Lincoln Road Corridor Improvements
Transport Assessment Report

Prepared for Auckland Transport

June 2016

MWH®

BUILDING A BETTER WORLD

QUALITY STATEMENT

PROJECT MANAGER	PROJECT TECHNICAL LEAD
Graeme Stanton	Jarrod Pettigrew

PREPARED BY	Matt Soper	
Matt Soper	.....	25/01/16
CHECKED BY		
Alan Gregory	.....	25/01/16
REVIEWED BY	G. Stanton	
Graeme Stanton	.....	25/01/16
APPROVED FOR ISSUE BY	G. Stanton	
Graeme Stanton	.....	25/01/16

AUCKLAND
MWH House Level 3, 111 Carlton Gore Road, Newmarket, Auckland 1023
PO Box 9176, Newmarket, Auckland 1149
TEL +64 9 580 4500, FAX +64 9 580 7600

REVISION SCHEDULE

Rev No	Date	Description	Signature or Typed Name (documentation on file).			
			Prepared by	Checked by	Reviewed by	Approved by
1	31/08/15	First draft	MS	AG	GS	GS
2	10/11/15	Second draft	MS	AG	GS	GS
3	15/12/15	Final	MS	AG	GS	GS
4	25/01/16	Final	MS	AG	GS	GS
5	29/02/16	Final	GS	GS	GS	GS
6	02/06/16	Amendments following review	GS	AG	AG	GS
7	20/06/16	Amendments for lodgement	GS	AG	AG	GS

Executive Summary

The purpose of this Transport Assessment Report is to outline the transport related benefits/costs, the alternatives considered for the Lincoln Road Corridor Improvement Project (LRCI project), the reasons why the project is necessary and how it will achieve Auckland Transport's objectives.

Project Outline

Lincoln Road is a key regional arterial route which serves one of the main growth areas within Auckland. It provides a primary connection between SH16 and the areas of Henderson and Swanson, whilst also providing an important access route to the Waitakere Hospital. Lincoln Road also forms an integral part of ATs Frequent Service Network and Freight Network. Given current and forecast trends in regard to urban development and traffic growth, there is an inherent need for the efficiency of the corridor to be improved so that Lincoln Road can facilitate effective travel for an ever growing number of people.

However, currently there are significant issues along the corridor relating to peak period traffic congestion, a lack of facilities which prioritise public transport and inadequate provisions for pedestrians and cyclists. Therefore, without effective treatment the performance of Lincoln Road will continue to deteriorate.

The LRCI Project seeks to identify suitable mitigation to improve the corridor efficiency, public transport reliability and road safety. The project objectives for Auckland Transport (AT) are as follows:

1. To accommodate more people travelling to and along Lincoln Road by improving corridor efficiency.
2. To improve public transport reliability within the Project area.
3. To improve safety for all road users, including by providing cycling infrastructure.
4. To integrate AT's Lincoln Road improvements with the NZTA Western Ring Route upgrade via the Lincoln Road Motorway Interchange.

Proposals

The main feature of the LRCI project is an additional lane in each direction of travel, which will be designated as a T3 transit lane with the ability to become a dedicated bus lane in the future. Other corridor improvements include intersection capacity enhancements, the provision of dedicated cycle lanes and a raised median.

Existing Conditions

The busiest section of the corridor is between Universal Drive and Central Park Drive, where the average daily traffic (ADT) is around 42,000 vehicles (combined two-way volume)[1]. This volume is around 27% higher than the volume recorded between Te Pai Place and Universal Drive. The total volume of traffic recorded on the Saturday was relatively comparable with the volume recorded during the weekday.

Lincoln Road currently experiences congestion northbound during the AM peak and southbound during the PM peak, with low (<24kph) average travel speeds experienced. Since 2012, improvements are likely to have only been experienced north of Central Park Drive at the SH16 interchange as a result of recent upgrade works.

Travel time surveys identified that undesirable levels of delay are currently expected during peak periods for the following routes:

- Lincoln Road (Northbound);
- Lincoln Road (Southbound);
- Paramount Drive to Lincoln Road, via Central Park Drive; and
- Paramount Drive to Lincoln Road, via Universal Drive.

[1] Data derived from MWH surveys undertaken in May 2015.

Cyclists

Only 28 cyclists were recorded travelling along Lincoln Road as part of the cyclist survey that was undertaken on Thursday 30th April 2015. Although the total daily volume increased to 142 cyclists on Saturday 2nd May 2015, the surveys identified that currently a low number of cyclists use Lincoln Road.

Future Conditions

AT forecast that the localised growth in vehicle demand between 2008 and the future 2026 model would be 19% for the morning peak, and 18% for the evening peak. This equates to around 1% per annum.[2]

AT also identified[3] interdependence between the vehicle capacity of SH16 and the capacity of the Lincoln Road and Te Atatu Road corridors and motorway interchanges. Should the LRCI Project not be progressed, the following impacts on traffic operations would be expected:

- The widening of SH16, as part the completion of the Western Ring Route provides additional capacity to accommodate city-bound traffic. However, Lincoln Road currently provides only one lane to accommodate this demand. Without capacity enhancements at the interface with the interchange considerable queuing back along Lincoln Road, Triangle Road and Central Park Drive would be expected.
- Without bus priority lanes, the additional delay incurred by buses travelling along the Lincoln Road corridor is predicted to be around 3-4 minutes during peak periods.
- Capacity enhancements along SH16 and at the interchange will increase the number of vehicles looking to access Lincoln Road, particularly during the PM peak. However, without improvements, Lincoln Road will be unable to accommodate the future demand and as a result significant queuing back onto the SH16 would be expected. Queues that build back onto SH16 not only impact vehicles trying to get off at Lincoln Road, but also restrict the flow of westbound vehicles heading further along SH16 and SH18.

The analysis undertaken by AT identified that the LRCI Project is essential for supporting the benefits that are gained by the future construction of the Western Ring Road. Furthermore, this analysis reinforces the importance of AT's objective that the Lincoln Road improvements should integrate with the Transport Agency's Western Ring Road upgrade.

Options Assessment

Intersection Layout

GHD undertook intersection operational analysis as a means of providing guidance to AT in regard to suitable layouts for each of the key intersections. A variety of alternative layouts were tested for each key intersection, with the options evaluated against factors including delays, queuing and potential land acquisition. The preferred layouts, as identified by GHD, were verified and endorsed by AT in 2013 following additional work undertaken using the Paramics micro-simulation model (refer to the Preliminary Design Report, GHD, 2013).[4]

Refinement of Design

Following consultation with local businesses and residents, concerns were raised in regard to the proposed restriction of the U-Turn from the north approach to the Lincoln Road/Universal Drive intersection. AT subsequently undertook additional assessments as a means of identifying a suitable layout that could accommodate a U-Turn movement from the north approach. AT concluded that replacing the signal controlled double left turns out of Universal Drive with a give-way control lane would provide the best outcome for the intersection, in terms of facilitating the U-Turn whilst delivering a minimal impact to the performance of other movements.[5]

[2] Waitakere Central City Model - Future Demand Forecasting Memorandum, AT, May 2013.
[3] Lincoln Road – Economic Assessment Supporting Memorandum, Pages 11-12.
[4] Volume 1: Preliminary Design Report – Addendum to Scheme Assessment Report, Section 5.4.1.
[5] 'Enabling of U-Turns at Universal Drive / Lincoln Road Intersection – Technical Note', AT, 17th August 2015.

Lincoln Road to SH16 Interchange Interface

Initial analysis undertaken by GHD and AT identified that the intersection of Lincoln Road and Central Park Drive/Triangle Road should include a continuous northbound T3 lane from the intersection to the westbound ramp.[6]

However, MWH identified that this arrangement would require a significant amount of weaving as the 'T3' traffic would have to swap traffic lanes with the traffic taking the northbound SH16 on-ramp. The refined preferred option, as agreed with AT, provides four lanes of traffic northbound approaching the motorway, but without a 'T3' lane. Southbound traffic allows for 3 lanes of traffic turning left off the motorway widening initially to four lanes and the addition of the 'T3' lane.

KFC Access Arrangements

AT identified that, coupled with coordinating the signal pair, either of the following options would be expected to result in the 95th percentile queue lengths being less than the distance back to Lincoln Road (i.e. <70m):

- Providing the pedestrian crossing for the eastern approach rather than the west approach; or
- Banning the right turn out of the KFC signals (Intersection 3).

It is understood that the preferred option will be determined during the next stage of the design process following consultation between AT and local businesses. Both options provide effective mitigation to ensure that the queuing does not extend back to Lincoln Road.

Special Vehicle Lanes

High-level analysis undertaken by GHD identified that a T3 lane in both directions will provide significant benefits to the overall travel time per person along the corridor.[7] Further analysis undertaken using the Paramics micro-simulation model identified that there are significant public transport travel time benefits to be gained from implementing bus or T3 lanes.[8]

It is proposed that T3 lanes will be introduced first with the ability to become a dedicated bus lane in the future.

Transportation Effects Summary

The key positive transport related implications of the Project are:[9]

1. **Improved Corridor Performance.** The Project is expected to significantly increase the person carrying performance of the corridor through the provision of the T3 lanes in each direction of travel. The lanes provide immediate additional capacity for buses and HOV, which has knock-on congestion relief benefits to general traffic.
2. **Increased Cycling Activity.** The provision of quality cycling facilities along the corridor is anticipated to increase the carrying capacity of Lincoln Road by encouraging modal shift.
3. **Reduced Number of Accidents.** Introducing a solid raised median along Lincoln Road will act to reduce the likelihood of vehicle turning collisions. If the Project does not go ahead, an increase in the number of right angle and turning collision accidents would be expected as vehicle traffic along the corridor continues to rise.
4. **Improved Network Efficiency**. Through the modelling undertaken, it has been identified that there are significant PM peak efficiency benefits from introducing the LRCI Project[10]. This result is considered to reflect the ability of the upgraded Lincoln Road corridor to accommodate traffic released by the improvements along SH16 and at the interchange with Lincoln Road as part of the completion of the Western Ring Route.

[6] Volume 1: Preliminary Design Report – Addendum to Scheme Assessment Report, Section 5.4.2.
[7] *Special Vehicle Lane Assessment Report*, Section 5.2.
[8] Lincoln Road Improvements - Traffic Modelling Memorandum, Section 3.1.2.
[9] Lincoln Road – Economic Assessment Supporting Memorandum, Page 16.
[10] Lincoln Road – Economic Assessment Supporting Memorandum, Page 20.

5. **Improved SH16 Interchange performance.** Capacity enhancements along SH16 and at the interchange will result in an increase in vehicles looking to access Lincoln Road, particularly during the PM peak.

Negative Impacts

The key negative transport related implications of the Project are:

1. **Increased Travel Distance.** The implementation of a raised median means vehicles will be restricted from making some movements into and out of certain driveways and minor side roads. This in turn will increase the travel distance and time for some people accessing certain properties. To mitigate the potential negative impact, right turn bays have been proposed to allow vehicles to make the turn into Daytona Road and Paramount Drive from both the northbound and southbound directions.
2. **Increased number of vehicles passing through intersections.** The introduction of a raised median is expected to have a relatively minor impact on both operational performance and additional travel time that is incurred as a result of diversions.[11] However, the disbenefits of additional delays incurred at the intersections due to the rerouting effect are offset by the significant road safety benefits and the allowance for HOV to utilise the T3 lane.
3. **Safety Issues.** The main safety concerns relating to the implementation of a raised median are:
    a) Concentration of right turning movements at signalised intersections; and
    b) May encourage pedestrians to cross away from the formalised crossings at the signalised intersections

    To mitigate these potential effects the design includes pedestrian crossings for all approaches to each of the signalised intersections together with a new signalised mid-block crossing between the Daytona Road and Paramount Drive intersections. This means that safe crossing opportunities across Lincoln Road will be provided every 120m-360m.

    A second mid-block crossing was considered near Te Pai Park, and discussed at one of the earlier workshops, but discounted as it did not offer enough benefits to warrant the additional disruption to the flow of traffic and therefore the successful operation of the corridor.
4. **Reduced Parking Supply.** Some existing on-street parking spaces along Paramount Drive, Daytona Road and Poinsettia Places (near the intersections with Lincoln Road) are expected to be lost to accommodate the new speed tables proposed at these side roads. As such, up to four spaces will be lost at each side road.

    The existing on-street parking on the slip road at 260-286 Lincoln Road will be reduced by up to 11 spaces.
5. **Construction impacts.** During the construction period there may periods when there is a need to reduce traffic down to two lanes, one each direction, for short periods. This is likely to be the case during the final surfacing layer works or road marking. The reduction in lane capacity will have a negative impact on congestion and delays during these short periods. Furthermore, during construction there will potentially be short periods where temporary speed limits are implemented.

Traffic Modelling

The traffic modelling undertaken for the project to date has encompassed intersection (SIDRA 5.1) assessments undertaken by GHD and micro-simulation (S-Paramics) modelling undertaken by AT. The analysis undertaken by GHD and AT has been peer reviewed by independent transport planning specialists (Opus and TES). As such, there can be a high level of confidence that the analysis and conclusions stated within the corresponding reports are accurate and fit for purpose.

We recommend that the Paramics traffic modelling is updated and finalised to incorporate the following:

- The final road layout, inclusive of recent changes to the Lincoln Road/Universal Drive intersection and tie-in with the SH16 Interchange;
- The mid-block crossing, located between the Daytona Road and Paramount Drive intersections;

[11] Lincoln Road Corridor Preliminary Design – Raised Median Report.

- The preferred option and signal phasing for the KFC signals;
- Consideration of any new and confirmed major developments, not already implicitly included within the model;
- Incorporation of the land use intensification in line with the PAUP (if not already done); and
- Justification for the appropriateness of the 2026 growth rate and update accordingly (if deemed necessary).

AT has confirmed that refinement of the model is planned for the detailed design stage and that the outcome is not expected to affect the proposed road geometry. However AT has noted the revision may influence the final optimal signal phasing along the corridor.

Auckland Transport

Lincoln Road Corridor Improvements

CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

Appendix K	Road Safety Audit (Stage 2A – Part One)
Appendix L	Road Safety Audit (Stage 2A – Part Two)
Appendix M	Raised Median Impact to Trip Redistribution
Appendix N	LRCI Project – Construction Sequencing and Traffic Management Report

1 Introduction

1.1 Overview

Lincoln Road is a key regional arterial route which serves one of the main growth areas within Auckland. Currently there are significant issues along the corridor relating to peak period traffic congestion, a lack of facilities which prioritise public transport and inadequate provisions for pedestrians and cyclists.

Without effective treatment the performance of the corridor will continue to deteriorate. The Lincoln Road Corridor Improvement (LRCI) Project therefore seeks to identify suitable mitigation to improve the corridor efficiency, public transport reliability and road safety.

The Project objectives for Auckland Transport (AT) are thus:

1. To accommodate more people travelling to and along Lincoln Road by improving corridor efficiency.
2. To improve public transport reliability within the Project area.
3. To improve safety for all road users, including by providing cycling infrastructure.
4. To integrate AT's Lincoln Road improvements with the NZTA Western Ring Route upgrade via the Lincoln Road Motorway Interchange.

Purpose of this Report

This report forms part of AT's Notice of Requirement for the Project.

The purpose of this report is to summarise the transport related benefits/costs, the alternatives considered and the reasons why the project is necessary and achieves the objectives of AT. This report contains:

- An outline of the function and the context of the corridor within the wider road network;
- An overview of the existing traffic conditions;
- A summary of the traffic modelling undertaken for the Project;
- An overview of the proposed design;
- Details of the design considerations and optioneering process;
- A summary of the findings of the road safety audit;
- An assessment of the impact of the proposed raised median; and
- Recommendations regarding the management of construction traffic effects.

Proposal

The LRCI Project applies to a 1.3 kilometre length of Lincoln Road, between its intersection with Te Pai Place / Pomaria Road to the south and the State Highway (SH) 16 on-ramp to the north. The Project will upgrade Lincoln Road through the provision of additional transit lanes, dedicated cycle lanes and footpaths in each direction whilst maintaining two lanes for general traffic in each direction. Additional or longer turning lanes will be constructed at controlled intersections to improve capacity and a raised median will be installed along the centre of the road, with right turning and U-turns provided for at controlled intersections. The improvements will be integrated with the New Zealand Transport Agency's (Transport Agency's) upgrades of SH16 at the Lincoln Road Interchange.

The LRCI Project also includes the construction of a new public road formed to the rear of 300-312 Lincoln Road, which will provide access to Daytona Reserve and existing properties that will be unable to be accessed directly from Lincoln Road.

In order to construct the improvements, the existing road reserve will be widened by varying amounts on each side (generally around 2m to 3m, up to approximately 8m). A greater area of land is required in the vicinity of intersections.

Further details of the Project proposals are provided in the Assessment of Environmental Effects which supports the Notice of Requirement.

Previous Studies

In the preparation of this report the following documents have been reviewed:

- Lincoln Road Corridor Preliminary Design – Volumes 1: Preliminary Design Report – Addendum to Scheme Assessment Report, GHD, August 2013;
- Lincoln Road Corridor Preliminary Design - Special Vehicle Lane Assessment, GHD, August 2013;
- Lincoln Road Corridor Preliminary Design – Raised Median Report, GHD, April 2013;
- Lincoln Road Corridor Preliminary Design - Intersection Operation Report, GHD, August 2013;
- Transit Lane Integration – Options of the 'Integration with NZTA Interchange' Memorandum, GHD, November 2012;
- Lincoln Road Corridor Preliminary Design – KFC Accesses Solutions, GHD, August 2013;
- Lincoln Road Upgrading – Preliminary Design Safety Audit, Opus/TPC, March 2013;
- Lincoln Road Upgrading – Preliminary Design Safety Audit – Part 2, Opus, August 2015;
- Paramics Model Specification Memorandum, GHD, January 2012;
- Network Modelling Advantages Memorandum, GHD, August 2012;
- Lincoln Road Improvements - Traffic Modelling Memorandum, AT, March 2013;
- Waitakere Central City – Future Year Testing Modelling Summary Report, Aurecon, February 2013;
- Waitakere Central City Simulation Model – Base Model Peer Review, Opus, May 2013;
- Waitakere Central City Simulation Model – Base Model Peer Review Response, Aurecon, May 2013;
- Waitakere Central City Model - Future Demand Forecasting Memorandum, AT, May 2013;
- Lincoln Road – Economic Assessment Supporting Memorandum, AT, 2013;
- Lincoln Road Corridor Upgrade – Modelling of KFC Access on Universal Drive Memorandum, AT, 13th August 2015; and
- Lincoln Road / Universal Drive – Modelling of Alternative Phasing to Allow for U-Turn from Lincoln Road, AT, 13th August 2015.

Where applicable, the corresponding peer review reports and peer review response memorandums have also been reviewed.

1.2 Project Location

The Lincoln Road Corridor Improvements project area extends for approximately 1.3km and is located within Auckland's western suburb of Henderson. A number of feeder routes connect with the corridor, and subsequently, the key intersections with Lincoln Road are considered to be:

- Central Park Drive/Triangle Road (signals);
- Paramount Drive (priority controlled);
- Universal Drive (signals);
- Pak 'n' Save/Laidlaw College (signals); and
- Te Pai Place/Pomaria Road (signals).

Figure 1-1 on the next page identifies the extent of the Project area and the key trip generating land uses.

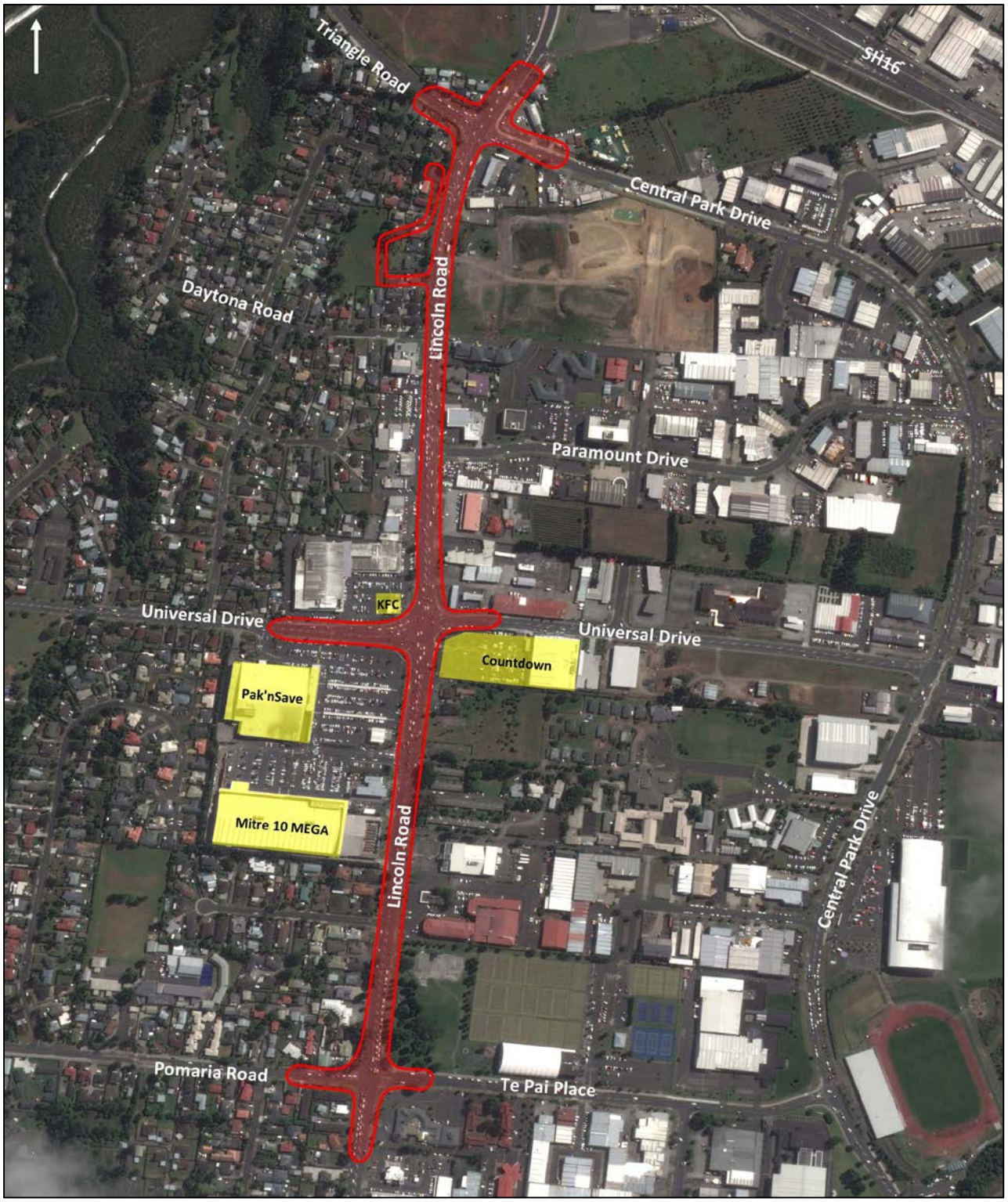


Figure 1-1: Project Area

2 Project Context

The purpose of this section is to explain the function of the road and its role in the wider network. This section also outlines the role of Lincoln Road within the long term strategies of Auckland Council, AT and the Transport Agency.

2.1 Functionality

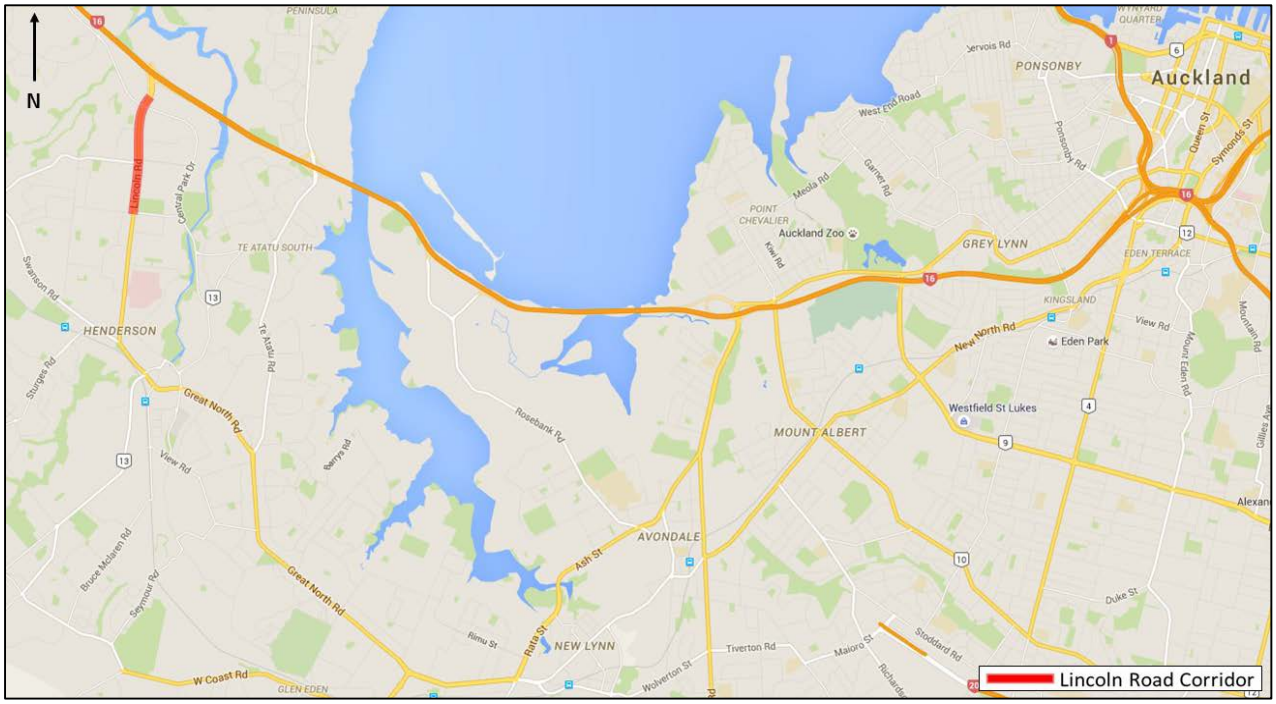
Lincoln Road provides a primary connection between SH16 and the areas of Henderson and Swanson, whilst also providing an important access route to the Waitakere Hospital. Along with Great North Road, the corridor forms part of a wider strategic east-west route which links the suburbs of New Lynn, Kelston and Henderson. Lincoln Road also provides an alternative route to Te Atatu Road for journeys between SH16 and Great North Road.

The Regional Arterial Road Plan classifies Lincoln Road as a Regional Arterial Road[12] that forms part of a Quality Transit Network. Furthermore, the section of the corridor between the SH16 Interchange and Universal Drive forms part of AT's Regional Freight Network[13].

Given current and forecast trends in regard to urban development and traffic growth[14], there is an inherent need for the efficiency of the corridor to be improved so that the Lincoln Road can accommodate a greater number of person-trips. Conversely, given the nature of the existing development along Lincoln Road, and in particular around the Universal Drive intersection, the corridor improvements need to strike a balance between the traffic mobility and access functionalities.

The corridor functions not only as commuter route but also as a main thoroughfare and destination. The corridor therefore observes a relatively sustained volume of traffic throughout the day, with the total volume of traffic on a Saturday equivalent to a weekday.

Currently, the primary road user is the motorist, with a relatively low proportion of trips undertaken by public transport and cyclists. An upgrade of the corridor to enhance safety for cyclists and improve travel times and service reliability of public transport is essential for encouraging a modal shift to sustainable modes. Further details regarding the existing conditions are provided within Section 3, whilst the location of the corridor within the context of the wider Auckland area is presented within Figure 2-1.



[12] Regional Arterial Road Plan, ARTA, February 2009.

[13] AT Draft Regional Land Transport Plan 2015-2025, Page 58.

[14] https://at.govt.nz/projects-roadworks/lincoln-road-upgrade

Figure 2-1: Wider Road Network Context

2.2 Road Description

Currently, Lincoln Road is a four lane arterial road that includes a flushed median and a number of right turn bays which facilitate turning movements into a number of minor side roads. The posted speed of the road is 50km/h. Surveys commissioned by MWH in May 2015 identified that, given a high volume of traffic and presence of four signalised intersections, the typical average travel speed throughout the day is also around 50kph.

There are no existing formal cycling facilities along Lincoln Road, however footpaths are provided on both sides of Lincoln Road.

There are currently four northbound and four southbound fully indented bus stops within the Project area. These are located close to the Daytona Road, Universal Drive, Pak 'n' Save and Triangle Road intersections.

On-street parking is restricted along Lincoln Road within the limits of the Project area. Off-street parking is provided for the majority of premises catering for employees, visitors and customers whilst on-street parking is available along all side roads including Universal Drive and Te Pai Place.

2.3 Land Use

Within the Project area, Lincoln Road provides access to a variety of adjoining land uses, including residential dwellings, commercial units and offices. The commercial sites along the northern part of the corridor are occupied by small businesses, whilst Mitre 10 Mega, Pak 'n' Save and Countdown occupy large sites to the south of Universal Drive.

Since the delivery of the *Lincoln Road - Preliminary Design Report (GHD, 2013)*, a Countdown supermarket, located at the corner of Lincoln Road and Universal Drive, has been opened (late 2013). AT has confirmed that the micro-simulation modelling, which has informed the LRCI project, included consideration of this development.[15]

Future Corridor Development

Two major developments are proposed to be introduced towards the northern end of the corridor, both of which are located adjacent to Lincoln Road and Central Park Drive. One site, located south of Central Park Drive at 297-307 Lincoln Road, encompasses approximately 54,077m^2 and is currently under development. The development will comprise the following[16]:

- Lot 1 (7,500m^2) incorporates the Lincoln Road frontage, with current consent to provide for a two-level mixed-use development comprising 17 retail units on the ground floor with showroom and office space above. It is understood that 60% of these retail developments have been pre-leased.[17] This development is consented and is currently under construction. [18]
- Lot 2 (31,500m^2) is accessible from Lincoln Rd, Soljan Drive and Central Park Drive. This site has been earmarked for bulk retail or other potential large format commercial uses and associated car parking. Soljan Drive will be extended to form a signalised intersection with Central Park Drive.[19] This development has been consented. This includes consent that went to the Environment Court, and also two subsequent variations, one of which removes the 8000sqm of office space. The Soljan Drive signals have already been installed.[18]
- Lot 3 (11,000m^2) will have access from Soljan Drive and Central Park Drive and is proposed to include mixed-use trade retail and showroom units. This Lot has also been consented with a series of retail units.[18]

AT has confirmed that the micro-simulation modelling undertaken by AT for this project has taken into account the development at 297-307 Lincoln Road.

[15] Waitakere Central City Model - Future Demand Forecasting Memorandum, AT, May 2013.
[16] http://www.nzherald.co.nz/property/news/article.cfm?c_id=8&objectid=11198613
[17] http://www.primecommercial.co.nz/2294342
[18] Details provided by AT via email, dated 03 November 2015.
[19] http://infocouncil.aucklandcouncil.govt.nz/Open/2015/04/HM_20150416_AGN_4481_AT_WEB.HTM

The second site is located to the north of Central Park Drive at 166 and 329 Lincoln Road. The site, comprising an approximate total area of 59,000m^2, has been made available for purchase. Details regarding the likely nature of the potential development are however unknown at this stage[20]. Given the uncertainty regarding the nature of the development, AT has confirmed that the modelling to date has not provided any specific uplift to reflect the development of this area.

Figure 2-2 identifies the developments which have been introduced since 2013 in addition to the sites of the aforementioned proposed developments.

Figure 2-2: Recent and Future Corridor Development

[20] http://www.bayleys.co.nz/Listings/Auckland/Waitakere-City/Henderson/1900199

Wider Network Development

In addition to localised development adjacent to Lincoln Road, there are further major developments within the wider area which will impact upon traffic volumes and trip distribution along Lincoln Road. The major development areas which were considered as part of AT's micro-simulation modelling were:[21]

- The North West Regional Strategic Growth Area (NORSGA); and
- The Albany area development.

2.4 Policy Context

The role of Lincoln Road within the context of the overarching regional transportation strategy is noted within the following statutory and strategic documents:

- Waitakere District Plan, 2003;
- Proposed Auckland Unitary Plan, Auckland Council, 2013;
- Regional Arterial Road Plan, ARTA, February 2009;
- Regional Public Transport Plan, AT, 2013;
- Auckland Regional Land Transport Plan 2015-2025, AT/NZTA;
- Integrated Transport Programme 2012-2041, AT; and
- Waitakere City Transport Strategy 2006-2016.

This section provides a summary of the relevant information from each of the documents listed above as a means of highlighting how Lincoln Road is a strategically important corridor to AT, Auckland Council and the Transport Agency.

Waitakere District Plan (Operative Plan)

The Operative Plan is the operative land use plan for the Project area, but is in the process of being replaced by the Proposed Auckland Unitary Plan (PAUP).

The Operative Plan notes that all land that is legal road is subject to the Transport Environment rules. The Operative Plan also notes that a number of designations apply along the route, including a Waitakere City issued road widening designation (WCCRW5).[22]

PAUP

The PAUP replaces the existing Regional Policy Statement and a total of thirteen district and regional plans.

The Plan identifies Lincoln Road, between Central Park Drive and Swanson Road, as a growth corridor. The Plan also provides objectives and policies in relation to the development of the Lincoln Precinct (Laidlaw College), which is located between Lincoln Road, Clemway Place and Central Park Drive[23]. The north-western section of the Lincoln Precinct has already been developed as the Countdown supermarket.

The PAUP provides the proposed land use planning maps, inclusive of the area surrounding Lincoln Road. The adjacent land use to the Project is highlighted in Appendix B. For comparative purposes, the figure identifies changes in planned land use between the PAUP and the Operative Plan.

The PAUP identifies that there is greater planned intensification development along, and within the surrounds of, the Lincoln Road corridor. The key areas of intensification are considered to be:

- The large area adjacent to Central Park Drive – rezoned from 'Open Space' to 'Special Use' land use.
- Rezoning of plots along the southern end of the Lincoln Road corridor from 'Living' to 'Mixed-use' and 'Terrace Housing and Apartment Building' land uses.
- Rezoning of plots located between Tudor Road and Lincoln Road from 'Living' to 'Terrace Housing and Apartment Building' land use.

[21] Lincoln Road – Economic Assessment Supporting Memorandum, Page 6.
[22] Gap Analysis – Lincoln Road Project, Hill Young Cooper, November 2014.
[23] Part 2 – Regional and District Objectives and Policies, Section 7.5.

- Rezoning of plots located along the north-western side of Lincoln Road from 'Living' to 'Mixed Use' and 'Light Industry' land uses.
- The PAUP also applies an 'Identified Growth Corridor' policy overlay to the entire length of Lincoln Road. This provides opportunity for the establishment of commercial (predominately retail) activities on sites fronting the road, even if the zone is residential.

Regional Arterial Road Plan

The Regional Arterial Road Plan defines the regional arterial road network and considers the functional classification of each road included within the network. The plan also identifies the functional priorities of different parts of the network, assesses deficiencies in performance over the next 10 years, and highlights the priority areas for attention.

The plan makes specific reference to the role and strategic direction of the regional arterial roads. In regard to Lincoln Road the plan outlines the role of the corridor as:

- A growth corridor with high traffic volumes running from Great North Road to SH16 (North-Western Motorway);
- An important freight route;
- Part of the Quality Transit Network[24];
- A corridor which provides both through traffic and local access functions; and
- The primary access to the Waitakere Hospital.

The strategic direction for the corridor is to enhance passenger transport, cycling infrastructure and the effective integration with SH16. AT's project objectives for LRCI are therefore closely aligned with the strategic direction for Lincoln Road, as outlined by the Regional Arterial Road Plan.

Regional Public Transport Plan

The Regional Public Transport Plan describes the public transport network that AT proposes for the region, identifies the services that are integral to that network over the next 10 years, and sets out the policies and procedures that apply to those services.

The Plan notes that a new integrated service network structure is to be built around a core network of rapid and frequent services. These services will deliver at least a 15-minute service operating all day (initially from 7am to 7pm, with reduced frequencies outside those hours). These services will be complemented by a network of connector routes that operate all day at half-hourly frequencies. In addition, a supporting network of local services, peak-only services and targeted services will cater for specific market needs.

The Plan identifies that Lincoln Road forms part of this 'rapid and frequent service network', with a stop close to the intersection of Lincoln Road/Triangle Road functioning as an 'intermediate interchange'.

Auckland Regional Land Transport Plan: 2015-2025

The Regional Land Transport Plan (RLTP) forms part of the National Land Transport Programme and represents the combined intentions of the New Zealand Transport Agency, Auckland Transport and KiwiRail to respond to growth and other challenges facing Auckland in the next ten years.

The plan recognises the importance of upgrading Lincoln Road in relation the potential success of State Highway improvements by noting the following:

> *"NZTA is spending $1.4 billion on the Waterview Connection, the last missing link in Auckland's motorway network, and the widening of the North Western motorway. If Auckland Transport is not able to carry out improvements to Lincoln and Te Atatu Roads due to budget constraints, then many of the benefits of the state highway improvements will be lost. The result is likely to be queuing on the new widened motorway as the increased traffic will not be able to exit the motorway any faster."*

The plan outlines that over the next ten years, the focus for road improvements will be the arterial and freight networks for which the highest priority will be assigned to Lincoln Road and Te Atatu Road.

[24] The Quality transit Network refers to the Auckland Transport plan for improving and simplifying the existing bus network to make catching the bus more convenient, faster and easier.

These improvements are intended to be delivered between the financial years of 2018/19 and 2024/25.[25]

Integrated Transport Programme: 2012-2041

The Auckland Plan proposes major investment in the transport system over the next 30 years to support the growth of the city and to achieve transport outcomes and targets consistent with its vision. Implementation of the transport aspects of the Auckland Plan will be done through the Integrated Transport Programme (ITP).

The ITP notes that some key arterials, such as Lincoln Road, are projected to experience high levels of traffic which will increase potential congestion. Lincoln Road is also highlighted to be part of the Regional Freight Network and Rapid and Frequent Service network. Chapter 4 of the ITP outlines the proposed transport programme for delivering the Auckland Plan. The Lincoln Road corridor upgrade is noted to be a priority project that should be implemented before 2021.[26]

Waitakere City Transport Strategy: 2006-2016

The Waitakere City Transport Strategy outlines Waitakere City Council's strategic position and plan for developing a sustainable and integrated transport system for the city. The document is based upon the Auckland Regional Land Transport Strategy 2005 and incorporates the former Council's transport policies, objectives and projects.

In regard to Lincoln Road, the strategy notes the following:

- The city's urban strategy envisages intensified urban development along major transport corridors such as Lincoln Road.
- Bus priority measures are proposed along key arterial roads, including Lincoln Road.
- Lincoln Road will continue to experience high volumes of traffic during peak times.
- Lincoln Road serves a multitude of needs including motorway access, through traffic, local traffic and access to adjoining business and residences.
- At present, there is significant conflict between the local access and through traffic functions of the route.
- Options for bus lanes, high-occupancy vehicle lanes, bus priority measures, as well as for improved access management and overall corridor management will be investigated.

[25] Auckland Regional Land Transport Plan 2015-2025, Page 37/54.

[26] Integrated Transport Programme 2012-2041, Pages 61 and 138.

3 Current Conditions

This section of the report describes the current traffic movements along Lincoln Road and for the surrounding road network.

3.1 Traffic Volumes

MWH commissioned traffic count and travel time surveys in May 2015 as a means of identifying the current traffic movements along Lincoln Road and adjacent feeder routes.

A total of ten surveys were undertaken for a continuous seven day period with recordings taken every 15 minutes for both directions of travel. Table 3-1 presents a summary of the peak period traffic volumes[27] recorded as part of the 2015 traffic surveys for an average (Monday-Friday) weekday. In line with the traffic model specification,[28] the peak periods have been taken to be 08:00-09:00 (AM), 12:15-13:15 (MD[29]) and 16:15-17:15 (PM). The location of the survey counts are identified within Appendix C.

Table 3-1: 2015 Average Weekday Peak Hour Traffic Volumes (Surveyed)

ID	Survey Location	AM		MD		PM		ADT
		NB/WB	SB/EB	NB/WB	SB/EB	NB/WB	SB/EB	Two-Way
1	Lincoln Road (Te Pai Place – Universal Drive)	947	934	1,087	1,147	1,147	1,237	30,527
2	Lincoln Road (Universal Dr – Central Park Drive)	1,233	1,286	1,469	1,298	1,720	1,462	41,837
3	Central Park Drive (East of Lincoln Road)	493	779	539	565	559	842	16,164
4	Daytona Road (W of Lincoln Road)	57	71	97	33	107	50	1,855
5	Moselle Avenue (E of Lincoln Road @ No.6)	107	162	141	165	179	148	3,466
6	Paramount Drive (E of Lincoln Road @ No.33)	148	98	143	116	168	89	2,543
7	Te Pai Place (E of Lincoln Road @ Quality Hotel)	328	424	285	228	494	352	8,658
8	Universal Drive (Tudor Drive – Lincoln Road)	507	1,178	667	810	1,069	857	25,868
9	Universal Drive Ext (Lincoln Road– Central Park Drive)	322	387	308	251	683	274	8,117
10	Waipareira Avenue (North of Moselle Ave @ No.4)	284	354	278	236	376	295	6,219

The surveys identified that busiest section of the corridor is between Universal Drive and Central Park Drive, where the average daily traffic (ADT) is around 42,000 vehicles (combined two-way volume). This volume is around 27% higher than the volume recorded between Te Pai Place and Universal Drive.

The total daily volume of traffic recorded along Lincoln Road, between Universal Drive and Central Park Drive, on Saturday 2nd May 2015 was around 43,000 vehicles (two-way). This volume is comparable to the ADT recorded for the peak weekday. Indeed for all surveyed sites, the total volume of traffic recorded between Monday-Saturday was relatively consistent.

Typically, road corridors across Auckland operate with tidal flow – i.e. the majority of traffic heads towards the CBD in the morning, and away from the CBD in the evening, coinciding with the typical

[27] Data from surveys along Lincoln Road in the southbound direction on Thursday 7th May 2015 was deemed to be unreliable and was removed from the dataset.
[28] Lincoln Road Corridor – Intersection Operation Report, Section 3.3, Table 1.
[29] MD - Midday

business hours of 08:30-17:00. However, for Lincoln Road the volume of traffic is relatively consistent in either direction of travel for each of the peak period. This effect is likely due to the fact that Lincoln Road not only provides a key through route and connection to SH16, but also provides access to numerous business and commercial facilities. Lincoln Road accommodates users undertaking a variety of trip purposes, and as a consequence the corridor experiences a high and sustained volume of traffic.

The volume of traffic along Universal Drive is also considered to be significant, with the two-way ADT recorded to be almost 26,000 vehicles. Central Park Drive is another key feeder route and carries an average of around 16,000 vehicles per day (two-way).

Vehicle Occupancy

AT undertook a vehicle occupancy survey[30] on the 21st June 2011, which recorded the number of vehicles and passengers travelling in each direction along Lincoln Road. The purpose of the surveys was to provide an understanding of the proportion of vehicles that are likely to utilise the T3 lanes, which were key inputs to the traffic modelling undertaken by AT[31] and GHD[32]. The surveyed percentage of vehicles carrying three or more occupants in each direction is presented within Table 3-2.

Table 3-2: Survey Percentage of Vehicles with Three or More Occupants

Direction	AM Peak (06:30-09:30)	PM Peak (15:00-18:00)
Northbound	3.71%	8.43%
Southbound	3.79%	4.48%

Cyclist Volumes

Cycle movement surveys were undertaken on Thursday 30th April 2015 and Saturday 2nd May 2015 at the Lincoln Road/Universal Drive intersection. The purpose of the survey was to provide an understanding of the existing number of cyclists who use Lincoln Road and Universal Road and to establish the proportion of cyclists that, in the absence of formalised facilities, currently utilise the footpaths. Table 3-3 provides a summary of the cycle survey data. Percentages noted within the table refer to the proportion of cyclists who used the footpath rather than the road.

Table 3-3: Lincoln Road/Universal Drive Cycle Volumes

Day	Period	Lincoln Road (North)	Lincoln Road (South)	Universal Drive (East)	Universal Drive (West)	Total
Thursday	AM (07:00-09:00)	5 (80%)	2 (50%)	1 (0%)	2 (50%)	10 (60%)
	PM (16:00-18:00)	3 (67%)	3 (67%)	4 (75%)	1 (0%)	11 (64%)
	Daily (06:00-19:00)	9 (89%)	6 (83%)	7 (86%)	6 (83%)	28 (86%)
Saturday	Daily (06:00-19:00)	31 (52%)	31 (35%)	11 (45%)	69 (23%)	142 (34%)

The surveys identified that a low number of cyclists currently travel through the Lincoln Road / Universal Drive intersection during the weekday. Cyclist numbers increased by around five times during the weekend which is a result likely to be attributed to a significant proportion of recreational riders travelling along the route. During the weekday the majority of cyclists passing through the intersection used the footpath, whilst during the weekend cyclists mainly used the road. Given that weekend volumes are similar to weekday volumes, this result may be because cyclists during the weekend travel for recreational purposes and feel less rushed to get to their destination.

A nationwide study undertaken by Land Transport New Zealand[33] identified that 15% of people regularly cycle, and a further 32% seriously think about cycling. A further study undertaken by the Transport Agency identified that potential cyclists strongly stated that they wanted to travel separately from motor

[30] Survey location south of Daytona Road (Waitakere Central City – Future Year Testing Modelling Summary Report).
[31] Waitakere Central City – Future Year Testing Modelling Summary Report, Page 3.
[32] Lincoln Road Corridor – Intersection Operation Report.
[33] Research Report 294: Increasing cycling and walking: an analysis of readiness to change (2006).

vehicles and to be able to cross safely at intersections.[34] Improving the visibility of cycling and providing good cycling facilities is therefore an essential measure for encouraging modal shift and achieving high levels of cycling.

3.2 Travel Time

3.2.1 Congestion Mapping

Appendix D provides congestion maps, taken from the AA road watch website, during the AM (09:00) and PM (15:30) peaks respectively. As a means of an indicative comparison, maps extracted in 2012 (as per the *Lincoln Road Corridor Preliminary Design – Volumes 1: Preliminary Design Report*) are provided alongside maps extracted on the 17th July 2015.

The figures identify that Lincoln Road currently experiences congestion northbound during the AM peak and southbound during the PM peak, with low (<24kph) average travel speeds. These conditions are likely to be similar to those experienced in 2012. However, conditions north of Central Park Drive and at the SH16 interchange have improved significantly as a result of the recent SH16 upgrade works.

3.2.2 Travel Time Surveys

As a means of further understanding the existing travel conditions along both Lincoln Road and the adjacent road corridors, a number of travel time surveys were undertaken on the 30th April 2015 and 1st May 2015. Figure 3-1 identifies the various travel time routes.

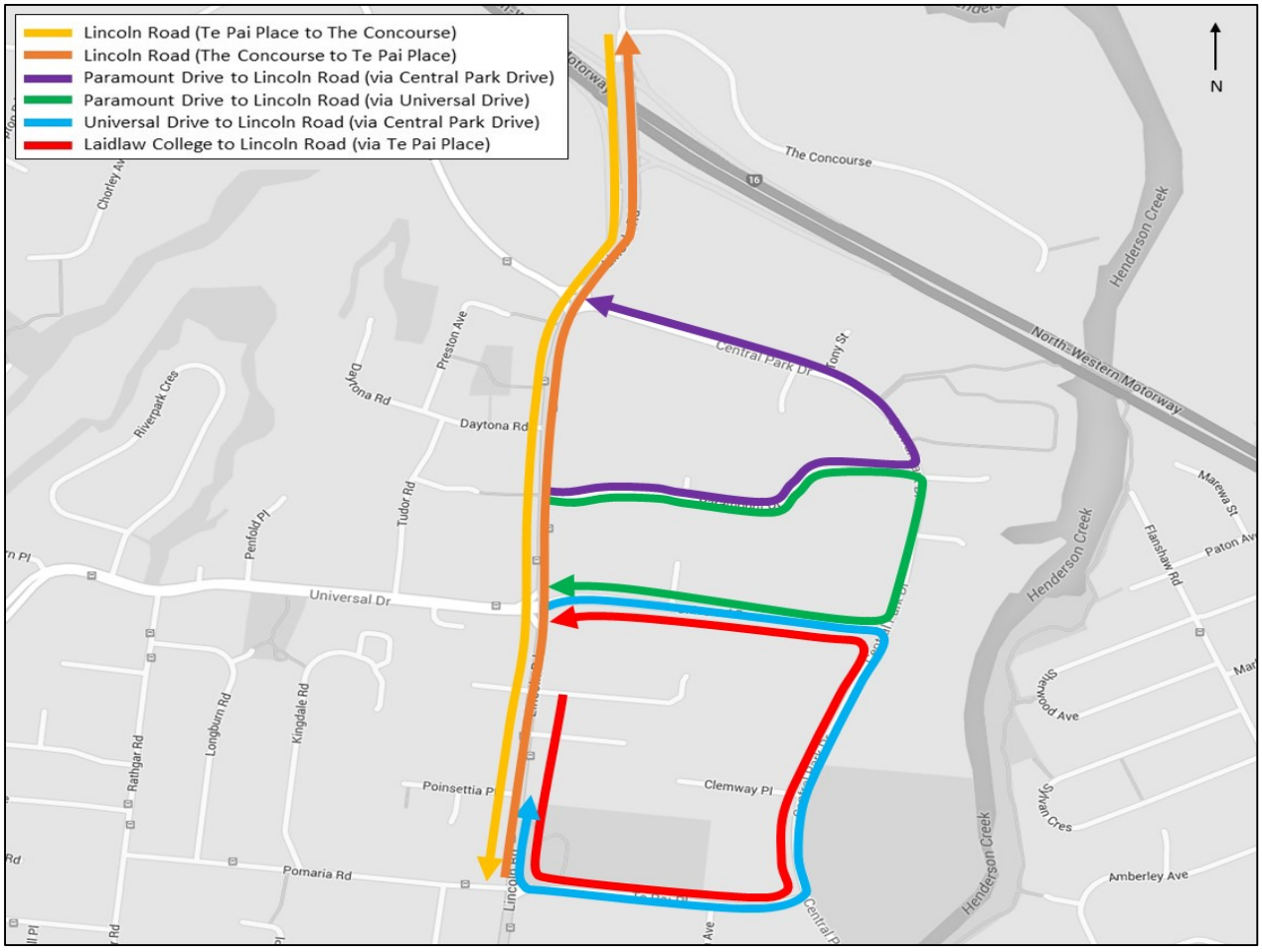


Figure 3-1: Travel Time Routes

[34] Research Report 449: Assessment of the type of cycling infrastructure required to attract new cyclists (2011).

A summary of the findings of the surveys are presented within Table 3-4, whilst Appendix E provides scatter graphs which plot time against average speed for each run undertaken for each of the routes. These graphs provide a representation of the times for which congestion was experienced. Appendix F provides the level of service (LOS) thresholds[35] (based upon average speed), noting that LOS E and F conditions are generally considered to be undesirable.

Table 3-4: Travel Time Survey Findings

Route	Findings
Orange Lincoln Road - Te Pai Place to The Concourse.	• Route = 1.7km. • Average Speed = 24.0kph (LOS C). • Average Travel Time = 5.2mins. • Travel Time Range = 2.4mins to 13.4mins. • LOS E/F conditions experienced throughout the morning peak period of 06:30-09:00. • LOS D conditions predominantly experienced during the AM and PM peak periods.
Yellow Lincoln Road - The Concourse to Te Pai Place.	• Route = 1.7km • Average Speed = 23.8kph (LOS C) • Average Travel Time = 4.6mins. • Travel Time Range = 2.3mins to 7.9mins. • LOS E/F conditions experienced for approximately a 30 minute period during both the AM and PM peak periods.
Purple Paramount Drive to Lincoln Road via Central Park Drive	• Route = 1.4km • Average Speed = 22.3kph (LOS D) • Average Travel Time = 4.8mins. • Travel Time Range = 1.8mins to 15.0mins • This route experienced a high variation in travel time, with LOS F conditions experienced continuously during the morning (07:00-10:00) and evening (15:00-18:30) peak periods. This result suggests significant congestion along Central Park Drive, and in particular upon the approach to the Lincoln Road intersection.
Green Paramount Drive to Lincoln Road via Universal Drive	• Route = 1.8km. • Average Speed = 24.3kph (LOS C). • Average Travel Time = 5.5mins. • Travel Time Range = 2.3mins to 17.3mins. • Heavy congestion and significant travel delays (LOS E/F conditions) are experienced during the morning (07:00-10:00) and evening (15:00-18:30) peak periods. Delays encountered at the intersections are considered to be the main cause of the delays.
Blue Universal Drive to Lincoln Road via Central Park Drive	• Route = 1.9km • Average Speed = 25.4kph (LOS C) • Average Travel Time = 4.5mins. • Travel Time Range = 2.7mins to 7.25mins • This route generally operates with LOS D conditions and consistent travel times throughout the day. Congestion along this route is not considered to be a major issue.
Red Laidlaw College to Lincoln Road via Te Pai Place.	• Route = 2.1km • Average Speed = 26.8kph (LOS C) • Average Travel Time = 4.7mins. • Travel Time Range = 2.6mins to 9.6mins • This route generally operates with LOS D conditions and consistent travel times throughout the day. Aside from during the morning peak (08:00-09:00), congestion along this route is not considered to be a major issue.

[35] As defined within Part 3 of the Guide to Traffic Management (Austroads).

The travel time surveys have identified that Lincoln Road (northbound and southbound) and Central Park Drive (westbound between Paramount Drive and Lincoln Road) experience undesirable levels of congestion during the morning and afternoon peak weekday periods. The predominent causes are the delays experienced at the intersections.

The effect of delay is to increase bus travel time and reduce service efficiency. The data thus supports AT's objectives that the corridor efficiency and bus reliability should be improved.

3.3 Crash History

A review of the NZTA Crash Analysis Database (undertaken by AT[36]) for the five year period from 2008 to 2012 identified that there were a total of 466 crashes along the Lincoln Road between Te Pai Place and the SH16 Interchange. A summary of the crash history statistics with the project corridor is presented within

Table 3-5: Crash History Statistics (2008-2012)

Crash Severity	No. Crashes
Fatal	1
Serious	2
Minor	96
Non-Injury	347
Total	446

One of the most predominant crash movements during the five year period involved 159 crossing and turning type collisions (36% of all crashes). A large proportion of these crashes occurred as a result of drivers turning into/out of driveways/side roads and failing to give-way.

Of the 159 crashes, 107 were the right turn against type. AT noted[36] that the most likely reason for this can be attributed to the current design of Lincoln Road as the presence of two lanes in each direction with a central flush median results in a large number of turning vehicles which have to give way to oncoming traffic across up to 4 lanes.

[36] Lincoln Road – Economic Assessment Supporting Memo, AT.

4 Future Conditions

This section describes the projected future traffic movements and the modelling used for the assessments of traffic performance.

4.1 Traffic Modelling

4.1.1 Overview

The traffic conditions along Lincoln Road, as a result of future development and traffic growth, was evaluated by GHD and AT through the development of various traffic models. The traffic modelling undertaken for the Project has encompassed:

- **Intersection Modelling.** GHD undertook evaluations of the performance of each of the major intersections for the base (2011) and future (2016/2026) years using the SIDRA 5.1 software. These models, which were finalised in 2013, were peer reviewed in 2012 by Traffic Engineering Solutions (TES) Ltd. Further assessments (detailed later in this report) were undertaken by GHD as a means of establishing the following:
    - The impact of introducing a raised median; and
    - The impact of introducing a transit lane.
- **Micro-Simulation Modelling.** The Waitakere Central City S-Paramics Base Model (2008) was developed by Aurecon (Baseplus) and peer reviewed by Opus in 2009. AT undertook the following evaluations for the 2026 future year:
    - Intersection performance;
    - The impact of providing either bus lanes or transit lane;
    - The impact of extending Soljan Drive through to Central Park Drive;
    - Optioneering for a suitable transition between Lincoln Road and the SH16 Interchange;
    - Optioneering for the Universal Drive intersection; and
    - Optioneering for the KFC signals.

The purpose of the intersection operation modelling was to provide AT with guidance regarding the performance and preferred layouts for each of the key intersections based upon the background traffic. As such, the SIDRA analysis did not consider the impacts (in terms of additional trips or redistribution of traffic) as a result of new developments.[37]

The traffic analysis undertaken by GHD and AT was peer reviewed by independent transport planning specialists (Opus and TES). Therefore, there can be a high level of confidence that the analysis and conclusions stated within the corresponding reports is accurate and fit for purpose.

The key modelling parameters that were applied as part of GHD's development of the SIDRA models are provided within Appendix G. The methodologies used for establishing the future year (2016/2026) traffic volumes as part of the intersection and micro-simulation models is provided within Appendix H.

The micro-simulation future year scenarios have taken into account the proposed improvements to public transport services along Lincoln Road (with or without the LRCI Project) [38].

4.1.2 Traffic Growth

AT forecasts that the localised growth in vehicle demand between 2008 and the future 2026 model would be 19% for the morning peak, and 18% for the evening peak. This equates to around 1% per annum.[39]

[37] Lincoln Road Corridor – Intersection Operation Report, Section 6.2.2.

[38] Lincoln Road – Economic Assessment Supporting Memorandum, Page 10.

[39] Waitakere Central City Model - Future Demand Forecasting Memorandum, AT, May 2013.

4.1.3 Validation of Traffic Forecasts

As a means of understanding the validity of the forecast 2016 traffic volumes used for the intersection assessments, a comparison against the actual recorded 2015 volumes has been undertaken. Appendix C identifies the 2015 survey locations, the intersections for which forecast volumes have been reported and data comparison points. Further details regarding the validation process are provided within Appendix I.

Summary

Typically the 2016 forecast volumes used for the intersection modelling are on average around 20% higher than the actual volumes. This conclusion is line with AT's conclusions, as noted within the *Lincoln Road – Economic Assessment Supporting Memorandum (2013)*:

> *"During the evaluation it was identified that the 2016 model was operating poorly in comparison with the 2026 network, particularly city-bound in the morning peak and returning in the evening peak…The (2016) growth scenario is considered to be too high and unreasonable, given that it only some 3 years into the future".*

MWH therefore concurs with AT that the forecast results for the 2016 scenario are not likely to be reflective of actual conditions. As such, the results of the 2016 assessments have not been referenced within this report. AT has however confirmed that they consider that the development of the local and wider area will recover back to the originally forecast 2026 levels. We consider this to be an optimistic scenario in terms of future growth, and as such the 2026 forecasts are more likely to be overstated than understated. The 2026 traffic forecasts are therefore considered to be conservative in terms of traffic projection and sufficiently robust for the purposes of informing the preliminary design.

4.1.4 Requirement for Additional Modelling

The traffic modelling undertaken for the project to date has encompassed intersection (SIDRA 5.1) assessments undertaken by GHD and micro-simulation (S-Paramics) modelling undertaken by AT. The analysis undertaken by GHD and AT has been peer reviewed by independent transport planning specialists (Opus and TES). As such, there can be a high level of confidence that the analysis (undertaken in 2013) and conclusions stated within the corresponding reports are accurate and fit for purpose.

MWH met with AT on the 24th August 2015 to discuss the need for additional traffic modelling. It is considered that the modelling undertaken to date is suitable for the notice of requirement for the following reasons:

- The Paramics micro-simulation model considers all recent and confirmed future developments (including the Lincoln Precinct and Mitre 10 developments) together with land use intensification.
- The Paramics models include the design (as of 2013) for both the Lincoln Road and Te Atatu Road corridors[40]. Since 2013, only minor changes to the design of the Lincoln Road corridor have been made. In addition, the models took account of the current design for the SH16 interchanges with Lincoln Road and Te Atatu Road.
- Additional modelling was undertaken by AT in August 2015 as a means of addressing the previously outstanding issues relating to the initial Preliminary Design; namely:
    - Lack of a U-Turn Provision for the north approach to the Lincoln Road / Universal Drive intersection; and
    - Queues extending back from the KFC signals to the Lincoln Road / Universal Drive intersection.
- Analysis undertaken by GHD, which informed the development of the preferred intersection layouts was peer reviewed by TES. An assessment of the viability of the layout was undertaken by AT for the 2026 scenario, using the Paramics micro-simulation model.
- Analysis undertaken by GHD relating to the KFC signals and the impact of a raised median was also peer reviewed by TES in 2013.

[40] Waitakere Central City – Future Year Testing Modelling Summary Report, Aurecon, February 2013.

Notwithstanding this, we recommend that the Paramics traffic modelling is updated and finalised to incorporate the following during the detailed design stage:

- The final road layout, inclusive of recent changes to the Lincoln Road/Universal Drive intersection and tie-in with the SH16 Interchange;
- The mid-block crossing, located between the Daytona Road and Paramount Drive intersections;
- The preferred option and signal phasing for the KFC signals;
- Consideration of any new and confirmed major developments, not already implicitly included within the model;
- Incorporation of the land use intensification in line with the PAUP (if not already done); and
- Justification for the appropriateness of the 2026 growth rate and update accordingly (if deemed necessary – i.e. actual traffic volumes and uptake of developments show significant differences from those predicted).

We consider that the forecasts should be updated at the detailed design stage to confirm the appropriateness of the 2026 growth rate, the intensification of land use in line with the PAUP and the inclusion of new and confirmed major developments (see Figure 2-2). The revised models should be peer reviewed by an independent transport planning specialist.

AT has confirmed that an update of the model is planned for the detailed design stage. That further work may impact on the forecast volumes of traffic along Lincoln Road, The outcome is not expected to affect the proposed road geometry but may influence the final optimal signal phasing along the corridor or the intersection layout (in terms of turning lanes or queue storage lengths) However, the benefits of providing T3 lanes in improving travel time for HOVs/buses will still be realised even if the traffic forecasts for Lincoln Road change.

4.2 Trip Distribution

AT has identified that there is likely to be a change in travel patterns during the AM peak period from a currently dominant movement towards the City to a more balanced distribution towards both the east and west in the future[41]. This forecast change is as a result of additional employment that is planned for the NORSGA[42] and Albany development, which are located to the west of the corridor, in addition to an improved public transport network.

A summary of existing and forecast 2026 demands for the AM peak around SH16, as per the Paramics micro-simulation model[41], is presented within Table 4-1.

Table 4-1: SH16 Forecast Traffic Demand

Movement	Existing (2013)	2026
Traffic towards SH16 East (City)	10,314	9,977
Traffic towards SH16 West	2,863	6,458
Traffic from SH16 East (City)	5,481	6,005
Traffic from SH16 West	2,615	3,626
Eastbound through traffic (West of Lincoln Road to East of Te Atatu Road)	6,743	7,864
Westbound through traffic (East of Te Atatu Road to West of Lincoln Road)	2,410	6,473
Total	**30,427**	**40,403**

[41] Lincoln Road – Economic Assessment Supporting Memorandum, Page 11.
[42] Northern Strategic Growth Area.

5 Preliminary Design

5.1 Overview

The key features of the design are:

- An additional lane in each direction of travel, which will be designated as a T3 transit lane with the ability to become a dedicated bus lane in the future. *This meets AT's objectives that corridor efficiency and public transport reliability should be improved.*
- Intersection capacity enhancements, to include additional or longer turning lanes. *This meets AT's objective that corridor efficiency should be improved.*
- Provision of a dedicated cycle lane in each direction of travel. *This meets AT's objective that road safety should be improved.*
- A raised median will be installed in the centre of the road, and U-turns will be enabled at controlled intersections. *This meets AT's objective that road safety should be improved. Analysis has identified that the implementation will have a minimal impact upon AT's objective that the corridor efficiency should be improved.*
- The northbound T3 lane at the Central Park Drive/Triangle Road intersection continues to the SH16 westbound on-ramp. *This meets AT's objective that improvements will be integrated with the New Zealand Transport Agency's upgrades of State Highway 16 at the Lincoln Road interchange.*

Cross-Section

The final proposed cross-section, has the following lane widths:[43]

- 3.2m wide nearside traffic (Transit) lane;
- 3.2m wide general traffic lanes; and
- 3.0m wide lane for the right turn bays into Paramount Drive and Daytona Road.

The adopted widths comply with the requirements set out in Section 3.4.1.3 of Waitakere's Code of Practice for City Infrastructure and Land Development.[43] It is understood that the adopted lane widths were agreed with by AT and key internal stakeholders during workshops held on the 5th December 2011 and 22nd November 2012.

Shoulders are not being proposed as part of the Preliminary Design. This complies with the requirements set out in the Austroads design guidelines for a regional arterial road[44].

Cyclist Infrastructure

Copenhagen cycle lanes[45] will be provided on both sides of Lincoln Road to achieve a high level of amenity for pedestrians and cyclists. This will allow adequate space for pedestrians and cyclists to safely travel along the corridor at different speeds.[46] Upgrades to cycle infrastructure, in the form of upgraded east-to-west connections, are proposed at the Triangle Road/Central Park Drive, Universal Drive and Pomaria Road/Te Pai Place intersections.

These measures have been designed to meet the AT objective that the safety of cyclists should be enhanced through the provision of cycling infrastructure.

[43] Volume 1: Preliminary Design Report – Addendum to Scheme Assessment Report, Section 5.3.1.

[44] Volume 1: Preliminary Design Report – Addendum to Scheme Assessment Report, Section 5.3.2.

[45] Copenhagen style cycle paths have kerbs that separate the cycle path from both the traffic lane and the footpath. The footpath kerb height is smaller than the traffic kerb.

[46] Volume 1: Preliminary Design Report – Addendum to Scheme Assessment Report, Section 5.3.4.

Pedestrian Infrastructure

Pedestrian crossing facilities will be provided at the following intersections as a means of enhancing safety and amenity:

- Triangle Road/Central Park Drive;
- Universal Drive; and
- Te Pai Place/Pomaria Road.

An additional signalised staggered pedestrian crossing is to be provided approximately mid-way between the Daytona Road and Paramount Drive intersections. The minor priority controlled intersections will have raised tables and surface treatments that highlight pedestrians to other road users. The raised tables, planted median and landscaping will help to reduce traffic speeds along the corridor.

These measures have been designed to meet AT's objective of improving road safety for all users.

Public Transport Provision

The implementation of transit T3 lanes will encourage a modal shift to public transport by enhancing service reliability and reducing bus journey times. Physical measures such as the introduction of bus shelters will also encourage greater patronage of public transport services.

The appropriate positioning of the bus stops was identified by the AT Public Transport Team, with the locations predominantly on the downstream side of intersections and, where possible, as close as possible to existing stop locations.[47]

Lincoln Road is designated as part of the Frequent Service Network within the Auckland Regional Public Transport Plan. This will see frequency of bus services along the corridor increase from around 5 per hour to 14 by 2022 and to 16 by 2041. The implementation of two transit lanes provides support to the new Frequent Service Network by improving the reliability of services.

Together these measures will meet AT's objective of improving public transport reliability within the Project area.

Parking

Although on-street parking is available on the slip lane adjacent to 260-286 Lincoln Road, as the corridor functions as a Regional Arterial Route, the Preliminary Design does not provide for parking along the main route. This parking arrangement will meet AT's objective of improving road safety for all users by removing potential conflicts with vehicle parking.

[47] Volume 1: Preliminary Design Report – Addendum to Scheme Assessment Report, Section 5.3.7.

6 Design Considerations

This section outlines why the Lincoln Road corridor has been designed in that way it has. Details are provided in regard to intersection design choices, the form of the transit lane and measures to enhance safety and performance of accesses to the commercial area that contains KFC at 192-198 Universal Drive.

6.1 Intersections

GHD undertook intersection operational analysis,[48] based upon forecasts for 2011, 2016 and 2026, as a means of providing guidance to AT in regard to suitable layouts for each of the key intersections. The analysis was peer reviewed by TES in June 2012. Each of the preferred intersection layouts was verified and endorsed by AT following additional work carried out by Aurecon and AT's traffic modelling team using the Paramics micro-simulation model.[49]

The lengths of the turning bays were initially based upon the 95th percentile queue lengths from the 2026 peak period SIDRA models. The lengths of the turning bays were finalised in response to comments from the peer review, TES.[50]

6.1.1 Lincoln Road/Central Park Drive/Triangle Road

The initial 'Baseline' option for the Central Park Drive/Triangle Road intersection, as identified by AT, consisted of the following design elements:

- North Approach - Three through lanes + a bus queue jump lane + one right turn bay + one left turn slip lane;
- South Approach - Two through lanes + bus queue jump lane + one right turn bay + one left turn slip lane; and
- East/West Approaches - Two right turn lanes + one through lane + one left turn slip lane.

The following options, which were variations of the 'Baseline' option, were evaluated by GHD:

- **Option 1** – Provision of an additional lane for the Lincoln Road North approach. This provides continuity with the three left turn lanes from the SH16 westbound off-ramp.
- **Option 1a** – As per Option 1, but the additional lane for the Lincoln Road North approach to be designated as a T3 lane.
- **Option 2** – Provision of only two lanes for the South approach.
- **Option 3** – Amendment of the Triangle Road approach to provide a dual signalised slip lane, a shared through-right lane and a right turn lane.
- **Option 4** – Amendment to the Central Park Drive approach to provide a shared through-right lane plus two additional right turn lanes and a left slip lane.

A summary of the findings of the assessment is presented within Table 6-1 below.

Table 6-1: Central Park Drive/Triangle Road Intersection Optioneering

Option	Conclusion
1	An additional lane is required to ensure that there is sufficient capacity to cater for forecast traffic demands. The provision of only two lanes for the North approach is likely to result in queuing extending back to the SH16 Interchange.
1a	For continuity, it is preferable to designate the additional southbound lane as a T3.
2	Reducing the capacity to two lanes increases delays by a magnitude of three times. Recommendation that the South approach remains as per the Baseline layout.

[48] Detailed within the *Lincoln Road Corridor - Intersection Operation Report*.

[49] Volume 1: Preliminary Design Report – Addendum to Scheme Assessment Report, Section 5.4.1.

[50] Lincoln Road Intersection Operation Report - Peer Review Response and Decision Tracking Form, August 2012.

Option	Conclusion
3	Delays are lower with the provision of a left-turn slip lane as opposed to a dual signalised slip lane. Recommendation that the Triangle Road approach remains as per the Baseline layout.
4	The allowance of a triple right turn has a negative impact on the performance of the through movement from Central Park Drive. The Baseline layout provides a better balance and presents a more efficient option. Recommendation that the Central Park Drive approach remains as per the Baseline layout.

The analysis identified that Option 1a was the preferred layout.

6.1.2 Lincoln Road / Universal Drive

The initial 'Baseline' option for the Universal Drive intersection, as identified by AT, consisted of the following design elements:

- North Approach – Two through lanes + one left turn slip lane + two right turn bays;
- South Approach – Two through lanes + one left turn slip lane + one right turn bay;
- East Approach – Two right turn lanes + one shared through-left lane; and
- West Approach – Two left turn signalised slip lanes + one shared through-right lane + one right lane.

The following options, which were variations of the 'Baseline' option, were evaluated by GHD:

- **Option 1** – Universal Drive (East) approach modified to a shared through-left lane + shared through-right lane + right turn lane.
- **Option 2** – As per Option 1 with the North approach modified to a through + shared through-right and 100m right turn bay.
- **Option 3** – As per Option 2 but with no shared lanes for the Universal Drive (West) approach. This allows the phasing to be changed to a lead lag on the side roads instead of split side road phasing.

A summary of the findings of the assessment are presented within Table 6-2 below.

Table 6-2: Universal Drive Intersection Optioneering

Option	Conclusion
1	Provides a better result than the Baseline layout as the eastern approach provides a more even lane distribution. The split side road phasing requires less green time which allows the dominant Lincoln Road movements increased green time, which results in smaller delays and queues.
2	Performs worse than Option 1 as a result of limited stacking capacity for the right turn movement for the North approach. Delays and queues are subsequently longer for Option 2 compared to Option 1.
3	The benefits gained from the lead lag phasing are offset by an inefficient layout for Universal Drive. As a result Option 3 would be expected to experience larger delays than both Option 1 and 2.

The analysis identified that Option 1 was the preferred layout. However, it should be noted that the analysis encompassed a restriction of the U-Turn movement from the North approach.

Additional Assessment

The *Lincoln Road Corridor - Intersection Operation Report* concluded that consideration should be given to providing an additional right turn lane from the Lincoln Road South approach into Universal Drive Extension. To resolve this issue, AT undertook an assessment using the Paramics micro-simulation model to identify the suitability of providing a second right turn lane.

The result of that analysis was that whilst the second right turn lane would provide overall network benefits, the performance of the intersection during peak periods was shown to be adequate with the provision of a single right turn lane.[51] Accordingly, the preliminary design includes a single right turn lane.

[51] Lincoln Road Improvements - Traffic Modelling Memorandum, AT, March 2013.

Design Refinement

A U-turn provision for the Lincoln Road (North) approach was not included as part of the initial Preliminary Design (GHD) as the identified optimal signal phasing would see the left turn from the Universal Drive (West) approach run at the same time as the U-turn manoeuvre from the Lincoln Road (North) approach. In order to safely provide the U-turn movement, the implementation of appropriate signal phasing would result in delays for the signalised double left turn from the Universal Drive (West) approach increase significantly.

However, since the initial design, concerns were raised from local businesses and residents during the public consultation sessions in regard to the inability to make this turn and the negative implications for property accessibility.[52]

AT therefore undertook further assessments in August 2015 to identify a suitable design for which a U-Turn from the North approach could be safely provided, without compromising the performance of other movements. As part of this process, the following options were tested using SIDRA 6.0:

- Universal Drive (West) signalised left turn is red whilst the Lincoln Road (North) right turn is green. Tested using the original volumes and dynamic volumes[53] derived from the Paramics model;
- Universal Drive (West) left turn facilitated by a single left turn lane and give way control, rather than two signalised lanes.
- Provision of an uncontrolled mid-block U-Turn facility; and
- Provision of a signalised mid-block U-Turn facility.

The analysis based upon the original demands identified that, by retaining the signalised double left turn and introducing the U-Turn from the North approach, the performance of the left turn would operate with LOS F during both the AM and PM peak periods. Revised analysis based upon dynamic demands from the Paramics model identified that LOS F conditions for the left turn would still be expected during the AM peak.

However, the analysis identified that replacing the signal controlled double left turns out of Universal Drive with a signal give-way control lane would see the movement operate with LOS C and D for the AM and PM peaks respectively. The provision of mid-block facilities were discounted by AT due to the potential safety related issues.

The analysis undertaken by AT therefore concluded that: [52]

> *"Replacing the signal controlled double left turns out of Universal Drive with a give way control would provide the best outcome for this intersection in terms of facilitating the required U-Turn movement, with minimal effects on the other movements."*

Given the information presented, we agree that the above design revision for the Lincoln Road / Universal Drive intersection is appropriate.

6.1.3 Lincoln Road / Te Pai Place / Pomaria Road

The initial 'Baseline' option for the Te Pai Place/Pomaria Road intersection, as identified by AT, consisted of the following design elements:

- North Approach – Two through lanes + one left turn slip lane + one right turn bay;
- South Approach – Two through lanes + one left turn lane + one right turn bay;
- East Approach – One through lane + one right turn lane + left turn slip lane; and
- West Approach – One shared through-right lane + one left turn lane.

The following options, which are variations of the 'Baseline' option, were evaluated by GHD:

- **Option 1** – Reduction of the left turn lane from Pomaria Road (West approach) from a full lane to a 50m left turn pocket and through lane for Te Pai Place (East approach) reallocated as a shared through-right lane.

[52] The Enabling of U-Turns at Universal Drive / Lincoln Road Intersection – Technical Note, AT, 17th August 2015.

[53] Demands derived from the Paramics model take consideration of rerouting as a result of downstream delays.

- **Option 2** – Widen the Pomaria Road approach to include a 50m left turn pocket, one through lane and a 50m right turn bay.

The analysis identified that when the pedestrian phase is called, there are minimal benefits for providing Option 1 over the Baseline layout, and whilst Option 2 performs significantly better than Option 1, land acquisition would be required. As widening is not desirable, GHD recommended that the Baseline layout was retained. Given the information presented and the comments of the peer reviewer, we concur with this recommendation.

6.2 SH16 Interchange

This section summarises the optioneering process undertaken by GHD and AT to identify a suitable design for the transition from Lincoln Road, at the Central Park Drive/Triangle Road intersection, through to the SH16 Interchange. The optioneering undertaken by GHD was peer reviewed by TES in June 2012.

Optioneering

As noted within the *Volume 1: Preliminary Design Report – Addendum to Scheme Assessment Report (GHD, 2012)*, to provide sufficient capacity and to avoid undesirable weaving manoeuvres, the design of the Central Park Drive/Triangle Road intersection included the following considerations:

- There should be sufficient capacity for the southbound approach to cater for the forecast demands and to mitigate potential queuing back onto the motorway.
- The design of the other three approaches should allow for the expectation that drivers will choose their preferred lane on the approach to the intersection, and should not be expected to change lanes within the short distance (approx. 80m) between the intersection and the diverge for the westbound ramp.

The following three options (illustrated within Appendix J) were evaluated as a means of identifying a suitable transition from a transit lane to the SH16 Interchange:[54]

- **Option 1:** The northbound T3 lane is merged with the adjacent general traffic lane, after the Central Park Drive intersection (at a distance of approximately 85m) and then resumed on the westbound on-ramp (approximately 80m further downstream).
- **Option 2:** Termination of the T3 lane prior to intersection, with a bus queue lump lane plus exit provided.
- **Option 3:** The northbound T3 lane is continuous from the Central Park Drive intersection to the westbound motorway on-ramp

Option 2 was discounted due to the potential impact the arrangement would have upon the northbound flow of vehicles towards the SH16 westbound on-ramp. This option would require the large volume of traffic heading to the westbound on-ramp during the peak periods to change lanes immediately prior to the intersection. Subsequently this would create a weaving issue for traffic within the T3 lane and may also lead to vehicles being caught in the wrong lane and then changing lanes within a short distance once past the intersection.

Options 1 and 3 are relatively similar. However, Option 3 requires fewer vehicles to merge after the Central Park Drive intersection and will result in reduced associated queuing. The negative implication of Option 3 is that drivers who need to merge may find it more difficult without the merge.

Notwithstanding this, the assessment peer reviewer (TES) noted that Option 3 was preferred as provided the following recommendation as it eliminates the bottleneck of Option 1 and increases the capacity of the intersection departure.[55]

AT agreed that Option 3 should be adopted within the preliminary design for the tie-in with the SH16 Interchange.[56]

[54] Detailed within the *Integration with NZTA Interchange Memorandum.*

[55] Review of Transit Lane Integration Options of the 'Integration with NZTA Interchange Memorandum' Report, November 2012.

[56] Volume 1: Preliminary Design Report – Addendum to Scheme Assessment Report, Section 5.4.2.

AT undertook additional modelling using the Waitakere Central City Micro-Simulation model to assess the implications of either Option 1 or Option 3 from a traffic operations perspective. A summary of the findings relating to the Central Park Drive/Triangle Road intersection is presented below:[57]

- AM Peak – A minor improvement in performance would be expected with Option 3 when compared to Option 1. However, within the context of the overall network the difference is negligible.
- PM Peak – Option 3 is predicted to provide greater benefits, with the northbound movement along Lincoln Road predicted to improve from LOS D to LOS C due to the reduction in merging traffic after the intersection.

From an operational perspective, Option 3 was considered to be the optimal solution.

Design Refinement

As above, the GHD proposals for the northbound approach to SH16 identified 3 lanes of traffic and a 'T3' lane. This arrangement would require a significant amount of weaving as the 'T3' traffic would have to swap traffic lanes with the traffic taking the northbound SH16 on-ramp. AT identified that further work would be required, and as such MWH prepared and evaluated five options in addition to the GHD option.

The preferred option, as agreed with AT, provides four lanes of traffic northbound approaching the motorway, but without a 'T3' lane. Southbound traffic allows for 3 lanes of traffic turning left off the motorway widening initially to four lanes and the addition of the 'T3' lane.

The AT preferred option has the following advantages:

- The four lanes of traffic northbound between Triangle Road and the motorway interchange provides 250m length of the corridor in which drivers can select the correct lane for their intended destination:
    - The left lane develops as a left only lane that continues to the SH16 westbound on-ramp;
    - The two right hand lanes continue over the motorway interchange bridge before turning right onto the motorway eastbound on-ramp; and
    - The second lane on the left provides dedicated through lane and right lane onto the motorway 'T2' lane.
- The southbound arrangement avoids a lane trap scenario for the 'T3' lane for traffic tuning left off the motorway.

The AT preferred option does not have a 'T3' lane for northbound traffic from Triangle Road to the motorway interchange and as such the advantages to passenger transport and 'T3' occupancy vehicles are less than an alternative with the 'T3' lane. However, the operational efficiency close to the motorway and safety benefits of the AT preferred option is preferable to a 'T3' lane option. A shorter length of carriageway in which the vehicles have to change lanes would result in an increase in crashes at this location.

Details of the optioneering process are provided within the *'Lincoln Road Corridor Improvements - Addendum Scheme Assessment Report (August 2015, MWH)'*.

[57] Lincoln Road Improvements – Traffic Modelling Memorandum.

6.3 Access

6.3.1 KFC

As part of the preliminary design process, GHD investigated safety and capacity issues at the 'KFC' accesses along Lincoln Road and Universal Drive[58]. The purpose of the assessment was to identify suitable mitigation measures for ensuring safe and effective access to the 'KFC' development area. The optioneering undertaken by GHD was peer reviewed by TES in July 2012.

To identify a suitable solution for access to the 'KFC' development area, the following options were tested (as detailed within the *Lincoln Road Corridor Preliminary Design – KFC Accesses Solutions Report*):

- **Base** – Intersections 1, 2 and 3 are priority controlled (as per the existing situation).
- **Option 1** – Signalise Intersection 3 whilst retaining the staggered pedestrian crossing on Universal Drive.
- **Option 1A** – Same as Option 1 but with three eastbound lanes.
- **Option 2** – As per Option 1, but prohibit the right turn out of Intersection 3 (hence forcing traffic toward Intersection 2).
- **Option 3** – Signalise Intersection 3 while replacing the existing staggered pedestrian crossing with a full crossing across the Universal Drive (East) approach to Intersection 3.
- **Option 4** – Move the Pak 'n' Save driveway out of Intersection 1 and into Intersection 3 to make a four legged intersection. This therefore makes Intersection 1 redundant. The staggered pedestrian crossing is replaced with a full crossing on the Universal Drive (West) approach to Intersection 2.

Figure 6-1 identifies the locations of the accesses from Universal Drive and Lincoln Road.

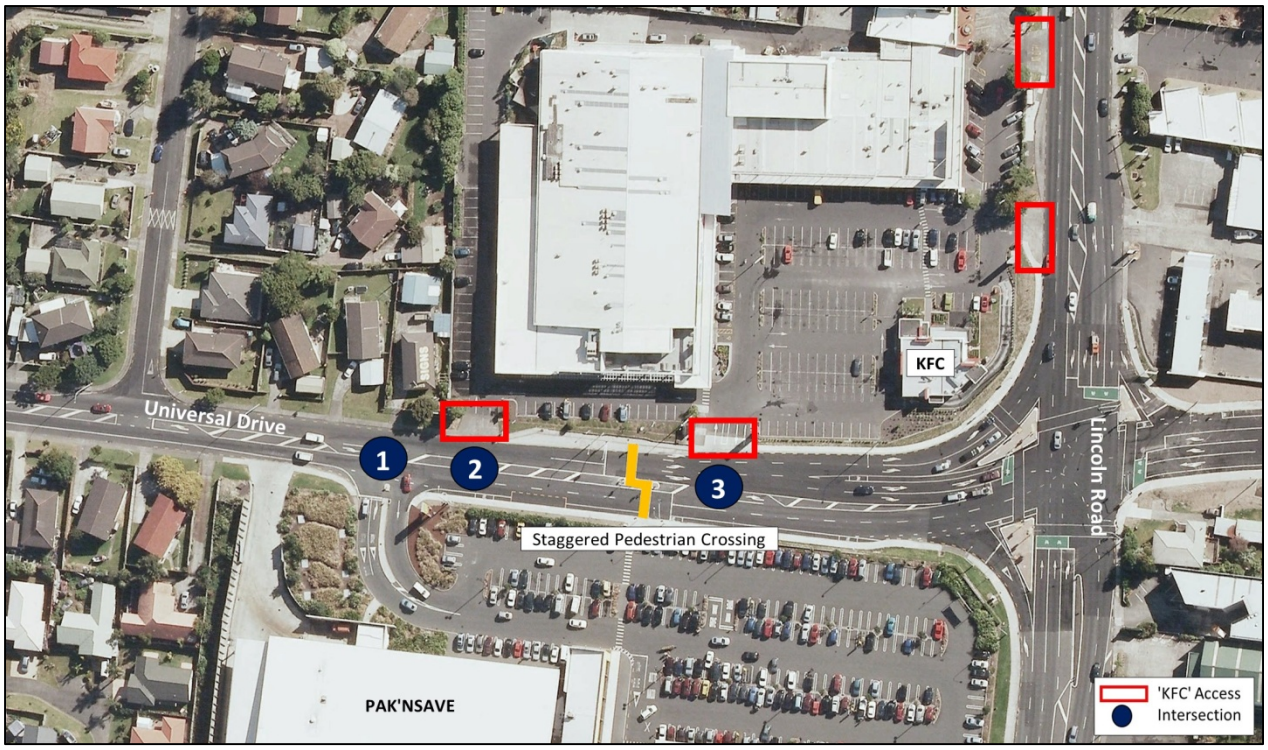


Figure 6-1: KFC Access Diagram

The analysis identified that, whilst the 'Base' option presented the lowest delays, there is a safety issue for right turning vehicles from the KFC accesses into Universal Drive. Option 2 was discounted due to

[58] Lincoln Road Corridor Preliminary Design – KFC Accesses Solutions, GHD, August 2013.

safety and delay issues for right turning vehicles and of Intersection 2, whilst Option 3 was not considered to be desirable as the option does not satisfy the pedestrian crossing desire lines.

Options 1, 1A and 4 were considered to address the safety issues. However, in terms of operation performance, Option 1A was forecast to deliver the lowest delays and as such was considered to be the preferred option.

Design Refinement

The analysis undertaken by GHD identified that queue lengths from the eastern approach to the KFC signals (for the preferred option) were expected to extend back to the Universal Drive / Lincoln Road intersection (max. 222m queue).[59] TES agreed[60] with the recommendation of GHD, in that:

> *"To gain maximum benefit from the implementation of Option 1, it is recommended that the phasing in the Intersection 3 is coordinated in SCATS with the Intersection of Universal Drive/Lincoln Road"*

Subsequently, AT undertook additional analysis in August 2015 using the SIDRA 6.0 software to evaluate the effect of coordinating the signal pair, and to identify a solution whereby queues do not extend back to downstream intersections. AT identified that the following two options would be expected to significantly reduce the likelihood of queuing extending back to Lincoln Road:

- Providing the pedestrian crossing for the eastern approach rather than the west approach; or
- Banning the right turn out of the KFC signals (Intersection 3).

It is understood that the preferred option will be determined during the next stage of the design process following consultation between AT and local businesses. The '*Lincoln Road Corridor Upgrade – Modelling of KFC Access on Universal Drive Memorandum (AT, 2015)*' provides further details in regard to the optioneering process that was undertaken.

6.3.2 Property Access

All adjacent properties with vehicle crossings onto Lincoln Road or other roads within the project site will retain vehicle access. For the properties on the west side of Lincoln Road between Daytona Road and Triangle Road, access will be via a new service lane.

For all other properties existing vehicle crossings will need to be rebuilt and relocated due to the widening of the carriageway. This will require some accommodation work within the adjacent properties to provide a smooth tie-in. At present, vertical design has not been completed and as such it is not possible at this stage to confirm the anticipated gradients of the driveways.

6.3.3 New Service Lane

The proposed carriageway widening will affect a number of existing properties along the project, particularly where the properties are located below the existing carriageway. Properties at 300 to 312 Lincoln Road currently have direct access on to Lincoln Road, although existing driveways to these properties are very steep. The proposed carriageway widening will worsen the current situation.[61]

There will therefore be a new public road formed to the rear of 300-312 Lincoln Road, which will provide access to Daytona Reserve and existing properties that will be unable to be accessed directly from Lincoln Road. The requirement for a retaining wall along this section of Lincoln Road enforces the need for the new service road.

A workshop was undertaken in 2014 to identify a preferred option for the new service lane.[62] During this workshop a number of road layout options and variations were considered; including:

- 'Park Edge Lane' Option;
- 'Back Lane' Option;
- 'Half Park Edge Lane' Option; and
- 'Lincoln Road Edge Lane' Option.

[59] The distance between the two sets of signals is approximately 70m.
[60] Lincoln Road Corridor Preliminary Design - KFC Accesses Solutions Peer Review, TES, July 2012.
[61] Lincoln Road – Preliminary Design Report, GHD, August 2013.
[62] Draft Lincoln Road Widening and Land Use Integration Workshop – Summary Report, Urbanismplus, July 2014.

These are illustrated diagrammatically in Figure 6-2 on the next page.

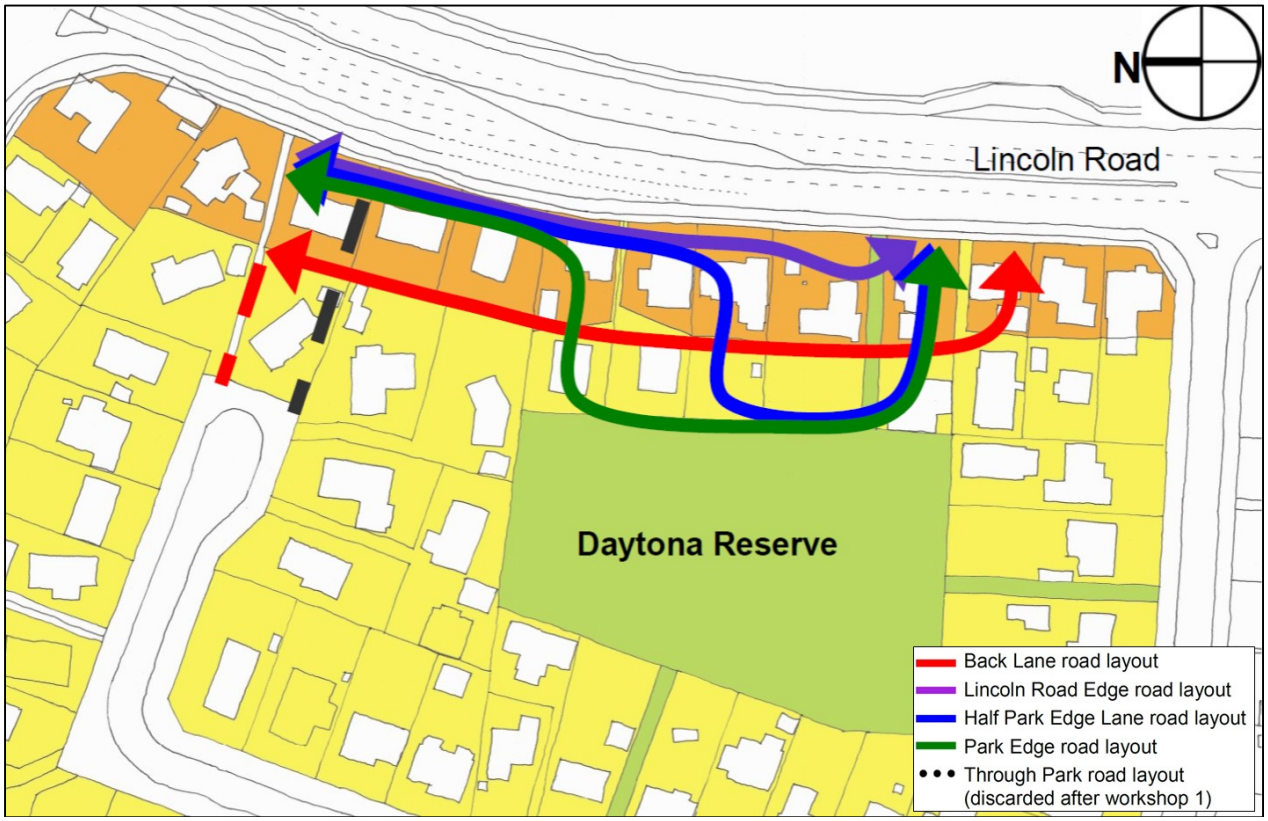


Figure 6-2: New Service Lane Options

The 'Park Edge Lane Option' was identified in the workshop to be the preferred option for the following reasons: [63]

- The option provides good sightlines from Lincoln Road into the park which should assist in raising awareness of this public amenity.
- The option provides for a range of development outcomes.
- The 'Back Lane' option does not provide any improvements to the park, such as increasing area, public access or passive surveillance. This option would also create considerable difficulties for stormwater management.
- The 'Half Park Edge Lane' would not require the purchase of 304a Lincoln Road. However this would mean that future development, in a high quality and intensified form, would not be provided. As such this option was not preferred.
- The 'Lincoln Road Edge Lane' Option does meet the Auckland Plan objectives as it does not provide for urban intensification in close proximity to transport link and open space amenity (Directive 10.3). The option also does not promote good design principles that will contribute to improving the built environment (Directive 10.5).

As a means of limiting the amount of land take from the Daytona Reserve and to avoid a special tree identified by the local board, the alignment of the new service lane road does not pass fully through the reserve.

A connection between the end of the service lane and the Preston Avenue cul-de-sac was considered. However, given community objections in regard to the link being potentially used as a 'rat-run', the preferred option includes a turnaround area at the end of the service lane.[62]

Final Preferred Option

The service lane options were further considered and assessed by the Project team in late 2015 in terms of their effects, costs and benefits. The final preferred option is a combination of the 'Park Edge'

[63] Draft Lincoln Road Widening and Land Use Integration Workshop – Summary Report, Urbanismplus, July 2014.

and ‘Back Lane’ road layouts; namely the alignment follows the park edge and then passes the rear of the properties along Lincoln Road. The final preferred option is shown within Figure 6-3.

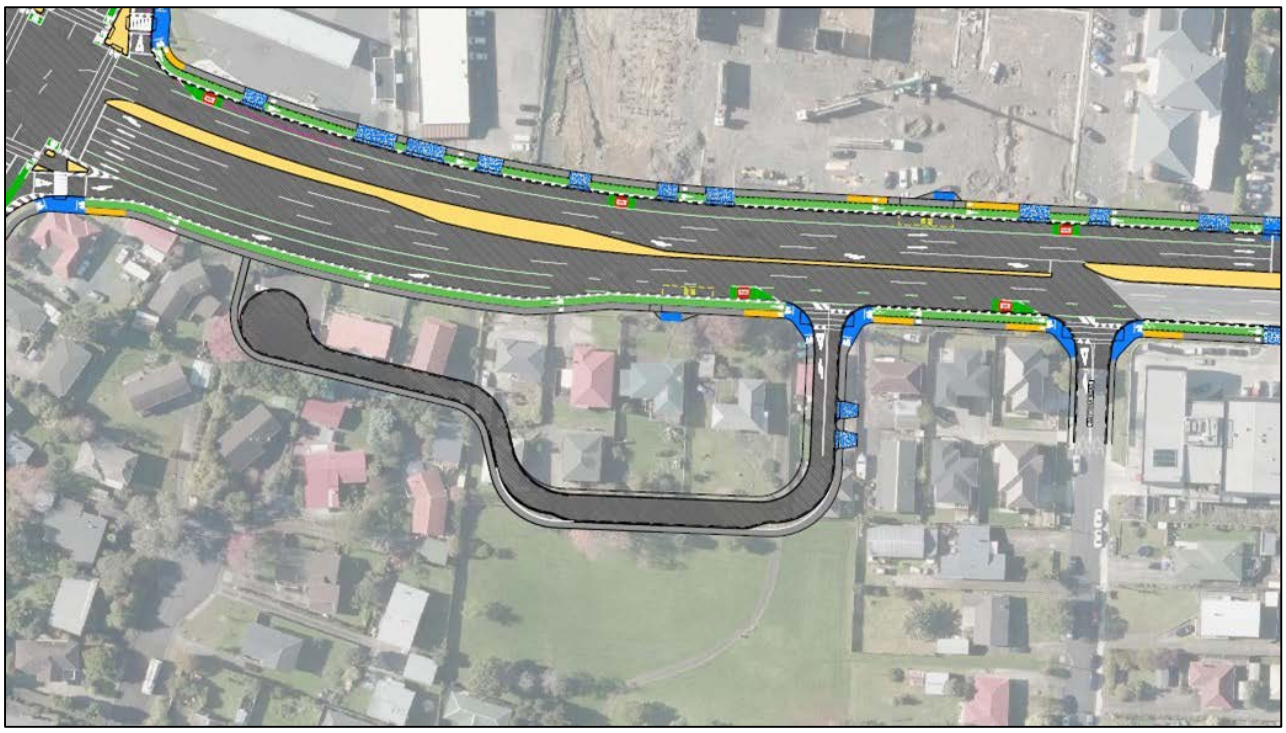


Figure 6-3: Service Lane – Final Preferred Option

6.4 Special Vehicle Lane

The main feature of the LRCI Project is the provision of an additional transit ‘T3’ lane in each direction of travel, which will prioritise movement for buses and high occupancy vehicles (HOV).

Lincoln Road is designated as part of the Frequent Service Network within the Auckland Regional Public Transport Plan. This will see frequency of bus services along the corridor increase from around 5 per hour to 14 by 2022 and to 16 by 2041[64]. The implementation of two transit lanes therefore provides support to the new Frequent Service Network by improving the reliability of services.

Ensuring buses operate with a good and consistent LOS is the primary objective of introducing the additional lanes. Therefore, if additional vehicles are allowed to use the priority lane it is important that the LOS for buses is not noticeably affected.

The benefits of providing either a bus lane or a transit lane were assessed from both a high-level perspective[65] and at a more detailed level using the Waitakere Central City Micro-Simulation Model[66]. This section of the report outlines the process undertaken by GHD[67] and AT for establishing the optimal form of the transit lanes.

High-Level Assessment

From a high-level perspective, analysis undertaken by GHD identified that if a T2 lane was implemented, the lane would carry a similar number of vehicles to each of the general traffic lanes. A T2 lane would thereby remove any potential travel time saving benefits for high occupancy vehicles and as such was not preferred. As such the provision of a T2 lane would not meet the project objectives of improving public transport reliability.

[64] Lincoln Road – Economic Assessment Supporting Memo.
[65] Detailed within the *Special Vehicle Lane Assessment Report*, Section 5.2.
[66] Detailed within the Lincoln Road Improvements - Traffic Modelling Memorandum.
[67] Lincoln Road Corridor Preliminary Design - Special Vehicle Lane Assessment, GHD, August 2013.

To understand the benefits of providing either a T3 lane or bus lane, the total person-delay[68] for each option was established. Table 6-3 summarises the findings of the assessment.

Table 6-3: Transit Lane Assessment – Total Person Delay

Scenario	Period	Northbound				Southbound			
		Total Person-Delay	LOS			Total Person-Delay	LOS		
			Bus	HOV	Other Traffic		Bus	HOV	Other Traffic
Bus Lane	AM	167 hrs/hr	D	F		396 hrs/hr	D	F	
	PM	191 hrs/hr	D	F		271 hrs/hr	D	F	
	Saturday	507 hrs/hr	D	F		689 hrs/hr	D	F	
T3 Lane	AM	153 hrs/hr	D		F	221 hrs/hr	D		F
	PM	130 hrs/hr	D		F	155 hrs/hr	D		E
	Saturday	235 hrs/hr	E		F	253 hrs/hr	D		F

The analysis indicated that a T3 lane in both directions will provide significant benefits to the overall travel time per person along the corridor. The analysis also identified that, if a bus lane is implemented rather than a T3 lane, the performance of the other general traffic lanes is likely to deteriorate to LOS F at an earlier stage. Based on the evidence presented with the report, this conclusion is robust.

Micro-Simulation Assessment

A comparison of the benefits of introducing either a bus lane or a T3 lane was undertaken by AT using the Waitakere Central City Micro-Simulation Model. The analysis identified the following:[69]

- The implementation of a bus lane is predicted to reduce bus travel times through the corridor from around 9.5 minutes to 5.5 minutes in the northbound direction during the AM peak in 2026. Heading southbound towards Henderson the bus travel time is predicted to reduce from around 7.5 minutes to 5.0 minutes.
- During the PM peak the implementation of a bus lane is expected to improve bus travel times by 1.5 minutes in the northbound direction and by 4.0 minutes in the southbound direction.
- Allowing HOVs to use the priority lane has a relatively minor impact on bus journey times during both the AM peak (15-20 seconds additional delay) and PM peak (20-25 seconds additional delay).
- Providing a T3 lane has a small positive benefit to general traffic during the AM peak, reducing the total time spent by vehicles travelling on the network by around 200 hours. During the PM peak the total travel time reduction is around 700 hours (approx. 4%) when compared to the bus lane option.

The conclusions derived from the micro-simulation modelling undertaken by AT concurred with the high-level assessment undertaken by GHD, that the additional lane should take the form of a transit 'T3' lane.

Proposed Operation

It is proposed that a T3 lane will be introduced first with the ability to become a dedicated bus lane in the future. The reasons for this approach are considered to be:

- Given that Lincoln Road is part of the 'Frequent Service Network', the frequency of buses along the corridor is likely to increase along with overall service patronage. A significant modal shift towards public transport may mean that additional economic benefits could arise from providing dedicated bus lanes.

[68] Person-delay = Total number of hours that all people in vehicles spend travelling along the corridor during one hour.
[69] Lincoln Road Improvements - Traffic Modelling Memorandum, Section 3.1.2.

- Given the existing traffic volumes and road conditions, the performance of the general traffic lanes is like to deteriorate to LOS F earlier if dedicated bus lanes were introduced first. As the Frequent Service Network is a future initiative, it is appropriate that during the interim period HOVs are allowed to utilise the transit lanes.
- The implementation of T3 lanes first will provide immediate benefits of the scheme to the public by providing additional road capacity (albeit only for HOV) to general traffic.
- A T3 lane can be implemented initially and monitored operationally. If required its status can be changed to a bus lane or even a T2 at a later date with changes in signing and markings.

6.5 Footpath / Cycleway

A workshop between MWH and AT was held on the 30th April 2015 to confirm the form of the proposed protected cycleway along Lincoln Road. The three options considered were:

1. Protected cycleway with a raised island.
2. Painted island separation.
3. Raised cycleway (Copenhagen[70] style).

Following a short discussion, the attendees agreed that Option 2 (painted island separation) would not be acceptable as the desired level of protection required for cyclists would not be achieved. The attendees then completed a high-level qualitative assessment of the remaining options (summarised in Table 6-4) based upon factors such as operation, safety and maintenance. Each option was assessed as to whether it provides a positive, neutral or negative outcome for each criteria.

Table 6-4: Cycleway Multi-Criteria Assessment

Criteria	Option 1 – Protected Cycleway with Raised Island	Option 3 – Raised Cycleway (Copenhagen Style)
Cyclist priority at intersections.	Positive	Neutral
Stormwater infrastructure.	Neutral	Positive
Refuse collection.	Negative	Positive
Maintenance (e.g. sweeper).	Neutral	Positive
Vehicle crossings.	Neutral	Positive

Based on the high-level assessment, MWH and AT were in agreement that Option 3 – Raised Cycleway (Copenhagen Style) was the preferred option for the protected cycleway along Lincoln Road.

The amendment from the originally proposed 2.5m wide shared path to a raised cycleway provides the key benefit that pedestrians, vehicles and cyclists and separated which will reduce conflicts and improve safety. This helps to meet the project objective of improving safety for all road users.

[70] Copenhagen style cycle paths have kerbs that separate the cycle path from both the traffic lane and the footpath. The footpath kerb height is smaller than the traffic kerb.

7 Road Safety Audit

Opus and Traffic Planning Consultants were commissioned by AT to undertake a Preliminary Design Safety Audit (Stage 2A). The objectives of the Road Safety Audit (RSA) were:

- To identify potential safety problems for road users and others affected by the project; and
- To ensure that measures to eliminate or reduce problems are considered fully.

A RSA was conducted on the 19th February 2013 and the 5th March 2013. GHD responded to the RSA comments, noting how each issue was to be addressed, with the final decision in regard to the necessary design changes made by AT. The issues, severity of the concern and recommendations noted within the Stage 2A (Part One) RSA are outlined in Appendix K.

