

Auckland Light Rail (ALR) Proposed Solution Attachment 1

October 2019

FOR DISCUSSION PURPOSES

Commercial in Confidence

Contents

1. Overview / Introduction

- Response Phase Program Governance / Structure / Timeline
- Parallel Process Requirements
- Our Strategic Approach to Responding

2. Commercial and Financial

- Delivery Entity, Governance and Partnerships Approach
- Funding and Financing
- Procurement and Risk Allocation

3. Technical Solution

- Alignment and future expansion potential
- Urban Transformation, Design and Development

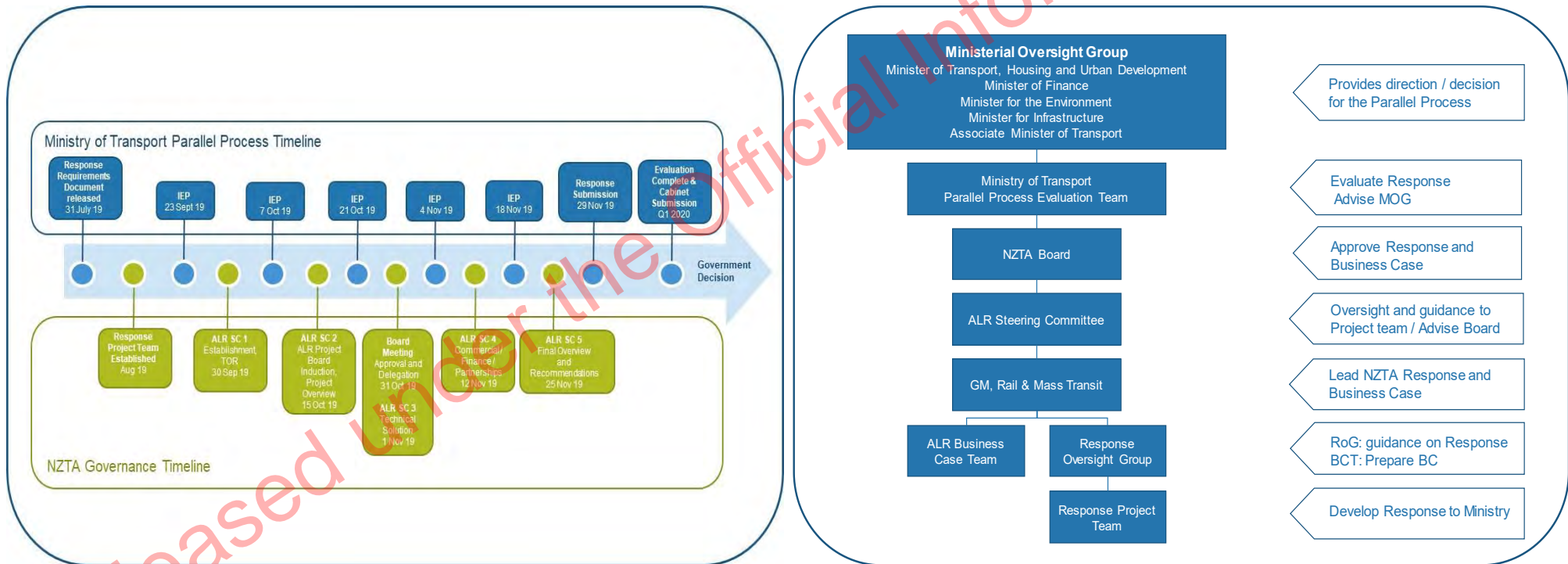
4. Service Delivery Solution

- Customer Experience
- Rolling Stock and Operating System
- Meeting the Outcomes – Streetcar vs Metro / Dominion vs Sandringham

Section 1: ALR Project Overview

Overview

Response Phase Program Governance / Structure / Timeline



Overview

Parallel Process Response Requirements

Key Outcomes



Demonstrates how the NZTA proposed solution achieves the Ministry's Key Outcomes:

- Access and Integration with network
- Environmental Sustainability
- Urban and Community Shaping
- Customer Experience Quality

20%

Stakeholder and Community Engagement



- Community and Stakeholder Engagement Plan + Example Initiatives
- Māori / iwi Engagement Plan (& CVA)

Māori / Iwi Outcomes

- Māori economy, work / education access
- Bi-cultural placemaking / urban design

15%

Technical Solution



- Route Alignment / future expansion
- Design Form and Visual Appearance
- Technical Design Approach
- Construction Methodology, Staging
- Geotechnical
- Environmental Management Strategy
- Consenting Strategy
- Land Acquisition Strategy
- Utilities Management Strategy
- Legislative /Regulatory Amendments
- Delivery Programme Plan

25%

Commercial and Financial



- Procurement / Contracting
- Financing /funding
- Risk allocation
- Asset ownership/management
- Delivery Model, Capability/Capacity
- Partnership Model

20%

Service Delivery



- Operating Strategy and Model
- Rolling Stock
- Fare setting/collection
- Customer Experience
- Safety
- Lifecycle and Asset Management

20%

Overview

Our Strategic Approach to Response

To meet the MoT Key Outcomes we have set the following objectives for our response:



Economic opportunities

Foster inclusive economic growth and expand access to opportunities for generations to come



Environment and sustainability

Support environmental outcomes by moving people more sustainably



Māori partnerships

Creating a platform for mana whenua and mātauranga to determine their own success.



Safety and security

Enhance safety and security for passengers and communities



Homes and communities

Accelerate housing delivery and promote the development of quality, compact urban communities that are well connected to rapid transit



Experience

Deliver fast, reliable and safe journeys to that make [ALR / public transport] the mode of choice



Health and wellbeing

Support quality of life, health and wellbeing improvements



Value for money

Deliver value for money for Auckland and New Zealand

Our Key Messages to central and local government, the community and partners are:

- Creating a sub-30 minute city
- Proposing a world class Rapid Transit Network
- Acting in the overall public interest (a profit for investors is not the top priority)
- Using the private sector for what it does best
- Delivering a flexible intergenerational solution
- An inclusive approach – no lock-in or lock-out
- No new legislation is required (leverage the existing)
- A realistic and credible affordability envelope

The Key Differentiators in our response are:

- The partner of choice for central & local government and for industry
- A new blueprint for infrastructure delivery that leverages international experience
- A segregated alignment is a better long term solution, and worth the extra investment
- A true public-public partnership balancing public and private sector interests, appropriate risk allocation & competitive procurement
- A funding and financing model that minimises government contributions and spreads these over time
- A solution that incentivises urban regeneration in planned communities

Section 2: Commercial and Financial

Commercial and Financial

Delivery Entity Model and Governance (subject to further due diligence)

This is the largest infrastructure project ever undertaken in New Zealand and the first light rail network of its kind for the country.

- The level of complexity in delivering such an undertaking cannot be underestimated.
- No single entity in NZ has capability/capacity to deliver a core infrastructure transport solution and wider urban regeneration outcomes.
- A new delivery entity is being proposed to meet the broad outcomes requested by MoT.

