Lake Road Detailed Business Case

Prepared for Auckland Transport (AT)
Prepared by Beca Limited (Beca)

4 September 2020

Creative people together transforming our world

Contents

Tables

Figures

Appendices

Revision History

Revision Nº	Prepared By	Description	Date
A	Dan Jackson / Jerry Khoo / Andy Lightowler	DRAFT	21 August 2020
B	Dan Jackson / Jerry Khoo / Andy Lightowler	FINAL	4 September 2020

Document Acceptance

Action	Name	Signed	Date
Prepared by	**Dan Jackson / Jerry Khoo / Peter Bradshaw**		4 August 2020
Reviewed by	**Georgia Cottrell**		4 August 2020
Approved by	**Andy Lightowler**		4 August 2020
on behalf of	Beca Limited		

Executive Summary

Overview

Lake Road is the only arterial road in and out of the Devonport peninsula and, alongside Esmonde Road, serves as the main connection to the rest of the North Shore and Auckland for people living and working in the area. Around half of all Lake Road journeys are short trips, that stay within the peninsula. A high proportion of trips are made in single-occupancy vehicles.

This detailed business case outlines the case for investing in improvements to Lake Road, Esmonde Road (which provides a critical transport link between Lake Road and State Highway 1 (SH1) and Bayswater Avenue (which connects Lake Road to Bayswater Ferry terminal).

Context

The Government Policy Statement on Land Transport (GPS) sets the priorities for investment for land transport. It takes a step change in approach for investment with a key priority on improving road safety and increasing and accelerating mode shift from single-occupancy private vehicle trips to walking, cycling, public transport and car-sharing.

More than 1.5 million people live in Auckland already and that number is expected to increase by another 730,000 people to reach 2.4 million by 2043. This could mean another 320,000 dwellings and 270,000 jobs for Auckland. As Auckland grows it is essential that more people use active modes, travel by public transport and car-pool. This will reduce pressure on the roads and free up room for freight and commercial travel supporting regional economic productivity.

The Government and Auckland Transport want to improve the accessibility, reliability, and availability of travel choices to and from the Devonport peninsula, and make it easier and more convenient for local residents to travel to local shops, parks, beaches, and community centres.

Local land use and transport policies are strongly aligned with the project. Capacity for growth analysis arising from the Auckland Unitary Plan process was undertaken by Auckland Council's Research and Evaluation Unit in 2015. This indicated the total capacity for additional development on the Devonport peninsula through redevelopment was in the order of 3,200 dwellings (a 37% increase).

Investment Logic

At the outset of the detailed business case process, representatives from AT, Auckland Council and Waka Kotahi reviewed the problems previously defined to ensure they were still fit for purpose. The key problems to be addressed by the project were agreed to be are as follows:

- **Problem 1**: Unattractive alternative modes combined with high vehicle movements is resulting in variable travel times and poor accessibility
- **Problem 2**: Existing corridor layout and lack of alternative routes is resulting in an inability to adequately accommodate place and movement needs
- **Problem 3**: Corridor form and high demand are contributing to an increasing number of deaths and serious injury (DSI) crashes and poor perception of safety.

The following four benefits were agreed as reflecting the expected outcome from addressing the three defined problems:

- **Benefit 1:** Travel time variability will be reduced and accessibility will be improved for people who car pool or travel by bus
- **Benefit 2:** Place and movement needs of the corridor will be better balanced
- **Benefit 3:** Crashes will be reduced, and poor safety perception improved
- **Benefit 4:** Improved environmental outcomes.

The following Investment objectives were defined for the project:

- **Investment Objective 1** – We will reduce travel time variability for all modes by 10% by 2031
- **Investment Objective 2** – We will improve the attractiveness of alternative modes to single-occupancy car use by increasing the proportion to 40% by 2031
- **Investment Objective 3** – We will balance the place and movement functions of the corridor in line with the appropriate RASF typology by 2031
- **Investment Objective 4** – We will reduce the number of DSIs on Lake Road by 20% by 2031.

Evidence to Support the Case for Change

Variable Travel Times and Poor Accessibility

Transport accessibility along Lake Road is compromised by existing high vehicle demands and a lack of bus priority and measures to encourage car sharing. This results in unpredictable travel conditions during weekday peak times and the weekends, and significant delays to buses and general traffic.

Growth in the peninsula is expected through several redevelopments, with the additional traffic generated expected to compound the existing problem, increasing travel costs. Significant additional commercial and residential development is also planned around the Takapuna Centre.

Movement Dominates Place

There is significant conflict between the movement and place needs along the Lake Road corridor, particularly in the vicinity of Belmont Centre.

Safety

The existing cycle lanes on Lake Road are of a poor-quality There are significant safety concerns among vulnerable road users. Of the 28 serious crashes in the area over the last ten years, ten of the casualties were pedestrians or cyclists. The causes an increasing number of DSI crashes and poor perception of safety was identified as corridor form and high traffic demand.

Preferred Option

Based on the problem statements, several treatment options for improvements to intersections and mid-block were developed though in a workshop with the key stakeholders from Waka Kotahi, Auckland Transport (AT) and Auckland Council (the shortlist). The options built on the preferred option defined in the earlier Indicative Business Case (IBC). Through a multi-criteria assessment process and subsequent option refinement process, with input from Auckland Council on the development of a preferred option for Belmont Centre, a preferred option was identified.

The preferred option seeks to help people making short trips have good alternatives to driving. This will help free up Lake Road for people making longer trips by car or who need to drive. The improvements also aim to make people using Lake Road and Bayswater Avenue safer, regardless of their mode of travel.

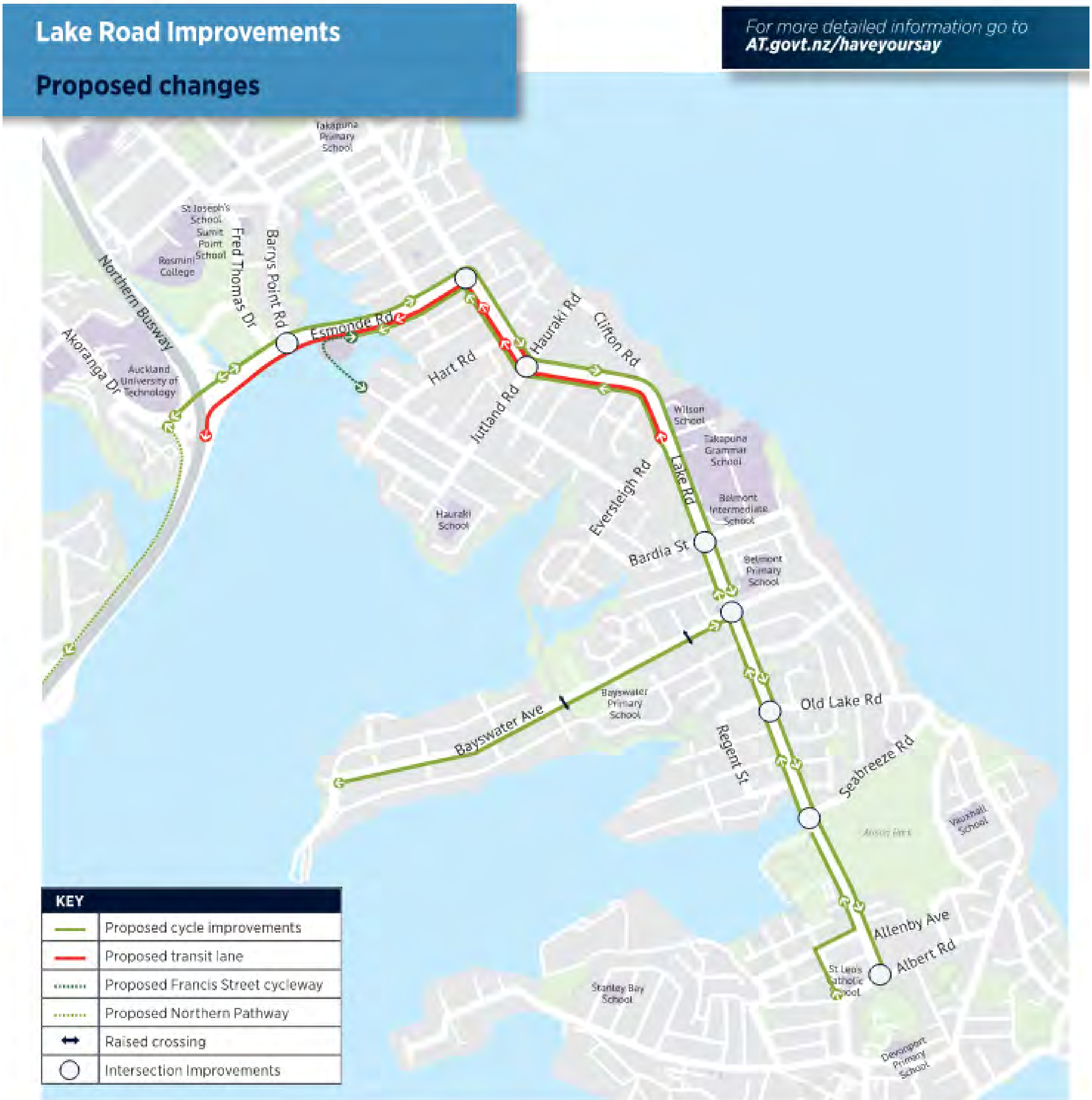
The preferred option includes a mix of new and re-purposed transit lanes (for higher occupancy vehicles and public transport), physically protected cycle lanes, safer pedestrian crossings, safer intersections and technology solutions to improve available trip information.

These improvements will assist in giving people more opportunity to make shorter trips safely on foot or by bike, or by bus or carpooling, and will free up road space for people who need to drive.

The preferred option is shown in the diagram below and includes:

- New transit lanes targeting the most congested parts of Esmonde Road and Lake Road
- Upgrading the existing Lake Road cycle lanes to be safer
- Implementing new cycle lanes on Bayswater Avenue and through Belmont centre
- A revitalised Belmont Centre precinct, with several enhancements including new public spaces, relocated bus stops and improved pedestrian crossings
- Safer and more efficient intersections
- New technology (such as electronic roadside signs) to provide travellers with up-to-date travel information.

The proposed infrastructure works involve localised kerb-line changes but avoid acquiring property or extensive and disruptive construction works.



Preferred Option Assessment

Strategic Alignment

While being developed independently of other projects and able to deliver significant benefits in its own right, the project will also provide an important connection to the local walking and cycling network, providing a safe and convenient connection between neighbourhood areas, parks and open space areas, and community facilities for active modes. It will also provide an important link to the proposed new Northern Pathway walking and cycling facility over the Auckland Harbour Bridge.

The preferred option for the project is strongly aligned with the GPS. Under the Investment Assessment Framework (2018-2021), attracting a “medium” rating.

Value for Money

The expected estimate of the project is $38.2m (P50) to $41.0m (P95). The economic benefits of the project have been calculated to be $24m of benefits to pedestrians and cyclist, $15m to buses with the remaining benefits to private vehicles.

The project is projected to have an economic benefit to cost ratio (BCR) of 1.3.

The sensitivity of the evaluation has been assessed against a number of parameters. The results show the BCR is sensitive to the changing assumptions producing a range between 0.9 and 1.6.

Investment Profile

The Preferred Option has been assessed as having a high strategic fit in accordance with the Investment Assessment framework (2018-2021) with strong policy alignment with the GPS 2018.

Key Benefits

The key benefits the project will deliver include:

- Improved access to local destinations and multi-modal transport options
- More reliable travel times for users of the transit lanes
- More reliable bus services, including those connecting with ferries
- Improved travel information
- Safer to cycle and walk in the area, and connect to future cycleways (e.g. Northern Pathway, Francis Street cycle link)
- Move more people within the corridor
- Avoiding an expensive and disruptive road widening
- Enable Auckland Council to work with AT on streetscape and safety improvements at Belmont Centre.

Implementing the Preferred Option

Implementation Strategy

There is a strong motivation, need and support to deliver the project as soon as possible. The implementation strategy will consider how this can be achieved most effectively and efficiently. Key considerations include:

- High level of ability to deliver on the GPS and government intent
- Ensuring design and construction can commence within the next NLTP funding round
- Level of connections and interfaces with Auckland Council and Waka Kotahi projects, including proposals for Belmont Centre and the Northern Pathway project
- Complementary consent, design and construction timing with Waka Kotahi's Northern Pathway project.

Should funding constraints be experienced, the delivery of the project could be by a staged approach.

Procurement Strategy

The recommended delivery model for procuring the project is a Staged/Traditional approach. This method is appropriate as the project complexity, uncertainty, innovation and risk are low. It will allow the project to come to the market in a timely manner as well as be delivered within the anticipated timeline. It also allows for a high level of involvement and control of the project by Auckland Transport.

Consenting Strategy

There are several notable and generally protected trees along road corridor as well as several heritage sites (both built heritage and cultural heritage). As such, several technical assessments and/or baseline monitoring will need to be undertaken during an early stage of detailed design to further refine the consenting risks and strategy.

Managing the Delivery of the Preferred Option

On-going stakeholder collaboration, consultation and management with the key partners and mana whenua will be required to provide a better understanding of any potential cultural effects associated with the proposed works and assist Auckland Transport to determine how any adverse environmental effects could be mitigated.

Recommendations

It is recommended that:

- The Preferred Option is taken forward to the detailed design stage; and
- Continue collaboration with Auckland Council and Waka Kotahi regarding connections to the local road network, access to reserves and natural features, improvements to Belmont Centre and access to the Northern Pathway.

Part A: The Case for Investment

1 Overview

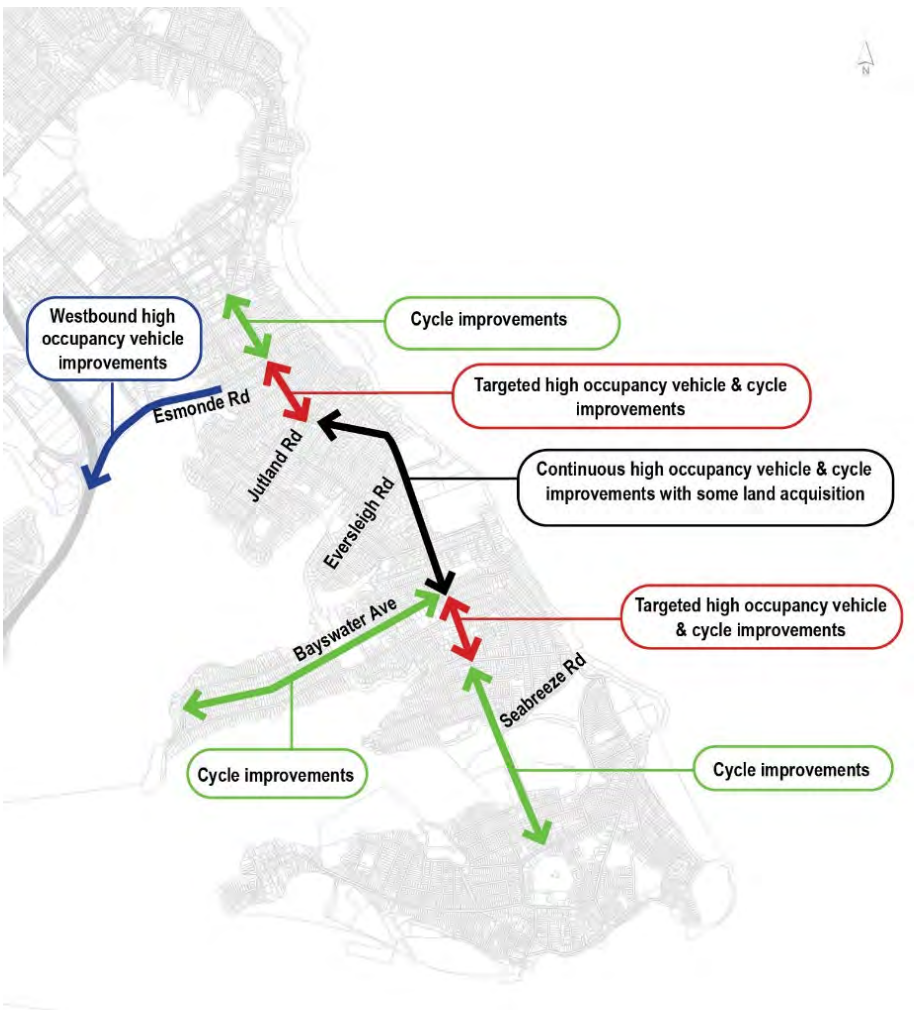
1.1 The Lake Road Improvement Project

In April 2019 Beca Limited were commissioned by AT to prepare a Detailed Business Case (DBC) for the Lake Road Improvement project (the project). The DBC identifies a preferred investment strategy for the project to facilitate it proceeding to pre-implementation (detailed design, consenting etc.). It builds on the preferred solution recommended in an earlier Indicative Business Case (IBC) for the project prepared in 2018, such that a robust preferred option is recommended to meet the overall project goals and objectives.

The main elements of the preferred solution for the project recommended in the IBC are shown in Figure 1-1 and include:

- Provision of continuous upgraded (separated if possible) cycle facilities along Lake Road between Albert Road and Esmonde Road and Esmonde Road
- Provision of targeted high occupancy vehicle lanes (transit lanes) on Lake Road between Seabreeze Avenue and Esmonde Road
- Conversion of the existing westbound bus lane on Esmonde Road to a transit lane which is extended to the State Highway 1 (SH1) ramp signals
- Improved cycle facilities along Bayswater Avenue (between Lake Road and the Bayswater Ferry terminal)
- Undergrounding of power lines on Lake Road to provide space to implement improved cycle/e-mobility facilities if funding permitted.

Figure 1-1: The Lake Road Improvement Preferred Solution



1.2 Background to the Project

Several studies of the Lake Road corridor have been undertaken which have recommended a wide range of solutions to its transport problems on the Devonport peninsula. Most recently, formal public consultation on the proposed investment approach was undertaken by Auckland Transport (AT) in 2017 to inform the 2018 IBC, building on an earlier Corridor Management Plan (CMP) completed in 2015. The consultation feedback showed broad support for prioritising alternative transport modes (including car sharing) over encouraging single occupancy car use and more support for improving cycling facilities than removing them.

The public engagement invited feedback on three possible investment levels:

- Low – only requiring minor shifting of kerbs
- Medium – requiring alterations to kerb lines within the road reserve
- High – requiring widening beyond the existing road reserve.

Feedback indicated greater levels of support for options with a 'medium' level of investment. This was identified to be in part due to a public desire to realise the early implementation of improvements.

1.2.1 Alignment with Other Projects and Initiatives

The preferred solution for the project identified in the IBC aligned with several other transport and land use plans and projects being developed for the Devonport peninsula by AT, the Devonport Takapuna Local Board (DTLB), Auckland Council and Waka Kotahi NZ Transport Agency (Waka Kotahi), as described later in the DBC. This includes the Auckland Northern Pathway, planned improvements to bus and ferry services, travel demand management (TDM) initiatives and measures, emerging new technology initiatives, the DTLB's greenways projects and current and planned development on the peninsula.

1.2.2 Cost and Benefits

The preferred solution identified in the IBC was estimated to cost $30million based on it requiring no land outside the current road designation. It was estimated to have an economic benefit to cost ratio (BCR) of 1.2-1.8. The IBC indicated that enhancements to the project could include an additional southbound transit lane on Lake Road between Hauraki Corner and Bayswater Avenue. This was estimated to have an additional cost of $3-5 million.

Overall, the IBC demonstrated that the project will deliver a transformative change to customer experience on the Devonport peninsula by providing better alternatives to travel by single-occupancy car and improved road safety. CapEx of $46.5 million was allocated to the project in the current 2018-28 Regional Land Transport Plan (RLTP).

1.3 Project Goals and Objectives

The overarching goal of the project is to improve customer experience and the movement of high numbers of people, whilst offering attractive transport alternatives to single-occupancy private car use. Despite the emphasis of this project on the improved bus, cycle and pedestrian facilities and infrastructure, a level of private vehicle access and circulation must also be maintained. The project has the following objectives:

- Improve transport infrastructure to support demand and future growth by reducing overall people travel time on the corridor
- Improve people throughput by prioritising high occupancy and healthier/active transport modes
- Improve the attractiveness of high occupancy and healthier transport modes by increasing their mode share
- Improve community satisfaction with transport infrastructure by reducing delays and increasing modal share for high occupancy modes of transport and healthier transport modes.

1.4 Belmont Centre Improvement Project

Belmont local centre is the largest centre along Lake Road south of Takapuna. It has around 40 shops and services and is located across four quadrants of the major Lake Road intersection with Bayswater Avenue and Williamson Avenue. Since 2016 the Auckland Unitary Plan has enabled additional residential and commercial development in and around Belmont Centre, which could enable its redevelopment and growth in the future.

A project to develop an improvement plan for the Belmont local centre commenced in October 2019. This project has been sponsored by the Devonport-Takapuna Local Board and undertaken by Auckland Council planning staff and urban design specialists working in collaboration with Auckland Transport's Lake Road improvements project team.

A Belmont community stakeholder group of local representatives has, through a number of meetings and workshops from November 2019 to February 2020, assisted and advised the combined project teams in developing principles for the centre and improvement options.

An investigation of the issues and opportunities at Belmont centre helped identify principles for future changes and improvements, along with a community concept plan. This informed the development of the draft improvement plan for how the centre could best accommodate Lake Road improvements and also identifies other improvements to the centre over time.

The draft improvement plan was supported in February 2020 by the DTLB for public consultation along with proposals for Lake Road improvements.

1.5 Scope of the Detailed Business Case

Consideration of changes to bus and ferry services and fares is beyond the scope of the DBC, as are options which require land outside the road reserve. It is also not in the scope of the DBC to identify which existing AT TDM/technology initiatives should be re-prioritised to support the Project, or to provide justification for this.

The scope of the project excluded providing an additional southbound transit lane between Hauraki Corner and Bayswater Avenue because of the need for land acquisition and the delay this would to implementing the project.

2 Partners and Key Stakeholders

2.1 The Project Investor

AT is responsible for the project. As a Council Controlled Organisation (CCO), AT is the primary partner leading the development of the DBC. Its involvement in the project is multi-faceted role as it is responsible for planning, funding, delivery and operation of transport infrastructure on Auckland's non-state highway roads. It is also responsible for the planning and funding of bus and ferry services.

2.2 Project Partners

The main project partners are summarised in Table 2-1.

Table 2-1: Project Partners

Partner	Description
Waka Kotahi	Waka Kotahi is the crown entity responsible for planning, operating and managing the state highway network and is an investor in the transport system. It has an objective to make walking, cycling, public transport and car-sharing safe and attractive transport choices. Waka Kotahi has multiple roles relevant to the project including allocating funds under the National Land Transport Programme (NLTP) that determine funding availability for the project and as a partner in the development of the Integrated Transport Plan (ITP) and the RLTP. Waka Kotahi must work with AT to ensure that committed projects within the wider transport network are coordinated and delivered promptly concerning the project.
Auckland Council	Auckland Council is responsible for land use planning and setting long-term policies for Auckland. It is responsible for the preparation of the Auckland Plan, Auckland Unitary Plan (AUP), Devonport-Takapuna Area Plan and planning for the Greater Takapuna Spatial Priority area. It is also responsible for the development of the Greenways projects, and the development of the Belmont Centre design proposals, which are being progressed in partnership with AT. Auckland Council develops the Long-Term Plan (LTP) which sets the investment to achieve the Auckland Plan vision.
Manu Whenua (Ngāti Whatua Orakei Whai Rawa Ltd)	Mana Whenua is partners to the Crown under the Treaty of Waitangi and are consequently considered partners to the process. The relationship of Mana WWhenua with their ancestral lands, water, sites, Wahi Tapu and other Taonga is a matter of national importance and has been recognised and provided for when considering the project. The Treaty relationship, including the outcomes of Treaty settlements, is also an important consideration to be taken into account.

2.3 Key Stakeholders

2.3.1 Auckland Transport

Several AT technical specialists and managers have been involved in several technical workshops to assist in developing the DBC. Also, several representatives. This includes representatives from its Planning and Investment team, Investigation and Design team, Design specialists, and funding specialists.

2.3.2 Waka Kotahi

The Project Team engaged with the Waka Kotahi throughout the project. Their representatives were invited to option evaluation and preferred concept option workshops to assist in the options development process. Their representatives were also engaged in the lead up to the public engagement.

2.3.3 Auckland Council

Representatives of Auckland Council have been engaged throughout the DBC process at a series of workshops and meetings. These sought to exchange information and maximise opportunities to coordinate proposed connections to and from the project, including proposed improvements to Belmont. They attended and participated in the project's option evaluation and preferred concept option workshops.

Auckland Council representatives were also engaged in the lead up to public engagement, particularly concerning proposals for Belmont Centre.

2.3.4 Manu Whenua

The project team collaborated on decisions impacting Mana Whenua values and sensitive issues during regular Iwi Integration Group (IIG) meetings throughout the DBC development. The aim of these meetings was for the project team to inform and seek input from Mana Whenua on the progress of the DBC. The meetings also provided Mana Whenua with the opportunity to engage directly with members of the project team and raise any project-specific concerns.

2.3.5 Other Key Stakeholders

Other key stakeholders that were engaged with as the DBC was developed are summarised in Table 2-2. Of particular note at the Devonport Takapuna Local Board (DTLB) and Bike Auckland.

Devonport Takapuna Local Board

Updates on the Project's progress were presented to the DTLB in May 2019, February 2020, before community engagement, and in June 2020 after community engagement.

Bike Auckland

The Project Team engaged with Bike Auckland during the DBC process as a key walking and cycling stakeholder and updates on the project were provided at regular intervals. These updates focused on seeking feedback from Bike Auckland on the emerging preferred concept option presented to consultation and on potential changes to the concept design. Bike Auckland generally provided feedback on their preferences following these meetings.

Table 2-2: Key Stakeholders

Stakeholder	Focus Area
Bike Auckland	Safe, connected and high-quality facilities for cyclists
Devonport and Takapuna Local Board (DTLB)	Implications for their area and how proposals benefit the community
Royal New Zealand Navy (Devonport Naval Base)	Large trip attractor and key stakeholder with regards to TDM / travel plan measures
Local Schools	Provision of walking and cycling facilities, and TDM measures
Takapuna College	Students and staff travel requirements. Interested in road safety, walking and cycling measures.
Local Community Groups (Peninsula Travel Association, Takapuna Residents Association, Belmont Hauraki Residents Association, Bayswater Community Committee, Devonport Peninsula Trust, Devonport Peninsula Precincts Group)	How proposals benefit the community and wider businesses in the area
Business Groups and Businesses	How proposals benefit businesses in the area
Accessibility Groups	How the proposals benefit people with mobility difficulties
Utility service providers (Vector, Transpower, Watercare)	The potential impact on existing and future upgrade of their respective utilities
Elected Officials	How proposals benefit the community and wider businesses in the area

3 Strategic Context

There have been several changes to the policy settings for investment in the land transport system since the IBC was completed. These changes in national and regional land use, transport, social and environmental policies and plans align with the project even more strongly with policies than when the IBC was completed, particularly concerning road safety.

3.1 National Policy Context

3.1.1 Government Policy Statement on Transport

The 2018 Government Policy Statement on Transport (GPS) on land transport outlines the Government's priorities for investment in the land transport system. It influences decisions on how money from the National Land Transport Fund (NLTF) will be invested across activity classes such as improvements to local roads, walking and cycling and public transport, and sets the priorities and focus of land transport investment.

The GPS identifies four strategic priorities for investment over the next ten years (namely safety, access, environment and value for money, as shown in Figure 3-1 and how these priorities relate to the GPS objectives.

Figure 3-1: GPS Strategic Priorities

The 2018 GPS acknowledges that currently, most people require a private motor vehicle to get to most places. This high level of dependency on private motor vehicles results in high transport costs, higher greenhouse emissions and increased congestion in our larger urban areas.

Walking, cycling and public transport are very important in supporting an efficient, sustainable and affordable transport system. Enabling more people to walk and cycle and to use public transport can also contribute to improved health outcomes as people increase levels of physical activity, through regularly incorporating walking and cycling into their daily lives.

A draft of the next (2021) GPS was released for public feedback in March 2020. This builds on the strategic direction of GPS 2018 by maintaining the priorities but updating them to align with recent policy work and simplifying them. This project meets several investment priorities identified in the GPS, including:

- Improving road safety
- Provision of good quality, safe, fit-for-purpose cycling infrastructure in areas of high demand
- Increasing the proportion of the population who live within a reasonable walking or cycling distance to frequent and reliable public transport
- Supporting mode shift to lower emission and lower-cost modes of transport
- Supporting the increased uptake of walking and cycling, public transport and car-sharing to support environmental and public health objectives.

The project provides improved cycle facilities and transit lanes which has a strong strategic alignment with the strategic investment priorities identified in the GPS. The project has been refined in this DBC to have a greater focus on achieving safety outcomes.

3.1.2 National Land Transport Plan

The NLTP is a three-year programme of planned activities and a ten-year forecast of revenue and expenditure prepared by Waka Kotahi to give effect to the GPS. All proposed activities are assessed for inclusion and prioritised through Waka Kotahi's Investment Assessment Framework (IAF) according to their value for money and alignment with the priorities, objectives and expected results within GPS.

The Northern Pathway project (formerly known as SkyPath and SeaPath), as described later in this section, has been identified as a key link in Auckland's walking and cycling network which will be delivered by Waka Kotahi. The Lake Road project will form a key connection to the Northern Pathway.

3.1.3 New Zealand's Road Safety Strategy

In December 2019, the Government launched Road to Zero: NZ's Road Safety Strategy 2020-2030. This articulates the Government's vision, guiding principles for how the road network is designed and how it makes road safety decisions, as well as targets and outcomes for 2030. It sets out the five areas the Government wants to focus on over the next decade, as shown in Figure 3-1, and a framework for how it will hold itself to account.

Figure 3-2: Road Safety Strategy Focus Areas

This strategy will be implemented through a series of separate action plans that will outline the actions it will take to drive change, as well as the timelines and responsibilities for implementing them. The Lake Road project has been developed in the IBC with a greater focus on road safety.

3.1.4 Climate Change Response (Zero-Carbon) Amendment Bill

The Climate Change Response Amendment Bill seeks to provide a framework for New Zealand to develop and implement climate change policies in support of the Paris Agreement. The Bill received royal assent on 13 November 2019.

Aspects of the Climate Change Response (Zero-Carbon) Amendment Bill relating to greenhouse gas emission reduction and climate change risk and adaptation. The legislation sets a net-zero carbon reduction target for 2050. Reductions will be managed with staged 'emissions budgets' every five years.

Projects that consider both material carbon emissions (arising from the scheme itself (design, construction and maintenance), and are supportive of modal shifts that enable wider reduction of emissions, like the Lake Road Improvement project, will be seen favourably.

Adaptation measures to account for climate change risk are also included and have a potential bearing on this project. Under the adaptation sections of the Bill, the relevant minister is empowered to require public sector entities such as AT to report on climate change risk and adaptation measures. The project will assist in reducing carbon emissions by encouraging greater use of active modes and public transport.

3.2 Regional Policy Context

The next ten years are expected to underline Auckland's performance as the fastest-growing major city in Australasia. More than 1.5 million people live in Auckland already and that number is expected to increase by another 730,000 people to reach 2.4 million by 2043 – an increase greater than the rest of New Zealand's population growth combined. This could mean another 320,000 dwellings and 270,000 jobs for Auckland.

Population growth is expected to be accompanied by employment and economic growth. This is expected to be concentrated in and around key business areas, such as the city centre and fringe area and new and existing metropolitan centres such as Takapuna. Higher employment levels in major employment centres will place additional pressure on already congested access routes to these centres.

Several documents recognise the critical role transport has to play supporting Auckland's growth and provide strategic direction to the project. As Auckland grows it is essential that more people use active modes, travel by public transport and car pool. This will reduce pressure on the roads and free up room for freight and commercial travel supporting regional economic productivity.

The key documents which support the case for change, and are relevant to the project, are summarised below.

3.2.1 Auckland's Better Travel Choice Mode Shift Plan

Auckland's Better Travel Choice Mode Shift Plan prepared by Waka Kotahi in December 2019 aims to provide better access and greater choice for residents to adopt new ways to move about the city. This is important with Auckland's population expected to increase by up to one million in the next 30 years. The plan is summarised in Figure 3-3.

Figure 3-3: Better Travel Choices Mode Shift Plan

Shaping a supportive urban form

- Enable, support and encourage housing and business growth in areas with better travel options.
- Locate significant public facilities near high quality public transport.
- Ensure the layout and design of new urban areas supports the use of public transport, walking and cycling.
- Improve the safety and attractiveness of streets for walking and cycling.

Making shared and active modes more attractive

- Expand, improve and optimise public transport services.
- Invest in infrastructure and network optimisation to make public transport more efficient and attractive.
- Accelerate implementation of major rapid transit, bus and cycle lane programmes.

Influencing travel demand and transport choices

- Make it safe, easy and intuitive for people to change the way they travel.
- Combine policy, service and infrastructure initiatives in target areas to maximise mode shift.
- Ensure financial incentives and disincentives support mode shift.

3.2.2 The Auckland Plan 2050

The Auckland Plan 2050 is a long-term spatial plan to ensure Auckland grows in a way that will meet the opportunities and challenges of the future. The plan outlines the big issues facing Auckland and recommends how Aucklanders and others involved in the future of Auckland can best respond to them.

The Plan recognises that Auckland's transport system is key to making the city more accessible, and for us all to benefit from growth. It notes that, while great improvements have been made over the past 20 years, historic under-investment, combined with rapid population growth, means we still face big challenges.

Devonport is identified in the Auckland Plan as a City Fringe Centre. Its transport functions are to support the City Centre (Auckland) with medium trip generation (mainly as origin) and has the provision for high-frequency public transport.

The Lake Road Improvement project will address transport and access to Devonport and Takapuna by providing those travelling to and from the peninsula with more sustainable and active alternatives to travel by single-occupancy car.

3.2.3 Integrated Transport Plan and Regional Land Transport Plan

The ITP provides a 30-year programme for transport investment. The RLTP provides a more detailed ten-year plan for investment than the Integrated Transport Plan. The 2018-28 RLTP allocates capex of $46.5m to the Lake Road Improvement project. The RLTP is currently under review.

3.2.4 Auckland Transport Alignment Project

The Auckland Transport Alignment Project (ATAP) is a strategic approach to the development of Auckland's transport system for the next 30 years. It recognises that Auckland has transport funding shortfalls and investigates delivery mechanisms. ATAP ensures transport investment priorities reflect the aligned transport vision of both the Government and Auckland Council.

ATAP provides funding direction (influencing the RLTP) and identifies the need to invest in both the Northern Pathway (formerly known as the SkyPath and SeaPath projects) to provide a high-quality cycle route from Auckland's City Centre to the North Shore. The Lake Road Improvement project will complement investment in the Northern Pathway.

3.2.5 Regional Public Transport Plan

The Regional Public Transport Plan (RPTP) sets out how AT will deliver on the public transport elements of the Auckland Plan. It proposes a greater focus on integration between services and focussing the bus network on a smaller number of road corridors. This requires an equally strong focus on the ongoing significant investment in public transport infrastructure, high-frequency services and a simple integrated fare system. The Lake Road improvement project supports the RPTP by providing additional priority for bus services operating in the peninsula.

3.2.6 Auckland Cycling – Programme Business Case

The Auckland Cycling Programme Business Case (PBC) was prepared in 2018 to guide AT's cycleway implementation over the next three years. It identifies Devonport / Belmont as one of nine priority areas to focus on as an 'early construction' initiative for a network of separated cycleways.

3.2.7 Vision Zero / Safe System Approach

In the light of New Zealand's Government's Road to Zero: NZ's road safety strategy 2020-2030, AT is now working closely with its partners including Waka Kotahi and NZ Police to make our roads safe for everybody. It wants to move towards a more "forgiving" road network, where a mistake made by a driver or road user does not lead to devastating consequences. AT is also moving away from the "blame the driver/road user" attitude towards solutions where death and serious injury do not occur in the event of a crash. This is the Vision Zero approach.

In 2018 AT's Board and Executive Leadership Team endorsed an ambitious safety infrastructure acceleration programme estimated to reduce deaths and serious injuries (DSI) by up to 18% over an initial three-year period. It adopted a Safe System approach in which all parts of the system are made safe. These include safe roads and roadsides, safe vehicles, safe road users and safe speeds. AT has also developed a Speed Management Plan and behaviour change activities to reduce road trauma, including in the DTLB area within which the Lake Road Improvement project sits.

4 Local Context

Local land use and transport policies are strongly aligned with the project and, where they have changed since the IBC was undertaken, provide greater support to the project, as summarised in this chapter.

4.1 Existing Land Use

The existing land use adjacent to Lake Road is predominantly suburban-type residential. There are currently approximately 9,000 dwellings on the Devonport peninsula. The Auckland Plan identifies Takapuna as a Metropolitan Centre and Devonport centre as City Fringe. Hauraki Corner and Belmont are defined as centres in the Auckland Plan.

Most of eight schools located on the Devonport peninsula are located near or along the Lake Road corridor. These schools have a total roll exceeding 4,000 and generate significant local and long distance travel demands. The peninsula is home to the NZ Navy Base which employs some 1700 staff.

Several open spaces are also located along Lake Road, including the Waitemata Gold Club south of Seabreeze Road, at and several popular local beaches are located along the corridor, notably Cheltenham beach some 700-800m to the east of Albert Road. Open spaces are popular for organised sporting activities and other recreational events. The peninsula also features several volcanic cones.

4.2 Auckland Unitary Plan

Growth in the Devonport peninsula is seen through AUP zoning that supports Hauraki and Belmont as local centres and Takapuna growing as a Metropolitan Centre, as well as encourages further infill and redevelopment. Additional transport demand is anticipated to be generated by these new activities and compound the existing problems.

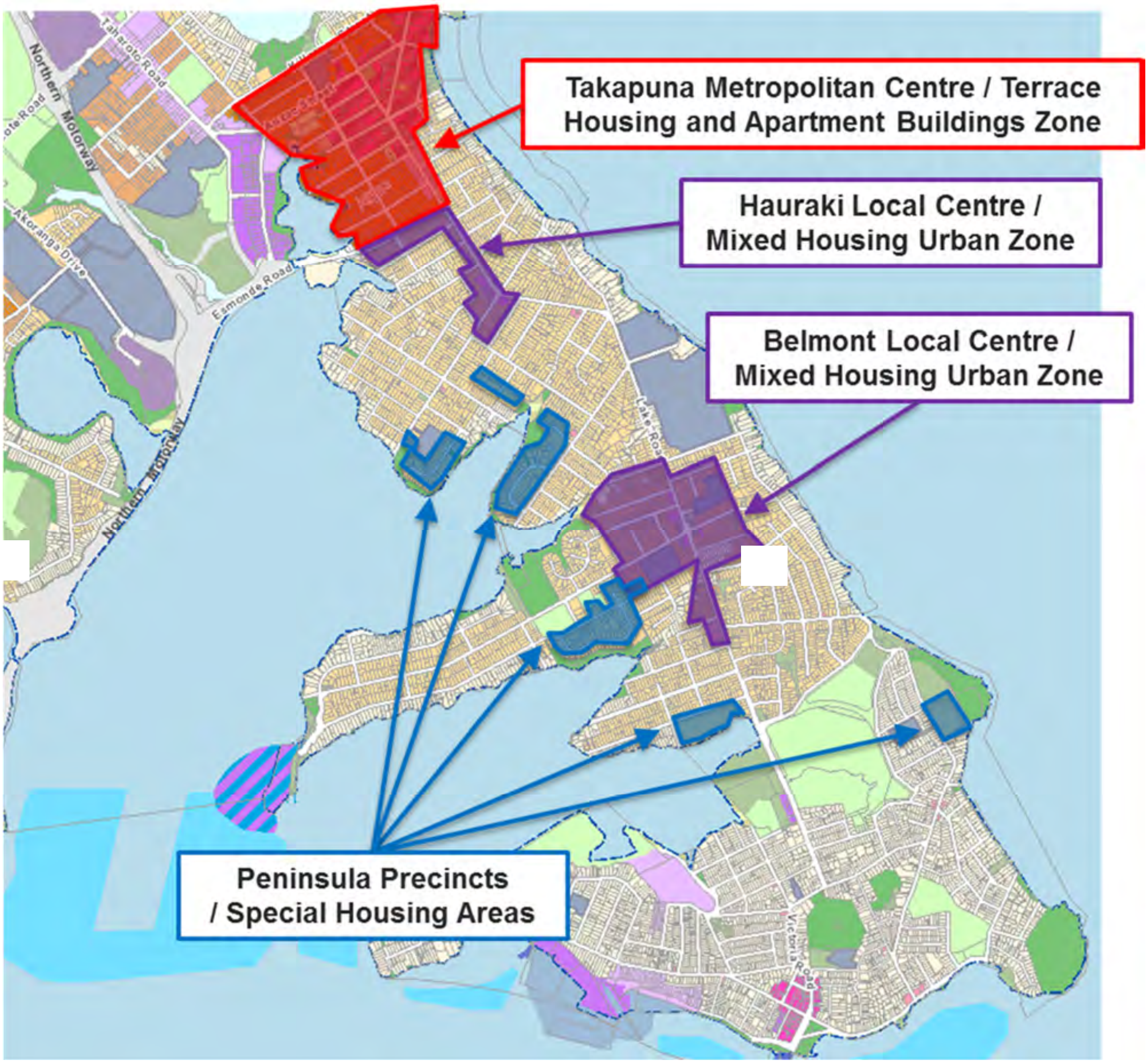
Devonport is also identified as City Fringe. The AUP identifies the Devonport Peninsula Precinct (DPP), which includes six sub-precincts with the potential to deliver more comprehensive and coordinated development in these areas. Given the geographical context of the area, any growth within the peninsula, particularly in the northern part, would directly affect the operation of Lake Road. Similarly, any improvements to the corridor may be the catalyst for unlocking growth within the peninsula.

The AUP identifies a number of development precincts across large ex-Navy housing sites on the Devonport Peninsula. There are also areas of more intensive Mixed Housing Urban zone along Lake Road and around Belmont Centre, and Terrace Housing and Apartment Buildings zone to the east of Belmont Centre. Significant up-zoning and development potential is proposed in Takapuna Centre and several existing Plan Changes already in place are building out strongly.

Capacity for growth analysis arising from the AUP process was undertaken by Auckland Council's Research and Evaluation Unit in 2015. This indicated the total capacity for additional development on the Devonport peninsula through redevelopment, including the redevelopment of amalgamated sub-precincts as single sites, was in the order of 3,200 dwellings (a 37% increase).

The overall extent of the future growth that can be enabled by the AUP is shown in Figure 4-1.

Figure 4-1: Auckland Unitary Plan (Decision Version) – Planned Growth Summary



4.3 Transport Proposals

Several projects are being developed by AT, Auckland Council, Waka Kotahi and the DTLB for the Devonport peninsula and Takapuna area that complements and/or are complemented by the project, as summarised below.

4.3.1 Northern Pathway

The Auckland regional cycle network has come a long way in the last decade. Although areas of the network are still fragmented the implementation of Waka Kotahi's Northern Pathway project will be a cornerstone project in the future regional and local cycling networks (shown in Figures 4-2 and 4-3).

Figure 4-2: Regional Walking and Cycling Network

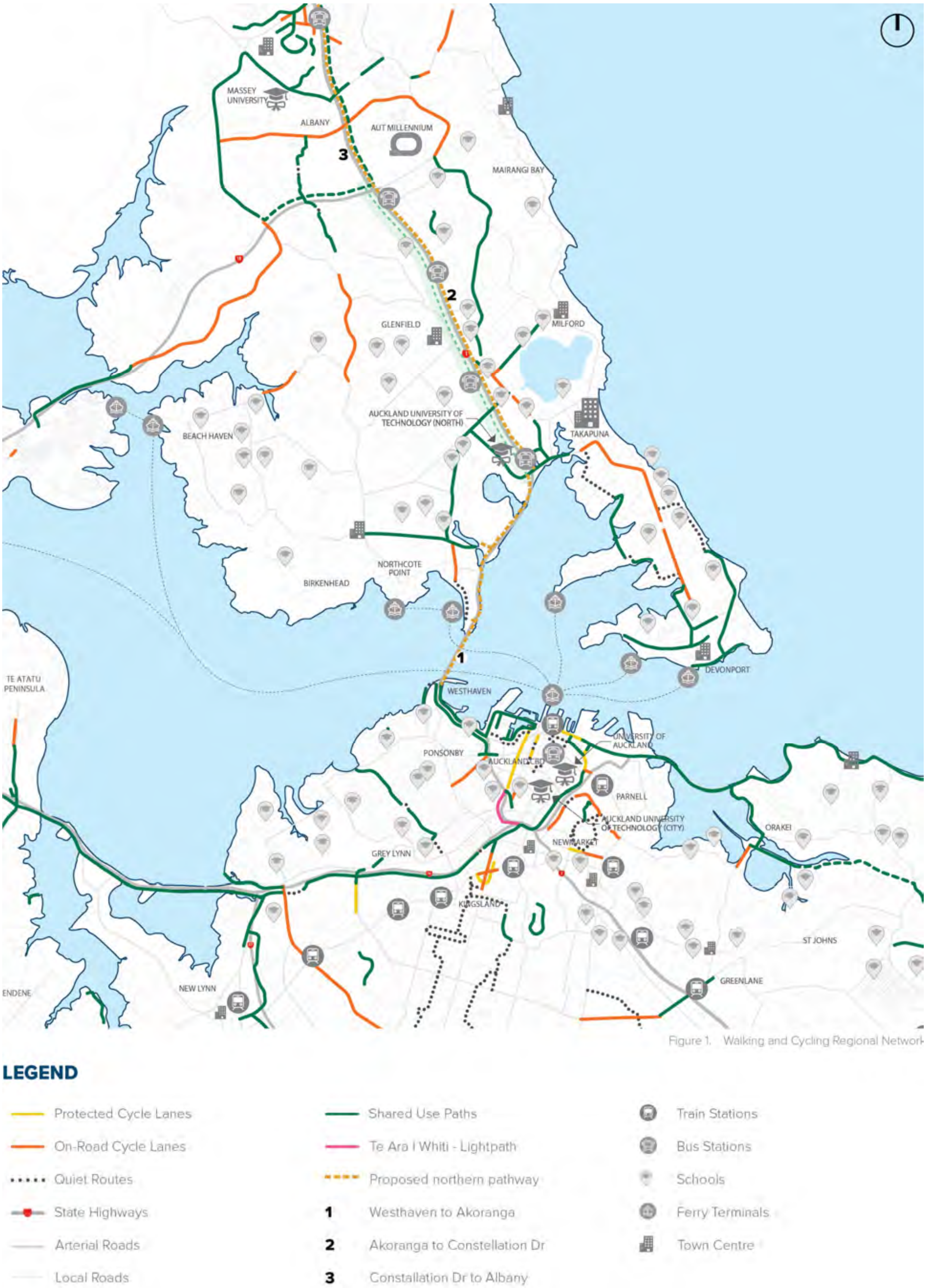
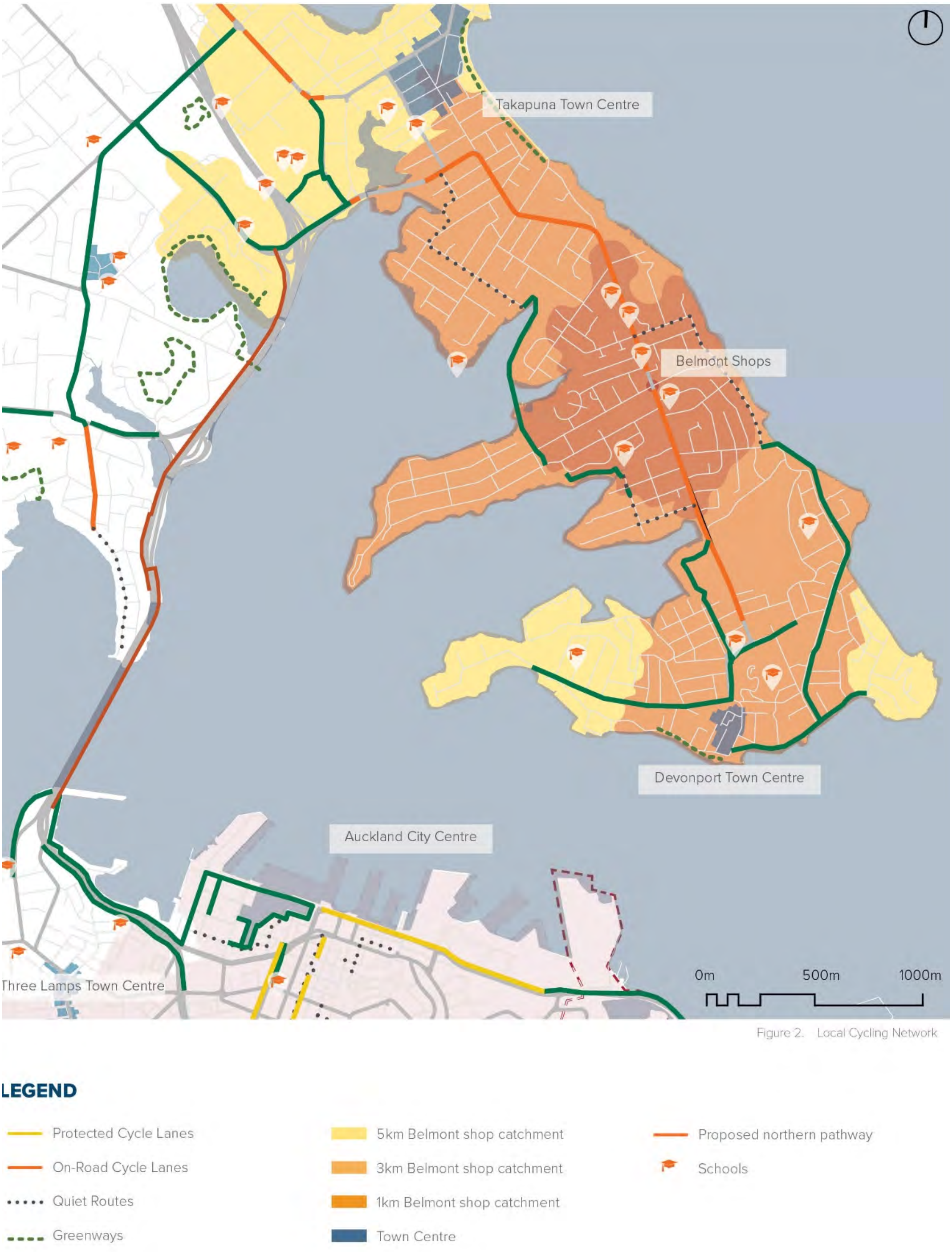


Figure 4-3: Local Cycling Network



The project will provide a new walking and cycling connection between Westhaven and Albany. It provides one of the critical links in completing the city's walking and cycling network, enabling Aucklanders and tourists to enjoy a city-wide network of walking and cycling facilities. Building this missing link in the network will provide real choice for how Aucklanders on both sides of the harbour access work, services, facilities and enjoy recreation opportunities. The project will help ensure people do not have to continue to rely on private vehicle use. It provides an important link across the harbour and opens up a safe network of shared paths for people to move easily about on foot or by bike.

From the city, the network links through the CBD to Grafton Gully to the Northwestern Motorway and Waterview, and then south to Manukau and Auckland Airport. It will connect to the shared path running through the eastern suburbs to Tamaki.

The project is being delivered in three stages. Stage 1, from Westhaven to Akoranga part, will provide Auckland's first walking and cycling connection across the Waitematā Harbour, as shown in Figure 4-4.

Figure 4-4: Northern Pathway Stage 1

Public consultation for Stage 1 of the project took place in April 2020 and indicated overwhelming support for the project. The NZ Upgrade Programme is providing $360 million for construction of Stage 1.

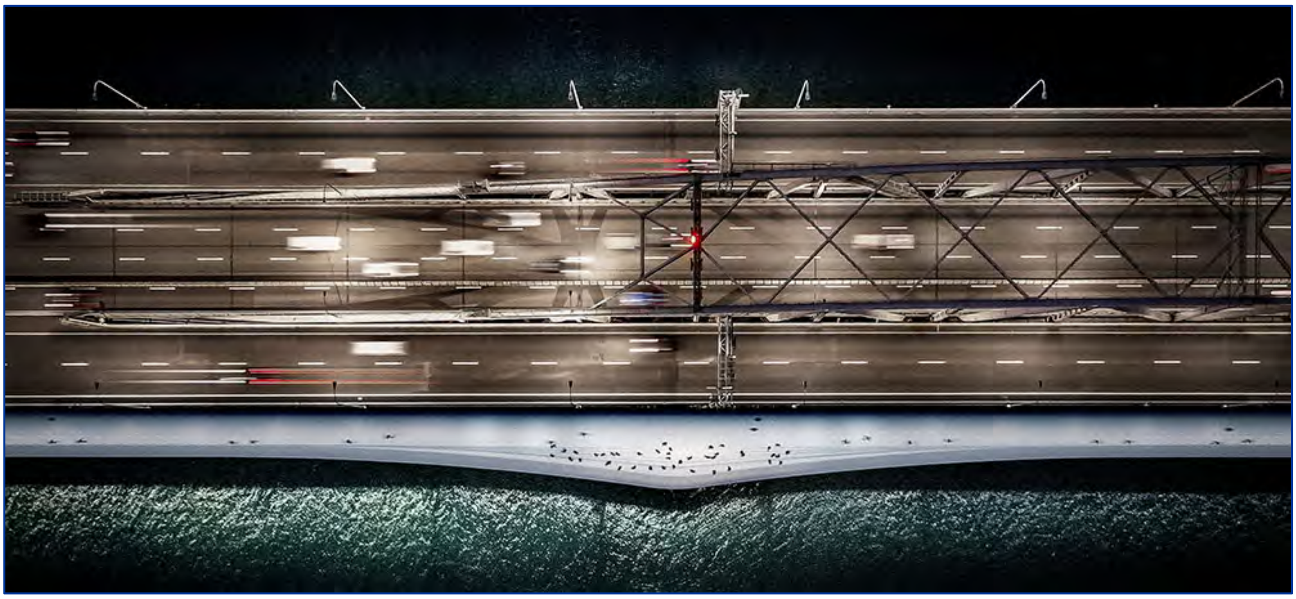
A single-stage business case (SSBC) to advance the case for funding to construct the Akoranga to Constellation section (Stage 2) is currently underway, and the Constellation to Albany section (Stage 3) is currently being built as part of the Northern Corridor Improvements project.

Bridge Component of Stage 1

The bridge component of Stage 1 of the project (formerly known as SkyPath) will provide a five-metre-wide path will cross the Waitematā Harbour flanking the Harbour Bridges' southbound traffic side, as shown in Figure 4-5 and Figure 4-6.

Figure 4-5: Auckland Harbour Bridge Shared Path Artists Impression

Figure 4-6: Auckland Harbour Bridge Shared Path Aerial View Artists Impression



Detailed design services are currently being procured, and construction could start in 2021.

Land Component of Stage 1

The land component of Stage 1 of the Northern Pathway project (formerly known as SeaPath) is a 4km long shared path which will run adjacent to the Northern Motorway (SH1). It links Esmonde Road (west of the northbound SH1 off-ramp) with the northern landing of the Auckland Harbour Crossing Shared Path at Northcote Point (see Figures 4-7) and provides good connections to the Takapuna and Devonport peninsula area.

Figure 4-7: Northern Pathway Stage 1 Sea Component Artists Impression

This component of the project will also be delivered by Waka Kotahi, and detailed design services have recently been procured. Construction could start in 2021.

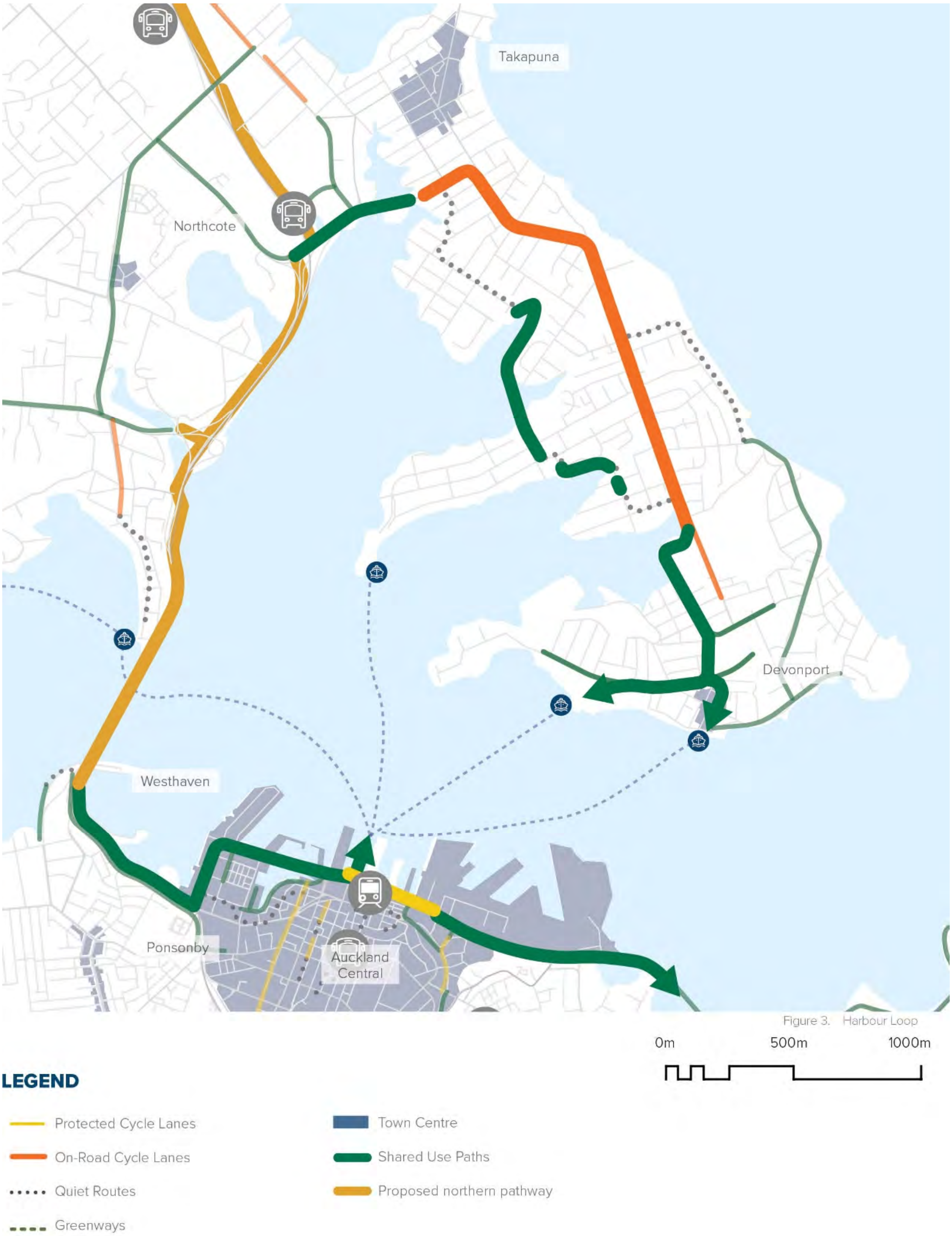
Northern Pathway Stage 2 (Akoranga to Constellation)

The implications of the second stage of the Northern Pathway project for this DBC are similar to that of stage 1, namely that it is likely to increase demand for cycling on Esmonde Road and Lake Road, and is likely to strengthen the case of improvements to cycle facilities on Esmonde Road.

The Harbour Loop

Improvements to Lake Road and Esmonde Road could form a key link to complete a 'Harbour Loop' cycle route, as shown in Figure 4-8.

Figure 4-8: Potential Harbour Loop Cycle Route



The loop would provide a safe and convenient connection between the Auckland city centre around Westhaven, Northcote, Takapuna, Devonport with a ferry link back to the city centre. Providing a whole of journey experience will allow users the ability to travel wholly via public transport and active modes. It will enable a safe and secure route for commuter cyclists during peak hours, as well as encouraging recreational users such as runners and walkers during off-peak times.

The environmental, economic and health benefits of cycling, running and walking notwithstanding, a Harbour Loop will help to create more social spaces and amenities in some underutilised and isolated areas.

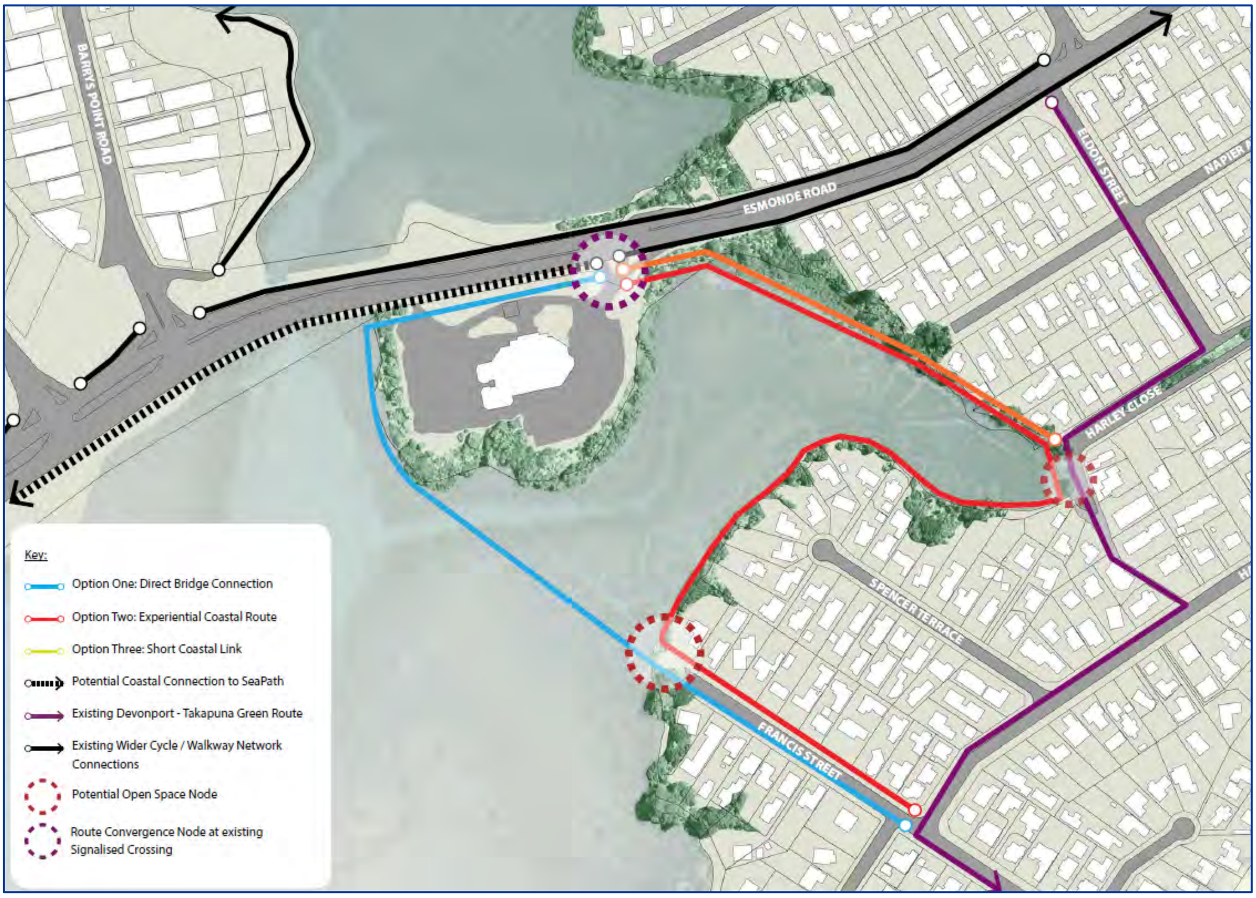
4.3.2 Devonport-Takapuna Greenways Plan

The DLTB's 2015 Devonport-Takapuna Greenways Plan seeks to improve the long-term walking, cycling and ecological corridors of the local board area. The Plan has eleven projects which the local board will prioritise to implement. These greenways connections will provide recreational, environmental, health, economic, social, and educational opportunities and benefits for the residents of the local board area. The key proposals relevant to the project are shown in Figure 4-9.

4.3.3 Francis Street to Esmonde Walking and Cycling Link

The feasibility of a cycle/walkway connection from Francis Street to Esmonde Road was examined by AT for the DTLB in early 2020. Several alternative route options were considered, as shown in Figure 4-10, and Option One is currently preferred. The project currently requires DTLB funding to proceed, as AT has not included this project in their current RLTP.

Figure 4-9: Francis Street Link Route Options



The DTLB is keen for AT to undertake a study to prepare a business case for a link from Francis Street to Takapuna Grammar school. This is proposed as a recreational cycle route that connects Esmonde Road and the schools near St Leonards Road via Eversleigh Road using some sections of the walkway that have been completed recently. It would provide a useful feeder into improved cycle facilities on Lake Road, as well as an alternative north-south route for (predominantly) recreational users.

4.3.4 Belmont Centre Plan

In June 2019 the DTLB agreed on funding for Auckland Council to commission a placemaking and urban design investigation of the Belmont centre, and to prepare an improvement plan for the area defined by the AUP business zones and shown in Figure 4-10.

Figure 4-10: Belmont Centre Study Area

The plan was commissioned by Auckland Council in late 2019 to respond to and benefit from changes to transport and accessibility as a result of the project emerging from this DBC, and also to respond to the development potential enabled by the AUP. The actions identified in the plan to improve the physical environment, amenity, accessibility and functioning of the centre have informed the options developed for Belmont Centre in this DBC.

4.4 Travel Demand Management

AT has an ongoing programme of school and workplace travel demand management initiatives to encourage the use of alternative modes of transport to the car, including:

- Workplace travel planning (e.g. with the NZ Navy)
- School travel plans
- Personalised journey planning
- Carpooling/rideshare

- Targeted campaigns such as:
  - Auckland bike challenge
  - Change the time you travel (e.g. associated with flexi-time working arrangements)
  - Kiwi carpool month
  - Walking campaigns (Auckland Feet Beat).

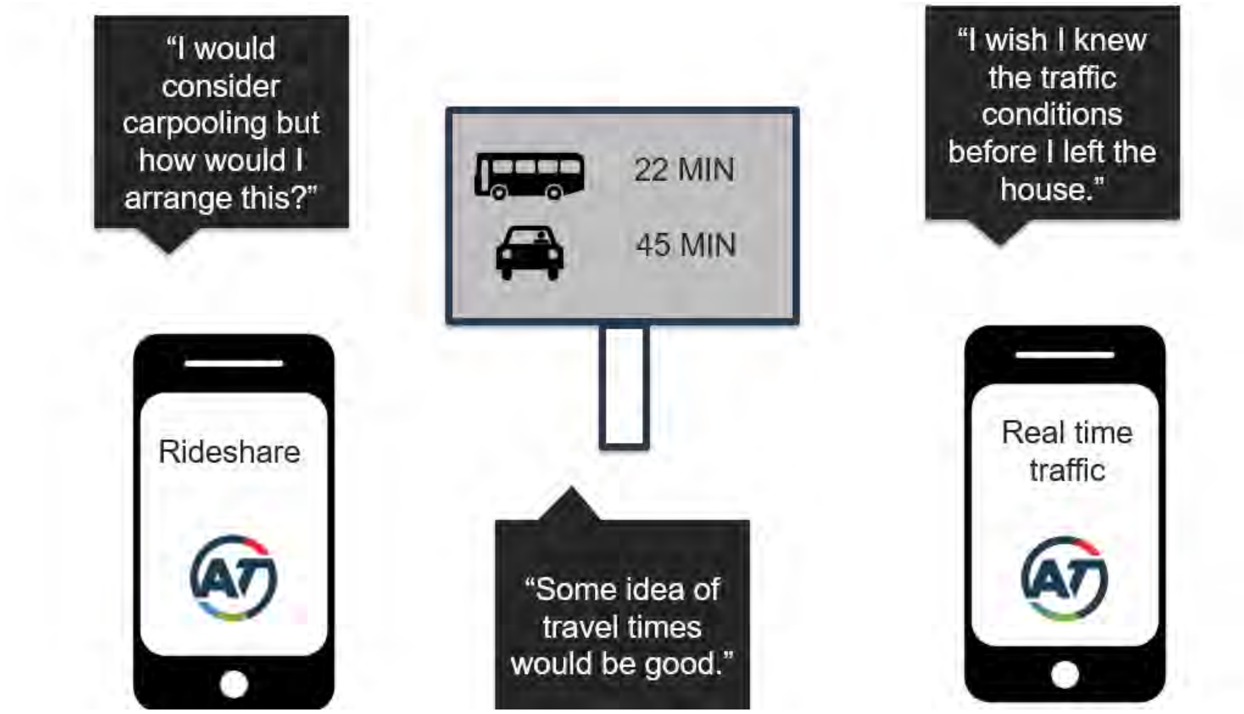
The prospect of a Bayswater Bike Train is also moving towards fruition. This is an AT initiative that supports a group of children cycling safely to local schools together with adult supervision. Children on the Bike Train do need to have an appropriate level of ability and confidence before they join the Bike Train.

4.5 Technology Initiatives

Technology plays an increasingly important role to help solve transport problems. AT has a maturing technology strategy aimed at improving the integration of the transport network using an integrated single-system approach encompassing public transport, roads, footpaths, other modes of transport and cycleways. It has several technology focussed initiatives and tools at its disposal, and is in the process of deploying, or is developing others, to complement existing traffic management as well as extend capability for future enhancements and improvements. Some of these initiatives leverage off Waka Kotahi's technology plans, such as the development of Mobility as a Service (MaaS). Some examples of current AT technology initiatives are shown in Figure 4-11 and include:

- Using data to support travel behaviour change, including:
  - Car sharing
  - The time people travel
  - The way (mode) people travel
- Using operational data to provide personally relevant information to commuters and push information to mobile/handheld and tablet devices to inform and help commuters make better travel choices (e.g. real-time journey planners, traffic advisory services, public transport tracking service).
- Using Closed Circuit Television (CCTV) monitoring and analytics:
  - Monitoring/counting vehicles, pedestrians, and cyclists (before and after any proposed changes)
  - Enforcement – special lanes, red-light running
  - Optimisation – signal phasing, queuing length
- Other apps and technology solutions, including those related to:
  - Parking
    - Online management of permits
    - Visibility of availability and occupancy of parking spaces
    - Streamlined charging and payment options (integration with HOP)
  - Ridesharing and on-demand shuttle services
    - Bridge barriers to public transport ('first and last leg' journey solutions)
  - Managing and optimising transit lanes:
    - Variable operational hours
    - Enforcement
    - Journey time information.

Figure 4-11: Examples of Current Technology Initiatives



Using Data for Behaviour Change Trial

AT's 2018 Using Data for Behaviour Change (UDBC) trial tested whether using personally relevant journey-specific data could influence the choice of travel mode and travel time by the Onewa Road commuters, and whereby consequently congestion.

Using data captured from CCTV feeds and video analytics, travel times for both general traffic lanes and the T3 lanes were presented on roadside Variable-Message Signs (VMS) to the commuting public, allowing them to assess their travel options whilst stuck in the AM peak traffic, as shown in Figure 4-12. A campaign was also created targeted at commuters from the nearby suburbs.

Figure 4-12: Variable Message Sign on Onewa Road

An evaluation survey and review conducted at the end of the trial assessed the effectiveness of the VMSs', advertising, and attitudes towards the use of the alternatives promoted via the trial. The key points were

- 43% of the respondents recalled seeing the VMS signs, compared with 26% who recalled seeing the advertising campaigns

- One in ten of those who saw the signs said they did something different to their commute, i.e. acted on the message
- Bus patronage increased by 3.5% in the trial period compared to the same period the year before
- Peak solo occupants' journey time during the trial reduced by around 4% (from 24.5 minutes to 23.4 minutes)
- Early AM (7am) solo car occupants' journey time increased to from 11.3 minutes to 13.0 minutes.

The key question the trial sought to answer was whether data could be used to change behaviour, and reduce congestion? Analysis of the results indicated that:

- Overall, the VMSs created awareness of travel time differences and led to some car users changing their transport behaviour (as demonstrated by the increase in bus patronage)
- The increase in solo car occupants journey times early in the AM peak indicated that some motorists changed their normal departure time by commuting earlier
- The reduction in sole car occupants journey times during the peak hour demonstrated the success of the trial, as it showed that congestion on Onewa Road during peak hour decreased.

AT has recently installed its Automatic Number Plate Recognition (ANPR) journey time technology on Esmonde Road, Manukau Road / Pah Road, and Constellation Drive, ready for future UDBC projects. The team is also working on the feasibility of deploying the journey time technology on other roads, which could include two locations on Lake Road.

4.6 Potential Future Use of E-mobility Modes

The public is becoming increasingly interested in e-Mobility options, and there continues to be strong demand for shared-Scooter use in Auckland since their introduction in October 2018. E-mobility modes are typically being used for different purposes, namely, e-bikes are more commonly used for commuting whereas e-scooters are more commonly used for errands and local trips.

E-bikes are particularly relevant for Lake Road as a typical e-bike electric-assist range is approximately 50km. The limits of commuting are more due to journey time (in the 30-45 minute range), which gives a practical commuting range of around 15kms. Typically, only when this trip time is reliably similar or quicker than by private car do users consider or make the mode shift. There are some cost barriers for many to purchase an e-bike. However, as demand increases, and technology advances, their base cost is decreasing.

Typical e-scooters use is less than 5km trips, which may increase over time to 10km, as current trips are biased towards a "pay by the minute" rather than "purchase cost, no per minute charge" ownership model. When shared-scooter trip distances are compared to taxis and private cars it has demonstrated that taxis travel shorter distances.

The implementation of Stage 1 of the Northern Pathway project is likely to provide a quicker, more reliable journey on an e-Bike than by private car or public transport, as summarised in Table 4-1.

Table 4-1: AM Peak Journey Times from Bayswater Avenue to Auckland CBD and Smales Farm

Method of Travel	Bayswater Avenue to Auckland CBD		Bayswater Avenue to Smales Farm	
	AM Peak	PM Peak	AM Peak	PM Peak
E-Bike	20 - 40 minutes	20 - 40 minutes	15 - 20 minutes	15 - 20 minutes
Shared-Scooter	25 - 45 Minutes	25 - 45 Minutes	20 - 25 minutes	20 - 25 minutes
Car	20 - 50 minutes	20 - 50 minutes	14 - 35 minutes	15 - 25 minutes
Public Transport	40- 45 minutes (via Ferry)	40-45 minutes (via Ferry)	20 - 30 minutes	30 - 40 minutes

It is likely that in the AM and PM peak periods, e-biking will be an attractive mode for both local and long distance (Auckland CBD, etc.) trips once the Northern Pathway project is constructed.

Parameter values for the benefits of active modes, including e-bikes, have recently been updated by Waka Kotahi.

5 The Case for Change and Investment Objectives

This section summarises the case for change and the project investment objectives. It builds on the Strategic Case prepared for the project by AT in 2016 and updated in the 2018 IBC, particularly in the light of a greater policy focus on safety.

5.1 Defining the Problem

Several problems have been identified as a result of the various previous studies. At the outset of the DBC, representatives from AT, Auckland Council and Waka Kotahi reviewed the problems defined in the Lake Road Improvements IBC to ensure they were still fit for purpose. At a workshop held on 10 June 2019, AT and the project partners agreed the key problems to be addressed by the project are as follows:

- **Problem 1**: Unattractive alternative modes combined with high vehicle movements is resulting in variable travel times and poor accessibility (50%)
- **Problem 2**: Existing corridor layout and lack of alternative routes is resulting in an inability to adequately accommodate place and movement needs (30%)
- **Problem 3**: Corridor form and high demand are contributing to an increasing number of DSI crashes and poor perception of safety (20%).

5.2 Problem Trajectory

To clarify the problems, the Problem Trajectory information gathered at the IBC stage has been revisited and supplemented with additional current thinking based on changes to the strategic context and new evidence.

Figures 5-1 to Figure 5-3 set out the expanded problem trajectories for each of the three problems, demonstrating the complexity that sits behind apparently simple statements such as ‘existing road layout’ and ‘high congestion’. The items in the grey boxes were identified in the IBC phase of work, and items in the purple boxes are considerations added as part of the DBC work, which has more fully explored the root causes and ultimate consequences of the problems.

Figure 5-1: Problem 1 Trajectory

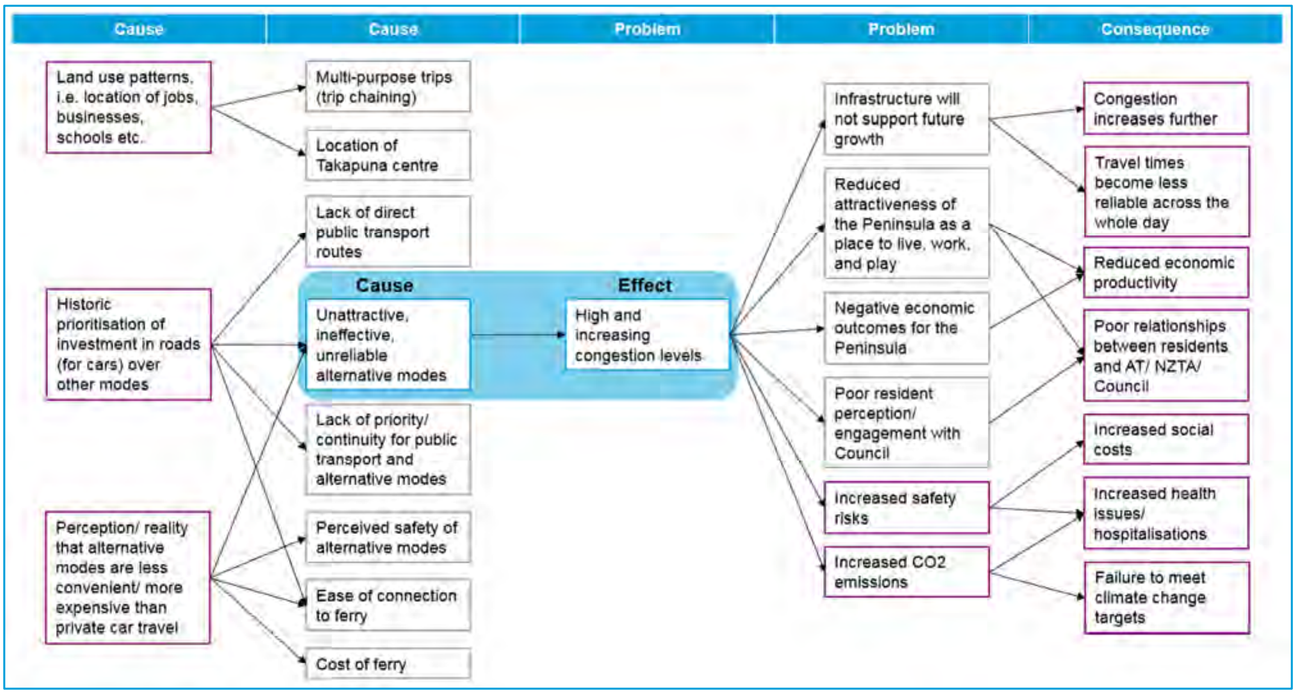


Figure 5-2: Problem 2 Trajectory

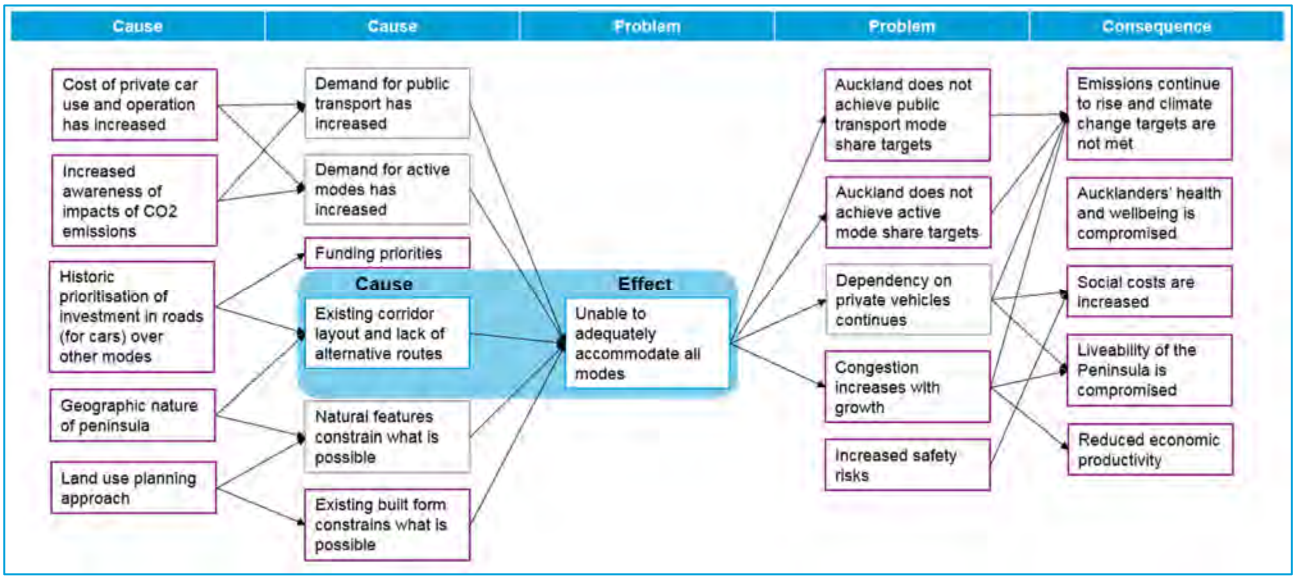
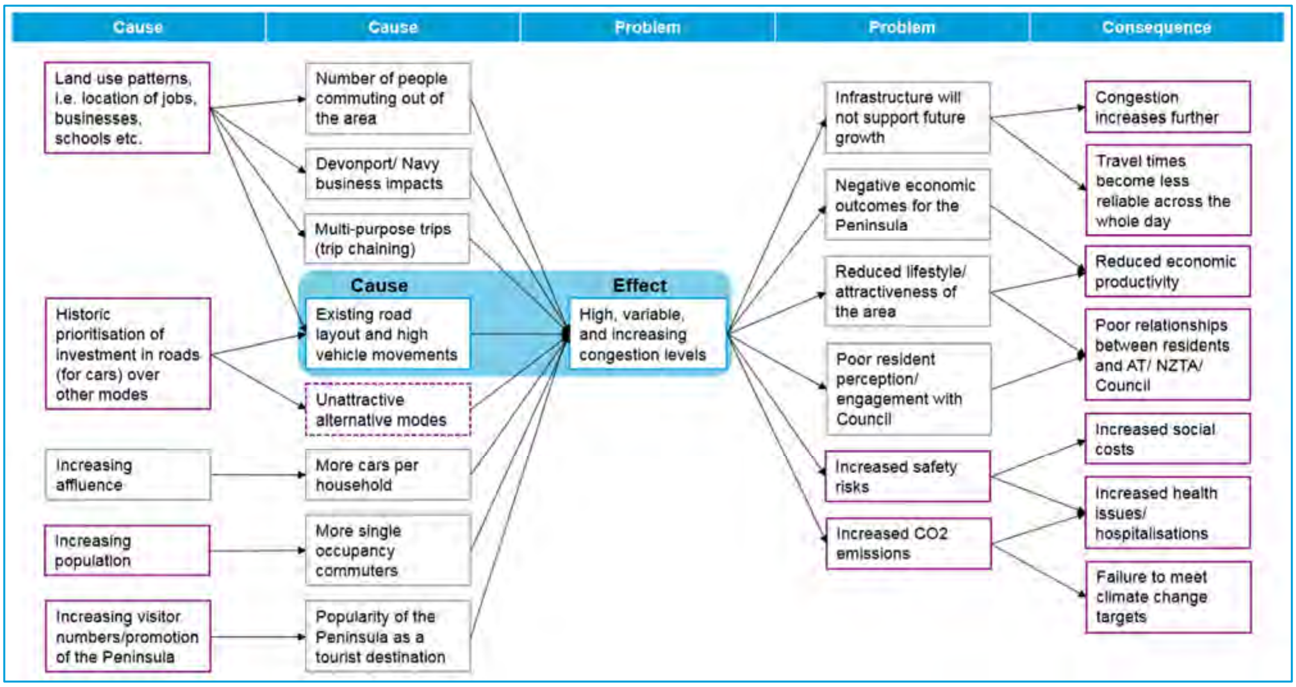


Figure 5-3: Problem 3 Trajectory



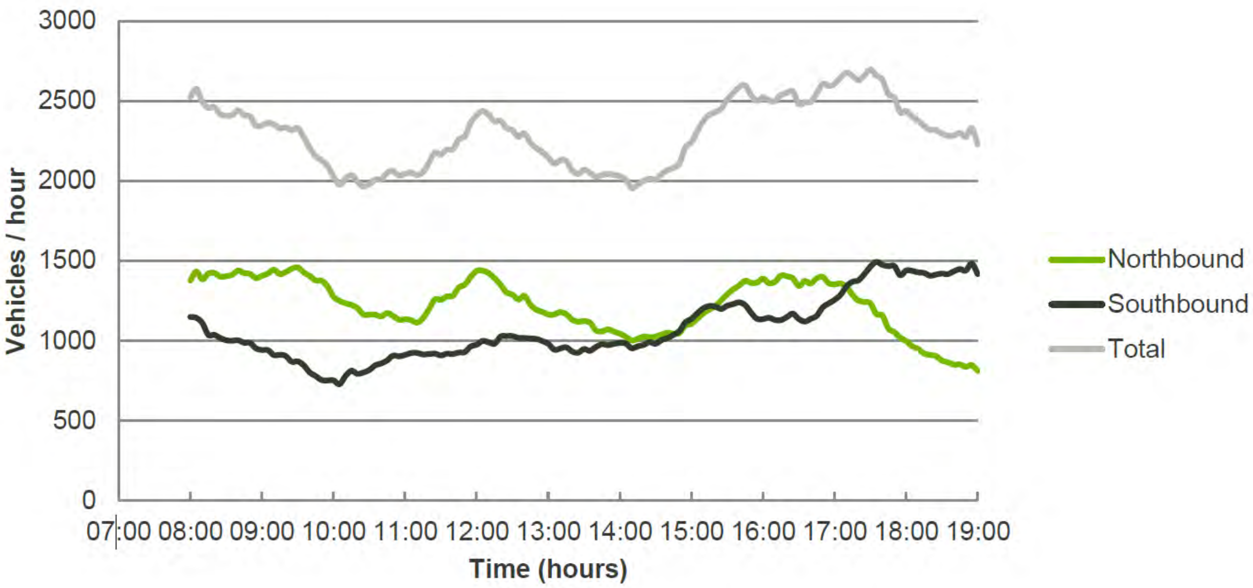
5.3 Evidence to Support Problem One

The cause of variable travel times was identified as high vehicle movements, and the cause of poor accessibility was identified as unattractive alternative modes. The evidence to support problem one is summarised below.

5.3.1 Variable Travel Times

Lake Road, north of Bayswater Avenue, carries approximately 30-32,000 vehicles per day (vpd), while south of Bayswater Avenue it carries up to 15-20,000 vpd. Esmonde Road carries up to approximately 35-38,000 vpd. There is very little difference in demand between the Monday-Friday and the Monday-Sunday Average Daily Traffic (ADT). Traffic flows in the weekday inter-peak period are also similar to weekday peak period traffic flows, as shown in Figure 5.4.

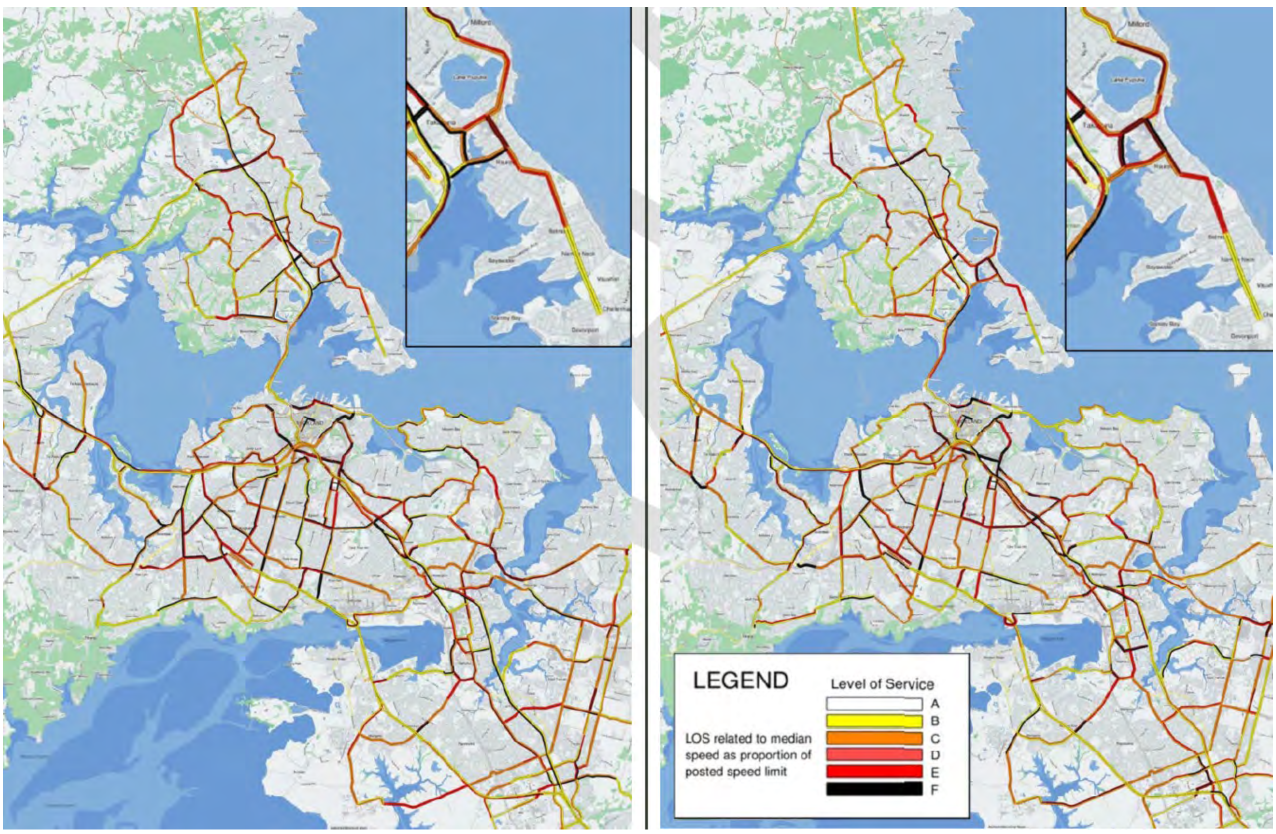
Figure 5-4: Hourly Traffic Flows (Hour Ending) on Lake Road, North of Jutland Road



Esmonde Road is used by up to approximately 38,000 vpd. Traffic flows on Esmonde Road are also nearly as busy at weekends as on weekdays. Traffic flows on Bayswater Avenue are between 6-10,000 vpd.

The high volume of traffic on Lake Road and Esmonde Road leads to significant traffic congestion and reduced level of service (LOS). Figure 5.5 shows the LOS for Lake Road and Esmonde Road compared to the wider Auckland Region during the weekday peak periods. The sections highlighted in black show the heaviest congestion with a level of service (LOS) of F and the road not highlighted in yellow show the more free-flowing sections with a LOS of B.

Figure 5-5: Weekday Morning and Evening Peak Hour Level of Service



The current LOS deficiencies are the causes of significant variability in car travel times. Evidence of this was established in the IBC (see Appendix B) and includes:

- Traffic speed variability is high for all weekday peak time periods (particularly affecting commuters and school-related trips) and at weekends
- The inter-peak period shows an increase in median speeds between Old Lake Road and Esmonde Road compared to the AM and PM peaks. During the peaks, the lowest median speed of 12 km/hour were observed between Old Lake Road and Bayswater/Williamson Avenue, compared to around 41 km/hour during the inter-peak
- Between Albert Road and Esmonde Road, the lowest northbound median speed during the peak periods is typically 12km/hour compared to around 33 km/hour during the inter-peak period
- The median speed and variability along Lake Road at weekends is very similar to the PM period.

With regard to bus service travel time variability, evidence from an analysis of bus ticketing (HOP) data (see Appendix A) indicates that buses on Lake Road experience even greater variability in travel times, as shown in Figures 5-6 to Figure 5-9. This analysis shows:

- The variability in journey time for buses increases during the weekday AM and PM peak periods, particularly in the northbound direction
- Both northbound and southbound bus journey times are higher and have greater variability in the weekday PM peak period, compared with other weekdays periods, and this period is more extended due to the end of the school day (around 3:30pm) being following by the typical weekday PM commuter peak
- The median southbound bus journey times on weekends are similar to the bus (and also general vehicle) median journey times in the weekday AM and PM peaks (up to around 15 minutes, compared to around eight to ten minutes in off-peak periods on weekdays and weekends).

The greater variability in bus travel times is partly because buses have no priority lanes on Lake Road. The only priority provided for buses is a short section of northbound bus lane on the approach to the Lake Road/Esmonde Road intersection, and a section of westbound bus lane on Esmonde Road on the approach to the SH1 Busway on-ramp.

Figure 5-6: Weekday Bus Journeys – Northbound

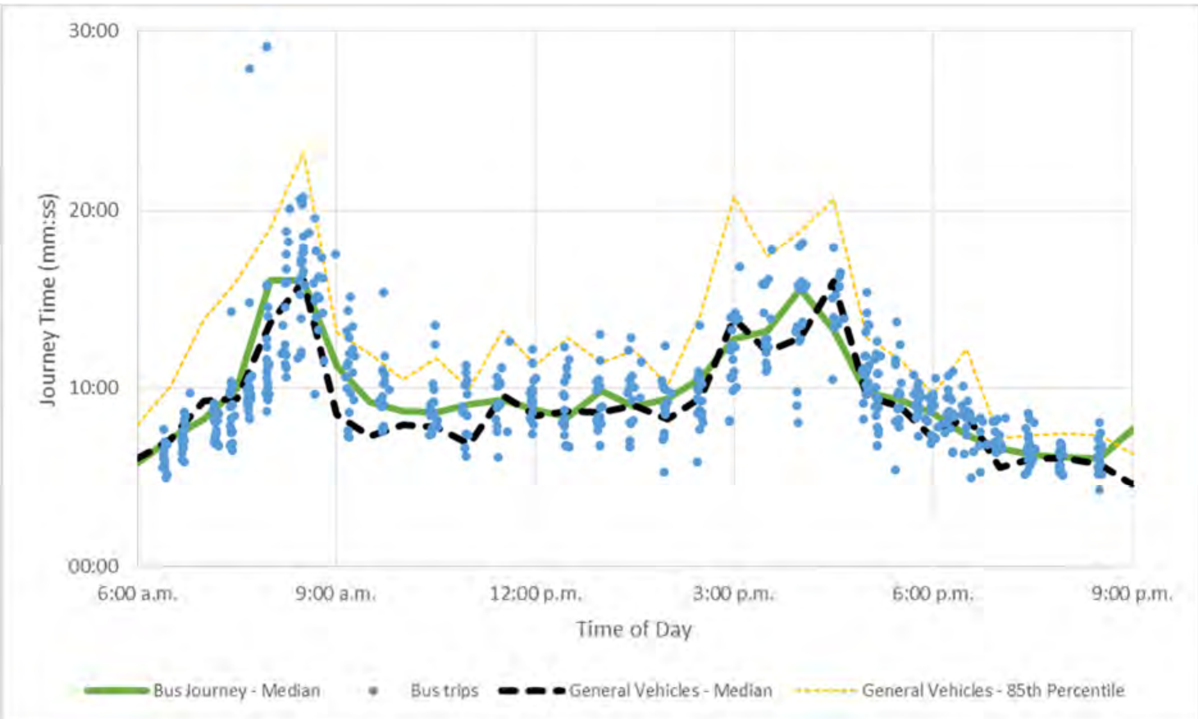


Figure 5-7: Weekday Bus Journeys – Southbound

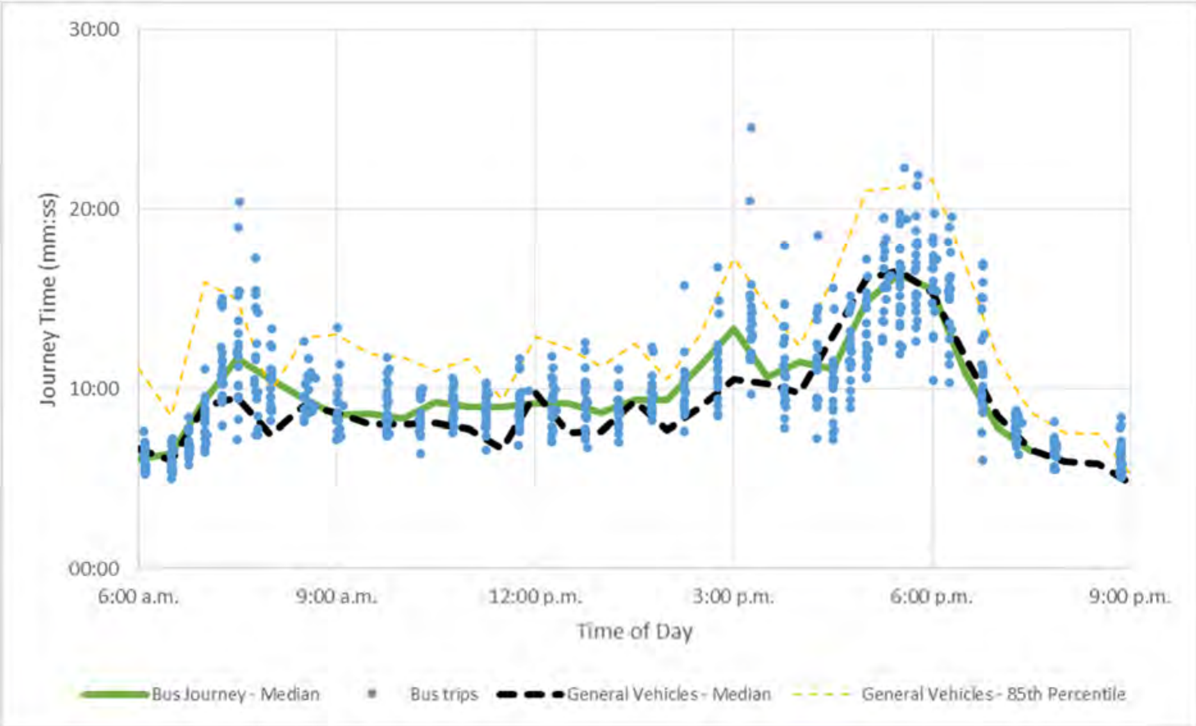


Figure 5-8: Weekend Bus Journeys – Northbound

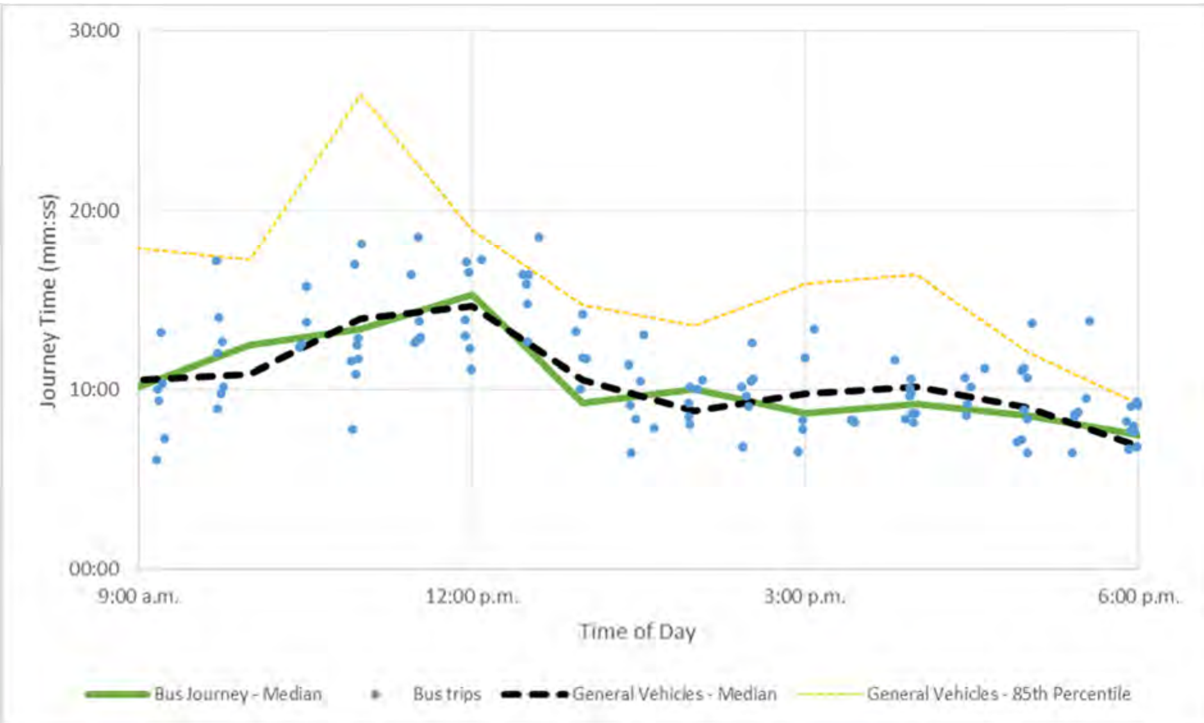
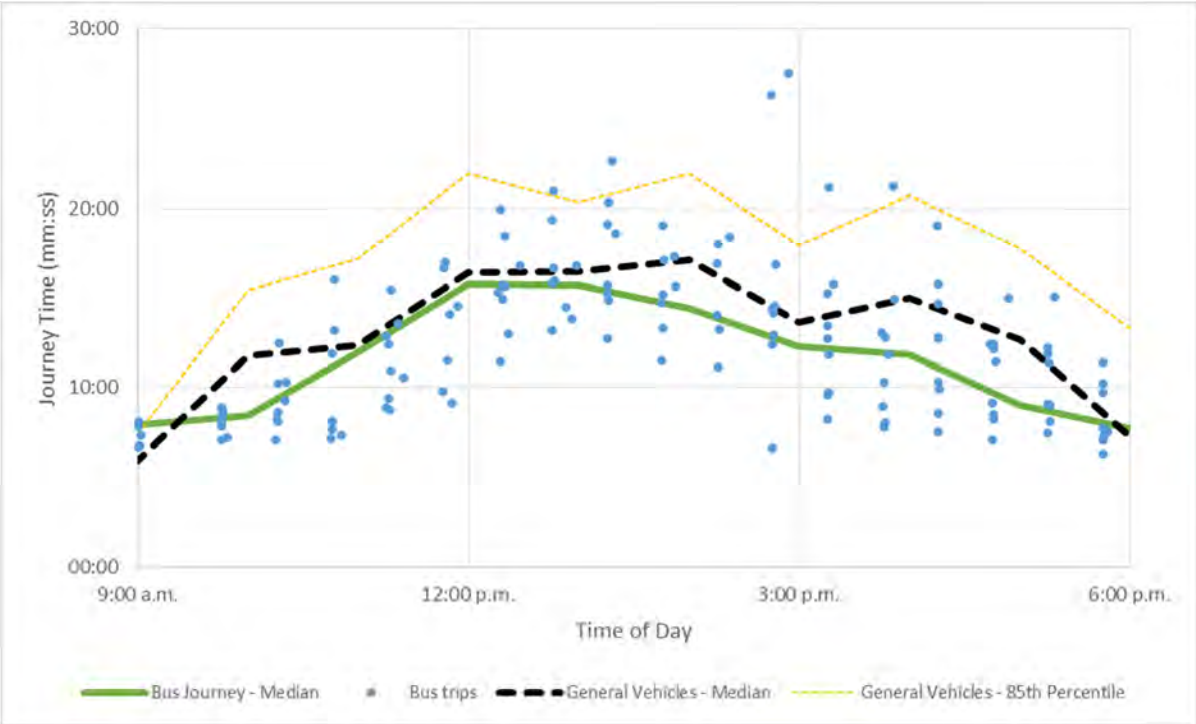


Figure 5-9: Weekend Bus Journeys – Southbound



5.3.2 Poor Accessibility

Travel time variability and traffic congestion described above impacts the ability to access desired destinations consistently and predictably.

