South-western Multi-modal Airport Rapid Transit

Auckland Transport

Draft Indicative Business Case

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South-western Multi-modal Airport Rapid Transit (SMART) – Draft Indicative Business Case

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Executive Summary

The Auckland Plan recognises that transport investment in south-west Auckland is vital to achieve the overarching goal for Auckland to be the 'world's most liveable city.' The Auckland International Airport and surrounding business areas play a critical role in Auckland's economy and the national significance of the Airport is likely to increase over time. Strong travel, freight, employment and population projections for the Airport and within in the study area indicate a significant increase in travel demand to the Airport in the future.

To enable and support the growth and development aspirations of the Airport, south-west Auckland and the Auckland region as a whole, it is important that an attractive, high capacity rapid transit system is implemented to provide access to the Airport. A number of local road and state highway projects have confirmed funding and will provide benefits to freight and private vehicles in the short term; however, they will not provide sufficient additional capacity or improved access in the medium to long term with the forecasted demand to the Airport.

The confirmed projects will not unlock the economic potential of the Airport, surrounding business areas and south-west Auckland and will undermine the liveability and prosperity of the Māngere-Ōtāhuhu area which is poorly served by public transport. Essentially, the economic growth and development of the Auckland region and New Zealand will be constrained by the network's inability to provide time efficient and reliable journey times during peak periods.

The Memorandum of Understanding developed a sub-regional strategy in 2010, concluding that investment in a high capacity public transport services to the Airport will be needed in addition to state highway and local road improvements. Phase 1 of the South Western Airport Multi-Modal Corridor Project (SWAMMCP) developed potential transit corridors and concluded that heavy rail , excluding light rail on the basis that it did not provide a single seat journey from the city centre to the Airport. However, it was noted that light rail could be reconsidered with the implementation of light rail along other corridors. Phase 2 of the project involved a Scheme Assessment Report and identified a preferred alignment for a heavy rail corridor to the Airport.

The Central Access Strategy proposed the introduction of light rail along key isthmus corridors which has changed the strategic transport environment. The implementation of a light rail line along Dominion Road has an impact on the final recommendation of Phase 2, therefore the Interim Business Case developed potential light rail alignment options to the Airport (as an extension of the Dominion Road line), and then compared a preferred option to the preferred heavy rail option. The Interim Business Case in 2015 estimated that the heavy rail option could cost between $2.2 billion and $2.37 billion with a benefit cost ratio within the range of 0.49 and 0.89. It was determined that the preferred light rail option would deliver similar transport benefits as heavy rail but with a significantly lower level of investment from $1.2 billion to $1.3 billion. The light rail option achieved a significantly higher benefit cost ratio in the range of 1.11 to 1.72.

Purpose of the Indicative Business Case

This Indicative Business Case aligns with the NZ Transport Agency's 'Better Business Case' framework. The Indicative Business Case reconfirms and develops the strategic case, investment story and evidence base within the Memorandum of Understanding, the SWAMMCP Phase 1 Summary Report, the SMART Interim Scheme Assessment Report and the Interim Business Case. Although the previous studies are not specifically Better Business Case documents, they are consistent with the framework requirements and address key elements of the strategic and programme business cases.

The evidence base is consistent throughout the previous studies and was used as the starting point to understand the key problems within the study area. This study will address the following key problems which were identified and developed as part of an investment logic mapping exercise:

- **Problem 1:** Constrained access to the Auckland Airport and surrounding districts will limit its economic growth and reduce the region's productivity;
- **Problem 2:** Limited accessibility and transport choice undermines liveability and economic prosperity for the Māngere-Ōtāhuhu area; and

- **Problem 3:** Unaffordable and inflexible planned transport investment constrains access to the Auckland Airport and surrounding business districts and Māngere-Ōtāhuhu area.

Project Objectives

Project objectives were developed with stakeholders and confirmed during stakeholder workshops. The project objectives guided the development and evaluation of options to deliver a high-quality solution for Auckland Airport, the Māngere-Ōtāhuhu area and the wider Auckland region.

The project objectives include:

- Significantly contribute to lifting and shaping Auckland's economic growth;
- Improve the efficiency and resilience of the transport network;
- Improve the accessibility and transport choice in the Māngere-Ōtāhuhu area;
- Contribute positively to a liveable, vibrant and safe city;
- Optimise the potential to implement a feasible solution;
- Provide a sustainable transport solution that minimises environmental impacts
- Investment in affordable solutions that provide value for money over the life of the asset

Option development

Heavy rail, light rail and bus rapid transit options were developed to address the identified key problems and this Indicative Business Case summarises all technically preferred options to date. Long list options were refined to a shortlist which includes the following options:

- **Heavy rail** – double tracking the Onehunga Branch Line from Penrose to Onehunga and extending the line across the Manukau Harbour to the Airport via SH20 and SH20A;

- **Light rail** – extending the light rail alignment for Dominion Road along SH20 and SH20A to the Airport via an interchange at Onehunga;

- **Bus rapid transit** – high frequency buses running on a busway along SH20/20A to Onehunga interchange and bus lanes along Manukau Road, Khyber Pass Road and Symonds Street to a tunnel on Wellesley Street in the city centre; and

- **Hybrid option** - high frequency buses running on a busway along SH20/20A to Onehunga interchange followed by a heavy rail connection to Penrose via an upgraded Onehunga Branch Line. The hybrid option was developed as a low cost alternative to implementing a busway along Manukau Road.

Travel time comparison

The methodology for calculating the travel time for the light rail alignment involved a simulation model for the sections along Dominion Road and Queen Street (which was consistent with the model used for the ALRT investigation), and a travel time model for the SMART extension of the Dominion Road line to the Airport. In the period since SMART options were first developed and benefits estimated in 2014/15, parallel projects have been investigating Light Rail alignments for the Dominion Road corridor in greater detail. This has included traffic micro-simulation modelling to determine likely LRT impacts and travel times more accurately. As a result, it is now known that LRT travel times along Dominion Road, that would form part of the SMART LRT option route, are faster than previously assumed. In the absence of modelled travel times, conservative assumptions were made on SMART LRT travel speed in the initial business case. Total travel time assumed for LRT from Britomart to SH20 at the lower end of Dominion Road was 28 minutes in the 2014/15 work. Whereas the current traffic modelling for LRT in Dominion Road has shown that this route will take a total of 21 minutes for the same distance, a time saving of 7 minutes over the original assumptions. These revised travel times for

LRT have been incorporated into the SMART IBC analysis. The travel time assessment for the short list options is provided in Table 1.1.

Table 1.1 Travel time assessment of the short list options

Section	Heavy rail	Light rail	Bus rapid transit	Hybrid
To/from Britomart	39– 42	42 – 44[1] 41 – 43[2]	N/A	47
To/from Aotea	41 – 44	38 – 41[3] 38 – 40[4]	40	49

The travel time estimates suggest that heavy rail provides the fastest travel time between the Airport and Britomart, with travel times varying between 39 minutes and 42 minutes. However, light rail would provide the fastest travel time to Aotea, varying between 37 minutes and 41 minutes. The BRT option would provide a travel time of approximately 40 minutes and the Hybrid BRT/heavy rail option has the slowest travel time at 47 minutes. The hybrid options offers no travel time saving compared to existing bus services which have a target travel time of 45 minutes. The hybrid option has an added travel time penalty as a result of the interchange at Onehunga.

Catchment analysis

The 2013 Census data has been used to determine the numbers of people living and working within an 800m walking distance of each of the proposed stations for the heavy rail, light rail and BRT options. The numbers give an indication of the potential number of passengers within a comfortable walking distance of a station at either end of their journey.

An 800 m walk is generally accepted as a typical maximum walking distance that people are prepared to walk to access rail services. The distance is highly dependent on the quality of the walking environment surrounding each station and may increase or decrease accordingly. A summary of the total population and employment within an 800m catchment of proposed stations for each of the shortlisted options has been assessed by Auckland Transport and is provided below in Table 1.2. Figures for the Hybrid option will be included in a subsequent revision of this document once they are made available.

Table 1.2 Employment and population catchments within 800m for the shortlist

Catchment	Heavy rail	Light rail	Bus rapid transit	Hybrid
Population	34,310	60,240	45,653	X
Employment	72,940	83,200	63,429	X

It can be seen that the total catchment for light rail is significantly greater than that of the preferred heavy rail and bus rapid transit options and that the light rail option provides access to the Airport and south-west Auckland for a significantly greater population. The greatest difference is due to the residential areas along Dominion Road.

[1] Assuming a vehicle speed of 80km/h on segregated sections
[2] Assuming a vehicle speed of 100km/h on segregated sections
[3] Assuming a vehicle speed of 80km/h on segregated sections
[4] Assuming a vehicle speed of 100km/h on segregated sections

Economic Case

The costs and benefits for each of the shortlisted options were calculated and discounted assuming a rate of 6% per annum. The discounted costs, benefits, benefit cost ratios (BCR), and net present value (NPV) for the assessed shortlisted options are shown in Table 1.3 for the 6% (mid-point) discount rate as per the EEM guidelines.

Table 1.3 Costs and benefits of shortlisted optioned assuming a 6% discount rate per annum

Shortlist option	Light rail	Heavy rail (low cost)	Heavy rail (high cost)	BRT	BRT hybrid (low cost)	BRT hybrid (high cost)
Benefits						
TOTAL Benefits NPV	$ 840 M	$ 613 M	$625 M	$ 497 M	$241 M	$254 M
Costs						
Total Cost $2016	$1.3 B	$2.7 B	$3.1 B	$1.8 B	$0.8 B	$1.1 B
Total Costs NPV	$790 M	$1,713 M	$1,946 M	$1,317 M	$564 M	$790 M
BCR	**1.06**	**0.36**	**0.32**	**0.38**	**0.43**	**0.32**

A sensitivity test was carried out which used discount rates of 4% and 8% to calculate the BCR for the shortlisted options. The benefit cost ratios at 4%, 6% and 8% discount rates are presented in Table 1.4.

Table 1.4 Benefit cost ratios

SMART shortlisted option	Benefit cost ratio		
Discount rate per annum	**4%**	**6%**	**8%**
LRT	1.52	1.06	0.78
Heavy rail (low cost)	0.53	0.36	0.26
Heavy rail (high cost)	0.48	0.32	0.23
BRT	0.53	0.38	0.28
BRT hybrid (low cost)	0.59	0.43	0.32
BRT hybrid (high cost)	0.46	0.32	0.24

Based on the evidence presented in this IBC, the preferred heavy rail option will present a low value for money despite developing both low and high cost alternatives for the heavy rail alignment. The heavy rail low cost alternative (without grade separation along the Onehunga Branch Line), has a higher benefit cost ratio than the grade separated alternative. It should be noted that no allowance has been made for potential higher accident costs or travel time impacts due to at grade crossings on the Onehunga Branch Line. This is due to the anticipated higher service frequencies as a result of double tracking the Onehunga Branch Line. It is recommended that heavy rail is to be removed from further option development for improving public transport access to the Airport.

Similar to the heavy rail option, grade separated and low cost alternatives were investigated for a bus rapid transit and heavy rail hybrid option. The interchange time penalty at the Onehunga interchange made this option inferior to existing public transport services and therefore the hybrid was removed from further investigation.

Summary

Based on the assessment against the project objectives, the LRT option performs very well in transport terms and provides a high level of accessibility and connectivity due to the number of stations and station catchments. LRT largely follows the existing road corridor and the infrastructure requirements can fit within the road reserve which reduces impacts to property. The MCA indicates that light rail will generate greater benefits but at a significantly lower cost than the preferred heavy rail option.

The heavy rail option performs well in terms of travel time and future patronage demand. It has risks associated with tunnelling in poor ground conditions at the Airport and has a considerable land requirement during construction. One of the key issues with heavy rail is the high cost of the option due to large infrastructure requirements and construction methodologies.

The BRT performs well in transport terms, will attract a large patronage and has a high level of accessibility due to the large residential catchment along Manukau Road. However, this option is the poorest overall from a land impact perspective due to the large spatial footprint at bus stops along Manukau Road which is densely populated. Whilst the transport benefits are high, the adverse effects to properties and property access are significant. This option will likely have considerable risks associated with consenting.

The Hybrid option does the least to respond to the existing and forecast transport problems within the study area. It is unlikely to attract significant patronage due to the time penalty associated with the interchange between bus and heavy rail at Onehunga.

Recommendation

The options considered to date have covered all technically feasible rapid transit options with regards to transport mode (heavy rail, light rail, and busway) and route selection, having assessed a number of different route configurations for each mode. Each option has been developed to a level where a robust and transparent 'like for like' assessment can be made against agreed objectives. In addition, a rigorous economic assessment lends further weight to the 'strategic alignment' test.

It is recommended that two shortlisted options are taken forward for further investigation through the Indicative and Detailed Business Case stages of project development. These options are:

1. SMART Light Rail Transit (LRT); and

2. SMART Bus Rapid Transit (BRT).

The two shortlisted options perform most strongly both strategically and economically and we are confident in our recommendation to focus on investigating these further, and therefore in ceasing to develop lesser performing options past this stage.

To date, neither option has been developed to an ultimate level of detail and significant development and further evaluation is still required to refine these to make sure that they deliver the best possible value for money proposition, and that their impacts are manageable, with the view to determining the preferred rapid transit option.

Critically this should be network wide, not merely at corridor or project level, as the integration and relationship of the preferred option with dependent existing and planned transport and urban development elements is fundamental to delivering strong and sustainable benefits for Auckland.

Important note about your report

The sole purpose of this report and the associated services performed by Jacobs is to *develop an Indicative Business Case to assess heavy rail, light rail and busway options for a rapid transit connection to Auckland Airport* in accordance with the scope of services set out in the contract between Jacobs and the Client. That scope of services, as described in this report, was developed with the Client.

In preparing this report, Jacobs has relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by the Client and/or from other sources. Except as otherwise stated in the report, Jacobs has not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete then it is possible that our observations and conclusions as expressed in this report may change.

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1. Introduction

The South-Western Multi-modal Airport Rapid Transit (SMART) project considers the multi-modal transport infrastructure required in south-west Auckland to meet the future needs of the area.

Auckland International Airport Limited (the 'Airport'), expects that the number of passengers flying into and out of Auckland will double in the next 10 years and triple by 2044. This is expected to play a key role in the growth and development of south-west Auckland and the Auckland region. A significant proportion of Auckland's growth over the next 30 years is forecast to occur in south Auckland.

The Auckland Plan recognises that transport investment in the south-west is vital to achieving the overarching goal for Auckland to be the "*world's most liveable city*". South-west Auckland will play a major role in delivering the aspirations of the Auckland Plan as it presents opportunities for developing attractive, vibrant and well-connected communities. The Airport and surrounding areas are key catchments for local employment which play a vital economic role for the nation as a whole.

An issue that will limit the potential of the Airport and south-west Auckland is the growing level of road congestion which is expected to increase with air passenger and freight growth. It will be difficult to increase capacity to meet demand forecasts given the existing constraints on the local and wider transport network.

To cater for the increase in demand and to facilitate growth and development, the Auckland Plan proposed a rapid transit network (RTN) which includes a link to the Airport. The Central Access Strategy (CAS) was then developed to further inform the development of the RTN.

1.1 Rapid Transit Network

The Auckland Regional Public Transport Plan (RPTP)[5] defines the RTN as an all-day network with a minimum service frequency of 15 minutes between 7:00am and 7:00pm and a dedicated right of way. The lack of a well-connected RTN is prohibiting an acceptable level of public transport accessibility across the wider Auckland region.

The network was reviewed in 2013 to confirm that the network would meet the changing transport needs for people living and travelling around the Auckland region and identify any deficiencies or gaps in the network. In general, the review found that the RTN was a good fit in terms of meeting the expected increase in demand for travel. The outcome of the review was the revised RTN for 2041 which includes a combination of heavy rail, light rail, busway and bus rapid transit (BRT) components to form a comprehensive network as shown in Figure 1.1.

The proposed RTN is designed to increased accessibility to areas within the Auckland region and shows how the RTN could serve the Airport in the future.

[5] Auckland Regional Public Transport Plan, Auckland Transport, 2013

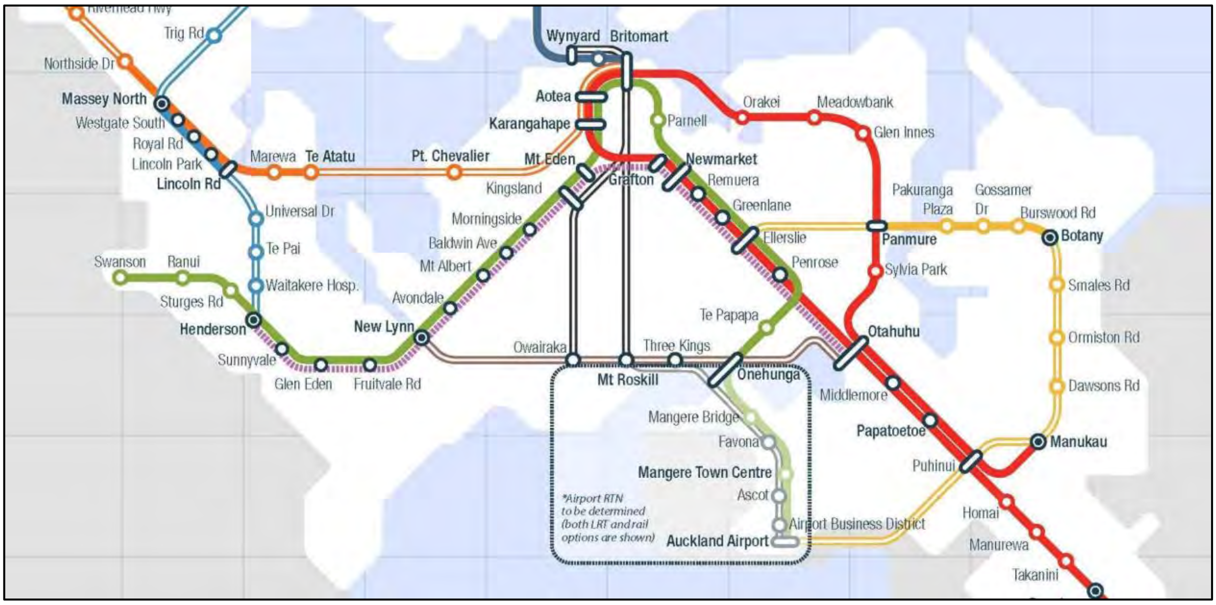


Figure 1.1 Rapid transit network proposed for Auckland by 2041

1.2 Central Access Strategy

The Central Access Study (CAS)[6] was developed for the purposes of developing an effective public transport network solution that achieves the following:

- Serves areas of Auckland that cannot be served by the commuter rail network, including the City Rail Link;
- Supports Auckland's growth requirements and enhances the quality and capacity of the city centre; and
- Addresses the impacts of too many buses in the city centre on urban amenity and the effective operation of the street network in the city centre.

The Strategy documents work undertaken by Auckland Transport to date on current and future transport problems. This Strategy has been drawn on for the development of this IBC.

A range of options were developed to achieve this purpose which included the following:

- Extended use of double-decker buses;
- Bus rapid transit;
- Bus infrastructure in the city centre;
- Extending the heavy rail Western Line to Mount Roskill; and
- Light rail transit.

The Strategy and previous studies clearly identify that significant capacity issues are anticipated and these will constrain Auckland's growth and prosperity. The Strategy determined that options including light rail transit (LRT) typically performed the best against the project objectives.

The preferred approach to improving the public transport network involves the implementation of light rail along key corridors including Sandringham Road, Dominion Road, Mount Eden Road and Manukau Road, as shown in Figure 1.2. This addresses operational constraints within the city centre, provides rapid transit for high volumes of passengers and will provide sufficient capacity for Auckland's anticipated growth.

[6] Central Access Study, Auckland Transport, September 2015

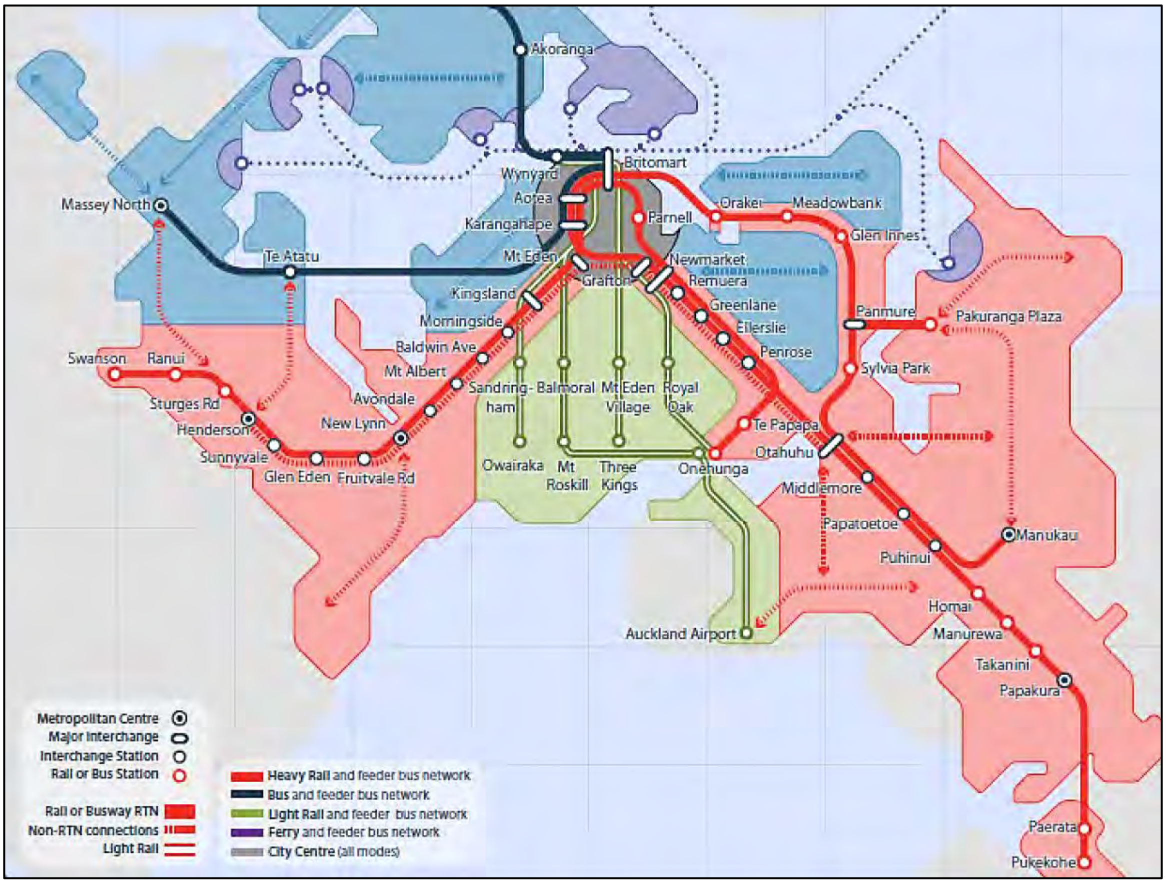


Figure 1.2 Preferred option and approach to Auckland's public transport network[7]

1.3 City Access Program

The City Access Program (CAP) study progressed from the Central Access Strategy and is currently at the Indicative Business Case stage. The CAP involves investigating mass transit options (light rail or bus rapid transit), along Sandringham Road and Dominion Road with the aim of reducing bus congestion.

Two alternatives were investigated for bus rapid transit options which included:

- Translohr STE6 Guided bus – a 45m long vehicle which operates on a segregated track with a capacity of 260 persons; and
- Van Hool Advanced Exquicity 24 bus – a 24 m long vehicle which operates in kerbside bus lanes with a capacity of 150 persons;

The CAP relates to the SMART study in that it investigates whether BRT can compare to LRT along these two corridors and be extended to the Airport.

The Translohr guided vehicles have a top operating speed of 60-70 km/hr which would offer no travel time benefits to the Airport over LRT. The vehicles are expensive and the overall cost of implementing a rapid transit system using Translohr vehicles would likely be greater than the cost of implementing LRT.

The Van Hool advanced bus vehicles have a lower capacity than light rail vehicles which means that a higher frequency would be required to match LRT. The vehicles require indented bus bays at stops and require a full depth pavement. There is no potential to widen the footpaths along the corridors due to space constraints, therefore this arrangement would result in narrowed footpaths and require the acquisition of a significant

[7] Central Access Study, Auckland Transport, September 2015

amount of property. The main issue with the advanced bus system is that there is no capacity to expand the system beyond the 2046 demand due to capacity limits at stops. The overall cost of implementing an advanced bus system is likely to be similar to the cost implementing LRT.

1.4 Auckland Airport Development

The Airport has developed a long-term development programme to be implemented over the next 30 years to accommodate forecasted growth in passengers and flights. This includes combining the domestic and international terminals, constructing a new local road network (and upgrades to the existing), and building a second runway to the north of the Airport. The developments will be staged to ensure that that vision for the Airport is affordable, flexible and delivered on time and will amount to a multi-billion dollar investment by the Airport. Given the significance of this investment programme, constructability and phasing with Airport development was a key consideration for the SMART project.

The international and domestic Airport terminals are to be combined by 2020 - 2021 and the second runway will be built and operational by around 2025 (± 3 years). It has been advised to plan rail construction approximately 5 years ahead of this expected timeframe to align with this planned development for the Airport.

The Airport anticipates that the second runway will need to be extended sometime after 2044 to improve efficiency and support larger aircrafts of which Auckland is forecast to receive in the future. The new runway is likely to be developed in two stages. The new runway will be constructed to the north of the Airport and to the west of George Bolt Memorial Drive and this will form the interim runway scenario in 2025. The runway is currently planned to be extended to its full length to the east of George Bolt Memorial Drive after 2044 to form the ultimate runway scenario. The future concept plan for the Airport after 2044 is shown in Figure 1.3.

Auckland Airport is required to have confirmed their decision regarding heavy rail or light rail within the airport by June 2016 which aligns with the time frame for the delivery of the SMART Indicative Business Case.

Figure 1.3 Future Auckland Airport developments beyond 2044[8]

1.5 Related Technical Documents and Studies

The Better Business Case adopted by the NZ Transport Agency typically involves four key steps including:

8 Auckland Airport Master Plan – Airport of the future, Auckland International Airport Limited, 2014

1. Strategic Case – sets the strategic context of the project, presents the investment logic mapping exercise and describes the significance of the problems and outcomes.
2. Programme Business Case – confirms the Strategic Case and identifies alternative options (or a preferred programme of options), at a high level to address the identified problems.
3. Indicative Business Case – reconfirms the Strategic and Programme Business Cases, further develops alternative options and recommends a preferred option or short list of options. The IBC will receive official NZ Transport Agency support to progress to the Detailed Business Case phase
4. Detailed Business Case – confirms an activity from the programme of activities, confirms the overall assessment profile and includes detailed reporting of the economic, financial and commercial assessments of the activity.

The NZ Transport Agency adopted the Better Business Case approach in 2013. Auckland Transport had undertaken a number of studies prior to this to establish the strategic case for the SMART project programme and the feasibility of providing multi-modal access to Auckland Airport. The earlier studies (used as inputs into the IBC) did not follow the business case process; however, the principles and requirements of the Strategic and Programme Business Cases are well documented in these studies.

The IBC builds on previous analysis and decisions made by Auckland Transport and the NZ Transport Agency. A brief summary of the key strategic documents and technical reports is provided in the following sections and the alignment with the business case process is summarised in Table 1.1.

Table 1.1 Alignment of SMART study process with BBC framework

Better Business Case relevance	Completion date	Scope of document
Strategic Business Case phase	2010	***Memorandum of Understanding,2010*** • Identifies the transport problems in the study area and the potential benefits of addressing the problems; • Confirms the case for change and identifies the need for further analysis; • Provides a framework for the identification of potential multi-modal connection configurations; • Outlines the initial strategic background of the SMART project.
Programme Business Case phase 	September 2011	***South-Western Airport Multi-Modal Corridor Project - Phase 1 Summary Report, GHD*** • Develops the strategic case for the project; • Develops the transport problems at a programme level and confirmed the need for investment; • Identified and evaluated high capacity public transport corridors for providing access to the Airport for heavy rail, light rail and buses; • Identified preferred options to be further analysed through a formal business case process.

Interim Scheme Assessment Report phase 	December 2013	***South-western Multi-modal Airport Rapid Transit (SMART) Interim Scheme Assessment Report, GHD*** • Investigates heavy rail and bus alignment options following the removal of light rail considerations in Phase 1; • Further development of the case for change, problems and evidence base at the activity level; • Evaluates a number of potential alignments and identifies a preferred heavy rail alignment.
Indicative Business Case phase	June 2016	***South-western Multi-modal Airport Rapid Transit (SMART) Indicative Business Case*** • Provides a comprehensive summary of analysis to date for heavy rail, light rail and bus rapid transit alignment options; • Confirms the strategic case for investment and investigates the evidence base for key problems within the study area; • Identifies and evaluates a range of options to address the problems; • Identifies a recommended option through an economic analysis of the shortlisted options to take forward for further assessment; • Identifies a procurement strategy and delivery model for the recommended option; • Financial analysis of the recommended option to evaluate the affordability of the preferred option and potential funding options.

1.5.1 Memorandum of Understanding

In 2010, Auckland Transport, the NZ Transport Agency, Auckland Council, KiwiRail and Auckland International Airport Limited (AIAL) developed a Memorandum of Understanding (MoU) for the SMART project. The MoU provided a framework to identify preferred configurations of multi-modal transport connections to Auckland Airport and outlined the documentation required for subsequent route protection phases.

The MoU proposed that the SMART project should determine future arrangements for the following:

- Long-term footprint for SH20A, SH20B and connections to SH20;
- Rail rapid transit network (RTN) connections including station locations along the alignment to the Airport;
- Interface between RTN connections and Airport passenger terminals;
- Long-term corridor walking and cycling routes/links;
- Progression plan for public transport infrastructure and service provisions over the next 30 years addressing the shift from bus-based to rail-based public transport; and
- Integrated transport and land use opportunities along the multi-modal connections to the Airport.

1.5.2 South Western Airport Multi-Modal Corridor Project – Phase 1 Summary Report

Following the Memorandum of Understanding, GHD was commissioned to develop a sub-regional strategy in response to transport constraints near the Airport and surrounding business areas as part of the South Western Airport Multi-Modal Corridor Project (SWAMMCP)[9]. Preferred routes for multi-modal transport connections to and from the Airport were identified through the study and were designed to integrate with land use development in the area.

The project was undertaken in three phases as summarised in Figure 1.4 below:

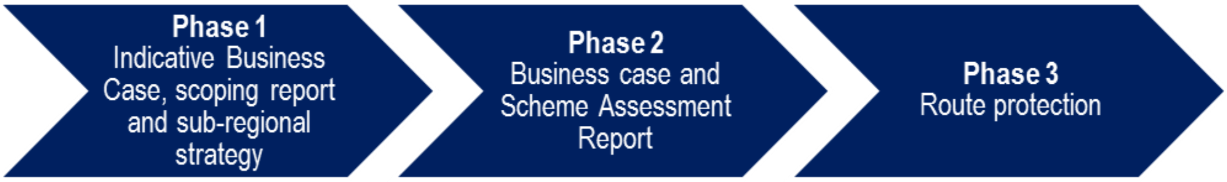


Figure 1.4 Phases of the South Western Multi-Modal Corridor Project

Phase 1 of the project developed the strategic case and need for investment which was based on facilitating economic growth and development through improving the transport network serving the Airport and surrounding areas over the next 30 years.

The study developed and investigated corridor options to accommodate high capacity public transport services in order to deliver the sub-regional strategy. The corridors considered heavy rail, light rail and busway connections to the Airport.

The study recommended that rail connections in the Airport corridor would be the most effective in delivering the strategic outcomes of the study in the long term, despite being more expensive than bus based options. It was also recommended that a progressive investment approach was taken to further stages of the project which would allow for different modes to be implemented as demand to the Airport increases and funding becomes available.

Light rail was not taken forward to Phase 2 of the study as the mode did not provide a single seat connection with the existing public transport network; however, the study noted that it could be reconsidered with the development of other light rail corridors in the future.

1.5.3 South-western Multi-modal Airport Rapid Transit – Interim Scheme Assessment Report

Phase 1 of the SWAMMCP was completed and the Board and project partners approved the commencement of Phase 2. GHD was commissioned by Auckland Transport in 2013 to develop an Interim Scheme Assessment Report (SAR) for the South-western Multi-modal Airport Rapid Transit project.

The SAR demonstrates the case for change and provides evidence of the key problems or rationale for investment. As recommended by Phase 1 of the study, the SAR investigated three options to connect the Airport to the wider RTN:

- Buses on road – buses run on the existing road network from the Airport and connect to the rail network via interchanges;
- Bus rapid transit – buses run on new busways from the Airport and connect to the rail network via interchanges; and
- Rail rapid transit – trains run from the Airport and directly connect to the rail network.

[9] South Western Airport Multi-Modal Corridor Project – Phase 1 Summary Report, GHD, September 2011

Technically preferred alignments and stop locations were developed and evaluated for bus rapid transit and rail rapid transit, with rail rapid transit emerging as the option which would best meet the long term strategic needs of the Auckland region.

The SAR study was truncated in late 2013 due to a number of external factors which meant that the preferred option was unable to be identified at the time. The external factors included uncertainties surrounding the following projects within the study area which would have had a large bearing on the technically preferred option:

- The Airport Master Plan exercise;

  A fatal flaw within the Airport designation would potentially undermine the technically preferred option within and beyond the Airport's designation.

- East-West Connections study;

  The East-West link could potentially change the state highway network in south-west Auckland could result in the reassessment of options for the SMART project.

- Rapid Transit Network study;

  The RTN study aims to identify existing constraints within the rail network, particularly between Westfield and Wiri and along the Onehunga Branch Line, with the outcomes being used to inform the SMART project.

However, Phase 2 progressed to a point where Auckland Transport identified a preferred alignment for a heavy rail corridor to the Airport. Phase 2 recommends further investigation of the preferred alignment following more certainty regarding the Airport Masterplan, the East-West Connections study and the RTN. The preferred heavy rail alignment identified by the SAR is discussed in section 6.

1.5.4 Interim Business Case

The Central Access Strategy presented an opportunity to extend the proposed light rail network to the Airport. Previously, the SWAMMCP ruled out the light rail as an option. The Interim Business Case was then developed to assess both heavy rail and light rail options for a rapid transit connection to Auckland Airport.

The Interim Business Case developed a preferred light rail option and compared this to the preferred heavy rail option which was originally presented in the Interim Scheme Assessment Report. A final preferred light rail option for the SMART project was recommended which involved extending the Dominion Road line to the Airport via SH20 and SH20A with a connecting stop to the heavy rail interchange at Onehunga.

The overall preferred rail investment option for the SMART project is the LRT option (with Onehunga access), for the following key reasons:

- Significantly less cost estimated at $1.15 billion compared to $2.37 billion for heavy rail;
- Provides access for a much greater catchment of population and employment, particularly in the Māngere-Ōtāhuhu area;
- Similar travel time for most trips to and from south-west Auckland;
- Higher frequency service;
- Lower delivery risks; and
- Less property impacts.

1.6 Changes to Strategic Context

Uncertainty surrounding transport projects within the study area resulted in the truncation of the SMART Interim SAR. Since the Interim SAR and Interim Business Case, the following projects have either been confirmed, completed or have reached the DBC phase.

The East-West Connections programme looks to improve freight efficiency, commuter travel, public transport and active mode options over the next 30 years in the Onehunga, Penrose, Mt. Wellington, Māngere, Ōtāhuhu and Sylvia Park areas. The project has moved into the DBC phase and has arrived at a preferred option for the Onehunga-Penrose connection and for public transport priority between Māngere, Ōtāhuhu and Sylvia Park. The NZ Transport Agency Board has approved a staged, full link between SH1 and SH20 to the north of the Māngere Inlet as the preferred approach.

Auckland Transport has further developed the RTN and identified existing capacity constraints within the wider transport network.

The Airport completed their master planning exercise in 2014 which sets out the proposed changes to the local transport network and the staging of these improvements to align with demand. However, the road layout remained subject to change due to further developments within the Airport land holding. It was confirmed during a stakeholder workshop[10] that the Airport local road layout was as per the Airport's Master Plan and the confirmed road layout was used to inform the alignment of options within the Airport.

These changes have been considered during option identification, development, and further refinement to ensure that the SMART project (and preferred option), aligns with other significant, city-shaping projects in the area. The strategic context of the SMART project has been captured within the Do Minimum assumptions in section 5.

1.7 Purpose of the Indicative Business Case

Jacobs has been commissioned by Auckland Transport to develop an IBC for the South-western Multi-modal Airport Rapid Transit (SMART) project activities as identified in the future RTN for Auckland and the Central Access Strategy study.

This IBC aligns with the NZ Transport Agency's 'Better Business Case' framework and focuses on the priority activities identified in the Interim SAR for further investigation. Heavy rail, light rail and BRT options were developed and evaluated as part of this study and this IBC identifies and progresses a preferred option(s) to take forward for further investigation.

The purpose of this report is to summarise the technical analysis that has been undertaken to identify a recommended option(s) to be taken forward for further analysis. This IBC:

- Confirms the strategic background and problems and benefits identified in the PBC phase within an economic and social context;
- Summarises the approach to stakeholder management and incorporation of key messages (see section 2 – Project Background);
- Summarises the analysis of problems, investment logic mapping process and development of project investment objectives (see section 4 – Problem Definition);
- Develops a long list of heavy rail, light rail and bus rapid transit options to address the project problems and deliver the investment objectives (see section 6 - Long List Option Identification and Evaluation);

[10] Workshop 7 – Airport Alignment Challenge, held on 8 April 2016

- Assesses the relative performance of the short list options using a multi-criteria analysis tool to inform the recommended option(s) to proceed to the DBC phase for further investigation (see section 8 – Short List Option Assessment);

- Assesses the economic benefits and costs of the shortlisted options (see section 9 - Economic Case);

- Provides a financial analysis of the whole of life costs, affordability, and funding options for the recommended option (see section 10 – Financial Case);

- Sets out an indicative project plan including governance, resourcing, stakeholder engagement and next steps to move the project through to the DBC phase (see section 11 - Management Case); and

- Discusses a range of procurement and potential delivery models for the recommended option(s). The assessment identifies key risks relevant to procurement and delivery and how these will be addressed in subsequent project stages (see section 12 – Commercial Case);

2. Project Background

2.1 Area Context

As shown in Figure 2.1, south-west Auckland is bordered by the Manukau Harbour to the north, west and south and by State Highway 1 (SH1) to the east. The main transport connections between south-west Auckland and the rest of Auckland are via SH20 and SH1 and the southern rail line which runs in between the two highways. The Airport is located in south-west Auckland which provides a critical connection between Auckland, the rest of New Zealand and the world.

The management of the transport network in south-west Auckland is undertaken by a combination of Auckland Council, Auckland Transport, the NZ Transport Agency, KiwiRail and Auckland International Airport Limited.

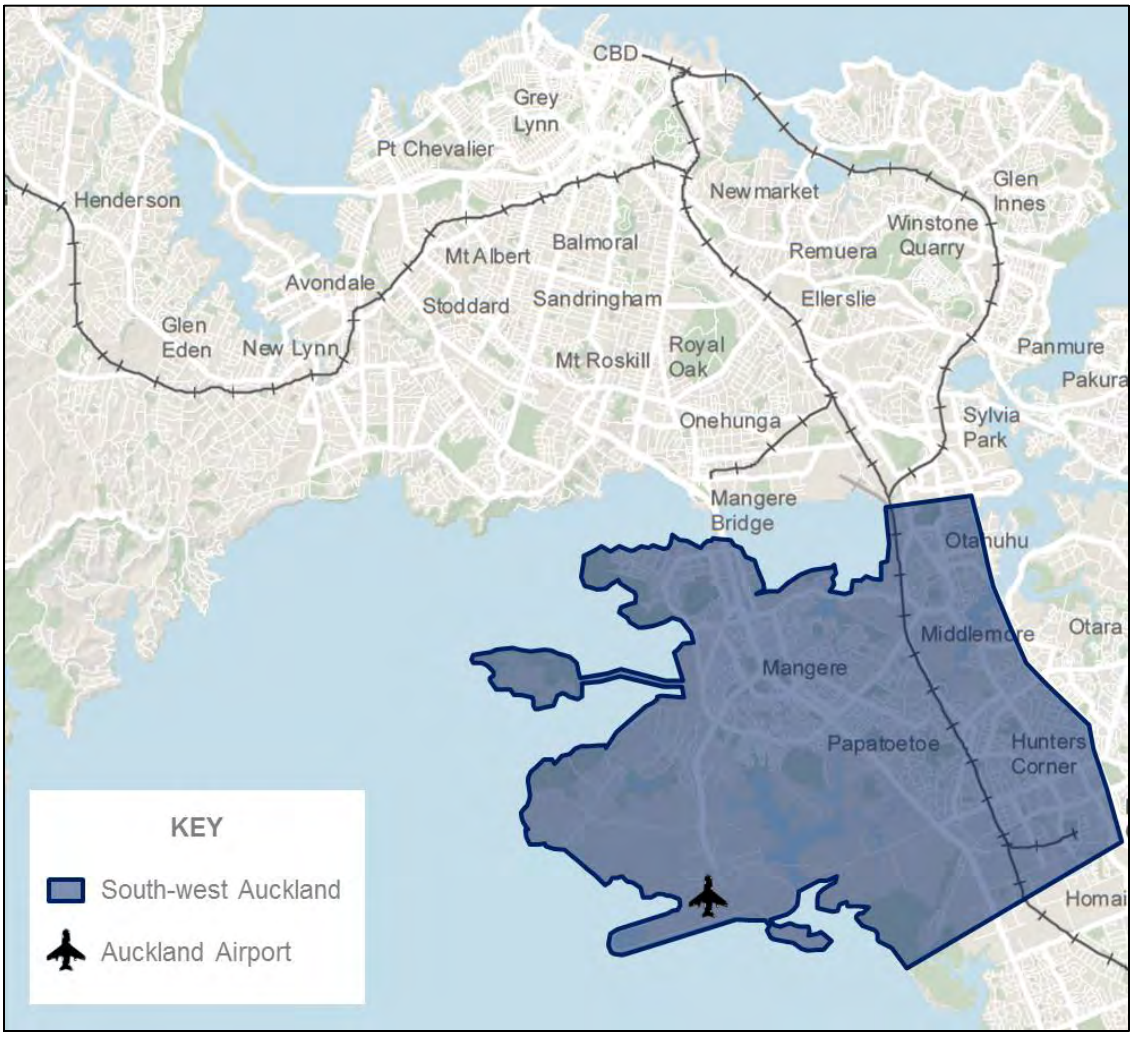


Figure 2.1 SMART study area

2.2 Stakeholder Engagement

The IBC has been developed through engagement with key stakeholders involving meetings, interviews and interactive workshops. The stakeholder groups included the following:

- Auckland Transport;
- Auckland International Airport Ltd (AIAL);

- NZ Transport Agency;
- Auckland Council;
- Māngere-Ōtāhuhu, Puketāpapa and Maungakiekie-Tāmaki Auckland Local Boards;
- KiwiRail;
- Mana Whenua; and
- Panuku Development Auckland (PDA).

Stakeholder engagement assisted in defining the project problems and objectives; developing the evaluation framework; and developing and evaluating heavy rail, light rail and bus rapid transit options.

The workshops undertaken as part of the SMART project included:

Workshop 1. Investment logic map (ILM) workshop;

Workshop 2. Evaluation framework;

Workshop 3. Do Minimum scenario;

Workshop 4. Light rail long list option evaluation;

Workshop 5. Light rail preferred option;

Workshop 6. Onehunga Branch Line challenge; and

Workshop 7. Auckland Airport rail alignment challenge.

Engagement captured stakeholder's key concerns and successful outcome aspirations for the project. These concerns were incorporated into option development and evaluation.

Public stakeholder engagement is expected to be undertaken and feedback will be addressed during subsequent stages of this project.

2.3 Project Objectives

Project objectives were developed with stakeholders and confirmed during the evaluation framework workshop. The project objectives guided the development and evaluation of options to deliver a high-quality solution for Auckland Airport, the Māngere-Ōtāhuhu area and the wider Auckland region.

The project objectives include:

- Significantly contribute to lifting and shaping Auckland's economic growth;
- Improve the efficiency and resilience of the transport network;
- Improve the accessibility and transport choice in the Māngere-Ōtāhuhu area;
- Contribute positively to a liveable, vibrant and safe city;
- Optimise the potential to implement a feasible solution;
- Provide a sustainable transport solution that minimises environmental impacts.

It should be noted that no project objective was developed to address the cost of the option. An additional objective was developed as the project progressed and is discussed in section 8.1.

3. Strategic Case

This section explains how the scope of the proposed transport investment fits within the existing strategies of the partner organisations in terms of their existing and future operational needs.

3.1 Strategic Alignment

The following strategic documents support the need to improve the efficiency and resilience of the transport connections to and from south-west Auckland to move people and goods more effectively. They also highlight the importance of improving the level of accessibility and transport choice in the Māngere-Ōtāhuhu area.

This IBC aims to address the strategic priorities in the documents and agree on a coordinated view for transport provisions within the study area. This will ensure that investment in the outcomes of the IBC will reflect the compelling needs identified within the project partner's organisational goals and outcomes.

3.1.1 Auckland Plan

The Auckland Plan Strategic Direction 13 is to *"create better connections and accessibility within Auckland, across New Zealand and to the world."* and Strategic Direction 6 is to *"develop an economy that delivers opportunity and prosperity for all Aucklanders and New Zealand."*

The Auckland Plan recognises south-west Auckland as a regionally significant employment area and defines Māngere, Onehunga and Ōtāhuhu as town centres and Māngere Bridge and Favona, as local centres within the study area.

Chapter 13 of the Auckland Plan provides strategic direction on how investment in transport should be directed to create better connections and accessibility within Auckland, across New Zealand and to the world. It includes a directive to provide for the long-term needs of Auckland Airport in an environmentally sustainable manner, to support New Zealand's international freight, trading competitiveness, and visitor industry. Figure 3.1 demonstrates how the Airport could be served by the rapid transit network in the future.

Figure 3.1 Auckland's future strategic rapid transit network, 2042[11]

[11] Map 13.1 Auckland Strategic Transport Network, Auckland Plan

3.1.2 Proposed Auckland Unitary Plan

The PAUP was published during 2013 with a submission period ending 28 February 2014. The Auckland Unitary Plan will ensure that Auckland can meet its economic and housing growth needs and help its centres meet their real potential, while protecting and enhancing what already makes the region great.

The PAUP is currently going through the hearing process, but it is important that the objectives and policies are considered, particularly with respect to land use change. There are also some rules (relating particularly to protecting the ecological and heritage values and discharges) that have immediate legal effect.

3.1.3 Local Board Plans

The study area traverses the Local Board areas of Māngere-Ōtāhuhu, Puketāpapa and Maungakiekie-Tāmaki. Auckland Council is currently undertaking a programme to develop area plans for each local board area. The area plans will help to implement the directions and outcomes of the Auckland Plan at a local level.

