North West Rapid Transit Corridor
Indicative Business Case

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Contents

Appendices

Glossary of Terms

AC	Auckland Council
AP	Auckland Plan
AT	Auckland Transport
ATAP	Auckland Transport Alignment Project
AUP	Auckland Unitary Plan
BRT	Bus Rapid Transit/Busway
CCO	Council Controlled Organisation
EEM	Economic Evaluation Manual
FTN	Frequent Transit Network
GDP	Gross Domestic Product
GPS	Government's Policy Statement on Land Transport
HCV	Heavy Commercial Vehicles
IBC	Indicative Business Case
ITP	Integrated Transport Programme
JTOC	Joint Transport Operations Centre
KPI	Key Performance Indicator
LB	Local Board
LRT	Light Rail
LTMA	Land Transport Management Act
LTP	Long Term Plan
NZTA	New Zealand Transport Agency
PBC	Programme Business Case
PT	Public Transport
RLTP	Regional Land Transport Plan
RLTS	Regional Land Transport Strategy
RTN	Rapid Transit Network
SH(#)	State Highway (#)
TOD	Transit Oriented Development
TFUG	Transport for Future Urban Growth
Vpd	Vehicles per day
WEB	Wider Economic Benefits

1 Executive summary

This Indicative Business Case (IBC) defines and progresses one of the Auckland Transport Alignment Project's - ATAP's - key recommendations: the Northwestern Busway, of which the first stage is included in the ATAP priority programme in decade one, and the second in decade two. The IBC reviewed all credible public transport modes, and did not presuppose a busway solution.

While the adopted solution is bus-based, it is a combination of a full busway and bus lanes, depending on the specific requirements of each of four sections between Westgate and the city centre (the preferred option is still referred to as a 'busway' for simplicity). Not all stages need to be implemented at once with the opportunity to phase the solution over multiple decades.

A busway has been selected as the recommended option for this corridor. This is because buses on a busway provide the right performance and capacity to match the needs of the corridor, while being the most affordable option to build, and easiest to deliver in stages. Buses can easily move on and off the busway, and also use the motorway, bus lanes and regular streets. This allows a staged implementation where critical parts of the busway can be delivered relatively quickly and cheaply, while less urgent parts can be done later. This makes it easy to get the busway running sooner, but also allows the costs of adding more capacity to be spread out over time as the north-west grows.

The chosen busway solution helps meet the needs of a major Auckland growth area – the north-west – and assists in compensating for the imbalance in future population and employment. The north-west is expecting an increase in population from about 45,000 in 2013 to some 90,000 in 2046 while employment is expected to increase from 9,000 to 50,000 over the same time period (an improved ratio, but greater total shortfall).

The study area for the business case was defined as the wider SH16 north-west Motorway corridor, focusing particularly on the corridor from Westgate to the city centre, but also including associated corridors, namely Lincoln Road, Te Atatu Road, SH16 to Kumeu, and the Upper Harbour corridor comprising SH18 and Hobsonville Road.

The outer areas represent significant components of Auckland's future growth areas. As such the scale and nature of the expected growth dominated the background considerations for the business case.

The busway links a location identified as transport disadvantaged with the high value city centre jobs. It allows the targeted ATAP public transport growth to happen on the north-west corridor which would otherwise be overly car-dependent.

The deficiencies of existing public transport facilities are:

- There are no public transport interchanges along SH16, meaning that buses seeking to pick up or drop off passengers, including for transfers between services, must leave the motorway to use on-street bus stops. Alternatively, buses do not leave the motorway and run directly to the city centre, resulting in a highly inefficient service with high numbers of partially full buses arriving in the space-constrained city centre.
- There are bus shoulder lanes along SH16 between Waterview and Lincoln Road. These do not provide continuous priority through ramps and interchanges, meaning that buses must merge into mixed traffic at these points.
- There are peak bus lanes on Great North Road that are limited in hours of operation and do not always extend through town centres.

The recommended option is effective in delivering the Investment Objectives in the following ways:

- **Access to jobs:** Brings 320,000 jobs within a 45-minute public transport journey of Westgate in 2046, compared to 120,000 with the Do-Minimum
- **Catchment for the north-west:** Creates a population catchment of 580,000 people within a 45-minute public transport trip of employers in Westgate compared to 300,000 with the Do-Minimum
- **Corridor throughput:** Increases the person throughput of the SH16 (all modes) at Waterview from 11,000/hour in the Do-Minimum to 16,000/hour. Expected demand for travel in 2046 is 13,000/hour
- **Mode share:** Increases bus passengers entering the city centre from the north-west from 6,800 in the Do-Minimum to 9,300 in 2046. It does this with the same number of buses entering the city centre with higher occupancy
- **Travel time:** Creates a journey time by bus from Westgate to the city centre of 32 minutes in the peak compared to an expected journey time of 50 minutes with the Do-Minimum
- **Public transport catchment:** Enables 40,000 people to live within walking distance of a rapid transit service on the north-west corridor compared to 23,000 with the Do-Minimum
- **Transport subsidy:** Will enable a saving of $11 million per year in operating costs. It will require $48m/year compared to $59m/year with the Do-Minimum.

The core busway solution is complemented by a host of other measures that give effect to the wider accessibility needs of north west Auckland and address the defined problems. The measures include:

- Land use improvements such as transit oriented development around stations
- Behaviour change measures to make the system easier to use and influence people's choices to optimise the effectiveness of the system. This could include pricing, information, first/last mile transport and Mobility as a Service as examples
- Network optimisation improvements to ensure that the entire transport system is geared and enabled to deliver optimal performance. This could include repurposing the current bus lanes on the motorway for High Occupancy Vehicles (HOVs) or freight, better enforcement of bus lanes and providing additional park and ride and mode transfer options
- Related capacity improvements to support the busway, including resolving city centre capacity issues and priority measures for local buses to access interchanges.

The diagram below shows the sections and the respective recommended infrastructure and timing:

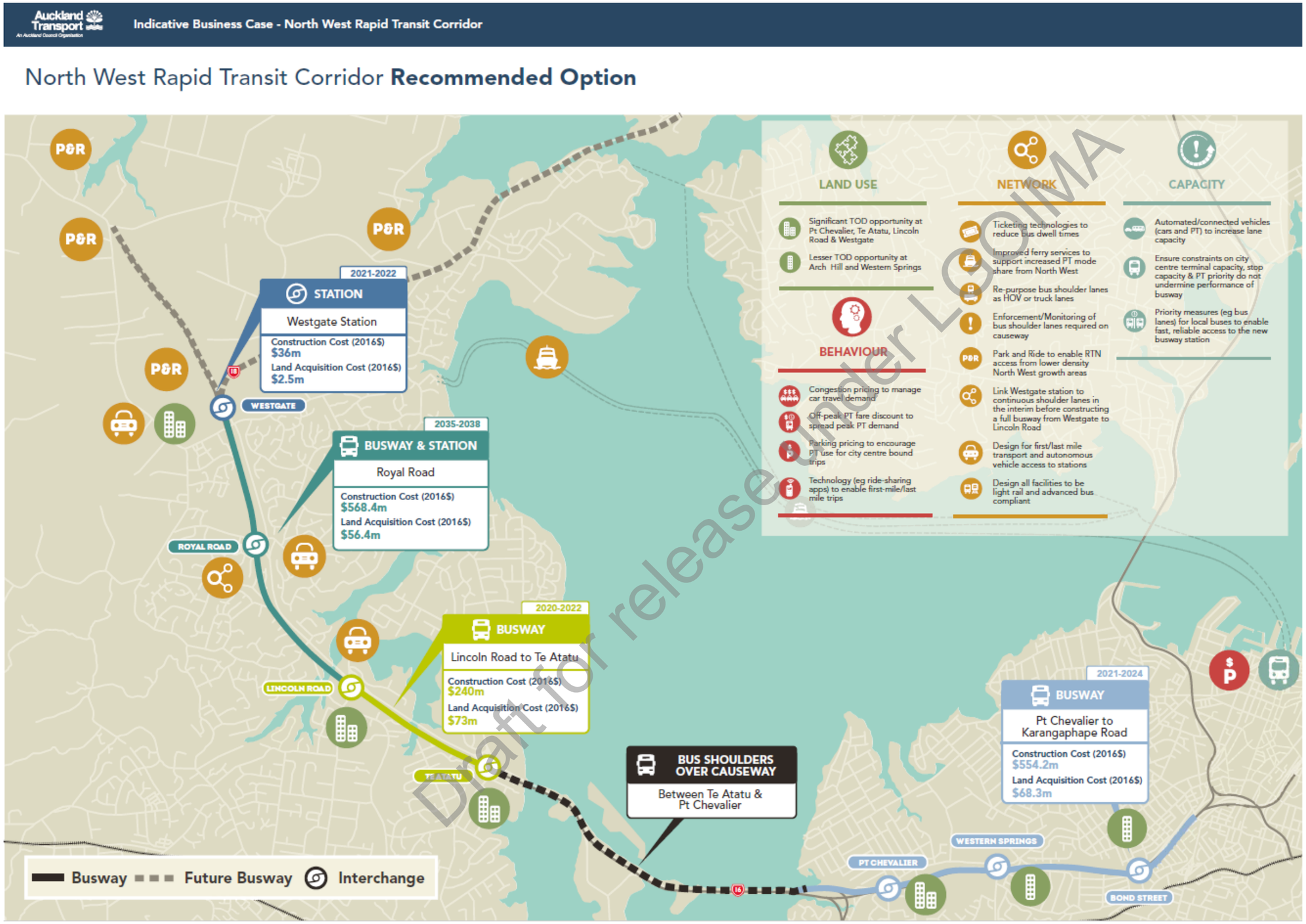


Figure 1.1 - NWRTC recommended staging

This preferred choice was made after considering an extensive list of public transport options with:

- Bus-based variations
- Light rail
- Metro rail (including conventional heavy rail, and specialised automated light metro systems)
- Ferries
- Alternative ways to manage demand and optimise the existing network.

The short-listing demonstrated that the preferred mode should be either bus (bus lanes or a busway), or light rail, based on a combination of criteria relating to cost, likely patronage and performance. The metro rail options (heavy rail and automated light metro) had higher costs than could be justified by expected patronage, the ferries were slow, with high operating costs and did not serve sufficient catchments – though they could have a complementary role.

The only outstanding issue with the bus mode remained uncertainty as to the availability of sufficient road and stop space in the central city. While outside the scope of the IBC, some assessment has been carried out and it is likely that a resolution exists for this issue.

In the final assessment, the preferred option was a bus-based solution with a range of infrastructure types along the corridor with careful staging to target sections of the corridor where the greatest problems occur and which could therefore provide higher benefits first. One of the major advantages of a bus-based solution over light rail is that it can be implemented in stages, whilst light rail has effectively to be built in one step to gain the benefits. Light rail also necessitates the widening of the causeway between Te Atatu and Waterview which would create high risks from a consenting, environmental and cultural perspective. Sub-options of using Great North Road for the busway were rejected in favour of using SH16 despite the former having intermittent bus lanes, as a better travel time with higher reliability can be achieved on the latter. This reduced travel time translates into better access to and from employment and education for people in the north-west of Auckland.

The recommended staging for the North West Rapid Transit Corridor (NWRTC) is:

- By early 2020s: Lincoln Rd to Te Atatu busway; Westgate Station; Lincoln Rd Station; Te Atatu Station
- By mid 2020s: Point Chevalier to Karangahape Rd busway via SH16; new stations at Point Chevalier, Western Springs, Arch Hill
- By 2035: Westgate to Lincoln Rd busway; Royal Rd Station.

The recommended solution for the Te Atatu to Point Chevalier (causeway) section is to use the existing bus shoulder lanes, with improved management and enforcement.

The last potential stage of a busway solution – across the causeway – has the highest challenges for consenting and construction. The timing when demand reaches a point where that stage could be justified may also trigger a re-examination of a light rail option – the IBC recommends that the busway be constructed to be suitable for conversion.

The costs of the busway and each stage are:

Table 1.1 - NWRTC estimated cost summary

Estimated costs						
Section	**Stage 1**		**Stage 2**		**Future stages**	
	Construction (P95)	**Land**	**Construction (P95)**	**Land**	**Construction (P95)**	**Land**
Westgate Station	$36.3M	$2.5M	-	-	-	-
Busway Lincoln to Te Atatu	$240M	$73M	-	-	-	-
Busway Point Chevalier to city centre	$554.2M	$68.3M	-	-	-	-
Busway Westgate to Lincoln Road	-	-	$568.4M	$56.4M	-	-
Busway Te Atatu to Point Chevalier	-	-	-	-	$737.4M	$56.8M
Total	**$830.5M**	**$143.8**	**$568.4M**	**$56.4M**	**$737.4M**	**$56.8M**
Total cost per stage	**$974.3M**		**$624.8M**		**$794.2M**	
Total solution cost	**$2,393.3M**					

The benefit cost ratio (BCR) of the full solution is estimated to range from 1.0 to 1.6. A busway from Point Chevalier to the city along SH16 would have the highest BCR, with a range from 1.3 to 2.7. This reflects the fact that this segment has the highest total demands and some of the greatest existing issues with slow travel times on local roads or congested motorways.

The IBC recommends that early attention is paid to the transport modelling to ensure that the economic impacts are able to be appropriately estimated.

Aside from the causeway section, which has significant environmental effects in the Coastal Marine Area and would cause substantial concerns to iwi, the remaining sections are straightforward in terms of both consentability and construction for a project of this scale.

The estimated (P95) cost of the full staged busway proposal is $2.4 billion.

The NZ Transport Agency and Auckland Transport (AT) are considering future responsibilities for implementing the BRT, aside from the standard approach with the “normal” split of responsibilities (the Transport Agency will design and build the mainline, while AT has responsibility for the stations).

It is anticipated that the initial stages of the busway programme, as recommended, will be advanced as detailed business cases.

If the recommended staging is followed, the first stages will be implemented and their performance monitored and assessed using standard AT monitoring of patronage and road volumes and travel times, which will allow the timing of later stages to be refined.

The supporting measures should be advanced in parallel. They include:

- Land use intensification, particularly near stations
- Making better use of existing networks through optimisation and pricing
- Influencing travel demand, particularly in newly developing areas
- Using new technology to enhance operations
- Using all transport modes to support access needs including ferries, walking and cycling.

The outstanding risk for the success of the project remains the capacity of city centre roads to accommodate the numbers of buses from the north-west and associated bus stops. This risk is being managed by AT with multiple potential mitigation measures being considered.

2 Strategic Case (Strategy)

This Indicative Business Case (IBC):

- Reconfirms and updates the activity and strategic context for the proposed investment
- Re-examines and updates the evidence base for the key problems and rationale for investing
- Demonstrates how the potential benefits of investing may be assessed using SMART (Specific, Measurable, Agreed upon, Realistic and time-related) transport KPIs (Key Performance Indicators)

2.1 Activity context - location

The study area for the business case is defined as the State Highway 16 (SH16) North-Western Motorway corridor, focusing particularly on the corridor from Westgate to the city centre, but also including associated corridors, namely Lincoln Road, Te Atatu Road, SH16 to Kumeu, and the Upper Harbour corridor comprising SH18 and Hobsonville Road. This study area is illustrated below.

The outer areas, represent significant components of Auckland's future growth areas. As such, the scale and nature of the expected growth dominates the strategic context considerations for the business case and provide a major driver for the need to invest in the NWRTC.

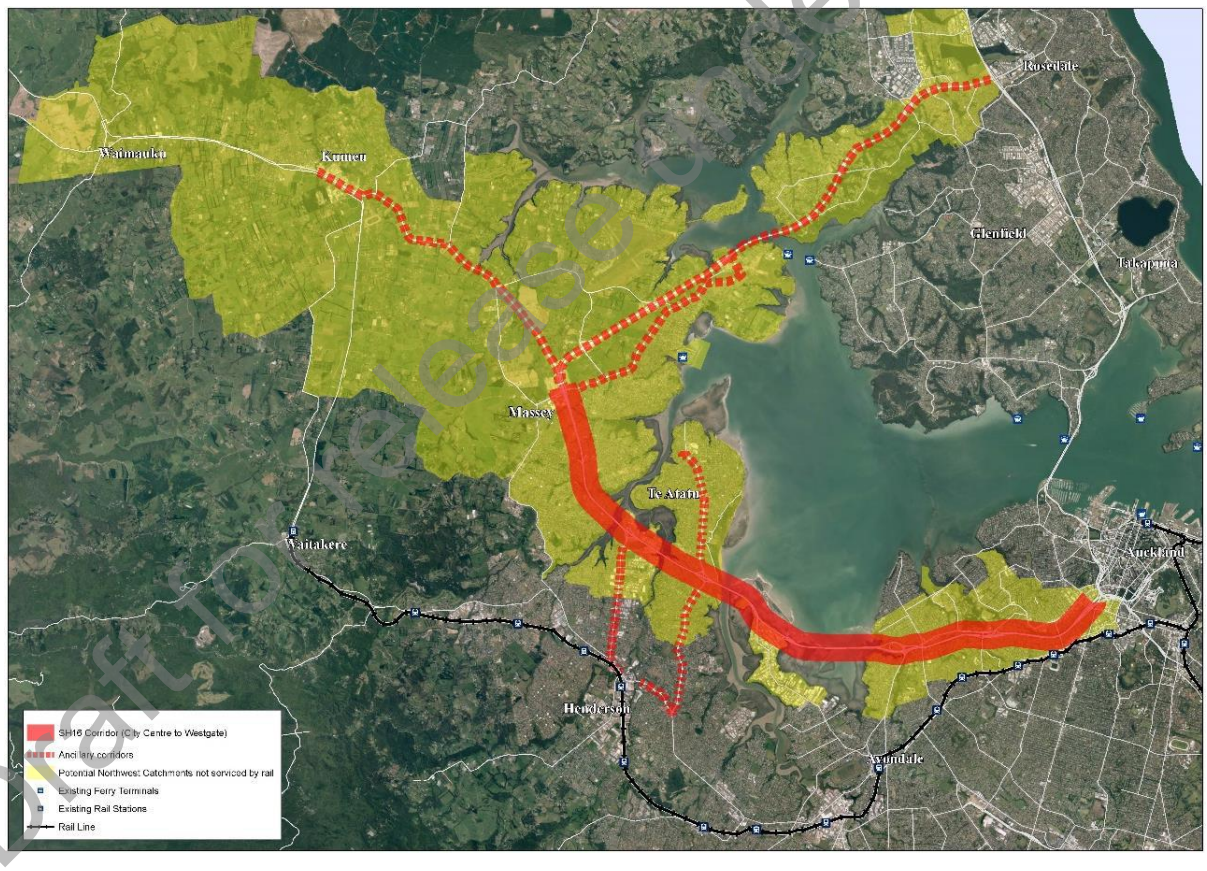


Figure 2.1 - North-west Rapid Transit Corridor study area

2.2 Expected population and employment growth

Greenfield growth is expected to occur around Massey North, the Upper Harbour area and Kumeu/Huapai, while further intensification is expected in the Lincoln Road and Te Atatu Road corridors. Over time, Westgate is expected to emerge and play an increasingly important role as a metropolitan centre. Growth in these areas is already occurring at a greater rate and scale than previously planned owing to initiatives such as the Auckland Housing Accord with its associated Special Housing Areas (SHAs). In addition, many areas in the north-west have been up-zoned, allowing for greater growth in the updated Auckland Unitary Plan (Unitary Plan) than was previously provided for within the earlier drafts.

Strategic growth drives this business case, and provides the need to investigate public transport service to the catchments within the growth areas.

The Great North Road corridor between Point Chevalier and the city centre has had significant development and intensification in recent years, with a large amount of apartment development on the inner section. There remains considerable potential for further intensive apartment and commercial redevelopment along the length of this corridor, which is both enabled by the Unitary Plan and consistent with current market activity.

2.3 Revised land use policy context

Since the Strategic Case for the north-west Rapid Transit Corridor (NWRTC) was completed in 2015, there is now increased certainty about the future direction for land use in the area. The Unitary Plan is now operative in part and provides clarity about the regulatory framework for urban development in the area.

The Unitary Plan establishes the regulatory framework for land use and development, including the location and density of future housing and employment growth. It therefore influences where, when, and how population and employment growth will occur in north-west Auckland and existing urbanised areas in west Auckland and the inner west.

In general terms, the Unitary Plan is expected to enable the land use forecasts incorporated into Auckland Transport's modelling of future transport demands (land use scenario I9). However, the timing and sequencing of development is potentially more uncertain, as the Unitary Plan opens up more opportunities for development overall.

There were three main changes in the Unitary Plan Operative in Part from previous versions that may influence urban development:

a) First, in north-west Auckland, the Future Urban Zone (FUZ) has been modestly extended outwards to provide further areas for development, with some areas around Red Hills, Scott's Point in Hobsonville, and Whenuapai immediately 'live-zoned' to allow for development. The NWRTC is therefore a timely investment to these areas which are effectively unconstrained. See Figure 2.2 for an overview of FUZ areas and live-zoned areas in north-west Auckland.

b) Second, residential zoning rules have been relaxed, enabling denser development both in new subdivisions and additional infill and redevelopment in the existing urbanised area. This has been achieved through changes that permit smaller lot sizes and more dwellings per site in residential zones, as well as 'rezoning' of some suburbs to allow for apartment buildings and terraced housing. Intensification is concentrated within the existing urban area along the corridor, and areas including Westgate, Te Atatu, Point Chevalier and Grey Lynn have been rezoned for apartment and terrace housing. As shown in Figure 2.2, the areas in Westgate and Te Atatu provide for apartments and terrace housing (orange overlay).

c) Third, although the Rural-Urban Boundary (RUB), which identifies the areas that will urbanise over the longer term, has been maintained, the Unitary Plan allows for private plan changes to enable urban development in areas outside the RUB. Auckland Council may reject any plan changes for

significant areas of re-zoning for two years[1]. Nevertheless, this 'Soft RUB' may not encompass the extent of further development in north-west Auckland.

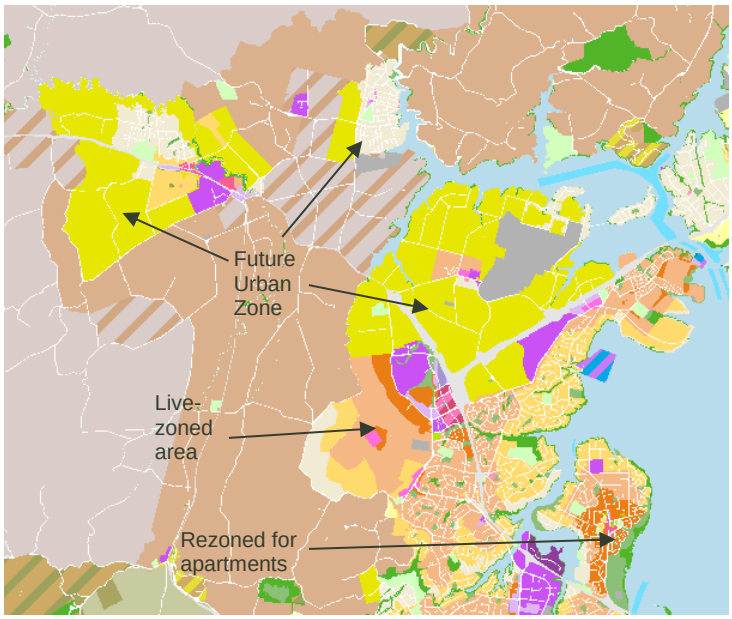


Figure 2.2 - Unitary Plan zoning in north-west Auckland

As part of the evidence base developed in hearings on the Unitary Plan, Auckland Council modelled the commercial feasibility of residential development capacity enabled by the Unitary Plan. This modelling compares the cost of developing new housing (e.g. land and construction costs) against the expected revenues from selling it, and identifies dwellings as 'feasible' if they are sufficiently profitable to develop based on 2015 prices.

Figure 2.3 summarises the results of this modelling, with greens and reds reflecting areas with more commercially feasible development capacity. Note that this excludes capacity in FUZ areas. The results show that:

a) North-west Auckland is expected to provide significant development capacity, mainly in greenfield areas;

b) Although residential and centre zoning in west Auckland enables significant development capacity in principle, little of this is commercially feasible based on today's prices; and

c) Te Atatu Peninsula is expected to provide some commercially feasible development capacity, as is the inner west on the isthmus.

[1] Pursuant to Section 25, Part 2, Schedule 1 of the Resource Management Act

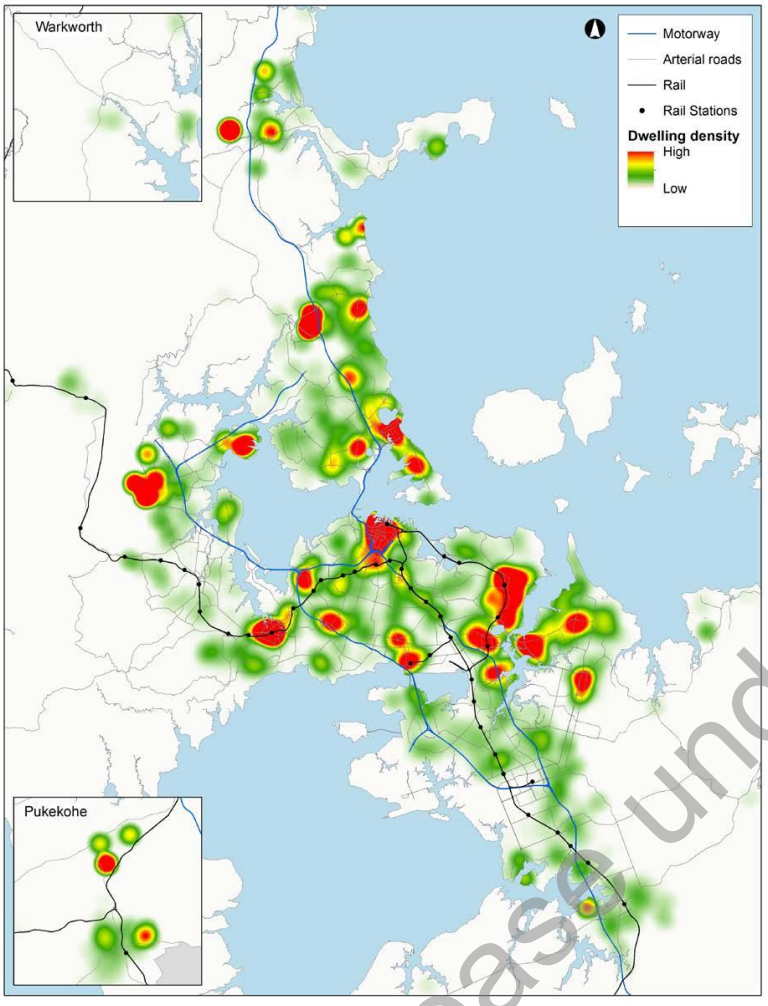


Figure 2.3 - Distribution of commercially feasible development capacity under the Unitary Plan

2.4 Future Population and Employment Growth

Figure 2.3 shows forecast change in population and employment along the study corridor and in north-west Auckland. This shows that:

- This scenario encompasses large increases in population density in north-west Auckland, especially at Westgate/Red Hills (which has now been 'live-zoned' for development), Hobsonville, and Whenuapai.
- Employment densities are also expected to increase significantly in north-west Auckland, particularly around Westgate and at Hobsonville.
- Changes in residential population density are expected to be more pronounced on the isthmus than in west Auckland. Most of the growth in west Auckland is expected to occur between the rail corridor and the NWRTC, with high growth projected especially around Henderson, New Lynn, and Avondale.

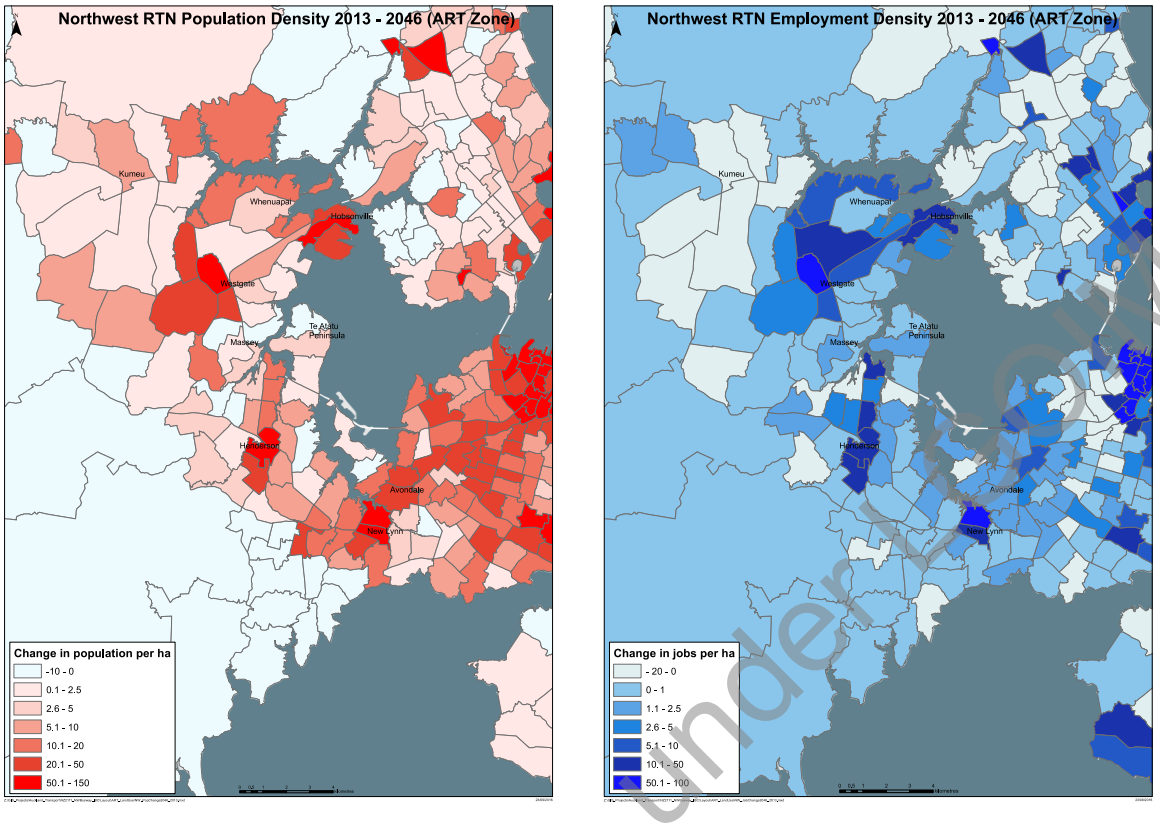


Figure 2.4 - Projected change in population and employment along the NWRTC, 2013-2046 (Scenario I)

Table 2.1 summarises the expected population and employment growth in two areas of north-west Auckland, compared against the city centre and fringe area and total growth in the Auckland region. By providing this comparison, the regionally significant scale of projected growth in north-west Auckland can be seen, including:

- Westgate-Whenuapai-Hobsonville is expected to grow to almost three times its current population, while employment in this area is expected to grow sevenfold. This area is expected to account for 8.4% of Auckland-wide population growth and 12.1% of Auckland-wide employment growth.
- Huapai-Kumeu is expected to grow to almost four times its current population, and marginally increase employment. It is expected to account for 2.2% of Auckland-wide population growth.
- Total residential growth in north-west Auckland (10.6% share of growth) is expected to be similar in magnitude to the city centre and fringe area (10.2%). The city centre and fringe area is, however, expected to account for 32.8% of Auckland's future employment growth compared to the 12.3% in the north-west. This highlights the ongoing importance of access to the city centre for region-wide commuting patterns and labour market outcomes.

Other areas along the SH16 north-west motorway, such as the Te Atatu Peninsula, are not included in the table. However, as shown in Figure 2.4 above they are expected to experience more modest growth under Scenario I9.

Table 2.1 - Projected population and employment in north-west Auckland, 2013-2046 (Scenario I9)

Area	Type	2013	2026	2036	2046	*Growth 2013–2046*	*Share of growth*
Westgate - Whenuapai - Hobsonville	Population	38,998	74,612	95,871	110,944	*71,946*	*8.4%*
	Employment	6,472	24,207	35,448	45,883	*39,411*	*12.1%*
Huapai - Kumeu	Population	6,766	8,787	15,795	25,959	*19,193*	*2.2%*
	Employment	2,879	2,389	2,570	3,376	*497*	*0.2%*
city centre + Fringe + Newmarket	Population	52,758	94,887	119,062	139,848	*87,090*	*10.2%*
	Employment	121,451	176,760	203,435	228,656	*107,205*	*32.8%*
Total Auckland	Population	1,397,349	1,812,705	2,041,614	2,251,429	*854,080*	*100.0%*
	Employment	555,058	720,971	799,964	881,516	*326,458*	*100.0%*

At present, north-west Auckland has a lower ratio of employment to population relative to the whole of Auckland. This means that most people in the area must commute outwards to access employment, education, and retail options. However, as shown Figure 2.5, the ratio of jobs to population in north-west Auckland (defined here as Westgate-Whenuapai-Hobsonville plus Huapai-Coatesville) is expected to rise in future decades, eventually approaching the Auckland-wide average.

Over time, this will mitigate some of the growth in transport demands from north-west Auckland to the rest of the city, while attracting people to commute to north-west Auckland. However, for the next 30 years there is a significant employment deficit requiring transport options for people in the north-west to access jobs and education outside the north-west if the region's growth requirements, particularly for housing, are to be realised.

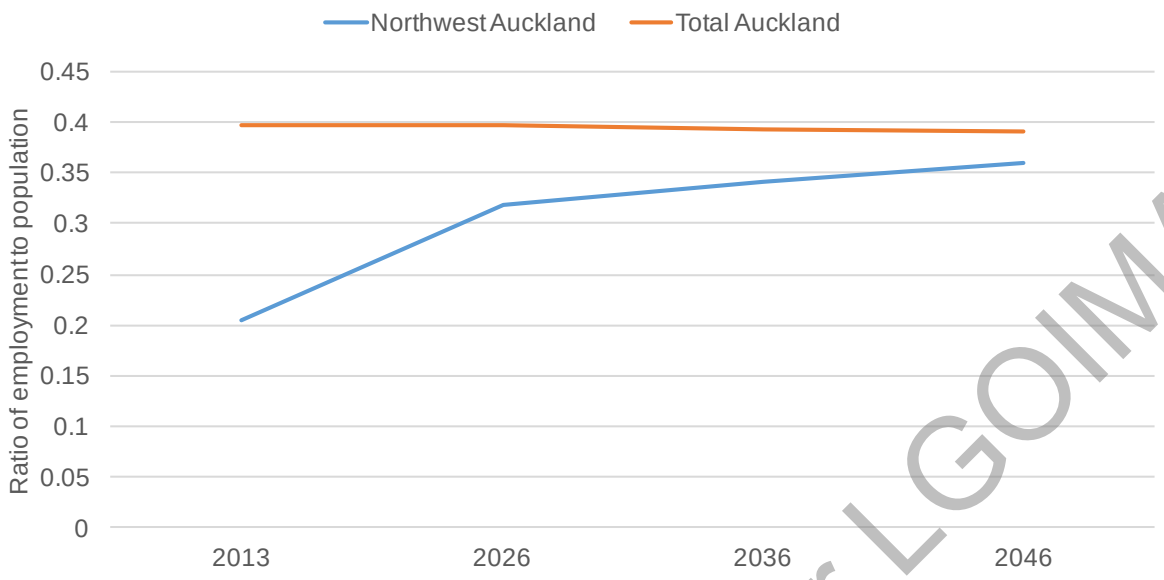


Figure 2.5 - Projected ratio of employment to population, 2013-2046 (Scenario I9)

These projections are based upon evaluations of the 'feasible capacity' for growth within the various areas of Auckland. The level of transport infrastructure and connectivity provided to an area is one factor that influences the location, level and timing of growth.

It is noted that the delivery of a rapid transit route to the north-west corridor would greatly increase the transport accessibility, which would in turn increase the level of feasible capacity for population growth in the corridor. Therefore, it is acknowledged that the NWRTC has the ability to influence and shape residential and employment development in the north-west, in addition to simply responding to it.

2.4.1 Recent land use trends within north-west Auckland

Recent land use data indicate that residential population growth is proceeding faster than employment growth in north-west Auckland. According to Statistics New Zealand's Subnational Population Estimates (updated to 2016) and Business Demography Statistics (updated to 2015):

- From 2013 to 2016, the overall residential population in north-west Auckland (Westgate-Whenuapai-Hobsonville plus Huapai-Coatesville) increased by 4140, or an 8.4% increase
- From 2013 to 2015, employment in north-west Auckland increased by 740, a 7.5% increase. Over this period, north-west Auckland added one job for every three additional residents.

While the trend in residential population growth in the area is consistent with the ART model projections, if the rate of employment growth does not increase, it will be challenging to achieve the higher ratio of employment to population in north-west Auckland depicted in Figure 2.5. This would result in higher demand for travel along the NWRTC as a larger share of residents of north-west Auckland would need to travel to other parts of the city for employment, shopping, and other needs.

Subdivision is proceeding faster than expected in some parts of north-west Auckland, often with smaller lot sizes that result in a higher density of residential population than was originally expected in the ART modelling. If this trend continues, it will result in a higher overall population in north-west Auckland, with correspondingly higher transport demands.

To illustrate this trend, data on residential developments at Hobsonville Point were analysed. According to land use scenario I9, the Hobsonville Point area is expected to have a density of 18.4 households per hectare by 2046. If about 30% of land is set aside for roads, parks, and other uses, this implies an average residential section size of around 400m^2.

Actual section sizes in the Hobsonville Point development (shown in Figure 2.6) are considerably smaller than this average. An analysis of homes advertised for sale as at 28 October 2016 shows that:

- The average section size for 108 standalone and terraced houses advertised for sale was 225m^2 – considerably smaller than the 400m^2 average lot size implied by Scenario I9. 90% of sections were smaller than 330m^2.
- In addition, there were 60 apartments advertised for sale, or 35% of the total dwellings being advertised. These are likely to be even higher-density than terraced and standalone houses.

If this trend continues in other parts of the growth area, there will be pressure on transport provision and an increased need for higher capacity transport modes such as dedicated public transport corridors not only in the NWRTC as defined in this business case, but also beyond this into the main corridors of the growth areas themselves.

Figure 2.6 - Hobsonville Point development

2.5 Transport context

2.5.1 Study corridor context

The study corridor is located within a strategic network and an emerging local network context.

The strategic network includes:

- A state highway network, in particular the Western Ring Route, an alternative through route from the north to the south and a major strategic distributing network for cross regional trips.
- A rapid transit network (proposed) which envisages a connected suite of rapid transit corridors across Auckland in the next 30 years. The NWRTC is one of these connections.

2.5.2 Future public transport provision in the growth areas

The Transport for Urban Growth (TFUG) Programme Business Case identified an emerging local and strategic network (by the ATAP definition of a strategic network). The network is important to the NWRTC as it provides access from the local network to the RTN services.

2.5.3 Study corridor

Figure 2.7 illustrates the transport study corridor (referred to as the North-West Rapid Transit Corridor (NWRTC)) and defines core public transport elements. Note that this differs from the Study Area that includes catchments and a wider area of influence. The NWRTC includes:

- Running ways – the road corridors between key points that divide the corridor into four key segments, each of which can be addressed individually:
  - Westgate to Lincoln Road corridor
  - Lincoln Road to Te Atatu Road corridor
  - Te Atatu to Point Chevalier (SH16 Causeway)
  - Point Chevalier to city corridor, which includes both Great North Road and SH16 between Waterview and Newton Road. (The study area ends at Karangahape Road but the rapid transit services are expected to continue downtown via Albert Street as per current north-west services.)
- Stops/ stations – main locations for potential passenger boarding/ alighting and transfers between services include:
  - Westgate
  - Royal Road
  - Lincoln Road
  - Te Atatu Road
  - Point Chevalier

  Other intermediate locations could support local access stations, some with transfer potential.

Figure 2.7 - NWRTC study corridor

2.5.4 Public transport services

Auckland Transport's New Network for central Auckland and west Auckland establishes a near-term future structure for public transport services on and around the NWRTC. The New Network is based on a frequent connected service model that aims to enable public transport journeys between a wider range of origins and destinations by providing a small number of frequent routes that offer 'turn-up-and-go' levels of service, along with less-frequent routes to serve areas not directly served by frequent routes and interchange points that allow for easy and convenient transfers between services.

Figure 2.8 displays the post-consultation New Network for west Auckland. This map shows the frequency of public bus routes – the thickest lines provide all-day (7am-7pm) service at 15-minute or better frequencies, while the narrower lines show services running at 30-minute frequencies or less.

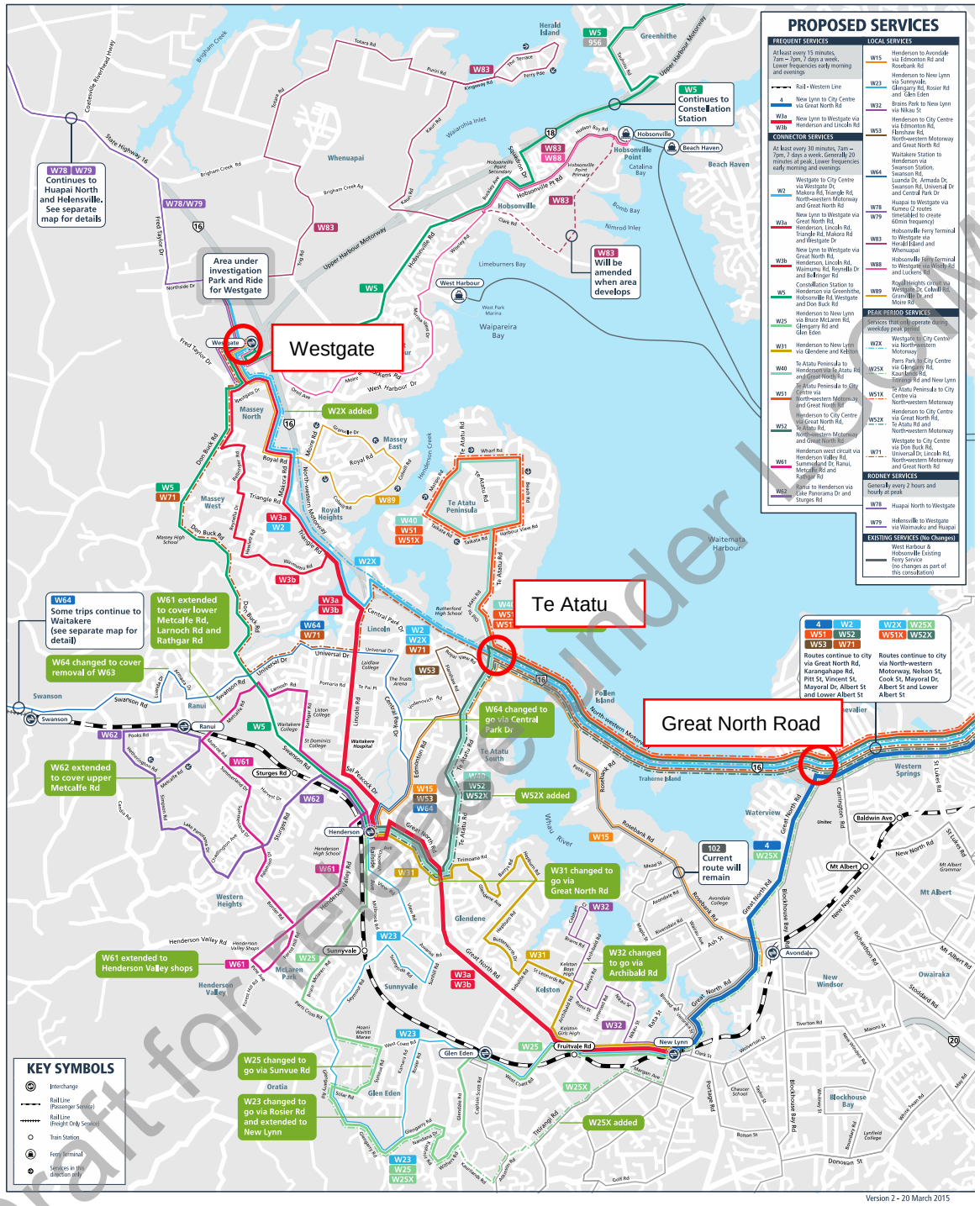


Figure 2.8 - New Network for west Auckland (Source: Auckland Transport)

The following routes provide public bus services to important destinations along the NWRTC:

- Westgate (leftmost red circle) is served by two main routes:
  - W2 provides a service from Westgate to the city centre at half-hourly frequencies, joining SH16 at Lincoln Road
  - W3a/W3b provide service between Westgate and Henderson, splitting into two different paths between Triangle Road and Westgate

- The Te Atatu area (middle red circle) is served by three routes that provide overlapping service patterns at lower levels of frequency:
  - W51 provides all-day service at half-hourly frequencies between Te Atatu and the city centre, and W51x provides additional peak express service
  - W52 provides all-day service at half-hourly frequencies between Henderson and the city centre, and W52x provides additional peak express service
  - W40 provides all-day service at half-hourly frequencies between Te Atatu and Henderson, overlapping with the above two routes
- The areas to the north and west of Westgate are not served by any frequent services:
  - Several buses that run on an hourly basis provide service to Huapai, Whenuapai, and west Harbour / Hobsonville
  - W5 provides all-day service on a half-hourly basis between Westgate and Constellation Station on the Northern Busway

All-day buses running to the city centre via the NWRTC generally leave the motorway after Waterview and travel via Great North Road (GNR) (rightmost red circle), while peak-only express buses may travel on either SH16 or Great North Road depending upon traffic conditions on the day.

Figure 2.9 shows the post-consultation New Network for Central Auckland. As above, this map shows the frequency of routes – the thickest lines provide all-day (7am-7pm) service at 15-minute or better frequencies, while the narrower lines show services running at 30-minute frequencies or less.