The unattractiveness of alternative modes to travel by car, and lack of good quality walking and cycling infrastructure or priority for buses, make travel by these modes unappealing.

Cycle facilities on Lake Road and Esmonde Road are of a generally poor standard, consisting of unseparated and intermittent on-road cycle lanes, and short sections of shared path, as shown in Figure 5-10. The facilities which do exist are below the standard that would be expected of a primary arterial road.

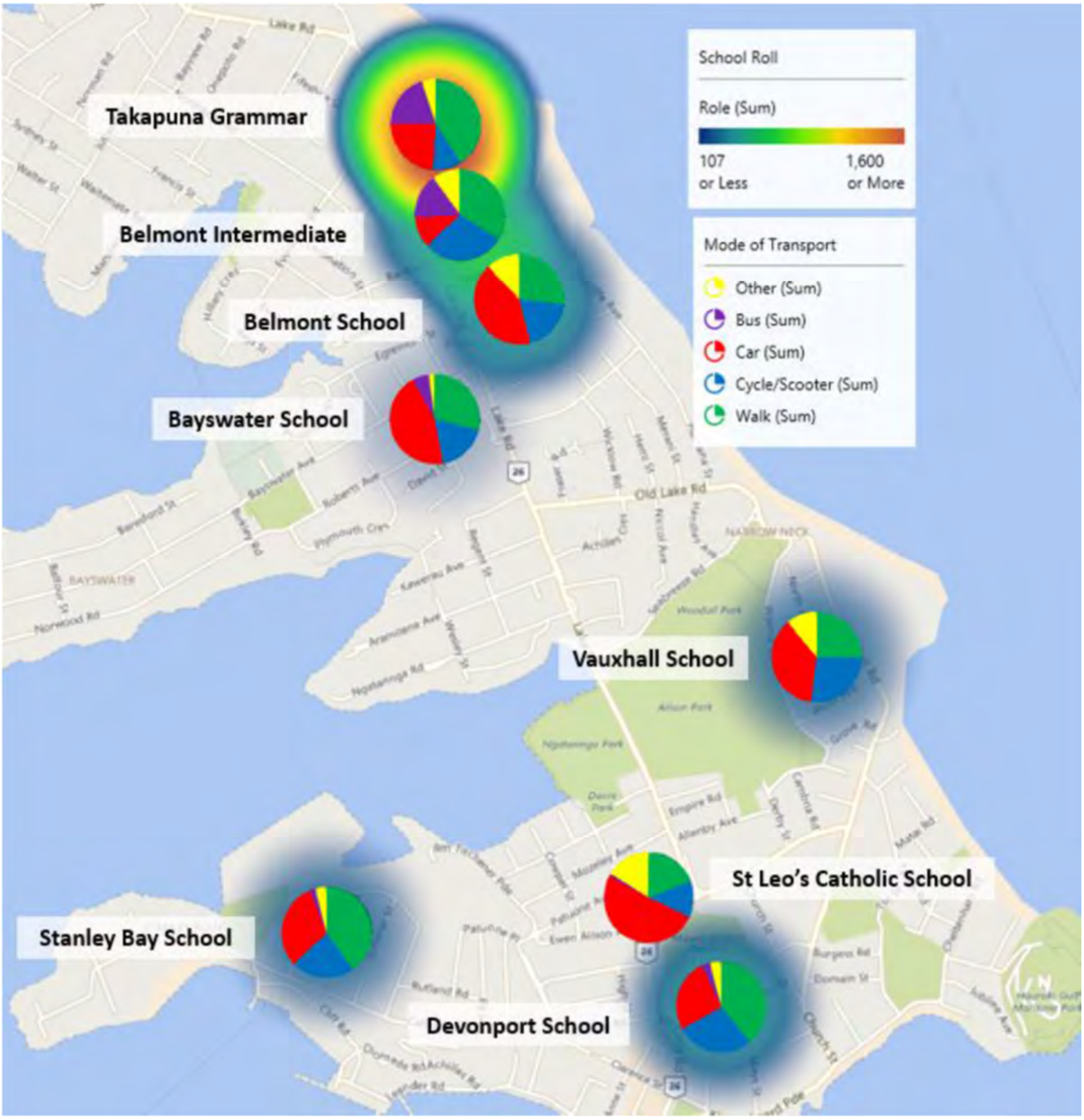
The alternative north-south cycle routes to Lake Road are circuitous, discontinuous and much steeper than using Lake Road, and are only really attractive for recreational purposes. There are no cycle lanes on Bayswater Avenue which leads to the ferry terminal at Bayswater.

The lack of safe cycle facilities means that there is significant potential to attract 'interested but concerned' users to the Lake Road corridor (i.e. people willing to bicycle if higher quality bicycle infrastructure is provided). This potential is supported by research recently undertaken by TRA for AT on measuring and growing the use of active modes in Auckland.

Figure 5-10: Existing Cycle Facilities

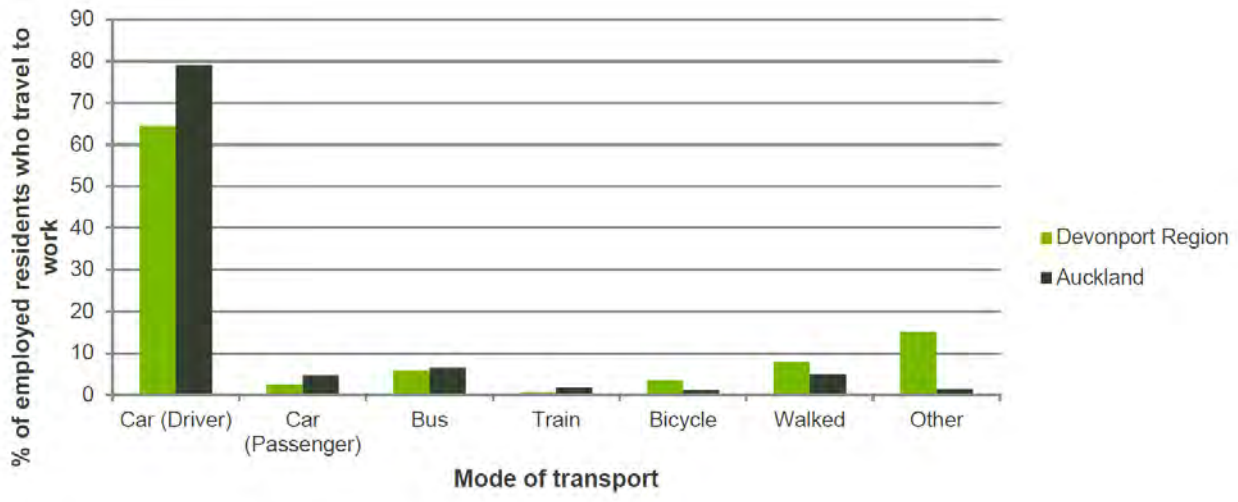
Despite the lack of good quality cycle facilities, TravelWise data indicates that a high percentage of students walk (34%) and cycle (13%) to school. Belmont Intermediate school is known to have the highest proportion of students cycling to school (29%) in Auckland (and New Zealand). The mode of transport used to access all schools is shown in Figure 5-11.

Figure 5-11: Travel Mode Share for Peninsula Schools



2013 Census data also indicates that cycling and walking for work trips is higher than the Auckland regional average, as shown in Figure 5-12, although the proportion of trips made by bus is slightly less than the regional average. This, and the high level of use of 'other' modes, probably reflects the availability of ferry services from the peninsula.

Figure 5-12: Means of Travel to Work



Information from the Devonport Peninsula Travel Survey[1] highlighted that during the weekday morning (AM) (6.30-9.30am) and evening (PM) (2.30-6.30pm) peak periods, over 80% and around 75% of surveyed vehicles respectively were single occupancy. Surveys undertaken of users of Esmonde Road indicated that around 85% of the vehicles along the corridor are single occupancy cars during the weekday AM peak period.

The 2013 Census indicated that of the 26,000 people who live within the Devonport and Takapuna Central areas units, approximately 6,200 people work in Devonport and 7,600 work in Takapuna Central. Approximately 40% of residents of the DTLB area travel to a workplace address within the Local Board area (i.e. less than 5km in length), which is a higher than usual proportion.

5.4 Evidence to Support Problem Two

Lake Road, between Esmonde Road and Albert Road, is classified as a primary arterial route. Esmonde Road is a regional arterial route and Bayswater Avenue is classified as a local road. The cross-section of Lake Road varies from two general traffic lanes in each direction between Esmonde Road and Hauraki Road and one lane in each direction from Hauraki Road to Albert Road. There are turning bays at most intersections and a central flush median is provided along most of the corridor except along the Hauraki Corner, Belmont local centre and near the Albert Road roundabout.

The Lake Road corridor is physically constrained by adjacent land use and topography. Overall, the corridor form is a challenging and sub-optimal environment for pedestrians, cyclists, buses and motorists.

Esmonde Road's cross-section varies from two lanes in each direction at its eastern end (Lake Road) to four lanes in each direction at its western end (SH1). There are turning bays at intersections and a central raised median is provided along most of the corridor. A westbound bus lane exists on the southern side of Esmonde Road from just west of Bracken Avenue to a dedicated on-ramp for buses heading south onto the Northern Busway which runs parallel to SH1 on the eastern side.

As the population and intensity of activity on the peninsula has grown over time, traffic growth and increasing traffic congestion has taken its toll on the urban amenity and place-making roles of the Lake Road corridor. In many locations, the movement function of Lake Road has been priorities over its place qualities. This adversely affects the amenity not just for street users, but for adjoining properties, particularly residents.

[1] Devonport Peninsula Travel Survey (Opus International Consultants Ltd, August 2015)

There is significant conflict between the movement and place needs of the corridor in the vicinity of Belmont Centre for example.

Other examples include a number of footpaths being of sub-standard width, and the existence of overhead power lines along most of Lake Road, which results in both physical and visual street clutter.

There is no route which parallels Lake Road for its entire length between Devonport and Takapuna, though short sections of alternative routes exist to the east and west, notably via Vauxhall Road/Old Lake Road. Where they exist, the parallel collector and local road corridors are circuitous and are generally not suitable to accommodate increased traffic demands.

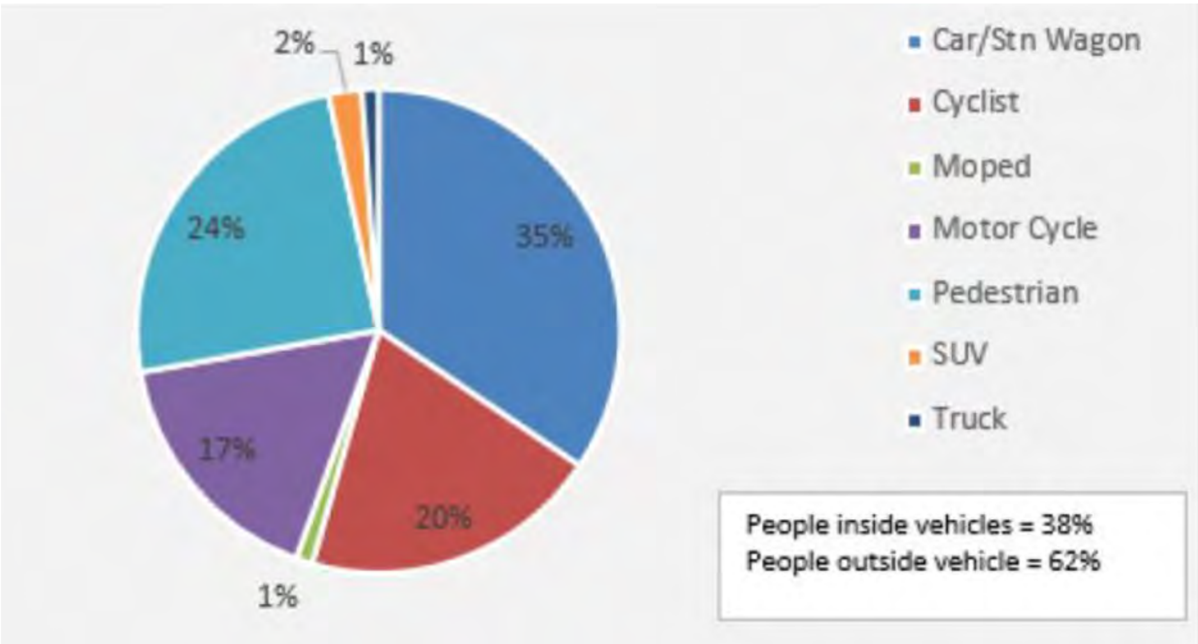
5.5 Evidence to Support Problem Three

In 2018 AT utilised the Urban KiwiRAP assessment tool to determined the Collective Risk for the Lake Road corridor. This is a measure used by KiwiRAP to estimate DSI casualty equivalents per kilometre of road. The objectives of KiwiRAP are to:

- Reduce deaths and injuries on New Zealand's roads by systematically assessing risk and identifying safety shortcomings that can be addressed with practical road improvement measures
- Have risk assessment as a key factor in strategic decisions on road improvements, crash protection and standards of road management
- Provide meaningful information on where the greatest levels of risk are faced, and in turn, to influence driver and rider behaviour.

AT established that the section of Lake Road between Albert Road and Jutland Road is an urban corridor with one of the highest mid-block DSI per km in Auckland. Lake Road is in the top 10% of the highest risk corridors in Auckland, and also features on the Waka Kotahi's Safe Network Programme (SNP) as it was identified in the top 10% of high-risk corridors nationwide. Furthermore, vulnerable users are disproportionately represented in serious crashes in the DLTB area, as shown in Figure 5-13.

Figure 5-13: Death and Serous Injuries by Travel Mode in the Devonport-Takapuna Local Board Area



Evidence of the recent (ten years) crash history for the study area (consisting of Lake Road between Albert Road and Esmonde Road, Bayswater Avenue and Esmonde Road between Lake Road and the SH1 On-ramp) is contained in Appendix D. This indicates that there is an increasing number of DSI crashes in the most recent five-year period, and an increasing number of serious crashes involving vulnerable users. In particular:

- There were 28 DSI crashes between 2009-2018, none of which were fatal
- Vulnerable users (cyclists and pedestrians) comprised ten of the 28 DSIs
- A total of 234 injury casualties (minor to serious) resulted from 587 crashes
- Estimated crash cost over this period was $4m/year
- Crashes involving cyclist and pedestrians were estimated by AT using Waka Kotahi's Economic Evaluation Manual (EEM) crash cost methodology at over $1 million per annum over the last ten years
- Between 2009 and 2013 there were more minor injury (94 crashes resulting in 109 casualties) and non-injury crashes (214 crashes) than in the period 2014-2018, which had 78 crashes resulting in 93 minor injuries, and 175 non-injury crashes
- This trend contrasts with serious injury crashes where ten crashes resulted in 15 serious injuries in the period 2009-2013, and 16 crashes resulting in 16 serious injuries in the period 2014-2018
- Between 2009-2013 there were 21 crashes involving cyclists, resulting in 17 injuries, one of which was serious
- Between 2014-2018 there were 30 crashes, resulting in 30 injuries, seven of which were serious
- This increasing trend is likely to be exacerbated in future with the projected growth in the area
- The trend relating to pedestrian injuries is relatively stable between the two five-year periods
- There was one serious injury resulting from five crashes in 2009-2013, and one serious injury resulting from six crashes in 2014-2018.

5.6 Root Causes of the Problems

Table 5-1 sets out suggested root causes of the problems, AT's ability to influence them, and the recommended focus of effort for this DBC to achieve the maximum impact in addressing the identified problems.

Table 5-1: Root Causes

	Root Cause	AT Influence	Focus of Effort in DBC	Notes
1	Historic prioritisation of investment in roads (for cars) over other modes	High	High	This DBC should focus on a balanced investment across all modes to address this inequity.
2	Perception/ reality that alternative modes are less convenient/ more expensive than private car travel	High	High	These elements should be considered and addressed via the TDM strategy proposed as part of this DBC.
3	Increased awareness of impacts of CO^2 emissions	Moderate	High	The TDM strategy should consider promoting alternative transport (to private cars) to improve awareness of their ability to lessen CO^2 emissions.
4	Land use patterns, i.e. location of jobs, businesses, schools etc.	Low	Low	Existing land uses are relatively fixed. Changes to land use fall within the remit of Auckland Council and are beyond the scope of this DBC. AT may be able to provide feedback on future land use plans as they impact on the transport system.
5	Cost of private car use and operation has increased	Very low	Very low	This is a macro-economic factor that is beyond the scope of this DBC.
7	Increasing affluence	Very low	Very low	This is a macro-economic factor that is beyond the scope of this DBC.
8	Increasing population	Very low	Very low	This is a macro-economic factor that is beyond the scope of this DBC.
9	Increasing visitor numbers/ promotion of the Peninsula	Very low	Very low	This is a macro-economic factor that is beyond the scope of this DBC.
6	Geographic nature of the peninsula	Not possible	None	This cannot be influenced.

Based on this assessment, it is clear there are a range of factors outside AT's control that may be contributing to the transport problems on the Devonport peninsula. As such – and recognising that AT's investment can only extend to the issues within their remit – there is some likelihood that problems may continue to occur or not be fully resolved by the emerging preferred option identified in the IBC alone.

5.7 The Benefits of Addressing the Problems

The following four benefits were agreed at the 10 June 2019 workshop as reflecting the expected outcome from addressing the three defined problems:

- **Benefit 1:** Travel time variability will be reduced and accessibility will be improved for people who car pool or travel by bus (35%)
- **Benefit 2:** Place and movement needs of the corridor will be better balanced (25%)
- **Benefit 3:** Crashes will be reduced, and poor safety perception improved (25%)
- **Benefit 4:** Improved environmental outcomes (15%).

5.8 KPIs and Measures

A range of KPIs were identified in the IBC that were used to evaluate the potential outcomes associated with shortlisted options. These have been refined based on the revised problems and benefits, in particular concerning safety and environmental indicators, and to reflect the indicators that can be measured by the forecasting tools available. The KPIs have been used both to inform the multi-criteria assessment (MCA) used to inform the selection of preferred concepts, and to evaluate the performance of the preferred option.

Table 5-2 sets out the revised KPIs and proposed measures. Where available baseline information for the identified measures together with indicative targets is set out in Table 5-3. These measures are a mixture of both quantitative and qualitative measures, such as the Community Satisfaction Rating KPI, which whilst a quantitative measure is based on surveying qualitative public perceptions of their experience.

Table 5-2: Key Performance Indicators and Measures

Benefits	KPIs	Measure
Benefit 1: Travel time variability will be reduced and accessibility will be improved for people who car pool or travel by bus	KPI 1 – Overall people travel time	Average travel time for people in single-occupancy vehicles, multiple occupancy vehicles and all travelling along Lake Road (between Albert Road and Esmonde Road) in the weekday AM peak (3-hour) period
	KPI 2 – Number of people throughput	Number of people travelling by car on the SH1 on-ramp in the weekday AM peak
		Number of people travelling by bus on the SH1 Busway on-ramp in the weekday AM peak hour
	KPI 3 – Reduced variability in car travel times	Average travel time between AM northbound and PM northbound weekday peak travel times from Albert Road to Esmonde Road
Benefit 2: Place and movement needs of the corridor will be better balanced	KPI 4 – Mode share for alternative modes	Predicted change on alternative modes mode share
	KPI 5 – Community satisfaction ratings	Community satisfaction surveyed by AT in its Annual Road User Satisfaction survey
Benefit 3: Crashes will be reduced, and poor safety perception improved	KPI 6 – DSIs	Reduce DSIs along Lake Road with the aim to reduce the likelihood and severity of crashes
	KPI 7 – Safe speeds	Number of instances of motorists exceeding the speed limit on Lake Road
Benefit 4: Improved environmental outcomes	KPI 8 – Vehicle emissions	Reduction in CO^2 emissions

Table 5-3: Summary of Benefits Map

Key Performance Indicator	Measure	Baseline	Baseline data source	Target
KPI 1 – Overall people travel time	Average travel time for people in single occupancy motor vehicles travelling along Lake Road (between Albert Road and Esmonde Road) in weekday AM and PM peak periods	21 minutes (AM) / 14 minutes (PM)	Traffic model	<10% increase
	Average travel time for people in multiple occupancy motor vehicles travelling along Lake Road (between Albert Road and Esmonde Road) in weekday AM and PM peak periods	21 minutes (AM) / 14 minutes (PM)	Traffic model	>10% reduction
	Average travel time for people in all vehicles travelling along Lake Road (between Albert Road and Esmonde Road) in weekday AM and PM peak periods	21 minutes (AM) / 14 minutes (PM)	Traffic model	>10% reduction
KPI 2 – Number of people throughout by mode	Total number of people travelling by car on the SH1 Esmonde Road On-ramp in the weekday AM peak hour	1,300 people	Traffic model	10% increase
	Total number of people travelling by bus on the Northern Busway Esmonde Road On-ramp in the weekday AM peak hour	550 people	Traffic model	10% increase
KPI 3 – Reduced variability in car travel times	Average travel time between AM northbound and PM northbound weekday peak travel times from Albert Road to Esmonde Road	21 minutes (AM) / 14 minutes (PM)	Traffic model	>10% reduction
KPI 4 – Mode share for alternative modes	Mode share for alternative modes across the Devonport peninsula	33 to 35%	2013 Census Journey to Work (Devonport Peninsula)	44 to 46%
KPI 5 – Community satisfaction ratings	Overall community satisfaction for Lake Road	16 - 47%	AT Annual Road User Satisfaction Surveys 2015	Increasing trend
	Overall community satisfaction for Esmonde Road	16 - 58%	AT Annual Road User Satisfaction Surveys 2015	Increasing trend
KPI 6 – DSIs	Reduction in DSIs over a 10-year period	28	CAS data	20% reduction over 10 years
KPI 7 – Safe speeds	Number of instances of motorists exceeding the speed limit on Lake Road	10	CAS data	20% reduction over 10 years
KPI 8 – CO^2	Reduction in vehicle emissions	Not known	Traffic model	10% reduction

5.9 Investment Objectives

The investment objectives were supplemented with measurable statements to address the SMART requirements. Following a revision of the problems, benefits, KPIs and measures, the investment objective were refined to the following:

- **Investment Objective 1** – We will reduce travel time variability for all modes by 10% by 2031.
- **Investment Objective 2** – We will improve the attractiveness of alternative modes to single-occupancy car use by increasing the proportion to 40% by 2031
- **Investment Objective 3** – We will balance the place and movement functions of the corridor in line with the appropriate RASF typology by 2031
- **Investment Objective 4** – We will reduce the number of DSIs on Lake Road by 20% by 2031.

Part B1: Option Development and Assessment

6 Overview

Part B1 of the DBC summarises how the preferred solution identified in the IBC was developed and assessed to concept design stage prior to community engagement.

6.1 Option Development and Assessment Process/Stages

The review and development of the preferred solution identified in the IBC was undertaken in the following stages:

- The strategic direction for the corridor (network role and modal priorities) was confirmed by the RASF assessment mandate completed for the project by AT
- A Safe System Assessment Framework (SSAF) was prepared
- A Cycle Facility Quality of Service (QoS) evaluation
- A long and short-list of mid-block treatment options for different segments of Lake Road, Bayswater Avenue and Esmonde Road was identified building on the preferred solution identified in the IBC and options identified in the earlier CMP
- A long and shortlist of intersection treatment options was developed
- MCA criteria were developed
- A MCA of the short-listed mid-block and intersection treatment options was undertaken
- Complementary (non-infrastructure) measures (TDM, ITS/technology, etc.) were developed.

These stages are explained in further detail in the sections following.

6.2 Network Role and Modal Priorities

To confirm the strategic direction for the Lake Road corridor (i.e. network role and mode priorities) defined for the project in the IBC, a RASF mandate for the project was prepared by AT. This enabled the level of intervention to be considered in a comparison between each mode. It also enabled place specific responses to be identified to inform the allocation of road space in the concept options that were developed.

6.3 Safe System Assessment Framework

A SSAF was prepared to highlight the risks for vulnerable road users of the corridor. This involved:

- Data collection with regards to use of the corridor and set up of spreadsheet containing information on traffic volumes, land use, the peak period of the day, etc.
- Site visit
- Notes from the site visit transferred to the Austroads SSAF templates.

Appendix E contains a summary of the findings of the SSAF.

6.4 Cycle Facility Quality of Service Evaluation

The cycle facility QoS evaluation tool (QoS tool) provides a method for scoring the quality of facilities from a user perspective. It was used to identify where existing facilities meet minimum standards and will be comfortably used by a broad range of cyclists (the ‘interested but concerned’ target market). Appendix F contains a summary of the findings of the evaluation.

6.5 Development of Intersection and Mid-Block Treatment Options

Lake Road, Bayswater Avenue and Esmonde Road were divided into several segments based on the network role of the corridor defined in the RASF mandate and on the geometric road layout of the road.

Initially, a shortlist of mid-block treatments was prepared to build on the preferred solution recommended in the IBC. Details of other options that were considered in the development of options but not shortlisted are contained in Appendix G. The shortlist of mid-block options, together with some initial intersection treatment options, were presented to a stakeholder drop-in session held at AT's offices on 25 September 2019.

6.6 Development of Option Multi-Criteria Assessment Criteria and Framework

To inform the selection of the preferred mid-block and intersection treatments, assessment criteria and a MCA was developed taking into account the principles of Waka Kotahi's 'Multi-Criteria Analysis for Transport Business Cases Guidance Document' (February 2017). The criteria were discussed with key technical stakeholders at a workshop held on 9 October 2019. The final criteria adopted are summarised in Table 6-1.

Table 6-1: Option Multi-Criteria Assessment Criteria

Criteria	Description
Consentability	What is the level of complexity anticipated in gaining statutory approvals? How significant could the costs of mitigation be to gain statutory approvals?
Constructability	How complex is constructing the option? What are the impacts on drainage and utilities?
Operational	Does the LoS improve for all modes? Is journey time and journey time reliability improved?
Safety	Does the option enhance safety for different transport users?
Place	How does the option integrate movement and place? Are they any adverse impacts on parking and loading or driveways?
Cost	Is the option deliverable within the budget?

Tables 6-2 and 6-3 summarise the scoring scale used in the MCA for both the mid-block and intersection options. In simple terms, the higher the score the better the variant – i.e. higher the benefit or lower the cost/risk.

Table 6-2: Option Scores

Score	Description
+3	The option presents a few difficulties on the basis of the criterion being evaluated and may provide significant benefits.
+2	The option presents some difficulties on the basis of the criterion being evaluated and may provide moderate benefits.
+1	The option presents minor difficulties on the basis of the criterion being evaluated and may provide minor benefits
0	No Change – existing scenario
-1	The option presents minor aspects of difficulty on the basis of the criterion being evaluated and provides some detrimental impacts.
-2	The options include moderate aspects of difficulty on the basis of the criterion being evaluated, and several detrimental impacts.
-3	The options include significant difficulties or problems on the basis of the criterion being evaluated and significant detrimental impacts.

6.7 Application of the Multi-Criteria Assessment Framework

The short-listed mid-block and intersection options were refined and evaluated using the MCA to determine a preferred concept design option. The MCA scoring was conducted by a range of technical specialists prior to and at an Options Assessment Workshop held with AT and Waka Kotahi's technical specialists on 30 October 2019 (mid-block options) and on 6 December 2019 (intersection options). The scores and justifications for the scores were sent to the stakeholders following the workshop for comment, and the final MCA scores are summarised in Appendix H.

The preferred treatments were then refined following this workshop in advance of public engagement commencing on 16 March 2020.

6.8 General Approach to Treatment of Cycle Lanes

In developing options for each mid-block segment, a range of cycle lane treatments were generally considered, namely:

- Provision of a sub-standard width unprotected uni-directional cycle lanes (i.e. painted cycle lanes) where no cycle lanes exist or where improvements can be made to the existing cycle lanes (due to constrained road width and undertaking no widening)
- Provision of at least minimum standard unprotected uni-directional cycle lanes (i.e. painted cycle lanes)
- Provision of protected uni-directional cycle lanes with minimum standard cycle lane (i.e. cycle lane with a physical separation between the cycle lane and traffic lane)
- Copenhagen style uni-directional cycle lanes (i.e. vertically separated) in both directions with a minimum width of 2.1m (inclusive of 600mm buffer).

Where appropriate, the option of a bi-directional (i.e. 2-way) protected cycle lanes with physical separation between the cycle lane and traffic lane was considered.

The cycle lane and physical separation widths referred to above are based on guidance contained in AT's Transport Design Manual (TDM).

6.9 General Approach to Provision of Transit Lanes on Lake Road

The inclusion of northbound transit lanes was made over southbound transit lanes because the IBC established that, generally, the benefits of providing transit lanes are generally greater at the northern end of the corridor. At this end of the corridor, traffic flows tend to be more tidal towards Takapuna/Auckland's CBD in the AM peak period and towards Devonport in the PM peak period.

Bus only lanes were not proposed on Lake Road because the IBC identified that frequency of bus services operating on Lake Road is unlikely to be sufficient to justify the provision of bus lanes. The IBC did note that, if bus frequencies increase in the longer term, however, it may be possible to convert the transit lanes to bus-only lanes.

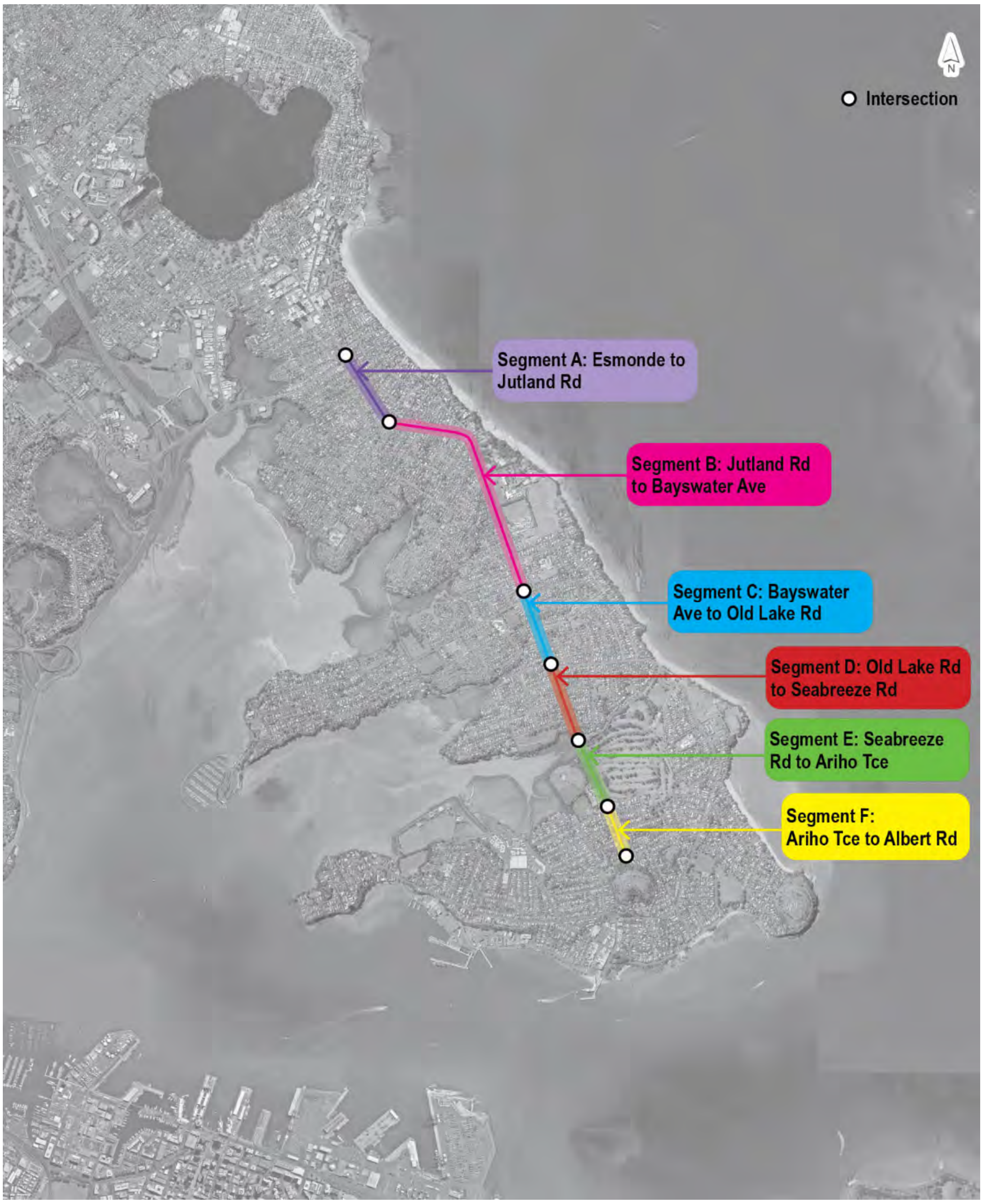
7 Development of Options for Lake Road

This section explains the development of concept options for the mid-block sections and major intersections on Lake Road between Esmonde Road and Albert Road.

7.1 Mid-Block Segments Considered

For option development, Lake Road was divided into a number of segments, as shown in Figure 7-1. The segments adopted different slightly from those used in the RASF mandate, as a more detailed consideration of segments was considered appropriate as concept design options were generated to reflect localised issues or challenges identified in the design process.

Figure 7-1: Lake Road Segments and Major Intersections/Centres Considered



7.2 Intersections and Centres Considered

The following major intersections and centres were considered, as also shown in Figure 7-1:

- Lake Road / Esmonde Road
- Lake Road / Jutland Road / Hauraki Road (henceforth referred to as Lake Road / Jutland Road)
- Belmont Centre (between Egremont Street and Bayswater Avenue / Williamson Avenue)
- Lake Road / Bayswater Avenue / Williamson Avenue (henceforth referred to as Lake Road / Bayswater Avenue)
- Lake Road / Old Lake Road
- Lake Road / Seabreeze Road
- Lake Road / Albert Road.

7.3 Lake Road / Esmonde Road Intersection

The existing intersection layout is shown in Figure 7-2.

Figure 7-2: Lake Road / Esmonde Road Intersection – Existing Layout

7.3.1 Options Short-listed

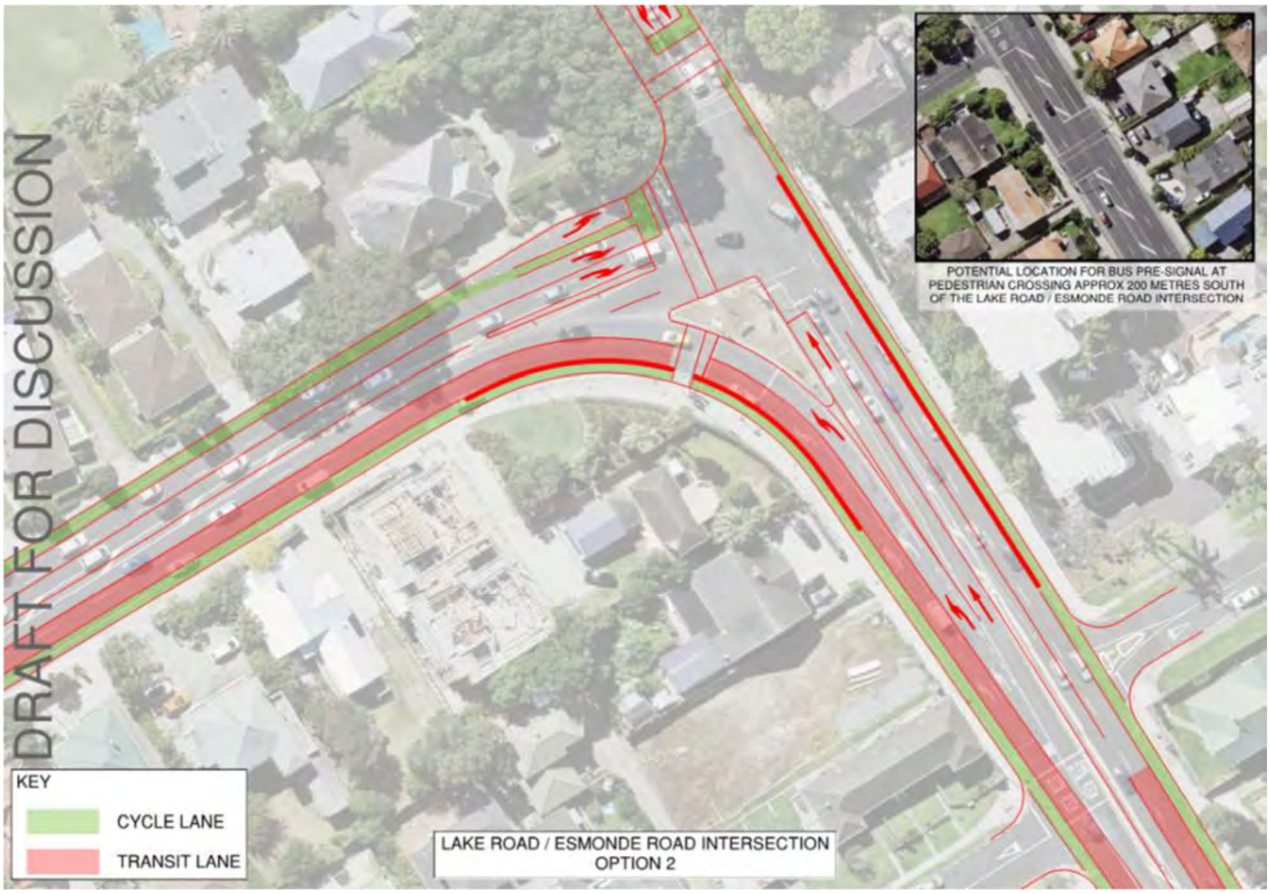
Four options were short-listed for the Lake Road/Esmonde Road intersection. All options incorporate a transit lane and cycle lane in both directions on Lake Road south of Esmonde Road (the southbound lane commencing at Rewiti Road to allow the two lanes of traffic approaching the intersection from the west to merge into single general traffic lane), with the northbound transit/cycle lane continuing west onto Esmonde Road.

Option 1 provides cycle lanes on the Esmonde Road (west) approach which terminate approximately 20m west of the intersection, and the southbound cycle lane on the Lake Road (south) approach commencing approximately 20m south of the intersection (see Figure 7-3). *Note: Bold Red line indicates a kerbed median.*

Figure 7-3: Lake Road / Esmonde Road Intersection - Option 1

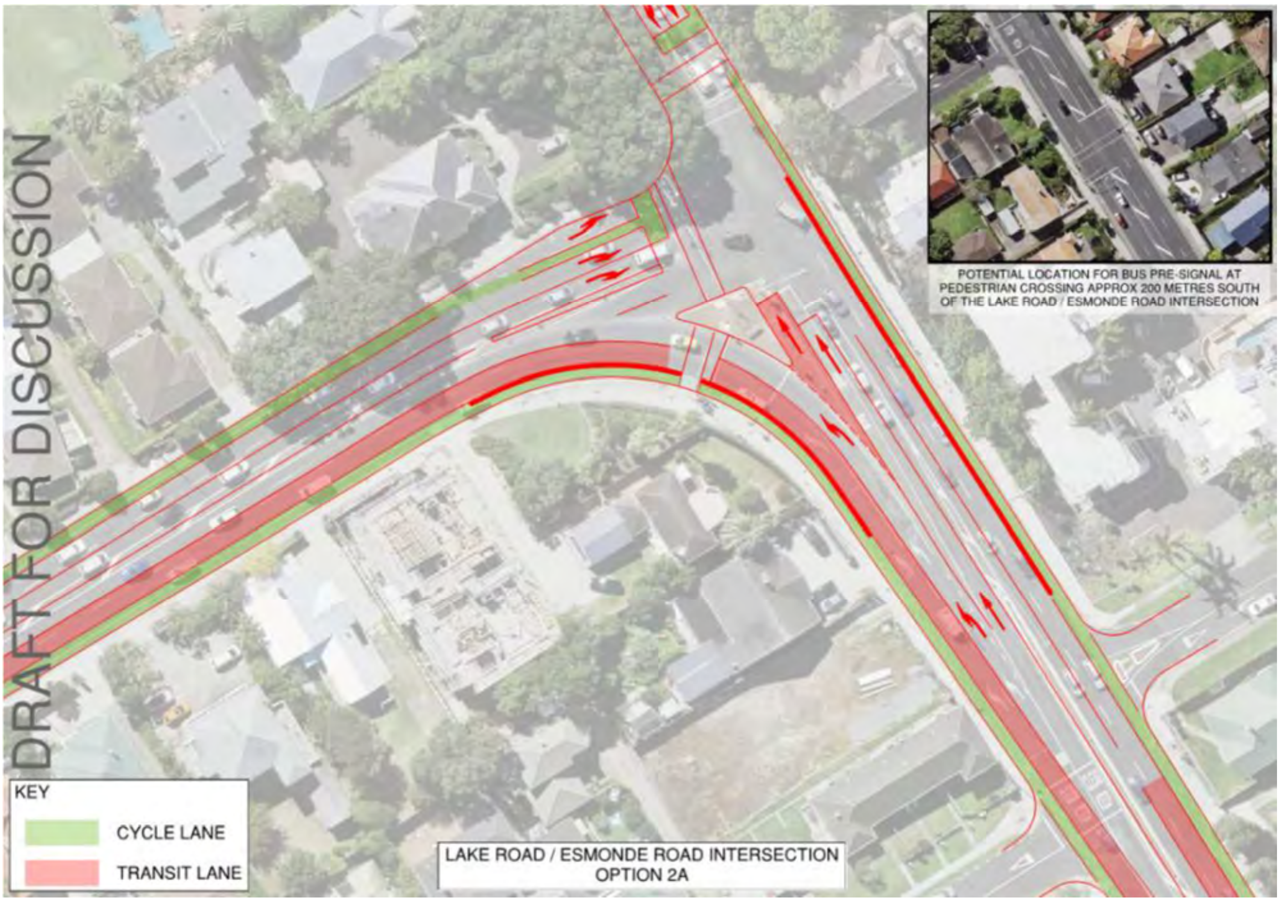
Option 2 is the same as Option 1 but including a continuous cycle lane on the Esmonde Road and Lake Road (north) approaches to and through the intersection and removing the existing bus advance area on the Lake Road (south) approach (see Figure 7-4). *Note: Bold Red line indicates a kerbed median.*

Figure 7-4: Lake Road / Esmonde Road Intersection - Option 2



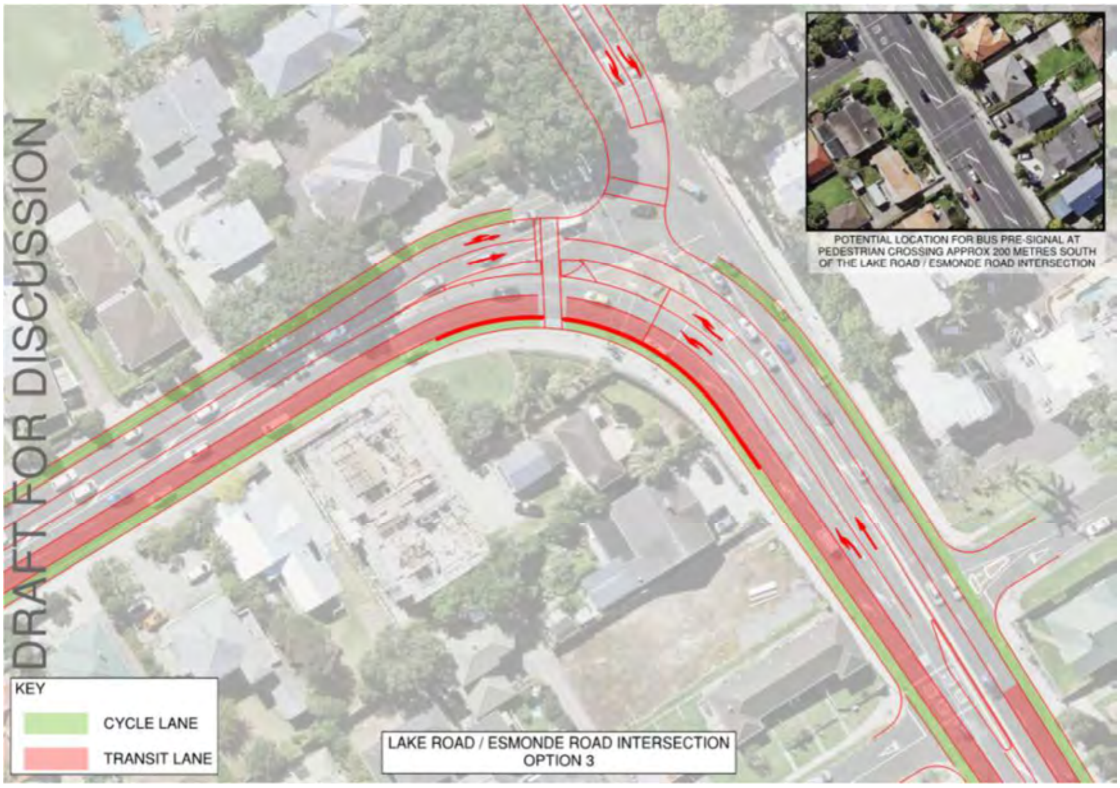
Option 2A is the same as Option 2 but retains the existing bus advance area on the Lake Road (south) approach (see Figure 7-5). *Note: Bold Red line indicates a kerbed median.*

Figure 7-5: Lake Road / Esmonde Road Intersection - Option 2A



Option 3 reconfigures the Lake Road north arm of the intersection and removes the existing bus advance area on the Lake Road (south) approach (see Figure 7-6). *Note: Bold Red line indicates a kerbed median.*

Figure 7-6: Lake Road / Esmonde Road Intersection - Option 3



7.3.2 Preferred Concept Option

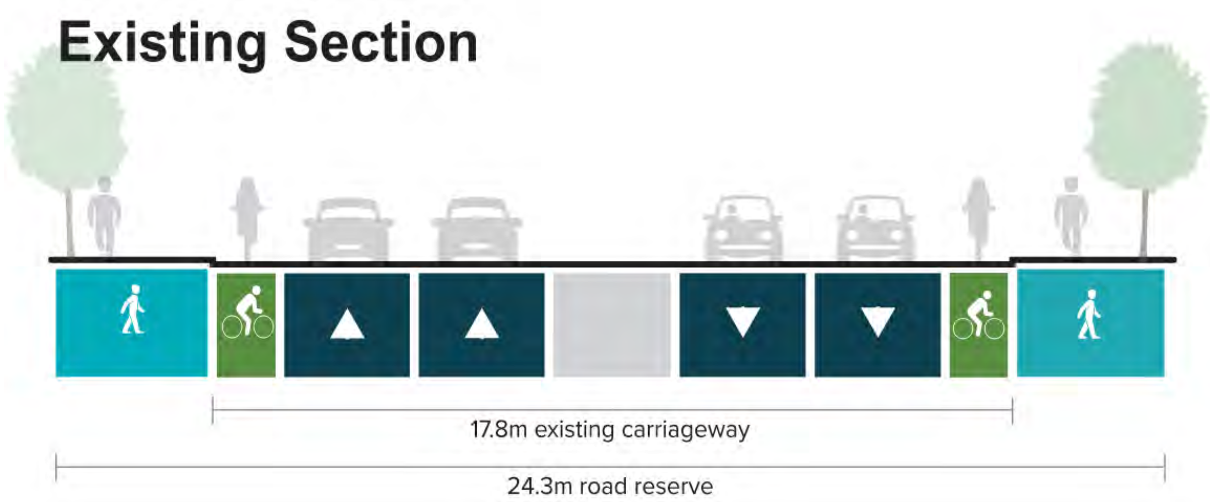
Based on the outcome of the MCA process it was concluded that Option 2A, incorporating protected cycle lanes in both directions on Lake Road and a continuous westbound transit lane from Lake Road to Esmonde Road (retaining the existing intersection configuration), should be progressed for further option development.

7.4 Segment A (Esmonde Road to Jutland Road)

This segment was upgraded in 2010/2011 and widened to have four traffic lanes (two in each direction), a 2.8m wide central flush median, unprotected (sub-standard width) uni-directional cycle lanes, and half-width indented bus stops. It generally has a 24.3m wide road reserve, forms part of the frequent bus route between Takapuna and Devonport and has the highest volume of traffic along the Lake Road corridor between Esmonde Road and Albert Road. The power lines are underground on the majority of this segment of Lake Road.

The predominant land use along this segment is low-density residential, with a localised exception at the southern end, the Hauraki Corner Shops. The existing typical cross-section is shown in Figure 7-7.

Figure 7-7: Segment A - Existing Cross Section



The strategic direction for this segment is to continue to provide a road that reflects the existing residential nature along an arterial road, whilst improving its person carrying capacity through increased vehicle occupancy and improving the safety and amenity for cyclists.

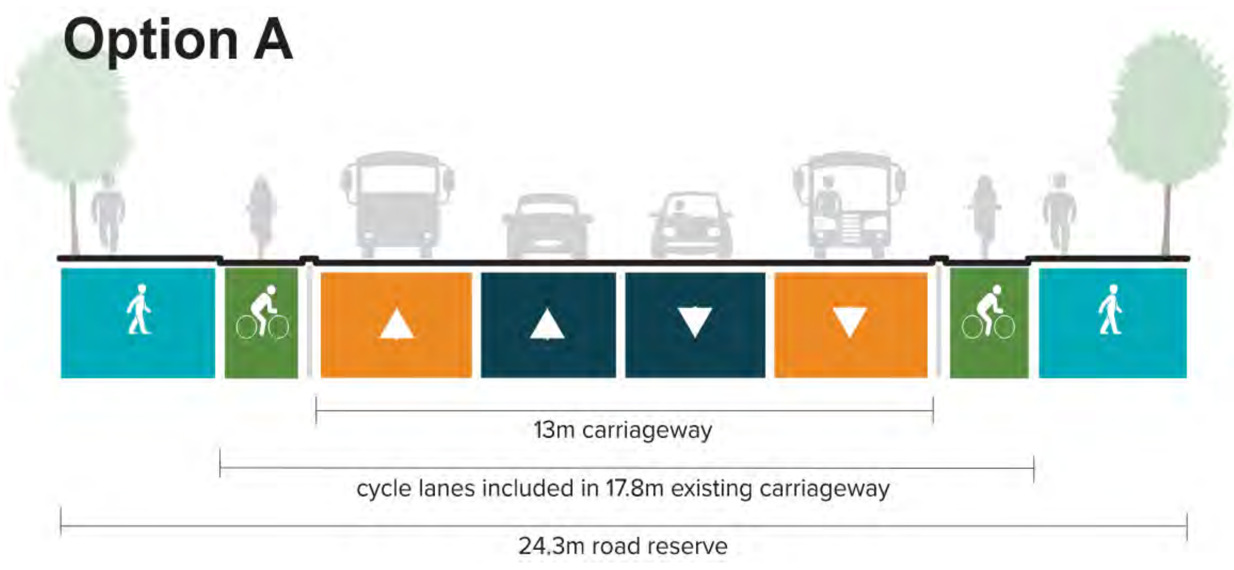
7.4.1 Short-listed Options

Two options were short-listed which:

- Remove of the central median to provide sufficient width to accommodate protected cycle facilities
- Retain the existing kerb line and pedestrian footpath width
- Convert a general traffic lane in each direction to a transit lane.

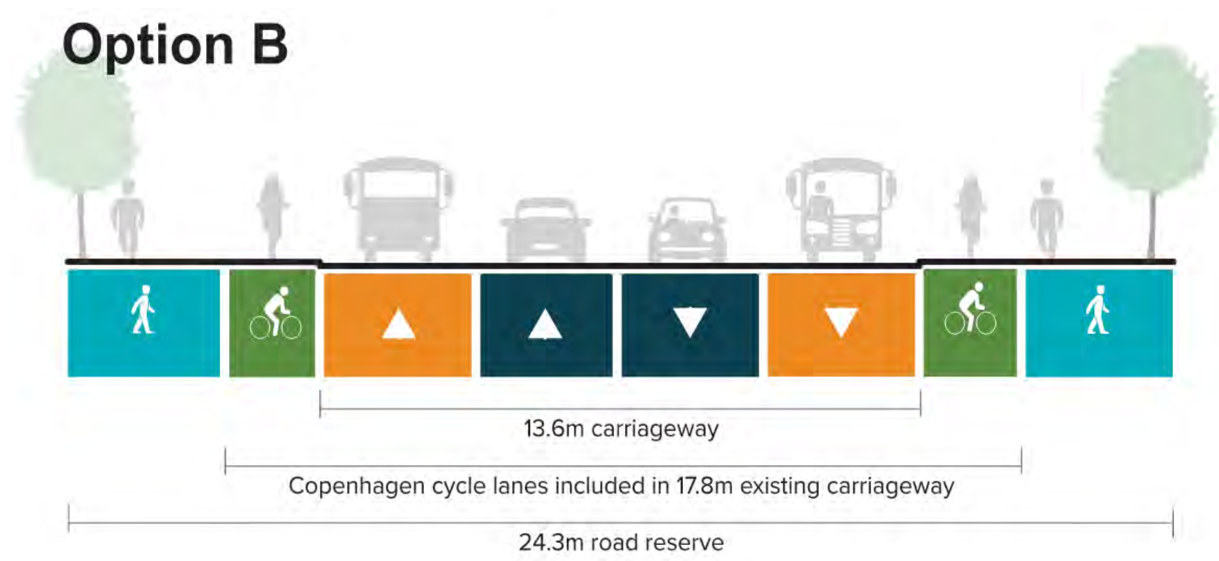
Option A incorporates protected uni-directional cycle lanes, as shown in Figure 7-8).

Figure 7-8: Segment A - Option A



Option B (see Figure 7-9) incorporates Copenhagen style uni-directional cycle lanes. The Copenhagen cycle lane enables vehicles exiting driveways to drive over the facility whereas a kerbed median will require several breaks and therefore, reduces protection.

Figure 7-9: Segment A - Option B



7.4.2 Preferred Concept Option

Based on the outcome of the MCA process, it was concluded that Option A should be progressed for further option development for Segment A. This option makes better use of the existing road space by providing improved cycle facilities and encouraging car sharing.

7.5 Lake Road/Jutland Road Intersection

The existing intersection layout is shown in Figure 7-10.

Figure 7-10: Lake Road / Jutland Road Intersection – Existing Layout

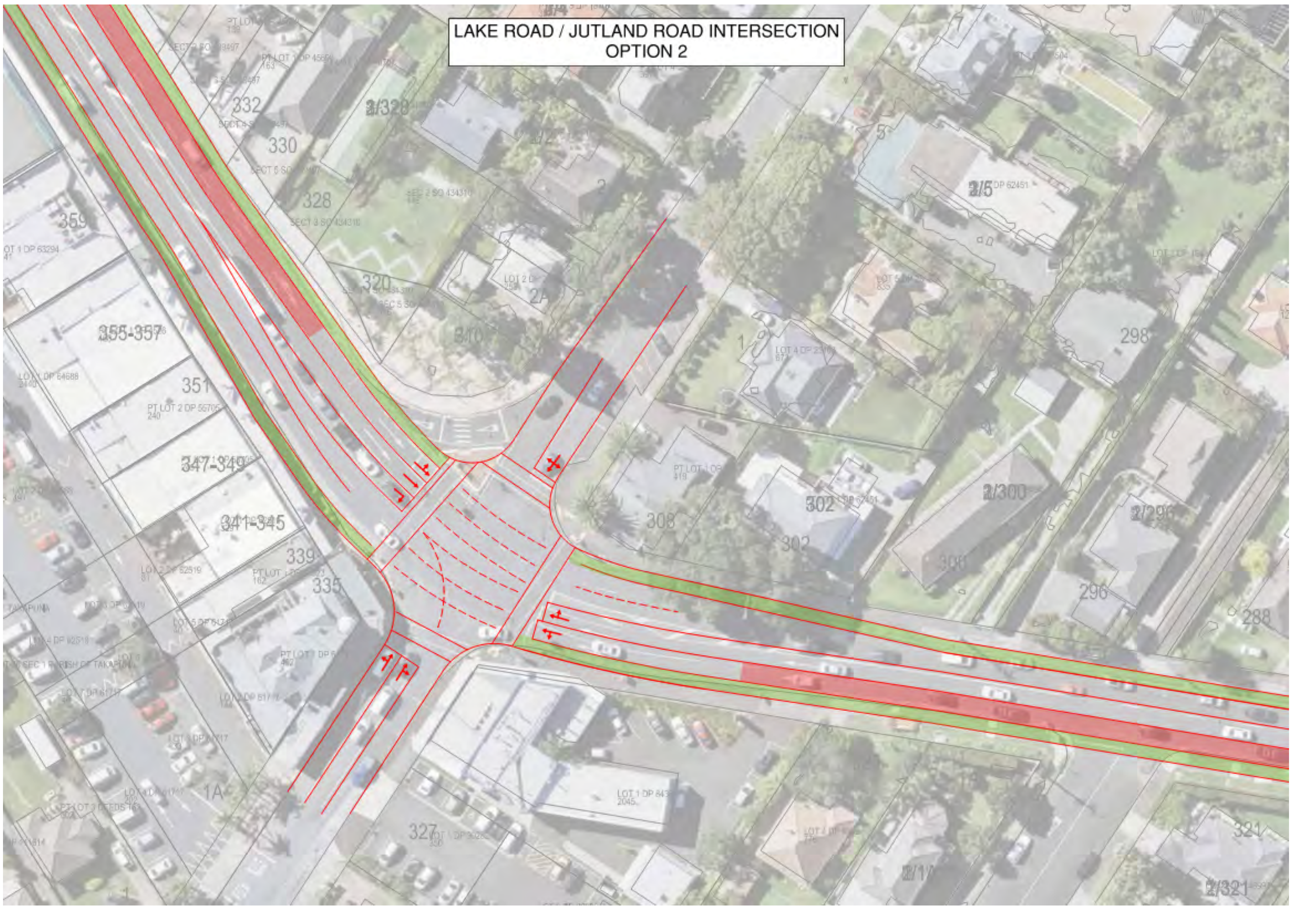
7.5.1 Options Short-listed

Two options were short-listed for the Lake Road/Jutland Road intersection. Option 1 includes the provision of improved and protected cycle lanes on Lake Road in both directions but narrowing and shortening of the right turn lane from Lake Road (north) to Jutland Road (see Figure 7-11).

Figure 7-11: Lake Road / Jutland Road Intersection - Option 1

Option 2 is similar to Option 1 but has the left turn filter lane from Lake Road (north) to Hauraki Road removed to maintain the length and width of the existing right turn lane from Lake Road (north) to Jutland Road (see Figure 7-12).

Figure 7-12: Lake Road / Jutland Road Intersection - Option 2



7.5.2 Preferred Concept Option

Based on the outcome of the MCA process it was concluded that Option 2, incorporating protected cycle lanes and the removal of the left-turn slip lane from Lake Road to Hauraki Road, should be progressed for further option development. This option will assist in improving road safety and pedestrian amenity at this intersection.

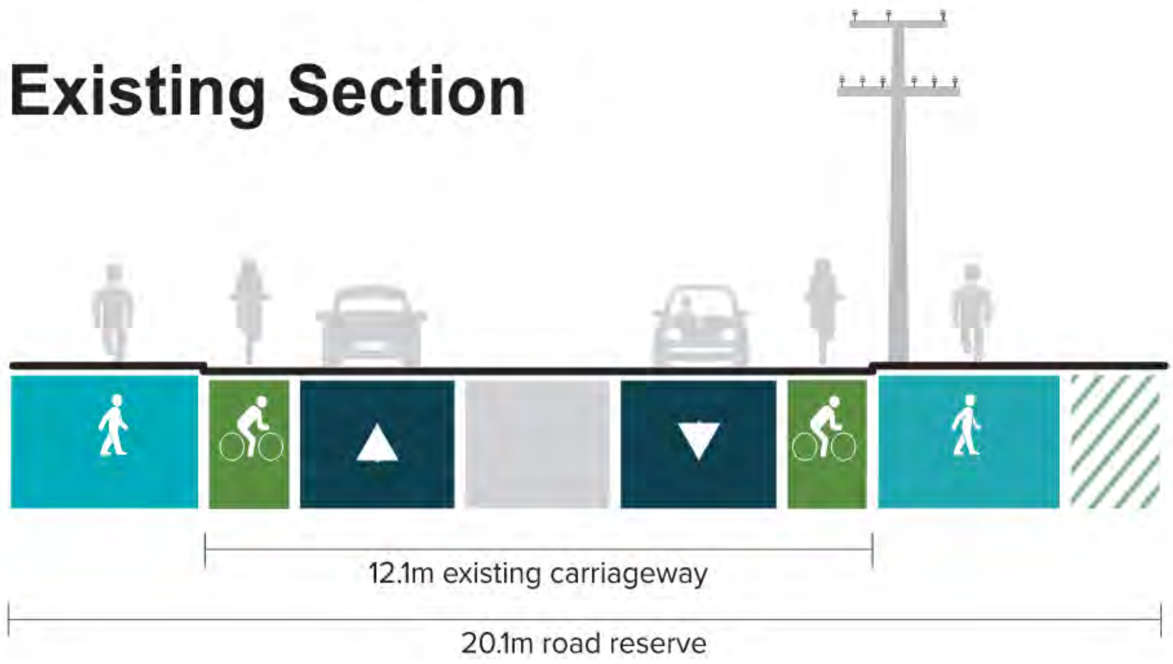
7.6 Segment B (Jutland Road to Egremont Street)

This segment also carries a high volume of traffic, as well as being a busy route for pedestrians and cyclists, and is used by the frequent bus route between Takapuna and Devonport. The land use is mainly residential with a cluster of schools along the eastern side. Hauraki Corner Shops is a major local attractor for pedestrians and other active modes at the northern end of the segment.

The cross-section width varies depending on the existence/width of a central flush median and the cycle lane provision. Sub-standard width unprotected cycle uni-directional lanes also exist along most of this segment. The cycleway is one-way southbound only from Jutland Road to Onepoto Road.

The land-use along this segment of the corridor is a mixture of low density residential and educational. The existing cross-section is shown in Figure 7-13.

Figure 7-13: Segment B - Existing Cross Section



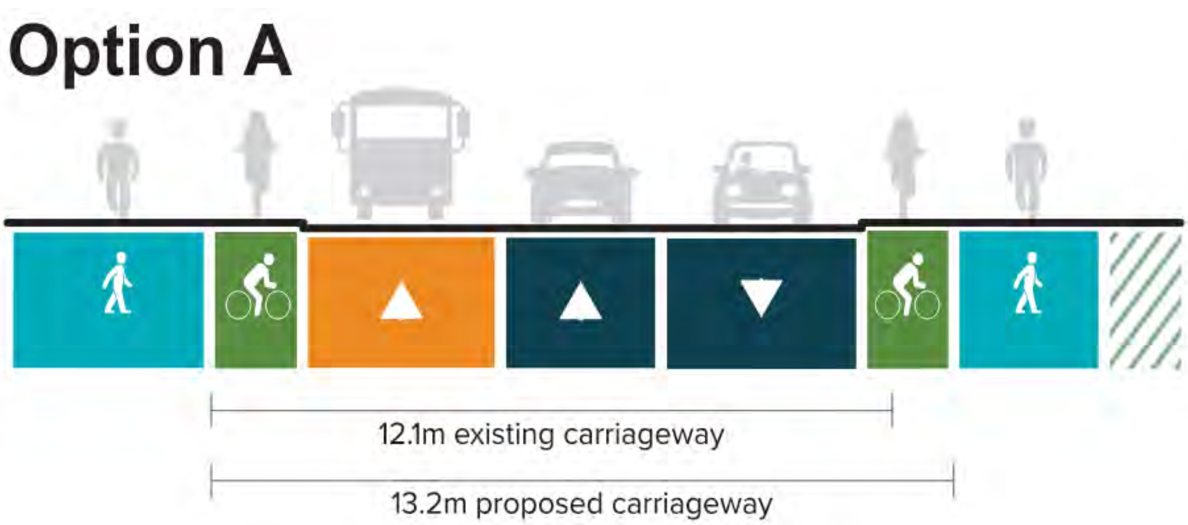
The strategic direction for this segment is to make better use of space to provide improved amenity and safety for pedestrians and cyclists while also adding a northbound transit where room exists between Hororata Road and Jutland Road to promote increased use of more efficient modes.

7.6.1 Short-listed Options

Three options were short-listed. Option A (shown in Figure 7-14), which is only practical between Jutland Road and Hororata Road, involves:

- Removal of the central median to accommodate protected cycle facilities
- Undergrounding of power lines
- Relocating the kerb line on the eastern side of the road
- A northbound transit lane
- Providing protected uni-directional cycle lanes

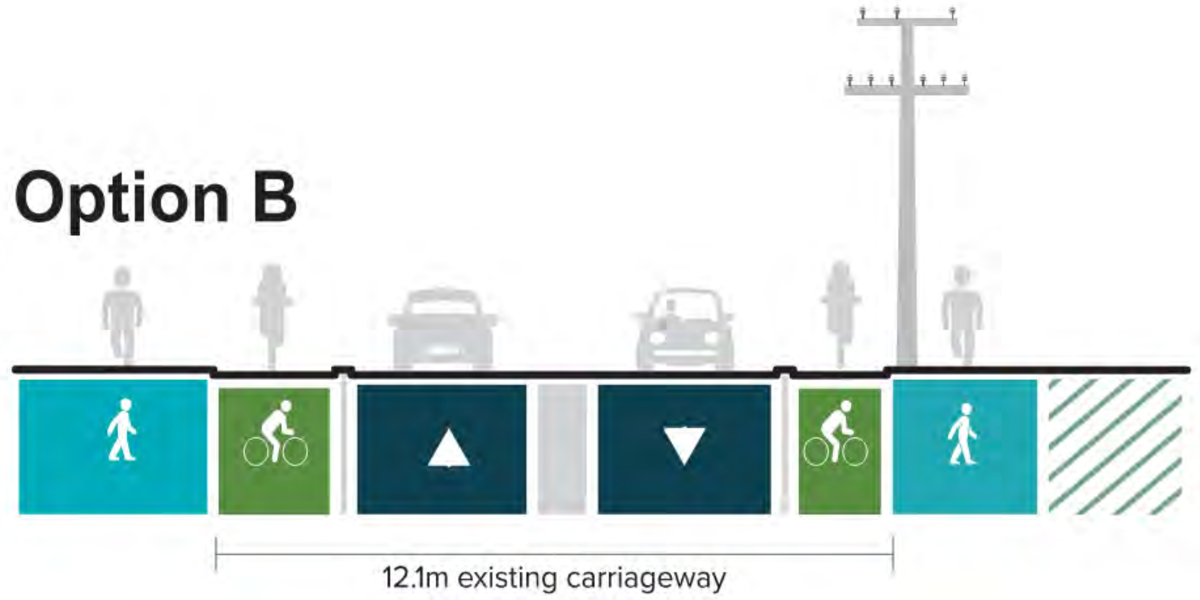
Figure 7-14: Segment B - Option A



Option B (shown in Figure 7-15): requires the following changes:

- Narrowing of the central median
- Provide protected uni-directional cycle lanes.

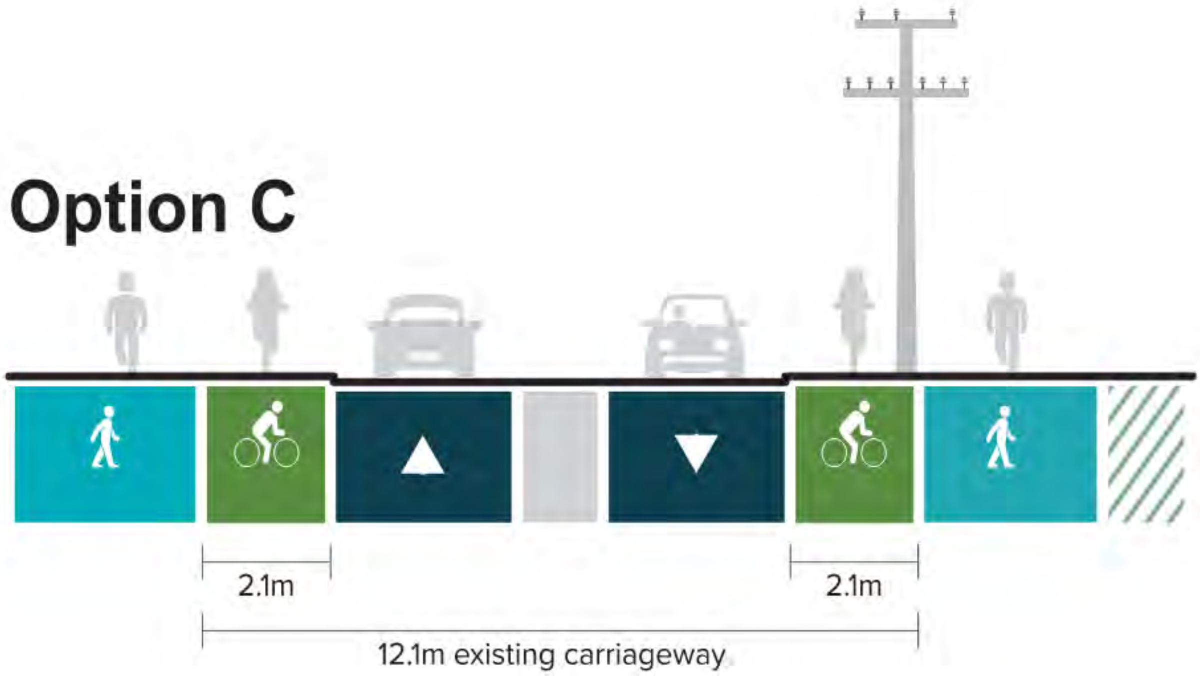
Figure 7-15: Lake Road Segment B - Option B



Option C (shown in Figure 7-16) requires the following changes:

- Narrowing of the central median
- Copenhagen style uni-directional cycle lanes.

Figure 7-16: Lake Road Segment B - Option C



7.6.2 Preferred Concept Option

The MCA process indicated that Option A should be progressed for further development for the section of Segment B between Jutland Road and Hororata Road and that Option C should be progressed for further development for the section of Segment B between Hororata Road and Egremont Street. This option is selected as it provides improved facilities for cyclists and additional priority for multiple occupancy vehicles at minimal cost.

7.7 Belmont Centre (inc. Lake Road / Bayswater Avenue Intersection)

The Belmont local centre is a moderately-sized concentration of local shops and services located at the approximate mid-point of the Devonport peninsula, as shown in Figure 7-17. The shops are in close proximity to residents of the suburbs of Bayswater, Belmont and Narrow Neck which are located some distance from the major centres of Takapuna or Devonport to the north or south, as well as being in close proximity to Bayswater Primary School.

Figure 7-17: Belmont Centre and Lake Road/Bayswater Avenue Intersection - Existing Situation

Through traffic creates a significant severance issue for people wishing to cross Lake Road on foot between shops and/or carparks on either side of the road. The only formal pedestrian crossing facility is provided to the south of the main shops at the Bayswater Avenue/Williamson Avenue intersection. There are no cycle lanes on Lake Road through the Centre.

Buses travelling in a southbound direction are diverted from Lake Road to a stop located in the car parking area between Lake Road and the shops on the eastern side of the Centre. Northbound bus services use a stop on Lake Road located approximately 100m to the north of the centre.

On-street car parking spaces also exist on the eastern side of Lake Road, servicing the convenience-based nature of the shops on this side of the road to passing motorists on Lake Road, as well as nearby on both sides of Bayswater Avenue and Williamson Avenue.

There is significant conflict between cyclists and other road users on Lake Road in the vicinity of the Centre as a result of the manoeuvring of parked cars and buses. It is a challenging and sub-optimal environment for pedestrians, cyclists and bus passengers.

7.7.1 Options Considered

Through the option development and evaluation process, a wide range of potential interventions were identified which seek to achieve continuity of approach with the preferred mid-block treatments on either side of Bayswater Avenue, while supporting the local centre function and enhancing the place-making potential of the local centre.

Initially, three illustrative options were short-listed which focus on improving the movement function of the Centre, including the Lake Road/Bayswater Avenue intersection. These options build on the proposals developed in the Lake Road CMP. Common to all three options are:

- Removal of the two left-turn slip lanes from Bayswater Avenue to Lake Road (North) and from Williamson Avenue to Lake Road (South) to enhance safety for pedestrian and cyclists by reducing conflict with turning traffic and reduce pedestrian wait times and crossing distances
- Retaining some on-street car parking spaces on the west side of Lake Road at the Centre
- Provision of a protected northbound and southbound cycle lane
- No impact on the slip lane on the east side of Lake Road.

Option 1 reduces the number of southbound traffic lanes to one, requiring no relocation of existing kerb lines on the east and west sides of Lake Road (see Figure 7-18).

Figure 7-18: Belmont Centre – Option 1

Option 2 provides two southbound traffic lane (one defined as a transit lane to allow priority vehicles to overtake other traffic) and one northbound traffic lane but requires a minor relocation of eastern kerb line (see Figure 7-19).

Figure 7-19: Belmont Centre – Option 2

Option 3 provides two northbound and two southbound traffic lanes (one in each direction defined as a transit lane), but removes on-street parking from the west side of Lake Road, and requires a major relocation of eastern kerb line which is likely to impact on the car parking area to the east of Lake Road (see Figure 7-20).

Figure 7-20: Belmont Centre – Option 3

7.7.2 Preferred Concept Option

A MCA was undertaken of these initial options. This indicated that Options 2 and 3 scored joint highest.

7.7.3 Auckland Council Proposals

In parallel with the development and evaluation of these options, Auckland Council developed several options as part of its project to prepare an improvement plan for the Belmont centre. Auckland Council's options have a greater focus on the place function of the Centre. They remove bus movements and the bus stop from the slip lane car park arrangement on the eastern side of the Centre between Lake Road and the shops/Rose Gardens, and re-configure this space for uses such as outdoor dining, street trees and planting, seating opportunities, and artwork.

The Auckland Council options also included an additional pedestrian crossing opportunity at the northern end of the shops, on or near alignment with the School Road intersection. Such a crossing will reduce severance between the shops on each side of Lake Road and provide an additional crossing point on a desire line between the primary school and shops on the western side.

Three options were identified by Auckland Council, as shown in Figures 7-21 to 7-23.

Figure 7-21: Belmont Centre – Auckland Council Option A

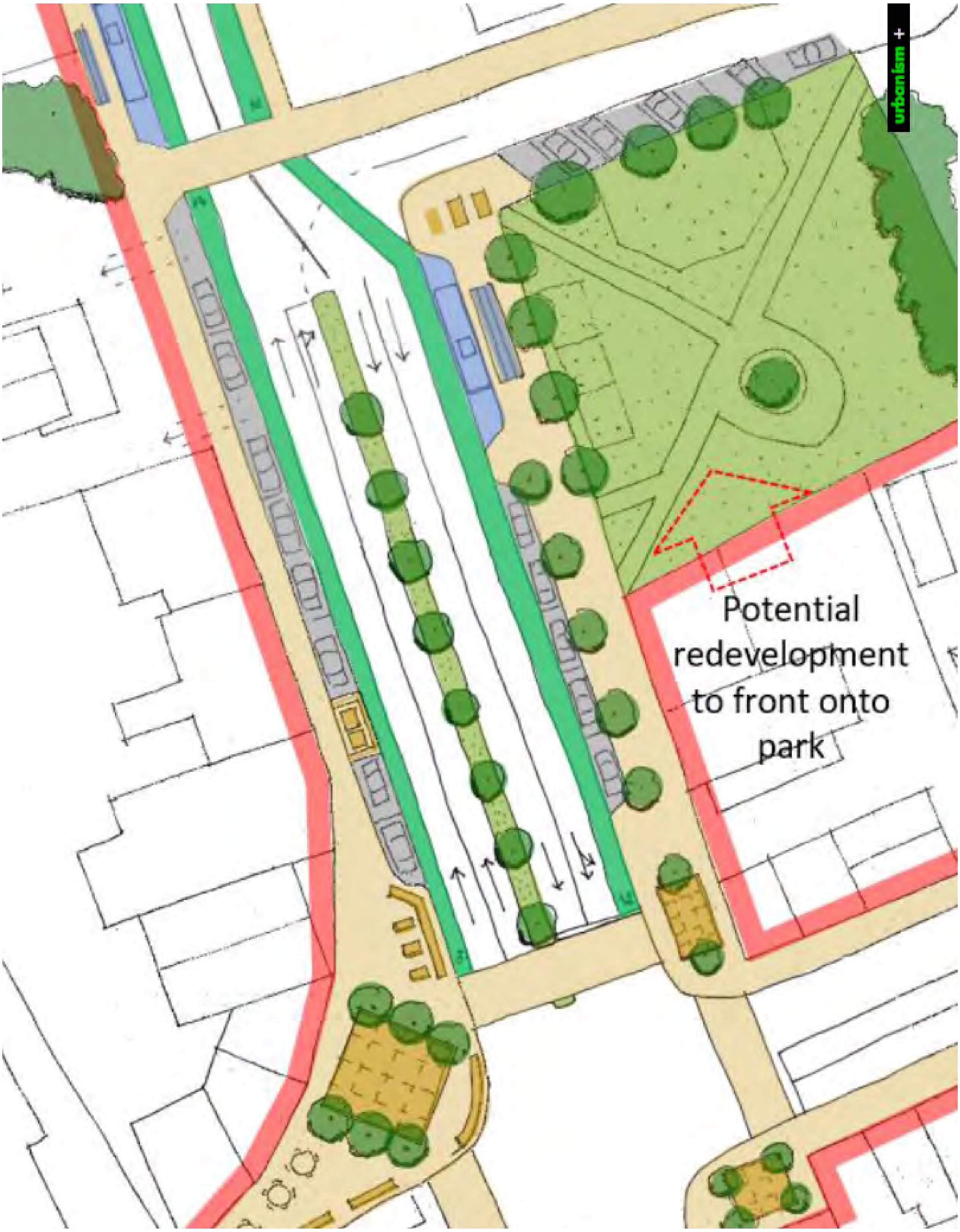
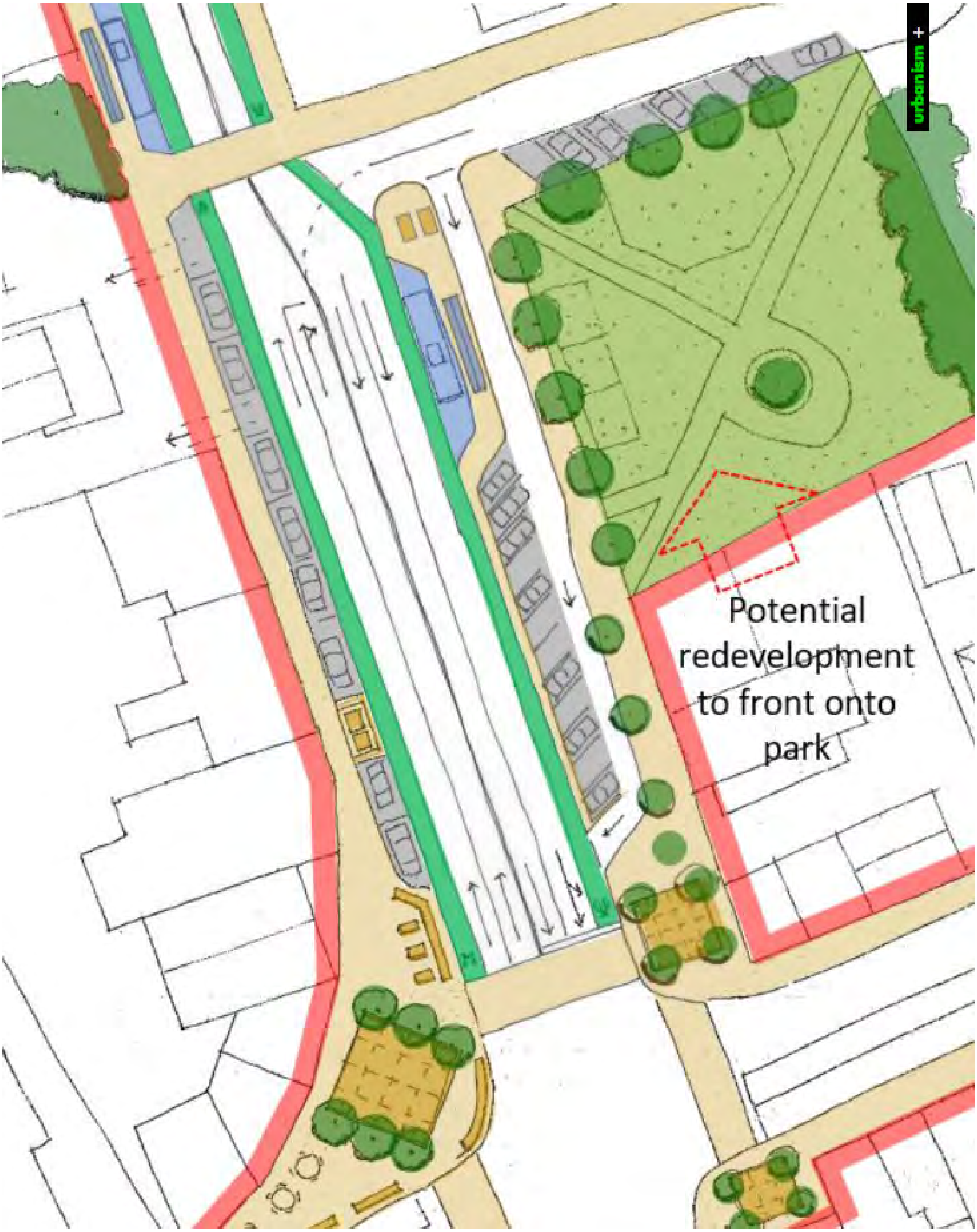


Figure 7-22: Belmont Centre – Auckland Council Option B

Figure 7-23: Belmont Centre – Auckland Council Option C



Beca reviewed the Auckland Council options and noted that the concepts had several issues which would need to be addressed:

- Options B and C incorporate angled car parking backing into the cycle lane, which is unlikely to be practical
- Options B and C create a wide area of the carriageway which could encourage high traffic speeds unless traffic calming is implemented
- The length of the road provided for traffic to merge from two to one lane would need to be approximately 80m (based on a design speed of 50kph), which could be reduced to around 50m if a 30kph design speed was adopted
- As noted earlier, a 30kph design speed is not consistent with arterial classification of Lake Road
- The lateral shift for motorists to access the car park is quite high, which will create a hard manoeuvre in reality, even if it is a 30kph zone, potentially ending up with cars parking incorrectly in the cycle lane space rather than in the car parking area.
- Opposing lanes face each other at the School Road intersection, which will create a situation where there is potential for head-on collisions, especially at night and in wet weather when drivers will see the headlights of vehicles heading straight for them in what they consider to be their own lane.

7.7.4 Preferred Concept Option

An MCA was undertaken of the Beca and Auckland Council options. This indicated that a variant of Option B was preferred. This would incorporate parallel car parking provision. The hybrid option developed by Auckland Council is shown in Figure 7-24 and Figure 7-25.

Figure 7-24: Concept for Belmont Centre Taken to Community Engagement

Figure 7-25: Artists Impression of the Belmont Centre Looking South Towards Williamson Avenue

Key features of the preferred concept proposal are:

- Rose Gardens park experience extended towards the street edge
- Footpaths retained on the west side, widened on the east side (which could require relocation of underground utilities)
- New and additional public spaces and potential for new landscape features
- Parking retained on both sides of Lake Road and other streets, reduced on the east side of Lake Road
- North and southbound cycle lanes through the centre, two-way cycle lane on Bayswater Avenue
- Shorter pedestrian crossing distances at the intersection, new crossings at School Road
- Existing buildings retained or redeveloped with active ground floor frontages
- Northbound bus stop relocated closer to the centre and the southbound bus stop moved onto Lake Road
- Vehicle lanes and turning reconfigured as shown
- Free left-turn lanes at the Lake Road/Bayswater Avenue intersection removed and replaced with new public spaces
- Eastern slip road removed and incorporated into southbound lanes, widened public space, cycle lanes, bus stop and parking area; no median strip.

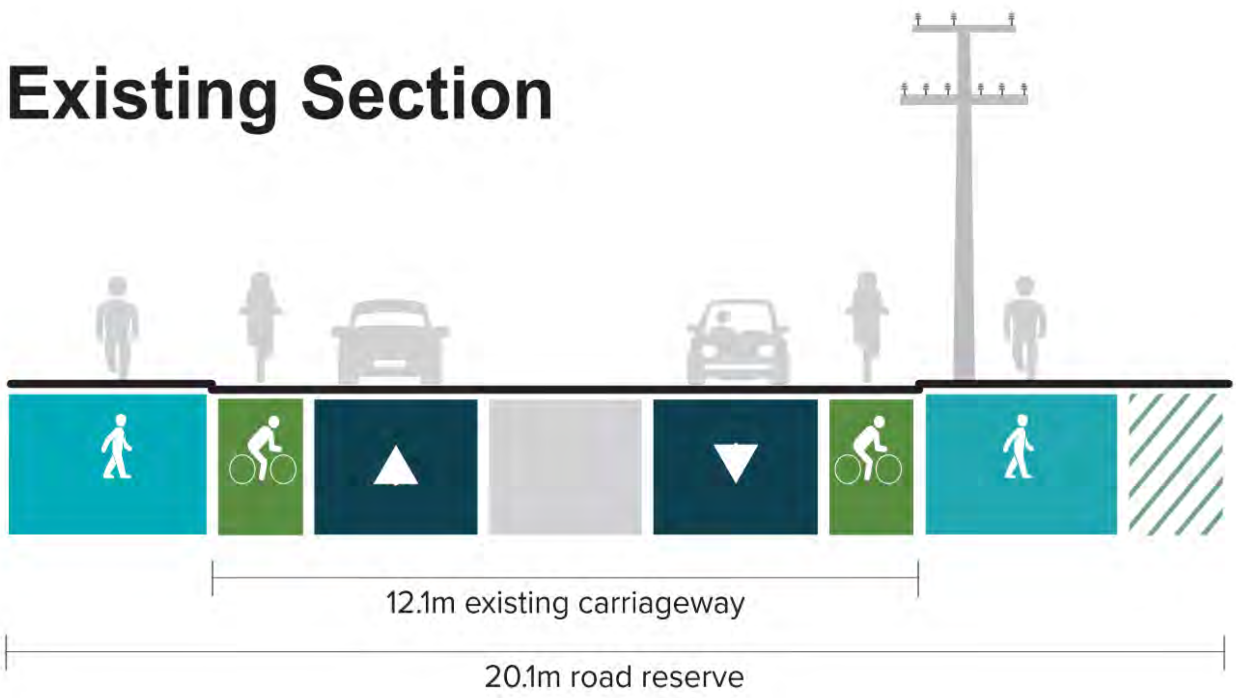
It should be noted that this option does not conform to AT’s current design standards, even if a design speed of 30kph were to be agreed as the basis of the design. Safety is noted as a major concern since there is the movement of cyclists and vehicles manoeuvring in and out of parking spaces, the parallel manoeuvres would occur within the cycle lane.

7.8 Segment C (Bayswater Avenue to Old Lake Road)

This segment is predominantly residential and forms part of the frequent bus route. South of Bayswater Avenue the traffic flows on Lake Road are lower than Segments A and B, as the total catchment area reduces. Pedestrian and cycle demand is high, particularly closer to Bayswater Avenue. The road reserve is typically 20.1m along the length of the segment.

The predominant land use along this segment is also low-density residential, except for Belmont shops. The existing cross-section is shown in Figure 7-26 It incorporates unprotected (sub-standard width) uni-directional cycle lanes.

Figure 7-26: Segment C - Existing Cross Section



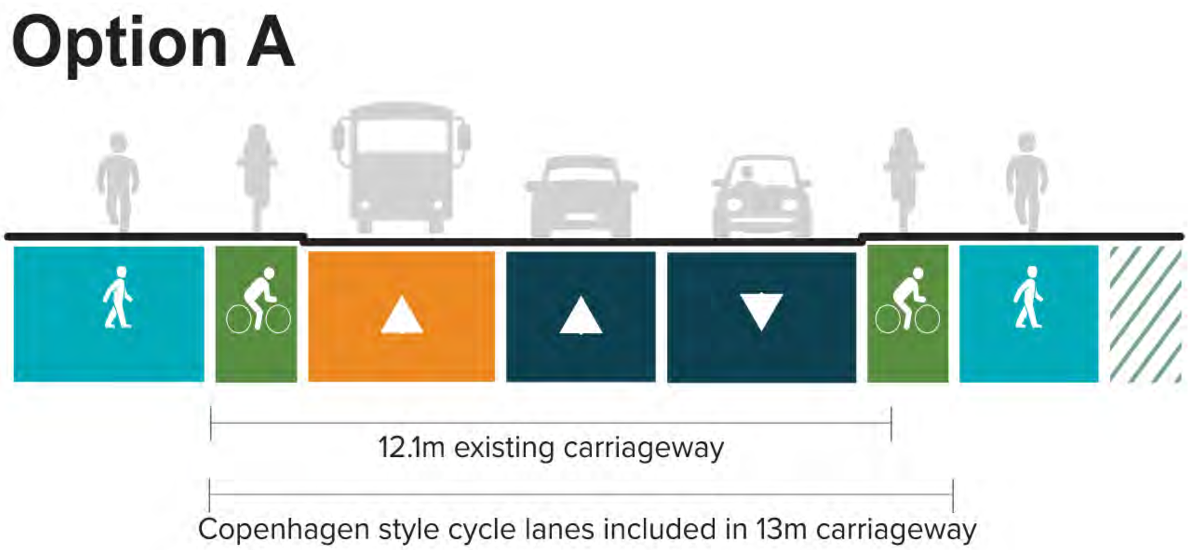
7.8.1 Short-listed Options

Three options were shortlisted for Segment C.

Option A (shown in Figure 7-27) involves the following changes:

- Removal of the central median
- Undergrounding of power lines
- Conversion of a general traffic lane to a transit lane in the northbound direction only
- Provide unprotected uni-directional cycle lanes.

Figure 7-27: Segment C - Option A

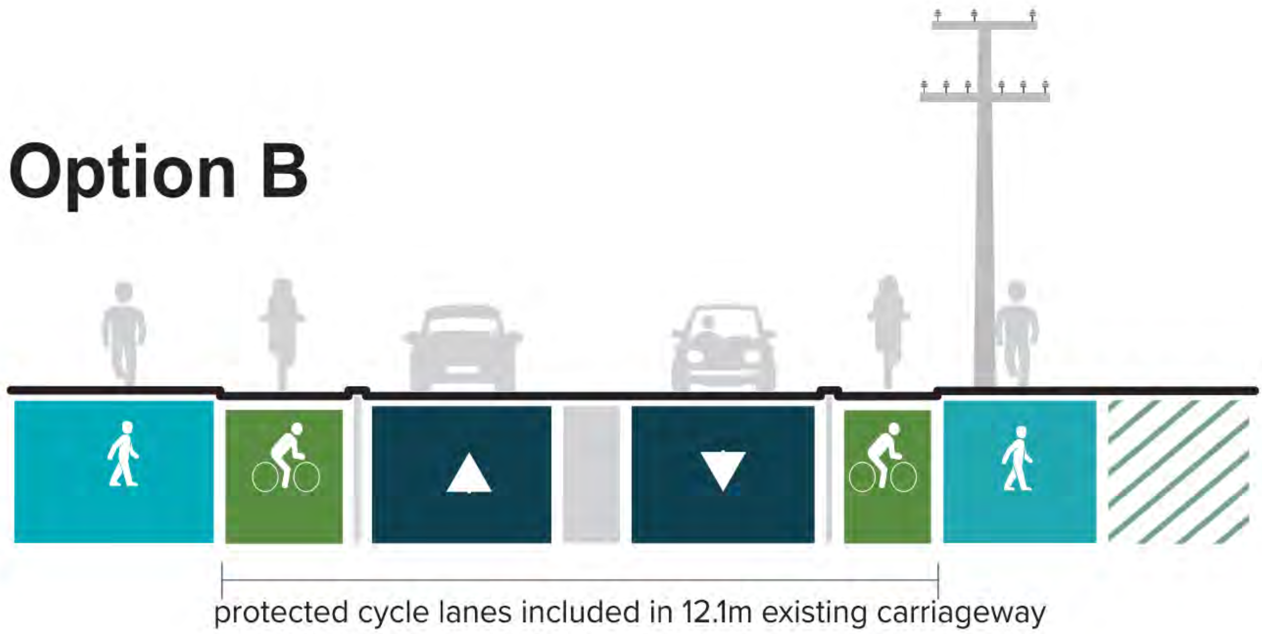


Option B (shown in Figure 7-28) requires the following changes:

- Narrowed central median

- Provide protected uni-directional cycle.

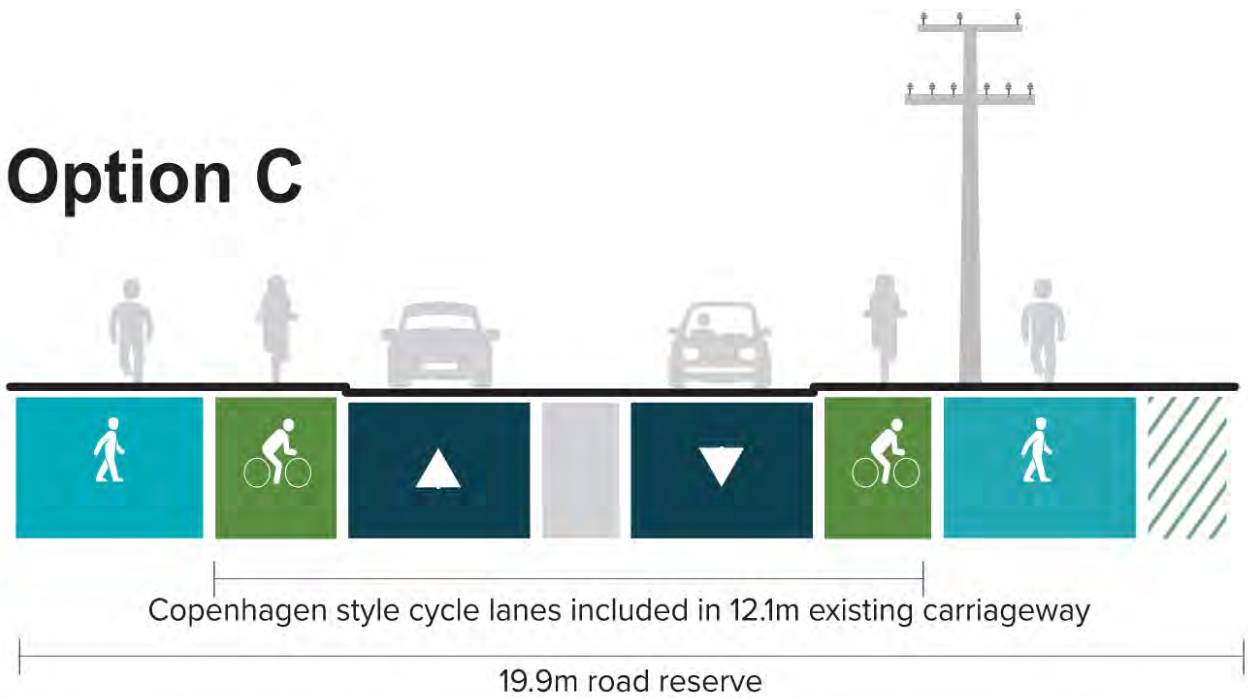
Figure 7-28: Segment C - Option B



Option C (shown in Figure 7-29): requires the following changes:

- Narrowed central median
- Provide a Copenhagen style uni-directional cycle.

Figure 7-29: Segment C - Option C



7.8.2 Preferred Concept Option

Based on the outcome of the MCA process it was concluded that Option C should be progressed for further option development for Segment C.

7.9 Lake Road / Old Lake Road

The existing intersection layout is shown in Figure 7-30.

Figure 7-30: Lake Road / Old Lake Road Intersection – Existing Layout

7.9.1 Options Short-listed

Two options were short-listed for the Lake Road/Old Lake Road intersection. Option 1 incorporating a new raised pedestrian crossing median on the south side of the intersection and five parking bays located on the west side of Lake Road (see Figure 7-31).

Figure 7-31: Lake Road / Old Lake Road Intersection - Option 1

Option 2 has traffic signal control, incorporating a pedestrian crossing facility on the south side of the intersection and removing all on-street car parking spaces provided in the vicinity of the intersection (see Figure 7-32).

Figure 7-32: Lake Road / Old Lake Road Intersection - Option 2

7.9.2 Preferred Concept Option

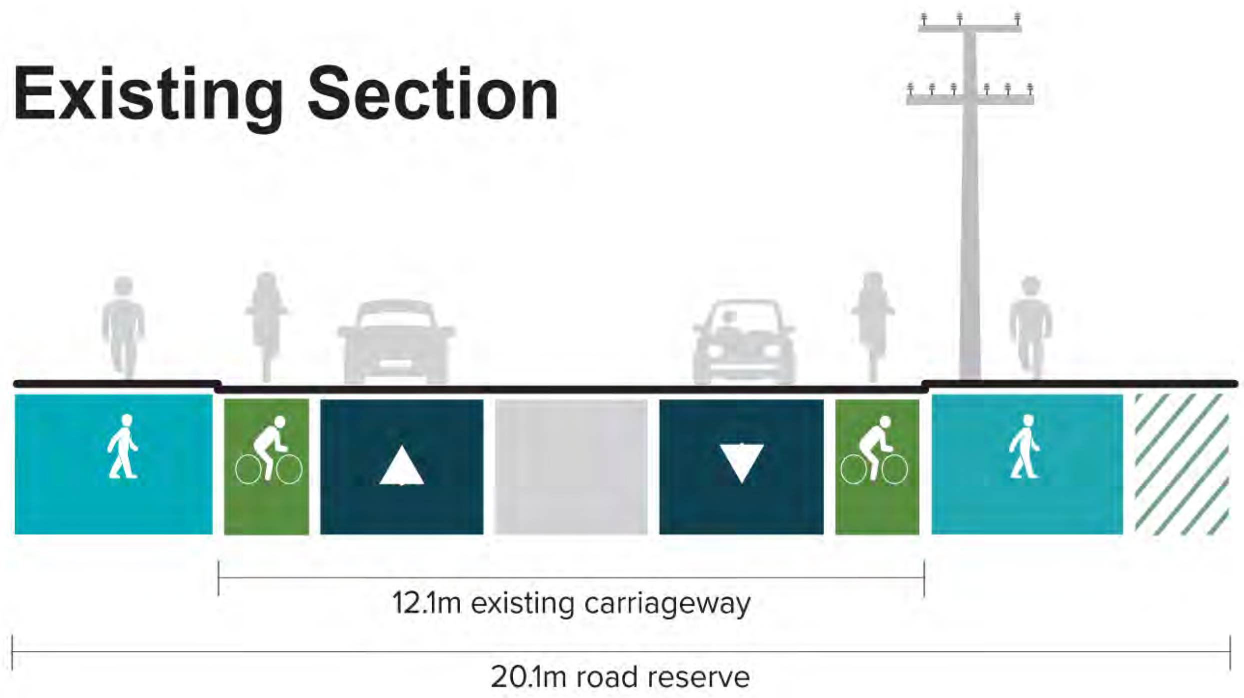
Based on the outcome of the MCA process it was concluded that Option 2 is the preferred concept option. Given that this option required the removal of some on-street parking, Option 1 was also presented to the community for comment.

7.10 Segment D (Old Lake Road – Seabreeze Road)

The segment is similar to that of Segment C but is not served by the frequent bus route between Takapuna and Devonport, as buses are routed to Devonport via Old Lake Road. The southern part of this segment forms part of the peninsula's 'green-route' cycling trail. The road reserve is approximately 20.1m along the length of the segment, except for the short section of the segment between Achilles Crescent and Hanlon Crescent which is narrower (typically 17.7m) and constrained by retaining walls on both sides of the road. Give the narrower width of this section of the segment, several additional options were developed specifically. These are described separately under Segment D1. Segment D incorporates unprotected (sub-standard width) uni-directional cycle lanes.

Land use along this segment is low-density residential, with the exception at Old Lake Road shops as described above. The existing cross-section is shown in Figure 7-33.