The Māngere-Ōtāhuhu Area Plan identifies six key opportunities to transform the Māngere-Ōtāhuhu into an area that attracts visitors, and a location where people want to live, work and play. There are opportunities for more employment in and around Auckland Airport, but there are also challenges regarding health, housing, unemployment and low educational achievement. The following opportunities are particularly relevant to his project:

- Provide for a multi-modal rapid transport corridor and improved public transport network to the airport, City Centre and the local and wider region; and
- Promote Māngere-Ōtāhuhu's businesses and Auckland Airport as the local and regional employment, tourism and recreation destinations and gateway to Auckland.

The Maungakiekie-Tāmaki Area Plan contains the following proposals relevant to the study area:

- Onehunga Foreshore restoration;
- Initiate planning and community engagement for the Onehunga to Airport rail link; and
- Improve movement of freight towards SH20.

The Puketāpapa Plan does not provide any specific proposals relevant to the study area.

3.1.4 Integrated Transport Programme

Auckland's Integrated Transport Programme (ITP) sets out the 30 year investment programme to meet the transport priorities outlined in the Auckland Plan across modes, covering the responsibilities of all transport agencies. The ITP was developed by Auckland Transport and NZTA in collaboration with Auckland Council. The programme encompasses state highways and local roads, railways, buses, ferries, footpaths, cycleways, intermodal transport facilities and supporting facilities such as park-and-ride.

The ITP promotes the 'one system' approach to better manage, plan and integrate the use of the transport networks with land use development at all levels of planning, as required by the Auckland Plan. The approach requires the key stakeholders to agree on a collaborative view of strategic intent for the Auckland region and how this is delivered by transport.

The One System approach provides a compelling case to result in:

- Better use of existing infrastructure

- Better alignment with changing patterns of land use and demand
- A safer, more resilient national and regional network, where a greater range of resources and options is available to deal with unexpected events or future changes
- Better alignment of effort between network providers and elimination of overlap and duplication

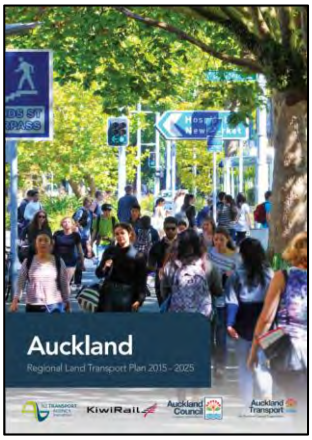
This IBC seeks to develop activities that better align with forecast changes in land use and to provide a more resilient transport network.

The four staged intervention process that has been developed in the ITP to enable the prioritisation of Auckland's 30 year transport programme is as follows:

1. Operate, maintain and renew infrastructure optimally;
2. Make better use of networks;
3. Manage demand efficiently and safely; and
4. Invest in new infrastructure, services and technology.

This IBC has been developed to align with stage 4 of this intervention process which addresses the importance of upgrading public transport infrastructure.

3.1.5 Regional Land Transport Plan



The Regional Land Transport Plan (RLTP) describes how transport providers intend to respond to growth and other challenges facing Auckland over the next ten years. It is updated every three years and includes a ten year prioritised delivery programme of transport services and activities for Auckland. The RLTP represents the combined transport programmes of the NZ Transport Agency, Auckland Transport and KiwiRail.

The RLTP has developed several strategic themes which are intended to shape the delivery of the transport components of the Auckland Plan. These themes include the following:

- Prioritise rapid, high frequency public transport;
- Transform and elevate customer focus and experience;
- Build network optimisation and resilience;
- Ensure a sustainable funding model; and
- Develop creative, adaptive, innovative implementation.

The SMART project is consistent with the strategic theme to '*prioritise rapid, high frequency public transport'*.

3.1.6 Statement of Intent

In order to align with the strategic direction of the Auckland Plan, Auckland Transport has identified, through its Statement of Intent, the following overarching outcome: *Auckland's transport system is effective, efficient, and safe*. Contributing to this outcome are six impacts:

- Better use of transport resources to maximise return on existing assets;
- Increased customer satisfaction with transport infrastructure and services;
- Auckland's transport network moves people and goods efficiently;
- Increased access to a wider range of transport choices;
- Improved safety of Auckland's transport system; and

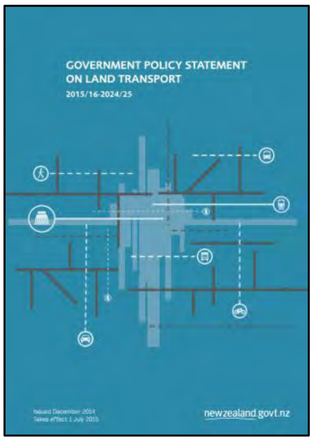
- Reduced adverse environmental effects from Auckland's transport system.

A Programme of Action (POA) has been developed in order to achieve the impacts and outcomes of the Statement of Intent. The 2014/15 POA comprises a list of activities and initiatives to be undertaken during that financial year with respect to planning and route protection, new transport infrastructure and significant operations.

The 2014/15 POA specifically recommends to "*undertake planning and route protection for major new transport infrastructure including the South-Western Multi-Modal Airport Rapid Transit (SMART) network*".

The SMART project will provide significantly more transport choice and will be able to move Auckland's people much more efficiently and reliably than is currently forecast.

3.1.7 Government Policy Statement on Land Transport Funding 2015/16 – 2024/25



The Government Policy Statement (GPS) requires both regional and national land transport programmes to prioritise activities that advance economic growth and productivity, value for money and road safety. In advancing these priorities and improving the provision of infrastructure and services, the Government expects to achieve the following impacts:

- Improved journey time reliability;
- Easing of severe congestion;
- More efficient freight supply chains;
- Better use of existing transport capacity;
- Better access to markets, employment and areas that contribute to economic growth;
- Greater transport choice, particularly for those with limited car access;
- A secure and resilient transport network.

The three key priorities from the draft Government Policy Statement (GPS) in 2015 are as follows:

1. Supporting economic growth and productivity;
2. Road safety; and
3. Value for money.

The objectives of the SMART project are closely aligned with these key priorities. The SMART project aims to significantly lift and shape Auckland's economic growth and productivity by increasing public transport capacity in order to support growing urban centres in the study area.

A key objective of the BBC process is to assess the value for money of options. The robustness of the BBC process ensures that any investment is able to generate sufficient benefits to offset capital costs. As such, the business case is likely to deliver outcomes that are extremely well aligned with the GPS investment priorities.

3.1.8 Auckland Regional Public Transport Plan

The Auckland Regional Public Transport Plan (RPTP) sets out the proposed public transport services for the Auckland region over the next 10 years as a range of service layers: rapid, frequent, connector, peak-only, local and targeted services.

Auckland’s Rapid Transit Network (RTN) is a passenger transport system with high frequency, high quality services. The current RTN is comprised of the passenger rail network and the Northern Busway.

The Auckland Plan identifies a series of projects to further develop the RTN over the next 30 years. In particular, the plan builds on and expands previous work by proposing rapid transit connections to planned growth areas including the airport from both Onehunga and Manukau with stations at the airport, Māngere town centre and Māngere Bridge.

The existing and proposed RTN is shown in Figure 3.2. The ability to consider physical changes consistent with the proposed RTN through this IBC process will better enable the objectives of the RPTP within the study area.

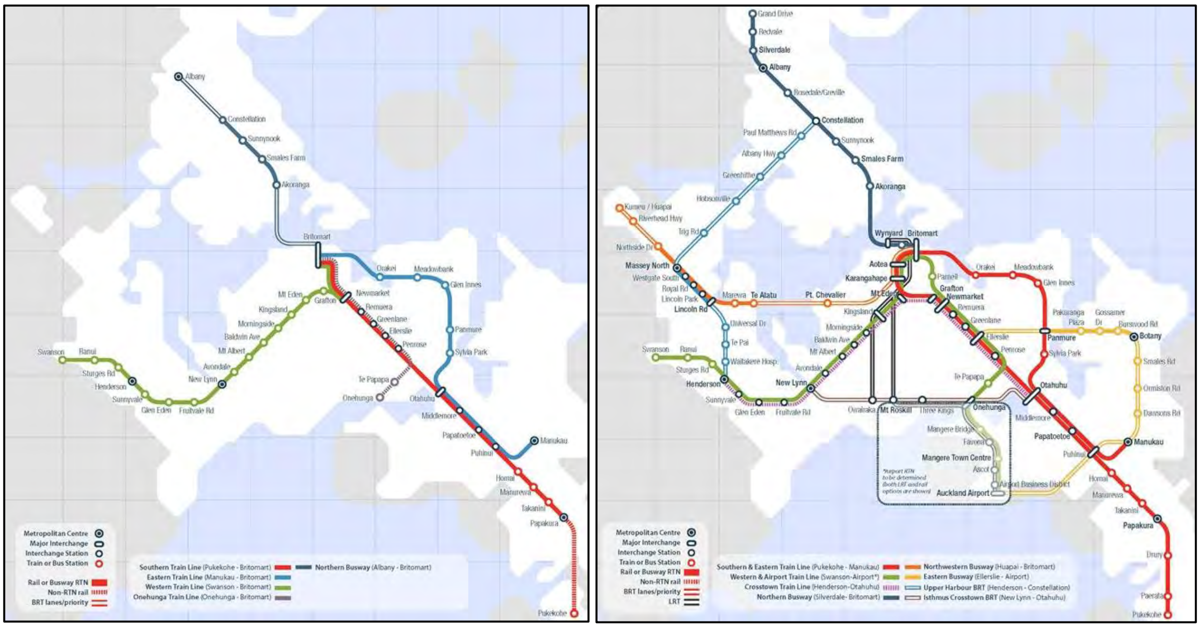


Figure 3.2 Existing and future rapid transit network for Auckland

The current regional bus network is considered to be complex, with over 400 different route variations, many of which are infrequent, long and indirect. In order to achieve the transformational shift in public transport required by the Auckland Plan, the RPTP therefore proposes a new frequent transport network (referred to as the ‘New Network’), that provides a simpler, more connected network made up of approximately 130 routes.

The New Network involves an ‘all day’ frequent service network consisting of rapid, frequent and connector services supported by local and peak only and targeted services. In comparison to the existing direct service network, the proposed network will provide fewer routes at higher frequency with high quality interchange facilities to provide efficient public transport services.

Within the study area, the RPTP proposes alterations to the existing network to focus movements on a smaller number of bus corridors. The ability to consider physical changes consistent with the proposed network through the IBC process will better enable these objectives within the study area.

Consultation on the proposed New Network for south Auckland was undertaken by Auckland Transport in 2013. The proposed New Network routes are shown in Figure 3.3 and are anticipated to be implemented in 2016.

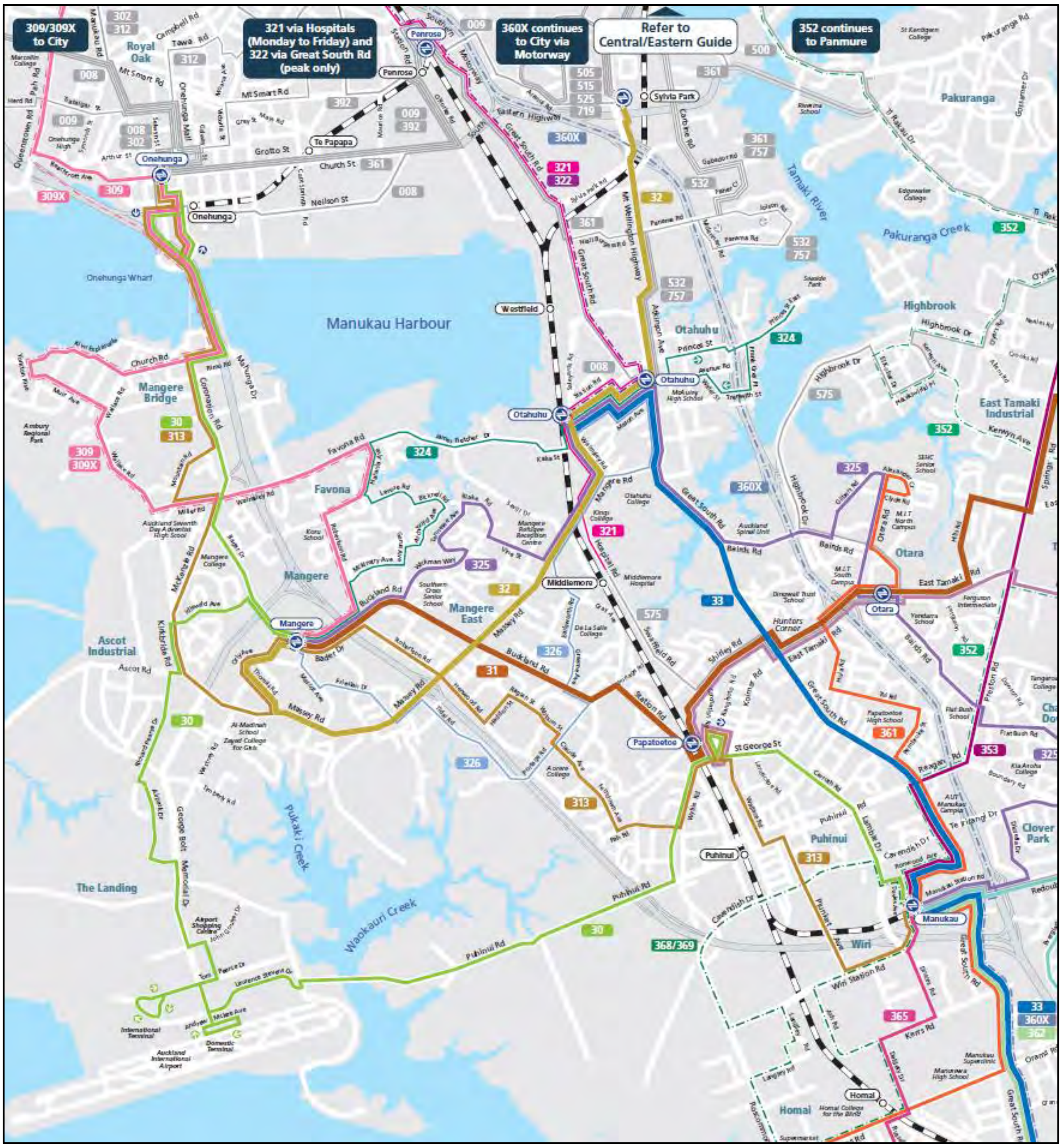


Figure 3.3 New Network for south-west Auckland

3.1.9 Auckland International Airport Limited Master Plan

The Auckland Airport Master Plan forecasts an increase in air passenger traffic from 14 million passengers in 2013 to 40 million passengers in 2044, with international passengers doubling to 24 million within 10 years.

The Master Plan recommends the following key infrastructure investments over the next 30 years which include:

- Combining and expanding the domestic and international terminals;
- Improvements to the terminal road network, bus and public transport access;
- Protection for rapid transit pathway to the terminal;

- New extended, northern runway;
- Development of the road network outside the terminal precinct including grade separation of the SH20A interchange to the Airport and improved connectivity between SH20A and SH20B.

The Master Plan's vision of significant growth for the Airport and surrounding businesses supports the case for change. The key assumption on which the Master Plan is based is that timely investments will be made to the land transport connections to adequately accommodate this forecast level of growth. An assessment of currently funded land transport projects indicates that these will be inadequate to support this growth; therefore, an objective of this IBC is to improve access to and from the Airport and surrounding business areas, moving people and goods more efficiently.

3.1.10 Auckland Housing Accord

The Auckland Housing Accord aims to accelerate the delivery of housing across Auckland. It is expected that around 39,000 homes and sections will be consented across Auckland during the three year period to 2016.

Through the accord, Special Housing Areas (SHAs) are identified for fast-tracked development. Six SHAs were identified within the study area (shown in Figure 3.4), indicating more than 2,130 new dwellings. These SHAs are:

- Jordan Avenue, Onehunga (Tranche 2) – 325 new dwellings;
- George Terrace, Onehunga (Tranche 3) – 220 new dwellings;
- Oruarangi Road, Māngere (Tranche 3) – 350 – 480 new dwellings;
- Walmsley Road, Māngere (Tranche 3) – 1,600 new dwellings;
- Bristol Road, Mt Roskill (Tranche 3) – 10 new dwellings; and
- Mt Roskill Cluster (Tranche 3) – 20 new dwellings.

The accord is of particular importance in the Māngere-Ōtāhuhu area where housing supply is very low in comparison with demand. The SHAs located close to the Airport and surrounding business areas are likely to intensify commuter demand within this area, which will contribute to the problem of limited accessibility and transport choice undermining liveability and economic prosperity for the Māngere – Ōtāhuhu area. Because of this, the SHAs are likely to increase the potential benefits achievable through investment by supporting population growth in the area.

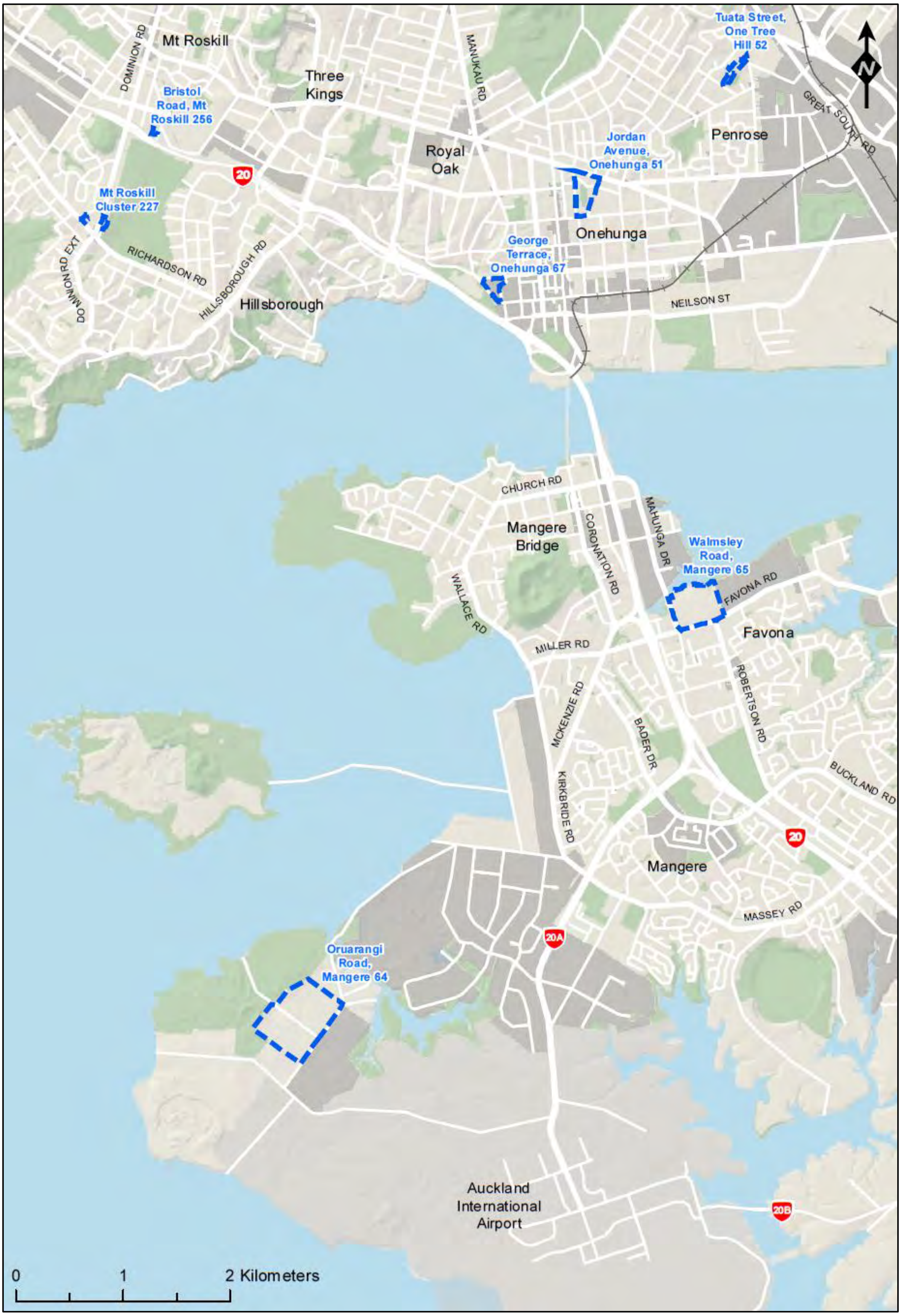


Figure 3.4 Special housing areas within the study area

4. Problem Definition

This IBC focuses on investment options for providing access to the Auckland Airport by connecting the Airport to the existing wider rapid transit network. Initially, the SMART project was to confirm the need to invest beyond the base case by gaining an understanding of the current transport issues in the project area.

A significant amount of analysis has been undertaken in regard to the problems surrounding access to the Airport however, this analysis predates the implementation of NZ Transport Agency's business case approach. There is significant evidence and a clear need for investment documented in these earlier studies as detailed in section 1.5.

The Interim SAR initially identified the following problems through an investment logic mapping (ILM) workshop in 2013:

- Demand for access to the Airport Business District and surroundings will overwhelm the existing transport network by 2026, curtailing growth and slowing the movement of people and goods; and
- Poor transport services and connections within the SMART area inhibit improvements to the social, environmental, cultural and economic outcomes for its businesses and communities.

In developing the ILM, the following investment objectives were established:

- To enable planned economic growth of at least 5% each year in the SMART area and in the wider Auckland region through timely and progressive improvement in the capacity and flexibility of the transport system;
- To improve land access to and from Auckland International Airport for travellers and freight progressively and in a timely way as demand grows; and
- To enable improved liveability through better accessibility to work, life and play activities.

The ILM and key performance indicators have been refined since the Interim SAR during the subsequent business case phases, as discussed in the following sections. However, there is a clear investment story which is consistent between the earlier studies and the IBC.

4.1 Revised Investment Logic Mapping

A facilitated ILM workshop was held on 13 November 2014 with the key stakeholders listed in section 2.2 to gain a better understanding of current issues and identify the logic to support transport investment in the area.

The panel identified and confirmed the following three key problems:

- **Problem 1:** Constrained access to the Auckland Airport and surrounding districts will limit its economic growth and reduce the region's productivity;
- **Problem 2:** Limited accessibility and transport choice undermines liveability and economic prosperity for the Māngere-Ōtāhuhu area; and
- **Problem 3:** Unaffordable and inflexible planned transport investment constrains access to the Auckland Airport and surrounding business districts and Māngere-Ōtāhuhu area.

Figure 4.1 summarises the agreed investment story including the key problems, benefits which could be achieved through investment, measures that can be used to assess performance of options, and the strategic investment objectives.

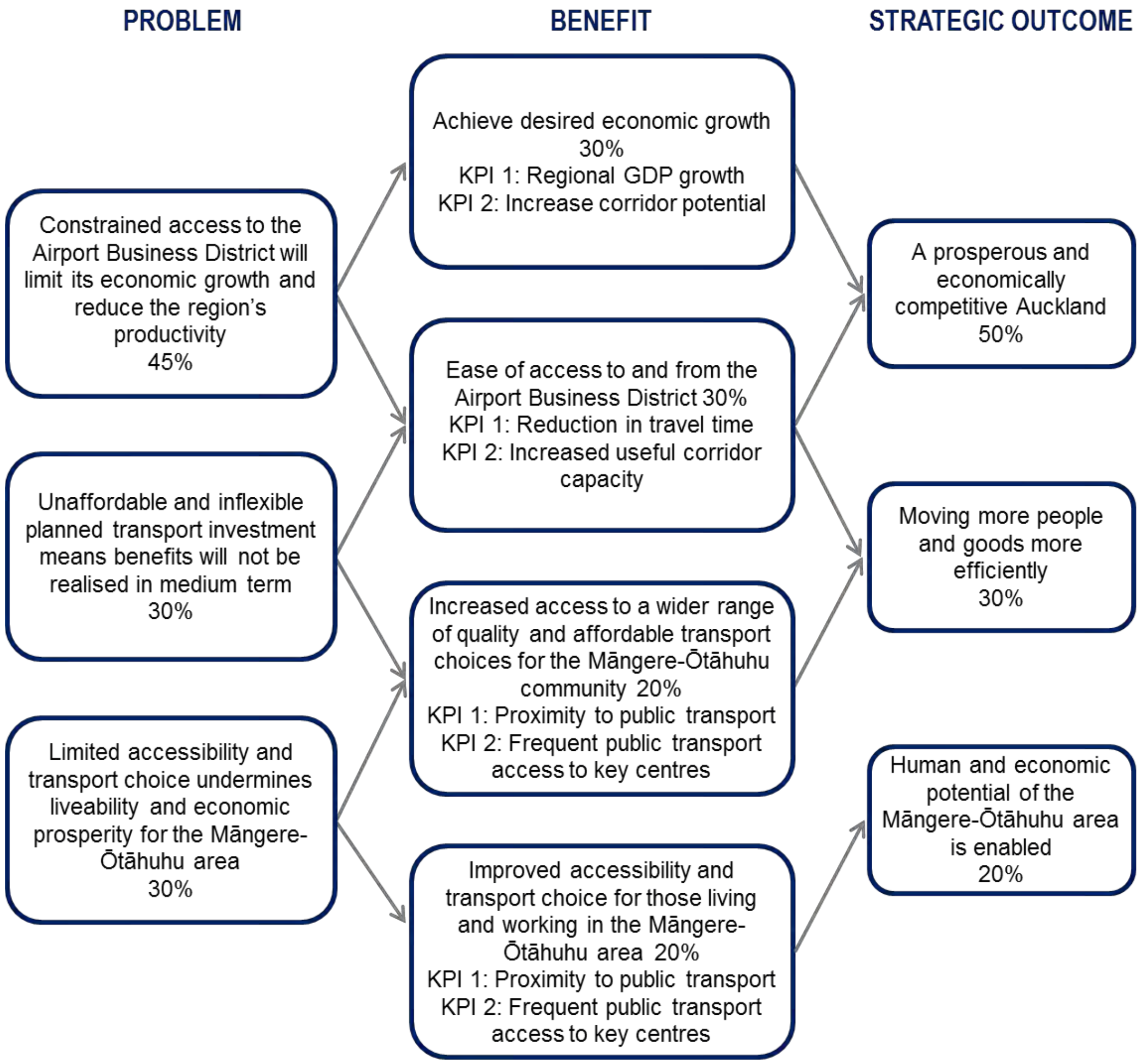


Figure 4.1 SMART project investment logic map

4.2 Problem Evidence Base

Previous studies have validated the problems identified at the strategic case level and confirmed that there is a need for investment beyond the proposed projects with confirmed funding.

The evidence base that supports the problems and benefits identified in the ILM workshop has been largely drawn from the information gathered for the Interim SAR and supplemented with updated information where relevant and available. Additional information relating to light rail and bus options was added to the evidence base to inform the light rail and BRT components of this study.

This section confirms the validity and provides the evidence base for the identified problems and discusses the importance and potential benefits of addressing the problems.

Problem Statement 1: Constrained access to the Auckland Airport and surrounding districts will limit its economic growth and reduce the region's productivity

Access is a key driver for economic activity and productivity. A lack of access is likely to discourage economic activity or cause it to relocate to other areas. This is particularly important for areas of such as the city centre or the Auckland Airport where the concentration of employment adds significant value to the area.

Creating an economically productive Auckland requires a transport network that will efficiently and effectively facilitate the movement of people and goods to and from Auckland Airport. The provision of a reliable, resilient transport network to move people and goods to and from the Airport is a high priority for facilitating growth and development.

Auckland Airport is already a critical element of Auckland's economy with the Airport and related business activities contributing $3.5 billion to Auckland's economy and lifting household incomes by $1.9 billion in 2013[12]. It plays a significant part in New Zealand's tourism industry, providing access for 75% of all international arrivals, including 92% of long haul arrivals. Of the total airport passengers and other visitors, 16% of all international passengers, 23% of international work related passengers, 22% of all domestic passengers and 26% of domestic work related passengers travel directly to or from the City Centre.

The New Zealand Tourism Industry Association has set a growth target of 6% growth in value of tourism each year until 2025 and Auckland Airport plays an important role in achieving this vision. The Airport currently serves over 120 international and 300 domestic flights every day, generating 14.5 million passengers per annum. Within ten years, passenger numbers are predicted to almost double to 24 million passengers per year. Within 30 years, this is expected to almost triple existing numbers to 40 million passengers per year.

The increase in the number of passengers arriving at Auckland Airport will be accommodated by larger aircrafts arriving more frequently[13] which will place more demand on the transport network serving the Airport. Forecasts show that the Airport will become progressively more important and dominant with the expected growth in air traffic and this plays a key role in the future development of Auckland.

The Airport and surrounding businesses have become a significant regional employment hub, attracting employees from across the Auckland region as shown in Figure 4.2. The Auckland Airport and surrounding businesses currently employ approximately 20,000 people through 900 businesses with over half of these business opportunities being based on Auckland Airport's land holding.

The area around the Airport has the potential for further development and is a key catchment for Airport and local employment. These areas present opportunities to develop attractive, well-connected locations where people can live and work in the future without having to commute large distances. The Auckland Airport Master Plan aims to increase employment to 27,000 jobs (as an aspirational target), within the next 30 years which will greatly contribute toward making south-west Auckland one of the largest employment hubs in Auckland.

[12] Auckland Airport Master Plan – Airport of the future, Auckland International Airport Limited, 2014
[13] Auckland Airport Master Plan – Airport of the future, Auckland International Airport Limited, 2014

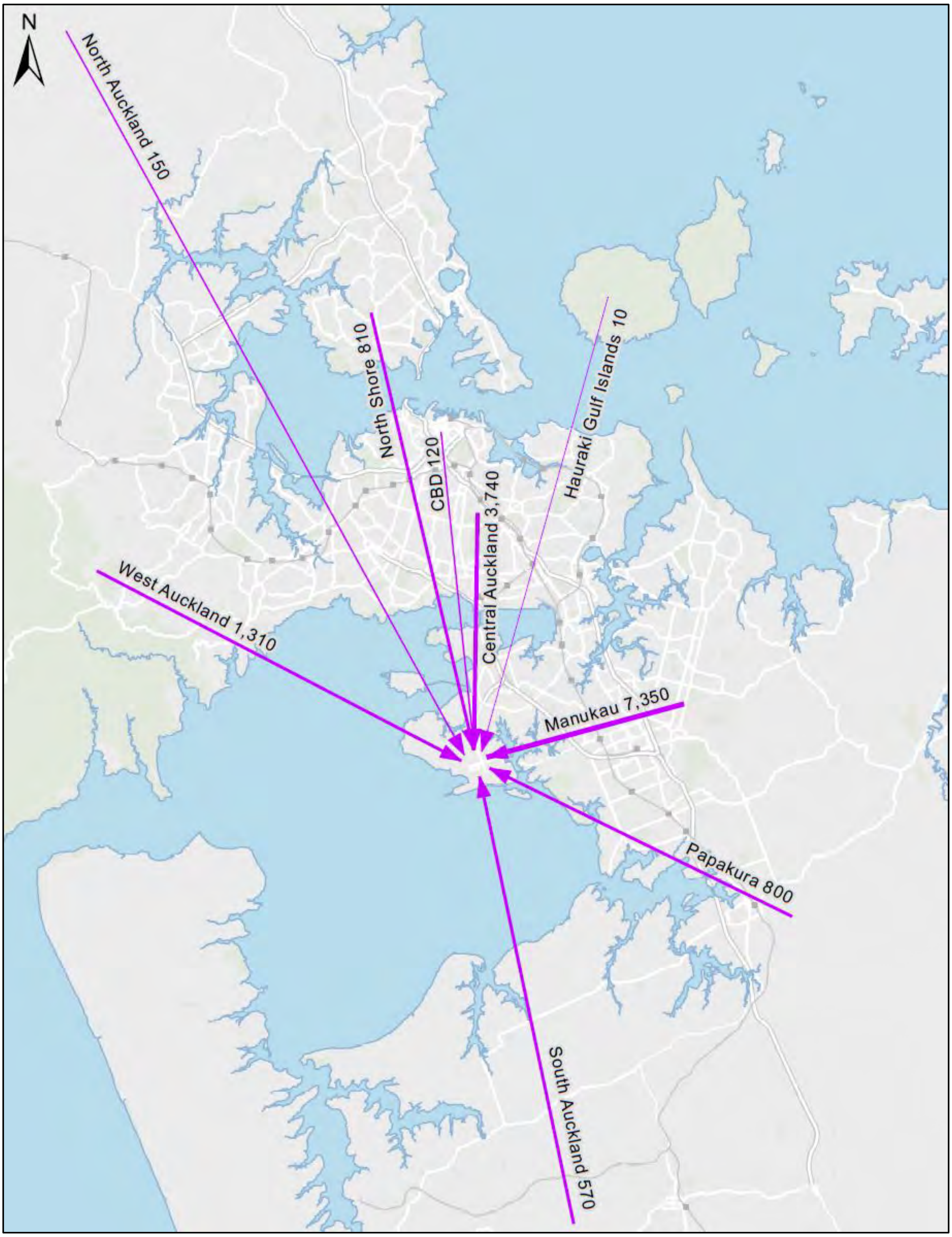


Figure 4.2 Daily commuter origin-destination patterns for the Airport and surrounding businesses

The Airport and surroundings have been faced with increasing traffic congestion as the Airport continues to grow. Constrained access to the Airport via the existing road network makes it difficult to accurately predict the journey time to the Airport and surrounding areas. Journey time reliability is important as it provides significant benefits to logistics operations and to the tourist economy.

The Airport is a nationally important freight hub and is the second largest cargo port in New Zealand by value, approximately 230,000 tonnes of freight every year with a value of $13 billion[14]. The impact of congestion and unreliability is likely to be particularly pronounced for commercial and strategic freight travel, which generally cannot rely on a public transport alternative and occurs mostly during the inter-peak period. The national significance of the Airport's freight carrying capacity is likely to increase over time as air freight becomes more important and achieves higher rates of return than sea freight. Delays and inefficient freight movements resulting from Airport access constraints is likely to have substantial cost implications for the nation's economy.

The findings from a recent survey of end-to-end journey times between Aotea Centre (in the city centre) and the domestic terminal at the Airport during peak times are presented in Figure 4.3. Travel time to the Airport varied considerably when making the journey by private car and by taxi. The journey time for private vehicles ranged between 41 minutes and 65 minutes which included the time required to park the vehicle. Taxis had a faster journey time, taking only 32 minutes to get to the Airport for some trips. However, the variation in travel time for taxis was the greatest of the three modes with the journey taking up to 64 minutes. The journey times for the Airbus were less varied ranging between 48 minutes and 53 minutes.

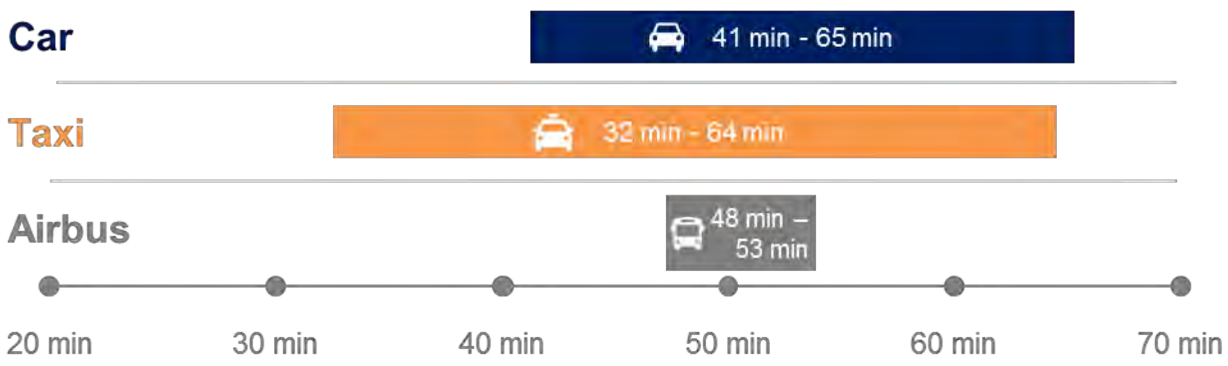


Figure 4.3 Surveyed travel times from Aotea Centre to the Airport[15]

It is predicted that journey times to and from the Airport will become less reliable as the effects of congestion increase. It is expected that nearly three-quarters of daily trips will be made by private vehicles in 2046 therefore poor reliability is expected to be a key issue in the future. The inability of travellers to predict travel time to results in unproductive time spent waiting at the Airport for flights or missing flights. If alternative transport options are not provided, some roads and highways providing access to the Airport will exceed capacity, particularly during peak times, which will lead to flow breakdown. This variability also makes it difficult to plan freight movements and hinders the ability of the network to provide for the most efficient use of transport resources.

Transport pressures are likely to increase with further economic growth and development in the study area. Existing transport capacity constraints on the local and wider road networks will be worsened by the growing problems likely to affect the road network over the next 30 years. If these issues are not addressed by not expanding capacity to meet demand, economic development aspirations outlined in the Auckland Plan are unlikely to be realised.

Considering the impact of future travel demands, if public transport capacity is not significantly increased, the development potential of the Airport and surrounding land will be severely restricted. Failure to address this issue would lead to deteriorating levels of service for people and freight in the area and will compromise the contributions of the Airport to the regional and national economies. This effectively limits the economic growth and development potential of south-west Auckland, the region and New Zealand as a whole.

[14] Auckland Airport Master Plan – Airport of the future, Auckland International Airport Limited, 2014
[15] Travel time surveys were undertaken by Jacobs over a four day period between 2 and 5 December 2014. Two trips were made simultaneously via each mode during the morning and evening 3-hour peak period in both directions.

Problem Statement 2: Unaffordable and inflexible planned transport investment constrains access to the Auckland Airport and surrounding business districts and Māngere-Ōtāhuhu area

There is a lack of connectivity and accessibility between local communities, labour markets and land uses in the south-west Auckland sub-region. In particular, transport options are limited for commuters accessing Auckland city centre, the Airport and the surrounding business areas.

The main purposes for trips to the Airport Business District include:

- Air freight;
- Commuter travel to areas of employment in the Airport Business District;
- Freight related to businesses located in the Airport Business District;
- Tourism; and
- Business travel to and from the Airport itself.

All of these trip purposes have different requirements with respect to travel time, mode, reliability and the value of each trip. Two main highways, SH20A and SH20B connect the Airport to the rest of the strategic transport network and there are currently no viable alternatives to road travel along these corridors to access to Airport. Currently, all of these trips must compete for a proportion of road space along these corridors and this roading capacity essentially limits the transport capacity to the Airport.

The Airport is constrained in terms of connections to the wider strategic transport network. Currently, 62,500 vehicles per day move to and from the Airport using SH20A and SH20B[16] and this volume is predicted to more than double to 158,000 vehicles per day by 2041[17]. The increase in travel demand to the Airport and surrounding areas is mainly driven by more businesses and houses in the area as well as the doubling of passengers flying into and out of the Airport over the next 10 years. With anticipated traffic volume growth, demand is expected to exceed the capacity of a 4 lane expressway in the next 5 – 10 years or a 4 lane motorway in the next 10 – 20 years[18].

The Airport is planning for substantial investment in their internal road network to accommodate these increases. Road based constraints are particularly important in the Airport context as 83% of all visitors used road-based transport modes to get to the International Airport terminal[19]. Upgrading the Kirkbride Intersection to a full interchange has commenced and is part of the first phase of improving access to the Airport. With the completion of the Waterview Connection, this will provide a continuous motorway link between the city centre and the Airport and provide travel time and reliability benefits in the short to medium term. The NZ Transport Agency has commenced a strategic case for investigating further road capacity improvements to the SH20B corridor.

Strategic modelling of volume to capacity ratios show that congestion issues will be experienced on most of Auckland's motorway network which indicates that road improvements alone will not provide sufficient capacity to the Airport in 2046. Demand on the northern approach to the Airport (along SH20A), is expected to exceed available capacity as shown in Figure 4.4 and Figure 4.5. This will result in severe congestion and traffic flow breakdown along a number of sections of these key access corridors.

16 State Highway Traffic Data Booklet 2014-2015, NZ Transport Agency, 2014
17 Demand forecast for 2041, Flow
18 South-western Multi-modal Airport Rapid Transit Interim SAR, GHD, December 2013
19 International Terminal Visitor Profiling, GHD, May 2012

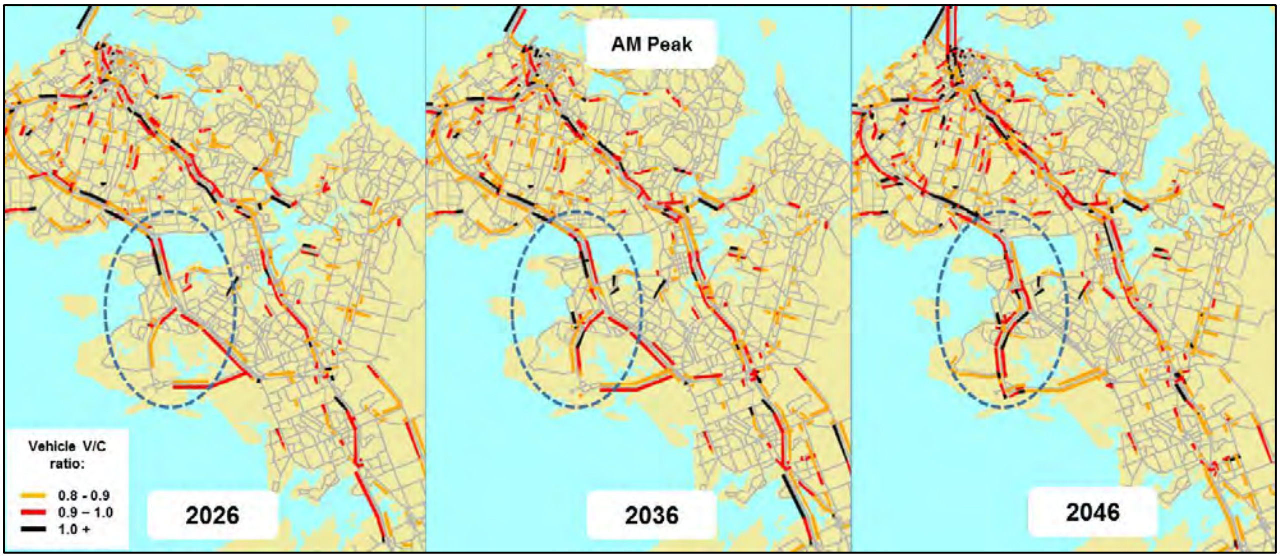


Figure 4.4 Volume-capacity ratio on the road network during the AM peak after upgrades[20]

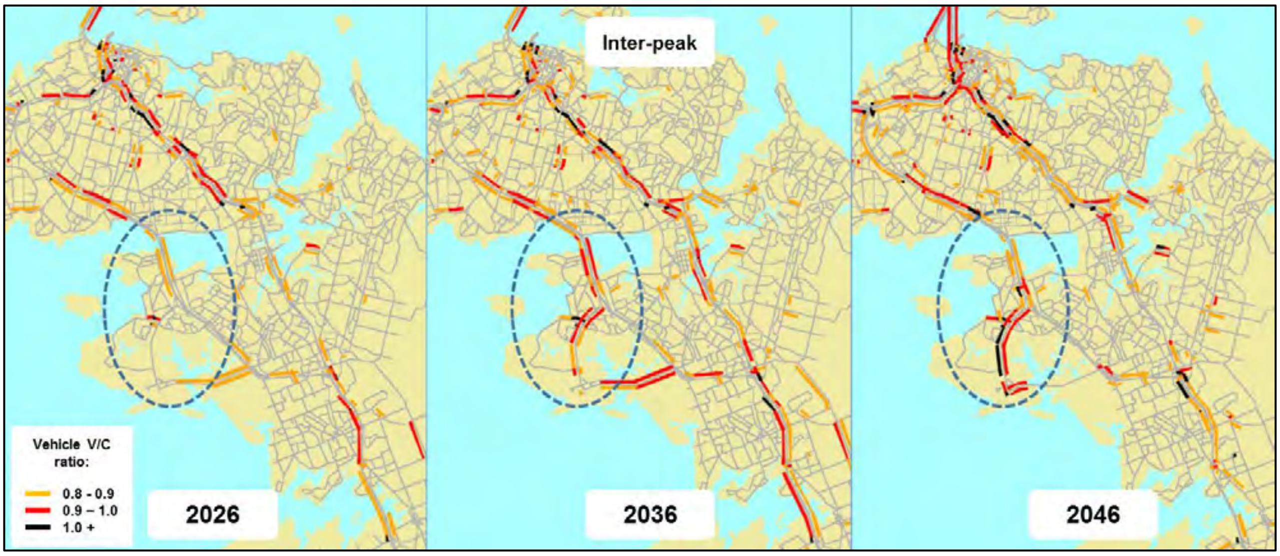


Figure 4.5 Volume-capacity ratio on the road network during the inter-peak after upgrades[21]

Public transport to the Airport and surrounding areas are limited, which encourages a high degree of car dependence. The nearest rail services are located on the Onehunga Branch Line (which terminates in Onehunga), to the north of the study area and along the North Island Main Trunk Line which is located several kilometres to the east of the Airport. Only one bus route (the 380 Airporter), currently serves the Airport and surrounding employment areas, operating between Manukau City Centre and Onehunga Train Station via Papatoetoe Train Station to the Airport. This service currently runs every 30 minutes during peak times and hourly during off-peak periods. This frequency will be increased to every 15 minutes between 7:00am and 7:00pm through the implementation of the New Network for South Auckland. Dedicated bus facilities are limited to bus lanes along some arterial roads and buses are required to run in general traffic along some sections. In addition, there is an absence of quality, connected walking and cycling facilities which discourages active modes as a viable form of transport.

[20] Foundation Report, Auckland Transport Alignment Project, February 2016
[21] Foundation Report, Auckland Transport Alignment Project, February 2016

Transport constraints and the effect of limited public transport services are evident in the most recent census data which shows that 70% of Māngere-Ōtāhuhu residents typically travel to work by private vehicle compared to 65% for the Auckland region (Figure 4.6 and Figure 4.7).

