AIRPORT TO BOTANY

Concept of Operations

Auckland Transport

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Glossary of abbreviations

Abbreviation	Term
A2B	Airport to Botany
AC	Auckland Council
AIAL	Auckland International Airport Limited
AMA	Auckland Motorway Alliance
AT	Auckland Transport
ATAP	Auckland Transport Alignment Project
ATOC	Auckland Transport Operations Centre
AVID	Automatic Video Incident Detection
AVL	Automatic Vehicle Location
BRT	Bus Rapid Transit
CC2M	City Centre to Māngere
CCTV	Closed Circuit Television
CPTED	Crime Prevention Through Environmental Design
EHP	Emergency Help Point
FPD	Fare Payment Device
INCOSE	International Council on Systems Engineering
ITDP	Institute for Transportation and Development Policy
IPTED	Injury Prevention Through Environmental Design
ITS	Intelligent Transport System
LTMA	Land Transport Management Act 2003
NOP	Network Operating Plan
ONRC	One Network Road Classification
PA	Public Address
PBC	Programme Business Case
PID	Passenger Information Display
PTOM	Public Transport Operating Model
RCA	Road Controlling Authority
RMA	Resource Management Act 1991
RTN	Rapid Transit Network
SCATS	Sydney Coordinated Adaptive Traffic System
SH(#)	State Highway (number)
SSBC	Single-Stage Business Case
SPBC	Supplementary Programme Business Case
SUP	Shared Use Path
TDM	Transport Design Manual
Transport Agency	NZ Transport Agency
TTMP	Temporary Traffic Management Plan
VIP	Very Important Person
VRD	Vending and Reload Device
WRR	Western Ring Route

1 Introduction

1.1 Background

In 2018, the Transport Agency, Auckland Transport (AT) and Auckland International Airport Limited (AIAL) designated the collective suite of projects addressing Airport access to the east and south as “The Southwest Gateway Programme”. It is a programme of three key transport projects to create a well-connected transport system that provides choice and reliability for how people and freight travel around southwest and southeast Auckland, including to and from the Airport. The programme aims to:

“Connect communities and support growth by ensuring it’s possible to move increasing numbers of people. The efficiency of freight will be improved by providing greater travel choice, improving safety and in turn improving accessibility to jobs, education and social opportunities, reducing congestion and providing health and environmental benefits.”

The Auckland Airport Access Programme Business Case (PBC) was endorsed by AIAL, the Transport Agency and AT in June 2017. Its key purpose is to strongly encourage mode shift, as well as better network and demand management to meet the growing demand needs of the Airport and surrounding area. It recognises that it will not be possible to accommodate the level of anticipated demand with road capacity alone.

To achieve this, 20Connect and Airport to Botany Rapid Transit projects are being planned jointly, along with AIAL improvements, to ensure that the staging and sequencing of improvements supports the overarching objectives of the programme. Figure 1-1 maps out the three projects that form the Southwest Gateway programme.

Figure 1-1: Southwest Gateway project map

1.2 Purpose of Document

This document describes the operation of the Airport to Botany Rapid Transit system (and adjacent transport network) as part of the Southwest Gateway programme.

The Concept of Operations forms part of a suite of documents developed to support the development of a rapid transit connection between the Auckland International Airport and Botany. Key documents include:

- **A Single Stage Business Case** which sets out the case for investment and value proposition including options considered, costs and benefits.
- **A Preliminary Design Philosophy Statement** which describes the design assumptions and philosophy
- **A Concept Design** which illustrates the proposed physical outcome, establishes feasibility and allows costs to be developed and impacts assessed
- **A Consenting Strategy** which details the proposed pathway for obtaining environmental approvals
- **This Concept of Operations** which describes the system design and operational concept

Together, these documents outline why the investment should be made, how much it will cost and its benefits, what form it should take operationally and physically, how it should be developed and when it should be developed. There are a number of Technical Notes and papers which support each of these documents. Those that are source documents for this Concept of Operations are detailed in Section 1.4.

Within this context, the primary purpose of the Concept of Operations is to cover the service and operational aspects of the future Airport to Botany service. As the service is expected to operate on corridors controlled by Auckland Transport, the NZ Transport Agency and Auckland International Airport, this Concept of Operations is intended to inform all road controlling authorities.

There are three objectives of developing this Concept of Operations for the proposed transport system:

1. To collate the operational assumptions underpinning the business case and concept design.
2. To identify important system attributes and potential interfaces.
3. To provide a basis for which system requirements can be developed as the design progresses through subsequent stages, in line with the System Engineering process.

1.3 Development note

The International Council on Systems Engineering (INCOSE) describes Systems Engineering as an interdisciplinary team process aimed at creating successful systems. The process starts by defining customer needs and functionality, before going onto create a holistic design. Business and technical needs of all customers are considered, with the goal of providing a quality product that meets the user needs.

Systems Engineering is an internationally accepted approach to complex transportation projects and is often referred to as the v-model (see Figure 1-2), which begins with a 'Concept of Operations' which informs subsequent phases. Figure 1-2 shows where the Airport to Botany RTN concept design, Design Philosophy Statement and Concept of Operations fit in the Systems Engineering process.

The INCOSE states that *"Research shows effective use of Systems Engineering can save 10-20% of the project budget. It is not hard to know when System Engineering fails, because when something important goes wrong it usually makes the news fast. People get hurt, programs are delayed and over-budget, the law becomes involved."*

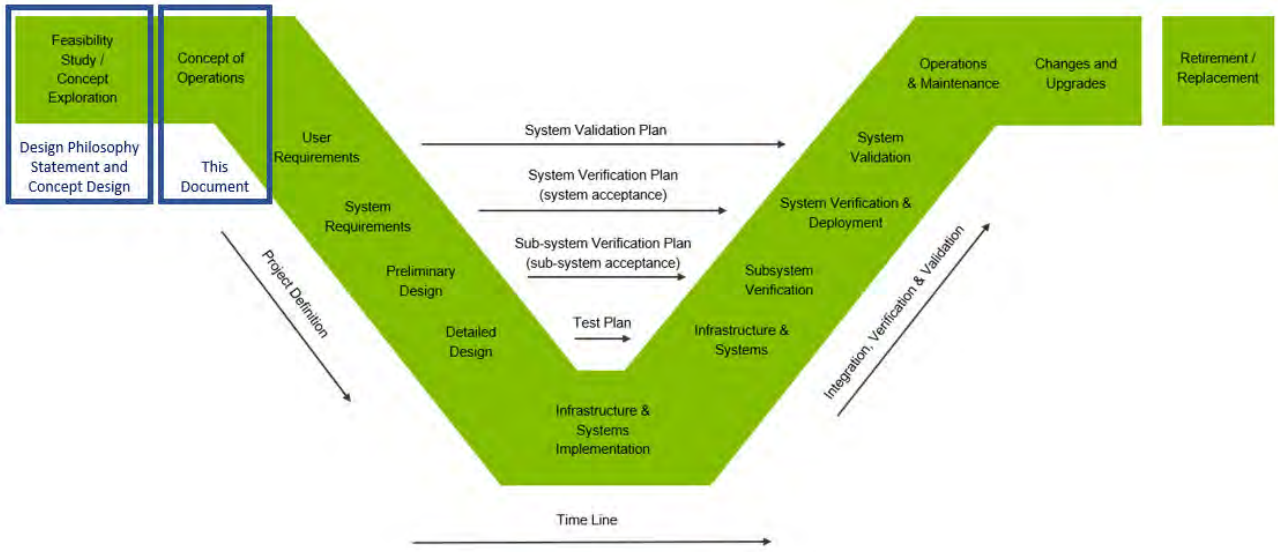


Figure 1-2: Systems engineering V-model showing current status (source: adapted from U.S. Department of Transportation guide for Designing for Transportation Management and Operations)[1]

Benefits of systems engineering include:

- A better product for the customer (for end-users).
- Reduced design changes.
- Reduced through-life costs.
- Better traceability of decision making.
- Management of risk.
- Improved organisational learning.

This document is intended to both commence the systems engineering process at this early stage and also to describe the intended operational concept for the system to inform scoping of future phases and give effect to the value proposition outlined in the business case. The document includes many areas undefined at this stage that should be defined as development progresses.

Note that this Concept of Operations is developed at a very early stage in the project's lifecycle as per Figure 1-2. The Concept of Operations is a *'living'* document and is subject to regular review and revision as the projects progress.

[1] https://ops.fhwa.dot.gov/publications/fhwahop13013/fhwahop13013.pdf

1.4 Relationship with other documents

This document is a collation of elements from a number of technical notes developed to inform the business case and concept design. Not all elements of all documents are relevant to the Concept of Operations. Figure 1-3 shows the documentation that has been used to develop this Concept of Operations. These documents can be referred to for greater detail in each specific area.

SWG Programme documents

- Auckland Airport Access PBC
- Auckland Airport Access SPBC
- Airport transport system improvements (led by AIAL).
- 20Connect SSBC
- Airport to Botany SSBC
- SWG Network Operating Plan (PLN-KK-0002)

Technical documents

- Short List Options Assessment and Preferred Option (502334-6000-TEC-JJ-0003)
- Long List Assessment and Short List recommendation (502334-6000-TEC-JJ-0002)
- Rationale and Design Principles for Active Modes (502334-7000-TEC-KK-0022)
- RTC Placement Assessment (502334-7000-TEC-KK-0030)
- Station Locations (502334-7000-TEC-KK-0004)
- RTN Modes and Demands (502334-7000-TEC-KK-0024)
- Speed Limits Along the Airport to Botany Mass Rapid Transit Corridor (502334-7000-TEC-KK-0040)
- Preliminary Design Philosophy Statement (502334-7000-REP-JJ-0024)
- High Level Station Access Assessment (502334-7000-REP-KK-0028)
- RTN Demands and Mode Tech Note (502334-7000-TEC-KK-0024)
- Vehicle and Fleet Procurement Tech Note (502334-7000-TEC-KK-0026)
- Equity Assessment (502334-7000-TEC-0032)
- Detailed Stations Access Study (502334-7000-REP-KK-0029)

Concept of Operations (this document)

Figure 1-3 Documentation informing this Concept of Operations

2 The Need for Change

2.1 Current system

2.1.1 Strategic need

The Strategic Case contained within the Airport to Botany and 20 Connect SSBC are the source for the strategic need for the system. This is summarised below.

Strategic issues

The Strategic Case describes the four strategic issues – which can be opportunities - being addressed in the business case. They are:

- A large gap in access to the rapid transit network resulting in a lack of rapid, efficient and reliable public transport serving the desire line between the south-west, south and east of Auckland
- Poor quality access for a large, highly disadvantaged population
- Poor and worsening access to Auckland International Airport
- The need to provide access for more affordable housing and higher quality urban development in South Auckland.

The issues are discussed now to provide the wider context before they are considered in depth in Section 4 looking at the problem statements and supporting evidence.

Problem definition

Problem statements were developed at a standard investment logic map (ILM) workshop. The ILM identifies four problems, that the business case responds to:

1) Costly, unreliable, long and complicated trips severely limit people's ability to meet daily needs for work, learning and socialising, reinforcing ongoing deprivation
2) Poor east-west travel choices in the study area constrain current and future growth, undermining prosperity for Aucklanders
3) The current transport system does not recognise cultural identity and taonga, diminishing the Mauri of the area
4) Perceptions of poor personal safety limit uptake of public transport and active modes.

The evidence to support these problem statements is discussed in the following sections, while the benefits of responding to the problems are discussed in the Strategic Case.

Objectives

The Objectives for the A2B project represent the measure of success of the system. These were designed to support the entire A2B process including route selection. The highlighted sections represent key aspects relevant to the operating strategy for A2B and 20 Connect:

- More **equitable access and travel choices to jobs, learning, cultural and social activities** for south and east Auckland
- **Reliable and resilient** transport system in south and east Auckland that is **easy to use**
- Transport network that enables **efficient movement** of people and goods
- Urban regeneration and **improved built environment**

- Minimal impact of the transport system on the environment and taonga
- **Safe and secure** transport facilities in south and east Auckland

Physical context

The corridor from the airport to Botany passes through various urban and rural areas each of which present their own set of opportunities and challenges when developing the transport network.

At the western end of the corridor the airport is bounded by Manukau Harbour to the west and south, and the large industrial zone of southern Māngere to the north. To the east the airport is partially separated from the Puhinui Peninsula by the Pukaki and Waokauri Creeks. Each of these creeks has Māori reservation status.

SH20B connects the airport to the Manukau central area via Puhinui Road which crosses the Pukaki Creek on the two lane Pukaki Bridge. This section of the corridor then travels onwards through largely open fields before the land becomes densely urban at the intersection with SH20A.

Taking a line along Puhinui Road from SH20A to Manukau city centre the urban environment is roughly divided into two zones with low density residential to the north including the suburb of Papatoetoe, and the industrial zones of Wiri and Manukau to the south. This section of the corridor is bisected by the North Island Main Trunk (NIMT) railway line. Puhinui passenger station is located centrally within this section of the corridor at the north-eastern corner of the Wiri industrial zone. A 2.5 km spur line off the NIMT railway line south of Puhinui station, passes through the commercial zone to Manukau city centre.

Central Manukau marks an approximate halfway point between the airport and Botany. The commercial centre sits on the north western side of the intersection of the Southern and the South-Western Motorways.

From Manukau the corridor heads in a straight line through to Botany. This section of the route has few notable geographical features except several streams and creeks. Taking Te Irirangi Drive as a central reference line, the eastern half of this section of the corridor is predominately residential, a zoning only broken by a small commercial zone at Botany Junction and Sancta Maria College. On the western side the area is dominated by the large industrial zone of East Tāmaki.

2.1.2 Current transport network

State highways

- SH20, SH20A and SH20B are each classified as National, High Volume highways under the One Network Road Classification (ONRC)
- SH20 is a four-lane motorway, connecting Manukau to the south with Māngere, the inner western suburbs and SH16 to the north.
- SH20 forms the southern-most section of the Western Ring Route (WRR)
- SH20A and SH20B connect from SH20 to the airport and the surrounding industrial area
- SH20A is a four-lane expressway, which has recently been upgraded to motorway standard with grade separation, running from SH20 at Māngere to the airport precinct
- SH20B is a two lane, undivided corridor with limited local access providing the southerly access to the airport.

Local roads:

A well-developed local network, including:

- Un-divided, two-lane arterial roads with direct property access such as Puhinui Road
- Divided two-lane roads with direct property access such as Lambie Drive and Ronwood Avenue
- Divided four-lane arterial roads with a mixture of direct and indirect property access such as Te Irirangi Drive

Rail

- The North island Main Trunk railway line runs north to south through the A2B corridor and provides both passenger and freight services
- The Manukau spur connects with the stations to the north only
- Stations in the study area located along the NIMT line include Homai, Puhinui, Papatoetoe, Middlemore, Māngere and Ōtāhuhu. The Manukau Station is located on the Manukau Branch.

Public transport services

AT's New Network for bus services in south Auckland was implemented in October 2016. 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.

There is currently very limited dedicated bus priority provided on SH20A or SH20B. This means that bus travel to and from the airport is often unreliable because of congestion on the road network. Some bus lanes exist on SH20A and transit lanes are provided in parts of AIAL's network.

AT provides the following public transport routes to the Airport:

- 380 Airporter. This service operates between Onehunga, Māngere Town Centre, and Manukau, via Papatoetoe and Onehunga Train Stations. Services operate every 15 to 20 minutes, seven days a week, 365 days a year, during the day. It takes a relatively circuitous route, particularly between the Airport and Onehunga.
- Train-Bus service to Auckland Airport via Papatoetoe and Onehunga Train Stations (using the 380 Airporter bus). Train services operate run between 5am – 10pm (approximately) with later evening services on Fridays.
- Route 31 Bus. This bus route travels between Botany Town Centre and Māngere Town Centre via the Papatoetoe Train Station – and via Otara Interchange (MIT campus), Hunters Corner and Papatoetoe Train Station (on Shirley Rd). Route 31 operates every 15 minutes from 7am to 7pm, seven days a week. Outside of these hours it runs every 30 minutes. The Route 31 still requires a transfer to the Route 380 to access the airport.

These routes are provided on a simple zoned fare system using cash or AT HOP.

SkyBus offers a commercial service to and from the Airport that has premium fares and runs every 12 minutes during peak times. It carries approximately 780 inbound passengers and 600 outbound passengers per day. SkyBus offers the following public transport options to and from the Airport:

- Auckland City Express – a frequent service via Mt Eden Road which operates 24/7
- North Harbour Express – a frequent service via Akoranga, Smales Farm and Westfield Albany. This service operations 04:00-23:00 to the Airport and 06:00-22:00 from the Airport.

Other bus operators offering public transport to the Airport include: Intercity and SKIP®.

Walking and cycling network

The area surrounding the Airport is relatively flat, however there is very little cycle infrastructure close to and within the airport precinct. The existing network is described below:

AT – local road connections

There are very limited cycling facilities provided on the AT road network around the airport, particularly when approaching from the south and south-east. The facilities provided are intermittent and do not currently provide a continuous cycle route to the Airport precinct from surrounding areas such as Onehunga, Māngere East, Favona, Ōtāhuhu, Papatoetoe and Puhinui.

NZ Transport Agency - state highway connections

No dedicated walking or cycling facilities are located alongside SH20B or SH20 and there are currently no strategic metro-grade cycling facilities to access the airport and its surrounds from the south-east. Vehicle speeds and volumes on SH20B are not considered appropriate for safe walking and cycling (although these activities are permitted), given the current lack of protection for vulnerable users on the road. Recently upgraded sections of SH20A have cycle facilities.

3 Programme Context

3.1 Southwest Gateway – Airport to Botany Rapid Transit and 20Connect

The Transport Agency, AT, and AIAL have agreed on a comprehensive set of actions based on behaviour change, improved network management and capacity interventions, implemented in a staged manner progressively over time. Each stage of the programme targets the specific problems of different customer groups, achieving cumulative benefits that will escalate and over time, meeting the investment objectives of the Southwest Gateway programme. These changes are summarised in Table 3-1 below.

The focus of this Concept of Operations is on the long-term improvements.

Table 3-1: Change programme

Programme stage	Transport system changes
Short-term improvements (2018 to 2020/21)	Within the overall Southwest Gateway strategy, a set of initial proposals were identified by the project partners to be advanced in the short-term period to 2021, to provide more immediate benefits. These improvements make the most of existing infrastructure and services to improve travel choices and journey experiences. The shorter-term measures are seen as having high importance and priority within the overall programme. The following improvements are expected to be completed by the end of 2020/early 2021, subject to consenting and funding: ▪ A new bus/rail interchange at Puhinui station - providing more reliable and timely travel choices as well as connecting people to wider Auckland through southern and eastern line train services. Allowance for the future rapid transit overbridge across the rail line to provide a more direct connection with Puhinui Station Interchange ▪ New direct bus services between the Airport, Puhinui station and Manukau and potential new bus service routes between the Airport and other centres (a new Route 36) – subject to funding ▪ Priority lanes for public transport between the Airport, Puhinui and Manukau via Lambie Drive ▪ Two new intersections on SH20B between Campana and Orrs Roads to accommodate a proposed future Park & Ride, and at Manukau Memorial Gardens to improve access and safety ▪ Localised road widening and resurfacing, drainage and stormwater treatment on SH20B ▪ Improved walking and cycling facilities between Pukaki Creek bridge, Puhinui Station and Manukau ▪ Improved cycling and walking in the Māngere, SH20/SH20A area. These improvements will deliver the following benefits: ▪ Every 10 minutes a bus will travel the 12-15-minute journey between the Airport and Puhinui Station allowing people to make connections via frequent train services and access Manukau. ▪ More reliable and timely travel choices around southwest and southeast Auckland, including to and from the Airport ▪ Improved access to jobs, education and social opportunities

Programme stage	Transport system changes
	▪ Improved safety and environment ▪ Contributes towards long-term outcomes.
Long-term improvements (2021 – 2048)	▪ Staged delivery of rapid transit between the Airport and Botany – Airport to Puhinui Rapid Transit system via SH20B – Puhinui through Manukau RTN via Manukau Centre along Ronwood Ave – Manukau to Botany RTN via Te Irirangi Drive ▪ State highway widening to support rapid transit – Widening of SH20B to a 4-lane expressway arterial road (including over Pukaki Bridge) – online at-grade – total of two lanes in each direction – New SH20B/SH20 southbound ramp ▪ Increased access to the state highways to free up local roads – New SH20A/SH20 southbound ramp – Additional lanes on SH20 between Manukau Harbour Crossing and SH20B interchange ▪ Walking and cycling facilities along SH20B ▪ Walking and cycling facilities along SH20 between Manukau Harbour Crossing and SH20B interchange.

3.2 Interfacing projects

There are a number of transport investments planned across Auckland. The Southwest Gateway programme will work with other initiatives including the City Centre to Māngere Light Rail and Eastern Busway projects to achieve a connected transport system that supports accessibility and growth in Auckland. It will also enable better use of existing investment in heavy rail with both the southern and eastern lines connecting to the upgraded Puhinui Station and onto the rapid transport corridor between the Airport and Botany.

Figure 3-1 Interfacing projects

3.2.1 Southwest Gateway – Auckland Airport Precinct Improvements

The Auckland Airport Precinct Improvements led by AIAL involves a programme of investment which enhances not only the transport network within the Airport precinct, but also integrates with the Transport Agency and AT's projects. In 2014, AIAL announced its latest master plan, which recommends a number of transformational infrastructure investments over the next 30 years, including a combined international and domestic terminal, new airfield infrastructure, second runway and upgraded departures and arrivals areas as well as upgrades to public transport, roading and walking infrastructure within the airport precinct.

3.2.2 Eastern Busway (Auckland - Manukau Eastern Transport Initiative)

The Eastern Busway is a project led by AT that will create a dedicated, congestion-free busway between Panmure, Pakuranga, and Botany town centres. Once the busway is completed, customers will be able to travel by bus and train between Botany and Britomart in less than 40 minutes. The busway will be supported by three new stations at Panmure, Pakuranga, and Botany, new cycling and walking connections, urban design enhancements, and improvements for general traffic such as advanced signalling at important intersections. Construction of the Pakuranga to Botany busway section and cycling and walking paths will be completed by 2025. The final stage between Panmure and Botany is due for completion in 2026. Botany Station will provide an interchange for the Eastern Busway and Airport to Botany Rapid Transit system.

3.2.3 City Centre to Māngere (CC2M) Light Rail

This light rail line between the airport and city centre will provide a reliable service along the route and connect communities along the corridor including employment hubs (i.e. city centre, Onehunga, Auckland Airport).

3.2.4 Supporting Growth – South Auckland

The Supporting Growth programme will support an additional 50,000 dwelling units and 30,000 job opportunities in the south Auckland communities of Takanini, Drury, Paerata and Pukekohe. This growth activity will generate increased transport demands that will directly affect the operation of the transport network. The aim of this initiative is to develop transport networks to support Auckland's new housing and business areas over the next 30 years. Projects currently being considered include:

- Road safety improvements
- Rail and bus infrastructure and service upgrades
- New walking and cycling facilities
- Strategic road network capacity upgrades.