The following routes provide service to key destinations along the NWRTC:

- The Great North Road corridor between Point Chevalier and the city centre is used by a range of bus routes, including:
  - The city centre-bound buses from the Westgate and Te Atatu (i.e. W2, W51, and W52)
  - 18, which travels from New Lynn to city centre via Point Chevalier
  - 195, which travels from New Lynn to city centre via Blockhouse Bay Road then via Great North Road
- A range of lower-frequency buses not listed herePoint Chevalier (circled in red) also serves as an important transfer point to cross-town buses, including:
  - The Outer Link, which travels in a circle around the western isthmus
  - Crosstown 6, which provides regular service from Point Chevalier to Glen Innes via St Luke's Road and Balmoral Road

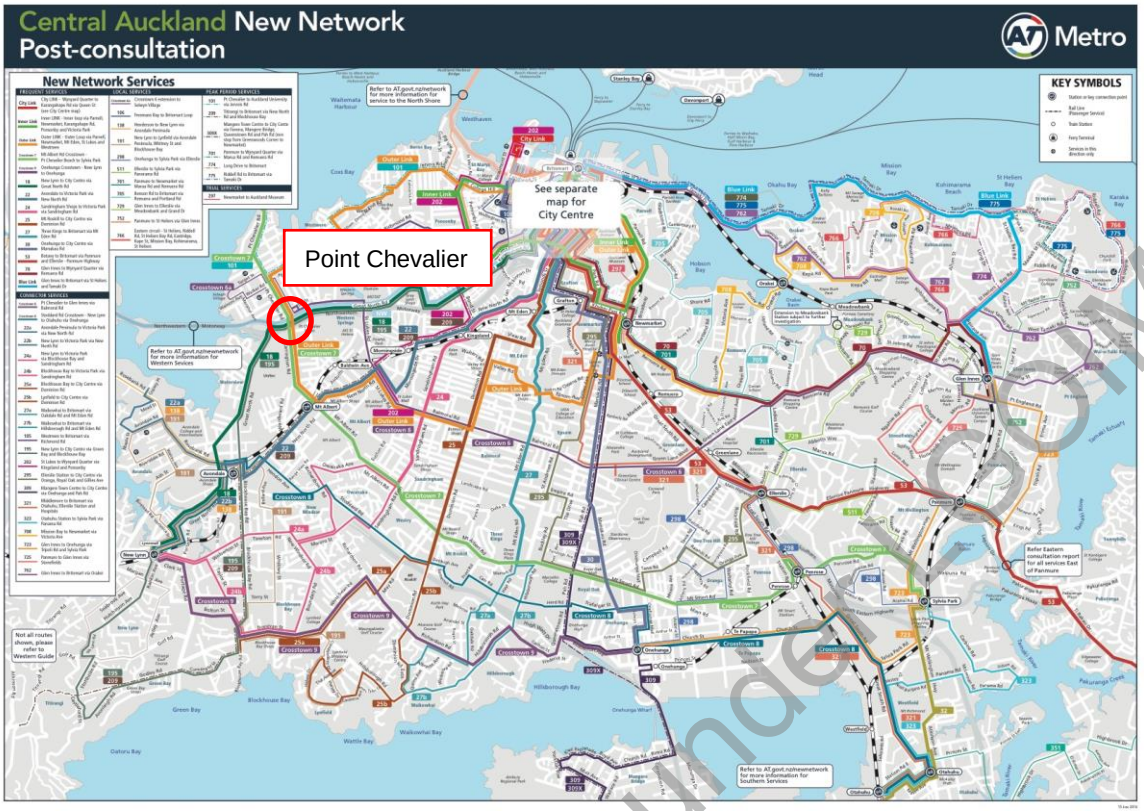


Figure 2.9 New Network for central Auckland (Source: Auckland Transport)

2.5.5 Potential growth area network

Based on the transport network developed by the TFUG Programme Business Case, a skeleton public transport network has been defined for the purpose of defining the requirements for provision for supporting public transport corridors.

Network Concept

The future public transport network will be an integrated system comprised of two trunk rapid transit routes, and numerous locally focussed Frequent and Connector bus routes.

The network follows the New Network connective grid concept and service delivery model. Under this model the Rapid Transit bus routes form the regional spine of the network, linking the city centre, metropolitan centres and major suburban hubs along fast and direct alignments, supported by infrastructure to insulate them from traffic congestion delays.

These Rapid routes are supported by a second tier network of Frequent and Connector bus routes, which run along main roads and serve local residential communities and smaller suburban centres. These routes are designed for two complementary roles: to give local access to nearby shops, services and employment centres, and to connect to the primary Rapid lines for onward travel to the city centre and other regional destinations. For this reason, bus interchanges are intentionally located at Metropolitan centres and other major destinations where possible: this allows the local bus routes to simultaneously provide direct local access while also acting as feeders to regional Rapid Transit.

Under the New Network model, local bus routes do not continue to downtown or regional destinations, while Rapid routes generally do not serve local communities. Connecting between these two tiers of

the network allows each tier to be specialised to its task, allowing the integrated network to achieve high performance and operational efficiency from a fixed operating budget.

All services will operate regular even headways all day, seven days a week. The main Rapid and Frequent routes will operate at high frequencies to allow timetable-free "turn up and go" access, and to keep waiting time at connection points to a minimum.

Rapid Transit Network Structure

Based upon current plans and future potential, the study team proposes two regional rapid transit corridors for the north-west:

- The "Northwest Express" operating on the Northwestern Busway following the SH16 corridor
  - This will be served by a single Rapid Transit service operating radially to the city centre via major interchange stations at Westgate, Royal Heights, Lincoln Rd, Te Atatu and Pt Chevalier.
  - This route provides fast and direct access between the Northwest, the isthmus and the city centre, analogous to the Northern Busway on the North Shore or the rail lines elsewhere in Auckland.
  - This will initially be served by buses operating on the motorway and local streets, before moving to a purpose built busway from the city centre through Westgate towards Kumeu.
  - Very high service levels will be required in future years. The base all-day timetable would operate with buses every 5 to 10 minutes , while more than 40 double decker buses per hour could be required at peak times to meet demand in future years.
- The "Upper Harbour Express" operating on the Upper Harbour corridor, following SH18. This transit corridor would support a trunk bus service running between West Auckland, the Northwest, and the North Shore.
  - The proposed network is for a single Rapid Transit bus service running along the upper harbour between Henderson, Lincoln Road, Westgate, Hobsonville, Greenhithe and Constellation and potentially onward to Albany or Takapuna on the Northern Busway.
  - This crosstown Rapid Transit line will serve to connect residents in the Northwest directly to regional employment and shopping centres in West Auckland and the North Shore, while also connecting to the Northwestern and Northern Busways, and the Western Rail Line, for onward links to the city centre and other parts of the region.
  - This will initially be served by buses operating on the SH18 motorway and local streets, moving to a SH18 busway over time. Additional interchange stations are required (i.e. Hobsonville) to integrate with the local network.
  - The part of the Upper Harbour Express route between Lincoln Road and Westgate would be shared with the Northwest Express.
  - This route will require high service levels, operating at 10 to 15 minute headways on the base timetable, with buses every five minutes or better at peak time.

Together, these two routes create a rapid transit network with east-west and north-south spines intersecting at Westgate.

Surface bus network structure

Supporting the rapid transit network is a local bus network of Frequent and Connector routes, with each route connecting one or more other stations on either of the two busway corridors as outlined in Figure 2.10. Almost all routes connect to the Westgate Metropolitan centre at one end, and another interchange station or town centre at the other.

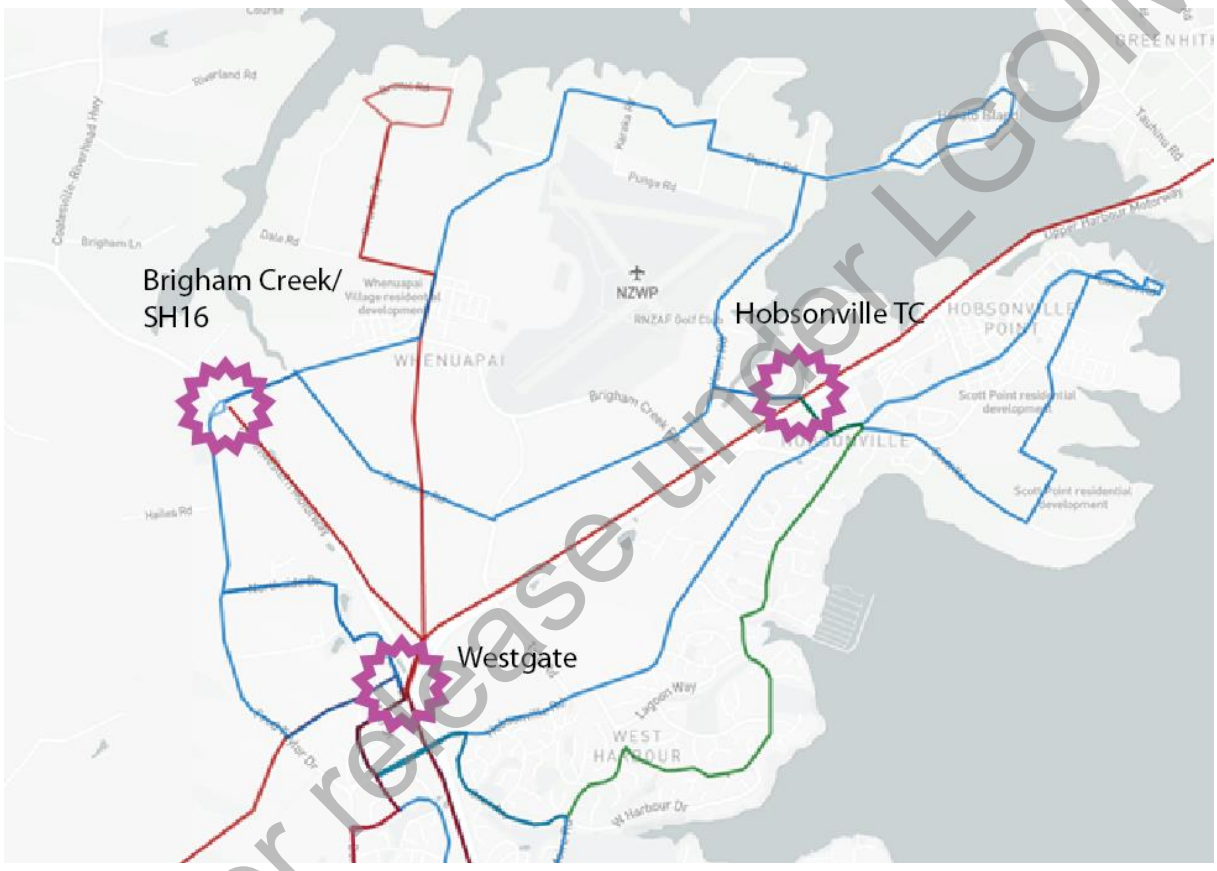
These routes are intended to transfer people to a busway at the earliest convenience, so that the largest proportion of their trip is spent on the fast link. This indicates that all local bus services within the area will connect to rapid transit at one of three stations. The primary interchange point is at

Westgate Town Centre, which is the anchor point of fifteen of the sixteen surface bus routes, as well as the intersection of the two rapid transit corridors.

Secondary interchange points occur at the intersection of Brigham Creek Rd and SH16 (two routes) and at the Hobsonville Town Centre (four routes).

The network as designed requires a bridge at Hobsonville Town Centre to carry buses across the motorway corridor.

Figure 2.10 - Growth area bus network



2.6 City centre capacity

Comparison of current and future demands indicates that Albert Street as currently proposed will be capable of accommodating the proposed local bus services and the Northwestern busway services until approximately 2029. This is the year that the projected bus volumes exceed the nominal capacity of 53 buses per hour on Albert Street. This is provided that the fleet is converted primarily to double-deckers over the next ten years.

Beyond 2029 it is reasonable to assume that additional bus capacity can be achieved with some intervention in the Albert Street corridor and its corresponding Britomart terminal. For example, quadruple length bus stops would accommodate all busway and other buses on Albert Street until sometime in the 2050s, with some degradation in customer experience at peak times. In practice this would amount to some bus queueing at times during the peak hour, in the peak direction, with good service at all other times.

If expanding the Albert Street bus corridor capacity was not possible or acceptable in the future, there are alterative corridors that could be used to accommodate Northwestern Busway buses, such as Hobson Street and Nelson Street. Alternative options could also include through-routing of Northwestern busway routes to the North Shore or elsewhere, or construction of a new bus terminal facility.

While these options have not been evaluated in detail by the current business case, it appears that the Albert Street corridor will be sufficient for at least the first decade, and there appear to be a range of options to continue to accommodate increasing bus numbers in subsequent decades.

Further planning of the detailed operation of the city centre bus networks, and evaluating the integration of the Northwestern corridor with other corridors on the regional network, should be undertaken in the next stage of the business case process.

2.7 Existing and planned transport infrastructure on the NWRTC

Table 2.2 summarises existing and planned bus facilities on the main components of the NWRTC. The critical observations on existing transport facilities are:

- There are no public transport interchanges along the NWRTC, so buses seeking to pick up or drop off passengers, including for transfers between services, must leave the motorway to use on-street bus stops.
- There are bus shoulder lanes along SH16 between Waterview and Lincoln Road, and Lincoln Road to Westgate by 2019. These do not provide continuous priority through ramps and interchanges, meaning that buses must merge into mixed traffic at these points.
- There are peak bus lanes on Great North Road that are limited in hours of operation and do not always extend through town centres.

In short, there are some bus facilities along the corridor, but these are incomplete and do not fully provide for the New Network service model. In particular, the lack of interchanges along the corridor means the connected network service model cannot be provided in the north-west, and infrequent, point-to-point services must instead be provided, reducing the efficiency of the bus network and reducing the number of destinations people can reach by public transport.

Table 2.2 - Existing bus facilities on the NWRTC

Segment	Existing bus facilities
Westgate station / stops	No station at present; there are bus stops at Westgate Shopping Centre and current plans for park-and-ride near Westgate
Westgate to Lincoln Road	All-day routes travel parallel to SH16 on Royal Road / Makora Road/Triangle Road; a small number of peak express buses run on motorway No bus priority measures on surface streets; SH16 shoulder bus lanes are under construction but do not extend to or through ramps
Lincoln Road station / stops	No station; there are local bus stops in several separate locations near to the Triangle Road/ Lincoln Road intersection

Lincoln Road to Te Atatu Road	Buses travel on SH16 Bus shoulder lanes have recently been built but do not extend to or through ramps
Te Atatu Road station / stops	No station or interchange facility; local bus stops on Te Atatu Road to the north and south of the motorway interchange
Te Atatu Road to Waterview (causeway)	Buses travel on SH16 SH16 shoulder bus lanes are constructed but do not extend to or through ramps
Point Chevalier station / stops	No interchange facility; local bus stops on Great North Road outside the Point Chevalier shops (as well as some stops on nearby cross-streets) Significant interchange point for isthmus services
Point Chevalier to Karangahape Road	Includes both Great North Road between Point Chevalier and Karangahape Road and SH16 between Waterview and off-ramps from the Central Motorway Junction Most buses travel on Great North Road, with some peak-only express buses using SH16 Some bus priority measures on Great North Road including bus lanes that operate only in the peak hours and typically do not extend through town centres and intersections where there are conflicts with on-street parking and other traffic movements. There is no bus priority on this section of SH16.

2.7.1 Auckland Transport Alignment Project

Since the Strategic Case was adopted in 2015, the Auckland Transport Alignment Project's (ATAP) Recommended Strategic Approach to future transport network management and investment in Auckland has been published[2]. It provides clarity about the timing and need for key transport infrastructure projects, and identifies the context in which they will take place.

ATAP sets out common objectives for Auckland's transport network:

- Improve access to employment/labour
- Improve travel time and reliability
- Improve public transport mode share
- Deliver net benefits from new investments

[2] Auckland Transport Alignment Project Recommended Strategic Approach September 2016, Ministry of Transport, The Treasury, Auckland Council, Auckland Transport, State Services Commission, NZ Transport Agency.

Based on these common objectives, and analysis of alternative investment programmes, ATAP recommended a strategic approach to managing and investing in Auckland's transport network. There are three elements to this approach:

- Make better use of existing networks, via better network management and use of new technology
- Target investment to the most significant challenges, e.g. enabling growth and addressing emerging capacity constraints
- Maximise opportunities to influence travel demand, including through smarter pricing

As part of the Recommended Strategic Approach, ATAP sets out indicative priorities for major new investments over a three-decade period. These are summarised in Figure 2.11. A Northwestern Busway is identified as a priority investment, with the following timing for implementation:

- Northwestern busway Westgate to Te Atatu identified as a priority for decade one
- Northwestern busway extensions are identified as decade two priority – these include extensions to Kumeu and from Point Chevalier to Newton.

ATAP identified the Northwestern busway-west Busway as a project that would contribute to strategic objectives for Auckland's transport network, including improved accessibility and higher public transport mode share.

Also of relevance is the recommended continued investment in transport facilities to support greenfield growth as this is expected to provide elements of the supporting network to an RTN.

Indicative priorities for major new investments		
Early priorities (completion in decade 1)	**Medium term priorities (completion in decade 2)**	**Longer term priorities (completion in decade 3)**
• Northwestern Busway (Westgate to Te Atatu section). • Address bottlenecks on Western Ring Route (SH20 Dominion Rd to Queenstown Rd) and Southern Motorway (Papakura to Drury). • New or upgraded arterial roads to enable greenfield growth in priority areas. • Protect routes and acquire land for greenfield networks. • Complete SH16 to SH18 connection. • Early Rail Development Plan priorities (see paragraph 81). • Upgraded eastern Airport access (SH20B). • Investments to enable smarter pricing. • Increased investment in Intelligent Network Management. • Progress advance works on medium-term priorities.	• Continued investment to enable greenfield growth. • New strategic roads to Kumeu and Pukekohe. • Implementation of mass transit on isthmus and then to the Airport. • Bus improvements Airport – Manukau – Botany. • Improved access to Port/ Grafton Gully. • Northwestern Busway extensions. • Improve connection between East-West link and East Tamaki. • Penlink. • Medium-term Rail Development Plan priorities.	• Continued investment to enable greenfield growth. • Southern Motorway improvements south tof Manukau. • Southwest Motorway (SH20) improvements and improved northern Airport access. • Northern Motorway widening. • Waitematā Harbour crossing improvements, including mass transit upgrade of Northern Busway. • Longer term Rail Development Plan priorities.

Figure 2.11 - ATAP indicative priorities for major new investments

2.8 The evolving role of technology

The business case was written at a time of change and rapid evolution of technology in the transport sector. There are emerging technologies in the form of autonomous vehicles, access to travel information and the way people can access of purchase travel and mobility. While many of these remain undefined at this time, there is also uncertainty as to the effect these technologies will have on the way people travel and the needs people will have from a service and infrastructure perspective. This is particularly relevant to a greenfield growth area as the urban form and transport dynamics may be influenced by these factors. As examples only, there are some innovations that are either at or in trial stages that may be relevant:

- Autonomous private vehicles may affect arrival modes at stations, requiring less park and ride space and greater drop off space, or improve the efficiency of the motorway corridor and improving overall transport conditions.

- Autonomous public transport vehicles may increase throughput and efficiency of a BRT operation (recognising that many rail systems are already operating in this mode) or provide first and last-mile transport options and influence ridership as well as interchange and supporting corridor design.
- Mobility as a service (MaaS) will provide people with better real-time information on transport options, including the ability to purchase and pre-purchase mobility. This may influence ridership patterns and access needs.
- Advanced bus technologies, as referred to in the Transport Agency's recent Advanced Bus Study, will enhance the ability of RTN options to deliver greater reliability and capacity through reduced dwell times, higher capacities and greater control over operations.

2.9 The possible projects emerging from the business case will need to take account of these uncertainties, for example in terms of interchange facilities and capacity provision.Demographic and economic context

The north-west corridor passes through four Auckland Council local board areas: Albert-Eden, Whau, Henderson-Massey, Upper Harbour and Waitemata (Figure 2.12). Demographic information is available for these areas which gives some broad guidance to the make-up of the corridor, though significant parts of the boards are not located within the corridor, for example, Mt Eden, Henderson and half of the Upper Harbour area that forms part of the North Shore.

Further, the scale of growth in the outer sections of the corridor means that the characteristics of the corridor are likely to change significantly. The available information comes from the 2013 census[3].

[3] http://www.aucklandcouncil.govt.nz/EN/planspoliciesprojects/reports/Pages/censusinaucklandhome.aspx#aucklandprofile

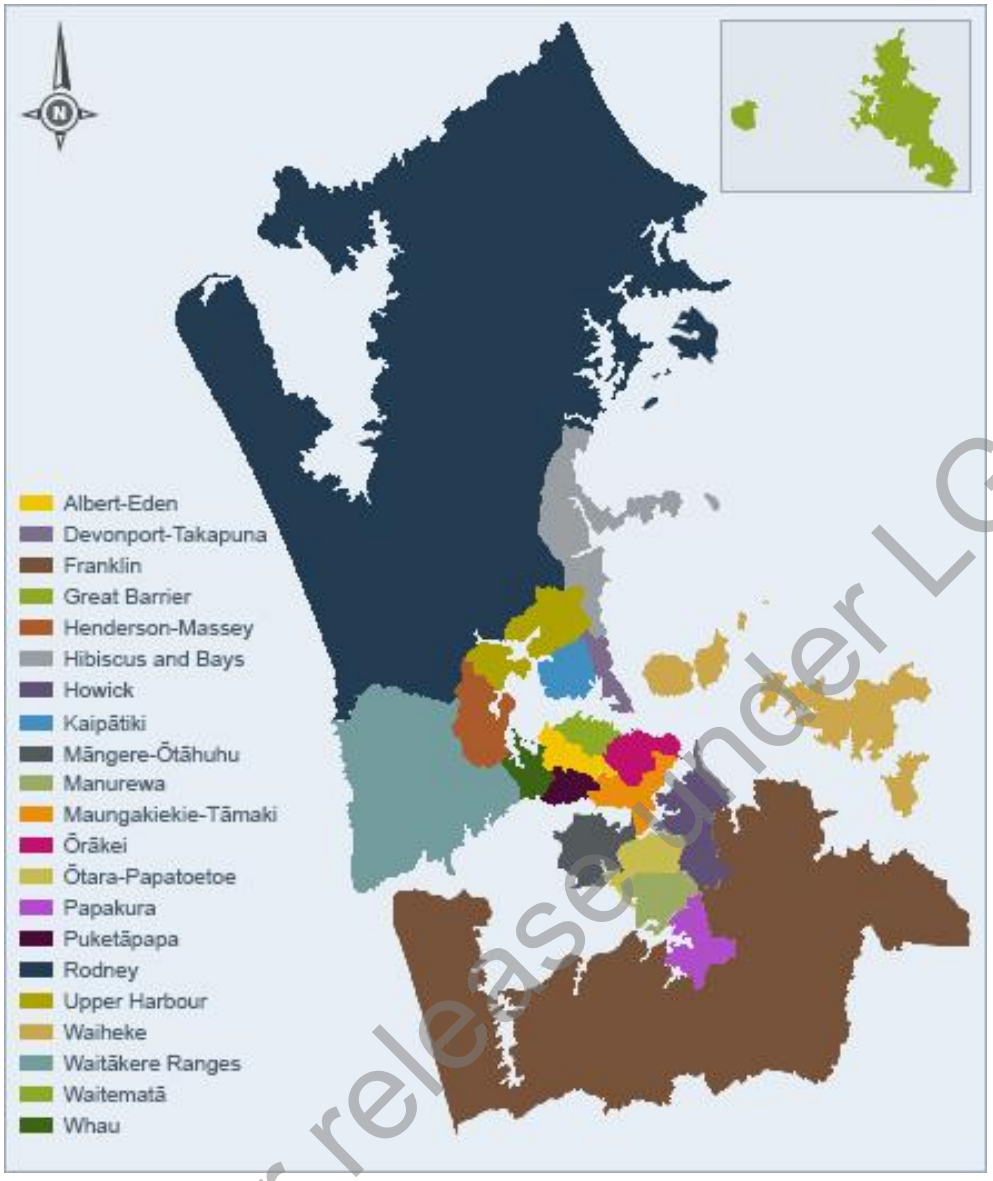


Figure 2.12 Auckland Local Boards

2.9.1 Albert-Eden

Rental, Hiring and Real Estate Services was the largest employment sector (14.6%) – much higher than the Auckland average of 3.0% - in the Albert-Eden board territory, followed by Health Care and Social Assistance at 12.6% (9.1%) and Professional, Scientific and Technical Services (11.6%) compared with the Auckland average of 9.9%.

The 2013 population was 106,600 – up 2.2% on the previous year. 73.8% of the population was of working age (15 – 64). The 2013 median personal income for adults in Albert-Eden was $32,800 per annum and the median household income was $87,500 per annum – both higher than that for Auckland as a whole - $29,500 and $69,500. The Albert-Eden Board comprises the suburbs of Point Chevalier, Mt Albert and Mt Eden.

2.9.2 Whau

In Whau manufacturing was the largest sector accounting for 23.4% of the total (Auckland 9.9%) followed by wholesale trade (11.3% vs 7.1%) and Rental, Hiring and Real Estate Services (6.8%).

The population of Whau was 82,500, up 2.6% on the previous year with 68.7% of working age. The census day median personal income for adults in Whau was $24,500 per annum – significantly lower than the Auckland average.

The Whau Local Board comprises the suburbs of New Lynn, Green Bay and Kelston, Rosebank, Avondale, New Windsor and Blockhouse Bay. The name Whau is from the estuarine arm of the Waitemata Harbour, which extends into the area.

2.9.3 Henderson-Massey

Manufacturing was the largest industry sector in Henderson-Massey accounting for 16.7% of the total (nearly double the Auckland average), followed by Health Care and Social Assistance at 10.4% and Retail Trade at 7.9% (Auckland, 9.7%).

The population was 119,000 in 2016, up 2.2% on the previous year. 67% of the population was of working age. The 2013 median personal income for adults in Henderson-Massey was $26,800 per annum – lower than that for Auckland.

The Henderson-Massey local board area is located at the western end of the Waitemata Harbour. It includes the Te Atatu Peninsula and the suburbs of West Harbour, Westgate, Ranui, Massey, Henderson and Glendene.

The main retail areas are in Henderson and the Massey/Westgate shopping centre. Business activity is also concentrated along the Lincoln Road corridor. Te Atatu town centre is noted to be a vibrant neighbourhood centre.

2.9.4 Upper-Harbour

In Upper Harbour Wholesale Trade was the largest contributor to Gross Domestic Product (GDP) at 16.4% (Auckland 7.1%) followed by Professional, Scientific and Technical Services (10.1%) and Manufacturing (8.5%).

The population was 62,800 – up 4.1% on the previous year. 70.6% of the population was of working age. The median personal income for adults in Upper Harbour was $31,100 per annum – slightly higher than that for Auckland.

The Upper Harbour Local Board area includes Whenuapai and Hobsonville in the west, Paremoremo, Greenhithe, Wainoni, Albany, and Northcross and Pinehill in the east – the latter group being outside the North-west corridor.

Upper Harbour is a rapidly growing area, and is undergoing significant change. In recent years, the land at Hobsonville airbase has been redeveloped into a new community, which has also meant the development of a new primary and secondary school, a ferry terminal and new business opportunities.

Waitematā is the largest local board area in terms of GDP and employment in the Auckland region. The average annual GDP and employment growth are higher than the Auckland average, and it's the highest contributor to Auckland's GDP and Employment. Waitematā has major sector strengths in financial and insurance services, professional, scientific and technical services and information and telecommunications.

Employment in Waitematā increased by an average of 1.7 per cent per annum in the ten years from 2005-15, higher than the Auckland rate of 1.5 per cent. During this period Waitematā job numbers increased the most in professional, scientific and technical services (+13,522), financial and insurance services (+5,666) and accommodation and food services (+3,037)

The Waitematā Local Board includes the Auckland central business district (CBD) and fringe retail and commercial areas, and the suburbs of Grey Lynn, Ponsonby, Arch Hill, St Mary's Bay, Newton, Eden Terrace and Grafton.

2.10 Environmental context

2.10.1 Overview

The environmental context with its discussion of land use, geology, vegetation, the terrestrial and freshwater environment, heritage and archaeology is important to set the scene for the analysis of the potential impacts of different options, their costs and any possible consenting and construction issues.

For convenience, the study area is divided into three sectors, as seen in Figure 2.13.

Figure 2.13 - Environmental context

2.10.2 Sector 1: Westgate – Te Atatu

Land use

Sector 1 of the study area comprises the section from Westgate to Te Atatu interchange.

Residential activity is the predominant land use and includes the areas of Massey, Royal Heights, Te Atatu South (south of SH16) and Te Atatu Peninsula (north of SH16). Except for a handful of post 2000 developments, the area is typical of suburban residential areas established in west Auckland over the 1960-1980 period.

High voltage powerlines run parallel to SH16, crossing the motorway just east of Lowtherhurst Reserve to a Transpower substation in Massey.

Social and Recreation

Within the surrounding residential area there are several schools - an early childhood centre (Te Puna Reo o Manawanui), three primary schools (including one Kohanga Reo), and one secondary school (Rutherford College).

Lowtherhurst Reserve is located 300m west of Huruhuru Road Bridge. Further west are Makora Park and the Waitakere Badminton Centre. Open space areas further east include Jack Colvin Park, McCormick Green and Harbourview Orangihina Park.

Geology

Sector 1 comprises ground with a variety of geological conditions. Most of the road alignment is underlain by East Coast Bays Formation, which is greenish grey alternating muddy sandstone and mudstone with occasional interbedded lenses of grit. The northern end of Sector 1 is underlain by the Puketoka Formation soils of the Tauranga Group, which are light grey to orange brown pumiceous silt, sand and gravel with lenses of muddy black compressible peat and lignite. The distribution of these deposits appears to be near to water bodies within the sector.[4]

The existing geology of the Te Atatu area is marine and stream alluvium containing silts and clays with varying sand and/or organic content.

Vegetation

Sector 1 contains a mixture of exotic and native species typical of residential areas and transport environments. The Te Atatu area is well established with many large trees, particularly around Titoki Street and Alwyn Avenue. The motorway-side vegetation, and near Jack Colvin Park, includes patches of mixed native and exotic scrubland and stands of mature trees.

Terrestrial environment

The topography of Sector 1 is undulating with relatively steep banks. The existing alignment of the motorway between Westgate and Royal Road Interchange follows this natural topography.

A survey undertaken by Bioresearches found evidence of copper and rainbow skinks (lizards) within and near the motorway corridor and at Lowtherhurst Reserve[5].

Freshwater environment

Sector 1 includes the Rarawaru Stream and its two tributaries, Ginders Drive tributary and Lowtherhurst Reserve tributary, as well as Henderson Creek and its tributary Pixie Stream.

A variety of native and exotic riparian vegetation offering moderate to dense shading is found along the streams including silver tree fern, manhoe and hangehange. Aquatic plants are generally absent from these streams. Fauna within the Rarawaru Stream and its tributaries are dominated by

[4] Western Ring Route – State Highway 16 Lincoln to Westgate: Assessment of Environmental Effects, Aurecon (29/01/2016)

[5] Western Ring Route – State Highway 16 Lincoln to Westgate: Assessment of Environmental Effects, 29 January 2016.

freshwater snails with some mites and larvae species present. The streams are also home to a small range of fish species, namely eel, whitebait and kokopu[6].

The Pixie Stream is piped along the northern boundary of Jack Colvin Park before discharging to the estuarine reaches of Henderson Creek. The Henderson Creek runs through residential and industrial areas, discharging into the Waitemata Harbour to the north-west of the Te Atatu Peninsula. Mangroves and common estuarine epifauna, including mud crabs, dominate the tidal habitat within the Coastal Marine Area (CMA). Overall, the streams are of moderate ecological value[7].

Heritage and Archaeology

Two potential heritage features (which do not meet the criteria of archaeological sites) have been recorded in Harbourview Orangihina Park. These are concrete foundations thought to have been part of a former cowshed and windmill, along with some brick foundations in the vicinity of a former homestead. Middens along the coast of the Whau River and the Auckland Brick & Tile Co brickworks site are recorded archaeological sites and scheduled in the Unitary Plan.

2.10.3 Sector 2: Te Atatu – Point Chevalier

Land use

Sector 2 comprises the wider SH16 corridor from the Whau River to Great North Road Interchange.

From west to east, Sector 2 includes the Whau River Bridge, the landward component of the Rosebank Peninsula, including Rosebank Interchange, Patiki Interchange, Rosebank Park Domain, the coastal section from Whau Bridge to the Waterview Interchange (terminating near the mouth of Oakley Inlet, parts of Traherne Island, Causeway Bridge, SH16/ Great North Road Interchange and the surrounding urban areas of Point Chevalier and Waterview.

The Rosebank Park Domain is identified as an Open Space area in the Unitary Plan and is used for go-karting and a speedway. The Rosebank Peninsula is an industrial area which is a large employment area dominated by the manufacturing industry. There are some commercial buildings catering mainly to office activity. The business hub attracts workers from the surrounding area as well as the wider Auckland region.

Across the causeway, the suburbs of Waterview and Point Chevalier comprise primarily detached single residential dwellings with some medium density residential development. There are educational facilities including primary schools and Unitec (tertiary education provider). The Waterview community travel to Point Chevalier or Avondale to access medical facilities, retail outlets and libraries. Few local shops/ services are located in Waterview itself. Most residents work within Auckland City.

Social and Recreation

The area to the north of Great North Road Interchange includes Eric Armishaw Park. To the south of the Interchange are Waterview Reserve, Waterview Esplanade, Cowley Reserve, Saxon Reserve and the northern portion of the Oakley Creek Esplanade Reserve. There is also an unnamed pocket of open space zoned land located between SH16 and Great North Road.

Geology

The geology of the land up to the east end of the causeway comprises marine and stream alluvium containing silts and clays with varying sand and/or organic content. Near Great North Road Interchange there is a mix of fill or Tauranga Group alluvium (predominantly silty clay with some sand, gravel and organic layers).

[6] Western Ring Route – State Highway 16 Lincoln to Westgate: Assessment of Environmental Effects, 29 January 2016.

[7] Western Ring Route – Waterview Connection: Assessment of Environmental Effects, August 2010.

Vegetation

There are semi-mature trees within the area. Most are located within Waterview Reserve.

Coastal Environment

All areas of the CMA in Sector 2 are identified as Significant Ecological Area (SEA) under the Unitary Plan, and located within the Motu Manawa (Pollen Island) Marine Reserve. The CMA is part of the Hauraki Gulf Marine Park. There is a mooring area in the Whau River.

The ecology of the Whau River adjacent to the SH16 bridge contains typical sub-tidal invertebrates (including mud crabs and worms), with low sediment contaminant concentrations due to the flushing out of fine sediment from the immediate area. Flora and fauna on the intertidal banks adjacent to the existing bridge predominantly comprise mangroves, some saltmarsh and exotic weed species.

The marine ecology within the causeway area includes mangrove forest, salt marsh, shellbanks, intertidal mudflats and sandflats, subtidal soft muds and man-made rocky shore. The coastal edge vegetation comprises a narrow bank of native shrub, saltmarsh and exotic weed species. The ecological values within this sector are variable, with an overall reduction in ecological value with increasing proximity to the causeway and the mouth of Oakley Creek. The ecological values present within the urbanised catchment area of Sector 2 are low.

The marine habitat provides feeding ground for several bird species, including white faced herons, pukeko, spotless crake and the endangered banded rail. Mimulus repens, a small creeping endemic maritime herb, presently classified as nationally uncommon and regionally endangered, exists alongside the SH16 causeway near Traherne Island. The Great North Road Interchange and Waterview Inlet site support native bird species including ed-billed gull and silvereye. The most common aquatic invertebrates are leeches, segmented worms and midges.

Heritage and Archaeology

Within Sector 2 the reclaimed causeway area has no recorded archaeological sites. It is noted that historically the mouth of the Whau River was used for seasonal settlement by Maori. At the northern end of the Rosebank Peninsula, archaeological sites have been recorded within the current SH16 designation and immediately adjacent to it. These sites include middens, a tramway and limeworks site on Pollen Island and the site of the former house of Mr Daniel Pollen (former Colonial Secretary and a noted historical figure in Auckland). Most of the recorded sites have been damaged or destroyed by past activities including the motorway and related developments.

Traherne Island has no known archaeological sites. Archaeological sites have been recorded close to the Great North Road Interchange, reflective of the long history of the human activity within the area. This is particularly prevalent around the coast and Waterview Inlet area, with middens, karaka trees, settlements, a stone wall, and the site of the Star Mill, which later became the Garrett Bros Tannery (1860-1890). The Star Mill site covers both the northern and southern sides of Oakley Creek. The archaeological site is in good condition. The Star Mill/Tannery/Quarry, the former Carrington Hospital (now part of Unitec) is a significant historic building in the corridor. The building and surrounds (extending to SH16), and the cluster of Maori habitation sites along Oakley Creek are scheduled in the Unitary Plan. The former Carrington Hospital is also a NZ Historic Places Trust (NZHPT) Category I registered Historic Place.

2.10.4 Sector 3: Point Chevalier – city centre (Karangahape Road)

Land use

Sector 3 of the study area geographically comprises SH16 and the land adjacent to it between St Lukes Road and Karangahape Road adjacent to the Central Motorway Junction (CMJ). The sector includes the suburbs of Point Chevalier, Mt Albert, Grey Lynn, Kingsland and Mt Eden. The predominant land uses adjacent to the motorway are open space, business and residential land uses.

The Point Chevalier shops front on to Great North Road on the northern side of SH16. The shops are occupied by a range of suburban retail and food outlets, including a supermarket.

Residential areas within this sector border the motorway alignment on either side. There is a mix of housing types from low to medium density within the suburbs and increasing to multi-storey high-rises close to Karangahape Road.

Social and Recreation

Educational facilities in the sector include Unitec, Gladstone Primary School, Point Chevalier Primary School and Pasadena Intermediate School. The 'Mason Clinic' is one of a few medical facilities also located within the area, and is a high security inpatient forensic psychiatric facility of sub-national and regional importance. These facilities are destinations which attract people from outside of the sector.

There are large areas of open space within this sector adjoining SH16 and Great North Road. The Western Springs Gardens adjoin the regionally significant Auckland Zoo and Western Springs but are separated from this reserve area by Great North Road. This reserve area contains the Western Springs community centre. The Chamberlain Park Golf Course is located to the south of SH16. Additional areas of land zoned as Open Space in the Unitary Plan include the RSA Bowls Club and a large parcel of private vacant land located at 1074 Great North Road.

The Arch Hill Scenic Reserve is in Grey Lynn and covers an approximate length of 700m to the north of the SH16 corridor. The reserve is densely vegetated apart from an open space area accessed off Ivanhoe Road. Nixon Park is situated to the south of the motorway corridor bordering Bond Street, and provides for football, basketball and a skate park.

Geology

The geology beneath most of this sector comprises areas of fill overlying Tauranga Group alluvium overlying Waitemata Group sandstones and siltstones. An exposed basalt cut exists alongside SH16.

Vegetation

Stands of mature trees (Pohutukawa and Pinus species) exist at the edge of the Chamberlain Park Golf Course adjoining the Northwestern Cycleway and are a strong visual feature within the sector.

Terrestrial and Freshwater Environment

In general, the natural environment has been heavily modified in Sector 3 from urbanisation and particularly the presence of SH16. Meola Creek flows within the sector, with its headwaters entirely piped above the Chamberlain Park Golf Course. Meola Creek is an urban stream in poor condition with high levels of pollutants such as zinc and lead entering the stream from the heavily urbanised catchment.

Other Infrastructure

The heavy rail North Auckland Line (NAL) runs generally parallel to the south of SH16 from Mt Albert Road to Mt Eden Station, at which point the City Rail Link will be connected to the NAL. The topography rises steeply from the lower motorway level to the Mt Eden Station area. Land use is characterised by a mixture of light industrial and office developments.

Heritage and Archaeology

Two Historic Heritage Areas identified under the Unitary Plan are located in Sector 3. The Cooper Street Historic Heritage Area borders the northern edge of the motorway alignment in Grey Lynn, and the city centre end of the study area is straddled by the Karangahape Road Historic Heritage Area.

2.11 Strategic context

The NWRTC business case is co-sponsored by Auckland Transport and the Transport Agency in partnership with Auckland Council. Development of the indicative business case is under the

overarching strategic direction of the Auckland Plan (2012) with strong links to the Government Policy Statement on Land Transport 2015/16 – 2024/25 (GPS 2015).

This section explains how the scope of the proposed investment in the NWRTC aligns within the existing strategies of the partner organisations.

2.11.1 Organisational overview

The Transport Agency) and Auckland Transport are together responsible for the planning, development, operation and maintenance of the road transport network throughout Auckland.

2.11.2 NZ Transport Agency

The Transport Agency is responsible for giving effect to the, which sets out the Government's strategic direction for investment in the land transport network. The GPS outlines three strategic priorities for investment in New Zealand's land transport system: economic growth and productivity; road safety; and value for money. The Draft GPS 2018/19 - 2027/28 re-adopts these strategic priorities.

The Transport Agency's responsibilities encompass planning and funding activities, supporting public transport, building the networks that connect communities, and ensuring the people and vehicles that use the system are safe to do so. One of the principal responsibilities for the Transport Agency in Auckland is the effective operation of the city's motorway network.

2.11.3 Auckland Council

Auckland Council has two complementary and non-hierarchical decision-making parts:

- The governing body, consisting of a mayor elected by all Aucklanders and 20 councillors elected on a ward basis; and
- Twenty-one local boards, with members elected by local board area.

The governing body and the local boards share the decision-making responsibilities of Auckland Council. The governing body focuses on the big picture and on region-wide strategic decisions, while local boards represent their local communities and make decisions on local issues, activities and facilities.

Auckland Council delivers services through the council itself and through council-controlled organisations (CCOs). Transport functions are delivered through Auckland Transport, which is one of Auckland Council's CCOs.

The administration, under Mayor Goff, developed the draft Letter of Expectation (LoE) to Auckland Transport which provides some important up-to-date context for the project[8].

The draft LoE emphasises, inter alia, the need for Auckland Transport to contribute positively to place-making and urban regeneration. The LoE asks for a "courageous balancing of movement and place, and bold commitment to reallocating road space towards public transport and active modes". It also raises the need for a "group-wide strategic perspective" to be incorporated into business cases.

It further emphasises the role of the bus network, calling for expanded bus lane networks, extending bus lane operating hours and removing or modifying on-street parking.

Attention is drawn to the recommendations of ATAP and supporting its strategic approach, including addressing the funding gap. Auckland Transport is asked in its 2017 Statement of Intent (SOI) to provide advice on new technologies and demand management options "including higher vehicle

[8] Draft Auckland Transport Letter of Expectations 2017-2018, Auckland Council, Finance and Performance Committee 13 December, 2016.

occupancy and smarter transport pricing" "that allow us to move beyond just investment in physical infrastructure to solve the issues associated with Auckland's growth".

Auckland Transport is asked to aggressively pursue growth in public transport use, with a strong customer focus.

In the Annual Budget 2017/18 committee meeting the Mayoral Proposal on items for Public Consultation considered a relevant item identified for potential inclusion in the annual budget consultation document, which was as follows:

"Mass transit network"

"An expanded and well-connected mass transit network is at the heart of Auckland Transport's plans for supporting growth in existing urban and future urban areas. Auckland Transport has indicated the intention to accelerate planning and design works on routes and the most optimal mode, whether it be bus or light rail."

2.11.4 Auckland Transport

Auckland Transport has responsibility for all the region's transport services (excluding state highways) – from roads and footpaths to cycling, parking and public transport. Figure 2.14 below illustrates the strategic themes endorsed by the Auckland Transport Board and how they relate to the NWRTC.

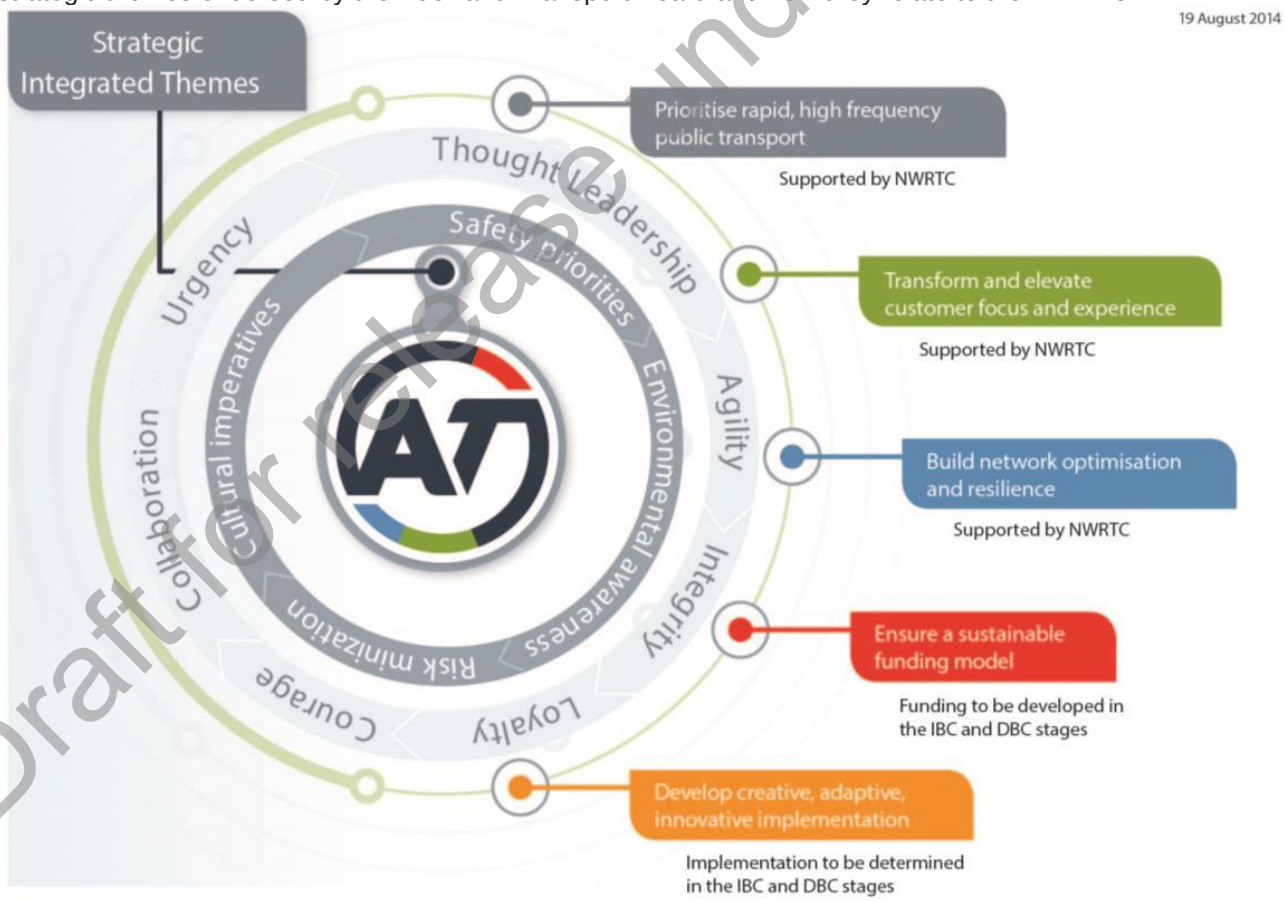


Figure 2.14 Link Between the NWRTC and the Auckland Transport Board's Strategic Integrated Themes

2.12 Organisational outcomes, impacts and objectives

The sections below give an overview of the organisational goals and outcomes sought by the Project Partners Auckland Transport, Transport Agency and Auckland Council that are of relevance to the proposed NWRTC investment.

2.12.1 Auckland Transport SoI 2015/16 to 2018/19

Auckland Transport's SOI 2015/16 to 2018/19 sets out the strategic approach and priorities for Auckland Transport over the next three years, as well as how it can contribute to Auckland Council's longer-term desired outcomes for the region.

The five strategic themes are:

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

Prioritise rapid, high frequency public transport

The SoI explains that "Prioritising rapid, frequent public transport will contribute to realising the Auckland Plan's vision by significantly enhancing transport choices, thereby improving transport accessibility in Auckland." The development of a rapid and frequent network will make public transport a more compelling choice for those that currently favour car travel, which is the larger number of Aucklanders. As more people use trains, buses and ferries, the transport system will be better able to cope with Auckland's significant growth, leading to better environmental and economic outcomes.

"Giving priority to developing the public transport system, with a particular focus on those parts of the network that are able to provide the rapid and frequent services that are necessary to enable significant patronage growth, will also help to realise one of the Auckland Plan's transformational shifts – to move to outstanding public transport within one network."

2.12.2 The Auckland Plan

The Auckland Plan (2012) encapsulates Auckland Council's vision for Auckland to be the world's most liveable city. This plan includes six "transformational shifts" that are required to achieve the plan's vision. With regard to transport, the major shift is: Move to outstanding public transport within one network. The view of the network as a cohesive system is of particular importance to Auckland Transport's operations. This approach will improve the connectivity of the transport system by ensuring that service modes are integrated to provide a seamless transport experience.