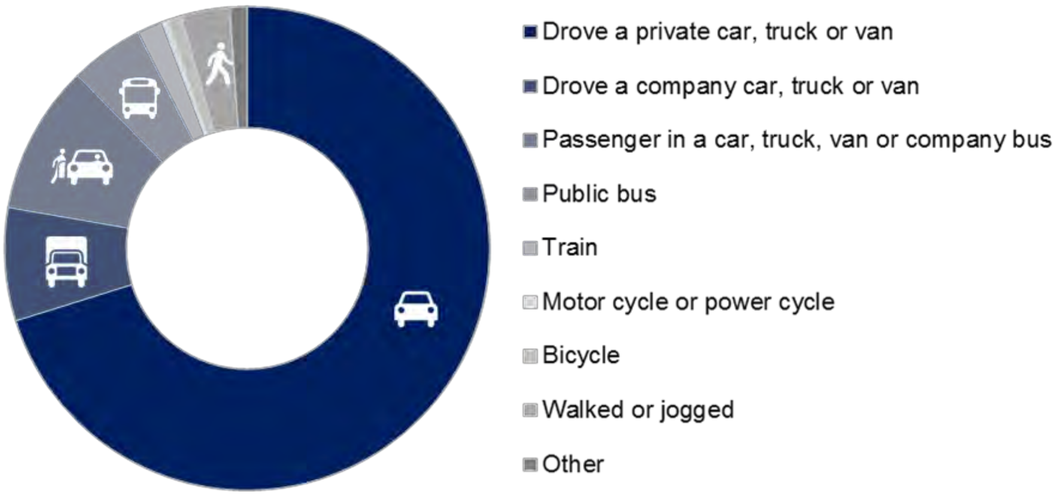


Figure 4.6 Main means of travel to work for the Māngere-Ōtāhuhu local board area[22]

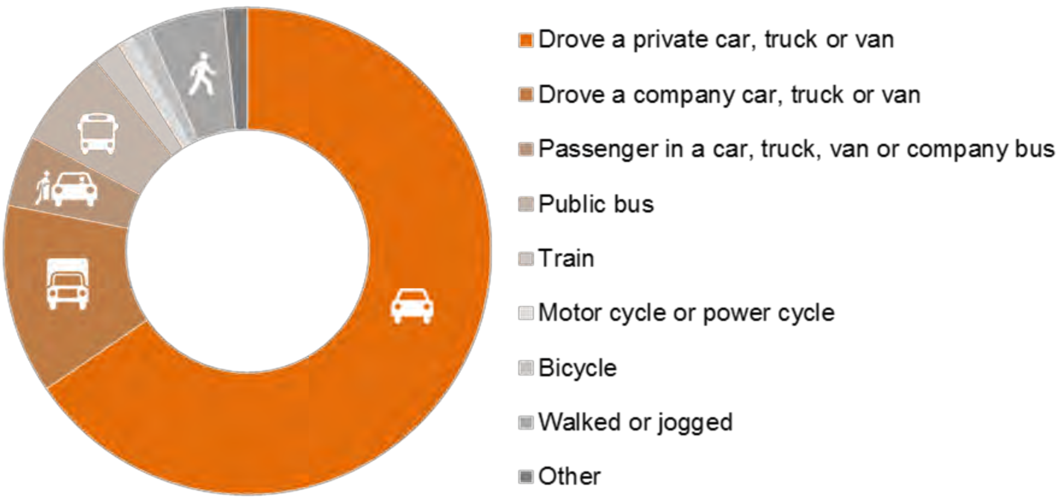


Figure 4.7 Main means of travel to work for the overall Auckland region[23]

For public transport to be a viable alternative to the private car, public transport needs to be affordable, flexible and convenient for people accessing the study area. 40% of surveyed respondents in the Māngere-Ōtāhuhu area do not perceive public transport to be affordable; 22% do not perceive public transport to be easily accessible; and 39% do not perceive public transport to be reliable[24].

The nature and type of employment within the study area also contributes to the high use of private vehicles. Shift work is common in south-west Auckland area as a large proportion of employment opportunities relate to hospitality, transport and logistics, industrial and manufacturing. This is shown in Figure 4.8 with a large number of surveyed employees arriving at the Airport early during the day and late during the evening; typically periods

[22] 2013 Census data for those who travelled to work for the Māngere-Ōtāhuhu local board area, Statistics New Zealand, 2013
[23] 2013 Census data for those who travelled to work the Auckland region, Statistics New Zealand, 2013
[24] Quality of Life Survey Report, Auckland Council, 2014

that are not well served by public transport. The misalignment of public transport operation times with shift work hours further limits the attractiveness of public transport as a mode of choice.

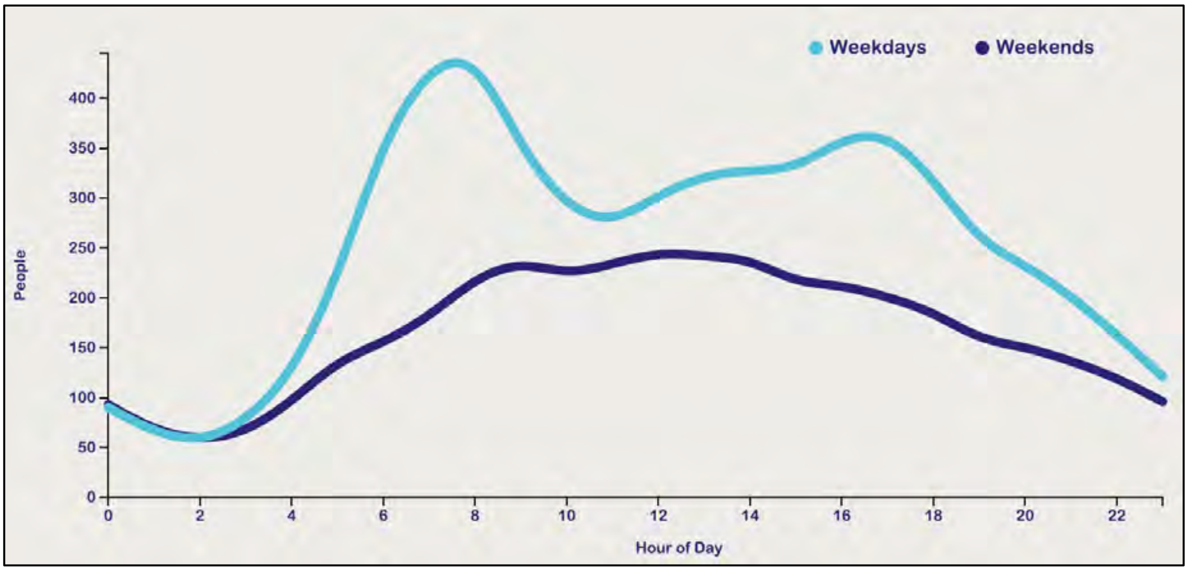


Figure 4.8 The average number of Airport workers arriving by hour[25]

Improving the person carrying capacity of key access corridors and improved public transport provisions will provide congestion relief by inducing greater public transport patronage, thereby freeing up capacity on the road network. This will result in greater capacity to deliver more people, more reliably, to high value employment that occurs in the Airport area.

Problem Statement 3: Limited accessibility and transport choice undermines liveability and economic prosperity for the Māngere-Ōtāhuhu area

Creating attractive, vibrant suburbs and an economically productive Auckland requires a comprehensive transport network that efficiently moves people and goods to and from the city centre and key employment hubs. Facilitating the movement of people without degrading the quality of the city centre, Airport or surrounding suburbs will improve the liveability and prosperity for south-west Auckland.

The 'Southern Initiative' is a geographic priority project identified in the Auckland Plan for the social, economic and physical regeneration of the Māngere-Ōtāhuhu, Otara-Papatoetoe, Manurewa and Papakura local board areas (Figure 4.9). The initiative focuses on improving educational achievement, economic development, employment growth, public transport, housing and social conditions.

The Auckland Plan identifies the Southern Initiative area as one with high social need, yet significant economic development potential. This is due to the opportunities that exist for industries requiring large sites for activities or require ease of access to the Airport. The Plan states that ongoing and coordinated efforts in the Southern Initiative area will realise the full development potential of the area and make the greatest difference to Auckland's and New Zealand's future well-being.

[25] Auckland Airport Traffic Analysis – workers, Qrious, July 2015. The data was obtained for February-May, 2015.

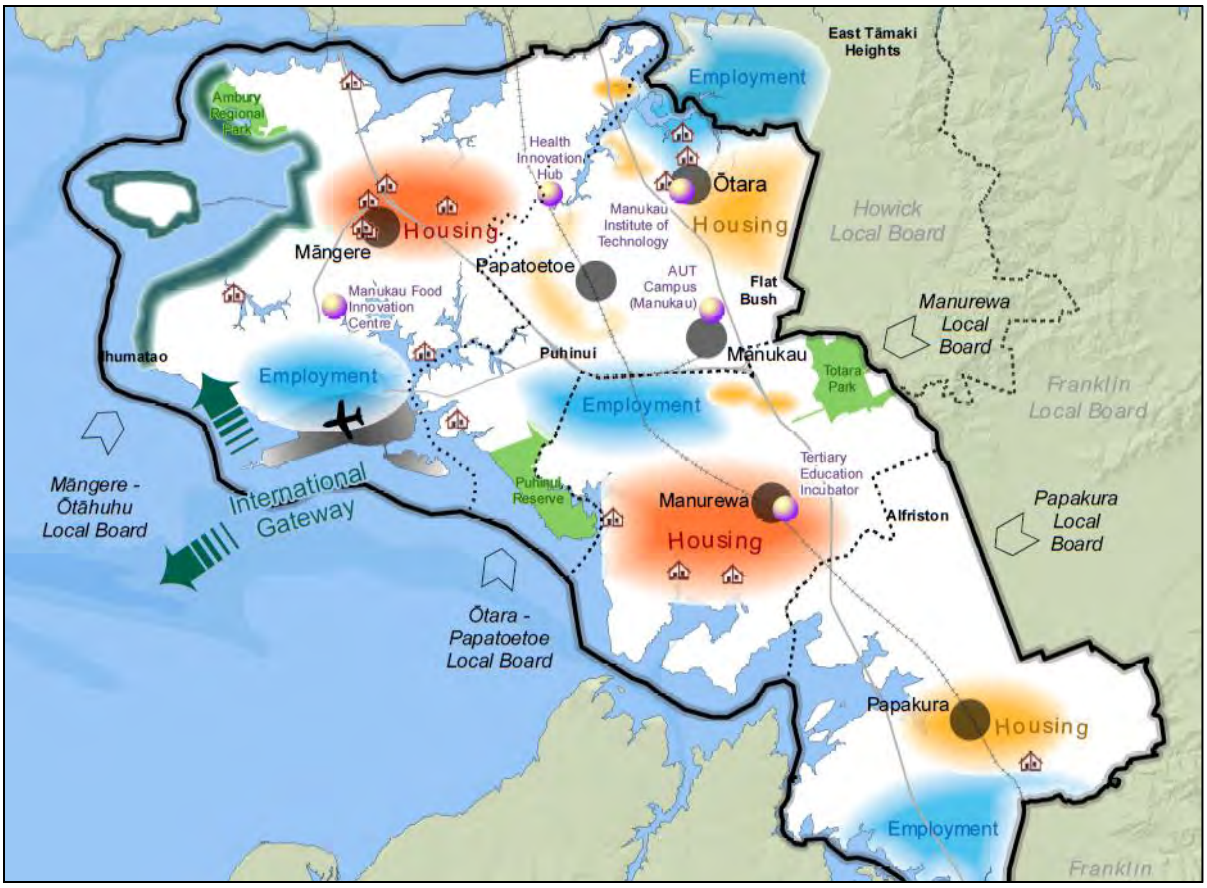


Figure 4.9 'Southern Initiative' area in South Auckland

The Southern Initiative area is characterised by a young, ethnically diverse population relative to Auckland's population as a whole. The area has a relatively low level of prosperity including lower incomes, lower car owner ship and higher rates of occupants per household. Despite the proximity to large employment areas such as Mount Wellington, Penrose, Onehunga and East Tamaki, the area has a low level of employment.

The population of adult residents who were employed in the Māngere-Ōtāhuhu area was 50% compared to 61.5% for the whole Auckland area[26]. The median income for adults in Māngere-Ōtāhuhu was $19,700 per annum which is significantly lower than the median for Auckland as a whole at $29,600 per annum[27]. This is clearly illustrated by the relative socioeconomic deprivation index (Figure 4.10) which indicates that 89% of Māngere-Ōtāhuhu residents experience the highest level of deprivation[28].

The high levels of unemployment in the Māngere-Ōtāhuhu area indicate that work opportunities for residents may be limited by a number of social factors such as level of education, access to job training and limitations on travel choice due to affordability. Approximately 11% of households in the Māngere-Ōtāhuhu area have no access to a car and are therefore dependent on access to public transport and non-motorised modes for commuting, social, educational and recreational trips[29]. A car is important for maintaining flexibility for jobs that are part time, involve shift-work or are in areas poorly served by public transport. The lack of a fast, reliable, low cost transport network significantly increases the cost of travelling to work for residents in the area and therefore may contribute to the high level of deprivation in the Māngere-Ōtāhuhu area.

[26] 2013 Census, Statistics New Zealand, 2013
[27] 2013 Census, Statistics New Zealand, 2013
[28] 2013 Census, Statistics New Zealand, 2013. Deprivation indices are derived from the 2013 Census data which takes into account income, communication, home ownership, employment, qualifications, support, living space and access to transport.
[29] 2013 Census, Statistics New Zealand, 2013

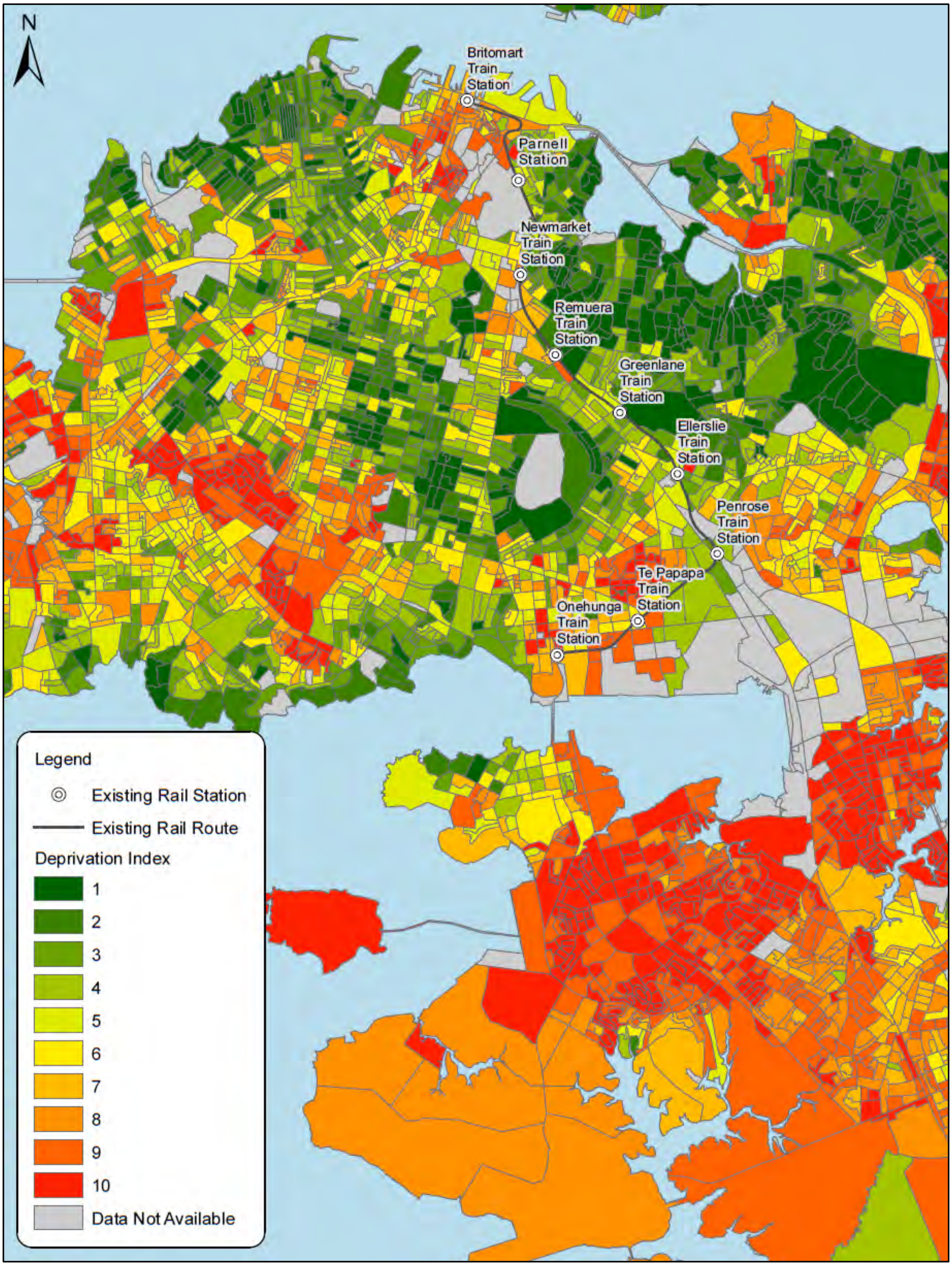


Figure 4.10 Socioeconomic deprivation index

This development potential is also shown by strong population and employment projections within the study area resulting from forecast changes in land use (Figure 4.11 and Table 4.1). This indicates a likely significant increase in demand for transport services to and from employment hubs in south-west Auckland.

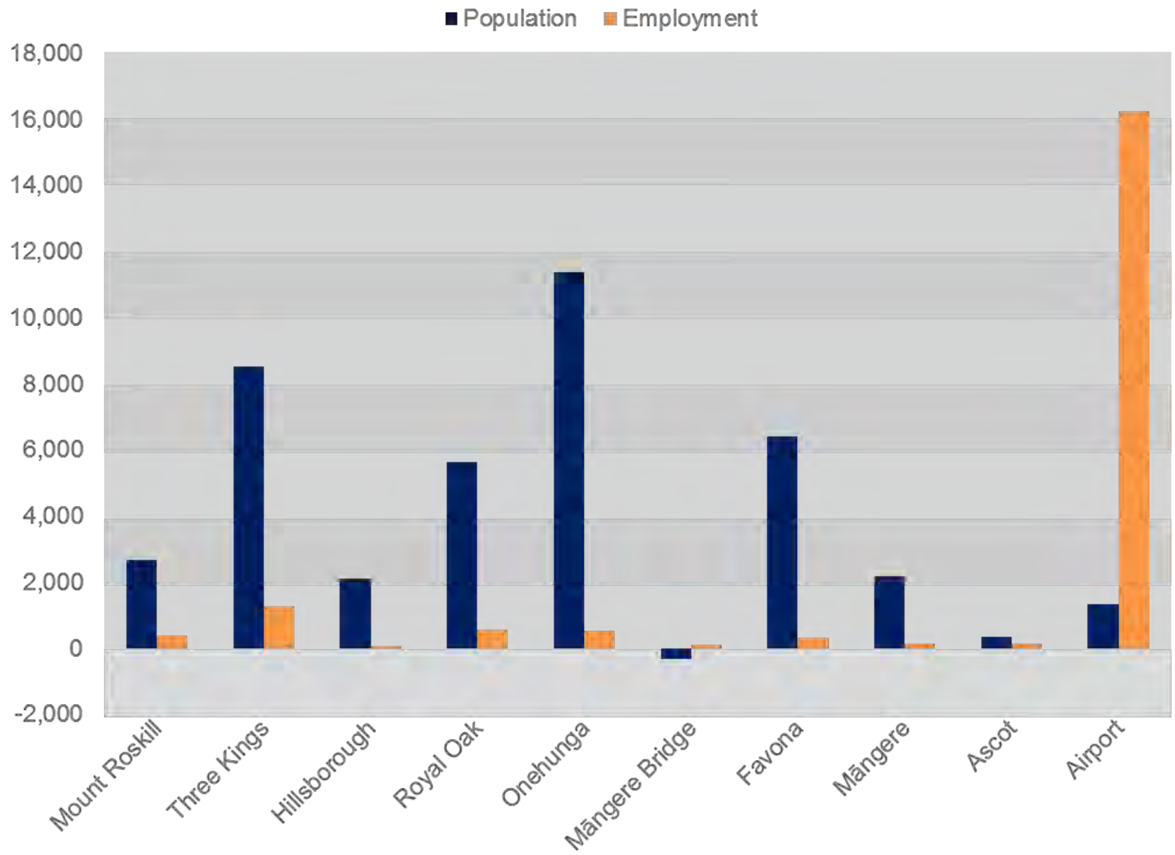


Figure 4.11 Forecast employment and population growth in zones within and around the study area corridor from 2016-2036[30]

Table 4.1 Forecast employment and population growth projections[31]

Zone		2016	2026	2036
Ascot	Population	265	395	520
	Employment	7,985	8,100	8,090
Auckland Airport	Population	480	940	1,385
	Employment	8,605	14,075	19,410
Total	Population	1,090	1,335	1,905
	Employment	16,590	22,175	27,500

Although considerable focus is placed on providing rapid transit to the Airport to serve visitors to Auckland, it was identified during Workshop 7 and from land use projections that the majority of patronage along the study corridor would actually be made up of commuters. Figure 4.12 clearly illustrates the strong existing relationship

[30] ART3 Scenario I9 Land Use Forecast, Auckland Council
[31] ART3 Scenario I9 Land Use Forecast, Auckland Council

between flows into Māngere South and employment at the Airport and the surrounding areas of employment. Because of the high expected volume of commuters, providing effective public transport links along this route between south-west Auckland, surrounding areas and the city centre would provide better access to employment opportunities available; improving the liveability and prosperity of the Māngere-Ōtāhuhu area.

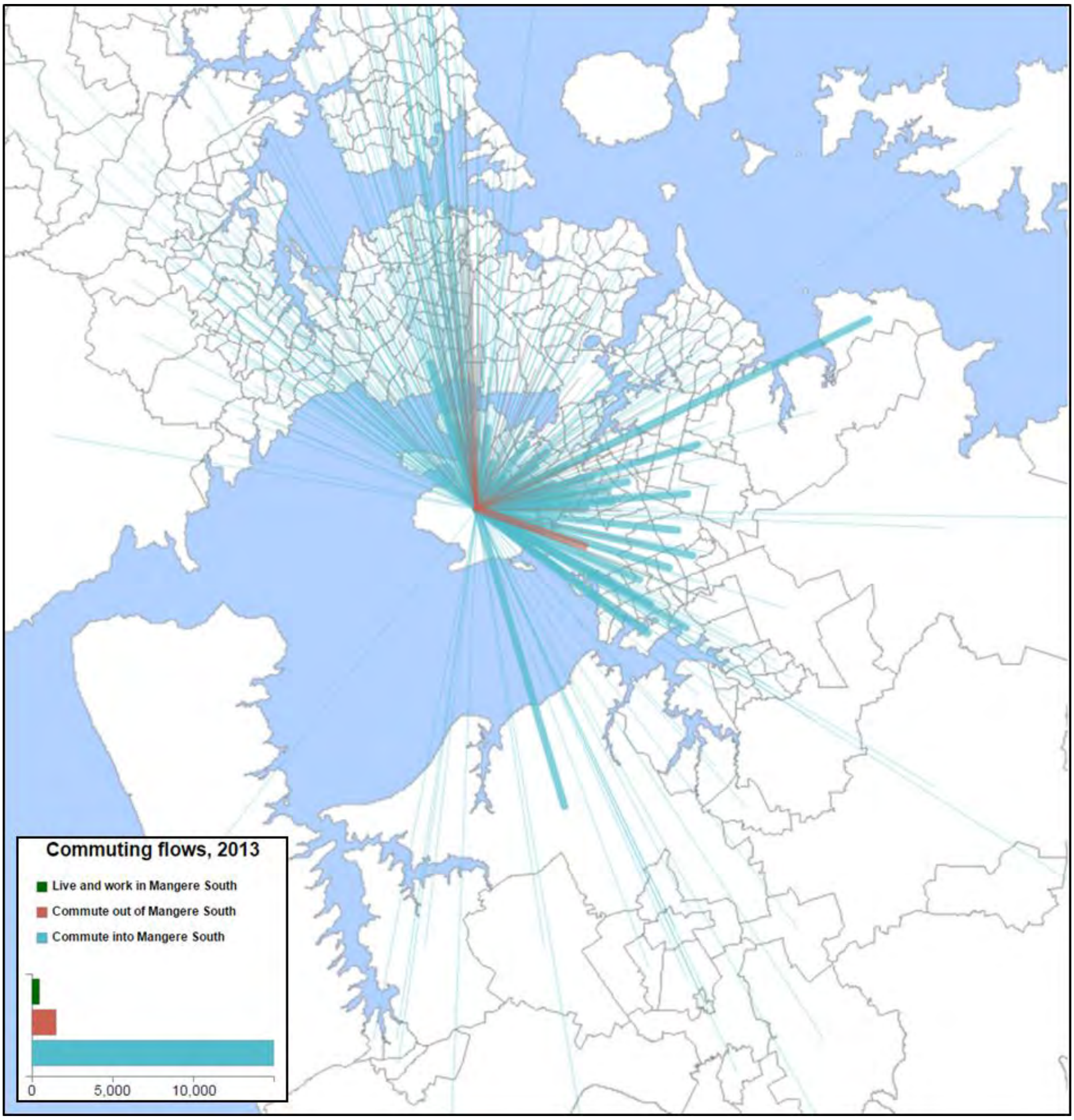


Figure 4.12 Commuting flows into and out of Māngere South in 2013[32]

If the issue relating to transport choice and accessibility for Māngere-Ōtāhuhu residents is not resolved, this will conflict with the key objectives of the Southern Initiative as documented in the Auckland Plan. This may limit accessibility to employment hubs and other opportunities proposed for the study area.

Addressing the problem relating to accessibility provides an opportunity to dramatically improve the quality of life and well-being of local residents and reduce growing disparities. It is likely that residential development would intensify around public transport stations and interchanges. The provision of a high quality public transport capacity connecting the city centre to the Airport has the potential to create higher social,

[32] Māngere South commuter view, Statistics New Zealand, 2013

environmental and land values in the area as movement becomes more concentrated and the costs of travel reduce.

4.3 Benefits of Investment

The benefits of investment include the following:

- Achieve desired economic growth in the SMART study area and wider Auckland region;
- Increased capacity and flexibility of the transport network;
- Auckland's transport network is able to move people and goods efficiently;
- Improved land access to and from the Airport and Airport Business District for people and freight;
- Ease of access to and from the Airport and Airport Business District;
- Increased access to a wider range of quality and affordable transport choices for the Māngere-Ōtāhuhu community;
- Enables improved liveability through better accessibility to work, life and play activities; and
- Enables growth in a way that supports communities and enables a high quality urban form.

5. Do Minimum Scenario

A 'Do Minimum' option (or base case), was included as a baseline for comparing the marginal costs and benefits of alternative heavy rail, light rail and bus rapid transit options. The Do Minimum represents the expected situation if none of the proposed options were implemented in the study area. It provides the benchmark for determining the relative marginal value for money added by other options under consideration.

The Do Minimum was developed with key stakeholder groups as part of Workshop 3. The Do Minimum has been further developed to be consistent with that used for the Central Access Strategy and is used as the base case for comparison against all options under consideration.

Subsequent to the assessment of options arising out of Workshop 3, the scope of SMART was extended to include consideration of BRT (bus) and BRT hybrid options as well as heavy rail and light rail (LRT) options. At the same time it was necessary to modify the base case to reflect parallel changes that had been made in LRT network planning. When the LRT network was first defined in CAS it considered LRT options for Manukau Road, Mt Eden Road, Dominion Road and Sandringham Road. Manukau Road and Dominion Road LRT were included in the original base case, as they had the highest patronage. However subsequent more detailed investigation of LRT options for the city centre as part of the following City Access Program (CAP) required changes to those assumptions. For bus operational and cost reasons it was concluded that LRT would first be built on Dominion Road and Sandringham Road, with other corridors not required until an unspecified later date. Therefore the base case LRT for SMART has been modified to include LRT on Dominion Road and Sandringham Road, but not Manukau Road.

5.1 Do Minimum Assumptions

The Do Minimum, which was agreed with key Auckland Transport stakeholders, consists of the following activities:

- City Rail Link (CRL) Do Minimum (ITP basic 100) projects. These projects essentially comprise the Long Term Plan transport networks from 2015 – 2025 which make up the constrained funding scenario as part of the ITP basic 100. They include a mixture of road and public transport projects and have been included as confirmed and funded works.
- Inclusion of CRL;
- Inclusion of the New Network bus service patterns. Implementation of these routes is in south Auckland is intended to commence in 2016;
- Inclusion of LRT from the City Centre to the SH20 / Dominion Road interchange. The route follows Queen Street, Ian McKinnon Drive and Dominion Road (Central Access Strategy Option 10A). This project forms a fundamental component of the light rail options as it will provide a direct, single seat (no transfer) journey between the airport and City Centre.
- Inclusion of LRT from the City Centre to Stoddard Road. The route branches from the Queen Street - Dominion Road LRT route at New North Road, and then follows Sandringham Road to Stoddard Road. This route supplements the Queen - Dominion LRT route to connect to bus routes from the western suburbs. It does not connect to any SMART option and does not affect SMART patronage or benefits. It is included in the base case for completeness to match the current scope of the City Access Program.
- Inclusion of Kirkbride Road grade separation and upgrading SH20A to motorway standard. This project, including the Montgomerie Road and Bader Drive improvements are currently being progressed by the NZ Transport Agency as a single project. These works are required to enable a light rail option to the airport and are being co-ordinated with the Transport Agency to provide adequate trench space to accommodate light rail. The NZ Transport Agency has advised that Bader Drive will not be closed as part of this project.
- Exclusion of Dominion Road Corridor Upgrade. This project, which comprised upgrades to the existing bus services, has essentially been replaced by the Central Access Strategy.
- Exclusion of the East West Connections (EWC) project. The project is a proposed new arterial connection between SH1 and SH20 on the northern side of the Manukau Harbour. It runs east-west between the

existing Onehunga station and SH20 Manukau Harbour Crossing Bridge. The traffic modelling effects related to EWC have not been included in the SMART base case.

The Interim SAR recommended the inclusion of a number of other projects as a Do Minimum to demonstrate the minimum recommended response to address congestion issues on the State Highway network:

- Improved linkage between SH20A and SH20B, for through traffic within airport property
- Provision of additional lanes on SH20B
- Improvements to the SH20 / SH20B interchange.

None of these projects are currently developed in any detail or included in the Do Minimum used for the CRL or the Central Access Strategy projects. Therefore for the purposes of this IBC they have not been included in the Do Minimum.

The land use scenario used for analysis is referred to as Scenario I version 9[33] which reflects the land use patterns consistent with the Proposed Auckland Unitary Plan and medium growth projections.

5.2 Implications of the Do Minimum

The activities included as part of the Do Minimum scenario are required and provide a number of benefits in the short term. However, it is clear that investment beyond the Do Minimum is required to meet the project objectives as defined by key performance indicators.

The Do Minimum is inconsistent with a number of project objectives and the underlying issue is that the scenario will not provide the required capacity to facilitate growth and development of south-west Auckland. The planned road improvement projects will not provide sufficient capacity for the demand to the Airport in the long term and constraints on the wider road network will make it difficult to expand capacity to meet forecast demands.

The Do Minimum includes the implementation of the New Network which involves more frequent bus services within the study area. However, this will not provide sufficient long term capacity with the forecast demand to the Airport and will not provide a single-seat rapid transport option from the city centre to the Airport.

The study area indicates strong population and employment growth forecasts and is already experiencing increased traffic congestion which will limit access to the Airport and surrounding business areas. Unless this issue is addressed, the growth and development opportunities within the study area are unlikely to be realised and accessibility to the Airport and city centre will be significantly reduced. The Airport is the gateway for the majority of New Zealand's international visitors and plays a vital economic role for the nation. Reduced accessibility to the Airport and surrounding businesses will impact on the economic wellbeing of New Zealand as a whole.

South-west Auckland has potential for development being a key catchment for the Airport and local employment. The Do Minimum will not significantly improve accessibility to the city centre in the long term and will not significantly improve the liveability and prosperity of the study area which will impact on the success of the Southern Initiative.

The range of quality transport options for visitors arriving or departing from the Airport is limited which is considered to detract from their first and last experience of the county during their visit. This detracts from the attractiveness of Auckland as a wold city which is of concern for a city competing on the global stage.

[33] The Interim IBC adopted Scenario I version 8b land use, employment and population projections for analysis.

6. Long List Option Identification and Evaluation

This section describes the method in which heavy rail, light rail and BRT options were identified. This section provides an overview of the recommendations of previous studies and studies occurring in parallel to the SMART project. It discusses how these studies have impacted the identification and development of potential options for SMART.

The infrastructure requirements for heavy rail, light rail and BRT are significantly different; therefore it was appropriate to adopt a different option identification process for each mode. The recommendations of a number of previous studies were incorporated into the identification and development of options.

6.1 Assumptions

In addition to the Do Minimum assumptions, the assumptions presented in Table 6.1 were used to inform the identification and development of options.

Table 6.1 Option specific assumptions

Assumption	Heavy rail	Light rail		Bus rapid transit
		2026 scenario	2046 scenario	
Vehicle type	3 car electric motor unit (EMU)	33 m light rail vehicle (LRV)	66m light rail vehicle (LRV)	(no double deck buses)
Capacity per vehicle (seated)	450 (240 seated)	210 (80 seated)	420 (160 seated)	60 (50 seated)
Service frequency	10 minute (6 trains/hour)	10 minute (6 LRVs/hour)	10 minute (6 LRVs/hour)	2 minute (30 veh/hour)
Line capacity (per direction)	2,700 passengers/hour	1,200 passenger/hour	2,500 passengers/hour	1,800 passengers/hour

6.2 Heavy Rail

The infrastructure requirements of heavy rail are significant relative to LRT and BRT alternatives, often requiring wide trenches, bridges, and considerable land take due to corridor cross section, stop sizing and geometric requirements. Accommodating these requirements is made increasingly difficult as a heavy rail corridor designation to the Airport has not been preserved and this effectively limits the number of feasible heavy rail alignment options to the Airport.

Phase 2 of the study performed a robust assessment of potential heavy rail alignments and arrived at a technically preferred alignment which was agreed on by Auckland Transport. This preferred heavy rail alignment option was further developed and then carried forward to the shortlist due to the large amount of analysis which has already been undertaken. Therefore, a long list of options was not developed or evaluated for the purposes of the SMART IBC.

It was identified early on in the SMART Interim SAR study that heavy rail would be the most expensive option with a low level of economic efficiency compared to other mass transit options. A recommendation of the SAR was that the preferred alignment would require further development to reduce costs and optimise benefits.

Three key studies were undertaken to developing the SAR preferred heavy rail alignment which included:

- Onehunga Branch Line Investigations[34];
- SMART Value Engineering Options Report[35]; and
- SH20A Kirkbride Road Grade Separation Report[36].

Further value engineering work undertaken by Jacobs refined the preferred alignment along the SH20/20A corridor (between the Manukau Harbour crossing and the Airport), to reduce impacts to surrounding land uses and minimise land requirements through design[37]. A number of potential options were developed with stakeholders to reduce property acquisition and an option was identified as the preferred of the shortlisted options. The preferred value engineering option involved reducing the cross section of the corridor and elevating the alignment south of Moyle Park. This allowed the rail corridor to be positioned predominantly within the existing motorway designation. This had significant cost savings in the order of $180 million compared to the alignment proposed by the Interim SAR.

Jacobs was then commissioned to assess the implications of providing an elevated rail structure along the median of the motorway and how this would affect the proposed design of the SH20A upgrade and Kirkbride Road grade separation project. This study further developed the heavy rail option which was identified as the preferred option by the SMART Value Engineering study. The motorway grades of the Kirkbride trench at 4.6% were too steep to accommodate heavy rail. The SH20A Kirkbride Road Grade Separation study assessed the feasibility and implications of futureproofing the SH20A upgrade to accommodate for an elevated rail structure in the motorway median. As an outcome of the assessment, it was recommended that a minimum 4m wide median was to be provided along SH20A and north of the Kirkbride Road interchange. The SH20A alignment runs in a trench below ground level and the Kirkbride Road Overbridge crosses the SH20A trench at existing ground level. By providing a 4m wide median along SH20A, the proposed heavy rail alignment is then able to run directly above SH20A and Kirkbride Road. An artist's impression of the alignment as it passes over the new Kirkbride interchange is shown in Figure 6.1.

[34] Onehunga Branch Line Investigations Summary Report, Jacobs, April 2014
[35] SMART Value Engineering Options Report, Jacobs, June 2014
[36] SH20A Kirkbride Road Grade Separation Report, Jacobs, July 2014
[37] SMART Value Engineering Options Report, Jacobs, June 2014

Figure 6.1 Heavy rail alignment elevated above SH20A

The heavy rail alignment remained elevated within the SH20A corridor south of Kirkbride Road until the approach to the Airport land near Verissimo Drive where the rail alignment passes out of the motorway corridor to follow an initial alignment provided by the Airport where it transitioned into a below ground structure.

The Interim SAR assumed that the preferred heavy rail alignment could tie into the rail network at Onehunga; however it was identified that the existing Onehunga Branch Line would need double tracking to provide additional capacity. The Onehunga Branch Line Investigations study estimated the cost of upgrading and double tracking the Onehunga Branch Line between Onehunga and Penrose (where it connects to the North Island Main Trunk line), and provided an understanding of the issues associated with grade separating existing level crossings along the line. This alignment provides a single seat journey from the Airport to the city centre. Three alternatives were considered which included running the rail alignment in a trench, elevating the rail alignment and realignment via Mt. Smart.

The preferred heavy rail alignment to progress to the shortlist is shown in Figure 6.2 and is summarised as follows:

1. **OBL**: double tracked along the existing corridor from Penrose to the Onehunga Station. Rail corridor is lowered to facilitate the level crossings. Onehunga Station relocated to Princess Street, with heavy rail the elevated to pass over the East West Connections proposed alignment.

2. **Manukau Harbour Crossing:** It passes east to west beneath the existing Manukau Harbour Bridge on a new structure before landing on the southern side of the Manukau Harbour to the north of Crawford Avenue;

3. **SH20 corridor:** the alignment continues south from the Manukau Harbour Crossing on the western side of SH20 (passing beneath Rimu Road), until Hall Avenue;

4. **SH20A corridor:** the alignment continues south from Hall Avenue before heading west to follow SH20A. The rail alignment is elevated from south of Moyle Park and follows the median of SH20A. The alignment passes above Bader Drive and the Kirkbride Road Overbridge on an elevated structure;

5. **Airport:** the alignment remains on an elevated structure within the SH20A corridor, then diverges from the SH20A corridor eastwards near Verissimo Drive transitioning to a below ground alignment and passes underneath the proposed second runway in the Airport's land holding before heading west along Tom Pearce Drive to the Airport terminal.

Figure 6.2 Preferred heavy rail alignment to proceed to the short list

6.3 Light Rail

Light rail vehicles have greater acceleration and deceleration than heavy rail due to the smaller and lighter vehicles and are able to traverse steeper grades and tighter geometric alignments. Light rail has a large urban renewal potential due to the perception that light rail is quieter and cleaner. Increased employment and increased property value has been attributed to the proximity to light rail corridors in a number of cases around the world.

Light rail was discarded as a potential option during Phase 1 of the previous study as it did not provide a single seat journey[38]. Since Phase 1, an investigation of implementing light rail along key corridors in the central isthmus has been undertaken as part of the Auckland Light Rail Transit (ALRT) project and the Central Access Strategy (CAS). The corridors include Sandringham Road, Dominion Road, Mt. Eden Road and Manukau Road, converging into two spines in the city entre along Queen Street and Symonds Street. The Queen Street spine is made up of the Sandringham Road and Dominion Road lines and the Symonds Street spine is fed by the Mt. Eden Road and Manukau Road lines.

The ALRT investigation has identified that the Queen Street spine (consisting of the Dominion Road and Sandringham Road feeder lines), needs to be implemented first. Symonds Street is Auckland's busiest bus corridor and there are no practical options to redistribute buses during construction[39]. In addition, Dominion Road is expected to reach bus corridor capacity in 2019 (shortly followed by Sandringham Road), based on current projections.

Light rail is considerably less constrained than heavy rail from a geometric design perspective and has reduced cross section and stop size requirements. Due to this flexibility, nine potential light rail alignment options were identified as part of the long list which was presented in the Interim Business Case in 2015.

To develop the long list options, it was assumed that the SMART light rail alignment would connect to the Dominion Road light rail line proposed by the Central Access Strategy to provide a single-seat journey from the city centre to the Airport. The long list of nine LRT route options connecting to the proposed Central Access Strategy alignments are shown in Figure 6.3 and include the following:

- Options connecting the end of Dominion Road to Auckland Airport were developed using the most direct road and rail corridors available (Options 1 and 2);
- An option connected to the alternative alignment proposed by the Central Access Strategy at the end of Manukau Road (Option 3);
- Hybrid options ran along SH20 for speed and arterial roads in Māngere for local access (Options 4 and 5);
- A direct route included provisions for a new bridge across the Manukau Harbour (Option 6);
- High local accessibility options were deviated further into Māngere and Onehunga (Options 7 and 8); and
- An option was added to connect to Dominion Road via Mount Albert and Mount Smart Roads (Option 9).

The options were initially developed based on a constraints map which included existing land use, cultural heritage and environmental heritage restrictions. A preliminary, high-level engineering assessment of constraints was undertaken which included cost factors such as bridges across Manukau Harbour.

[38] South Western Airport Multi-Modal Corridor Project – Phase 1 Summary Report, GHD, September 2011
[39] Light Rail Transit Backgrounder – Stages 1-3, Auckland Transport

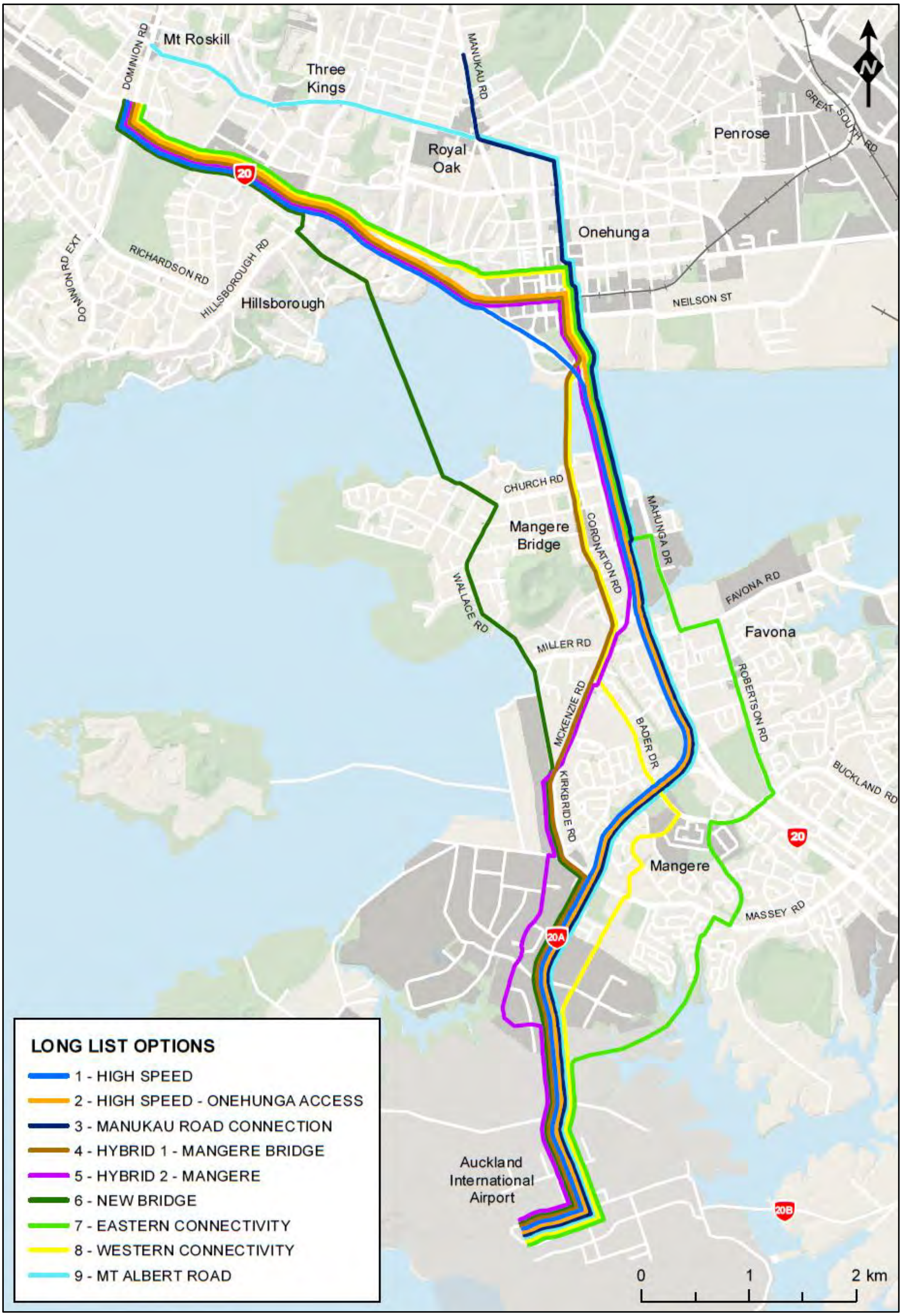


Figure 6.3 Long list light rail alignment options

The long list options were evaluated during Workshop 4 and the evaluation process identified the options which demonstrate, at a high level, measurable benefits over the Do Minimum. The evaluation process also identified the options which could be discarded because they did not adequately meet the project objectives or show measurable benefits over the Do Minimum. A summary of the high level assessment of the long list options is shown in Table 6.2.

Table 6.2 Evaluation of light rail long list options

Option	Benefits	Disadvantages	Comments
Do Minimum			
Option 1	Provides the fastest and most direct access to the Airport and Airport Business District	Lack of interchange at Onehunga may result in lower patronage compared to other options. Poor integration with the adjacent network and is therefore likely to attract fewer passengers than other options.	This option has not been progressed further due to poor integration with the wider transport network.
Option 2	Fast option. The interchange is likely to increase patronage compared to Option 1. This provides the shortest travel time to the Airport of the long list options. Long ballasted section would reduce costs.	Alignment runs along Gloucester Park which is identified as an outstanding natural feature. Potentially significant cultural and environmental issues.	Highest ranked option from the Long List Evaluation workshop.
Option 3	Fast option with an interchange at Onehunga which is likely to increase patronage. Very similar to Option 3 but connects to Manukau Road rather than Dominion Road. Lower consenting risk as can mostly be contained within the road reserve..	Overall travel time from the city centre is greater than for Option 2 due to length of street running. Longer street running sections are likely to increase the overall cost.	Second highest ranked option from workshop. Relies on the connection of the Central Access Strategy to Manukau Road.
Option 4	Utilises existing Māngere Bridge. Passes a good catchment of residential activity.	Slower than other options and is therefore less likely to attract patronage compared to other options. Passes more residential properties and increases the likelihood of issues relating to property access, noise and visual amenity.	This option delivers slower travel times than the Do Minimum option and is therefore not likely to attract sufficient patronage. This option has not been considered further in this assessment.
Option 5	Utilises existing Māngere Bridge. Passes good residential and commercial catchment.	Slower than Option 4 due to longer street running section.	This option results in longer travel times than the Do Minimum and is therefore not likely to attract adequate patronage. This option has not been considered for further assessment.
Option 6	Most direct alignment to the Airport.	New bridge across Manukau Harbour would significantly increase risks	This option has significant potential risk and will likely have a low

			associated with cost, environmental, consenting and implementation. Slow compared to other options.	patronage. This option has not been considered for further assessment.
	Option 7	Passes through a good residential catchment.	Slow – significantly longer travel time than existing modes is likely to attract insufficient patronage.	This option is not likely to attract enough patronage to be an economically viable option. It has not been considered for further assessment.
	Option 8	Passes through a good residential catchment.	Slow – significantly longer travel time than existing modes is likely to attract insufficient patronage.	This option is not likely to attract enough patronage to be an economically viable option. It has not been considered for further assessment.
	Option 9	Passes through a good residential catchment. Increase the level of accessibility from the Isthmus to the city centre.	Relatively slow compared to some options due to long section of street running. Passes a number of dwellings which may cause issues with property access and noise.	