4 Proposed System Overview

4.1 Route

The proposed alignment for the Airport to Botany Rapid Transit is illustrated in Figure 4-1

Figure 4-1: Proposed route and station locations

This route has been selected through the Airport to Botany SSBC process[2]. The route connects several major generators of demand and land use development, including the following:

Major employment areas:

- Auckland International Airport and its surrounding employment areas
- Manukau Central and Wiri
- East Tamaki
- Botany

Metropolitan Centres as defined in the Unitary Plan (major town centres with significant growth and mixed-use potential):

- Botany Town Centre
- Manukau Centre

Major mode interchanges with existing or proposed rapid transit lines and public transport services:

- Future light rail at Auckland Airport
- North Island Main Trunk (southern line services) at Puhinui

[2] Airport to Botany Single Stage Business Case, Part B

- Manukau Rail Line (eastern line services) at Manukau
- Bus services at Manukau Interchange
- Bus services and Eastern Busway at Botany

The route is 18km long and is expected to have 12 stations. The likely mode is bus rapid transit (BRT) although geometry will be such that light rail is possible in the future should conditions be appropriate. The system design is generally to have running ways separated from traffic, other public transport, pedestrians and cyclists although intersections with be at-grade with signal prioritisation for the RTN services. A separated cycle and pedestrian way are proposed along the length of the route.

4.2 Project stakeholders

Mana Whenua in the Auckland region are a partner and will retain a partnership role in the ongoing development of the system.

The key stakeholders in the ongoing system design include:

- Auckland Transport internal stakeholders
- New Zealand Transport Agency
- Auckland International Airport Limited
- Auckland Council
- KiwiRail
- Rail operators
- Bus operators
- Local Boards
- Panuku
- Kaianga Ora and other relevant Government agencies
- Heritage New Zealand Pouhere Taonga
- Freight and road user groups
- Union
- Advocacy and interest groups
- Community stakeholders
- Business associations
- Network utility operators
- Emergency services
- Directly affected property owners, lessees and tenants

5 Customers and User Needs

5.1 Travel patterns

5.1.1 Demands and occupancy

Figure 5-2 and Figure 5-3 indicate that the predicted demand profile is relatively flat and bi-directional. Unlike most radial transit routes that are strongly peaked in one direction, this corridor is generally predicted to have counter-peak flows that are approximately one-third to one half of the peak direction.

Furthermore, the flatness of the demand profile along the route suggests a high level of patronage turnover or 'churn'. This is where passengers board and alight at a range of points along the route in both directions, rather than travelling to a single anchor destination at one end of the route (as is usually the case with routes serving a city centre). This is not unexpected as the A2B route has what amounts to four anchor stations: one at either end by the commercial/employment centres of the airport and Botany Town Centre respectively, and in the middle at Puhinui rail interchange, and the Manukau Metropolitan Centre. Figure 5-1 shows this pattern. Annual estimates for major stations would see Botany with 6.4 million, the airport terminal with 4.0 million, Puhinui with 5.0 million and Manukau with 3.4 million boardings per year in 2040. Refer refer to Appendix A for further patronage data.

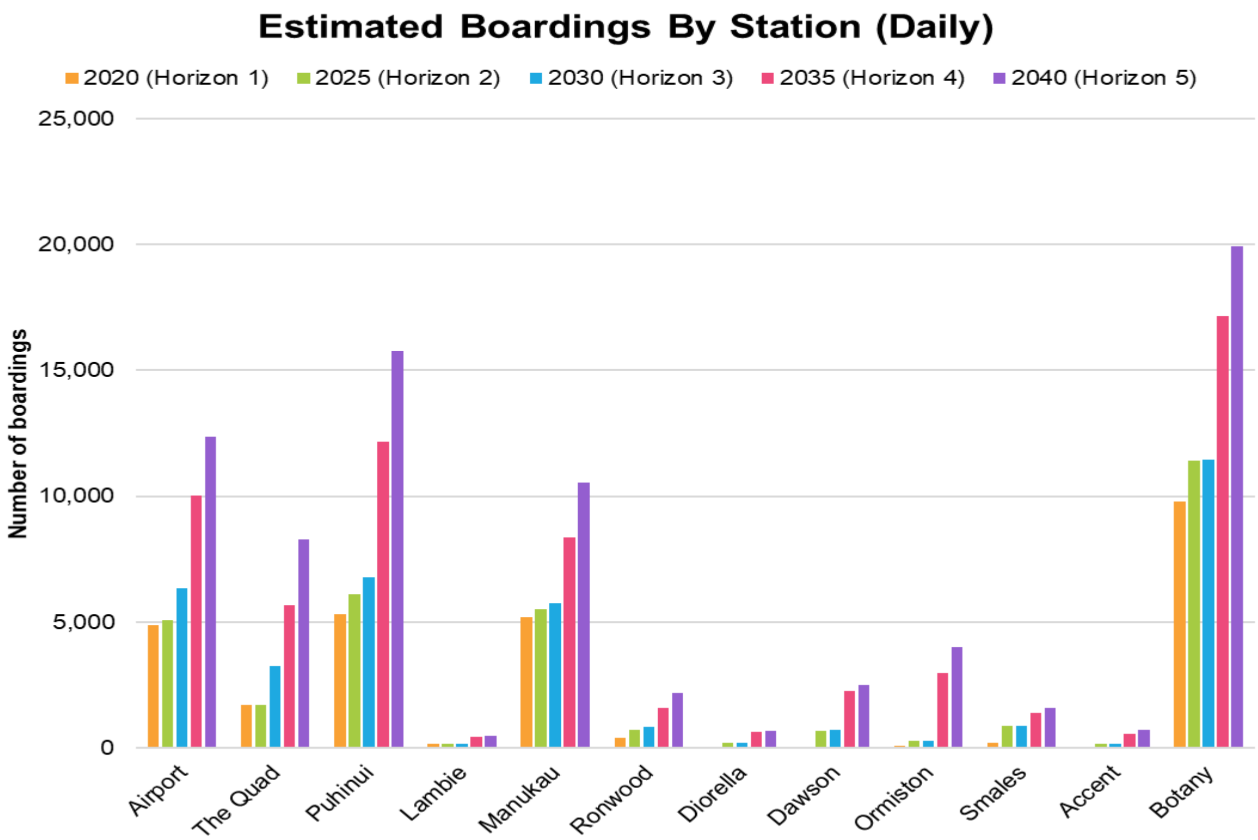


Figure 5-1: Forecast station patronage (source: MSM)

This combination of bidirectionality and high passenger turnover creates good conditions for efficient operations, translating into high boarding's (and fare revenue) per service-hour with high utilisation of fleet resources. Each 'seat' of capacity operated can be utilised multiple times in both directions by different passengers, unlike strongly radial unidirectional routes which achieve only one boarding per seat per return run.

This general trend notwithstanding, there is still a clearly observable peak flow originating in the generally suburban areas of Botany and Ormiston at one end of the route, and at the employment areas of Manukau and the Airport at the other. This manifests as generally higher occupancies on the Manukau to Airport section, with the highest occupancies observed on the section between Puhinui and the Airport. Furthermore, a small but distinct step change in occupancy is visible at Puhinui in each peak, indicating significant volumes of passengers using the Airport to Botany corridor to shuttle between Puhinui train station and the Airport in one direction, and between Puhinui and Manukau and the eastern suburbs in the other.

Overall, occupancies in 2048[3] can be broadly described as being in the range of 500 to 900 passengers per hour both ways during the interpeak and in the counter peak direction, increasing to peak loads of 1,500 to 1,900 passengers in the peak direction at peak times. This suggests the line could be served by a relatively simple service pattern that provides base capacity for 900 passengers per hour in both directions at all times, supplemented by additional capacity up to a total of 1,900 passengers per hour in the peak direction, at peak times.

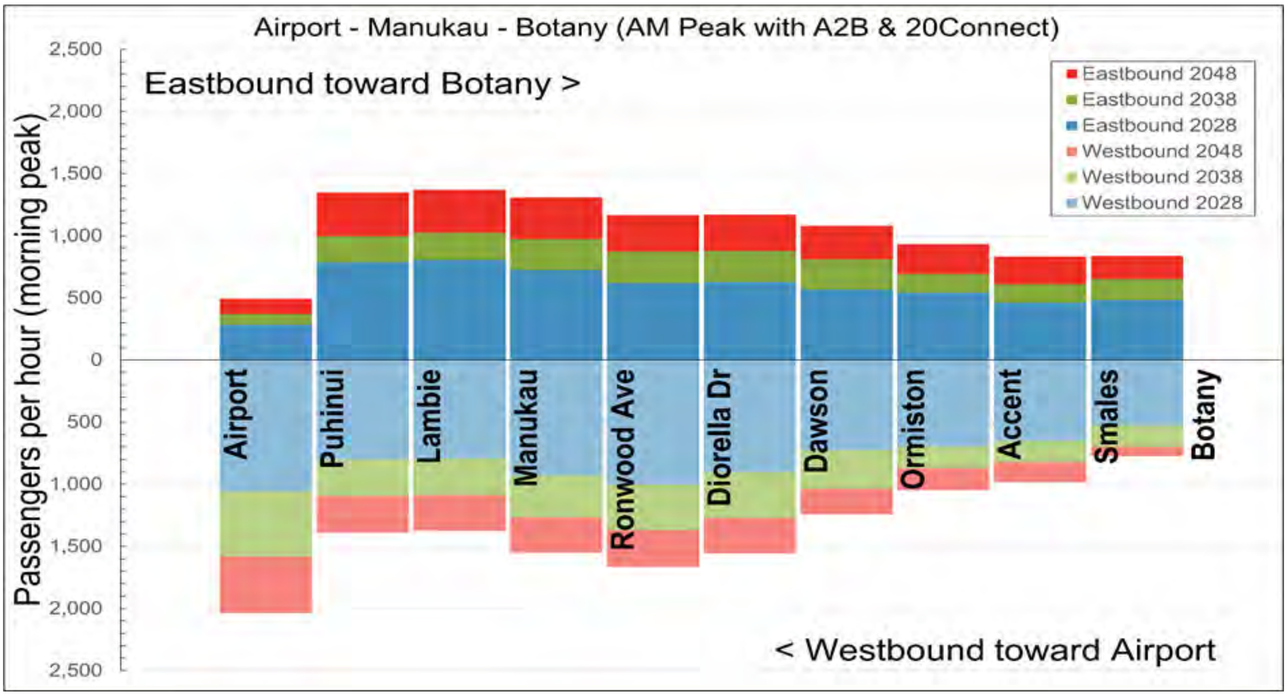


Figure 5-2: AM Peak occupancy by section and direction, by decade

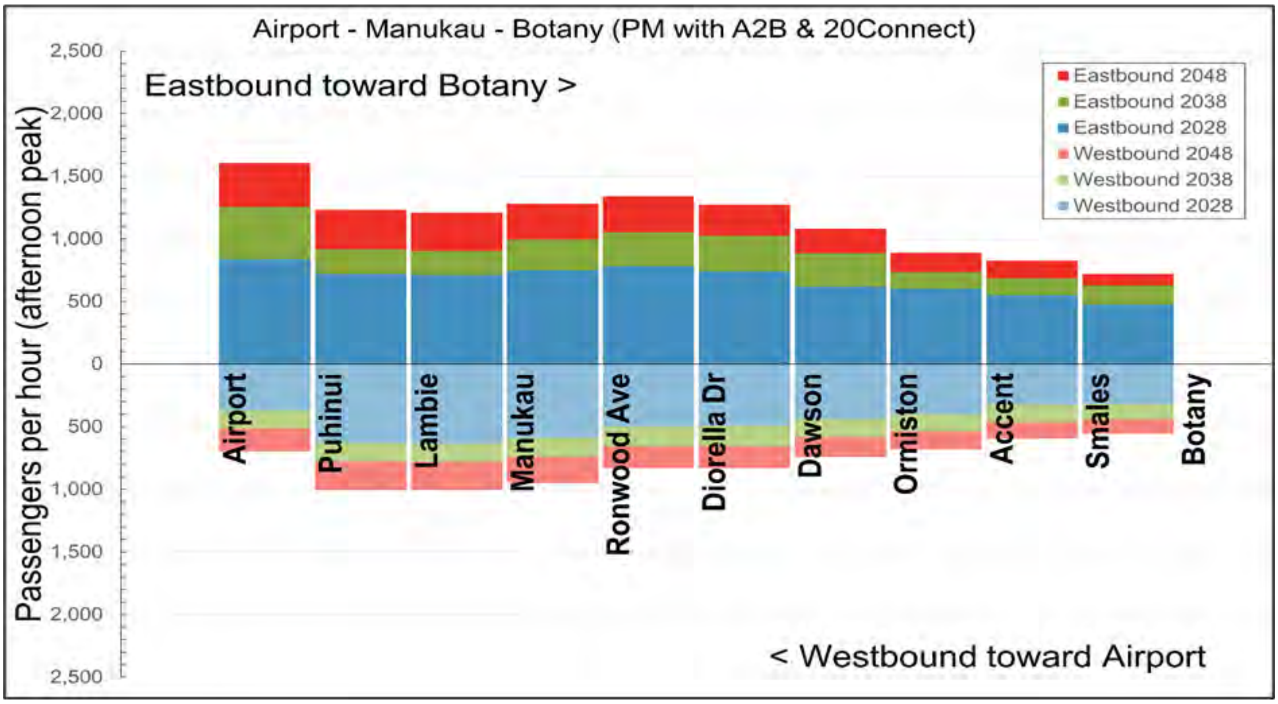


Figure 5-3: PM Peak occupancy by section and direction, by decade

[3] MSM forecasts i11 land use

5.1.2 System integration – origins and destinations of trips

At this early stage in development, patronage forecasts rely on a strategic model (MSM) which has limitations at a detailed level. It is possible however, to draw some conclusions as to the likely usage patterns and means/locations of access to the system in order to understand the system integration needs for the system.

Taking a forecast screenline on Te Irirangi Drive around the State Highway 1 crossing entering Manukau in 2048 (Figure 5-4) shows that:

- Just over half of all passengers crossing the screenline at Manukau have transferred from buses making operational and physical connections with local bus services crossing Te Irirangi Drive and at Botany important.
- Botany interchange is the largest source of transfers, but collectively the local bus interchanges at Smales, Ormiston and Dawson Roads are almost equal to Botany
- Approx. 42% of people crossing the screenline at Manukau have walked or cycled to stations, making pedestrian quality around stations important.
- Approx. 42% of people who are on the RTN as it enters Manukau are still on the system as it enters the airport, showing that the airport and its employment areas (including its specific customer groups and their needs) are significant considerations in the system design.

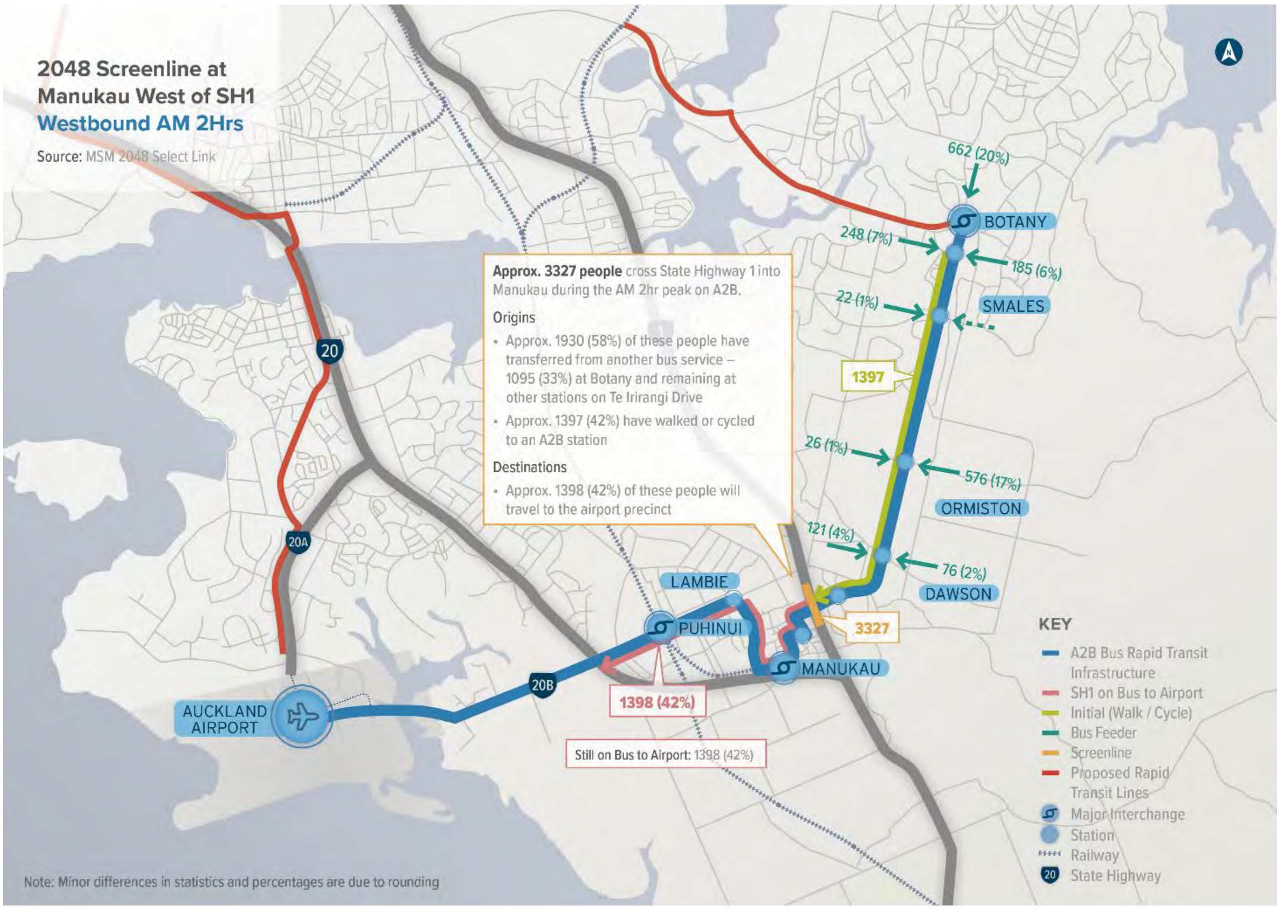


Figure 5-4: Demand origins and destinations. Screenline on Te Irirangi Dr, west of SH1 (source MSM i11.5 2048)

Taking a screenline on State Highway 20B as it enters the airport area in 2048 (Figure 5-5) shows that:

- There is a strong link with rail services at Puhinui Station. Almost half (45%) of the patronage entering the airport has come from trains (11% from the north and 34% from the south). This reinforces the importance of Puhinui Interchange and the importance of maintaining and enhancing a seamless transfer.
- There is a strong link with the southern growth areas of Auckland. Approx. a quarter of all people on the RTN as it enters the airport have come from Papakura or further south. This illustrates the alignment with Supporting Growth South and the need to consider wider network integration.

- People are making relatively long trips on the Airport to Botany system. Over half (52%) of the people accessing the airport on the service have come from the Airport to Botany route from east of Puhinui. This demonstrates a need for a fast service as a high proportion of customers are travelling relatively long distances.

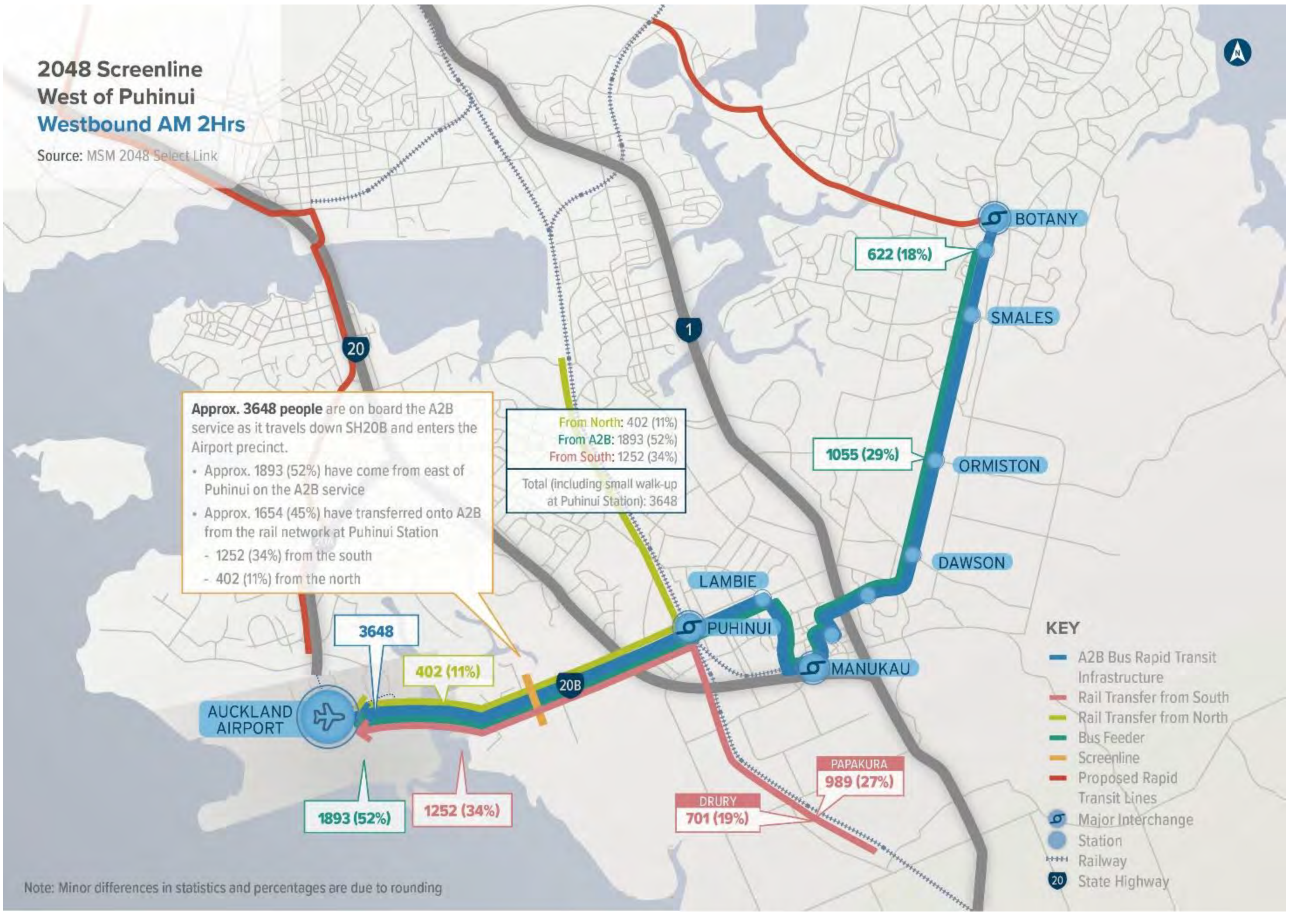


Figure 5-5: Demand origins and destinations. Screenline on SH20B (source: MSM i11.5 2048)

Taking a screenline on Puhinui Road as it enters Manukau in 2048 (Figure 5-6) shows that:

- There is a strong link with rail services at Puhinui Station. Two-thirds of the patronage entering the Manukau from the west has come from trains (8% from the north and 59% from the south)
- There is a strong link with the southern growth areas of Auckland. Approx. half of all people on the RTN as it enters the Manukau from the west have come from Papakura or further south.

Figure 5-6: Demand origins and destinations. Screenline on Puhinui Road (source MSM i11.5 2048)

5.1.3 System design implications

This data illustrates the need for an integrated design of the Airport to Botany system with the operation and design of the wider public transport network. The Airport to Botany line is a cross-connection linking:

- Two Metropolitan Centres in Botany and Manukau, each of which are major hubs for local bus services
- Four rapid transit lines, assuming Eastern Busway and City Centre to Mangere lines are built
- A number of arterial routes with frequent bus services accessing catchments east and west of the RTN route.

Customers will access the system via the following modes of transport:

- Walking
- Bicycle (including e-versions)
- Scooters and skateboards (including e-versions of these modes)
- Motorbikes
- Cars, vans and mini-buses e.g. private vehicle, taxi, on-demand taxi, rental car
- Buses e.g. local buses and Airport to Botany Rapid Transit line
- Trains.

Station function and arrival mode priorities are established in the High-Level Station Access Assessment[4] and discussed in detail in Section 6.3.1. A focus on access by a range of modes, including vehicular modes is a

[4] 502334-7000-REP-KK-0028

part of a response to a relatively low land use density, but significant catchments outside of the main centres the route serves.

5.2 Customer research

The SWG Programme has taken a customer-focused approach to planning and testing ideas, stemming from the early work in support of the Programme Business Case[5].

Customers will use this transport system for a variety of reasons, including:

- Commute to and from work (nine-to-five and a high proportion of shift-work movements). Key areas of employment include Auckland Airport, Airport precinct businesses, Manukau Metropolitan Centre, Botany own Centre, distribution centres in Wiri and East Tamaki, and Middlemore hospital
- Travel to education opportunities, particularly at Manukau (AUT and MIT campuses) and also numerous schools
- International and domestic air travel
- Travel to amenities e.g. shops, community venues and services, and Manukau Memorial Gardens
- Travel to local venues and leisure activities
- Picking up or dropping off friends and relatives at hubs.

5.2.1 Demographics

The Airport to Botany corridor has some of the most diverse populations in Auckland from an ethnicity, age and income perspective. Most of the users of the system are expected to live in the corridor or close by. Designing a transport system response to the needs of its community is important to ensure it is effective.

Socio-economic

Some areas surrounding the Airport to Botany route are scored as some of the more deprived areas according to the NZ Index of Deprivation in Auckland and indeed New Zealand. This index considers employment, income, crime rates, housing, health, education and access to services, such as medical, education and shopping. Areas to the north-east of the route have lower levels of deprivation index scores compared to the south-west. This is also reflected in the median incomes of the populations in these areas.

The study area is located within the Māngere-Ōtāhuhu, Ōtara-Papatoetoe, Manurewa, and Howick local board areas of Auckland Council. The information below provides a comparison between the local boards and the region as a whole of three of the basic measures of deprivation.

The information in Table 5-1 comes from the 2013 census[6] and data held by Auckland Council[7].

Table 5-1: Socio-economic data (Census 2013, Auckland Council)

Local Board	Population	Median Household Income ($)	Unemployment (%)	No formal qualifications (%)
Māngere-Ōtāhuhu	81,590	59,900	15.5	31
Ōtara-Papatoetoe	89,610	60,800	14	29
Manurewa	96,200	67,800	13.3	28.2

[5] Airport Access Supplementary Programme Business Case, 2017
[6] Latest data available has been used. a
[7] Demographic and economic statistics from https://ecoprofile.infometrics.co.nz/Auckland

Local Board	Population	Median Household Income ($)	Unemployment (%)	No formal qualifications (%)
Howick	150,200	84,500	6	14
Auckland avg.	**NA**	**76,500**	**6**	**17**

The Table 5-1 shows that wealth and opportunity are not shared equally throughout the local boards within the study corridor. When compared against the Auckland average, the three local boards closest to the airport, Māngere-Ōtāhuhu, Ōtara-Papatoetoe, and Manurewa all compared unfavourably across all of the three measures. Māngere-Ōtāhuhu, in particular, had high rates of unemployment, low levels of educational attainment, and the lowest median household income (MHI) in the study area.

Census 2013 information indicates high rates of renting from government organisations, such as Kāinga Ora, compared with the New Zealand average.

This is likely to present issues with affordability of travel and access to the system.

Age

The average age of people living near the proposed route is relatively young compared to the Auckland region. Most areas around the preferred route have a median age between 15 and 40. There are relatively few areas around the route where the median age is greater than 40. Several areas along the route have more than a quarter of the population under 15.

This attribute creates the need to enable access to education, access for people who cannot drive, and also present issues with affordability using the system.

Ethnicity

The catchment area is ethnically diverse, when compared with the rest of Auckland. Pasifika and Asian populations make up the largest population groups along the preferred route.

In some areas, particularly near Ōtara and East Tamaki, Pasifika populations make up more than 80% of the population. This is significantly higher than most of Auckland.

To the east of the route and in the area around Manukau, more than 40% of the population identifies as Asian. The areas surrounding the route have some of the lowest rates of population identifying as European in Auckland.

In areas to the south of the route, more than 20% of the population identifies as Māori. This means the area has a higher proportion of the population identifying as Māori than most of Auckland, except for some areas further south.

International and airport users

Directly servicing Auckland International Airport, the system is likely to have a greater than usual proportion of users who have limited or no English and have limited or no knowledge of Auckland's place names, geography and travel options.

This is likely to generate issues with legibility and language in using the service and require a simple, intuitive design of stations, the service pattern and signage, service labelling and timetables. This will also create the need for a simple suite of fare products that are easily accessible.

The airport is also likely to generate a higher than average proportion of one-off or infrequent users which will have implications for ease of use, legibility and access to fare products.

System response to demographic data

There are interventions, both in the development of the design and operation of the system that can greatly increase the access offered by the service to its likely specific users. These are detailed in Table 5-2 and are divided into interventions/design/operation already included in the system, and those which should be considered in further designs of both service and facilities as the service and infrastructure are further developed.

These interventions would enable people who are transport disadvantaged with more transport choice and are based on the 'seven principles of universal design' adapted for bus rapid transit by Bitterman and Hess (2008). These are:

- Equitable use
- Flexibility in use
- Simple and intuitive
- Perceptible information
- Tolerance of error
- Low physical effort
- Size and space for approach and use

Table 5-2: Design and operational responses to demographic and equity needs

Community sector	Sub group	Potential issues / travel behaviour	Design response	Operational response
Socio-economic deprivation	N/A	Limited access to smart phone data Less likely to have access to a car and high dependency on public transport Higher likelihood of working shift hours or early morning/late night stops and starts and lateness penalties	Welcoming and comfortable station design, including places to sit, Realtime information Sufficiently detailed information about the public transport network and available connections Toilets	Wi-fi access at stations for real time information / journey planning Timetabling of services to facilitate the movement of shift workers i.e. long service span, frequency, and onward connections. Availability of frequent and reliable onward connections Fare structure based on trip patterns of lower socio-economic groups Reliable service Frequent service
Age	Older people (65+ years)	Feeling of safety Space for carers Stress Lack of mobility leading to social exclusion	Places to sit Clear wayfinding Beauty Reduce the walking distance between shops, stops and benches to sit on Non-slip surfaces Shelter and shade	Enough time to connect between train and bus services Clear transfer information Longer pedestrian phases around stations Friendly, well-trained drivers Culture of offering seats to those in need Longer pedestrian phases around stations

Community sector	Sub group	Potential issues / travel behaviour	Design response	Operational response
	Younger people (5-20 years)	Travel in larger groups Physical safety, especially night time Potentially not able to drive High reliance on public transport More likely to work and socialise outside of peak hours May be taking part in study Limited income	Space to meet / linger Active transport connections in and around the A2B corridor	Fare concessions Frequent off-peak operating hours Tracking of youth ridership rates
	Children (0-5 years)	Space for carers Reliance on caregivers for transport	Family space Safe spaces for kids Wide paths without obstructions Safe, obvious, step-free access routes Toilet facilities at/near stations	
Gender	Pregnant women	Slower movement Stress Bathroom Easily exhausted	Places to sit out of traffic/busy areas Reduce the walking distance between shops, stops and benches to sit on Safe, obvious, step-free access routes Toilet facilities at stations	Enough time to connect between train and bus services Clear transfer information
	Women	Feeling of safety and actual safety Bathroom Sexual harassment More likely to be in a caring role for children or elderly Carry a lot of gear Multi-leg journeys	More toilets for women Safe night time waiting spaces 'Eyes on the street' Diverse land use, including public spaces such as parks and playgrounds which activate the community Storage or carrying capacity for different size and style of bikes Seating and resting places along walking routes Human scale lighting	Unscheduled stops at night to let women off the service closer to home
	Childcare	Slower movement More gear Changing facilities Limited time Prams and other children – safety Complex trip chaining	Unisex changing facilities Breastfeeding space A place to temporarily store gear / prams while working out logistics All door boarding Safe, obvious, step-free access routes	Trollies to transport gear Kneeling buses Frequent service, regular connection points for a range of journeys. Fare structure that does not deter multi-leg journeys / affordable weekly passes.
	Trans and non-binary people	Feeling of safety Physical abuse Sexual harassment Verbal harassment	Unisex toilets 'Eyes on the street'	Staff training including awareness of Trans and non-binary needs

Community sector	Sub group	Potential issues / travel behaviour	Design response	Operational response
Disabilities	Sensory impairment	Low or no vision Low or no hearing	Tactile wayfinding Cues and hazard identification	Audible and visual real-time wayfinding information Station/ operational staff available to answer queries
	Cognitive impairment	Orientation Stress	Space away from congestion to read wayfinding Obvious accessible routes	Clear line of sight Wayfinding
	Mobility impairment	Mobility aids – wheelchair, modified bicycle Uneven surfaces causing stress and uncertainty	Safe, obvious, step-free access routes Level boarding	Print, digital and on-street wayfinding information Station/ operational staff available to answer queries
	Mental health	Stress Anxiety Depression	Speed of lifts Beautification of station, such as street trees and green streets People watching areas Lighting Service standards reducing crowding	Frequent service Station/ operational staff available to answer queries Service crowding measurement and response strategies
Multicultural needs	Māori Pasifika Asian European	Family travel – potential for large groups Using the station as a meeting point Languages other than English	Place to meet and greet – large space needed Wayfinding with a range of languages Images and iconography in wayfinding Timetables available in more than one language	Allowing enough time for large family groups to board services Employ staff who speak more than one language

5.2.2 Customer profiles

To understand the customers and their purpose for travelling the Airport Access Programme Business Case 2017 categorised customers and used observed data from a range of sources to determine the proportions of the total customer base, as shown Figure 5-7. This was broken down broadly as employees (28%), air traveller international (20%), air traveller domestic (21%), meeters & greeters (28%), and freight (3%).

Figure 5-7 AT Customer Insights breakdown of customer segments by purpose of journey to airport

In the development of the Programme Case, investment partners and key stakeholders participated in a workshop in February 2017 to identify customer groups and understand their specific problems. These user groups align with the AT Customer Insights data and are grouped along with their key problem/s in Figure 5-8. “Needs” expressed as personal statements were developed by AT using actual customer feedback.

Air traveller - Business

"Getting to the airport by car or taxi means I don't have to work around schedules, can maximise time working rather than travelling, make calls on my way, and just get home after my trip. I need a better option so I know how long it will take and doesn't get me stuck in more and more traffic"

Air traveller - Non-business (from Auckland)

"I am focussed on our trip, not on getting to the airport. We have to build in a lot of extra time so we aren't late. If family can't take us, the park and ride is OK and our car will be waiting for an easy trip home. Taxis are expensive, and there is no train that we could easily get a family with luggage on without long transfers"

Air traveller - Non-business (from outside of Auckland)

"Auckland is a big enough city to have a good train and bus system, but when I arrive I don't see easy to use, affordable options. It's easier to take a taxi or shuttle, or a rental car especially if I am just passing through Auckland"

Nine to Five employee

"I am frustrated that it takes me longer and longer to drive in. I haven't really considered other options, because from where I live it would take a long time and multiple connections. I have a good car and like the flexibility, and have parking provided at work"

Shift employee

"I start and finish at odd times, I can't afford to be late, and cost is an issue for me. Buses don't start early enough, take a long time, and I don't feel safe walking after dark at either end. I would rather not drive, which takes ages when my shifts are at busy times, but it is the cheapest way to make sure I am on time"

Freight & passenger transport driver

"Getting in and out of the airport area is unreliable as we get caught in all the other traffic. It costs us time, limiting the number of jobs we can deliver and increasing costs through wages and vehicle running. There are very limited options for contingency planning as our clients' needs and schedules are fixed"

Figure 5-8: Customer problem statements (AT customer insights)

While being focused on airport access, this research indicates a broad range of users with specific needs unique to airport access and need to be considered in system design. Considerations such as the following are relevant to the operating concept:

- Reliability of journey times
- Easy to use to compete with simple options like taxis and car driving/parking
- Reducing connections or improving quality of connections (frequency, quality of facilities)
- A service span (duration and level of service) to allow access to airport shift patterns and flight times
- Comfort and quality to allow travel time to be spent productively
- Personal safety and security

5.2.3 Auckland Transport’s Kantar TNS research

Auckland Transport engaged research agency Kantar TNS to understand the current transport patterns, along with barriers to transport modes, transport needs, and opportunities to influence travel behaviour and mode choice. Their approach involved a qualitative phase made up of focus groups and intercept interviews at the airport, and an online survey of 1,000+ people for the quantitative phase. The groups the study targeted were office/ regular hour workers, shift workers, Auckland resident business customers, Auckland resident leisure travellers, domestic visitors to Auckland, and international visitors to Auckland.

The study found that cars were the most common travel mode to the airport, and recent infrastructure upgrades such as the Waterview Tunnel and services such as Park & Ride are seen as positives for those travelling by car. Cars are frequently preferred because of ease of travel and length of the journey, as well as free parking for workers and free pick up zones for visitors. The study identified that "pain points" for car travel are unreliable journey times and traffic congestion and found that the majority of those working in the airport area were dissatisfied with car travel.

Only 5% of non-public transport users between Botany and the airport would consider it in its current form and 63% of study participants "reject" public transport as an option. The study found the following barriers to using public transport:

- Changing buses to make a journey
- Unpredictable services
- Inconsistent service frequency
- Low service frequency
- Poor comfort and convenience
- Perception of poor experience

Addressing these barriers in the operating concept will be key to creating mode shift and achieving the objectives of the project.

When shown a design for a high-quality rapid transit system including extended routes and new stops and interchanges, 42% - 47% of non-public transport users said they would use it. This substantial improvement from 5% suggests that high quality system can effectively negate the above barriers to create an opportunity to shift people from cars to public transport.

The required response in the system design to these issues is:

- Quality, intuitive interchanges to allow mode changes to be easy and safe
- A dedicated right of way and signal priority to allow fast, reliable journey times
- A high frequency and long span of this frequency to allow journeys at the times people need to travel to access jobs and travel opportunities on this route
- Stations, waiting and arrival mode facilities of quality
- Information on approaches to stations, at stations and in vehicles of a form and quality to enable simple navigation and customer assurance

6 Description of Proposed Airport to Botany Rapid Transit System

6.1 Airport to Botany Rapid Transit and 20Connect

6.1.1 Southwest Gateway Programme

The Airport to Botany corridor runs from Auckland International Airport to Botany Town Centre, via major interchanges at Puhinui rail station and Manukau Town Centre and other intermediate stations. The corridor primarily runs within State Highway 20B, Puhinui Road and Te Irirangi Drive. This corridor alignment minimises the system's footprint and integrates the system within the existing urban/suburban fabric. SH20B will be widened to enable the rapid transit corridor to the Airport.

The rapid transit system will be a "managed system" that operates high-capacity BRT vehicles on a fully dedicated rapid transit corridor, with street level platform-style stops, offboard ticketing and all-door level boarding to deliver 'turn up and go' service levels. A managed system means that access to the system is limited to vehicles and services that meet certain standards so that the reliability and customer experience is not degraded through congestion and variable levels of service.

To achieve this 'turn up and go' experience, the system will operate all day and most of the evening, seven days a week. Minimum service will provide 10-minute headways (6 vehicles per hour) at all times of day, and 3 to 4 minute headways (20 vehicles per hour) at peak, where required for capacity.

As illustrated in Figure 6-1, as well as the Airport to Botany dedicated route and stations, 20Connect will make additional infrastructure changes to local highways to improve journey time reliability, network resilience and safety. These changes are:

- New SH20A/SH20 and SH20B/SH20 southbound ramps
- Widening of SH20 between Manukau Harbour Crossing and SH20A (online at grade)
- Widening of SH20 between SH20A and SH20B (online at grade)
- Widening of SH20B to four lanes (including over Pukaki Bridge) – online at-grade
- Walking and cycling facilities along SH20 and SH20B.

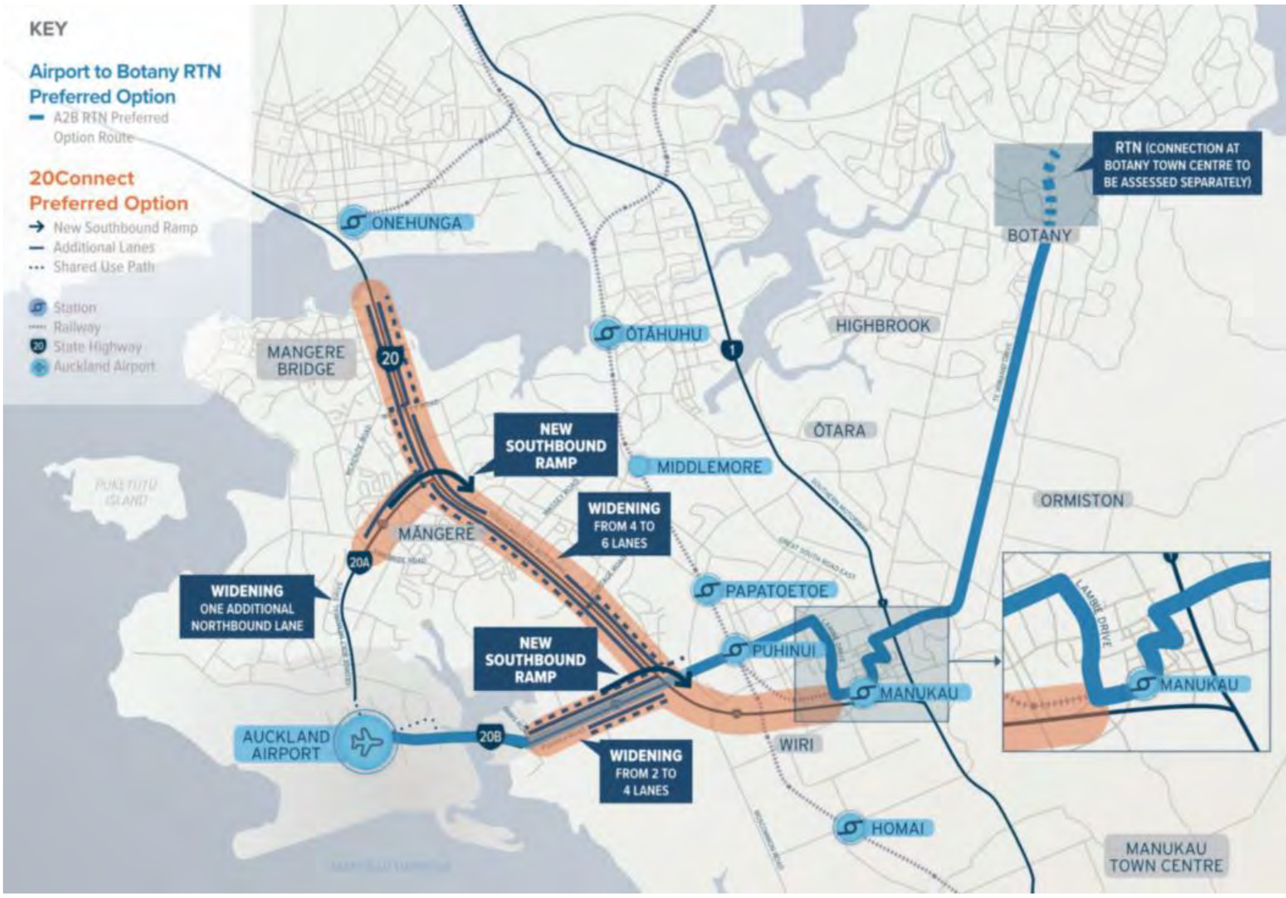


Figure 6-1 Airport to Botany and 20Connect recommended option infrastructure elements[8]

6.1.2 Network Operating Plan

The main priorities by mode, for the Network Operating Plan (NOP) study area are outlined below and illustrated in Figure 6-2.

Public Transport

Public transport is shown as a high priority along all proposed frequent bus or rapid transit routes. These include all the key corridors to and from the Airport. The Airport to Botany rapid transit route can be seen along SH20B - Puhinui Road - Manukau - Te Irirangi Drive.

Cycling

Active modes are a high priority on both SH20A and SH20B corridors. Typically cycling is provided as a high priority along all corridors on which public transport is a high priority to support last mile trips from public transport stops. Cycling has also been provided as a high priority on McKenzie Road and Coronation Road to connect cyclists travelling north-south with the new Mangere Bridge and SH20 cycleway.

Cycling is a high priority along the full length of the Airport to Botany rapid transit route, as well as along the two key arterials that run parallel to Te Irirangi Drive, supporting the east west connection.

On Massey Road and Ti Rakau Drive, only the active modes and public transport are given priority to better support the place and movement function of these east west connections.

Pedestrians

Although not shown on this map pedestrians are considered a high priority along every corridor except for SH20. Notwithstanding this, pedestrians are prioritised around public transport stations as well as in town

[8] The location of the shared use path is not fully depicted in the layout.

centres such as Mangere, Manukau, Botany, Ormiston and on the airport precinct, in particular around the terminal buildings.

Freight

Freight is a high priority on SH20 to facilitate inter-regional trips and access to the inland ports at Wiri and Onehunga. Freight is a high priority on SH20A and parallel Kirkbride Road, Richard Pearse Drive and Landing Drive to facilitate access to and from Airport Oaks given the large industrial and freight forwarding land use. Freight is a high priority along Favona Road and Walmsley Road to support east-west freight movements, previously provided for on Massey Road. There is no freight priority provided on SH20B however freight will still be accommodated. Southbound freight from airport Oaks will be encouraged, through mode prioritisation to first head north on SH20A and then south on SH20.

Secondary freight routes are shown by the dashed line, which represents an alternative access for freight to the state highway to ensure there is resilience in the system for freight which is typically time sensitive in nature.

General Traffic

General traffic and freight are only prioritised on SH20 and SH20A. General traffic is also given priority on SH20B but only between SH20 and Prices Road/ Campana Road where the Auckland Airport Park and Ride South is proposed as well as access through to future greenfield developments on this peninsula. Although general traffic is not prioritised on any other corridors, it is still accommodated to minimise delays where possible.

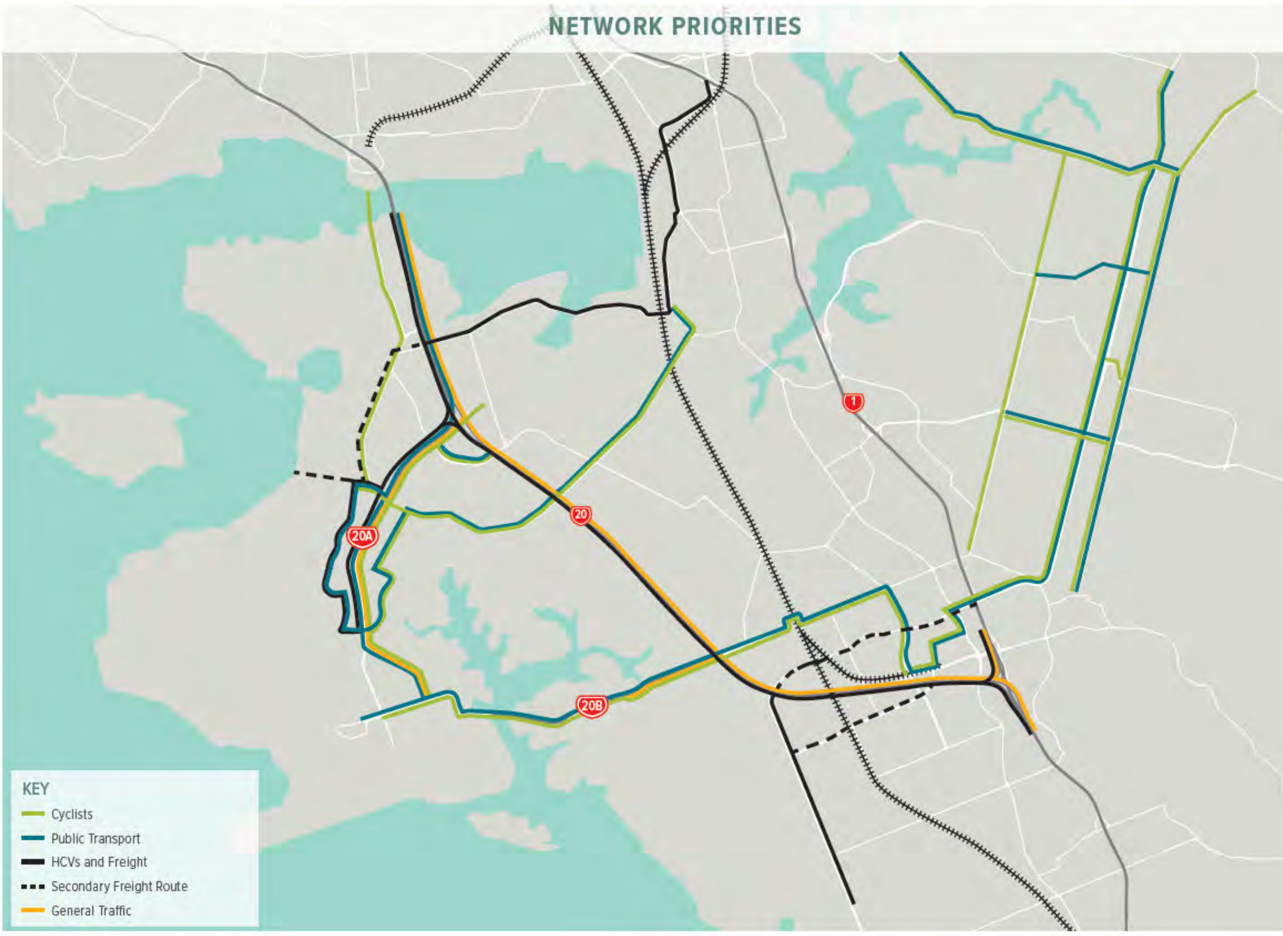


Figure 6-2: Network Operating Plan mode priorities

6.2 General system definition

6.2.1 A managed system

The preferred operating concept is for a fully dedicated rapid transit corridor that runs at-grade within the road corridor to avoid high land-acquisition costs and minimise impacts on existing transport and land uses. Therefore, the A2B system requires a road-capable mode with a relatively compact footprint that can be well-integrated with the existing urban/suburban fabric.

From a customer experience perspective, the intent behind the project is to generate changes in travel behaviour which, in turn will require delivering a product to people that is attractive and easy to use. To achieve this, the system design approach is to adopt as many of the positive characteristics as light rail transit which is generally seen as an attractive and easy to use mode.

For these reasons, a **managed-system** operating model is preferred. A 'closed system' is typical of light rail and BRT lines internationally. A managed system is proposed for A2B which is essentially the same but recognises that there may be locations where some sharing of the facility may be required and, in this case, recognises the early stage in design and definition and that there is the possibility of change in future stages. The managed system will operate as a single coordinated system of purpose-designed infrastructure and stations integrated with specifically-procured, high-capacity vehicles and information systems. The line will be designed to operate similar to a light rail or metro line, with one service pattern operating all-stops (further discussed in Section 6.5.2), and a high frequency service to station-style stops along a dedicated trunk route.

This is paired with inline stations with street level platform-style stops, offboard ticketing and all-door level boarding, to ensure consistent short dwell times and reliable operating of an inline system at high frequencies. Service frequency must be high enough to deliver 'turn up and go' service levels, but not so high it creates operational difficulties or congestion.

High system capacity will be provided by a relatively small number of long, high capacity articulated buses running at regular and even intervals. The buses will operate as a serial in-line system at 'turn up and go' frequencies all day, seven days a week. Buses will not pass each other, skip stops or overtake.

Vehicles will be specific to the line, designed to align the floor level with platforms at stops to allow level boarding and offboard ticketing. All-door boarding and alighting, through multiple doors simultaneously, allows rapid turnover of passengers and more convenient access from any point of the vehicle or platform. Access to and from the system will be via passenger connections at stations, all of which will be interchange stations. This integrates the line into the wider network of local bus routes and other rapid transit lines, without the vehicles leaving the dedicated corridor.

Under the recommended service pattern only RTN vehicles will use the running way, although flexibility for alternative service patterns will be retained where practical. This is to avoid potential delays and conflicts with other vehicles and enable fast, legible and highly reliable operation. This will also maintain a consistently high customer experience. See Section 6.5.2 for further justification on the recommended service pattern.

6.2.2 Flexibility

The proposed system design has flexibility in its ability to adapt to higher and slower rates of growth. Discussed further in 6.5.1 and specifically outlined in Figure 6-8 the proposed system has capacity for around 20% higher growth than forecast in 2048. Even higher growth can be accommodated in the route's physical design of accommodate light rail. The staged implementation also allows for slower or lower than expected growth.

Operational flexibility in degraded scenarios can be accommodated in the station design. For example, where bunching of buses occurs, additional platform length will be provided to allow for a second vehicle to pull up behind the bus at the active platform. This arrangement also allows services to operate around a broken-down vehicle. An additional passing lane is also provided at many stations allowing vehicles to pass one another.

While a managed system operating model is recommended for the corridor, the design provides flexibility for different operating patterns that may be required in future. In addition to the extended station lengths and passing lanes mentioned above there are opportunities to enable buses to enter and exit the busway along the corridor, including through the provision of mid-block merge and exit points.

6.2.3 Key characteristics

The following are the main characteristics of the system. Many of these characteristics are outlined in more detail in following sections:

- **Service frequencies:** Headways of three to five minutes at peak times, and a minimum of 10-minute frequencies at all times, will deliver high customer service standards with minimal wait times, to allow for timetable-free use of the line and facilitate seamless connections to local buses and other rapid transit lines on the network. The high passenger capacity of the rapid transit buses enables these service labels to be maintained without congestion at stops, intersections and terminals, and a minimised chance of bunching or other delays. A higher frequency using standard buses would not offer this benefit.
- **Number of routes:** A single service pattern is recommended for this route. This provides a clear and legible service offering for customers, supports efficient and reliable operations, and prevents any need for buses to pass one another. However, the design has been future-proofed to allow additional service patterns to use the system if there is a strong justification for this in future.
- **Types of buses:** The system is restricted to buses that meet the design parameters for high capacity, level-boarding and access, short dwell times and fast passenger turnover.
- **Stop layout:** Fewer services and moderately high service frequency on the busway mean operations will be more reliable than regular bus routes, so inline stops can be used. This further reduces delays or disruption by avoiding the need for buses to pull in and out of each stop.
- **Station size:** The system requires smaller stations than an open busway like the Northern Busway, because fewer services will use the route, therefore requiring fewer and shorter platforms. Buses will stop inline, so no passing lanes are required (unless specific locations require). This allows for narrower stations within the road corridor. Smaller stations require less land acquisition and construction costs, as well as improved urban integration by being easier to fit in the most ideal locations.
- **Dwell time at stations:** Faster boarding is afforded because the vehicle and platform are level, and off-board ticketing and all-door boarding procedures can be provided. Buses will not be delayed upon exit because stops are in-line and buses do not need to pull out. Dwell times should be in the 20-30 second range.
- **Speed and reliability:** With a fully dedicated pair of busway lanes along the entire route, just one or two services using the busway for large distances, and inline stops, services will be very reliable. Combined with signal priority at intersections and off-bus ticketing and validation, the rapid transit buses should be able to complete most runs from end to end without stopping for any reason other than letting passengers on and off at stations.
- **Signal priority:** Fewer services, operating more evenly with inline stops and regular dwell times, make it easier to provide signal priority at intersections for the rapid transit services. Three to five-minute headways require modifying only every second or third signal cycle to prioritise the transit phase, allowing plenty of time for the signal system to catch up the other phases in between. This provides the means to provide a green wave for transit on the corridor without unduly disrupting connecting buses or private vehicles on cross streets.
- **Actively managed:** To retain reliability and regularity of service, active management of headways through manipulation of traffic signals and communication with drivers and passengers.
- **Fleet size and operating costs:** A relatively lower number of higher capacity vehicles means operations are more efficient and reliable, so a smaller fleet can deliver an equivalent service level and capacity to other operating conditions. This reduces the vehicle and driver costs and allows the operating budget to be focussed on a broad span of frequent service across the day and week.

- **Boarding experience:** Because the vehicles and stations are designed together and stations are inline, buses will be able to pull into the station consistently and quickly align to the platform, and passengers can step directly onto the platform with no level change.
- **All-door boarding:** To reduce dwell times and produce more consistent dwell times and improve customer experience, all-door boarding is proposed. This will allow a "train-like" boarding operation. This will also provide improved utilisation of space within the longer vehicles as there is no need for people to board at the front and move down the vehicle. This is considered important for travellers to the airport with baggage.
- **Off-vehicle ticketing and validation:** To improve customer experience through not having to "tag on" at the door potentially resulting in delays and causing anxiety, all-door boarding will allow people to purchase and validate tickets on the platform as is typical with trains or light rail. This will reduce dwell-times and improve reliability as well as make the system easier to use.
- **Customer perception:** Customer perception should be very high because stations and vehicles are designed to give a similar 'feel' to train and light rail, and bus arrivals are frequent, regular and predictable.

6.3 Infrastructure and access

6.3.1 Stations

The role of the rapid transit network (RTN) in Auckland is to provide regional connectivity, supported by multiple bus routes and feeder services that, in turn, provide a local access coverage service role. Airport to Botany, as part of the proposed RTN, provides services focused on patronage and therefore, in line with the policy of the Auckland Regional Public Transport Plan, focuses on speed and directness above local access. Consequently, Airport to Botany, as a rapid transit line with a patronage service focus, targets station locations at major destinations and interchanges, rather than regularly spaced stop locations, which would be prioritised if the focus was on coverage.

The RTN platforms will be 34m long with additional length provided at some stations to be approximately 50m long to accommodate a second vehicle behind one at the active platform and allow them to move around one another.

The location of stations is a critical component for the accessibility and usefulness of a rapid transit line. For safe and efficient operations, passengers may only get on and off a rapid transit line at designated stations. This is especially so for 'closed' transit corridors operated by a single service pattern, like Airport to Botany, where local services do not move on or off the rapid transit running way, and network connections are based around passengers transferring at stations.

Locations

Station locations have been confirmed through the Station Locations Tech Note (502334-7000-TEC-KK-004) and are illustrated in Figure 6-3. This shows the relationship between the station locations and land use planning. Zones in purple are employment zones, striped purple/pink are high density town centres and yellow/orange residential.

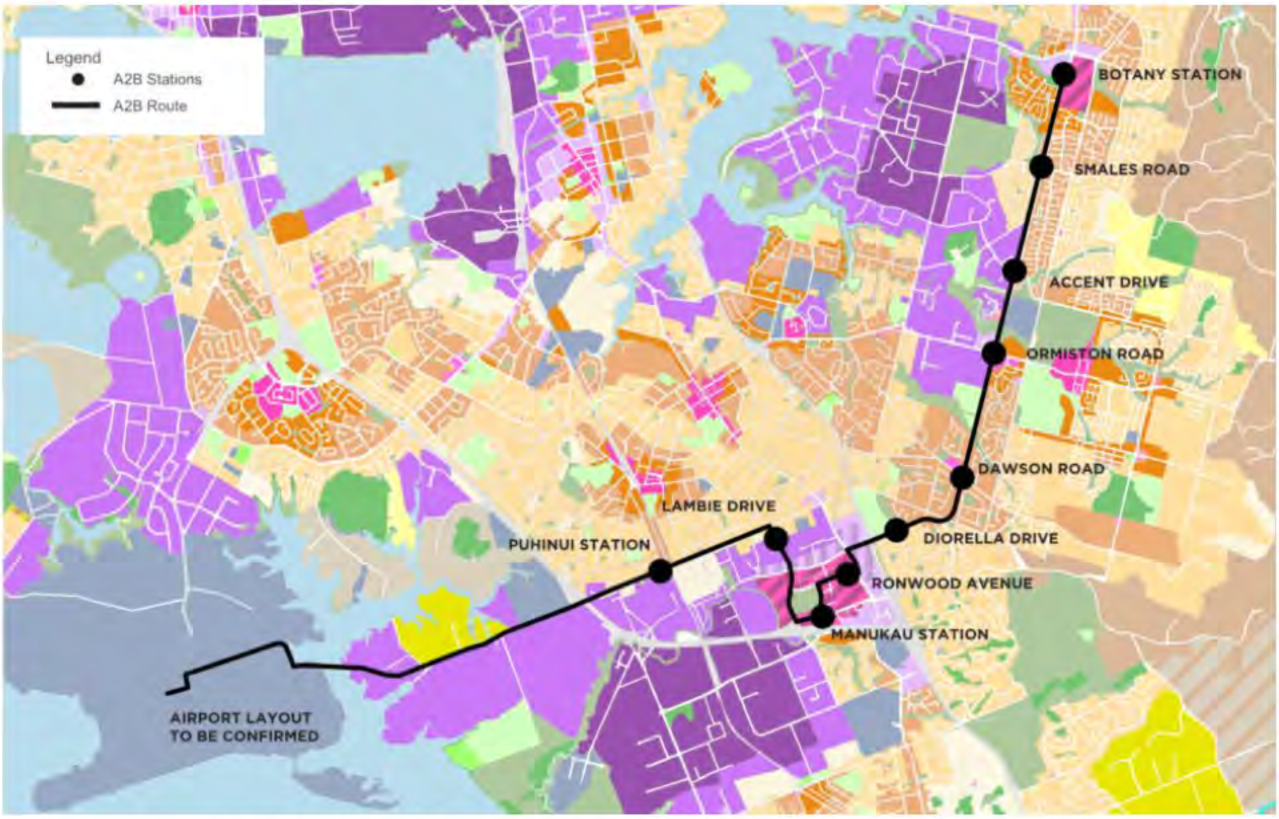


Figure 6-3: Proposed station locations and land uses

Table 6-1 provides the full list of the Airport to Botany Rapid Transit stations and their indicative classification.

Table 6-1: Station classifications

Stop number	Section	Location	Major interchange	Minor interchange
1	Airport	Airport Passenger Terminal	X	
2	Airport	The Quad Business Park (Eastern Airport Precinct)		X
3	Puhinui	Puhinui Rail Station	X	
4	Puhinui	Puhinui Road/ Lambie Drive		X
5	Manukau	Manukau Station	X	
6	Manukau	Ronwood Avenue (Manukau Metropolitan Centre)		X
7	Te Irirangi	Diorella Drive (AUT/Sportsbowl)		X
8	Te Irirangi	Dawson Road		X
9	Te Irirangi	Ormiston Road – Botany Junction Shopping Centre		X
10	Te Irirangi	Accent Drive		X
11	Te Irirangi	Smales Road		X
12	Botany	Botany Metropolitan Centre	X	

These stations are a mixture of intermediate and interchange stations, where customers can connect with other public transport services. Design features of the intermediate and interchange stations are outlined in the following sections. As outlined in Section 5.1.2 many stations provide a key role in access to the system through facilitating interchange with local bus services.

Major interchange stations

The arrangement of each major interchange station will provide short accessible paths with clear sightlines to connecting public transport services. Table 6-2 provides a summary of the requirements for each of the major interchange stations.

Table 6-2 Major interchange station design requirements

Interchange Stations	Design requirements
International and Domestic Airport Passenger Terminal at Airport business park	▪ As a minimum, the assets provided will be equal to intermediate stations. In addition to these, the following apply: ▪ Platforms will be a minimum of 5m wide at this station ▪ Platforms will be a minimum of 34m long at all stations to accommodate light rail vehicles ▪ Staffed Customer Service Centre, ticket machines and validation ▪ Simple, comfortable (in all conditions), short and efficient customer connections between Airport to Botany Rapid Transit services and domestic and international terminals ▪ Rapid transit vehicle charging facilities ▪ Staff welfare facilities that are accessible from the layover location ▪ Accessible toilets if adjacent airport facilities are not available.
Puhinui Station	▪ As a minimum, the assets provided will be equal to intermediate stations. In addition to these, the following apply: ▪ The Puhinui Interchange stop is to tie-into the balcony designed in the Puhinui Interchange project, above the railway line ▪ Platforms will be a minimum of 5m wide at this station ▪ As Puhinui interchange station will be on an elevated bridge deck, the platform lengths will be designed to 67m lengths to allow for potential future coupling of LRT vehicles and avoid rebuilding the bridge deck ▪ Staffed Customer Service Centre, ticket machines and validation ▪ Simple and efficient customer connections between Airport to Botany Rapid Transit services and train services.
Manukau Station	▪ As a minimum, the assets provided will be equal to intermediate stations. In addition to these, the following apply: ▪ Staffed Customer Service Centre (existing) ▪ Simple and efficient customer connections between Airport to Botany Rapid Transit services, train services, and local bus services. This will include a pedestrian priority space within the intersection between the three public transport modes.

Interchange Stations	Design requirements
Botany Metropolitan Centre	▪ As a minimum, the assets provided will be equal to intermediate stations. In addition to these, the following apply: ▪ Platforms will be a minimum of 5m wide at this station ▪ Platforms will be a minimum of 34m long at all stations to accommodate light rail vehicles ▪ Staffed Customer Service Centre (existing), ticket machines and validation ▪ Convenient customer access to and from the Metropolitan Centre ▪ Simple and efficient customer connections between Airport to Botany Rapid Transit services, Eastern Busway services, and local bus services.

Minor interchange stations

The arrangement of each minor interchange station will provide short accessible paths with clear sightlines to connecting public transport services. Table 6-3 summarises the assets provided at each minor interchange station. In addition to these assets, the North of Botany Terminus will require charging facilities for the rapid transit vehicles, and staff welfare facilities that are accessible from the layover location.

Table 6-3 Minor interchange station design requirements

Asset	Design requirements
Platforms	▪ Platforms will be a minimum of 3m wide at all stations ▪ Platforms at Davies Ave and Ronwood Ave stops will be wider than 3m – the exact dimension is dependent on property constraints ▪ Platforms will be a minimum of 34m long at all stations to accommodate a range of single bus rapid transit and light rail vehicles. Only spatial future proofing for coupled light rail vehicles will be provided ▪ Platform markings to indicate safe areas etc.
Lighting	▪ To satisfy CPTED and IPTED principles
Shelter	▪ High standard of protection against wind, rain and sun ▪ To satisfy CPTED principles
Seating	▪ As per current best practice and AT codes
Vending and Reload Devices (VRDs)	▪ As per current best practice and AT codes
Fare Payment Devices (FPDs)	▪ As per current best practice and AT codes – no gate lines
Emergency Help Points (EHPs)	▪ As per current best practice and AT codes
Passenger Information Displays (PIDs)	▪ Dynamic real-time service information, including audible messages ▪ As per current best practice and AT codes
Public Address (PA) speakers	▪ As per current best practice and AT codes
Static information boards	▪ Route and service information posters ▪ As per current best practice and AT codes

Asset	Design requirements
Wayfinding signage (including maps)	▪ Simple and legible signage, in accordance with existing AT standards ▪ Illuminated station marker totem ▪ Platform signage that identifies the Rapid Transit direction of travel
CCTV	▪ As per current best practice and AT codes
Wi-Fi	▪ As per current best practice and AT codes
Rubbish bins	▪ As per current best practice and AT codes
Bicycle parking for privately owned bicycles (to provide first and last mile connections)	▪ As per current best practice and AT codes
Bicycle & scooter parking for shared mobility devices (to provide first and last mile connections)	▪ As per current best practice and AT codes
On-demand transport options (to provide first and last mile connections)	▪ Parking for taxis, Uber/ride-share vehicles, e-scooters etc. shall be accessible from the station e.g. within a 50m radius.

Station access hierarchy

Detailed in the High-Level Stations Access Study (502334-7000-REP-KK-0028) there is a proposed hierarchy for station mode access and approach to first and last mile transport. Figure 6-4 illustrates that pedestrians have the greatest priority at stations, followed by cyclists and feeder buses. Vehicular arrives are lower priorities in a spatial sense although as outlined below, these are still an important part of the A2B system design. Park and ride are not expected to play a significant role.

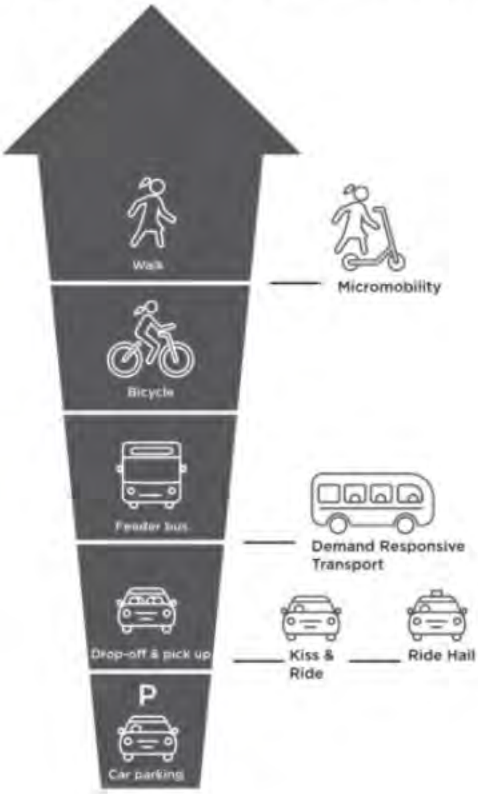


Figure 6-4: Mode access hierarchy

Walking

Walking is the top priority for station access and should be prioritised. The High-Level Stations Access Study (502334-7000-REP-KK-0028) and Detailed Stations Access Study (502334-7000-REP-KK-0029) provide a detailed strategy for including quality walk-up experience for A2B customers. A 1km waling catchment is assumed and is consistent with best practice for RTNs and supported by Walkable catchment analysis at Auckland train stations (2012 Auckland Council technical report, TR2012/023).

Other arrival modes

Given the relatively low land use densities in much of the route, careful attention will be required to arrival modes that can extend the catchment of the service and enable the system to fully give effect to the project objectives. Figure 6-5 illustrates the 1km and 3km catchments of proposed stations. The 1km catchment can be considered a reasonable catchment for walk-up passengers. A 3km catchment can be applied to a range of modes including cycling, micromobility, taxi, ride share or drop off and pick up. The 3km catchment extends to cover a significant proportion of the urban area in the corridor.

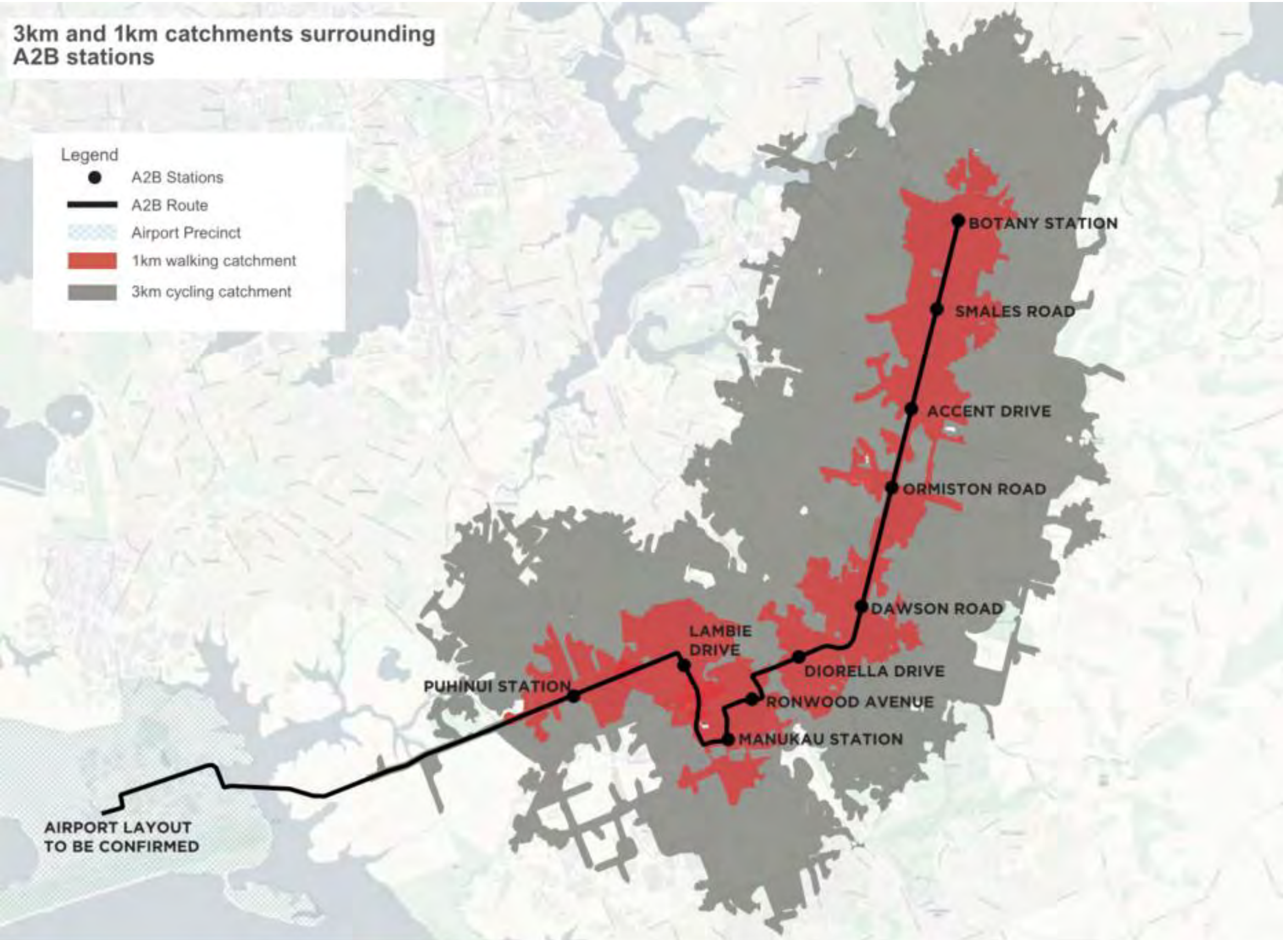


Figure 6-5: 1km and 3km station catchments

To enable this wider catchment to be accessed effectively and provide people with genuine travel choices, consideration of network integration and specific design for the following arrival modes will be required.

Cycling (including electric bikes)

Cycling is evolving and with the uptake of powered e-bikes cycling is becoming a real alternative for longer distances and wider sections of the community. This will require:

- Secure bike storage
- Safe access routes

- Integration with wider cycling networks
- Potentially bike share schemes

Other micromobility

This is a mode or range of modes that is rapidly changing and may have evolved further when A2B is designed in detail. Consideration of access for, safety of and storage of scooters and other forms of mobility will be required.

Buses

The Potential Changes to the Local Bus Network in Response to A2B tech note (502334-7000-TEC-KK-0027) outlines a range of network changes. Figure 6-6 illustrates the stations that connect with either RTN services or Frequent Services. These locations will require specific facilities for local bus routes and customers and quality pedestrian connections to Airport to Botany line stations.

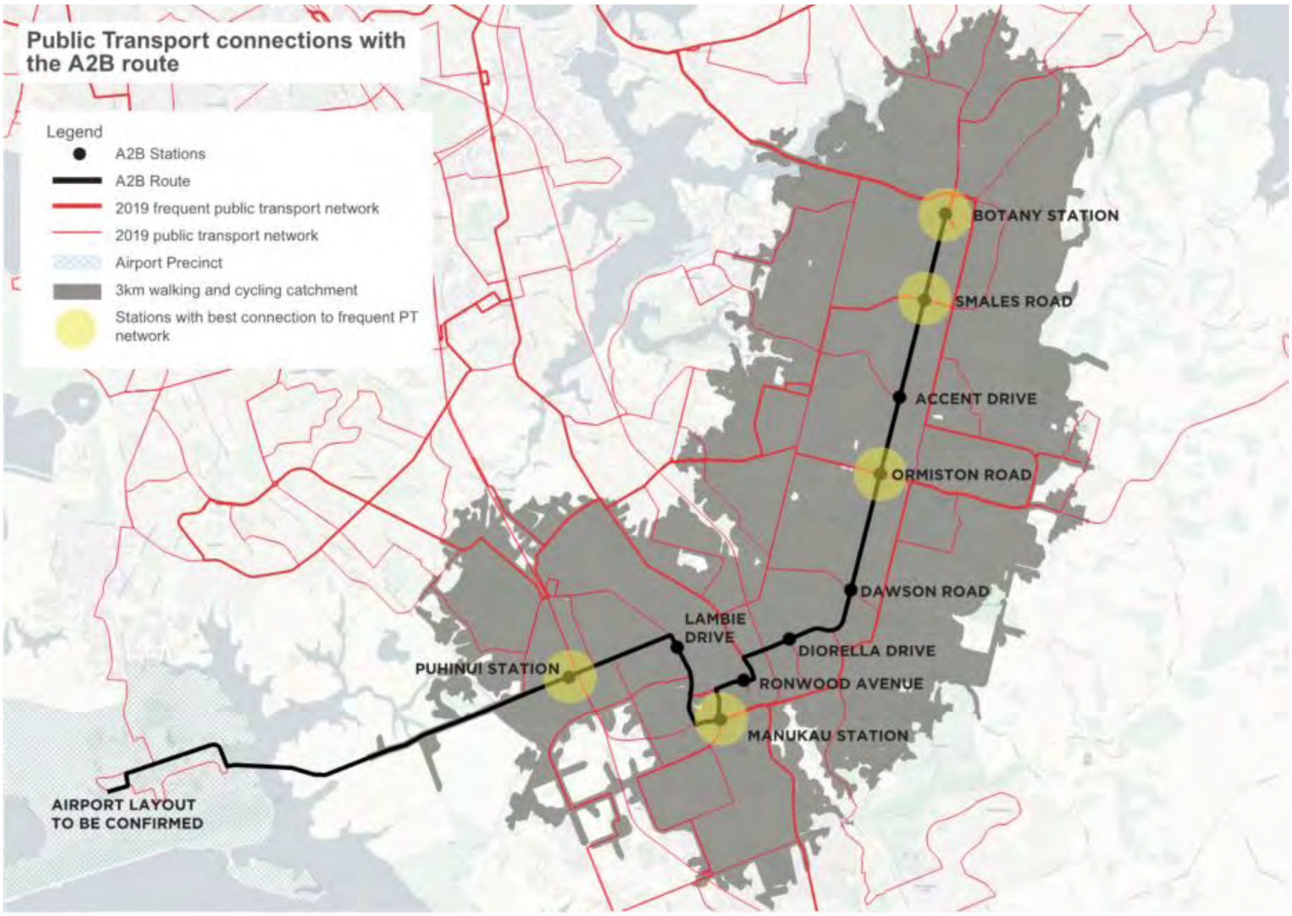


Figure 6-6: Public transport connections with A2B

Demand responsive transport

While at this time there are no proposals to operate demand responsive transport in the Airport to Botany area, it has the potential to support access to the system and should be provide for if proposed.

Taxi and ride share

Taxis and ride share, including Uber for example are likely to be a mode of access to stations, particularly with the airport as a key destination. Space should be provided on local streets near stations with lighting and quality access to stations.

Private vehicle pick-up and drop-off

While private vehicle arrivals are not high in the access hierarchy, drop off and pick up may be an attractive mode of access given the number of cross-arterial roads that access motorways and major employments zones, meaning that ride-sharing and drop off could be a practical access mode.

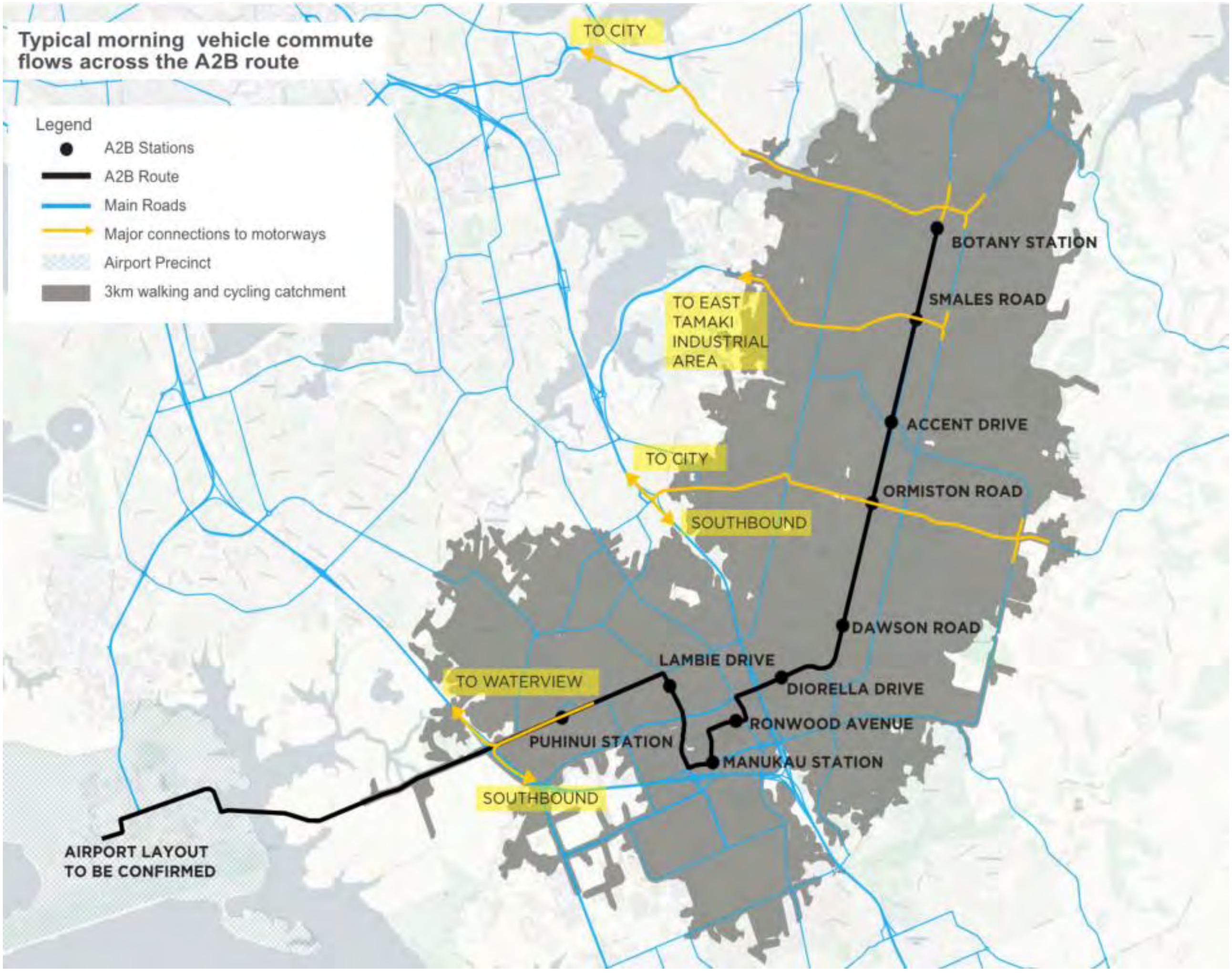


Figure 6-7: Potential drop off and pick up routes and locations

Figure 6-7 illustrates these key commuter routes and the likely locations for this activity. Short term parking that is safe and well connected to stations should be provided at these locations.

Park and ride

Provision of park and ride has not been proposed as part of the A2B project.

6.3.2 Rapid transit corridor in the public carriageway

The Airport to Botany Rapid Transit route will run from the proposed Auckland International Airport terminal to Botany Town Centre, via major interchanges at Puhinui and Manukau and other intermediate stations. The corridor primarily runs within State Highway 20B, Puhinui Road, Lambie Drive, Manukau Station Road, Davies Avenue, Ronwood Avenue, Great South Road and Te Irirangi Drive, along a dedicated rapid transit lane in each direction. As a dedicated rapid transit corridor, no other vehicles are permitted to operate within these lanes apart from emergency vehicles responding to an incident.

General traffic lanes and protected walking and cycling facilities will be provided alongside the rapid transit corridor. The rapid transit stops will be provided in-line with the corridor at street level, with no facility for passing. While general traffic lanes are generally retained in the concept design in each direction the extent of retention of this space for general traffic should be rigorously tested before being included in the final design.

The Preliminary Design Philosophy Statement (502334-7000-REP-JJ-0024) outlines the design considerations adhered to in the concept design.

Features of the rapid transit corridor and public carriageway include:

- On street segments (including at intersections) where more than one vehicle lane per direction currently exist, the conditions and vehicle demands will be tested to determine if the number of vehicle lanes can be reduced. Where possible, the number of vehicle lanes will be reduced, with reallocation of space to enhance the public realm with high quality walking and cycling facilities and/or landscaped berms. This will also mitigate the negative stormwater and amenity impacts of removing the existing landscaped median space.
- Replacement of the short-term bus priority lanes along Puhinui Road and Lambie Drive with the rapid transit corridor. This will include a bridge over the railway line at Puhinui Station
- Davies Avenue will be closed to general vehicle access between Putney Way and Manukau Station Road:
- Only rapid transit vehicles will be able to travel in both directions along Davies Avenue between Putney Way and Manukau Station Road.
- General vehicle access will be maintained on Davies Avenue between Ronwood Avenue and Putney Way. General vehicle traffic running down Davies Avenue will be diverted along Putney Way, and vice versa.
- At Manukau Bus Station, buses will enter the station at Osterley Way and exit southbound at the Davies Avenue/Manukau Station Road intersection.
- A bi-directional cycle path will run continuously along Davies Avenue (including in front of the rail station) and connect into the bi-directional cycle path on Manukau Station Road and the uni-directional cycle paths on Ronwood Avenue.
- Provision of a shared space on Davies Avenue outside the interchange at Manukau Station, subject to final design and operational requirements of the rapid transit corridor.
- Replacement of existing parking adjacent to Hayman Park with parallel parking along the eastern edge of Davies Avenue. The space required for this will not restrict the amount of space provided to active modes moving along or across Davies Avenue.

Speeds

Table 6-4 shows the proposed operating and designs speeds for each road along the rapid transit corridor. Any changes to road speeds are subject to a Waka Kotahi review process and consultation.

The Speed Limits Along the Airport to Botany Mass Rapid Transit Corridor tech note (502334-7000-TEC-KK-0040) outlines how these proposed speed changes can meet the investment objectives and align with wider strategic and policy context. This is reflected in the Preliminary Design Philosophy Statement.

Table 6-4 Proposed road operating and design speeds

Road	AT Roads and Streets Framework Typology		Posted Speed Limit		Proposed Design Speed
	Current	Proposed	Current	Proposed	
SH20B	NA	NA	50 km/h to 80 km/h	50 km/h to 80 km/h (no change)	50 km/h to 80 km/h (no change)
Puhinui Road	Single Use (Out of Centre) Arterial	Mixed Use Arterial	60 km/h	50 km/h	50 km/h
Lambie Drive (North of Cavendish Dr)	Mixed Use Arterial	Mixed Use Arterial	60 km/h	50 km/h	50 km/h
Lambie Drive (South of Cavendish Dr)	Mixed Use Arterial	Mixed Use Arterial	60 km/h	50 km/h	50 km/h
Manukau Station Road	Mixed Use Arterial	Mixed Use Arterial	60 km/h	50 km/h	50 km/h
Davies Avenue	Mixed Use Collector	Mixed Use Collector	60 km/h	30 km/h	30 km/h
Ronwood Avenue	Mixed Use Arterial	Mixed Use Collector	50 km/h	30 km/h	30 km/h
Great South Road	Mixed Use Arterial	Mixed Use Arterial	60 km/h	50 km/h	50 km/h
Te Irirangi Drive (South of Whetstone Road)	Mixed Use Arterial	Mixed Use Arterial	60 km/h	50 km/h	50 km/h
Te Irirangi Drive (North of Whetstone Road)	Single Use (Out of Centre) Arterial	Mixed Use Arterial	80 km/h	50 km/h	50 km/h

Intersections

The following operating principles apply to the intersections along the rapid transit corridor:

- Pre-emption or priority for the rapid transit service at intersections.
- All existing signalised intersections are maintained in the concept design and operational assumptions. As the operational concept is progressed, trade-offs between rapid transit journey time and reliability may be required and may require consideration of reducing conflicting turns across the rapid transit corridor.
- The level of service for general vehicles at most intersections is likely to drop below the current level. This is necessary to enable to the rapid transit to run efficiently and ensure its customers accessing stations can do so safely and comfortably.
- Intersections should align with the intersection principles of the latest Transport Design Manual (TDM). These principles will include making intersections safe for all users and considering vision zero.
- Slip lanes will be removed and replaced with left turn lanes that will be phased. Wherever possible left turns will be combined with a through lane to reduce the overall intersection size.
- Where there are currently two right turn vehicle lanes, one will be removed to make way for the rapid transit corridor. The only exception to this is at the Great South Road/Te Irirangi Drive intersection due to the demand for the motorway ramps.

- The existing Ronwood Avenue/Davies Avenue roundabout will be converted into a signalised intersection.
- The existing Ronwood Avenue/Osterley Way/Sharkey Street roundabout will be upgraded to a signalised intersection.
- All vehicle approach and exit lanes at signalised intersections (including the rapid transit corridor) will be aligned.
- Protected walking and cycling facilities should be physically separated from each other approaching and through crossing points (this includes at mid-block crossings, signalised and unsignalised intersections). Where these occur at stations, these will be staggered on either side of the platform.
- All existing unsignalised intersections that allow right turn movements will be converted into left-in, left-out junctions.
- At intersections where rapid transit stops are located, platforms will be staggered on either side of the intersection and pedestrian and cycle crossings will be staggered on either side of the platforms.

Legal status and enforcement

The Airport to Botany route will be required to be legally recognised as a special vehicle lane under the Local Government Act (1974) and the Land Transport Act (1998). At the appropriate time in the project's development, mechanisms will be required to provide this status.

Enforcement measures will need to be developed to ensure the safe and efficient operation of the BRT corridor. This is likely to be a joint responsibility of the NZ Police and AT.

6.3.3 Walking and cycling

The following principles apply to walking and cycling **along** the Rapid Transit corridor:

- Walking and cycleway design will be in accordance with the TDM. Cycling facilities along the corridor (mid-block segments) and at intersections (intersection segments) should aim to achieve Quality of Service 1 as stated in the Bike Quality of Service Guide from AT. Facility qualities should not be lower than Quality of Service 2.
- Provision of protected, separated, and continuous cycling facilities along the rapid transit corridor and Cavendish Drive. Protected cycle paths are a cycle path which is both vertically and horizontally separate from the carriageway used by motor vehicles. Guidance for the form of separation is as follows:
- Horizontal protection could take the form of planted berm, street trees with canopies lifted to provide 2m clearance, planter boxes or concrete/ pavers/ asphalt strip.
- Vertical protection typically takes the form of full height kerb or another form of continuous vertical feature. Depending on the context this could be a low wall if no pedestrian cross movement is needed.
- Guidance around horizontal width and vertical heights are noted in the TDM, widths and heights relate to traffic speed and volume with greater protection (width and height) needed for higher volume faster roads.
- Separation between the walking and cycling paths must be identifiable for a vision impaired user and safely traversed by a mobility impaired user.
- Protected walking and cycling facilities should be physically separated from each other approaching and through crossing points (this includes at mid-block crossings, signalised and unsignalized intersections). Where these occur at stations, these will be staggered on either side of the platform.
- Comfortable waiting spaces will be provided.

- Where there are existing parallel side roads adjacent Te Irirangi Drive, these streets will transform into bicycle streets (streets where bicycles are prioritised, and cars are visitors). Elements of these future bicycle streets include:
    - Reduced speeds,
    - Retaining existing vegetated buffer,
    - Closing/restricting or redesigning private vehicle entry and exit points from Te Irirangi Drive (to reduce conflict opportunities),
    - Guiding bicycles to travel in the middle of the road with local traffic, and
    - Guiding pedestrians to use existing footpaths.

All new walking and cycling facilities will be designed to have priority across side roads.

6.4 Intelligent transport systems

ITS will be used across the Southwest Gateway programme and will be fundamental to delivering the 'one network' operating model. The applications and services to be used on the project are outlined below.

6.4.1 Customer experience

Timely travel choice and journey information for customers meets the objectives of the project, international standards, and the desirable characteristics of the project. Potential ITS applications for the customer experienced are outlined in the Table 6-5 below.

Table 6-5 Potential ITS applications for customer experience

Pre-departure	▪ Mobile app to inform on real travel times, suggested routes, modes, park and ride availability and connections ▪ Integrated airport and public transport travel information ▪ Simple ticketing through AT HOP and airport ticket solutions
During journey	▪ Mobile app to inform on real travel times, suggested routes, modes, park and ride availability and connections and their services ▪ On-vehicle real-time passenger information e.g. journey times, flight departures, major connecting services etc. ▪ Station PA announcements, hearing loops, and dynamic real-time PIDs. Including integrated airport and public transport travel information, including major connecting services ▪ Variable Message Signs for journey information at key decision points on SH20, SH20A, and SH20B.

6.4.2 Network performance

The following ITS applications can be deployed to optimise network performance.

- SCATS to optimise signal phasing and traffic signal priority
- Variable speed and lane management
- Traffic data collection
- Incident detection using Automatic Video Incident Detection (AVID)
- Automatic Incident Response Plans

- CCTV throughout the rapid transit corridor, stations, and state highways
- Automatic Vehicle Location (AVL).

6.4.3 Safety

Detection and management of safety and security risks across the network to meet safety objectives could include the following.

- CCTV throughout the rapid transit corridor, stations, and state highways
- EHPs at stations.

6.4.4 Signal priority

With an at-grade BRT in which buses are expected to negotiate traffic signals, it is desirable to provide a form of signal pre-emption or priority to reduce journey times and improve reliability. While detailed assessment can be carried out on the corridor, international experience is that typically a frequency greater than twenty buses per hour will limit this potential. At frequencies of less than twenty buses per hour, signal priority tends to minimize the irregularity with which vehicle services operate, enabling priority to be inserted into intersection cycle times without excessive disruption to cross-movements of traffic, cyclists, pedestrians and local buses. This provides a limitation to the number and frequency of routes that can be accommodated in a managed at-grade system.

Traffic signal priority operations

Using the traffic signal management system, signals will be set up and operated to prioritise the A2B rapid transit services and to further support movements for pedestrians and bicycles; this shift in prioritisation may discourage some general traffic to use the A2B corridor. Conversely, the signals will be set up to encourage general traffic to use alternative routes such as parallel corridors.

The traffic signal management system will be used to enable more efficient detour routes when there are temporary closures, incidents or planned events occurring on key corridors, the rapid transit corridor or major routes nearby (e.g. SH20 and SH20A).

The following operating principles apply to traffic signals along the rapid transit corridor:

- Traffic signals will form part of the intersection signals and be managed and operated via the wider network traffic signal management system.
- Priority will be given to the rapid transit corridor to provide efficient operation with minimum delays whilst balancing this with the needs of other users moving along or across the corridor such as pedestrians and people on bicycles, i.e. maintaining acceptable levels of service for all modes.
- Using the traffic signal management system, stop line and advanced detection on the rapid transit corridor, priority will be given to the rapid transit services by facilitating green extensions, early cut-offs for conflicting movements, head starts or repeat phases
- Detection loops will be provided at each station to detect vehicle departure
- To reduce wait times and increase the time allowed to cross for both passengers and other intersection priority users, the signal cycle times will be minimised; this can be done through reducing the number of phases that may require consideration of prohibiting or removing some vehicle movements. Time to cross intersections will be sufficient to allow all users to cross safely e.g. vision impaired and mobility impaired users.
- Signals will display a crossing countdown for pedestrians.
- Co-ordination of the signals along the corridor will further promote priority for the rapid transit services along the route.

Future versions of this document will include the prioritisation of modes and movements at the signalised interchanges along SH20, SH20A and other key intersections that link to the state highway network and rapid transit system.

Rapid Transit traffic signal aspects

The traffic signals used for the Airport to Botany Rapid Transit system should be consistent with those used for the Eastern Busway.

6.5 Fleet and service

6.5.1 Demand and capacity

In 2048, the projected passenger loading along the Airport to Botany corridor is estimated to be 1,200 to 1,900 passengers per hour in the peak direction, during the morning peak hour at the peak load point, and 500 to 900 per hour in the counter-peak direction and during the interpeak period.

Overall, this indicates the need for a public transport mode that can efficiently deliver a base demand of 900 passengers per hour while still maintaining good service frequencies, and which can accommodate peak occupancies of around 2,000 passenger per hour without requiring frequencies so high they negatively impact operations.

Model analysis indicates a relatively even and bi-directional demand profile along the route, albeit with a noticeable peak flow from the suburban areas at the Botany-Ormiston end of the corridor to the employment areas at the Manukau-Airport end of the route. Modelling also indicates the corridor will support a significant shuttle function between the Puhinui rail interchange station and both the airport and Manukau.

Figure 6-8 presents each of the modes and their capacities at the service levels considered, compared to the modelled peak demands of the A2B service in 2028, 2038 and 2048. The key features of this chart are:

- Yellow horizontal bars: low service levels to meet demand (5 to 15-minute headways)
- Green horizontal bars: ideal service levels to meet demand (3 to 5-minute headways)
- Blue horizontal bars: ‘stretch’ service levels to meet demand (2 to 3-minute headways), reaching the limit of service that can be provided
- Red vertical bars: A2B forecast demands by decade – peak direction/location.

If the red demand bar intersects with the green part of the bar for a given mode, that mode should provide sufficient capacity for the A2B service in the given year, operating at ideal service levels with 3- to 5-minute headways. Where the red line intersects with the blue zone, the service would need to operate at headways that will make managing signal priority and a reliability difficult. The yellow area requires a low level of service to meet demand, meaning either a lower level of frequency to meet demand or if a higher frequency is operated, a low vehicle utilisation. The modes that would be over- or under-utilised if they were selected for the service have been greyed out.

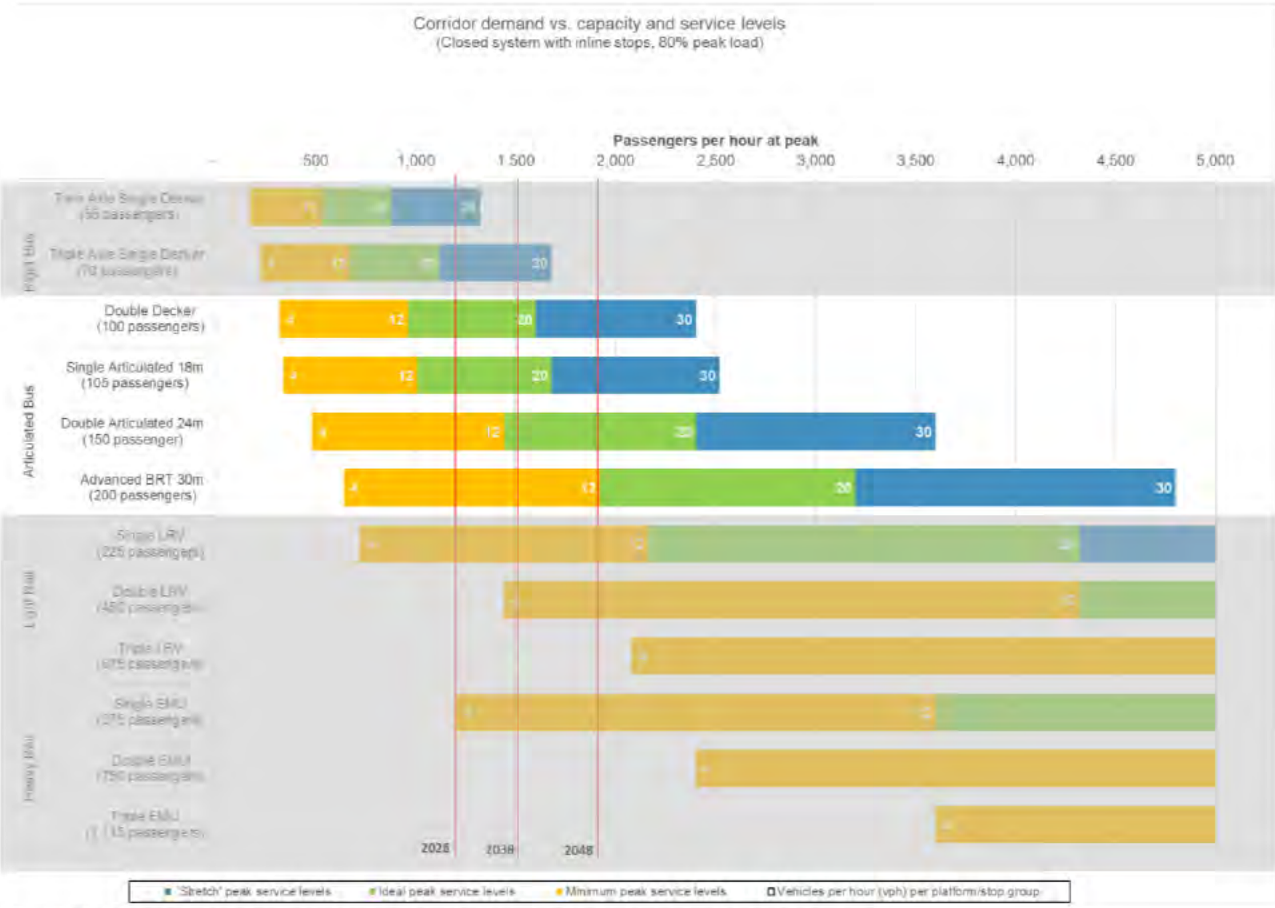


Figure 6-8: A2B peak demand by decade vs. mode capacity and service levels

The results of this assessment indicate that the lower capacity bus modes (standard buses, double decker buses, single-articulated buses) could accommodate projected interpeak demands and peak demands in 2028 and 2038 but would have insufficient capacity to accommodate peak demands at acceptable headways in 2048. A double decker or single-articulated bus could accommodate the projected peak demands in 2028 and 2038, so could be used as an interim vehicle before a higher capacity vehicle is required for later years. Conversely, the results also indicate that the higher-capacity modes (light rail and heavy rail) would be a significant over-provision of capacity at the targeted service levels, even at peak times in 2048.

Based on this assessment, a 24m double-articulated bus, with capacity for 150 people, would best accommodate the predicted demands at the preferred service levels for the A2B service. This mode option could service the predicted demands in 2048 with headways of just under 5-minutes. With acceptable headways of as low 3-minutes, this option provides for further demand growth beyond 2048 and/or higher-than-predicted demands before 2048.

In summary, this assessment indicates the ideal mode for the Airport to Botany corridor is BRT using high capacity double-articulated buses. However, where practical, it will be prudent not to preclude either specialised bus-based urban transit vehicles or light rail if higher demands eventuate.

6.5.2 Service design

It is proposed that the corridor is served by a single service pattern with all-stops services only. The long space between stops means that skip-stop services are unlikely to be required. The “managed system” concept does allow for more than one service pattern should future planning identify the need for an additional service, however the intent is that service patterns are limited to two or three at most.

A single service pattern is preferred over multiple service patterns, as it:

- Can operate like a ‘trunk’ rail / light rail line
- Will be faster and more reliable (multiple services may suffer due to bunching)

- Will be highly legible and provide customers with certainty
- Will allow consistent headways, meaning signal priority can be used more effectively and easily, and bunching will be less likely to occur
- Can be more easily designed for off-board ticketing and all-door boarding
- Can deliver highest capacity by operating exclusively high-capacity vehicles at high frequencies.

Multiple service patterns have the potential to make the network confusing and will also be likely to involve lower capacity vehicles with single-door boarding, resulting in longer dwell times. Unless priority is provided for the entirety of all routes, multiple services will also be less reliable.

The service pattern is proposed to exist in the context of a local bus network (refer tech note 502334-7000-TEC-KK-0027). The local bus network can be altered to 'branch' off the main single service.

There may be limited parts of the corridor that shared running is required for operational reasons, for example in the vicinity of Manukau Central and the airport.

6.5.3 Service levels

Auckland's rapid transit system is intended be a 'turn up and go' service when it is fully functional. The service levels will increase with demand as the infrastructure is constructed, Table 6-6 presents the estimated future service levels. Services will operate with dwell times of approximately 20-30 seconds to achieve the desired 'turn up and go' level of service.

Table 6-6 Service levels

Time of day	Headways
Peak services (between 07:00 – 08:59 and 16:00 - 18:59)	Up to 5-minutes (12 vehicles per hour) between 2028 and 2038 Up to 3-minutes (20 vehicles per hour) after 2038
Off-peak services (between 06:00-06:59, 09:00-15:59 and 19:00-23:59)	Minimum of 10-minutes (6 vehicles per hour)
Early-morning and late-night services (between 04:30 - 06:59 and 00:00 - 01:29)	15-minutes (4 vehicles per hour)

6.5.4 Journey times

Fast and reliable journey times is a core part of the value proposition for the service and key to generating mode shift. The journey time from the Airport Terminal to Botany is estimated to be 36 - 41 minutes based on analysis at the time of writing this part of Concept of Operations. Estimated timings between stations are outlined in Table 6-7 and Table 6-8.

Table 6-7: Approximate journey times between A2B stations

From	To	Journey time
Airport	**Botany**	**36-41 minutes**
Airport	Puhinui	10-12 minutes
Puhinui	Lambie	~2 minutes
Lambie	Manukau	4-5 minutes
Manukau	Ronwood	~2 minutes
Ronwood	Diorella	2-4 minutes
Diorella	Dawson	~2 minutes

From	To	Journey time
Dawson	Ormiston	~3 minutes
Ormiston	Accent	~2 minutes
Accent	Smales	~2 minutes
Smales	Botany	~3 minutes

Table 6-8: Travel times between key stations

From	To	Journey time
Airport	**Botany**	**36-41 minutes**
Airport	Puhinui	10-12 minutes
Puhinui	Manukau	5-7 minutes
Manukau	Ormiston	9-11 minutes
Ormiston	Botany	7-8 minutes

These journey times will be refined as design and corridor operation is developed in greater detail.

6.5.5 Operating hours

The operating hours of the Airport to Botany line are proposed to be consistent with the existing 380 Airporter bus – 04:30am - 01:30am (next day), seven days a week. The three-hour non-service period will be used for maintenance works.

6.5.6 Fleet requirements - general

In the Demands and Mode for the Airport to Botany RTN Corridor tech note (502334-7000-TEC-KK-0024), demand forecasting supports an advanced BRT mode as the most appropriate for the Airport to Botany corridor. This would meet 2048 forecast peak demands with high, but manageable frequencies.

A 24m-long double-articulated electric bus has been selected as the ultimate design vehicle for the Airport to Botany corridor.

- The 2048 required passenger capacity and service levels can be most readily delivered with a double-articulated bus of approximately 24m length, configured for urban BRT operations with multiple doors and level boarding.
- Lesser demands in earlier decades could be served by standard single-decker buses (e.g. 13.5m) and/or single-articulated buses (e.g. 18m), however these should also have door and interior configurations designed for high frequency operation and short dwell times.
- Double decker buses are not preferred at any time for the A2B closed-system operating model due to the inefficient boarding/alighting capabilities and the provision of platforms for longer buses in the future anyway.
- A 24m double-articulated vehicle based on conventional bus technology is available from a range of suppliers, at relatively low cost. However, these would need changes to meet relevant standards such as Vehicle Dimensions and Mass Rules, and the Requirements for Urban Buses.
- Battery electric buses, with overnight charging at the depot, potentially with midday top-up charging are assumed for the design vehicle.

- Zero-emission electric buses will be required for the Airport to Botany corridor if procured from 2025, as per Auckland Transport policy. This policy excludes diesel or hybrid buses.
- Systems that require intermittent charging infrastructure at stations or along the route in-service are not preferred, due to the requirement for additional infrastructure and the potential to delay vehicles in-service but should be considered.

The rapid transit vehicles will be approximately 24m long to accommodate 150 passengers i.e. 50 seated and 100 standing (4pax/m2). These vehicles will be a single level specialised articulated bus, with conventional right-hand drive, single ended, and driver operated Figure 6-9.

Figure 6-9: Van Hool Exquicity 24m

The rapid transit corridor will be future proofed for advanced rapid transit vehicles that are 32m long, see example in Figure 6-10, recognising that technology in this area is evolving and the “ultimate” fleet will not be procured for a number of years.

Figure 6-10: "Trackless Tram" CRRC 31m

The Vehicle Specification and Fleet Procurement for RTN Corridor Tech Note (502334-7000-TEC-KK-0026) discusses a staged approach to the fleet evolution. The requirements outlined in this Concept of Operations relate primarily to the ultimate service design to align with the intent of the concept design and business case. It is noted that detailed planning for fleet and procurement is a task for subsequent stages.

Staging

An initial service-only stage and three subsequent fleet stages are proposed in combination with the ongoing development of the corridor's infrastructure.

- Early 2020s (existing fleet, service only on-street): Begin service as an on-street route using conventional buses from the existing fleet.
- Mid 2020s: (First generation custom vehicles, mixed on-street and transit corridor running to operate on partially completed infrastructure). Procure bespoke vehicle based on a conventional single decker rigid bus, but with electric motive power and urban transit style configuration.
- Mid 2030s: (Second generation vehicles, operating primarily off-street on continuous infrastructure). Supplement and replace first generation fleet with 24m double-articulated electric BRT buses.
- 2040s: Increase fleet size with additional tranches of 24m double-articulated electric BRT buses or replacing with equivalent advanced bus or 'trackless tram' vehicle if demands require larger vehicles.

Procurement model

The status quo PTOM procurement model (where private operators own, maintain and supply buses under contract, and account for fleet and depot ownership in their service contract rates), has been selected as the most appropriate method for the Airport to Botany business case.

Depot and stabling

At this early stage, it is assumed that stabling, maintenance and servicing can take place at an existing facility such as the existing depot on Ti Rakau Drive. This is particularly the case for early stages. More detailed definition of vehicle types, procurement models, operating models and design will need to define in more detail the servicing, stabling and operational requirements of the fleet.

Specific, off-street layover capacity is expected to be designed into the terminal stations at the airport and at Botany.

6.5.7 Fleet size

The Airport to Botany line is likely to require each vehicle to operate around 600 km per day in service. This would require buses with large, heavy, batteries to operate under charge-at-depot system, with vehicles charging overnight, as well as returning to the depot during the day for a top-up charge.

The service plan indicates a broad span of up to 21 operational hours per day. The first generation of vehicles is expected to have a peak vehicle requirement of 11-12 buses, and 6 buses in operation in the early/late hours (i.e. from 04:30-06:00 and 23:59-01:30). The peak bus requirement would run from 7am to 9am, and from 4pm to 7pm. The requirement for spares will also need to be assessed.

6.5.8 Features of the recommended A2B vehicle

The Vehicle Specification and Fleet Procurement for RTN Corridor Tech Note (502334-7000-TEC-KK-0026) outlines the proposed vehicle and fleet requirements and evolution.

High passenger capacity, single deck, long articulated buses

- A passenger capacity of approximately 150 passengers per vehicle appears optimal for the proposed system design and demands for the third decade of operation
- A single deck cabin configuration is required to allow fast boarding and alighting through multiple doors, to maximise the use of floor space, and to provide sufficient headroom in the passenger cabin to allow for a significant ratio of standing passengers.

A 'rapid transit' appearance and design

- A distinctive exterior design and livery that identifies the vehicle as "Rapid Transit" and indicates the rail-like service offering of the proposed system.
- A high-quality interior design, distinct from conventional bus design and promoting a premium user experience.

A mass transit style cabin configuration,

- An 'urban transit' interior layout designed for high passenger turnover, with a relatively high standing to seating ratio (for example, 2:1), broad interior aisles, and wide vestibule areas with clear circulation space.
- Seating can be delivered as a combination of transverse and longitudinal rows.
- Space for luggage, shopping and parcels. This could be delivered either as dedicated luggage racks, and/or areas of clear floor space near seating.
- Space for wheelchair and mobility scooters to be parked without any special process or assistance.
- Allowance to bring bikes, scooters and other personal mobility devices on board, including appropriate storage space within the cabin. This is to replicate the existing arrangement on Auckland's rapid transit rail lines, i.e. to extend the catchment and utility of the line for the maximum number of customers.

Door designs that allow all-door boarding and alighting from multiple doors for fast dwell times and high passenger turnover:

- Multiple doors are required, i.e. at least three sets of doors spaced along the length of the vehicle.
- All doors to be double width, to allow two streams of people to board or alight in parallel at each door, and to allow any door to accommodate a person using a wheelchair, pram or luggage without additional delay.
- All doors should be level boarding from the platform, with no step-up or stairs.
- The door to platform threshold should afford a minimal platform gap that allows wheelchair and luggage users to cross from platform to vehicle without requiring assistance, and without additional delay.

Offboard ticketing to facilitate high turnover with short dwell times:

- The vehicle configuration should operate under the 'rail-style' offboard ticketing regime.
- HOP card tag posts and ticket machines should be located on the platform, with all ticketing and validation to occur before or after boarding to avoid any source of delay or disruption to dwell times.
- The vehicle should be designed as a fare paid area. No ticket sales and validation should occur on the vehicle. Accordingly, no HOP readers or ticket vending machines should be installed in the vehicle.
- The driver shall not be required to sell, validate or inspect any tickets or HOP cards, or engage in any routine customer interaction that would interrupt their primary driving task. Accordingly, the driver may be located in a separate compartment that is not accessible from the passenger saloon.

Other requirements

In addition, the rapid transit vehicles will:

- Provide step-free boarding and alighting at three (or more) sets of double doors on the left-hand side.
- Provide onboard space for the safe and efficient movement of wheelchairs, luggage, prams and bicycles.
- Provide space onboard for personal wheeled mobility devices, including scooters and bicycles.
- Be electric to satisfy AT's zero local emissions policy.

