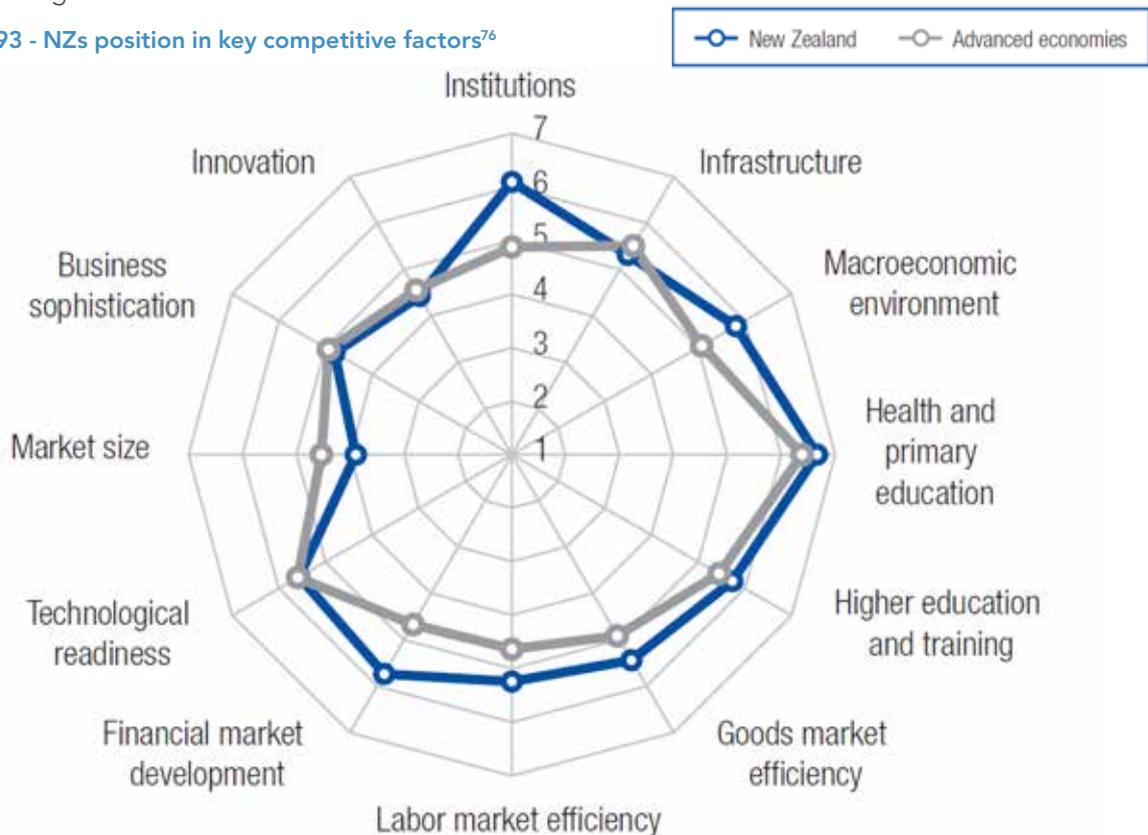
The NIP 2011 notes that “The World Economic Forum’s Global Competitiveness Report rates New Zealand’s infrastructure performance as weaker than that of other areas, e.g. the strength of our institutions or the openness of the economy.”⁶⁷ Infrastructure is the second worst performing of the index components, in terms of ranking (37 against the overall ranking of 23 for New Zealand among 144 countries). The macroeconomic environment is also a comparative weakness. For these reasons, AT believes that a strategy of investment in infrastructure that addresses macroeconomic under-performance, such as the CRL, should be a priority for Auckland and New Zealand as a whole.

The lowest component ranking for New Zealand (60) is for market size, which is clearly an inherent weakness for any small country given that half of the contributing factors is the size of the domestic market (even overall seventh ranking Finland, with its low population of 5.6 million people, ranks 56 on this criterion). That said, the foreign market size for New Zealand ranks even lower than the domestic, suggesting that a focus on the number of knowledge workers who produce export services and who would normally be based in the centre of a country’s largest city, need the boost that is planned to be catalysed by the CRL.

In the same report inadequate supply of infrastructure was listed as the top problematic factor for doing business in New Zealand.

In the 2014 version of the report⁶⁸ New Zealand’s overall position had improved to 17 (with a comment in the report noting New Zealand outranking Australia), but the overall picture remained similar with infrastructure remaining a weakness (rank 29) and macroeconomic environment at 25. The market size, unsurprisingly, remained a major constraint, ranking only two positions higher than in 2011, at 62. Inadequate supply of infrastructure remained the most problematic factor for doing business. The story was unchanged in 2015.⁶⁹

Figure 93 - NZs position in key competitive factors⁷⁶



67 Insight Report, The Global Competitiveness Report 2012–2013, World Economic Forum, September 2011

68 Insight Report, The Global Competitiveness Report 2014–2015, World Economic Forum, September 2014

69 The Global Competitiveness Report 2015–2015, World Economic Forum Page 290

Similarly, the 2014 Economist Intelligence Unit Liveability Ranking has Auckland as the World's 10th most liveable city with its weakest score out of a hundred being for Infrastructure, which includes transport aspects as two out of the seven sub-categories.⁷⁰

1.5 A growing New Zealand

Comments are contained in the section of the NIP that addresses a growing New Zealand. As the fastest growing major urban area, Auckland has to focus very hard on providing a city that will thrive with the growth and which has the right infrastructure to support it. In this context, the make-up of the "high level trends [that] will shape our economy (including global trends around climate change, technology and peak oil), and with it the demands for infrastructure" would suggest that a major project that will reduce the impact of transport on climate change and lower dependence on oil, is likely to be a logical investment. It is also likely to make sense to invest in a project expected to enhance the service sector which delivers its export products through electronic media, rather than through use of conventional transport.

1.6 Economic performance

The development and analysis around the CRL has been strongly linked to achieving higher economic performance. The CRL, with its unique role in unlocking critical constraints on the performance of the City Centre, is a core intervention in Auckland's Economic Development Strategy. In this way the project supports the NIP view that:

Infrastructure has a dual role in this strategy. It underpins growth by providing the supporting networks demanded by a growing economy. It also catalyses growth by creating new economic opportunities.

1.7 Investment analysis

The NIP provides guidance on how infrastructure projects should be designed and evaluated to ensure that they support economic growth:

Infrastructure investment will be subject to rigorous analysis and based on consistent evaluation methodologies. Given the long lead times and life spans of infrastructure, this may mean erring on the side of slight over-investment, rather than risking significant under-investment. Decision makers should consider and allow for future options, rather than lock in configurations or investments that rule out further expansion.

Future investment decisions should consider:

- Future demand and then build extra capacity and development options into new infrastructure.
- The value of developing networks of infrastructure.
- Wider economic benefits including those created by more efficient land use and resource allocation.
- The costs and implications of ownership over the life of the asset/network.

The CRL has been designed so that additional capacity can be provided through running extra train services, should demand warrant it and to allow for future network expansion, for example to the airport and to the North Shore.

AT welcomes the confirmation that networks are important. Rail is a classic network with the CRL just one stage in a well-planned development of a RTN for Auckland. Further, the explicit endorsement of the need to consider the wider economic benefits, is valuable backing for the analysis in Section 8.3 where more efficient use of land, both in the City Centre for more productive jobs, and elsewhere for more intensive housing, are shown to provide very substantial economic benefits.

Different forms of ownership have been tested in the procurement and financing strategies (and will continue to be), but are potentially somewhat limited by the role of KiwiRail.

70 A Summary of the Liveability Ranking and Overview, The Economist Intelligence Unit, August 2014

1.8 Compatibility of CRL with NZ Government energy strategies

1.8.1 Government Energy Strategies

The government has two related energy strategies⁷¹, each of which has a section in relation to transport. New Zealand Energy Strategy.⁷²

For transport, the Government's key focus will be on creating the most efficient mix of integrated modes and travel options for New Zealanders and our visitors. To do this the Government will continue to invest in:

- Reliable and more cost effective public transport systems that offer benefits to attract a greater percentage of long-term users.

CRL alignment:

The CRL is expected to enable a shift from road use to rail. It will allow a step-change in public transport use.

1.8.2 New Zealand Energy Efficiency and Conservation Strategy⁷³

Objective: Transport

A more energy efficient transport system, with a greater diversity of fuels and alternative energy technologies.

CRL contribution:

As part of an electrified rail network, implementation of the CRL will contribute to greater energy efficiency and greater diversity of fuel use.

1.9 The Auckland Plan - economic development

1.9.1 Vision

The Auckland Plan is the systematic, comprehensive approach towards achieving the Council's vision of making Auckland the world's most liveable city.

1.9.2 Economic development

The Auckland Plan takes as a given that a strong economy that delivers opportunities and prosperity for everyone results in a better quality of life for all and that continuing disparities and high unemployment inflict huge personal cost on those who are disadvantaged and on society as a whole.⁷⁴

The City Centre is where many of Auckland's cultural institutions of international scale are located with the potential to create a cluster of attractions for the visitor industry. The Auckland Plan therefore emphasises accessibility to these institutions, particularly through public transport.⁸²

1.9.3 Economic direction

The Auckland Plan has a clear economic goal with explicit supporting targets and priorities.⁷⁵

71 Referenced on page 42 of the Government Policy Statement

72 New Zealand Energy Strategy 2011–2021, August 2011

73 New Zealand Energy Efficiency and Conservation Strategy 2011-2016, August 2011

74 Auckland Plan, page 80

75 Ibid, page 120

76 Ibid, page 150

Figure 94 - Strategic direction, targets and priorities

Strategic Direction 6				
Develop an economy that delivers opportunity and prosperity for all Aucklanders and New Zealand				
Targets				
Improve Auckland's OECD ranking of cities (GDP per capita) of 69th place in 2011 by 20 places in 2031	Increase annual average productivity growth from 1% p.a. in the last decade to 2% p.a. for the next 30 years		Increase annual average export growth from 3% p.a. in the last decade to 6% for the next 30 years	
Increase annual average real GDP growth from 3% p.a. in the last decade to 5% p.a. for the next 30 years		Ongoing provision of planned and services capacity for Group 1 business land, including large lots, to meet 5-yearly demand as assessed by annual surveys		
Priorities				
1	2	3	4	5
Grow a business-friendly well-functioning city	Develop an innovation hub of the Asia-Pacific rim	Become internationally connected and export driven	Enhance investment in people to grow skills and a local workforce	Develop a creative, vibrant, international city

In the Auckland Plan, the City Centre is to remain the focal point for finance and business services and similar industries for which Auckland is New Zealand's main commercial centre. The strong growth expected in office activity will be encouraged in centres and areas identified for future business intensification, to make the best use of existing infrastructure and investment. The majority of the demand (64 per cent) is expected to occur in the centre of Auckland.