Options 2, 3 and 9 were ranked the highest of the long list options and were further developed to inform the preferred light rail option. More detailed investigations were undertaken relating to the following:

- Refinement of the alignments to better fit within the existing road reserve where possible;
- Land take requirements from adjacent properties;
- Improvements to the location and design of interchanges;
- Stations locations were refined;
- The ability to provide dedicated cycle facilities was considered; and
- The ability to provide park and ride facilities was considered.

Option 2 (which connects to the proposed Dominion Road line), was identified by key stakeholder groups as the preferred light rail option during Workshop 5. Option 2 is shown in Figure 6.4 and was progressed to the shortlist.

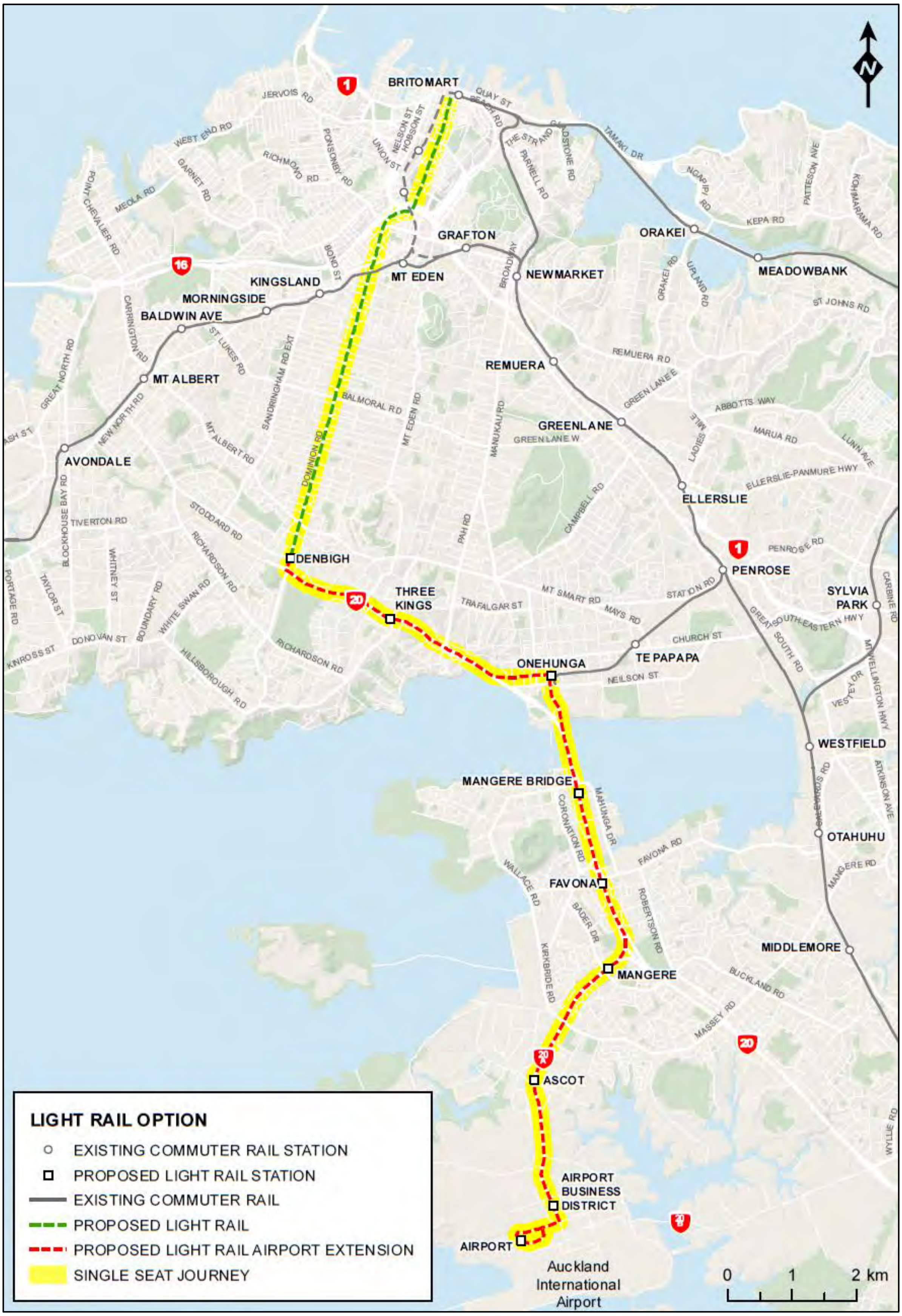


Figure 6.4 Preferred light rail option to proceed to the shortlist

6.4 Bus Rapid Transit

The Central Access Strategy (CAS) was drawn on to identify the BRT long list options. Potential alignments were focussed on arterial corridors with sufficient space for required infrastructure and with the potential to provide the most impact in terms of additional capacity and improved access.

A number of key corridors providing access to the city centre were considered and daily boardings were used to determine the corridors with the most demand for travel by public transport. It was identified that the two major public transport access points to the city centre are the Eden Terrace and Newmarket/Grafton areas. Figure 6.5 shows the daily boardings for main corridors within the Auckland isthmus.

As part of developing the CAS, the corridors were assessed to determine whether they would undergo further option development. The findings are summarised in Table 6.3.

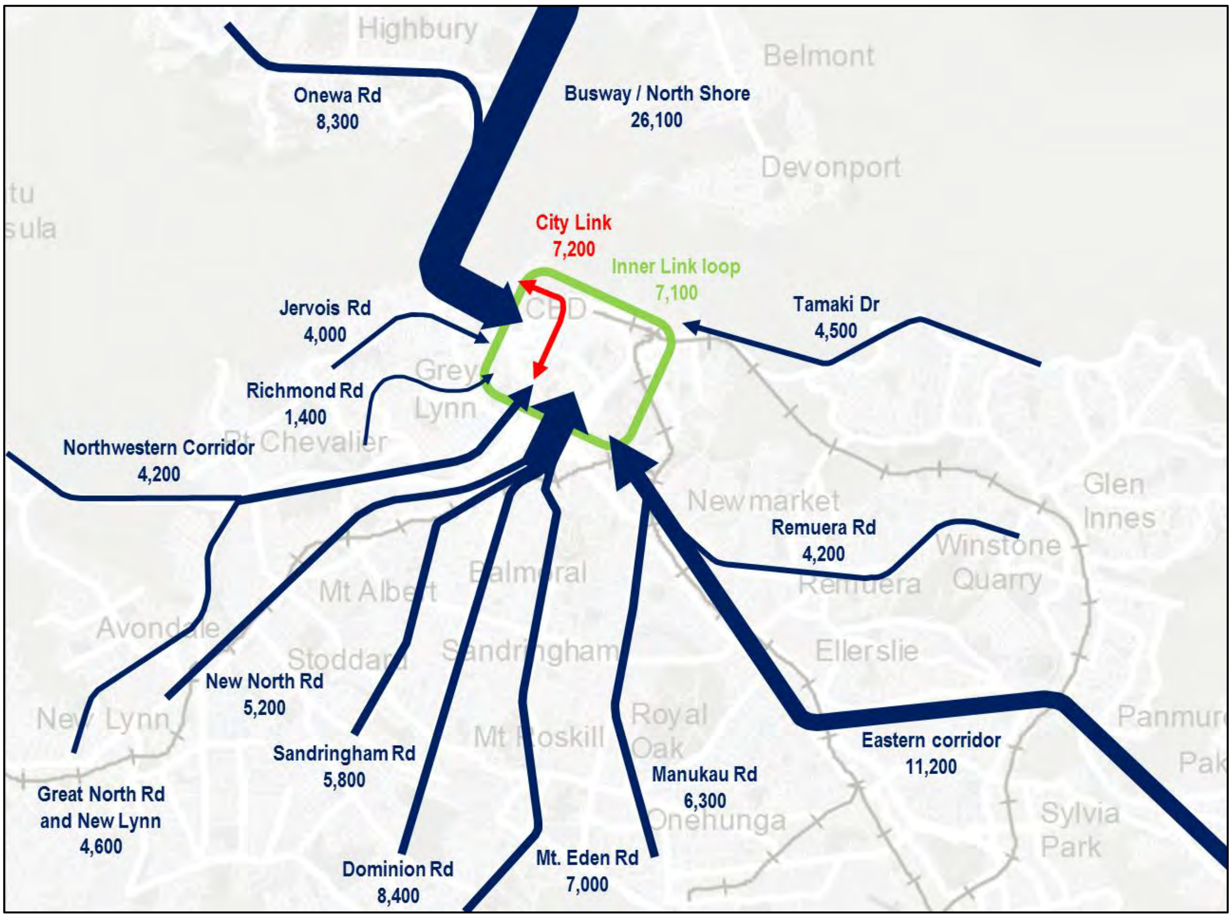


Figure 6.5 Daily bus boardings in both directions (updated in March 2015)[40]

Table 6.3 Preliminary assessment of major corridors in the Auckland isthmus[41]

Corridor	Patronage	Forecast demand	Bus volumes	Comments
Jervois Road	Low	Low	Low	Excluded

[40] Central Access Strategy, Auckland Transport, September 2015
[41] Central Access Strategy, Auckland Transport, September 2015

Richmond Road	Very low	Very low	Low	Excluded
New North Road	Medium	Medium	Medium	Excluded
Sandringham Road	Medium	High	High	Included
Dominion Road	High	High	High	Included
Mt. Eden Road	Medium	Medium	Medium	Included
Manukau Road	High	High	High	Included
Great South Road	High	High	High	Excluded
Remuera Road	Low	Medium	Medium	Included
Tamaki Drive	Low	Low	Low	Excluded

Despite having high patronage, forecast demand and bus volumes, some corridors were excluded on the basis that these corridors would be optimised through the implementation of the CRL and associated improvements. The Strategy identified a preferred option which involved implementing light rail along the Sandringham Road, Dominion Road, Mt. Eden Road and Manukau Road corridors. These four corridors are the most relevant to the SMART project in the context of providing access to the Airport.

Although buses can run along existing road corridors and can utilise bus lanes and shoulders, BRT systems have larger infrastructure and spatial requirements than LRT at stops. BRT requires more space to allow buses to pass, for bus layover and bus turnaround.

BRT alignments along Mt. Eden Road and Sandringham Road were excluded from the longlist due to the spatial constraints of the corridors and the likely consentability issues, therefore only alignments utilising Dominion Road and Manukau Road were evaluated as part of the long list. Long list options were developed for the city centre through to the isthmus and then from the isthmus to the Airport.

Five long list options were developed for the alignment between the Airport and the isthmus (as shown in Figure 6.6), which included:

- Option 1 – Dominion Road busway;
- Option 2 – Dominion Road bus lanes;
- Option 3 – Manukau Road busway;
- Option 4 – Manukau Road bus lanes;
- Option 5 – Manukau Road / SH1 hybrid busway;

Four long list alignment options were developed for the city centre (Figure 6.7), which included:

- CBD option 1 – Queen Street bus lanes;
- CBD option 2 – Symonds Street bus lanes;

- CBD option 3 – Wellesley Street through to the North Shore via Carlton Gore Road / Ian McKinnon Drive linking routes; and

- CBD option 3A – Wellesley Street through to the North Shore via Khyber Pass Road.

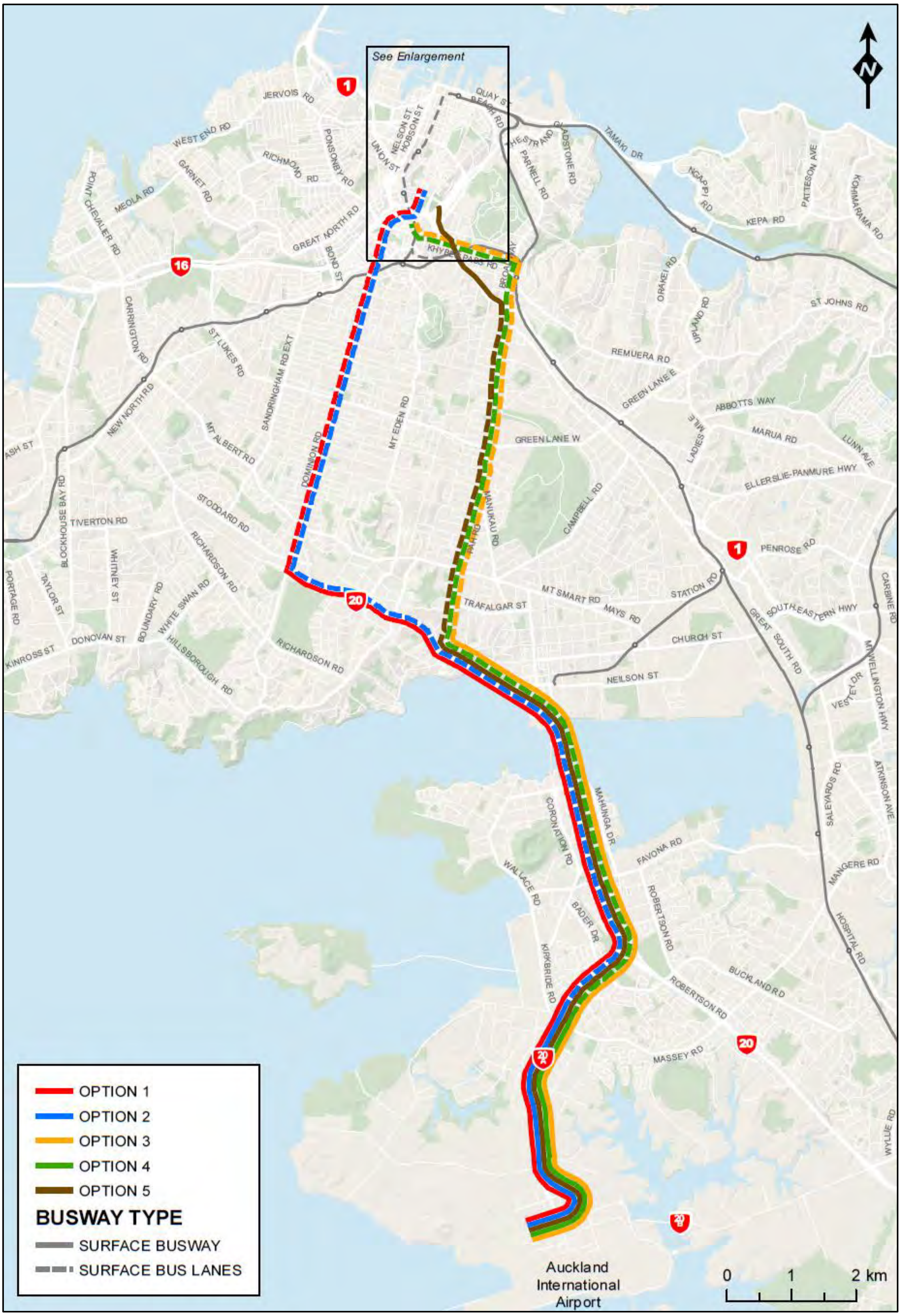


Figure 6.6 Long list BRT alignment options from the Airport to the isthmus

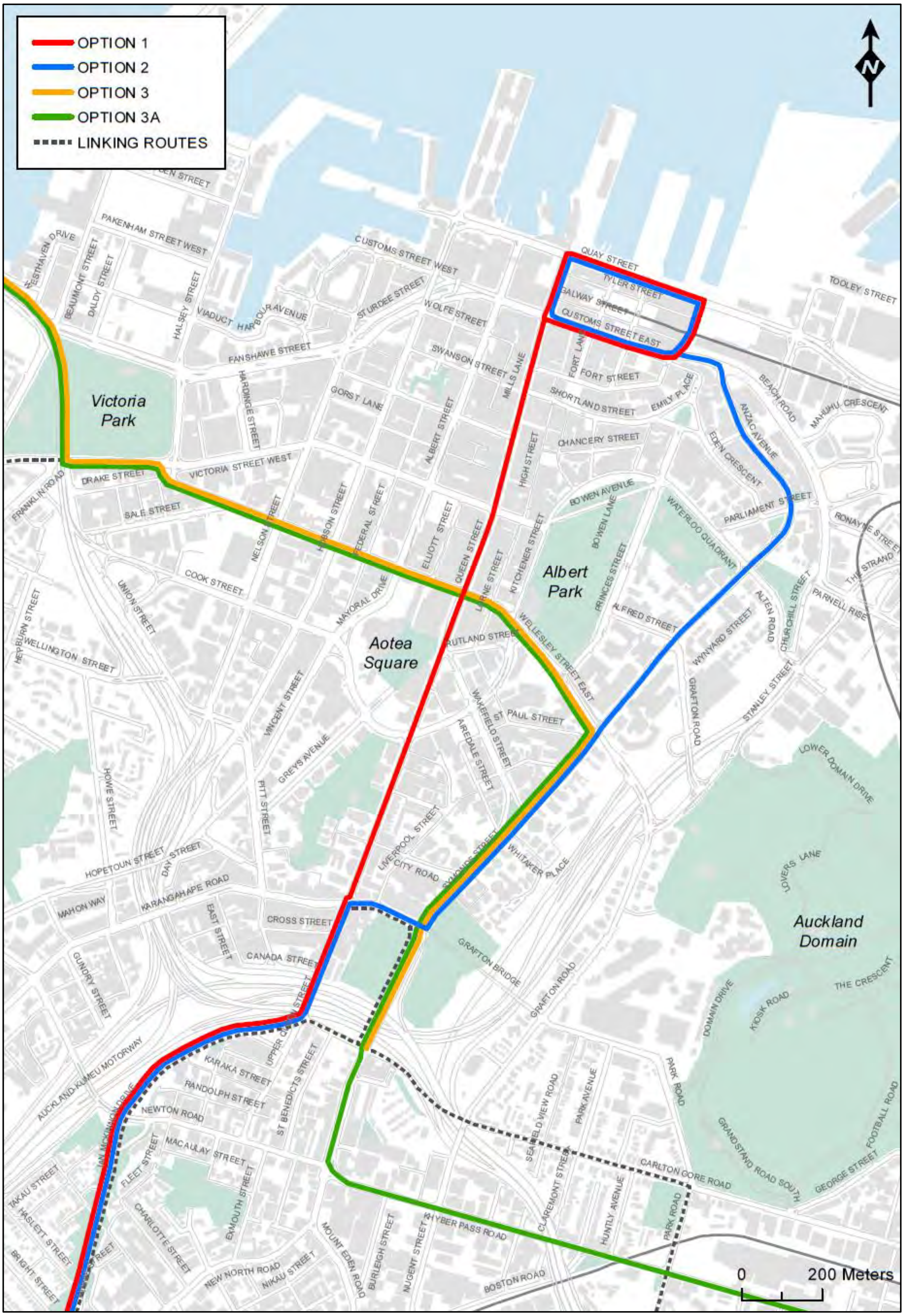


Figure 6.7 Long list BRT options in the city centre

Since the Central Access Strategy, the City Access Plan (CAP) Indicative Business Case has been undertaken in parallel with the SMART project. The CAP IBC involves the investigation of BRT options for the Dominion Road and Sandringham Road lines which are also the subject of investigation for the ALRT project. This excluded Dominion Road and Sandringham Road from being considered for a BRT alignment option as part of the SMART project to avoid running two rapid transit alignments along the same corridor. Therefore, only the Manukau Road alignment was carried forward to the shortlist as the preferred BRT option.

BRT option 4 (busway along SH20A and SH20 and bus lanes across the Manukau Harbour and along Manukau Road), as shown in Figure 6.6 was the preferred option between the Airport and the isthmus. Option 3A along Khyber Pass Road, Symonds Street and Wellesley Street (see Figure 6.7), was the preferred of the long list city centre alignments. The overall preferred BRT option from the city centre to the Airport is referred to as BRT Option 4 from hereon.

6.5 Hybrid BRT / Heavy Rail

Following the refinement of the preferred heavy rail and bus options, a hybrid option was also developed as a low cost alternative to a busway option along Manukau Road. This was made up of the preferred BRT option to connect the Airport with the Onehunga Train Station and the double tracking of the OBL to Penrose, consistent with the heavy rail option. This option retains the Airbus Express service from the city centre to the Airport to achieve the single seat journey requirement for passengers travelling to and from these locations.

Figure 6.8 outlines the option identification and process used to determine the shortlist options to be taken forward for further investigation and refinement in the shortlisting and assessment process.

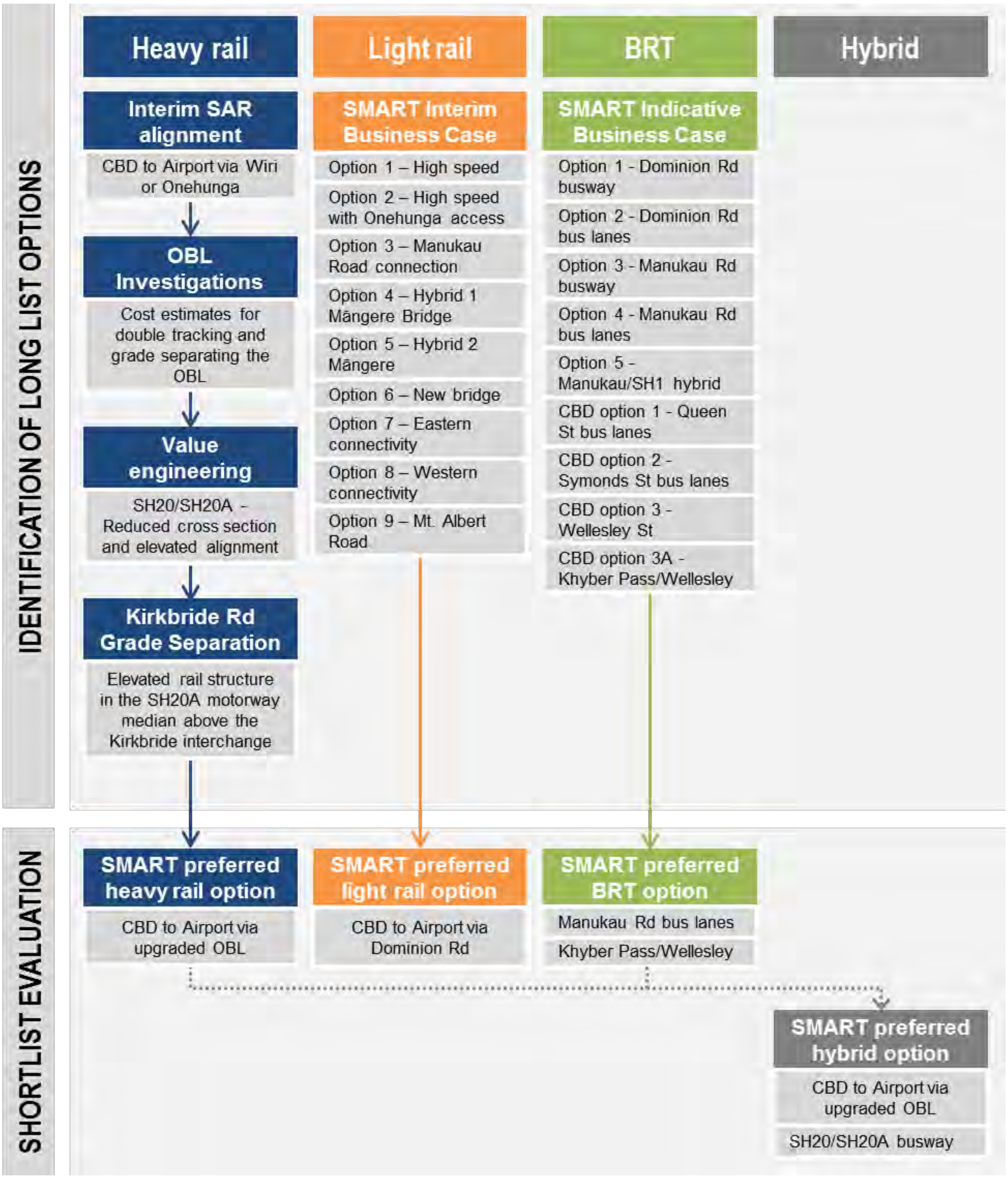


Figure 6.8 SMART option identification process

7. Short List Options and Development

This section describes the assessment of the shortlisted options for heavy rail, light rail, BRT and hybrid BRT / heavy rail. This process informed the identification of a preferred option to carry forward to the DBC phase for further investigation.

As detailed in section 6, the evaluation of the long list options for heavy rail, light rail and bus rapid transit identified the following shortlisted options:

- Heavy rail option VEN 7;
- Light rail option 2;
- Bus rapid transit option 4; and
- Hybrid BRT / heavy rail.

The following sections set out how the shortlisted options for heavy rail, light rail and BRT were developed through more detailed design and analysis.

7.1 Heavy Rail Option

As discussed in section 6.2, the shortlisted heavy rail option is similar to the preferred alignment identified in the Interim SAR. Since the Interim SAR and the Interim Business Case, the preferred heavy rail option has been refined to align with the confirmed Airport Master Plan local road network upgrades[42], the East-West Connections alignment and specialist inputs. The preferred heavy rail alignment option was developed with key stakeholder representatives during Workshops 6 and 7. The discussions, outcomes and actions resulting from these workshops are summarised and attached in Appendix H and Appendix I.

The following sections outline the further analysis and development of the shortlisted heavy rail option (VEN 7) that was undertaken.

7.1.1 Onehunga Branch Line

The preferred heavy rail alignment was developed based on the Onehunga Branch Line Investigations study[43] which investigated the cost of extending and double tracking the existing single track Onehunga Branch Line (OBL). The OBL must be double tracked in order to operate services at a 10 minute frequency to align with the train schedule over the wider network with the implementation of the City Rail Link.

The assumptions of the previous OBL study were revisited during Workshop 6. A key assumption of the initial OBL double tracking investigation was that of the eight existing level crossings, four along the line were to be grade separated, and four closed, given the increased safety risks associated with more train services. No specific policies are currently in place for the treatment of level crossings therefore further investigations may be required to justify the need for grade separating existing level crossings. It was confirmed that each level crossing needs to be assessed on a case by case basis (due to the different road and surrounding land uses), and that the justification for closures will be undertaken as a group assessment or local traffic model to achieve a holistic solution.

As agreed in Workshop 6 and following concerns regarding the high cost of upgrading this section of the track, a low cost option was developed for double tracking the OBL. This involved closing two of the existing crossings with the remaining crossings receiving full barriers, CCTV or active pedestrian gate treatments as an alternative to grade separation. This significantly decreased the overall cost compared to the option which involved closing

[42] Local road network upgrade plans were provided by Auckland International Airport Limited, following *Workshop 7 - Airport Alignment Challenge*.
[43] Onehunga Branch Line Investigations Study – Summary Report, Jacobs, April 2014

or grade separating all level crossings. As a result, it was decided that two scenarios would be considered as part of the shortlisted heavy rail option:

- 'High cost option' - preferred heavy rail alignment with grade separation/closures; and
- 'Low cost option' - preferred heavy rail alignment with no grade separation (full barriers, CCTV, pedestrian gates).

The comparison of the two scenarios was undertaken to understand a range of costs and benefit cost ratios. Should the low cost option (in conjunction with the heavy rail costs at the Airport), reasonably compare with the light rail, BRT and hybrid option costs, further review of grade separation requirements for this corridor will be needed.

There is a significant risk that the low cost option may not be acceptable in terms of safety. It should be noted that an Australian Level Crossing Assessment Model (ALCAM) risk assessment needs to be undertaken for each of the level crossings. The findings from the risk assessment will indicate the change in risk profile associated with the Onehunga Branch Line duplication. This changed risk profile should be supported by safety policy to create clear guidance on when grade separation is required.

If heavy rail is to be developed further or if the OBL is upgraded independent of the outcome of SMART (i.e. for land development purposes), it is recommended that an ALCAM assessment is undertaken if level crossings are to remain with double tracking or an increased service frequency.

7.1.2 Airport

Further work was focused within the Airport land. Four alternative alignments for the shortlisted heavy rail option within the Airport environment were presented at Workshop 7 which included the following:

- Option HR1;
- Option HR2;
- Option HR3; and
- Option HR4.

The Airport alignment alternatives are shown in Figure 7.1.

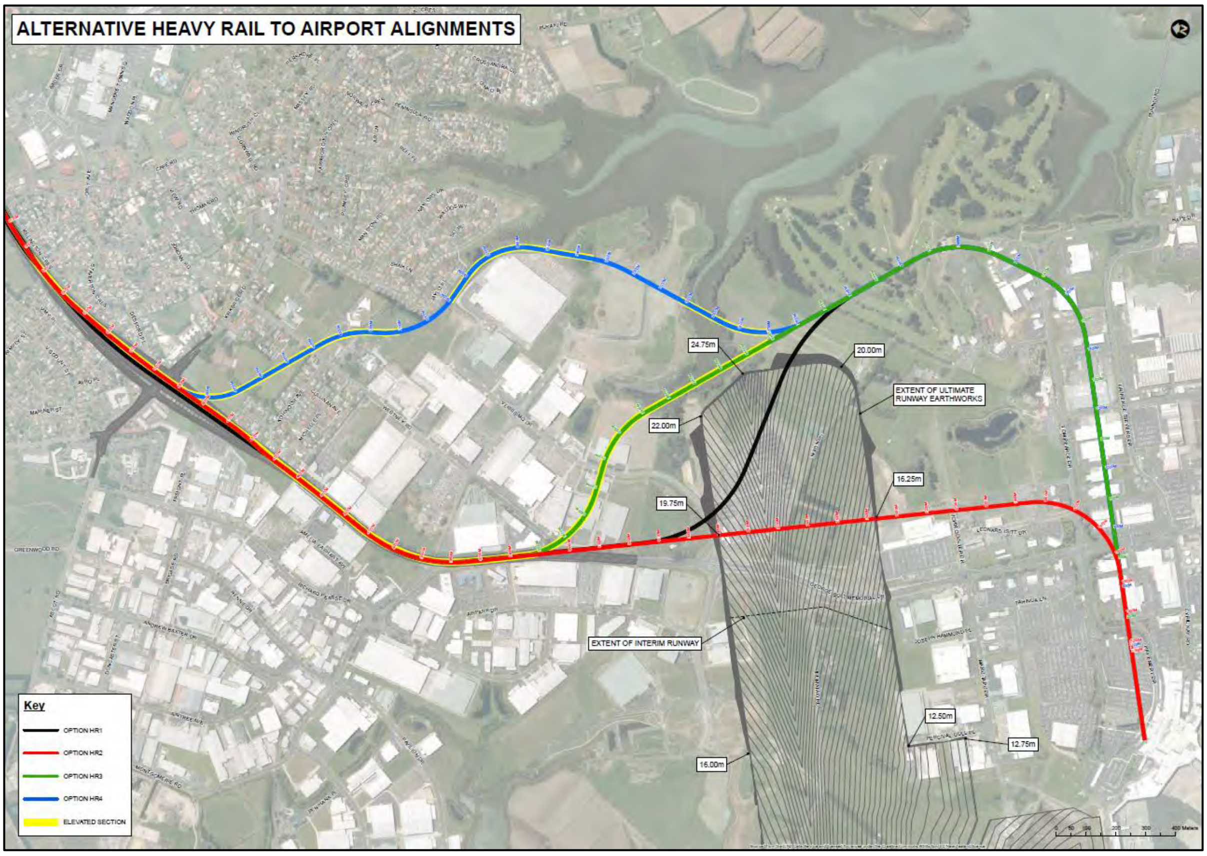


Figure 7.1 Alignment sub-options within the Airport environment for the shortlisted heavy rail option

The four heavy rail alignment options discussed at the workshop provide underground Airport access and all would require an underground station near the Airport terminal. The heavy rail alignments approach the Airport environment on an elevated structure along the centre of SH20A, and passes above the Kirkbride Road interchange. The design of the Kirkbride Road interchange and the vertical profile used for the mainline motorway (gradients of approximately 4.6%), does not enable heavy rail to run at grade through this section.

Option HR1 was the initial alignment which was based on early information provided by the Airport. This option assumed that alignment could be constructed using cut and cover methodologies. It can be seen that the alignment intrudes on the zone reserved for the full future runway extension. It was noted during the workshop that the alignment was based on early information and that the Airport's approach to a potential rail alignment has since progressed.

Option HR2 was developed to provide a more direct connection to the Airport terminal, passing beneath the future second runway extension. To achieve this, SH20A requires separation of the northbound and southbound carriageways in the vicinity of Montgomerie Road to enable the heavy rail to transition from being on structure to below ground. The widening of SH20A will require purchase of adjacent commercial / industrial property.

Options HR3 and HR4 were developed to demonstrate alternative options that could avoid the future second runway extension. It was considered that these alignments could be developed using a combination of elevated structure, at grade and tunnelled sections.

It was agreed by key stakeholder representatives that the preferred of the alignments within the Airport environment was Option HR2 and that this would form part of the overall preferred option for heavy rail within the SMART IBC. Due to the progressive development of the Airport land over time, construction of the heavy rail alignment would need to adopt a tunnel boring methodology. Cut and cover tunnel construction was or constructing the alignment at grade was not considered feasible or acceptable.

It was assumed and agreed that the tunnel configuration would be twin parallel tunnels, approximately 7 m in diameter with allowances for emergency cross passages and surface egress shafts. The minimum depth, or cover, to the tunnel crown below the ground surface should be at least the diameter of the tunnel. Challenging ground conditions within the Airport present a significant risk for tunnelling and will inform the tunnelling methodology.

A sealed (watertight) station 'box' structure will need to be constructed underneath the Airport terminal and it was confirmed that construction will adopt a top down cut and cover methodology with diaphragm walls. The approximate dimensions of the station box would be a minimum of 300 m x 50 m to provide for station platforms, tunnel and station ventilation and emergency egress, train storage, turning facilities, crossovers on the station approach and other rail services.

For these heavy rail alignment options to be feasible, it was confirmed that the proposed Airport Station box would need to be built prior to the tunnel construction, and at the same time as the terminal upgrades. If the station box is unable to be built first or if issues regarding staging with the terminal upgrades cannot be resolved, this will effectively preclude heavy rail options that require an underground terminus station. This is noted as a significant risk for the heavy rail option.

The additional underground station located near John Goulter Drive provides a higher level of accessibility and is consistent with a station provided at this location for the light rail option. This additional station would provide access for 1,065 people employed within an 800 m catchment in 2046 with the forecasted growth in the Airport Business District[44].

The Option 2 alignment (see Figure 7.1), has been selected as the preferred heavy rail option within the Airport for the purposes of this IBC assessment. An additional heavy rail alignment was presented by the Airport during the workshop which had been developed to integrate with the road layout as proposed by the Masterplan. If heavy rail is considered further, additional investigation is recommended for the Option 2 alignment and the additional Masterplan alignment within the Airport environment to select a preferred alignment within the Airport land.

The Masterplan alignment generally follows the proposed SH20A alignment and passes under the north-west corner of the new runway in a tunnel through to the terminal as shown in Figure 7.2. Option 2 includes a stop located in the vicinity of John Goulter Drive (which would potentially serve the Airport Business District), whereas the Masterplan alignment does not present an opportunity for a second stop within the Airport. Further investigations would involve assessing the impact on cost, travel time implications and the ability of stop locations to better serve the proposed Airport developments.

[44] ART3 Scenario I9 Land Use Forecast, Auckland Council

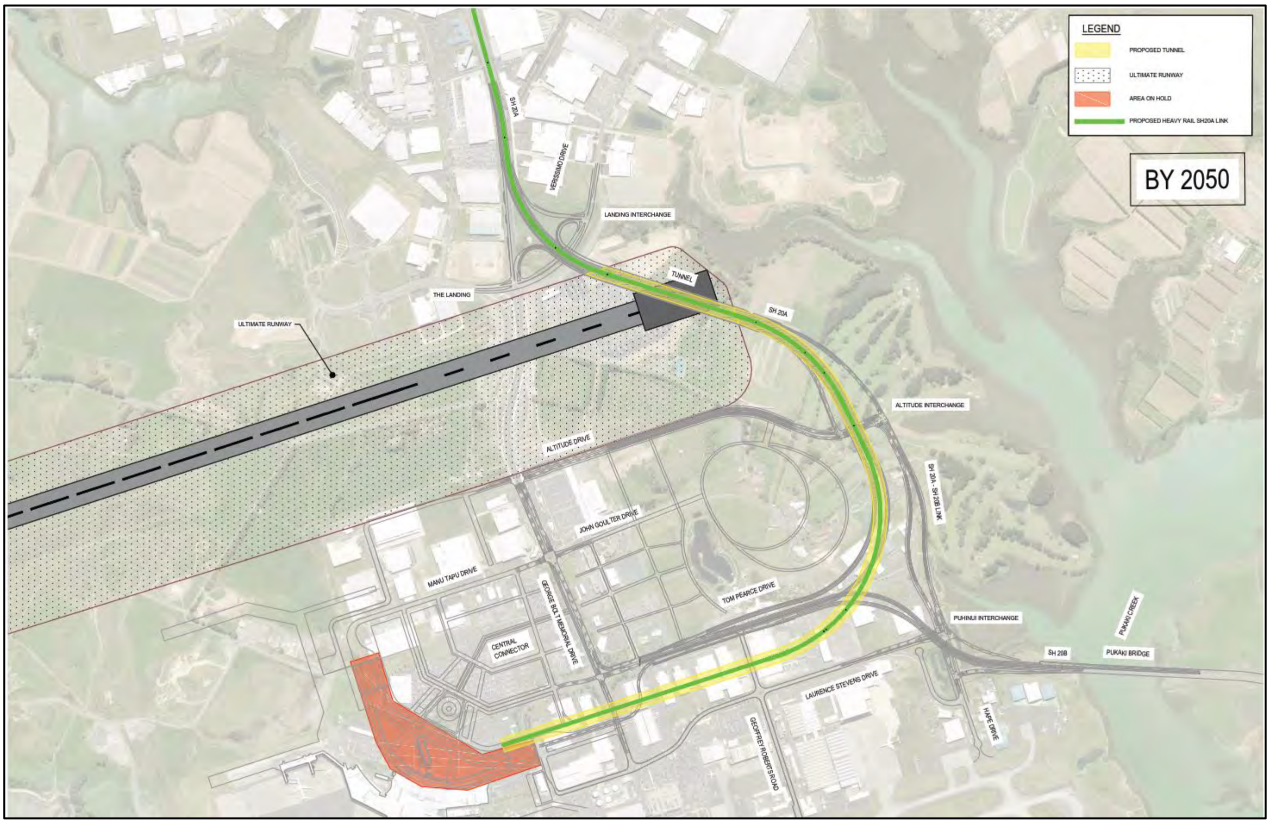


Figure 7.2 Heavy rail alignment proposed by the Airport to integrate with the Masterplan

Incorporating these developments, the preferred heavy rail alignment and proposed stops are shown in Figure 7.3. General arrangement plans of the preferred heavy rail alignment option are included in Appendix B.

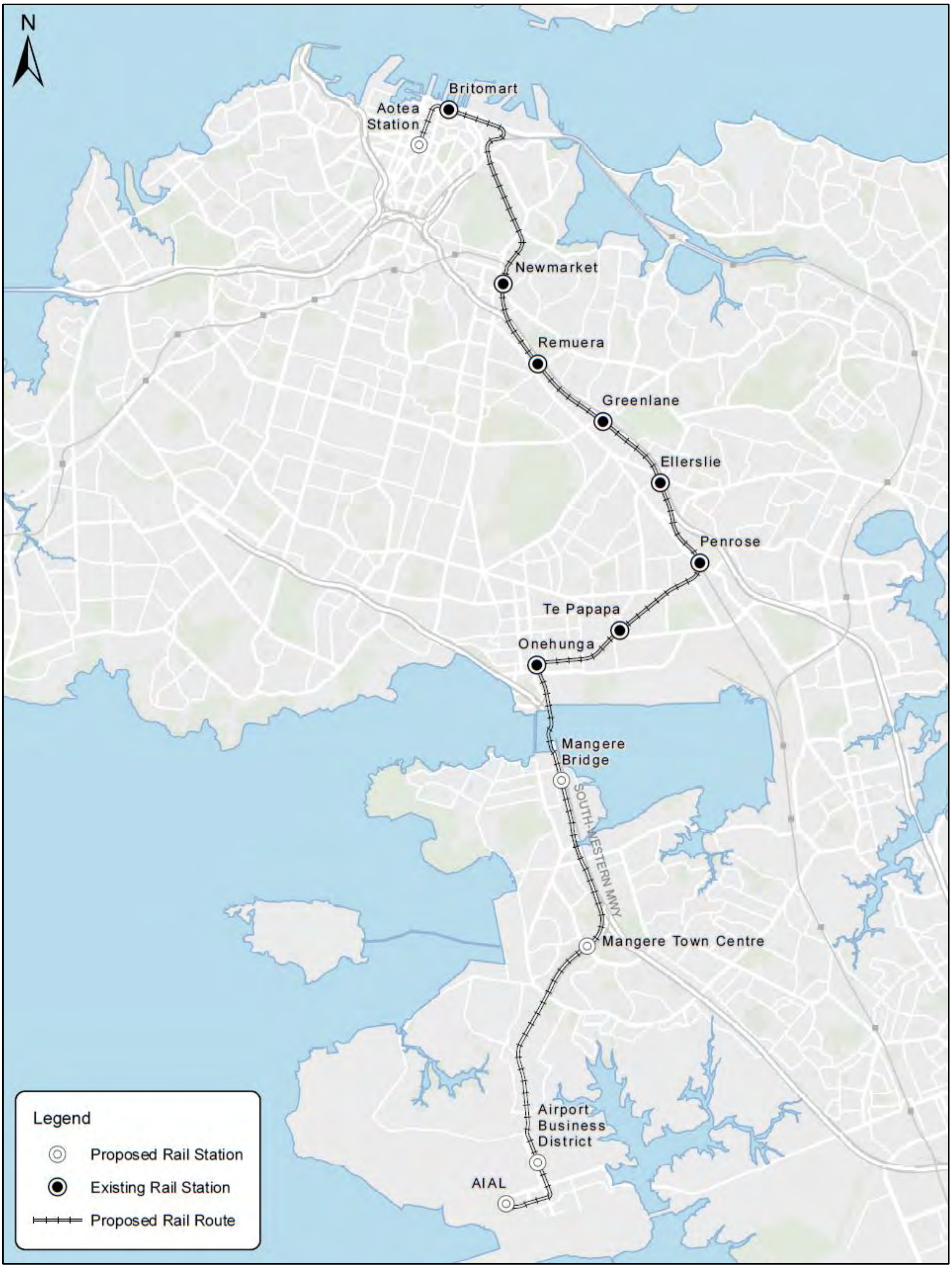


Figure 7.3 Preferred heavy rail alignment option to be included in the shortlist assessment

7.2 Light Rail

The refinement of the preferred LRT option alignment was mainly focused within the Airport and was undertaken with key stakeholders during Workshop 6.

Representatives from the Airport provided a potential future light rail alignment through the Airport which aligned with their recently confirmed Masterplan and future road layout as shown in Figure 7.4. This potential alignment proposes to retain light rail within the centre of the SH20A corridor which continues on through the proposed Landing Interchange and then beneath the north east corner of the proposed future runway extension. The alignment then passes over the future road network on a structure and then returns to being at grade along the north side of John Goulter Drive before connecting to the new Airport terminal. Two stations are proposed within the Airport land; one station at grade in the vicinity of John Goulter Drive and one elevated station at the terminal.

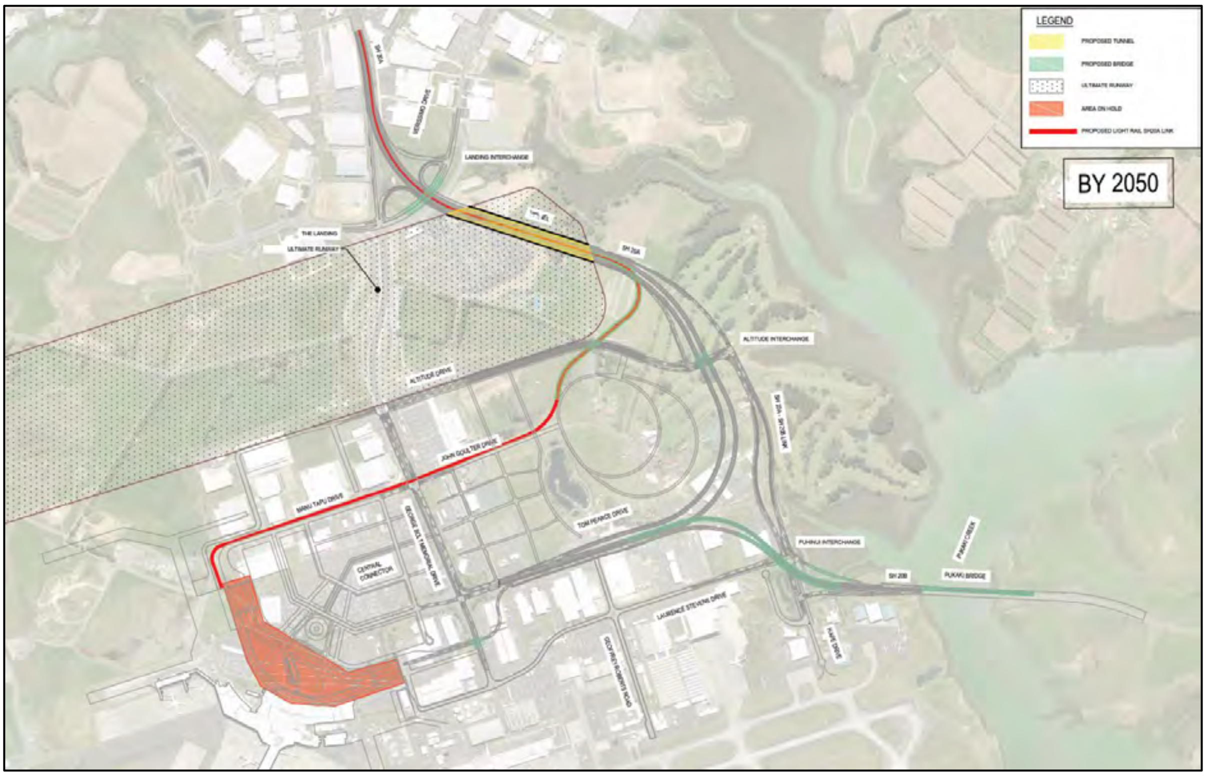


Figure 7.4 Preferred light rail alignment within the Airport and proposed road Masterplan layout

The preferred light rail option shown in Figure 7.5 is to proceed to the short list for assessment against the heavy rail, BRT and hybrid options. General arrangement drawings for the preferred light rail option are included in Appendix C.