Proposed Governance Approach

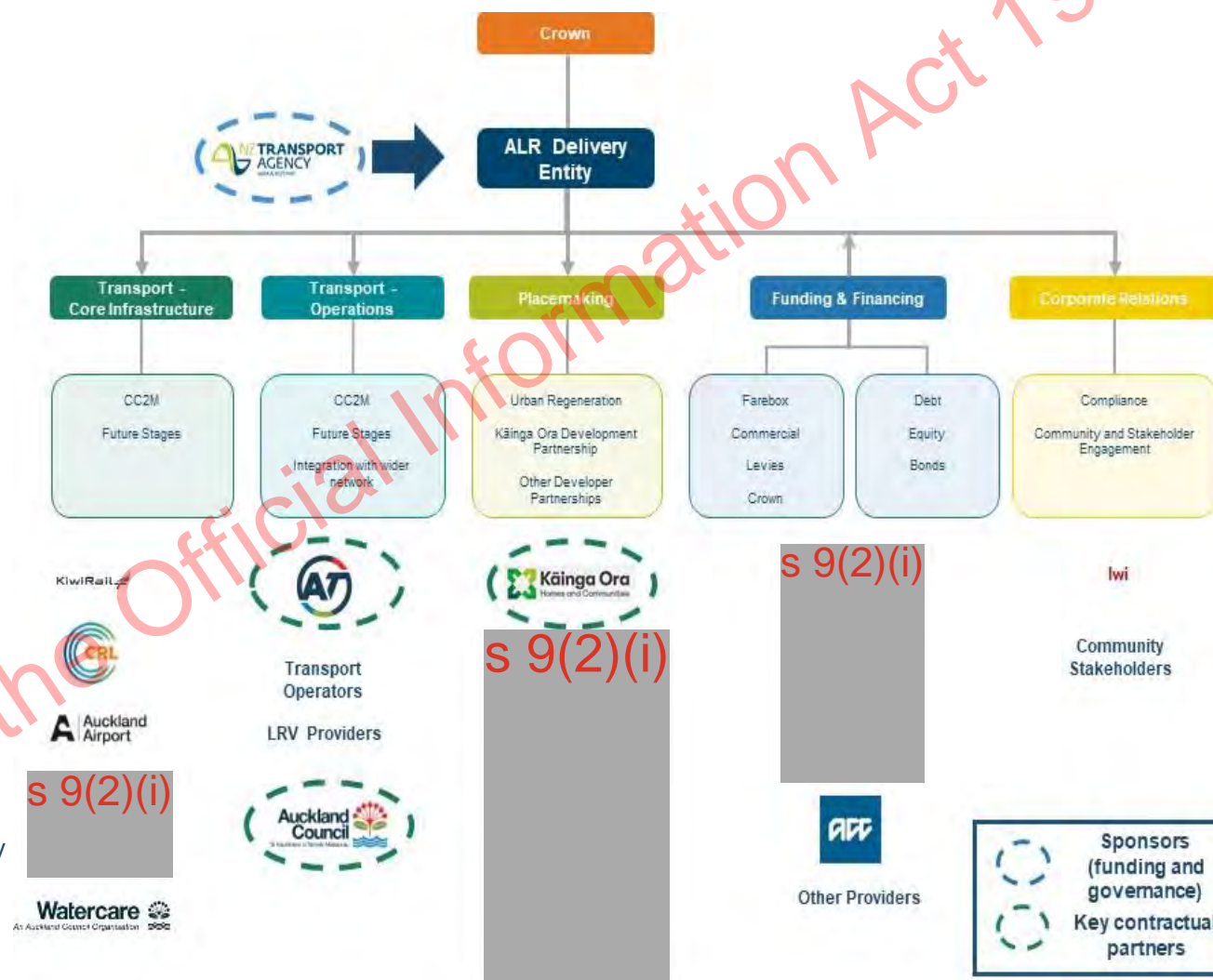
(subject to further diligence)

Key entity features

- Schedule 4A company
- NZTA will remain a key sponsor (alongside the Crown)
- NZTA will also be responsible for the development of the programme while the delivery entity is established.
- Formal governance agreement between Crown, NZTA and Delivery Entity
- Entity operates within agreed funding

Key benefits of proposed approach

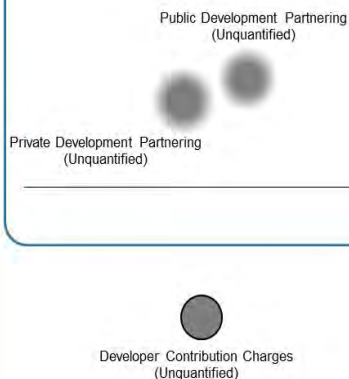
- Centre of excellence for long term integrated planning and delivery of future projects
- Increases efficiency, certainty of delivery, flexibility minimal constraints.
- Balances autonomy with Crown control
- Commercially incentivised for performance management
- Partnership agreements leverage capability and expertise



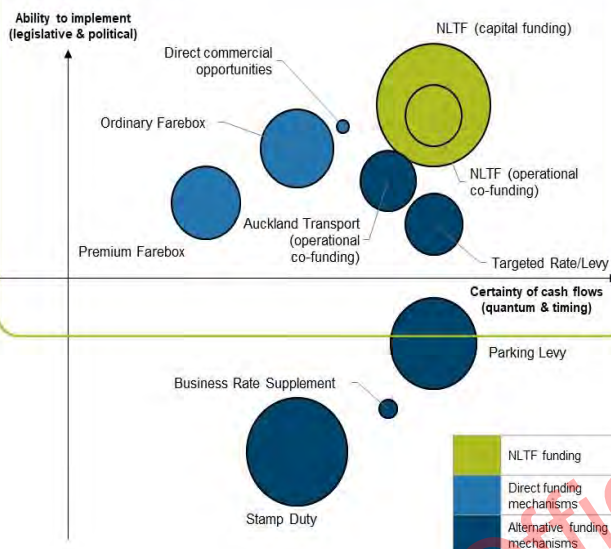
Commercial and Financial Funding and Financing



Opportunities



Primary area of focus



Revenue Streams

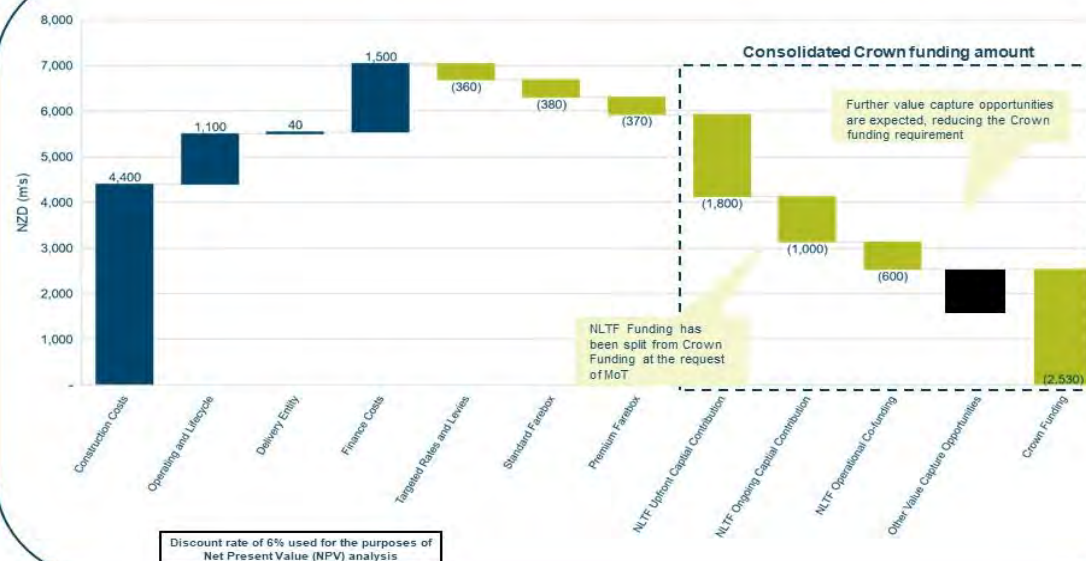
Our initial focus is to develop funding streams that have predictable cash flows and can be realistically implemented.