In addition, Auckland is anticipated in the Plan to grow by around one million people by 2050. Auckland Transport must respond accordingly, developing infrastructure and expanding PT service to ensure the system remains efficient and facilitates growth in an affordable manner.

2.12.3 Auckland Regional Land Transport Plan 2015 – 2025

The Auckland Regional Land Transport Plan 2015 – 2025 (RLTP) sets out all the transport priorities in Auckland for the next ten years. It states that all funding decisions and delivery agencies are aligned toward the need to address:

- "Growth: infrastructure is required to support Auckland's increase in new housing, jobs, student numbers and tourists."

- "Congestion: long-standing issues with traffic flows will only get worse as Auckland grows. Public transport is one dimension but investment to support freight movement and improve key road corridors is needed."
- "Business as usual: a large stock of existing infrastructure investments needs to be maintained, and safety and environmental factors kept to the fore."

Further, the RLTP has as one of five strategic themes:

- "Prioritise rapid, high frequency public transport to achieve the Auckland Plan outcome of moving to outstanding public transport."

2.13 Alignment with existing strategies and organisational goals

2.13.1 National level goals and strategies

The Government's GPS gives three strategic priorities for investment in New Zealand's land transport system, along with six national land transport objectives, as listed below.

Table 2.3 - GPS 2015 Strategic Priorities and National Land Transport Objectives

Strategic Priorities	National Land Transport Objectives
Economic growth and productivity	A land transport system that addresses current and future demand for access to economic and social opportunities A land transport system that provides appropriate transport choices A land transport system that is reliable and resilient
Road safety	A land transport system that is a safe system, increasingly free of death and serious injury
Value for money	A land transport system that delivers the right infrastructure and services to the right level at the best cost

The NWRTC is expected to contribute to all three of the GPS 2015 priorities.

In terms of economic growth and productivity, the NWRTC connects residential areas to employment opportunities in the city centre, thereby expanding the size of the labour market that can access the high-productivity jobs that are available there. The NWRTC also connects Westgate to surrounding residential areas and allows it to fulfil its role as a metropolitan centre. Greater employment and recreational opportunities should reduce external demands placed on the regional road network. NWRTC also reduces the demand for private vehicle travel across the study area, and alleviates congestion on the strategic road network, especially SH16, SH18, and SH20. This will benefit commercial travel and enable the Western Ring Route to provide a viable alternative to SH1, thereby reducing congestion across the network.

In terms of road safety, the NWRTC seeks to deliver a significant improvement in the quality and effectiveness of public transport in the study area. The associated increase in demand for public transport travel, and reduction in demand for private vehicle travel, is expected to reduce accident numbers and contribute to improved road safety. The development of the NWRTC will also provide a catalyst for ancillary improvements in pedestrian and cycle infrastructure in the surrounding area, helping to reduce accident rates for these modes as well.

Finally, in terms of GPS 2015's focus on value for money, preliminary engineering analysis suggests the NWRTC is relatively cost-effective, with costs for a busway solution of a similar order of magnitude to the Northern Busway. Hence, for a relatively marginal capital investment the maximum throughput capacity of the SH16 corridor in one direction is increased from approximately 6,000 people per hour, to over 20,000 people per hour. Experience with the Northern Busway has also found that core services operating on such a corridor are able to achieve cost recovery in excess of 100% within the first decade of operation. In the case of the NWRTC, the development of strategically located interchanges, which enable connections between the core service and local services, is also expected to reduce operating costs and increase passenger revenues across the network. In this way, the NWRTC is considered to deliver high value for money when considered from both capital and operational expenditure perspectives.

The Transport Agency has the following relevant long term goals, and three-year priorities[9]:

"Our goals over the next 10–20 years:"

"1. Integrate one effective and resilient network for customers."

We are integrating planning, investment and operations so that travel around our towns, cities and rural areas is seamless and more efficient – whether by walking, cycling, using public transport, freight vehicles or cars.

"2. Shape smart efficient, safe and responsible transport choices."

We are helping shape the transport choices that people make by providing good information and encouraging them to travel safely and efficiently. We want to work cooperatively with other network *operators to unlock the land transport system's contribution to a thriving New Zealand.*

"3. Deliver efficient, safe and responsible, and resilient highway solutions for customers."

We are ensuring that the state highway network plays its part in the wider transport network and contributes to safe and reliable journeys. Over time we want to improve the experiences that people have on our highways, and work to ensure the state highway network is resilient to" change.

"4. Maximise effective, efficient and strategic returns for New Zealand."

We are making smart and innovative investments in the national, regional and local land transport system because we need to ensure every dollar we spend helps New Zealand thrive. Together with our partners we allocate funds to advance national and regional transport objectives."

Investment in the NWRTC aligns with and/ or support the goals as it should provide a high-quality public transport connection between one of Auckland's major greenfield growth areas and the city centre. It provides a high-quality public transport spine to which local public transport services can connect at key interchanges. It will support connections and travel choices within the wider study area.

The NWRTC is a high-capacity passenger transport solution that will help shift some of the increasing numbers of travel movements arising from ongoing development in the study area from private vehicles to public transport. By freeing up the state highway network for journeys that can only be taken by car, this ensures the efficient use of existing infrastructure and makes better use of the current state highway network's capacity, while insulating the wider state highway network from the effects of population and employment growth. The NWRTC ensures the SH16 corridor can support future projected growth.

[9] https://www.nzta.govt.nz/about-us/about-the-nz-transport-agency/our-purpose-and-priorities/ accessed 9/10/2016

2.13.2 Regional level goals and strategies

This section considers how the NWRTC aligns with Auckland Council's and Auckland Transport's strategic goals and strategies.

The high-level strategic regional context to this assessment is provided by the Auckland Plan developed by Auckland Council. The Auckland Plan identifies transport and housing shortages as one of the key issues confronting the region. The Plan establishes a strategic direction for transport investment to "create better connections and accessibility within Auckland, across New Zealand, and to the world." This strategic direction is associated with five targets; the following table shows how the NWRTC aligns with these targets.

Table 2.4 - Alignment between Auckland Plan transport targets and investment in the NWRTC

Auckland Plan Transport Target	Degree of alignment
1. Double public transport patronage from 70 million trips p.a. in 2012 to 140 million trips p.a. in 2022 (subject to additional funding)	The NWRTC will play a key role in growing Auckland's overall public transport patronage within a constrained budget. It presents an effective and efficient way to meet large growth in sub-regional travel demands.
2. Increase the proportion of trips made by public transport into the city centre during the morning peak to 70% by 2040	The NWRTC facilitates a significant increase in the proportion of public transport trips into the city centre from the north-west.
4. Reduce congestion on the strategic freight network to at or below the average 2006 2009 levels (average daily speed of 45 km/hr and average delay of 32 seconds per km) by 2021	The NWRTC will provide an alternative to private vehicle travel for individuals travelling on SH16 and SH18, thereby slowing the increase in congestion on the strategic freight network. It will in turn provide indirect benefits for travel time reliability on SH1 and SH20, especially where these connect with SH16 and SH18.
5. Increase the proportion of people living within walking distance of frequent public transport stops from 14% to 32% by 2040	The NWRTC will expand access to frequent public transport, not just within the SH16 corridor but also in ancillary corridors.

The Auckland Plan identifies an Auckland-wide Rapid Transit Network (RTN) as part of a strategic transit network for 2042, which includes a rapid transit corridor extending along SH16 from Westgate to Waterview.

The NWRTC is part of the wider Auckland regional transport network, including an overlap with the Henderson to Constellation (SH18) rapid transit corridor between Westgate and Lincoln Road. Consequently, investment in the NWRTC will support both radial and crosstown public transport services, thereby supporting the wider state highway network, including SH18 and SH1. The Rapid Transit Network identified in the Auckland Plan contains a gap between Waterview and the city centre. The definition of the study area seeks to address this gap and mitigate future risks to the effectiveness of these RTN corridors by securing an alignment along the SH16 corridor to Karangahape Road.

The Unitary Plan identifies some areas for intensification and others for greenfield expansion. The Unitary Plan allows for major growth in the north-west study area, as discussed above. Greenfield areas of expansion are proposed for Westgate/Massey North, Kumeu-Huapai, Hobsonville corridor (including Hobsonville Village town centre), Hobsonville Point, Scott Point (Hobsonville Peninsula), Redhills, Whenuapai, and Riverhead. Te Atatu, Massey and Westgate are also zoned for intensification.

When considered against Auckland's current rapid rates of population growth, the risk exists that investment in the NWRTC will need to be accelerated from the timelines that were previously identified.

With regards to the strategic approach of the Regional Public Transport Plan (RPTP)[10] investment in the NWRTC is a very close fit, particularly the ability of the NWRTC to deliver efficient high frequency trunk services along the north-west corridor that are linked to frequent feeder routes at interchange stations. Enabling people to connect between trunk and feeder services is paramount to the success of the New Network.

Finally, the NWRTC also aligns well with the priorities identified in the RLTP[11] as it is designed to support proposed growth in the north-west by expanding public transport options and improving connectivity between the north-west and the city centre. The proposed infrastructure investment would encourage shifts in behaviour from driving towards greater use of public transport by reducing travel times and creating a viable alternative to the automobile. This would reduce the demand for additional travel on the north-west motorway, better utilising existing infrastructure by moving more people per vehicle, reducing the need for roadway expansion in the future and offsetting growth in carbon emissions.

2.13.3 Auckland Transport Alignment Project

As noted above, since the Strategic Case was adopted, the ATAP has been adopted. Minister for Transport Simon Bridges in his foreword stated:

"ATAP has identified the following priorities for additional funding over the next decade:

- New and upgraded roads to unlock land for housing in the north-west, the south and the north
- **The first phase of the Northwestern Busway from Westgate to Te Atatu to provide for growth, increased access into the city centre and help tackle congestion on the Northwestern Motorway** (emphasis added)
- Motorway improvements to address congestion and provide for ongoing growth in the north-west, south and southwest."

The body of the report contains multiple relevant references:

"Supporting greenfield growth: Early priorities (p. 28)

Progress the Northwestern Busway to increase access to and from the north-west Greenfield area and increase throughput along the congested Northwestern Motorway corridor.

"Addressing motorway capacity constraints: Early priorities (p. 29)

Public transport investments, including the City Rail Link, extending the Northern Busway and accelerating the Northwestern Busway, to assist in taking pressure off the motorway network at peak times, especially for trips heading to the city centre.

[10] (https://at.govt.nz/media/1191335/auckland-transport-rptp-final.pdf),

[11] https://at.govt.nz/media/1191335/Regional-Land-Transport-Plan-Adopted-Version-July-2015.pdf

“Indicative priorities for major new investments:

Early priorities (completion in decade 1)

- Northwestern Busway (Westgate to Te Atatu section).

Medium term priorities (completion in decade 2):

- Northwestern Busway extensions.

“Action (p. 47)

Complete business cases for each of the high priority interventions identified in this report, to enable early decisions on funding, timing and route protection to proceed as soon as possible. (Responsibility: Auckland Transport and NZ Transport Agency)”

3 Strategic Case (Activity)

3.1 Investment Logic Map, problem statements, benefits, Investment Objectives and Key Performance Indicators

3.1.1 Investment Logic Map (ILM), Problem Statements and Benefits

A workshop was help on Wednesday 12th October to reconfirm the problem statements and potential benefits for investing in public transport in the north-western corridor. The workshop was run by accredited ILM facilitator Kaaren Goodall. The workshop reviewed and updated the previous Investment Logic Map (from October 2014) based on revised evidence.

From the facilitated workshop, and the post-workshop dialogue between participants and facilitator, the previous ILM was amended as follows:

- A reduction in the number of problem statements from four to three with a stronger focus on the efficiency of public transport service delivery
- A corresponding reduction in the number of benefit statements from four to three.

The new agreed Investment Logic Map is contained in Appendix A1. In summary, the identified problems and benefits were:

Table 3.1 - Problems and Benefits

Problem Statement	Benefits in investing in a solution
Accelerated growth and rising travel demand will exceed the NW corridor capacity, undermining access to homes, jobs, education and the attractiveness of growth areas (40%)	Better connected city, better match for people, jobs, education opportunities (50%)
Absence of competitive public transport to/from the NW growth area restricts public transport choices (35%)	Expanded transport choices for the north-west (35%)
Inefficient PT network and lack of interchanges limit the ability to lift service standards for corridor users (25%)	More affordable access and improved value for money (15%)

3.1.2 Investment Objectives

Following on from the updated Investment Logic Map, the project team developed a set of investment objectives, which directly correlate with the benefits, including in order of weighting.

- Substantially improve connections to and from the north-west. (50%)
- Make public transport a realistic option for the majority of journeys to and from the north-west. (35%)
- Increase the efficiency of public transport to and from the north-west (15%)

3.1.3 Key Performance Indicators

To assess options against the Investment Objectives and to determine the level of “benefit” that could be derived, a set of Key Performance Indicators (KPIs) were developed.

Table 3.2 - Investment Objectives and KPIs

Investment Objective	Measure (Key Performance Indicator)
Substantially improve connections to and from the north-west.	**KPI 1**: Jobs accessible within a 45 minute trip by PT from the north-west.
	KPI 2: Size of catchment accessible from the north-west by car (30 minutes), public transport (45 minutes) and active mode (30 minutes).
	KPI 3: Corridor throughput: No. of buses, cars and trucks times the average occupancy
Make public transport a realistic option for the majority of journeys to and from the north-west.	**KPI 1**: PT mode share along the NW corridor: Percentage shares of people throughput, by mode
	KPI 2: Faster, more reliable journey times: Travel time; Travel time reliability
	KPI 3: Catchment within a frequent transport network: Catchment within a frequent transport network: Proportion of the population living within 500m of a frequent network bus stop and 1km from a rail or bus rapid transit station
Increase the efficiency of public transport to and from the north-west	**KPI 1**: Subsidy cost per passenger-km: Cost per passenger-km: Proportion of operating costs covered by fares for public transport services operating in north-west corridor.
	KPI 2: Capacity in city centre terminal/stop capacity: Number of on-street bus stops in city centre operating within their practical capacity

3.2 Status of the evidence base

The evidence base in support of the problems is strong with the growth in population in north-west Auckland expected to be a primary driver of growth in transport demands along the NWRTC, both by car and public transport.

Auckland Regional Transport (ART) model outputs for three future model years (2026, 2036, and 2046) were used to quantify growth in transport demands from north-west Auckland by car and public transport, using modelling of the 'Common Elements Enhanced version 4' (CEEv4) scenario which was the base case in ATAP's analysis.

This analysis focused on travel during the AM peak period as this period is likely to experience the most significant capacity constraints. It serves as a baseline for understanding how future demands will change in the absence of further intervention.

3.2.1 Quantifying growth in transport demands from north-west Auckland

Table 3.3 summarises ART forecasts for total vehicular (car+public transport) travel demand and public transport demand from the Westgate-Whenuapai-Hobsonville area. It breaks out growth in demand:

- To all ART model zones
- Excluding travel internal to the area, i.e. within the Westgate-Whenuapai-Hobsonville area
- To the city centre and fringe area.

This analysis shows that, under a base case transport network scenario, total travel from the Westgate-Whenuapai-Hobsonville area to other parts of the city will double over the 2013-2046 period. Public transport demand from this area to other parts of the city is forecast to increase by almost 400%. Over this time, the AM peak PT mode share for travel from this area to other parts of the city is expected to more than double from 9.9% to 23.6%.

The city centre and fringe area is expected to account for a significant share of outward AM peak travel from the Westgate-Whenuapai-Hobsonville area. Approximately 27% of overall growth in outward vehicular travel demand and 60% of growth in outward public transport demand is expected to be destined for the city centre. This highlights the importance of public transport journey time and reliability along the NWRTC.

Table 3.3 - Growth in AM peak total vehicular transport demand and public transport demand from Westgate-Whenuapai-Hobsonville (Scenario I9/CEEv4)

Destination	Value	2013	2026	2036	2046	*Percent change*
Total to all ART zones	Total demand (people)	18,100	38,000	45,800	48,700	*169%*
	PT demand (people)	1,400	4,500	6,500	7,700	*459%*
	PT mode share	7.6%	11.7%	14.2%	15.9%	
Excluding travel internal to area	Total demand	13,000	22,800	25,500	26,500	*104%*
	PT demand	1,300	3,900	5,400	6,200	*388%*
	PT mode share	9.9%	17.2%	21.0%	23.6%	
To city centre + fringe + Newmarket	Total demand	2,300	4,700	5,500	6,000	*157%*
	PT demand	800	2,400	3,300	3,800	*358%*
	PT mode share	35.9%	51.2%	59.6%	64.0%	

Table 3.4 presents a similar analysis for AM peak travel demands from Huapai-Coatesville. Once again, public transport demands are forecast to increase more rapidly than car demands, albeit from a considerably lower base. This will lead to a significant increase in public transport mode-share.

Population growth in the Huapai-Coatesville area is also expected to lead to an increase in travel demands to the city centre, albeit to a slightly lesser degree than in Westgate-Whenuapai-Hobsonville. Approximately 16% of overall growth in outward vehicular travel demand and 52% of growth in outward public transport demand is expected to be destined for the city centre.

Table 3.4 - Growth in AM peak total vehicular transport demand and public transport demand from Huapai-Coatesville (Scenario I9/CEEv4)

Destination	Value	2013	2026	2036	2046	*Percent change*
Total to all ART zones	Total demand (people)	3,300	4,600	8,10	10,400	*218%*
	PT demand (people)	100	400	1,000	1,400	*1450%*
	PT mode share	2.7%	8.7%	12.0%	13.4%	
Excluding travel internal to area	Total demand	2,300	3,500	6,000	7,700	*230%*
	PT demand	100	400	900	1,300	*1520%*
	PT mode share	3.5%	10.7%	15.2%	17.0%	

To city centre + fringe + Newmarket	Total demand	300	500	900	1,100	*305%*
	PT demand	100	200	500	700	*1130%*
	PT mode share	20.2%	45.2%	56.7%	61.2%	

Travel demands from areas around the NWRTC, including the Te Atatu-Lincoln Road North area in west Auckland, are also likely to play a significant role in transport demands on the NWRTC. Consequently, Table 3.5 summarises AM peak transport demands from this area. Although growth in total transport demand from this area is expected to be much more modest – a 7.3% increase in total AM peak vehicular trips to other parts of Auckland – it is expected to experience significant growth in outward public transport demand as increasing road congestion encourages people to switch mode.

Between 2013 and 2046, AM peak public transport demand from the Te Atatu-Lincoln Road North area to other parts of the city is expected to rise by 86%, nearly doubling PT mode share. Approximately 37% of the increase in outward PT trips is expected to be bound to the city centre and fringe area, with the remainder bound for other destinations, principally in west Auckland. This highlights the importance of public transport journey time reliability along the NWRTC, but also the importance of 'cross-town' journeys within west Auckland.

Table 3.5 - Growth in AM peak total vehicular transport demand and public transport demand from Te Atatu-Lincoln Road North (Scenario I9/CEEv4)

Destination	Value	2013	2026	2036	2046	*Percent change*
Total to all ART zones	Total demand (people)	14,000	14,500	14,500	14,300	*2.2%*
	PT demand (people)	1,300	1,900	2,300	2,400	*85.2%*
	PT mode share	9.2%	13.3%	15.5%	16.7%	
Excluding travel internal to area	Total demand	10,800	11,700	11,700	11,600	*7.3%*
	PT demand	1,200	1,800	2,100	2,300	*86.5%*
	PT mode share	11.3%	15.6%	18.2%	19.6%	
To city centre + fringe + Newmarket	Total demand	2,400	2,400	2,400	2,300	*-1.1%*
	PT demand	900	1,100	1,200	1,300	*44.7%*
	PT mode share	37.0%	45.2%	51.6%	54.1%	

3.2.2 Quantifying growth in transport demands to north-west Auckland

In addition to experiencing significant growth in population leading to a growth in transport demands from north-west Auckland, the Westgate-Whenuapai-Hobsonville area is expected to experience significant employment growth in coming decades. This will also result in an increase in inward journeys to the area.

Table 3.6 summarises growth in AM peak total transport demands and public transport demands to the Westgate-Whenuapai-Hobsonville area. Overall travel demand from other parts of the city to this area are expected to increase by over 160%, while public transport demand is forecast to increase more than tenfold.

Increases in overall transport demands and PT demands are expected to originate from a diverse range of sources, predominantly but not entirely in west Auckland. This highlights the importance of enabling a range of journeys within the public transport network.

Table 3.6 - Growth in AM peak total vehicular transport demand and public transport demand to Westgate-Whenuapai-Hobsonville (Scenario I9/CEEv4)

Destination	Value	2013	2026	2036	2046	*Percent change*
Total to all ART zones	Total demand (people)	12,200	29,300	37,900	41,000	*235%*
	PT demand (people)	300	1,500	2,800	3,700	*1200%*
	PT mode share	2.3%	5.0%	7.4%	8.9%	
Excluding travel internal to area	Total demand	7,100	14,100	17,500	18,700	*163%*
	PT demand	200	900	1,700	2,200	*1130%*
	PT mode share	2.5%	6.4%	9.4%	11.6%	

3.2.3 Mapping transport demands to the NWRTC

Transport demands between aggregated ART model zones mapped to Auckland's public transport network shows how growth will manifest in increased demand along the NWRTC. The analysis focused on demands originating in the following areas along the NWRTC:

- Westgate-Whenuapai-Hobsonville
- Huapai-Coatesville
- Rural Helensville area
- Te Atatu-Lincoln Road North
- Inner west Isthmus, excluding areas that are served by buses that do not run on Great North Road.

These areas are likely to provide most AM peak transport demands on the NWRTC.

Table 3.7 summarises expected growth in PT demands at three segments of the NWRTC over the next three decades. AM peak public transport demands are expected to rise significantly, with a large share of the forecast increase occurring over the next decade. By 2046, around 40% of the people travelling on the NWRTC from the selected west Auckland and north-west Auckland model zones are expected to be using public transport.

Table 3.7 - Forecast AM peak public transport demand On The NWRTC (Scenario I9/CEEv4)

Location	2013	2026	2036	2046	2046 PT mode share (for journeys from selected areas)
Westgate to Lincoln Road	1,200	3,400	4,800	5,700	42%
SH16 causeway	2,100	4,600	6,300	7,200	41%

Point Chevalier to Karangahape Road (both Great North Road and SH16)	2,800	6,000	8,100	9,300	39%

3.3 Access and travel choice deficiency

3.3.1 Introduction

This section summarises the findings from the transport deficiency analysis of the NWRTC in a do-minimum situation. It identifies areas where current and future performance against the KPIs is likely to be deficient, in the absence of further investment.

The performance of the NWRTC is assessed in a relative sense, compared against the performance of other parts of the transport system, and (in the case of the analysis of journey time and reliability) against the Northern Busway as a benchmark for the performance of an RTN facility. The analysis assesses the current and future performance of the NWRTC against the KPIs using a 'traffic light' system:

- Green indicates that the corridor (or element of the corridor) performs well
- Orange indicates that the corridor (or element of the corridor) is likely to underperform, but not to a severe degree
- Red indicates serious underperformance – i.e. a case where the NWRTC is unlikely to deliver RTN-style service quality or outcomes to users.

Outcomes observed in a given year are projected forward into the future, and modified where appropriate with transport model forecasts. In the absence of further investment, underperformance against KPIs in 2016 will also result in underperformance in 2026 and beyond.

This section addresses the strategic performance of the entire NWRTC as it relates to north-west Auckland and other areas along the corridor. Principal conclusions are summarised in Table 3.8. The analysis of the NWRTC's strategic performance indicates that it underperforms against all three KPIs.

Table 3.8 - Strategic performance of the NWRTC

KPI	Current (2013-16) performance	2026 performance	2036 performance	2046 performance
KPI 1.1: Jobs accessible within a 45 minute trip on PT	Residents of major growth areas in north-west Auckland are expected to be able to access only 35% as many jobs by PT as the average Auckland resident. The number of jobs that are accessible by PT is expected to rise over time, but not catch up with the Auckland-wide average. This is exacerbated by the fact that, under ATAP's base case scenario, access to jobs by car is expected to decline in north-west Auckland.			
KPI 1.2: Lift in NW access to wider range of destinations	Accessibility to all jobs serves as a proxy for access to other destinations. For instance, PT access to tertiary institutions relies upon connections to the city centre (where University of Auckland and Auckland University of Technology are located) and also to the availability of bus transfers (e.g. transferring at Point Chevalier to access Unitec).			
KPI 2.3: Catchment within a frequent transport network Proportion of the population living within 500m of a frequent network bus stop and 1km from a rail or bus rapid transit station	Under current arrangements, very little of north-west Auckland is served by frequent public transport services. To a degree, this reflects the fact that this includes large Future Urban Zone areas where arterial roads have not been established. However, the need to run low-frequency services due to a lack of trunk-and-feeder interchange points along the NWRTC is also a major contributor. This is evidenced by an analysis of the Te Atatu area, where implementation of a Te Atatu Interchange and supporting service changes would increase the share of the area within a frequent bus service catchment from 15% to 74%.			

3.3.2 Transport performance of the NWRTC for users

This sub-section summarises the current and future transport performance of specific segments of the NWRTC. The analysis in this sub-section is more detailed than the analysis of strategic outcomes, as these outcomes relate to specific areas of the corridor. It reports outcomes separately for each individual KPI.

Table 3.9 summarises the NWRTC performance against KPI 1.3, increased corridor throughput. The main finding from this analysis was that the SH16 corridor is likely to hit 'hard' constraints on capacity relatively soon, except on the Westgate to Lincoln Road section. Rising traffic congestion will greatly increase public transport journey time and significantly reduce reliability along the remainder of the corridor.

Figure 3.1 shows the forecast AM peak traffic speeds once the Waterview Tunnel is open and the SH16 upgrade is compete. While not a long-term forecast, this map does use a demand scenario higher than the expected demand, used as a sensitivity test and provides an indication of the pattern of performance expected on SH16. The route is expected to function poorly east of Lincoln Road and

into the city centre fringe. West of Lincoln Road the route is expected to perform well initially, although this is expected to worsen over time as growth occurs in the north-west growth areas.

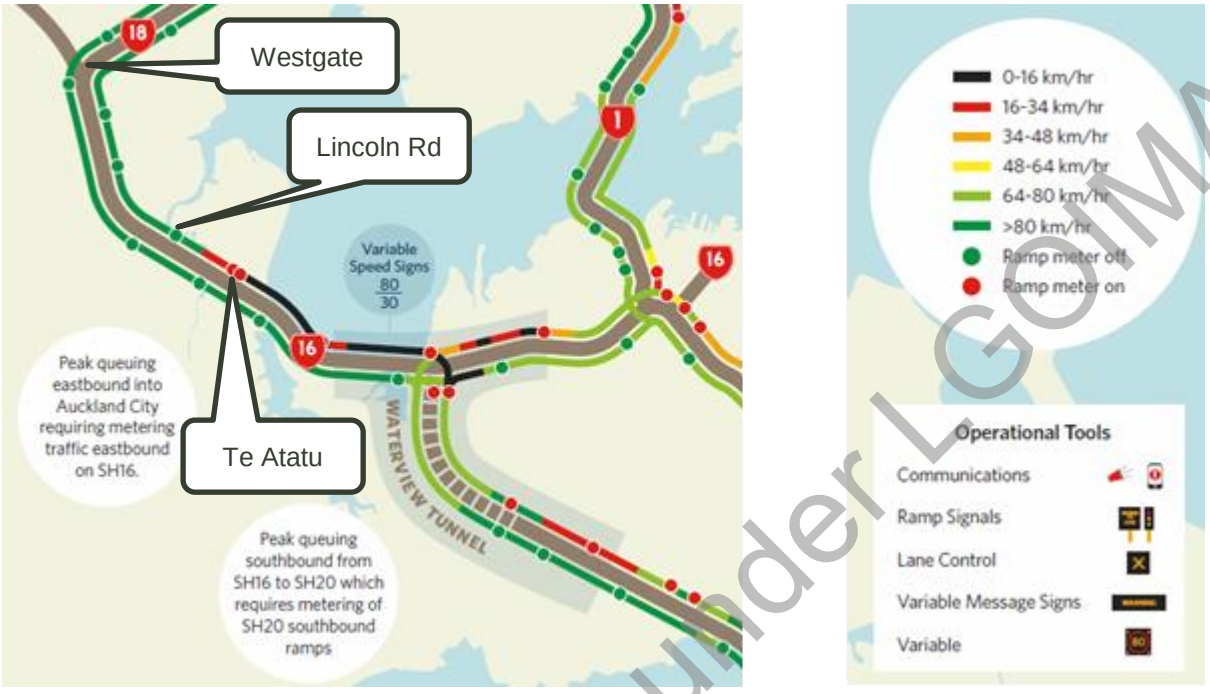


Figure 3.1 - Expected AM peak traffic performance on Western Ring Route, opening year of Waterview Tunnel (Demand Level 5 - high demand scenario) – source: Cell Transmission Model, April 2016, NZTA Congestion Maps Forecast.

Table 3.9 - Performance of the NWRTC against KPI 1.3: Increased corridor throughput

Corridor segment	Current (2017-18) performance	2026 performance	2036 performance	2046 performance
Westgate to Lincoln Road				
	Throughput on this segment of the NWRTC is unlikely to be constrained by congestion levels during the early period covered by the analysis. Traffic is predicted to be relatively free flowing within the first five years after the Western Ring Route opening; beyond this time, the ART model indicates there is likely to be limited growth in private vehicle travel on this segment of the corridor owing to downstream congestion.			
Lincoln Road to Te Atatu				
	Severe congestion is expected on this segment of SH16 around five years after the Western Ring Route opening, which will limit the overall throughput of the corridor.			
Te Atatu to Waterview (causeway)				
	Severe traffic congestion on SH16 is expected soon after the Western Ring Route opening, which will limit the overall throughput of the corridor. There is the potential for additional bus throughput issues to emerge later on in the period due to constraints on the number of buses that can exit SH16 into Great			

	North Road and city centre intersections. The precise timing and magnitude of these constraints will depend, in significant part, on the PT service model, with a significantly lower likelihood of constraints arising under a trunk-and-feeder service model than under a single-seat service model.
Point Chevalier / Waterview to city	Throughput on this segment of the NWRTC is likely to be constrained by intersection capacity on Great North Road and in the city centre. The precise timing and magnitude of these constraints will depend, in significant part, on the PT service model, with constraints arising at a later date under a trunk-and-feeder service model. However, under either service model, constraints are expected to arise by 2046. In addition, traffic congestion on the parallel SH16 motorway corridor is expected between Waterview and Western Springs from soon after the Western Ring Route opening.

Table 3.10 summarises the NWRTC performance against KPI 2.2, faster, more reliable journey time. This analysis informs the assessment of whether current PT arrangements on the corridor will be attractive to users and hence increase PT mode share (KPI 2.1).

The key finding from this analysis was that journey time and reliability on the NWRTC underperforms significantly against the Northern Busway, which establishes a relevant benchmark for RTN performance. This results in substantial excess journey time for users and poor reliability leading to the need to schedule in additional time for delays. This reflects a combination of:

- Lack of separated running-ways on and through motorway ramps and interchanges on SH16
- Limited bus capacity on Great North Road due to discontinuous bus lanes and intersection timing
- Lack of interchange facilities to enable buses to pick up / drop off passengers and transfer between services without leaving the motorway.

Traffic modelling results suggest that issues observed now will persist and become more severe if left unaddressed. Furthermore, slow journey times on the NWRTC persist across all time periods.

Table 3.10 - Performance of the NWRTC against KPI 2.2: Faster, more reliable journey time

Corridor segment	Current (2016) performance	2026 performance	2036 performance	2046 performance
Westgate to Lincoln Road	At present, buses journey times between Westgate and Lincoln Road are roughly twice as long as journey times on an equivalent section of the Northern Busway. During peak periods, they are also significantly less reliable. Running buses on SH16 rather than on local roads may reduce some speed and reliability issues, as this segment of the corridor is not expected to be severely congested in the near to medium term; however, this would reduce accessibility to users due to the lack of interchange and stop facilities on SH16.			
Lincoln Road to Te Atatu	At present, bus journey times from Lincoln Road to Point Chevalier or Albert St (peak express buses only) are almost twice as long as journey times on an			

	equivalent section of the Northern Busway. During peak periods, they are also significantly less reliable. Comparison with outcomes for buses between Te Atatu Road and Point Chevalier or Albert St suggests that most of this delay arises to the east of Te Atatu Road, rather than between Lincoln Road and Te Atatu Road. This is borne out by traffic modelling of SH16 congestion. However, these outcomes are likely to be exacerbated by rising congestion prior to 2026, meaning that the relative performance of this segment is likely to deteriorate further.
Te Atatu to Waterview (causeway)	At present, bus journey times from Te Atatu Road to Point Chevalier or Albert St (peak express buses only) are over twice as long as journey times on an equivalent section of the Northern Busway. During peak periods, they are also significantly less reliable, with unpredictable delays five to seven times as long as experienced on the Northern Busway. Traffic modelling of SH16 congestion suggests that this performance is likely to degrade further in future years.
Point Chevalier / Waterview to city	At present, bus journey times from Point Chevalier to Karangahape Road are almost three times as long as journey times on an equivalent section of the Northern Busway. During peak periods, they are also significantly less reliable, with unpredictable delays almost three times as long as experienced on the Northern Busway. Modelling of Great North Road intersection capacity suggests that this performance may degrade further in future years if bus volumes increase significantly to meet growing demand.

Finally, note that the under-performance identified here has implications for KPI 2.1, increase in public transport mode share along the north-west corridor. On one hand, constrained capacity for additional people throughput will reduce the ability to deliver on a higher public transport mode share. On the other hand, poor performance in terms of journey time and reliability will reduce the attractiveness of NWRTC public transport services relative to alternative options, and hence reduce actual demand. The assessment here identifies the latter factor as the more severe constraint.

3.4 Changes since the Strategic Case

Since the strategic case was undertaken, the housing situation in Auckland has developed with housing (un)affordability growing and therefore greater pressure coming on housing supply to be ramped-up to meet demand. The Special Housing Area legislation accelerated subdivision and development in north-west Auckland**.**

The Unitary Plan decisions version being adopted by Council gives greater certainty about the regulatory framework for growth. The planning decisions are expected to deliver on land use forecasts, but timing/sequencing remain more uncertain.

Unitary Plan decisions:

- Future Urban Zone has been (modestly) extended in the area, with some areas immediately 'live-zoned' to allow for development

- Unitary Plan also allows for denser development – lower lot sizes and more dwellings per site
- The 'Soft RUB' creates more uncertainty about the timing and location of further development in the area

The ATAP agreement has provided clarity on the strategic direction for transport investment.

Owing to the recent planning decisions (SHAs, Unitary Plan), north-western Auckland development is now 'locked in'; key infrastructure including transportation must respond.

3.5 Stakeholders' agreement

The inclusion of a north-west Busway in the ATAP report (see Section 2.4.3) is a clear-cut demonstration not only of the collective stakeholders' agreement to the strategic case, but also acceptance of the priority to address its findings.

3.6 Customers' needs

While the generalised travel needs of potential customers are inherent in the problem definition and transport analysis carried out in support of this business case, there is also a need to identify the likely user groups of the NWRTC and their specific "problems" and needs. This approach is designed to challenge the analysis from a personal perspective to ensure that there is a human aspect to the business case and that the recommended option has an understanding of customers built into its origin and ongoing development.

Working with Auckland Transport's Customer Insights Team, the following customer groups and their transport problems have been identified. These are expressed as a personal view, based on Auckland Transport's customer feedback and surveys. In identifying the groups, an assessment has been made of the likely proportion of future NWRTC users that each group would make up based on HOP data and to estimate the distribution of the Recreation Seekers we used the 'Time Use Survey' conducted by Statistics NZ in 2009/10.

City Centre Employees (47%):

"I work in the CBD but my life takes place in northwest Auckland.

Driving to the CBD in the peak hours is stressful and time-consuming, plus parking downtown is expensive.

I don't want to spend my time in traffic nor waiting on or in a crowded bus that meanders through suburbs.

- *I need a fast, direct and reliable service with simple connection that performs especially during peak hours."*

Industrial employees (18%):

"A lot of jobs are in the industrial areas in Rosebank or Henderson where car parks are available.

I can reach my work in the industrial area via the SH16 much better than I can by public transport.

Taking the bus would save me a lot of money but the journey takes longer than by car, is unreliable and sometimes doesn't cover my shift very well. I risk my job if I don't show up on time.

- *I need an affordable reliable service to and from my work place in the industrial areas at any time of the day."*

Students (14 %):

"I have several destinations (school, work, friends) across Auckland plus I am on a budget.

- *I need an affordable, fast, direct and reliable service throughout the day and week."*

Elderly/ Mobility Challenged (16%):

"I want to be mobile and part of society. I travel off peak to activities, to health care facilities and to see family and friends also locally.

Using the bus can be overwhelming: tagging on/off, finding the right connection and many of the bus stops are not designed barrier-free.

Services are often infrequent and connections are difficult when I travel

- *I need easy connections and barrier-free facilities."*

Recreation Seekers (5%):

"I live in the north- west of Auckland but I would like to enjoy Auckland's shops, parks, beaches and night life. Some events also happen during the week. The bus isn't a realistic alternative: a journey to the CBD takes almost three times as long as it would by car. Services later at night and weekends run only hourly and stop quite early during the week.

On weekends, unless we decide to take the night service that is fast but only runs very late, one of us has to drive and stay away from drinks.

- *I need a service that is faster, more frequent also on weekends and runs longer during the week."*

In section 6 of this business case, the effectiveness of the recommended option in meeting the needs of each of these groups is assessed and direction provided as to how the recommended option can be developed to better meet the needs of customers.

4 Activity development – Long List

4.1 Do Minimum

This is the base case which uses the existing infrastructure and currently proposed services. This includes the use of bus lanes on motorway shoulders during peak hours. There are no new services or infrastructure beyond what is currently committed. The Do Minimum assumes that a form of basic bus-bus interchange will be developed at Westgate, but not anywhere else.

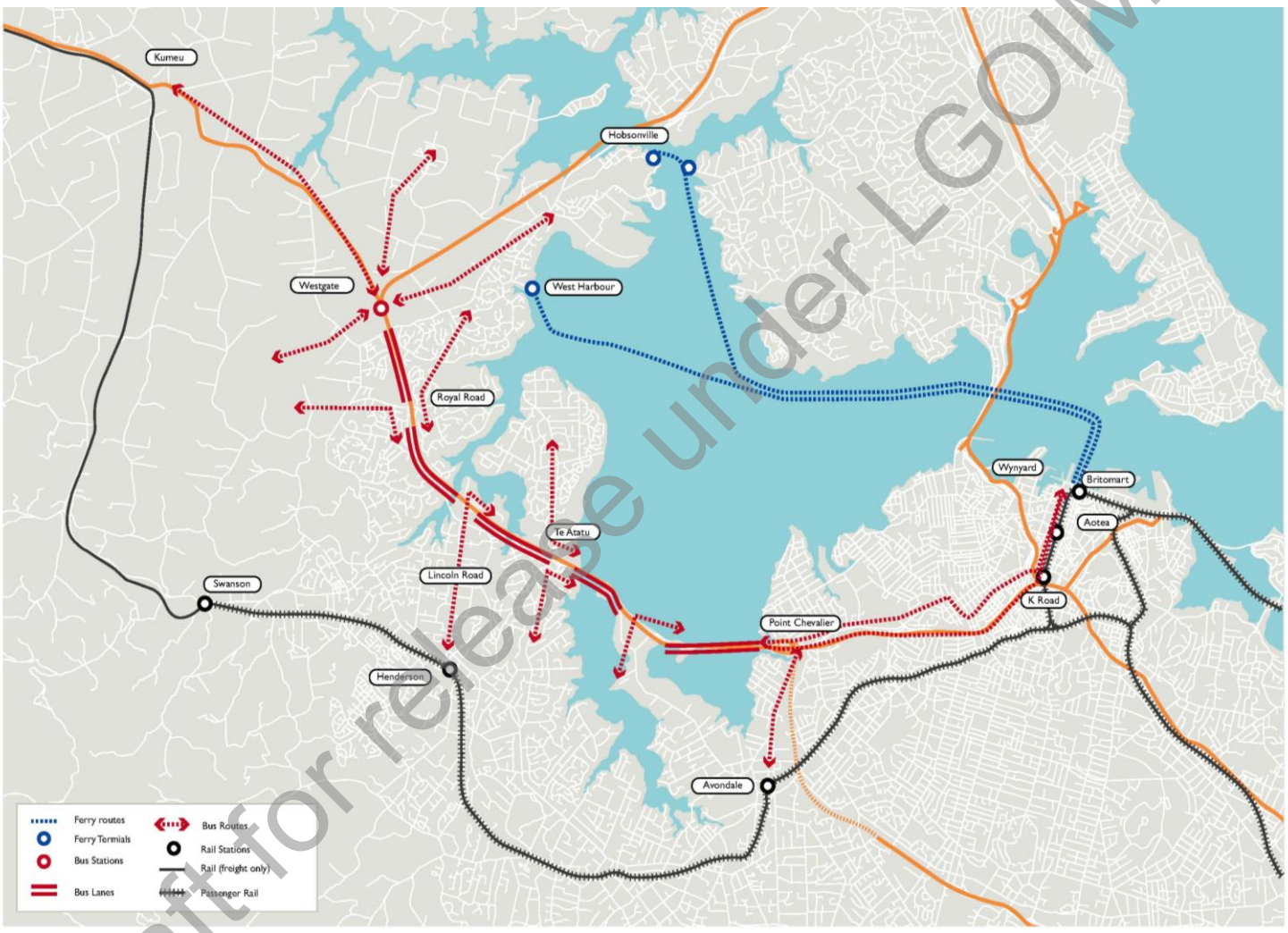


Figure 4.1 - Do Minimum

4.2 Long-list options

A facilitated long-list workshop was held on 27 October 2016 with representatives of the three major stakeholders (Auckland Transport, the Transport Agency and Auckland Council) supported by members of the project team.

The attendees generated a set of possible interventions and options that had the potential to help deliver against the Investment Objectives. The hierarchy adopted by both the Transport Agency and Auckland Transport of considering Demand Management, Productivity and Supply options was adopted.

The output from the workshop was subsequently grouped into three categories:

- A – Do Minimum;
- B – Demand Management and Productivity; and
- C – Increased Supply,

These are outlined in detail in Table 4.1.

Table 4.1 - Long-list options

Alternatives	A1 - Do Min	B1 - Land use	B2 - Pricing led	B3 - Capacity management	B4 - Technology maximisation and reliance
Summary and intent	*Base case. Use existing infrastructure and currently proposed services.*	*Address growth pressure on base case through minimising the need to travel in peak direction.*	*Optimise use of existing assets and services through variable pricing to influence locational and trip timing decisions.*	*Optimise the productivity of the existing (entire) SH16 corridor by reallocating road space to optimise total throughput and minimal new infrastructure.*	*Minimising or deferring major capital spend through introducing and/or relying on new or emerging technologies*
Headline Intervention	No new services or infrastructure beyond that currently committed (i.e. Shoulder bus lanes on parts of SH16 as currently being provided by NZTA) Assumes a basic bus-bus interchange will be developed at Westgate	This option seeks to achieve behaviour change through land uses that enable greater employment self-sufficiency. The key change is increasing the proportion of employment land in the north-west growth area to minimise the demand for travel outside of the north-west growth area and as a result reduce the need to provide external transport capacity. Also considered was further upzoning around key stops/stations.	Variable congestion pricing to increase efficiency of corridor for both PT and cars. PT fares pricing (e.g. discounts) to encourage shoulder/ off peak travel and minimise the need to provide high capacity PT services and infrastructure.	T2/T3 lanes on the motorway. This could involve adding or taking general traffic lanes in an optimised way. Tidal flow lanes though movable median barriers. Bus lanes (e.g. on approaches to interchanges) Ramp signals to control the performance of the state highway corridor.	ATAP considered: Connected vehicles leading to greater lane-capacity Ride-sharing technologies leading to higher vehicle occupancy Driverless buses leading to lower PT operating costs (or redeployment of resources into more service) Use of technology (e.g. off-board ticketing) to reduce dwell times. The intent is to reduce the need to invest through reliance of improved technology.

Table 4.2 - Long List Options (Physical Interventions)

Alternatives	C1 - PT service levels (no infrastructure)	C2 - Interchanges and local access	C3 - Enhanced bus lanes	C4 - Continuous busway	C5 - Ferry-based	C6 - Light rail	C7 - Automated light metro	C8 - Heavy rail
Summary and intent	*Taking a service-based approach using existing infrastructure with more buses and higher frequencies to provide for capacity.*	*Allowing a connected network and improved customer experience through adding interchanges and improved access to base case bus lanes.*	*Making base case bus lanes as continuous as possible without the need to introduce a new alignment with consequential land and cost impacts.*	*Provide a continuous, bus rapid transit solution to address capacity and reliability problems.*	*Use ferries to provide reliability and capacity as a solution to address infrastructure and costs on SH16.*	*Provide a continuous, separated LRT rapid transit solution to address capacity and reliability problems.*	*Provide a continuous, fully separated ALM transit solution to address capacity and reliability problems.*	*Provide a continuous, fully separated heavy rail rapid transit solution to address capacity and reliability problems.*

Alternatives	C1 - PT service levels (no infrastructure)	C2 - Interchanges and local access	C3 - Enhanced bus lanes	C4 - Continuous busway	C5 - Ferry-based	C6 - Light rail	C7 - Automated light metro	C8 - Heavy rail
Headline Intervention	Increase frequency of do-min services which is a continuation of the trunk and branch model. I.e., specifically upgrade the following to frequent status: W2 W51 W52 Add new cross-town routes (e.g. Te Atatu to Westgate) Provide services to growth areas as they develop within limited priority.	Add an interchange at Te Atatu with kiss n ride (no park n ride) No mid-block stations proposed due to difficulty with access/ safety from bus shoulders Bus services change to hub at Westgate and Te Atatu where a high frequency motorway trunk service operates to/from the city	Enhance "existing" (or under construction) bus shoulders on SH16 by extending them either through or around all on and off ramps to avoid merging into general traffic lanes. Enhance existing bus lanes on Great North Road and Karangahape Road to be continuous through town centres and intersections. Providing connections to growth areas.	Segregated busway from Westgate to city centre (southern periphery) in vicinity of Karangahape Road). Assume on street bus priority for final 2km along Karangahape Road, Pitt Street, Mayoral Drive and Albert Street. New Bus-bus Interchanges at Westgate, Royal Road, Lincoln Road, Te Atatu Point Chevalier, Western Springs and Bond Street. "Street based" Bus-Rail interchange opportunities at Karangahape Road, Aotea and Britomart	New ferry termini at: ■ Whenuapai (Herald Island) ■ Te Atatu Upgrade ferry termini at ■ Hobsonville ■ West Harbour Implementing infrastructure and services to support access to ferry terminals.	Grade-separated Light Railway alongside SH16 from Westgate to Point Chevalier. LRT on Great North Road between Point Chevalier and Karangahape Road. LRT to use Albert St in City New Bus-LRT Interchanges at Westgate, Royal Road, Lincoln Road, Te Atatu Point Chevalier, Western Springs and Bond Street. LRT-Rail interchange opportunities at Karangahape Road, Aotea and Britomart. Supporting infrastructure and services in growth areas for access to LRT stations, particularly at Westgate.	Fully grade-separated metro alignment from Westgate to city centre. At grade to Bond St, tunnel through city centre via Karangahape Road, Uni precinct, Aotea to Wynyard New Metro-bus Interchanges at Westgate, Royal Road, Lincoln Road, Te Atatu Point Chevalier, Western Springs and Bond Street. with Metro-Rail interchange at Karangahape Road and Aotea. Supporting infrastructure and services in growth areas for access to busway stations, particularly at Westgate.	Fully grade-separated heavy rail from Westgate to city centre. At grade to Grey Lynn, across motorway to join North Auckland Line at New North Road, then via CRL tunnel from Mt Eden through city New Bus-Rail Interchanges at Westgate, Royal Road, Lincoln Road, Te Atatu Point Chevalier, Western Springs and Bond Street. Use CRL stations for city centre access. Supporting infrastructure and services in growth areas for access to rail stations, particularly at Westgate.

4.3 Long-List options assessment

The summary assessment of each of the long-list options is set out below.

Options C1 - PT service levels (no infrastructure) and C2 - Interchanges and local access - were discarded following discussions with Auckland Transport as neither on their own was seen to be a realistic response to the problems. Effectively, they were therefore considered as elements of Option C3.

This section sets out how the remaining options were assessed to develop a short list for more detailed evaluation and comparison. In each case a most likely form of the modal option was considered to allow the comparison to take place. The ferry option was limited both by the speeds that can be provided on the harbour and the practical ability to expand capacity at the Downtown Ferry Terminal.

4.3.1 Comparative assessment against the investment objectives

Options not assessed in detail

Option A (Do Minimum) and all the B suite of options (Demand Management and Productivity) were assessed against key criteria and did not meet the investment objectives as standalone options.

In particular:

- The **capacity** requirements are very unlikely to be addressed by these solutions alone. This was very likely to result in poor performance against throughput and mode share criteria.
- The **travel time** of the ferry option (C5) was worse than the Do-Minimum and as a result was likely to perform poorly against accessibility criteria. Travel time for B suite options alone relied on the Do-Minimum solution which is considered poor against relevant benchmarks and would be very unlikely to perform well against other options. Ferries could however still be used to supplement the preferred option

In the context of the growth expectation that underpins the problem statements for this business case, these options are effective in many ways when supporting a higher capacity, higher performance option. They are unlikely to solve the problems on their own. Elements of the B options are still expected to be included in the final programme(s) to progress to the Detailed Business Case as part of a holistic access solution.

The C suite of options, except C5 Ferry (which did not change travel times compared to the Do Minimum), are assessed comparatively against the Investment Objectives below.

4.3.2 Investment Objective 1: Substantially improve connections to and from the north-west.

KPI 1: Jobs accessible within 45 minutes by public transport from the north-west

The following chart highlights the number of jobs accessible within 45 minutes in Westgate, Te Atatu, Point Chevalier and Aotea.

Key observations are:

- All options tested show a significant improvement in access to jobs over the Do-Minimum.
- There is a step-change from Continuous Bus Lanes to options with fully dedicates rights of way, with LRT and Busway performing similarly.
- Faster options that operate on a fully grade-separated right of way (Metro and Heavy Rail) provide the best access to jobs due to their greater speed, in part due to the tunnelled city centre access, which comes at a very high cost.

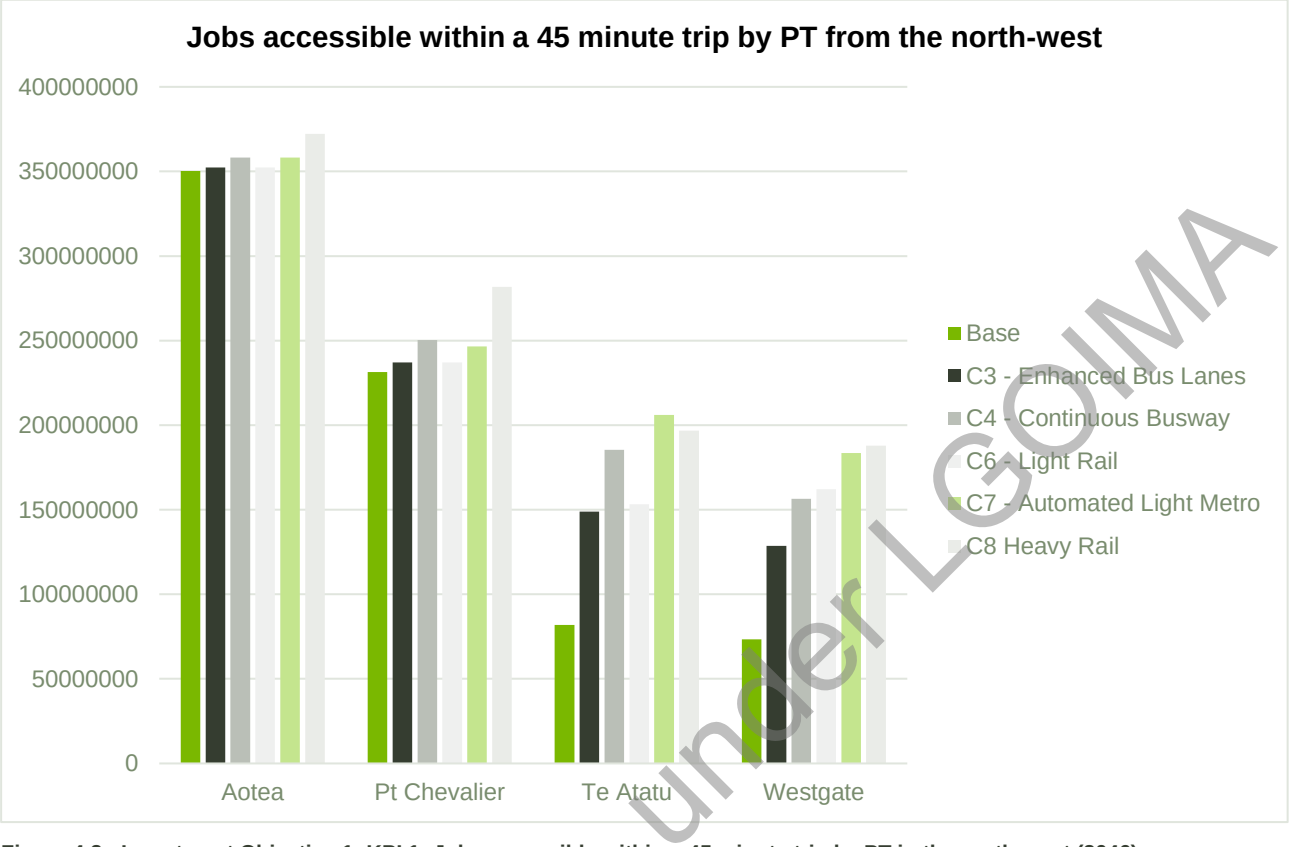


Figure 4.2 - Investment Objective 1: KPI 1: Jobs accessible within a 45 minute trip by PT in the north-west (2046) (assessed for the morning peak, door-to-door)

KPI 2: Size of catchment accessible from north-west by car, PT and active mode

KPI 2 was not measured at long list stage as it was not considered likely to show a significant difference.

KPI 3: Increased corridor throughput

The following charts show a comparison of predicted future demand levels and the estimated capacity of each mode. Sufficient capacity is provided with the bus, light rail, automated light metro and heavy rail modes, but not the base case or ferry mode. By way of comparison, the expected 2046 demands of approximately 5,000 people per hour are roughly similar to the throughput of the Northern Busway in 2016.

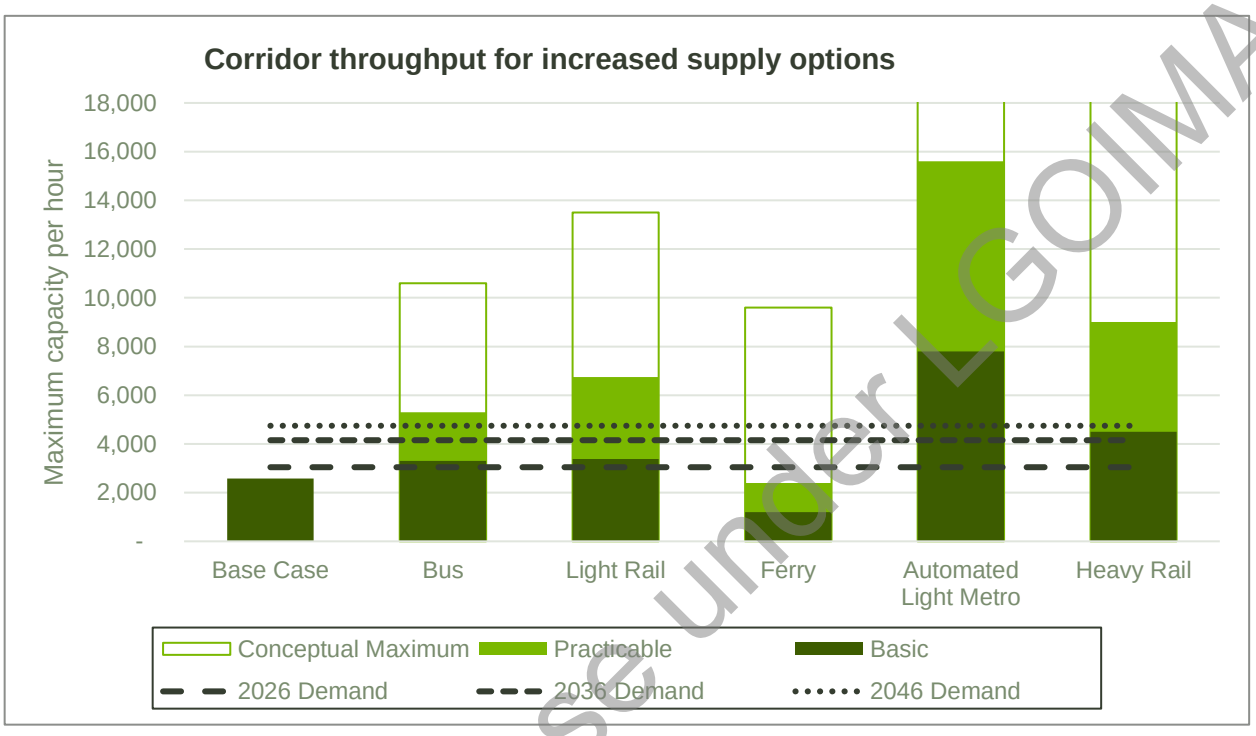


Figure 4.3 - Investment Objective 1: KPI 3: Maximum capacity per hour comparison between all increased supply based options

Specific observations are:

- The Do-Minimum and Ferry options do not, alone or together provide enough capacity to meet the access requirements of the north-west growth areas and corridor.
- Heavy rail and Light Metro can easily accommodate the expected demands and in fact provide a significant over-supply of capacity. This over-supply comes at a considerable cost and does not optimise the investment.
- Both Busway and Light Rail options provide adequate capacity, with Light Rail providing a greater capacity for demands to exceed forecasts than Busway, based on current assumptions relating to the capacity of the city centre to accept buses and trams.
- Note that should options be found to improve on the assumed city centre operation and terminal capacity, both a Busway and Light Rail are capable of handling the forecast demand with capacity to spare.

4.3.3 Investment Objective 2: Make public transport a realistic option for the majority of journeys to and from the north-west.

KPI 1: Mode share

Mode share was not specifically measured at long list stage, with travel time, access to employment and throughput being used as proxies for mode share potential.

KPI 2: Travel times

Travel times were estimated from Westgate to the City for each mode based on benchmarking existing and comparable routes to each of the three main sections of the route, particularly accounting for whether the section was on street, on shoulder lanes, or on a dedicated running way.

This chart shows the estimated travel time in minutes for the on-land options by section in shades of green, From Westgate to Waterview, from Waterview to Karangahape station, and through the city centre from Karangahape to Britomart. The Automated Light Metro option does not run to Britomart, therefore the time to Aotea is shown.

The ferry option is shown in blue with two sections, the first is the feeder bus travel time from Westgate to West Harbour wharf, the second by ferry from the wharf to the Downtown Ferry Terminal.

This data indicates a range of travel time outcomes by mode and corridor. The slowest overall is the ferry option, in part due to the requirement to use a connecting bus to access the wharf from Westgate, but also the relatively long travel time on the water.

The enhanced bus lanes with interchange option shows a relatively small improvement in travel time over the do minimum case. Busway and LRT show fast travel times if they run a full off-street route via the SH16 corridor, and somewhat slower if either operates via Great North Road. The LRT options are slightly superior to the comparable busway options in each case.

Overall, the shortest travel times were estimated for the full off-line ALM and heavy rail options, however any of the busway and LRT options represents a significant improvement over the base case.

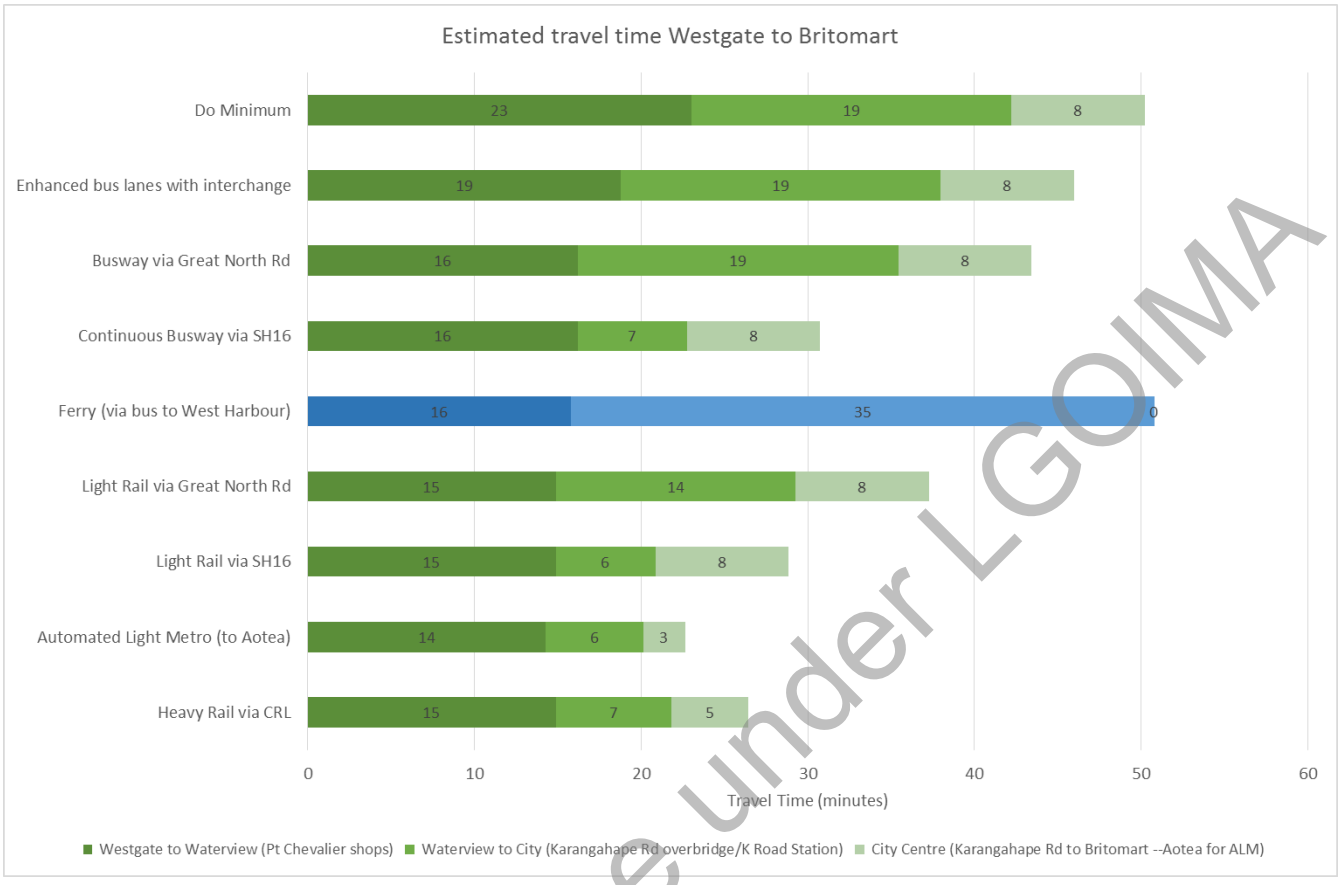


Figure 4.4 - Investment Objective 2: KPI 2: Travel Time by Option

KPI 3: Catchment

All options were tested with the same or very similar station locations resulting in a low differentiation between options. The Light Metro option has a higher catchment mainly due to its assumed alignment within the city centre which brought the Auckland Hospital and universities into its catchment. The Ferry option was not tested. As ferry terminals are located on the coast, meaning direct catchments are limited it would have performed poorly against this measure.

While not included in the analysis, all options would in reality have a supporting public transport feeder network extending into the growth areas. This would be unlikely to differentiate options except potentially the ability of a bus-based option to allow for some single-seat journeys from the growth areas to the city centre depending on the details of the service pattern.

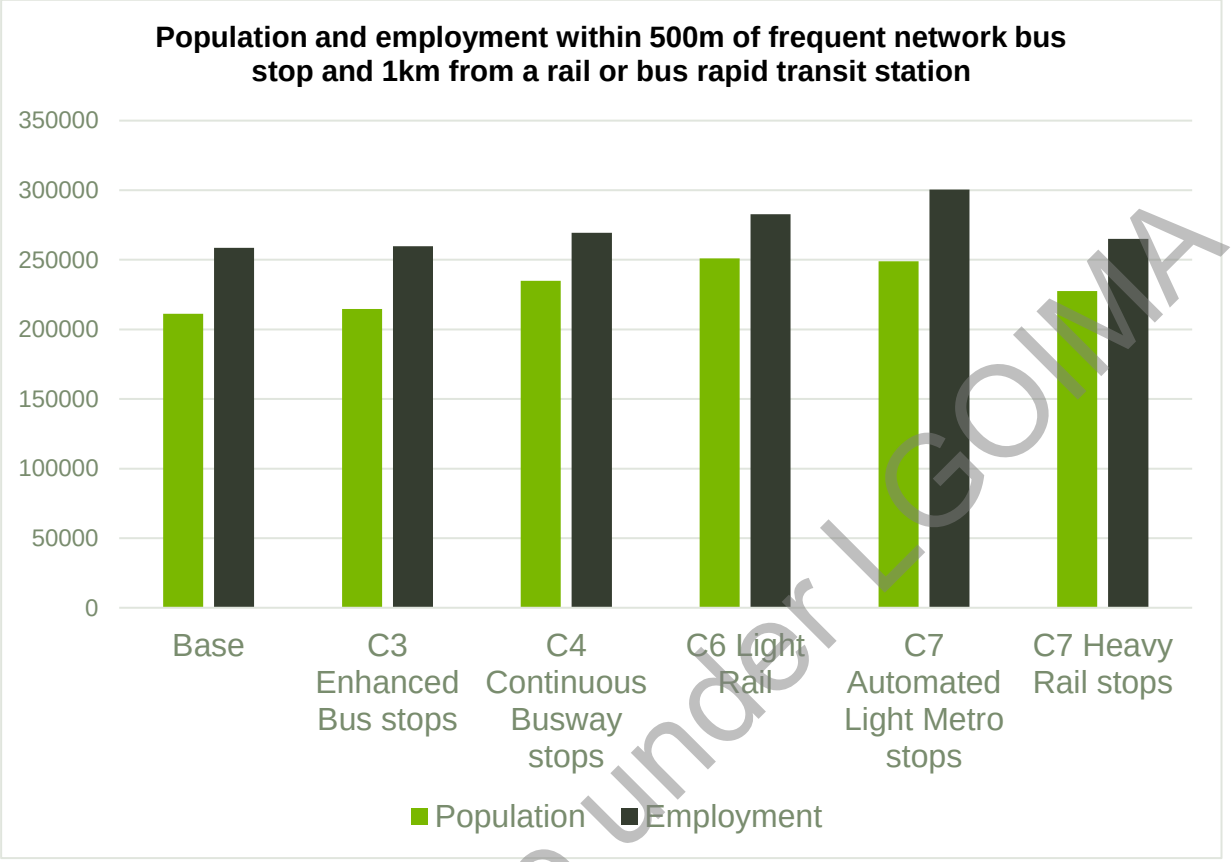


Figure 4.5 - Investment Objective 2: KPI 3: Catchment within a frequent transport network: Proportion of the population living within 500m of a frequent network bus stop and 1km from a rail or bus rapid transit station

4.3.4 Investment Objective 3: Increase the efficiency of public transport to and from the north-west

KPI 1: Operating costs

Total annualised operating and fleet costs are shown in Figure 4.6. Operating cost is a function of the peak fleet size and the number of service-kilometres and service-hours required in each case to meet the capacity and service levels for the future.

These service metrics and costs refer to the trunk north-west service pattern of each option only. It is assumed that in each option the service levels of the existing bus network will be reconfigured to connect to the new trunk services on a cost-neutral basis, i.e. all existing SH16 buses will be repurposed to feeder routes with no net change in local bus operating costs. This is intended to give a level playing field comparison of the operating costs of the core component of each option. However, note that in practice further efficiencies are likely to be found in the local bus network in response to a new rapid transit line.

This shows that busway and light rail have somewhat improved operating costs, while metro and heavy rail are more significantly improved. The ferry option requires considerably higher operating costs than any of the land based modes, largely due to high costs and relatively low capacity per vehicle.

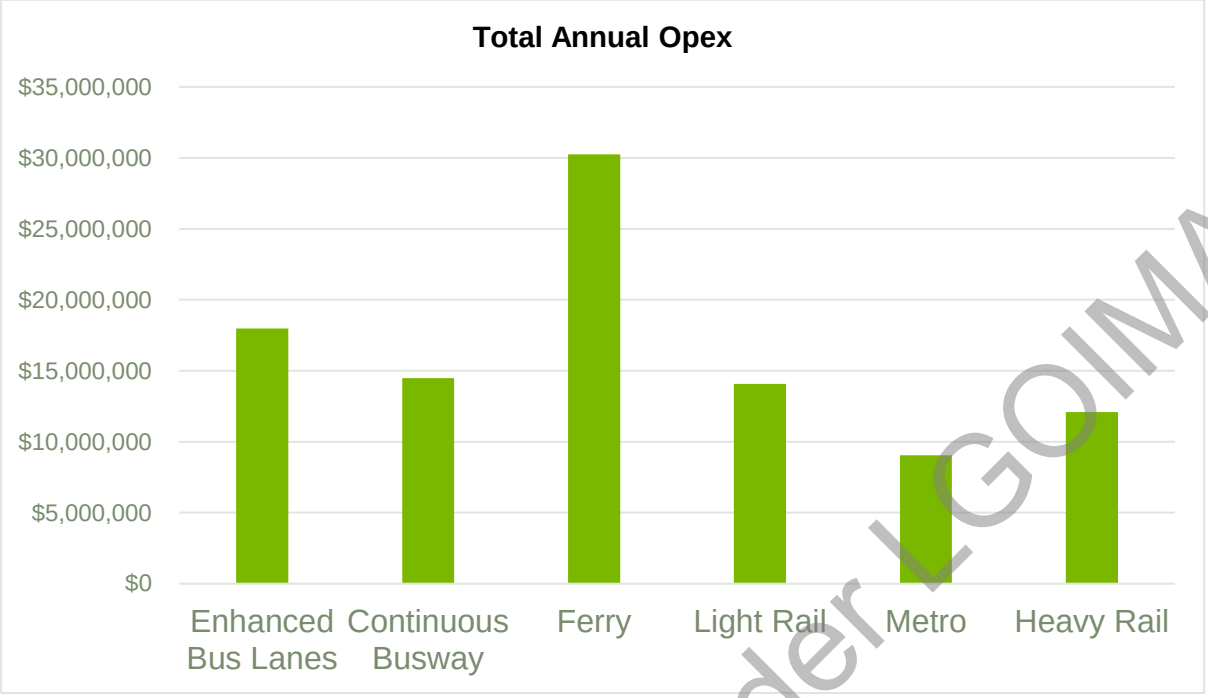


Figure 4.6 Investment Objective 3: KPI 1: Service delivery requirements and operating cost comparison

4.3.5 Capital Cost

The construction cost estimates below include 25% for Preliminary and General. For clarity, Preliminary and General, refers to the Contractor's on site costs and overheads. In this case it includes the following:

- Contractors On-Site Staff
- External Consultants
- Travel and Accommodation
- Plant, Equipment and Site Vehicles
- Site Operating Costs
- Materials Testing
- Insurances, Bonds and Consent Fees
- Project Site Establishment
- Mobilisation and Demobilisation
- OH&S, Quality, Environmental, HR and Stakeholder Management

Table 4.3 - Capital costs by option

Route	Construction Cost Estimate
Enhanced Bus Lanes	$550m
Busway (Great North Road)	$850m
Busway (SH16)	$1.1b
Light Rapid Transit (Great North Road)	$950m
Light Rapid Transit (SH16)	$1.25b
Heavy Rail (incl. Mt Eden Station redevelopment)	$2.8b
Automated Light Metro (to Aotea Station)	$2.5b

4.3.6 MCA Summary

The options were assessed through a Multi Criteria Assessment (MCA) process using two core layers:

- One, the weighted KPIs related to Investment Objectives, Benefits and Problems identified in the Investment Logic Map. This provides an assessment of effectiveness against these measures and in solving the problems.
- Two, an unweighted assessment of the feasibility, cost and risks of options. This provides an ability to balance effectiveness against the ability to deliver, cost and assess the likelihood of achieving the outcome.

Overall all of the proposed options performed equal to or greater than the Do Minimum. The full MCA and assessment is included in Appendix B1

- Three of the Demand Management/Productivity Options, B1, B2 and B4 were found to perform slightly better than the Do Minimum.
- Option B3, Capacity Management, was not found to provide any improvement to the Do Minimum.
- Options C3 (Enhanced Bus Lanes) and C5 (Ferry) performed somewhat better than the Do Minimum
- Options C4, C6, C7 and C8 all performed significantly better than the Do Minimum.

4.3.7 Long list workshop feedback

A long list MCA workshop was held on 12 December 2016 where the options were presented and discussed alongside the MCA. Attendance included a wide range of practitioners and analysts from AT, the Transport Agency and Council. They were supported by members of the consultant team who were able to provide additional technical information.

4.3.8 Conclusions and recommendations following workshop

The workshop participants were in overall agreement as to the future direction for the short list.

Preferred options:

The short listed options contained a number of “core” or “headline” RTN interventions, but also include elements of other programmes that would logically integrate with, give better effect to or support gaps

in the provision of an RTN corridor. While much of the focus is on the RTN solution, it is very much a suite of integrated interventions.

- A combination of multiple options are likely across the entire length of the corridor – need to understand varying demands.
- Take through options C3 (Enhanced Bus lanes), C4 (Busway) and C5 (Light Rail) to the short list. Include variants that use SH16 east of Point Chevalier.
- Consider pathways to move from one modal option to another, over time.
- C3 Enhanced Bus Lanes, is likely to form part of the solution strategy. Interchange opportunities are likely to be important.
- Ferry upgrades or service increases should be considered as supplementary to an RTN.
- The B suite of options (Demand Management and Productivity) should be considered as part of the final programme(s), including TODs.

5 Activity development – Short list

5.1 Short-listed options description

5.1.1 Physical description

This section provides a physical description of the short-listed options.

On the basis of the work described in section 4 regarding the long list assessment, above, the following options were shortlisted:

- Do Minimum
- Continuous bus lanes and Te Atatu bus interchange (via Great North Road)
- Busway (via Great North Road)
- Busway (via SH16)
- Light rail (via Great North Road)
- Light rail (via SH16)
- Busway (via Great North Road) with shoulder bus lanes on SH16 causeway
- Busway (via SH16) with shoulder bus lanes on SH16 causeway

These are headline interventions. All options were considered in the context of a range of supporting measures including access from the catchments within the growth areas to the stations on the RTN, improved land uses around stations and supporting modes such as ferries.

5.1.2 Do Minimum

This is the base case which uses the existing infrastructure and currently proposed services. This includes the use of bus lanes on motorway shoulders during peak hours. There are no new services or infrastructure beyond what is currently committed. This option assumes that some form of basic bus-bus interchange will be developed at Westgate, but not elsewhere.

5.1.3 Continuous bus lanes and Te Atatu bus interchange (via Great North Road)

This option enhances 'existing' (or under construction) bus shoulders on SH16 by extending them either through or around all on- and off-ramps to avoid merging into general traffic lanes. In all cases the existing infrastructure at the interchanges would need to be upgraded to enable bus priority.

This option includes a Te Atatu bus station to allow connection between local feeder buses and the trunk bus services using the continuous bus lanes on the motorway.

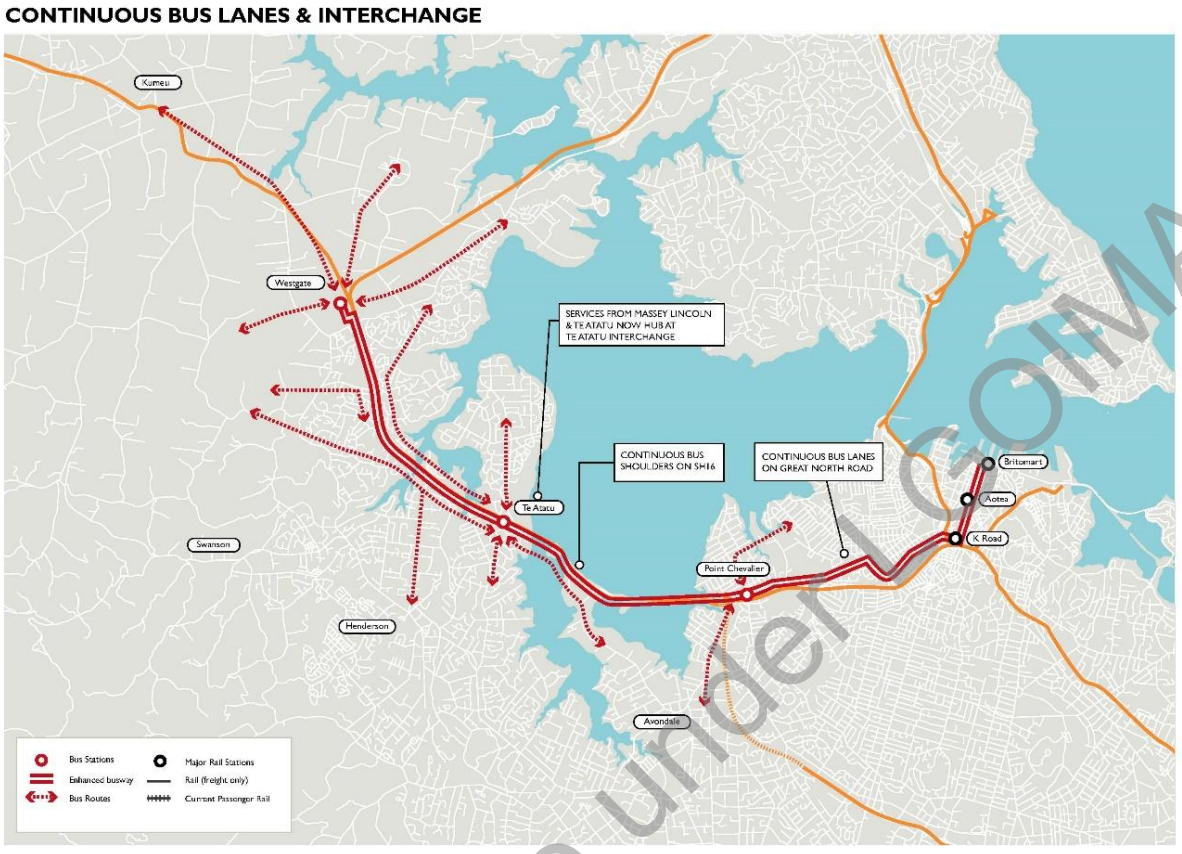


Figure 5.1 - Continuous bus lanes and interchange alignment

Westgate to Point Chevalier

A bus interchange station would be provided at Westgate.

At Royal Road Interchange the existing layout provides south facing on- and off-ramps only. New north-facing on- and off- ramps, for buses only, would be constructed, resulting in four-way signalised intersections either side of Royal Road bridge with bus priority. The existing southbound on-ramp has a bus lane, while the existing northbound off-ramp does not and would need to be upgraded.

At Lincoln Road Interchange the existing layout provides north and south facing on- and off-ramps. The existing southbound on ramp has a bus lane, while the others do not and would need to be upgraded to include these. Bus priority would be provided at both intersections.

At Te Atatu Road Interchange the existing layout provides east and west facing on- and-off ramps. The existing westbound off-ramp has a continuous bus lane up to Te Atatu Road. Allowance was made for a continuous bus lane along the eastbound off-ramp up to Te Atatu Road.

An interchange station is proposed at Te Atatu at McCormick Green. This would provide a Kiss and Ride facility. There is no provision for Park and Ride.

Dedicated bus ramps are required to bypass the Rosebank and Patiki ramps. Eastbound these will directly bypass both existing ramps using a bridge structure around the outside of both eastbound ramps. Westbound buses will merge with general traffic through this area. This area (Patiki and Rosebank ramps) is a significant factor in the inefficiencies of the bus shoulder lanes arrangement.

Allowance was made for a separate bus lane exiting the eastbound causeway bus shoulder lanes at Waterview up to Great North Road.

Point Chevalier to city centre (along Great North Road)

Bus lanes would be installed on both sides of Great North Road. Bus lanes, in peak times, are already provided on approximately 75% of Great North Road. Where additional bus lanes are proposed there is already adequate width in some locations, whereas at others localised widening may be required to accommodate an extra lane. Additionally, or alternatively, on street parking would be removed/relocated.

Existing bus stops would be retained with a consistent bus lane through to Karangahape Road.

5.1.4 Continuous Busway

There are two continuous busway options which were considered in the short list assessment. These both follow the same alignment between Westgate and Point Chevalier, after which one alignment follows SH16 and the other follows Great North Road.

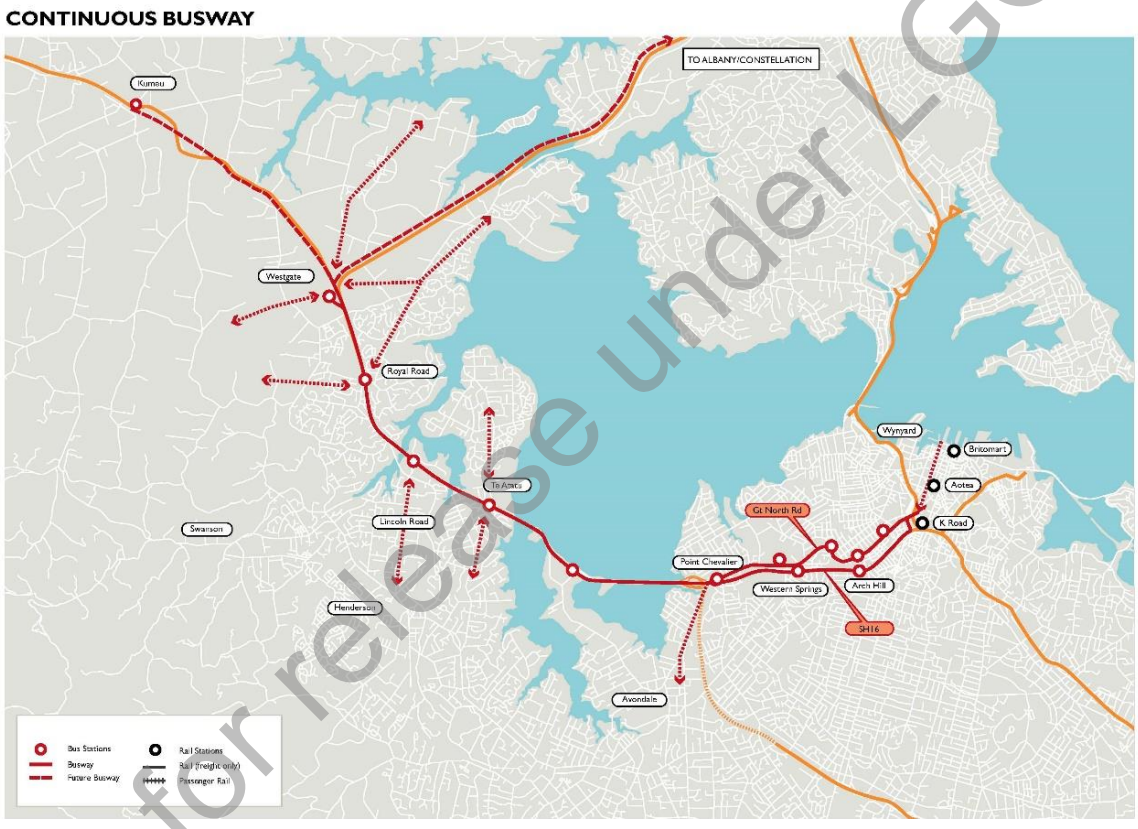


Figure 5.2 - Continuous busway alignment

Busway via Great North Road

A continuous, segregated, two-lane busway is proposed from Westgate to the city centre (southern periphery) in the vicinity of Karangahape Road. On-street bus priority would be required for the final two kilometres between Karangahape Road and Britomart.

New bus-to-bus interchanges would be constructed at Westgate, Royal Road, Lincoln Road, Te Atatu and Point Chevalier to provide connectivity with feeder bus routes and walk-up catchments, with 'street-based' bus-rail interchange opportunities at Karangahape Road, Aotea and Britomart.

Westgate to Te Atatu

Throughout this section the busway is aligned adjacent to the outbound carriageway.

The busway would terminate to the north of the SH16 / SH18 grade-separated interchange at a new bus-to-bus interchange at Westgate Station.

Te Atatu to Point Chevalier

There are two sub options for this alignment. The first with a full offline busway over the causeway. The second using bus shoulder lanes over the causeway with ramps connecting the bus shoulder lanes to the busway at Te Atatu and Point Chevalier.

Point Chevalier to city centre (along Great North Road)

The busway passes through the Great North Road/Carrington Road intersection via bus priority signals to the centre of Great North Road. The busway continues along Great North Road in the centre of the carriageway. The busway would be protected by a physical 'buffer' between itself and the general vehicle running lanes.

Throughout this route any existing signalised intersections or pedestrian crossings are proposed to remain, however all minor streets onto and off Great North Road would convert to left in/left out only, as would all driveways. Where possible all stations would be incorporated at existing intersections / pedestrian crossings.

This section would be similar to the AMETI-Eastern Busway design.

Busway via SH16

A continuous, grade-separated, two-lane busway is proposed from Westgate to the city centre (southern periphery) in the vicinity of Karangahape Road, including along SH16 between Point Chevalier and Newton Road.

The alignment from Westgate to Point Chevalier ramps is the same as the Busway via Great North Road. From a new Point Chevalier station the two-way busway would continue along the northern side of SH16 to the city centre via local stations at Western Springs and Arch Hill.

5.1.5 Light Rail

A light rail alignment is proposed from Westgate to the city centre. Two routes are proposed, both of which follow the same alignment until Point Chevalier where one follows Great North Road and the other follows SH16. Any light rail alignment would require an additional structure over the causeway.

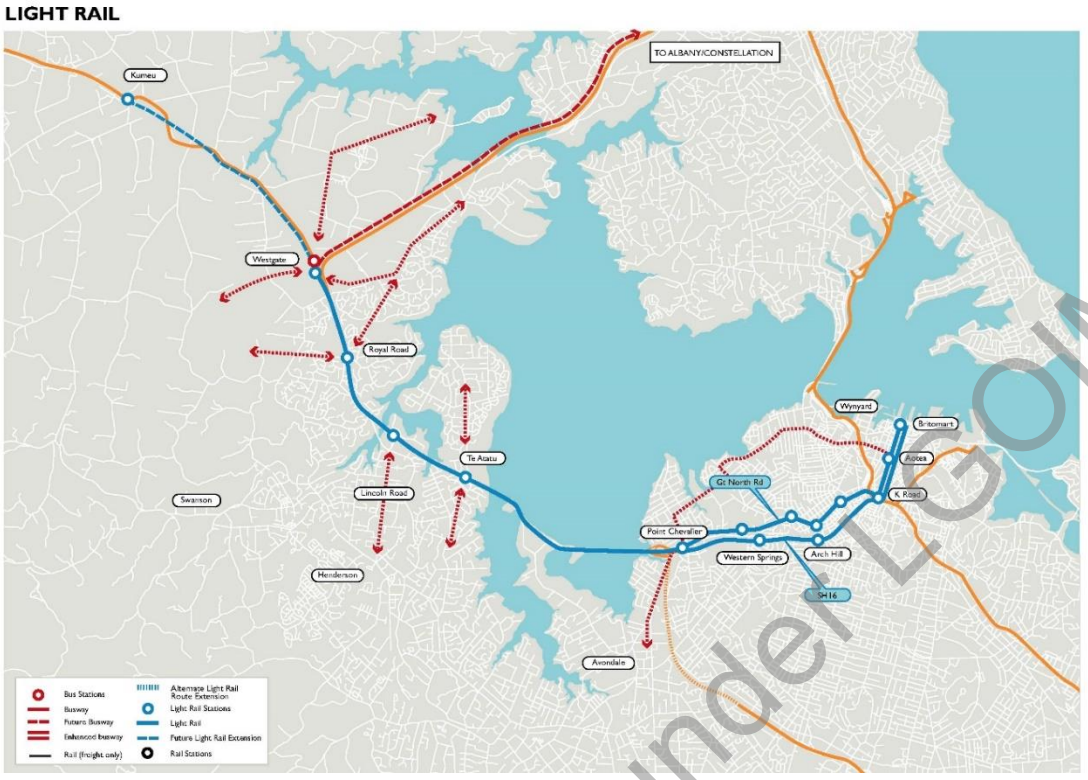


Figure 5.3 - Light Rail alignment

Light Rail via Great North Road

A continuous, segregated, two-way LRT route is proposed from Westgate to the city centre (southern periphery) in the vicinity of Karangahape Road. The continuation of LRT into the city (Britomart) would be via Albert Street. The LRT runs adjacent to SH16 before diverting along Great North Road.

New bus-to-LRT Interchanges at Westgate, Royal Road, Lincoln Road, Te Atatu, Point Chevalier, Western Springs and Bond Street provide connectivity, with 'Street based' LRT-Rail interchange opportunities at Karangahape Road, Aotea and Britomart.

The proposed LRT through this section would be as the 'Busway via Great North Road' option with an identical alignment.

Light Rail via SH16

A continuous, segregated, two-way LRT route is proposed from Westgate to the city centre (southern periphery) via SH16 in the vicinity of Karangahape Road. The continuation of LRT into the city (Britomart) would be via Albert Street.

The proposed LRT through this section would be as the 'Busway via SH16' option.

5.2 Assessment of short-listed options

The assessment generally excludes the busway options with shoulder bus lanes on the SH16 causeway, as described in the physical description (5.1.1). These options are expected to perform largely the same as the full busway options, respectively, except where otherwise noted. These two options can be considered as sub-options or stages towards a full busway solution.

5.2.1 Modelling of short-listed options

Auckland Forecasting Centre ART and APT model runs were run for five options:

- Continuous bus lanes and Te Atatu interchange (via Great North Road)
- Busway (via Great North Road)
- Busway (via SH16)
- Light rail (via Great North Road)
- Light rail (via SH16)

In addition, model outputs from the ATAP CEE4 scenario were used as the Do Minimum scenario.

These model outputs informed the assessment for many of the measures described in this business case. Model outputs have been provided for all bus options and the light rail via SH16 option. The model was found to predict that light rail performs worse on patronage, travel time and accessibility metrics than the busway and continuous bus lane options. For example, ART model outputs for the two-hour AM peak show light rail via SH16 carrying 2,000 fewer people across the SH16 causeway than the Do Minimum scenario. This is counter to expectations (i.e. light rail is expected to perform at least as well as busway), and suggests that the models – which model light rail using the same parameters as heavy rail – may not accurately represent light rail. The modelling should be refined for the Detailed Business Case.

Thus, the assessment of each of the two light rail options is based on the model outputs for the busway option on the same alignment.

5.3 Assessment against the Investment Objectives

5.3.1 Investment Objective 1: Substantially improve connections to and from the north-west

This investment objective relates to Benefit 1: "Better connected city, better match for people, jobs and education opportunities." Three measures were used to assess the short-list options against this investment objective: job accessibility from the north-west, residents' accessibility to the north-west, and increased corridor throughput.

KPI 1: Jobs accessible to north-west residents

The first measure assesses the number of jobs accessible within a 45-minute trip by public transport (PT) from the north-west (assessed for morning peak, door-to-door). Travel time from the north-west was derived from ART model outputs, for which travel times are reported between model zone centroids. Two different origin zones within the north-west were considered, as shown in Figure 5.4: Massey (to the south of Fred Taylor Drive), which includes the current Westgate Shopping Centre, and Westgate Station (to the north of Fred Taylor Drive), in which the future Westgate RTN station will be located.

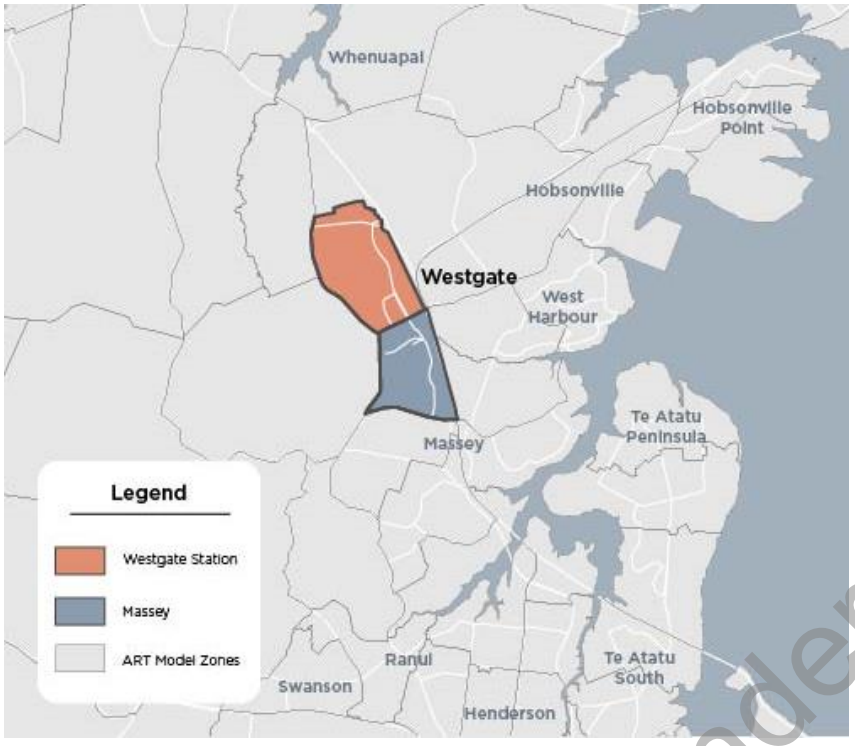


Figure 5.4 Origin zones for travel from Westgate

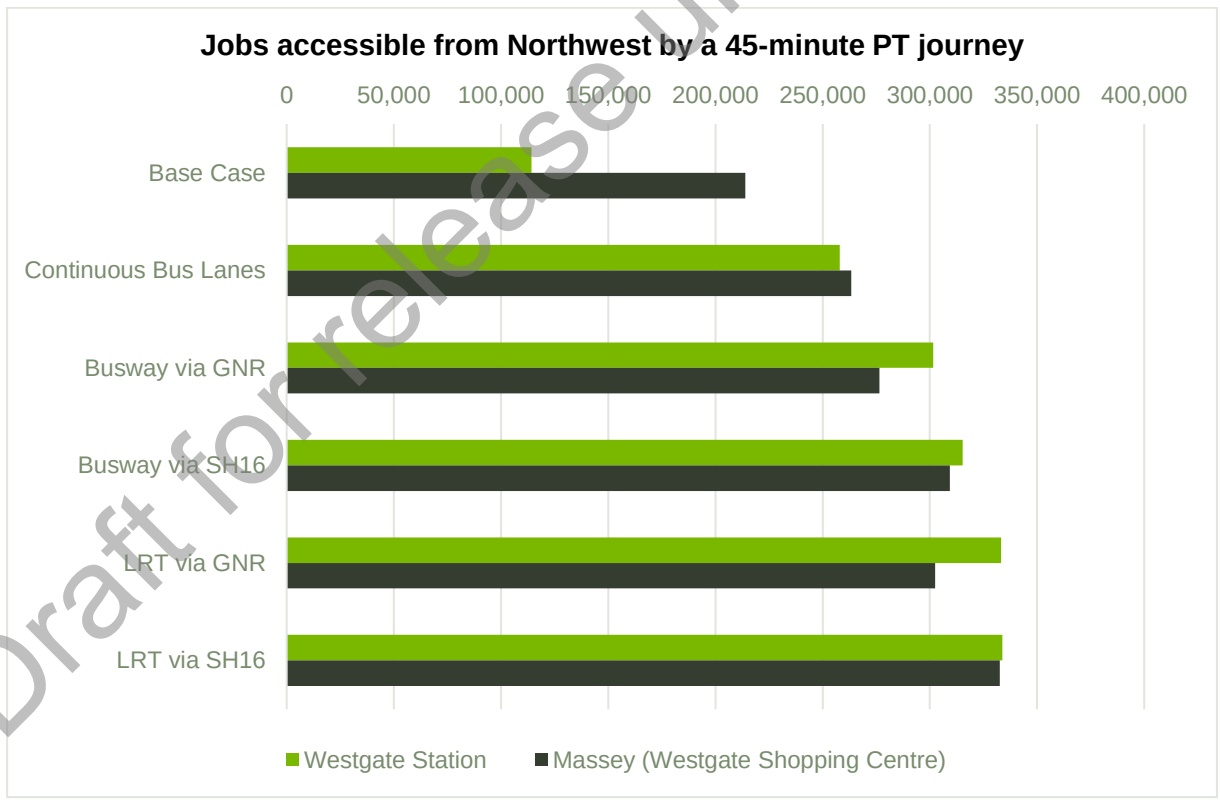


Figure 5.5 – Investment Objective 1: KPI 1: Number of jobs accessible within 45 minutes from the north-west by public transport (ART model, 2046, I9 land use scenario).

Figure 5.5 summarises the number of jobs accessible from both origin zones for each option. Job accessibility increases as the level of grade separation increases – and thus average travel speed – is

increased. The SH16 alignment east of Waterview provides better job accessibility than the Great North Road alignment with shorter travel times into the dense employment core of the city centre.

Accessibility from the Massey zone is representative of access to jobs for people based in the planned Westgate Metropolitan Centre, while the Westgate Station zone is more representative of access to jobs for people from greenfield growth areas such as Whenuapai and Kumeu. Both zones see a significant improvement in accessibility with the implementation of a rapid transit corridor from Westgate to the city centre, but the increase in job accessibility is greater for access from greenfield areas (the Westgate Station zone).

The spatial aspect of job accessibility is also shown in the isochrones maps in Figure 5.6 to Figure 5.9, which illustrate travel time from the Westgate Station zone to other ART model zone centroids in five-minute bands. These maps show that the Continuous Bus lanes option extends the reach of a 45-minute public transport journey to the western parts of the city centre, the Busway via Great North Road extends access to the universities and hospital, and the Busway via SH16 speeds up access to the city centre.

Do Minimum

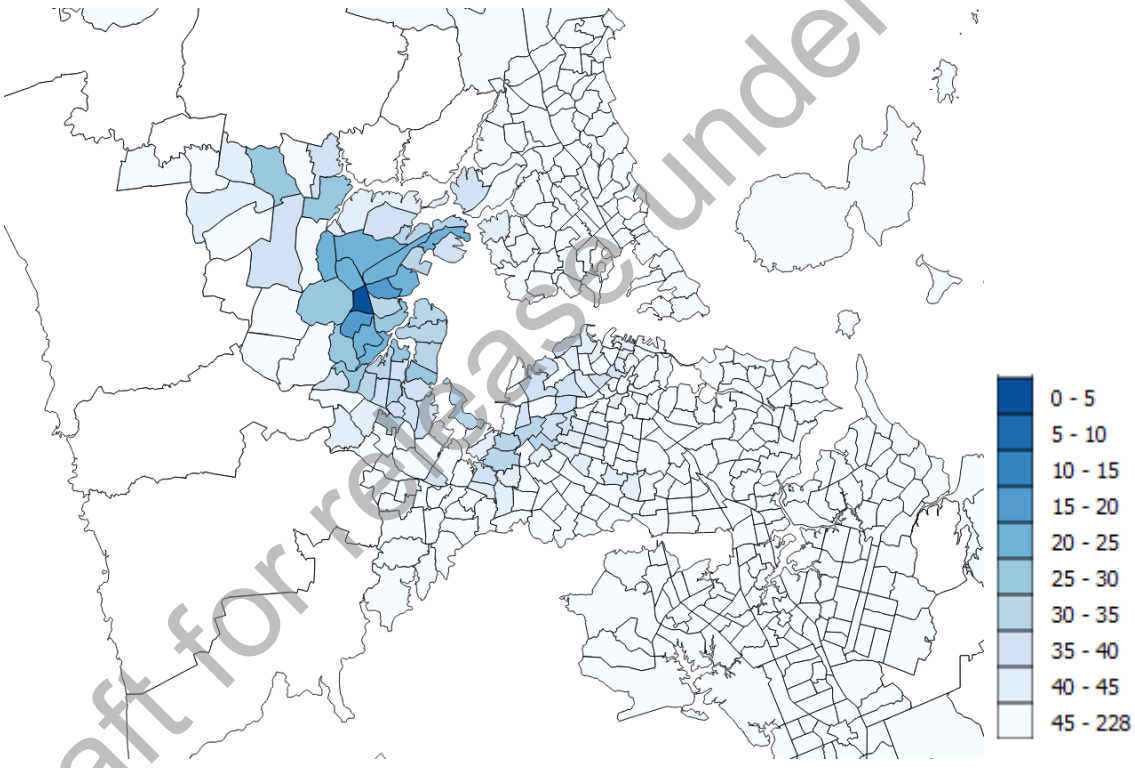


Figure 5.6 - Investment Objective 1: KPI 1: Travel time from Westgate Station for the Do Minimum scenario (ART model, 2046).

All options tested performed better than the Do-Minimum. Of note are the following observations:

- Generally, the penetration of the 45 minute travel time into key employment areas is a factor of journey time. As a result, both LRT and Busway on SH16 was better than using Great North Road.
- Using SH16 created an ability to bring the northern edges of the city centre, including Downtown and the Queen Street valley, the eastern edge of the city centre including Quay Park and the

universities as well as Newmarket further within the 45 minute travel time. While geographically small, these areas are contain the highest employment and educational densities in the region.

Continuous bus lanes

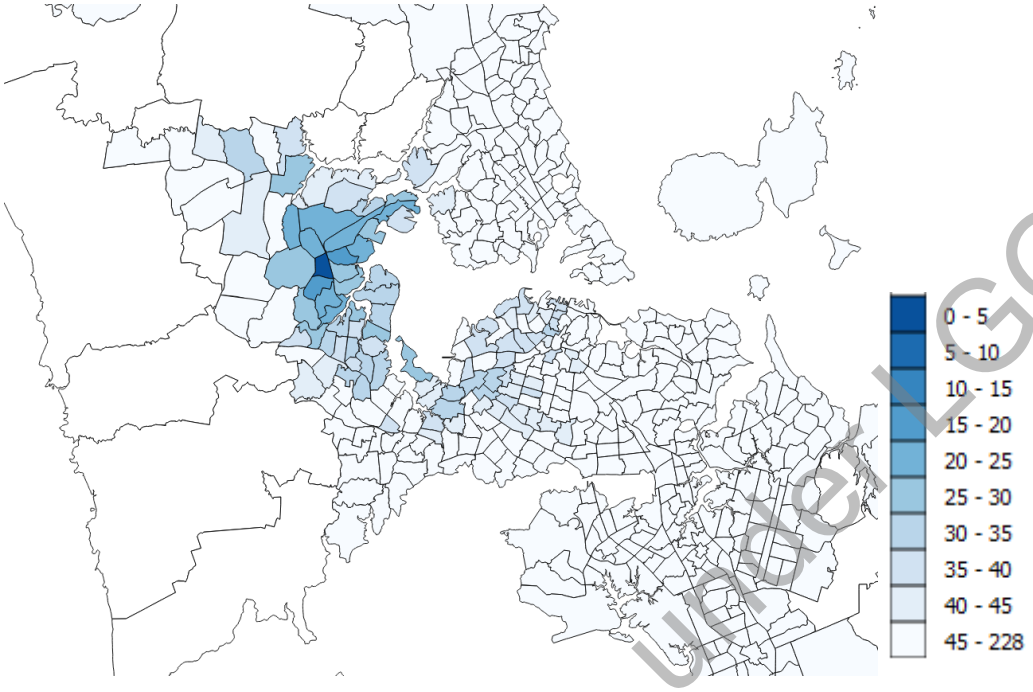


Figure 5.7 - Investment Objective 1: KPI 1: Travel time from Westgate Station for the Continuous bus lanes scenario (ART model, 2046).

Busway via Great North Road

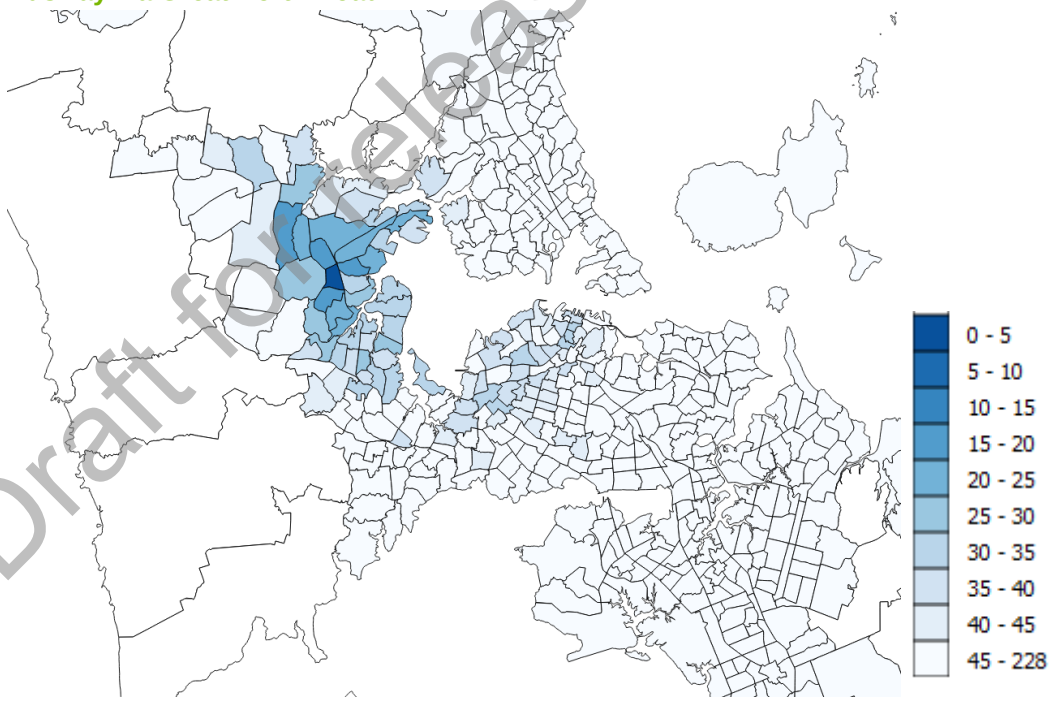


Figure 5.8 - Investment Objective 1: KPI 1: Travel time from Westgate Station for the Busway via Great North Road scenario (ART model, 2046).

Busway via SH16

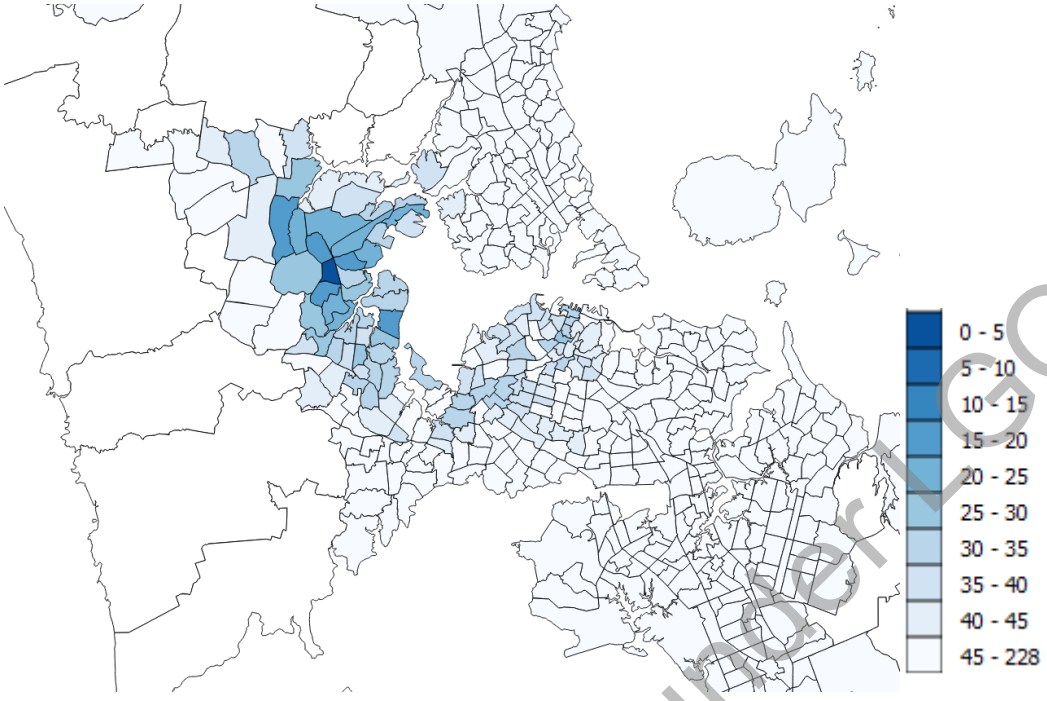


Figure 5.9 - Investment Objective 1: KPI 1: Travel time from Westgate Station for the Busway via SH16 scenario (ART model, 2046).

KPI 2: Catchment accessible from the north-west by car, public transport and active modes

This measure assesses the size of catchment accessible ***to*** the north-west by car (30 minutes), public transport (45 minutes) and active mode (30 minutes). This is a consideration recognising that the north-west is a key growth area and the desire outlined in Section 2.4 to improve the balance between employment and residential numbers in the north-west which is currently significantly lower than the rest of the region.

Access to the north-west was assessed as access to the Westgate Station model zone. The population accessible by public transport and car was determined from the ART model outputs, with the I9 land-use scenario for 2046. Walking and cycling access was estimated using GIS analysis of travel times along available walking and cycling links, with population from the I9 land-use scenario.

The number of people with access to Westgate by foot, bicycle or private vehicle remains effectively constant across the different shortlist options, as shown in Figure 5.10. In contrast, the number of people with access to Westgate by public transport increases substantially with the implementation of a rapid transit corridor, particularly with the full busway and light rail options.

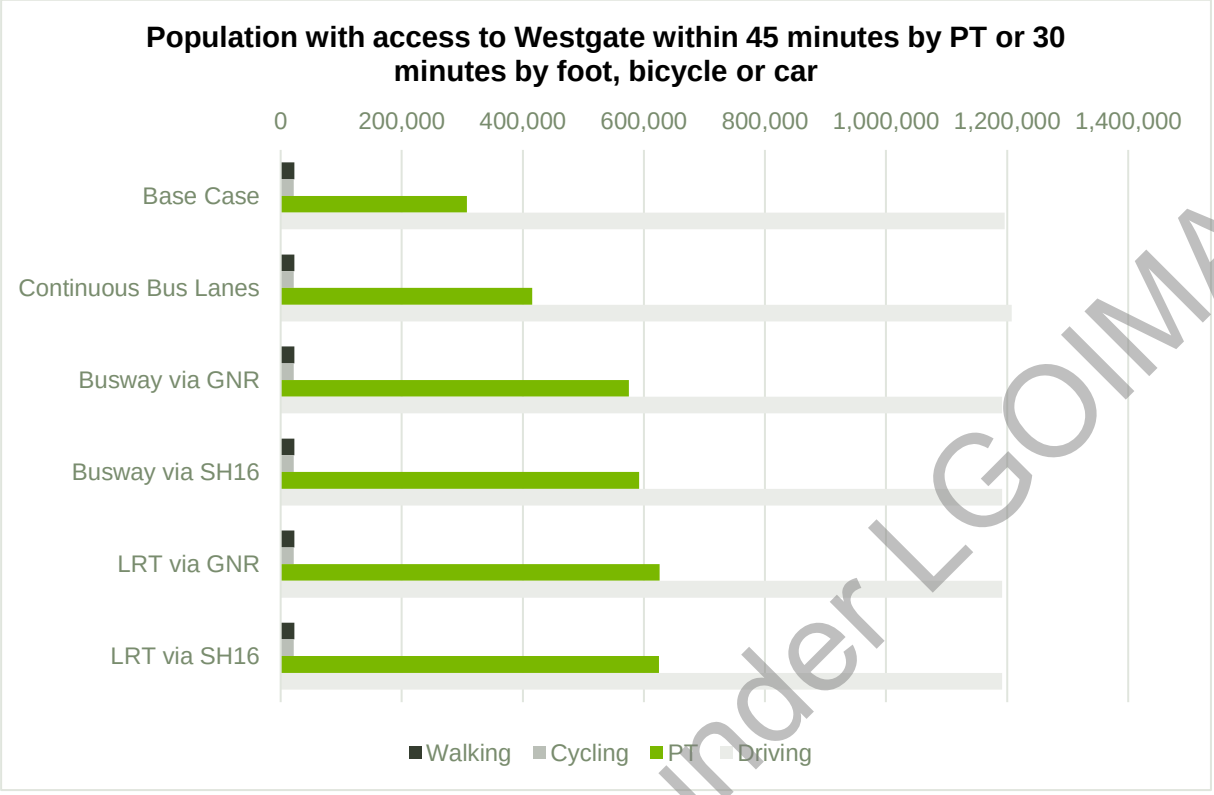


Figure 5.10 - Investment Objective 1: KPI 2: Population with access to Westgate within 45 minutes by public transport or 30 minutes by foot, bicycle or private vehicle (ART model, 2046).

KPI 3: Corridor throughput

This measure assesses corridor throughput, i.e. the number of buses, cars and trucks multiplied by the average occupancy.

Figure 5.11 shows the total service delivery of the north-west to city centre corridor. The capacity of each segment of the motorway corridor from Westgate to the city centre and Great North Road from Point Chevalier to Karangahape Road is derived from SATURN model outputs for 2031. The capacity of public transport modes is constrained by the city centre and thus is shown to be constant across the length of the corridor; the corridor itself can carry significantly more buses than can be accommodated at stops and terminals in the city centre.

Adding together the capacity of the road and public transport networks, the people-carrying capacity of the SH16 corridor in the Do Minimum is about 10,000 people per hour from Westgate to Te Atatu, growing to 12,400 people per hour between Te Atatu and Waterview, and up to 14,500 people per hour into the city centre including both the SH16 and Great North Road corridors.

The “ART total throughput” line suggests that base case corridor capacity (private vehicle + bus) is sufficient to cater for projected throughput in all segments except Waterview to St Lukes; however, the projected mode split shows a greater proportion of passengers travelling by public transport than is available. There is little opportunity to expand road capacity beyond what is currently being constructed.

The people-carrying capacity of the whole corridor can be expanded by 3,000–4,000 people per hour by adding a higher-capacity public transport mode (busway or LRT) and assuming minor upgrades to on-street stop capacity are possible in the city centre. This assumes the north-west bus services would use the entire capacity of the planned triple-bay bus stops on Albert Street, while the other services on

Albert Street (Great North Road, Richmond Road and Freemans Bay) would be accommodated in a new set of double-bay bus stops.

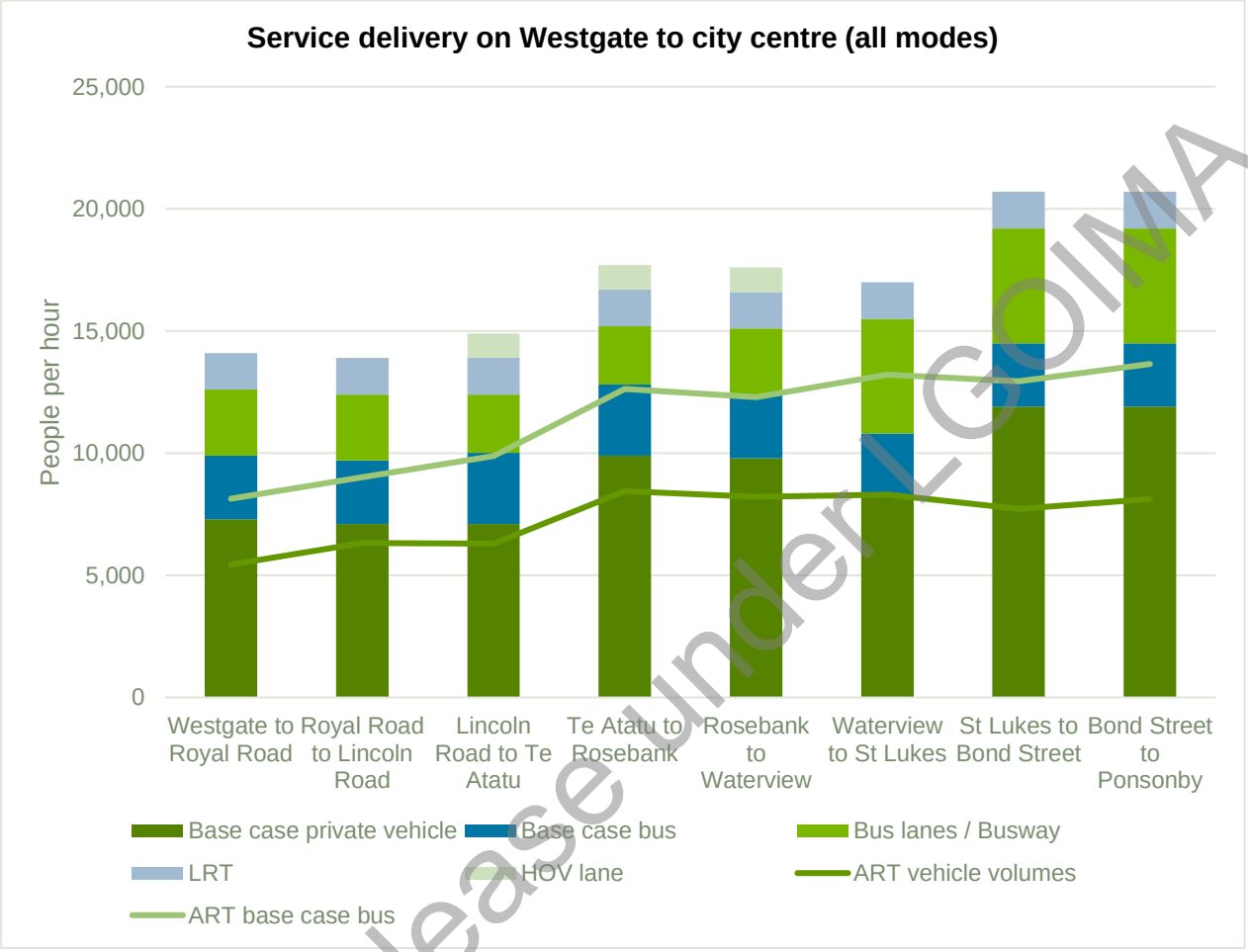


Figure 5.11 - Investment Objective 1: KPI 3: Service delivery and ART model demand for all modes along the north-west rapid transit corridor (2046).

Figure 5.12 shows the service delivery and ART model demand just of public transport. To provide a likely range of public transport passenger throughput, the forecast model demands for 2046 are shown for both the Do Minimum (lower demand) and Busway via SH16 (higher demand) options. Provision of a better public transport option increases the attractiveness of the service and increases patronage.

This figure shows the capacity along the potential rapid transit corridor. From Westgate to Waterview this is the capacity of bus lanes or busway along the SH16 Northwestern Motorway corridor. From Waterview onwards, the capacity shown is the combination of bus lanes or busway on the motorway corridor together with the capacity of the bus lanes on the parallel Great North Road corridor. The substantial jump in public transport capacity at Waterview reflects the fact that two major transit corridors run in parallel between there and the city centre. Likewise, the corresponding jump in PT demand reflects the fact that the Northwestern and Great North Road public transport routes converge at Waterview/Point Chevalier, and likewise run in parallel between there and the city.

The busway option is sufficient to cater for the forecast 2046 transport demands with headroom for about 5% further patronage growth on the SH16 causeway. The main constraint on busway capacity is the city centre, which was outside the scope of this study, so it may be possible to achieve a

significantly higher throughput using a busway solution if a greater number of buses could be accommodated in the city centre than is currently proposed. LRT provides a throughput greater than required, although this provides room for growth beyond forecast.

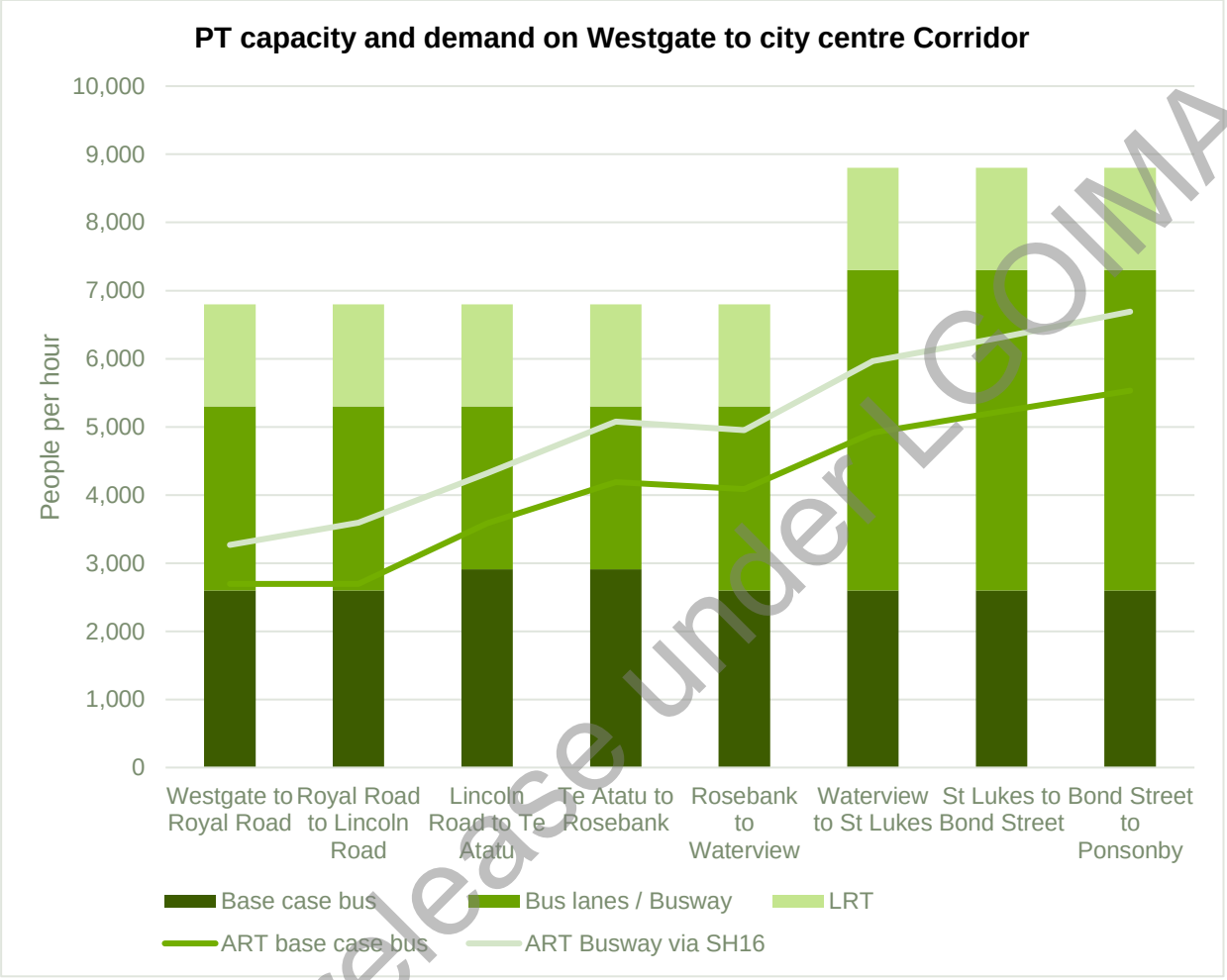


Figure 5.12 - Investment Objective 1: KPI 3: Service delivery capacity and ART model demand for public transport along the north-west rapid transit corridor (2046).

5.3.2 Investment Objective 2: Make public transport a realistic option for the majority of journeys to and from the north-west

This investment objective relates to Benefit 2: "Expanded transport choices for the north west." Three measures were used to assess the shortlist options against this investment objective: increased public transport mode share, faster and more reliable journey times, and the walking catchment of the north-west rapid transit network.

KPI 1: Public transport mode share along the north-west corridor

This measure assesses the growth public transport mode share along the north-west corridor that each option enables, i.e., the percentage shares of people throughput by mode.

Figure 5.13 shows public transport mode share determined from ART model public transport and private vehicle demands on the SH16 and Great North Road corridors. The 2046 mode share is not

predicted to increase significantly with the implementation of continuous bus lanes or a fully grade-separated busway.

Note, however, that the Do Minimum scenario predicts a doubling of public transport mode share from 2013 to 2046, which is not likely to be achievable without some form of investment in upgraded public transport infrastructure along the corridor. It is therefore likely that the base case mode share predicted by the ART model is an overestimate, and that the investment options would result in a greater increase in mode share than predicted.

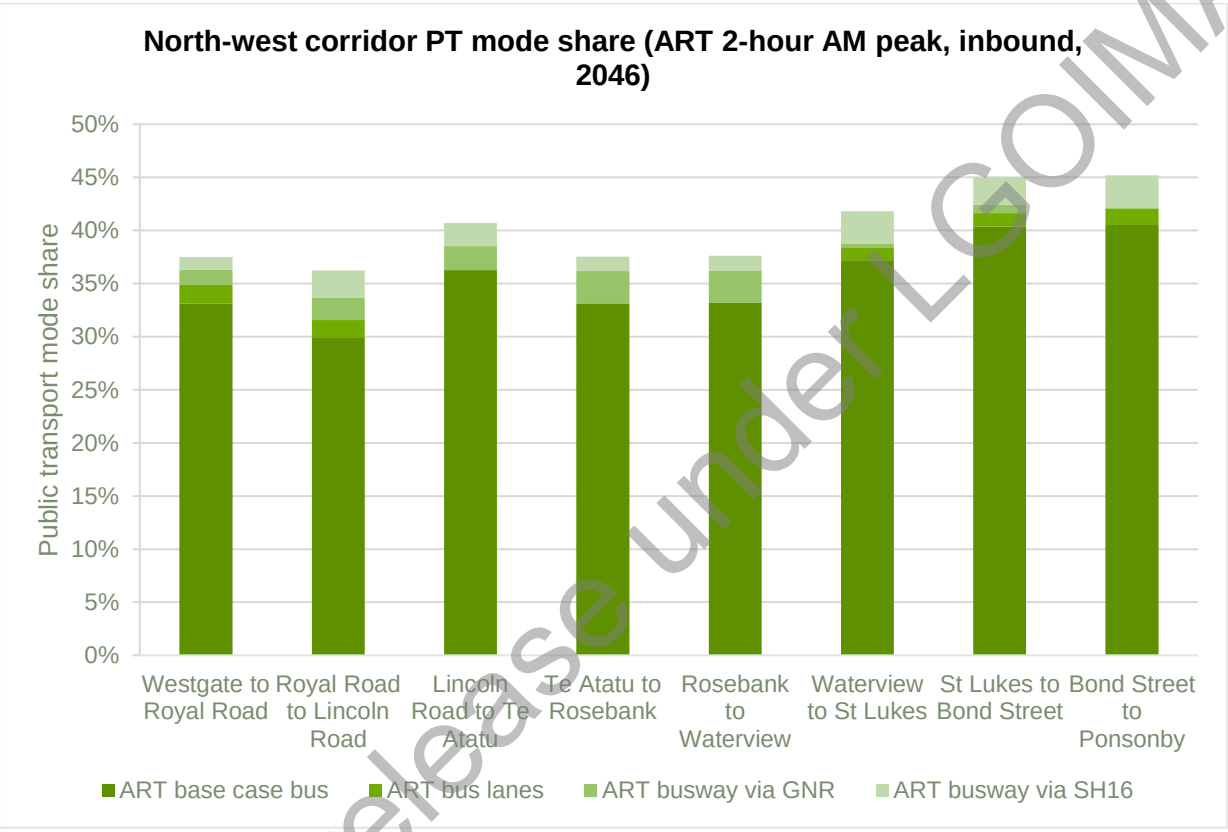


Figure 5.13 - Investment Objective 2: KPI 1: Public transport mode share from ART model outputs (AM peak inbound, 2046).

In order to get an indication of the growth in public transport mode share from investing in an RTN solution for the north-west, APT model demand across the SH16 causeway can also be compared to demand on the Western rail line, as shown in Figure 5.14.

The busway and continuous bus lanes options are predicted to increase patronage on the north-west corridor, while causing a smaller decrease in patronage on the western rail line. Thus, total modelled peak-hour demand for travel by public transport from the west and north-west to the city centre increases from 12,900 for the Do Minimum scenario to 14,000 with the Busway via SH16, in 2046

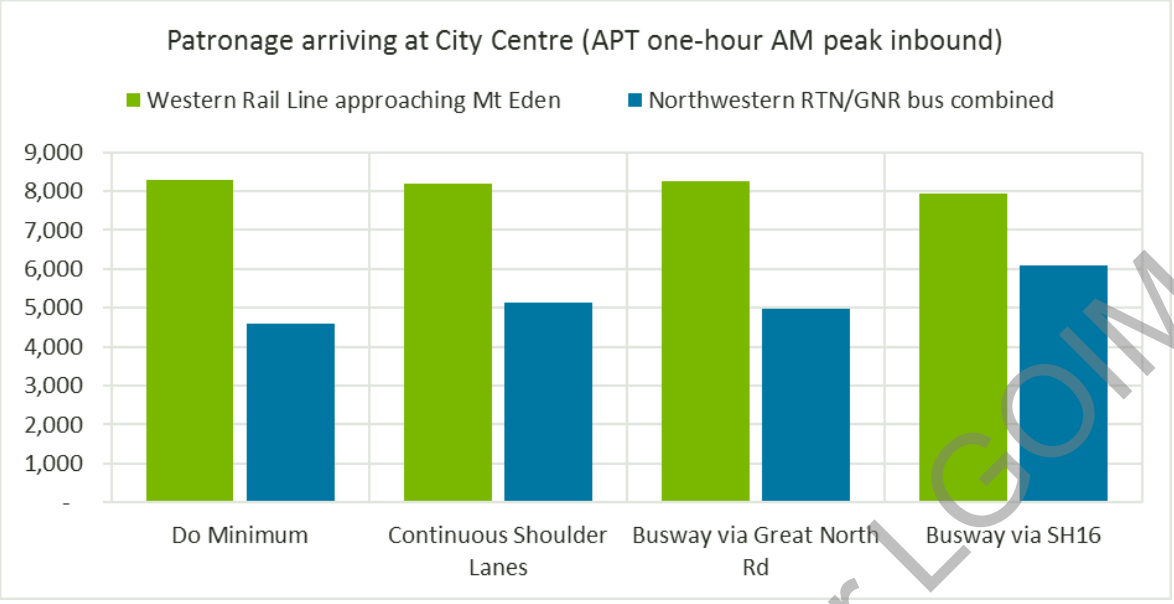


Figure 5.14 – Investment Objective 2: KPI 1: Public transport demand on north-west buses and Western rail line (APT model, one-hour AM peak inbound, 2046).

KPI 2: Travel time and reliability

This measure assesses each option for its ability to deliver faster, more reliable journey times. It encompasses both travel time and travel time reliability (measured as the coefficient of variation of travel time divided by average travel time).

Travel times between Westgate station and Britomart were estimated for each option, as shown in Figure 5.15. The travel time from Albany busway station to Britomart is included for comparison. Continuous shoulder lanes are predicted to save 5 minutes of travel time compared to the Do Minimum, with a full busway or light rail solution saving an additional 5 to 16 minutes. Light rail is two minutes faster than a busway, while an alignment via SH16 east of Waterview is nearly 10 minutes faster than an alignment via Great North Road.

The two busway options with shoulder lanes on the SH16 causeway are assumed to be one to two minutes slower than the complete busway options.

Figure 5.15 includes the journey from Albany to the city centre using the Northern Busway which is a similar distance to the journey from Westgate to the city centre as a benchmark that represents a successful model for customers in an Auckland context. Only the SH16 options for both LRT and Busway meet or better the Albany – city centre journey time. Notably, the option with a busway on SH16 and west of Te Atatu, but with bus shoulder lanes on the causeway bettered the Albany – city centre benchmark. Great North Road options for LRT and Busway as well as Continuous Bus Lanes are likely to generate longer travel times than this benchmark.

This measure is considered key to supporting the strategic growth areas. Peripheral urban growth can impose significant journey times on people with the associated economic and social costs. Options that can generate short travel times to major areas of employment are likely to support strategic growth best.

Demand modelling of the Western Rail Line indicates that in future decades parts of this line could have peak passenger demands close to, or in excess of, the future capacity of this line. For example, these data show demands approaching Mt Eden station of over 8,000 people per hour in 2046, equivalent to eleven six-carriage trains per hour at maximum occupancy.

As a result, rapid transit options for the north-west corridor that attract some demand away from the Western Rail Line could indeed be beneficial for rail efficiency by easing passenger loadings on a very busy and potentially overcapacity line.

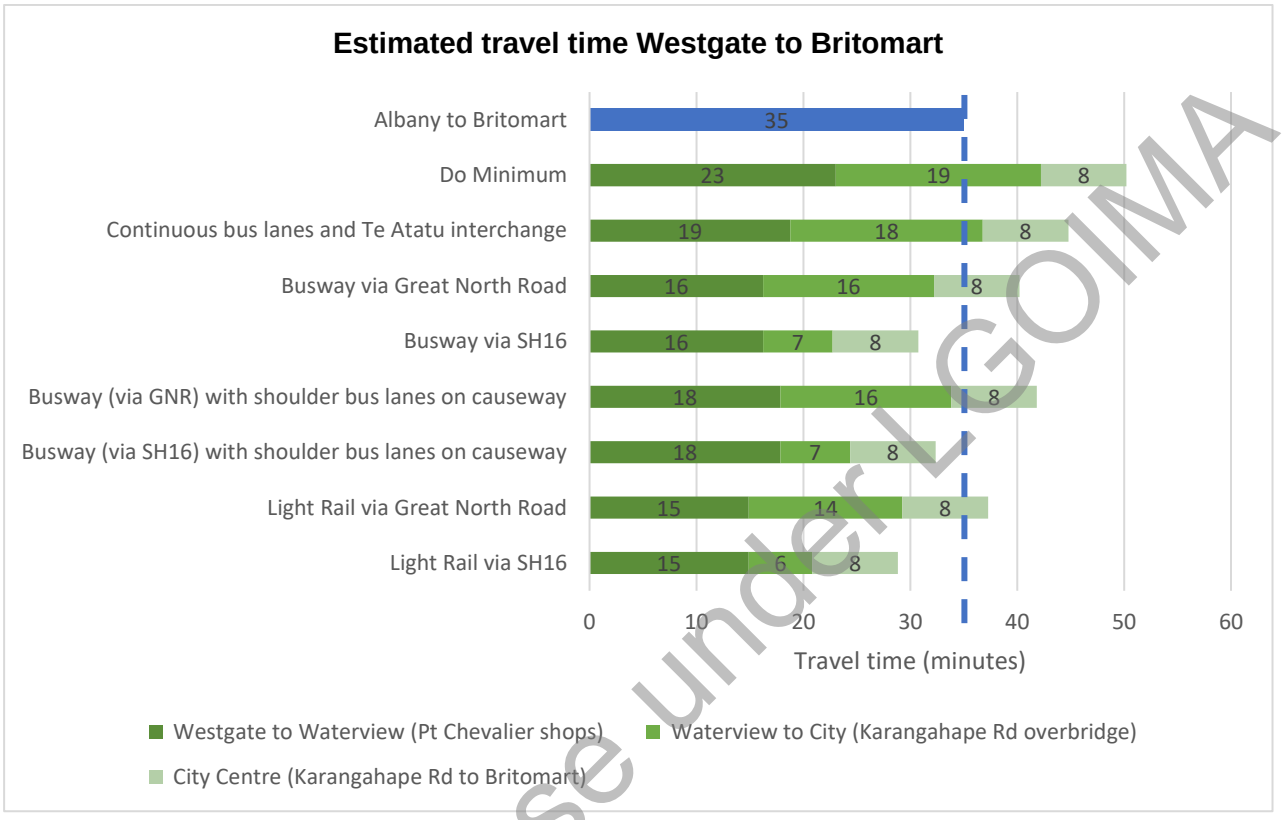


Figure 5.15 – Investment Objective 2: KPI 2: Estimated travel time from Westgate to Britomart, AM peak.

Travel time reliability is expected to improve alongside average travel time. Table 5.1 summarises the reliability gains offered by each option.

Table 5.1 - Qualitative assessment of travel time reliability for shortlist options. (Investment Objective 2: KPI 2)

Option	Reliability assessment
Do Minimum	**Poor**. Susceptible to delays caused by merging into general traffic congestion at motorway on- and off-ramps, exposure to slow travel speeds in general traffic lanes adjacent to motorway shoulder lanes, and sections of arterial road and intersections without bus lanes.
Continuous shoulder bus lanes and Te Atatu interchange	**Adequate**. Small improvements with motorway shoulder lanes being extended around on- and off-ramps, and on-road bus lanes being extended through intersections.
Busway via Great North Road	**Good**. Improved reliability provided by grade-separated busway on SH16 motorway corridor and segregated median busway along Great North Road with partial signal pre-emption at intersections.

Busway via SH16	**Very good**. High level of reliability provided by fully grade-separated busway alongside SH16 motorway corridor from Westgate to Newton Road.
LRT via Great North Road	**Very good**. High level of reliability provided by grade-separated light rail along SH16 motorway corridor and segregated median light rail along Great North Road with full signal priority at intersections. More reliable than busway as lower service frequency reduces likelihood of vehicles bunching at intersections or stations.
LRT via SH16	**Very good**. High level of reliability provided by fully grade-separated light rail alongside SH16 motorway corridor from Westgate to Newton Road. More reliable than busway as lower service frequency reduces likelihood of vehicles bunching at intersections or stations.

KPI 3: Catchment within a frequent transport network

This measure assesses the number of people living within the walkable catchment of a north-west frequent transport network, specifically the population living within 500 metres of a frequent network bus stop and one kilometre of a rail or bus rapid transit station.

Figure 5.16 summarises the total population accessible for each option based on the illustrated walking catchments. The continuous shoulder lanes option exhibits a decrease in walking catchment relative to the Do Minimum (from 23,400 residents to 21,000), while this option adds a rapid transit station at Te Atatu, it assumes a limited-stops service for north-west buses along Great North Road without upgrading the infrastructure on the corridor to the standard of a rapid transit corridor.

The Great North Road busway/light rail alignment is shown to have the greatest walking catchment from the rapid transit stops (56,400 residents). This is because it replaces bus services on Great North Road with rapid transit in the street corridor, including upgrading numerous stops along the way to rapid transit standard.

However, we note that the SH16 busway/light rail alignment options retain bus service along Great North Road, which would continue to operate as an intensive high frequency bus route using the existing bus lanes. The SH16 option supplements the existing bus stops along Great North Road with the addition of three new rapid transit stations at Point Chevalier, Western Springs and Arch Hill respectively. Thus, while the SH16 options are shown to have a smaller *rapid transit* walking catchment (40,000 residents) than the Great North Road options, this would be in addition to, rather than instead of, the existing frequent service catchment.

Therefore, the total number of people in the Auckland region within walking distance of a rapid transit station or frequent bus stop would increase more if rapid transit was added on the SH16 alignment.

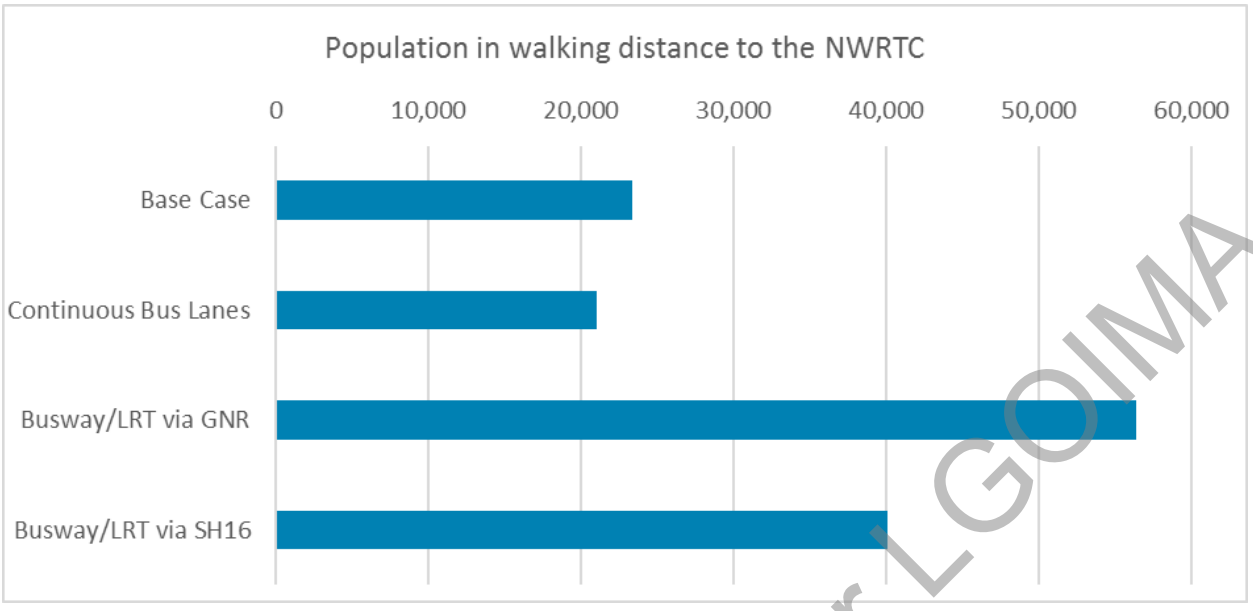


Figure 5.16 – Investment Objective 2: KPI 3: Population along the north-west rapid transit corridor within a 1-kilometre walk of a rapid transit station or a 500-metre walk to a frequent bus stop (2046 I9 land-use scenario).

5.3.3 Investment Objective 3: Increase the efficiency of public transport to and from the north-west

This investment objective relates to Benefit 3: "More affordable access and improved value for money." Two measures were used to assess the shortlist options against this investment objective: operating cost, and capacity in the city centre.

KPI 1: Value for money: Operating cost

This measure assesses value for money provided by each option. The MCA measure refers to value for money as "cost per passenger-km: proportion of operating costs covered by fares for public transport services operating in north-west corridor." However, the differences between the operating costs of each option are much greater than the modelled differences in patronage, so differences in the value for money for each option will be driven by operating cost, not passenger-km.

Two detailed network plans for the north-west were provided by Auckland Transport Metro for the purpose of estimating network operating costs for the base case and shortlist options:

a) A base case, assuming only bus shoulder lanes on SH16 and direct service from the north-west suburbs to the city (i.e. no interchange at Te Atatu, or anywhere else between Westgate and Point Chevalier), with bus lanes on Great North Road to the city centre.

b) A busway case, assuming a full busway and interchanges between Westgate and Point Chevalier (at Te Atatu), and bus lanes from Point Chevalier to the city centre.

Summary of shortlist annual operating costs

Table 5.2 presents the estimated operating cost per annum for each of the shortlist options. The continuous shoulder lanes option saves over $4 million per annum by adding a Te Atatu interchange station, which allows direct service from north-west suburbs to be replaced by a trunk-and-feeder operating model. Additional savings of $6–$7 million are provided by implementing a full busway option, due to further network efficiencies enabled by additional north-west stations, and fleet savings

due to improved travel times. The LRT options cost about $5 million less to operate per annum than the busway options primarily due to reduced vehicle requirements and related driver cost savings.

Table 5.2 - Annual operating cost of north-west public transport services for each option.

Option	Description	Local/ feeder buses ($millions)	Direct service buses ($millions)	Northwest trunk WEX buses ($millions)	Northwest LRT* ($millions)	Total
Do Minimum	Base Case.	$33.0	$15.3	$11.0	-	**$59,300,000**
Continuous Shoulder Lanes with Te Atatu interchange	Base Case, no direct service buses at Te Atatu, increased WEX.	$33.0	-	$21.9	-	**$54,900,000**
Busway via Great North Road†	Busway Case.	$27.3	-	$21.9	-	**$49,200,000**
Busway via SH16	Busway Case, with faster WEX via full busway.	$27.3	-	$20.7	-	**$48,000,000**
Light Rail via Great North Road†	Busway Case, no WEX bus, LRT via GNR.	$27.3	-	-	$17.4	**$44,700,000**
Light Rail via SH16	Busway Case, no WEX bus, LRT via SH16.	$27.3	-	-	$15.6	**$42,900,000**

**LRT operating cost includes network maintenance cost ($3.74 million for LRT via SH16 and $3.8 million for LRT via Great North Road).*

†The busway and light rail options via Great North Road do not include any changes to the cost of running the New Lynn to city via Great North Road bus services, as no changes to the isthmus bus network are included. In practice, these buses would be relocated off Great North Road, and while much of this service delivery would still be operated on parallel corridors there could be net savings overall.

KPI 2: Capacity in city centre

This measure assesses city centre terminal and stop capacity, i.e., the number of on-street bus stops in the city centre operating within their practical capacity.

While the city centre is outside the scope of the NWRTC IBC, the following assumptions were used for the city centre capacity.

- For the Do Minimum scenario, a maximum of 40 buses per hour can be accommodated on the northwest rapid transit corridor. The near-term infrastructure configuration on the Albert Street corridor in the city centre provides one set of triple-bay stops (maximum 53 buses per hour, if operated in conjunction with all-door boarding where necessary and careful departure scheduling), of which ~13 buses per hour needs to be allocated to local Great North Road and Richmond Road buses. These numbers could vary greatly depending upon the final configuration of the Albert Street corridor, the Britomart West bus terminal, and the configuration of the bus routes intended to run on Albert Street.
- For the continuous bus lanes and busway scenarios, it is assumed city centre bus infrastructure and operations could be reconfigured to provide a full three-bay stop on the Albert Street corridor for the north-west busway alone. This would have an estimated maximum capacity of 53 buses per hour per direction. An additional two-bay stop would be required by 2046 on Albert Street or another city centre corridor to accommodate the Great North Road and Richmond Road bus services that are currently planned to use Albert Street.
- For the light rail scenarios, a maximum frequency of 15 vehicles per hour per direction is possible where light rail runs on street (including on Albert Street), assuming the vehicles are required to terminate at a standard footprint two-track LRT stop. Frequencies up to 24 vehicles per hour per direction could be possible if LRT runs on a dedicated, light rail-only right-of-way, including converting Albert Street to light rail-only operation or developing an alternative LRT corridor in the city centre.

If these assumptions were to change, the impact of each option on city centre stop capacity would also change.

Table 5.3 documents the vehicle volumes required to be accommodated for each option. All shortlist options except the Do Minimum provide at least one station along the north-west corridor, which enables a more efficient public transport network design in the north-west with fewer low-occupancy vehicles travelling into the city centre. However, these gains in efficiency may be offset by a higher-quality service attracting more patronage and the need to accommodate other bus services on Albert Street in the city centre. Designs for improving the city centre capacity issues are outside the scope of this project.

Table 5.3 - City centre stop capacity requirements.

Option	Vehicle volumes in the city centre
Do Minimum	Estimated **70 buses per hour** required on Albert Street in 2046 (including north-west, Great North Road, and Richmond Road services). Inefficient service pattern with lower occupancy from NW.
Continuous shoulder bus lanes and Te Atatu interchange	**58 buses per hour** on Albert Street – reduced service frequency due to Te Atatu Station enabling trunk-and-feeder service model with higher occupancies approaching city centre.
Busway via Great North Road	**56 buses per hour** on Albert Street – reduced service frequency due to Te Atatu Station enabling trunk-and-feeder service model with higher occupancies approaching city centre, and WEX serving Great North Road catchment from Point Chevalier to City.
Busway via SH16	**69 buses per hour** on Albert Street – higher demand due to better service.
LRT via Great North Road	**12 LRVs per hour plus 12 buses** (shared corridor on Albert Street or buses to be accommodated elsewhere in city centre).
LRT via SH16	**11 LRVs per hour plus 24 buses** (shared corridor on Albert Street or buses to be accommodated elsewhere in city centre).

5.4 Planning, environmental and land requirement assessment

5.4.1 Introduction

This section provides a preliminary planning, environmental and land requirement risks/opportunities assessment for the short-listed options:

- Option A - Do Minimum
- Option B- Continuous bus lanes and Te Atatu interchange (via Great North Road)
- Option C - Busway (via Great North Road)
- Option D - Busway (via SH16)
- Option E - Light rail (via Great North Road)
- Option F - Light rail (via SH16)
- Option G - Busway (via Great North Road) with shoulder bus lanes on SH16 causeway
- Option H - Busway (via SH16) with shoulder bus lanes on SH16 causeway

It covers two elements:

- Environmental and Planning Assessment
  - Environmental effects (noise, water, air, urban design) - degree to which these can be mitigated
  - Likely consent requirements and consenting risks
- Land requirements

- Number of properties required for purchase and number of commercial properties impacted.

5.4.2 Do Minimum

This option uses the existing motorway corridor and no new infrastructure is proposed, there would be no planning approval requirements.

5.4.3 Continuous bus lanes and Te Atatu Interchange

Bus Lane Upgrade

This option upgrades the existing SH16 bus shoulders to provide for dedicated bus lanes within the existing motorway corridor. The upgrades are anticipated to be largely contained within the existing Transport Agency motorway designations for SH16 and SH1, with the exception of the Rosebank and Patiki ramp (this is described in the next section).

As the works are limited to upgrading the existing bus shoulders and widening works at interchanges to accommodate additional bus lanes on the on and off-ramps, the additional construction footprint would be limited to existing interchange areas. On this basis the environmental impacts are anticipated to be localised and can be achieved by submitting an Outline Plan of Works (OPW) within the existing motorway designation.

Rosebank and Patiki Ramps

The only exception to the above is at the Rosebank and Patiki ramps, currently located in the Coastal Marine Area (CMA). The CMA at this location is identified as a Significant Environmental Area (SEA) (Marine).

In the case where additional bus ramps require reclamation and structures in the CMA, this would be considered a Non-Complying Activities under the Auckland Unitary Plan. A resource consent application for a Non-Complying Activity is subject to onerous statutory tests and carries a high risk of public notification.

Bus interchange at Te Atatu

A pre-feasibility study undertaken by Aurecon (June 2016) investigated four options for a bus interchange in the vicinity of the Te Atatu motorway interchange with SH16. The recommended option was a bus station at McCormick Green. The exact location and property impact will be further investigated during the next project phase.

5.4.4 Busway and light rail

The busway and light rail options have the same alignment. Options involve either a bridge structure over the causeway or the use of existing bus shoulder lanes. All light rail options involve a bridge structure over the causeway. There are two alignment options between Point Chevalier and the city centre, one along Great North Road and the other along SH16.

The assessment section has therefore been split into the following sections:

- Westgate to Te Atatu
- Te Atatu to Point Chevalier
- Point Chevalier and Karangahape Road (Central City) via Great North Road
- Point Chevalier and Karangahape Road (Central City) via SH16

An Alignment Plan for the routes along Great North Road and adjacent SH16 are in Figure 5.17 - Environmental and Planning Risk and Opportunities Overview Map below. This figure also show the general wider environment and should be referred to when reading the following subsections.

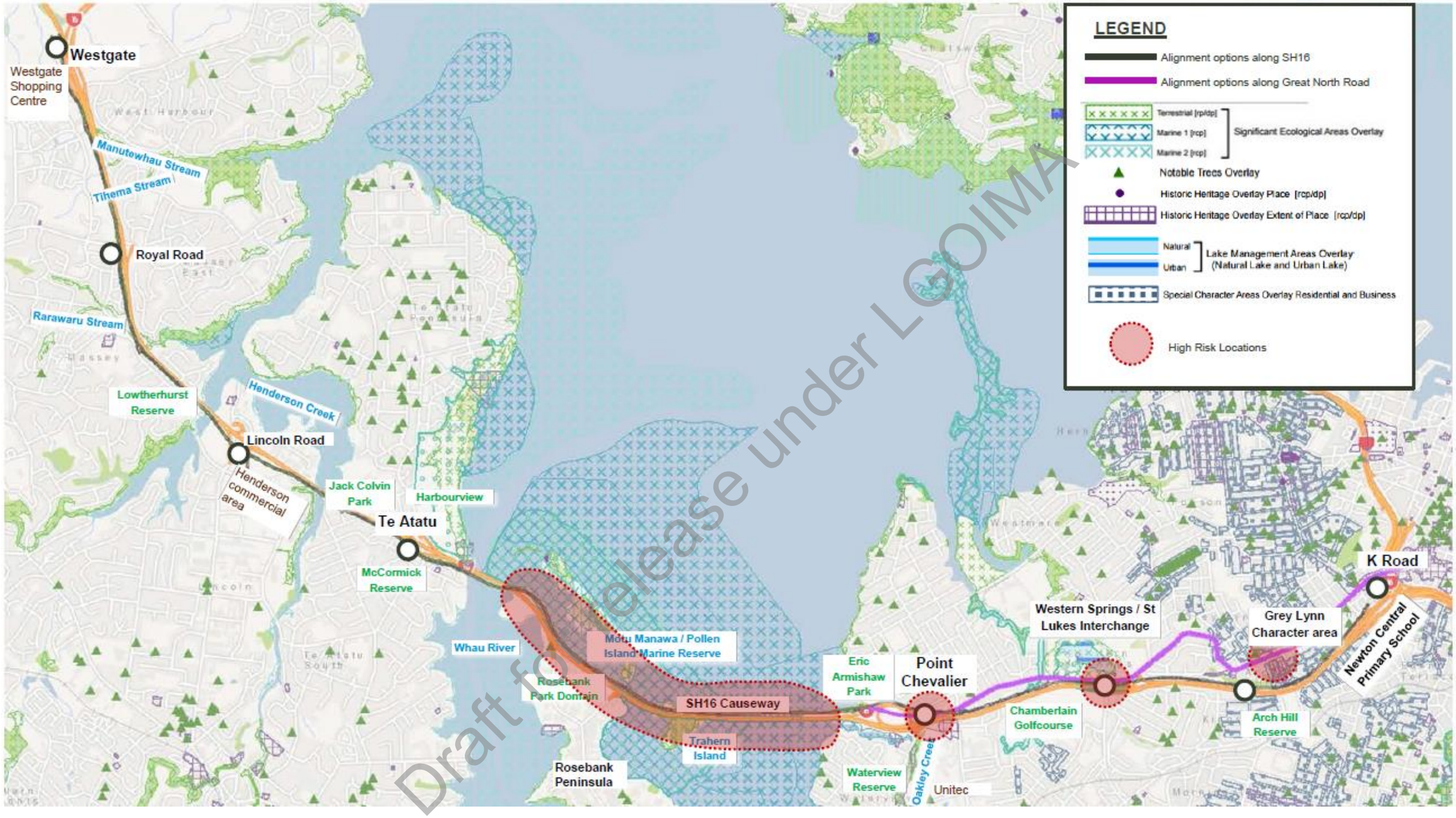


Figure 5.17 - Environmental and Planning Risk and Opportunities Overview Map

Westgate to Whau River (Busway and LRT options)

The transport corridor impacts a number of designations administered by other requiring authorities. These are listed below:

Table 5.4 - Requiring authorities Westgate to Whau River

Location	Designation	Requiring Authority
1 Maki Street, Westgate	Westgate Substation	Vector Ltd
112 Royal Road, Massey	Royal Road Primary School	Ministry of Education, Royal Road School Board of Trustees
326-330 Lincoln Road, Henderson	Telecommunication and radio communication transmission facilities	Radio New Zealand Ltd
Flanshaw Road, Te Atatu	Wastewater pump station	Watercare Services Ltd
Royal View Road, Te Atatu	Substation	Vector Ltd

A section 176 approval would potentially be required from each of the requiring authorities where an option crossed a designation. It is anticipated that constructing a permanent busway within these designations will require negotiations with the various requiring authorities. The availability of land to relocate these designated activities poses a key risk to these negotiations. This is considered a high stakeholder buy-in risk.

Existing Community – Westgate, Royal Heights and Te Atatu

The alignment would potentially require the demolition of 10 residential dwellings adjacent to the southern boundary of SH16 between Royal Road and Te Atatu Interchange. The identified bus interchange at Te Atatu would also permanently require McCormick Park. These works pose a potential negative social impact resulting from the loss of homes and public open space.

Loss of Commercial Activity

The alignment would potentially impact approximately 10 commercial properties. These works may pose a negative economic and social impact if it results in loss of commercial activity in the local communities.

Stream Environment

A high level ecological assessment has been undertaken for the alignments. The assessment identifies areas of sensitive freshwater environment including:

- Manutewhau and Tihema Streams
- Rarawaru Stream and riparian vegetation
- Henderson Creek.

These streams are identified as SEAs under the Unitary Plan. It is anticipated a bridge crossing Henderson Creek will be considered a Non-Complying Activity under the Unitary Plan as its length is over 30m, while crossings over other streams are anticipated to be a Discretionary Activity. A new bridge over Whau River would be considered a Non-Complying activity under the Unitary Plan as it is longer than 30m. A planning application for a Non-Complying Activity is subject to onerous statutory tests and likely to be publicly notified.

The ecological assessment evaluates this sector to be of moderate ecological value, and concludes that adverse effects on the streams and estuaries can be reduced by use of bridges that span the waterways, with abutments set back as far as possible.

Stormwater Treatment

To the east of Huruhuru Road, the alignment dissects an existing wetland utilised by the Transport Agency's treatment of stormwater from SH16. The alignment would need to meet the SH16 consented stormwater treatment, as well as account for additional run-off resulting from the new transport corridor. As there is no space within the existing designation to find an alternative location for stormwater treatment, additional property may need to be acquired to meet stormwater treatment criteria. These works would require early engagement with the Auckland Council Stormwater Team and Iwi to achieve buy-in from these key stakeholders on the best practical option.

Whau River

The eastern estuarine margin of the Whau River is identified as an SEA (Marine) under the Unitary Plan. Construction of the new bridge over the Whau River would be considered a Non-Complying Activity under the Unitary Plan due to its length being over 30m[1]. A resource consent application for a Non-Complying Activity is subject to onerous statutory tests and carries a high risk of public notification.

The ecological assessment evaluates this sector to be of high ecological value, and concludes that there will be some permanent loss of habitat as a result of a new structure. Adverse effects on the streams and estuaries can be reduced by minimising the number of piers, and setting back bridge abutments as far from the water as possible. Further mitigation measures will require a more detailed assessment.

SH16 causeway Section (Busway and LRT options with structure over the causeway)

The CMA across the SH16 causeway section is identified as a SEA (Marine) providing high ecological habitat for many threatened species. Traherne Island and Motu Manawa-Pollen Island Marine Reserve are important ecological areas adjacent the causeway.

The existing causeway between Rosebank Peninsula and the Waterview Interchange would need to be enlarged to accommodate the additional transport corridor. There are two options to widen the causeway: through reclamation to form a new embankment or a bridged structure. On the basis that reclamation will cause more adverse environmental effects in comparison to a bridge structure, a bridge structure has been presumed for this assessment.

New structures within the CMA and SEA (Marine) would be considered Non-Complying under the Unitary Plan[2]. A resource consent application for a Non-Complying Activity is subject to onerous statutory tests and carries a high risk of public notification.

Support would unlikely be gained from iwi on the option requiring widening or additional structures in across the causeway[3].

Key environmental impacts in this area relate to the CMA as a receiving environment, and particularly the impact of the permanent loss of marine habitat and coastal processes associated with the works.

An ecological assessment was undertaken and identifies this sector as having high ecological value, and recommends the alignment be kept on the western side of SH16 across the causeway into the Rosebank industrial/commercial land area, to reduce effects on the marine reserve. The bridge

[1] Rule E3.4.1(A44) of the Unitary Plan
[2] Rule F2.19.10 (A121)
[3] Advised at Hui in February 2017

structure should be designed to minimise the number of piers in the CMA, and construct a bridge structure over Traherne Island with as few piers as possible. Other mitigation measures should also be carefully considered.

Oakley Creek

To the east of Oakley Creek estuary crossing over SH16 at Waterview interchange is identified as a high risk area. All busway and light rail options would result in permanent habitat loss in this area. While it is difficult to directly mitigate these effects, lessons learnt from the previous Waterview Connection Project highlighted that there would be opportunities to off-set these effects, including improving stormwater discharge quality, habitat restoration, additional vegetation, removal of litter from the stream and adjacent CMA.

Karangahape Road via Great North Road (Great North Road alignment options)

There is no consenting and land requirement for busway or LRT along Great North Road from the Waterview Interchange to Karangahape Road as the alignment is within the existing Great North Road corridor.

There are potential adverse effects on the urban environment which are also opportunities for good urban design. The assessment considers Great North Road as a highly sensitive and space-constrained urban corridor that presents both significant opportunity for positive urban amenity effects as well as the risk of significant adverse effects.

Accommodating a Busway/LRT corridor within Great North Road, plus space allocation for general traffic and cycle lanes, would reduce the pedestrian footpath width significantly. Around the town centres of Point Chevalier, Western Springs and Grey Lynn, the environment is very sensitive to any loss of pedestrian space and would result in high adverse urban amenity effects.

The urban design assessment recognises the corridor through Great North Road also presents an opportunity for good urban design which could lead to a high quality multi-modal urban environment. The assessments recommend detailed consideration of space allocation to achieve a high quality multi-modal urban street environment.

Karangahape Road via SH16 (SH16 alignment options)

The proposed transport corridor affects designation administered by other requiring authorities:

Table 5.5 - Requiring authorities Karangahape Road via SH16

Location	Designation	Requiring Authority
1-9 Parr Road North Point Chevalier	Council carpark	Auckland Transport (internal parking team)
820 Great North Road Grey Lynn	Council carpark	Auckland Transport (internal parking team)
15-19 Monmouth Street, Grey Lynn	Educational purposes - primary school years 0-8 Newton Central School	Ministry of Education

A section 176 approval would be required from each of the requiring authorities where an option crosssd a designation. It is anticipated that constructing a permanent busway within these designations will require negotiations with the various requiring authorities. The availability of land to relocate these designated activities to, poses key risks to these negotiations. This is considered a high stakeholder buy-in risk.

Stormwater Treatment

The SH16 St Lukes Interchange Upgrade Project in 2013 included the widening of the motorway corridor to five lanes in each direction between Carrington Road and St Lukes Interchange. This project resulted in 2.6 hectares of new impervious area. Shortage of land within the Transport Agency's designation limited the ability to provide stormwater treatment that fully meets the standards required by the WCP stormwater consents or standards identified in council planning documents and technical publications at the time. Extensive consultation was undertaken with the council Stormwater Team to agree on a Best Practical Option.

In addition to generating a significant area of new impervious surface, the busway also dissects a wetland near Huruhuru Road. Relocation of the stormwater wetland will be required and treatment of stormwater runoff generated by the additional impervious surface will need to be addressed. This work is required to meet the consented stormwater treatment conditions of the WCP. Opportunities to treat stormwater runoff would be very limited within the existing motorway designations.

This is considered a high risk. Stormwater treatment may necessitate acquiring additional property to meet the Unitary Plan criteria. Early engagement with the Auckland Council Stormwater Team and Iwi is required to achieve buy-in from these key stakeholders on the best practical option.

St Lukes Interchange

There is a constrained environment at the St Lukes Interchange as a result of the location of MOTAT and vegetation significant to the community. These constraints limit the availability of land for construction and operation of further lanes on Great North Road. This is anticipated to be a high risk.

Western Springs Community Centre

Western Springs Community Centre site has been increasingly encroached upon by works on SH16 and presents a physical barrier to further work. This option will encroach into the community centre building. The majority of the Western Springs Garden carpark would also be impacted. This carpark provides public parking for Western Springs Park as well as the community centre. Extensive consultation would be required with the Albert Eden Local Board, as well as Auckland Council Parks Department for the relocation or compensation of the community centre and carpark. The lack of available land to relocate the community centre and carpark poses a significant risk to landowner agreement and the ability to mitigate adverse social and cultural effects on the local community.

Locally Significant Trees – St Lukes

The length of Great North Road close to the St Lukes Interchange is lined with large mature trees in the road reserve, as well as Western Springs and MOTAT. The SH16 Lukes Interchange Upgrade project included the proposed removal of six Pohutukawa trees at the intersection of Great North Road and St Lukes Road. The project was fully notified and the proposed tree removal attracted a large number of opposing submissions. A council hearing was held, resulting in a favourable recommendation of the project including the removal of the six Pohutukawa trees. This caused significant public and media attendance at the Auckland Transport Board meeting where it was intended to confirm the designation. The Auckland Transport Board declined to confirm the designation over the subject trees, and this component of the project did not progress further. Busway and light rail options along SH16 appear to impact these trees. Any proposal to modify or remove them would likely again attract public attention opposition, posing a high risk to consenting programme.

Existing Community – Grey Lynn

The alignment would potentially require acquisition of the row of residential housing between St Lukes Interchange and Arch Hill Scenic Reserve on the northern side of SH16, including a Caltex petrol station at the St Lukes eastbound off-ramp. The alignment would also permanently requires approximately a 10m wide strip along the entire Arch Hill Scenic Reserve. Acquiring land from this reserve will need to be undertaken under the Reserves Act process to address the gazetted status of the land. These works impose a negative social impact resulting from the loss of homes and public open space.

Newton Central Primary School

The alignment potentially encroaches slightly into Newton Central Primary School. Consideration will need to be given to address impacts including noise and vibration, school environment, and potential reduction to the school roll. Landowner approval is required from the Ministry of Education and consultation with the Waitematā Local Board will likely focus on mitigation of adverse social and community effects in Grey Lynn and Newton.

Designation and Regional Resource Consent Requirements.

It has yet to be confirmed whether Auckland Transport or the Transport Agency will be the requiring authority for the NWRTC, or whether both organisations will be responsible for various components of the project.

A new designation approach would be adopted to provide for the busway alignment and station footprints. This would be achieved by a Notice of Requirement (NoR), and considered under sections 168 to 179 of the RMA.

Regional resource consents are likely to be required for multiple activities.

5.4.5 Assessment summary

The NWRTC project would have significant environmental effects both operationally and during construction - typical of large transport infrastructural developments.

Of particular environmental risk is the bridging works along the SH16 causeway, which would result in irreversible adverse effects to the marine habitats in the area. The causeway is sited within a significant ecological area providing high value habitat for many threatened species. Widening the causeway would be extremely difficult to gain Iwi support. This risk applies to busway and light rail options with infrastructure over the causeway.

The main risks for busway and LRT options are the ability to address impacts on many requiring authority assets, and adverse social effects resulting from loss of community assets and housing. The impact on businesses is also a risk. Early consultation with the requiring authorities, community and businesses is critical to understand ways to minimise project impact and inform alternative design solutions.

From an urban design perspective, there are opportunities for positive urban design outcomes, as well as significant risks for the options along Great North Road. These options would result in significant negative urban design effects but with considerable potential to avoid, reduce and mitigate these effects through detailed design changes.

5.4.6 Consultation

Consultation would be required for an extensive list of stakeholders.

To date, early engagement has been undertaken with Iwi. Auckland Transport attended a Hui in February 2017 to introduce Iwi on the longlist options. Feedback was received on the various alignments, the key feedback being:

- Further reclamation and widening of the SH16 causeway would be viewed with serious concern.
- General support for concept and purpose of the NWRTC.
- Concerns and requests that have been raised in previous projects undertaken along SH16 (i.e. Waterview Connection Project) remain relevant.

5.4.7 Land Impacts

The table below outlines the approximate number of properties potentially impacted by each option:

Table 5.6 - Land impacts by option

Options	No. of properties impacted	Comments
Do Minimum	None	N/A
Continuous bus lanes with Te Atatu interchange	~ 10	This option uses the existing motorway corridor and is anticipated to be largely contained within the existing designations for SH16. The new bus interchange at Te Atatu will require additional properties at McCormick Green, Te Atatu and would require full acquisition of a number of private properties.
Busway and light rail options along Great North Road	~ 120	The alignment would impact approximately 10 commercial properties. Land requirements also include residential properties, and properties owned and administered by network utility operators, schools and Council Reserves.
Busway and light rail options along SH16	~ 200	The alignment would impact approximately 10 commercial properties. Land requirements also include residential properties, and properties owned and administered by network utility operators, schools and Council Reserves.

5.5 Engineering and Cost Assessment

5.5.1 Purpose

This section provides information supporting the engineering assessment of the short-listed options. It supports the Constructability and Feasibility elements of the Short List MCA Assessment. The assessment criteria cover:

- **Stageability:** Ability to deliver the outcome in stages and as demand or funding allows. Also, the ability to deliver effective outcomes earlier.
- **Operability:** Ability to operate effectively as part of the transport system and with other modes

- **Feasibility:** Complexity and risk in construction, including disruption to travel, services and business during construction.
- **Capital Costs**

5.5.2 Stageability

Continuous bus lanes and Te Atatu interchange (via Great North Road)
The option can initially use existing shoulder lanes. It is stageable as connection points can be built at different times with sections points which can be gradually connected.

Busway (via Great North Road)
There is the potential to construct lengths of median busway in isolation (intersection to intersection). An early stage could use the existing shoulder lanes on Great North Road to run services before median bus lanes are constructed.

Busway (via SH16)
A busway solution is compatible with a staged delivery as the busway can be built in sections and have services that run from Westgate to the city with a mix of offline and online motorway sections.

The option can use existing shoulder lanes where the busway is not completed. This could, however, lead to redundant infrastructure. It allows a delay in construction over the causeway where it can use the shoulder lanes.

The busway allows sections of the route to be improved more quickly, reducing travel times and giving an early benefit for parts of the corridor.

Light rail (via Great North Road and on SH16)
A light rail solution is less compatible with a staged delivery than a bus based solution. To provide an effective solution most (if not all) of the corridor would need to be constructed between Westgate and the city centre.

While functionally operable short stages of light rail could be constructed, for example Point Chevalier to city centre or Te Atatu to city centre.

These short stages would either require a change in mode to get from Westgate to the centre, or more likely require Westgate to city centre buses to continue operation in parallel. In either case these represent somewhat ineffective early stages. While they would not be sunk costs into 'wasted' infrastructure, they would require significant capital expenditure without any substantial operating savings or network improvements realised until the full route was completed to Westgate.

Compared to bus based options there is little flexibility in stage progression: the line would effectively need to start at the city centre and work outwards towards Westgate regardless of the relative costs and benefits of each option. In particular, there is no ability to defer construction of the expensive and less consentable causeway section for any LRT to operate beyond Point Chevalier, while bus based options can utilise the existing shoulders on this section.

Therefore, these LRT short stage options are unable to provide an effective early outcome.

Busway (via Great North Road) with shoulder bus lanes on SH16 causeway
The Great North Road Busway option has considerable flexibility for staging. There are minimal structures required to bypass Rosebank and Patiki ramp. It could use existing shoulder lanes on Great

North Road to run services before a median bus lane is constructed. Additional interface structures would be required at Te Atatu and Waterview interchange.

There is the potential to construct lengths of median busway in isolation (intersection to intersection) through Great North Road.

Busway (via SH16) with shoulder bus lanes on SH16 causeway

For this option also there are minimal structures required to bypass Rosebank and Patiki ramps. Additional interface structures would be required at Te Atatu and SH16/SH20 interchange.

Extending beyond Westgate

Busway options, via SH16 and Great North Road, are easily extendable beyond Westgate into the growth areas. This could be in a number of forms and allow an integrated service pattern including single-seat services:

- Fully separated busway to Brigham Creek Road on SH16 serving Kumeu
- Full separated busway to Greenhithe on SH18 serving Hobsonville
- Shoulder lanes
- Median bus lanes along arterials (e.g. Northside Drive)

Light rail options are more expensive and difficult to extend into the growth areas. Light rail requires a separate running way or operating on a motorway corridor. While no specific demand/capacity analysis has been carried out beyond Westgate, as noted in Section 5.3.1, even the inner parts of the NWRTC with greater demands are not expected to require the capacity of a Light Rail option.

5.5.3 Operability

Continuous bus lanes and Te Atatu interchange (via Great North Road)

The connections at motorway interchanges would be challenging – resulting in major detours for bus services. North facing 'bus only' ramps at Royal Road could be abused by other vehicles – retractable bollard type solution may be required.

The westbound Lincoln Road off-ramp bus bypass could be difficult to implement as it leads to buses having to weave across the ramp. The option has less impact on other users of Great North Road compared to a segregated busway solution.

Busway (via Great North Road)

There would be no local traffic interference to the operation of a busway between Westgate and Great North Road. A benefit would be that local buses could use sections of the busway as required.

Stations on Great North Road would be situated at existing signalised intersections/pedestrian crossings. All signalised intersections and pedestrian crossings along Great North Road would be maintained though all side roads would need to be left in/left out only, with right turns banned leading to potential pressure on signalised intersections. Accesses would be affected.

Busway (via SH16)

The busway via SH16 would avoid local traffic interference for the full length of the busway between Westgate and Karangahape Road. Local buses could use some sections of the busway if required.

Light rail (via Great North Road)
Significant infrastructure upgrades may be required outside the project area to integrate with the rest of the network. Stations on Great North Road would be situated at existing signalised intersections/pedestrian crossings. All signalised intersections and pedestrian crossings along Great North Road would be maintained though all side roads would need to be left in/left out only, with right turns banned leading to potential pressure on signalised intersections. Accesses would likewise be affected.

Light rail (via SH16)
Significant infrastructure upgrades may be required outside the project area to integrate with the rest of the network.

Busway (via Great North Road) with shoulder bus lanes on SH16 causeway
Similar advantages to Busway (via Great North Road) with a reduced service on the SH16 causeway section.

Busway (via SH16) with shoulder bus lanes on SH16 causeway
Similar advantages to Busway (via SH16) with a reduced service on the SH16 causeway section.

5.5.4 Feasibility

Continuous bus lanes and Te Atatu interchange (via Great North Road)
While this option uses the existing motorway infrastructure where it can, there are still areas where additional construction is required:

- *New north facing bus only ramps at Royal Road*

  The construction would be offline and is considered to be a standard operation.

- *Bus bypass ramp at Patiki*

  Eastbound a bus ramp will be constructed around the existing off-ramp. This will require construction or reclamation works around SH16 causeway. Whilst at-grade and relatively straightforward, construction is in a sensitive marine environment.

  Westbound the bus ramp follows the shared-use path up to the off-ramp. In this area it is challenging to navigate the existing ramps, property and infrastructure due to space and level constraints.

  This construction is challenging with high risk but has been carried out in New Zealand before. An alternative solution is to maximise the existing bus shoulders rather than bypassing them.

- *Bus bypass ramp at Rosebank*

  Westbound a bus ramp will be constructed around the existing ramp. This will require construction or reclamation works around SH16 causeway. Whilst at-grade and relatively straightforward construction is in a sensitive marine environment.

  Construction is at-grade at the Rosebank westbound ramp, resulting in straight forward construction.

  The eastbound ramp around Rosebank is at-grade on to SH16 causeway. An alternative solution is again to maximise the existing bus shoulders rather than bypassing them.

- *Potential 'busway' solution required at SH1/SH16/Great North Road Ramps*

This location would require a very complex intersection with regard to the infrastructure and the environment. Building a busway to the north in this section is preferred as it reduces the number of new structures amongst already substantial infrastructure with ramps on that section of the motorway.

- *Widening of Great North Road*

  The majority of Great North Road is wide enough to accommodate a bus lane with minimal works to undertake widening where required. At all interchanges the addition of bus lanes must be implemented and synchronised with the existing traffic signals. While Temporary Traffic Management (TTM) will be required at all affected local road interchanges the disruption is unlikely to be onerous.

Busway (via Great North Road)

Westgate to Te Atatu

Through this section the challenges lie where the busway intersects with roads crossings along SH16. In all instances, except for the Royal Road off-ramp, the busway is to be aligned under the existing carriageway requiring retaining structures and top down construction. There will be disruption to the local roads in these areas requiring TTM. This is considered to be standard operations.

The Royal Road area, with inclusion of a bus-to-bus interchange and close proximity of the bridge and off-ramp is a particularly challenging area with a combination of cuts and ramps to create the alignment in this area. A large Watercare water main located at Royal Road may also have to be diverted, depending on the alignment of the busway.

The majority of the alignment is enabled through land take, with retaining structures to minimise this requirement.

Te Atatu to Point Chevalier

There are two main interactions with existing roads in this section: At Te Atatu Road the busway is to be aligned under the existing carriageway requiring retaining structures and top down construction. Careful TTM will be required on the existing roads. The existing cycle and pedestrian underpass will be replaced with the new busway structure which will incorporate the cycle and pedestrian facility. This is considered to be standard operations.

From the Whau River to Carrington Road the structure will be bridged, including the crossing of SH16 to bring the busway to the other side of the motorway. This will require TTM on the motorway, though the majority of the works will be offline. The option requires construction over SH16 causeway marine area, which is anticipated to be very challenging.

Point Chevalier to city centre

From Point Chevalier to Karangahape Road the busway will use the median of Great North Road:

- Works along Great North Road will be hindered by the close proximity of properties and the constrained nature of undertaking works in a suburban area. However, implementing parking restrictions in the early phase of the construction works will allow traffic to be diverted to the side maximising the working widths in the centre of the carriageway.
- TTM will be key in maintaining the operation of the existing network while undertaking the construction works with diversions required to complete some of the works.

Busway (via SH16)

This option is identical to ‘Busway (via Great North Road)’ from Westgate to Point Chevalier:

Point Chevalier to city centre

There are two main interactions with existing roads in this section. The busway bridges over St Lukes Road resulting in a high structure potentially impacting adjacent properties and vegetation. The structure is considered to be standard construction practice but there are challenges in this area with the impact on trees and property.

Large retaining structures are required through a section of cut, with another bridge structure over Newton Road. This is within standard construction practice.

Light rail (via Great North Road)

Point Chevalier to city centre

Through this section the same constructability challenges and opportunities exist as 'Busway (via Great North Road)'.

The depth of construction for an LRT solution in the median may require utility relocations to insulate services from stray currents, and to allow for future servicing access once the track slab is constructed over the median. While unique to the LRT solution consideration should be had in the development of the busway as to whether utility relocations are carried out to future proof the busway solution for LRT.

Light rail (via SH16)

This option is identical to 'Busway (via SH16)' from Westgate to Point Chevalier.

Busway (via Great North Road) with shoulder bus lanes on SH16 causeway

This option is identical to 'Busway (via Great North Road)' except that additional structures are not required on the SH16 causeway section. This avoids risks of working in a marine environment.

Busway (via SH16) with shoulder bus lanes on SH16 causeway

This option is identical to 'Busway (via SH16)' with the exception of no additional structures are required on the SH16 causeway section. This mitigates risks of working in a marine environment.

5.5.5 Capital Cost

The P95 cost estimates for the Continuous Bus Lanes, Busway and Light Rail options are:

Table 5.7 - Cost estimates

Option	Cost Estimate (P95)
Continuous Bus Lanes	$560M
Busway (via GNR)	$1.8B
Busway (via SH16)	$2.0B
Light Rail (via GNR)	$2.1B
Light Rail (via SH16)	$2.2B

The following items have been included in the cost estimate:

- Project development (investigation and reporting)
- Pre-Implementation (Design and Project Development)
- Implementation Fees (MSQA)

- Busway or LRT Infrastructure and Physical Works
- Stations
- Contractor's Design
- Contractor's Overhead (Preliminary and General)
- Contractor's Margin

The cost estimate does not include any additional cost associated with the staging of options.

5.5.6 Property Cost

Preliminary property costs are:

Table 5.8 - Property Cost Estimates

Alignment	Property parcels impacted	Cost
Busway/LRT via SH16	203	$251M
Busway/LRT via Great North Road	125	$132M

Table 5.9 - Property Cost Estimates split into stages

Staging	Property parcels impacted	Cost
Westgate to Lincoln	70	$59M
Lincoln to Te Atatu	55	$73M
Te Atatu to Point Chevalier	38	$51M
Point Chevalier to CBD	43	$50M

The preliminary costs are based on the following assumptions:

- Affected residential properties are purchased in their entirety
- Residential property costs are derived 2017 values from homes.co.nz, which provide indicative costs based on property sales history and recent sales data
- $800/sqm for commercial/industrial zoned properties where the business operation does not appear to be affected
- $200/sqm is used for Auckland Council owned open space/reserve land
- At this early stage there is insufficient information regarding impacted business operations. Business loss and acquisition costs for lessees are based on ball park figures for similar acquisitions on Northern Corridor Improvements Project
- The costs do not include professional fees for valuers, planners, surveyors, property agents and other miscellaneous fees
- No allowance for any increase in value have been made should the properties be purchased in 6, 12 or 18 months' time.

5.6 Assessment Summary

Figure 5.18 provides a summary of the short list assessment carried out in the short list MCA workshop. It contains two main sections:

- An assessment of performance against weighted investment objectives drawn from the ILM. This is on a seven point scale against the Do-Minimum. -3 being significantly worse than the Do-Minimum and 3 being significantly better.
- An assessment of feasibility and risk, including costs and economics. This is on a five-point scale described in detail in Figure 5.19.

Figure 5.18 - Short list MCA Summary

			0	1	2	3	4	5	6	7
			Do Min (existing bus lanes on SH16 and Gt Nth Rd)	Continuous Bus Lanes (via Gt Nth Rd)	Busway (via Gt Nth Rd)	Busway (via SH16)	Busway (via Great North Road) with shoulder bus lanes on SH16 causeway	Busway (via SH16) with shoulder bus lanes on SH16 causeway	LRT (via Gt Nth Rd)	LRT (via SH16)
Benefit	**Investment Objective**	**Measure**	**Rating**	**Rating**	**Rating**	**Rating**	**Rating**	**Rating**	**Rating**	**Rating**
1. Better connected city, better match for people, jobs, education opportunities. (50%)	Substantially improve connections to and from the north west.	Jobs accessible within a 45 minute trip by PT from the north west (assessed for morning peak, door-to-door)	0	2	3	3	3	3	3	3
		Size of catchment accessible from the north west by car (30 minutes), public transport (45 minutes) and active mode (30 minutes).	0	1	3	3	3	3	3	3
		Increased corridor throughput: No. of buses, cars and trucks times the average occupancy	0	1	2	3	2	3	3	3
2. Expanded transport choices for the north west. (35%)	Make public transport a realistic option for the majority of journeys to and from the north west.	Increase in PT mode share along the NW corridor: Percentage shares of people throughput, by mode Patronage - summing total travel demand is fixed. Therefore greater pax = greater mode share	0	1	1	3	1	3	3	3
		Faster, more reliable journey times: Travel time Travel time reliability Coefficient of variation of travel time divided by average travel time:	0	1	2	3	2	3	2	3
		Catchment within a frequent transport network: Population living within 500m of a frequent network bus stop and 1km from a rail or bus rapid transit station	0	1	3	2	3	2	3	2
3. More affordable access and improved values for money. (15%)	Increase the efficiency of public transport to and from the north west	Cost per passenger-km: Proportion of operating costs covered by fares for public transport services operating in Northwest corridor.	0	1	2	2	2	2	3	3
		Capacity in city centre terminal/stop capacity: Number of on-street bus stops in city centre operating within their practical capacity, (NB: No option rated 3 as consequential impacts have not been defined)	0	2	2	1	2	1	2	2
Weighted Scores			0	1	2	3	2	3	3	3
Feasibility Assessment	**Constructability/Feasibility**	**Stageability:** Ability to delivery the outcome in stages and as demand or funding allows. Also the ability to deliver effective outcomes early	0	5	4	3	4	3	1	1
		Operability: Ability to operate effectively as part of the transport system and with other modes - in operation	0	3	4	5	4	5	4	5
		Feasibility: Complexity and risk in implementation, including disruption to travel, services and business during construction as well as implementation risks with support from key partners	0	5	4	4	4	4	3	3
	Consenting, Environmental and Property Requirements	**Land requirements:** Number of properties required for purchase, number of commercial properties. Number of sites that can/cannot be re-purposed following implementation	0	3	2	1	2	1	2	1
		Environment and Planning requirements: Consent profile (type, notification status) and likely feasiblity of obtaining consent Environmental effects (noise, water, air, urban design) - degree to which these can be mitigated	0	3	1	1	2	2	1	1
	Finance and economics	**BCR Range**	0.00	0.00	0.37	0.75	0.49	1.08	0.36	0.72
		Costs: (Capex $2017)	0	0.56b	$1.8b	$2.0b	$1.5b	$1.3b	$2.1b	2.2b

Figure 5.19 - Assessment Scale - feasibility and risk

Feasibility assessment scale	1	2	3	4	5
Stageability	Cannot be staged - must be implemented as one project. Long lead times (>10 years) ahead of benefits realisation	Limited and ineffective staging options Long lead times ahead of benefit realisation (7-10 years) Potentailly high risk with support from key partners	Limited, moderately effective staging options. Moderare lead times to benefit realisation (5-7 years)	Can be effectively staged Benefit realisation in 3-5 years Normal levels of scrutiny and likely support of partners and stakeholders	Easily and effectively staged Benefit realisation in <3 years Strong and certain support of partners and stakeholders
Operability	Very likely to cause a major loss of functionality for traffic, pedestrisans, cyclists and parking No connections to other PT modes and routes	Likely to cause significant loss of functionality for traffic, pedestrisans, cyclists and parking Limited connections to other PT modes and routes	Moderate loss of functionality for traffic, pedestrisans, cyclists and parking - likely to be mitigated or managed. Limited connections to other PT modes and routes	Minor loss of functionality for traffic, pedestrisans, cyclists and parking - likely to be mitigated or managed. Acceptable connections to other PT modes and routes - achieves most of New Network outcomes	Negligable loss of functionality for traffic, pedestrisans, cyclists and parking - likely to be mitigated fully or managed - or improved Excellent connections to other PT modes and routes - achives or exceeds Newt Network outcomes
Feasibility	Very large, highly complex project Construction of this kind has not been done before or often in NZ. The work is highly specialised.	Large and complex Construction of this kind has been done before but not often in NZ, but experience is very limited The work is specialised, but limited suppliers are available	Large but not overly complex Construction of this kind has been done before but not often in NZ, but there is confidence the capability exists. The work is complex but limited suppliers are available	Moderate works Construction of this kind not uncommon in NZ, and there is confidence the capability exists. The work is moderately complex but suppliers are available	Straight forward and minor works. Construction of this kind is common in NZ. The work is simple and a wide range of suppliers are available
Land Requirements	Impacting significant land holdings, whole or parts of communities and large, well established businesses. 100+ properties	Impacting a large number of residential and businesses i.e. 40-100 parcels.	Impacting a moderate number of residential and businesses. i.e. 10-40 parcels	minimal land requirement. i.e. >10 parcels	No land requirement
Environment and Planning Requirements	- Adverse effects are significant - Irreversible degredation to the environment and cultural values - No mitigation available - Publically notified - Unable to obtain stakeholder buy-in and agreements	- Non-complying Activity Status - Publically notified - Difficult stakeholder buy-in and approvals - Strong iwi objection - Regionally significant adverse effects on environmental and cultural values. - Multiple objections - significant effects but can be	- Suite of consents - Regional Consents likely to be limited notified. - Environmental and cultural impacts are capable of adequate resolution.	- Suite of consents - Regional consents likely to be non-notified. - Less than minor effects, mitigation available within project boundaries.	- Basic consents – non notified - Less than minor/ negligible environmental and cultural effects.
BCR Range	Significantly <1	Slightly <1	Around 1	Slightly >1	Significantly >1
Cost	Very high (>2bn)	High (1.5-2bn)	Moderate (1-1.5bn)	Low (0.5-1bn)	Very low (<.05bn)

5.7 Assessment Conclusion

The results of the short list assessments were presented during the Short list MCA workshop on 2 March 2017. An initial conclusion from the workshop was that the Continuous Bus Lanes option was not likely to be effective in achieving the investment objectives as a complete solution, but that as part of a staging plan, bus lanes are likely to be effective in sections.

5.7.1 Observations to inform detailed conclusions

In considering the assessment of options, the following observations were made:

- The forecast patronage demand for the north-west RTN is not in itself of a scale to require investment in a high capacity rail-based mode and should be well within the capacity of a bus-based system.
- The ability of the city centre to receive buses in terms of corridor and terminal capacity is uncertain. A greater number of public transport vehicles entering the city centre, generally will create greater pressure and risks and the MCA has rated options accordingly. However, while light rail will result in fewer vehicles entering the city centre, the consequential effects on other bus routes currently using the city centre routes and stops that light rail would use have not been assessed, so remain a risk.
- There is a significant environmental and consenting constraint should additional major infrastructure be required across the causeway. This was considered very significant as a risk.
- From an engineering constructability perspective, no options were considered overly complex or risky.
- All options require significant land acquisition. In their entirety, this does not differentiate the options, however bus-based options can be staged, deferring the need to acquire land and the consequential disruption.

In term of performance of options, the following conclusions were drawn:

- All options provide a significant improvement over the Do-Minimum and Continuous Bus Lanes options, with no areas of worsening outcomes against all Investment Objectives.
- Light rail generally performed better than bus-based options against transport KPIs, although the difference was not considered significant.
- Both light rail and busway options performed better than Continuous Bus Lanes against Objective 1, *substantially improve connections to and from the north-west* and Investment Objective 2 *Make public transport a realistic option for the majority of journeys to and from the north-west.*
- Options that used SH16 between Point Chevalier and the city centre generally performed better against Investment Objective 1, *substantially improve connections to and from the north-west* and Investment Objective 2 *Make public transport a realistic option for the majority of journeys to and from the north-west* than those that used Great North Road due to faster speeds reducing travel time and likely improved reliability.
- Light rail and busway options resulted in an improved outcome against Investment Objective 3 *Increase efficiency of public transport to and from the north-west*, with light rail performing slightly better due to its lower operating costs.
- Light rail is likely to require a major physical intervention on the causeway, significantly increasing its risk profile.

- Bus options can be staged and more easily extended into the growth areas using bus lanes as an interim solution in sections, enabling earlier delivery of the assessed improved transport outcomes.
- The ability to stage bus-based options lowers the risk profile and enhances certainty that the transport benefits identified will actually be delivered in a timely manner. This was considered important as the route serves major growth areas and there was a strong desire to influence travel behaviours early as development occurs.
- Light rail has a lower operating cost than bus based solutions but has a higher capital cost. Due to a limited ability for the light rail to be staged efficiently most of this increased cost is required up front.
- Model data indicates that, at an operational level, future passenger demands would be sufficient to justify a light rail option on the same timeframes as a busway option. In terms of service frequency, operating efficiency and fleet size alone, a light rail line would be an effective transit route from the 2020s onward. Nonetheless, once the higher capital costs and limited stageability are taken into account, it is unlikely that a light rail line would be a viable overall proposition until later decades.

5.7.2 Detailed conclusions

The core conclusion from the assessment was that the options represent a series of step-changes in delivery of transport outcomes and were not in themselves exclusive choices. In particular:

- Light rail is the “best” option in achieving transport outcomes, but may not be required for some time and has many risks that bus-based options can avoid, particularly the need to build across the causeway. Nevertheless, should higher growth eventuate, or some other factor such as road use charging increase demand then light rail may be required sooner. With this in mind, all aspects of the NWRTC as they are delivered should be designed to be light rail capatible.
- Bus based options, including advanced bus technologies, are likely to provide for the demands of the north-west corridor until at least the mid-2040s, assuming an adequate operating and terminal solution is developed in the city centre.
- Bus lanes are likely to provide an appropriate outcome for sections of the corridor as RTN-level facilities are developed.
- In order to support all stages of development, a range of initiatives that were included in the Long List Assessment should be incorporated or developed in parallel. Examples include:
  - Land use intensification, particularly near stations
  - Making better use of existing networks through optimisation and pricing
  - Influencing travel demand, particularly in newly developing areas
  - Using new technology
  - Using all transport modes to support access needs including ferries, walking and cycling.
- The ability to reach into the greenfield growth areas through extensions to Brigham Creek Road on SH16 and Hobsonville on SH18 is an important outcome and staging should allow for this should a case for such extensions be confirmed.

As a result, next steps should be to develop:

- A staging plan for a migration from the Do-Minimum to a largely segregated busway that is light rail capable
- An improved understanding of the operating and terminal patterns in the city centre.
- Study connections to future SH18 busway to Hobsonville.

6 Activity development – recommended programme

6.1 Summary

The recommended programme is illustrated in Figure 6.1 and is a suite of initiatives built around a core rapid transit spine that includes:

- A station at Westgate Town Centre
- Separated busway on SH16 between Westgate and Lincoln Road
- Separated busway on SH16 between Lincoln Road and Te Atatu
- Using the existing bus shoulder lanes on SH16 between Te Atatu and Waterview Interchange
- Separated busway on SH16 between Waterview Interchange and the end of the Newton Road off ramp
- Use of a bus only median lane on Newton Road to connect the busway to Karangahape Road.

To fully achieve the accessibility needs of north-west Auckland and realise the full effectiveness of the proposed rapid transit connection, a range of supporting measures are likely to be required, including:

- Transit Oriented Development opportunities
- Increased ferry services
- Improving enforcement of the bus shoulder lanes that are used as part of the rapid transit service.
- Optimising city centre terminal capacity
- Priority measures for bus feeder services to access the busway on the local network
- Pedestrian and cycle prioritised links to and from bus stations
- Park and ride development in outer areas, in particular north of Westgate. It is expected that the best location for this will be in the vicinity of Brigham Creek Road intersection with SH16, although in the short term and opportunity may exist near Fred Taylor Drive.
- In sections where a separated busway is built, there is an opportunity to look into repurposing the existing bus shoulder lanes on SH16. This could be to be to provide for high occupancy, premium lanes, freight lanes or other purposes that may improve the effectiveness of the state highway.

6.2 The recommended option

The recommended option is a bus based solution which uses both a fully separated offline busway and bus shoulder lanes with a wide range of supporting initiatives. This is illustrated in Figure 6.2. A set of general arrangement drawings of both the alignment and the stations can be found in Appendix G.

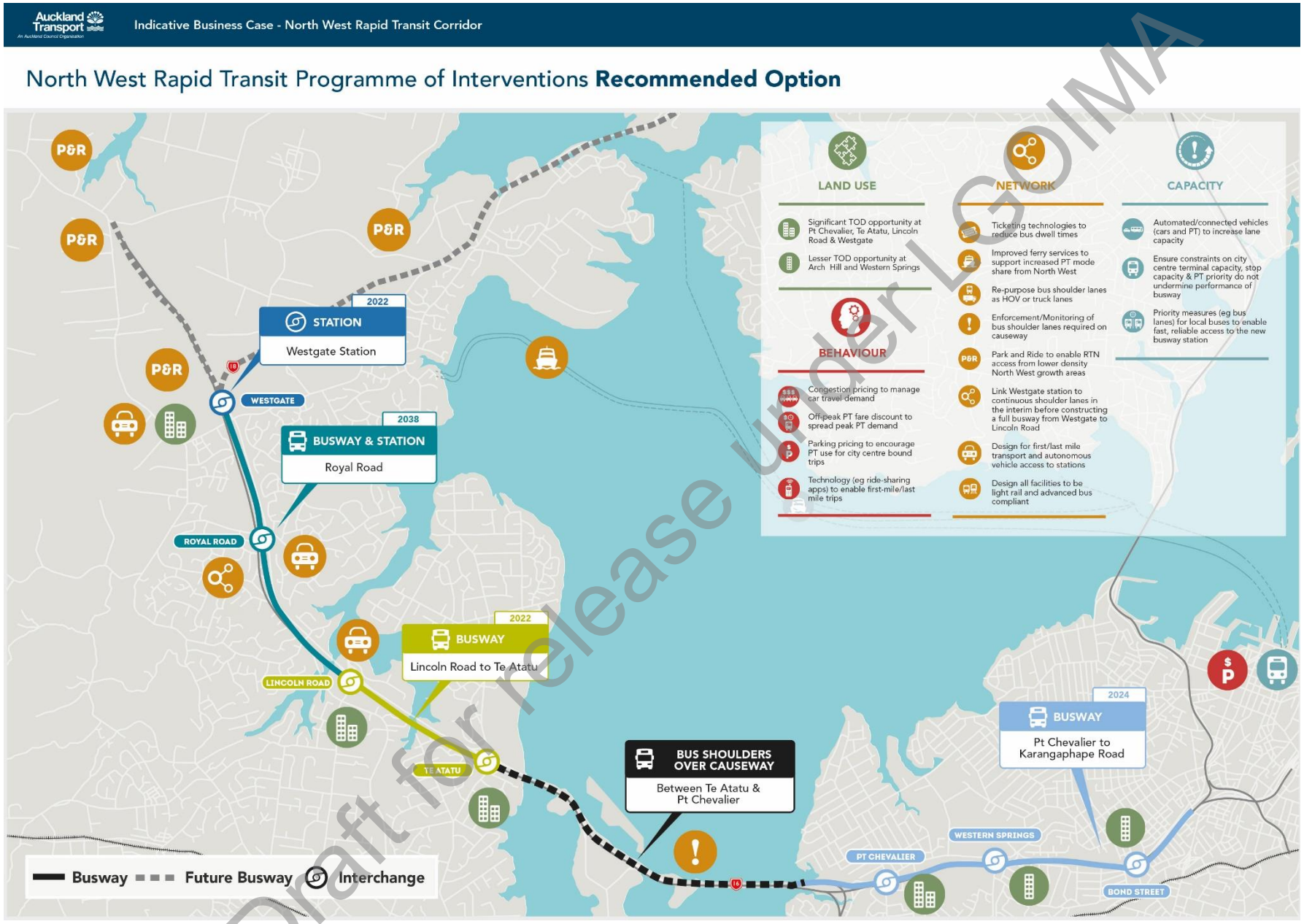


Figure 6.1 - NWRTC Recommended option and supporting interventions

Figure 6.2 - NWRTC Recommended option

There are two key cross section types used along the alignment. The first being a fully separated busway next to the motorway (see Figure 6.3) (both with and without a shared use path) and the second using bus shoulder lanes alongside the motorway (see Figure 6.4).

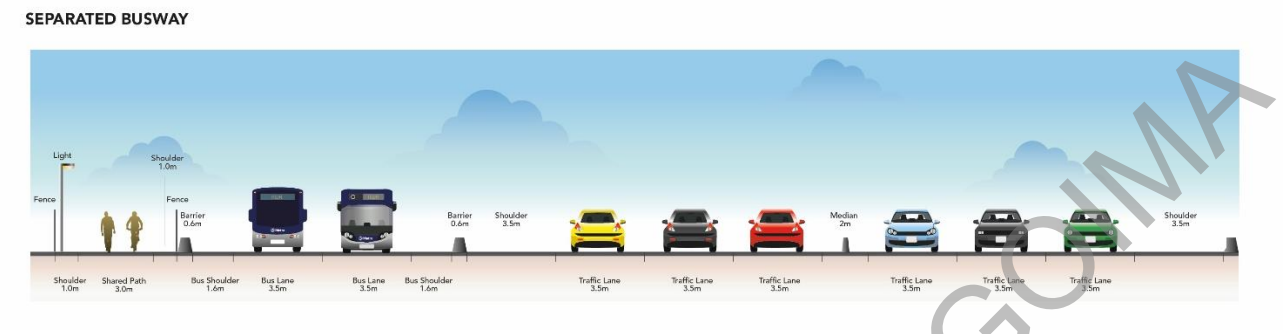


Figure 6.3 - Separated busway cross section

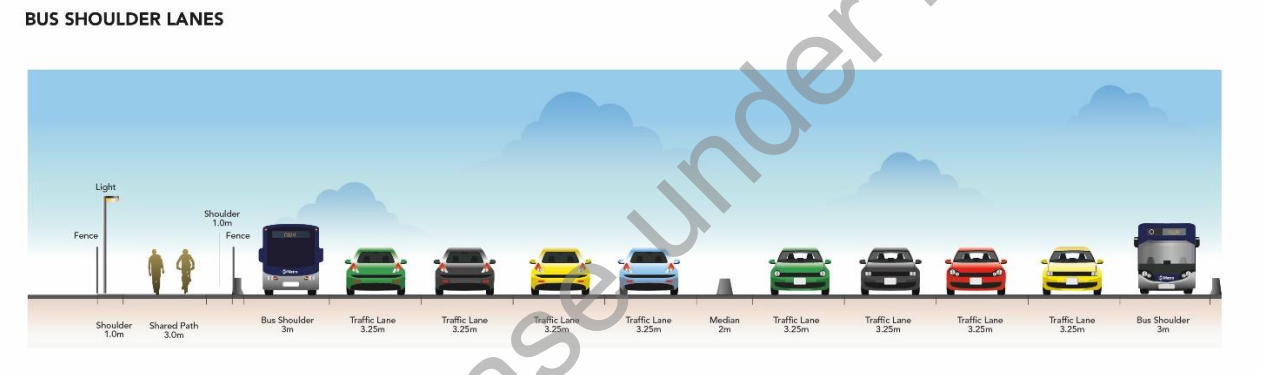


Figure 6.4 - Bus shoulder lanes cross section

A separated busway with a shared use path is provided between Westgate and Te Atatu. Between Te Atatu and Point Chevalier bus only ramps connect separated busway to bus shoulder lanes which run between Te Atatu and Point Chevalier over the causeway. A separated busway (with no shared path) is provided between Point Chevalier and Newton Road. The busway connects to Karangahape Road through bus only right turn bays provided on the median of Newton Road.

Three station types have been used along the alignment determining by forecast demand and use of that station.

Major stations (Figure 6.5) act as a major interchange and hub. The stations at Westgate and Te Atatu will be major interchanges. Stations at Royal Road, Lincoln Road, Point Chevalier and Bond Street will be minor interchanges (Figure 6.6). Western Springs station will be a Local RTN stop (Figure 6.7).

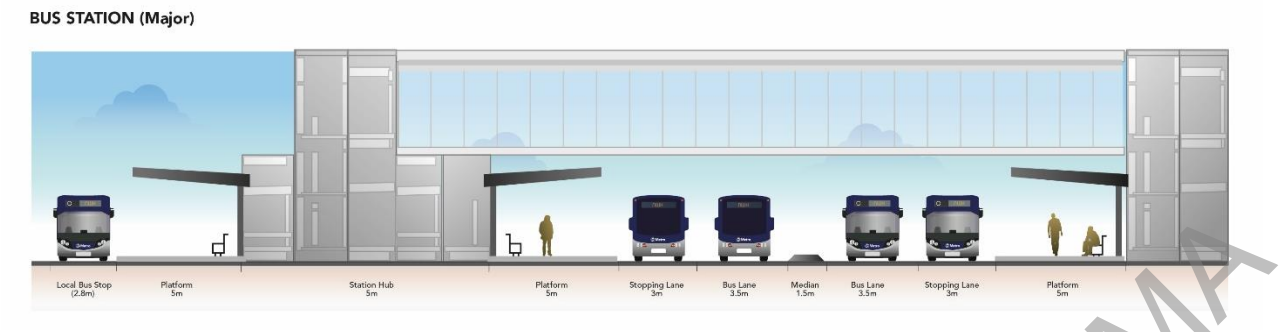


Figure 6.5 - Bus station cross section (Major)

Figure 6.6 - Bus station cross section (Minor)

Figure 6.7 - Bus station cross section (Local RTN)

6.3 Reasons for the recommended option

6.3.1 Why a busway is recommended

The business case identified that buses on a busway provide the right performance and capacity to match the needs of the corridor, while being the most affordable to build, and easiest to deliver in stages.

Buses can easily move on and off the busway, and also use the motorway, bus lanes and regular streets. This allows a staged implementation where critical parts of the busway can be delivered relatively quickly and cheaply, while less urgent parts can be done later. This makes it easy to get the rapid transit line running sooner, but also allows the costs of adding more capacity to be spread out over time as the northwest grows.

The busway mode can support a range of different bus types. It can use any of conventional buses, high capacity double-deckers, articulated “bendy” buses, or high tech ‘Advanced Bus’ buses. For now, it is assumed the Northwestern busway would use double-deckers like the Northern Busway, but the next stage of the investigation may find another kind of bus, or a mix of bus types, is better.

Options for heavy rail and metro rail systems were looked at. These rail systems provide very high capacity and performance, but are also very expensive to build, difficult to stage, and complex to integrate into the existing rail system. A heavy rail or metro rail would cost around twice the cost of a full busway or light rail line. The evaluation showed that a heavy rail or metro system could provide capacity for 20,000 to 30,000 people per hour, which is excessive for the Northwestern corridor where demand is expected to be in the range of 5,000 to 6,000 people per hour at peak times. Given the excessive capacity the considerably higher construction costs could not be justified.

Light rail was also evaluated, and identified as the second-best mode. Light rail would give appropriate capacity (around 7,000 passengers per hour) and performance for the corridor, at a cost higher but not significantly higher than a full busway ($2.2b for light rail versus $2.0b for busway). However, light rail is very difficult to implement in stages. In order to operate a useful light rail service, at least half of the line would need to be built in a single stage, and there is little chance to defer spending on difficult but lower value sections of the line, especially as any depot would likely be located in outer areas of the north west where more land is available. This means that whole corridor would need to be fully funded and built in one package, while the investment in a busway can be spread out over several years of successive extensions and improvements.

Nonetheless, the busway has been designed to meet the geometric standards of a light rail line. This leaves open the option of converting it to light rail in the future when demands may be high enough to justify it. An upgrade to light rail could be considered as a final stage of the busway programme.

6.3.2 The use of shoulder lanes on the motorway

The recent Western Ring Route project delivered by NZ Transport Agency has included bus shoulder lanes along large sections between motorway interchanges.

The bus shoulder lanes on the motorway are useful and form part of the recommended option and staging. The bus shoulder lanes on the causeway section of the motorway between Te Atatu and Waterview would continue to be used as the middle part of the busway corridor, at least in the early stages.

However, the motorway shoulder lanes alone aren’t sufficient to support the projected north-west bus network into the future. Motorway shoulder lanes are best for express buses, but don’t work well with bus stations and make it difficult to operate an efficient trunk-and-feeder bus network. They also

require buses to mix with traffic in and around motorway interchanges, which can make them slower and less reliable.

6.3.3 Recommendation to use SH16 instead of using Great North Road between Point Chevalier and the City centre

The business case evaluated both options for the route between the Point Chevalier shops and the City centre, and found that building a busway alongside the motorway was better than upgrading Great North Road to a busway standard. There were a number of reasons for this:

Capacity

The Northwestern Busway will be very busy in the future, carrying about as many buses and passengers as the Northern Busway does today. At the same time, Great North Road will be a busy bus route itself, with buses every few minutes at peak times serving existing properties and new apartment and commercial developments.

Effects on communities

Adding the Northwestern Busway to the Great North Road bus corridor would result in a very high number of buses travelling along the road and through the neighbourhoods along the way, more than the road can currently accommodate. This would require converting the road to a street level busway which would be expensive and create significant restrictions on local properties, business and traffic.

Reliability and speed

Even with an upgrade, the Great North Road route would still have many intersections and signalised intersections, and buses would be restricted to the 50 km/h speed limit. In comparison, a busway along the motorway would have an 80km/h speed limit and would only need to stop at the stations, making it much faster and more reliable. It is better to keep the busway running in an express manner past Great North Road than to divert the busway buses into the street corridor through Point Chevalier, Western Springs and Grey Lynn.

Accessibility

The busway along the motorway gives more options and better transit services to local residents and business, and gives better coverage of the public transport system overall. This is because the busway would be a new rapid transit route, in addition to and complementing the main bus route on Great North Road. It includes new stations at Point Chevalier, Western Springs and Bond Street, so people in the Great North Road area would have the choice of still catching the regular Great North Road bus, or using one of the new busway stations for an express trip. People travelling from the Northwest to Great North Road, or vice versa, would have easy connections between the busway and Great North Road buses at Point Chevalier or Western Springs.

6.4 Recommended option design considerations

This section describes the reasoning for the location of the alignment and assumed physical solution, for example why the recommended option is located on the northern or southern side of the motorway and the physical solutions assumed (bridges, underpasses etc).

6.4.1 General

Design considerations

There are a number of design considerations which can be applied to the length of the project. The bus station locations and busway alignment are linked – there is a trade-off between the best location for the station and the best side of the motorway for the busway – the busway and bus stations always remain on the same side of the motorway at a given point to avoid an unnecessary structure to link the busway and the station.

There has been a minimisation of motorway crossings to reduce cost and visual impacts. As a result of this while the preferred option is on two different sides of the motorway along the route, the transition is achieved where the busway converts to bus shoulders on the causeway and back again.

Bus station locations are located near motorway interchanges for effective integration with local bus services and to maximise station catchment areas.

Risks and unknowns

At the Indicative Business Case stage, ground investigations have not been carried out. Given the scale of infrastructure required, including large bridges, this may influence the final busway alignment or station locations.

Only major utilities have been identified at this stage – further detail on the impact that the busway will have on existing utilities alongside the motorway alignment will need to be explored during further stages of design.

There are also a number of risks associated with station locations:

- Emerging technologies may require a greater provision for kiss and ride or drop off zones at each station.
- Supporting Growth – Delivering Transport Networks (SG) alignment on SH16/18 and service plan might affect station layouts.
- Diversions of local bus services through SH16 stations could have an impact on operational costs and travel time, which has not been assessed.
- Pedestrian accessibility to stations impacted by the location of stations adjacent to SH16. Safe pedestrian crossings would have to be provided.
- A traffic impact assessment has not been carried out on any of the station locations.

6.4.2 Westgate to Lincoln Road

The recommended option through this section places a busway on the southern side of SH16. The busway alignment follows that of the motorway. Stations are provided on the southern side of the motorway at Westgate town centre, Royal Road and Lincoln Road.

Westgate Station

Assumptions

There were a number of assumptions associated with the conceptual design of Westgate station. Firstly, that the station operates as a ‘hub’ with local services commencing and terminating here. Secondly, no park and ride is provided at this location, as it could potentially be provided nearby at Westgate or possibly further north at Brigham Creek Station.

Location considerations

The preferred location is near the town centre – fulfilling the function of a 'destination' station and allowing good connection to the local road and local bus services that will serve the town centre.

While the area is physically constrained by the Fred Taylor Drive interchange area, there is sufficient undeveloped space for the required station footprint on the south side of SH16.

The stormwater pond on the southern side of the motorway can be extended and utilised by the station for stormwater treatment.

An option to locate the station in the existing carpark near the town centre and relocating any lost parking spaces was investigated but this would not be as compatible with an alignment to extend the busway along SH16 or SH18, the station location had to allow for the possible future extension of the busway further along SH16 and connection to a busway on SH18.

Risks and unknowns

One of the risks in for this section is that there is a significant Watercare pipe in this area which may be affected by the station.

There are also a number of unknowns for future developments and impacts in the area, which may influence the final location for the station. These include (but are not limited to) the following:

- Proposed SH16/SH18 ramps near the station, the final location is yet to be confirmed
- A possible extension of the busway alignment further north via Fred Taylor Drive, and SH16/18 busway connection might impact Westgate station location and configuration.
- The SG service plan and possible services commencing from Westgate Park and Ride or Brigham Creek might affect station configuration

Royal Road Station

Assumptions

For concept design purposes, it was assumed that Royal Road bridge will not be widened to accommodate ant new local bus stops. Local bus movements that operate in the east-west direction over Royal Road Bridge use existing local stops along Royal Road west of the proposed station location.

Location considerations

The preferred location for Royal Road station has no impact on residential housing in the area as it is located on undeveloped land. This location also avoids the North Harbour Watermain which is located on the Royal Road bridge.

Risks and unknowns

The identified location for the Royal Road station is operationally and physically constrained. The station footprint area is available – but space for other facilities are limited. Very limited local bus drop off and kiss and ride drop off area can be catered for. The demand for this station is expected to increase with developments in the Red Hills growth area. Increased kiss and ride demand and additional local bus services may necessitate additional land acquisition in order to provide facilities. This includes the widening of Royal Road bridge to allow for local stops and safe access via the shared use path.

Pedestrian and vehicular access to the station is potentially inefficient and poor quality due to the close proximity of major intersections and indirect paths of access.

There are a large number of overhead and underground utilities in the Royal Road interchange area which will need to be considered during further design development.

It is considered that options for a station in the vicinity of Royal Road should be investigated in greater detail in the DBC stage.

Lincoln Road Station

Assumptions

The concept design for the Lincoln Road station has land from the development area is going to be obtained via a possible land swap to provide station access from Central Park Drive.

Location considerations

The preferred option is situated on land owned which is already owned by the NZ Transport Agency and is compatible with future development plans of Auckland Transport in the Lincoln Road area.

Locating the station on the southern side of SH16 services a large portion of the Lincoln Road catchment.

Large Transpower transmission lines on the northern side of the motorway are avoided by locating the station on the southern side of the motorway.

Risks and unknowns

There are a number of risks and unknowns associated with the station at Lincoln Road. There is uncertainty around the private development which is adjacent to the station and how it may influence the station.

The access from Lincoln Road to the station is limited as the current road layout does not allow right turning in and out of the station due to the close proximity of the Triangle Rd/Central Park Drive intersection and the Lincoln Road interchange.

Local bus services from Lincoln Road East and West to Triangle Road will experience increased travel times due to additional movements required through Central Park drive and through the station. This may influence local service patterns.

There is a risk that shared use of the access road from Central Park Drive by buses and adjacent development traffic may result in reduced reliability for buses.

Alignment

Design considerations

There is land that has been purchased on the southern side for the purpose of a busway. Between Royal Road and Lincoln Road the property impacts would be similar on either side of the motorway. It has been noted that there is a greater area of undeveloped land on the southern side of the motorway through this section.

There are a number of creeks through this section which will need to be bridged over and placing the alignment on the southern side of the motorway has a lesser impact on the Huruhuru Creek area.

A stormwater pond near Westgate is affected by the alignment, but there is undeveloped land available nearby to extend the pond to account for this. By aligning the busway on the southern side of the motorway the new pond at Lowtherhurst Reserve is avoided.

As part of the SH16 Lincoln to Westgate project Royal Road Bridge, the North Harbour Watermain and Huruhuru Bridge have been futureproofed for a busway on the southern side of the motorway. The footbridge at Westgate has also been avoided by the alignment of the preferred option.

There is a shared use path along the southern side of the motorway between Lincoln Road and Westgate which is to be constructed as part of the SH16 Lincoln to Westgate project. By keeping the busway and shared use path alignment on the southern side of the motorway through this area the existing shared use path and local road connections can be maintained.

Major Transpower transmission lines run through this area along the northern side of the motorway and would require a significant relocation or undergrounding of these if the alignment was on the northern side.

The location of Westgate Town Centre and as a result Westgate Station, on the south-western side of the motorway and the logical location of Lincoln Road Station on the southern side of the motorway, means that unless there is a very good reason to locate the busway on the northern side of the motorway, the southern side would be preferred. This would avoid the need to cross the motorway on structures.

Risks and unknowns

There are a number of risks and unknowns throughout this section of SH16:

- The substation at Westgate is impacted by the alignment on the southern side of the motorway. Providing the busway on the southern side of the motorway restricts future development strategies at the Westgate Shopping Centre south of Fred Taylor Drive.
- There are areas that are known to have poor ground conditions throughout this section.
- There are known slip areas near Royal Road and the undeveloped land opposite Lowtherhurst Reserve.

6.4.3 Lincoln Road to Te Atatu Road

The preferred option through this section places a busway on the southern side of the motorway. The busway alignment is similar to that of the motorway. A station is provided on the southern side of the motorway at Te Atatu (McCormick Green).

This section includes a grade separated transition from the off line busway west of Te Atatu to the shoulder lanes on the causeway.

The rationale for Lincoln Road station is provided with the Westgate to Lincoln Road section.

Te Atatu Station

Assumptions

The concept design for Te Atatu station assumed that no park and ride facilities is to be provided at this location

Location considerations

The recommended location is located on open space land. Locations in the other quadrants of Te Atatu interchange have been assessed by previous studies and affected residential properties and council land which is currently leased to the Te Atatu Pony Club.

Other locations which were considered for the station in the north east and south east quadrants of Te Atatu interchange have been identified as areas with cultural and heritage value.

The preferred location is compatible with feeder services in the area and serves a large catchment in the area. A station in this location can also be designed to function as an interchange prior to construction of the NWRTC busway.

Risks and unknowns

Access to the station in the concept design has been identified at Royal View Road. This access point is a risk as right turns are currently banned from Te Atatu Road into Royal View Road.

There have been proposals for a ferry terminal at Te Atatu, the connection of this terminal to the station is unknown at this stage.

Alignment

Design considerations

The preferred location for both Lincoln and Te Atatu stations is on the southern side of the motorway. By connecting the stations on the southern side unnecessary infrastructure crossing the motorway can be avoided.

Busway alignment on the southern side of the motorway avoids the sports fields at Jack Colvin park and has a lesser impact on commercial properties in the area.

Busway alignment on the southern side of the motorway allows expansion of the existing stormwater ponds for the busway, avoid relocation of the SW pond by Henderson Creek and have a lesser impact on the sensitive coastal marine area at Henderson Creek.

There are large Transpower transmission lines along the northern side of SH16 through this section, these are avoided by the aligning the busway on the southern side.

Risks and unknowns

The Watercare pump station at Te Atatu is affected by the busway alignment on the southern side of the motorway. There is a risk that the station will need to be relocated or designed around with property implications

6.4.4 Te Atatu to Point Chevalier

The preferred option through this section utilises the existing bus shoulders along SH16. At Te Atatu and Waterview ramps connect the busway to the bus shoulders. Stations are connected at Te Atatu and Point Chevalier.

Alignment

Design Considerations

There are existing bus shoulders on SH16 in this area, with only two ramped connections (Rosedale Road and Patiki Road) in each direction over the 4km between Te Atatu and Waterview Tunnel.

Therefore, there are only two locations where the buses will need to navigate off and on the shoulders around the motorway ramps in each direction. These ramps at Patiki and Rosebank Road would be difficult to navigate with a busway structure.

Aligning the busway around the Waterview and Great North Road interchange avoids the difficulties of navigating these large structures and the need to realign part of Great North Road.

There are a number of commercial properties on the southern side of the motorway at Rosebank which are avoided by using the bus shoulder lanes.

Using the bus shoulder lanes avoids the sensitive coastal marine area through the causeway, which is likely to create significant issues obtaining consents to build a busway structure additional to the existing motorway footprint in this area.

Risks and unknowns

There are risks associated with using the existing bus shoulders over the causeway. There is the risk of illegal use of bus shoulder lanes by the general public when cars are queuing at the motorway off-ramps. It is also noted that the bus shoulder lanes are narrow, which may affect the speed that the buses can travel through this section of motorway, particularly during peak periods.

6.4.5 Point Chevalier to City centre

The recommended option through this section places a busway on the northern side of SH16, following the motorway alignment through this area. Stations are provided on the northern side of the motorway at Point Chevalier, Western Springs and Bond Street. The busway alignment ties into Newton Road to connect to the city centre.

This section includes a grade separated transition from the shoulder lanes on the causeway to the off line busway east of Waterview.

Point Chevalier Station

Assumptions

Concept design of the station at Point Chevalier assumes that the existing bus stops along Carrington Road and Great North Road are located at an appropriate walking distance from the station so additional local road connections to the station are not required.

Location considerations

The location of a station at Point Chevalier shops is physically constrained by Great North Road on the western side of Carrington Road.

A station position near Carrington Road allows integration with local feeder routes and provides a smoother transfer from local services to the RTN.

There are a number of heritage buildings that are anticipated to be affected by the station, these could be incorporated into the station design.

Risks and unknowns

These heritage buildings near Carrington Road may result in movement of station further away from Carrington Road, reducing station accessibility and smoothness of transfers.

There is a requirement for the Carrington Road Bridge eastern abutment to be shifted further east in order to fit station footprint.

Western Springs Station

Assumptions

The concept design for the station at Western Springs assumed that existing bus stops on Great North Road are adjacent to the station and are located within an appropriate walking distance, providing local feeder connections to the station. This allows a small station footprint as no additional stops for transfer buses are required.

Location considerations

The preferred location for the bus station at Western Springs has no impact to property as the busway is over the motorway at this point.

The location is on the same side of the motorway as the attractions in the area (MOTAT, Auckland Zoo, Western Springs and Stadium) and provides a good connection to the existing services on Great North Road.

Risks and unknowns

There is some risk associated with the level of the bus station that higher than that of the motorway and overbridge. The concept design for the bus station structure is significantly higher than the motorway level with a platform located over the motorway. This high vertical alignment also means that no emergency access to the busway can be provided at this station.

Public parking is taken out by the busway at this location and will be reinstated in the space under the busway structure. There are CPTED issues with providing parking under a large structure.

The alignment in this area, including the proposed station is close to the Pohutukawa trees that line Great North Road at this location. While not confirmed at this stage in design and the intent of the design is to avoid these trees, nevertheless there is a risk that they could be affected.

Bond Street Station

Location considerations

The preferred option for the station at Bond Street has no property issues as it utilises existing undeveloped space along the motorway.

The station also aligns with catchment area on the northern side of SH16 with no need to cross the motorway over Bond Street.

Risks and unknowns

The level difference between the motorway/busway and the local connections provides some risk for this station.

There is also a requirement for the eastern bridge abutment of the Bond Street Bridge to be moved to accommodate a station at this location.

Alignment

Design considerations

The Point Chevalier to city centre station locations were influenced by the potential to increase the catchment area for rapid transit in neighbourhoods with no alternative rapid transport options into the city. The Western Rail Line is located close to the motorway with Baldwin Avenue, Morningside and Kingsland Stations being between 500m and 1 km south of the motorway.

At either end of this section, the Point Chevalier Town Centre is located on the northern side of the motorway and as a result the location of this station is logically located on this side and the city centre itself and the main access to the city centre via Karangahape Road is located on the northern side of the motorway. Maintaining the alignment on the northern side of the motorway avoids the need to cross the motorway twice.

The busway alignment on the northern side of the motorway avoids the golf club (which is currently being re-developed) on the southern side of the motorway and utilises undeveloped space next to the motorway corridor.

There is a stormwater pond on the northern side of the motorway which could be expanded for use for the busway stormwater treatment.

Alignment on the northern side of the motorway allows an emergency access point to the busway opposite Motions Road.

Risks and unknowns

The key risks for this section of motorway are around the western springs area. There is basalt rock around the St Lukes/Western Springs area and the busway alignment impacts the Western Springs community centre, which would need to be relocated as part of the project.

6.4.6 Newton Road connection to Karangahape Road

The preferred alignment for the two-way offline busway ends at Newton Road, but there is a need for the busway to connect to Karangahape Road. The existing median is utilised for two bus only right turn lanes into Karangahape Road and the offline busway. By utilising this median, the adjacent side streets (Ophir Street and Abbey Street) will need to be converted to left in and left out only streets with alternate access available from Karangahape Road.

6.5 Effectiveness of the recommended programme

6.5.1 Strategic alignment

Supporting growth

- Strongly supports greenfield growth in the north-west through providing the capacity required for the increased journeys from the growth areas, access to jobs and education for 10.6% of Auckland's residential growth and 12.1% of employment growth through to 2046.
- Supports inner urban growth by improving access to the city centre and fringe which is expected to contain 10.2% of Auckland's residential growth and 32.8% of Auckland's employment growth to 2046 as well as access for established areas such as Te Atatu and Massey to jobs and education.
- A busway option provides for extension into greenfield growth areas beyond Westgate.

Making public transport more efficient

- The busway concept allows a more cost effective public transport service that is consistent with Auckland Transport's connected public transport network model.
- Allows fewer buses carrying more people to enter the space-constrained city centre improving efficiency and urban quality outcomes.

ATAP

- The busway's Te Atatu – Westgate section is specifically included in ATAP's Decade 1 Priorities and extensions in ATAP's Decade 2 Priorities.

6.5.2 Investment objectives

Table 6.1 contains the Investment Objectives defined for the NWRTC and the Key Performance Indicators that were used to measure the effectiveness of options in meeting them.

Table 6.1 - Investment Objectives and KPIs

Investment Objective	Measure (Key Performance Indicator)
Substantially improve connections to and from the north-west.	**KPI 1**: Jobs accessible within a 45-minute trip by PT from the north-west.
	KPI 2: Size of catchment accessible from the north-west by car (30 minutes), public transport (45 minutes) and active mode (30 minutes).
	KPI 3: Corridor throughput: No. of buses, cars and trucks times the average occupancy
Make public transport a realistic option for the majority of journeys to and from the north-west.	**KPI 1**: PT mode share along the North-West corridor: Percentage shares of people throughput, by mode
	KPI 2: Faster, more reliable journey times: Travel time; Travel time reliability
	KPI 3: Catchment within a frequent transport network: Catchment within a frequent transport network: Proportion of the population living within 500m of a frequent network bus stop and 1km from a rail or bus rapid transit station
Increase the efficiency of public transport to and from the north-west	**KPI 1**: Subsidy cost per passenger-km: Cost per passenger-km: Proportion of operating costs covered by fares for public transport services operating in north-west corridor.
	KPI 2: Capacity in city centre terminal/stop capacity: Number of on-street bus stops in city centre operating within their practical capacity

Using these KPIs as indicators, in summary, the recommended option is effective in delivering the Investment Objectives in the following ways:

- **Access to jobs:** Brings 320,000 jobs within a 45-minute public transport journey of Westgate in 2046, compared to 120,000 with the Do-Minimum.

- **Catchment for the north-west:** Creates a population catchment of 580,000 people within a 45-minute public transport trip of employers in Westgate compared to 300,000 with the Do-Minimum
- **Corridor throughput:** Increases the person throughput of the SH16 (all modes) at Waterview from 11,000/hour in the Do-Minimum to 16,000 per hour. Expected demand for travel in 2046 is 13,000/hour.
- **Mode share:** Increases bus passengers entering the city centre from the north-west from 6,800 in the Do-Minimum to 9,300 in 2046. It does this with the same number of buses entering the city centre with higher occupancy.
- **Travel time:** Creates a journey time by bus from Westgate to the city centre of 32 minutes in the peak compared to an expected journey time of 50 minutes with the Do-Minimum.
- **Public transport catchment:** Enables 40,000 people to live within walking distance of a rapid transit service on the north-west corridor compared to 23,000 with the Do-Minimum.
- **Transport subsidy:** Will enable a saving of $11 million per year in operating costs. It will require $48m/year c $59m/year with the Do-Minimum.

6.5.3 Customers

In Section 3.6 a number of key customer groups, based on Auckland Transport's customer information and research were identified as the main likely users of the NWRTC. Section 3.6 identified their expected needs and issues associated with using public transport. This section provides an assessment of the effectiveness of the recommended option in meeting the needs of these customers.

City Centre employees (47%):

"I work in the CBD but my life takes place in northwest Auckland.

Driving to the CBD in the peak hours is stressful and time-consuming, plus parking downtown is expensive.

I don't want to spend my time in traffic nor waiting on or in a crowded bus that meanders through suburbs.

- *I need a fast, direct and reliable service with simple connection that performs especially during peak hours."*

The recommended option addresses the needs of city centre employees in the following ways:

- A direct connection between the north-west and the city centre core
- Higher levels of reliability and a large travel time saving
- Reduced direct costs of travel through removing the need to pay for city centre parking

Industrial employees (18%):

"A lot of jobs are in the industrial areas in Rosebank or Henderson where car parks are available.

I can reach my work in the industrial area via the SH16 much better than I can by public transport.

Taking the bus would save me a lot of money but the journey takes longer than by car, is unreliable and sometimes doesn't cover my shift very well. I risk my job if I don't show up on time.

- *I need an affordable reliable service to and from my work place in the industrial areas at any time of the day."*

The recommended option addresses the needs of Industrial employees in the following ways:

- Providing the potential for longer service spans to cover shift patterns.
- Enabling a core spine and high quality interchanges from which a variety of destinations can be reached easily.
- Improved reliability through a separated corridor meaning people can access jobs on time.

Students (14 %):

"I have several destinations (school, work, friends) across Auckland plus I am on a budget.

- *I need an affordable, fast, direct and reliable service throughout the day and week."*

The recommended option addresses the needs students in the following ways:

- Providing a core spine service that allows a range of destinations to be reached with high quality transfers
- Providing realistic transport option with a lower direct cost of travel than driving a car
- Provides a direct connection between the north-west and the city centre universities as well as Unitec at Point Chevalier.

Elderly/ Mobility Challenged (16%):

"I want to be mobile and part of society. I travel off peak to activities, to health care facilities and to see family and friends locally.

Using the bus can be overwhelming: tagging on/off, finding the right connection and many of the bus stops are not designed barrier-free.

Services are often infrequent and connections are difficult when I travel

- *I need easy connections and barrier-free facilities."*

The recommended option addresses the needs of elderly and mobility challenged in the following ways:

- Provides for high quality stations with full facilities for barrier-free access.
- Enables a connected network with confidence for people to make connections and access a wide variety of destinations.
- Stations provide a safe, secure and legible place to connect feeder services to the main spine service enables secure.

Recreation Seekers (5%):

"I live in the north- west of Auckland but I would like to enjoy Auckland's shops, parks, beaches and night life. Some events also happen during the week. The bus isn't a realistic alternative: a journey to the CBD takes almost three times as long as it would by car. Services later at night and weekends run only hourly and stop quite early during the week.

On weekends, unless we decide to take the night service that is fast but only runs very late, one of us has to drive and stay away from drinks.

- *I need a service that is faster, more frequent also on weekends and runs longer during the week."*

The recommended option addresses the needs of recreation seekers in the following ways:

- Provides a connection to the wider rapid transit network enabling connections to regional facilities.
- Provides fast travel times making public transport a realistic option for recreational use.
- Good quality stations provide safe and secure facilities for night time use.

6.5.4 Risks and opportunities

In the course of the Indicative Business Case, a number of issues were raised that were considered important to progress alongside development of the core rapid transit project. These are separate to the project development risks in relation to consenting and design.

Risks to be mitigated

- The reliance on bus lanes on the SH16 causeway sections raises risks in terms of ensuring the bus lanes are allowed to perform in an optimum manner. An adequate enforcement approach will be required to ensure that the shoulder lanes provide the speed and reliability required to achieve the benefits of investing in the other sections of the busway.
- Any introduction of road pricing may influence the forecast demands for the corridor. Any significant changes in demand profile are likely to require a further consideration of the development of the recommended option and staging.
- The ability of the city centre to receive buses from the corridor and provide terminal and stop capacity in the context of other major route groups entering the city centre, for example North Shore, Isthmus and East Auckland is considered a risk. As part of refining the NWRTC, it is likely that a more detailed understanding will be required of the city centre operation and the interaction with other major transit lines.
- Integration of the RTN operation into the developing greenfield growth areas to ensure that this catchment is afforded fast, direct and easy-to-use access to the NWRTC is a key consideration. This may involve considering extending the RTN deeper into the growth areas, provision of park and ride facilities and implementing reliable feeder networks.
- New developments on land located adjacent to the motorway where the busway alignment would be located. Advanced purchase is required to avoid costly changes.

Opportunities

- A significant area of opportunity is to use the accessibility afforded by the NWRTC to promote or actively generate transit oriented developments adjacent to the corridor. Transit Oriented Developments can generate higher yield from land adjacent to the corridor, supporting land use objectives of Auckland Council while optimising the performance of the investment in the RTN through increased ridership.
- The transport sector is in a phase of considerable change at present with emerging technologies evolving that may influence the way busway corridors can be used and their capacities. Autonomous vehicles (private or public) are able to operate in a connected manner providing potential for lower headways and greater capacities. The ongoing scoping and design of the

NWRTC should remain flexible and retain the ability for a range of operating modes as certainty over the potential for these technologies becomes clearer.

- Advanced bus technologies are emerging with the potential to achieve greater capacities and lower dwell times through the use of long, multi-articulated vehicles that are able to replicate many aspects of a light rail operation. The development and design of the NWRTC should remain light rail capable, but also consider flexibility to utilise advanced bus technologies.
- In sections where a separated busway is built, there is an opportunity to look into repurposing the existing bus shoulder lanes on SH16. This could be to be to provide for high occupancy, premium lanes, freight lanes or other purposes that may improve the effectiveness of the motorway.
- Improved pedestrian and cycling access along the North-Western Cycleway at roads crossing SH16 by including this at the crossings, such as at Lincoln Road and Royal Road. Cycle storage facilities can be provided at all stations.

6.6 Staging and sequencing of recommended option

6.6.1 Overall programme:

While physically the delivery of rapid transport infrastructure may be carried out in stages, the delivery of a product for customers and provision of accessibility and transport choice to north-west Auckland is an integrated whole. The overall solution comprises a range of interventions including demand management, network optimisation and provision of new capacity both on and off the SH16 corridor.

The following points should be considered in all aspects of the staging of the NWRTC:

- This is a Westgate to City link as part of a wider regional Rapid Transit Network. Improvements need to be made over the *entire corridor length* to create an effective rapid transit operation and attractive customer experience.
- The improvements can be made over time and do not need to provide the same solution on all parts of the corridor.
- A wide suite of complementary measures to meet customers' needs should be implemented. This is ranging from local access (cycle, walking links, bus connections, park and ride), supporting modes and routes (buses, ferries) to fare, information and access products to implement a holistic "system".
- Opportunities for value capture and land use development need to be progressed in parallel and aligned with the core route development.

6.6.2 Recommended staging of infrastructure to support the RTN

Stage 1:

Lincoln Road – Te Atatu

- Lincoln Road to Te Atatu should be upgraded **first** to provide network benefits. It contains two critical interchanges (Lincoln Road and Te Atatu) that extend the desired benefits to a broad catchment. This section should be coupled with a Westgate Station, similar to Albany on the Northern Busway as well as faster and more reliable access (bus priority) to the bus lanes west of Lincoln Road, park and ride and other supporting measures.
- The interchanges at Lincoln Road and Te Atatu are needed to implement the planned bus network and run a rapid transit service from Westgate to the city centre with a trunk-and-feeder style of operation.

- Lincoln Road – Te Atatu is the second most economically beneficial component and should be relatively easy to construct, with land acquisition likely to be the critical path issue (start construction in the early 2020s).
- This section should include Westgate Station as this has the benefit of alignment with expectations (as per ATAP), overtly supporting growth and transport options from the North West and is deliverable in a relatively short timeframe. It also means that the RTN level of customer experience can be created from Westgate in advance of full busway delivery in a similar manner to Albany Station on the northern busway since 2008.

Point Chevalier – City

- The Point Chevalier to City section should be progressed **in parallel** with the Lincoln Road – Te Atatu section.
- This section would save an estimated twelve minutes off the trip between Pt Chevalier and the city centre, compared to the current bus lanes on Great North Road, and allow buses to avoid all the unreliability caused by traffic lights and traffic congestion.
- Because this section is located on the busy inner section of the route through established suburbs, the greatest number of users will benefit from these improvements as an early stage.
- There may be some potential value in splitting the Point Chevalier to City segment into two components (Point Chevalier to St Lukes Road and St Lukes to City) for analysis - this could save a significant amount of money by using Great North Road from Point Chevalier to St Lukes avoiding the need to construct an alignment under Carrington Road and over St Lukes Interchange. This sub-option should be considered in a Detailed Business Case.
- The earlier the Point Chevalier to City SH16 component is delivered, the better the economic value of the programme. This section has by far the highest benefits and economic return.
- The Point Chevalier to City component should be progressed with urgency along with the Lincoln to Te Atatu section but may take longer to implement due to the scale and complexity of the task so delivery may be a year or two later. As a result, it forms the **second** element of the staging plan in terms of delivery, but **first equal** in terms of progressing the next stages of project development.
- This section should be coupled with improvements to the city centre and access from SH16, Karangahape Road and Albert St.

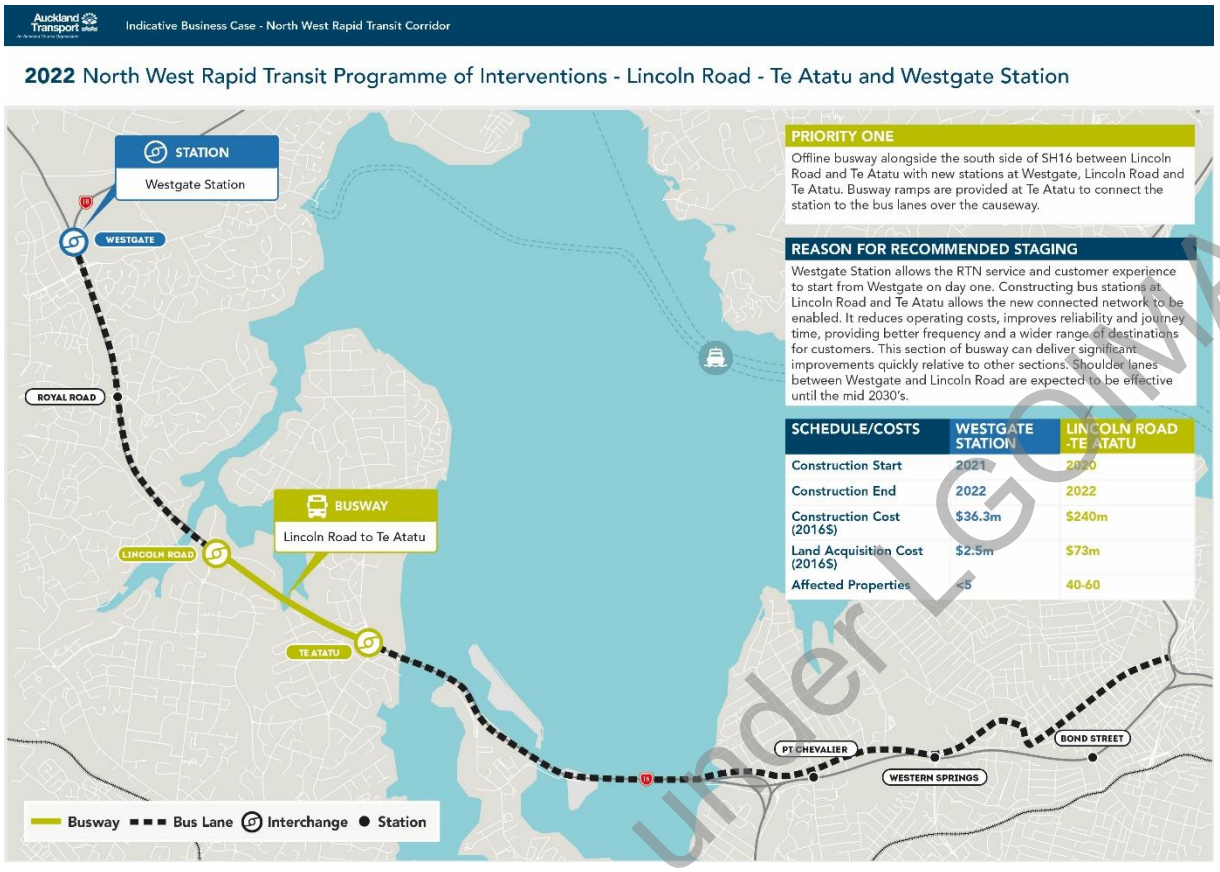


Figure 6.8 – Stage 1: Lincoln Road – Te Atatu and Westgate Station

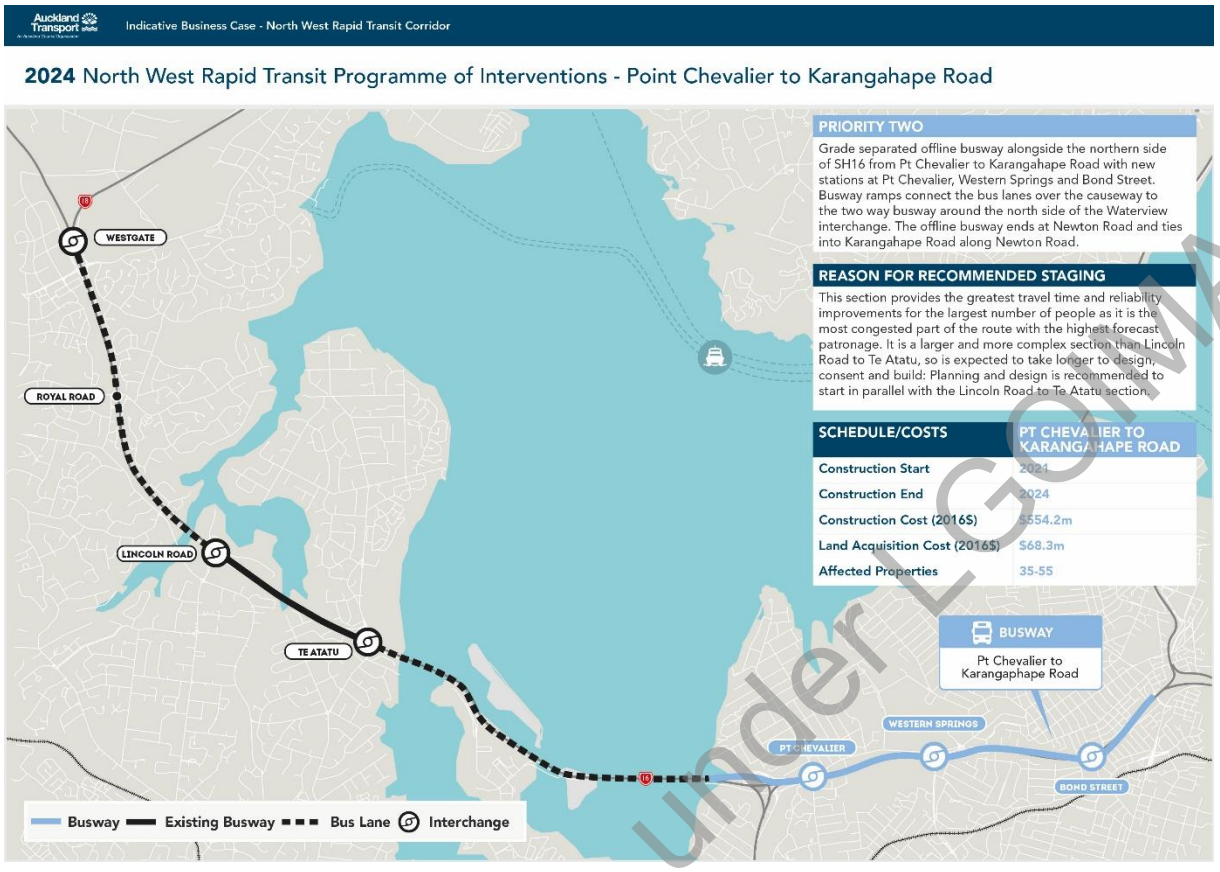


Figure 6.9 – Stage 1: Point Chevalier – City Centre

Stage 2:

Westgate to Lincoln Road

- A Westgate to Lincoln Road busway should be constructed later in the programme, after demand increases through growth and as congestion worsens making bus lanes less effective and travel times longer.
- Smaller supporting projects to enable network delivery and performance should be provided in the interim. Staging this piece later in the programme would enable funds to be brought forward to the Point Chevalier to City component which is far more beneficial. This follows the successful model used on the Northern Busway where the busway was built, to the extent possible, in the inner urban sections – although not the city centre – with extensions north now being implemented.

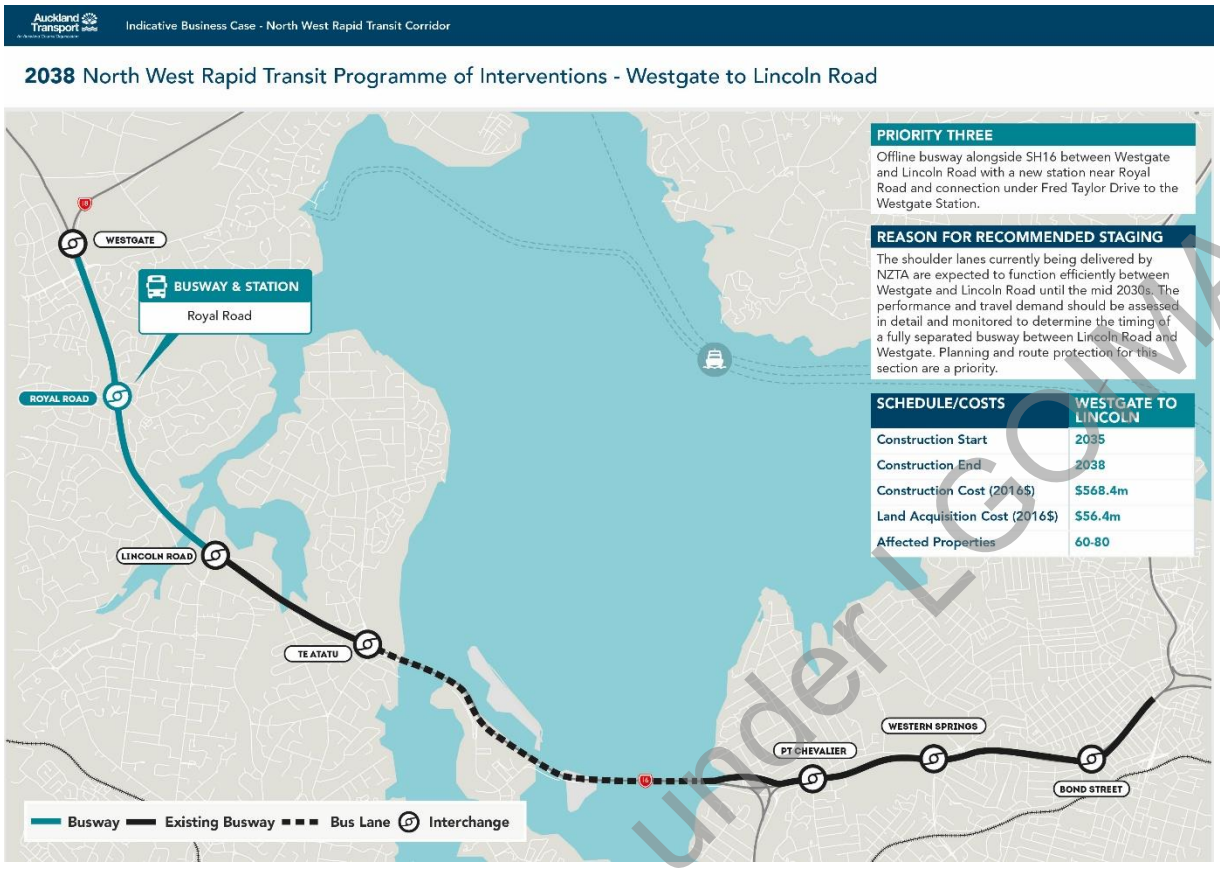


Figure 6.10 – Stage 2: Westgate – Lincoln Road

Stage 3:

Causeway:

- The causeway busway should be implemented late in the overall programme, if at all.
- It is the most expensive section and does not access a catchment, either directly or indirectly through a station interchange and as a result, its benefits are low in the short-to-medium term. The trigger for this section this may lie in in very high demand (higher than expected) and the bus lanes proving unworkable and unreliable, with mitigation, optimisation or enhancement measures proving similarly unworkable.
- If the trigger for the causeway section occurs from demand and poor performance, that may also be the time to consider a move to light rail.
- As part of the DBC, more detailed modelling and analysis should be carried out and potential enhancement of the bus lanes should be identified along with management and enforcement improvements to ensure they bus lanes function properly.
- Enhancement to the bus lanes over the causeway can be provided by installing continuous bus shoulder lanes around the ramps at Patiki and Rosebank Road for more efficient bus services along the causeway.

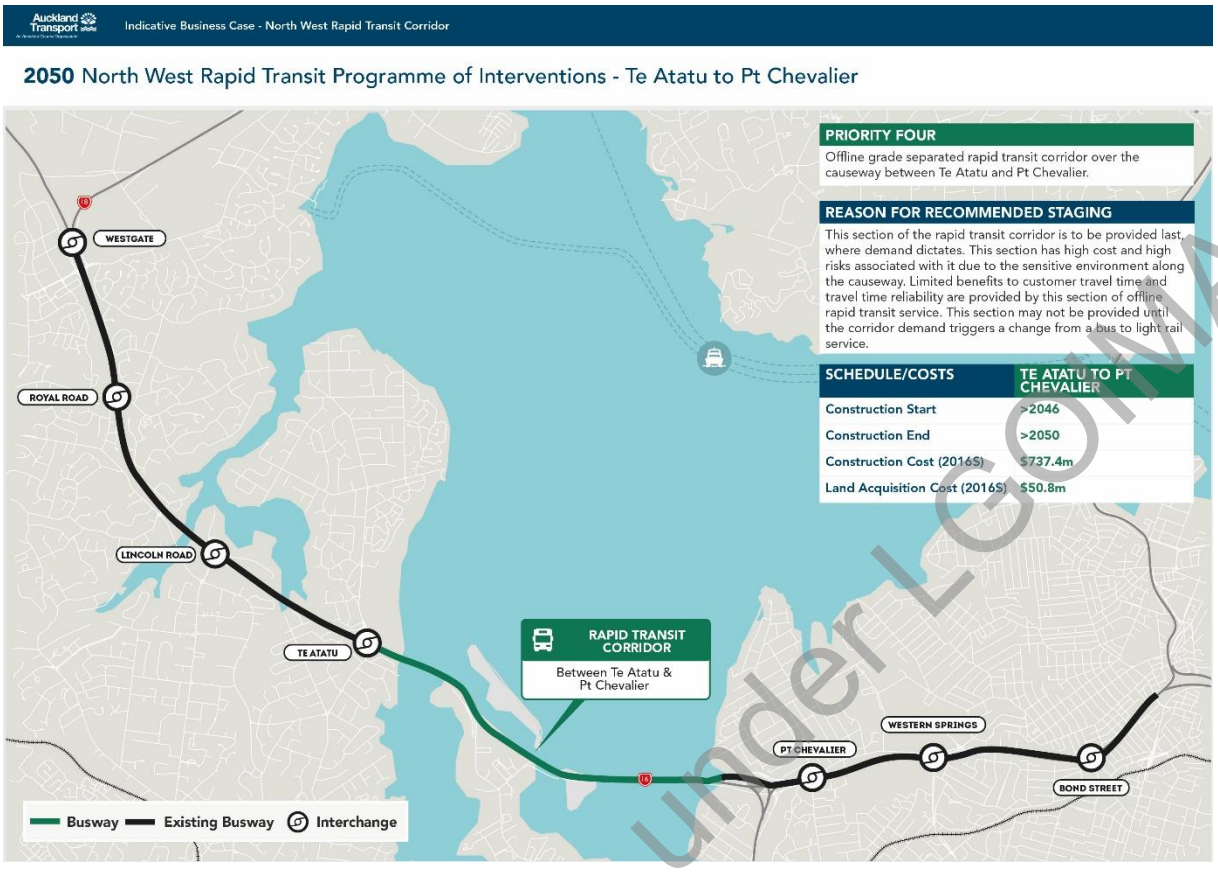


Figure 6.11 – Stage 3: Causeway

Advanced Bus/Light Rail

- The potential exists for this corridor and the staging options to accept an “advanced bus” vehicle and operation. There are some complexities in shared stops on streets with other services, particularly in the city centre. This issue could be investigated at a DBC stage, as it may have implications on details associated with the stations, access and service pattern. Station concepts have been developed to suit both light rail and advanced bus in this IBC.
- All aspects of all stages should to be designed to be light rail capable. Current forecasts do not indicate an early need for light rail capacity and operations, however this assumes that the city centre terminal capacity and routing can be resolved using a bus or advanced bus operation. It is noted, however that many historic and recent forecasts of rapid transit patronage in Auckland have been lower than actual growth.
- Economics and risks associated with light rail are currently poor due to cost and the need to construct the causeway section of the route. Benefits are not considered significantly better than bus, without higher growth.

6.6.3 Description of Stage 1

Stage 1 includes:

- A station at Westgate Town Centre
- Utilising bus lanes on SH16 between Westgate and Lincoln Road, with enhanced priority on the local network to ensure that buses can access the shoulder lanes in a fast and reliable manner.

- Separated busway on SH16 between Lincoln Road and Te Atatu
- Using the existing bus shoulder lanes on SH16 between Te Atatu and Waterview Interchange
- Separated busway on SH16 between Waterview Interchange and the end of the Newton Road off ramp
- Implementation of supporting measures outlined in Section **Error! Reference source not found.**

6.6.4 Benefits and effectiveness of Stage 1 -

Strategic alignment

Supporting growth

- Supports greenfield growth in the north-west through providing the capacity required for the increased journeys from the growth areas, access to jobs and education for the north-west growth areas, some of which are already live-zoned. By 2026 by which time Stage 1 is expected to be in place, the Hobsonville/Whenuapai/Westgate area is expected to grow from a population of 39,000 to 75,000, an increase of 96%. This is expected to generate an increase in total transport demand by 2026 from 18,000 in the am peak now to 38,000 in the am peak by 2026.
- Supports inner urban growth by improving access to the city centre and fringe as well as access for established areas such as Te Atatu and Massey to jobs and education.
- Provides for a station at Westgate to enable an RTN customer experience and integrated service to exist from the growth areas at the commencement of Stage 1. This is similar to the way Albany Station has operated on the Northern Busway since 2008.
- The Great North Road corridor between Point Chevalier and the city centre has had significant development and intensification in recent years, with a large amount of apartment development on the inner section. There remains considerable potential for further intensive apartment and commercial redevelopment along the length of this corridor, which is both enabled by the Unitary Plan and consistent with current market activity.
- The preferred option supports this growth by providing greatly increased transport capacity and options to the wider corridor, by adding busway stations at Point Chevalier, Western Springs and Bond Street. The preferred option also avoids running regional rapid transit buses on Great North Road itself, which allows the service delivery on the Great North Road bus lanes to be tailored to suit frequent urban transit operations.

Making public transport more efficient

- The inclusion of stations at Westgate, Lincoln Road and Te Atatu provides hubs at which local services can interchange with mainline busway services. This allows a more cost effective public transport service that is consistent with Auckland Transport's connected public transport network model.
- The Westgate, Lincoln Road and Te Atatu stations allow fewer buses carrying more people to enter the space-constrained city centre improving efficiency and urban quality outcomes.

ATAP

- The Te Atatu to Westgate section is specifically included in ATAP's Decade 1 Priorities and extensions in ATAP's Decade 2 Priorities. Stage 1 includes the key elements of the ATAP Decade 1 recommendation with the stations at Westgate, Lincoln Road and Te Atatu and separated busway between Lincoln Road and Te Atatu. Stage 1 diverges slightly from ATAP in recommending inclusion of the Waterview to Karangahape Road section whereas ATAP included "Northwestern

busway extensions" in Decade Two. This is still considered consistent with the intent of ATAP and is recommended on the basis of more detailed assessment.

Effectiveness

As Stage 1 introduces most of the core elements of the recommended option, it delivers most of the benefits. As this business case recommends retaining the bus shoulder lanes on the causeway between Te Atatu and Waterview, the only significant element of the Northwest Busway not included in Stage 1 is the section between Lincoln Road and Westgate. It is expected that bus shoulder lanes will be able to operate effectively on this section for some time as growth gradually drives increased demands and congestion.

The inclusion in Stage 1 of stations at Westgate, Lincoln Road and Te Atatu enables most of the accessibility and operational benefits to be realised while the sections of busway between Lincoln Road and Te Atatu and Waterview and Karangahape Road, combined with the causeway bus shoulder lanes provide most of the travel time and reliability benefits.

Specific to the KPIs, effectiveness of Stage 1 is:

- **Accessibility:** While the bus shoulder lanes on SH16 between Lincoln Road and Te Atatu remain effective in the first decade meaning an improved access to jobs for people in the north-west to almost the same level as the full option as growth occurs.
- **Corridor throughput:** Stage 1 increases the person throughput of the SH16 (all modes) at Waterview from 11,000 per hour in the Do-Minimum to 16,000 per hour. While the bus shoulder lanes on the Lincoln Road to Te Atatu section are operating effectively and supporting priority on the local network is implemented, the throughput on Stage 1 is similar to the full option.
- **Mode share:** Increases bus passengers entering the city centre from the north-west from 6,800 in the Do-Minimum to 9,300 in 2046. It does this with the same number of buses entering the city centre with higher occupancy.
- **Travel time:** Creates a journey time by bus from Westgate to the city centre of approximately 35 minutes in the peak compared to an expected journey time of 50 minutes with the Do-Minimum.
- **Transport subsidy:** Will save $11 million per year in operating costs. It will require $48m/year against $59m/year with the Do-Minimum. As Stage 1 includes all of the proposed interchanges, it allows the same service pattern as the full option to be operated. There may be a very slightly higher cost than the full option due to the need to access the bus lanes at Lincoln Road and Westgate.

The benefits of implementing Stage 2 relate to maintaining the effectiveness of the Stage 1 investment as traffic grows and levels of service of the bus lanes and local access degrade as well as some improvement to catchments with additional stations. Stage 2 also aligns investment with the timing of growth and adds reliability and capacity to the outer parts of the catchment area as growth occurs.

6.7 Implications for a future-ready busway

The context within which the northwest busway is to be developed is more rapidly changing than ever in many respects including technology, access to information and services as well as people's expectations, behaviours and access to information and services. At this early stage, it is important that the role of emerging technology and future behaviours and developments is recognised and that these are considered more deeply in future stages of the development of the busway.

6.7.1 Connected and autonomous vehicles

Busways are typically constrained operationally by the capacity of rigid or articulated single vehicles and the need for individual driver operation which also adds cost per unit. Connected or autonomous vehicles could increase the potential capacity of a bus-based operation closer to that of a light rail operation, while maintaining the lower capital costs and operational flexibility of a bus-based operation. Autonomous vehicles would also be capable of operating more accurately providing for better platform alignment, faster boarding and improved platform utilisation.

Implications may arise in terms of platform design and operation, however as the station concepts and all design standards in the NWRTC have been guided by light rail design standards, as long as this design philosophy is maintained, the potential for connected and autonomous vehicles provides an opportunity for greater capacity and efficiency.

6.7.2 Mobility as a Service

Information and journey mapping for all modes is now available on various mobile apps and websites. In some cases, connected journeys can also be planned and information obtained on departure times, real time operation, and journey maps. Actual purchase of journeys is still carried out separately. For example, AT HOP is the method used for public transport trips and is subject to a separate pricing structure and payment mechanism than, for example Uber or even road use. This means that as an overall network, the consumer's ability to easily make trade-offs in terms of time, cost and reliability or quality is limited.

Mobility as a Service (MaaS) would take this a step further and enable consumers to not only understand the journey choices, but also make purchases in the same application. It may also allow consumers to pre or bulk-purchase a transport product and choose how these are used.

MaaS may have an effect on the north west busway and in fact all public transport routes by influencing arrival modes and the peaks in demand.

6.7.3 First mile and last mile transport

The combination of MaaS allowing pre-purchasing of transport to and from interchanges and potentially autonomous vehicles providing local distribution services cheaper than a taxi and more directly than a feeder bus may result in changes in the mix of space required for arrival and departure modes from stations.

Some potential modes and considerations are:

- Ride sharing / taxi services – These services will require dedicated parking and queueing (and even charging) facilities in and around the interchange.
- Car sharing / short term car rental services – Just like ride sharing, these services may also require dedicated parking spaces in the interchange. In addition, dedicated on-street parking (which can be free to permitted service providers) may be needed in the vicinity of the interchange.
- On-demand shuttle services – These services provide connection between interchanges and dispersed/specific/low volume destinations. Routes can either be fixed or dynamically plotted based on pickup and drop off locations. These services will require parking (and even charging) facilities at interchanges which should be separated from the main bus services.
- Bus services – MaaS is expected to increase the use of bus services. This could translate to a need for double deckers and larger local platforms. Charging facilities (in ground or above ground) for electric buses are to be considered.

- Private vehicles – There will continue to be a demand for park & ride and kiss & ride facilities. Park and ride demand may not grow to the same extent or be allocated in the same way as we have experienced to date. More park & ride facilities may be allocated for vehicles with multiple occupants and EVs/hybrids/AVs/small vehicles. Parking spaces dedicated to EVs may come with charging facilities.
- Walking – With more transport modes and choice available at the interchange, there will need to be more wayfinding signage and markings in and around the interchange to guide users. Users will want clear information and guidance on transiting from one mode to another and the available options at the interchange. The interchange layout should enable easy and efficient transfer between different transport services within the bus interchange e.g. bus services on one side and first/last mile transport services on the other separated by a platform.
- Bike Sharing – Secure parking and bike share facilities (preferably undercover). For bike share to work, there will need to be bike share facilities on the wider network e.g. at key destinations / high density areas.
- Autonomous vehicles (AVs) – In the future, MaaS will likely incorporate AVs which can be used for personal or public transport. Apart from charging, it is unclear what specific facilities will be needed for AVs at this stage. However, it is possible that AVs will rely on clear signage and road marking as well as logical and recognisable layout.
- Accurate and reliable live information about departure/arrival times, journey times, parking availabilities, etc. displayed at strategic locations in and around the interchange.

It should be noted that investment should not be limited to interchanges alone. The quality and operation of the surrounding road network are also key factors in first/last mile transport. For instance, the usage of the active modes as first/last mile transport is largely dependent on the quality and connectivity of cyclist and pedestrian provisions on the surrounding road network.

6.8 Economic Evaluation

This section describes how whole of life benefits from NWRTC options were calculated, relative to the Do-Minimum scenario.

6.8.1 Methodology

Following the New Zealand Transport Agency's (NZ Transport Agency) (2016) *Economic Evaluation Manual*, the assessment accounted for the full range of costs and benefits that may arise from the NWRTC options. The following table lists project costs and benefits, describes how they arise, and identifies sources for the estimates.

Table 6.2 - Overview of project costs and benefits

Category	Description	Source
Project costs		
Construction costs	Costs to physically build NWRTC options, broken down by segment. Focused on the P50 cost estimate as the most likely outcome.	Initial engineering estimates as in Section 4.
Land costs	Costs to acquire land to develop corridors and stations, broken down by NWRTC segment.	Initial property acquisition costs as in Section 5.5.6.

Annual operating cost savings	Future reduction in operating costs arising from implementation of new stations / interchanges enabling bus network simplification.	Initial network cost savings as in Section 4.
Project benefits		
Public transport user benefits	Reductions in journey time and improvements in journey quality for existing and new public transport users on the NWRTC.	APT model outputs (with and without the crowding module applied) used to estimate reduction in generalised cost of travel for PT users. EEM values used to monetise resultant health benefits.
Public transport reliability benefits	Reductions in the variability of journey time for PT users on the NWRTC.	Relative magnitude of PT user benefits from improved average travel time and improved reliability estimated using Auckland Transport Real Time bus data for the Northern Busway and the existing Northwestern bus services.
Road user benefits	Decongestion benefits for road users reflecting reduced journey times due to mode shift on NWRTC, taking account of any reductions in road capacity due to new bus facilities.	ART model outputs used to estimate reduction in generalised cost of travel for drivers. EEM values used to monetise resultant health benefits.
Health benefits from added walking	Increased public transport use also increases walking to and from stations/ stops, resulting in some health benefits.	Demand outputs from the APT model used to estimate additional walking trips to and from public transport. EEM values used to monetise resultant health benefits.
Emission reduction benefits	Mode shift from car to public transport and rationalisation of public transport routes reduces vehicle emissions affecting the environment (carbon dioxide) and human health (fine particulates).	Demand outputs from the ART model used to estimate reduction in car emissions combined with estimates of savings on bus service-km used to estimate reductions in bus emissions. EEM values used to monetise benefits.
Agglomeration benefits	Reduced journey times between firms and workers results in higher economic productivity.	ART model outputs used to estimate reduction in the generalised cost of commuting and work purpose trips, by car and PT. EEM procedures were used to estimate resulting percentage change in productivity within individual model zones. MRCagney's Urban Productivity Database was used to estimate dollar value of agglomeration benefits.

Imperfect competition benefits	Reduced journey times for work purpose trips result in an additional saving due to the price-cost margin between travel costs and prices charged to customers.	ART model outputs used to estimate reduction in the generalised cost of work purpose trips, by car and PT. EEM values were used to estimate added imperfect competition benefits.
Tax wedge on increased labour supply	Reduced journey times for commuting trips enable some people to enter the labour market. This results in an additional benefit associated with the taxes that they pay on labour income.	ART model outputs used to estimate reduction in the generalised cost of commuting trips, by car and PT. EEM procedures were used to estimate resulting change in labour market participation. Data from the 2013 Census and MRCagney's Urban Productivity Database were used to estimate dollar value of labour supply benefits.
Residual value	Infrastructure may still have usable life at the end of the project period. The remaining ('residual') value of infrastructure is counted as a project benefit.	Straight-line depreciation was applied to the value of capital assets (land, running ways, and stations) and the residual value at the end of the project period was calculated.

Because these costs and benefits arise over different timeframes, it was necessary to calculate the discounted present value of future costs and benefits to enable a consistent comparison. The following table summarises the range of discount rates and evaluation periods in the analysis.

Table 6.3 - Discount rates and evaluation periods

Scenario	Discount rate	Evaluation period
Central (EEM standard)	6%	40 year
Low discount rate, long evaluation period	4%	60 year
High discount rate, short evaluation period	8%	30 year

6.8.2 How benefits were estimated for staging and earlier years

Because transport model outputs were only available for complete busway options for a single year (2046), it was necessary to extrapolate them forwards and backwards and allocate benefits to specific segments of the NWRTC.

This section describes how this extrapolation and allocation was done, including the limitations and caveats associated with this approach.

Extrapolating benefits to evaluation period

ART3 model forecasts of AM peak public transport demand (from the Common Elements Enhanced v4 scenario from ATAP) in 2026, 2036, and 2046 were used to extrapolate project benefits to earlier dates.

The following table shows the ratio of 2026 and 2036 demands on the NWRTC relative to 2046 demands. These factors were used to extrapolate demand forward and backwards throughout the evaluation period.

Table 6.4 - Ratio of NWRTC peak public transport demand relative to 2046 demands

Overview of project costs and benefits	Overview of project costs and benefits
2026	64%
2036	87%
2046	100%

The limitation of this extrapolation approach is that it focuses on transport demands and does not account for other factors that may scale non-linearly with demand, such as peak period congestion affecting bus operations.

Estimating benefits for specific segments of the NWRTC

In order to understand the costs and benefits of alternative staging options, it was necessary to allocate modelled benefits for the entire project to individual segments of the NWRTC. This involved comparison of modelled 2046 benefits between Options B, C, and D, plus the use of relative modelled 2046 PT passenger-kilometres on different segments of the NWRTC to allocate benefits to segments.

The following table summarises the individual NWRTC segments used in the analysis and describes how benefits for each segment were estimated based on 2046 model outputs.

Table 6.5 - Approach to allocating benefits to NWRTC segments

Segment	Approach to estimating benefits
Busway segments	
Busway Point Chevalier-Karangahape Road SH16	Estimated as the difference in benefits between Option D (full busway via SH16) and Option B (continuous bus lanes).
BRT Point Chevalier-Karangahape Road GNR	Estimated as a share of the difference in benefits between Option C (full busway via Great North Road) and the Do-Minimum. Benefits allocated based on the share of NWRTC AM peak passenger-kilometres using this segment (see Table 6.6).
Busway Causeway	
Busway Te Atatu-Lincoln	
Busway Westgate-Lincoln	
Light rail segments	
LRT Point Chevalier-Karangahape Road SH16	Same benefits as equivalent segment of busway
LRT Point Chevalier-Karangahape Road GNR	
LRT Causeway	
LRT Te Atatu-Lincoln	
LRT Westgate-Lincoln	

The following table shows the estimated AM peak passenger kilometres occurring on each segment of the NWRTC in 2046.

Table 6.6 - 2046 passenger-kilometres on each segment of the NWRTC

NWRTC segment	Distance (km)	2046 AM peak patronage	AM peak pax-km
Waterview to Karangahape Road (via either SH16 or GNR)	5.0	9,220	46,100
Te Atatu to Waterview (Causeway)	5.2	6,810	35,412
Te Atatu to Lincoln	2.1	5,977	12,552
Westgate to Lincoln	4.5	4,492	20,214

6.8.3 Summary of economic evaluation

This section summarises the results of economic evaluation of the preferred option and incremental options for implementing separate stages of the project, as well as the results of sensitivity testing of project benefits.

Economic evaluation for recommended NWRTC staging option

The recommended staging option for the NWRTC is as follows:

- 2020: Lincoln Road to Te Atatu busway; Westgate Station; Lincoln Road Station; Te Atatu Station
- 2021: Point Chevalier to Karangahape Road busway via SH16; new stations at Point Chevalier, Western Springs, Arch Hill
- 2035: Westgate to Lincoln Road busway; Royal Road Station
- Not included: Te Atatu to Point Chevalier (causeway) busway

Table 6.7 summarises the costs and benefits of the recommended option, in present value terms, using standard EEM assumptions about discount rates and evaluation period. Low and high estimates of benefits are provided, with the lower end of the range reflecting ART and APT outputs and the upper end of the range scaled up to account for probable under-counting of some benefits.

This analysis shows that:

- The present value costs of this option are estimated as $518 million. This includes present value operating cost savings of $76 million which partially offset some of the up-front capital costs.
- The present value benefits of this option are estimated to range from $514 million to $830 million. This can be further broken down as follows:
  - Public transport user benefits (reduced journey times and improved journey time reliability) account for around 60% of total project benefits
  - Other conventional transport benefits account for around 6% of total project benefits.
  - Wider economic benefits (WEN) (agglomeration, imperfect competition, and tax wedge benefits) account for around 20% of total project benefits.
  - The residual value of infrastructure accounts for the remainder of project benefits.
- The benefit cost ratio (BCR) is estimated to range from 1.0 to 1.6 if WEBs are included and from 0.8 to 1.3 if WEBs are excluded.

Table 6.7 - Cost benefit analysis of recommended NWRTC staging option (6% discount rate, 40 year period)

	Low estimate	High estimate
Costs (present value, $000s)		
Gross land costs	$166,323	$166,323
Construction costs	$593,149	$593,149
Operating cost savings	-$75,629	-$75,629
Total project costs	$517,521	$517,521
Benefits (present value, $000s)		
Public transport user benefits	$240,529	$417,576
Public transport reliability benefits	$60,571	$105,156
Road user benefits	$6,407	$11,123
Health benefits from added walking	$17,942	$31,149
Emission reduction benefits	$4,255	$4,255
Parking resource cost correction benefits	$1,806	$1,806
Agglomeration benefits	$82,971	$144,044
Imperfect competition benefits	$2,680	$4,653
Tax wedge on increased labour supply	$18,217	$31,627
Residual value of infrastructure	$78,477	$78,477
Total project benefits	$513,857	$829,867
Benefit cost ratio		
Benefit-cost ratio (with WEBs)	1.0	1.6
Benefit-cost ratio (no WEBs)	0.8	1.3

Analysis of individual project stages

The present value costs and benefits of each individual segment were estimated in order to understand their relative economic value. To enable a consistent comparison, all corridor segments were assumed to begin construction in 2020.

Note that it is *not* recommended that most stages start construction in 2020. The analysis compares their net worth and shows which stages should be deferred until higher demand and traffic levels mean that the benefits will be significantly higher.

This analysis shows that, if construction begins in 2020:

- A busway from Point Chevalier to the city along SH16 would have the highest BCR, with a range from 1.3 (low benefit estimate, no WEBs) to 2.7 (high benefit estimate with WEBs). This reflects the fact that this segment has the highest total demands and some of the greatest existing issues with slow travel times on local roads or congested motorways.
- The second-highest BCR would be achieved by a busway from Point Chevalier to the city on Great North Road, which would offer fewer travel time savings but still serve a large market.
- The Lincoln to Te Atatu segment would offer the third-highest BCR, with a range of 0.3 to 0.7 if construction begins in 2020. This segment would offer significant operating cost savings to offset

construction and land costs, reflecting its important role in enabling delivery of a more efficient and connected bus network model in West Auckland. The BCR indicates that start on this stage should be delayed.

- If construction begins in 2020, the Westgate to Lincoln segment is expected to have a BCR in the range of 0.2 to 0.3, reflecting the fact that this segment is comparatively long (and hence costly to build) while having generally lower initial levels of demand. This stage should therefore be considered once demand has increased significantly.
- The Causeway segment is expected to have the lowest BCR. It is the costliest single piece of the overall NWRTC, with significant consenting challenges, and is the corridor segment where existing shoulder bus lanes may be most appropriate as a long-term solution.

The relative composition of benefits is broadly similar in all options and hence it is not reported in detail in this table.

Table 6.8 - Cost benefit analysis of individual NWRTC segments (6% discount rate, 40-year period)

NWRTC segment	Point Chevalier to city (SH16)	Point Chevalier to city (GNR)	Causeway	Lincoln to Te Atatu	Westgate to Lincoln
Costs (PV, $000s)					
Gross land costs	$94,370	$0	$0	$57,823	$46,666
Construction costs	$278,070	$161,255	$428,695	$158,322	$354,361
Operating cost savings	-$4,663	-$4,888	-$8,027	-$60,894	-$26,348
Total project costs	$273,407	$156,366	$420,667	$97,429	$328,014
Low estimate of benefits (PV, $000s)					
Conventional benefits	$342,408	$66,714	$51,321	$33,047	$50,027
Conventional benefits + WEBs	$428,886	$112,344	$69,231	$45,471	$68,544
High estimate of benefits (PV, $000s)					
Conventional benefits	$575,151	$108,399	$67,095	$44,397	$66,638
Conventional benefits + WEBs	$725,282	$187,615	$98,188	$65,965	$98,784
Benefit cost ratios					
Low BCR (with WEBs)	1.6	0.7	0.2	0.5	0.2
Low BCR (no WEBs)	1.3	0.4	0.1	0.3	0.2
High BCR (with WEBs)	2.7	1.2	0.2	0.7	0.3
High BCR (no WEBs)	2.1	0.7	0.2	0.5	0.2

Sensitivity testing

Finally, sensitivity testing was conducted on the benefits and costs of the recommended NWRTC staging option. These results are reported in the following table. All BCRs are reported inclusive of

conventional transport benefits and WEBs, noting that conventional benefits alone are around 80% of total benefits.

This analysis shows that, although some sensitivity tests result in low estimate of the BCR below 1.0, the upper end of the range remains above 1.0 in all scenarios. This suggests that the project is likely to have net economic benefits under a range of potential scenarios.

Combinations of multiple sensitivity tests reveal that:

- A 4% discount rate and 60-year evaluation period in combination with faster development and a 1.5% annual real increase in the value of conventional benefits would result in a BCR range of 2.6 to 4.5.
- An 8% discount rate and 30-year evaluation period in combination with a P95 construction cost outcome, development proceeding according to the Auckland Plan land use, and a 0% annual real productivity increase (and hence the value of WEBs) would result in a BCR range of 0.7 to 1.0.

Table 6.9 - Results of sensitivity testing on recommended NWRTC staging option

Sensitivity test	BCR – low estimate	BCR – high estimate
Standard assumptions (6% discount rate, 40-year period, Auckland Plan land use)	1.0	1.6
4% discount rate, 60-year evaluation period	1.7	2.9
8% discount rate, 30-year evaluation period	0.8	1.2
Faster north-west development (demand brought forward 5 years)	1.1	1.8
1.5% annual real increase in value of conventional benefits (in line with productivity growth assumption)	1.2	2.0
0% annual real increase in value of WEBs (reflecting no productivity growth)	0.9	1.5
P95 construction cost estimate (approximately 17% higher)	0.9	1.4

7 Commercial Case

7.1 Industry capability

The recommended programme includes a combination of using the existing bus lanes that have been constructed as part of the Western Ring Route project that has upgraded much of SH16 as well as implementation of a new, separated busway and stations. In terms of design and construction techniques and capability, the programme involves infrastructure that is relatively common in New Zealand and well within the capability of a number of members of the local industry to deliver.

The Western Ring Route project has involved the widening, upgrading and implementation of new structures on the SH16 corridor. As a result, there is good knowledge of the project sites and the issues associated with implementation of major new infrastructure in this location. The Northern Busway was completed in 2008 providing relatively recent industry experience in developing an off-line busway and associated interchanges and operational facilities. In addition, new interchanges have been developed throughout the Auckland Region, for example Otahuhu and New Lynn among others.

The most significant risk to delivery is likely to be capacity within the industry rather than capability given the forecast programme in the transport sector.

7.2 Certainty and funding

While addressed in more detail in the Financial Case and Strategic Case, the NWRTC is well foreshadowed in strategic and financial strategies. The project is key to supporting strategic growth, and as a result is specifically included in ATAP's Decade One programme. This provides a sound base for the industry's consideration of the project as a sound commercial proposition.

7.3 Delivery options and issues

7.3.1 Responsibility

Depending on decisions made in project responsibility (see the Management Case), there is potential to deliver this project either in accordance with the "normal" practice up to this time of Auckland Transport delivering stations while the Transport Agency provides running ways or with the Transport Agency providing the entire facility. As the responsibility for delivery of the NWRTC has not been determined at this time, the Commercial Case outlined here is indicative only and outlines issues in general terms. It is expected that the organisation that is determined responsible and that will act as requiring authority under the Resource Management Act will take a view on these matters.

7.3.2 Land Acquisition

With a potential of approximately 200 properties to be partially or fully acquired to deliver the entire recommended option, the ability to acquire land is a key risk and likely to be an early activity in the successful and/or timely delivery of the project. Recent accelerated projects carried out by the Transport Agency in Auckland have adopted an approach based around early negotiation with land owners concurrently with project planning and ahead of formal lodgement of Notices of Requirement or commencement of Boards of Inquiry. This is an approach that could be considered in this case given the demand and strategic drivers underpinning the project.

7.3.3 Consenting

The recommended option will require a wide range of consents, however fundamentally there will need to be the lodgement of a significant Notice of Requirement under the Resource Management Act. This activity, along with land acquisition noted above is likely to comprise a high risk in the delivery of the project and form a critical path activity in terms of programme. There are two potential

paths for this to take place. Firstly a standard approach involving lodgement of the Notice of Requirement with Auckland Council with a submission and appeal process via a hearings panel and, if required, the Environment Court. The alternative approach is to use a Board of Inquiry process. The latter provides greater certainty of outcome and timing.

The NWRTC corridor also potentially affects several utilities of significance including Transpower, Vector, Watercare and Radio NZ. Advanced discussion with these organisations and early development of agreements would help to identify and reduce risk early.

7.4 Design and business case

The next stage of business case development is expected to be a detailed business case for the Stage 1 elements of the NWRTC.

Should an accelerated approach be desired, delivery requires active identification and management of risks. Early development of specific, co-ordinated and risk-based strategies for the following areas will provide a framework for the accelerated delivery and provide certainty as to the approach:

- Consenting and planning approvals
- Land acquisition
- Procurement
- Communications and engagement
- Specific consultation with utility service providers (Transpower, Vector, Watercare, Radio NZ)

Development of these strategies is likely to uncover specific issues and risks and allow Auckland Transport and the Transport Agency to consider and respond to them.

Following a sequential model where a Notice of Requirement and all property has been acquired prior to construction commencing, there are a number of procurement options available, including a traditional lump sum method. If an accelerated approach is desired, it is possible that some residual property risk may remain going into the construction phase. This can be managed through methods such as alliances allowing contracting partners to manage the property acquisition and the timing of land availability within their design and construction methodologies, providing a flexible programme. The property acquisition risk would be shared amongst the Alliance partners.

Recent accelerated projects in Auckland run by the Transport Agency have reduced delivery time by running the Statutory Approval process in parallel with the procurement process. Procurement would commence shortly after the time of lodgement of the NOR and would be based on the draft Consent Conditions and effectively a Scheme Design that would form the Specimen Design (with minor enhancement). These Consent Conditions would then be updated to the Draft/Final Approved Consent Conditions prior to Award and rolled into the tenderers design/price in the final month of the tender.

The complexity of change likely through this planning process and ability to fully define scope would be a key factor in deciding the Contract form. If early delivery is sought, the form may be a Design and Construct, Early Contractor Involvement or a Competitive Alliance for the NWRTC. This is likely to be split into procurement packages that align with the delivery staging programme.

8 Financial Case

8.1 Cash Flow

Based on current estimates, the anticipated cash flows for the investment proposal over its intended life span are set out in the table below.

Table 8.1 - Summary of estimated costs

Estimated costs						
Section	**Decade 1**		**Decade 2**		**Future stages**	
	Construction (P95)	**Land**	**Construction (P95)**	**Land**	**Construction (P95)**	**Land**
Westgate Station	$36.3M	$2.5M	-	-	-	-
Busway Lincoln to Te Atatu	$240M	$73M	-	-	-	-
Busway Point Chevalier to city centre	$554.2M	$68.3M	-	-	-	-
Busway Westgate to Lincoln Road	-	-	$568.4M	$56.4M	-	-
Busway Te Atatu to Point Chevalier	-	-	-	-	$737.4M	$56.8M
Total	**$830.5M**	**$143.8**	**$568.4M**	**$56.4M**	**$737.4M**	**$56.8M**
Total cost per stage	**$974.3M**		**$624.8M**		**$794.2M**	
Total solution cost	**$2,393.3[1]**					

The funding assumes the “normal” inter-agency split - i.e. the Transport Agency will be responsible for the mainline and AT the stations – with usual FAR from the Agency.

The cost to the two authorities will be spread over multiple decades. The initial costs, in the first decade, of $974.3m should be viewed in the context of the National Land Transport Programme (NLTP) which is guided by the GPS. The latest (draft) GPS provides annual ranges for public transport expenditure for the years 2018/19, 2019/20 and 2020/21 of $315m – $435m, $315m - $450m and $320m - $465m, respectively (p. 26). The GPS comments that expenditure is currently in the middle of the range.

Without being able to comment on other demands and priorities, it appears that there is no reason that the Programme should be considered unaffordable for the Agency.

AT is currently advising Council on its future needs which will be considered in the Council’s Long-term Plan. At present, there is no reason to anticipate that the staged busway cannot be funded.

It should be noted that there should be high awareness of the need to fund the NWRTC as it was explicitly included in ATAP, albeit with different staging.

[1] Construction cost estimates include cost associated with the staging of the recommended programme.

8.2 ATAP

The ATAP recommendations include: as an early priority (completion in decade 1):

- Northwestern Busway (Westgate to Te Atatu section).

The ATAP medium term priorities (completion in decade 2) then has:

- Northwestern Busway extensions.

These indicative timings reflect ATAP's view on public transport mode share.

> *"Both the current plan and the indicative package project a strong increase in public transport mode share, from 7% in 2013 to 11% by 2026. This equates to a doubling in total annual public transport trips over that period, to around 146 million by 2026. Further improvements are projected under the indicative package, with mode share increasing to 16% by 2046 (276 million passengers)". P. 39*

It should be noted that funding and financial responsibility of the ATAP programme will be worked through by all agencies and the NWRTC recommendations will be covered.

9 Management Case

The default assumption is that the implementation will adopt the “normal” split of responsibilities (the NZ Transport Agency will design and build the mainline, while Auckland Transport has responsibility for the stations). There is some potential for changing this approach for this project.

The precise arrangement is to be determined - being actively discussed at the time of writing.

9.1 Project development

To date the NWRTC project has been led by Auckland Transport with close support from the NZ Transport Agency. As noted in this IBC, the North-West Busway is included in the ATAP agreed programme, having been assessed within that framework following the adoption of the Indicative Business Case, Strategic Case Review & Scoping of May 2016.

The IBC has been prepared by Aurecon in conjunction with MRCagney, reporting through an Auckland Transport Project Manager to a Project Control Group (PCG). The PCG has been responsible for ‘signing-off’ critical stages of the business case.

9.2 Future project management strategy and framework

It is anticipated that the initial stages of the busway programme, as recommended, will be advanced as detailed business cases.

If the recommended staging is followed, the first stages will be implemented and their performance monitored and assessed using standard Auckland Transport monitoring of patronage and road volumes and travel times, which will allow the timing of later stages to be refined.

9.3 Risk management

The outstanding risk for the project remains the capacity of city centre roads to accommodate the numbers of buses from the north-west and associated bus stops. Resolving this issue is linked to questions relating to the Dominion Road corridor and the plans for the Northern Busway.

There are no particular construction or consenting risks in relation to the preferred programme.

A reputational risk may arise in regard to possible changes to the north-western motorway following recent construction works.

Another key risk to the project is new development being located.

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