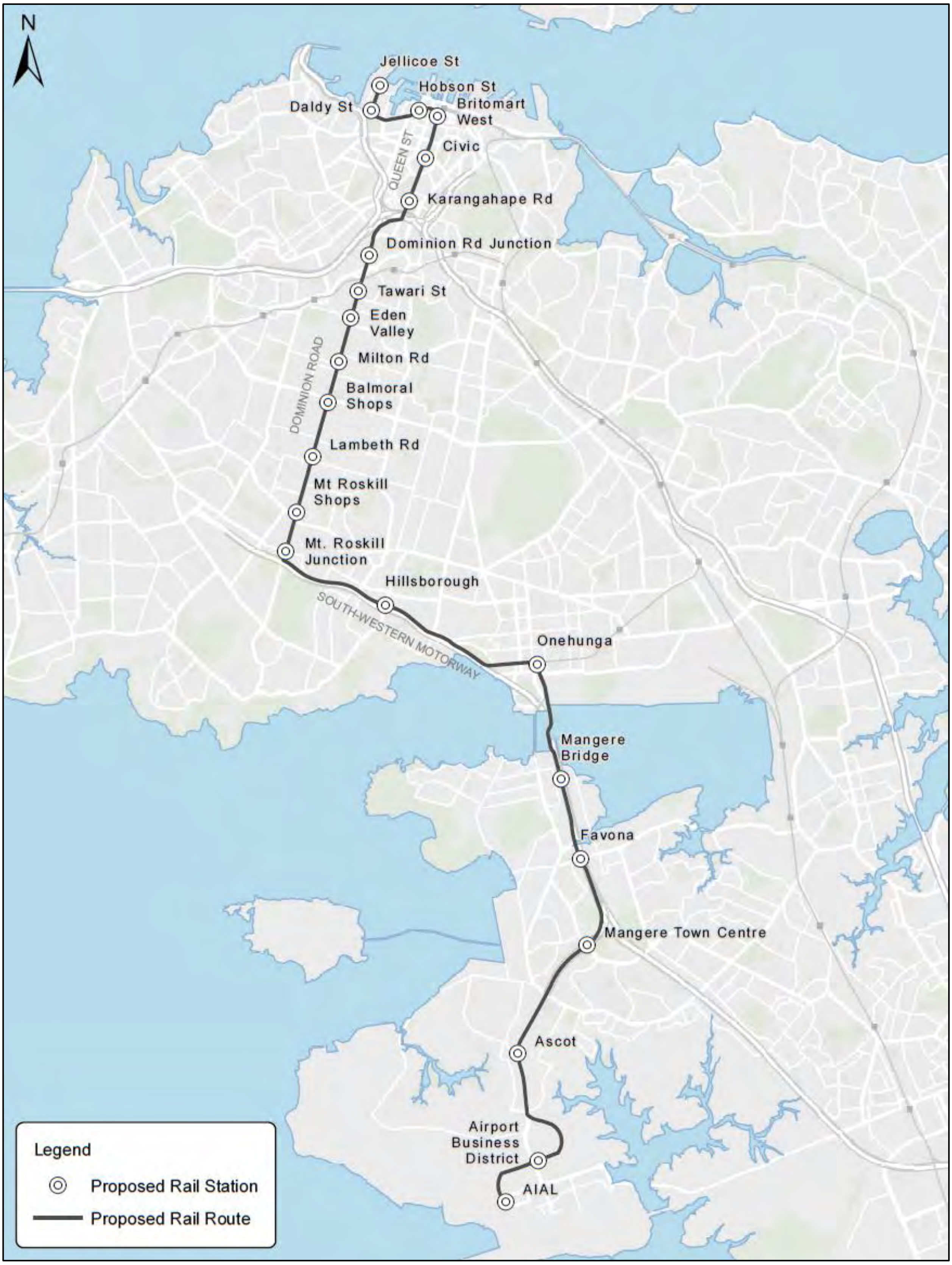


Figure 7.5 Preferred LRT option to be included in the shortlist assessment

7.3 Bus Rapid Transit

The preferred BRT option 4 was refined through further development of bus stops, infrastructure, vertical and horizontal alignment. A number of factors were considered to inform further developments which included road and stop capacity, operational performance (determined from transport modelling), and spatial requirements.

7.3.1 Bus stop design

The general approach to identifying stop locations for the BRT option was similar to that of the LRT option. If the existing stop pattern along the Pah Road / Manukau Road corridor was replicated, the BRT option would not enable services to be any faster than the current bus lane arrangement. This would not generate any additional benefit and the BRT option would not compare to light rail or heavy rail with respect to travel time. Similarly to LRT, the stops were located further apart but with a higher capacity (compared to existing stops), which will result in faster bus travel times and less delay.

Infrastructure is driven by the frequency of bus services along Manukau Road, with the aim of reducing bus travel times and delays along the corridor. The provision of bus infrastructure is beneficial to both bus services and general traffic in that buses are able to bypass congested general traffic lanes and general traffic is not held up by stopped buses.

The estimated 2018 bus volume in Newmarket (and along Manukau Road), following the implementation of the CRL is 46 buses per hour[45]. The practical capacity of a 3 bay bus stop without passing lanes is 53 buses per hour. The current Airport bus volume is 10 buses per hour which will increase over time with the forecast patronage growth. With the addition of the volume of Airport buses, the capacity of Manukau Road will be exceeded by 2018 and the bus lanes will fail due to delays at stops.

As part of the CAP study, S-Paramics software was used to model the performance and potential implications of three types of commonly used bus stops layouts including:

1. Layout option 1 - bus stops in bus lane;
2. Layout option 2 - indented bus bays (bus layover style stop); and
3. Layout option 3 - indented bus bays with manoeuvring lane (busway style stop).

Modelling confirmed that bus stops in lanes (layout option 1, shown in Figure 7.6), would have inadequate capacity for bus forecasts. Layout option 1 performed the worst of the 3 modelled options and it was observed in the model that buses were regularly unable to reach their designated bus stop due to buses already dwelling. This resulted in buses congested bus lanes and delays as buses were unable to pass stopped buses.

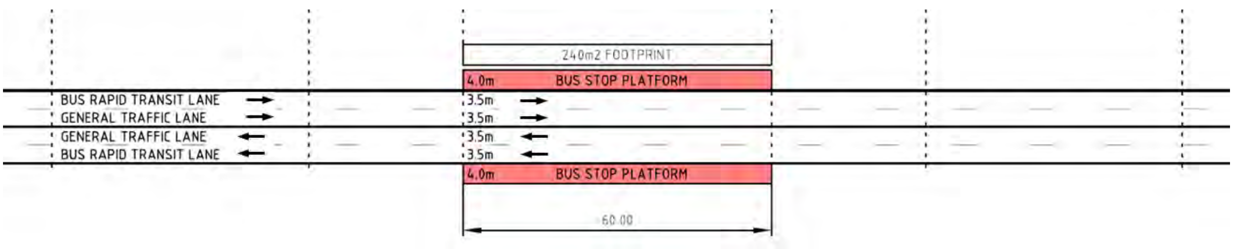


Figure 7.6 Layout option 1 - bus stops in bus lane

With bus stops upgraded to a busway standard (layout option 2 as shown in Figure 7.7), bus stop capacity increases to above 150 buses per hour which will be adequate for the forecast bus volumes along the Manukau Road corridor. The standard taper length for the stop approaches in a 50km/hour speed limit area is 30m. Significant improvements in performance were observed in the model for layout option 2 compared to layout

[45] City Centre Bus Reference Case – Final Report (under peer review), MRCagney Pty Ltd, March 2016

option 1; however, indented bus stops will clearly have a considerably larger spatial footprint than bus lanes. This will result in additional property cost which is incorporated into section 9.

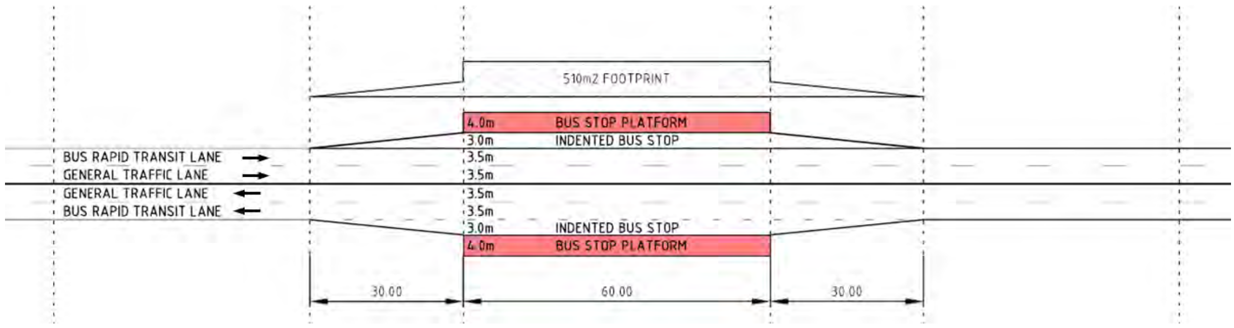


Figure 7.7 Layout option 2 – indented bus bays

7.3.2 Bus stop locations

The BRT option would involve incorporating bus lanes into BRT lanes, and existing bus services will also use the new BRT stops. As discussed in the previous section, the limiting factor for the BRT option is the stop capacity. The bus stop locations were developed to minimise impacts to adjacent properties whilst providing a high level of accessibility and fast travel times.

The Khyber Pass Road bus stop proposed near the intersection of Broadway and Khyber Pass Road in Newmarket required further development due to the large potential property or structure requirements. The only section of road wide enough to fit a BRT stop is immediately south of the intersection of Khyber Pass Road and Broadway. However, this section of road is 40 m long which is too short to fit a BRT stop with a standard length of 60 m (plus tapers on approaches). Using a stop length of less than 60 m will not provide the required bus capacity and will result in queueing along the bus lanes as buses wait to move into the indented bus bays. Omitting this stop altogether would significantly decrease the potential patronage and catchment of the BRT option, so this was not considered.

There are two alternatives options for accommodating a BRT stop in this location with adequate capacity for buses and both alternatives would incur a significant additional cost. The options include:

- Impact on (and acquire) the building and land on the south-west corner of the intersection (at 135 - 151 Broadway); or
- Grade separating the BRT stop.

Lengthening the BRT stops and impacting commercial buildings would pose a significant consentability risk; therefore the grade separation option was progressed.

A surface BRT stop arrangement (with general traffic lanes in a tunnel underneath), was investigated as this would require a narrower tunnel width than an underground BRT stop with general traffic on the surface. The tunnel ramps would have to be back at grade at the chicane and pedestrian crossing near Khyber Pass Road and the length of the ramps would be 75 m for a tunnel design speed of 60 km/hour. The length of the tunnel would be 120 m to allow for the bus stop and taper length requirements on the surface, plus 75 m at each end for the tunnel ramps[46]. If the ramp at the northern end of the tunnel begins at the chicane near Khyber Pass Road, the ramp at the southern end of the tunnel would not return to grade until south of Morrow Street. This would effectively shut off access to Remuera Road from Broadway for general traffic.

For this reason, the bus stop was moved to be in the tunnel and general traffic on the surface. For this arrangement, the bus lanes would be located either side of the centre line (rather than the side of the road).

[46] Total tunnel length requirement of 75 + 30 + 60 + 30 + 75 = 270 m for bus over and general traffic in tunnel arrangement.

This enabled the ramp length to be decreased from 75 m to 50 m (with a design speed of 40 km/hour), and the taper length from 30 m to 20 m. Including the 4 m wide platforms and provisions for access, the trench will be the full width of the road at the middle of the bus stop.

Using these revised measurements (200 m between the top of the tunnel ramps[47]), the tunnel will fit between Khyber Pass and Remuera Road and would maintain general traffic access to Remuera Road and Teed Street. This layout will require alterations to signal phasing to allow buses to straighten up before the ramps leading down to the bus stop platforms in the tunnel.

This will likely have a negative impact on the capacity of the Khyber Pass Road / Broadway intersection and will increase congestion for general traffic as a result. It is noted that the additional congestion will not have been included as part of the APT modelling as the model does not consider intersection capacity or delay.

The benefit cost ratio (BCR) calculations (included in section 9), will overstate the benefits of the BRT case because negative traffic impacts have not been captured in the APT model. If BRT is progressed to the DBC stage, detailed traffic modelling would need to be undertaken using a micro-sim model similar to the Aimsun Isthmus Model which was used for measuring the traffic impacts of LRT options.

7.3.3 Spatial requirements

The preferred BRT alignment is largely within the existing kerblines of the corridor (with the removal of parking). As discussed in the previous section, the bus stops along the corridor have a large spatial requirement to ensure that the capacity of the corridor is not limited by the capacity of the stops.

A high level spatial assessment was undertaken to identify the long list BRT options which excluded Mt. Eden Road and Sandringham Road for further consideration. With Manukau Road identified as the preferred BRT alignment, a more comprehensive spatial assessment was undertaken to assess the potential impacts on properties and businesses. The spatial footprint of each stop was assessed to determine whether the stop required the acquisition of adjacent properties.

If a bus stop completely obstructed the frontage or access way for a parcel of land, it was assumed that the whole property would have to be purchased. Similarly, if a building was predominantly situated on the land frontage, it was assumed that the entire property would need to be purchased and the building demolished. If a property was partially impacted by a bus stop but access to the property could be maintained, it was assumed that a partial land purchase would be required. This is consistent with the approach taken for LRT stops along Dominion Road for the Central Access Plan IBC. The spatial analysis informed the total cost of the BRT option and therefore the benefit cost ratio (see section 9).

Incorporating the developments mentioned previously, the preferred BRT option to be assessed is shown in Figure 7.8. General arrangement plans for the preferred BRT option are included in Appendix D.

[47] Revised tunnel length of 50 + 20 + 60 + 20 + 50 = 200 m for general traffic on surface and buses in tunnel arrangement.

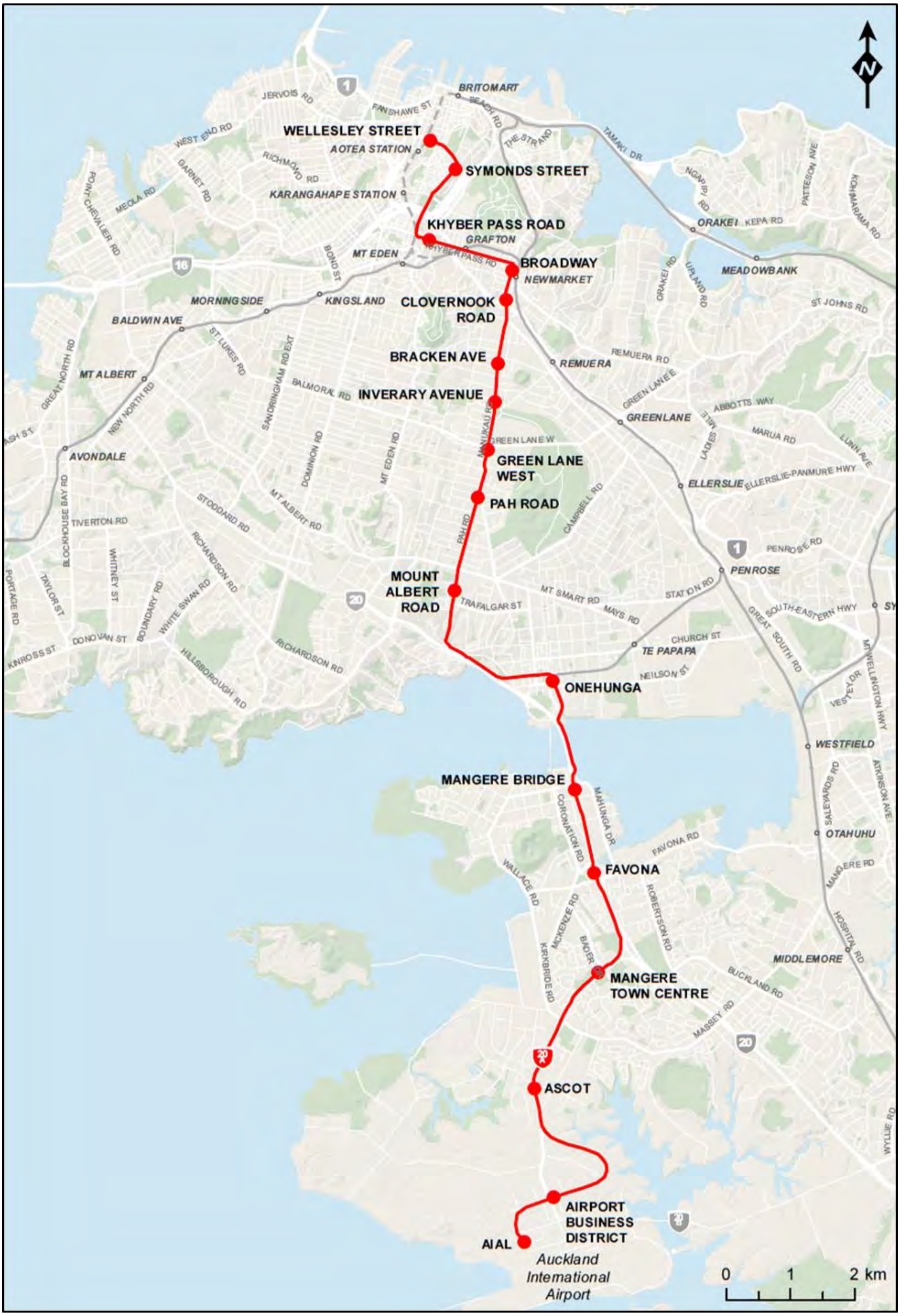


Figure 7.8 Preferred BRT option to be included in the shortlist assessment

7.4 Hybrid BRT / Heavy Rail

The hybrid option was refined by developing a high and low cost sub-option to be consistent with the assessment undertaken for the heavy rail option along the Onehunga Branch Line. General arrangement plans for the hybrid option are attached in Appendix E.

7.5 East West Connections

The integration of the SMART and the East West Connections projects is critical to the success of both projects. The East West Connections project is in the design development phase and refinement of the preferred option is ongoing. The SMART project team is working in close liaison with the East West Connections team to integrate the recommended SMART LRT and BRT options and further work will be required as both projects progress. No further work has progressed on the refinement of the heavy rail and East West integration based on the latest information provided by the East West team.

8. Short List Option Assessment

This section describes the assessment of the four shortlisted options based on potential passenger catchments, travel time, capacity and demand, and a summary assessment against the project objectives. This information assists in the identification of a preferred option(s) to go forward to the next stage for further investigation.

8.1 Evaluation Framework

A multi-criteria analysis (MCA) framework was developed for the assessment of the shortlisted options. The evaluation framework was based on the project objectives described in section 2.3 and a mixture of qualitative and quantitative measures for each objective were developed for each objective. The aim was to incorporate as many quantitative measures as possible in order to strengthen the evidence base for the assessment of the options. The majority of quantitative measures were outputs from Auckland Public Transport (APT) model runs.

The framework described in this section was initially confirmed by key stakeholder groups at Workshop 2 for the purposes of comparing heavy rail and light rail options as part of the Interim Business Case. This Indicative Business Case compares heavy rail, light rail, bus and hybrid options where cost was a significant differentiator between options. An additional project objective was developed to assess and incorporate the value for money of the option into the evaluation framework.

The criteria included as part of the evaluation framework were revisited during Workshop 7 and it was confirmed along with stakeholders that the criteria were still consistent with the project objectives.

Significantly contribute to lifting and shaping Auckland's economic growth

Economic performance is one of the key drivers for improving access to the airport and surrounding business areas and Māngere-Ōtāhuhu. This objective assesses the extent to which each option contributes to the economic performance of the airport and surrounding business areas, Māngere-Ōtāhuhu area and wider Auckland region. The measures were mainly qualitative for this objective.

Improve the efficiency and resilience of the transport network

This objective assesses the impact on access to the airport and surrounding business areas. It measures the extent to which the option increases the person-carrying capacity of the corridor to the airport and surrounding business district. It also considers the reduction in congestion and travel time and improvement in travel time reliability. Impacts on all modes of transport were assessed under this objective.

Improve the accessibility and transport choice in the Māngere-Ōtāhuhu area

This objective aimed to improve the accessibility and transport choice available to residents and businesses within the Māngere-Ōtāhuhu area. Network impacts like congestion, general traffic movements, area-wide public transport usage, network integration and resilience were assessed.

Contribute positively to a liveable, vibrant and safe city / provide a sustainable transport solution that minimises environmental impacts

The majority of the measures for this objective were qualitative as they related to image, quality and amenity of the options. Space and land requirements were also assessed at a concept level for each option. Natural environmental impacts focused on the removal of vehicles and subsequently emissions across the network.

Optimise the potential to implement a feasible solution

This objective sought to differentiate the options based on the likely impacts related to construction. The criteria included staging potential, construction duration and complexity, construction impacts, consenting requirements and operating costs. In general, options that comprised long sections of street running scored lower than options that predominantly operated within the motorway corridor. This reflects the increased requirements to maintain property access and close sections of carriageway during construction of street running sections.

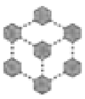
Investment in affordable solutions that provide value for money over the life of the asset

It should be noted that this objective was developed for the purposes of the Indicative Business Case and was not included as part of the previous Interim Business Case.

Capital cost was a major differentiator for the heavy rail, light rail and bus rapid transit options that were considered. Indicative cost estimates were prepared for use in the evaluation. Operating and maintenance costs have also been calculated at a high level and included in the assessment.

The project objectives and evaluation criteria are outlined in Table 8.1.

Table 8.1 Project objectives and option evaluation criteria

Project objective	Evaluation criteria
Significantly contribute to lifting and shaping Auckland's economic growth 	• Allows efficient access to existing and planned employment within the airport and business district • Allows efficient access to existing and planned employment from the wider Māngere area • Potential to increase development along the corridor • Enables employment growth and supports economic regeneration in the wider Mangere area
Improve the efficiency and resilience of the transport network 	• Increases public transport patronage to/from the airport and business district • Reduces congestion to/from the airport and business district • Improves public transport travel times on key routes to/from the airport and business district • Enables efficient public transport travel between the City Centre and the Airport • Improves freight travel times to/from the airport and business district on the strategic freight network • Improves private vehicle travel times to/from the airport and business district within the area of influence of the study • Improves public transport journey time reliability to the airport and business district • Improves freight journey time reliability to the airport and business district • Improves corridor productivity on approaches to the airport and business district • Connects key airport and business district areas, including employment • Adds useful additional capacity
Improve the accessibility and transport choice in the Māngere-Ōtāhuhu area 	• Increases pubic transport patronage on the local network • Reduces congestion on the local network • Improvements to connectivity and transport choice in the wider Māngere area • Impacts on the ability to provide a cycle metro facility within the State Highway corridor • Impacts on the ability to integrate with local active mode networks
Contribute positively to a liveable, vibrant and safe city	• Safety impacts • Personal security • Visual impacts • Contributes positively to local character • Contributes to the Airport as a 'gateway' • Promotes street vitality, active street edges and weather protection

	• Allows sufficient space for pedestrian movement and activity • Impacts on heritage buildings and structures • Land take requirements • Compatibility with the East West Connection alignment
Optimise the potential to implement a feasible solution	• The length of time required to construct the option • Constructability • The difficulty of consenting the option (planning requirements) • The impact of construction on network utilities • The amount of temporary land take related to construction • The impact of construction on transport network operations • The ability of the option to be constructed in stages
Provide a sustainable transport solution that minimises environmental impacts	• Emissions effects including greenhouse gases • The extent to which the operational noise and emissions of the option affects sensitive receivers • Impacts on contaminated land or creates contamination issues • Impacts to archaeological values • The extent to which the option impacts open space and biodiversity • Cultural values impacts • Impacts on non-built environment heritage values
Investment in affordable solutions that provide value for money over the life of the asset	• Construction cost – CAPEX (low/medium/high) • Gross operation cost – OPEX (low/medium/high) • Expected renewal cost (accrual cost per year) • Fleet cost • Expected fare box revenue • Maintenance cost

8.2 Potential catchments

The 2013 Census data has been used to determine the numbers of people living and working within an 800m walking distance of each of the proposed stations for the heavy rail, light rail and BRT options. The numbers give an indication of the potential number of passengers within a comfortable walking distance of a station at either end of their journey.

An 800 m walk is generally accepted as a typical maximum walking distance that people are prepared to walk to access rail services. The distance is highly dependent on the quality of the walking environment surrounding each station and may increase or decrease accordingly. A more detailed accessibility assessment should be undertaken during subsequent project stages to understand the potential walk-up catchments.

A summary of the total population and employment within an 800m catchment of proposed stations for each of the shortlisted options has been assessed by Auckland Transport and is provided in Table 8.2 It should be noted that the Parnell Station will also open during the analysis period and has been included in the APT modelling of options; however, it has not been shown in the preferred options maps. Figures for the Hybrid option will be included in a subsequent revision of this document once they are made available.

It can be seen that the total catchment for light rail is significantly greater than that of the preferred heavy rail and bus rapid transit options and that the light rail option provides access to the Airport and south-west Auckland for a significantly greater population. The greatest difference is due to the residential areas along Dominion Road.

Table 8.2 Total population and employment catchments within 800m for shortlisted options

Catchment	Heavy rail	Light rail	Bus rapid transit	Hybrid
Population	34,310	60,240	45,653	X
Employment	72,940	83,200	63,429	X

The population and employment catchments from the city to the Airport for the preferred heavy rail option are shown in Figure 8.1 and Figure 8.2 respectively and are summarised in Table 8.3. The population and employment catchments for the preferred light rail option are shown in Figure 8.3 and Figure 8.4 respectively and are summarised in Table 8.4. The population and employment catchments for the preferred bus rapid transit option are shown in Figure 8.5 and Figure 8.6 respectively and are summarised in Table 8.5. The total population and employment catchments for the hybrid option are made up of the heavy rail catchments between Onehunga and Aotea Stations and the bus rapid transit catchments between Onehunga and the Airport. The population and employment catchments for the hybrid option are summarised in Table 8.6. The corresponding information for the hybrid option is currently being assessed by Auckland Transport and will be included in a subsequent revision of this IBC.

Where the station catchments overlap as shown in the previous catchment figures, the population/employees in that area have access to more than one station. It should be noted that the total employment and total population catchments have been calculated without double counting the population/employees in the overlap.

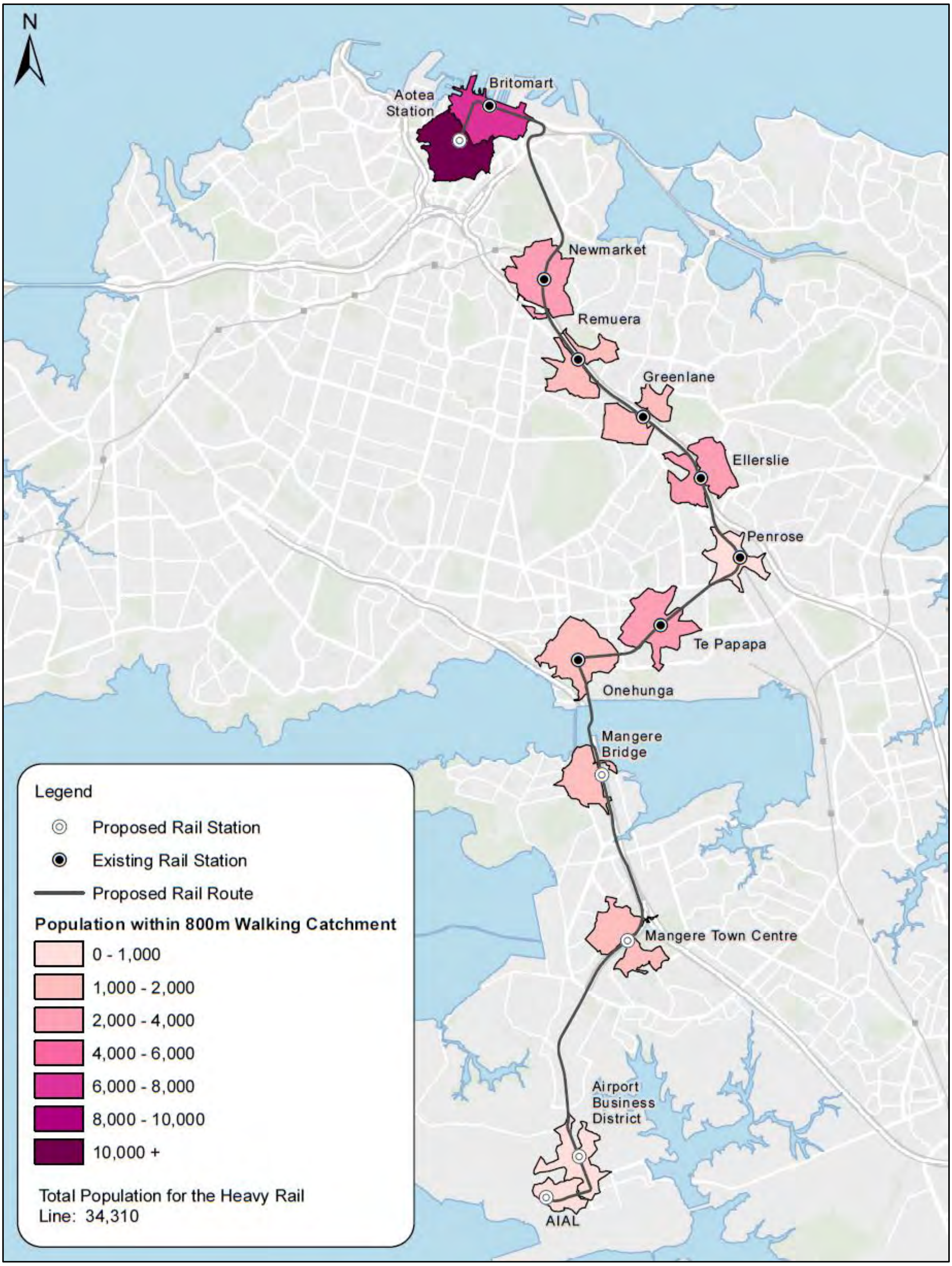


Figure 8.1 Preferred heavy rail option – resident population catchment

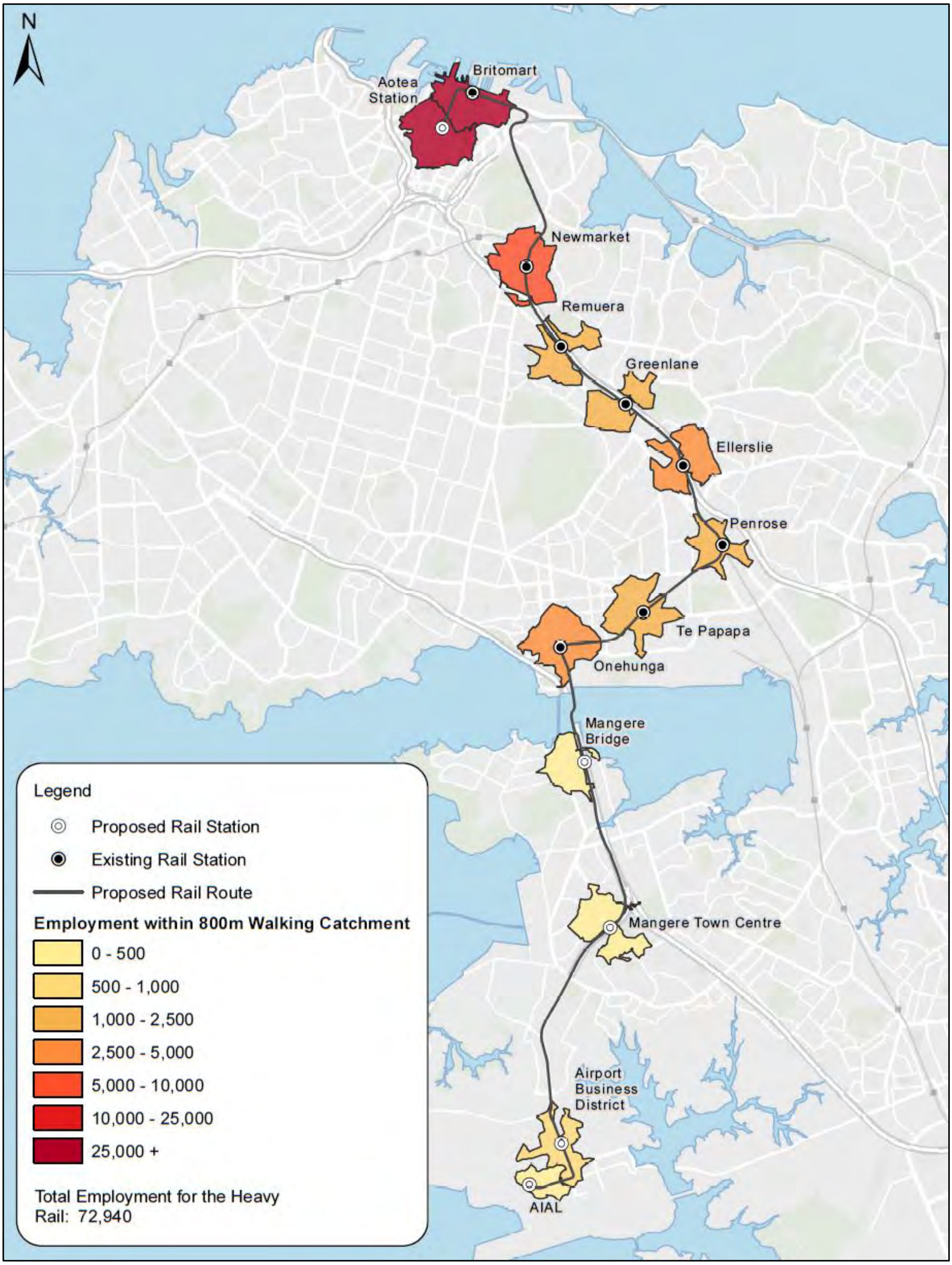


Figure 8.2 Preferred heavy rail option – employment catchment

Table 8.3 Employment and population catchments for the preferred heavy rail option

Station	Population within 800m walking distance	Employment within 800m walking distance
Aotea Station	12,889	38,383
Britomart	7,939	29,399
Newmarket	3,491	7,864
Remuera	1,867	1,234
Greenlane	1,880	1,298
Ellerslie	2,154	4,121
Penrose	19	2,161
Te Papapa	2,048	1,522
Onehunga	1,492	2,659
Māngere Bridge	1,234	284
Māngere Town Centre	1,944	433
Airport Business District	3	509
Auckland Airport	1	320
TOTAL	**34,313**	**72,941**

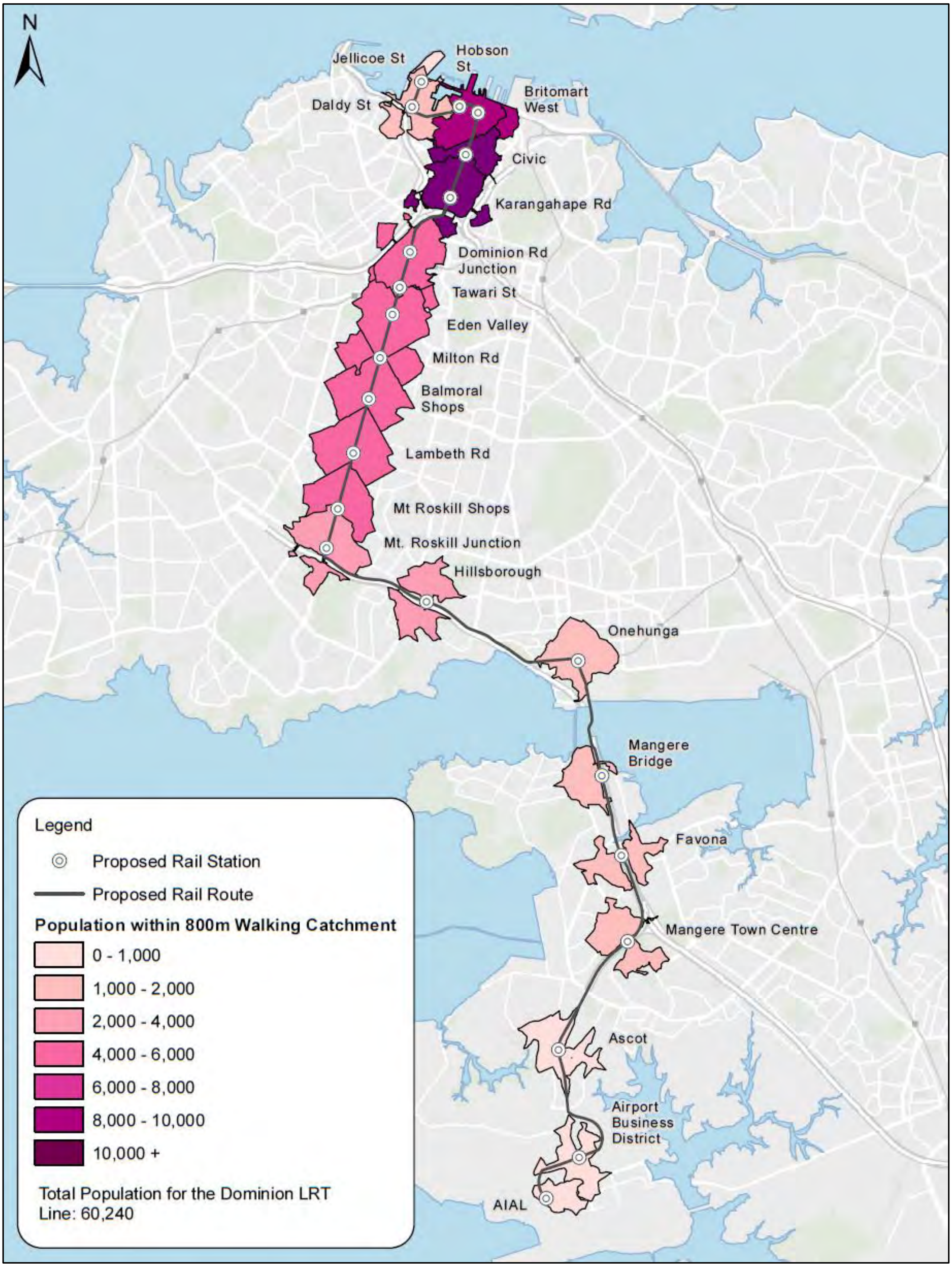


Figure 8.3 Preferred light rail option - resident population catchment

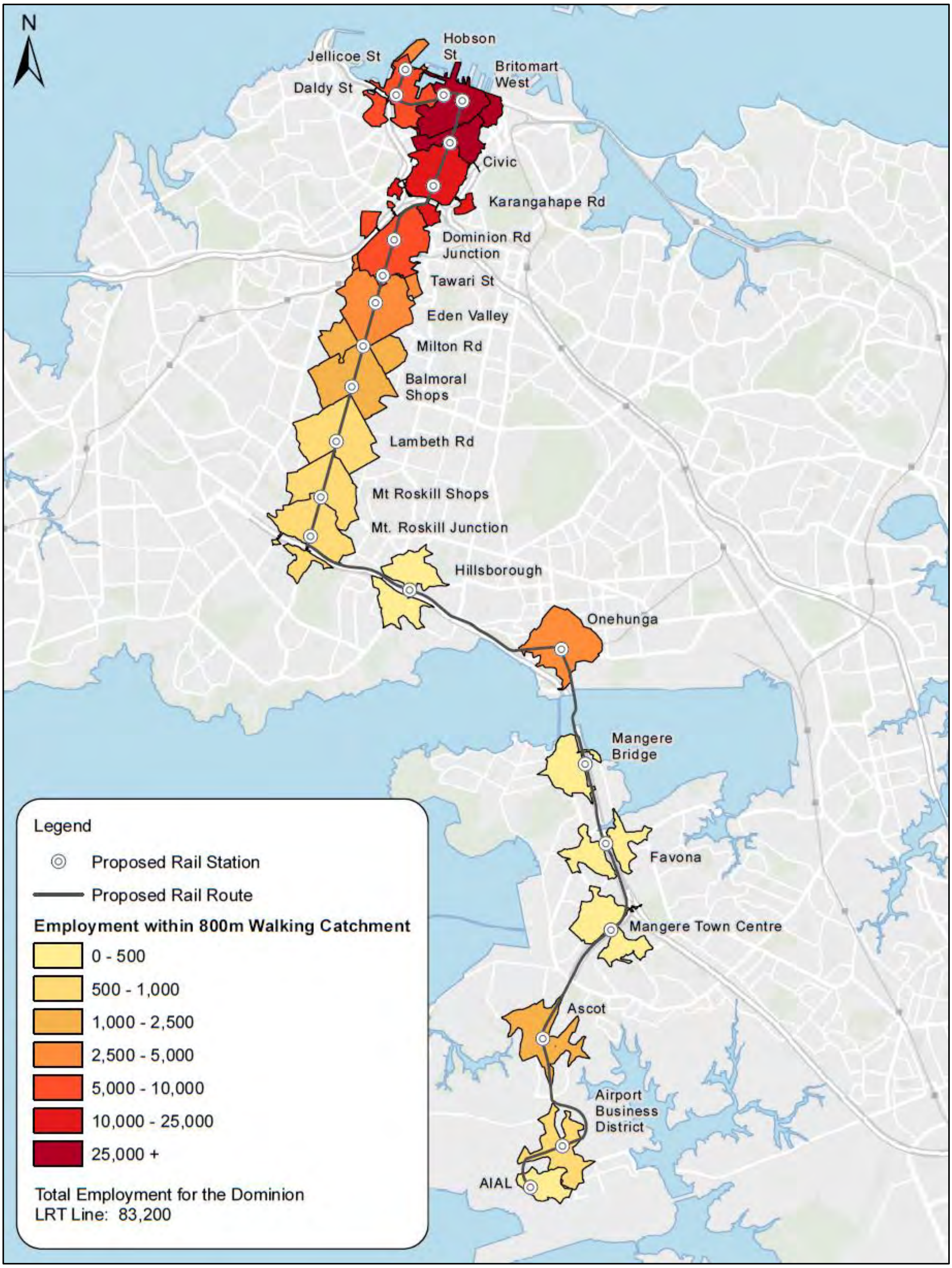


Figure 8.4 Preferred light rail option - employment population catchment

Table 8.4 Employment and population catchments for the preferred light rail option (Option 2)

Station	Population within 800m walking distance	Employment within 800m walking distance
Jellicoe Street	246	7,005
Daldy Street	1,716	15,512
Hobson Street	8,037	46,806
Britomart West	8,740	46,129
Civic	16,196	47,069
Karangahape Road	11,611	13,735
Dominion Road Junction	4,245	5,376
Kingsland Station	3,575	2,226
Shaw Street	3,883	1,307
Lancing Road	4,900	1,151
Sandringham Village	5,591	708
Taumata Road	4,284	328
Sandringham Junction	3,136	628
Mt. Roskill Junction	3,058	549
Hillsborough	2,357	341
Onehunga	1,492	2,659
Māngere Bridge	1,234	284
Favona	1,961	99
Māngere Town Centre	1,944	433
Ascot	76	1,452
Airport Business District	3	509

Auckland Airport	1	320
TOTAL	**60,240**	**83,197**

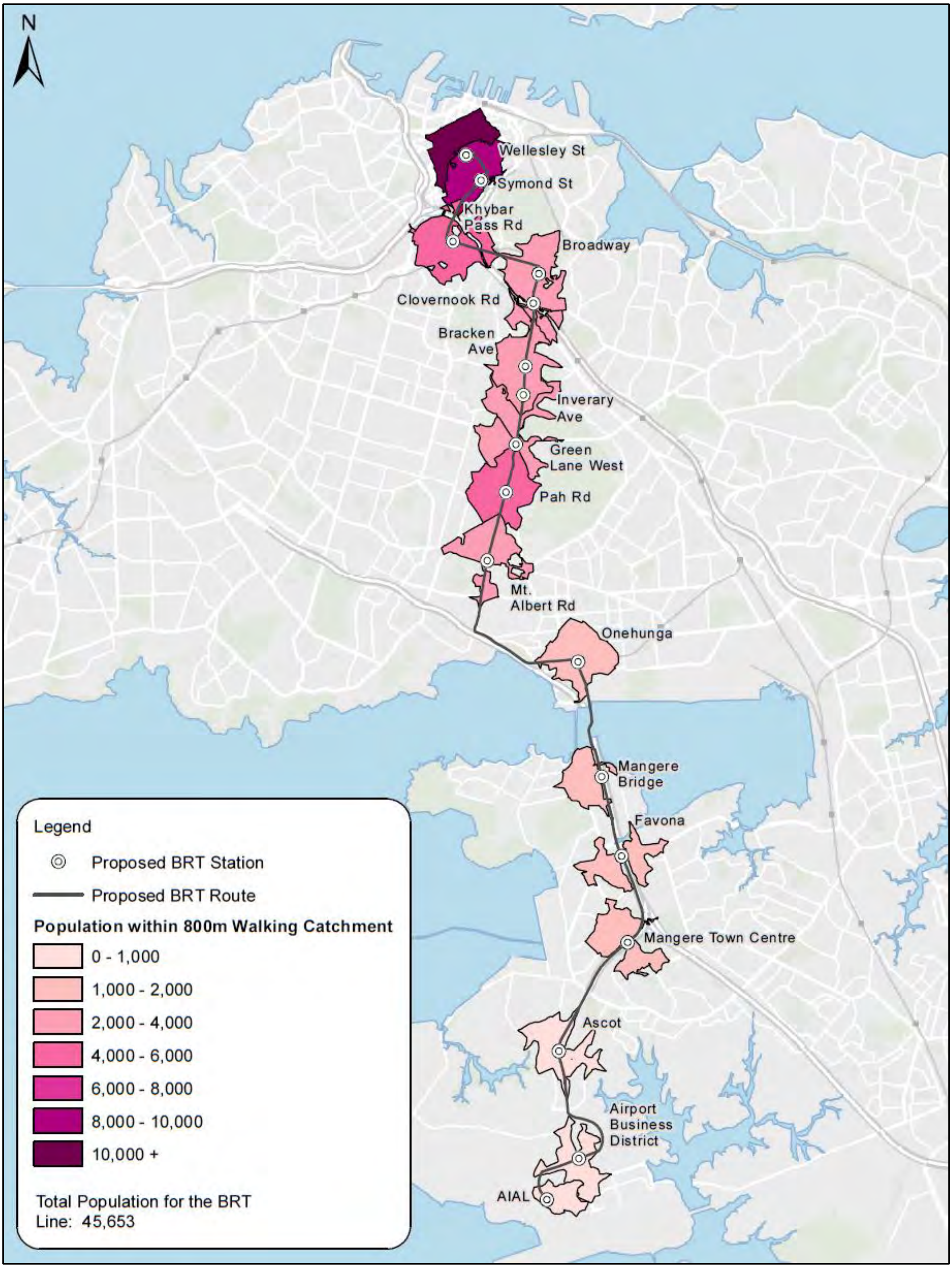


Figure 8.5 Preferred BRT option - resident population catchment

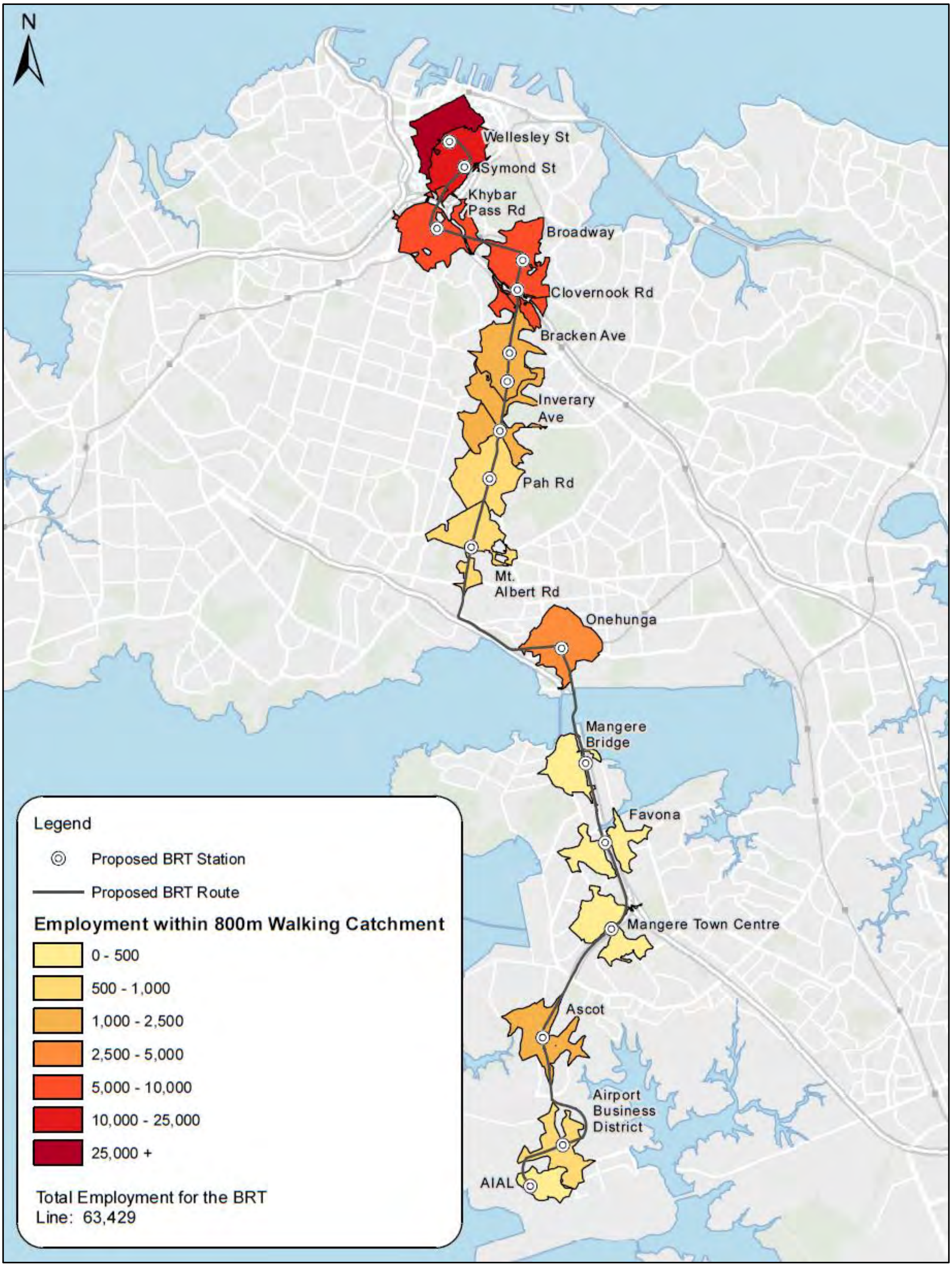


Figure 8.6 Preferred BRT option - employment population catchment

Table 8.5 Employment and population catchments for the preferred BRT option

Station	Population within 800m walking distance	Employment within 800m walking distance
Wellesley Street	Catchment figures being produced by Auckland Transport	
Symonds Street		
Khyber Pass Road		
Broadway		
Clovernook Road		
Bracken Avenue		
Inverary Avenue		
Green Lane West		
Pah Road		
Mt. Albert Road		
Onehunga	1,492	2,659
Māngere Bridge	1,234	284
Favona	1,961	99
Māngere Town Centre	1,944	433
Ascot	76	1,452
Airport Business District	3	509
Auckland Airport	1	320
TOTAL	45,653	63,429

Table 8.6 Employment and population catchments for the preferred hybrid option

Station	Population within 800m walking distance	Employment within 800m walking distance
Aotea Station	12,889	38,383
Britomart	7,939	29,399
Newmarket	3,491	7,864
Remuera	1,867	1,234
Greenlane	1,880	1,298
Ellerslie	2,154	4,121
Penrose	19	2,161
Te Papapa	2,048	1,522
Onehunga	1,492	2,659
Māngere Bridge	1,234	284
Favona	1,961	99
Māngere Town Centre	1,944	433
Ascot	76	1,452
Airport Business District	3	509
Auckland Airport	1	320
TOTAL[48]	38,998	91,738

One of the main problems that this project aims to address is the issue of limited accessibility and transport choice and how this undermines liveability and economic prosperity for the Māngere-Ōtāhuhu area. This is also fundamental to the Southern Initiative as part of the Auckland Plan.