Government Contributions

Illustrative example only

The RRD requires us to determine the level of Government contributions that will be required without being prescriptive as to its source from within Government.

Both core Crown and NLTF funding will be required to deliver the project.

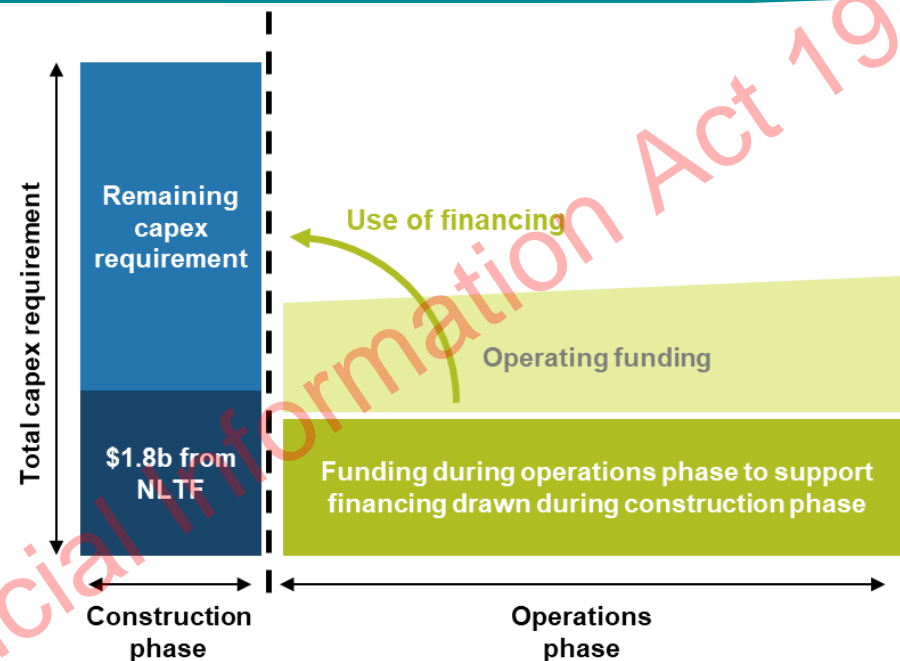


Section 3: Technical Solution



Funding during the Construction phase:

- There is currently \$1.8b funding available from the NLTF.
- The NLTF could theoretically provide more funding during the construction phase, but other pressures on the fund over the current cycle makes this challenging.



Funding remainder of capex:

Option 1

NZTA borrow against the NLTF to provide greater upfront funding to the Delivery Entity i.e. greater than the current \$1.8b proposed from the NLTF.

Key considerations

- NLTF unlikely to have capacity to service finance to fully fund capex.
- NZTA/NLTF financing model can be used to fund other transportation investments.

Option 2

Delivery Entity borrow directly against future Crown and NLTF funding (split between Crown and NLTF to be agreed).

Key considerations

- Does not preclude use of NZTA / NLTF financing model.

Commercial and Financial Procurement and Risk Allocation

Emerging Preferred Packaging Approach

The emerging preferred Procurement Approach includes a focus on ensuring maximum aggregation of packages (where possible, within the boundaries of market capability and capacity).

Utilities Package

Site surveys, utilities identification and utilities relocation (scope TBC) along entire alignment. Potential to include other elements of early works where it drives program / risk benefit

Depot, Supply, Operate, Maintain (DSOM) Package

Depot, Station fit-out, Supply of Light Rail Vehicles (LRV's) & Systems & Communications, Operations and Maintenance

Main Works Package(s) (Subject to staging / sub-package agreement)

Core civils, tunnelling and elevated structures.

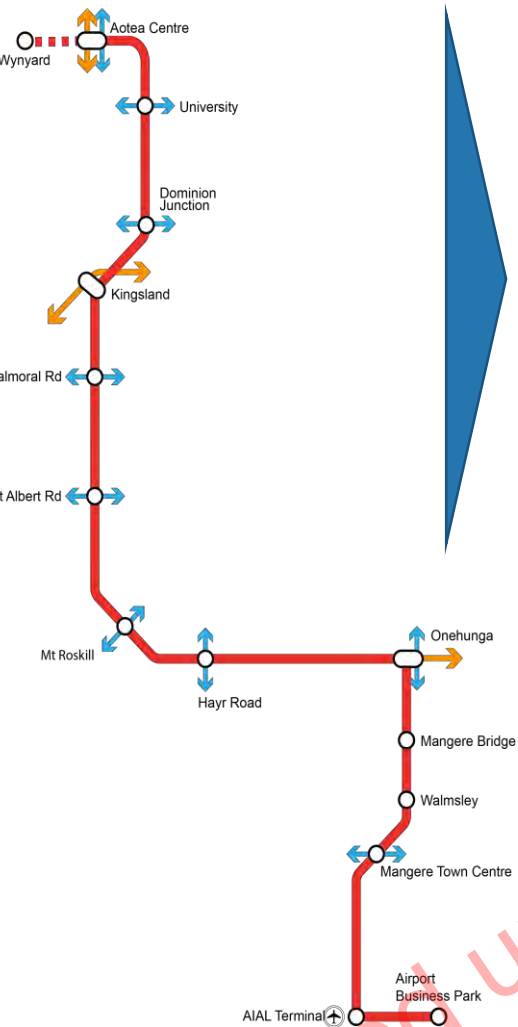
1 - Tunnels	2A – Trenched	2B & 2C – At Grade	3 – New Bridge (Delivered with 2A)	4 – At Grade (minor cut and cover tunnels)
CBD Tunnel	Sandringham Road	Mt Roskill to Depot	Depot to Onehunga	Onehunga to Mangere
				Mangere to Airport

Type	Event	Consequence **
Consenting	The time to achieve consents is much longer than expected	Delay
Consenting	The alignment cannot be consented resulting in major change	Delay, Cost
Delivery Entity	The proposed partners are not able to form the delivery entity	Delay, Cost, Funding, Reputation
Delivery Entity	The delivery entity is not able to exercise the regulatory rights expected	Delay, Reputation
Funding	Funding mechanisms are unable to be utilised	Cost, Funding
Financing	Private sector financing is not available	Failure
Cost	The capital cost is much higher than expected	Cost, Funding
Development	Development becomes subject to politics and is not delivered to the expected timeframe or quality	Reputation
Development	There is less appetite for development in the corridor	Funding
Delivery	Procurement and/or construction proceeds much more slowly than expected	Time, Cost
Delivery	Procurement fails to achieve contracts on the terms expected	Time, Cost, Funding

Risk Allocation

The emerging preferred Procurement Approach includes a focus on ensuring maximum aggregation of packages (where possible, within the boundaries of market capability and capacity).

Technical Solution
Route Alignment and Station Overview



The route and alignment design is future-proofed for the full network in 2048

- Designed to fully integrate with the broader Rapid Transit Network
 - Current network of rail and bus
 - Future network extensions
- Links the network to committed and proposed housing development areas
- Design with full consideration of impact on vehicle length, concept of operations, signalling, platform length and height, total cost and operational impact.
- Supports the areas with the greatest placemaking and urban revitalisation opportunities.



14 stops including Airport business park		Population within 15-minute walk		Jobs within 15-minute walk	
Catchment	Distance from previous stop (m)	2016	2048	2016	2048
Wynyard Turnback/Station	0	-	-	-	-
Aotea	900	26929	39573	62365	106405
University	1000	22134	33516	49007	76376
Dominion Junction	1400*	12041	21407	14856	22216
Kingsland	1400*	9650	14029	5029	5539
Balmoral Rd	1700	12422	17458	3536	3840
Mt Albert Rd	1400	12188	15328	1683	1960
Mt Roskill	1200	4423	5841	1646	1802
Hayr Rd	2500	8459	13268	1840	3081
Onewhanga	3000	13091	17226	3838	3988
Mangere Bridge	1900	2411	2733	1028	1077
Walmsley	1400	4925	5141	376	599
Mangere Town Centre	1500	6726	7347	1442	1506
Airport Business Park	4200*	3	7	759	1522
AIAL Terminal	1500*	10	38	1293	2688

Our proposed route alignment supports:

- Fully separated at grade and trenched
- Sub-30 minute journeys for 95% of travellers across the network
- Speed of 80km/hr
- Integrated to future network requirements
- Multi-modal linkages
- Supporting urban revitalisation, placemaking and urban redevelopment opportunities

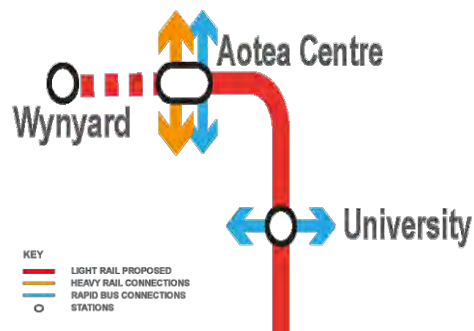
In designing our proposed route we have taking into account:

- The outcomes and objectives of the project
- Technical constraints and
- Cost / Value for money
- Community Impacts, consenting challenges and opportunities
- Environmental impact

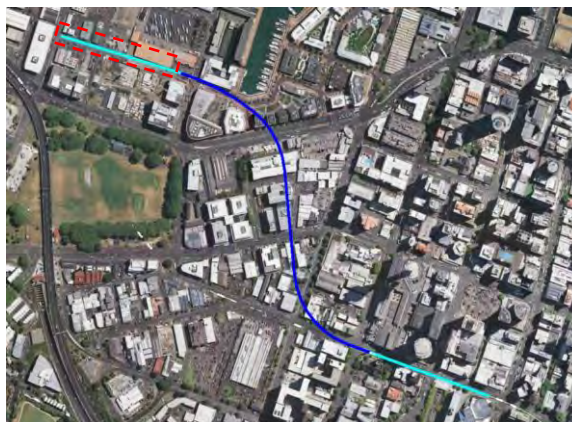
Technical Solution

Meeting the Outcomes: Stations and Focus Areas

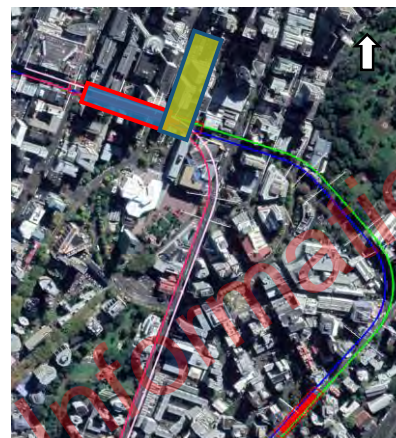
City Centre



Wynyard Turnback/Station*



Aotea Station



University Station



Meeting the key outcomes

Access and Integration



Urban and Community



Experience



Environment



Deliverability



Value for Money



- ✓ Wynyard provides turnback. Modelling indicates a future station will provide patronage to the network, but is not required to meet the outcomes
- ✓ Can integrate effectively with the regeneration of the Wynyard Quarter to future proof network
- ✓ Direct access to AKL waterfront
- ✓ Future underground station has minimal impact on the surrounding environment
- ✓ The designated site is zoned for intensification
- ✓ Development potential to the South East and ongoing around site

* Turnback/Station Under consideration

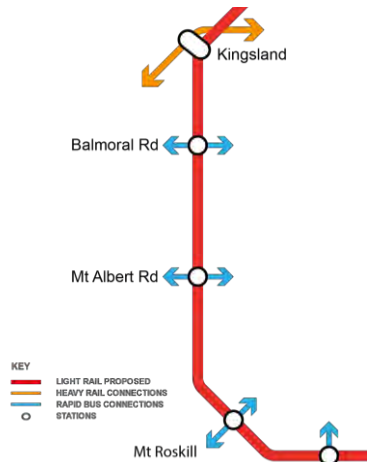
- ✓ Major interchange with existing rail provision, futureproof for nth shore
- ✓ Central access to city centre
- ✓ Enables reduced PT Queen street
- ✓ Improve pedestrian environment
- ✓ Access to AKL waterfront, ferries
- ✓ Underground station minimal impact on surrounding environment
- ✓ Existing provision provides clear area for mined station
- ✓ Key station for providing economic uplift and access to city centre
- ✓ Mined station additional cost, options for shaft construction

- ✓ Modelling: 2nd highest stations for patronage
- ✓ Access to health and education: AUT/UoA/AC Hospital
- ✓ Reduce buses around campus
- ✓ Better use campus space
- ✓ Ties education and social opportunities to rapid network
- ✓ Minimal environmental impact of a mined station
- ✓ Deep level mined station feasible
- ✓ Future proof North Shore campus link