Figure 7-33: Segment D - Existing Cross Section



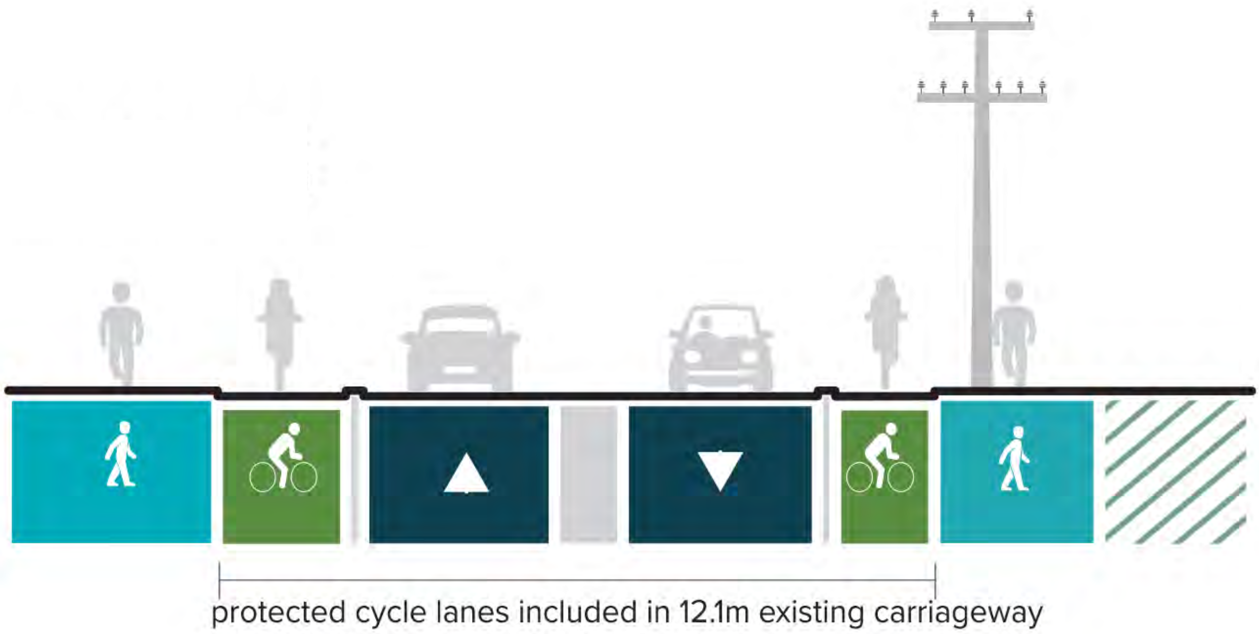
7.10.1 Short-listed Options

The options short-listed for Segment D are similar to Segment C.

Option A (shown in Figure 7-34) requires the following changes:

- Removal of the central median
- Uni-directional protected cycles lanes.

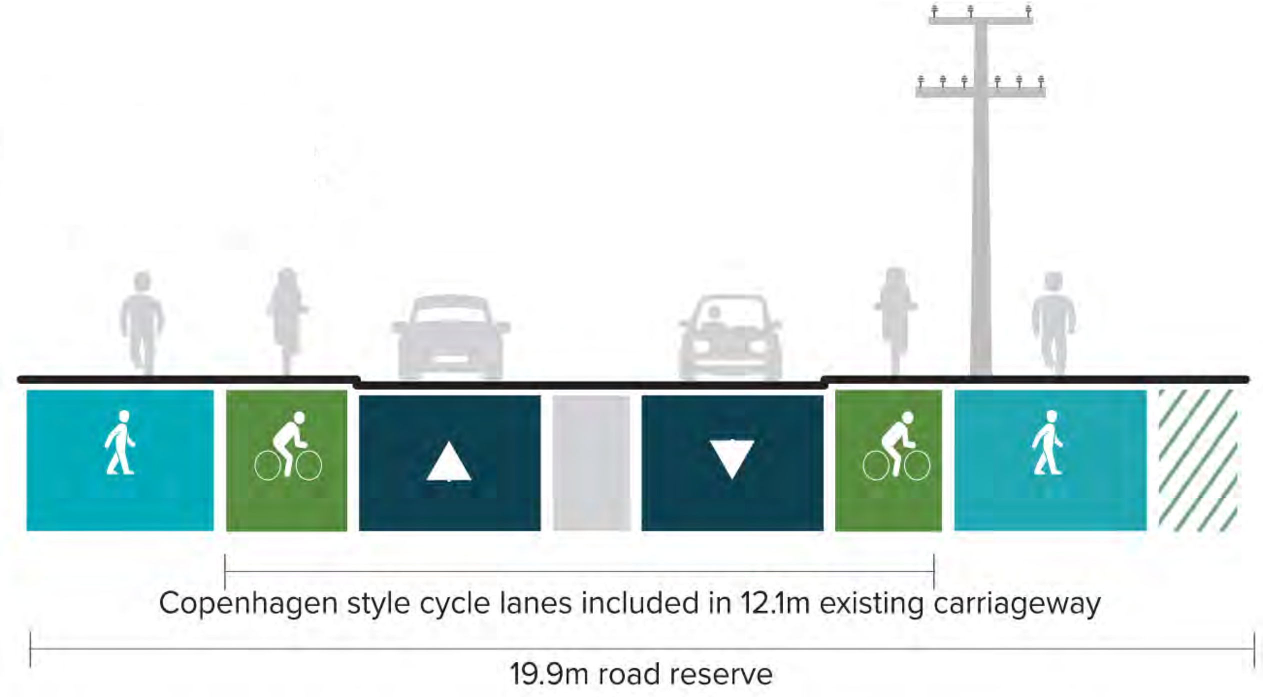
Figure 7-34: Lake Road Segment D - Option A



Option B (shown in Figure 7-35) requires the following changes:

- Removal of on-street car parking
- Copenhagen style uni-directional protected cycle lanes.

Figure 7-35: Segment D - Option B



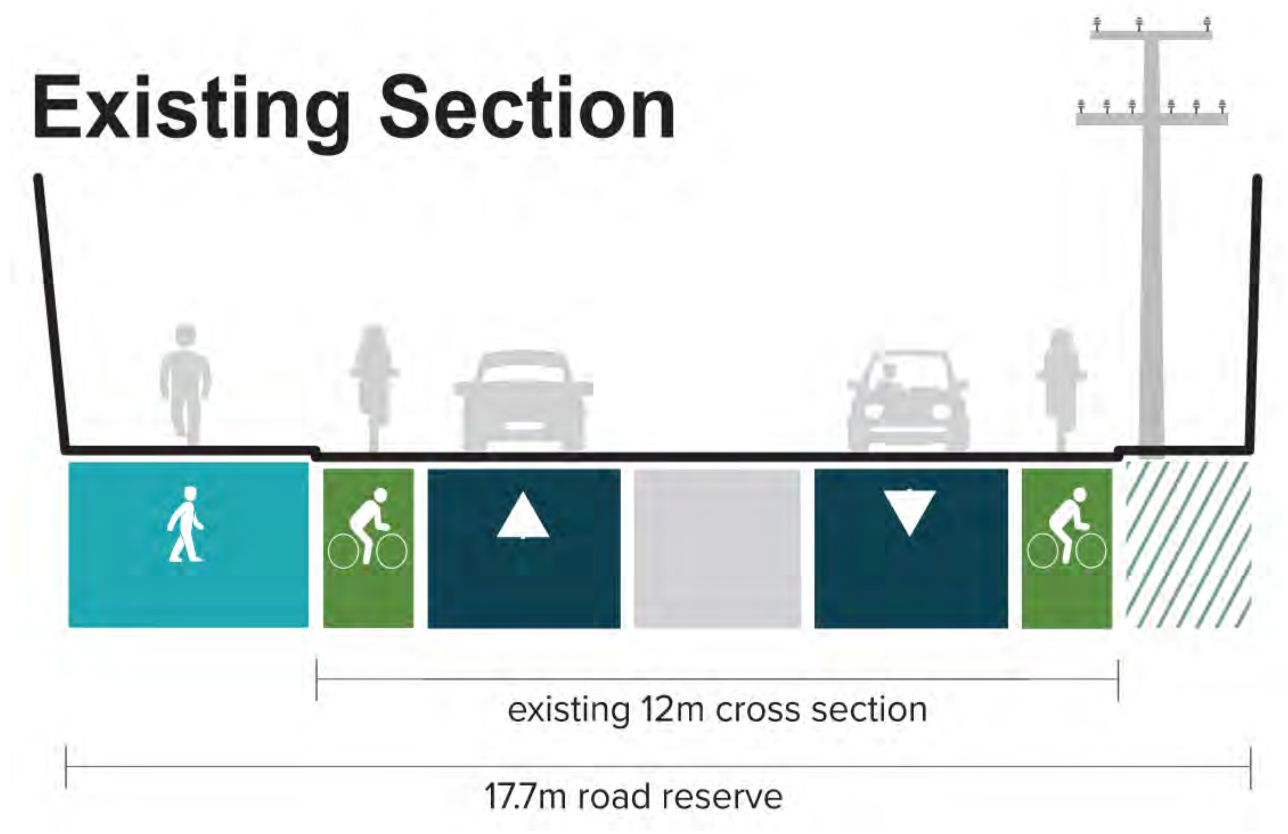
7.10.2 Preferred Concept Option

Option A and Option B scored equally in the MCA. Both options were therefore presented in community engagement.

7.11 Segment D1 (Achilles Crescent – Hendon Crescent)

This sub-segment is residential and is typically 17.7m along the length of the segment. The existing cross-section is shown in Figure 7-36. It incorporates unprotected (sub-standard) uni-directional cycle lanes.

Figure 7-36: Segment D1 – Existing Cross Section

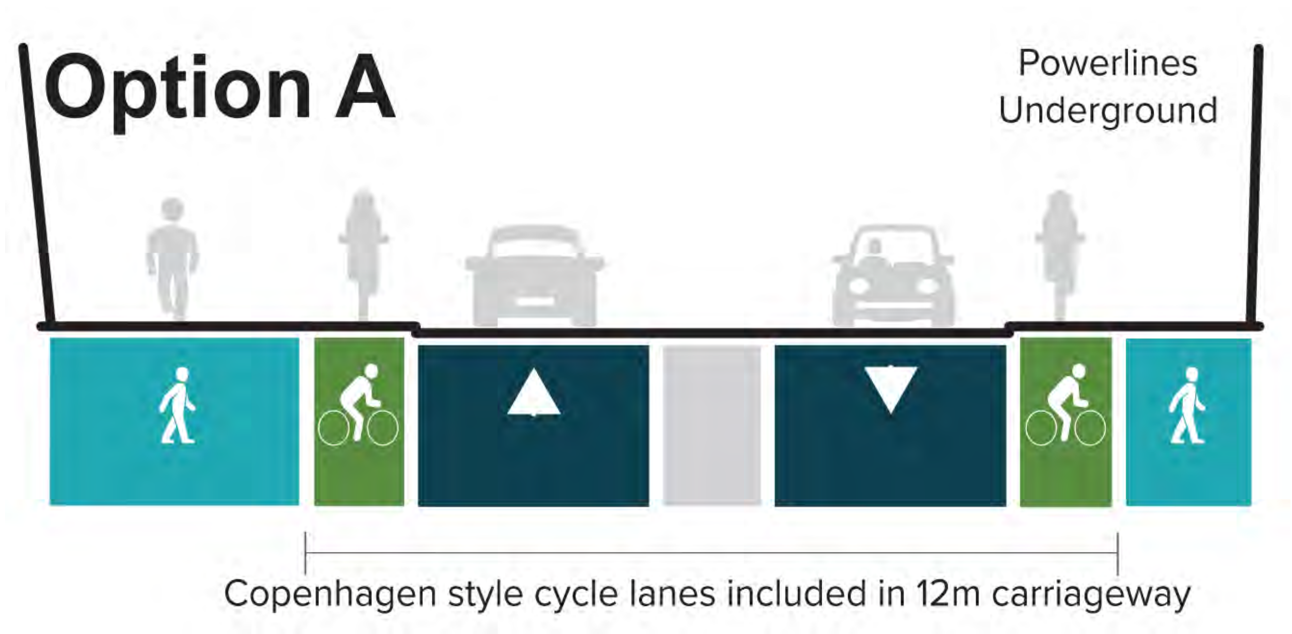


7.11.1 Short-listed Options

Three options were shortlisted for Segment C. Option A (shown in Figure 7-27 requires the following changes:

- Narrowing of the central median
- Undergrounding powerlines
- Provide unprotected uni-directional cycle lanes.

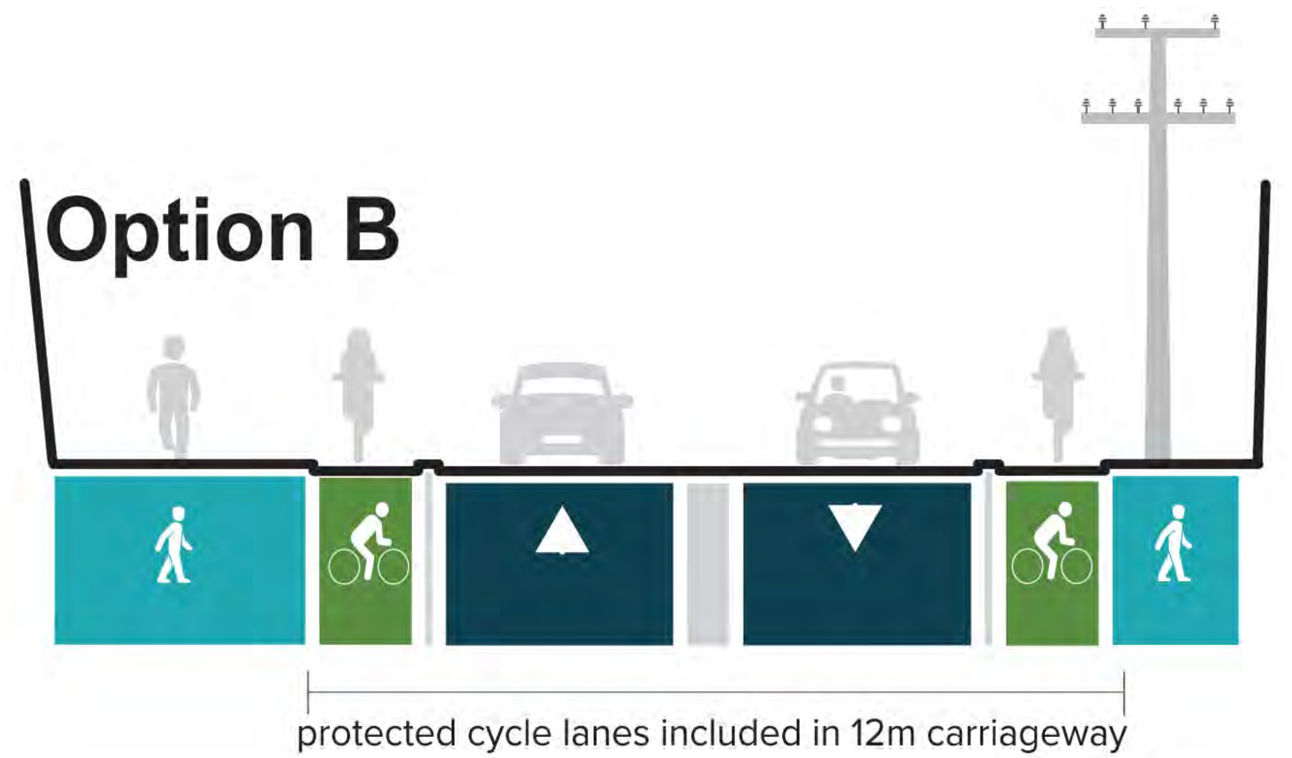
Figure 7-37: Segment D1 - Option A



Option B (shown in Figure 7-38) requires the following changes:

- Narrowing of the central median
- Uni-directional protected cycle lanes.

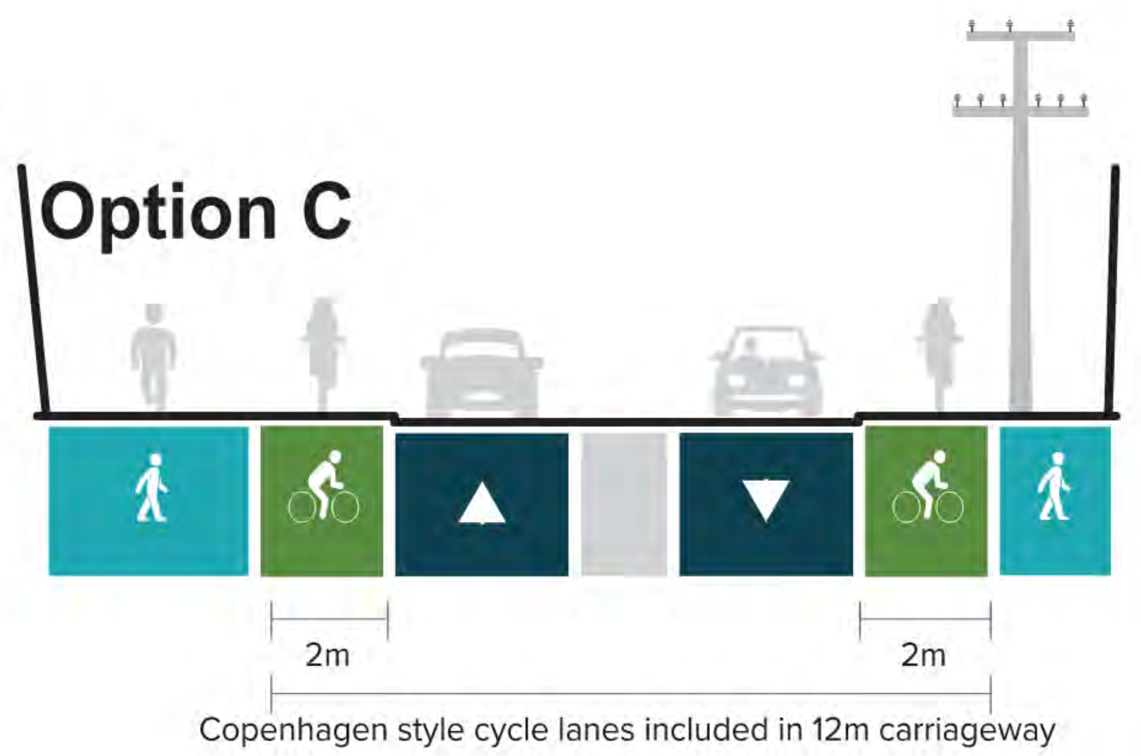
Figure 7-38: Segment D1 - Option B



Option C (shown in Figure 7-39) requires the following changes:

- Narrowing of the central median
- Provide Copenhagen style uni-directional cycle lanes.

Figure 7-39: Segment D1 - Option C



7.11.2 Preferred Concept Option

Based on the outcome of the MCA process it was concluded that Option C should be progressed for further option development for Segment D1.

7.12 Lake Road / Seabreeze Road

The existing intersection layout is shown in Figure 7-40.

Figure 7-40: Lake Road / Seabreeze Road Intersection – Existing Layout

7.12.1 Options Short-listed

Two options were short-listed for the Lake Road/Seabreeze Road intersection. Option 1 incorporates a new traffic signal-controlled pedestrian and cycle (Toucan) crossing located approximately 20m to the south of the intersection, to allow pedestrians to cross the road and providing a transition between the bi-directional cycle facility proposed to the north of the intersection and the two-way cycle facility proposed to the south of the intersection (see Figure 7-41).

Figure 7-41: Lake Road / Seabreeze Road Intersection - Option 1

Option 2 is the same as Option 1 but incorporates a narrowing and minor realignment of the Seabreeze Road approach to the intersection (Figure 7-42).

Figure 7-42: Lake Road / Seabreeze Road Intersection - Option 2

7.12.2 Preferred Concept Option

Based on the outcome of the MCA process it was concluded that Option 2, incorporating a new signal-controlled crossing on Lake Road south of the intersection and Seabreeze Road realigned to form more of a right-angled intersection, should be progressed for further option development.

7.13 Segment E (Seabreeze Road to Ariho Terrace)

This segment of the carriageway is distinctive in its park-like nature. The surrounding land use is recreational with a short section of light industry at the southern end. This segment has a similar transport demand to Segment D. The road reserve along this segment widens out to 30.2m through the park.

This segment has a distinctive park nature. It provides access to Ngataringa Park, forms part of the cycle 'Green Route' as well as providing a memorial function commemorating local people who lost their lives in the Second World War. The existing cross-section is shown in Figure 7-43. It incorporates unprotected (sub-standard) uni-directional lanes and parking prevision on the west (northbound) side of the road.

Figure 7-43: Segment E - Existing Cross Section

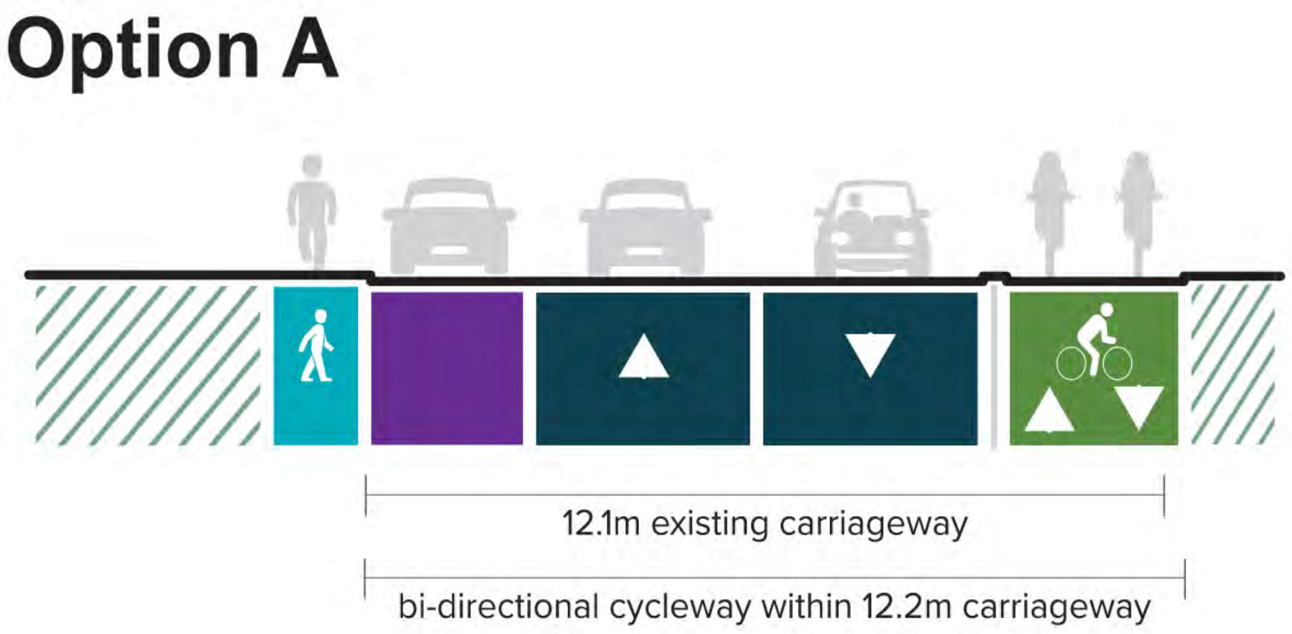
7.13.1 Short-listed Options

Three options were shortlisted for Segment E. It should be noted that on-street parking is seen as being better accommodated by side streets and off-street facilities.

Option A (shown in Figure 7-44) requires the following changes:

- Removal of the central median
- Protected bi-directional cycle lanes.

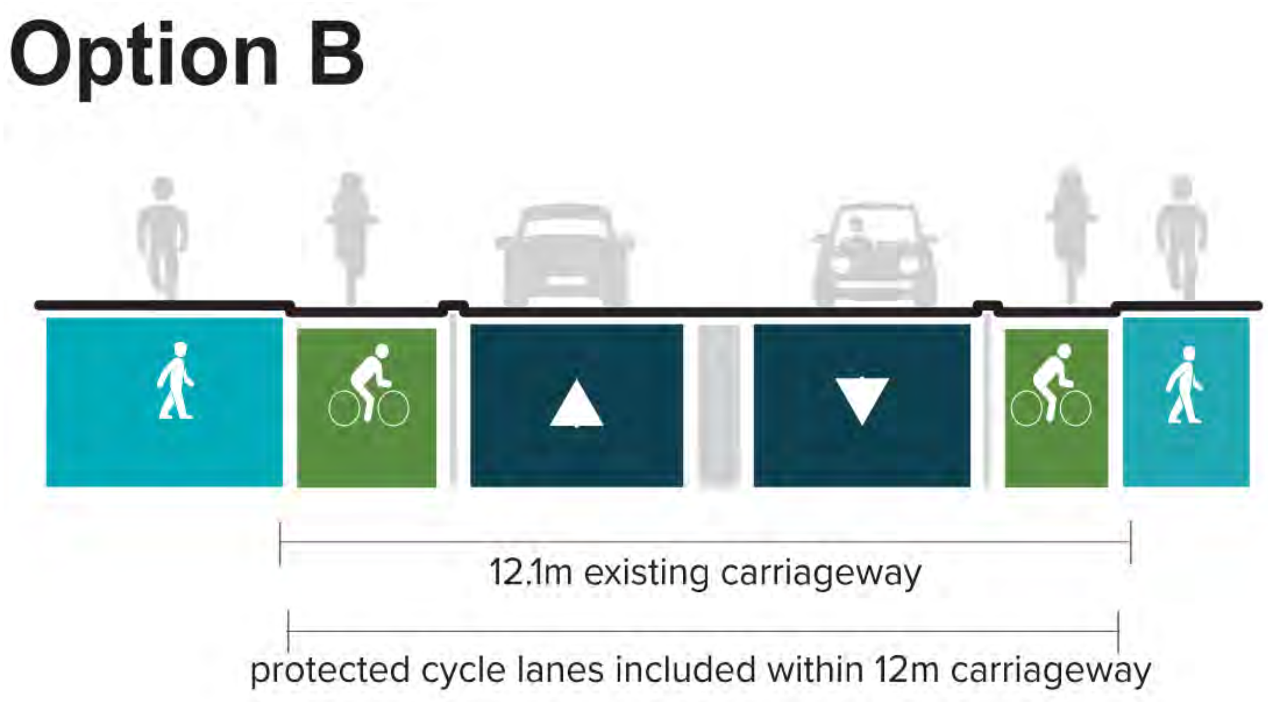
Figure 7-44: Segment E - Option A



Option B (shown in Figure 7-45) requires the following changes:

- Narrowing of central median to 0.8m
- Protected uni-directional cycle lanes.

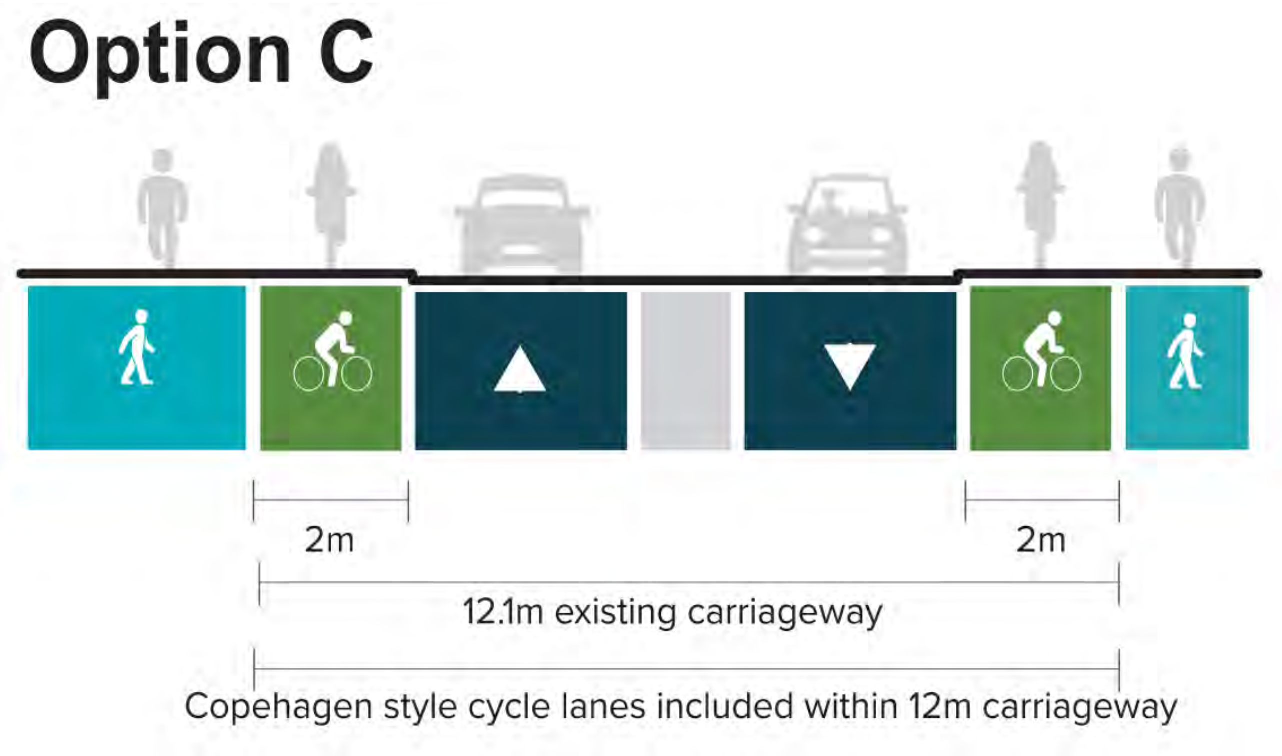
Figure 7-45: Segment E - Option B



Option C (shown in Figure 7-46) requires the following changes:

- Narrowing of central median to 1.8m
- Copenhagen style uni-directional cycle lanes.

Figure 7-46: Segment E - Option C



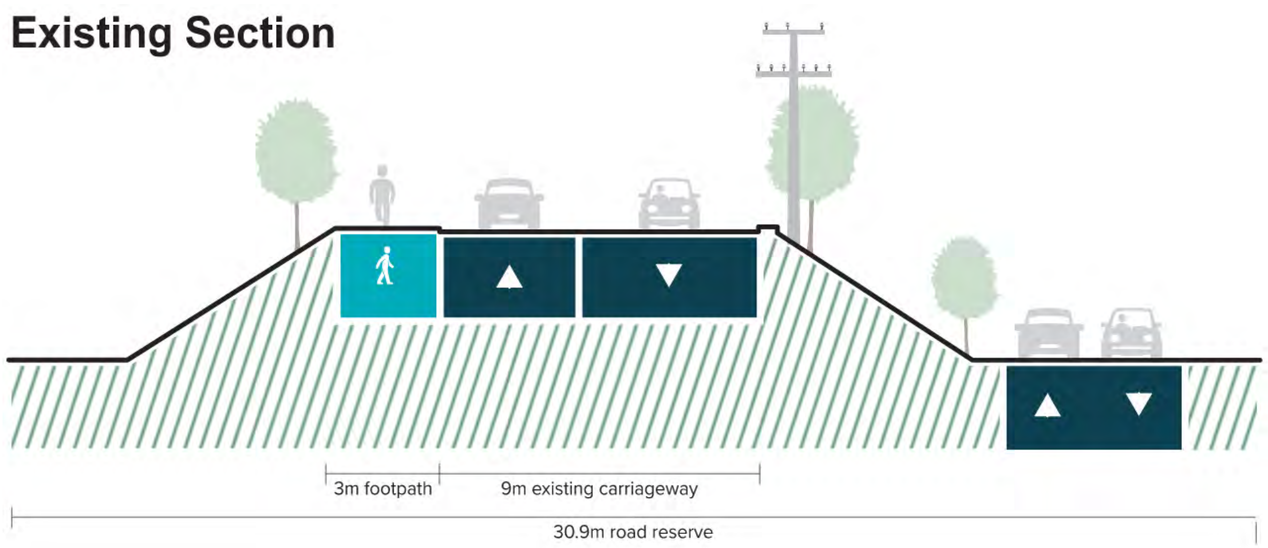
7.13.2 Preferred Concept Option

Based on the outcome of the MCA process it was concluded that Option A should be progressed for further option development for Segment E.

7.14 Segment F (Ariho Terrace to Albert Road)

The southernmost segment is characterised by low-density residential land use and a lack of driveways leading directly onto Lake Road. Slip lanes on one or both sides of the road provide access to adjacent residential properties. The road reserve widens out to approximately 30.9m, as shown in Figure 7-47. No on-road cycle lanes or central median exists.

Figure 7-47: Segment F - Existing Cross Section



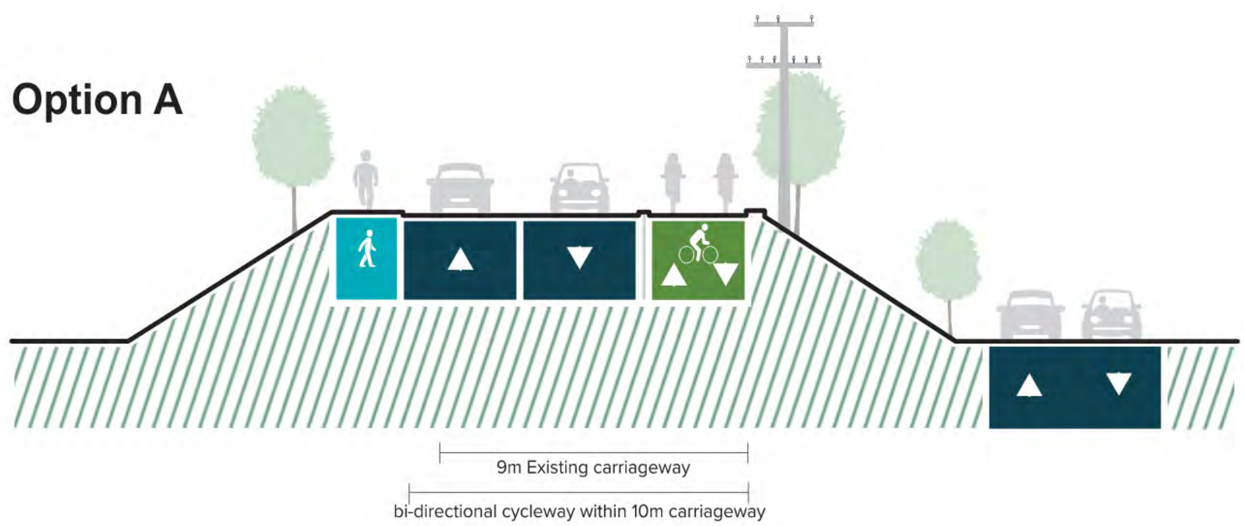
7.14.1 Options Short-listed

Three options were shortlisted for Segment F.

Option A (shown in Figure 7-48) requires the following changes:

- Footpath and traffic lanes narrowed
- Western side kerb line relocated further to the west
- Protected bi-directional cycle lane.

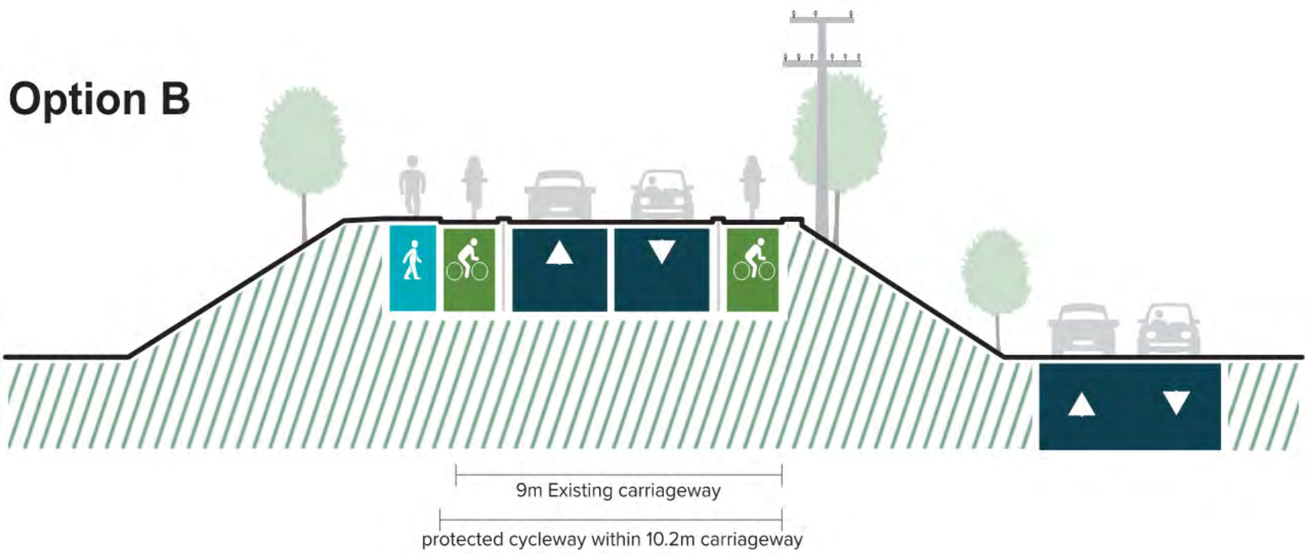
Figure 7-48: Segment F - Option A



Option B (shown in Figure 7-49) requires the following changes:

- Footpath and road narrowed (with the western side kerb line moved)
- Protected uni-directional cycle lanes (sub-standard width).

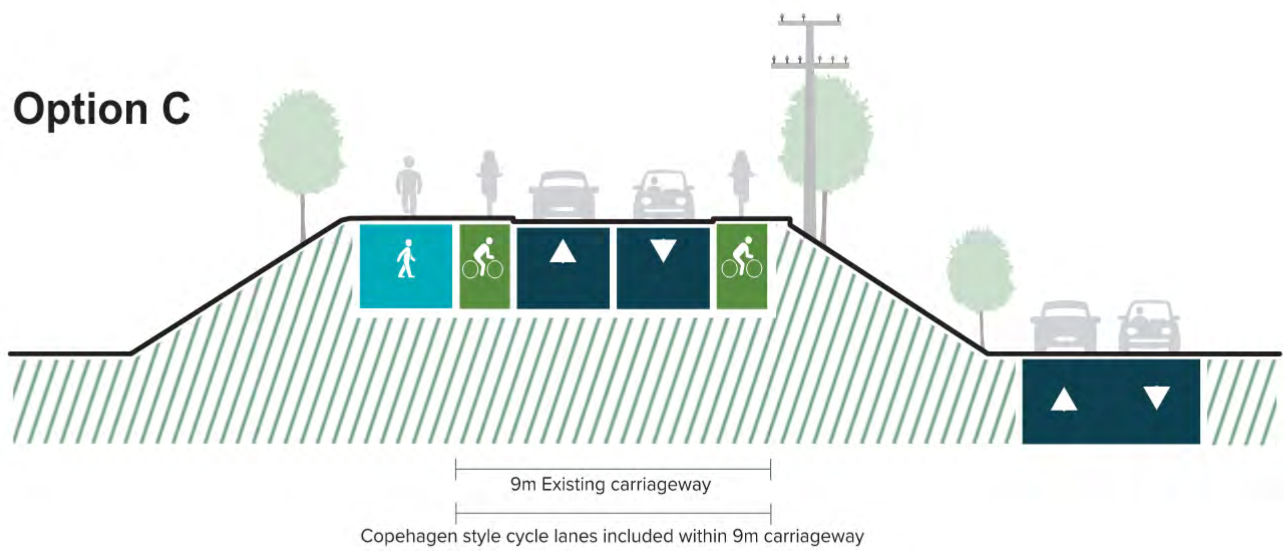
Figure 7-49: Segment F - Option B



Option C (shown in Figure 7-50) requires the following changes:

- Road narrowed
- Unprotected (sub-standard width) uni-directional cycle lanes.

Figure 7-50: Segment F - Option C



7.14.2 Preferred Concept Option

The MCA indicated that Option C should be progressed for further option development for Segment F. However, Option A was presented in community engagement as this is compatible with the option selected for the Seabreeze – Ariho Terrace segment (i.e. Option A).

7.15 Lake Road / Albert Road

The existing intersection layout is shown in Figure 7-51.

Figure 7-51 Lake Road / Albert Road Roundabout – Existing Layout

7.15.1 Options Short-listed

Five options were short-listed for the Lake Road/Albert Road roundabout:

Option 1 retains the existing roundabout but incorporating a pedestrian/cycle crossing facility on Albert Road, approximately 30m to the east of the roundabout (see Figure 7-52).

Figure 7-52 Lake Road / Albert Road Roundabout Option 1

Option 1A is the same as Option 1, but also incorporating a pedestrian/cycle crossing facility on Lake Road, approximately 40m to the north of the roundabout (see Figure 7-53).

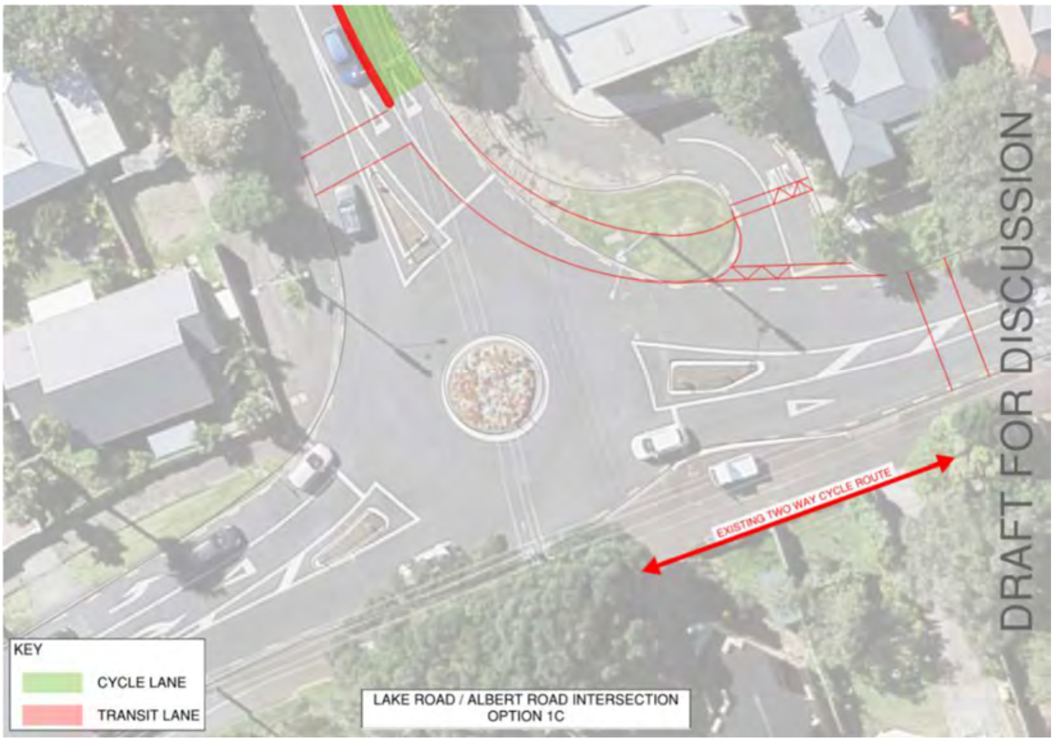
Figure 7-53 Lake Road / Albert Road Roundabout Option 1A

Option 1B is a further variant of Option 1, but also incorporating a pedestrian/cycle crossing facility on Albert Road, approximately 40m to the west of the roundabout (see Figure 7-54).

Figure 7-54 Lake Road / Albert Road Roundabout Option 1B

Option 1C is a variant of Option 1 but incorporates a pedestrian/cycle crossing facility on Albert Road, approximately 60m to the east of the roundabout and a pedestrian/cycle crossing facility on Lake Road, approximately 40m to the north of the roundabout (see Figure 7-55).

Figure 7-55 Lake Road / Albert Road Roundabout Option 1C



Option 2 replaces the existing roundabout with a traffic signal-controlled intersection incorporating pedestrian crossing facilities on the Lake Road and Albert Road (east) approaches to the intersection (see Figure 7-56).

Figure 7-56 Lake Road / Albert Road Roundabout Option 2

Option 3 reconfiguring the intersection so that the traffic entering the intersection from the Albert Road (east) approach must give way to traffic and incorporating pedestrian crossing facilities on the Lake Road and Albert Road (east) approaches to the intersection (see Figure 7-57).

Figure 7-57 Lake Road / Albert Road Roundabout Option 3

7.15.2 Preferred Concept Option

Based on the outcome of the MCA process it was concluded that Option 1A and Option 1C should be progressed for further option development.

8 Development of Options for Bayswater Avenue

8.1 Mid-Block Segments Considered

For option development, Bayswater Avenue was divided into three main segments. As shown in Figure 8-1. They are:

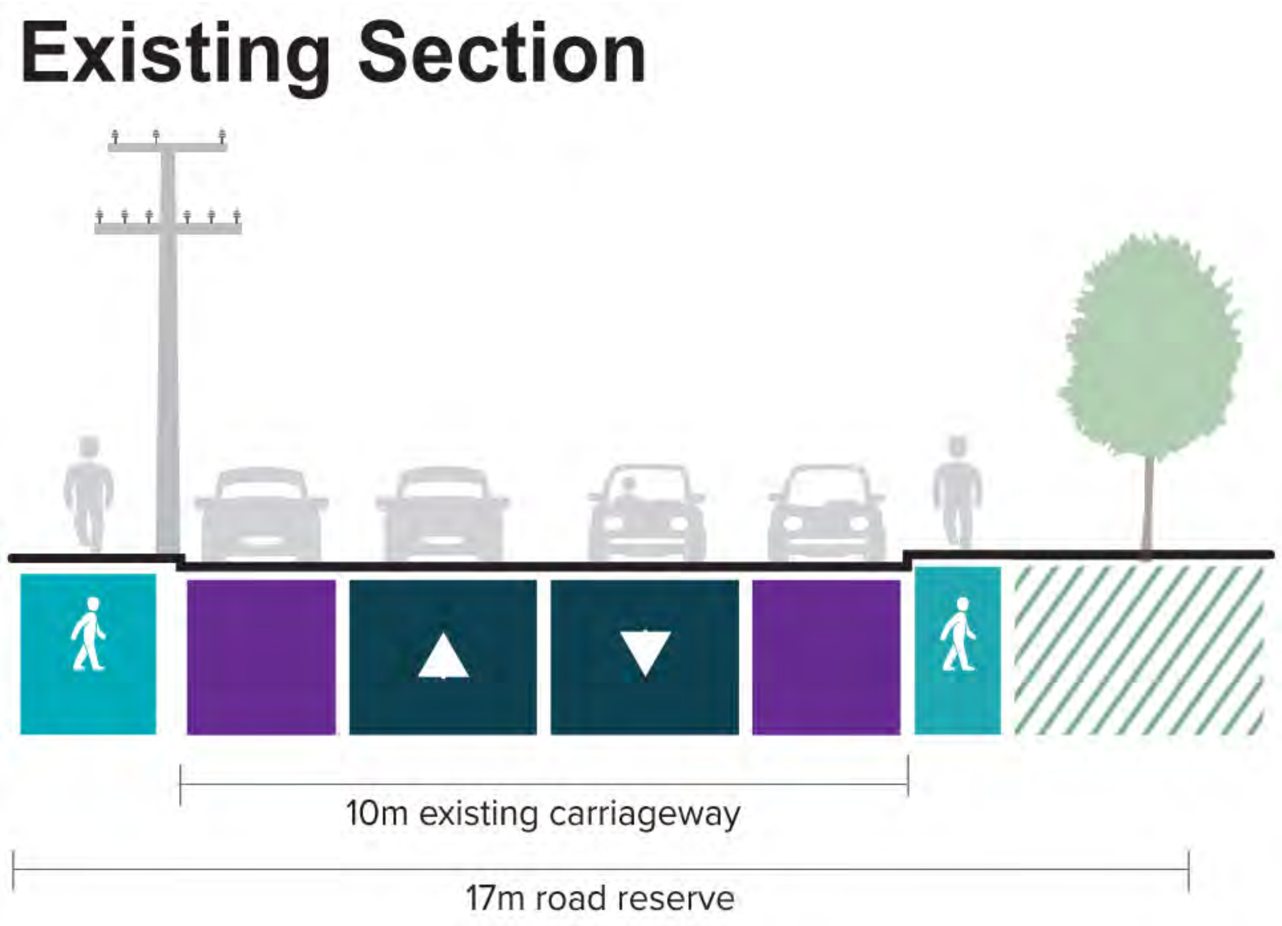
- Between Moana Avenue (Bayswater Primary School) and 179 Bayswater Avenue) – henceforth referred to as Bayswater Avenue Eastern Segment
- Between 179 and 11 Bayswater Avenue – henceforth referred to as Bayswater Avenue Central Segment
- Between 11 Bayswater Avenue and Beresford Street – henceforth referred to as Bayswater Avenue Western Segment.

Figure 8-1: Bayswater Avenue Segments

8.2 Eastern Segment

The Eastern Segment of Bayswater Avenue is predominantly residential with a primary school. The road reserve is approximately 17m wide. The existing cross-section is shown in Figure 8-2.

Figure 8-2: Eastern Segment – Existing Cross Section



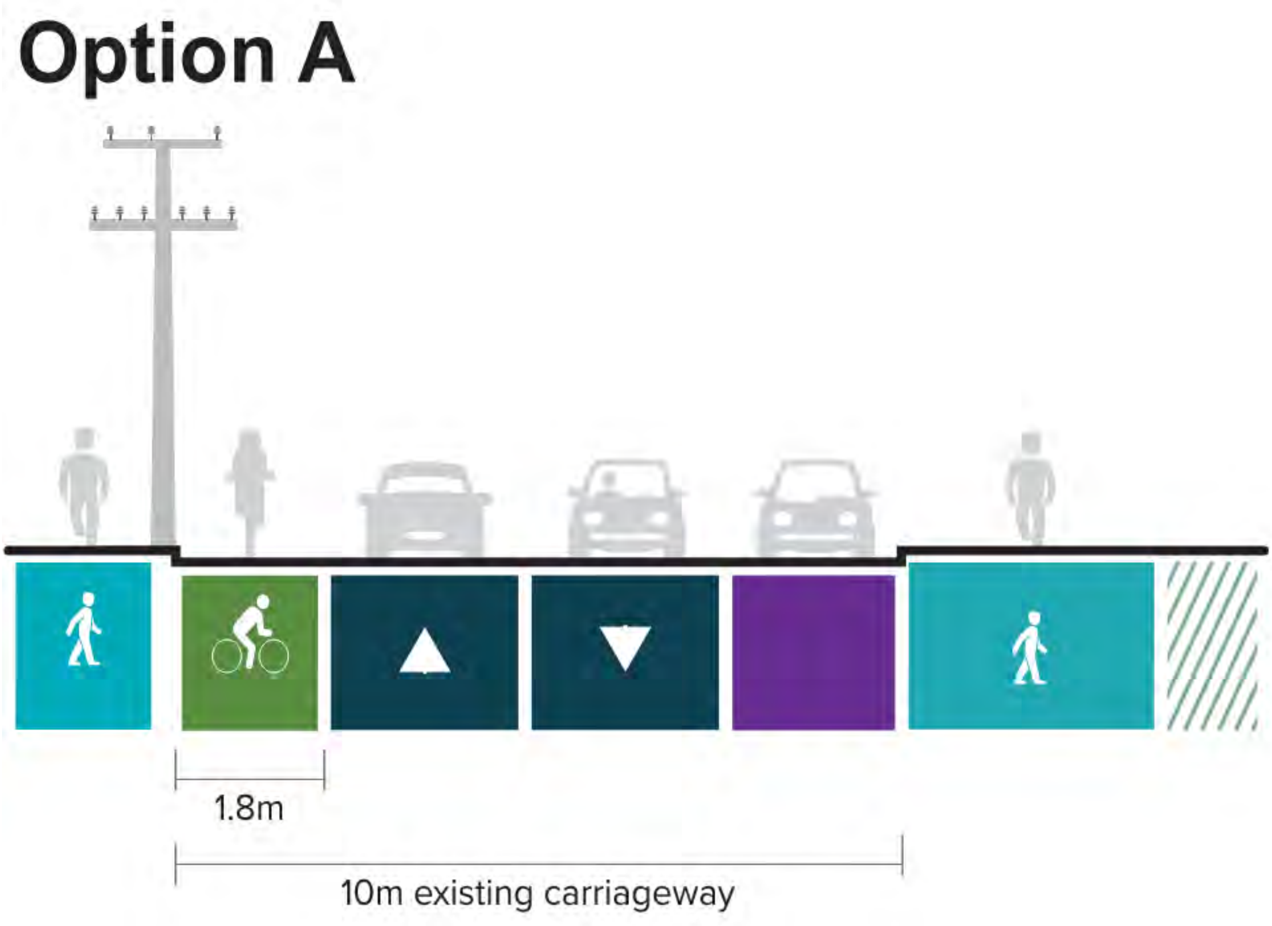
8.2.1 Options Short-listed

Four options were shortlisted for the Eastern Segment:

Option A (shown in Figure 8-3) requires the following changes:

- The footpath on the south side of the road is widened into the berm to provide a shared path (for westbound cyclists to use)
- Tree trimmed or possibly removed to accommodate shared path
- On-street parking is removed from the north side of the road to provide an on-road cycle lane.

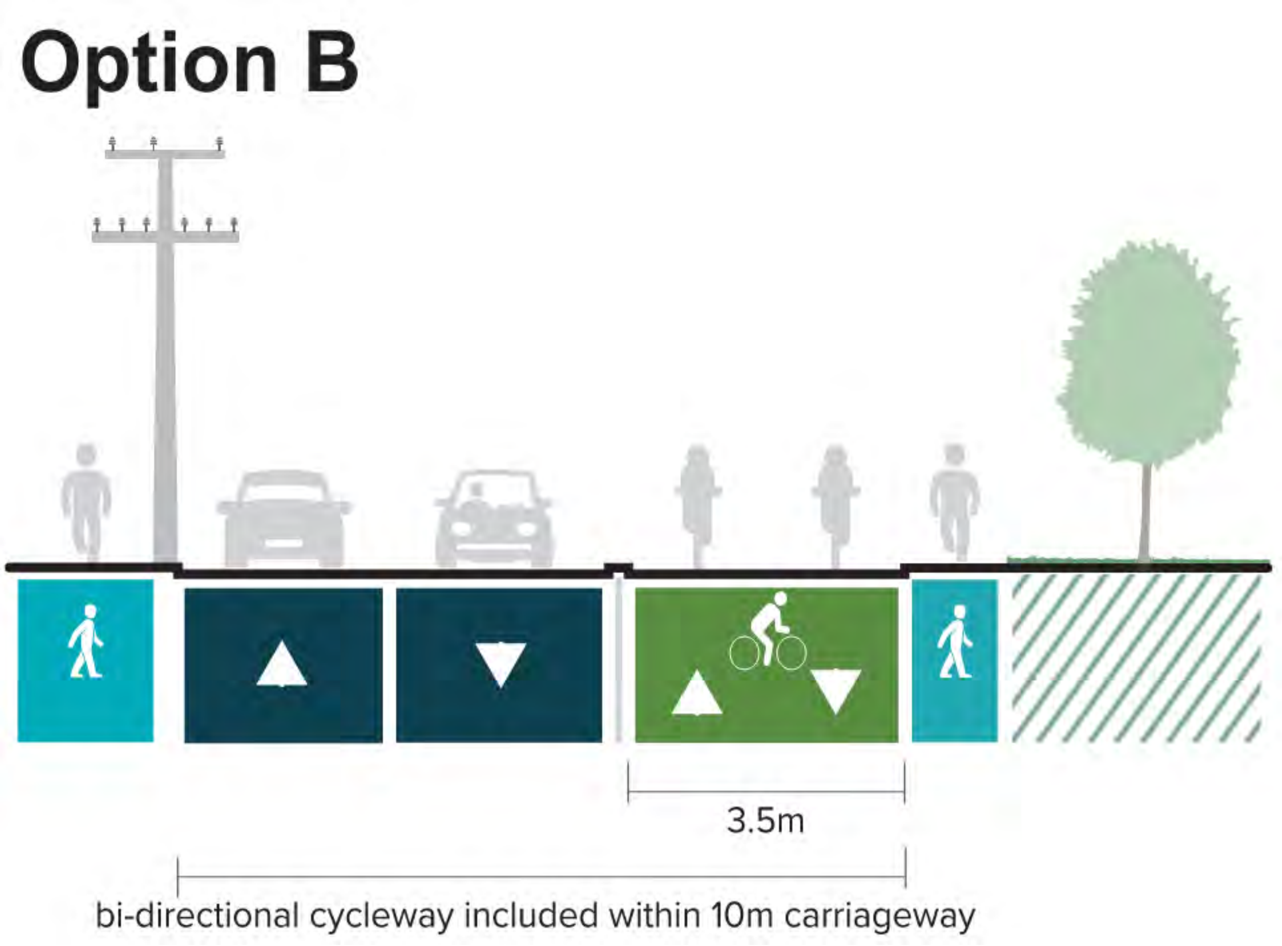
Figure 8-3 Eastern Segment - Option A



Option B (shown in Figure 8-4) requires the following changes:

- Provides a bi-directional separated cycle path on the south side of the road
- On-street parking is removed from both sides of the road.

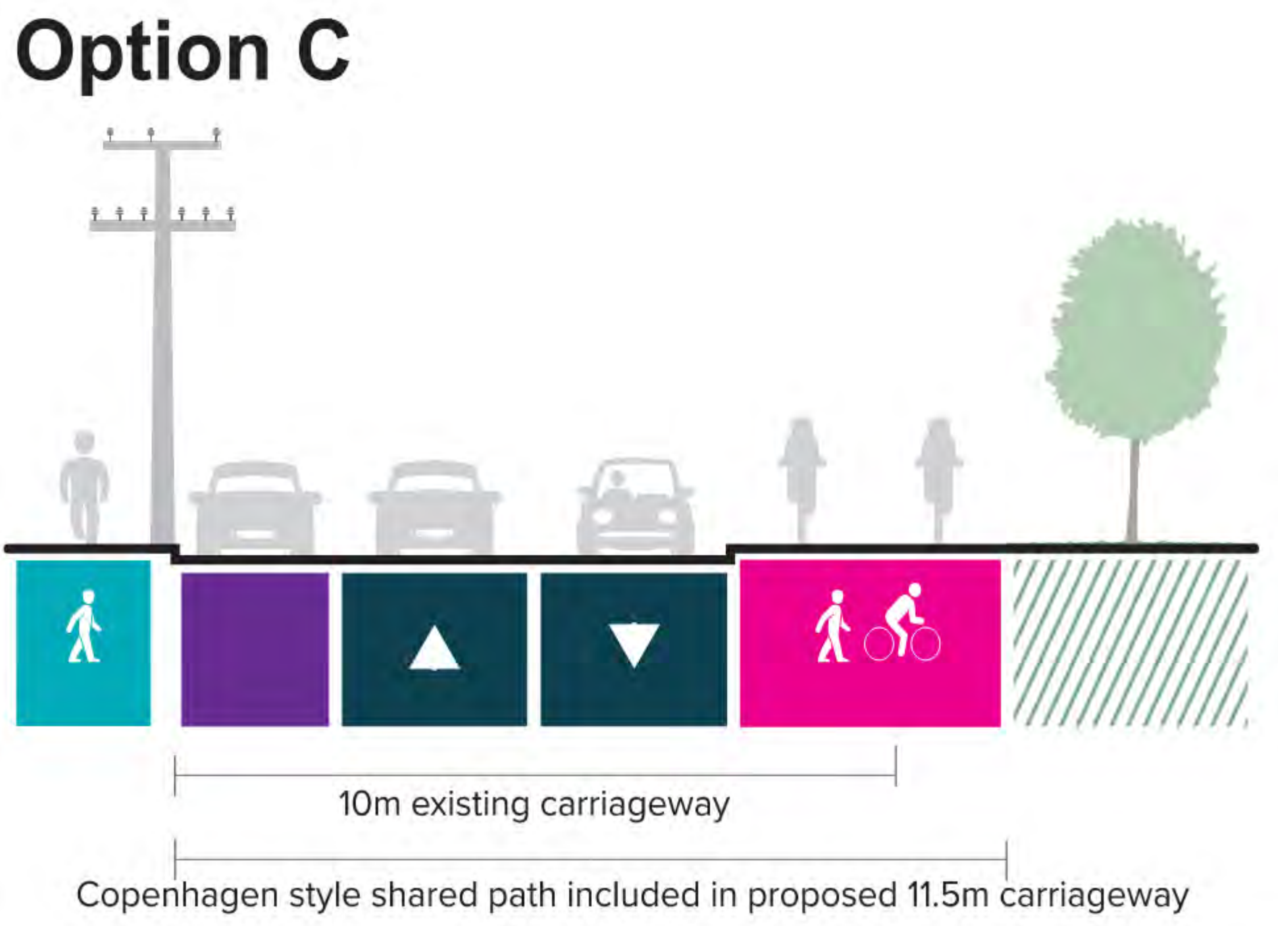
Figure 8-4: Eastern Segment - Option B



Option C (shown in Figure 8-5) requires the following changes:

- Provides a bi-directional shared path
- On-street parking is removed from the south side of the road.

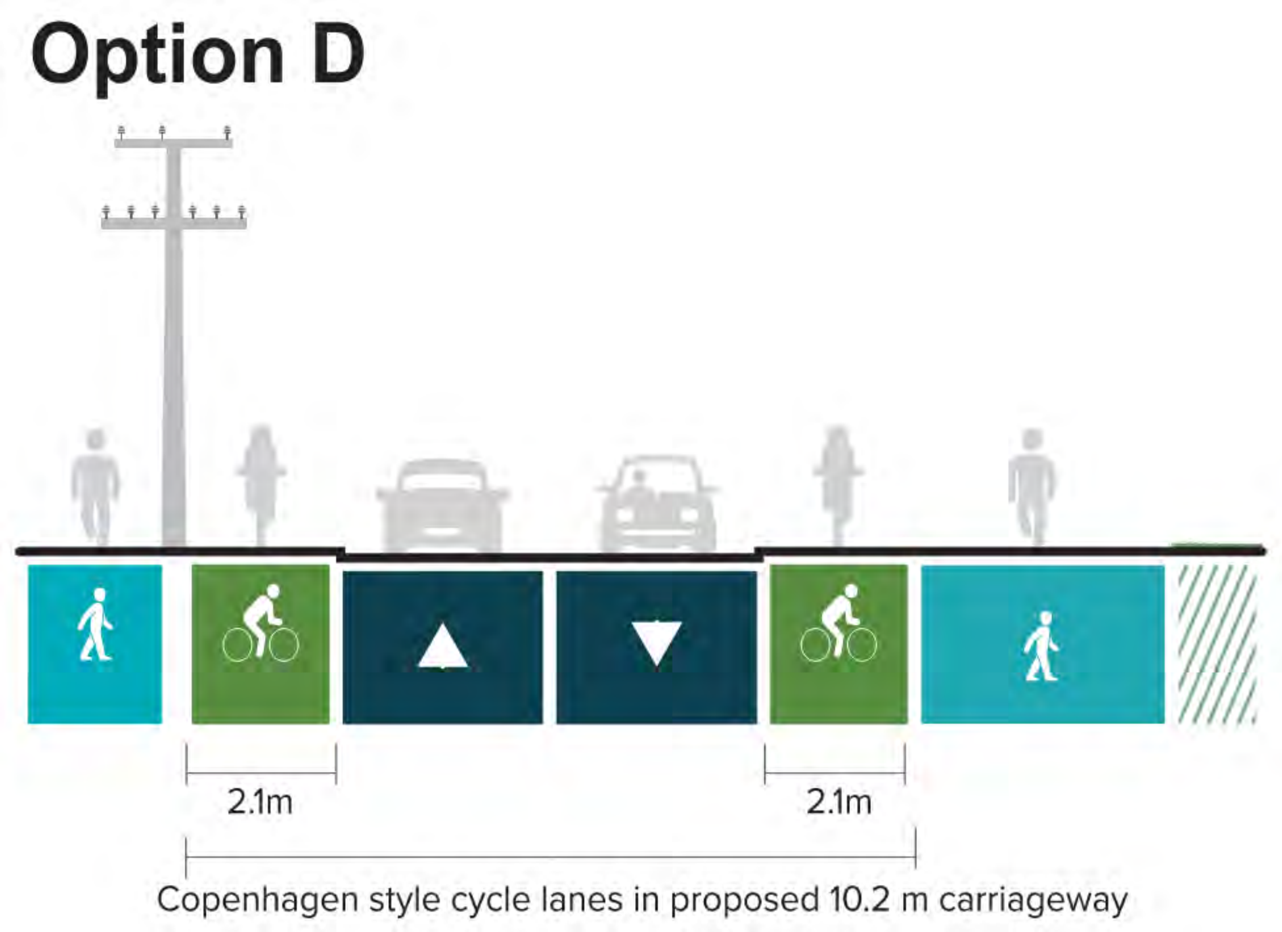
Figure 8-5: Eastern Segment - Option C



Option D (shown in Figure 8-6) requires the following changes:

- Provides a Copenhagen style uni-directional cycle lane
- On-street parking is removed from both sides of the road.

Figure 8-6: Eastern Segment - Option D



8.2.2 Preferred Concept Option

Based on the outcome of the MCA process it was concluded that Option A or C were the preferred options for the Eastern Segment. Option C was selected in preference to Option A, to avoid the need to remove trees.

8.3 Central Segment

The Central Segment of Bayswater Avenue is predominantly residential. The road reserve is approximately 16m wide. The existing cross-section is shown in Figure 8-7.

Figure 8-7: Central Segment – Existing Cross Section

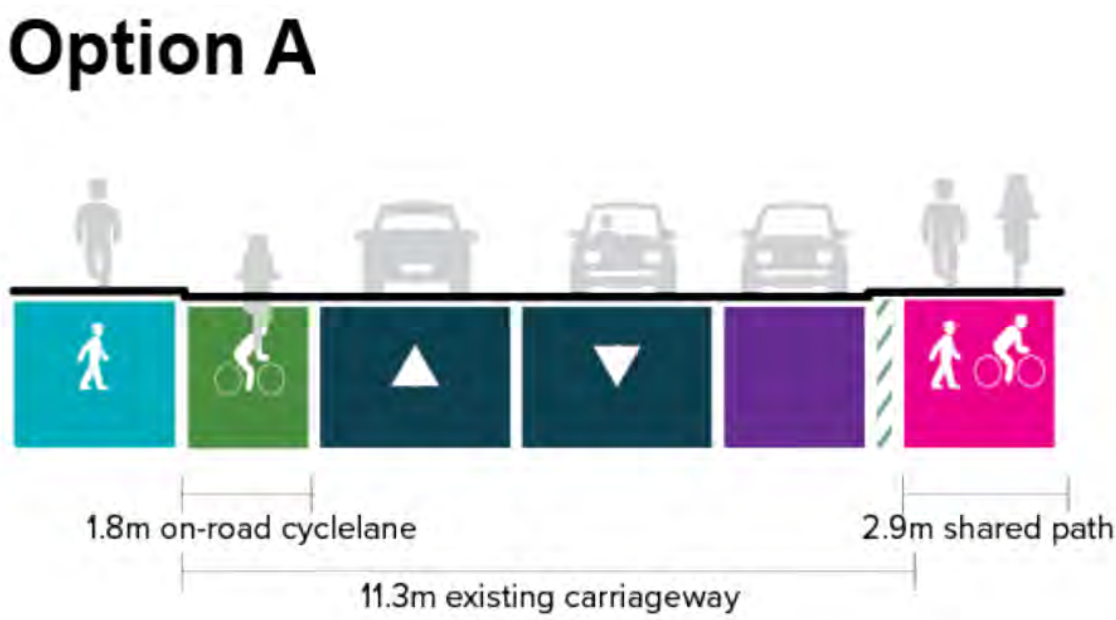
8.3.1 Options Short-listed

Three options were shortlisted for the Central Segment.

Option A (shown in Figure 8-8) requires the following changes:

- The existing footpath is widened to accommodate pedestrians, scooters and cycles.
- An eastbound, on-road unprotected cycle lane is provided
- On-street parking is removed from the north side of the road.

Figure 8-8: Central Segment - Option



Option B (shown in Figure 8-9) requires the following changes:

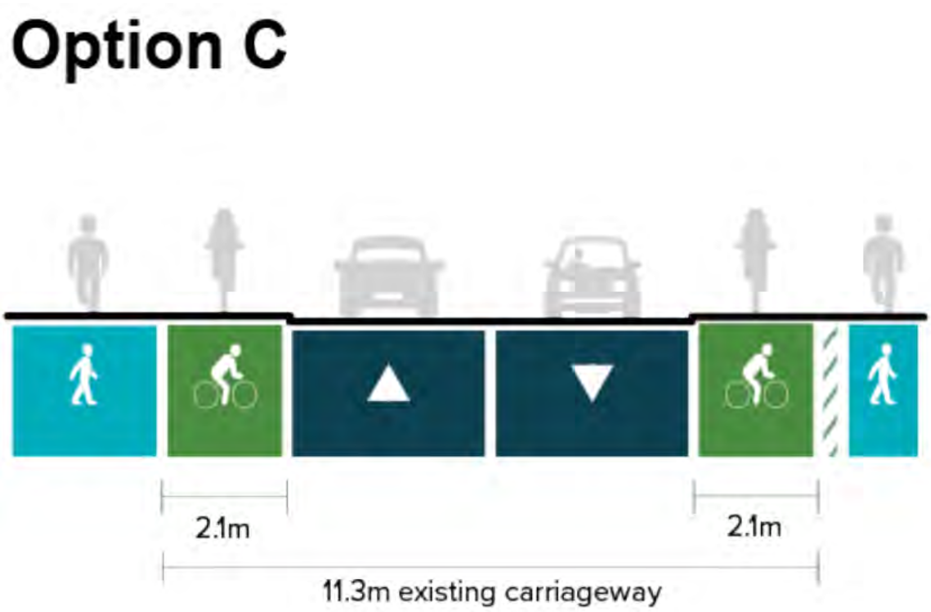
- On-street parking is removed from the south side of the road
- A bi-directional cycleway is provided on the south side of the road.

Figure 8-9: Central Segment - Option B

Option C (shown in Figure 8-10) requires the following changes:

- On-street parking is removed from both sides of the road
- Copenhagen style uni-directional cycle lanes are provided.

Figure 8-10: Central Segment - Option C



8.3.2 Preferred Concept Option

Based on the outcome of the MCA process, Option A or B were ranked the same. Option B was chosen in preference to Option A, to be consistent with the cross-section chosen for the Eastern Segment (i.e. Option C which incorporates a bi-directional cycle facility).

8.4 Western Segment

The Western Segment of Bayswater Avenue is predominantly residential. The road reserve is approximately 19m wide. The existing cross-section is shown in Figure 8-11.

Figure 8-11: Western Segment – Existing Cross Section

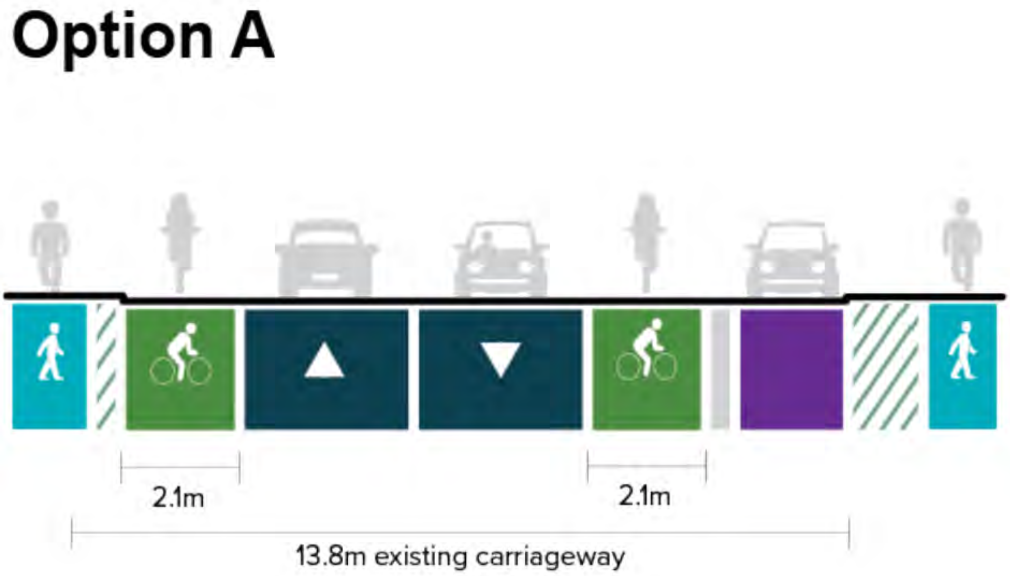
8.4.1 Options Short-listed

Three options were shortlisted for the Western Segment.

Option A (shown in Figure 8-12) requires the following changes:

- Copenhagen style uni-directional cycle lanes are provided
- On-street parking is removed from the north side of the road.

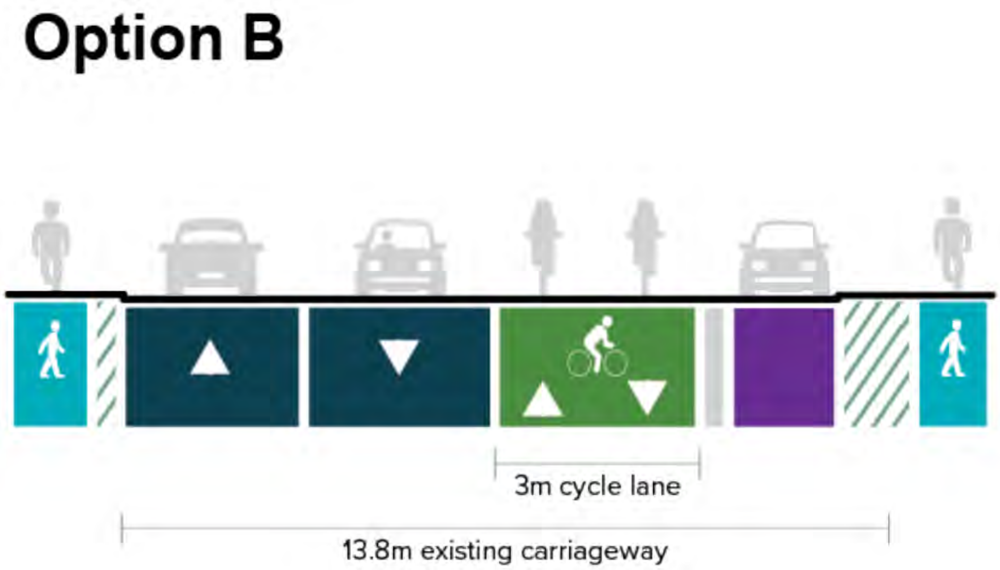
Figure 8-12: Western Segment - Option A



Option B (shown in Figure 8-13) requires the following changes:

- On-street parking is removed from the south side of the road
- Provide a bi-directional cycle path on the south side of the road, which could be Copenhagen style.

Figure 8-13 Western Segment - Option B



8.4.2 Preferred Concept Option

Based on the outcome of the MCA process it was concluded that Option A or V should be progressed for further option development for the Western Segment. Option B was chosen in preference to Option A, to be consistent with the cross-section chosen for the Central Segment (i.e. Option B which incorporates a bi-directional cycle facility).

9 Development of Options for Esmonde Road

Esmonde Road experiences congestion during peak and off-peak periods, and at weekends, due to its operation as a primary arterial connection between the Devonport and Takapuna areas and Auckland's Northern Motorway (SH1).

9.1 Mid-Block Segments Considered

For the purpose of option development, Esmonde Road was divided into two segments. The boundary between the two segments is the Harbourside Church intersection, which provides the last north/south crossing location before Esmonde Road significantly widens to the west of. The two segments are:

- Eastern Segment, between Lake Road and the access to Harbourside Church)
- Western Segment (between the access to Harbourside Church and the SH1 on-ramp.

9.2 Eastern Segment

Esmonde Road is predominantly residential at its eastern end. The road reserve is approximately 21.4metres wide. The existing cross-section of the eastern segment is shown in Figure 9-2.

Figure 9-1: Eastern Segment – Existing Cross Section

9.2.1 Options Considered

The options identified for the Eastern Segment of Esmond Road were as follows:

- Option A – Uni-directional protected cycle path with a kerbed median
- Option B - Bi-directional protected cycle path on the north side of the road
- Option C - Upgrading the existing unprotected uni-directional cycle facility to a raised (Copenhagen style) cycle path.

Option A was rejected because there too many driveways on both sides of Esmonde Road, which would mean a significant number of breaks in the protection provided. Option B was also rejected because of the large number of driveways on this segment, and because vehicles crossing a bi-directional facility may block it when trying to join Esmonde Road.

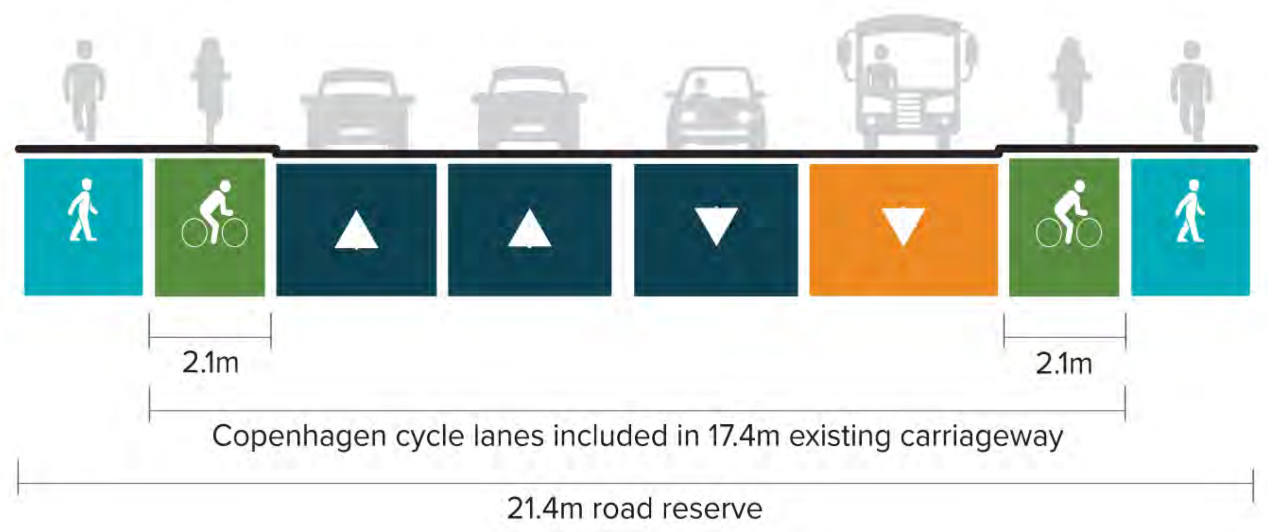
9.2.2 Preferred Option

The preferred option was Option C, as is shown in Figure 9-3. This option requires the following changes:

- Narrowing of the existing central median
- Upgrade the existing unprotected uni-directional cycle lane on Esmonde Road to become a protected (Copenhagen style) cycle path.

It should be noted that an eastbound bus or transit lane was not proposed because of the lack of space to provide an additional lane, and the significant adverse impact on traffic congestion the conversion of one of the existing traffic lanes to a priority lane is likely to have on the operation of the Esmonde Road/Lake Road intersection.

Figure 9-2: Eastern Segment - Option C



9.3 Western Segment

Esmonde Road is predominantly light industrial its western end. It has two eastbound traffic lanes and three westbound traffic lanes. One of the westbound traffic lanes is currently a bus-only lane.

9.3.1 Preferred Concept Option

Building on the findings of the IBC, an early decision was made upgrade the existing bi-directional cycle facility on the northern side of Esmonde Road between the SH1/Akoranga Drive/Esmonde Road Interchange and the Harbourside Church Intersection.

Work was undertaken by Aecom/Edin in 2019 (see below) recommended the conversion of the existing westbound bus lane to a transit lane. This work has been incorporated into the preferred concept option for Esmonde Road.

9.4 Esmonde Road / Barry's Point Road Intersection

Consideration was given to providing a new crossing facility at Barry's Point Road to connect with the proposed Francis Street link, but this was not recommended because of the adverse impact it would have on the operation of Esmonde Road. It was recommended that a kerbed median is provided between the two westbound traffic lanes on Esmonde Road and the existing bus lane (which is recommended to be converted into a transit lane). This will provide additional travel time benefits to HOVs and buses using the transit lane. The right-turning lanes from Barry's Point Road will not be able to turn into the transit lane. The practicalities of this should be explored during Detailed Design due to the lack of topographical survey in this area for Preliminary Design.

9.5 Esmonde Road / Fred Thomas Drive Intersection

As with the Barry's Point Road intersection, it was recommended that a kerbed median is provided between the two westbound traffic lanes on Esmonde Road and the existing bus lane (which is recommended to be converted into a transit lane). This will provide additional travel time benefits to HOVs and buses. The right-turning lanes from Fred Thomas Drive will not be able to turn into the transit lane. No other changes are proposed at the Esmonde Road / Fred Thomas Drive intersection.

9.6 Esmonde Road / State Highway 1 Southbound On-ramp

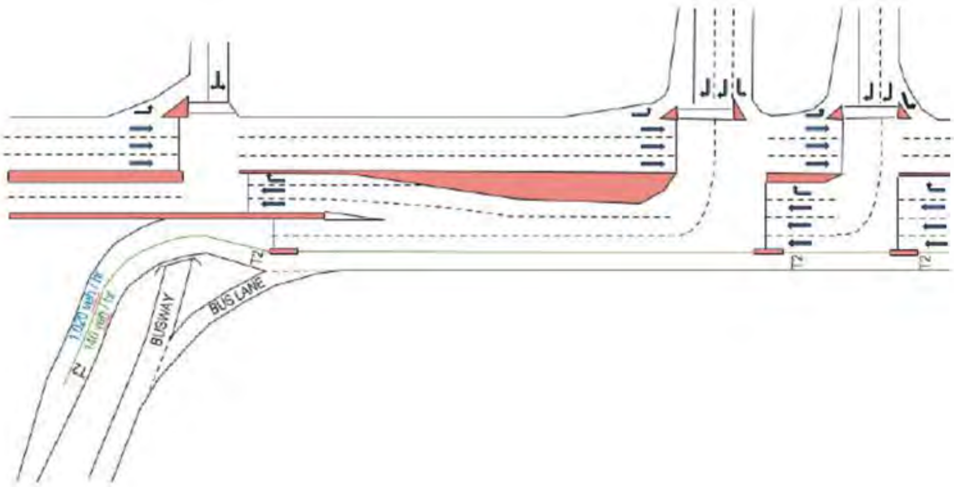
Several investigations have been undertaken into ways of improving priority for HOVs on Esmonde Road between Lake Road and the southbound SH1 on-ramp. This includes a study undertaken by Stantec AT in 2016 and a study undertaken for AT by Aecom in 2017. The findings of this work were incorporated into the 2018 Lake Road Improvements IBC.

In 2019, Aecom/Edin were appointed by AT to undertake a further investigation. The scope of this included reviewing previous investigation reports and options, developing concept designs for new options, and identifying a preferred option. The two primary assessment criteria it defined for identifying viable options were:

- Transit lane users must get a benefit in getting to the on-ramp signals
- The transit lane must not impede buses accessing the Northern Busway.

The study recommended further investigation of Option 1 (see Figure 9-5).

Figure 9-3: Preferred Option for Esmonde Road / SH1 On-ramp (AECOM / Edin Option 1)



In this option, the existing westbound bus lane is converted to a transit lane with the construction of an additional lane before the on-ramp. General traffic lanes are metered to merge into one lane before the on-ramp. The transit lane and general traffic lane are merged at a zip merge into the location of the current ramp metering signals.

The benefits of this option are:

- Merge conflicts reduced due to the introduction of additional ramp metering signals
- Provides sizeable transit lane the length of the existing bus lane
- HOVs will experience reduced delays as they are not subject to ramp signal metering
- Buses and transit vehicles bypass two sets of traffic signals which decrease travel times.

Challenges noted are that general traffic queueing capacity is reduced at the on-ramp, road widening is required, and high volumes of unmetered vehicles in the T2 lane will impact motorway flow if not managed/enforced.

This option has therefore been incorporated into the preliminary design for the project. Modelling undertaken of the option indicates that the proposal does not lead to any significant increase in traffic joining the motorway from the on-ramp.

10 Other Complementary Measures

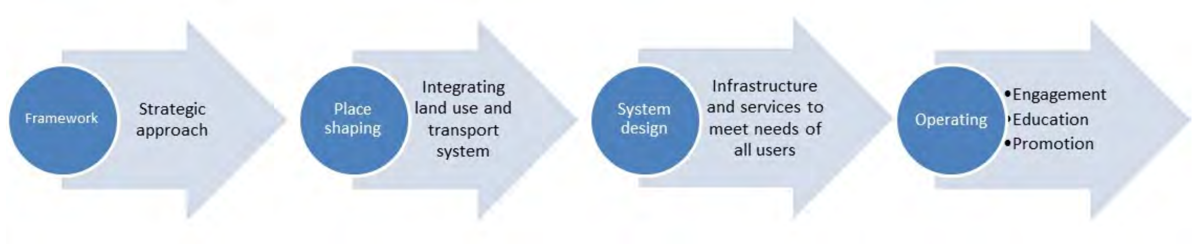
10.1 Overview

TDM is fundamental to the successful operation of the transport system in Auckland over the next 30 years. It is not feasible to continue to build additional infrastructure to accommodate unconstrained transport demand. This applies to the Lake Road corridor in particular.

As indicated earlier in the DBC, AT have several other non-infrastructure (TDM, operational and technology) measures planned. This chapter specifically identifies opportunities to better manage travel demand in the Devonport peninsula area. The purpose is to:

- Outline how TDM is considered within the DBC (based on the stages shown in Figure 10-1)
- Discuss how TDM measures have been incorporated into the project
- Demonstrate the effect these measures have to manage demand and achieve mode shift in the Devonport peninsula area.

Figure 1010-1: Phases of Interventions for Travel Demand Management



10.2 Definition of Travel Demand Management

TDM is defined as activities that "improve the performance of the land transport system by changing transport demand and travel behaviour"[2] . It describes the purpose of TDM as supporting the efficient and effective use of the transport system and reducing the negative impacts of travel and freight movement. TDM activities influence how, when and where people and freight travel. They generally have the following objectives:

- Shaping transport demand to better balance it with supply, and/or
- Shaping travel behaviour to ease pressure on the transport network and the environment, and/or
- Delivering economic benefits to businesses and communities.

10.3 Why Travel Demand Management is Needed

People generally travel for a reason, and the benefit they gain from choosing to travel by a particular mode usually exceeds the perceived costs associated with that mode of travel. Should some part of this change, such as the perceived benefit or cost, then travellers will usually change their behaviour or travel choices.

Generally, travellers tend to make decisions that are optimal for themselves and do not perceive the 'externalities' of those choices, such as the impact on others (congestion, severance, safety etc) or the environment (noise, emissions etc). As a result, the demand for travel (i.e. how, where and when) begins to exceed the capacity of the network to accommodate those demands, resulting in congestion. New or expanded transport capacity can reduce the immediate effects of congestion, however, the reduced travel costs then induce greater demand of the same type.

---

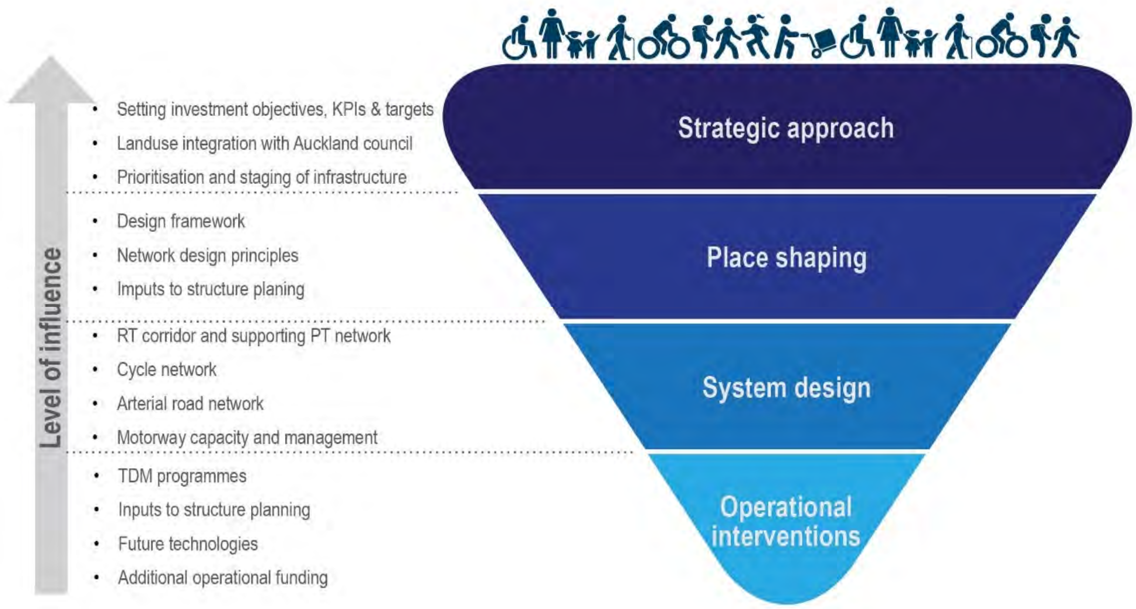
[2] https://www.nzta.govt.nz/planning-and-investment/planning-and-investment-knowledge-base/activity-classes-and-work-categories/road-safety-promotion/wc-421-travel-demand-management.

Often the wider economic, social and environmental costs of continued increases in transport infrastructure are not considered acceptable or sustainable, especially in the longer-term. The role of TDM is therefore generally to influence the choices travellers to make with the aim of meeting the objectives identified above.

10.4 Travel Demand Framework

The overall hierarchy of intervention for TDM is shown below in Figure 10-2. This framework has been at the forefront of thinking in the development of the project from its initiation in the CMP and IBC, though it is noted that thinking has developed since this framework was developed.

Figure 10-2: Travel Demand Management Influences Through the Project Life Cycle



Earlier stages of the development of the project, including the CMP and IBC, examined managing demand through strategic approaches and place-shaping influences, such as public transport network design and cycle network design. This work identified that, as the Devonport peninsula is not a greenfield area, it is unlikely that TDM measures in isolation will be able to address the transport problems identified. The DBC does not re-assess those decisions, but rather uses these as a framework and expand on the system design and operational interventions.

The main opportunities to use TDM measures explored in this DBC are through encouraging major trip generators to develop TDM measures specific to their needs. This is already being progressed by AT, but the key components of this are summarised in Table 10-1.

Table 10-1: Travel Demand Management Measures

Type of Measure	Description
Travel Behaviour Change Schemes	Workplace travel planning
	School travel planning
	Personalised journey planning
	Community walking and cycling groups
	Walking school buses
Service Provision	Car-pooling schemes and support
	Car sharing schemes
	Bike hire schemes
Promotional / Educational Campaigns	Fund-raising / schemes for free bikes
	Cycle incentives and training
	Cycling proficiency/safety in schools
	Information provision
	Advertising/media campaigns
Technology	Mobility as a Service (MaaS)
	Protecting corridors for Drones
	On-demand services
	Online shopping

Whilst there measures generally contribute only a small amount of reducing single-occupancy car demand (typically less than 5% based on the findings of recent AT initiatives, though the impacts tend to be very location specific), they will be important to the success of the project.

10.5 Operational Measures

Another opportunity to encourage the use of the proposed infrastructure changes is though operational measures.

10.5.1 Parking Management

Parking management is an important part of encouraging residents, employees and customers to travel by mode other than a single-occupant vehicle.

The AUP has initiated a change in the philosophy surrounding parking provisions and generated a shift from requiring on-site parking minimums to be used to manage the effects of parking from associated with development. It reiterates the importance of managing parking in a manner that supports urban amenity, efficient use of land, the functional requirements of activities, and also acknowledges that parking can be managed to have a significant influence on reducing car use, in particular commuter travel.

The AUP introduced the concept of “parking maximums” to manage potential parking oversupply and in turn, reduce traffic congestion and provide opportunities to improve amenity in areas earmarked for intensification. Some of the policies in the AUP that detail these intentions are:

- Limit the supply of on-site parking for office developments in all locations to
  - minimise the growth of private vehicle trips by commuters travelling during peak periods
  - support larger-scale office developments in the business zoned areas
- Enable the reduction of on-site parking for retail and commercial services activities in the Business - Metropolitan centre zone, Business - Town centre zone, Business – Local venture zone, and in the Business – Mixed-use zone so that the parking does not undermine
  - the efficient use of land or growth and intensification provided for in the Unitary Plan for the site or locality
  - the use of public transport in these zones.

Given the peninsula is not a greenfield area, the opportunities to implement these policies is limited. There is however a significant opportunity to implement parking mechanisms and parking provisions that support mode shift targets in Belmont, Devonport and Takapuna.

These parking mechanisms can be enabled at minor cost and can be facilitated through consent conditions. There is a however a need to support the provision of limited parking with alternative transport options, such as cycle parking, end of trip facilities, and frequent reliable public transport options.

There may be a cost associated with the enforcement and management of on-street parking that will fall to AT to manage should insufficient mode alternatives be provided.

10.5.2 Increased Public Transport

Increased public transport services will facilitate the movement of residents locally within the peninsula and provide frequent connections to employment in Takapuna and Auckland’s CBD. They will also provide connections to public transport hubs at Akoranga in particular – connecting passengers with Northern Busway. To support these, several operational measures have been identified, as summarised in Table 10-2.

Table 10-2: Travel Demand Management Measures

Supporting PT Services	Comment
Increased frequency of public transport services on future networks	A key outcome in terms of PT offering would be a five-minute headway service at peak times and ten minutes off-peak. This could encourage greater bus patronage and support wider public transport objectives, with a "turn up and go" outcome.
Subsidised public transport services	Research completed by AT[3] indicates that affordability of PT services is not a significant determining factor in terms of barriers to using PT. Rather the number of interchanges, frequency of services and travel times are identified as key barriers. As such the implementation of subsidised PT, services are not recommended, and rather increased frequencies have been proposed.

The additional costs for these increased frequencies have not been included within the recommended project at this stage as further work would be needed to confirm if the costs of this would exceed the benefits.

10.5.3 End of Trip Facilities

There is an opportunity for improved end of trip facilities to be provided. This would include showers, change facilities, lockers and appropriate storage for bikes. Additional on-street cycle parking can be provided within the road reserve to support shorter trips to be undertaken by bike. The provision of bike parking should be integrated with high turn-over land uses for example retail, café, and local centre activities.

10.5.4 Travel Behaviour Change Scheme

Measures that can be adopted by major employers and retailers on the peninsula to encourage staff to use alternatives to single-occupancy vehicles and to use public transport including raising the profile of these travel options.

Most workplace and retailer incentives can be developed by internal staff, supported by AT. An alternative to this is a coordinated approach where a business-led Transport Management Association could be initiated to provide collaborative support and solutions. Examples of this include the Wynyard Quarter and the North Harbour Business Association. It is expected that measures such as these, and those in more detail below would require the support of resources within AT.

We note that there may be funding constraints to delivering the level of support needed to encourage behaviour change in the peninsula as the current focus of AT's TDM team is region-wide initiatives such as the Auckland Bike Challenge, Auckland Walking Challenge, Kiwi Carpool Month and Car Free Day.

10.5.5 Personalised Journey Planning

An additional resource is available Personalised Journey planning can be facilitated as part of existing TDM programmes undertaken by AT. An example of a PJ project undertaken by AT was in Unsworth Heights/Totara Vale in 2016/2017. This confirmed an estimated BCR of over six. Post evaluation reports also

[3] Auckland Transport's Integrated Corridor Customer Research, survey size 1500, Nov/Dec 2018

stated that of the 417 participants, the evaluation of the programme indicated a 38% behaviour change and 86% customer satisfaction.[4]

Currently, this is undertaken primarily in the existing urban areas and focused on workplaces and/or geographic residential areas.

10.5.6 Financial Incentives

Another key constraint is the limitations to offer incentives to encourage modal shift or as a minimum testing or trialling alternative modes of transport. A dedicated resource within the TDM team could provide additional support to develop this opportunity, for example looking for alternative funding such as developers.

10.5.7 Partnership Opportunities

Additional opportunities to support mode shift could be enabled through partnership opportunities such as

- Electric bike trials/discounts/share programmes
- E- scooter trials/discounts/share programmes
- Carshare opportunities such as City Hop
- Business partnerships as part of the Green Coalition initiative being progressed by AT. This could include rewards – such as a free coffee at a local café with ten rides with a hop card, discounts for Hop Card users or similar
- Coordination with existing Travel Plan initiatives, such as those developed at Smales Farm and North Shore Hospital.

In addition to this, it is also considered that there may be opportunities for data sharing and a greater understanding of travel patterns in the growth areas through a wider partnership with micro-mobility providers. This could support the focus of future infrastructure and the location and provision of infrastructure to support alternative modes e.g. charging locations, dedicated parking.

10.5.8 Communication and Promotional Campaigns

A range of communication and promotional advertising campaigns are recommended. These could include:

- Information packs for new residents or new staff, which could include
  - Local bus services and connections to key destinations
  - Cycle parking and end of trip facilities and where they are located
  - How to obtain, use and top up AT HOP cards
  - Car sharing/carpooling and bike schemes
- Open Days coordinated to occur with community/school events with an information booth and free AT Hop cards/free coffee/incentives for trialling public transport
  - E-Bike Trial schemes or e-scooter schemes initially targeted at offering a personal mobility option to residents to connect to frequent PT services from Takapuna and Akoranga.

10.6 Next Steps and Summary of Proposed Measures

It is recommended that the measures identified in this chapter are developed in more detail in the next stage of the project to complement the infrastructure components of the project. A TDM Action Plan could be developed by a specific TDM co-ordinator appointed to be involved in the project. The Action Plan should define the scope and focus efforts on the most effective approaches to be led by the right teams in AT or appropriately qualified external parties. The TDM co-ordinator should be responsible for developing the

[4] Travelwise Choices: A year in review - 2016/2017 Travel Demand Team Highlights

measures outlined in this chapter, and oversee how the budget is spent, making the most of the change opportunity that the construction phase offers.

Table 10-3 summarises the operational measures that have been proposed to support the TDM approach. The estimated cost of these interventions is approximately $300-600,000 per annum. This broad brush estimate is based on recent work undertaken by Beca for the Supporting Growth Alliance (SGA).

Table 10-3: Operational Measures Summary

Lever	Mechanism	Recommended?	
Parking Mechanisms	Unitary Plan Parking Maximums	Parking maximums to encourage mode shift	✓
	Time restriction parking	Monitor utilisation of parking and adopt if parking	✗
	Parking restrictions on bus routes	Support through movement on key bus networks. Support reduction in the availability of long- term free parking	✓
Improved Bus Services	Increased frequency of bus services on Lake Road corridor to connect with the Northern Busway	Would provide additional capacity to connect to Akoranga Busway Station	✓
	Subsidised bus services	Feedback from AT surveys that bus fares are not a key barrier to bus update	✗
End of trip facilities including cycle parking	End of trip facilities – for example, showers/lockers	Part of the required new building provisions Removal of travel choice barrier	✓
	Establishment and running of a local bike hub	Installation of a bike hub	✓
	Cycle parking/Bike maintenance stands	Supports short trips being made by bike	✓
Ongoing assistance for alternative travel options	Carpooling schemes and support	Low cost, easy to promote	✓
	Assisted cycle purchase	Not recommended as difficult to monitor the effectiveness	✗
Technology	Mobility as a Service, on-demand services, online shopping	Wider programme initiative, inbuilt design	✓

Travel behaviour change schemes	TDM Taskforce including TDM Champions and Staff internal to AT to support The key resource identified to build region-wide relationships	Support for PJO schemes and carpooling schemes and promotional campaigns Will enable effective and time-critical work to be completed	✓
	Personal Journey Planning/Give it a go	Coordinate with promotional and educational campaigns	✓
	Welcome Travel Packs	Coordinate with promotional and educational campaigns	✓
	Annual PT Pass – employer-assisted purchase	Enabled/supported through travel behaviour schemes	✓

Part B2: Developing the Preferred Concept Option

11 Developing the Preferred Concept Option

11.1 Overview

Part B2 summarises the development of the preferred concept option. This process took into account feedback from community and stakeholder consultation, transport modelling, consideration of consenting and construction issues, the undertaking of a Safety in Design (SiD) workshop and the outcome of design development work (including that arising from the use of topographical survey data).

11.2 Transport Modelling

Transport modelling was undertaken to inform the development of the concept design, and to confirm the concept design was optimal as it was refined during the preliminary design development phase. Several tests were undertaken to help confirm the suitability of the concept design:

- Test 1 (AM peak only test) - Moving the SH1 on-ramp signals further west
- Test 2 (AM peak only test) - Retaining the existing bus lane on Esmonde Road
- Test 3 (AM peak only test) - Removing the northbound transit lane on Lake Road on the approach to Bayswater Avenue
- Test 4 (PM peak only test) - Removing the southbound transit lane on Lake Road between Esmonde Road and Jutland Road.

These tests indicated the following:

- Moving the SH1 on-ramp signals further west slightly improved people throughput
- Retaining the existing bus lane on Esmonde Road reduced people throughput
- Removing the northbound transit lane on Lake Road on the approach to Bayswater Avenue slightly increased people travel times
- Removing the southbound transit lane on Lake Road between Esmonde Road and Jutland Road reduced people travel times.

Consequently, the only refinement to the preliminary design was to remove the southbound transit lane on Lake Road between Esmonde Road and Jutland Road. Further details of the modelling results are contained in Appendix I.

11.3 Economic Analysis

An initial economic evaluation was undertaken to inform the refinement of the concept design. Further details are contained on Appendix L.

11.4 Utility Surveys

To understand the potential impacts the recommended option may have on utilities, a review of the the topographical survey and a desktop survey of existing utilities undertaken to enable early identification of the extent of potentially affected services.

Further information is provided within Appendix K.

11.5 Environmental Assessment

The impact of the preferred concept option on the natural environment was assessed. Consideration was given to treatments key environmental features. Appendix J contains the Preliminary Environmental Assessment.

11.6 Stormwater Assessment

The impact of the preferred concept option on the existing drainage network was assessed. Consideration was given to treatments around existing drainage infrastructure to support high-quality transport outcomes.

Further information is provided within Appendix K.

11.7 Consenting Assessment

A preliminary assessment of relevant consent requirements under the RMA, and risks associated with the recommended option was made and identified. Further discussion of the consenting strategy is contained in the Management Case.

11.8 Safety in Design

A SiD workshop was held with AT on 29 July 2020 to identify risks and mitigation measures that can be put in place through design. The SiD process assessed construction, operation and maintenance phases of the project and identified respective owners of the risks.

Construction stage risks identified included impacts on local businesses and access to residential properties. Residual construction risks will be allocated to contractors to mitigate, through safe working methods to be identified in Construction Management Plans.

Operational risks assessed included the potential for conflict between modes, and for pedestrians/cyclists exposed to vehicular traffic at intersections. Mitigation measures such as delineation, barriers and speed control systems for bikes are proposed to be developed in the pre-implementation phase.

11.9 Road Safety Audit

AT indicated there was no need to undertake a road safety audit.

11.10 Design Philosophy Statement

A design Philosophy Statement is included in Appendix K.

11.11 Reflecting Public Engagement Feedback in the Preferred Concept Option

11.11.1 Engagement During the DBC

During March and April 2020, community engagement took place and on-line meetings were held with some key stakeholders. The engagement was an opportunity to update on project progress, outline the next steps, and seek feedback on the concept design.

A brochure was sent to many households in the peninsula, which included a feedback form (there appear to have been some issues with delivery due to the Covid-19 Alert Level 4 lockdown, but AT undertook additional steps and broad coverage was achieved). To promote the consultation, AT undertook local newspaper advertising, press releases and social media. Some project info boards were erected, though all planned public events could not take place.