Figure 8.7, Figure 8.8 and Figure 8.9 show that the preferred light rail option services a greater area of high socioeconomic deprivation compared to the preferred heavy rail, bus rapid transit and hybrid options. This can be attributed to a greater overall number of stops as well as providing stops in areas of high social need, such as Favona and Ascot. Favona is identified as one of the most deprived in New Zealand and improving public transport services in this area will likely have significant impacts on the social and economic wellbeing of the area.

[48] It should be noted that the total population and employment catchment for the hybrid option will be overestimated as the estimates in the overlap areas have not been split, resulting in some double counting of population/employment numbers for stations located in close proximity to each other. This is particularly significant for the total employment catchment due to the concentration of employment in the city centre.

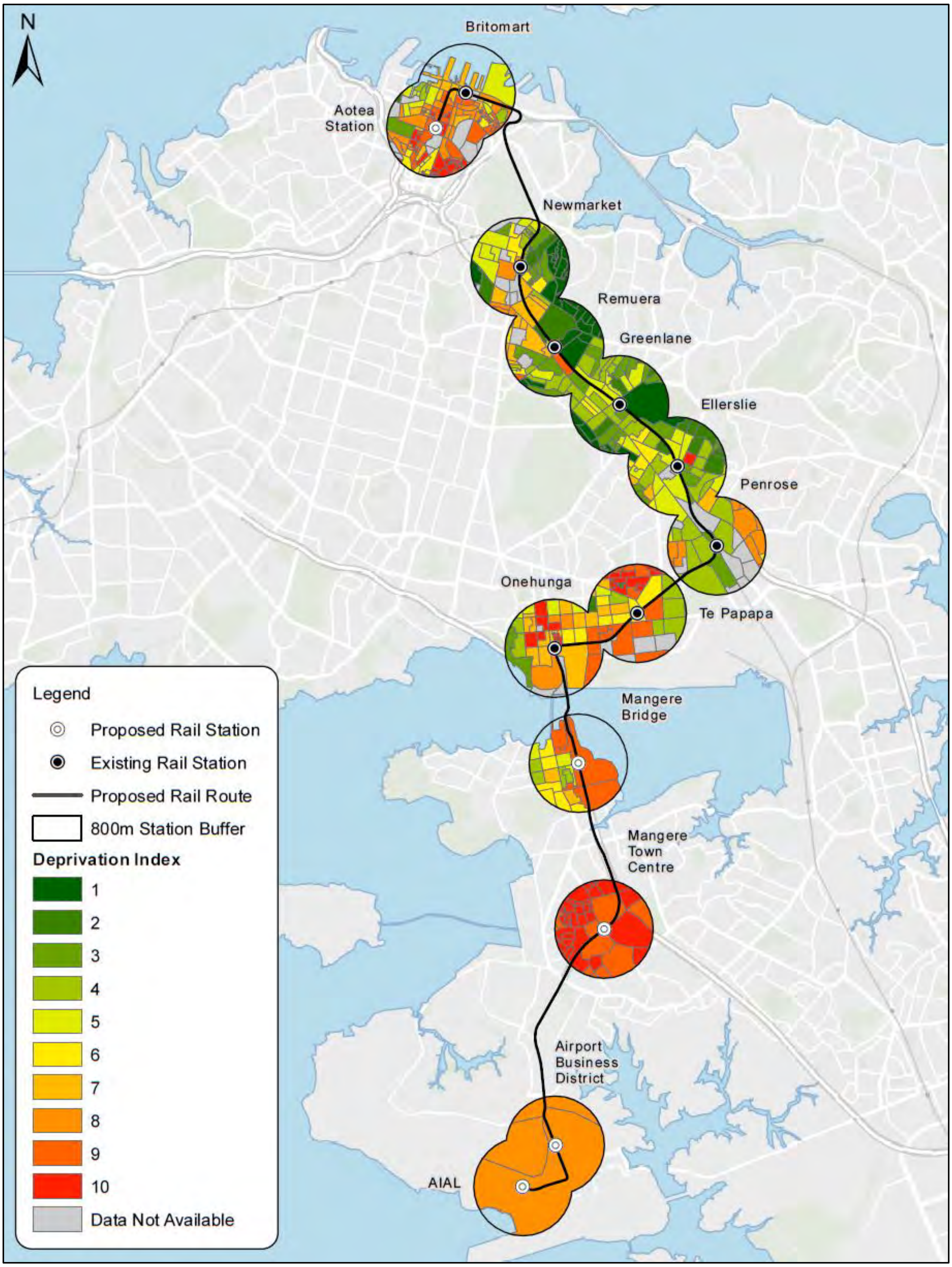


Figure 8.7 Socioeconomic deprivation within an 800m catchment of proposed heavy rail stations

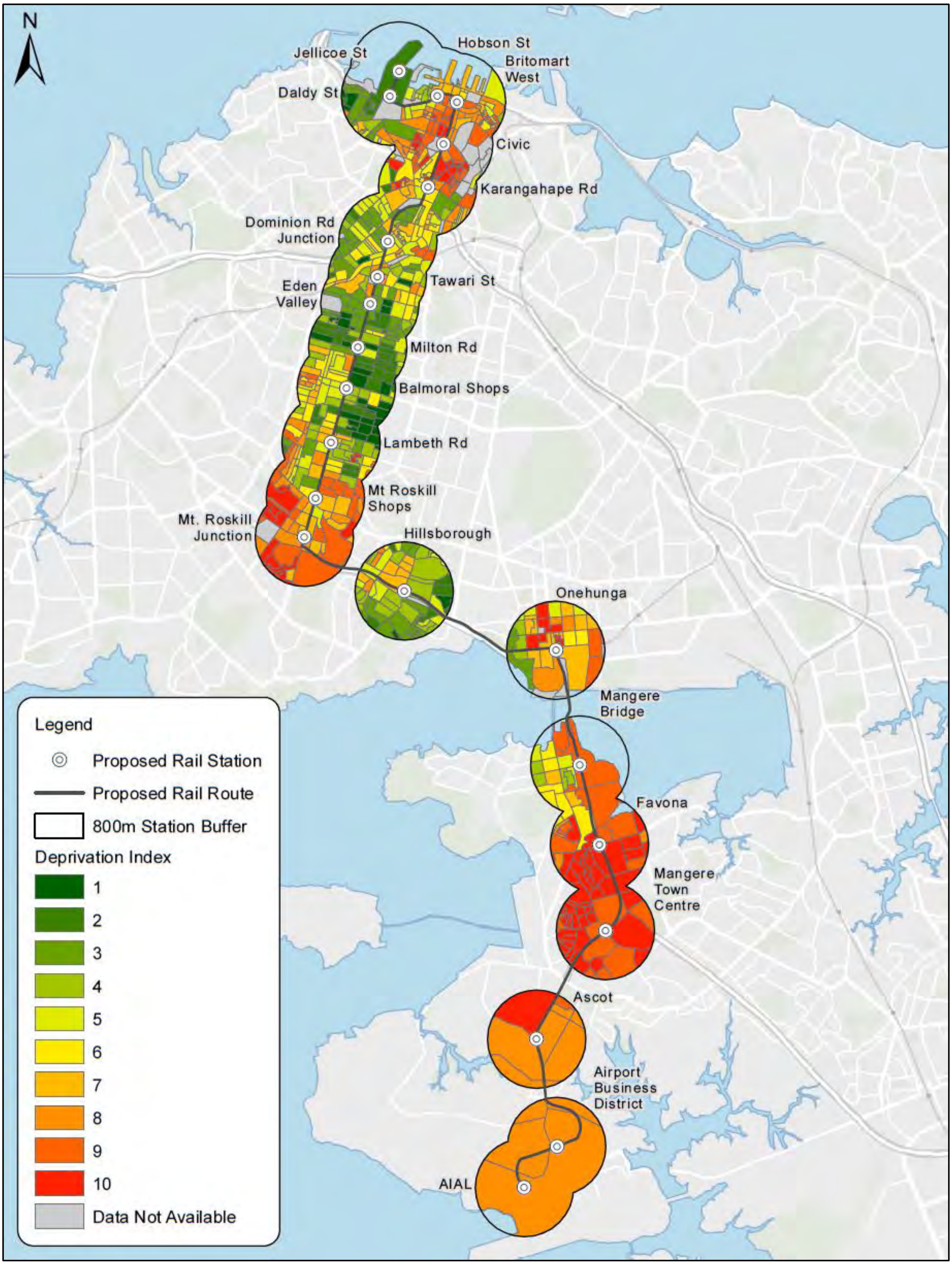


Figure 8.8 Socioeconomic deprivation within an 800m catchment of proposed light rail stations

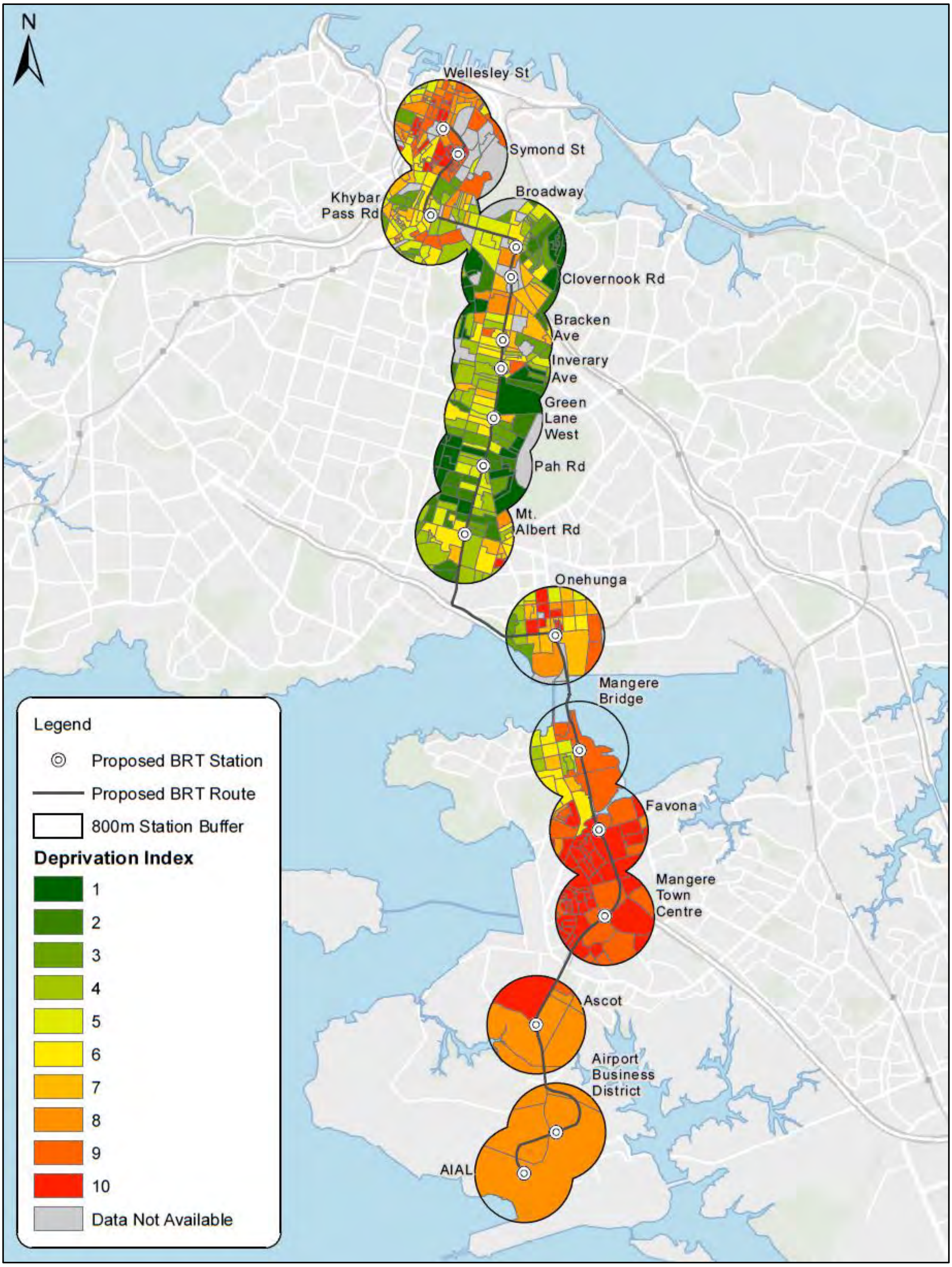


Figure 8.9 Socioeconomic deprivation within an 800m catchment of proposed bus rapid transit stations

8.3 Capacity and demand

The Auckland Public Transport model (APT3) was used to predict the two-hour AM peak demand patronage for the four shortlisted options based on land use, employment and population forecasts. The public transport travel demand across the network in 2026 and 2046 has been extracted from the following model runs (which correspond to each of the shortlisted options):

- 2026am_PT vol_LRT_SandDom_NoCrowd – the Do Minimum which includes LRT on Dominion Road and Sandringham Road in the 2046 AM peak;
- 2026am_PT vol_LRT_SandDom_HeavyRailAirport_NoCrowd – preferred heavy rail option in 2026 AM peak;
- 2026am_PT vol_LRT_SandDomAirport_NoCrowd – preferred LRT option in 2026 AM peak;
- 2026am_PT vol_BRT_WellesleyAirport_NoCrowd – preferred BRT option in 2026 AM peak;
- 2026am_PT vol_Hybrid_OnehungaAirport_NoCrowd – preferred hybrid option in 2026 AM peak;
- 2046am_PT vol_LRT_SandDom_NoCrowd – Do Minimum which includes LRT on Dominion Road and Sandringham Road in the 2046 AM peak;
- 2046am_PT vol_LRT_SandDom_HeavyRailAirport_NoCrowd – preferred heavy rail option in 2046 AM peak;
- 2046am_PT vol_LRT_SandDomAirport_NoCrowd – preferred LRT option in 2046 AM peak;
- 2046am_PT vol_BRT_WellesleyAirport_NoCrowd – preferred BRT option in 2046 AM peak;
- 2046am_PT vol_Hybrid_OnehungaAirport_NoCrowd – preferred hybrid option in 2046 AM peak;

The APT3 modelling outputs for all shortlisted options in 2026 and 2046 are included in Appendix G.

Six reference points (shown in Figure 8.10), were chosen for comparing forecast patronage for each of the shortlisted options which include:

1. Bridge across Manukau Harbour;
2. Dominion Road, immediately north of the intersection with Balmoral Road;
3. Manukau Road, immediately north of the intersection with Balmoral Road;
4. Onehunga Branch Line, immediately south of Te Papapa Station;
5. SH20A, directly south of Bader Drive interchange; and
6. SH20A, in the Airport immediately north of Ihumatao Road.

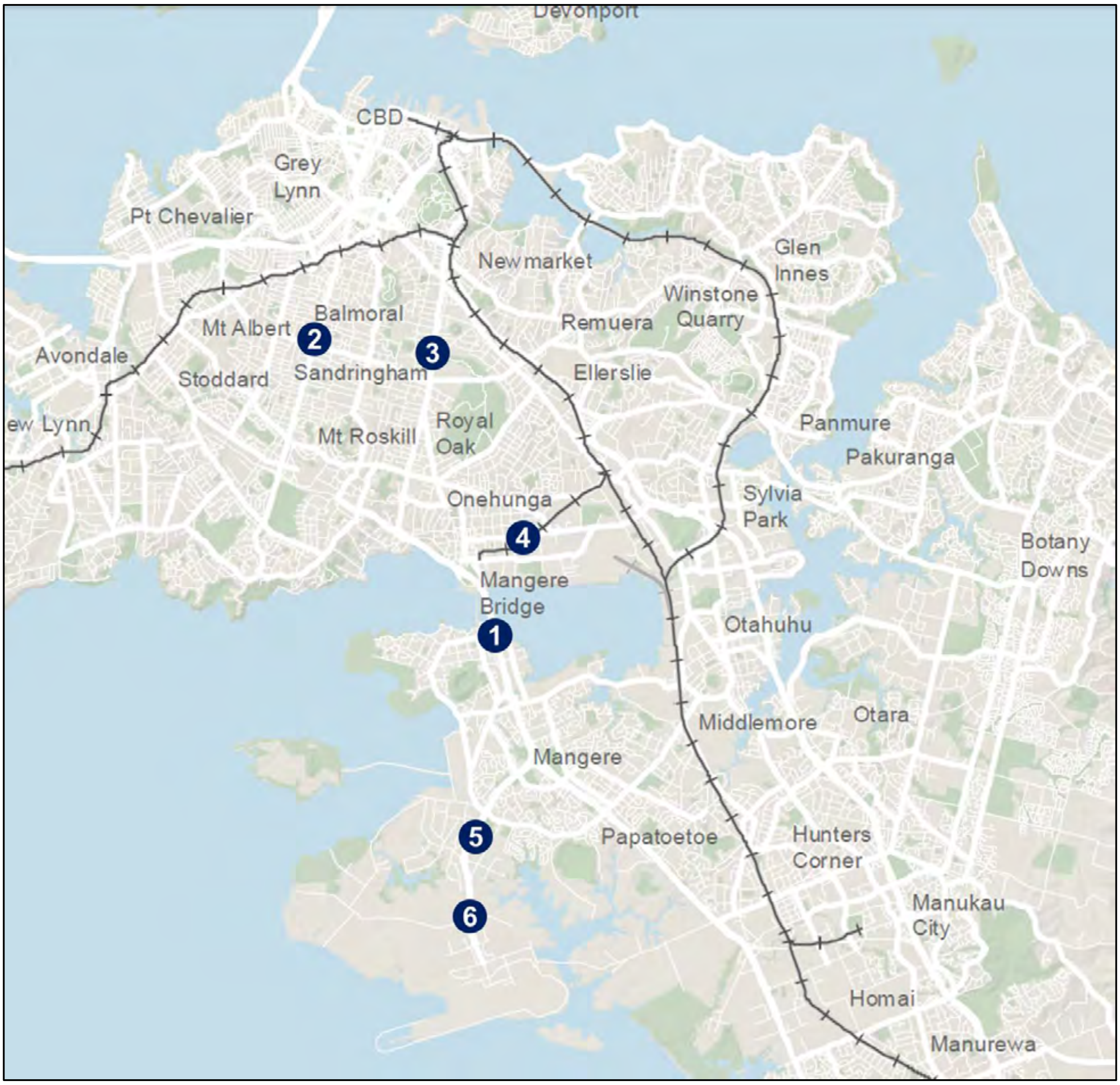


Figure 8.10 APT modelling reference points for shortlisted options

The modelled AM peak patronage figures for the shortlisted options in 2026 and 2046 are presented in Table 8.7 and Table 8.8 respectively. It should be noted that the Do Minimum scenario that was modelled by ATP includes the LRT alignments along Sandringham Road and Dominion Road. For the Do Minimum option, some reference locations may feature more than one mode of public transport and therefore two figures are shown.

Table 8.7 APT modelled patronage for AM peak in 2026 for shortlisted options[49]

Location and traffic direction			APT modelled patronage for AM peak, 2026				
			Do Minimum, 2026	Heavy rail	Light rail	BRT	Hybrid
1	Manukau Harbour Bridge	NB	1,125	816	911	1,243	1,087
		SB	765	728	742	861	835

[49] APT3 Modelling outputs for 2026, Joint Modelling Application Centre, June 2016

2	Dominion Road	NB	142 (bus) 1,763 (LRT)	N / A	3,754	N / A	N / A
		SB	148 (bus) 377 (LRT)	N / A	725	N / A	N / A
3	Manukau Road	NB	2,724	N / A	N / A	2,619	N / A
		SB	466	N / A	N / A	732	N / A
4	Onehunga Branch Line	NB	827	1,715	N / A	N / A	988
		SB	324	990	N / A	N / A	657
5	SH20A	NB	292	329	326	265	229
		SB	489	587	638	702	690
6	Airport SH20A	NB	334	329	320	264	229
		SB	620	587	609	677	666

Table 8.8 APT modelled patronage for AM peak in 2046 for shortlisted options[50]

Location and traffic direction			APT modelled patronage for AM peak, 2046				
			Do Minimum, 2026	Heavy rail	Light rail	BRT	Hybrid
1	Manukau Harbour Bridge	NB	1,591	1,316	1,493	1,901	1,635
		SB	1,355	1,956	1,994	2,132	2,046
2	Dominion Road	NB	256 (bus) 2,507 (LRT)	N / A	5,976	N / A	N / A
		SB	339 (bus) 372 (LRT)	N / A	1,365	N / A	N / A
3	Manukau Road	NB	4,263	N / A	N / A	4,280	N / A
		SB	719	N / A	N / A	1,308	N / A
4	Onehunga Branch Line	NB	1,427	2,994	N / A	N / A	1,829
		SB	474	2,301	N / A	N / A	1,535
5	SH20A	NB	493	584	574	528	469
		SB	890	1,741	1,873	2,028	1,970
6	Airport SH20A	NB	552	584	562	525	466
		SB	1,177	1,741	1,828	1,986	1,930

[50] APT3 Modelling outputs for 2026, Joint Modelling Application Centre, June 2016

8.4 Travel time

The methodology for calculating the travel time for the light rail alignment involved a simulation model for the sections along Dominion Road and Queen Street (which was consistent with the model used for the ALRT investigation), and a travel time model for the SMART extension of the Dominion Road line to the Airport. The proposed light rail alignment was separated into sections of track geometry for curve radii and gradient. Each section was analysed to calculate the maximum speed that the light rail vehicle could travel along the sections based on the vehicle traction power and friction from the curve radii and gradients. The maximum speed is not governed only by the track geometry but by the preceding and proceeding track segments, and is limited by the available distance to accelerate or decelerate. The performance specifications for the light rail vehicle were obtained from the manufacturer.

Travel times for the heavy rail option were calculated using a similar traction power model for the new track section from the Airport to Onehunga, and existing scheduled service times for trains from Onehunga to the city. Travel times for the BRT option were calculated from average bus service travel times, including stops, on existing busway corridors in Auckland. For the BRT and bus element of the hybrid options, the alignment was separated into sections based on infrastructure and travel speed. The speed limit for the Northern Busway is set at 80km/hr and this speed was assumed for the Airport busway along SH20 and SH20A. For the bus lanes along Manukau Road, a speed of 50km/hr was assumed and the dwell time was assumed to be 60 seconds per BRT stop.

Tests were carried out to assess the impact of station locations on travel times. Station dwell times were assumed to be 40 seconds for heavy rail, 30 seconds for light rail and 60 seconds for bus rapid transit based on industry averages for light rail vehicles and Auckland field data for heavy rail vehicles and buses. The dwell time, acceleration and deceleration required at each station means that a reduction in stations can have a significant impact on the overall travel time.

Heavy rail would generally be expected to be faster than light rail, however, this is not the case for the SMART alignment as no corridor was preserved to the Airport to suit heavy rail geometry and infrastructure requirements. Light rail vehicles are able to traverse steeper gradients and tighter track curves and are therefore able to travel faster than heavy rail along a number of sections, particularly near Onehunga.

In the period since SMART options were first developed and benefits estimated in 2014/15, parallel projects have been investigating Light Rail alignments for the Dominion Road corridor in greater detail. This has included traffic micro-simulation modelling to determine likely LRT impacts and travel times more accurately. As a result, it is now known that LRT travel times along Dominion Road, that would form part of the SMART LRT option route, are faster than previously assumed. In the absence of modelled travel times, conservative assumptions were made on SMART LRT travel speed in the Interim Business Case. Total travel time assumed for LRT from Britomart to SH20 at the lower end of Dominion Road was 28 minutes in the 2014/15 work. Whereas the current traffic modelling for LRT in Dominion Road has shown that this route will take a total of 21 minutes for the same distance, a time saving of 7 minutes over the original assumptions. These revised travel times for LRT have been incorporated into the SMART IBC analysis.

The modelled travel times for the shortlisted options are summarised in Table 8.9. The travel time estimates suggest that heavy rail provides the fastest travel time between the Airport and Britomart, with travel times varying between 39 minutes and 42 minutes. However, light rail would provide the fastest travel time to Aotea, varying between 37 minutes and 41 minutes. The BRT option would provide a travel time of approximately 40 minutes and the Hybrid BRT/heavy rail option has the slowest travel time at 47 minutes. The hybrid options offers no travel time saving compared to existing bus services which have a target travel time of 45 minutes. The hybrid option has an added travel time penalty as a result of the interchange at Onehunga.

Table 8.9 Travel time of shortlisted options from the city centre to the Airport

Section	Heavy rail	Light rail	Bus rapid transit	Hybrid
To/from Britomart	39– 42	42 – 44[51] 41 – 43[52]	N/A	47
To/from Aotea	41 – 44	38 – 41[53] 38 – 40[54]	40	49

8.5 Sensitivity Test

Overall speed and travel time was prioritised over accessibility for the preferred heavy rail option which has two less stations than the proposed light rail option. A sensitivity test was undertaken which included adding the Favona and Ascot stations to the heavy rail option. This would increase the overall travel time between the Airport and the city centre but would also increase accessibility, with 1,961 and 79 people living within an 800m catchment of the Favona and Ascot stations respectively. Parnell station will also open within the analysis period which would provide access for approximately 4,000 people. This would increase the overall population catchment to 40,350 people for the heavy rail option which is still considerably lower than the overall population catchment for light rail (60,240) and for bus rapid transit (45,653). However, a station at Ascot is unlikely to be a feasible option due to the nature of the heavy rail alignment. The alignment descends at a 3% grade from being elevated above SH20A at the Kirkbride Road interchange to pass beneath the second runway to the north of the Airport which makes it difficult to provide a station at Ascot.

In terms of employment population, the two additional stations at Parnell, Favona and Ascot would potentially add 7,830, 99 and 1,452 people respectively to the overall employment catchment. This brings the total employment catchment to 82,322 people compared to for 83,197 people within the 800m catchment for light rail and 63,429 for the bus rapid transit option.

8.6 MCA Assessment

The four shortlisted options were evaluated against the MCA framework described in section 8.1 relative to the Do Minimum scenario.

Table 8.10 presents the performance of the shortlist options against the project objectives based on the design and modelling outcomes. In summary, the Hybrid option does the least to respond to the existing and forecast transport problems within the study area. It is unlikely to attract significant patronage due to the time penalty associated with the interchange between bus and heavy rail at Onehunga.

The BRT performs well in transport terms, will attract a large patronage and has a high level of accessibility due to the large residential catchment along Manukau Road. However, this option is the poorest overall from a land impact perspective due to the large spatial footprint at bus stops along Manukau Road which is densely populated. Whilst the transport benefits are high, the adverse effects to properties and property access are significant. This option will likely have considerable risks associated with consenting.

The LRT option performs very well in transport terms and provides a high level of accessibility and connectivity due to the number of stations and station catchments. LRT largely follows the existing road corridor and the infrastructure requirements can fit within the road reserve which reduces impacts to property. The MCA

[51] Assuming a vehicle speed of 80km/h on segregated sections
[52] Assuming a vehicle speed of 100km/h on segregated sections
[53] Assuming a vehicle speed of 80km/h on segregated sections
[54] Assuming a vehicle speed of 100km/h on segregated sections

indicates that light rail will generate greater benefits but at a significantly lower cost than the preferred heavy rail option.

The heavy rail option performs well in terms of travel time and future patronage demand. It has risks associated with tunnelling in poor ground conditions at the Airport and has a considerable land requirement during construction. One of the key issues with heavy rail is the high cost of the option due to large infrastructure requirements and construction methodologies.

Table 8.10 Overview of shortlist option assessment against project objectives

✓ Good/beneficial impact - Neutral/minor impact ✗ Bad/negative impact

Project objective and performance criteria		Source/measure	Light Rail		Heavy rail		Bus rapid transit		Hybrid BRT / Heavy rail	
Significantly contribute to lifting and shaping Auckland's economic growth	Allows efficient access to existing and planned employment within the airport and business district	Travel time from model	✓	Station integrated into Masterplan	✓	Station integrated into Masterplan	✓	Station integrated into Masterplan	✓	Station integrated into Masterplan
	Allows efficient access to existing and planned employment from the wider Māngere area	Travel time from model	✓	Adds 5 stations at major employment nodes	-	Adds 2 stations with only major employment node	✓	Adds 5 stations at major employment nodes	✓	Adds 5 stations at major employment nodes
	Potential to increase development along the corridor	Qualitative assessment of employment catchments	✓	Least impact on available space and amenity	-	Improves access but reduces amenity	✓	Improves access but reduces amenity; serves large catchment in Manukau Road	-	Improves access but reduces amenity
	Enables employment growth and supports economic regeneration in the wider Mangere area	Qualitative assessment to employment catchments	✓	Increased capacity and reduced travel time	✓	Increased capacity and reduced travel time	✓	Increased capacity and reduced travel time	-	Increased capacity but travel time unaffected
Improve the efficiency and resilience of the transport network	Increases public transport patronage to/from the airport and business district	PT patronage from model	✓	2,500 trips/h in 2046	✓	2,500 trips/h in 2046	✓	2,500 trips/h in 2046	-	2,400 trips/h in 2046
	Reduces congestion to/from the airport and business district	Private vehicle km from model	✓	Benefits proportional to PT trips	✓	Benefits proportional to PT trips	✓	Benefits proportional to PT trips	-	Benefits proportional to PT trips
	Improves public transport travel times on key routes to/from the airport and business district	PT travel time in peak from model	✓	Faster than current bus	✓	Faster than current bus	✓	BRT faster than current bus	-	Slower speed to current bus due to interchange
	Enables efficient public transport travel between the City Centre and the Airport	PT travel time between CBD and airport from model. Target of 45 min for current bus.	✓	Faster than current bus to Onehunga	✓	Faster than current bus to Onehunga	-	Similar speed to current bus	✗	5 minutes slower than the current assumed bus travel time
	Improves freight travel times to/from the airport and business district on the	Travel times on strategic freight	-	Minor impact on freight outside of peak	-	Minor impact on freight outside of peak periods	-	Minor impact on freight outside of peak periods	-	Minor impact on freight outside of peak periods

	strategic freight network	routes from model		periods						
	Improves private vehicle travel times to/from the airport and business district within the area of influence of the study	Travel times on key routes from model	✓	Relief to traffic via diverted trips	✓	Relief to traffic via diverted trips	✓	Relief to traffic via diverted trips	✓	Relief to traffic via diverted trips
	Improves public transport journey time reliability to the airport and business district	Qualitative assessment	✓	Option runs in segregated tracks	✓	Option runs in segregated tracks	✓	Option runs in segregated lanes	✓	Option runs in segregated tracks/lanes
	Improves freight journey time reliability to the airport and business district	Qualitative assessment	-	Minor impact on freight outside of peak periods	-	Minor impact on freight outside of peak periods	-	Minor impact on freight outside of peak periods	-	Minor impact on freight outside of peak periods
	Improves corridor productivity on approaches to the airport and business district	PT travel time in peak from model	✓	Increased capacity and reduced travel time	✓	Increased capacity and reduced travel time	-	Increased capacity and reduced travel time	✗	Similar travel time to existing buses
	Connects key airport and business district areas, including employment	Qualitative assessment, GIS mapping	✓	Largest employment catchment and connectivity	✓	Large potential catchment	-	Fairly large catchment but better serves residential population than employment catchment	-	Lower Better serves areas of employment in south-west Auckland than heavy rail due to more stations
	Adds useful additional capacity	Volume at key screen lines from model	✓	Increases PT capacity by at least 2,000pass/h in each direction to airport	✓	Increases PT capacity by at least 2,000pass/h in each direction to airport	✓	Increases PT capacity by at least 2,000pass/h in each direction to airport	✓	Increases PT capacity by at least 2,000pass/h in each direction to airport
Improve the accessibility and transport choice in the Māngere-Ōtāhuhu area	Increases public transport patronage on the local network	PT Patronage from model	✓	Increase PT patronage on SH20A by at least 1000pass/h	✓	Increase PT patronage on SH20A by at least 1000pass/h	✓	Increase PT patronage on SH20A by at least 1000pass/h	✓	Increase PT patronage on SH20A by at least 1000pass/h
	Reduces congestion on the local network	Congested VKT from model	✓	Benefit proportional to PT trips	✓	Benefit proportional to PT trips	✓	Benefit proportional to PT trips	✓	Benefit proportional to PT trips
	Improvements to connectivity and transport choice in the wider Māngere area	Qualitative assessment	✓	Five stations for access and interchange	-	Five stations for access and interchange	✓	Five stations for access and interchange	✓	Five stations for access and interchange
	Impacts on the ability to provide a cycle metro facility within the State Highway corridor	Qualitative assessment	-	Not a differentiator – however, cycle facilities can be included within the existing corridor	-	Not a differentiator	-	Not a differentiator	-	Not a differentiator
	Impacts on the ability to	Qualitative	✓	Adds pedestrian	✓	Adds pedestrian overpasses	✓	Adds pedestrian	✓	Adds pedestrian

	integrate with local active mode networks	assessment		overpasses and cycle lanes		and cycle lanes		overpasses and cycle lanes		overpasses and cycle lanes
Contribute positively to a liveable, vibrant and safe city	Safety impacts	Qualitative assessment	-	Safety at crossings and intersections, access onto public transport, side roads and mobility access	-	Safety at crossings and intersections, access onto public transport, side roads and mobility access	-	Safety at crossings and intersections, access onto public transport, side roads and mobility access	-	Safety at crossings and intersections, access onto public transport, side roads and mobility access
	Personal security	Qualitative assessment	✓	CPTED principles for all stations	✓	CPTED principles for all stations	✓	CPTED principles for all stations	✓	CPTED principles for all stations
	Visual impacts	Qualitative assessment	✗	Elevated structures highly visible	✗	Elevated structures highly visible	✗	Motorway structures highly visible	✗	Motorway structures highly visible
	Contributes positively to local character	Qualitative assessment	-	Potential for improvement depending on quality of design	-	Potential for improvement depending on quality of design	-	Potential for improvement depending on quality of design	-	Potential for improvement depending on quality of design
	Contributes to the Airport as a 'gateway'	Qualitative assessment	✓	Airport station integrated into terminal	✓	Airport station integrated into terminal	-	Busway access combined with bus station	-	Busway access combined with bus station
	Promotes street vitality, active street edges and weather protection	Qualitative assessment	✓	LRT can enhance but most of SMART route is in separate corridor. Stations are weatherproof at 5 locations.	-	Minimal impact on local connectivity	✓	BRT stops may enhance Manukau Road. Stations weatherproof at all locations	✓	Most of busway route is in separate corridor. Stations weatherproof at 5 locations
	Allows sufficient space for pedestrian movement and activity	Qualitative assessment	-	Minimal impact on street space as SMART corridors are in motorway reserves	-	Minimal impact on street space as SMART corridors are in motorway reserves	✗	Adverse impact on Manukau Road	-	Minimal impact on street space as SMART corridors are in motorway reserves
	Impacts on heritage buildings and structures	Qualitative assessment	-	Passes historic buildings in Onehunga	-	Passes historic buildings in Onehunga	✗	Adverse impact on well-established buildings along Manukau Road (pre-1944 Building Demolition Control)	-	Passes historic buildings in Onehunga
	Land take requirements	Qualitative assessment	-	Minimal land impact	-	Minimal land impact	✗	Adverse impact on Manukau Rd	-	Minimal land impact
	Compatibility with the East	Qualitative	✓	Designed to avoid	✓	Designed to avoid	✓	Designed to avoid	✓	Designed to avoid

	West Connection alignment	assessment								
Optimise the potential to implement a feasible solution	The length of time required to construct the option		-	Tracks, power, major bridge construction – 3 years	✘	Track, power, elevated structure, major tunnel and bridge – 3+ years	✓	Busway and structures – 2 years	✓	Track and structures – 2 years
	Constructability		-	Moderate for bridge/major structures. Large off line sections	✘	Tunnelling in difficult environment	-	Impacts on Manukau Road services	✓	Straightforward
	The difficulty of consenting the option (planning requirements)	Qualitative assessment	-	Harbour crossing and proximity to outstanding natural feature, lagoon and Maori cultural heritage sites. Largely follows the existing road corridor	✘	Significant elevated structure which will impact on amenity	✘	Significant land take required along Manukau Road	-	Runs on existing shoulders across the Manukau Harbour
	The impact of construction on network utilities	Qualitative assessment	-	Largely runs in road reserve	✘	Potential risk to overhead lines to double track the OBL	✘	Largely runs in road reserve. Potential impacts along Manukau Road due to housing density. Significant risk to utilities associated with underground BRT stops on Broadway and Wellesley Street. Potential risk to overhead lines to double track the OBL	✘	Potential risk to overhead lines to double track the OBL
	The amount of temporary land take related to construction		-	Can largely be contained within the road reserve	✘	Large requirement due to tunnel boring	✘	Impacts to road reserve and footpaths particularly along Manukau Road to construct deep lift pavements	✘	Larger requirement due to double tracking of the OBL
	The impact of construction on transport network operations		✘	Major on SH20/20A. Off line sections have lower disruption.	✘	Major on SH20/20A	✘	Major on SH20/20A and OBL	✘	Major on SH20/20A and OBL
	The ability of the option to be constructed in stages		-	Can stage to	-	Can stage with OBL	-	Can stage to Onehunga	-	Can stage with OBL

				Onehunga		upgrade				upgrade
Provide a sustainable transport solution that minimises environmental impacts	Emissions effects including greenhouse gases	Transport model	✓	Reduction in GHG, significant diversion	✓	Reduction in GHG, divert private vehicles to public transport	✓	Reduction in GHG	-	Small change in public transport use and GHG
	The extent to which the operational noise and emissions of the option affects sensitive receivers	Qualitative	-	Not significant	-	Not significant	-	Not significant	-	Not significant
	Impacts on contaminated land or creates contamination issues	Qualitative	-	Not significant as largely in road reserve	✗	Industrial areas along the Onehunga Branch Line, potential contamination	-	Not significant as largely in road reserve	✗	Industrial areas along the Onehunga Branch Line, potential contamination
	Impacts to archaeological values	Qualitative	-	Non-differentiator	-	Non-differentiator	-	Non-differentiator	-	Non-differentiator
	The extent to which the option impacts open space and biodiversity	Qualitative	-	Minor	-	Minor	✗	Impacts on Manukau Road	-	Minor
	Cultural values impacts	Qualitative mapping	✗	Potential impacts to heritage sites	✗	Potential impacts to heritage sites	✗	Impacts to well-established buildings along Manukau Road and Newmarket	✗	Potential impact to heritage sites in Newmarket
	Impacts on non-built environment heritage values	Qualitative mapping	✗	Impacts on lagoon and heritage buildings in Onehunga	-	Follows existing rail corridor	✗	Impacts on lagoon and heritage buildings in Onehunga	-	Follows existing rail corridor
Investment in affordable solutions that provide value for money over the life of the asset	Construction cost – CAPEX (low/medium/high)	Quantitative assessment	-	$1.2 B	✗	Highest – up to $3.1 B	-	$1.8 B	-	Up to $1.1 B
	Gross operation cost – OPEX (low/medium/high)	Quantitative assessment	✓	Lower than Do Minimum	✓	Lower than Do Minimum	✗	Higher than the Do Minimum	✗	Higher than the Do Minimum
	Expected renewal cost (accrual cost per year)	Quantitative assessment	-	Infrastructure renewal not as frequent	-	Infrastructure renewal not as frequent	✗	Greater fleet / infrastructure renewal cost (pavement and buses)	✗	Greater fleet/infrastructure renewal cost (pavement and buses)
	Fleet cost	Quantitative assessment	✗	$42,000,000	✗	$45,000,000	-	$30,000,000	✓	$10,000,000
	Expected fare box revenue	Quantitative assessment	✓	Highest	-	Moderate	-	Moderate	✗	Lowest
	Maintenance cost	Quantitative assessment	✗	High	✗	High	-	Moderate	-	Moderate

9. Economic Case

The section outlines the economic assessment of the shortlisted options in alignment with the NZ Transport Agency assessment methodology.

9.1 Economic Methodology

An economic analysis of the short-listed SMART options has been undertaken in accordance with the NZTA Economic Evaluation Manual (EEM). This analysis has been undertaken and reported in a manner consistent with the Central Access Strategy Business Case, for ease of comparison. The EEM is as per updates issued by NZTA to January 2016.

The options are Heavy Rail (Low Cost and High Cost sub-options), LRT, BRT and BRT Hybrid (Low Cost and High Cost sub-options). As well as evaluating the SMART options themselves, this chapter also reports on SMART economic performance in the context of other projects. The SMART LRT option forms an extension of the Central Access Strategy LRT scheme, and would enhance its utilisation. The SMART Heavy Rail option would add demand to the North Island Main Trunk rail line and increase utilisation of the City Rail Link (CRL). The BRT options would interchange with the new bus network and improve connectivity to it.

Benefits have been determined using standard methodology for valuing savings in modelled travel time and vehicle operating costs. Demand forecasts and user benefits have been obtained from APT3 model output. Benefits for Wider Economic Benefits (WEBs) are discussed in Section 9.4.

9.2 Options Compared

Cost estimates have been prepared for the short listed and best performing options. These are included in Appendix F. The costs are only determined to a preliminary planning order of accuracy, for purposes of option comparison. They should not be used as programme figures. This is considered to be appropriate for the purpose of this IBC and is due to the lack of detailed survey, alignment plans and geotechnical data undertaken at this stage of project development. Heavy rail, light rail and BRT cost estimates were developed on a similar basis in 2016$ and therefore represent a like-for-like comparison of options.