Technical Solution

Meeting the Outcomes: Stations and Focus Areas

Sandringham Corridor: Fully Trenched, segregated rapid route



Meeting the key outcomes

Access and Integration



Urban and Community



Experience



Environment



Deliverability



Value for Money



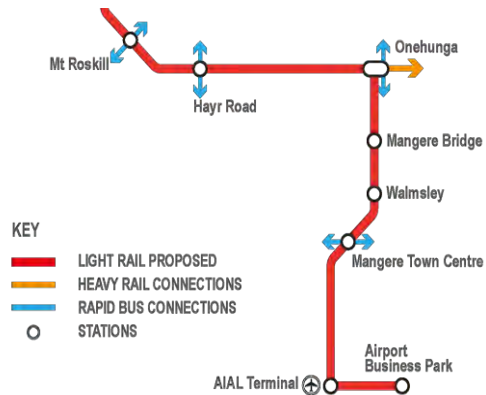
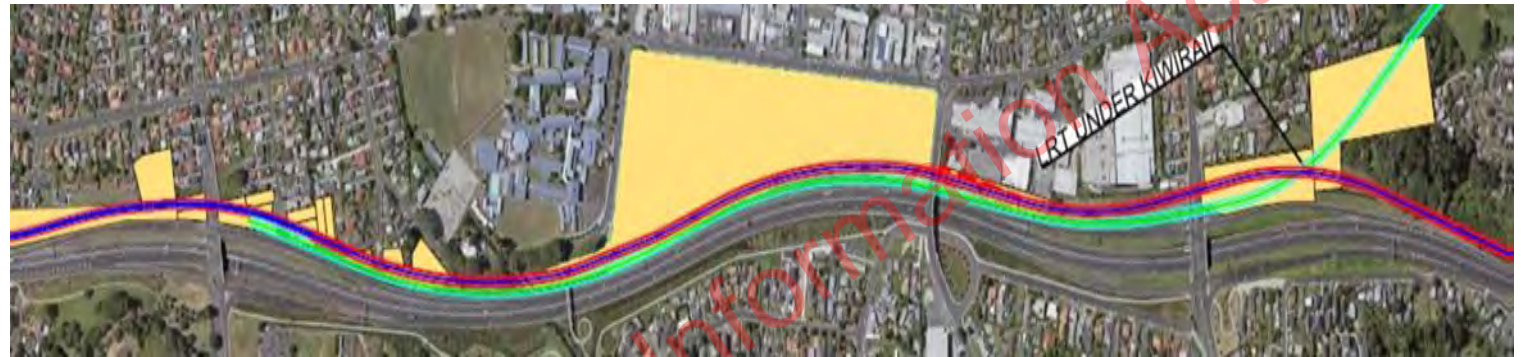
- ✓ Fully segregated, enables cross traffic, pedestrian and cycle movements along/across the corridor
- ✓ Minimal visual impact along the corridor
- ✓ Provision for cycleways along entire corridor, safe crossings
- ✓ Quality, reliable, safe, fast and accessible journeys
- ✓ Provision for active mobility/ cycleway
- ✓ Reduced congestion
- ✓ Avoids elevated structure and significant consenting challenges
- ✓ Significant cost reduction on tunnelling option



Technical Solution

Meeting the Outcomes: Stations and Focus Areas

Mt Roskill to Airport

Mount Roskill to Queenstown Rd
Along the motorway at grade

Meeting the key outcomes

Access and Integration



Urban and Community



Experience



Environment



Deliverability



Value for Money



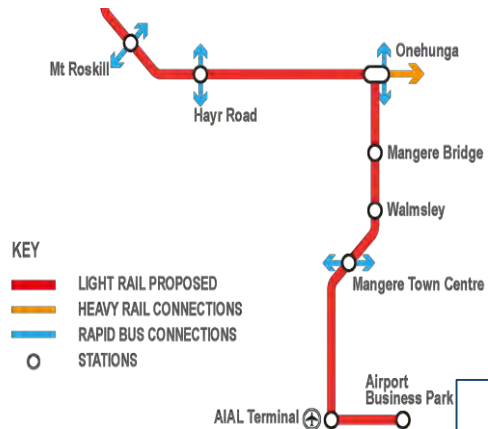
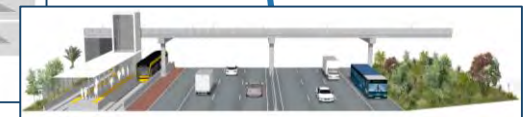
- ✓ Supports access between key stations
- ✓ Future proofed for Kiwi rail expansion/maintenance
- ✓ Reduced visual impact
- ✓ Quality, safe and accessible journeys
- ✓ No differentiating impact
- ✓ Constructible in accordance with programme
- ✓ Easier construction, integrate by adjustment of cross motorway bridges
- ✓ Reduced cost by keeping rail at grade



Technical Solution

Meeting the Outcomes: Stations and Focus Areas

Mt Roskill to Airport

Lagoon area
At grade /low structureLagoon to Onehunga
At grade/trenched along Neilson StMangere Town Centre
Under motorway

Meeting the key outcomes

Access and Integration



Urban and Community



Experience



Environment



Deliverability



Value for Money



- ✓ Provides access and integration through Onehunga station
- ✓ Use of motorway shoulder minimises lane encroachment
- ✓ Limited visual impact, mitigation of loss of community facilities by planting and wetland leisure facilities
- ✓ Quality, safe and accessible journeys
- ✓ Avoids reclamation
- ✓ Noise, visual and shadow impacts avoided
- ✓ Using existing transport corridor
- ✓ At grade solution achieves reduction in costs

- ✓ Provides fully segregated route
- ✓ Good link with Onehunga transport interchange
- ✓ Cross traffic continues on local roads to the North
- ✓ Quality, safe and accessible journeys
- ✓ No differentiating impact
- ✓ Close liaison with NZTA to provide freight access routes during construction
- ✓ Significant opportunity to create new growth hubs around stations

- ✓ Provides access to community N-W of motorway
- ✓ Integrated to existing bus links
- ✓ Opportunity to support development potential with KO in future
- ✓ Provides rapid route for increased job/education access
- ✓ Quality, safe, fast and accessible journeys
- ✓ No reclamation anticipated, design can accommodate if required
- ✓ Utilises future proofed Kirkbride interchange
- ✓ Comparatively low cost to extending to Mangere Town Centre

Technical Solution

Urban Transformation, Design and Development

Considerable development and urban regeneration opportunities exist along the proposed corridor.

Key moves for transport integration:

- Provide Auckland wide access to station precincts
- Integration with wider transport network
- Extend metro coverage
- Prioritise sustainable transport options
- Act as a catalyst for precinct development
- Allow for efficient transport operations
- Future proof for new transport technologies

Realising opportunities will rely on:

- consolidation of land ownership through 'private treaty' negotiation or
- compulsory acquisition powers (which may become available under proposed UDA initiatives).

Stations & Stops – streetscape architecture

- The design response will represent high level design thinking only – it won't be a fully resolved design
- Station design cognisant of Auckland Transport Design Guidance and Maori values
- Design will be subject to a full engagement process following successful award of the project
- Indicative Street Level Architecture to be represented in public realm visualisations

Consenting & Land Acquisition

- Consenting Strategy/Environmental Management: optioneering managing key impacts: construction/ utility/ business disruption
- Land acquisition strategy: c. 392 properties over c. 26km
- KO, AT, AIAL, CRL, KiwiRail discussions underway

Key urban development opportunities – summary

Note: Provisional values

Location	Development opportunity	Reason for opportunity	Indicative land value / acquisition cost	Area	Potential land value uplift	Master developer / land purchaser	Potential development partners
Dominion Junction	Large scale comprehensive urban regeneration	<ul style="list-style-type: none"> • Potential for comprehensive high density development • Release of road reserve • 'Twilight' light industrial uses 	~\$170m	~5+ha plus road reserve (say 1.5ha)	~\$80m	<ul style="list-style-type: none"> • ALR-PE 	<ul style="list-style-type: none"> • KO • Institutional developers / investors
Balmoral / St Lukes	Urban redevelopment around Westfield St Lukes	<ul style="list-style-type: none"> • Westfield St Lukes precinct has potential for high density intensification 	~\$150m	~7ha	~\$100m	<ul style="list-style-type: none"> • ALR-PE for station node • Institutional developer for St Lukes precinct 	<ul style="list-style-type: none"> • Potentially Scentre Group (owner of St Lukes SC) • Institutional developers / investors
Mt Roskill	Significant densification and urban regeneration	<ul style="list-style-type: none"> • Extensive Crown land holdings • Supportive zoning for densification 	Value of existing Crown estate within node ~\$940m	~60ha within 800m	~\$300m	<ul style="list-style-type: none"> • ALR-PE for station node • KO 	<ul style="list-style-type: none"> • KO
Onehunga	Large scale comprehensive urban regeneration	<ul style="list-style-type: none"> • Council land ownership • Limited Crown land ownership • Extensive 'twilight' light industry land holdings • Connection to heavy rail 	~\$175m	~10+ha	~\$120m	<ul style="list-style-type: none"> • Auckland Council (Panuku) • Institutional Developer / investors 	<ul style="list-style-type: none"> • Auckland Council • Institutional developers / investors
Mangere	Significant densification and urban regeneration	<ul style="list-style-type: none"> • Significant latent potential • Opportunity for significant densification • Extensive Crown land holdings 	Value of existing Crown estate within node ~\$500m	~50ha within 800m	~\$190m	<ul style="list-style-type: none"> • KO • Auckland Council (Panuku) 	<ul style="list-style-type: none"> • KO • Auckland Council (Panuku) • Mangere Town Centre interests

Land acquisition costs based on rateable values and exclude any premium which may be required to consolidate land ownership. The land value uplift is gross and does not take into account the costs of masterplanning, consenting, partnering agreements etc.

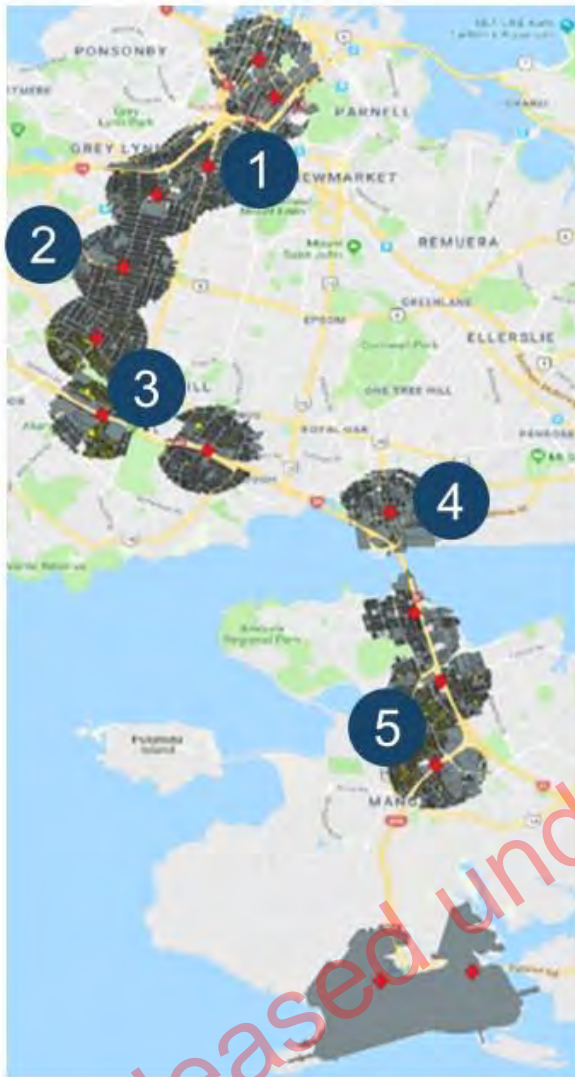
Total potential uplift
\$700m - \$900m

Indicative Section Visualisations Only



Technical Solution

Urban Development Opportunities



Key development areas:

- 1 Dominion Junction
- 2 St Lukes
- 3 Mt Roskill
- 4 Onehunga
- 5 Māngere

Expected land value uplift of approx. \$800m

Expected uplift over total route (<1.6km of an ALR station, not including full uplift from Dominion Junction) of approx. \$5.2bn

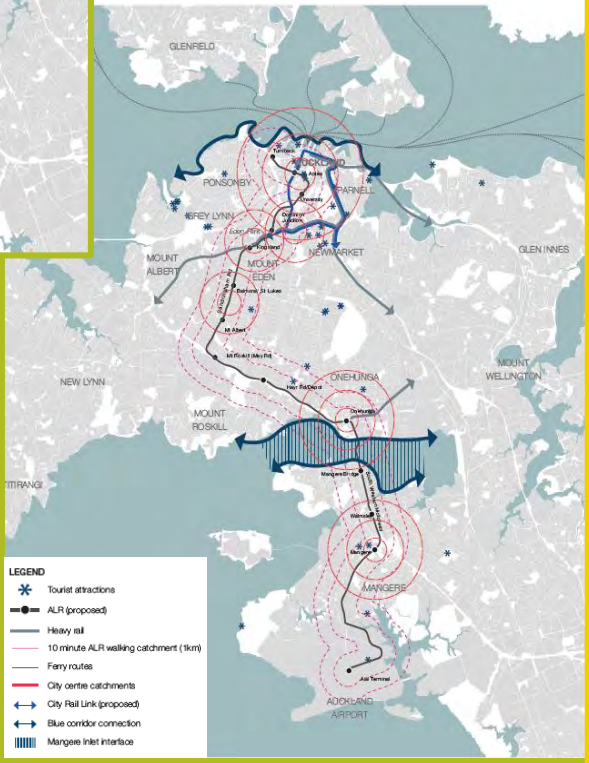
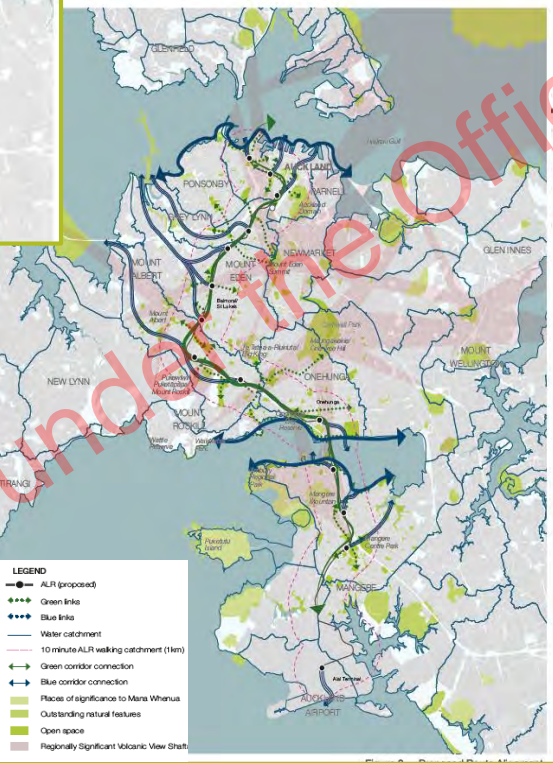
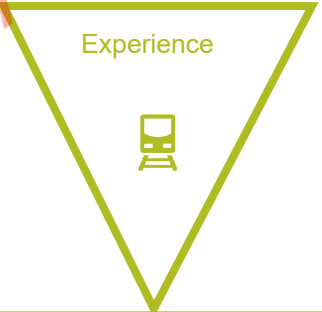
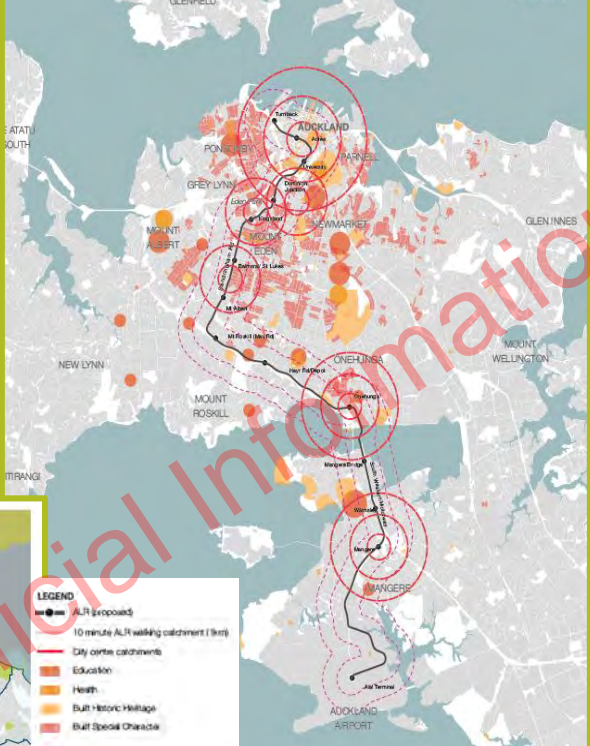
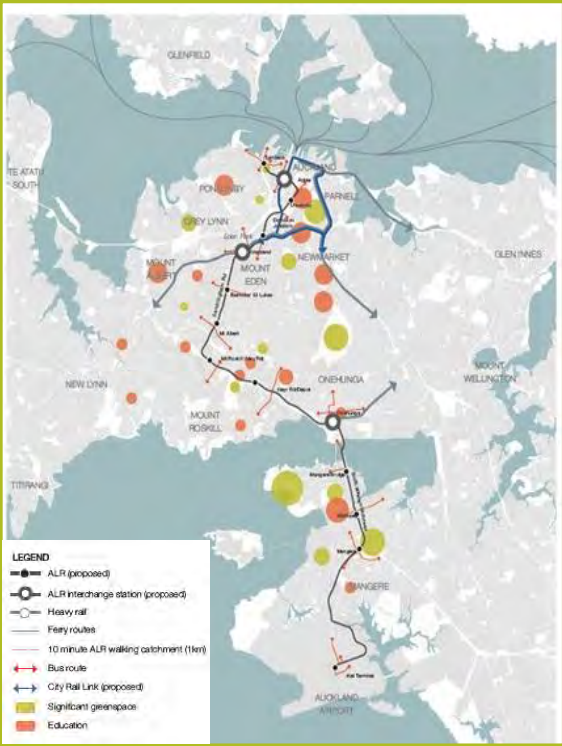
The delivery entity will facilitate the partnership arrangements to allow

- the delivery of Transit Oriented Development (TOD)
- placemaking to support integration of the transport infrastructure
- optimisation of accessibility for communities along the corridor.



Technical Solution

Urban Transformation, Design and Development – Urban Design Framework



Service Delivery Solution

Customer Experience



Example customer experience – business commuter

Customer profile, wants and needs
 Arsha is an environmentally-conscious commuter on the C&G.
 Arsha wants reliable transport where she can turn up and go, however she also understands that sometimes there are delays or service disruptions.
 Arsha values real-time information delivered straight to her mobile device, which provides alternative route and mode suggestions.
 Arsha prefers to cycle to the station instead of driving, for fitness and the environmental benefit, so she values bike storage facilities.



Example customer experience – school student

Customer profile, wants and needs
 Amanda is a school student with cashless payment options.
 Amanda's parents want her to have a fast and easy way for her to get to school so that they don't have to drive her.
 Amanda and her friends like to use scooters to get around, especially since they live a 20 minute walk from the nearest station.
 Sometimes, Amanda leaves school late after soccer practice. Amanda's parents want her to be safe, even when traveling at night.



The vision for customer experience leverages best practice and builds on the key outcomes



Example customer experience - elderly wheelchair user

Customer profile, wants and needs
 David is an elderly who uses an electric wheelchair.
 David likes to visit his friends using public transport, he struggles not to drive long distances given his mobility needs.
 David seldom uses his mobile phone and finds it difficult to use, by waiting for help and using maps.
 David wants a safe and intuitive journey. He values easy access to the station and on-board safety features, including a dedicated space for his wheelchair.

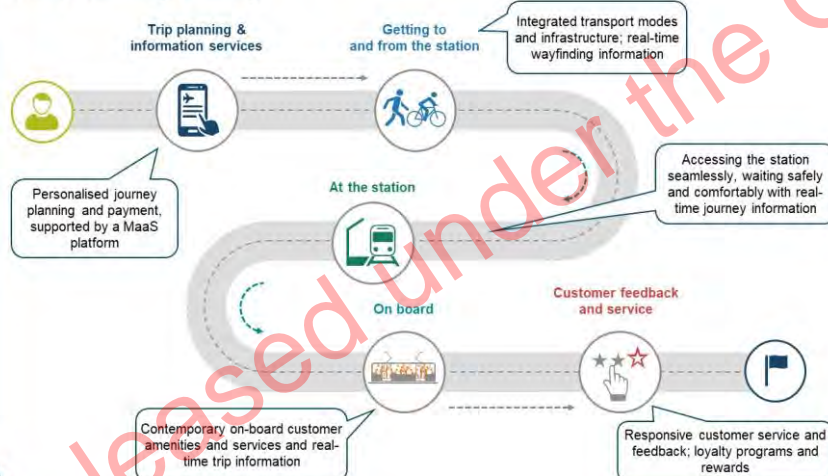


Example customer experience: international tourist

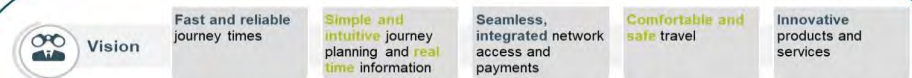
Customer profile, wants and needs
 Sven is a recently arrived international tourist.
 Sven wants a fast and cost effective way to get to the city from the airport. He needs secure storage space on board for his luggage.
 While in Auckland, Sven would like to plan his journey in the morning, ahead of a hot day of sight seeing.
 Sven does not want to have to go through the effort of setting up an AT account. He would like to pay for transport by tapping on and off with his credit card or e-wallet.



Customer journey



Vision



Key elements of the customer experience



Service Delivery Solution

Rolling Stock and Systems



Key Points

- AIAL to Aotea in 30mins
- Metro Style vehicles
- Key operating systems decisions are interdependent
- Maximise performance by segregated infrastructure, automation and high floor
- Maximise capacity with no driving cabs
- Discussion with manufacturers progressing to identify vehicle
- Vehicle size being tested to respond to future patronage scenarios throughout network

Third Rail Systems (not catenary)



Automation GOA4:No onboard staff



- Lower rate of collision and derailment
- Platform doors protect customers
- Auto cut off on track access

Floor Height – High (>800mm)



All images illustrative of vehicle types only
– not illustrating proposed track infrastructure

Meeting the key outcomes

Access and Integration

Urban and Community

Experience

Environment

Deliverability

Value for Money

- ✓ Ability to achieve high frequency and high speeds
- ✓ Reduced profile and visual impact
- ✓ Safety: line only live in contact, onboard/station safety systems protect public
- ✓ Faster/ Reliable/resilient services supported by better resistance to system failure and ease of maintenance
- ✓ Efficiency: regenerative braking
- ✓ Less complex to construct
- ✓ Simpler consenting process
- ✓ Proven solution overseas
- ✓ Potentially cheaper build
- ✓ More metro experience / supply chain flexibility parts, low operating cost
- ✓ No isolated infrastructure or pedestrian crossing blockage required as segregated or trenched
- ✓ Train Performance Consistent
- ✓ Dwell times consistent with GOA4
- ✓ More passenger space as no cabs
- ✓ Higher frequency possible
- ✓ Staff rostering service failure avoided
- ✓ Single supplier provides opportunity for long term contract cost scale negotiability
- ✓ Improved commercial speed
- ✓ Improved safety and accessibility at station
- ✓ Improved travel time,
- ✓ Ease of boarding and alighting
- ✓ Improved customer mobility inside train
- ✓ No distinctive feature/impact
- ✓ High compatibility with automation

Service Delivery Solution

Light Rail (streetcar) vs Metro

ALR must encourage a mode shift to public transport. One proven way of doing this is shorter travel times e.g. Northern Busway (median 25 mins) vs private car (median 45 mins) → see chart

Separation – no external interaction with pedestrians or other vehicles provides:

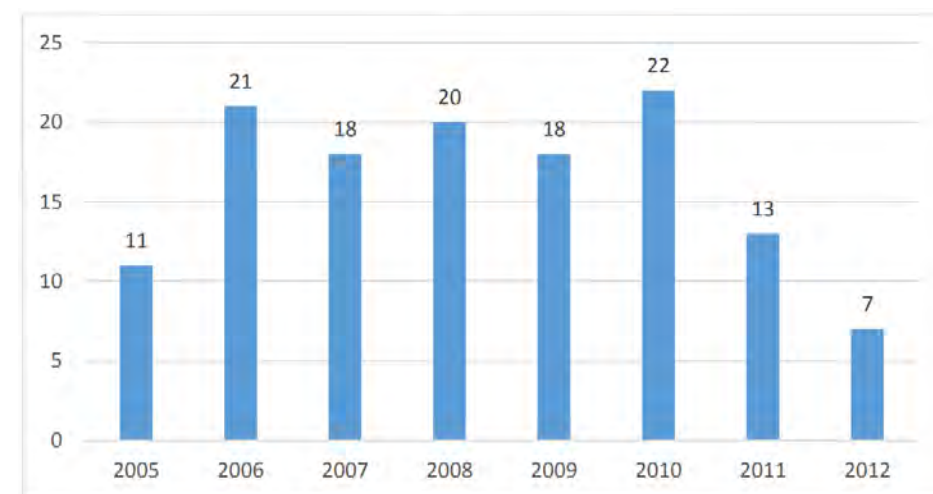
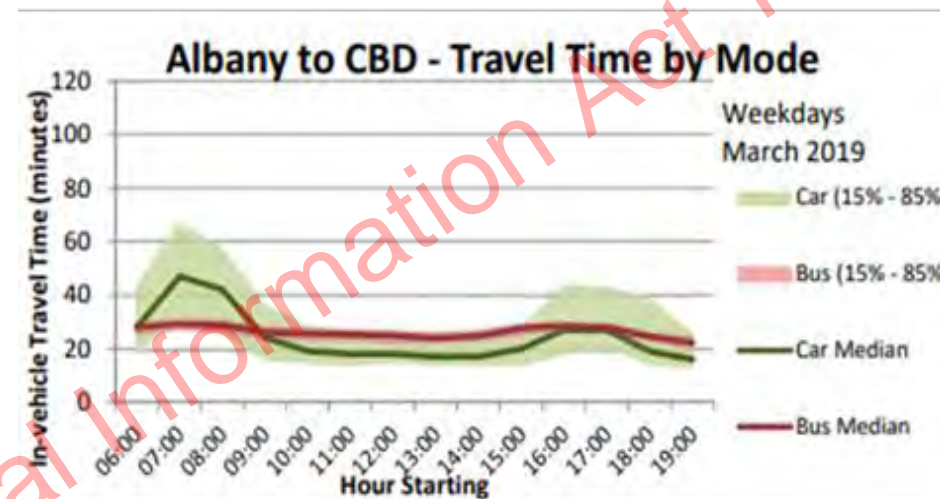
- Automation allowable: 3-minute headways not possible with 'line of sight' system on-street. Vehicles would be overcrowded or would need to be longer if headways are longer. Lower OPEX with automation
- More reliable as not impacted by on-road accidents
- Safer than on-street systems e.g. Luas (Dublin; street-running LRT)* → see charts
- More frequent service thanks to lower headways
- More consistent journey times as no external interaction
- Higher CAPEX costs, but higher capacity to support development as well

Construction:

- Separated systems generally less disruptive, but longer programme. No impact on existing network during operation.



Graph 3-15: Number of Road Traffic Accidents involving a tram, by year



Graph 3-17: Tram/Pedestrian coming into contact

[*Irish Railway Safety Performance report, 2012](#)

Service Delivery Solution

Light Rail (streetcar) vs metro: Dominion vs Sandringham

A metro style solution is not well suited to fit within Dominion Rd unless we tunnel because:

- The town centres along Dominion Road have significant **heritage and character protections** through Unitary Plan provisions, so it would be more difficult to take any properties or frontages should they be required for a metro station.
- Unlike Sandringham Road, a Dominion Road metro alignment would require a tunnel to avoid taking properties through the town centres.
- The southern end of Dominion Road is narrower than Sandringham Road. In these areas, a partially open trench would not have been possible and also provide traffic, cycle and pedestrian lanes.
- A metro style partially open trench alignment along Sandringham provides a route with less basalt to contend with than an alignment along Dominion Road.

Development supply between Dominion and Sandringham
Sandringham road has greater supply capacity

Meeting the key outcomes

Access and Integration



On street LRT

- ✓ Increase public transport capacity
- ✓ Improves accessibility
- ✓ Allows for permeability across LRT alignment

Urban and Community



- ✓ Likely improved streetscape post-construction
- ✓ Access to existing land uses/permeability
- ✗ High levels of construction disruption

Experience



- ✗ Close interaction with pedestrians/traffic
- ✗ More unreliable frequency and journey time
- ✓ Improved journey times on CC2M and wider network
- ✗ Headways of >3mins due to line of sight operating system

Environment



- ✓ Increasing public transport ridership
- ✓ Reduced emissions due to cars/buses removed from route

Metro

- ✓ Higher frequency and speed – less impact on pedestrians
- ✓ Increases public transport capacity more than on-street
- ✓ Improves accessibility to employment/education
- ✓ Integrated with existing and future rapid transport network
- ✓ Significantly improved access to employment, education, amenities, interchanges
- ✓ City Centre Construction programme, less disruptive
- ✗ Reduced permeability to existing land uses and communities when not at grade ('hop off and shop')
- ✓ Improved journey time
- ✓ Operate at 90 second headway – 40 trains per hour
- ✓ Less division of villages and local traffic disruption by segregation
- ✓ Significant increase in the public transport mode share on and around corridor due to increased accessibility and modal shift – reduce congestions, sustainable mode trips, improved air quality.