To mitigate this, AT extended the consultation period by two weeks, created additional online videos, undertook increased promotion and included an email on the project webpage for one-on-one engagement if members of the public required it.

Some examples of images used in the engagement are shown in Figure 11-1 to Figure 11-4.

Figure 11-1: Artists impression of the Lake Road/Esmonde Road Improvements

Figure 11-2: Artists impression of the Lake Road/Jutland Road Improvements

Figure 11-3: Artists impression of the Bayswater Avenue Improvements

Figure 11-4: Artists impression of the Lake Road/Seabreeze Road Improvements

11.11.2 Engagement Response Rate

There was a total of 563 submissions received, which AT considered to be sufficient. The majority were from people who live or work near Lake Road or use it regularly.

11.11.3 Engagement Responses

The main themes emerging from the consultation included:

- Strong support for making Lake Road cycling safer, including physically separate facilities
  - There was a recognition that the current painted cycle lanes are not perceived as safe so are not used by new potential users, resulting in additional car trips.
- Concerns that the proposals would worsen or not address traffic congestion
  - This has been a consistent theme over preceding project phases, with a strong community desire to see improved traffic flows (albeit with a range of views as to how this should be achieved - widened road, new coastal bypass routes, etc.).
- Desire to better connect the project proposals north of Esmonde Road, towards Takapuna
  - The original project extent sought to not encroach into the Takapuna area to avoid overlap with development plans there, however, respondents saw the benefit in taking the cycling facilities north of Esmonde Road to provide a more connected outcome.
- Desire to ensure future facilities safely separated pedestrians and cyclists
  - The proposal had some locations, such as at Belmont centre, where pedestrians and cyclists may have shared or overlapping locations, and this was queried by some respondents.
- Support for proposals at Belmont Centre and undergrounding of powerlines
  - There was general support for proposed public space and transport improvements at Belmont. There was a general desire to improve the appearance of Lake Road and reduce street clutter.

Responses to some of the specific questions posed are summarised in Figure 11-5 to Figure 11-8.

Figure 11-5: What Was Liked

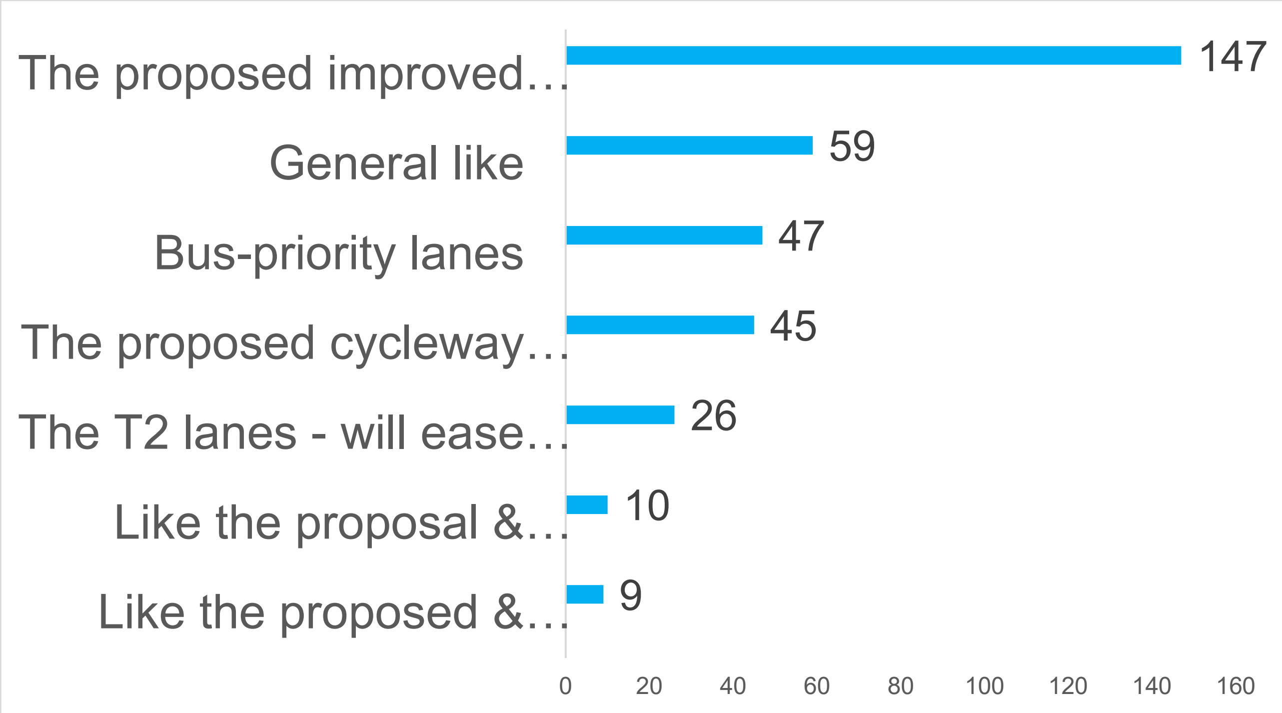


Figure 11-6: What Was Not Liked

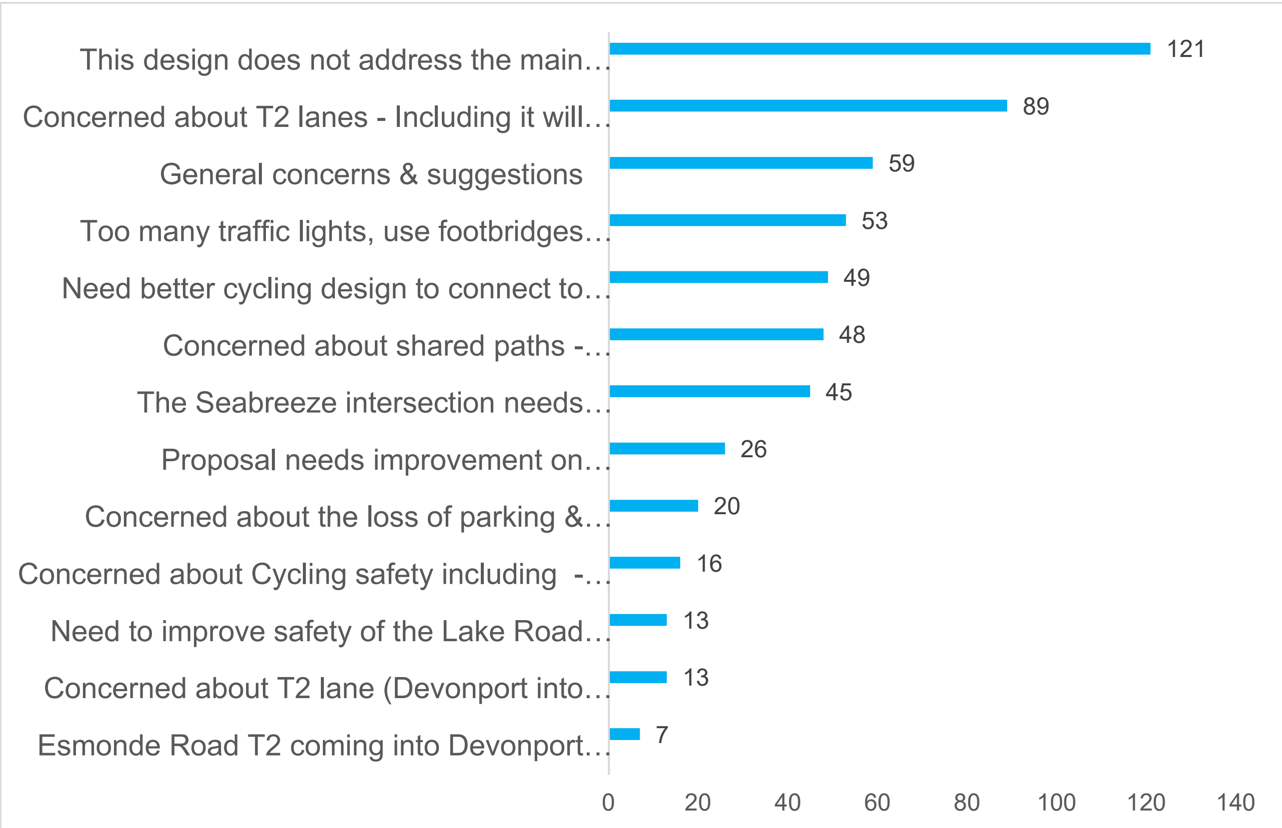


Figure 11-7: Would Physically Separated Cycle Lanes Improve Your Ability to Cycle?

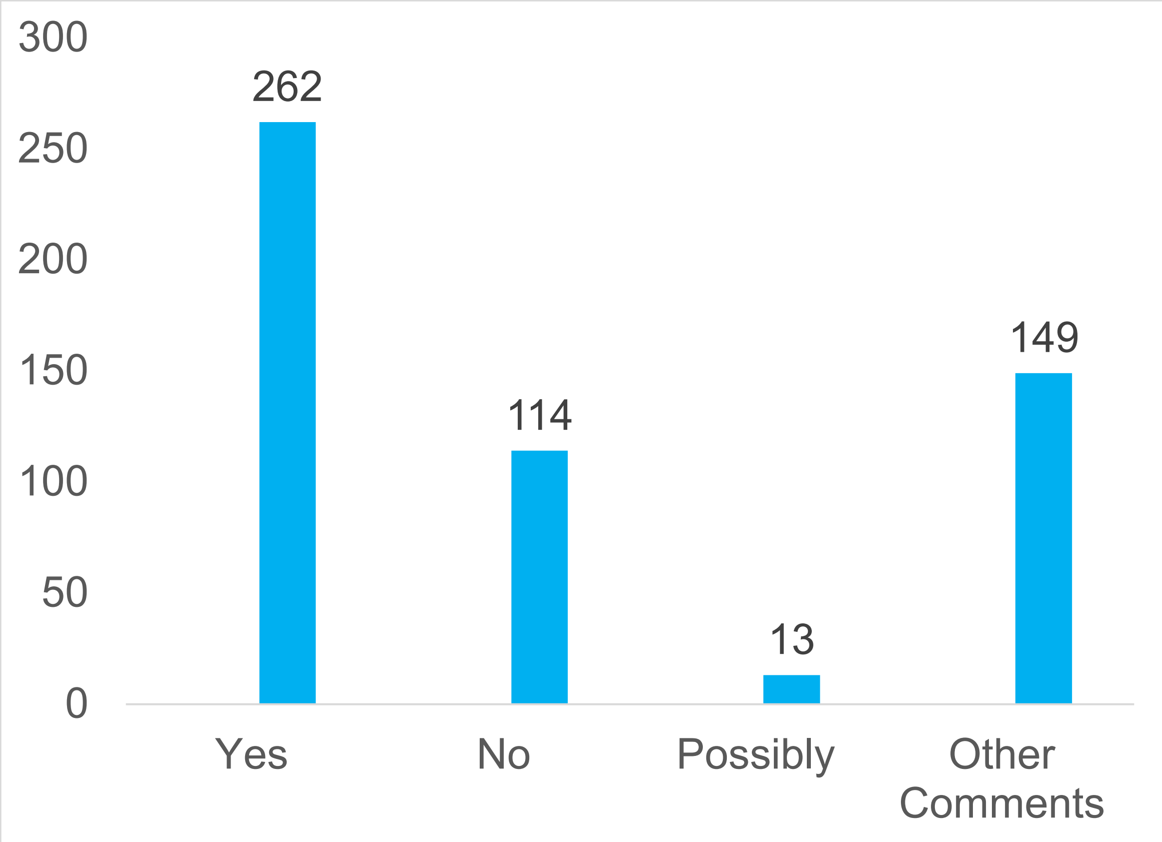
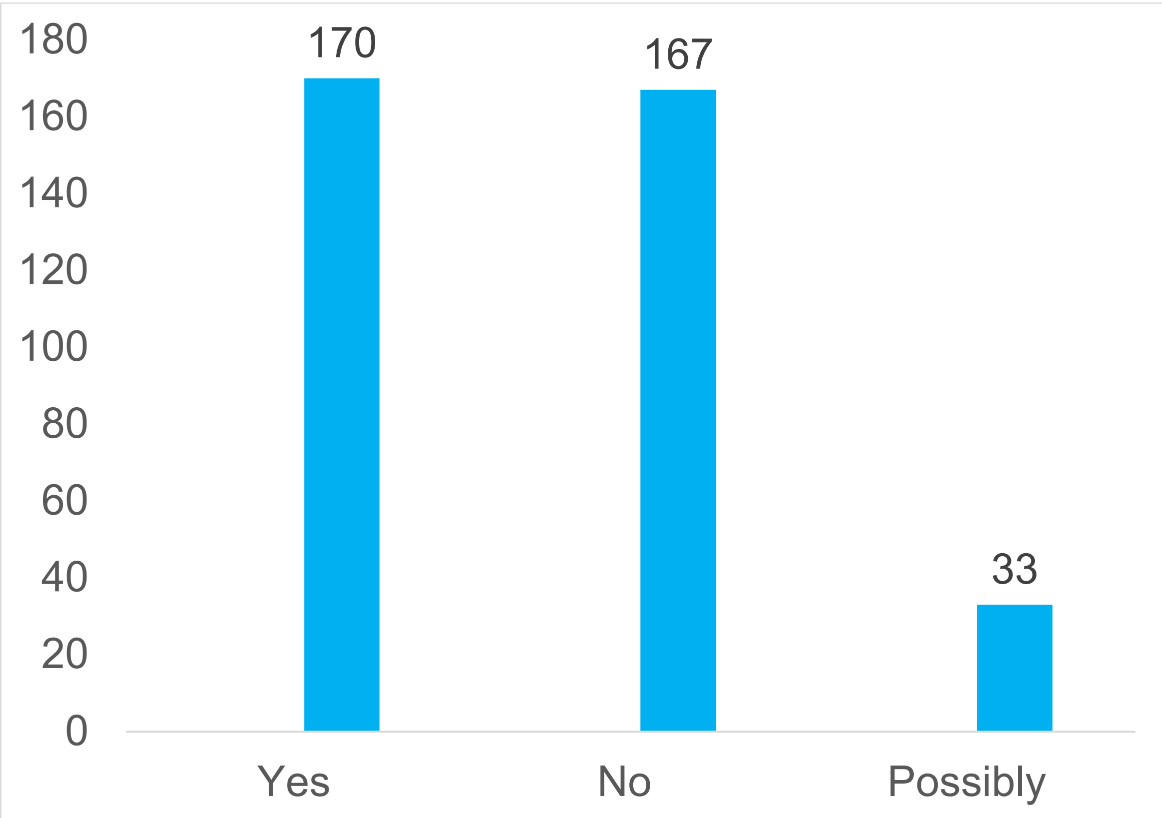


Figure 11-8: Would Transit Lanes Make You Consider Taking the Bus or Car Sharing



11.11.4 Local Board Response

The DTLB voted against supporting the project at a meeting held on 23 June 2020 on the grounds that it did not address congestion issues on Lake Road. Two Councillors supported the project.

11.11.5 Response to Feedback

The project team have taken on board the consultation feedback and are progressing with the design, with several amendments. It was not always possible or viable to address all issues raised however the main actions were:

- Investigating whether the proposed two-way cycleway south of Seabreeze Road can instead be standard uni-directional cycle lanes
  - This had been the result of a constrained section near Mozeley Avenue, so the revised proposal may require localised kerb line changes. This will also simplify the design at Albert Road and Seabreeze Road.
- Investigating the potential to underground powerlines wherever footpath works are required
  - There are substantial costs with undergrounding, however where utilities may be expected to be affected by kerb line changes then there is an opportunity to additionally underground powerlines at this time
- Investigating more detailed designs of the Old Lake Road and Belmont Centre areas
  - The feedback raised several issues, including the need to relocate the protected cycle lanes to the inside rather than outside of parking (for safety reasons). This is relevant in locations such as the shops opposite Old Lake Road. The Belmont Centre design proposals had a range of feedback and revisions will be developed further with Auckland Council.
- Investigating the preferred option for connecting the Esmonde Road transit lane to the citybound motorway on-ramp.
  - The integration of the proposed transit lane into the motorway interchange will be considered in collaboration with Waka Kotahi, but an updated option has been developed for review.

12 The Preferred Option

This chapter summarises the changes made to the concept developed for community engagement following that process and during the preliminary design process.

12.1 Design Responses Required

The preferred option responds to a range of factors raised during community and stakeholder engagement. The main issues to address are as follows:

- Revisions to Albert Road / Lake Road roundabout
- Revisions to proposed two-way cycleway on Lake Road between Albert Road and Seabreeze Road
- Retaining kerbside parking on the west side of Lake Road in the vicinity of Ngataringa Park
- Signalisation of Seabreeze Road and Old Lake Road intersections
- Improved facilities for cyclists on Lake Road heading north towards Takapuna at and beyond the Esmonde Road intersection
- Refinements to proposals for cycle lanes, parking arrangements and extent of additional public space at Belmont Centre.

12.2 Revisions Made in Response

The following revisions were made to the preferred concept option:

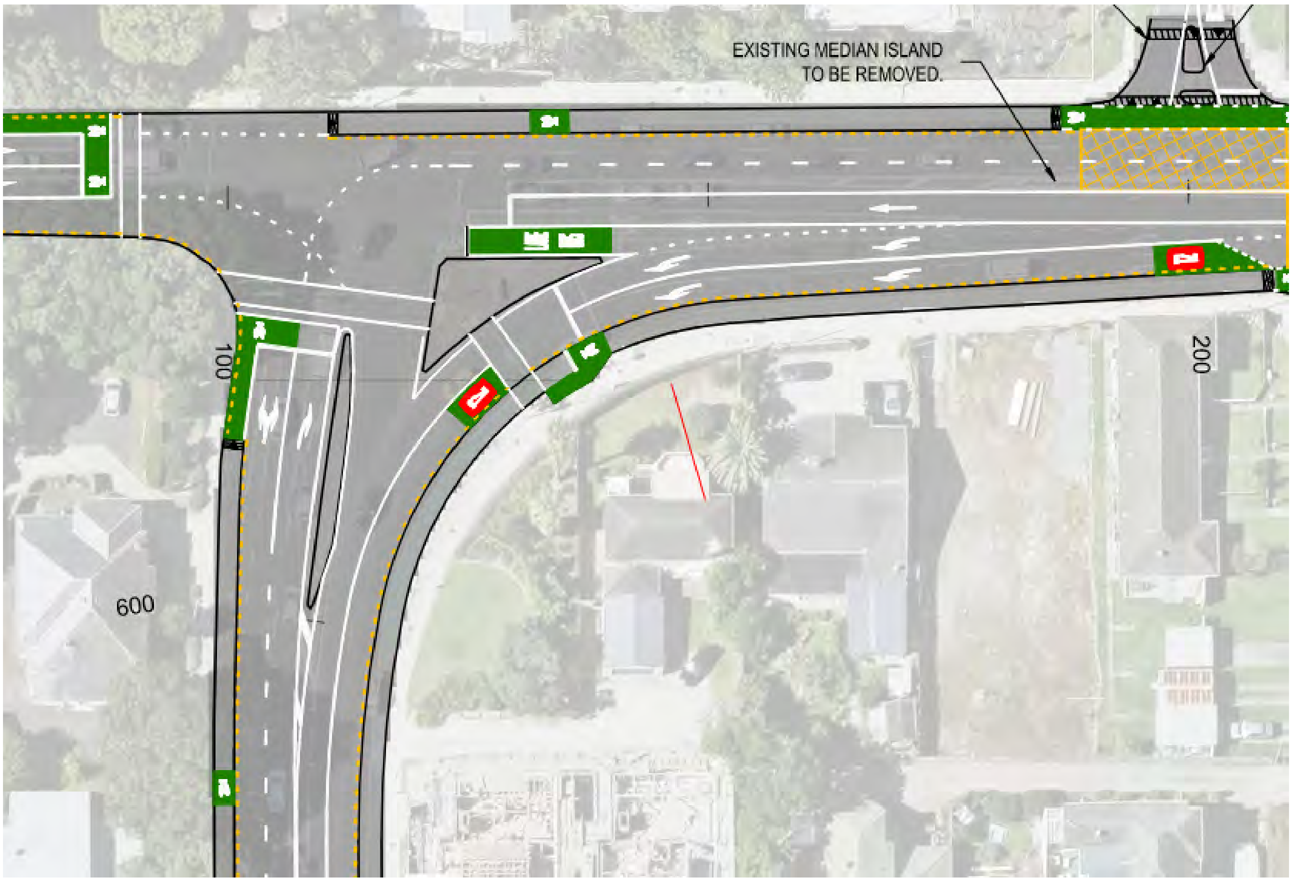
12.2.1 Lake Road / Esmonde Road Intersection

The following changes were made after community engagement took place on the preferred concept option:

- Minor adjustments to the intersection layout to make it safer and easier for cyclists travelling north along Lake Road towards Takapuna to use the intersection, including the provision of additional space for cyclists to wait to cross the left turn lanes from Lake Road to Esmonde Road
- Removal of southbound Transit Lane on Lake Road commencing approximately 50m south of the intersection, in the vicinity of Rewiti Avenue, as traffic modelling work indicated that the reduction from two to one traffic lanes for southbound general traffic led to increased queueing on Esmonde Road, affecting traffic travelling from Esmonde Road into Takapuna.

The revised intersection layout is shown in Figure 12-1.

Figure 12-1: Lake Road / Esmonde Road Intersection - Preliminary Design Layout



12.2.2 Lake Road Segment A (Esmonde Road to Jutland Road)

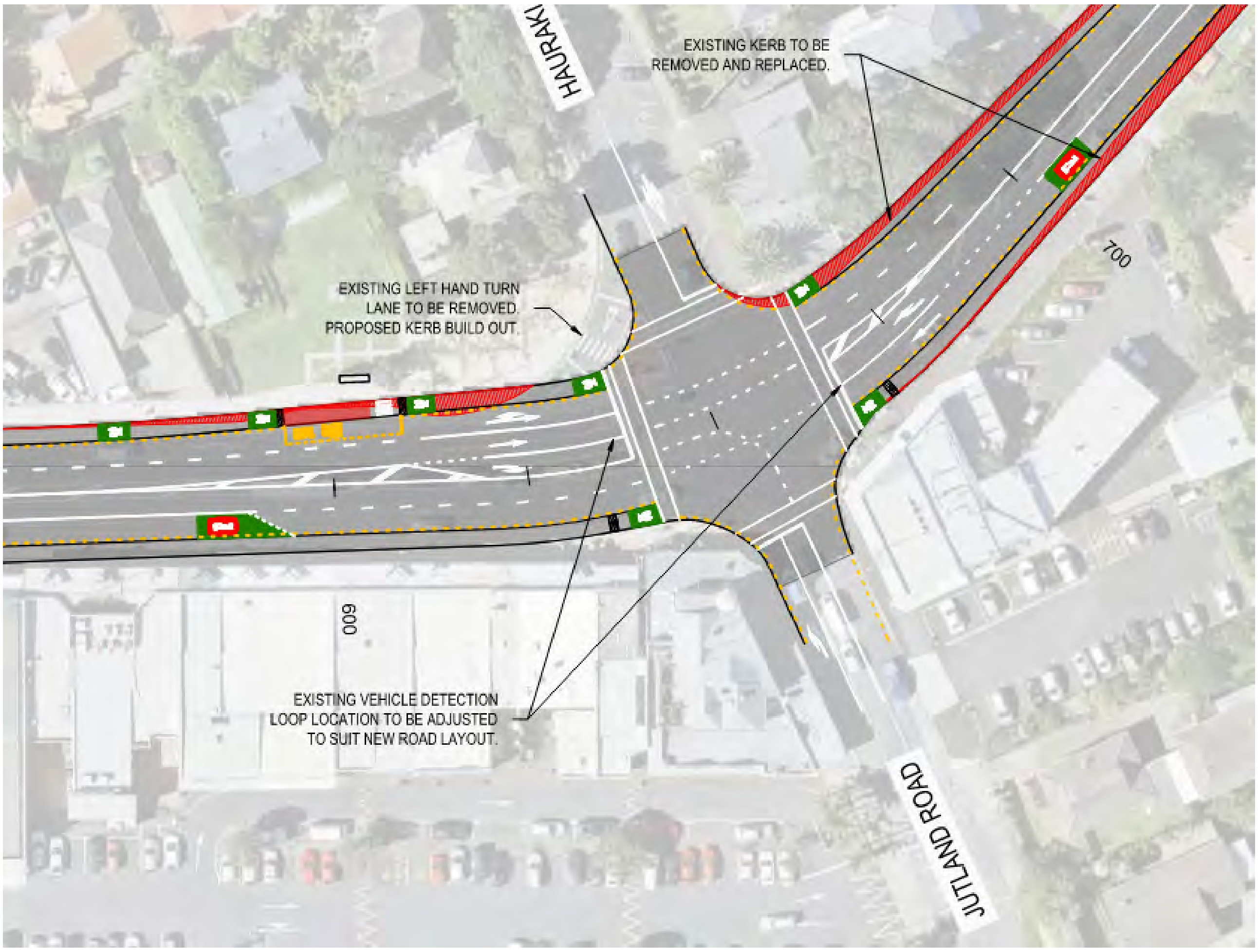
Following community engagement, the southbound transit lane was omitted due to traffic modelling indicating that the reduction from two to one traffic lane on Lake Road south of Esmonde Road results in significant additional traffic queues on Esmonde Road. No further significant changes were made during the preliminary design process.

12.2.3 Lake Road / Jutland Road Intersection

The main refinement made to the design after stakeholder engagement was the removal of southbound Transit Lane on Lake Road terminating approximately 50m north of Hauraki Road, for the reasons explained earlier, and realignment of kerb line on both north and south sides of Lake Road.

The revised intersection layout is shown in Figure 12-2.

Figure 12-2: Lake Road / Jutland Road Intersection Preliminary Design Layout



12.2.4 Lake Road Segment B (Jutland Road to Egremont Street

Following community engagement, the design was refined to incorporate widening on the west side of the road on the section of Segment B between Jutland Road and Hororata Road rather than the east side due to the presence of berm which can be utilised to re-provide a footpath.

12.2.5 Belmont Centre (including the Lake Road / Bayswater Avenue Intersection)

Following community engagement, and further assessment through discussions with Auckland Council, DTLB and stakeholders, the following general refinements made were to the concept design:

- Design to 50kph design speed adopted for the design
- Cycle lane to be positioned on the kerb side of the road
- Design 'Future-proofed' to enable streetscape enhancements to be added when Auckland Council have funding available.

The resulting concept design has two options, reflecting the availability of project funding. A 'base option' shown in Figure 12-4 retains a slip road with parallel parking to the eastern side of Lake Road. This option achieves the transport objectives at Belmont and is supportable by AT.

However, the base option does not realise the more extensive public space increase or improvements that were envisaged by the preferred concept plan and generally supported through stakeholder engagement and public consultation. Accordingly, an 'enhanced option' is shown at Figure 12-5 that retains the same transport outcomes for Belmont with the removal of the eastern slip road. Car parking is retained but reconfigured as parallel spaces on Lake Road.

Ultimately, the selection of which option is most appropriate at Belmont centre will be based on comparative costings and the available budget. It may be that the achievement of the enhanced option is dependent on additional funding sources being identified, to achieve an expected level of quality for new and additional public spaces shown in that option.

Figure 12-3: Preferred Design for Belmont Centre

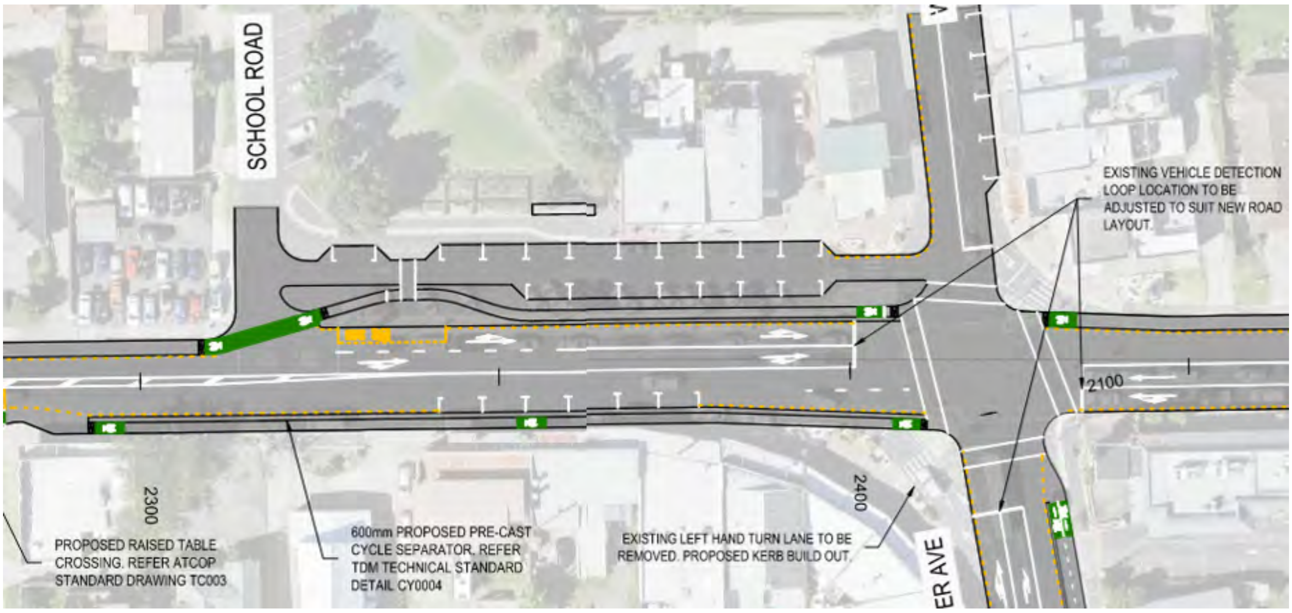
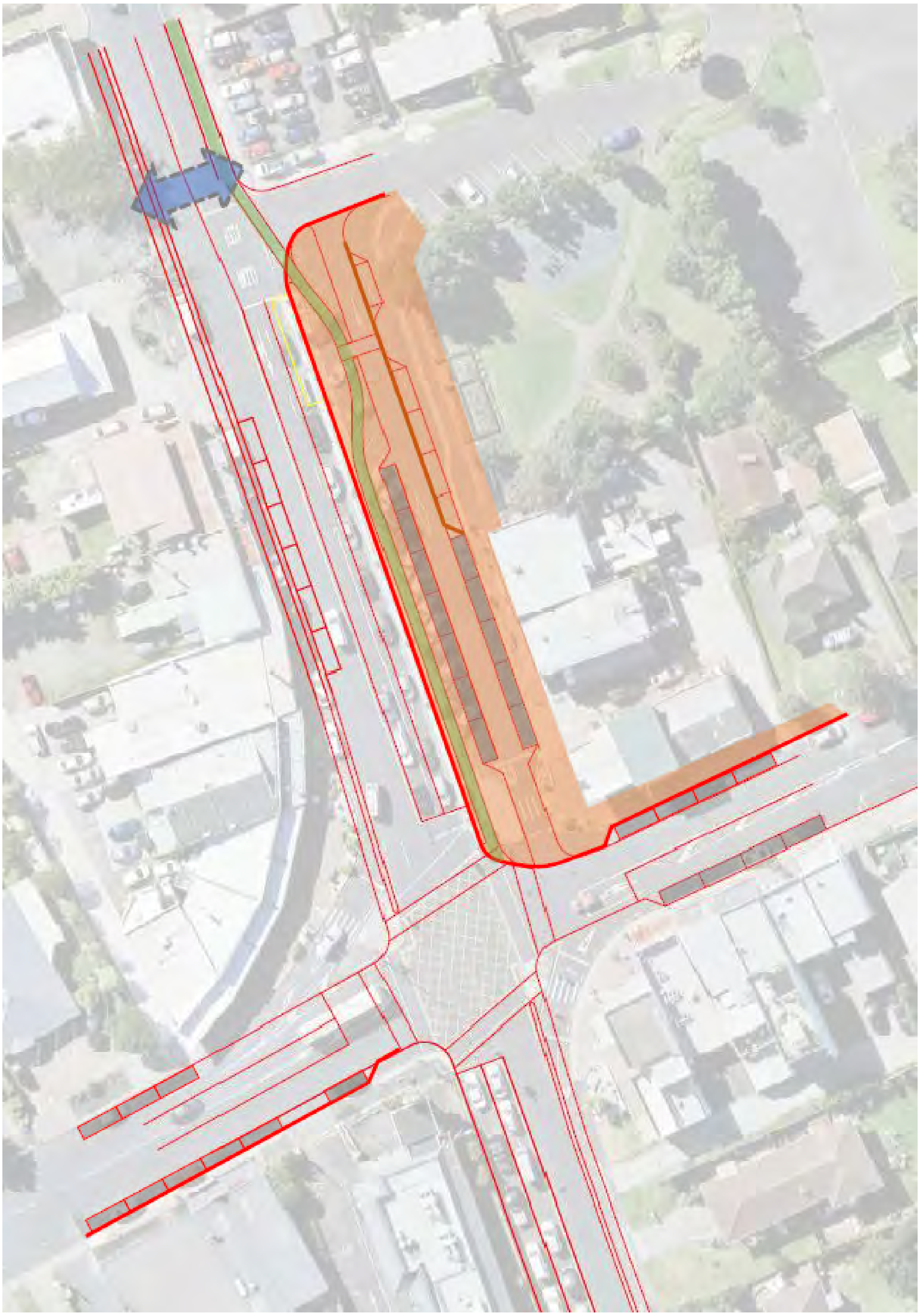


Figure 12-4: Preferred Design for Belmont Centre



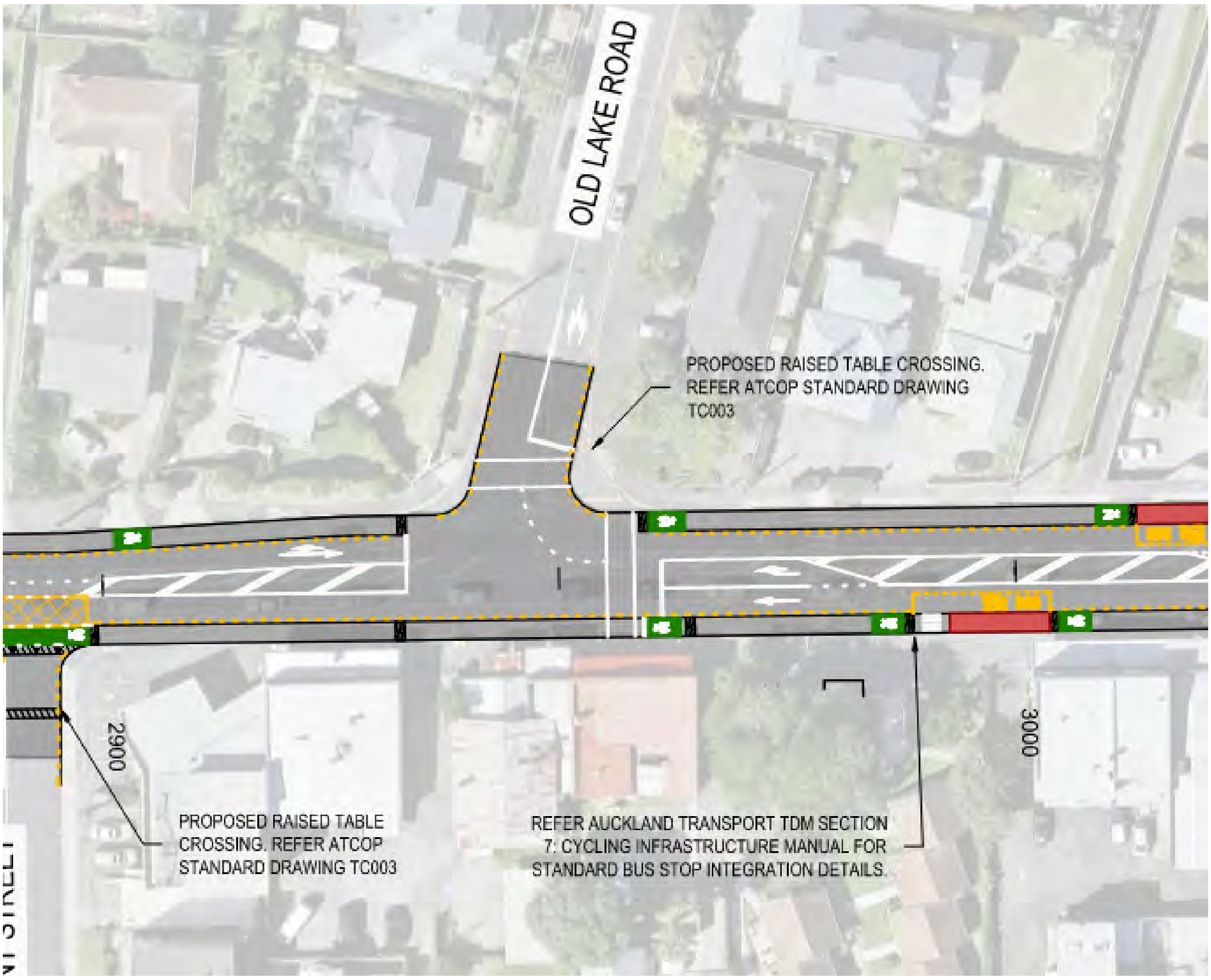
12.2.6 Lake Road Segment C (Bayswater Avenue to Old Lake Road)

No further refinements were made to the preferred concept option segment post community engagement.

12.2.7 Lake Road / Old Lake Road Intersection

Stakeholder engagement indicated that Option 1 was preferred, but that the cycle lane should be positioned next to the footpath. Further design work indicated that there was not enough room to achieve this, and so Option 2 was adopted as the basis of the preliminary design.

Figure 12-5: Lake Road / Old Lake Road Intersection Preliminary Design Layout



12.2.8 Lake Road Segment D (Old Lake Road – Achilles Crescent and Hanlon Crescent - Seabreeze Road)

Following community consultation, further design work led to the conclusion that Option B should be progressed for further option development for Segment D, as a Copenhagen style cycle facility is more suited to this segment than a kerb separated facility because of the large number of driveways which lead onto Lake Road.

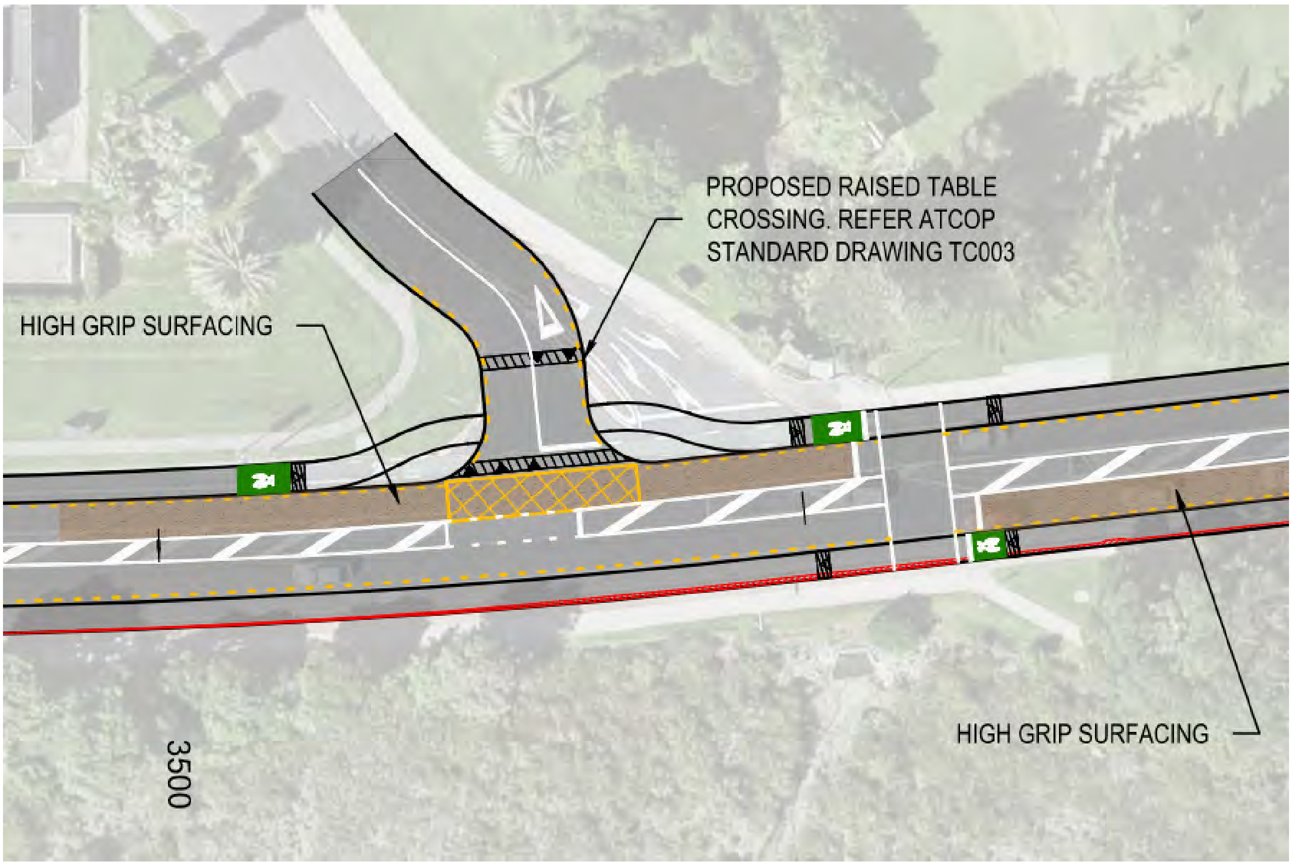
12.2.9 Lake Road Segment D1 (Achilles Crescent – Hendon Crescent)

No significant changes to this design were made in response to community engagement or during the preliminary design stage.

12.2.10 Lake Road / Seabreeze Road Intersection

Following stakeholder engagement, the design of the intersection was modified to incorporate a uni-directional cycle facility south of the proposed new Toucan crossing located. This was in response to design changes made to Segments E and F following stakeholder engagement, as explained below. The revised intersection layout is shown in Figure 12-6.

Figure 12-6: Lake Road / Seabreeze Road Intersection Preliminary Design Layout



12.2.11 Lake Road Segment E (Seabreeze Road to Ariho Terrace)

In response to feedback from community engagement on the concept option proposed for Segment F (Arihio Terrace to Albert Road) described below, a separated (Copenhagen style) uni-directional cycle facility was incorporated in the final preliminary design (i.e. Option C).

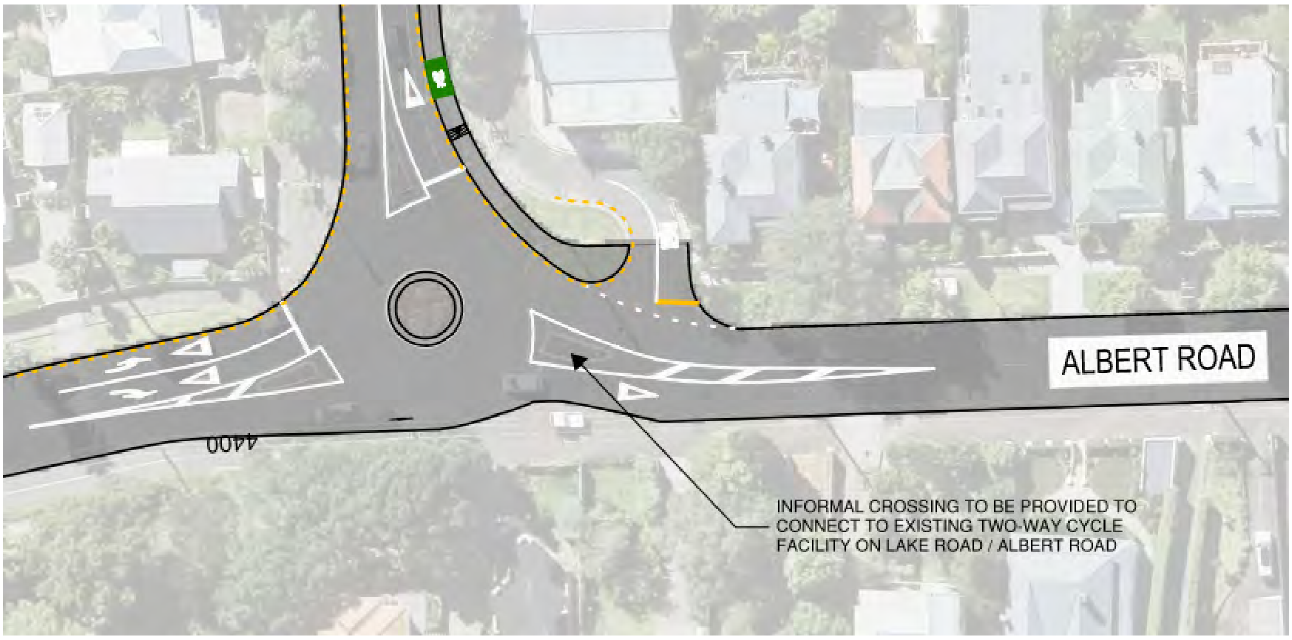
12.2.12 Lake Road Segment F (Ariho Terrace to Albert Road)

Following community engagement, it was concluded that the design would be modified to provide a uni-directional cycle lane (southbound only). Enhancements to Victoria Road and Mozeley Avenue were proposed to provide a better and more cost-effective facility than could realistically be provided on Lake Road for northbound cyclists.

12.2.13 Lake Road / Albert Road Roundabout

Following stakeholder engagement, an improved design, based on Option 1C was developed to tie into the proposed southbound only cycle facility on Lake Road. The revised intersection layout is shown in Figure 12-9.

Figure 12-7: Lake Road / Albert Road Intersection Preliminary Design Layout



12.2.14 Bayswater Avenue Eastern Segment

Following community engagement, the design was modified to incorporate separate walking and cycling lanes on the south side of the road. The refined cross section is shown in Figure 12-10.

12.2.15 Bayswater Avenue Central Segment

No significant refinements were made to the preferred concept design in response to community engagement and during the preliminary design stage.

12.2.16 Bayswater Avenue Western Segment

Following community engagement, the cycleway was repositioned to the south side of the road to be consistent with the TDM. The refined cross section is shown in Figure 12-11.

12.2.17 Esmonde Road

No significant refinements were made to the preferred concept cross section following community engagement.

12.2.18 SH1 / Esmonde Road Interchange

No significant refinements were made to the preferred concept for the SH1 / Esmonde Road interchange following community engagement.

12.3 Bus Stop Treatments

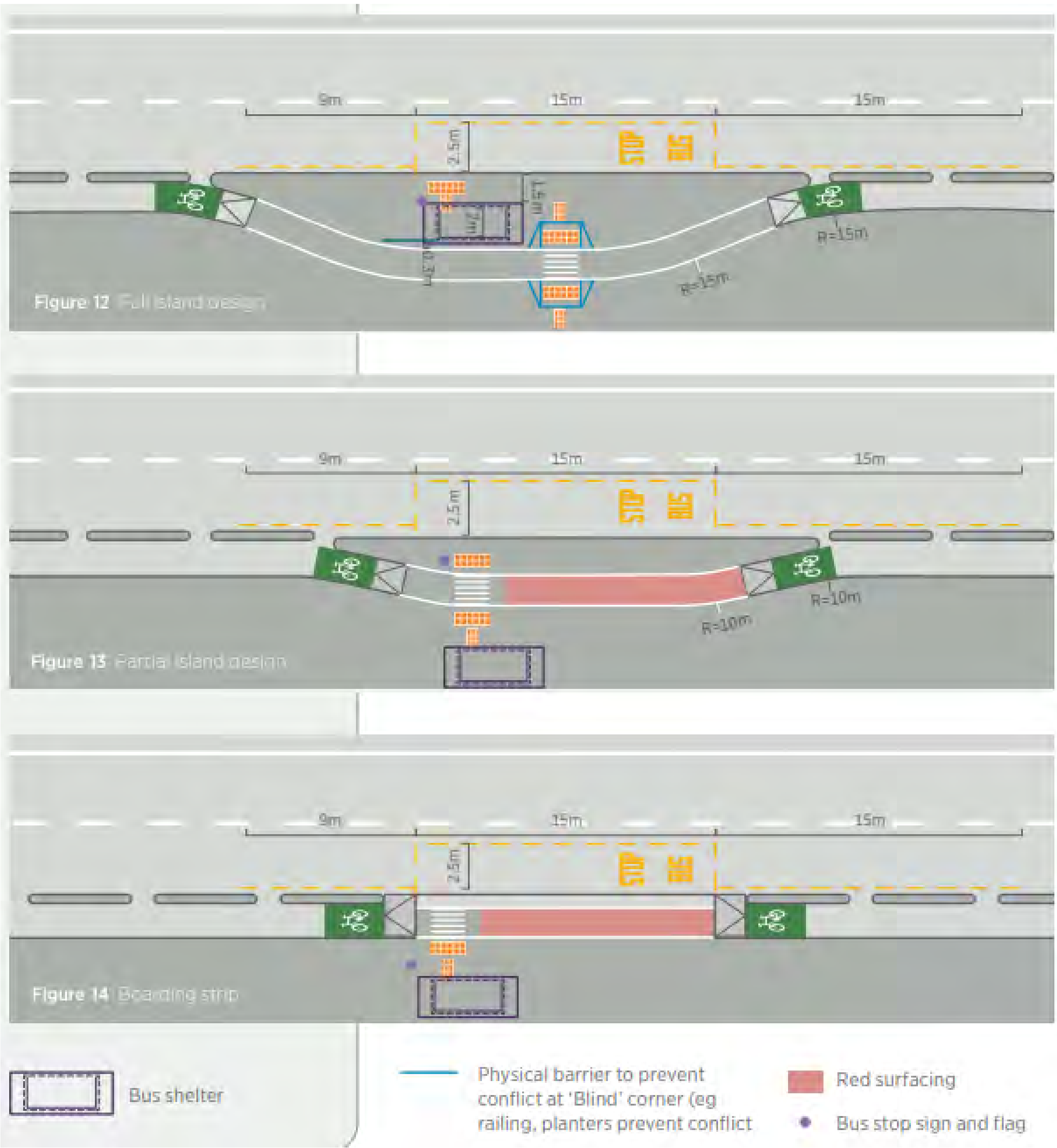
Lake Road and Bayswater Avenue have a large number of bus stops along their length. A number of these are for school bus services only. Bus stops are predominately standard kerbside arrangements. The exception is the recently reconstructed section between Esmonde Road and Jutland Road (which features two partial indented bus stops in each direction). The bus stop shelters are a mixture of old and new. The bus stops on Lake Road that have the highest number of public bus boardings are located at Belmont shops.

Several options for refinement of these stops was considered in the preliminary design process, taking into account the guidance contained in the TDM (under cycling infrastructure). This states that *'there are three types of treatments where cycleway pass through bus stops:*

- *Full island*
- *Partial island*
- *Boarder*

They provide the hierarchy of treatment. A full island stop should be used for all new street design. It provides the least disruption for pedestrians and people on bikes and the safest environment for bus passengers. Partial island and Boarder stops may only be used by Departure'.

Figure 12-8: Bus Stop Treatment Options Considered



Between Esmonde Road and Old Lake Road, there are nine bus stops in each direction, equating to an average of 300m distance between stops. The TDM suggests a 400m stopping distance. Given the above, options for optimising bus stop locations and spacing was explored further as the preliminary design was developed.

12.4 Provision of Improved Mid-Block Pedestrian Crossings Facilities

Building on work undertaken in the CMP and IBC, several options to reduce the severance effect of Lake Road were examined. Options to improve the ability for pedestrians to cross considered in the preliminary design stage included:

- Reducing the distance between crossing facilities
- Identifying significant desire lines that are not currently supported by crossing facilities
- Changing the type of crossing facility provided i.e. signalised or zebra rather than refuge.

The specific opportunities that were identified and examined are as follows:

- Relocation of existing pedestrian crossing between Esmonde Road and the Hauraki Corner (Segment A)
- Additional informal pedestrian crossing facilities along the 510m stretch between Hauraki Shops and Clifton Road (Segment B)
- Upgrade of the existing refuge island crossing north of the Clifton Road intersection (Segment B) to a signalised crossing or enhanced refuge island crossing (Segment B)
- Informal crossing facilities at the Clifton Road intersection (Segment B)
- Additional pedestrian crossing facilities along the 420m stretch between Clifton Road and the existing signalled crossing at Takapuna Grammar (south of St Leonards Road) (Segment B)
- Enhancements to the existing signalised pedestrian crossing outside Takapuna Grammar, including the width of crossing and standing room to each side (Segment B)
- Additional crossing facilities in proximity to the Belmont Intermediate Lake Road entrance (Segment B)
- Upgrade of existing refuge island crossing to the north of Montgomery Avenue to increase the separation of waiting pedestrians from traffic through larger/longer raised median islands (Segment C)
- Additional pedestrian crossing opportunities along the 600m stretch between the zebra crossing to the south of Old Lake Road and Seabreeze Road (Segment D)
- Upgrade of existing refuge island crossing south of Seabreeze Road to provide additional pedestrian priority and increase the separation of waiting pedestrians from traffic through larger/longer raised median islands (Segment E)
- Potential measures to improve pedestrian crossing experience across Mozeley Avenue intersection along the western side of Lake Road, such as narrowing of the intersection through reduction from two to one lane turning onto Lake Road from Mozeley Avenue, lane narrowing, tighter corner radii or realignment of Mozeley Avenue at this intersection (Segment F).

12.5 Key Features of the Preferred Option

Key features of the preferred option are:

- Separated cycle facilities along Lake Road (between Albert Road and Esmonde Road)
- Transit lanes (on the approaches to the Bayswater Avenue, Jutland Road and Esmonde Road intersections in the northbound direction)
- Separated cycle facilities on Bayswater Avenue
- Improved cycle facilities on Esmonde Road (between Lake Road and SH1)
- The existing westbound Esmonde Road bus lane converted to a transit lane
- One of the two southbound traffic lanes on the SH1 on-ramp at the Esmonde Road intersection converted to a transit lane (with pre signals)
- Improvement to Belmont Centre
- Improved safety treatment, particularly at intersections
- Improved pedestrian crossing facilities at intersections and mid-block

- Complementary travel demand / information / technology / ITS / public transport service improvements.

12.6 Performance Against Investment Objectives

The performance of the recommended option against the Investment Objectives and associated KPI's defined in Section 4 is summarised in Table 12-1. This indicates the project:

- Supports the greatest mode shift for trips from private vehicles to more efficient, low cost modes like walking and cycling
- Improves overall transport network capacity and resilience by increasing the capacity and shifting people away from private cars
- Drives improvements in safety outcomes for all road users, including increased investment in footpaths and cycle ways to support access to, and uptake of, active travel modes
- Improves transport choices for people by providing good quality, safe, fit-for-purpose walking and cycling infrastructure encouraging more people to use active travel modes such as walking and cycling
- Provides an important link between the proposed Northern Pathway walking and cycling connection over the Auckland Harbour Bridge to Auckland's CBD and the Devonport peninsula.

Table 12-1: Performance Against Investment Objectives

Key Performance Indicator	Measure	Baseline	Target	Predicted Impact	Achieves Investment Objective?
KPI 1 – Overall people travel time	Average travel time for people in single occupancy motor vehicles travelling along Lake Road (between Albert Road and Esmonde Road) in weekday AM and PM peak periods	21 minutes (AM) / 14 minutes (PM)	<20% increase	24 minutes (AM) / 15 minutes (PM)	Yes
	Average travel time for people in multiple occupancy motor vehicles travelling along Lake Road (between Albert Road and Esmonde Road) in weekday AM and PM peak periods	21 minutes (AM) / 14 minutes (PM)	>20% reduction	11 minutes (AM) / 15 minutes (PM)	Yes
	Average travel time for people in all vehicles travelling along Lake Road (between Albert Road and Esmonde Road) in weekday AM and PM peak periods	21 minutes (AM) / 14 minutes (PM)	>10% reduction	17 minutes / 15 minutes (PM)	Yes
KPI 2 – Number of people throughout by mode	Total number of people travelling by car on the SH1 Esmonde Road On-ramp in the weekday AM peak three hours)	1,300 people per hour	>20% increase	1,450-1,650 people per hour	Yes
	Total number of people travelling by bus on the Northern Busway Esmonde Road On-ramp in the weekday AM peak three hours	550 people per hour	10% increase	610 people per hour	Yes
KPI 3 – Reduced variability in car travel times	Average travel time between AM northbound and PM northbound weekday peak travel times from Albert Road to Esmonde Road	21 minutes (AM) / 14 minutes (PM)	>10% reduction	Not determined	Yes
KPI 4 – Mode share for alternative modes	Mode share for alternative modes to solo occupancy cars across the Devonport peninsula	33 to 35%	44 to 46%	45-50%	Not known but likely to
KPI 5 – Community satisfaction ratings	Overall community satisfaction for Lake Road	16 - 47%	Increasing trend	Not determined	Not known but likely to
	Overall community satisfaction for Esmonde Road	16 - 58%	Increasing trend	Not determined	Not known but likely to
KPI 6 – DSIs	Reduction in DSIs over a 10-year period	28	20% reduction over 10 years	Not determined	Not known but likely to
KPI 7 – Safe speeds	Number of instances of motorists exceeding the speed limit on Lake Road	10	20% reduction over 10 years	Not determined	Not known
KPI 8 – CO^2	Reduction in vehicle emissions in the AM and PM peak three hours	N/a	5% reduction	7.2% reduction	Yes

12.7 Preferred Option Assessment – Value for Money Outcomes

The economic appraisal of the project has been undertaken in accordance with Waka Kotahi's Economic Evaluation Manual (EEM) procedures (2019 Update) and with Waka Kotahi's new Investment Decision Making Framework (IDMF, 2020 First Release). The purpose of the economic evaluation is to calculate the benefit to cost ratio (BCR) for the project.

12.7.1 Basis of the Evaluation

The project has been assessed based on both a 40 and 60-year evaluation period, given the different requirements of the EEM and IDMF. A three-year construction period beginning has been assumed, during which time no benefits accrue.

General assumptions for the economic evaluation of the scheme are as follows:

- Base Date for the evaluation is 1 July 2019
- Time Zero is 1 July 2020
- The base assumption for the discount rate is 6% for a 40-year evaluation period and 4% for a 60-year evaluation period
- The evaluation period is 40 or 60 years from the start of construction
- Construction takes place over a three-year period between January 2022 and December 2024
- Demand for bus services increases by 10% (based on the likely demand response to the time savings the proposed transit lanes are anticipated to provide)
- 200 extra users per day of the Lake Road cycle facilities are due to the increasing use of e-mobility modes
- 100 extra users per day of the Lake Road cycle facilities are due to the opening of the Northern Pathway project (which is forecast to attract 3,000 users per day by 2038)
- 40% of motorists using lake Road and Esmonde Road car pool.

The implementation of the project has been assessed based on the full delivery of the preferred option. Dis-benefit to general traffic during construction has not been considered in economic analysis as they are not anticipated to be significant.

Further details of the economic evaluation are contained in Appendix L.

12.7.2 Capital Costs

Indicative cost estimates were prepared for the preferred concept option and are summarised in Table 12-2. A more detailed breakdown of the estimated costs is contained in Appendix M.

Table 12-2: Summary of Capital Costs

Description	Cost ($M)
Lake Road Physical Works	11.91
Esmond Road Physical Works	2.53
Bayswater Avenue Physical Works	2.86
Provisional Items	2.68
Environmental Compliance	0.06
Traffic Management	2.44

Preliminary and General	4.49
Design and Consenting Fees	3.57
Total Base Estimate	**30.53**
Contingency (25%)	7.63
Total Expected Estimate (P50)	**38.16**
Funding Risk	5.72
Total 95th Percentile Cost Estimate (P95)	**43.89**

For the economic analysis, the P50 expected estimate has been used, which results in a total Net Present Value (NPV) cost over 40 years of $34.29M or 36.61M over 60 years).

12.7.3 Maintenance Costs

Additional annual maintenance is estimated at $50-75,000 per annum.

12.7.4 Cost of Supporting Measures

The supporting measures recommended for the project have also been indicatively priced. These are summarised in Table 12-3.

Table 12-3: Cost of Supporting Measures

Description	Cost ($M)
Marketing and Communications	0.20
MaaS Rideshare software	0.05 per annum
Education campaign	0.10 per annum
Travel planning	0.15 per annum
TOTAL CAPEX	**0.10**
TOTAL OPEX	**0.30 per annum**

12.7.5 Benefits

The following benefit streams have been assessed for the recommended option:

- Amenity benefits for pedestrians
- Cyclist crash cost savings
- Health Benefits for cyclists
- Crash benefits for cyclists and pedestrians
- Vehicle operating cost (VOC) savings for buses and private vehicles using transit lanes
- Travel time savings for existing and additional bus users using transit lanes
- Travel time savings for multiple occupancy vehicles using transit lanes
- Travel time reliability benefits for existing and new bus users using transit lanes

- Travel time reliability benefits for multiple occupancy car users using transit lanes.

Table 12-4 summarises the total discounted benefits predicted for the project. The benefits of the supporting measures has not been estimated.

Table 12-4: Benefit Streams and Overall Benefit to Cost Ratio

Benefit Stream	Based on EEM Approach	Based on IDMF Approach
Pedestrian amenity benefits	0.00	0.32
Cyclist crash cost savings	3.90	6.66
Cyclists health benefits	6.23	17.03
Private vehicle travel time and VOC savings	9.21	14.11
Private vehicle reliability benefits	0.46	0.71
Bus travel time and VOC savings	5.10	7.82
Bus reliability benefits	5.10	7.82
Total Benefits (NPV)	**24.43**	**45.93**
Total Costs (NPV)	**34.29**	**36.61**
First-Year Rate of Return (FYRR)	**4%**	**4%**
Benefit to Cost Ratio (BCR)	**0.71**	**1.25**

12.7.6 Wider Economic Benefits

Wider Economic Benefits (WEBs) have not been quantified. WEBs refer to the impacts of transport improvements on economic productivity and output that are additional to benefits that accrue directly to transport users. They may include:

- Agglomeration benefits brought about by providing a quality cycle route between the Devonport peninsula and Takapuna and potentially Auckland once the Northern Pathway project is constructed
- Increased tourism spend on accommodation, food and other activities as a result of tourists visiting the Devonport peninsula.

WEBs have not traditionally been measured for projects which provide transit lane and walking and cycling improvements. However, this project is likely to support some WEBs, such as improved agglomeration economies and increased labour supply benefits, as it provides an improved link between the Devonport peninsula and Takapuna/Auckland city centre. If WEBs were included, these would only increase the BCR, and therefore it is conservative in this regard.

12.7.7 Evaluation Results

The project is considered to be economically efficient as it has an indicative BCR of above one.

12.7.8 Incremental Analysis

Incremental assessment is used to evaluate differences in cost-benefit appraisal among mutually exclusive investment options, such as proposed changes in scope to a preferred option. Incremental assessment may also be applied in other situations to support an investment decision, for example, in the sequencing and timing of elements in an implementation plan.

As only a preferred option has been developed following the concept MCA process, incremental analysis has not been undertaken for the project. The present value costs and benefits of the three main components of the project have been evaluated however in order to understand their relative economic value. The results of this evaluation are summarised in Table 12-5.

Table 12-5: Analysis of Individual Project Components

	BCR (base on IMDF approach)
Lake Road Improvements only	1.80
Bayswater Avenue Improvements only	0.25
Esmonde Road Improvements only	1.42
All Improvements	**1.25**

12.7.9 Sensitivity Testing

Sensitivity tests using Waka Kotahi standard variables have been undertaken and presented in Table 12-6. The sensitivity testing suggests that there is a strong likelihood that the recommended option would retain a positive economic efficiency rating under the sensitivity testing scenarios considered and that it could achieve a positive economic efficiency rating should there be greater benefits or reduced costs.

Table 12-6: Sensitivity Test Results – Impact on BCR

	EEM Approach	IDMF Approach
Capital costs (+/- 20%)	0.59-0.89	1.05-1.57
Increase in cycle demand (+/- 50%)	0.62-0.80	1.06-1.45
Private vehicle travel time saving (+/- 20%)	0.48-0.94	0.92-1.58
Bus travel time saving (+/- 20%)	0.68-0.74	1.21-1.30
Buses per hour (+/- 20%)	0.68-0.74	1.21-1.30
Traffic growth rate (0.5% rather than 1% p.a.)	0.69	1.21

13 Investment Assessment Framework Results Alignment

13.1 Results Alignment

The GPS priority that is most applicable given the key driver for this project is access. Using the 2018-21 IAF assessment criteria, the project meets the MEDIUM criteria.

The rationale for this is that the project makes the best use of existing transport infrastructure to prioritise multi-modal choice. This will help provide improved access to social or economic opportunities.

Using the 2018-21 IAF assessment criteria, the project meets the LOW criteria for environment and the MEDIUM criteria for safety. The rationale for this is as follows:

- Safety – The project provides significant improvements to safety for cyclists
- Environment – The project will result in a modest long-term reduction in greenhouse gases.

13.2 Alignment with Results Sought Under the GPS

The project has also been assessed against Waka Kotahi's Investment Assessment Framework (IAF) 2018-21 to consider how the project aligns with the results sought under the GPS. Waka Kotahi uses a process known as the '16 investment questions' to aide in checking whether business case development is on track.

13.2.1 Problem

Q1. Is it clear what the problem is that needs to be addressed (both the cause and the effect)?

The DBC has reconsidered and restructured the problem statements and associated identified in the IBC to better reflect a cause and effect structure. The update has also acknowledged that there is a safety problem that did not receive much focus in the IBC.

Q2. Is there evidence to confirm the cause and effect of the problem?

There is evidence to confirm the causes and effects of traffic problems. Regarding the safety problem, further evidence has been provided in the form of an SSAF to show the impact of corridor form on safety.

Q3. Does the problem need to be assessed at this time?

Car-dominance, lack of appropriate multi-modal facilities, and road safety are key issues facing AT. There are a range of negative outcomes – social, economic, environmental – associated with not addressing these issues. There is political will, funding, and local and national government support to transition to a safer multi-modal network, therefore it is considered that the identified problems need to be addressed.

Q4. Is the problem specific to this investment or should a broader perspective be taken?

The identified problems are not unique to Lake Road, with similar issues (car-dominance, congestion, safety issues) being experienced across Auckland, and other cities in New Zealand. Devonport peninsula is however unique geographically, and as such the problems are exacerbated by a lack of feasible alternative routes and historic land use patterns. Therefore, the approach taken to this investment has been targeted to the specific issues experienced.

13.2.2 Benefits

Q1. Have the benefits that will result from fixing the problem been adequately defined?

The benefits have been clearly defined and linked to the problem statements.

Q2. Are the benefits of high value to the organisation?

The benefits are considered high value to AT.

Q3. Will the KPIs that have been specified provide reasonable evidence that the benefits have been delivered?

A range of KPIs have been defined with a clear line of sight back to the benefits. They provide good qualitatively and quantitatively evidence that the benefits have been delivered.

Q4. Are the KPIs both measurable and totally attributable to this investment?

The majority of the KPIs are quantitative and measurable. A number require qualitative assessment by experienced professionals. As with any transport project, some metrics may be influenced by other factors beyond the scope of the project, such as community satisfaction and CO^2 emissions. It is, however, important to consider factors beyond purely quantitative transport numbers, to reflect investors desire to achieve these outcomes, even if other factors may be at play.

13.2.3 Strategic Response

Q1.Have a sufficient range of strategic alternatives and options been explored (demand, productivity and supply)?

The DBC has identified travel demand management measures to complement the proposed improvements to infrastructure.

Q2.Is it clear what strategic alternatives and options are proposed and the rationale for their selection?

The IBC and earlier CMP consider a wide range of strategic alternatives and options.

Q3. Are the proposed alternatives and options the most effective response to the problem (comprehensive and balanced)?

The IBC demonstrated that the option progressed in this DBC is the most effective response to the problems identified, given the funding envelope and the need to avoid land or property acquisition.

Q4. Are the proposed alternatives and options feasible?

The alternatives and options considered have been evaluated from a variety of perspectives, including their feasibility.

13.2.4 Solution

Q1. Consistent with the strategic alternatives and options, have a reasonable range of project options been analysed?

This DBC has considered a wide range of options which conform to the funding envelope for the project and which do not require land or property acquisition.

Q2. Is the proposed solution specified clearly and fully?

The proposed solution has been developed to a preliminary design stage to demonstrate the proposed solution is specified.

Q3. Is the proposed solution the best way to respond to the problem and deliver the expected benefits?

The evaluation of the recommended option has confirmed that the project is the most effective response to the problems identified, given the funding envelope and the need to avoid land or property acquisition.

Q4. Can the solution be delivered (costs, risks, timeframes, governance, etc)?

The preliminary design work undertaken in this DBC stage has confirmed the project can be delivered within the available funding envelope and that the risks associated with the project can be managed.

Part C: Implementing the Preferred Option

14 Commercial Case

The commercial case for implementing the preferred option involves commercial and financial analysis considering the capacity demand and attractiveness; accessibility and network linkages; affordability of delivering the option; and the associated implications. The commercial case is underpinned by the implementation, procurement, and consenting strategies for the project.

14.1 Implementation Strategy

The implementation strategy sets out the approach to obtain all statutory approvals necessary to enable construction, operation and maintenance of the project. It also considers construction options for the project and collaboration opportunities.

It is recommended that there is a robust pre-implementation stage to confirm procurement and the implementation strategy including considering staging options if financial constraints dictate. There is a strong motivation, need and support for AT to deliver the project as soon as possible, and the implementation strategy will consider how this can be achieved most effectively and efficiently, including how to gain DTLB support for the project.

Through implementation, the project will need to have:

- A high level of ability to align with the GPS and AT intent
- Strong local support, including support from the DLTB
- Design and construction commencing within the 2021/24 NLTP funding round.

The primary activities to be undertaken during the pre-implementation phase are:

- Detailed design and construction support services
- Consents
- Collaboration with Waka Kotahi regarding the project's interface with SH1 at the Esmonde Road interchange.

14.2 Implementation Options Considered

Two main implementation options have been considered:

- Full delivery of the entire project
- Staged delivery, such as
  - Lake Road constructed first (Stage 1) followed by Bayswater Avenue (Stage 2) then Esmonde Road (Stage 3)
  - Lake Road constructed first (Stage 1) followed by then Esmonde Road (Stage 2) followed by Bayswater Avenue (Stage 3).

A staged approach provides an opportunity to decouple the risks associated with each stage, as delays or issues in one stage would not impact on the other. By taking a staged delivery approach, the project will be delivered over a longer timeframe, and there is a risk that the project may not have the same continuity. Also, staged delivery could be costly due to the doubling up of services and materials. As such, a staged delivery for implementation is not recommended. However, should funding constraints be experienced, the delivery of the project could revert to a staged delivery.

A single professional design, engineering and consents services supplier is recommended to be utilised for the full project. Detailed design and tender services would have a duration in the order of 12-18 months from the award and will be required to provide design information to the statutory applications.

The proposed implementation strategy has been developed by considering the critical path elements to enable the construction of the project as soon as practicable. It is estimated that the project will have a construction period of 18-24 months due to its constrained built environment.

14.3 Procurement Strategy

14.3.1 Pre-Implementation Procurement Options

AT's Procurement Manual indicates the following supplier selection methods may be used for the procurement of professional services:

- Direct appointment
- Lowest price conforming
- Purchaser nominated price
- Price quality
- Quality based.

The key attributes for consideration are as follows:

- Scale and complexity of the project - the majority of the risks are associated with stakeholder/political influences
- Timeframe – there is high public and political expectation to deliver the project quickly
- Market competition – use of standard AT procurement for professional services is likely to provide the best value-for-money and help to sustain competition in the professional services industry.

It is recommended that AT procures its professional services provider for the pre-implementation phase through its standard procurement processes. In this case, this would be using an AT approved procurement price-quality approach.

The professional services would probably be procured through an open tender process. There are likely to be in the order of 6-10 engineering consultants based in New Zealand who would have the capability to deliver a project like this. The engineering consultants would typically be engaged under AT's standard Conditions of Contract for Consultancy Services (CCCS).

Given the nature of the project risks; particularly those relating to stakeholders and the public and political profile of the project, it is recommended that a high weighting is placed on quality to manage price/quality trade-offs and attract the right suppliers to the project. Other important considerations are likely to be:

- The ability of the procurement model to meet construction deadlines
- The ability of the model to accommodate unexpected changes to scope or original specification during procurement and construction due to potential changes in the transport network over the analysis period (e.g. completion of the Northern Pathway project)
- The procurement model's ability to deliver innovation in asset design, construction and management, achieving lower whole-of-life project costs.

If the need to accelerate the project is required there is the option of progressing elements of pre-implementation using a direct appointment approach. The implementation phase will be guided by decisions made during the pre-implementation phase.

14.3.2 Implementation Procurement Options

The Land Transport Management Act 2003 Section 25 requires that procurement procedures used by approved organisations like AT are designed to obtain the best value for money spent. A critical aspect of this is ensuring the procurement method is appropriate to manage the project scale, time frames, complexity innovation potential, risk, and supplier market.

The objective of the procurement procedure design is to select a delivery model for the procurement and the delivery of the project. This will maximise the potential for obtaining the greatest economic, social and environmental benefits possible, for the lowest overall whole-of-life cost.

14.3.3 Delivery Model

AT has four delivery models for the procurement of infrastructure project contracts:

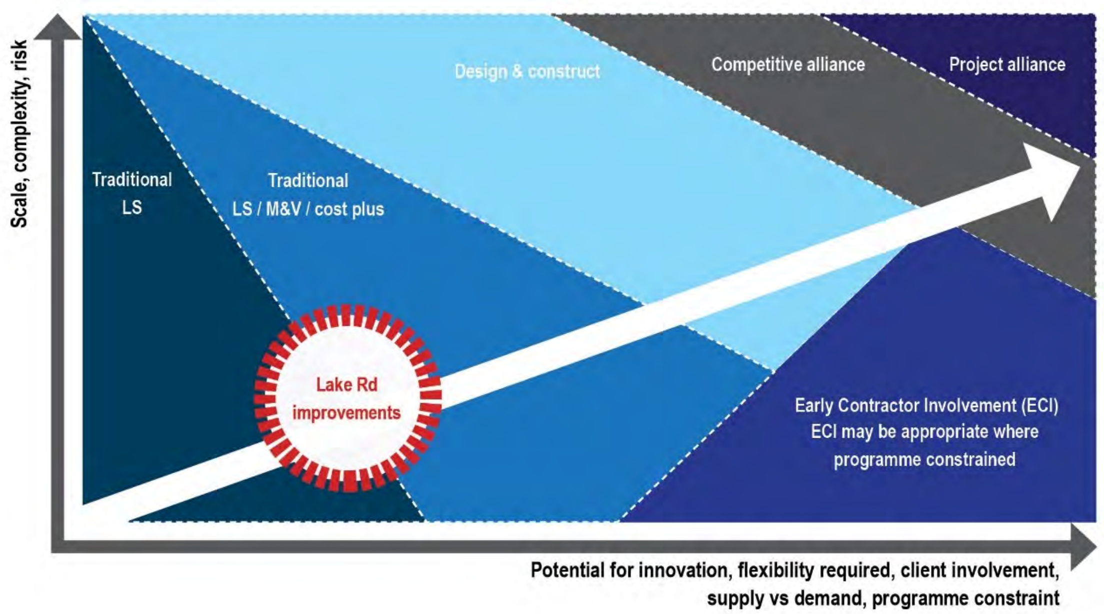
- Staged - traditional
- Design and build
- Shared risk
- Supplier panel.

The appropriateness of the delivery model is determined by the defining characteristics of the procurement activity including complexity, scale, timing, innovation potential, risk and supplier market.

14.3.4 Recommended Procurement Approach

The recommended delivery model for procuring the project is a traditional approach. This method is appropriate as the project complexity, uncertainty, innovation and risk are low. It will allow the project to come to the market in a timely manner as well as be delivered within the anticipated timeline. It also allows for a high level of involvement and control of the project by AT. If possible, it would be beneficial to engage and obtain involvement from contractors to inform the design process before releasing to the market. The rationale behind this recommendation is summarised in Figure 14-1.

Figure 14-1: Recommended Delivery Model



It is recommended that one design consultant is engaged for pre-implementation and one contractor is engaged for delivery.

It is believed that there is currently the capability and capacity for the market to deliver, however, the procurement methodology will need to attract the right type of contractors. There is an opportunity to attract a range of contractors to deliver the project. This will, however, require awareness of ensuring the right weighting of price, quality and timing aspirations are achieved to avoid additional risk to the project.

14.3.5 Interdependencies and Risks

The project shares some similar objectives to Waka Kotahi's Northern Pathway project, such as to improve active mode facilities, connections, and accessibility for a range of customers. There will be common stakeholders, and their delivery timeframes could be similar too. Whilst both projects will be delivered independently, there are opportunities and benefits for the project teams to collaborate to share information, ideas, learnings and expertise. Subject to confirmation of delivery timing for Stage 1 of the Northern Pathway project, there may be advantages in reviewing the form and physical extent of implementation models and scopes to seek optimisation and collaboration between projects.

The project also has several potential interdependencies with the wider local transport network and local environment, such as Auckland Council's proposals for Belmont Centre and the proposed Francis Street to Esmonde Road walking and cycling link.

Risk management has been undertaken to identify all significant risks in accordance with the General and Advanced Approach of Minimum Standard Z/44 of Amendment 8 of SM030. A project risk register has been developed and regularly reviewed throughout the DBC process to manage risks appropriately.

The assessment of risks and its possible impact on the estimate has been used to inform the contingency and funding risk used in the cost estimates, in accordance with AT's Cost Estimating Manual.

14.3.6 Risk Allocation and Transfer

In the pre-implementation phase, it is likely that the majority of the technical risks associated with obtaining statutory approvals will be transferred to the professional service providers on award except for the risks discussed further in the Management Case. The transfer of risk for detailed design and implementation phases will be determined in the project planning and the finalised in the Procurement Strategy. Risk Management is further discussed in the Management and Financial Cases.

14.3.7 Communication

The recommended procurement strategy for the project needs to be communicated to the supplier market. This will aid with obtaining early involvement of contractors both into the early design requirements as well as enabling them to plan adequately to resource the delivery.

14.3.8 Payment Mechanisms

The basis of payment shall be in accordance with AT's standard basis of payment. There are no specific milestone or bonus payments for the delivery under a traditional project delivery for this contract. Should the project be fast-tracked, then the potential for bonus payments and liquidated damages for non-delivery should be considered in the pre-implementation stage of the project.

14.3.9 Contract Management

The contracts for pre-implementation and implementation shall be managed in accordance with AT's minimum standards and special conditions will be included in the contract documents.

14.4 Consenting Strategy

A consenting strategy has been prepared which identifies project consenting, statutory approvals, environmental considerations and key mitigation areas. The strategy is contained in Appendix N.

The strategy identifies that there are several notable and generally protected trees along road corridor as well as several heritage sites (both built heritage and cultural heritage). As such, the following preliminary technical assessments and/or baseline monitoring is recommended during an early stage of detailed design to further refine the consenting risks and strategy:

- A social and community impact assessment is required to better understand potential construction and operational effects on those directly affected by the project and wider the local community
- An arboricultural report is prepared to assess the potential effects on the trees along the corridor and potential mitigation options
- An urban and landscape assessment recommended to determine how it will be integrated into the existing environment, measures to mitigate landscape/amenity effects and opportunities for enhancement.

It is also recommended that the detailed design be discussed with Mana Whenua to provide a better understanding of any potential cultural effects associated with the proposed works. This is because this corridor has views of volcanos and heritage features.

Further public engagement and public participation in the consenting process will assist AT in determining how any adverse environmental effects could be mitigated.

15 Financial Case

The financial case covers the financial viability of the project, funding sources for the project and the process the project must follow to gain funding.

15.1 Project Delivery Costs

A risk-based cost estimate has been prepared for the recommended option based on the assumed construction methodology and programme outlined above. The financial analysis for the project has been developed in accordance with AT's Project Cost Estimation Manual. The estimate includes the whole of life costs of assets and operational costs. The cost estimate is contained in Appendix M.

The project has a pre-implementation/implementation cost in the range of $38.2m (P50)-$43.9m (P95). Table 16-1 shows the P50 capital cost estimate for the project in base year values (2020) and does not account for inflation or discounting.

This cost estimate includes the following:

- Design fees and AT-managed costs
- Traffic management
- Environmental compliance
- Provisional sums for service relocation, urban design and smart systems
- Contractor's preliminary and general costs
- 25% contingency.

The cost estimate excludes:

- GST
- Escalation from May 2020
- Property costs
- Land acquisition costs.

The following assumptions were made:

- 70% of the road area is resurfaced
- Existing bluestone kerb and channel is removed for the new cycle path
- A 600mm wide V dish channel is constructed along the new cycle path
- New catch pits and manholes are provided along the cycle path every 100 metres
- Transit lane markings are provided every 100 metres
- Cycle paths greening to be 100% covered, with cycle symbol markings every 60 metres.

15.2 Ongoing Maintenance Costs

Implementation of the preferred network will result in additional AT assets requiring ongoing maintenance. The additional costs have an estimated range of between $50,000 and $75,000 per annum.

15.3 Funding Options

Funding for transport investment in Auckland comes from two main sources, Auckland Council (largely borrowing and rates) and the National Land Transport Fund (NLTF), largely from fuel taxes. While there is broad alignment on approach, each funding source comes with a slightly different set of priorities and processes.

The AT Board is required by legislation to prepare the RLTP for the Auckland Region. The RLTP includes proposed capital projects for funding by Auckland Council and Waka Kotahi. The RLTP needs to address both national and regional objectives and align the different funding strands.

AT developed an ITP calculator as a tool to prioritise the regional capital programme for the RLTP. The calculator provides an objective and transparent way of prioritising projects. The projects come from various departments within AT and reflect a range of sources (e.g. existing 'on the books' projects, public transport network development, DTLB proposals, responses to residential growth, safety, network operations, walking and cycling, ATAP, etc.). The calculator assesses projects by creating a unique score based on a set of criteria reflecting policy objectives. Scores from each criterion are combined and weighted to give a unique score. The activities (proposals) are prioritised based on the unique score.

There is Capex funding allocated in the current (2018-28) RLTP for this project of $46.5m. The RLTP is still being developed by AT for 2021-31 but is unresolved. Also, the priority of the Lake Road Improvements project recommended in this DBC has yet to be determined in the light of the DTLB voting against the project and current budget constraints arising from Covid-19.

Alignment of the Lake Road corridor improvements with Safe Networks Programme (SNP) may allow AT to apply for additional funding for some aspects of the project under their safety funding allocation at a higher rate, known as the Targeted Enhanced Funding Assistance Rate (TEFAR). This is a matter for AT to consider.

No third-party contributions, e.g. partial funding from property developers, has been identified for the project.

15.4 Funding Plan

Based on the above approach, the anticipated funding plan for the project is summarised in Table 15-1. This assumes a usual finding assistance rates (FAR) from Waka Kotahi.

Table 15-1: Project Funding Plan

Component	Year 1	Year 2	Year 3
Bayswater Avenue Improvements	$2.86M	0	0
Lake Road Improvements	0	$5.95M	$5.95M
Esmonde Road Improvements	2.530	0	

16 Management Case

The project will be developed and delivered by AT. This chapter outlines the AT systems for managing their components of the project and sets out the governance structure to enable all project elements are delivered and that delivery is co-ordinated.

16.1 Governance Structure

Project implementation will be led by AT, as the project sponsor, in partnership with Auckland Council, Waka Kotahi and Mana Whenua. Design and construction will be undertaken by its consultants and contractors.

The existing AT Project Control Group (PCG) that has sat across the delivery of the DBC is recommended to continue to ensure the co-ordinated delivery of the project in its next stage.

The project will be managed by an AT Project Manager who reports to the PCG. The PCG includes a representative who supports an AT Steering Group that also manages/interfaces with other supporting projects in the area. As the project affects a range of 'Council family' initiatives and projects as well as interests of stakeholders, landowners and developers, a reference structure will assist the AT Project Manager. This involves:

- An internal reference group comprising AT and Auckland Council representatives from operational, planning and capital development areas of the organisation
- An external reference group that comprises representatives of property owners and tenants, businesses and other stakeholders relevant to the project, including Waka Kotahi, landowners and schools/colleges.

16.2 Project Roles

Table 16-1 outlines the likely key roles in the pre-implementation and implementation phases of the project. The list is not exhaustive. For all decision making, AT's significance policy (and associated delegations) apply.

Table 16-1: Key Project Roles

Role	Team Member
Project Sponsor	Daniel Newcombe
Project Manager	Sreekanth Vidhyadharan
Manager Traffic Engineering	Melanie Alexander
Manager Travel Demand	Miguel Menezez
ATOC Central Manager	Rua Pani
Manager Planning Integration	Dean Ingoe
Group Manager Communications	Hanno Willers
AT Design Office (Chief Engineer)	Murray Burt
Service Network Development	Steve Wrenn

Head of Healthy Streets and Active Modes	Greg Bassam
Waka Kotahi System Optimisation	Graham O'Connell
Chief Planning Office (Auckland Council)	Ross Moffatt

16.3 Construction Phasing

An initial construction phasing strategy has been developed and is contained in Appendix O. This strategy will need to be refined during the detailed design stage to determine its practicality.

Given the importance of keeping the Lake Road corridor operational during the construction of works, careful consideration has been given to the likely construction impacts of the project. As there no full diversionary routes available on the peninsula, complete closure of Lake Road will be extremely problematic. Night-time working was not considered to be practical given the residential nature of the road corridor. The assessment has considered the ability to keep at least two lanes open on Lake Road (i.e. a lane in each direction), as well as providing a continuous facility for walking and cycling.

To achieve this, and for a project of this length, complexity and high public and business profile the following assumptions and clarifications formed the basis of developing the preliminary design (which will need to be reconfirmed during detailed design):

- A two-phase construction programme consisting of enabling services works followed by the main contract
- The contract is based on having three work crews working at any one time
- Each work crew is to work in an area no greater in length than 500 metres and only on one side of the carriageway
- No two crews shall work opposite each other at one time
- Where the flush median is to be removed, this is to be used as part of a traffic lane
- Delays caused by unknown ground conditions, services and pavement issues are likely to have a more than usual impact on a shortened construction period
  - The risk could be reduced by undertaking a greater than usual pre-construction investigation of the existing pavement, utility services and quantification of rock during the design period
  - This would help to better quantify their costs and thus help to reduce risks.

Based on the staged construction outlined above the following forms the basis of the Temporary Traffic Management (TTM) approach, which needs to be determined during the detailed design phase:

- All TTM is to be undertaken as specified in COPTTM and AT's Manual of Temporary Traffic Management
  - Accommodation of the existing traffic flows by maintaining at least two traffic lanes with minimum lane widths, utilising the flush median and shoulder widths throughout the construction
- The use of plastic water-filled barriers (not concrete) and associated cones to delineate the edge of the construction work area.

16.4 Implementation Programme

An indicative programme which is the basis of the Financial and Management Case is outlined in Table 16-2.

Table 16-2: Project Programme

Activity	Completion Date
AT Board Approval of DBC	Q3 2020
RFP for Detailed Design issued	Q4 2020

Detailed design contract awarded	Q1 2021
Detailed design commences	Q2 2021
Apply for RMA statutory approvals	Q2 2021
Detailed design complete	Q3 2021
Consent decisions received and construction starts	Q4 2021
Implementation complete (to practical completion)	Q4 2023
Implementation phase complete (including one-year defects liability period)	Q4 2024

16.5 Ongoing Engagement

The development of a Communications and Engagement Plan will form the starting point for ongoing engagement. There are potential conflicts between different stakeholders and the community, and their demands. A high level of awareness of these potential interactions is necessary.

16.5.1 Auckland Council

Auckland Council is a key partner in respect of improvements to the Belmont centre.

16.5.2 Waka Kotahi

Waka Kotahi is a key partner as it will want to be confident of any impact on the operation of SH1, as well as be satisfied with the process from an investor's perspective.

16.5.3 Manu Whenua / Ngati Whatua

Mana Whenua holds strong cultural associations with the project area and have been active participants in identifying areas of cultural significance and informing design development. The project team will need to work with Mana Whenua to ensure that iwi aspirations are embodied in the detailed design as early as possible and that cultural recognition throughout the development of the project is explored. Mana Whenua engagement is ongoing, mainly through AT's monthly hui.

AT is also engaging with Ngati Whatua as a local developer.

16.5.4 Key Stakeholders

In addition to the stakeholders engaged in the development of the DBC, as the design progresses in more detail, additional stakeholders are likely to become more actively involved in the project. Specific issues already raised by stakeholders will be explored in more detail. This includes the various local schools and businesses concerning TDM measures.

16.5.5 Wider Community

There is high interest in this project from the wider community and future users, and it is intended to continue to seek feedback and to provide information.

16.6 Assurance and Acceptance

AT has documented processes and policies for independent road safety audits, design reviews, etc. These will be used where appropriate in the detailed design stage.

16.7 Contract Management

Contract Management will be undertaken by the obligations set out in the relevant Contracts. These are to be in line with the terms and conditions in Waka Kotahi's SM030 for Professional Services Contracts in the pre-implementation and implementation phases and Waka Kotahi's SM031 for Construction Contracts in the implementation phases.

16.8 Cost Management

Financial management shall be undertaken in accordance with the relevant AT procedures. As a minimum the consultant/contractor shall provide the following information in each month of the respective contract(s) for the AT Project Manager to update internal financial systems (e.g. SAP) and to support its claims:

- Budgeted cashflow (baseline and risk-adjusted baseline)
- Value of work completed in the preceding month and contract to date (including rates and quantities for all items within the contract)
- Forecast value of work completed and revised cashflow through to project completion
- Exception reports outlining the reasons for not meeting any financial targets.

The proposed target performance measures on a monthly basis is that the claim should be within +/- 5% from the previous month's forecast and within the boundary of the cash flow set in the risk-adjusted baseline programme.

16.9 Project Risks and Mitigation Measures

Several project risks have been identified and monitored in accordance with NZ Transport Agency risk management practices and guidance and its risk management manual (Z/44). Risk management is a dynamic process throughout the life of the project. The key to managing risks lies in the assessment of the impact and level of disruption the risk will impose on the project. The main risks associated with the project and current status of mitigation/treatment is contained in the risk register in Appendix P and summarised in Table 16-3.

Table 16-3: Key Project Risks

Risk	Rating	Risk Type	Treatment
Stakeholder	High	The perceived impacts of the project such as visual impacts, proximity to private property, concerns around parking and noise could affect ongoing support for the project.	Ongoing engagement with stakeholders to understand concerns and continue to explore avenues to address community concerns
Financial	Medium	There is a risk that funding is insufficient for the project due to assumptions included in the estimate being incorrect; error or omission; Change in market conditions.	Cost estimates have been developed in accordance with Waka Kotahi standards (SM014 and Z/44). Estimate to be independently assessed through a parallel estimate on commencement of detailed design
Operations/ Enforcement of Cycle and	Medium	There are risks associated with providing a safe and appropriate environment for a cycle lane and transit lane users associated with	An Operations Plan will be developed as part of the pre-implementation phase

Transit Lanes		keeping customers informed and managing safe operations and access.	
Design	Low	There is a risk that detailed design development identifies impacts on private properties and tree drip lines. The consequence of this risk is that there may be additional consenting requirements, creating delay associated with the further design	Detailed design to avoid impacts on private property and to minimise impacts on tree drip lines.
Construction	Low	There is a threat that unforeseen issues are discovered during construction. A potential cause of this risk is that incorrect as-built information or insufficient investigation completed. The consequence of the threat is the project cannot be constructed in accordance with the resource consent with associated Project delays, negative media coverage and additional cost	Ongoing engagement and consultation with key stakeholders to present construction methodology and identify and resolve issues early. Communication with the public via open days, media coverage and consultation to present construction methodology.
Supporting TDM Measures	Low	Supporting TDM measures required to maximise the success of the project. Funding for resources to implement TDM measures is a risk	Incorporate funding requirements in RLTP

It is recommended that further work be undertaken to address these risks and maximise the successful delivery of the project in the detailed design stage.

16.10 Change Control and Issue Management

AT has documented policies and procedures on scope change with defined financial delegations. These change control will be adhered to during the delivery of the project. Escalation to the AT PCG will be undertaken as required to ensure that any initiated scope change is given full value-for-money considerations.

Change control and issues register shall operate as an extension to the risk register and track issues as they arise. It is anticipated that a change control and issues management process will be included in the contract documents for the project.

Change control and issues management will be undertaken in accordance with:

- AT's Significance Policy
- AT's Corporate Risk Management Policies
- Conditions of contract for project-specific issues.

Each issue shall be logged in an issues register, which includes the following information:

- Title and description of the issue
- Date raised
- Status (open, escalated, transferred to the risk register, resolved)
- Primary impact area for the issue (project, personnel, health and safety, corporate risk, stakeholder management etc.)

- Delegated authority for closing out the issue (following the project management structure)
- Whether the issue is a project-specific issue or another issue
- Level of significance
- Whether the issue requires transferring to the Project Risk Register
- Remedial action proposed to address the issue
- The date that the issue has been resolved.

16.11 Benefits Realisation and Performance Management

Table 16-4 sets out a potential monitoring regime to assess the achievement of the Investment Objectives defined earlier in the DBC. The baseline data relating to the Investment Objectives is contained in Table 5-3.

Table 16-4: Post-Project Monitoring Regime

Investment Objective	Potential Monitoring Regime
IO1 - We will reduce travel time variability for all modes by 10% by 2031	GPS data
IO2 - We will improve the attractiveness of alternative modes to single-occupancy car use by increasing the proportion to 40% by 2031	Car Occupancy Surveys
IO3 - We will balance the place and movement functions of the corridor in line with the appropriate RASF typology by 2031	Qualitative
IO4 - We will reduce the number of DSIs on Lake Road by 20% by 2031	CAS data

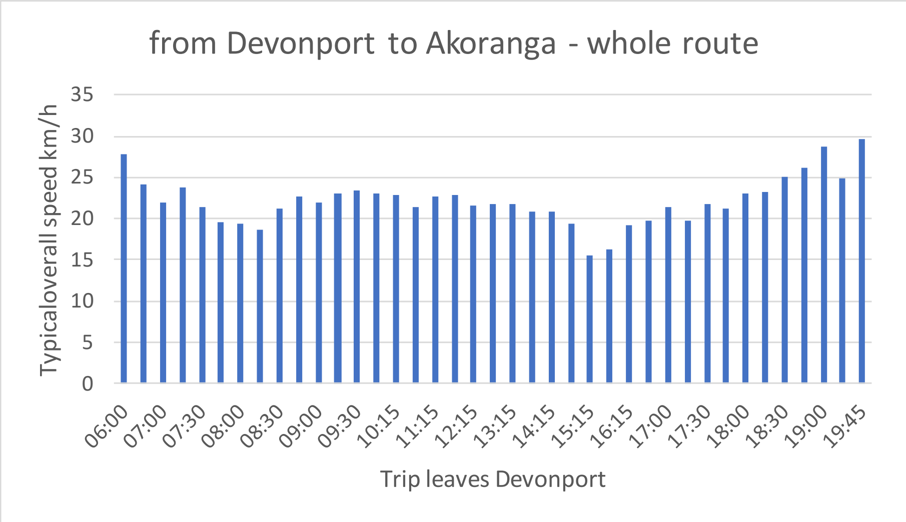
16.12 Lessons Learned

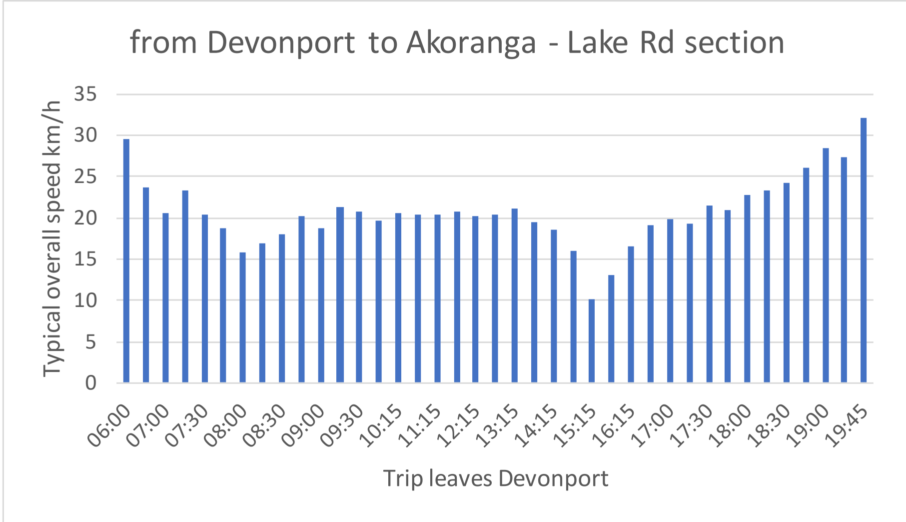
Lessons learnt from the project will be fed back into AT's project development and delivery lifecycle through several mechanisms and levels of project and AT management. It will be the responsibility of the AT project manager for the DBC to complete these reviews with the respective suppliers.

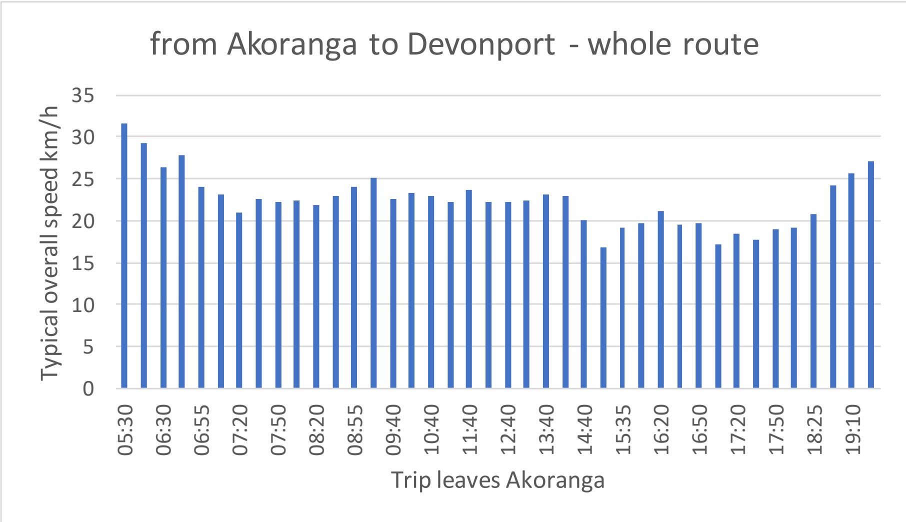
Appendix A: Bus Travel Time Variability

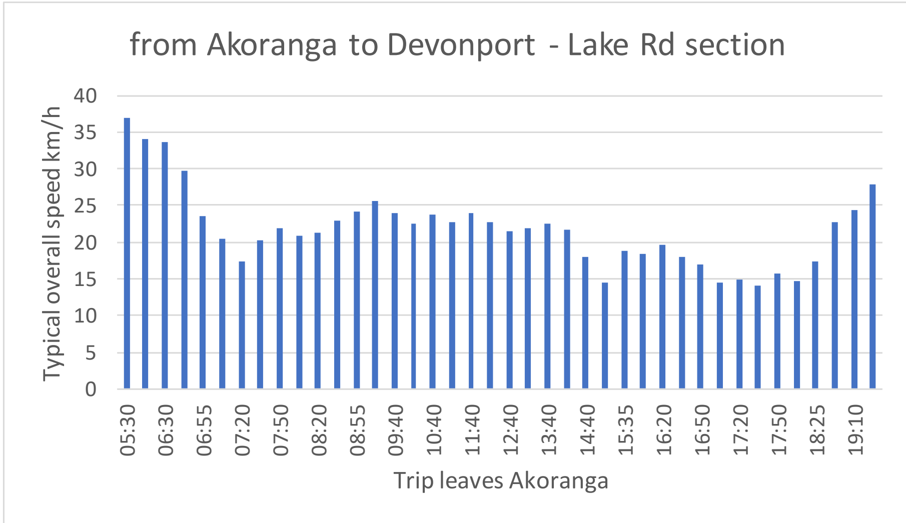
Based on May 2019 weekday data for service 814 (which operates between Devonport and Akoranga via the route shown below), graphs of the typical overall average speed of buses for the whole route and for just the section of Lake Road between Devonport and Takapuna, broken down by trip time and direction of travel, are provided below.

Median Travel Times on Route 814 on Weekdays During May 2019









Median Travel Times on Route 814 on Weekdays During May 2019

overall speed under 20km/h

from DEVONPORT to AKORANGA

End to end First stop at Devonport to last stop at Akoranga	typical journey minutes	typical journey overall km/h	Lake Rd section only Last stop before Lake Rd to first stop after Lake Rd	typical journey minutes	typical journey overall km/h
06:00	21	28	06:00	8	30
06:30	24	24	06:30	10	24
07:00	27	22	07:00	11	21
07:15	25	24	07:15	10	23
07:30	27	21	07:30	11	20
07:45	30	20	07:45	12	19
08:00	30	19	08:00	14	16
08:15	31	19	08:15	13	17
08:30	28	21	08:30	13	18
08:45	26	23	08:45	11	20
09:00	27	22	09:00	12	19
09:15	25	23	09:15	11	21
09:30	25	23	09:30	11	21
09:45	25	23	09:45	12	20
10:15	26	23	10:15	11	21
10:45	27	21	10:45	11	20
11:15	26	23	11:15	11	20
11:45	26	23	11:45	11	21
12:15	27	22	12:15	11	20
12:45	27	22	12:45	11	20
13:15	27	22	13:15	11	21
13:45	28	21	13:45	12	20
14:15	28	21	14:15	12	19
14:45	30	19	14:45	14	16
15:15	38	15	15:15	22	10
15:45	36	16	15:45	17	13
16:15	31	19	16:15	14	17
16:45	30	20	16:45	12	19
17:00	27	21	17:00	11	20
17:15	29	20	17:15	12	19
17:30	27	22	17:30	11	22
17:45	27	21	17:45	11	21
18:00	25	23	18:00	10	23
18:15	25	23	18:15	10	23
18:30	23	25	18:30	9	24
18:45	22	26	18:45	9	26
19:00	20	29	19:00	8	28
19:15	23	25	19:15	8	27
19:45	20	30	19:45	7	32
20:15	20	29	20:15	8	30
20:45	21	27	20:45	7	31
21:15	20	29	21:15	7	34
21:45	18	32	21:45	6	36
22:15	19	31	22:15	6	37
22:45	19	31	22:45	6	36
23:15	16	36	23:15	6	41
23:45	14	41	23:45	5	43

from AKORANGA to DEVONPORT

End to end First stop at Akoranga to last stop at Devonport	typical journey minutes	typical journey overall km/h	Lake Rd section only Last stop before Lake Rd to first stop after Lake Rd	typical journey minutes	typical journey overall km/h
05:30	18	32	05:30	6	37
06:00	20	29	06:00	7	34
06:30	22	26	06:30	7	34
06:40	21	28	06:40	7	30
06:55	24	24	06:55	9	24
07:05	25	23	07:05	11	20
07:20	27	21	07:20	13	17
07:35	26	23	07:35	11	20
07:50	26	22	07:50	10	22
08:05	26	22	08:05	11	21
08:20	26	22	08:20	10	21
08:35	25	23	08:35	10	23
08:55	24	24	08:55	9	24
09:10	23	25	09:10	9	26
09:40	26	23	09:40	9	24
10:10	25	23	10:10	10	22
10:40	25	23	10:40	9	24
11:10	26	22	11:10	10	23
11:40	24	24	11:40	9	24
12:10	26	22	12:10	10	23
12:40	26	22	12:40	10	21
13:10	26	22	13:10	10	22
13:40	25	23	13:40	10	23
14:10	25	23	14:10	10	22
14:40	29	20	14:40	12	18
15:05	34	17	15:05	15	15
15:35	30	19	15:35	12	19
16:05	29	20	16:05	12	18
16:20	27	21	16:20	11	20
16:35	29	20	16:35	12	18
16:50	29	20	16:50	13	17
17:05	34	17	17:05	15	15
17:20	31	18	17:20	15	15
17:35	33	18	17:35	16	14
17:50	30	19	17:50	14	16
18:05	30	19	18:05	15	15
18:25	28	21	18:25	13	17
18:40	24	24	18:40	10	23
19:10	22	26	19:10	9	24
19:40	21	27	19:40	8	28
20:10	21	27	20:10	8	29
20:40	19	31	20:40	7	32
21:10	21	28	21:10	7	31
21:40	19	30	21:40	7	33
22:10	19	30	22:10	6	35
22:40	18	31	22:40	6	37
23:10	17	33	23:10	5	41

Example map from Swiftly
Travel speeds on trips from Devonport to Akoranga
3pm - 4pm, Wednesday 01 May

Appendix B: Car Travel Time Variability

Commercial GPS data for a 12 month period (July 2015 to June 2016) was analysed when the IBC was prepared to determine the variability and median speed of general traffic along Lake Road. The Austroads Variability formula was used to calculate variability. This is an industry-standard for assessing variability (by dividing the standard deviation of travel time by the mean).