6.6 Airport section

6.6.1 General

The section of the route beyond the boundary of AIAL's land is subject to AIAL's design processes and must integrate with the transport network being developed by AIAL. The two stations proposed in the airport area are expected to contribute significantly to the ridership of the system and strategically the connection with the airport is a core factor in the need for the system making these stations and the effectiveness of the section within the airport area key to the success of the entire route.

While from a design perspective the part of the route that sits within AIAL's boundary is outside the scope of the Airport to Botany SSBC, the section is a core part of the future operation and the expectation is that the system performance characteristics described in this Concept of Operations will be applied to the system as it operates within the airport area.

At the time of writing this Concept of Operations, it is understood that there are two key differences likely to apply to the system operation that will need to be managed, discussed below.

6.6.2 Shared running way

While the form and function of future light rail between the city centre and the airport is not confirmed, modelling and designs to date have assumed a shared alignment with Airport to Botany services on Tom Pearce Drive within the airport area.

There is an expectation that the performance characteristics outlined in this Concept of Operations and supporting material will be applied in the design of the shared facility.

6.6.3 Shared stations

This potential shared alignment will create the need for shared stations so that both the proposed light rail and Airport to Botany services can access the key activity centres within the airport area.

Tom Pearce Drive

The station serving the airport's office park is proposed to be served by both light rail and Airport to Botany lines. This will create a number of design and operational integration issues which will require resolution. Platform height and length will be key issues as these interfaces with vehicle design when combined with the desire to achieve level boarding on both systems. Dwell time will affect the reliability and journey time for both routes. These issues may have implications for the entire Airport to Botany route.

Airport Terminal

It is understood that design of the airport terminal station will accommodate both Airport to Botany and light rail services. This will require consideration of all aspects referred to in this Concept of Operations, including but not limited to:

- Platform layout and allocation
- Legibility, facilities, comfort and information for customers
- End of trip facilities for drivers and recovery space for buses
- Repositioning for buses
- Scheduling and reliability of timetable for each route on departure (noting shared proposed shared carriageway)
- Safety and conflicts

The design and location of the airport terminal station will also require consideration of customer access to terminals and ensuring that the terminals is highly placed in the access hierarchy for the terminal itself with associated quality, legible, comfortable and direct access between terminal and the platforms.

7 System management

While at an early stage of design, this section outlines what a typical management system could include and how it could work. This is an aspect of the system that will be developed in later phases, but in principle is considered important to deliver the customer experience, reliability and speed attributes required to deliver the benefits of the Airport to Botany service and assumed in the SSBC.

7.1 Control centre

It is anticipated that to provide for the intended reliability, performance and customer experience that a system of active, real-time management will be required. Early intervention to resolve issues and maintain system performance will be key to delivering the quality of product sought in the business case for Airport to Botany. The systems involved in the control and management of BRT (Figure 7-1) would include:

- Operation Aid and Planning System to get real-time vehicle location and operations planning
- Radio Communication System(s) for communication between drivers and Control Centre staff and transmission of data (e.g. vehicle location, passenger information panels)
- Traffic Signal Priority System for signal timing and ability to influence intersection priority
- Real-time Passenger Information System at stations and in vehicles
- Public Address at stations and in vehicles
- Telephony/Intercom systems for communication between passengers and the Control Centre staff
- CCTV and security monitoring in stations and in vehicles
- Monitoring of ticketing equipment
- Operation and monitoring of charging power supply equipment (if BRT vehicles are electric)
- Interface with the wider network management systems and teams in Auckland Transport and Waka Kotahi.

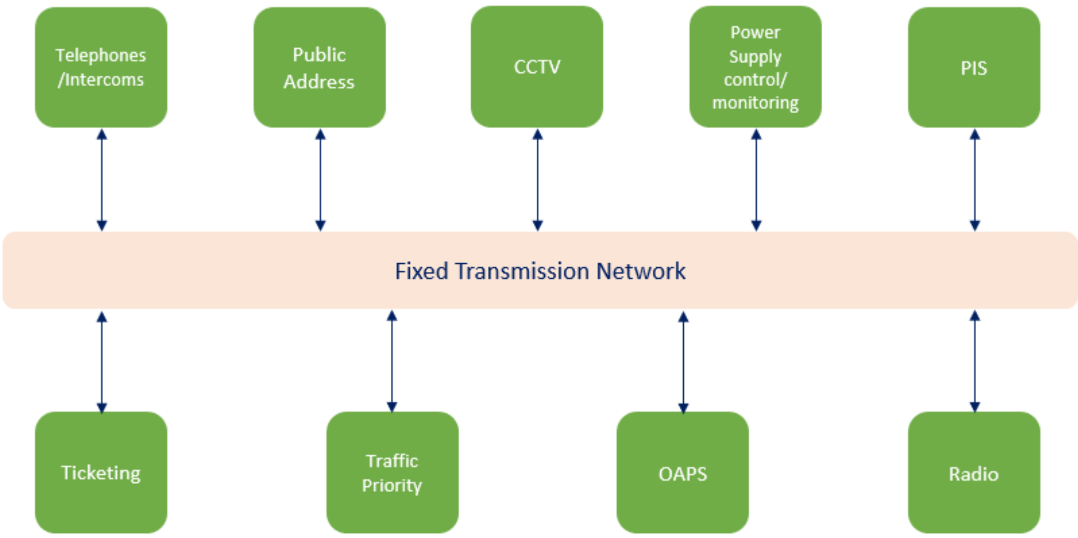


Figure 7-1: Systems involved in the control and management of BRT operations

A control centre could be specific to the route or an additional function of Auckland Transport's existing control centre arrangements. In any case, it will be necessary to install video panels, which show the entire BRT route, so that an operator can monitor for example the location of buses, status of traffic signals at junctions, charging points, cameras, ticketing machines, alarms, etc and be able to inform of any incidents to the necessary staff or agency.

The same operator could also answer passenger calls from help points depending on the roles and manning of the Control Centre.

The following sections outline some of the typical functions of a control centre in operating a BRT.

7.1.1 Operation Aid and Planning System (OAPS)

This system could be functionally divided into two parts, the Real Time OAPS and the Deferred Time OAPS.

The first one is responsible for the management in real time of the operation and is composed of two agents, a central module, installed on a server in the control centre and an on-board module, installed in the vehicles.

To allow consistent operation of both systems, central and on-board, it is necessary that all on-board units are synchronized with the central server and that this, in turn, is synchronized with the central clock of the control centre, which is usually based on GPS as time source.

The Deferred OAPS is responsible for carrying out the work before and after the operation, that is, it allows the planning of the different services in the first instance, as well as the planning of the personnel and mobile units associated with them. Additionally, once the day is over, the application will allow the generation of different reports and statistics for analysis of the operation.

Figure 7-2 is an outline of a typical architecture of the OAPS system, as well as its interaction with third parties.

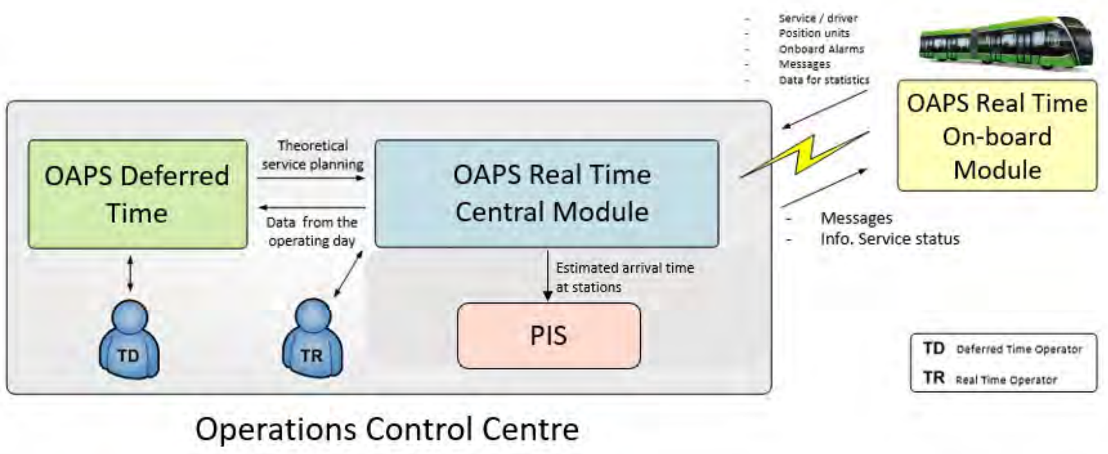


Figure 7-2: OAPS system architecture

7.1.2 Radio Communication System

Two systems can be distinguished with two different purposes:

- Voice communication: This system will be used for the transmission of voice and light data in real time along the entire route between bus drivers and the control centre staff, as well as for communication with maintenance or security personnel. Private Radio Networks are used, standards such as TETRA or more future-proof technologies based on 4G or 5G
- Data transmission: This system will be used for the transmission of heavy data to and from mobile units e.g. through WIFI. The premises of workshops and garages will provide coverage so that, outside operating hours, data can be transferred from the vehicles to central systems (OAPS).

7.1.3 Traffic Signal Priority System

This system, shown in Figure 7-3, is used on junctions with other road vehicles to give priority to buses, which is a key aspect in the implementation of a BRT. There are different systems depending on the way buses are given priority and detected (which are called “active signal priority” systems), for example:

- Bus detection based on elements installed on the road
- Bus detection based on vehicle-road detectors (e.g. loop detectors)
- Remote Control: priority is requested by the driver through a push-button

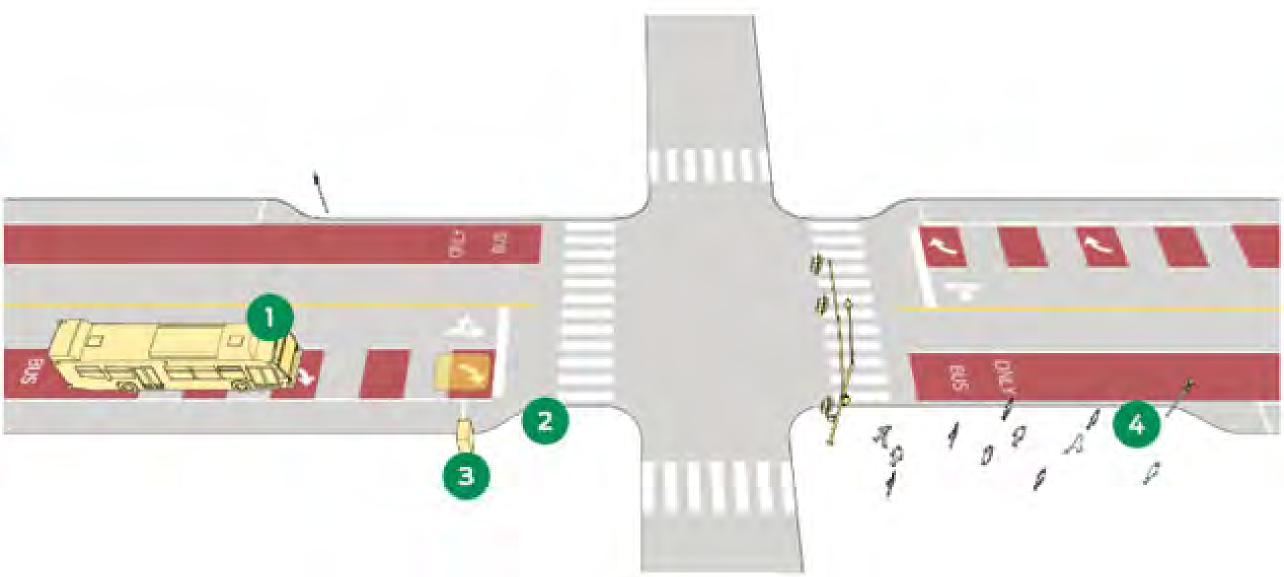


Figure 7-3: Traffic Signal Priority is key in the implementation of a BRT system

- Active signal priority uses a combination of on-board and wayside technology that determines what type of signal priority can be implemented. Conditional priority usually requires on-board automatic vehicle location, GPS, optical or laser communication, or other link between the transit vehicle and the signal system (1)
- Active transit signal priority can be provided on transitways using in-ground loop detectors to identify arriving transit vehicles, since only authorized vehicles are present (2)
- Intersection signal controllers and centralized traffic signal management systems are usually the longest-lifecycle elements of the system, and should be chosen with flexibility in mind and in direct coordination with transit agencies and technical specialists (3)
- A simple detection system that detects vehicle presence only, such as an in-ground loop detector, can be used to provide unconditional priority to transit vehicles operating on a transitway without the need for special equipment, as long as the intersection already has detection capability for other vehicles (4)

7.1.4 Real-time Passenger Information Displays (PIDs)

Auckland Transport has a system in place, and it is expected the Airport to Botany system would form part of this.

This system aims to disseminate information of interest to passengers, such as next bus arrivals. It consists of graphic terminals at bus stations and in vehicles as wells as centralised components located in the control centre. The PIDs gets the information from the OAPS.

The type of information which the PIDs may present includes service information such as vehicles location, estimated time of arrival, occupancy and destination.

7.1.5 Public Address (PA)

This system is used to make announcements to passengers at bus stations. Messages can be pre-recorded or transmitted live from an operator's microphone.

The following main components are distinguished within the Public Address system at a station:

- Speakers distributed and integrated within the scope of the station
- Power stages sized to power all speakers distributed in the station with redundant configuration

For the management and supervision of all the equipment mentioned above, specific equipment is required in the control centre:

- A microphone desks
- PA server including management software

The management software will allow direct supervision of all system elements so that any incident will be reported to the corresponding operator.

7.1.6 Telephony/Intercom System

This system will allow the following:

- Communication between passengers through intercoms at bus stations and the control centre staff
- Communication between operations staff and the control centre e.g. through telephones at ticketing offices, technical rooms, garage.
- Communication between control centre staff to external numbers through the public operator network

In general, this kind of systems consist of the following main components, which are shown in the figure below:

- Telephones in offices at bus stations, charging points, garage, etc
- Telephony server (PABX) in the control centre
- Help-point intercoms in stations

  Audio recorder (can be combined with the audio recorder for the Radio System for Voice communication)

7.1.7 CCTV

The video surveillance system, also called CCTV, has the function of capturing images in strategic locations to allow the following:

- Supervision of the movement of buses
- Provide security for example in the following areas:
  - Passengers area: e.g. at help points
  - Equipment in bus stations or technical rooms: the system can be integrated with the Access Control system in case an alarm is raised (intrusion detected)
  - Traffic signals
  - Access to buildings: workshops, garage, control centre

Auckland Transport has a suite of CCTV cameras and monitoring systems for train stations, busway stations and other facilities. It is expected that Airport to Botany will require an expansion of this service.

7.1.8 Operation and Monitoring of Charging Power Supply Equipment

When using electric buses, it is essential to be able to control and monitor the power supply equipment in electrical substations, which are responsible for delivering the necessary power to the bus charging points. This is done by having a "Command and Control" system.

The following parameters can be monitored in the charging points:

- Power transformer temperature
- Currents and power consumption cells (e.g. disconnectors, and breakers state. Currents and power consumption. Voltage, Temperature monitoring).
- UPS (e.g. state of the batteries and breakers)
- Monitoring of alarms

The Command and Control system also involves HW and SW in the Control Centre such as central server(s) and the corresponding operator workstation, so that remote control of power equipment is possible.

7.2 Revenue protection

The proposed off-vehicle ticketing model involving validation on platforms and all-door boarding is likely to require ongoing revenue protection staffing requirements to reduce fare evasion. This is an existing activity within Auckland Transport for the rail system which operates many stations the same way. This service is likely to require expansion with the proposed operating model.

7.3 Staff and training

The core intent of the system is an easy to use, turn-up-and-go model in order to attract new users and achieve behaviour change. The system proposed significant investment in stations, vehicles and running ways to be design with the potential to achieve these outcomes.

Staffing levels have not been specifically defined at this time, however staff at major stations is likely and, in some cases, already provided (Manukau) and proposed (Puhinui). Vehicles are likely to have a driver-only operation.

In daily operation, the optimal implementation of the potential for this system will be the responsibility of staff. As this is a form of bus for example, alignment at platforms and in-vehicle ride quality is the responsibility of drivers. This can be mitigated through technology such as limitations of acceleration and deceleration and autonomous operation, however staff will always have an influence on customer experience. It is suggested that training and protocols be put in place to specify key aspects that cannot be mitigated through technology. This includes energy consumption though guidelines and monitoring of driver performance.

7.4 Modes of operation

The proposed transport system will operate under the following operational modes:

- Normal operations
- Degraded operations
- Incidents and emergency operations
- Planned maintenance
- Special events.

The following sections provide a high-level description of each of these modes. Future development of the operational concept and system design will include greater definition of the modes and their management responses to align with AT's wider network. This will include the return to normal service.

7.4.1 Normal operations

During normal operating conditions, a safe and efficient network means traffic is flowing freely at or near the posted speed, and the likelihood of congestion is low, or the duration and intensity of congestion is minimised. A reliable network means users are informed about traffic conditions in an appropriate and timely manner, enabling each journey to be predictable with expected travel times, resulting in no surprises to the road or public transport user.

Normal operations include the following defined periods of the day:

- **Peak –** between 07:00 - 08:59 and 16:00 -18:59
  This is the period with the highest volume of traffic during a day. Across the network, several proactive traffic management practices using a range of ITS tools and services will be used to provide customers with a reliable, safe and efficient journey during peak periods. The minimum frequency of peak services will be five minutes.

- **Off-Peak –** between 06:00 - 06:59, 09:00 - 15:59 and 19:00 - 23:59
  This is the remainder of the time that is not 'peak'. Off-peak periods may include weekends and will be associated with relatively low traffic flows and generally free flow conditions with speeds at or near the posted speed limit. The minimum frequency of off-peak services will be 10 minutes.

- **Early-morning and late-night –** between 04:30-06:59 and 00:00-01:29
  This period has a lower demand but is essential for some workers to get to and from work. The minimum frequency of early-morning/late-night services will be 15 minutes.

Normal operations is considered as *Business as Usual*, where the system operates and performs as planned within defined limits and constraints. This includes typical scenarios that are not considered as degraded or emergency, e.g. the bunching of buses. In this scenario, where stations are located adjacent to signals, the second bus can pull up behind the active platform and wait (see Figure 7-4). Short dwell times mean delay would be minimal. Other scenarios will be explored as the operational concept is developed.

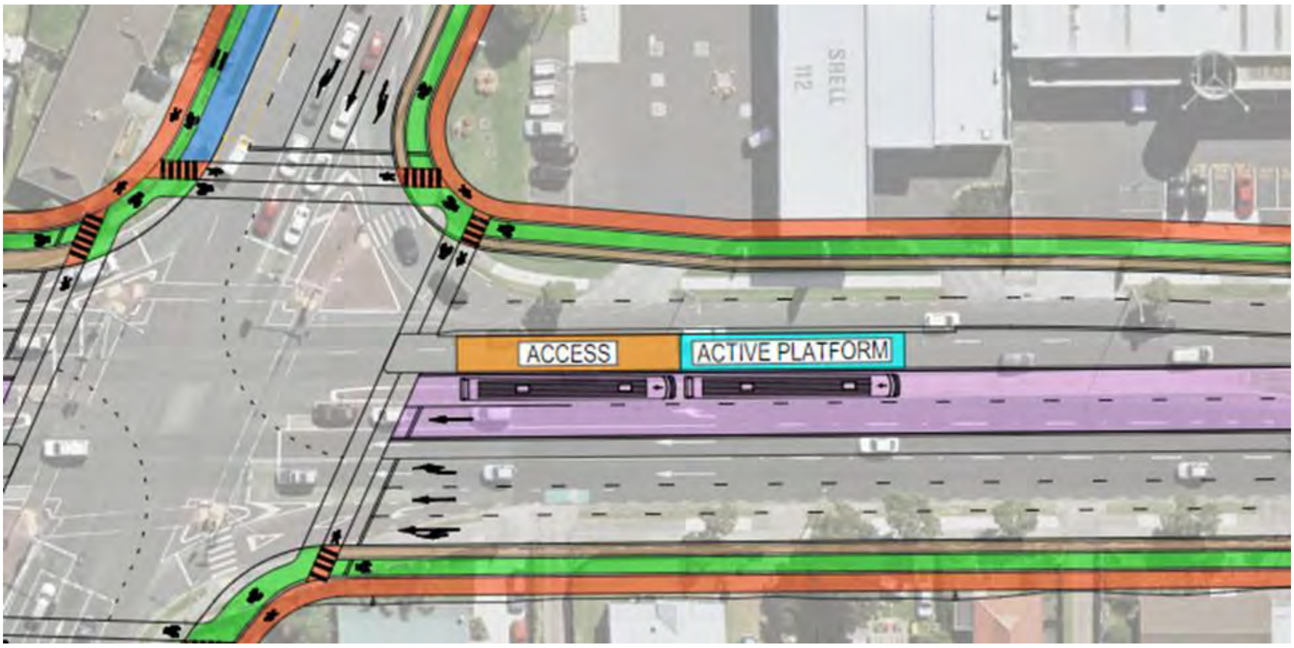


Figure 7-4: Management of bunching at stations

7.4.2 Degraded operations

Degraded operations are defined as the restricted conditions under which systems and subsystems may be operated in the event of a technical failure that requires intervention. Such events are not planned, and customers cannot be informed at least 24 hours in advance about deviations to the standard levels of service. Degraded operation is likely to affect service delivery on the system, with capacity affected by irregular headways and/or slower journey times.

Degraded scenarios and their contingency plans will be determined as the operational concept is developed. These scenarios may include:

- Stranded bus (between stations or at a station)
- Traffic signals failure
- Bus failure at start of service.

7.4.3 Incidents and emergency operations

Incident and emergency operations are defined as situations where systemwide operational capability, including functional and performance capability, is severely degraded, or completely lost due to a catastrophic system event, or major system or security event. In the context of the A2B system, an incident or emergency is an unplanned event or activity that may lead to:

- disturbances in normal traffic flow conditions,
- public transport unreliability, or
- risk to human life and the transport infrastructure.

Incidents require a safe and efficient response that reduces the risk of secondary incidents and restores the network to normal conditions as soon as possible. These events can occur at any time of the day and during any traffic or weather conditions. Incident detection, response and escalation will be coordinated through ATOC, in consultation with other partners, depending on incident level and defined partner roles and responsibilities.

The strategy for managing incidents and emergencies will be determined as the operational concept is developed. These scenarios may include:

- Fire
- Bomb threat
- Explosion
- Public disorder, armed intrusion or criminal acts
- Chemical, biological or radiological event
- Medical event
- Collision of bus
- Extreme weather event
- Earthquake, tsunami or volcanic eruption
- Evacuation or loss of ATOC
- Unplanned major service disruption (crowding)
- Traffic signals or communication system outage.

7.4.4 Planned maintenance

During planned events, a safe and efficient network means that customers are well informed of the event in advance, and well-planned traffic diversions and replacement services in place to minimise the impact on customer journeys. For the road network, Temporary Traffic Management Plans (TTMPs) will need to be prepared and approved by relevant authorities for all planned maintenance.

7.4.5 Special events

Special events may require direct use of corridors or indirectly influence traffic flows. Traffic management plans be prepared and approved by relevant authorities for events that may interfere with normal network operations.

Appendix A

Notes:

These ables (w th the exception of the Puhinui Rail boardings/al ghtings) should reflect the data contained in F g. 5-1 of the Concept of Operat ons.
Any assumpt ons shou d be stated (e.g. what is the AM peak, PM peak, Interpeak; are these f gures for A2B services only or for all services using the stat on in question etc.)

Airport to Botany Rapid ransit Forecast Boardings by Station

				Do min / Horizon 1 (2021) Model year: 2028 Boardings					Horizon 2 (2025) Model year: 2028 Boardings					Hor zon 3 (2030) Model year: 2028 Boardings					Horizon 4 (2035) Model year: 2038 Boardings					Horizon 5 (2046) Model year: 20 8 Boardings				
				AM Peak	PM Peak	Interpeak	Daily	Annual	AM Peak	PM Peak	Interpeak	Da ly	Annual	AM Peak	PM Peak	Interpeak	Daily	Annual	AM Peak	PM Peak	Interpeak	Daily	Annual	AM Peak	PM Peak	Interpeak	Daily	Annual
All stations	Total			NO FILLED OU O AVOID M SIN ERPRE A ION OF RESUL S SEE ASSUMP IONS SHEE FOR DE AILS ON ASSUMP IONS																								
	Walk-up																											
	Transfers from other PT																											
Airport erminal	Total	num_boardings	Airport	559	706	697	,858	1,56 ,520	610	732	735	5,081	1,625,796	1002	8 6	1017	6,335	2,027,3 2	1755	1296	1662	10,027	3,208,778	2133	1606	2020	12,353	3,952,831
	Walk-up	num_journey_starts	Airport	79	671	653	,555	1, 57,631	82	676	658	,589	1, 68, 50	91	688	669	,668	1, 93,76	629	886	861	6,009	1,923,025	781	1103	1073	7, 78	2,392,908
	Transfers from other PT		Airport	80	35	5	303	96,889	128	56	78	92	157,3 6	512	158	3 8	1,667	533,578	1,127	10	800	,018	1,285,753	1,352	505	9 8	,875	1,559,923
he Quad	Total	num_boardings	The Quad Business Park	110	190	639	1,719	5 9,951	110	188	633	1,702	5 ,595	17	333	1383	3,256	1,0 2,039	300	590	2370	5,679	1,817,398	30	862	3 6	8,271	2,6 6,67
	Walk-up	num_journey_starts	The Quad Business Park	110	190	639	1,719	5 9,951	110	188	633	1,702	5 ,595	17	333	1383	3,256	1,0 2,039	300	590	2370	5,679	1,817,398	30	862	3 6	8,271	2,6 6,67
	Transfers from other PT		The Quad Business Park	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Puhinui	Total	num_boardings	Puhinui Bus	10 2	227	188	2,396	763,571	1286	278	239	2,9 2	9 1,567	1 16	305	280	3,262	1,0 0,5 9	2 7	587	677	6,1 6	1,966,629	3311	73	1029	8,085	2,587,119
	Walk-up	num_journey_starts	Puhinui Bus	71	2	15	207	66,2 8	112	36	26	320	102,355	123	1	31	363	116,299	157	63	5	521	166,765	175	80	53	63	202,7 2
	Transfers from other PT		Puhinui Bus	971	203	172	2,179	697,322	1,17	2 2	213	2,623	839,212	1,29	26	2 9	2,688	92 ,250	2,317	525	633	5,625	1,799,86	3,136	655	977	7, 51	2,38 ,377
Lambie	Total	num_boardings	Lamb e	30	15	1	1 8	7,509	28	17	31	1 5	6,329	29	16	31	1 2	5, 37	106	50	77	39	1 0,365	119	51	99	80	153,75
	Walk-up	num_journey_starts	Lamb e	30	15	1	1 6	7,509	28	17	31	1 5	6,329	29	16	31	1 2	5, 37	102		66	391	125,135	11	3	78	10	131,290
	Transfers from other PT		Lamb e	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		6	12	8	15,230	5	9	21	70	22, 6
Manukau Station	Total	num_boardings	Manukau (Davies Avenue)	1031	580	1217	5,206	1,665,809	1052	619	1309	5,520	1,766,288	1096	6 0	1370	5,727	1,832,763	1 51	1000	1808	8,357	2,67 ,255	1896	1260	2227	10,553	3,377,081
	Walk-up	num_journey_starts	Manukau (Davies Avenue)	1 1	272	670	2,200	703,856	153	296	7 2	2, 02	768,737	156	303	756	2, 57	786,1 2	262	5	1003	3,53	1,131,008	35	523	1139	,161	1,331, 25
	Transfers from other PT		Manukau (Davies Avenue)	890	308	5 7	3,006	961,95	900	32	567	3,117	997,551	9 0	337	61	3,271	1,0 6,821	1,189	555	806	,823	1,5 3,2 6	1,5	737	1,088	6,393	2,0 5,656
Ronwood	Total	num_boardings	Ronwood (Incl. AUT)	35	8	126	08	130,60	57	81	235	706	225,831	6	96	262	817	261,5	128	18	508	1,57	503,731	191	258	680	2,187	699,682
	Walk-up	num_journey_starts	Ronwood (Incl. AUT)	35	8	126	08	130,60	57	81	235	706	225,831	6	96	262	817	261,5	128	18	508	1.57	503,731	191	258	680	2,187	699,682
	Transfers from other PT		Ronwood (Incl. AUT)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diorella	Total	num_boardings	Dorel a	0	0	0	0	0	65	22	16	195	62,253	69	23	17	205	65,625	215	71	6	622	199,032	233	75	52	668	213,851
	Walk-up	num_journey_starts	Dorel a	0	0	0	0	0	65	22	16	195	62,253	69	23	17	205	65,625	215	71	6	622	199,032	233	75	52	668	213,851
	Transfers from other PT		Dorel a	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dawson	Total	num_boardings	Dawson	0	0	0	0	0	1 3	83	116	68	218,927	1 9	87	119	710	227,208	567	277	260	2,2 1	716,99	685	296	303	2, 96	798,626
	Walk-up	num_journey_starts	Dawson	0	0	0	0	0	1 3	83	115	683	218,592	1 9	87	118	708	226,680	82	2 5	232	1,963	628,070	598	25	282	2,15	689,153
	Transfers from other PT		Dawson	0	0	0	0	0	0	0	0	1	335	0	0	1	2	527	85	32	28	278	88,925	67	2	0	3 2	109, 73
Ormiston	Total	num_boardings	Ormiston	7		17	83	26, 5	6	27	60	260	83,208	6	28	62	267	85,28	710	313	66	2,972	951,0 6	913	0	832	3,991	1,277,135
	Walk-up	num_journey_starts	Ormiston	33		12	6	20,582	57	26	58	2 6	78,620	57	26	59	251	80,230	7	1	118	373	119,209	5	7	138	30	137, 66
	Transfers from other PT		Ormiston	1	0	5	18	5,872	7	1	2	1	,588	8	1	2	16	5,05	66	273	5 5	2,599	831,838	859	39	69	3,561	1,139,669
Smales	Total	num_boardings	Smales	50	30	1	217	69, 26	251	10	97	878	280,9 9	253	105	99	886	283, 8	17	156	17	1,368	,10	75	17	209	1,570	502,306
	Walk-up	num_journey_starts	Smales	50	30	1	217	69, 26	251	10	97	877	280,685	253	10	98	882	282,185	390	1 6	153	1,286	11,	0	162	18	1, 53	6 ,800
	Transfers from other PT		Smales	0	0	0	0		0	0	0	1	26	0	1	1		1,262	27	11	21	102	32,660	35	11	25	117	37,508
Accent	Total	num_boardings	Accent	2	0		6	1 ,709	5	12	56	165	52,823	6	1	56	173	55,325	112	58	133	5 1	173,192	151	76	160	699	223,631
	Walk-up	num_journey_starts	Accent	39	0		3	13,706	2	12	50	155	9,552	2	1	51	16	52,502	89	6	116	38	1 0,15	115	59	137	556	177,879
	Transfers from other PT		Accent	3	0	0	3	1,003	3	0	6	10	3,271	3	0		9	2,823	23	12	17	103	33,038	35	17	22	1 3	5,752
Botany	Total	num_boardings	Botany	1886	1282	1357	9,779	3,129,3 7	2272	1 65	1675	11, 17	3,653,551	2279	1 70	1673	11, 51	3,66 ,358	3583	2077	3011	17,165	5, 92,682	176	2 20	3 15	19,933	6,378,68
	Walk-up	num_journey_starts	Botany	566	370	9	2,9 6	9 2,816	96	356	77	2,790	892,767	96	357	77	2,792	893, 56	751	563	78	, 05	1, 09,739	9 5	716	975	5,573	1,783,3 1
	Transfers from other PT		Botany	1,320	912	863	6,833	2,186,531	1,777	1,108	1,198	8,627	2,760,78	1,783	1,11	1,196	8,659	2,770,901	2,812	1,51	2,227	12,759	,082,9 3	3,231	1,70	2, 0	1 ,360	,595,3
Puhinui Station Rail Patronage	Total	num_boardings	Puhinui Ra l	62	289	979	2,917	933,562	9	316	1061	3,169	1,01 ,12	527	372	1110	3,532	1,130,365	1056	616	1818	6,015	1,92 ,7 6	1 95	7 7	2389	7,693	2, 61,789
	Walk-up	num_journey_starts	Puhinui Ra l	381	1 9	195	1,338	28,1 7	362	1	190	1,288	12,2	356	1 1	18	1,257	02,208	339	130	159	1,162	371,665	512	173	231	1,628	520,815
	Transfers from other PT		Puhinui Ra l	81	1 0	783	1,579	505, 16	133	172	871	1,881	601,881	172	231	926	2,275	728,156	717	86	1,659	,853	1,552,681	983	573	2,157	6,066	1,9 0,97

A rport to Botany Rapid ransit Forecast Alightings by Station

				Do min / Horizon 1 (2021) Model year: 2028 A ightings					Horizon 2 (2025) Model year: 2028 Alightings					Hor zon 3 (2030) Model year: 2028 Alightings					Horizon 4 (2035) Model year: 2038 Al ghtings					Horizon 5 (2046) Model year: 20 8 A ightings				
				AM Peak	PM Peak	Interpeak	Daily	Annual	AM Peak	PM Peak	Interpeak	Da ly	Annual	AM Peak	PM Peak	Interpeak	Daily	Annual	AM Peak	PM Peak	In erpeak	Daily	Annual	AM Peak	PM Peak	Interpeak	Daily	Annual
All stations	Total			NO FILLED OU O AVOID M SIN ERPRE A ION OF RESUL S SEE ASSUMP IONS SHEE FOR DE AILS ON ASSUMP IONS																								
	Walk-off																											
	Transfers																											
Airport erminal	Total	num_al ghtings	Airport	6	7 3	713	5,1 6	1,6 6,737	696	770	751	5,371	1,718,781	1089	88	1032	6,631	2,122,070	1861	13 9	1683	10, 23	3,335,2	2262	1675	20 8	12,851	,112,389
	Walk-off	num_journey_ends	Airport	56	706	668	,8 3	1,5 9,8 7	568	71	673	,879	1,581, 3	577	726	685	,96	1,588, 92	73	939	883	6, 05	2,0 9, 91	911	1170	1100	7,976	2,552, 67
	Transfers		Airport	80	35	5	303	96,889	128	56	78	92	157,3 6	512	158	3 8	1,667	533,578	1,127	10	800	,018	1,285,753	1,352	505	9 8	,875	1,559,923
he Quad	Total	num_al ghtings	The Quad Business Park	679	22	232	2,055	657, 95	675	220	229	2,027	6 8,532	1583	56	22	,328	1,385,105	27 3	820	735	7,659	2, 50,9 1	035	1202	106	11,226	3,592, 75
	Walk-off	num_journey_ends	The Quad Business Park	679	22	232	2,055	657, 95	675	220	229	2,027	6 8,532	1583	56	22	,328	1,385,105	27 3	820	735	7,659	2, 50,9 1	035	1202	106	11,226	3,592, 7
	Transfers		The Quad Business Park	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Puhinui	Total	num_al ghtings	Puhinui Bus	65	135	757	1,508	82,712	129	181	880	1,93	618,8	157	210	932	2,160	691,177	621	502	1699	,881	1,561,891	808	601	2172	6,0 5	1,93 ,371
	Walk-off	num_journey_ends	Puhinui Bus	5	8	30	79	25,280	12	15	39	127	0,627	13	16	0	133	2,519	27	31	68	255	81,673	29	0	76	307	98,318
	Transfers		Puhinui Bus	60	126	727	1, 29	57, 32	117	166	8 1	1,807	578,217	1 5	19	893	2,027	6 8,658	595	71	1,631	,626	1, 80,218	780	561	2,097	5,738	1,836,053
Lambie	Total	num_al ghtings	Lamb e	89	33	0	297	95,180	1	21	37	186	59,596	5	22	0	195	62,301	77	0	82	361	115,659	83	8	97	25	135,95
	Walk-off	num_journey_ends	Lamb e	89	33	0	297	95,180	1	21	37	186	59,596	5	22	0	195	62,301	73	3	69	31	100, 30	79	39	77	355	113, 90
	Transfers		Lamb e	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		6	12	8	15,230	5	9	21	70	22, 6
Manukau Station	Total	num_al ghtings	Manukau (Davies Avenue)	1 75	503	760	,801	1,536,36	1573	573	81	5,309	1,698,782	1680	591	865	5,507	1,762,085	201	1161	131	9 2 6	2,958,8 5	2336	1391	1695	11,123	3,559,226
	Walk-off	num_journey_ends	Manukau (Davies Avenue)	622	26	220	2,191	701,236	708	312	2 8	2,5 9	815,731	723	320	253	2,610	835,099	1086	621	25	678	1, 97,088	1185	688	89	5,182	1,658,172
	Transfers		Manukau (Davies Avenue)	852	239	5 0	2,610	835,128	865	260	566	2,760	883,051	907	270	612	2,897	926,987	928	539	889	,568	1, 61,757	1,151	703	1,206	5,9 1	1,901,05
Ronwood	Total	num_al ghtings	Ronwood (Incl. AUT)	211	96	76	777	2 8,603	392	151	110	1,27	07,7 7	06	157	115	1,321	22,8 9	6 3	289	215	2,333	7 6,716	865	398	300	3,195	1,022,277
	Walk-off	num_journey_ends	Ronwood (Incl. AUT)	211	96	76	777	2 8,603	392	151	110	1,27	07,7 7	06	157	115	1,321	22,8 9	6 3	289	215	2,333	7 6,716	865	398	300	3,195	1,022,277
	Transfers		Ronwood (Incl. AUT)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diorella	Total	num_al ghtings	D orel a	0	1	0	6	1,766	2	11	0	120	38,358	26	11	2	126	0, 00	0	2	88	252	80,61	8	27	160	3	109,973
	Walk-off	num_journey_ends	D orel a	0	1	0	6	1,766	2	11	0	120	38,358	26	11	2	126	0, 01	0	2	88	252	80,61	8	27	160	3	109,973
	Transfers		D orel a	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dawson	Total	num_al ghtings	Dawson	0	0	0	0	0	121	8	81	8	1 3,221	123	51	83	68	1 9,762	285	152	378	1, 37	59,960	318	16	72	1,62	519,77
	Walk-off	num_journey_ends	Dawson	0	0	0	0	0	121	8	81	7	1 2,886	123	51	82	66	1 9,235	277	138	3 7	1,328	2 ,965	308	155	38	1,536	91,5
	Transfers		Dawson	0	0	0	0	0	0	0	0	1	335	0	0	1	2	527	7	1	31	109	3 ,896	11	9	3	88	28,230
Ormiston	Total	num_al ghtings	Ormiston	19	3	26	58	18,702	67	23	7	232	7 ,3 1	68	2	8	2 0	76,892	787	321	597	3,020	966, 76	1005	8	756	,036	1,291,588
	Walk-off	num_journey_ends	Ormiston	1	3	20	8	15,205	65	22	6	225	71,999	66	23	8	232	7 ,182	12	8	52	21	13 ,638	1 6	52	61	75	151,919
	Transfers		Ormiston		0	6	11	3, 97	2	1	0	7	2,3 1	2	1	1	8	2,710	66	273	5 5	2,599	831,838	859	39	69	3,561	1,139,669
Smales	Total	num_al ghtings	Smales	22	33	9	239	76, 17	76	62	162	556	177,982	77	63	163	56	180,3 9	156	110	285	1,005	321,5 8	133	127	35	1,137	363,716
	Walk-off	num_journey_ends	Smales	22	33	9	239	76, 17	76	62	161	555	177,719	77	63	162	560	179,087	129	100	26	903	288,889	98	116	329	1,019	326,208
	Transfers		Smales	0	0	0	0		0	0	0	1	26	0	1	1		1,262	27	11	21	102	32,660	35	11	25	117	37,508
Accent	Total	num_al ghtings	Accent		0	1	20	6,319	9	15	35	161	51,508	51	17	35	173	55,239	1	58	101	539	172, 98	172	69	128	652	208,595
	Walk-off	num_journey_ends	Accent		0	1	20	6,319	6	15	29	151	8,236	8	17	30	16	52, 16	121	5	8	36	139, 60	137	52	105	509	162,8 3
	Transfers		Accent	0	0	0	0	0	3	0	6	10	3,271	3	0		9	2,823	23	12	17	103	33,038	35	17	22	1 3	5,752
Botany	Total	num_al ghtings	Botany	1691	12 5	1228	9,269	2,966,0 0	2169	1 68	1616	11,293	3,613,6 1	2197	1 75	161	11,331	3,625,862	3 67	207	2852	16 898	5, 07,303	067	2 16	3232	19,651	6,288,355
	Walk-off	num_journey_ends	Botany	379	337	36	2, 63	788,122	20	36	17	2,693	861,653	22	365	16	2,699	863,558	669	567	626	,189	1,3 0,561	87	731	805	5, 05	1,729, 3
	Transfers		Botany	1,312	906	86	6,806	2,177,918	1,768	1,105	1,199	8,601	2,752,188	1,775	1,110	1,198	8,632	2,762,30	2,798	1,507	2,226	12,709	,066,7 2	3,213	1,688	2, 27	1 ,2 7	,558,911
Puhinui Station Rail Patronage	Total	num_al ghtings	Puhinui Ra l	1078	269	18	2,866	917,233	1272	297	28	3,217	1,029,305	1 03	350	65	3,653	1,168,869	252	586	8 0	6 353	2,032,801	3 52	719	1287	8, 05	2,689, 6
	Walk-up	num_journey_ends	Puhinui Ra l	85	52	189	537	171,927	82	9	186	520	166, 30	82	9	183	516	165,121	93	50	185	535	171,05	119	57	256	663	212,127
	Transfers		Puhinui Ra l	992	217	229	2,329	7 5,306	1,190	2 8	2 2	2,696	862,875	1,321	301	282	3,137	1,003,7 8	2, 31	536	655	5,818	1,861,7 7	3,333	662	1,032	7,7 2	2, 77,319

Assumptions

From AFC

Daily boardings are estimated as: AM + 5.1* P + PM

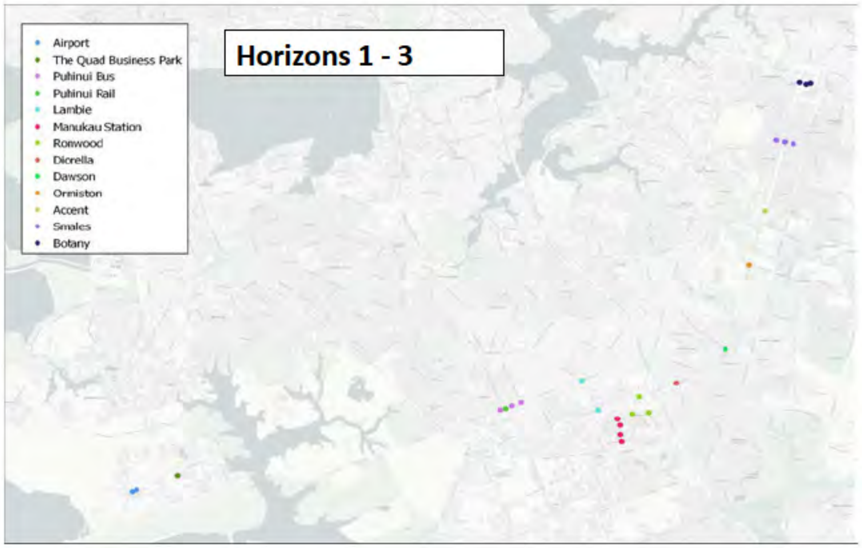
Peak periods all represent 2 hours as per AFC assumptions

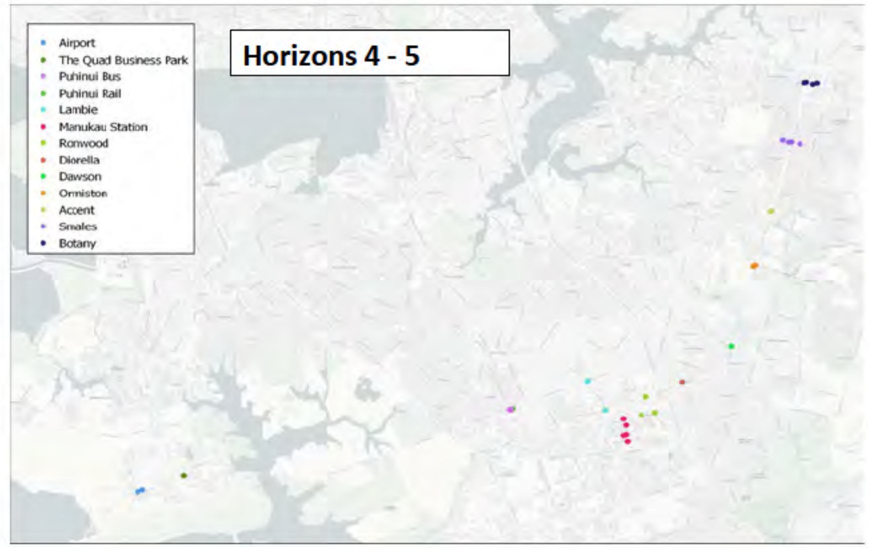
General

Annualisation factor is 320 for PT (see economics)

Boardings and alightings are for all routes at a station (NOT FOR A2B ONLY)

Nodes for analysis are included below





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