AT commissioned a subsequent Stage 2A (Part Two) RSA to assess the safety implications of specific changes to the Preliminary Design. The RSA was completed in August 2015. The issues, severity of the concern and recommendations noted within the Stage 2A-Part Two RSA are outlined in Appendix L.

Note that each issue has been ranked in terms of the overall concern, which is a function of severity (likelihood of death or serious injury consequence) and frequency (probability of a crash). A summary of the risk categories is presented within Table 7-1.

Table 7-1: Risk Categories

Risk Level		Description
	Serious	A major safety concern that must be addressed and requires changes to avoid serious safety consequences.
	Significant	Significant concern that should be addressed and requires changes to avoid serious safety consequences.
	Moderate	Moderate concern that should be addressed to improve safety
	Minor	Minor concern that should be addressed where practical to improve safety.
	Comment	A concern or an action that may be outside the scope of the Road Safety Audit, but which may improve overall design or be of wider significance.

Stage 2A (Part One) Summary

The Stage 2A (Part One) RSA identified a total of 28 issues, of which there were 11 significant concerns and 13 minor concerns. There were however no serious concerns. In total, 13 issues have been addressed as part of the Preliminary Design, whilst the remaining 15 issues will be addressed within the Detailed Design stage.

The key issues raised by the Stage 2A (Part One) RSA, which are considered to have traffic operation implications, are summarised in Table 7-2.

Table 7-2: Stage 2A (Part One) RSA – Key Issues

Issue	Details	Design Revision
(1) Lane allocation signage approaching the motorway	With the increase in lane numbers on the approach to the SH16 interchange it is important that drivers get early warning of the correct lane to be in upon the approach to the Triangle Road intersection and SH16 Interchange.	The requirement for overhead advance destination and origin-destination signs, including supporting gantries, will form part of the **Detailed Design** stage.
(10) Right turns at priority intersections.	Right turns are permitted into Daytona Road and Paramount Drive. However, long queues develop from adjacent signalised intersections particularly in the northbound direction. This currently occurs and is still likely to occur following the upgrade. If this does occur, then the two general lanes are likely to be at a standstill but the T3 lane could be flowing freely. This can often result in crashes between turning traffic and through traffic on the T3 lane.	The use of keep clear marking to be assessed during the **Detailed Design** stage.
(12) Lane configuration along Universal Drive (Eastbound).	The lane configuration on Universal Drive in the eastbound direction develops a cycle lane immediately after the KFC entrance signals. This cycle lane then terminates at the cycle ASB. The cycle lane is developed with a chevron marking before the full width of the cycle lane is reached, which is likely to be slippery for cyclists when wet.	The **Preliminary Design** includes the following amendments: 1: Cycle advance boxes to be provided for the kerbside lane and the lane closest to the centreline to cater for cyclists. 2: The use of green surfacing and continuity line to develop the cycle lane. 3: Left lane changed to a shared left and through lane. Design also shows the location of the bus stop facility and the starting of the kerbside clearly.
(13) T3 hours of operation.	The T3 lane hours of operation are stated as 7am to 9am and 3pm to 6pm. Outside of these times the lane can be used by all traffic and the lane will be used as a general lane at all other times as there will be no impediments to its use such as parked vehicles. Outside of the hours of operation, the traffic flow in this T3 lane could be quite high and buses may experience difficulties in re-joining the traffic stream from the indented bus bays.	T3 lane provided for Monday to Saturday during peak periods with the possibility that it operates throughout the day for Monday to Saturday.
(23) Lane allocation at Pomaria Road.	The signal phasing for Poinsettia Place and Te Pai Place is for all movements on both roads to go together. For Poinsettia Place there is a shared through and right lane and a separate left turn lane. With this phasing and lane layout, it is highly likely that right turning vehicles from Poinsettia Place will block the path of through traffic. If this should occur then drivers may be tempted to use either the cycle lane or the left turning lane for the through movement.	To be addressed during the **Detailed Design** stage.

Stage 2A (Part Two) Summary

The Stage 2A (Part Two) RSA identified a total of 17 issues, of which there were three significant concerns and five major concerns. Where applicable, all outstanding issues will be addressed during the Detailed Design stage.

The key issues raised by the Stage 2A (Part One) RSA, which are considered to have traffic operations implications, are summarised in Table 7-3.

Table 7-3: Stage 2A (Part Two) RSA – Key Issues

Issue	Details	Design Revision
(1) Lane allocation signage.	On the approach to the SH16 interchange, the northbound carriageway has four lanes. The kerbside lane is a left turn only lane leading traffic to the westbound on-ramp. This is not clear from existing road markings until 100m from the intersection, where the left turn arrow is shown.	Appropriate road marking and text to be added during the **Detailed Design** stage.
(10) Right turn into Daytona Road and Paramount Drive across three lanes on Lincoln Road.	Given the poor visibility, vehicles making the right turn from Lincoln Road may try to make the right turn believing all through lanes have stopped and could crash into an oncoming vehicle in the T3 Lane. This could lead to a serious injury crash and is a significant safety concern.	Keep clear markings to be added during the **Detailed Design** stage.

8 Raised Median Impact

8.1 Accessibility

The implementation of a raised median on Lincoln Road means vehicles will be restricted from making some movements into and out of certain driveways and minor side roads. Where right-turn restrictions are in place, vehicles would be required to perform U-Turns at the closest signalised intersection or take an alternative route using side roads. The signalised intersections where U-turns are to be permitted are:

- Central Park Drive/Triangle Road;
- Universal Drive;
- Pak 'n' Save/Laidlaw Bible College; and
- Te Pai Place/Pomaria Road.

Figure 8-1 below provides an illustration of where U-Turns are proposed to be permitted.

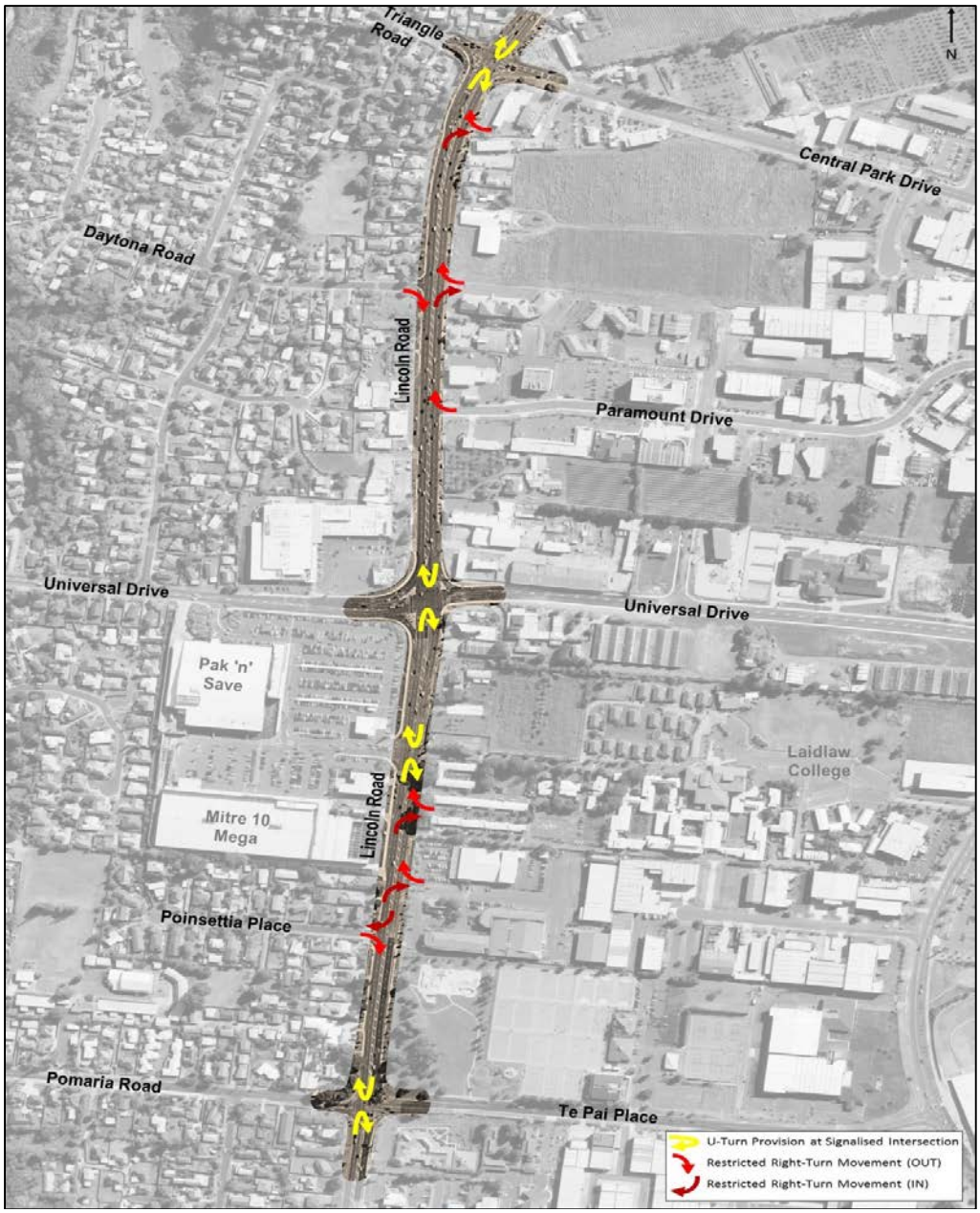


Figure 8-1: Proposed U-Turn Provisions and Restrictions

A summary of the expected rerouting, as per the *Lincoln Road Corridor Preliminary Design – Raised Median Report*, is provided below:

Side Road Restrictions

- Right turners out of Daytona Road will turn right out of Universal Drive and continue in the southbound direction.
- Right turners out of Paramount Drive will turn right out of Central Park Drive and continue towards the on-ramps.
- Right turners out of Poinsettia Place will turn left and perform a U-turn at the Pak N' Save intersection.
- Right turners into Poinsettia Place will perform a U-turn at the Te Pai Place.

Driveway Restrictions

- Daytona Road - A proportion of the city bound vehicles that intended to turn right out of property #325 Lincoln Road will use the access on Central Park Drive instead of performing a U-turn movement at the Daytona Road intersection. However, right-turning traffic demand is minimal at #325 Lincoln Road and re-assignment will have negligible impact on traffic operation. There are no businesses with accesses onto both Lincoln Road and Daytona Road.
- Paramount Drive – GHD identified that the majority of vehicles recorded from the section from Paramount Drive to Universal Drive were generated by the shops on the corner of Universal Drive and Lincoln Road. Site visits (undertaken by GHD) indicated that there were negligible right turns generated by the shops on the eastern side of Lincoln Road.
- Universal Drive – It is anticipated that the city bound U-turn movement will be negligible as retail facilities near the corner of Universal Drive and Lincoln Road have accesses to both roads. A raised median would simply divert vehicles towards the Universal Drive entrance. GHD observed this during the AM and PM peaks where heavy queuing from the motorway had suppressed demand for the Lincoln Road entrances, causing vehicles to reassign towards the Universal Drive entrance.

Properties fronting onto Paramount Drive can access via either Lincoln Road or Central Park Drive. As such the impact of the raised median to these properties may be considered to be less prominent than for other driveways along the corridor. Indeed a significant proportion of vehicles destined for Paramount Drive, and in particular to the eastern side, are likely to already access via Central Park Road.

Table 8-1 provides a summary of the impact of the raised median upon movements between destinations along the corridor, as well as through the corridor. For each route, an estimation of the additional distance and time is provided based upon the assumption that a 40kph average speed is maintained and a maximum intersection delay of 105 seconds at signals is incurred[71].

Appendix M provides diagrams which illustrate the alternative routes that vehicles are likely to take as a result of the introduction of a raised median for movements onto and off of Lincoln Road respectively.

Table 8-1: Impact of Raised Median to Travel Time and Distance

Approach/Driveway	Movement	Additional Distance	Max Additional Time	Diversion Route
Daytona Road	Right Out	250m	0.4 mins	Alternative route via Tudor Road.
Poinsettia Place	Right Out	380m	2.3 mins	U-Turn at Pak ‘n’ Save signals.
Petrol Station @ Central Park Drive/Lincoln Road Intersection	Right Out	0m	0.0 mins	Alternative access available onto Central Park Drive.
	Right In	70m	1.9 mins	U-Turn at the Central Park Drive/Triangle Road signals.

[71] Assumed that a 120 cycle time used, with six phases per cycle. As the right turn is not the predominant movement, a 15 second phase time is assumed and therefore a 105 maximum delay may be incurred for right turning vehicles.

Approach/Driveway	Movement	Additional Distance	Max Additional Time	Diversion Route
Lincoln Manor Offices	Right Out	690m	2.8 mins	U-Turn at the Universal Drive signals.
	Right In	520m	2.5 mins	U-Turn at the Central Park Drive/Triangle Road signals.
Paramount Drive	Right Out	400m	2.4 mins	U-Turn at the Universal Drive signals. Alternative route available via Central Park Drive.
Laidlaw College	Right Out	630m	2.7 mins	U-Turn at the Te Pai Place/Pomaria Road signals.
	Right In	180m	2.0 mins	U-Turn at Pak 'n' Save signals.
Commercial Development at 207 Lincoln Road.	Right Out	480m	2.5 mins	U-Turn at the Te Pai Place/Pomaria Road signals.
	Right In	320m	2.2 mins	U-Turn at Pak 'n' Save signals.
Pomaria Road	Right In	400m	2.4 mins	U-Turn at the Te Pai Place/Pomaria Road signals.

8.2 Operational Performance Implications

The objective of the operational assessment undertaken by GHD (detailed within the *Lincoln Road Corridor Preliminary Design – Raised Median Report*), was to provide an indication of when a raised median should be implemented based upon safety issues and to determine the likely knock-on effect to intersection performance.

The assessment included two scenarios; namely – with a flush median and with a raised median. Both scenarios are based around a corridor upgrade from four lanes to six, inclusive of a transit lane in each direction. The assessment was based upon the design submitted to AT on the 1st August 2011 and was undertaken using the SIDRA 5.1 software.

Table 8-2 identifies the intersection volume increases as a result of the introduction of a raised median, noting that the volumes take into consideration background traffic growth and development traffic.

Table 8-2: Traffic Volume Increase Resultant from the Raised Median Introduction

Intersection	Year	AM	IP	PM	SAT
Central Park Drive / Lincoln Road	2011	0.7%	1.9%	1.0%	1.2%
	2026	0.7%	1.7%	0.7%	1.2%
Universal Drive / Lincoln Road	2011	1.5%	5.0%	3.1%	4.2%
	2026	2.0%	4.9%	4.6%	4.2%
Pak 'n' Save / Lincoln Road	2011	1.6%	1.4%	1.5%	0.8%
	2026	1.4%	1.4%	2.2%	1.0%
Te Pai Place / Lincoln Road	2011	1.0%	0.2%	0.8%	0.6%
	2026	1.1%	0.3%	0.9%	0.5%

The analysis identified that the raised median option generally results in marginal increases in traffic volumes in the signalised intersections with percentage increases ranging from 0.2% to 5.0% during the peak periods.

A summary of the intersection performance results[72], as per the *Lincoln Road Corridor Preliminary Design – Raised Median Report*, is provided below.

- Central Park Drive/Triangle Road Intersection - The delays experienced for either the flush median or raised median scenarios are comparable. This is because there are minimal differences between the traffic demands for each scenario.
- Universal Drive Intersection - The movement delays experienced for the two options are fairly similar on the Universal Drive and Lincoln Road northbound approaches. However, for the other two approaches, the provision of a raised median is expected to result in higher delays for some movements. This intersection has the highest increases in traffic volumes in the critical peak (PM/Saturday peak) as a result of the raised median (3.1%-4.6%).
- Pak 'n' Save Intersection - The movement delays experienced for the two options are very similar with almost all movements having similar delays in the critical peak. This is because this intersection has minimal increases in traffic in the critical PM peak (0.8-1.0%).
- Te Pai Place/Pomaria Road Intersection - The movement delays experienced for the two options are fairly comparable with most movements having similar delays. However, the Lincoln Road southbound right turn movement experiences significant additional delay as a result of the raised median. This intersection has minimal increases in traffic volumes in the critical peak (Saturday inter peak) as a result of the raised median, however the additional vehicles are focussed on the Lincoln Road southbound right turn movement.

8.3 Summary

The alternative to the raised median would be the retention of the existing flush median. Given the forecast rises in traffic volumes, the opportunities to find suitable gaps between three lanes of traffic will be limited. As such, the risk of collisions would be significantly increased. From a safety perspective, the retention of a flush median is not suitable as the risk of collision from right turns into side roads will be increased as a result of the provision of additional transit lanes.

The implementation of the road median is expected to decrease the likelihood of right angle and other turning collisions along mid-block sections by 20%-30%. This benefit more than offsets the expected maximum increase in travel time of less than three minutes; a delay that would be experienced by a small number of vehicles entering Lincoln Road from side roads.

Therefore, the implementation of a raised median meets AT's objective that road safety should be improved, whilst also having a minimal impact upon AT's objective that corridor efficiency should be improved. The impact of the redistribution of traffic attributed to the provision of the raised median has been accounted for as part of the micro-simulation traffic analysis undertaken by AT.[73]

[72] As noted within the *Lincoln Road Corridor Preliminary Design – Raised Median Report*.

[73] Lincoln Road Improvements – Traffic Modelling Memorandum, Section 1.

9 Temporary Transport Effects

Details regarding the management of the effects of construction are included within the *LRCI Project – Construction Sequencing and Traffic Management Report*, provided within Appendix N.

This section however provides a brief summary in regard to the following:

- The type of construction traffic;
- The potential impact onto network operations;
- Matters to be included in a construction traffic management plan; and
- Recommendations for other conditions considered necessary to mitigate transport, traffic and access effects.

Construction Traffic

Construction traffic generated by the Project will mostly consist of trucks bringing materials and plant to site and also removing surplus material and plant which are no longer required from the site. Light vehicles, including cars, vans and utility vehicles, will also be used for this purpose and to convey construction personnel to and from the site.

Most trucks will be rigid, non-articulated vehicles without trailers with lengths not exceeding 12.6m. However articulated vehicles with trailers and total lengths up to 19m in length will be used in some cases, particularly for delivery of pavement aggregate to site.

Plant, which is expected to be used at the site and will be delivered and removed by truck, includes rollers, excavators, pavers, milling machines, mobile cranes, and similar plant typical of the type employed for road construction. Potential locations for a site office, and the storage of materials and machinery during the works will be identified as the design is developed.

Traffic Impact

The seven day annual average daily traffic (AADT) for Lincoln Road between Universal Drive and Central Park Drive is 41,837 vehicles with 8.4% heavy commercial vehicles (HCV%). There may be a need to reduce traffic down to two lanes, one each direction, for short periods, particularly for final surfacing layer works or road marking. In these instances construction work should be undertaken at night between 21:00 (646vph) and 06:00 (821vph).

To date, no traffic modelling has been carried out for the proposed traffic management and therefore the impact of the project on the local and wider road cannot be quantified. Traffic modelling will be undertaken once the design is at a more developed stage and feedback has been received from service companies with assets which require relocation. If required the construction staging will be modified based on the outcome of the modelling in order to ensure that any congestion resulting from the works is kept at acceptable levels.

Temporary Traffic Management (TTM)

The following matters are proposed to be included in a construction temporary traffic management plan:

- For safety reasons, it is desirable to keep operating speeds low during the works. For this reason it is proposed that traffic lanes adjacent to work zones are narrowed down to 3.2m and side friction is created by separating opposing lanes with a row of traffic cones and to separate traffic lanes from work areas by use of water filled plastic crash barriers. Traffic lane widths on side roads around the intersections with Lincoln Road are less than 3.2m where space is limited. The Code of Practice for Temporary Traffic Management (COPTTM) permits lanes to be reduced to 2.75m wide if 30kph speed restrictions and ‘Safe Hit’ flexible delineators are used.
- The contractor will be required to provide flexibility in the proposed traffic management arrangement. Should the actual traffic volumes differ from the expected traffic flows, the contractor may be required to alter the layout. Any changes will be subject to discussion and agreement with AT.
- In general, if additional work space is needed then a 2.75m lane width is permitted under COPTTM but with a 30km/hr speed limit. Given the intersection workspace restraints, traffic volumes and worker safety issues, a 30km/hr speed restriction should apply for the entire duration of the project.

- Pedestrian access will be maintained along both sides of Lincoln Road and side roads throughout the construction. Pedestrian areas will be cordoned off from work zones, typically by the use of water filled barriers where practical.
- There are currently no cycle lanes on Lincoln Road. During construction cyclists will be accommodated within the general traffic lanes. During construction operating speeds will be reduced by the use of temporary speed limits and this will improve safety for cyclists mixing with general traffic.
- Once construction on a stage is complete and temporary traffic management has been removed cyclists will be provided for on the new Copenhagen lanes on each side.
- Access to properties adjacent to the site will need to be maintained throughout the works. This will require that breaks be left in the water filled barriers condoning off the site at vehicle crossings. Temporary works will be required in places during construction where new and existing levels differ. In some cases work may need to be done outside of business hours in order to minimise disruption to adjacent businesses.

Effects Management

The following consent conditions are recommended to mitigate construction transport, traffic and access effects.

- Prior to commencement of construction activities the consent holder shall provide a copy of a detailed design safety audit to the Team Leader Western Monitoring including a signed copy of the tracking table of the audit.
- Prior to the commencement of construction activities, the consent holder shall submit a Construction Traffic Management Plan to be Team Leader Western Monitoring. The temporary traffic management measures in the plan shall include provision for controlling construction access to the site, traffic control adjacent to the site, and the protection of the public.
- A copy of the approved Traffic Management Plan, shall be kept on the site at all times. All measures for the protection of the public and other personnel set out in the approved Traffic Management Plan shall be maintained and complied with at all times until such time as the works are completed.

10 Permanent Transport Effects

10.1 Positive Impacts

Lincoln Road

The key benefits of the Project are[74]:

- Improved corridor performance;
- Increased cycling activity;
- Reduced number of accidents; and
- Improved network efficiency.

Improved Corridor Performance

The Project is expected to significantly increase the person carrying performance of the corridor through the provision of the T3 lanes in each direction of travel. The lanes provide immediate additional capacity for buses and HOV, which has knock-on congestion relief benefits to general traffic. Improved reliability and reduced bus journey times will encourage a modal shift towards higher occupancy vehicles, which once in effectively increases the capacity of the corridor.

Table 10-1 presents a summary of the 2026 network performance statistics with (LCRI) and without (Do Minimum) the introduction of the Project[75]. Figure 10-1 graphically demonstrates the increase in the peak hour carrying performance of the corridor following the introduction of the Project. Overall the introduction of the LCRI Project is expected to reduce the overall average journey time in 2026 from 8.7 minutes to 8.1 minutes. General traffic times along Lincoln Road are predicted to remain relatively consistent with the implementation of the project.[76] The increase in the number of cars following the introduction of the LRCI is likely a result of additional drivers being attracted to the corridor to make use of the immediate travel time benefits once buses and HOV utilise the T3 lanes and free up capacity in the general traffic lanes.

Table 10-1: 2026 Corridor Performance Statistics

	Bus		HOV		Cars	
	Do Minimum	LRCI	Do Minimum	LRCI	Do Minimum	LRCI
Travel Time (mins)	9.0	5.7	8.6	6.6	8.6	8.8
Total No. People	650	650	237	307	2,384	3,097
Total Person Travel Time (mins)	5,850	3,705	2,034	2,028	20,500	27,251

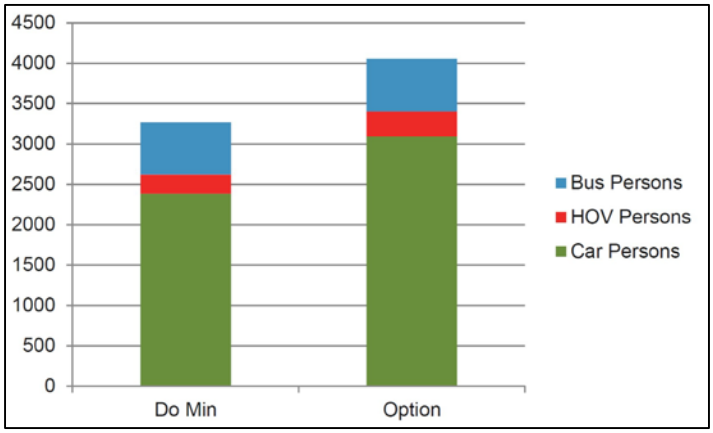


Figure 10-1: Person-Carrying Capacity

[74] Lincoln Road – Economic Assessment Supporting Memorandum, Page 16.
[75] Lincoln Road – Economic Assessment Supporting Memorandum, Page 18.
[76] Lincoln Road – Economic Assessment Supporting Memorandum, Page 17.

If the Project does not go ahead, a deterioration of bus reliability and increase in bus journey times would be expected.

Increased Cycling Activity

The provision of quality cycling facilities along the corridor is expected to increase the carrying capacity of Lincoln Road by encouraging modal shift. The provision of off-road cycle paths along Lincoln Road also provides improved connections with existing on-road cycle lanes along Te Pai Place, Pomaria Road, Universal Drive, Triangle Road and Central Park Drive.

Reduced Number of Accidents

Introducing a solid raised median along Lincoln Road will act to reduce the likeliness of vehicle turning collisions. Overall, the safety advantages of implementing a raised median along Lincoln Road are considered to be[77]:

- An estimated reduction by between 20%-30% in right angle and other turning collisions along mid-block sections;
- Reduction in delays and queuing from side roads results in less driver frustration which otherwise may result in drivers taking unacceptable gaps to merge with Lincoln Road traffic;
- A raised median will eliminate mid-block U-Turn manoeuvres; and
- A raised median may help prevent collisions that would otherwise be caused by traffic crossing the centreline/flush median.

If the Project does not go ahead, an increase in the number of right angle and turning collision accidents would be expected as vehicle traffic along the corridor continues to rise.

The reduction in on-street parking, albeit in limited locations, will reduce the frequency of parking manoeuvres and have a minor positive impact on road user safety.

Improved Network Efficiency

AT has identified that there are significant PM peak benefits from introducing the LRCI Project[78]. This result is considered to reflect the ability of the upgraded Lincoln Road corridor to accommodate traffic released by the improvements along SH16 and at the interchange with Lincoln Road as part of the completion of the Western Ring Route.

SH16

The Central Park Drive/Triangle Road intersection is approximately 200m to the south of the Lincoln Road Interchange, which has recently been upgraded. Given the close proximity, the performances of the Central Park Drive/Triangle Road intersection and the interchange are closely related.

AT also identified[79] an interdependence between the SH16 vehicle capacity and the capacity of the Lincoln Road and Te Atatu Road corridors and motorway interchanges. Without the LRCI Project, considerable queuing back from the interface to the interchange along Lincoln Road, Triangle Road and Central Park Drive would be expected.

Capacity enhancements along SH16 and at the interchange will result in an increase in vehicles looking to access Lincoln Road, particularly during the PM peak. However, without improvements, Lincoln Road will be unable to accommodate the future demand and as a result significant queuing back onto the SH16 is predicted. Queues that build back onto SH16 not only impact vehicles trying to get off at Lincoln Road, but also restrict the flow of westbound vehicles heading further along SH16 and SH18.

Summary

Whilst we recommend that the traffic model is updated (see Section 4.2), any updates to the model would not be expected to affect the aforementioned project benefits.

[77] *Lincoln Road Corridor Preliminary Design – Raised Median Report*, Section 6.2.

[78] Lincoln Road – Economic Assessment Supporting Memorandum, Page 20.

[79] Lincoln Road – Economic Assessment Supporting Memorandum, Pages 11-12.

10.2 Negative Impacts

The key negative transport related implications of the Project are:

- Increased travel distances.
- Increased number of vehicles passing through intersections.
- Safety issues.
- Reduced parking supply.
- Construction impacts.

Further details in regard to the above negative impacts of the Project are provided below.

Increased Travel Distance

The implementation of a raised median means vehicles will be restricted from making some movements into and out of certain driveways and minor side roads. This in turn will increase the travel distance and time for some people accessing certain properties. To mitigate the potential negative impact, right turn bays have been proposed to allow vehicles to make the turn into Daytona Road and Paramount Drive from both the northbound and southbound directions.

The negative implications of increased travel time for some people accessing the minor roads is offset by the significant safety benefits which arise from introducing the raised median.

Increased number of vehicles passing through intersections.

The impact of the introduction of a raised median is expected to have a relatively minor impact on both operational performance and additional travel time that is incurred as a result of diversions.[80] However, despite the rise in total intersection traffic, all intersections are expected to operate with acceptable levels of performance up until 2026. The disbenefits of additional delays incurred at the intersections due to the rerouting effect is offset by the significant road safety benefits and the allowance for HOV to utilise the T3 lane.

Safety Issues

The safety disadvantages of implementing a raised median are considered to be:

- A raised median will concentrate right turning movements at signalised intersections.
- A raised median may encourage pedestrians to cross away from the formalised crossings at the signalised intersections.

To mitigate against the potential negative impacts noted above, the Preliminary Design includes pedestrian crossings for all approaches to each of the signalised intersections together with a new signalised mid-block crossing between the Daytona Road and Paramount Drive intersections. This means that safe crossing opportunities across Lincoln Road will be provided every 120m-360m, and as such a pedestrian looking to cross Lincoln Road will be no further than 180m (approximate 2 minute walk) from a safe crossing point.

Reduced Parking Supply

The impact upon parking supply within the project area is minimal.

Although on-street parking along Lincoln Road is permitted to the slip lane adjacent to 260-286 Lincoln Road, in keeping with the functionality of a regional arterial road, on-street parking is not permitted on the main line. Approximately 11 of these spaces will be lost as a result of the corridor improvements.

On-street parking is not permitted along sections of Universal Drive, Triangle Road, Central Park Drive or Pomaria Road which are part of the project site.

However, some existing on-street parking spaces along Paramount Drive, Daytona Road and Poinsettia Places (near the intersections with Lincoln Road) are expected to be lost to accommodate the new speed tables proposed at these side roads. As such, approximately up to four spaces will be lost at each side road.

[80] Lincoln Road Corridor Preliminary Design – Raised Median Report.

Construction impacts.

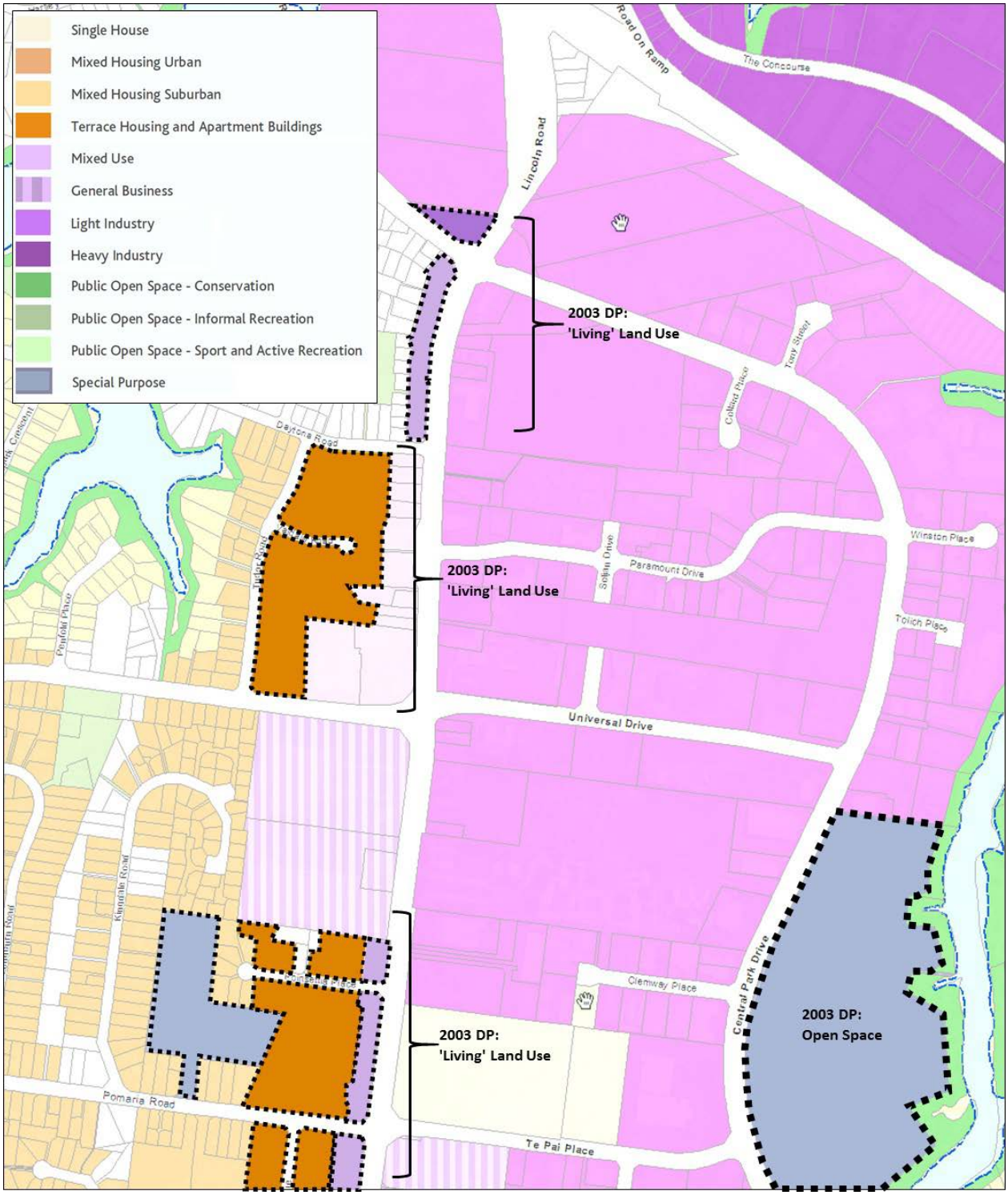
During the construction period there may periods when there is a need to reduce traffic down to two lanes, one each direction, for short periods. This is likely to be the case during the final surfacing layer works or road marking.

Although no traffic modelling has been carried out for the proposed traffic management has been undertaken to date, the reduction in lane capacity will have a negative impact to congestion and delays during these short periods. The construction impact will therefore have to be carefully managed as a means of reducing the negative traffic operation implications.

Furthermore, during construction there will potentially be short periods of time where temporary speed limits are implemented.

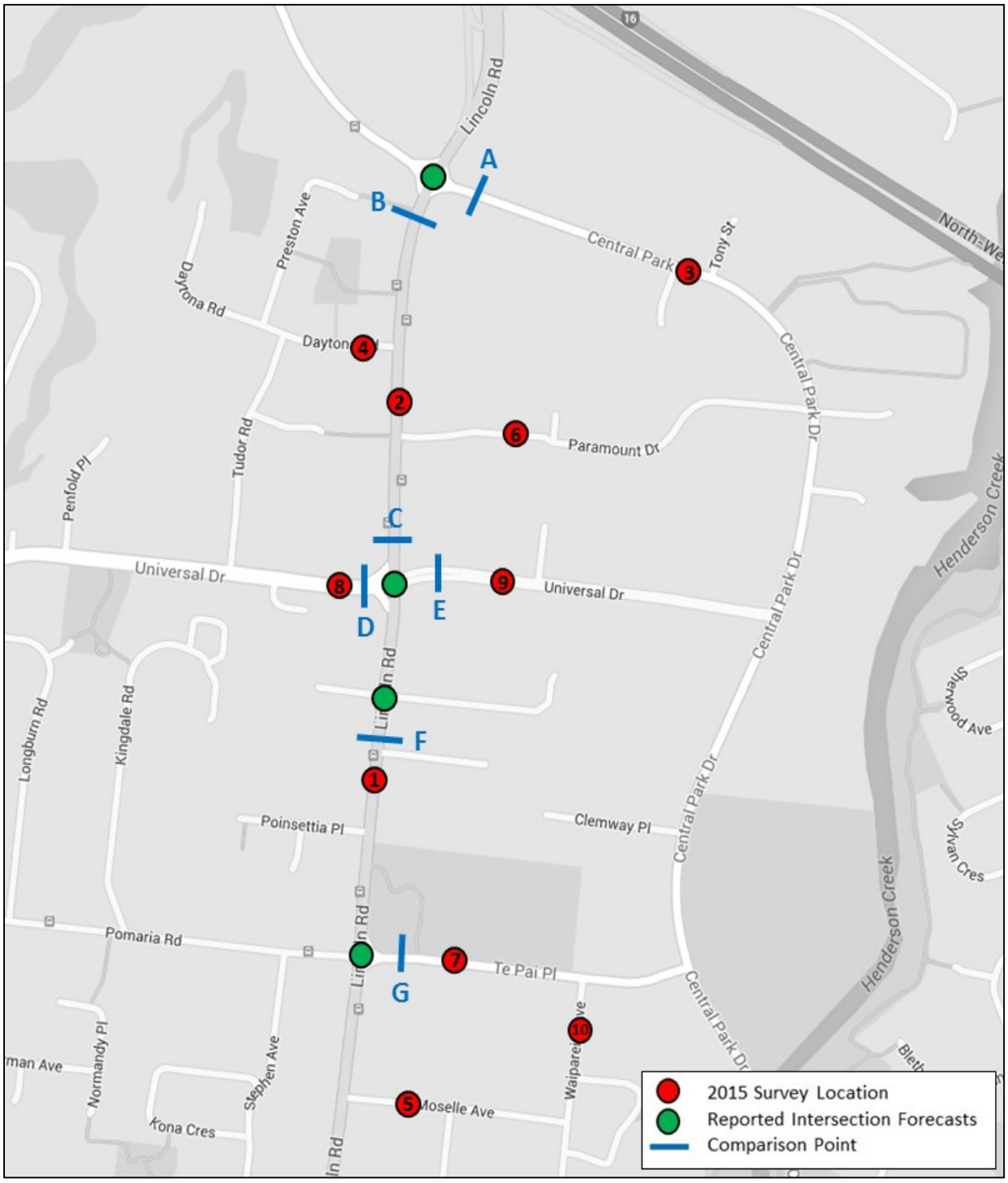
Appendix A Preliminary Design (10/06/2015)

Appendix B PAUP - Land Use Plan

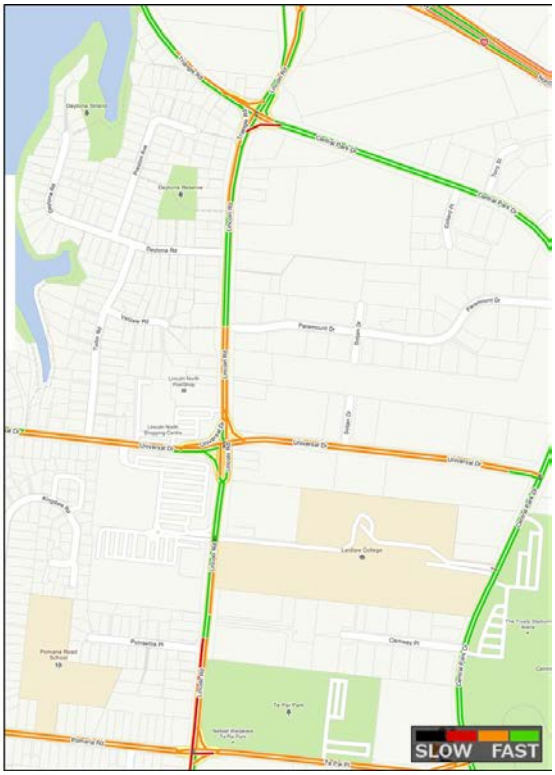


Proposed Auckland Unitary Plan - Land Use

Appendix C Traffic Survey Locations


Lincoln Rd
Preston Ave
Central Park
Tony St
Central Park Dr
Paramount Dr
Tudor Rd
Penfold Pl
Universal Dr
Henderson Creek
Longburn Rd
Kingdale Rd
Poinsettia Pl
Clemway Pl
Sylvan Cres
Pomaria Rd
Te Pai Pl
Normandy Pl
Stephen Ave
Moselle Ave
Kona Cres
A
B
C
D
E
F
G
1
2
3
4
5
6
7
8
9
10
2015 Survey Location
Reported Intersection Forecasts
Comparison Point

Appendix D Congestion Mapping



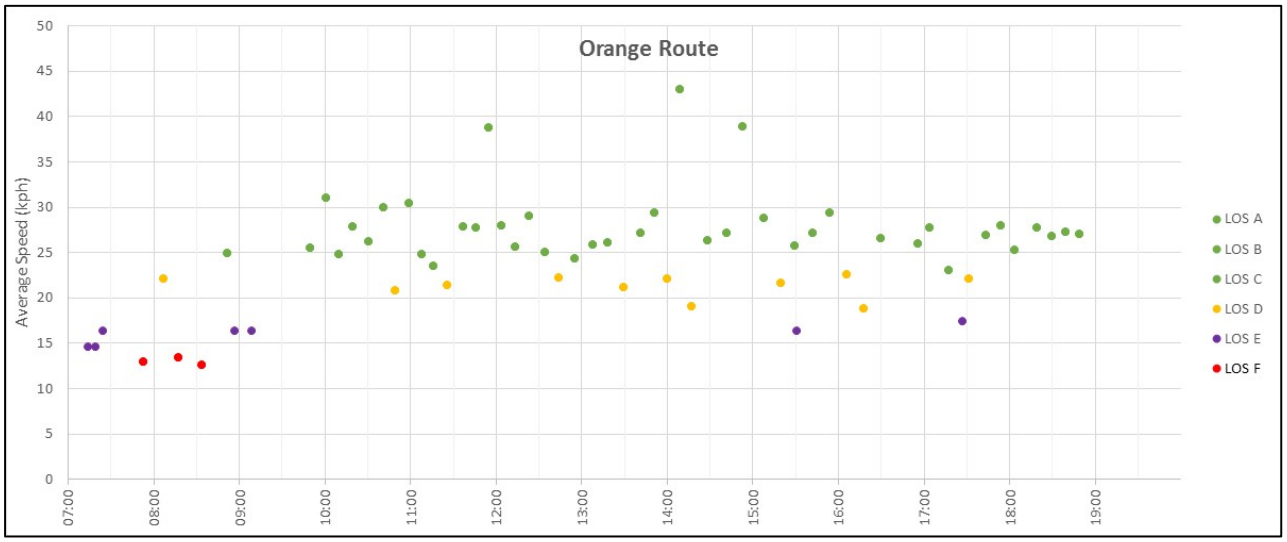
AM Peak - 2012 Conditions *AM Peak - 2015 Conditions*

Lincoln Road Congestion Map (AM Peak)

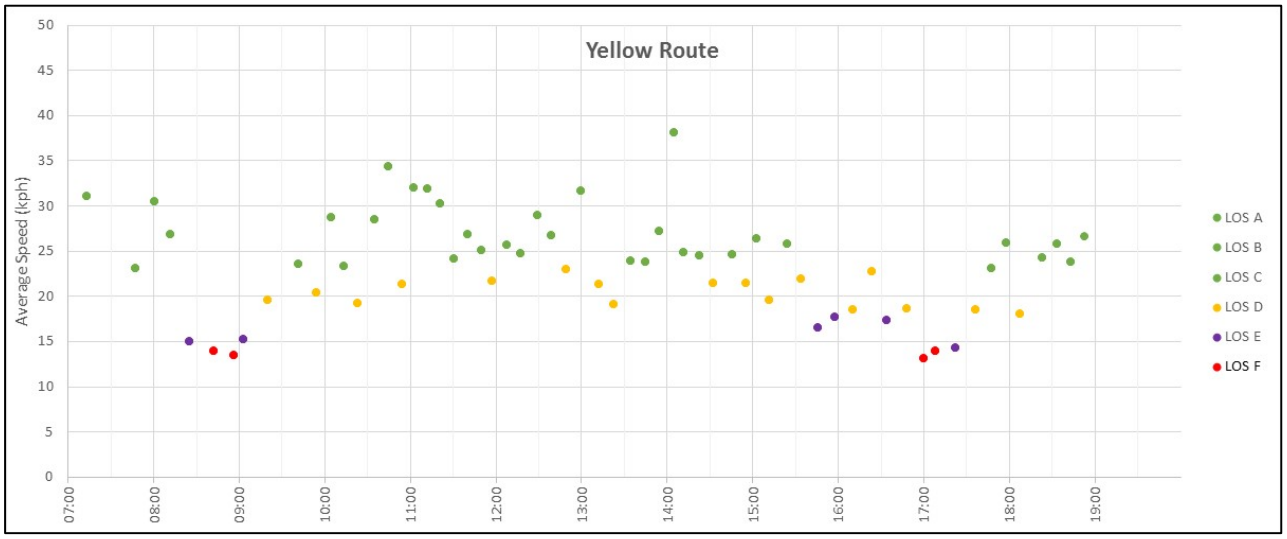
PM Peak - 2012 Conditions *PM Peak - 2015 Conditions*

Lincoln Road Congestion Map (PM Peak)

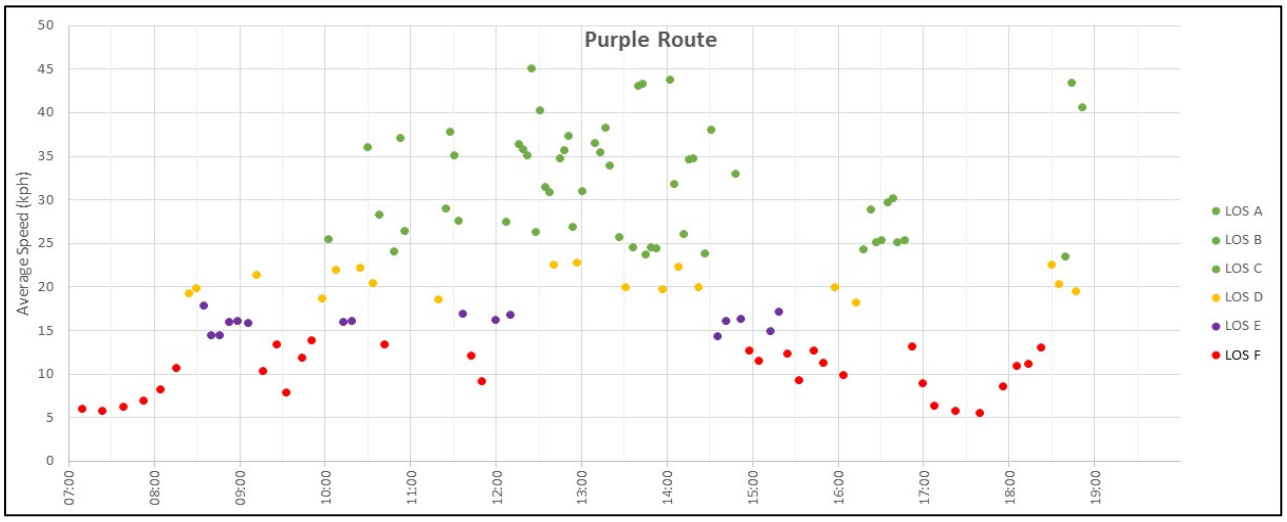
Appendix E Travel Time Statistics



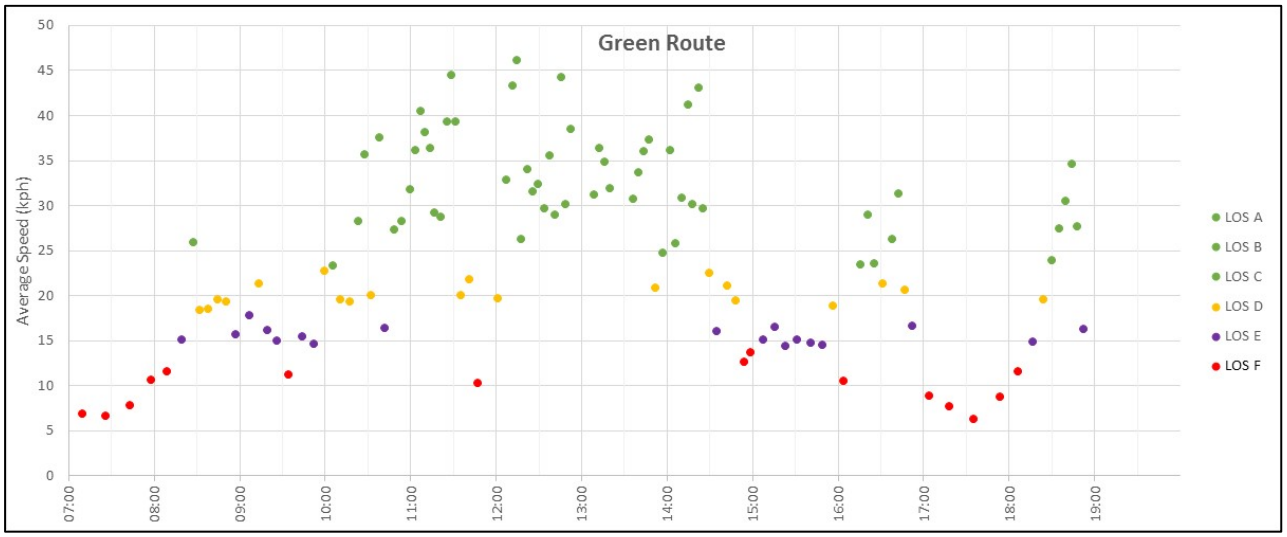
Te Pai Place to the Concourse (Orange Route) – Travel Time LOS



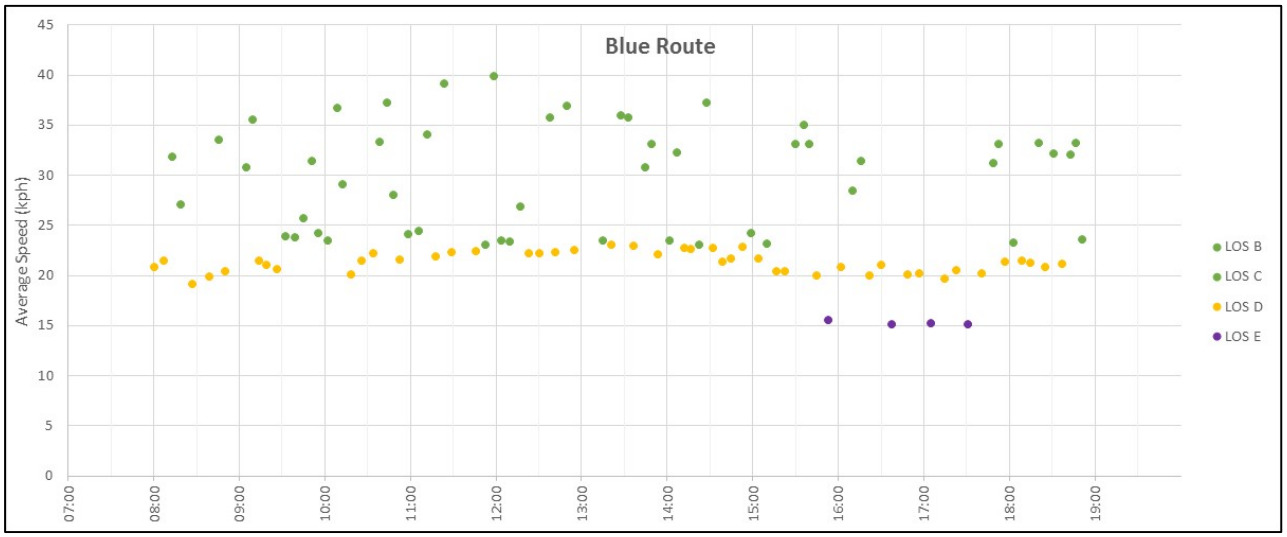
The Concourse to Te Pai Place (Yellow Route) – Travel Time LOS



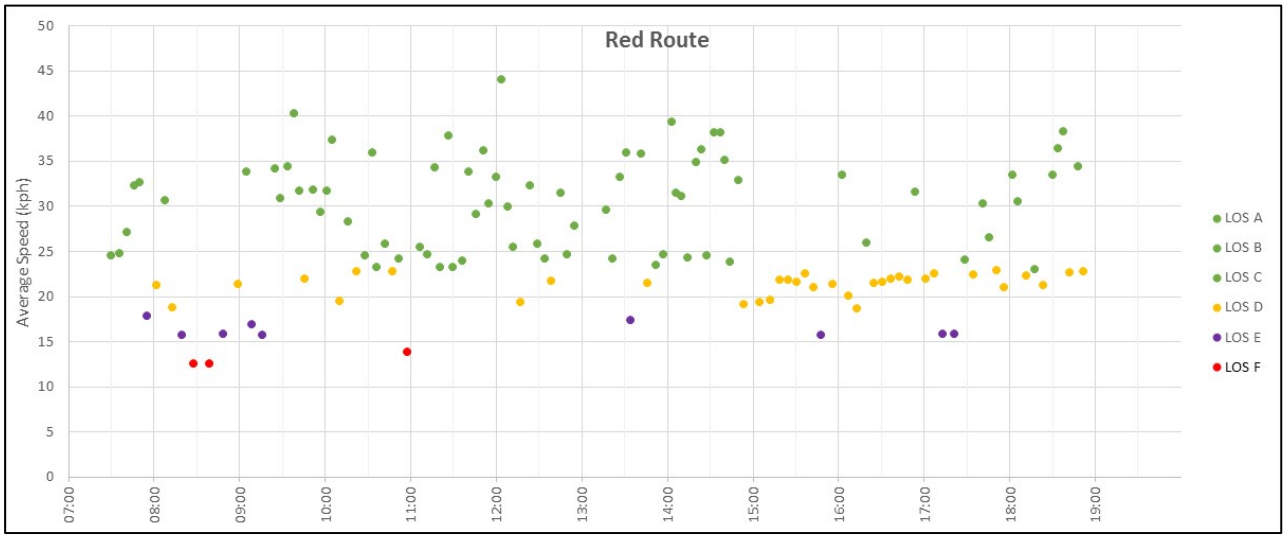
Paramount Drive to Lincoln Road via Central Park Drive (Purple Route) – Travel Time LOS



Paramount Drive to Lincoln Road via Universal Drive (Green Route) – Travel Time LOS



Universal Drive to Lincoln Road via Central Park Drive (Blue Route) – Travel Time LOS



Laidlaw College to Lincoln Road via Te Pai Place (Red Route) – Travel Time LOS

Appendix F Level of Service Criteria

Definitions of Level of Service for Signalised Intersections

Delay (s)	LOS	Description
d<=10	A	Free-flow conditions with unimpeded manoeuvrability. Stopped delay at signalised intersection is minimal.
10<d<=20	B	Reasonably unimpeded operations with slightly restricted manoeuvrability. Stopped delays are not bothersome.
20<d<=35	C	Stable operations with somewhat more restrictions in making mid-block lane changes than LOS B. Motorists will experience appreciable tension while driving.
35<d<=55	D	Approaching unstable operations where small increases in volume produce substantial increases in delay and decreases in speed.
55<d<=80	E	Operations with significant intersection approach delays and low average speeds.
80<d	F	Operations with extremely low speeds caused by intersection congestion, high delay, and adverse signal progression.

Level of Service Criteria (Average Speed)

Level of Service	Speed Threshold
A	>50kph
B	39 – 50kph
C	28 – 39kph
D	22 – 28kph
E	17 – 22kph
F	< 17kph

Appendix G Modelling Parameters

The following assumptions were applied as part of GHD's development of the SIDRA models:[81]

- Signals along Lincoln Road were assumed to be coordinated;
- Non-standard signal phasing was not considered;
- The proportion of high occupancy vehicles will not change as a result of the introduction of transit lanes;
- A 10% level of illegal use was used when assigning traffic to particular lanes;
- Bus stopping time and bus stop layouts were not considered;
- Pedestrian crossings are called for each signal cycle;
- Maximum signal cycle time of 150 seconds;
- HCVs were converted to PCUs using a factor of 2.5 for trucks and 2.0 for buses; and
- 6 seconds intergreen time consisting of 4 seconds of yellow and 2 seconds of all red.

[81] Lincoln Road Corridor – Intersection Operation Report, Section 3.3.

Appendix H Methodology for Establishing Future Traffic Growth

Intersection Modelling

The growth rates used for the intersection models were based upon EMME/2 model data that was provided to GHD by AT in two sets; namely intersection volume data and node/link attribute data. This data ranged from 2011-2021 (ART2) and 2016-2026 (ART3).

The ART3 intersection volume data was used to determine the growth in traffic between 2016 and 2026 for the three main signalised intersections with Lincoln Road; namely – Central Park Drive/Triangle Road, Universal Drive and Te Pai Place/Pomaria Road. Whilst, the 2011-2016 growth was determined based upon an interpolation of data from the ART2 model[82]. For the remaining intersections the growth rates were established based upon the growth rates from adjacent intersections, growth along mid-blocks and the overall corridor growth rate. Further adjustments were undertaken to take account for seasonal, daily and hourly traffic variations.

Although the presence of the transit lanes were not specifically included within the SIDRA models, it is understood that the pedestrian crossing times within the models were adapted to take account of the presence of additional lanes in each direction[83].

Micro-Simulation Modelling

Future traffic growth was estimated from the Waitakere Strategic Road Traffic Assignment Model (WSRTAM), which is a vehicle assignment model based on vehicle demands from the Auckland Regional Transport Model (ART3)[84]. Additional volume adjustments were then undertaken to take account of two specific known developments; namely:

- The Lincoln Junction development south of Universal Dr Extension; and
- The Mitre 10 development, east of Lincoln Road and accessed off Central Park Drive.

The future year traffic models also accounted for the following ongoing (or recently completed) projects that will impact the Lincoln Road corridor[85]:

- Lincoln Road / SH16 Interchange Upgrade;
- Widening of SH16 and the completion of the Western Ring Route; and
- Te Atatu Road Upgrade.

[82] Lincoln Road Corridor – Special Vehicle Assessment Report, Section 4.5.

[83] Lincoln Road Corridor – Intersection Operation Report, Section 3.3

[84] Waitakere Central City Model - Future Demand Forecasting Memorandum, AT, May 2013.

[85] Lincoln Road – Economic Assessment Supporting Memorandum.

Appendix I Validation of 2016 Traffic Forecasts

Intersection Modelling

As a means of understanding the validity of the forecast 2016 traffic volumes used for the intersection assessments, MWH have undertaken a comparison against the actual recorded 2015 volumes. Appendix C identifies the 2015 survey locations, the intersections for which forecast volumes have been reported and data comparison points.

A summary of the volumes[86] used for the intersection modelling (2015 volumes interpolated using 2011 and 2016 forecasts) is provided below.

2015 Modelled Peak Hour Screenline Volumes (Interpolated)

Comparison Point		AM		IP		PM	
		NB/WB	SB/EB	NB/WB	SB/EB	NB/WB	SB/EB
A	Central Park Drive (East of Lincoln Road)	664	1,018	636	550	837	801
B	Lincoln Road (Central Park Drive to Daytona Road)	1,571	1,944	1,681	1,671	2,085	1,899
C	Lincoln Road (Paramount Drive to Universal Drive)	1,655	1,723	1,853	1,639	2,076	1,848
D	Universal Drive (West)	630	1,187	860	917	1,326	920
E	Universal Drive (East)	341	506	256	285	572	317
F	Lincoln Road (Mitre 10 to Poinsettia Place)	980	1,465	997	1,489	1,513	1,244
G	Te Pai Place	354	544	362	281	581	416

The table below presents a comparison between the 2015 surveyed volumes and interpolated 2015 volumes that were used for the purposes of the intersection modelling. Negative values refer to where the modelled volume is greater than the surveyed volume, whilst cells highlighted in red identify differences in excess of 200 vehicles per hour.

Survey and Modelled Volume Comparison (Peak Hour)

Survey ID	Comparison Point		AM		IP		PM	
			NB/WB	SB/EB	NB/WB	SB/EB	NB/WB	SB/EB
3	A	Central Park Drive (East of Lincoln Road)	-171	-239	-97	15	-278	41
2	B	Lincoln Road (Central Park Dr to Daytona Rd)	-338	-658	-212	-373	-365	-437
2	C	Lincoln Road (Paramount Dr to Universal Dr)	-422	-437	-384	-341	-356	-386
8	D	Universal Drive (West)	-123	-9	-193	-107	-257	-63
9	E	Universal Drive (East)	-19	-119	52	-34	111	-43
1	F	Lincoln Road (Mitre 10 to Poinsettia Place)	-33	-531	90	-342	-366	-7
7	G	Te Pai Place	-26	-120	-77	-53	-87	-64

The comparison of the 2015 forecast vs 2015 surveyed volumes has identified that, across the project area, the forecast volumes are in excess of the actual recorded volume.

[86] Mid-block volumes have been derived from the reported turning volumes.

Typically forecast volumes were identified to be on average around 20% higher than the actual volumes. Of particular significance to the project is the discrepancy of between 300-600 vehicles (30-60% difference) in the peak direction along Lincoln Road.

It is recognised that an element of the discrepancy will be attributed to the following:

- The actual peak period does not correspond exactly with the modelled peak period for all links (although the discrepancy is noted to be relatively minor).
- The comparison is between intersection volumes and mid-block volumes, and therefore are not directly comparable given the presence of minor roads and property accesses. Once more, this effect is considered to be relatively minor.
- The surveyed volume reflects an average weekday volume, rather than peak day volume. However it should be noted that there was relatively little variation in traffic volumes throughout the course of the working week for all links. It is unclear if the modelled volumes reflect a peak weekday or average weekday.

Notwithstanding the above, it is evident that the forecast volumes used within the intersection models are consistently higher than the actual volumes recorded in 2015. The intersection modelling undertaken is therefore has potentially overstated the existing issues, particularly given that the 2015 volumes incorporate the additional traffic generated by new developments such as the Countdown Supermarket.

Micro-Simulation Modelling

The Paramics modelling undertaken by AT focussed on the 2026 future year for the purpose of making key decisions regarding the capacity and operational requirements for the corridor.

However, for the purposes of the economic evaluation, a 2016 future year demand was estimated based upon an ART3 traffic demand scenario. As noted by AT within the *Lincoln Road – Economic Assessment Supporting Memorandum (2013)*:

> *"During the evaluation it was identified that the 2016 model was operating poorly in comparison with the 2026 network, particularly city-bound in the morning peak and returning in the evening peak…The (2016) growth scenario is considered to be too high and unreasonable, given that it only some 3 years into the future".*

AT considered that the reason for this is because the ART3 forecast was developed in 2006 and did not account for poor economic conditions and the limited development and traffic growth that was observed between 2008 and 2013.

AT concluded that the 2016 traffic scenario should be excluded. However, AT consider that the 2026 scenario is fit for purpose and have made the following comment in that regard[87]:

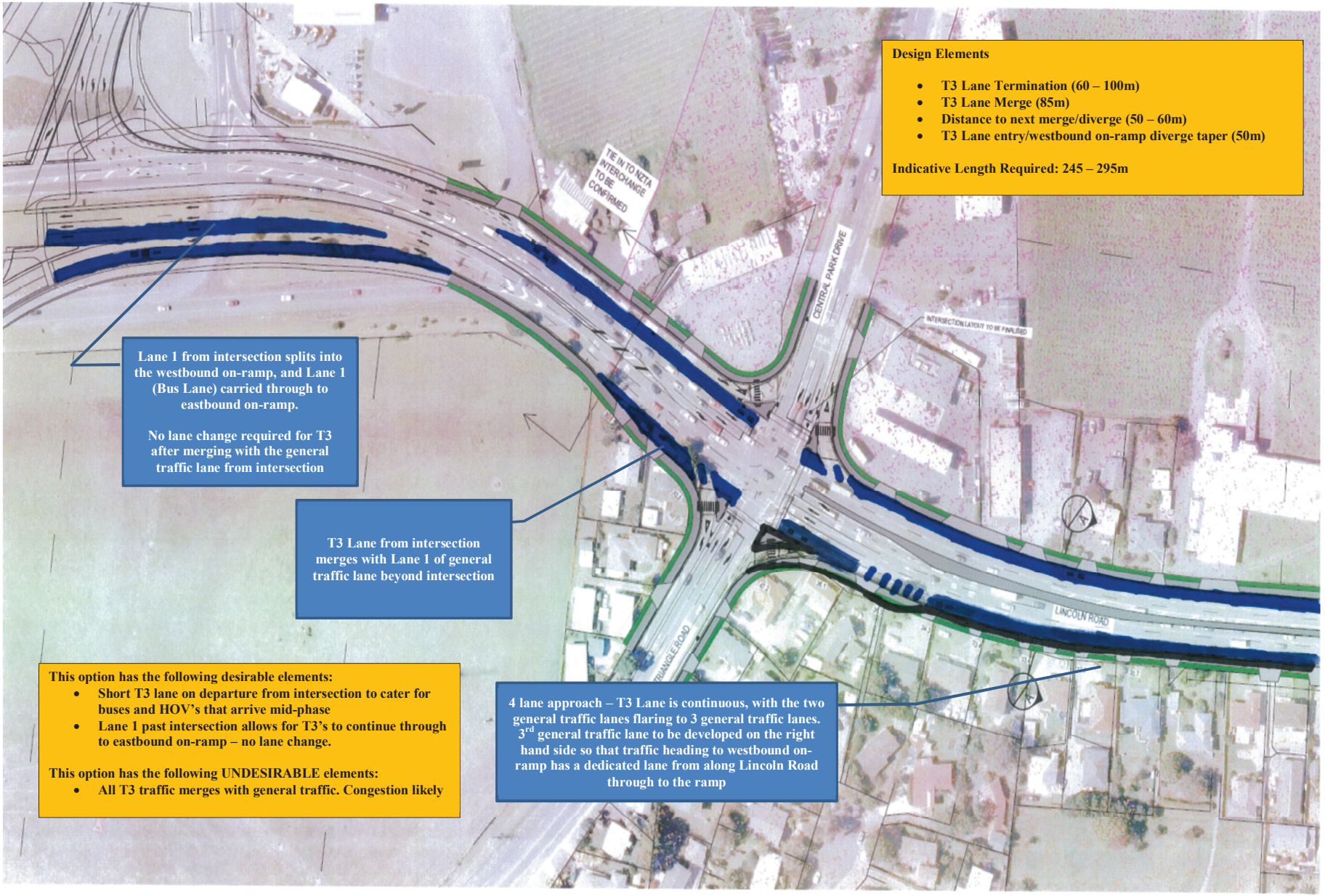
> *"This 2026 scenario reflects current expectation of minimal traffic growth towards the CBD (complemented with high PT growth), but still includes developments at NORSGA and Albany that result in increased demand heading west on SH16 and SH18."*

Typically forecast volumes used for the intersection modelling were identified to be on average around 20% higher than the actual volumes. MWH therefore concur with AT that the forecast results for the 2016 scenario are not likely to be reflective of actual conditions.

[87] Lincoln Road – Economic Assessment Supporting Memorandum, Page 12.

Appendix J Interchange Integration Options

Transit Lane Integration – Option 1: Transit Lane with Downstream Exit



Design Elements

- T3 Lane Termination (60 – 100m)
- T3 Lane Merge (85m)
- Distance to next merge/diverge (50 – 60m)
- T3 Lane entry/westbound on-ramp diverge taper (50m)

Indicative Length Required: 245 – 295m

Lane 1 from intersection splits into the westbound on-ramp, and Lane 1 (Bus Lane) carried through to eastbound on-ramp.

No lane change required for T3 after merging with the general traffic lane from intersection

T3 Lane from intersection merges with Lane 1 of general traffic lane beyond intersection

This option has the following desirable elements:

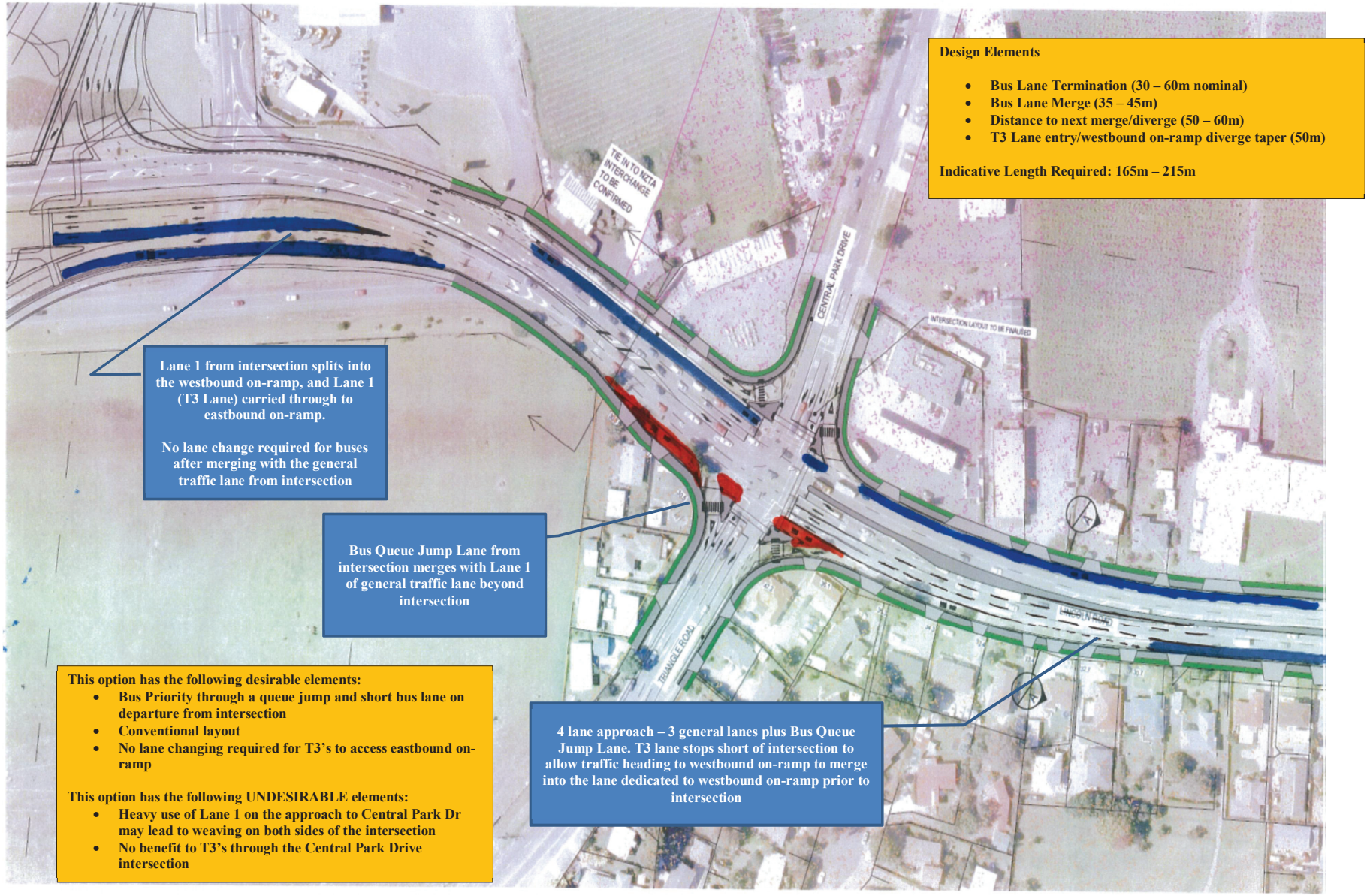
- **Short T3 lane on departure from intersection to cater for buses and HOV's that arrive mid-phase**
- **Lane 1 past intersection allows for T3's to continue through to eastbound on-ramp – no lane change.**

This option has the following UNDESIRABLE elements:

- **All T3 traffic merges with general traffic. Congestion likely**

4 lane approach – T3 Lane is continuous, with the two general traffic lanes flaring to 3 general traffic lanes. 3rd general traffic lane to be developed on the right hand side so that traffic heading to westbound on-ramp has a dedicated lane from along Lincoln Road through to the ramp

Transit Lane Integration – Option 2: Termination prior to intersection but Bus Queue Jump Lane plus exit provided



Design Elements

- **Bus Lane Termination (30 – 60m nominal)**
- **Bus Lane Merge (35 – 45m)**
- **Distance to next merge/diverge (50 – 60m)**
- **T3 Lane entry/westbound on-ramp diverge taper (50m)**

Indicative Length Required: 165m – 215m

Lane 1 from intersection splits into the westbound on-ramp, and Lane 1 (T3 Lane) carried through to eastbound on-ramp.

No lane change required for buses after merging with the general traffic lane from intersection

Bus Queue Jump Lane from intersection merges with Lane 1 of general traffic lane beyond intersection

4 lane approach – 3 general lanes plus Bus Queue Jump Lane. T3 lane stops short of intersection to allow traffic heading to westbound on-ramp to merge into the lane dedicated to westbound on-ramp prior to intersection

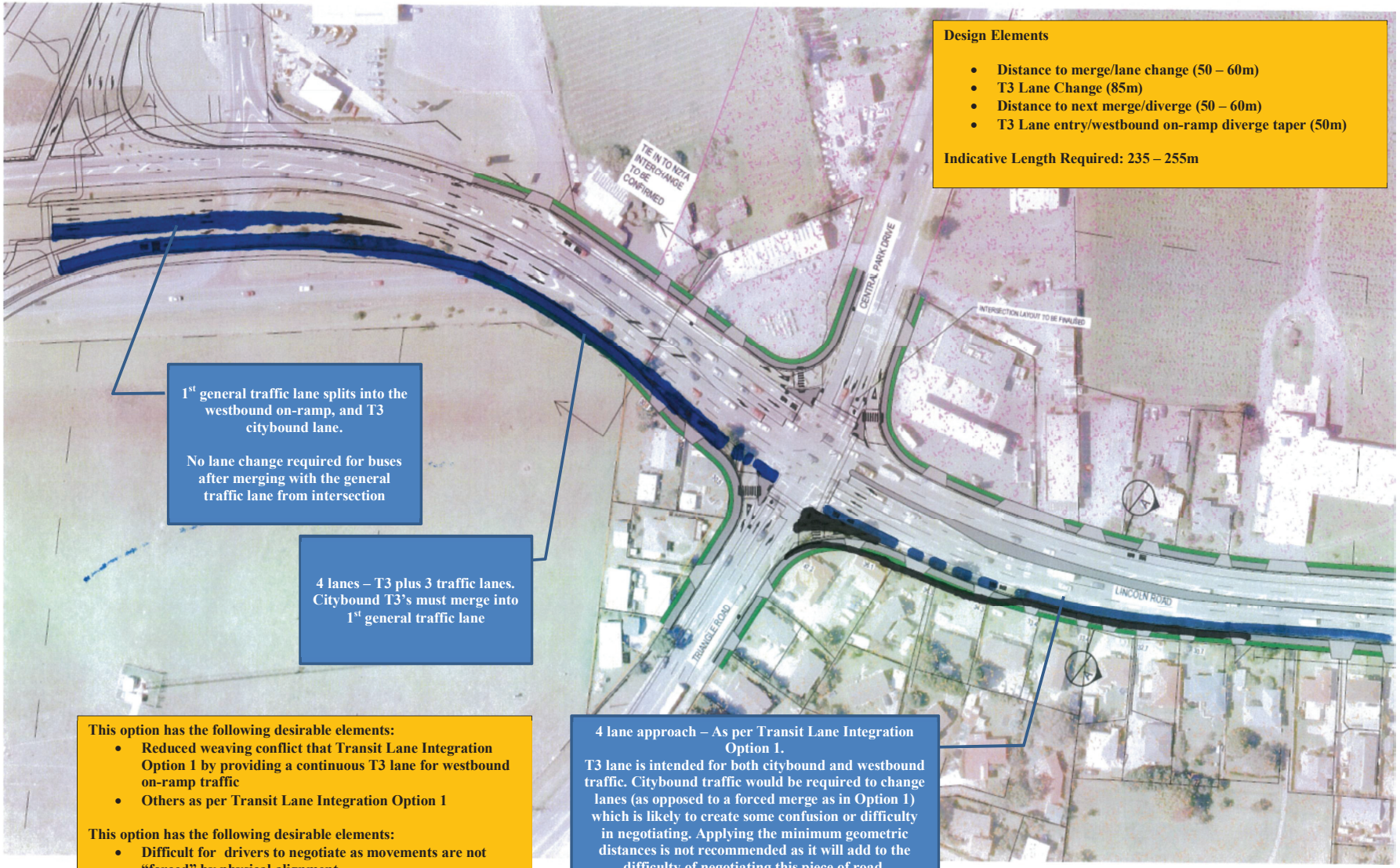
This option has the following desirable elements:

- **Bus Priority through a queue jump and short bus lane on departure from intersection**
- **Conventional layout**
- **No lane changing required for T3's to access eastbound on-ramp**

This option has the following UNDESIRABLE elements:

- **Heavy use of Lane 1 on the approach to Central Park Dr may lead to weaving on both sides of the intersection**
- **No benefit to T3's through the Central Park Drive intersection**

Transit Lane Integration – Option 3: Continuous Transit Lane



Design Elements

- Distance to merge/lane change (50 – 60m)
- T3 Lane Change (85m)
- Distance to next merge/diverge (50 – 60m)
- T3 Lane entry/westbound on-ramp diverge taper (50m)

Indicative Length Required: 235 – 255m

1st general traffic lane splits into the westbound on-ramp, and T3 citybound lane.

No lane change required for buses after merging with the general traffic lane from intersection

4 lanes – T3 plus 3 traffic lanes. Citybound T3's must merge into 1st general traffic lane

This option has the following desirable elements:

- Reduced weaving conflict that Transit Lane Integration Option 1 by providing a continuous T3 lane for westbound on-ramp traffic
- Others as per Transit Lane Integration Option 1

This option has the following desirable elements:

- Difficult for drivers to negotiate as movements are not "forced" by physical alignment.

4 lane approach – As per Transit Lane Integration Option 1.
T3 lane is intended for both citybound and westbound traffic. Citybound traffic would be required to change lanes (as opposed to a forced merge as in Option 1) which is likely to create some confusion or difficulty in negotiating. Applying the minimum geometric distances is not recommended as it will add to the difficulty of negotiating this piece of road.

Appendix K Road Safety Audit (Stage 2A – Part One)

Stage 2A – Part One Road Safety Audit

No.	Issue	Details	Recommendation	Designer Comment / Action
1	Lane allocation signage approaching the motorway.	With the increase in lane numbers on the approach to the SH16 interchange it is important that drivers get early warning of the correct lane to be in upon the approach to the Triangle Road intersection and SH16 Interchange. This section of road is complicated further by the introduction of a second T3 lane to the north of Triangle Road.	Investigate the need for lane allocation pavement markings and an overhead sign gantry.	The requirement for overhead advance destination and origin-destination signs, including supporting gantries, will form part of the **Detailed Design** stage.
2	Left turning traffic crossing through the T3 lane.	At the intersections of Triangle Road, Daytona Road, Universal Drive and Poinsettia Place for the northbound direction and Paramount Drive, Universal Drive, Laidlaw College and Te Pai Place in the southbound direction, the left turning traffic from the general lane must cross through the straight through movement on the T3 lane. There is the potential for crashes with the lane changing that will occur in this situation.	Stop the T3 lane earlier before each intersection so that the cross over movement becomes a merge movement for left turning traffic.	Markings at the intersections have been provided in accordance with the T3 lanes that were introduced along Remuera Road by AT. A T3 box marking is a minimum of 50m prior to the intersection followed by a continuity line to allow turning traffic to cross over the left turn manoeuvre. Issue addressed as part of the **Preliminary Design**.
3	Use of T3 lane by cyclists.	The roads crossing Lincoln Road have cycle lanes and whilst right turn Advance Stop Boxes (ASB) are not provided, any cyclists that stay on the road when turning right (or left) will find themselves in the T3 lane with no easy way of traversing to the shared path. This is likely to encourage cyclists to stay on the T3 lane rather than moving to the shared path. Given the high traffic flow on Lincoln Road and the expected number of vehicles using the T3 lanes, this will leave cyclists in a much more vulnerable position.	Provide cycle ramps between the T3 lane and the shared path so that cyclists can safely transition between the two.	To be addressed during the **Detailed Design** stage.
4	Right turn for cyclists from the side roads.	No provision has been made for cyclists to turn right from the side roads.	Investigate the needs of right turning cyclists from the side roads.	Hook turns provided for at the Lincoln Road / Universal Drive intersection as part of the **Preliminary Design**. Further investigation to be undertaken during the **Detailed Design** stage.
5	Width of pedestrian crossing walk lines.	The cross walk lines at the intersection of Universal Drive are 3.0m wide whereas they are only 1.8 metres wide at all the other signalised intersections. The wider cross walk lanes have the effect of moving the limit lines further back from the intersection which increases the distance for vehicles to clear the intersection which reduces the overall intersection efficiency.	Review the width of all pedestrian cross walk lines.	The crossing widths at the Universal Drive intersection match the current layout. The width of the pedestrian cross walk lines amended as part of the **Preliminary Design**. Further investigation to be undertaken during the **Detailed Design** stage.
6	Pedestrian crossing north side of the Triangle Road intersection.	Across Lincoln Road on the northern side of Triangle Road and Central Park Drive, no pedestrian crossing has been provided. While this does not appear to be a very busy pedestrian area, any pedestrians in this area will be expected to possibly cross three times to maintain walking on the northern side of these two side roads.	Provide a crossing across Lincoln Road on the northern side of the Triangle Road intersection.	Issue addressed as part of the **Preliminary Design**.

No.	Issue	Details	Recommendation	Designer Comment / Action
7	Pedestrian crossing advance diamond left slip lanes.	The left turn slip lanes are provided with zebra marked pedestrian crossings on speed tables. This will control the speed of vehicles using the slip lanes.	Zebra marked pedestrian crossings should have advance warning diamonds marked in advance of the crossing to alert motorists to the pedestrian crossing up ahead.	To be addressed during the **Detailed Design** stage.
8	Service lane not detailed.	The properties between 296 and 312 Lincoln Road are substantially below road level and, with the proposed widening, direct access is not possible from Lincoln Road. Instead a service lane is proposed, however no details of this have been provided.	Provide details of the service lane.	To be addressed during the **Detailed Design** stage.
9	Indented bus bays.	Indented bus bays have been provided over the length of the road upgrade. These are not usually favoured by bus operators as it is difficult for buses to re-join the traffic stream after stopping. In this case they will be entering a T3 lane which may have less traffic than the adjacent general lanes in the peak hours, but in the inter-peaks this lane by revert back to function as a general traffic lane.	Review the design of the indented bus stops.	Issue addressed as part of the **Preliminary Design**. Details regarding the preferred option for bus facilities is provided within the *'LRCI Project – Footpath, Cycleway and Bus Stop Options'* report.
10	Right turns at priority intersections.	There are priority "T" intersections at Daytona Road and Paramount Drive where right turns into the side roads are permitted. These intersections are all situated where there are three lanes to turn through. Long queues develop from adjacent signalised intersections particularly in the northbound direction. This currently occurs and is still likely to occur following the upgrade. If this does occur, then the two general lanes are likely to be at a standstill but the T3 lane could be flowing freely. This can often result in crashes between turning traffic and through traffic on the T3 lane.	Consider the need for right turn provision at these locations and provide appropriate "Keep Clear" markings at these intersections.	The use of keep clear marking to be assessed during the **Detailed Design** stage.
11	Cycle advance stop box (ASB) at the Universal Drive intersection.	The Universal Drive westbound approach to Lincoln Road is provided with an ASB on a shared through and right turn lane. Although cyclists wishing to turn right are being encouraged to effectively exercise a "hook turn" manoeuvre, even though there are no markings for this, and then enter the shared cycle footpath, cyclists that wait in this ASB to turn right are at risk from being hit by eastbound through traffic.	Remove the ASB from in front of the shared lane.	Issue addressed as part of the **Preliminary Design**.

No.	Issue	Details	Recommendation	Designer Comment / Action
12	Lane configuration along Universal Drive (Eastbound).	The lane configuration on Universal Drive in the eastbound direction develops a cycle lane immediately after the KFC entrance signals. This cycle lane then terminates at the cycle ASB. The cycle lane is developed with a chevron marking before the full width of the cycle lane is reached, which is likely to be slippery for cyclists when wet.	1: Investigate starting the cycle lane prior to the KFC signal. 2: Replace the chevron paint markings with green cycle lane markings. 3: Review lane movement allocation through the two intersections.	1: Cycle advance boxes to be provided for the kerbside lane and the lane closest to the centreline to cater for cyclists. Although desirable, a cycle lane prior to the KFC signals is not achievable due to the need to provide non-standard treatments and increased land acquisition. Addressed in the **Preliminary Design**. 2: Agreed that chevron markings are not appropriate. The use of green surfacing and continuity line to develop the cycle lane would be more appropriate. Addressed in the **Preliminary Design**. 3: Designer to change the left lane to a shared left and through lane. Designer has to show the location of the bus stop facility and the starting of the kerbside clearly. Addressed in the **Preliminary Design**.
13	T3 hours of operation.	The T3 lane hours of operation are stated as 7am to 9am and 3pm to 6pm. Outside of these times the lane can be used by all traffic and the lane will be used as a general lane at all other times as there will be no impediments to its use such as parked vehicles. Outside of the hours of operation, the traffic flow in this T3 lane could be quite high and buses may experience difficulties in re-joining the traffic stream from the indented bus bays.	Consider extending the T3 lane hours of operation to all day and all week	T3 lane provided for Monday to Saturday during peak periods with the possibility that it operates throughout the day for Monday to Saturday.
14	Northbound start of the T3 lane.	At the southern end of the project, the northbound traffic opens out to four lanes from two. The left hand lane is a shared lane designated for straight ahead and left into Pomaria Place. Immediately after the intersection the T3 lanes starts, and immediately after the start of the T3 lane there is an indented bus stop. Potentially this creates a situation of high activity over a short distance and may lead to excessive lane changing.	Starting the T3 lane after the bus stop would reduce the incidence of lane changing and the potential for crashes. Investigation into the most appropriate location to start the T3 lane is recommended.	The shared left and through can be marked as a dedicated left turn lane with little or no impact to the overall intersection operation.
15	Cycle lanes along Triangle Road.	Cycle lanes are to be provided on Triangle Road however these end and start quite abruptly.	Liaise with the appropriate section of Auckland Transport to have the cycle lanes on Triangle Road extended.	The proposed cycle lanes will tie in with the existing cycle lanes on Triangle Road. Addressed within the **Preliminary Design**, but within the extents of the Project area.
16	Bus Stop at No. 7 Pomaria Road.	There is an existing indented bus stop outside number 7 Pomaria Road that has not been shown on the plan. The indented area is being extended to form the exclusive left turn lane to Lincoln Road. It is not clear if the bus stop is to remain and how this will interact with the left turn lane. The safety concern is that if this lane is full of cars, then the bus will have nowhere to stop to drop-off or pick-up passengers.	Establish if this existing bus stop is to remain and install appropriate pavement markings.	The noted bus stop is to remain. Issue addressed as part of the **Preliminary Design.**

No.	Issue	Details	Recommendation	Designer Comment / Action
17	Termination of shared paths.	At both ends of the project, the shared footpath cycle path stops abruptly. The safety concern is that pedestrians and cyclists may find themselves competing for the same space.	Ensure adequate tie-in of the shared cycle footpath to the existing.	Designer needs to provide signage to provide clear information regarding begin/end of shared path. Addressed during the **Preliminary and Detailed Design** stages.
18	RG4 Signs.	A number of RG17.1 keep-left signs have been detailed on the drawings. These smaller signs are not as visible as the larger RG-17 signs and therefore in difficult visibility situations there is increased probability that motorists will not notice the approaching end of the median traffic islands.	Use RG-17 keep-left signs in preference to RG17.1.	To be addressed during the **Detailed Design** stage.
19	Location of signs.	The shared footpath cycleway has been placed against the proposed kerb of the widened Lincoln Road. In order to avoid cluttering the path, the signs have been placed at the back of the path. In this location they are 2.5 to 3 metres offset from the nearest traffic lane which is the T3 lane. Traffic using the general traffic lanes are offset at least 6 metres from the proposed sign. In this location the signs will not be as visible to passing motorists.	Assess if a berm can be placed between the road and the shared footpath cycleway and if so place the signs in the berm.	This issue was discussed with AT. It was resolved that a back berm was favoured to provide a safety buffer to mitigate the safety risks associated with vehicles (from driveways) and cyclist conflict. To be addressed during the **Detailed Design** stage.
20	Possible drainage issues at intersections.	Drainage details have not been provided to the auditors. There is concern that with the widening of the road there will be considerably more pavement to be drained. There is also a concern that flat spots may develop in areas where changes in super-elevation occur as the road alignment moves through the horizontal curves. Lincoln Road is situated on a ridgeline and is nearly horizontal from one end to the other. If puddles do form then aquaplaning is a real possibility.	Ensure there are adequate grades and that changes in super-elevation do not coincide with section of level grade.	To be addressed during the **Detailed Design** stage.
21	Geometry at the KFC intersection.	A splitter island has been shown at the entrance to the KFC car park off Universal Drive west. Currently there is a painted island in this location and many vehicles were observed to be travelling over this paint marking. It would appear that vehicles were travelling over this marking because the destination desire line is through the centre of this painted island. Placing a raised island in this area is likely to be hit by vehicles unless the geometry and island shape are correct.	Check the vehicle tracking past this island and adjust the shape so that the island is not driven over.	The island will be removed given that it will not cater for any signal poles. Issue addressed as part of the **Preliminary Design.**
22	Vehicle Tracking to Poinsettia Place.	Trucks tracking into Poinsettia Place track over the centreline. There is a risk that head on collisions could occur because of this.	Widen the intersection to allow trucks to turn in without going over the centreline.	Issue addressed as part of the **Preliminary Design.**
23	Lane allocation at Pomaria Road.	The signal phasing for Poinsettia Place and Te Pai Place is for all movements on both roads to go together. For Poinsettia Place there is a shared through and right lane and a separate left turn lane. With this phasing and lane layout, it is highly likely that right turning vehicles from Poinsettia Place will block the path of through traffic. If this should occur then drivers may be tempted to use either the cycle lane or the left turning lane for the through movement.	Change the phasing to split phasing or change the lane allocation	To be addressed during the **Detailed Design** stage.

No.	Issue	Details	Recommendation	Designer Comment / Action
24	Landscaping in the median.	Landscaping is planned in the central median. While landscaping has a positive effect on reducing traffic speeds from the calming effects the trees have, the potential when they are mature to worsen the injuries to occupants of vehicles is real.	Review the location of trees, the species and provide appropriately designed barriers to protect vehicles from impacting the trees.	To be addressed during the **Detailed Design** stage.
25	Lack of pedestrian crossings between the signalised intersections.	There are two existing pedestrian refuges on Lincoln Road between Triangle Road (station 300) and Universal Drive (station 900), a distance of 600 metres. One refuge island is situated at station 470 meters and the other at 780 metres near bus stops to cater for pedestrian crossing demand. These refuges are to be removed as pedestrians should not be encouraged to cross six-lane highways without the aid of pedestrian signals. However, up to a 600 metre detour for pedestrians to cross at the nearest signalised crossing is unlikely to happen and pedestrians will attempt to cross the six lanes wherever it suits.	Install signalised mid-block pedestrian facilities to service bus stops and future developments.	Issue addressed as part of the **Preliminary Design**.
26	Tactile Pavers at Pedestrian Crossings.	There are existing plastic tactile studs at some of the intersections. These plastic tactile studs can be very slippery when wet after they have been in service for a number of years and have become polished by the constant wear of foot traffic.	Concrete tactile pavers have a better service life and are preferred.	To be addressed during the **Detailed Design** stage.
27	Drop-off at the edge of the cross-section.	At a number of locations along the upgraded section of Lincoln Road, the contour drops away. In widening the road, it appears that a number of retraining walls will be needed to achieve a suitable road and berm cross section. In some instances this wall could be quite high; this could make for difficult access to adjacent properties, be an issue for pedestrians particularly at night and a hazard for out of control vehicles.	Investigate access and guard railing requirements for the sections where a retaining wall is required.	Based on the road geometry and the current Preliminary Design, the project area is unlikely to require safety barriers. To be addressed during the **Detailed Design** stage.
28	Traffic signal poles.	All of the intersections are designed to have Joint Use Mast Arms (JUMA) and overhead aspects. The JUMA presents an immoveable object to any vehicles that may impact with them.	The JUMA poles need to be redesigned, relocated to the boundary with longer outreach arms or vehicles protected from impacting with them.	5m outreach poles will not be adequate in terms of more than 3 lanes; hence it may require using 6-7m outreach with different specifications for installation. To be addressed during the **Detailed Design** stage.

Appendix L Road Safety Audit (Stage 2A – Part Two)

Stage 2A – Part Two Road Safety Audit

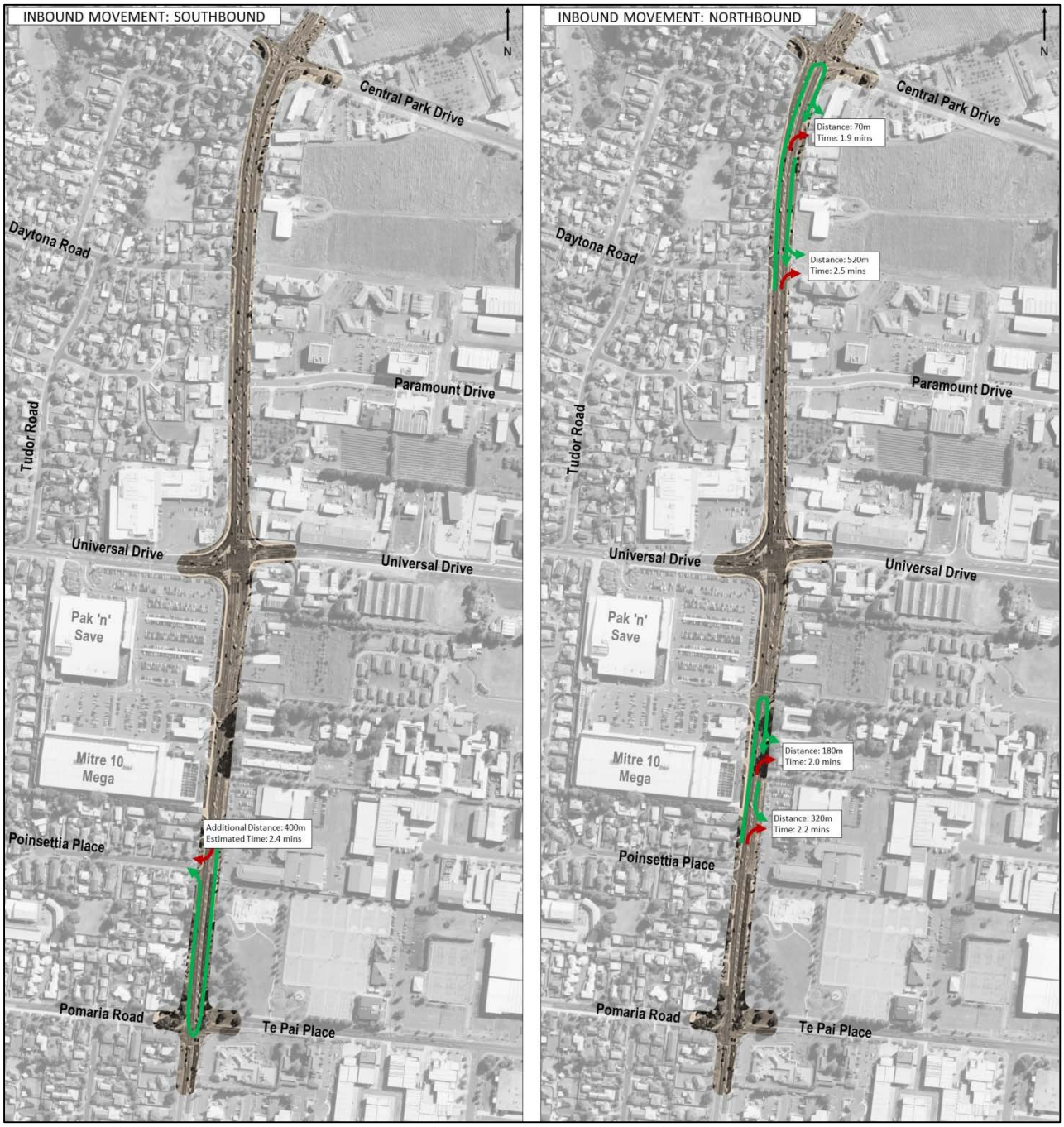
No.	Issue	Details	Recommendation	Designer Comment / Action
1	Lane allocation signage.	On the approach to the SH16 interchange, the northbound carriageway has four lanes. The kerbside lane is a left turn only lane leading traffic to the westbound on-ramp. This is not clear from existing road markings until 100m from the intersection, where the left turn arrow is shown.	Investigate the need for lane allocation pavement markings and an overhead sign gantry, in particular a left turn arrow with "SH16 WBD ONLY" pavement marking for the kerbside lane.	Appropriate road marking and text to be added during the **Detailed Design** stage.
2	Transition from on-road to off-road cycle facilities.	The traffic island at the intersection on the western side of Lincoln Road at Triangle Road has been amended to provide easy access to cyclists allowing them to transition from the T3 lane to the off-road cycle facility. However, on eastern side of the intersection a solid traffic island has been proposed which will require cyclists to dismount.	Provide consistent cycle friendly traffic islands on both sides of the intersection or alternatively provide ramps between the T3 lane and the shared path so that cyclists can safely transition between the two.	Provision of e a consistent transition between T3 lane and the shared path for cyclists to be addressed during the **Detailed Design** stage.
3	Double right turn at the intersection from the side roads.	At the Central Park Drive and Triangle Road intersection there are opposing double right turn lanes leading to Lincoln Road. The road width is such that the double right turns cannot occur simultaneously.	Ensure the double right turns into Lincoln Road from the side roads at the Central Park Drive and Triangle Road intersection do not occur simultaneously.	Double right turns has been modelled to run separately due to traffic volume imbalance and insufficient road geometry to allow simultaneous (diamond) phasing. **No action required.**
4	Width of shared pedestrian and cycle facility.	On both sides of Lincoln Road from the SH16 interchange to the Triangle Road intersection, a shared cycle and pedestrian facility is provided which is only 2.5m in width. The eastern side of this path connects to an existing facility on Central Park Drive which has a much wider width of 3.5m.	Review the width of the shared footpath and cycle facility on Lincoln Road north of the Triangle Road intersection. Consider providing a 3.0m width for this facility where space allows.	Width of the shared path to be updated to a minimum of 3.0m during the **Detailed Design** stage.
5	Cycle lane located adjacent to a bus stop.	Marking the cycle lane separate from the pedestrian footpath encourages cyclists to remain along the road edge where passengers enter and exit buses. This would lead to minor pedestrian/cyclist crashes when passengers disembark the buses.	Review the layout of the bus stop adjacent to the cycle lane and provide a consistent safe treatment along the route.	To be addressed during the **Detailed Design** stage.
6	Inconsistent layout on the Lincoln Road corridor.	Paths for pedestrians have been treated inconsistently regarding placement in relation to kerbing.	Provide consistent treatments for the route.	Changing the proposed layout for the cycleway/footpath will increase the likelihood of pedestrian and cyclist conflict. Traffic island treatment is different for different side roads. **No action required.**
7	One direction on cycle lanes.	The design proposes one direction for the off-road cycle facilities. Cyclists are directed in one direction only using arrows on both sides of Lincoln Road. Cyclists are unlikely to follow this rule on a footpath.	Consider removing the One Direction and Give Way markings on cycle lanes.	The design seeks to provide clarity for cyclists with regard to the one-way Copenhagen style cycleway. A 1.8m wide cycleway does not provide space for two way cyclists. **No action required.**
8	Use of zebra crossing and toucan markings at intersections.	The use of Zebra crossings at left turns will result in cyclists needing to dismount at the Zebra crossing. The concern is that cyclists are unlikely to dismount at Zebra crossings and will continue to ride across this shared space with pedestrians.	Review the Zebra markings and consider the implication of cyclists on shared spaces at intersections.	**No action required.**

No.	Issue	Details	Recommendation	Designer Comment / Action
9	No right turn from Daytona Road or Paramount Drive.	During the visit it was clear that it is difficult to turn right from Daytona Road to Lincoln Road, which involves crossing two lanes of traffic. The proposal will increase these two lanes to three lanes, exacerbating the issue.	Place a No Right Turn sign on the Lincoln Road central island opposite the Daytona Road and Paramount Drive intersections.	**Detailed Design** plans to accommodate the recommended signage, solid median island to be reshaped to discourage illegal right turners as additional protection measure
10	Right turn into Daytona Road and Paramount Drive across three lanes on Lincoln Road.	Given the poor visibility, vehicles making the right turn from Lincoln Road may try to make the right turn believing all through lanes have stopped and could crash into an oncoming vehicle in the T3 Lane. This could lead to a serious injury crash and is a significant safety concern.	Review the intersection layout and ensure adequate visibility to all opposing traffic is provided at all times for right turning vehicles. Alternatively, consider closing off the central traffic island if a safe right turn movement cannot be accommodated at these intersections.	Keep clear markings to be added during the **Detailed Design** stage.
11	Reduced width of flush median opposite Hirepool entrance on Central Park Drive.	The proposed width will not be adequate for waiting vehicles to remain clear of the through vehicle lane. This puts vehicles in the flush median at risk of being hit by through vehicles and possibly being shunted into the path of oncoming traffic.	Review the need for narrowing the flush median opposite the Hirepool entrance on Central Park Drive. Ensure the proposed width is adequate for the type of vehicles expected to use the flush median.	The proposed width of the flush median at Hirepool is 3m. The Auditors may have misread the drawing that shows the MWH design in white and the new commercial development access in magenta. **No action required.**
12	Cycle lane next to a shared lane.	A dedicated 1.5m wide on-road cycle lane has been provided on Central Park Drive from east of the new Soljan Drive intersection. It is expected that the majority of the cyclists will travel straight through the intersection to reach Lincoln Road and Triangle Road, whereas some vehicles are expected turn left to Soljan Drive using the shared left and through traffic lane at this intersection. This creates a conflict between through cyclists and left turning vehicles with a high potential for injury crashes.	Review the current layout and consider providing an advance cycle stop box in front of the shared lane for cyclists at the intersection to clearly establish priority between the two movements. This will allow cyclists to await in advance of through and turning vehicles on Central Park Drive.	Not part of the MWH design. Auditors' Comments passed over to the Development Consents team within AT. **No action required.**
13	Width of footpath around parked vehicles.	An indented parking bay has been created outside 166 Central Park Drive (outside the Hirepool building) and a new footpath has been built around the new parking bay. Due to the indented parking arrangement, the rear of a parked car does encroach a long way over the footpath, thus reducing the usable footpath width to less than 1.5m. This will create a pinch point for users of mobility scooters to get around a parked vehicle when taking into consideration the shyline effect	Consider widening the footpath as shown in the above photograph to reduce pinch point for mobility scooters around parked vehicles.	Not part of the MWH design. Auditors' Comments passed over to the Development Consents team within AT. **No action required.**
14	Drainage around speed tables.	On all side streets along Lincoln Road from Triangle Road to Te Pai Place speed tables have been proposed. Without adequate drainage, water will collect at the low points, forming puddles, and detritus will collect at these points.	Ensure adequate drainage is provided around the proposed speed tables.	To be addressed during the **Detailed Design** stage.

No.	Issue	Details	Recommendation	Designer Comment / Action
15	Use of speed tables on side roads.	The purpose of the speed tables appears to be to connect the footpath and cycle facilities either side of the side streets to provide continuity for these dedicated facilities. This will result in the speed tables being used by pedestrians as pedestrian crossings.	Review the need to use speed tables at side streets. To improve pedestrian connectivity consider providing a refuge island at these intersections that clearly establishes priority without adversely affecting Lincoln Road through traffic.	To be addressed during the **Detailed Design** stage.
16	Lighting.	A night time visit has confirmed that lighting on this corridor is dated and will need to be upgraded. It is expected that lighting will be upgraded to meet the current standards.	Review lighting and ensure adequate lighting is provided for the proposed upgrade.	**Detailed Design** plans to include the street lighting design.
17	Use of Toucan marking.	The design plan shows the use of Toucan marking at the signalised intersections allowing pedestrians and cyclists to cross simultaneously. This is used overseas and but has not been used in New Zealand.	Ensure the proposed Toucan marking can be legally used in New Zealand before implementation.	AT's road Safety and Operations teams to confirm compliance. To be finalised as part of the Detailed Design package. **No action required.**

Appendix M Raised Median Impact to Trip Redistribution

Re-routing of Minor Road to Lincoln Road (Outbound) Trips



Re-routing of Lincoln Road to Minor Road (Inbound) Trips

Appendix N LRCI Project – Construction Sequencing and Traffic Management Report