The reported data analysed represent a typical working day, excluding school, university and public holidays. The 'typical' day has been derived using 12 months' data, which will include seasonal variations in demand, performance and weather. Individual road user experience on any individual day may vary from the typical results provided (e.g. due to weather), but this one-year date range provides some confidence that the results are representative of the typical performance of the corridor.

For this exercise, very low speeds (less than 20km/hour) are considered unstable and represent congestion (equivalent to LOS E in the TRB Highway Capacity Manual). The following paragraphs providing an overview of the findings.

The following weekday analysis periods, as well as the weekend, were considered:

- Weekday AM peak period – 7am to 10am
- Weekday Inter peak period – 10am to 3pm
- Weekday PM peak period – 3pm to 7pm.

Travel Times – AM Peak

As shown in Figure B-1, south of Esmonde Road to Jutland/Hauraki Road experiences higher speeds on average during the AM peak period but may be prone to flow breakdown due to the high variability. This is likely due to the Hauraki Road signalised intersection gradually filtering traffic onto this section, which has increased lane capacity (four lanes compared with two lanes further south on Lake Road). The high variability may be a consequence to queues backing up from Esmonde Road or the phasing of the Esmonde Road signalised intersection.

The section from Bayswater/Williamson Avenue through to Jutland/Hauraki Road (northbound) experiences low speeds (i.e. less than 25 km/hour) and high travel time variability. This may be as a result of the two schools starting along this section and high traffic volumes within a two-lane road corridor. The extreme high variability in the upstream sections (Seabreeze Road to Bayswater/Williamson Avenue) may be as a result of long queues forming due to students being dropped off and queuing back from Jutland/Hauraki Road intersection.

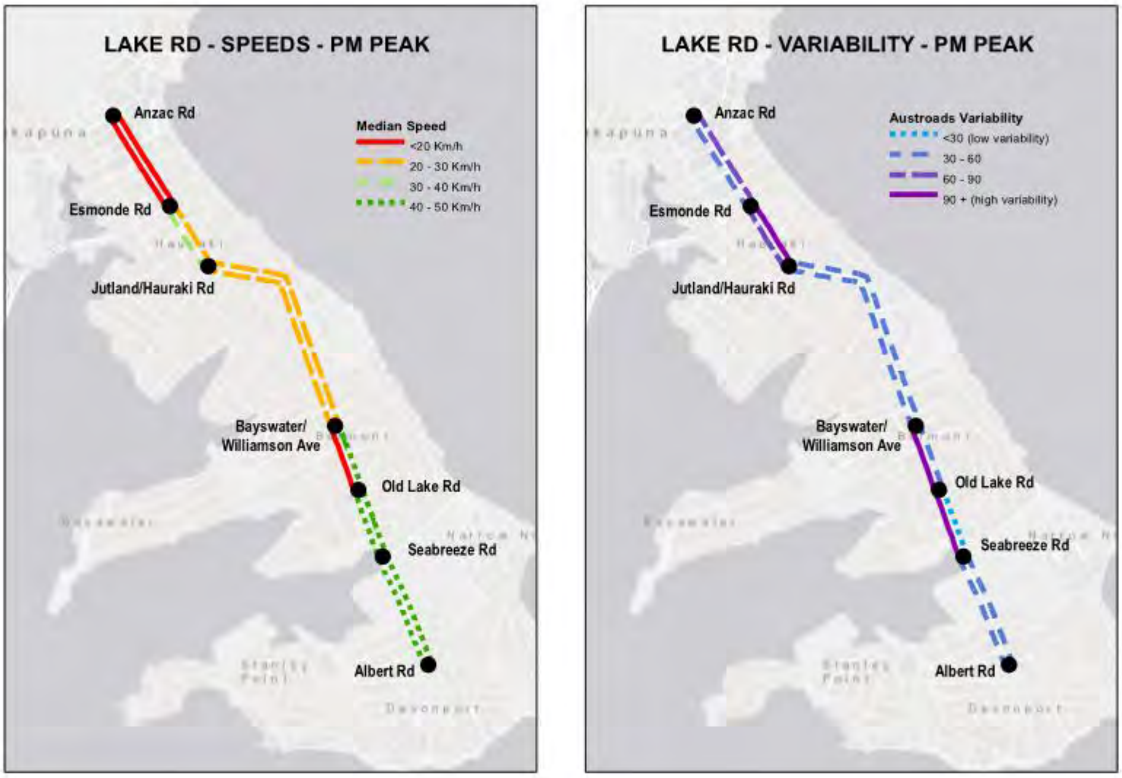
Figure B-1: AM Peak Travel Time Median Speeds and Variability

Travel Times – PM Peak

During PM peak, low speeds (i.e. speeds less than 25 km/hour) are observed southbound from Esmonde Road through to Bayswater/Williamson Avenue, as shown in Figure B-2. A key difference from the AM peak period is that the PM peak period has much lower variability. This leads to more consistent driver experiences.

Similar to the AM peak period, low speeds are observed northbound from the Bayswater/Williamson Avenue intersection through to Jutland/Hauraki Road intersection, with significant congestion observed upstream from Old Lake Road to Bayswater/Williamson Avenue.

Figure B-2: PM Peak Travel Time Median Speeds and Variability



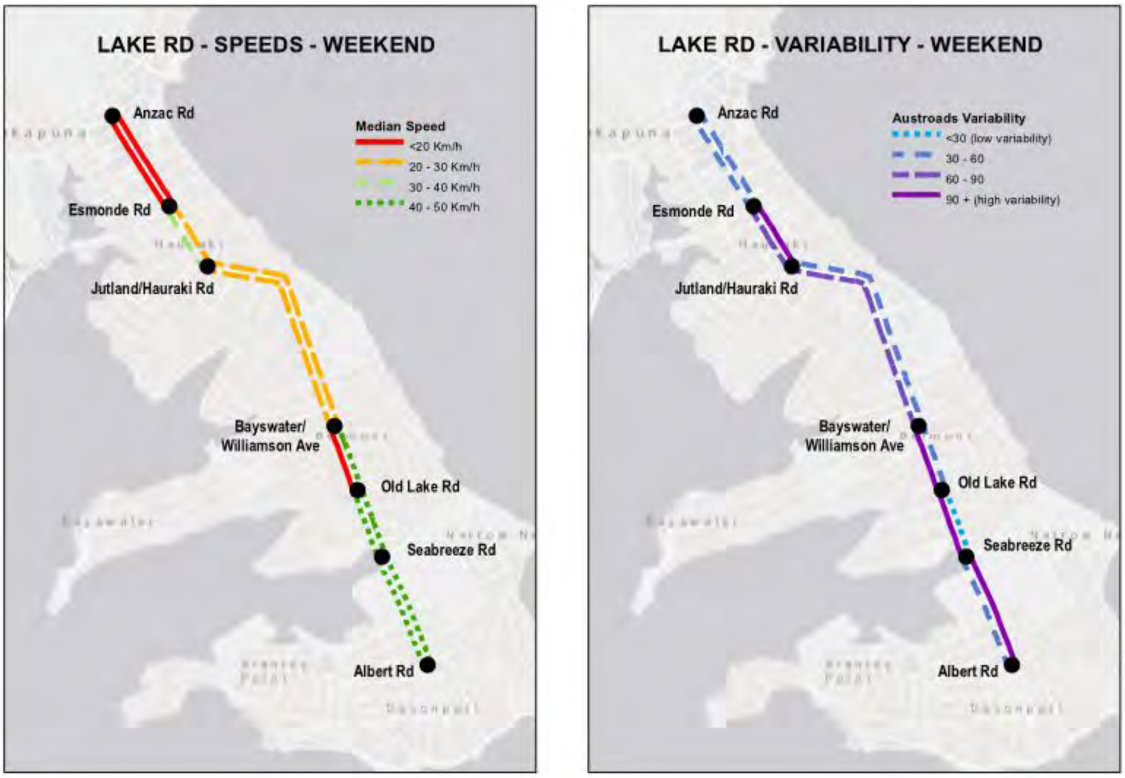
Travel Times – Interpeak

The median speeds and variability during the inter-peak period between Albert Road and Jutland/Hauraki Road intersection is similar to the variability profile during the PM peak period (both with very high variability northbound between the Seabreeze Road intersection and Bayswater/Williamson Avenue intersection). The highest variability during the inter-peak is observed northbound between the Jutland/Hauraki Road and Esmonde Road intersections.

Travel Times – Weekend

The weekend median speeds and variability are shown in Figure B-3. The median speed and variability along Lake Road during the weekend period are very similar to the Weekday PM peak period.

Figure B-3: Weekend Travel Time Median Speeds and Variability



The main differences between the PM peak period and weekend period are:

- Decreased variability southbound between the Anzac Road and Esmonde Road intersections
- Increased variability southbound between the Seabreeze Road and Albert Road intersections
- Increased variability northbound between the Bayswater/Williamson Avenue and Jutland/Hauraki Road intersections.

AT Snitch Data Comparison – Travel Time Variability

To corroborate the Commercial GPS data analysis undertaken by Beca, Snitch data collected and analysed by AT for the Lake Road corridor between Albert Road and Esmonde Road.

Snitch is a GPS vehicle tracking service, used by a full range of companies in New Zealand. The vehicle travel times are aggregated along the NZ roading network to provide a range of data for roading authorities. The Snitch data has also been used to assess the conditions on Esmonde Road.

Figure B-4 to Figure B-7 below illustrate a comparison of Commercial GPS and Snitch data. It should be noted there will be differences in the data shown, as the Snitch is only for a three month period (July to September 2016) and averages the travel time across the peak periods (which 'flattens' the peaks and troughs in the data), whilst the Commercial GPS is for a twelve-month period and in 15 minute time intervals through the day.

Figure B-4: Commercial GPS vs Snitch – Weekday Northbound Travel Time Variability

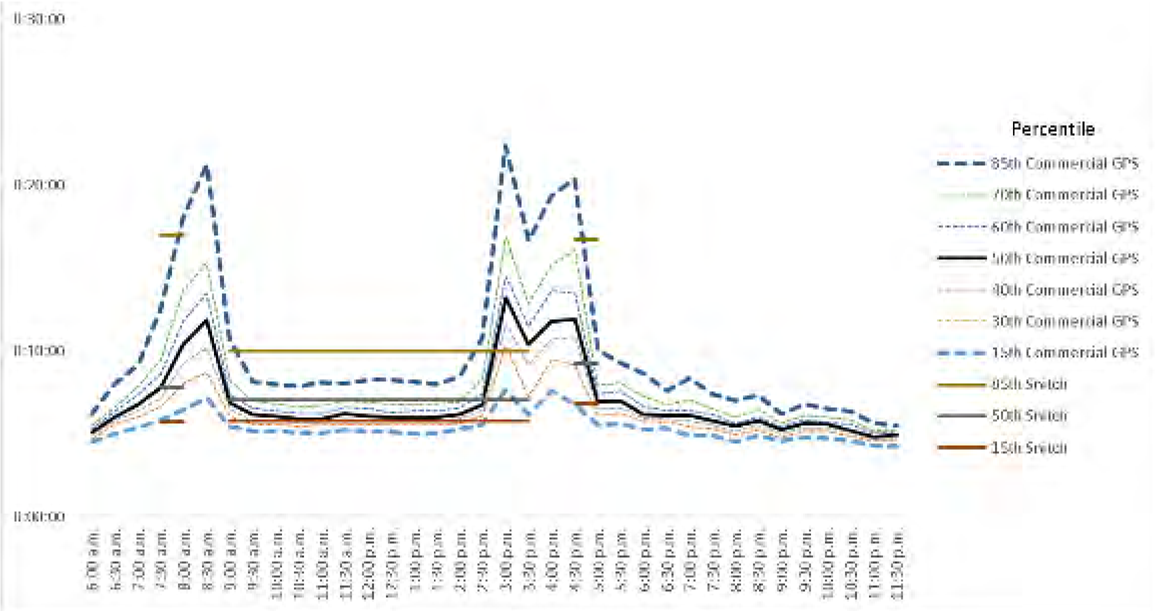
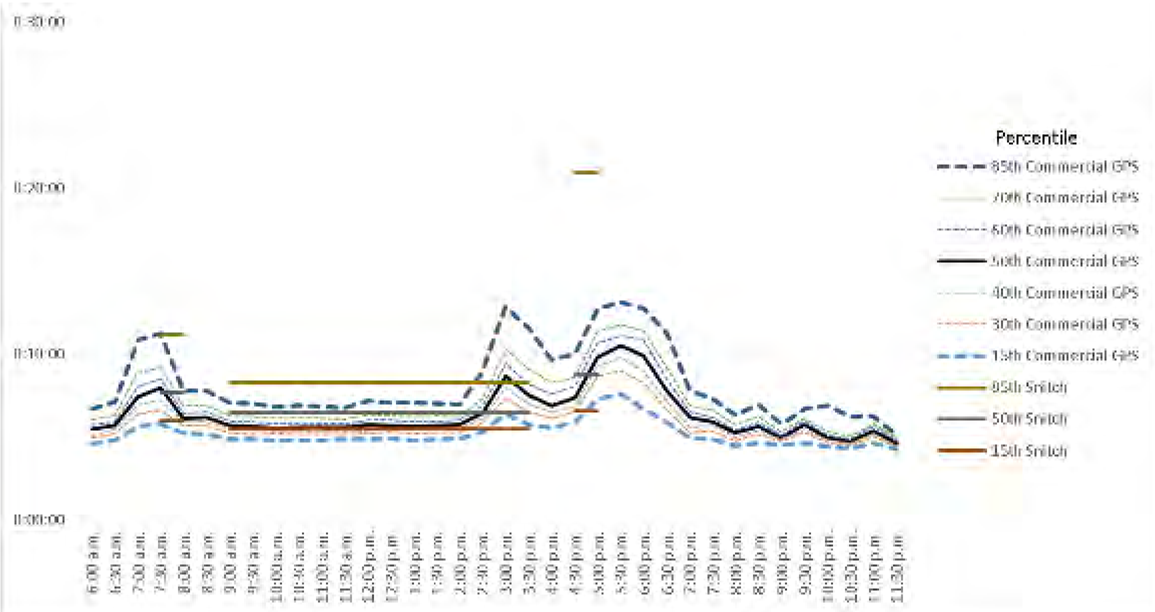


Figure B-5: Commercial GPS vs Snitch – Weekday Southbound Travel Time Variability



Generally, the Snitch data corroborates the variability in travel times on Lake Road shown in the Commercial GPS data. Indeed for the weekday PM peak period, it identifies a much higher 85th percentile southbound travel time than the Commercial GPS data. With the weekend data and to a lesser extent the weekday inter-peak period, the Snitch data the effect of the average across the peak period flattening out the peaks/troughs from the Commercial GPS can be observed.

Figure B-6: Commercial GPS vs Snitch – Weekend Northbound Travel Time Variability

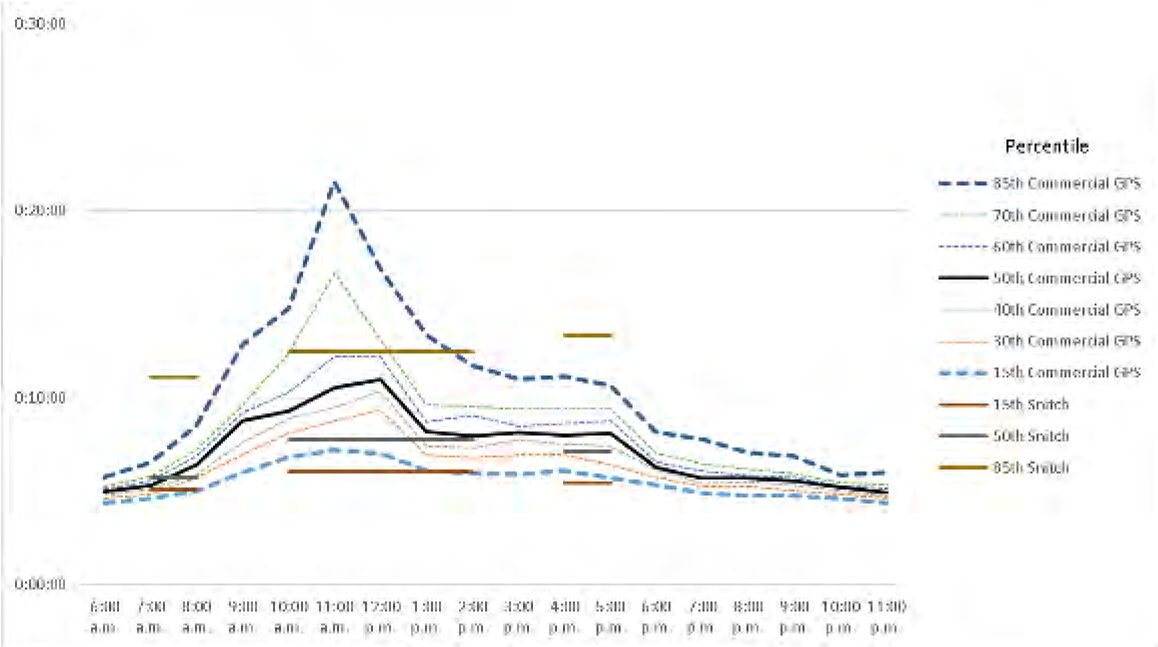
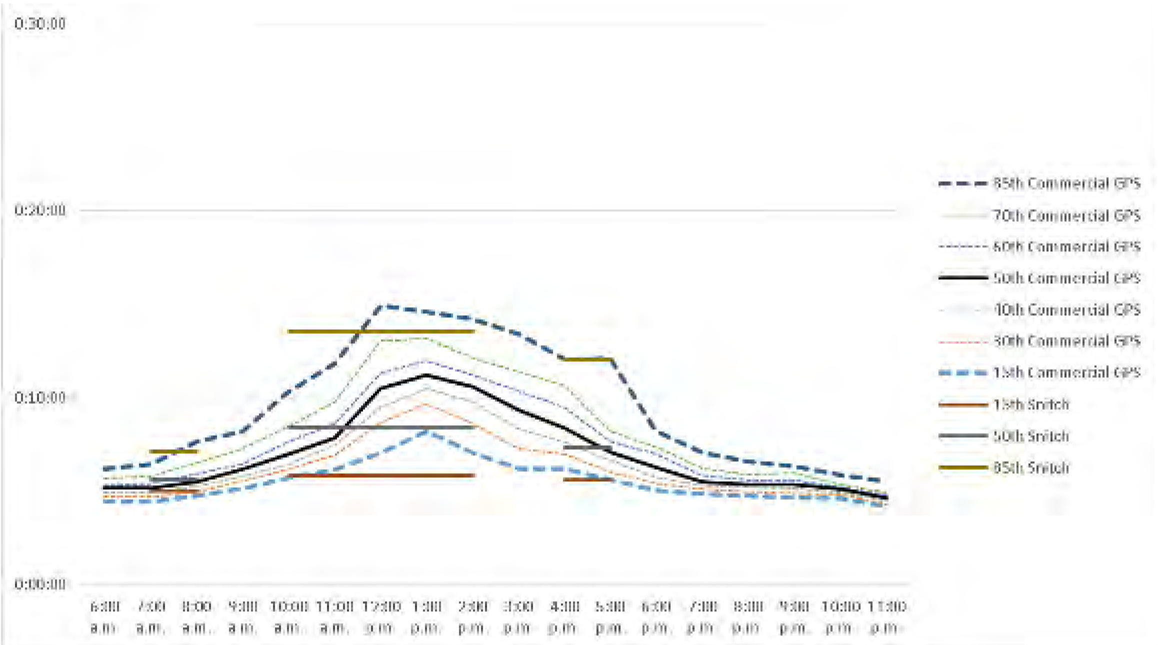


Figure B-7: Commercial GPS vs Snitch – Weekend Southbound Travel Time Variability



Appendix C: Roads and Street Framework Assessment

Roads and Streets Framework Assessment

Lead Working Group members:	*Nick Renton*	INP	*Hamish Scott*	ADO	*Amir Kayal*	D&S
Steering Group members:	*Andrew McGill*	INP	*Ben VanBruggen*	ADO	*Chris Beasley*	D&S
Date of endorsement:	*13 December 2019*					

Typology Assessment

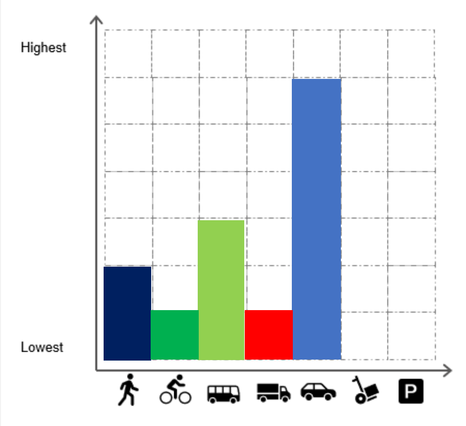
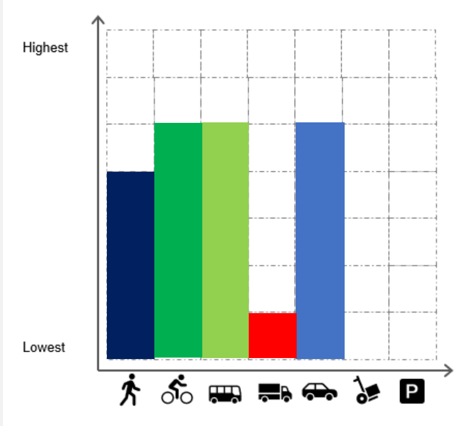
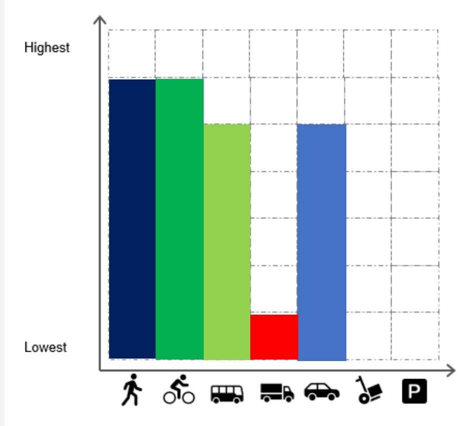
Existing Typology Assessment

Road/Street section	Place Assessment	Movement Assessment	Existing Typology
Esmonde Road (Barrys Point Road to Lake Road) 	**P1** ▪ Local place significance ▪ Land use predominantly residential, Harbourside Church	**M3** ▪ High strategic movement significance ▪ Primary connection between Takapuna and Devonport Peninsula to SH1. ▪ Frequent bus route connecting Takapuna and Devonport Peninsula with Northern Busway and City Centre. ▪ It is on the strategic cycle network. ▪ It is an over-dimensional Freight route.	**P1/M3**

Future Typology Assessment

Assumptions	Place Assessment	Movement Assessment	Future Typology
Year: 2031	**P1**	**M3**	**P1/M3**
▪ Seapath and Skypath complete ▪ Assuming 2031 Strategic Cycle Network ▪ Assuming 2031 Strategic PT Network	▪ Local place significance ▪ Some higher density residential planned but won't change the catchment or Place significance.	▪ Strategic movement significance ▪ Importance of cycle and walking connections will increase due to Seapath and Skypath connecting this area with the city centre.	

Modal Priority Assessment

Observed Modal Priority	Optimal Modal Priority	Future Modal Priority
		

Walking	Cycling	Public Transport	Freight	Private Motor Vehicles	Loading & Servicing	Parking & Access
Observed Modal Priority						
Some pedestrian priority reflective of capacity of footpaths and crossing opportunities. Footpath on northern side of corridor connects to Akoranga Station.	Cycling given a small amount of priority along Esmonde Road in the form of painted on street cycle lanes. Lanes are consistent between Lake Road and the intersection by the Harbourside Church. Cyclists use the footpath and shared path from there towards Akoranga Station or Takapuna. The provision is inadequate for the vehicle speeds along this road.	Westbound / citybound bus lanes along sections of Esmonde Road provide some priority to the multiple frequent / connector buses using the route.	No specific freight priority provided within the corridor. Lanes may be designed to accommodate OD vehicles as this is on an OD route.	There are four general traffic lanes, central medians and turning lanes along this section of Esmonde Road.	No loading and servicing priority provided.	No parking priority provided within the corridor.
Optimal Modal Priority						

Key connection to Northern Express buses. Increase in priority required.	Part of strategic cycle network. Increase in priority required.	There is currently one frequent bus route (82 between Takapuna and the city centre) and one peak connector route using Esmonde Road.	This section of Esmonde Road is an OD route.	Key access from the harbour bridge into Devonport and Takapuna. Decrease in priority required to allow for an increase for other modes.	No demand	No demand
Future Modal Priority						
With the introduction of a cross harbour walking and cycling connection between the city and the north shore, the pedestrian priority for this section of Esmonde Road will be high.	With the introduction of a cross harbour walking and cycling connection between the city and the north shore, the cycling priority for this section of Esmonde Road will be high.	No anticipated change in priority for public transport in the future.	No change in demand	No change	No change	No change

Modal Priority summary

- **Observed:** General Traffic is currently the highest priority. The existing bus priority is not suitable considering the frequent services currently operating on Esmonde Road.
- **Optimal:** Walking, cycling and public transport should all be provided additional priority along this section. Cycling and public transport see an increase in priority due to their strategic network significance, while priority for pedestrians is increased because existing quality of service being low. General traffic is still one of the highest priorities along Esmonde Road.
- **Future:** With the introduction of a cross harbour walking and cycling facility assumed, walking and cycling priority along this section of Lake Road are increased. General traffic and bus priority remain a high priority.

Safety Considerations

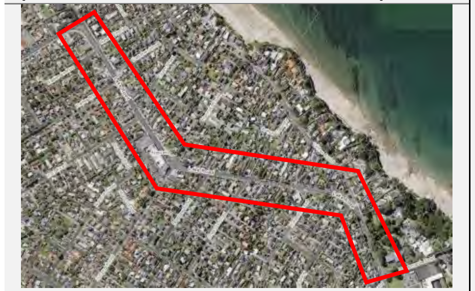
- Requires survivable speeds for vulnerable road users
- Medium Collective Crash-risk

Roads and Streets Framework Assessment

Lead Working Group members:	*Nick Renton*	INP	*Hamish Scott*	ADO	*Amir Kayal*	D&S
Steering Group members:	*Andrew McGill*	INP	*Ben VanBruggen*	ADO	*Chris Beasley*	D&S
Date of endorsement:	*13 December 2019*					

Typology Assessment

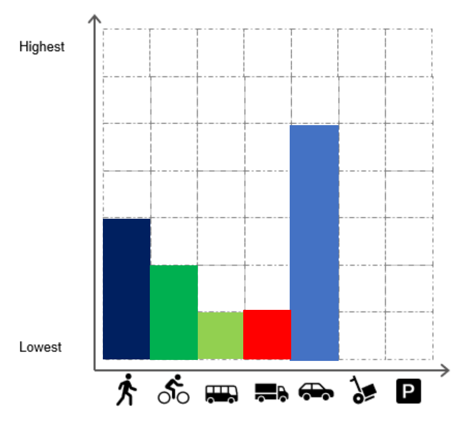
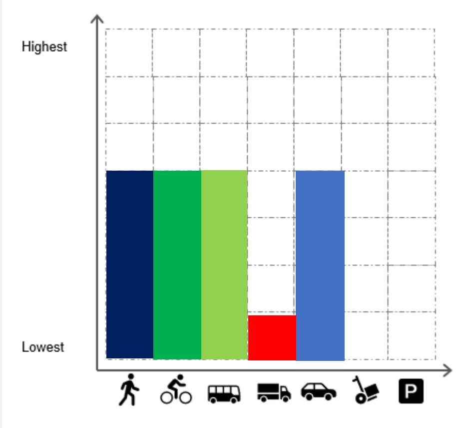
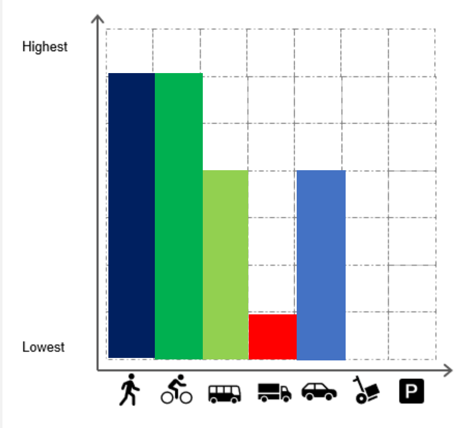
Existing Typology Assessment

Road/Street section	Place Assessment	Movement Assessment	Existing Typology
Lake Road **(Esmonde Road to St Leonards Road)** 	**P1** ▪ Local place significance ▪ Predominantly low density residential, Hauraki Corner shops have a small variety of commercial activities with a local catchment (doctors, pharmacy, restaurants and cafe)	**M3** ▪ High strategic movement significance ▪ Lake Road is a highly strategic link connecting the Devonport Peninsula to rest of the North Shore and to SH1. ▪ Currently there are a number of connector buses using Lake Road which connect to Devonport / Devonport Ferry, Takapuna and the Northern Busway (802 bus connects to city centre in peak hours). ▪ It is part of the strategic cycle network. ▪ It is not on the freight network but is an OD route.	**P1/M3**

Future Typology Assessment

Assumptions	Place Assessment	Movement Assessment	Future Typology
Year: 2031	**P1**	**M3**	**P1/M3**
▪ Seapath and Skypath complete ▪ Assuming 2031 Strategic Cycle Network ▪ Assuming 2031 Strategic PT Network	▪ No anticipated change in existing place function	▪ Strategic movement significance ▪ Importance of cycle connections will increase due to Seapath and Skypath connecting this area with the city centre. ▪ 814 bus route identified as a future frequent bus route (15 minute frequency 7am-7pm 7 days a week)	

Modal Priority Assessment

Observed Modal Priority	Optimal Modal Priority	Future Modal Priority
		

Walking	Cycling	Public Transport	Freight	Private Motor Vehicles	Loading & Servicing	Parking & Access
Observed Modal Priority						
Some pedestrian priority through footpaths, signalised crossings. Limited crossing opportunities throughout section.	Provision provided in form of narrow painted on street cycle lanes.	No bus lanes provided. Provision in form of indented bus stops.	No freight priority provided within the corridor. Lake Road is an Over Dimension route.	Two general traffic lanes for most of Lake Rd including central median.	No loading and servicing priority provided.	No parking priority provided within the section of corridor.
Optimal Modal Priority						
Increase to reflect connections to Takapuna, Hauraki corner shops and connections down to local schools.	Increase to reflect connections to Takapuna, plus on strategic cycle network.	Connector PT routes use this section of Lake Road.	No change.	Key connection between Devonport and north shore / city centre for motorists but overall priority is decreased to allow for an increase in priority for other modes.	No change.	No change.
Future Modal Priority						
With the introduction of a cross harbour walking and cycling	With the introduction of a cross harbour walking and cycling connection	The 814 bus route is planned to become a frequent bus route.	No freight priority provided within the corridor. Lake Road is	Reduction in priority given increased priority for	No change.	No change.

connection between the city and the north shore, the pedestrian priority for this section of Lake Road will be high.	between the city and the north shore, the cycling priority for this section of Lake Road will be high.	Increased number of services using Lake Road.	an Over Dimension route.	pedestrians and cyclists.		

Modal Priority summary

- **Observed:** General Traffic is currently the highest priority. There is some walking and cycling provision provided within the street, but both the quality and safety of facilities result in a lower observed priority.
- **Optimal:** Walking, cycling and public transport should all be provided additional priority along this section of Lake Road. Cycling and general traffic are the highest priorities along the corridor.
- **Future:** With the introduction of a cross harbour walking and cycling facility assumed, walking and cycling priority along this section of Lake Road are increased. General traffic priority is decreased.

Safety Considerations

- Requires survivable speeds for vulnerable road users
- High Collective Crash-risk, including Medium High Active Road User and High Motorcycle Collective Crash Risk

Roads and Streets Framework Assessment

Lead Working Group members:	*Nick Renton*	INP	*Hamish Scott*	ADO	*Amir Kayal*	D&S
Steering Group members:	*Andrew McGill*	INP	*Ben VanBruggen*	ADO	*Chris Beasley*	D&S
Date of endorsement:	*13 December 2019*					

Typology Assessment

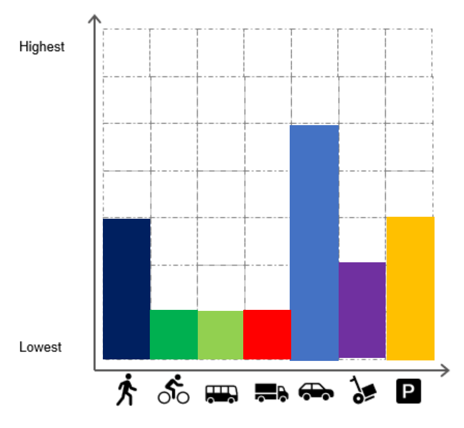
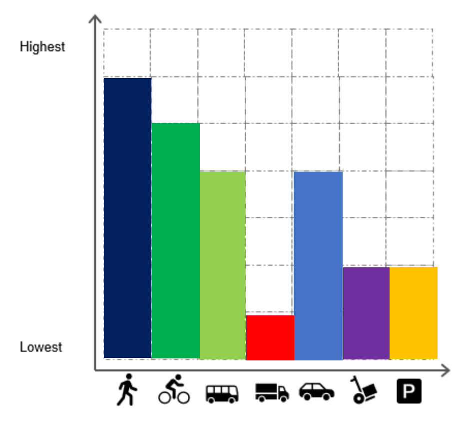
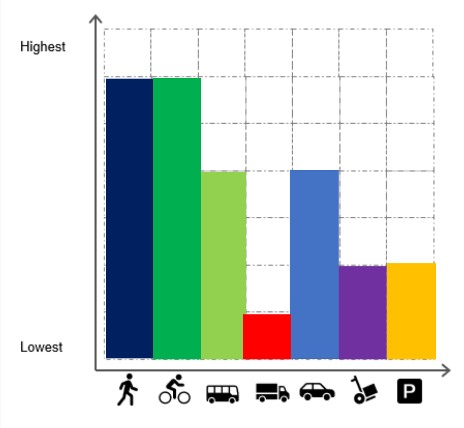
Existing Typology Assessment

Road/Street section	Place Assessment	Movement Assessment	Existing Typology
Lake Road **(St Leonards Road to Alamein Avenue – including the junction of Bayswater Avenue, Williamson Avenue and Lake Road)** 	**P2** ▪ Sub-regional place significance ▪ Wider variety of land use activities occurring within this section of Lake Road (Takapuna Grammar, Belmont Intermediate School, Belmont School, Baptist Church, Community Centre and Belmont shops and restaurants). ▪ Western edge of section is predominantly low density residential outside of Belmont centre.	**M3** ▪ Strategic Movement significance ▪ Lake Road is a highly strategic link connecting the Devonport Peninsula to rest of the North Shore and to SH1, ▪ Currently there are a number of connector buses using Lake Road which connect to Devonport / Devonport Ferry, Takapuna and the Northern Busway (802 bus connects to city centre in peak hours) ▪ High pedestrian priority within this section due to connections between centre and schools. ▪ It is part of the strategic cycle network. ▪ It is not on the freight network or an OD route.	**P2/M3**

Future Typology Assessment

Assumptions	Place Assessment	Movement Assessment	Future Typology
Year: 2031	**P2**	**M3**	**P2/M3**
▪ Seapath and Skypath complete ▪ Assuming 2031 Strategic Cycle Network ▪ Assuming 2031 Strategic PT Network	▪ Potential for small increase in density but not significant enough to increase the Place significance to P3.	▪ Importance of cycle connections will increase due to Seapath and Skypath connecting this area with the city centre. ▪ 814 bus route identified as a future frequent bus route (15 minute frequency 7am-7pm 7 days a week)	

Modal Priority Assessment

Observed Modal Priority	Optimal Modal Priority	Future Modal Priority
		

Walking	Cycling	Public Transport	Freight	Private Motor Vehicles	Loading & Servicing	Parking & Access
Observed Modal Priority						
Some pedestrian priority through footpaths, signalised crossings. Limited crossing opportunities throughout section.	Provision provided in form of narrow painted on street cycle lanes. Around the Belmont shops, northbound cyclists use the footpath as there are no cycle lanes through this section.	No bus lanes provided. Provision in form of indented bus stops.	No freight priority provided within the corridor. Lake Road is an Over Dimension route.	Two general traffic lanes for most of Lake Rd including central median.	Some spaces within the Belmont centre.	Parking provided around centres and P90 parking provided outside of schools.
Optimal Modal Priority						
Increase in pedestrian priority required to reflect connections to Takapuna, Belmont shops and connections down to local schools.	Increase to reflect connections to Takapuna and schools along Lake Road plus on strategic cycle network.	Connector PT routes use this section of Lake Road.	No change.	Key connection between Devonport and north shore / city centre for motorists. Decrease in priority due to increase in other modes.	No change.	Some demand around centres but decrease in priority to make way for increase in active mode priority. Demand for cycle parking.

Future Modal Priority						
The pedestrian priority for this section of Lake Road will remain high, further supported by introduction of Seapath and Skypath although noting the distance to this may not attract significant number of peds from this area. No change from optimal modal priority.	With the introduction of a cross harbour walking and cycling connection between the city and the north shore, the cycling priority for this section of Lake Road will be high.	The 814 bus route is planned to become a frequent bus route. Increased number of services using Lake Road.	No freight priority provided within the corridor. Lake Road is an Over Dimension route.	Reduction in priority given increased priority for pedestrians and cyclists.	No change from optimal.	No change from optimal.

Modal Priority summary

- **Observed:** General Traffic is currently the highest priority. Walking and parking are also important to the current functioning of the street. Minimal provision in place for cyclists.
- **Optimal:** Walking and cycling become the highest priority along this section of corridor due to connections to local centres and schools. Public transport priority is also increased. Parking remains a priority within the corridor but is decreased to allow for increase in other modes.
- **Future:** With the introduction of a cross harbour walking and cycling facility assumed, cycle priority along this section of Lake Road are increased.

Safety Considerations

- Requires survivable speeds for vulnerable road users
- High Collective Crash-risk, including Medium High Active Road User and High Motorcycle Collective Crash Risk
- Intersection of Bayswater and Lake Road is Medium High Crash-risk

Roads and Streets Framework Assessment

Lead Working Group members:	*Nick Renton*	INP	*Hamish Scott*	ADO	*Amir Kayal*	D&S
Steering Group members:	*Andrew McGill*	INP	*Ben VanBruggen*	ADO	*Chris Beasley*	D&S
Date of endorsement:	*13 December 2019*					

Typology Assessment

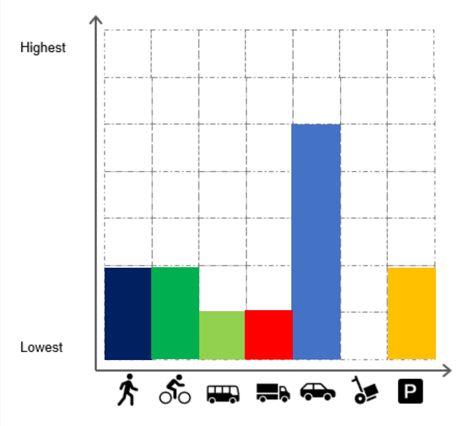
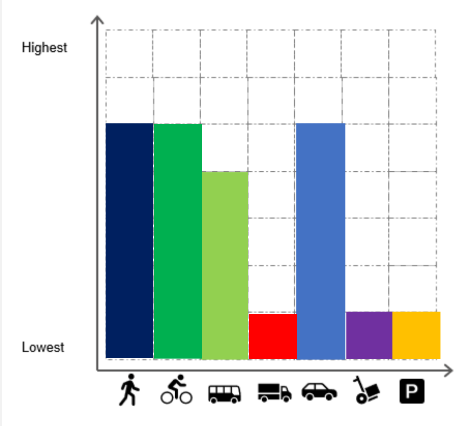
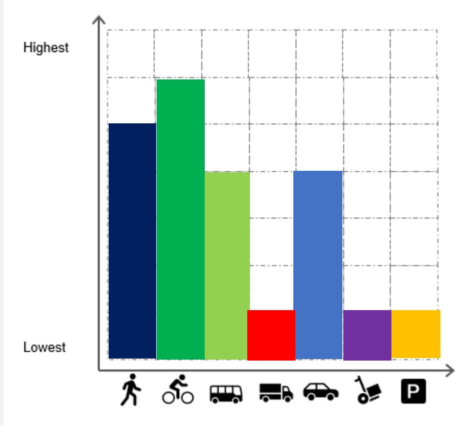
Existing Typology Assessment

Road/Street section	Place Assessment	Movement Assessment	Existing Typology
Lake Road **(Alamein Avenue to Kawerau Avenue)** 	**P1** ▪ Local Place significance ▪ Section predominantly low density residential with a small number of local shops close to Old Lake Rd although their frontage is not particularly active.	**M3** ▪ Strategic Movement significance ▪ Lake Road is a highly strategic link connecting the Devonport Peninsula to rest of the North Shore and to SH1, ▪ Currently there are a number of connector buses using Lake Road which connect to Devonport / Devonport Ferry, Takapuna. ▪ High pedestrian priority within this section due to connections to Belmont centre ▪ It is part of the strategic cycle network. ▪ It is not on the freight network or an OD route.	**P1/M3**

Future Typology Assessment

Assumptions	Place Assessment	Movement Assessment	Future Typology
Year: 2031	**P1**	**M3**	**P1/M3**
▪ Seapath and Skypath complete ▪ Assuming 2031 Strategic Cycle Network ▪ Assuming 2031 Strategic PT Network	▪ No anticipated change in place function.	▪ 814 bus route identified as a future frequent bus route (15 minute frequency 7am-7pm 7 days a week)	

Modal Priority Assessment

Observed Modal Priority	Optimal Modal Priority	Future Modal Priority
		

Walking	Cycling	Public Transport	Freight	Private Motor Vehicles	Loading & Servicing	Parking & Access
Observed Modal Priority						
Some pedestrian priority through footpaths. Limited crossing opportunities throughout section.	Provision provided in form of narrow painted on street cycle lanes.	No bus lanes provided. Provision in form of indented bus stops.	No freight priority provided within the corridor.	Two general traffic lanes for most of Lake Rd including central median.		Parking provided around shops.
Optimal Modal Priority						
Increase in pedestrian priority required to reflect connections to Takapuna, Belmont shops and connections down to local schools.	Increase to reflect connections to Takapuna and schools along Lake Road plus on strategic cycle network.	Connector PT routes use this section of Lake Road.	No change.	Key connection between Devonport and north shore / city centre for motorists.	No change.	Some demand around centres but decrease in priority to make way for increase in active mode priority.
Future Modal Priority						
The pedestrian priority for this section of Lake Road will be high. No change from optimal modal priority.	With the introduction of a cross harbour walking and cycling connection between the city and the north shore, the cycling priority for this	The 814 bus route is planned to become a frequent bus route. Increased number of services using Lake Road.	No freight priority provided within the corridor. Lake Road is an Over Dimension route.	Reduction in priority given increased priority for pedestrians and cyclists.	No change from optimal.	No change from optimal.

	section of Lake Road will be high.					

Modal Priority summary

- **Observed:** General Traffic is currently the highest priority. Walking, cycling and parking are provided some space within the existing corridor.
- **Optimal:** Walking and cycling become the highest priority (alongside general traffic) along this section of corridor due to connections to local centres and schools. Public transport priority is also increased. Parking remains a priority within the corridor but is decreased to allow for increase in other modes.
- **Future:** With the introduction of a cross harbour walking and cycling facility assumed, cycle priority along this section of Lake Road are increased. General traffic decreased due to increase in active mode priority.

Safety Considerations

- Requires survivable speeds for vulnerable road users
- High Collective Crash-risk, including Medium High Active Road User and High Motorcycle Collective Crash Risk

Roads and Streets Framework Assessment

Lead Working Group members:	*Nick Renton*	INP	*Hamish Scott*	ADO	*Amir Kayal*	D&S
Steering Group members:	*Andrew McGill*	INP	*Ben VanBruggen*	ADO	*Chris Beasley*	D&S
Date of endorsement:	*13 December 2019*					

Typology Assessment

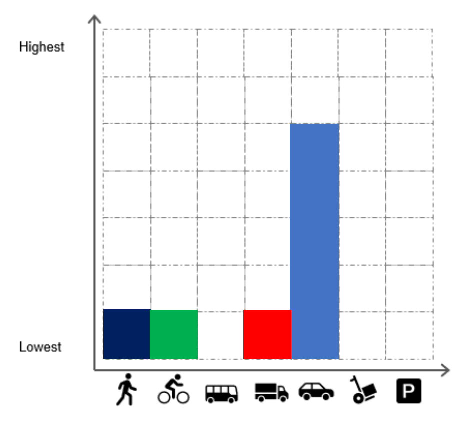
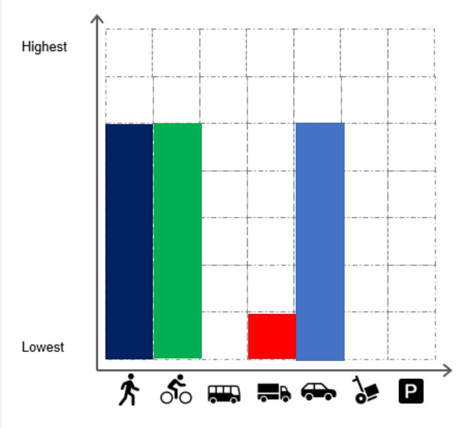
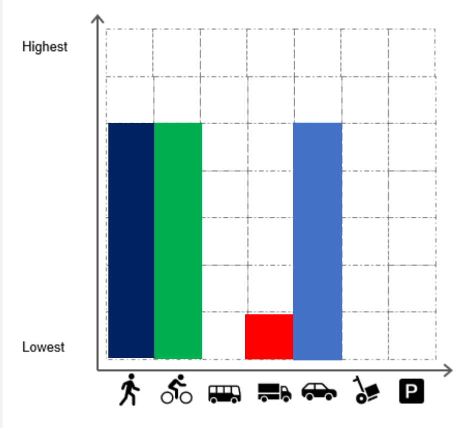
Existing Typology Assessment

Road/Street section	Place Assessment	Movement Assessment	Existing Typology
Lake Road (Kawerau Avenue to Albert Road roundabout) 	**P1** ▪ Local Place significance ▪ Section predominantly low density residential with a small number of local shops close to Old Lake Rd although their frontage is not particularly active. ▪ Waitemata Golf course and a local park border Lake Road. However, the main access for these are not from Lake Rd.	**M3** ▪ High strategic Movement significance ▪ Lake Road is a highly strategic link connecting the Devonport Peninsula to rest of the North Shore and to SH1, ▪ No buses run on Lake Road south of Old Lake Road intersection. ▪ It is part of the strategic cycle network. ▪ It is not on the freight network but is an OD route.	**P1/M3**

Future Typology Assessment

Assumptions	Place Assessment	Movement Assessment	Future Typology
Year: 2031	**P1**	**M3**	**P1/M3**
▪ Seapath and Skypath complete ▪ Assuming 2031 Strategic Cycle Network ▪ Assuming 2031 Strategic PT Network	▪ No anticipated change.	▪ No anticipated change in Movement significance	

Modal Priority Assessment

Observed Modal Priority	Optimal Modal Priority	Future Modal Priority
		

Walking	Cycling	Public Transport	Freight	Private Motor Vehicles	Loading & Servicing	Parking & Access
Observed Modal Priority						
Some sections do not have a footpath on both sides of the road. Limited crossing opportunities.	Some provision provided in form of narrow painted on street cycle lanes. Some sub-sections do not contain cycle lanes at all despite modes presence on cycle network.	No bus routes through this section.	Lake Road is an Over Dimension route.	Two general traffic lanes for most of Lake Rd.	No loading and servicing spaces.	No parking.
Optimal Modal Priority						
Increase in pedestrian priority required to reflect connections to Takapuna, Belmont shops and connections down to Devonport.	Increase to reflect connections to Devonport and towards Belmont shops and schools. Section is on the Auckland Cycle Network.	No change from observed.	No change.	Key connection between Devonport and north shore / city centre for motorists.	No change.	No change.
Future Modal Priority						

No change from optimal modal priority.	No change from optimal modal priority.	No bus route through this section of Lake Road.	No change.	Key connection between Devonport and north shore / city centre for motorists.	No change.	No change.

Modal Priority summary

- **Observed:** General Traffic is currently the highest priority. Walking and cycling provided minimal amount of priority (and in sub sections – no priority).
- **Optimal:** Walking and cycling become the highest priority along with general traffic this section of corridor due to connections to local centres and schools.
- **Future:** No change from optimal.

Safety Considerations

- Requires survivable speeds for vulnerable road users
- High Collective Crash-risk, including Medium High Active Road User and High Motorcycle Collective Crash Risk

Roads and Streets Framework Assessment

Lead Working Group members:	*Nick Renton*	INP	*Hamish Scott*	ADO	*Amir Kayal*	D&S
Steering Group members:	*Andrew McGill*	INP	*Ben VanBruggen*	ADO	*Chris Beasley*	D&S
Date of endorsement:	*13 December 2019*					

Typology Assessment

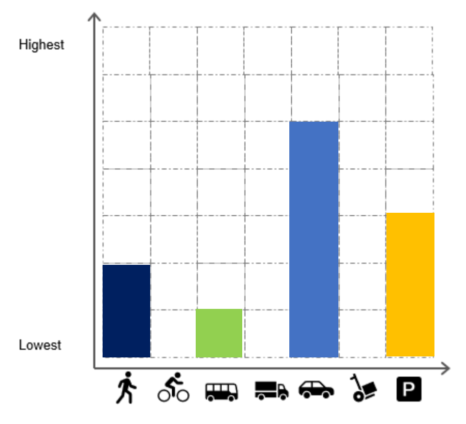
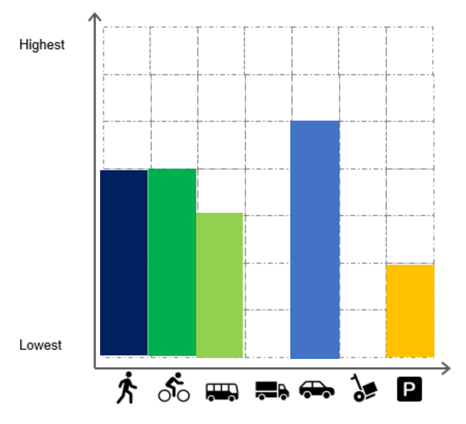
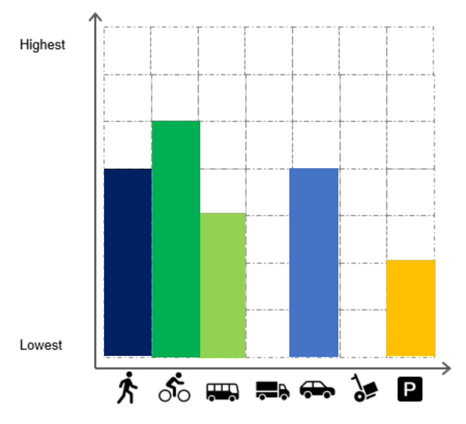
Existing Typology Assessment

Road/Street section	Place Assessment	Movement Assessment	Existing Typology
Bayswater Avenue (Marine Terrace to Moana Avenue) 	**P1** ▪ Local Place significance ▪ Majority of section is low density residential land use with some shops, schools and community activities occurring adjacent Bayswater Avenue including; Bayswater Primary School, Tennis Club, Kindergarten, Sports club.	**M2** ▪ Sub-regional Movement significance ▪ Bayswater Avenue plays an important strategic connection within the Devonport Peninsula as a primary connector for users looking to access the Bayswater Marina and Ferry and Lake Road (towards Takapuna, Devonport or the City Centre). ▪ There are a number of existing connector bus routes along Bayswater Avenue (801 to Takapuna and Akoranga Station and 802 to city centre). ▪ It is part of the strategic cycle network and currently intersects with Greenway cycle routes. ▪ It is not on the freight network.	**P1/M2**

Future Typology Assessment

Assumptions	Place Assessment	Movement Assessment	Future Typology
Year: 2031	**P1**	**M2**	**P1/M2**
▪ Seapath and Skypath complete ▪ Assuming 2031 Strategic Cycle Network ▪ Assuming 2031 Strategic PT Network	▪ No anticipated change to Place function	▪ Importance of cycle connections will increase due to Seapath and Skypath connecting this area with the city centre. ▪ No anticipated change in Movement function.	

Modal Priority Assessment

Observed Modal Priority	Optimal Modal Priority	Future Modal Priority
		

Walking	Cycling	Public Transport	Freight	Private Motor Vehicles	Loading & Servicing	Parking & Access
Observed Modal Priority						
Pedestrian priority through footpaths. Limited crossing opportunities throughout section. Xebra crossing across from school.	No cycle provision provided.	No bus lanes provided. Provision in form of indented bus stops.	No freight priority provided.	Two general traffic lanes along section.	No loading and servicing provision provided.	Parking provided throughout majority of corridor.
Optimal Modal Priority						
Increase in pedestrian priority reflecting routes to local attractors and key ped route to ferry	Increase to reflect connections to ferry, schools and Greenway paths. Bayswater Avenue also on strategic cycle plan.	Connector PT routes use this section of Lake Road.	No change.	Key connection between Devonport and north shore / city centre for motorists.	No change.	Some demand around local attractors but decrease in priority to make way for increase in active mode priority.
Future Modal Priority						
No change from optimal modal priority.	With the introduction of a cross harbour walking and cycling connection between the city and the	No change from optimal modal priority.	No change.	Reduction in priority given increased priority for	No change from optimal.	No change from optimal.

	north shore, the cycling priority for this section of Bayswater Avenue will be high.			pedestrians and cyclists.		

Modal Priority summary

- **Observed:** General traffic is currently the highest priority. Walking and parking are also important to the current functioning of the street.
- **Optimal:** General traffic remains the highest priority on street. Walking, cycling and public transport increase in priority along this section of corridor due to connections to local attractors.
- **Future:** Cycle priority increases in the future to be the highest priority.

Safety Considerations

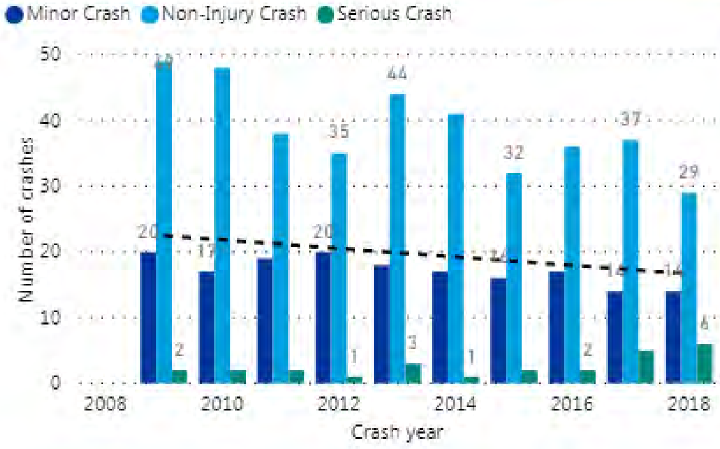
- Requires survivable speeds for vulnerable road users
- Medium Collective Crash-risk

Appendix D: Crash Evidence

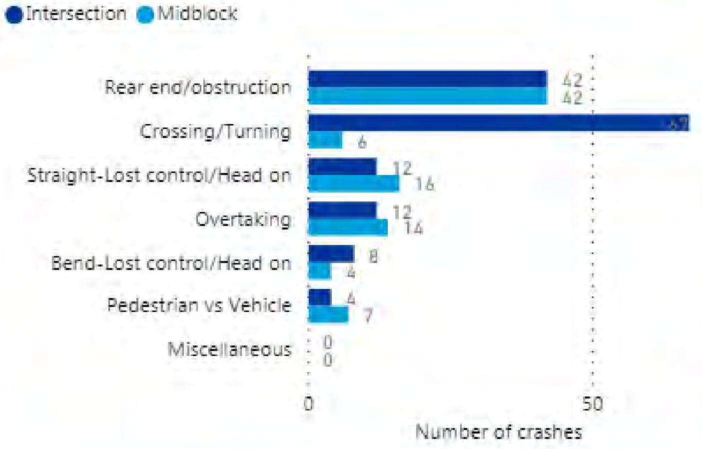
See details

All crash severities	All road user types	All movements selected
Crash severity	Road user category	Movement type

Number of reported crashes



Number of vulnerable user reported crashes



0
Fatal injury count

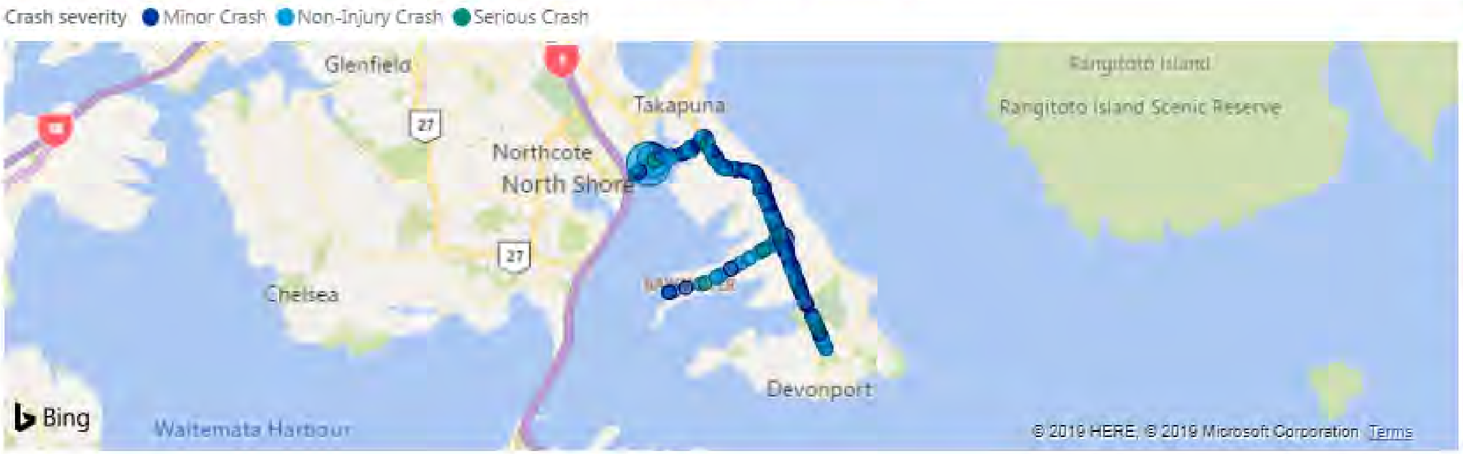
28
Serious injury count

234
Injury casualties

587
Crash count

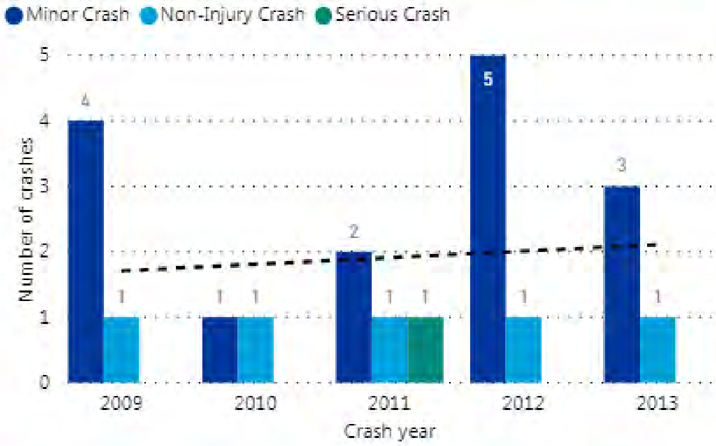
$4M
Crash cost / year

Crash location and severity

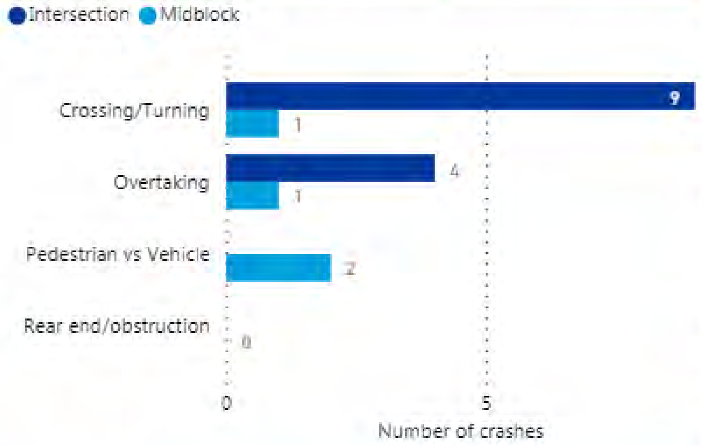


5-year (2009-2013)	All crash severities	Cycle	All movements selected
Time period	Crash severity	Road user category	Movement type

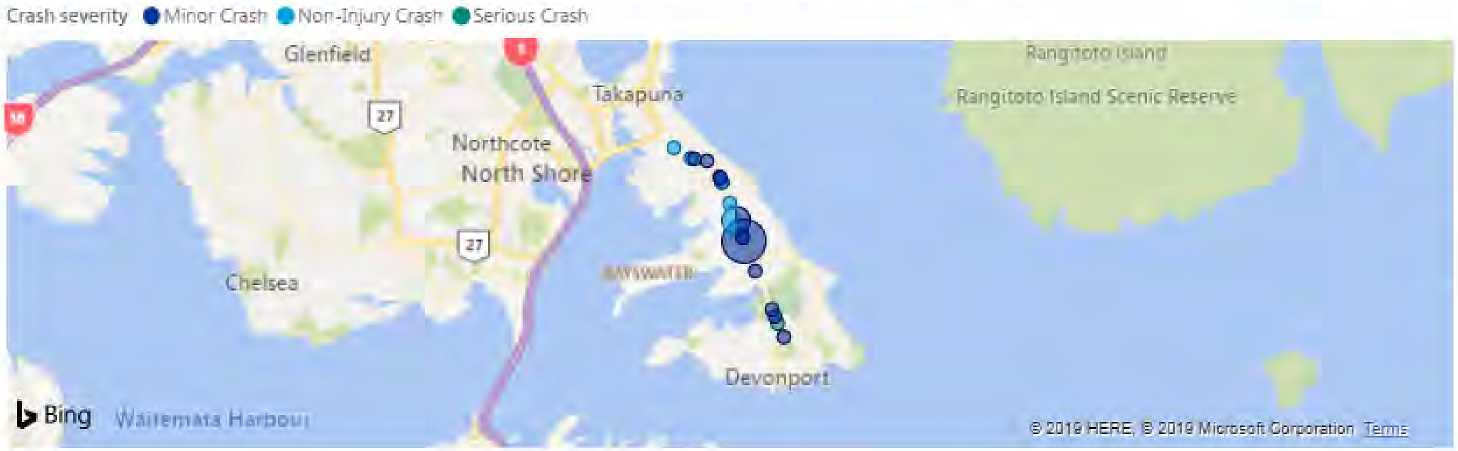
Number of reported crashes



Number of vulnerable user reported crashes



Crash location and severity



0
Fatal injury count

1
Serious injury count

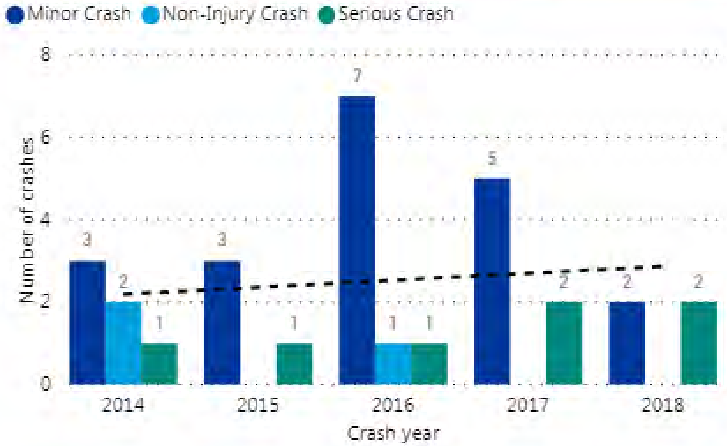
17
Injury casualties

21
Crash count

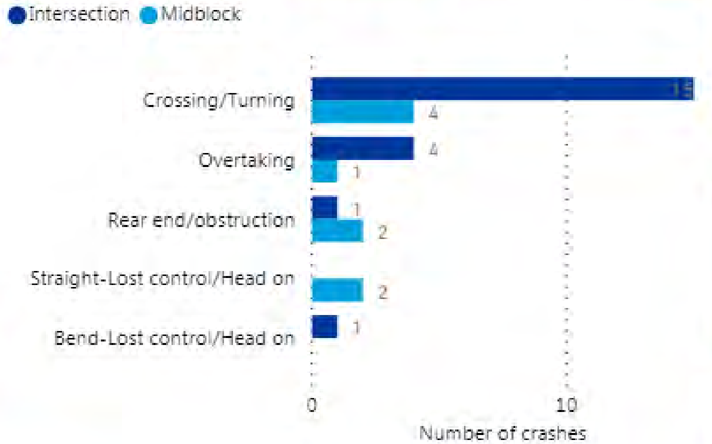
$351K
Crash cost / year

5-year (2014-2018)	All crash severities	Cycle	All movements selected
Time period	Crash severity	Road user category	Movement type

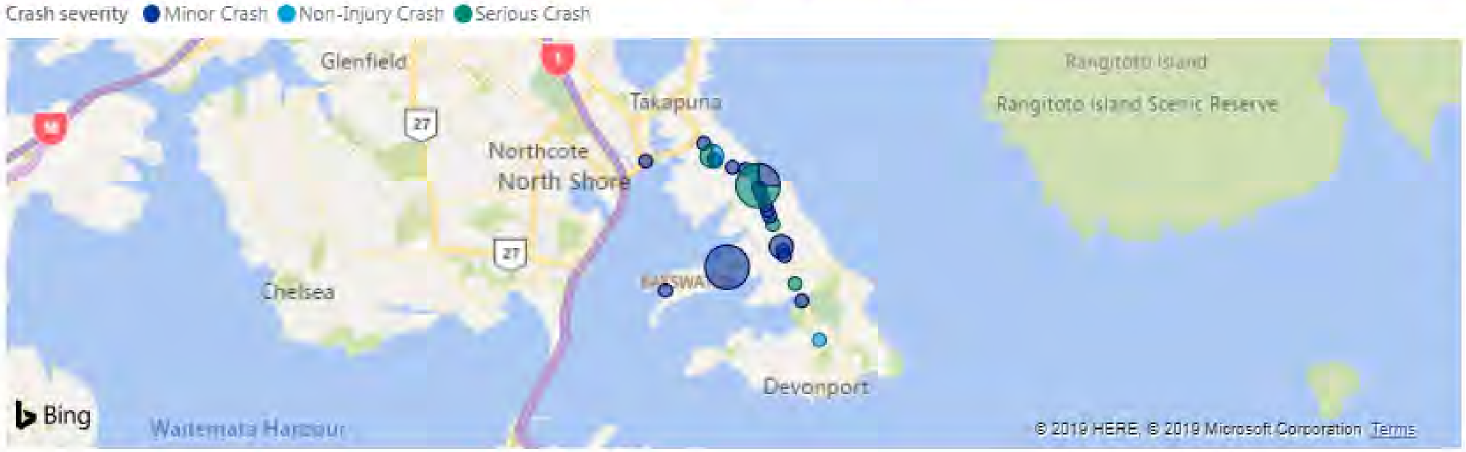
Number of reported crashes



Number of vulnerable user reported crashes



Crash location and severity



0
Fatal injury count

7
Serious injury count

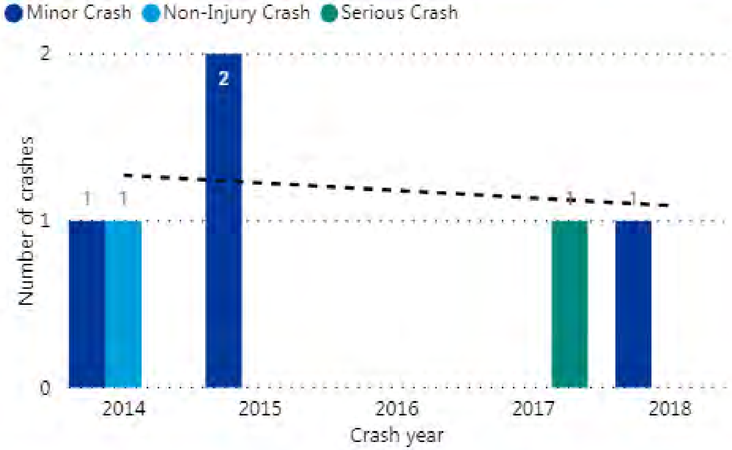
30
Injury casualties

30
Crash count

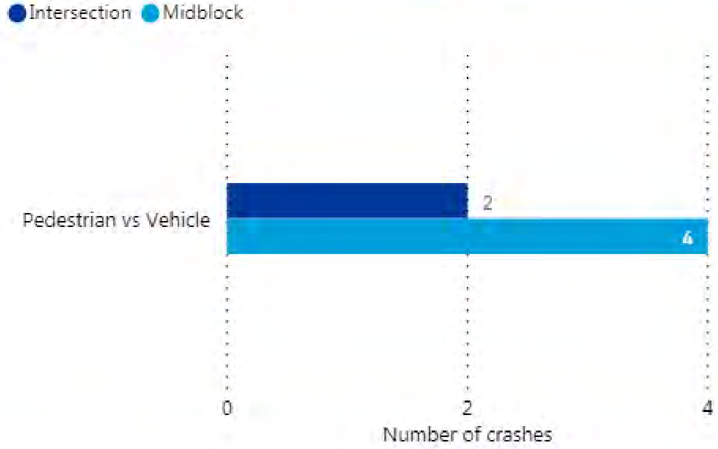
$1M
Crash cost / year

5-year (2014-2018)	All crash severities	Pedestrian	All movements selected
Time period	Crash severity	Road user category	Movement type

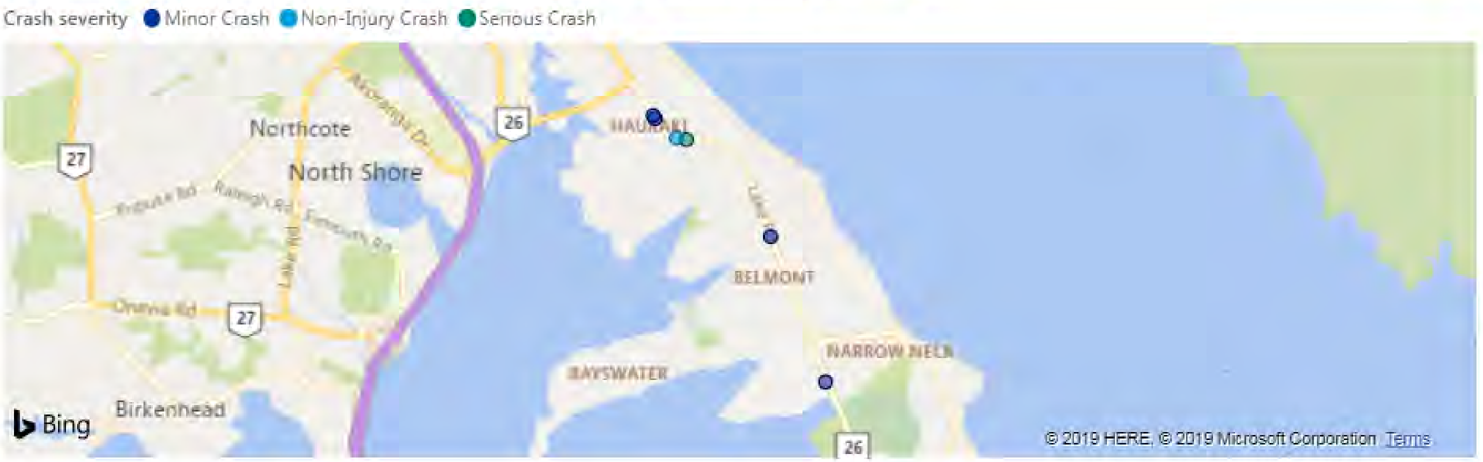
Number of reported crashes



Number of vulnerable user reported crashes



Crash location and severity



0
Fatal injury count

1
Serious injury count

6
Injury casualties

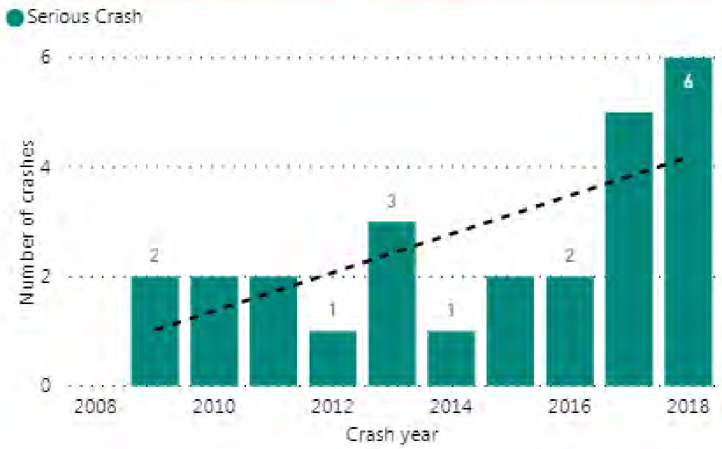
6
Crash count

$269K
Crash cost / year

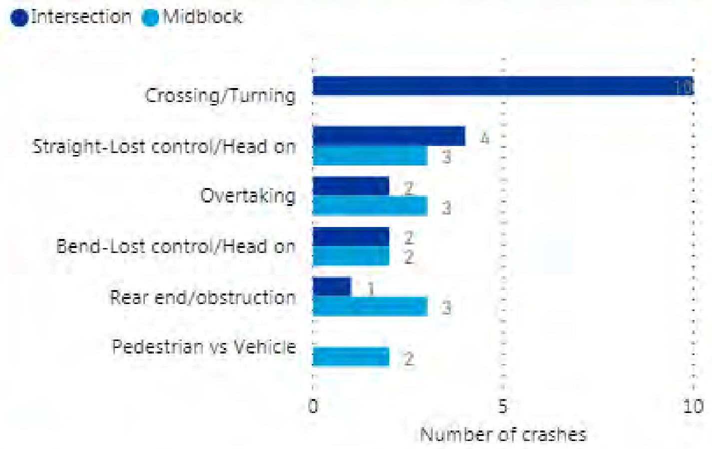
See details

Serious Crash	All road user types	All movements selected
Crash severity	Road user category	Movement type

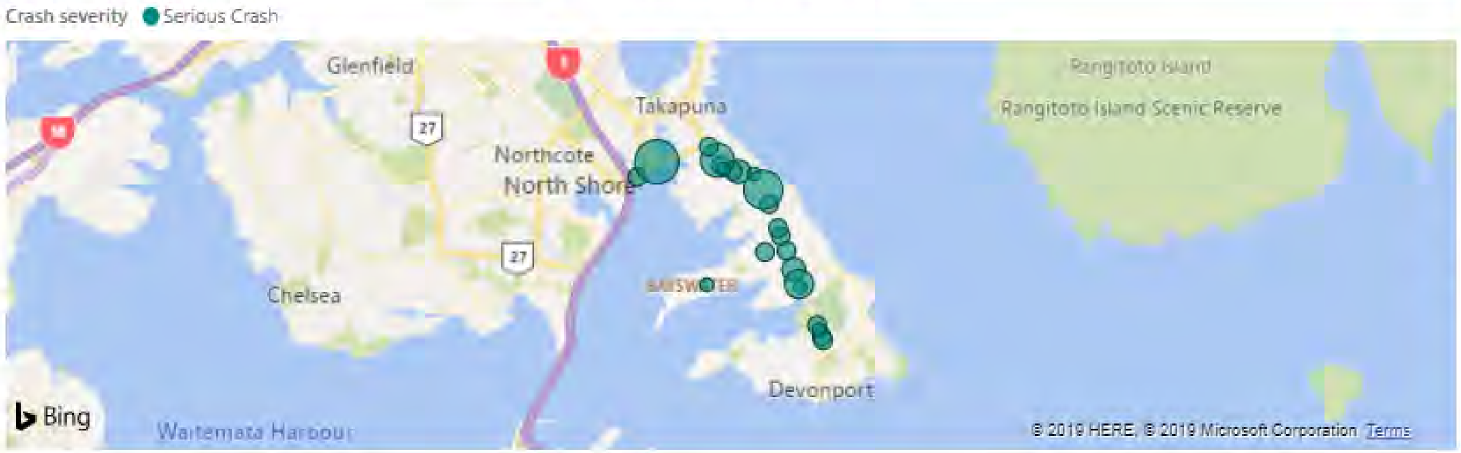
Number of reported crashes



Number of vulnerable user reported crashes



Crash location and severity



0
Fatal injury count

28
Serious injury count

32
Injury casualties

26
Crash count

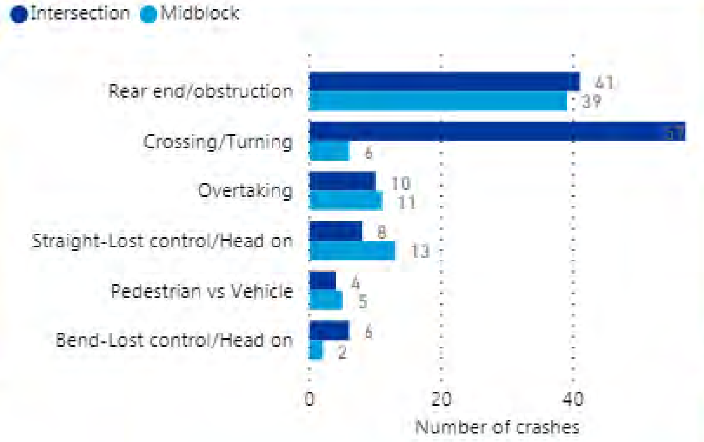
$2M
Crash cost / year

See details

Minor Crash	All road user types	All movements selected
Crash severity	Road user category	Movement type

Number of reported crashes

Number of vulnerable user reported crashes



0

Fatal injury count

0

Serious injury count

202

Injury casualties

172

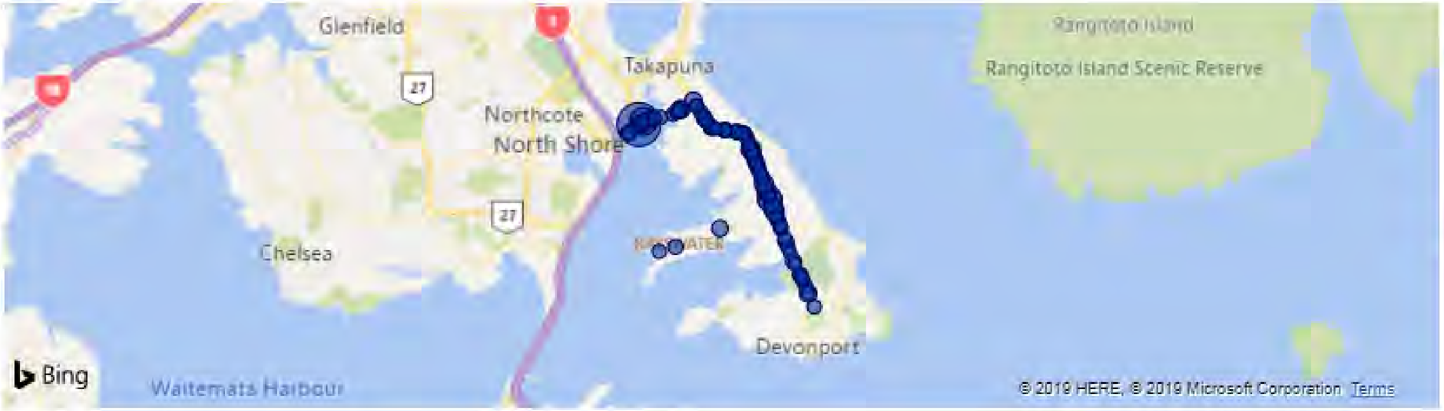
Crash count

$1M

Crash cost / year

Crash location and severity

Crash severity ● Minor Crash



Appendix E: Safe System Assessment Framework

Safe System Assessment Score - Lake Rd

Road Name	Description	Side Road/Access	Segment #	Option	Vehicle Volume (AADT)	Side road/Access Volume	Main Road Speed (km/h)	Across Pedestrian Vol (P2)	Along Pedestrians Vol (P1)	Cycle Volume (2-way)	Motorcycle Volume (2-way)
Lake Road	Esmonde Rd Signalised Intersection	Esmonde Rd	Segment 1	Current	15,000-25,000	30,000-40,000	40 to 50	50 to 200	50 to 200	100 to 300	>100
Lake Road	Midblock with signalised pedestrian crossing	Rewiti Ave, Napier Ave, Cameron St, Harley Rd, Ewen St,	Segment 2	Current	30,000-40,000	300 to 3,000 (Napier Ave)	40 to 50	50 to 200	50 to200	100 to 300	>100
Lake Road	Midblock with bus stops	Hart Rd	Segment 3	Current	30,000-40,000	300 to 3,000 (Hart Rd)	40 to 50	20 to 50	50 to200	100 to 300	>100
Lake Road	Jutland Rd/Hauraki Rd signalised Intersection	Jutland Rd, Hauraki Rd	Segment 4	Current	30,000-40,000	3,000 to 15,000 (Jutland Road)	40 to 50	200 to 500	200 to 500	100 to 300	>100
Lake Road	Midblock with bus stop	Bayview Rd, Onepoto Rd	Segment 5	Current	25,000-30,000	300 to 3,000 (Onepoto Road)	40 to 50	20 to 50	200 to 500	100 to 300	>100
Lake Road	Midblock with refuge island	Hororata Rd, Northumberland Ave, Clifton Rd	Segment 6	Current	25,000-30,000	300 to 3,000 (Clifton Road)	40 to 50	50 to200	50 to200	100 to 300	>100
Lake Road	Takapuna Grammar School with signalised pedestrian crossing	St Leonards Rd,Eversleigh Rd,Takakpuna Grammar School vehicle access	Segment 7	Current	25,000-30,000	3000 to 3,000 (Eversleigh Road)	40 to 50	200 to 500	200 to 500	100 to 300	>100
Lake Road	Belmont Intermediate	Belmont Intermediate ped&cycle access, Bardia St, Winscombe St	Segment 8	Current	15,000-25,000	3,000 to 15,000 (Winscombe Street)	40 to 50	200 to 500	200 to 500	100 to 300	>100
Lake Road	Midblock	Westwell Rd, Corrella Rd, Egremont St	Segment 9	Current	15,000-25,000	300 to 3,000 (Egremont Street)	40 to 50	20 to 50	200 to 500	100 to 300	>100

Segment #	Vehicles: Head On				Run Off Road				Intersection				Other - (Merging/Rear End)			
	E	L	S	Tot	E	L	S	Tot	E	L	S	Tot	E	L	S	Tot
Segment 1	4	1	0	0	4	2	0	0	4	2	2	16	4	2	0	0
Segment 2	4	1	0	0	4	1	0	0	4	3	2	24	4	2	0	0
Segment 3	4	1	0	0	4	1	0	0	4	2	2	16	4	2	0	0
Segment 4	4	1	0	0	4	1	0	0	4	2	2	16	4	2	0	0
Segment 5	4	1	0	0	4	1	0	0	4	3	2	24	4	2	0	0
Segment 6	4	1	0	0	4	1.5	0	0	4	3	2	24	4	1	0	0
Segment 7	4	1	0	0	4	1	0	0	4	3	2	24	4	2	0	0
Segment 8	4	1	0	0	4	1	0	0	4	2	2	16	4	2	0	0
Segment 9	4	2	0	0	4	1	0	0	4	3	2	24	4	2	0	0

Segment #	Pedestrian: P1 Intersection (Veh Turning)				P2 Mid Block Crossing				P3 Intersection (Veh through)				Cycle: C1 Mid Block				C2 Intersection				Motorcyclist: M1 Intersection				Head On	Run Off Road	Intersection	Other- (Merging/Rear End)	Pedestrian (Max of P1, P2,P3)	Cycle (Max of C1 or C2)	Motorcycle	Total Score
	E	L	S	Tot	E	L	S	Tot	E	L	S	Tot	E	L	S	Tot	E	L	S	Tot	E	L	S	Tot								
Segment 1	4	2	4	32	2	2	4	16	0	0	0	0	3	2.5	4	30	4	2	4	32	4	2	4	32	0	0	16	0	32	32	32	112
Segment 2	3	4	2	24	3	2	4	24	0	0	0	0	4	2.5	4	40	4	4	2	32	4	1	4	16	0	0	24	0	24	40	16	104
Segment 3	4	3	2	24	3	4	4	48	0	0	0	0	4	2.5	4	40	4	4	2	32	4	1	4	16	0	0	16	0	48	40	16	120
Segment 4	4	3	3	36	4	2	4	32	4	2	4	32	4	3.5	4	56	4	2.5	4	40	4	1	4	16	0	0	16	0	36	56	16	124
Segment 5	4	4	2	32	2	4	4	32	0	0	0	0	4	3.5	4	56	4	3	2	24	4	1	4	16	0	0	24	0	32	56	16	128
Segment 6	3	4	3	36	3	3	4	36	0	0	0	0	4	2.5	4	40	4	3	3	36	4	1.5	4	24	0	0	24	0	36	40	24	124
Segment 7	4	4	3	48	4	2	4	32	0	0	0	0	4	2.5	4	40	4	3	3	36	4	1	4	16	0	0	24	0	48	40	16	128
Segment 8	4	2	2	16	3	2	4	24	4	2	4	32	4	2.5	4	40	4	2.5	4	40	4	1	4	16	0	0	16	0	32	40	16	104
Segment 9	4	4	2	32	2	4	4	32	0	0	0	0	3	4	4	48	4	3	2	24	4	1	4	16	0	0	24	0	32	48	16	120

Safe System Assessment Score - Orakei Road and Ngapipi Road

Road Name	Description	Side Road/Access	Segment #	Option	Vehicle Volume (AADT)	Side road/Access Volume	Main Road Speed (km/h)	Across Pedestrian Vol (P2)	Along Pedestrians Vol (P1)	Cycle Volume (2-way)	Motorcycle Volume (2-way)
Lake Road	Bayswater Ave/Williamson Ave Intersection	Belmont shopping centre vehicle access, Bayswater Ave, Williamson Ave	**Segment 9**	**Current**	>10000	3000-15000 (Bayswater Ave)	50km/h	200-500	50-200	100-300	>100
Lake Road	Residential	Alamein Ave, Roberts Ave, Montgomery Ave	**Segment 10**	**Current**	>10 000	300-3000 (Montgomery Ave)	50km/h	20-50	50-200	100-300	>100
Lake Road	Residential with small area business	Regent St, Old Lake Rd, Kawerau Ave	**Segment 11**	**Current**	>10 000	3000-15000 (Old Lake Rd)	50km/h	20-50	50-200	100-300	>100
Lake Road	Residential	Achiles Cres, Aramoana Ave, Hanlon Cres, Ngataringa Rd, Seabreeze Rd	**Segment 12**	**Current**	>10 000	300-3000(Seabreeze Rd)	50km/h	20-50	50-200	100-300	>100
Lake Road	Open Space	Devonport Skate Park, Waitemata Golf Club, Small business area, Ariho Ter	**Segment 13**	**Current**	>10 000	100-300(Arihio Ter)	50km/h	20-50	50-200	100-300	>100
Lake Road	Residential	Empire Rd, Mozeley Ave, Allenby Ave, Owens Rd	**Segment 14**	**Current**	>10 000	300-3000 (Mozeley Ave)	50km/h	20-50	50-200	100-300	>100
Lake Road	Albert Rd roundabout	Albert Rd	**Segment 15**	**Current**	>10 000	3000-15000(Alberty Rd)	50km/h	50-100	50-200	100-300	>100

Segment #	Vehicles: Head On E	L	S	Tot	Run Off Road E	L	S	Tot	Intersection E	L	S	Tot	Other - (Merging/Rear End) E	L	S	Tot
Segment 9	4	1	1	4	4	1	1	4	4	2	2	16	4	1	1	4
Segment 10	4	1	1	4	4	2	1	8	4	1	2	8	4	1	1	4
Segment 11	4	1	1	4	4	1	1	4	4	2	2	16	4	2	1	8
Segment 12	4	1	1	4	4	1	1	4	4	2	2	16	4	2	1	8
Segment 13	4	1	1	4	4	1	1	4	4	1	2	8	4	1	1	4
Segment 14	4	1	1	4	4	1	1	4	4	1	2	8	4	1	1	4
Segment 15	4	1	1	4	4	1	1	4	4	1	2	8	4	1	1	4

Segment #	Pedestrian: P1 Intersection (Veh Turning) E	L	S	Tot	P2 Mid Block Crossing E	L	S	Tot	P3 Intersection (Through Veh) E	L	S	Tot	Cycle: C1 Mid Block E	L	S	Tot	C2 Intersection E	L	S	Tot	Motorcyclist: M1 Intersection E	L	S	Tot
Segment 9	3	2	4	24	3	2	4	24	2	2	4	16	3	3.5	4	42	4	2	4	32	4	1	4	16
Segment 10	3	4	4	48	1	3	4	12		2	4	0	3	2.5	4	30	4	4	4	64	4	1	4	16
Segment 11	3	3	4	36	1	3	4	12		3	4	0	3	2.5	4	30	4	4	4	64	4	1	4	16
Segment 12	3	4	4	48	1	3	4	12		4	4	0	3	2.5	4	30	4	4	4	64	4	1	4	16
Segment 13	2	4	4	32	1	4	4	16		4	4	0	3	2.5	4	30	3	4	4	48	4	1	4	16
Segment 14	3	3	4	36	1	2	4	8		2	4	0	3	3.5	4	42	4	4	4	64	4	1	4	16
Segment 15	3	4	4	48	2	4	4	32		4	4	0	3	4	4	48	4	4	4	64	4	1	4	16

Segment #	Head On	Run Off Road	Intersection	Other- (Merging/Rear End)	Pedestrian (Max of P1, P2,P3)	Cycle (Max of C1 or C2)	Motorcycle	Total Score
Segment 9	**4**	**4**	**16**	**4**	**24**	**42**	**16**	**110**
Segment 10	**4**	**8**	**8**	**4**	**48**	**64**	**16**	**152**
Segment 11	**4**	**4**	**16**	**8**	**36**	**64**	**16**	**148**
Segment 12	**4**	**4**	**16**	**8**	**48**	**64**	**16**	**160**
Segment 13	**4**	**4**	**8**	**4**	**32**	**48**	**16**	**116**
Segment 14	**4**	**4**	**8**	**4**	**36**	**64**	**16**	**136**
Segment 15	**4**	**4**	**8**	**4**	**48**	**64**	**16**	**148**

Segment 9:
Higher probability of Intersection crashes due to more legs/more approaches at the signalised intersection

Segment 10:
Higher probability of run off road due to downhills geometry in the southbound direction

Segment 11:
Higher probability of intersection due to blocked visibility of NB Lake Road vehicle for drivers on Regent St. Higher probability of rear end due to pedestrian crossing in use causing a queue in the NB direction which may be in conflict with LT from Kawerau Ave

Segment 12:
Higher probability of intersection due to obscured visibility due to retaining wall adjacent to side streets. Higher probability of Rear end at Seabreeze Rd due to difficult to speed up into the NB Lake Road direction after turning due to uphills geomtry.

Segment 13:
Higher probability of intersection due to obscured visibility due to retaining wall adjacent to side streets.

Ped/Cycle:
C1 = 2.5 because Cycle lane exists but not wide(2) and not a bus lane(3)
C1= 3.5 because no cycle lane but no on street parking

Segment 14:
C1 = 3.5, considered Owens Rd (Worst case) where no cycle lane exists

Appendix F: Cycle Facility Quality of Service Evaluation

1.1 Cycle Facility Quality of Service Evaluation

The objective of Quality of Service Assessment is to determine appropriateness of the existing cycle facilities on mid-block segments and intersections segments by scoring against five criteria, infrastructure type suitable for street conditions, appropriate facility dimensions, minimised potential conflicts, direct, and comfort levels.

The cycling facilities on Lake Road, Bayswater Avenue, and Esmonde Road are divided into six groups with one for each direction. The group are further divided into mid-block and intersection segments based on the features of the cycling facilities. The mid-block segments are classified as mixed traffic, cycle lanes, protected cycle paths, or shared paths. The intersection segments are classified as signalised, un-signalised, or roundabouts. Each segment is scored against the assessment criteria. A score of 1 to 4 is given for each mid-block and intersection segment. The score represents the following quality:

- QoS 1: facility is consistent with or exceeds best practice design guidance.
- QoS 2: facility meets the best practice design guidance.
- QoS 3: facility does not meet best practice design guidance and may introduce safety concerns for users.
- QoS 4: facility presents shortcomings in design that are likely to introduce safety concerns for most users.

QoS 1 and 2 facilities are considered appropriate for a wide range of users. QoS 3 and 4 facilities highlights the potential deviation from the best practice design and shortcoming with the facility designs.

1.1.1 Group 1: Lake Road-Southbound

The bicycle facilities on Southbound Lake Road are mixed of cycle lanes and mixed traffic. The major intersections are signalised. It is divided into five segments with cycle lanes, one mixed-traffic segment, four signalized intersections, and one roundabout.

Summary of the Quality of Service Assessment (see Table).

- Segment 1: Esmonde Road to Jutland Road (cycle lane)
  Safe-infrastructure type: QoS 4; inappropriate due to heavy traffic volume and number of traffic lanes
  Safe-infrastructure dimension: QoS 3; inappropriate due to the width of the facility
  Safe-conflict: QoS 2; appropriate
  Direct: QoS 1; appropriate
  Comfort: QoS 1; appropriate

- Segment 2: Jutland Road to Bardia Street (cycle lane)
  Safe-infrastructure type: QoS 4; inappropriate due to heavy traffic volume and number of traffic lanes
  Safe-infrastructure dimension: QoS2; appropriate
  Safe-conflict: QoS 4; inappropriate due to lack of interaction with public transport stops and the treatment at driveway intersections
  Direct: QoS 1; appropriate

Comfort: QoS 1; appropriate

- Segment 3: Bardia Street to School Road (cycle lane)
  Safe-infrastructure type: QoS 2; appropriate
  Safe-infrastructure dimension: QoS2; appropriate
  Safe-conflict: QoS 3; inappropriate due to lack of treatment at driveway intersections
  Direct: QoS 1; appropriate
  Comfort: QoS 2; appropriate

- Segment 4: School Road to Bayswater Avenue (mixed traffic)
  Safe-infrastructure type: QoS 4; inappropriate due to heavy traffic volume, high posted speed, and number of traffic lanes
  Direct: QoS 1; appropriate
  Comfort: QoS 2; appropriate

- Segment 5: Bayswater Avenue to Allenby Avenue (cycle lane)
  Safe-infrastructure type: QoS 4; inappropriate due to heavy traffic volume
  Safe-infrastructure dimension: QoS2; appropriate
  Safe-conflict: QoS 3; inappropriate due to interaction with public transport stops and lack of treatment at driveway intersections
  Direct: QoS 1; appropriate
  Comfort: QoS 2; appropriate

- Segment 6: Allenby Avenue to Albert Road (mixed traffic)
  Safe-infrastructure type: QoS 4; inappropriate due to heavy traffic volume and high posted speed
  Direct: QoS 1; appropriate
  Comfort: QoS 2; appropriate

- Intersection 1: Lake Road and Esmonde Road (signalised intersection)
  Safe-infrastructure type: QoS 1; appropriate
  Safe-infrastructure dimension: QoS 4; inappropriate due to wide corner kerb radii
  Safe-conflict: QoS 4; inappropriate due to lack of dedicate cycle signal phase, absent of facility continuity across intersection, and long mixing zone
  Direct: QoS 2; appropriate

- Intersection 2: Lake Road and Jutland Road (signalised intersection)
  Safe-infrastructure type: QoS 1; appropriate
  Safe-infrastructure dimension: QoS 4; inappropriate due to wide corner kerb radii
  Safe-conflict: QoS 4; inappropriate due to lack of dedicate cycle signal phase, absent of facility continuity across intersection, and long mixing zone
  Direct: QoS 2; appropriate

- Intersection 3: Lake Road and Bardia Street (signalised intersection)
  Safe-infrastructure type: QoS 1; appropriate
  Safe-infrastructure dimension: QoS 4; inappropriate due to wide corner kerb radii

Safe-conflict: QoS 4; inappropriate due to lack of dedicate cycle signal phase, absent of facility continuity across intersection, and long mixing zone
Direct: QoS 2; appropriate

- Intersection 4: Lake Road and Bayswater Avenue (signalised intersection)
  Safe-infrastructure type: QoS 1; appropriate
  Safe-infrastructure dimension: QoS 4; inappropriate due to wide corner kerb radii
  Safe-conflict: QoS 4; inappropriate due to lack of dedicate cycle signal phases, absent of facility continuity across intersection, and long mixing zone
  Direct: QoS 2; appropriate

- Roundabout 1: Lake Road and Albert Road
  Safe-infrastructure type: QoS 4; inappropriate due to the heavy traffic volume and high speed volume on the streets crossed
  Safe-conflict: QoS 4; inappropriate due to absent of facility continuity across intersection, and long mixing zone
  Direct: QoS 3; inappropriate due to lack of geometric directness

Table 1 provides a summary of the scores:

	Intersection 1	Segment 1	Intersection 2	Segment 2
Location	Lake Road and Esmonde Road Intersection	Esmonde Road to Jutland Road	Lake Road and Jutland Road Intersection	Jutland Road to Bardia Street
Infrastructure type	Signalised Intersection	Cycle Lane	Signalised Intersection	Cycle Lane
Safe - Infrastructure Type Suitable for Street Conditions	1	4	1	4
Safe - Appropriate Facility Dimensions	4	3	4	2
Safe - Potential Conflicts Minimised	4	2	4	4
Direct	2	1	2	1
Comfortable	0	1	0	1

	Intersection 3	Segment 3	Segment 4	Intersection 4
Location	Lake Road and Bardia Street Intersection	Bardia Street to School Road	School Road to Bayswater Ave	Lake Road and Bayswater Ave Intersection
Infrastructure type	Signalised Intersection	Cycle Lane	Mixed Traffic	Signalised Intersection
Safe - Infrastructure Type Suitable for Street Conditions	1	2	4	1
Safe - Appropriate Facility Dimensions	4	2	0	4
Safe - Potential Conflicts Minimised	4	3	0	4
Direct	2	1	1	2
Comfortable	0	2	2	0

	Segment 5	Segment 6	Roundabout 1
Location	Bayswater Ave to Allenby Ave	Allenby Ave to Albert Road	Lake Road and Albert Road Roundabout
Infrastructure type	Cycle Lane	Mixed Traffic	Roundabout
Safe - Infrastructure Type Suitable for Street Conditions	4	4	4
Safe - Appropriate Facility Dimensions	2	0	0
Safe - Potential Conflicts Minimised	3	0	4
Direct	1	1	3
Comfortable	2	2	0

Table 1: Summary of scores for southbound Lake Road

1.1.2 Group 2: Lake Road-Northbound

Northbound Lake Road is divided into two mixed-traffic segments, one shred-path segment, four segments with cycle lanes, and three signalised intersections.