1) BASE Central Access Strategy – with CRL and LRT on Dominion Road and Sandringham Road, used as a comparator for purposes of defining option benefits only (Do Minimum);
2) LRT – High speed with Onehunga access;
3) Heavy rail – refined heavy rail option cost incorporating EWC crossing.
   a) Heavy Rail Low cost – Heavy rail with Onehunga Branch Line upgraded with at grade crossings.
   b) Heavy Rail High cost – Heavy rail with Onehunga Branch Line upgraded with grade separated crossings.
4) BRT 4 – Busway Airport to Onehunga; bus lanes Manukau Road to City.
5) Hybrid BRT / heavy rail – Busway from the Airport to Onehunga; Heavy Rail Onehunga Branch Line to city centre.
   a) BRT Hybrid Low cost – Onehunga Branch Line upgraded with at grade crossing.
   b) BRT Hybrid High cost – Onehunga Branch Line upgraded with grade separated crossings.

9.3 Economic Benefit Categories

The categories of economic benefits considered are as follows:

- Public transport existing user benefits;
- Public transport new user benefits;
- Car Decongestion benefits;

- Public transport reliability;
- Health benefits from walking;
- Emissions;
- Residual value;
- Wider Economic Benefits (only agglomeration at this stage); and
- Noise.

Heavy rail benefits were previously calculated in the Interim SAR study. That benefit estimate has been updated to match the LRT benefit estimate, and both are compared in this chapter. It now includes emissions, health and wider economic benefits for the heavy rail benefits. This results in a higher benefit figure for the heavy rail than reported in the Interim SAR though, as we shall see, it remains lower than the LRT benefit.

9.3.1 Public Transport User Benefit (Existing and New)

Comparing the public transport user benefits of SMART (LRT and Heavy Rail) is complex because the two options connect to the city and rest of the Auckland public transport network via different routes. Consequently, they benefit different groups of PT users, by differing amounts.

Generally the heavy rail option gives the greatest benefit to commuters from the Airport to the northern City Centre. The LRT option gives the greatest benefit to commuters from the airport and Dominion Road corridor to the southern and central City Centre. The BRT option gives the greatest benefits to commuters from the airport and Manukau Road corridor to the City Centre. The BRT Hybrid option benefits commuters between the Airport and northern City Centre similar to the Heavy Rail option, although user benefits are reduced due to the time required to interchange at Onehunga.

Public transport user benefits for SMART rapid transit options fall into two categories:

- Travel time savings for LRT users transferring from current car or bus travel to LRT (the project will be faster than bus services and as road congestion increases over time will increasingly become faster than cars)
- Travel time savings for additional LRT users of the connecting Central Access Strategy system that commence a linked trip on SMART (LRT).

There is an additional category of user benefit defined in the EEM but not included in this analysis. Qualitative journey benefits accrue to PT rapid transit users from fixed infrastructure features such as better ride (due to a dedicated guideway), security, seating and passenger information systems. These may be converted to an equivalent time saving for valuation purposes under the EEM. In this instance they have been assumed to be incorporated within the mode specific factors for passenger willingness to use each mode built into the APT model mode choice segmentation.

Travel times for the CAP (LRT) base case were derived from the traffic micro-simulation models of the Auckland City Centre and Isthmus used to develop a reference design for that project. It should be noted that travel times for the CAP portion of the LRT (Queen Street and Dominion Road) have been reduced compared to previous assessments of SMART (LRT). As more detailed investigations of the CAP LRT option have proceeded, it has been possible to refine the design to improve LRT speed. Travel times for the SMART (LRT) were calculated using a traction power-model that determined acceleration and deceleration of LRT vehicles on each straight and curved section of the route. Travel times for SMART (Heavy Rail) users were calculated using a similar traction power model for the new track section from the Airport to Onehunga, and existing scheduled service times for trains from Onehunga to the city. Travel times for the BRT option were calculated from average bus service travel times, including stops, on existing busway corridors in Auckland.

Generally the LRT and Heavy Rail options have the largest potential travel time saving, and the BRT Hybrid option the least due to the time penalty for interchanging at Onehunga. Exact travel time saving for each journey varies depending on their origin and destination. The relative travel time benefit from SMART options compared to current modes will rise over time, as travel times on the current road network are likely to worsen with future traffic growth and congestion.

From 2015 onwards, SMART trips to the Airport provide travel time savings compared to car travel. Note that former car users of SMART (LRT or Heavy Rail) currently travelling by taxi to the airport will make a considerable financial saving in switching from taxi fares to public transport fares. However this is not a resource cost and is not counted in the economic benefit calculation (since it represents a gain to passengers and a loss to taxi drivers).

Public transport user benefits for both the SMART Heavy Rail and LRT options are lower in this analysis than in previous analyses that assumed the CAP base case would include LRT on Dominion Road and Manukau Road, rather than Dominion Road and Sandringham Road. This suggests that there were a significant number of linked public transport trips originating from the Airport – Mangere area with destinations on Manukau Road and in Newmarket. This does not change the relative merits of SMART options, but does suggest that a rapid transit facility in Manukau Road is of more benefit than one in Sandringham Road.

The BRT option may have potential for additional user benefits. Other existing bus routes in the south-eastern approaches to the city that pass along or near Manukau Road but are not destined for Onehunga or the airport, could be rerouted to Manukau Road to take further advantage of the travel time savings gained from the BRT lanes and stops. This is likely to increase PT user benefits in the short term. In the long term, when bus numbers on Manukau Road exceed 100 during the AM or PM peak, this may cause failure of the bus stops on capacity grounds, reducing asset life or necessitating additional investment. Assessment of this potential benefit stream will require a broader investigation of bus services in this sector in further phases of SMART project development. Nevertheless, it is considered that for this reason, the BRT option is likely to be more feasible than the raw BCR number suggests.

APT modelling of SMART rapid transit options was available for 2026 and 2046. Demand and user benefits were extrapolated between these years and beyond them to the horizon year. The starting year of investment was assumed to be 2022, with a four year investment period (including property acquisition and construction), and a f40 year analysis period extending to 2061. APT model benefits were factored by the 2015 NZTA EEM update factors, to match 2016 valuations, since the APT model was calibrated with previous (2008) economic parameters from the EEM as it was at that time.

APT model benefit outputs for the Heavy Rail option were manually adjusted to increase the public transport user benefit for airport trips to match the calculated travel time saving to the airport. This corrected an anomaly in the model rail average speeds.

APT model benefit outputs for the BRT Hybrid option were manually adjusted to match half the benefits of the BRT option (for the common section of busway from the Airport to Onehunga). The raw APT model outputs for the BRT Hybrid option gave a negative benefit valuation, as the bus/rail interchange time penalty at Onehunga gave a travel time slower than existing bus services. In practice, a negative benefit valuation is nonsensical and is considered an artefact of the APT modelling process. In reality if travel from the airport to the city were faster by the existing private express bus airport passengers would remain on that service and no negative benefit would occur. This result highlights that the economic case for the BRT Hybrid option is poor. Introduction of LRT or Heavy Rail in place of buses also creates qualitative improvements for PT passengers, in terms of the level of amenity on the vehicle and while waiting at stops. Vehicle improvements include on-board information, air-conditioning, ride quality and seating comfort (the LRT vehicle and seats are wider than a bus). Stop improvements include shelter, security measures and information.

9.3.2 Car Decongestion Benefit

To the degree that they attract new trips to public transport from car travel, SMART options will result in some reduction of projected future car congestion. This benefit is largest for the options that attract the most new passengers to public transport, namely LRT and BRT.

This benefit was calculated for each option from APT model statistics for total network car trips and average delay, by comparing the option and base case road network performance. Separate modelling of the traffic impacts of the Onehunga Branch Line with and without grade separation has not been carried out. Therefore the Heavy Rail and BRT Hybrid High Cost and Low Cost options will have the same reported benefits. In practice, the High Cost options would have a higher decongestion benefit, owing to the removal of delays at level crossings. This benefit would require mode detailed modelling to calculate at a later stage of project development, although in practice it is not proposed to develop either option further.

9.3.3 Public Transport Reliability

Travel time reliability is a significant factor in people's choice to use public transport and also affects the perception of system quality by public transport users. Introducing a rapid transit system (bus rail or light rail) travelling in exclusive right of way, together with traffic priority measures such as signal pre-emption, will both reduce travel time and greatly improve the running time reliability of public transport services compared to buses mixing in general traffic. The EEM permits a benefit for improved public transport reliability to be assessed up to the magnitude of the public transport user benefit. This has been incorporated into benefit calculations for all SMART options.

The value of the public transport reliability benefit is determined by the relative improvement in travel time reliability likely from the project. For SMART the project will replace current bus services from the Airport to the City Centre (Airbus) and from the Airport to Onehunga (Service 380). Data collected from every Airbus Express service between November 2013 and September 2014 showed that the travel time on weekdays for services departing during the peak varied from 38 - 77 minutes. The average variability in travel time is 6 minutes with current buses.

With the replacement of the bus services by BRT, Heavy Rail or LRT operating in a separate right of way, travel time reliability is likely to be improved from an average variability of 6 minutes or more with current buses, to an average variability of 2 to 3 minutes or less with SMART. That is, travel time variability should be able to be reduced by 3 to 4 minutes or more. The assumption for LRT travel time variability has been confirmed by modelling for the Central Access Strategy. Given that all SMART options operate in a dedicated alignment, the Central Access Strategy time performance should be able to be equalled or achieved by all SMART options.

Under the EEM assessment methodology, an improvement in travel time reliability of 1 minute is sufficient to derive a user benefit equal in magnitude to the travel time saving (public transport user benefit). For SMART options the improvement in travel time reliability is likely to be three times that. Therefore, this benefit is capped for SMART LRT at a value equal in magnitude to the public transport user benefit for SMART LRT.

9.3.4 Health Benefits from Walking

Physical activity is closely linked to rates of obesity and the incidence of various severe diseases. The EEM recognises that public transport that encourages a greater degree of walking will have a secondary health benefit for the public transport users. SMART is likely to increase walking in the study area due to two factors:

- Additional public transport users who currently drive will instead walk to the SMART stops to catch the LRT or Heavy Rail. This is assumed to be an average distance of 400 metres
- Existing public transport users who currently catch the local (Route 380) bus will have a slightly increased average walking distance. SMART stop spacing along the LRT and BRT routes is also longer than the current bus stop spacing. This is assumed to be a net average distance increase of 100 metres.

This parameter has been calculated for the IBC. It is likely to be a positive (and additional) benefit for all SMART rapid transit options. The LRT project is likely to gain the largest health benefit as the increased number of local destinations accessed by additional stations in the Mangere area should attract more local trips, encouraging more local residents to walk to the LRT rather than using their car.

9.3.5 Emissions

The EEM allows for the value of reduced emissions resulting from a project to be counted as a benefit, based on the carbon price for reduced fossil fuel burning, and the value of health benefits from reducing particulate emissions. For SMART (Heavy Rail and LRT), emission reductions will occur from two sources:

- The project will enable the replacement of current bus services to the airport (Airbus) and AT local passenger services (Route 380) in Mangere and Mangere Bridge.
- The project will result in a net reduction in car travel, particularly south of Mangere, as modelling suggests that some employees and passengers travelling to Auckland Airport by car will prefer LRT to driving.
- For SMART (BRT) options, only the second source of emission reductions is relevant.

The valuation of emission benefits is based on the same parameter costs as used for the Central Access Strategy:

- CO2: $40 / tonne
- Particulates (PM10): $399,000 per tonne
- NOx: $10,400 per tonne.

Annual service kilometres for replaced bus services and reduced car vehicle kilometres travelled are the same as those used in the operating cost assessment. Assumptions on emissions per bus, car and LRV are identical to those assumed for the Central Access Strategy.

Both the LRT and Heavy Rail options achieve a positive and similar benefit for reduction of emissions. Energy usage per service km for Heavy Rail and LRT vehicles is assumed to be the same.

9.3.6 Residual Value

The residual value of the SMART capital investment has been calculated based on the depreciated value of the lane/ track asset at the end of the analysis period of 40 years. The asset is assumed to be worth 50% of its construction cost (discounted) at that time.

Rail infrastructure (heavy or light) tends to have a very long operating life, with examples of systems still in operation on track in Germany and Melbourne over 70 years old. With electric rolling stock and modern rail track there is no appreciable difference in design life between heavy and light rail.

For SMART BRT the residual value for the busway and BRT track and stops infrastructure has been calculated in the same manner as the rail options. Average life for bus rolling stock has been assumed to be 14 years, with no residual value.

9.3.7 Noise

The SMART (LRT) project runs predominantly in a high speed alignment in or parallel to SH20 and SH20A. Relative to the ambient noise level in these environments we do not expect there to be any significant noise reduction as a result. Therefore no economic benefit from noise reduction has been calculated.

There may be a small benefit from noise reduction in Princes Street in the section of SMART (LRT) that connects to the interchange in Onehunga. This may be investigated and quantified in the next phase of the business case process. Overall it is expected that the SMART (LRT) project will have a positive but small impact on noise levels, due to a reduction in the number of surface buses when they are replaced by LRT services.

The SMART (Heavy Rail) project, similar to the LRT, runs predominantly in a high speed alignment parallel to SH20 and SH20A. Relative to the ambient noise level in these environments, we do not expect there to be any significant difference (increase or reduction) in noise level as a result. No economic benefit from noise reduction has been calculated.

There may be a small adverse impact in noise levels in Onehunga from the duplication of the Onehunga to Penrose heavy rail line and the need to move the Onehunga Station into Princes Street. This is considered unlikely to be significant and may be countered by a slight reduction in traffic volume from a shift in travel mode shares caused by the project. Consequently no noise dis-benefit has been calculated for the heavy rail option.

9.3.8 Summary of Benefits

Benefits have been summed to calculate overall benefit valuations for SMART rapid transit options and then discounted and compared with costs to derive Benefit Cost Ratios (BCR) and Net Present Values (NPV) for each SMART option. For the SMART Heavy Rail and BRT Hybrid options, BCRs have been calculated for the High Cost (Onehunga Branch Line grade separated) and Low Cost (Onehunga Branch Line at grade) options, with the different capital costs of each, but assuming project benefits were the same.

SMART LRT benefits are based on the difference in transport costs between the Central Access Strategy (Option 10) network and the Central Access Strategy with SMART added, and without. The SMART heavy rail October 2015 option also includes the Central Access Strategy (Option 10) as the comparison, to allow a 'like for like' comparison to be made between the two. The economic evaluation methodologies for these two options are the same.

Overall, LRT generates higher public transport user benefits than the Central Access Strategy, due to the LRT better catering for local travel demands in the Onehunga to Mangere corridor, which are poorly served by the current local bus (380). SMART also increases benefits beyond the Central Access Strategy, since it both adds public transport trips to the SMART LRT alignment, as well as additional linked trips on the Central Access Strategy. LRT also results in additional heavy rail trips through the heavy rail/light rail interchange at Onehunga.

The costs and benefits calculated for the SMART options have been discounted assuming discount rates of 4%, 6% and 8% per annum. The Benefit Cost analysis for all SMART options has been undertaken with a discount rate of 6%, and sensitivity tests for 4% and 8% discount rates. This is in accordance with the NZTA Economic Evaluation Manual (EEM), January 2016.

It should be noted that these discount rates are relatively high compared to a recent history of New Zealand interest rates and rates of return on equity, which have been markedly lower since the end of the "Dot Com" bubble in the early 2000s. The New Zealand Treasury monitors both long term real and nominal interest rates and discount rates. The nominal long term discount rate for asset valuation has been lowered from 5.5% to 4.75% as of May 2016. The last survey of real long term rates of return (2010) varied from 3.65 to 4.4%. All of this would suggest that the 6% discount rate is relatively high, and closer to a nominal rate of return on commercial borrowing, than a government borrowing or discount rate. Refer to the following websites:

http://www.treasury.govt.nz/publications/guidance/reporting/accounting/discountrates

http://www.treasury.govt.nz/publications/guidance/reporting/accounting/discountrates/methodology/05.htm

Other jurisdictions are now using lower discount rates for infrastructure appraisal. This can have a significant effect on option selection where some options have longer asset lives (e.g. rail vs road). For example, the UK Department for Transport now specifies a 4% discount rate as standard, with a sensitivity test for 3%.

The discounted costs, benefits, benefit cost ratio (BCR) and net present value (NPV) for assessed options are shown in Table 9.1 for the mid-point discount rate of 6% per annum as per EEM Guidelines.

Table 9.1 Discounted costs and benefits for shortlisted options at 6% discount rate

	Light rail	Heavy rail (low cost)	Heavy rail (high cost)	BRT	Hybrid (low cost)	Hybrid (high cost)
Benefits						
PT Existing User Benefits	$173 M	$95 M	$95 M	$122 M	$61 M	$61 M

PT New User Benefits	$109 M	$74M	$74 M	$24 M	$0	$0
Car Decongestion Benefits	$62 M	$21 M	$21 M	$31 M	$0	$0
Reliability	$282 M	$169 M	$169 M	$146 M	$61 M	$61 M
Walking	$91 M	$82 M	$82 M	$82 M	$72 M	$72 M
Emissions	$13 M	$13 M	$13 M	-$30 M	-$12 M	-$12 M
Residual Value	$43 M	$92 M	$105 M	$54 M	$25 M	$38 M
Agglomeration	$67 M	$67 M	$67 M	$67 M	$34 M	$34 M
TOTAL Benefits NPV	**$840 M**	**$612 M**	**$625 M**	**$497 M**	**$241 M**	**$254 M**
Costs						
Capital	$847 M	$2,000 M	$2,000 M	$1,200 M	$507 M	$732 M
OPEX	-$57 M	-$54 M	-$54 M	$130 M	$58 M	$58 M
TOTAL Costs NPV	**$790 M**	**$1,714 M**	**$1,946 M**	**$1,317 M**	**$564 M**	**$790 M**
BCR	**1.06**	**0.36**	**0.32**	**0.38**	**0.43**	**0.32**

The BCR results for each shortlist option for each discount rate are shown in Table 9.2. The BCR for the LRT option is much higher than the BCR for the Heavy Rail option. This is because they both generate similar levels of benefits but the heavy rail option costs significantly more.

Table 9.2 Option benefit cost ratios

SMART Option	BCR		
	4%	6%	8%
LRT	1.52	1.06	0.78
Heavy Rail (Low Cost)	0.53	0.36	0.26
Heavy Rail (High Cost)	0.48	0.32	0.23
BRT	0.53	0.38	0.28

BRT Hybrid (Low cost)	0.59	0.43	0.32
BRT Hybrid (High cost)	0.46	0.32	0.24

Overall the SMART LRT gains the best economic result for the following reasons:

1) Public transport patronage and trip length for passengers are both increased by SMART LRT, meaning there are more passengers using the system, with a greater benefit per passenger.
2) LRT extends the City Access Program network, making use of the depot and facilities constructed in the City Access Program. Construction cost per kilometre has reduced for LRT compared to the initial Central Access Strategy.
3) SMART LRT improves public transport services to areas currently with poor public transport accessibility, notably in Mangere and Mangere Bridge. Demand from this area is *more significant to the project than demand from the airport.*

Benefit Cost Ratios (BCRs) for the short-listed and best performing options for the standard range of Treasury stated discount rates (4%, 6% and 8%) are shown graphically in Figure 9.1.

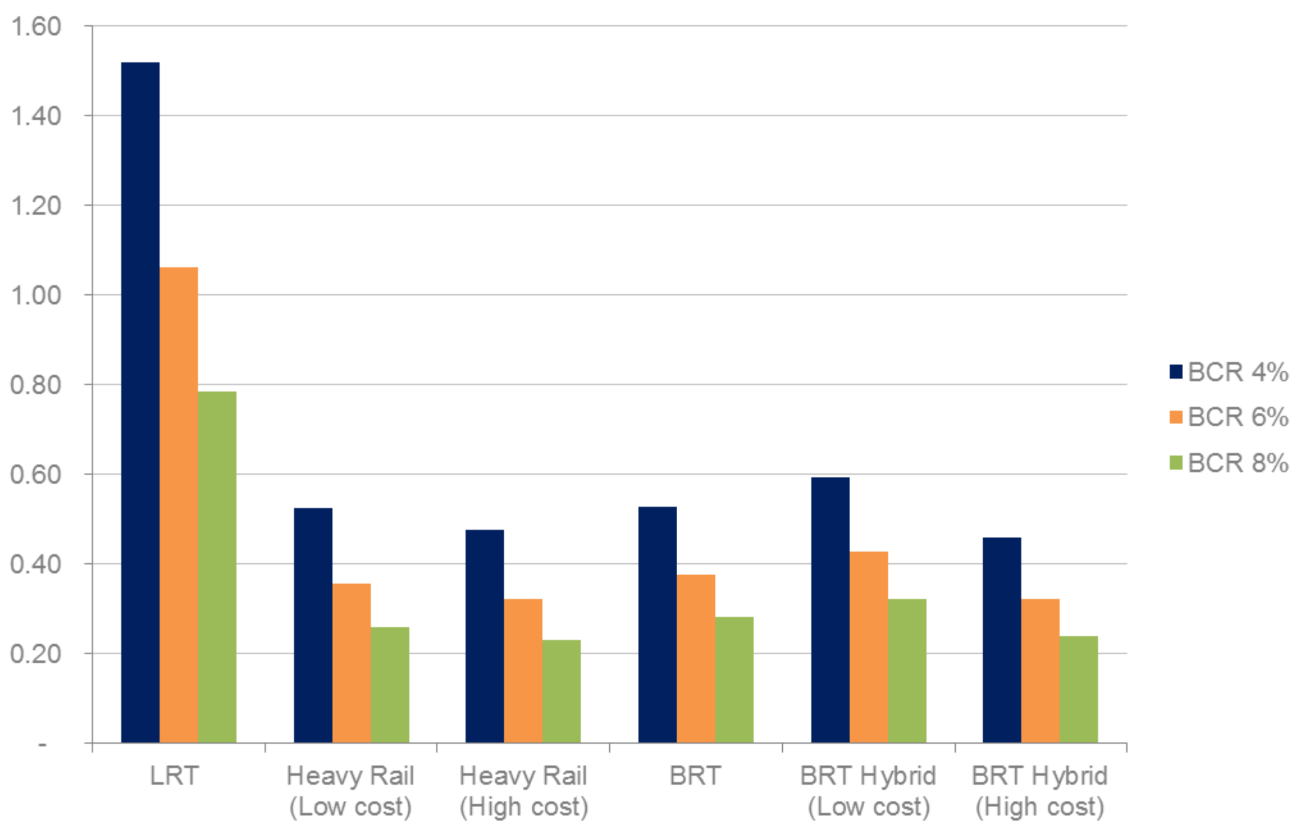


Figure 9.1 SMART options benefit cost ratio comparison

Caveats should be noted for these interim business case BCR results:

- Benefits have been calculated from APT modelling data in the absence of ART 3 modelling outputs.
- Any conflicting dis-benefits to car travel are not identified in the APT model.
- Benefits have not been calculated for emissions, health benefits from walking or operating costs
- Costs have been calculated from order of magnitude estimates. Accuracy is only approximate.
- Costs are based on plans developed without survey. This increases estimating risk.

- There is an unquantifiable geotechnical risk for the Manukau Harbour Bridge because foundation conditions are unknown.
- There may be other options with superior performance that have not yet been identified.

9.4 Wider Economic Benefits

Wider Economic Benefits (WEBs) are those positive impacts not captured in standard cost-benefit analysis, and include effects relating most importantly to agglomeration, but also to returns of scale, densification of labour markets, and company or household behavioural adaptations to changes in transport infrastructure and related cost structures. It is assumed that all rapid transit options that connect the Airport and adjacent employment areas to the rest of the city with high quality public transport services will achieve some form of WEBs benefit. This has been calculated for the LRT option[55], and the benefit applied to all short listed options. This assumption is considered appropriate, since each option has similar travel time to the airport except the BRT Hybrid, for which WEBs benefits are halved.

The NZ Transport Agency Economic Evaluation Manual sets out economic evaluation procedures and values to be used for calculating benefits and costs and for preparing applications or business case seeking investment for land transport projects in NZ. The EEM states that the following WEBs can be used in a NZ project evaluation context:

- Agglomeration where firms and workers cluster for some activities that are more efficient when spatially concentrated.
- Imperfect competition where a transport improvement causes output to increase in sectors where there are price cost margins.
- Increased labour supply where a reduction in commuting costs removes a barrier for new workers entering the workforce.

WEBs for LRT projects can be significant, with several recent studies (e.g. Melbourne Metro and Hobart Light Rail) establishing that WEBs added notably to traditional user benefits. As another example, in Adelaide, a recent *post hoc* study of the Adelaide LRT CBD extension revealed WEBs that were worth more that the entire capital cost of the project. These benefits were over and above the traditional transport benefits derived from the investment. The following section provides an overview of the WEBs assessment.

9.4.1 SMART WEBs Assessment

WEBs assessment was originally calculated for the LRT option and has then been extended to the Heavy Rail and BRT options.

The WEBs assessment is based on the best performing LRT option. The option joins the proposed SMART (LRT) with the City Access Program (Britomart to Denbigh Avenue LRT). This assessment assumes that the Britomart to Denbigh LRT section is committed and therefore the WEBs / development impact is the impact of extending the LRT to the airport and surrounding business areas.

The Auckland Airport Master Plan indicates there are currently 900 firms operating within the airport and surrounding business areas, employing ~20,000 people in total. Currently, there is an additional 400 hectares of provisional space which can be used to expand the site.

The ART3 model predicts that access routes to the airport and particularly SH20 and SH20A will remain congested in 2021 and will be very congested from 2026. The LRT will impact on employment growth within the airport and surrounding business areas, supporting additional development through its impact on accessibility, capacity and image.

[55] Development Impact of SMART LRT – Draft Report, Volterra Partners, January 2014

Improvements in accessibility and image from the LRT will mean that the airport and surrounding business area becomes a more attractive place to work, thus providing a more attractive location for investment. This is the major impact LRT provides over the current trend rate of development.

The capacity impact is to overcome what would otherwise be a constraint on growth within the airport and surrounding business areas. That is, the difference between the trend rate of growth and what will actually be able to occur without the LRT before further development is constrained by congestion. Increasing traffic volumes along the two State Highways serving the City Centre and the airport mean that journey times by bus and car are becoming longer.

The image effect is that investors, employers and workers are all more likely to invest or base themselves in nicer places. LRTs generally create nicer locations than would otherwise be the case. They tend to be green, modern, reliable, quiet and require no parking spaces. The overall impact is to increase the attractiveness of the areas they serve, whether residential or commercial.

10. Financial Case

This section outlines the financial considerations for the project and outlines possible funding sources and commercial opportunities pertaining to the two options recommended to be taken forward for further more detailed analysis. Note that more detailed analysis of the financial case, including ultimate affordability for the project's stakeholders takes place at the Indicative and Detailed Business Case stages. The following section provides a high level comparison of the likely Whole of Life (WoL) costs for each shortlisted option against the agreed Base Case 'do minimum' option.

10.1 Impact on financial statements

Current cost estimates are based on high level concepts only. More detailed costing certainty will be provided at subsequent option development, planning and Business Case stages. These more detailed cost estimates will be based on a more advanced level of understanding and design.

Table 9.3 shows the current estimated capital and operations / maintenance costs for the two options recommended to be taken forward for further development (LRT and BRT). These have been rounded to the nearest $ million.

Table 9.3 Summary of estimate financial costs

Description	LRT	Bus Rapid Transit (BRT)
Total Land & Property	$75 M	$321 M
Total Investigation & Reporting	$21 M	$14 M
Total Design and D&C monitoring	$61 M	$42 M
Total D&C delivery	$817 M	$1,050 M
Total Contingency	$270 M	$385 M
Total expected cost	**$1,244 M**	**$1,812**
Total operating costs including increases in normal asset maintenance	$5 M (annual)	$11 M (annual)

10.2 Projected delivery timeline (LRT)

It is anticipated that the Central Access Strategy works would be constructed and operational prior to the commencement of SMART (LRT) Option 2. Overlapped or parallel construction may be possible if both funding and market capacity to deliver such capital works is deemed adequate. It may however be preferable to deliver the capital works sequentially. At this stage, if progressed, SMART LRT Option 2 construction is assumed to commence in 2021 with completion and commissioning occurring in 2025 (allowing for a 4+ year construction period).

The possible staging of the Central Access Strategy and LRT Option 2 is shown in Table 9.4.

Table 9.4 Possible staging of the Central Access Strategy and LRT Option 2

Project	Construction period	Operating by
Central Access Strategy (City)	2018 – 20	2021+
Central Access Strategy (Dominion Road)	2018 - 20	2021+
Central Access Strategy (Sandringham Road)	2019 - 21	2022+
SMART (LRT) Option 2	2022 - 25	2026+

Based on the LRT route being in operation in calendar year 2026, the following is a possible programme (Table 9.5):

Table 9.5 Estimated LRT option delivery programme

Calendar year	Activity
2016 - 2017	SMART Indicative Business Case completed
2017	Consultation and agreement on delivery and procurement models to be applied Funding and environmental approvals secured
2017	Community consultation undertaken Regulatory regime and operating model agreed
2018 - 2020	Property acquisition undertaken Detailed surveys undertaken
2021	Services relocation undertaken Preconstruction works undertaken D+C contract procured and detailed design completed Rolling stock contract negotiated and order placed
2022-2025	Construction of track, depot and stations commenced Light rail rolling stock purchased Major structures completed Landscaping completed Commissioning of rolling stock completed Handover and commencement of operations

Tighter construction periods may be possible (three years instead of four) but this program has been assumed for purposes of economic analysis and has been deliberately kept conservative.

10.3 Projected delivery timeline (BRT)

It is considered that construction of the bus rapid transit option could commence in 2023, the construction period being estimated as shorter than that for LRT, due to the absence of major bridgeworks.

Based on the BRT option being in operation in calendar year 2026, the following table provides an indicative programme:

Table 9.6 Estimated BRT delivery programme

Calendar year	Activity
2016 - 2017	SMART Indicative Business Case completed
2017	Consultation and agreement on delivery and procurement models to be applied Funding and environmental approvals secured
2018	Community consultation undertaken Regulatory regime and operating model agreed
2019 – 2021	Property acquisition undertaken Detailed surveys undertaken

Calendar year	Activity
2022	Services relocation undertaken Preconstruction works undertaken D+C contract procured and detailed design completed Rolling stock contract negotiated and order placed
2023-2025	Construction of busway, depot and stations commenced Bus rolling stock purchased Major structures completed Landscaping completed Commissioning of rolling stock completed Handover and commencement of operations

10.4 Key Assumptions

The high-level assumptions underpinning the forecasts for both shortlisted project options are described in Table 9.7. It is important to note that all option estimates are high level and have been provided without the benefit of surveys, field investigations and other more detailed design and analysis. More detailed analysis will be completed during subsequent stages of project development.

Table 9.7 Key assumptions for LRT and BRT options

Category	Details of assumptions for both LRT and BRT
Project costs	Project costs estimates based on initial Project Team and QS cost analysis of high level options. Key uncertainties include: • Geotechnical, (further investigation in the next phases) • Property and business compensation (further analysis in the next phases) • Route / Lane configuration / capacity, (Investigation & modelling in the next phases) • Environmental mitigation / enhancement, (not allowed at this stage)
O+M costs	• LRT - Based on those used for the assessment of the LRT network. They include staff and power costs, track maintenance and renewal costs and 'other' service cost components. For LRT it is assumed that the operator would be the same for CAP and SMART in order to avoid unnecessary duplication of facilities, contracting resources, risk and regulatory regimes. • BRT - Costs to be based on current average contract operating costs for AT bus system. This would include staff, fuel, vehicle maintenance, stop facilities and deprecation.
Development timeframes	• Construction timeframes based on individual project characteristics and Project Team estimates • Property purchases assumed to start at least one year prior to construction
Funding costs	Funding costs are not included in project costs as they are dependent on the analysis of funding solutions. Possible funding options are to be developed and refined at the IBC and DBC stages, with improved understanding allowing more informed decision making around funding option(s) feasibility.

10.5 Funding Sources

A combination of central, local government and private funding sources may be available to deliver and sustain either of the two shortlisted options being progressed to the next stage of assessment. Central government funding may be sought subject to negotiation between Auckland Transport and the NZ Transport Agency. Additionally, private sector funding may be brought to bear if deemed appropriate by Auckland Transport and/or NZ Treasury. It is considered that there may be private funding opportunities available for either of the shortlisted project options. These arrangements will be assessed further during subsequent project development stages.

10.5.1 Funding Opportunities

Auckland's Regional Land Transport Programme (RLTP) is currently funded primarily through 'traditional' taxes levied on businesses and individuals. There are a number of possible sources for funding (or part funding) either of the shortlisted project options. These should be explored in detail in the next phase of project planning and development. Some of these options are presented below:

- Central Government
- Local Government – Auckland Council
- Value capture through:
  - Contribution to costs from Auckland International Airport Ltd, who will be a major beneficiary from either project option being delivered. The current Airport masterplan factors in substantial commercial and industrial development that would be directly facilitated by either SMART LRT or BRT options.
  - Private beneficiaries adjacent to new LRT or BRT route and station sites through a benefited area scheme. The Manukau Road route for the BRT option would increase this potential.
  - Developers who may be involved in new developments around new station or interchange sites (e.g. Transport Orientated Developments (TODs)), subject to amendments to the Unitary Plan.
  - In the case of LRT or BRT, private 'Park and Ride' operators at Mangere Town Centre, Denbigh Avenue (LRT only) and Three Kings (LRT only) sites (if deemed desirable to attempt to secure such an arrangement).
  - For BRT only, improvement of bus capacity in Newmarket may support increased retail and commercial density.
  - The BRT option on Manukau Road has the potential to reduce operating costs and improve revenue for other existing bus services not destined for the airport. These savings may warrant review of the current contract pricing for those services.
- Private finance brought through PPP / BOOT style arrangement may be possible for both LRT and BRT options.
- Other possible arrangements such as City Centre parking levy or City Centre road area (or cordon) pricing scheme, or SH20 tolling, where monies generated could be used to fund such PT projects.

It is recommended that these possible funding sources be researched and tested in more detail to establish feasibility, palatability and the most appropriate combination going forward, through a separate process subsequent to this Indicative Business Case.

10.5.2 Traditional Funding by Central and Local Government

Most major transport projects in New Zealand are funded through traditional means via taxation of businesses and individuals. This approach is well understood and is generally a 'known quantity'; however the Government funding body administering funding and managing the contracts wears significant risk under this funding regime.

These risks must be carefully managed, as transfer to private sector contractors is difficult to achieve. This however can be achieved through the adoption of robust processes and the selection of appropriate personnel for key positions. It is recommended that the opportunities and constraints related to alternative approaches should be assessed relative to this traditional method of project funding and delivery.

10.5.3 Funding through Public Private Partnerships (PPP)

A PPP can be defined as *"a long term contractual arrangement between a public authority and a private entity for providing a public asset or service in which the private party bears significant risk and management responsibility."*

When well designed and implemented in a balanced regulatory environment, PPPs can bring greater efficiency and sustainability to the provision of public services such as transport, water, sanitation, energy, telecommunications, health care and education. PPPs can also allow for the more equitable allocation of delivery risk between public and private bodies, taking into account their capacity to manage those risks.

This structure can help make the most of limited public funding and can be used to introduce private sector technology, experience and innovation, to provide better quality public services through improved design and operational efficiency.

It is also important to recognise that PPPs are just one tool available to Government. Every country has its own unique challenges, priorities, and financial constraints. In some cases, PPPs can bring great benefit by leveraging the management, innovation and expertise of the private sector, but in other circumstances a traditional public sector approach may be more appropriate or palatable for Government.

In theory, both light rail and bus rapid transit lend themselves well to a PPP style arrangement, with many of each (with varying success) delivered worldwide. A future PPP for BRT may however be more difficult due to the existing bus contracts and their geographic scope and nature.

It should be noted that PPPs for public transport projects can be financially risky and there are a number of unsuccessful examples to learn from, including Brisbane Airport Rail-link and Sydney Airport Rail-link, plus a number of recent Australian road tunnel PPP toll projects that also went bankrupt. Generally PPPs have managed delivery and operational risks well, but not demand forecasting risk. The latter risk should remain with government. The recent successful delivery of Gold Coast Light Rail using a PPP contract demonstrates that this split may be achieved in a well-designed contracting mechanism.

Income generated from the PT operations is not generally sufficient to facilitate the repayment of capital outlay, so a separate mechanism is required to repay the net financial cost of project delivery.

10.5.4 Funding through value capture

Value capture represents an attempt to recover part or all of the cost of transportation improvements from private landowners or developers who benefit directly from the resulting increase in the real value of land or property. Value capture revenue mechanisms can include:

- Tax increment financing
- Special assessments
- Development impact fees
- Negotiated exactions
- Benefited area schemes
- Joint development

In the case of either shortlisted option, a benefitted area scheme may be appropriate. Property value uplift is likely for properties within an approximate 400m distance of key station sites along the proposed LRT or BRT alignments. LRT projects in other jurisdictions have demonstrated the ability to achieve such uplift over longer distances where pedestrian links to stations are of high quality.

In the case of LRT - notable uplift may be experienced around planned station locations (in Three Kings, Onehunga, Mangere Bridge, Favona, Mangere, and Ascot) and a portion of this benefit could be 'taxed' in the form of increased Council rates. This can then contribute directly to project funding.

Similarly for BRT, at the planned station locations of Mangere, Favona and Mangere Bridge, value uplift can be expected and a similar arrangement could be implemented.

In Mangere however, where average property values are relatively lower than in surrounding areas, unemployment rates are above the city average, and where stimulating increased economic development is an acknowledged Auckland Plan objective, increased taxation to extract any property value uplift in this area may not be socially or economically desirable. It is likely that this could represent a disincentive to increased economic activity or investment in the area.

A more socially equitable mechanism to implement value capture in a project corridor might, for example, be to limit its focus only to benefitted properties with real property valuations that are above the city average.

Historically, value capture contributions have usually taken the following forms:

1) The ceding of land for transport corridors, public open spaces, school sites, drainage or other types of reserves.
2) Construction of infrastructure works which are transferred to public authorities upon their completion.
3) Voluntary monetary contributions to acquire land or to undertake works by public authorities or others.
4) Levies placed on private beneficiaries as a result of Government project expenditure.
5) Incremental land taxes and rates revenues from property value uplift beyond historical trend may be hypothecated towards repaying project capital.

In this case of LRT or BRT networks, the fourth approach may be most viable, although in some instances, developers around new station sites can be encouraged to either contribute funds and/or construct required infrastructure to offset a portion of the benefit that they may realise due to the project. The fifth approach is similar, and has been used for several projects in Canada and the United States. It has no adverse impact on development viability but requires long term financial discipline and agreement between government agencies.

It is generally accepted that the following principles should apply in determining the validity and extent of any private sector contributions:

- The contribution (tax) must be fair and reasonable and reflect the true costs of the infrastructure, or a reasonable portion of the private benefits realised.
- The contribution should be fairly apportioned between multiple parties proportional to the share of their need, or of the benefit they experience.
- Any financial contributions must be spent within a reasonable and agreed period of time.
- There should be clear transparency and accountability for the manner in which contributions are determined and expended.

If it is deemed desirable to look further into the possibility of adopting value capture for the ultimate project solution, in either a LRT or BRT case we suggest that there are two means of identifying and assessing the contribution that may be appropriate:

1) Number of households and business that may be in the 'area on benefit'.
2) Assessment of the individual benefits that may be experienced.

In the case of either the LRT or BRT option, it is considered unlikely that private beneficiaries would agree to voluntary contributions, therefore a transparent and equitable means of calculating and collecting a portion of the private benefits experienced would be required. Many Governments have a well-established understanding and relevant supporting procedures for value capture and if deemed appropriate, these proven methods could be adopted and applied to either LRT or BRT benefitted areas.

Importantly, a key advantage that Auckland has over many other cities is the fact that the LRT or BRT project sits wholly within one Council area and so if this type of approach is seen as attractive, it negates the required negotiating and ongoing management of complex arrangements and interfaces between multiple LGAs, each of whom can have a different position on such schemes.

A major beneficiary from either the SMART LRT or the BRT project would be Auckland International Airport Ltd. The delivery of either project option would greatly improve accessibility to the airport for passengers and employees, and would likely increase land values and surrounding development uptake markedly.

It is recommended that this situation be assessed in more detail should project development proceed past the Indicative Business Case stage.

10.5.5 Funding through BOOT type projects

Private sector funding input into the procurement of public works and services is continuing to increase in Australasia. This is driven by the requirement to deliver infrastructure that both maintains and facilitates growth. Managing this situation is a challenge for both the construction industry and for Government. The increase in BOOT (Build, Own, Operate, and Transfer) projects is a response to the need to deliver infrastructure whilst not impacting negatively upon the Government's often limited budgetary allowances.

BOOT projects are complex, with an inequitable portion of the risk being transferred to the private sector. This risk, consequently, tends to be priced into the contract. There are well acknowledged risk factors that can be used to determine the likely issues with BOOT projects, and so attempts can be made to mitigate these through the relevant stages of the project development and delivery. Administration costs also tend to be relatively high in BOOT project environments.

Successful public and private partnership BOOT projects in Australia and New Zealand are hard to find, as the concession periods (often 20 to 30 years) have generally not yet expired, and so the financial outcomes for each party are not yet clear.

Under a BOOT arrangement, the private sector constructor builds the project, and then owns and operates the asset for a set period of time (usually 20+ years) during which they collect the revenues generated. At the end of the contract period, the project is handed back to Government who will generally continue to own and operate the asset.

This approach packages together the construction, operation and maintenance of the asset. This is often not the optimal arrangement, as private companies are not necessarily highly skilled in each of these areas. Furthermore, it is generally healthy to have service arrangements that are subjected to regular scrutiny and competition, for example being competitively retendered periodically. This tends to keep service standards higher and pricing sharper; all to the benefit of the consumer.

Additionally, when Government takes control of the asset after the contract period, maintenance may well have been neglected in the last years of the contract to reduce outgoings, thereby leaving Government picking up responsibility for a substandard asset.

These benefits and risks are well documented and would be very similar regardless of the ultimate project solution selected. Regardless, they need to be carefully considered within the individual project environment.

10.6 Financial Case Summary

Regardless of whether LRT or BRT emerges as the preferred solution, this Interim Financial Case does not specifically seek to define and / or address ultimate funding arrangements or delivery frameworks. Additional work is required in this area and that is beyond the scope of this Indicative Business Case.

Our finding is that Auckland Transport should continue to pursue both traditional and alternative funding models, with alternative approaches particularly focusing on value capture opportunities, or if palatable, levies such as City Centre road area pricing, City Centre parking or highway tolls. Once the best performing option details are better developed and agreed, more clarity can be established around the optimal blend of funding and delivery approaches.

11. Management Case

The South-Western Airport Multi-Modal Corridor (SMART) LRT and Bus Rapid Transit (BRT) projects were commissioned by Auckland Transport in order to build improved understanding and thus confidence around the selection and development of an effective and efficient response to airport access over a 30-year period. Work to develop this Indicative Business Case has retained a coordinated approach within the organisation across all levels of project development and decision-making.

This section outlines how the project team will manage the relevant activities and inputs to the project. It should again be noted that we recommend taking both LRT and BRT project options forward for further assessment, as it has not been possible to adequately differentiate between their relative costs and benefits at such an early stage of option development and assessment.

11.1 Project Background

The SMART project has a number of key interfaces with other major planned works.

- The Central Access Strategy recommends a light rail network for Auckland's isthmus, including a line currently proposed to run from Wynyard Quarter, via the City Centre to the southern extent of Dominion Road. A pivotal assumption for the investigation of the light rail options is that the Central Access Strategy is constructed between the City Centre and Dominion Road.

- East West Connections (EWC) recommends a new arterial connection between SH1 and SH20 on the northern side of the Manukau Harbour. This project has not been included in the Do Minimum SMART (LRT) assessment due to uncertainty surrounding its confirmed alignment and form.

11.2 Benefits Realisation

It is anticipated that the key benefits that will be realised through the implementation of SMART LRT or BRT options are as follows:

- Improve connectivity between current and future residential, business and employment nodes i.e. Auckland Airport, City Centre, Onehunga, Auckland Airport, Mangere, and other commercial and industrial areas in the Auckland metropolitan area.

- Reduce traffic pressure on arterial roads and motorways in the area of interest.

- Create opportunities for the attraction of jobs around Auckland Airport and adjacent to the route and around proposed station sites.

- Increase residential, industrial, commercial and business investment potential in the Southern Initiative area.

- Encourage greater investment and intensification of surrounding developments.

- Reduce travel times and improve reliability for private, public transport and freight traffic.

- For BRT - reduced bus delay for non-airport services in Manukau Road corridor.

- BRT or LRT both complement future CAP through easy integration of services in the city centre.

The outcomes of the project will be measured to evaluate the success of the project throughout its use, i.e. over the long term life of the project. The primary performance indicators will include:

- Travel time savings.

* Productivity and development increases.
* Increase in public transport mode usage.
* Secondary health benefits (and flow-on benefits into productivity) from increased walking by public transport users.
* Reduction in car km travelled and related congestion.
* Reduction in greenhouse gas (GHG) emissions.

Auckland Transport will be responsible for the measurement of project benefits against target outcomes. Specific, measurable KPIs will be finalised during the detailed planning and delivery phases.

There are other areas where it is expected that the project will deliver ‘wider economic benefits’ – that is those benefits not captured in a standard cost-benefit analysis, including effects relating most importantly to agglomeration and also to returns of scale, densification of labour markets, and company and household behavioural adaptations to changes in transport infrastructure and related cost structures.

This area is highly dependent upon the Auckland Council Unitary Plan permitting increases in density in the vicinity of LRT or BRT stops. It is imperative that the policy framework supports the delivery of these benefits otherwise projected wider economic benefits will not be realised. Most case studies of transit schemes that have achieved economic uplift have included frameworks for increasing land use density near them. Conversely, transit investments that did not include such frameworks have often failed to achieve an economic uplift e.g. Sheffield Supertram.

It was beyond the scope of this IBC to calculate WEBs and accessibility benefits at a block by block level. However, we anticipate that they may include the following:

Auckland International Airport Ltd – it is anticipated that the proposed SMART LRT or BRT option will significantly improve accessibility to the airport and to the surrounding business district. The airport operator is likely to experience significant uplift in the site’s land value and improved take up of rents within the airport complex. AIAL is likely to be a major beneficiary should the project go ahead.

Onehunga – this has significant redevelopment potential relating to former industrial land adjacent to the proposed heavy rail / LRT station interchange. With LRT or BRT in place, this area will have excellent access both north to the city and a greatly extended catchment south to the airport & Mangere town centre. It is already starting to redevelop, is zoned to permit commercial and mixed use development, and improvements to the public transport network would give it a significant boost. At present road access from Onehunga to the City Centre is quite slow (>30 minutes in peak) and unreliable (variability of up to 20 minutes in bus arrival time due to congestion). With either SMART project delivered, the journey time would be reduced by up to 5 minutes and reliability would be greatly improved (in exclusive running SMART should remain within 2-3 minutes of schedule).