The Auckland Plan includes increasing Auckland's export income and achieving the targets through building on its strengths, focusing on investment in research and development and strengthening the innovation system. Certain sectors – many having a central city location - are seen to have the greatest potential to contribute to productivity growth based on their current rate of employment growth, international export activity and dollar value exports.⁷⁷ They include:

- finance
- high tech (including science and health)
- advanced materials
- marine
- clean technology
- tertiary education
- screen production
- food and beverage.

While raising productivity and export performance is seen to be important, the Auckland Plan comments that the greatest gains may be made by focusing on removing impediments to growth and facilitating opportunities for key sectors. A major focus of Auckland's economic development strategy is therefore around developing competitive clusters of companies that can succeed against international competition in the domestic and international markets in a sustainable way.

Tourism and education – both of which have a City Centre weighting - are major contributors to Auckland's export earnings.

Auckland attracts skilled workers and knowledge-intensive high value sectors. Seventy per cent of new migrants settle in Auckland. Many migrants remain connected to their countries of origin, which offers scope for further mutual benefit between countries. International firms and entrepreneurs are attracted

⁷⁷ Ibid, page 161

to Auckland because of the lifestyle it provides, the ease of establishing a company and the relatively cheap and well-educated labour force. Attracting such firms is part of the Plan to further strengthen the economy and provide entry points into overseas markets.

2 The Auckland Plan - Transport

2.1 Strategic direction, targets and priorities

The transport chapter contains a hierarchy of a strategic direction, specific quantified targets and four priorities.⁷⁸

The Auckland Plan considers Auckland’s transport system to be overburdened and inefficient with Aucklanders relying heavily on private cars as their primary transport mode. It states that roads and

Figure 95 - Strategic direction, targets and priorities

Strategic Direction 13				
Create better connections and accessibility within Auckland, across New Zealand and to the world				
Targets				
Double public transport from 70 million trips in 2012 to 140 million trips by 2022 (subject to additional funding)	Increase the proportion of trips made by public transport into the City Centre during the morning peak, from 47% of all vehicular trips in 2011 by 70% in 2040	Reduce road crash fatalities and serious injuries from 506 (2010) to no more than 410 in 2020	Reduce congestion levels for vehicles on the strategic freight network to at or below the average of 2006-2009 levels (average daily speed of 45kph and average delay of 32 seconds per km) by 2021	Increase the proportion of people living within walking distance of frequent public transport stops from 14% (2011) to 32% by 2040
Priorities				
1	2	3	4	
Manage Auckland’s transport as a single system	Integrate transport planning and investment with land use development	Prioritise and optimise investment across transport modes	Implement new transport funding mechanisms	

motorways are heavily congested and further expansion severely constrained with a need for radical transformation to prevent population growth exacerbating the problems.

The three components identified to address the current congestion problems, accommodate future business and population growth, and to move to a single transport system – the first priority - are, to:

- improve and complete the existing road and rail network
- encourage a shift towards public transport
- support environmental and health objectives through walking and cycling.

The Auckland Plan requires the transport system to integrate land use and transport to support growth centres and that this will necessitate improvements to the road and rail system.

In order to reduce the reliance on cars, improving public transport options and connections along key transport corridors are expected to encourage commuters to use public transport. Such a shift is

78 Ibid, page 312

expected to reduce congestion, and free up the roads for freight transport and commercial travel (thus improving productivity and competitiveness), and journeys where there is no alternative to using cars.

The goal is for public transport patronage to reach 140 million trips by 2022. It is acknowledged that this will require a greater allocation of funding to public transport than in the past.

Stated advantages of additional investment in public transport are improved resilience of the transport system, reduction in pollutants from motor vehicles and reduced fossil fuel consumption, improved energy efficiency and decrease dependence on imported fuels.

2.1.1 Integrate transport planning and investment with land-use development⁷⁹

The second priority area is for the transport system to support Auckland's vision for future growth and development. Stated fundamentals of particular relevance to the CRL are:

- transport investment and services, especially public transport and regional arterial roads, must align with areas of future growth and development
- the system must be easily accessible and ensure reliable journey times
- particular emphasis must be given to freight movement and other related business travel on international, national and Auckland-wide transport corridors
- transport projects must recognise and contribute to place-shaping
- a change in parking strategy and standards is required to encourage intensification, mixed-use development, more efficient use of land, and shifts to walking, cycling and public transport
- a more rapid rate of investment is needed, requiring new forms of revenue.

2.1.2 Benefits of the CRL in the Auckland Plan

The Auckland Plan therefore discusses the project at some length including noting the dramatic travel time changes that are expected and its ability to facilitate commercial and residential development, and access to employment and educational opportunities for all communities on the rail network. The Council sees the CRL as a key enabler of increasing employment in the City Centre and metropolitan centres on the rail network. Previous experience with Britomart station and the double-tracking are noted as evidence of the potential. In the Auckland Plan the CRL is expected to be the foremost transformation project in the next decade creating the most significant place-shaping opportunity - as the entire City Centre would be within ten minutes' walk of a railway station.

Eighty per cent of submitters to the draft Auckland Plan, who referred to the CRL, supported its construction.

2.1.3 Need to commit to environmental action and green growth

The Auckland Plan records that the health of the Auckland environment, and its biodiversity, are deteriorating.⁸⁰ Air pollution, soil degradation, the poor state of many of the waterways, and declining fish stocks are some of the pressing environmental problems – as well as high and rising levels of greenhouse gas emissions. Joining the global shift towards green growth is seen to be essential to achieving Auckland's environmental and economic goals.

The State of the Auckland Region Report (2010) is cited as noting, inter alia, that:

- natural hazards cost Auckland millions of dollars each year, and with the effects of climate change these costs may rise
- resource consumption and waste production is increasing.⁸¹

79 Ibid, page 322

80 Ibid, page 33

81 Ibid, page 177

Emissions to air result in levels of particulate matter and nitrogen oxides that regularly exceed standards and guidelines.

The State of Auckland report card for 2013 gives the social cost from air pollutions as \$1.07b, and attributes approximately 300 premature deaths each year to that cause.⁸²

Transport is identified in the Auckland Plan as the main contributor to total air pollution and while improved fuels and new vehicle technologies have lowered emissions these gains have been offset by increasing vehicle numbers, longer travelling distances and an ageing vehicle fleet. At 35 per cent of the total, land transport is also Auckland's largest source of greenhouse gas emissions.

2.2 Plan targets

2.2.1 The role of the CRL and its expected influence

The challenge for Auckland is seen to be to separate the link between GHG emissions and development, economic growth, and energy use and that this will require a transformation from a "fossil fuel-dependent, high energy-using, high-waste society to an 'eco- or liveable city'". A liveable city is typified in the Plan by sustainable resource use, a quality compact form, an eco-economy, and transport and energy systems that are efficient, maximise renewable resource use and minimise reliance on fossil-based transport fuel.

Council is developing an integrated Energy and Climate Change Mitigation (ECCM) strategy and action plan which will provide greater specificity on the actions to be taken and will build on a range of existing initiatives and commitment by the Council and others.

Of particular relevance to the CRL, these initiatives include developing a quality compact Auckland supported by sustainable transport choices such as public transport, walking and cycling options, and rail electrification.

This strategy will be informed by an analysis of costs and benefits from which a prioritised set of short-, medium- and long-term projects and corresponding targets will be developed. Areas of focus relevant for the CRL are:

- public transport and travel demand management
- pricing mechanisms (e.g. the NZ ETS, parking charges and road pricing)
- integrated land-use and transport patterns
- efficient transport networks and operations.

Auckland's future spatial form is stated to be important because it can mitigate and adapt to the effects of climate change.⁸³

2.2.2 Low Carbon Auckland

Low Carbon Auckland, Auckland's Energy Resilience and Low Carbon Action Plan, released by Council in July 2014, sets out a 30 year pathway to 2040 with actions for the first 10 years. There are five areas of transformation identified, including "the way we travel". There are four elements for the pathway to 2040:

82 State of Auckland Air Quality Report Card, July 2013

83 State of Auckland Region Report, 2010, page 209

- reducing travel demand
- increasing the use of public transport, walking and cycling
- improving transport efficiency
- alternative fuels.

Action 10 is to “Complete key Auckland Plan first decade public transport projects, e.g. City Rail Link, busway improvements.”

Low Carbon Auckland states that the fossil fuel-dependent transport system generates significant adverse health and environmental impacts equating to \$465 million in health costs per year⁸⁴ and physical inactivity costs⁸⁵ of \$405 million per year.

2.2.3 Energy use, efficiency and affordability

Auckland’s projected energy demand will increase by approximately 65 per cent by 2031 with the city becoming increasingly reliant on imported energy supplies and vulnerable to increases in the cost of energy.

The same combination of city form and preferred transport system that can respond to the pollution and greenhouse gas challenges can mitigate the energy demand challenge.

2.3 The City Centre Masterplan

2.3.1 Strategic fit

The Masterplan is a non-statutory supporting document to the Auckland Plan setting out the preferred direction and priorities for the City Centre. The Masterplan puts considerable emphasis on the role of the CRL as a critical transformational project for the whole City Centre with particular emphasis on the “quarters” where the new stations will be major development catalysts.

The vision and transformational moves of the Masterplan are embedded in the Auckland Plan and, in turn, guide the strategic direction for the City Centre in the Unitary Plan, giving planning direction in support of the transformational moves.

The Masterplan also supports other direction-setting Council strategies - the Auckland Economic Development Strategy and the Auckland Visitor Strategy produced by the Council CCO - Auckland Tourism, Events and Economic Development.

2.3.2 Setting and delivering priorities

The Masterplan identifies a strong place-based focus for the revitalisation and growth of the City Centre organised around eight transformational moves. Over the next 10 years, transformational projects focus on the core City Centre, or Engine Room, and the waterfront. An energised Engine Room is expected in the Masterplan to lift investor confidence and provide the impetus for other quarters to grow.

Momentum created around the Wynyard Quarter, is anticipated to continue, to create a ‘water city’ of international acclaim.

The first period of the Masterplan also includes projects that help reinforce the Aotea Quarter’s roles as the civic and central heart of the City Centre, ensuring it remains resilient to the shifting centre of focus on the harbour’s edge. The Masterplan affirms that the CRL station at Aotea will make this area more accessible to the region.

84 Emission Impossible et al (2012). Health & Air Pollution in New Zealand Study. Accessed from: www.hapinz.org.nz

85 Market Economics et al (2013). The Costs of Physical Inactivity – Towards a regional full-cost accounting perspective. Accessed from www.waikatoregion.govt.nz/Costs-of-Physical-Inactivity

Together with the CRL, the first period is seen in the Masterplan to create the necessary impetus for change elsewhere in the centre; specifically, growth around the proposed stations at Karangahape Road and Newton.⁸⁶ The second period will start as and when the train stations are opened, with agglomeration benefits occurring over 20 years. The Masterplan confirms that Council will encourage and incentivise development around these stations.

The timing of the transformational moves is led by the CRL as the most critical element in determining what happens when

2.3.3 The CRL role in the Masterplan

The Masterplan states that the top public transport priority is the CRL as it is “vital to transform the City Centre and support growth of organisations such as the universities”... “and will be implemented in a way that encourages city centre development in the right place at the right time”.

“City neighbourhoods with an energy and pulse are places to which people gravitate. They can’t be manufactured, but their foundations can be put in place. Access is one such foundation. In addition to being great places to live, work, socialise and walk around, city neighbourhoods must be easy to get to. The City Rail Link is our opportunity to create highly accessible city precincts – or growth nodes – around the existing and new (Aotea, Karangahape and Newton³²) City Rail Link stations.”

2.4 The Auckland Regional Public Transport Plan

2.4.1 Purpose of the Auckland Regional Public Transport Plan

The 2013 RPTP replaced the 2010 edition and the Passenger Transport Network Plan (PTNP) prepared by ARTA in 2006.

AT’s vision in the plan is for an integrated, efficient and effective public transport network that caters for a wider range of trips and is valued by Aucklanders.

To achieve the vision, the plan states that Auckland’s public transport system needs to deliver the following outcomes:

- services that align with future land-use patterns
- services that meet customer needs
- increased passenger numbers
- increased public transport mode share
- improved value for money.

The RPTP includes measures that will be used to judge progress towards achieving the outcomes as outlined below, with an indication of current performance and projected targets that reflect both the Auckland Plan targets and those considered achievable over 10 years within then current funding provision.

2.4.2 The RPTP priority

The RPTP states that the priority investment for the first decade is the CRL as it will provide a dramatic increase in the capacity and effectiveness of the public transport system. It notes that the CRL will result in a more cost-effective use of the whole rail network by removing the bottleneck at Britomart, in the same way that investments in the motorway network have progressively removed bottlenecks and increased the efficiency of the state highway network.

2.4.3 RPTP policies

Relevant policies from the RPTP include:

- 1.4 Encourage mutually supportive land-use and public transport development policies:
 - a. Work with the Council to ensure that the Unitary Plan includes land-use policies that support intensification at locations on the rapid and frequent service network
 - b. Promote transit-oriented development around key interchange locations on the rapid and frequent service network
 - c. Work with Council to ensure that the value added by investment in the rapid and frequent service network is part of apportioning costs for the adjoining land-use development proposals.
- 3.1 Integrate infrastructure and service provision:
 - d. Work with Council and (as required) KiwiRail to implement the City Rail Link.
- 4.2 Improve public transport journey times to provide a service that is competitive with car travel:
 - e. Identify and eliminate significant delay points for public transport services.

2.4.4 The Implementation plan section states under Section 8.1, Implementation timetable:

'Beyond 2016, significant further improvements will be enabled by the implementation of the City Rail Link.' and

'When complete, the City Rail Link will enable further changes to be made to the wider public transport network, including:

- Increased service frequencies to the rail network as journey times from areas such as Manurewa, New Lynn and Henderson improve
- Some reduction of growth in bus numbers as rail access to the city centre improves.'

Appendix 3

1 Product definition

1.1 Customer market

The CRL 'product' is the full package provided for customers. It includes:

- the trains that passengers travel on through the tunnel
- the services provided with their origins, destinations, frequency, hours of operation, reliability and punctuality
- the stations used with their internal décor, lifts, passageways, escalators and external amenities and surrounds
- the access and egress to and from the stations by different modes
- the information provided both within the CRL footprint and more widely.

In planning and designing the CRL all aspects of the package matter. In order to optimise the product the differing customer characteristics and priorities need to be understood.

1.2 Existing rail customer characteristics

Customer surveys carried out on a six-monthly basis provide a good understanding of existing rail customers⁸⁷.

1.2.1 Frequency of trip

The surveys show that 90 per cent of train passengers are regular users, travelling at least three times per week. Nearly 15 per cent travel every day, including weekends. About six per cent travel once a week or less often.

1.2.2 Main purpose of trip

Travel to work and tertiary education completely dominate trip purpose with 68 per cent travelling to work and 26 per cent for tertiary study. Only three per cent of trips were for leisure purposes.

1.2.3 Gender and age

There is a marked imbalance towards a female ridership with 55 per cent against 45 per cent male. The younger adult groups are also well-represented with 58 per cent of passengers in the 18 – 34 cohort, presumably reflecting in part the tertiary education grouping.

1.2.4 Car availability and reason for using public transport

Approximately 65 per cent of public transport users (separate rail information not available) had a private vehicle available for their trip – either as a driver or passenger. Of those who could have made their trip by private vehicle, 29 per cent gave the difficulty of finding a place to park or its expense as the main reason for using public transport, 17 per cent stated that it was easier or more convenient to use public transport and 14 per cent quoted the cost of fuel/running vehicles being too expensive. Thirteen per cent were avoiding congestion and 10 per cent found public transport quicker.

⁸⁷ Public Transport Customer Satisfaction Survey October 2013-June 2014 Rail Report, Opus International Consultants Ltd, July 2014

1.2.5 Customer potential

As a start point it is clearly critical that CRL caters well for existing rail users. With the scale of increase in patronage targeted, however, there should be an expectation that the rail product becomes attractive to a wider cross-section of the travelling public.

It will be important that the product caters for wider markets that are likely to be able to be served with a post-CRL railway – a greater proportion of travellers with a choice, and those who are travelling to the shops, for leisure purposes – including tourists – and therefore those who are likely to be less frequent and less familiar users than the current patrons, and also to be travelling outside the peaks. Each of these factors is likely to be influential on features of the required product.

1.3 Design parameters for customer requirements

1.3.1 Context

A modal shift in Auckland's commuter transport habits is required to meet increasing demand on the transport network. By providing a positive, memorable, efficient and convenient passenger experience, the CRL is seen by Council to be an essential ingredient in realising that change.

Stations are the 'front doors' to passenger rail transport and as such, they can contribute significantly to customers' first impressions of the new and improved network. The design recognises that stations are important and significant public buildings and should be developed with a level of civic quality that is representative of Auckland as a modern, international city, with a strong connection to its history and place.

The stations will have a significant effect on their localities, and the provision of a high-quality public realm that facilitates street life and surface-level activity will provide the greatest benefit to the city and the travelling public.

The CRL stations are in areas of established urban fabric. These areas will see further development and change in the future as the city densifies and develops. The identity and integration of the stations into their local precincts should reinforce both the existing identity (past and present) and a more pedestrian-focused future public realm, in line with the Auckland Plan and Masterplan objectives.

These desired qualities have been considered throughout the development of the design and should continue to be developed in all future phases of work.

1.3.2 User experience

The user experience should be the primary consideration for the station designs. Through intuitive wayfinding, patrons should be able to navigate the stations without the need to seek information from signage or staff. Core passenger functions (e.g. entrances, ticket offices, gate lines, escalators and platforms) should be arranged logically and be clearly identifiable.

Intuitive wayfinding should be further enhanced through implementation of a standard set of planning principles and design elements for consistency throughout stations. Each station should be designed to maximise legibility through the careful placement of circulation elements (lifts and escalators), clear sight lines between key decision points, and uncluttered station environments. Where possible, the use of natural light should be incorporated.

Facilities provided should meet the expectations of the modern traveller with full capability of their electronic devices. Expectations for safety, cleanliness and an agreeable experience overall must be met.

1.3.3 Customer service standards

The customer service standards for the CRL stations will be measured against the following objectives:

- be safe, functional and provide straightforward movement patterns for customers
- be efficient in terms of energy use, operating staff requirement and usage of space
- facilitate convenient integration with other transportation modes
- meet customer expectations, be comfortable, convenient and have a good level of amenity
- be cost effective.

1.3.4 Passenger levels of service

The tolerance to passenger congestion and acceptable levels of passenger comfort for railway stations in New Zealand is more likely to be in line with Northern European and North American requirements, rather than Asian cities such as Hong Kong. The following levels of service were established for CRL passenger spaces for:

- platforms (waiting passengers): 0.8 m² per person
- concourses: 1.0 m² per person
- stairways: 28 persons per minute per metre width - two way flows
- passageways: 40 persons per minute per metre width - two way flows
- escalator: maximum capacity of 100 passengers per minute (based on an escalator speed of 0.6 m/s)
- gateline: maximum capacity of 25 passengers per minute (based on the gate design).

The choice of generous or less generous levels of passenger comfort within railway station facilities has a direct impact upon the size of the station footprint and the capital cost of its construction and the operating and maintenance cost. Adopting a less generous approach has the effect of creating passenger congestion, reducing passenger comfort, reducing propensity to use the railway and possibly increasing journey times.

1.3.5 Station access and queuing times

The level of service that passengers expect at transport facilities has risen in line with improving standards in other transport modes. Consequently, in order to attract passengers and increase modal share of public transport over private car use, the CRL will need to offer superior service levels. The standards cover waiting and transaction times for ticket purchase, real time information and the ability to understand train departure and destination details, efficiency of station layouts and the time it takes to get between train services and entrances and the appropriate linkages with adjacent employment centres and interchange with other modes of travel.

Passengers expect to be able to transfer between rail and bus, taxi, cycle, car, ferry and footpaths without undue delay and excessive walking distance without obstructions and unexpected changes in direction. Clean sight lines with complementary way-finding advice through clear and simple signage regimes should assist in this process.

Specific customer service levels are proposed for station access and queuing.

1.3.6 Station environment (lighting, temperature, noise, etc.)

The station environment also needs to have service standards that are attractive to customers. An important component is lighting, for example so that wall and ceiling illuminances will be bright and uniform to minimise the 'cave effect' in the underground spaces.

Audio information is required in stations to deliver intelligible audible information in all public areas and for management and emergency communication throughout back of house areas.

Temperature and air quality must also have appropriate systems to ensure that there is no degradation in thermal comfort when a customer enters the station from outside and waits on the platforms during the summer period. This target requires the station platforms to be cooler than the ambient outdoor temperatures.

1.3.7 Retail

Retail facilities provided at the station entrances and/or concourse levels help to increase the level of amenity for customers as well as improving the level of safety and security. They can also provide another revenue stream through leasing income.

1.3.8 Mobile phone coverage and wi-fi

Mobile phone and wi-fi coverage will improve the level of amenity for customers. The coverage will also assist with security, for example during quiet times customers will feel safer if they can make emergency phone calls from within the CRL stations and tunnels.

1.3.9 Universal access provisions

Public facilities including stations need to be designed to facilitate access for all. Within stations, access routes should be obvious and accessible to all members of the community, whether able bodied or mobility impaired. The design for universal access will include the stations and station precincts as required under the relevant legislation. For station precincts this includes appropriately designed taxi drop-off and pick-up, kiss and ride, bus stops, public external waiting areas and public spaces, information signage, wayfinding and lighting.

1.3.10 Environmental performance and sustainability

The resource demands of the station environment are many and will increase over the operational life of the system as patronage increases. The stations need to minimise the use of energy and materials while meeting the requirements of the operator and customers, and be able to adapt to climate and technology changes.

Solutions that focus on energy reduction, water reuse, recycling and waste minimisation are important and should form part of an integrated design approach as the design is refined.

Integration of low-energy systems within stations, such as exposed thermal mass, water recycling and ground heat source, require detailed design and analysis and could be investigated as the design progresses.

Materials should be selected that are highly durable, elegant and vandal-resistant where they come into contact with patrons. The materials should be assessed to ensure they have minimal embodied environmental impact and a forward-thinking approach to sustainable technologies – see Section 19, Sustainability.

1.4 Principal project parameters

The parameters shown in Figure 96 have shaped the CRL design solutions. The space planning of stations and tunnels has been derived from these initial baseline requirements. These requirements will be subject to further review, international benchmarking, testing, and refinement as the design develops.

1.4.1 Design loading

The design is based on a maximum operating capacity of 24 trains per hour, in which all trains entering the CRL are at maximum passenger capacity (under normal operation). In addition, the following assumptions have been made:

- two trains per hour will terminate at Britomart station, spaced 30 minutes apart
- peak evening demand is the reverse position of the peak morning demand
- passenger alighting loads are evenly distributed along the whole train.

Figure 96 - Core design principles

Element	Parameter
Type	Electric Multiple Unit (EMU)
Length	144m
Configurations	Six car configurations (two sets of three car units)
Access for mobility impaired	Level access to central coach in each three car set
Door configuration	Two door cars (per side)
Seated capacity	468 seats per six car configuration
Maximum capacity, seated and standing under normal operation	750 per six car configuration
Maximum capacity, seated and standing under abnormal operation	930 per six car configuration
Electricity Supply type	Two segregated independent supplies each capable of taking 100 per cent of the load
System type	25kV Overhead System
Minimum contact wire height	420mm from top of rail to electrified overhead line
Signalling System type	ETCS Level 1 with Automatic Train Protection
Train fire size	10 MW
Platform and concourse fire size	1.5MW
Tunnel smoke ventilation	Single or uni-directional smoke ventilation system with fresh air openings at each station and the portal locations
Driven tunnel cross passage spacing	Nominally 244m between cross passage and adjacent exit
Maximum vertical grade: running tunnels	3.5 per cent
Maximum vertical grade: stations	1.0 per cent
Horizontal curve	No tighter than 100m radius
Minimum track spacing	3.8m separation between centrelines plus allowances for curve and cant effects
Horizontal clearance requirements	2750 mm minimum from track centreline to fences and retaining walls
Vertical clearance requirements	5200mm minimum from top of track for road bridges and 6000mm minimum for pedestrian bridges
Platform length	150m
Platform height	750mm
Minimum island platform face width	3000mm from platform edge to an obstruction
Minimum single face platform width	4500mm
Revenue control	Electronic gate lines between station entrance and platform access
Platform screen doors	Provision for future installation of platform screen doors for all sub-surface stations
Ticket purchase facilities	Ticket vending machines and customer service desks in ticket halls/ concourses at each station
Station control	Group Station control room (currently proposed at Mt Eden Station) with satellite control rooms at each station
Design life	100 years
Driven tunnel dimensions	6.24 m internal diameter
Cut and cover dimensions	5.2 - 5.7m wide by 5.62m high internal per track
Driven tunnel lining	Precast segments with gasket seals
Evacuation and service walkways	Minimum 850mm wide by 2000mm high

Appendix 4

1 The City Rail Link

1.1 Project constraints and issues

Any major underground infrastructure project in a City Centre environment faces constraints from the natural and built environment in terms of geology, existing buildings, their foundations, and utilities (underground cables and pipes). The main constraints that have had an impact on the form of the design and selection of the indicative construction methodology for CRL are:

1.1.1 Rail alignment and topography

Starting beneath ground at Britomart, the alignment is required to rise 70m in a relatively short distance. The required combinations of vertical gradient and horizontal curvature have been matched to the capabilities of the EMU rolling stock.

1.1.2 Geology

The geological and hydrogeological profile shows the extent of the East Coast Bays Formation (ECBF) below ground along the route. The formation is well-suited to tunnelling using a tunnel boring machine (TBM) along the majority of the alignment.

Investigation has identified certain areas that need to be considered further. These include materials used for reclamation of the harbour, hard sandstone at the site of the proposed Karangahape Station, and basalt from Mt Eden volcano and underlying soft soils.

1.1.3 Significant buildings and structures

The impact of the CRL construction on the built environment requires consideration (e.g. noise, vibration and ground movement) in order to mitigate any adverse effects.

Whilst the CRL alignment generally follows public roads along the route, there are a number of buildings which require attention owing to their proximity to the route or because of their heritage value.

A high-level study has been undertaken to assess these effects. A thorough detailed analysis is, however, required to establish appropriate mitigation measures.

1.1.4 Settlement and ground movement

Construction work involving tunnelling and excavation can result in surface settlement. Settlement occurs either from the removal of material, causing ground deformation, or through consolidation from decreases in soil pore water pressure.

The design recognises that the effect of settlement on buildings and utilities will vary in relation to each structure and its individual response to ground movement.

1.1.5 Utilities

Utilities are generally located within the road reserve in order to service adjacent properties and avoid impact on private property. As the CRL is also generally located within the existing road corridor, there are existing services on the alignment that conflict with the project infrastructure. The main areas affected by utilities are the Britomart to Aotea Station tunnels (including the station), access shafts at Karangahape Station and the connections to the existing NAL near Mt Eden Station.

Some utilities will need to be relocated prior to construction of the CRL (because of major conflicts that cannot be addressed through the construction methodology), whilst others can be temporarily supported in their current position for the duration of the works. Minor utilities can be diverted during the project.

1.2 Project elements

The following diagram demonstrates how the CRL can be separated into four individual geometric elements. These are shown in Figure 96 below.

Figure 96 - CRL Alignment Plan



The CRL Up and Down Mains connect the existing Britomart Station to the existing NAL in the vicinity of Mt Eden Station. Between Britomart Station and the NAL, two new underground stations will be constructed (Aotea and Karangahape), and a new platform within an open trench will be constructed on the west facing connection at Mt Eden Station. The location of these stations is the main governor of the horizontal CRL alignment.

Connecting Britomart Station to the NAL requires a vertical rise of approximately 70m, requiring a maximum gradient of 3.5 per cent with a flat gradient through the station platforms.

1.2.1 Connection to Britomart Station

The alignment connects from the end of the existing platforms one and five at Britomart Station, resulting in a through-running station. A reverse curve in the CRL Up Main alignment is introduced from platform five in order to avoid impact on the Zurich Building foundations. The tunnels that connect to platforms one and five will pass beneath the former Chief Post Office building which will require underpinning of the existing structure. Modifications to Britomart station will also be implemented to cater for the increased levels of patronage arising from the CRL including additional vertical transport, relocation of back-of-house facilities affected by the new lines and changes to the paid/unpaid areas. Whilst works are carried out to the Chief Post Office building a temporary station facility is created for public and staff to the east of the current entrance.

1.2.2 Downtown Shopping Centre site

The reverse curve introduced from platform five has the advantage of bringing the two running tunnels together to minimise the footprint through the Downtown Shopping Centre site. The shopping centre will be demolished and the running tunnels will be constructed as cut-and-cover tunnels. The rail alignments have relatively tight curves (130m to 140m radius), which bring the running tunnels around the Zurich Building to then align in a southerly direction along Albert Street.

1.2.3 Albert Street running tunnels

From the Downtown Shopping Centre, the CRL Up and Down mains will cross Customs Street (at the intersection with Albert Street) and head southwards under Albert Street parallel with each other. The running tunnels will be constructed as a single cut-and-cover twin-box tunnel located within Albert Street. The conditions of the CRL designation require a temporary traffic lane and footpath to be maintained along Albert Street (on both sides) to allow vehicle and pedestrian access to neighbouring properties during construction. Temporary modifications to the streetscape that is affected by the piling and temporary traffic arrangements will be required.

The gradient increases to approximately 3.0 per cent to connect with Aotea Station.

1.2.4 Aotea Station

The Aotea Station cut-and-cover box will be located under Albert Street between Victoria Street West and Wellesley Street West with additional plant accommodation located to the north of Victoria Street. The gradient will be flat for the CRL tracks through the station platforms.

1.2.5 Aotea Station to Karangahape Station

South of Aotea Station, the CRL tracks run underneath Mayoral Drive, Vincent Street and Pitt Street until they arrive at Karangahape Station. Upon leaving Aotea Station, the track gradient increases to approximately 3.3 per cent and the maximum depth of the tunnel in this section is almost 35m.

1.2.6 Karangahape Station

Karangahape Station is located under the intersection of Pitt Street, Karangahape Road and Mercury Lane. Again, the gradient will be flat for the CRL tracks through the station platforms. On approach to Karangahape Station, the CRL tracks are required to deviate from their typical separation of 12m to approximately 50m to accommodate the mined underground station layout.

1.2.7 Karangahape Station to Mt Eden Station and North Auckland Line (NAL)

Between Karangahape Station and Mt Eden Station, the running tunnels pass below the Central Motorway Junction (CMJ). On leaving Karangahape Station, the track gradient increases to approximately 3.0 per cent and the maximum depth of the tunnel in this section is almost 40m. South of the CMJ, the tracks continue to rise whilst splitting from single tracks into a two-track configuration (4 tracks). The CRL East Link Up and East Link Down mains diverge from the CRL Up and Down mains and rise in an eastward direction to connect with the NAL between Mt Eden Station and Normanby Road. The CRL east-facing southern tunnel portal is located near the NAL on the eastern side of Mt Eden Road. The CRL West Link tracks pass over the East Link Down main in a grade separated configuration. The west facing connection incorporates a new platform at Mt Eden Station within an open trench that connects to the rebuilt NAL Mt Eden platform. West of the CRL Mt Eden platform the CRL tracks connect with the NAL between Mt Eden Station and Dominion Road.

1.3 Civil infrastructure and rail systems

1.3.1 Tunnels

The CRL tunnels will be constructed through ground that varies between rock and soft soil, and with a variation in depth to natural ground level of between 40m and 0m, at the tunnel portal.

The middle section of the tunnel, between Aotea Station and the turnout tunnels near Mt Eden Station, will be excavated in East Coast Bays Formation (ECBF). This sandstone is typically a weak rock so this tunnel section is well-suited to construction with a TBM with the turnout tunnels being constructed using mining techniques.

The two ends of the tunnel (Albert Street and south of the turnout tunnels to NAL section) will be constructed with cut-and-cover techniques owing to their relatively shallow depth below existing ground level.

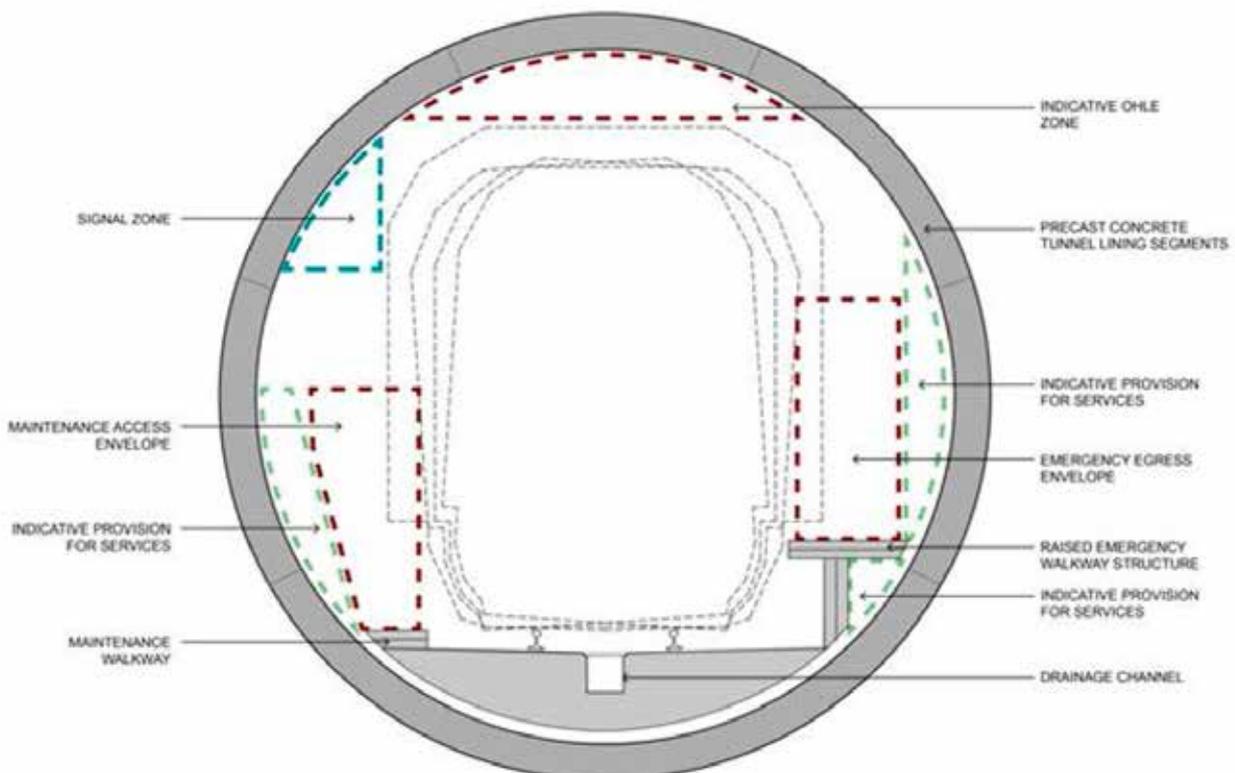
1.3.2 TBM tunnel internal cross section

Sections of tunnel excavated by a TBM have a circular cross section with a fixed diameter. Typically, the diameter of a single track rail tunnel is governed by the vertical dimensional requirements given below:

- an allowance of 0.55m for the overhead line electrification equipment. (The scheme proposes a rigid overhead conductor)
- a height of 4.42m from the top of the rails to the overhead contact conductor. This height is the specified minimum operational contact conductor height for the new EMUs
- an allowance of 1.17m from the top of the rails to the tunnel invert for a non-ballasted concrete slab track form system which is commonly used in rail tunnels. Track isolation measures may be used in the vicinity of vibration sensitive receivers
- an overall construction tolerance of 100mm on the tunnel radius

These requirements result in an indicative internal tunnel diameter of 6.24m for the TBM tunnels.

Figure 97- TBM excavated tunnel cross-section



Significant components that are required to fit within the tunnel are:

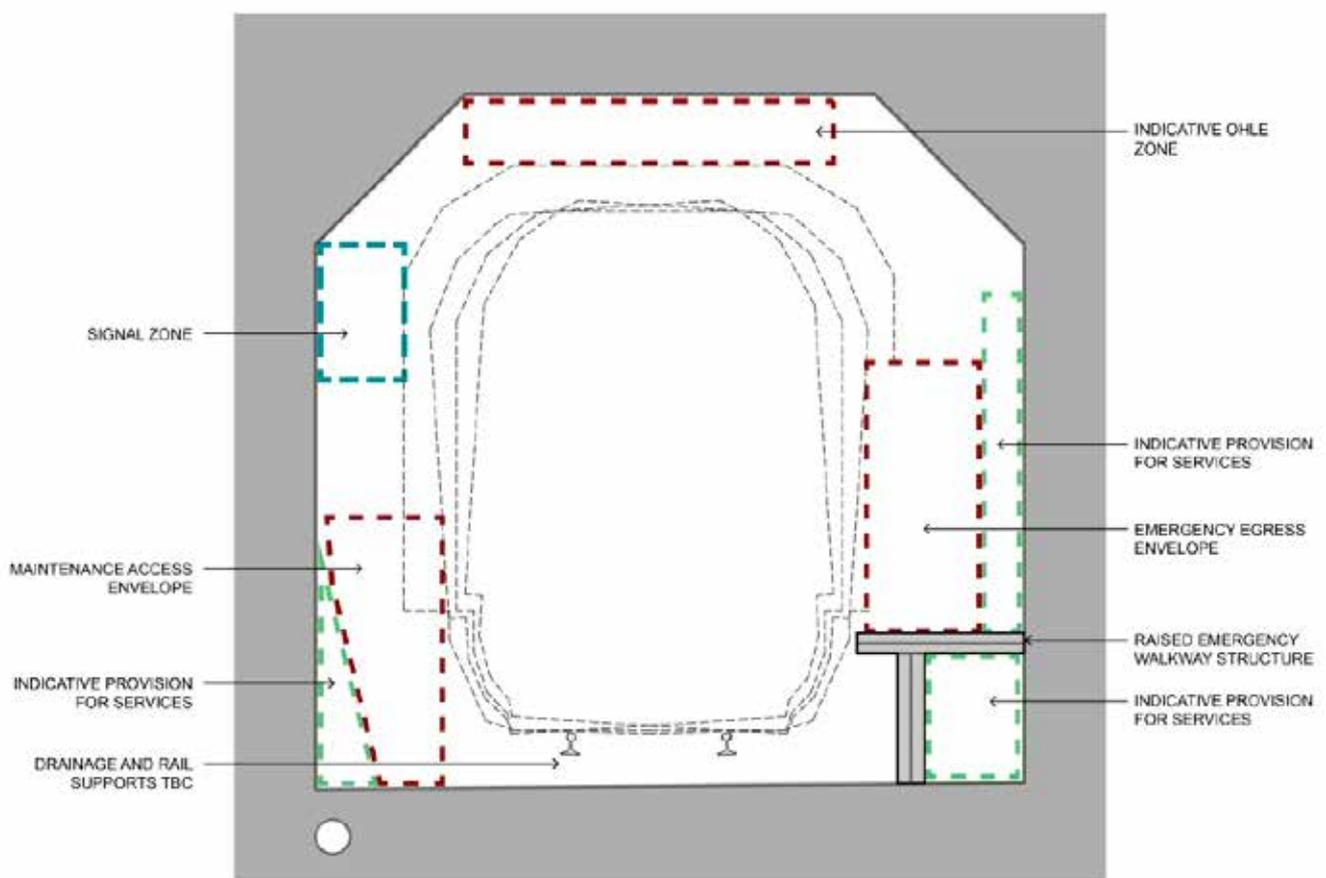
- an elevated emergency evacuation walkway along one side of the tunnel that will use a clear walkway envelope 0.85m wide by 2m high
- a maintenance access way located at rail level on the opposite side of the tunnel to the emergency evacuation walkway
- a fire main, services and cabling for LV and HV power supplies and for communications. Their proposed location is on the sidewalls of the running tunnel
- internal tunnel drainage will be required to collect condensation, spillages, groundwater seepage, and any water from a burst fire main.

Sections of tunnel constructed as cut-and-cover have a rectangular cross section. This enables the tunnel's internal width and height to be adjusted independently.

The internal dimensional requirements of the cut-and-cover tunnel are broadly similar to those of the TBM tunnel. The key difference is an allowance of approximately 0.7m from top of the rails to the tunnel's flat base slab.

These requirements result in an indicative internal tunnel that is 5.62m high and 5.2 to 5.7m wide:

Figure 98 - Mined tunnel cross-section



1.3.4 Rail systems

The CRL requires several rail systems to facilitate operation and maintenance of the railway. The systems will include:

- ventilation
- traction power and over-head line equipment
- signalling and train control
- information and communication technologies
- tunnel services
- fire and life safety.

Each of these systems will be required to integrate with the existing Auckland network. For some of these systems this will include potential modifications to the National Train Control Centre in Wellington or a proposed Northern Train Control Centre, and a proposed Station Group Control Centre and at the interface with the existing NAL to the east and west of Mt Eden station.

1.4 Design of stations

1.4.1 Station typologies

CRL has three station typologies, each of which is common in underground stations around the world:

- cut-and-cover 'box' typology used for Aotea Station
- mined side-platform typology used for Karangahape Station
- cut and cover open box typology used for the new platform at Mt Eden Station

Each typology has areas of associated functions such as entrances, plant room spaces, evacuation points and air vents.

Britomart Station is an existing station which will be modified to accommodate the through tracks and capacity required for the CRL.

1.4.2 Urban integration

Station entrances have been designed to address the needs of each station in terms of function, performance and personality, as well as the needs of the particular urban context into which they are to be inserted. Effort has been made in placing and configuring the above-ground components of the station entries and other station components to maximise local benefits. This included consideration of:

- potential for architectural treatments and materiality
- scale, massing and form
- activation of street frontages
- preserving important heritage structures
- transit oriented developments
- potential to explore inclusion of Iwi cultural landscape and design themes.

1.4.3 Art, advertising and commercial space

Retail spaces have been identified within the station footprints for small concessions. The size and use of retail concessions will be considered with regard to safe evacuation and fire engineering in the next phase of design. Consideration will also be given to integration of advertising and art strategy throughout the stations.

1.4.4 Station access and precinct planning

Access to the stations by various modes, including walking, cycling, bus, taxi and private vehicle have been considered at each location. Further work is required to confirm integration of street infrastructure with available space and competing demands. The design includes preliminary consideration of:

- bus stops
- bicycle parking
- covered access and waiting areas
- public furniture
- public lighting
- public art integration of service elements
- emergency vehicular access
- operator, maintenance and service vehicle parking and access
- taxis
- street trees
- footpaths
- station components.

Level access to the central coach in each three carriage set is to be provided. Step-free access will be provided at each station via lifts.

The design anticipates a range of components that will be required in stations, including:

- public seating and lean bars
- ticket machines
- staff facilities
- revenue protection gates
- signage and wayfinding elements.

A common approach to these elements will improve legibility and minimise capital and maintenance costs.

1.4.5 Station Systems

The station information, communication and technology (ICT) systems will support both passenger information and the safety systems. Communication and information systems and ICT systems that are being designed for the underground stations include:

- CCTV surveillance
- passenger information systems

Figure 100 - Core information – stations

Station	Britomart	Aotea	Karangahape	Mt Eden
Form of construction	Existing modified	Cut and cover top down	Mined platform tunnels	Cut and cover open trench
Configuration	Through platforms one and five retention of two terminating platform faces	Island platform	Side platforms	Island platform
Depth from ground to rail level	11m	15.5m	33m	7m
Entrances - Number	Three	Three + future proofing for the North Shore Line	One + one future	One
Entrances – Locations(s)	Three out of the four Existing maintained	Two Victoria St and one Wellesley St	Mercury Lane and Beresford Square(future)	Shaddock Street
Concourse	Existing	Yes	Yes	Yes
Ticketing arrangement	Automatic ticket vending machines, customer service centre at paid/ unpaid boundary, and automatic ticket barriers			
Passenger Circulation - Escalators	As existing upgraded + 3 additional	11	Nine	Three
Passenger Circulation – Lifts	No new lifts	Four	Three	Four
Passenger Circulation – Stairs	Four new	Three	Three	Two
Number of platform faces	Four	Two	Two	Four
Platforms – length and width per platform	Majority as existing with some modifications	150m and 9.6m max	150m and 4.5m	150m, 13m max (existing platform) and 10.6m max (new platform)

- customer help-point
- public address system
- passenger information displays
- emergency services radio coverage
- electronic security
- FM radio re-broadcast
- telecommunication cabling
- supervisory controls and data acquisition system (SCADA) systems

- operation and maintenance telephone system
- systems integration
- staff radio

1.5 Construction Planning

1.5.1 Overview of Construction Sequence and Method

This section outlines possible construction methods, their interdependencies (which may change with further design refinement and analysis), and their effects.

As discussed in Section 1.6, some of the construction will be included in an Enabling Works package.

1.5.2 Britomart Station

Construction planning of the various sections of Britomart Station requires an approach that allows customers still to receive a good standard of service, emergency evacuation and the maintenance of station functionality. Temporary measures will be required as will staging between works on the Up and Down Mains to provide safe public access at all times. A temporary station facility will be created to the east of the CPO Building to enable the works in that building to be completed without significant impact upon the operation of the existing station.

1.5.3 Cut-and-cover tunnels - Britomart to Aotea Station

The sections of the cut-and-cover tunnels between Britomart and Aotea Stations have the following requirements:

- Lower Queen Street is to be constructed in stages to allow continued pedestrian flows between Customs Street West and Quay Streets
- the section within Queen Elizabeth II Square and within the Downtown Shopping Centre is to be entrusted to Precinct Properties to construct
- the crossing under Customs Street West requires staging between the north and south sides with alternate requirements for traffic management, excavation and construction of the cut-and-cover structure
- Albert Street similarly requires alternate workings on the east and west side to maintain traffic access. Preparation works include relocating the street furniture, adjustments to footpaths, protecting and/or relocating services, construction and excavation, and reinstatement.

1.5.4 Aotea Station

Construction for Aotea Station will be staged so that only one of Victoria Street, Wellesley Street and Custom Street West is closed at any one time. As Aotea Station is on the critical path, early enabling works to divert the stormwater culvert in Albert Street are planned to reduce the overall construction programme.

Components of the Station construction include:

- southern construction yard and shaft
- Wellesley Street West intersection structural works covering relocation of the street furniture and utilities, constructing the roof slab and reinstating the Albert Street/Wellesley Street intersection for public use, constructing the station box to platform level, the structures for the station entrance, ventilation, and mechanical and electrical equipment. The base slab at platform level will be designed to span the tunnel works for the future North Shore Line. This section of the station is on the critical path as it must be completed to receive the TBM from the first tunnel bore.
- Victoria Street intersection structural works covering the street furniture, utilities relocation, constructing the roof slab and reinstating the Albert Street/Victoria Street intersection for public use, construction of the station box to platform level from the adjacent section and the structures for the

station escape passage and entrance

- Durham Street intersection structural works including carefully removing the heritage bluestone wall (for reinstatement on completion), construction of the roof slab and reinstatement of the Albert Street/ Durham Street intersection for public use, and construction of the station box to platform level. This section of Aotea Station is on the critical path, as it must be completed before the rail track installation works can proceed to Britomart Station.

After completion of the tunnelling and structural works, the station will be accessible for fit-out.

1.5.5 Karangahape Station

The construction sequence for Karangahape station needs site preparation, service protection/diversion, and demolition of existing buildings followed by construction of the main entrance shafts, excavation of the sloped entrance escalator shafts, and construction of the permanent works after the mined tunnels have been completed. The Mercury Lane shaft must be completed before the down main TBM reaches this location.

After completion of the tunnelling and structural works, the stations will be accessible for fit-out.

1.5.6 Turnouts, grade separated junction, and cut-and-cover tunnels to the North Auckland Line

The construction sequence of the various sections of the mined turnouts, grade separated junction, and cut-and-cover tunnels to the North Auckland Line (NAL) tie-in include constructing a shaft at the grade separated junction, construction of the CRL Main cut-and-cover sections and excavation of the CRL Main tunnels. The size of the excavation profile will provide the TBM with access as well as a structure gauge for the rail junction.

1.5.7 TBM tunnels

The rail tunnels between the turnout tunnels, and the CMJ and Mt Eden station, and the stations at Karangahape, and Aotea will be constructed using an earth pressure balance (EPB) TBM. This type of TBM has been selected based on the available geological information along the tunnel routes.

The EPB TBM excavates the ground using a rotating cutter wheel. Ground support to the excavation face is provided by consolidating the excavated material in the chamber behind the cutterhead. The material in the excavation chamber is removed by a screw conveyor. The tunnel excavation is supported by a segmental lining that is assembled in the tail section of the TBM.

In stable ground conditions, the TBM can operate in unpressurised mode, thus achieving a higher production rate.

The works are dependent on the timely completion of the TBM assembly area, cut-and-cover/mined tunnels towards the CMJ, and the Mercury Lane shaft and platform tunnels at Karangahape Station. The TBM tunnels are not on the critical path of the programme.

1.5.8 East and West facing connections to the NAL

The CRL tunnels will connect to the NAL in both an easterly and a westerly direction, near each end of Mt Eden Station. Separate tunnels are proposed for the East and West Facing Connections (four tunnels in total).

The East Facing Connection to the NAL will diverge from the West Facing Connection just south of the CMJ. To provide these grade-separated rail connections to the NAL, the existing NAL will be realigned to allow the east- and west-facing tunnels to rise up at the centre of the NAL rail corridor.

The main construction tasks in this area are:

- road modifications at Porters Avenue
- construction of the West Facing Connections

Figure 101 - Tunnel boring machine (TBM) – cutter head



- construction of the open box trench for the new platform at Mt Eden Station and its associated entrance and concourse
- grade separation of Normanby Road level crossing
- Down Main cut-and-cover tunnel
- construction of the East Facing Connection Up and Down Mains
- grade separation of the NAL Down Main.

The existing NAL Mains will be slewed in stages to enable the CRL track structures to be constructed while the NAL remains operational.

Normanby Road will be closed to road traffic from the start of the excavation of the southern rail trough until the bridge is completed. Traffic restrictions will be required throughout the construction of the new Normanby Road Bridge and during the tunnel works across Mt Eden Road. Following completion of the civil infrastructure in and around the NAL the following activities will be implemented:

- station fit-out of the CRL and NAL platforms
- streetscaping in the vicinity of the Mt Eden Station redevelopment
- system testing and commissioning along this section of the CRL.

1.5.9 Tracks, OHLE, and services

The construction sequence of the various activities relating to the track installation, OHLE, and signalling is:

- cast the primary stage concrete in the Up Main and Down Main tunnels, install concrete trackform and rails, and cast the secondary concrete. These works include the drainage system
- complete the track works for the Up Main and Down Main tunnels to Britomart Station after the completion of Aotea Station at Durham Street
- install the OHLE, signalling, and services for the Up Main and Down Main tunnels

The works outlined above will be dependent on the timely completion of the entire Up Main and Down Main tunnels - including the grade separated junction, turnouts, and platform tunnels at the stations. These activities are on the critical path of the programme.

1.5.10 System-Wide Testing and Commissioning

When each mechanical and electrical system installation in the system-wide contracts has been completed, testing and commissioning will be carried out:

- test and commission individual items of equipment in the tunnels and the stations for the system-wide contracts.

1.5.11 Construction programme

An indicative construction programme is set out below. It is based on the indicated construction methodology for each work site. This indicative construction programme is suitable for commonly-adopted procurement methods.

1.6 Enabling works

1.6.1 Purpose of Enabling works contract

The aim of the enabling works is to complete the CRL related construction activities located to the north of Customs St as well as some works along Albert St. By undertaking work along Albert St the project team can ensure that CRL construction activities undertaken as part of the main works package will not require laydown space to the north of Customs St. The enabling works will progress the construction a sufficient distance up Albert St to create a viable laydown area for the main works constructor to use. To minimise disruption to the Stamford Plaza, the enabling works will extend to immediately south of the Wyndham St junction with Albert St.

1.6.2 Enabling works packages

The enabling works covers two packages.

Package one

From Britomart to the DSC site

- establishing a temporary station entrance and accommodation east side of the glass box
- upgrades to Tyler and Galway Streets
- CPO underpinning
- CPO and Britomart construction of running tunnels (through to west end of platforms one and five)
- re-establishment of a functioning CPO
- Mechanical and electrical modifications in for the west end of Britomart station
- running tunnels from the CPO, under Lower Queen Street

Package two

From the DSC site to Wyndham Street - running tunnels from the Albert St / Customs St intersection up Albert St as far as Wyndham St (i.e. to the North end of Aotea Station)

- 1950mm diameter pipe jack approximately 520m extent, from Swanson Street to Wellesley Street.

There will be no fit-out of the tunnels relating to mechanical, electrical, trackform or rail systems as part of the enabling works.

The intention is to commence enabling works in stages from late 2015/ mid 2016 with an Early Contractor Involvement type contract, which is best able to deliver against the desired outcomes.

1.6.3 Diversion of utilities

Early works are envisaged prior to starting construction of the CRL. The main service relocation works have been identified for early delivery to avoid future conflicts with other projects.

Diversion of flow away from the Albert Street stormwater main will need to happen before tunnel construction can start along Albert Street or at Aotea Station. The works will involve pipe jacking a new concrete stormwater line to connect into the existing stormwater system at Swanson Street, and diverting flow at Wellesley Street down the new stormwater line. Modifications to strengthen the existing Orakei Main Sewer where it passed below the future Aotea station are also planned to be incorporated into the enabling works phase.

1.6.4 Transport Logistics

Construction of the CRL creates a number of issues around existing public transport operations, pedestrian access to central city facilities, vehicular access to the commercial and business operations within the City Centre, and general traffic flow. The success of the CRL temporary traffic management in the central area will be as a direct result of co-ordinated planning between the various construction projects associated with CRL and the City Centre Integration initiative, and the subsequent communications package that results from that co-ordination.

The traffic impacts of the various construction stages have been modelled using the SATURN programme. This work has allowed optimisation of the available network alongside the preferred construction approach.

1.7 Design and optimisation

1.7.1 Definition design stage one

The concept design phase was completed in mid-2012 to support the NOR and designation process.

An exercise was undertaken to establish initial project parameters and requirements to enable the further development of the design. This formed part of a broader 'product definition' process to define the governance, operational, functional and technical requirements for the project.

Together, the concept design, value management and product definition processes and outcomes guided the development of the definition design, phase one, (DDP1).

The definition design phase one (June 2013) resulted from the incorporation of newer information, greater definition of constraints, and accounted for the outcome of adopted value-management initiatives. These initiatives were identified and investigated to determine potential effects on project risk, cost, safety, constructability, operations, maintenance, technical performance, and property impact.

1.7.2 Definition design phase two and reference design phase

Between January and July 2014 further optimisation of the project was carried out in definition design phase two (DDP2). Initiatives investigated during DDP2 were evaluated against the DDP1 design to establish if there were constructability, cost, functionality, risk or safety advantages.

The items considered under the DDP2 were identified from the following sources:

- key future actions identified in the Product Definition (Basis of Design) Papers and Technical Discipline Reports prepared during DDP1
- items identified for further consideration as part of the Challenge Review during the Establishment Phase
- opportunities identified through internal review of requirements during the Establishment Phase
- workshops held during DDP2.

After analysis, the following main items were adopted for the substantive design. Multiple minor items were also adopted.

Figure 103- Definition design and reference design phase

Rail alignment	
Reverse curves	Improve the geometry of the reverse curves exiting Britomart – approximate 10 seconds journey time saving.
Aotea Station platform realignment	The 8.3m platform width at Aotea station was assessed as sub-standard for the expected patronage. An alternative alignment was developed allowing the width to increase to 9.6m in the centre of the platform.
Track separation south of Aotea Station	Level station platforms were achieved by easing the horizontal curves which also has speed and travel time benefits.
Newton Station relocation/Mt Eden Station redevelopment	An optimised alignment that involves a repositioned Newton station, 400m to the northwest compared to the earlier Newton Station position, results in sufficient room for the East Link Down Main to be fully grade separated from the CRL tracks heading west. The station in its new position has level platforms compared to one per cent at the previous position.
NAL connections	<p>The west link NAL connection has been optimised. The previous (DDP1) version connected to the NAL through 1 in 12 turnouts with an operating speed of 40km/hr, whereas the new alignment has 1 in 18 turnouts with an operating speed of up to 60km/hr.</p> <p>The east link NAL connection can be optimised with the east link diverging before the old Newton Station location. Combined with the purchase of an additional property this has enabled the layout of the east link to be optimised. Tying into the NAL before the proposed Normanby Road bridge allows a 1 in 18 turnout for the East Link Down Main resulting in a speed improvement of up to 20km/hr.</p> <p>The alignment has been configured so most of the track work can be built offline, away from the existing NAL, with less disruption to existing NAL services during construction.</p>
Britomart Station East end turnout modifications	The eastern end of Britomart will be modified to give priority to the outside CRL tracks over the inside terminating tracks with turnouts so the straight roads serve the CRL and with two tracks terminating in the middle of the station, reducing the current five track arrangement to four tracks.
Station platform gradients	The change of alignment allows level station platforms at Aotea, Karangahape and the redeveloped Mt Eden Stations.
Grade separation of East and West facing connections	The changed alignment allows grade separation of the east and west facing connections, providing a valuable contribution to improved reliability.

Newton Junction grade separation underground works	<p>South of the platform tunnels at Karangahape Road the alignment splits into two branches with "Y" junctions at the mainline tunnels. South of the "Y" junctions, the ground surface slopes steeply down, reducing depth of cover over the tunnel, which is suited to cut-and-cover construction.</p> <p>These branches are grade-separated at the southern portal box in the updated alignment. The down track branch dives from the "Y" junction to ensure vertical clearance at the southern portal box structure. A cross-over shaft is proposed to construct the section of railway where the East Link Down runs below the CRL Up and Down Mains. Two mined sections of tunnel are proposed to be constructed at the northern ends of this shaft to facilitate TBM launch towards Aotea Station.</p>
Britomart Station	
Queen Elizabeth II Square tunnel ventilation plant room and outlets	Deletion of a tunnel ventilation plant room and outlets from under the Queen Elizabeth II Square provides benefits in relation to reduced future maintenance costs and public domain.
Aotea Station	
Platform and station box width	The introduction of an optimised alignment has allowed the platform width of Aotea Station to be increased to 9.6m at the centre maintaining 8.4m at either end. The increased platform width at the centre allows for two banks of two escalators with >3m clearance to the platform edge on each side for an improved passenger flow. Further allowance has been made for access from the concourse to a potential North Shore Line.
North end ventilation outlet	<p>To improve the usable width of Albert Street allowing four traffic lanes and an evenly distributed footpath width, the design team investigated different locations for the surface ventilation structures. Consideration was also given to potential modifications to the heritage sensitive Martha's corner building.</p> <p>The preferred option has fans under Albert Street, with vents in Albert and Kingston Streets.</p>
Over site development Integration	The feasibility of a multi-storey commercial development above Aotea Station, Wellesley Street, depends on the desired footprint and height of the building. The underground entrance box would need to be increased in size to allow services to bypass the core structure. Layout changes required to suit the building core and building entrance lobby have been made to the station design.

Karangahape Station	
Reconfigured Beresford Square entrance in Mercury Lane and reduced Pitt Street shaft	<p>A revised Mercury Lane entrance and ticketing location incorporates modifications to the vertical transportation approach. A reduction in complexity of access for mobility impaired and gating at street level with reduced access times from entrance to platform level is the result.</p> <p>The tunnel ventilation has been relocated from the Beresford square box to the Pitt Street box. The ventilation structures at ground level were reviewed from an impact and sightline perspective and relocated to Pitt Street.</p> <p>The feasibility for a Transit Orientated Development above and beside the Mercury Lane entrance has been undertaken and modification to the structure and layout of the station has been made to future proof this opportunity.</p>
Mt Eden Station	
Urban re-generation of worksite	<p>There are opportunities for development within the construction site, which are appropriate to the designation and likely to provide a catalyst for regeneration of the precinct. Three options were investigated:</p> <p>Additional floors added to the basic station service footprint in the 'wedge' of land contained within the KiwiRail designation</p> <p>Additional floors to the Station precinct but maximising floor plates within the KiwiRail designation</p> <p>A building adjacent the station located over the open cut trench of the CRL line that sits partially within the KiwiRail designation but wholly within the designation footprint.</p> <p>Further exploration will be carried out in subsequent phases to test the viability of a more integrated station and over-site approach given the constraints of the station footprint.</p>

<p>East and West facing connections</p>	<p>The new alignment provides significant advantages for the East facing connection:</p> <p>The CRL tracks crossing Mt Eden Road are now closer together resulting in a single cut-and-cover trench across the road</p> <p>The CRL tracks connect on the outside of the NAL tracks, eliminating the need for a flyover structure, which is replaced by a smaller, single CRL track (East Link Down) in a cut-and-cover tunnel</p> <p>The CRL East Link Up and NAL Down are able to merge into a single track before the Normanby Road bridge with the advantage that the bridge span is reduced, allowing a reduced structural depth, benefitting the approach ramps and property access.</p> <p>The revised alignment provides significant advantages for the West facing connection including:</p> <p>Change in horizontal alignment to accommodate a new platform at Mt Eden Station</p> <p>Change in vertical alignment from the removal of Newton Station has the advantage that it has reduced the size of retaining walls</p> <p>Assumed closure of the Porters Avenue rail crossing which allows for gentler vertical gradients as the CRL and NAL tracks merge, again reducing the size of retaining walls required</p>
<p>Early Works</p>	
<p>CPO building</p>	<p>Underpinning works are required to the CPO Building to enable construction of the CRL tunnels. To facilitate the underpinning preparation activities are required including the construction of an alternative access to Britomart Station. Previous work considered a staged approach, with construction of the tunnels under the CPO Building one at a time so as to retain public access through half of the building not accommodating construction.</p> <p>This constraint could be avoided by providing alternative access through the existing glass box. The design has been developed on the basis of closing the CPO Building and provide alternative access through the glass box.</p>
<p>Queen Street tunnels</p>	<p>Constraints associated with construction of the Queen Street tunnels include:</p> <p>Tunnel excavation below the founding level of the Zurich Building piles</p> <p>Poor ground conditions through the Downtown Shopping Centre (DSC) site</p> <p>Densely located services in footpaths adjacent to the DSC</p> <p>Stability of the basement wall where the rail tunnel passes into and out of the DSC basement</p>

<p>Customs Street tunnels</p>	<p>Constraints associated with construction of the Customs Street tunnels include:</p> <p>The requirement for staged construction to match road possession</p> <p>The need to accommodate a large number of major service crossings</p> <p>Excavation and demolition of the existing major stormwater drain and pump station located under the middle of the intersection between Customs Street and Albert Street</p> <p>Given the high potential for programme delays associated with the above identified constraints these works will be progressed as early works.</p>
<p>Albert Street tunnels</p>	<p>Constraints associated with construction of the Albert Street tunnels include:</p> <p>The need to accommodate a varying depth of ECBF rock</p> <p>Interfacing with Aotea Station and the station plant rooms above the tunnel between Wyndham Street and Victoria Street</p> <p>These constraints have led to the development of a cut-and-cover tunnel solution with three typical sections:</p> <p>Northern section between Customs and Swanson Streets – near surface ECBF rock</p> <p>Central section between Swanson Street and Wyndham Streets – tunnel roof typically below the top of rock</p> <p>Southern section between Wyndham and Victoria Streets – level of rock below the tunnel roof</p> <p>Given the high potential for programme delays from the above constraints, the northern and central sections are proposed as early works with the southern section to be completed under the Aotea Station package.</p>



Victoria Street East entrance to Aotea Station

Appendix 5

Technical Risk Register

Risk	Cause	Impact
Britomart alteration to the Designation goes to an Environment Court hearing.	No settlement/agreement of appeals prior to hearing. Management of appeals to stop broadening of scope.	Alteration delayed, bolder broader scope requested during litigation. Programme impact. Later commencement of C1 works in the CPO.
Ground Conditions: Unexpected / Unforeseen conditions impact safety, programme and costs.	Adverse ground conditions found late. Under estimation of Geotechnical Investigation (GI) required for tunnelling project. Concept Design with limited GI data undertaken. Assumptions made in concept/reference design relating to geotechnical information are not supported in GI findings.	Project delivery cost and programme implications Reactive or late GI. Further cost. Health and Safety risk
Project disruption, additional costs and reputational impact associated with damage to existing utilities during construction (Particularly telecoms).	Fragile Chorus cables are not diverted and are damaged by construction works. A significant number of Chorus cables and telecommunication manholes are located within the proposed Aotea station extents including copper cables which form a key component of the Chorus network	Chorus have advised that damage to Chorus Cables within the Aotea station extents would result in significant compensation payments
Stakeholders object to permanent closure of Porters Avenue which forces lowering of NAL and CRL alignment deeper into basalt.	Alignment of NAL raised for NoR, does not enable grade separated crossing for road vehicles.	Finance, delay, environmental effects

Existing Controls	Consequence	Likelihood	Rating
Engaged advice on programme and options. Environment court hearing on consent pathway held. Mediation on appeal matters.	3	High 50%-75% (4)	12
Robust programming. International Advisors engaged. PTA Peer review of GI testing schedule (Aurecon Aus.) 2013 GI findings feedback to be incorporated into Ref. design. 2014 Independent GI peer review report to be incorporated into Ref. Design. Procured GI, Boreholes, Utilities and trenches (Stage 3B Completed). Pump test complete. PTA engaged Golders Associates. Factual report submitted, pump test report submitted, physical works completed.	4	Medium 20%-50% (3)	12
Further utility surveys have been undertaken	3	High 50%-75% (4)	12
Consultation and stakeholder management plan. Robust options assessment	4	Medium 20%-50% (3)	12

<p>Flooding at Britomart and along the rail network</p>	<p>Increased rainfall and/or sea level rise resulting in:</p> <ul style="list-style-type: none"> - Inability of storm water network to cope. Pumping water causes flooding elsewhere. - Flooding of plant and plant rooms 	<ul style="list-style-type: none"> - Damage to track / electronics - Closing of Britomart and associated wider network issues - Surface flooding around stations - Disruption or stoppage of services due to Britomart closing (Aotea not feasible to be used as a substitute)
<p>Serious harm or other health and safety event for on-site work</p>	<p>Poor H&S leadership and management.</p>	<p>H&S Incident. Project disruption. Cost and reputational risk. Loss of life, life threatening injuries, serious harm.</p>
<p>Urban design, city transformation projects and transport initiatives conflict or hold integration impact on CRL</p>	<p>Separate progression of transformational projects in isolation of CRL</p> <p>Gap between Aurecon and Urban Design</p> <p>New initiatives materialise. Timeline for initiative definition.</p> <p>Change in urban finishes</p> <p>Lack of interface between AT and City transformation projects.</p>	<p>Design disruption and rework. Time taken to integrate. Cost impact.</p> <p>Significant network and traffic effects and continued disruption to public.</p> <p>Budget - Urban finishes more than estimate</p> <p>Urban Design panel</p>

<ul style="list-style-type: none"> - Careful locating of plant and openings within plant rooms to consider water flow. - AC's storm water network upgraded in 2011 and designed to cope with 16% increase. - Humidity and drainage controls provided in some plant rooms. - Current design has natural ventilation with some forced air. - Drainage, pumps and sumps and utility connections monitoring, maintenance and cleaning. - Britomart has raised entrances - The Strand has been identified as a possible backup station, however should there be a sea level rise then it will also be affected. 	4	Medium 20%-50% (3)	12
<p>Contractor & PTA management plans, on-site monitoring and reporting. Method statements.</p> <p>AT internal reporting and assurance. Dashboard reporting.</p> <p>AT Approval to work methods streamlined (limited works delivered)</p> <p>H&S Management Plan and Manager in place..</p>	4	Medium 20%-50% (3)	12
<p>Project team engagement in CCI working group.</p> <p>Urban design framework compliance.</p> <p>Urban Designer engaged.</p> <p>PTA responsible for interface with Urban Designer - to be included in the interface management plan e.g. Mercury lane</p>	2	Very High >75% (5)	10



Aotea Station platform