Summary of the Quality of Service Assessment (see Table 2):

- Segment 1: Albert Road to Owens Road (mixed traffic)
  Safe-infrastructure type: QoS 4; inappropriate due to heavy traffic volume and high posted speed
  Direct: QoS 1; appropriate
  Comfort: QoS 2; appropriate

- Segment 2: Owens Road to Bayswater Avenue (cycle lane)
  Safe-infrastructure type: QoS 3; inappropriate due to heavy traffic volume
  Safe-infrastructure dimension: QoS 2; appropriate
  Safe-conflict: QoS 3; inappropriate due to lack of treatment at driveway intersections
  Direct: QoS 1; appropriate
  Comfort: QoS 1; appropriate

- Segment 3: Bayswater Avenue to Corella Road (mixed traffic)
  Safe-infrastructure type: QoS 4; inappropriate due to heavy traffic volume and high posted speed
  Direct: QoS 1; appropriate
  Comfort: QoS 2; appropriate

- Segment 4: Corrella Road to Bardia Road (cycle lane)
  Safe-infrastructure type: QoS 3; inappropriate due to heavy traffic volume and number of traffic lanes
  Safe-infrastructure dimension: QoS 3; inappropriate due to narrow cycle lane
  Safe-conflict: QoS 3; inappropriate due to lack of treatment at driveway intersections
  Comfort: QoS 1; appropriate

- Segment 5: Bardia Street to Onepoto Road (cycle lane)
  Safe-infrastructure type: QoS 3; inappropriate due to heavy traffic volume
  Safe-infrastructure dimension: QoS 2; appropriate

Safe-conflict: QoS 3; inappropriate due to interaction with public transport stops and lack of treatment at driveway intersections
Direct: QoS 1; appropriate
Comfort: QoS 2; appropriate

- Segment 6: Onepoto Road to Jutland Road (shared path)
  Safe-infrastructure type: QoS 1; appropriate
  Safe-infrastructure dimension: QoS 3; inappropriate due to narrow cycle lane path
  Safe-conflict: QoS 3; inappropriate due to lack of treatment at driveway intersections
  Direct: QoS 2; appropriate
  Comfort: QoS 2; appropriate

- Segment 7: Jutland Road to Esmonde Road (cycle lane)
  Safe-infrastructure type: QoS 3; inappropriate due to heavy traffic volume, high posted speed, and number of traffic lanes
  Safe-infrastructure dimension: QoS 3; inappropriate due to narrow cycle lane path
  Safe-conflict: QoS 3; inappropriate due to lack of treatment at driveway intersections
  Direct: QoS 1; appropriate
  Comfort: QoS 2; appropriate

- Intersection 1: Lake Road and Bayswater Avenue (signalised intersection)
  Safe-infrastructure type: QoS 1; appropriate
  Safe-infrastructure dimension: QoS2; appropriate
  Safe-conflict: QoS 4; inappropriate due to lack of dedicate cycle signal phase, absent of facility continuity across intersection, and long mixing zone
  Direct: QoS 2; appropriate

- Intersection 2: Lake Road and Bardia Street (signalised intersection)
  Safe-infrastructure type: QoS 1; appropriate
  Safe-infrastructure dimension: QoS 4; inappropriate due to wide corner kerb radii
  Safe-conflict: QoS 4; inappropriate due to lack of dedicate cycle signal phase, absent of facility continuity across intersection, and long mixing zone
  Direct: QoS 2; appropriate

- Intersection 3 (Lake Road and Jutland Road (signalised intersection)
  Safe-infrastructure type: QoS 1; appropriate
  Safe-infrastructure dimension: QoS 4; inappropriate due to wide corner kerb radii
  Safe-conflict: QoS 4; inappropriate due to lack of dedicate cycle signal phases, absent of facility continuity across intersection, and long mixing zone
  Direct: QoS 2; appropriate

Table 2 provides a summary of the scores:

	Segment 1	Segment 2	Intersection 1
Location	Albert Road to Owens Road	Owens Road to Bayswater Ave	Lake Road and Bayswater Intersection
Infrastructure type	Mixed Traffic	Cycle Lane	Signalised Intersection
Safe - Infrastructure Type Suitable for Street Conditions	4	3	1
Safe - Appropriate Facility Dimensions	0	2	2
Safe - Potential Conflicts Minimised	0	3	4
Direct	1	1	2
Comfortable	2	1	0

	Segment 3	Segment 4	Intersection 2	Segment 5
Location	Bayswater Ave to Corella Road	Corrella Road to Bardia Street	Lake Road and Bardia Street Intersection	Bardia Street to Onepoto Road
Infrastructure type	Mixed Traffic	Cycle Lane	Signalised Intersection	Cycle Lane
Safe - Infrastructure Type Suitable for Street Conditions	4	3	1	3
Safe - Appropriate Facility Dimensions	0	3	4	2
Safe - Potential Conflicts Minimised	0	3	4	3
Direct	1	1	2	1
Comfortable	1	1	0	2

	Segment 6	Intersection 3	Segment 7
Location	Onepoto Road to Jutland Road	Lake Road and Jutland Road Intersection	Jutland Road to Esmonde Road
Infrastructure type	Shared Path	Signalised Intersection	Cycle Lane
Safe - Infrastructure Type Suitable for Street Conditions	1	1	3
Safe - Appropriate Facility Dimensions	3	4	3
Safe - Potential Conflicts Minimised	3	4	3
Direct	2	2	1
Comfortable	2	0	2

Table 2: Summary of scores for northbound Lake Road

1.1.3 Group 3: Bayswater Avenue-Eastbound

Eastbound Bayswater Avenue is divided to one mixed-traffic segment and one roundabout.

Summary of the Quality of Service Assessment (see Table):

- Segment 1: Beresford Street to Lake Road (mixed traffic)
  Safe-infrastructure type: QoS 4; inappropriate due to heavy traffic volume and high posted speed limit Direct: QoS 1; appropriate

Comfort: QoS 1; appropriate

- Roundabout 1: Bayswater Avenue and Beresford Street (roundabout)
  Safe-infrastructure type: QoS 2; appropriate
  Safe-conflict: QoS 4; inappropriate due to absent of facility continuity across intersection, and long mixing zone
  Direct: QoS 4; inappropriate due to lack of geometric directness

Table 3 provides a summary of the scores:

	Roundabout 1	Segment 1
Location	Bayswater Ave and Beresford Street Roundabout	Beresford Street to Lake Road
Infrastructure type	Roundabout	Mixed Traffic
Safe - Infrastructure Type Suitable for Street Conditions	2	4
Safe - Appropriate Facility Dimensions	0	0
Safe - Potential Conflicts Minimised	4	0
Direct	4	1
Comfortable	0	1

Table 3: Summary of scores for eastbound Bayswater Avenue

1.1.4 Group 4: Bayswater Avenue-Westbound

Westbound Bayswater Avenue (Lake Road to Beresford Street) is one mixed-traffic segment.

Summary of the Quality of Service Assessment (see Table):

- Segment 1: Lake Road to Beresford Street (mixed traffic)
  Safe-infrastructure type: QoS 4; inappropriate due to heavy traffic volume and high posted speed
  Direct: QoS 1; appropriate
  Comfort: QoS 1; appropriate

Table 4 provides a summary of the scores:

	Segment 1
Location	Lake Road to Beresford Street
Infrastructure type	Mixed Traffic
Safe - Infrastructure Type Suitable for Street Conditions	4
Safe - Appropriate Facility Dimensions	0
Safe - Potential Conflicts Minimised	0
Direct	1
Comfortable	1

Table 4: Summary of scores for westbound Bayswater Avenue

1.1.5 Group 5: Esmonde Road-Eastbound

Eastbound Esmonde Road is divided into for shared-path segments, two segments with cycle lanes, and three unsignalised intersections, and one signalised intersection.

Summary of the Quality of Service Assessment (see Table):

- Segment 1: SH1 Southbound Ramp to Akoranga Station Entrance (shared path)
  Safe-infrastructure type: QoS 1; appropriate
  Safe-infrastructure dimension: QoS 3; inappropriate due to narrow shared path
  Safe-conflict: QoS 1; appropriate
  Direct: QoS 1; appropriate
  Comfort: QoS 1; appropriate

- Segment 2: Akoranga Station Entrance to Fred Thomas Drive (shared path)
  Safe-infrastructure type: QoS 1; appropriate
  Safe-infrastructure dimension: QoS 3; inappropriate due to narrow shared path
  Safe-conflict: QoS 1; appropriate
  Direct: QoS 1; appropriate
  Comfort: QoS 2; appropriate

- Segment 3: Fred Thomas Drive to Barrys Point Road (shared path)
  Safe-infrastructure type: QoS 1; appropriate
  Safe-infrastructure dimension: QoS 2; appropriate
  Safe-conflict: QoS 1; appropriate
  Direct: QoS 1; appropriate
  Comfort: QoS 2; appropriate

- Segment 4: Barrys Point Road to Harbourside Church Entrance (shared path)
  Safe-infrastructure type: QoS 1; appropriate
  Safe-infrastructure dimension: QoS 3; inappropriate due to narrow shared path
  Safe-conflict: QoS 1; appropriate
  Direct: QoS 1; appropriate
  Comfort: QoS 2; appropriate

- Segment 5: Harbourside Church to Burns Avenue (cycle lane)
  Safe-infrastructure type: QoS 4; inappropriate due to heavy traffic volume, high posted speed, and number of traffic lanes
  Safe-infrastructure dimension: QoS 3; inappropriate due to narrow cycle lane path
  Safe-conflict: QoS 2; appropriate
  Direct: QoS 1; appropriate
  Comfort: QoS 2; appropriate

- Segment 6: Burns Avenue to Lake Road (cycle lane)
  Safe-infrastructure type: QoS 4; inappropriate due to heavy traffic volume, high posted speed, and number of traffic lanes
  Safe-infrastructure dimension: QoS 3; inappropriate due to narrow cycle lane path
  Safe-conflict: QoS 2; appropriate
  Direct: QoS 1; appropriate
  Comfort: QoS 2; appropriate

- Intersection 1: Esmonde Road and Akoranga Station Entrance (unsignalised slip lanes)
  Safe-infrastructure type: QoS 4; inappropriate due to the heavy traffic volume and high speed volume on the streets crossed
  Safe-infrastructure dimension: QoS 4; inappropriate due to wide corner radii
  Safe-conflict: QoS 4; inappropriate due to absent of facility continuity across intersection, and long mixing zone
  Direct: QoS 4; inappropriate due to lack of geometric directness and long wait time at intersection for cyclists

- Intersection 2: Esmonde Road and Fred Thomas Drive (unsignalised skipe lanes)
  Safe-infrastructure type: QoS 4; inappropriate due to the heavy traffic volume and high speed volume on the streets crossed
  Safe-infrastructure dimension: QoS 4; inappropriate due to wide corner radii
  Safe-conflict: QoS 4; inappropriate due to absent of facility continuity across intersection, and long mixing zone
  Direct: QoS 4; inappropriate due to lack of geometric directness and long wait time at intersection for cyclists

- Intersection 3: Esmonde Road and Barrys Point Road (unsignalised slipe lanes)
  Safe-infrastructure type: QoS 4; inappropriate due to the heavy traffic volume and high speed volume on the streets crossed
  Safe-infrastructure dimension: QoS 4; inappropriate due to wide corner radii
  Safe-conflict: QoS 4; inappropriate due to absent of facility continuity across intersection, and long mixing zone
  Direct: QoS 4; inappropriate due to lack of geometric directness and long wait time at intersection for cyclists

- Intersection 4: Esmonde Road and Burns Avenue (signalised intersection)
  Safe-infrastructure type: QoS 2; appropriate

Safe-infrastructure dimension: QoS 4; inappropriate due to wide corner radii
Safe-conflict: QoS 4; inappropriate due to absent of facility continuity across intersection, and long mixing zone
Direct: QoS 4; inappropriate due to lack of geometric directness and long wait time at intersection for cyclists

Table 5 provides a summary of the scores:

	Segment 1	Intersection 1	Segment 2	Intersection 2
Location	SH1 Southbound Offramp to Akoranga Station Entrance (Eastbound)	Intersection with Esmonde Road and Akoranga Station Entrance	Akoranga Station Entrance to Fred Thomas Drive	Intersection with Esmonde Road and Fred Thomas Drive
Infrastructure type	Shared Path	Unsignalised Intersection	Shared Path	Unsignalised Intersection
Safe - Infrastructure Type Suitable for Street Conditions	1	4	1	4
Safe - Appropriate Facility Dimensions	3	4	3	4
Safe - Potential Conflicts Minimised	1	4	1	4
Direct	1	4	1	4
Comfortable	1	0	2	0

	Segment 3	Intersection 3	Segment 4
Location	Fred Thomas Drive to Barrys Point Road	Intersection with Esmonde Road and Barrys Point Road	Barrys Point Road to Harbourside Church Entrance
Infrastructure type	Shared Path	Unsignalised Intersection	Shared Path
Safe - Infrastructure Type Suitable for Street Conditions	1	4	1
Safe - Appropriate Facility Dimensions	2	4	3
Safe - Potential Conflicts Minimised	1	4	1
Direct	1	3	1
Comfortable	1	0	2

	Segment 5	Intersection 4	Segment 6
Location	Harbourside Church to Burns Ave	Intersection with Esmonde Road and Burns Avenue	Burns Ave to Lake Road
Infrastructure type	Cycle Lane	Signalised Intersection	Cycle Lane
Safe - Infrastructure Type Suitable for Street Conditions	4	2	4
Safe - Appropriate Facility Dimensions	3	4	3
Safe - Potential Conflicts Minimised	2	4	2
Direct	1	2	1
Comfortable	2	0	2

Table 5: Summary of scores for eastbound Esmonde Road

1.1.6 Group 6: Esmonde Road-Westbound

Westbound Esmonde Road is divided to one mixed-traffic segment, one segment with cycle lane, one signalised intersection, and one signalisation intersection.

Summary of the Quality of Service Assessment (see Table 1):

- Segment 1: SH1 Southbound Ramp to Harbourside Church entrance (mixed traffic)
  Safe-infrastructure type: QoS 4; inappropriate due to heavy traffic volume, high posted speed limit, and number of traffic lanes
  Direct: QoS 2; appropriate
  Comfort: QoS 2; appropriate

- Segment 2: Harbourside Church entrance to Lake Road (cycle lane)
  Safe-infrastructure type: QoS 3; inappropriate due to heavy traffic volume, high posted speed, and number of traffic lanes
  Safe-infrastructure dimension: QoS 3; inappropriate due to narrow cycle lane path
  Safe-conflict: QoS 3; inappropriate due to facility blockage and interaction with public transport stop
  Direct: QoS 1; appropriate
  Comfort: QoS 2; appropriate

- Intersection 1: Burns Avenue/Eldon Street and Esmonde Road (signalised intersection)
  Safe-infrastructure type: QoS 2; appropriate
  Safe-infrastructure dimension: QoS 4; inappropriate due to wide corner radii
  Safe-conflict: QoS 4; inappropriate due to lack of dedicated cycle signal phase, and long mixing zone
  Direct: QoS 2; appropriate

- Intersection 2: Esmonde Road and to Harbourside Church entrance (unsignalised slip lanes)
  Safe-infrastructure type: QoS 4; inappropriate due to the heavy traffic volume and high speed volume on the streets crossed

Safe-infrastructure dimension: QoS 4; inappropriate due to wide corner radii
Safe-conflict: QoS 4; inappropriate due to absent of facility continuity across intersection, and long mixing zone
Direct: QoS 4; inappropriate due to lack of geometric directness and long wait time at intersection for cyclists

Table 6 provide a summary of the scores:

	Segment 1	Intersection 1	Segment 2	Intersection2
Location	SH1 Southbound On-ramp to Harbourside Church entrance	Intersection with Burns Ave/Eldon Street and Esmonde Road	Harbourside Church entrance to Intersection with Lake Road (Westbound)	Intersection with Harbourside Church Entrance
Infrastructure type	Mixed Traffic	Signalised Intersection	Cycle Lane	Unsignalised Intersection
Safe - Infrastructure Type Suitable for Street Conditions	4	2	4	4
Safe - Appropriate Facility Dimensions	0	4	3	4
Safe - Potential Conflicts Minimised	0	4	3	4
Direct	2	2	1	4
Comfortable	2	0	2	0

Table 1: Summary of scores for westbound Esmonde Road

2 Recommendations

Based on the assessment, the cycle facilities on Lake Road, Bayswater Avenue, and Esmonde Road are unsuitable for safety (safe infrastructure, dimensions, and conflict minimisation), and directness because of the heavy traffic volume, high posted speed limit, narrow facility width, wide kerb radii, lack of dedicated cycle signal phasing and facility at intersections, and long mixing zones. It is unlikely that the cycle facilities will attract wide range of people who may choose to cycle.

In order to improve the quality of service, it is recommended to:

- Install protected cycle lanes with appropriate width (ideally over 2m wide) on mixed traffic segments
- Replace unprotected cycle lanes with physically protected cycle lanes with appropriate width (over 2m wide)
- Provide safety treatments at driveways and public transport stops to minimise conflicts
- Provide dedicated cycle signal phasing at signal-controlled intersections where practical
- Install protected (pocketed) lanes at mixing zones to minimise conflict for cyclists
- Signalise the slip lanes at the Bayswater Avenue and to improve safe crossings for cyclists
- Minimise geometric distance between intersections and deviations from straight line at intersections
- Provide continuity cycle facilities across intersections
- Reduce wait time for cyclist crossing opportunity
- Provide safe bypasses for cyclists at all roundabout if room permits.

Appendix G: Other Options Not Short-Listed

Lake Road

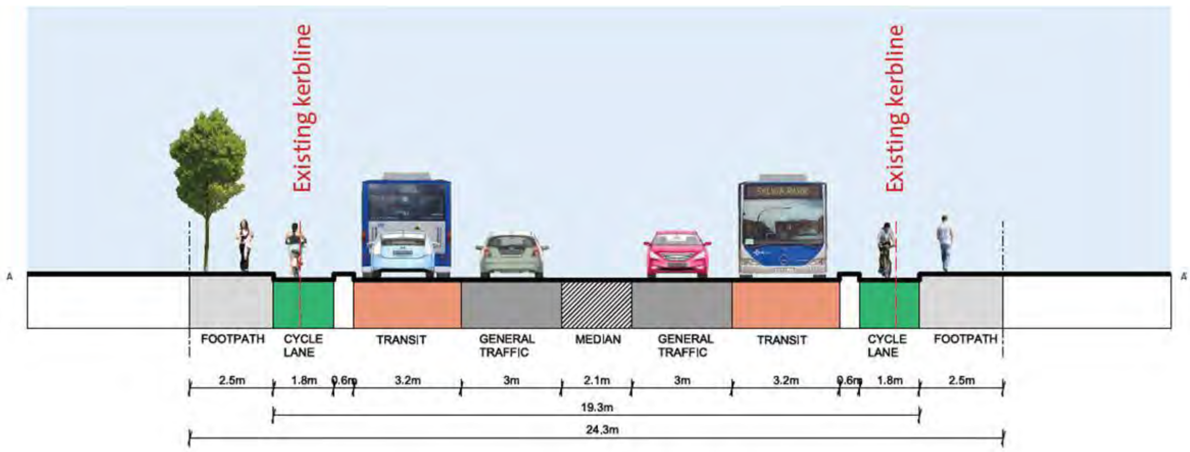
Lake Road / Esmonde Road Intersection

Consideration was given to developing an option which includes a pedestrian crossing facility on the Lake Road (south) side of the intersection, but this option was not progressed because the benefits to pedestrians are unlikely to be greater than the significantly increase traffic delays which are likely to arise.

Segment A (Esmonde Road to Jutland Road)

A further option of maintaining the current central flush median for turning movements (Option C) was considered. This was not short-listed as it requires the kerb line to be moved on both sides of the road, as shown in Figure H-1. Moving only one of the kerb lines would also be possible, though, to maintain an acceptable footpath width, it would only be possible of the central flush median width is reduced or removed. The cost of these two alternative options is likely to outweigh the benefits.

Figure G-1 Segment A - Option C

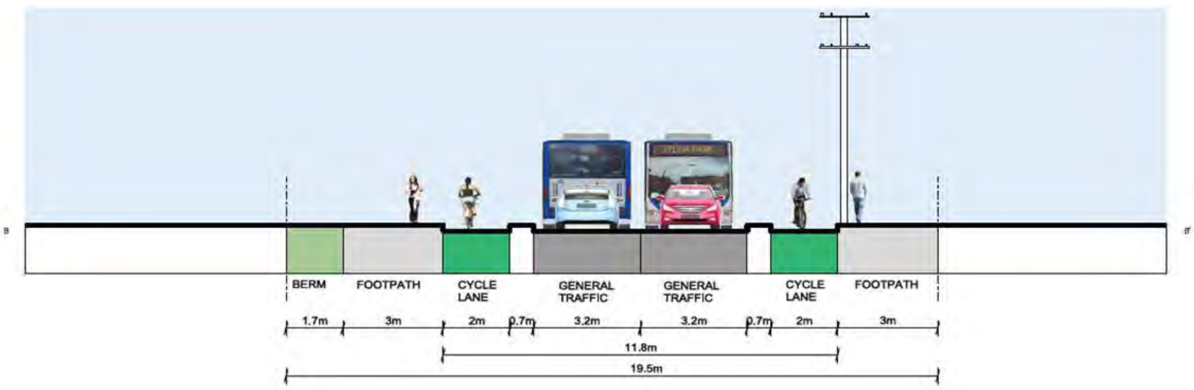


Segment B (Jutland Road to Egremont Street

Several other options were identified but not short-listed, as outlined below.

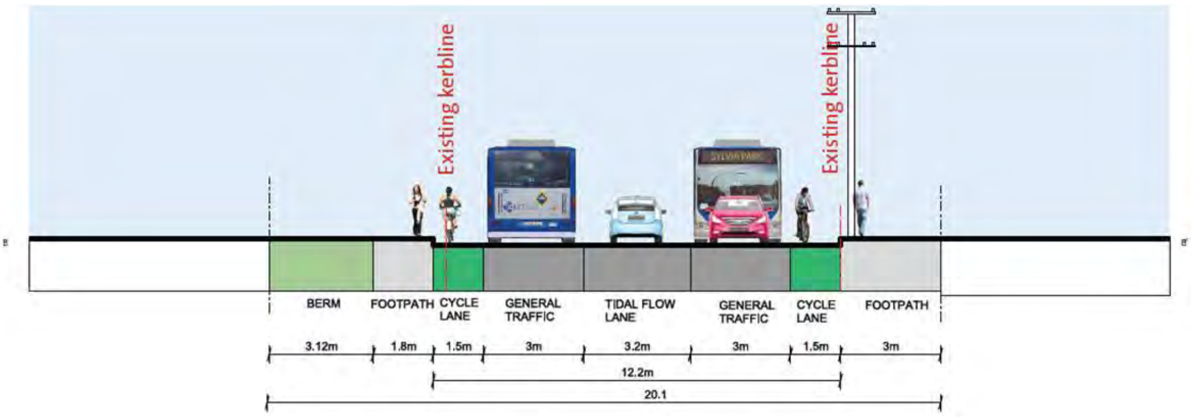
Option D provides wider than minimum standard uni-directional separated cycle lanes, as well as improving pedestrian provision, as shown in Figure H-2. This option was not short-listed because it was concluded that, given the choice between wider cycle lanes and the provision of a median, the latter was preferred.

Figure G-2 Lake Road Segment B - Option D



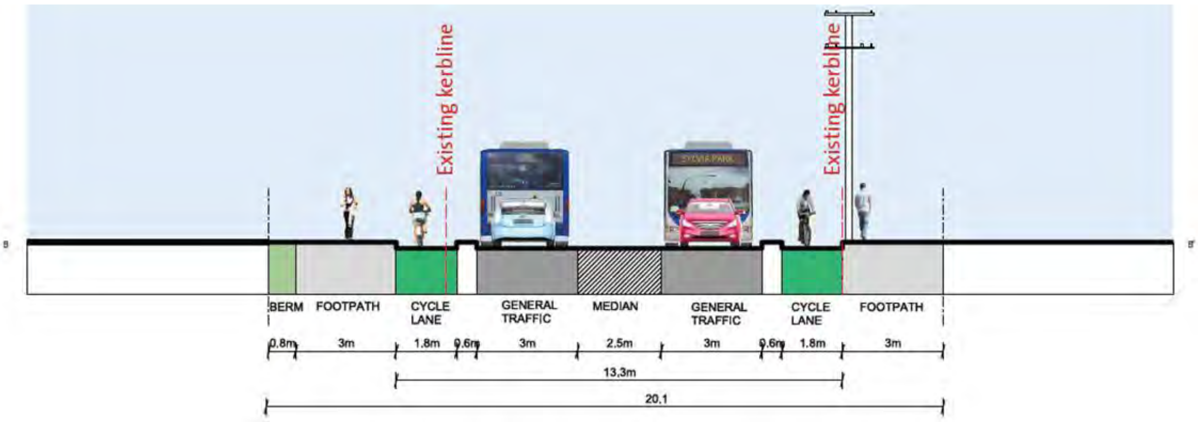
Option E includes the provision of a central tidal flow traffic lane that can operate in either direction to provide additional capacity for general traffic during peak periods, as shown in Figure H-3. This option would require the western kerb-line to be moved by 0.4m. This option was not short-listed principally because the traffic flows on this section of Lake Road do not lend themselves well to a tidal flow arrangement, as was demonstrated in the earlier IBC.

Figure G-3 Segment B - Option E



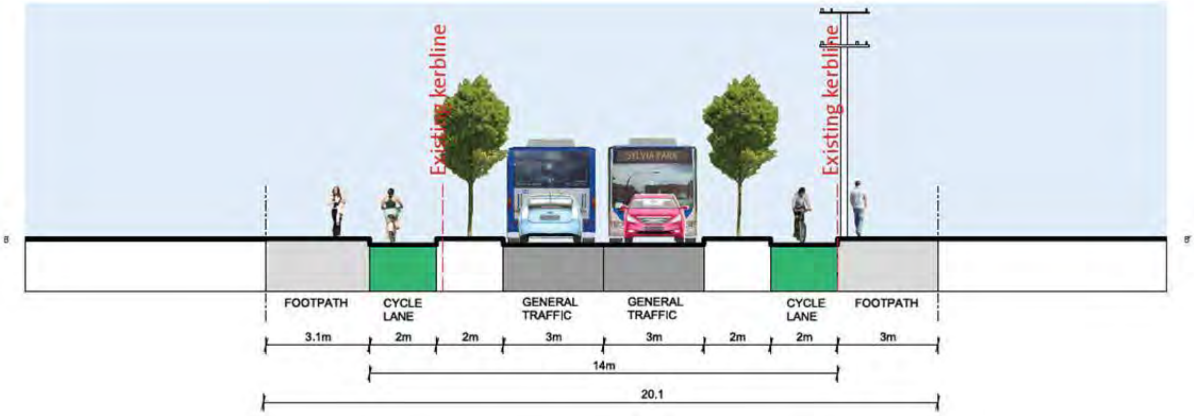
Option F involves widening of the existing western kerb-line by around 1.5m, which can be achieved within the existing road reserve, to provide improved safety for cycling as well as improving pedestrian provision. This option is shown in Figure H-4. It was not short-listed because the costs are likely to exceed the benefits.

Figure G-4 Segment B - Option F



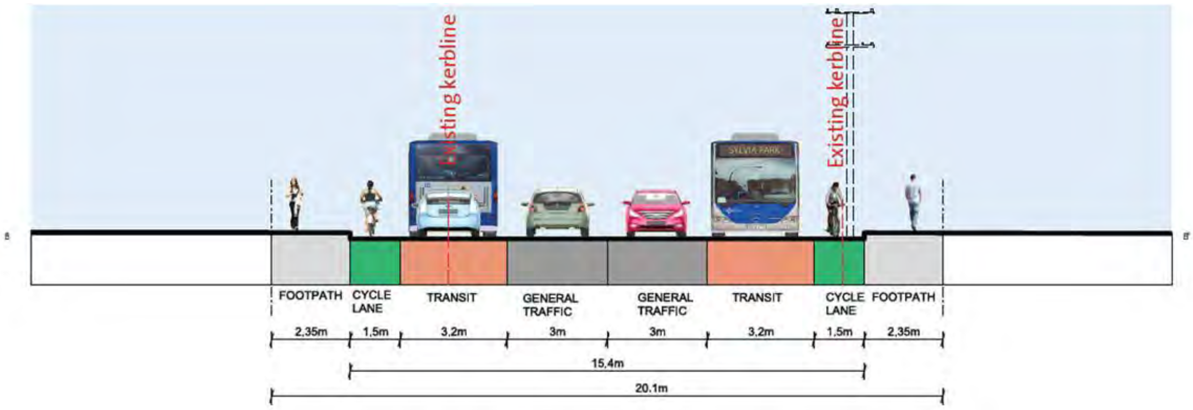
Option G further improves safety for cycling by providing vertical and wide horizontal buffers separating cyclists and general traffic, as shown in Figure H-5. It will require an approximately 2.2m widening of the existing western kerb-line, which can be achieved within the existing road reserve. This option improves pedestrian provision and the urban design/place feel of this segment. This option was not short-listed because the costs are likely to exceed the benefits.

Figure G-5 Lake Road Segment B - Option G



Option H provides transit lanes in both directions while also maintaining the existing unprotected sub-standard width uni-directional cycle lanes, as shown in Figure H-6. This option will require roughly a 3.6m widening of the existing kerb-line, which can mostly be achieved within the existing road reserve width. This option was not short-listed because the costs are likely to significantly exceed the benefits, and because of the likely need for some land acquisition.

Figure G-6 Segment B - Option H



Segment C (Bayswater Avenue to Old Lake Road)

Several other options considered, but not shortlisted. These are the same options are described for Segment B and so are not repeated. These other options were not shortlisted for the same reasons explained for Segment B.

Segment D (Old Lake Road – Achilles Crescent and Hanlon Crescent - Seabreeze Road)

No other practical options were identified for this segment of Lake Road.

Segment E (Seabreeze Road to Ariho Terrace)

No other practical options were identified for this segment of Lake Road.

Segment F (Arihio Terrace to Albert Road)

No other practical options were identified for this segment of Lake Road.

Bayswater Avenue

No other practical options were identified for Bayswater Avenue.

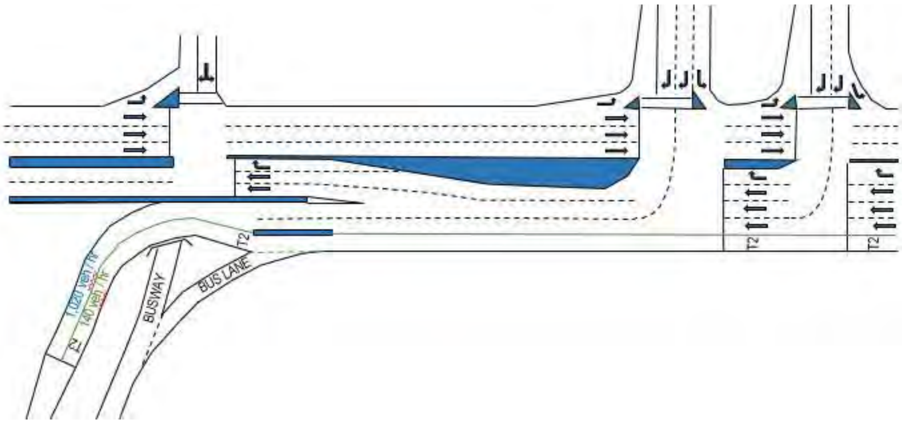
Esmonde Road

No other practical options were identified for Esmonde Road.

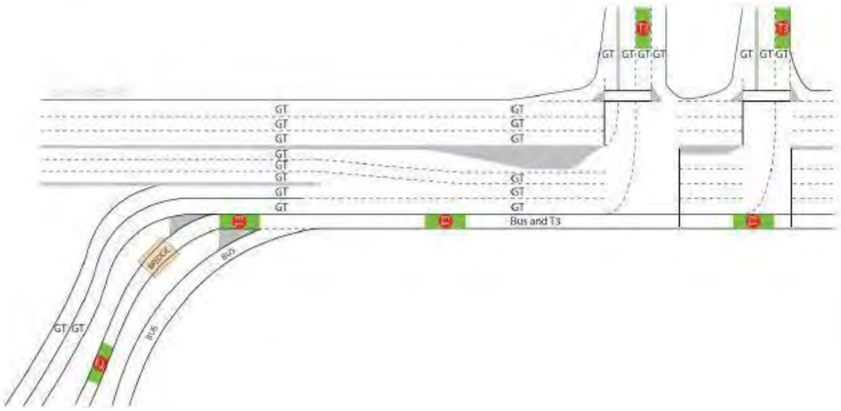
State Highway 1 On-ramp

The other options considered for the SH1 on-ramp in the Aecom report are shown below.

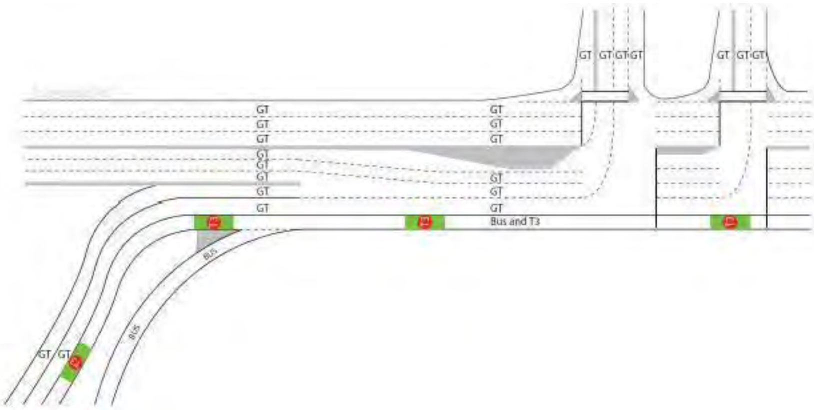
Stantec Option 1:



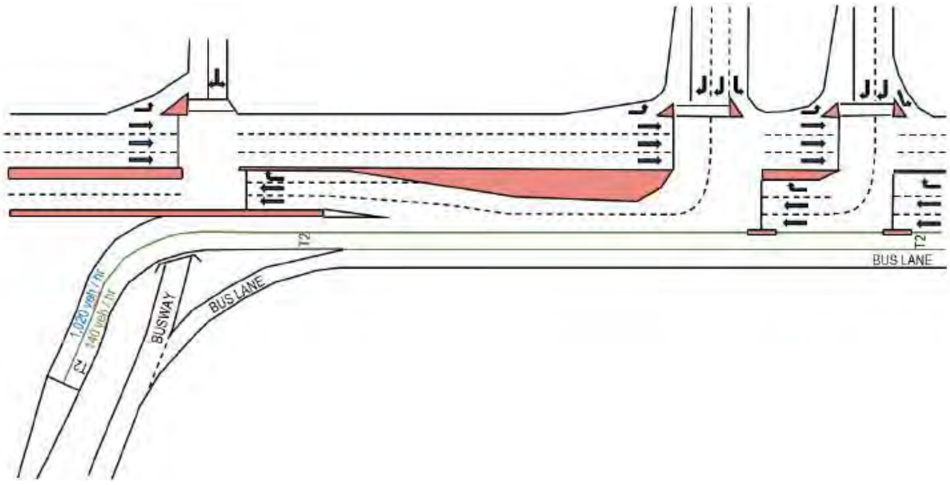
Stantec Option 3A:



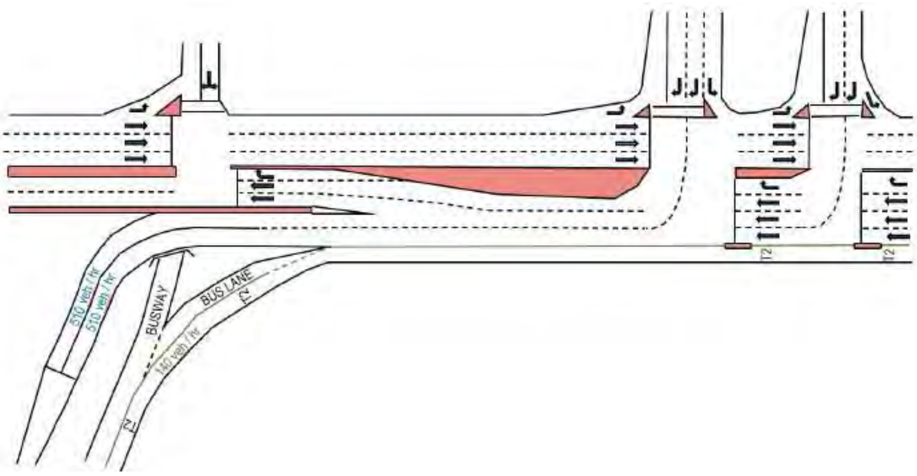
Aecom Option 3:



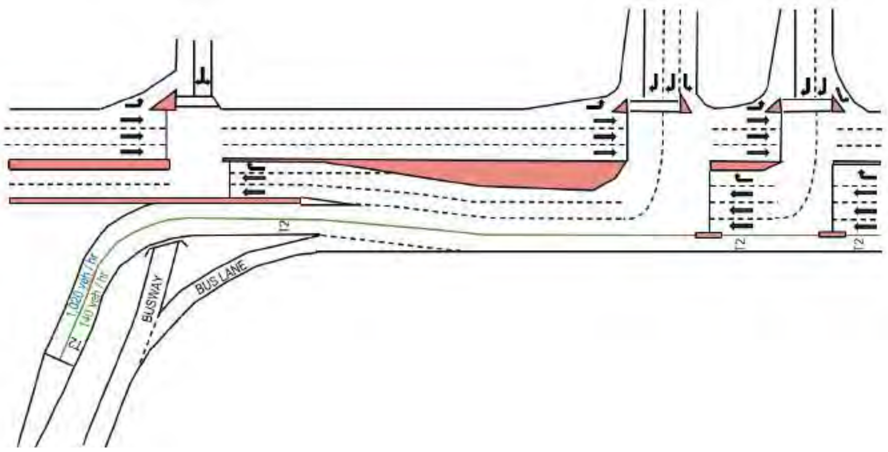
Edin Option 2:



Edin Option 3:



Edin Option 4:



Lake Road Detailed Business Case

Structural Assessment of Potential Alternative Options

Prepared for Auckland Transport
Prepared by Beca Limited

19 June 2020

Contents

Appendices

Revision History

Revision Nº	Prepared By	Description	Date
00	**Dan Jackson**	DRAFT ISSUE	19.06.20
01	**Dan Jackson**	FIRST ISSUE	25.06.20

Document Acceptance

Action	Name	Signed	Date
Prepared by	**Dan Jackson**		25.06.20
Reviewed by	**Andy Lightowler**		25.06.20
Approved by	**Andy Lightowler**		25.06.20
on behalf of	Beca Limited		

1 Introduction

1.1 Preamble

In a response to Bike Auckland feedback on the concept design proposals, Beca Limited (Beca) have been requested by Auckland Transport (AT) to investigate the construction and cost implications of lowering the retaining wall adjacent to Lake Road / McDonalds Belmont and widening Lake Road between Allenby Avenue and Albert Road. Bike Auckland's specific requests were to consider:

- Reprofiling of the existing shared path along the western edge of Lake Road between Roberts Avenue and Bayswater Avenue to provide a gradient closer to, or the same as, that of the existing road level; and
- Widening the eastern edge of Lake Road between Allenby Avenue and Albert Road to provide a width sufficient to accommodate north and southbound protected cycle lanes between Seabreeze Road and Albert Road instead of the two-way facility that was proposed.

2 Lake Road / McDonalds Belmont

The approximate extent and a photo of part of the retaining wall that has been considered for reprofiling is shown in Figure 2-1 and Photo 2-1.

Figure 2-1: Location of Retaining Wall between Roberts Road and Bayswater Avenue

Photo 2-1: Retaining Wall along the western edge of Lake Road between Roberts Road and Bayswater Avenue

The existing shared path runs along the top of a wall that starts and ends at road level peaking at 2.1m above road level. The road gradient is, therefore, a smoother and gentler gradient but has a stone retaining wall with minimal shoulder width along the western edge, which means cyclists are between the wall and traffic (if on-road).

2.1 Options Identified

There are two options for reprofiling the footpath.

The first option is to reprofile the footpath by installing a second retaining wall along the back of the footpath and reducing the height of the existing wall. The second option is to install a new full height retaining wall in line with the back of the footpath, effectively moving the footpath to road level.

Reprofiling would look to reduce the length of the largest difference between the road and path level. This is located along the stretch of the wall at the McDonalds car park and the two adjacent houses. A change in the level of 1m is assumed at this location to provide negligible benefits to the gradients. Reprofiling would create a level change for access to the properties. To provide a significant improvement, the level change would need to be greater than the average height of a step, therefore, stepped access to the properties would not be feasible (multiple steps would intrude on the footpath and cause an obstruction). For this reason, both this and the full height retaining wall option would require the closure of the access to the properties.

2.2 Key Issues

Services are evident in the path with several manholes and access points. These are thought to include stormwater, freshwater and power. Two service boxes are present along with two lampposts and two road signs. All of these assets would need to be relocated for either option. Both options would also require a minimum of a single lane closure on the main road and stop/go traffic management over the lifetime of the project.

A similar level of work is required for either option both in terms of relocating existing assets and constructing the permanent works. Due to that access to the properties would be prevented with either option, there is no obvious benefit of partial reprofiling when compared to full removal of the existing wall.

2.3 Cost Estimate Assumptions

To provide a cost estimate the full height option has been assumed. A contiguous bored pile wall offset by circa 0.5m from the existing fence line and clad with reclaimed stone from the existing wall has been used for pricing.

The reason for using bored piles is due to the possibility of high rock level in this area preventing driven options and the need to retain the ground during the works immediately adjacent to the McDonalds building.

Were the design to progress soil nailed wall options requiring easement could be considered for the length of the wall away from the building. It is assumed this can be installed without affecting the adjacent properties.

2.4 Cost Estimate

The cost estimate associated with these works is between $2.8 – 4.4 million (-10% to +40% accuracy), as contained in Appendix A. This excludes:

- Property costs;
- Loss of business;
- Land acquisition;
- Escalation from October 2020; and
- GST.

The cost of the current proposal for this section of the route (exc. intersection improvements) is less than $400,000.

2.5 Other Issues

As indicated above, reprofiling the shared path will impact on access to McDonalds. As there are other entrances to the business McDonalds, closing this entrance is unlikely to have any significant impact on the building's operation.

However, several residential properties have alternative access via the driveway. Whilst it is likely that they would use the entrance onto the footpath if, on foot, these residents would probably regard the removal of this access is a major issue for them. This matter would need further investigation.

Construction works associated with reprofiling the shared path is likely to be significant and is likely to require temporary use of privately-owned land. This matter will need further investigation and could be a significant additional cost to any works.

3 Lake Road / Lower Lake Road

The extent and a photo of the area considered for widening is shown in Figure 3-1 and Photo 3-1.

Figure 3-1: Location of Widening between Allenby Avenue and Albert Road

Photo 3-1: Existing Verge along the eastern edge of Lake Road between Allenby Avenue and Albert Road

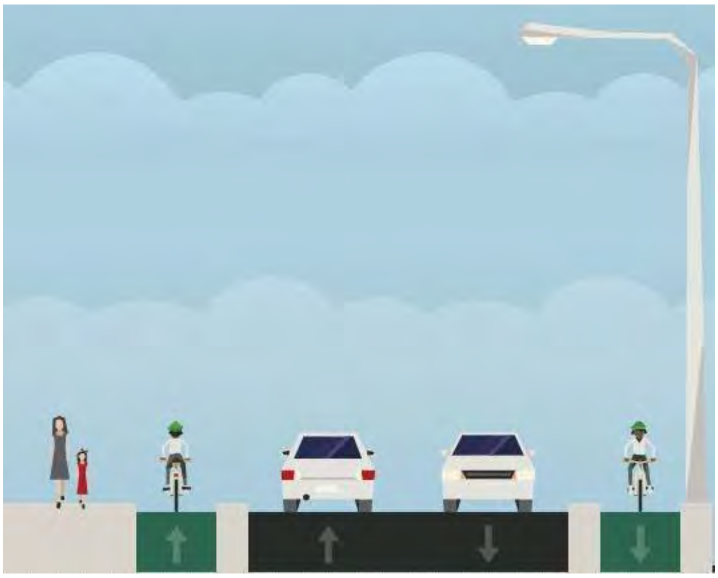
3.1 Proposed Cross-Section

To accommodate a protected cycle facility in each direction along Lake Road between Albert Road and Allenby Avenue, the existing road requires widening by at least 2.5m from the existing eastern kerb line. The extension will extend over the steep embankment on the eastern side of the road between Lake Road and the lower section of Lake Road. The proposed cross-section retains the existing western footway width, which is recommended due to the large volume of users of the footway, particularly at school opening and closing times.

The existing and proposed cross-section is shown in Figures 3-2 and 3-3. The figures have been aligned left to demonstrate the additional width required to accommodate a uni-directional protected cycle in each direction. Please note that the general traffic lanes are narrowed by approximately 0.5 metres each.

Figure 3-2: Existing Cross Section

Figure 3-3: Assessed Cross Section



3.2 Proposed Construction Method

The embankment over which the widening is proposed varies in height from level with the roadway at each end to a maximum height of circa 6m (estimated by eye). It is estimated that 140m of the embankment would require modification.

3.2 Proposed Construction Method

The embankment over which the widening is proposed varies in height from level with the roadway at each end to a maximum height of circa 6m (estimated by eye). It is estimated that 140m of the embankment would require modification.

The embankment is heavily vegetated with numerous trees of reasonably large diameter. Several trees and stumps (>10) are located within the 2m offset from the existing kerb line. Also located within the widening region are four large overhead power poles and two utility boxes. Manholes are located at the Albert Rd end of the embankment that indicates stormwater assets in the embankment. A stepped 0.8m high concrete retaining wall is present at the toe of the embankment for 45m from the Allenby end of the embankment. For all modification options, all service assets will need to be removed and relocated as part of the works.

There are two choices for access when widening in this area. The site can be accessed from the main road at the top of the embankment, this would require a minimum of a single lane closure and stop/go traffic management over the lifetime of the project. It is not considered likely that this will be acceptable in this location. However, should this be acceptable then some of the trees located lower down the embankment may not require removal. A more likely scenario is that works would be carried out from the local road utilising narrow lanes to allow for two-way traffic to be maintained on the main road. Access from the local road would likely require full clearance of the embankment.

Options for widening the road include installing a retaining wall or installation of an elevated walkway. The retained height would be circa 2-3m along most of its length. As this is a steep embankment, piled foundations are likely for either option.

3.3 Cost Estimate Assumptions

To provide a rough cost estimate a pre-bored H-Pile retaining wall of 2.5m retained height and 140m length has been used. A road barrier will need to be installed between the road and the cycleway and a guardrail at the top of the new wall (it is assumed that this has been accounted for in the 2m additional width requirement supplied).

3.4 Cost Estimate

The cost estimate associated with these works is between $2.9 – 4.5 million (-10% to +40% accuracy). This excludes:

- Property costs;
- Land acquisition;
- Escalation from October 2020; and
- GST.

The cost of the current proposal for this section of the route is less than $250,000.

3.5 Other Issues

The clearance of the embankment, including removal of most or all tress, and the need to install a retaining wall would significantly transform the local road from being screened by the vegetation to being open to the public and traffic passing above. This would likely increase noise levels and the road would change significantly in character. Existing residential properties would be overlooked by the widened road.

It is unlikely that the local community/residents would support such a change, even if the road widening could be reduced to say 1.5metres by departures from design standards and the adoption of a narrower (but likely more expensive) retaining wall/barriers.

Relocation (and potential undergrounding) of utilities, including power lines, is a significant cost risk to the project. Undergrounding of power lines would have some potential benefits to the wider area if this were to be carried out further north of the area being considered, albeit at a cost unlikely to be affordable to Auckland Transport.

4 Conclusion and Recommendations

The two enhancements suggested to the proposed concept design do not appear to be cost-effective solutions. Each alternative option costs approximately 10% of the overall project budget (20% cumulatively) and is unlikely to be affordable.

It is recommended that no changes are made to the concept design in the vicinity of Belmont.

4.1 Alternative Proposal

In the vicinity of Albert Road, it is recommended that improvements are made to the Victoria Road to Mozeley Avenue parallel route for northbound cyclists and provide a protected cycle lane on Lake Road south of Mozeley Avenue for southbound cyclists. This route is shown in Figure 4-1.

Figure 4-1: Recommended Cycle Facilities between Mozeley Road and Albert Road / Victoria Road

We do not recommend progressing an option for southbound cyclists to use the lower level road alongside Lake Road for southbound cyclists due to undesirable level differences (as shown in Photo 4-1), the number of driveways with poor visibility out onto the potential southbound route and the prominence of parked cars (as shown in Photo 4-2).

Photo 4-2: Alternative Route via Parallel Road to Lake Road

Photo 4-3: Parked Cars on Alternative Parallel Road to Lake Road

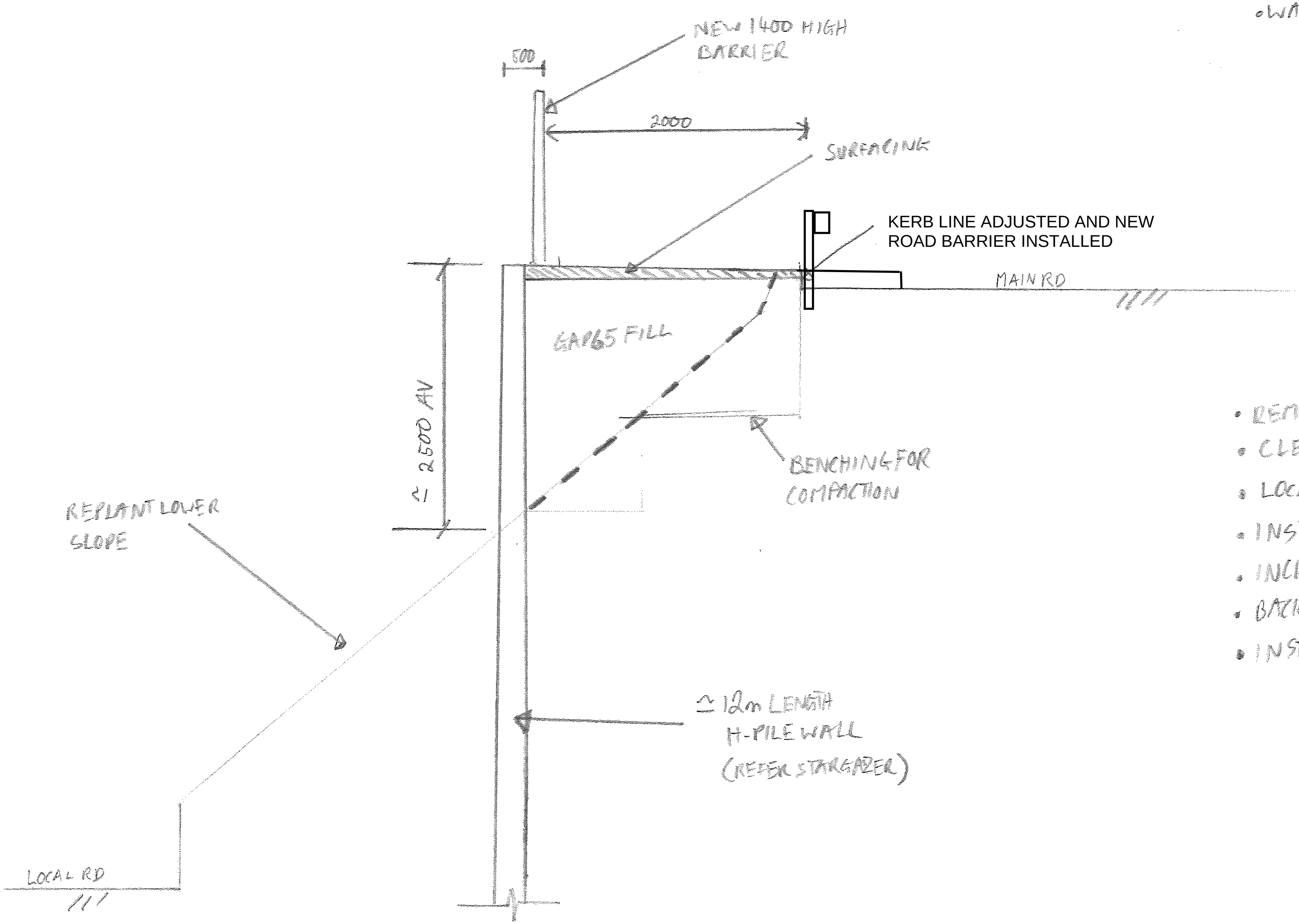
The proposed cross-section between Mozeley Avenue and Albert Road is shown in Figure 4-2. This cross-section retains the existing western footpath width, narrows general traffic lanes and provides a southbound only protected cycle facility. This option does not require any widening.

A

Appendix A – Structural Assessment Memo

N.T.S.

NOTES
- ALL DIMS BY EYE, TOPO REQUIRED
- CONCEPT ONLY - NO CALCS
- WALL LENGTH = 140m



TYPICAL SECTION

SEQUENCE
- REMOVE POWER INFRA + BARRIER
- CLEAR VEG FROM SLOPE
- LOCATE DRAINAGE
- INSTALL H PILES + LAGGING
- INCREASE MANHOLE DEPTHS
- BACKFILL, SURFACE + PLANT SLOPE
- INSTALL BARRIER

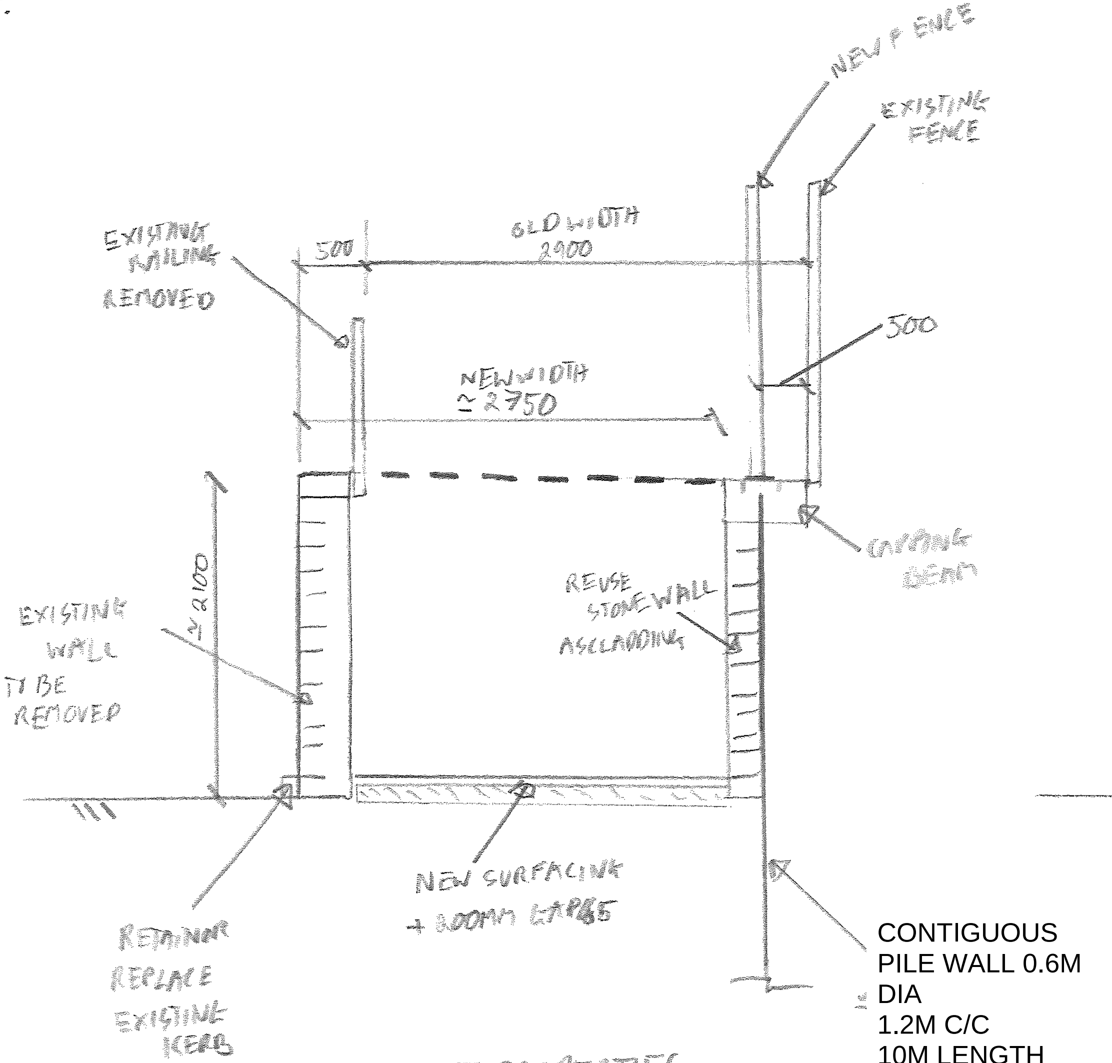
LAKE RD - ALBERT to ALLENBY

12/06/20 MJ

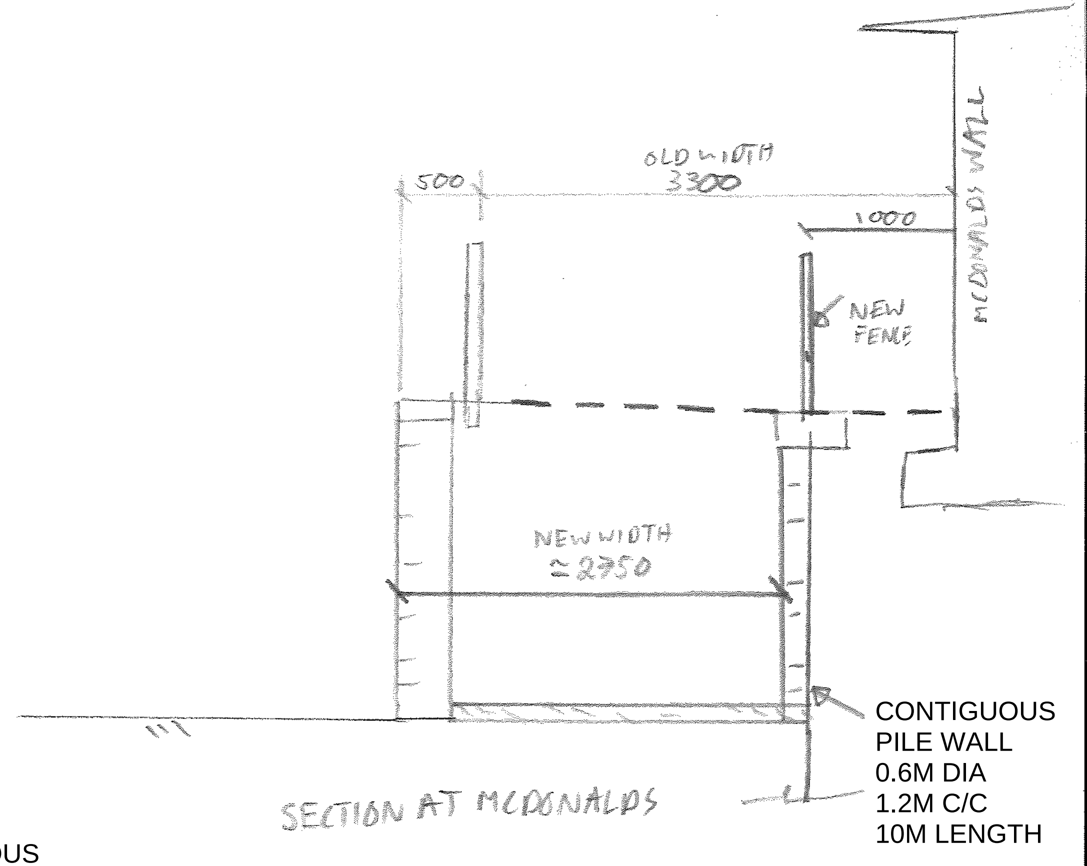
N.T.S.

- DIMS BY EYE, TOPO REQUIRED
- CONCEPT ONLY - NO CALCS

WALL LENGTH = 140m



SECTION AT PROPERTIES



SECTION AT MCDONALDS

SEQUENCE

- REMOVE EXISTING SIGNS + POWER BOX + LAMPPOST
- DIVERT SERVICES
- INSTALL WALL + CAP + FENCE
- REMOVE EXISTING WALL + CUT
- NEW SURFACING
- NEW SIGNAGE + LIGHTING

LAKE RD - BELMONT McD WALL

12/06/20 MJ

Site Visit Report

Lake Rd - Albert to Allenby Embankment
Site Walkover

Overview

Name of Asset	Lake Rd - Albert to Allenby Embankment
Name of Inspection	Site Walkover
Site Visit Report Number	SE 001
Date	11-06-2020
Time	10:47
Client / Beca Job Number as Reference	3820149
Purpose of Visit	Site walkover to understand feasibility of widening road above embankment.
Inspector	Mike Johnston
Weather	Sunny and dry

Health and Safety

Health and Safey Observations	Slopes are steep and slippy in places, access to slope face not viable after Ch80.

Observation # 1, Ch 00-20

Observation Notes	Obstructions within 2m include; 2 Manholes, a power pole and several trees. Five medium size trees present. It looks like drainage along line would need to be moved.

Observation Photos

Observation # 1, photo 1

Observation # 1, photo 2

Observation # 1, photo 3

Observation # 1, photo 4

Observation # 1, photo 5

Observation # 2, Ch 20 to 40

Observation Notes	Large trees within 2m.

Observation Photos

Observation # 2, photo 1

Observation # 2, photo 2

Observation # 2, photo 3

Observation # 2, photo 4

Observation # 3, Ch 40 to 60

Observation Photos

Observation # 3, photo 1

Observation # 3, photo 2

Observation # 3, photo 3

Observation # 3, photo 4

Observation # 3, photo 5

Observation # 4, Ch 60 to 80

Observation Photos

Observation # 4, photo 1

Observation # 4, photo 2

Observation # 4, photo 3

Observation # 5, 80 onwards top of embankment

Observation Notes	Between power poles and behind barrier is minor veg an one tree within offset.

Observation Photos

Observation # 5, photo 1

Observation # 5, photo 2

Observation # 5, photo 3

Observation # 6, Ch 120

Observation Notes	Power pole and box at end of existing barrier.

Observation Photos

Observation # 6, photo 1

Observation # 7, Concrete wall

Observation Notes	Circa 0.8m high stepped wall ch 90 to 135

Observation Photos

Observation # 7, photo 1

Observation # 7, photo 2

Observation # 7, photo 3

Observation # 8, 80 onwards bottom of embankment

Observation Notes	Several large trees present. A 0.8m high concrete wall and smaller power pole.

Observation Photos

Observation # 8, photo 1

Observation # 8, photo 2

Observation # 8, photo 3

Site Visit Report

Lake Rd - Albert to Allenby Embankment
Site Walkover

Other Information

Other 1	A chainage system was set up for purposes of referencing using the give way line on the main rd as ch0 and marking 10m along the lower road at a time.

Inspector / Reviewer Sign Offs

Inspected By	Mike Johnston
Date	11-06-2020
Signature	

Site Visit Report

Lake Rd - Belmont McD' Ret Wall
Site Walkover

Overview

Name of Asset	Lake Rd - Belmont McD' Ret Wall
Name of Inspection	Site Walkover
Site Visit Report Number	SE 002
Date	11-06-2020
Time	11:57
Client / Beca Job Number as Reference	3820149
Purpose of Visit	Site walkover to understand feasibility of re-profiling path.
Inspector	Mike Johnston
Weather	Sunny and dry

Health and Safety

Health and Safey Observations	No footpath adjacent to bottom of wall

Site Visit Report

Lake Rd - Belmont McD' Ret Wall
Site Walkover

Observation # 1, Services

Observation Notes	Multiples services in footpath

Observation Photos

Observation # 1, photo 1

Observation # 1, photo 2

Observation # 1, photo 3

Observation # 1, photo 4

Observation # 1, photo 5

Observation # 1, photo 6

Observation # 1, photo 7

Observation # 1, photo 8

Observation # 1, photo 9

Observation # 2, Property access to path.

Observation Notes	Four houses and McDonalds have direct access to path.

Observation Photos

Observation # 2, photo 1

Observation # 2, photo 2

Observation # 2, photo 3

Site Visit Report

Lake Rd - Belmont McD' Ret Wall
Site Walkover

Observation # 3, Signage and lighting

Observation Notes	Two lampposts and two sign posts present in path.

Observation Photos

Observation # 3, photo 1

Observation # 3, photo 2

Observation # 4, Cracking in Surfacing

Observation Notes	Cracking along length on wall, may be due to movement or (more likely) poor compaction over services.

Observation Photos

Observation # 4, photo 1

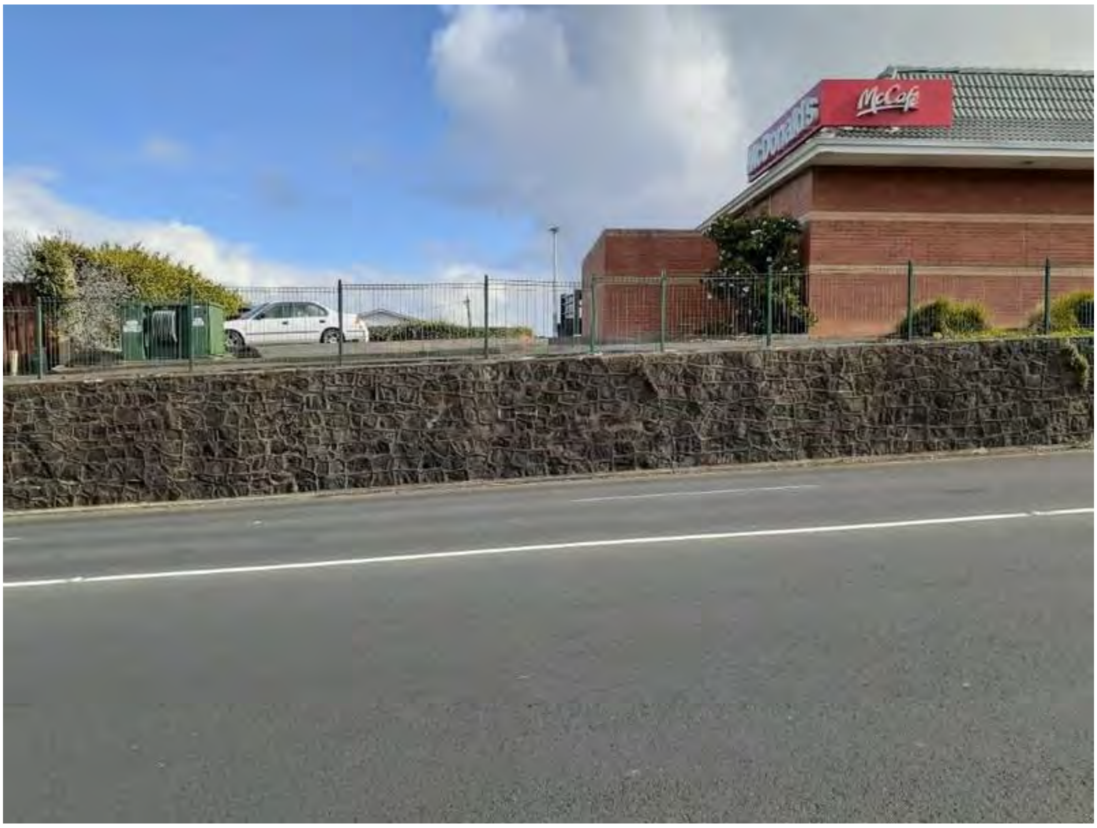
Observation # 4, photo 2

Observation # 5, Wall

Observation Notes	Max height 2.1m generally fair condition no obvious bulging or leaning.

Observation Photos

Observation # 5, photo 1



Observation # 5, photo 2

Observation # 5, photo 3

Observation # 5, photo 4

Observation # 5, photo 5

Observation # 6, Diagonal cracking in Wall.

Observation Notes	Several diagonal cracks present extending the full height of the wall spaced approx 10 m apart. Looks historic with vegetation.

Observation Photos

Observation # 6, photo 1

Observation # 6, photo 2

Observation # 6, photo 3

Observation # 6, photo 4

Observation # 7, Voids in base of wall.

Observation Notes	Three voids are present at the base of the wall, two appear to be missing stones, the third looks formed and is therefore perhaps drainage.

Observation Photos

Observation # 7, photo 1

Observation # 7, photo 2 - One large void looks formed may be drainage

Inspector / Reviewer Sign Offs

Inspected By	Mike Johnston
Date	11-06-2020
Signature	

B

Appendix B – Cost Estimate

High Level Cost Estimate

Description	Total
LAKE ROAD - BELMONT McDonald's RETAINING WALLS	3,110,000

Estimate prepared by: Jason Luo

Estimate reviewed by: Michael Johnston and Dan Jackson

Date of Estimate: June 2020

Job No: 3820149

Scope of Work

Remove existing signs, power box and lamppost

Divert services

Construct 140m long 10m long 600mm diameter contiguous pile wall

Remove existing retaining walls

New pavement and surfacing

New signage and lighting

Inputs

Memorandum from Michael Johnston dated 12 June 2020

Site visit report dated 11 June 2020

Site measurements and notes dated 11 June 2020

Sketch for the retaining walls

Assumptions

Contiguous pile wall 600mm diameter 1.2m centres 10 length

All cut to be cut to waste

Preliminary and General - 20%

Contingency - 25%

Project Development Phase fees - 4%

Pre-Implementation consultant fees - 7%

Implementation consultant fees - 6%

Exclusions

Property costs

Land acquisition

Escalation from October 2020

GST

Accuracy

Level of accuracy: -10% to +40%

	Description	Total
	$2,800,000 to $4,400,000	

High Level Cost Estimate

	Description	Unit	Quantity	Rate	Total
1	**ENVIRONMENTAL COMPLIANCE**				
2	Allowance for environmental compliance	LS	1	5,000.00	5,000
	Sub Total				5,000
4	**EARTHWORKS**				
5	Remove existing kerb and channel	m	140	30.00	4,200
6	Remove existing handrails	m	140	40.00	5,600
7	Remove existing traffic signs	No	2	200.00	400
8	Remove existing lighting poles	No	2	2,000.00	4,000
9	Remove existing power boxes	No	2	500.00	1,000
10	Remove existing existing stonewall carefully, clean and store for re-use	m	140	130.00	18,200
11	Cut to waste	m3	809	65.00	52,585
	Sub Total				85,985
13	**DRAINAGE**				
14	Kerb and channel	m	140	70.00	9,800
15	Subsoil drain	m	140	60.00	8,400
16	Allowance for modifying existing stromwater water system to suit new layout	LS	1	20,000.00	20,000
	Sub Total				38,200
18	**PAVEMENT AND SURFACING**				
19	Pavement widening	m2	385	250.00	96,250
	Sub Total				96,250
21	**RETAINING WALLS**				
22	Mob/demobile piling rig	LS	1	40,000.00	40,000
23	10m long 600mm diameter contiguous pile wall, 1.2m c/c	No	118	8,700.00	1,026,601
24	Shotcrete between piles	m2	294	120.00	35,280
25	Uplift stone facing from stockpile and reinstall	m2	294	130.00	38,220
	Sub Total				1,140,101
27	**TRAFFIC SERVICES**				
28	Allowance for lane marking	LS	1	2,000.00	2,000
29	Traffic sings	No	2	1,000.00	2,000
30	Lighting	No	2	10,000.00	20,000
	Sub Total				24,000
32	**SERVICES RELOCATIONS**				
33	Allowance for services relocations	LS	1	50,000.00	50,000
34	Power boxes	No	2	6,000.00	12,000
	Sub Total				62,000
36	**LANDSCAPING**				
37	1400mm high fencing	m	140	200.00	28,000

High Level Cost Estimate

Description	Total
LAKE ROAD - ALBERT TO ALLENBY EMBANKMENT	3,190,000
Estimate prepared by: Jason Luo	
Estimate reviewed by: Michael Johnston and Dan Jackson	
Date of Estimate: June 2020	
Job No: 3820149	
Scope of Work	
Construct 140m long pre-bored H-Pile retaining wall of 2.5m retained height	
Construct 140m long TL3 W-Section guardrails	
Construct new pavement	
Construction 140m long 1400mm high handrails	
Inputs	
Memorandum from Michael Johnston dated 12 June 2020	
Site visit report dated 11 June 2020	
Site measurements and notes dated 11 June 2020	
Sketch for the retaining walls	
Assumptions	
12m long H-Pile wall	
All cut to be cut to waste	
All fill to be imported GAP65 fill	
Preliminary and General - 20%	
Contingency - 25%	
Project Development Phase fees - 4%	
Pre-Implementation consultant fees - 7%	
Implementation consultant fees - 6%	
Exclusions	
Property costs	
Land acquisition	
Escalation from October 2020	
GST	
Accuracy	
Level of accuracy: -10% to +40%	
$2,900,000 to $4,500,000	

High Level Cost Estimate

	Description	Unit	Quantity	Rate	Total
1	**ENVIRONMENTAL COMPLIANCE**				
2	Allowance for environmental compliance	LS	1	20,000.00	20,000
	Sub Total				20,000
4	**EARTHWORKS**				
5	Site clearance including removing existing large trees	m2	350	40.00	14,000
6	Backfill with GAP65	m3	438	107.00	46,865
	Sub Total				60,865
8	**DRAINAGE**				
9	Raise existing manhole	No	1	2,000.00	2,000
10	Allowance for modifying existing drainage system	LS	1	5,000.00	5,000
	Sub Total				7,000
12	**PAVEMENT AND SURFACING**				
13	Pavement widening	m2	350	250.00	87,500
	Sub Total				87,500
15	**RETAINING WALLS**				
16	Mob/demobile piling rig	LS	1	40,000.00	40,000
17	12m long 310UC137 H-Pile wall, 1.5m c/c	No	118	9,600.00	1,132,800
	Sub Total				1,172,800
19	**TRAFFIC SERVICES**				
20	TL3 W-Section barriers	m	140	110.00	15,400
21	TL3 W-Section leading end	No	1	5,000.00	5,000
22	TL3 W-Section trailing end	No	1	3,000.00	3,000
	Sub Total				23,400
24	**SERVICES RELOCATIONS**				
25	Relocate existing power poles	No	4	20,000.00	80,000
26	Power boxes	No	2	6,000.00	12,000
	Sub Total				92,000
28	**LANDSCAPING**				
29	1400mm high handrails	m	140	350.00	49,000
	Sub Total				49,000
31	**TRAFFIC MANAGEMENT**				
32	Allowance for traffic management	%	1,512,565	0.20	302,513
33	Sub Total				
34	**PRELIMINARY AND GENERAL**				
35	Allowance for P & G	%	1,815,078	0.20	363,016
36	Rounding	LS	1	1,906.72	1,907
37	Sub Total				
					2,180,000

High Level Cost Estimate

	Description	Unit	Quantity	Rate	Total
39	Total for Physical Works				
40	**FEES**				
41	Allowance for project development phase (4%)	%	2,180,000	0.04	87,200
42	Allowance for Pre-implementation phase (7%)	%	2,180,000	0.07	152,600
43	Allowance for consultancy fees, AT managed costs and construction monitoring fees (6%)	%	2,180,000	0.06	130,800
44	Rounding	LS	1	-600.00	-600
45	Sub Total				
	TOTAL BASE ESTIMATE				2,550,000
47	**CONTINGENCY**				
48	Allowance for construction (25%)	%	2,180,000	0.25	545,000
49	Allowance for project development phase (25%)	%	87,200	0.25	21,800
50	Allowance for Pre-implementation phase (25%)	%	152,600	0.25	38,150
51	Allowance for consultancy fees, AT managed costs and construction monitoring fees (25%)	%	130,800	0.25	32,700
52	Rounding	LS	1	2,350.00	2,350
	Sub Total				640,000
	TOTAL EXPECTED ESTIMATE (P50)				3,190,000

	Description	Unit	Quantity	Rate	Total
	Sub Total				28,000
39	**TRAFFIC MANAGEMENT**				
40	Allowance for traffic management	%	1,479,536	0.20	295,907
	Sub Total				295,907
42	**PRELIMINARY AND GENERAL**				
43	Allowance for P & G	%	1,775,443	0.20	355,089
44	Rounding	LS	1	-531.18	-531
	Sub Total				354,557
	Total for Physical Works				2,130,000
47	**FEES**				
48	Allowance for project development phase (4%)	%	2,130,000	0.04	85,200
49	Allowance for Pre-implementation phase (7%)	%	2,130,000	0.07	149,100
50	Allowance for consultancy fees, AT managed costs and construction monitoring fees (6%)	%	2,130,000	0.06	127,800
51	Rounding	LS	1	-2,100.00	-2,100
52	Sub Total				
	TOTAL BASE ESTIMATE				2,490,000
54	**CONTINGENCY**				
55	Allowance for construction (25%)	%	2,130,000	0.25	532,500
56	Allowance for project development phase (25%)	%	85,200	0.25	21,300
57	Allowance for Pre-implementation phase (25%)	%	149,100	0.25	37,275
58	Allowance for consultancy fees, AT managed costs and construction monitoring fees (25%)	%	127,800	0.25	31,950
59	Sub Total	LS	1	-3,025.00	-3,025
	TOTAL EXPECTED ESTIMATE (P50)				3,110,000

Appendix H: Option Multi Criteria Assessment

Lake Road / Albert Road Intersection

Option	Consentability		Constructability			Operational								Safety			Place		Cost
	What is the level of complextity in gaining statutory approval?	How significant would the costs of mitigation be to obtain a statutory approval?	What is the complexiity of the constructing the option?	Impacts on		Is the facility improved for...				Is the journey time improved for…				Does the option enhance safety for…			How well does the option integrate movement and place?	Are there any impacts on parking and loading or crossovers / driveway?	
				Drainage	Utilities	Pedestrian	Cycle	Public Transport (HOV)	Vehicle (SOV)	Pedestrian	Cycle	Public Transport (HOV)	Vehicle (SOV)	Pedestrian	Cycle	Vehicle			
1	0	0	0	-1	-1	1	1	0	-1	1	1	0	-1	1	1	0	1	0	$
1A	0	0	0	-1	-1	2	1	0	-1	1	1	0	-1	2	2	0	1	0	$
1B	0	0	0	-1	-1	1	1	0	-1	1	1	0	-1	2	2	0	1	0	$
1C	0	0	0	-1	-1	2	1	0	-1	1	1	0	-1	2	2	0	1	0	$
2	0	0	-1	-1	-1	2	1	0	-1	1	1	-1	-1	2	2	0	1	0	$$
3	-1	-1	-1	-1	-1	2	1	0	-1	1	1	-1	1	2	2	1	1	0	$$

Lake Road / Seabreeze Road Intersection

Option	Consentability		Constructability			Operational								Safety			Place		Cost
				Impacts on		Is the facility improved for...				Is the journey time improved for…				Does the option enhance safety for…					
	What is the level of complextity in gaining statutory approval?	How significant would the costs of mitigation be to obtain a statutory approval?	What is the complexiity of the constructing the option?	Drainage	Utilities	Pedestrian	Cycle	Public Transport (HOV)	Vehicle (SOV)	Pedestrian	Cycle	Public Transport (HOV)	Vehicle (SOV)	Pedestrian	Cycle	Vehicle	How well does the option integrate movement and place?	Are there any impacts on parking and loading or crossovers / driveway?	
1	0	0	-1	-1	0	1	1	0	0	0	0	0	0	1	1	0	1	0	$
2	0	0	-1	-1	0	1	1	0	0	0	0	0	0	1	1	1	1	0	$
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	$
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	$
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	$

Lake Road / Old Lake Road Intersection

Option	Consentability		Constructability			Operational								Safety			Place		Cost
	What is the level of complextity in gaining statutory approval?	How significant would the costs of mitigation be to obtain a statutory approval?	What is the complexiity of the constructing the option?	Impacts on		Is the facility improved for...				Is the journey time improved for…				Does the option enhance safety for…			How well does the option integrate movement and place?	Are there any impacts on parking and loading or crossovers / driveway?	
				Drainage	Utilities	Pedestrian	Cycle	Public Transport (HOV)	Vehicle (SOV)	Pedestrian	Cycle	Public Transport (HOV)	Vehicle (SOV)	Pedestrian	Cycle	Vehicle			
1	0	0	-1	-1	-1	0	1	0	0	0	0	0	0	0	1	0	1	-1	$
2	0	0	-2	-1	-1	1	1	1	0	0	0	1	-1	1	1	1	0	-2	$$

Belmont Shops Intersection

Option	Consentability		Constructability			Operational								Safety			Place		Cost
	What is the level of complextity in gaining statutory approval?	How significant would the costs of mitigation be to obtain a statutory approval?	What is the complexiity of the constructing the option?	Impacts on		Is the facility improved for…				Is the journey time improved for…				Does the option enhance safety for…			How well does the option integrate movement and place?	Are there any impacts on parking and loading or crossovers / driveway?	
				Drainage	Utilities	Pedestrian	Cycle	Public Transport (HOV)	Vehicle (SOV)	Pedestrian	Cycle	Public Transport (HOV)	Vehicle (SOV)	Pedestrian	Cycle	Vehicle			
Low	-1	-1	-2	-2	-2	1	2	-1	-3	1	0	-3	-3	0	2	0	0	-1	$$$
Medium	-1	-1	-2	-2	-2	1	2	1	-2	1	0	1	-1	1	2	0	1	-1	$$$
High	-1	-1	-2	-2	-2	1	2	2	-2	1	0	2	-1	1	2	0	1	-3	$$$
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	$

Belmont Shops Intersection

Option	Consentability		Constructability			Operational								Safety			Place		Cost	Total
	What is the level of complextity in gaining statutory approval?	How significant would the costs of mitigation be to obtain a statutory approval?	What is the complexiity of the constructing the option?	Impacts on		Is the facility improved for...				Is the journey time improved for…				Does the option enhance safety for…			How well does the option integrate movement and place?	Are there any impacts on parking and loading or crossovers / driveway?		
				Drainage	Utilities	Pedestrian	Cycle	Public Transport (HOV)	Vehicle (SOV)	Pedestrian	Cycle	Public Transport (HOV)	Vehicle (SOV)	Pedestrian	Cycle	Vehicle				
A	-1	-1	-2	-2	-2	1	2	1	0	0	1	1	0	1	2	0	2	-1	$$$	4
B	-1	-1	-2	-2	-2	2	2	1	0	1	1	1	0	1	3	0	2	-1	$$$	5
C	-1	-1	-2	-2	-2	2	2	1	0	1	1	1	0	1	2	0	2	-1	$$$	4

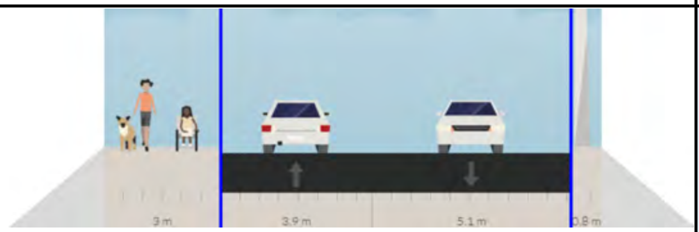
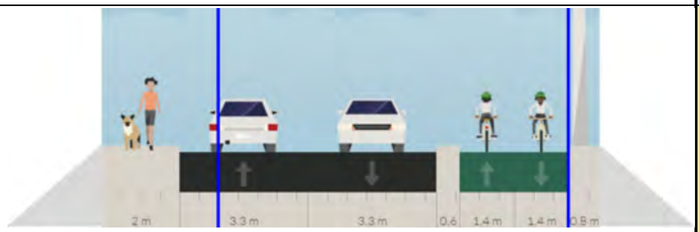
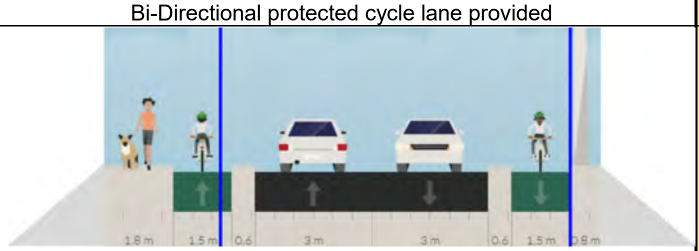
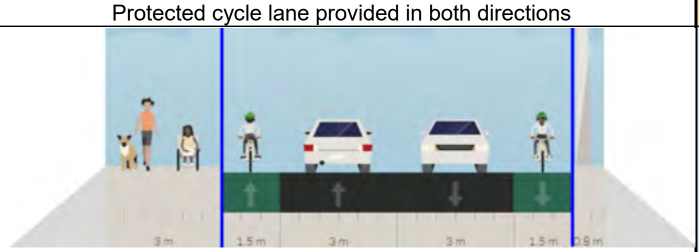
Lake Road / Jutland Road Intersection

Option	Consentability		Constructability			Operational								Safety			Place		Cost
	What is the level of complextity in gaining statutory approval?	How significant would the costs of mitigation be to obtain a statutory approval?	What is the complexiity of the constructing the option?	Impacts on		Is the facility improved for...				Is the journey time improved for…				Does the option enhance safety for…			How well does the option integrate movement and place?	Are there any impacts on parking and loading or crossovers / driveway?	
				Drainage	Utilities	Pedestrian	Cycle	Public Transport (HOV)	Vehicle (SOV)	Pedestrian	Cycle	Public Transport (HOV)	Vehicle (SOV)	Pedestrian	Cycle	Vehicle			
1	0	0	-1	-1	0	0	1	2	-1	0	0	1	-1	0	1	0	0	0	$
2	0	0	-1	-1	0	1	1	2	-1	0	0	1	-1	1	1	0	0	0	$

Sensitivity: General

Lake Road / Esmonde Road Intersection

Option	Consentability		Constructability			Operational								Safety			Place		Cost
	What is the level of complextity in gaining statutory approval?	How significant would the costs of mitigation be to obtain a statutory approval?	What is the complexiity of the constructing the option?	Impacts on		Is the facility improved for…				Is the journey time improved for…				Does the option enhance safety for…			How well does the option integrate movement and place?	Are there any impacts on parking and loading or crossovers / driveway?	
				Drainage	Utilities	Pedestrian	Cycle	Public Transport (HOV)	Vehicle (SOV)	Pedestrian	Cycle	Public Transport (HOV)	Vehicle (SOV)	Pedestrian	Cycle	Vehicle			
1	0	0	-1	-1	-1	0	1	1	-1	0	-1	1	-1	0	1	0	0	0	$
2	0	0	-1	-1	-1	0	2	1	-1	0	1	1	-1	0	2	0	0	0	$
2A	0	0	-1	-1	-1	0	2	2	-1	0	1	2	-1	0	2	0	0	0	$
3	-1	-1	-2	-2	-2	1	2	1	-1	1	1	1	-1	1	3	1	1	0	$$$

Section and Option			Consentability		Constructability			Operational								Safety			Place		Cost
			What is the level of complextity in gaining statutory approval?	How significant would the costs of mitigation be to obtain a statutory approval?	What is the complexity of the constructing the option?	Impacts on		Is the facility improved for...				Is the journey time improved for...				Does the option enhance safety for...			How well does the option integrate movement and place?	Are there any impacts on parking and loading or crossovers / driveway?	
						Drainage	Utilities	Pedestrian	Cycle	Public Transport (HOV)	Vehicle (SOV)	Pedestrian	Cycle	Public Transport (HOV)	Vehicle (SOV)	Pedestrian	Cycle	Vehicle			
Lake Road between Ariho Terrace and Albert Road	X		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
	A	 Footpath and Road Narrowed - Western Kerbline Moved Bi-Directional protected cycle lane provided	-1	-1	-3	-2	-2	-1	3	0	0	-1	2	0	0	-1	3	1	0	0	$$
	B	 Footpath Narrowed and Road - Western Kerbline Moved Protected cycle lane provided in both directions	-1	-1	-3	-2	-2	-1	2	0	-1	-1	2	0	0	-1	3	1	0	0	$$
	C	 Road Narrowed Painted cycle lane provided in both directions	0	0	0	0	0	0	1	0	-1	0	0	0	0	0	1	1	0	0	$

Appendix I: Traffic Modelling

Assumptions

Select the transit lane type between T2 and T3. This adjusts the average vehicle occupancy for general vehicles and transit vehicles used to calculate person level statistics.

	General	Transit
T2	1	2.25

There is a risk of blocking back from the Lake Rd northbound through movement that interrupts general vehicle lane and propogates back and causes additional queueing for general vehicles and transit vehicles.
In order to adress this issue, the transit vehicle lane has been removed from Lake Road between Hart Road and Napier Ave

Bus passenger volumes have been assumed to be 50 per bus in the do minimum, with a 10% increase in the option (55)

Scenarios

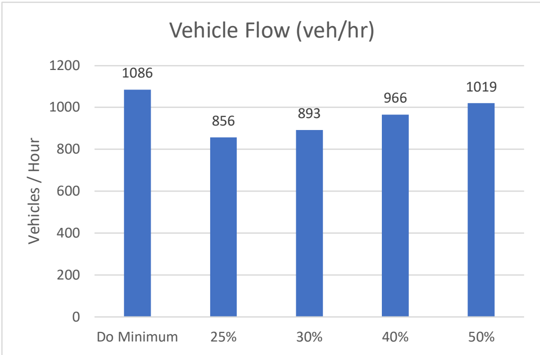
Do Minimum	No change to the existing network
25%	Introduction of Transit lanes, with 25% transit vehicles to motorway on-ramp
30%	Introduction of Transit lanes, with 30% transit vehicles to motorway on-ramp
40%	Introduction of Transit lanes, with 40% transit vehicles to motorway on-ramp
50%	Introduction of Transit lanes, with 50% transit vehicles to motorway on-ramp

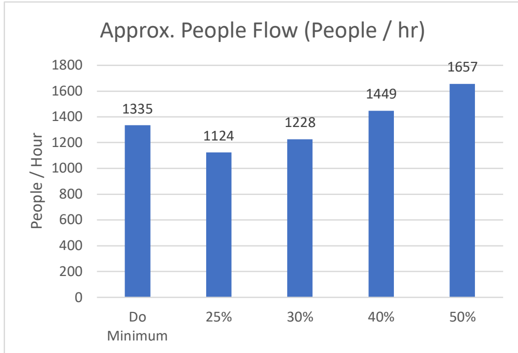
On Ramp Flow

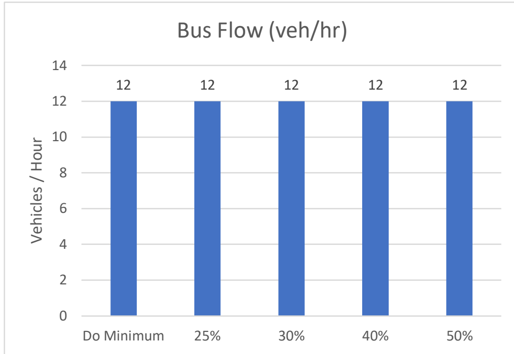
	Vehicle Flow (veh/hr)		Approx. People Flow (People / hr)	
Do Minimum	1086		1335	
25%	856	229	1124	-212
30%	893	192	1228	-107
40%	966	120	1449	114
50%	1019	66	1657	321

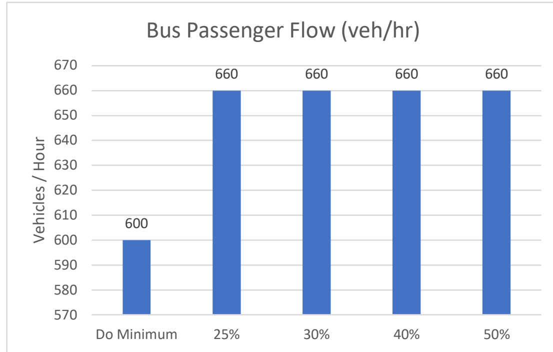
Bus Ramp

	Vehicle Flc	Approx. People Flow (People / hr)
Do Minimum	12	600
25%	12	660
30%	12	660
40%	12	660
50%	12	660









Travel Time

Travel Time Ro	**From**	**To**
Lake Road 1	Albert Rd	Hororata Rd
Lake Road 2	Hororata I	Esmonde Rd
Esmonde Rd	Lake Rd	SH1 Southbound Onramp
SH1 Southbour	Esmonde I	SH1 Ramp Meter

Average Vehicle Travel Times (s)

Scenario	Lake Road 1			Lake Road 2			Esmonde Rd			SH1 Southbound On Ramp			Total		
	Average	General	Transit	Average	General	Transit	Average	General	Transit	Average	General	Transit	Average	General	Transit
DM	430			169			434			254			1287		
25%	506	524	438	251	278	160	831	1063	136	249	325	59	1837	2190	794
30%	451	463	409	209	233	140	741	1002	131	242	329	63	1642	2027	743
40%	355	360	333	165	185	125	539	817	122	239	344	93	1299	1705	673
50%	309	312	302	122	132	104	356	598	113	257	370	145	1044	1413	663

Average Travel Time Change (s)

Scenario	Lake Road 1			Lake Road 2			Esmonde Rd			SH1 Southbound On Ramp			Total		
	Average	General	Transit	Average	General	Transit	Average	General	Transit	Average	General	Transit	Average	General	Transit
DM															
25%	76	94	8	81	109	-9	397	629	-298	-5	72	-194	550	903	-493
30%	21	34	-21	39	63	-29	307	568	-303	-12	76	-191	356	740	-543
40%	-75	-70	-97	-4	15	-45	105	383	-312	-14	90	-160	12	418	-613
50%	-121	-118	-128	-47	-37	-66	-78	164	-321	3	117	-109	-243	126	-624

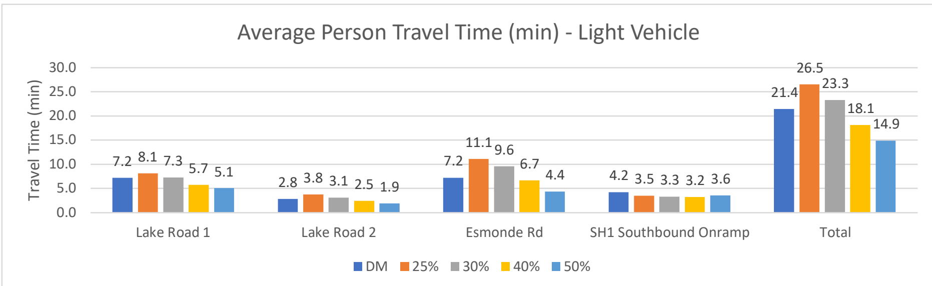
Average Vehicle Travel Times (min)

Scenario	Lake Road 1			Lake Road 2			Esmonde Rd			SH1 Southbound On Ramp			Total		
	Average	General	Transit	Average	General	Transit	Average	General	Transit	Average	General	Transit	Average	General	Transit
DM	7.2			2.8			7.2			4.2			21.4		
25%	8.4	8.7	7.3	4.2	4.6	2.7	13.9	17.7	2.3	4.2	5.4	1.0	30.6	36.5	13.2
30%	7.5	7.7	6.8	3.5	3.9	2.3	12.3	16.7	2.2	4.0	5.5	1.0	27.4	33.8	12.4
40%	5.9	6.0	5.5	2.8	3.1	2.1	9.0	13.6	2.0	4.0	5.7	1.6	21.6	28.4	11.2
50%	5.2	5.2	5.0	2.0	2.2	1.7	5.9	10.0	1.9	4.3	6.2	2.4	17.4	23.5	11.1

Scenario	Lake Road 1			Lake Road 2			Esmonde Rd			SH1 Southbound On Ramp			Total		
	Average	General	Transit	Average	General	Transit	Average	General	Transit	Average	General	Transit	Average	General	Transit
DM	0.0			0.0			0.0			0.0			0.0		
25%	1.3	1.6	0.1	1.4	1.8	-0.2	6.6	10.5	-5.0	-0.1	1.2	-3.2	9.2	15.1	-8.2
30%	0.4	0.6	-0.3	0.7	1.1	-0.5	5.1	9.5	-5.0	-0.2	1.3	-3.2	5.9	12.3	-9.1
40%	-1.2	-1.2	-1.6	-0.1	0.3	-0.7	1.8	6.4	-5.2	-0.2	1.5	-2.7	0.2	7.0	-10.2
50%	-2.0	-2.0	-2.1	-0.8	-0.6	-1.1	-1.3	2.7	-5.3	0.1	1.9	-1.8	-4.0	2.1	-10.4

Average Person Travel Times (sec) - Light Vehicles ONLY

Scenario	Lake Road	Lake Road	Esmonde I	SH1 South	Total
DM	430	169	434	254	1287
25%	487	227	666	211	1592
30%	437	187	574	198	1397
40%	344	149	400	194	1086
50%	305	112	262	214	894



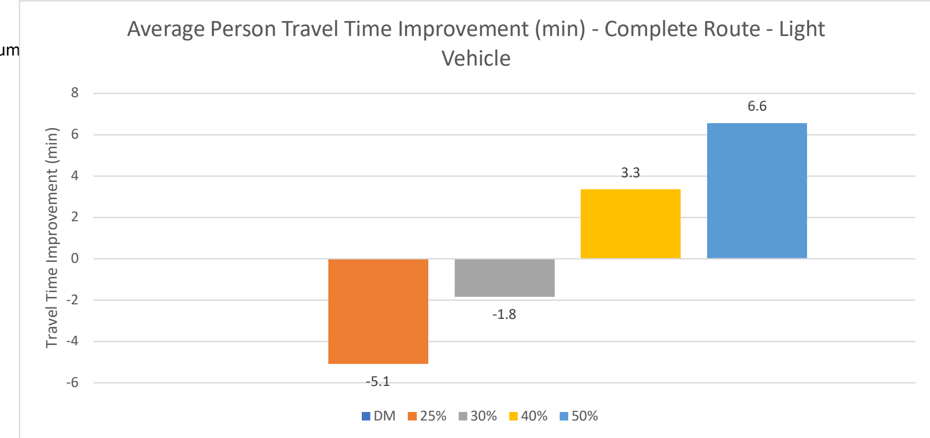
Average Person Travel Times (min)

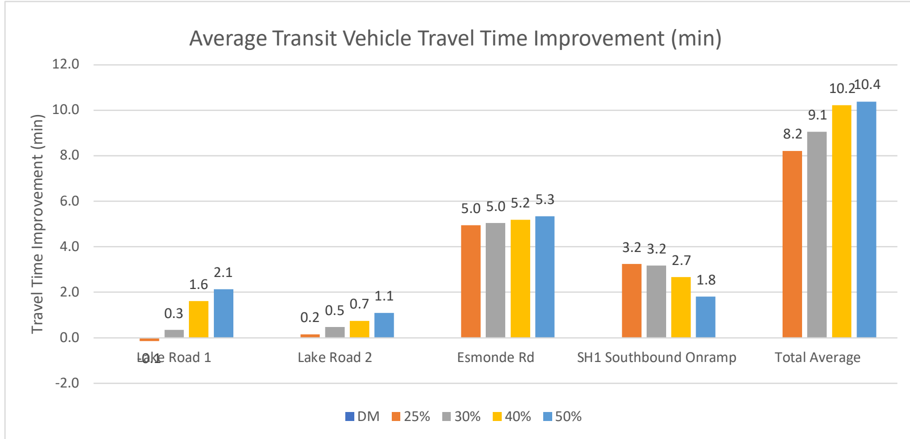
	Lake Road	Lake Road	Esmonde I	SH1 South	Total	
DM	7.2	2.8	7.2	4.2	21.4	0
25%	8.1	3.8	11.1	3.5	26.5	-5.1
30%	7.3	3.1	9.6	3.3	23.3	-1.8
40%	5.7	2.5	6.7	3.2	18.1	3.3
50%	5.1	1.9	4.4	3.6	14.9	6.6

Average Transit Vehicle Travel Time Improvement (min)

	Lake Road	Lake Road	Esmonde I	SH1 South	Total Aver	Total Mini	Total Maximum
DM							
25%	-0.1	0.2	5.0	3.2	8.2	5.0	12.7
30%	0.3	0.5	5.0	3.2	9.1	1.1	11.9
40%	1.6	0.7	5.2	2.7	10.2	1.6	14.0
50%	2.1	1.1	5.3	1.8	10.4	1.1	15.5

	Total Maxi	Total Mini	Total Average
25%	12.7	5.0	8.2
30%	11.9	1.1	9.1
40%	14.0	1.6	10.2
50%	15.5	1.1	10.4



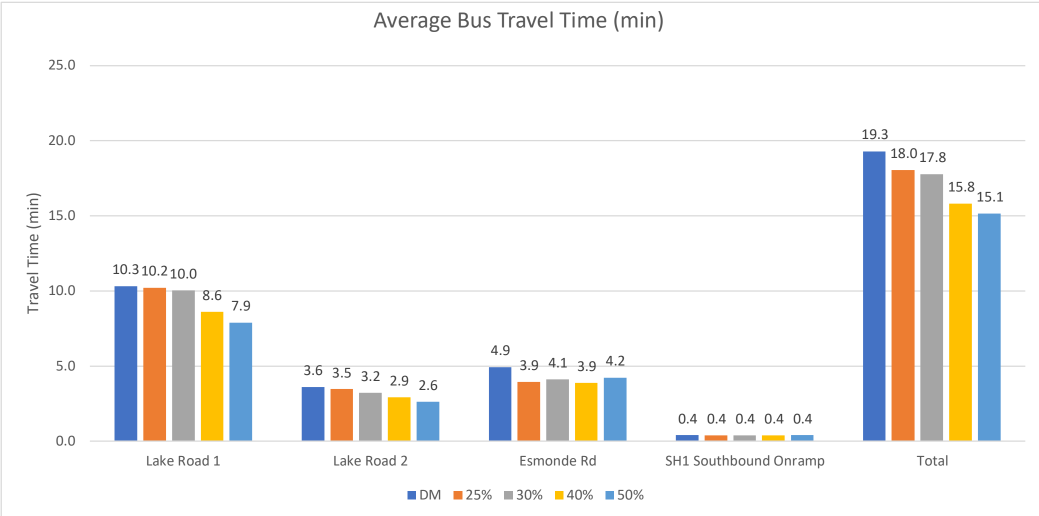


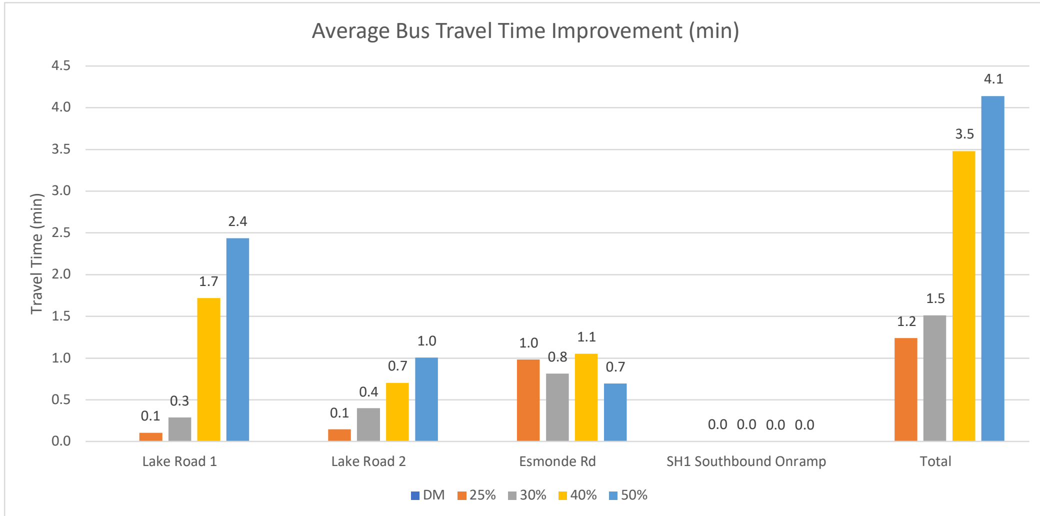
Bus Travel Time

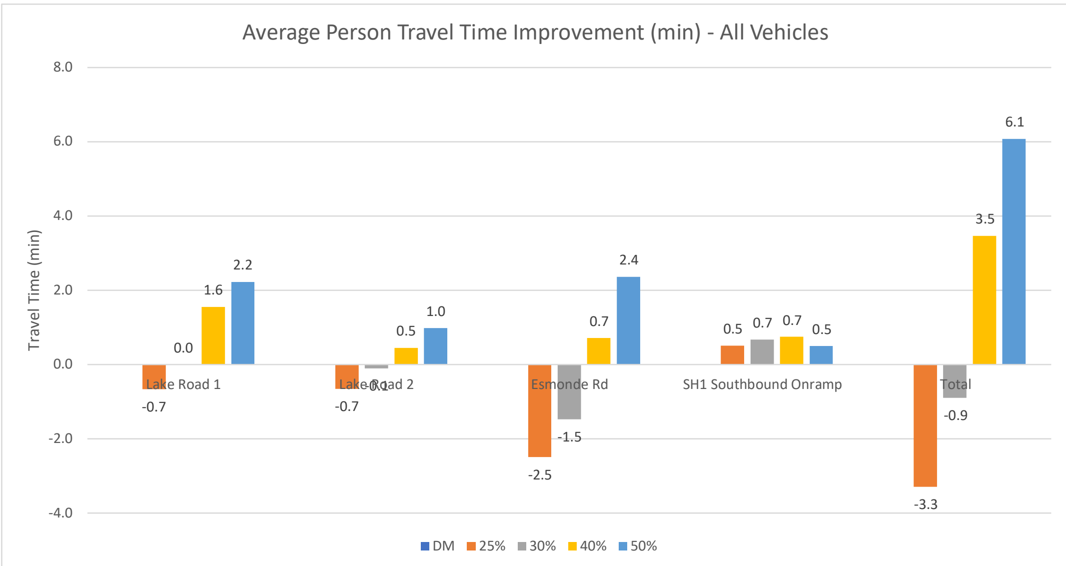
Scenario	Lake Road	Lake Road	Esmonde I	SH1 South	Total
DM	620	217	296	25	1157
25%	613	209	237	24	1083
30%	602	193	247	24	1067
40%	517	175	233	24	949
50%	473	157	254	24	909

	Lake Road	Lake Road	Esmonde I	SH1 South	Total	
DM	10.3	3.6	4.9	0.4	19.3	0
25%	10.2	3.5	3.9	0.4	18.0	3.4
30%	10.0	3.2	4.1	0.4	17.8	3.7
40%	8.6	2.9	3.9	0.4	15.8	5.6
50%	7.9	2.6	4.2	0.4	15.1	6.3

	Lake Road	Lake Road	Esmonde I	SH1 South	Total	
DM	0.0	0.0	0.0	0.0	0.0	0
25%	0.1	0.1	1.0	0.0	1.2	20.2
30%	0.3	0.4	0.8	0.0	1.5	19.9
40%	1.7	0.7	1.1	0.0	3.5	18.0
50%	2.4	1.0	0.7	0.0	4.1	17.3







Overall Weighted Person Travel Time Improvement

	Lake Road	Lake Road	Esmonde I	SH1 South	Total
DM	0.0	0.0	0.0	0.0	0.0
25%	-0.7	-0.7	-2.5	0.5	-3.3
30%	0.0	-0.1	-1.5	0.7	-0.9
40%	1.6	0.5	0.7	0.7	3.5
50%	2.2	1.0	2.4	0.5	6.1

Assumptions

Select the transit lane type between T2 and T3. This adjusts the average vehicle occupancy for general vehicles and transit vehicles used to calculate person level statistics.