City Centre – the LRT will allow people to get from the ferry terminal (and cruise ships), commercial centre and international hotel area to the airport without any interchange. Journey time will be comparable to taxi time now (5 min quicker in peak) and 5 minutes quicker than bus (due to exclusive running in Dominion Road).

BRT would also deliver notable time savings, although not to the extent the LRT delivers.

Mangere – accessibility from this area to the airport for *employees* will be greatly improved. The majority of airport employees live in the Mangere – Otahuhu – Papatoetoe area but public transport mode share is currently very low at ~2%. The current airport SkyBus does not stop in Mangere and so bus access for local employees to the airport and the adjacent business district is currently poor.

11.3 Anticipated Project Plan

11.3.1 Delivery Programme

The following key dates have been identified for the project team and summarised in Table 11.1.

Table 11.1 Key project development activities

Activity	Description
Problem Definition Discussion Paper	Completed October 2014
Draft Indicative Business Case	June 2016
Option development	Target 2016
Finalisation of Indicative Business Case	Target 2017
Detailed Business Case	Target 2018

The management case addresses the achievability of the proposal and planning arrangements required to both ensure successful delivery and to adequately manage project risks.

A detailed delivery schedule will be determined when the overall funding, governance model and timing of delivery is confirmed. Overall, the project should take approximately 3-4 years to design and construct, with an additional 2 years for planning, survey, and early works. Suggested key milestones for the SMART project delivery are summarised in Table 11.2.

Table 11.2 Suggested delivery schedule

Calendar Year	Activity schedule for SMART LRT or BRT
2017	Indicative Business Case completed
2018	Detailed Business Case completed
2018	Consultation and agreement on delivery and procurement models to be applied Funding and environmental approvals secured
2019	Community consultation undertaken Regulatory regime and operating model agreed
2020-2021	Property acquisition undertaken
2022-2025	Services relocation undertaken Preconstruction works undertaken D+C contract procured and detailed design completed Rolling stock contract negotiated and order placed Construction of busway or track, depot and stations commenced Rolling stock / buses purchased Major structures completed Landscaping completed Commissioning of rolling stock completed Handover and commencement of operations

11.3.2 Key roles and responsibilities

The current key roles and responsibilities within the project are shown in Table 11.3.

Table 11.3 Key project roles and responsibilities

Role	Name	Organisation
Project Executive	Peter Clark	Auckland Transport
Project Sponsor	Peter Clark	Auckland Transport
Project Director	Theunis Van Schalkwyk	Auckland Transport
Project Manager	Julian Smith	Auckland Transport

11.3.3 Resourcing Strategy

Further development of the project will be managed by Auckland Transport using internal project management resources and external technical consultants as required. Design and delivery resources will be dependent on the delivery model chosen. It is anticipated that Auckland Transport will play a major role in managing the delivery of the project.

11.3.4 Recommended Delivery Method

The method of delivery for either SMART LRT or BRT option is likely to be either a Design and Construct form of contract (D&C) or an Alliance style contract. The key reasons are as follows:

- Based on AT's capabilities and experience, a conventional form of delivery contract is recommended. This will reduce complexity in tendering, contract negotiation and administration.
- A public private partnership model (PPP) is possible for the part-funding of the project (i.e. for the funding of select packages of the project – e.g. LRT or BRT vehicles provision and LRT operations). This funding model can still be combined with delivering the project conventionally. It is recommended that this be further explored to assess suitability and feasibility at Indicative and Detailed Business Case stages.

11.4 Governance and Reporting

It should be noted that the delivery method for the SMART project, following this IBC, has not been finalised, and that this will guide the ultimate project delivery governance structure and supporting processes. These processes will include directions relating to project controls and will clarify responsibilities for decision making, strategic direction setting and reporting.

It is envisaged that a Project Control Group (PCG) will be established during the Indicative or Detailed Business Case stage, continuing through to the completion of the construction and commencement of operations. The PCG should include representatives from key stakeholders in the development and implementation phases of the project and should meet regularly to discuss issues pertaining to the project. All key decisions should be made collaboratively and clearly documented, taking adequate account of integration requirements across multiple organisations.

To ensure clear, accountable project execution, control mechanisms may include a direct reporting line from the IBC / DBC Team Leader to the PCG and regular interface meetings between key Auckland Transport staff, external advisors and the Team Leader.

The proposed governance for the next planning phase would be a continuation of the existing arrangement between Auckland Transport and its providers, to further develop the business case towards delivery and to ensure that the key objectives of the SMART project can be delivered upon, irrespective of which shortlisted option becomes preferred.

In addition to internal project reporting requirements, external reporting requirements should include:

- Auckland Transport Board;
- Auckland Council;
- NZ Transport Agency;
- AIAL Board;
- KiwiRail; and
- Other key stakeholders being reported to on progress.

Note – it is also important to establish governance for the operational life of the asset, not merely for the planning and delivery stages. This area is often overlooked and can constitute a high risk to ultimate project success. This will be addressed further at IBC / DBC stages.

Such operational governance considerations should include:

- Who regulates the operations?
- Who measures operational performance?
- Who conducts key reporting to Government?
- Is there a subsidy required to operate? If yes, how is this structured and managed?
- Who ensures the condition of the asset is satisfactory at the end of the contract?

11.4.1 Governance Considerations

Governance structure and arrangements should also account for a number of key planning and project delivery considerations that need to be effectively managed in order to facilitate smooth project delivery, cost efficiency and sustained benefits.

Currently planned projects that interface with the SMART project include:

- Central Access Strategy – this project proposes to provide a light rail network on Auckland's isthmus, connecting the City Centre with Dominion Road, Manukau Road, Sandringham Road and Mt Eden Road. Its provision is critical for the success of the LRT Option 2 as this assumes a continued service from the airport to the City Centre.
- SH20A Kirkbride Interchange – this project is under currently construction as part of the wider SH20A to Airport project. It provides a grade separated interchange on SH20A. Allowance has been made for LRT and BRT to run in trench in the centre of the proposed motorway alignment.
- RPTP Bus Network upgrade – this project is intended to optimise the performance of the bus network, increasing bus frequencies and providing routes that better connect to interchange points. This project is important for the SMART project as it will provide high frequency feeder services to SMART stations, allowing good quality interchange and associated patronage attraction.
- The East West Connections (EWC) project runs in the vicinity of the LRT Option 2 between Onehunga station and the SH20 Manukau Harbour Crossing Bridge. In this area, space is very constrained and close co-ordination of the geometric considerations related to each project has been undertaken. However traffic modelling effects related to EWC have not been included in the do minimum.

Auckland Transport has undertaken investigations with respect to an upgrade of the Onehunga Branch Line (OBL). This upgrade would comprise double tracking of some sections to enable higher frequency services to operate. It has been assumed that the OBL upgrade would not occur if the LRT or BRT is implemented.

In addition to these projects, developed by Auckland Transport and the Transport Agency, significant private development is proposed, particularly at the airport and in its adjacent business district.

Auckland Airport's Master Plan indicates that a second runway will be operational by 2025. The international and domestic terminals are to be combined and patronage is forecast to increase to 40 million passengers by

2044. Significant light industrial and commercial development is proposed around the airport itself and in the adjacent business areas.

11.5 Risk Management

Given the complexity of the project and its surrounding environment, effective and timely risk management is a critical component in ensuring the project remains on track. At this stage of the project, a formal risk management exercise has not been undertaken. However an initial desktop assessment has identified that the greatest risks are likely to be associated with final project scope, approvals, on-ground delivery, funding mechanisms and community impacts.

Most risks can be effectively managed or mitigated through careful scoping, tight contract documentation and appropriate and proactive management effort.

Risk identification and management frameworks will be developed and confirmed by Auckland Transport during subsequent project phases, as well as by the designer and contractor. These are 'live' risk registers and should be continually reviewed and updated regularly throughout the delivery of the project. If the project is funded, it is suggested that a specialist risk consultant be engaged to prepare and maintain a comprehensive risk management strategy.

To ensure the successful delivery of the project, risks will be addressed by a number of measures, including:

- Scope risks - ensure that all appropriate structural, safety and civil design standards are identified and applied during design development.
- Scope risks - ensure that project scope is well defined, agreed and documented.
- Scope risks - ensure that project coordination is achieved between this and any adjacent or similar works via liaison with Auckland Transport.
- Cost risks – ensure that capital and O+M estimates are robust and that suitable contingencies are applied.
- Safety – targets / regulations to be met during construction and operation phases.
- Cultural Heritage and Environmental risks – rigorous upfront assessment work and planning to identify and avoid / mitigate negative impacts.
- Community risks - ensure that community screening requirements, such as noise walls are well defined, documented and implemented.
- Community risks – develop appropriate community engagement plans, management plans and consult with and inform community of resultant plans.
- Traffic risks - Develop Traffic Management Plan (TMP) and suitable site working hours to be managed in such a way that disruption is kept to a minimum during peak operating times.
- Procurement risks – robust assessment to establish the optimal procurement strategy for the project.
- Project management and delivery risks – develop robust project planning and delivery guidance tools and ensure that the right people are selected for key deliver and management roles.
- Operational risks – ensure governance and operating regime is appropriate and well controlled throughout the project's operational life.

These risks, their likelihood, severity and possible mitigation strategies are suggested in Table 11.4. Risk likelihoods are rated from 0 (rare) to 5 (almost certain) and severity from 0 (insignificant) to 5 (severe).

Risk ratings define risk to successful delivery of the project prior to implementation of the proposed mitigation strategies. The aim of mitigation is to ensure that no risk is rated worse than medium after mitigation.

Table 11.4 Risk identification, rating and possible mitigation

Cause	Potential Risk	Consequence	Likelihood (0-5)	Consequence (0-5)	Risk Rating	Mitigation Strategy
Due to the fact that the project is complex and standards for new LRT or BRT modes are not well defined or tested in a NZ context	There is a risk that delivery outcomes may not be reliable / fit for purpose	Resulting in suboptimal delivery, rework, increased costs and delays	1 - Rare	3 - Moderate	**Medium**	Further definition of best performing option in Indicative and Detailed Business Cases. Robust risk identification and mitigation through project. Draw on best practice experience worldwide.
Due to the fact that the project is highly complex and delivery experience in LRT or BRT is low in NZ	There is a risk that ultimate project scope and delivery does not provide a fit for purpose asset	Resulting in inefficiencies, lost opportunity and reputational risk	3 - Possible	4 - Major	**High**	Further testing and refining of best performing project option during detailed investigation. Project team with extensive experience in design and implementation of light rail or rapid busway systems. Consider involving international specialists.
Due to the fact that the project is a major infrastructure asset creation	There is a risk that safety issues may eventuate during construction	Resulting in injury or loss of life, plus lost time, additional cost and reputational risk	3 - Possible	3 - Moderate	**Medium**	Develop detailed safety in design process and construction safety plan and engage contractors with strong safety culture and record.
Due to the fact that the project is a major multidisciplinary, multi-package infrastructure asset creation	There is a risk that the procurement strategy is not optimal	Resulting in delivery issues such as cost over-run, delays and reputation loss	3 - Possible	3 - Moderate	**Medium**	Develop a robust project procurement approach for the overall project and for sub-project components or packages of work. Ongoing monitoring of procurement and delivery activities against program. Consider incentive program.

Cause	Potential Risk	Consequence	Likelihood (0-5)	Consequence (0-5)	Risk Rating	Mitigation Strategy
Due to the fact that the project directly impacts upon local communities	There is a risk that project liaison and / or outcomes may not be acceptable to community groups. Visual or noise effects may be a potential issue	Resulting in lack of public support, and political and reputational risk	4 - Likely	4 - Major	**High**	Develop a robust and transparent community engagement strategy, and actively involve stakeholders through the project. Consider Community Working Group (CWG) approach used successfully elsewhere.
Due to the fact that the project involves large scale construction	There is a risk that there may be undesirable cultural heritage impacts. Effects related to Gloucester Park could be significant	Resulting in delays to programme, lack of public support, increased cost and reputational risks	4 - Likely	4 – Major	**High**	Requires a robust cultural heritage assessment of best performing SMART option and active engagement with and involvement of key stakeholders.
Due to the fact that the project involves large scale construction	There is a risk that there may be undesirable environmental effects to coastal environment, local flora and fauna	Resulting in delays to programme, increased cost and reputational risks	3 - Possible	3 - Moderate	**Medium**	Requires a robust environmental assessment of best performing project option. Ensure environmental approvals are sought well in advance.
Due to the fact that no detailed surveys or site investigations have been carried out	There is a risk that there may be unfavourable site conditions (e.g. geotechnical)	Resulting in unexpected cost and time impacts to project delivery	3 - Possible	4 - Major	**High**	Undertake detailed site investigations and surveys to establish key project risks and uncertainties. Ensure cost estimates factor in adequate contingencies.
Due to the fact that the project involves significant construction in a busy urban environment	There is a risk that traffic impacts during construction may be unacceptable	Resulting in lengthy delays, reduced productivity and reputational risk	2 - Unlikely	3 - Moderate	**Medium**	Requires robust traffic modelling of construction stages as well as for the final project, leading to an effective construction period traffic management plan.

Cause	Potential Risk	Consequence	Likelihood (0-5)	Consequence (0-5)	Risk Rating	Mitigation Strategy
Due to the fact that the project involves numerous and complex stakeholder groups and multiple conflicting priorities	There is a risk that outcomes may not be palatable to all political stakeholders (across parties and Government agencies)	Resulting in reputational risk	3 - Possible	3 - Moderate	**Medium**	Continue to involve Council, Transport Agency, AIAL, IWI and key interest groups in process; attempt to secure central government support through early and open engagement.
Due to the fact that the project involves large scale and complex construction	There is a risk that available funds may be insufficient to deliver the optimal solution	Resulting in project delays, overspend or the delivery of a compromised solution that delivers suboptimal benefits	3 - Possible	5 - Severe	**Extreme**	Develop robust cost plan with adequate contingency. Liaise early with Treasury / Transport Agency to understand criteria for funding. Define options for funding contributions by private investors or other mechanisms (if appropriate).
Due to the fact that the project is complex and has many significant interfaces	There is a risk that scope and contractor management may be difficult to control	Resulting in cost escalation, possible delays or suboptimal delivery outcomes	3 - Possible	4 - Major	**High**	Project management rigor. Get the right management team in place and have a robust project plan to guide activities.
Due to the fact that Auckland Transport has limited LRT or BRT operating experience	There is a risk that operational governance and planning is not appropriate	Resulting in suboptimal operational performance, financial outcomes, and reputational risk	3 - Possible	4 - Major	**High**	Ensure operational governance is established and tested early. Draw on best practices worldwide. Robust review plan to inbuilt flexibility to tailor over time.

11.6 Design Standards for LRT

The project works must be designed to meet all reasonable standards of safety, maintenance and operational service to the public and must form an integral part of the local transport network. The project works must accommodate the needs of all legal network users including all passengers, pedestrians, road users, cyclists and people with disabilities.

The Track Design Handbook for Light Rail Transit[56] provides guidelines and descriptions for the design of various common types of LRT track and has been used as the basis for the interim track design undertaken as part of this IBC.

To ensure a design consistent with the Central Access Strategy the same LRT vehicle specifications have been assumed for SMART LRT. All route options assume 10 minute headways and 30 second average dwell time at each station. An operating speed of 50 km/h has been assumed for street running sections (consistent with Central Access Strategy) and 80 km/h to 100 km/hr for ballasted track sections (these are not required in the Central Access Strategy). Maximum speeds will depend on the type of rolling stock selected.

LRT - Design vehicle assumptions include:

- Width – 2.65m (Dynamic Kinematic Envelope for two street tracks – 6.7 to 7.5m; ballasted track 8.5m)
- Capacity – 200 passengers (for 33m vehicle) or 420 passengers (for 66m vehicle)
- Length – 33m or 66m (potential to couple 33m vehicles together in train sets as demand rises)
- Maximum grade – 8% (including curve compensation)

The Auckland Transport Code of Practice (ATCOP) is the guidance document used to achieve a consistent approach to transport infrastructure design across the Auckland region. The principles of these design guidelines have been applied where the LRT vehicle is operating within the road corridor and standard vehicle design speeds for the road have been applied to the LRT design.

As a minimum, all construction works must meet Auckland Transport's Contract Works Specifications.

11.7 LRT Design Opportunities

Through the development of the LRT Option to date, there have been a number of design opportunities identified. Through further subsequent investigation, these opportunities may add benefit or reduce costs in relation to the LRT scheme. A brief summary of these design opportunities is provided in Table 11.5 below:

Table 11.5 LRT design opportunities

Opportunity	Description
Walmsley Road	The LRT alignment is constrained within the SH20 corridor through the Walmsley Road interchange. Further alignment design refinement should be undertaken to ensure adjacent property impacts can be avoided.
Mangere Bridge Station Location	There is potential to relocate the Mangere Bridge station further North to the Auckland Council reserve on the southern side of the Manukau Harbour. This would reduce the number of properties affected, and may provide a better location should the Port of Onehunga be redeveloped in the future.

[56] Track Design Handbook for Light Rail Transit, Transportation Research Board of the National Academies, 2012, Washington D.C.

Additional Station in Onehunga	An additional LRT station located between the Hillsborough and Onehunga stations (potentially bounded by SH20 and Beachcroft Avenue) may improve LRT patronage. Further assessment may be warranted to determine the likely costs, impact on patronage and effects on overall route travel times.
Alignment around the Onehunga Bay Reserve	Through the development of the LRT scheme, a number of alternative alignments were considered across the Onehunga Bay Reserve. Further investigation into the preferred alignment to best integrate the LRT within this environment should be undertaken as the design for LRT develops.
Integration with East West Connections	The development of the LRT alignment to date south of the Onehunga station has been based on information provided by the East West Connections project team. Ongoing integration between the two projects may lead to optimised alignments and potential cost savings.
Onehunga interchange integration into Onehunga Mall street design	The light rail/heavy rail interchange will be a focal point for activity in Onehunga. It may create an opportunity for enhanced urban design and integration with the town centre.
Station locations within the Airport Environment	Assumptions have been made to date with regard to the LRT alignment stop locations within the Airport environment. Further dialogue with AIAL and integration of the LRT design with the Airport Masterplan is recommended as the LRT design progresses.

It is considered that these opportunities may be explored through any subsequent IBC / DBC stages.

11.8 Design Standards for BRT

The BRT busway section would be designed to match the standards for the Northern Busway already operated by AT. The BRT bus lanes section in Pah Road / Manukau Road / Khyber Pass Road would be designed to match AT bus lane standards. Key BRT standards would include:

1) Busway section from Airport to Onehunga in SH20/SH20A corridors.
   a) Busway designed as two-way two-lane bus-only roadway with 100 km/hr design speed.
   b) Busway lanes 3.5 m wide with 1.5m shoulders and median separator.
   c) Busway grade separated over other roads with no crossing intersections.
   d) Pedestrian crossings grade separate over busway.
   e) Busway pavement reinforced concrete or deep lift asphaltic cement (AC) in all running lanes and bus stops.
2) BRT (bus lane) section from Onehunga to City via Manukau Road
   a) BRT bus lanes designed as one lane in each direction (kerbside) with all on-street parking removed.

b) BRT bus lanes 3.5m wide with 60 km/hr design speed (50 km/hr posted speed).

c) Line marking and pavement colour used to distinguish BRT bus lanes from other general traffic lanes.

d) Bus lane pavement reinforced concrete or deep lift asphaltic cement (AC) in all running lanes and bus stops.

3) For the SMART BRT option there would be two different types of BRT stop:

a) BRT High Speed stop (in busway section between Airport and Onehunga) as per Figure 11.1 below, 14m wide, with 60m long stop and 60m tapers on each approach. A grade separated pedestrian crossing is required at each stop.

b) BRT Low Speed stop (in arterial road section of Manukau Road between Onehunga and City) as per Figure 11.2, 10.5m wide, with 60m long stop and 30m tapers on each approach.

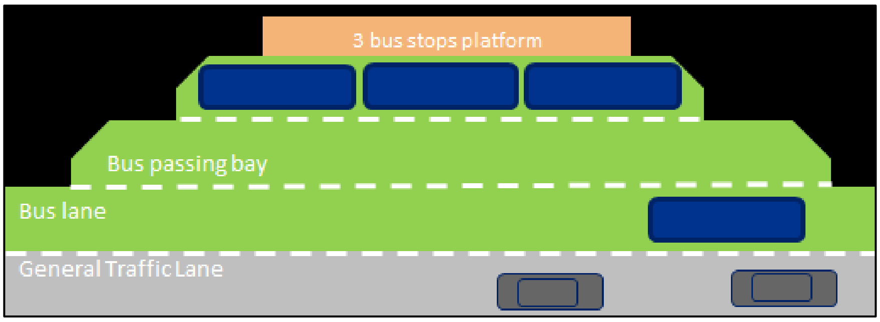


Figure 11.1 High speed BRT stop (SH20/20A busway corridor)

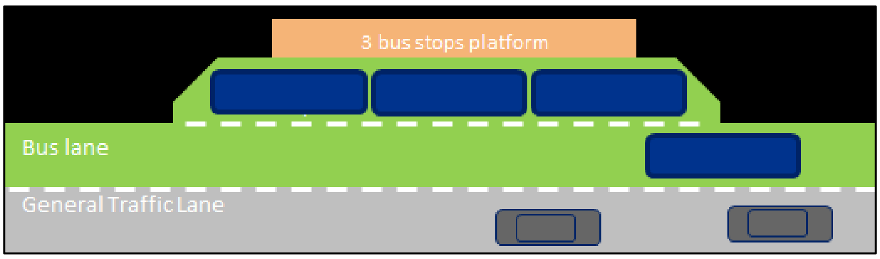


Figure 11.2 Low speed BRT stop (Manukau Road)

11.9 BRT Design Opportunities

Throughout the SMART BRT project option development process a number of related design opportunities have been identified. Generally, there are opportunities for either LRT or BRT to integrate iconic architectural elements, particularly into the main stations or interchanges. This can help to give the project a real sense of identity and can empathise strongly with users. For example the Eurostar terminus at St Pancreas International Station in London is now a tourist destination in its own right due to the unique architectural nature of the site. It was recently upgraded and great care was taken to complement the iconic Victorian architecture of the mid-1800s. It is also possible to integrate unique design elements or features along the routes of public transport corridors. This can assist with aesthetics and can help to reduce negative impacts associated with the developments. Design opportunities for the BRT option are presented in Table 11.6.

Table 11.6 Design opportunities for BRT

Design opportunity	Description
Manukau Road – incorporate other bus services	Bus services in the Manukau Road corridor should be investigated to understand how they may beneficially utilize the busway. This may require longer stops.
Onehunga interchange – integration into Onehunga Mall street design	The bus/heavy rail interchange will be a focal point for activity in Onehunga. It may create an opportunity for enhanced urban design and integration with the town centre.
Broadway underground stop	The bus stop in Broadway, Newmarket will need to be undergrounded to fit within the available road reserve. This creates potential for integration with the streetscape.
Wellesley Street underground stop	The bus stop in Wellesley Street, City will need to be undergrounded for capacity and space reasons. This creates potential for integration with the streetscape and the nearby Aotea heavy rail and Civic light rail stops and commercial opportunities from the high passenger flows.
Electric bus recharging at stops	Recharging points for electric buses could be included at BRT stops, facilitating the introduction of electric buses (Figure 11.3).

Figure 11.3 Electric bus recharging (Geneva)

11.10 Stakeholder Engagement and Communications Plan

A detailed stakeholder engagement and communication plan has not been developed at the Indicative Business Case stage. This will be developed during subsequent project phases when an appropriate level of detail has been established for the preferred SMART option.

It is envisaged that this plan will address future engagement during subsequent phases, along with designated roles and responsibilities to implement this engagement. It will recommend possible frameworks and methodologies for communication with each key stakeholder group, appreciating the complexities associated with both internal and external relationships. It will be regularly updated to reflect changes as the project progresses.

It is acknowledged that there are significant risks around stakeholder engagement and that this needs to be managed in a structured and transparent manner, in order that stakeholders feel involved and issues and interests can be identified and managed early. The stakeholder plan will identify these risks as well as potential mitigation measures. These risks will also be included in the project risk register, with an owner and mitigation plan assigned to each. Stakeholder feedback will be used to inform ultimate project design and the evaluation of options.

A number of recent major transport infrastructure projects delivered in Western Australia developed a highly successful process to involve community, business and Government stakeholders in the project development and decision making process. A Community Working Group (CWG) was established early in the project and was involved in all major aspects of options development and refinement. This provided stakeholders with the opportunity to be directly involved in the project and resulted in a high level of awareness and 'buy-in', and a very low level of resistance to the preferred project solution. This was seen as a highly effective risk mitigation tool, which added very little cost to the project development process while removing significant risk and potential cost impacts later in the project delivery phase. By running one integrated process, overall planning time was reduced.

The process was also seen as enhancing Government's reputation, due to the value that stakeholders placed on being involved in genuine and open consultation, rather than, as if often the case, merely being informed of key decisions and outcomes after the fact.

Consideration should be given to adopting a similar process for SMART, in order to deliver the following potential benefits:

- Improved Government reputation as an open and engaged body.
- Reduction in negative stakeholder impacts in relation to the preferred solution.
- Potential to save time and cost through early and ongoing consultation and negotiation of issues.
- Better understanding of stakeholder interest in incorporation of opportunities to support their objectives.
- Improved ultimate solution through real engagement with all key stakeholder groups.
- Prove the value of the concept for use on future infrastructure programs.

12. Commercial Case

An initial outline of the commercial case is provided in this Interim Business Case to provide decision makers with some guidance on the likely commercial arrangements surrounding the project. This is particularly relevant for unfamiliar or innovative projects or for more complex elements of project funding, planning, delivery or operations where there may be little market depth and delivery experience to bring to bear. Issues identified within the commercial case should inform the scoping plan developed for subsequent option development.

At the Indicative Business Case stage, this chapter sets out the framework for determining risk allocation and selecting a possible SMART project delivery model(s), with the actual final selection process to be refined during subsequent investigations.

Key aspects outlined at this Indicative Business Case stage are:

- Overview of the short listed options.
- Key project risks relevant to the procurement approach(es) available.
- How these project risks will be assessed.
- The delivery model(s) to be considered for the project.
- The evaluation criteria that will be used to assess these delivery and procurement models.

A market sounding of potential private sector providers (e.g. contractors, etc.) has not been undertaken at this stage, but may be considered at the Detailed Business Case stage to ensure that sufficient market capability, capacity and interest exists for the selected transit mode, delivery model(s) to be appropriate.

It is important to consider other major projects (current and planned) and their impact upon the market's ability or willingness to deliver specific packages of work. Considerations of contract size and packaging should be made with these factors clearly in mind.

There is also a need to align the implementation of the SMART solution with projects outlined in the AIAL Master Plan. Significant upgrades to the terminal buildings are planned by 2022. The construction of a new northern runway is proposed to be completed before 2030 and there are also significant road projects and surrounding land development planned during this period. The interface of these projects with the ultimate SMART solution should be carefully considered and planned.

12.1 Procurement methodology

A suitable procurement methodology needs to be established through the Commercial Case process. In order to establish a suitable commercial case, the following steps illustrated in Figure 12.1 may be undertaken. In particular, it is considered valuable for members of the project team and key stakeholders to jointly discuss key aspects of the Commercial Case. An example framework is shown below.

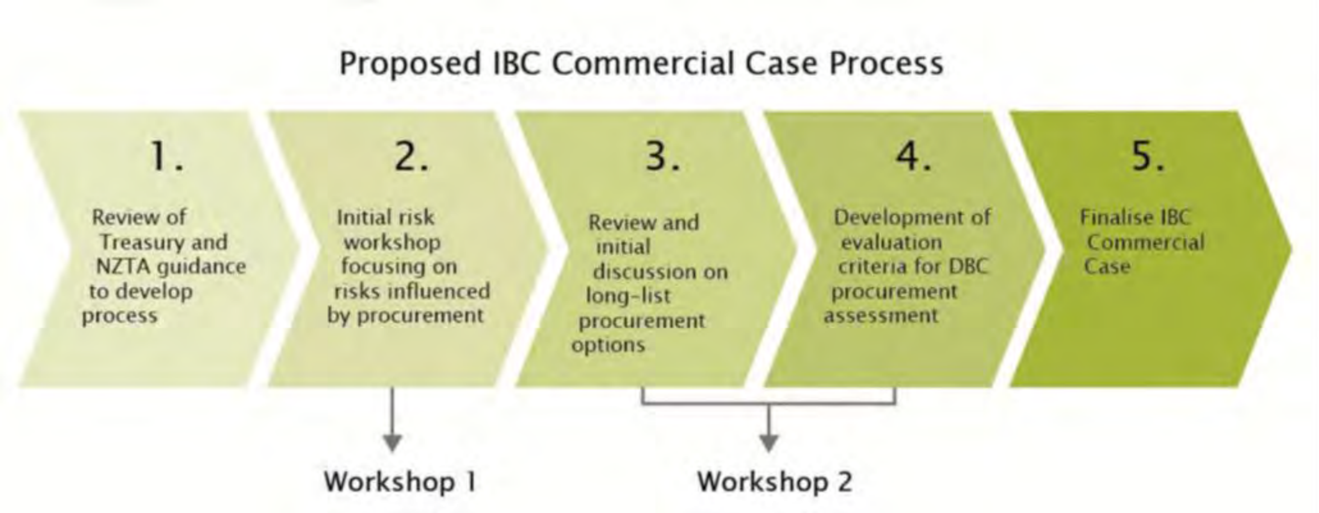


Figure 12.1 Proposed IBC commercial case process

The procurement methodology outlined in the Transport Agency's Procurement Manual and in Treasury's guidance for developing 'Better Business Cases' could be used as the basis for these discussions.

12.2 Project Characteristics and Risks

12.2.1 Procurement implications for shortlisted SMART options

The anticipated key procurement considerations relating to the two shortlisted SMART options are highlighted in Table 12.1. Specific procurement risks should be discussed in detail, scored and mitigation actions defined and assigned once the preferred mode is determined through further assessment. Initial procurement implications for each option were considered at the options assessment stage.

Table 12.1 Description and procurement implications for the highest ranking option

Option Name	Description	Anticipated procurement implications
LRT	High Speed LRT with Onehunga access	✓ Central Access Strategy to Dominion Road must be completed before SMART LRT can be operable. ✓ Rolling stock strategy must suit both operating regimes (SMART (LRT) and Central Access Strategy) – speed differential. ✓ Order/supply lead time for critical items such as rolling stock. ✓ Local maintenance capability for specific rolling stock or high maintenance critical items. ✓ Large and complex lends itself to procurement packaging, potentially adding increased interfaces but yielding significant benefits if structured and delivered effectively. ✓ Co-ordination with airport terminal upgrades, new northern runway and associated road realignments is necessary.
BRT	New alignment - Airport to City buses from City (Wellesley Street) to Airport via Symonds Street, Manukau Road	✓ Central Access Strategy to Dominion Road must be completed. ✓ Must interface cleanly with existing bus infrastructure, operations and contracts. ✓ Local capability and capacity to deliver, maintain and

Option Name	Description	Anticipated procurement implications
	and Onehunga	operate must be considered when planning and packaging procurement contracts. ✓ Clearly understand the availability / lead time of time critical items. ✓ Impact on preferred future corridor across Airport

12.2.2 SMART Procurement risks

It is recommended that discussions are scheduled to assess project risks from a procurement perspective. The overall project risk register can be used as a starting point to identify relevant risks, with dedicated discussion used to refine specific procurement related risks.

These risks can be used as part of the assessment of delivery and funding models. When considering risk allocation in a procurement sense, the overriding principle is that all risks should be allocated to the party that is best positioned to manage them. Table 12.2 suggests possible procurement related risks across various project risk categories. These risks apply to both LRT and BRT solutions.

Table 12.2 Key risks related to project procurement

Risk Category	Description
Design Risk	✓ Establish (or adopt) appropriate design standards for light rail or busways for Auckland ✓ Delays in obtaining sign-off for design
Approvals Risk	✓ Delays in approvals process ✓ Delays in route protection, environmental or heritage approvals, or property acquisition
Stakeholder Risk	✓ Risk of stakeholders objecting to preferred delivery model(s) selected
Construction Risk	✓ Construction requirements insufficiently defined ✓ Costs exceed initial projections ✓ Cultural risk (e.g. archaeological, indigenous issues/delays) ✓ Geotechnical risk (e.g. ground conditions) – especially for harbour crossing ✓ Environmental risks/impacts during construction ✓ Service/utility risks ✓ Traffic impacts during construction ✓ Interface with design is unclear, resulting in additional cost/delay
Financial Risk	✓ Ultimate affordability of selected option ✓ Funding availability/gap given current economic / funding environment ✓ Operating and maintenance cost liabilities ✓ Interest rate risk ✓ Inflationary risk ✓ Counterparty credit risk – default risk
Operational Risk	✓ Interface with construction and operation is unclear ✓ Interface with existing operations is inadequate ✓ Unforeseen consequences in other areas (e.g. increased congestion) ✓ Higher than expected maintenance cost requirements (e.g. due to changing usage from original design or operating intent)
Commissioning / Decommissioning	✓ Maintain control over maintenance requirements/capabilities post contract (dependent on delivery and procurement models adopted)

Risk Category	Description
Risk	
Deliverability Risk	✓ Lack of institutional capacity and/or capability to deliver ✓ Market capacity / interest
Legislative / Legal	✓ Framework to support operating model (running LRT or BRT in a busy urban environment)

These and other identified risks should be assessed to establish:

- The probability that the risk will occur, ranked as high, medium or low. The percentage bands that will be applied to the rankings will be confirmed during subsequent option development.
- The monetary impact that the risk will have if it does occur, ranked as high, medium or low. The monetary bands that will be applied to the rankings will be confirmed during subsequent option development.
- Whether the risks are likely to be best retained by the Auckland Transport or transferred to the private sector (or shared between the two), from the perspective of who is best placed to manage the specific risk.

The intention is to apply this framework to the risks noted above for each shortlisted option, as while there may be a high degree of similarity between options, there may also be key factors that make a difference to the appropriate delivery models eventually selected. This will take place and the next stage of Business Case development.

12.2.3 Procurement delivery model options

Following the identification of the project characteristics and risks, a range of potential delivery models should be considered.

The long-list of possible delivery models for either solution may include:

- Early works / enabling works
- Staged Delivery (Traditional / Design, Bid & Build)
- Design & Construct (Design & Build and Early Contractor Involvement)
- Design, Build and Maintain
- Design, Build, Maintain and Operate
- Design, Build, Finance, Maintain and Operate (DBFMO or PPP)

It is important to consider that more than one of these approaches can be utilised, depending upon project packaging. Some elements of the project may lend themselves well to different delivery and operating approaches. For example, some LRT projects have used PPP style approaches for rolling stock procurement, but traditional design and construct approaches for track work, within the same project. These options must be carefully researched and analysed.

Figure 12.2 below illustrates the Transport Agency‘s assessment of the level of risk transfer achieved under a range of delivery models, as well as the level of project complexity that may suit the respective model. This again may also be applicable to different elements with the project.

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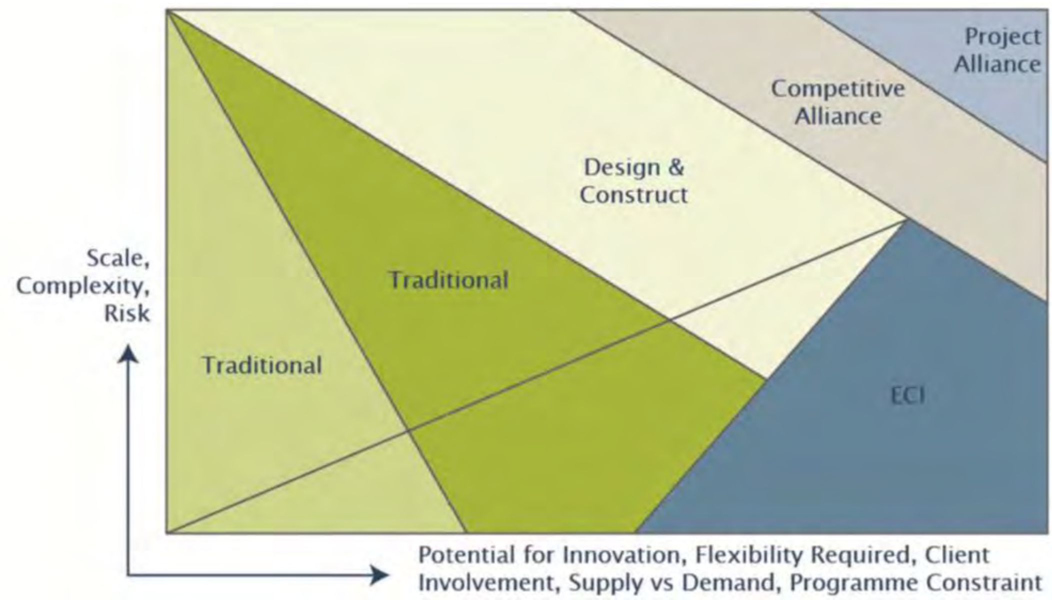

Figure 12.2 NZ Transport Agency's delivery model profiles

Note: The PPP style of delivery model would sit at the top right of this chart if included.

For the purposes of this preliminary evaluation, possible approaches are shown below in Table 12.3.

Table 12.3 Possible procurement approaches for SMART LRT or BRT options

Category	Asset Improvement Model	Recent Example Where Used
Traditional Delivery	Design procured separately and when completed to acceptable standard, construction is then procured as a totally separate contract.	Various European LRT and BRT projects; Perth Mandurah Rail Line, Brisbane Busways
Design & Construct (including ECI)	Design and construct is combined into one contract and let to a single contractor, or consortium.	Adelaide LRT – Coleman Rail delivered the design and construct of the original tram project. A subsequent tram extension was delivered by Theiss, also by D+C.
BOO / BOOT / BOT type projects	Represents complete integration of the project delivery: the same contract governs the design, construction, operations, and maintenance of the project. After an agreed concessionary period, the facility is transferred back to the owner. ✓ In the BOO model, the customer does not own the asset and the contracting company expects to recover its outlays from charges to customers or to the public authority buying its services. ✓ In the BOOT model, the customer also gets the benefit of the service provider's financing of the capital expenses necessary to deliver the project. In a pure BOOT, the service provider owns and finances the infrastructure in addition to managing it for a fee. ✓ In the BOT model, the customer provides the financing for the new infrastructure. In a pure BOT, the service provider does not own the infrastructure but is a concessionaire entitled	South East Sydney LRT - contract to design, construct, operate and maintain the $2.1 billion CBD and South East Light Rail line has been awarded to ALTRAC Light Rail consortium. Major construction of the project is now expected to finish in 2018, and services scheduled to commence in early 2019.

Category	Asset Improvement Model	Recent Example Where Used
	to manage it for a fee that covers its operating expenses.	
PPP / DBFMO	Characterised by a co-operation between public and private sector entities, the latter usually having major capital input, to realise a major investment project. The partnership is long term for mutual benefit. Elements of a service often previously run by the public sector are provided through a partnership between the government and one or more private sector companies. A characteristic feature of such cooperation is that the parties pursue common objectives and interests for the project itself even though they have differing ones in terms of their broader functions. PPPs are often used for infrastructure projects, and may be supported through exclusive licensing, or usage guarantees. Unlike a full privatisation scheme, in which the new venture is expected to function like any other private business, the government continues to participate in a PPP arrangement.	Puhoi to Warkworth Road of National Significance – (PPP to be confirmed in 2015) NZ Prisons - Wiwi and Auckland East - proposal for designing, building, financing and maintaining a new maximum security facilities Transmission Gully PPP – 4 lane motorway from MacKays to Linden. Wellington Gateway Partnership will design, construct, finance, operate and maintain the new Transmission Gully motorway for the 25 years that will follow the expected five-year period to build the motorway. It is aimed to have the motorway open for traffic by 2020. Brisbane Airport Link / Northern Busway (~$5 billion AUD) – A consortium including Macquarie Capital Group, Thiess and John Holland - known as BrisConnections built Australia's largest public private partnership (PPP) project. Gold Coast LRT - includes the design, build, operations and maintenance of 13km light rail system including the manufacture and supply of the trams and power supply. The operations and maintenance contract is for 15 years, which includes running tram services to the timetable, cleanliness and maintenance of the trams, and maintenance of the system infrastructure. Now being extended. Capital Metro, Canberra – consortium appointed to build and operate 12km light rail route, due to open in 2019. Contract includes provision for future extension and possible wire free running.

12.2.4 Procurement packaging

Given the nature of the project and the number of different components within the short-listed options, it is possible that a number of different procurement models could be appropriate, although one sometimes represents the best value for money. During further option assessment, this will be assessed in more detail through potential options to “package” components with similar procurement characteristics. The best procurement model for each package can then be assessed.

Some key considerations that can be made when reviewing packaging alternatives include:

- Contractor / market capability and capacity
- Developing improved local capability and capacity

- Maximising existing local content
- Concurrent projects and their delivery mechanisms
- Project staging
- Market dynamics
- Geographical spread of works
- Commonality or complementarity of activity type
- Funding availability or timing

In LRT for example, projects, it is common for track-work, civil and stations to be packaged together. Another example would be the packaging of BRT or LRT vehicle and maintenance depot procurement, as this can better support continuity and consistency between key interface elements.

If LRT is preferred over the BRT alternative, and if timeframes permit, it may also be possible and desirable to package up SMART LRT with the Central Access Strategy. Whilst a costly package to deliver, benefits would be experienced quickly and the two projects are highly complementary.

For BRT the critical items will be the construction of the pavement (asphalt or concrete) in surface running (Manukau Road) and disruption to traffic and adjoining businesses. Contract conditions could include time of availability for road space for construction, and rewards or penalties for early or late completion.

12.2.5 Procurement method evaluation criteria

The evaluation criteria that will be used to assess the procurement could be based on the Transport Agency procurement manual, and cross referenced against Treasury guidance for alignment purposes.

The evaluation criterion, the methodology behind their selection and a description of how they should be applied, is outlined in the *NZ Transport Agency Procurement Manual - Section 6.0 Procurement procedure 1 – Infrastructure.*

12.2.6 Next Steps

Key steps that will be undertaken as part of the commercial case during further option development include:

- Evaluation of common and option specific risks using the risk framework and including specific analysis of procurement risks for each short listed option.
- Determination of whether the best performing option selected during the Detailed Business Case stage can be packaged into separate components for procurement purposes, and agreement on the most appropriate procurement method for each package of works.
- Confirmation of the scoring methods to be used for each evaluation criteria.
- Market sounding of potential private sector providers (e.g. contractors etc.) to ensure that sufficient market capacity exists for the selected delivery model(s) (note: particularly relevant if tight delivery timeframe is desired).

It would be beneficial to transition smoothly and quickly through the business case process as the subsequent stages of project development build upon the already solid foundation of data and understanding that has been laid during the assessments undertaken to date.

13. Next Steps

It is recommended that two shortlisted options are taken forward for further more detailed investigation. These options are:

3. Light Rail Transit (LRT); and

4. Bus Rapid Transit (BRT).

These options should continue to be assessed incrementally against the base case 'do minimum' option.

The options considered to date have covered all technically feasible rapid transit options with regards to transport mode (heavy rail, light rail and busway) and route selection, having assessed a number of different route configurations for each mode. Each option has been developed to a level where a robust and transparent 'like for like' assessment can be made against agreed objectives. In addition, a rigorous economic assessment lends further weight to the 'strategic alignment' test.

The two shortlisted options perform most strongly both strategically and economically and we are confident in our recommendation to focus on investigating these further, and therefore in ceasing to develop lesser performing options past this stage.

To date, neither option has been developed to an ultimate level of detail and significant development and evaluation is still required to refine these to make sure that they deliver the best possible cost benefit combination, and that their impacts are manageable.

Critically this should be network wide, not merely at corridor or project level, as the integration and relationship of the preferred option with dependent existing and planned transport and urban development elements is fundamental to delivering strong and sustainable benefits for Auckland.

Particular attention should be given to the following areas:

<u>Best network outcomes</u> – Careful consideration should be given to identifying and developing the optimal combination of projects and modes at a network wide level. Individual projects can appear to work well on their own, but if poorly integrated into wider transport systems, can compromise overall network performance. Full consideration should be given to all existing operations and current and planned transport and urban development initiatives that may impact on, or be impacted by the SMART solution. These include Central Access Strategy, Southern Initiative, Unitary Plan, existing and planned heavy rail, future bus network and road upgrading projects.

<u>Auckland Airport masterplan</u> – the airport is keen to push on with finalising and developing its masterplan for the future. This is highly dependent on the ultimate SMART solution, whether LRT or BRT. The preferred solution must be well integrated into the configuration of the masterplan, or significant cost and benefit inefficiencies may result. It is recommended that timely engagement with the Airport is critical in order to set and manage mutual expectations. This may necessitate an early decision on the final SMART mode choice.

<u>Corridor protection</u> – Regardless of the ultimate option for SMART, corridor protection requirements should be assessed. Corridors need to be protected against encroaching urban development or changes to land-use policy. Preferred alignments for each mode should be finalised and required land for one (or both) options should be secured, in order that optimal alignments and cost vs benefit relationships can be delivered.

<u>Auckland Council Unitary Plan</u> – The final positions laid down by the Unitary Plan could have a major impact upon the benefits delivered by either shortlisted SMART option. In order to deliver potentially significant wider economic benefits (WEBs), and not merely transport related benefits, increases in density around key stops and interchanges must be permitted in the urban planning regime. It is this increase in density that will deliver benefits in areas like investment, employment, efficiency, and land value, that will help to improve and sustain the long-term health of the southern region.

Stakeholder Engagement – To date, broad stakeholder engagement around the SMART project has not been undertaken. It is now important to identify and actively engage with a range of key stakeholders and to work with them to manage opportunities, risks and constraints as the project moves through development and into delivery. Key stakeholders include Central Government, Kiwi Rail, Iwi, existing public transport operators, the community, Auckland Airport, other Government agencies and industry regarding their capacity to deliver the capital works. Further details of a strong approach that could be adopted are provided in the Stakeholder Engagement and Communications Plan section of the Management Case.

Refinement of buses on Manukau Road – Regardless of the ultimate SMART solution (LRT or BRT) there is significant benefit in looking closely at bus operations in the Manukau Road area to make sure that SMART integration into existing services is optimised. Manukau Road has exhibited a high demand for public transport services and a highly connective link to it should be a priority. A network view must be taken to ensure the best possible combination of modes and services is provided to meet with current and future demand.

It is recommended that a Project Steering Committee, made up of carefully selected decision makers and influencers, is formalised to assist in developing the project through the next stages of planning and delivery preparation. This group should meet regularly and must liaise closely with Auckland Transport to help to shape the optimal solution for the SMART project.