	General	Transit
T2	1	2.25

There is a risk of blocking back from the Lake Rd northbound through movement that interrupts general vehicle lane and propogates back and causes additional queueing for general vehicles and transit vehicles.
In order to adress this issue, the transit vehicle lane has been removed from Lake Road between Hart Road and Napier Ave

Bus passenger volumes have been assumed to be 50 per bus in the do minimum, with a 10% increase in the option (55)

Scenarios

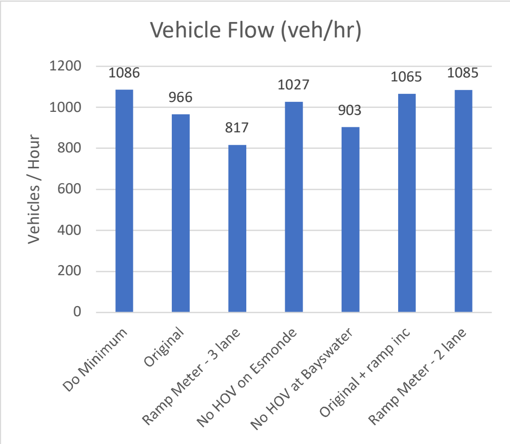
Do Minimum	No change to the existing network
Original	Introduction of Transit lanes, with 40% transit vehicles to motorway on-ramp
Ramp Meter - 3	Shift of the ramp meter to reduce the stacking space available on the southbound on ramp, ramp meter over all three lanes
No HOV on Esm	Revert HOV lanes back to bus only lane on Esmonde Rd
No HOV at Bays	Remove the HOV lanes at Bayswater
Original + ramp	Increase ramp metering signal capacity to achieve approvimately the same throughput as the do minimum
Ramp Meter - 2	Shift of the ramp meter to reduce the stacking space available on the southbound on ramp, ramp meter over general traffic lanes (not transit lane)

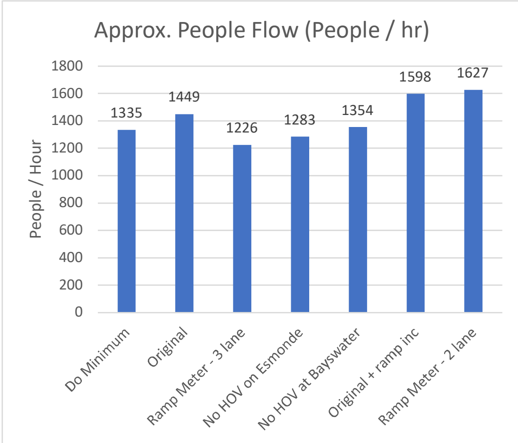
On Ramp Flow

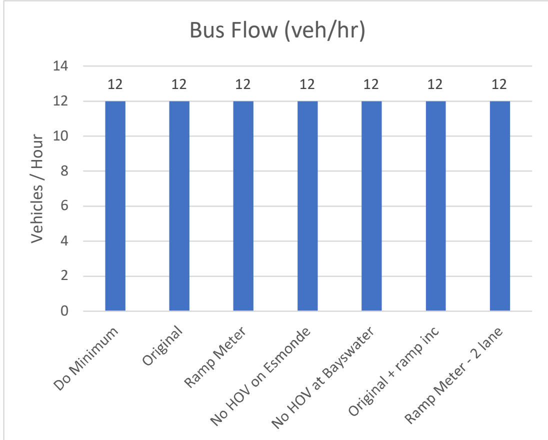
	Vehicle Flow (veh/hr)		Approx. People Flow (People / hr)	
Do Minimum	1086		1335	
Original	966	120	1449	114
Ramp Meter - 3	817	268	1226	-109
No HOV on Esm	1027	59	1283	-52
No HOV at Bays	903	183	1354	19
Original + ramp	1065	20	1598	263
Ramp Meter - 2	1085	1	1627	292

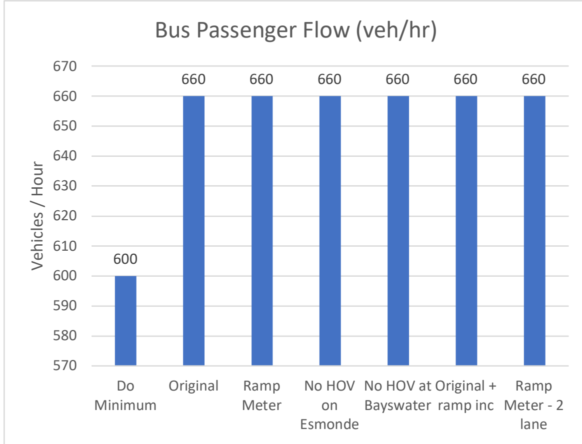
Bus Ramp

	Vehicle Flc	Approx. People Flow (People / hr)
Do Minimum	12	600
Original	12	660
Ramp Meter	12	660
No HOV on Esm	12	660
No HOV at Bays	12	660
Original + ramp	12	660
Ramp Meter - 2	12	660









Travel Time

Travel Time Ro	**From**	**To**
Lake Road 1	Albert Rd	Hororata Rd
Lake Road 2	Hororata F	Esmonde Rd
Esmonde Rd	Lake Rd	SH1 Southbound Onramp
SH1 Southbour	Esmonde F	SH1 Ramp Meter

Average Vehicle Travel Times (s)

Scenario	Lake Road 1			Lake Road 2			Esmonde Rd			SH1 Southbound On Ramp			Total		
	Average	General	Transit	Average	General	Transit	Average	General	Transit	Average	General	Transit	Average	General	Transit
DM	430			169			434			254			1287		
Original	355	360	333	165	185	125	539	817	122	239	344	93	1299	1705	673
Ramp Meter	608	629	536	263	293	171	708	1084	144	197	248	39	1776	2254	889
No HOV on Esm	317	321	304	135	146	110	496	496	496	344	344	342	1291	1307	1251
No HOV at Bays	387	389	373	172	191	131	537	812	125	235	328	83	1330	1720	712
Original + ramp	321	324	307	145	159	112	444	666	112	162	227	69	1072	1376	601
Ramp Meter - 2	317	322	303	151	167	118	490	732	126	135	180	57	1093	1401	604

Average Travel Time Change (s)

Scenario	Lake Road 1			Lake Road 2			Esmonde Rd			SH1 Southbound On Ramp			Total		
	Average	General	Transit	Average	General	Transit	Average	General	Transit	Average	General	Transit	Average	General	Transit
DM															
Original	-75	-70	-97	-4	15	-45	105	383	-312	-14	90	-160	12	418	-613
Ramp Met	178	199	106	94	124	2	274	650	-290	-57	-5	-215	490	968	-398
No HOV or	-113	-109	-126	-35	-24	-60	62	62	62	90	91	89	4	20	-35
No HOV at	-43	-41	-57	2	21	-39	103	378	-309	-19	74	-171	44	433	-575
Original +	-109	-106	-123	-24	-11	-57	10	232	-322	-92	-27	-184	-215	89	-686
Ramp Met	-113	-108	-127	-18	-3	-52	56	298	-308	-119	-73	-197	-194	114	-683

Average Vehicle Travel Times (min)

Scenario	Lake Road 1			Lake Road 2			Esmonde Rd			SH1 Southbound On Ramp			Total		
	Average	General	Transit	Average	General	Transit	Average	General	Transit	Average	General	Transit	Average	General	Transit
DM	7.2			2.8			7.2			4.2			21.4		
Original	5.9	6.0	5.5	2.8	3.1	2.1	9.0	13.6	2.0	4.0	5.7	1.6	21.6	28.4	11.2
Ramp Meter	10.1	10.5	8.9	4.4	4.9	2.9	11.8	18.1	2.4	3.3	4.1	0.6	29.6	37.6	14.8
No HOV on Esm	5.3	5.4	5.1	2.2	2.4	1.8	8.3	8.3	8.3	5.7	5.7	5.7	21.5	21.8	20.9
No HOV at Bays	6.4	6.5	6.2	2.9	3.2	2.2	9.0	13.5	2.1	3.9	5.5	1.4	22.2	28.7	11.9
Original + ramp	5.3	5.4	5.1	2.4	2.6	1.9	7.4	11.1	1.9	2.7	3.8	1.2	17.9	22.9	10.0
Ramp Meter - 2	5.3	5.4	5.1	2.5	2.8	2.0	8.2	12.2	2.1	2.2	3.0	1.0	18.2	23.3	10.1

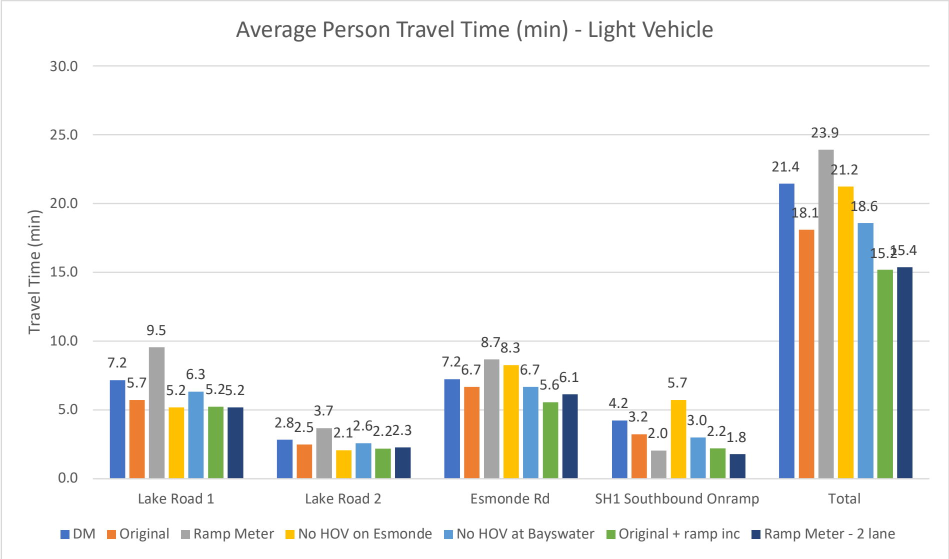
Scenario	Lake Road 1			Lake Road 2			Esmonde Rd			SH1 Southbound On Ramp			Total		
	Average	General	Transit	Average	General	Transit	Average	General	Transit	Average	General	Transit	Average	General	Transit
DM	0.0			0.0			0.0			0.0			0.0		
Original	-1.2	-1.2	-1.6	-0.1	0.3	-0.7	1.8	6.4	-5.2	-0.2	1.5	-2.7	0.2	7.0	-10.2
Ramp Met	3.0	3.3	1.8	1.6	2.1	0.0	4.6	10.8	-4.8	-0.9	-0.1	-3.6	8.2	16.1	-6.6
No HOV or	-1.9	-1.8	-2.1	-0.6	-0.4	-1.0	1.0	1.0	1.0	1.5	1.5	1.5	0.1	0.3	-0.6
No HOV at	-0.7	-0.7	-0.9	0.0	0.4	-0.6	1.7	6.3	-5.1	-0.3	1.2	-2.8	0.7	7.2	-9.6
Original +	-1.8	-1.8	-2.0	-0.4	-0.2	-0.9	0.2	3.9	-5.4	-1.5	-0.4	-3.1	-3.6	1.5	-11.4
Ramp Met	-1.9	-1.8	-2.1	-0.3	0.0	-0.9	0.9	5.0	-5.1	-2.0	-1.2	-3.3	-3.2	1.9	-11.4

Average Person Travel Times (sec) - Light Vehicles ONLY

Scenario	Lake Road	Lake Road	Esmonde F	SH1 South	Total
DM	430	169	434	254	1287
Original	344	149	400	194	1086
Ramp Meter	573	220	520	123	1435
No HOV on Esm	311	124	496	343	1274
No HOV at Bays	380	155	400	181	1115
Original + ramp	314	131	333	132	911
Ramp Meter - 2	311	137	368	106	923

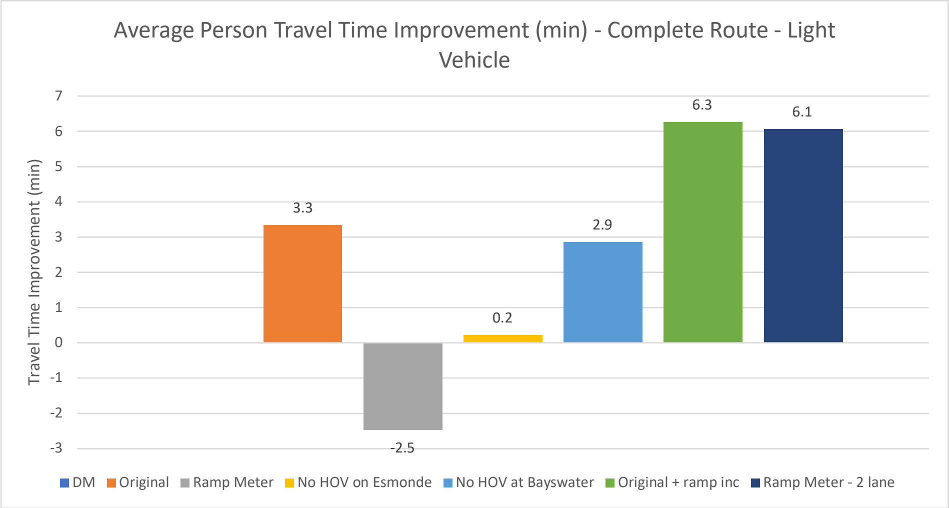
Average Person Travel Times (min)

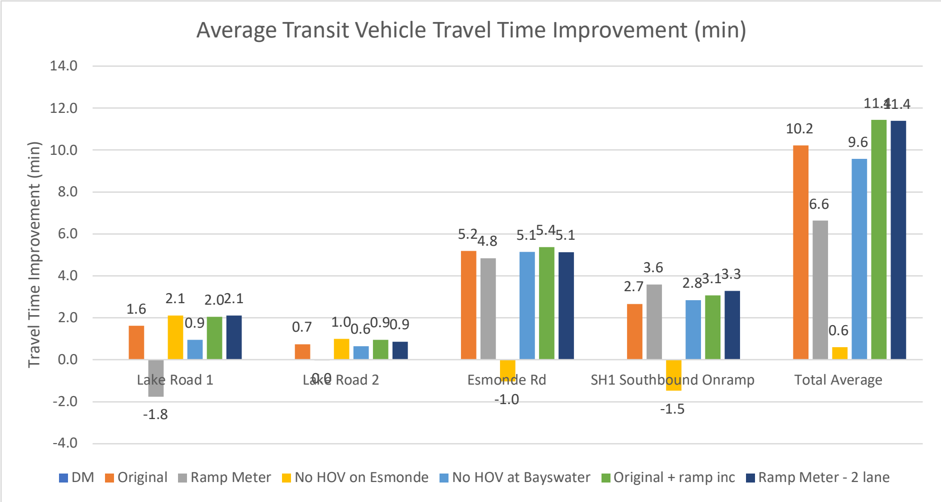
	Lake Road	Lake Road	Esmonde F	SH1 South	Total	
DM	7.2	2.8	7.2	4.2	21.4	0
Original	5.7	2.5	6.7	3.2	18.1	3.3
Ramp Meter	9.5	3.7	8.7	2.0	23.9	-2.5
No HOV on Esm	5.2	2.1	8.3	5.7	21.2	0.2
No HOV at Bays	6.3	2.6	6.7	3.0	18.6	2.9
Original + ramp	5.2	2.2	5.6	2.2	15.2	6.3
Ramp Meter - 2	5.2	2.3	6.1	1.8	15.4	6.1



Average Transit Vehicle Travel Time Improvement (min)

	Lake Road	Lake Road	Esmonde F	SH1 South	Total Average
DM					
Original	1.6	0.7	5.2	2.7	10.2
Ramp Meter	-1.8	0.0	4.8	3.6	6.6
No HOV on Esm	2.1	1.0	-1.0	-1.5	0.6
No HOV at Bays	0.9	0.6	5.1	2.8	9.6
Original + ramp	2.0	0.9	5.4	3.1	11.4
Ramp Meter - 2	2.1	0.9	5.1	3.3	11.4



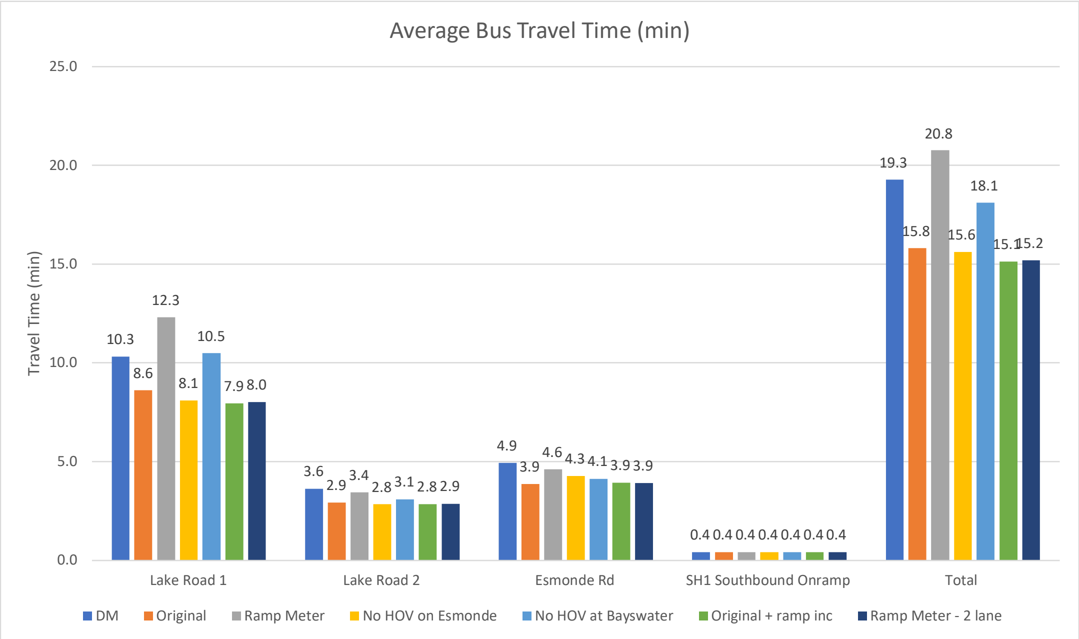


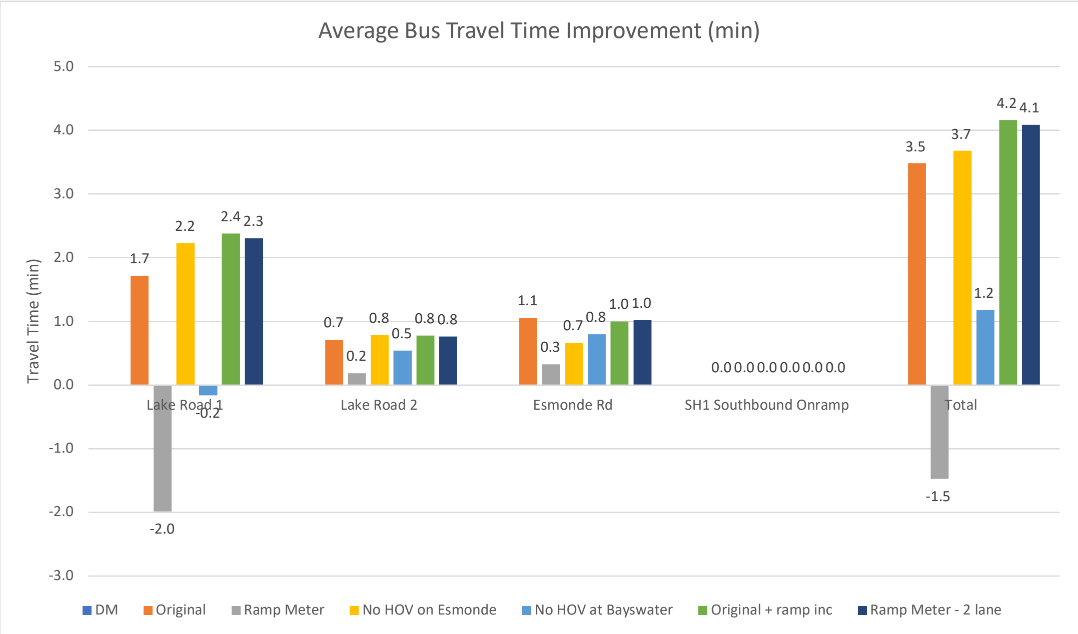
Bus Travel Time

Scenario	Lake Road	Lake Road	Esmonde F	SH1 South	Total
DM	620	217	296	25	1157
Original	517	175	233	24	949
Ramp Meter	739	206	276	24	1246
No HOV on Esm	486	170	256	24	937
No HOV at Bays	629	185	248	24	1087
Original + ramp	477	171	236	24	908
Ramp Meter - 2	481	172	235	24	912

	Lake Road	Lake Road	Esmonde F	SH1 South	Total	
DM	10.3	3.6	4.9	0.4	19.3	0
Original	8.6	2.9	3.9	0.4	15.8	5.6
Ramp Meter	12.3	3.4	4.6	0.4	20.8	0.7
No HOV on Esm	8.1	2.8	4.3	0.4	15.6	5.8
No HOV at Bays	10.5	3.1	4.1	0.4	18.1	3.3
Original + ramp	7.9	2.8	3.9	0.4	15.1	6.3
Ramp Meter - 2	8.0	2.9	3.9	0.4	15.2	6.2

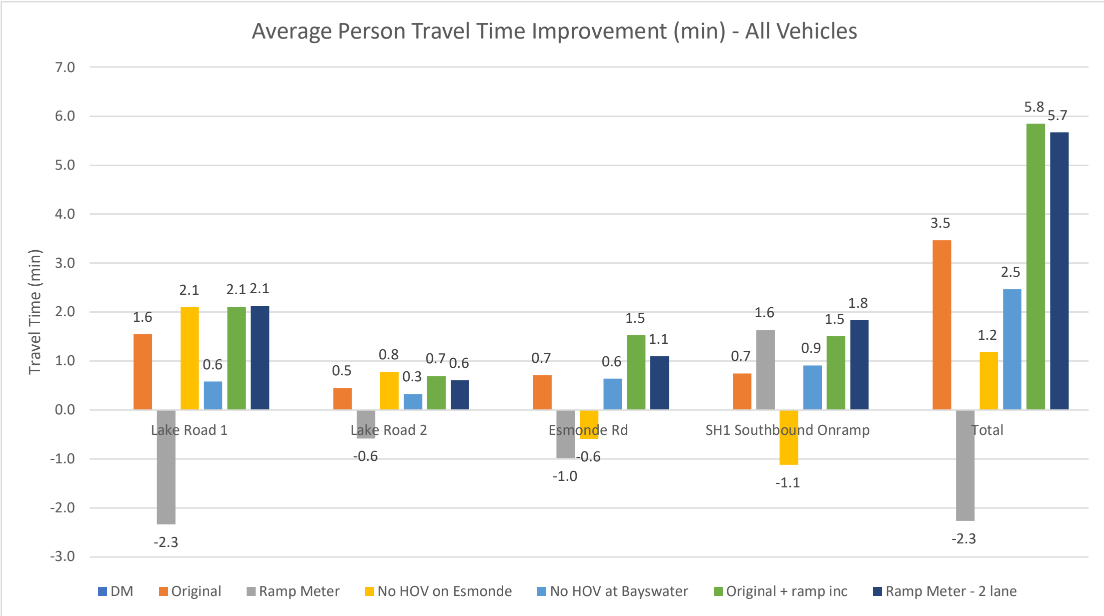
	Lake Road	Lake Road	Esmonde F	SH1 South	Total	
DM	0.0	0.0	0.0	0.0	0.0	0
Original	1.7	0.7	1.1	0.0	3.5	18.0
Ramp Meter	-2.0	0.2	0.3	0.0	-1.5	22.9
No HOV on Esm	2.2	0.8	0.7	0.0	3.7	17.8
No HOV at Bays	-0.2	0.5	0.8	0.0	1.2	20.3
Original + ramp	2.4	0.8	1.0	0.0	4.2	17.3
Ramp Meter - 2	2.3	0.8	1.0	0.0	4.1	17.4





Overall Weighted Person Travel Time Improvement

	Lake Road	Lake Road	Esmonde F	SH1 South	Total
DM	0.0	0.0	0.0	0.0	0.0
Original	1.6	0.5	0.7	0.7	3.5
Ramp Meter	-2.3	-0.6	-1.0	1.6	-2.3
No HOV on Esm	2.1	0.8	-0.6	-1.1	1.2
No HOV at Bays	0.6	0.3	0.6	0.9	2.5
Original + ramp	2.1	0.7	1.5	1.5	5.8
Ramp Meter - 2	2.1	0.6	1.1	1.8	5.7



Assumptions

Select the transit lane type between T2 and T3. This adjusts the average vehicle occupancy for general vehicles and transit vehicles used to calculate person level statistics.

	General	Transit
T2	1	2.25

The transit lane at the approach to Bayswater Ave has been removed as this causes significant travel time increases (in the model) and will likely be difficult to enforce and provides very limited benefit to transit vehicles

Scenarios

Do Minimum	No change to the existing network
25%	Introduction of Transit lanes, with 25% transit vehicles to Devonport
30%	Introduction of Transit lanes, with 30% transit vehicles to Devonport
40%	Introduction of Transit lanes, with 40% transit vehicles to Devonport
50%	Introduction of Transit lanes, with 50% transit vehicles to Devonport

Travel Time

Travel Time Ro	**From**	**To**
Esmonde Rd	Southbour	Lake Rd
Lake Road SB 2	Esmonde F	Hororata Rd
Lake Road SB 1	Hororata F	Albert Rd

Average Vehicle Travel Times (s)

Scenario	Esmonde Rd NB			Lake Road SB 2			Lake Road SB 1			Total		
	Average	General	Transit	Average	General	Transit	Average	General	Transit	Average	General	Transit
DM	269			204			340			813		
25%	588	586	587	151	156	132	312	312	310	1050	1054	1030
30%	560	558	559	150	156	133	310	310	308	1020	1024	1000
40%	409	406	411	166	181	147	330	330	330	905	917	888
50%	406	404	408	162	176	144	325	325	324	893	905	876

Average Travel Time Change (s)

Scenario	Esmonde Rd NB			Lake Road SB 2			Lake Road SB 1			Total		
	Average	General	Transit	Average	General	Transit	Average	General	Transit	Average	General	Transit
DM												
25%	318	317	318	-53	-48	-72	-28	-28	-30	237	241	216
30%	290	289	290	-54	-48	-71	-30	-30	-31	206	211	187
130%	140	137	142	-38	-23	-56	-10	-9	-10	92	104	75
230%	137	134	138	-42	-28	-60	-15	-15	-15	80	92	63

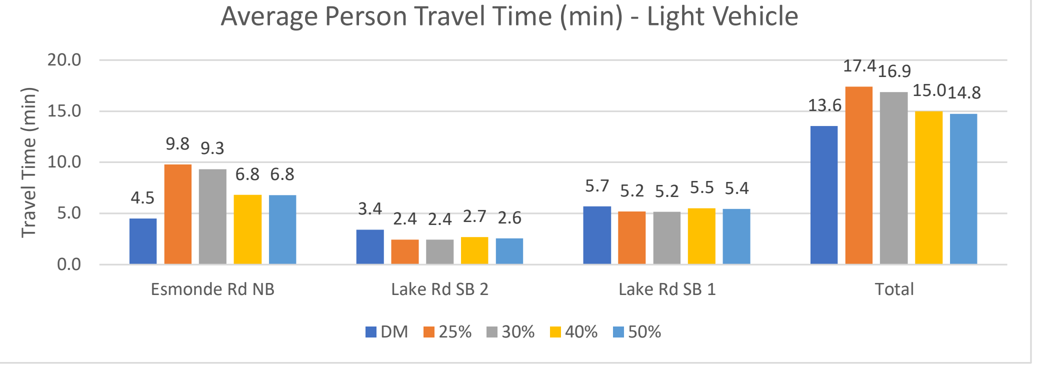
Average Vehicle Travel Times (min)

Scenario	Esmonde Rd NB			Lake Road SB 2			Lake Road SB 1			Total		
	Average	General	Transit	Average	General	Transit	Average	General	Transit	Average	General	Transit
DM	4.5			3.4			5.7			13.6		
25%	9.8	9.8	9.8	2.5	2.6	2.2	5.2	5.2	5.2	17.5	17.6	17.2
30%	9.3	9.3	9.3	2.5	2.6	2.2	5.2	5.2	5.1	17.0	17.1	16.7
40%	6.8	6.8	6.9	2.8	3.0	2.5	5.5	5.5	5.5	15.1	15.3	14.8
50%	6.8	6.7	6.8	2.7	2.9	2.4	5.4	5.4	5.4	14.9	15.1	14.6

Scenario	Esmonde Rd NB			Lake Road SB 2			Lake Road SB 1			Total		
	Average	General	Transit	Average	General	Transit	Average	General	Transit	Average	General	Transit
DM	0.0			0.0			0.0			0.0		
25%	5.3	5.3	5.3	-0.9	-0.8	-1.2	-0.5	-0.5	-0.5	4.0	4.0	3.6
30%	4.8	4.8	4.8	-0.9	-0.8	-1.2	-0.5	-0.5	-0.5	3.4	3.5	3.1
130%	2.3	2.3	2.4	-0.6	-0.4	-0.9	-0.2	-0.2	-0.2	1.5	1.7	1.3
230%	2.3	2.2	2.3	-0.7	-0.5	-1.0	-0.3	-0.2	-0.3	1.3	1.5	1.1

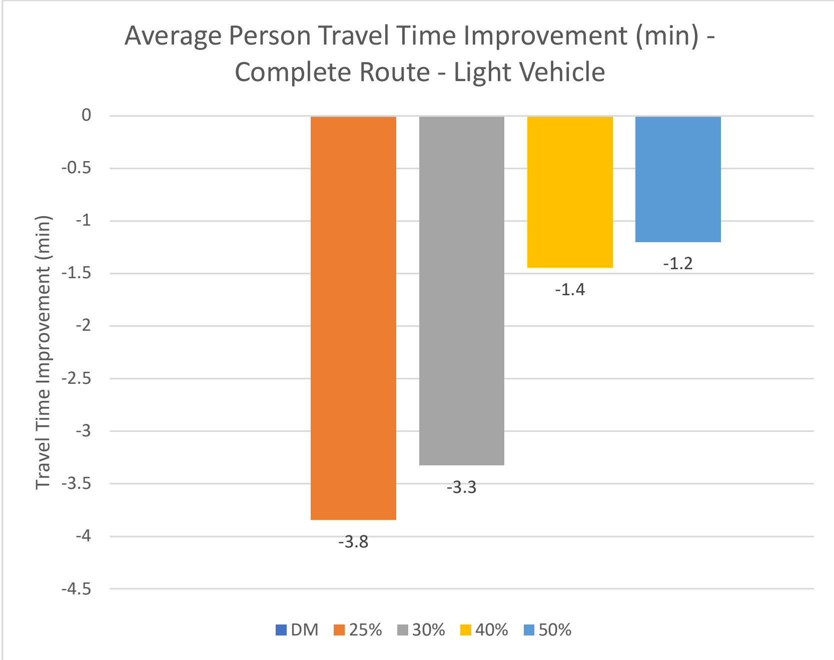
Average Person Travel Times (sec) - Light Vehicles ONLY

Scenario	Esmonde F	Lake Rd SB	Lake Rd SB	Total
DM	269	204	340	813
25%	587	146	311	1044
30%	559	145	309	1012
40%	409	161	330	900
50%	407	154	325	885



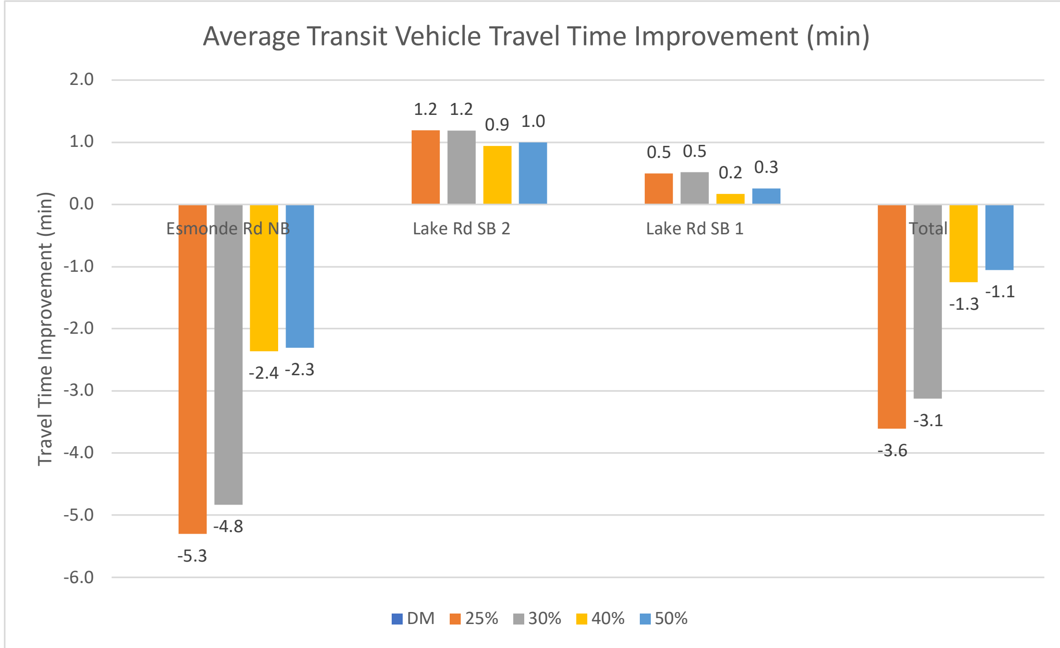
Average Person Travel Times (min)

	Esmonde F	Lake Rd SB	Lake Rd SB	Total	
DM	4.5	3.4	5.7	13.6	0
25%	9.8	2.4	5.2	17.4	-3.8
30%	9.3	2.4	5.2	16.9	-3.3
40%	6.8	2.7	5.5	15.0	-1.4
50%	6.8	2.6	5.4	14.8	-1.2



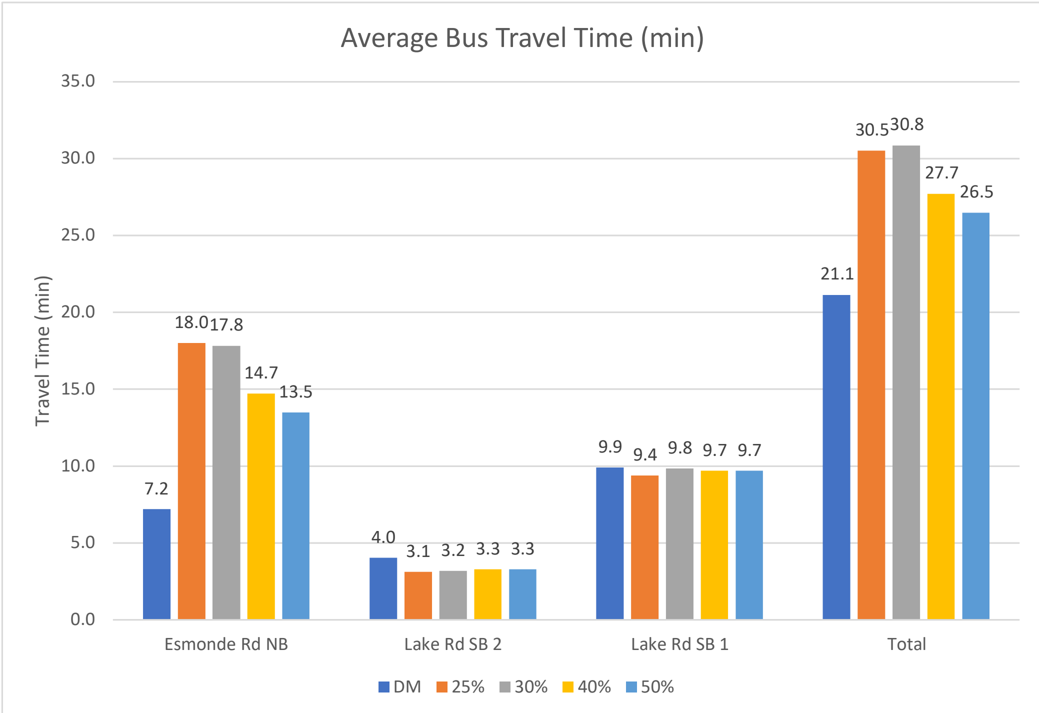
Average Transit Vehicle Travel Time Improvement (min)

	Esmonde F	Lake Rd SB	Lake Rd SB	Total
DM				
25%	-5.3	1.2	0.5	-3.6
30%	-4.8	1.2	0.5	-3.1
40%	-2.4	0.9	0.2	-1.3
50%	-2.3	1.0	0.3	-1.1

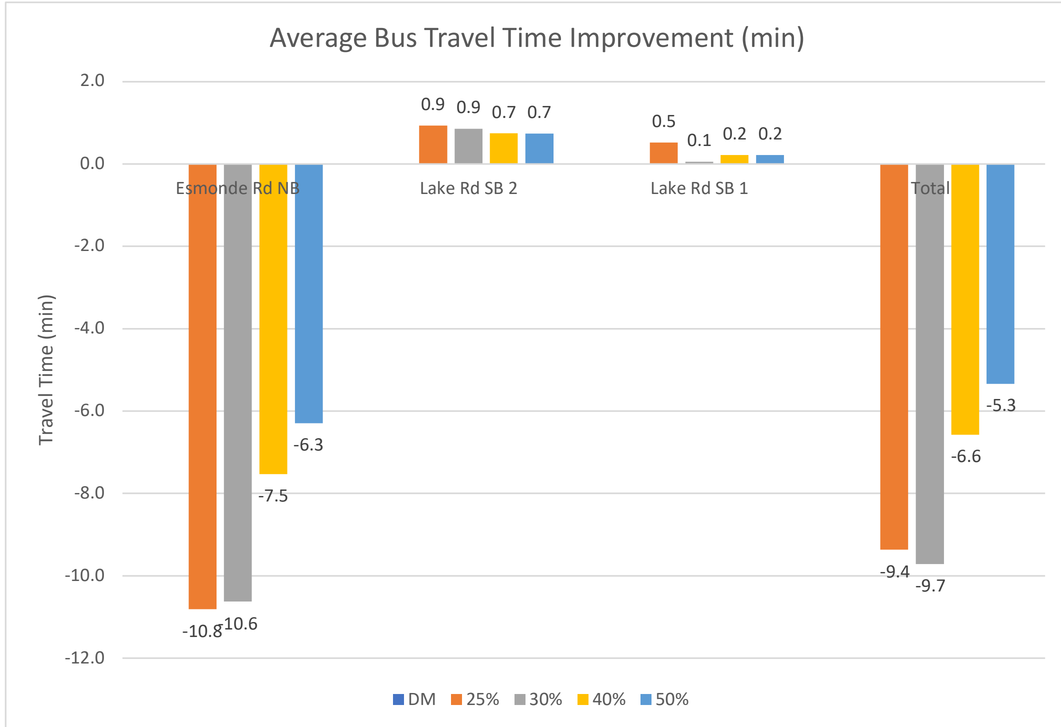


Bus Travel Time

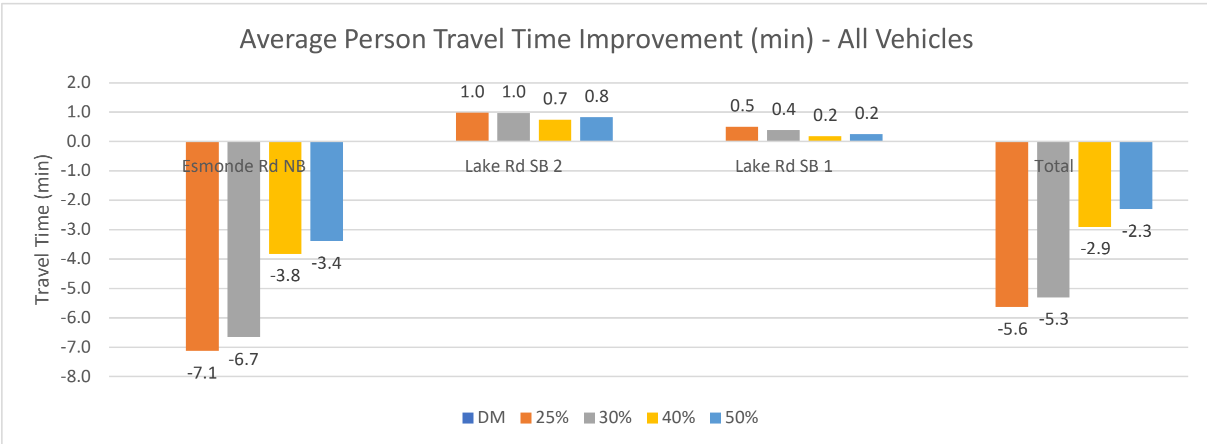
Scenario	Esmonde F	Lake Rd SB	Lake Rd SB	Total
DM	431	242	594	1268
25%	1080	187	563	1830
30%	1069	191	591	1851
40%	883	198	581	1662
50%	809	198	581	1588



	Esmonde F	Lake Rd SB	Lake Rd SB	Total	
DM	7.2	4.0	9.9	21.1	0
25%	18.0	3.1	9.4	30.5	-17.0
30%	17.8	3.2	9.8	30.8	-17.3
40%	14.7	3.3	9.7	27.7	-14.2
50%	13.5	3.3	9.7	26.5	-12.9



	Esmonde F	Lake Rd SB	Lake Rd SB	Total	
DM	0.0	0.0	0.0	0.0	0
25%	-10.8	0.9	0.5	-9.4	22.9
30%	-10.6	0.9	0.1	-9.7	23.3
40%	-7.5	0.7	0.2	-6.6	20.1
50%	-6.3	0.7	0.2	-5.3	18.9



Overall Weighted Person Travel Time Improvement

	Esmonde F	Lake Rd SB	Lake Rd SB	Total
DM	0.0	0.0	0.0	0.0
25%	-7.1	1.0	0.5	-5.6
30%	-6.7	1.0	0.4	-5.3
40%	-3.8	0.7	0.2	-2.9
50%	-3.4	0.8	0.2	-2.3

Assumptions

Select the transit lane type between T2 and T3. This adjusts the average vehicle occupancy for general vehicles and transit vehicles used to calculate person level statistics.

	General	Transit
T2	1	2.25

The transit lane at the approach to Bayswater Ave has been removed as this causes significant travel time increases (in the model) and will likely be difficult to enforce and provides very limited benefit to transit vehicles

Scenarios

Do Minimum	No change to the existing network
Original Model	Introduction of Transit lanes, with 40% transit vehicles to Devonport
No HOV Lake R	Removal of Transit lanes on Lake Road Southbound

Travel Time

Travel Time Ro	**From**	**To**
Esmonde Rd	Southbour	Lake Rd
Lake Road SB 2	Esmonde F	Hororata Rd
Lake Road SB 1	Hororata F	Albert Rd

Average Vehicle Travel Times (s)

Scenario	Esmonde Rd NB			Lake Road SB 2			Lake Road SB 1			Total		
	Average	General	Transit	Average	General	Transit	Average	General	Transit	Average	General	Transit
DM	269			204			340			813		
Original Model	409	406	411	166	181	147	330	330	330	905	917	888
No HOV Lake R	213	212	213	193	194	193	340	339	340	746	745	745

Average Travel Time Change (s)

Scenario	Esmonde Rd NB			Lake Road SB 2			Lake Road SB 1			Total		
	Average	General	Transit	Average	General	Transit	Average	General	Transit	Average	General	Transit
DM												
25%	140	137	142	-38	-23	-56	-10	-9	-10	92	104	75
30%	-57	-57	-57	-10	-10	-11	0	0	0	-67	-68	-68

Average Vehicle Travel Times (min)

Scenario	Esmonde Rd NB			Lake Road SB 2			Lake Road SB 1			Total		
	Average	General	Transit	Average	General	Transit	Average	General	Transit	Average	General	Transit
DM	4.5			3.4			5.7			13.6		
Original Model	6.8	6.8	6.9	2.8	3.0	2.5	5.5	5.5	5.5	15.1	15.3	14.8
No HOV Lake R	3.5	3.5	3.5	3.2	3.2	3.2	5.7	5.7	5.7	12.4	12.4	12.4

Scenario	Esmonde Rd NB			Lake Road SB 2			Lake Road SB 1			Total		
	Average	General	Transit	Average	General	Transit	Average	General	Transit	Average	General	Transit
DM	0.0			0.0			0.0			0.0		
25%	2.3	2.3	2.4	-0.6	-0.4	-0.9	-0.2	-0.2	-0.2	1.5	1.7	1.3
30%	-0.9	-1.0	-0.9	-0.2	-0.2	-0.2	0.0	0.0	0.0	-1.1	-1.1	-1.1

Average Person Travel Times (sec) - Light Vehicles ONLY

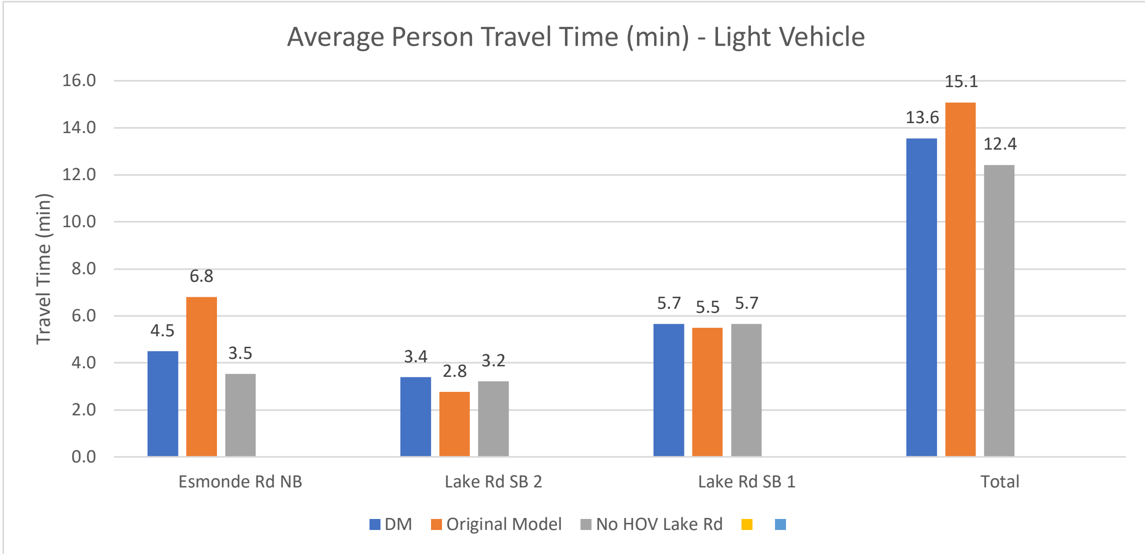
Scenario	Esmonde F	Lake Rd SE	Lake Rd SE	Total
DM	269	204	340	813
Original Model	408	166	330	905
No HOV Lake R	212	193	340	745

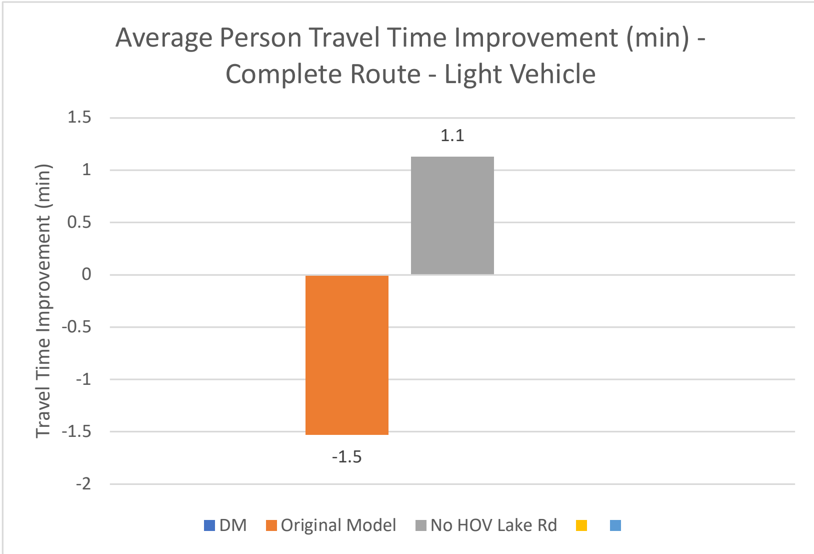
Average Person Travel Times (min)

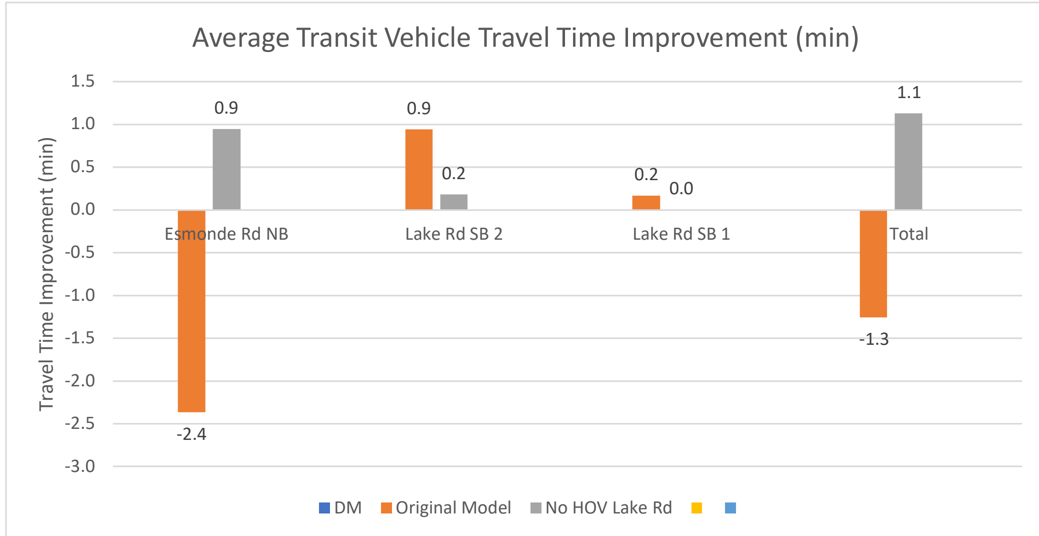
	Esmonde F	Lake Rd SE	Lake Rd SE	Total	
DM	4.5	3.4	5.7	13.6	0
Original Model	6.8	2.8	5.5	15.1	-1.5
No HOV Lake R	3.5	3.2	5.7	12.4	1.1

Average Transit Vehicle Travel Time Improvement (min)

	Esmonde F	Lake Rd SE	Lake Rd SE	Total
DM				
Original Model	-2.4	0.9	0.2	-1.3
No HOV Lake R	0.9	0.2	0.0	1.1





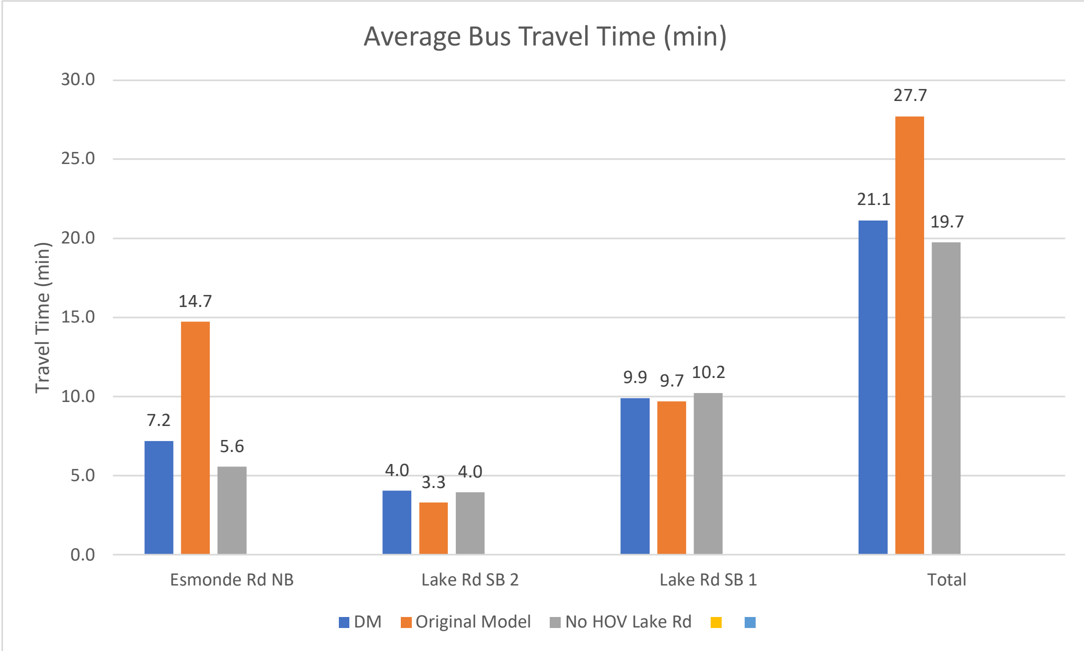


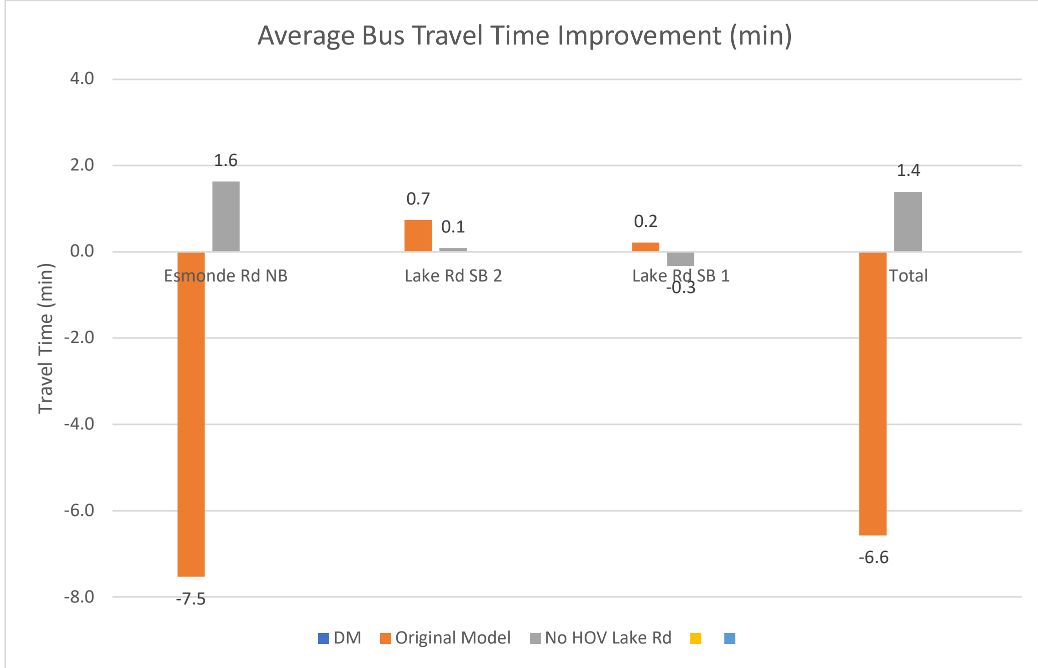
Bus Travel Time

Scenario	Esmonde F	Lake Rd SE	Lake Rd SE	Total
DM	431	242	594	1268
Original Model	883	198	581	1662
No HOV Lake R	334	237	614	1184

	Esmonde F	Lake Rd SE	Lake Rd SE	Total	
DM	7.2	4.0	9.9	21.1	0
Original Model	14.7	3.3	9.7	27.7	-14.2
No HOV Lake R	5.6	4.0	10.2	19.7	-6.2

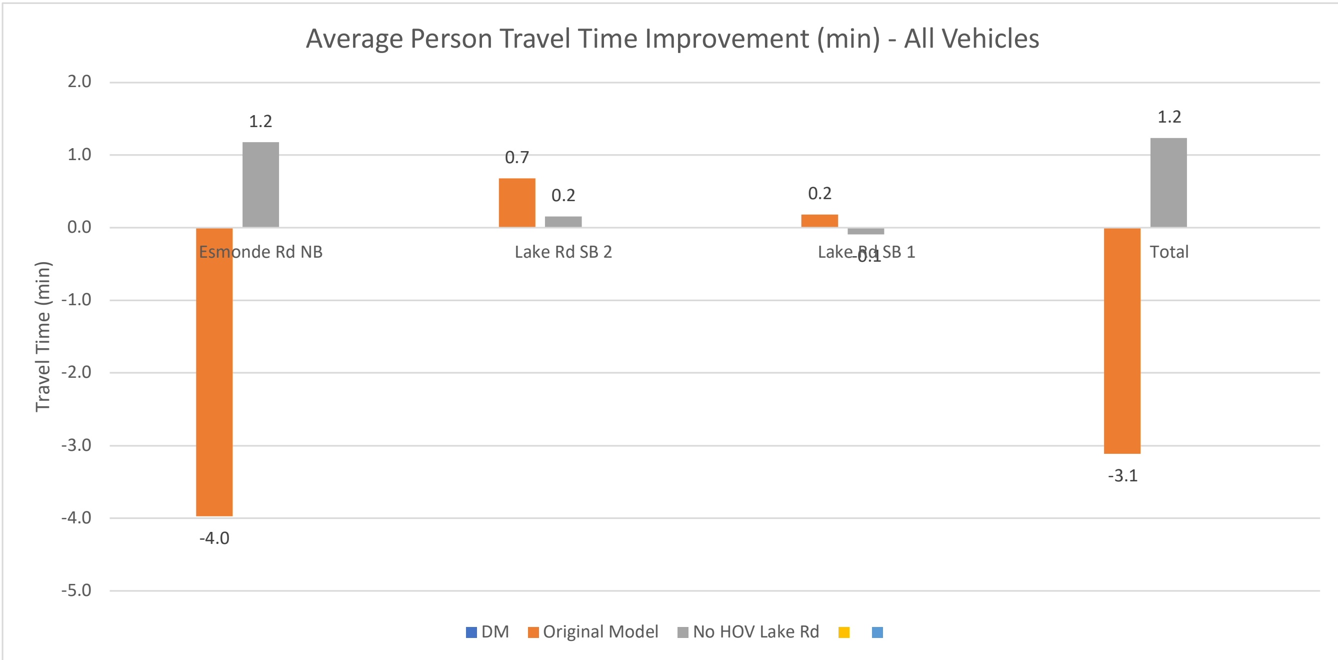
	Esmonde F	Lake Rd SE	Lake Rd SE	Total	
DM	0.0	0.0	0.0	0.0	0
Original Model	-7.5	0.7	0.2	-6.6	20.1
No HOV Lake R	1.6	0.1	-0.3	1.4	12.2





Overall Weighted Person Travel Time Improvement

	Esmonde F	Lake Rd SE	Lake Rd SE	Total
DM	0.0	0.0	0.0	0.0
Original Model	-4.0	0.7	0.2	-3.1
No HOV Lake R	1.2	0.2	-0.1	1.2



These tables summarise the change in VKT and Emmissions between the Do Minimum and the Preferred Option
The emissions are for the modelled periods of AM and PM peak only.
To calculate a yearly amount the following approximations have been made:

- Off peak has negligible change in VKT / Emissions
- Model represents an average work weekday
- There are approximately 250 working days in a calendar year

OUTPUT

Sheet	Year	Period	Scenario	Veh Class	VKT	CO tonne	CO2 tonne	VOC tonne	NOx tonne	NO2 tonne	PM2.5 Eg tonne	PM10 B&T tonne	FC 1000 Litre
2028_LCV	2028	AM	DM	LCV	94,475	0.0895	19.1877	0.0076	0.0377	0.0096	0.0008	0.0016	8.03
2028_HCV	2028	AM	DM	HCV	5,477	0.0029	2.4075	0.0003	0.0094	0.0010	0.0003	0.0002	0.90
DM AM Total					**99,952**	**0.0924**	**21.5951**	**0.0079**	**0.0472**	**0.0107**	**0.0011**	**0.0018**	**8.92**
2028_LCV	2028	PM	DM	LCV	110,729	0.1005	22.5343	0.0095	0.0420	0.0107	0.0009	0.0022	9.43
2028_HCV	2028	PM	DM	HCV	5,888	0.0042	3.6440	0.0004	0.0135	0.0015	0.0004	0.0004	1.36
DM PM Total					**116,617**	**0.1047**	**26.1783**	**0.0100**	**0.0555**	**0.0122**	**0.0013**	**0.0026**	**10.79**
AM + PM Total					**216,569**	**0.1971**	**47.7735**	**0.0178**	**0.1027**	**0.0229**	**0.0024**	**0.0044**	**19.7131**

2028_LCV	2028	AM	Option	LCV	90,632	0.0848	18.2199	0.0072	0.0360	0.0092	0.0008	0.0015	7.62
2028_HCV	2028	AM	Option	HCV	5,560	0.0029	2.4081	0.0003	0.0092	0.0010	0.0003	0.0002	0.90
OP AM Total					**96,193**	**0.0877**	**20.6280**	**0.0075**	**0.0452**	**0.0102**	**0.0011**	**0.0017**	**8.52**
2028_LCV	2028	PM	Option	LCV	105,143	0.0898	20.3177	0.0082	0.0392	0.0099	0.0008	0.0019	8.50
2028_HCV	2028	PM	Option	HCV	5,898	0.0039	3.3964	0.0004	0.0116	0.0013	0.0004	0.0003	1.27
OP PM Total					**111,041**	**0.0937**	**23.7140**	**0.0086**	**0.0507**	**0.0112**	**0.0012**	**0.0023**	**9.77**
AM + PM Total					**207,234**	**0.1814**	**44.3420**	**0.0161**	**0.0959**	**0.0213**	**0.0022**	**0.0040**	**18.2908**
%age change in AM+PM peak totals					**4.3**	**8.0**	**7.2**	**10.0**	**6.6**	**6.6**	**6.5**	**9.4**	**7.2**

5%	AM Demand Reduction Assumption
5%	PM Demand Reduction Assumption

Difference	VKT	CO tonne	CO2 tonne	VOC tonne	NOx tonne	NO2 tonne	PM2.5 Eg tonne	PM10 B&T tonne	FC 1000 Litre
AM	- 3,759	0.00	-0.97	0.00	0.00	0.00	0.00	0.00	-0.40
PM	- 5,576	-0.01	-2.46	0.00	0.00	0.00	0.00	0.00	-1.02
Daily	- 9,335	-0.02	-3.43	0.00	-0.01	0.00	0.00	0.00	-1.42
Yearly	- 2,333,805	-3.94	-857.86	-0.44	-1.69	-0.38	-0.04	-0.10	-355.58

Appendix J: Preliminary Environmental Assessment

Beca

Lake Road Environmental Risk Assessment

Final Report

Prepared for Auckland Transport (AT)
Prepared by Beca Limited (Beca)

4 September 2020

Creative people together transforming our world

Contents

Figures

Revision History

Revision Nº	Prepared By	Description	Date
1	Karien Killian, Ecologist	Draft	3 July 2020
2	Karien Killian, Ecologist	Final	4 September 2020

Document Acceptance

Action	Name	Signed	Date
Prepared by	**Karien Killian**		3 July 2020
Reviewed by	**Sam Turner**		3 July 2020
Approved by			
on behalf of	Beca Limited		

1 Introduction

Lake Road is the only arterial road in and out of the Devonport peninsula and, alongside Esmonde Road, serves as the main connection to State Highway 1 (SH1) and the rest of Auckland for people living and working in the area. As a result, traffic conditions along Lake Road during peak times can be quite unpredictable.

This proposed Lake Road Improvement project aims to improve the accessibility, reliability, and availability of travel choices to and from the Devonport peninsula by maximising the use of existing infrastructure and services. The project proposes to do this by using a mix of re-purposed and new transit lanes for higher occupancy vehicles and buses, as well as improved walking and cycling facilities.

Some of the key benefits of this project would be as follows:

- Increase the number of people able to move through the corridor.
- Improve access to local destinations.
- Improve the reliability of trip times.
- Improve access to alternative transport options, including public transport, walking and cycling.
- Encourage more use of higher occupancy vehicles and buses.
- Provide dedicated, safe cycling and walking facilities, as well as improving connections to the parallel “green ways”.
- Relieve pressure on the network through travel-planning measures.

2 Methods

The purpose of this report is to identify possible environmental risks associated with the Lake Road Improvements and to inform the detailed business case. In general, effects from construction have not been considered.

A draft desktop review of existing and available information was completed including the Auckland Unitary Plan – Operative in Part (AUP-OP), Auckland Council Geomaps, and available online information.

No site visit was undertaken as part of this assessment.

The main environmental issues are likely to be associated with:

- Minor road widening which may impact the root zones of trees in the road reserve.
- Increase in impermeable surfaces which may cause an increase in stormwater runoff.
- Minor reduction in traffic volumes may have a positive impact on air quality and noise.

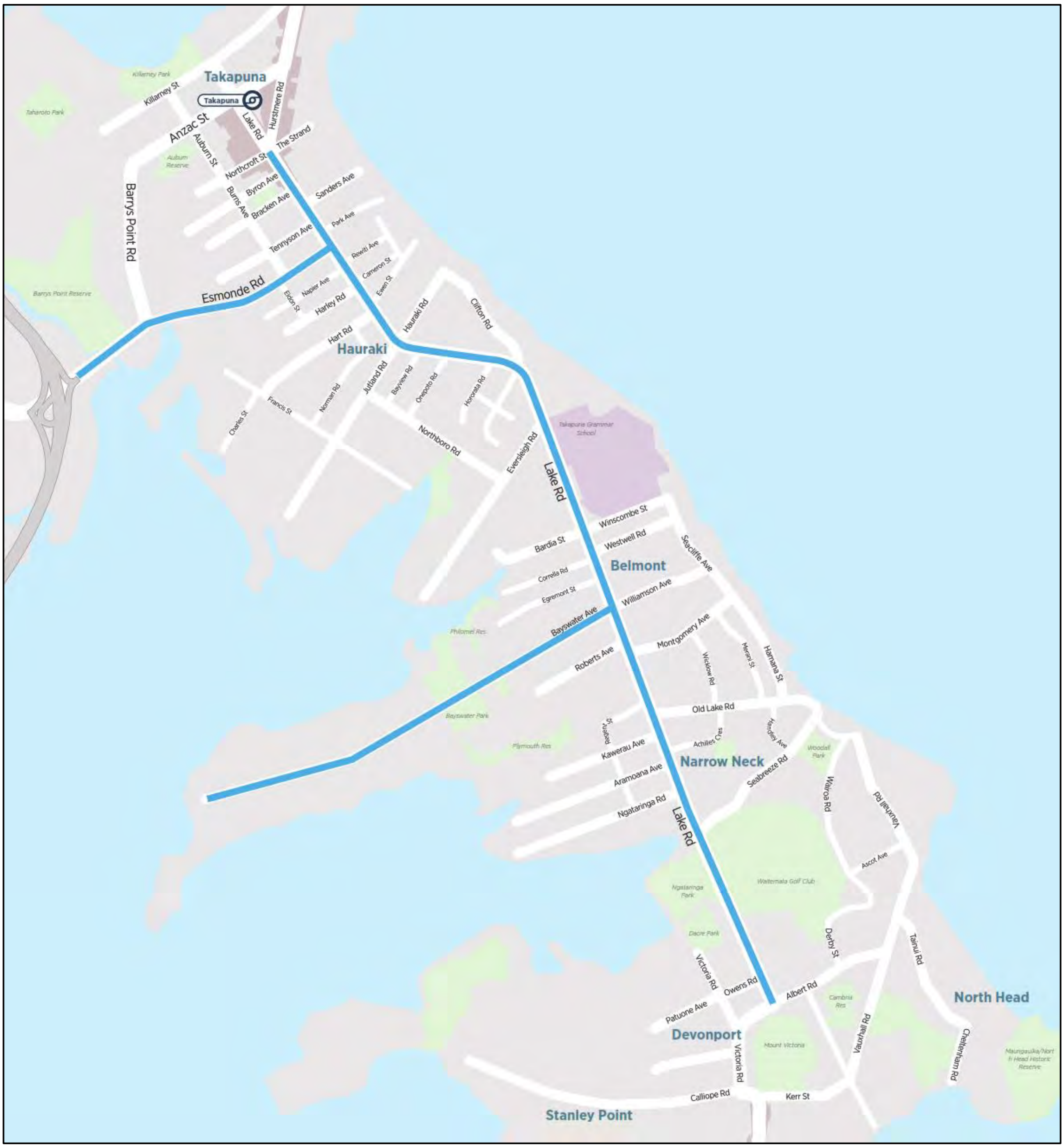


Figure 1: Lake Road Improvements area map.

3 Environmental Risks

3.1 Lake Road between Esmonde Road and Jutland Road

No realignment of the road is proposed between Esmonde Road and Jutland Road. The existing alignment will be relocated within the existing corridor to include a northbound dedicated transit lane.

The effects on the environment in this section are likely to be minimal, therefore this section is considered very low risk.

3.2 Lake Road between Jutland Road and Hororata Road

The existing northbound footpath will be reallocated as a cycleway and a new footpath will be constructed resulting in minor widening of the existing northbound carriageway.

The works will likely extend into the root zones of three trees along this section (Figure 2 and Figure 3), potentially resulting in damage to them. The Puriri (Figure 3) on the corner of Lake Road and Onepoto Road is a Notable Tree identified in the AUP-OP. The risks associated with works in the root zones are severed roots, soil compaction, and stress to the trees caused by drainage changes. This type of damage can cause root dieback, loss of structural stability of the tree, and tree mortality and/or uprooting. Due to the potential effects to the Puriri tree, the risk associated with the final design in this location is moderate.

Work in tree driplines (or root zones) should be avoided where possible. If it cannot be avoided, risks might be mitigated, for example, by using best practice construction techniques and/or using a pervious paving surfaces over root zones of affected trees. Note: All works in root zones of trees in the road reserve, are subject to provisions in in the AUP-OP.

The works will result in a small increase in impermeable surface. The change in effects on the overall runoff and quality are likely to be very minimal (if any) from the existing situation. This aspect is considered low risk.

Overall there is potential effect to the notable Puriri Tree, although this might be able to be minimised with the appropriate management or controls. Based on this, the risk associated with the upgrade of this section of Lake Road is considered moderate to low.

Figure 2: Two of the three trees that may be affected by the works.

Figure 3: Puriri tree, a Notable Tree potentially affected by the works.

3.3 Lake Road between Hororata Road and Egremont Road

From Hororata Road to just past Northumberland Road, the northbound lane will be widened and one of the lanes will be repurposed into a transit lane. The works will extend into the root zones of three trees along this section, one of them being a pōhutukawa tree, potentially causing damage to the root zones.

The environmental risks associated with works in the root zones are severed roots, soil compaction, and stress to the trees caused by drainage changes which may ultimately cause root dieback, loss of structural stability of the tree, and tree mortality and/or uprooting. There are potential effects associated with works around the root zone of these trees, which are all located within the road reserve. However, none are notable and the pōhutukawa appears to be the only (significant) native tree, overall the risk is considered low.

Work in tree driplines (or root zones) should be avoided where possible. If it cannot be avoided, effects on the tree can be mitigated, for example, by installing a pervious surface around the base of the affected tree. Note: All works in root zones of trees in the road reserve, are subject to provisions in in the AUP-OP.

No further road widening is proposed beyond Northumberland to Egremont Road.

Figure 4: The root zones of these three trees may potentially be affected by the works.

Figure 5: The pōhutukawa tree, potentially affected by the works.

3.4 Bayswater Avenue

A section of Bayswater Avenue in the vicinity of Bayswater Primary School will be widened to provide improved facilities for pedestrians and cyclists, affecting a row of trees along the westbound carriageway. Works will extend into the root zones of these trees, potentially causing damage to the trees that could result in mortality and uprooting. None of these trees have been designated as notable but given their distinctiveness and location next to a park are likely to be valued by the community. The space required for construction may increase effects. There may be opportunities through design and construction to minimise the impact on the trees i.e. pervious pavement, or a pervious surface over any affected root zones.

The works will result in a small increase in impermeable surface. The change in effects on the overall runoff and quality are likely to be very minimal (if any) from the existing situation. This aspect is considered low risk.

The effects on the environment in this section are likely to be minor, therefore this section is considered low risk.

Figure 6: Trees along Bayswater Avenue that may be affected by the works.

3.5 Lake Road between Roberts Avenue and Old Lake Road

No realignment of the road is proposed between Roberts Avenue and Old Lake Road. The existing alignment will be reallocated to include a cycleway across its length.

The effects on the environment in this section are likely to be minimal, therefore this section is considered very low risk.

3.6 Lake Road between Old Lake Road and Seabreeze Road

No realignment of the road is proposed between Old Lake Road and Seabreeze Road. It should be noted that the area adjacent to the northbound lane, between Hanlon Crescent and Seabreeze Road is a Significant Ecological Area (SEA) as well as within the indicative coastline. Should works extend into these areas or construction impacts be significant, there may be greater risk of effects.

The effects on the environment in this section are likely to be minimal, therefore (based on the permanent design) this section is considered low risk.

3.7 Lake Road between Seabreeze Road and Ariho Terrace

The northbound footpath will be widened by approximately 350mm along 320m of its length. The existing carriageway will be reallocated to include a cycleway.

At the start of the road widening, at the Seabreeze and Lake Road intersection, there is a risk that the root zone of a Pohutukawa tree located within the SEA will be impacted. The tree is within 10m of the estuary, and therefore protected under the AUP-OP. Depending on the extent of the works around the tree and the approach to construction, this may present a planning risk. Due to the potential impact to the tree, the risk associated with the final design in this location is moderate. There may need to be some consideration of the impact of construction on the SEA, particularly from erosion and sediment.

There is a large box culvert at the Seabreeze/ Lake Road intersection, there are no changes proposed to the culvert itself.

The rest of the section of Lake Road, also known as Memorial Drive, contains a row of planted Pohutukawa trees along the western side and Norfolk Pines on the east. This group of trees are listed as notable in the AUP-OP. There is a low risk that the root zones of these trees will be affected by the works, because the widening is limited to a narrow strip (350mm) on the eastern side. It is likely that with best practice construction techniques minimal damage would occur and the overall all effects considered minor.

Works in this area are considered to have moderate to low effects on the environment, and the overall risk should be considered moderate to low. However, it should be noted the group of notable trees along the Memorial Drive corridor are part of the War Memorial commemorating men from Devonport who Died in the Second World War, and there may be heritage impactions (these are not addressed by this report).

3.8 Lake Road between Ariho Terrace and Albert Road

No major realignment of the road is proposed between Ariho Terrace Road and Albert Road. The existing alignment will be reallocated to include a southbound cycleway.

The effects on the environment in this section are likely to be minimal, therefore this section is considered very low risk.

3.9 Project wide Considerations

The road improvements are anticipated to result in an increase in pedestrians and cyclists, more efficient use of buses, and a decrease in single occupancy car use, ultimately resulting in a slight reduction in traffic on the road.

By reducing the number of cars on the road, exhaust emissions will potentially see a slight decrease, which may result in localised improvements to air quality although the distribution of any effects is not considered to have materially changed. With a change in traffic patterns there is potential for there to be a slight (potentially imperceptible) change in noise profile for some properties, but overall the alignment does not significantly deviate from the existing corridor. There should be no change in noise receptors along the road.

Environmental effects associated with noise and air quality, are considered neutral, and risk is considered low.

4 Conclusions and Recommendations

Overall, as the proposed changes are largely within the existing road corridor the environmental effects from the proposed works is generally considered to be minor, and potentially managed through detailed design and construction planning.

The areas where there may be some risk are where sections of road are widened and impact on the root zones of some of the larger trees along the alignment. Of particular note is the Puriri on the corner of Lake Road and Onepoto Road. It is anticipated that effects on most tree roots could be minimised with good practice construction techniques and potentially enhanced with pervious paving or pervious concrete at these locations.

There is a low risk that an increase in impervious surfaces would have an effect on stormwater runoff. Similarly, changes in traffic volumes are unlikely to present a significant change in noise levels or air quality and should be considered low risk.

Appendix K: Design Philosophy Statement

Lake Road Detailed Business Case – Design Philosophy Statement

Prepared for Auckland Transport
Prepared by Beca Limited

04 September 2020

Creative people together transforming our world

Revision History

Revision Nº	Prepared By	Description	Date
A	Sam Twyman / Dan Jackson	FINAL ISSUE	4 September 2020

Document Acceptance

Action	Name	Signed	Date
Prepared by	Sam Twyman		4 September 2020
Reviewed by	Dan Jackson		4 September 2020
Approved by	Andy Lightowler		4 September 2020
on behalf of	Beca Limited		

Contents

1 Introduction

1.1 Background

Auckland Transport (AT) has commissioned Beca Limited (Beca) to undertake a Detailed Business Case (DBC) and supporting Preliminary Design for the Lake Road project (the Project).

Lake Road is the only arterial road in and out of the Devonport peninsula and, alongside Esmonde Road, serves as the main connection to the rest of the North Shore and Auckland for people living and working in the area. Around half of all Lake Road journeys are short trips, that stay within the peninsula. A high proportion of trips are made in single-occupancy vehicles.

This detailed business case outlines the case for investing in improvements to Lake Road, Esmonde Road (which provides a critical transport link between Lake Road and State Highway 1 (SH1) and Bayswater Avenue (which connects Lake Road to Bayswater Ferry terminal).

The overarching goal of the project is to improve customer experience and the movement of high numbers of people, whilst offering attractive transport alternatives to single-occupancy private car use. Despite the emphasis of this project on the improved bus, cycle and pedestrian facilities and infrastructure, a level of private vehicle access and circulation must also be maintained. The project has the following objectives:

- Improve transport infrastructure to support demand and future growth by reducing overall people travel time on the corridor
- Improve people throughput by prioritising high occupancy and healthier/active transport modes
- Improve the attractiveness of high occupancy and healthier transport modes by increasing their mode share
- Improve community satisfaction with transport infrastructure by reducing delays and increasing modal share for high occupancy modes of transport and healthier transport modes.

1.2 Purpose

The purpose of this report is to provide the design philosophy for each design discipline for the Lake Road DBC preliminary design. Furthermore, this report will outline key constraints, assumptions and provide further considerations which will need to be considered at the next design stage.

1.3 Project Scope

1.3.1 Preliminary Design

The project scope includes the preliminary design of the following:

- Geometric and layout design of revised lane arrangements, shared paths, footpaths, cycleways, bus stops and intersections;
- Line marking design;
- Consideration of the impacts of this preliminary design on stormwater, utilities and pavement throughout the project scope;
- Responses to internal and external consultation;
- Preparation of preliminary design drawings; and
- Responses to Stage 3 Road Safety Audit (deferred until Detailed Design).

1.3.2 Topographical Data

A full topographical survey for Lake Road and Bayswater Avenue has been completed by Beca, dated April 2020, extending road corridor boundary to boundary to a minimum 50mm accuracy (detailed design standard). The survey measured kerb lines (edge of seal / bottom / top and back of kerb), road centrelines, road markings footpath alignments, street furniture and utility service provider furniture.

A topographical survey has not yet been completed for Esmonde Road. Topographical survey information was not procured for this length of the corridor on the basis that As-Built information for the recent works on Esmonde Road would be provided. Therefore, it is recommended that this survey is completed as part of the detailed design to maintain a consistent level of accuracy across the project corridor.

1.3.3 Geotechnical

No geotechnical investigations or design has been completed as part of this preliminary design. It is anticipated that this will be competed to inform the detailed design scope.

2 Project Overview and Key Design Elements

2.1 Project Extents

The Lake Road Preliminary Design is split in three interconnected sections:

- Esmonde Road: From the intersection with SH1 Southbound On-Ramp, East to the intersection with Lake Road;
- Lake Road: From the intersection with Esmonde Road, South to the intersection with Albert Road; and
- Bayswater Avenue: From the intersection with Lake Road, West to the roundabout with Marine Terrace, Sir Peter Blake Parade and Beresford Street.

Figure 2-1: Lake Road Preliminary Design Project Extent

2.2 Key Constraints

The following key constraints have been identified:

- Existing road corridor alignment and road furniture.
- Constrained urban environment (existing trees and parking) – limited existing cross-sectional width
- Existing features such as mature trees – impacting upon sight lines.
- Local businesses and residents – being affected or concerned about the works.
- Loss of car parking – resulting from realigned road geometry and inclusion of a cycle lane facility.
- Minimal existing stormwater reticulation – based on limited existing underground stormwater provision
- Larger vehicle requirements – key design vehicle for the arterial roads, sight distances, minimum curve radii etc.
- Existing below and above ground services.

2.3 Key Design Elements

The preliminary design has been based on the schematic design, presented in the Beca IBC dated June 2017. The three interconnected sections have the following broad key design elements.

2.3.1 Esmonde Road

- Single uni-directional raise cycle facilities separated from the existing footpath through transitional height kerbing.
- Installation of a transit and priority bus lane.
- Reconfiguration of traffic lane widths, raised medians, critical intersections and bus stops.

2.3.2 Lake Road

- Single uni-directional raise cycle facilities separated from the existing footpath through transitional height kerbing.
- Installation of transit and priority bus lanes from Clifton Road North.
- Reconfiguration of traffic lane widths, medians, critical intersections and bus stops.
- Realignment of kerbing where minimum allowable widths cannot be achieved within the existing road corridor.
- Side street raised tables.

2.3.3 Bayswater Avenue

- Bi-directional cycleway facility at the existing road level, split using 600mm raised precast cycleway separators.
- Reconfiguration of traffic lane widths, medians, traffic calming devices and bus stops.
- Realignment of kerbing where minimum allowable widths cannot be achieved within the existing road corridor.
- Side street raised tables.

3 Civil Design

3.1 Layout and Geometric Design

3.1.1 Design Overview

The aim of the layout and geometric design is to achieve the key design elements outlined in Section 2.3, achieving the preferred design criteria outlined in Table 1 where possible, whilst minimising the departures from the existing layout configuration. This includes minimising the proposed widening, minimising reconfigurations of intersections and any constructability disruptions.

3.1.2 Design Standards

The primary design standards, codes, manuals and other documents that are relevant to the civil works design of this project are listed below.

The following design standards form the basis for the design of the geometric elements:

- Austroads Guide to Road Design Part 3: Geometric Design;
- Austroads Guide to Road Design Part 6A: Pedestrian and Cyclist Paths;
- Auckland Transport Code of Practice (ATCOP), 2013; and
- Auckland Transport - Transport Design Manual (TDM), February 2020.

3.1.3 Cross-Sections

Cross-Sections have been provided within the preliminary design drawings for every approximately 300-400 m section of the project extent. These cross sections form the basis of design and include relevant information on any departure from standards, where necessary. Table 1 provides the civil design criteria and relevant standard reference for each element of the preliminary design.

Table 3-1: Design Criteria

Item	Elements	Design Criteria	Standard Reference
Lane Widths	Arterial (on a bus route) Arterial (non-bus route) Collector Local	3.5m preferred 3.2m preferred (3.0m min) 3.2m preferred (3.0m min) Min 3.0m preferred (2.7m min)	TDM – Road Layout and Geometric Design Section 7.4, Table 16
Cycle Lanes	Kerbside cycle lanes	2.0m preferred (1.5m min)	TDM – Cycling Infrastructure Section 13.1, 13.2 and 13.3
	Cycle lanes between other lanes	2.0m preferred (1.5m min)	
	Bi-directional contra-flow cycle lanes	2.0 m preferred (1.5m min)	
	Cycle lane Buffer (without parking) Buffer (next to parking)	2.0m preferred (1.5m min) 0.6m preferred (0.4m min) 1.0m preferred (0.6m min with bollards)	

Item	Elements	Design Criteria	Standard Reference
	Cycle lanes width Separator width (without parking) Separator width (next to parking)	2.0m preferred (1.5m min) 0.6m preferred (0.4m min) 1.0m preferred (0.6m min)	TDM – Cycling Infrastructure and Section 13.2
Roadway Lane Widths	Wide kerbside lanes (without parking) Wide kerbside lanes (with parking allowed at some)	4.2m to 5.0m 4.2m to 5.0m	TDM – Cycling Infrastructure Section 13.2
Bus and Transit Lanes	Lane Widths	4.2 m preferred (3.2m min)	TDM – Cycling Infrastructure Section 13.2
Medians	Arterial flush median width Raised Median	3.0 desirable (2.5m min) 0.5m for buffer separation 1.0m to 2.5m	TDM – Road Layout and Geometric Design Section 7.4
Vehicle Crossings	Driveway design	TDM – Traffic Calming Devices/LATM – Section 8	
Parking	0° (Parallel Parking) Width Depth of parking space (from wall) Depth of parking space (from kerb)	6m 2.1m 2.1m	TDM – Parking Design Section 11
Local Area Traffic Management	Raise tables and speed tables	TDM – Traffic Calming Devices/LATM – Section 8	
Bus Stops	In line bus stopping facility	ATCOP Chapter 20: Public Transport – Buses	

3.1.4 Design Vehicles

The design vehicle for intersection turning movements shall be designated vehicles defined in the Urban and Rural Roadway Design - Section 4.2 of the TDM. The design and check vehicles have been selected based on road classification as defined in the TDM.

The proposed horizontal and vertical alignment has been matched to the existing road horizontal and vertical geometry. Further considerations at detailed design is expected to confirm if the crown of the existing road profile needs reshaping to align with the new cycleway facility, reconfigured intersections and re-alignment of the median.

3.1.5 Corridor Widening

In order to maintain compliant cycleway widths, lane widths and clearances in accordance with the standards listed in Table 1, the following locations have been identified as requiring widening:

- Chainage 400 to 650: Jutland Road/Lake Road Intersection.
- Chainage 650 to 1350: Lake Road from Jutland Road to Northumberland Avenue.
- Chainage 3500 to 3600: Lake Road Seabreeze Intersection South.
- Chainage 4200: Lake Road Allenby Avenue.
- Chainage 1800 to 2000: Bayswater Avenue Lake Road Intersection.

These areas have been shown within the drawing set attached.

3.1.6 Intersections

The configurations for all major intersection layouts as shown in this preliminary design have been changed to align with the schematic design outlined in the IBC. Auckland Transport TDM indicates specific design vehicles to use for swept analysis based on road classification. The road classification at each intersection will be reviewed and the appropriate design vehicle swept paths and 0.5m clearances (vehicle wheel track clearance to the kerb line) applied to determine the correct intersection size and kerb locations.

3.2 Traffic Signage and Marking

3.2.1 Design Overview

The road marking and traffic signage design will be developed to provide clarity as to which road users have priority, as well as providing clear direction as to how various road users should move through the revised road environment. Care will be taken to combine any new signage on existing street furniture and to move it out of the pedestrian and cyclist desire line to reduce street clutter. Signage design will include regulatory signs and permanent warning signs.

The scope of Active Mode Transport signage will need to be agreed with AT.

3.2.2 Design Standards

- Auckland Transport - Transport Design Manual (TDM), Version 1, 2020;
- Auckland Transport Code of Practice (ATCOP), 2013 (Draft);
- Manual of Traffic Signs and Markings (MOTSAM) – Part 1: Traffic Signs, 2010;
- Manual of Traffic Signs and Markings (MOTSAM) – Part 2: Road Markings, 2010;
- NZTA Traffic Devices Control Devices Manual (TCD); and
- NZTA P/24: Specification for Permanent Traffic Signs, 2020
- NZTA P/30: Specification for High Performance Road marking,2009

3.3 Stormwater Drainage

3.3.1 Design Overview

As part of this preliminary design, consideration has been given to the location of existing stomwater infrastructure, whilst no formal design activities have been undertaken. The aim of the stormwater design will be to retain existing overland flow paths and to minimise any adverse effects created by the works by repositioning catchpits and connections to existing stormwater manholes where possible.

In some areas along the extent of work there is limited existing underground ground drainage, therefore, the use of ACO channel slab drains or similar approved, should be considered as the next practical solution used to address stormwater reticulation during detailed design.

The design philosophy and further actions for the stormwater design at detailed design are outlined below:

- Minimising the effects of stormwater discharges on the downstream receiving environment (in accordance with the Auckland Regional Plan: Air, Land and Water);
- Efficient stormwater drainage of the separated cycleway, kerb built-outs, speed tables and modified intersections for the safety and convenience of all road users (vehicles, cyclists and pedestrians);
- Existing overland flows are maintained or in the event that their effects are made worse by the new works, that new controls are introduced mitigate these effects; and
- No adverse effects are created by the works (i.e. no worsening of flooding)

3.3.2 Design Standards

The primary design standards, codes, manuals and other documents that are/will be relevant to the stormwater design associated with Lake Road DBC project are listed below.

The primary design references that will be used include the following:

- Auckland Transport - Transport Design Manual (TDM) – Road Drainage, 2020;
- AUSTROADS - Guide to Road Design, Part 5A, 2009; and
- Auckland Unitary Plan: Operative in Part (AUP OP)*

3.4 Pavement Design

3.4.1 Design Overview

As part of this preliminary design, consideration has been given to the existing pavement surfacing only, whilst no formal design activities have been undertaken. This comprised of visual identification and costing for replacement, up to 70% of the current paved area.

The design philosophy and further actions for the pavement design at detailed design are outlined below:

- Minimise the required pavement resurfacing/reconstruction from a cost, quality, constructability, public disruption and sustainability perspective.
- Site investigations (test-pits) will likely be required during the design to confirm the existing pavement depth and ground conditions. This information will be used to develop the pavement design adjacent proposed new infrastructure.
- Resurfacing and/or rehabilitation design of pavement in areas where civil works relating to kerb buildouts, speed tables, stormwater and utility diversions will be required.

- Cycleway pavement and surfacing design.
- Where a raised table and kerb buildouts are required at intersections, pavement design will include resurfacing and/or rehabilitation of existing pavement to achieve a desired design life.

3.4.2 Design Standards

The primary design standards, codes, manuals and other documents that are/will be relevant to the pavement design associated with Lake Road DBC project are listed below.

- Austroads Guide to Pavement Technology – Part 2: Pavement Structural Design;
- Auckland Transport Code of Practice (ATCOP) – Part 16: Road Pavements and Surfacings; and
- NZTA Specifications (relevant to pavement and surfacing design and construction).

3.5 Utilities

3.5.1 Design Overview

As part of the preliminary design, existing utility information was compiled from topographical survey, Auckland Council Geomaps and 'Before you Dig' requests to supplement the proposed design. General design philosophy for utilities is to leave existing utilities in place unless the works decrease the existing cover / spacing requirements beyond the utility providers minimum requirements.

The design philosophy and further actions for the pavement design at detailed design are outlined below:

- All utilities locations are to be confirmed. In particular those which conflict with the proposed cycleway facility. Where conflicts occur and raising cannot be achieved, relocation will need to be discussed between the utility owner, Auckland Transport and any other relevant key stakeholders.
- Service trench investigation will be selected where considered areas of interest in the proposed design (such as new stormwater manholes/ catchpits, power pole and lighting pole relocation).
- Existing buried utility services will be isolated, protected, or diverted into common trenches along the extent of works.
- Where the utility is required to be relocated, consultation and coordination will be carried out with the utility owner.
- Utility operators will advise on minimum cover where their service is located in the carriageway, shared path or berm.
- Where possible the minimum cover will be retained. However, where the minimum cover cannot be met, and there is no other reason to divert the service, a concrete slab will be constructed above the utility to provide additional physical protection. This is a standard requirement of utility providers where the minimum cover is not available. For those services which are to be diverted, minimum cover will be maintained within the service trenches.
- All services will be 100% contained and made accessible for maintenance purposes.

The design team have been provided with historic utility information provided through the previous design stage. This information will be refreshed with new 'Before U Dig' information from the utility operators. Using the historic information, the project may impact on the following utilities:

- Watercare (Watermain and Wastewater Assets)
- Auckland Council Network (Stormwater network)
- Vector Gas

- Vector Electricity
- Transpower (Trunk Power and Fibre Optics)
- Vector Communications (Fibre Optics)
- Chorus (Telecommunications)
- Vodafone (Telecommunications)

The full impact of the proposed works on these existing utilities is yet to be determined and will require confirmation as part of the detailed design.

4 Design Departures

In certain circumstances where it is not possible to apply the preferred standard then the minimum standard will be applied and approved through a departure from standards process. Instances where a departure approval are required is outlined in the Urban and Rural Roadway Design and Cycling Infrastructure sections of the TDM. Required departures will be discussed and agreed with the relevant disciplines within Auckland Transport during Detailed Design.

5 Risks and Opportunities

Key Risks

- Incompleteness and inaccuracy of topographical survey. Esmonde Road requires topographical survey to ensure consistency with the rest of the project corridor;
- Stormwater capacity and reconfiguration of the network across the corridor;
- Geometrics compliances of the proposed design whilst maintaining budgeting thresholds;
- Constructability whilst maintaining daytime continuous lane operations; and
- Protracted process in obtaining agreements and consenting for the works.

Key Opportunities

- Subsidising portions or review cost share agreements of this capital project with maintenance capital expenditure budget. Examples being replacing long extents of existing poor condition kerbing, road surface replacement;
- Rationalisation and consolidation of bus stops and provision of associated pedestrian crossing facilities; and
- Opportunity to further enhance the streetscape and public amenity by undergrounding sections of the existing overhead power lines along the extent of works.

6 Further Considerations

As part of the next phase of design, the following further considerations are recommended:

- Stormwater drainage along the length of the project corridor. In particular the following elements:
    - Consideration of the road capacity due to the introduction of a half-height Type 3 kerb.

  - Slot drains along Lake Road from the intersection with Esmonde Road to the intersection with Jutland Road.
  - Reconfiguration of the road corridor and intersections with respect to location and capacity of catch pits and leads.
- The proposed configuration of the intersection of Lake Road and Clifton Terrace with respect to closing an existing entry lane and facilitating a shared path scheme. Furthermore, a requirement for land acquisition at south of Northumberland Road may be required, this is currently due to the constrained area by retaining walls on both sides of the road;
- Radius and lane widths for buses around the curve at chainage 1200 to 1300. Tracking and optimisation will be required to confirm that there is no sight distance or wide swing problems;
- All side streets to be re-evaluated to assess whether side streets can be narrowed, which may enable cyclists to be pulled onto the raised tables; and
- The adequate termination of the bi-direction contraflow cycleway at the end of Bayswater Avenue.

Appendix L: Economic Evaluation

Technical Note

Regarding: Lake Road Corridor Improvements Detailed Business Case Monetarised Benefits

Prepared by: Caleb Deverell/Olivia Maxwell

Date: 3 September 2020

1 Monetarised Benefits Evaluation Framework

1.1 Methodology Overview

This economic evaluation of the Lake Road Improvements project (the project) has been undertaken in accordance with both the NZ Transport Agency Waka Kotahi's Economic Evaluation Manual (EEM, 2019 Update) and with Waka Kotahi's new Investment Decision Making Framework (IDMF, 2020 First Release) as summarised in the table below. A summary of benefits accrued under each approach, and the resultant BCRs, is given in section 3.

	Benefit / disbenefit Component
Pedestrians	Amenity benefits
Cyclists	Crash cost savings
Cyclists	Health benefits for cycling facilities
Vehicles/Buses	Travel time savings / loss
Vehicles/Buses	Vehicle operating cost savings
Vehicles/Buses	Reliability improvement benefits

1.2 The Project being Evaluated

The main elements of the project for which benefits arise are:

- Protected cycle lane on Lake Road between Esmonde Road and Albert Road
- Transit lanes in the northbound direction from Old Lake Road to Esmonde Road and from to Roberts Avenue to Bayswater Avenue
- Protected cycle lane facilities on Bayswater Avenue between Lake Road and Beresford Street
- The existing westbound bus lane on Esmonde Road converted to a Transit Lane
- A new transit lane provided on the SH1 southbound on-ramp (utilising one of the existing two traffic lanes)
- Undergrounding of power lines to improve the useable footpath width on east side of Lake Road between Hauraki Road and Belmont shops.
- Intersection improvements on Lake Road, contributing to crash savings

The preferred project option has been evaluated against a Do-Minimum scenario. This is defined as the on-going maintenance and renewal activity which will occur in the project corridor to maintain the current level of service, over the evaluation period of the project (i.e. assuming no major investment).

1.3 Evaluation Assumptions

The general economic assumptions are:

- Base Date: 1st July 2019

- Time Zero: 1st July 2020
- End of Construction / Facility Opening: 1st July 2023
- Analysis Period: 40 years with a 6% discount rate (EEM); 60 years with a 4% discount rate (IDMF)
- Traffic growth rate: 1% per annum over a 30-year period (capped between year 30 and 40).

The benefit update factors used within the EEM evaluation approach are as follows.

Benefit	Base date	Update factor
Crash cost savings	July 2015	1.09
Benefits for walking and cycling facilities	July 2008	1.24
Travel time cost savings	July 2002	1.54
Vehicle operating cost savings	July 2015	1.10

Further assumptions are described below.

1.3.1 Crash reduction assumptions

The crash data used within this evaluation were obtained via the use of the Waka Kotahi-managed Crash Analysis System (CAS). Data was obtained for a five-year period between 2014 and 2018.

All cyclist-related crashes that occurred along the length of the proposed cycle lane improvements on Lake Road, Bayswater Avenue and Esmonde Road were included in the evaluation. There were no applicable DSIs recorded for pedestrians in the five-year data period, so crash savings for pedestrians have not been considered.

Assumption	Value selected	Justification
Crash reduction factor (CRF) for cyclists	20%	As all proposed cycle lane facilities are greater than 1.4m in width, the treatment pertaining to ‘on-road cycle lanes – Wide’ from Waka Kotahi’s Crash Estimation Compendium was applied.
Annual Do-Minimum Cycle Crash Costs	$1.46M	Calculated using EEM SP11-6, for 7 serious, 23 minor and 3 non-injury crashes recorded in CAS between 2014 and 2018

1.3.2 Cyclist related assumptions

Assumption	Value selected	Justification
Lake Road		
Existing cyclist AADT	600 cyclists/day	AT analysis of demand undertaken in 2020
Cyclist growth rate	1.2% (per annum)	In accordance with the Gap Analysis and Evidence Base Report conducted by Beca for the IBC. This identified a 35% growth over a 30-year period.
Increase in cyclist demand due to Northern Pathway and Increased Use of E-Bikes		
Increase of 300 cyclists/day assumed due to opening of Northern Pathway A further increase in demand of 20% due to the increasing use of E-Bikes		300/days is based on an assumed 10% of Northern Pathway Harbour Bridge demand continuing to Lake Road. 20% additional E-Bike demand assumed in the same ratio as was

		forecasts for the Northern Pathway project.
Length cycled after improvements		
	3.2 km (Esmonde Road to Albert Road)	2/3 of the length of Lake Road that is subject to improvement (4.8 km) has been deemed as the average commute distance of this section.
Bayswater Avenue		
Cyclist AADT	50 cyclists/day	Calculated in accordance with Intersection Surveys conducted by Opus in 2015.
Cyclist growth rate	1.2% (per annum)	In accordance with the Gap Analysis and Evidence Base Report conducted by Beca for the IBC. This identified a 35% growth over a 30-year period.
Increase in cyclist demand	100% +20% demand in E-Bikes	Estimate. Additional E-Bike demand assumed in same ratio as for Flow modelling for Northern pathway.
Length cycled after improvements	2 km	The entire length of Bayswater Avenue from Lake Road has been deemed as the average commute distance of this section.
Cycle Health Benefits		
Cycle benefit per km	$2.20	Waka Kotahi IDMF Guidance – Health & Active Modes Impact
Max annual cycle benefit	$2,500	As above.
E-Bike benefit per km	$1.00	As above.
Max annual E-Bike benefit	$2,000	As above.
Annual Trip Days	250	5 days per week * 50 weeks
(pre-July 2020 cycle benefit - non-electrified bikes only)	*$1.30*	*As per EEM and 2019 update factor of 1.24*

1.3.3 Pedestrian benefit related assumptions

Pedestrians were assumed to infer some amenity benefit due to the removal of street-level power lines, which effectively increases footpath width. The following assumptions were used to calculate amenity benefits, using the approach outlined in section 3.1.1 of Waka Kotahi's IDMF guidance (Urban Amenity in Pedestrian Environments). As health benefits only accrue to new (induced) demand, pedestrian health benefits have not been included.

Assumption	Value selected	Justification
Footpath width – willingness to pay	0.07	From Waka Kotahi's IDMF guidance (Urban Amenity in Pedestrian Environments) – table 3, for an uncrowded/narrow footpath.
Walking speed	4.5km/hr	From Waka Kotahi's IDMF guidance (Urban Amenity in Pedestrian Environments)
Average walked distance	800m	Typical average walked distance.

Daily pedestrian trips	750	Estimate based on inference from Lake Road/Jutland Rad pedestrian counts.
Value of Time ($/min)	$0.09	From Waka Kotahi's EEM Value of Time (Walk + Cycle) Table A4.1(a); assuming a 50/50 split of commuters/other.

1.3.4 Transit lane related assumptions

The vehicle operating costs (VOC) used in the evaluation were in accordance with the guidelines presented in Waka Kotahi's EEM.

Assumption	Value selected	Justification
General		
Bus occupancy	50/55 (do minimum / do something)	The typical average number of occupants in buses during the peak hours.
Vehicle operating costs		
Bus	85.3 cents/km	Bus VOC with a gradient of 6% and an average speed of 25.5 km/h
Private vehicles	33.2 cents/km	Urban arterial VOC with a gradient of 6% and an average speed of 25 km/h
Lake Road Improvements		
Duration of time for which benefits were claimed	5 hours/day	Conservative assumption
Do Minimum Modelled travel time for HOVs and Buses		
AM Peak 3 Hour Period	10.0 minutes	Traffic modelling undertaken for the DBC
PM Peak 3 Hour Period	9.6 minutes	Traffic modelling undertaken for the DBC
Vehicles per hour		
AM Peak	900	Traffic modelling undertaken for the DBC. Vehicles that can take advantage of transit lane.
PM Peak	800	
Proportion of Multiple Occupancy Vehicles (MOVs)		
Current Situation	20%	Car occupancy surveys conducted by Opus in 2015
Preferred Option	40%	Traffic modelling undertaken for the DBC
AM (3 hr) Peak Period travel time		
HOV / Bus Travel Time Saving	31% (3.1 minutes)	Modelling
SOV Travel Time Increase	0% (0 minutes)	Modelling
PM (3 hr) Peak Period travel time savings for MOV & buses		
HOV / Bus Travel Time Saving	15% (1.4 minutes)	Modelling
SOV Travel Time Increase	3% (0.3 minutes)	Modelling
Buses per hour		
	8 buses per hour at peak times	Modelling
Esmonde Road Transit Lane		
Do Minimum modelled travel time for HOVs and buses	7.2 minutes	Traffic modelling undertaken for the DBC

Duration of time for which benefits were claimed	3 hours/day	The duration of the AM peak period
Vehicles per hour	1400 veh/h	Traffic modelling undertaken for the DBC
HOV percentage	40%	Traffic modelling undertaken for the DBC
Travel time savings for HOVs	72% (5.2 minutes)	Traffic modelling undertaken for the DBC
Travel time increase for SOVs	51% (3.7 minutes)	Traffic modelling undertaken for the DBC
Buses per hour	12 buses per hour at peak times	Modelling
SH1 On Ramp Transit Lane		
Do Minimum modelled travel time for HOVs	4.2 minutes	Traffic modelling undertaken for the DBC
Duration of time for which benefits were claimed	3 hours/day	The duration of the AM peak period.
Vehicles per hour	1100 veh/h	Traffic modelling undertaken for the DBC
HOV percentage	40%	Traffic modelling undertaken for the DBC
Travel time savings for HOVs	79% (3.3 minutes)	Modelling
Travel time increase for SOVs	0% (0 minutes)	Modelling
Buses per hour	12 buses per hour at peak times	Modelling

1.3.5 Reliability benefits

The EEM procedures for determining the trip reliability of private vehicles are complex. From previous experience with other comparable projects, trip time reliability benefits range from 5% to 10% of base travel time saving benefits. For this assessment, trip time reliability benefits were assumed as 5% of the base travel time benefits.

For bus users, the procedures in the EEM (Appendix A18.2) were used to estimate the reliability improvement benefits as follows:

Reliability benefit = EL (VTT($/h)/60) x AML x NPT

where : EL is the equivalent time ratio (4.8 for Bus, as shown in EEM Table A18.1)

VTT is the vehicle travel time value ($/h)

AML is the reduction in average minutes late (in minutes)

NPT is the number of passengers affected.

The reduction in average minutes late (AML) for buses were estimated as follows:

- Bus GPS data collected in 2016 indicated that peak-direction travel times varied ± 4 minutes from the average peak-direction travel time

- It is also assumed that a bus arriving (and leaving) early at a stop is as undesirable as a bus arriving late
- Assuming that bus timetables allow for some level of variability, it is estimated that the AML is half of the variation in travel time (i.e. half of 4 minutes = 2 minutes).
- Given the introduction of transit lanes, it could be expected that variability would be low. Hence, it was assumed that there would be a 50% reduction in AML, giving savings of one minute.

Using this AML saving of one minute and the EL factor of 4.8 suggests reliability savings of 4.8 minutes per passenger affected.

Our modelling indicated an in-vehicle time saving over the same section as approximately 1 - 2 minutes, resulting in reliability benefits that are estimated as greater than 100% of the in-vehicle time savings. However, as the EEM states that reliability benefits cannot exceed in-vehicle time savings, a maximum of 100% of the bus travel time savings was assumed.

2 Capital Costs

The P50 project cost is estimated to be $38.16 million. This estimate is based on the concept design cost and will be revised when the preliminary design is completed. An additional maintenance cost of $100,000 dollars per year was assumed.

3 Economic Analysis Results

Given the capital costs and derived benefits of the preferred option, the benefit-cost ratio (BCR) and first year rate of return (FYRR) is summarised below. For comparative purposes, benefits are displayed both in terms of the current (IDMF approach) discount rate of 4% for a 60 year analysis period, and in terms of the pre-July 2020 (EEM approach) rate of 6% for a 40 year analysis period.

	Preferred Option (EEM approach) - $M	Preferred Option (IDMF approach) - $M
Pedestrian – Amenity benefits	0.00	0.32
Cyclist - Crash cost savings	3.90	6.66
Cyclist – Health benefits for cycling facilities	6.23	17.03
Private vehicles – Travel time + VOC savings	9.21	14.11
Private vehicles – Reliability benefits	0.46	0.71
Bus - Travel time + VOC savings	5.10	7.82
Bus – Reliability benefits	5.10	7.82
First year benefits	1.48	1.64
Total benefits (NPV)	24.43	45.93
Total costs (NPV)	34.29	36.61

FYRR	4%	4%
BCR	0.71	1.25

The economic benefits of the three difference components of the project are summarised in the table below.

	Bayswater Avenue Improvements Only -$M		Esmonde Road Improvements Only - $M		Lake Road Improvement Only - $M	
	EEM	**IDMF**	**EEM**	**IDMF**	**EEM**	**IDMF**
Cyclist - Crash cost savings	0	0	n/a	n/a	3.90	6.66
Cyclist – Health benefits for cycling facilities	0.59	1.49	n/a	n/a	5.64	15.53
Pedestrian Amenity Benefits	n/a	n/a	n/a	n/a	n/a	0.32
Private vehicles – Travel time + VOC savings	n/a	n/a	2.48	3.80	6.73	10.31
Private vehicles – Reliability benefits	n/a	n/a	0.12	0.19	0.34	0.52
Bus – Travel time + VOC savings	n/a	n/a	1.18	1.81	3.91	5.99
Bus – Reliability benefits	n/a	n/a	1.18	1.81	3.91	5.99
First year benefits	0.04	0.06	0.20	0.20	1.24	1.49
Total benefits (NPV)	0.59	1.49	4.96	7.60	24.43	45.32
Total costs (NPV)	5.66	6.05	5.02	5.36	23.61	25.21
FYRR	0.71%	0.99%	4.02%	3.77%	5.25%	5.91%
BCR	0.10	0.25	0.99	1.42	1.03	1.80

4 Sensitivity Analysis

Sensitivity tests were undertaken to assess the robustness of our proposed options. These were:

- Private vehicle travel time savings – ± 20% on the projected values
- Bus travel time savings – ± 20% on the projected values
- Buses per hour – ± 20% on the assumed values
- Increase in cyclist volume – ± 50% on the projected values
- Capital costs – ± 20% on the projected values
- Traffic growth rate – 0.5% per annum (instead of 1% per annum).

The impact of the analysis on the BCRs of the options is summarised below:

Variable	Preferred Option (EEM approach)	Preferred Option (IDMF approach)
Capital cost (± 20%)	0.59 – 0.89	1.05 – 1.57
Increase in cyclist volume (± 50%)	0.62 – 0.80	1.06 – 1.45
Private vehicle travel time savings (± 20%)	0.48 – 0.94	0.92 – 1.58
Bus travel time savings (± 20%)	0.68 - 0.74	1.21 – 1.30
Buses per hour (± 20%)	0.68 – 0.74	1.21 – 1.30
Traffic Growth Rate - 0.5% pa	0.69	1.21

Appendix M: Cost Estimate

ESTIMATE SUMMARY - LAKE ROAD DBC

Beca Cost Management

Code	Description	Quantity	Unit	Rate	Total
	LAKE ROAD DBC				
1	Esmonde Road: From start to Intersection with Fred Thomas Dr				708,646
2	Esmonde Road: From Intersection with Fred Thomas Dr to Intersection with Lake Road				1,821,198
3	Lake Road: From Intersection Esmonde/Lake Road to Lake Road/Jutland Road				2,143,957
4	Lake Road:From Intersection with Jutland Road to Lake Road/Hororata Road				1,464,721
5	Lake Road:From Hororata Road to Egremont Road				3,073,718
6	Lake Road:From Egremont Road to Roberts Avenue				975,246
7	Lake Road:From Roberts Avenue to Old Lake Road				890,358
8	Lake Road:From Old Lake Road to Seabreeze Road				1,526,843
9	Lake Road:From Seabreeze Road to Ariho Terrace				1,260,607
10	Lake Road:From Ariho Terrace to Albert Road				570,901
11	Bayswater Ave:From Intersection with Beresford Street to Intersection with Balfour Street				1,000,146
12	Bayswater Ave:From Intersection with Balfour Street to Birkley Road				1,060,981
13	Bayswater Ave:From Birkley Road to Moana Avenue				794,360
14	Provisional Items				2,675,000
15	Environmental Compliance				60,000
16	Traffic Management				2,440,000
17	Preliminary and General (20%)				4,493,320

ESTIMATE SUMMARY - LAKE ROAD DBC

Beca Cost Management

Code	Description	Quantity	Unit	Rate	Total
18	Fees				3,570,000
	TOTAL BASE ESTIMATE				**30,530,000**
20	Contingency (25%)				7,630,000
	TOTAL EXPECTED ESTIMATE (P50)				**38,160,000**
22	Funding Risk				5,720,000
	TOTAL 95TH PERCENTILE COST ESTIMATE				**43,880,000**
	Lake Road Detailed Business Case Estimate (DBE)				
	Estimate prepared by: Rylee Hong				
	Estimate reviewed by: Jason Luo				
	Date of Estimate: August 2020				
	Job No: 3820149				
	Inputs				
	Drawings and sketch received on 21/01/2020 for Esmonde Road				
	Drawings received on 21/08/2020 for Lake Road & Bayswater Ave				
	Assumptions				
	70% road area to be resurfaced				
	Existing bluestone kerb and channel to be removed for new cycle path				
	Existing catchpit and manhole assumed every 100 metres				
	New catchpit and manhole along cycle path assumed every 100 metres				
	Existing stormwater pipe catchpit lead assumed 3 metres every 100 metres				
	New stormwater pipe catchpit lead assumed 3 metres every 100 metres				
	New signage & removal of existing signage				
	Bus lane marking assumed every 100 metres for Esmonde Road				
	Cycle path greening to be 100% covered, cycle symbol marking every 60 metres for Esmonde Road				

Code	Description	Quantity	Unit	Rate	Total
	All cut to be cut to waste				
	All fill to be imported GAP65 fill				
	Implementation consultant fees have been assumed				
	Allowances for the AT Managed Costs have been assumed				
	Preliminary and General - 20%				
	Contingency - 25%				
	Project Development Phase fees - Sunk cost				
	Pre-Implementation consultant fees - 7%				
	Implementation consultant fees - 6%				
	Funding risk - 15%				
	Exclusions				
	Property costs				
	Land acquisition				
	Escalation from November 2020				
	GST				

ESTIMATE DETAIL - LAKE ROAD DBC

Beca Cost Management

	Description	Unit	Quantity	Rate	Total
1.1	*620m*				
1.2	**EARTHWORKS**				
1.3	Site Clearance	LS	1	2,000.00	2,000
1.4	Remove existing lane marking and texts	LS	1	5,000.00	5,000
1.5	Removal of existing guard rails	m	90	30.00	2,700
1.6	Existing concrete island to be removed for pavement extension	m2	35	30.00	1,050
1.7	Remove kerb and channel	m	100	25.00	2,500
1.8	Remove existing signage	LS	1	500.00	500
1.9	Import fill GAP65	m3	460	107.00	49,219
	Sub Total for Earthworks				62,969
1.11	**DRAINAGE**				
1.12	Kerb and Channel - Standard Type 3 extruded half height	m	100	130.00	13,000
1.13	Subsoil drains	m	100	55.00	5,500
1.14	Allow for standard catchpit	no	1	3,700.00	3,700
1.15	Allow for standard manhole	no	1	5,500.00	5,500
1.16	Allow for standard stormwater pipe	m	3	345.00	1,035
1.17	Allow for connection to existing drainage	LS	1	1,000.00	1,000
	Sub Total for Drainage				29,735
1.19	**PAVEMENT AND RESURFACING**				
1.20	Pavement widening	m2	300	280.00	84,000
	Sub Total for Pavement and Surfacing				84,000
1.22	**RETAINING WALLS**				
1.23	Timber retaining wall	m	130	840.00	109,200
	Sub Total for Retaining Walls				109,200
1.25	**TRAFFIC SERVICE**				
1.26	**Signage**				
1.27	Relocation of VMS Signal	no	1	7,000.00	7,000
1.28	Allowance for traffic signs	LS	1	2,000.00	2,000
	Sub Total				9,000
1.30	**Lighting**				
1.31	Relocate the existing street lighting	no	3	3,000.00	9,000
	Sub Total				9,000
1.33	**Barriers**				
1.34	W-Section guard rails	m	90	100.00	9,000
1.35	Leading terminal	no	1	4,000.00	4,000
	Sub Total				13,000
1.37	**Road Marking**				
1.38	Bus lane greening every 100 metres	m2	542	70.00	37,940

	Description	Unit	Quantity	Rate	Total
1.39	T2 Marking	no	9	70.00	630
1.40	BUS LANE marking	no	10	100.00	1,000
1.41	Allowance for remaining lane marking	LS	1	20,000.00	20,000
	Sub Total				59,570
1.43	**Traffic Signals**				
1.44	Allow to revise traffic signals	LS	1	50,000.00	50,000
	Sub Total				50,000
	Sub Total for Traffic Services				140,570
1.47	**LANDSCAPE**				
1.48	400mmm wide175mm high raised separator	m	315	650.00	204,750
1.49	Allowance for reinstatement of landscaping	LS	1	13,000.00	13,000
	Sub Total for Landscaping				217,750
1.51	**ALLOWANCE FOR NIGHT WORKS**				
1.52	Night works	%	644,224	0.10	64,422
	Sub Total for Allowance for Night Works				64,422
	TOTAL FOR THIS SECTION				**708,646**

ESTIMATE DETAIL - LAKE ROAD DBC

Beca Cost Management

	Description	Unit	Quantity	Rate	Total
2.1	*280m transit lane + 580m Copenhagen+ 40m to intersection*				
2.2	**EARTHWORKS**				
2.3	Site Clearance	LS	1	3,000.00	3,000
2.4	Allow to remove existing lane marking	LS	1	19,000.00	19,000
2.5	Break out existing median island and dispose off site	m2	726	30.00	21,780
2.6	Carefully remove bluestone kerb and channel	m	1,240	70.00	86,800
2.7	Allow to remove existing catchpit	no	15	500.00	7,500
2.8	Allow to remove existing manhole	no	15	700.00	10,500
2.9	Allow to remove existing stormwater pipe	m	44	80.00	3,520
2.10	Allow to remove existing signage and dispose off site	LS	1	800.00	800
	Sub Total for Earthworks				152,900
2.12	**DRAINAGE**				
2.13	Kerb and channel - Standard Type 3 extruded half height	m	1,240	130.00	161,200
2.14	Subsoil drain	m	1,240	55.00	68,200
2.15	Allow for standard catchpit	no	15	3,700.00	55,500
2.16	Allow for standard manhole	no	15	5,500.00	82,500
2.17	Allow for standard stormwater pipe	m	44	345.00	15,180
2.18	Allow for connection to existing drainage	LS	1	3,000.00	3,000
	Sub Total for Drainage				385,580
2.20	**Pavement and Resurfacing**				
2.21	Allow for road reinstatement	m2	509	280.00	142,520
2.22	Road resurfacing (70%)	m2	7,552	47.00	354,944
	Sub Total for Pavement and Resurfacing				497,464
2.24	**TRAFFIC SERVICE**				
2.25	**Road Marking**				
2.26	Allow for lane marking	LS	1	26,000.00	26,000
2.27	Cycleway Greening (AS2700-1996 Colour G13 Emerald)	m2	1,872	70.00	131,040
2.28	Cycleway Marking	no	25	70.00	1,750
2.29	Bus lane greening every 100 metres	m2	542	70.00	37,940
2.30	BUS LANE marking	no	10	100.00	1,000
2.31	T2 Marking	no	10	70.00	700
	Sub Total				198,430
2.33	**Signage**				
2.34	Allow for traffic signs	LS	1	4,000.00	4,000
	Sub Total				4,000
2.36	**Traffic Signals**				
2.37	Allow to revise traffic signals	LS	1	50,000.00	50,000
	Sub Total				50,000

	Description	Unit	Quantity	Rate	Total
	Sub Total for Traffic Services				252,430
2.40	**LANDSCAPE**				
2.41	Median island to tie into existing	m2	218	200.00	43,600
2.42	Raise cycle path	m2	1,928	120.00	231,360
2.43	400mmm wide175mm high raised separator	m	142	650.00	92,300
	Sub Total for Landscaping				367,260
2.45	**ALLOWANCE FOR NIGHT WORKS**				
2.46	Night works	%	1,655,634	0.10	165,563
	Sub Total for Allowance for Night Works				165,563
	TOTAL FOR THIS SECTION				**1,821,198**

	Description	Unit	Quantity	Rate	Total
3.1	*116m Esmonde Rd + 650m Lake Rd*				
3.2	**EARTHWORKS**				
3.3	Site Clearance	LS	1	4,000.00	4,000
3.4	Allow to remove existing lane marking	LS	1	32,000.00	32,000
3.5	Remove existing bus lane green marking	m2	319	18.00	5,742
3.6	Remove existing cycleway greening	m2	1,475	18.00	26,550
3.7	Break out existing median island and dispose off site	m2	145	30.00	4,350
3.8	Break out existing pedestrian island and dispose off site	m2	29	30.00	884
3.9	Carefully remove bluestone kerb and channel	m	1,436	70.00	100,520
3.10	Allow to remove existing catchpit	no	15	500.00	7,500
3.11	Allow to remove existing manhole	no	15	700.00	10,500
3.12	Allow to remove existing stormwater pipe, Catchpit lead	m	50	80.00	4,000
3.13	Allow to remove existing signage and dispose off site	LS	1	600.00	600
	Sub Total for Earthworks				196,646
3.15	**DRAINAGE**				
3.16	Kerb and channel - Standard Type 3 extruded half height	m	1,436	130.00	186,680
3.17	Mountable kerb - Type 15 extruded cycle mountable kerb	m	1,436	80.00	114,880
3.18	Subsoil drain	m	1,436	55.00	78,980
3.19	Allow for standard catchpit	no	15	3,700.00	55,500
3.20	Allow for standard manhole	no	15	5,500.00	82,500
3.21	Allow for standard stormwater pipe, catchpit lead	m	50	345.00	17,250
3.22	Allow for connection to existing drainage	LS	1	3,000.00	3,000
	Sub Total for Drainage				538,790
3.24	**Pavement and Resurfacing**				
3.25	Allow for road reinstatement	m2	174	280.00	48,720
3.26	Road resurfacing (assume 70%)	m2	9,807	47.00	460,929
	Sub Total for Pavement and Resurfacing				509,649
3.28	**TRAFFIC SERVICE**				
3.29	**Road Marking**				
3.30	Allow for lane marking	LS	1	37,000.00	37,000
3.31	Cycleway Greening (AS2700-1996 Colour G13 Emerald)	m2	543	70.00	38,010
3.32	Cycleway Marking	no	28	70.00	1,960
3.33	Bus lane Greening	m2	45	70.00	3,150
3.34	BUS STOP marking	no	5	100.00	500
3.35	T2 Greening	m2	192	70.00	13,440
3.36	T2 Marking	no	7	70.00	490
3.37	Yellow No Stopping hatch line marking	m2	826	10.00	8,261
	Sub Total				102,811

	Description	Unit	Quantity	Rate	Total
3.39	**Signage**				
3.40	Allow for new signage	LS	1	3,000.00	3,000
	Sub Total				3,000
3.42	**Traffic Signal**				
3.43	Relocation existing traffic signal	no	2	10,000.00	20,000
3.44	Allow to revise traffic signals	No	3	50,000.00	150,000
3.45	Adjust existing vehicle detection loop location to suit new road layout	no	4	700.00	2,800
	Sub Total				172,800
3.47	**Guard rail**				
3.48	W-Section guard rail	m	50	100.00	5,000
3.49	Leading terminal	no	1	4,000.00	4,000
3.50	Trail terminal	no	1	2,000.00	2,000
	Sub Total				11,000
	Sub Total for Traffic Service				289,611
3.53	**LANDSCAPE**				
3.54	Allow to modify traffic island	LS	1	9,000.00	9,000
3.55	Raised cycle path	m2	2,313	120.00	277,613
3.56	Raised table crossing	m2	581	220.00	127,743
3.57	Footpath	m2	n/a	120.00	0
3.58	400mmm wide175mm high raised separator	m	n/a	650.00	0
	Sub Total for Landscaping				414,356
3.60	**ALLOWANCE FOR NIGHT WORKS**				
3.61	Night works	%	1,949,052	0.10	194,905
	Sub Total for Allowance for Night Works				194,905
	TOTAL FOR THIS SECTION				2,143,957

ESTIMATE DETAIL - LAKE ROAD DBC

Beca Cost Management

	Description	Unit	Quantity	Rate	Total
4.1	*450m*				
4.2	**EARTHWORKS**				
4.3	Site Clearance	LS	1	2,000.00	2,000
4.4	Allow to remove existing lane marking	LS	1	11,000.00	11,000
4.5	Remove existing bus lane green marking	m2	n/a	18.00	0
4.6	Remove existing cycleway greening	m2	444	18.00	7,992
4.7	Break out existing median island and dispose off site	m2	n/a	30.00	0
4.8	Break out existing pedestrian island and dispose off site	m2	9	30.00	262
4.9	Break out existing concrete footpath and dispose off site	m2	968	30.00	29,033
4.10	Carefully remove bluestone kerb and channel	m	870	70.00	60,900
4.11	Allow to remove existing catchpit	no	10	500.00	5,000
4.12	Allow to remove existing manhole	no	10	700.00	7,000
4.13	Allow to remove existing stormwater pipe, catchpit lead	m	30	80.00	2,400
4.14	Allow to remove existing signage and dispose off site	LS	1	400.00	400
	Sub Total for Earthworks				125,987
4.16	**DRAINAGE**				
4.17	Kerb and channel - Standard Type 3 extruded half height	m	870	130.00	113,100
4.18	Mountable kerb - Type 15 extruded cycle mountable kerb	m	870	80.00	69,600
4.19	Subsoil drain	m	870	55.00	47,850
4.20	Allow for standard catchpit	no	10	3,700.00	37,000
4.21	Allow for standard manhole	no	10	5,500.00	55,000
4.22	Allow for standard stormwater pipe, catchpit lead	m	30	345.00	10,350
4.23	Allowance for connection to existing drainage	LS	1	2,000.00	2,000
	Sub Total for Drainage				334,900
4.25	**Pavement and Resurfacing**				
4.26	Allow for road reinstatement	m2	9	280.00	2,520
4.27	Road resurfacing (70%)	m2	4,482	47.00	210,654
	Sub Total for Pavement and Resurfacing				213,174
4.29	**TRAFFIC SERVICE**				
4.30	**Road Marking**				
4.31	Allow for lane marking	LS	1	19,000.00	19,000
4.32	Cycleway Greening (AS2700-1996 Colour G13 Emerald)	m2	529	70.00	37,049
4.33	Cycleway Marking	no	32	70.00	2,240
4.34	Bus lane Greening	m2	n/a	70.00	0
4.35	BUS STOP marking	no	3	100.00	300
4.36	T2 Greening	m2	125	70.00	8,761
4.37	T2 Marking	no	4	70.00	280
4.38	Yellow No Stopping hatch line marking	m2	364	10.00	3,641

	Description	Unit	Quantity	Rate	Total
	Sub Total				71,271
4.40	**Traffic Signal**				
4.41	Allow to revise traffic signals	No	2	50,000.00	100,000
	Sub Total				100,000
	Sub Total for Traffic Service				171,271
4.44	**LANDSCAPE**				
4.45	Raised cycle path	m2	2,483	120.00	297,998
4.46	Raised table crossing	m2	328	220.00	72,101
4.47	Footpath	m2	968	120.00	116,134
4.48	400mmm wide175mm high raised separator	m	n/a	650.00	0
	Sub Total for Landscaping				486,233
4.50	**ALLOWANCE FOR NIGHT WORKS**				
4.51	Night works	%	1,331,564	0.10	133,156
	Sub Total for Allowance for Night Works				133,156
	TOTAL FOR THIS SECTION				**1,464,721**

	Description	Unit	Quantity	Rate	Total
5.1	*1200m*				
5.2	**EARTHWORKS**				
5.3	Site Clearance	LS	1	4,000.00	4,000
5.4	Allow to remove existing lane marking	LS	1	39,000.00	39,000
5.5	Remove existing bus lane green marking	m2	n/a	18.00	0
5.6	Remove existing cycleway greening	m2	354	18.00	6,378
5.7	Break out existing median island and dispose off site	m2	49	30.00	1,463
5.8	Break out existing pedestrian island and dispose off site	m2	17	30.00	511
5.9	Break out existing concrete footpath and dispose off site	m2	n/a	30.00	0
5.10	Remove existing barrier fencing and dispose off site	m	32	30.00	960
5.11	Remove existing bus shelter	no	6	3,000.00	18,000
5.12	Carefully remove bluestone kerb and channel	m	2,220	70.00	155,400
5.13	Allow to remove existing catchpit	no	23	500.00	11,500
5.14	Allow to remove existing manhole	no	23	700.00	16,100
5.15	Allow to remove existing stormwater pipe, catchpit lead	m	70	80.00	5,600
5.16	Allow to remove existing signage and dispose off site	LS	1	900.00	900
	Sub Total for Earthworks				259,812
5.18	**DRAINAGE**				
5.19	Kerb and channel - Standard Type 3 extruded half height	m	2,220	130.00	288,600
5.20	Mountable kerb - Type 15 extruded cycle mountable kerb	m	2,220	80.00	177,600
5.21	Subsoil drain	m	2,220	55.00	122,100
5.22	Allow for standard catchpit	no	23	3,700.00	85,100
5.23	Allow for standard manhole	no	23	5,500.00	126,500
5.24	Allow for standard stormwater pipe, catchpit lead	m	70	345.00	24,150
5.25	Allow for connection to existing drainage	LS	1	5,000.00	5,000
	Sub Total for Drainage				829,050
5.27	**Pavement and Resurfacing**				
5.28	Allow for road reinstatement	m2	66	280.00	18,480
5.29	Road resurfacing (70%)	m2	10,523	47.00	494,581
	Sub Total for Pavement and Resurfacing				513,061
5.31	**TRAFFIC SERVICE**				
5.32	**Road Marking**				
5.33	Allow for lane marking	LS	1	61,000.00	61,000
5.34	Cycleway Greening (AS2700-1996 Colour G13 Emerald)	m2	508	70.00	35,536
5.35	Cycleway Marking	no	38	70.00	2,660
5.36	Bus lane Greening	m2	n/a	70.00	0
5.37	BUS STOP marking	no	7	100.00	700
5.38	Yellow No Stopping hatch line marking	m2	348	10.00	3,482

	Description	Unit	Quantity	Rate	Total
	Sub Total				103,379
5.40	**Traffic Signal**				
5.41	Allow to revise traffic signals	LS	1	50,000.00	50,000
5.42	Adjust existing vehicle detection loop location to suit new road layout	no	4	700.00	2,800
	Sub Total				52,800
	Sub Total for Traffic Service				156,179
5.45	**LANDSCAPE**				
5.46	Median traffic island by carpark area	m2	150	200.00	30,000
5.47	Raised cycle path	m2	4,662	120.00	559,440
5.48	Raised table crossing	m2	424	220.00	93,227
5.49	Footpath	m2	n/a	120.00	0
5.50	600mm wide175mm high raised separator - CY0005	m	67	800.00	53,520
5.51	Bus shelter	no	6	45,000.00	270,000
5.52	Street furniture to bus stop locations	no	6	5,000.00	30,000
	Sub Total for Landscaping				1,036,187
5.54	**ALLOWANCE FOR NIGHT WORKS**				
5.55	Night works	%	2,794,289	0.10	279,429
	Sub Total for Allowance for Night Works				279,429
	TOTAL FOR THIS SECTION				**3,073,718**

	Description	Unit	Quantity	Rate	Total
6.1	*300m*				
6.2	**EARTHWORKS**				
6.3	Site Clearance	LS	1	2,000.00	2,000
6.4	Allow to remove existing lane marking	LS	1	15,000.00	15,000
6.5	Break out existing concrete footpath and dispose off site	m2	n/a	30.00	0
6.6	Remove existing barrier fencing and dispose off site	m	46	30.00	1,372
6.7	Remove existing bus shelter	no	1	3,000.00	3,000
6.8	Carefully remove bluestone kerb and channel	m	701	70.00	49,070
6.9	Allow to remove existing catchpit	no	8	500.00	4,000
6.10	Allow to remove existing manhole	no	8	700.00	5,600
6.11	Allow to remove existing stormwater pipe, catchpit lead	m	25	80.00	2,000
6.12	Break out existing traffic island planter box and dispose off site	m2	189	30.00	5,670
6.13	To remove trees and shrubs in the existing traffic island planter box	no	11	300.00	3,300
6.14	Allow to remove existing single post signage and dispose off site	no	3	100.00	300
	Sub Total for Earthworks				91,312
6.16	**DRAINAGE**				
6.17	Kerb and channel - Standard Type 3 extruded half height	m	555	130.00	72,150
6.18	Mountable kerb - Type 15 extruded cycle mountable kerb	m	555	80.00	44,400
6.19	Subsoil drain	m	555	55.00	30,525
6.20	Allow for standard catchpit	no	8	3,700.00	29,600
6.21	Allow for standard manhole	no	8	5,500.00	44,000
6.22	Allow for standard stormwater pipe, catchpit lead	m	25	345.00	8,625
6.23	Allow for connection to existing drainage	LS	1	1,000.00	1,000
	Sub Total for Drainage				230,300
6.25	**Pavement and Resurfacing**				
6.26	Road resurfacing (70%)	m2	3,541	47.00	166,427
	Sub Total for Pavement and Resurfacing				166,427
6.28	**TRAFFIC SERVICE**				
6.29	**Road Marking**				
6.30	Allow for lane marking	LS	1	13,000.00	13,000
6.31	Cycleway Greening (AS2700-1996 Colour G13 Emerald)	m2	177	70.00	12,423
6.32	Cycleway Marking	no	11	70.00	770
6.33	Bus lane Greening	m2	n/a	70.00	0
6.34	BUS STOP marking	no	2	100.00	200
6.35	T2 Greening	m2	n/a	70.00	0
6.36	T2 Marking	no	n/a	70.00	0
6.37	Yellow No Stopping hatch line marking	m2	510	10.00	5,101
	Sub Total				31,494

	Description	Unit	Quantity	Rate	Total
6.39	**Signage**				
6.40	Allow for single post signage	LS	1	1,500.00	1,500
	Sub Total				1,500
6.42	**Traffic Signal**				
6.43	Allow to revise traffic signals	LS	1	50,000.00	50,000
6.44	Adjust existing vehicle detection loop location to suit new road layout	no	3	700.00	2,100
	Sub Total				52,100
	Sub Total for Traffic Service				85,094
6.47	**LANDSCAPE**				
6.48	Raised cycle path	m2	1,103	120.00	132,360
6.49	Raised table crossing	m2	209	220.00	45,870
6.50	Footpath	m2	n/a	120.00	0
6.51	400mm wide175mm high raised separator - CY0004	m	54	650.00	35,224
6.52	Bus shelter	no	2	45,000.00	90,000
6.53	Street furniture to bus stop locations	no	2	5,000.00	10,000
	Sub Total for Landscaping				313,454
6.55	**ALLOWANCE FOR NIGHT WORKS**				
6.56	Night works	%	886,587	0.10	88,659
	Sub Total for Allowance for Night Works				88,659
	TOTAL FOR THIS SECTION				**975,246**

ESTIMATE DETAIL - LAKE ROAD DBC

Beca Cost Management

	Description	Unit	Quantity	Rate	Total
7.1	*350m*				
7.2	**EARTHWORKS**				
7.3	Site Clearance	LS	1	1,000.00	1,000
7.4	Allow to remove existing lane marking	LS	1	11,000.00	11,000
7.5	Break out existing pedestrian island and dispose off site	m2	9	30.00	270
7.6	Carefully remove bluestone kerb and channel	m	655	70.00	45,850
7.7	Allow to remove existing catchpit	no	8	500.00	4,000
7.8	Allow to remove existing manhole	no	8	700.00	5,600
7.9	Allow to remove existing stormwater pipe, catchpit lead	m	25	80.00	2,000
7.10	Allow to remove existing single post signage	LS	1	400.00	400
	Sub Total for Earthworks				70,120
7.12	**DRAINAGE**				
7.13	Kerb and channel - Standard Type 3 extruded half height	m	655	130.00	85,150
7.14	Mountable kerb - Type 15 extruded cycle mountable kerb	m	655	80.00	52,400
7.15	Subsoil drain	m	655	55.00	36,025
7.16	Allow for standard catchpit	no	8	3,700.00	29,600
7.17	Allow for standard manhole	no	8	5,500.00	44,000
7.18	Allow for standard stormwater pipe, catchpit lead	m	25	345.00	8,625
7.19	Allow for connection to existing drainage	LS	1	1,000.00	1,000
	Sub Total for Drainage				256,800
7.21	**Pavement and Resurfacing**				
7.22	Allow for road reinstatement	m2	9	280.00	2,520
7.23	Road resurfacing (70%)	m2	3,216	47.00	151,152
	Sub Total for Pavement and Resurfacing				153,672
7.25	**TRAFFIC SERVICE**				
7.26	**Road Marking**				
7.27	Allow for lane marking	LS	1	18,000.00	18,000
7.28	Cycleway Greening (AS2700-1996 Colour G13 Emerald)	m2	108	70.00	7,566
7.29	Cycleway Marking	no	9	70.00	630
7.30	Bus lane Greening	m2	n/a	70.00	0
7.31	BUS STOP marking	no	2	100.00	200
7.32	T2 Greening	m2	n/a	70.00	0
7.33	T2 Marking	no	n/a	70.00	0
7.34	Yellow No Stopping hatch line marking	m2	74	10.00	744
	Sub Total				27,140
7.36	**Signage**				
7.37	Allow for single post signage	LS	1	1,500.00	1,500
	Sub Total				1,500

	Description	Unit	Quantity	Rate	Total
	Sub Total for Traffic Service				28,640
7.40	**LANDSCAPE**				
7.41	Raised cycle path	m2	1,376	120.00	165,120
7.42	Raised table crossing	m2	190	220.00	41,712
7.43	Footpath	m2	n/a	120.00	0
7.44	600mm wide175mm high raised separator - CY0005	m	54	800.00	43,352
7.45	Bus shelter	no	1	45,000.00	45,000
7.46	Street furniture to bus stop locations	no	1	5,000.00	5,000
	Sub Total for Landscaping				300,184
7.48	**ALLOWANCE FOR NIGHT WORKS**				
7.49	Night works	%	809,416	0.10	80,942
	Sub Total for Allowance for Night Works				80,942
	TOTAL FOR THIS SECTION				**890,358**

	Description	Unit	Quantity	Rate	Total
8.1	*610m*				
8.2	**EARTHWORKS**				
8.3	Site Clearance	LS	1	2,000.00	2,000
8.4	Allow to remove existing lane marking	LS	1	20,000.00	20,000
8.5	Remove existing bus shelter	no	1	3,000.00	3,000
8.6	Carefully remove bluestone kerb and channel	m	1,081	70.00	75,670
8.7	Allow to remove existing catchpit	no	14	500.00	7,000
8.8	Allow to remove existing manhole	no	14	700.00	9,800
8.9	Allow to remove existing stormwater pipe	m	40	80.00	3,200
8.10	Allow to remove existing signage	LS	1	300.00	300
	Sub Total for Earthworks				120,970
8.12	**DRAINAGE**				
8.13	Kerb and channel - Standard Type 3 extruded half height	m	1,081	130.00	140,530
8.14	Mountable kerb - Type 15 extruded cycle mountable kerb	m	1,081	80.00	86,480
8.15	Subsoil drain	m	1,081	55.00	59,455
8.16	Allow for standard catchpit	no	14	3,700.00	51,800
8.17	Allow for standard manhole	no	14	5,500.00	77,000
8.18	Allow for standard stormwater pipe	m	40	345.00	13,800
8.19	Allow for connection to existing drainage	LS	1	2,000.00	2,000
	Sub Total for Drainage				431,065
8.21	**Pavement and Resurfacing**				
8.22	Road resurfacing (70%)	m2	5,760	47.00	270,720
	Sub Total for Pavement and Resurfacing				270,720
8.24	**TRAFFIC SERVICE**				
8.25	**Road Marking**				
8.26	Allow for lane marking	LS	1	31,000.00	31,000
8.27	Cycleway Greening (AS2700-1996 Colour G13 Emerald)	m2	312	70.00	21,810
8.28	Cycleway Marking	no	21	70.00	1,470
8.29	Bus lane Greening	m2	n/a	70.00	0
8.30	BUS STOP marking	no	1	100.00	100
8.31	T2 Greening	m2	n/a	70.00	0
8.32	T2 Marking	no	n/a	70.00	0
8.33	Yellow No Stopping hatch line marking	m2	168	10.00	1,680
	Sub Total				56,060
8.35	**Signage**				
8.36	Allow for single post signage	LS	1	1,500.00	1,500
	Sub Total				1,500
8.38	**Traffic Signal**				

	Description	Unit	Quantity	Rate	Total
8.39	Allow for pedestrian crossing signal	no	1	25,000.00	25,000
	Sub Total				25,000
	Sub Total for Traffic Service				82,560
8.42	**LANDSCAPE**				
8.43	Raised cycle path	m2	2,359	120.00	283,080
8.44	Raised table crossing	m2	680	220.00	149,644
8.45	Footpath	m2	n/a	120.00	0
8.46	600mm wide175mm high raised separator - CY0005	m	n/a	800.00	0
8.47	Bus shelter	no	1	45,000.00	45,000
8.48	Street furniture to bus stop locations	no	1	5,000.00	5,000
	Sub Total for Landscaping				482,724
8.50	**ALLOWANCE FOR NIGHT WORKS**				
8.51	Night works	%	1,388,039	0.10	138,804
	Sub Total for Allowance for Night Works				138,804
	TOTAL FOR THIS SECTION				**1,526,843**

	Description	Unit	Quantity	Rate	Total
9.1	*490m*				
9.2	**EARTHWORKS**				
9.3	Site Clearance	LS	1	2,000.00	2,000
9.4	Allow to remove existing lane marking	LS	1	15,000.00	15,000
9.5	Break out existing concrete footpath and dispose off site	m2	50	30.00	1,503
9.6	Remove existing bus shelter	no	2	3,000.00	6,000
9.7	Carefully remove bluestone kerb and channel	m	949	70.00	66,430
9.8	Allow to remove existing catchpit	no	10	500.00	5,000
9.9	Allow to remove existing manhole	no	10	700.00	7,000
9.10	Allow to remove existing stormwater pipe, catchpit lead	m	29	80.00	2,320
9.11	Allow to remove existing signage and dispose off site	LS	1	200.00	200
	Sub Total for Earthworks				105,453
9.13	**DRAINAGE**				
9.14	Kerb and channel - Standard Type 3 extruded half height	m	949	130.00	123,370
9.15	Mountable kerb - Type 15 extruded cycle mountable kerb	m	949	80.00	75,920
9.16	Subsoil drains	m	949	55.00	52,195
9.17	Allow for standard catchpit	no	10	3,700.00	37,000
9.18	Allow for standard manhole	no	10	5,500.00	55,000
9.19	Allow for standard stormwater pipe, catchpit lead	m	29	345.00	10,005
9.20	Allowance for connection to existing drainage	LS	1	2,000.00	2,000
	Sub Total for Drainage				355,490
9.22	**PAVEMENT AND RESURFACING**				
9.23	Resurfacing (70%)	m2	4,368	47.00	205,296
	Sub Total for Pavement and Surfacing				205,296
9.25	**TRAFFIC SERVICE**				
9.26	**Road Marking**				
9.27	Allow for lane marking	LS	1	24,000	24,000
9.28	Cycleway Greening (AS2700-1996 Colour G13 Emerald)	m2	1,500	70.00	105,000
9.29	Cycleway Marking	no	16	70.00	1,120
9.30	Bus lane Greening	m2	n/a	70.00	0
9.31	BUS STOP marking	no	2	100.00	200
9.32	T2 Greening	m2	n/a	70.00	0
9.33	T2 Marking	no	n/a	70.00	0
9.34	Yellow No Stopping hatch line marking	m2	327	10.00	3,274
	Sub Total				133,594
9.36	**Signage**				
9.37	Allowance for traffic signs	LS	1	1,000.00	1,000
	Sub Total				1,000

	Description	Unit	Quantity	Rate	Total
	Sub Total for Traffic Service				134,594
9.40	**LANDSCAPE**				
9.41	Raised cycle path	m2	1,993	120.00	239,160
9.42	Footpath	m2	50	120.00	6,013
9.43	400mmm wide175mm high raised separator	m	n/a	650.00	0
9.44	Bus shelter	no	2	45,000.00	90,000
9.45	Street furniture to bus stop locations	no	2	5,000.00	10,000
	Sub Total for Landscaping				345,173
9.47	**ALLOWANCE FOR NIGHT WORKS**				
9.48	Night works	%	1,146,006	0.10	114,601
	Sub Total for Allowance for Night Works				114,601
	TOTAL FOR THIS SECTION				**1,260,607**

	Description	Unit	Quantity	Rate	Total
10.1	*350m*				
10.2	**EARTHWORKS**				
10.3	Site Clearance	LS	1	2,000.00	2,000
10.4	Remove existing lane marking and texts	LS	1	13,000.00	13,000
10.5	Breakout existing traffic island and dispose off site	m2	n/a	30.00	0
10.6	Existing concrete island to be removed for pavement extension	m2	113	30.00	3,383
10.7	Carefully remove bluestone kerb and channel	m	275	70.00	19,250
10.8	Allow to remove existing catchpit	no	3	500.00	1,500
10.9	Allow to remove existing manhole	no	3	700.00	2,100
10.10	Allow to remove existing stormwater pipe, catchpit lead	m	10	80.00	800
10.11	Allow to remove existing signage and dispose off site	LS	1	1,400.00	1,400
	Sub Total for Earthworks				43,433
10.13	**DRAINAGE**				
10.14	Kerb and channel - Standard Type 3 extruded half height	m	275	130.00	35,750
10.15	Mountable kerb - Type 15 extruded cycle mountable kerb	m	275	80.00	22,000
10.16	Subsoil drains	m	275	55.00	15,125
10.17	Allow for standard catchpit	no	3	3,700.00	11,100
10.18	Allow for standard manhole	no	3	5,500.00	16,500
10.19	Allow for standard stormwater pipe	m	10	345.00	3,450
10.20	Allowance for connection to existing drainage	LS	1	1,000.00	1,000
	Sub Total for Drainage				104,925
10.22	**PAVEMENT AND RESURFACING**				
10.23	Road widening, 1m	m2	320	280.00	89,600
10.24	Road reinstatement	m2	113	280.00	31,576
10.25	Road resurfacing (70%)	m2	2,806	47.00	131,882
	Sub Total for Pavement and Surfacing				253,058
10.27	**TRAFFIC SERVICE**				
10.28	**Signage**				
10.29	Allowance for traffic signs	LS	1	7,000.00	7,000
	Sub Total				7,000
10.31	**Barriers**				
10.32	W-Section guard rails	m	n/a	100.00	0
10.33	Leading terminal	no	n/a	4,000.00	0
	Sub Total				0
10.35	**Road Marking**				
10.36	Cycleway Greening (AS2700-1996 Colour G13 Emerald)	m2	9	70.00	635
10.37	Cycleway Marking	no	1	70.00	70
10.38	Allowance for the lane marking	LS	1	5,000.00	5,000

	Description	Unit	Quantity	Rate	Total
	Sub Total				5,705
	Sub Total for Traffic Services				12,705
10.41	**LANDSCAPE**				
10.42	Raised cycle path	m2	874	120.00	104,880
10.43	Footpath	m2	n/a	120.00	0
10.44	400mmm wide175mm high raised separator	m	n/a	650.00	0
	Sub Total for Landscaping				104,880
10.46	**ALLOWANCE FOR NIGHT WORKS**				
10.47	Night works	%	519,001	0.10	51,900
	Sub Total for Allowance for Night Works				51,900
	TOTAL FOR THIS SECTION				**570,901**

	Description	Unit	Quantity	Rate	Total
11.1	*663m Beresford to Balfour*				
11.2	**EARTHWORKS**				
11.3	Site Clearance	LS	1	4,000.00	4,000
11.4	Allow to remove existing lane marking	LS	1	12,000.00	12,000
11.5	Remove existing bus lane green marking	m2	n/a	18.00	0
11.6	Break out existing median island and dispose off site	m2	n/a	30.00	0
11.7	Break out existing pedestrian island and dispose off site	m2	n/a	30.00	0
11.8	Carefully remove bluestone kerb and channel - Existing kerb to remain	m	n/a	70.00	0
11.9	Allow to remove existing catchpit	no	n/a	500.00	0
11.10	Allow to remove existing manhole	no	n/a	700.00	0
11.11	Allow to remove existing stormwater pipe	m	n/a	80.00	0
11.12	Removal of existing guard rail	m	n/a	30.00	0
11.13	Allow to remove existing signage and dispose off site	LS	1	600.00	600
	Sub Total for Earthworks				16,600
11.15	**DRAINAGE**				
11.16	Kerb and channel - Standard Type 3 extruded half height	m	n/a	130.00	0
11.17	Mountable kerb - Type 15 extruded cycle mountable kerb	m	n/a	80.00	0
11.18	Subsoil drain	m	n/a	55.00	0
11.19	Allow for standard catchpit	no	n/a	3,700.00	0
11.20	Allow for standard manhole	no	n/a	5,500.00	0
11.21	Allow for standard stormwater pipe	m	n/a	345.00	0
11.22	Allow for connection to existing drainage	LS	n/a	3,000.00	0
	Sub Total for Drainage				0
11.24	**Pavement and Resurfacing**				
11.25	Allow for road reinstatement	m2	n/a	280.00	0
11.26	Road resurfacing (assume 70%)	m2	6,355	47.00	298,685
	Sub Total for Pavement and Resurfacing				298,685
11.28	**TRAFFIC SERVICE**				
11.29	**Road Marking**				
11.30	Allow for lane marking	LS	1	28,000.00	28,000
11.31	Cycleway Greening (AS2700-1996 Colour G13 Emerald)	m2	59	70.00	4,123
11.32	Cycleway Marking	no	8	70.00	560
11.33	Bus lane Greening	m2	n/a	70.00	0
11.34	BUS STOP marking	no	2	100.00	200
11.35	STOP marking	no	1	100.00	100
11.36	Zebra crossing	m	n/a	6.00	0
	Sub Total				32,983
11.38	**Signage**				

	Description	Unit	Quantity	Rate	Total
11.39	Allow for new signage	LS	1	3,000.00	3,000
	Sub Total				3,000
11.41	**Traffic Signal**				
11.42	Relocation existing traffic signal	no	n/a	10,000.00	0
11.43	Allow to revise traffic signals	No	n/a	50,000.00	0
	Sub Total				0
11.45	**Guard rail**				
11.46	W-Section guard rail	m	n/a	100.00	0
11.47	Leading terminal	no	n/a	4,000.00	0
11.48	Trail terminal	no	n/a	2,000.00	0
	Sub Total				0
	Sub Total for Traffic Service				35,983
11.51	**LANDSCAPE**				
11.52	Allow to modify traffic island	LS	n/a	1,500.00	0
11.53	Median traffic island to tie into existing	m2	n/a	200.00	0
11.54	Raise cycle path	m2	n/a	120.00	0
11.55	Raised table crossing	m2	263	220.00	57,860
11.56	Footpath	m2	n/a	120.00	0
11.57	600mm wide175mm high raised separator - CY0005	m	625	800.00	500,096
	Sub Total for Landscaping				557,956
11.59	**ALLOWANCE FOR NIGHT WORKS**				
11.60	Night works	%	909,224	0.10	90,922
	Sub Total for Allowance for Night Works				90,922
	TOTAL FOR THIS SECTION				1,000,146

	Description	Unit	Quantity	Rate	Total
12.1	*713m Balfour to Birkley*				
12.2	**EARTHWORKS**				
12.3	Site Clearance	LS	1	4,000.00	4,000
12.4	Allow to remove existing lane marking	LS	1	13,000.00	13,000
12.5	Remove existing bus lane green marking	m2	n/a	18.00	0
12.6	Break out existing median island and dispose off site	m2	n/a	30.00	0
12.7	Break out existing pedestrian island and dispose off site	m2	19	30.00	567
12.8	Remove existing bus shelter	no	2	3,000.00	6,000
12.9	Carefully remove bluestone kerb and channel - Existing kerb to remain	m	n/a	70.00	0
12.10	Allow to remove existing catchpit	no	n/a	500.00	0
12.11	Allow to remove existing manhole	no	n/a	700.00	0
12.12	Allow to remove existing stormwater pipe	m	n/a	80.00	0
12.13	Removal of existing guard rail	m	n/a	30.00	0
12.14	Allow to remove existing signage and dispose off site	LS	1	200.00	200
	Sub Total for Earthworks				23,767
12.16	**DRAINAGE**				
12.17	Kerb and channel - Standard Type 3 extruded half height	m	n/a	130.00	0
12.18	Mountable kerb - Type 15 extruded cycle mountable kerb	m	n/a	80.00	0
12.19	Subsoil drain	m	n/a	55.00	0
12.20	Allow for standard catchpit	no	n/a	3,700.00	0
12.21	Allow for standard manhole	no	n/a	5,500.00	0
12.22	Allow for standard stormwater pipe	m	n/a	345.00	0
12.23	Allow for connection to existing drainage	LS	n/a	3,000.00	0
	Sub Total for Drainage				0
12.25	**Pavement and Resurfacing**				
12.26	Allow for road reinstatement	m2	n/a	280.00	0
12.27	Road resurfacing (assume 70%)	m2	5,539	47.00	260,333
	Sub Total for Pavement and Resurfacing				260,333
12.29	**TRAFFIC SERVICE**				
12.30	**Road Marking**				
12.31	Allow for lane marking	LS	1	30,000.00	30,000
12.32	Cycleway Greening (AS2700-1996 Colour G13 Emerald)	m2	104	70.00	7,311
12.33	Cycleway Marking	no	14	70.00	980
12.34	Bus lane Greening	m2	n/a	70.00	0
12.35	BUS STOP marking	no	4	100.00	400
12.36	STOP marking	no	2	100.00	200
12.37	Zebra crossing	m	36	6.00	216
	Sub Total				39,107

	Description	Unit	Quantity	Rate	Total
12.39	**Signage**				
12.40	Allow for new signage	LS	1	1,000.00	1,000
	Sub Total				1,000
12.42	**Traffic Signal**				
12.43	Relocation existing traffic signal	no	n/a	10,000.00	0
12.44	Allow to revise traffic signals	No	n/a	50,000.00	0
	Sub Total				0
12.46	**Guard rail**				
12.47	W-Section guard rail	m	n/a	100.00	0
12.48	Leading terminal	no	n/a	4,000.00	0
12.49	Trail terminal	no	n/a	2,000.00	0
	Sub Total				0
	Sub Total for Traffic Service				40,107
12.52	**LANDSCAPE**				
12.53	Allow to modify traffic island	LS	n/a	1,500.00	0
12.54	Median traffic island to tie into existing	m2	n/a	200.00	0
12.55	Raise cycle path	m2	n/a	120.00	0
12.56	Raised table crossing	m2	222	220.00	48,943
12.57	Footpath	m2	n/a	120.00	0
12.58	400mm wide175mm high raised separator - CY0004	m	222	650.00	144,099
12.59	600mm wide175mm high raised separator - CY0005	m	434	800.00	347,280
12.60	Bus shelter	no	2	45,000.00	90,000
12.61	Street furniture to bus stop locations	no	2	5,000.00	10,000
	Sub Total for Landscaping				640,322
12.63	**ALLOWANCE FOR NIGHT WORKS**				
12.64	Night works	%	964,528	0.10	96,453
	Sub Total for Allowance for Night Works				96,453
	TOTAL FOR THIS SECTION				1,060,981

	Description	Unit	Quantity	Rate	Total
13.1	*690m Birkley to Moana Ave*				
13.2	**EARTHWORKS**				
13.3	Site Clearance	LS	1	4,000.00	4,000
13.4	Allow to remove existing lane marking	LS	1	13,000.00	13,000
13.5	Remove existing bus lane green marking	m2	n/a	18.00	0
13.6	Break out existing median island and dispose off site	m2	n/a	30.00	0
13.7	Break out existing pedestrian island and dispose off site	m2	7	30.00	206
13.8	Break out existing concrete footpath and dispose off site	m2	266	30.00	7,967
13.9	Remove existing bus shelter	no	1	3,000.00	3,000
13.10	Carefully remove bluestone kerb and channel - Existing kerb to remain	m	n/a	70.00	0
13.11	Allow to remove existing catchpit	no	n/a	500.00	0
13.12	Allow to remove existing manhole	no	n/a	700.00	0
13.13	Allow to remove existing stormwater pipe	m	n/a	80.00	0
13.14	Removal of existing guard rail	m	n/a	30.00	0
13.15	Allow to remove existing signage and dispose off site	LS	1	400.00	400
	Sub Total for Earthworks				28,572
13.17	**DRAINAGE**				
13.18	Kerb and channel - Standard Type 3 extruded half height	m	n/a	130.00	0
13.19	Mountable kerb - Type 15 extruded cycle mountable kerb	m	n/a	80.00	0
13.20	Subsoil drain	m	n/a	55.00	0
13.21	Allow for standard catchpit	no	n/a	3,700.00	0
13.22	Allow for standard manhole	no	n/a	5,500.00	0
13.23	Allow for standard stormwater pipe	m	n/a	345.00	0
13.24	Allow for connection to existing drainage	LS	n/a	3,000.00	0
	Sub Total for Drainage				0
13.26	**Pavement and Resurfacing**				
13.27	Allow for road reinstatement	m2	n/a	280.00	0
13.28	Road resurfacing (assume 70%)	m2	5,359	47.00	251,873
	Sub Total for Pavement and Resurfacing				251,873
13.30	**TRAFFIC SERVICE**				
13.31	**Road Marking**				
13.32	Allow for lane marking	LS	1	28,000.00	28,000
13.33	Cycleway Greening (AS2700-1996 Colour G13 Emerald)	m2	97	70.00	6,785
13.34	Cycleway Marking	no	14	70.00	980
13.35	Bus lane Greening	m2	n/a	70.00	0
13.36	BUS STOP marking	no	6	100.00	600
13.37	STOP marking	no	1	100.00	100
13.38	Zebra crossing	m	n/a	6.00	0

	Description	Unit	Quantity	Rate	Total
	Sub Total				36,465
13.40	**Signage**				
13.41	Allow for new signage	LS	1	2,000.00	2,000
	Sub Total				2,000
13.43	**Traffic Signal**				
13.44	Relocation existing traffic signal	no	n/a	10,000.00	0
13.45	Allow to revise traffic signals	No	n/a	50,000.00	0
	Sub Total				0
13.47	**Guard rail**				
13.48	W-Section guard rail	m	n/a	100.00	0
13.49	Leading terminal	no	n/a	4,000.00	0
13.50	Trail terminal	no	n/a	2,000.00	0
	Sub Total				0
	Sub Total for Traffic Service				38,465
13.53	**LANDSCAPE**				
13.54	Allow to modify traffic island	LS	n/a	1,500.00	0
13.55	Median traffic island to tie into existing	m2	n/a	200.00	0
13.56	Raise cycle path	m2	n/a	120.00	0
13.57	Raised table crossing	m2	460	220.00	101,251
13.58	Footpath	m2	266	120.00	31,920
13.59	400mm wide175mm high raised separator - CY0004	m	339	650.00	220,064
13.60	Bus shelter	no	1	45,000.00	45,000
13.61	Street furniture to bus stop locations	no	1	5,000.00	5,000
	Sub Total for Landscaping				403,235
13.63	**ALLOWANCE FOR NIGHT WORKS**				
13.64	Night works	%	722,145	0.10	72,215
	Sub Total for Allowance for Night Works				72,215
	TOTAL FOR THIS SECTION				794,360

Beca Cost Management

	Description	Unit	Quantity	Rate	Total
14.1	**Service Relocation**				
14.2	Allow for underground power line as advised by engineer	LS	1	2,000,000.00	2,000,000
14.3	**Landscape**				
14.4	Existing footpath upgrading as advised by engineer	m2	4,500	150.00	675,000

	Description	Unit	Quantity	Rate	Total
15.1	**Environmental Compliance**				
15.2	Allowance for environmental compliance	LS	1	60,000.00	60,000
	Total for Environmental Compliance				**60,000**

	Description	Unit	Quantity	Rate	Total
16.1	**Traffic Management**				
16.2	Allowance for traffic management	LS	1	2,437,600.00	2,437,600
16.3	Rounding	LS	1	2,400.00	2,400
	Total for Traffic Management				**2,440,000**

	Description	Unit	Quantity	Rate	Total
17.1	**Preliminary and General**				
17.2	Allowance for Preliminary and General (20%)	%	22,466,680	0.20	4,493,336
17.3	Rounding	LS	1	-16.00	-16
	Total for Preliminary and General				**4,493,320**

	Description	Unit	Quantity	Rate	Total
18.1	**Fees**				
18.2	Allowance for project development phase	%		Nil	0
18.3	Allowance for Pre-implementation phase (7%)	%	26,960,016	0.07	1,954,601
18.4	Allowance for consultancy fees, AT managed costs and construction monitoring fees (6%)	%	26,960,016	0.06	1,617,601
18.5	Rounding	LS	1	-2,202.00	-2,202
	Total for Fees				**3,570,000**

ESTIMATE DETAIL - LAKE ROAD DBC

Beca Cost Management

	Description	Unit	Quantity	Rate	Total
20.1	**Contingency**				
20.2	Allowance for construction (25%)	%	26,960,000	0.25	6,740,000
20.3	Allowance for project development phase	%		Nil	0
20.4	Allowance for Pre-implementation phase (25%)	%	1,954,601	0.25	488,650
20.5	Allowance for consultancy fees, AT managed costs and construction monitoring fees (25%)	%	1,617,601	0.25	404,400
20.6	Rounding	LS	1	-3,051.00	-3,051
	Total for Contingency				**7,630,000**

	Description	Unit	Quantity	Rate	Total
22.1	**Funding Risk**				
22.2	Funding risk for construction (15%)	%	33,700,000	0.15	5,055,000
22.3	Funding risk for project development phase	%	0	Nil	0
22.4	Funding risk for implementation phase (15%)	%	2,443,251	0.15	366,488
22.5	Funding risk for consultancy fees, AT managed costs and construction monitoring fees (15%)	%	2,022,001	0.15	303,300
22.6	Rounding	LS	1	-4,788.00	-4,788
	Total for Funding Risk				**5,720,000**

Appendix N: Consenting Strategy

Lake Road DBC – Consenting Strategy

Technical Note

Prepared for Auckland Transport
Prepared by Beca Limited

3 September 2020

Creative people together transforming our world

Contents

Appendices

No table of contents entries found.

Revision History

Revision Nº	Prepared By	Description	Date
0.1	**Liam Winter**	Draft for review	13 July 2020
1.0	**Liam Winter**	Final	3 September 2020

Document Acceptance

Action	Name	Signed	Date
Prepared by	**Liam Winter**		
Reviewed by	**Andy Lightowler**		
Approved by			
on behalf of	Beca Limited		

1 Introduction

1.1 Purpose of this technical note

This technical note serves as an appendix to the Lake Road Detailed Business Case (DBC). Its purpose is to provide a high-level summary of the consenting requirements associated with the preferred option for the Lake Road Improvements Project ('the project') under the Auckland Unitary Plan Operative in Part (AUP-OP).

1.2 Limitations and assumptions

This technical note is a high-level summary only, and it is anticipated that it will need to be revisited and updated during the pre-implementation (detailed design and consenting) stage of the project. The following limitations and assumptions should be noted:

- The findings are based on desktop analysis only based on the Preliminary Design Drawing Set provided on 13 July 2020;
- At the time of writing, the drawing set did not include the Esmonde Road section of the project, and accordingly the consenting requirements associated with that section are not included in this report; and
- The analysis has assumed based on the draft preliminary designs provided, which indicates that the proposed improvements can be accommodated with the existing road reserve, and accordingly that no Notices of Requirement and/or property acquisition are required.

2 The Project

The project extent includes a 4.3km length of Lake Road traversing the Devonport Peninsula between Esmonde Road in the north and Albert Road in the south. It also includes improvements to Bayswater Avenue and Esmonde Road.

As noted in the main DBC document, the project comprises the following main elements:

- Provision of continuous upgraded (separated where possible) cycle facilities along Lake Road between Albert Road and Esmonde Road;
- Provision of targeted high occupancy vehicle lanes (transit lanes) on Lake Road between Seabreeze Avenue and Esmonde Road;
- Conversion of the existing westbound bus lane on Esmonde Road to a transit lane which is extended to the State Highway 1 (SH1) ramp signals;
- Improved cycle facilities along Bayswater Avenue (between Lake Road and the Bayswater Ferry Terminal); and
- Undergrounding of power lines on Lake Road to provide space to improve pedestrian amenity in the vicinity of Takapuna Grammar school, funding permitting.

3 Planning Context

3.1 Zoning

Existing road reserves, within which the project is assumed to be entirely accommodated, are not subject to a land use zoning in the AUP-OP. A short section of the project (Lake Road approx. chainage 2350) traverses an Open Space – Informal Recreation Reserve zoned area (Belmont Rosegardens) which applies to the existing road.

The following zones apply to the areas surrounding the project:

- The project area is largely surrounded by areas of residential zoning, with the majority of the corridor traversing areas of Mixed Housing Urban (MHU) and Mixed Housing Suburban (MHS) zoning. The southern end of Lake Road is dominated by Single House zoning, while the Terrace Housing and Apartment Building (THAB) zone has been applied along both Esmonde Road and near the Belmont centre;
- The project area adjoins several centre-zoned areas. These include Local Centres at Hauraki Corner and Belmont, and Neighbourhood Centres near Hororata Road and Old Lake Road. The Belmont centre also contains an area of Mixed-Use zoning;
- The project area adjoins several areas of open space zoning, notably including the Waitemata Golf Club, Belmont Park and Bayswater Park (all zoned Open Space – Sports and Recreation), the O'Neill's Point Cemetery and Quentin Park (both zoned Open Space – Conservation), and several areas of Open Space – Informal Recreation zone;
- There is a small area of Light Industrial zoning north of the Devonport Fire Station; and
- There are several schools adjoining the project area. The state schools (Takapuna Grammar, Belmont Intermediate, Bayswater Primary) follow their adjoining residential zoning, while the Wilson School has a Special Purpose – Healthcare Facility and Hospital zoning.

3.2 Overlays

3.2.1 Significant Ecological Areas

The Significant Ecological Area – Terrestrial (SEA-T) overlay applies to an approximately 35m section within the road reserve between Hanlon Crescent and Seabreeze Road. The Significant Ecological Area – Marine 2 (SEA-M2) overlay also applies to the immediate west of the road reserve in the same location.

3.2.2 Notable Trees

The project area passes properties containing several trees listed in the notable tree schedule (Schedule 10 of the AUP-OP). These are listed below. The project does not propose the removal of any of these trees:

- ID 1203 – Pohutukawa at 53 Lake Road;
- ID 1204 – Pohutukawa at 210 Lake Road (Takapuna Grammar School), described as a single tree on the road frontage;
- ID 1205 – 2x Pohutukawa and 2x Norfolk Pine at 212 Lake Road;
- ID 1206 – Totara at 228 Lake Road;
- ID 1207 – Pohutukawa at 242A Lake Road;
- ID 1208 – 2x Puriri at 270 Lake Road;
- ID 1209 – 3x Pohutukawa at 302 Lake Road;
- ID 1211 – Norfolk Pine at 419 Lake Road;
- ID 1269 – 2x Puriri at 2A Onepoto Road;
- ID 1339 – Coral Tree at 2 Rewiti Avenue; and
- ID 2945 – Norfolk Pine and Pohutukawa in the Memorial Drive section of Lake Road adjacent to the Waitemata Golf Course. The schedule states two trees in total, but it is unclear which these are given that there are ~400m row of Norfolk Pines on the eastern side of the road, and a ~270m row of Pohutukawa on the western side of the road in the general locality.

3.2.3 Regionally Significant Viewshafts

The project area is subject to the following Regionally Significant Volcanic Viewshafts listed in the Volcanic Viewshafts Schedule (Schedule 9 of the AUP-OP):

- ID V1 – Mount Victoria viewshaft – applies to Lake Road between Clifton Road and Albert Road; and
- ID T3 – Rangitoto Island viewshaft – applies to Bayswater Avenue and Lake Road between Belmont and Narrow Neck.

3.2.4 Historic Heritage and Special Character

The project area passes several historic heritage places and extents of place listed in the Schedule of Historic Heritage (Schedule 14.1 of the AUP-OP). The project does not propose the removal of any of these features:

- ID 1050 – Frank Sargeson cottage, 14A Esmonde Road;
- ID 1080 – Grace Abbot residence, 415 Lake Road (extent partially in road reserve);
- ID 1055 – Former Duddings Store, 335 Lake Road;
- ID 1079 – St Leonards/Wilson complex, 212 Lake Road;
- ID 1111 – Takapuna Grammar School;
- ID 1104 – St Michael and All Angels Church, 159 Bayswater Avenue (extent partially in road reserve);
- ID 1144 – O'Neills Point Cemetery, 122 Bayswater Avenue;
- ID 1215 – Residence, 21 Bayswater Avenue;
- ID 2694 – Devonport Jubilee Clock, 63 Lake Road (extent partially within road reserve);
- ID 1146 – Memorial Drive (extent partially within road reserve);
- ID 2693 – Former Auckland Gas and Fire Brick Company Building, Clay Store Concrete Retaining Wall / Brickworks Site, 27 Lake Road;
- ID 1170 – Residence, 24 Allenby Avenue; and
- ID 1112 – Former Buffalo Hall / Court Victoria Hall (extent partially within road reserve).

The Special Character Overlay applies to virtually all of the Single House zoned residential sites along Lake Road south of the Waitemata Golf Course.

3.3 Controls

3.3.1 Arterial Road

The arterial road control applies to Lake Road south of Esmonde Road, and Esmonde Road. This control in turn triggers rules in section E27 of the AUP-OP relating to vehicle access restrictions and reverse manoeuvring restrictions.

3.3.2 Vehicle Access Restrictions

General vehicle access restriction controls apply to the following localities:

- The section of Lake Road between Hart Road and Jutland Road (Hauraki Corner local centre); and
- The section of Lake Road between Egremont Street and Bayswater Avenue (Belmont local centre).

The motorway interchange vehicle access restriction control applies to Esmonde Road between Barrys Point Road and Burns Avenue.

3.3.3 Coastal Inundation 1% AEP + 1m Control

The coastal inundation 1% AEP +1m control applies to an approximately 450m long section of Lake Road adjacent to the Waitemata Golf Course.

3.4 Precincts

3.4.1 Devonport Peninsula sub-precinct F

The Devonport Peninsula Precinct applies to several areas of former Navy housing land, and seeks to provide for comprehensive residential development by enabling greater intensity of development. The eastern boundary of Sub-Precinct F (Wakakura Crescent) adjoins Lake Road between Ngataringa and Seabreeze Roads. The Precinct provisions enable building heights of up to 8m on the Lake Road frontage, with a minimum front yard depth of 3m facing Lake Road.

3.5 Designations

The following designations adjoin the project area. The project does not propose to occupy any of these designations:

- Designation 4548 – Education purposes – Takapuna Grammar School (Minister of Education);
- Designation 4506 – Education purposes – Belmont Intermediate School (Minister of Education);
- Designation 4504 – Education purposes – Bayswater Primary School (Minister of Education);
- Designation 8870 – Electricity works (substation) (Vector); and
- Designation 7523 / 2621 – Telecommunication and radiocommunication and ancillary purposes (Spark / Chorus).

In addition, Designation 4311 (Ministry of Defence) applies to the airspace over much of the project area.

4 Consent Requirements

4.1 Consents Required

4.1.1 Relevant AUP-OP provisions

An assessment of the planning provisions pertinent to the project is provided in Table 1. This assessment is based on the current understanding of the project, its planning context, and should be read having regard to the limitations and assumptions noted in section 1.2 of this report.

In particular it is important to reiterate that this assessment assumes that all proposed works are within the road reserve. On this basis, it is assumed that the provisions of AUP-OP Chapter E26 – Infrastructure apply.

Table 1 – Assessment of consents required for the Lake Road Improvements Project

Proposed Activity	Approximate location(s)	Relevant Rules	Activity Status
Undergrounding of existing power lines in the road reserve.	Lake Road – approx. chainage 800-2300	E26.2.3.1(A6) – Removal of network utilities and electricity generation facilities. E26.2.3.1 (A22) – Underground electricity lines E26.5.3.1 (A97A) – Earthworks greater than 2500m3 other than for maintenance, repair, renewal, minor infrastructure upgrading	Permitted Permitted Restricted Discretionary
Potential vegetation alteration within an SEA-T.	Lake Road – approx. chainage 3400-3500	E26.3.3.1 (A76 / A77) – Vegetation alteration or removal	Permitted or Restricted Discretionary, depending on whether Permitted Activity Standards (E26.3.5) are met.
Potential tree trimming or alteration	Multiple locations – TBC. Higher risk locations include Bayswater Avenue approx. chainage 1800-2000.	E26.4.3.1 (A83 / A84) – Tree trimming or alteration	Permitted or Restricted Discretionary, depending on compliance with standards E26.4.5.1 (trees in roads) or E26.4.5.3 (notable trees).

Proposed Activity	Approximate location(s)	Relevant Rules	Activity Status
Potential Works within the protected root zone of trees	Multiple locations – TBC. Higher risk locations include Bayswater Avenue approx. chainage 1800-2000.	E26.4.3.1(A87) – Works within the protected root zone that comply with Standard E26.4.5.2. E26.4.3.1(A88) – Works within the protected root zone not otherwise provided for.	Permitted Restricted Discretionary
Earthworks	Multiple locations – TBC	E26.5.3.1 (A96) – Earthworks up to 2500m³ other than for maintenance, repair, renewal, minor infrastructure upgrading. E26.5.3.1 (A97A) – Earthworks greater than 2500m³ other than for maintenance, repair, renewal, minor infrastructure upgrading	Permitted Restricted discretionary
Road network activities within a regionally significant volcanic viewshaft	Whole of corridor	E26.11.3.1 (A155) – Minor upgrading of road network utilities. E26.11.3.1 (A160, A161, A162) – Road network activities comprising road lighting and associated support structures, traffic and direction and road name signs, traffic safety and operational signals, traffic signals, traffic information signage, and support structures.	Permitted Permitted
Road network activities within the Historic Heritage Overlay	Multiple locations – up to twelve throughout the corridor – TBC	E26.8.3.1(A120) – Minor upgrading of road network utilities. E26.8.3.1 (A126, A127, A128) – Road network activities comprising road lighting and associated support structures, traffic and direction and road name signs, traffic safety and operational signals, traffic signals, traffic information signage, and support structures. E26.8.3.1 (A131) – Network utilities that do not comply with permitted activity standards in E26.8.5.1.	Permitted Permitted or Restricted Discretionary, depending on compliance with permitted activity standards (E26.8.5.1). Restricted Discretionary

Proposed Activity	Approximate location(s)	Relevant Rules	Activity Status
Works within the coastal inundation 1% AEP + 1m control	Lake Road – approx. chainage 3400-3900	E36.4.1 (A53) – Construction, operation, maintenance, renewal, and repair of road network activities within the legal road or road formation width in the coastal inundation 1% AEP + 1m control area.	Permitted

4.1.2 Belmont Rosegardens section

Notwithstanding the above stated assumption that the project falls entirely with the road reserve, a short ~25 metre section of the project (at approx. chainage 2350) falls within an Open Space – Informal Recreation zone associated with the Belmont Rosegarden (see Figure 1). The street address is given as R152 Lake Road.

Figure 1 – Belmont Rosegardens reserve in the context of Lake Road

While within reserve land, the area subject to the project functions as part of the road, and contains a vehicular slip lane, parking, and bus stops. The reason for the application of open space zoning to the road is unclear, but is likely a historical anomaly of how allotments were vested in legacy councils. It is unclear whether there is an easement across the reserve enabling the road.

The Open Space – Informal Recreation zone does not provide for road network activities, and accordingly under standard H7.9.1(A1) would be a non-complying activity (as an activity not provided for). However., given that the area already functions as part of the road corridor, it is expected that the anomaly could be resolved by negotiation between Auckland Transport and Auckland Council without triggering the non-complying activity status. This may include registration of an easement, a land swap, or simply a rezoning of the relevant part of the site to reflect its existing use.

4.2 Overall Activity Status

As can be seen from Table 1, further design and construction methodology detail is required before the activity status of the project as a whole can be ascertained. This will be undertaken in the detailed design stage. Numerous activities are subject to permitted activity assessment criteria, on which a determination cannot yet be made as to compliance with the level of design detail currently available.

Accordingly, while it is eminently conceivable that the proposed works may be able to be undertaken as a permitted activity (subject to compliance with the applicable permitted activity standards), a conservative assumption would be that the project as a whole would require resource consent as a **restricted discretionary** activity. This assumes that the above-noted Belmont Rosegarden anomaly is resolved.

Drawing on the table above, the likely resource consents under a conservative/worst case scenario to be required under the AUP-OP include:

- Earthworks greater than 2500m^3 pursuant to rule E26.5.3.1 (A97A) – restricted discretionary (district plan only);
- Vegetation alteration or removal pursuant to rule E26.3.3.1 (A76/A77) – restricted discretionary (regional plan within SEA, otherwise district plan only);
- Tree trimming or alteration pursuant to rule E26.4.3.1 (A83/A84) – restricted discretionary (district plan only);
- Works within the protected root zone of a tree pursuant to rule E26.4.3.1 (A88) – restricted discretionary (district plan only); and
- Road network activities within the historic heritage overlay pursuant to rules E26.8.3.1 (A126-128, A131) – restricted discretionary (district plan only).

4.3 Further Information Requirements

In addition to the additional design and construction methodology detail noted above, the following further information at the detailed design stage would be instructive in finalising the consent requirements:

- Arboricultural Report – to confirm and assess the potential effects on trees along the corridor and identify potential mitigation options;
- Social Impact Assessment – to identify the potential construction and operational effects on those directly affected by the project and the wider community;
- Urban and Landscape Assessment – to identify how the project can be best integrated into the context of the existing environment, how any landscape and visual amenity effects can be mitigated, and any opportunities for enhancement/betterment;
- Mana Whenua consultation – to identify any potential cultural effects associated with the project and any other items of interest to mana whenua; and
- Heritage Assessment – to confirm and assess the potential effects on the heritage features identified along the route in this report.

Appendix O: Construction Report

3 September 2020

Andy Lightowler
Technical Director
Transport Advisory
Beca
Auckland.

Dear Andy

Lake Road Detailed Business Case – Constructability Report

Auckland Transport (AT) is investigating how they can improve travel choices and the reliability of travel along Lake and Esmonde Roads, between Takapuna and the Devonport peninsula. They have engaged Beca to prepare a Detailed Business Case for the work, based on a preliminary design. Beca have engaged BondCM to review the traffic management and constructability of the proposed works as detailed on the latest issue of the preliminary design drawings.

Background

Lake Road is the only arterial road in and out of the Devonport peninsula and alongside Esmonde Road serves as the main connection to the rest of the North Shore and Auckland for people living and working in the area. Lake Road is also the designated transportation route for the Devonport Naval Dockyard facility for both personnel and equipment. As a result, Lake Road must cope with heavy peak commuter flows in both directions.

The local community has raised concerns about the unpredictability of travel conditions along Lake Road during both weekday peak times and the weekends. The Preliminary Design uses a mix of new and re-purposed transit lanes (for higher occupancy vehicles and public transport), walking and cycling facilities, and technology solutions to improve travel options and trip information. Around half of all Lake Road journeys are short trips, that stay within the peninsula and the proposed solution will provide residents making these short trips with good alternatives to driving, freeing up space on Lake Road for people making longer trips by car or who have other reasons to drive.

Safety is a major focus for AT. The aim of the improvements is to make using Lake Road and Belmont Road safer, regardless of people's mode of travel. With the high volumes of traffic, the preliminary design comprises physically protected cycle lanes, safer pedestrian crossings and safer intersections.

Information Provided

Beca provided BondCM with a draft copy of the preliminary design drawings (Rev 1) for discussion on 10 July. We undertook a site visit on the 15 July and provided feedback to Beca prior to a Safety in Design workshop held on 29 July.

BondCM have now been provided with the updated preliminary design drawings (Rev A) which have been revised to address the key issues that we highlighted following our site visit.

We have not been provided with any draft consents and have therefore based our traffic management and constructability assessments on previous work undertaken for AT on their transportation projects.

Traffic Management
Lake Road is a very busy arterial route, even off-peak in the school holidays. Peak flows are typically in both directions, with commuters heading in and out of the Auckland CBD and navy personnel heading to and from the naval dockyard facility. There is significant congestion, especially during school terms. We have not been provided with any consented working time restrictions so have assumed that AT would impose restrictions to site working hours Monday to Friday. This would have a significant impact on daily construction productivities for daytime working.

Even outside of these hours, the proposed works will involve significant traffic management planning and stakeholder engagement to manage traffic flows effectively. With traffic volumes and the need to provide a safe working environment for the construction activities, there will unfortunately be some delays to commuters that will be unavoidable. Consideration could be given to working at night and on weekends to lessen the impact on the travelling public and to maximise construction productivities. Night and weekend work activities would however have further impact on residents living alongside the road and would require significant stakeholder engagement during design and construction. Ultimately, it is likely to be impractical to work at night in a residential area.

Traffic management for construction will require all central medians and hatching to be removed. There is sufficient road width to move the traffic around the worksites between Esmonde Road and Northumberland Avenue (Ch 1350) but it will require a single lane in each direction to avoid compromising the new cycle lane. There will be no provision for Transit lanes during construction work unless the new cycle lane can be used for traffic.

Construction of the cycleway will need to be undertaken in a series of worksites dictated by the intersections spacing. One side will have to be completed before moving to the other side of the road.

Segregation of pedestrian and cyclists through the worksites will require considerable planning as will maintaining access to properties.

The section from Northumberland Avenue (Ch1350) to Winscombe Street, in front of Takapuna Grammar School, would be best undertaken in the summer holidays to reduce the impact on traffic flows. However, there is insufficient road width along this section to maintain two-way traffic flows and a safe construction working area unless the new cycle lane can be used for vehicles. We have assumed that one-way traffic light operation will not be allowed by AT on this arterial route.

The same comment above applies to the section from Winscombe Street to Egremont Street.

From Egremont Street to Kawerau Avenue there is central median which is of sufficient width to allow two-way traffic flows and a safe construction working area.

The section from Kawerau Avenue to Seabreeze Road has insufficient road width to maintain two-way traffic flow and a safe construction working area, unless the new cycle lane can be used for vehicles.

The section from Seabreeze Road to Albert Road has sufficient road width to allow two-way traffic flows and a safe construction working area.

The same comment above applies for the works shown in Bayswater Road.

We envisage that traffic management cost will be a significant part of the overall project cost and will require careful consideration. It will be appreciably higher than would normally be expected for this type of project due to the high volume of traffic flows, duration, complexity of construction and the necessity for extensive stakeholder management. We would suggest an allowance of between 15-20% of the construction physical works cost be allowed for traffic management.

Construction

Typical cross-sections on the preliminary drawings have been revised following our comments from our site visit. Lake Road and Bayswater Avenue have quite a high central crown relative to the kerb which has had substantial hotmix overlays since the kerb and channel were laid.

Existing kerb lines are a mixture of Bluestone kerbs and in-situ concrete sections which will all need to be replaced and uplifted to provide an elevated cycleway The elevated cycleway will involve the footpaths also being reprofiled and upgraded.

There may be issues where the footpath height is increased, relative to the floor level of the adjacent property where the property is low lying, i.e. water could run off the footpath into the property. See photo below.

All the cesspits on Lake Road and Bayswater Avenue are located on the existing kerbline. The raised cycleway will involve some major drainage works to relocate the cesspits to the outside of the cycleway.

We also note that there are also some very flat longitudinal sections along Bayswater Road and Lake Road. This is particularly evident on the section on Lake Road between Reweti and Cameron Roads on the northern side of the road, and Napier and Ewen Roads on the southern side both of which have an 'Acco' longitudinal drain running parallel with the existing kerb line.

These would have to be replicated on the outside of the cycleway and some thought will need to be given to how to ensure that the cycleway drainage prevents ponding, without using slot drains which would introduce a potential hazard to anyone using a narrow tyred racing bike. See photos below.

Creating a raised threshold at the Reweti Road intersection could potentially remove an overland flow path down Reweti Road and cause localised flooding on Lake Road. This will need to be addressed during detailed design.

Construction Sequence

The proposed works lend themselves to being procured in a series of work packages over a number of years, to suit budgetary requirements and limit the intensity and duration of the inevitable disruption that the works will cause to local stakeholders. We envisage the work being split into a series of work packages of about 6 months duration and approximately 600m in length. These will be based around the intersections onto Lake Road, possibly with the works on Bayswater Avenue running at the same time to effectively deploy resources during the peak flow work restrictions on Lake Road.

The feasibility of having more than one work package running concurrently to reduce the duration and therefore the impact of the works, will ultimately be mainly dependent on the capacity of local stakeholders to withstand the inevitable disruption. It is hoped that the incentive of the replacement the visibly aged streetscape with a vibrant new user-friendly streetscape, effective stakeholder engagement and sound planning during detailed design and construction and will ensure the success of the project which will ultimately benefit the community.

If you have any queries regarding this report, please do not hesitate to contact me on 0275-412446.

Yours faithfully
Jonathan Broome
Bond Construction Management Ltd

Appendix P: Risk Register

Risk Assessment Register
Lake Road

Job No: **3820149**

Approved By: **Andy Lightowler**

Date: **01-Aug-20**

Stage of Design / Project: **Preliminary Design**

REF	IDENTIFIED RISK												RESIDUAL RISK			COMMENTS	
	Risk Category	Risk Title	Risk Description, Cause & Outcome	Threat / Opportunity	Risk Owner	Owning Org	Project Phase	Existing controls (& Effectiveness)	Likeli-hood	Conse-quence	Severity Rating	PROPOSED CONTROLS	Likeli-hood	Conse-quence	Severity Rating	Updates	Closure comments
F 01	Funding	Preliminary Cost Estimates	Description: There is a threat that the cost estimates do not reflect the actual cost required to complete the project. Cause: The cause of the threat is underestimation of quantities or cost allowances Consequence: The consequence of the threat is increased costs or possibly reduced scope; Project will need to be split into two sections. The second section would require increased funding; Potential delay to second stage construction	Threat		Beca	Operations		Possible	Significant	High Threat	Cost estimates have been developed in accordance with Waka Kotahi standards (SM014 and Z/44). Estimate to be independently assessed through a parallel estimate on commencement of detailed design.	Possible	Significant	High Threat		
STK 01	Stakeholders	Stakeholder objection to removal of parking	Description: There is a threat that stakeholders object to removal of parking. Cause: The cause of the threat is the scheme involves removal of up to 50 carparks from a residential area, some sections of which are actively used. Consequence: The consequence of the threat is project delay and public objection.	Threat		Beca	Operations		Possible	Moderate	Medium Threat	Ongoing engagement with stakeholders to understand concerns and continue to explore avenues to address community concerns.	Possible	Moderate	Medium Threat		
STK 02	Stakeholders	Stakeholder objection to final project decisions	Description: There is a threat that stakeholder objection to final project decisions. Cause: The cause of the threat is main stakeholders not satisfied with outcome of the consultations and affected by project decisions Consequence: The consequence of the threat is negative impact to the moral of AT Projects.	Threat		Beca	Operations		Possible	Significant	High Threat	Ongoing engagement with stakeholders to understand concerns and continue to explore avenues to address community concerns.	Possible	Significant	High Threat		
STK 03	Stakeholders	Additional scope or changes to agreed treatments	Description: There is a threat that additional scope or changes to agreed treatments is required. Cause: The cause of the threat is requests for additional features or removal by client and stakeholders Consequence: The consequence of the threat is significant negative impacts to both cost and delivery timeframes.	Threat		Beca	Operations		Possible	Moderate	Medium Threat		Possible	Moderate	Medium Threat		
PS 01	Project Scope	Project does not meet public's expectation.	Description: There is a threat that the completed project does not meet the public's expectation. Cause: The cause of the threat is poor communication of project scope; project scope limited to reducing the frequency and extent of inundation. Consequence: The consequence of the threat is reputational damage; negative media coverage; scope change.	Threat		Beca	Operations		Possible	Moderate	Medium Threat	Ongoing engagement with stakeholders to understand concerns and continue to explore avenues to address community concerns.	Possible	Moderate	Medium Threat		
STK 04	Stakeholders	AT to include additional elements to the obtain all key stakeholder approvals.	Description: There is a threat that Auckland Transport are required to include additional elements to the project scope to obtain all key stakeholder approvals. Cause: The cause of the threat is multiple stakeholders with diverse and competing requirements object to AT scope; tight design and approval timeframes. Consequence: The consequence of the threat is	Threat		Beca	Operations		Possible	Low	Low Threat		Possible	Low	Low Threat		
PM 01	Programme	Identify resources with the appropriate competency suited to the project	Description: There is an opportunity to identify resources with the appropriate competency and experience suited to each of the remaining project phases e.g. detailed design and construction. Cause: The cause of the opportunity is to identify suitable resources within AT and project team to work on this high profile project. Consequence: The consequence of the opportunity is a high performing team.	Opportunity		Beca	Operations		Unlikely	Moderate	Low Threat		Unlikely	Moderate	Low Threat		

Sensitivity: General

Risk Assessment Register
Lake Road

Job No: 3820149

Approved By: **Andy Lightowler**

Date: **01-Aug-20**

Stage of Design / Project: **Preliminary Design**

REF	IDENTIFIED RISK										PROPOSED CONTROLS	RESIDUAL RISK			COMMENTS	
	Risk Category	Risk Title	Risk Description, Cause & Outcome	Threat / Opportunity	Risk Owner	Owning Org	Project Phase	Existing controls (& Effectiveness)	Likeli-hood	Conse-quence	Severity Rating		Likeli-hood	Conse-quence	Severity Rating	Updates	Closure comments
PM 02	Programme	Slow decision making by stakeholders	Description: There is a threat that there is slow decision making/approvals by Auckland Transport/Auckland Council/Other stakeholders to meet the requirements of the programme milestones. Cause: The cause of the threat is tight programme and the requirement for AT to get sign off from a significant number of internal and external stakeholders . Consequence: The consequence of the threat is project delays; late changes in AT requirements due to stakeholder competing/unforeseen requirements; scope change; additional cost.	Threat		Beca	Operations		Likely	Moderate	Medium Threat		Likely	Moderate	Medium Threat		
PM 03	Programme	Works delayed by public event	Description: There is a threat that construction works delayed as a result of an unforeseen public event. Cause: The cause of the threat is a lack of engagement with AC / AT to identify upcoming events and confirm timing and duration. Consequence: The consequence of the threat is construction delays; additional temporary works; extension of time claims.	Threat		Beca	Operations		Unlikely	Moderate	Low Threat		Unlikely	Moderate	Low Threat		
F 02	Funding	Detailed design costs are higher than the project budget	Description: There is a threat that detailed design costs or the tenders received are higher than the project budget. Cause: The cause of the threat is design and/or estimate has not been scoped appropriately; estimating error or omission; change in market conditions. Consequence: The consequence of the threat is funding shortfall; project delays; design rework; late scope adjustments.	Threat		Beca	Operations		Possible	Significant	High Threat	Cost estimates have been developed in accordance with Waka Kotahi standards (SM014 and Z/44). Estimate to be independently assessed through a parallel estimate on commencement of detailed design.	Possible	Significant	High Threat		
F 03	Funding	Costs to operate facility is higher than budget	Description: There is a threat that on-going costs to maintain and operate the facility are higher than acceptable and budgeted for by AT. Cause: The cause of the threat is that the use of materials that are costly to maintain; design does not consider life-cycles costs, the minimisation of vandalism, weather deterioration and/or dangerous access to areas to carry out repairs at height. Consequence: The consequence of the threat is increase in maintenance costs; potential health and safety issues; requirement to use specialist contractors.	Threat		Beca	Operations		Possible	Moderate	Medium Threat		Possible	Moderate	Medium Threat		
STK 05	Stakeholders	Lower uptake of users of new facility than anticipated and POBs use the narrowed traffic lanes instead.	Description: There is a threat that there is a lower uptake of users of new facility than anticipated and POBs use the narrowed traffic lanes instead. Cause: The cause of the threat is POB want to avoid interacting with pedestrians / children; POB want to avoid "dooring" as some parking adjacent to facility; H & S hazard associated with striking low tree limbs; POB training groups want to go fast. Consequence: The consequence of the threat is reputation damage; negative media coverage; Health and Safety issues.	Threat		Beca	Operations		Possible	Significant	High Threat		Possible	Significant	High Threat		
STK 06	Stakeholders	Disruption during construction will impact businesses	Description: There is a threat that disruption during construction will impact business operations and finance to greater extent than anticipated. Cause: The cause of the threat is construction activity making the area less attractive or accessible; delay to completion of construction works; unexpected items encountered resulting in greater disruption. Consequence: The consequence of the threat is reputation damage to AT; businesses seeking legal action	Threat		Beca	Construction		Possible	Significant	High Threat		Possible	Significant	High Threat		
Con 01	Consenting	Resource consenting process becomes extended	Description: There is a threat that Resource Consenting process becomes extended due to notification requirements or delayed agreement with stakeholders. Cause: The cause of the threat is potential difficulties reaching agreement with key stakeholders with significant changes to the environment e.g. tree removal/ relocations, removal of carparks, forming cycle lane structures. Consequence: The consequence of the threat is project delays; design change.	Threat		Beca	Operations		Possible	Significant	High Threat		Possible	Significant	High Threat		

Risk Assessment Register
Lake Road

Job No: 3820149
Approved By: Andy Lightowler
Date: 01-Aug-20
Stage of Design / Project: Preliminary Design

REF	IDENTIFIED RISK										PROPOSED CONTROLS	RESIDUAL RISK			COMMENTS	
	Risk Category	Risk Title	Risk Description, Cause & Outcome	Threat / Opportunity	Risk Owner	Owning Org	Project Phase	Existing controls (& Effectiveness)	Likeli-hood	Conse-quence	Severity Rating		Likeli-hood	Conse-quence	Severity Rating	Updates	Closure comments
Con 02	Consenting	Stormwater treatment design does not obtain a consent from AC.	Description: There is a threat that stormwater treatment design does not obtain a consent from AC. Cause: The cause of the threat is AC doesn't approve stormwater design. Consequence: The consequence of the threat is consenting delays; objections; scope creep; additional cost.	Threat		Beca	Operations		Unlikely	Significant	Medium Threat		Unlikely	Significant	Medium Threat		
Con 03	Consenting	Consent conditions are more onerous than assumed	Description: There is a threat that consent conditions are more onerous than assumed e.g. tree, earthworks, hours, noise Cause: The cause of the threat is poor consent process by AT team; stakeholder objections during consenting are upheld. Consequence: The consequence of the threat is project delays; design change; additional cost.	Threat		Beca	Operations		Possible	Moderate	Medium Threat		Possible	Moderate	Medium Threat		
Con 04	Consenting	Trees die following transplanting.	Description: There is a threat that trees die following transplanting. Cause: The cause of the threat is poor methodology; tree condition worse than assumed. Consequence: The consequence of the threat is reputational damage; negative media coverage; consent non-compliance.	Threat		Beca	Construction		Possible	Moderate	Medium Threat		Possible	Moderate	Medium Threat		
Con 05	Consenting	To enhance planting along the alignment to achieve a better amenity.	Description: There is an opportunity to enhance planting along the alignment to achieve a better amenity. Cause: The cause of the opportunity is establishing opportunities to increase planting levels. Consequence: The consequence of the opportunity is enhanced reputation; avoidance of consent delays / onerous conditions.	Opportunity		Beca	Operations		Almost Certain	Significant	High Threat		Almost Certain	Significant	High Threat		
CON 01	Construction	Contractor non compliance with consent conditions	Description: There is a threat that contractor non compliance with consent conditions e.g. dust; noise etc. Cause: The cause of the threat is procurement of an inexperienced Contractor chosen on price rather than experience, methodology and resources. Consequence: The consequence of the threat is reputation; negative media coverage; consent non-compliance; abatement notice; project delays.	Threat		Beca	Construction		Unlikely	Moderate	Low Threat		Unlikely	Moderate	Low Threat		
HSE 02	Health and Safety	Member of the public is injured while using the facility post construction.	Description: There is a threat that a member of the public is injured while using the facility post construction. Cause: The cause of the threat is that design not adequate to accommodate demand / interest of potential users. Consequence: The consequence of the threat is medical treatment / hospitalisation; Negative media coverage; Reputation damage to AT; Retrofitting additional safety measures.	Threat		Beca	Construction		Possible	Significant	High Threat		Possible	Significant	High Threat		
D 01	Design	Delay in obtaining approval from AC for working around tree roots leading to scope creep.	Description: There is a threat that delay in obtaining approval from AC for working around tree roots leading to scope creep. Cause: The cause of the threat is proposed path connections interfere with roots. Consequence: The consequence of the threat is cost; design rework; consent delays.	Threat		Beca	Design		Possible	Significant	High Threat		Possible	Significant	High Threat		

Risk Assessment Register
Lake Road

Job No: **3820149**

Approved By: **Andy Lightowler**

Date: **01-Aug-20**

Stage of Design / Project: **Preliminary Design**

REF	IDENTIFIED RISK											PROPOSED CONTROLS	RESIDUAL RISK			COMMENTS	
	Risk Category	Risk Title	Risk Description, Cause & Outcome	Threat / Opportunity	Risk Owner	Owning Org	Project Phase	Existing controls (& Effectiveness)	Likeli-hood	Conse-quence	Severity Rating		Likeli-hood	Conse-quence	Severity Rating	Updates	Closure comments
D 02	Design	Design not approved by AT as a result of significant Road Safety Audit issues.	Description: There is a threat that design not approved by AT as a result of significant Road Safety Audit issues. Cause: The cause of the threat is design includes a number of departures and compromises from AT design standards. Consequence: The consequence of the threat is cost; Design rework; Consent delays.	Threat		Beca	Design		Possible	Significant	High Threat		Possible	Significant	High Threat		
D 03	Design	Scope and extent of utility services protection and/or relocation works is greater than anticipated.	Description: There is a threat that scope and extent of utility services protection and/or relocation works is greater than anticipated. Cause: The cause of the threat is limited investigation carried out to date to confirm condition; Delay in obtaining information / approval from utility providers. Consequence: The consequence of the threat is scope creep; design rework; construction programme delays; additional cost.	Threat		Beca	Design		Possible	Significant	High Threat		Possible	Significant	High Threat		
D 04	Design	To deliver innovative, vibrant and inclusive walking, cycle and streetscaping project that can be used as the benchmark for future projects.	Description: There is a threat that to deliver innovative, vibrant and inclusive walking, cycle and streetscaping project that can be used as the benchmark for future projects. Cause: The cause of the threat is ability to review previous projects to produce a design in collaboration with stakeholders, that can be used as a benchmark to for future project designs. Consequence: The consequence of the threat is positive media coverage; Enhance AT and project team reputation; Consistent design standards.	Threat		Beca	Design		Possible	Major	High Threat		Possible	Major	High Threat		
CON 02	Construction	Construction traffic causes congestion along the local road network.	Description: There is a threat that construction traffic causes congestion along the local road network. Cause: The cause of the threat is poor Contractor traffic management planning and implementation; Poor supervision and maintenance of traffic control measures. Consequence: The consequence of the threat is reputational damage; Frustrated road users & stakeholders; Change in methodology; Project delays.	Threat		Beca	Construction		Possible	Moderate	Medium Threat	Ongoing engagement and consultation with key stakeholders to present construction methodology and identify and resolve issues early. Communication with the public via open days, media coverage and consultation to present construction methodology.	Possible	Moderate	Medium Threat		
CON 03	Construction	Existing stormwater system is found to be poorer condition than anticipated and requires replacement.	Description: There is a threat that existing stormwater system is found to be poorer condition than anticipated and requires replacement. Cause: The cause of the threat is limited investigation carried out to date to confirm condition. Consequence: The consequence of the threat is Reputational damage; Frustrated road users & stakeholders; Change in methodology; Project delays.	Threat		Beca	Construction		Possible	Significant	High Threat	Ongoing engagement and consultation with key stakeholders to present construction methodology and identify and resolve issues early.	Possible	Significant	High Threat		
CON 04	Construction	Contractor inadvertently strikes a utility service.	Description: There is a threat that contractor inadvertently strikes a utility service. Cause: The cause of the threat is inadequate Contractor site investigations; Incorrect as-builts; Poor protection / construction methodology. Consequence: The consequence of the threat is Health & safety issue; Programme delays; Change in Contractor methodology.	Threat		Beca	Construction		Possible	Critical	Extreme Threat	Ongoing engagement and consultation with key stakeholders to present construction methodology and identify and resolve issues early.	Possible	Critical	Extreme Threat		
CON 05	Construction	Discovery of unforeseen contaminated material during construction.	Description: There is a threat that discovery of unforeseen contaminated material during construction. Cause: The cause of the threat is inadequate Contractor site investigations; Unforeseen contaminated materials. Consequence: The consequence of the threat is Health issues to construction personnel; Consenting issues; Programme delay	Threat		Beca	Construction		Possible	Significant	High Threat	Ongoing engagement and consultation with key stakeholders to present construction methodology and identify and resolve issues early.	Possible	Significant	High Threat		

Risk Assessment Register
Lake Road

Job No: **3820149**

Approved By: **Andy Lightowler**

Date: **01-Aug-20**

Stage of Design / Project: **Preliminary Design**

REF	IDENTIFIED RISK											PROPOSED CONTROLS	RESIDUAL RISK			COMMENTS	
	Risk Category	Risk Title	Risk Description, Cause & Outcome	Threat / Opportunity	Risk Owner	Owning Org	Project Phase	Existing controls (& Effectiveness)	Likeli-hood	Conse-quence	Severity Rating		Likeli-hood	Conse-quence	Severity Rating	Updates	Closure comments
CON 06	Construction	Archaeological find during construction	Description: There is a threat that archaeological find during construction Cause: The cause of the threat is Limitation of investigations; Unforeseen discovery. Consequence: The consequence of the threat is Project delays; Design rework.	Threat		Beca	Construction		Possible	Moderate	Medium Threat	Ongoing engagement and consultation with key stakeholders to present construction methodology and identify and resolve issues early.	Possible	Moderate	Medium Threat		
CON 07	Construction	Lack of temporary cycle facility available during construction.	Description: There is a threat that lack of temporary cycle facility available during construction. Cause: The cause of the threat is Constrained corridor with work being carried out on shared path and road corridor simultaneously. Consequence: The consequence of the threat is Health and safety issues if no safe temporary facility available; Reputational damage; Traffic congestion as a result of cyclists using the road.	Threat		Beca	Construction		Unlikely	Moderate	Low Threat	Ongoing engagement and consultation with key stakeholders to present construction methodology and identify and resolve issues early. Communication with the public via open days, media coverage and consultation to present construction methodology.	Unlikely	Moderate	Low Threat		
CON 09	Construction	Work completed by the Contractor is of a low quality and does not meet the requirements of the design / specification.	Description: There is a threat that work completed by the Contractor is of a low quality and does not meet the requirements of the design / specification. Cause: The cause of the threat is poor Contractor selected based on lowest conforming tender; lack of Contractor Quality Management systems and resources. Consequence: The consequence of the threat is project delays; prolonged disruption to local traffic / businesses; negative media coverage.	Threat		Beca	Construction		Unlikely	Significant	Medium Threat	Ongoing engagement and consultation with key stakeholders to present construction methodology and identify and resolve issues early.	Unlikely	Significant	Medium Threat		

Workshop Attendance: