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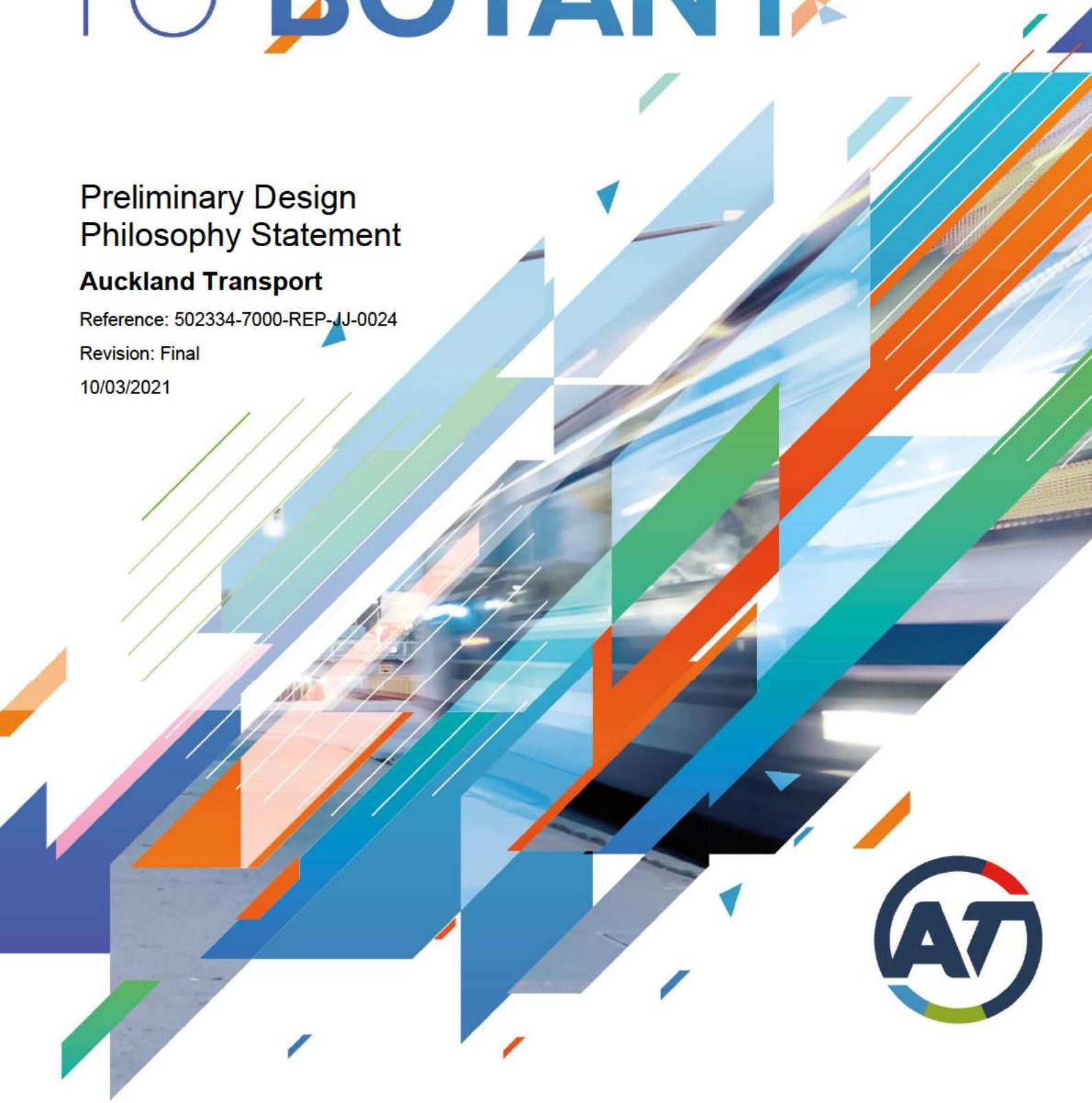
Preliminary Design Philosophy Statement

Auckland Transport

Reference: 502334-7000-REP-JJ-0024

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Appendix A

Rationale and Design Principles for Active Modes

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Appendix C

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Appendix E

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Appendix J

Safety in Design Register

Appendix K

Supporting Information for Stormwater Ponds

Glossary of Abbreviations

Abbreviation	Term
A2B	Airport to Botany Project
AC	Auckland Council
AC (Pavement)	Asphaltic Concrete
AEP	Annual Exceedance Probability
AFC	Auckland Forecasting Centre
AGRD	Austroads Guide to Road Design
AGTM	Austroads Guide to Traffic Management
AIAL	Auckland International Airport Limited
ASD	Approach Sight Distance
AT	Auckland Transport
ATCOP	Auckland Transport Code of Practice
ATMS	Advanced Traffic Management System
ATOC	Auckland Transport Operations Centre
AUP	Auckland Unitary Plan
BPDM	North Shore Busway Planning and Design Manual
BRT	Bus Rapid Transit
CC2M	City Centre to Mangere Light Rail
CP	Catchpit
CPMH	Catchpit Manhole
CBR (Pavement)	Californian Bearing Ratio
DG7 (Pavement)	Dense Grade Asphalt with a Mix Nominal Size 7mm
EEM	NZ Transport Agency Economic Evaluation Manual
GIS	Geographic Information System
HOV	High Occupancy Vehicle
HSDG	Highway Structure Design Guide
ITS	Intelligent Transport System
LiDAR	Light Detection and Ranging
LINZ	Land Information New Zealand
LRT	Light Rail Transit
MCA	Multi Criteria Analysis
MOTSAM	Manual of Traffic Signs and Markings
MSM	Auckland Macro Strategic Model
NZGD	New Zealand Geodetic Datum
NZVD	New Zealand Vertical Datum
OGPA (Pavement)	Open Graded Porous Asphalt
ONRC	One Network Road Classification
PDPS	Preliminary Design Philosophy Statement
PGAR	Preliminary Geotechnical Appraisal Report
RASF	Roads and Streets Framework (Auckland Transport)
RSA	Road Safety Audit
RTC	Rapid Transit Corridor
RTS	Road and Traffic Guidelines Series
S/B	Southbound
SAMI (Pavement)	Stress Absorbing Membrane Interlayer
SATURN	Simulation and Assignment of Traffic in Urban Road Networks
SCATS	Sydney Coordinated Adaptive Traffic System
SD	Sight Distance

SH1	State Highway 1
SH20	State Highway 20
SH20A	State Highway 20A
SH20B	State Highway 20B
SHGDM	State Highway Geometric Design Manual
SiD	Safety in Design
SIDRA	Signalised (and Unsignalised) Intersection Design and Research Aid
SIL (Pavement)	Subgrade Improvement Layer.
SISD	Safe Intersection Sight Distance
SMAF	Stormwater Management Area: Flow
SSBC	Single Stage Business Case
SSD	Stopping Sight Distance
STAAI	Short-term Airport Access Improvements
STC	Short Term Cycling Improvements
SUP	Shared Use Path
TCD	Traffic Control Devices Manual
TDM	Transport Design Manual (Auckland Transport)
TL	Test Level
TTM	Temporary Traffic Management
VMS	Variable Message Sign
W/B	Westbound
WQV	Water Quality Volume

Terms and Definitions

Terms	Definitions
20Connect Project	20Connect includes infrastructure upgrades to improve journey reliability and increase modal choice along State Highway (SH) 20, State Highway (SH) 20A and State Highway (SH) 20B to provide more choice for people when travelling around southwest Auckland, including to and from the airport.
Airport to Botany Project (A2B)	The Airport to Botany project consists of providing a new dedicated Rapid Transit Corridor (RTC) and improved walking and cycling facilities from Auckland International Airport to Botany, to provide a viable alternative to private vehicles for east and south Auckland.
Preferred Option	The preferred design for the A2B Project to inform the cost for this Single Stage Business Case (SSBC).
Puhinui Road Bus Priority project	Forms part of the wider project for the Short-Term Airport Access Improvements (STAAI) project. Involves provision of an enhanced and integrated transport interchange at Puhinui Station, a high frequency Bus Rapid Transit (BRT) service between the airport and Manukau Bus Station and a new shared use path (SUP) facility.
SH20B early improvements project	The first stage of the 20Connect project. the Transport Agency, alongside investment partners Auckland Transport (AT) and Auckland International Airport Limited (AIAL) are undertaking improvements to SH20B which support public transport, cater for pedestrians and cyclists and improve access to growth areas adjacent to the state highways.
Short-term Airport Access Improvements project (STAAI)	Consists of the Puhinui Road Bus Priority project and the Mangere Cycling Improvements project
GAP65	Course Graded Crushed Stone Material used to construct sub base pavement layers.
AC14HF (Pavements)	Grade 14 Asphaltic Concrete High Fatigue layer used to strengthen an existing pavement layer.

1 Introduction

1.1 Project Background

Auckland Transport (AT), alongside investment partners, The Transport Agency and Auckland International Airport Limited (AIAL) are investigating improvements to customer journey experiences and access to and from Auckland International Airport (Auckland Airport) and the surrounding area. A key demand management element of the PBC was a rapid transit connection between the Airport and Botany in the form of a dedicated Rapid Transit Corridor (RTC), to provide a viable alternative to private vehicles for east and south Auckland, where one third of airport trips originate.

The preferred option route of the RTC runs down the entirety of Te Irirangi Drive, through Manukau passing Manukau bus and train station connecting to Puhinui Interchange along Puhinui Road and heads west towards Auckland Airport via State Highway (SH) 20B. Figure 1-1 below shows the route of the A2B RTC in relation to the surrounding network. The segment to west of SH20 overlaps with the SH20, SH20A and SH20B (20 Connect) improvements Single-Stage Business Case (SSBC) study area.

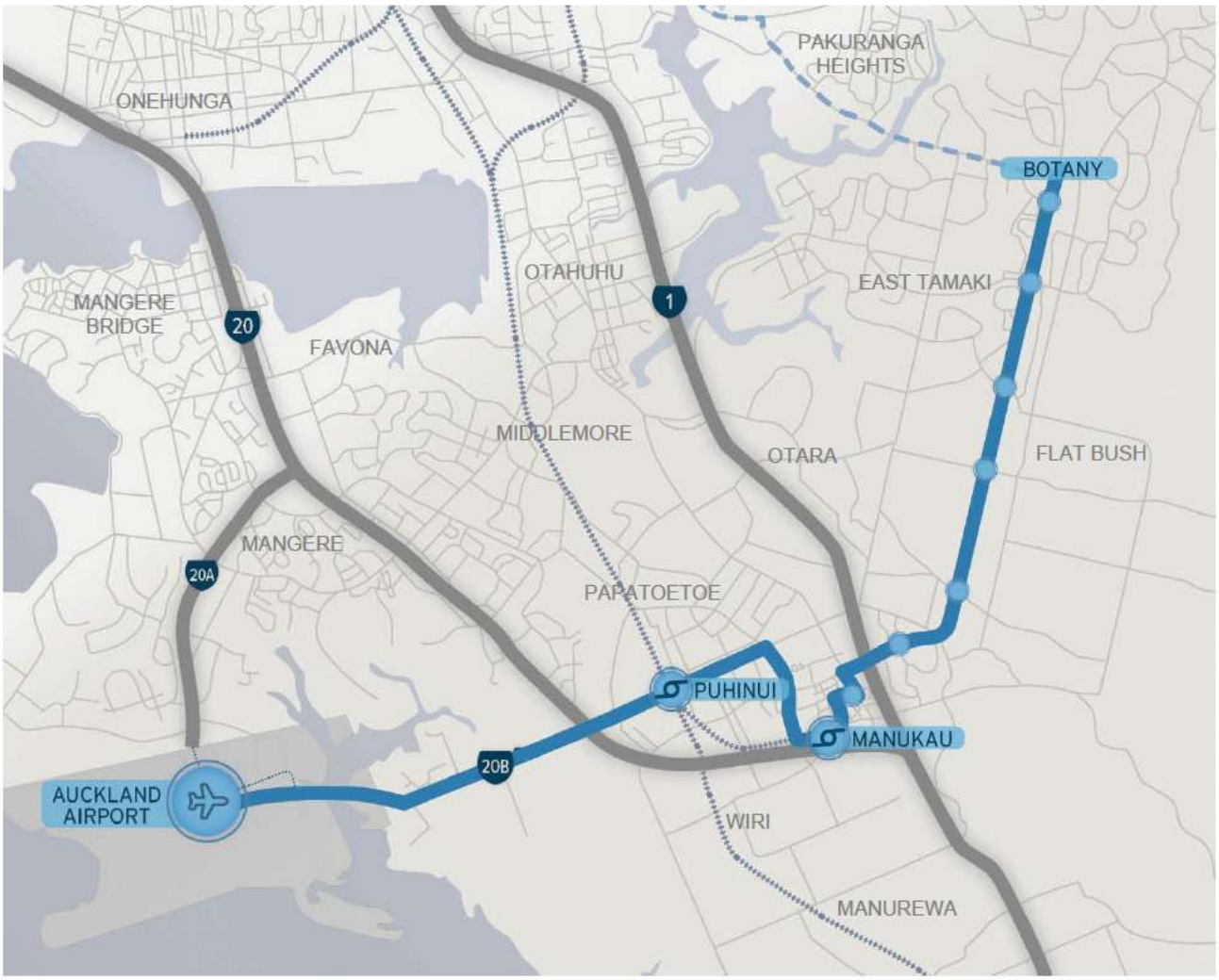


Figure 1-1: A2B Study Area

1.2 Purpose of this Report

It is the intention of this Design Philosophy Statement (DPS) to provide high level details of the design assumptions, parameters and criteria used to develop the SSBC preferred Option.

This document provides an overview of the design development during the SSBC stage and summarises the influence of the Road Safety Audit (RSA) and Safety in Design (SiD) activities.

Throughout this report, references have been made to the 'Project', which refers to the A2B SSBC preferred design.

It should be acknowledged this design has been developed to support a business case, therefore the key focus has been on determining footprint and likely construction costs. Implementation of the project is anticipated to be staged over the next 30 years, therefore the design, and design standards could be anticipated to change within this time.

1.3 Related Documents

Numerous sub-studies were undertaken for the A2B route, within the project extents, to identify and inform the project. These studies can be seen outlined in Section 1.3.1.

1.3.1 Option Assessment Technical Notes

This report should be read in conjunction with the following appended reports, technical notes and drawings:

- Appendix A: 502334-7000-TEC-KK-0022 Rationale and Design Principles for Active Modes
- Appendix B: 502334-7000-TEC-KK-0030 RTC Placement Analysis and 502334-7000-TEC-RR-0034 Corridor Widening Analysis
- Appendix C: 501094-4401-TEC-RR-0023 SH20B Options Assessment
- Appendix D: 502334-7000-TEC-KK-0040 Speed Limits along Airport to Botany Mass Rapid Transit Corridor
- Appendix E: 502334-7000-TEC-KK-0041 Traffic lane Rearrangement/Reduction
- Appendix F: 502334-7000-TEC-SS-0037 Te Irirangi Drive SH1 Bridge Option Assessment and 502334-7000-TEC-SS-0031 Puhinui Ramp Structure Option Assessment
- Appendix G: 502334-7000-REP-KK-0022 Preliminary Geotechnical Appraisal Report
- Appendix H: Road Safety Audit Report
- Appendix I: Departures
- Appendix J: Safety in Design Register
- Appendix K: Support Information for Existing Ponds

Other pertinent reports and technical notes should also be read in conjunction with this PDPS:

- 502334-7000-REP-JJ-0020 Concept of Operations
- 502334-7000-TEC-KK-0004 Station Locations
- 502334-7000-TEC-KK-0028 High Level Station Access Assessment
- 502334-7000-TEC-KK-0021 Detailed Station Access Assessment
- 501094-4401-REP- JJ-0010 20 Connect Preliminary Design Philosophy Statement

1.3.2 Concept Design Drawings

This PDPS should be read in conjunction with Concept Design Drawings developed for the project with the following drawing sets:

- General Arrangement
- Typical Cross Section
- Plan and Long Section
- Stormwater
- Bridge Layouts
- Affected Utilities

1.4 Existing Site Description and Constraints

There are significant interfaces with elements of the local transport network of multi-modal natures. Adopting a 'One Network' approach, the Transport Agency has been working collaboratively with Auckland Transport and Auckland International Airport (AIAL) to facilitate integration across all transport modes. Accordingly, connectivity to the Puhinui Interchange and the existing and proposed local cycling network has informed the Project.

1.4.1 Project Tie-Ins

The design of the Project has considered both the existing site and potential future constraints. This includes the following:

- Short-term Airport Access Improvements (STAAI) enhancing the public transport connects between Manukau, Puhinui and Auckland Airport;
- SH20, SH20A and SH20B improvements (20Connect) SSBC. The A2B corridor is integrated with 20Connect to the west of the SH20 interchange.
- Auckland International Airport Transport Network Improvements
- Eastern Busway between Panmure and Botany

1.4.2 Topography and Survey

Accurate topographical survey information is unavailable and will not be available until after completion of the DBC. LiDAR data was captured in 2016 and 2017 and obtained from Auckland Council in 2018. The horizontal datum is based on the coordinate system of NZGD 2000/Mt Eden 2000. The original vertical datum is based on NZVD 1946 and it was adjusted to NZVD 2016 by lowering 300mm in height. The data is provided in two formats of LAS and Point cloud. The existing terrain is considered "flat" in terms of Austroads Road Design & Guides (AGRD) Part 3 Table 8.3.

Aerial photography of the Project Area was captured in May 2018. The photography was captured with a 0.10 m ground sample distance pixel resolution and a spatial accuracy of +/-0.1 m at 95% confidence. Aerial imagery has been used to estimate existing carriageway layouts and pavement markings.

There are risks involved in using LiDAR survey and aerial imagery for design purposes, including accuracy of cost estimates (e.g. for earthworks and retaining walls quantities) and property impacts (e.g. incorrect boundary treatments and extents). It is recommended to procure accurate topographical survey information prior to the next stage of the project.

1.4.3 Geotechnical

For further details refer to the Preliminary Geotechnical Appraisal Report (PGAR) in Appendix G.

2 Safety in Design

2.1 General

While investigating the design options, the philosophy was to integrate hazard identification and risk assessment methods early in the design process to eliminate or minimise the risks of injury throughout the entire life of the product being designed.

AT has developed a Safety in Design (SiD) manual 'HS08-01 Safety in Design' which contains the standards, guidelines, tools and references that have been adopted to meet the SiD commitments.

The NZ Transport Agency Health and Safety in Design manual 'Health and Safety in Design Minimum Standards' has also been referenced.

The objectives of the SiD process are to:

- Reduce the risk of directly, or indirectly, causing harm to people throughout the lifecycle of an asset;
- Continually challenging and improving designs;
- Make changes early in the design stage which are more cost effective than retrofitted changes (to resolve issues) made during operation and maintenance;
- Better health and safety outcomes by considering and reconciling the interests of different parties in an asset;
- Comply with the duty of care that Designers have to create safe places to live and work; and
- Comply with health and safety legislation

The focus at SSBC stage is to identify the key risks (i.e. hazards) at the construction, operation, maintenance and demolition phases of the project life cycle and designing out or around the big issues where possible. Mitigation measures and eliminating risks are not analysed at SSBC.

The risks identified are then communicated to AT and other relevant parties. These need to be managed during the construction, operation, maintenance and decommissioning of the Project at subsequent design phases.

This SiD philosophy statement provides an outline of the procedures that must be applied during the Project to manage the SiD process.

2.2 Design Philosophy

Safe design was coordinated on this project by the Engineering and Design Lead using the methodology outlined in the 'Health and Safety Minimum Standard' guideline. This involved the following:

- Informal reviews of risk during design
- Workshops involving the design team, AT and stakeholders
- 'Walk through' of the designs, considering operation and maintenance personnel
- Constructability reviews
- The development, maintenance and closing out of the SiD risk register

2.3 Design Standards

The SiD process to date has been carried out to the current standards outlined by AT. The standards state a workshop should be held at the '80% Concept Design' stage , as outlined in HS08-01 Safety in Design

Auckland Transport, Figure 3.

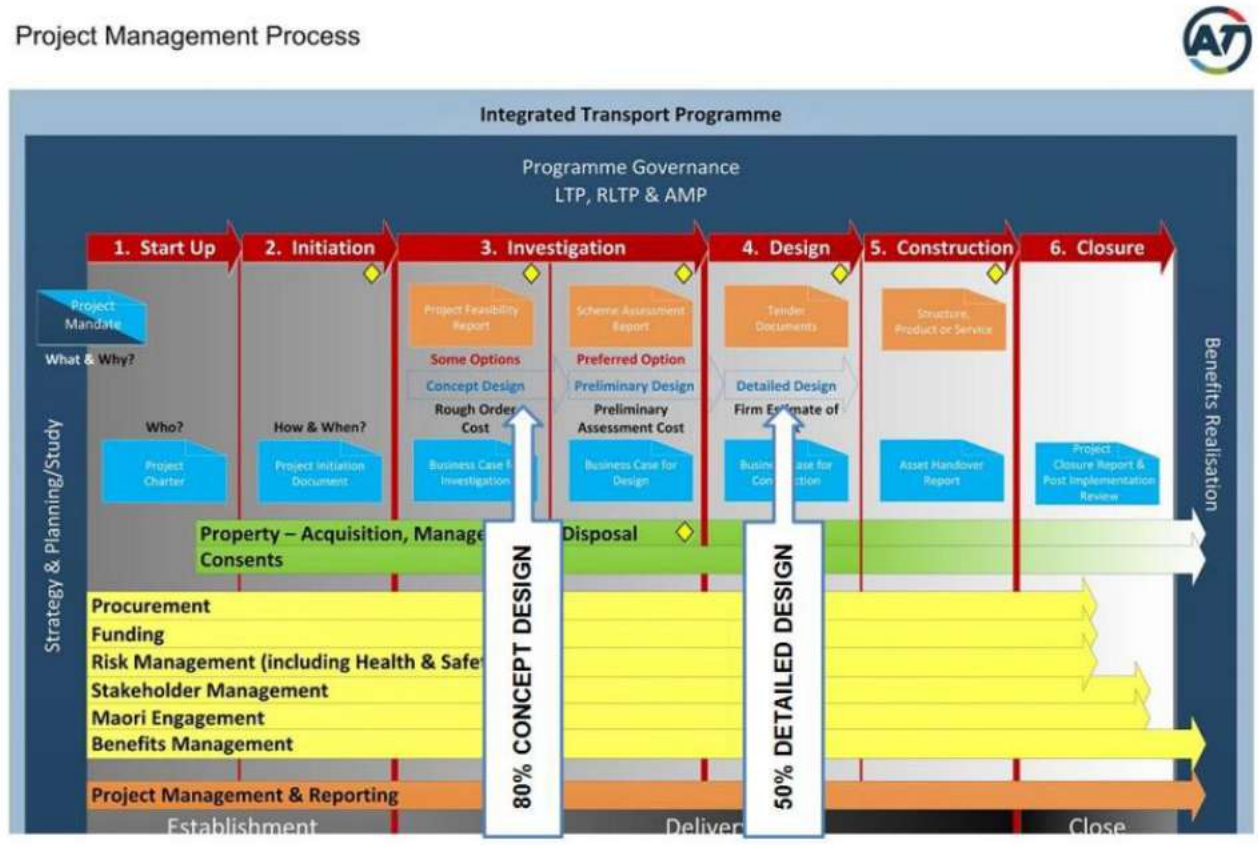


Figure 2-1: Minimum Standard Lifecyle for SiD

2.4 Design Development

2.4.1 SiD Workshops

A SiD risk identification workshop for A2B was held on the 11th October 2019 in conjunction with the 20Connect project. The attendees are shown in Table 2-1.

Table 2-1: SiD workshop attendees

Name	Organisation	Role
Renata Smit	AT	Mgr Strategic Projects (South & East)
James Georgetti	AT	Assistant Transport Planner
Melanie Taylor	AT	Senior Transport Planner
Debajeet Baruah	AT	Infrastructure Operations Specialist
Edwin Chong	AT	Specialist Project Manager
Peter Bierens	AT	Facilities Manager
Twan Van Duivenbooden	AT	Senior Speci-Active & Shared Modes Design
Khushbir Singh	AT	Senior Project Manager - South
Gang Yu	AT	Principal Asset Structures Engineer
Lucy Begg	AT	Property Facilities Manager

Name	Organisation	Role
Steve Wrenn	AT	Senior Service Network Planner
Andy Irwin	AT	Principal Specialist- Transport Mobility
Minnie Liang	AT	Senior Transportation Engineer
Amanda Taylor (AT)	AT	Senior Asset Roading Engineer
Remi Cruz	AT	N/A
Angela Parsonage (AT)	AT	Principal Asset Roading Engineer
Irene Tse (AT)	AT	Road Safety Engineering Team Leader C/S
[redacted]	Aurecon	Transport Engineer
[redacted]	Aurecon	Structural Engineer
[redacted]	Aurecon	Civil Engineer
[redacted]	Aurecon	Principal Transport Planner
[redacted]	Aurecon	Highways/Roads Senior Engineer
[redacted]	Aurecon	Civil Engineer
[redacted]	Aurecon	Associate
[redacted]	Aurecon	Associate

The agenda for the workshop was as follows:

- Introduction to Safe Design:
  - What, Why & Responsibilities
- Overview of the Project
- Key Hazards identification & Safety in Design Review of three scenarios:
  - Construction through Manukau City Centre
  - Maintenance at RTC stations
  - Interaction of RTC with other modes including general traffic, pedestrians, cyclists (operation)
- Conclusions and Wrap Up

The essential function of the workshop was to focus on identifying hazards and flagging key design risks.

2.4.2 SiD Risks Register

Following the workshop, a SiD risk register was produced to capture the workshop outcomes and shared with the attendees for review.

Refer to Appendix J for the SiD risk register.

2.4.3 Information Transfer

The SiD register should be used to inform the next stage of the project (Pre-implementation). The SiD register is provided to form part of the documentation across the project lifecycle.

3 Road Layout and Geometry

The road layout and geometry design philosophy for the project considers the existing and proposed conditions of the A2B route and the various project constraints.

The proposed works are intended to create a safe and efficient transport network and improve the overall function of it. The design will not exacerbate any existing design deficiencies and will attempt to improve or remove existing deficiencies, where practicable.

The design values adopted within this design philosophy are the intended desirable values for the ultimate design solution. However, it is likely that in some locations due to existing geometry and physical constraints, the desirable values may not be achievable. These situations will be highlighted and departures from standards will be applied for through the appropriate Departure Request process to AT or the relevant authority.

As far as practicable the horizontal and vertical geometry of the existing alignment will be retained, and it is not the intention of this project to change the risk profile of the road.

3.1 Design Standards

The current versions of the standards, manuals and guidelines listed in Table 3-1 have been adopted for the design of RTC, RTC stations, road layouts and geometry of the Project.

Table 3-1: Road layout and geometric design standards

Author	Title	Date	Abbreviation
Auckland Transport	Draft Transport Design Manual	March 2019	TDM
Auckland Transport	Roads and Streets Framework		R&SF
Auckland Transport	Code of Practice	2013	ATCoP
Auckland Transport	Schedule of Speed Limits	2012	
Auckland Transport	Draft Auckland Light Rail Transit Design Standards	May 2016	ALRTDS
Auckland Transport	Design Vehicle Outlines	2016	
Auckland Transport	AT Intersection Raised Safety Platform Protocol		
Austroads	Guide to Road Design Series	2017	AGRD
New Zealand Transport Agency	Draft State Highway Geometric Design Manual	2007	SHGDM
New Zealand Transport Agency	Draft North Shore Busway Planning and Design Manual	Dec 2002	BPDM
New Zealand Transport Agency	Bridge Manual	2016	NZTA BM
New Zealand Transport Agency	Road and Traffic Standards Series	Last updated 2015	RTS
New Zealand Transport Agency	Manual of Traffic Signs and Markings	2010 (parts 1 & 2 2009 (part 3)	MOTSAM
New Zealand Transport Agency	One Network Road Classification		ONRC
New Zealand Transport Agency	Traffic Control Devices Manual		TCD

3.2 Urban Design and Alignment with other initiatives

The concept design has been developed recognising linkages with a range of other projects and initiatives within the area. Particularly within the Manukau City Centre the look and feel of the design will need to be cognisant of these developments and provide an outcome that is appropriate for a Metropolitan Centre.

The Manukau Framework Plan sets out the approach for how Panuku and partners will transform Manukau over the next 20 to 25 years. It's an ambitious programme of change designed to cater for a growth in population from 6000 to 20,000, working closely with Manukau communities aiming to lead Manukau to its true transformation as the thriving heart of the south. Panuku's plans for Manukau's transformation line up closely with The Southern Initiative, which aims to stimulate and support social change and community innovation in south Auckland. Airport to Botany's project objectives tie in well with this urban transformation project.

Further information on wider projects, constraints and opportunities is provided in the Southwest Gateway Corridor Strategy (501094-4401-REP-NN-0019).

3.3 Design Criteria

This section outlines the design criteria requirements for the RTC, general traffic lanes, and pedestrian and cycling facilities along the A2B route.

3.3.1 Road Classification

Table 3-2 summarises the existing classification for each road that the RTC will follow based on the NZTA One Network Road Classification (ONRC) and is cross referenced against Auckland Transport's 'Roads and Streets Framework'. It then outlines the proposed classifications of these roads based on technical note 5022334-7000-TEC-KK-0040 Speed limits along A2B.

Additionally, the cycleway design has different requirements depending on the classification of adjacent road and whether the traffic volumes are low or high, as well as the speed limits of the road in question. Therefore, each road has been referenced against the criteria that determines the classification in Section 3.1 of the TDM - Engineering design code - Cycling Infrastructure and has been added to Table 3-2 for cycleway design.

Table 3-2: Mainline Road Classifications

Road Name	AADT (ONRC)	Existing Classification		Proposed Classification	Cycleway design classification
		ONRC	Roads and Streets Framework		
Puhinui Road	13,707	Arterial	Single Use (Out of Centre) Arterial	Mixed Use Arterial	Busy, fast and/or heavy
Lambie Drive (North of Cavendish Dr)	15,000	Arterial	Mixed Use Arterial	Mixed Use Arterial	Busy, fast and/or heavy
Lambie Drive (South of Cavendish Dr)	15,000	Regional	Mixed Use Arterial	Mixed Use Arterial	Busy, fast and/or heavy
Manukau Station Road	14,441	Regional	Mixed Use Arterial	Mixed Use Arterial	Busy, fast and/or heavy
Davies Avenue	6,129	Primary Collector	Mixed Use Collector	Centre Local Street	Busy, fast and/or heavy
Ronwood Avenue	15,000	Arterial	Mixed Use Arterial	Mixed Use Collector	Busy, fast and/or heavy
Great South Road	24,791	Arterial	Mixed Use Arterial	Mixed Use Arterial	Busy, fast and/or heavy

Road Name	AADT (ONRC)	Existing Classification		Proposed Classification	Cycleway design classification
		ONRC	Roads and Streets Framework		
Te Irirangi Drive	30,453	Regional	Single Use (Out of Centre) Arterial	Mixed Use Arterial	Busy, fast and/or heavy

Along Te Irirangi Drive, there are several parallel running side roads that provide access to properties facing Te Irirangi Drive and are separated by existing planted buffers. These existing access roads may be used as shared paths between bicycles and the limited cars using it to enter private property. This proposal also features in technical note 502334-7000-TEC-KK-0022 Speed limits along the A2B Mass RTC.

Table 3-3 summarises the existing classification for each side access road based on the NZTA One Network Road Classification (ONRC) and are then cross referenced against Auckland Transport's 'Roads and Streets Framework'. It also includes a classification for cycleway design.

Table 3-3: Road classifications for parallel side roads along Te Irirangi Drive

Road name	AADT (ONRC)	Existing Classification		Road Classification adopted for this DPS	Cycleway design classification
		ONRC	Roads and Streets Framework		
Leixlep Lane	122	Low Volume	Local Street	Local Street (with mixed traffic cycling)	Low volume and slow traffic
Franco Lane	183	Access	Local Street	Local Street (with mixed traffic cycling)	Low volume and slow traffic
Marlon Lane	143	Low Volume	Local Street	Local Street (with mixed traffic cycling)	Low volume and slow traffic
Aaronville Way	204	Access	Local Street	Local Street (with mixed traffic cycling)	Low volume and slow traffic
Kellaway Drive	204	Access	Local Street	Local Street (with mixed traffic cycling)	Low volume and slow traffic
Cratloe Lane	102	Low Volume	Local Street	Local Street (with mixed traffic cycling)	Low volume and slow traffic
Gransna Lane	204	Access	Local Street	Local Street (with mixed traffic cycling)	Low volume and slow traffic
Sheddings Lane	265	Access	Local Street	Local Street (with mixed traffic cycling)	Low volume and slow traffic
Wando Lane	224	Access	Local Street	Local Street (with mixed traffic cycling)	Low volume and slow traffic
Shingleton lane	102	Low Volume	Local Street	Local Street (with mixed traffic cycling)	Low volume and slow traffic
Moravale lane	183	Low Volume	Local Street	Local Street (with mixed traffic cycling)	Low volume and slow traffic
Treneary lane	82	Low Volume	Local Street	Local Street (with mixed traffic cycling)	Low volume and slow traffic

3.3.2 Design Vehicles

Rapid Transit Corridor and Bus/Transit Lanes

The RTC and bus/transit lanes will be designed to cater for the vehicles stated in Table 3-4 for mid-block scenarios.

Table 3-4: Mid-block design vehicles for the RTC

Facility	Design Vehicle and length	Tracking Type*	Check Vehicle	Tracking Type*	Comment
▪ Bus/Transit Lane	12.6 m Bus	A	13.5 m Bus	B	
▪ RTC	67 m LRT Vehicle (Use 19 m articulated bus for swept path analysis)	A	N/A	N/A	A 19m Articulated bus has been used as this is the longest vehicle in AT's Design Vehicles Library

*Tracking Type:

A - Remain within marked lane, or allow safe encounter with conflicting Design vehicle where no lane is marked

B - Do not cross a marked centreline or flush median to penetrate opposing traffic lane

General Traffic Lanes

Road and intersection geometry for local roads shall be designed to accommodate movement of the design vehicles as specified in Table 3-5. The design vehicle specifications are defined in the TDM, Engineering Design Code – Urban and Rural Roadway Design, Section 4.2.

Table 3-5: General traffic lane design vehicle

Facility	Road Classification	Design Vehicle and length	Tracking Type*	Check Vehicle	Tracking Type*
Midblock	Arterial				
	▪ First general lane	19.45 m Semi-Trailer	A	23 m Truck & Trailer	B
	▪ Additional lanes	8.3 m Truck	A	23 m Truck & Trailer	B
	Collector				
	▪ Residential	8.3 m Truck	A	10.3 m truck	B
	▪ Commercial	12.6 m Rigid	A	19.45 m Semi	B
	Local Roads				
	▪ Residential	6.3 m Van	A	10.3 m Truck	B
	▪ Commercial or light industrial	8.3 m Medium Rigid Truck	A	17.9 m Trailer	B
Intersections	Local -> Arterial / Collector	6.3 m Van	A	10.3 m Truck	D
	Collector -> Collector (Commercial)	12.6 m Rigid	A	19.45 m Semi	D
	Collector -> Arterial	12.6 m Rigid	A	19.45 m Semi	D
	Arterial -> Collector	12.6 m Rigid	A	19.45 m Semi	D
	Arterial -> Arterial	19.45 m Semi	C, F	23 m Truck & Trailer	B, C

*Tracking Type:

A - Remain within marked lane, or allow safe encounter with conflicting Design vehicle where no lane is marked

B - Do not cross a marked centreline or flush median to penetrate opposing traffic lane

C – May use adjacent lanes in same direction

D – Conditions B, C apply on major (or crossing) road, E on minor (or terminating) road

E – May use full road width to turn

F – For multiple turning lanes, design vehicle and 8.3m truck must be able to turn together without penetrating opposing traffic lane

3.3.3 Overdimension Routes

The routes outlined in Table 3-6 have been identified as overdimension routes within the Project area.

Table 3-6: Overdimension routes

Overdimension Route	Reference
SH20B (*from SH20 to Airport*)	▪ Transit New Zealand - Overdimension Vehicle Route Maps (2004) 4-0 Auckland Key Map, 4-42
Puhinui Road (from Great South Road to Tavistock St)	▪ Transit New Zealand - Overdimension Vehicle Route Maps (2004) 4-0 Auckland Key Map, 4-42
Great South Road	▪ ATCoP Chapter 5.1 Special route and road elements, Table 13 ▪ Transit New Zealand - Overdimension Vehicle Route Maps (2004) 4-0 Auckland Key Map, 4-42

Overdimension vehicle routes shall accommodate the following clearance envelope specifications:

- A 10m wide load with an allowance for a possible off-centre load.
- In accordance with AGRD Part 3 "Table 8.1: Typical minimum vertical clearances over roadways and pedestrian/cycle paths", a minimum 6.1 m vertical clearance over a carriageway width of at least 10m is to be provided between road surface to underside of structure for all overhead bridges and structures on over dimension vehicle routes.
  - This shall be increased to 6.3m vertical clearance for all overhead pedestrian structures on overdimension vehicle routes

The effects of superelevation and vehicle tracking on curves shall be accounted for in the preparation of over dimension vehicle clearance envelopes.

The NZ Heavy Haulage Association require an 11.5m by 6.5m envelope.

3.3.4 Design Speed

The roads along the A2B corridor shall be designed to the proposed design speeds in Table 3-7. For further information on the rationale behind these proposed design speeds, refer to technical note 502334-7000-TEC-KK-0040 Speed limits along the A2B Mass Rapid Transit Corridor.

It is proposed in all cases that the operating speed of the RTC is matched with the adjacent general traffic (refer to TDM - 'Urban busway operating on roadway').

Table 3-7: Existing and proposed speeds along the A2B corridor

Road	Current Operating Speed	Proposed Operating Speed	Proposed Design Speed
Te Irirangi Drive (North of Whetstone Road)	80 km/hr	50 km/hr & 60 km/hr	50 km/hr & 60 km/hr

Road	Current Operating Speed	Proposed Operating Speed	Proposed Design Speed
Te Irirangi Drive (South of Whetstone Road)	60 km/hr	50 km/hr	50 km/hr
Great South Road	60 km/hr	50 km/h	50 km/h
Ronwood Avenue	50 km/hr	30 km/h	30 km/h
Davies Avenue	50 km/hr	30 km/h	30 km/h
Manukau Station Road	60 km/hr	50 km/h	50 km/h
Lambie Drive	60 km/hr	50 km/h	50 km/h
Puhinui Road	50 km/hr	50 km/h	50 km/h
SH20B	50 to 80 km/hr	50 km/h to 80 km/h (no change)	50 km/h to 80 km/h (no change)

*A2B will consider reducing the speed down to both 50 km/hr and 60 km/hr

As outlined in technical note 502334-7000-TEC-KK-0022 Speed limits along the A2B Mass RTC, several side streets that run parallel to Te Irirangi Drive are proposed to be modified as 'access streets' and thus, their speed limits reduced from 50km/hr to 30km/hr. These streets include:

- Leixlep Lane
- Marlong Lane
- Franco Lane
- Kellaway Lane
- Aaronville Lane
- Cratloe Lane
- Gransna Lane
- Sheddings Lane
- Wando lane
- Shingleton Lane
- Moravale Lane
- Treneary Lane

3.3.5 Cross-section

This section outlines the typical cross-section criteria, unless specifically noted otherwise in this DPS.

Rapid Transit Corridor

RTC Mainline

The cross-sections for the RTC mainline shall be designed based on the values in Table 3-8.

Table 3-8: Cross-section dimensions for the RTC mainline

Item	Value	Reference	Comments
Number of lanes	2	BPDM (dwg. No. E-10)	1 in each direction
Lane width:	50 km/hr DS - 3.5 m 80 km/hr DS - 3.5 m	TDM – 'Engineering Design Code – Urban and Rural Roadway Design' Section 7.3	Preferred width even in a 50km/hr speed zone should be increased to 3.5 m for a FTN bus route.

Item	Value	Reference	Comments
Minimum shoulder width ■ Constrained Areas ■ Elsewhere	0.6 m 1.0 m	BPDM Section 5.2.2 (b) BPDM Section 5.2.2 (c)	Constrained areas (i.e. over/under bridges) should still meet sight distance requirements All values exclude drainage requirements
Drainage channel width	0.3 m	TDM 'Engineering Design Code – Road Drainage' Section 05 Kerbs and channels	For drainage systems, kerb types 1 or 3 shown in plans GD008 and GD009 (modified plan GD008A & GD009A) is suitable. Kerbs with 0.3m wide channels is used Potential to use combined kerb and drainage channel in constrained areas providing 0 m channel width
Minimum median width between RTC and public carriageway	0.5 m	TDM 'Engineering Design Code – Urban and Rural Roadway Design' Section 7.8	0.5 m is allowed for buffer separation. Street lighting can be provide from edge of general traffic lanes with extended reach arms to light the RTC lanes.
Minimum vertical clearance ■ General ■ OD* route	 6.1 m 6.5 m	 NZTA Bridge Manual New Zealand Heavy Haulage Association	 *OD = Overdimension
Structure clearance over rail lines (when allowing for electrification of rail network)	6.0 m	ATCoP - Section 21 Public Transport - Rail	From rail track to structure within stations A 5.5 m clearance has been agreed for the concept design of Puhinui interchange

RTC Stations

The recommended RTC stations outlined in technical note 502334-7000-TEC-KK-0004 Station Locations will be designed using the criteria below.

Based on technical note 502334-7000-TEC-KK-0024 RTN mode and demands, the following are outlined and shall be considered for the station cross-section dimensions.

- In line stations with no passing lanes are preferred in accordance with the preferred operating concept. Therefore stations will adopt dimensions for a low-volume station in the BPDM. To provide future flexibility, consideration has also been given to an alternative design with passing lanes provided. The stations also provide for a platform that can cater for two buses stopping clear of adjacent intersections.
  - Two options ('passing lanes' and 'passing and turning lanes') were investigated against the base design (streamlined busway, no passing lanes) and the passing lanes option was deemed to be the most suitable. This was because it will provide good operational resilience for breakdowns and maintenance, and future proofing for alternative service patterns as buses can pass one another at stations. The passing and turning lanes option was deemed unsuitable, mainly due to its significant adverse impacts on intersection performance (with additional signal phases).
- In the long-term, a 24m double-articulated bus will be used to service predicted demands in 2048, however, higher-than-modelled growth by 2048 may require a vehicle as big as a LRT-based unit.

Where stations and local bus stops are located near intersections, the stop should be on the departure side (i.e. past the intersection) as per Section 5.5.2 of TDM - Section 2 – Engineering Design Code - Public Transport – Bus Infrastructure.

Requirements for stations, including cycling and pedestrians, are further documented in the Concept of Operations document which should be read in conjunction with this PDPS.

The cross-sections for the RTC at stations shall be designed based on the values in Table 3-9.

Table 3-9: Cross-section dimensions for the RTC at stations

Item	Value	Reference	Comments
Number of lanes ▪ Intersection stations ▪ Midblock stations	 2 2	 BPDM (Dwg. No. E-1) BPDM (Dwg. No. E-1)	One lane in each direction with inline stops.
Lane / Bay width	3.5 m	BPDM (Dwg. No. E-1)	Bay width is equal to the lane width
Central median width	0 m	BPDM (Dwg. No. E-1)	Median not required for low-volume stations
Minimum shoulder width	Constrained areas -0.6 m Elsewhere - 1.0 m	BPDM Section 5.2.2 (b) BPDM Section 5.2.2 (c)	Shoulder may be removed as per drawing E-1 of the BPDM
Drainage channel width	0.6 m	BPDM Section 5.2.2 (c)	
Min median width between RTC and public carriageway (on side without platform)	2.5 m	BPDM (dwg. No. E-10)	May potentially be reduced as per the AMETI project
Platform width	Minimum - 4 m Desirable - 5 m	BPDM (Dwg. No. E-1)	Based on cross-section drawings for a busway on Arterial Street and practical considerations.
Pedestrian barrier width between platform and public carriageway	0.6 m	BPDM (Dwg. No. E-1)	Safety barrier required for median running RTC
Platform length	34 m	ATLRTDS	To accommodate for a single light rail unit.
Bus stop length	34 m (minimum) 50m (desirable)	ATLRTDS	To accommodate for a single light rail unit. 50m desirable at some stations to allow two vehicles to stop.

General Traffic Lanes

The horizontal cross section elements for the general traffic lanes shall be designed to the widths and clearances given in Table 3-10.

Table 3-10: Cross-section dimensions for general traffic lanes

Item	Value	Reference	Comments
Arterial Lane width ■ Speed >50km/h ■ Speed 50km/h or less	3.5 m 3.2 m	TDM, Engineering Design Code – Urban and Rural Roadway Design, Section 7.3	All widths are desirable widths and measured from the lane line to the kerb face Widths are to increase to 3.5 m on a heavy vehicle route FTN route
Collector Lane width ■ Speed >50km/h ■ Speed 50km/h or less	3.3 m 3.2 m	TDM, Engineering Design Code – Urban and Rural Roadway Design, Section 7.3	All widths are desirable widths and measured from the lane line to the edge of road Lane widths are to increase to 3.5 m on a heavy vehicle route or FTN route
Local Lane width ■ Speed >50km/h ■ Speed 50km/h or less	3.1 m 3.0 m	TDM, Engineering Design Code – Urban and Rural Roadway Design, Section 7.3	All widths are desirable widths and measured from the lane line to the edge of road Width increased to 3.5 m for freight access to industrial land uses
Shoulders	1.5 m 1.5 – 2.5 m	TDM, Engineering Design Code – Urban and Rural Roadway Design, Section 7.9 SHGDM Table 6.8	TDM states - 'In urban areas, road shoulders should not be provided unless there is a good safety reason to do so and the design speed is 70 km/h or more' SHGDM states - The normal nearside shoulder for use on major urban roads - in urban situations isolated stopped vehicles on a 1.8 m shoulder have been shown to have a negligible effect on capacity and safety.
Parking width	2.1m	TDM, Engineering Design Code – Parking Design – Table 1	Manoeuvring space for parallel parking is 2.1m which is measured perpendicular to the face of kerb.
Drainage channel width	0.3 m	TDM, Drawing GD008, Standard Kerb and Channel	Not recommended over 60km/h

Local bus stops

Local bus stops are to be provided at several intersections on roads that intersect with the A2B RTC stations, to feed local services to the RTC. Local bus stop requirements are to be designed in accordance with the TDM – Engineering Design Code – Public Transport – Bus Infrastructure and are summarised in Table 3-11.

Table 3-11: Cross-section requirements for local bus stops

Item	Value	Reference	Comments
Bus bay width	2.5m	TDM, Engineering Design Code – Public Transport – Bus Infrastructure, Section 6	
Platform width ■ Waiting zone ■ Shelter	1.5 m 2 m	TDM, Engineering Design Code – Cycling Infrastructure	Based on a full island bus stop design.

Item	Value	Reference	Comments
Platform length	15 m	TDM, Engineering Design Code – Public Transport – Bus Infrastructure, Section 6	
Entry taper length ■ In-line stop ■ Half-indented stop ■ Fully indented stop ■ After intersections	 11 m 10 m 20 m 6 m	TDM, Engineering Design Code – Public Transport – Bus Infrastructure, Section 7	NACTO allows a 3m clearance from intersections. NACTO guidance is reflective of global best practice.
Exit taper length ■ In-line stop ■ Half-indented stop ■ Fully indented stop	 9 m 9 m 11 m	TDM, Engineering Design Code – Public Transport – Bus Infrastructure, Section 7	

Cycling Facilities

Cycle facilities shall be designed in accordance with the TDM – Engineering design code - Cycling Infrastructure.

Based on Section 5 of the Roads and streets framework, a separated cycle facility is required for mixed-use arterials and should be considered for mixed-use collectors for thresholds that exceed 2,000 vpd. This applies to all mainline roads along the A2B corridor.

There is an opportunity for the A2B project to create bicycle streets on the existing parallel access streets along Te Irirangi Drive outlined in Table 3-3. The bicycle streets are merely a shared path between passing bicycles and private cars entering private property. A similar option may be considered along Puhinui Road.

Separated cycleway

A separated cycleway adjacent to busy, higher operating speed and/or heavily traffic roads (as described in Table 3-3) must adopt the requirements outlined in Table 3-12.

Table 3-12: Cross-section requirements for separated cycleways adjacent to busy, fast and/or heavy roads

Item	Value	Reference	Comments
Minimum Cycleway width ■ Uni-directional ■ Bi-directional	 2.0 m 3.2 m	TDM, Engineering Design Code – Cycling Infrastructure, Section 3.1	A minimum 1.5 to 1.8 m uni-directional cycleway may be suitable if no safety or public realm issues are present. However due to width and scale of this corridor, it is anticipated 'wrong way' cycling will likely occur along sections of this cycle path due to difficulties in crossing the corridor, therefore the minimum width should not drop below 1.8m. With the cross-sectional widths constraints related to property boundaries, bi-directional cycles lanes cannot exceed 3.0m in width.
Minimum cycleway width behind local bus stop platforms	1.4 m	TDM, Engineering Design Code – Cycling Infrastructure, Section 3.1	This is for a uni-directional path only Desirable to have the cycleway width the same as the first item for consistency

Item	Value	Reference	Comments
Minimum traffic side separator / buffer	2.0 m	TDM, Engineering Design Code – Cycling Infrastructure, Section 3.1	A minimum of 0.9 m wide separator may be suitable if no safety or public realm issues are present. Parking may replace the separator in areas where the separator is wider than 2.9m.
Door Zone (where parking is within the separator)	0.8m	TDM, Engineering Design Code – Cycling Infrastructure, Section 3.1	Door zone must be provided if parking is available in the separator. The separator may not be used for car parking for out-of-centre arterials. Street trees will be difficult to be included in this buffer/berm width if it is less than 1.5m. Street trees in the berms will provide human scale and will play an important role on this corridor for active modes.
Kerb	0.3 m	TDM, Engineering Design Code – Cycling Infrastructure, Section 3.1	Applies to both road classifications. K01 or K03 Kerbs to be placed on either side of the cycleway which may be flush or vertically separated. Where the cycleway is flush with its surroundings, a street furniture zone must be provided between the footpath and cycleway. For K01 kerbs, there is to be no lip at cycle surface.

A separated cycleway adjacent to low volume, low speed roads (as described in Table 3-3) must adopt the requirements outlined in Table 3-13.

Table 3-13: Cross-section requirements for separated cycleways adjacent to a low volume, slow road

Item	Value	Reference	Comments
Minimum Cycleway width ■ Uni-directional ■ Bi-directional	2.0 m 3.2 m	TDM, Engineering Design Code – Cycling Infrastructure, Section 3.1	A minimum 1.5m to 1.8 m uni-directional cycleway may be suitable if no safety or public realm issues are present. With the cross-sectional widths constraints related to property boundaries, bi-directional cycles lanes cannot exceed 3.0m in width.

Item	Value	Reference	Comments
Minimum traffic side separator / buffer	0.8 m	TDM, Engineering Design Code – Cycling Infrastructure, Section 3.1	
Kerb	0.3 m	TDM, Engineering Design Code – Cycling Infrastructure, Section 3.1	Applies to both road classifications K01 or K03 Kerbs to be placed on either side of the cycleway which may be flush or vertically separated. Where the cycleway is flush with its surroundings, a street furniture zone must be provided between the footpath and cycleway. For K01 kerbs, there is to be no lip at cycle surface

Access street facility

Creating access streets along the A2B corridor involves the following elements:

- Connecting footpaths along the A2B corridor with footpaths on existing local roads.
- Reducing traffic volumes and speeds through:
  - Self-evident communicated priority of bicycles on carriageway using road material, geometric design, signage and posted traffic speeds of 30km/h or lower.
  - Bicycle paths will simply connect into and out of these streets, but it will be designed so that bikes, scooters and cars will share the access street comfortably and safely.
  - No motor vehicle parking – unless there is sufficient space. These bays would ideally be indented so a consistent narrow street width remains over the length.
- Removing multiple conflict points (driveways) across the bicycle path by:
  - Creating access via a 'bicycle street' for residential property access along sections of Te Irirangi Drive, removing direct access off these high volume, high speed arterials.
  - Creates safer more attractive property frontage for houses along these busy roads.

    Any properties to be developed along the frontage of the A2B corridor will have these access streets incorporated or include rear access lanes for vehicle access.

Pedestrian facilities

Pedestrian facilities are to be designed in accordance with the TDM – Design Code – Footpaths and the public realm. Table 3-14 summarises the cross-section requirements for pedestrian facilities.

Table 3-14: Cross-section requirements for pedestrian facilities

Location	Value					Reference	Comments
	Kerb	Street Furniture/Front Berm	Through route	Frontage/Back Berm	Total width		
Main street, mixed use & centres	0.15m	1.2m	2.4m (min)	0.75m (paved)	4.5m (min)	TDM, Engineering Design Code – Footpaths and	Street furniture zone may be reduced to minimum required

Location	Value					Reference	Comments
	Kerb	Street Furniture/Front Berm	Through route	Frontage/Back Berm	Total width		
Out of centre Arterial (Single Use Arterial)	0.15m	1.2m	1.8m	0.15m	3.3m (min)	public realm, Section 3.1 – Table 1	to cater for any street furniture (signs, waste bins etc.)
Local Roads	0.15m	0.9m	1.8m	0.15m	3.0m		

3.3.6 Sight Distance

This section outlines the sight distance criteria, unless specifically noted otherwise in this DPS.

Rapid Transit Corridor

Sight distances for the RTC and bus lanes shall be in accordance with the values in Table 3-15 below.

Table 3-15: Sight distance requirements for the RTC

Item	Value	Reference	Comments
Driver eye height	2.1 m	BPDM Section 4.3.3 (a)	Bus driver eye height
Stationary object target height	0.2 m	AGRD Part 3; Table 5.1: Vertical height parameters	Used for Stopping Sight Distance (SSD)
Road surface / markings target height	0.0 m	AGRD Part 3; Table 5.1: Vertical height parameters	Used for Approach Sight Distance (ASD)
Reaction Time, R_T	1.75 sec	BPDM Section 4.3.3 (b)	
Coefficient of deceleration, d (sealed surface)	0.15	AGRD Part 3: Table 5.3 Design domain for coefficient of deceleration	Desirable for passenger comfort

General Traffic

Sight distances for general traffic lanes shall be in accordance with the values in Table 3-16 below

Table 3-16: Sight Distance requirements for general traffic

Item	Value	Reference	Comments
Driver eye height	1.1 m	AGRD Part 3; Table 5.1: Vertical height parameters	Eye height of cars to calculate SSD, ASD and SISD (see below)
Stationary object target height	0.2 m	AGRD Part 3; Table 5.1: Vertical height parameters	Used for Stopping Sight Distance (SSD)
Road surface / markings target height	0.0 m	AGRD Part 3; Table 5.1: Vertical height parameters	Used for Approach Sight Distance (ASD)
Top of car target height	1.25m	AGRD Part 4A Section 3.2.2: Safe Intersection Sight Distance (SISD)	Used for Safe Intersection Sight Distance (SISD)
Reaction Time, R_T	2.0 sec	AGRD Part 3; Table 5.2: Driver reaction times	For higher speed urban areas

Item	Value	Reference	Comments
Coefficient of deceleration, d (sealed surface) ■ Cars ■ Trucks	 0.36 0.29	AGRD Part 3: Table 5.3 Design domain for coefficient of deceleration	

3.3.7 Horizontal Geometry

This section outlines the horizontal geometry criteria, unless specifically noted otherwise in this report. Wherever the RTC, general traffic lanes, cycling facilities and pedestrian facilities run parallel to one another and are constrained by one another geometrically, the more conservative criterion will be used.

Rapid Transit Corridor

The horizontal geometry requirements for the RTC are summarised in Table 3-17.

As per the BPDM Section 4.3.4 h), station platforms should be on a tangent to the extent practical and the tangent should extend at least 20m beyond each end of the station platforms where practical.

Table 3-17: Horizontal geometry for the RTC

Item	Value	Reference	Comments
Maximum super elevation ■ Desired ■ Absolute	 3% 5%	BPDM Section 4.3.4 (c)	A 5% superelevation must have approval from AT Refer to Austroads Guide to Road Design Part 3: Geometric Design Section 7.7 Super-elevation
Crossfall	3%	BPDM Section 4.3.4 (c)	Fall away from centre
Minimum horizontal curve radii ■ For 90 km/hr DS ■ For 70 km/hr DS ■ For 60 km/hr DS	 400 m 330 m 120 m	BPDM Section 4.3.4 (a)	400 m radius allows LRT to achieve an 80 km/hr design speed
Minimum horizontal curve length	90 m (including spirals)	BPDM Section 4.3.4 (g)	ALRTDS desirable min = 15 m and absolute min = 12 m
Minimum horizontal tangent length between curves	0.6V m	SHGDM	ALRTDS desirable min length = 15 m ALRTDS absolute min length = 6 m or 0.1 V (whichever is greatest) V = design speed in km/hr
Minimum turning radius at intersections ■ For light rail ■ For Buses	 25 m 15 m	ALRT Table 2.2.1 TDM – Urban & Rural Roadway Design & BPDM Table 4.6.A	As per the TDM, turning speed should generally be in 5 – 15km/h range at intersections.

General traffic lanes

The horizontal geometry requirements for general traffic lanes are summarised in Table 3-18

Table 3-18: Horizontal Geometry Requirements for general traffic lanes

Item	Value	Reference	Comments
Maximum superelevation (Urban – all speeds) ▪ Minimum ▪ Maximum	 2% 5%	AGRD Part 3 Section 10.3 Horizontal Geometry and Section 7, Table 7.8 TDM – Urban and Rural Roadway design, Section 6.2.2	Super-elevation is not permitted on local or collector roads and is unlikely to be used on arterial roads
Crossfall	-3%	TDM – Urban and Rural Roadway design, Section 6.2.1	Fall is to the outer edge of the road. Where existing features prevent this crossfall, 2% - 4% may be used. At intersections, the crossfall of the major road should take priority.
Minimum horizontal curve radii			Transition curves may be used on roads > 50km/hr
Minimum horizontal tangent length between curves	0.6V m	SHGDM, Austroads Part 3, Section 7.5.3	V = design speed in km/hr

Cycle facilities

The horizontal geometry requirements for cycle facilities are summarised in Table 3-19.

Table 3-19: Horizontal geometry requirements for cycle facilities

Item	Value	Reference	Comments
Minimum horizontal radius curve	2 m	TDM, Engineering Design Code – Cycling Infrastructure, Section 8.2	This is only applicable when cyclists are stopping or close to stopping.
Crossfall ▪ Desirable ▪ Maximum	 2% 3%	TDM, Engineering Design Code – Cycling Infrastructure, Section 8.2	

Pedestrian facilities

The horizontal geometry requirements for cycle facilities are summarised in Table 3-20

Table 3-20: Horizontal geometry requirements for pedestrian facilities

Item	Value	Reference	Comments
Crossfall	2%	TDM, Engineering Design Code – Footpaths and public realm, Section 3.4	

3.3.8 Vertical Geometry

This section outlines the vertical geometry criteria, unless specifically noted otherwise in this report. Wherever the RTC, general traffic lanes, cycling facilities and pedestrian facilities run parallel to one another and are

geometrically constrained by one another, the more conservative criterion will be used. For example, the minimum crest curve k value for the RTC at a 60km/hr design speed is 17, whereas the minimum k value for general traffic lanes at a 60 km/hr design speed is 12. Since these road elements will be running parallel to each other and are constrained to each other geometrically, the more conservative value of 17 will be used.

Rapid Transit Corridor

RTC Mainline

The vertical geometry requirements for the RTC mainline are summarised in Table 3-21.

Table 3-21: Vertical geometry requirements of the RTC mainline

Item	Value	Reference	Comments
Longitudinal gradient ■ Desirable ■ Maximum	 +3% / -3% +5% / -5%	BPDM Section 4.4.2(a)(i)	LRT has a desirable gradient of +7% / - 7% and a max of +8.5% / -8.5% as per ATLRTDS.
Minimum longitudinal gradient ■ Absolute minimum ■ Absolute minimum, if independently graded drainage provided	 0.35 % 0 %	BPDM Section 4.4.2(b)(i)	
Desirable crest curve minimum k values ■ for 90 km/h DS ■ for 60 km/h DS	 65 17	BPDM Section 4.4.3(b)	Taken based on driver eye height of 2.1 m, Stopping sight object height of 0.2 m Values of K less than 17 may be used in the vicinity of stations but shall be greater than 8
Desirable sag curve minimum k values ■ for 90 km/h DS ■ for 60 km/h DS	 59 17	BPDM Section 4.4.3(b)	Values of K less than 17 may be used in the vicinity of stations but shall be greater than 8
Minimum length of vertical curve ■ for 90 km/h DS ■ for 60 km/h DS	 100 m 50 m	AGRD Part 3 Table 8.6	

RTC Stations

The vertical geometry requirements for the RTC stations are summarised in Table 3-22.

Table 3-22: Vertical geometry for RTC stations

Item	Value	Reference	Comments
Longitudinal gradient at stations ■ Desirable ■ Maximum	 +0.5% / -0.5% +0.8% / -0.8%	BPDM Section 4.4.2(a)(ii)	Max grades through stations shall be 2% for buses and 0.8% for LRT
Minimum longitudinal gradient ■ desirable minimum for kerbed section ■ absolute minimum	 0.5 % 0.35 %	BPDM Section 4.4.2(b)(iii)	
Vertical geometry at stations	Stations shall be on single gradient	ATLRTDS 2.2.1	Where practical stations should be on crest curves
Desirable proximity of vertical alignment changes to station platform extents	14 m	BPDM Section 4.4.2(ii)	May be reduced to 6 m for LRT as per the ATLRTDS

General Traffic Lanes

Table 3-23: Vertical geometry for general traffic lanes

Item	Value	Reference	Comments
Longitudinal gradient ■ Minimum ■ Maximum	3% 5%	TDM, Engineering Design Code – Road Drainage and Surface Water Control, Section 3 TDM, Engineering Design Code – Urban and Rural Roadway Design Section 5.3	Where topography prevents a 5% grade, max gradient over route length of 8% may be acceptable Maximum gradient with departure may not exceed 16%
Desirable crest curve minimum k values ■ for 80 km/h DS ■ for 60 km/h DS ■ for 50 km/h DS	30 12 7	AGRD Part 3 Table 8.7	Reaction time = 2.0 sec
Desirable sag curve minimum k values (Arterial Roads) ■ for 80 km/h DS ■ for 60 km/h DS ■ for 50 km/h DS	28 16 11	AGRD Part 3 Figure 8.9	Arterial Roads using upper limit of "Other Urban and Rural Roads without streetlighting (Headlight Criteria Govern)"
Desirable sag curve minimum k values (Non- Arterial Roads) ■ for 80 km/h DS ■ for 60 km/h DS ■ for 50 km/h DS	17 10 7	AGRD Part 3 Figure 8.9	Non – Arterial Roads using upper limit of "Other Urban and Rural Roads with streetlighting (Comfort Criteria Govern)"
Minimum length of vertical curve ■ for 80 km/h DS ■ for 60 km/h DS ■ for 50 km/h DS	80 m 50 m 40 m	AGRD Part 3 Table 8.6	Minimum length of crest vertical curve Using the higher end value from the range.

Cycling facilities

The vertical geometry requirements for cycle facilities are summarised in Table 3-24.

Table 3-24: Vertical geometry requirements for cycling facilities

Item	Value	Reference	Comments
Vertical gradient ■ Desirable ■ Maximum	3% 5%	TDM, Engineering Design Code – Cycling Infrastructure, Section 8.2	>5% gradients have maximum lengths, refer to reference for further details
Landings ■ Length ■ Gradient	4 m (min) 2%	TDM, Engineering Design Code – Cycling Infrastructure, Section 8.2, Table 10	To be provided for gradients > 3%

Pedestrian facilities

The vertical geometry requirements for pedestrian facilities are summarised in Table 3-25.

Table 3-25: Vertical geometry requirements for pedestrian facilities

Item	Value	Reference	Comments
Vertical gradient ■ Desirable ■ Maximum	 3% 8%	TDM, Engineering Design Code – Footpaths and public realm, Section 3.4	>3% gradients have maximum lengths, refer to reference for further details

3.3.9 Intersections

Signalised intersections

The dimensional layouts of intersections between mainline carriageways and ramps (e.g. at ramp terminals) shall be designed in accordance with the TCD Manual Part 10 with guidance taken from AGRD Part 4C in respect of all other aspects of ramp terminal design.

Since the A2B project will be proposing a future cycling route along the corridor by providing protected cycle and pedestrian facilities, all signalised intersections are to be protected. These shall be designed in accordance with Section 6.3.1 of the TDM – Engineering Design Code – Cycling Infrastructure. See Figure 3-1.

Some other considerations regarding protected intersections are as follows:



Figure 3-1: Protected intersection example

- Spaces for a protected intersection should not reduce footpath widths below the standards outlined in the Engineering Design Code - Footpaths and public realm.
- Tight corner radii should be used for vehicles. These are to be based on the design and checking vehicles required to make these turns as outlined in Table 3-5.
- The design will use vertical or horizontal deflection to reduce cyclist speed and raise awareness of pedestrians and the crossing facilities.
- The receiving island (between the cycleway and traffic lanes) needs to be able to hold all pedestrians waiting to cross where possible. This creates a shorter crossing distance, gives priority to pedestrians across the cycleway by use of a zebra, and removes cyclists from the signal control for left turn movements.

Refer to Section 4.4.11 for further information on protected intersections along the A2B corridor.

Unsignalised intersection

Where a cycleway and footpath cross an unsignalised side road, a raised crossing is to be provided. Table 3-26 summaries the requirements of a raised crossing in accordance with the TDM – Engineering Design Code – Traffic Calming.

Table 3-26: Raised table dimensions

Item	Value	Reference	Comments
Maximum ramp approach gradient ▪ Non-bus route ▪ Bus route	 1:10 1:20	TDM – Engineering Design Code – Traffic Calming	Bus route is for low-speed zones
Maximum height ▪ Non-bus route ▪ Bus route	 100 mm 75 mm		
Minimum length ▪ Non-bus route ▪ Bus route	 4 m 6 m		Bus route is for low-speed zones. 4m allows a 2m pedestrian and 2 m cycle crossing over the table
Raised table set-back from intersecting road	5 m		Taken from the edge of the outside through-lane to the top of the raised crossing

Refer to Section 0 and Section 3.4.6 for information on the application of raised tables along the A2B corridor.

3.4 Design Development

3.4.1 Design Philosophy

As far as practicable, abortive works shall be minimised by maintaining the geometric alignment of the existing carriageways. It is not the intention of this project to change the risk profile of the road, nor to fix any existing geometric deficiencies, unless specifically stated otherwise.

3.4.2 Design Assumptions

Whilst developing the preferred option, various assumptions have been made based on previous project experiences. The following assumptions have been made in the roadworks elements along the A2B corridor:

- The dedicated bus lanes for the Short-Term Airport Access Improvements (STAAI) works along Puhinui Road and Lambie Drive, as well as Medium Term works planed along Ti Irirangi Drive, will be removed and replaced with the dedicated RTC facility.
- All existing signalised intersections will be retained. This includes all proposed signalised intersections as part of the STAAI works.
- All existing roundabouts will be converted into signalised intersections.
- Existing access to surrounding property will be retained unless otherwise stated.
- Where the RTC is central running, right-turn movements of vehicles approaching from side roads or driveways will be limited to left turn only and will be permitted to make legal U-turns at signalised intersections.
- At signalised intersections where there are two dedicated right-turn lanes, one of the lanes may be removed.
- All existing slip lanes will be removed and replaced with either a left-turn lane or be combined with a through movement lane.
- The RTC is to tie into the concourse level of the proposed Puhinui Interchange early deliverable design where possible.

- At the Puhinui interchange, the clearance from the RTC bridge structure soffit to the rail line and adjacent roads (Kenderdine and Cambridge Terrace) is 6m.
- Cyclists and pedestrians wishing to access the RTC station at Puhinui Interchange can do so using the facilities provided.
- Pedestrians wishing to get from one side of Puhinui Interchange to the other can use the proposed interchange facilities to do so.
- The existing parking lane on the western side of Davies Avenue will be removed.
- Existing parallel parking on Puhinui Road, Lambie Drive and Ronwood Avenue will be removed.

3.4.3 Rapid Transit

The Airport to Botany Concept of Operations (502334-7000-REP-JJ-0020) presents a comprehensive outline of the requirements of the rapid transit corridor and stations. This document should be read in parallel with the Design Philosophy Statement.

3.4.4 Access streets

Access streets are low traffic, low speed environments, where bicycles and pedestrians are prioritised, and cars are deemed as visitors. There is an opportunity for this project to create these streets on the existing parallel access streets along Te Irirangi Drive and through building new bicycle streets along Puhinui Road.

A portion of the A2B route currently functions as a limited access road, presenting the opportunity to create access streets on Puhinui Road and parts of Te Irirangi Drive to provide continuity of infrastructure as well as remove a significant safety hazard of vehicles at speed turning directly off the corridor across cycleways and footpaths into private driveways. Additionally, access streets enable safe bi-directional movements for people on bicycles; and, provide the opportunity to integrate and extend this project's positive impact into the adjacent neighbourhood. Further details into how these can be incorporated along Te Irirangi Drive and Puhinui Road are outlined in the following sections.

Further information on the description, benefits and performance standards of access streets are outlined in the TDM – Engineering Design Code – Cycling Infrastructure.

Te Irirangi Drive parallel side streets

Along Te Irirangi Drive, there is an opportunity to create access streets on the existing low volume parallel side streets, which are outlined in Table 3-3. A summary of how this can be incorporated in these roads include:

- Footpaths along Te Irirangi Drive are to tie into existing footpaths along the parallel side streets. These footpaths will still require quality infrastructure upgrades, particularly at further side street interactions to the bicycle streets.
- Self-evident communicated priority of bicycles on the carriageway using contrasting road material, geometric design features, signage and narrow carriageways. Additionally, posted traffic speeds are proposed to be at 30km/h or lower, providing a safer environment for cyclists (refer to 502334-7000-TEC-KK-0040).
- Bicycle paths will simply connect into and out of these streets, but will be designed so that bikes, scooters and cars will share the access street comfortably and safely.
- Existing parking is to be retained. Parking bays are to be indented so a consistent narrow street width is created over the length.

Some level of intervention will be required to ensure these streets are welcoming and safe for all ages and provide seamless connections with the active mode infrastructure on either side. Currently all the streets off Te Irirangi Drive are made up from similar elements and dimensions and all have a vegetated berm, which provides a buffer from the busy Te Irirangi Drive. It is recommended that consideration be given to closing entrances directly off Te Irirangi Drive onto these streets (as access from the existing street network is

available) or are re-aligned to reduce vehicle entrance speeds and include a threshold treatment to provide clarity around the expectations of different users. Vehicle exits of these streets present a much lower safety issue so the majority of these can remain.

Table 3-27 outlines an assumed treatment for entrances to the side streets from Te Irirangi Drive. It is recommended that this treatment be further considered in later design stages with input from the local community.

Table 3-27: Entrance treatments for parallel side roads along Te Irirangi Drive

Proposed cycle street	Entrance treatment	Commentary
Leixlep Lane	Closed	Alternative access is achievable
Cratloe Lane / Aaronville Way	Closed	Alternative access is achievable
Kellaway Drive	Closed	Alternative access is achievable
Gransna Lane	Retained	Alternative access unachievable
Sheddings Lane	Closed	Alternative access is achievable
Wando Lane	Retained	Alternative access unachievable
Shingleton lane	Closed	Alternative access is achievable
Moravale lane	Closed	Alternative access is achievable
Treneary lane	Closed	Alternative access is achievable
202 – 213 Te Irirangi Drive	Retained	Alternative access unachievable

Table 3-28 outlines an assumed treatment for exits of the side streets onto Te Irirangi Drive.

Table 3-28: Exit treatments for parallel side roads along Te Irirangi Drive

Proposed cycle street	Exit treatment	Commentary
Leixlep Lane	Retain	One-way vehicle movement exists, therefore exit can't be removed.
Cratloe Lane / Aaronville Way	Close	Exit at Cratloe Drive and Aaronville Way intersection to close, as alternative access is achievable.
Kellaway Drive	Close	Alternative access achievable.
Gransna Lane	Retain	Alternative access unachievable.
Sheddings Lane	Retain	One-way vehicle movement, thus, exit can't be removed.
Wando Lane	Retain	Alternative access unachievable.
Shingleton lane	Retain	One-way vehicle movement, thus, exit can't be removed.
Moravale lane	Retain	One-way vehicle movement, thus, exit can't be removed.
Treneary lane	N/A	No existing exit.
202 – 213 Te Irirangi Drive	Retain	Alternative access unachievable.

Puhinui Road and southern section of Te Irirangi Drive

This section outlines an opportunity to create new bicycle streets along Puhinui Road and along the southern section of Te Irirangi Drive, south of Belinda Avenue. These would be one-way vehicle streets and will typically run the length of the block between side streets off Puhinui Road and Te Irirangi Drive. Provision of these will require further consideration in later design phases.

Intervention will be required to ensure these streets are welcoming and safe for all ages and provide seamless connections with the active mode infrastructure on either side. The proposed bicycle streets will therefore require appropriate alignment and entry/exit threshold treatment.

A summary of how bicycle streets can be incorporated along Puhinui Road includes the following:

- Reducing the buffer between the bicycle street and Puhinui Road to 1.3 m.
- The bicycle street will be uni-directional and a minimum of 3.0 m wide (as per local road lane width requirements).
- Footpath will not be buffered from the bicycle street and will be 1.95 m wide (1.8 m through-route and 0.15 m frontage zone) as per footpath design standards.
- Parallel parking will not be permitted on the bicycle streets unless there is sufficient space. These bays would ideally be indented so a consistent narrow street width remains over the length.
- Self-evident communicated priority of bicycles on carriageway using road material, geometric design, signage and posted traffic speeds of 30km/h or lower.
- Bicycle paths will simply connect into and out of these streets, but it will be designed so that bikes, scooters and cars will share the access street comfortably and safely.

3.4.5 Bi-directional cycle lane opportunities

There is an opportunity for the A2B project to implement bi-directional cycle paths along the corridor. These are to be designed in accordance with the TDM – Engineering Design Code – Cycling Infrastructure.

Two-way cycling facilities can pose a safety risk and reduce accessibility. To be suitable, they must provide safety, directness, comfort or attractiveness benefits. Table 3-29 outlines the potential opportunities of implementing bi-directional cycle facilities along the A2B route in various sections.

Table 3-29: Potential Bi-Directional Cycle Facilities along A2B Sections

Section	Bi-directional opportunity considerations	Summary
Te Irirangi Drive (North of Whetstone Road)	▪ This section is predominately a limited access road, with parallel side streets providing vehicle access to adjacent property. ▪ As outlined in Section 3.4.3, the parallel side streets will be converted into bicycle streets, allowing bi-directional movements for cyclists. Bi-directional cycle facilities between bicycle streets will enable continuity for bi-directional flow, increasing safety, directness and attractiveness. ▪ Crossing points to access either side of Te Irirangi Drive are only provided at signalised intersections, with separations of up to 1640 m. If a uni-directional facility is provided, this may result in the potential misuse of the facility as cyclists may head the wrong way down the cycleway as a more direct way to get to where they want to go. Providing a bi-directional facility ensures directness for cyclists and minimises the likelihood of a head-on crash between cyclists, making the facility more attractive and safe. ▪ The additional width required for bi-directional facilities (i.e. a further 2.4 m) will result in the cross-section encroaching into some property which wasn't impacted with a uni-directional facility. Consequently, driving up costs.	Consider uni-directional cycle facilities or bi-directional with bicycle streets

Section	Bi-directional opportunity considerations	Summary
Te Irirangi Drive (South of Whetstone Road)	▪ This section is predominately a high access road with private driveways feeding directly onto Te Irirangi Drive. Thus, cycleways and footpaths cross directly over driveways, with the opportunity of conflict ▪ A bi-directional facility will further increase the number of potential conflicts between cyclists and vehicles, as cyclists will be coming from both directions. This further decrease safety and attractiveness for cyclists. ▪ There is an opportunity here to create bicycle streets to enable safe bi-directional movements for cyclists and avoid conflict between vehicles and cars at driveways which would originally cross the cycleway. Providing bi-directional facilities between the bicycle streets will enable continuity of flow, increasing safety, directness and attractiveness for cyclists.	Consider uni-directional cycle facilities or bi-directional with bicycle streets
Great South Road	▪ This section is predominately a high access road with accessways into commercial properties feeding directly onto Great South Road. These accessways are expected to attract higher vehicle volumes as well as larger vehicles when compared to residential driveways. ▪ Providing bi-directional facilities may not provide additional benefits as it would increase the number of potential conflicts between cyclists and vehicles. ▪ Although bi-directional facilities will provide directness for cyclists, there are crossings points every 150m.	Consider uni-directional cycle facilities
Ronwood Avenue	▪ This section is predominately a high access road with accessways into commercial properties feeding directly onto Great South Road. These accessways are expected to attract higher vehicle volumes as well as larger vehicles when compared to residential driveways. ▪ Providing bi-directional facilities may not provide additional benefits as it would increase the number of potential conflicts between cyclists and vehicles. ▪ Although bi-directional facilities will provide directness for cyclists, there are crossings points at a maximum every 150m.	Consider uni-directional cycle facilities
Davies Avenue	▪ This section has no access to adjacent property on the western side and several vehicle access points to property on the eastern side. Therefore, providing a bi-directional cycling facility on the western side of Davies Avenue will allow an unimpeded free-flowing movement, increasing rider safety and attractiveness. ▪ Removing a cycle facility from the eastern side will increase safety by minimising conflict with vehicles wishing to enter property.	Consider bi-directional cycle facilities on west-side of road
Manukau Station Road	▪ This section has a low number of access points to adjacent property (one on the southern side, 2 on the northern) ▪ The south side property is currently undergoing construction as of the writing of this DPS. The cross-section with uni-directional cycle lanes already impacts the property and further widening may be critical to the site. ▪ Although bi-directional facilities will provide directness for cyclists, there are crossing points located at a maximum every 200m.	Consider uni-directional cycle facilities

Section	Bi-directional opportunity considerations	Summary
Lambie Drive	▪ The section south of Ronwood Ave has minimal access points to adjacent property (Hayman park and Mitre10 / Bunnings), so the need for bi-directional facilities is unlikely to be desired. ▪ The section north of Ronwood Avenue is predominately a high access road with accessways into commercial properties feeding directly onto Great South Road. These accessways are expected to attract higher vehicle volumes as well as larger vehicles when compared to residential driveways. – Providing bi-directional facilities may not provide additional benefits as it would increase the number of potential conflicts between cyclists and vehicles. ▪ The cross-section with uni-directional cycle lanes just fits within property extents, with impacts primarily occurring near intersections. Providing bi-directional facilities will impact all property along Lambie Drive.	Consider uni-directional cycle facilities
Puhinui Road	▪ This section is predominately a high access road with private driveways feeding directly onto Puhinui Road. Thus, cycleways and footpaths cross directly over driveways, with the opportunity of conflict ▪ A bi-directional facility will further increase the number of potential conflicts between cyclists and vehicles, as cyclists will be coming from both directions. This further decreases safety and attractiveness for cyclists. ▪ There is an opportunity here to create bicycle streets to enable safe bi-directional movements for cyclists and avoid conflict between vehicles and cars at driveways which would originally cross the cycleway. Providing bi-directional facilities between the bicycle streets will enable continuity of flow, increasing safety, directness and attractiveness for cyclists.	Consider uni-directional cycle facilities or bi-directional with bicycle streets

3.4.6 Vehicle crossings

Vehicle crossings are to be designed in accordance with Section 6.6 of the TDM – Engineering Design Code – Cycling Infrastructure.

In all instances private driveways are to be designed to show priority for pedestrians and people on bikes on footpaths and cycleways. The driveway needs to be accessible for the design vehicle, but a flat surface of the path or cycleway takes precedent over the smooth or shallow entry for vehicles. In design terms, this means providing:

- A flush surface for the pedestrian and cyclist e.g. the cycleway, footpath etc is to have a flat vertical alignment and the driveway changes grade between road and property boundary.
- A continuous surface e.g. the cycleway, footpath etc. is to be a single, uninterrupted surface, while the driveway material or colour is interrupted. (see below).

Visibility splays must be provided suitable for the operating speed of the cycleway, from a vehicle stopped clear of the cycleway.

On-street parking must be controlled to ensure adequate visibility for vehicles turning into a property.

Vehicle crossings to multiple residential properties may require a speed control measure such as a ramp up to the vehicle crossing at the property boundary in addition to visibility splay.

Commercial driveways

Where possible, without deviating too significantly from the desire line or interrupting sightlines, cycleways and footpaths should be recessed across a vehicle crossing point away from the road so as to allow entering or exiting vehicles to stop between the bikeway and the through road, for safety and capacity benefits. Throughout the majority of the route, a buffer of 1.5m or more is provided. This should provide an adequate set-back from the through road.

3.4.7 Side road treatment

Where a road or large driveway intersects with an A2B mainline road and it is not possible to close access to all movements, a safe pedestrian and cyclist crossing must be provided to ensure safety and continuity of these modes along the A2B route.

For all instances along the corridor, side road treatments shall consist of raised tables and be designed to the criteria outlined in Table 3-26 and in accordance with the TDM – Engineering Design Code – Traffic Calming. Important elements to consider include the following:

- Narrow side street entrances, particularly since access will be left-in left-out and larger vehicles will be allowed to partially cross the centre line, due to infrequent movements (as per the TDM).
- Raised tables are flush with adjacent footpath and cycle-paths. Therefore, full table height is required.
- A 5 m setback from the top of the table to the front face of the kerb/outside lane edge. This allows a car to turn into the street and give-way to the active modes before crossing the table. It also means the vehicle can move completely off the main arterial while giving way.
- Increase curve radii so that the footpath and cycle path gently connect to the table. This means no sharp abrupt curves (i.e. use 15 m radius curves) and low vegetation in the berm, so that good sightlines are retained between bikes, pedestrians and motor vehicles and to maintain the feel of a direct and seamless route.

Where a road intersects with a bicycle street along the A2B corridor, a raised table must also be provided with the same elements outlined above, with the exception that the top of the raised table can be set back only 2-3 m from the edge of the through lane. These streets are low-volume streets, so having the raised table closer to the intersection shouldn't decrease the safety.

3.4.8 Protected Signalised Intersections

As outlined in Section 3.3.9, all signalised intersections must be protected intersections with separated cycle and pedestrian crossings. A typical protected intersection can be seen in Figure 3-2.

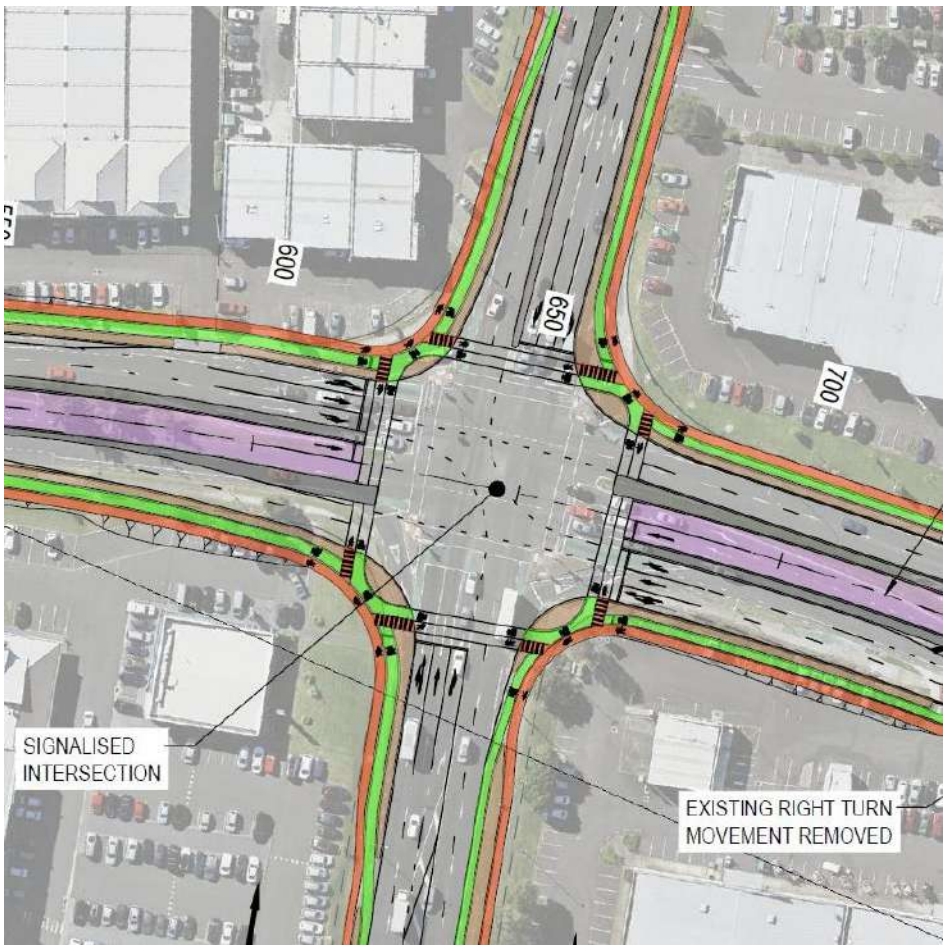


Figure 3-2: Example of a protected intersection along the A2B corridor

Some further considerations for protected intersections are as follows:

- Where a protected intersection is provided, separated cycle and pedestrian facilities must tie into existing facilities at a safe and appropriate location on roads which intersect with the A2B mainline.
- A minimum 2m median must be provided between the approach lanes of the RTC and general traffic to allow for a traffic signal poles.
- A minimum 1.2m median must be provided between the exit lanes of the RTC and general traffic to allow for a road sign.
- Where a pedestrian and cycle crossings distanced at an intersection is too long (i.e. in excess of 30m), the crossing facilities are to be staggered with a median of at least 2.4m provided between crossings.

3.4.9 Midblock Crossings

Provisions for at-grade, walking and cycling mid-block crossings, need to be provided where possible, but particularly where there is an anticipated demand between commercial areas, shops or other desired destinations.

It is acknowledged that an unsignalised facility will not be accessible for everyone in the community, due to the skill and agility needed to use these. However, it is anticipated that in areas where there is a large demand for a highly accessible crossing facility (e.g. outside of schools), adjacent to local bus and RTN stops a signalised crossing will be provided.

Currently along Te Irirangi Drive, there are two grade-separated pedestrian crossings, connecting one side of the road to the other and to enable the proposed cross-section design to be implemented, these bridges will need to be removed. A survey of the existing usage was conducted , and these were found to be not frequently utilised. Given this, a crossing facility of some form is expected to be replaced at these locations, since the next opportunity to cross Te Irirangi Drive range between 600m and 1000m. These crossing facilities could be in the form of an at-grade signalised mid-block crossing or provision of a replacement over pass.

- Where a signalised mid-block crossing is to be provided for cyclists and pedestrians, separate crossings should be provided.
- Pedestrian crossings are to be 2 m wide, while cycle crossings are to be 2 m to 3 m wide according to the movements.
- As a minimum, any existing at-grade midblock crossing along the A2B corridor will be replaced with the same kind of crossing facility or better.

  Where an informal crossing is used, it would be safest where there is a single lane of general vehicle traffic and based on the predicted RTC frequencies should be able to be crossed safely.

3.4.10 U-turn facilities

Since, many side roads intersecting the A2B corridor, it is proposed to restrict right turn movements and be converted into left-in, left-out intersections. Therefore, facilities need to be provided to allow U-turn movements.

Generally, these are proposed to be provided at signalised intersections and will be phased to operate at the same time as right turn movements.

There are also various opportunities throughout the road network for general traffic to drive around the block or to use other residential streets to access signalized intersections to access their desired direction of travel.

3.4.11 Parallel parking

Along the A2B route, opportunities exist to provide parallel parking in some locations, utilising the shoulder and cycleway buffer. As a general principle provision however, on street parking is not a priority for this project

and should only be provided if absolutely necessary. It is recommended that this be assessed following more detailed consultation with the local community.

Taking the land acquisition along Puhinui Road into account, as well as the opportunity for access streets, an opportunity does exist to replace some of the on-street parking that will be affected.

Through the proposed corridor, the design cross section is highly restricted by the existing property boundaries. In order to fit the proposed design cross section, the existing parallel parking cannot be replaced without further property acquisition.

With the introduction of bi-directional cycle lanes along various sections of the corridor, the addition of parallel parking along these cycle lanes does reduce the sight distance from motorist entering property from the general traffic lance into properties. Therefore, parallel parking does pose a safety risk for cyclists, as well as for pedestrians along the route.

The status of existing on street parking is outlined in Table 3-30.

Table 3-30: Parallel parking extents along the A2B route

Road Name	Lane Direction	Number of Parking Bays	Total No. of P- Bays per Road
Puhinui Road From Vision Place to Lambie Drive	Eastbound	55	107
	Westbound	52	
Lambie Drive From Puhinui Road to Manukau Station Road	Northbound	22	62
	Southbound	40	
Manukau Station Road From Lambie Drive to Davies Avenue	Eastbound	14	25
	Westbound	11	
Davies Avenue From Manukau Station Road to Ronwood Avenue	Northbound	20	20
	Southbound	0	
Ronwood Avenue From Davies Avenue to Great South Road	Eastbound	22	44
	Westbound	22	
Great South Road From Ronwood Avenue to Te Irirangi Drive	Both directions	0	0
Te Irirangi Drive side access roads From Great South Road to Ti Rakau Drive	Both directions	0	0
TOTAL NUMBER OF PARKING BAYS			258

3.4.12 Separator widths

In the A2B Project, separators are used to vertically divide bike lanes, general vehicle lanes and RTC lanes from one another as shown in an example in Figure 3-3.

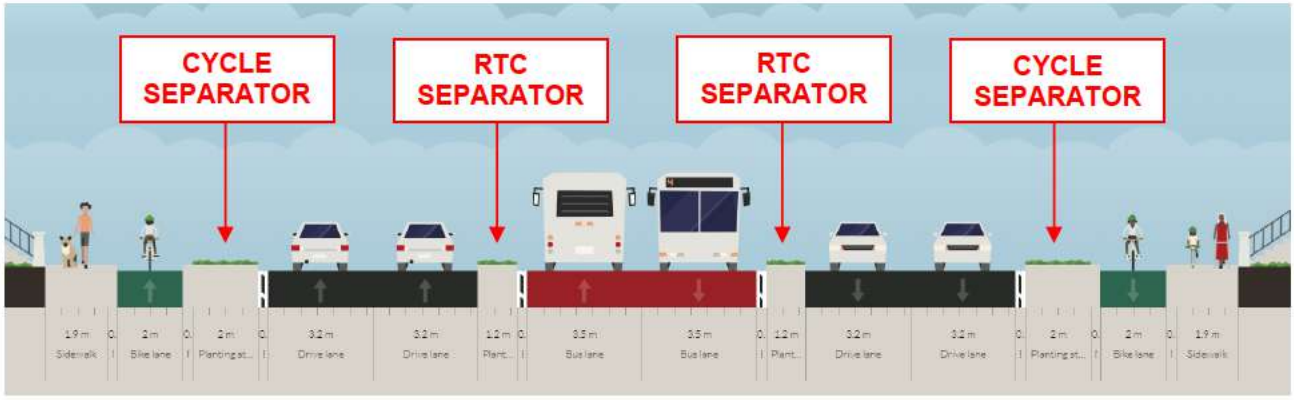


Figure 3-3: Separator example

The separator widths vary throughout the A2B route to provide opportunities for vegetation/ stormwater facilities, allow enough waiting space for pedestrian crossings, minimise property impact and to allow turning lanes to develop at intersections. Widths are measured from back of kerb to back of kerb. Table 3-31 shows the range of widths for each road that the RTC runs down.

Table 3-31: Separator widths along the A2B route

Road Name	Cycle Separator width	RTC separator width
Te Irirangi Drive	0.9m - 1.2m	0.6m – 5.2m
Great South Road	2.0m	0.6m – 5.2m
Ronwood Ave	0.7m - 2.0m	0.6m – 5.2m
Davies Ave	2.0m - 4.5m	2.0m – 5.2m
Manukau Station Road	1.5m	1.2m – 5.2m
Lambie Drive	1.5m	1.2m – 5.2m
Puhinui Road	1.2m - 2.0m	1.2m – 5.2m

3.4.13 RTC station design elements

Minimum design elements for the RTC stations along the preferred route can be found in Section 6.3.1 of report 502334-7000-REP-JJ-0020 Concept of Operations.

3.4.14 Local bus stops

This section outlines further considerations regarding local bus stops in addition to the criteria outlined in Section 3.3.5: Cross-section - Local Bus Stops.

Intersections

Local bus stops are to be provided at all intersections along Te Irirangi Drive, where a RTC station is located. This is to encourage easy transfers between local services and RTC services. Refer to technical note 502334-7000-TEC-RR-0027 for further details.

The intersections where these local bus stops will be provided are as follows:

- Smales Road

- Accent Drive
- Ormiston Road
- Dawson Road
- Diorella Drive

To make the distance from local bus stop to RTC platform as short as possible and to ensure a more seamless transfer between services, local bus stops are to be set 3m back from the edge of the pedestrian crossings on the departure side of intersections. Although the TDM states a 6 m set-back, NACTO guidelines allow for as close as 3 metres which is what A2B is adopting to achieve minimal walking distances.

The following considerations apply for the local bus stops at Smales Road and Ormiston Road, due to the high traffic volumes and lane configurations: (Figure 3-4 has reference.)

- Local bus stops will be fully indented. Because these roads are high volume, four lane, two-way roads, providing an in-line stop will be dangerous as vehicles behind a stopping bus will be forced to weave into the offside lane.
- The approaching left turn lane will allow through movements for buses to enter the bus stop indent
- The indented stop will merge into the departing nearside lane with cycle facilities merging shortly after.

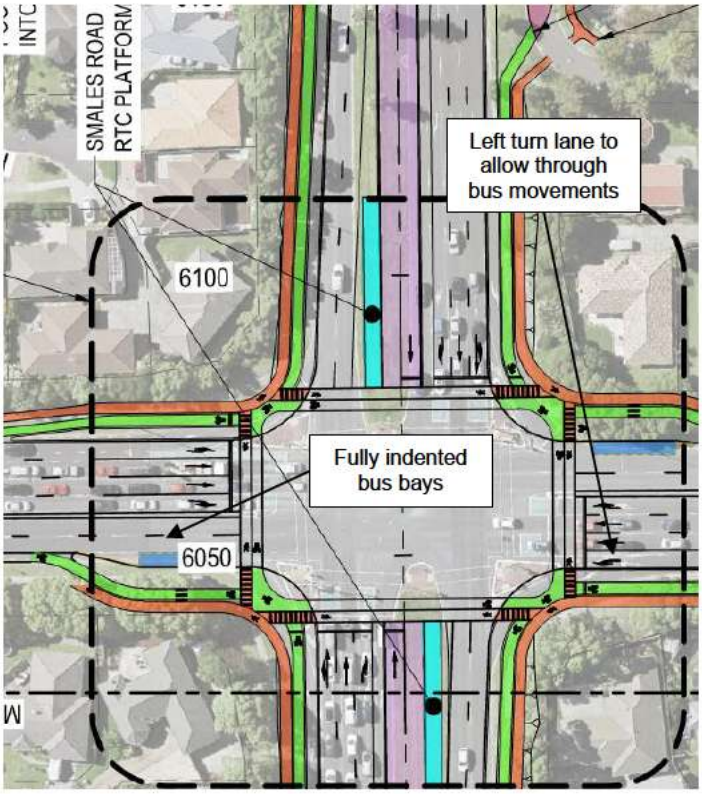


Figure 3-4: Smales Road local bus stop considerations

The following considerations apply for the local bus stops at Accent Drive and Dawson Road due to the high traffic volumes and lane configurations: (Refer to Figure 3-5)

- Currently, there are two lanes on the departure sides of these roads[1] which merge into one. The local bus stops will be placed in-line on the nearside departure lane.
- The nearside approaching through lane will be for buses only. These roads are one lane in each direction currently, so providing one short through lane for buses and another for general traffic on the intersection approach is preferred.

[1] The eastern leg of the Dawson Road interchange currently only has one departure lane, however a second departure lane will be added as part of the A2B project.

- On the departures to the intersections, buses will merge with general traffic.

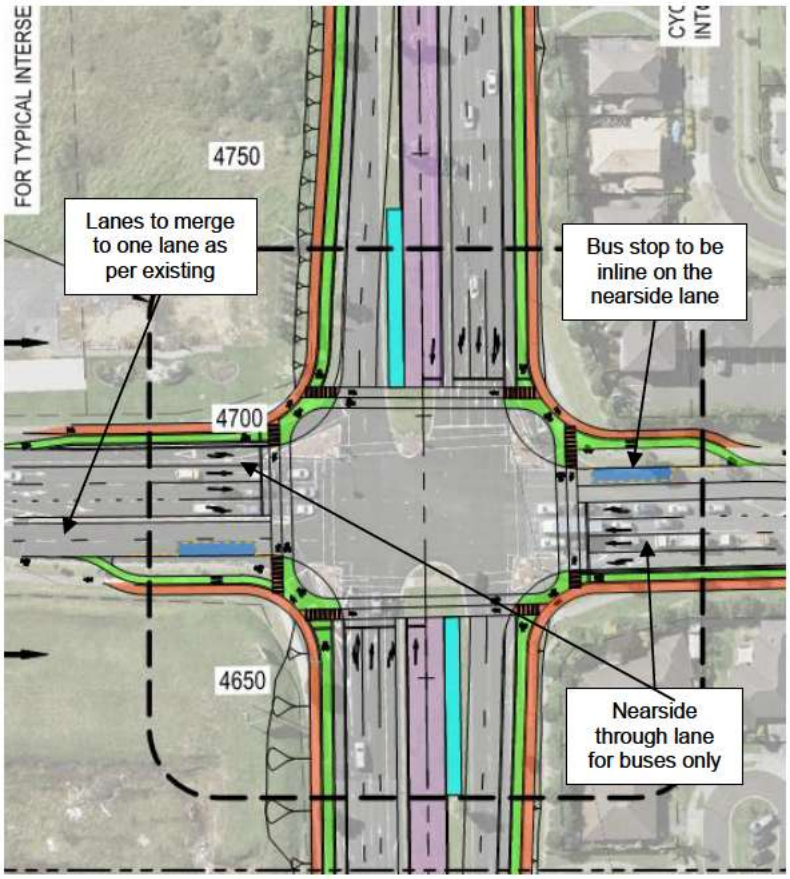


Figure 3-5: Accent Drive local bus stop considerations

Diorella Drive is a two-lane, two-way road. The existing 325 local bus services will require a stop near the RTC station at Diorella Drive intersection, currently traverses along Diorella Drive, eastbound along Te Irirangi Drive before heading down Hollyford Drive and vice versa. There is an opportunity in the future to alter this bus service to continue north through the Manukau Sport Bowl. Because of the uncertainty of the route, both of the local bus stops are currently placed on the south side of the Diorella Drive intersection. The following outlines considerations for the bus stops at Diorella Drive intersection:

- To avoid major impacts on property and due to an anticipated low volume of passengers using the 325 service, a partial island bus stop can be a suitable solution. The TDM Engineering Design Code - Cycling Infrastructure, Section 7 does indicate that using a partial island bus stop will require a departure should this become a definite option in future design phases.
- The existing stops on Te Irirangi Drive (near the Diorella Drive intersection), will be removed and replaced with the stops on Diorella Drive.
- The bus stop on the departure lane will be in-line, but slightly indented so that 3.5m is available for vehicles to pass a stopping bus.
- The bus stop on the departure lane is to be set back approximately 6m from the edge of the pedestrian crossing to account for the radius of the intersection so that the bus stop isn't sitting on a curve.
- The bus stop on the approaching side will be in-line.

Midblock

As per technical note 502334-7000-TEC-KK-0027: Proposed Change to Local Bus Network, there are proposed local bus stops to be placed at two midblock locations along Lambie Drive adjacent to the RTC. Refer to Figure 3-6.

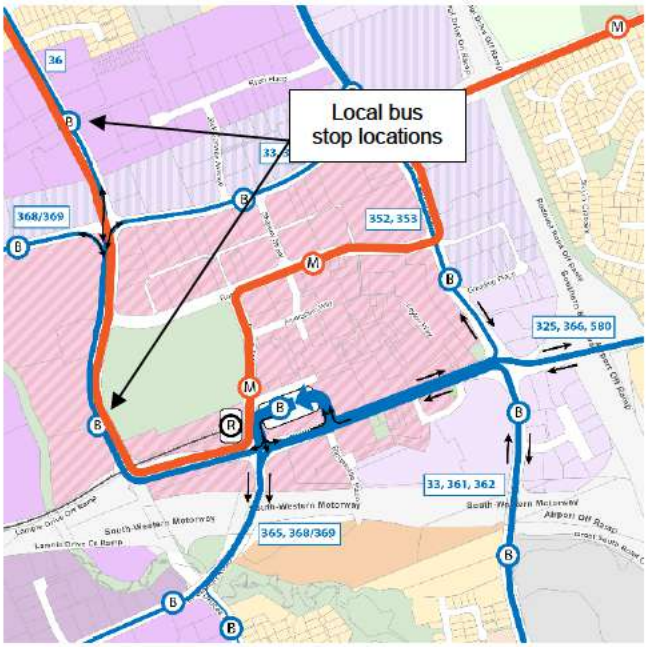


Figure 3-6: Proposed Local Bus Stops along Lambie Drive

The following outlines further considerations for these midblock local bus stops:

- A midblock pedestrian and cycle crossing will be provided where a local bus stop is located. This will be a singular phase crossing for the northern bus stop and a staggered crossing for the southern stop.
- Bus stops are to be located 3m beyond the departure side of the midblock crossing.
- The northern bus stop on Lambie Drive will be inline and indented such that there is a 3m passing space for a vehicle to clear a stopping bus.
- The southern bus stop on Lambie Drive will be inline on the nearside lane. No indentation is required for the bus stop as vehicles behind a stopping bus can pass using the offside lane to pass.

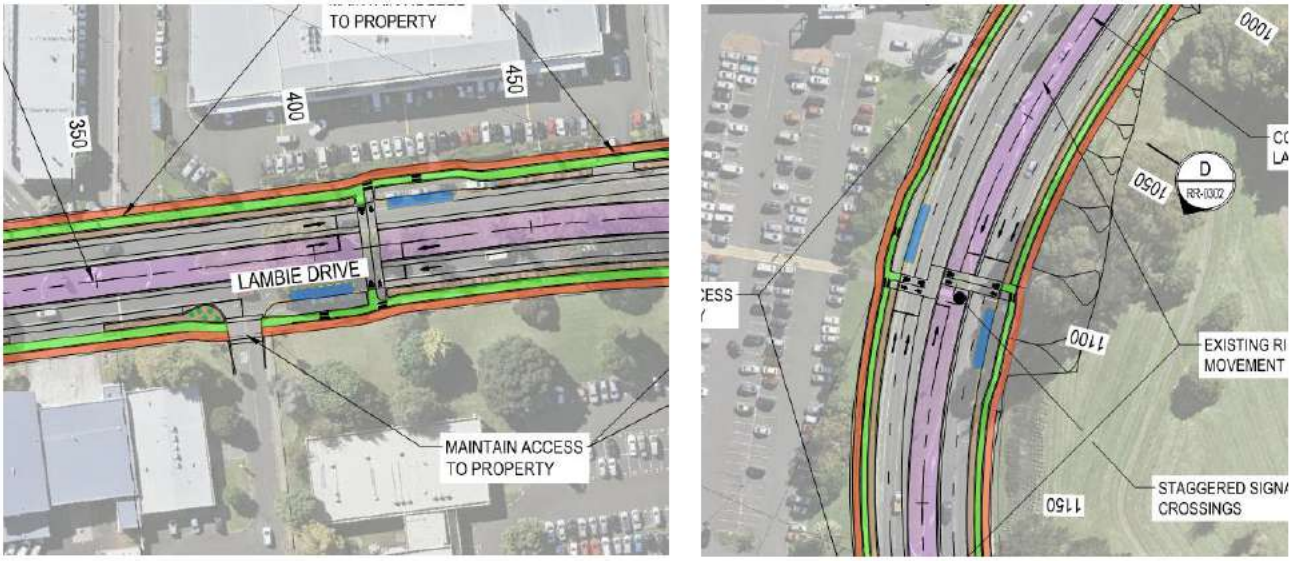


Figure 3-7: Local bus stops along the A2B route

3.4.15 Puhinui Interchange RTC bridge structure

Along Puhinui Road, the RTC is to run in the centre of the road (refer to 502334-7000-TEC-KK-0030) and as outlined in the design assumptions, will tie into the concourse of the Puhinui Interchange early deliverable design at a soffit height, 6 m above the rail line. Additionally, since the RTC is central running, westbound movements from Kenderdine Road to Puhinui Road and eastbound movements from Cambridge Terrace to

Puhinui Road will need to be retained by crossing beneath the RTC structure, also with a clearance of 6m. Therefore, the RTC bridge structure will span from the intersection of Kenderdine Road/Puhinui Road to Cambridge Terrace/Puhinui Road before the ramps to tie back to the exciting road level on Puhinui Road.

Based on discussions with AT, a 5% grade for the RTC ramp is favoured as this satisfies requirements for buses/LRT.

For the ramp on the west-side of Puhinui Interchange, Figure 3-8 displays the location and length of the 5% grade ramp to reach a 6m height above road level and the approximate tie-in point along Puhinui Road.

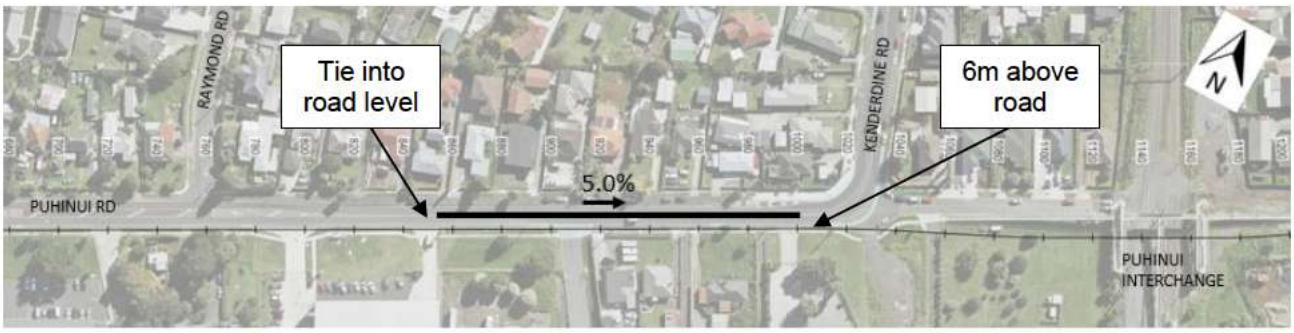


Figure 3-8: RTC ramp length and location on the west side of Puhinui Interchange

For the ramp on the east-side of Puhinui Interchange, Figure 3-9 displays the location and length of the 5% grade ramp to reach a 6m height above road level and the approximate tie-in point along Puhinui Road.

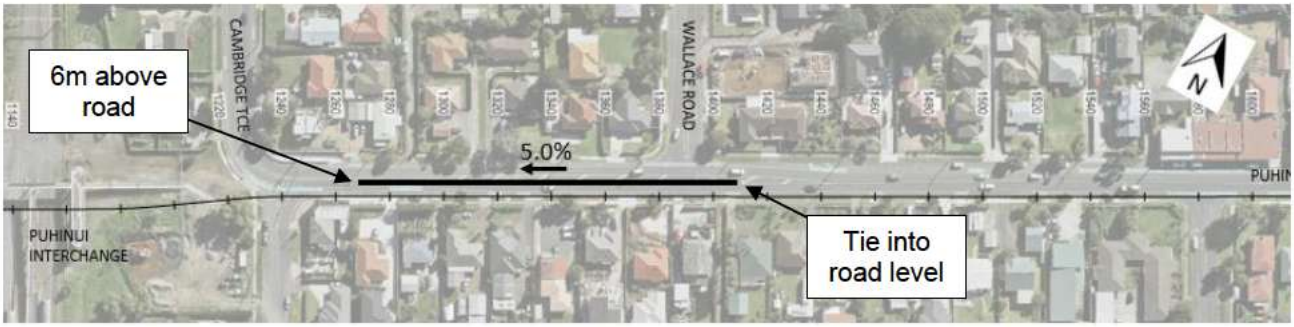


Figure 3-9: RTC ramp length and location on the east side of Puhinui Interchange

3.4.16 Pedestrian and cyclist bypass at Puhinui Interchange

As outlined in Section 3.3.8, a 5% grade ramp will be implemented for the RTC vehicles to tie into the concourse level of Puhinui interchange. This grade does not completely satisfy pedestrian and cycling needs which require a desired longitudinal grade of 3% (without requiring 3m landings). In addition, creating a cycle facility along the RTC ramp, means that cyclists must cross Puhinui Road to reach the base of the ramp disrupting continuity of flow for cyclists. As a result, alternative routes for cyclists and pedestrians wishing to bypass the interchange need to be investigated.

As outlined in the design assumptions, pedestrians wishing to through route, can use the interchange facilities to do so. However, for cyclists, an assessment into the best through routing facility needs to be analysed.

Based on the surrounding environment and constraints, there are 4 options for through routing cyclists to bypass Puhinui interchange. These are summarised in Table 3-32 and Figure 3-10.

Table 3-32: Cycle throughrouting options

Option	Description
Option 1	Cyclists use separated cycle facilities along the existing Kenderdine Road, Bridge Street and Cambridge Terrace roads to bypass the interchange
Option 2	Cyclists bypass the interchange via a separate ramp structure to the RTC bridge structure

Option	Description
Option 3	Cyclists bypass the interchange by running a cycleway on the RTC bridge structure
Option 4	Cyclists utilise the proposed facilities at Puhinui interchange. This will require cyclists getting off their bikes to use lifts/stairs.

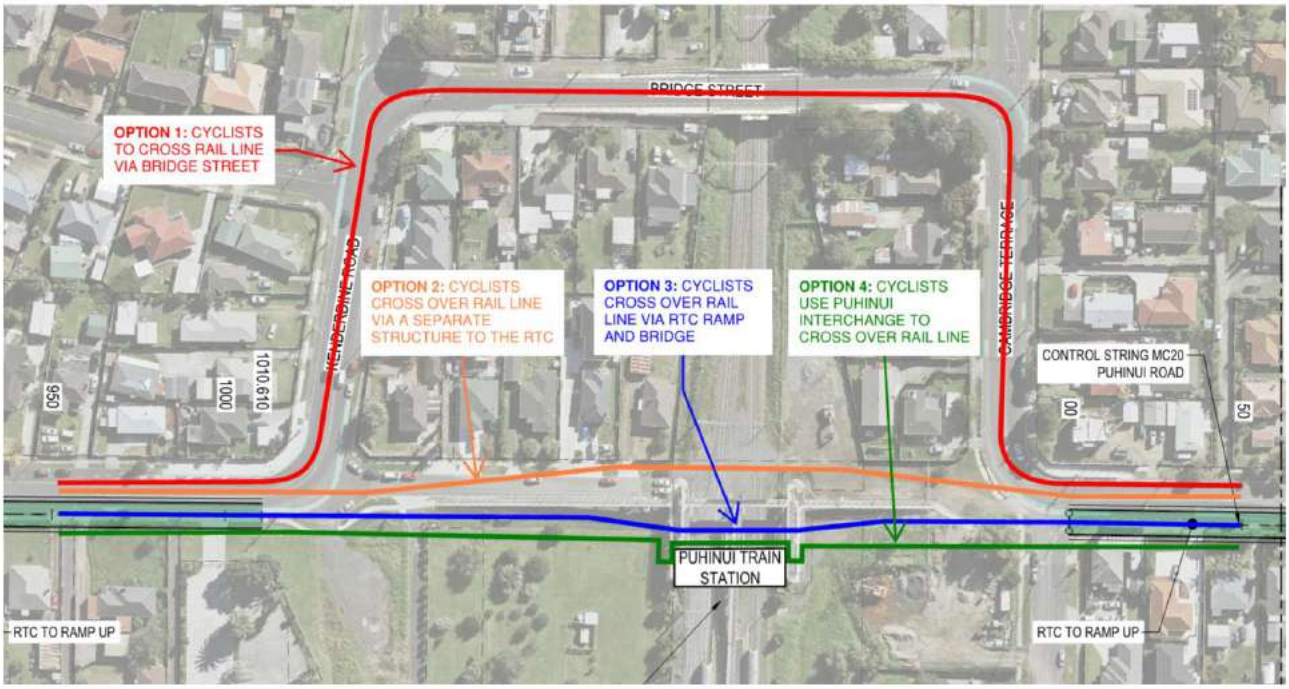


Figure 3-10: Cycle through routing options

A comparison assessment is outlined in Table 3-33.

Table 3-33: Puhinui Interchange cycle bypass options comparison

Option	Positives	Negatives
Option 1	▪ Is consistent with the rest of the A2B corridor ▪ There is sufficient space to provide protected facilities with the exception of the Bridge St bridge. ▪ The bridge on Bridge Street is anticipated to be widened when the third and fourth mainline tracks are being placed along the rail corridor. This creates an opportunity to widen the bridge to accommodate separated cycle facilities. ▪ Is mostly an unimpeded facility with priority given to cyclists	▪ Longest route of all the options (425m) ▪ Current bridge structure on Bridge Street is not wide enough to accommodate separated cycle facilities to the standards outlined in this DPS ▪ Option has the highest interaction with side streets and driveways posing a safety concern
Option 2	▪ Unimpeded separate solution ▪ Lowest number of interactions along the option	▪ A new separate structure is required ▪ Second longest route if ramped (400 m). Providing a compliant gradient would result in bridge being longer than the RTC bridge which would result in a poor visual outcome. ▪ Would require cycleway from one side of Puhinui Road to cross the RTC to access the bridge therefore disrupting cycle movement.

Option	Positives	Negatives
Option 3	▪ Widen RTC bridge structure ▪ Direct connection by bike to A2B route	▪ Constrained gradient of 5%, therefore won't be suitable for all ages and abilities ▪ Cyclists have to cross into the middle of the road to access the cycleway
Option 4	▪ Cheapest option as it uses the facilities that will already be provided for people accessing the interchange	▪ Most inconvenient option regarding wait times and size limits ▪ Cyclists must get off their bikes to get over the interchange ▪ Cyclists must mix in with pedestrians wishing to access the RTN and railway ▪ Pedestrians space and access will be affected by people with bicycles moving through station areas

At this stage Option 1 has been adopted in the business case concept design as this provides a solution consistent with the remainder of the project therefore avoiding the need for cyclists to cross the RTN and provides acceptable cyclist grades. Further consideration should be made in the next design stage once more clarity on timing of the Bridge Street upgrade (associated with NIMT widening) is available.

Further consideration should be given to paid / unpaid areas and pedestrian through-routing through the station / RTN overbridge in the future stages of design.

3.4.17 Sight distance at Pedestrian Crossing on Puhinui Road

The stopping sight distance to a pedestrian crossing at Ch 680m on Puhinui Road are below the required standards when travelling from both directions. This midblock crossing is proposed to be unsignalized and pose a safety risk for pedestrians and cycles using the facility.

It was proposed through the Road Safety Audit that a regrade of over the affected length of Puhinui Road need to be investigated to increase the sight distance. As part of this investigation, the effects on property access and constructability also needs to be considered.

Required sight distances were determined using the design criteria listed in Section 3.3.6: Sight Distance.

A summary of the design criteria and required stopping sight distance are is outlined below:

- Sight distance for a driver in a light motor vehicle:
  - Design speed = 50km/h, d = 0.36, R_T=2.0s
  - Required Sight Distance = 55.0m
- Sight distance for a driver in a bus or truck:
  - Design speed = 50km/h, d = 0.29, R_T=2.0s
  - Required Sight Distance = 62.0m

The actual sight distances were checked from a driver perspective and from a pedestrian perspective for both the base case scenario and for the proposed regrading scenario.

The regraded scenario can be depicted on Drawing no's. 502334-7000-DRG-RR-0201 to 0202: Preferred Option Plan and Long Section.

The regarding option starts at Ch 380 and ends at Ch 888.

- Actual Sight Distance from pedestrian crossing:

- Pedestrian eye height: 1.05m
- Object target height (Car) : 1.25m
- Object target height (Bus/Truck) : 2.5m

Table 3-34 : Pedestrian crossing Sight Distance

Description	Required SD (m)	Actual SD Looking West (m)	Check	Actual SD Looking East (m)	Check
Original Vertical Design					
Actual Sight Distance for a spotting a Car	55	>150	OK	>150	OK
Actual Sight Distance for a spotting Bus or Truck	62	>150	OK	>150	OK
Regraded Vertical Design					
Actual Sight Distance for a spotting a Car	55	>150	OK	>150	OK
Actual Sight Distance for a spotting Bus or Truck	62	>150	OK	>150	OK

The table above illustrate that there is sufficient sight distance for a pedestrian to see oncoming vehicles from both sides based on the original vertical design, as well as the regraded vertical design option.

The horizontal alignment for Puhinui Road though this section is straight and therefore horizontal sight distance is not in question.

- Actual Sight Distance from vehicle perspective :
  - Driver eye height (Car) : 1.1m
  - Driver eye height (Bus/Truck) : 2.1m
  - Object Target Height (Road Surface) : 0.0m

Table 3-35 : Driver Sight Distance

Description	Required SD (m)	Actual SD Driving towards the West (m)	Check	Actual SD Driving towards the East (m)	Check
Original Vertical Design					
Actual Sight Distance for a Car Driver	55	49	FAIL	155	OK
Actual Sight Distance for a Bus or Truck Driver	62	68	OK	185	OK
Regraded Vertical Design					
Actual Sight Distance for a Car Driver	55	98	OK	128	OK
Actual Sight Distance for a Bus or Truck Driver	62	>150	OK	166	OK

One of the main focus points of the regrade option was to shift the crest curve to a position for the pedestrian crossing to be on the highest point. This could be achieved and the from the table above, it is evident that regrade option increases the sight distance by almost double in some instances.

From a mass earthworks perspective, the maximum fill is approximately 1m high and the maximum cut is approximately 0.6m deep. The largest part of the earthworks is between Ch 500 and Ch 850. The realignment would also likely require additional pavement construction

The majority of the properties along the regrade section will either be acquired as part of the Puhinui Road widening and the remaining structure on the properties appear to be set back far enough from the new road edge to provide an acceptable access from the amended road levels.

It is recommended that further consideration be given to regrading this segment of Puhinui Road in later design phases. A risk allowance has been included within the cost estimate related to this decision.

3.4.18 South section of Davies Avenue

The design for this segment was developed in collaboration with Panuku and Auckland Transport. The following design features for Davies Avenue were adopted:

- At the Davies Avenue and Putney Way intersection, a shared space area is proposed. This facility is proposed to create a free-flowing connection for pedestrians between Manukau Train Station, Manukau Bus Station and Manukau RTC Station. RTC vehicles and a bi-directional cycle path will retain their dedicated lanes through the shared space, but pedestrians will be able to cross over these lanes wherever they wish within the space.
- The southern section of Davies Avenue between Putney Way and Manukau station road will be closed off for general traffic. With this, the following will be adopted:
  - Buses entering Manukau Bus Station will only be allowed to enter via the Osterley Way access point.
  - Buses exiting Manukau Bus Station will only be allowed to exit via Davies Avenue and will be forced south to enter back into the road network at the Manukau Station Road intersection.
  - General traffic On Davies Ave will be diverted down Putney Way

  These changes to local bus circulation are further discussed in the Local Bus Technical Note.

  It must also be noted that the operation speed for both the RTC vehicles and general traffic may not exceed 30km/h through the entire length of Davies Avenue.

3.4.19 Design Departures

A2B is likely to require departures from standards to facilitate improvements necessary to meet the project's design objectives within constrained environments. Departures from standards will be avoided or minimised where possible and existing non-conformances will be rectified, where practicable. A summary of the departures that may be required are provided in Table 3-36.

For the full list of departures and further details refer to the Departure Forms in Appendix I.

Table 3-36: Design departures summary

Dep. No.	Location	Description	Required standard	Status
D-0001	RTC (Project wide)	Proposed reduction in shoulder width within the RTC for the entire A2B route	0.0m	Open
D-0002	Te Irirangi Drive (Ch. 2251.99 – Ch. 2496.78)	Proposed grade length more than maximum grade length for footpath because of existing topography constraint	3.38%	Open
D-0003	General Traffic Lane (Project wide) except Davies Ave and Manukau Station Road	Proposed reduction of general traffic lane for Frequent Transit Network (FTN) bus route and freight route.	3.2 m	Open

4 Stormwater and Hydrology

4.1 Introduction

The Auckland Airport to Botany (A2B) project is a transportation project proposed by Auckland Transport (AT) to improve the multi model transportation options between the Auckland International Airport and the Botany region.

The project is located primarily within the Puhinui Creek and Otara Creek/Flat Bush stormwater catchments, and partially intersects the adjacent Pakuranga Creek catchment. This report aims to provide the reader with the following information

- An overview of the existing environment;
- The design standards, criteria and philosophy used;
- A concept level stormwater management design for the A2B project including how the new road corridor drainage will be integrated into the existing stormwater systems.; and;
- Make recommendations for future design phases of the project.

This report is to be read in conjunction with the A2B Stormwater layout plans (Refer Appendix K). Stormwater drainage features are presented with respect to the road corridor chainages, starting at Puhinui Road (at the junction with State Highway 20 (SH20)) running east through to Manukau city, and then north along Te Irirangi Drive where the project terminates at Botany town centre.

4.2 Existing Environment

The following sections aim to provide an overview of the existing environment of which the A2B project is proposed to pass through.

4.2.1 Stormwater Catchment Descriptions

The project passes through three Auckland Council stormwater catchments. These are summarised in Table 4-1, below.

Table 4-1: Stormwater Catchment Areas (sourced from Auckland Council GeoMaps)

CATCHMENT NAME	CATCHMENT RECEIVING ENVIRONMENT	CATCHMENT AREA (ha)
Puhinui Creek	Manukau Harbour	2,964
Otara Creek/Flat Bush	Tamaki River	3,477
Pakuranga Creek	Tamaki River	2,918

Puhinui Creek Catchment

The Puhinui Creek stormwater catchment is 2,964 ha in area. It's located in southern Auckland with both the South-Western (SH20) motorway and the Southern State Highway 1 (SH1) motorways passing through it. The catchment is comprised of four suburbs: Puhinui, Manukau, Wiri and Homai. The catchment neighbours the Pukaki-Waokauri stormwater catchment to the west; Waimahia Creek catchment to the south-east; and Papakura Creek catchment to the east. The Manukau Harbour is to the west and south-west of the catchment.

Key sites within Puhinui catchment include various rail lines and associated train stations, as well as the Manukau CBD and Hayman Park in central-north of the catchment. The Auckland Botanic Gardens/Totora Park are located to the east, and in the south-west, there is the Puhinui Reserve.

Otara Creek/Flat Bush Catchment

The Otara Creek/Flat Bush stormwater catchment is 3,477 ha in area, and the suburbs within this area include Otara, Flat Bush and South-East Tamaki. The catchment is bounded by Puhunui Creek and Papakura Stream catchments in the south; the Papatoetoe–Tamaki River catchment to the west; Turanga Creek to the east, and bounded by Redoubt Road; Pakuranga Creek and Mangemangeroa Creek to the north.

Key sites within Otara catchment include the Southern SH1 motorway in the west, the Otara town centre, Barry Curtis Park in the centre of the catchment, and the Murphys Bush Reserve in the south-centre.

Pakuranga Creek Catchment

The Pakuranga Creek stormwater catchment is 2,918 ha in area. It contains the suburbs of: North-East Tamaki, East Tamaki Heights, Botany, Botany Downs, Pakuranga Heights and Highland Park. The Pakuranga catchment neighbours the Otara Creek/Flat Bush catchment to the south; Mangeomangeroa Creek to the east, the Pakuranga-Tamaki River catchment to the north-west and the Cockle Bay stormwater catchment to the north-east.

Key sites within Pakuranga catchment include Botany town centre in the south, and Lloyd Elsmore Park in the central-north of the catchment.

Figure 4-1 shows an overview of the three project stormwater catchment areas.

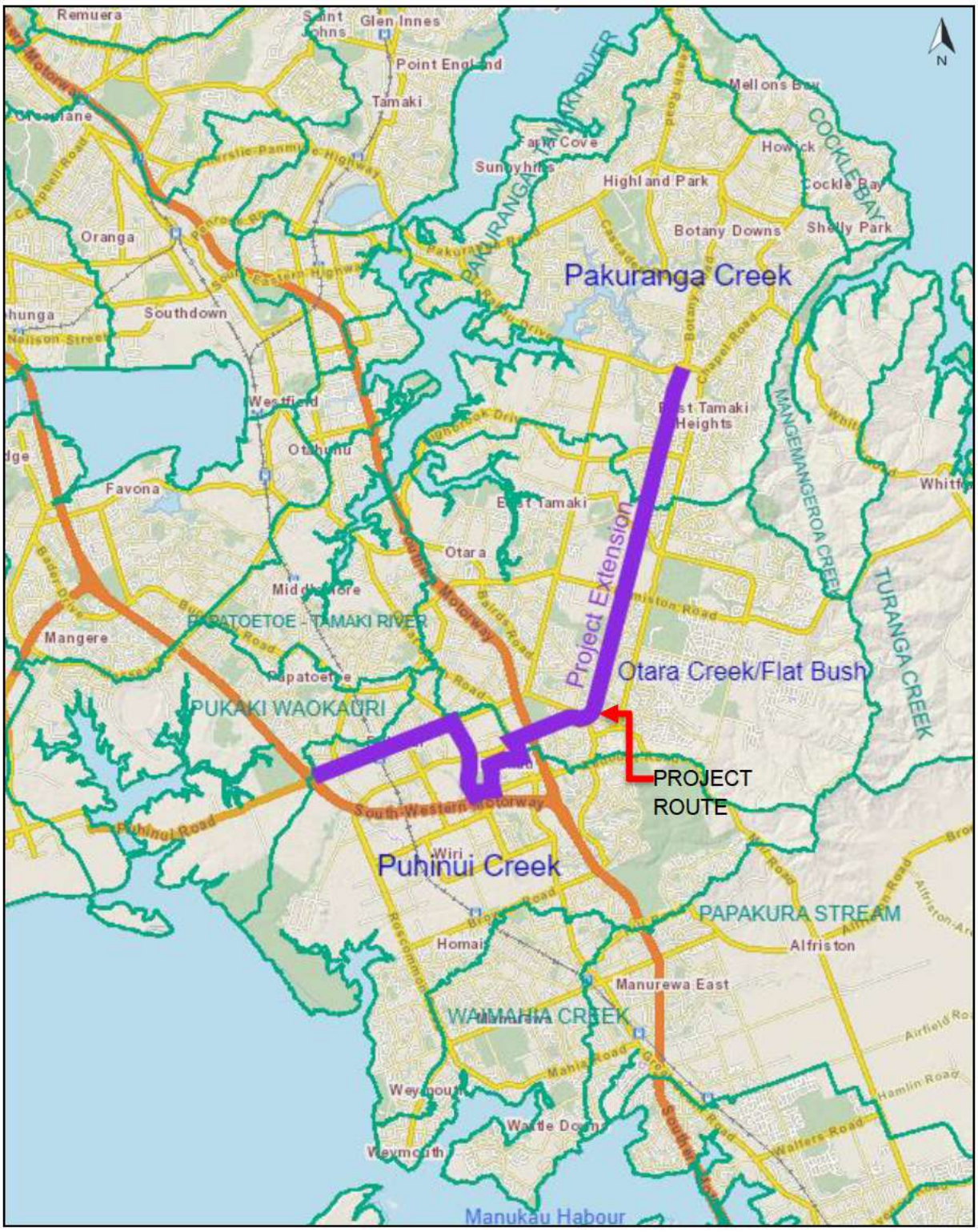


Figure 4-1: Airport to Botany Stormwater Catchments (Source: Auckland Council Geomaps)

4.2.2 Stormwater Catchment Topography

Puhinui Creek Catchment

Ground levels in the Puhinui Creek catchment range from about 170 mRL at the intersection with Otara Creek/Flat Bush and Papakura Stream to the east, down to sea level along the Puhinui Creek in the south-west, as depicted in Figure 4-2. The central area of the catchment is relatively flat with an altitude around 25 mRL. Steeper terrain is found in the east within the Totara Park.

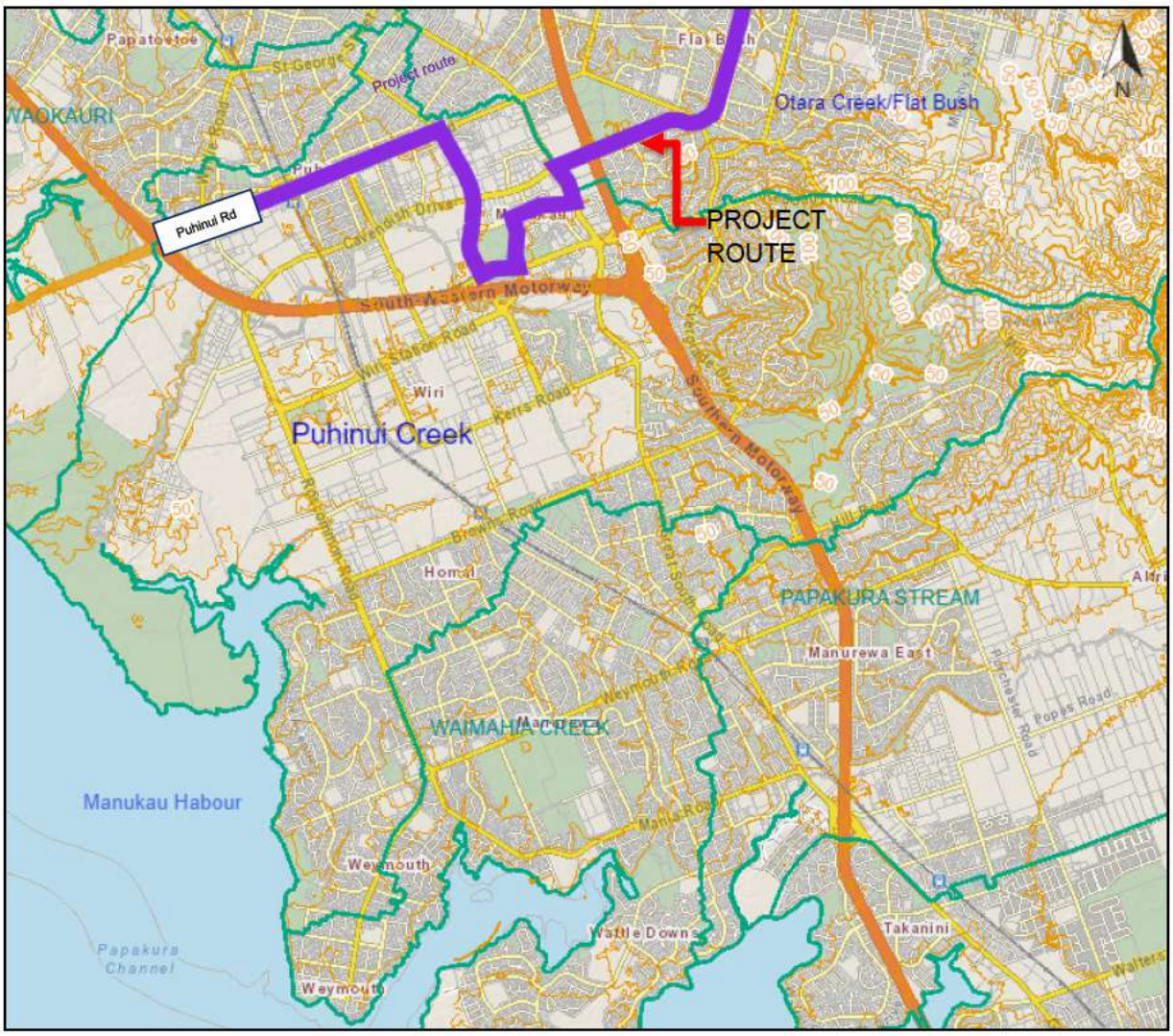


Figure 4-2: Puhinui Creek Catchment Topography (Source: Auckland Council GeoMaps)

Otara Creek/Flat Bush Catchment

Topography in the Otara Creek / Flat Bush catchment ranges from about 180 mRL in the south boundary with the Papakura Stream and Turanga Creek catchments, down to sea level along the Otara Creek to the north-west, as shown in Figure 4-3. Significant slopes are also found in localised areas adjacent to natural watercourse. The catchment is predominantly flat although some localised areas of steeper ground are found, particularly adjacent to natural watercourses.

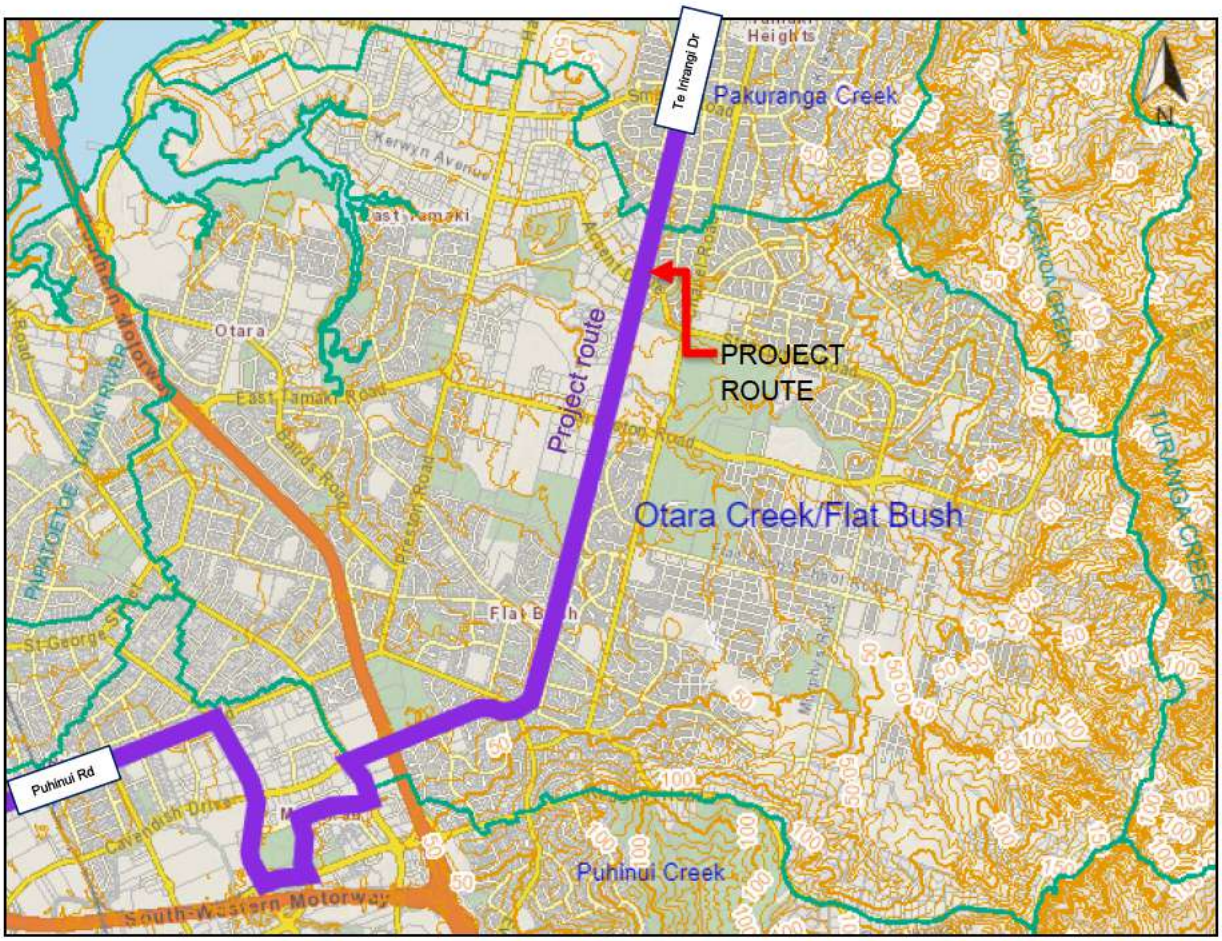


Figure 4-3: Otarai Creek/Flat Bush Catchment Topography (Source: Auckland Council GeoMaps)

Pakuranga Creek Catchment

Topography in the Pakuranga catchment ranges from about 135 mRL at the intersection with Otara Creek/Flat Bush and Mangemangeroa Creek catchments to the south, down to sea level along the Pakuranga Creek in the south-west, as presented in Figure 4-4. The terrain of the catchment is typically uneven, with a flatter area in the south-west adjacent to the watercourse and in the central-north area containing the Lloyd Elsmore Park.



Figure 4-4: Pakuranga Creek Catchment Topography (Source: Auckland Council GeoMaps)

4.2.3 Existing and Future Land Use

Puhinui Creek Catchment

Currently land in Puhinui Creek catchment (refer) is predominantly zoned for industrial/commercial use, with many commercial buildings situated in the vicinity of the SH20 motorway. Some residential land use can be found in the eastern and southern parts of the catchment.

Future land use has been defined by the latest Unitary Plan, and this document proposes a Business zone in Wiri area, including areas of 'Light Industry Zone', 'Heavy Industry Zone' and 'Metropolitan Centre Zone'. The existing residential zones would remain. Other zones within the catchment are designated as 'Open space areas'. That includes the Puhinui Reserve, defined as a 'Conservation Zone' and Totara Park, defined as an 'Informal Recreation Zone'.

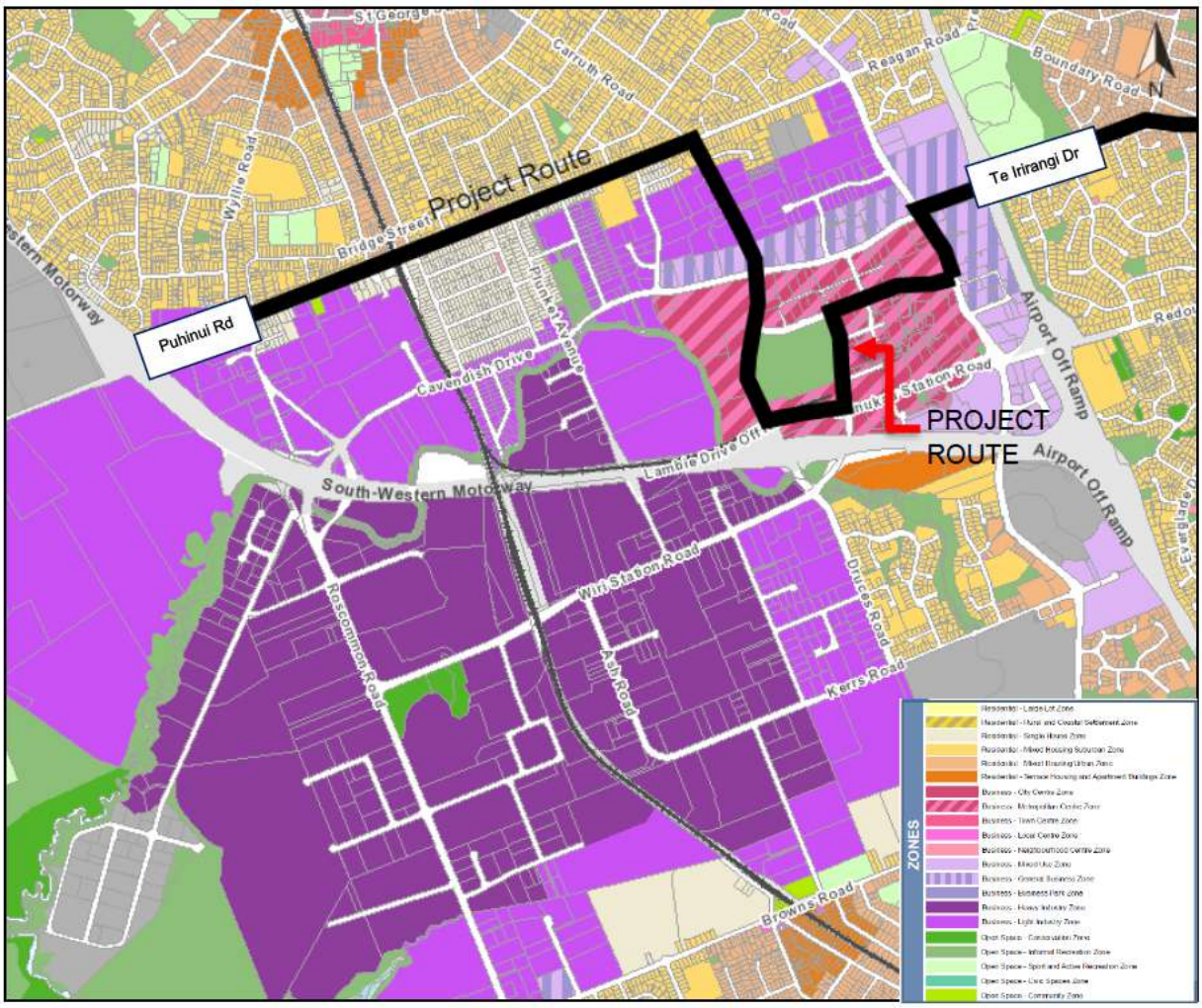


Figure 4-5: Puhinui Creek Catchment Future Land Use (Source: Auckland Council Unitary Plan GeoMaps)

Otara Creek/Flat Bush Catchment

The Otara Creek / Flat Bush catchment currently has a diversified land use (refer to Figure 4-6Figure 4-6). A large commercial zone is found in South-East Tamaki, with residential areas in Otara and Flat Bush. West of Redoubt Road is zoned rural. Various green spaces are found around the catchment.

Future land use as defined by the latest Unitary Plan proposes a business zone in East Tamaki area, separated into 'Light Industry Zone' and 'Heavy Industry Zone', with a 'Metropolitan Centre Zone' proposed at the intersection of Ti Rakau Drive, Chapel Road and Te Irirangi Drive. An area adjacent to Barry Curtis Park is shown as a 'Town Centre Zone. The remaining area of Barry Curtis Park is classified as Open Space 'Informal Recreation Zone' and 'Sport and Active Recreation Zone'.

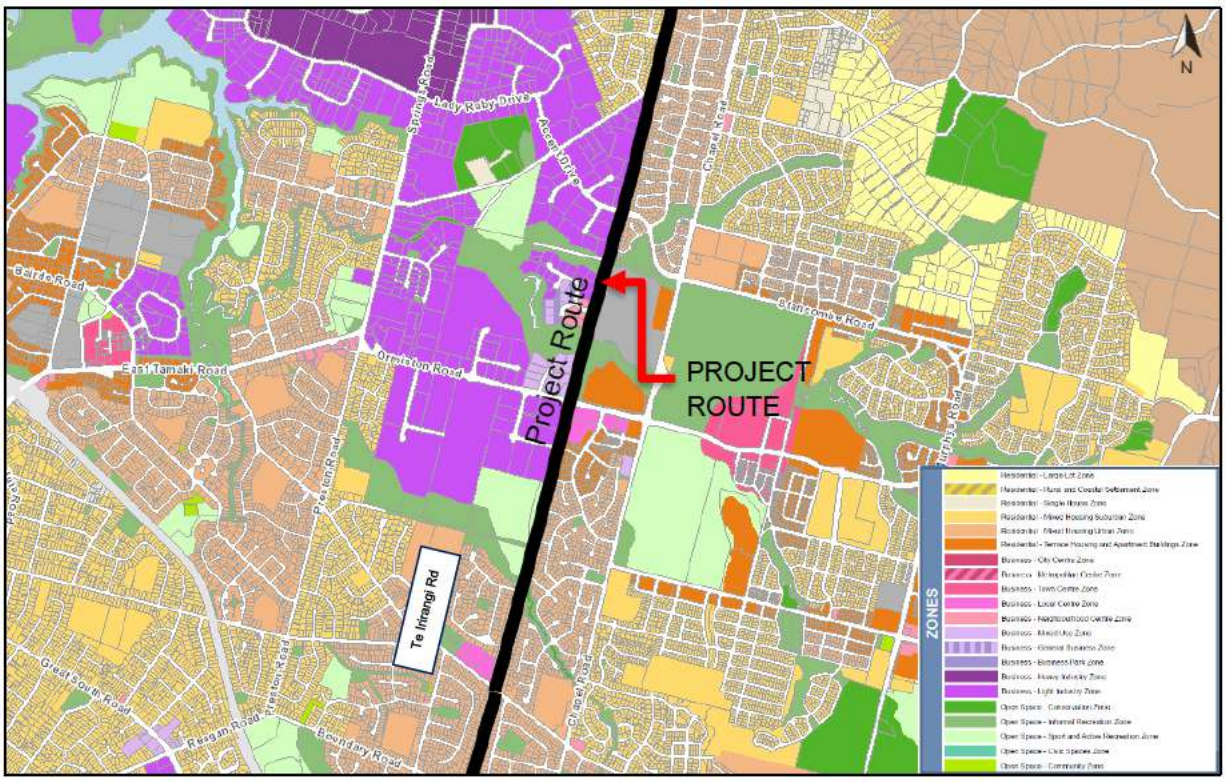


Figure 4-6: Otara Creek/Flat Bush Catchment Future Land Use (Source: Auckland Council Unitary Plan GeoMaps)

Pakuranga Creek Catchment

Current land use in Pakuranga (Refer to Figure 4-7Figure 4-7) is predominantly residential, with the north East Tamaki area being the only commercial zone.

The projected future land use for the catchment area, similar to Otara catchment, is a 'Light Industry Zone' and 'Heavy Industry Zone' business zone in north East Tamaki, with some 'Mixed use zone' around the town centre zones. The Lloyd Elsmore Park is predicting to be an 'Informal Recreation Zone' and 'Sport and Active Recreation Zone'. The remaining areas are classified as residential.

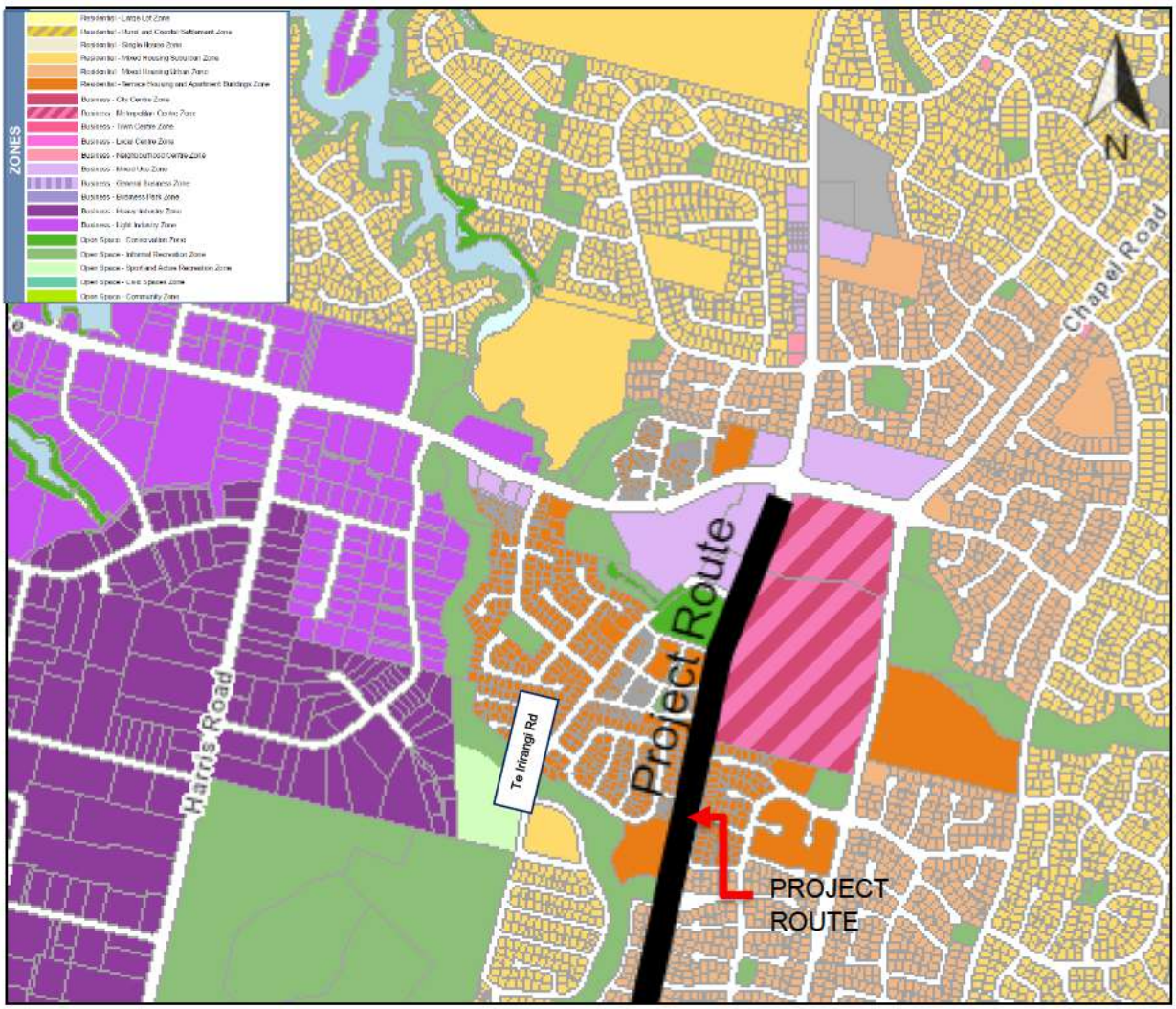


Figure 4-7: Pakuranga Creek Catchment Future Land Use (Source: Auckland Council Unitary Plan GeoMaps)

4.2.4 Existing Catchment Stormwater Drainage

Puhinui Creek Catchment

Due to the heavily urbanised nature of the land, the Puhinui Creek catchment is largely reliant on the stormwater drainage (pipe) network to convey flows to the Manukau Harbour from local residential and commercial properties. The Puhinui Stream is the largest open watercourse in the catchment receiving most of the catchment runoff, except for a small number of watercourses located in the south west of the catchment coastal region (refer to Figure 4-8). In the Manukau CBD area of the catchment, where it is highly urbanised with commercial developments, there are a series of wetlands/ponds that provide limited water quality treatment and storage to stormwater runoff from SH20 and many of the local commercial developments.

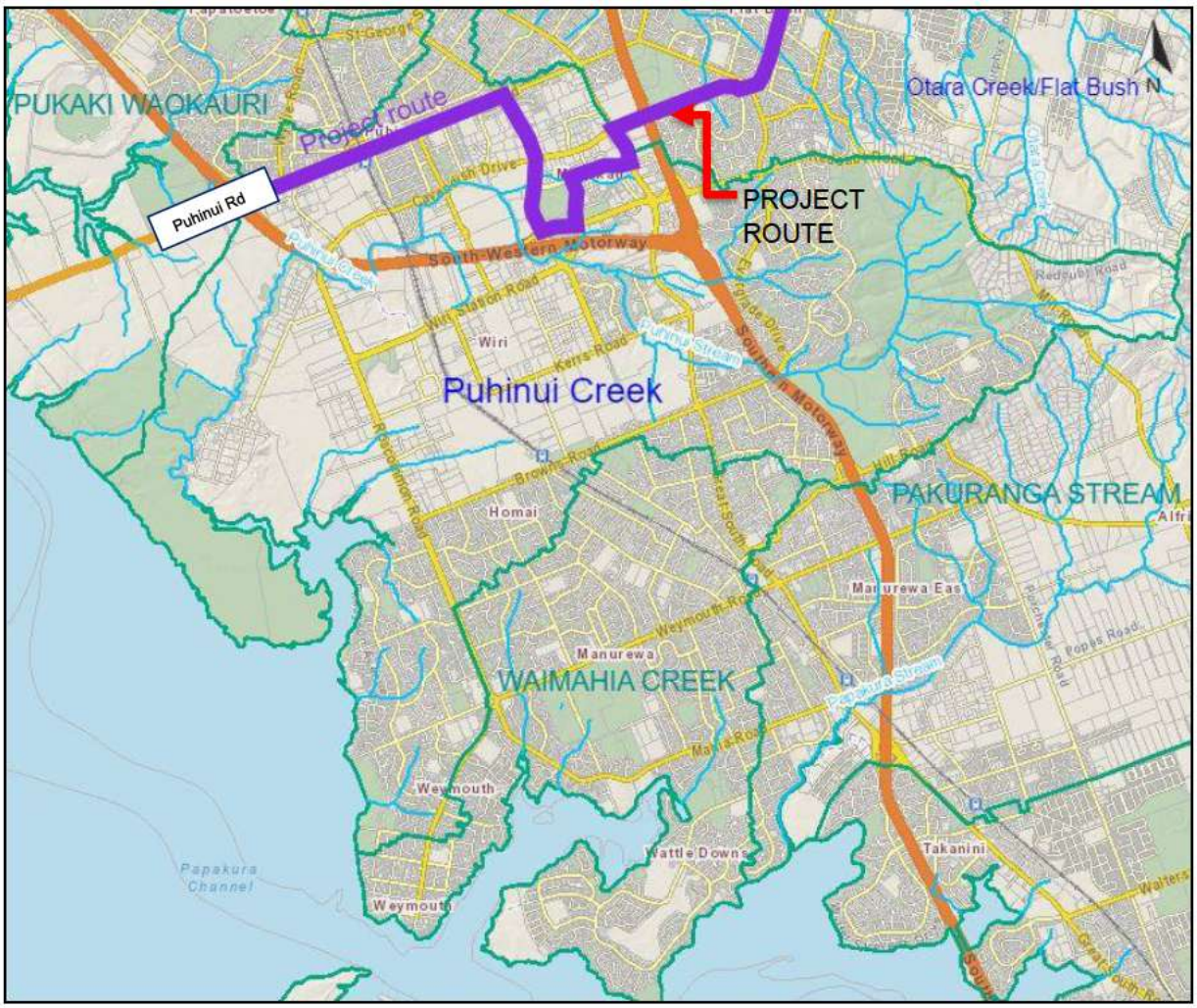


Figure 4-8: Puhinui Creek Catchment Watercourses (Source: Auckland Council Unitary Plan GeoMaps)

Otara Creek/Flat Bush Catchment

Due to the heavily urbanised nature of the Otara catchment the area is largely reliant on the stormwater drainage pipe network to convey flows to Tamaki River from local residential and commercial developments.

The Otara Creek is the largest watercourse in the catchment receiving most of the catchment runoff. This is fed by a number of smaller contributory watercourses, that cross Te Irirangi Drive in a number of locations, as shown in Figure 4-9. In the central catchment alongside Te Irirangi Drive there are a series of ponds that provide limited water quality treatment and storage to runoff from Te Irirangi Drive and some of the local area.

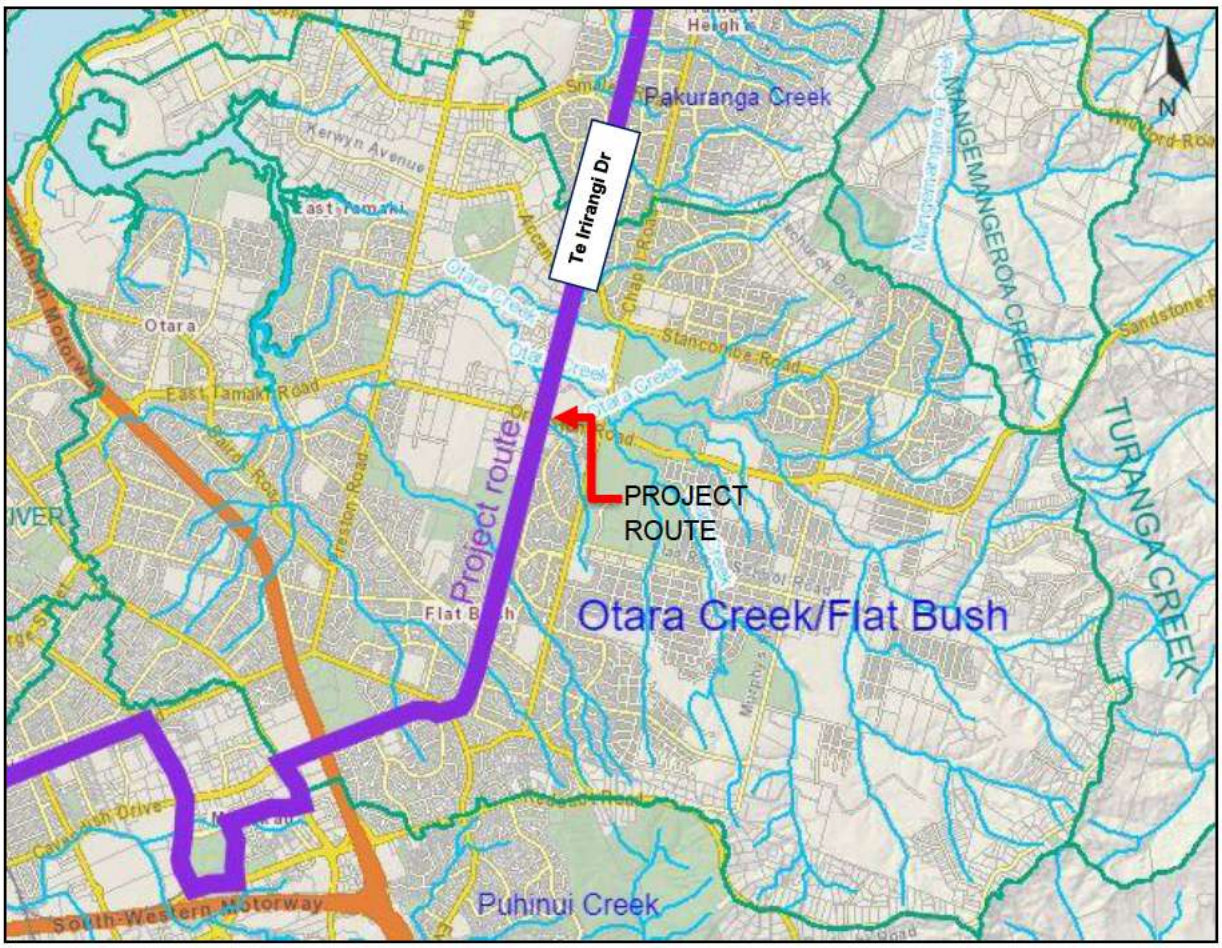


Figure 4-9: Otara Creek/Flat Bush Catchment Watercourses (Source: Auckland Council Unitary Plan GeoMaps)

Pakuranga Creek Catchment

Similar to Otara Creek catchment, the Pakuranga Creek catchment is reliant on the piped stormwater drainage network to convey flows to Tamaki River from local residential and commercial properties. Botany Creek is the largest watercourse in the catchment, receiving runoff from approximately 565 ha of sub-catchments in the north-eastern portion of Pakuranga Creek; followed by Pakuranga Creek that receives a runoff from approximately 400 ha, in the north-west. A sequence of wetlands / ponds is found in the southern portion of the catchment and provides some water quality treatment and storage to runoff from Te Irirangi Drive and local properties, as shown in Figure 4-10.

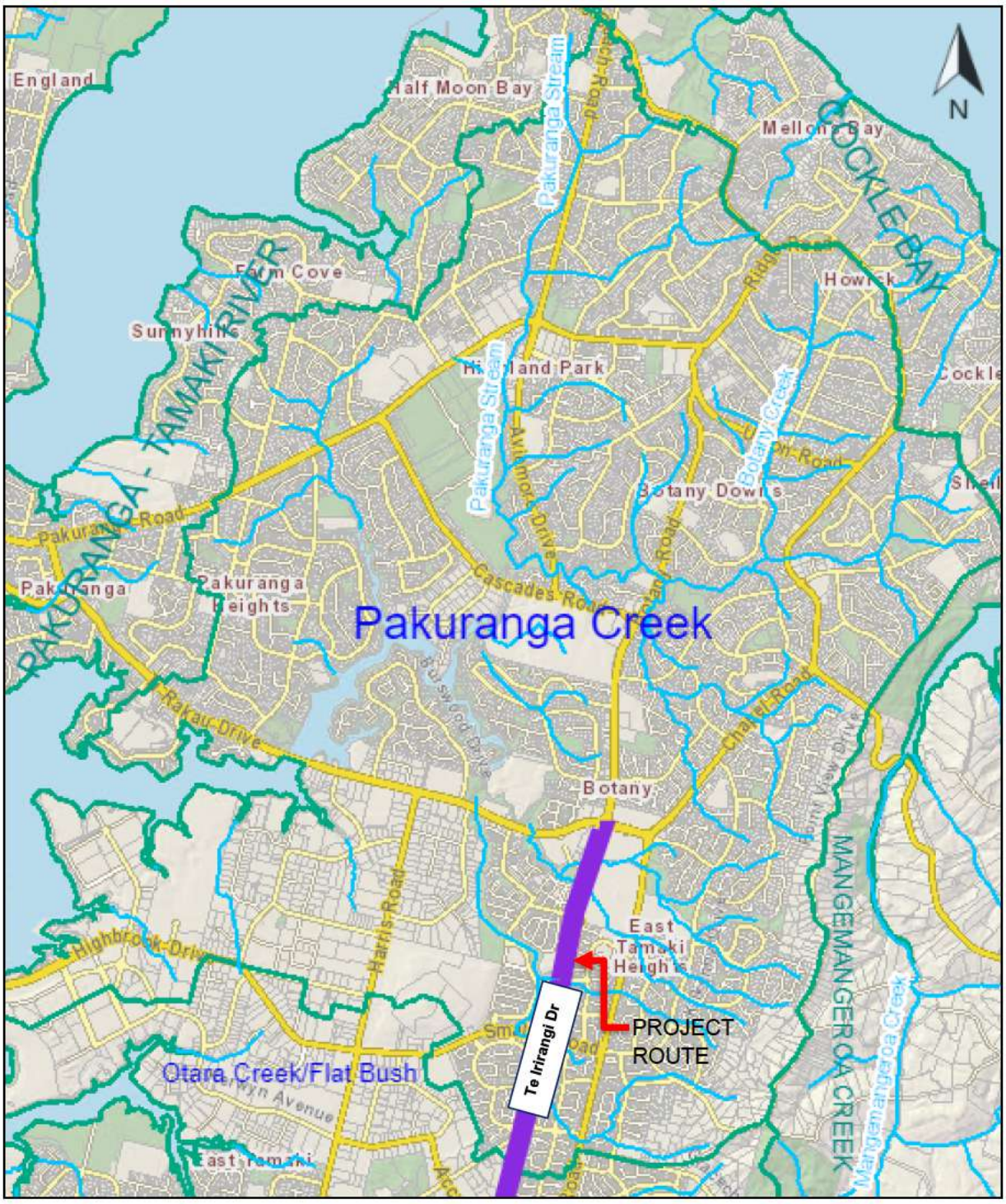


Figure 4-10: Pakuranga Creek Catchment Watercourses (Source: Auckland Council Unitary Plan GeoMaps)

4.2.5 Existing Flood Plains

The existing 1% Annual Exceedance Probability rainfall event (1% AEP) flood plains within the stormwater catchments were extracted from Auckland Council GeoMaps data. This information has been developed based on the Maximum Probable Development (MPD) within each catchment. The flood plains are described below.

Puhinui Creek Catchment

The review identified a significant flood plain of approximately 175 ha between Puhinui Road/Lambie Drive and SH20 (Figure 4-11). According to the extracted data, the maximum flood depth varies from 2.5 to 3.0 m in the central areas of the flood plain, down to 0.1 to 0.5 m at the flood plain edges. There are significant number of residential properties and commercial developments already predicted to be at risk of flooding in a 1% AEP

even. The possible impact of the A2B project on these properties will be confirmed as part of subsequent phases of the project design.

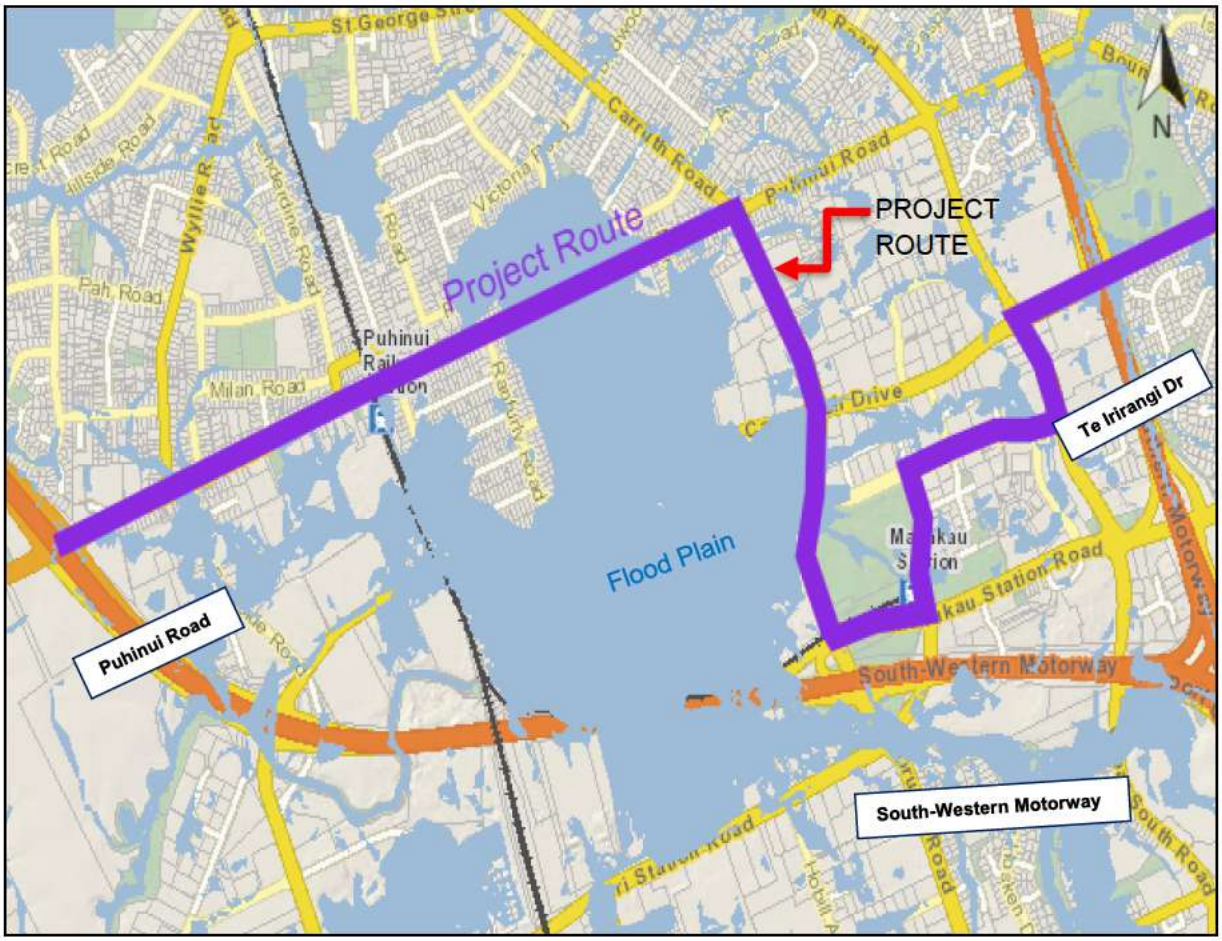


Figure 4-11: Puhinui Creek Catchment Flood Plain (Source: Auckland Council GeoMaps)

Otara Creek/Flat Bush Catchment

The review identified a series of flood plains within Otara Creek catchment. These flood plains generally align with the Otara Creek course and pass across Te Irirangi Drive at some points (refer Figure 4-12). According to the data, the maximum flood depth is between 0.1 to 0.5 m in the south of the catchment and above 3 m in the north.

It is expected that there will be an increase in the impervious area in the catchment due the removal of permeable areas to accommodate the project. There are significant number of residential properties and commercial developments already predicted to be at risk of flooding in a 1% AEP event, and the possible impact of the A2B project on these properties will be confirmed as part of subsequent phases of the project design.

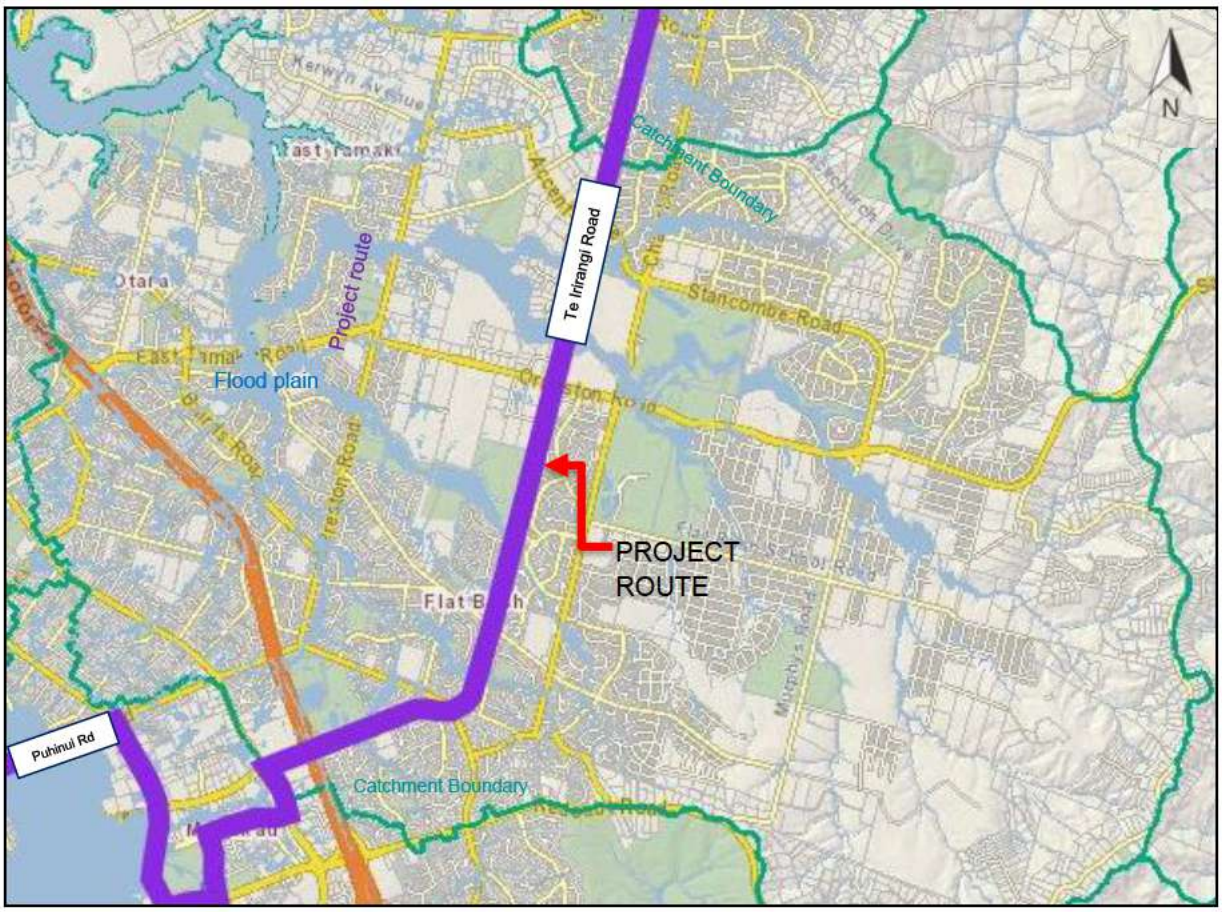


Figure 4-12: Otara Creek/ Flat Bush Catchment Flood Plain (Source: Auckland Council GeoMaps)

Pakuranga Creek Catchment

The flood plain review identified a series of flood plains within Pakuranga Creek catchment. These flood plains generally align with the Pakuranga Creek's watercourse and intersect Te Irirangi Drive at points (refer Figure 4-13). According to the data, the maximum flood depth is about 3 m.

There are significant number of residential properties and commercial developments already predicted to be at risk of flooding in a 1% AEP AP event, and the possible impact of the A2B project new impervious areas on these properties will be confirmed as part of subsequent phases of the project design.

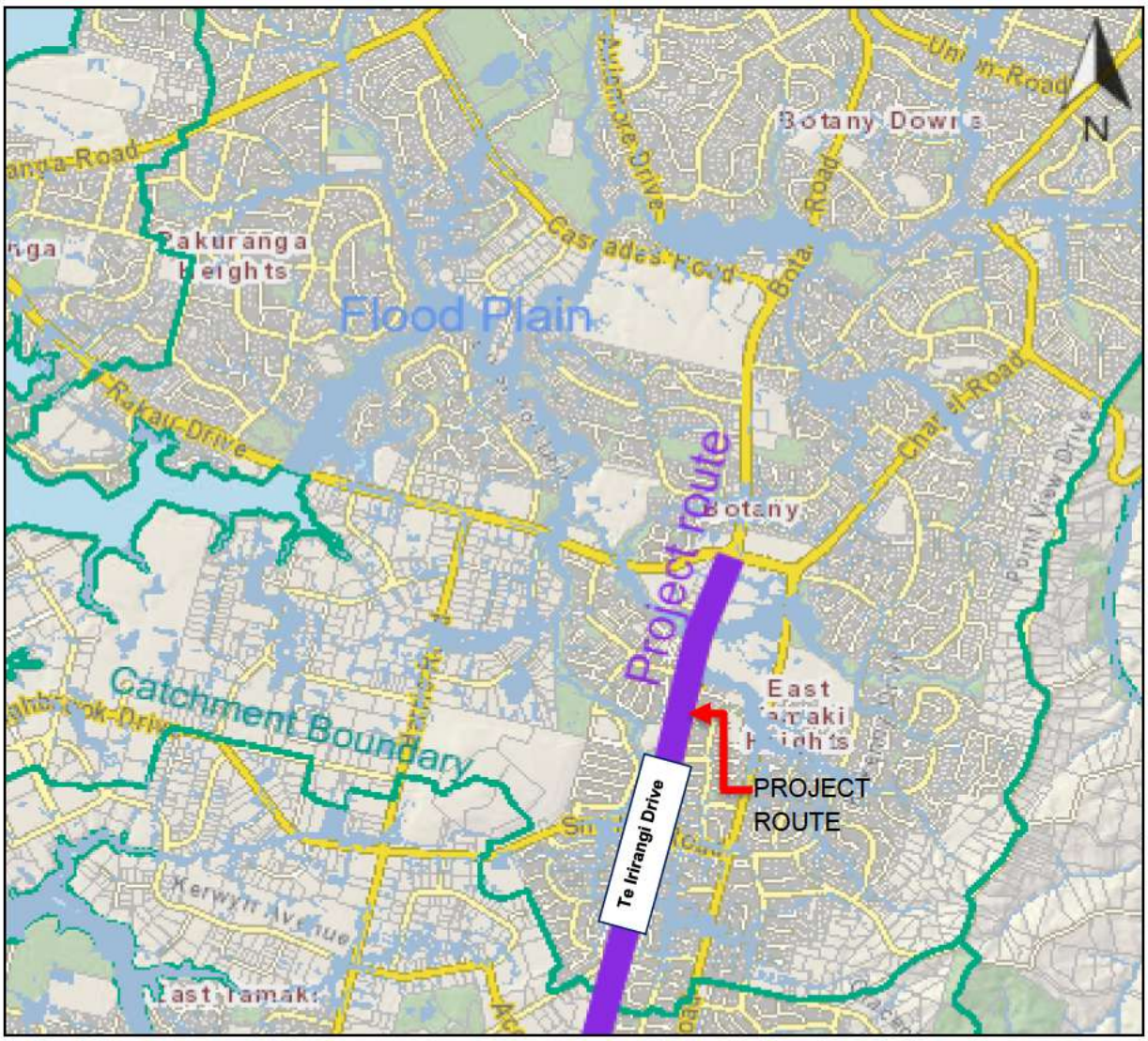


Figure 4-13: Pakuranga Creek Catchment Flood Plain (Source: Auckland Council GeoMaps)

4.2.6 Existing Ponds

The contributory sub-catchments and storage volumes of the key existing stormwater ponds identified within the project area have been assessed as these may be able to be modified or used to provide treatment and attenuation to the proposed works. The volume data was provided by Auckland Council through a request for available data through the Auckland Council Healthy Waters Development team.

The following information was provided:

- As-built records
- Hydraulic Model outputs of pond performance

A meeting was held on the 16th July 2019 with Danny Curtis a Principal Catchment Planner of Auckland Council. The following information was provided as general comment for ponds within the Puhinui Creek, Otara Creek/Flat Bush, and Pakuranga Creek catchments:

1. Ponds have been designed for Total Suspended Solids (TSS) removal.
2. Stormwater management area flow (SMAF) and attenuation requirements have been provided on a catchment specific basis.
3. Auckland Council advised that they prefer to see the rationalising of ponds rather than creating new ponds.

Table 4-2 provides a summary of the existing volumes and stormwater management achieved for each of the existing ponds. Volumes shown are the maximum values derived from the multiple sources. It is recommended that field as-built survey be undertaken to confirm the volumes of existing ponds during subsequent phases of

the project. It is further recommended that condition assessment is undertaken to determine the health of the assets.

Table 4-2: Existing Pond Data

Stormwater Catchment	Pond Name**		Physical Address/Reference	Volume (m^3)	Function
Puhinui Creek	Puhinui Domain Pond		Plunket Ave 50R	556*	Amenity
	Puhinui Pond		12a Diversey Lane Manukau Central 2025 (Aerovista Place Reserve)	6000	Detention
	Hayman Park	West Pond	15R Davis Avenue, Manukau	3042****	Treatment (Attenuation volume unknown)
		East Pond		120****	
Otara Creek/Flat Bush	Rongomai Park Dam Ponds	Lower Pond	30 Rongomai Road Otara Auckland 2016	750 ***	Treatment and Attenuation
		Upper Pond	Preston Road Reserve	6,900 ***	Attenuation
	Sancta Maria Ponds	Accent Drive Pond (North)	2 Stancombe Road, Flat Bush, Auckland 2016	3,847*	Treatment and Attenuation
		336R chapel Road (South)	336R Chapel Road, Flat Bush/SA	3,300*	Treatment and Attenuation
Pakuranga Creek	20R Kelvin Hart Dr (former 81R+124 Guys Road)		Kellaway Drive Reserve	12,000*	Treatment (Water Quality)
	240R Guys Road		Whaka Maumahara (Guys Reserve)	8,000*	Treatment (Water quality)

*Resourced from Auckland Council GeoMaps, assigned as a "Volume - Normal";

**As named on Auckland Council GeoMaps:

***Dead volume, see further information on section 1.1.4.

**** No available data from AC. Volume estimated from available contours. Pond volume to assessed in subsequent phases of the project.

4.2.7 Existing Auckland Council Pond Projects

Rongomai Park Dam Project

There is currently a project being undertaken by Auckland Council to assess the capacity of the existing Rongomai Park Dam, as depicted on Figure 4-14. Auckland Council will be contacted in subsequent phases of the A2B project for an update of the status of the Rongomai Park Dam project. There is a potential opportunity for the Rongomai Park Dam to offer stormwater attenuation for the A2B project at this location.



Figure 4-14: Rongomai Park Dam Location (Source: Auckland Council GeoMaps)

4.2.8 Existing Culverts

A desktop review and site visit were undertaken to identify any existing culverts along the extents of the A2B project. The results of the review are described below and summarised in Table 4-3: Existing Culverts along A2B Project Alignment. This information will need to be confirmed by field survey in the upcoming phases of the project.

Table 4-3: Existing Culverts along A2B Project Alignment

Culvert Location	Catchment	Installation Date	Shape	Material	Dimensions
Hayman Park	Puhinui Creek	25/09/1990	Circular*	Concrete*	unknown
Rongomai Park (On Te Irirangi Dr.)	Otara Creek/Flat Bush	Unknown	Box*	Concrete*	Approx. 2 cells (2.0mx1.0m) *
Sancta Maria Ponds	Otara Creek/Flat Bush	11/05/2001	unknown	Corrugated Iron	H = 2500mm *
Kellaway Drive	Pakuranga Creek	21/07/1999	Circular*	Concrete	Φ =1200mm *

* Site visit data.

Existing Culvert Condition

It is recommended that a CCTV condition survey is obtained for all existing culverts during subsequent phases of the project to confirm their physical condition.

Existing Culvert Hydraulic Performance

No current information is currently available on the existing culvert performance. It is recommended that during subsequent phases of the project an assessment is carried out to determine the performance of all culverts. The assessment should comply with Section 4.3.9.8 of the Auckland Council SW COP.

4.2.9 Existing Resource Consents

Aurecon requested all available existing design data and resource consents for existing stormwater infrastructure from Auckland Council, including the stormwater ponds along the route of the A2B project, where there is the potential for new or upgraded discharge connections. Auckland Council were not able to find consent and design data for all ponds. It is noted that Auckland Council were able to provide only limited pond specific resource consent and as such the proposed concept stormwater design, will in general, comply with catchment Resource Consent Permits. The information provided by Auckland Council is summarised below. Refer to Appendix L for other relevant information related to the existing ponds.

Puhinui Catchment

No pond information was available for assets located within this catchment.

Otara Creek/Flat Bush Catchment

336R Chapel Road, Flat Bush/SA (Sancta Maria Pond - South)
Resource Consent Permit No. 26039 (file reference 15957), dated May 2005 and granted before the pond construction, currently authorises approximately 320m of streambed disturbance and the associated diversion of surface water in Te Irirangi Drive and Chapel Road, Flat Bush, Manukau City.

The key conditions that control the pond management include:

- That stormwater flows in excess of the capacity of the primary structure, i.e. a secondary flow path shall be provided and maintained to allow surplus stormwater from critical storms up to the 1% Annual Exceedance Probability (1% AEP) to discharge with minimum of nuisance and damage.
- That the culvert be terminated with a structure of such location, design and performance as to minimise erosion, risk of obstruction of the watercourse, and hazards to safety. The said outfall structure shall be maintained by the consent holder to preceding standards.
- That works within any watercourse shall only be carried out during periods when all flows can be diverted around the area of works.
- That if any watercourse is to be temporarily dammed, sufficient flow shall be maintained at all times below the site of works so as not to adversely affect instream biota.
- That the consent holder shall ensure that temporary dam structure built within the stream shall be constructed from non-erodible material such as sandbags.

Resource Consent Permit No. 26053 (file reference 15964), currently authorises the damming and discharge of an unnamed tributary of Otara Creek for stormwater quality pond in Te Irirangi Drive and Chapel Road, Flat Bush, Manukau City.

The key conditions that control the dam management include:

- That the consent holder shall ensure that the dam will be constructed with flood spillway capable of safely passing water for the 1% AEP storm event without overtopping the dam crest and with minimal damage to the flood spillways. The surface of the flood spillway shall be constructed to protect it from significant erosion during operation.

- That the consent holder shall operate and maintain the dam and associated structures to ensure that they are structurally sound, pose no undue risk to life, property or the natural environment, and are able to perform satisfactorily under all foreseeable circumstances.
- That the consent holder shall protect the entry to the outlet manhole and spillways from becoming restricted by debris.
- That the consent holder shall ensure that all spillways, overflows and bypass arrangements are terminated and maintained in such a way as to minimise erosion of the stream, risk of obstruction of the waterways, and hazards to safety.
- That the consent holder shall ensure that the dam structure, spillways, and bypass are adequately maintained at all times to minimise surface damage, and that no trees or vegetation, other than grass, that could weaken the structural stability of the dam, be allowed to grow on or near the embankment.
- That the consent holder shall provide protection to the upstream face of the dam against wave action and scour.

Pakuranga Creek Catchment

Kevin Hart Drive

Land Use Resource Consent Permit No.19728 (file reference ES 6906/124), dated May 2005 and granted before the construction of the pond, declares that Kevin Hart Drive pond (previously named as 124 Guys Road) would provide stormwater quality and flow attenuation to improve water quality and reduce potential erosion from flood events. No dimensional information was available.

Auckland Region - Wide Network

Resource Consent “Auckland Council – Stormwater Network Diversion and Discharge Consent (Auckland Stormwater NDC)”, Application No. DIS60069613, dated April 2019, currently authorises diversions and discharges of stormwater from the Public Stormwater Network within existing and future urban areas (including special purpose zoned land and marina land), and authorises the following activities:

- Existing stormwater diversions to (including from existing road and other existing land uses) and discharges from the Public Stormwater Network at the time of commencement of this consent;
- New or changes to stormwater diversions and discharges from the renewal, maintenance, development or improvement of the Public Stormwater Network, subject to compliance with either:

i. the performance requirements in Schedule 4 of the mentioned consent; or

ii. a Stormwater Management Plan adopted in accordance with Schedule 8 of the mentioned consent.

- New, or changes to existing, diversions and discharges resulting from:

i. the increase of, or changes to, impervious areas from redevelopment, intensification, and/or land use change within existing urban areas that discharge to the Public Stormwater Network or

ii. the increase of/changes to impervious areas from the development of greenfield areas where stormwater assets connect directly to, and/or are subsequently vested and become part of, the Public Stormwater Network;

subject to compliance with the performance/connection requirements in Schedule 4 or a Stormwater Management Plan adopted in accordance with Schedule 8 of the mentioned consent.

For the avoidance of doubt the following activities are not authorised under this consent:

- Discharge of contaminants from the activity area of an industrial and trade activity site;

- Sediment discharges from earthworking;
- Stormwater diversions and discharges from the existing or new road network:

i. that discharge directly to a stormwater network that is not owned and operated by Auckland Council; and/ or

ii. that discharge directly to a freshwater or coastal natural environment or to ground;

- Stormwater diversions and discharges in rural zoned areas, other than stormwater discharges from urban areas that may enter rural areas;
- Wastewater discharges and discharges from the combined sewer network;
- Private network discharges and any associated stormwater infrastructure that directly connect to a stormwater network that is not owned and operated by the Auckland Council, and / or are not subsequently vested to the Auckland Council;
- Any diversion of overland flow paths and floodplains as a result of structures or land modification not authorised by the holder of this consent;
- Physical works that give effect to the discharge consent.
- All other discharges (not being stormwater) that are either permitted under the AUP (e.g. including those in E.4 of the AUP) or for which resource consent has been obtained.

4.3 Design Standards

The design of the stormwater components of the A2B project have considered the following key design standards and guidance documents:

- Auckland Council Code of Practice for Land Development and Subdivision Chapter 4 – Stormwater (Version 2.0, November 2015) (SW COP);
- Auckland Council Stormwater Flood Modelling Specifications (AC FMS) (2011);
- Auckland Council Stormwater Management Devices in the Auckland Region – Guideline Document 2017/001, version 1 (December 2017) (GD01);
- Auckland Council TR2013/035 - Auckland Unitary Plan stormwater management provisions: Technical basis of contaminant and volume management requirements (2013);
- Auckland Regional Council Guidelines for Stormwater Runoff Modelling in the Auckland Region (1999), Technical Publication No. 108 (TP108);
- Auckland Regional Council Guidelines for Stormwater Treatment Devices (2003), Technical Publication No. 10 (TP10);
- Auckland Transport Code of Practice, Chapter 17 Road Drainage (2013);
- Auckland Transport Transport Design Manual, Road Drainage;
- Auckland Unitary Plan Operative in Part, 15 November 2016 (2016);
- Ministry for the Environment, Climate Change Effects and Impacts Assessment – A Guidance Manual for Local Government in New Zealand, Second edition (2008); and
- New Zealand Transport Agency, Stormwater Treatment Standard for State Highway Infrastructure (May 2010).

4.4 Design Philosophy

The concept design has been carried out using the following Design Philosophy as agreed with Auckland Council on 16 July 2019. The proposed design method followed these steps:

1. Calculate the Pre- and Post-Development stormwater discharge flows and volumes from each sub-catchment.

2. Assess whether additional attenuation is required for the Post-Development scenario – typically required when the peak flows or total discharge volume is predicted to increase above the Pre-Development flows.
3. Assess the sub-catchment areas of the road and where they are discharging to (i.e. pipe network, watercourse, or pond).
4. Consider water quality treatment required, and whether any attenuation / detention can be incorporated into the treatment device.
5. Treatment is to be provided at source, where practicable.
6. Assess if there are any properties currently within the Floodplain.

This concept design has aimed to provide a conservative approach to stormwater management. It is recommended that subsequent design stages should utilise the Auckland Council stormwater catchment models to refine the design. The following should be carried out in subsequent design stages of the project:

7. Consider maintenance requirements of recommended treatment approach and consequential costs.
8. Consider downstream network capacity. Confirm whether the Project flows be discharged into the existing network without causing new flooding.
9. Assess the potential impacts of discharges from the project.
10. Assess whether additional attenuation is required for the Post-Development scenario i.e. do the immediate and downstream receiving environments have capacity to manage the additional runoff from the proposed project?

The following sections provide information on the design philosophy approach to key elements of the project design;

4.4.1 Hydrology

The Auckland Council TP108 procedure was used to determine the peak runoff and volumes for the project catchments for both the pre and post development scenarios. The design rainfall depth for the Puhinui, Otara Creek/Flat Bush and Pakuranga Creek catchments were estimated from the design rainfall contour maps provided for a range of average recurrence interval (ARI) within the TP108 document (ARC, 1999).The impact of climate change on the 2090 future design storm, representative of 2.1°C temperature increase, is quantified as a 16.8% increase of rainfall depth proportional to the storm event.

4.4.2 Tidal Data

In accordance with the Healthy Waters Stormwater Flood Modelling Specification, a constant tide level was assigned to MPD model runs, representative of Mean High-Water Springs plus 0.5m accounting for climate change. Catchment specific tide data is provided in the Table 4-4.

Table 4-4: Tide Levels

Catchment	Tidal Zone	Tidal Boundary m RL (+0.5m climate change)
Puhinui Creek	Waitemata Harbour	1.89
Otara Creek / Flat Bush	Manukau Harbour	2.44
Pakuranga Creek	Manukau Harbour	2.44

4.4.3 Future Imperviousness

Due the nature of project within an already heavily urbanised area, no significant land use changes are envisaged that change the permeability around the project route. Through a review of AC Unitary Plan, it was

found that the existing green areas and parks should retain their current use, either as recreational areas or as conservation areas, with no future developments planned to take place in these locations.

However, a model of future impervious representation should be reviewed and updated where required to improve model confidence. It will need to be taken into consideration for modelling of the MPD event in subsequent phases of the project and will need to be carried out in coordination with Auckland Council modelling guidelines.

4.4.4 Stormwater Treatment, Detention and Attenuation

The philosophy used for the Concept Design is summarised as follows:

- It is proposed that treatment devices be design in accordance with GD01 for existing and new High Use Roads as required by Auckland Unitary Plan Operative (AUPOIP0 standards E9.6.1.2., E9.6.1.3(2) for Activity A1 (Permitted) and E9.6.2.2.
- Attenuation up to the 1% AEP event flows generated by the A2B project (where practicable) is proposed for discharges upstream of existing buildings at risk of flooding (to meet clause E8.6.1 of the AUP).
- For the Concept Design the project passes through highly developed urban areas with residential, business and commercial buildings and therefore a blanket 1% AEP event attenuation has been applied. It is recommended that this is refined in subsequent phases of the project.
- Attenuation up to the 10% AEP event flows generated by the A2B project (where practicable) is proposed elsewhere to ensure flooding is not increased in downstream properties (to meet clause E8.6.1 of the AUP) where there are capacity restrictions on the existing primary drainage (piped) network.
- Discharges to the Coastal Marine Area do not require detention retention or peak flow attenuation. This does not apply to the Project.
- SMAF2 detention / retention is proposed in the locations identified in Appendix L. It is noted of the three catchments the A2B project passes through only the Puhinui Creek contains a SMAF Zone.

Therefore, those locations fall within the Stormwater Management Area Flow2 (SMAF2), the following stormwater measures are required to comply with requirements set out in AUP standard E10.4.1 for activity A7 (Restricted Discretionary), which includes:

- Detention for the 90th percentile storm and retention as set out in standard E10.6.3.1.1; and
- Stormwater runoff from the new impervious areas and any existing impervious areas discharging to the same drainage network point must be managed to achieve the hydrology mitigation requirements specified in Table E10.6.3.1.1 Hydrology Mitigation Requirements.

There are no activities occurring on the site that can re-use the full 5mm retention volume of water. As set out in Table E10.6.3.1.1, further geotechnical investigations will be carried out during the next phase to confirm soil infiltration rates. Due to unknown geotechnical conditions for retention, the proposed detention volumes in sections following assume the full SMAF2 detention volume without reduction for retention.

As discussed with [redacted] of Auckland Council on 16 July 2019 there are opportunities to optimise attenuation requirements during subsequent phases of the project by quantifying and assessing post-development upstream and downstream impacts with flood modelling, with consideration to the best practicable option to address stormwater related effects.

The order of preference for stormwater management devices are as follows:

- Use of existing stormwater wetlands/ponds where practicable;
- New wetlands and ponds are for catchments that requiring treatment, detention and attenuation;
- Swales are proposed for sub-catchments requiring treatment only; and

- Proprietary devices are only proposed where ponds/wetlands and swales cannot be provided due to space constraints. The use of proprietary devices will be considered as a last resort and requires specific approval. Stormwater treatment should be integrated into street design and landscaping.

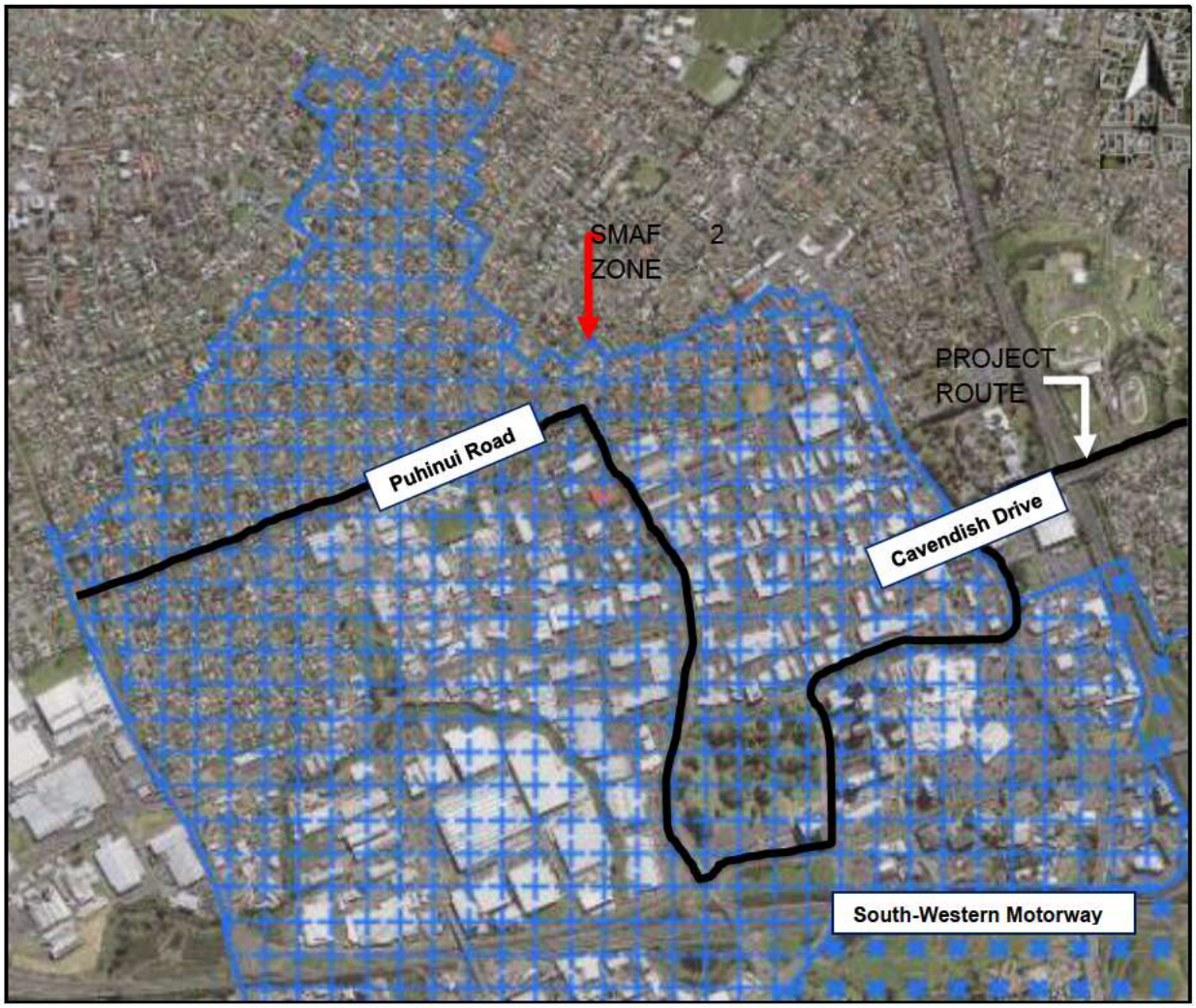


Figure 4-15: Puhinui Catchment SMAF2 Zone (Source: Auckland Council GeoMaps)

Detention is proposed to be achieved by internal storage (tanks or enlarged pipes) within conveyance systems, diverting stormwater towards the existing ponds and proposed wetlands where practicable. As retention cannot be provided by wetlands, retention swales may be designed/sized during subsequent phases of the project, with consideration of site geology when more specific geotechnical information becomes available (e.g. soil infiltration rates).

An effort has been made to rationalise (i.e. combine) multiple existing ponds into a single wetland where possible to minimise future maintenance and upgrade needs. Further optioneering, refinements and consultation with the Auckland Council will be undertaken during subsequent phases of the project to determine the best practicable option with regards to access and maintenance considerations.

The AC document GD01 has been used as a guideline for stormwater management design elements that are not covered by TP10, such as design of SMAF detention devices. The online Auckland Stormwater Device Sizing Tool (ado-calc.gfws.co.nz/#/) has also been utilised to aid stormwater management design.

4.4.5 Culverts

Culverts are typically assessed based on structural condition and hydraulic capacity. It is recommended for subsequent phases of the project that the following tasks are undertaken to determine the structural condition and capacity of the existing culverts:

- Condition – CCTV study to determine structural condition.

- Existing Culvert Capacity – Analysis against the criteria outlined in the Auckland Council Code of Practice for Land Development and Subdivision Section 4.3.9.8.

The following items should be considered when carrying out culvert analysis:

- Flow rates for culverts to be determined from Auckland Council's flood models where applicable.
- Fish passage requirements for new and existing culverts.

Refer to Section 4.6.2 design criteria for culverts.

4.4.6 Network Drainage

The philosophy is to provide network drainage via a combination of piped network and conveyance swales where practicable (conveyance swales are unlikely to practical within the urban environment the majority of the project passes). Due to the proposed widening of Puhinui Road and Te Irirangi Drive, as well as some stretches of Lambie Drive, Manukau Station Road, Davies Avenue, Ronwood Avenue and Great South Road it is considered adequate to assume that all existing longitudinal pipes will be abandoned for the purpose of costings at the concept design stage.

The proposed new pipe drainage system will need to be designed to consider private property connections that currently discharge to the road drainage system during subsequent phases of the project. Network drainage has not been designed as part of the concept design.

4.4.7 Overland Flow Paths

The following applies to the Overland flow paths:

- Overland flows paths will be managed and designed in line with recommendations from sections 4.3.4.2, 4.3.5.2 and 4.3.5.3 of the Auckland Council SW COP.
- The existing constructed or natural flow paths shall be retained as far as practical. Any alteration of the existing stormwater system shall result in no detrimental impacts to either upstream or downstream properties, or to natural watercourses.
- Sizing of overland flow paths has not been carried out as part of this concept design and will be undertaken in subsequent phases of the project.

4.4.8 Kerb and Channel

Provision of kerbs, and selection of kerb profiles for traffic purposes should be in accordance with ATCOP Section 7.7. Kerbs and Channels Kerbing may be also be required for surface water control in these circumstances:

- As part of a surface water channel for collection and conveyance to, a catch pit or a treatment device (such as a rain garden, or filter).
- On all roads where the channel gradient exceeds 8%, or 5% unless a side drain system is provided that collects surface water effectively along its length.
- To contain overland flow and ponding within the roadway for the protection of property or the safety of footpath users.
- Roads with side drains / water tables where the road passes through a cutting and the side drain is interrupted to limit the width of cutting or for scour protection of steep grades.

4.4.9 Outfalls to Watercourses

Erosion protection will be provided at all outfalls to existing watercourses. In accordance with the recommendations of TR2013/018 (Hydraulic Energy Management: Inlet and Outlet Design for Treatment Devices) the following types of outfalls will be provided based on culvert sizes:

- Rip-rap basins – for culverts greater than 1.5m diameter; or
- Rip-rap aprons – for culverts with a diameter of 1.5m or less.

4.5 Auckland Council Flood Models and Future Application

The following sections aims to provide an overview of the currently available Auckland Council Flood models and their recommended use during subsequent phases of the project. It is noted that no hydraulic modelling has been undertaken during the concept design.

4.5.1 Auckland Council Flood Models

[redacted] (Principal Catchment Planner) of Auckland Council provided the information presented in Table 4-5 for the three catchments that the A2B project passes through. All three catchments have a current Auckland Council stormwater catchment model, these are at a detailed level and include the following information:

- Auckland Council (public) stormwater pipe networks
- Wetlands/Ponds (storage areas)
- Representation of the catchment main watercourses

The modelling limitations that were identified include that the Pakuranga Creek model verification status is unknown; that all models use the 2013 Lidar data as opposed to the latest 2016 Lidar data; and that the latest land developments are not represented in the models.

Taking the above into consideration further work may be required to update the three hydraulic models to a standard suitable to assess the proposed A2B stormwater management. Any future hydraulic modelling work should be discussed and agreed with Auckland Council Healthy Waters in the first instance to determine appropriate model updates.

Table 4-5: Summary of Existing Auckland Council Catchment Models

Catchment Ref	Model Type	Modelling Software	Model Validation undertaken	Lidar	Opportunities	Limitations
Puhinui Creek	Mike Flood 3 Way Coupled Model	DH1 2014	Yes (Flow Gauge and Historic Flood events)	2013	Potential to use existing wetlands and ponds to attenuate project runoff	The models do not contain latest developments in the catchment 2013 Lidar is now superseded by 2016 data
Otara Creek / Flat Bush	Mike Flood 3 Way Coupled Model	DH1 2014	Yes	2013	Rongomai Park dam project is currently looking at developing attenuation/storage capacity in the area. This may provide the opportunity to attenuate flows	
Pakuranga Creek	Detailed 1D/2D	ICM v7.5	Unknown	2013	Potential to use existing wetlands and ponds to attenuate project runoff	

4.5.2 Future Modelling

It is recommended that analysis using available Auckland Council catchment hydraulic models be undertaken in subsequent phases of the project. The hydraulic modelling should aim to achieve the following objectives:

- Assess the magnitude of any increase in runoff due to the A2B project.
- Assess the performance of the existing primary piped drainage network with the proposed project stormwater runoff.
- Assess the impact of the project on existing or new stormwater flooding issues.
- Assess if existing stormwater management devices (specifically ponds) can manage the proposed project runoff.
- Assess practicable systems for stormwater flow management including attenuation, in consultation with Auckland Council, for fully-developed catchments including the A2B project.

4.6 Design Criteria

4.6.1 Hydrology

The hydrological parameters adopted for the concept design are summarised in Table 4-6: Hydrological Parameters.

Table 4-6: Hydrological Parameters

Design Rainfall Parameters - Adjusted for Climate Change			
	Intensity – 10min duration (mm/hr)	**Total Rainfall Event Depth – 24hrs (mm)**	**Standard / Comment**
50% AEP rainfall	58	84	AC Code of Practice for Land Development and Subdivision Chapter 4 – Stormwater, with climate change to year 2090.
10% AEP rainfall	109	157	
1% AEP rainfall	174	251	
Water quality event (90%ile rainfall)	10	25	Auckland Council Stormwater Management Devices in the Auckland Region – Guideline Document 2017/001, version 1 (December 2017).
SMAF1 detention event (95%ile rainfall)	-	34	
Design Runoff Coefficients			
	Value		**Standard / Comment**
CN Impervious	98		AC TP108 – AC Stormwater Flood Modelling Specifications.
CN Pervious	61*		
Rational Runoff Coefficient – Impervious	0.95		NZTA Stormwater Treatment Standards, Table 6-2: "Rational Runoff Coefficients 'C'

		Values" - "Impervious surfaces".
Rational Runoff Coefficient – Pervious	0.40	NZ Building Code E1 - Table 1: "Run-off Coefficients, "Heavy clay soil type" - "pasture and grass cover".

*CN value of 98 have been adopted for impervious surface runoff and is consistent with Auckland Council's Stormwater Flood Modelling Specifications (2011). CN value of 61 for pervious runoff was adopted following the site geology – Tauranga Group - which is equivalent to "Group B – alluvial soil" of SCS classification, combined with land use defined as "urban lawns".

4.6.2 Culverts

Culvert capacity analysis, and culverts that require upgrading will be assessed/designed in accordance with the Auckland Transport Code of Practice, Chapter 17 Road Drainage (2013) (AT COP) and Auckland Council Code of Practice for Land Development and Subdivision Chapter 4 - Stormwater (AC CoP). Summarised below are the key criteria taken from the AC COP. It is noted there are further consideration in the design specification, therefore, the designer should refer to both specifications identified above when designing and assessing culverts;

1. The culvert shall be designed to cater for the flows and water levels generated by the 1% AEP event without affecting upstream and downstream properties.
2. The headwater pond created by the culvert during the 1% AEP event shall have a depth not exceeding 3.0m above the invert of the pipe and shall provide 500mm freeboard to the edge of the seal of the road (or equivalent feature) at the top of the embankment. For cases where the approach velocity is greater than 2m/s, the freeboard shall be at least 1.5 times the velocity head at the entrance. The headwater pond created by the 10% AEP event shall not be higher than the soffit of the culvert.
3. Culverts shall be designed such that the maximum velocity within the culvert generated by the 1% AEP event does not exceed 6.0 m/s. Higher velocities in culverts require approval from the council. High outlet velocities are likely to cause scour and erosion of natural channels and reference shall be made to Auckland Council technical report TR2013/018 (Hydraulic Energy Management: Inlet and Outlet Design for Treatment Devices) for design guidance for energy dissipation. Note that energy dissipation will be required at far lower velocities than the maximum allowed within the conduit stated above.
4. Culverts shall be designed such that an absolute minimum velocity of 0.6m/s and desired minimum of 1.0m/s is achieved. Minimum flow velocities apply to the 50% AEP design storm.

Existing culverts shown in Section 4.2.8 of this report (Table 4-2) will be assessed under these culvert design criteria in the future stages of the A2B project design. Discussion will be held with AC and AT stormwater specialisits to determine if the compliance with the standards of existing culverts warrant replacement.

4.6.3 Stormwater wetlands

The existing ponds' functionality (refer Section 1.1.3) have been considered for development into stormwater wetlands for the A2B project. Some new wetlands also been proposed along the project route to cater for the extra flows as per GD01 section C8.0 - Technical guidance: wetlands.

4.6.4 Proposed Stormwater Management Criteria

Table 4-7 identifies the proposed treatment for each sub-catchment based on the specific criteria applying to each area. Drawings 502334-7000-DRG-WD-1400 series indicates the location of these sub-catchments area.

Table 4-7: Proposed Stormwater Management Criteria

Catchment Ref	Road Name	Location (A2B chainage, m)	Discharge point	Proposed Stormwater Management
CA-01	Puhinui Road (west of Puhinui Train Station)	Cha. 0+035 to 0+170	At Cha. 0+095 to Existing network	Treatment No SMAF zone AEP 1% Attenuation
CA-02		Cha. 0+170 to 0+293	At Cha. 0+240 to Existing network	Treatment No SMAF zone AEP 1% Attenuation
CA-03		Cha. 0+293 to 0+705	At Cha. 0+435 to Existing network	Treatment No SMAF zone AEP 1% Attenuation
CA-04		Cha. 0+705 to 1+010	At Cha. 0+840 to Existing network	Treatment wetland No SMAF zone AEP 1% Attenuation
CA-05	Puhinui Road (east of Puhinui Train Station	Cha. 1+240 to 1+403	At Cha. 1+245 to Existing network	Treatment SMAF 2 AEP 1% Attenuation
CA-06		Cha. 1+403 to 1+591	At Cha. 1+520 to Existing network	Treatment SMAF 2 AEP 1% Attenuation
CA-07		Cha. 1+591 to 2+275	At Cha. 1+743 to Existing network	Treatment SMAF 2 AEP 1% Attenuation
CA-08		Cha. 2+275 to 2+661 (east)	At Cha. 2+400 to Existing network	Treatment wetland SMAF 2 AEP 1% Attenuation
CA-09	Lambie Drive	Cha. 0+014 to 0+182	At Cha. 0+075 to Existing network	Treatment SMAF 2 AEP 1% Attenuation
CA-10		Cha. 0+182 to 0+547	At Cha. 0+498 to Existing network	Treatment SMAF 2 AEP 1% Attenuation
CA-11A		Cha. 0+547 to 0+900	At Cha. 0+675 to Existing network	Treatment SMAF 2 AEP 1% Attenuation
CA-11B		Cha. 0+900 to 1+318 (west)	At Cha. 1+050 to Existing network	Treatment SMAF 2 AEP 1% Attenuation
CA-11C		Cha. 0+877 to 1+318 (east)	At Cha. 1+050 to Existing network	Treatment SMAF 2 AEP 1% Attenuation
CA-12A	Manukau Station Road	Cha. 0+00 to 97m (south)	Connected to existing network at South of Catchment	Treatment SMAF 2 AEP 1% Attenuation
CA-12B		Cha. 0+00 to 0+350	At Cha. 0+180 to Existing network	Treatment SMAF 2 AEP 1% Attenuation

Catchment Ref	Road Name	Location (A2B chainage, m)	Discharge point	Proposed Stormwater Management
CA-12C		Cha. 0+350 to 0+453 (south-east)	Connected to existing network at 0+350 on Manukau Stat. Road	Treatment SMAF 2 AEP 1% Attenuation
CA-12D		Cha. 0+350 to 453 (north-east)	Connected to existing network at 0+400 on Manukau Stat. Road	Treatment SMAF 2 AEP 1% Attenuation
CA-13	Davies Avenue	Cha. 0+31 to 0+260	At Cha. 0+115 to Existing network	Treatment SMAF 2 AEP 1% Attenuation
CA-14A	Davies Avenue/ Ronwood Avenue	Cha. 0+260 to 0+433/ 0+00 to 0+338 (south side of road)	At Cha. 0+067 (Ronwood Av.)	Treatment SMAF 2 AEP 1% Attenuation
CA-14B	Ronwood Avenue	Cha. 0+157 to 0+338 (north side of road)	At Cha. 0+295 to Existing network	Treatment SMAF 2 AEP 1% Attenuation
CA-15	Ronwood Avenue/ Great South Road	Cha. 0+338 to 568 /Cha. 0+00 to 95m (south)	At Cha. 0+400 to Existing network on Ronwood Avenue	Treatment SMAF 2 AEP 1% Attenuation
CA-16	Great South Road	Cha. 0+00 to 0+261	At Cha. 0+031 to Existing network	Treatment SMAF 2 AEP 1% Attenuation
CA-17A	Great South Road/ Te Irirangi Drive	Cha. 0+261 to +333/ Cha. 0+00 to 80m (west)	At Cha. 0+302 to Existing network	Treatment No SMAF zone AEP 1% Attenuation
CA-17B	Te Irirangi Drive	Cha. 0+00 to 0+309	At Cha. 0+036 to Existing network	Treatment No SMAF zone AEP 1% Attenuation
CA-18		Cha. 0+309 to 1+017	At Cha. 0+783 to Existing network	Treatment No SMAF zone AEP 1% Attenuation
CA-19A		Cha. 1+017 to 1+305	At Cha. 1+090 to Existing network	Treatment No SMAF zone AEP 1% Attenuation
CA-19B		Cha. 1+305 to 70m (north)	At Cha. 1+280 to Existing network	Treatment No SMAF zone AEP 1% Attenuation
CA-19C		Cha. 1+305 to 35m (south)	At Cha. 1+330 to Existing network	Treatment No SMAF zone AEP 1% Attenuation
CA-20		Cha. 1+338 to 1+963	At Cha. 1+662 to Existing network	Treatment No SMAF zone AEP 1% Attenuation
CA-21A		Cha. 1+963 to 2+873	At Cha. 2+550 to Existing network	Treatment No SMAF zone AEP 1% Attenuation

Catchment Ref	Road Name	Location (A2B chainage, m)	Discharge point	Proposed Stormwater Management
CA-21B	Te Irirangi Drive	Cha. 2+873 to 3+100	At Cha. 3+040 to Existing network	Treatment No SMAF zone AEP 1% Attenuation
CA-22A		Cha. 3+100 to 3+581	On Ormiston Road into Existing network near Te Irirangi Drive	Treatment No SMAF zone AEP 1% Attenuation
CA-22B		Cha. 3+581 to 4+150	At Cha. 3+960 & 4+000 to Existing network	Treatment No SMAF zone AEP 1% Attenuation
CA-23A		Cha. 4+150 to 4+875	At Cha. 4+265 & 4+320 to Existing network	Treatment No SMAF zone AEP 1% Attenuation
CA-23B		Cha. 4+875 to 5+075	At Cha. 4+970 to Existing network	Treatment No SMAF zone AEP 1% Attenuation
CA-24A		Cha. 5+075 to 6+084	At Cha. 5+960 to Existing network	Treatment No SMAF zone AEP 1% Attenuation
CA-24B		Cha. 5+373 to 5+590 (west)	At Cha. 5+510 to Existing network	Treatment SW360 filter (TBC) No SMAF zone AEP 1% Attenuation
CA-24C		Cha. 6+060 to 80m (west)	On Smales Road into Existing network near Te Irirangi Drive	Treatment No SMAF zone AEP 1% Attenuation
CA-25A		Cha. 6+084 to 6+458	At Cha. 6+270 to Existing network	Treatment No SMAF zone AEP 1% Attenuation
CA-25B		Cha. 6+458 to 6+760	At Cha. 6+660 to Existing network	Treatment No SMAF zone AEP 1% Attenuation
CA-25C		Cha. 6+675 to 6+760 (west)	At Cha. 6+720 to Existing network	Treatment No SMAF zone AEP 1% Attenuation
CA-26A		Cha. 6+760 to 6+842 (west)	At Cha. 6+805 to Existing network	Treatment No SMAF zone AEP 1% Attenuation
CA-26B		Cha. 6+859 to 6+948 (west)	On Haven Dr. into Existing network near Te Irirangi Drive	Treatment No SMAF zone AEP 1% Attenuation
CA-26C		Cha. 6+760 to 7+590	At Cha. 7+105 & 7+070 to Existing network	Treatment No SMAF zone AEP 1% Attenuation

Note: Table should be read in conjunction with concept design drawings ref (502334-7000-DRG-WD-1400 series).

4.7 Concept Design Development

4.7.1 Stormwater Sub-catchments

A desktop study identified and calculated the project sub-catchment areas. This was undertaken using contours extracted from Auckland Council GeoMaps, as well as existing long sections, cross-sectional profiles and locations of the existing stormwater network and overland flow paths.

The A2B project has been divided into forty-four proposed stormwater catchments along Puhinui Road, Lambie Drive, Manukau Station Road, Davies Avenue, Ronwood Avenue, Great South Road and Te Irirangi Drive. Refer to the design drawings (Appendix K) for the location of the catchments.

The total area of the proposed stormwater catchments is 57.3 ha and the additional impervious area due to the proposed works is approximately 95,670m² (9.56ha).

4.7.2 Stormwater Catchment Flow Calculations

The stormwater sub-catchments areas, runoff flow characteristics and detention calculations for each sub-catchment are shown in Table 4-8 calculated using the hydrology parameters outlined in Section 4.6.1.

Table 4-8: Stormwater Catchment Flow Calculations

STORMWATER CATCHMENT FLOW CALCULATIONS FOR AIRPORT TO BOTANY (A2B) PROJECT																						
Sr. No.	Catchment No.	Catchment Areas (ha)					Runoff Volumes (m^3)															Remarks
		Pre - Development Areas		Post - Development Areas		Total Area (ha)	Pre-development Volumes					Post-Development Volumes					Difference - Volumes (m^3)					
		Pervious	Impervious	Pervious	Impervious		2-Year ARI	10-Year ARI	100-Year ARI	WQV	SMAF2	2-Year ARI	10-Year ARI	100-Year ARI	WQV	SMAF2	2-Year ARI	10-Year ARI	100-Year ARI	WQV	SMAF2	
1	CA 01	0.223	0.314	0.060	0.477	0.537	331	691	1,176	73	73	400	783	1,282	101	101	68	92	107	28	28	No SMAF Zone
2	CA 02	0.123	0.286	0.049	0.360	0.408	272	552	924	64	64	303	593	972	76	76	31	41	48	13	13	No SMAF Zone
3	CA 03	0.267	1.383	0.163	1.487	1.650	1,193	2,357	3,883	296	296	1,237	2,416	3,951	314	314	44	59	68	18	18	No SMAF Zone
4	CA 04	0.311	0.713	0.121	0.903	1.024	679	1,381	2,315	159	159	759	1,488	2,439	191	191	80	107	124	32	32	No SMAF Zone
5	CA 05	0.079	0.474	0.067	0.487	0.553	405	796	1,309	101	101	410	803	1,317	103	103	5	7	8	2	2	Under SMAF 2 Zone
6	CA 06	0.133	0.504	0.075	0.562	0.637	448	893	1,480	109	109	472	926	1,517	119	119	24	32	38	10	10	Under SMAF 2 Zone
7	CA 07	0.478	1.837	0.273	2.042	2.315	1,630	3,249	5,380	398	398	1,717	3,365	5,514	433	433	86	115	134	35	35	Under SMAF 2 Zone
8	CA 08	0.290	1.056	0.100	1.246	1.346	943	1,883	3,121	229	229	1,023	1,990	3,246	262	262	80	107	124	32	32	Under SMAF 2 Zone
9	CA 09	0.189	0.411	0.049	0.552	0.601	396	806	1,353	92	92	455	885	1,445	116	116	59	79	92	24	24	Under SMAF 2 Zone
10	CA 10	0.322	0.863	0.110	1.075	1.185	802	1,620	2,703	190	190	891	1,739	2,842	227	227	89	120	139	36	36	Under SMAF 2 Zone
11	CA 11(A)	0.466	1.368	0.115	1.719	1.834	1,255	2,526	4,206	300	300	1,403	2,723	4,436	360	360	148	197	230	60	60	Under SMAF 2 Zone
12	CA 11(B)	0.205	0.588	0.051	0.742	0.793	541	1,090	1,816	129	129	606	1,177	1,917	156	156	65	87	101	26	26	Under SMAF 2 Zone
13	CA 11(C)	0.270	0.780	0.067	0.984	1.051	718	1,445	2,407	172	172	803	1,560	2,540	206	206	86	114	133	35	35	Under SMAF 2 Zone
14	CA 12(A)	0.027	0.137	0.007	0.157	0.164	118	234	385	29	29	127	245	398	33	33	8	11	13	3	3	Under SMAF 2 Zone
15	CA 12(B)	0.263	1.320	0.071	1.511	1.582	1,141	2,257	3,719	283	283	1,222	2,365	3,845	315	315	80	108	125	33	33	Under SMAF 2 Zone
16	CA 12(C)	0.054	0.281	0.015	0.320	0.335	242	478	788	60	60	259	500	813	67	67	17	22	26	7	7	Under SMAF 2 Zone
17	CA 12(D)	0.039	0.205	0.011	0.233	0.244	176	348	574	44	44	188	364	592	49	49	12	16	18	5	5	Under SMAF 2 Zone
18	CA 13	0.116	0.605	0.109	0.612	0.721	522	1,030	1,697	129	129	525	1,035	1,702	131	131	3	4	5	1	1	Under SMAF 2 Zone
19	CA 14(A)	0.443	1.521	0.199	1.765	1.964	1,368	2,736	4,541	331	331	1,470	2,873	4,700	373	373	103	137	160	42	42	Under SMAF 2 Zone
20	CA 14(B)	0.084	0.229	0.038	0.276	0.314	213	429	716	51	51	232	455	747	58	58	20	26	30	8	8	Under SMAF 2 Zone
21	CA 15	0.356	0.954	0.119	1.191	1.310	887	1,791	2,990	211	211	987	1,924	3,144	251	251	99	133	155	40	40	Under SMAF 2 Zone
22	CA 16	0.145	0.983	0.090	1.037	1.128	832	1,633	2,679	209	209	854	1,663	2,714	218	218	23	31	36	9	9	Under SMAF 2 Zone
23	CA 17(A)	0.101	0.384	0.061	0.423	0.485	341	680	1,126	83	83	358	702	1,152	90	90	17	22	26	7	7	No SMAF Zone
24	CA 17(B)	0.303	1.131	0.184	1.249	1.434	1,007	2,009	3,327	245	245	1,057	2,075	3,405	265	265	50	67	78	20	20	No SMAF Zone
25	CA 18	0.943	2.069	0.260	2.752	3.012	1,987	4,048	6,791	463	463	2,274	4,431	7,237	579	579	287	384	446	116	116	No SMAF Zone
26	CA 19(A)	0.284	0.895	0.078	1.100	1.179	813	1,632	2,713	196	196	900	1,747	2,847	231	231	86	116	134	35	35	No SMAF Zone
27	CA 19(B)	0.046	0.152	0.013	0.186	0.198	138	276	458	33	33	152	294	479	39	39	14	19	22	6	6	No SMAF Zone
28	CA 19(C)	0.050	0.162	0.014	0.198	0.212	147	295	489	35	35	162	315	513	42	42	15	20	24	6	6	No SMAF Zone
29	CA 20	0.865	1.786	0.259	2.392	2.651	1,734	3,543	5,953	401	401	1,989	3,883	6,350	505	505	255	341	397	103	103	No SMAF Zone
30	CA 21(A)	1.133	2.194	0.276	3.051	3.327	2,156	4,420	7,441	496	496	2,517	4,902	8,002	642	642	360	482	561	146	146	No SMAF Zone
31	CA 21(B)	0.266	0.536	0.065	0.737	0.802	523	1,069	1,798	121	121	607	1,182	1,930	155	155	84	113	132	34	34	No SMAF Zone
32	CA 22(A)	0.570	4.424	0.176	4.818	4.994	3,712	7,269	11,908	937	937	3,877	7,491	12,166	1,004	1,004	166	222	258	67	67	No SMAF Zone
33	CA 22(B)	0.756	2.070	0.233	2.592	2.825	1,918	3,869	6,454	456	456	2,137	4,163	6,796	545	545	220	294	342	89	89	No SMAF Zone
34	CA 23(A)	1.195	2.251	0.302	3.144	3.446	2,224	4,565	7,693	510	510	2,600	5,068	8,277	662	662	375	502	584	152	152	No SMAF Zone
35	CA 23(B)	0.280	0.513	0.071	0.722	0.793	509	1,047	1,766	116	116	598	1,165	1,903	152	152	88	118	137	36	36	No SMAF Zone
36	CA 24(A)	1.200	3.042	0.375	3.867	4.242	2,852	5,773	9,648	674	674	3,199	6,237	10,187	815	815	347	464	540	141	141	No SMAF Zone
37	CA 24(B)	0.087	0.223	0.027	0.283	0.310	208	422	705	49	49	234	456	744	60	60	25	34	39	10	10	No SMAF Zone
38	CA 24(C)	0.074	0.184	0.023	0.234	0.257	173	350	585	41	41	194	378	618	49	49	21	28	33	9	9	No SMAF Zone
39	CA 25(A)	0.615	1.125	0.315	1.425	1.740	1,118	2,299	3,877	255	255	1,244	2,468	4,073	307	307	126	169	197	51	51	No SMAF Zone
40	CA 25(B)	0.453	0.819	0.232	1.040	1.272	816	1,678	2,832	186	186	909	1,803	2,977	224	224	93	124	145	38	38	No SMAF Zone
41	CA 25(C)	0.011	0.032	0.006	0.037	0.043	29	59	98	7	7	31	62	101	8	8	2	3	3	1	1	No SMAF Zone
42	CA 26(A)	0.010	0.036	0.002	0.044	0.046	33	65	107	8	8	36	69	112	9	9	3	4	5	1	1	No SMAF Zone
43	CA 26(B)	0.034	0.146	0.008	0.172	0.180	128	255	421	31	31	139	269	438	36	36	11	15	17	4	4	No SMAF Zone
44	CA 26(C)	0.447	1.739	0.106	2.080	2.186	1,541	3,071	5,083	376	376	1,685	3,263	5,306	435	435	143	192	223	58	58	No SMAF Zone

Table 4-9 identifies the proposed flood management for each sub-catchment and 3 different options are proposed for potential stormwater management devices. These potential mitigations options are subject to confirmation of flood modelling extents which will be undertaken in the next stages of the project. Hence, sizing of the devices may change and are subject to further analysis and consultations. It is noted that Option 1 (Detention Tanks and SW360 filters) is not preferred by Auckland Transport and will therefore require further consideration in the next phase of design.

The design team will further consult with Auckland Transport and Auckland Council (AC) during the development of detailed design and subsequently will get guidance and approval from AC on preferred stormwater management devices (both mitigation & treatment) for the A2B project based on hydraulic modelling, land availability & suitability.

Table 4-9: Detention Device Management

DETENTION DEVICE MANAGEMENT					
No.	**Sub-Catchment No.**	**Detention Requirement for Flood Management**	**Option 1 - Detention Tanks with SW360 filters (Proposed Dimensions)**	**Option 2 - Existing Ponds (Attenuation & Treatment)**	**Option 3 - Combined mitigation Proposals (Wetlands/Option 1/ Option 2)**
1	CA-01	1% AEP detention required	2x(6.0mx10.0mx1.0m)	Puhinui Pond - 12a Diversey Lane Manukau Central (Aerovista Place Reserve)	**Option 1**
2	CA-02		5.0mx10.0mx1.0m		Wetland Base size (3.5mx17.5mx1.0m)
3	CA-03		6.0mx12.0mx1.0m		Wetland Base size (4.0mx20.0mx1.0m)
4	CA-04		2x(6.0mx11.0mx1.0m)		Wetland Base size (5.5mx27.5mx1.0m)
5	CA-05		3.0mx4.0mx1.0m	Plunket Ave 50R (Puhinui Domain/Park Pond) Plunket Ave 50R (Puhinui Domain/Park Pond)	Wetland Base size (1.5mx7.5mx1.0m)
6	CA-06		6.0mx8.0mx1.0m		Wetland Base size (3.5mx17.5mx1.0m)
7	CA-07		2x(7.5mx12.0mx1.0m)		Wetland Base size (6.0mx30.0mx1.0m)
8	CA-08		2x(7.0mx12.0mx1.0m)		Wetland Base size (6.0mx30.0mx1.0m)
9	CA-09		2x(6.0mx10.0mx1.0m)	Hayman Park Ponds (15R Davis Avenue, Manukau)	**Option 1**
10	CA-10		2x(7.0mx13.0mx1.0m)		**Option 1**
11	CA-11(A)		3x(8.0mx12.5mx1.0m)		**Option 2**
12	CA-11(B)		2x(6.0mx11.0mx1.0m)		
13	CA-11(C)		2x(8.0mx11.0mx1.0m)		
14	CA-12(A)		4.0mx4.50mx1.0m)		
15	CA-12(B)		2x(7.0mx11.5mx1.0m)		
16	CA-12(C)		4.0mx8.5mx1.0m)		
17	CA-12(D)		5.0mx5.0mx1.0m		
18	CA-13		2.50mx3.0mx1.0m		
19	CA-14(A)		2x(8.5mx12.0mx1.0m)		
20	CA-14(B)		5.0mx8.0mx1.0m)		
21	CA-15	1% AEP detention required (Subject to confirmation of a capacity of downstream AC pipe network)	3x(6.5mx10.5mx1.0m)		**Option 1**
22	CA-16		5.0mx9.0mx1.0m		**Option 1**
23	CA-17(A)		4.0mx6.5mx1.0m		**Option 1**
24	CA-17(B)		7.0mx12.0mx1.0m		**Option 1**
25	CA-18		5x(7.0mx12.0mx1.0m)		Wetland Base size (9.5mx47.50mx1.0m)
26	CA-19(A)		2x(6.5mx11.0mx1.0m)		**Option 1**
27	CA-19(B)		4.5mx5.0mx1.0m		**Option 1**
28	CA-19(C)		5.0mx5.0mx1.0m		**Option 1**
29	CA-20		5x(7.0mx12.0mx1.0m)		**Option 1**
30	CA-21(A)		6x(8.0mx12.0mx1.0m)	Rongomai Dam Ponds	**Option 2**
31	CA-21(B)		2x(6.0mx12.0mx1.0m)		
32	CA-22(A)		4x(6.0mx11.0mx1.0m)		Wetland Base size (12.0x60.0mx1.0m)
33	CA-22(B)		5x(7.0mx10.0mx1.0m)		

34	CA-23(A)		7x(7.0mx12.0mx1.0m)	Sancta Maria Ponds	**Option 2**
35	CA-23(B)		2x(6.0mx12.0mx1.0m)		
36	CA-24(A)		6x(7.5mx12.0mx1.0m)	20R Kelvin Hart Drive (Kellaway Drive Reserve)	**Option 1**
37	CA-24(B)		5.0mx8.0mx1.0m		**Option 1**
38	CA-24(C)		5.0mx+7.0mx1.0m		**Option 1**
39	CA-25(A)		3x(6.0mx11.0mx1.0m)		**Option 1**
40	CA-25(B)		3x(5.0mx10.0mx1.0m)		**Option 1**
41	CA-25(C)		2.0mx2.0mx1.0m		**Option 1**
42	CA-26(A)		2.0mx2.5mx1.0m	240R Guys Road Pond (Whaka Maumahara / Guys Reserve)	**Option 2**
43	CA-26(B)		4.0mx5.0mx1.0m		
44	CA-26(C)		3x(6.5mx12.0mx1.0m)		

4.7.3 Network drainage

No drainage network has been designed as part of the concept design. Any drainage network will be designed in subsequent phases of the design.

4.7.4 Outfalls Erosion Control

No outfall erosion control has been sized as part of the concept design. Outfall erosion control will be designed in subsequent phases of the design.

4.7.5 Stakeholder Consultation

The design team consulted with Auckland Council (AC) during the development of the A2B design and subsequently AC provided guidance on preferred stormwater management for the A2B project. Full consultation records were captured and available on request. A summary of the guidance provided by AC includes the following considerations for the A2B design:

- Stormwater quality should be treated at the source to avoid using existing ponds for detention;
- Ponds are an acceptable device for stormwater volume management and should be considered along with wetlands;
- The existing flood plain within the Puhinui Creek catchment will make the design standards difficult to achieve. AC advised that a *practicable* approach should be taken in this area because it looks that the 1% AEP MPD CC storage is not practicable within this catchment.
- AC advised that attenuation that should be provided should be assessed on a sub-catchment basis, relating to the specific network tie-in configuration – specifically does the existing network have the capacity to manage the A2B project flows without causing flooding elsewhere for heavily urbanised areas like the Puhinui Creek catchment.

- AC advised that a reduced level of attenuation would be acceptable in heavily urbanised areas, the extent of attenuation provided should be discussed and agreed with Council in the later stages of the A2B project design.

Internal engagement with AT Environmental Specialist Cathy Bebelman was undertaken by the project team. Further review of the PDPS and stormwater drainage design was undertaken by [redacted] Transvalue Consultants. The below provides an overall summary of feedback on matters considered important to guide the next phase of design:

No.	AT feedback to be addressed during the next design phase
1	Engagement in relation to stormwater and water quality is important to Mana Whenua and to support discussions with Auckland Council's Healthy Waters team. The project team needs to ensure good levels of engagement ahead of (where applicable) and during the consenting phase.
2	Future engagement with Healthy Waters to seek feedback on stormwater treatment, attenuation and flooding is important. However overall, AT is the asset owner and determines what is an acceptable design/asset. AT as an asset owner sometimes has differing requirements and preferences from Healthy Waters. Full treatment (Healthy Waters' preferred approach) versus Best Practicable Option (AT's preferred) approaches in the design in brownfields retrofit sites.
3	Maintenance-led design (also addressing safety issues with access) is important to AT. The project needs an integrated maintenance approach in the future.
4	It is recommended to include stormwater maintenance requirements and costs in any future MCAs.
5	Noted that life cycle cost assessments are required by Stormwater Management Plans (although often not enforced by Healthy Waters).
6	AT's TDM does not allow detention tanks. SW360 filters - note that AT does not approve/accept proprietary devices by default as these are very expensive to maintain. These design elements will need to be reviewed during the next phase. Recommended that the project looks at Glen Innes as an example and sub-catchment treatment options with gross pollutant traps.
7	Flooding: OLFPs along/across roads is fine within prescribed limits but 100 year attenuation is not something that can be done via roads at surface level. So if flows need to go to a pond sized for this then it will be large enough to attenuate lesser events. As discussed in the report, at source stormwater is going to be difficult in this setting. The concept of lots of big buried detention tanks (creating a confined space access problem) is an unusual approach. Piping of OLFs is not usually supported by Healthy Waters and it is considered they would not support tanks as an option given that Auckland Council would own them, being for flood flows.
8	AT does not accept manholes in the road carriageway or cycle lanes.
9	There may be future inclusion in AT's Statement of Intent for indicators relating to green network connectivity and water quality.
10	In future design phases consider resilience in the network for increasing frequency of events and climate change. E.g. detention tanks may not have the capacity to handle future volumes and more frequent events, whereas green infrastructure has greater capacity. Green infrastructure builds greater resilience into the environment for lower socio-economic communities which already have lower base levels of resilience, which is highly relevant to the study area - particularly South Auckland.
11	Innovation and green infrastructure in stormwater design is important. Consider including this within the scope of the next design phase.
12	A high level of integration is needed between design disciplines in the next phase of options assessment and design - stormwater, landscape, urban design, residual land / development opportunities.
13	Note that further assessment of stormwater design needed on Puhinui Road during the next phase and the interface between different disciplines.
14	Some notable areas of flooding around Puhinui / Manukau. Consider opportunities for A2B to link in with other project's such as Panuku's Puhinui Stream project, which has ongoing engagement with Mana Whenua.

5 Geotechnical

A preliminary Geotechnical Appraisal Report has been developed for the corridor (Refer to Appendix G for the 502334-7000-REP-KK-0022 Preliminary Geotechnical Appraisal Report). This report has compiled existing geotechnical information that is available for the corridor and presents a high level overview of site geology and geotechnical risks. No additional testing has been undertaken for the project, due to anticipated length of time prior to implementation.

The proposed works largely require minor earthworks (cut and fill) and construction of new pavement areas. Some retaining structures may be required along parts of the alignment though these are anticipated to be low to moderate heights. The highest risk geotechnical elements are anticipated to be the new bridge structure at the Puhinui Interchange and three existing road bridges to be widened or otherwise upgraded. The existing bridges requiring works are as follows:

- State Highway 1 Overbridge (Te Irirangi Drive)
- Otara Stream Bridge (Te Irirangi Drive)
- Dannemora Underpass (Te Irirangi Drive)

6 Structures

6.1 Introduction

A preliminary option assessment was undertaken to determine the configurations for the structures identified as requiring modification in the Short List Assessment and to inform the cost estimate. The project requires three widened, and one new structure in order to facilitate the proposed road design. Refer to the summary provided in Table 6-1.

The list of structures below details the significant structures along the route that require modification and have been subject to further investigation.

Table 6-1: Bridge Structures Summary

Road	Bridge No.	Bridge Name	Comments
Puhinui Road	BR01	Puhinui Interchange Ramp	New highway ramps leading up to elevated platform at Puhinui Interchange
Te Irirangi Drive	BR02	Te Irirangi Drive – SH1 Underpass	Widening of existing local road bridge over State Highway 1
Te Irirangi Drive	BR03	Te Irirangi Drive – Otara Stream	Widening of existing local road bridge over stream
Te Irirangi Drive	BR04	Te Irirangi Drive – Dannemora Underpass	Widening of existing local road bridge over pedestrian underpass

6.2 Design Standards

The design of all bridge structures will comply with the NZTA Bridge Manual and other standards referred to in the Bridge Manual.

Design Standards to be referenced during the design are as follows:

- New Zealand Building Code
- NZTA Bridge Manual 3rd Edition (including Amendment 3 – October 2018).
- NZTA Highway Structure Design Guide
- NZTA Standards and Guidelines
- NZ Standards

Where the NZTA Bridge Manual and/or NZ Standards do not explicitly cover parts or issues related to the design or construction of specific structural forms; Australian, European or American codes or standards that are applicable may be proposed subject to the agreement of the Transport Agency.

6.3 Design Criteria

The design of the bridges will comply with the performance criteria and technical requirements specified in the NZTA Bridge Manual as modified below. It should be noted that this section applies to new structures only. For structures which are widened, the design criteria will be confirmed prior to detailed design to ensure compatibility of the foundations.

6.3.1 Design Life and Importance Level

The design life for all new structures will be 100 years and the Importance Level will range between 2 to 4 depending on the service requirements and location. The lower importance level will be adopted for footbridges with the highest level being assigned to the interchanges and selected critical structures along the primary route to Auckland Airport.

6.3.2 Durability

For reinforced and prestressed concrete structures, durability will be achieved by appropriate detailing and by complying with the concrete grade and requirements of NZS3101:2006.

All structural steelwork used for the project will be protected against atmospheric corrosion in accordance with NZ Transport Agency 'Protective Coatings for Steel Bridges': Amendment 1, 2017 and AS/NZS 2312: 2014 'Guide to Protection of Structural Steel against Atmospheric Corrosion by the Use of Protective Coating'. Local environmental effects will be assessed, using AS/NZS 2312 as the base in conjunction with HERA Report R4-133:2011 New Zealand Steelwork Corrosion Coatings Guide.

6.3.3 Horizontal and Vertical Clearances

In accordance with the NZTA Bridge Manual (Appendix A3 Figure A4), a minimum vertical clearance of will be adopted. For through lanes this is 6.1m measured between the road surface and the underside of the structure. For the shoulder area 5.6 m will be adopted. In addition, the vertical clearance to new pedestrian structures is recommended to be at least 200 mm greater than adjacent traffic bridges, but not less than 5.1 m and with a minimum of 6.3 m where there are no adjacent traffic bridges over the road crossed by the footbridge. The vertical clearances include 100 mm for future surfacing overlays.

Horizontal clearance of 1.1m between rigid concrete barrier face and bridge piers or abutment is required as per NZTA Bridge Manual.

Horizontal and vertical clearances to existing structures may not meet the above NZTA Bridge Manual requirements for new structures. However, the widening bridges will be designed so that these existing clearances will not be reduced, considering the increased bridge width and effect of the crossfall.

6.3.4 Cross Sections and Side Protection Requirements

Bridge cross sections will comply with geometric and road layout requirements.

Edges of the new structures crossing over road or rail will be protected using rigid concrete TL5 HT barriers consisting of a T80HT barrier system with an elliptical steel top rail and 'F' shape concrete barrier profile, including 12 m long transition lengths from bridge to road barriers where required. This barrier system will be installed on the widened structures only on the side modified by the works.

Edges of all widened existing bridges crossing over stream or pedestrian underpass will be protected using TL4 barrier.

6.3.5 Form, Configuration and Urban Design

The bridge solutions were developed with aesthetics in mind. Bridge forms that are well portioned, integrate the different components of the structure elegantly and have a consistent appearance, are desired. Bridges will have smooth clean lines in elevation and have the minimum practical structure depth to achieve a slender overall appearance. The outside face of bridge barriers will incorporate urban design panels with motifs as per Urban Design artwork requirements. This design will be informed by Mātauranga Māori.

6.3.6 Geotechnical

A high-level desktop study of the project site was undertaken based on historical knowledge of the area (refer to Preliminary Geotechnical Appraisal Report 502334-7000-REP-GG-0022 Revision 0, dated 12 August 2019). The majority of the alignment is located within a region generally described as the Manukau Lowlands and Auckland Volcanic Field and is generally flat or gently undulating. The 1:50,000 scale Geological Map of the Auckland area (Kermode, 1992) indicates the alignment is predominantly underlain by sediments of the Plio-Pleistocene aged Puketoka Formation, which is part of the Tauranga Group. The Puketoka Formation is variably comprised of 'light-grey to orange-brown pumiceous mud, sand, and gravel with muddy peat and lignite'. Younger, Holocene-aged alluvial deposits have been mapped approximately mid-way along the alignment and are described as 'sand, silt mud and clay with local gravel and peat beds. In the wider area are volcanic deposits associated with the Manurewa, Papatoetoe and Crater Hill Volcanoes.

Older geologic formations are buried below alluvial deposits in this map extract but are interpreted as being Kaawa Formation (mapped in the Weymouth area, and known from multiple investigations in South Auckland), underlain by the East Coast Bays (ECB) Formation.

Loose sands, silts, peats and clays are all expected within the Tauranga Group soils. As such, geotechnical risks such as consolidation settlement and liquefaction are likely to impact the design of structures along the alignment.

Existing bridges were all founded on piles, embedded into bedrock. Therefore, piles are adopted to support the widening portion of the existing bridges. The expected depth to rock at each structure location is summarised in Table 6-2, though it should be noted that presented values are approximate estimates only (on the order of +/- 5m accuracy) and subject to confirmation by a geotechnical investigation.

Table 6-2: Expected Rock Depth Summary

Road	Bridge No.	Bridge Name	Likely Rock Depth (m)
Puhinui Road	BR01	Puhinui Interchange Ramp	~ 25m*
Te Irirangi Drive	BR02	Te Irirangi Drive – SH1 Underpass	~ 15m**
Te Irirangi Drive	BR03	Te Irirangi Drive – Otara Stream	Unknown, estimated to be <25m*
Te Irirangi Drive	BR04	Te Irirangi Drive – Dannemora Underpass	~ 15m*

*Based on estimate from Preliminary Geotechnical Appraisal Report 502334-7000-REP-GG-0022 Revision 0, dated 12 August 2019.

**Based on as-built bridge drawing 9100946 (Sheet S015), titled ETCART Motorway Overbridge Main Contract, dated August 1999.

Geotechnical investigations will be required at a later design stage to inform an assessment of the geotechnical risks to the proposed works.

6.3.7 Design Loads

Design loads for new bridge structures will be in accordance with the NZ Transport Agency Bridge Manual.

6.3.8 Seismic Design and Performance

Bridge structures will be designed to seismic demand requirements of Section 5 of the Bridge Manual and NZS1170.5.

It should be noted that liquefaction-related risks have not been identified given the preliminary nature of geotechnical studies so far (desktop study only). This will be identified later in the design and incorporated into the seismic design philosophy.

6.3.9 Bridge Deck Joints and Bearings

Design will minimise number of bridge deck joints and bearings with the use of semi-integral/integral construction.

Where bearings are required, preference will be for laminated elastomeric bearing as per NZTA Bridge Manual maintenance requirements.

6.3.10 Access for Inspection and Maintenance

All parts of structures except buried surfaces, abutment backwalls and the rear face of earth retaining structures will be accessible for the purposes of maintenance, repair and inspection. Maintenance requirements were considered when developing the bridge solutions and minimised (or eliminated) where possible. Some examples include:

- Using concrete elements instead of steel to eliminate repainting
- Using standard precast girders with proven construction detailing and installation methodology
- Using integral or semi-integral construction, where possible, thereby eliminating or minimising bearing and deck joint inspection and replacement.

6.3.11 NZTA Ownership

The ownership of bridge structures over the state highway is normally NZTA responsibility, AT is liable to maintain the carriage/shared path/footpath pavement and facilities above excluding the side barriers. Further liaison with NZTA and their maintenance team is required in the next design phase.

6.4 Design Development

6.4.1 Design Philosophy

The key drivers in the development of the bridge solutions included addressing the design standards, Safety in Design, anticipated construction requirements (e.g. temporary traffic management), and maintenance requirements. Simple bridge structural forms with symmetrical span arrangements were preferred.

The bridge solutions were developed to maximise the use of standard precast concrete bridge beams. This follows from having well-established capabilities in construction of precast concrete bridges in the Auckland bridge construction industry. As several the bridges will be spanning over state highway or rail lines, using precast concrete bridge beams is preferred as they facilitate rapid bridge construction with span installation that will minimise disruption to the surrounding road network. The durable nature of precast concrete assists in reducing the maintenance requirements of these structures to achieve the required design life.

The final structure configurations are a function of the span limitations of precast beams, for a given structural depth.

The use of integral construction is adopted where feasible to remove on-going inspection and maintenance requirements for bridge bearings as well as elimination of expansion joints.

6.4.2 Design Assumptions

The bridge designs were developed based on the following design assumptions:

- Geometry of the existing bridges are assumed to be as per as-built drawings. No site measurement has been undertaken. As-built drawings may not be perfectly accurate but was considered acceptable at this design stage. Notably, one set of drawings for the bridge over Otara stream was illegible, and dimensions were roughly scaled and assumed.
- Road levels above and under existing bridges are assumed from LIDAR survey, so would not be accurate (+/-0.2m accordingly to LINZ). This could have impact on clearance of the widened bridges, especially in cases where existing bridge crossfall is to be maintained.
- Condition of existing bridges are assumed to be fair and would remain in service for foreseeable future, based on available inspection reports from asset owner (Auckland Transport and Auckland Motorway Alliance).
- Design live loads for new bridges and widened portion of bridge is assumed to be HN-HO-72 which would be appropriate for buses (including double decked buses in service currently). No allowance has been made for light rail loading, because this is not yet defined. In future, when it is better defined, the light rail loading would need to be accessed against the capacity of both the existing bridge elements and new widening elements.
- No allowance has been made for gantries supporting overhead wires for light rails. Again, this is because light rail is not defined. In far future, light rail technology may develop so that there won't be need for overhead wires.

6.4.3 Puhinui Interchange Ramp

The proposed structural configuration for the Puhinui interchange ramps utilises standard precast super-T girders, either 1.0m to 1.2m deep for short spans and 1.525m deep for longer spans (27m up to 32m). The superstructure comprises either 5 or 6 girders with a 200mm thick deck slab. The girders will be positioned evenly under the carriageway.

At top of the ramps, and elevated platform is proposed to comprise of hollow core beams over the rail track, to minimise structural depth and match the Puhinui Interchange concourse (under construction as a seperate project).

The ramps will be continuous at the pier and simply supported at each of the abutments and at interface with the elevated platform.

Based on the limited geotechnical information a preliminary foundation option has been developed for the proposed design. The foundation comprises of reinforced concrete 'hammerhead' headstocks supported by a single 1.5m diameter cast-insitu concrete column. The column terminates below ground level and is supported by a single 2.1m diameter piles.

Earthworks for the approach formations will be retained by MSE walls. Currently 1.2m diameter piles have been allowed for to support the abutment bearing seat.

For further details refer to the preliminary structure options technical note for the Puhinui Interchange Ramp in Appendix M.

6.4.4 Te Irirangi Drive Bridge over SH1

The preferred structural option for the bridge over SH1 is widening on the northern side, with hollowcore girders 0.8m deep to match the existing bridge. Widening on the northern side has advantage of maintaining existing vertical clearance over SH1, due to longitudinal fall of SH1 level toward the north. Existing piers and abutment will be extended and supported on additional piles to match existing.

Articulation of the widened bridge will have to match existing configuration, i.e. simply supported at both piers and abutments.

For further details refer to the preliminary structure options technical note for the SH1 bridge in Appendix F.

6.4.5 All other Structures

All other structures that require modification are considered less complex and therefore as part of the project scope have not undergone a specific option study. The structural configurations have been selected within the identified constraints using standard details developed from best practice and previous project experience.

6.4.6 Summary of Bridges

Table 6-3: Bridge Structure Solutions

Puhinui Road – New Puhinui Interchange Ramp	
Bridge width	Total 9.0 m, comprises 2 no. 3.5 m RTC lanes, and 2 no. shoulder 1.0 m at the ramp. Widened out to 17.6 m at the elevated platform, comprises 2 no. 3.5 m RTC lanes, 2 no. 0.3m channel drains and 2 no. 5.0 m lanes.
Span arrangement	17 spans varies in length from 11.5 m to 35.0 m, total length of 440 m.
Superstructure	Super-Ts 1.525m deep typically, and hollowcore 0.75m deep over rails. All with 0.18m thick insitu concrete topping.
Substructure	Concrete hammer head supported on 1.5m diameter concrete column for ramp piers, or concrete headstock supported on blade walls for platform piers.
Foundation	Single 2.1 m dia. bored concrete piles at ramp piers, or 5 no. 1.2m dia. bored concrete piles at platform piers.
Additional comments	The ramps are adjacent to Hunua watermain running under Puhinui Road. Therefore, single large diameter piles were adopted to be 3m clear from the watermain.

Te Irirangi Drive - Existing Bridge over SH1	
Bridge width	Total 40.1 m, comprises of 2 no. 6.2 m shared use paths (including 2.1 m buffer), 5 no. 3.2 m traffic lanes, 2 no. 3.5m RTC lanes, 4 no. 0.3m channel drains, and 2 no. raised medians 2.0m and 1.5m. Widening existing bridge by 17 m approx. on the northern side.
Span arrangement	4 spans 11.5 - 18.0 - 18.0 - 11.5 m (same as existing bridge)
Superstructure	15 new 800 mm hollowcore beams simply supported
Substructure	Concrete pier headstock supported on concrete columns
Foundation	3 new 1200 mm dia. bored concrete piles at piers 3 new 900 mm dia. bored concrete piles at abutments
Additional comments	The new bridge is a widening of the existing bridge by approximately 17 m. The superstructure and substructure will be of a similar form to that of the existing bridge. The existing abutment seat and pier headstock will be rigidly connected to the new ones. The existing barriers on each side of the bridge will be removed and replaced with TL5 HT barriers. Strengthening of the southern footpath and deck slab would be required as the existing barrier provides untested level of containment (likely to be below TL3). This widening toward the northern side does not reduce vertical clearance to SH1 below, which is critical at the southern side. But this would need to be confirmed by survey.

Te Irirangi Drive - Existing Bridge over Otara Stream	
Bridge width	Total 37.6 m, comprises of 2 no. 6.45 m shared use paths (including 2.1 m buffer), 4 no. 3.2 m traffic lanes, 2 no. 3.5m RTC lanes, 4 no. 0.3m channel drains, and 2 no. raised medians 3.1m and 0.6m. Infilling between the existing twin bridges and widening by 4.4m and 7.0m at eastern and northern side respectively.
Span arrangement	Single span 18 m (same as existing bridge)
Superstructure	12 new 775 mm Super-Tee beams integral with abutment
Substructure	Abutment seat on piles and integral with superstructure
Foundation	8 new 600 mm dia. bored concrete piles
Additional comments	The new bridge is an infilling of the existing twin bridges by approx. 8m, and widening on both side, by 4.4m and 7.0m at eastern and northern side respectively. The superstructure and substructure will follow a similar structural form to the existing bridge. The existing abutment seat will be rigidly connected to the new abutment seat. The existing barriers on each side of the bridge will be removed and replaced with TL4 concrete barriers. This widening toward the northern side does not reduce vertical clearance to Otara stream below, because a reverse cross fall is adopted for the widening portion.

Te Irirangi Drive - Existing Bridge over Dannemora Pedestrian Underpass	
Bridge width	Total 36.5 m, comprises of 2 no. 6.55 m shared use paths (including 2.1 m buffer), 4 no. 3.2 m traffic lanes, 2 no. 3.5m RTC lanes, 4 no. 0.3m channel drains, and 2 no. raised medians 1.2 m. Infilling between the existing twin bridges and widening by 4.6m both sides.
Span arrangement	Single span 8.7 m (same as existing bridge)
Superstructure	4 new 587 mm hollowcore beams each side, and 8 new solid precast beam with insitu topping for infilling portion, all simply supported.
Substructure	Abutment seat on piles
Foundation	7 new 600 mm dia. bored concrete piles
Additional comments	The new bridge is an infilling of the existing twin bridges by approx. 8m, and widening on both side by 4.6m. The superstructure and substructure will follow a similar structural form to the existing bridge. The existing abutment seat will be rigidly connected to the new abutment seat. The existing barriers on each side of the bridge will be removed and replaced with TL4 semi rigid thrie beam barriers. This widening toward the northern side does not reduce vertical clearance to the footpath below, because a reverse cross fall is adopted for the widening portion.

6.4.7 Design Departures

No design departures have been identified at this stage however, when full topographic survey and geotechnical data is available a more detailed assessment will be undertaken.

7 Utilities

7.1 Design Standards

Minimum clearance requirements and treatment of existing and proposed utilities with respect to protection and or relocation are based on experience from previous projects of similar nature. The proposed realignment, relocation, protection and/or proposed new services still need to be discussed and agreed with the utility owners and operators.

The following guidelines were referenced for other standard specifications such as cover level requirements:

- National Code of Practice for Utility Operators' Access to Transport Corridors (Minister for Infrastructure)
- State Highway Control Manual (NZ Transport Agency)
- NZECP 34:2001 New Zealand Code of Practice for Electrical Safe Distances (Ministry of Consumer Affairs)
- Working on Your Land. Information for Landowners and Occupiers (Transpower)
- National Policy Statement on Electricity Transmission (Ministry of Environment / NZ Government
- AS 5488 Classification of Subsurface Utility Information (SUI)
- Auckland Council (November 2015), Code of Practice for Land Development and Subdivision Chapter 4 – Stormwater, Version 2.0;
- Watercare (December 2017), Water and Wastewater Code of Practice for Land Development and Subdivision, Chapter 5: Wasterwater;
- Watercare (December 2017), Water and Wastewater Code of Practice for Land Development and Subdivision, Chapter 6: Water;
- Watercare, Water transmission standards
- Watercare, General Civil Construction Standard
- A Guide for Working Safely (Vector)
- Vector, A Guide for Working Safely
- Open Trench and Ducting Specifications for Natural Gas Service Pipes (Vector)
- Vector, Open Trench and Ducting Specifications for Natural Gas Service Pipes
- General Specification – Duct Laying and Jointing Chamber Work (June 2013) (Vodafone)
- Chorus, UFB Ready Property Guidelines

7.2 Available Information

The utility services information has been collated from the following sources:

- Water reticulation and bulk water supply as-builts records from Auckland Council – Watercare
- Wastewater reticulation and bulk water supply as-built records from Auckland Council – Watercare
- Fibre communication as-built records from Chorus, Vodafone and Vector
- Low to medium Voltage as-built records from Vector Electricity and WEL Services
- High Voltage power line as-built records from Transpower
- Gas pipes as-built records from Nova Gas, First Gas and Vector Gas.

All the information was provided in the form of CAD drawing or GIS data.

The data were combined and was checked against the property boundaries as an early quality check. From this high-level desktop investigation, it is important to note that various optic fibre communication cables from Chorus do not follow a logic path and will have to be investigated further during the next phase of this project. The occurrence of the is only in isolated areas and do not pose any major risk to the project.

7.3 Design Criteria

Generally, the Utility Operators preference is for their utilities to be located outside the main traffic lanes to enable access and maintenance. Where any road widening, and structural works may impact on this, the utilities are to be either relocated, replaced or protected provided the Utility Operator considers their asset is adequately protected and will not cause issues for the provision of their service to their customers.

No consideration has been made at this stage for future proofing the services however this will be addressed as part of the next phase of consultation.

This section provides preliminary methods and management of relocating the affected utilities, as well as proposed treatments thereof within road corridors in the Auckland region. These criteria may at times be impractical to achieve and will require further investigation and mitigation measures. In these circumstances any deviation from the standard will be discussed and agreed with the affected utility operators.

7.3.1 Methods and Management of Relocation Works

Network utility relocation works will be managed so that the installation, design, operation, maintenance and upgrade will be in compliance with the relevant (national, international or industry) standards, codes of practice or guidelines in order to avoid, remedy or mitigate potential adverse effects on the health and safety of people and on the surrounding environment. All relocation works will take into account the relevant provisions in the Local Government Acts and NZTA New Zealand Acts and any other relevant legislation. In additional any utility relocation works within the State Highway (motorway) and local road reserves will consider the guidelines from the proposed National Code for Utilities' Access to the Transport Corridors.

7.3.2 Proposed Treatment to Utility Services

The general philosophy in dealing with utility services is that services will be protected by concrete capping or similar methods where possible, in preference to relocation, to reduce the disruption to the Utility Authority and their customers in accordance with specific Utility Standards.

All affected utility operators are to be consulted to discuss the proposals, effects on the existing utilities and any potential opportunities for new (future proofing). This proposed utility design will be consulted with each utility provider for their approval.

Existing utilities within the project extent have been reviewed. Any existing utilities along Puhinui Drive corridor which are affected by the proposed widening and intersections are to be diverted.

Any utilities, crossing the carriageways, is under the existing carriageways or affected by a motorway resulting in level changes are to be replaced with new to maintain existing minimum cover levels in accordance with the standards.

Where possible, minimum covers and minimum clearance to the utility assets will be provided. However, where this cannot be achieved, diversion of services or installation of protective slabs will be considered as part of the future design process.

Where possible, Transpower high voltage pylon realignments will be avoided by revisiting the roadway alignments in conjunction with cycle and footpath alignments under the next phase of the project.

Network utility operations will be managed so that the installation, design, operation, maintenance and upgrade will be in compliance with the relevant (national, international or industry) standards, codes of practice or guidelines in order to avoid, remedy or mitigate potential adverse effects on the health and safety of people and on the surrounding environment.

In some areas it is anticipated that construction activities will be able to commence without impact on the services. In the affected areas the majority of services if possible will be relocated and/or protected prior to commencing construction works.

7.4 Design Development

7.4.1 Design Philosophy

This design philosophy is based on a highly level desktop study that addresses the ultimate RTC conceptual design. The proposals will require various levels of protection, replacement and/or relocation works to existing utilities and future proofing. The existing utilities data was collected using GIS and BeforeUDig for the purpose of the desktop study and preliminary approach. Updated as-built information and other information from the utility operators will be obtained during consultation with them to validate and build the baseline data as the project progresses.

Table 7-1 summarises all utility operators with their assets within the project extent and their contact representative.

Table 7-1 Utility Organisations

Organisation	Utility Type
Watercare (Auckland Council)	Watermain, Wastewater
Chorus	Chorus Fibre Optics
Vodafone	Vodafone Fibre Optics
Vector Services	Gas Supply Electricity Communications.
WEL Services	*Electricity
Transpower	High Voltage Electricity
Nova Gas	Gas Supply
First Gas	Gas Supply
NZTA	ITS (ATMS)

* From the information supplied by WEL Electric services, it is not affected by the protect. More investigation will however be done in the next phase to ensure that there are none of their services affected.

7.5 Design Assumptions

From the desktop study, our main design assumption is that, all existing utilities that need to be potentially protected, relocated or replaced will be able to be engineered and the works to be undertaken.

7.6 Affected Utilities

Due to the nature of the project and utility study conducted, the project can be divided into three main sections:

- Puhinui Road, from SH20 through Kenderdine Road, Bridge Street and Cambridge Terrance to Lambie Drive
- Manukau CBD, which includes:

- Lambie Drive,
- Manukau Station Road,
- Davies Avenue,
- Ronwood Avenue,
- Great South Road,

- Te Irirangi Drive, from the corner of Cavendish Drive and Great South Road to Haven and Park Drive.

Refer to Table 7-2, Table 7-3 and Table 7-4 for affected utilities, including potential mitigation measures, for Puhinui Road, Manukau CBD, Te Irirangi Drive respectively.

7.6.1 Puhinui Road (SH20 – Lambie Drive)

Table 7-2: Affected Utilities Puhinui Road

Affected Utility Owner	Utility Description	Location	Potential Mitigation
Watercare (AC)	Potable Water Reticulation	Along the road section and crossing	Pipes to be protected, or relocated to cycle or footpaths as required. This includes Humua 4 watermain which is proposed to be protected. Crossing pipes to be protected where necessary. Valve boxes to be relocated to cycle and footpaths.
Watercare (AC)	Wastewater Reticulation	Along the road section and crossing	In isolated cases, wastewater manholes to be relocated to tie in with kerb lines. Various wastewater pipes to be decommissioned where properties are acquired Where there is potential redevelopment of acquired properties, wastewater pipes to be extended to new connection points.
Chorus	Fibre Optic Communication	North and South side along the road section. Various crossings	The majority of the northern cable runs are unaffected with isolated protection required. The southern cable runs to be relocated to the cycle or footpaths.
Vodaphone	Fibre Optic Communication	Short cable runs along the road section with a few crossings.	Isolated relocation may be required, especially west of the proposed new Puhinui Railway Station.
Vector Services	Gas Supply	Along the road section and intermitted crossings	Gas pipe from SH20 to the Puhinui Railway line to be relocated towards southern cycle or footpaths. Isolated crossings to be extended along the remaining road section.

Affected Utility Owner	Utility Description	Location	Potential Mitigation
Vector Services	Electricity	Overhead cables from SH20 to the proposed new Puhinui Railway Station, running along the existing southern edge of the road. From the railway line to Lambie Drive, the cables are mostly on the northern edge.	Overhead cables from SH20 to the proposed new Puhinui Railway Station to be relocated (underground) towards the south, to the edge of the footpath. Various crossing along the route to be relocated to suitable positions as required.
Vector Services	Fibre Optic Communication	Most cable runs are running along the road section under the existing footpaths with isolated crossings.	Cables to be relocated to cycle or footpaths where they will be running underneath the proposed new roadway as required.
Nova Gas	Gas Supply	Along the righthand edge of the existing roadway section with intermitted crossings	Gas pipe to be relocated towards southern cycle or footpath. Isolated crossings to be extended along the remaining road section.
First Gas	Gas Supply	No First Gas pipes are present.	N/A
Transpower	High Voltage Overhead Cables	No Transpower cables are present.	N/A

7.6.2 Manukau CBD (Lambie Drive through CBD to Te Irirangi Drive)

Table 7-3: Affected Utilities Manukau CBD

Affected Utility Owner	Utility Description	Location	Potential Mitigation
Watercare (AC)	Potable Water Reticulation	Along the road section and crossing	Very few water reticulation pipes are affected. Pipes to be protected through cover slabs as required.
Watercare (AC)	Wastewater Reticulation	Along the road section and crossing	Manhole covers to be upgraded to cycle friendly covers as required.
Chorus	Fibre Optic Communication	Various cable runs are under the existing roadways.	Cable runs to be relocated as required.
Vodaphone	Fibre Optic Communication	Most cable runs are running along the road section under the existing footpaths with a few crossings.	Protection at some intersections may be required, otherwise relocation for cables will be recommended.

Affected Utility Owner	Utility Description	Location	Potential Mitigation
Vector Services	Gas Supply	Mostly along the road section and intermitted crossings. Pipes running under the roadway in isolated areas i.e. at upgraded intersections.	Gas pipe to be protected, otherwise relocated in isolated areas to cycle or footpath.
Vector Services	Electricity	Most services are underground and is running mostly under the existing footpaths.	Relocate as required.
Vector Services	Fibre Optic Communication	Most cable runs are running along the road section under the existing footpaths with isolated crossings.	Cables to be relocated to cycle or footpaths where they will be running underneath the proposed new roadway. Others can be protected.
Nova Gas	Gas Supply	No Nova Gas pipes are affected, or it is not present.	N/A
First Gas	Gas Supply	No First Gas pipes are present.	N/A
Transpower	High Voltage Overhead Cables	No Transpower cables are present.	N/A

7.6.3 Te Irirangi Drive (Great South Road – Park Drive)

Table 7-4: Affected Utilities Te Irirangi Drive

Affected Utility Owner	Utility Description	Location	Potential Mitigation
Watercare (AC)	Potable Water Reticulation	Along the road section and crossing	Most water reticulation pipes are unaffected. Protection at intersections as required.
Watercare (AC)	Wastewater Reticulation	Along the road section and crossing	Manhole covers to be upgrade to a cycle friendly cover as required.
Chorus	Fibre Optic Communication	Various cable runs are under the existing roadways.	Isolated relocation required.
Vodaphone	Fibre Optic Communication	No Vodaphone services are affected or it is not present.	N/A
Vector Services	Gas Supply	The majority of the gas pipes are outside of the proposed new roadway, with isolated encroachment under the proposed new roadway.	Gas pipe to be protected, otherwise relocated in isolated areas to cycle or footpath.

Affected Utility Owner	Utility Description	Location	Potential Mitigation
Vector Services	Electricity	Most services are low voltage underground cable feeding the street lights and is running mostly under the existing footpaths.	Relocate as required.
Vector Services	Fibre Optic Communication	Most cable runs are running along the road section under the existing footpaths with isolated crossings.	Cables to be relocated to cycle or footpaths where they will be running underneath the proposed new roadway. Others to be protected.
Nova Gas	Gas Supply	One gas pipe crossing	Gas pipe to be protected, where necessary.
First Gas	Gas Supply	One gas pipe crossing	Gas pipes to be protected, where necessary.
Transpower	High Voltage Overhead Cables	Crossing at Ch 0.350 at SH1. Not affected. Crossing at Ch 1.600. Eastern side Pylon is affected. Crossing at Ch 2.515. Not affected. Crossing at Ch 2.625. Not affected Crossing at Ch 2.700. Not affected. Two Transpower underground power cables along northbound lane and centre of Te Irirangi Drive	Affected pylon to be relocated. The two underground cables to be protected where required.

8 Pavements and Surfacing

8.1 Design Development

No assessment of the existing pavement condition, design of any rehabilitation of the existing pavement, or design of any new pavement has been undertaken at the SSBC stage. This is due to the anticipated long project implementation timeframes and likelihood that the condition of the existing pavement will change considerably between now and implementation.

8.1.1 Design Assumptions

To inform the SSBC cost estimate, the following assumptions been made in respect to pavement types and must be read in conjunction with Table 8-1:

- Type 1: New pavement structure:

This pavement type will be utilized where roads need to be widened or where the median need to be filled for the new bus lanes.

It can alternatively be used where an existing pavement has come to the end of its design life and are need to of heavy rehabilitation.

This pavement is suited for higher traffic volumes may reduce frequent maintenance during the design life of the pavement, but will highly depend on the maintenance strategy that will be developed during the detail design stage.

- Type 2: Strengthening an existing pavement structure:

This pavement type will typically be used where the existing pavement structure shows signs of base or subbase failures over a large area of the pavement.

Where every there are isolated pavement failures, this pavement may be used to fix those areas, by removing the failed pavement and to be replaced with this pavement. This will however need to be investigated closer to the construction.

- Type 3: Resurfacing an existing pavement structure:

The resurfacing pavement type will be used where the exiting road levels remain intact and also in conjunction with an existing pavement structure that has a reasonable life time left. The remaining pavement life will need to be determined closer to construction.

In some areas, a levelling course may be required to produce final road levels. These factors were built into the costing of this pavement type.

- Type 4: Full reconstruct or partially strengthening:

There are several local streets and larger accesses that need to tie into the general traffic lanes, which do not necessarily carry heavy traffic loading. Therefore, this pavement type will have utilised to construct the tie-in areas or where the pavement structure of a local road with lesser traffic needs strengthening.

- Type 5: Bridge Surfacing

This pavement will only be used where surfacing is required directly on a new concrete structure for instance on the new bridge ramps to bus station platforms at the Puhinui Train Station and the widening of the road bridge over State Highway 1.

- Type 6: Shared Use Path Pavement

This pavement type is reserved for Shared Use Path, bicycle lanes and foot paths. For the purpose of the construction cost estimate, all areas where access streets of bicycle streets are proposed, a Type 4 pavement has been measured.

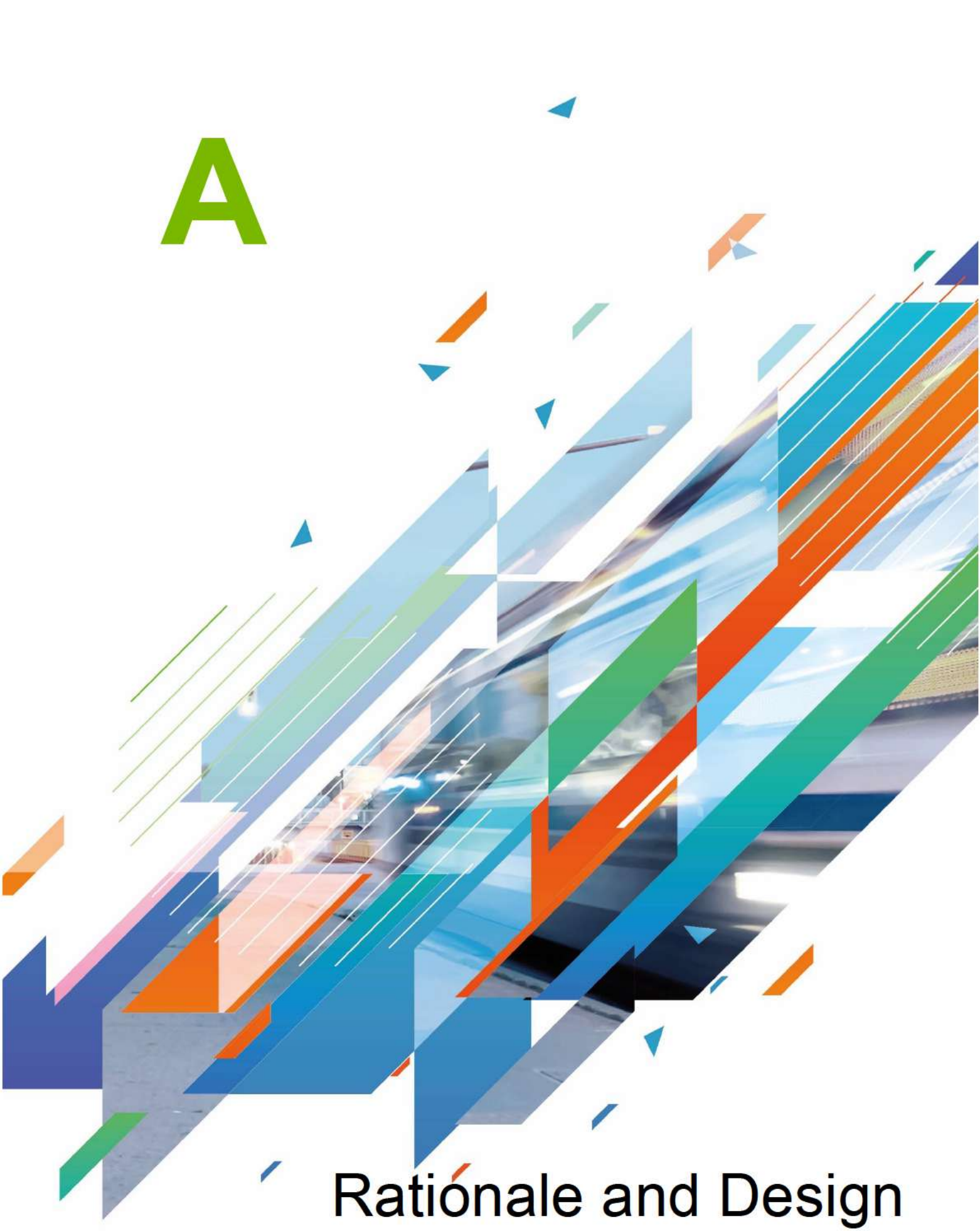
The pavement types are based on experience from recent projects of similar scope and location.

These pavement types are indicative only and will need to be refined once a detailed pavement investigation and analysis have been conducted, as well as an accurate topographical survey.

Table 8-1: Proposed pavement types for all pavement works

Type 1 Pavement (Widening / RTC OGPA)	Type 2 Pavement (Strengthening OGPA)	Type 3 Pavement (Resurface OGPA)	Type 4 Pavement (Local Road resurface)	Type 5 Pavement (Bridge OGPA)	Type 6 SUP Pavement
30mm EPOXY OGPA	30mm EPOXY OGPA	30mm OGPA	50mm AC14	30mm EPOXY OGPA	100mm 20MPa concrete
Grade 5 membrane	Grade 5 membrane	Grade 5 membrane	100mm AP40. CBR ≥ 80%	25mm DG7 60/70 Binder, levelling course	100mm unbound granular ≥ 45%
280mm AC20	145mm AC20		150mm unbound granular subbase CBR ≥ 15%		Imported fill with CBR 15%
SAMI	50mm AC14 HF		150mm lower subbase		Design subgrade CBR 3%
200mm Cement bound GAP65 subbase (pre-cracked)			Design subgrade CBR 3%		
400mm SIL (Soaked CBR 10%)					
Design subgrade CBR 3%					

A



Rationale and Design Principles for Active Modes

Appendix A
Rationale and Design Principles for Active Modes

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Technical Note

To	**Auckland Transport**	From	[redacted]
Copy	[redacted]	Reference	**502334-7000-TEC-KK-0022**
Date	**13/03/2020**	Pages (including this page)	**22**
Subject	**Rationale and Design Principles for Active Modes**		

1 Introduction

This technical note outlines the importance of integrating active mode infrastructure along the A2B corridor, both as an essential component of connecting customers to the rapid transit stations, and as an additional transport option in and of itself along the corridor. It is intended that this note is read in conjunction with the technical note on the Key Design Elements for Active Modes.

It is worth noting that a separate package of work, still part of the A2B Business Case, is investigating networks for active mode access to the stations, outside of the A2B corridor. This technical note, therefore, only refers to active mode access moving along the corridor itself.

2 Rationale for active mode infrastructure along the A2B corridor

Active mode infrastructure along the A2B corridor will provide several important roles in the wider A2B project; it will:

1. Provide more transport choices for people to access the A2B stations and the wider area.
2. Contribute to all the project objectives for A2B.
3. Be in line with existing design guidelines, policies and strategies concerning active modes.

2.1 Enable access choice and build an equitable street

The provision of active mode infrastructure will enable better access choices both to the A2B stations and around the area for the local community.

Existing transport options to move around this part of Auckland are narrow. The greatest share of infrastructure, space and facilities are focused on moving the private car around, and where it needs to stop. This is the only mode that offers quality, in terms of facilities and travel time, and that feels 'safe' and comfortable. Because of such a strong focus on one form of transport, it is unsurprising that most people move around in private cars.

Despite this, there is a significant number of people in the community who can't drive because of their age (young and old), or who can't afford to own a car. By offering these people a safe, direct, comfortable place to walk or ride a bike/scooter/mobility scooter, we will be creating a street with an equitable environment for everyone to enjoy. We also know from research and survey data that there are many people in the community who, if offered a safe, direct, comfortable and attractive alternative transport choice to the private car, would take it.

As shown in Figure 1, the station access catchments for the proposed station locations cover much of the A2B corridor itself. These catchments represent a 1km distance, or approximately 12-minute walking time, from/to the proposed stations. Research shows this is the average distance most people will walk

to reach a rapid transit station. Overlapping sections of these catchments highlight how these sections of corridor are important for accessing stations in both directions.

A desired and important outcome for this infrastructure is a continuous facility along the whole corridor. While some small sections of the corridor are not captured in the catchments shown in Figure 1, this does not mean a break in the active mode facility should occur. The overlaps of catchments shown in Figure 1 help us to understand where there will likely be a consolidation of people near the stations, and where path infrastructure will need to be widened to safely and comfortably accommodate these movements. Following the rapid transit route will be the most direct, and therefore fastest, way to reach the stations for anyone living along, or close to, the corridor.

While not many people are expected to walk the entire corridor length (approximately 18km), the attractiveness of it along shorter segments, and as a single distance to be travelled on by a wheeled mobility device, particularly a bike, is high. For this reason, it is important to provide continuous active mode facilities. Additionally, it is likely there will be a portion of people using the facility to travel longer distances by active modes, rather than just to reach a single station. Such uses include connecting to places of employment or reaching specific destinations. The Northwestern shared path, which follows SH16 from Auckland CBD to Westgate, has some of the highest numbers of people on bikes using it daily in Auckland, when comparing routes with cycle counters in Auckland, around the 600-1,000 people per day. It is worth noting that the infrastructure provided on the Northwestern shared path no longer meets AT's best practice standards, as pedestrians and people on wheeled mobility devices are not separated from each other.



Figure 1: A2B proposed stations and 1km catchments (approximately 12-minute walk)

2.2 Contributes to the project's investment objectives

Integrating active mode infrastructure along the A2B corridor directly aligns and supports the project's investment objectives. Without active mode infrastructure, stations would have limited opportunities for access and the communities into which the corridor is being connected would see minimal benefit. Active

mode infrastructure brings an opportunity for everyone to enjoy and utilise this corridor for movement, and as a place to socialise with others. Further, such infrastructure is free for everyone to use. A summary table of the different ways active mode infrastructure supports the A2B investment objectives is included in Attachment 1 of this technical note.

2.3 In line with existing design guidelines, policies and strategies concerning active modes

There are several existing guidelines, Business Cases, strategies and policies that provide support for, and guidance on, active modes. Of particular relevance to the provision of active mode infrastructure along the A2B corridor are the following, further details of which are provided in Attachment 2 of this technical note.

- The Auckland Transport Urban Street and Road Design Guide (USRDG) (Due for publication 2019). This guide sets a new vision and approach to designing and developing urban streets, that is focused on people, safety, and increasing the choices and opportunities of Aucklanders.
- The Auckland Cycling Programme Business Case (ACPBC) which established a case for investment in a programme of cycling activities in Auckland over the 2018-2028 period (MRCagney for Auckland Transport, 2017).
- The Government Policy Statement (GPS) (Ministry of Transport, 2018) includes a number of strategic priorities which align with enabling safe and comfortable active mode access along the A2B corridor.
- The Cycle Safety Action Plan published by the NZ Transport Agency entitled *Making Cycling Safer and More Attractive* (2015). This was produced to aid implementation of the 35 recommendations that the Cycling Safety Panel made in its 2014 report (Cycling Safety Panel, 2014).
- The Auckland Plan 2050, published by Auckland Council (2018) is a 30-year strategic vision for Auckland and is the primary strategic document to guide Council activities and the activities of council-controlled organisations like AT.
- The Auckland Transport Alignment Project (ATAP) (2016), which aligned the strategic approach for the development of Auckland's transport systems for both local and central government.

3 Customers' insights on active modes

There is a growing body of data collating the public's attitudes and perceptions of active modes. Detailed in Attachment 3 are some wider key findings from a range of sources around active mode attitudes and current travel behaviour. These findings are relevant when considering whether active mode infrastructure should be included along the corridor of the A2B rapid transit and, if so, what it should look like. More specifically related to the A2B corridor is a Customer Insights Survey undertaken in March 2019 Kantar TNS, of a review of current travel behaviours between Botany and the Airport (2019). Key findings from the survey were:

- 60% of respondents indicated they were flexible about changing to public transport or cycling if the conditions suited them better.
- Barriers to public transport were listed as: transfer requirements, poor frequency, poor reliability, short span, inconvenient journey endpoints, no parking near bus stop, slow travel times, inconvenient.
- Barriers to cycling were listed as: unsafe, lack of dedicated space, lack of confidence, distance and hills, need to carry gear, requirement for showers at work, slow, inconvenient.
- Key motivators for public transport & cycling were listed as: potential to be cheaper, potential to be faster, health and fitness reasons, and environmental considerations.

In the review of current travel behaviours between Botany and Manukau, the mode share included 4% of people walking and 4% of people cycling. The summary also captured whether people surveyed would consider other transport modes, with 15% indicating that they would cycle more and 14% would walk more between Botany and Manukau if the conditions were more conducive to those modes. The Kantar TNS survey identified that the mode share for cycling two or more times per week would increase from 4% to 7% between Botany and Manukau if conditions were improved. Further details from the survey are shown in Figure 2 below.

Reactions towards A2B MRT – summary

Measure	Botany to Manukau	Manukau to Airport
Public perceptions of importance of project	PT very important: 68% PT not important: 20% Cycling not important: 39% Walking not important: 40%	PT very important: 66% PT not important: 15% Cycling not important: 39% Walking not important: 51%
Positive feedback on street cross-sections	Dedicated PT space is great Keeping 2 traffic lanes + cycle ways per direction is good	Great to have
Concerns about street cross-sections	Safety of accessing PT stations	
Flexibility to change to PT or cycling	A little flexibility: 40%	A little flexibility: 38%
Proportion that would travel more by mode	Car: 28% PT: 42%	Car: 38% PT: 47%
Expected change in proportion of people that would travel by <mode> 2+ times per week, based on survey responses	Car: 60% → 59% PT: 7% → 22%	Car: 61% → 60% PT: 13% → 25%

Figure 2:Exert from customer insight memorandum. Source: MRC, 2019

In summary, these customer insights strongly suggest that if quality active mode infrastructure is provided as part of the A2B rapid transit project, there is significant opportunity for mode shift to occur. Cycling is where the most significant mode shift potential could occur for several reasons: the speed and distance covered by this mode can be competitive with driving or public transport; many people have access to bikes; and people would like to ride if the conditions were safe, separated from vehicles, and attractive.

4 Existing conditions for active modes along A2B

Conditions for active modes relate not only to footpath width and obstruction. Many other features should also be considered. These include:

- The speed and volumes of motor vehicles adjacent to the footpath
- The footpath/cycle path location in relation other street elements
- How the footpath crosses driveways and side streets
- How active modes move through intersections, e.g. following desire lines, is there priority?
- The presence of elements such as trees or furniture to provide human scale design, comfort, and to shelter under during short periods of unexpected weather

These 'other features' of the active mode environment can encourage and enable, or discourage and restrict, peoples' ability to choose an active mode, even if the correct footpath and cycle path dimensions are installed as per the AT Transport Design Manual (TDM). This is the key focus of both this technical note and the Key Design Elements for Active Modes technical note, with the intention of providing an integrated street design approach, as outlined in Chapter 1 of the USRDG.

The existing conditions can be broken down into two groups. First, the wider street layout and corridor qualities and the implications of this for the provision of active modes and, second, the specific existing infrastructure environment.

4.1 Wider street layout and corridor qualities

While current infrastructure provided for active modes along the corridor is poor, the corridor has a street layout and other qualities which would provide a great setting and base to enable active modes to use. These include:

- The extended block sizes, with well-spaced intersecting roads create long sections with fewer intersections to cause delays, this also means reduced interactions and conflicts with motor vehicles.
- The raised central median results in side streets along the corridor only having a left in and left out movement function for motor vehicles. This minimises possible conflicts that could occur at these intersections with an active mode user crossing.
- The topography along the route is relatively flat, therefore the exertion required for active travel is minimal.

4.2 Specific existing infrastructure environment

Most of the existing infrastructure for active modes along the A2B corridor is limited to footpaths; often these footpaths are narrow (1.5m wide) and only separated from fast moving vehicles by a 125mm vertical kerb (Figure 3.) These conditions are enough to prevent many people from even considering using the facilities. As a city, we understand now that such environments are unsuitable, uncomfortable and unattractive for people to use.

Infrastructure for people on bikes or other wheeled mobility devices has, in the past, been minimal on Auckland streets. Some sections along the A2B route have painted cycle lanes (as shown in Figure 4). It was thought that painted cycle lanes provided a reasonable level of service for people on bikes, however it is now widely understood that these facilities only support a small number of brave and confident riders, many of whom were already riding before the lanes were installed. As per the Bicycle QoS guide (2016) cycle lanes will only meet acceptable QoS level of 1 and 2 where traffic volumes are less than 5000 per day and where speeds are less than 50km/hr. Currently, these cycle lanes along sections of this corridor would receive a QoS score of 4, where 4 represents a facility with "shortcomings in design that are likely to introduce major safety concerns for most users, or other quality problems that will detract many potential user." The desired QoS score of 1 represents a facility that is "consistent with or exceeds best practice design guidance. Facility is suitable for a very wide range of users" (MRCagney for Auckland Transport, 2016).



Figure 3: Footpaths on Puhinui Road



Figure 4: Painted cycle lane on Puhinui Road

With limited or no facilities for bicycles and scooters in most locations along this route, there is great confusion around what street space these modes should use, resulting in many of them using the

footpath, further reducing the comfort and safety levels for pedestrians also using the footpaths. The lack of infrastructure and understanding of the requirements for active modes is reflected in the poor safety outcomes for these vulnerable modes. As noted in the RLTP (2018), vulnerable road user trauma (pedestrians, motorcyclists and cyclists) makes up a significant proportion of all Auckland road trauma (47% in 2015).

Two pedestrian overbridges are provided along Te Irirangi Drive, these provide access for pedestrians and people on wheeled mobility devices to move from one side of the road to the other. One is located by Whetstone Road (Figure 5), the other is by Banville Road. The actual distance to cross Te Irirangi Drive (if it was possible to cross at grade) is 25m. The distance to cross the road using these overbridges is significantly increased by needing to physically move up and over the road. For example, at Whetstone Road bridge, the total approximate distance if using stairs, including the 25m bridge over the road, is 67m. If the ramps are used, the total distance is between 172m and 243m, depending on the direction of travel. While these bridges enable movement across the arterial road away from fast moving traffic, and without having to wait at a signal, the additional distance and effort required to use these will affect people's choice both in terms of what mode they use, and whether to make a journey at all.

A survey to understand the current use levels of these bridges was undertaken on the 27th & 30th of July 2019. Please find results in tables in Attachment 4.



Figure 5: Pedestrian overbridge at Whetstone Rd across Te Irirangi Road (image from google maps)

In summary, existing conditions along the A2B route are poor for active modes, but the corridor structure offers positive qualities for active mode movements. Therefore, there is significant opportunity to increase the level of participation in this transport mode along the corridor. This will be achieved by providing infrastructure suitable for users of All Ages and Abilities (AAA) to enable these communities to have an accessible and enjoyable route to walk, run, or ride along.

5 Opportunities to enable active modes along the A2B corridor

The A2B project is completely changing the look, feel and function of all the streets it travels along. This provides the ideal opportunity to redesign these streets based on Auckland's goals to design and develop equitable urban streets. These goals focus on people and safety and increasing transport choices and opportunities for Aucklanders.

The following features of the A2B corridor make it particularly conducive to creating quality infrastructure for prioritising active modes:

- The A2B corridor connects to several key places of employment, retail and recreation, as well as residential areas.
- Connection to the proposed AMETI active mode infrastructure network along Ti Rakau Drive, which will contribute to a wider active mode network for the region.
- The topography along the route is relatively flat, therefore the exertion required for travel is minimal. This topography is also accessible and attractive for all ages and abilities and different types of active modes.
- The extended block sizes, with well-spaced intersecting roads, creates long sections with fewer intersections causing delays. This reduces interactions and conflicts with motor vehicles.
- The raised central median (existing) and, as part of the A2B project, a closed central running bus system (proposed) mean side streets along the corridor only have a left in and left out movement function for vehicles. These side street intersections could be further simplified to remove conflicts for active modes and create a more continuous safe and attractive routes – further details on side streets are provided within the Key Design Elements for Active Modes technical note.
- Supporting and connecting to areas where significant investment in cycling infrastructure is proposed under the Auckland Cycling Programme Business Case (ACPBC 2017) and has funding to develop. Figure 5 shows the coverage and extent of the cycling infrastructure in 2017 to what it could look like in 2030 with funding and prioritisation through completion of the ACPBC. The red line represents the A2B corridor with the yellow circles indicating a combination of early and late start focus areas outlined in the ACPBC. These include Pakuranga, Māngere East, Papatoetoe/Ōtara, Manukau and Manurewa.

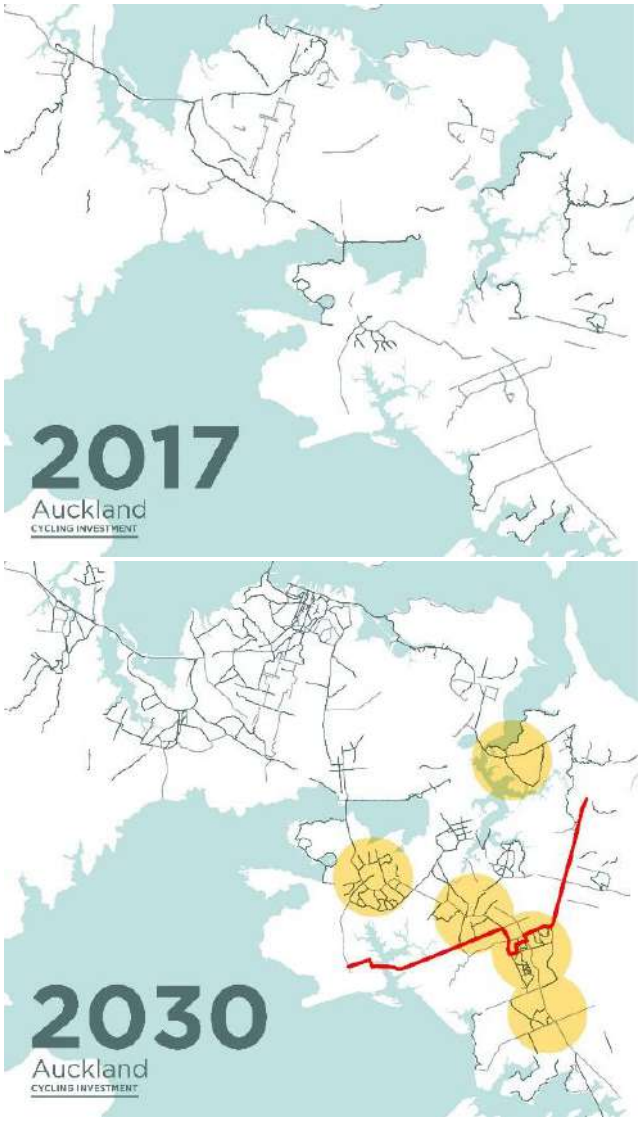


Figure 5: Auckland Cycle Investment map from ACPBC, with the 2030 plan showing where the A2B corridor is in relation to focus areas outlined which are prioritised and funded.

6 Active Mode Design Principles

There are several existing guidelines which outline design principles for active modes. The AT Transport Design Manual – Engineering Design Code (2019) details key design elements for both pedestrian and cycling infrastructure. Further, the Bicycle Quality of Service Tool is used by AT to evaluate cycling infrastructure and plan for new infrastructure. The USRDG, discussed in Section 2.3 and Attachment 2, also outlines design elements for the two key active mode types: people on foot and people on bicycles. Chapter 3 of the USRDG provides useful information to inform design decisions for both active mode types. These guidelines have formed the basis for the design principles outlined below, which have specifically been developed for the A2B corridor. These principles elaborate further on the current guidelines, taking the design concepts further by factoring in the "other features" that contribute to decision making when it comes to active modes and will support the overall A2B project in meeting its overall objectives.

6.1 People on foot & people on wheeled mobility are different

People walking and people riding a bike, or scooter, should always be separated horizontally (e.g. using buffers) and/or vertically (e.g. using kerbs) due to the differential in speed between these users. This

separation is important not only at the mid-block, but at conflict points including intersections and mid-block crossings. Separation of these modes benefits both modes equally. As a significant proportion of our population moves into older age brackets, with potential mobility and vision inhibition, we want to ensure people still feel safe and comfortable to walk to destinations and local places of interest.

6.2 It is possible to move across the A2B corridor, not only along it

While the A2B project focuses primarily on a linear movement of people in buses, we need to understand, and design for, people walking or using wheeled mobility devices to safely move across the corridor. People will require the ability to cross the A2B corridor for a wide variety of reasons, such as accessing an A2B station, shopping, or getting home. These crossing opportunities should be provided both formally, at signalised intersections, and informally where appropriate, for example, where a single lane of vehicle traffic can be crossed, such as Lambie Drive, Ronwood Avenue or Puhinui Road, by crossing in several stages with refuge islands.

6.3 Bicycle Streets are good for everyone

A bicycle street is a street where bikes are prioritised, and cars are visitors. These streets have low traffic volumes (<500 vehicles per day) and low traffic speeds (<30km/hr). Priority is achieved with a combination of both physical design features and signage.

The existing parallel access streets along both the east and west side of Te Irirangi Drive provide an excellent opportunity for wheeled mobility devices to move through. Instead of building a separate cycle path and footpath directly adjacent to these streets and removing a significant planted berm area, there is the opportunity to retain these streets and adjacent planting and direct the active mode movements along the corridor through these streets. This approach would also be a way to positively engage with adjacent residents and ensure the benefits of this project are not confined to the corridor but extend and improve the surrounding community.

Some guidance is provided for these types of facilities in the *Transport Design Manual /Cycling Infrastructure /Chapter 3 Approved facilities within the road reserve/ 3.5 Cycle Streets*.

6.4 Design for social safety

People of all different ages, genders, ethnicities and levels of impairment should be safe in real and perceived terms. This can be designed, for example. by ensuring passive surveillance, using lighting, and influencing land use and architecture to encourage active edges. These treatments improve both the real and perceived safety in urban environments. Lighting for example would likely need to be upgraded along all the bicycle streets for both pedestrians and people on wheeled mobility devices.

6.5 Design for universal accessibility

People with different levels of mobility and levels of sensory impairment should be designed for. This includes the design of level changes and intersections, and providing opportunities for rest, such as bench seats with pleasant surrounding environments.

6.6 Design for human scale and human senses

The street environment should be designed according to the dimensions, speed of movement, senses and vulnerability of the human body. This guides decisions on spatial design, traffic engineering, lighting, speeds and timing in the urban environment.

In the past, designing for pedestrians or bicycle traffic only considered the throughput and volume of people along the route. This basically applied the same idea and principles as designing for motor

vehicles. We know now that this approach does not create great environments for people, nor does it encourage active modes.

This will be critical in this project, due to the size and scale of the changes being made to these corridors. Removal of the existing central green berm with trees (in some sections) and creating a paved busway will need to be mitigated in part by the inclusion of trees into the berms that will separate active mode infrastructure from the carriageway. These will be essential to creating a level of comfort and safety to the people using these spaces.

6.7 Design for wheeled micro-mobility

Our understanding and prediction is that, in 2019, we are likely at the very beginning of the micro mobility journey. The range and types of wheeled personal and shared mobility devices that will be available in the future will be hugely diverse. However, these are already becoming increasingly popular. Ensuring the width, surface, interactions and overall design of the cycle path element within this project provides adequate space for this transport mode to grow and operate safely is important. As these modes usually have no emissions, low noise level and enable people of all ages with all kinds of disabilities or limitations to move, they should be supported and prioritised in any design decisions. Examples of micro mobility we see now include electric mobility scooters, e-scooters, e-bikes, conventional bikes, kick-scooters, skateboards and e-skateboards.

6.8 Design for the social experience

The ability for people to walk, ride or scoot side-by-side is an important function that the footpath and cycle paths should support and enable. This supports the social interactions that these modes facilitate in the modern environment, and also enables parents to walk/ride/scoot next to their child, rather than following behind or leading in front.

6.9 Anticipate ‘wrong way’ use of the cycle path

Due to the corridor’s significant width along the A2B route, and the frequency with which formal crossing will be provided, it is anticipated that there will likely be substantial movements along the cycle paths in the ‘wrong’ direction, particularly in close proximity to stations. In a perfect world, a bi-directional cycle path would have been proposed along both sides of the corridor. However bi-directional cycle paths have safety issues at unsignalised intersection, and additional space requirements that this project could not incorporate at this time. However, bicycle streets are an additional to this project which provides significant lengths of the route to more safely and comfortably accommodate the demand for bi-directional movements, especially over those short journeys such as accessing the A2B stations.

7 Summary

This technical note has outlined the rationale for the development of active mode infrastructure along the A2B corridor and establishes design principles for this infrastructure. In conjunction with the Key Design Elements for Active Modes technical note, this technical note justifies investment in active mode infrastructure along the A2B corridor which will:

- Increase transport options for south and east Auckland - connect to other networks that are proposed or already exist, to start establishing a connected network.
- Create a continuous, direct, safe, attractive and comfortable “all ages and abilities” active mode route that will become well recognised, well regarded and well used.
- Be as well-known as the Northwestern shared path, with high-quality designs, and excellent connections to stations, centres and local attractions.
- Attract people from other parts of Auckland.

- Become one of New Zealand's best urban active mode routes.
- Provide a street environment that attracts people of all ages and abilities, and positively contributes to the lives of the surrounding community by improving access.

These goals can be achieved by the A2B project if an integrated street design approach is taken.

The inclusion of active mode infrastructure is now an accepted and expected component of inclusive and equitable street design in New Zealand. However, what is often overlooked when adding these components into a street is the need for an integrated street design approach. Active mode components cannot be simply added onto the side of the road if there is space, rather they must be included as an essential part of the corridor and be coherent and easy to use. The A2B project is completely changing the look, feel and function of all the streets it travels along, and will increase the use of other modes on these streets, so an integrated street design approach is essential.

Approvals:

	Author	Reviewer
Name		
Signature		
Designation		

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Technical Note

Attachment 1

How active modes infrastructure supports A2B investment objectives

A2B Investment Objectives	How active mode infrastructure relates
Provide more equitable access and travel choices to jobs, learning, cultural and social activities in the south and east Auckland	Currently, poor-quality walking infrastructure is provided, and the infrastructure for wheeled mobility devices consist of either intermittent sections of cycle lanes which would score QoS 4 (under Auckland Transport's Bicycle QoS tool, 2016) due to the volume and speed of traffic directly adjacent. In summary, there are limited travel options to choose from, resulting in people either travelling in private vehicles or walking in unsafe and uncomfortable conditions. The A2B project presents an opportunity to develop equitable street environments by designing for safe, attractive, comfortable and universally accessible conditions for active modes, including walking, riding a bike or scootering.
To improve the reliability and resilience of the transport system	Providing high* quality active mode facilities to both access the rapid transit stations and travel along the rapid transit corridor to other centres or destinations, would result in consistently reliable journey time for customers. Delays from crashes or congestion are rarely experienced by people moving by active modes. Therefore, very little, if any, variance of travel time is experienced by day of the week, hour of the day, weather conditions or time of year. Active mode infrastructure adds a layers of resilience both by allowing and enabling people who can ride or walk to do so, thereby removing them from their private car or seat on the rapid transit, and by offering a network which will likely remain open and clear during conditions such as traffic congestion or a crash. * For wheeled mobility devices, infrastructure should score a Bicycle QoS 1 or 2
To improve economic performance of the airport area, Auckland and NZ.	The most efficient way to get people to rapid transit stations, or local destinations and services, is by walking. Walking is a quiet form of transport, can be used by most people (of many ages and abilities, and all financial situations), generates no emissions, and requires no storage space of vehicles at or near stations or destinations. The benefits of walking include more resilient communities with stronger relations, significant health benefits for individuals who walk, greater awareness of pedestrians because there are more of them, and safer streets due to increased awareness of pedestrians. By providing quality environments to support active modes, some people will shift from other modes, improving the efficiency of the transport network for those other modes (e.g. cars).

Reduce the effects of the transport system on the environment and taonga	Emissions from transport are a significant contribution to climate change, as well as general air pollution and reduced air quality. Active mode travel releases no harmful emissions into the environment, require less paved surface to move on which reduces overall impermeable surfaces resulting in fewer contaminants entering the water system. The speed at which active modes move allows people to have a deeper connection to the landscape, the views, smells and sights, and enables a much stronger relationship to form between people and the land. Elements such as trees and vegetation support active mode movements by providing separation from motor vehicle traffic and, therefore, a level of perceived and actual safety. They also provide shade, shelter and bring a human scale to the corridor while benefiting the environment by reducing stormwater runoff, improving air quality and providing habitat for birds and insects.
To improve health, safety and security of people	Investing in active mode infrastructure along the A2B corridor offers a healthy transport option for everyone needing to move along the corridor to access rapid transit stations or other destinations along the route. The fastest and easiest way to make a street or place feel safer and feel more secure is to attract more people into it or along it. This will likely occur as a result of providing a comfortable and attractive environment for active modes, as a greater number of people will converge onto this route. This could also offer the opportunity for parents to feel comfortable to allow their children to visit their local friends or walk to school by themselves. Obesity statistics from New Zealand from the Ministry of Health show 1 in 3 adults are obese, as are 1 in 8 children. Adults living in deprived areas were 1.6 times as likely to be obese as adults living in the least deprived areas. For children, this rate is 2.1 times. The way our environment (particularly streets) are designed affects decisions that are made, both about which mode we choose to access places of employment or destinations, but also what we chose to do in our recreation time. Our bodies were designed to move, and there is significant research now showing the positive association between physical activity and mental wellbeing. By encouraging and enabling a more diverse and greater number of people to access this route, the health outcomes of the community will improve as well creating a corridor which feels and is safer to occupy and move along. This benefits everyone including the people who need to continue driving.

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Attachment 2

The following details key information from a range of guides, reports, policies and strategies which support the rationale for providing active mode infrastructure as part of the A2B corridor, as discussed in Section 2.3 of this technical note.

Urban Street and Road Design Guide (USRDG).

Auckland Transport have recently developed the Urban Street and Road Design Guide (USRDG). This guide sets a new vision and approach to designing and developing urban streets, that is focused on people, safety, and increasing the choices and opportunities of Aucklanders.

The strategy for active modes along the A2B corridor has used this guide to propose infrastructure and suitable street layouts for this route. The guiding principles in Chapter 1 of the USRDG are listed below

- **Design for people** – the basic design unit for cities and liveable streets. Designing for people requires understanding how fast people move, how far they can see and how they feel in different environments
- **Design for safety** – safety for all users, especially the most vulnerable, is paramount
- **Design for context** – streets should reflect and support adjacent land uses
- **Streets influence our health** – the way in which streets are designed can encourage people to make healthy decisions by supporting walking and cycling
- **Streets as ecosystems** – street design can improve water quality and improve as well as bring nature into the city
- **Te Aranga principles** – desire for Māori to enhance their presence, visibility and participation in the design process
- **Streets are public spaces** – street design should encourage and enable recreation, social interaction and business activity
- **Better streets are great for business** – streets serve as the key platform for economic exchange in cities, therefore good access and welcoming streets will attract more people and more activity, improving the local community and businesses
- **Streets impact our quality of life** – streets influence our ability to move around and connect to opportunities in the city
- **Streets are multimodal** – street design must support safe, comfortable and attractive multimodal transport for all users
- **Streets can change** – a street's design should reflect its current conditions and priorities, regardless of what its conditions or priorities may have been in the past
- **Streets carry people and goods** – efficient movement of all people travelling by all modes should be supported. Movement of freight and servicing land uses must be balanced with the ways people move in the street.

The overarching message in the USRDG is that a strategy for active modes is a strategy for a good street design. This supports the purpose for designing for and supporting active modes travel along the A2B corridor.

Auckland Cycling Programme Business Case

The purpose of the Auckland Cycling Programme Business Case (ACPBC) was to establish a case for investment in a programme of cycling activities in Auckland over the 2018-2028 period.

The ACPBC identified that the role cycling currently plays in the Auckland transport system is minor relative to other large NZ cities and international comparator cities and there is significant opportunity to increase this. One of the four key opportunities outlined in this business case to increase cycling/wheeled mobility devices role in Auckland is;

> *To provide connectivity to Auckland's developing Rapid Transit Network and therefore increasing the reach and transport accessibility to jobs and other opportunities provided by public transport*

Over half of Aucklanders live within a 15-minute ride of Auckland's existing RTN. Therefore, A2B will be expanding this opportunity to more Aucklanders if the right environment and infrastructure is provided

Improving safety in the overall transport system through improving the cycling environment by building high quality infrastructure and facilities is an outcome identified by this business case. The ACPBC notes that currently there are a disproportionate number of crashes which are cycling related;

> *7% of total recorded road crashed in Auckland and 10% of serious injury crashes are cycling related, even though cycling or wheeled mobility devices are only being used for 0.4% of household transport trips.*

Government Policy Statement 2018/19

Enabling safe and comfortable active mode access along the A2B corridor aligns with all Government Policy Statement (GPS) strategic priorities including:

- Safety - A land transport system that is safe and free of death and serious injury. This is addressed by reducing the actual and perceived risk
- Access - Liveable cities, provides increased access to economic and social opportunities. This is about people movement, which is particularly relevant for enabling the movement of people with modes other than cars.
- Access - Provides increased access to economic and social opportunities. Active mode users typically spend more money along their journey than car users.
- Environment – A land transport system that reduces GHG emissions and adverse effects on the local environment and public health. Enabling walking and cycling is part of the solution to reducing car dependency (and the largest carbon emitting source of our urban transport system).

Cycling Safety Action Plan 2015

In 2015 the NZ Transport Agency published a Cycling Safety Action Plan Titled *Making Cycling Safer and More Attractive* This was produced to aid implementation of the 35 recommendations that the Cycling Safety Panel made in its 2014 report. The key areas of focus for improvements identified in this Action Plan are:

- Improving quality and quantity of cycle infrastructure;
- Improved design guidance to ensure facilities match world best practice, with a special focus on intersections;

- Reviewing road rules; and
- Reducing speeds in urban areas

These focus areas are all relevant to this project, ensuring wheeled mobility devices are provided for on quality infrastructure and the surrounding road environment is safe and creates an attractive place to ride adjacent to.

Auckland Plan 2050

The Auckland Plan provides a 30-year strategic vision for Auckland and is the primary strategic document published by Auckland Council to guide its own activities and the activities of council-controlled organisations like AT. It establishes a long-term spatial plan for the city, including informing land use and transport planning.

Transport and Access is one of six desired outcomes noted in the Auckland Plan. This is an area in which significant progress needs to be made so Auckland can continue to be place where people want to live work and visit.

The Transport & Access Outcome is;

'*Aucklanders will be able to get where they want to go more easily, safely and sustainably*'

Three key directions and seven focus areas are outlined in this document. All three directions listed below, directly support incorporating active mode infrastructure along the A2B corridor. Most of the focus areas also support the infrastructure but in particular *Focus area 4 – Make walking, cycling and public transport preferred choices for many more Aucklanders*.

Direction 1 Better connect people, places, goods and services

Direction 2 Increase genuine travel choices for a healthy, vibrant and equitable Auckland

Direction 3 Maximise safety and environmental protection

Auckland Transport Alignment Project (ATAP)

This process involved central and local government working together to identify an aligned strategic approach for the development of Auckland's transport system in 2016.

In 2017 the recommendations were refreshed and included placing greater weight on the Government's priorities and developing a transport system for Auckland that provides safe, reliable and sustainable access.

This means that transport:

- *Easily connects people, goods and services to where they need to go*
- *Provides high quality and affordable travel choices for people of all ages and abilities*
- *Seeks to eliminate harm to people and the environment*
- *Supports and shapes Auckland's growth*
- *Creates a prosperous, vibrant and inclusive city*

Again, all these objectives from ATAP support the inclusion of active mode infrastructure along the A2B corridor. *Affordable travel choices for all ages and abilities* is a key one. Providing facilities like wide safe footpaths and separated bike paths means a primary school aged child could easily ride their bike or scoter to school along this corridor. An essential part of *creating a vibrant and inclusive city* is to create environments for people to gather in but also to move through.

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Attachment 3

Customer Insights

Below are some key findings from a range of sources around active mode attitudes, current travel behaviours other interesting pieces of information. These findings are relevant when thinking about the question around, fundamentally should active mode infrastructure be included along the corridor of the A2B rapid transit and then if it is, what should it look like and what role can it play.

- Key conclusions from a Baseline Survey of New Zealanders' Attitudes and Behaviours towards Cycling in Urban Settings (Research New Zealand, 2016).
  - The ownership of, or access to bicycles is relatively high.
    - Two-thirds of all urban New Zealanders, 18 years of age or more own or have access to a bicycle in working order (67%)
  - Many people ride bicycles already
    - A little over one-half of all urban New Zealanders, 18 years of age or more state they have ridden a bicycle in the last 12 months (56%), while 44% have not.
    - 16% of all urban New Zealanders have used a bicycle to commute in the last 12 months, 24% have used a bicycle to get around town, and 50% have cycled for recreational purposes.
- Evidence from the Auckland Transport Active Mode survey (TRA, 2018).
  - In the most recent research completed by TRA an independent research company for Auckland transport the following information was found:
  - The two biggest barriers which prevent people choosing the mode of cycling is
    - They don’t feel safe because of how people drive
    - There are not enough cycle lanes or routes that are physically separated from drivers
  - The two biggest barriers which prevent people choosing the mode of walking is
    - They don’t feel safe walking in the dark
    - The find that walking is slower than other modes
  - 71% of people surveyed agreed that investing in cycling infrastructure is important as it gives people more travel options.

Walkable catchments analysis at Auckland train and Northern Busway stations – 2013.

A study (Wilson, 2013) was undertaken gathering information around how far people were walking to access rapid transit stations. Some interesting findings were:

- Walking was the most common mode of arrival at nine of 12 stations. Ellerslie (73%) and Newmarket (69%) recorded the highest percentage of respondents walking to stations. Manurewa recorded the small percentage of respondents walking 41 per cent
- For trips under 2km, walking was the dominant mode of arrival at four stations: Glen Eden, Henderson, Ōtāhuhu and Newmarket.

- At four stations more than 50 per cent of respondents walked further than 800 metres to get to a train station;
- At eleven stations more than 15 per cent of respondents walked further than 1500 metres to get to a train station; and

Auckland Regional Land Transport Plan 2018-2028

An exert below from the RLTP outlines the great potential there is for walking.

Walking accounts for 14 percent of journeys taken in Auckland and AT's research indicates there is significant potential for more. The quality of the pedestrian environment is the key barrier to increasing the number of walking trips, particularly the lack of safe, direct routes for walking. Around Auckland 51 percent of pedestrian DSI occurs away from a formal crossing point. There is clear potential to encourage walking for short journeys for people who live close to the city centre, nearby public transport stations, for school journeys and trips to local centres, supported by safe places to cross, and accessible and connected walking routes.

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Attachment 4

Pedestrian Overbridge Survey Results

Banville Rd Overbridge

12:59 1 Adult West To East Crossing Te Itirangi Drive
16:42 1 Adult East To West Crossing Te Irirangi Drive

[redacted]

Time	Tuesday 30 July 2019 Weather Fine							
	East To West (Ramp Cam 2)				West To East (Ramp Cam 2)			
	Pedestrian's		Cyclist's		Pedestrian's		Cyclist's	
	Adult	Child	Adult	Child	Adult	Child	Adult	Child
7:00	0	0	0	0	1	0	0	0
7:15	0	0	0	0	0	0	0	0
7:30	0	0	0	0	1	0	0	0
7:45	0	0	0	0	0	1	0	0
8:00	0	0	1	0	1	0	0	1
8:15	0	0	0	0	0	0	0	0
8:30	0	0	0	0	0	0	0	0
8:45	0	0	0	0	0	0	0	0
11:00	1	0	0	0	[redacted]	0	0	0
11:15	[redacted]	0	0	0	[redacted]	0	0	0
11:30	1	0	0	0	5	0	0	0
11:45	0	0	0	0	0	0	0	0
12:00	1	0	0	0	[redacted]	0	0	0
12:15	1	0	0	0	0	0	0	0
12:30	0	0	0	0	1	1	0	0
12:45	0	0	0	0	0	0	0	0
14:30	0	0	0	0	0	0	0	0
14:45	0	0	0	0	0	0	0	0
15:00	0	0	0	0	0	0	0	0
15:15	0	1	0	0	0	0	0	0
15:30	0	1	0	0	0	0	0	0
15:45	1	6	0	0	0	0	0	0
16:00	0	4	0	0	0	0	0	0
16:15	0	0	0	0	0	0	0	0
16:30	0	0	0	0	1	0	0	0
16:45	0	0	0	0	0	0	0	0
17:00	0	0	0	0	0	1	0	0
17:15	0	0	0	0	3	0	0	0
17:30	0	0	0	0	2	0	0	0
17:45	0	0	0	0	1	1	0	0

Time	Saturday 27 July 2019 Weather Fine							
	East To West (Ramp Cam 2)				West To East (Ramp Cam 2)			
	Pedestrian's		Cyclist's		Pedestrian's		Cyclist's	
	Adult	Child	Adult	Child	Adult	Child	Adult	Child
10:00	0	0	0	0	1	0	0	0
10:15	2	2	0	0	1	0	0	0
10:30	0	0	0	0	1	0	0	0
10:45	3	0	0	0	1	0	0	0
11:00	1	0	0	0	0	0	0	0
11:15	0	0	0	0	0	0	0	0
11:30	1	0	0	0	2	0	0	0
11:45	0	0	0	0	0	0	0	0
12:00	0	0	0	0	2	0	0	0
12:15	4	0	0	0	2	2	0	0
12:30	1	0	0	0	0	0	0	0
12:45	0	0	0	0	0	0	0	0
13:00	1	0	0	0	0	0	0	0
13:15	1	0	0	0	1	0	0	0
13:30	0	0	0	0	0	0	0	0
13:45	0	0	0	0	0	0	0	0

Whetstone Rd Overbridge

8:48 2 Child East To West Crossing Te Irirangi Drive
12:25 1 Adult East To West Crossing Te Irirangi Drive

Time	Tuesday 30 July 2019 Weather Fine							
	East To West				West To East			
	Pedestrian's		Cyclist's		Pedestrian's		Cyclist's	
	Adult	Child	Adult	Child	Adult	Child	Adult	Child
7:00	0	0	0	0	0	0	0	0
7:15	0	0	0	0	0	0	0	0
7:30	0	0	0	0	0	0	0	0
7:45	0	0	0	0	0	0	0	0
8:00	0	0	0	0	0	0	0	0
8:15	0	1	0	0	0	0	0	0
8:30	1	1	0	0	0	0	0	0
8:45	0	0	0	0	1	1	0	0
11:00	0	0	0	0	0	0	0	0
11:15	0	0	0	0	0	0	0	0
11:30	0	0	0	0	0	0	0	0
11:45	0	0	0	0	0	0	0	0
12:00	0	0	0	0	0	0	0	0
12:15	0	0	0	0	2	0	0	0
12:30	[redacted]	0	0	0	0	0	0	0
12:45	0	0	0	0	1	0	0	0
14:30	0	0	0	0	0	0	0	0
14:45	0	0	0	0	0	0	0	0
15:00	0	0	0	0	1	0	0	0
15:15	0	0	0	0	0	0	0	0
15:30	0	0	0	0	0	1	0	0
15:45	0	0	0	0	0	2	0	0
16:00	0	0	0	0	0	0	0	0
16:15	0	0	0	0	0	3	0	0
16:30	0	0	0	0	0	0	0	0
16:45	0	0	0	0	0	0	0	0
17:00	2	2	0	0	0	0	0	0
17:15	0	0	0	0	0	0	0	0
17:30	0	0	0	0	1	3	0	0
17:45	0	0	0	0	0	0	0	0

Time	Saturday 27 July 2019 Weather Fine							
	East To West				West To East			
	Pedestrian's		Cyclist's		Pedestrian's		Cyclist's	
	Adult	Child	Adult	Child	Adult	Child	Adult	Child
10:00	0	0	0	0	1	0	0	0
10:15	0	0	0	0	0	0	0	0
10:30	1	1	0	0	1	1	0	0
10:45	0	0	0	0	0	0	0	0
11:00	0	0	0	0	0	0	0	0
11:15	0	0	0	0	0	0	0	0
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13:15	0	0	0	0	0	0	0	0
13:30	0	0	0	0	0	0	0	0
13:45	0	0	0	0	0	0	0	0

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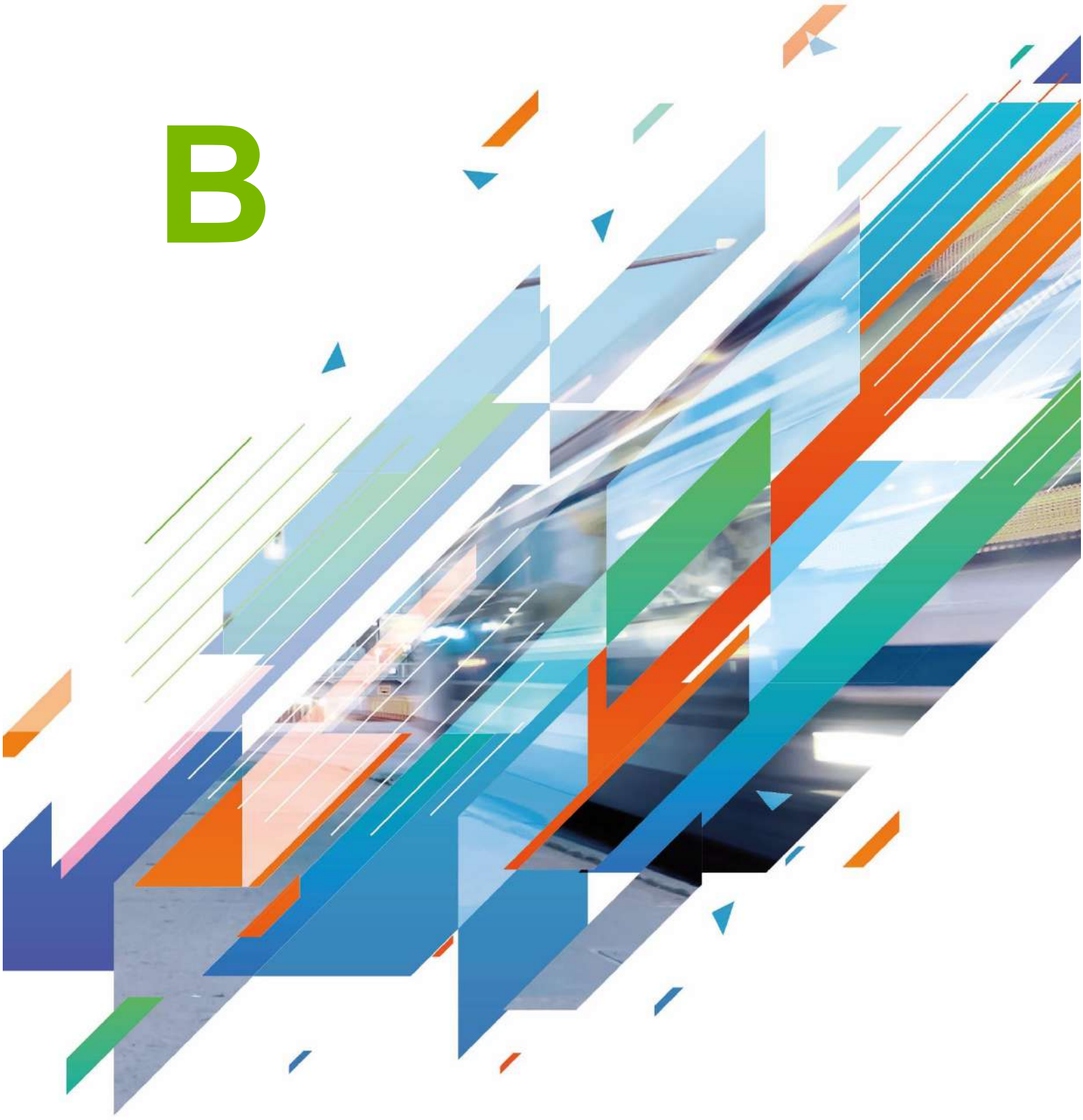
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B



RTC Placement and Corridor Widening Assessment

Appendix B
RTC Placement and Corridor Widening Assessment

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Technical Note

To	**Auckland Transport**	From	**A2B Project Team**
Copy		Reference	**502334-7000-TEC-KK-0030**
Date	**09/08/2019**	Pages (including this page)	**22**
Subject	**RTC Placement Assessment**		

1 Introduction

This technical note introduces the four different potential alignments for the Airport to Botany (A2B) Rapid Transit Corridor (RTC) placement within the preferred corridor. The rationale for the preferred default placement of the RTC is outlined along with conditions for when exceptions to this default may be appropriate. For the sections where a deviation from the general preferred placement may be appropriate, a Multi-Criteria Analysis (MCA) is applied to determine the best alignment option.



Figure 1: A2B preferred alignment

2 Background

As part of the A2B project, a dedicated Rapid Transit Corridor (RTC) is to run from the Auckland International Airport to Botany Town Centre. At the long-list and short-list stages of the project, an MCA was used to assess route options against various indicators related to the investment objectives

and benefits of the project to identify a preferred option route. The outcome was a route which follows that as seen in Figure 1.

This technical note covers the RTC route from Botany through to the SH20 Interchange. Beyond this the RTC placement is documented in a separate technical note in conjunction with the 20Connect state highway upgrade project.

Technical note 502334-7000-TEC-RR-0023 identifies the preferred side of the road for the RTC approaching Botany Station and north of Botany (if it is decided the A2B service should continue further north) as part of the Botany RTC turnaround analysis.

3 RTC Placement Options

There are four recognised RTC placement options. Each of these is summarised below followed by an analysis of the challenges of each placement option and a recommended preferred placement option for A2B.

3.1 Option: A-side running RTC

This option has the RTC running along the side of the preferred route identified as the A-side in Figure 1. This would predominantly involve the RTC running along the western and northern side of the route. Figure 2 provides a visual representation of how this would operate for context only.

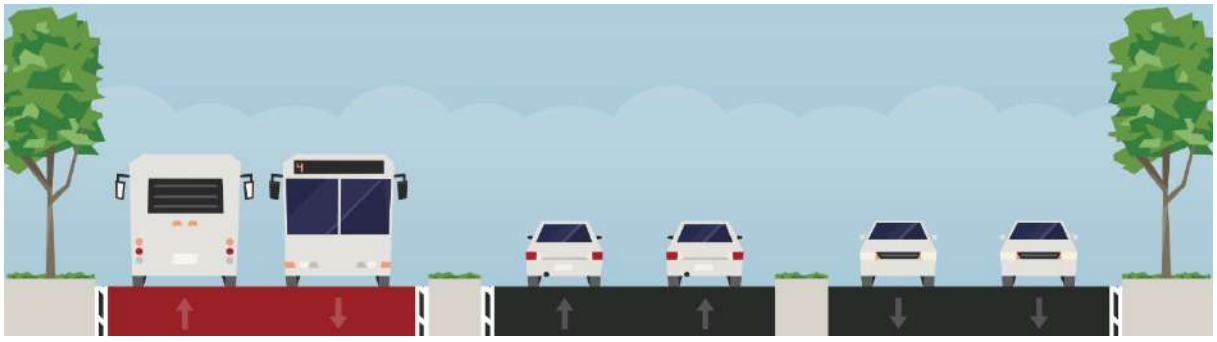


Figure 2: A-side running RTC

3.2 Option: Central running RTC

This option has the RTC running in the centre of the preferred route, with the general traffic running on either side. For context only, Figure 3 illustrates how this option would operate.

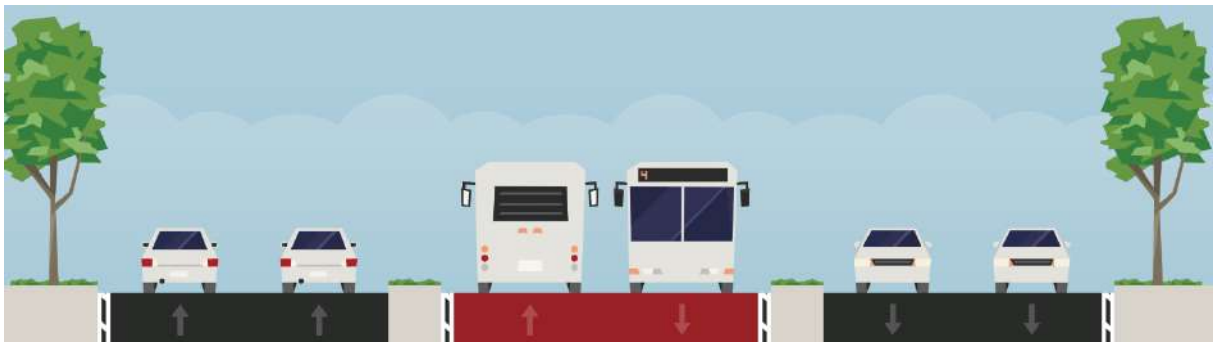


Figure 3: Central running RTC

3.3 Option: B-side running RTC

This option has the RTC run on the side of the preferred route identified as the B-side in Figure 1, being predominantly the eastern or southern side of the preferred route. Figure 4, below illustrates this alignment.

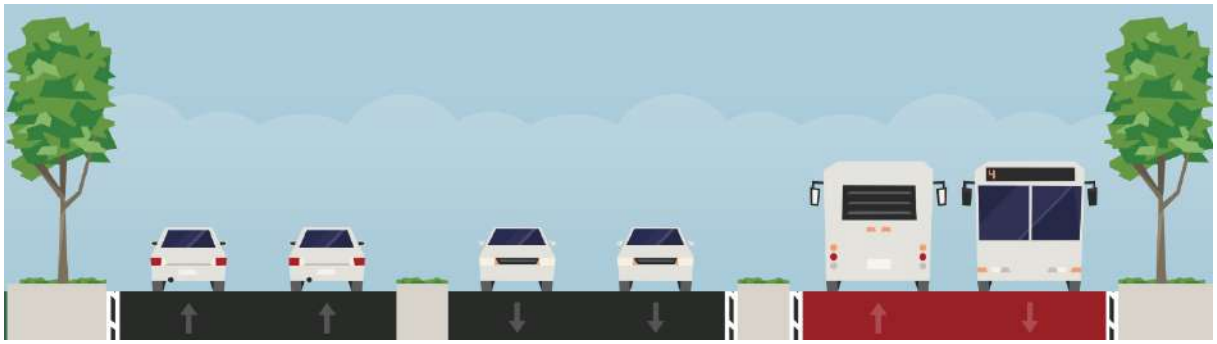


Figure 4: B-side running RTC

3.4 Option: Split-side running RTC

This option has RTC split with east/northbound services running on the A-side of the corridor and the west/southbound services running the on the B-side of the preferred route. For context only Figure 5 provides an illustrated example of this alignment.



Figure 5: Split-side running RTC

4 Placement Option Analysis

There are various factors to consider when determining the best placement option for an RTC. These include:

- **Spacing and frequency of access points**: in environments with frequent accesses and side streets, a side running or split-side running RTC will result in more conflict points, including frequent unsignalised driveway crossings of the RTC.
- **Adjacent land uses**: land uses with frequent access points, such as residential areas or local centres, will generate more traffic and introduce more conflict points than a large school, which may have just one or two access points. Additionally, if adjacent land uses are likely to change in the short to medium term, the expected land uses should also be considered.
- **Layout of signalised intersections**: the preference for a side running or central running option would be influenced by the volume and type of general traffic turning movements that are permitted.
- **Demand for particular intersection movements**: where there is a particularly dominant demand for one movement, such as motorway on- or off-ramps, a side running RTC can avoid these key conflict points.
- **Crossing environments and distances for active modes**: a key principle of the A2B route is that all pedestrian crossing points will be signalised. The potential disadvantage of providing a side running RTC is that one side of the catchment will have to cross the full (wide) street corridor to access the stations.

Table 1 summarises the four placement options in terms of the main interactions between the RTC and the surrounding environment, this includes how the alignment may or may not conflict with various access and turning movements and a consideration of how far pedestrians and active modes have to travel to access the RTC stations given the different placement options.

Table 1: Summary table of the placement options and main challenges

Placement Option	Interaction with driveway and street accesses	Interaction with left turn movements	Interaction with right turn movements	Crossing environment and distance for active modes
A-side running	Conflicts	Conflicts	Conflicts	Close and easy access from the north/west but further from south/east
Central running	Conflicts (only for right turn movements)	None	Conflicts	Medium for both sides
B-side running	Conflicts	Conflicts	Conflicts	Close and easy access from south/east but further from north/west
Split-side running	Conflicts	Conflicts	Conflicts	Medium for both sides (depends on direction of travel)

4.1 Preferred Default Placement Option

Overall, the preferred default placement option for the A2B route between Botany and the SH20 Interchange is the central running RTC option, as this enables the following design features:

- Easy street-entry from driveways and side streets: access from driveways and side streets operates as it would in a typical street. All other options would require vehicle access points to cross the RTC (potentially with two opposing directions of travel) before merging into general traffic lanes.
- Left-in, left-out for driveways and small side streets: driveways and smaller side streets can operate as uncontrolled left-in left-out intersections, without the need for signals to control either the general traffic lanes or the RTC lanes.
- Fewer RTC conflicts with vehicle movements: for most intersections, the central alignment enables the RTC to proceed with the main through-traffic movements and can be phased without conflicting with left turn movements or parallel pedestrian phases. The only conflict is with right turn movements, which need to be signalised to cross general traffic lanes in any case.

However, it is recognised that this preferred placement option may not be best suited along the full length of the corridor. Sections that have different land use or property access conditions on one side of the road, or atypical intersections may better suit an alternative RTC placement. For example, a side running RTC alignment may be more appropriate where a section of corridor features land uses and accessways on one side only, or where an intersection has a strongly unilateral design or usage.

Consequently, the remainder of this technical note addresses where such potential exceptions have been identified and applies a multi-criteria analysis (MCA) to determine which of the four placement options is most suitable for each section. A key challenge if the placement changes along the length of the route will be the design of the transition points where the RTC changes from the preferred central running alignment to one of the alternatives and then how it transitions back again.

4.2 Excluded Split Side-Running Placement Option

An initial assessment of all corridor sections, shown in Figure 1,has identified that the split side-running placement option offers no advantages over the default placement option or the two other side options for any section.

The split side-running option always conflicts with land use and property accesses on both sides of the road, even where these only located on one side of the corridor. Furthermore, at intersections, the split-side running option means that the RTC movements always conflict with all left turns and all right turns, such that it is less efficient at standard four-way intersections while also offering no potential advantages at other intersection configurations.

Therefore, the split-side running placement option has been excluded from further assessment.

5 A2B Sections and Options Analysis

The route has been split into ten sections (shown in

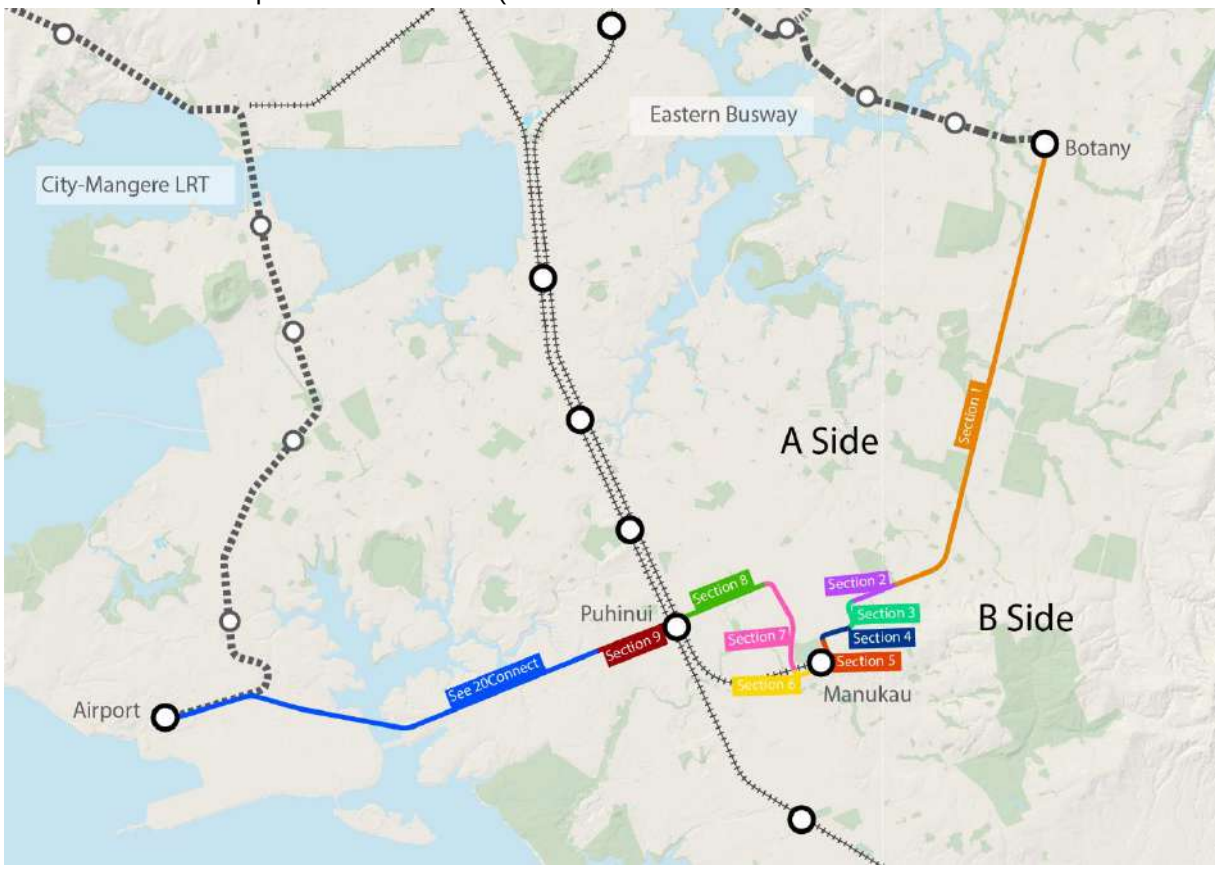


Figure 1) based on identifying where there are changes to the road classification (based on the Urban Street and Road Design Guide, an internal Auckland Transport document), speed, or access conditions to adjacent properties. The preferred RTC placement option for the length of each of these sections is expected to be the same as the operating conditions are the same for the full length. Each of these sections is included in Table 2, where it is identified whether that section is a potential exception to the default preferred (central running) RTC placement.

Note that access to Botany Station and the northern part of the corridor is heavily dependent on the preferred location and configuration of Botany Station, which is being designed and assessed under a separate assessment (refer to technical note 502334-7000-TEC-RR-0023).

Table 2: A2B sections and exceptions to the preferred placement option

Section	Road	Extent	Street environment	Preferred option or exception
1	Te Irirangi Drive	Botany Town Centre to Diorella Drive	▪ Single use arterial road ▪ 60-80km/h speed (existing) ▪ Limited right turn movements ▪ Non-direct and direct access to neighbouring property	Preferred Central running RTC
2	Te Irirangi Drive	Diorella Drive to Great South Road	▪ Single use arterial road ▪ 60km/h speed (existing) ▪ Limited right turn movements ▪ Direct access to property on the south side ▪ Interaction with north-facing SH1 motorway ramps	Potential Exception
3	Great South Road	Te Irirangi Drive to Ronwood Avenue	▪ Mixed use arterial ▪ 60km/h speed (existing) ▪ Limited right turn movements ▪ Direct access to neighbouring property	Preferred Central running RTC
4	Ronwood Avenue	Great South Road to Davies Avenue	▪ Mixed use arterial ▪ 50km/h speed (existing) ▪ Limited right turn movements ▪ Direct access to neighbouring property ▪ Parking on both sides of the street	Preferred Central running RTC
5	Davies Avenue	Entire length	▪ Mixed use collector ▪ 50km/hr speed (existing) ▪ Right turn movements allowed ▪ Direct access to neighbouring property	Potential Exception
6	Manukau Station Road	Davies Avenue to Lambie Drive	▪ Mixed use arterial ▪ 60km/h speed (existing) ▪ Right turn movements allowed ▪ Direct access to neighbouring property	Potential Exception
7	Lambie Drive	Manukau Station Road to Puhinui Road	▪ Mixed use arterial ▪ 60km/h speed (existing) ▪ Limited right turn movements ▪ Direct access to neighbouring property	Potential Exception
8(1)	Puhinui Road	Lambie Drive to Cambridge Terrace	▪ Single use arterial road ▪ 50km/h speed (existing) ▪ Right turn movements allowed ▪ Direct access to neighbouring property	Preferred Central running RTC
9(1)	Puhinui Road	Kenderdine Road to SH20 interchange, including MRT bridge	▪ Single use arterial road ▪ 50km/h speed (existing) ▪ Right turn movements allowed ▪ Direct access to neighbouring property	Preferred Central running RTC

10	Puhinui Road	Between SH20 Interchange and the Airport	Covered by 20 Connect Project

Note 1: Along Puhinui Road, a central running RTC is preferred, however any deviations required to connect to the Puhinui Mass Rapid Transit Bridge will be covered in the Design Philosophy Statement (502334-7000-REP-JJ-0024).

5.1 Multi Criteria Analysis

An MCA will be used to assess the RTC placement along the preferred corridor. This is a framework designed to assess options against key performance indicators, and feasibility indicators related to the investment objects and benefits of the project to select a preferred option.

The proposed options will be scored against the technical criteria summarised in Table 3. The criteria are split into two sections: transport planning and engineering. Only two transport planning criteria were considered relevant for the assessment of the RTC placement within the cross-section of the preferred route alignment; other transport planning criteria would not differentiate between the options. These transport planning criteria relate to the following A2B investment objectives:

- IO1: More equitable access to jobs, learning, social activities
- IO2: Travel is easier and more affordable

Criteria related to environment and planning matters have not been applied to this assessment as the RTC placement is primarily driven by operational and technical engineering feasibility, with all placement options resulting in broadly similar footprints and environmental outcomes. Accordingly, there would be minimal, if any, differentiation between options from a planning and environment perspective. Instead, a broader planning and environmental assessment will be undertaken on the preferred option, including on any options that require corridor widening.

This assessment has taken into consideration the engineering feasibility in relation to the proposed options. No surveys, investigations or detailed site visits have been undertaken as part of this assessment.

Table 3: Assessment criteria

Discipline	Criterion	Description
Transport Planning	Public transport, cost/time of travel	IO1 (*More equitable access to jobs, learning, social activities*): Estimated 'cost' (time) effects of each option: model evaluation of travel time for the A2B service, including time spent at intersections.
	Travel time reliability	IO2 (*Travel is easier and more affordable*): Expert assessment of the effects of PT separation (with general traffic) and right of way on variability of travel times.
Engineering	Constructability	How straightforward is it to implement the option? What are the challenges with construction methodology and staging or constraints. What is the surrounding environment like including: topography, gradients, utilities, existing infrastructure etc.
	Construction disruption	Construction impacts on people and businesses regarding traffic, access levels, duration etc.
	Construction cost and risk	Estimated construction costs, including complexity and risk in construction.

Discipline	Criterion	Description
	Safety in Design	Are there significant hazards associated with the option which pose a health and safety risk in design, build and final product? Can safety be developed into the design process to control it? Level of complexity in risk management through safety in design.
	Operation and Maintenance	Assessment of maintenance and operational implications over the projected life.

5.1.1 Scoring

Transport planning criteria will be scored on a scale from -3 to +3, with a score of 0 reflecting that the option is equivalent to if the vehicles operated in general traffic lanes. A positive score therefore indicates an improvement over operating in general traffic lanes, and a negative score indicates that the option is worse than operating alongside private vehicles, with no priority.

Engineering criteria are assessed on a 5-point scale, with 1 representing high risk with high impact and 5 indicating negligible risk with minor impact. Table 4 details how the 5-point scale is applied to the engineering criteria.

Table 4: Scoring of criteria

Rating	Description
5	Straight forward and minor works. Low level of health and safety in design. Negligible/minor construction impacts, construction costs and maintenance and operation costs
4	Moderate works. Low to moderate level of health and safety in design. Minor to Moderate maintenance and operation costs. Minor amount of construction impacts and construction costs.
3	Major construction works. Moderate to high level of health and safety in design. Moderate maintenance and operation costs. Moderate amount of construction impacts and construction costs.
2	Uncommon construction works. High level of health and safety in design. Moderate to high maintenance and operation costs. high amount of construction impacts and construction costs.
1	Construction that has never been done in NZ. Significant/extreme level of health and safety in design. Significant maintenance and operation costs. Significant amount of construction impacts and construction costs.

5.1.2 General Assumptions

This section outlines the general assumptions that apply to the options assessment:

- Bus priority lanes as part of the Short-Term Airport Access Improvements (STAAI) will be removed and replaced with the RTC.
- The final RTC will be a 24/7 bus-only running way.
- Protected walking and cycling facilities will be provided along the corridor.

- Existing roundabouts will be converted into signalised intersections.
- All existing signalised intersections will be retained and the RTC will be controlled by phases at all signalised intersections.
- Slip lanes are removed and replaced with left turn lanes at intersections, and where two right turn lanes exist, one will be removed.
- The parking lane along the western side of Davies Ave will be removed
- At the southern end of Davies Avenue (between Putney Way and Manukau Station Road), general traffic lanes will be removed. Thus, only the RTC and buses egressing from the Manukau bus station will be diverted to the Manukau Station Road/Davies Avenue intersection. The signals at Putney Way/Davies Ave intersection will be removed.

As outlined in Section 4.1 and at the beginning of Section 5, the general preference is for a central-running RTC, except where there is a reason to believe a single side-running RTC may be more suitable for a segment (eg lots of conflict points on one side of the road, and very few on the other). Therefore, the rest of this section assesses the RTC placement options for the segments where such potential exceptions were identified, as per Table 2.

5.2 Section 1: Te Irirangi Drive – Botany Town Centre to Diorella Drive

Default preferred option of central-running is appropriate here. Refer to section 4 for this default preference and Table 2 for a description of the street environment, confirming that this section has no features that might except it from this default position.

5.3 Section 2: Te Irirangi Drive - Diorella Drive to Great South Road

The existing layout of this section of Te Irirangi Drive consists of a raised median of varying width throughout, except at major intersections allowing cross movements. The key distinguishing feature of this section is that two motorway ramps on the north connect SH1 with Te Irirangi Drive.

The adjacent properties are a mixture of residential, recreational and commercial. This includes residential properties and a Countdown shopping area with direct access to Te Irirangi Drive to the south, and AUT and Manukau Velodrome with no direct access to Te Irirangi Drive to the north.

Figure 6 shows the considerations of the RTC placement. Table 5 details the MCA for this section of A2B.



Figure 6: Section 2: Te Irirangi Drive – Placement Considerations

Table 5: RTC placement assessment for Te Irirangi Drive between Diorella Drive and Great South Road

Criterion	A-side (north)	Central	B-side (south)	Description
Public transport, cost /time of travel	1	2	2	A-side (north) scored 1, indicating this option provides a slightly better travel time than a bus travelling in vehicle lanes. This assumes the RTC has priority over general vehicle traffic. The positive effects of dedicated lanes and priority is expected to outweigh the negative effects of conflicts with significant volumes of vehicles using the motorway ramps. Central and B-side both scored 2, for moderate improvements over buses operating in vehicle lanes. Central conflicts with the right-in and right-out movements at the motorway ramps, which will slightly affect travel times. B-side (south) involves two transitions of the RTC itself (to the south side and back to the median).
Public transport travel time reliability	-1	2	2	A-side (north) scored -1, indicating that it would be better to operate in vehicle lanes than a dedicated RTC on the north side. In this option, both directions of travel of the RTC interfere with all movements on and off the two motorway ramps, whereas a bus in vehicle lanes would not interrupt the left-in flow of traffic to the on-ramp, and the left-out traffic would have to give way to it anyway. The likely requirement for signalising these movements will introduce additional variability to the A2B service. Central and B-side both scored 2 for reliability. These options will still have some variability from the intersections (in Central, with the right-turn motorway ramp movements, and in B-side, with the intersections where it transitions to the south side and back again).
Constructability	3	3	3	All scored 3. The existing bridge structure is not adequate to accommodate an RTC, therefore a new or widened structure is required for all options.
Construction disruption	3	3	3	All scored 3. The construction of providing a new or widened structure is consistent across all options. The construction of the RTC to the A-side (north) and Central will result in an interaction with, and therefore disruption to, the north facing motorway ramps, but this is not enough to affect the scoring. The construction of the RTC to the B-side (south) will result in an interaction with, and therefore disruption to, the access of the row of properties to the south west and access to Countdown to the south west, but this is not enough to affect the scoring.

Construction cost and risk	2	2	2	All scored 3. The existing bridge structure is not adequate to accommodate an RTC, therefore a new or widened structure is required for all options. The construction cost and risk are the same for all options.
Safety in Design	3	3	3	All scored 3. Moderate level of SiD due to bridge construction works over SH1, which is the same across all options.
Operation and Maintenance	3	3	3	**Maintenance**: The construction of providing a new or widened structure is consistent across all options and require additional infrastructure of similar area, therefore similar maintenance requirements. **Operation:** The A-side (north) and Central running RTC will impact the two motorway ramp intersections. B-side running RTC directly interferes with vehicle movements to nine residential houses and a left-in movement to the Countdown shopping area. A-side and Central running RTC options do not impede on existing vehicle movements.

Central or B-side running scores higher for this section. Section 1 and Section 3 on either side of this section were previously identified as being preferred for Central running. As Central and B-side scored the same, Central is preferred on the whole, to avoid designing deviations to the RTC placement that would yield no better a result than staying in the centre.

5.4 Section 3: Great South Road

Default preferred option of central-running is appropriate here. Refer to section 4 for this default preference and Table 2 for a description of the street environment, confirming that this section has no features that might except it from this default position.

5.5 Section 4: Ronwood Avenue

Default preferred option of central-running is appropriate here. Refer to section 4 for this default preference and Table 2 for a description of the street environment, confirming that this section has no features that might except it from this default position.

5.6 Section 5: Davies Avenue

Davies Avenue runs between Ronwood Avenue and Manukau Station Road. The existing layout consists of a flushed median with a single traffic lane in either direction. No parking is permitted on the eastern side of Davies Avenue. The key distinguishing feature is the linear park along the western side of Davies Avenue which separates some adjacent parking from the traffic lanes.

The western side of Davies Avenue is taken up almost entirely with Hayman Park and then the Manukau Train Station on the southwestern corner. The eastern side of Davies Avenue comprises a series of office blocks and surface carparks along with the Manukau Bus Station on the southeastern corner. Figure 7 shows the considerations of the RTC placement on Davies Avenue. Table 6 details the MCA for this section.



Figure 7: Section 5: Davies Ave – Placement Considerations

Table 6: RTC placement assessment for Davies Ave between Ronwood Ave and Manukau Station Road

Criterion	A-side (west)	Central	B-side (east)	Description
Public transport, cost /time of travel	2	1	0	A-Side (west) scored 2, indicating this option provides a substantially better travel time than a bus travelling in vehicle lanes. This is because the RTC would have dedicated lanes along the park edge without any need to stop other than at a pedestrian crossing, and would avoid any interaction with any traffic movements between Davies Avenue and the streets and lanes to its east. However, as the RTC will be centre running on Ronwood Ave to the northeast of Davies Avenue, this score is contingent on the ability for the design of the Davies Avenue/Ronwood Avenue intersection and signal phasing to retain priority for the RTC transitioning from the west side of Davies Avenue to the centre of Ronwood Avenue. Central scored 1, for moderate improvements over buses operating in vehicle lanes. Central conflicts with half of the traffic movements on or off Davies Avenue, including all northbound traffic from Putney Way, which will slightly affect RTC travel times by increasing the probability of red signals. B-side (east) scored 0 for no significant improvements over buses operating in vehicle lanes. While the RTC will afford priority, it would require several signalised intersections that conflict with all traffic movements utilising Davies Avenue at one point or another, including the intermediate property access.
Public transport travel time reliability	2	1	0	A-side (west) scored 2, as the west alignment removes all interaction with traffic avoids the need for any intermediate signals or intersections other than pedestrian crossings, eliminating most sources of unreliability. As noted above, this score is contingent on the design of the Davies Avenue/Ronwood Avenue intersection. Central scored 1, as it requires signals to control the RTC for traffic movements turning right on or off Davies Avenue from Putney Way and the intermediate lanes, which will slightly impact on RTC reliability by increasing the probability of red signals. B-side (east) scored 0 due to conflict with all traffic movements utilising Davies Avenue and its side streets at one point or another, including the intermediate property access.
Constructability	5	4	4	A-side (west) scored 5, due to the straight-forward methodology required to construct as construction can be undertaken in the existing parking lane to the west of Davies Ave, and kerb lines of existing public carriageway are likely to be retained. Central and B-side (east) scored 4, as the construction methodology will involve shifting the existing traffic to complete the works.

Construction disruption	5	4	3	A-side (west) scored 5 as there is no disruption to any accesses. Existing parking is affected but is removed in the final solution. Hyman Park has multiple accesses. Central scored 4 as some movements to adjacent access to commercial and high-density properties to the east are affected during construction. B-side (east) scored 3, as the construction causes disruption to the access to commercial and high-density properties.
Construction cost and risk	4	4	4	All options scored 4, as construction costs will be minor (in relation to the project as a whole).
Safety in Design	4	4	4	All options scored 4, as SiD issues will be low to moderate.
Operation and Maintenance	5	4	3	**Maintenance**: All options require additional infrastructure of similar area, therefore similar maintenance requirements. **Operation:** A-side (west) scored 5, as no vehicle movements will be impacted. Central scored 4, as this will restrict right-turn movements from two side roads and one property access. B-side (east) scored 3, as this will impede all movements from two side roads and one property access.

A-side clearly scored higher than both Central and B-side for Davies Avenue, therefore A-side is the preferred option here. This assumes that the transition to this side and back to the centre again (where that is back to the preferred placement) can be designed without significant negative effects to the wider corridor design.

5.7 Section 6: Manukau Station Road – Davies Avenue to Lambie Drive

The existing layout of Manukau Station Road comprises of a wide raised median along the entire section. There is an uncontrolled, all movement access mid-way along the section to the MIT campus, and a second left-in left-out access to a carpark on the northern edge. There are on-road cycle lanes on both sides of the road.

The land to the south, at the time of writing, is expected to be developed by MIT to the edge of the existing road reserve. It is currently unknown what land use and property accesses this development will include. However, given that the site is bordered by bridge approaches to the east and west and the motorway to the south, it is assumed that development of this site will include one or more additional vehicle accessways on Manukau Station Road. Figure 8 shows the considerations for the RTC placement. Table 7 details the MCA for this section.

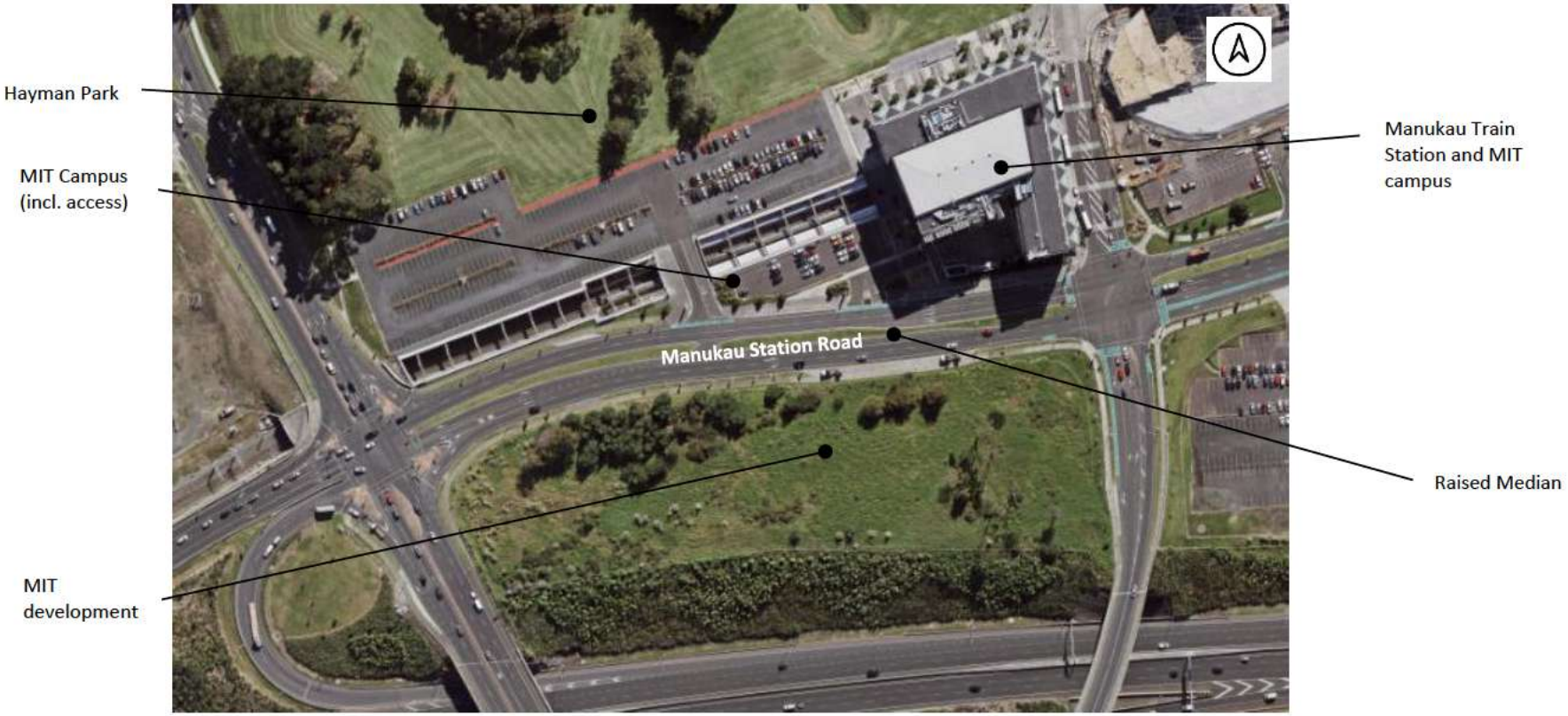


Figure 8: Section 6: Manukau Station Road – Placement Considerations

Table 7: RTC placement assessment for Manukau Station Road between Lambie Drive and Davies Ave

Criterion	A-side (north)	Central	B-side (south)	Description
Public transport, cost /time of travel	1	1	0	A-side (north) scored 1, indicating this option provides a somewhat better travel time than a bus travelling in vehicle lanes. This is because the RTC would have dedicated lanes to the north and the ability for both directions of the RTC to turn into and out of Davies Avenue without any conflict with traffic movements. However, this would still conflict with pedestrian phases at this intersection and would conflict with the two property accesses to the existing MIT site. This option would score higher if the two uncontrolled property accesses were consolidated into a single signalised intersection, however this would result in three very closely spaced intersections. It would also score higher if the Lambie Drive section were aligned to the east side, as this would allow the RTC to avoid all traffic conflicts at the Lambie Drive/Manukau Station Road intersection also. Central also scored 1, for moderate improvements over buses operating in vehicle lanes. Central conflicts with approximately half of the traffic and pedestrian movements at the intersections at either end, and one of the intermediate property accesses. This score assumes that the existing all-movement access is signalised, and the other existing or new accesses are left-in left-out only. B-side (south) scored 0 for no significant improvements over buses operating in vehicle lanes. This alignment would increase the probability of red signals by conflicting with a higher proportion of traffic movements and pedestrian phases at the intersections with Lambie Drive to the east and Davies Avenue to the west. It would avoid the existing property accesses to the north, however it would still conflict with the corresponding property accesses that are expected to be developed to the south.
Public transport travel time reliability	1	1	0	A-side (north) and Central scored 1, as they both partially limit the conflicts with traffic and pedestrian movements at each intersection either side and/or intermediate traffic access points, reducing the potential for red signals with variable delays. B-side (south) scored 0 due to the higher risk of red signals due to similar interaction with local property accesses and a greater number of conflicting movements at the adjacent intersections.
Constructability	4	4	4	All options scored 4, as all works will have a similar construction methodology for staging of the works.
Construction disruption	4	4	4	All options scored 4, as there will be similar disruption (MIT buildings situated on both sides of the road).
Construction cost and risk	4	4	4	All options scored 4, as construction costs will be minor (in relation to the project as a whole).
Safety in Design	3	4	4	A-side (north) scored 3 due to the SiD issues to mitigate working adjacent to the rail trench.

				Central and B-side (south) scored 3, as SiD issues will be moderate.
Operation and Maintenance	3	4	3	**Maintenance**: All options require additional infrastructure of similar area, therefore similar maintenance requirements. **Operation:** A-side (north) scored 3, as this will impede all movements from two MIT accesses Central scored 4, as this will restrict right-turn movements from two accesses to MIT, however left-turn movements can be retained. B-side (south) scored 3, as this will impede all movements from two MIT accesses

Central and A-side scored the same for all transport planning and some engineering criteria. However, central scored higher on safety in design and operation and maintenance. Central running is also consistent with the rest of the corridor. For these reasons, central is the preferred option for this section. The nature of the future MIT developments on Manukau Station Road may also have implications on the operation and preferred position of the RTC for this section; such implications should be considered, and this decision should be reconsidered, as those development plans are finalised.

5.8 Section 7: Lambie Drive – Manukau Station Road to Puhinui Road

The existing layout of this section of Lambie Drive comprises of a raised grass/tree lined median along the section with some breaks to allow right-turn movements into property. There are on-road cycle lanes on both sides of this section of Lambie Drive. Hayman Park lies to the southeast of Lambie Drive. For most of the rest of the route, commercial businesses line the roadside, except towards the north where the area changes to residential (towards Puhinui Road).

In the short term, to the north of Cavendish Drive, bus lanes will be replacing existing roadside parking. Figure 9 shows the considerations of the RTC placement. Table 7 details the MCA for this section.



Figure 9: RTC placement comparison for Lambie Drive between Manukau Station Road and Puhinui Road (excerpt shown as example)

Table 8: RTC placement assessment for Lambie Drive between Manukau Station Road and Puhinui Road

Criterion	A-side (east)	Central	B-side (west)	Description
Public transport, cost/ time of travel	1	2	1	A-side (east) scores 1. This alignment for rapid transit priority would be superior to buses on street, however this section of the corridor features continuous retail and commercial land use and property accesses along the eastern side. As there is limited opportunity to close or realign these accesses, their crossing with the RTC would need to be either signalised or operate uncontrolled. A proliferation of signalised intersections would limit the ability to consistently prioritise the RTC and increase the chance of stopping for red signals, while uncontrolled operation of a two-way RTC across driveways and side streets would require slow travel speeds to minimise the chance of collision. Central scores 2, as it allows substantial improvements over buses operating on street. This section has moderate interaction with traffic movements at the main intersections but avoids direct conflicts with the large number of local property accesses along both sides of this section which can operate as left-in left-out without conflict with the central

				running RTC. It is noted that this section currently features eight points, in addition to the main intersections, where traffic can cross the median to turn right in or out of properties. This scoring is based on the assumption that these points are converted to left-in left-out only, or otherwise signalised to allow the RTC to retain priority. If this cannot occur the score would be lower. B-side (west) scores 1, as an improvement over buses operating on street. In the vicinity of Hayman Park, this alignment would present a direct route along the park edge without conflict with traffic movements or property access and would afford a less-conflicted connection to Manukau Station Road. However, the benefit on the southern parts of this section are offset on the northern section by the increased conflict with local property accesses, as per the A-side above, and at the two main intersections at Ronwood Avenue and Cavendish Drive, both of which have primary demand flows to the western leg.
Public transport travel time reliability	1	2	1	A-Side (east) and B-Side (west) scored 1 due to the higher risk of red signals and unplanned stops from significant interaction with local property accesses and the RTC, and a potentially greater number of conflicting movements at the adjacent intersections. Central scored 2, as the conflicts with side streets and property accesses are minimised (subject to redesign of existing uncontrolled right turns), allowing for the full potential of the RTC priority lanes to be realised by reducing the potential for red signals and delays.
Constructability	4	4	4	All options scored 4, as all works will have a similar construction methodology for staging of the works.
Construction disruption	4	4	4	All options scored 4, as there will be similar disruption (Commercial/Industrial buildings situated on both sides of the road).
Construction cost and risk	4	4	4	All options scored 4, as construction costs will be minor (in relation to the project as a whole).
Safety in Design	4	4	4	All options scored 4, as SiD issues will be low to moderate.
Operation and Maintenance	3	4	3	**Maintenance**: All options require additional infrastructure of similar area, therefore similar maintenance requirements. **Operation:** A-side (east) scored 3, as this will impede all movements from numerous western property accesses. Central scored 4, as this will restrict right-turn movements from numerous property accesses, however left-turn movements can be retained. B-side (west) scored 3, as this will impede all movements from numerous eastern property accesses

Central scored higher than both A-side and B-side options here, therefore Central is the preferred placement for Lambie Drive.

5.9 Section 8: Puhinui Road – Lambie Drive to Cambridge Terrace

Default preferred option of central-running is appropriate here. Refer to section 4 for this default preference and Table 2 for a description of the street environment, confirming that this section has no features that might except it from this default position.

5.10 Section 9: Puhinui Road – Kenderdine Road to SH20 interchange

Default preferred option of central-running is appropriate here. Refer to section 4 for this default preference and Table 2 for a description of the street environment, confirming that this section has no features that might except it from this default position.

5.11 Section 10: SH20B

Covered by 20Connect project.

6 RTC Placement Option Preference

Table 9 below summarises the results of this technical note, identifying the preferred RTC placement option for each of the A2B sections. Careful consideration will be needed regarding the transition points where the preferred placement option changes.

Table 9: Preferred RTC Placement Option by A2B Section

A2B Section		Preferred RTC Placement Option
1	Te Irirangi Drive – Botany Town Centre to Diorella Drive	Central Running RTC
2	Te Irirangi Drive – Diorella Drive to Great South Road	Central Running RTC
3	Great South Road – Te Irirangi Drive to Ronwood Avenue	Central Running RTC
4	Ronwood Avenue – Great South Road to Davies Avenue	Central Running RTC
5	Davies Avenue – Entire length	A-side Running RTC
6	Manukau Station Road – Davies Avenue to Lambie Drive	Central Running RTC
7	Lambie Drive – Manukau Station Road to Puhinui Road	Central Running RTC
8	Puhinui Road – Lambie Drive to Cambridge Terrace	Central Running RTC
9	Puhinui Road – Kenderdine Road to SH20 interchange	Central Running RTC
10	Puhinui Road – SH20 interchange to the Airport	N/A

Approved by:

Title		Qualification		Date
Author	[redacted]		[redacted]	13 August 2019
Author				13 August 2019
Reviewer				20 August 2019

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Technical Note

To	**Renata Smit**	From	[redacted]
Copy	[redacted]	Reference	**502334-7000-TEC-RR-0034**
Date	**23/07/2020**	Pages (including this page)	**16**
Subject	**A2B Road Corridor Widening Analysis**		

A preliminary assessment of the potential effects on the environment was carried out for the Airport to Botany (A2B) Multi Criteria Analysis (MCA) of the Rapid Transit Corridor (RTC) preferred route where the desired cross-section does not fit within existing road reserve, the purpose of which is to inform the preferred option for Single Stage Business Case (SSBC) for A2B for further consideration and assessment.

It covers the A2B project area from immediately east of the Puhinui Interchange (Puhinui Road and SH20 Intersection) through to Botany. The project area is depicted in Figure 1 with each individual option shown on the schematics provided at **Appendix A**.

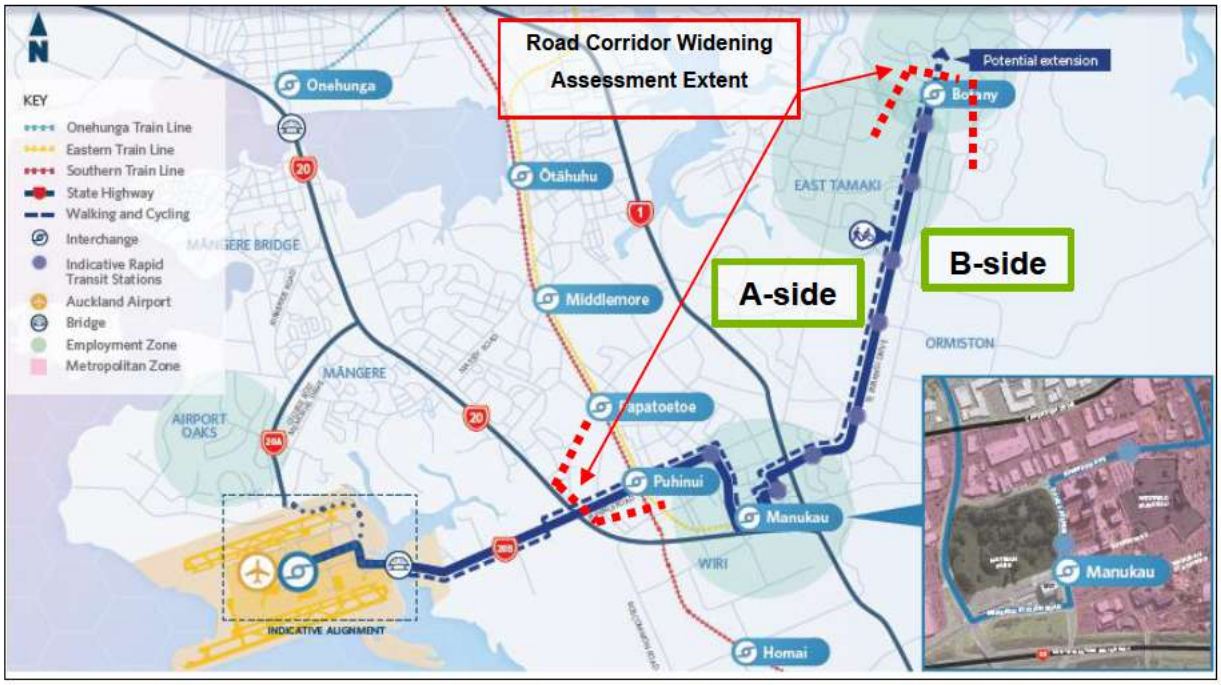


Figure 1. Road Corridor Widening Option Area with A and B Side Notations

This cover note provides a summary of the method and assumptions used, a summary of scores, and a summary of the main points raised by the environmental specialists.

Attachments to this cover note include:

- Appendix A: Road Corridor Widening Option Schematics
- Appendix B: Constructability Technical Note
- Appendix C: Property Technical Note
- Appendix D: Planning and Consentability Technical Note
- Appendix E: Urban Design and Visual Amenity Technical Note
- Appendix F: Social and Community Impact Technical Note
- Appendix G: Stormwater Technical Note
- Appendix H: Contaminated Land Technical Note
- Appendix I: Noise and Vibration Technical Notes
- Appendix J: Road Corridor Widening Descriptions and Assumptions Memorandum

1 Methodology and assumptions

Given property boundary constraints, sections along the A2B corridor will require property acquisition to accommodate the desired RTC cross-section. Where this widening is required, there are three options, each of which are summarised in Section 2.

Specialist assessments were undertaken in the topic areas of property, consentability, third party consents, landscape, visual and urban design, social / community, stormwater, contaminated land, noise

and vibration and constructability[1]. The assessments are based on the descriptions and schematics of the options provided at **Appendix A** and the assumptions detailed in **Appendix J**. Overall, 42 options were assessed.

Each of the specialists assigned each option a score ranging between -3 (significant adverse effect) to 3 (significant positive benefit) (Table 1). The focus was on the assessment of the option, as opposed to a focus on the score itself. Environmental specialists inputted to the specific assessment criteria and the assumptions deemed important to consider as part of the assessment. Weighting has not been applied to the scores.

Table 1 Scoring scale

Scoring scale
3 (Significant positive effects)
2 (Moderate positive effects)
1 (Minor positive effects)
0 (Neutral effects)
-1 (Minor adverse effects)
-2 (Moderate to significant adverse effects)
-3 (Significant adverse or unmitigable effects)

2 Description of the Road Corridor Widening Options

There are three road corridor widening options for each section of the A2B corridor:

2.1 Option: A-side widening

This option requires encroachment into property solely on the A side of the preferred option route (A-side is as identified in Figure 1).

2.1 Option: B-side widening

This option requires encroachment into property solely on the B side of the preferred option route (B-side is identified in Figure 1).

2.2 Option C: A-side and B-side widening

This option involves property encroachment on both sides of the preferred option route (i.e. on both the A and B sides identified in Figure 1).

[1] The noise and vibration assessment was a broad qualitative assessments carried out by the planning team and did not involve specialist input.

To assess the three options at an appropriate level of detail, the route has been split into fourteen sections based on the following changes along the preferred route as shown in Table 2:

- **Surrounding land use**: Whether surrounding land use is largely or a mixture of residential, industrial, commercial, recreational. Land use influences the property acquisition process, so it is important to distinguish when this changes.
- **Level of impact to surrounding property**: A section may have no or minor impacts to property (i.e. encroaches property frontage) whereas the next block over may have major impacts (e.g. affecting structures within property). Impact to property determines whether an MCA will be applied to determine the best side to widen the corridor.
- **Flexibly in Design:** Where the civil design requires road widening to occur on a given side of the road (i.e. for example on the approach to some intersections), or if there are fatal flaws in one of the widening options considered, then an MCA may not be deemed necessary.

Table 2: A2B Corridor Widening Sections

Section	Sheet/s	Road name	Section extent	Surrounding land use	Property impact	Conduct MCA
1	1 - 2	Puhinui Road	SH20 interchange to Kenderdine Road	Adjacent property is residential and commercial	Major - Property required along the entirety of the section	**Yes**
2	2	Kenderdine Road, Bridge Street & Cambridge Terrace	MRT Bridge (Kenderdine Road to Cambridge Terrace along Bridge Street)	Adjacent property is residential and commercial	Major. Road Corridor widening must occur on both sides of the road.	**No**
3	2 - 4	Puhinui Road	Cambridge Terrace to Lambie Drive	Mixture of primarily residential	Major - Property required along the entirety of the section	**Yes**
4	4 - 6	Lambie Drive	Puhinui Road to Manukau Station Road	Mixture of commercial and industrial	Minor - Widening required on both sides of the approaches of Ronwood Avenue and Puhinui Road intersections. Must occur on both sides of the road.	**No**
5	6	Manukau Station Road	Lambie Drive to Davies Avenue	Predominately recreational	Major - Property required along the entirety of the section	**Yes**
6	6	Davies Avenue	Manukau Station Road to Ronwood Avenue	Mixture of commercial and recreational	None - The RTC cross section can be	**No**

					accommodated within the existing road corridor	
7	6	Ronwood Avenue	Davies Avenue to Osterley Way / Sharkey Street	Commercial	Major - Property required along the entirety of the section	**Yes**
8	6 - 7	Ronwood Avenue	Osterley Way / Sharkey Street to Great South Road	Commercial	Minor – on approaches to the Great South Road Intersection. Road Corridor widening must occur on both sides of the road.	**No**
9	7	Great South Road	Ronwood Avenue to Te-Irirangi Drive	Mixture of commercial and industrial	Major - Property required along the entirety of the section	**Yes**
10	7 - 8	Te Irirangi Drive	Great South Road to Diorella Drive	Mixture of residential, commercial and recreational	Major - Property required along the entirety of the section. Existing SH1 overbridge widening required	**Yes**
11	8 - 9	Te Irirangi Drive	Diorella Drive to Te Irirangi Drive Ch. 1525	Predominantly residential	Major - The area near Diorella Drive requires large areas of property take.	**Yes**
12	9 – 10	Te Irirangi Drive	Te Irirangi Drive Ch. 1525 to Dawson Road	Predominantly Residential	Minor – on approaches to Dawson Road intersection. Widening must occur along both sides of the road.	**No**
13	10	Te Irirangi Drive	Dawson Road to Penion Drive	Mixture of Commercial and Residential	Major - Associated with widening of the intersection with Dawson Road.	**Yes**
14	10 - 17	Te Irirangi Drive	Penion Drive to Botany Town Centre	Predominately residential	Minor – Widening required on the approaches of Haven Drive, Bishop Dunn Place and Ormiston road intersections and must occur on both sides of the road.	**No**

Eight of the fourteen corridor widening sections were determined as requiring an assessment.

3 Criteria

This technote summarises the scoring made against the MCA criteria:

- **Traffic Management** - Traffic Management during construction.
- **Pavement/Structures** - The interface between new and existing pavement and/or structures, which include the general footprint and complexity thereof.
- **Utilities** – Impact on Utilities.
- **Property -** Extent and complexity of properties that require acquisition. Level of anticipated risk associated with property negotiation and acquisition under the Public Works Act 1981.
- **Consentability** - Level of complexity of gaining approvals (e.g. activity status, risk of appeal, accordance with policy direction). Level of compliance with regulatory plans e.g. could the option include activities which are prohibited/ non-complying under the policies and rules of the district or regional plan.
- **Third Party Consents** - Potential to require third party consents as a result of property acquisition, requirement to run RTC or buses on private roads, site configuration etc.
- **Urban Design** – Extent, nature and degree of effects on urban design (including open space). Integration with surrounding land uses and the potential number of sites that can/cannot be repurposed following implementation.
- **Visual Amenity** - Extent, nature and degree of effects on visual amenity (including tree loss).
- **Accessibility -** Extent and degree of effects on the community concerning accessibility to/from facilities, services, properties and businesses. Accessibility of jobs.
- **Community** - Extent and degree of change to groups and activities, including sense of community and to known aspirations and plans.
- **Stormwater Quality and Quantity** - Impact of operational stormwater discharges on water quality and quantity within the catchment.
- **Contaminated Land** - Potential to encounter and ability to manage the effects of contaminated soils on human health and the environment.
- **Noise and Vibration** - Extent, nature and degree of operational and construction noise and vibration effects.

4 Summary of MCA scores for the environmental workstream

The Road Corridor Widening scores ranged between -3 (significant adverse) and 0 (neutral) (Table 3). Overall, most options within the corridor are anticipated to have an adverse effect, this is particularly so for the property criteria. Consequently, early engagement with owners / occupiers will influence both the design and 'how adverse' an option is scored. All scores exclude consideration of any mitigation measures that may be undertaken to address perceived or potential effects.

While several experts have identified significant adverse effects associated with some of the options none have identified unmitigable effects despite scoring some options (-3).

Table 3 MCA Road Corridor Widening Score Summary

Measure	Section 1			Section 3			Section 5			Section 7			Section 9			Section 10			Section 11			Section 13		
	Side / Option			Side / Option			Side / Option			Side / Option			Side / Option			Side / Option			Side / Option			Side / Option		
	A	B	Both	A	B	Both	A	B	Both	A	B	Both	A	B	Both	A	B	Both	A	B	Both	A	B	Both
Property	-3	-2	-3	-1	-2	-3	-3	-1	-2	-3	-3	-2	-3	-3	-3	-2	-2	-1	-2	-3	-1	-3	-1	-2
Consentability	-1	-2	-2	-1	-2	-2	-1	-1	-1	-1	-2	-2	-1	-3	-3	-3	-2	-3	-1	-1	-1	-2	-1	-2
Third Party Consents	-2	-2	-2	-1	-1	-1	-3	-2	-3	-1	-1	-2	-2	-2	-3	-2	-2	-3	-1	-1	-1	-2	-1	-2
Visual Amenity	-1	-1	-2	-1	-1	-2	0	0	0	-1	-1	-1	-1	-2	0	-2	-2	-2	-1	-1	-1	-1	-1	-2
Urban Design	-1	-2	-2	-1	-1	-2	0	0	0	0	-1	0	0	0	0	-3	-2	-1	-1	-1	-2	-1	-1	-1
Accessibility	-1	-1	-1	-1	-1	-1	0	0	0	0	0	0	0	0	0	-1	-1	-1	-1	-1	-1	-1	-1	-1
Community	-2	-2	-1	-2	-2	-1	0	0	0	0	-1	0	0	0	0	-1	-2	-2	0	0	0	0	0	0
Stormwater	-2	-1	-2	-2	-1	-2	-1	-1	-1	-1	-2	-2	-2	-1	-2	-1	-1	-1	-1	-2	-2	-1	-1	-1
Contamination Management	-1	-2	-2	-1	-1	-1	0	0	0	-1	-1	-1	-1	-2	-1	-1	-1	-1	-1	-1	-1	-2	-1	-1
Traffic Management	-1	-1	-2	-1	-1	-2	-1	-1	-1	-1	-1	-1	-2	-2	-2	-2	-1	-2	-1	-1	-2	-1	-1	-2
Pavements / Structures	-1	-1	-2	-1	-1	-2	-1	-1	-1	-1	-1	-1	-1	-1	-2	-3	-3	-3	-1	-2	-2	-2	-1	-1
Utilities	-1	-1	-3	-1	-1	-3	-1	-1	-1	-2	-1	-2	-3	-3	-3	-1	-1	-2	-1	-1	-2	-1	-1	-1
Noise and Vibration	-1	-2	-2	-1	-2	-2	0	-1	-1	0	0	0	-1	0	-1	-1	-2	-2	-1	-1	-2	-1	-2	-2
Summary Totals	A	B	Both	A	B	Both	A	B	Both	A	B	Both	A	B	Both	A	B	Both	A	B	Both	A	B	Both
	0	0	0	0	0	0	0	6	5	5	0	4	2	4	0	3	4	4	0	0	0	0	1	1	1	0	1	1	1
	-1	9	8	2	-1	11	9	4	-1	5	7	6	-1	7	8	4	-1	5	2	2	-1	6	5	5	-1	11	9	6	-1	7	11	6
	-2	3	7	9	-2	2	4	7	-2	0	1	1	-2	1	2	5	-2	3	4	3	-2	4	7	5	-2	1	2	6	-2	4	1	6
	-3	1	0	2	-3	0	0	2	-3	2	0	1	-3	1	1	0	-3	2	3	4	-3	3	1	3	-3	0	1	0	-3	1	0	0
Recommended Option	B-Side widening			A-Side widening			B-Side widening			Both Side widening			A-Side widening			B-Side widening			A-Side widening			B-Side widening		

5 Engagement

Stakeholder engagement has been undertaken through several MCA workshops. The purpose of these workshops was to discuss the MCA scoring criteria.

MCA workshops have been undertaken on the following dates:

- 17/01/2020
- 04/02/2020
- 21/02/2020
- 06/03/2020

5.1 Mana Whenua

Three Hui have been undertaken with Mana Whenua utilising the Auckland Transport Southern Table Hui and the Te Ākitai Southern Gateway Programme Hui. They are the following:

- Te Ākitai Southern Gateway Programme Hui 22 May 2020
- Auckland Transport Southern Table Hui 25 June 2020
- Auckland Transport Southern Table Hui 30 July 2020

No direct feedback on this MCA has been provided at this stage.

6 Summary of the main points raised by each environmental specialist

6.1 Constructability

Traffic management during construction

All options scored negatively for traffic management during construction with the scores ranging from minor (-1) to moderate (-2) adverse effects.

All options that scored minor adverse effects (-1) will require staged construction, as well as traffic detours. Off-line construction would also assist to ease adverse impacts on traffic.

Where options scored a -2, there are complex traffic management issues that will require mitigation, including bi-directional traffic control and the establishment of site access points.

It is noted that traffic management along Great South Road (Ronwood Avenue to Te Irirangi Drive) is particularly critical (a result of the road status and high volume of traffic). Staged construction will be important to ensure the traffic is managed sufficiently and detours may also be required.

Interface between new/existing pavement and/or structures

The interface between new/existing pavement and/or structures is anticipated to have mostly minor (-1) to moderate (-2) adverse effects, with the exception of Section 10 (Te Irirangi Drive from Great South Road to Diorella Drive) which is expected to have significant (-3) adverse effects for all options.

All options for Section 10 are anticipated to have significant adverse effects due to the complexity of problems associated with corridor widening in the vicinity of the existing SH1 overbridge. Widening the existing bridge structure is very complex and there are significant restrictions either side (due to the need to meet vertical bridge clearance, vertical grade and additional retaining required to support widened embankment fills).

Of the remaining options, seven are anticipated to have moderate adverse effects (-2). This is largely due changes in compaction and uniform pavement structures, which can result in higher maintenance costs in future.

Overall, it is noted that from a pavement perspective better uniformity is achieved throughout the pavement structure by having a wider construction area when widening to one side only. It provides space for the contractor to place, mix and compact the new pavement layers.

Impact on utilities

Similar to the other constructability criteria, the impact on utilities had scores ranging from minor (-1) to significant (-3).

Where the impact on utilities is anticipated to be significant (-3) it is expected that widening will result in the relocation of most existing utilities. For instance, all widening options considered for Section 9 along Great South Road (Ronwood Avenue to Te Irirangi Drive) are expected to have a significant impact on utilities because there are large high voltage underground cables on either side of the road, requiring protection or relocation.

Within the corridor, 15 out of the 24 options are expected to only have minor impacts on existing utilities. It is anticipated that only protection and minor relocations would be required for these widening options.

6.2 Property

The property scores for all options ranged from minor (-1) to significant (-3) adverse effects.



Overall, all options within the corridor will require different levels of acquisitions (commercial and residential), creating a range of adverse impacts for surrounding land owners and occupiers.

6.3 Planning

Consentability

Notable planning considerations that are likely to affect the consentability of the corridor include:

- Puhinui School (116 Puhinui Road) is designated by the Ministry of Education (Designation #4980) which increases the planning complexity associated with the B-Side and Both-side widening options within Section 3 (Puhinui Road: Cambridge Terrace to Lambie Drive). Approval is needed to widen within this designation from the Ministry of Education.The Wiri Electricity Substation at 656 Great South Road located on the eastern side of the road is designed by Transpower New Zealand Ltd (Designation #8533). Both the B-Side and both side corridor widening options within Section 9 (Great South Road: Ronwood Avenue to Te Irirangi Drive) will impact this designation and require approval from Transpower New Zealand.
- AUT Manukau Campus at 640 Great South Road is designated by the Minister for Tertiary Education, Skills and Employment (Designation #6102). Both the A-Side and both side corridor widening options for Section 10 (Te Irirangi Drive: Great South Road to Diorella Drive) will impact this designation and require approval from the Minister for Tertiary, Education, Skills and Employment.
- State Highway 1 is designated by the Waka Kotahi NZ Transport Agency (the Agency) for the Southern Motorway (Designation #6714). Both the A-Side and B-Side widening options for Section 10 (Te Irirangi Drive: Great South Road to Diorella Drive) will impact this designation and require written approval from the Agency.
- There are 3 sections within the corridor (Section 5, 7 & 9) that are subject to the buildings frontage control (general commercial frontage). The Business – Metropolitan Centre Zone policy seeks that buildings with frontages, subject to the General Commercial Frontage Control, achieve a reasonable level of street activation, building continuity along the frontage, pedestrian amenity and safety and visual quality.
- Options within some sections are also impacted by the National Grid Corridor Overlay (i.e. applicable to Sections 9, 10 and 11). There are three service stations, Mobil located on the corner of Noel Burnside Road and Puhinui Road (Section 1 – impacted most by the B-Side widening option), Caltex on the corner of Great South Road and Te Irirangi Drive (Section 9 - impacted most by the B-Side widening) and Z located on 136 Dawson Road (Section 13 - impacted most by the A-Side widening), which will be impacted by the corridor widening. Ground fuel tanks are likely at these sites and a consent under the 'National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health' is likely to be required associated with contaminated land and the potential removal of underground fuel tanks. Consequently, these options have also scored negatively to reflect the additional National Environmental Standard (NES) consent requirements.

The consentability scores for corridor widening range from having minor (-1) to significant (-3) adverse impacts. The level of complexity of gaining approvals varies within each option and is attributed to the different planning constraints.

Generally, those options that will impact designated land or the national grid corridor overlay and require approval from third parties have scored the poorest. Section 9 (Great South Road: Ronwood Avenue to Te-Irirangi Drive) and Section 10 (Te Irirangi Drive: Great South Road to Diorella Drive) are the only sections with options that have significant adverse effects (-3).

A-Side widening for Section 10 for example would require permission from the Minister for Tertiary Education, Skills and Employment for any widening impacting the AUT Manukau Campus designation, as well permission from Transpower given the National Grid Corridor would be intersected by the works.

Written approval would also be required from the Agency for any changes to the existing State Highway 1 overbridge.

11 out of the 24 options are anticipated to have minor adverse impacts. For instance, all widening options on Section 5 Manukau Station Road (Lambie Drive to Davies Avenue) have scored a -1 as there is no zoning or overlay differentiation between the options which would impact consentability. There was also no discernible difference for the corridor widening options for Section 11 (Te Irirangi Drive: Diorella Drive to Te Irirangi Drive Ch. 1525) which also all scored (-1).

Third Party Consenting

All options were considered to generate third party consent implications in some form and consequently the scoring for this criterion is negative. Typical third-party consent implications include new potential bulk and location non-compliances because of reduced site areas and reconfigured site boundaries and removal of landscaping, vehicle access / carparking and loading areas that are likely required by underlying resource consents which will precipitate site reconfigurations[2] and consent amendments.

There are nine options that are anticipated to have only minor adverse impacts in terms of third-party approvals.

Those options that largely impact residential property have scored the best for this criterion

6.4 Urban Design and Visual Amenity

Urban Design

Scores for urban design criteria ranged from neutral (0) to significant adverse effects (-3).

All options for Sections 5, 7 (excluding B-side widening), and 9 scored neutrally (0) on the basis that there would be no discernible change to urban design as a result of those widening options.

One option, the A-Side widening option for Section 10 (Te Irirangi Drive: Great South Road to Diorella Drive) would have significant adverse effects (-3). This option would impact the AUT campus and require the reduction of two open spaces within this section of corridor (the open space area on the northern side of Te Irirangi Drive and the Manukau Velodrome site).

The remaining options either scored -1 or -2, having minor to moderate impacts on urban design. Where property acquisition is required, the assessment consider the quality of the residual land. Where impacts require such extensive acquisition of the front yard that the house ceases to function or after acquisition there will be less residential re-development opportunities due to lower intensity house zoning this has been reflected. Those options more difficult to redevelop were scored a -2, with those easier to redevelop scoring a -1.

Visual

Visual amenity scores ranged from neutral (0) to having moderate to significant adverse impacts (-2).

Similar to urban design, all options for Sections 5, 7 and 9 had neutral scores. For example, all for Section 5 (Manukau Station Road: Lambie Drive to Davies Avenue) scored neutrally reflecting that this

[2] and potentially rendering sites unusable – which is not evaluated here but scored in the Property criteria.

section is an urbanised section of road, which is visually dominated by wide roads and limited shrub and tree planting along the southern side. There is anticipated to be neutral impacts on visual amenity as each option will result in only minor losses of young tree and shrub planting to the southern boundary.

14 of the options are expected to have minor (-1) impacts on the visual amenity. For these options, it is anticipated that existing garden boundaries will be retained and only minor changes to the vegetation and landscape will occur. This may reduce the visual cohesiveness however overall there will only be minor impacts to visual amenity.

Six options will have moderate to significant adverse impacts (-2) as a result of the loss of mature tree (s) (or a notable tree), as well the removal of private garden boundaries. On various options this creates asymmetric landscapes with mixed boundary treatments, reducing visual cohesiveness.

6.5 Social and Community Impact

Accessibility

Accessibility scores ranged from neutral (0) to having minor adverse impacts (-1).

All options for Sections 5, 7 and 9 were scored neutral on the basis that any impacts of the corridor widening would not change the accessibility of sites or properties in the surrounding area. The assessment assumes that where property acquisition occurs, including the removal of buildings, the existing level of access to private property would be retained including vehicular and pedestrian access. For Section five, all options were scored neutral as even with road corridor widening, the new MIT trade training school and Manukau train station will continue to be accessible.

The remaining options were considered to have minor adverse effects for accessibility relating to the direct impacts on properties and potential for uncertainty for owners regarding the property acquisition process and their adaptability to change.

Community

Community scores ranged from neutral (0) to having moderate to significant adverse impacts (-2).

All options for Sections 5, 7 (excluding B-side widening), 9, 11 and 13 scored neutrally (0) on the basis that there would be no discernible change for community groups and activities as a result of widening. urban design as a result of those widening options. Therefore, the overall sense of community would be unlikely to be impacted.

The remaining options been scored as having minor (-1) to moderate (-2) adverse effects. This is largely due to the potential loss of community because of the acquisition of residential properties. In some cases, there would also be a loss of community as the result of occupants electing to move out of the neighbourhood as a result of partial property acquisitions.

6.6 Stormwater

The project area is urban and heavily developed with the proposed corridor widening options typically occurring within existing hardscape/impervious surface areas. Sections 3 to 9 of the corridor are within the Stormwater Management Area Control – Flow 2 (SMAF2) are and there are flood plains and overland flow paths throughout the corridor.

Sections 3 to 9 are also within the high-use stream management area overlay and sections 3 to 10 are within the high-use aquifer management areas overlay.

Section 3 through to 10 have the most AUP restrictions and the most stormwater features, and therefore are the most challenging sections from a stormwater mitigation perspective.

All the options have a negative scoring due to the increase in impervious surface area resulting from the proposed corridor widening although all options were scored as having only minor to moderate adverse effects. None of the options were considered to have significant adverse or unmitigable effects. All options go through a very similar stormwater environment and therefore will have similar scoring to each other.

14 of the options scored as having minor (-1) impacts and 10 of the options scored moderately (-2).

Stormwater mitigation will be challenging for many sections within the corridor due to the prominence of stormwater features. Additional stormwater treatment will be required for Sections 3 to 9 due to their location within the SMAF2.

6.7 Contaminated Land

All options have neutral or negative scores (up to moderate adverse impacts (-2)) reflecting the potential for corridor widening works to encounter contaminated soils.

17 out of 24 options anticipate minor (-1) impacts. As stated above, it is likely that these options will encounter different types of contaminants within the vicinity. For example, parts of the corridor have been in operation for over 60 years so based on likely construction materials, techniques, infilling, levelling, diffuse contaminants are anticipated across the project area, which will require a nominal level of management during civil works.

Those options that have scored the poorest for this criterion have petrol stations located along their section that would be impacted by road corridor widening. For example, for Section 1 (Puhinui Road: SH20 interchange to Kenderdine Road) B-side and both side widening scored -2 as the service station at the corner of Puhinui Road and Noel Burnside Road will require removal. This will involve the removal of the petroleum hydrocarbon storage and distribution infrastructure, which may be associated with gross soil and groundwater contamination.

Three options are anticipated to have neutral effects (0) regarding contamination. For example, all options for section 5 (Manukau Station Road: Lambie Drive to Davies Avenue) are expected to have neutral impacts because bulk earth works were completed for the Manukau Train Station prior to the completion date in 2012, and it is considered unlikely contaminated soils will be encountered in this area.

It is noted that where an option has been evaluated to cause minor (-1) to significant (-3) adverse impacts, it has been identified that there is likely to be asbestos and lead contamination within the vicinity which may result in increased soil disposal costs and H&S considerations during building removal and bulk earthworks.

Further contaminated land assessment (e.g. PSI and DSI) should be conducted prior to further detailed design to gain more understanding of land contamination risks and any required mitigation measures.

6.8 Noise and Vibration

Scores for the noise and vibration criteria ranged from neutral (0) to moderate to significant adverse effects (-2).

Those options that scored the best have no surrounding sensitive noise receptors (for example all options within Section 7 (Ronwood Avenue: Davies Avenue to Osterley Way / Sharkey Street)).

Majority of the options scored either -1 or -2 reflecting that the road corridor will be brought closer to residential properties and other sensitive noise receptors (places of worship, accommodation providers or educational facilities). Those options that scored the worst reflected the proximity of the road corridor widening to potentially sensitive receptors:

- Kingdom Hall of Jehovah's Witnesses (Section 1 – B-Side and Both Side widening and Section 13 - B-Side and Both Side widening); and
- Educational facilities (Puhinui School for Section 3, B-Side and Both Side widening and AUT Campus for Section 10 (B-Side and Both Side widening).

Construction noise and vibration effects are likely to have an adverse impact on sensitive receptors along most of the corridor.

7 Recommended Option

After considering the performance of all options, the following options are recommended for each Section:

- Section 1 (Puhinui Road: SH20 interchange to Kenderdine Road):

  B-Side Widening

  B-Side Widening is recommended as it was the option with no significant adverse effects (-3) [redacted]

- Section 3 (Puhinui Road: Cambridge Terrace to Lambie Drive):

  A-Side Widening

  A-Side Widening is recommended as it would have no significant adverse effects and the greatest amount of minor effects of all three options.

- A key factor in recommending A-Side Widening was that it did not impact the designation at Puhinui School. B-Side and Both-Side Widening had increased planning complexity due to the designation and the approvals that would be required.Section 5 (Manukau Station Road: Lambie Drive to Davies Avenue):

  B-Side Widening

  B-Side Widening is recommended as it would have no significant adverse effects and the greatest amount of neutral or minor effects of all three options (this option only had one moderate adverse effect relating to third party consents).

  Particularly, A-Side Widening and Both-Side Widening would impact the railway lines and carparking for the Manukau Institute of Technology (MIT). Substantial mitigation costs would be required to relocate carparking (if possible), which would have significant adverse effects.

  B-Side Widening will also provide an opportunity to integrate the design with the proposed MIT development.

- Section 7 (Ronwood Avenue: Davies Avenue to Osterley Way / Sharkey Street):

  Both-Side Widening

  Both-Side Widening is recommended as it would have no significant adverse effects. [redacted]

Specifically, [redacted]

B-Side Widening would also have significant adverse effects as it would impact the Auckland Transport Ronwood Avenue carparking building and would require the relocation of an external stairwell/life shaft. The common area of a large residential apartment building will also be impacted and require redesign.

- Section 9 Great South Road: Ronwood Avenue to Te-Irirangi Drive):

  A-Side Widening

  A-Side Widening is recommended as it was the option with the lowest number of criterions being scored as having significant adverse effects (-3). In addition, it has the greatest amount of neutral or minor effects of all three options.

  A-Side Widening also avoids acquisition of Transpower's Wiri Substation. Whereas, B-Side Widening and Both-Side Widening would require the partial or full acquisition of the substation.

- Section 10 (Te Irirangi Drive: Great South Road to Diorella Drive):

  B-Side Widening

  B-Side Widening is recommended as it was the option with the lowest number of criterions being scored as having significant adverse effects (-3).

  [redacted], however it would avoid any impacts on the Auckland University of Technology buildings and the Manukau Velodrome.

- Section 11 (Te Irirangi Drive: Diorella Drive to Te Irirangi Drive Ch. 1525):

  A-Side Widening

  A-Side Widening is recommended as it has no significant adverse effects (-3). In addition, it has the greatest amount of neutral or minor effects of all three options.

  The key differentiator for Section 11 is the property criteria. [redacted] along with 1 partial acquisition of land owned by Auckland Council, which would result in significant adverse effects.

- Section 13 (Te Irirangi Drive: Dawson Road to Penion Drive):

  B-Side Widening

  A-Side Widening is recommended as it has no significant adverse effects (-3). In addition, it has the greatest amount of neutral or minor effects of all three options.

Attachments:

- Appendix A: Road Corridor Widening Option Schematics
- Appendix B: Constructability Technical Note
- Appendix C: Property Technical Note
- Appendix D: Planning and Consentability Technical Note
- Appendix E: Urban Design and Visual Amenity Technical Note
- Appendix F: Social and Community Impact Technical Note
- Appendix G: Stormwater Technical Note
- Appendix H: Contaminated Land Technical Note
- Appendix I: Noise and Vibration Technical Notes
- Appendix J: Road Corridor Widening Descriptions and Assumptions Memorandum

Approvals:

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Technical Note

To		From	
Copy		Reference	**502334**
Date	**2020-04-20**	Pages (including this page)	**19**
Subject	**A2B Road Corridor Widening Preferred Options Assessment - Constructability**		

1 Introduction

The following provides an assessment of the options for the road corridor widening options for the Airport to Botany (A2B) Rapid Transit Corridor (RTC) preferred route where the desired cross-section does not fit within existing road reserve, as part of the preferred option route for the Airport to Botany (A2B) Single-Stage Business Case (SSBC). It covers the A2B project area from immediately east of the State High 20 Interchange along Puhinui Road, through Manukau CBD to Botany Town Centre along Ti Irirangi Drive.

This tech note details the considerations which have been used to inform the assessment. This assessment is designed to contribute to the Multi-Criteria Analysis (MCA) assessment which is being undertaken for this section of the preferred option route.

The options are outlined in **Table 1**. The sections are summarised in **Table 2.**

Table 1 | Options summary

Option	Description
Option A: A-side widening	This option requires encroachment into property solely on the A side of the preferred option route (A-side is as identified on the option schematics).
Option B: B-side widening	This option requires encroachment into property solely on the B side of the preferred option route (B-side as identified on the option schematics).
Option C: A-side and B-side widening	This option involves property encroachment on both sides of the preferred option route (i.e. on both the A and B sides).

Table 2. A2B MCA Corridor Widening Sections

Section	Option		
Section 1 Puhinui Road (SH20 interchange to Kenderdine)	A-Side Widening	B-Side Widening	Both Side Widening
Section 3 Puhinui Road (Cambridge Terrace to Lambie Drive)	A-Side Widening	B-Side Widening	Both Side Widening
Section 5 Manukau Station Road (Lambie Drive to Davies Avenue)	A-Side Widening	B-Side Widening	Both Side Widening
Section 7 Ronwood Avenue (Davies Avenue to Osterly Way / Sharkey Street	A-Side Widening	B-Side Widening	Both Side Widening
Section 9 Great South Road (Ronwood Avenue to Te Irirangi Drive)	A-Side Widening	B-Side Widening	Both Side Widening
Section 10 Te Irirangi Drive (Great South Road to Diorella Drive)	A-Side Widening	B-Side Widening	Both Side Widening

Section 11 Te Irirangi Drive (Diorella Drive to Te Irirangi Drive Ch. 1525)	A-Side Widening	B-Side Widening	Both Side Widening
Section 13 Te Irirangi Drive (Dawson Road to Penion Drive)	A-Side Widening	B-Side Widening	Both Side Widening

2 Assessment Methodology

The source information is assessed in a desktop investigation only. The assessments are based on:

- A2B Road Corridor Widening Preferred Options Assessment Memorandum, dated 22/01/2020;
- Drawings (*App A – Sketch_Corridor Widening Options_Sh1-17*), dated 21/01/2020;
- Te Irirangi Drive SH1 Bridge Preliminary Structure Options Assessment, dated 22/11/2019;
- Typical Road Cross Sections 502334-7000-DRG-RR-0301-0305; and
- Existing Utility Drawings 502334-7000-DRG-UT-1601-1617.

No detailed site visits have been undertaken as part of this assessment.

2.1 Scoring

All options where assessed against the scores set out in **Table 3**.

Table 3 | Scoring criteria

Score	Statement
3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

2.2 Criteria

This technote summarises the scoring made against three criteria:

- Traffic Management during Construction;
- The interface between new and existing pavement and/or structures, which include the general footprint and the complexity thereof; and
- Impact on Utilities.

2.3 Assumptions

- It is assumed that the existing road levels will be retained throughout the width of the corridor and that the road will simply be widened to extend within the proposed typical cross-section road width.

- A decision is yet to be made on whether A2B continues north from Botany Town Centre. Should A2B extend past the town centre, the road corridor widening, and detailed design will be subject to separate design process.
- Widening of side roads joining the main corridor at intersections along to the proposed corridor are not included in this assessment, but it can be assumed that land acquisition will be required while developing the intersections layouts.
- Station locations and associated land requirements will be dealt with separately and are independent from the side of road assessment.
- It is assumed that a closed RTN System will be implemented (this will result in a slightly smaller footprint at a few intersections along the corridor).
- The assessment is to be undertaken without any consideration of mitigation measures. For example, no noise mitigation is to be considered (i.e. noise attenuation walls that may impact visual amenity).
- The scores and assessments are presented in **Tables 4 to 11** below.

Table 4 Multi Criteria Analysis Scoring Sheet – Section 1/Option A/B/Both

Scenario 1/Option A/B/Both: Puhinui Road (SH20 interchange to Kenderdine Road)	
Name of assessor (incl. qualifications and organisation)	, Aurecon – B-Tech Degree Transportation Engineering
Area of assessment	Constructability

Score:

Option	Traffic Management During Construction	Interface between new/existing pavement and/or structures	Impact on Utilities
A-Side Widening	-1	-1	-1
B-Side Widening	-1	-1	-1
Both Side Widening	-2	-2	-3

Traffic management during construction - Reasons / Comments

A-Side

- A-Side widening will enable predominantly off-line construction adjacent to (north of) the existing roadway.
- Having off-line construction will ease traffic management and provide the contractor with more working space.

B-Side

- B-Side widening will enable predominantly off-line construction adjacent to (south of) the existing roadway.
- Having off-line construction will ease traffic management and provide the contractor with more working space.

Both Side

- Widening associated with the both side option enables partially off-line construction, although work would be split between work zones to north and south of existing alignment.
- Bi-directional traffic control and site access points would be required, and work space may become a restriction.

Interface between new and existing pavement and/or structures - Reasons / Comments

A-Side

- A-Side widening would have a reduced impact on Noel Burnside Rd intersection.
- Puhinui train station access road would require reconfiguration.
- From a pavement perspective better uniformity is achieved throughout the pavement structure by having a wider construction area when widening to one side only. It provides space for the contractor to place, mix and compact the new pavement layers.

B-Side

- B-Side widening would slightly reduce impact on Milan, Wylie & Raymond intersection configuration.
- From a pavement perspective better uniformity is achieved throughout the pavement structure by having a wider construction area when widening to one side only. It provides space for the contractor to place, mix and compact the new pavement layers.

Both Side

- Widening associated with the both side option reduces the working space that influence compaction efforts and could cause an ununiform pavement structure.
- This may also translate in higher maintenance costs and premature pavement failures, especially on construction joints where the new pavement joins the old pavement structure.

Impact on Utilities - Reasons / Comments

A-Side

- A-Side widening would affect almost all existing utilities. The amount of utilities on the northern edge the existing road is approximately equal to the southern edge of the existing road.
- Widening A-Side will mostly affect utilities on the northern edge of the existing road. This will require the utilities to be relocated and the southern edge utilities may only require protection.

B-Side

- Almost all existing utilities are affected with the widening of B-Side. The amount of utilities on the northern edge the existing road is approximately equal to the south edge or the existing road.
- Widening B-Side will mostly affect utilities on the southern edge of the existing road. This will require the utilities to be relocated and the northern edge utilities may only require protection.

Both Side

- Widening both sides will impact the existing utilities to both the north and south of the existing road configuration and most will likely have to be relocated.

Table 5 Multi Criteria Analysis Scoring Sheet - Section 3/Option A/B/Both

Multi Criteria Analysis Scoring Sheet – Section 3/Option A/B/Both

Name of assessor (incl. qualifications and organisation)	, Aurecon – B-Tech Degree Transportation Engineering
Area of assessment	Constructability

Score:

Option	Traffic Management During Construction	Interface between new/existing pavement and/or structures	Impact on Utilities
A-Side Widening	-1	-1	-1
B-Side Widening	-1	-1	-1
Both Side Widening	-2	-2	-3

Traffic management during construction - Reasons / Comments

A-Side

- A-Side widening enables predominantly off-line construction adjacent to (north of) the existing roadway.
- Having off-line construction will ease traffic management and provide the contractor with more working space.

B-Side

- B-Side widening enables predominantly off-line construction adjacent to (south of) the existing roadway.
- Having off-line construction will ease traffic management and provide the contractor with more working space.

Both Side

- Widening associated with the both side option enables partially off-line construction although work would be split between work zones to the north and south of existing alignment.
- Bi-directional traffic control and site access points would be required, and work space may become a restriction.

Interface between new and existing pavement and/or structures - Reasons / Comments

A-Side

- From a pavement perspective better uniformity is achieved throughout the pavement structure by having a wider construction area when widening to one side only. It provides space for the contractor to place, mix and compact the new pavement layers.

B-Side

- From a pavement perspective better uniformity is achieved throughout the pavement structure by having a wider construction area when widening to one side only. It provides space for the contractor to place, mix and compact the new pavement layers.

Both Side

- Widening both sides reduces the working space that influence compaction efforts and could cause an ununiform pavement structure.
- This may also translate to higher maintenance costs and premature pavement failures, especially on construction joints where the new pavement joins the old pavement structure.

Impact on Utilities - Reasons / Comments

A-Side

- A-Side widening affects almost all existing utilities.
- The amount of utilities on the northern edge of the existing road is approximately equal to the southern edge of the existing road.
- Widening of A-Side will mostly affect utilities on the northern edge of the existing road and will required relocation. The southern edge utilities may only require protection.

B-Side

- B-Side widening will affect almost all existing utilities. The amount of utilities on the northern edge of the existing road is approximately equal to the southern edge of the existing road.
- Widening B-Side will mostly affect utilities on the southern edge of the existing road and will require relocation. The northern edge utilities may only require protection.

Both Side

- Widening both sides impacts the existing utilities to both north and south of the existing road configuration and will likely require relocation.

Table 6 Multi Criteria Analysis Scoring Sheet - Section 5/Option A/B/Both

Section 5/Option A/B/Both: Manukau Station Road (Lambie Drive to Davies Avenue)

Name of assessor (incl. qualifications and organisation) , Aurecon – B-Tech Degree Transportation Engineering

Area of assessment Constructability

Score:

Option	Traffic Management During Construction	Interface between new/existing pavement and/or structures	Impact on Utilities
A-Side Widening	-1	-1	-1
B-Side Widening	-1	-1	-1
Both Side Widening	-1	-1	-1

Traffic management during construction - Reasons / Comments

A-Side

- The current road layout allows traffic to be diverted to the opposite carriageway to create contraflow to complete the widening in stages from one side to the other.
- Diversion will cause the traffic flow to degrade through the area while construction occurs, although access can still be provided where required.

B-Side

- The current road layout allows traffic to be diverted to the opposite carriageway to create contraflow to complete the widening in stages from one side to the other.
- Diversion will cause the traffic flow to degrade through the area while construction occurs, although access can still be provided where required.

Both Side

- The current road layout allows traffic to be diverted to the opposite carriageway to create contraflow to complete the widening in stages from one side to the other.
- Diversion will cause the traffic flow to degrade through the area while construction occurs, although access can still be provided where required.

Interface between new and existing pavement and/or structures - Reasons / Comments

A-Side

- The new bus rapid lane (BRL) will be constructed mostly along the existing grassed median area. Although access to an existing carpark would need to be maintained, the overall complexity of constructing this section of road is moderate.
- No significant pavement construction risks are envisaged.

B-Side

- The new BRL will be constructed mostly along the existing grassed median area. Although access to an existing carpark would need to be maintained, the overall complexity of constructing this section of road is moderate.
- No significant pavement construction risks are envisaged.

Both Side

- The new BRL will be constructed mostly along the existing grassed median area. Although access to an existing carpark would need to be maintained, the overall complexity of constructing this section of road is moderate.
- No significant pavement construction risks are envisaged.

Impact on utilities - Reasons / Comments

A-Side

- There are several utilities on the northern edge of the road that require protection or relocation.

B-Side

- There are a very limited number of utilities that require protection or relocation on the southern edge of the road.

Both Side

- Widening on both sides will require all existing services to be protected or relocated.
- The impact itself is minor in comparison to the amount of utilities in the Puhinui Road reserve.

Table 7 Multi Criteria Analysis Scoring Sheet - Section 7/Option A/B/Both

Section 7/Option A/B/Both: Ronwood Avenue (Davies Avenue to Osterley Way / Sharkey Street)	
Name of assessor (incl. qualifications and organisation)	, Aurecon – B-Tech Degree Transportation Engineering
Area of assessment	Constructability

Score:

Option	Traffic Management During Construction	Interface between new/existing pavement and/or structures	Impact on Utilities
A-Side Widening	-1	-1	-2
B-Side Widening	-1	-1	-1
Both Side Widening	-1	-1	-2

Traffic management during construction - Reasons / Comments

A-Side

- The current road layout allows traffic to be diverted to the opposite carriageway to create contraflow to complete the widening in stages from one side to the other.
- Diversion will cause the traffic flow to degrade through the area while construction occurs, although access will still be able to be provided where required.
- The traffic can also be diverted around this area to make use of the existing road network, should it be necessary.

B-Side

- The current road layout allows traffic to be diverted to the opposite carriageway to create contraflow to complete the widening in stages from one side to the other.
- Diversion will cause the traffic flow to degrade through the area while construction occurs, although access will still be able to be provided where required.
- The traffic can also be diverted around this area make use of the existing road network, should it be necessary.

Both Side

- The current road layout allows traffic to be diverted to the opposite carriageway to create contraflow to complete the widening in stages from one side to the other.
- Diversion will cause the traffic flow to degrade through the area while construction occurs, although access will still be able to be provided where required.
- The traffic can also be diverted around this area make use of the existing road network, should it be necessary.

Interface between new and existing pavement and/or structures - Reasons / Comments

A-Side

- The new BRL will be constructed mostly along the existing grassed median area. Although access to an existing carpark would need to be maintained, the overall complexity of constructing this section of road is moderate.
- No significant pavement construction risks are envisaged.

B-Side

- The new BRL will be constructed mostly along the existing grassed median area. Although access to an existing carpark would need to be maintained, the overall complexity of constructing this section of road is moderate.
- No significant pavement construction risks are envisaged.

Both Side

- The new BRL will be constructed mostly along the existing grassed median area. Although access to an existing carpark would need to be maintained, the overall complexity of constructing this section of road is moderate.
- No significant pavement construction risks are envisaged.

Impact on utilities - Reasons / Comments

A-Side

- A-Side widening will have a large impact as there are several utilities on the northern edge of the road that will require relocation or protection.

B-Side

- B-Side widening will have a minor impact as there are limited utilities that will require relocation or protection.

Both Side

- Widening both sides will require all utilities within this corridor to be relocated or protected. It seems likely that most utilities will be able to be protected, compared to relocated.

Table 8 Multi Criteria Analysis Scoring Sheet – Section 9/Option A/B/Both

Section 9/Option A/B/Both: Great South Road (Ronwood Avenue to Te-Irirangi Drive)

Name of assessor (incl. qualifications and organisation) [redacted], Aurecon – B-Tech Degree Transportation Engineering

Area of assessment Constructability

Score:

Option	Traffic Management During Construction	Interface between new/existing pavement and/or structures	Impact on Utilities
A-Side Widening	-2	-1	-3
B-Side Widening	-2	-1	-3
Both Side Widening	-2	-2	-3

Traffic management during construction - Reasons / Comments

A-Side

- Widening A-Side will require staged construction to ensure the traffic is managed throughout this section of road.
- Some traffic may have to be placed on detours during the construction phase.
- Traffic management will be critical due to the class of road and high volume of traffic.

B-Side

- B-Side widening will involve staged construction to ensure the traffic is managed throughout this section of road.
- Some traffic may have to be placed on detours during the construction phase.
- Traffic management will be critical due to the class of road and high volume of traffic.

Both Side

- Both side widening will involve staged construction to ensure the traffic is managed throughout this section of road.
- Some traffic may have to be placed on detours during the construction phase.
- Traffic management will be critical due to the class of road and high volume of traffic.

Interface between new and existing pavement and/or structures - Reasons / Comments

A-Side

- Widening the road towards the west will reduce the impact on the Countdown access intersection.
- From a pavement perspective better uniformity is achieved throughout the pavement structure by having a wider construction area when widening to one side only. It provides space for the contractor to place, mix and compact the new pavement layers.

B-Side

- Widening the road towards the east increases the impact on the Countdown access intersection, which may increase the complexity to a small extent.
- From a pavement perspective better uniformity is achieved throughout the pavement structure by having a wider construction area when widening to one side only. It provides space for the contractor to place, mix and compact the new pavement layers.

Both Side

- Widening both sides reduces the working space available that influences compaction efforts and can cause an ununiform pavement structure.
- This may also translate to higher maintenance costs and premature pavement failures, especially on construction joints where the new pavement joins the old pavement structure. It also includes the impact on the Countdown access intersection.

Impact on utilities - Reasons / Comments

A-Side

- There are large underground electrical cables on either side of the road.
- Widening the road towards the west may have a minor impact on utility relocation as there are less cables located on the western side of the road. The cables on the eastern side may only require protection.

B-Side

- There are large underground electrical cables on either side of the road.
- Widening the road towards the east may have a major impact on the relocation of high voltage cables as there are more cables on the eastern side of the road.

Both Side

- Widening both sides will impact utilities on either side of the road.
- There will be a significant impact regarding the relocation of the large number of high voltage underground electrical cables and other minor services within the footprint.

Table 9 Multi Criteria Analysis Scoring Sheet - Section 10/Option A/B/Both

Section 10/Option A/B/Both: Te Irirangi Drive (Great South Road to Diorella Drive)

Name of assessor (incl. qualifications and organisation) [redacted], Aurecon – B-Tech Degree Transportation Engineering

Area of assessment Constructability

Score:

Option	Traffic Management During Construction	Interface between new/existing pavement and/or structures	Impact on Utilities
A-Side Widening	-2	-3	-1
B-Side Widening	-1	-3	-1
Both Side Widening	-2	-3	-2

Traffic management during construction - Reasons / Comments

A-Side

- Widening A-Side may have more complex traffic management issues as access will be required for the North facing on-and-off ramps to SH1.
- To ease traffic management, east of SH1 to Diorella Drive could provide off-line construction.

B-Side

- Traffic management associated with B-Side widening may be minor and with little interference of the access ramps to SH1.
- To ease traffic management, east of SH1 to Diorella Drive could provide off-line construction.

Both Side

- Both side widening enables partially off-line construction, although there are split work zones to the north and south of the existing alignment.
- Bi-directional traffic control and site access points would be required, and work space may become a restriction.

Interface between new and existing pavement and/or structures - Reasons / Comments

A-Side

- The section of road on the western side of the SH1 Bridge has a major impact on the existing university buildings and will require retaining walls.
- The access ramps to SH1 increases the overall complexity of tying in the existing road infrastructure, however it does not pose a major risk.
- The existing bridge over SH1 needs to be widened to the north, due to vertical bridge clearance and the existing vertical grade of SH1 restrictions.

- The section of road east of the SH1 bridge is mainly greenfield and uniformity throughout the pavement structure can be achieved by having a wider construction area when widening to one side only. It provides space for the contractor to place, mix and compact the new pavement layers.

B-Side

- The section of road on the western side of the SH1 bridge has a minor impact on the surrounding infrastructure.
- It reduces the complexity of the interchange ramp tie-in; however, the bridge cannot be widened to the south without major modification to the existing over road bridge.
- Widening the section of road on the eastern side of the SH1 bridge towards the southern side does create more workspace but will also require an entire row of house to be acquired.
- Construction occurring east of SH1 bridge will be mainly greenfield and uniformity throughout the pavement structure can be achieved by having a wider construction area when widening to one side only. It provides space for the contractor to place, mix and compact the new pavement layers.

Both Side

- Widening both sides will restrict workspace. There is also no uniformity through the pavement structure which may cause higher maintenance in the future.
- Widening an existing bridge structure is not feasible and can become very complex.
- More retaining walls will be needed to support widened embankment fills, which are adjacent to the bridge approaches.
- Widening both sides will also have further impacts on residential houses.

Impact on utilities - Reasons / Comments

A-Side

- There are only a few utilities that are required to be protected or relocated should the road be widened to the north. Therefore, it does not pose a major risk.

B-Side

- If B-Side widening occurs there are utilities located in the south that will require protection or relocation.

Both Side

- Both side widening will impact utilities on either side of the road and will require relocation or protection.

Table 10 Multi Criteria Analysis Scoring Sheet - Section 11/Option A/B/Both

Section 11/Option A/B/Both: Te Irirangi Drive (Diorella Drive to Te Irirangi Drive Ch. 1525)	
Name of assessor (incl. qualifications and organisation)	, Aurecon – B-Tech Degree Transportation Engineering
Area of assessment	Constructability

Score:

Option	Traffic Management During Construction	Interface between new/existing pavement and/or structures	Impact on Utilities
A-Side Widening	-1	-1	-1
B-Side Widening	-1	-2	-1
Both Side Widening	-2	-2	-2

Traffic management during construction - Reasons / Comments

A-Side

- Widening A-Side will require staged construction to ensure the traffic is managed throughout this section of road.
- Traffic detours may be required during the construction phase.
- Off-line construction will be possible to ease traffic management.

B-Side

- Widening B-Side will require staged construction to ensure the traffic is managed throughout this section of road.
- Traffic detours may be required during the construction phase.
- Off-line construction will be possible to ease traffic management.

Both Side

- Widening both sides will require staged construction to ensure the traffic is managed throughout these sections of roads.
- Traffic detours may be required during the construction phase.
- Bi-directional traffic control and site access points will be required, and work space may become a restriction.

Interface between new and existing pavement and/or structures - Reasons / Comments

A-Side

- A-Side widening will have minor impact on tying in the existing five intersections on the southern side to Te Irirangi Drive in terms of complexity and total footprint area.

- From a pavement perspective better uniformity is achieved throughout the pavement structure by having a wider construction area when widening to one side only. It provides space for the contractor to place, mix and compact the new pavement layers.

B-Side

- Widening B-Side will involve tying in five intersections onto the southern side to Te Irirangi Drive, which will increase the complexity and construction footprint. This will have a large impact on traffic management and construction costs.
- From a pavement perspective better uniformity is achieved throughout the pavement structure by having a wider construction area when widening to one side only. It provides space for the contractor to place, mix and compact the new pavement layers.

Both Side

- Widening both sides restricts the available workspace.
- There is also no uniformity through the pavement structure, which may cause higher maintenance in the future.
- Widening an existing bridge structure is not feasible and can become very complex.
- Both side widening involves tying in all seven intersections along this section of road, increasing the complexity.

Impact on utilities - Reasons / Comments

A-Side

- A-Side widening will require a minor number of utilities to be protected or relocated. Therefore, no major risk is posed.

B-Side

- Widening B-Side would require several utilities located to the south to be protected or relocated.

Both Side

- Both side widening will impact utilities on either side of the road and will require relocation or protection.

Table 11 Multi Criteria Analysis Scoring Sheet - Section 13/Option A/B/Both

Section 13/Option A/B/Both: Te Irirangi Drive (Dawson Road to Penion Drive)	
Name of assessor (incl. qualifications and organisation)	, Aurecon – B-Tech Degree Transportation Engineering
Area of assessment	Constructability

Score:

Option	Traffic Management During Construction	Interface between new/existing pavement and/or structures	Impact on Utilities
A-Side Widening	-1	-2	-1
B-Side Widening	-1	-1	-1
Both Side Widening	-2	-1	-1

Traffic management during construction - Reasons / Comments

A-Side

- Widening A-Side will require staged construction to ensure the traffic is managed throughout this section of road.
- Traffic detours may be required during the construction phase.
- Off-line construction will be possible to ease traffic management.

B-Side

- Widening B-Side will require staged construction to ensure the traffic is managed throughout this section of road.
- Traffic detours may be required during the construction phase.
- Off-line construction will be possible to ease traffic management.

Both Side

- Widening both sides will require staged construction to ensure the traffic is managed throughout this section of road.
- Traffic detours may be required during the construction phase.
- Bi-directional traffic control and site access points will be required, and work space may become a restriction.

Interface between new and existing pavement and/or structures - Reasons / Comments

A-Side

- Widening A-Side may provide more workspace; however the tie-in and the surrounding commercial land may be complex.

- From a pavement perspective better uniformity is achieved throughout the pavement structure by having a wider construction area when widening to one side only. It provides space for the contractor to place, mix and compact the new pavement layers.

B-Side

- Widening B-Side involves residential access issues on the southern side of Te Irirangi Drive during construction. This will restrict the available work space for the contractor.
- From a pavement perspective better uniformity is achieved throughout the pavement structure by having a wider construction area when widening to one side only. It provides space for the contractor to place, mix and compact the new pavement layers.

Both Side

- Widening both sides will restrict the workspace available.
- There is also no uniformity through the pavement structure, which may cause higher maintenance in the future.
- Widening both sides of the road would be more beneficial to maintain the existing alignment of Te Irirangi Drive.

Impact on utilities - Reasons / Comments

A-Side

- Utilities on the northern side of the road are almost equal to those on the southern side.
- A-Side widening would likely require utilities to be relocated.

B-Side

- Utilities on the northern side of the road are almost equal to those on the southern side.
- B-Side widening would likely require utilities to be relocated.

Both Side

- Utilities on the northern side of the road are almost equal to those on the southern side.
- Both side widening would likely require utilities to be relocated.

Approved by:

Title	Name	Qualification		Date
Author	[redacted]	MEnvMgmt	[redacted]	04.03.2020
Reviewer	[redacted]	B-Tech Degree Transportation Engineering		22.04.2020

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Technical Note

To		From	
Copy		Reference	**502334**
Date	**2020-04-23**	Pages (including this page)	**11**
Subject	**A2B Road Corridor Widening Preferred Options Assessment – Property**		

1 Introduction

The following provides an assessment of the options for the road corridor widening options for the Airport to Botany (A2B) Rapid Transit Corridor (RTC) preferred route where the desired cross-section does not fit within existing road reserve, as part of the preferred option route for the Airport to Botany (A2B) Single-Stage Business Case (SSBC). It covers the A2B project area from immediately east of the Puhinui Interchange (Puhinui Road and SH20 Intersection) through to Botany.

The assessment details the considerations which have been used to inform the assessment. This assessment is designed to contribute to the Multi-Criteria Analysis (MCA) assessment which is being undertaken for this section of the preferred option route.

The options are outlined in **Table 1**. The sections are summarised in **Table 2**.

Table 1. Options summary

Option	Description
Option A: A-Side widening	This option requires encroachment into property solely on the A side of the preferred option route (A-Side is as identified on the option schematics).
Option B: B-Side widening	This option requires encroachment into property solely on the B side of the preferred option route (B-Side as identified on the option schematics).
Option C: A-Side and B-Side widening	This option involves property encroachment on both sides of the preferred option route (i.e. on both the A and B sides).

Table 2. A2B Side of Road Assessment MCA Options

Section	Option		
Section 1 Puhinui Road (SH20 interchange to Kenderdine)	A-Side Widening	B-Side Widening	Both Side Widening
Section 3 Puhinui Road (Cambridge Terrace to Lambie Drive)	A-Side Widening	B-Side Widening	Both Side Widening
Section 5 Manukau Station Road (Lambie Drive to Davies Avenue)	A-Side Widening	B-Side Widening	Both Side Widening
Section 7 Ronwood Avenue (Davies Avenue to Osterly Way / Sharkey Street	A-Side Widening	B-Side Widening	Both Side Widening
Section 9 Great South Road (Ronwood Avenue to Te Irirangi Drive)	A-Side Widening	B-Side Widening	Both Side Widening
Section 10 Te Irirangi Drive (Great South Road to Diorella Drive)	A-Side Widening	B-Side Widening	Both Side Widening

Section 11 Te Irirangi Drive (Diorella Drive to Te Irirangi Drive Ch. 1525)	A-Side Widening	B-Side Widening	Both Side Widening
Section 13 Te Irirangi Drive (Dawson Road to Penion Drive)	A-Side Widening	B-Side Widening	Both Side Widening

2 Assessment Methodology

The source information is assessed in a desktop investigation only. The assessments are based on:

- A2B Road Corridor Widening Preferred Options Assessment Memorandum, dated 22/01/2020; and
- Drawings (*App A – Sketch_Corridor Widening Options_Sh1-17*), dated 21/01/2020.

No detailed site visits have been undertaken as part of this assessment., impacts on property were based on the land requirement plans provided under each option.

2.1 Scoring

All options where assessed against the scores set out in **Table 3**.

Table 3 | Scoring criteria

Score	Statement
3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

2.2 Criteria

This technote summarises the scoring made against the following property criterion:

- Extent and complexity of properties that require acquisition. Level of anticipated risk associated with property negotiation and acquisition under the Public Works Act 1981.

2.3 Assumptions

- It is assumed that the existing road levels will be retained throughout the with the corridor and that the road will simply be widened to extend within the proposed typical cross-section road width.
- A decision is yet to be made on whether A2B continues north from Botany Town Centre. Should A2B extend past the town centre, the road corridor widening, and detailed design will be subject to separate design process.
- Widening of side roads joining the main corridor at intersections along to the proposed corridor widening sections are not included in this assessment, but it can be assumed that land acquisition will be required while developing the intersections layouts.

- Station locations and associated land requirements will be dealt with separately and are independent from the side of road assessment.
- It is assumed that a closed RTN System will be implemented (this will result in a slightly smaller footprint at a few intersections along the corridor).
- The assessment is to be undertaken without any consideration of mitigation measures. For example, no noise mitigation is to be considered (i.e. noise attenuation walls that may impact visual amenity).

The scores and assessments are presented in **Tables 4 to 11** below.

Table 4 Multi Criteria Analysis Scoring Sheet – Section 1/Option A/B/Both

Scenario 1/Option A/B/Both: Puhinui Road (SH20 interchange to Kenderdine Road)	
Name of assessor (incl. qualifications and organisation)	[redacted] – AT, BBS
Area of assessment	Property

Score:

Option	Property Score
A-Side Widening	-3
B-Side Widening	-2
Both Side Widening	-3

Reasons / Comments

A-Side

- A side widening has a large impact. [redacted]
- This would result in a significant adverse effect.

B-Side

- [redacted]
- This option impact is considered to have a moderate adverse effect.

Both Side

- [redacted]
- This would result in a significant adverse effect.

Table 5 Multi Criteria Analysis Scoring Sheet – Section 3/Option A/B/Both

Section 3/Option A/B/Both: Puhinui Road (Cambridge Terrace to Lambie Drive)	
Name of assessor (incl. qualifications and organisation)	[redacted] – AT, BBS
Area of assessment	Property

Score:

Option	Property Score
A-Side Widening	-1
B-Side Widening	-2
Both Side Widening	-3

Reasons / Comments

A-Side

- [redacted]
- This option results in a minor adverse effect.

B-Side

- [redacted]
- [redacted]
- This option results in a moderate adverse effect.

Both Side

- [redacted]
- This option results in a significant adverse effect.

Table 6 Multi Criteria Analysis Scoring Sheet – Section 5/Option A/B/Both

Section 5/Option A/B/Both: Manukau Station Road (Lambie Drive to Davies Avenue)	
Name of assessor (incl. qualifications and organisation)	[redacted] – AT, BBS
Area of assessment	Property

Score:

Option	Property Score
A-Side Widening	-3
B-Side Widening	-1
Both Side Widening	-2

Reasons / Comments

A-Side

- [redacted]
- This option would have a significant adverse effect.

Reasons / Comments (B-Side)

- B side widening will not impact the MIT / railway station site; however, [redacted]
- The corridor widening would not impact the works currently under construction, resulting in a minor effect.
- This option results in a minor adverse effect.

Reasons / Comments (Both Side)

- [redacted]
- This option results in a moderate adverse effect.

Table 7 Multi Criteria Analysis Scoring Sheet – Section 7/Option A/B/Both

Section 7/Option A/B/Both: Ronwood Avenue (Davies Avenue to Osterley Way / Sharkey Street)	
Name of assessor (incl. qualifications and organisation)	[redacted] – AT, BBS
Area of assessment	Property

Score:

Option	Property Score
A-Side Widening	-3
B-Side Widening	-3
Both Side Widening	-2

Reasons / Comments

A-Side

- [redacted]
- This impact results in a significant adverse effect.

B-Side

- [redacted]
- [redacted]
- Both these impacts collectively result in a significant adverse effect.

Both Side

- Both side widening affects the greatest number of properties, however the impact is moderate considering no carparks or building operation will need to be altered.

Table 8 Multi Criteria Analysis Scoring Sheet – Section 9/Option A/B Both

Section 9/Option A/B/Both: Great South Road (Ronwood Avenue to Te-Irirangi Drive)	
Name of assessor (incl. qualifications and organisation)	[redacted], AT- BBS
Area of assessment	Property

Score:

Option	Property Score
A-Side Widening	-3
B-Side Widening	-3
Both Side Widening	-3

Reasons / Comments

A-Side

- [redacted]
- This impact results in a significant adverse effect.

B-Side

- [redacted]
- [redacted]
- This impact results in a significant adverse effect.

Both Side

- [redacted]
- [redacted]
- This impact results in a significant adverse effect.

Table 9 Multi Criteria Analysis Scoring Sheet – Section 10/Option A/B/Both

Section 10/Option A/B/Both: Te Irirangi Drive (Great South Road to Diorella Drive)	
Name of assessor (incl. qualifications and organisation)	[redacted] – AT, BBS
Area of assessment	Property

Score:

Option	Property Score
A-Side Widening	-2
B-Side Widening	-2
Both Side Widening	-1

Reasons / Comments

A-Side

- [redacted]
- This impact results in a moderate adverse effect.

B-Side

- [redacted]
- This impact results in a moderate adverse effect.

Both Side

- Both sides would have similar number of properties impacted compared to either A or B side widening. Noting that:
  - [redacted]
  - [redacted]
  - [redacted]
- This impact results in a minor adverse effect.

Table 10 Multi Criteria Analysis Scoring Sheet – Section 11/Option A/B/Both

Section 11/Option A/B/Both: Te Irirangi Drive (Diorella Drive to Te Irirangi Drive Ch. 1525)	
Name of assessor (incl. qualifications and organisation)	[redacted] – AT, BBS
Area of assessment	Noise

Score:

Option	Property Score
A-Side Widening	-2
B-Side Widening	-3
Both Side Widening	-1

Reasons / Comments

A-Side

- [redacted]
- This impact results in a moderate adverse effect.

B-Side

- [redacted]
- This impact results in a significant adverse effect.

Both Side

- [redacted]
- This impact results in a minor adverse effect.

Table 11 Multi Criteria Analysis Scoring Sheet – Section 13/Option A/B/Both

Section 13/Option A/B/Both: Te Irirangi Drive (Dawson Road to Penion Drive)	
Name of assessor (incl. qualifications and organisation)	[redacted] – AUT, BBS
Area of assessment	Property

Score:

Option	Property Score
A-Side Widening	-3
B-Side Widening	-1
Both Side Widening	-2

Reasons / Comments

A-Side

- [redacted]
- This impact results in a significant adverse effect.

B-Side

- [redacted]
- This impact results in a minor adverse effect.

Both Side

- [redacted]
- This impact results in a moderate adverse effect.

Approved by:

Title	Name	Qualification		Date
Author	[redacted]	BBS	[redacted]	27/03/2020
Reviewer		MEP (Hons), BEMP		24/04/2020

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Technical Note

To		From	
Copy		Reference	**502334**
Date	**2020-04-21**	Pages (including this page)	**19**
Subject	**A2B Road Corridor Widening Preferred Options Assessment – Planning and Consentability**		

1 Introduction

The following provides an assessment of the options for the road corridor widening options for the Airport to Botany (A2B) Rapid Transit Corridor (RTC) preferred route where the desired cross-section does not fit within existing road reserve, as part of the preferred option route for the Airport to Botany (A2B) Single-Stage Business Case (SSBC). It covers the A2B project area from immediately east of the Puhinui Interchange (Puhinui Road and SH20 Intersection) through to Botany.

The assessment details the considerations which have been used to inform the assessment. This assessment is designed to contribute to the Multi-Criteria Analysis (MCA) assessment which is being undertaken for this section of the preferred option route.

The options are outlined in **Table 1**. The sections are summarised in **Table 2.**

Table 1. Options summary

Option	Description
Option A: A-side widening	This option requires encroachment into property solely on the A side of the preferred option route (A-side is as identified on the option schematics).
Option B: B-side widening	This option requires encroachment into property solely on the B side of the preferred option route (B-side as identified on the option schematics).
Option C: A-side and B-side widening	This option involves property encroachment on both sides of the preferred option route (i.e. on both the A and B sides).

Table 2. A2B MCA Corridor Widening Sections

Group	Option		
Section 1 Puhinui Road (SH20 interchange to Kenderdine)	A-Side Widening	B-Side Widening	Both Side Widening
Section 3 Puhinui Road (Cambridge Terrace to Lambie Drive)	A-Side Widening	B-Side Widening	Both Side Widening
Section 5 Manukau Station Road (Lambie Drive to Davies Avenue)	A-Side Widening	B-Side Widening	Both Side Widening
Section 7 Ronwood Avenue (Davies Avenue to Osterly Way / Sharkey Street	A-Side Widening	B-Side Widening	Both Side Widening
Section 9 Great South Road (Ronwood Avenue to Te Irirangi Drive)	A-Side Widening	B-Side Widening	Both Side Widening
Section 10 Te Irirangi Drive (Great South Road to Diorella Drive)	A-Side Widening	B-Side Widening	Both Side Widening

Section 11 Te Irirangi Drive (Diorella Drive to Te Irirangi Drive Ch. 1525)	A-Side Widening	B-Side Widening	Both Side Widening
Section 13 Te Irirangi Drive (Dawson Road to Penion Drive)	A-Side Widening	B-Side Widening	Both Side Widening

2 Road Corridor Widening Assessment Methodology

The source information is assessed in a desktop investigation only. The assessments are based on:

- A2B Road Corridor Widening Preferred Options Assessment Memorandum, dated 22/01/2020; and
- Drawings (*App A – Sketch_Corridor Widening Options_Sh1-17*), dated 21/01/2020.

This assessment is a desktop study has been carried out using Auckland Council AUP and Geo Maps. assessment has been undertaken without any consideration of mitigation measures.

2.1 Scoring

All options where assessed against the scores set out in **Table 3**.

Table 3 | Scoring criteria

Score	Statement
3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

2.2 Criteria

This technote summarises the scoring made against two criteria:

- **Consentability** - Level of complexity of gaining approvals (e.g. activity status, risk of appeal, accordance with policy direction). Level of compliance with regulatory plans e.g. could the option include activities which are prohibited/ non-complying under the policies and rules of the district or regional plan?
- **Third Party Consents** - Potential to require third party consents as a result of property take, requirement to run RTC or buses on private roads, site configuration etc.

2.3 Assumptions

- For all options where road corridor widening will impact residential property, it is assumed those residential properties where the alignment impacts a building will be a full acquisition. For those options where residential property is impacted and a building is not impacted, assume partial acquisition.

- It is assumed that the existing road levels will be retained throughout the with the corridor and that the road will simply be widened to extend within the proposed typical cross-section road width.
- A decision is yet to be made on whether A2B continues north from Botany Town Centre. Should A2B extend past the town centre, the road corridor widening, and detailed design will be subject to separate design process.
- Widening of side roads joining the main corridor at intersections along to the proposed corridor widening sections are not included in this assessment, but it can be assumed that land acquisition will be required while developing the intersections layouts.
- Station locations and associated land requirements will be dealt with separately and are independent from the side of road assessment.
- It is assumed that a closed RTN System will be implemented (this will result in a slightly smaller footprint at a few intersections along the corridor).
- The assessment is to be undertaken without any consideration of mitigation measures. For example, no noise mitigation is to be considered (i.e. noise attenuation walls that may impact visual amenity).

The scores and assessments are presented in **Tables 4 to 11** below.

Table 4 Multi Criteria Analysis Scoring Sheet – Section 1/Option A/B/Both

Scenario 1/Option A/B/Both: Puhinui Road (SH20 interchange to Kenderdine Road)	
Name of assessor (incl. qualifications and organisation)	[redacted] – Aurecon, BSc
Area of assessment	Consentability/Third Party Consents

Score:

Option	Consentability Score	Third Party Consents Score
A-Side Widening	-1	-2
B-Side Widening	-2	-2
Both Side Widening	-2	-2

Reasons / Comments – Consentability

The zoning for this section is a mixture of Business Light Industrial Zone near Vison Place, Residential Single House Zone, Residential Mixed Housing Suburban Zone, Business Neighbourhood Centre Zone and Open Space Community Zone (250 Puhinui Road – southern side/B-Side).

The following overlays are applicable:

- High Use Stream Management Overlay
- High-Use Aquifer Management Area Overlay
- Aircraft Noise Overlay
- Notable Tree Overlay
  - 250 Puhinui Road – *southern side / B-Side*
  - Puhinui Road Reserve (in front of 307 Puhinui Road near Vision Place) – *northern side / A-Side*
- Historic Heritage Overlay Extent of Place - Cambria House (250 Puhinui Road) – *southern side / B-Side*

A-Side

- A notable tree (flowering gum tree) located near Vision Place within the Puhinui Road Reserve will require removal as a result of A-Side road corridor widening.

B-Side

- B-Side widening has the potential to impact two CHI items associated with the former US military temporary camp at Cambria Park that existed between 1942 and 1945 (located west of Puhinui Station and south of Puhinui Road).
- [redacted] A consent under the 'National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health' is likely to be required.

- The road corridor already has a greater setback on the B-Side for a portion of this section (244-258 Puhinui Road), reducing any adverse effects and consent requirements for widening at this location.

Both Side

- This option also has the potential to impact two CHI items associated with the former US military temporary camp at Cambria Park that existed between 1942 and 1945 (located west of Puhinui Station and south of Puhinui Road).
- [redacted] A consent under the 'National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health' is likely to be required.
- A notable tree (flowering gum tree) located near Vision Place within the Puhinui Road Reserve will be impacted as a result of road corridor widening to both sides.

Reasons / Comments - Third Party Consents

All options are anticipated to generate third party consent implications in some form and consequently all options have scored negatively. The implications introduce new potential bulk and location compliances because of reduced site areas, reconfigured site boundaries and removal of landscape vehicle access and carparking and loading areas that are likely required by underlying resource consents which will precipitate site reconfigurations and consent amendments. Key elements to note are:

A-Side

- [redacted]

B-Side

- [redacted]

Both Side

- [redacted]

Table 5 Multi Criteria Analysis Scoring Sheet - Section 3/Option A/B/Both

Multi Criteria Analysis Scoring Sheet – Section 3/Option A/B/Both

Name of assessor (incl. qualifications and organisation) [redacted] – Aurecon, BSc

Area of assessment Consentability/Third Party Consents

Score:

Option	Consentability Score	Third Party Consents Score
A-Side Widening	-1	-1
B-Side Widening	-2	-1
Both Side Widening	-2	-1

Reasons / Comments – Consentability

The zoning for this section is a mixture of Residential Mixed Housing Suburban Zone (A-side and a portion B side) and Residential Single House Zone (B-Side) and Business Neighbourhood Centre Zone (small area on A-Side opposite the intersection with Ranfurly Road).

The following overlays are applicable:

- High Use Stream Management Overlay
- High-Use Aquifer Management Area Overlay
- Aircraft Noise Overlay
- Stormwater Management Area Control – Flow 2

In addition, Puhinui School at 116 Puhinui Road (located on the southern/B-Side) is designated (#4980) by the Minster of Education for educational purposes (primary school and may include early childhood education).

A-Side

- A-Side widening will impact the local neighbourhood centre (Business Neighbourhood Centre Zone located opposite the intersection with Ranfurly Road).

B-Side

- A designation associated with Puhinui School (116 Puhinui Road) increases the planning complexity for B-Side widening, with approval from the Ministry of Education required. This has the potential to add additional time and risk to the planning process.

Both Side

- A designation associated with Puhinui School (116 Puhinui Road) increases the planning complexity for B-Side widening, with approval from the Ministry of Education required. This has the potential to add additional time and risk to the planning process.

Reasons / Comments - Third Party Consents

A-Side

- [redacted]

B-Side

- [redacted]

Both Side

- [redacted]

Table 6 Multi Criteria Analysis Scoring Sheet - Section 5/Option A/B/Both

Section 5/Option A/B/Both: Manukau Station Road (Lambie Drive to Davies Avenue)

Name of assessor (incl. qualifications and organisation) [redacted] – Aurecon, BSc

Area of assessment Consentability/Third Party Consents

Score:

Option	Consentability Score	Third Party Consents Score
A-Side Widening	-1	-3
B-Side Widening	-1	-2
Both Side Widening	-1	-3

Consentability - Reasons / Comment

Both sides of the road are zoned Business – Metropolitan Centre Zone, with the following overlays applicable:

- High Use Stream Management Overlay
- High-Use Aquifer Management Area Overlay
- Aircraft Noise Overlay
- Stormwater Management Area Control – Flow 2
- Buildings Frontage Control - General Commercial Frontage - *northern side (A-Side) only*

A-Side

- Manukau Train Station is located on the north side of the Manukau Station Road with the railway lines located close to the road corridor.
- There is no zoning differentiation (or overlay differentiation) either side of Manukau Station Drive.

B-Side

[redacted]

- There is no zoning differentiation (or overlay differentiation) either side of Manukau Station Drive.

Both Side

- Both side widening will affect Manukau train station on the northern side of the road with the railway lines located close to the road corridor.
- [redacted]

Third Party Consents - Reasons / Comments

A-Side

- A-Side widening will result in a loss of carparks and possible effects to the railway line, which may trigger the need for third party consent amendments, and additional approvals associated with changes to the station.

B-Side

- [redacted]

Both Side

- Both side widening will result in a loss of carparks and possible effects on the railway line and [redacted]

Table 7 Multi Criteria Analysis Scoring Sheet - Section 7/Option A/B/Both

Section 7/Option A/B/Both: Ronwood Avenue (Davies Avenue to Osterley Way / Sharkey Street)	
Name of assessor (incl. qualifications and organisation)	[redacted] – Aurecon, BSc
Area of assessment	Consentability/Third Party Consents

Score:

Option	Consentability Score	Third Party Consents Score
A-Side Widening	-1	-1
B-Side Widening	-2	-1
Both Side Widening	-2	-2

Consentability - Reasons / Comment

Both sides of the road are zoned Business – Metropolitan Centre Zone, with the following overlays applicable:

- High Use Stream Management Overlay
- High-Use Aquifer Management Area Overlay
- Aircraft Noise Overlay
- Stormwater Management Area Control – Flow 2
- Buildings Frontage Control - General Commercial Frontage – *applicable to both sides*

In addition, the public car park at 8 Davies Avenue, Manukau is designated (#1822) by Auckland Transport for public off-street parking, including ongoing maintenance, repairs and like for like replacement works to the existing parking facility and minor operational improvements to the same (located on the B-Side/southern side of Ronwood Avenue).

A-Side

- The Business – Metropolitan Centre Zone policies seek buildings with frontages subject to the General Commercial Frontage Control achieve a reasonable level of street activation, building continuity along the frontage, pedestrian amenity and safety and visual quality (applies to both sides of Ronwood Avenue).

B-Side

- There is a Public Car Park – Davies Avenue designated as 1822 at 8 Davies Avenue, Manukau by Auckland Transport for public off-street parking, including ongoing maintenance, repairs and like for like replacement works to the existing parking facility and minor operational improvements to the same.
- The Business – Metropolitan Centre Zone policies seek buildings with frontages subject to the General Commercial Frontage Control achieve a reasonable level of street activation, building continuity along the frontage, pedestrian amenity and safety and visual quality (applies to both sides of Ronwood Avenue).

Both Side

- The Business – Metropolitan Centre Zone policies seek buildings with frontages subject to the General Commercial Frontage Control achieve a reasonable level of street activation,

building continuity along the frontage, pedestrian amenity and safety and visual quality (applies to both sides of Ronwood Avenue).

- There is a Public Car Park – Davies Avenue designated as 1822 at 8 Davies Avenue, Manukau by Auckland Transport for public off-street parking, including ongoing maintenance, repairs and like for like replacement works to the existing parking facility and minor operational improvements to the same (potential to be impacted by both-side road corridor widening).

Third Party Consents - Reasons / Comments

A-Side

- The requirement for buildings with frontages to the General Commercial Frontage Control to achieve a reasonable level of street activation, building continuity along the frontage, pedestrian amenity and safety and visual quality, means that corridor widening to the A-Side may trigger additional consent amendments.
- A-Side may trigger the need to alter third party consents due to impacts on road frontage landscaping and car parking access.

B-Side

- The requirement for buildings with frontages to the General Commercial Frontage Control to achieve a reasonable level of street activation, building continuity along the frontage, pedestrian amenity and safety and visual quality, means that corridor widening to the B-Side will trigger additional consent amendments.
- B-Side may trigger the need to alter third party consents due to impacts on road frontage landscaping and car parking access.

Both Side

- Widening on both sides of Ronwood Avenue will create greater impacts along this road corridor, and to the surrounding businesses. Third-party consent considerations would likely be required for both sides (due to the impacts on road frontage landscaping and car parking access).

Table 8 Multi Criteria Analysis Scoring Sheet – Section 9/Option A/B/Both

Section 9/Option A/B/Both: Great South Road (Ronwood Avenue to Te-Irirangi Drive)

Name of assessor (incl. qualifications and organisation) [redacted] – Aurecon, BSc

Area of assessment Consentability/Third Party Consents

Score:

Option	Consentability Score	Third Party Consents Score
A-Side Widening	-1	-2
B-Side Widening	-3	-2
Both Side Widening	-3	-3

Consentability - Reasons / Comments

Both sides of the road are zoned Business – Metropolitan Centre Zone, with the following overlays applicable:

- High-Use Aquifer Management Area Overlay
- National Grid Substation Corridor Overlay (runs along Great South Road)
- Aircraft Noise Overlay
- Stormwater Management Area Control – Flow 2
- Buildings Frontage Control - General Commercial Frontage - *western side/A-Side only*

In addition, Wiri Electricity Substation at 656 Great South Road, Manukau is designated (#8533) by Transpower New Zealand Ltd for Electricity Transmission (located on the B side/eastern side of Great South Road).

A-Side

- The Business – Metropolitan Centre Zone policies seek buildings with frontages subject to the General Commercial Frontage Control achieve a reasonable level of street activation, building continuity along the frontage, pedestrian amenity and safety and visual quality (applies to A-side/western side of Great South Road only).

B-Side

- B-Side widening will impact the Wiri Electricity Substation (8533) at 656 Great South Road, Manukau which is owned by Transpower New Zealand Ltd. This will require approval from Transpower New Zealand.
- [redacted] A consent under the 'National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health' is likely to be required.

Both Side

- Widening to the eastern side of Great South Road (the B side) will intersect with the designation associated with the Wiri Electricity Substation. This will require approval from Transpower New Zealand and adds additional time and risk to the planning process.

- The Business – Metropolitan Centre Zone policies seek buildings with frontages subject to the General Commercial Frontage Control achieve a reasonable level of street activation, building continuity along the frontage, pedestrian amenity and safety and visual quality (applies to A-side/western side of Great South Road only).

Third Party Consents - Reasons / Comments

A-Side

- The requirement for buildings with frontages to the General Commercial Frontage Control to achieve a reasonable level of street activation, building continuity along the frontage, pedestrian amenity and safety and visual quality, means that corridor widening to the west (A-Side) is likely to trigger additional consent amendments than widening to the east. However, all options will trigger the need for consent amendments due to the impacts on road frontage landscaping, car parking, access and on-site manoeuvring requirements.
- [redacted]

B-Side

- [redacted]
- [redacted]

Both Side

- Widening on both sides of the road is likely to trigger third party consent amendments for commercial properties on both sides of the road due to the impacts on road frontage landscaping, car parking, access and on-site manoeuvring requirements. Both side widening will trigger the need for consent amendments due to the impacts on road frontage landscaping, car parking, access and on-site manoeuvring requirements.
- [redacted]

Table 9 Multi Criteria Analysis Scoring Sheet - Section 10/Option A/B/Both

Section 10/Option A/B/Both: Te Irirangi Drive (Great South Road to Diorella Drive)	
Name of assessor (incl. qualifications and organisation)	– Aurecon, BSc
Area of assessment	Consentability/Third Party Consents

Score:

Option	Consentability Score	Third Party Consents Score
A-Side Widening	-3	-2
B-Side Widening	-2	-2
Both Side Widening	-3	-3

Consentability - Reasons / Comments

West of State Highway One (SH1) both the northern (A-Side) and southern (B-Side) sides of Te Irirange Drive are zoned Business - General Business Zone.

To the east of SH1 the northern side (A-Side) is a mixture of Open Space – Sport and Active Recreation Zone and Open Space Informal Recreation Zone.

To the east of SH1 on the southern side (B-Side) is a mainly Mixed Housing Suburban Zone, with a msall portion zoned Open Space Informal Recreation Zone (located directly east adjacent to SH1).

The following overlays apply to this section:

- High-Use Aquifer Management Area Overlay – *applicable west of SH1 to both the A-Side and B-Side*
- National Grid Substation Corridor Overlay (runs along Te Irirangi Drive)
- National Grid Yard Uncompromised Overlay (travels along the immediate of east of the Southern Motorway (SH1))
- Aircraft Noise Overlay

In addition, AUT Manukau Campus at 640 Great South Road is designated (#6102) by the Minister for Tertiary Education, Skills and Employment (located on the A-Side / northern side of Te Irirangi Drive).

State Highway 1 is also designated (#6714) by the Waka Kotahi NZ Transport Agency (the Agency) for the Southern Motorway (relevant to both A-Side and B-Side widening).

A-Side

- A-Side widening would require permission from the Ministry of Education to carry out works within Designation 6102.
- Removal of trees within an open space zone would be required for A-Side widening.
- Any changes to the existing State Highway 1 overbridge would require written approval from the Agency.
- Any earthworks associated with the widening of the State Highway 1 overbridge would require written approval from Transpower as the National Grid Corridor would be intersected by the works.

B-Side

- Any changes to the existing State Highway 1 overbridge would require written approval from the Agency.
- Any earthworks associated with the widening of the State Highway 1 overbridge would require written approval from Transpower as the National Grid Corridor would be intersected by the works.

Both Side

- Both Side widening would require permission from the Ministry of Education to carry out works within Designation 6102.
- Any changes to the existing State Highway 1 overbridge would require written approval from the Agency.
- Any earthworks associated with the widening of the State Highway 1 overbridge would require written approval from Transpower as the National Grid Corridor would be intersected by the works.
- Removal of trees within an open space zone would be required for both side widening.

Third Party Consents - Reasons / Comments

A-Side

- Possible impact on AUT operations (including landscaping, and carparking) which may trigger the need for consent amendments.
- Changes to the road frontage landscaping and access to the Manukau Veldrome will trigger the need for approvals from Auckland Council and may trigger the need for consent amendments.
- Any changes to the existing State Highway 1 overbridge, or temporary traffic management during construction that impact SH1 would require approval from the Agency.
- Any road corridor widening associated with the widening of the State Highway 1 overbridge would require written approval from Transpower as the National Grid Corridor would be intersected by the works.

B-Side

- Widening to the south (B-Side) would impact road frontage landscaping, access, carparking and manoeuvring for the commercial property located between Great South Road and SH1 which may trigger the need for consent amendments.
- Any changes to the existing State Highway 1 overbridge, or temporary traffic management during construction that impact SH1 would require approval from the Agency
- Any road corridor widening associated with the widening of the State Highway 1 overbridge would require written approval from Transpower as the National Grid Corridor would be intersected by the works.

Both Side

- Widening on both sides of Puhinui Road will create greater impacts along this road corridor, resulting in greater impacts to the community than widening on just one side of the road.
- Any changes to the existing State Highway 1 overbridge, or temporary traffic management during construction that impact SH1 would require approval from the Agency.
- Possible impact on AUT operations (including landscaping, and carparking) which may trigger the need for consent amendments.
- Any road corridor widening associated with the widening of the State Highway 1 overbridge would require written approval from Transpower as the National Grid Corridor would be intersected by the works.
- Both-Side Widening would impact road frontage landscaping and access to the Manukau Veldrome that will trigger the need for approvals from Auckland Council and may trigger the need for consent amendments.

Table 10 Multi Criteria Analysis Scoring Sheet - Section 11/Option A/B/Both

Section 11/Option A/B/Both: Te Irirangi Drive (Diorella Drive to Te Irirangi Drive Ch. 1525)	
Name of assessor (incl. qualifications and organisation)	[redacted] – Aurecon, BSc
Area of assessment	Consentability/Third Party Consents

Score:

Option	Consentability Score	Third Party Consents Score
A-Side Widening	-1	-1
B-Side Widening	-1	-1
Both Side Widening	-1	-1

Consentability - Reasons / Comments

The A-Side/northern side of Te Iriangi Drive is zoned Residential Mixed Housing Urban.

The B-Side/southern side of Te Iriangi Drive is zoned a mixture of Mixed Housing Suburban and Residential Mixed Housing Urban.

Both sides also have potions of Open Space Informal Recreation Zone (for A -Side/Northern Side this is directly opposite Diorella Drive and for a small portion at the intersection with Boundary Road; for the B-Side/Southern side this is for a road frontage sliver north of the intersection with Boundary Road).

The following overlays also apply:

- Aircraft Noise Overlay
- National Grid Substation Corridor Overlay – *east of Sandrine Avenue (within the existing road reserve)*

A-Side / B-Side / Both Side

- There is no discernible difference to widening on either the A-Side, B-Side or Both-Sides from a consentability point of view with all options impacting both the Residential and Open Space Informal Zoned land. There are no differing overlays or notations.

Third Party Consents - Reasons / Comments

A-Side

- Changes to the road frontage landscaping and access to the Manukau Veldrome will trigger the need for approvals from Auckland Council and may trigger the need for consent amendments.

B-Side

- Land impacted is primarily residential and given majority of the properties are assumed to be full acquisitions there will be no third-party consent requirements.

Both Side

- Changes to the road frontage landscaping and access to the Manukau Veldrome will trigger the need for approvals from Auckland Council and may trigger the need for consent amendments.

Table 11 Multi Criteria Analysis Scoring Sheet - Section 13/Option A/B/Both

Section 13/Option A/B/Both: Te Irirangi Drive (Dawson Road to Penion Drive)

Name of assessor (incl. qualifications and organisation) [redacted] – Aurecon, BSc

Area of assessment Consentability/Third Party Consents

Score:

Option	Consentability Score	Third Party Consents Score
A-Side Widening	-2	-2
B-Side Widening	-1	-1
Both Side Widening	-2	-2

Consentability - Reasons / Comment

The surrounding environment (A-Side and B-Side) is Residential Mixed Housing Urban Zone. The exception is on the A-Side/Western side of Te Irirangi Drive where there is the Business Local Centre Zone.

The following overlay also applies:

- Aircraft Noise Overlay

A-Side

- [redacted]. A consent under the 'National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health' is likely to be required.

B-Side

- No notations or overlays of relevance.

Both-Side

- [redacted] and a consent under the 'National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health' is likely to be required.

Third Party Consents - Reasons / Comments

A-Side

- [redacted]
- Widening in this option is likely to trigger third party consent amendments for commercial properties on the northern side of Te Irirangi Drive due to the impacts on road frontage landscaping, car parking, access and on-site manoeuvring requirements.

B-Side

- Land impacted in this option residential and given majority of the properties are assumed to be full acquisitions there will be no third-party consent requirements.

- [redacted]

Both Side

- [redacted]
- Widening in this option is likely to trigger third party consent amendments for commercial properties on the northern side of Te Irirangi Drive due to the impacts on road frontage landscaping, car parking, access and on-site manoeuvring requirements.
- [redacted]

Approved by:

Title	Name	Qualification		Date
Author	[redacted]	BSc	[redacted]	21/04/2020
Reviewer		BEMP, MEP (Hons)		21/04/2020

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Technical Note

To	[redacted]	From	**Jasmax (** [redacted]
Copy		Reference	**502334**
Date	**2020-04-23**	Pages (including this page)	**15**
Subject	**A2B Road Corridor Widening Preferred Options Assessment - Urban Design and Visual Amenity**		

1 Introduction

The following provides an assessment of the options for the road corridor widening options for the Airport to Botany (A2B) Rapid Transit Corridor (RTC) preferred route where the desired cross-section does not fit within existing road reserve, as part of the preferred option route for the Airport to Botany (A2B) Single-Stage Business Case (SSBC). It covers the A2B project area from immediately east of the Puhinui Interchange (Puhinui Road and SH20 Intersection) through to Botany.

This urban design and visual amenity assessment details the considerations which have been used to inform the assessment. This assessment is designed to contribute to the Multi-Criteria Analysis (MCA) assessment which is being undertaken for this section of the preferred option route.

The options are outlined in **Table 1**. The sections are summarised in **Table 2.**

Table 1 | Options summary

Option	Description
Option A: A-side widening	This option requires encroachment into property solely on the A side of the preferred option route (A-side is as identified on the option schematics).
Option B: B-side widening	This option requires encroachment into property solely on the B side of the preferred option route (B-side as identified on the option schematics).
Option C: A-side and B-side widening	This option involves property encroachment on both sides of the preferred option route (i.e. on both the A and B sides).

Table 2. A2B Corridor Widening Sections

Section	Option		
Section 1 Puhinui Road (SH20 interchange to Kenderdine)	A-Side Widening	B-Side Widening	Both Side Widening
Section 3 Puhinui Road (Cambridge Terrace to Lambie Drive)	A-Side Widening	B-Side Widening	Both Side Widening
Section 5 Manukau Station Road (Lambie Drive to Davies Avenue)	A-Side Widening	B-Side Widening	Both Side Widening
Section 7 Ronwood Avenue (Davies Avenue to Osterly Way / Sharkey Street	A-Side Widening	B-Side Widening	Both Side Widening
Section 9 Great South Road (Ronwood Avenue to Te Irirangi Drive)	A-Side Widening	B-Side Widening	Both Side Widening

Section 10 Te Irirangi Drive (Great South Road to Diorella Drive)	A-Side Widening	B-Side Widening	Both Side Widening
Section 11 Te Irirangi Drive (Diorella Drive to Te Irirangi Drive Ch. 1525)	A-Side Widening	B-Side Widening	Both Side Widening
Section 13 Te Irirangi Drive (Dawson Road to Penion Drive)	A-Side Widening	B-Side Widening	Both Side Widening

2 Assessment Methodology

The source information is assessed in a desktop investigation only. The assessments are based on:

- A2B Road Corridor Widening Preferred Options Assessment Memorandum, dated 22/01/2020; and
- Drawings (*App A – Sketch_Corridor Widening Options_Sh1-17*), dated 21/01/2020.

This assessment is based on a desktop study carried out using Auckland Council Geo Maps and a review of the current Auckland Council AUP Maps as well as Google Earth and associated street view. A site visit has also been carried out along the length of the corridor.

2.1 Scoring

All options where assessed against the scores set out in **Table 3**.

Table 3 | Scoring criteria

Score	Statement
3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

2.2 Assumptions

It is assumed that the existing road levels will be retained throughout the with the corridor and that the road will simply be widened to extend within the proposed typical cross-section road width.

Widening of side roads joining the main corridor at intersections along to the proposed corridor widening sections are not included in this assessment, but it can be assumed that land acquisition will be required while developing the intersections layouts.

Station locations and associated land requirements will be dealt with separately and are independent from the side of road assessment.

It is assumed that a closed RTN System will be implemented (this will result in a slightly smaller footprint at a few intersections along the corridor).

The assessment is to be undertaken without any consideration of mitigation measures.

The scores and assessments are presented in **Tables 4 to 11** below.

Table 4 Multi Criteria Analysis Scoring Sheet – Section 1/Option A/B/Both

Scenario 1/Option A/B/Both: Puhinui Road (SH20 interchange to Kenderdine Road)	
Name of assessor (incl. qualifications and organisation)	[redacted] – Jasmax, BA (Hons), PGDip, MA
Area of assessment	Urban Design/Visual Amenity

Score:

Option	Urban Design Score	Visual Amenity Score
A-Side Widening	-1	-1
B-Side Widening	-2	-1
Both Side Widening	-2	-2

Urban Design - Reasons / Comments

A-Side

- A-Side widening will disrupt a small group of local shops which are located on the north side of the road at the intersection of Wyllie Road.

B-Side

- B-Side widening will disrupt a small group of local shops which are located on the on the southern side of the road at the intersection of Noel Burnside Road.
- Widening on the B-Side (the south side of Puhinui Road) would likely require properties to be acquired, but there are less residential re-development opportunities on the south side due to lower intensity house zoning in the Auckland Unitary Plan (single house zone).
- There are greater restrictions on new residential development due to a higher category of airport / aircraft noise zone.

Both Side

- Although the widening required for both side widening may not actually run-through adjacent houses, it may require such extensive acquisition of the front yard that the houses ceases to function (in terms of outlook, outdoor living space, parking and manoeuvring).
- There are two groups of local / neighbourhoods shops in this section – one on the north side (intersection of Wyllie Road) and one on the south side (intersection of Noel Burnside Road). Either one of these groups of shops will be affected by A-Side or B-Side widening, whilst both would be affected by both side widening.
- Any widening on the south side would likely require properties to be acquired, but there are less residential re-development opportunities on the south side due to lower intensity house zoning in the Auckland Unitary Plan (single house zone).
- There are greater restrictions on new residential development due to a higher category of airport / aircraft noise zone.

Visual Amenity - Reasons / Comments

A-Side

- A-Side widening will result in the loss of a notable tree near Vision Place
- A-Side widening will allow for the retention of existing garden boundary and vegetation along the south side road berm.
- A-Side widening will create an asymmetric landscape with mixed boundary treatments which will reduce potential visual cohesiveness.

B-Side

- B-Side widening will result in the loss of a notable tree near Vision Place.
- B-Side widening will allow for the retention of existing garden vegetation on the north side grass berm of the road.
- Existing trees along this berm are assumed to be removed to enable the Short-Term Airport Access Improvement (STAAI) works.
- A-Side widening will create an asymmetric landscape with mixed boundary treatments which will reduce potential visual cohesiveness.

Both Side

- Both side widening will result in the loss of a notable tree near Vision Place.
- Both side widening will result in the removal of all roadside trees within the grass berm located on the northern and southern sides of the road
- Both side widening will remove garden boundary trees from both sides of the road.
- Both side widening is highly dependent on mitigation on both sides of the road to create a cohesive legible streetscape (with mitigation considerations excluded from this score). It is noted that mitigation along this section would have the potential to create an equally balanced streetscape with greater consistency in boundary definition and planting.

Table 5 Multi Criteria Analysis Scoring Sheet - Section 3/Option A/B/Both

Multi Criteria Analysis Scoring Sheet – Section 3/Option A/B/Both	
Name of assessor (incl. qualifications and organisation)	[redacted] – Jasmax, BA (Hons), PGDip, MA
Area of assessment	Urban Design/Visual Amenity

Score:

Option	Urban Design Score	Visual Amenity Score
A-Side Widening	-1	-1
B-Side Widening	-1	-1
Both Side Widening	-2	-2

Urban Design - Reasons / Comments

A-Side

- A-Side widening will disrupt a group of local shops which are located opposite to Ranfurly Avenue.

B-Side

- B-Side widening will require property acquisition, but there are less residential re-development opportunities on the south side (B-side) due to lower intensity house zoning in the Auckland Unitary Plan (single house zone).
- Along this section of Puhinui Road, both sides of the street are within the same category of Airport noise restriction overlay.

Both Side

- Although both side widening may not actually run-through adjacent houses, it may require such extensive acquisition of the front yard that the houses ceases to function (in terms of outlook, outdoor living space, parking and manoeuvring).
- A group of local shops located opposite to Ranfurly Avenue will be disrupted by both side widening.
- Any widening on the south side would likely require properties to be acquired, but there are less residential re-development opportunities on the south side due to lower intensity house zoning in the Auckland Unitary Plan (single house zone).
- Along this section of Puhinui Road, both sides of the street are within the same category of Airport noise restriction overlay.

Visual Amenity - Reasons / Comments

A-Side

- A-Side widening will allow for the retention of existing garden vegetation on the grass berm located on the southern side of the road.
- Some of the existing trees along this berm are assumed to be removed to enable STAAI works.

- A-Side widening will create an asymmetric landscape with mixed boundary treatments reducing potential visual cohesiveness.

B-Side

- B-Side widening will allow for the retention of existing garden vegetation on the grass berm located on the northern side of the road.
- Existing trees along this berm are assumed to be removed to enable STAAI works.
- B-Side widening will create an asymmetric landscape with mixed boundary treatments reducing potential visual cohesiveness.

Both Side

- Both side widening will allow for the retention of existing garden vegetation on the grass berm located on the northern side of the road.
- Existing trees along this berm are assumed to be removed to enable STAAI works.
- Both side widening is highly dependent on mitigation on both sides of the road to create a cohesive legible streetscape (with mitigation considerations excluded from this score). It is noted that mitigation along this section would have the potential to create an equally balanced streetscape with greater consistency in boundary definition and planting.

Table 6 Multi Criteria Analysis Scoring Sheet - Section 5/Option A/B/Both

Section 5/Option A/B/Both: Manukau Station Road (Lambie Drive to Davies Avenue)	
Name of assessor (incl. qualifications and organisation)	[redacted] – Jasmax, BA (Hons), PGDip, MA
Area of assessment	Urban Design/Visual Amenity

Score:

Option	Urban Design Score	Visual Amenity Score
A-Side Widening	0	0
B-Side Widening	0	0
Both Side Widening	0	0

Urban Design - Reasons / Comments

- A-Side, B-Side and Both Side widening will not result in any discernible change to urban design.

Visual Amenity - Reasons / Comments

This is an urbanised section of road, visually dominated by wide road with limited tree and shrub planting along southern side to mitigate the existing road and traffic.

A-Side

- A-side widening will result in a minor loss of young tree and shrub planting to southern boundary.
- Limited potential for mitigation and placemaking tree planting due to proximity to rail trench structures.

B-Side

- B-Side widening will result in minor loss of young tree and shrub planting to southern boundary

Both Side

- Both side widening will result in minor loss of young tree and shrub planting to southern boundary.
- Both side widening has limited potential for mitigation and placemaking tree planting due to proximity to rail trench structures.
- Both side widening will result in continuous alignment with adjoining sections, and therefore has greater visual legibility and continuity than A-Side or B-Side widening.

Table 7 Multi Criteria Analysis Scoring Sheet - Section 7/Option A/B/Both

Section 7/Option A/B/Both: Ronwood Avenue (Davies Avenue to Osterley Way / Sharkey Street)	
Name of assessor (incl. qualifications and organisation)	[redacted] – Jasmax, BA (Hons), PGDip, MA
Area of assessment	Urban Design/Visual Amenity

Score:

Option	Urban Design Score	Visual Amenity Score
A-Side Widening	0	-1
B-Side Widening	-1	-1
Both Side Widening	0	-1

Urban Design - Reasons / Comments

- A-Side, B-Side and Both Side widening will not result in any discernible change to urban design.

Visual Amenity - Reasons / Comments

- This is an urbanised section of road visually dominated by wide road with limited tree and shrub planting to mitigate the existing road and traffic.
- All options will result in the removal of all road corridor trees and the visual amenity that they provide.

Table 8 Multi Criteria Analysis Scoring Sheet – Section 9/Option A/B/Both

Section 9/Option A/B/Both: Great South Road (Ronwood Avenue to Te-Irirangi Drive)	
Name of assessor (incl. qualifications and organisation)	[redacted] Jasmax, BA (Hons), PGDip, MA
Area of assessment	Urban Design/Visual Amenity

Score:

Option	Urban Design Score	Visual Amenity Score
A-Side Widening	0	-1
B-Side Widening	0	-2
Both Side Widening	0	0

Urban Design - Reasons / Comments

- A-Side, B-Side and Both Side widening will not result in any discernible change to urban design.

Visual Amenity - Reasons / Comments

- This is an urban section of the road is a major arterial road with limited tree cover.

A-Side

- A-Side widening will result in the loss of regularly spaced mature palm trees on the berm of the east side of the road.

B-Side

- B-Side widening will result in the loss of mature urban trees within the adjoining property located within the south west area of the section, visual impact will be limited by retained backdrop trees within private curtilage and loss of regularly spaced palms tress on the berm located on the eastern side of the road.

Both Side

- Locally significant loss of mature urban trees within the adjoining property on south west area of this section, although visual impact limited by retained backdrop trees within private curtilage.

Table 9 Multi Criteria Analysis Scoring Sheet - Section 10/Option A/B/Both

Section 10/Option A/B/Both: Te Irirangi Drive (Great South Road to Diorella Drive)	
Name of assessor (incl. qualifications and organisation)	[redacted] – Aurecon, BSc
Area of assessment	Urban Design/Visual Amenity

Score:

Option	Urban Design Score	Visual Amenity Score
A-Side Widening	-3	-2
B-Side Widening	-2	-2
Both Side Widening	-1	-2

Urban Design - Reasons / Comments

A-Side

- A-Side widening will have an impact on the open space area on the northern side of Te Irirangi Drive.
- A-Side widening will impact the AUT South site, removing an education facility.
- Widening towards the Manukau Velodrome site will reduce green open space in this part of Manukau.

B-Side

- B-Side widening likely to take properties to such an extent that the land would be problematic to redevelop. Resulting in low quality residual land.

Both Side

- Both side widening would require property take but the resulting surplus land could be redeveloped in a suitable urban form.
- Both side widening will not impact the AUT site.

Visual Amenity - Reasons / Comments

- A large group of mature trees are located on both sides of the bridge embankments of Te Irirangi Drive. Those located on the south east side of SH1visually mitigate the apparent scale of the large format building and extensive car park on the south side of the road. Those located on the west side are more extensive and provide shade for pedestrian road users along the north west side of the road. Both groups of vegetation visually mitigate the scale of the road embankment and provide a high level of visual amenity to the road-scape..

A-Side

- Trees along the south east embankment to the State Highway overbridge can be retained
- Major loss of trees on the north western side embankment.

B-Side

- Major loss of mature trees to south east road embankment with loss of some trees to the north west side.

Both Side

- Major loss of mature to both embankments.

Table 10 Multi Criteria Analysis Scoring Sheet - Section 11/Option A/B/Both

Section 11/Option A/B/Both: Te Irirangi Drive (Diorella Drive to Te Irirangi Drive Ch. 1525)	
Name of assessor (incl. qualifications and organisation)	[redacted] Jasmax, BA (Hons), PGDip, MA
Area of assessment	Urban Design/Visual Amenity

Score:

Option	Urban Design Score	Visual Amenity Score
A-Side Widening	-1	-1
B-Side Widening	-1	-1
Both Side Widening	-2	-1

Urban Design - Reasons / Comments

A-Side

- Many of the properties along this section have houses built to the rear of the houses facing the street, which may not be affected by any scenario. In these cases, property acquisition may only apply to the front house and the residual land may then not be practically able to be redeveloped, thus negating the potential urban design benefits of property acquisition.

B-Side

- Many of the properties along this section have houses built to the rear of the houses facing the street, which may not be affected by any scenario. In these cases, property acquisition may only apply to the front house and the residual land may then not be practically able to be redeveloped, thus negating the potential urban design benefits of property acquisition.

Both Side

- Although the widening required for both sides may not actually run-through adjacent houses, it may require such extensive acquisition of the front yard that the houses ceases to function (in terms of outlook, outdoor living space, parking and manoeuvring).

Visual Amenity- Reasons / Comments

A-Side

- Northern residential boundaries affected. Very few trees of reasonable stature. Cluster of young trees / tall shrubs near the entrance of the Manukau Sports Bowl entrance will be removed. However, backdrop of existing park trees diminishes this impact.
- A-Side widening will not impact the southern property boundary.

B-Side

- Southern residential boundaries affected. Very few trees of reasonable stature. Cluster of young trees / tall shrubs near the entrance of the Manukau Sports Bowl entrance will be removed. However, backdrop of existing park trees diminishes this impact.
- B-Side widening will not affect the northern property boundary.

Both Side

- Both side widening will affect the property boundaries on both the northern and southern side of the road.
- Both side widening, provided that an equitable boundary treatment can be provided for both sides of the road will allow for improved visual legibility.

Table 11 Multi Criteria Analysis Scoring Sheet - Section 13/Option A/B/Both

Section 13/Option A/B/Both: Te Irirangi Drive (Dawson Road to Penion Drive)	
Name of assessor (incl. qualifications and organisation)	[redacted] – Jasmax, BA (Hons), PGDip, MA
Area of assessment	Urban Design/Visual Amenity

Score:

Option	Urban Design Score	Visual Amenity Score
A-Side Widening	-1	-1
B-Side Widening	-1	-1
Both Side Widening	-1	-2

Urban Design - Reasons / Comments

A-Side

- A-Side widening would require the acquisition of five properties on the western side of the road.
- The Z Energy site located at 136 Dawson Road does not represent an ideal urban form response on a prominent intersection. The acquisition and subsequent re-development could be seen as a potential benefit in terms of urban design.

B-Side

- B-Side widening will require property acquisition on the eastern side, due to the dimensions and cross-leases on the sites the potential for re-development is low.

Both Side

- Both side widening may not require any property acquisition on the western side of the road but may still impact several properties on the eastern side of the road, these would be full property acquisitions as it would affect the front yards of these properties to such an extent the house may not continue to function.
- The Z Energy site located at 136 Dawson Road does not represent an ideal urban form response on a prominent intersection. The acquisition and subsequent re-development could be seen as a potential benefit in terms of urban design.

Visual Amenity - Reasons / Comments

A-Side

- Five residential boundaries and properties will be directly affected.
- A-Side widening may allow for the regularly spaced street trees which are located on the eastern road berm.

B-Side

- Nine residential boundaries and properties will be directly affected.

- B-Side widening will result in the loss of regularly spaced boundary trees on the southern side of the road.

Both Side

- Fourteen residential boundaries and properties will be directly affected.
- Both side widening will result in the loss of regularly spaced boundary trees on the southern side of the road.

Approved by:

Title	Name	Qualification	Signature	Date
Author	[redacted] – Jasmax,	BA (Hons), PGDip, MA	[redacted]	23/04/2020
Reviewer	[redacted] – Aurecon	BEMP, MEP (Hons)		24/04/2020

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Technical Note

To	[redacted]	From	[redacted]
Copy	[redacted]	Reference	**502334**
Date	**2020-01-15**	Pages (including this page)	**26**
Subject	**Airport to Botany: Road Corridor Widening Options: Multi-Criteria Analysis Scoring Sheet: Social Impact**		

The following provides an assessment of the road corridor widening options for the Airport to Botany (A2B) Rapid Transit Corridor (RTC) preferred route where the desired cross-section does not fit within existing road reserve, as part of the preferred option route for the Airport to Botany (A2B) Single-Stage Business Case (SSBC).

The Road Corridor Widening options have been assessed separately and in isolation from one another. The assessment details the considerations which have been used to inform the assessment. This assessment is designed to contribute to the Multi-Criteria Analysis (MCA) assessment which is being undertaken for this section of the preferred option route.

The source information assessed is desktop analysis only. The 24 assessments are based on:

- A2B Road Corridor Widening Option Schematics (Sheets 1-17) dated 14 January 2020; and
- Preferred Options Assessment and Assumptions Memorandum (dated 16 January 2020).

Attachment 1 outlines a high-level overview of the existing social environment along the preferred route to provide the social context for this assessment. It also provides information about selected future plans or aspirations.

The options are outlined in Table 1. The scores and assessments are presented in Tables 2-25.

Table 1. A2B Road Corridor Widening Options Summary

Section	Road name	Section extent	Widening
1 – A Side	Puhinui Road	SH20 interchange to Kenderdine Road	A Side Widening
1 – B Side	Puhinui Road	SH20 interchange to Kenderdine Road	B Side Widening
1 – Both Side	Puhinui Road	SH20 interchange to Kenderdine Road	Both Side Widening
3 – A Side	Puhinui Road	Cambridge Terrace to Lambie Drive	A Side Widening
3 – B Side	Puhinui Road	Cambridge Terrace to Lambie Drive	B Side Widening
3 – Both Side	Puhinui Road	Cambridge Terrace to Lambie Drive	Both Side Widening
5 – A Side	Manukau Station Road	Lambie Drive to Davies Avenue	A Side Widening
5 – B Side	Manukau Station Road	Lambie Drive to Davies Avenue	B Side Widening
5 – Both Side	Manukau Station Road	Lambie Drive to Davies Avenue	Both Side Widening

7 – A Side	Ronwood Avenue	Davies Avenue to Osterley Way / Sharkey Street	A Side Widening
7 – B Side	Ronwood Avenue	Davies Avenue to Osterley Way / Sharkey Street	B Side Widening
7 – Both Side	Ronwood Avenue	Davies Avenue to Osterley Way / Sharkey Street	Both Side Widening
9 – A Side	Great South Road	Ronwood Avenue to Te-Irirangi Drive	A Side Widening
9 – B Side	Great South Road	Ronwood Avenue to Te-Irirangi Drive	B Side Widening
9 – Both Side	Great South Road	Ronwood Avenue to Te-Irirangi Drive	Both Side Widening
10 – A Side	Te Irirangi Drive	Great South Road to Diorella Drive	A Side Widening
10 – B Side	Te Irirangi Drive	Great South Road to Diorella Drive	B Side Widening
10 – Both Side	Te Irirangi Drive	Great South Road to Diorella Drive	Both Side Widening
11 – A Side	Te Irirangi Drive	Diorella Drive to Te Irirangi Drive Ch. 1525	A Side Widening
11 – B Side	Te Irirangi Drive	Diorella Drive to Te Irirangi Drive Ch. 1525	B Side Widening
11 – Both Side	Te Irirangi Drive	Diorella Drive to Te Irirangi Drive Ch. 1525	Both Side Widening
13 – A Side	Te Irirangi Drive	Dawson Road to Penion Drive	A Side Widening
13 – B Side	Te Irirangi Drive	Dawson Road to Penion Drive	B Side Widening
13 – Both Side	Te Irirangi Drive	Dawson Road to Penion Drive	Both Side Widening

Table 2 Multi Criteria Analysis Scoring Sheet – Section 1 -Puhinui Road (SH20 interchange to Kenderdine Road) A Side Widening

Section 1 – A Side	
Name of assessor (incl. qualifications and organisation)	[redacted] BPlan (Hons), Aurecon
Area of assessment	Social Impact

Score:

3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

Accessibility: Extent and degree of effects on the community concerning accessibility to/from facilities, services, properties and businesses. Accessibility of jobs.	**Community**: Extent and degree of change to groups and activities, including sense of community and to known aspirations and plans.
-1	-2

Notes:

Reasons / Comments

- *Accessibility:*
  - Potential for uncertainty regarding future access for occupants/owners due to understanding of the property acquisition process and their adaptability to change.
- *Community:*
  - Likelihood that sense of community will change as a result of acquisition of residential dwellings.
  - Change to community groups and activities unlikely.

Assumptions

- Assumes that where property acquisition occurs, including removal of buildings, that the existing level of access to private property would be retained including vehicular and pedestrian access.
- The assessment excludes consideration of potential economic effect on businesses as a result of partial or full property acquisition.
- The social impact assessment considers the A2B route and its immediate surrounds (as shown on Figure 1 of the briefing note). The Census 2013 Census Area Units are used to provide a broad understanding of the surrounding and dependent population.

Other Information relied upon

- Census of Population and Dwellings (2013) (Census 2013), Stats NZ. Note that the Census 2018 data was not available at the time of writing and has not been used to inform this assessment.
- Draft Corridor Strategy (December 2019, prepared for Auckland Transport and Waka Kotahi) – mapping showing notable projects within the corridor environs and community and civic facilities
- Draft Equity Assessment (December 2019, prepared for Auckland Transport) – includes information on socio-economic deprivation, healthy deprivation, age, gender, ethnicity and access to a vehicle at the Census Area Unit, based on the Census 2013.

Table 3 Multi Criteria Analysis Scoring Sheet – Section 1 -Puhinui Road (SH20 interchange to Kenderdine Road) B Side Widening

Section 1 - B Side	
Name of assessor (incl. qualifications and organisation)	[redacted] BPlan (Hons), Aurecon
Area of assessment	Social Impact

Score:

3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

Accessibility: Extent and degree of effects on the community concerning accessibility to/from facilities, services, properties and businesses. Accessibility of jobs.	**Community**: Extent and degree of change to groups and activities, including sense of community and to known aspirations and plans.
-1	-2

Notes:

Reasons / Comments

- *Accessibility:*
  - Potential for uncertainty regarding future access for occupants/owners due to understanding of the property acquisition process and their adaptability to change.
- *Community:*
  - Likelihood that sense of community will change as a result of acquisition of residential dwellings.
  - Change to community groups and activities unlikely.

Assumptions

- Assumes that where property acquisition occurs, including removal of buildings, that the existing level of access to private property would be retained including vehicular and pedestrian access.
- The assessment excludes consideration of potential economic effect on businesses as a result of partial or full property acquisition.
- The social impact assessment considers the A2B route and its immediate surrounds (as shown on Figure 1 of the briefing note). The Census 2013 Census Area Units are used to provide a broad understanding of the surrounding and dependent population.

Other Information relied upon

- Census of Population and Dwellings (2013) (Census 2013), Stats NZ. Note that the Census 2018 data was not available at the time of writing and has not been used to inform this assessment.

- Draft Corridor Strategy (December 2019, prepared for Auckland Transport and Waka Kotahi) – mapping showing notable projects within the corridor environs and community and civic facilities
- Draft Equity Assessment (December 2019, prepared for Auckland Transport) – includes information on socio-economic deprivation, healthy deprivation, age, gender, ethnicity and access to a vehicle at the Census Area Unit, based on the Census 2013.

Table 4 Multi Criteria Analysis Scoring Sheet – Section 1 -Puhinui Road (SH20 interchange to Kenderdine Road) Both Side Widening

Section 1 – Both Side	
Name of assessor (incl. qualifications and organisation)	[redacted] BPlan (Hons), Aurecon
Area of assessment	Social Impact

Score:

3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

Accessibility: Extent and degree of effects on the community concerning accessibility to/from facilities, services, properties and businesses. Accessibility of jobs.	**Community**: Extent and degree of change to groups and activities, including sense of community and to known aspirations and plans.
-1	-1

Notes:

Reasons / Comments

- *Accessibility:*
  - Potential for uncertainty regarding future access for occupants/owners due to understanding of the property acquisition process and their adaptability to change.
- *Community:*
  - Change to community groups and activities unlikely.
  - Potential that some property owners/occupants may elect to move away as a result of partial acquisition.

Assumptions

- Assumes that where property acquisition occurs, including removal of buildings, that the existing level of access to private property would be retained including vehicular and pedestrian access.
- The assessment excludes consideration of potential economic effect on businesses as a result of partial or full property acquisition.
- The social impact assessment considers the A2B route and its immediate surrounds (as shown on Figure 1 of the briefing note). The Census 2013 Census Area Units are used to provide a broad understanding of the surrounding and dependent population.

Other Information relied upon

- Census of Population and Dwellings (2013) (Census 2013), Stats NZ. Note that the Census 2018 data was not available at the time of writing and has not been used to inform this assessment.
- Draft Corridor Strategy (December 2019, prepared for Auckland Transport and Waka Kotahi) – mapping showing notable projects within the corridor environs and community and civic facilities
- Draft Equity Assessment (December 2019, prepared for Auckland Transport) – includes information on socio-economic deprivation, healthy deprivation, age, gender, ethnicity and access to a vehicle at the Census Area Unit, based on the Census 2013.

Table 5 Multi Criteria Analysis Scoring Sheet – Section 3 -Puhinui Road (Cambridge Terrace to Lambie Drive) A Side Widening

Section 3 – A Side	
Name of assessor (incl. qualifications and organisation)	BPlan (Hons), Aurecon
Area of assessment	Social Impact

Score:

3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

Accessibility: Extent and degree of effects on the community concerning accessibility to/from facilities, services, properties and businesses. Accessibility of jobs.	**Community**: Extent and degree of change to groups and activities, including sense of community and to known aspirations and plans.
-1	-2

Notes:

Reasons / Comments

- *Accessibility:*
  - Potential for uncertainty regarding future access for occupants/owners due to understanding of the property acquisition process and their adaptability to change.
- *Community:*
  - Likelihood that sense of community will change as a result of acquisition of residential dwellings.
  - Change to community groups and activities unlikely.

Assumptions

- Assumes that where property acquisition occurs, including removal of buildings, that the existing level of access to private property would be retained including vehicular and pedestrian access.
- The assessment excludes consideration of potential economic effect on businesses as a result of partial or full property acquisition.
- The social impact assessment considers the A2B route and its immediate surrounds (as shown on Figure 1 of the briefing note). The Census 2013 Census Area Units are used to provide a broad understanding of the surrounding and dependent population.

Other Information relied upon

- Census of Population and Dwellings (2013) (Census 2013), Stats NZ. Note that the Census 2018 data was not available at the time of writing and has not been used to inform this assessment.

- Draft Corridor Strategy (December 2019, prepared for Auckland Transport and Waka Kotahi) – mapping showing notable projects within the corridor environs and community and civic facilities
- Draft Equity Assessment (December 2019, prepared for Auckland Transport) – includes information on socio-economic deprivation, healthy deprivation, age, gender, ethnicity and access to a vehicle at the Census Area Unit, based on the Census 2013.

Table 6 Multi Criteria Analysis Scoring Sheet – Section 3 -Puhinui Road (Cambridge Terrace to Lambie Drive) B Side Widening

Section 3 – B Side	
Name of assessor (incl. qualifications and organisation)	[redacted] BPlan (Hons), Aurecon
Area of assessment	Social Impact

Score:

3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

Accessibility: Extent and degree of effects on the community concerning accessibility to/from facilities, services, properties and businesses. Accessibility of jobs.	**Community**: Extent and degree of change to groups and activities, including sense of community and to known aspirations and plans.
-1	-2

Notes:

Reasons / Comments

- *Accessibility:*
  - Potential for uncertainty regarding future access for occupants/owners due to understanding of the property acquisition process and their adaptability to change.
- *Community:*
  - Puhinui School open space land would partially be acquired and may affect the use by students, teachers and parents. It appears this land is used for passive/informal recreation.

Assumptions

- Assumes that where property acquisition occurs, including removal of buildings, that the existing level of access to private property would be retained including vehicular and pedestrian access.
- The assessment excludes consideration of potential economic effect on businesses as a result of partial or full property acquisition.
- The social impact assessment considers the A2B route and its immediate surrounds (as shown on Figure 1 of the briefing note). The Census 2013 Census Area Units are used to provide a broad understanding of the surrounding and dependent population.

Other Information relied upon

- Census of Population and Dwellings (2013) (Census 2013), Stats NZ. Note that the Census 2018 data was not available at the time of writing and has not been used to inform this assessment.

- Draft Corridor Strategy (December 2019, prepared for Auckland Transport and Waka Kotahi) – mapping showing notable projects within the corridor environs and community and civic facilities
- Draft Equity Assessment (December 2019, prepared for Auckland Transport) – includes information on socio-economic deprivation, healthy deprivation, age, gender, ethnicity and access to a vehicle at the Census Area Unit, based on the Census 2013.

Table 7 Multi Criteria Analysis Scoring Sheet – Section 3 -Puhinui Road (Cambridge Terrace to Lambie Drive) Both Side Widening

Section 3 – Both Side	
Name of assessor (incl. qualifications and organisation)	[redacted] BPlan (Hons), Aurecon
Area of assessment	Social Impact

Score:

3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

Accessibility: Extent and degree of effects on the community concerning accessibility to/from facilities, services, properties and businesses. Accessibility of jobs.	**Community**: Extent and degree of change to groups and activities, including sense of community and to known aspirations and plans.
-1	-1

Notes:

Reasons / Comments

- *Accessibility:*
  - Potential for uncertainty regarding future access for occupants/owners due to understanding of the property acquisition process and their adaptability to change.
- *Community:*
  - Change to community groups and activities unlikely.

Assumptions

- Assumes that where property acquisition occurs, including removal of buildings, that the existing level of access to private property would be retained including vehicular and pedestrian access.
- The assessment excludes consideration of potential economic effect on businesses as a result of partial or full property acquisition.
- The social impact assessment considers the A2B route and its immediate surrounds (as shown on Figure 1 of the briefing note). The Census 2013 Census Area Units are used to provide a broad understanding of the surrounding and dependent population.

Other Information relied upon

- Census of Population and Dwellings (2013) (Census 2013), Stats NZ. Note that the Census 2018 data was not available at the time of writing and has not been used to inform this assessment.

- Draft Corridor Strategy (December 2019, prepared for Auckland Transport and Waka Kotahi) – mapping showing notable projects within the corridor environs and community and civic facilities
- Draft Equity Assessment (December 2019, prepared for Auckland Transport) – includes information on socio-economic deprivation, healthy deprivation, age, gender, ethnicity and access to a vehicle at the Census Area Unit, based on the Census 2013.

Table 8 Multi Criteria Analysis Scoring Sheet – Section 5 – Manukau Station Road (Lambie Drive to Davies Avenue) A Side Widening

Section 5 – A Side	
Name of assessor (incl. qualifications and organisation)	[redacted] BPlan (Hons), Aurecon
Area of assessment	Social Impact

Score:

3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

Accessibility: Extent and degree of effects on the community concerning accessibility to/from facilities, services, properties and businesses. Accessibility of jobs.	**Community**: Extent and degree of change to groups and activities, including sense of community and to known aspirations and plans.
0	0

Notes:

Reasons / Comments

- *Accessibility:*
  - Neutral effect on accessibility as a result of property acquisition. The new MIT trade training school to the south and the Manukau train station to the north will continue to be accessible.
- *Community:*
  - Change to community groups and activities unlikely.

Assumptions

- Assumes that where property acquisition occurs, including removal of buildings, that the existing level of access to private property would be retained including vehicular and pedestrian access.
- The assessment excludes consideration of potential economic effect on businesses as a result of partial or full property acquisition.
- The social impact assessment considers the A2B route and its immediate surrounds (as shown on Figure 1 of the briefing note). The Census 2013 Census Area Units are used to provide a broad understanding of the surrounding and dependent population.

Other Information relied upon

- Census of Population and Dwellings (2013) (Census 2013), Stats NZ. Note that the Census 2018 data was not available at the time of writing and has not been used to inform this assessment.

- Draft Corridor Strategy (December 2019, prepared for Auckland Transport and Waka Kotahi) – mapping showing notable projects within the corridor environs and community and civic facilities
- Draft Equity Assessment (December 2019, prepared for Auckland Transport) – includes information on socio-economic deprivation, healthy deprivation, age, gender, ethnicity and access to a vehicle at the Census Area Unit, based on the Census 2013.

Table 9 Multi Criteria Analysis Scoring Sheet – Section 5 – Manukau Station Road (Lambie Drive to Davies Avenue) B Side Widening

Section 5 – B Side	
Name of assessor (incl. qualifications and organisation)	[redacted] BPlan (Hons)
Area of assessment	Social Impact

Score:

3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

Accessibility: Extent and degree of effects on the community concerning accessibility to/from facilities, services, properties and businesses. Accessibility of jobs.	**Community**: Extent and degree of change to groups and activities, including sense of community and to known aspirations and plans.
0	0

Notes:

Reasons / Comments

- *Accessibility:*
  - Neutral effect on accessibility as a result of property acquisition. The new MIT trade training school to the south and the Manukau train station to the north will continue to be accessible.
- *Community:*
  - Change to community groups and activities unlikely.

Assumptions

- Assumes that where property acquisition occurs, including removal of buildings, that the existing level of access to private property would be retained including vehicular and pedestrian access.
- The assessment excludes consideration of potential economic effect on businesses as a result of partial or full property acquisition.
- The social impact assessment considers the A2B route and its immediate surrounds (as shown on Figure 1 of the briefing note). The Census 2013 Census Area Units are used to provide a broad understanding of the surrounding and dependent population.

Other Information relied upon

- Census of Population and Dwellings (2013) (Census 2013), Stats NZ. Note that the Census 2018 data was not available at the time of writing and has not been used to inform this assessment.

- Draft Corridor Strategy (December 2019, prepared for Auckland Transport and Waka Kotahi) – mapping showing notable projects within the corridor environs and community and civic facilities
- Draft Equity Assessment (December 2019, prepared for Auckland Transport) – includes information on socio-economic deprivation, healthy deprivation, age, gender, ethnicity and access to a vehicle at the Census Area Unit, based on the Census 2013.

Table 10 Multi Criteria Analysis Scoring Sheet - Section 5 – Manukau Station Road (Lambie Drive to Davies Avenue) Both Side Widening

Section 5 – Both Side	
Name of assessor (incl. qualifications and organisation)	[redacted] BPlan (Hons)
Area of assessment	Social Impact

Score:

3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

Accessibility: Extent and degree of effects on the community concerning accessibility to/from facilities, services, properties and businesses. Accessibility of jobs.	**Community**: Extent and degree of change to groups and activities, including sense of community and to known aspirations and plans.
0	0

Notes:

Reasons / Comments

- *Accessibility:*
  - Neutral effect on accessibility as a result of property acquisition. The new MIT trade training school to the south and the Manukau train station to the north will continue to be accessible.
- *Community:*
  - Change to community groups and activities unlikely.

Assumptions

- Assumes that where property acquisition occurs, including removal of buildings, that the existing level of access to private property would be retained including vehicular and pedestrian access.
- The assessment excludes consideration of potential economic effect on businesses as a result of partial or full property acquisition.
- The social impact assessment considers the A2B route and its immediate surrounds (as shown on Figure 1 of the briefing note). The Census 2013 Census Area Units are used to provide a broad understanding of the surrounding and dependent population.

Other Information relied upon

- Census of Population and Dwellings (2013) (Census 2013), Stats NZ. Note that the Census 2018 data was not available at the time of writing and has not been used to inform this assessment.

- Draft Corridor Strategy (December 2019, prepared for Auckland Transport and Waka Kotahi) – mapping showing notable projects within the corridor environs and community and civic facilities
- Draft Equity Assessment (December 2019, prepared for Auckland Transport) – includes information on socio-economic deprivation, healthy deprivation, age, gender, ethnicity and access to a vehicle at the Census Area Unit, based on the Census 2013.

Table 11 Multi Criteria Analysis Scoring Sheet – Section 7 – Ronwood Avenue (Davies Avenue to Osterley Way / Sharkey Street) A Side Widening

Section 7 – A Side	
Name of assessor (incl. qualifications and organisation)	[redacted] BPlan (Hons), Aurecon
Area of assessment	Social Impact

Score:

3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

Accessibility: Extent and degree of effects on the community concerning accessibility to/from facilities, services, properties and businesses. Accessibility of jobs.	**Community**: Extent and degree of change to groups and activities, including sense of community and to known aspirations and plans.
0	0

Notes:

Reasons / Comments

- *Accessibility:*
  - Neutral effect on accessibility as a result of property acquisition.
- *Community:*
  - It is noted that Panuku Development (Auckland Council) propose to redevelop the Ronwood carpark (2 and 8 Davies Avenue). The 'A side' widening option is unlikely to affect this plan.
  - Change to community groups and activities unlikely.

Assumptions

- Assumes that where property acquisition occurs, including removal of buildings, that the existing level of access to private property would be retained including vehicular and pedestrian access.
- The assessment excludes consideration of potential economic effect on businesses as a result of partial or full property acquisition.
- The social impact assessment considers the A2B route and its immediate surrounds (as shown on Figure 1 of the briefing note). The Census 2013 Census Area Units are used to provide a broad understanding of the surrounding and dependent population.

Other Information relied upon

- Census of Population and Dwellings (2013) (Census 2013), Stats NZ. Note that the Census 2018 data was not available at the time of writing and has not been used to inform this assessment.

- Draft Corridor Strategy (December 2019, prepared for Auckland Transport and Waka Kotahi) – mapping showing notable projects within the corridor environs and community and civic facilities
- Draft Equity Assessment (December 2019, prepared for Auckland Transport) – includes information on socio-economic deprivation, healthy deprivation, age, gender, ethnicity and access to a vehicle at the Census Area Unit, based on the Census 2013.

Table 12 Multi Criteria Analysis Scoring Sheet – Section 7 – Ronwood Avenue (Davies Avenue to Osterley Way / Sharkey Street) B Side Widening

Section 7 – B Side	
Name of assessor (incl. qualifications and organisation)	[redacted] BPlan (Hons), Aurecon
Area of assessment	Social Impact

Score:

3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

Accessibility: Extent and degree of effects on the community concerning accessibility to/from facilities, services, properties and businesses. Accessibility of jobs.	**Community**: Extent and degree of change to groups and activities, including sense of community and to known aspirations and plans.
0	-1

Notes:

Reasons / Comments

- *Accessibility:*
  - Neutral effect on accessibility as a result of property acquisition.
- *Community:*
  - It is noted that Panuku Development (Auckland Council) propose to redevelop the Ronwood carpark (2 and 8 Davies Avenue). This option is unlikely to affect this plan. Slightly more acquisition when compared with the A-side or both-sides.
  - Change to community groups and activities unlikely.

Assumptions

- Assumes that where property acquisition occurs, including removal of buildings, that the existing level of access to private property would be retained including vehicular and pedestrian access.
- The assessment excludes consideration of potential economic effect on businesses as a result of partial or full property acquisition.
- The social impact assessment considers the A2B route and its immediate surrounds (as shown on Figure 1 of the briefing note). The Census 2013 Census Area Units are used to provide a broad understanding of the surrounding and dependent population.

Other Information relied upon

- Census of Population and Dwellings (2013) (Census 2013), Stats NZ. Note that the Census 2018 data was not available at the time of writing and has not been used to inform this assessment.
- Draft Corridor Strategy (December 2019, prepared for Auckland Transport and Waka Kotahi) – mapping showing notable projects within the corridor environs and community and civic facilities
- Draft Equity Assessment (December 2019, prepared for Auckland Transport) – includes information on socio-economic deprivation, healthy deprivation, age, gender, ethnicity and access to a vehicle at the Census Area Unit, based on the Census 2013.

Table 13 Multi Criteria Analysis Scoring Sheet – Section 7 – Ronwood Avenue (Davies Avenue to Osterley Way / Sharkey Street) Both Side Widening

Section 7 – Both Side	
Name of assessor (incl. qualifications and organisation)	[redacted] BPlan (Hons), Aurecon
Area of assessment	Social Impact

Score:

3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

Accessibility: Extent and degree of effects on the community concerning accessibility to/from facilities, services, properties and businesses. Accessibility of jobs.	**Community**: Extent and degree of change to groups and activities, including sense of community and to known aspirations and plans.
0	0

Notes:

Reasons / Comments

- *Accessibility:*
  - Neutral effect on accessibility as a result of property acquisition.
- *Community:*
  - It is noted that Panuku Development (Auckland Council) propose to redevelop the Ronwood carpark (2 and 8 Davies Avenue). The 'both side' widening option is unlikely to affect this plan.
  - Change to community groups and activities unlikely.

Assumptions

- Assumes that where property acquisition occurs, including removal of buildings, that the existing level of access to private property would be retained including vehicular and pedestrian access.
- The assessment excludes consideration of potential economic effect on businesses as a result of partial or full property acquisition.
- The social impact assessment considers the A2B route and its immediate surrounds (as shown on Figure 1 of the briefing note). The Census 2013 Census Area Units are used to provide a broad understanding of the surrounding and dependent population.

Other Information relied upon

- Census of Population and Dwellings (2013) (Census 2013), Stats NZ. Note that the Census 2018 data was not available at the time of writing and has not been used to inform this assessment.

- Draft Corridor Strategy (December 2019, prepared for Auckland Transport and Waka Kotahi) – mapping showing notable projects within the corridor environs and community and civic facilities
- Draft Equity Assessment (December 2019, prepared for Auckland Transport) – includes information on socio-economic deprivation, healthy deprivation, age, gender, ethnicity and access to a vehicle at the Census Area Unit, based on the Census 2013.

Table 14 Multi Criteria Analysis Scoring Sheet – Section 9 – Great South Road (Ronwood Avenue to Te-Irirangi Drive) A Side Widening

Section 9 – A Side	
Name of assessor (incl. qualifications and organisation)	[redacted] BPlan (Hons), Aurecon
Area of assessment	Social Impact

Score:

3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

Accessibility: Extent and degree of effects on the community concerning accessibility to/from facilities, services, properties and businesses. Accessibility of jobs.	**Community**: Extent and degree of change to groups and activities, including sense of community and to known aspirations and plans.
0	0

Notes:

Reasons / Comments

- *Accessibility:*
  - Neutral effect on accessibility as a result of property acquisition.
- *Community:*
  - Change to community groups and activities unlikely.

Assumptions

- Assumes that where property acquisition occurs, including removal of buildings, that the existing level of access to private property would be retained including vehicular and pedestrian access.
- The assessment excludes consideration of potential economic effect on businesses as a result of partial or full property acquisition.
- The social impact assessment considers the A2B route and its immediate surrounds (as shown on Figure 1 of the briefing note). The Census 2013 Census Area Units are used to provide a broad understanding of the surrounding and dependent population.

Other Information relied upon

- Census of Population and Dwellings (2013) (Census 2013), Stats NZ. Note that the Census 2018 data was not available at the time of writing and has not been used to inform this assessment.
- Draft Corridor Strategy (December 2019, prepared for Auckland Transport and Waka Kotahi) – mapping showing notable projects within the corridor environs and community and civic facilities

- Draft Equity Assessment (December 2019, prepared for Auckland Transport) – includes information on socio-economic deprivation, healthy deprivation, age, gender, ethnicity and access to a vehicle at the Census Area Unit, based on the Census 2013.

Table 15 Multi Criteria Analysis Scoring Sheet – Section 9 – Great South Road (Ronwood Avenue to Te-Irirangi Drive) B Side Widening

Section 9 – B Side	
Name of assessor (incl. qualifications and organisation)	[redacted] BPlan (Hons), Aurecon
Area of assessment	Social Impact

Score:

3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

Accessibility: Extent and degree of effects on the community concerning accessibility to/from facilities, services, properties and businesses. Accessibility of jobs.	**Community**: Extent and degree of change to groups and activities, including sense of community and to known aspirations and plans.
0	0

Notes:

Reasons / Comments

- *Accessibility:*
  - Neutral effect on accessibility as a result of property acquisition.
- *Community:*
  - Change to community groups and activities unlikely.

Assumptions

- Assumes that where property acquisition occurs, including removal of buildings, that the existing level of access to private property would be retained including vehicular and pedestrian access.
- The assessment excludes consideration of potential economic effect on businesses as a result of partial or full property acquisition.
- The social impact assessment considers the A2B route and its immediate surrounds (as shown on Figure 1 of the briefing note). The Census 2013 Census Area Units are used to provide a broad understanding of the surrounding and dependent population.

Other Information relied upon

- Census of Population and Dwellings (2013) (Census 2013), Stats NZ. Note that the Census 2018 data was not available at the time of writing and has not been used to inform this assessment.
- Draft Corridor Strategy (December 2019, prepared for Auckland Transport and Waka Kotahi) – mapping showing notable projects within the corridor environs and community and civic facilities

- Draft Equity Assessment (December 2019, prepared for Auckland Transport) – includes information on socio-economic deprivation, healthy deprivation, age, gender, ethnicity and access to a vehicle at the Census Area Unit, based on the Census 2013.

Table 16 Multi Criteria Analysis Scoring Sheet – Section 9 – Great South Road (Ronwood Avenue to Te-Irirangi Drive) Both Side Widening

Section 9 – Both Side	
Name of assessor (incl. qualifications and organisation)	[redacted] BPlan (Hons), Aurecon
Area of assessment	Social Impact

Score:

3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

Accessibility: Extent and degree of effects on the community concerning accessibility to/from facilities, services, properties and businesses. Accessibility of jobs.	**Community**: Extent and degree of change to groups and activities, including sense of community and to known aspirations and plans.
0	0

Notes:

Reasons / Comments

- *Accessibility:*
  - Neutral effect on accessibility as a result of property acquisition.
- *Community:*
  - Change to community groups and activities unlikely.

Assumptions

- Assumes that where property acquisition occurs, including removal of buildings, that the existing level of access to private property would be retained including vehicular and pedestrian access.
- The assessment excludes consideration of potential economic effect on businesses as a result of partial or full property acquisition.
- The social impact assessment considers the A2B route and its immediate surrounds (as shown on Figure 1 of the briefing note). The Census 2013 Census Area Units are used to provide a broad understanding of the surrounding and dependent population.

Other Information relied upon

- Census of Population and Dwellings (2013) (Census 2013), Stats NZ. Note that the Census 2018 data was not available at the time of writing and has not been used to inform this assessment.
- Draft Corridor Strategy (December 2019, prepared for Auckland Transport and Waka Kotahi) – mapping showing notable projects within the corridor environs and community and civic facilities

- Draft Equity Assessment (December 2019, prepared for Auckland Transport) – includes information on socio-economic deprivation, healthy deprivation, age, gender, ethnicity and access to a vehicle at the Census Area Unit, based on the Census 2013.

Table 17 Multi Criteria Analysis Scoring Sheet – Section 10 – Te Irirangi Drive (Great South Road to Diorella Drive) A Side Widening

Section 10 – A Side	
Name of assessor (incl. qualifications and organisation)	[redacted] BPlan (Hons), Aurecon
Area of assessment	Social Impact

Score:

3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

Accessibility: Extent and degree of effects on the community concerning accessibility to/from facilities, services, properties and businesses. Accessibility of jobs.	**Community**: Extent and degree of change to groups and activities, including sense of community and to known aspirations and plans.
-1	-1

Notes:

Reasons / Comments

- *Accessibility:*
  - Potential for uncertainty for occupants/owners to the south regarding the property acquisition process and their adaptability to change.
- *Community:*
  - It is noted that Panuku Development (Auckland Council) plan to redevelop the Manukau Sports Bowl site, to the north of Te Irirangi Drive. Social effects as a result of the proposed property acquisition of this site is likely to be minor. It would result in neutral effects to sense of community for the existing use as a mixed sport venue.
  - Sense of community likely to be affected through the acquisition of residential homes to the south.

Assumptions

- Assumes that where property acquisition occurs, including removal of buildings, that the existing level of access to private property would be retained including vehicular and pedestrian access.
- The assessment excludes consideration of potential economic effect on businesses as a result of partial or full property acquisition.
- The social impact assessment considers the A2B route and its immediate surrounds (as shown on Figure 1 of the briefing note). The Census 2013 Census Area Units are used to provide a broad understanding of the surrounding and dependent population.

Other Information relied upon

- Census of Population and Dwellings (2013) (Census 2013), Stats NZ. Note that the Census 2018 data was not available at the time of writing and has not been used to inform this assessment.
- Draft Corridor Strategy (December 2019, prepared for Auckland Transport and Waka Kotahi) – mapping showing notable projects within the corridor environs and community and civic facilities
- Draft Equity Assessment (December 2019, prepared for Auckland Transport) – includes information on socio-economic deprivation, healthy deprivation, age, gender, ethnicity and access to a vehicle at the Census Area Unit, based on the Census 2013.

Table 18 Multi Criteria Analysis Scoring Sheet – Section 10 – Te Irirangi Drive (Great South Road to Diorella Drive) B Side Widening

Section 10 – B Side	
Name of assessor (incl. qualifications and organisation)	[redacted] BPlan (Hons), Aurecon
Area of assessment	Social Impact

Score:

3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

Accessibility: Extent and degree of effects on the community concerning accessibility to/from facilities, services, properties and businesses. Accessibility of jobs.	**Community**: Extent and degree of change to groups and activities, including sense of community and to known aspirations and plans.
-1	-2

Notes:

Reasons / Comments

- *Accessibility:*
  - Potential for uncertainty for occupants/owners to the south regarding the property acquisition process and their adaptability to change.
- *Community:*
  - It is noted that Panuku Development (Auckland Council) plan to redevelop the Manukau Sports Bowl site, to the north of Te Irirangi Drive. Social effects as a result of the proposed property acquisition of this site is likely to be minor. It would result in neutral effects to sense of community for the existing use as a mixed sport venue.
  - Sense of community likely to be affected through the acquisition of residential homes to the south.

Assumptions

- Assumes that where property acquisition occurs, including removal of buildings, that the existing level of access to private property would be retained including vehicular and pedestrian access.
- The assessment excludes consideration of potential economic effect on businesses as a result of partial or full property acquisition.
- The social impact assessment considers the A2B route and its immediate surrounds (as shown on Figure 1 of the briefing note). The Census 2013 Census Area Units are used to provide a broad understanding of the surrounding and dependent population.

Other Information relied upon

- Census of Population and Dwellings (2013) (Census 2013), Stats NZ. Note that the Census 2018 data was not available at the time of writing and has not been used to inform this assessment.
- Draft Corridor Strategy (December 2019, prepared for Auckland Transport and Waka Kotahi) – mapping showing notable projects within the corridor environs and community and civic facilities
- Draft Equity Assessment (December 2019, prepared for Auckland Transport) – includes information on socio-economic deprivation, healthy deprivation, age, gender, ethnicity and access to a vehicle at the Census Area Unit, based on the Census 2013.

Table 19 Multi Criteria Analysis Scoring Sheet – Section 10 – Te Irirangi Drive (Great South Road to Diorella Drive) Both Side Widening

Section 10 – Both Side	
Name of assessor (incl. qualifications and organisation)	[redacted] BPlan (Hons), Aurecon
Area of assessment	Social Impact

Score:

3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

Accessibility: Extent and degree of effects on the community concerning accessibility to/from facilities, services, properties and businesses. Accessibility of jobs.	**Community**: Extent and degree of change to groups and activities, including sense of community and to known aspirations and plans.
-1	-2

Notes:

Reasons / Comments

- *Accessibility:*
  - Potential for uncertainty for occupants/owners to the south regarding the property acquisition process and their adaptability to change.
- *Community:*
  - It is noted that Panuku Development (Auckland Council) plan to redevelop the Manukau Sports Bowl site, to the north of Te Irirangi Drive. Social effects as a result of the proposed property acquisition of this site is likely to be minor. It would result in neutral effects to sense of community for the existing use as a mixed sport venue.
  - Sense of community likely to be affected through the acquisition of residential homes to the south.

Assumptions

- Assumes that where property acquisition occurs, including removal of buildings, that the existing level of access to private property would be retained including vehicular and pedestrian access.
- The assessment excludes consideration of potential economic effect on businesses as a result of partial or full property acquisition.
- The social impact assessment considers the A2B route and its immediate surrounds (as shown on Figure 1 of the briefing note). The Census 2013 Census Area Units are used to provide a broad understanding of the surrounding and dependent population.

Other Information relied upon

- Census of Population and Dwellings (2013) (Census 2013), Stats NZ. Note that the Census 2018 data was not available at the time of writing and has not been used to inform this assessment.
- Draft Corridor Strategy (December 2019, prepared for Auckland Transport and Waka Kotahi) – mapping showing notable projects within the corridor environs and community and civic facilities
- Draft Equity Assessment (December 2019, prepared for Auckland Transport) – includes information on socio-economic deprivation, healthy deprivation, age, gender, ethnicity and access to a vehicle at the Census Area Unit, based on the Census 2013.

Table 20 Multi Criteria Analysis Scoring Sheet – Section 11 – Te Irirangi Drive (Diorella Drive to Te Irirangi Drive Ch. 1525) A Side Widening

Section 11 – A Side	
Name of assessor (incl. qualifications and organisation)	[redacted] BPlan (Hons), Aurecon
Area of assessment	Social Impact

Score:

3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

Accessibility: Extent and degree of effects on the community concerning accessibility to/from facilities, services, properties and businesses. Accessibility of jobs.	**Community**: Extent and degree of change to groups and activities, including sense of community and to known aspirations and plans.
-1	0

Notes:

Reasons / Comments

- *Accessibility:*
  - Potential for uncertainty regarding future access for occupants/owners due to understanding of the property acquisition process and their adaptability to change.
- *Community:*
  - Change to community groups and activities unlikely.

Assumptions

- Assumes that where property acquisition occurs, including removal of buildings, that the existing level of access to private property would be retained including vehicular and pedestrian access.
- The assessment excludes consideration of potential economic effect on businesses as a result of partial or full property acquisition.
- The social impact assessment considers the A2B route and its immediate surrounds (as shown on Figure 1 of the briefing note). The Census 2013 Census Area Units are used to provide a broad understanding of the surrounding and dependent population.

Other Information relied upon

- Census of Population and Dwellings (2013) (Census 2013), Stats NZ. Note that the Census 2018 data was not available at the time of writing and has not been used to inform this assessment.

- Draft Corridor Strategy (December 2019, prepared for Auckland Transport and Waka Kotahi) – mapping showing notable projects within the corridor environs and community and civic facilities
- Draft Equity Assessment (December 2019, prepared for Auckland Transport) – includes information on socio-economic deprivation, healthy deprivation, age, gender, ethnicity and access to a vehicle at the Census Area Unit, based on the Census 2013.

Table 21 Multi Criteria Analysis Scoring Sheet – Section 11 – Te Irirangi Drive (Diorella Drive to Te Irirangi Drive Ch. 1525) B Side Widening

Section 11 – B Side	
Name of assessor (incl. qualifications and organisation)	[redacted] BPlan (Hons), Aurecon
Area of assessment	Social Impact

Score:

3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

Accessibility: Extent and degree of effects on the community concerning accessibility to/from facilities, services, properties and businesses. Accessibility of jobs.	**Community**: Extent and degree of change to groups and activities, including sense of community and to known aspirations and plans.
-1	0

Notes:

Reasons / Comments

- *Accessibility:*
  - Potential for uncertainty regarding future access for occupants/owners due to understanding of the property acquisition process and their adaptability to change.
- *Community:*
  - Change to community groups and activities unlikely.

Assumptions

- Assumes that where property acquisition occurs, including removal of buildings, that the existing level of access to private property would be retained including vehicular and pedestrian access.
- The assessment excludes consideration of potential economic effect on businesses as a result of partial or full property acquisition.
- The social impact assessment considers the A2B route and its immediate surrounds (as shown on Figure 1 of the briefing note). The Census 2013 Census Area Units are used to provide a broad understanding of the surrounding and dependent population.

Other Information relied upon

- Census of Population and Dwellings (2013) (Census 2013), Stats NZ. Note that the Census 2018 data was not available at the time of writing and has not been used to inform this assessment.

- Draft Corridor Strategy (December 2019, prepared for Auckland Transport and Waka Kotahi) – mapping showing notable projects within the corridor environs and community and civic facilities
- Draft Equity Assessment (December 2019, prepared for Auckland Transport) – includes information on socio-economic deprivation, healthy deprivation, age, gender, ethnicity and access to a vehicle at the Census Area Unit, based on the Census 2013.

Table 22 Multi Criteria Analysis Scoring Sheet – Section 11 – Te Irirangi Drive (Diorella Drive to Te Irirangi Drive Ch. 1525) Both Side Widening

Section 11 – Both Side	
Name of assessor (incl. qualifications and organisation)	[redacted] BPlan (Hons), Aurecon
Area of assessment	Social Impact

Score:

3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

Accessibility: Extent and degree of effects on the community concerning accessibility to/from facilities, services, properties and businesses. Accessibility of jobs.	**Community**: Extent and degree of change to groups and activities, including sense of community and to known aspirations and plans.
-1	0

Notes:

Reasons / Comments

- *Accessibility:*
  - Potential for uncertainty regarding future access for occupants/owners due to understanding of the property acquisition process and their adaptability to change.
- *Community:*
  - Change to community groups and activities unlikely.

Assumptions

- Assumes that where property acquisition occurs, including removal of buildings, that the existing level of access to private property would be retained including vehicular and pedestrian access.
- The assessment excludes consideration of potential economic effect on businesses as a result of partial or full property acquisition.
- The social impact assessment considers the A2B route and its immediate surrounds (as shown on Figure 1 of the briefing note). The Census 2013 Census Area Units are used to provide a broad understanding of the surrounding and dependent population.

Other Information relied upon

- Census of Population and Dwellings (2013) (Census 2013), Stats NZ. Note that the Census 2018 data was not available at the time of writing and has not been used to inform this assessment.

- Draft Corridor Strategy (December 2019, prepared for Auckland Transport and Waka Kotahi) – mapping showing notable projects within the corridor environs and community and civic facilities
- Draft Equity Assessment (December 2019, prepared for Auckland Transport) – includes information on socio-economic deprivation, healthy deprivation, age, gender, ethnicity and access to a vehicle at the Census Area Unit, based on the Census 2013.

Table 23 Multi Criteria Analysis Scoring Sheet – Section 13 – Dawson Road to Penion Drive) A Side Widening

Section 13 – A Side	
Name of assessor (incl. qualifications and organisation)	[redacted] BPlan (Hons), Aurecon
Area of assessment	Social Impact

Score:

3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

Accessibility: Extent and degree of effects on the community concerning accessibility to/from facilities, services, properties and businesses. Accessibility of jobs.	**Community**: Extent and degree of change to groups and activities, including sense of community and to known aspirations and plans.
-1	0

Notes:

Reasons / Comments

- *Accessibility:*
  - Potential for uncertainty regarding future access for occupants/owners due to understanding of the property acquisition process and their adaptability to change.
- *Community:*
  - Change to community groups and activities unlikely.

Assumptions

- Assumes that where property acquisition occurs, including removal of buildings, that the existing level of access to private property would be retained including vehicular and pedestrian access.
- The assessment excludes consideration of potential economic effect on businesses as a result of partial or full property acquisition.
- The social impact assessment considers the A2B route and its immediate surrounds (as shown on Figure 1 of the briefing note). The Census 2013 Census Area Units are used to provide a broad understanding of the surrounding and dependent population.

Other Information relied upon

- Census of Population and Dwellings (2013) (Census 2013), Stats NZ. Note that the Census 2018 data was not available at the time of writing and has not been used to inform this assessment.

- Draft Corridor Strategy (December 2019, prepared for Auckland Transport and Waka Kotahi) – mapping showing notable projects within the corridor environs and community and civic facilities
- Draft Equity Assessment (December 2019, prepared for Auckland Transport) – includes information on socio-economic deprivation, healthy deprivation, age, gender, ethnicity and access to a vehicle at the Census Area Unit, based on the Census 2013.

Table 24 Multi Criteria Analysis Scoring Sheet - Section 13 – Dawson Road to Penion Drive) B Side Widening

Section 13 – B Side	
Name of assessor (incl. qualifications and organisation)	[redacted] BPlan (Hons), Aurecon
Area of assessment	Social Impact

Score:

3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

Accessibility: Extent and degree of effects on the community concerning accessibility to/from facilities, services, properties and businesses. Accessibility of jobs.	**Community**: Extent and degree of change to groups and activities, including sense of community and to known aspirations and plans.
-1	0

Notes:

Reasons / Comments

- *Accessibility:*
  - Potential for uncertainty regarding future access for occupants/owners due to understanding of the property acquisition process and their adaptability to change.
- *Community:*
  - Change to community groups and activities unlikely.

Assumptions

- Assumes that where property acquisition occurs, including removal of buildings, that the existing level of access to private property would be retained including vehicular and pedestrian access.
- The assessment excludes consideration of potential economic effect on businesses as a result of partial or full property acquisition.
- The social impact assessment considers the A2B route and its immediate surrounds (as shown on Figure 1 of the briefing note). The Census 2013 Census Area Units are used to provide a broad understanding of the surrounding and dependent population.

Other Information relied upon

- Census of Population and Dwellings (2013) (Census 2013), Stats NZ. Note that the Census 2018 data was not available at the time of writing and has not been used to inform this assessment.

- Draft Corridor Strategy (December 2019, prepared for Auckland Transport and Waka Kotahi) – mapping showing notable projects within the corridor environs and community and civic facilities
- Draft Equity Assessment (December 2019, prepared for Auckland Transport) – includes information on socio-economic deprivation, healthy deprivation, age, gender, ethnicity and access to a vehicle at the Census Area Unit, based on the Census 2013.

Table 25 Multi Criteria Analysis Scoring Sheet – Section 13 – Dawson Road to Penion Drive) Both Side Widening

Section 13 – Both Side	
Name of assessor (incl. qualifications and organisation)	[redacted] BPlan (Hons), Aurecon
Area of assessment	Social Impact

Score:

3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

Accessibility: Extent and degree of effects on the community concerning accessibility to/from facilities, services, properties and businesses. Accessibility of jobs.	**Community**: Extent and degree of change to groups and activities, including sense of community and to known aspirations and plans.
-1	0

Notes:

Reasons / Comments

- *Accessibility:*
  - Potential for uncertainty regarding future access for occupants/owners due to understanding of the property acquisition process and their adaptability to change.
- *Community:*
  - Change to community groups and activities unlikely.

Assumptions

- Assumes that where property acquisition occurs, including removal of buildings, that the existing level of access to private property would be retained including vehicular and pedestrian access.
- The assessment excludes consideration of potential economic effect on businesses as a result of partial or full property acquisition.
- The social impact assessment considers the A2B route and its immediate surrounds (as shown on Figure 1 of the briefing note). The Census 2013 Census Area Units are used to provide a broad understanding of the surrounding and dependent population.

Other Information relied upon

- Census of Population and Dwellings (2013) (Census 2013), Stats NZ. Note that the Census 2018 data was not available at the time of writing and has not been used to inform this assessment.

- Draft Corridor Strategy (December 2019, prepared for Auckland Transport and Waka Kotahi) – mapping showing notable projects within the corridor environs and community and civic facilities
- Draft Equity Assessment (December 2019, prepared for Auckland Transport) – includes information on socio-economic deprivation, healthy deprivation, age, gender, ethnicity and access to a vehicle at the Census Area Unit, based on the Census 2013.

Approved by:

Title	Name	Qualification	Signature	Date
Author	[redacted]	BPlan (Hons)	[redacted]	4 January 020
Reviewer	[redacted]	MSc City & Regional Planning BA (Hons)		4 January 020

Attachment 1: Summary of the social environment

The following provides a high-level overview of the existing social environment along the A2B route. It focusses on the two criteria used in the MCA – accessibility and community. The Census of Population and Dwellings (2013) (Stats NZ) is used to inform the overview. The 2018 Census information was not available at the time of writing and as such is not used as part of this summary.

Social infrastructure

Social infrastructure is located along the A2B route. There is a cluster of community facilities near the Manukau town centre including a major retail centre, primary and secondary schools, community centre and libraries. Other community facilities are scattered along the A2B route. Existing public transport connections along the A2B route are limited.

Social infrastructure directly adjacent to the options discussed in this MCA assessment, from west to east, are:

- Puhinui School – primary school
- Manukau Institute of Technology site to the south of Manukau Train Station – consented trade training school, not yet constructed.
- Manukau Sports Bowl site to the north of Te Irirangi Drive – currently used as a mixed sport venue.

Demography

When compared with Auckland, the people who live near the A2B RTN route have complex needs and travel behaviours. The area is characterised by:

- A young population with higher than average levels of health deprivation, unemployment and expected disability.
- High levels of socio-economic deprivation with correlated mental and physical health issues, particularly to the north and west of the route.
- High rates of renting from government organisations, such as Kāinga Ora, compared with New Zealand.
- Lower rates of car ownership and high dependency on public transport.
- Diverse cultural and ethnic groups, with a high Pasifika and Māori population

Current plans and aspirations

There are multiple plans and aspirations for communities along or near to the A2B route. This reflects a high degree of change in the area surrounding the A2B route. Major plans and aspirations are reflected in the following.

- Auckland International Airport (AIAL) Masterplan
- Kainga Ora – Mangere Neighbourhood Spatial Framework
- SH20B Future Business Park
- Puhinui Stream Upgrade
- Transform Manukau - Manukau City Centre Transformation Project – Panuku Development Auckland

- Manukau Westfield mall upgrade (Scentre Group)
- Ormiston Road Business Park

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Memorandum

To	[redacted]	From	[redacted]
Reviewer	[redacted]	Reference	**502334**
Date	**2020-04-14**	Pages (including this page)	**9**
Subject	**A2B Road Corridor Widening Preferred Options Assessment – Stormwater**		

1 Introduction

The following provides a stormwater assessment of the options for the road corridor widening options for the Airport to Botany (A2B) Rapid Transit Corridor (RTC) preferred route where the desired cross-section does not fit within existing road reserve, as part of the preferred option route for the Airport to Botany (A2B) Single-Stage Business Case (SSBC). It covers the A2B project area from immediately east of the Puhinui Interchange (Puhinui Road and SH20 Intersection) through to Botany.

The stormwater assessment details the considerations which have been used to inform the assessment. This assessment is designed to contribute to the Multi-Criteria Analysis (MCA) assessment which is being undertaken for this section of the preferred option route.

The options are outlined in **Table 1**. The sections are summarised in **Table 2**.

Table 1 | Options summary

Option	Description
Option A: A-side widening	This option requires encroachment into property solely on the A side of the preferred option route (A-side is as identified on the option schematics).
Option B: B-side widening	This option requires encroachment into property solely on the B side of the preferred option route (B-side as identified on the option schematics).)
Option C: A-side and B-side widening	This option involves property encroachment on both sides of the preferred option route (i.e. on both the A and B sides).

Table 2 | Corridor widening sections

Section	Sheet/s	Road name	Section extent	Conduct MCA
1	1 - 2	Puhinui Road	SH20 interchange to Kenderdine Road	Yes
2	2	Kenderdine Road, Bridge Street and Cambridge Terrace	MRT Bridge (Kenderdine Road to Cambridge Terrace along Bridge Street)	No
3	2 - 4	Puhinui Road	Cambridge Terrace to Lambie Drive	Yes
4	4 - 6	Lambie Drive	Puhinui Road to Manukau Station Road	No

5	6	Manukau Station Road	Lambie Drive to Davies Avenue	**Yes**
6	6	Davies Avenue	Manukau Station Road to Ronwood Avenue	**No**
7	6	Ronwood Avenue	Davies Avenue to Osterley Way / Sharkey Street	**Yes**
8	6 - 7	Ronwood Avenue	Osterley Way / Sharkey Street to Great South Road	**No**
9	7	Great South Road	Ronwood Avenue to Te-Irirangi Drive	**Yes**
10	7 - 8	Te Irirangi Drive	Great South Road to Diorella Drive	**Yes**
11	8 - 9	Te Irirangi Drive	Diorella Drive to Te Irirangi Drive Ch. 1525	**Yes**
12	9 – 10	Te Irirangi Drive	Te Irirangi Drive Ch. 1525 to Dawson Road	**No**
13	10	Te Irirangi Drive	Dawson Road to Penion Drive	**Yes**
14	10 - 17	Te Irirangi Drive	Penion Drive to Botany Town Centre	**No**

2 Assessment Methodology

The source information is assessed in a desktop investigation only. The assessments are based on:

- A2B Road Corridor Widening Preferred Options Assessment Memorandum, dated 22/01/2020; and
- Drawings (*App A – Sketch_Corridor Widening Options_Sh1-17*), dated 21/01/2020.

This assessment is a desktop study has been carried out using Auckland Council Geo Maps. No surveys, investigations or detailed site visits have been undertaken as part of this assessment. All roads are assumed to have over >5000 vehicles per day Annual Daily Traffic volume, triggering AUP Section E9 high contaminant generating zones requirements for water quality treatment.

2.1 Scoring

All options where assessed against the scores set out in **Table 3**. All increases to impervious surface area are considered to have an adverse effect on the local stormwater situation, therefore all options will have a negative scoring.

Table 3 | Scoring criteria

Score	Statement
3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

2.2 Assumptions

It is assumed that the existing road levels will be retained throughout the with the corridor and that the road will simply be widened to extend within the proposed typical cross-section road width. The assessment is to be undertaken without any consideration of mitigation measures. All options go through a very similar stormwater environment, based off the information provided by Auckland Council GeoMaps and the Auckland Unitary Plan GeoMaps.

3 Assessment

The scores and assessments are presented in **Tables 4 to 11** below. All options go through a very similar stormwater environment and therefore will have similar scoring to each other.

Table 4 | Section 1 Assessment

Section 1 – Puhinui Road from the SH20 interchange to Kenderdine Road
Area of assessment: Stormwater – Impact of operational stormwater discharges on water quality and quantity within the catchment.
Scores for each option in this Section: Option A: -2 Option B: -1 Option C: -2
Reasons / comments: *Option A:* Extension on the northern side of Puhinui Road which partially covers x5 flood plains (x2 entirely), x6 flood prone areas and x13 overland flow paths. This is the most challenging option to mitigate for this section given the widening has the greatest intersection with the known flood plain areas around Vision Place. *Option B:* Extension on the southern side of Puhinui Road, which partially covers x5 flood plains, x6 flood prone areas and x9 overland flow paths. This is the least challenging option to mitigate given it has the least amount of area within a flood plain area. *Option C:* Extension on both sides of Puhinui Road, which partially covers x5 flood plains, x6 flood prone areas and x13 overland flow paths and would encounter the same issues as options A and B.
Information relied upon: Section 1 is within the Puhinui Creek stormwater catchment, which covers approximately 2,264 hectares (ha). The existing stormwater discharge from Puhinui Road ultimately discharges into Puhinui Stream which is located on the southern side of the wider catchment (lower quarter). Flows from this section of Puhinui Road ultimately flows into the SH20B pond through stormwater networks. Waka Kotahi (NZ Transport Agency) is the asset owner of the SH20B pond. The following are stormwater overlays and controls in this section under the Auckland Unitary Plan (operative in part) (AUP): ■ High-use stream management areas overlay; and ■ High-use aquifer management areas overlay (Manukau Southeast Kaawa and Manukau Waitemata Aquifer)

Table 5 | Section 3 Assessment

Section 3 – Puhinui Road from Cambridge Terrace to Lambie Drive
Area of assessment: Stormwater – Impact of operational stormwater discharges on water quality and quantity within the catchment.
Scores for each option in this Section:

Option A:	-2
Option B:	-1
Option C:	-2

Reasons / comments:

Option A: Extension on the northern side of Puhinui Road is the most challenging option to mitigate as it goes through the most amount of flood plain area (by a small amount) and follows major overland flow paths on that side of the road.

Option B: Extension on the southern side of Puhinui Road is the least challenging option to mitigate as it goes through the least amount of flood plain area (by a small amount) and only covers small sections of minor overland flow paths on that side of the road.

Option C: Extension on both sides of Puhinui Road, which faces the same issues as options A and B.

Note: Additional stormwater treatment will be required for all three options in Section 3 due to its location within the Stormwater Management Area Control – Flow 2.

Information relied upon:

Section 3 is within the Puhinui Creek stormwater catchment. Flows from Section 3 of Puhinui Road flows into Wiri Stream that runs south of the road and Puhinui domain pond which positioned south of Puhinui Road (Auckland council is asset owner of Puhinui domain pond). There is a history of flooding in the mid-Puhinui catchment. The current catchment study has indicated that a 1% AEP event could give rise to flooding problems in this mid-Puhinui catchment area. The following are stormwater overlays and controls in this section under the AUP:

- High-Use Stream Management Areas Overlay;
- High-Use Aquifer Management Areas Overlay (Manukau Waitemata Aquifer); and
- Stormwater Management Area Control – Flow 2.

Table 6 | Section 5 Assessment

Section 5 – Manukau Station Road between Lambie Drive to Davies Avenue
Area of assessment: Stormwater – Impact of operational stormwater discharges on water quality and quantity within the catchment.
Scores for each option in this Section:

Option A:	-1
Option B:	-1
Option C:	-1

Reasons / comments:

Option A: Extension on the northern side of Manukau Station Road is the least challenging option to mitigate due to it covering the least amount of the flood plain. However, encroaching into the rail corridor may provide its own operational stormwater risks.

Option B: Extension on the southern side of Manukau Station Road is the most challenging option to mitigate in terms of flooding due to it covering more of the flood plain.

Option C: Extension on both sides of Manukau Station Road, which faces the same issues as options A and B.

Note: Additional stormwater treatment will be required for all three options in Section 5 due to its location within the Stormwater Management Area Control – Flow 2.

Information relied upon:

Section 5 is within the Puhinui Creek stormwater catchment. Minimal flood plains and overland flow paths cover this section. The following are stormwater overlays and controls in this section under the AUP:

- High-Use Stream Management Areas Overlay;
- High-Use Aquifer Management Areas Overlay (Manukau Waitemata Aquifer); and
- Stormwater Management Area Control – Flow 2.

Table 7 | Section 7 Assessment

Section 7 – Ronwood Avenue between Davies Avenue to Osterley Way / Sharkey Street

Area of assessment: Stormwater – Impact of operational stormwater discharges on water quality and quantity within the catchment.

Scores for each option in this Section:

Option A:	-1
Option B:	-2
Option C:	-2

Reasons / comments:

Option A: Extension on the northern side of Ronwood Avenue is the least challenging option to mitigate as it does minimal on the southern side of the road (where the most risk lies). Extends into an overland flow path and flood plain.

Option B: Extension on the southern side of Ronwood Avenue is the most challenging option to mitigate as it fully covers the most amount of flood plain, flood prone area and a major overland flow path.

Option C: Extension on both sides of Ronwood Avenue has the same issues as options A and B.

Note: Additional stormwater treatment is required for all three options in Section 7 due to its location within the Stormwater Management Area Control – Flow 2.

Information relied upon:

Section 7 is within the Puhinui Creek stormwater catchment, where most of the flood plains, flood prone areas and overland flow paths are located on the southern side of the road and partially the northern side of the road. The following are stormwater overlays and controls in this section under the AUP:

- High-Use Stream Management Areas Overlay;
- High-Use Aquifer Management Areas Overlay (Manukau Waitemata Aquifer); and
- Stormwater Management Area Control – Flow 2.

Table 8 | Section 9 Assessment

Section 9 – Great South Road from Ronwood Avenue to Te-Irirangi Drive

Area of assessment: Stormwater – Impact of operational stormwater discharges on water quality and quantity within the catchment.

Scores for each option in this Section:

Option A:	-2
Option B:	-1
Option C:	-2

Reasons / comments:

Option A: Extension on the western side of Great South Road is the most challenging option to mitigate as the majority of the extensions out east are within all of the AUP overlays and controls listed in the next row.

Option B: Extension on the eastern side of Great South Road is the least challenging option to mitigate as the northern part of the extensions out west are outside of the AUP Stormwater Management Area Control and the High-Use Stream Management Areas Overlay.

Option C: Extension on both sides of Great South Road has the same issues as options A and B.

Note: Additional stormwater treatment is required for options A and C, and part of option B, in Section 9 due to its location within the Stormwater Management Area Control – Flow 2.

Information relied upon:

Section 9 is on the boarder of the Puhinui Creek (east) and Otara Creek / Flat Bush (west) stormwater catchments. The main area of flood plains and overland flow paths are on the southern end of this section. The following are stormwater overlays and controls in this section under the AUP:

- High-Use Stream Management Areas Overlay;
- High-Use Aquifer Management Areas Overlay (Manukau Waitemata Aquifer); and
- Stormwater Management Area Control – Flow 2.

Table 9 | Section 10 Assessment

Section 10 – Te Irirangi Drive from Great South Road to Diorella Drive	
Area of assessment: Stormwater – Impact of operational stormwater discharges on water quality and quantity within the catchment.	
Scores for each option in this Section:	
Option A:	-1
Option B:	-1
Option C:	-1
Reasons / comments:	
Option A: Extension on the northern side of Te Irirangi Drive is the least challenging option to mitigate as it encroaches on the least amount of flood plain on the eastern end of this section.	
Option B: Extension on the southern side of Te Irirangi Drive is the most challenging option to mitigate as it encroaches on a couple of minor overland flow paths and the most amount of flood plain on the eastern end of this section.	
Option C: Extension on both sides of Te Irirangi Drive has the same issues as options A and B.	
Information relied upon:	
Section 10 is within the Otara Creek / Flat Bush stormwater catchment. This section includes a road bridge over SH1, therefore, there will not be any impacts on the overland flow paths or flood plains shown along SH1. The following are stormwater overlays and controls in this section under the AUP:	
■ High-Use Aquifer Management Areas Overlay (Manukau Waitemata Aquifer).	

Table 10 | Section 11 Assessment

Section 11 – Te Irirangi Drive from Diorella Drive to 118 Te Irirangi Drive	
Area of assessment: Stormwater – Impact of operational stormwater discharges on water quality and quantity within the catchment.	
Scores for each option in this Section:	
Option A:	-1
Option B:	-2
Option C:	-2
Reasons / comments:	
Option A: Extension on the northern side of Te Irirangi Drive is the least challenging option to mitigate, as it encroaches on the major and minor overland flow paths and the least amount of flood plains and flood prone areas.	
Option B: Extension on the southern side of Te Irirangi Drive is the most challenging option to mitigate , as it encroaches on the most major and minor overland flow paths and the most amount of flood plains and flood prone areas.	
Option C: Extension on both sides of Te Irirangi Drive has the same issues as options A and B.	

Information relied upon:

Section 11 is within the Otara Creek / Flat Bush stormwater catchment, where most of the overland flow paths and flood plains are in the eastern half of the section. The are no stormwater overlays and controls under the AUP in this section.

Table 11 | Section 13 Assessment

Section 13 – Te Irirangi Drive from Dawson Road to Penion Drive
Area of assessment: Stormwater – Impact of operational stormwater discharges on water quality and quantity within the catchment.
Scores for each option in this Section:

Option A:	-1
Option B:	-1
Option C:	-1

Reasons / comments:

Option A: Extension on the northern side of Te Irirangi Drive is the most challenging option to mitigate as it may encroach on the flood plain to the north and encroaches on two minor overland flow paths.

Option B: Extension on the southern side of Te Irirangi Drive is the least challenging option to mitigate as it only encroaches on two minor overland flow paths.

Option C: Extension on both sides of Te Irirangi Drive has the same issues as options A and B.

Information relied upon:

Section 13 is within the Otara Creek / Flat Bush stormwater catchment, with only minor overland flow paths either side of the road. There are no stormwater overlays and controls in this section under the AUP.

4 Relevant AUP Chapters

The following are the relevant chapters under the AUP:

- *E8 Stormwater – Discharge and diversion*: Relevant to all sections, which will have additional impervious areas;
- *E9 Stormwater quality – High contaminant generating car parks and high use roads*: Relevant to all sections, as all of these roads are considered "high use roads" under the AUP: "A road, motorway or state highway that carries more than 5000 vehicles per day, excluding cycle lanes, footpaths and ancillary areas that do not receive stormwater runoff from the road carriageway";
- *E10 Stormwater management area – Flow 1 and Flow 2:* Relevant to sections 3 – 9 within this control area (Flow 2);
- *E36 Natural hazards and flooding:* Relevant to all sections, as there are flood plains and overland flow paths throughout the corridor;
- *D1 High-use Aquifer Management Areas Overlay*: Relevant to sections 3 – 10 within this overlay; and
- *D3 High-use Stream Management Areas Overlay:* Relevant to sections 3 – 9 within this overlay.

Sections 3 through to 10 have the most AUP restrictions and the most stormwater features, and therefore are the most challenging sections from a stormwater mitigation perspective.

5 Summary

A summary of the final scores is shown in **Table 12** below. All the options have a negative scoring due to the increase in impervious surface area, though they were only considered to have minor to moderate adverse effects. None of the options were considered to have significant adverse or un-mitigatable effects. Sections 3 through to 10 are the riskiest sections due to their stormwater environment and AUP context.

Table 12 | Summary of scores

Section	Options rating		
	Option A	Option B	Option C
Section 1	-2	-1	-2
Section 3	-2	-1	-2
Section 5	-1	-1	-1
Section 7	-1	-2	-2
Section 9	-2	-1	-2
Section 10	-1	-1	-1
Section 11	-1	-2	-2
Section 13	-1	-1	-1

Title	Name	Qualification	Signature	Date
Author	[redacted]	Consultant, Environment and Planning	[redacted]	-04-14
Reviewer	[redacted]	Stormwater Engineer		-04-14

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Technical Note

To	[redacted]	From	[redacted]
Copy	[redacted]	Reference	**502334**
Date	**2020-04-21**	Pages (including this page)	**26**
Subject	**Airport to Botany: Road Corridor Widening Options: Multi-Criteria Analysis Scoring Sheet: Site Contamination**		

The following provides an assessment of the road corridor widening options for the Airport to Botany (A2B) Rapid Transit Corridor (RTC) preferred route where the desired cross-section does not fit within existing road reserve, as part of the preferred option route for the Airport to Botany (A2B) Single-Stage Business Case (SSBC).

The Road Corridor Widening Options have been assessed separately and in isolation from one another. The assessment details the considerations used. This assessment is designed to contribute to the Multi-Criteria Analysis (MCA) which is being undertaken for this section of the preferred option route.

The source information is desktop analysis only. The 24 options for assessments are based on:

- A2B Road Corridor Widening Option Schematics (Sheets 1-17) dated 14 January 2020; and
- Preferred Options Assessment and Assumptions Memorandum (dated 16 January 2020).

The 24 options are outlined in Table 1. The scores and assessments are presented in Tables 2-25.

Table 1. A2B Road Corridor Widening Options Summary

Section	Road name	Section extent	Widening
1 – A Side	Puhinui Road	SH20 interchange to Kenderdine Road	A Side Widening
1 – B Side	Puhinui Road	SH20 interchange to Kenderdine Road	B Side Widening
1 – Both Side	Puhinui Road	SH20 interchange to Kenderdine Road	Both Side Widening
3 – A Side	Puhinui Road	Cambridge Terrace to Lambie Drive	A Side Widening
3 – B Side	Puhinui Road	Cambridge Terrace to Lambie Drive	B Side Widening
3 – Both Side	Puhinui Road	Cambridge Terrace to Lambie Drive	Both Side Widening
5 – A Side	Manukau Station Road	Lambie Drive to Davies Avenue	A Side Widening
5 – B Side	Manukau Station Road	Lambie Drive to Davies Avenue	B Side Widening
5 – Both Side	Manukau Station Road	Lambie Drive to Davies Avenue	Both Side Widening
7 – A Side	Ronwood Avenue	Davies Avenue to Osterley Way / Sharkey Street	A Side Widening
7 – B Side	Ronwood Avenue	Davies Avenue to Osterley Way / Sharkey Street	B Side Widening

7 – Both Side	Ronwood Avenue	Davies Avenue to Osterley Way / Sharkey Street	Both Side Widening
9 – A Side	Great South Road	Ronwood Avenue to Te-Irirangi Drive	A Side Widening
9 – B Side	Great South Road	Ronwood Avenue to Te-Irirangi Drive	B Side Widening
9 – Both Side	Great South Road	Ronwood Avenue to Te-Irirangi Drive	Both Side Widening
10 – A Side	Te Irirangi Drive	Great South Road to Diorella Drive	A Side Widening
10 – B Side	Te Irirangi Drive	Great South Road to Diorella Drive	B Side Widening
10 – Both Side	Te Irirangi Drive	Great South Road to Diorella Drive	Both Side Widening
11 – A Side	Te Irirangi Drive	Diorella Drive to Te Irirangi Drive Ch. 1525	A Side Widening
11 – B Side	Te Irirangi Drive	Diorella Drive to Te Irirangi Drive Ch. 1525	B Side Widening
11 – Both Side	Te Irirangi Drive	Diorella Drive to Te Irirangi Drive Ch. 1525	Both Side Widening
13 – A Side	Te Irirangi Drive	Dawson Road to Penion Drive	A Side Widening
13 – B Side	Te Irirangi Drive	Dawson Road to Penion Drive	B Side Widening
13 – Both Side	Te Irirangi Drive	Dawson Road to Penion Drive	Both Side Widening

Table 2 Multi Criteria Analysis Scoring Sheet – Section 1 -Puhinui Road (SH20 interchange to Kenderdine Road) A Side Widening

Section 1 – A Side	
Name of assessor (incl. qualifications and organisation)	[redacted] – Aurecon, CEnvP(SC)
Area of assessment	Contaminated Land

Score:

3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

Contamination Management
-1

Notes:

Reasons / Comments

- *Potential to encounter contaminated soils and ability to manage potential risk to human health and the environment:*
  - Multiple residential properties constructed prior to 2000 are present. Asbestos and lead contamination in the vicinity of these residences may result in increased soil disposal costs and H&S considerations during building removal and bulk earthworks.
  - The nature of commercial/industrial activities could not be confirmed
  - The roadway has been in operation for over 60 years; based on likely construction materials, techniques, infilling, levelling and contaminants in roadway run-off which include metals, hydrocarbons and asbestos, diffuse contamination is anticipated across the project area which will require a nominal level of management during civil works

Assumptions

- The petroleum hydrocarbon storage and distribution infrastructure associated with the service station at the corner of Puhinui Road and Noel Burnside Road will not be impacted by improvement works
- Study area as described in Aurecon letter *A2B Road Corridor Widening Preferred Options Assessment* dated 23/01/2020
- Civil works associated with redevelopment are unlikely to encounter groundwater
- Further contaminated land assessment (e.g. PSI and DSI) will be conducted prior to progressing with the preferred option to gain more understanding of land contamination risks.

Other Information relied upon

- A review of historical and current aerial photography available on Auckland Council Geomaps
- A review of historical aerial photography available on Retrolens
- A review of the Aurecon Technical Note 502334-7000-TEC-KD-0039

Table 3 Multi Criteria Analysis Scoring Sheet – Section 1 -Puhinui Road (SH20 interchange to Kenderdine Road) B Side Widening

Section 1 - B Side	
Name of assessor (incl. qualifications and organisation)	[redacted] – Aurecon, CEnvP(SC)
Area of assessment	Contaminated Land

Score:

3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

Contamination Management
-2

Notes:

Reasons / Comments

- *Potential to encounter contaminated soils and ability to manage potential risk to human health and the environment:*
  - Multiple residential properties constructed prior to 2000 are present. Asbestos and lead contamination in the vicinity of these residences may result in increased soil disposal costs and H&S considerations during building removal and bulk earthworks.
  - [redacted]
  - The nature of commercial/industrial activities could not be confirmed
  - The roadway has been in operation for over 60 years; based on likely construction materials, techniques, infilling, levelling and contaminants in roadway run-off which include metals, hydrocarbons and asbestos, diffuse contamination is anticipated across the project area which will require a nominal level of management during civil works

Assumptions

- Study area as described in Aurecon letter *A2B Road Corridor Widening Preferred Options Assessment* dated 23/01/2020
- Civil works associated with redevelopment are unlikely to encounter groundwater
- Further contaminated land assessment (e.g. PSI and DSI) will be conducted prior to progressing with the preferred option to gain more understanding of land contamination risks

Other Information relied upon

- A review of historical and current aerial photography available on Auckland Council Geomaps
- A review of historical aerial photography available on Retrolens
- A review of the Aurecon Technical Note 502334-7000-TEC-KD-0039

Table 4 Multi Criteria Analysis Scoring Sheet – Section 1 -Puhinui Road (SH20 interchange to Kenderdine Road) Both Side Widening

Section 1 – Both Side	
Name of assessor (incl. qualifications and organisation)	[redacted] – Aurecon, CEnvP(SC)
Area of assessment	Contaminated Land

Score:

3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

Contamination Management
-2

Notes:

Reasons / Comments

- *Potential to encounter contaminated soils and ability to manage potential risk to human health and the environment:*
  - Multiple residential properties constructed prior to 2000 are present. Asbestos and lead contamination in the vicinity of these residences may result in increased soil disposal costs and H&S considerations during building removal and bulk earthworks.
  - [redacted]
  - The nature of commercial/industrial activities could not be confirmed
  - The roadway has been in operation for over 60 years; based on likely construction materials, techniques, infilling, levelling and contaminants in roadway run-off which include metals, hydrocarbons and asbestos, diffuse contamination is anticipated across the project area which will require a nominal level of management during civil works

Assumptions

- Study area as described in Aurecon letter *A2B Road Corridor Widening Preferred Options Assessment* dated 23/01/2020
- Civil works associated with redevelopment are unlikely to encounter groundwater
- Further contaminated land assessment (e.g. PSI and DSI) will be conducted prior to progressing with the preferred option to gain more understanding of land contamination risks

Other Information relied upon

- A review of historical and current aerial photography available on Auckland Council Geomaps
- A review of historical aerial photography available on Retrolens
- A review of the Aurecon Technical Note 502334-7000-TEC-KD-0039

Table 5 **Multi Criteria Analysis Scoring Sheet – Section 3 -Puhinui Road (Cambridge Terrace to Lambie Drive) A Side Widening**

Section 3 – A Side	
Name of assessor (incl. qualifications and organisation)	[redacted] – Aurecon, CEnvP(SC)
Area of assessment	Contaminated Land

Score:

3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

Contamination Management
-1

Notes:

Reasons / Comments

- *Potential to encounter contaminated soils and ability to manage potential risk to human health and the environment:*
  - Multiple residential properties constructed prior to 2000 are present. Asbestos and lead contamination in the vicinity of these residences may result in increased soil disposal costs and H&S considerations during building removal and bulk earthworks.
  - The nature of commercial/industrial activities could not be confirmed
  - The roadway has been in operation for over 60 years; based on likely construction materials, techniques, infilling, levelling and contaminants in roadway run-off which include metals, hydrocarbons and asbestos, diffuse contamination is anticipated across the project area which will require a nominal level of management during civil works

Assumptions

- Study area as described in Aurecon letter *A2B Road Corridor Widening Preferred Options Assessment* dated 23/01/2020
- Civil works associated with redevelopment are unlikely to encounter groundwater
- Further contaminated land assessment (e.g. PSI and DSI) will be conducted prior to progressing with the preferred option to gain more understanding of land contamination risks

Other Information relied upon

- A review of historical and current aerial photography available on Auckland Council Geomaps
- A review of historical aerial photography available on Retrolens
- A review of the Aurecon Technical Note 502334-7000-TEC-KD-0039

Table 6 Multi Criteria Analysis Scoring Sheet – Section 3 -Puhinui Road (Cambridge Terrace to Lambie Drive) B Side Widening

Section 3 – B Side	
Name of assessor (incl. qualifications and organisation)	[redacted] – Aurecon, CEnvP(SC)
Area of assessment	Contaminated Land

Score:

3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

Contamination Management
-1

Notes:

Reasons / Comments

- *Potential to encounter contaminated soils and ability to manage potential risk to human health and the environment:*
  - Multiple residential properties constructed prior to 2000 are present. Asbestos and lead contamination in the vicinity of these residences may result in increased soil disposal costs and H&S considerations during building removal and bulk earthworks.
  - The nature of commercial/industrial activities could not be confirmed
  - The roadway has been in operation for over 60 years; based on likely construction materials, techniques, infilling, levelling and contaminants in roadway run-off which include metals, hydrocarbons and asbestos, diffuse contamination is anticipated across the project area which will require a nominal level of management during civil works

Assumptions

- Study area as described in Aurecon letter *A2B Road Corridor Widening Preferred Options Assessment* dated 23/01/2020
- Civil works associated with redevelopment are unlikely to encounter groundwater
- Further contaminated land assessment (e.g. PSI and DSI) will be conducted prior to progressing with the preferred option to gain more understanding of land contamination risks

Other Information relied upon

- A review of historical and current aerial photography available on Auckland Council Geomaps
- A review of historical aerial photography available on Retrolens
- A review of the Aurecon Technical Note 502334-7000-TEC-KD-0039

Table 7 **Multi Criteria Analysis Scoring Sheet – Section 3 -Puhinui Road (Cambridge Terrace to Lambie Drive) Both Side Widening**

Section 3 – Both Side	
Name of assessor (incl. qualifications and organisation)	[redacted] – Aurecon, CEnvP(SC)
Area of assessment	Contaminated Land

Score:

3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

Contamination Management
-1

Notes:

Reasons / Comments

- *Potential to encounter contaminated soils and ability to manage potential risk to human health and the environment:*
  - Multiple residential properties constructed prior to 2000 are present. Asbestos and lead contamination in the vicinity of these residences may result in increased soil disposal costs and H&S considerations during building removal and bulk earthworks.
  - The nature of commercial/industrial activities could not be confirmed
  - The roadway has been in operation for over 60 years; based on likely construction materials, techniques, infilling, levelling and contaminants in roadway run-off which include metals, hydrocarbons and asbestos, diffuse contamination is anticipated across the project area which will require a nominal level of management during civil works

Assumptions

- Study area as described in Aurecon letter *A2B Road Corridor Widening Preferred Options Assessment* dated 23/01/2020
- Civil works associated with redevelopment are unlikely to encounter groundwater
- Further contaminated land assessment (e.g. PSI and DSI) will be conducted prior to progressing with the preferred option to gain more understanding of land contamination risks

Other Information relied upon

- A review of historical and current aerial photography available on Auckland Council Geomaps
- A review of historical aerial photography available on Retrolens
- A review of the Aurecon Technical Note 502334-7000-TEC-KD-0039

Table 8 Multi Criteria Analysis Scoring Sheet – Section 5 – Manukau Station Road (Lambie Drive to Davies Avenue) A Side Widening

Section 5 – A Side	
Name of assessor (incl. qualifications and organisation)	[redacted] – Aurecon, CEnvP(SC)
Area of assessment	Contaminated Land

Score:

3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

Contamination Management
0

Notes:

Reasons / Comments

- *Potential to encounter contaminated soils and ability to manage potential risk to human health and the environment:*
  - Landscaping, carpark and pedestrian walkway use associated with the Manukau Train Station are present in this area. Based on the completion date in 2012 and bulk earthworks required for station construction, it is considered unlikely contaminated soils will be encountered beneath current site development in this area.

Assumptions

- Study area as described in Aurecon letter *A2B Road Corridor Widening Preferred Options Assessment* dated 23/01/2020
- Civil works associated with redevelopment are unlikely to encounter groundwater
- Further contaminated land assessment (e.g. PSI and DSI) will be conducted prior to progressing with the preferred option to gain more understanding of land contamination risks

Other Information relied upon

- A review of historical and current aerial photography available on Auckland Council Geomaps
- A review of historical aerial photography available on Retrolens
- A review of the Aurecon Technical Note 502334-7000-TEC-KD-0039

Table 9 **Multi Criteria Analysis Scoring Sheet – Section 5 – Manukau Station Road (Lambie Drive to Davies Avenue) B Side Widening**

Section 5 – B Side	
Name of assessor (incl. qualifications and organisation)	[redacted] – Aurecon, CEnvP(SC)
Area of assessment	Contaminated Land

Score:

3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

Contamination Management
0

Notes:

Reasons / Comments

- *Potential to encounter contaminated soils and ability to manage potential risk to human health and the environment:*
  - A vacant lot and pedestrian walkway are present on the site. Based on the estimated completion date in 2008 and bulk earthworks required for roadway construction, it is considered unlikely contaminated soils will be encountered beneath current site development in this area.

Assumptions

- Study area as described in Aurecon letter *A2B Road Corridor Widening Preferred Options Assessment* dated 23/01/2020
- Civil works associated with redevelopment are unlikely to encounter groundwater
- Further contaminated land assessment (e.g. PSI and DSI) will be conducted prior to progressing with the preferred option to gain more understanding of land contamination risks

Other Information relied upon

- A review of historical and current aerial photography available on Auckland Council Geomaps
- A review of historical aerial photography available on Retrolens
- A review of the Aurecon Technical Note 502334-7000-TEC-KD-0039

Table 10 **Multi Criteria Analysis Scoring Sheet - Section 5 – Manukau Station Road (Lambie Drive to Davies Avenue) Both Side Widening**

Section 5 – Both Side	
Name of assessor (incl. qualifications and organisation)	[redacted] – Aurecon, CEnvP(SC)
Area of assessment	Contaminated Land

Score:

3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

Contamination Management
0

Notes:

Reasons / Comments

- *Potential to encounter contaminated soils and ability to manage potential risk to human health and the environment:*
  - Landscaping, carpark and pedestrian walkway use associated with the Manukau Train Station are present to the north of Manukau Station Road. Based on the completion date in 2012 and bulk earthworks required for station construction, it is considered unlikely contaminated soils will be encountered beneath current site development in this area.
  - A vacant lot and pedestrian walkway are present to the south of Manukau Station Road. Based on the estimated completion date in 2008 and bulk earthworks required for roadway construction, it is considered unlikely contaminated soils will be encountered beneath current site development in this area.

Assumptions

- Study area as described in Aurecon letter *A2B Road Corridor Widening Preferred Options Assessment* dated 23/01/2020
- Civil works associated with redevelopment are unlikely to encounter groundwater
- Further contaminated land assessment (e.g. PSI and DSI) will be conducted prior to progressing with the preferred option to gain more understanding of land contamination risks

Other Information relied upon

- A review of historical and current aerial photography available on Auckland Council Geomaps
- A review of historical aerial photography available on Retrolens
- A review of the Aurecon Technical Note 502334-7000-TEC-KD-0039

Table 11 Multi Criteria Analysis Scoring Sheet – Section 7 – Ronwood Avenue (Davies Avenue to Osterley Way / Sharkey Street) A Side Widening

Section 7 – A Side	
Name of assessor (incl. qualifications and organisation)	[redacted] – Aurecon, CEnvP(SC)
Area of assessment	Contaminated Land

Score:

3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

Contamination Management
-1

Notes:

Reasons / Comments

- *Potential to encounter contaminated soils and ability to manage potential risk to human health and the environment:*
  - The nature of commercial/industrial activities could not be confirmed
  - The roadway has been in operation for over 40 years; based on likely construction materials, techniques, infilling, levelling and contaminants in roadway run-off which include metals, hydrocarbons and asbestos, diffuse contamination is anticipated across the project area which will require a nominal level of management during civil works

Assumptions

- Study area as described in Aurecon letter *A2B Road Corridor Widening Preferred Options Assessment* dated 23/01/2020
- Civil works associated with redevelopment are unlikely to encounter groundwater
- Further contaminated land assessment (e.g. PSI and DSI) will be conducted prior to progressing with the preferred option to gain more understanding of land contamination risks

Other Information relied upon

- A review of historical and current aerial photography available on Auckland Council Geomaps
- A review of historical aerial photography available on Retrolens
- A review of the Aurecon Technical Note 502334-7000-TEC-KD-0039

Table 12 Multi Criteria Analysis Scoring Sheet – Section 7 – Ronwood Avenue (Davies Avenue to Osterley Way / Sharkey Street) B Side Widening

Section 7 – B Side	
Name of assessor (incl. qualifications and organisation)	[redacted] – Aurecon, CEnvP(SC)
Area of assessment	Contaminated Land

Score:

3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

Contamination Management
-1

Notes:

Reasons / Comments

- *Potential to encounter contaminated soils and ability to manage potential risk to human health and the environment:*
  - The nature of commercial/industrial activities could not be confirmed
  - The roadway has been in operation for over 40 years; based on likely construction materials, techniques, infilling, levelling and contaminants in roadway run-off which include metals, hydrocarbons and asbestos, diffuse contamination is anticipated across the project area which will require a nominal level of management during civil works

Assumptions

- Study area as described in Aurecon letter *A2B Road Corridor Widening Preferred Options Assessment* dated 23/01/2020
- Civil works associated with redevelopment are unlikely to encounter groundwater
- Further contaminated land assessment (e.g. PSI and DSI) will be conducted prior to progressing with the preferred option to gain more understanding of land contamination risks

Other Information relied upon

- A review of historical and current aerial photography available on Auckland Council Geomaps
- A review of historical aerial photography available on Retrolens
- A review of the Aurecon Technical Note 502334-7000-TEC-KD-0039

Table 13 Multi Criteria Analysis Scoring Sheet – Section 7 – Ronwood Avenue (Davies Avenue to Osterley Way / Sharkey Street) Both Side Widening

Section 7 – Both Side	
Name of assessor (incl. qualifications and organisation)	[redacted] – Aurecon, CEnvP(SC)
Area of assessment	Contaminated Land

Score:

3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

Contamination Management
-1

Notes:

Reasons / Comments

- *Potential to encounter contaminated soils and ability to manage potential risk to human health and the environment:*
  - The nature of commercial/industrial activities could not be confirmed
  - The roadway has been in operation for over 40 years; based on likely construction materials, techniques, infilling, levelling and contaminants in roadway run-off which include metals, hydrocarbons and asbestos, diffuse contamination is anticipated across the project area which will require a nominal level of management during civil works

Assumptions

- Study area as described in Aurecon letter *A2B Road Corridor Widening Preferred Options Assessment* dated 23/01/2020
- Civil works associated with redevelopment are unlikely to encounter groundwater
- Further contaminated land assessment (e.g. PSI and DSI) will be conducted prior to progressing with the preferred option to gain more understanding of land contamination risks

Other Information relied upon

- A review of historical and current aerial photography available on Auckland Council Geomaps
- A review of historical aerial photography available on Retrolens
- A review of the Aurecon Technical Note 502334-7000-TEC-KD-0039

Table 14 Multi Criteria Analysis Scoring Sheet – Section 9 – Great South Road (Ronwood Avenue to Te-Irirangi Drive) A Side Widening

Section 9 – A Side	
Name of assessor (incl. qualifications and organisation)	[redacted] – Aurecon, CEnvP(SC)
Area of assessment	Contaminated Land

Score:

3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

Contamination Management
-1

Notes:

Reasons / Comments

- *Potential to encounter contaminated soils and ability to manage potential risk to human health and the environment:*
  - The nature of commercial/industrial activities could not be confirmed
  - The roadway has been in operation for over 60 years; based on likely construction materials, techniques, infilling, levelling and contaminants in roadway run-off which include metals, hydrocarbons and asbestos, diffuse contamination is anticipated across the project area which will require a nominal level of management during civil works

Assumptions

- Study area as described in Aurecon letter *A2B Road Corridor Widening Preferred Options Assessment* dated 23/01/2020
- Civil works associated with redevelopment are unlikely to encounter groundwater
- Further contaminated land assessment (e.g. PSI and DSI) will be conducted prior to progressing with the preferred option to gain more understanding of land contamination risks

Other Information relied upon

- A review of historical and current aerial photography available on Auckland Council Geomaps
- A review of historical aerial photography available on Retrolens
- A review of the Aurecon Technical Note 502334-7000-TEC-KD-0039

Table 15 Multi Criteria Analysis Scoring Sheet – Section 9 – Great South Road (Ronwood Avenue to Te-Irirangi Drive) B Side Widening

Section 9 – B Side	
Name of assessor (incl. qualifications and organisation)	[redacted] – Aurecon, CEnvP(SC)
Area of assessment	Contaminated Land

Score:

3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

Contamination Management
-2

Notes:

Reasons / Comments

- *Potential to encounter contaminated soils and ability to manage potential risk to human health and the environment:*
  - [redacted]
  - The nature of commercial/industrial activities could not be confirmed
  - The roadway has been in operation for over 60 years; based on likely construction materials, techniques, infilling, levelling and contaminants in roadway run-off which include metals, hydrocarbons and asbestos, diffuse contamination is anticipated across the project area which will require a nominal level of management during civil works

Assumptions

- Study area as described in Aurecon letter *A2B Road Corridor Widening Preferred Options Assessment* dated 23/01/2020
- Civil works associated with redevelopment are unlikely to encounter groundwater
- Further contaminated land assessment (e.g. PSI and DSI) will be conducted prior to progressing with the preferred option to gain more understanding of land contamination risks

Other Information relied upon

- A review of historical and current aerial photography available on Auckland Council Geomaps
- A review of historical aerial photography available on Retrolens
- A review of the Aurecon Technical Note 502334-7000-TEC-KD-0039

Table 16 Multi Criteria Analysis Scoring Sheet – Section 9 – Great South Road (Ronwood Avenue to Te-Irirangi Drive) Both Side Widening

Section 9 – Both Side	
Name of assessor (incl. qualifications and organisation)	[redacted] – Aurecon, CEnvP(SC)
Area of assessment	Contaminated Land

Score:

3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

Contamination Management
-1

Notes:

Reasons / Comments

- *Potential to encounter contaminated soils and ability to manage potential risk to human health and the environment:*
  - The nature of commercial/industrial activities could not be confirmed
  - The roadway has been in operation for over 60 years; based on likely construction materials, techniques, infilling, levelling and contaminants in roadway run-off which include metals, hydrocarbons and asbestos, diffuse contamination is anticipated across the project area which will require a nominal level of management during civil works

Assumptions

- The petroleum hydrocarbon storage and distribution infrastructure associated with the service station at the corner of Great South Road and Te Irirangi Drive will not be impacted by improvement works
- Study area as described in Aurecon letter *A2B Road Corridor Widening Preferred Options Assessment* dated 23/01/2020
- Civil works associated with redevelopment are unlikely to encounter groundwater
- Further contaminated land assessment (e.g. PSI and DSI) will be conducted prior to progressing with the preferred option to gain more understanding of land contamination risks

Other Information relied upon

- A review of historical and current aerial photography available on Auckland Council Geomaps
- A review of historical aerial photography available on Retrolens
- A review of the Aurecon Technical Note 502334-7000-TEC-KD-0039

Table 17 Multi Criteria Analysis Scoring Sheet – Section 10 – Te Irirangi Drive (Great South Road to Diorella Drive) A Side Widening

Section 10 – A Side	
Name of assessor (incl. qualifications and organisation)	[redacted] – Aurecon, CEnvP(SC)
Area of assessment	Contaminated Land

Score:

3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

Contamination Management
-1

Notes:

Reasons / Comments

- *Potential to encounter contaminated soils and ability to manage potential risk to human health and the environment:*
  - The roadway has been in operation for less than 35 years; based on likely construction materials, techniques, infilling, levelling and contaminants in roadway run-off which include metals, hydrocarbons and asbestos, diffuse contamination is anticipated across the project area which will require a nominal level of management during civil works

Assumptions

- The petroleum hydrocarbon storage and distribution infrastructure associated with the service station at the corner of Great South Road and Te Irirangi Drive will not be impacted by improvement works
- Study area as described in Aurecon letter *A2B Road Corridor Widening Preferred Options Assessment* dated 23/01/2020
- Civil works associated with redevelopment are unlikely to encounter groundwater
- Further contaminated land assessment (e.g. PSI and DSI) will be conducted prior to progressing with the preferred option to gain more understanding of land contamination risks

Other Information relied upon

- A review of historical and current aerial photography available on Auckland Council Geomaps
- A review of historical aerial photography available on Retrolens
- A review of the Aurecon Technical Note 502334-7000-TEC-KD-0039

Table 18 Multi Criteria Analysis Scoring Sheet – Section 10 – Te Irirangi Drive (Great South Road to Diorella Drive) B Side Widening

Section 10 – B Side	
Name of assessor (incl. qualifications and organisation)	[redacted] – Aurecon, CEnvP(SC)
Area of assessment	Contaminated Land

Score:

3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

Contamination Management
-1

Notes:

Reasons / Comments

- *Potential to encounter contaminated soils and ability to manage potential risk to human health and the environment:*
  - Multiple residential properties constructed prior to 2000 are present. Asbestos and lead contamination in the vicinity of these residences may result in increased soil disposal costs and H&S considerations during building removal and bulk earthworks.
  - The roadway has been in operation for less than 35 years; based on likely construction materials, techniques, infilling, levelling and contaminants in roadway run-off which include metals, hydrocarbons and asbestos, diffuse contamination is anticipated across the project area which will require a nominal level of management during civil works

Assumptions

- The petroleum hydrocarbon storage and distribution infrastructure associated with the service station at the corner of Great South Road and Te Irirangi Drive will not be impacted by improvement works
- Study area as described in Aurecon letter *A2B Road Corridor Widening Preferred Options Assessment* dated 23/01/2020
- Civil works associated with redevelopment are unlikely to encounter groundwater
- Further contaminated land assessment (e.g. PSI and DSI) will be conducted prior to progressing with the preferred option to gain more understanding of land contamination risks

Other Information relied upon

- A review of historical and current aerial photography available on Auckland Council Geomaps
- A review of historical aerial photography available on Retrolens
- A review of the Aurecon Technical Note 502334-7000-TEC-KD-0039

Table 19 Multi Criteria Analysis Scoring Sheet – Section 10 – Te Irirangi Drive (Great South Road to Diorella Drive) Both Side Widening

Section 10 – Both Side	
Name of assessor (incl. qualifications and organisation)	[redacted] – Aurecon, CEnvP(SC)
Area of assessment	Contaminated Land

Score:

3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

Contamination Management
-1

Notes:

Reasons / Comments

- *Potential to encounter contaminated soils and ability to manage potential risk to human health and the environment:*
  - Multiple residential properties constructed prior to 2000 are present. Asbestos and lead contamination in the vicinity of these residences may result in increased soil disposal costs and H&S considerations during building removal and bulk earthworks.
  - The roadway has been in operation for less than 35 years; based on likely construction materials, techniques, infilling, levelling and contaminants in roadway run-off which include metals, hydrocarbons and asbestos, diffuse contamination is anticipated across the project area which will require a nominal level of management during civil works

Assumptions

- The petroleum hydrocarbon storage and distribution infrastructure associated with the service station at the corner of Great South Road and Te Irirangi Drive will not be impacted by improvement works
- Study area as described in Aurecon letter *A2B Road Corridor Widening Preferred Options Assessment* dated 23/01/2020
- Civil works associated with redevelopment are unlikely to encounter groundwater
- Further contaminated land assessment (e.g. PSI and DSI) will be conducted prior to progressing with the preferred option to gain more understanding of land contamination risks

Other Information relied upon

- A review of historical and current aerial photography available on Auckland Council Geomaps
- A review of historical aerial photography available on Retrolens
- A review of the Aurecon Technical Note 502334-7000-TEC-KD-0039

Table 20 **Multi Criteria Analysis Scoring Sheet – Section 11 – Te Irirangi Drive (Diorella Drive to Te Irirangi Drive Ch. 1525) A Side Widening**

Section 11 – A Side	
Name of assessor (incl. qualifications and organisation)	[redacted] – Aurecon, CEnvP(SC)
Area of assessment	Contaminated Land

Score:

3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

Contamination Management
-1

Notes:

Reasons / Comments

- *Potential to encounter contaminated soils and ability to manage potential risk to human health and the environment:*
  - Multiple residential properties constructed prior to 2000 are present. Asbestos and lead contamination in the vicinity of these residences may result in increased soil disposal costs and H&S considerations during building removal and bulk earthworks.
  - The roadway has been in operation for less than 35 years; based on likely construction materials, techniques, infilling, levelling and contaminants in roadway run-off which include metals, hydrocarbons and asbestos, diffuse contamination is anticipated across the project area which will require a nominal level of management during civil works

Assumptions

- Study area as described in Aurecon letter *A2B Road Corridor Widening Preferred Options Assessment* dated 23/01/2020
- Civil works associated with redevelopment are unlikely to encounter groundwater
- Further contaminated land assessment (e.g. PSI and DSI) will be conducted prior to progressing with the preferred option to gain more understanding of land contamination risks

Other Information relied upon

- A review of historical and current aerial photography available on Auckland Council Geomaps
- A review of historical aerial photography available on Retrolens
- A review of the Aurecon Technical Note 502334-7000-TEC-KD-0039

Table 21 Multi Criteria Analysis Scoring Sheet – Section 11 – Te Irirangi Drive (Diorella Drive to Te Irirangi Drive Ch. 1525) B Side Widening

Section 11 – B Side	
Name of assessor (incl. qualifications and organisation)	[redacted] – Aurecon, CEnvP(SC)
Area of assessment	Contaminated Land

Score:

3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

Contamination Management
-1

Notes:

Reasons / Comments

- *Potential to encounter contaminated soils and ability to manage potential risk to human health and the environment:*
  - Multiple residential properties constructed prior to 2000 are present. Asbestos and lead contamination in the vicinity of these residences may result in increased soil disposal costs and H&S considerations during building removal and bulk earthworks.
  - The roadway has been in operation for less than 35 years; based on likely construction materials, techniques, infilling, levelling and contaminants in roadway run-off which include metals, hydrocarbons and asbestos, diffuse contamination is anticipated across the project area which will require a nominal level of management during civil works

Assumptions

- Study area as described in Aurecon letter *A2B Road Corridor Widening Preferred Options Assessment* dated 23/01/2020
- Civil works associated with redevelopment are unlikely to encounter groundwater
- Further contaminated land assessment (e.g. PSI and DSI) will be conducted prior to progressing with the preferred option to gain more understanding of land contamination risks

Other Information relied upon

- A review of historical and current aerial photography available on Auckland Council Geomaps
- A review of historical aerial photography available on Retrolens
- A review of the Aurecon Technical Note 502334-7000-TEC-KD-0039

Table 22 Multi Criteria Analysis Scoring Sheet – Section 11 – Te Irirangi Drive (Diorella Drive to Te Irirangi Drive Ch. 1525) Both Side Widening

Section 11 – Both Side	
Name of assessor (incl. qualifications and organisation)	[redacted] – Aurecon, CEnvP(SC)
Area of assessment	Contaminated Land

Score:

3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

Contamination Management
-1

Notes:

Reasons / Comments

- *Potential to encounter contaminated soils and ability to manage potential risk to human health and the environment:*
  - Multiple residential properties constructed prior to 2000 are present. Asbestos and lead contamination in the vicinity of these residences may result in increased soil disposal costs and H&S considerations during building removal and bulk earthworks.
  - The roadway has been in operation for less than 35 years; based on likely construction materials, techniques, infilling, levelling and contaminants in roadway run-off which include metals, hydrocarbons and asbestos, diffuse contamination is anticipated across the project area which will require a nominal level of management during civil works

Assumptions

- Study area as described in Aurecon letter *A2B Road Corridor Widening Preferred Options Assessment* dated 23/01/2020
- Civil works associated with redevelopment are unlikely to encounter groundwater
- Further contaminated land assessment (e.g. PSI and DSI) will be conducted prior to progressing with the preferred option to gain more understanding of land contamination risks

Other Information relied upon

- A review of historical and current aerial photography available on Auckland Council Geomaps
- A review of historical aerial photography available on Retrolens
- A review of the Aurecon Technical Note 502334-7000-TEC-KD-0039

Table 23 Multi Criteria Analysis Scoring Sheet – Section 13 – Dawson Road to Penion Drive) A Side Widening

Section 13 – A Side	
Name of assessor (incl. qualifications and organisation)	[redacted] – Aurecon, CEnvP(SC)
Area of assessment	Contaminated Land

Score:

3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

Contamination Management
-2

Notes:

Reasons / Comments

- *Potential to encounter contaminated soils and ability to manage potential risk to human health and the environment:*
  - [redacted]
  - The roadway has been in operation for over 25 years; based on likely construction materials, techniques, infilling, levelling and contaminants in roadway run-off which include metals, hydrocarbons and asbestos, diffuse contamination is anticipated across the project area which will require a nominal level of management during civil works

Assumptions

- Study area as described in Aurecon letter *A2B Road Corridor Widening Preferred Options Assessment* dated 23/01/2020
- Civil works associated with redevelopment are unlikely to encounter groundwater
- Further contaminated land assessment (e.g. PSI and DSI) will be conducted prior to progressing with the preferred option to gain more understanding of land contamination risks

Other Information relied upon

- A review of historical and current aerial photography available on Auckland Council Geomaps
- A review of historical aerial photography available on Retrolens
- A review of the Aurecon Technical Note 502334-7000-TEC-KD-0039

Table 24 Multi Criteria Analysis Scoring Sheet - Section 13 – Dawson Road to Penion Drive) B Side Widening

Section 13 – B Side	
Name of assessor (incl. qualifications and organisation)	[redacted] – Aurecon, CEnvP(SC)
Area of assessment	Contaminated Land

Score:

3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

Contamination Management
-1

Notes:

Reasons / Comments

- *Potential to encounter contaminated soils and ability to manage potential risk to human health and the environment:*
  - Multiple residential properties constructed prior to 2000 are present. Asbestos and lead contamination in the vicinity of these residences may result in increased soil disposal costs and H&S considerations during building removal and bulk earthworks.
  - The roadway has been in operation for over 25 years; based on likely construction materials, techniques, infilling, levelling and contaminants in roadway run-off which include metals, hydrocarbons and asbestos, diffuse contamination is anticipated across the project area which will require a nominal level of management during civil works

Assumptions

- The petroleum hydrocarbon storage and distribution infrastructure associated with the service station at the corner of Te Irirangi Drive and Dawson Road will not be impacted by improvement works
- Study area as described in Aurecon letter *A2B Road Corridor Widening Preferred Options Assessment* dated 23/01/2020
- Civil works associated with redevelopment are unlikely to encounter groundwater
- Further contaminated land assessment (e.g. PSI and DSI) will be conducted prior to progressing with the preferred option to gain more understanding of land contamination risks

Other Information relied upon

- A review of historical and current aerial photography available on Auckland Council Geomaps
- A review of historical aerial photography available on Retrolens
- A review of the Aurecon Technical Note 502334-7000-TEC-KD-0039

Table 25 Multi Criteria Analysis Scoring Sheet – Section 13 – Dawson Road to Penion Drive) Both Side Widening

Section 13 – Both Side	
Name of assessor (incl. qualifications and organisation)	[redacted] – Aurecon, CEnvP(SC)
Area of assessment	Contaminated Land

Score:

3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

Contamination Management
-1

Notes:

Reasons / Comments

- *Potential to encounter contaminated soils and ability to manage potential risk to human health and the environment:*
  - Multiple residential properties constructed prior to 2000 are present. Asbestos and lead contamination in the vicinity of these residences may result in increased soil disposal costs and H&S considerations during building removal and bulk earthworks.
  - The roadway has been in operation for over 25 years; based on likely construction materials, techniques, infilling, levelling and contaminants in roadway run-off which include metals, hydrocarbons and asbestos, diffuse contamination is anticipated across the project area which will require a nominal level of management during civil works

Assumptions

- The petroleum hydrocarbon storage and distribution infrastructure associated with the service station at the corner of Te Irirangi Drive and Dawson Road will not be impacted by improvement works
- Study area as described in Aurecon letter *A2B Road Corridor Widening Preferred Options Assessment* dated 23/01/2020
- Civil works associated with redevelopment are unlikely to encounter groundwater
- Further contaminated land assessment (e.g. PSI and DSI) will be conducted prior to progressing with the preferred option to gain more understanding of land contamination risks

Other Information relied upon

- A review of historical and current aerial photography available on Auckland Council Geomaps
- A review of historical aerial photography available on Retrolens
- A review of the Aurecon Technical Note 502334-7000-TEC-KD-0039

Approved by:

Title	Name	Qualification		ate
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Technical Note

To		From	
Copy		Reference	**502334**
Date	**2020-04-21**	Pages (including this page)	**1010**
Subject	**A2B Road Corridor Widening Preferred Options Assessment – Noise and Vibration**		

1 Introduction

The following provides an assessment of the options for the road corridor widening options for the Airport to Botany (A2B) Rapid Transit Corridor (RTC) preferred route where the desired cross-section does not fit within existing road reserve, as part of the preferred option route for the Airport to Botany (A2B) Single-Stage Business Case (SSBC). It covers the A2B project area from immediately east of the Puhinui Interchange (Puhinui Road and SH20 Intersection) through to Botany.

The assessment details the considerations which have been used to inform the assessment. This assessment is designed to contribute to the Multi-Criteria Analysis (MCA) assessment which is being undertaken for this section of the preferred option route.

The options are outlined in **Table 1**. The sections are summarised in Error! Reference source not found..

Table 1 | Options summary

Option	Description
Option A: A-side widening	This option requires encroachment into property solely on the A side of the preferred option route (A-Side is as identified on the option schematics).
Option B: B-Side widening	This option requires encroachment into property solely on the B side of the preferred option route (B-Side as identified on the option schematics).
Option C: A-side and B-side widening	This option involves property encroachment on both sides of the preferred option route (i.e. on both the A and B sides).

Table 2 | A2B MCA Sections

Section	Option		
Section 1 Puhinui Road (SH20 interchange to Kenderdine)	A-Side Widening	B-Side Widening	Both Side Widening
Section 3 Puhinui Road (Cambridge Terrace to Lambie Drive)	A-Side Widening	B-Side Widening	Both Side Widening
Section 5 Manukau Station Road (Lambie Drive to Davies Avenue)	A-Side Widening	B-Side Widening	Both Side Widening
Section 7 Ronwood Avenue (Davies Avenue to Osterly Way / Sharkey Street	A-Side Widening	B-Side Widening	Both Side Widening
Section 9 Great South Road (Ronwood Avenue to Te Irirangi Drive)	A-Side Widening	B-Side Widening	Both Side Widening
Section 10 Te Irirangi Drive (Great South Road to Diorella Drive)	A-Side Widening	B-Side Widening	Both Side Widening

Section 11 Te Irirangi Drive (Diorella Drive to Te Irirangi Drive Ch. 1525)	A-Side Widening	B-Side Widening	Both Side Widening
Section 13 Te Irirangi Drive (Dawson Road to Penion Drive)	A-Side Widening	B-Side Widening	Both Side Widening

2 Road Corridor Widening Design Options Assessment

The source information is assessed in a desktop investigation only. The assessments are based on:

- A2B Road Corridor Widening Preferred Options Assessment Memorandum, dated 22/01/2020; and
- Drawings (*App A – Sketch_Corridor Widening Options_Sh1-17*), dated 21/01/2020.

This assessment is a desktop study has been carried out using Auckland Council AUP and Geo Maps. No surveys, investigations or detailed site visits have been undertaken as part of this assessment. The assessment has been undertaken without any consideration of mitigation measures. For example, no noise mitigation is to be considered (i.e. noise attenuation walls that may impact visual amenity).

For all options where road corridor widening will impact residential property, it is assumed those residential properties where the alignment impacts a building will be a full acquisition. For those options where residential property is impacted and a building is not impacted, assume partial acquisition.

2.1 Scoring

All options where assessed against the scores set out in **Table 3.** All options are considered to have either neutral or an adverse effect on noise and vibration and therefore all options will have neutral or negative scoring.

Table 3 | Scoring criteria

Score	Statement
3	Negligible/minor impacts to the environment and/or significant positive effects
2	Minor impacts to the environment and/or moderate positive effects
1	Low impacts to the environment and/or minor positive effects
0	Neutral Effects
-1	Minor effects on the environment and adverse effects
-2	Moderate to significant adverse effects
-3	Significant adverse or un-mitigatable effects

Table 4 Multi Criteria Analysis Scoring Sheet – Section 1/Option A/B/Both

Scenario 1/Option A/B/Both: Puhinui Road (SH20 interchange to Kenderdine Road)	
Name of assessor (incl. qualifications and organisation)	[redacted] – Aurecon, BSc
Area of assessment	Noise

Score

Option	Score
A-Side Widening	-1
B-Side Widening	-2
Both Side Widening	-2

Reasons / Comments

- All options will bring the road corridor closer to a larger number of residential properties. Those residential properties which remain following any property acquisition will would have the road corridor closer to their properties, resulting in potentially increased adverse noise effects.

A-Side

- A-Side road widening would bring the road corridor (and operational noise generated on the corridor) closer to large number of sensitive noise receptor (residential properties located on the northern side of Puhinui Road);
- Construction noise and vibration effects have the potential to adversely impact sensitive noise receptors (residential properties) to the north of Puhinui Road.

B-Side

- B-Side road widening would bring the road corridor (and operational noise generated on the corridor) closer to a larger number of sensitive noise receptors (residential properties on the southern side of Puhinui Road);
- A spiritual activity (Kingdom Hall of Jehovah's Witnesses) is a potentially sensitive noise [redacted]
- [redacted]
- Construction noise and vibration effects have the potential to adversely impact sensitive receptors (residential properties) to the south of Puhinui Road.

Both Side

- This option would bring the road corridor closer to a larger number of sensitive noise receptors (residential properties and Kingdom Hall of Jehovah's Witnesses).
- Construction noise and vibration effects have the potential to adversely impact sensitive receptors (residential properties) to both the north and south of Puhinui Road, and the spiritual activity (Kingdom Hall of Jehovah's Witnesses) located on the southern side of Puhinui Road.

Table 5 Multi Criteria Analysis Scoring Sheet – Section 3/Option A/B/Both

Section 3/Option A/B/Both: Puhinui Road (Cambridge Terrace to Lambie Drive)	
Name of assessor (incl. qualifications and organisation)	[redacted] – Aurecon, BSc
Area of assessment	Noise

Score

Option	Score
A-Side Widening	-1
B-Side Widening	-2
Both Side Widening	-2

Reasons / Comments

A-Side

- A-Side road widening would bring the road corridor (and operational noise associated with the corridor) closer to large number of sensitive noise receptors (residential properties located on the northern side of Puhinui Road);
- Construction noise and vibration effects have the potential to adversely impact sensitive receptors (residential properties) to the north of Puhinui Road.

B-Side

- B-Side road widening would bring the road corridor (and operational noise generated on the corridor) closer to large number of sensitive noise receptors (residential properties located on the southern side of Puhinui Road);
- An educational activity (Puhunui School) is a sensitive noise receptor, located on the southern side of Puhinui Road (at 116 Puhinui Road).

Both Side

- This option would bring the road corridor closer to a larger number of residential properties. Those residential properties which remain following any property acquisition will would have the road corridor closer to their properties, resulting in potentially increased adverse noise effects;
- Construction noise and vibration effects have the potential to adversely impact sensitive receptors (residential properties) to both the north and south of Puhinui Road, and Puhinui School (located on the southern side of Puhinui Road).

Table 6 Multi Criteria Analysis Scoring Sheet – Section 5/Option A/B/Both

Section 5/Option A/B/Both: Manukau Station Road (Lambie Drive to Davies Avenue)	
Name of assessor (incl. qualifications and organisation)	[redacted] – Aurecon, BSc
Area of assessment	Noise

Score

Option	Score
A-Side Widening	0
B-Side Widening	-1
Both Side Widening	-1

Reasons / Comments

The extent of road corridor widening is minimal for this section as shown by the Schematic Plans.

A-Side

- A-Side widening will have negligible to minimal adverse operational noise and vibration effects given this will bring the road corridor closer to the existing train station (non-sensitive receiver within a highly built up urban environment).

B-Side

- B-Side widening has the potential to increase operational noise effects in the vicinity of the MIT campus extension (currently under construction).

Both Side

- Widening on both sides has the potential to increase operational noise effects in the vicinity of the MIT campus extension (currently under construction);
- Construction noise and vibration effects have the potential to adversely impact the future sensitive receiver being the MIT campus extension. There is also potential for adverse effects to properties located to the south of Puhinui Road properties and Manukau Station Road.

Table 7 Multi Criteria Analysis Scoring Sheet – Section 7/Option A/B/Both

Section 7/Option A/B/Both: Ronwood Avenue (Davies Avenue to Osterley Way / Sharkey Street)	
Name of assessor (incl. qualifications and organisation)	[redacted] – Aurecon, BSc
Area of assessment	Noise

Score

Option	Score
A-Side Widening	0
B-Side Widening	0
Both Side Widening	0

Reasons / Comments

The extent of road corridor widening is minimal for this section as shown by the Schematic Plans.

A-Side

- A-Side widening will have minimal operational noise and vibration effects, there are no surrounding sensitive noise receptors and the surrounding land use is predominantly industrial and commercial (comprising office buildings along the northern side of Ronwood Avenue for this section (i.e. the DIA and ACC offices).

B-Side

- An accommodation business is located on the southern side of Ronwood Avenue (Tatai Vaihere at 15-7 Osterley Way) which is a potentially sensitive noise receptor for both construction and operational noise effects.
- On the southern side of Ronwood Avenue is the Ronwood Avenue public carpark (non-sensitive noise receptor).

Both Side

- Both side widening will have a minimal operation and noise effect on the surrounding land use but may increase noise effects to the accommodation complex on the southern side (Tatie Vaihere).
- Construction noise and vibration effects have the potential to adversely impact sensitive receptors (the accommodation complex).

Table 8 Multi Criteria Analysis Scoring Sheet – Section 9/Option A/B Both

Section 9/Option A/B/Both: Great South Road (Ronwood Avenue to Te-Irirangi Drive)	
Name of assessor (incl. qualifications and organisation)	[redacted] – Aurecon, BSc
Area of assessment	Noise

Score

Option	Score
A-Side Widening	-1
B-Side Widening	0
Both Side Widening	-1

Reasons / Comments

Great South Road is a highly built up urban environment, with a minimum of five traffic lanes for this section. All additional operational and construction noise effects will be generated within the context of a high vehicular traffic noise environment.

A-Side

- The western side of Great South Road (corridor widening on the A-Side will encroach the western side of the road) is primarily used for commercial purposes.
- A potentially sensitive noise receptor is the Manukau Motor Lodge located at 631 Great South Road. Given this is within an existing high vehicular traffic noise environment, any operational and construction noise and vibration effects associated with the corridor widening are anticipated to be minimal.

B-Side

- The eastern side of Great South Road is primarily used for commercial purposes with a large portion occupied for Wiri Electricity Substation (8533) at 656 Great South Road, Manukau owned and operated by Transpower New Zealand Ltd.
- No potentially sensitive noise receptor's have been identified.

Both Side

- The surrounding land use is predominantly commercial, except for the Manukau Motor Lodge located at 631 Great South Road. Given this is within an existing high vehicular traffic noise environment, any operational and construction noise and vibration effects associated with the corridor widening are anticipated to be minimal.

Table 9 Multi Criteria Analysis Scoring Sheet – Section 10/Option A/B/Both

Section 10/Option A/B/Both: Te Irirangi Drive (Great South Road to Diorella Drive)	
Name of assessor (incl. qualifications and organisation)	[redacted] – Aurecon, BSc
Area of assessment	Noise

Score

Option	Score
A-Side Widening	-1
B-Side Widening	-2
Both Side Widening	-2

Reasons / Comments

Te Irirangi Drive is a highly built up urban environment and for this section crosses State Highway One. All additional operational and construction noise effects will be generated within the context of this high vehicular traffic noise environment.

A-Side

- A-Side widening would bring the road corridor closer to AUT (sensitive noise receptor). Vibration and noise during construction has the potential to generate adverse effects.
- Road widening on the A-Side would extend the road on the northern side of Te Irirangi Drive into open space/greenspace areas (non-sensitive noise receptors).

B-Side

- B-Side road widening would bring the road corridor (and operational noise generated on the corridor) closer to large number of sensitive noise receptors (residential properties located on the southern side of Te Irirangi Drive);
- Construction noise and vibration effects have the potential to adversely impact sensitive noise receptors (residential properties) to the south of Te Irirangi Drive.

Both Side

- Both side widening would impact the AUT Campus on the northern side of Te Irirangi Drive and residential properties on the southern side (multiple sensitive noise receptors).

Table 10 Multi Criteria Analysis Scoring Sheet – Section 11/Option A/B/Both

Section 11/Option A/B/Both: Te Irirangi Drive (Diorella Drive to Te Irirangi Drive Ch. 1525)

Name of assessor (incl. qualifications and organisation) [redacted] – Aurecon, BSc

Area of assessment Noise

Score

Option	Score
A-Side Widening	-1
B-Side Widening	-1
Both Side Widening	-2

Reasons / Comments

A-Side

- A-Side road widening would bring the road corridor (and operational noise generated on the corridor) closer to large number of sensitive noise receptors (residential properties located on the northern/western side of Te Irirangi Drive);
- Construction noise and vibration effects have the potential to adversely impact sensitive noise receptors (residential properties).

B-Side

- A-Side road widening would bring the road corridor (and operational noise generated on the corridor) closer to large number of sensitive noise receptors (residential properties located on the southern/eastern side of Te Irirangi Drive);
- Construction noise and vibration effects have the potential to adversely impact sensitive noise receptors (residential properties).

Both Side

- Both Side widening would bring the road corridor (and operational noise generated on the corridor) closer to large number of sensitive noise receptors (residential properties on either side of Te Irirangi Drive) and has the potential to generate adverse construction noise and vibration effects.

Table 11 Multi Criteria Analysis Scoring Sheet – Section 13/Option A/B/Both

Section 13/Option A/B/Both: Te Irirangi Drive (Dawson Road to Penion Drive)	
Name of assessor (incl. qualifications and organisation)	[redacted] – Aurecon, BSc
Area of assessment	Noise

Score

Option	Score
A-Side Widening	-1
B-Side Widening	-2
Both Side Widening	-2

Reasons / Comments

A-Side

- The land use on the western side of Te Irirangi Drive in this section is predominantly commercial (less sensitive noise receptor). A-Side road widening would bring the road corridor (and operational noise generated on the corridor) closer to the commercial area located at 136 Dawson Road and 186 Te Iriangi Drive (Z Te Irirangi Drive Petrol Station and Liquor Legends) which are non-sensitive noise receptors.
- It would also bring the road corridor closer to a small portion of residential properties near Penion Drive (i.e. 190-194 Te Irirangi Drive).

B-Side

- The land use on the eastern side of Te Irirangi Drive at this section is residential (sensitive noise receptors).
- In addition, a spiritual activity (Kingdom Hall of Jehovah's Witnesses) is located on the eastern side of Te Iriangi Drive (at 152 Dawson Road);

Both Side

- This option would bring the road corridor closer to a larger number of sensitive noise receptors (residential properties and Kingdom Hall of Jehovah's Witnesses).

Approved by:

Title	Name	Qualification	Signature	Date
Author	[redacted]	BSc	[redacted]	21/04/2020
Reviewer	[redacted]	MEP (Hons)		21/04/2020

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Memorandum

To	**Environmental Specialists – Airport to Botany SSBC**	From	[redacted]
Copy	[redacted]	Reference	**502334**
Date	**2020-01-23**	Pages (including this page)	**8 + appendices**
Subject	**A2B Road Corridor Widening Preferred Options Assessment**		

1 Introduction

This memorandum provides descriptions and assumptions for road corridor widening options for the Airport to Botany (A2B) Rapid Transit Corridor (RTC) preferred route where the desired cross-section does not fit within existing road reserve, as part of the preferred option route for the Airport to Botany (A2B) Single-Stage Business Case (SSBC). It covers the A2B project area from immediately east of the Puhinui Interchange (Puhinui Road and SH20 Intersection) through to Botany. The project area is depicted in Figure 1 with each individual option shown on the schematics provided at **Appendix A**.

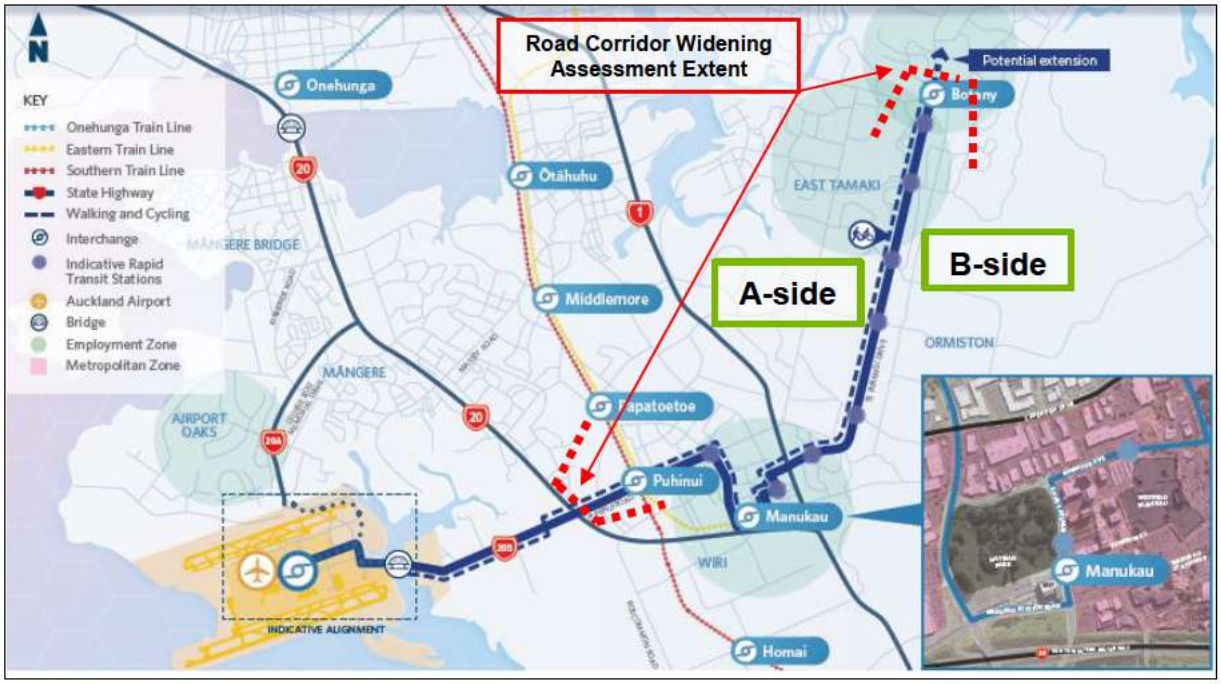


Figure 1. Road Corridor Widening Option Area with A and B Side Notations

2 Corridor Widening Options

Given property boundary constraints, sections along the A2B corridor will require property acquisition to accommodate the desired RTC cross-section. Where this widening is required, there are three options, each of which are summarised in this section.

2.1 Option: A-side widening

This option requires encroachment into property solely on the A side of the preferred option route (A-side is as identified in **Figure 1**).

2.2 Option: B-side widening

This option requires encroachment into property solely on the B side of the preferred option route (B-side is identified in **Error! Reference source not found.**).

2.3 Option C: A-side and B-side widening

This option involves property encroachment on both sides of the preferred option route (i.e. on both the A and B sides identified in **Error! Reference source not found.**).

3 A2B Road Corridor Widening Sections

To assess the three options at an appropriate level of detail, the route has been split into fourteen sections based on the following changes along the preferred route:

- **Surrounding land use**: Whether surrounding land use is largely or a mixture of residential, industrial, commercial, recreational. Land use influences the property acquisition process, so it is important to distinguish when this changes.
- **Level of impact to surrounding property**: A particular section may have no or minor impacts to property (i.e. encroaches property frontage) whereas the next block over may have major impacts (e.g. affecting structures within property). Impact to property determines whether an MCA will be applied to determine the best side to widen the corridor.
- **Flexibly in Design:** Where the civil design requires road widening to occur on a given side of the road (i.e. for example on the approach to some intersections), or if there are fatal flaws in one of the widening options considered, then an MCA may not be deemed necessary.

Table 1: A2B Corridor Widening Sections

Section	Sheet/s	Road name	Section extent	Surrounding land use	Property impact	Conduct MCA
1	1 - 2	Puhinui Road	SH20 interchange to Kenderdine Road	Adjacent property is residential and commercial.	Major - Property required along the entirety of the section	**Yes**
2	2	Kenderdine Road, Bridge Street & Cambridge Terrace	MRT Bridge (Kenderdine Road to Cambridge Terrace along Bridge Street)	Adjacent property is residential and commercial.	Major. Road Corridor widening must occur on both sides of the road.	**No**
3	2 - 4	Puhinui Road	Cambridge Terrace to Lambie Drive	Mixture of primarily residential.	Major - Property required along the entirety of the section	**Yes**
4	4 - 6	Lambie Drive	Puhinui Road to Manukau Station Road	Mixture of commercial and industrial.	Minor - Widening required on both sides of the approaches of Ronwood Avenue and Puhinui Road intersections. Must occur on both sides of the road.	**No**

5	6	Manukau Station Road	Lambie Drive to Davies Avenue	Predominately recreational	Major - Property required along the entirety of the section	**Yes**
6	6	Davies Avenue	Manukau Station Road to Ronwood Avenue	Mixture of commercial and recreational	None - The RTC cross section can be accommodated within the existing road corridor	**No**
7	6	Ronwood Avenue	Davies Avenue to Osterley Way / Sharkey Street	Commercial	Major - Property required along the entirety of the section	**Yes**
8	6 - 7	Ronwood Avenue	Osterley Way / Sharkey Street to Great South Road	Commercial	Minor – on approaches to the Great South Road Intersection. Road Corridor widening must occur on both sides of the road.	**No**
9	7	Great South Road	Ronwood Avenue to Te-Irirangi Drive	Mixture of commercial and industrial.	Major - Property required along the entirety of the section	**Yes**
10	7 - 8	Te Irirangi Drive	Great South Road to Diorella Drive	Mixture of residential, commercial and recreational.	Major - Property required along the entirety of the section. Existing SH1 overbridge widening required	**Yes**
11	8 - 9	Te Irirangi Drive	Diorella Drive to Te Irirangi Drive Ch. 1525	Predominantly residential.	Major - The area near Diorella Drive requires large areas of property take.	**Yes**
12	9 – 10	Te Irirangi Drive	Te Irirangi Drive Ch. 1525 to Dawson Road	Predominantly Residential	Minor – on approaches to Dawson Road intersection. Widening must occur along both sides of the road.	**No**
13	10	Te Irirangi Drive	Dawson Road to Penion Drive	Mixture of Commercial and Residential	Major - Associated with widening of the intersection with Dawson Road.	**Yes**
14	10 - 17	Te Irirangi Drive	Penion Drive to Botany Town Centre	Predominately residential.	Minor – Widening required on the approaches of Haven Drive, Bishop Dunn Place and Ormiston road intersections and must occur on both sides of the road.	**No**

4 Criteria

The Environment and Planning criteria, along with the individuals responsible for scoring each criterion are included below. Please note there are additional criteria included in the assessment that address matters related to transport planning and implementability.

Discipline	Measure		Individual
Property	Property	Extent and complexity of properties that require acquisition. Level of anticipated risk associated with property negotiation and acquisition under the Public Works Act 1981.	AT Fenella Fischer
Planning	Consentability	Level of complexity of gaining approvals (e.g. activity status, risk of appeal, accordance with policy direction). Level of compliance with regulatory plans e.g. could the option include activities which are prohibited/ non-complying under the policies and rules of the district or regional plan?	Aurecon [redacted] (Review)
	Third Party Consents	Potential to require third party consents as a result of property take, site configuration etc.	Aurecon [redacted] (Review)
Landscape, Visual and Urban Design	Urban Design	Extent, nature and degree of effects on urban design (including open space). Integration with surrounding land uses and the potential number of sites that can/cannot be repurposed following implementation.	Jasmax [redacted]
	Visual Amenity	Extent, nature and degree of effects on visual amenity (including tree loss).	Jasmax [redacted]
Social / Community Impact	Accessibility	Extent and degree of effects on the community concerning accessibility to/from facilities, services, properties and businesses. Accessibility of jobs.	Aurecon [redacted] (Review)
	Community	Extent and degree of change to groups and activities, including sense of community and to known aspirations and plans, and sensitive construction receivers.	Aurecon [redacted] (Review)
Stormwater	Stormwater Quality	Impact of operational stormwater discharges on water quality within the catchment	Aurecon [redacted] (Review)
	Stormwater Quantity	Impact of operational stormwater discharges on flooding within the catchment, including vulnerability to impacts of climate change such as increased storm events, and opportunities to increase resilience.	Aurecon [redacted] (Review)

Contaminated Land	Contamination Management	Potential to encounter and ability to manage the effects of contaminated soils and groundwater on human health and the environment.	Aurecon
Noise and Vibration	Operational Noise	Extent, nature and degree of operational noise effects.	Aurecon (Review)
Constructability	Constructability	What are the challenges or constraints with construction in this location? Consider constraints in the physical environment including topography, gradients, utilities, existing infrastructure etc.	Aurecon

5 Scoring

The options are to be scored against the criteria using the following 7-point score system:

Scoring scale
3 (Significant positive effects)
2 (Moderate positive effects)
1 (Minor positive effects)
0 (Neutral effects)
-1 (Minor adverse effects)
-2 (Moderate to significant adverse effects)
-3 (Significant adverse or un-mitigatable effects)

6 Assumptions

The following outlines the general assumptions for the Road Corridor Widening for A2B options for the Airport to Botany (A2B) Rapid Transit Corridor (RTC) preferred route where the desired cross-section does not fit within existing road reserve:

Design Elements	Assumption description
General	■ It should be assumed that the road-corridor cross-section will have an RTN that is centrally running. ■ It is assumed that the existing road levels will be retained throughout the with the corridor and that the road will simply be widened to extend within the proposed typical cross-section road width. ■ A decision is yet to be made on whether A2B continues north from Botany Town Centre. Should A2B extend past the town centre, the road corridor widening, and detailed design will be subject to separate design process. ■ Widening of side roads joining the main corridor at intersections along to the proposed corridor widening sections are not included in this assessment, but it can be assumed that land acquisition will be required while developing the intersections layouts. ■ Station locations and associated land requirements will be dealt with separately and are independent from the side of road assessment. ■ It is assumed that a closed RTN System will be implemented (this will result in a slightly smaller footprint at a few intersections along the corridor). ■ Assume that any services within the road corridor will be located underground. If existing services are located overhead, they will be either removed or relocated underground. ■ Where a street tree will be impacted by property corridor widening it is assumed that it will be removed in its entirety. ■ The assessment is to be undertaken without any consideration of mitigation measures. For example, no noise mitigation is to be considered (i.e. noise attenuation walls that may impact visual amenity).
Land Use	■ Although land use is likely to change in the future, assume for this MCA that the impacts are to the existing or consented land use. ■ Where there is likely to be residual land, following a property take any future land use considered as part of consideration of land repurposing (Urban Design and Social Criteria) it is assumed that the land impacted can only be redeveloped as permitted by current zoning provisions (not a plan change to enable a higher and better use of the residual land).
Property	■ Property assessment by AT will provide who the impacted land owners are. ■ [redacted]

Appendices:

Appendix A: Road Corridor Widening Option Schematics

Section	Road name	Section extent	Widening
1 – A Side	Puhinui Road	SH20 interchange to Kenderdine Road	A Side Widening
1 – B Side	Puhinui Road	SH20 interchange to Kenderdine Road	B Side Widening
1 – Both Side	Puhinui Road	SH20 interchange to Kenderdine Road	Both Side Widening
3 – A Side	Puhinui Road	Cambridge Terrace to Lambie Drive	A Side Widening
3 – B Side	Puhinui Road	Cambridge Terrace to Lambie Drive	B Side Widening
3 – Both Side	Puhinui Road	Cambridge Terrace to Lambie Drive	Both Side Widening
5 – A Side	Manukau Station Road	Lambie Drive to Davies Avenue	A Side Widening
5 – B Side	Manukau Station Road	Lambie Drive to Davies Avenue	B Side Widening
5 – Both Side	Manukau Station Road	Lambie Drive to Davies Avenue	Both Side Widening
7 – A Side	Ronwood Avenue	Davies Avenue to Osterley Way / Sharkey Street	A Side Widening
7 – B Side	Ronwood Avenue	Davies Avenue to Osterley Way / Sharkey Street	B Side Widening
7 – Both Side	Ronwood Avenue	Davies Avenue to Osterley Way / Sharkey Street	Both Side Widening
9 – A Side	Great South Road	Ronwood Avenue to Te-Irirangi Drive	A Side Widening
9 – B Side	Great South Road	Ronwood Avenue to Te-Irirangi Drive	B Side Widening
9 – Both Side	Great South Road	Ronwood Avenue to Te-Irirangi Drive	Both Side Widening
10 – A Side	Te Irirangi Drive	Great South Road to Diorella Drive	A Side Widening
10 – B Side	Te Irirangi Drive	Great South Road to Diorella Drive	B Side Widening
10 – Both Side	Te Irirangi Drive	Great South Road to Diorella Drive	Both Side Widening
11 – A Side	Te Irirangi Drive	Diorella Drive to Te Irirangi Drive Ch. 1525	A Side Widening
11 – B Side	Te Irirangi Drive	Diorella Drive to Te Irirangi Drive Ch. 1525	B Side Widening

11 – Both Side	Te Irirangi Drive	Diorella Drive to Te Irirangi Drive Ch. 1525	Both Side Widening
13 – A Side	Te Irirangi Drive	Dawson Road to Penion Drive	A Side Widening
13 – B Side	Te Irirangi Drive	Dawson Road to Penion Drive	B Side Widening
13 – Both Side	Te Irirangi Drive	Dawson Road to Penion Drive	Both Side Widening

C



SH20B Options Assessment

Appendix C
SH20B Options Assessment

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Technical Note

To	**NZ Transport Agency**	From	**20Connect Project Team**
Copy		Reference No:	**501094-4401-TEC-RR-0023**
Date	**10/03/2021**	Pages (including this page)	**69**
Subject	**SH20B Long Term Options**		

1 Introduction

1.1 Project Background

The NZ Transport Agency, alongside investment partners Auckland Transport (AT) and Auckland International Airport Limited (AIAL) are investigating improvements to customer journey experiences and access to and from Auckland International Airport (Auckland Airport) and the surrounding area as part of the Southwest Gateway Programme. In particular, the Transport Agency are seeking to address the gaps between the expected and present performance of the State Highway (SH) 20, SH20A and SH20B corridors.

In addition to the early improvements to SH20B, which are to be implemented by 2020 / 2021, Aurecon have also been asked to investigate the opportunities for long term improvements to the SH20B corridor. This Technical Note outlines the long-term options for SH20B as part of the 20Connect Single Stage Business Case (SSBC).

Throughout this Technical Note, references have been made to AT's Airport to Botany (A2B) Single Stage Business Case, which investigates the implementation of a dedicated public transport Rapid Transit Corridor (RTC) from Botany to AIAL.

1.2 Purpose of this Technical Note

The purpose of this technical note is to:

- Assess the long-term options for SH20B improvements and the Rapid Transit Corridor (RTC) and identify a preferred option;
- Assess the long-term options for walking and cycling along the SH20B corridor and identify a preferred option; and
- Document any significant changes to the preferred design since the short-list stage.

1.3 Study Area

State Highway 20B (SH20B) is a section of state highway that runs along Puhinui Road, between the SH20 / SH20B interchange and its intersection with Orrs Road. The Transport Agency is the road controlling authority (RCA) for this section. Auckland International Airport Limited (AIAL) is the RCA for the remaining section of Puhinui Road, from west of Orrs Road to the Tom Pearce Drive roundabout.

For the purpose of this assessment, the Project extents are limited to the AIAL designation boundary at Orrs Road and the SH20 / SH20B interchange as illustrated in Figure 1-1.



Figure 1-1: Study Area

2 SH20B and Rapid Transit Corridor

2.1 General

For the purpose of this assessment, the SH20B corridor has been split into the following four sections as follows:

- Section 1: SH20/20B Interchange to Manukau Memorial Gardens (including the SH20 / 20B interchange)
- Section 2: Manukau Memorial Gardens (MMG) to Waokauri Creek (including the MMG intersection)
- Section 3: Waokauri Creek
- Section 4: Waokauri Creek to Orrs Road (including the Campana Road intersection)

2.2 Design Assumptions

The following assumptions have been made when developing and assessing all options:

- The proposed SH20B Short Term Improvements project (STIP), the AIAL Park and Ride South and the realignment of Prices Road are treated as the 'existing environment'. I.e. the options area assessed in the context where those improvement works have been delivered and are operational.
- The cross section of SH20B does not require further widening beyond the short term works except in locations where either existing lane widths are <3.5m or a median <2.4m has been provided.
- The footprints assessed do not include earthworks, foundations and retention structures and on this basis the proposed options cannot be differentiated based on geotechnical considerations at this stage of the Multi Criteria Analysis (MCA). It is noted that geological conditions within any specific section of the highway are not expected to vary considerably and accordingly geotechnical risks across the proposed options are not expected to vary significantly. As such regardless of the option selected, any risks associated with poor ground conditions are expected to be manageable through

utilising a combination of robust ground improvement and structural/earthworks solutions. It is expected that all MCA options will require standard geotechnical methods and solutions to mitigate risks associated with settlement, bearing capacity, slope instability, underground obstructions (such as utilities or foundations), liquefaction, cyclic softening and lateral spreading. Without considering specific structural forms and earthworks associated with each of the proposed MCA options, it is not possible to quantify geotechnical risks and level of mitigation measures required for each of the various options. Qualitative geotechnical risks have however been presented based on the footprint of works associated with the SH20B Short Term Improvements project, we note that the footprint of the proposed options extend beyond the footprint of works for the SH20B Short Term Improvements project. The exception to this is Section 4, where information gathered during the SH20B Short Term Improvements project allows a comparison between the options.

- The preferred location of the RTC on Puhinui Road (east of the SH20 / SH20B interchange) has been identified as being in the median by the A2B project (document reference 502334-7000-TEC-KK-0030).
- The RTC is proposed as a 'closed system' and therefore no access is permitted for the shuttle buses from the AIAL Park and Ride South facility (document reference 502334-7000-REP-0020).
- No stations are required on the RTC within the study extents. The A2B project has identified the potential for a station at Prices Road (New Industrial Estate/Memorial Gardens) but has not yet confirmed. Therefore, this assessment is limited to the construction disruption that would result if a station was retrofitted to the RTC at this location.
- Access to SH20B is restricted to the signalised intersections at Manukau Memorial Gardens (MMG) and Campana Road. A service road will be required on the northern edge to link the remaining side road and driveways (existing and future) to the intersection at Campana Road. Access on the southern side will be via the realigned Prices Road planned as part of the AIAL Park and Ride South works.
- Traffic demands have been taken from the 2048 SATURN model developed for the project. Demands for this model are based on the MSN model run by AFC. The PM peak were used primarily for SIDRA comparative assessment of options as it provides the highest turning movements with subsequent checks using AM flows. For the initial assessment the pedestrian crossing location and configuration were assumed to minimise conflicts. Development traffic accessing onto SH20B in the PM peak for the Puhinui precinct area was assumed to be 1232 and 867 for flows into and out of the development.
- The existing Jetfuel lines can be retained if located under the service road on the northern edge (if appropriate cover is available). Relocation is required if they are located under the SH20B carriageway or RTC.
- Any stormwater edge details that are impacted will be replaced on a like-for-like basis (i.e. if a swale constructed in the short-term works is impacted, then a swale of the same size is provided in the revised cross section). It is assumed that the replacement stormwater assets will ensure that equivalent performance standards will be maintained in regard to quality and quantity.
- Culvert sizing for the SH20B Short Term Improvements project was based on a life span of approximately 15 years after which a replacement is envisaged. The use of the Existing Development scenario was therefore used to assess culvert capacity (agreed to be appropriate, with the Transport Agency and AMA). The Maximum Probable Development scenario runoff volumes will need to be used, to assess culvert capacities for the current assessment. It is envisaged that all culverts, other

than Culvert 33A1 and 33F[1], will require upsizing and replacement. This is not considered a differentiator for any of the options.

2.3 Section 1: SH20/20B Interchange to Manukau Memorial Gardens (including SH20/20B interchange)

2.3.1 Options Assessed

The options assessed in Section 1 are as follows:

- Option 1A – RTC in median (widening applied symmetrically)
- Option 1B - RTC in median (all widening applied on northern side)
- Option 1C - RTC in median (all widening applied on southern side)
- Option 1D - RTC on northern side
- Option 1E - RTC on southern side

All options include a southbound ramp between SH20B and SH20 crossing over the existing interchange.

The options are shown on sketches 501094-4403-SKT-RR-0308 to 0310 and 501094-4403-SKT-RR-0315 to 0317, which can be found in Appendix A of this technical note.

A typical layout for the southbound ramp between SH20B and SH20 is shown on sketch 501094-4403-SKT-RR-0335, which can be found in Appendix A of this technical note.

2.3.2 Highways

In terms of the relevant design standards, all options provide a fully compliant cross section for most of Section 1, except through the SH20 / SH20B interchange. Where the RTC is located in the median through the interchange (Options 1A, 1B and 1C), the RTC shoulders have been omitted and the achievable roll allowance to the bridge piers is limited to 0.6m. The absence of RTC shoulders and reduced roll allowance at this location would require minor departures. However, this is generally consistent with the design philosophy used for the A2B Project and therefore, is not considered to be a major differentiator.

Options 1A, 1B and 1C which comprise of the median RTC are considered to provide a slightly safer overall outcome, compared to Options 1D and 1E. This is more relevant for non-frequent travellers of this route (e.g. tourists), as it provides a consistent and continuous RTC and road transition between SH20B and the SH20 / SH20B interchange, consequently avoiding driver confusion. However, as the RTC is physically separated for all options, this is not seen to be a major differentiator. The median RTC through the SH20 / SH20B interchange would require removal of the right turn movement onto SH20. However, this is accommodated by providing the new SH20B to SH20 southbound ramp for general traffic

Options 1D and 1E would prevent an SUP through the SH20 / SH20B interchange as it would not fit through the spill through abutments, with the addition of the adjacent RTC, on the northern and southern side, respectively. This would mean shared path users would need to cross SH20B and Puhinui Road multiple times depending on where the SUP was provided on SH20B as part of the next study. Options

[1] Refer to 504330-0000-DRG-WD-1400-1491[0] drawing set for reference

1A, 1B and 1D all impact the early works shared use path making it abortive, while Options 1C and 1E, present an opportunity to retain it.

Overall, there does not seem to be any major differentiators between the options. However, Option 1C is slightly preferred as it would allow the RTC to continue in the median through the SH20 / SH20B interchange, without requiring a full rebuild of the existing SH20 / SH20B interchange, whilst also presenting an opportunity to retain the existing shared use path

Table 2-1: SH20B/RTC Section 1 Highways

	Option 1A RTC in Median (Widening Applied Symmetrically)	**Option 1B** RTC in median (all widening applied on northern side)	**Option 1C** RTC in median (all widening applied on southern side)	**Option 1D** RTC on northern side	**Option 1E** RTC on southern side
Highways					

2.3.3 Traffic / Intersection Performance

A number of enhancements to the SH20 / 20B interchange were assessed and are outlined below. These would provide benefits regardless of the location of the RTC within the corridor and are therefore not considered differentiators for that assessment.

SH20 / SH20B Interchange: Grade-Separation of the RTC

An option to address spatial issues of threading the RTC beneath SH20 at the SH20 / SH20B interchange through a grade separated RTC over SH20 were considered at an early stage of the project. A grade separated RTC crossing was investigated but was discounted due to several adverse impacts. The issues include: increased property acquisitions on Puhinui Road, a significant length of structure would be required to provide a crossing as shown in [redacted]; With a 5% longitudinal gradient, the RTC would have to start climbing from as far back as Wyllie Road, further adding to the property impacts. Similar design and cost issues were identified to the west of SH20 with the elevated structure extending to the Memorial Gardens intersection.



Figure 2-1: Concept RTC design over SH20 / SH20B interchange (view: southwest)

It was therefore concluded that grade separating the RTC, whilst providing full priority for buses, was not the most appropriate option due to the excessive land take and cost.

SH20 / SH20B Interchange: At-Grade Modifications to Accommodate the RTC

In order to accommodate the RTC through the SH20 / SH20B interchange at-grade whilst remaining in the median, a general traffic lane would need to be removed. Options of removing an east-, or west-bound lane were tested in conjunction with reallocation of movements between the remaining lanes.

The SIDRA modelling showed that the Level of Service at the SH20 / SH20B interchange was very poor (LOS F) for all the tested options.

For the 2048 design year delays at the intersection were forecast to be excessive at around 10 – 15 minutes for eastbound traffic on SH20B. These delays would form very large queues in the peak hours and would severely limit access to and from the airport from the south, as well as causing dangerously long queues from SH20B onto SH20 in both directions.

SH20 / SH20B Interchange: Grade Separation of General Traffic

Based on the results above, it was considered that grade separation would greatly improve intersection performance and several options were considered as summarised below.

Table 2-2: SH20 / SH20B Interchange Ramp Options

Grade Separated Traffic Movement	Pros	Cons	Comment
SH20B / Puhinui Road east-west through movement	Removes a significant movement from the intersection	Gives priority to general traffic rather than to PT – contravenes the project objectives	Not recommended
SH20 southbound to SH20B westbound	Removes a significant turning movement from the intersection	North facing ramps discounted at longlist stage	Not recommended
SH20 northbound to Puhinui Road eastbound	Removes a significant turning movement from the intersection	Low flows through the intersection don't justify expense of this ramp	Not recommended
SH20B eastbound to SH20 northbound	Major flow through the intersection.	North facing ramps discounted at longlist stage	Not recommended
SH20B eastbound to SH20 southbound	Removes a significant turning movement from the intersection In line with project Objectives of providing airport access to the east and south	Requires amendment of the braided ramp arrangement	Preferred option

The greatest traffic conflicts occur between the SH20B to SH20 south turning movement, and the mainline through flows along SH20B. An option was therefore tested to grade separate this movement.

This option was tested and found to improve intersection performance from LOS F to LOS D confirming that the proposed ramp allows for a much-improved level of service at the intersection.

The proposed ramp will remove major conflicting traffic volumes at the interchange, allowing prioritisation of public transport trips, accommodation of the RTC, simplification of traffic signal phasing and reallocation of available traffic signal green times.

As such, a southbound ramp grade separating the flows from SH20B to SH20 southbound greatly improves operational efficiency of the intersection and allows better accommodation of the RTC through the SH20 / SH20B interchange.

Transport demands to and from the airport to the south are forecast to increase significantly with the proposed special housing areas and development of North Waikato. Revised MSM and SATURN transport modelling of the proposed SH20B to SH20 southbound ramp shows much improved intersection performance, travel times and reliability for bus, freight and car journeys accessing the airport precinct to from the south and east. The grade separated ramp was therefore adopted as a key design feature at the intersection and applied to all of the RTC alignment options tested.

SH20B RTC Alignment Options

Options for threading the RTC though the Puhinui Intersection beneath SH20 were assessed using SIDRA and are summarised below.

Table 2-3: SH20B/RTC Section 1 Highways

	Option 1A RTC in Median (Widening Applied Symmetrically)	**Option 1B** RTC in median (all widening applied on northern side)	**Option 1C** RTC in median (all widening applied on southern side)	**Option 1D** RTC on northern side	**Option 1E** RTC on southern side
SH20 / SH20B Interchange	Lower overall delays and shorter queues. (LOS B/D) Simpler signal phasing Better public transport priority and service levels (LOS A/C)	As per Option 1A (no difference in intersection performance)	As per Option 1A (no difference in intersection performance)	Higher public transport delays (LOS E) Slightly lower overall delays and shorter queues for traffic (LOS B/C)	Higher overall delays and longer queues for traffic (LOS E/F) and public transport. (LOS D) Long queues on both the southbound and northbound off-ramps

Based on the traffic assessment, the options that include a median-running RTC are preferred through the SH20 / SH20B interchange. The central running option also allows more of the RTC vehicles to clear both sides of the intersection without stopping. Options 1D and 1E are feasible but result in higher delays for the RTC, more complicated signal phasing and longer queues on the ramps.

2.3.4 Structures

All options implement a southbound interchange overpass between SH20B and SH20. The proposed alignment for this overpass structure is fixed for all road alignments. Therefore, the proposed overpass

structural configuration will be identical for all alignments and there is no differentiator between the options from a structures perspective.

Table 2-4: SH20B/RTC Section 1 Structures

	Option 1A RTC in Median (Widening Applied Symmetrically)	**Option 1B** RTC in median (all widening applied on northern side)	**Option 1C** RTC in median (all widening applied on southern side)	**Option 1D** RTC on northern side	**Option 1E** RTC on southern side
Structures					

2.3.5 Geotechnical

Ground conditions across Section 1 comprise embankment fill of variable nature supporting the existing carriageway and infilling a historic gully adjacent to the Manukau Memorial Gardens. Underlying the fill material is Puketoka formation clays, silts and sands followed by Kaawa formation rock generally comprising sandstone. Groundwater is generally deep (approx. 10mRL summer levels) with the existing carriageway at approximately 25mRL and therefore pavement subsoil and liquefaction effects are considered relatively low risk. Geological conditions are generally considered manageable through standard geotechnical practises associated with detailed design for slope stability, settlement and seismic design (Liquefaction, Cyclic Softening and Lateral Spreading) for all options.

For Section 1 specifically, organic material was encountered near the SH20 / SH20B interchange however the extents of this are unknown laterally, it would be recommended that this material is considered during foundation considerations for the options for the SH20B to SH20 southbound ramp.

Soil conditions at the base of the gully features extending to the north and south of the existing carriageway are expected to comprise soft soils that require settlement and stability consideration for any options extending into them.

As all options involve some level of widening into the gullies and in lieu of ground investigations outside of the SH20B Short Term Improvements project footprint geotechnical risks across all options are considered similar.

The risks associated with these identified ground conditions are expected to be managed through investigation and design during the implementation process. Investigation and design is however recommended when the project requirements are better developed.

As the proposed options (north, south or symmetrical) will likely encroach into the gullies and the exclusion of earthworks considerations in this MCA, geotechnical effects are considered neutral on all options based on the information currently available.

Table 2-5: SH20B/RTC Section 1 Geotechnical

	Option 1A RTC in Median (Widening Applied Symmetrically)	Option 1B RTC in median (all widening applied on northern side)	Option 1C RTC in median (all widening applied on southern side)	Option 1D RTC on northern side	Option 1E RTC on southern side
Geotechnical					

2.3.6 Stormwater

As noted in Section 2.2, stormwater assets resulting from the SH20B Short Term Improvements project will be replaced on a like-for-like basis.

The following provides additional context of the assessment and highlights elements that may require further assessment in future design stages.

The corridor between SH20 / SH20B interchange to Manukau Memorial Gardens (MMG) intersection includes two watersheds, with a high point located approximately in line with MMG's eastern boundary line. Both watersheds result in discharge to Stormwater Management Areas: Flow (SMAF), and therefore require attenuation and treatment prior to discharge. The first watershed results in discharge to existing stormwater reticulation east of SH20B and the second results in discharge to Waokauri Creek East, which is discussed further in Section 2.

From a stormwater quality perspective, the STIP results in a proprietary treatment device on the southern side of the highway at the SH20 / SH20B interchange (refer to Figure 2-2), which will likely require upsizing and relocation[2] for the options being assessed.

From a quantity/attenuation standard, the STIP results in an attenuation swale on the northern side of the highway. For Options 1C and 1E, the attenuation capacity of the swale will likely require upsizing to accommodate the increase in impervious areas. Whereas, for Options 1A, 1B and 1D, the swale size and position will need to be revised. A proprietary storage device may need to be considered, should earthworks associated with the relocation of the swale be impracticable.

[2] Relocation of proprietary treatment device required for Options 1A, 1C and 1E.

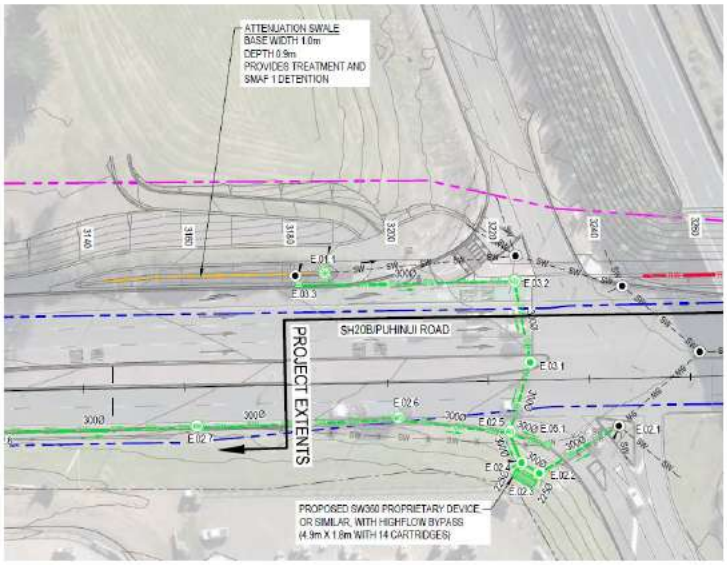


Figure 2-2: SH20B STIP Design Layout *(Extracted from Aurecon Drawing 504330-0000-DRG-WD-1410 rev 0)*

Based on the above, there is not considered to be any significant differences between the options in terms of water quality performance or water quantity / attenuation performance.

Table 2-6: SH20B/RTC Section 1 Stormwater

	Option 1A RTC in Median (Widening Applied Symmetrically)	**Option 1B** RTC in median (all widening applied on northern side)	**Option 1C** RTC in median (all widening applied on southern side)	**Option 1D** RTC on northern side	**Option 1E** RTC on southern side
Stormwater Quality					
Stormwater Quantity					

2.3.7 Utilities

Options 1A, 1B and 1D all impact the shared use path on the eastbound side under which the utilities, are located. For these options the utilities would require relocation. Options 1C and 1E, which widen only to the southside, allows for the northern shared use path / utilities corridor to be retained. The utilities on the southern side will require diverting for all options except 1B and 1D. Realigning the IP20 Gasmain applies to all options.

Table 2-7: SH20B/RTC Section 1 Utilities

	Option 1A RTC in Median (Widening Applied Symmetrically)	**Option 1B** RTC in median (all widening applied on northern side)	**Option 1C** RTC in median (all widening applied on southern side)	**Option 1D** RTC on northern side	**Option 1E** RTC on southern side
Utilities					

2.3.8 Environmental / Planning

Section 1 contains options which encroach into the Manukau Memorial Gardens (MMG) Cemetery.

In terms of social impacts, Options 1A, 1B and 1D all share the significant adverse effects of encroaching north into the MMG site requiring the relocation of graves. The exhumation and reburial of these bodies is considered an unacceptable social and community effect, particularly when options exist that avoid the need for this to occur.

In terms of contaminated land, Options 1A, 1B and 1D all carry medium risk due to groundworks within location of graves. Cemeteries are an activity listed on the Hazardous Activities and Industries List (HAIL), and these options are likely to encounter contamination risk to both soil and groundwater as a result of the decomposition process and leachate.

There are not considered to be any freshwater ecological effects or marine ecological effects for any of the options. This is due to construction effects being excluded from this assessment and based on the assumption that the infrastructure will be able to operate without further encroachment or streamworks at MMG.

Options 1A, 1B and 1D affect varying amounts of landscape vegetation within the MMG site. However, in regard to terrestrial ecological effects there are no significant differentiators between the options.

In terms of landscape effects, the removal, or partial removal, of vegetation as result of Options 1B and 1D, and to a lesser extent Option 1A, will significantly diminish the amenity values and visual screening of the state highway within the cemetery. Options 1C and 1E avoid the removal of this amenity vegetation and present opportunity for further amenity given its encroachment into currently undeveloped land to the south.

Bearing in mind the above, the options (Options 1A, 1B and 1D) that encroach into MMG would present great consentability risk, particularly when a viable option that avoids these effects is available to the south and would form part of the alternatives assessment for any Notice of Requirement sought for the project. Therefore, Options 1C and 1E are preferred in Section 1 given their avoidance of direct effects on the MMG site.

The supporting environmental specialist technical notes are contained at Appendix B.

South facing ramp:

Section 1 includes the provision of the south facing ramp onto SH20. This structure is consistent across all options and is contained within the existing NZ Transport Agency designations (ID 6709 relating to SH20 and 6717 relating to SH20B).

The ramp will be elevated above SH20 (which in itself is already elevated) to a height of approximately 23m above the surrounding ‘natural’ contours (based on a bridge deck height of 37.6m and surrounding contours of approximately 15m), meaning that it is potentially visible from a wide area. However, surrounding properties tend to be commercial or industrial (or are likely to be developed with this land use based on Auckland Unitary Plan zoning), with the exception of some residential areas to the northeast, and MMG to the northwest. Both these latter areas are separated from the proposed ramp by intervening vegetation and existing mounding on which SH20 is located. The ramp would have a character typical of roading infrastructure, and not out of character with the major interchange it will form part of. There are no natural waterways of areas of natural habitat in close proximity to the ramp. There exists opportunity within the design process for the ramp to provide quality urban design outcomes in accordance with the NZTA Bridging the Gap guidelines. In this regard, it is considered that the ramp presents a low risk to consentability and programme.

Table 2-8: SH20B/RTC Section 1 Environmental / Planning

Discipline	Sub-topic	Criteria	1A	1B	1C	1D	1E
Ecology	Aquatic ecology	Extent, nature and degree of effects on freshwater aquatic ecology, in particular on significant habitats of indigenous fauna and vegetation, and opportunities for ecological restoration and enhancement.					
	Terrestrial ecology	Extent, nature and degree of effects on terrestrial ecology, in particular on significant habitats of indigenous fauna and vegetation, and opportunities for ecological restoration and enhancement.					
	Marine ecology	Extent, nature and degree of effects on marine ecology, in particular on significant habitats of indigenous fauna and vegetation, and opportunities for ecological restoration and enhancement.					
Landscape, visual and urban design	Natural character and landscape	Extent, nature and degree of effects on natural character, features, and landscape.					
	Visual	Extent, nature and degree of effects on visual amenity.					
	Urban design	Extent, nature and degree of effects on urban design, including open space.					
Social/community impact	Accessibility	Extent and degree of effects on the community concerning accessibility to/from facilities, services, properties and businesses.					
	Community	Extent and degree of change to groups and activities, including sense of community and to known aspirations and plans.					
	Health and safety	Extent and degree of effects on human health and safety.					
Contaminated land	Contamination management - soil	Potential to encounter and ability to manage the effects of contaminated soils on human health and the environment.					
	Contamination management - groundwater	Potential to encounter and ability to manage the effects of groundwater on human health and the environment.					
Consentability	Consentability	Level of complexity of gaining approvals (e.g. activity status, risk of appeal, accordance with policy direction). Level of compliance with regulatory plans e.g. could the option include activities which are prohibited/ non-complying under the policies and rules of the district or regional plan?					

[redacted]



2.3.10Construction Disruption

The differentiators within Section 1 arise due to both the location of the RTC and the introduction of the SH20B to SH20 southbound ramp.

Option 1A retains the existing crown position, allowing the median RTC and the rest of the carriageway to be constructed, by extension of crossfall and without any pavement shape correction. However, due to online widening works on both sides of the carriageway, Option 1A requires greater TTM phases and therefore, it scores the worst as it would result in the most disruption.

Options 1B and 1D, and 1C and 1E retain some of the existing westbound and eastbound carriageway, respectively. Therefore, with the widening works limited to one side of the carriageway and with some aspect of offline construction, overall fewer TTM shifts are required compared to Option 1A.

However, there is a subtle difference in terms of the construction methodologies and the construction disruption that Options 1B, 1C, 1D and 1E would cause.

Option 1D and 1E are fairly similar, in that they both limit widening works to one side of the carriageway. In both options, the new southbound ramp impacts majority of the early works pavement and requires closure of at least one traffic lane, prior to undertaking offline construction on the respective side. However, Option 1D presents an opportunity to retain the existing crown position, whereas, for Option 1E, it would have to be shifted, with further shape correction and pavement overlay applied.

The main difference between Options 1B and 1C, is due to the impact to the existing early works pavement. Option 1B also has widening limited to one side, however, with the southbound ramp situated

north of the existing carriageway, it would result in the least abortive pavement and therefore, be the quickest to construct, with the least disruption.

Options 1C and 1E retain the existing shared use path on the eastbound side as a viable route, providing some benefit for pedestrians and cyclists, during and post construction. However, this is not considered to have an impact on the scoring, as a separate study and MCA will be undertaken to determine the location of the shared use path.

Overall, Option 1B is ultimately preferred in terms of the least construction disruption and with the opportunity to retain the existing pavement and crown, it would be the quickest to build.

Table 2-10: SH20B/RTC Section 1 Construction Disruption

	Option 1A RTC in Median (Widening Applied Symmetrically)	**Option 1B** RTC in median (all widening applied on northern side)	**Option 1C** RTC in median (all widening applied on southern side)	**Option 1D** RTC on northern side	**Option 1E** RTC on southern side
Construction Disruption					

2.3.11 Cost

The cost of the civils works for each option will be reasonably similar. The majority of the cost difference is likely to come from constructability issues such as Temporary Traffic Management (TTM) and programme. However, the magnitude of cost difference compared to the overall cost of the corridor works is low and therefore, the options are considered neutral.

[redacted]

2.3.12 Option Summary

A summary of the main considerations for each option are presented and compared in **Table 2-12** below:

Table 2-12: SH20B/RTC Section 1 Option Summary

	Option 1A RTC in Median (Widening Applied Symmetrically)	**Option 1B** RTC in median (all widening applied on northern side)	**Option 1C** RTC in median (all widening applied on southern side)	**Option 1D** RTC on northern side	**Option 1E** RTC on southern side
Highways					

	Option 1A RTC in Median (Widening Applied Symmetrically)	Option 1B RTC in median (all widening applied on northern side)	Option 1C RTC in median (all widening applied on southern side)	Option 1D RTC on northern side	Option 1E RTC on southern side
Traffic / Intersection Performance					
Structures					
Geotechnical					
Stormwater					
Utilities					
Environmental / Planning					
Property					
Construction Disruption					
Cost					

Based on the above assessment, Option 1C provides the most appropriate balance of the issues. This is primarily based on the reduced traffic performance of Options 1D and 1E at the SH20 / SH20B interchange, and the significant adverse effects on Manukau Memorial Gardens in Options 1A, 1B, and 1D.

2.4 Section 2: Manukau Memorial Gardens to Waokauri Creek (inc MMG intersection)

2.4.1 Options Assessed

The options assessed in Section 2 are as follows:

- Option 2A – RTC in median (widening applied symmetrically)
- Option 2B - RTC in median (all widening applied on northern side)
- Option 2C - RTC in median (all widening applied on southern side)
- Option 2D - RTC on northern side
- Option 2E - RTC on southern side

The options are shown on sketches 501094-4403-SKT-RR-0308 and 501094-4403-SKT-RR-0321 to 0323, which can be found in Appendix A of this technical note.

2.4.2 Highways

In terms of the relevant design standards, all options provide a fully compliant cross section within Section 2. The addition of 1.0 m width shoulders, edge and median WRSB, where appropriate, physically

separated RTC and the widening of the existing 3.2 m 'T3' lanes to 3.5 m traffic lanes, provides an overall safer environment.

Options 2A, 2B and 2C which comprise of the median RTC are considered to provide both the RTC and the general traffic with a consistent and safer transition through the Manukau Memorial Gardens intersection.

Whilst, Options 2D and 2E, which include the addition of a widened 2.4 m flush median, with a median WRSB and position the RTC on the edge of the carriageway are considered to provide a safer, more conventional layout along the length of Section 2. However, with the RTC on the edge of the carriageway for Options 2D and 2E, there is a potential for the general traffic travelling in the westbound direction through the MMG intersection, to inadvertently merge into the RTC. However, this is not seen to be a major differentiator and this concern could be designed out using appropriate signage and engineering controls.

Options 2B and 2D provide an opportunity to retain the early works shared use path on the westbound side. Whereas, Options 2A, 2C and 2E all impact the shared use path, with no opportunity to retain.

Overall, there are no major differentiators from a highways perspective.

Table 2-13: SH20B/RTC Section 2 Highways

	Option 2A RTC in Median (Widening Applied Symmetrically)	**Option 2B** RTC in median (all widening applied on northern side)	**Option 2C** RTC in median (all widening applied on southern side)	**Option 2D** RTC on northern side	**Option 2E** RTC on southern side
Highways					

2.4.3 Traffic / Intersection Performance

This traffic assessment was based on the assumption of the RTC not switching position within the intersection. Following selection of preferred position throughout the corridor, performance of switches (if required) will be assessed for the relevant movements.

The intersection performance for the alignment options is shown below. Generally, intersection performance at Memorial gardens is acceptable for all options with overall LOS of B/C. This is due to low flows accessing Memorial Gardens in the peak hour.

Table 2-14: SH20B/RTC Section 2 Traffic / Intersection Performance

	Option 2A RTC in Median (Widening Applied Symmetrically)	Option 2B RTC in median (all widening applied on northern side)	Option 2C RTC in median (all widening applied on southern side)	Option 2D RTC on northern side	Option 2E RTC on southern side
Manukau Memorial Gardens (MMG) intersection	Acceptable intersection performance with LOS C for traffic and A/B for RTC.	As per Option 2A (no difference in intersection performance)	As per Option 2A (no difference in intersection performance)	Slightly worse performing layout due to conflict between RTC and Memorial Gardens access. LOS C for traffic and A for RTC	Best performing option due to reduced conflicts between RTC and general traffic. LOS B for traffic and A for RTC

2.4.4 Structures

As no structures are proposed to be modified or installed under the proposed alignment options, there is no differentiator between the options from a structures perspective.

Table 2-15: SH20B/RTC Section 2 Structures

	Option 2A RTC in Median (Widening Applied Symmetrically)	Option 2B RTC in median (all widening applied on northern side)	Option 2C RTC in median (all widening applied on southern side)	Option 2D RTC on northern side	Option 2E RTC on southern side
Structures					

2.4.5 Geotechnical

Ground conditions across Section 2 comprise embankment fill of variable nature supporting the existing carriageway. Immediately below the carriageway fill is expected a layer of Auckland Volcanic Field Ash. Underlying this material is Puketoka formation clays, silts and sands followed by Kaawa formation rock generally comprising sandstone. Groundwater is generally deep (approx. 10mRL summer levels) with the existing carriageway at approximately 17mRL and therefore pavement subsoil and liquefaction effects are considered relatively low risk. Geological conditions are generally considered manageable through standard geotechnical practises associated with detailed design for slope stability, settlement and seismic design (Liquefaction, Cyclic Softening and Lateral Spreading) for all MCA options.

In lieu of ground investigations outside of the SH20B Short Term Improvements project footprint, there is no preferred option from a geotechnical perspective as all options will likely encounter similar geotechnical risks.

The risks associated with these identified ground conditions are expected to be managed through investigation and design during the implementation process. Investigation and design is however recommended when the project requirements are better developed.

Due to the relatively consistent nature of the expected geology across all of the proposed options and the exclusion of earthworks considerations in this MCA, geotechnical effects are considered neutral on all options based on the information currently available.

Table 2-16: SH20B/RTC Section 2 Geotechnical

	Option 2A RTC in Median (Widening Applied Symmetrically)	**Option 2B** RTC in median (all widening applied on northern side)	**Option 2C** RTC in median (all widening applied on southern side)	**Option 2D** RTC on northern side	**Option 2E** RTC on southern side
Geotechnical					

2.4.6 Stormwater

As per the design assumptions, Options 2A to 2E, propose a like-for-like replacement of in comparison with the SH20B Short Term Improvements project. In relation to design options considered, the attenuation requirements prior to discharge cannot be achieved for Options 2A, 2B and 2D due to onsite constraints and the location of the swale.

Table 2-17: SH20B/RTC Section 2 Stormwater

	Option 2A RTC in Median (Widening Applied Symmetrically)	**Option 2B** RTC in median (all widening applied on northern side)	**Option 2C** RTC in median (all widening applied on southern side)	**Option 2D** RTC on northern side	**Option 2E** RTC on southern side
Stormwater Quality	Like for like level of treatment may be achieved through installation of proprietary treatment device		Like for like level of treatment achieved as capacity of swale may be retained through retaining walls and potentially fixed barriers	Like for like level of treatment may be achieved through installation of proprietary treatment device	Like for like level of treatment achieved as capacity of swale may be retained through retaining walls and potentially fixed barriers
Stormwater Quantity	No reasonable substitution exists to meet the required attenuation prior to discharge without purchasing additional land		Attenuation capacity of swale may be retained through retaining walls and potentially fixed barriers	No reasonable substitution exists to meet the required attenuation prior to discharge without purchasing additional land	Attenuation capacity of swale may be retained through retaining walls and potentially fixed barriers

The following provides additional context of the assessment and highlights elements that may require further assessment in future design stages.

The swale constructed as a result of the SH20B Short Term Improvements project, located on the northern side of SH20B and to the west of the MMG intersection, provides both attenuation and treatment (to GD01 standard) prior to discharge further downstream (in Waokauri Creek East). The effective length of treatment of the existing swale is approximately 70m. The size of the swale is driven predominantly by the depth required to enable the upstream pipe network to discharge into it[3].

All options intersect the swale, some to a lesser extent than others. The extent that Options 2A, 2B and 2D intersect the swale's footprint, would require the swale to be removed. Due to space constraints, a proprietary treatment device would likely be required to substitute the swale, in order to meet the required stormwater treatment prior to discharge. However, the removal of the swale heavily impacts on the attenuation required prior to discharge (in accordance with the SMAF requirements). No reasonable alternative is available to meet the required quantity targets, unless additional land is made available.

For Option 2C and 2E, the swale may be retained through minor retaining and potentially concrete barriers straddling the length of the swale. While further design will be required, for the purposes of this assessment, it is estimated that the swale will have sufficient treatment and attenuation capacity to accommodate the increased catchment area.

All options present the opportunity to include treatment swales on the southern side of the motorway[4], however, this will require acquisition of additional land.

2.4.7 Utilities

Options 2A, 2C and 2E will require re-diversion of the utilities placed under the SUP as part of the SH20B Short Term Improvements project. Whereas options 2B and 2D allow the existing shared use path and the utilities underneath to be retained. Options 2B and 2D are preferred with respect to effect on utilities.

The IP20 gasmain will likely require diversion under all options as these works have been delayed and not included in the SH20B Short Term Improvements project.

Table 2-18: SH20B/RTC Section 2 Utilities

	Option 2A RTC in Median (Widening Applied Symmetrically)	**Option 2B** RTC in median (all widening applied on northern side)	**Option 2C** RTC in median (all widening applied on southern side)	**Option 2D** RTC on northern side	**Option 2E** RTC on southern side
Utilities					

2.4.8 Environmental / Planning

Section 2 presents limited environmental effects due to its size, nature and ownership.

In terms of ecological effects and contaminated land, there are no differentiators between Options 2A to 2D, all are low risk.

[3] The effective upstream runoff/treatment area discharging into the swale extends further east, with the highpoint in the road located approximately in line with the MMG eastern boundary line.
[4] Highly recommended to increase efforts of providing additional 'green' treatment

In terms of visual effects, Option 2A is considered to minimise visual effects on both MMG to the north and the private residences to the south while the other options would result in greater effects on one of these properties.

In terms of social impacts, the three options that propose the RTC in the middle of the carriageway (Options 2A, 2B and 2C) are less favourable from an accessibility perspective (should access be required to the RTC at a future point in time).

Overall, there are no notable differentiators within Section 2. Therefore, there is no obvious preference and each option presents relatively low consentability risk.

The supporting environmental specialist technical notes are contained at Appendix B.

Table 2-19: SH20B/RTC Section 2 Environmental / Planning

Discipline	Sub-topic	Criteria	2A	2B	2C	2D	2E
Ecology	Aquatic ecology	Extent, nature and degree of effects on freshwater aquatic ecology, in particular on significant habitats of indigenous fauna and vegetation, and opportunities for ecological restoration and enhancement.					
	Terrestrial ecology	Extent, nature and degree of effects on terrestrial ecology, in particular on significant habitats of indigenous fauna and vegetation, and opportunities for ecological restoration and enhancement.					
	Marine ecology	Extent, nature and degree of effects on marine ecology, in particular on significant habitats of indigenous fauna and vegetation, and opportunities for ecological restoration and enhancement.					
Landscape, visual and urban design	Natural character and landscape	Extent, nature and degree of effects on natural character, features, and landscape.					
	Visual	Extent, nature and degree of effects on visual amenity.					
	Urban design	Extent, nature and degree of effects on urban design, including open space.					
Social/community impact	Accessibility	Extent and degree of effects on the community concerning accessibility to/from facilities, services, properties and businesses.					
	Community	Extent and degree of change to groups and activities, including sense of community and to known aspirations and plans.					
	Health and safety	Extent and degree of effects on human health and safety.					
Contaminated land	Contamination management - soil	Potential to encounter and ability to manage the effects of contaminated soils on human health and the environment.					
	Contamination management - groundwater	Potential to encounter and ability to manage the effects of groundwater on human health and the environment.					
Consentability	Consentability	Level of complexity of gaining approvals (e.g. activity status, risk of appeal, accordance with policy direction). Level of compliance with regulatory plans e.g. could the option include activities which are prohibited/ non-complying under the					

Discipline	Sub-topic	Criteria	2A	2B	2C	2D	2E
		policies and rules of the district or regional plan?					



2.4.10 Construction Disruption

Option 2A retains the existing crown position, allowing the median RTC and the rest of the carriageway to be constructed, by extension of crossfall and without any pavement shape correction. However, Option 2A does require online widening works on both sides of the carriageway as well as a full rebuild of the MMG intersection. This would require additional TTM phases and therefore, result in greater disruption to traffic. It is worth noting, that given the sensitivity of the land use on the northern side, Option 2A is considered to be significantly disruptive.

The remaining four options (Options 2B, 2C, 2D and 2E) all have similar, but moderately less disruption effects and therefore, likely fewer TTM phases, compared to Option 2A. All four options, retain a majority of the early works pavement, with the required widening being undertaken offline. The differences arise at the MMG intersection, whereby Options 2B and 2C require a partial rebuild of the MMG intersection.

Option 2D and 2E, provide the opportunity to retain the existing crown position, thereby allowing extension of crossfall with no pavement shape correction required. Additionally, with offline construction of the RTC, both options require minimal widening works, which would be limited to one side of the carriageway, consequently requiring fewer TTM phases. The main differentiator between the two options is that Option 2D requires rebuild of the MMG intersection northern arm, whereas Option 2E retains the entire early works MMG intersection.

Options 2B and 2D which have widening applied on the northern side, allow retention of the early works SUP on the westbound side, minimising disruption for pedestrians and cyclists, during and post construction. Whereas, the remaining three options results in abortive works for the shared use path.

However, this is not considered to have an impact on the scoring, as a separate study and MCA will be undertaken to determine the location of the shared use path.

Table 2-21: SH20B/RTC Section 2 Construction Disruption

	Option 2A RTC in Median (Widening Applied Symmetrically)	**Option 2B** RTC in median (all widening applied on northern side)	**Option 2C** RTC in median (all widening applied on southern side)	**Option 2D** RTC on northern side	**Option 2E** RTC on southern side
Construction Disruption					

2.4.11 Cost

The cost of the civils works for each option will be reasonably similar. The majority of the cost difference is likely to come from constructability issues such as Temporary Traffic Management (TTM) and programme. However, the magnitude of cost difference compared to the overall cost of the corridor works is low and therefore the options are considered neutral

[redacted]

2.4.12 Option Summary

A summary of the main considerations for each option are presented and compared in **Table 2-23** below:

Table 2-23: Road and RTC Section 2 Option Summary

	Option 2A RTC in Median (Widening Applied Symmetrically)	**Option 2B** RTC in median (all widening applied on northern side)	**Option 2C** RTC in median (all widening applied on southern side)	**Option 2D** RTC on northern side	**Option 2E** RTC on southern side
Highways					
Traffic / Intersection Performance					
Structures					
Geotechnical					
Stormwater					

	Option 2A RTC in Median (Widening Applied Symmetrically)	Option 2B RTC in median (all widening applied on northern side)	Option 2C RTC in median (all widening applied on southern side)	Option 2D RTC on northern side	Option 2E RTC on southern side
Utilities					
Environmental / Planning					
Property					
Construction Disruption					
Cost					

Based on the above assessment, Option 2E provides the most appropriate balance of the issues. This is primarily based on the stormwater issues and subsequent land acquisition to resolve those issues for Options 2A, 2B, and 2D. There is increased property risk with Option 2D and construction disruption with Option 2A.

2.5 Section 3: Waokauri Creek

2.5.1 Options Assessed

The options assessed in Section 3 are as follows:

- Option 3A – Online widening of existing alignment
- Option 3B – Offline replacement on northern side
- Option 3C – Offline replacement on the southern side

The options are shown on sketches 501094-4403-SKT-RR-0306 to 0307, 501094-4403-SKT-RR-0325 to 0327 and 501094-4403-SKT-RR-0351 to 0356, which can be found in Appendix A of this technical note.

2.5.2 Highways

The intention of Section 3 is to assess the footprints of the bridge structures required to accommodate three varying alignments. In terms of the relevant design standards, all options within Section 3 provide similar levels of geometry with a fully compliant cross section and no departures required.

It is to be noted that from a highways perspective, the configuration of the cross-sectional elements for Section 3 are dictated by Sections 2 and 4.

Option 3A includes online widening of the existing Waokauri Creek bridge, while retaining the existing alignment. This provides a fairly conventional outcome and allows flexibility in terms of the location of both the RTC and SUP.

There are no major differentiators between Options 3B and 3C, as they both involve realigning the carriageway to provide an offline replacement of the existing Waokauri Creek bridge on the northern and southern side, respectively. Both options allow flexibility in terms of the location of both the RTC

and SUP within the cross section, except for Option 3C, for which the service road must be located on the existing Waokauri Creek bridge.

All options within Section 3 allow for edge bridge barriers, addition of 1 m shoulders and a WRSB in the widened flush median, depending on the final cross-sectional configuration.

Overall, from a highways perspective there are no major differentiators.

Table 2-24: SH20B/RTC Section 3 Highways

	Option 3A Online widening of existing alignment	**Option 3B** Offline replacement on northern side	**Option 3C** Offline replacement on the southern side
Highways			

2.5.3 Traffic / Intersection Performance

For section 3 there are no intersections affected and consequently there are no differentiators from a traffic performance perspective.

Table 2-25: SH20B/RTC Section 3 Traffic / Intersection Performance

	Option 3A Online widening of existing alignment	**Option 3B** Offline replacement on northern side	**Option 3C** Offline replacement on the southern side
Traffic / Intersection Performance			

2.5.4 Structures

The proposed structure at Waokauri Creek will consist of a similar structural form for all alignment options, utilising a multiple span, standard precast concrete girder beams on top of reinforced concrete headstocks and bored piles.

Single span bridge configurations were considered for all alignment options to eliminate piling works in the Coastal Marine Area. A multiple girder structural form is the preferred spanning mechanism due to the required bridge width and the limitations on alternative bridge forms in this regard. Due to the required minimum span length of 60m, the structural depth and lifting weight requirements for a single span girder bridge were deemed excessive and this option was not progressed at this stage of the analysis. Further investigation into a single span option should take in account the constraint on cranage height restrictions due to the Airport Obstacle Limitation Surface requirements as part of the Auckland Unitary Plan

Online widening for Option 3A will require a staged construction sequence and associated detailing to demolish existing structural elements while maintaining road access during construction. The existing bridge deck cannot be widened without implementing longitudinal deck joints. It is proposed to replace the existing deck as a minimum to ensure the completed bridge is tied together across the width of the structure. Due to the replacement of the deck, the limited residual design life of the existing substructure, and the potential for displacement incompatibility between the old and new bridge elements, there is almost no benefit of retaining any existing structural elements and full replacement is proposed.

Offline construction for Options 3B and 3C will implement similar construction sequencing and bridge detailing that can't be differentiated at this stage of the analysis. As Option 3B retains the shared path bridge and the existing bridge as a service road it leads to the narrows bridge overall between the three options however this is better differentiated in cost savings rather than structural form.

In summary Options 3B and 3C are preferred from a structures perspective due to the ease of offline replacement. Option 3A will require a higher level of detailing for the piers to ensure the completed structure is adequately tied together.

Table 2-26: SH20B/RTC Section 3 Structures

	Option 3A Online widening of existing alignment	**Option 3B** Offline replacement on northern side	**Option 3C** Offline replacement on the southern side
Structures	To minimise formation works in the CMA two additional land spans are required, extending the bridge length to ~92m. Single span configuration not progressed due to lifting weight requirements. Piers require positioning to clear existing bridge piles. Online widening requires replacement of the existing deck as a minimum. Due to the limited residual design life of the existing structure and potential displacement compatibility between the old and new elements, full replacement is proposed. To maintain road access and minimise disruption to the State Highway the new bridge needs to be constructed in at least two stages. This will require adequate detailing and additional support to temporary and permanent pier configurations.	New offline structure using standard design elements. To minimise formation works in the CMA, requires a 75m overall bridge length. Single span configuration not progressed due to lifting weight requirements.	New offline structure using standard design elements. Bridge at this location requires the shortest overall length at 60m. Single span configuration not progressed due to lifting weight requirements.

2.5.5 Geotechnical

Ground conditions across Section 3 comprise embankment fill of variable nature supporting the existing carriageway, infilling historic gullies and forming the existing bridge abutments. Immediately below the carriageway fill is expected a layer of Auckland Volcanic Field Ash. Underlying the ash material is Puketoka formation clays, silts and sands followed by Kaawa formation rock generally comprising

sandstone. The Coastal Marine Area is underlain by soft alluvial materials to an unknown depth. Groundwater varies from 7mRL to 5mRL (approx. levels) and the existing carriageway is at approximately 10mRL and therefore pavement subsoil and liquefaction effects will need consideration. Geological conditions are generally considered manageable through standard geotechnical practises associated with detailed design for slope stability, settlement and seismic design (Liquefaction, Cyclic Softening and Lateral Spreading) for all MCA options.

For Section 3 specifically liquefaction risk and pavement sub soil risk will need to be assessed for all options as earthworks requirements are better understood due to the shallower groundwater level in relation the existing carriageway.

Soil conditions at the base of the gully features and streams extending to the north and south of the existing carriageway are expected to comprise soft soils that require settlement and stability consideration for any options extending into them.

Piling conditions are generally considered standard for Auckland with likely founding depths in the Kaawa formation sandstone should deep foundations be required.

In lieu of ground investigations outside the SH20B Short Term Improvements project footprint to the north and south of the existing bridge, there is no preferred option from a geotechnical perspective as all options will likely encounter similar geotechnical risks. We note that liquefaction potential was negligible in the SH20B detailed design, this may not hold for the options presented, site investigations would be required to confirm the seismic requirements.

For this reason and the exclusion of earthworks considerations in this MCA, geotechnical effects are considered neutral on all options based on the information currently available.

Table 2-27: SH20B/RTC Section 3 Geotechnical

	Option 3A Online widening of existing alignment	Option 3B Offline replacement on northern side	Option 3C Offline replacement on the southern side
Geotechnical			

2.5.6 Stormwater

A like-for-like replacement in comparison to the SH20B Short Term Improvements project is possible for all options assessed in Section 3, and therefore no differentiators exist for any of the options in terms of reticulation, quality and quantity performance objectives.

Table 2-28: SH20B/RTC Section 3 Stormwater

	Option 3A Online widening of existing alignment	Option 3B Offline replacement on northern side	Option 3C Offline replacement on the southern side
Stormwater Quality			
Stormwater Quantity			

The following provides additional context of the assessment and highlights elements that may require further assessment in future design stages.

All stormwater runoff (as a result of the SH20B Short Term Improvements project) from Section 3 is conveyed and discharged to the Waokauri Creek. Treatment and attenuation is required prior to discharge on the southern side of the highway, whereas only treatment is required on the northern side (discharge to the northern side of highway, at Waokauri Creek, is not located in the SMAF1 zone).

In accordance with the existing design (SH20B Short Term Improvements project), the three key stormwater elements that meet both treatment and attenuation requirements for Section 3, include:

- a treatment swale on the western side of Waokauri Creek;
- a proprietary treatment device at the Prices Road interchange (refer to Figure 2-3); and
- an attenuation basin immediately downstream of the proprietary treatment device.

The alignment and footprint of Option 3A accommodates the location of the treatment swale, on the western side of Waokauri Creek, in comparison to the other options which will require the swale to be relocated. Similarly, Option 3A and 3C clash with the proprietary treatment device and downstream attenuation basin. Therefore, relocation of the device and basin will be required. In addition to the relocation, upsizing of the device and downstream attenuation is likely required for all options to accommodate the increased impervious areas.

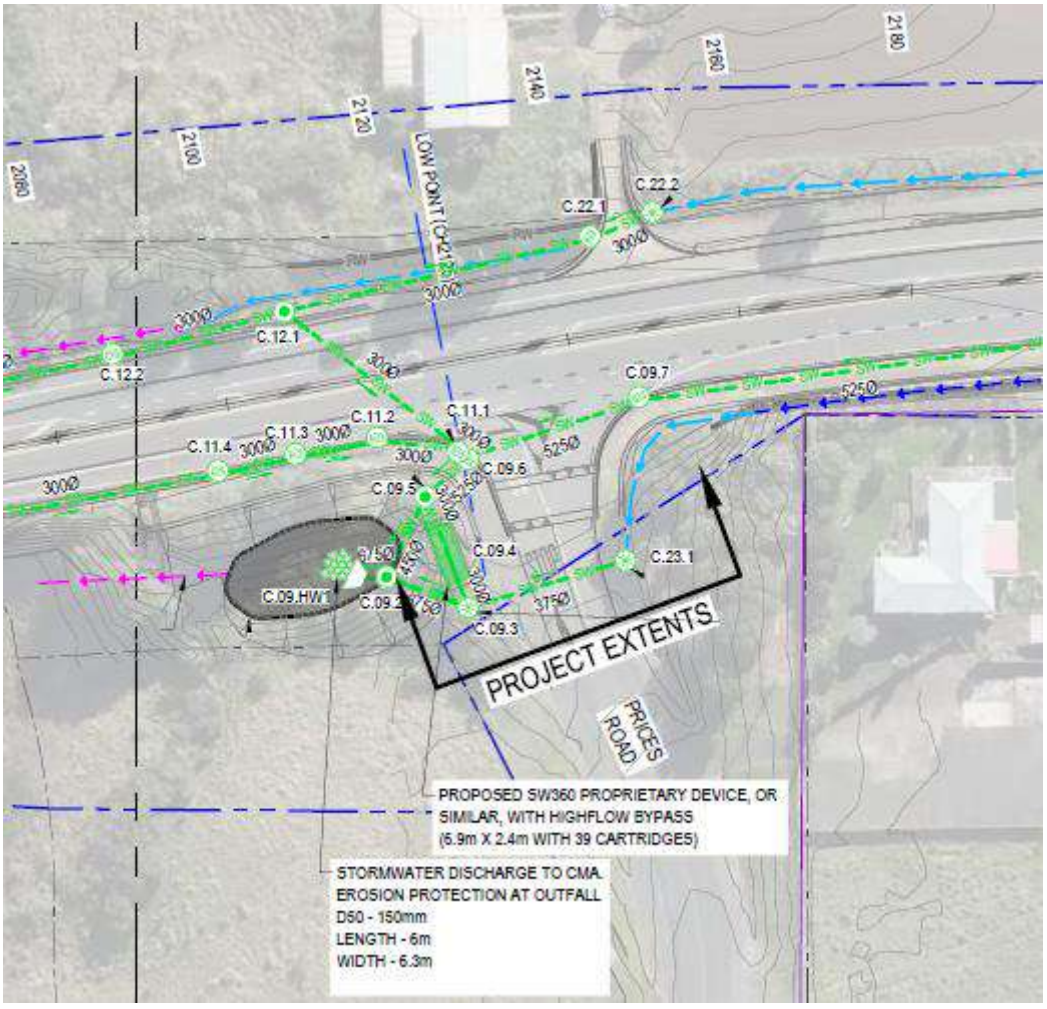


Figure 2-3: Proprietary Treatment Device at Prices Road *(Extracted from Aurecon Drawing 504330-0000-DRG-WD-1407 rev 0)*

An opportunity exists to reduce the area of hardstand requiring treatment. In accordance with the Auckland Unitary Plan, it is unlikely that the proposed service road, will require treatment prior to discharge.[5] To take advantage of this, the stormwater collection and discharge of this runoff will need to be separated to avoid contamination with the higher ADT lanes. A detailed cost benefit analysis and discussions with Council will be required in future stages to determine whether separation is a desired outcome. Alternatively, combined collection and treatment may be considered, which will require larger treatment devices.

All Section 3 options propose a swale on the southern side of the motorway, which may provide additional treatment capacity. In order to successfully leverage the treatment capability of the proposed swale, a minimum swale depth of 1.2 m will be required to allow for piped reticulation to discharge into the swale[6].

[5] If the service road has less than 10,000 Average Daily Traffic (ADT)
[6] The cross section along the proposed realigned road for all options, is likely to be on superelevation and therefore sufficient depth is required to enable connectivity into the swale from the northern side of the highway.

2.5.7 Utilities

Option 3A would require diversion of all the utilities on both sides of the bridge

Option 3B on the northern side would have the least effect on the existing utility services located under the SUP on the southside. The existing IP20 Gasmain on the north side may be affected by this option.

Option 3C involves the demolition and removal of the SUP under which utilities 11kV, Vector and Chorus Fibre Optics are located. These utilities would be further diverted to the proposed new SUP. To maintain continuity of service to customers the services are likely to be required to be diverted and cutover prior to removal of the existing SUP bridge. Standard diversion works are required for these. The existing IP20 Gasmain would be least affected by this option.

The preferred option for utilities in this section would be Option 3B

Table 2-29: SH20B/RTC Section 3 Utilities

	Option 3A Online widening of existing alignment	**Option 3B** Offline replacement on northern side	**Option 3C** Offline replacement on the southern side
Utilities			

2.5.8 Environmental / Planning

All three options within Section 3 require the crossing of the main tributary of Waokauri Creek.

Option 3B poses a high risk and Option 3A poses a medium risk, in terms of seal level rise and coastal climate change, and natural character and landscape effects, due to the further encroachment into the CMA (to the north).

Terrestrial ecological effects are considered medium risk for Option 3B as this option has the greatest loss of coastal riparian vegetation. Option 3A and 3B require works within the Significant Ecological Area (SEA_M2) and within the Mana Whenua Management Precinct. This would likely result in the loss of mangrove and salt marsh habitat (which is notably the habitat for banded rail species) which in turn results in a decrease in terrestrial connectivity. Option 3A encroaches into these habitats to a lesser extent than Option 3B, while Option 3C results in effects on the CMA to a very small extent on the southern side of the existing bridge. Works associated with Option 3B would also require works in the CMA and SEA_M2 at Waokauri Creek East with the loss of mangrove and *Cotula* meadow habitats.

All options present similar risk in regard to freshwater ecological effects. Options 3A and 3B result in small amounts of streamworks required at both Waokauri Creek East and West and Option 3C will result in modification (including shading) of the existing habitats upstream for approximately 40m.

In terms of contaminated land, Options 3A and 3B are low risk. Option 3C is medium risk as the south-eastern corner of the intersection of Prices Road and SH20B presents a potential site of contamination associated with historic filling activities which may be affected by Option 3C,

There are no differentiators in terms of social impacts, all options are low risk.

The three options at Section 3 present varying levels of risk and therefore difficulty in regard to consentability. The CMA in this location of Option 3A and 3B is identified as SEA-M2 as well as being within the Mana Whenua Management Precinct. This coupled with the non-complying activity status of construction of structures within the CMA, Options 3A, and particularly 3B present higher risk to consentability.

However, Option 3B presents a high risk due to the effects on marine and terrestrial ecology, cultural values, natural character and landscape, sea level rise and coastal climate change. This is particularly due to the fact that the width of the crossing at this location is such that works directly in the CMA would not be able to be avoided.

Option 3C largely avoids the CMA and therefore while the risk is not removed, a strong argument would be required to be presented for Options 3A and 3B to be preferred when Option 3C provides an alternative that avoids much of these impacts.

The supporting environmental specialist technical notes are contained at Appendix B.

Table 2-30: SH20B/RTC Section 3 Environmental / Planning

Discipline	Sub-topic	Criteria	3A	3B	3C
Ecology	Aquatic ecology	Extent, nature and degree of effects on freshwater aquatic ecology, in particular on significant habitats of indigenous fauna and vegetation, and opportunities for ecological restoration and enhancement.			
	Terrestrial ecology	Extent, nature and degree of effects on terrestrial ecology, in particular on significant habitats of indigenous fauna and vegetation, and opportunities for ecological restoration and enhancement.			
	Marine ecology	Extent, nature and degree of effects on marine ecology, in particular on significant habitats of indigenous fauna and vegetation, and opportunities for ecological restoration and enhancement.			
Coastal Processes	Construction effects on CMA	Extent of temporary effects on coastal physical processes.			
	Geomorphology/sedimentation & tidal flows	Extent of permanent effects on coastal physical processes, including effects of geomorphology, exacerbating sedimentation and changes in tidal and storm-tide flows in the upper creeks.			
	Sea-level rise and coastal climate change	Extent of increasing impacts on coastal physical processes from sea-level rise and climate change, including vulnerability of the works (present and proposed) and opportunities to improve resilience.			
Landscape, visual and urban design	Natural character and landscape	Extent, nature and degree of effects on natural character, features, and landscape.			
	Visual	Extent, nature and degree of effects on visual amenity.			
	Urban design	Extent, nature and degree of effects on urban design, including open space.			
Social/community impact	Accessibility	Extent and degree of effects on the community concerning accessibility to/from facilities, services, properties and businesses.			
	Community	Extent and degree of change to groups and activities, including sense			

Discipline	Sub-topic	Criteria	3A	3B	3C
		of community and to known aspirations and plans.			
	Health and safety	Extent and degree of effects on human health and safety.			
Contaminated land	Contamination management - soil	Potential to encounter and ability to manage the effects of contaminated soils on human health and the environment.			
	Contamination management - groundwater	Potential to encounter and ability to manage the effects of groundwater on human health and the environment.			
Consentability	Consentability	Level of complexity of gaining approvals (e.g. activity status, risk of appeal, accordance with policy direction). Level of compliance with regulatory plans e.g. could the option include activities which are prohibited/ non-complying under the policies and rules of the district or regional plan?			

[redacted]

2.5.10 Construction Disruption

Option 3A is significantly disruptive for all modes of transport within Section 3, with a significant number of TTM shifts required.

It may be possible to maintain a two-lane access during the works. An indicative methodology would be as follows: Construction of two semi-independent bridges to the north and south of the existing structure, approximately 7m wide each, while maintaining the alignment on the existing structure. The number of operational lanes on the existing Waokauri Creek bridge would have to be reduced down from four lanes down to two, while the formation is established. Given the investment in bus reliability as part of the short-term works, this would disrupt bus services for a significant period of time. Once the semi-

independent structures are constructed, traffic could be opened to one of the new structures (to allow access to the centre section), whilst the existing bridge deck is demolished and replaced.

The biggest risk to this methodology will be the access required for construction and the quality of the formation. Replacement of the formation may require several short shutdowns with associated temporary retaining works to achieve adequate tie in of the overall structure. Widening the existing structure is not possible without partial closure of the existing bridge. Although Option 3A can be constructed while maintaining traffic on SH20B, significant TTM shifts would be required, causing major disruption over an extended period of time.

For Options 3B and 3C, general traffic and 'T3' lanes can be kept operational for the most part, on the existing Waokauri Creek bridge, whilst the offline structures are constructed. Option 3B is seen as marginally less disruptive as it does not impact the early works shared use path on the southern side, providing an opportunity to cater for pedestrians and cyclists during and post construction. Overall, offline replacement of the structure is significantly easier with the existing bridge remaining open throughout the works and the alignment being switched over when the offline structure is complete.

Table 2-32: SH20B/RTC Section 3 Construction Disruption

	Option 3A Online widening of existing alignment	**Option 3B** Offline replacement on northern side	**Option 3C** Offline replacement on the southern side
Construction Disruption			

2.5.11 Cost

The cost of the civils works for each option will be reasonably similar. The majority of the cost difference is likely to come from constructability issues such as Temporary Traffic Management (TTM) and programme.

2.5.12 Option Summary

A summary of the main considerations for each option are presented and compared in **Table 2-34** below:

Table 2-34: Road and RTC Section 3 Option Summary

	Option 3A Online widening of existing alignment	Option 3B Offline replacement on northern side	Option 3C Offline replacement on the southern side
Highways			
Traffic / Intersection Performance			
Structures			
Geotechnical			
Stormwater			
Utilities			
Environmental / Planning			
Property			
Construction Disruption			
Cost			

Based on the above assessment, Option 3C provides the most appropriate balance of the issues. This is primarily based on the construction disruption and cost that would result from Option 3A, and Option 3B resulting in more adverse environmental / planning effects.

The configuration of the cross section in Section 3, such as location of the RTC, will be determined by the adjacent sections.

2.6 Section 4: Waokauri Creek to Orrs Road (inc Campana Road intersection)

2.6.1 Options Assessed

The options assessed in Section 4 are as follows:

- Option 4A – RTC in median (widening applied symmetrically)
- Option 4B - RTC in median (all widening applied on northern side)
- Option 4C - RTC in median (all widening applied on southern side)
- Option 4D - RTC on northern side
- Option 4E - RTC on southern side

The options are shown on sketches 501094-4403-SKT-RR-0304 to 0305 and 501094-4403-SKT-RR-0331 to 0333, which can be found in Appendix A of this technical note

2.6.2 Highways

In terms of the relevant design standards, all options provide a fully compliant cross section width within Section 4, including the addition of 1.0 m width shoulders and a service road, to cater for properties on the northern side.

Options which comprise of the median RTC (4A, 4B and 4C), as well as Option 4E provide a WRSB on the edge of both the carriageways of SH20B for an overall safer environment. On the other hand, Option 4D which includes the RTC on the northern side, is separated from the service road and the eastbound carriageway, by a rigid concrete barrier and therefore, is not as safe as a flexible WRSB. Additionally, it is also considered to be less pleasant, both for potential SUP users, depending on the outcome of the SH20B SUP study currently being undertaken and also for general traffic.

Options 4B and 4D, retain the existing 2.4 m flush median with the WRSB. Both these options also provide an opportunity to retain the early works shared use path on the westbound side. Whereas, Options 4A, 4C and 4E all impact the shared use path, with no opportunity to retain. It is worth nothing, that Options 4B, 4D and 4E would retain the existing swale on the westbound side.

Overall, there does not seem to be any major differentiators between the options.

Table 2-35: Road and RTC Section 4 Highways

	Option 4A RTC in Median (Widening Applied Symmetrically)	**Option 4B** RTC in median (all widening applied on northern side)	**Option 4C** RTC in median (all widening applied on southern side)	**Option 4D** RTC on northern side	**Option 4E** RTC on southern side
Highways					

2.6.3 Traffic / Intersection Performance

Traffic generated by the SWG was assumed to be 1232 and 867 vehicles in and out at Campana in the PM peak based on an assumption for developable area.

The intersection performance results are shown below.

Table 2-36: Road and RTC Section 4 Traffic / Intersection Performance

	Option 4A RTC in Median (Widening Applied Symmetrically)	Option 4B RTC in median (all widening applied on northern side)	Option 4C RTC in median (all widening applied on southern side)	Option 4D RTC on northern side	Option 4E RTC on southern side
Campana Road Intersection	Marginally longer overall delays and queues than the northern RTC Public transport service levels D EB right turn and WB left turn movements needs to be held during RTC green phase.	As per Option 4A (no difference in intersection performance)	As per Option 4A (no difference in intersection performance)	Slightly lower overall delays and shorter queues. Public transport LOS B/D	Longest delays and queues. Public transport LOS D Provides an opportunity for direct access from RTC to the Park and Ride facility LT slip lanes for Campana South cannot be incorporated into the design

The modelling results show that the intersection has a fairly poor level of service (LOS E/F) for all options. This is a result of large flows conflicting between the SH20B through traffic and vehicles accessing the SWG development to the south. As such, performance for the RTC northern alignment is slightly better (LOS E) due to less conflicts between the flows accessing the development to the north and the RTC. Delays on the RTC are also less for this option (LOS B/D). The other options have a LOS F for traffic and D for the RTC.

It should be noted that if airport shuttle buses were to use the busway this would have a negative impact on intersection performance as RTC turning movements into Campana South need to be accommodated requiring a change in signal phasing.

The south-running RTC results in the longest queues and delays of the options assessed. However, it does offer the opportunity to provide direct access form the RTC to the Airport South Park & Ride facility.

An option elevating the RTC over the intersection shows RTC at LOS A (grade separated). However, the intersection performance remains fairly poor (LOS E) due the heavy conflicting traffic flows.

2.6.4 Structures

As no structures are proposed to be modified or installed under the proposed alignment options, there is no differentiator between the options from a structures perspective.

Table 2-37: Road and RTC Section 4 Structures

	Option 4A RTC in Median (Widening Applied Symmetrically)	Option 4B RTC in median (all widening applied on northern side)	Option 4C RTC in median (all widening applied on southern side)	Option 4D RTC on northern side	Option 4E RTC on southern side
Structures					

2.6.5 Geotechnical

Ground conditions across Section 4 comprise embankment fill of variable nature supporting the existing carriageway and infilling historic gullies. Immediately below the carriageway fill is expected a layer of Auckland Volcanic Field Ash. Underlying the ash material is Puketoka formation clays, silts and sands followed by Kaawa formation rock generally comprising sandstone. Groundwater remains at an elevation of approximately 10mRL however the existing carriageway changes from 17mRL (approx.) to 12mRL (approx.) and therefore pavement subsoil and liquefaction effects will need consideration in the lower lying areas.

For Section 4 specifically liquefaction risk and pavement sub soil risk will need to be assessed for all options as earthworks requirements are better understood due to the shallower groundwater level in relation the existing carriageway. This risk will likely be encountered across all options presented.

Within the middle of section 4 is an existing geogrid reinforced earth structure that supports a jet fuel line that will need consideration for all options to the north (Options 4A, 4B and 4D). The geotechnical implications of any widenings to the north may improve the existing retaining structure with placement of additional fill at an appropriate batter to bury the existing wall however ground conditions associated with this are unknown as it is outside the SH20B Short Term Improvement project footprint. The unknown ground conditions associated with the northern widenings and the geotechnical interaction (settlements and displacements) with the jet fuel line may require an engineered solution (pipe protection piles or concrete slabs) and therefore may offset the benefits of improving the existing geogrid reinforced earth structure. All options to the north (4A, 4B and 4D) are therefore considered neutral against one another. The preferred option is to widen to the south (Option 4C and 4E) and avoid filling adjacent to the jet fuel line for the reasons mentioned above. Based on the existing information associated with the SH20B Short Term Improvements project footprint and unknown conditions of Option 4E where widening is further to the south, Options 4C and 4E are neutral against each other.

There are unknown ground risks associated with all options outside of the SH20B Short Term Improvements project footprint. Investigation and design is recommended when the project requirements are better developed.

Table 2-38: Road and RTC Section 4 Geotechnical

	Option 4A RTC in Median (Widening Applied Symmetrically)	Option 4B RTC in median (all widening applied on northern side)	Option 4C RTC in median (all widening applied on southern side)	Option 4D RTC on northern side	Option 4E RTC on southern side
Geotechnical					

2.6.6 Stormwater

Options 4A to 4E propose a 'like for like' replacement of the SW assets between Waokauri Creek West and Orrs Road. Therefore, no notable differentiators are identified between the five options.

Elements that will require further assessment, as a result of potential downstream impacts of the remaining roading corridor include:

- Assets - the potential replacement of the culvert located immediately west of Campana Road, with a more conventional linear culvert arrangement; and
- Treatment and attenuation requirements - the increased number of carriageways requiring treatment will certainly influence the required attenuation storage and treatment prior to discharge. The treatment/attenuation swale (as a result of STIP) will need resizing to ensure it can meet the SMAF attenuation requirements.

Table 2-39: Road and RTC Section 4 Stormwater

	Option 4A RTC in Median (Widening Applied Symmetrically)	**Option 4B** RTC in median (all widening applied on northern side)	**Option 4C** RTC in median (all widening applied on southern side)	**Option 4D** RTC on northern side	**Option 4E** RTC on southern side
Stormwater Quality					
Stormwater Quantity					

2.6.7 Utilities

Options 4B and 4D have the two WOSL jet fuel lines located under trafficable lanes (SH20B/RTC). These would require the realignment. These options however have the least impact on the existing SUP located on the southern side which contains the majority of other utilities. Option 4A would also likely require realignment of the fuel lines, due to lack of cover under the new service road and close proximity to the proposed rope barrier. These lines are considered strategic NZ assets. Relocation of these lines is considered a significant differentiator.

Options 4C and 4E are similar and more acceptable as the two WOSL Jet fuel lines can be maintained under the service road. However, maintaining minimum cover will need to be addressed.

Options 4A, 4C and 4E affect the SUP on the southern side and hence require the relocation of the underlying utilities. The realignment of the IP20 gasmain would likely affect all options.

Options 4C and 4E are preferred with respect to the position of the existing Fuel pipelines and being strategic NZ assets will affect the weighting of considerations.

Table 2-40: Road and RTC Section 4 Utilities

	Option 4A RTC in Median (Widening Applied Symmetrically)	Option 4B RTC in median (all widening applied on northern side)	Option 4C RTC in median (all widening applied on southern side)	Option 4D RTC on northern side	Option 4E RTC on southern side
Utilities					

2.6.8 Environmental / Planning

At the time of writing this technical note, the RTC is to operate as a closed system and therefore not have any stops or stations along this corridor. However, that is not definitive and definitely does not rule out the possibility of this in the future, particularly once the surrounding land develops. Therefore, the accessibility criteria of this assessment has commented on the practicality of gaining access to the RTC within the notional arrangement of the infrastructure elements should this be considered in the future.

On this basis, in terms of social impacts, the options with the RTC located on one side (Options 4D and 4E) of the corridor as opposed to the middle, are slightly more favourable when considering accessibility and health and safety)

All options for Section 4 are considered to be medium risks in terms of natural character and landscape effects, and low risk in terms of visual and urban design effects. Some visual effects would be created on residential properties and some loss of vegetation would occur roadside and in private property areas (including AIAL), although this not deemed significant and therefore there is little to no differentiation in regard to natural character and landscape and visual effects.

In terms of contaminated land, there are no differentiators between the options, all are medium risk. All options require construction over the existing fuel pipeline. Ground conditions near the pipeline have not been thoroughly investigated, and it is considered more likely than not this asset may be a source of soil contamination.

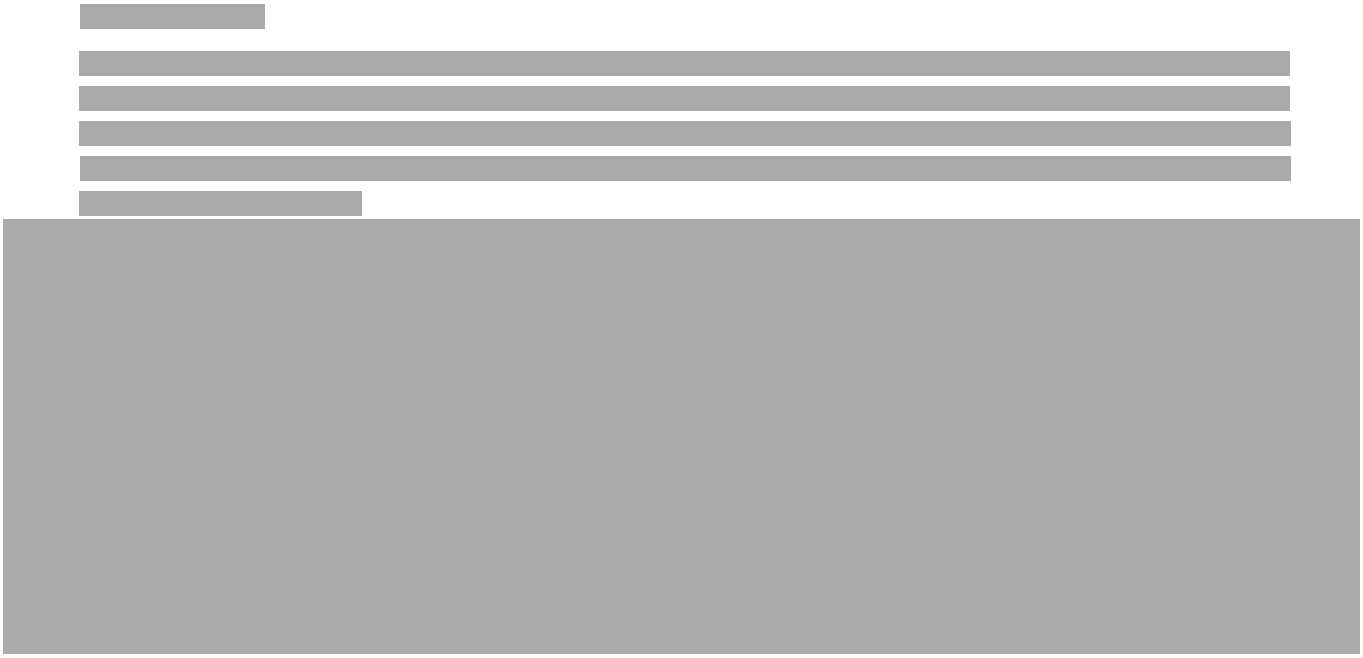
All options also affect a watercourse at the top of a gully system immediately west of Campana Road which is identified as a degraded habitat but has wetland characteristics. There are no other ecological features of note within this section.

In regard to consentability, each option presents relatively the same low risk and therefore no preference for any of the options is provided.

The supporting environmental specialist technical notes are contained at Appendix B.

Table 2-41: Road and RTC Section 4 Environmental / Planning

Discipline	Sub-topic	Criteria	4A	4B	4C	4D	4E
Ecology	Aquatic ecology	Extent, nature and degree of effects on freshwater aquatic ecology, in particular on significant habitats of indigenous fauna and vegetation, and opportunities for ecological restoration and enhancement.					
	Terrestrial ecology	Extent, nature and degree of effects on terrestrial ecology, in particular on significant habitats of indigenous fauna and vegetation, and opportunities for ecological restoration and enhancement.					
	Marine ecology	Extent, nature and degree of effects on marine ecology, in particular on significant habitats of indigenous fauna and vegetation, and opportunities for ecological restoration and enhancement.					
Landscape, visual and urban design	Natural character and landscape	Extent, nature and degree of effects on natural character, features, and landscape.					
	Visual	Extent, nature and degree of effects on visual amenity.					
	Urban design	Extent, nature and degree of effects on urban design, including open space.					
Social/community impact	Accessibility	Extent and degree of effects on the community concerning accessibility to/from facilities, services, properties and businesses.					
	Community	Extent and degree of change to groups and activities, including sense of community and to known aspirations and plans.					
	Health and safety	Extent and degree of effects on human health and safety.					
Contaminated land	Contamination management - soil	Potential to encounter and ability to manage the effects of contaminated soils on human health and the environment.					
	Contamination management - groundwater	Potential to encounter and ability to manage the effects of groundwater on human health and the environment.					
Consentability	Consentability	Level of complexity of gaining approvals (e.g. activity status, risk of appeal, accordance with policy direction). Level of compliance with regulatory plans e.g. could the option include activities which are prohibited/ non-complying under the policies and rules of the district or regional plan?					



2.6.10 Construction Disruption

Option 4A retains the existing crown position, allowing the median RTC and the rest of the carriageway to be constructed, by extension of crossfall and without any pavement shape correction. However, Option 4A does require online widening works on both sides of the carriageway as well as a full rebuild of the Campana Road intersection. This would require additional TTM phases and therefore, results in greater disruption to traffic.

On the other hand, the remaining four options (Options 4B, 4C, 4D and 4E) retain at least two of the short-term traffic lanes and therefore, require fewer TTM phases, compared to Option 4A.

Options 4B and 4C are both considered to be moderately disruptive, as the addition of a median RTC results in relatively extensive pavement shape correction and overlay, as well as requiring a partial rebuild of the Campana Road intersection. However, both these factors result in fewer TTM phases, compared to Option 4A.

Options 4D and 4E score comparatively higher as they have the least associated abortive works from the short-term works. Both options provide the opportunity to retain the existing crown position, thereby, allowing extension of crossfall with no pavement shape correction required. Although, Option 4E requires removal / conversion of the left turn slip lane into Prices Road on the southern side to accommodate the RTC. Additionally, with offline construction of the RTC, both options require no widening works on SH20B, consequently requiring no additional TTM phases. The main differentiator between the two options is that Option 4D requires rebuild of the Campana Road intersection northern arm, whereas Option 4E requires rebuild of the of the Prices Road intersection southern arm. Option 4E is seen to be more disruptive for all users in terms of access to and from the Park and Ride facility. Whereas, Option 4D is considered to be the least disruptive amongst all options, as it retains the entire existing pavement and limits widening works to one side of the carriageway.

Options 4B and 4D which have widening applied on the northern side, allow retention of the early works SUP on the westbound side, minimising disruption for pedestrians and cyclists, during and post construction. Whereas, the remaining three options results in abortive works for the shared use path. However, this is not considered to have an impact on the scoring, as a separate study and MCA will be undertaken to determine the location of the shared use path.

A potential reduction in speed limits, with temporary lane closures and installation of temporary safety barriers is likely to cause significant disruption to turning movements within the Campana Road intersection. Due to the proximity of Campana Road intersection to the Auckland International Airport, it would be ideal to limit online widening as far as practicable and therefore, Option 4A has been scored negatively. Overall, Option 4D and 4E are considered to be the least disruptive and hence, they have been scored as the most favourable Options.

The ability to retrofit a RTC station at Prices Road at any point in the future is significantly disadvantaged, if a median RTC Option (Options 4A, 4B or 4C) is progressed and constructed. Evidently, it would be less disruptive to provide an RTC station for Options 4E and 4D, where the RTC is situated on the edge of the intersection / carriageway.

Table 2-43: Road and RTC Section 4 Construction Disruption

	Option 4A RTC in Median (Widening Applied Symmetrically)	**Option 4B** RTC in median (all widening applied on northern side)	**Option 4C** RTC in median (all widening applied on southern side)	**Option 4D** RTC on northern side	**Option 4E** RTC on southern side
Construction Disruption					

2.6.11 Cost

The cost of the civils works for each option will be reasonably similar. The majority of the cost difference is likely to come from constructability issues such as Temporary Traffic Management (TTM) and programme. However, the magnitude of cost difference compared to the overall cost of the corridor works is low and therefore, the options are considered neutral.



2.6.12 Option Summary

A summary of the main considerations for each option are presented and compared in **Error! Reference source not found.** below:

Table 2-45: Road and RTC Section 4 Option Summary

	Option 4A RTC in Median (Widening Applied Symmetrically)	**Option 4B** RTC in median (all widening applied on northern side)	**Option 4C** RTC in median (all widening applied on southern side)	**Option 4D** RTC on northern side	**Option 4E** RTC on southern side
Highways					
Traffic / Intersection Performance					
Structures					
Geotechnical					
Stormwater					
Utilities					
Environmental / Planning					
Property					
Construction Disruption					
Cost					

Based on the above assessment, Options 4D and 4E are reasonably evenly matched. Option 4D requires realignment of the jet fuel lines which is considered a significant issue. Option 4E avoids the fuel lines, but results in a reduction in performance of Campana Road intersection.

2.7 Preferred Option

2.7.1 Section 1: SH20/20B Interchange to Manukau Memorial Gardens (inc SH20/20B interchange)

Option 1C is preferred which places the RTC in the median, with all widening applied on the southern side.

2.7.2 Section 2: Manukau Memorial Gardens to Waokauri Creek (inc MMG intersection)

Option 2E is preferred which places the RTC on the southern side of SH20B, with all widening applied on the southern side.

2.7.3 Section 3: Waokauri Creek

Option 3C is preferred which provides a new bridge at Waokauri Creek on the south side of the existing alignment. The configuration of the cross section in Section 3, such as location of the RTC, will be determined by the adjacent sections.

2.7.4 Section 4: Waokauri Creek to Orrs Road (inc Campana Road intersection)

Options 4D and 4E which place the RTC on the northern and southern sides respectively are reasonably evenly matched.

Option 4E would align well with the preferred option in section 2.

Option 4D would require the RTC to move to the northern side at the Manukau Memorial Gardens intersection. This would also require Option 2D to be selected, which would result in significant property and stormwater impacts. In addition, SIDRA modelling was undertaken to investigate how the transition of the RTC from the median in section 1 to the northern side in sections 2/4 would affect intersection performance at Memorial Gardens.

Table 2-46: SH20B/RTC Memorial Gardens Intersection Performance

	RTC Transition to North Side (Options 2D,4D)	RTC Transition to South Side (Options 2E,4E)
MMG Intersection Performance	Overall LOS E, PT LOS E/F	Overall LOS C PT LOS E/F

As shown above, adopting Option 4D would result in a significant impact to the performance of the Manukau Memorial Gardens intersection. Therefore, Option 4E is preferred.

2.7.5 Other Considerations

The airport terminal is located to the south of SH20B / Puhinui Road. Whilst the network within the AIAL road controlling authority has yet to be confirmed, it is anticipated that an RTN on the south side of SH20B would remove the need to cross Puhinui Road to access the terminal. This would further support the preferred option 4E.

3 SH20B Walking & Cycling

3.1 General

For the purpose of this assessment, the SH20B corridor has been split into the following three sections as follows:

- Section 1: SH20/20B Interchange to Manukau Memorial Gardens (including SH20/20B interchange)
- Section 2: Manukau Memorial Gardens to Campana Road (inc MMG intersection)
- Section 3: Campana Road to Orrs Road (inc Campana Road intersection)

3.2 Design Assumptions

The following assumptions have been made when developing and assessing all options:

- No stations are required on the RTC within the study extents.

3.2.1 Walking & Cycling Facility

The facility provided is a 3.0m wide SUP with a 1.0m edge shoulder on both sides. Further discussion on the form of this facility can be found in technical note no. 501094-4401-KK-0017.

At the time of writing this technical note, connections will be required to the segregated footpaths and cycle paths proposed by the Airport to Botany project on Puhinui Road. A connection will also be required to the SUP proposed in the SH20 corridor.

Segregated walking and cycling facilities directly adjacent to the SH20B carriageway in accordance with the Auckland Council Transport Design Manual (TDM) were considered. However, the posted speed of SH20B may be as high as 80km/h which would result in a hostile environment. In addition, constructing these details would require the safety barriers, stormwater and street lighting on SH20B to be replaced.

3.3 Section 1: SH20/20B Interchange to Manukau Memorial Gardens (including SH20/20B interchange)

3.3.1 Options Assessed

The options assessed in Section 1 are as follows:

- Option 1A – SUP on northern side (retention of existing)
- Option 1B – SUP on southern side + northern side (retention of existing)

The options are shown on sketches 501094-4403-SKT-RR-0368 to 0370 and 501094-4403-SKT-RR-0388 to 0390, which can be found in Appendix C of this technical note.

3.3.2 Highways

Both options provide SUPs with the same compliant width. Whilst the SUP on the northern side has reduced shoulders compared to the southern side, this is not considered a significant differentiator.

Option 1B would provide a safer outcome, allowing on-road cyclists travelling westbound through the SH20 / SH20B interchange to leave the carriageway and use the SUP to avoid conflict with general traffic.

Option 1B would also provide an improved user experience, avoiding the need to cross Puhinui Road / SH20B at multiple locations when travelling to/from the airport. These crossings will require multiple stages for optimal signal phasing, which will result in further delays for pedestrians and cyclists.

Table 3-1: Walking & Cycling Section 1 Highways

	Option 1A **SUP on northern side (retention of existing)**	**Option 1B** **SUP on southern side + northern side (retention of existing)**
Highways		

3.3.3 Traffic / Intersection Performance

Access Requirements for All Options

In addition to provision for the SUP, there are a number of active mode access requirements for this intersection that apply to both options:

- Active mode connections are required to the SH20 SUP which traverses the east side of the SH20 southbound off ramp and terminates in the north-east corner of this intersection.

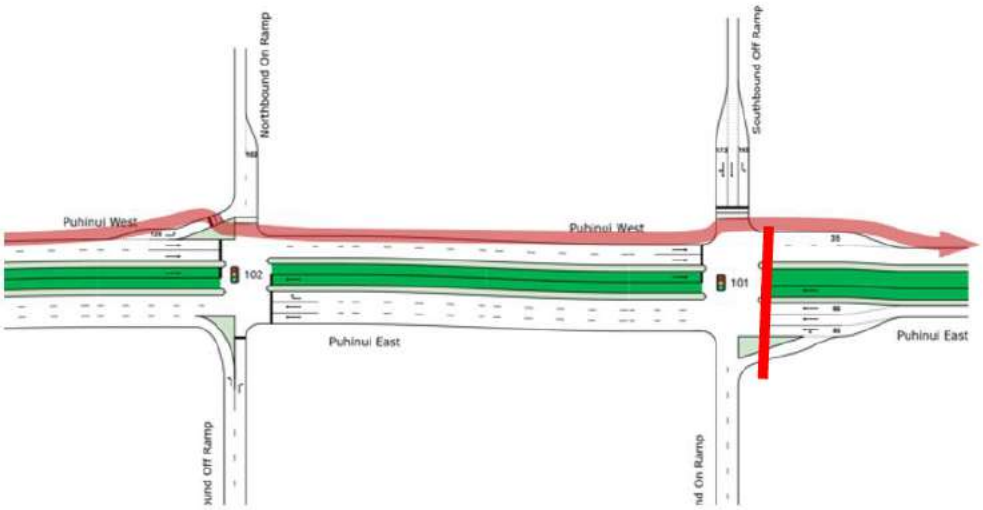
- Active mode provision to the east of the intersection are likely to be unidirectional facilities along the north and south sides of Puhinui Road

As such a north-south connection is required to the east of the intersection. This crossing needs to be staggered between the traffic approaches and the RTC in order to allow for efficient signal phasing.

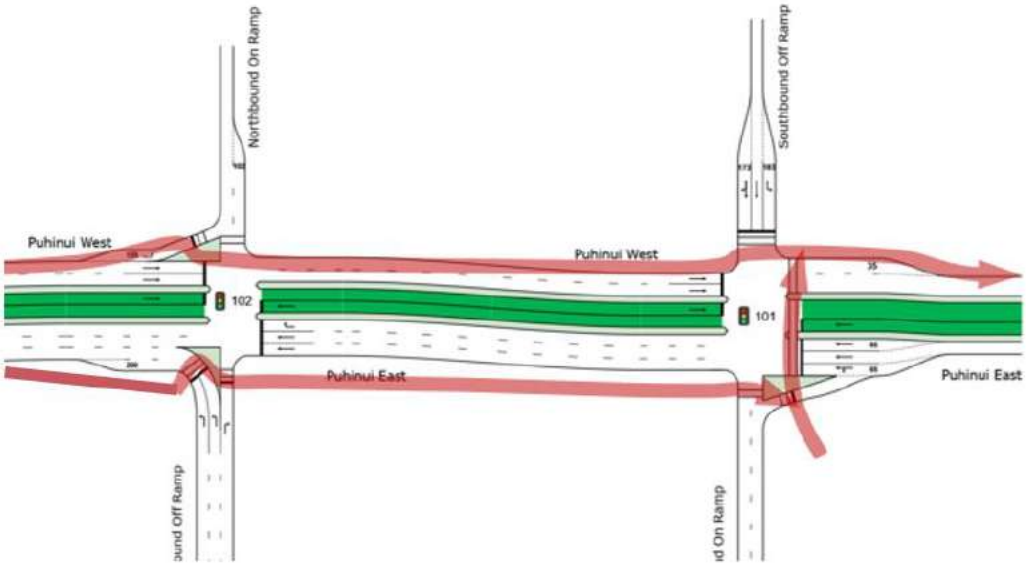
SUP Location

The two options were tested in SIDRA runs as follows:

Option 1A SUP on northern side (retention of short term alignment)



Option 1B SUP on northern side (retention of short term alignment) and southern side



The results show that Option 1A performs better with regard to intersection performance.

Option 1B is also a feasible layout if the airport -bound SH20 northbound off ramp is widened to a two-lane approach prior to the crossing. Keeping the left turn as a one lane approach would cause significant queuing. Option 1B degrades intersection performance slightly compared to Option 1A due to the provision for more active mode movements.

Table 3-2: Walking & Cycling Section 1 Traffic / Intersection Performance

	Option 1A **SUP on northern side (retention of existing)**	**Option 1B** **SUP on southern side + northern side (retention of existing)**
Traffic / Intersection Performance	Acceptable effects on traffic queues as active mode movements run with traffic in most cases.	Slightly worse intersection performance compared to option 1A

3.3.4 Structures

As no structures are proposed to be modified or installed under the proposed alignment options, there is no differentiator between the options from a structures perspective.

Table 3-3: Walking & Cycling Section 1 Structures

	Option 1A **SUP on northern side (retention of existing)**	**Option 1B** **SUP on southern side + northern side (retention of existing)**
Structures		

3.3.5 Geotechnical

Option 1B will require additional widening into the gully on the southern side. However, this would only represent a relatively small increase over and above the proposed road / RTC works and therefore is not considered to be a significant differentiator based on the information currently available. See the geotechnical comments on the proposed road / RTC works for Section 1 for more details.

Table 3-4: Walking & Cycling Section 1 Geotechnical

	Option 1A **SUP on northern side (retention of existing)**	**Option 1B** **SUP on southern side + northern side (retention of existing)**
Geotechnical	Geotechnically no different to proposed road / RTC	

3.3.6 Stormwater

Existing stormwater assets would be impacted by the proposed road / RTC works, and therefore Option 1B would have no further effect.

Based on the above, there is not considered to be any significant differences between the options in terms of water quality performance or water quantity / attenuation performance.

Table 3-5: Walking & Cycling Section 1 Stormwater

	Option 1A SUP on northern side (retention of existing)	Option 1B SUP on southern side + northern side (retention of existing)
Stormwater Quality	The addition of a SUP does not have an impact on stormwater quality. No treatment is required for the SUP runoff	
Stormwater Quantity	No differentiators identified.	

3.3.7 Utilities

Both options would allow the utilities under the existing SUP on the northern side to be retained.

Table 3-6: Walking & Cycling Section 1 Utilities

	Option 1A SUP on northern side (retention of existing)	Option 1B SUP on southern side + northern side (retention of existing)
Utilities		

3.3.8 Environmental / Planning

Section 1 presents two options. Option 1A involves the retention of the existing SUP on the northern side of SH20B. Given this is a 'do - nothing' option, and will not result in any effects, all assessments rate it low risk.

Option 1B involves the retention of the existing SUP on the northern side, and a new SUP on the southern side of SH20B. As the existing SUP on the northern side does not involve proposed works, the technical memorandums have focussed on the addition of the new SUP on the southern side of SH20B. The key points made by the technical specialists include:

- It is low risk in terms of contaminated land.
- It is low risk in terms of all social impacts, and is considered advantageous due to the increase in continual access, connectivity and reduced complexity of crossing Puhinui Interchange;
- It is low risk in terms of all landscape and visual effects. While it increases the overall width of the corridor there in an increase in connectivity, an opportunity for planting and an increase in natural character.
- From an ecological perspective, the inclusion of the SUP on the southern side may require modification of the cross culvert (located at approximately CH 2770) which may result in effects on its freshwater habitat.

The positive effects generated from the inclusion of the additional SUP potentially outweigh any additional adverse effects. Therefore, it is considered low risk in regard to consentability.

Table 3-7: Walking & Cycling Section 1 Environmental / Planning

Discipline	Sub-topic	Criteria	1A	1B
Ecology	Aquatic ecology	Extent, nature and degree of effects on freshwater aquatic ecology, in particular on significant habitats of indigenous fauna and vegetation, and opportunities for ecological restoration and enhancement.		
	Terrestrial ecology	Extent, nature and degree of effects on terrestrial ecology, in particular on significant habitats of indigenous fauna and vegetation, and opportunities for ecological restoration and enhancement.		
	Marine ecology	Extent, nature and degree of effects on marine ecology, in particular on significant habitats of indigenous fauna and vegetation, and opportunities for ecological restoration and enhancement.		
Landscape, visual and urban design	Natural character and landscape	Extent, nature and degree of effects on natural character, features, and landscape.		
	Visual	Extent, nature and degree of effects on visual amenity.		
	Urban design	Extent, nature and degree of effects on urban design, including open space.		
Social/community impact	Accessibility	Extent and degree of effects on the community concerning accessibility to/from facilities, services, properties and businesses.		
	Community	Extent and degree of change to groups and activities, including sense of community and to known aspirations and plans.		
	Health and safety	Extent and degree of effects on human health and safety.		
Contaminated land	Contamination management - soil	Potential to encounter and ability to manage the effects of contaminated soils on human health and the environment.		
	Contamination management - groundwater	Potential to encounter and ability to manage the effects of groundwater on human health and the environment.		
Consentability	Consentability	Level of complexity of gaining approvals (e.g. activity status, risk of appeal, accordance with policy direction). Level of compliance with regulatory plans e.g. could the option include activities which are prohibited/ non-complying under the policies and rules of the district or regional plan?		



3.3.10 Construction Disruption

Option 1B would result in works constructed offline with minimal additional disruption to general traffic over and above the proposed road / RTC works. Whilst some minor disruption would result from constructing the crossings on the existing SH20 / SH20B interchange ramps, these ramps are already being altered as part of the road / RTC works. Option 1A would require no additional works.

Table 3-9: Walking & Cycling Section 1 Construction Disruption

	Option 1A SUP on northern side (retention of existing)	Option 1B SUP on southern side + northern side (retention of existing)
Construction Disruption		

3.3.11 Cost

Option 1B would result in additional costs. However, these additional costs are not considered significant given the overall cost of the SH20B corridor works.

Table 3-10: Walking & Cycling Section 1 Cost

	Option 1A SUP on northern side (retention of existing)	Option 1B SUP on southern side + northern side (retention of existing)
Cost		

3.3.12 Option Summary

A summary of the main considerations for each option are presented and compared in **Table 3-11** below:

Table 3-11: Walking & Cycling Section 1 Option Summary

	Option 1A SUP on northern side (retention of existing)	Option 1B SUP on southern side + northern side (retention of existing)
Highways		
Traffic / Intersection Performance		
Structures		
Geotechnical		
Stormwater		
Utilities		
Environmental / Planning		
Property		
Construction Disruption		
Cost		

Based on the above assessment, Option 1A would be preferred However, based on the improved safety of the SUP users through the SH20 / SH20B interchange and the added convenience of avoiding multiple crossings of Puhinui Road / SH20B, Option 1B is preferred. In order to mitigate the effects of a signalised crossing at the braided ramp northbound to SH20B westbound movement, two left turn lanes are recommended.

3.4 Section 2: Manukau Memorial Gardens to Campana Road (inc MMG intersection)

3.4.1 Options Assessed

The options assessed in Section 2 are as follows:

- Option 2A – SUP on northern side (northern side of service road + demolition of existing SUP bridge)
- Option 2B – SUP on northern side (southern side of service road + retention of existing SUP bridge)
- Option 2C – SUP on southern side (demolition of existing SUP bridge)

The options are shown on sketches 501094-4403-SKT-RR-0365 to 0368, 501094-4403-SKT-RR-0375 to 0378 and 501094-4403-SKT-RR-0385 to 0388, which can be found in Appendix C of this technical note.

3.4.2 Highways

All options provide SUPs with the same compliant width.

Options 2A and 2B would result in the SUP running adjacent to the service road and live traffic. Option 2C would result in a slightly safer outcome with the SUP being fully segregated from live traffic.

Table 3-12: Walking & Cycling Section 2 Highways

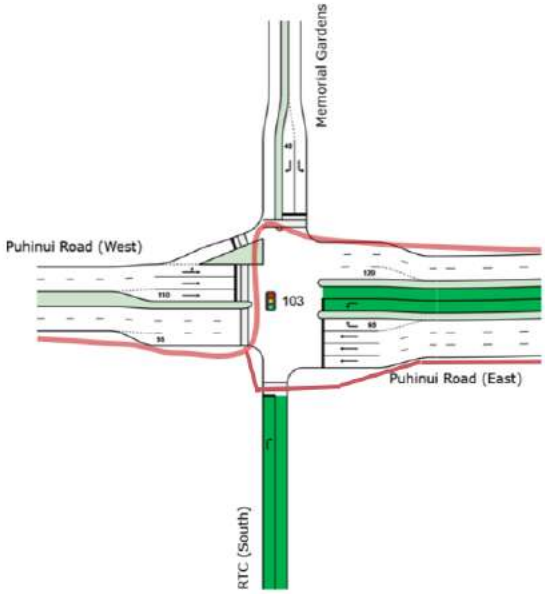
	Option 2A SUP on northern side (northern side of service road + demolition of existing SUP bridge)	Option 2B SUP on northern side (southern side of service road + retention of existing SUP bridge)	Option 2C SUP on southern side (demolition of existing SUP bridge)
Highways			

3.4.3 Traffic / Intersection Performance

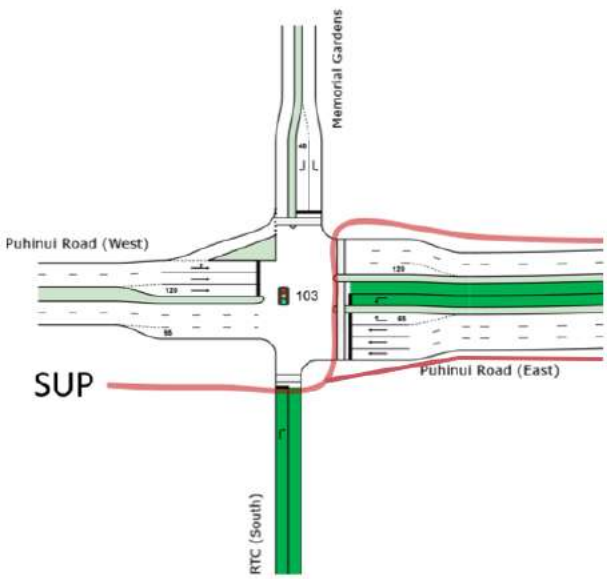
Access Requirements for All Options

A north-south connection across SH20B is required to allow access to Manukau Memorial Gardens. Modelling was undertaken to establish whether the east or west side of the intersection is most efficient.

Crossing on the west side



Crossing on the east side



The SIDRA modelling shows minimal difference in intersection performance between these options and the two options are very similar in traffic terms. The short-term improvements will have a crossing on the east side of Memorial Gardens. However, upon construction of the RTC, locating the crossing on the west side requires less land take for the staggered crossing across SH20B and the busway. Therefore this is recommended.

SUP Location

Based on the above, crossings are required on the North, South and West intersection approaches for connectivity. Therefore, the location of the SUP to the west of the intersection has the same traffic performance regardless of whether it is located to the north or south of the highway.

Table 3-13: Walking & Cycling Section 2 Traffic / Intersection Performance

	Option 2A SUP on northern side (northern side of service road + demolition of existing SUP bridge)	Option 2B SUP on northern side (southern side of service road + retention of existing SUP bridge	Option 2C SUP on southern side (demolition of existing SUP bridge)
Traffic / Intersection Performance	Same LOS for all options	Same LOS for all options	Same LOS for all options

3.4.4 Structures

Option 2A places the SUP on the existing SH20B road bridge by utilising existing deck width and demolishes the existing SUP bridge. Option 2B utilises the existing SUP bridge. Option 2C requires additional width on the new bridge carrying SH20B and the RTC and demolishing the existing SUP bridge. From a structures technical perspective, there are no significant differentiators between the options.

Table 3-14: Walking & Cycling Section 2 Structures

	Option 2A SUP on northern side (northern side of service road + demolition of existing SUP bridge)	Option 2B SUP on northern side (southern side of service road + retention of existing SUP bridge)	Option 2C SUP on southern side (demolition of existing SUP bridge)
Structures	Reuse of the existing Waokauri Creek bridge for the SUP by use of a raised kerb or separation by raised median. Additional load effects to be confirmed during detail design.	Minimises new bridge area, retains existing SUP bridge	Maximises the new bridge area and abortive works

3.4.5 Geotechnical

In lieu of ground investigations outside of the SH20B Short Term Improvements project footprint, there is no preferred option from a geotechnical perspective as all options will likely encounter similar geotechnical risks. See the geotechnical comments on the proposed road / RTC works for Section 2 for more details.

The risks associated with these identified ground conditions are expected to be managed through investigation and design during the implementation process. Investigation and design is recommended when the project requirements are better developed.

Due to the relatively consistent nature of the expected geology across all the proposed options, and the exclusion of earthworks considerations in this MCA, geotechnical effects are considered neutral on all options based on the information currently available.

Table 3-15: Walking & Cycling Section 2 Geotechnical

	Option 2A SUP on northern side (northern side of service road + demolition of existing SUP bridge)	Option 2B SUP on northern side (southern side of service road + retention of existing SUP bridge)	Option 2C SUP on southern side (demolition of existing SUP bridge)
Geotechnical	Ground conditions need further investigation – there could be unknown risks		

3.4.6 Stormwater

Existing stormwater assets would be impacted by the proposed road / RTC works, and therefore the options would have no further effect.

Based on the above, there is not considered to be any significant differences between the options in terms of water quality performance or water quantity / attenuation performance.

Table 3-16: Walking & Cycling Section 2 Stormwater

	Option 2A SUP on northern side (northern side of service road + demolition of existing SUP bridge)	Option 2B SUP on northern side (southern side of service road + retention of existing SUP bridge)	Option 2C SUP on southern side (demolition of existing SUP bridge)
Stormwater Quality	The addition of a SUP does not have an impact on stormwater quality. No treatment is required for the SUP runoff		
Stormwater Quantity	No differentiators identified.		

3.4.7 Utilities

Minimising relocation of utilities is beneficial for any option. All the options have similar overall impact on utilities.

Table 3-17: Walking & Cycling Section 2 Utilities

	Option 2A SUP on northern side (northern side of service road + demolition of existing SUP bridge)	Option 2B SUP on northern side (southern side of service road + retention of existing SUP bridge)	Option 2C SUP on southern side (demolition of existing SUP bridge)
Utilities			

3.4.8 Environmental / Planning

From a coastal processes perspective, there are no differentiators except in relation to construction effects on the coastal marine area (CMA). Options 2A and 2B, which involve extending the SUP footprint to the north, result in additional potential construction effects at Waokauri Creek East and West. Therefore, Option 2C is preferred in terms of construction effects on the CMA.

There are no differentiators among the options regarding terrestrial ecology, all are medium risk. Regarding freshwater ecology, Option 2C does score slightly less favourably due to the possible intrusion into a wetland habitat, the potential crossing of a stream and that it may require modification of the culvert at Waokauri Creek West. In comparison, Option 2B proposes no additional effects due to the use of the existing SUP bridge and Option 2A has a reduction of effects as a result of the SUP utilising the existing bridge. In addition, the demolition of the existing SUP bridge for Options 2A and 2C requires construction activities within the CMA. Consequently, Option 2B is preferred as it retains the existing SUP bridge and has no further effect on marine ecology.

There are no differentiators in terms of contaminated land, all options are low risk in terms of groundwater and medium risk in terms of soil. This is because potential contaminating activities have been identified for the additional areas not previously assessed. In particular, the south western corner of the Memorial Gardens intersection which requires further investigation.

In terms of landscape and visual effects, Option 2A is medium risk for all measures. Option 2B is medium risk in terms of visual effects and urban design, due to CPTED issues but low risk in terms of natural character as retains amenity planting along the Memorial Gardens boundary. Option 2C is low risk for all landscape and visual effects, as it avoids further encroachment into Memorial Gardens and retains amenity planting along the boundary. Option 2C also provides better urban design outcomes and opportunities comparatively due to the alignment being more direct (for faster cycle use) and a reduction in of potential crime prevention through environmental design (CPTED) issues.

There are no differentiators in terms of social impacts. All options are low risk in terms of accessibility and community and medium risk in terms of health and safety due to the crossing at Campana Road.

From a consentability point of view, all options present similar levels of risk when taking into account the effects already considered as part of the road and RTC alignment study. None of the options present any significant planning issues however, given the social, landscape, visual and urban design benefits of Option 2C, it is considered that this option is preferred.

Table 3-18: Walking & Cycling Section 2 Environmental / Planning

Discipline	Sub-topic	Criteria	2A	2B	2C
Ecology	Aquatic ecology	Extent, nature and degree of effects on freshwater aquatic ecology, in particular on significant habitats of indigenous fauna and vegetation, and opportunities for ecological restoration and enhancement.			
	Terrestrial ecology	Extent, nature and degree of effects on terrestrial ecology, in particular on significant habitats of indigenous fauna and vegetation, and opportunities for ecological restoration and enhancement.			
	Marine ecology	Extent, nature and degree of effects on marine ecology, in particular on significant habitats of indigenous fauna and vegetation, and opportunities for ecological restoration and enhancement.			

Discipline	Sub-topic	Criteria	2A	2B	2C
Coastal Processes	Construction effects on CMA	Extent of temporary effects on coastal physical processes.			
	Geomorphology/ sedimentation & tidal flows	Extent of permanent effects on coastal physical processes, including effects of geomorphology, exacerbating sedimentation and changes in tidal and storm-tide flows in the upper creeks.			
	Sea-level rise and coastal climate change	Extent of increasing impacts on coastal physical processes from sea-level rise and climate change, including vulnerability of the works (present and proposed) and opportunities to improve resilience.			
Landscape, visual and urban design	Natural character and landscape	Extent, nature and degree of effects on natural character, features, and landscape.			
	Visual	Extent, nature and degree of effects on visual amenity.			
	Urban design	Extent, nature and degree of effects on urban design, including open space.			
Social/community impact	Accessibility	Extent and degree of effects on the community concerning accessibility to/from facilities, services, properties and businesses.			
	Community	Extent and degree of change to groups and activities, including sense of community and to known aspirations and plans.			
	Health and safety	Extent and degree of effects on human health and safety.			
Contaminated land	Contamination management - soil	Potential to encounter and ability to manage the effects of contaminated soils on human health and the environment.			
	Contamination management - groundwater	Potential to encounter and ability to manage the effects of groundwater on human health and the environment.			
Consentability	Consentability	Level of complexity of gaining approvals (e.g. activity status, risk of appeal, accordance with policy direction). Level of compliance with regulatory plans e.g. could the option include activities which are prohibited/ non-complying under the policies and rules of the district or regional plan?			



3.4.10 Construction Disruption

All options would result in works constructed offline with minimal additional disruption to general traffic over and above the proposed road / RTC works.

Option 2C may require the existing SUP bridge being demolished prior to the new SUP crossing at Waokauri Creek, interrupting pedestrian and cyclist access. Options 2A and 2B are more likely to retain a crossing of Waokauri Creek during construction. Demolition of the existing SUP will also result in some disruption for Options 2A and 2C.

Table 3-20: Walking & Cycling Section 2 Construction Disruption

	Option 2A **SUP on northern side (northern side of service road + demolition of existing SUP bridge)**	**Option 2B** **SUP on northern side (southern side of service road + retention of existing SUP bridge)**	**Option 2C** **SUP on southern side (demolition of existing SUP bridge)**
Construction Disruption			

Table 3-21: Walking & Cycling Section 2 Cost

	Option 2A SUP on northern side (northern side of service road + demolition of existing SUP bridge)	Option 2B SUP on northern side (southern side of service road + retention of existing SUP bridge)	Option 2C SUP on southern side (demolition of existing SUP bridge)
Cost			

3.4.12 Option Summary

A summary of the main considerations for each option are presented and compared in **Table 3-22** below:

Table 3-22: Walking & Cycling Section 2 Option Summary

	Option 2A SUP on northern side (northern side of service road + demolition of existing SUP bridge)	Option 2B SUP on northern side (southern side of service road + retention of existing SUP bridge)	Option 2C SUP on southern side (demolition of existing SUP bridge)
Highways			
Traffic / Intersection Performance			
Structures			
Geotechnical			
Stormwater			
Utilities			
Environmental / Planning			
Property			
Construction Disruption			
Cost			

Based on the above assessment, Option 2C provides the most appropriate balance of the issues.

3.5 Section 3: Campana Road to Orrs Road (inc Campana Road intersection)

3.5.1 Options Assessed

The options assessed in Section 3 are as follows:

- Option 3A – SUP on northern side (northern side of service road)

- Option 3B – SUP on northern side (southern side of service road)
- Option 3C – SUP on southern side (southern side of RTC)
- Option 3D – SUP on southern side (retention of existing)

The options are shown on sketches 501094-4403-SKT-RR-0364 to 0365, 501094-4403-SKT-RR-0374 to 0375, 501094-4403-SKT-RR-0384 to 0385 and 501094-4403-SKT-RR-0394 to 0395, which can be found in Appendix C of this technical note.

3.5.2 Highways

All options provide SUPs with the same compliant width.

Options 3A and 3B would result in the SUP running adjacent to the service road and live traffic. Options 3C and 3D would result in a slightly safer outcome with the SUP being fully segregated from live traffic.

Table 3-23: Walking & Cycling Section 3 Highways

	Option 3A **SUP on northern side (northern side of service road)**	**Option 3B** **SUP on northern side (southern side of service road)**	**Option 3C** **SUP on southern side (southern side of RTC)**	**Option 3D** **SUP on southern side (retention of existing)**
Highways				

3.5.3 Traffic / Intersection Performance

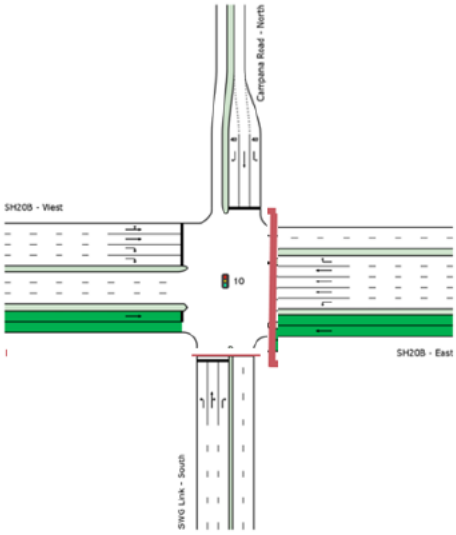
Access Requirements for All Options

The service road connecting to the northern arm of the intersection serves local access and traffic requirements of this area. In order to adequately serve active modes connecting to the service road a crossing is required across the northern arm of the intersection.

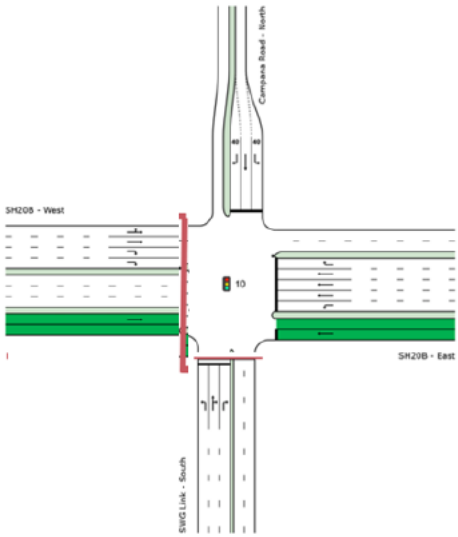
A further crossing is likely to be required across the south of the intersection to connect to the footways and cycle facilities on the perimeter of the Park and Ride facility.

Additionally, a north-south link for active modes is required near the park and ride, to provide safe access across SH20B. A staggered crossing would be required in all cases due to the large crossing distance across SH20B and the need to maintain a reasonable level of service for traffic. Two options were tested:

Staggered Crossing on east side



Staggered crossing on west side



The results show that locating the crossing on the east side of the intersection is better than the west side. This option is slightly better as it does not conflict with heavy right turn from SH20B eastbound into Campana Road to the south.

In addition, a qualitative review of providing a Mid-block staggered crossing 200m west of Campana intersection was considered.

In traffic terms a midblock crossing adjacent to the park and ride allows the Campana Intersection to operate more efficiently but requires another set of signals close to the Campana intersection and adds additional delays when the crossing is activated. However, this will require a lengthy diversion for many of the active mode movements. For these reasons this option is not recommended.

SUP Location

Due to the crossings required as discussed above, the SUP can be provided at either the north or south of the intersection without any additional crossings. The location of the SUP is therefore neutral in traffic terms.

Table 3-24: Walking & Cycling Section 3 Traffic

	Option 3A SUP on northern side (northern side of service road)	Option 3B SUP on northern side (southern side of service road)	Option 3C SUP on southern side (southern side of RTC)	Option 3D SUP on southern side (retention of existing)
Traffic				

3.5.4 Structures

As no structures are proposed to be modified or installed under the proposed alignment options, there is no differentiator between the options from a structures perspective.

Table 3-25: Walking & Cycling Section 3 Structures

	Option 3A SUP on northern side (northern side of service road)	Option 3B SUP on northern side (southern side of service road)	Option 3C SUP on southern side (southern side of RTC)	Option 3D SUP on southern side (retention of existing)
Structures				

3.5.5 Geotechnical

In lieu of ground investigations outside the SH20B Short Term Improvements project footprint, there is no preferred option from a geotechnical perspective as all options will likely encounter similar geotechnical risks. We note that liquefaction potential was negligible in the SH20B detailed design, this may not hold for the options presented, site investigations would be required to confirm the seismic requirements. See the geotechnical comments on the proposed road / RTC works for Section 3 for more details.

The risks associated with these identified ground conditions are expected to be managed through investigation and design during the implementation process. Investigation and design is recommended when the project requirements are better developed.

Due to the relatively consistent nature of the expected geology across all the proposed options, and the exclusion of earthworks considerations in this MCA, geotechnical effects are considered neutral on all options based on the information currently available.

Table 3-26: Walking & Cycling Section 3 Geotechnical

	Option 3A SUP on northern side (northern side of service road)	Option 3B SUP on northern side (southern side of service road)	Option 3C SUP on southern side (southern side of RTC)	Option 3D SUP on southern side (retention of existing)
Geotechnical				

3.5.6 Stormwater

Existing stormwater assets would be impacted by the proposed road / RTC works, and therefore the options would have no further effect.

Based on the above, there is not considered to be any significant differences between the options in terms of water quality performance or water quantity / attenuation performance.

Table 3-27: Walking & Cycling Section 3 Stormwater

	Option 3A SUP on northern side (northern side of service road)	Option 3B SUP on northern side (southern side of service road)	Option 3C SUP on southern side (southern side of RTC)	Option 3D SUP on southern side (retention of existing)
Stormwater Quality	The addition of a SUP does not have an impact on stormwater quality. No treatment is required for the SUP runoff			
Stormwater Quantity	No differentiators identified.			

3.5.7 Utilities

Option 3D would allow the utilities under the existing SUP on the southern side to be retained. All other options would require relocation of those utilities.

Table 3-28: Walking & Cycling Section 3 Utilities

	Option 3A SUP on northern side (northern side of service road)	Option 3B SUP on northern side (southern side of service road)	Option 3C SUP on southern side (southern side of RTC)	Option 3D SUP on southern side (retention of existing)
Utilities				

3.5.8 Environmental / Planning

Section 3 presents four options and extends between Campana Road intersection and Orrs Road intersection.

There are no differentiating factors in relation to ecology and coastal processes. However, in terms of ecological effects, it is noted that Options 3A and 3B require minor encroachment into the upper headwaters of a watercourse west of Campana Road (that is already being impacted by the road and RTC elements).

There are no differentiators in terms of contaminated land, all options are low risk. All options include additional agricultural areas where potentially contaminating activities are and have historically been undertaken.

Section 3 does not provide many differentiators from a social impact perspective other than Option 3D being slightly less favourable due to the SUP location restricting north-south accessibility due to its location between the RTC and roading elements.

In terms of landscape and visual effects, Option 3A and 3C are low risk for all measures. All options are low risk in terms of visual effects. Options 3B and 3D are considered medium risk in terms of natural character and landscape effects as they place the SUP between roading infrastructure and restrict planting opportunities. This impacts Option 3D to the extent that it is considered high risk on terms of urban design as it would diminish the user experience and pose safety and CPTED concerns being located between SH20B carriageway and the busway.

In terms of social impacts, all options are low risk in terms of community and medium risk in terms of health and safety. In terms of accessibility, Option 3A, 3B and 3C are low risk, while Option 3D is medium risk, due to the SUP location restricting north-south accessibility.

From a consentability point of view, all options present similar levels of low risk when taking into account the effects already considered as part of the road and RTC alignment study. None of the options present any significant planning issues. However, given the social, landscape, visual and urban design adverse effects of Options 3B and 3D, it is considered that Options 3A and 3C are preferred.

Table 3-29: Walking & Cycling Section 3 Environmental / Planning

Discipline	Sub-topic	Criteria	3A	3B	3C	3D
Ecology	Aquatic ecology	Extent, nature and degree of effects on freshwater aquatic ecology, in particular on significant habitats of indigenous fauna and vegetation, and opportunities for ecological restoration and enhancement.				
	Terrestrial ecology	Extent, nature and degree of effects on terrestrial ecology, in particular on significant habitats of indigenous fauna and vegetation, and opportunities for ecological restoration and enhancement.				
	Marine ecology	Extent, nature and degree of effects on marine ecology, in particular on significant habitats of indigenous fauna and vegetation, and opportunities for ecological restoration and enhancement.				
Landscape, visual and urban design	Natural character and landscape	Extent, nature and degree of effects on natural character, features, and landscape.				
	Visual	Extent, nature and degree of effects on visual amenity.				
	Urban design	Extent, nature and degree of effects on urban design, including open space.				
Social/community impact	Accessibility	Extent and degree of effects on the community concerning accessibility to/from facilities, services, properties and businesses.				
	Community	Extent and degree of change to groups and activities, including sense of community and to known aspirations and plans.				
	Health and safety	Extent and degree of effects on human health and safety.				
Contaminated land	Contamination management - soil	Potential to encounter and ability to manage the effects of contaminated soils on human health and the environment.				
	Contamination management - groundwater	Potential to encounter and ability to manage the effects of groundwater on human health and the environment.				
Consentability	Consentability	Level of complexity of gaining approvals (e.g. activity status, risk of appeal, accordance with policy direction). Level of compliance with regulatory plans e.g. could the option include activities which are prohibited/ non-complying under the policies and rules of the district or regional plan?				

[redacted]

[redacted]

[redacted]

3.5.12 Option Summary

A summary of the main considerations for each option are presented and compared in **Table 3-33** below:

Table 3-33: Walking & Cycling Section 3 Option Summary

	Option 3A SUP on northern side (northern side of service road)	Option 3B SUP on northern side (southern side of service road)	Option 3C SUP on southern side (southern side of RTC)	Option 3D SUP on southern side (retention of existing)
Highways				
Traffic / Intersection Performance				
Structures				
Geotechnical				
Stormwater				
Utilities				
Environmental / Planning				
Property				
Construction Disruption				
Cost				

Based on the above assessment, the options are fairly evenly balanced. However Option 3C is the preferred option due to accessibility of the SUP and the land uses further west at Auckland Airport.

3.6 Walking & Cycling Preferred Option

3.6.1 Section 1: SH20/20B Interchange to Manukau Memorial Gardens (including SH20/20B interchange)

Option 1B is the preferred option in this section, which retains the existing SUP on the northern side and also adds an SUP on the southern side.

In order to mitigate the effects of a signalised crossing at the braided ramp northbound to SH20B westbound movement, two left turn lanes are recommended.

3.6.2 Section 2: Manukau Memorial Gardens to Campana Road (inc MMG intersection)

Option 2C is the preferred option in this section, which demolishes the existing SUP and replaces it with an SUP along the southern side of the RTC.

3.6.3 Section 3: Campana Road to Orrs Road (inc Campana Road intersection)

Option 3C is the preferred option in this section, which demolishes the existing SUP and replaces it with an SUP along the southern side of the RTC.

3.6.4 Compatibility of Sections

In order to tie the sections together, signalised at-grade crossings will be required at the following locations:

SH20 / SH20B Interchange

- Puhinui Road (north-south)
- Puhinui Road Southbound On-Ramp (east-west)
- Puhinui Road Northbound Off-Ramp (east-west)

MMG Intersection

- SH20B (north-south)

Campana Road Intersection

- Prices Road (east-west)
- Campana Road (east-west)
- SH20B (north-south)

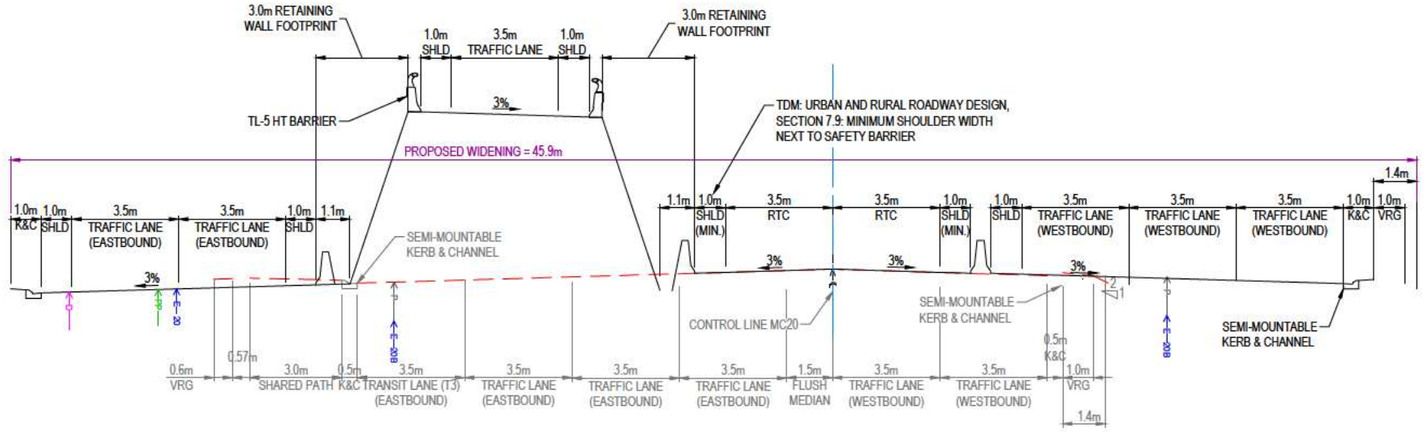
Approvals:

	Author	
Name		
Signature		
Designation	Civil Engineer, Transport	Associate, Transport

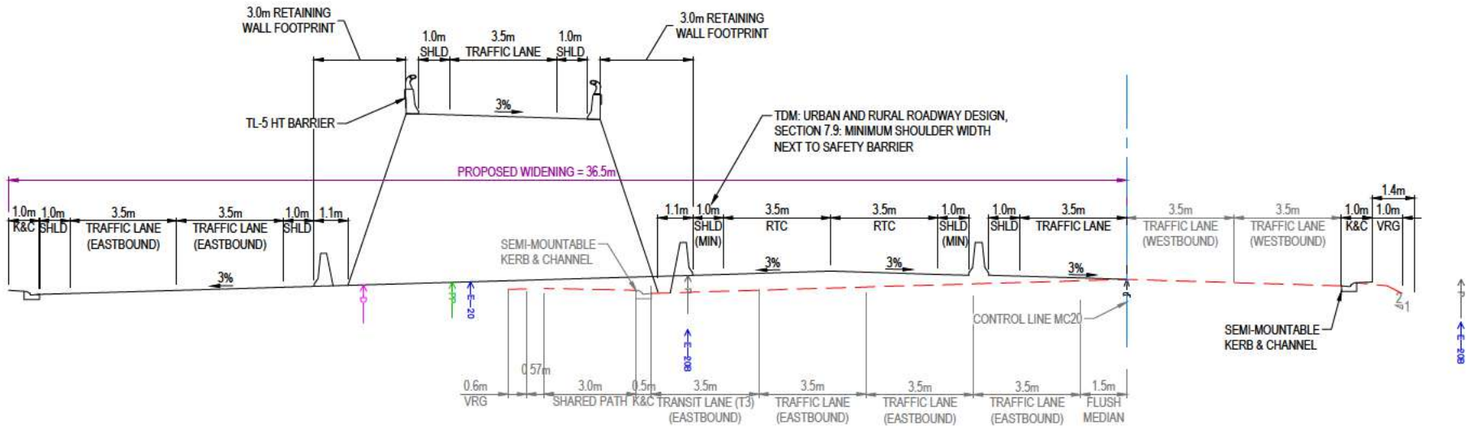
Appendix A: SH20B / RTC Options

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- EXISTING CROWN
- AUCKLAND COUNCIL DESIGNATION
- 2019 MINOR ALTERATION TO DESIGNATION
- 2019 PERMANENT PURCHASED BDY
- 2019 EARLY WORKS EXISTING SH20 NZTA DESIGNATION BDY
- 2019 EARLY WORKS EXISTING SH20B NZTA DESIGNATION BDY
- 2019 EARLY WORKS EXISTING PROPERTY BDY
- 2019 PROPERTY BOUNDARY (SURVEYED)
- WIRI OIL DESIGNATION



OPTION 1A: RTC IN MEDIAN (WIDENING APPLIED SYMETRICALLY)
1:100



OPTION 1B: RTC IN MEDIAN (WIDENING APPLIED TO NORTHERN SIDE)
1:100

1 0 2 4m
SCALE 1:100

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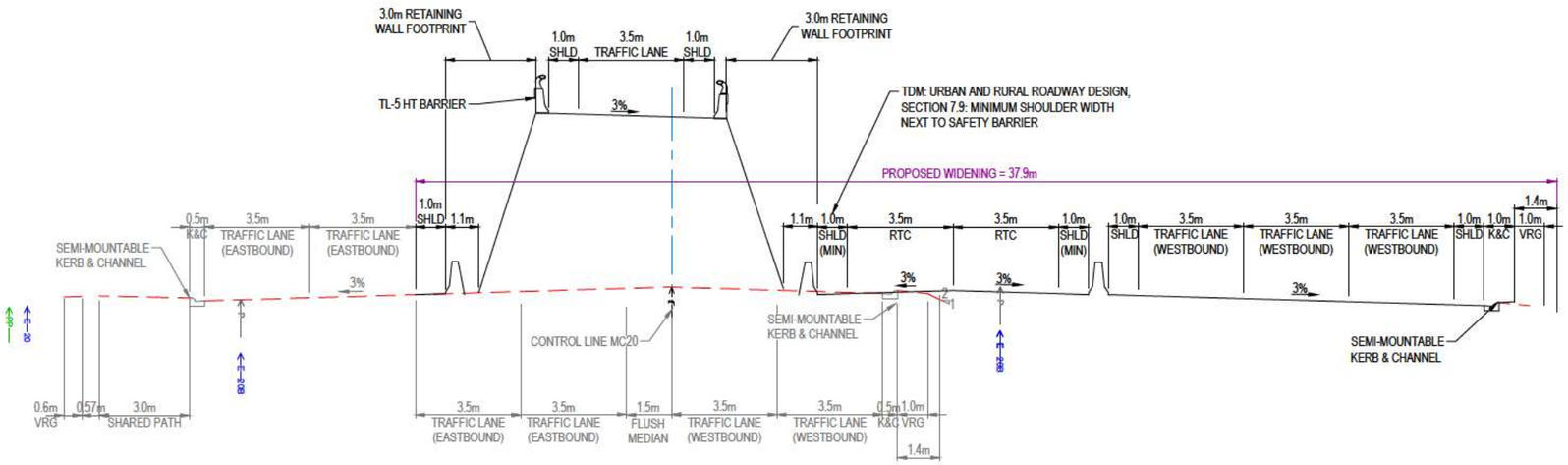
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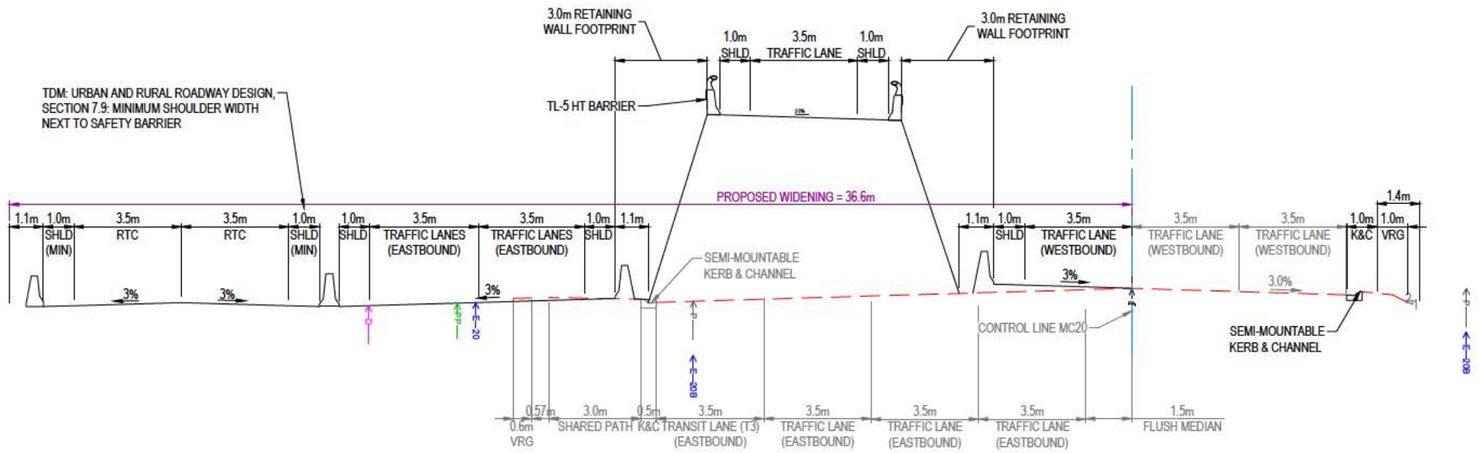
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- 2019 PERMANENT PURCHASED BDY
- 2019 EARLY WORKS EXISTING SH20 NZTA DESIGNATION BDY
- 2019 EARLY WORKS EXISTING SH20B NZTA DESIGNATION BDY
- 2019 EARLY WORKS EXISTING PROPERTY BDY
- 2019 PROPERTY BOUNDARY (SURVEYED)
- WIRI OIL DESIGNATION



OPTION 1C: RTC IN MEDIAN (WIDENING APPLIED ON SOUTHERN SIDE)
1:100



OPTION 1D : RTC ON NORTHERN SIDE
1:100

1 0 2 4m
SCALE 1:100

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TITLE	SH20B TYPICAL CROSS SECTIONS OPTIONS 1C AND 1D

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LEGEND

EXISTING CROWN

AUCKLAND COUNCIL DESIGNATION

2019 MINOR ALTERATION TO DESIGNATION

2019 PERMANENT PURCHASED BDY

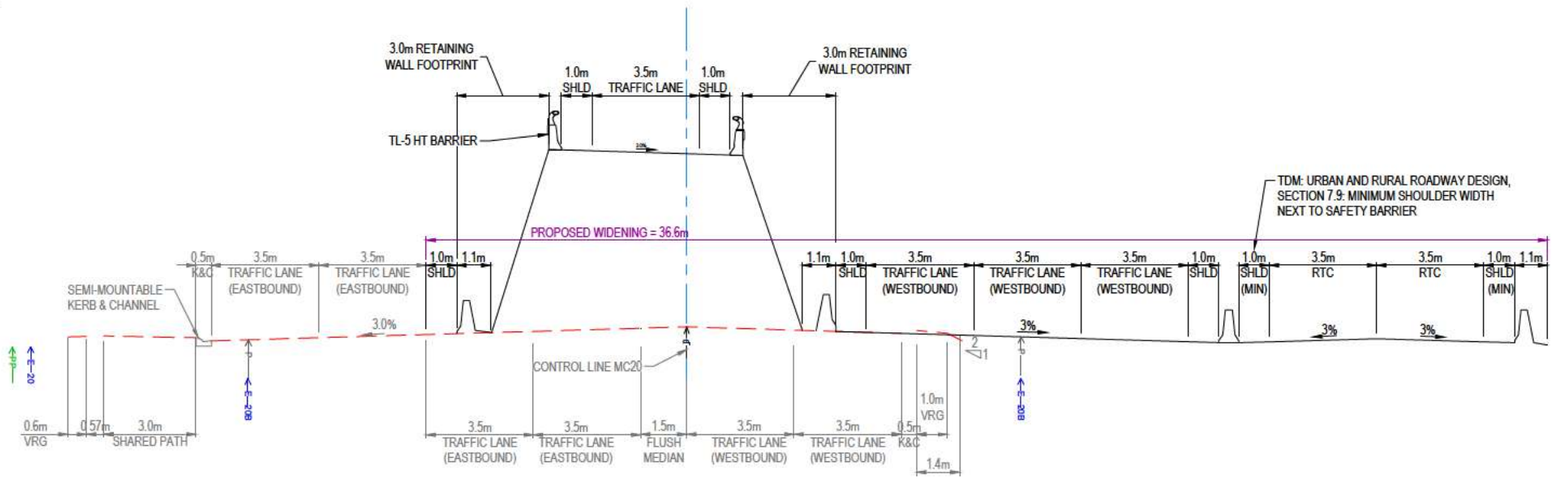
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2019 EARLY WORKS EXISTING SH20B NZTA DESIGNATION BDY

2019 EARLY WORKS EXISTING PROPERTY BDY

2019 PROPERTY BOUNDARY (SURVEYED)

WIRI OIL DESIGNATION



OPTION 1E: RTC ON SOUTHERN SIDE

1:100

SCALE 1:100

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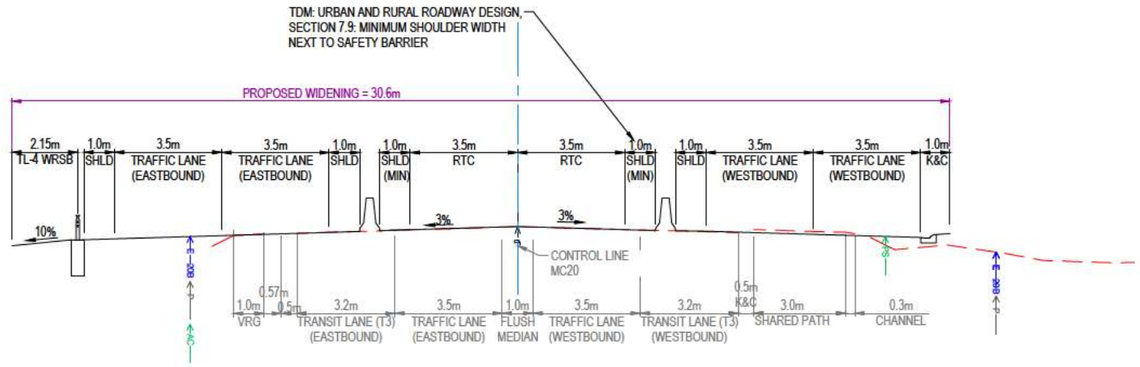
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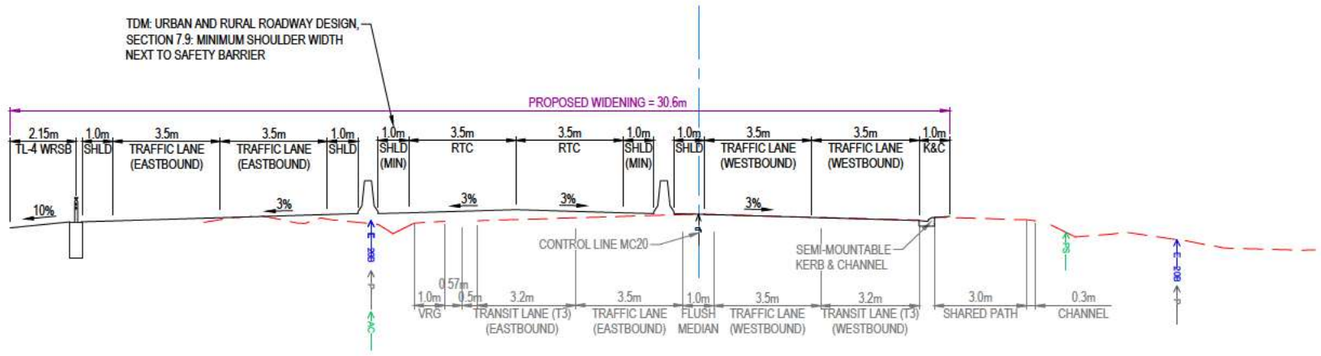
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LEGEND

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- 2019 MINOR ALTERATION TO DESIGNATION
- 2019 PERMANENT PURCHASED BDY
- 2019 EARLY WORKS EXISTING SH20 NZTA DESIGNATION BDY
- 2019 EARLY WORKS EXISTING SH20B NZTA DESIGNATION BDY
- 2019 EARLY WORKS EXISTING PROPERTY BDY
- 2019 PROPERTY BOUNDARY (SURVEYED)
- WIRI OIL DESIGNATION



OPTION 2A: RTC IN MEDIAN (WIDENING APPLIED SYMMETRICALLY)
1:100



OPTION 2B: RTC IN MEDIAN (WIDENING APPLIED ON NORTHERN SIDE)
1:100

1 0 2 4m
SCALE 1:100

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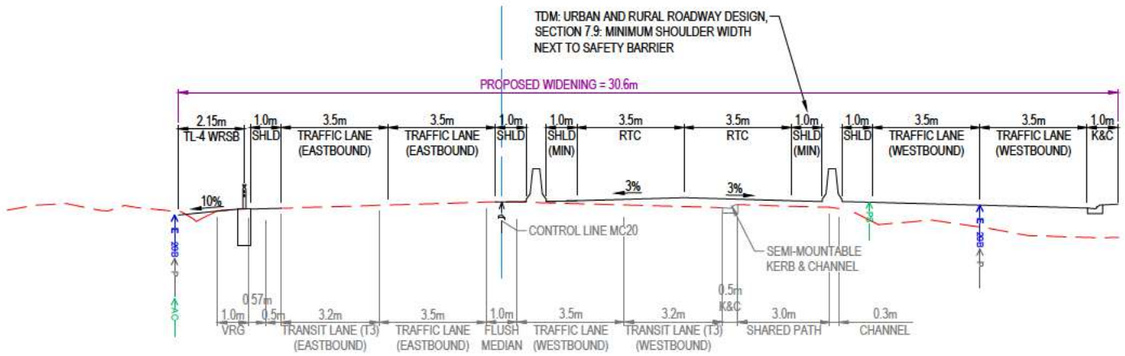
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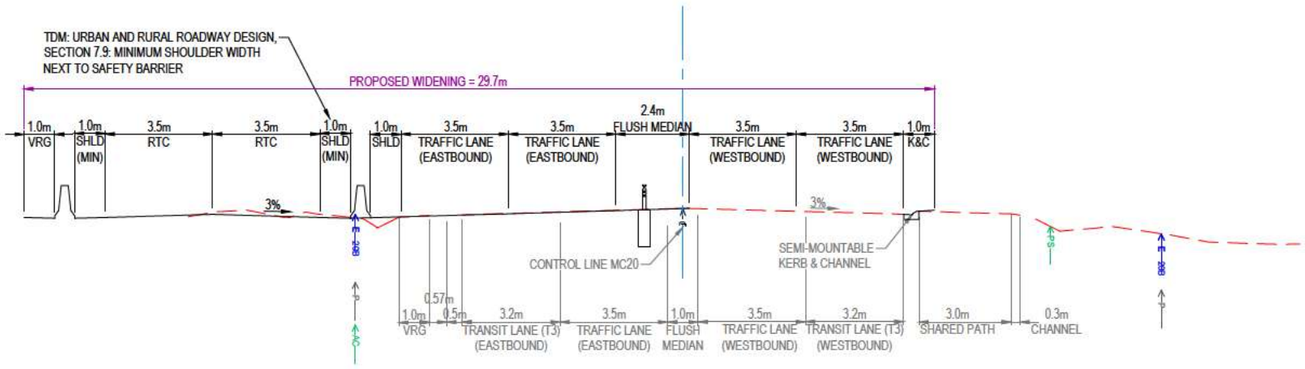
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- 2019 MINOR ALTERATION TO DESIGNATION
- 2019 PERMANENT PURCHASED BDY
- 2019 EARLY WORKS EXISTING SH20 NZTA DESIGNATION BDY
- 2019 EARLY WORKS EXISTING SH20B NZTA DESIGNATION BDY
- 2019 EARLY WORKS EXISTING PROPERTY BDY
- 2019 PROPERTY BOUNDARY (SURVEYED)
- WIRI OIL DESIGNATION



OPTION 2C: RTC IN MEDIAN (WIDENING APPLIED ON SOUTHERN SIDE)
1:100



OPTION 2D: RTC ON NORTHERN SIDE
1:100

1 0 2 4m
SCALE 1:100

CLIENT	REV	DATE	REVISION DETAILS	APPROVED
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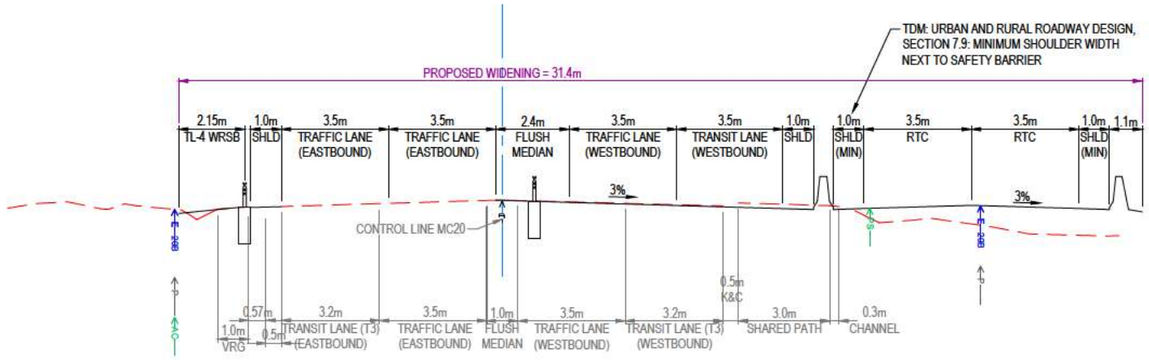
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TITLE	SH20B TYPICAL CROSS SECTIONS OPTIONS 2C AND 2D

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- 2019 MINOR ALTERATION TO DESIGNATION
- 2019 PERMANENT PURCHASED BDY
- 2019 EARLY WORKS EXISTING SH20 NZTA DESIGNATION BDY
- 2019 EARLY WORKS EXISTING SH20B NZTA DESIGNATION BDY
- 2019 EARLY WORKS EXISTING PROPERTY BDY
- 2019 PROPERTY BOUNDARY (SURVEYED)
- WIRI OIL DESIGNATION



OPTION 2E: RTC ON SOUTHERN SIDE
1:100

SCALE 1:100

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AS SHOWN	A1

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PRELIMINARY
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PROJECT	A2B / 20CONNECT SSBC
TITLE	SH20B TYPICAL CROSS SECTIONS OPTION 2E

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EXISTING CROWN

AUCKLAND COUNCIL DESIGNATION

2019 MINOR ALTERATION TO DESIGNATION

2019 PERMANENT PURCHASED BDY

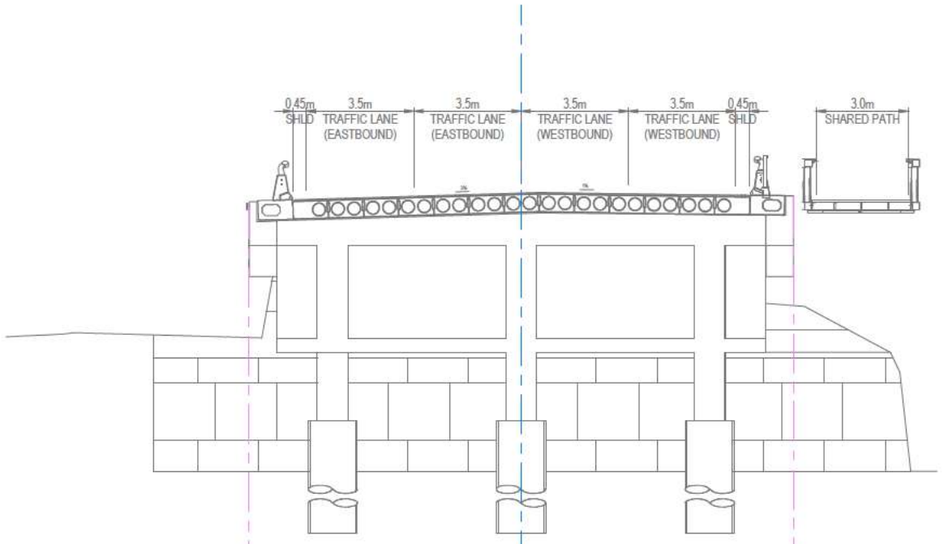
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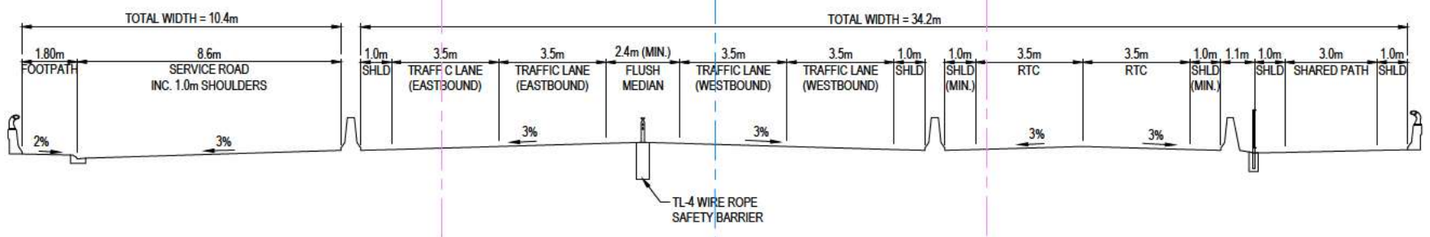
2019 EARLY WORKS EXISTING PROPERTY BDY

2019 PROPERTY BOUNDARY (SURVEYED)

WIRI OIL DESIGNATION



SECTION 3: WAOKAURI CREEK BRIDGE TYPICAL CROSS SECTION
SH20B SHORT TERM DETAILED DESIGN



SECTION 3: WAOKAURI CREEK BRIDGE TYPICAL CROSS SECTION
OPTION 3A - ONLINE WIDEN OF EXISTING ALIGNMENT

1 0 2 4m
SCALE 1:100

CLIENT	REV	DATE	REVISION DETAILS	APPROVED
aurecon / NZ TRANSPORT AGENCY WAKA KOTAHI / AT	A	19.07.19	ISSUE FOR MCA	

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APPROVED

DATE 17.07.19

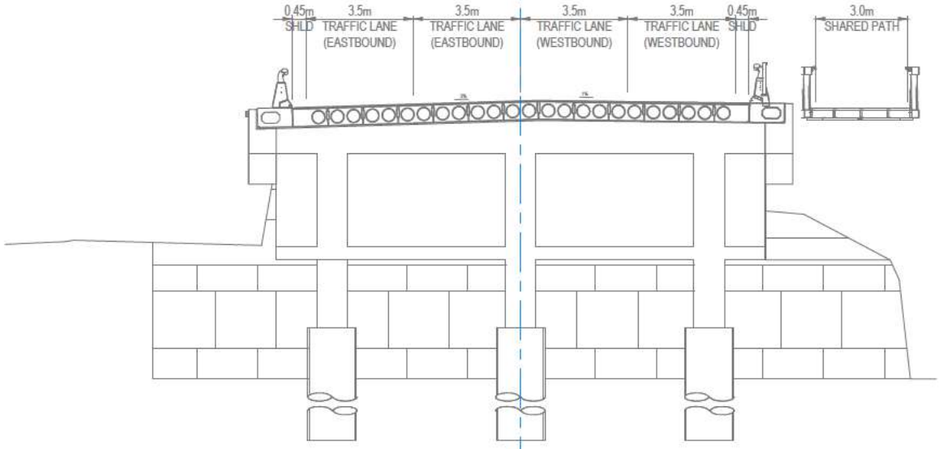
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TITLE	SH20B TYPICAL CROSS SECTIONS OPTION 3A

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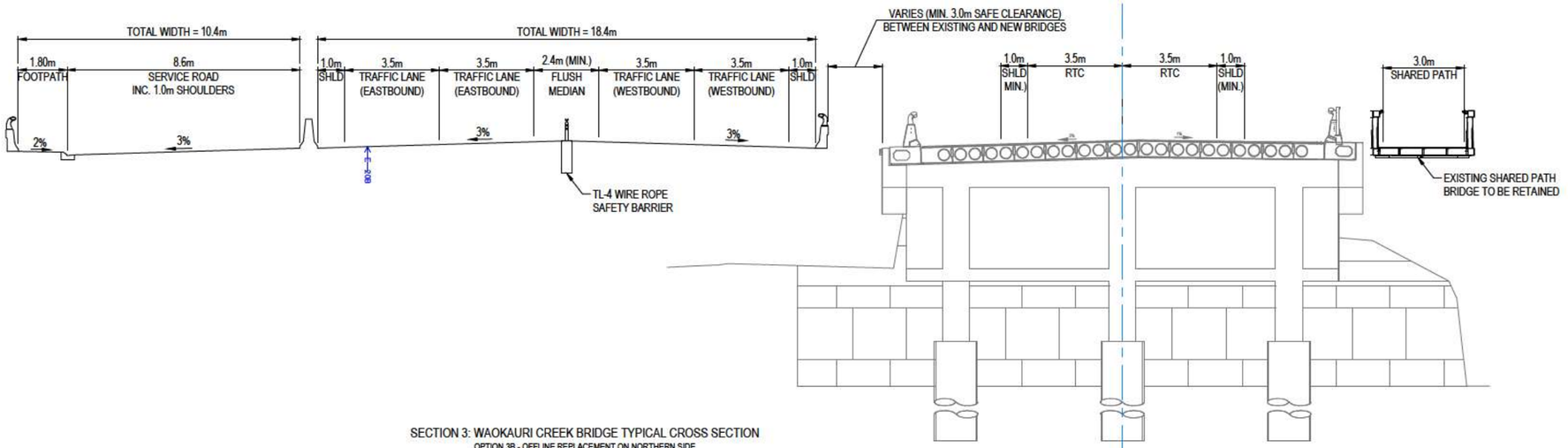
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LEGEND

- EXISTING CROWN
- AUCKLAND COUNCIL DESIGNATION
- 2019 MINOR ALTERATION TO DESIGNATION
- 2019 PERMANENT PURCHASED BDY
- 2019 EARLY WORKS EXISTING SH20 NZTA DESIGNATION BDY
- 2019 EARLY WORKS EXISTING SH20B NZTA DESIGNATION BDY
- 2019 EARLY WORKS EXISTING PROPERTY BDY
- 2019 PROPERTY BOUNDARY (SURVEYED)
- WIRI OIL DESIGNATION



SECTION 3: WAOKAURI CREEK BRIDGE TYPICAL CROSS SECTION
SH20B SHORT TERM DETAILED DESIGN



SECTION 3: WAOKAURI CREEK BRIDGE TYPICAL CROSS SECTION
OPTION 3B - OFFLINE REPLACEMENT ON NORTHERN SIDE

1 0 2 4m
SCALE 1:100

REV	DATE	REVISION DETAILS	APPROVED
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SCALE	SIZE
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DATE 17.07.19

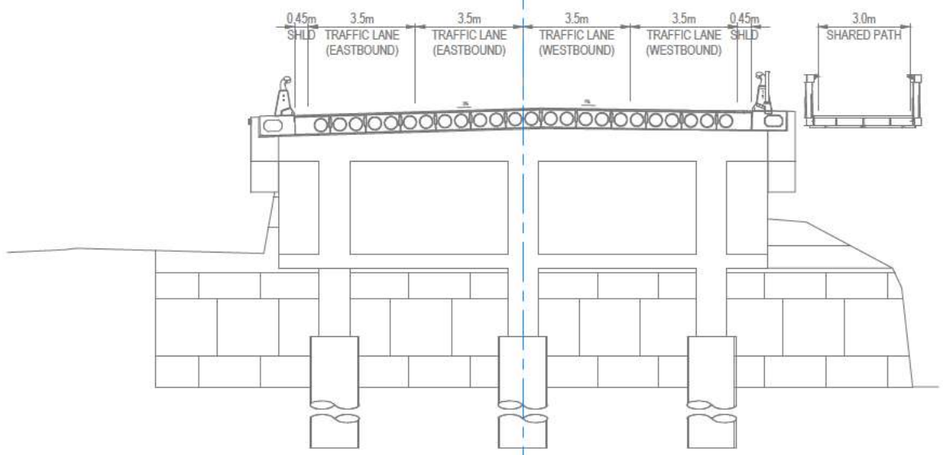
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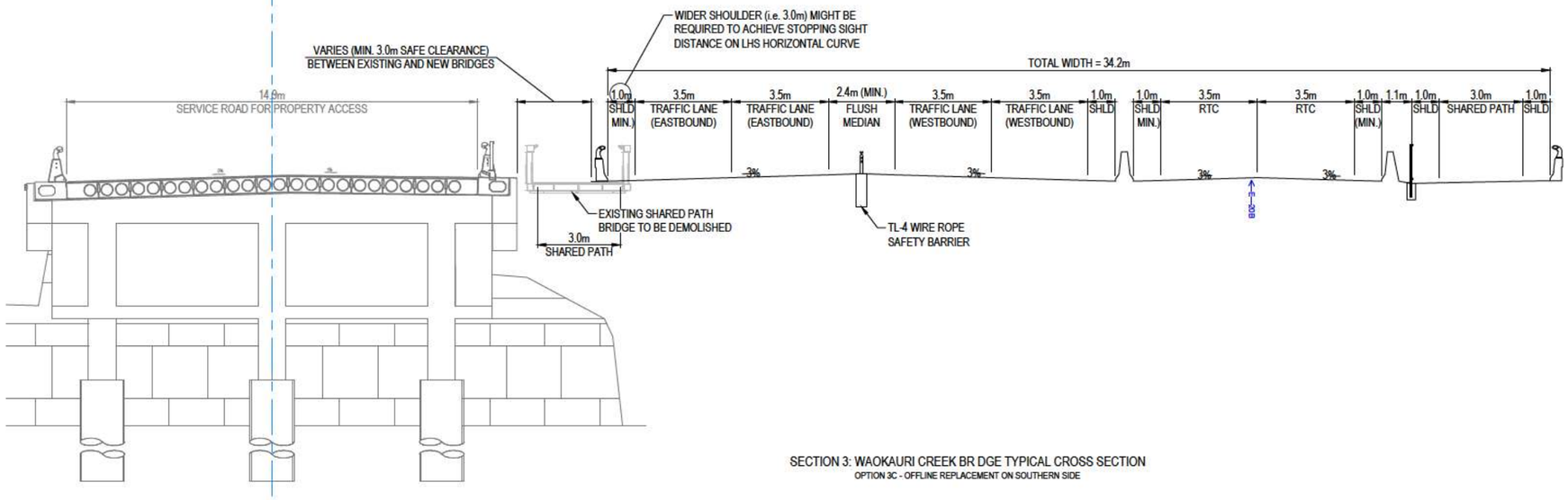
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- 2019 PERMANENT PURCHASED BDY
- 2019 EARLY WORKS EXISTING SH20 NZTA DESIGNATION BDY
- 2019 EARLY WORKS EXISTING SH20B NZTA DESIGNATION BDY
- 2019 EARLY WORKS EXISTING PROPERTY BDY
- 2019 PROPERTY BOUNDARY (SURVEYED)
- WIRI OIL DESIGNATION



SECTION 3: WAOKAURI CREEK BRIDGE TYPICAL CROSS SECTION
SH20B SHORT TERM DETAILED DESIGN



SECTION 3: WAOKAURI CREEK BR DGE TYPICAL CROSS SECTION
OPTION 3C - OFFLINE REPLACEMENT ON SOUTHERN SIDE

SCALE 1:100

CLIENT	REV	DATE	REVISION DETAILS	APPROVED
NZ TRANSPORT AGENCY WAKA KOTAHI	A	19.07.19	ISSUE FOR MCA	

SCALE	SIZE
AS SHOWN	A1

PRELIMINARY
NOT FOR CONSTRUCTION

DATE 17.07.19

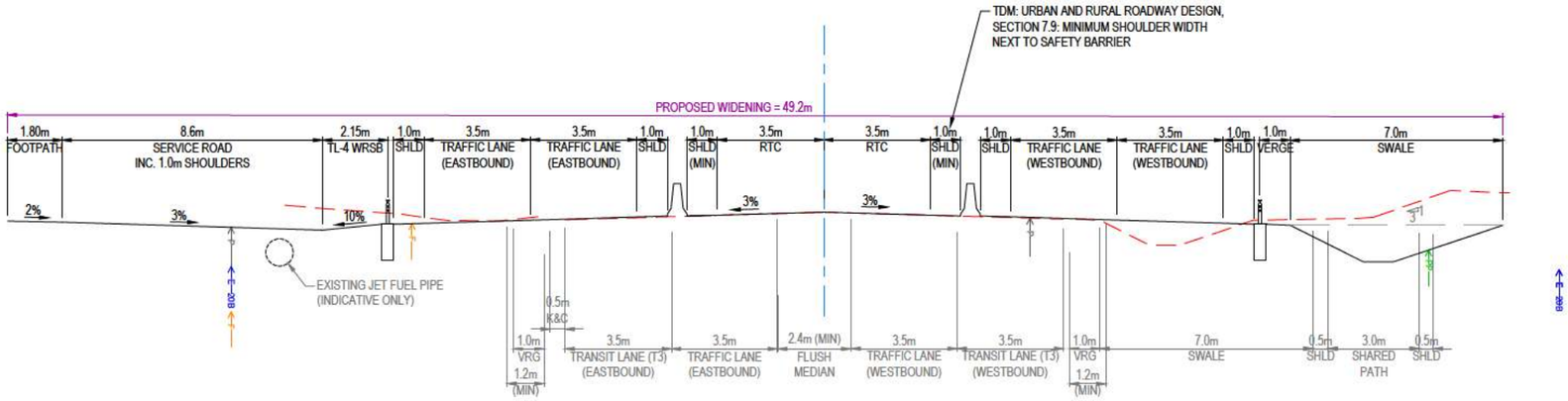
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TITLE	SH20B TYPICAL CROSS SECTIONS OPTION 3C

DRAWING No.	PROJECT No.	WBS	TYPE	DISC	NUMBER	REV
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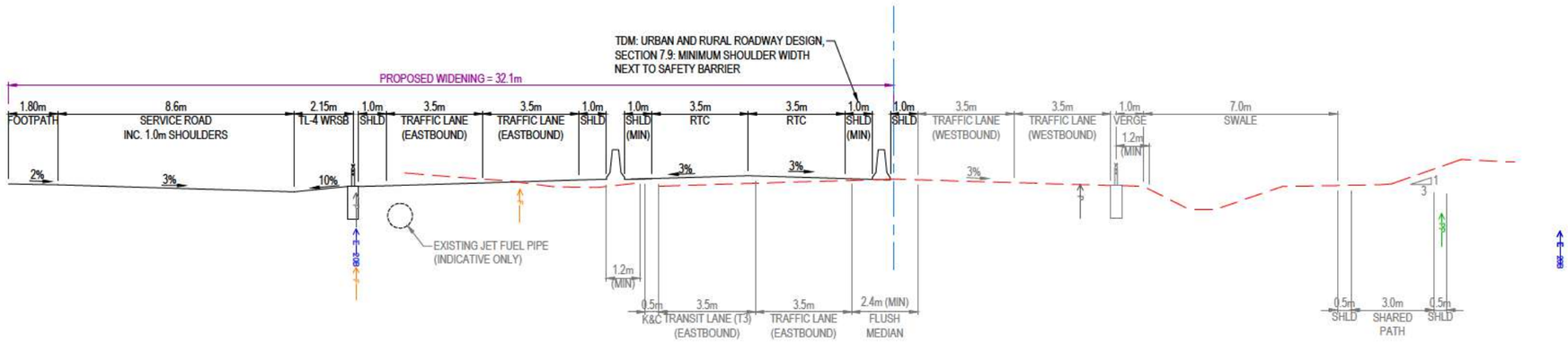
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LEGEND

- EXISTING CROWN
- AUCKLAND COUNCIL DESIGNATION
- 2019 MINOR ALTERATION TO DESIGNATION
- 2019 PERMANENT PURCHASED BDY
- 2019 EARLY WORKS EXISTING SH20 NZTA DESIGNATION BDY
- 2019 EARLY WORKS EXISTING SH20B NZTA DESIGNATION BDY
- 2019 EARLY WORKS EXISTING PROPERTY BDY
- 2019 PROPERTY BOUNDARY (SURVEYED)
- WIRI OIL DESIGNATION



OPTION 4A: RTC IN MEDIAN (WIDENING APPLIED SYMMETRICALLY)
1:100



OPTION 4B: RTC IN MEDIAN (WIDENING APPLIED ON NORTHERN SIDE)
1:100

1 0 2 4m
SCALE 1:100

REV	DATE	REVISION DETAILS	APPROVED
A	19.07.19	ISSUE FOR MCA	

CLIENT: NZ TRANSPORT AGENCY WAKA KOTAHI

SCALE	SIZE
AS SHOWN	A1

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PRELIMINARY
NOT FOR CONSTRUCTION

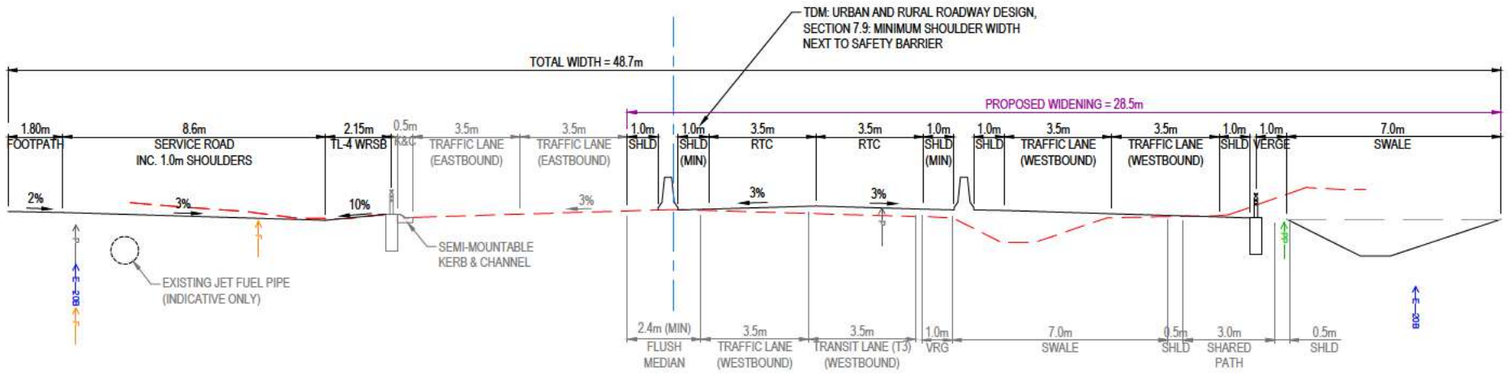
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TITLE	SH20B TYPICAL CROSS SECTIONS OPTIONS 4A AND 4B

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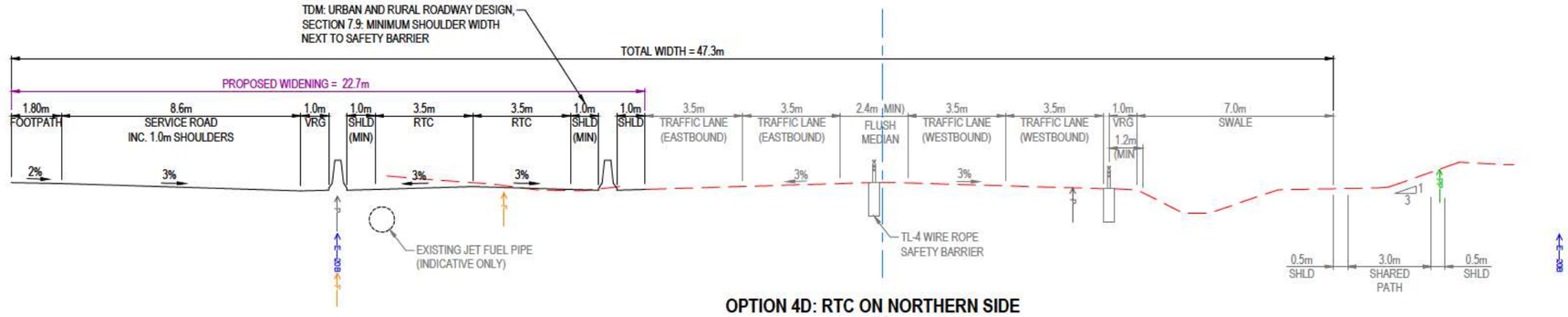
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LEGEND

- EXISTING CROWN
- AUCKLAND COUNCIL DESIGNATION
- 2019 MINOR ALTERATION TO DESIGNATION
- 2019 PERMANENT PURCHASED BDY
- 2019 EARLY WORKS EXISTING SH20 NZTA DESIGNATION BDY
- 2019 EARLY WORKS EXISTING SH20B NZTA DESIGNATION BDY
- 2019 EARLY WORKS EXISTING PROPERTY BDY
- 2019 PROPERTY BOUNDARY (SURVEYED)
- WIRI OIL DESIGNATION



OPTION 4C: RTC IN MEDIAN (WIDENING APPLIED ON SOUTHERN SIDE)
1:100



OPTION 4D: RTC ON NORTHERN SIDE
1:100

1 0 2 4m
SCALE 1:100

REV	DATE	REVISION DETAILS	APPROVED
A	19.07.19	ISSUE FOR MCA	C

SCALE	SIZE
AS SHOWN	A1

DRAWN

APPROVED

PRELIMINARY
NOT FOR CONSTRUCTION

CLIENT: NZ TRANSPORT AGENCY WAKA KOTAHI

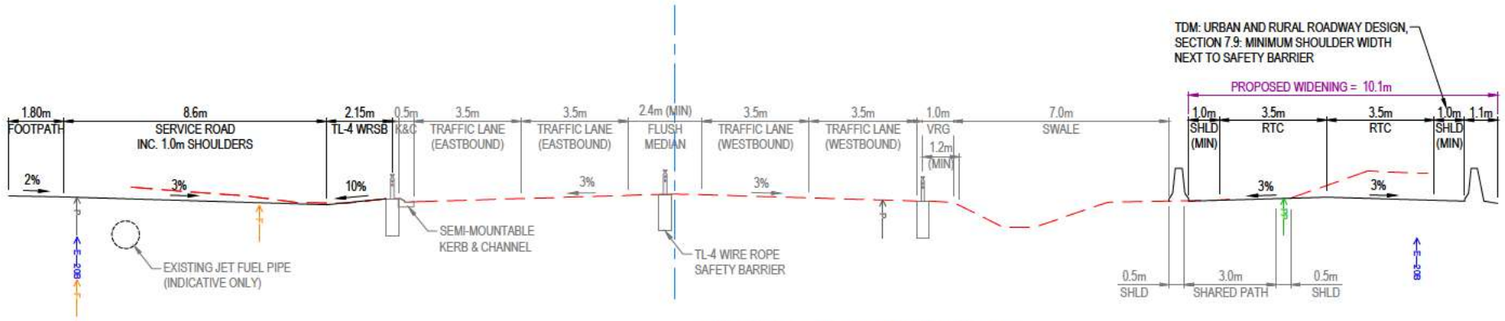
PROJECT	A2B / 20CONNECT SSBC
TITLE	SH20B TYPICAL CROSS SECTIONS OPTIONS 4C AND 4D

DRAWING No.	PROJECT No.	WBS	TYPE	DISC	NUMBER	REV
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LEGEND

- EXISTING CROWN
- AUCKLAND COUNCIL DESIGNATION
- 2019 MINOR ALTERATION TO DESIGNATION
- 2019 PERMANENT PURCHASED BDY
- 2019 EARLY WORKS EXISTING SH20 NZTA DESIGNATION BDY
- 2019 EARLY WORKS EXISTING SH20B NZTA DESIGNATION BDY
- 2019 EARLY WORKS EXISTING PROPERTY BDY
- 2019 PROPERTY BOUNDARY (SURVEYED)
- WIRI OIL DESIGNATION



OPTION 4E: RTC ON SOUTHERN SIDE
1:100

SCALE 1:100

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NZ TRANSPORT AGENCY WAKA KOTAHI

REV	DATE	REVISION DETAILS	APPROVED
A	19.07.19	ISSUE FOR MCA	

SCALE	SIZE
AS SHOWN	A1

DRAWN

DATE 17.07.19

PRELIMINARY
NOT FOR CONSTRUCTION

PROJECT	A2B / 20CONNECT SSBC
TITLE	SH20B TYPICAL CROSS SECTIONS OPTION 4E

DRAWING No.	PROJECT No.	WBS	TYPE	DISC	NUMBER	REV
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Plot Date: 2019-07-19 16:08:00 Office: Auckland Filename: pw://akgroup.eu.aurecongroup.com/PW_AUDC1/Documents/Projects/501094 - SWC - 20Connect SSBC/05 Delivery Design/03 CAD/Drawings/Sketches/501094-4403-SKT-RR-0333.dwg

Appendix B: SH20B / RTC Environmental Supporting Documents

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Memorandum

To	[redacted]	From	[redacted]
Copy	[redacted]	Reference	**501094**
Date	**2019-06-17**	Pages (including this page)	**11**
Subject	**20Connect: SH20B optioneering – Social impact**		

1 Introduction

The purpose of this technical memorandum is to provide a high-level assessment of potential social impact of the long-term options for SH20B improvements combined with the Rapid Transit Corridor (RTC).

The extent of the proposed work is along the SH20B corridor between the SH20/20B interchange and Orrs Road, Wiri. The information provided to assist assessment is limited to typical cross section and approximate footprint of works for each option in the drawings provided 501094-4403-SKT-RR-0301-0310, 501094-4403-SKT-RR-0315-0332 and 501094-4403-SKT-RR-0351-0356

For this assessment, the proposed work is assessed in four sections.

1) SH20/SH20B interchange to Memorial Gardens (including the SH20/SH20B interchange);
2) Memorial Gardens to Waokauri Creek (including Memorial Gardens Intersection);
3) Waokauri Creek Crossing; and
4) Waokauri Creek to Orrs Road (including Campana Intersection).

The options (representing potential configurations/scenarios) assessed at each section of the corridor are as follows:

- Option A – RTC in median (widening applied symmetrically);
- Option B - RTC in median (all widening applied on northern side);
- Option C - RTC in median (all widening applied on southern side);
- Option D - RTC on northern side of SH20B (SH20B remains largely unchanged);
- Option E - RTC on southern side of SH20B (SH20B remains largely unchanged)

2 Assumptions and Limitations

The following assumptions and limitations are considered for the assessment of all options.

- The baseline environment ('existing environment') assumes the operation of the proposed SH20B Short Term Improvements project, the Auckland International Airport Ltd (AIAL) Park and Ride South and the realignment of Prices Road. I.e. it is anticipated that these improvement works have already been delivered and are operational.
- The cross section of SH20B does not require further widening beyond the SH20B Short Term Improvements project except in locations where either lane widths are <3.5m or a median <2.4m has been provided.

- The preferred location of the RTC on Puhinui Road (east of the SH20/20B interchange) is in the median.
- Access to SH20B is restricted to the signalised intersections at Manukau Memorial Gardens (MMG), Wiri and Campana Road, Wiri. Access on the southern side is via the realigned Prices Road, Wiri which was constructed as part of the AIAL Park and Ride South works.
- A service road (which is included in the footprint) would be required on the northern edge to link the remaining side road and driveways to the intersection at Campana Road.
- The existing jet fuel lines can be retained if located under the service road on the northern edge. Relocation would be required if they are located under the SH20B carriageway or RTC.
- Any stormwater assets implemented during the short term works that are impacted will be replaced on a like-for-like basis (i.e. if a swale constructed in the short term works is impacted, then a swale of the same size is provided in the revised cross section).
- The footprints provided do not include any earthworks or retaining batters/structures required for the construction of the alignment. These design and construction elements could influence the assessment and resultant scoring.
- Air quality is a potential human health issue but has not been assessed.

3 Methodology

The assessment and scoring of the proposed options with relation to potential social impact is high level and excludes quantitative information.

3.1 Scoring

A traffic light system is used for the purposes of this assessment.

Low risk (to consentability / programme); no or very minor issues.	Medium risk (to consentability / programme); a few issues or an issue with moderate difficulty.	High risk (to consentability / programme), fatal flaw, significant difficulties.

3.2 Social impact study area and existing social environment

The 'study area' specific to the assessment of potential social impacts is located between the SH20/ SH20B interchange and Orrs Road – the extent of SH20B corridor. The social effects study area is located in the Otara-Papatoetoe Local Board area. Compared with New Zealand, the local board area is characterised by a young population and a high proportion of couples with children. The main occupation is labourers, machinery operators and drivers and professionals. This suggests that many people travel out of the area to access employment. Many do so currently by using a private motor vehicle. The local board area is ethnically diverse with a high proportion of Pacific peoples, followed by Asian and European.

SH20B is surrounded to the north and south by pasture land, horticulture activities and scattered houses. Orrs Road and Campana Road to the north, Prices Road to the south and property driveways currently have direct vehicular access from SH20B in the form of uncontrolled (priority) intersections.

Future land use changes as indicated in the Auckland Unitary Plan Operative in Part is likely to include light industrial use to the north and south.

Social infrastructure of note along the project extent includes Manukau Memorial Gardens. While not directly within the corridor being assessed, there is a scenic lookout further along the corridor to the west. The scenic lookout is provided by Auckland Airport on Puhinui Road, Mangere and appears to be popular with locals and aviation enthusiasts.

The Manukau Memorial Gardens at 361 Puhinui Road, Wiri to the north of SH20B provide an important space for chapel services, cremation and large functions with up to 250 people being accommodated.

The 380 Airporter bus currently runs along SH20B every day at a frequency of 15-20 minutes. The Auckland Airport is located to the west, providing an important employment centre for the surrounding community as well as an important transport link for passenger travel (domestic and international) and freight.

4 Assessment

Using the above methodology (and subject to the assumptions and limitations above), the tables below assess each option/scenario within each section and provide justification of the colour attributed.

The following criteria is used to assess the options.

Accessibility	Extent and degree of effects on the community concerning accessibility to/from facilities, services, properties and businesses.
Community	Extent and degree of change to groups and activities, including sense of community and to known aspirations and plans.
Health and safety	Extent and degree of effects on human health and safety.

4.1 Section 1 - SH20 / SH20B Interchange to Memorial Gardens Intersection:

	Option 1A RTC in median (widening applied symmetrically)	**Option 1B** RTC in median (all widening applied on northern side)	**Option 1C** RTC in median (all widening applied on southern side)	**Option 1D** RTC on northern side	**Option 1E** RTC on southern side
Accessibility	RTC in central median makes accessibility to it from MMG less achievable, should a stop/station be considered.	RTC in central median makes accessibility to it from MMG less achievable, should a stop/station be considered.	RTC in central median makes accessibility to it from MMG less achievable, should a stop/station be considered.	Good accessibility to RTC from MMG, although this would require more space.	Good accessibility to RTC from undeveloped future industrial area, should a stop/station be considered in this location.

	Option 1A RTC in median (widening applied symmetrically)	**Option 1B** RTC in median (all widening applied on northern side)	**Option 1C** RTC in median (all widening applied on southern side)	**Option 1D** RTC on northern side	**Option 1E** RTC on southern side
	No private access onto SH20B. The southbound ramp provides the same level of accessibility however, in a more efficient form for users of that manoeuvre than the current interchange arrangement.	No private access onto SH20B. The southbound ramp provides the same level of accessibility however, in a more efficient form for users of that manoeuvre than the current interchange arrangement.	No private access onto SH20B. The southbound ramp provides the same level of accessibility however, in a more efficient form for users of that manoeuvre than the current interchange arrangement.	No private access onto SH20B. The southbound ramp provides the same level of accessibility however, in a more efficient form for users of that manoeuvre than the current interchange arrangement.	No private access onto SH20B. The southbound ramp provides the same level of accessibility however, in a more efficient form for users of that manoeuvre than the current interchange arrangement.
Community	Potential impact on graves within MMG which is a significant social adverse effect. This cemetery is of significance particularly to the Pacific communities.	Potential impact on graves within MMG which is a significant social adverse effect. This cemetery is of significance particularly to the Pacific communities.	This option utilises undeveloped land to the south of the current alignment (and therefore there is no land requirement from MMG). Impact on surrounding community unlikely.	Potential impact on graves within MMG which is a significant social adverse effect. This cemetery is of significance particularly to the Pacific communities.	This option utilises undeveloped land to the south of the current alignment (and therefore there is no land requirement from MMG). Impact on surrounding community unlikely.
Health and Safety	It is not expected that there be any significant adverse health and safety effects. H&S issues may arise should access to the RTC be required.	It is not expected that there be any significant adverse health and safety effects. H&S issues may arise should access to the RTC be required. .	It is not expected that there be any significant adverse health and safety effects. H&S issues may arise should access to the RTC be required.	It is not expected that there be any significant adverse health and safety effects. H&S issues may arise should access to the RTC be required.	It is not expected that there be any significant adverse health and safety effects. H&S issues may arise should access to the RTC be required.

4.2 Section 2 – Memorial Gardens Intersection to Waokauri Creek:

	Option 2A RTC in median (widening applied symmetrically)	**Option 2B** RTC in median (all widening applied on northern side)	**Option 2C** RTC in median (all widening applied on southern side)	**Option 2D** RTC on northern side	**Option 2E** RTC on southern side
Accessibility	RTC in central median makes accessibility to it from either side of the road less achievable. No private access onto SH20B.	RTC in central median makes accessibility to it from either side of the road less achievable. No private access onto SH20B.	RTC in central median makes accessibility to it from either side of the road less achievable. No private access onto SH20B.	RTC on northern side may be possible but is made difficult due to the Service Road. No private access onto SH20B.	RTC can be easily accessed from southern side where future development is likely. No private access onto SH20B.
Community	Impact on surrounding community unlikely.	Impact on surrounding community unlikely.	Impact on surrounding community unlikely.	This option requires some encroachment into the MMG. Future use for this land to be determined in consultation with the MMG before potential impact on community can be determined.	Impact on surrounding community unlikely.
Health and Safety	It is not expected that there would be any significant adverse health and safety effects. H&S issues may arise should access to the RTC be required.	It is not expected that there would be any significant adverse health and safety effects. H&S issues may arise should access to the RTC be required.	It is not expected that there would be any significant adverse health and safety effects. H&S issues may arise should access to the RTC be required.	It is not expected that there would be any significant adverse health and safety effects. H&S issues may arise should access to the RTC be required.	It is not expected that there would be any significant adverse health and safety effects. H&S issues may arise should access to the RTC be required.

4.3 Section 3 Waokauri Creek Crossing:

	Option 3A RTC in median (widening applied symmetrically)	**Option 3B** RTC in median (all widening applied on northern side)	**Option 3C** RTC in median (all widening applied on southern side)
Accessibility	Each option provides the same level of accessibility by providing both the road and RTC elements to cross Waokauri Creek.	Each option provides the same level of accessibility by providing both the road and RTC elements to cross Waokauri Creek.	Each option provides the same level of accessibility by providing both the road and RTC elements to cross Waokauri Creek.
Community	Impact on surrounding community unlikely	Impact on surrounding community unlikely	Impact on surrounding community unlikely
Health and Safety	It is not expected that there would be any significant adverse health and safety effects.	It is not expected that there would be any significant adverse health and safety effects.	It is not expected that there would be any significant adverse health and safety effects.

4.4 Section 4 Waokauri Creek to Orrs Road:

	Option 4A RTC in median (widening applied symmetrically)	**Option 4B** RTC in median (all widening applied on northern side)	**Option 4C** RTC in median (all widening applied on southern side)	**Option 4D** RTC on northern side	**Option 4E** RTC on southern side
Accessibility	RTC in central median makes accessibility to it from either side of the road less achievable for users should a stop/station be considered.	RTC in central median makes accessibility to it from either side of the road less achievable for users should a stop/station be considered..	RTC in central median makes accessibility to it from either side of the road less achievable for users should a stop/station be considered..	RTC on northern side may be difficult to access due to Service Road.	RTC can be easily accessed from southern side where future development is likely.
Community	The RTC in the centre would provide difficult community connection (for future surrounding land uses) should a	The RTC in the centre would provide difficult community connection (for future surrounding land uses) should a	The RTC in the centre would provide difficult community connection (for future surrounding land uses) should a	The RTC on the northern side would provide a connection to the future urban land use (as provided for by the Future Urban zoning)	The RTC on the southern side would provide a connection to the future development land (as provided for by the Industrial

	stop/station be considered. Requires property acquisition but this is assessed by property assessment.	stop/station be considered. Requires property acquisition but this is assessed by property assessment.	stop/station be considered. Requires property acquisition but this is assessed by property assessment.	should a stop/station be considered. Requires property acquisition but this is assessed by property assessment.	zoning) should a stop/station be considered. Requires property acquisition but this is assessed by property assessment.
Health and Safety	Significant adverse health and safety effects are not anticipated. H&S issues may arise should access to the RTC be required.	Significant adverse health and safety effects are not anticipated. H&S issues may arise should access to the RTC be required.	Significant adverse health and safety effects are not anticipated. H&S issues may arise should access to the RTC be required.	Significant adverse health and safety effects are not anticipated. H&S issues may arise should access to the RTC be required.	Significant adverse health and safety effects are not anticipated. H&S issues may arise should access to the RTC be required.

5 Summary

Accessibility: SH20B provides an important connection for people accessing Auckland Airport and some nearby local social infrastructure, including Auckland Airport's 'viewing platform'. All options would maintain vehicular access to Auckland Airport.

Community: The Manukau Memorial Gardens is a significant local and regional site. Any direct impact (property acquisition) to this site would be considered a 'show stopper' from a social impact perspective. Any indirect impact (increased noise or vibration, change to air quality) as a result of the proposal should also be considered. Options 1A, 1B and 1D would have direct impact on the Manukau Memorial Gardens.

Health and safety: Adverse health and safety effects are not anticipated. It is likely that access to the RTC from the northern or southern sides of SH20B would be safer when considering pedestrian safety.

Overall, it is considered that most options present a low risk to consentability / programme when considering potential social effect. Direct impact to the Manukau Memorial Gardens (Options 1A, 1B and 1D) should be avoided.

6 South facing ramp commentary

For the Rapid Transit Corridor (RTC) to traverse from Puhinui Road onto SH20B, it has been identified that a grade separated south-facing ramp connecting SH20B traffic southbound to SH20 is required. It will consist of two general traffic lanes.

Given this has to occur to ensure service level performance of the RTC through the interchange and that it fits within the NZTA designation, we do not require you to assess this using the above assessment tool. Despite the ramp location being entirely within the designation, are there particular

features / catchments or comments from your disciplines perspective that would make delivery challenging? Please provide any commentary relating to this ramp that you think may be relevant.

The following provides high-level commentary about the potential social impact of the south facing ramps.

Accessibility: The south facing ramps would provide an important connectivity and accessibility component. This would provide a more direct connection to SH20 than the traffic light arrangement that currently exists. The grade separated ramp is also required to provide the required performance of the RTC through the interchange. The primacy of and modal shift to public transport provides an important connection to the airport.

Community: community effects not anticipated. Amenity effects such as noise during construction would need to be considered for the MMG site. The grade separation and therefore removal of the southbound traffic from the at grade intersection may provide better opportunity and safety for walking and cycling integration.

Health and safety: Providing this direct connection results in an improvement in health and safety as it removes two 'stops' thereby increasing the safety of the interchange for vehicles and the users of the RTC. Should the SUP provided as part of the short-term work be retained, walking and cycling facilities would be provided on the southern side of the interchange. Safety, such as CPTED principles, would need to be considered during future design phases.

Approved by:

Title	Name	Qualification		Date
Author	[redacted]	B.E.P Int.NZPI		17/06/2019
Reviewer	[redacted]	BPlan (Hons)		15/07/2019

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Memorandum

To	[redacted]	From	[redacted]
Copy	[redacted]	Reference	**501094**
Date	**2019-06-27**	Pages (including this page)	**2**
Subject	**20Connect: SH20B optioneering ADDENDUM – SOCIAL IMPACT**		

In addition to my assessment, dated 17 June 2019 undertaken for the 20Connect SH20B optioneering, the below provides a more nuanced assessment using the seven-point scoring scale provided at Table 1 below.

Table 1 Scoring scale

Scoring scale
3 (Significant positive)
2 (Moderate positive)
1 (Minor positive)
0 (Neutral)
-1 (Minor/moderate adverse)
-2 (Significant adverse)
-3 (Significant Adverse/Un-mitigatable)

Using the above methodology, the tables below provide a more specific score than that of the traffic light methodology initially used.

1.1 Section 1 - SH20 / SH20B Interchange to Memorial Gardens Intersection:

	Option 1A RTC in median (widening applied symmetrically)	**Option 1B** RTC in median (all widening applied on northern side)	**Option 1C** RTC in median (all widening applied on southern side)	**Option 1D** RTC on northern side	**Option 1E** RTC on southern side
Accessibility	-1	-1	-1	1	1
Community	-3	-3	0	-3	0
Health and Safety	0	0	0	0	0

1.2 Section 2 – Memorial Gardens Intersection to Waokauri Creek:

	Option 2A	**Option 2B**	**Option 2C**	**Option 2D**	**Option 2E**

	RTC in median (widening applied symmetrically)	RTC in median (all widening applied on northern side)	RTC in median (all widening applied on southern side)	RTC on northern side	RTC on southern side
Accessibility	-1	-1	-1	1	1
Community	0	0	0	0	0
Health and Safety	0	0	0	0	0

1.3 Section 3 Waokauri Creek Crossing:

	Option 3A RTC in median (widening applied symmetrically)	**Option 3B** RTC in median (all widening applied on northern side)	**Option 3C** RTC in median (all widening applied on southern side)
Accessibility	0	0	0
Community	0	0	0
Health and Safety	0	0	0

1.4 Section 4 Waokauri Creek to Orrs Road:

	Option 4A RTC in median (widening applied symmetrically)	**Option 4B** RTC in median (all widening applied on northern side)	**Option 4C** RTC in median (all widening applied on southern side)	**Option 4D** RTC on northern side	**Option 4E** RTC on southern side
Accessibility	-1	-1	-1	0	0
Community	-1	-1	-1	0	0
Health and Safety	0	0	0	0	0

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Memorandum

To	[redacted]	From	[redacted]
Copy	[redacted]	Reference	**501094**
Date	**2019-06-21**	Pages (including this page)	**6**
Subject	**20Connect: SH20B optioneering – Coastal processes and sea-level rise**		

1 Introduction

The purpose of this technical memorandum is to assess the long-term options for SH20B improvements and the Rapid Transit Corridor (RTC) from a **Coastal Processes** perspective including the effects of sea-level rise.

The study is for the SH20B corridor and extends from the SH20/20B interchange and Orrs Road. The information provided to assist assessment is limited to typical cross section and approximate footprint of works for each option in the Drawings provided 501094-4403-SKT-RR-0301 to 0310, 501094-4403-SKT-RR-0315 to 0332 and 501094-4403-SKT-RR-0351 to0356

This study extent is divided into four sections.

1) SH20/SH20B interchange to Memorial Gardens (including the SH20/SH20B interchange);
2) Memorial Gardens to Waokauri Creek (including Memorial Gardens Intersection);
3) Waokauri Creek Crossings; and
4) Waokauri Creek to Orrs Road (including Campana Intersection).

The options (representing potential configurations/scenarios) assessed at each section of the corridor are as follows:

- Option A – RTC in median (widening applied symmetrically);
- Option B – RTC in median (all widening applied on northern side);
- Option C – RTC in median (all widening applied on southern side);
- Option D – RTC on northern side of SH20B (SH20B remain largely unchanged);
- Option E – RTC on southern side of SH20B (SH20B remains largely unchanged)



Figure 1: Areas where branches of Waokauri Creek intersect SH20B and may impinge on the coastal environment and Coastal Marine Area (CMA). [*Base map:* Auckland Council GeoMaps plus hatched areas representing the Coastal Storm Inundation (CSI) Layer in the Auckland Unitary Plan (AUP) for 1% Annual Exceedance Probability (AEP) coastal flooding plus 1 m sea-level rise].

2 Assumptions and Limitations

The following assumptions and limitations have been made when developing and assessing all options:

- The proposed SH20B Short Term Improvements project, the AIAL Park and Ride South and the realignment of Prices Road are treated as the baseline environment ('existing environment') i.e. it is anticipated that these improvement works have already been delivered and are operational.
- The cross section of SH20B does not require further widening beyond the short term works except in locations where either lane widths are <3.5m or a median <2.4m has been provided.
- The preferred location of the RTC on Puhinui Road (east of the SH20/20B interchange) is in the median.
- Access to SH20B is restricted to the signalised intersections at Manukau Memorial Gardens (MMG) and Campana Road. Access on the southern side is via the realigned Prices Road constructed as part of the AIAL Park and Ride South works.
- A service road (which is included in the footprint) will be required on the northern edge to link the remaining side road and driveways to the intersection at Campana Road.
- The existing jet fuel lines can be retained if located under the service road on the northern edge of the project area. Relocation is required if they are located under the SH20B carriageway or RTC.

- Any stormwater assets implemented during the short-term works that are impacted by the long-term project will be replaced on a like-for-like basis (i.e. if a swale constructed in the short-term works is impacted, then a swale of the same size is provided in the revised cross section).
- The footprints provided do not include any earthworks or retaining batters/structures required for the construction of the alignment. These design and construction elements could impact assessment and scoring.
- Deck levels for the new bridge(s) across Waokauri Creek will be at or similar level to the current bridge of around 9 m AVD-43.

3 Methodology

A traffic light system is being adopted for the purposes of this assessment.

Low risk (to consentability / programme); no or very minor issues.	Medium risk (to consentability / programme); a few issues or an issue with moderate difficulty.	High risk (to consentability / programme), fatal flaw, significant difficulties.

4 Assessment

Using the above methodology (and subject to the assumptions and limitations above), the tables below assess each option/scenario within each section (only Section 3 is relevant for coastal processes) and provide justification of the colour attributed.

Assumptions applicable to coastal processes and sea-level rise along with previous generic issues identified in the short-list phase are described in the *20 Connect Short List Options: Multi-Criteria Analysis Scoring Sheet for Coastal Processes & Sea-Level Rise (Bell, 2018)*. I also considered the recent report: *State Highway 20B, Short Term Improvements: AEE - Coastal Processes* prepared by Aurecon NZ Ltd. and Dr Terry Hume (Hume Consulting Ltd) – dated 29-May-2019.

Also considered were:

- Chapter F2 of the AUP (e.g., Section F2.14, which aims to only have activities in the CMA that have a functional or operational need to be located in the CMA),
- the Coastal Storm Inundation (CSI) overlay in the AUP (related to E36: Natural Hazards and Flooding in the District Plan) – see hatched areas in Figure 1 (noting the overlay with sea-level rise was cut-off at the northern side of SH20B for the East and West arms of Waokauri Creek).
- Chapter B.10 (Environmental Risk including climate change) of the Regional Policy Statement.

Note: Only Section 3 of the long-term SH20B options is assessed here in relation to this high-level assessment of effects on coastal processes, as the other Sections have no direct connection to the Coastal Marine Area (CMA).

4.1 Section 1 - SH20 / SH20B Interchange to Memorial Gardens Intersection:

	Option 1A RTC in median (widening applied symmetrically)	**Option 1B** RTC in median (all widening applied on northern side)	**Option 1C** RTC in median (all widening applied on southern side)	**Option 1D** RTC on northern side	**Option 1E** RTC on southern side
N/A					

4.2 Section 2 – Memorial Gardens Intersection to Waokauri Creek:

	Option 2A RTC in median (widening applied symmetrically)	**Option 2B** RTC in median (all widening applied on northern side)	**Option 2C** RTC in median (all widening applied on southern side)	**Option 2D** RTC on northern side	**Option 2E** RTC on southern side
N/A					

4.3 Section 3 Waokauri Creek Crossings: *(includes Waokauri Creek East and West branches)*

	Option 3A RTC in median (**widening applied symmetrically** online; existing bridge shared pathway bridge demolished)	**Option 3B** RTC in median (all widening applied offline on **northern** side; existing bridge used for RTC, shared pathway bridge retained)	**Option 3C** RTC in median (all widening applied offline on **southern** side; existing bridge retained for northern service road, existing shared path bridge demolished)
Construction effects on present CMA			
Geomorphology, sedimentation & tidal flows			
Sea-level rise and climate change incl. landward transition of the CMA			

Justification of these consentability risk ratings is provided below.

4.4 Section 4 Waokauri Creek West to Orrs Road:

	Option 4A RTC in median (widening applied symmetrically)	**Option 4B** RTC in median (all widening applied on northern side)	**Option 4C** RTC in median (all widening applied on southern side)	**Option 4D** RTC on northern side	**Option 4E** RTC on southern side
N/A					

4.5 Justification

Options 3A to 3C in Section 3 of the long-term options for SH20B improvements and the Rapid Transit Corridor (RTC) have been assessed for their effects coastal processes including climate change effects, with the rating shown in Table 3.

The offline northern bridged option across the main tributary of Waokauri Creek (Option 3B) poses the most significant risk for consentability. This is due mainly to encroachment on the CMA, both for present-day (the bridge crossing) and in the future with sea-level rise, where the CMA will move upstream through the culverts.

Further, for the northern options (3A and especially 3B), the proposed embankments infill across the adjacent West and East branches of Waokauri Creek (Figure 1 and refer to Drawing 501094-4403-SKT-RR-0354-A), where culverts currently service land drainage from the south into the creeks. This adds to the overall consenting risk both in terms of potential construction effects (e.g. sediment run-off that reaches the CMA) but also the need to occupy the present-day CMA (which is presently close to the northern side of SH20B) or place structures above the CMA.

Note: there is confusion of where the present-day CMA boundary lies, with the 20Connect Drawings showing the CMA in the West and East Creeks just to the north of SH20B, while the Aurecon & Hume (2019) report (using the AUP Zoning) indicates the CMA is 100 m north for the East Creek and 200 m north for the West Creek, backed up by photo evidence. However, for the period of the next 100 years (NZ Coastal Policy Statement – NZCPS) relevant to assessing these long-term options, this may be a moot point as the future CMA will encroach further inland (to the south side of SH20B) as sea level rises – and both Objective 5 and Policy 25 require management or avoidance of increasing the risk and "*encourage the location of infrastructure away from areas of hazard risk where practicable*" extending over at least the next 100 year period [NZCPS 25(d)].

The key question that would need to be addressed in consenting Option 3B would be justifying the functional or operational need to occupy and/or reclaim part of the CMA – present or future (Section F2.14, AUP and NZCPS), when there are practical alternative options (3A and more so 3C) that reduce the risk and interaction with coastal processes over the 100-year period.

The effects of construction activities on the CMA for all options could be mitigated to being no more than minor (with effective sediment and erosion control measures) – so the construction effects criterion for consentability is a low risk. The Waokauri Creek bridge deck elevation is assumed to be high enough (existing deck >9 m AVD-46) to avoid future storm-tide flooding combined with sea-level rise (over 100 years) so the long-term effects of sea-level rise on the bridge operation is not an issue. However, the critical issue remains in terms of consenting the activity involving CMA occupation, embankments to the West and East creek crossings and possible reclamation/infill to cover the northern extension of the relevant culverts. This latter risk rating has been attached to the sea-level

rise and climate change criterion, as it would not be rated as high a risk if sea level was static at present-day levels and the current CMA boundary.

Based solely on the effects on coastal physical processes (geomorphology, sedimentation, altering tidal flows criterion) over the operational life of the project, the risk to consentability is low for all three options (leaving aside the issue of CMA occupancy and any reclamation), particularly given the piers of the new main Creek bridge (for all options) would be positioned outside the main creek channel including on the south side.

The only outstanding consideration would be the upgrade of the SH20B culverts in the East and West Creeks to accommodate both increased tidal and storm-tide flows (from sea-level rise) and more intense rainfall (due to climate warming) leading to fluvial flooding from the landward side, and when that would be undertaken, either as an adaptive approach at some later stage, or taking the opportunity during the initial construction.

5 Summary

Overall, Option 3C (southern offline bridge and culverts) poses the least consenting risk, primarily from a CMA consentability risk (see above), but also in terms of coastal processes (geomorphology, sedimentation & tidal flows) and construction effects. This is because there would be minimal disturbance and occupation on the northern side of SH20B, where the CMA is at present and construction for 3C would be mainly in dry-land conditions to the south, where sediment runoff can be better controlled.

Note: the south-facing ramp at the SH20B/SH20 interchange (Section 1) is not relevant to coastal processes.

Approved by:

Title	Name	Qualification		ate
Author	[redacted]	PhD (Civil Engineering) CPEng (Environmental Engineering), CMEngN	[redacted]	-Jun-2019
Reviewer	[redacted]	PhD (Ocean Engineering), BE(Hons. (Civil Engineering), MEngNZ		-Jun-2019

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Memorandum

To	[redacted]	From	[redacted]
Copy	[redacted]	Reference	**501094**
Date	**2019-07-01**	Pages (including this page)	**2**
Subject	**20Connect: SH20B optioneering ADDENDUM - Coastal processes**		

In addition to my assessment, dated 21-June-2019 undertaken for the 20Connect SH20B optioneering, the below provides a more nuanced assessment using the seven-point scoring scale provided at Table 1 below.

Table 1 Scoring scale

Scoring scale
3 (Significant positive)
2 (Moderate positive)
1 (Minor positive)
0 (Neutral)
-1 (Minor/moderate adverse)
-2 (Significant adverse)
-3 (Significant Adverse/Un-mitigatable)

Using the above methodology, the tables below provide a more specific score than that of the traffic light methodology initially used. Note: Only Section 3 is applicable in relation to coastal processes.

1.1 Section 1 - SH20 / SH20B Interchange to Memorial Gardens Intersection:

	Option 1A RTC in median (widening applied symmetrically)	**Option 1B** RTC in median (all widening applied on northern side)	**Option 1C** RTC in median (all widening applied on southern side)	**Option 1D** RTC on northern side	**Option 1E** RTC on southern side
N/A					

1.2 Section 2 – Memorial Gardens Intersection to Waokauri Creek:

	Option 2A RTC in median (widening applied symmetrically)	**Option 2B** RTC in median (all widening applied on northern side)	**Option 2C** RTC in median (all widening applied on southern side)	**Option 2D** RTC on northern side	**Option 2E** RTC on southern side

N/A					

1.3 Section 3 Waokauri Creek Crossings *(includes Waokauri Creek East and West branches)*:

Criteria	**Option 3A** RTC in median (**widening applied symmetrically**)	**Option 3B** RTC in median (all widening applied on **northern side**)	**Option 3C** RTC in median (all widening applied **on southern side**)
Construction effects on present CMA	-1	-1	-1
Geomorphology, sedimentation & tidal flows	-1	-1	-1
Sea-level rise and climate change incl. landward transition of the CMA	-2	-3	-1

1.4 Section 4 Waokauri Creek to Orrs Road:

	Option 4A RTC in median (widening applied symmetrically)	**Option 4B** RTC in median (all widening applied on northern side)	**Option 4C** RTC in median (all widening applied on southern side)	**Option 4D** RTC on northern side	**Option 4E** RTC on southern side
N/A					

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Memorandum

To	[redacted]	From	[redacted]
Copy	[redacted]	Reference	**501094**
Date	**2019-06-18**	Pages (including this page)	**4**
Subject	**20Connect: SH20B optioneering – Site Contamination**		

1 Introduction

The purpose of this technical memorandum is to assess the long-term options for SH20B improvements and the Rapid Transit Corridor (RTC) from a site contamination perspective.

The extents of the study are along the SH20B corridor between the SH20/20B interchange and Orrs Road. The information provided to assist assessment is limited to typical cross section and approximate footprint of works for each option in the Drawings provided 501094-4403-SKT-RR-0301-0310, 501094-4403-SKT-RR-0315-0332 and 501094-4403-SKT-RR-0351-0356

This study extent is divided into four sections.

1) SH20/SH20B interchange to Memorial Gardens (including the SH20/SH20B interchange);
2) Memorial Gardens to Waokauri Creek (including Memorial Gardens Intersection);
3) Waokauri Creek Crossing; and
4) Waokauri Creek to Orrs Road (including Campana Intersection).

The options (representing potential configurations/scenarios) assessed at each section of the corridor are as follows:

- Option A – RTC in median (widening applied symmetrically);
- Option B - RTC in median (all widening applied on northern side);
- Option C - RTC in median (all widening applied on southern side);
- Option D - RTC on northern side of SH20B (SH20B remain largely unchanged);
- Option E - RTC on southern side of SH20B (SH20B remains largely unchanged)

2 Assumptions and Limitations

The following assumptions and limitations have been made when developing and assessing all options:

- Acid sulphate soils have not been considered in this site contamination assessment. Acid sulphate soils and potential acid sulphate soils (ASS/PASS) are coming under increasing scrutiny across New Zealand. A memorandum dated 14 May 2019 prepared as an addendum to the Ground Investigation Interpretive Report (Ref. 5043300-0000-REP-KK-0024) did not identify an acute risk from ASS/PASS associated with short-term improvements to SH20B; however, ground conditions

relating to ASS/PASS across the SH20B corridor have not been investigated to an extent where long-term impacts can be completely ruled out to future infrastructure and the environment.

- The proposed SH20B Short Term Improvements project, the AIAL Park and Ride South and the realignment of Prices Road are treated as the baseline environment ('existing environment'). I.e. it is anticipated that these improvement works have already been delivered and are operational.
- The cross section of SH20B does not require further widening beyond the short term works except in locations where either lane widths are <3.5m or a median <2.4m has been provided.
- The preferred location of the RTC on Puhinui Road (east of the SH20/20B interchange) is in the median.
- Access to SH20B is restricted to the signalised intersections at Manukau Memorial Gardens (MMG) and Campana Road. Access on the southern side is via the realigned Prices Road constructed as part of the AIAL Park and Ride South works.
- A service road (which is included in the footprint) will be required on the northern edge to link the remaining side road and driveways to the intersection at Campana Road.
- The existing jet fuel lines can be retained if located under the service road on the northern edge. Relocation is required if they are located under the SH20B carriageway or RTC.
- Any stormwater assets implemented during the short term works that are impacted will be replaced on a like-for-like basis (i.e. if a swale constructed in the short term works is impacted, then a swale of the same size is provided in the revised cross section).
- The footprints provided do not include any earthworks or retaining batters/structures required for the construction of the alignment. These design and construction elements could impact assessment and scoring.

3 Methodology

A traffic light system is being adopted for the purposes of this assessment.

Low risk (to consentability / programme); no or very minor issues.	Medium risk (to consentability / programme); a few issues or an issue with moderate difficulty.	High risk (to consentability / programme), fatal flaw, significant difficulties.

4 Assessment

Using the above methodology (and subject to the assumptions and limitations above), the tables below assess each option/scenario within each section and provide justification of the colour attributed.

4.1 Section 1 - SH20 / SH20B Interchange to Memorial Gardens Intersection:

	Option 1A RTC in median (widening applied symmetrically)	**Option 1B** RTC in median (all widening applied on northern side)	**Option 1C** RTC in median (all widening applied on southern side)	**Option 1D** RTC on northern side	**Option 1E** RTC on southern side
Contamination management - Soil	Potential to encounter contamination at cemetery periphery	Likely to encounter contamination within cemetery.	No contaminating activities identified to south of alignment	Likely to encounter contamination within cemetery	No contaminating activities identified to south of alignment
Contamination management - Groundwater	Leachate may be encountered in close proximity to cemetery	Leachate may be encountered in close proximity to cemetery	No contaminating activities identified to south of alignment	Leachate may be encountered in close proximity to cemetery	No contaminating activities identified to south of alignment

4.2 Section 2 – Memorial Gardens Intersection to Waokauri Creek:

	Option 2A RTC in median (widening applied symmetrically)	**Option 2B** RTC in median (all widening applied on northern side)	**Option 2C** RTC in median (all widening applied on southern side)	**Option 2D** RTC on northern side	**Option 2E** RTC on southern side
Contamination management - Soil	Historical review and investigation results indicate contamination is unlikely to require significant soil investigation or remediation in this area				
Contamination management - Groundwater	Historical review and investigation results indicate contamination is unlikely to require significant groundwater investigation or remediation in this area				

4.3 Section 3 Waokauri Creek Crossing:

	Option 3A RTC in median (widening applied symmetrically)	**Option 3B** RTC in median (all widening applied on northern side)	**Option 3C** RTC in median (all widening applied on southern side)
Contamination management - Soil	Historical review and soil sampling results do not indicate site contamination is likely to be encountered in this area	Historical review and soil sampling results do not indicate site contamination is likely to be encountered in this area	Potential site contamination associated with historical activities is not well understood (cnr Prices Rd and SH20B)
Contamination management - Groundwater	Historical review and soil sampling results do not indicate site contamination is likely to be encountered in this area	Historical review and soil sampling results do not indicate site contamination is likely to be encountered in this area	Potential site contamination associated with historical activities is not well understood however, less likely to affect groundwater than soil (cnr Prices Rd and SH20B)

4.4 Section 4 Waokauri Creek to Orrs Road:

	Option 4A RTC in median (widening applied symmetrically)	**Option 4B** RTC in median (all widening applied on northern side)	**Option 4C** RTC in median (all widening applied on southern side)	**Option 4D** RTC on northern side	**Option 4E** RTC on southern side
Contamination management - Soil	All options require construction over the existing fuel pipeline. Ground conditions near the pipeline have not been thoroughly investigated, and it is considered more likely than not this asset may be a source of soil contamination				
Contamination management - Groundwater	All options require construction over the existing fuel pipeline. Ground conditions near the pipeline have not been thoroughly investigated, and it is considered more likely than not this asset may be a source of groundwater contamination				

5 Summary

Based on the above assessment …

What are the differentiators, if any, between the options?

- Undertaking earthworks on adjoining lots where HAIL activities are currently being, or more likely than not to have been undertaken
- There are three specific areas of the alignment which include the cemetery, the corner of SH20B and Prices Road, and the areas in Section 4 which may interact with underground fuel lines

Are there any options which are significantly negative? Any near-fatal flaws?

- Contamination associated with disposal to land area likely within the cemetery. This will require significant investigation, remediation and site validation before works can be progressed. Additionally, the stigma associated with land contamination may prove an added challenge when communicating with stakeholders to re-develop this area. Cultural sensitivity may present challenges for the classification of the material beneath the cemetery as 'contaminated material'.
- This assessment assumes the underground fuel pipeline will remain protected and untouched during construction works. Should the line require removal / decommissioning prior to construction works, or should construction works impact the pipeline integrity during works, this assessment will require additional consideration.

Are there any options which are preferred? Why?

- The preferred is a combination of arrangements which avoid identified HAIL sites, as indicated in Table 4.1 to Table 4.4 above.

6 South facing ramp commentary

In order for the Rapid Transit Corridor (RTC) to traverse from Puhinui Road onto SH20B, it has been identified that a grade separated south-facing ramp connecting SH20B traffic southbound to SH20 is required and will consist of two general traffic lanes.

Given this has to occur to ensure service level performance of the RTC through the interchange and that it fits within the NZTA designation, we do not require you to assess this using the above assessment tool. Despite the ramp location being entirely within the designation, are there particular features / catchments or comments from your disciplines perspective that would make delivery challenging? Please provide any commentary relating to this ramp that you think may be relevant.

- None that we are aware of.

Approved by:

Title	Name	Qualification		ate
Author	[redacted]	BSci, CEnvP:SC	[redacted]	/06/2019
Reviewer	[redacted]	BSc, MSc (Hons), CChem		/06/2019

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Memorandum

To		From	
Copy		Reference	**501094**
Date	**2019-06-28**	Pages (including this page)	**2**
Subject	**20Connect: SH20B optioneering ADDENDUM – Site Contamination**		

In addition to my assessment, dated 18 June 2019 undertaken for the 20Connect SH20B optioneering, the below provides a more nuanced assessment using the seven-point scoring scale provided at Table 1 below.

Table 1 Scoring scale

Scoring scale
3 (Significant positive)
2 (Moderate positive)
1 (Minor positive)
0 (Neutral)
-1 (Minor/moderate adverse)
-2 (Significant adverse)
-3 (Significant Adverse/Un-mitigatable)

Using the above methodology, the tables below provide a more specific score than that of the traffic light methodology initially used.

1.1 Section 1 - SH20 / SH20B Interchange to Memorial Gardens Intersection:

	Option 1A RTC in median (widening applied symmetrically)	**Option 1B** RTC in median (all widening applied on northern side)	**Option 1C** RTC in median (all widening applied on southern side)	**Option 1D** RTC on northern side	**Option 1E** RTC on southern side
Contamination management - Soil	-1	-2	0	-2	0
Contamination management - Groundwater	-1	-1	0	-1	0

1.2 Section 2 – Memorial Gardens Intersection to Waokauri Creek:

	Option 2A RTC in median (widening applied symmetrically)	**Option 2B** RTC in median (all widening applied on northern side)	**Option 2C** RTC in median (all widening applied on southern side)	**Option 2D** RTC on northern side	**Option 2E** RTC on southern side
Contamination management - Soil	0				
Contamination management - Groundwater	0				

1.3 Section 3 Waokauri Creek Crossing:

	Option 3A RTC in median (widening applied symmetrically)	**Option 3B** RTC in median (all widening applied on northern side)	**Option 3C** RTC in median (all widening applied on southern side)
Contamination management - Soil	0	0	-1
Contamination management - Groundwater	0	0	0

1.4 Section 4 Waokauri Creek to Orrs Road:

	Option 4A RTC in median (widening applied symmetrically)	**Option 4B** RTC in median (all widening applied on northern side)	**Option 4C** RTC in median (all widening applied on southern side)	**Option 4D** RTC on northern side	**Option 4E** RTC on southern side
Contamination management - Soil	-1	-2	-1	-2	-1
Contamination management - Groundwater	-1	-1	-1	-1	-1

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Memorandum

To	[redacted]	From	[redacted]
Copy	[redacted]	Reference	**501094**
Date	**2019-06-14**	Pages (including this page)	**6**
Subject	**20Connect: SH20B optioneering - Ecology**		

1 Introduction

The purpose of this technical memorandum is to assess the long-term options for SH20B improvements and the Rapid Transit Corridor (RTC) from an ecological perspective (freshwater, terrestrial and marine ecology).

The extents of the study are along the SH20B corridor between the SH20/20B interchange and Orrs Road. The information provided to assist assessment is limited to typical cross section and approximate footprint of works for each option in the Drawings provided 501094-4403-SKT-RR-0301-0310, 501094-4403-SKT-RR-0315-0332 and 501094-4403-SKT-RR-0351-0356

This study extent is divided into four sections.

1) SH20/SH20B interchange to Memorial Gardens (including the SH20/SH20B interchange);
2) Memorial Gardens to Waokauri Creek (including Memorial Gardens Intersection);
3) Waokauri Creek Crossing; and
4) Waokauri Creek to Orrs Road (including Campana Intersection).

The options (representing potential configurations/scenarios) assessed at each section of the corridor are as follows:

- Option A – RTC in median (widening applied symmetrically);
- Option B - RTC in median (all widening applied on northern side);
- Option C - RTC in median (all widening applied on southern side);
- Option D - RTC on northern side of SH20B (SH20B remain largely unchanged);
- Option E - RTC on southern side of SH20B (SH20B remains largely unchanged)

2 Assumptions and Limitations

The following assumptions and limitations have been made when developing and assessing all options:

- The proposed SH20B Short Term Improvements project, the AIAL Park and Ride South and the realignment of Prices Road are treated as the baseline environment ('existing environment'). I.e. it is anticipated that these improvement works have already been delivered and are operational.

- The cross section of SH20B does not require further widening beyond the short term works except in locations where either lane widths are <3.5m or a median <2.4m has been provided.
- The preferred location of the RTC on Puhinui Road (east of the SH20/20B interchange) is in the median.
- Access to SH20B is restricted to the signalised intersections at Manukau Memorial Gardens (MMG) and Campana Road. Access on the southern side is via the realigned Prices Road constructed as part of the AIAL Park and Ride South works.
- A service road (which is included in the footprint) will be required on the northern edge to link the remaining side road and driveways to the intersection at Campana Road.
- The existing jet fuel lines can be retained if located under the service road on the northern edge. Relocation is required if they are located under the SH20B carriageway or RTC.
- Any stormwater assets implemented during the short term works that are impacted will be replaced on a like-for-like basis (i.e. if a swale constructed in the short term works is impacted, then a swale of the same size is provided in the revised cross section).
- **The footprints provided do not include any earthworks or retaining batters/structures required for the construction of the alignment. These design and construction elements would impact assessment and scoring.**

3 Methodology

A traffic light system is being adopted for the purposes of this assessment.

Low risk (to consentability / programme); no or very minor issues.	Medium risk (to consentability / programme); a few issues or an issue with moderate difficulty.	High risk (to consentability / programme), fatal flaw, significant difficulties.

4 Assessment

Using the above methodology (and subject to the assumptions and limitations above), the tables below assess each option/scenario within each section and provide justification of the colour attributed.

4.1 Section 1 - SH20 / SH20B Interchange to Memorial Gardens Intersection:

	Option 1A RTC in median (widening applied symmetrically)	**Option 1B** RTC in median (all widening applied on northern side)	**Option 1C** RTC in median (all widening applied on southern side)	**Option 1D** RTC on northern side	**Option 1E** RTC on southern side
Freshwater Ecology	No freshwater ecological effects	No freshwater ecological effects	No freshwater ecological effects	No freshwater ecological effects	No freshwater ecological effects

Terrestrial Ecology	No significant terrestrial ecological effects. Small amount of short-term improvements landscape vegetation loss in MMG adjacent to and north of SH20B. Mitigation by replacement planting and restoration of connectivity	No significant terrestrial ecological effects. Moderate amount of short-term improvements landscape vegetation loss in MMG adjacent to and north of SH20B. Mitigation by replacement planting and restoration of connectivity.	No significant terrestrial ecological effects.	No significant terrestrial ecological effects. Moderate amount of short-term improvements landscape vegetation loss in MMG adjacent to and north of SH20B. Mitigation by replacement planting and restoration of connectivity.	No significant terrestrial ecological effects.
Marine Ecology	No marine ecological effects	No marine ecological effects	No marine ecological effects	No marine ecological effects	No marine ecological effects

4.2 Section 2 – Memorial Gardens Intersection to Waokauri Creek:

	Option 2A RTC in median (widening applied symmetrically)	**Option 2B** RTC in median (all widening applied on northern side)	**Option 2C** RTC in median (all widening applied on southern side)	**Option 2D** RTC on northern side	**Option 2E** RTC on southern side
Freshwater Ecology	No additional freshwater ecological effects.	No additional freshwater ecological effects.	No additional freshwater ecological effects.	No additional freshwater ecological effects.	No additional freshwater ecological effects.
Terrestrial Ecology	No terrestrial habitats of significance, outside of the short-term improvements, affected.	No terrestrial habitats of significance, outside of the short-term improvements affected.	No terrestrial habitats of significance, outside of the short-term improvements, affected.	No terrestrial habitats of significance, outside of the short-term improvements, affected.	No terrestrial habitats of significance, outside of the short-term improvements, affected.
Marine Ecology	No marine ecological effects	No marine ecological effects	No marine ecological effects	No marine ecological effects	No marine ecological effects

4.3 Section 3 Waokauri Creek Crossing:

	Option 3A RTC in median (widening applied symmetrically)	**Option 3B** RTC in median (all widening applied on northern side)	**Option 3C** RTC in median (all widening applied on southern side)
Freshwater Ecology	Effects with demolition of current bridge and SUP bridge. Diversion of stormwater stream adjacent to south-east abutments. Small amount of streamworks in Waokauri Creek West with potential culvert extension in upper section of stream and wetland habitat. Small amount of streamworks in Waokauri Creek East with short culvert extension in upper section of stream and wetland habitat. Loss of riparian vegetation. Mitigation through enhancement of remainder of the site.	Streamworks in Waokauri Creek West with loss of habitat and riparian vegetation. Likely culvert extension required. Extensive streamworks in Waokauri Creek East with culvert extensions and reclamation of stream and wetland habitat. Loss of riparian vegetation. Possible requirement for offset at this site.	No works in Waokauri West or East over short-term improvements. Waokauri Creek: Shading and therefore loss of raupō habitat and modification of other wetland habitat, extending approximately 40m upstream; modification and partial loss of wetland bird habitat; no loss of stream habitat in Waokauri Creek. Loss of amenity pond on 436 Puhinui Road, but no loss of wetland. Mitigation with wetland restoration and replacement planting with shade tolerant species. Mitigation for loss of raupō habitat with replacement plantings or possible offset.
Terrestrial Ecology	No significant native vegetation loss. Some loss of vegetation important for ecological linkages between habitats (CMA to wetland).	Greatest extent of coastal riparian vegetation loss (of the three options). Decrease in the connectivity of the coastal and terrestrial habitats at Waokauri Bridge. Only partially mitigated by restoration plantings. Potential for mitigation with design	No significant native vegetation loss. Minimal loss of vegetation important ecological linkages between habitats.

		of a dry wildlife corridor under the bridge.	
Marine Ecology	Works in SEA-M2. Works in the CMA in Waokauri Creek with potential for loss of mangrove and salt marsh habitat. Loss of vegetation adjacent to the CMA. Minor loss of banded-rail habitat. Potential for adverse effects in CMA and SEA when bridge is demolished. Potential for works in the CMA at Waokauri East with loss of mangrove habitats.	Significant work in SEA-M2. Significant works in the CMA in Waokauri Creek with loss of mangrove and most of the salt marsh habitat. Significant loss of banded rail habitat. Works in the CMA and SEA-M2 at Waokauri East with loss of mangrove and partial loss of *Cotula* meadow habitats.	Shading and potential loss of part of the *Cotula* meadow under the existing bridge. Works currently outside of the CMA after taking into account short-term improvement works. Potential to impinge on the small area of CMA south of bridge when SUP bridge is removed.

4.4 Section 4 Waokauri Creek to Orrs Road: Crossing:

	Option 4A RTC in median (widening applied symmetrically)	**Option 4B** RTC in median (all widening applied on northern side)	**Option 4C** RTC in median (all widening applied on southern side)	**Option 4D** RTC on northern side	**Option 4E** RTC on southern side
Freshwater Ecology	Upper headwaters of watercourse at the top of the gully running parallel to, and immediately west of Campana Road. Degraded habitat but with wetland features. Approximately **15 linear metres** of	Upper headwaters of watercourse at the top of the gully running parallel to, and immediately west of Campana Road. Degraded habitat but with wetland features. Approximately **20 linear metres** of	Upper headwaters of watercourse at the top of the gully running parallel to, and immediately west of Campana Road. Degraded habitat but with wetland features. Approximately **10 linear metres** of	Upper headwaters of watercourse at the top of the gully running parallel to, and immediately west of Campana Road. Degraded habitat but with wetland features. Approximately **20 linear metres** of	Upper headwaters of watercourse at the top of the gully running parallel to, and immediately west of Campana Road. Degraded habitat but with wetland features. Approximately **10 linear metres** of

	habitat affected. Mitigation could be offered with improvement of downstream habitat through plantings and weed control.	habitat affected. Mitigation could be offered with improvement of downstream habitat through plantings and weed control.	habitat affected. . Mitigation could be offered with improvement of downstream habitat through plantings and weed control.	habitat affected. Mitigation could be offered with improvement of downstream habitat through plantings and weed control.	habitat affected. . Mitigation could be offered with improvement of downstream habitat through plantings and weed control.
Terrestrial Ecology	No terrestrial habitats of significance, outside of the short-term improvements, affected.	No terrestrial habitats of significance, outside of the short-term improvements, affected.	No terrestrial habitats of significance, outside of the short-term improvements, affected.	No terrestrial habitats of significance, outside of the short-term improvements, affected.	No terrestrial habitats of significance, outside of the short-term improvements, affected.
Marine Ecology	No marine ecological effects	No marine ecological effects	No marine ecological effects	No marine ecological effects	No marine ecological effects

5 Summary

Based on the above assessment the most significant effects are associated with the crossings of Waokauri Creek and it's tributaries (Waokauri Creek West and Waokauri Creek East).

The option with the least impact (on the SEA, CMA, salt water marsh) at Waokauri Creek Bridge is Option C. Option A requires significant works in both north and south i.e. CMA and wetland. In the short-medium term i.e. over the construction period and the demolition of the existing bridge, Option A will have the greatest ecological impact of the three options. Although Option C (offline replacement on southern side) will involve the modification and shading of the existing wetland, aside from the patch of raupō, the wetland is of low ecological value. The adverse ecological effects on this area are less than the effects of widening and demolition of the existing bridge (and SUP). Option B (offline replacement on the northern side) is the least preferred option, because of the significant effects on and in the CMA at Waokauri Creek, plus the Waokauri West and East.

None of the options have near-fatal flaws ecologically, although expansion to the north has the greatest ecological impacts and is likely to provide significant difficulties in gaining consent. This option will require the greatest mitigation of the impacts and will potentially require offset.

6 South facing ramp commentary

In order for the Rapid Transit Corridor (RTC) to traverse from Puhinui Road onto SH20B, it has been identified that a grade separated south-facing ramp connecting SH20B traffic southbound to SH20 is required and will consist of two general traffic lanes.

There are no identified ecological effects associated with the ramps within the NZTA designation in the vicinity of the SH20B – SH20 interchange.

Approved by:

Title	Name	Qualification	Signature	Date
Author	[redacted]	M.Sc. (Hons) Aquatic Ecologist	[redacted]	14 June 19
Reviewer	[redacted]	M.Sc. (Hons) Senior Ecological Consultant		14 June 19

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Memorandum

To		From	
Copy		Reference	**501094**
Date	**2019-07-02**	Pages (including this page)	**2**
Subject	**20Connect: SH20B optioneering ADDENDUM - Ecology**		

In addition to my assessment, dated 14 June 2019 undertaken for the 20Connect SH20B optioneering, the below provides a more nuanced assessment using the seven-point scoring scale provided at Table 1 below.

Table 1 Scoring scale

Scoring scale
3 (Significant positive)
2 (Moderate positive)
1 (Minor positive)
0 (Neutral)
-1 (Minor/moderate adverse)
-2 (Significant adverse)
-3 (Significant Adverse/Un-mitigatable)

Using the above methodology, the tables below provide a more specific score than that of the traffic light methodology initially used.

1.1 Section 1 - SH20 / SH20B Interchange to Memorial Gardens Intersection:

	Option 1A RTC in median (widening applied symmetrically)	**Option 1B** RTC in median (all widening applied on northern side)	**Option 1C** RTC in median (all widening applied on southern side)	**Option 1D** RTC on northern side	**Option 1E** RTC on southern side
Freshwater Ecology	0	0	0	0	0
Terrestrial Ecology	-1	-1	0	-1	0
Marine Ecology	0	0	0	0	0

1.2 Section 2 – Memorial Gardens Intersection to Waokauri Creek:

Criteria	**Option 2A** RTC in median (widening applied symmetrically)	**Option 2B** RTC in median (all widening applied on northern side)	**Option 2C** RTC in median (all widening applied on southern side)	**Option 2D** RTC on northern side	**Option 2E** RTC on southern side
Freshwater Ecology	0	0	0	0	0
Terrestrial Ecology	0	0	0	0	0
Marine Ecology	0	0	0	0	0

1.3 Section 3 Waokauri Creek Crossings:

	Option 3A RTC in median (widening applied symmetrically)	**Option 3B** RTC in median (all widening applied on northern side)	**Option 3C** RTC in median (all widening applied on southern side)
Freshwater Ecology	-1	-2	-1
Terrestrial Ecology	0	-1	0
Marine Ecology	-1	-3	-1

1.4 Section 4 Waokauri Creek to Orrs Road:

	Option 4A RTC in median (widening applied symmetrically)	**Option 4B** RTC in median (all widening applied on northern side)	**Option 4C** RTC in median (all widening applied on southern side)	**Option 4D** RTC on northern side	**Option 4E** RTC on southern side
Freshwater Ecology	-1	-1	-1	-1	-1
Terrestrial Ecology	0	0	0	0	0
Marine Ecology	0	0	0	0	0

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Memorandum

To	[redacted]	From	[redacted]
Copy	[redacted]	Reference	**501094**
Date	**2019-06-17**	Pages (including this page)	**8**
Subject	**20Connect: SH20B optioneering – Landscape & Visual**		

1 Introduction

The purpose of this technical memorandum is to assess the long-term options for SH20B improvements and the Rapid Transit Corridor (RTC) from a landscape, natural character and visual effects perspective. It is important to note that this report does not consider urban design outcomes.

The extents of the study are along the SH20B corridor between the SH20/20B interchange and Orrs Road. The information provided to assist assessment is limited to typical cross section and approximate footprint of works for each option in the Drawings provided 501094-4403-SKT-RR-0301-0310, 501094-4403-SKT-RR-0315-0332 and 501094-4403-SKT-RR-0351-0356

This study extent is divided into four sections.

1) SH20/SH20B interchange to Memorial Gardens (including the SH20/SH20B interchange);
2) Memorial Gardens to Waokauri Creek (including Memorial Gardens Intersection);
3) Waokauri Creek Crossing; and
4) Waokauri Creek to Orrs Road (including Campana Intersection).

The options (representing potential configurations/scenarios) assessed at each section of the corridor are as follows:

- Option A – RTC in median (widening applied symmetrically);
- Option B - RTC in median (all widening applied on northern side);
- Option C - RTC in median (all widening applied on southern side);
- Option D - RTC on northern side of SH20B (SH20B remain largely unchanged);
- Option E - RTC on southern side of SH20B (SH20B remains largely unchanged)

2 Assumptions and Limitations

The following assumptions and limitations have been made when developing and assessing all options:

- The proposed SH20B Short Term Improvements project, the AIAL Park and Ride South and the realignment of Prices Road are treated as the baseline environment ('existing environment'). I.e. it is anticipated that these improvement works have already been delivered and are operational.

- The cross section of SH20B does not require further widening beyond the short term works except in locations where either lane widths are <3.5m or a median <2.4m has been provided.
- The preferred location of the RTC on Puhinui Road (east of the SH20/20B interchange) is in the median.
- Access to SH20B is restricted to the signalised intersections at Manukau Memorial Gardens (MMG) and Campana Road. Access on the southern side is via the realigned Prices Road constructed as part of the AIAL Park and Ride South works.
- A service road (which is included in the footprint) will be required on the northern edge to link the remaining side road and driveways to the intersection at Campana Road.
- The existing jet fuel lines can be retained if located under the service road on the northern edge. Relocation is required if they are located under the SH20B carriageway or RTC.
- Any stormwater assets implemented during the short term works that are impacted will be replaced on a like-for-like basis (i.e. if a swale constructed in the short term works is impacted, then a swale of the same size is provided in the revised cross section).
- The footprints provided do not include any earthworks or retaining batters/structures required for the construction of the alignment. These design and construction elements could impact assessment and scoring.

3 Methodology

A traffic light system is being adopted for the purposes of this assessment.

Low risk (to consentability / programme); no or very minor issues.	Medium risk (to consentability / programme); a few issues or an issue with moderate difficulty.	High risk (to consentability / programme), fatal flaw, significant difficulties.

4 Assessment

Using the above methodology (and subject to the assumptions and limitations above), the tables below assess each option/scenario within each section and provide justification of the colour attributed.

4.1 Section 1 - SH20 / SH20B Interchange to Memorial Gardens Intersection:

	Option 1A RTC in median (widening applied symmetrically)	**Option 1B** RTC in median (all widening applied on northern side)	**Option 1C** RTC in median (all widening applied on southern side)	**Option 1D** RTC on northern side	**Option 1E** RTC on southern side
Natural Chr & Lasc Effects	Option requires some intrusion into MMG, and would involve removal of amenity vegetation along	Option requires significant intrusion into MMG and would involve elimination of all landscape	Option avoids effects on MMG and laces the corridor largely on land that is currently undeveloped.	Option requires significant intrusion into MMG and would involve elimination of all landscape	Option avoids effects on MMG and laces the corridor largely on land that is currently undeveloped. Would allow

	MMG boundary, which would diminish landscape amenity in cemetery, and potential impact natural character within the cemetery gullies (noting that these gullies are somewhat modified). Difficult to remediate, as this would require relocation of grave sites.	amenity vegetation along MMG boundary, significantly diminishing landscape amenity in cemetery. Also would potentially impact natural character within the cemetery gullies (noting that these gullies are somewhat modified) Difficult to remediate, as this would require further relocation of grave sites.	Would allow additional room for amenity planting around MMG, which would provide improved landscape and natural character outcomes.	amenity vegetation along MMG boundary, significantly diminishing landscape amenity in cemetery. Also would potentially impact natural character within the cemetery gullies (noting that these gullies are somewhat modified) Difficult to remediate, as this would require further relocation of grave sites.	additional room for amenity planting around MMG, which would provide improved landscape and natural character outcomes.
Visual Effects	Option would eliminate most screening vegetation between the road and MMG. Remediation would be difficult to achieve as it would require relocation of graves.	Option would eliminate all screening vegetation between the road and MMG. Remediation would be difficult to achieve as it would require relocation of graves.	Option avoids removal of screening vegetation between road and MMG, and would potentially allow for more screening to be established.	Option would eliminate all screening vegetation between the road and MMG. Remediation would be difficult to achieve as it would require relocation of graves.	Option avoids removal of screening vegetation between road an d MMG, and would potentially allow for more screening to be established.
Urban Design	Opportunities exist for urban design	Opportunities exist for urban design	Opportunities exist for urban design	Opportunities exist for urban design	Opportunities exist for urban design

4.2 Section 2 – Memorial Gardens Intersection to Waokauri Creek:

	Option 2A RTC in median (widening applied symmetrically)	**Option 2B** RTC in median (all widening applied on northern side)	**Option 2C** RTC in median (all widening applied on southern side)	**Option 2D** RTC on northern side	**Option 2E** RTC on southern side

Natural Chr & Lasc Effects	Extent of the infrastructure is exacerbated by the presence of the service road which is butted directly adjacent to the corridor. Ideally option would provide more width for planting/separation between SH20B and service lane, to reduce perceived effects of the overall width of the infrastructure corridor. Would require the loss of some amenity trees directly in front of MMG.	Extent of the infrastructure is exacerbated by the presence of the service road which is butted directly adjacent to the corridor. Ideally option would provide more width for planting/separation between SH20B and service lane, to reduce perceived effects of the overall width of the infrastructure corridor. Would require the loss of some amenity trees directly in front of MMG.	Extent of the infrastructure is exacerbated by the presence of the service road which is butted directly adjacent to the corridor. Ideally option would provide more width for planting/separation between SH20B and service lane, to reduce perceived effects of the overall width of the infrastructure corridor. Would result in the loss of some amenity planting within private residential properties.	Extent of the infrastructure is exacerbated by the presence of the service road which is butted directly adjacent to the corridor. Ideally option would provide more width for planting/separation between SH20B and service lane, to reduce perceived effects of the overall width of the infrastructure corridor. Would require the loss of some amenity trees directly in front of MMG.	Extent of the infrastructure is exacerbated by the presence of the service road which is butted directly adjacent to the corridor. Ideally option would provide more width for planting/separation between SH20B and service lane, to reduce perceived effects of the overall width of the infrastructure corridor. Would result in the loss of some amenity planting within private residential properties.
Visual Effects	Minimises visual effects on both MMG and two residential properties and allows space for some mitigation.	Would result in the loss of some screening vegetation near to the entrance of MMG, which could only be mitigated within MMG land.	Visual effects on two private residences would be increased	Would result in the loss of some screening vegetation near to the entrance of MMG, which could only be mitigated within MMG land.	Visual effects on two private residences would be increased
Urban Design	Opportunities exist for urban design	Opportunities exist for urban design	Opportunities exist for urban design	Opportunities exist for urban design	Opportunities exist for urban design

4.3 Section 3 Waokauri Creek Crossing:

	Option 3A RTC in median (widening applied symmetrically)	**Option 3B** RTC in median (all widening applied on northern side)	**Option 3C** RTC in median (all widening applied on southern side)

Natural Chr & Lasc Effects	Landscape and natural character values tend to be higher on the northern side due to increased vegetation, wider waterway channels and less modifications. Widening of existing bridge would result in loss of vegetation on the northern side, and also a small patch of habitat on the southern side. Would result in loss of some native planting on northern side. Also creates a dense cluster of infrastructure across the bridge, including the service road, and increases the dominance of the infrastructure overall.	Landscape and natural character values tend to be higher on the northern side due to increased vegetation, wider waterway channels and less modifications. A new bridge structure in this location would result in significant loss of vegetation on the northern side. Would result in loss of some native planting on northern side. Provides some separation of the infrastructure components which would help to reduce overall dominance.	Landscape and natural character values tend to be higher on the northern side due to increased vegetation, wider waterway channels and less modifications. A new bridge structure on the southern side involves bridging a more modified landscape and will result in the loss of some planting. However this could likely be further remedied on the southern side. Provides some separation of the infrastructure components which would help to reduce overall dominance.
Visual Effects	Potentially results in the loss of the property that would be subject to visual effects, and no other private properties affected by this section.	Potentially results in the loss of the property that would be subject to visual effects, and no other private properties affected by this section.	Potentially results in the loss of the property that would be subject to visual effects, and no other private properties affected by this section.
Urban Design	Opportunities exist for urban design	Opportunities exist for urban design	Opportunities exist for urban design

4.4 Section 4 Waokauri Creek to Orrs Road:

	Option 4A RTC in median (widening applied symmetrically)	**Option 4B** RTC in median (all widening applied on northern side)	**Option 4C** RTC in median (all widening applied on southern side)	**Option 4D** RTC on northern side	**Option 4E** RTC on southern side
Natural Chr & Lasc Effects	Extent of the infrastructure is exacerbated by the presence of the service road which is butted directly adjacent to the corridor. Ideally option would provide more width for planting/separation	Extent of the infrastructure is exacerbated by the presence of the service road which is butted directly adjacent to the corridor. Ideally option would provide more width for planting/separation	Extent of the infrastructure is exacerbated by the presence of the service road which is butted directly adjacent to the corridor. Ideally option would provide more width for planting/separation	Extent of the infrastructure is exacerbated by the presence of the service road which is butted directly adjacent to the corridor. Ideally option would provide more width for planting/separation	Extent of the infrastructure is exacerbated by the presence of the service road which is butted directly adjacent to the corridor. Ideally option would provide more width for planting/separation

	between SH20B and service lane, to reduce perceived effects of the overall width of the infrastructure corridor. Few (if any) natural waterways or natural habitats of notable quality along the route. Would be some loss of vegetation on roadside and in private property areas (including AIAL), although this not deemed significant. Additional space for planting on the outside edges of the corridor should be considered, as this road forms an important gateway to Auckland Airport and Te Akitai rohe, which needs to be reflected in structural planting.	between SH20B and service lane, to reduce perceived effects of the overall width of the infrastructure corridor. Few (if any) natural waterways or natural habitats of notable quality along the route. Would be some loss of vegetation on roadside and in private property areas (including AIAL), although this not deemed significant. Additional space for planting on the outside edges of the corridor should be considered, as this road forms an important gateway to Auckland Airport and Te Akitai rohe, which needs to be reflected in structural planting.	between SH20B and service lane, to reduce perceived effects of the overall width of the infrastructure corridor. Few (if any) natural waterways or natural habitats of notable quality along the route. Would be some loss of vegetation on roadside and in private property areas (including AIAL), although this not deemed significant. Additional space for planting on the outside edges of the corridor should be considered, as this road forms an important gateway to Auckland Airport and Te Akitai rohe, which needs to be reflected in structural planting.	between SH20B and service lane, to reduce perceived effects of the overall width of the infrastructure corridor. Few (if any) natural waterways or natural habitats of notable quality along the route. Would be some loss of vegetation on roadside and in private property areas (including AIAL), although this not deemed significant. Additional space for planting on the outside edges of the corridor should be considered, as this road forms an important gateway to Auckland Airport and Te Akitai rohe, which needs to be reflected in structural planting.	between SH20B and service lane, rather than between road and RTC, to reduce perceived effects of the overall width of the infrastructure corridor and provide more opportunity to create a 'local' road. Few (if any) natural waterways or natural habitats of notable quality along the route. Would be some loss of vegetation on roadside and in private property areas, although this not deemed significant. Additional space for planting on the outside edges of the corridor should be considered, as this road forms an important gateway to Auckland Airport and Te Akitai rohe, which needs to be reflected in structural planting.
Visual Effects	Some visual effects would be created on residential properties, but this could be relatively easily mitigated (should these properties exist at time of construction). Allowance is being made as part of	Some visual effects would be created on residential properties, but this could be relatively easily mitigated (should these properties exist at time of construction).	Some visual effects would be created on residential properties, but this could be relatively easily mitigated (should these properties exist at time of construction). Allowance is being made as part of	Some visual effects would be created on residential properties, but this could be relatively easily mitigated (should these properties exist at time of construction).	Some visual effects would be created on residential properties, but this could be relatively easily mitigated (should these properties exist at time of construction). Allowance is being made as part of

	the Airport P&R facility for wider corridor and so unlikely to affect any conditions around visual effects of this facility.		the Airport P&R facility for wider corridor and so unlikely to affect any conditions around visual effects of this facility.		the Airport P&R facility for wider corridor and so unlikely to affect any conditions around visual effects of this facility.
Urban Design	Opportunities exist for urban design	Opportunities exist for urban design	Opportunities exist for urban design	Opportunities exist for urban design	Opportunities exist for urban design

5 Summary

The following provides a summary of the key consenting and programme risks identified by the assessment from a natural character, landscape, visual and urban design perspective:

- The short-term SH20B project has highlighted a number of concerns around the intrusion of the road corridor into the Manukau Memorial Gardens (Section 1). A number of the options involve the removal of vegetation that will be planted as part of the short-term project, and the extent of intrusion means that remediation within MMG is unlikely because it would involve relocation of graves. Therefore, the favoured options are those that extend the road to the southern side, particularly where additional space becomes available to add more screening/mitigation around the MMG boundary.
- The service road exacerbates the overall extent of infrastructure that will be present in the corridor, and provides little opportunity to create a 'local road' character. Ideally options would be considered that provides greater separation between the SH20B corridor and this service road. This has increased importance when considering SH20B as a gateway into the Airport and Te Akitai's rohe.
- It is understood that this assessment is being undertaken to inform the potential RTC alignment. However, the short-term SH20B project has highlighted the importance of this route as a gateway to Auckland airport (or to the city) and Te Akitai's rohe. The plans provide little scope for planting to celebrate this gateway. It is recommended that additional space be incorporated into the proposal for the purpose of achieving quality landscape and urban design outcomes.
- There are likely to be some landscape and natural character effects created by widening the Waokauri Creek bridge which will require mitigation, especially if the widening is undertaken on the northern side.
- There will likely be some visual effects created by the proposal, however these are on residential properties that are unlikely to remain in the longer term.

Considering all four sections combined, from a natural character, landscape, visual and urban design perspective, it is considered that ***Option E*** provides the best overall outcome. This option largely limits effects to the southern side of the corridor, in an area which is more modified, and delivers better RTC and SUP outcomes.

In terms of Section 1, the options that avoid effects on MMG are considered to provide better outcomes, these being ***Options 1C and 1E***. In Section 2, all options are essentially equal, in that they will present some landscape risks, largely as a result of the overall corridor width and proximity of the service road, with little space for mitigation planting. For Section 3, ***Option 3C*** provides the best

outcome as it widens the bridge to the south, reducing potential effects on the CMA. And for Section 4, any of the options could be considered, although they all present some risk due to the lack of space to provide amenity landscaping that reflects the area as an important gateway.

6 South facing ramp commentary

In order for the Rapid Transit Corridor (RTC) to traverse from Puhinui Road onto SH20B, it has been identified that a grade separated south-facing ramp connecting SH20B traffic southbound to SH20 is required and will consist of two general traffic lanes.

The ramp will be elevated above SH20 (which in itself is already elevated) to a height of approximately 23m above the surrounding 'natural' contours (based on a bridge deck height of 37.6m and surrounding contours of approximately 15m), meaning that it is potentially visible from a wide area. However, surrounding properties tend to be commercial or industrial (or are likely to be developed with this land use based on Auckland Unitary Plan zoning), with the exception of some residential areas to the northeast, and Manukau Memorial Gardens to the northwest. Both these latter areas are separated from the proposed ramp by intervening vegetation and existing mounding on which SH20 is located.

The ramp would have a character typical of roading infrastructure, and not out of character with the major interchange it will form part of. There are no natural waterways of areas of natural habitat in close proximity to the ramp.

In this regard, it is considered that the ramp presents a low risk to consentability and programme from a natural character, landscape and visual effects perspective.

There exists opportunity within the design process for the ramp to provide quality urban design outcomes in accordance with the NZTA Bridging the Gap guidelines.

Approved by:

Title	Name	Qualification		Date
Author		Registered Landscape Architect		17 June 2019
Reviewer				

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Memorandum

To	[redacted]	From	[redacted]
Copy	[redacted]	Reference	**501094**
Date	**2019-06-27**	Pages (including this page)	**4**
Subject	**20Connect: SH20B optioneering ADDENDUM – Landscape & Visual**		

In addition to my assessment, dated 17 June 2019 undertaken for the 20Connect SH20B optioneering, the below provides a more nuanced assessment using the seven-point scoring scale provided at Table 1 below.

Table 1 Scoring scale

Scoring scale
3 (Significant positive)
2 (Moderate positive)
1 (Minor positive)
0 (Neutral)
-1 (Minor/moderate adverse)
-2 (Significant adverse)
-3 (Significant Adverse/Un-mitigatable)

Using the above methodology, the tables below provide a more specific score than that of the traffic light methodology initially used.

1.1 Section 1 - SH20 / SH20B Interchange to Memorial Gardens Intersection:

	Option 1A RTC in median (widening applied symmetrically)	**Option 1B** RTC in median (all widening applied on northern side)	**Option 1C** RTC in median (all widening applied on southern side)	**Option 1D** RTC on northern side	**Option 1E** RTC on southern side
Natural Chr & Lasc Effects	-1 Would require additional grave removal to provide mitigation	-2 Would require significant additional grave removal to provide mitigation	1 Avoids most natural character and landscape effects	-2 Would require significant additional grave removal to provide mitigation	1 Avoids most natural character and landscape effects
Visual Effects	-1 Would require additional grave	-2 Would require significant	2 Allows for enhanced	-2 Would require significant	2 Allows for enhanced

	removal to provide mitigation	additional grave removal to provide mitigation	visual effects mitigation	additional grave removal to provide mitigation	visual effects mitigation
Urban Design	Opportunities for Urban Design Exist [1]	Opportunities for Urban Design Exist [1]	Opportunities for Urban Design Exist [1]	Opportunities for Urban Design Exist [1]	Opportunities for Urban Design Exist [1]

1.2 Section 2 – Memorial Gardens Intersection to Waokauri Creek:

	Option 2A RTC in median (widening applied symmetrically)	**Option 2B** RTC in median (all widening applied on northern side)	**Option 2C** RTC in median (all widening applied on southern side)	**Option 2D** RTC on northern side	**Option 2E** RTC on southern side
Natural Chr & Lasc Effects	-1 Need space between service lane and motorway. Loss of amenity in front of gardens.	-1 Need space between service lane and motorway. Loss of amenity in front of gardens.	-1 Need space between service lane and motorway. Loss of amenity in private properties.	-1 Need space between service lane and motorway. Loss of amenity in front of gardens.	-1 Need space between service lane and motorway. Loss of amenity in private properties.
Visual Effects	0 Mitigation can be incorporated in design	-1 Loss of screening into MMG but can be mitigated	-1 Loss of screening into MMG but can be mitigated	-1 Loss of screening into MMG but can be mitigated	-1 Loss of screening into MMG but can be mitigated
Urban Design	Opportunities for Urban Design Exist [1]	Opportunities for Urban Design Exist [1]	Opportunities for Urban Design Exist [1]	Opportunities for Urban Design Exist [1]	Opportunities for Urban Design Exist [1]

1.3 Section 3 Waokauri Creek Crossing:

	Option 3A RTC in median (widening applied symmetrically)	**Option 3B** RTC in median (all widening applied on northern side)	**Option 3C** RTC in median (all widening applied on southern side)
Natural Chr & Lasc Effects	-1 Some work in CMA which can probably be mitigated.	-2 Significant work in CMA where natural character values highest, but can potentially be mitigated	0 Avoids areas where natural character values are highest.
Visual Effects	0 No residential properties affected	0 No residential properties affected	0 No residential properties affected
Urban Design	Opportunities for Urban Design Exist [1]	Opportunities for Urban Design Exist [1]	Opportunities for Urban Design Exist [1]

1.4 Section 4 Waokauri Creek to Orrs Road:

	Option 4A RTC in median (widening applied symmetrically)	**Option 4B** RTC in median (all widening applied on northern side)	**Option 4C** RTC in median (all widening applied on southern side)	**Option 4D** RTC on northern side	**Option 4E** RTC on southern side
Natural Chr & Lasc Effects	-1 Need space between service lane and motorway. Need more space for gateway amenity.	-1 Need space between service lane and motorway. Need more space for gateway amenity.	-1 Need space between service lane and motorway. Need more space for gateway amenity.	-1 Need space between service lane and motorway. Need more space for gateway amenity.	-1 Need space between service lane and motorway. Need more space for gateway amenity.
Visual Effects	-1 Can likely mitigate visual effects with planting	-1 Can likely mitigate visual effects with planting	-1 Can likely mitigate visual effects with planting	-1 Can likely mitigate visual effects with planting	-1 Can likely mitigate visual effects with planting

Urban Design	Opportunities for Urban Design Exist [1]	Opportunities for Urban Design Exist [1]	Opportunities for Urban Design Exist [1]	Opportunities for Urban Design Exist [1]	Opportunities for Urban Design Exist [1]

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Memorandum

To	[redacted]	From	[redacted]
Copy	[redacted]	Reference	**501094**
Date	**2019-07-18**	Pages (including this page)	**4**
Subject	**20Connect: SH20B optioneering – Property**		

1 Introduction

The purpose of this technical memorandum is to assess the long-term options for SH20B improvements and the Rapid Transit Corridor (RTC) from a Property perspective.

The extents of the study are along the SH20B corridor between the SH20/20B interchange and Orrs Road. The information provided to assist assessment is limited to typical cross section and approximate footprint of works for each option in the Drawings provided 501094-4403-SKT-RR-0301-0310, 501094-4403-SKT-RR-0315-0332 and 501094-4403-SKT-RR-0351-0356

This study extent is divided into four sections.

1) SH20/SH20B interchange to Memorial Gardens (including the SH20/SH20B interchange);
2) Memorial Gardens to Waokauri Creek (including Memorial Gardens Intersection);
3) Waokauri Creek Crossing; and
4) Waokauri Creek to Orrs Road (including Campana Intersection).

The options (representing potential configurations/scenarios) assessed at each section of the corridor are as follows:

- Option A – RTC in median (widening applied symmetrically);
- Option B - RTC in median (all widening applied on northern side);
- Option C - RTC in median (all widening applied on southern side);
- Option D - RTC on northern side of SH20B (SH20B remain largely unchanged);
- Option E - RTC on southern side of SH20B (SH20B remains largely unchanged)

2 Assumptions and Limitations

The following assumptions and limitations have been made when developing and assessing all options:

- The proposed SH20B Short Term Improvements project, the AIAL Park and Ride South and the realignment of Prices Road are treated as the baseline environment ('existing environment'). I.e. it is anticipated that these improvement works have already been delivered and are operational.
- The cross section of SH20B does not require further widening beyond the short term works except in locations where either lane widths are <3.5m or a median <2.4m has been provided.

- The preferred location of the RTC on Puhinui Road (east of the SH20/20B interchange) is in the median.
- Access to SH20B is restricted to the signalised intersections at Manukau Memorial Gardens (MMG) and Campana Road. Access on the southern side is via the realigned Prices Road constructed as part of the AIAL Park and Ride South works. However, private property access will be provided to all properties in some form. The specific design for this is unknown at this point, so access is assumed to be suitable for future development. A service road (which is included in the footprint) will be required on the northern edge to link the remaining side road and driveways to the intersection at Campana Road.
- The existing jet fuel lines can be retained if located under the service road on the northern edge. Relocation is required if they are located under the SH20B carriageway or RTC.
- Any stormwater assets implemented during the short term works that are impacted will be replaced on a like-for-like basis (i.e. if a swale constructed in the short term works is impacted, then a swale of the same size is provided in the revised cross section).
- The footprints provided do not include any earthworks or retaining batters/structures required for the construction of the alignment. These design and construction elements could impact assessment and scoring.
- The property effects are based on the options footprints (properties and areas) provided by Aurecon for the purposes of this study only. Therefore, the assessments are subject to review once further detail is known.
- The analysis has been on a desktop basis only, based on initial information provided.
- The property assessment is completed as at June 2019, no development consents, property files or further details have been assessed.
- No effect on lessees or business was considered in the criteria analysis.
- No injurious affection is included for the purposes of this assessment. It is noted that this could add a significant cost to the Project.
- Impacts to utilities and their property requirements has not been assessed.
- The cost information has been prepared on a very limited, mass appraisal basis. It is suggested that this be updated once further information is known about the Project.
- A 25% contingency allowance has been added to the cost assessed for the Project.
- Costs exclude any assessment on lessee's compensation, section 66 or 72 entitlements under the Public Works Act 1981 (PWA) and any consultancy fees or costs in relation to the acquisition.
- Costs exclude any compensation payable for coastal land (including tidal land) or transfer of road.
- No allowance has been made for costs of severance land. Severance land is land where there is such an effect of the property from the requirement that the remainder is no longer viable.
- Option 3A appears to slightly touch the boundary at 440 Puhinui Road and 437 Puhinui Road, this has assumed to be designed out and improvements can remain, however a full purchase of the property may be necessary. Options 3B and 3C affect these properties more substantially so the cost of acquiring these improvements has been included for the respective requirements.

- It has been assumed that Options 2A and 2B do not include an additional land requirement from the Manukau Memorial Gardens. If, even a small amount of land was required for temporary occupation, this could have significant affects on time, risk and cost.
- The land areas provided do not include any provision for temporary occupation land for construction, this will be an additional property cost.
- The costs provided are an indication of the relative cost of each option only. They include the exclusions above, which could significantly change and affect the overall Project cost.
- It is recommended the costs and option classification be reviewed when further detailed design is available.

3 Methodology

A traffic light system is being adopted for the purposes of this assessment.

Low risk (to consentability / programme); no or very minor issues.	Medium risk (to consentability / programme); a few issues or an issue with moderate difficulty.	High risk (to consentability / programme), fatal flaw, significant difficulties.

4 Assessment

Using the above methodology (and subject to the assumptions and limitations above), the tables below assess each option/scenario within each section and provide justification of the colour attributed.





5 Summary

Based on the above assessment although the options requiring land from the northern side in sections 1 and 2 appear to be more cost efficient, there are a number of complicating factors which from a property perspective, lead to the southern side being preferred (either the RTC located in the median or the southern side). This includes the acquisition of cemetery land, which is subject to the Burial and Cremations Act. It may also be a risk to Project timeframes, as traditionally the Public Works Act compulsory acquisition process is not used on Council land.

In section 3, Option 3C is the preferred option as any reduction on the creek and tidal lands from a Property perspective is positive. Coastal and Reserve land can present acquisition difficulties from a process, risk and timeframe point of view. Option 4B and 4D are the preferred options in section 4.

Due to the simplicity of the Records of Title and acquisition timeframes being able to be preserved through the fallback of the compulsory acquisition process.

6 South facing ramp commentary

In order for the RTC to traverse from Puhinui Road onto SH20B, it has been identified that a grade separated south-facing ramp connecting SH20B traffic southbound to SH20 is required and will consist of two general traffic lanes.

Given this has to occur to ensure service level performance of the RTC through the interchange and that it fits within the existing NZ Transport Agency designation, we do not require you to assess this using the above assessment tool. Despite the ramp location being entirely within the designation, are there particular features / catchments or comments from your disciplines perspective that would make delivery challenging? Please provide any commentary relating to this ramp that you think may be relevant.

[redacted]

Approved by:

Title	Name	Qualification	Signature	Date
Author	[redacted]	BCom (VPM)	[redacted]	2/7/2019
Reviewer	[redacted]	BBS (VPM)		2/7/2019

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Memorandum

To	[redacted]	From	[redacted]
Copy	[redacted]	Reference	**501094**
Date	**2019-06-27**	Pages (including this page)	**2**
Subject	**20Connect: SH20B optioneering ADDENDUM – Property**		

In addition to my assessment, dated 20 June 2019 undertaken for the 20Connect SH20B optioneering, the below provides a more nuanced assessment using the seven-point scoring scale provided at Table 1 below.

Table 1 Scoring scale

Scoring scale
3 (Significant positive)
2 (Moderate positive)
1 (Minor positive)
0 (Neutral)
-1 (Minor/moderate adverse)
-2 (Significant adverse)
-3 (Significant Adverse/Un-mitigatable)

Using the above methodology, the tables below provide a more specific score than that of the traffic light methodology initially used.

1.1 Section 1 - SH20 / SH20B Interchange to Memorial Gardens Intersection:

	Option 1A RTC in median (widening applied symmetrically)	**Option 1B** RTC in median (all widening applied on northern side)	**Option 1C** RTC in median (all widening applied on southern side)	**Option 1D** RTC on northern side	**Option 1E** RTC on southern side
Property	-3	-3	-1	-3	-1

1.2 Section 2 – Memorial Gardens Intersection to Waokauri Creek:

	Option 2A RTC in median (widening applied symmetrically)	**Option 2B** RTC in median (all widening applied on northern side)	**Option 2C** RTC in median (all widening applied on southern side)	**Option 2D** RTC on northern side	**Option 2E** RTC on southern side

Property	0	0	-1	-3	-1

1.3 Section 3 Waokauri Creek Crossing:

	Option 3A RTC in median (widening applied symmetrically)	**Option 3B** RTC in median (all widening applied on northern side)	**Option 3C** RTC in median (all widening applied on southern side)
Property	-2	-2	-2

1.4 Section 4 Waokauri Creek to Orrs Road:

	Option 4A RTC in median (widening applied symmetrically)	**Option 4B** RTC in median (all widening applied on northern side)	**Option 4C** RTC in median (all widening applied on southern side)	**Option 4D** RTC on northern side	**Option 4E** RTC on southern side
Property	-2	-1	-2	-1	-2

Appendix C: Walking and Cycling Options

Appendix D: Walking and Cycling Environmental Supporting Documents

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Memorandum

To	[redacted]	From	[redacted] **(NIWA)**
Copy	[redacted]	Reference	**501094**
Date	**2019-07-10**	Pages (including this page)	**4**
Subject	**20Connect: SH20B Walking and Cycling Optioneering – COASTAL**		

1 Introduction

The purpose of this technical memorandum is to assess the walking and cycling options for SH20B from a coastal processes perspective. The extents of the study are along the SH20B corridor between the SH20/20B interchange (including the interchange) and Orrs Road.

The walking and cycling optioneering follows the optioneering process undertaken for the roading elements (including the Rapid Transit Corridor). Therefore, this assessment only considers the extent of the footprint over and above that already assessed as part of the previous phase.

The information provided to assist assessment is limited to the following drawing sets:

- 501094-4403-SKT-0364 – 0370;
- 501094-4403-SKT-0374 – 0380;
- 501094-4403-SKT-0384 – 0390; and
- 501094-4403-SKT-0394 – 0400.

The corridor has been divided into three sections (based on the available crossing/intersection locations). The options assessed are described:

Section 1: SH20/20B Interchange to Manukau Memorial Gardens

- Option 1A – SUP on northern side (retention of existing)
- Option 1B – SUP on southern side + northern side (retention of existing)

Section 2: Manukau Memorial Gardens to Campana Road (incl. MMG intersection)

- Option 2A – SUP on northern side (northern side of service road, SUP on existing SH20B road bridge + demolition of existing SUP bridge).
- Option 2B – SUP on northern side (southern side of service road + retention of existing SUP bridge).
- Option 2C – SUP on southern side (demolition of existing SUP bridge).

Section 3: Campana Road to Orrs Road (incl. Campana Road intersection)

The options assessed in Section 3 are as follows:

- Option 3A – SUP on northern side (northern side of service road).
- Option 3B – SUP on northern side (southern side of service road).
- Option 3C – SUP on southern side (southern side of RTC).
- Option 3D – SUP on southern side (retention of existing).

2 Methodology

Scoring has been undertaken two ways, a traffic light methodology and a more nuanced seven-point scale in accordance with the below. Therefore, each option will be assigned both a colour and a number.

Low risk (to consentability / programme); no or very minor issues.	Medium risk (to consentability / programme); a few issues or an issue with moderate difficulty.	High risk (to consentability / programme), fatal flaw, significant difficulties.

Scoring scale
3 (Significant positive)
2 (Moderate positive)
1 (Minor positive)
0 (Neutral)
-1 (Minor/moderate adverse)
-2 (Significant adverse)
-3 (Significant Adverse/Un-mitigatable)

3 Assumptions/limitations

The following assumptions and limitations have been made when developing and assessing all options:

- The roading / RTC footprint and alignment has been determined based on the preferred option of the MCA (essentially Option 3C in the previous Optioneering Memo for Coastal Processes and Sea-level Rise dated 21-June-2019) and is the basis of the additional options proposed for walking and cycling facilities.
- The posted speed of SH20B (general traffic and the RTC) may be up to 80km/h
- Locations for crossing SH20B is restricted to the signalised intersections at Manukau Memorial Gardens (MMG) and Campana Road.
- The footprints provided do not include any earthworks or retaining batters/structures required for the construction of the SUP. These design and construction elements could impact assessment and scoring.
- Deck levels for any new bridge(s) across Waokauri Creek will be at or similar level to the current bridge of around 9 m AVD-43.

4 Assessment

Using the above methodologies (and subject to the same assumptions /limitations above), the tables below assess each option/scenario for the Shared Pathway within each section and provide

justification of the colour and number attributed. This assessment is a relative one, with the baseline being the environmental effects and consentability scores provided for Option 3C in the previous Optioneering Memo. Note: for the previous Option 3C, the existing SUP bridge across Waokauri Creek was earmarked to be demolished in any case.

4.1 Section 1 - SH20 / SH20B Interchange to Memorial Gardens Intersection:

	Option 1A SUP on northern side (retention of existing)	**Option 1B** SUP on southern side + northern side (retention of existing)
N/A		

4.2 Section 2: Manukau Memorial Gardens to Campana Road (incl. MMG intersection and Waokauri Creek crossings)

	Option 2A SUP on northern side (northern side of service road, SUP on existing SH20B road bridge + demolition of existing SUP bridge).	**Option 2B** SUP on northern side (southern side of service road + retention of existing SUP bridge).	**Option 2C** SUP on southern side (demolition of existing SUP bridge).
Construction effects on present CMA	This option has minor effects over and above the effects assessed during the previous phase, arising from accommodating the SUP on the northern edge, further potential effects of works in or near the CMA at Waokauri Creek East and West culvert crossings (compared to more manageable construction effects on the southern side in relation to	This option has minor effects over and above the effects assessed during the previous phase, arising from accommodating the SUP on the southern side of the service road and therefore extending the service road footprint further north, with potential effects of works in or near the CMA at Waokauri Creek East and West culvert crossings (compared to more manageable construction effects on the southern side in	This option has no effect over and above the effects assessed during the previous phase, as the SUP remains on the southern edge of the corridor. [0]

	discharges and disturbances). [-1]	relation to discharges and disturbances). [-1]	
Geomorphology, sedimentation & tidal flows	This option has no effect over and above the effects assessed during the previous phase. [0]	This option has no effect over and above the effects assessed during the previous phase. [0]	This option has no effect over and above the effects assessed during the previous phase. [0]
Sea-level rise and climate change incl. landward transition of the CMA	This option has no effect over and above the effects assessed during the previous phase. [0]	This option has no effect over and above the effects assessed during the previous phase. [0]	This option has no effect over and above the effects assessed during the previous phase. [0]

4.3 Section 3: Campana Road to Orrs Road (incl. Campana Road intersection)

	Option 3A SUP on northern side (northern side of service road).	**Option 3B** SUP on northern side (southern side of service road).	**Option 3C** SUP on southern side (southern side of RTC).	**Option 3D** SUP on southern side (retention of existing).
N/A				

Approved by:

Title	Name	Qualification	ate
Author	[redacted]	PhD (Civil Engineering), CPEng (Environmental Engineering), CMEngNZ	1-July-2019
Reviewer	[redacted]	PhD (Ocean Engineering), BE(Hons.) (Civil Engineering), MEngNZ	2-July-2019

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Memorandum

To		From	
Copy		Reference	**501094**
Date	**2019-07-12**	Pages (including this page)	**5**
Subject	**20Connect: SH20B Walking and Cycling Optioneering – SITE CONTAMINATION**		

1 Introduction

The purpose of this technical memorandum is to assess the walking and cycling options for SH20B from a site contamination perspective. The extents of the study are along the SH20B corridor between the SH20/20B interchange (including the interchange) and Orrs Road.

The walking and cycling optioneering follows the optioneering process undertaken for the roading elements (including the Rapid Transit Corridor). Therefore, this assessment only considers the extent of the footprint over and above that already assessed as part of the previous phase.

The information provided to assist assessment is limited to the following drawing sets:

- 501094-4403-SKT-0364 – 0370;
- 501094-4403-SKT-0374 – 0380;
- 501094-4403-SKT-0384 – 0390; and
- 501094-4403-SKT-0394 – 0400.

The corridor has been divided into three sections (based on the available crossing/intersection locations). The options assessed are described:

Section 1: SH20/20B Interchange to Manukau Memorial Gardens

- Option 1A – SUP on northern side (retention of existing)
- Option 1B – SUP on southern side + northern side (retention of existing)

Section 2: Manukau Memorial Gardens to Campana Road (incl. MMG intersection)

- Option 2A – SUP on northern side (northern side of service road, SUP on existing SH20B road bridge + demolition of existing SUP bridge).
- Option 2B – SUP on northern side (southern side of service road + retention of existing SUP bridge).
- Option 2C – SUP on southern side (demolition of existing SUP bridge).

Section 3: Campana Road to Orrs Road (incl. Campana Road intersection)

The options assessed in Section 3 are as follows:

- Option 3A – SUP on northern side (northern side of service road).
- Option 3B – SUP on northern side (southern side of service road).
- Option 3C – SUP on southern side (southern side of RTC).
- Option 3D – SUP on southern side (retention of existing).

2 Methodology

Scoring has been undertaken two ways, a traffic light methodology and a more nuanced seven-point scale in accordance with the below. Therefore, each option will be assigned both a colour and a number.

Low risk (to consentability / programme); no or very minor issues.	Medium risk (to consentability / programme); a few issues or an issue with moderate difficulty.	High risk (to consentability / programme), fatal flaw, significant difficulties.

Scoring scale
3 (Significant positive)
2 (Moderate positive)
1 (Minor positive)
0 (Neutral)
-1 (Minor/moderate adverse)
-2 (Significant adverse)
-3 (Significant Adverse/Un-mitigatable)

3 Assumptions/limitations

The following assumptions and limitations have been made when developing and assessing all options:

- The roading / RTC footprint and alignment has been determined based on the preferred option of the MCA and is the basis of the options proposed for walking and cycling facilities.
- The posted speed of SH20B (general traffic and the RTC) may be up to 80km/h
- Acid sulphate soils have not been considered in this site contamination assessment. Acid sulphate soils and potential acid sulphate soils (ASS/PASS) are coming under increasing scrutiny across New Zealand. A memorandum dated 14 May 2019 prepared as an addendum to the Ground Investigation Interpretive Report (Ref. 5043300-0000-REP-KK-0024) did not identify an acute risk from ASS/PASS associated with short-term improvements to SH20B; however, ground conditions relating to ASS/PASS across the SH20B corridor have not been investigated to an extent where long-term impacts can be completely ruled out to future infrastructure and the environment.
- Locations for crossing SH20B is restricted to the signalised intersections at Manukau Memorial Gardens (MMG) and Campana Road.
- The footprints provided do not include any earthworks or retaining batters/structures required for the construction of the SUP. These design and construction elements could impact assessment and scoring.
- It is noted the footprint of roadworks associated with properties south west of the Manukau Memorial Gardens intersection (Section 2) has increased beyond the southern corridor extent

assessed in optioneering memorandums *20Connect: SH20B optioneering – Site Contamination* dated 18 June 2019, and *20Connect: SH20B optioneering ADDENDUM – Site Contamination* dated 27 June. The footprint indicated in Option 2A, Option 2B and Option 2C include agricultural and residential areas where potentially contaminating activities are, or may have been undertaken. It is noted all options associated with this assessment include the same footprint, so any works required to address site contamination in this area will be the same for all options considered, regardless of severity. Therefore, all options have been assigned a risk score of '-1' for Contamination Management – Soil, based on potential site contamination associated with properties south west of the Manukau Memorial Gardens intersection.

- It is noted the footprint of roadworks associated with properties north of the Campana Road intersection (Section 3) has increased beyond the northern corridor extent assessed in optioneering memorandums *20Connect: SH20B optioneering – Site Contamination* dated 18 June 2019, and *20Connect: SH20B optioneering ADDENDUM – Site Contamination* dated 27 June. The footprint indicated in Option 3A, Option 3B, Option 3C and Option 3D include agricultural areas where potentially contaminating activities are, and have historically been undertaken. It is noted all options associated with this assessment include the same footprint, so any works required to address site contamination in this area will be the same for all options considered, regardless of severity. Therefore, potential site contamination associated with properties north of the Campana Road intersection has not been considered in this assessment. Therefore, all options have been assigned a risk score of '-1' for Contamination Management – Soil, based on potential site contamination associated with properties north of the Campana Road intersection.

4 Assessment

Using the above methodologies (and subject to the same assumptions /limitations above), the tables below assess each option/scenario within each section and provide justification of the colour and number attributed.

4.1 Section 1 - SH20 / SH20B Interchange to Memorial Gardens Intersection:

	Option 1A SUP on northern side (retention of existing)	**Option 1B** SUP on southern side + northern side (retention of existing)
Contamination management - Soil	N/A – existing [0]	No contaminating activities identified to south of alignment [0]
Contamination management - Groundwater	N/A – existing [0]	No contaminating activities identified to south of alignment [0]

4.2 Section 2: Manukau Memorial Gardens to Campana Road (incl. MMG intersection)

	Option 2A SUP on northern side (northern side of service road, SUP on existing SH20B road bridge + demolition of existing SUP bridge).	**Option 2B** SUP on northern side (southern side of service road + retention of existing SUP bridge).	**Option 2C** SUP on southern side (demolition of existing SUP bridge).
Contamination management - Soil	Historical review and investigation results indicate contamination is unlikely to require significant soil investigation or remediation in this area [-1]	Historical review and investigation results indicate contamination is unlikely to require significant soil investigation or remediation in this area [-1]	Potential site contamination associated with historical activities is not well understood (cnr Prices Rd and SH20B); however, potential contaminant issues likely to be addressed through roadway construction. Therefore, no significant difference from other options. [-1]
Contamination management - Groundwater	Historical review and investigation results indicate contamination is unlikely to require significant groundwater investigation or remediation in this area [0]		

4.3 Section 3: Campana Road to Orrs Road (incl. Campana Road intersection)

	Option 3A SUP on northern side (northern side of service road).	Option 3B SUP on northern side (southern side of service road).	Option 3C SUP on southern side (southern side of RTC).	Option 3D SUP on southern side (retention of existing).
Contamination management - Soil	May require construction near / over the existing fuel pipeline. Ground conditions near the pipeline have not been thoroughly investigated, and it is considered more likely than not this asset may be a source of soil contamination); however, potential contaminant issues likely to be addressed through roadway construction. Therefore, no significant difference from other options. [-1]		SUP built to the south of the roading elements – No contaminating activities identified to south of alignment. [-1]	N/A – existing [-1]
Contamination management - Groundwater	May require construction near / over the existing fuel pipeline. Ground conditions near the pipeline have not been thoroughly investigated, and it is considered more likely than not this asset may be a source of groundwater contamination; however, potential contaminant issues likely to be addressed through roadway construction. Therefore, no significant difference from other options. [0]		SUP built to the south of the roading elements – No contaminating activities identified to south of alignment. [0]	N/A – existing [0]

Approved by:

Title	Name	Qualification	Signature	Date
Author	[redacted]	BSci, CEnvP:SC	[redacted]	12/07/2019
Reviewer	[redacted]	BSc, MSc (Hons), CChem		12/07/2019

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Memorandum

To		From	
Copy		Reference	**501094**
Date	**2019-07-12**	Pages (including this page)	**5**
Subject	**20Connect: SH20B Walking and Cycling Optioneering – ECOLOGY**		

1 Introduction

The purpose of this technical memorandum is to assess the walking and cycling options for SH20B from an ecology perspective. The extents of the study are along the SH20B corridor between the SH20/20B interchange (including the interchange) and Orrs Road.

The walking and cycling optioneering follows the optioneering process undertaken for the roading elements (including the Rapid Transit Corridor). Therefore, this assessment only considers the extent of the footprint over and above that already assessed as part of the previous phase.

The information provided to assist assessment is limited to the following drawing sets:

- 501094-4403-SKT-0364 – 0370;
- 501094-4403-SKT-0374 – 0380;
- 501094-4403-SKT-0384 – 0390; and
- 501094-4403-SKT-0394 – 0400.

The corridor has been divided into three sections (based on the available crossing/intersection locations). The options assessed are described:

Section 1: SH20/20B Interchange to Manukau Memorial Gardens

- Option 1A – SUP on northern side (retention of existing)
- Option 1B – SUP on southern side + northern side (retention of existing)

Section 2: Manukau Memorial Gardens to Campana Road (incl. MMG intersection)

- Option 2A – SUP on northern side (northern side of service road, SUP on existing SH20B road bridge + demolition of existing SUP bridge).
- Option 2B – SUP on northern side (southern side of service road + retention of existing SUP bridge).
- Option 2C – SUP on southern side (demolition of existing SUP bridge).

Section 3: Campana Road to Orrs Road (incl. Campana Road intersection)

The options assessed in Section 3 are as follows:

- Option 3A – SUP on northern side (northern side of service road).
- Option 3B – SUP on northern side (southern side of service road).
- Option 3C – SUP on southern side (southern side of RTC).
- Option 3D – SUP on southern side (retention of existing).

2 Methodology

Scoring has been undertaken two ways, a traffic light methodology and a more nuanced seven-point scale in accordance with the below. Therefore, each option will be assigned both a colour and a number.

Low risk (to consentability / programme); no or very minor issues.	Medium risk (to consentability / programme); a few issues or an issue with moderate difficulty.	High risk (to consentability / programme), fatal flaw, significant difficulties.

Scoring scale
3 (Significant positive)
2 (Moderate positive)
1 (Minor positive)
0 (Neutral)
-1 (Minor/moderate adverse)
-2 (Significant adverse)
-3 (Significant Adverse/Un-mitigatable)

3 Assumptions/limitations

The following assumptions and limitations have been made when developing and assessing all options:

- The roading / RTC footprint and alignment has been determined based on the preferred option of the MCA and is the basis of the options proposed for walking and cycling facilities.
- The posted speed of SH20B (general traffic and the RTC) may be up to 80km/h
- Locations for crossing SH20B is restricted to the signalised intersections at Manukau Memorial Gardens (MMG) and Campana Road.
- The footprints provided do not include any earthworks or retaining batters/structures required for the construction of the SUP. These design and construction elements could impact assessment and scoring.

4 Assessment

Using the above methodologies (and subject to the same assumptions /limitations above), the tables below assess each option/scenario within each section and provide justification of the colour and number attributed.

4.1 Section 1 - SH20 / SH20B Interchange to Memorial Gardens Intersection:

	Option 1A SUP on northern side (retention of existing)	**Option 1B** SUP on southern side + northern side (retention of existing)
Freshwater Ecology	N/A – existing [0]	Potential modification of culvert 33A inlet (near chainage 2770) [-1]
Terrestrial Ecology	N/A – existing [0]	No significant terrestrial ecological effects [0]
Marine Ecology	N/A – existing [0]	N/A – No marine ecological effects [0]

4.2 Section 2: Manukau Memorial Gardens to Campana Road (incl. MMG intersection)

	Option 2A SUP on northern side (northern side of service road, SUP on existing SH20B road bridge + demolition of existing SUP bridge).	**Option 2B** SUP on northern side (southern side of service road + retention of existing SUP bridge).	**Option 2C** SUP on southern side (demolition of existing SUP bridge).
Freshwater Ecology	On the northern side of the alignment, the SUP would result in a minor reduction in effects on freshwater ecology from previously assessed footprint at Waokauri Creek bridge due to the SUP utilising the existing bridge. As the SUP appears to be on the embankment at Waokauri Creek East and Waokauri Creek	SUP in this location utilises the SUP bridge (constructed at short term). As the additional assessment area for the SUP appears to be on the embankment at Waokauri Creek East and Waokauri Creek West, no freshwater ecological effects are determined. [0]	Possible intrusion into wetland habitat at Chainage 2700 and potential crossing of an intermittent stream (not marked on the Precinct Plan) at Chainage 2700. Modification of culvert inlet at Waokauri West and small amount of wetland loss. [-1]

	West, no freshwater ecological effects are determined. [0]		
Terrestrial Ecology	Loss of up to 20m length of riparian vegetation at Chainage 2700 south (within 'SUP additional area for assessment'). This will trigger a RD activity under E15.4.1. [-1]	Loss of up to 20m length of riparian vegetation at Chainage 2700 south (within 'SUP additional area for assessment') This will trigger a RD activity under E15.4.1. [-1]	Loss of up to 20m length of riparian vegetation at Chainage 2700 south. This will trigger a RD activity under E15.4.1. [-1]
Marine Ecology	Option requires the removal of the existing SUP bridge which will result in demolition and construction activities within this area of identified CMA. No works north of existing bridge. [-1]	Option retains the existing SUP and therefore there are no further works required within the CMA [0]	Option requires the removal of the existing SUP bridge which will result in demolition and construction activities within this area of identified CMA. No works north of existing bridge. [-1]

4.3 Section 3: Campana Road to Orrs Road (incl. Campana Road intersection)

	Option 3A SUP on northern side (northern side of service road).	**Option 3B** SUP on northern side (southern side of service road).	**Option 3C** SUP on southern side (southern side of RTC).	**Option 3D** SUP on southern side (retention of existing).
Freshwater Ecology	Minor encroachment into upper headwaters of watercourse at the top of the gully running parallel to, and immediately west of Campana Road. Degraded	Increase in potential encroachment into upper headwaters of watercourse at the top of the gully running parallel to, and immediately west of Campana	Avoids additional impact on gully as SUP on southern side. No additional freshwater habitats on southern side. [0]	N/A existing retained [0]

	habitat but with wetland features. [-1]	Road. Degraded habitat but with wetland features. [0]		
Terrestrial Ecology	No terrestrial habitats of significance [0]	No terrestrial habitats of significance [0]	No terrestrial habitats of significance. [0]	N/A existing retained [0]
Marine Ecology	N/A – No marine ecological effects [0]	N/A – No marine ecological effects [0]	N/A – No marine ecological effects [0]	N/A – No marine ecological effects [0]

Approved by:

Title	Name	Qualification		Date
Author	[redacted]	M.Sc. (Hons) Aquatic Ecologist	[redacted]	12 July 19
Reviewer	[redacted]	M.Sc. (Hons) Senior Ecological Consultant		12 July 19

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Memorandum

To		From	
Copy		Reference	**501094**
Date	**2019-07-15**	Pages (including this page)	**8**
Subject	**20Connect: SH20B Walking and Cycling Optioneering – Landscape and Visual**		

1 Introduction

The purpose of this technical memorandum is to assess the walking and cycling options for SH20B from a landscape and visual perspective. The extents of the study are along the SH20B corridor between the SH20/20B interchange (including the interchange) and Orrs Road.

The walking and cycling optioneering follows the optioneering process undertaken for the roading elements (including the Rapid Transit Corridor). Therefore, this assessment only considers the extent of the footprint over and above that already assessed as part of the previous phase.

The information provided to assist assessment is limited to the following drawing sets:

- 501094-4403-SKT-0364 – 0370;
- 501094-4403-SKT-0374 – 0380;
- 501094-4403-SKT-0384 – 0390; and
- 501094-4403-SKT-0394 – 0400.

The corridor has been divided into three sections (based on the available crossing/intersection locations). The options assessed are described:

Section 1: SH20/20B Interchange to Manukau Memorial Gardens

- Option 1A – SUP on northern side (retention of existing)
- Option 1B – SUP on southern side + northern side (retention of existing)

Section 2: Manukau Memorial Gardens to Campana Road (incl. MMG intersection)

- Option 2A – SUP on northern side (northern side of service road, SUP on existing SH20B road bridge + demolition of existing SUP bridge).
- Option 2B – SUP on northern side (southern side of service road + retention of existing SUP bridge).
- Option 2C – SUP on southern side (demolition of existing SUP bridge).

Section 3: Campana Road to Orrs Road (incl. Campana Road intersection)

The options assessed in Section 3 are as follows:

- Option 3A – SUP on northern side (northern side of service road).
- Option 3B – SUP on northern side (southern side of service road).
- Option 3C – SUP on southern side (southern side of RTC).
- Option 3D – SUP on southern side (retention of existing).

2 Methodology

Scoring has been undertaken two ways, a traffic light methodology and a more nuanced seven-point scale in accordance with the below. Therefore, each option will be assigned both a colour and a number.

Low risk (to consentability / programme); no or very minor issues.	Medium risk (to consentability / programme); a few issues or an issue with moderate difficulty.	High risk (to consentability / programme), fatal flaw, significant difficulties.

Scoring scale
3 (Significant positive)
2 (Moderate positive)
1 (Minor positive)
0 (Neutral)
-1 (Minor/moderate adverse)
-2 (Significant adverse)
-3 (Significant Adverse/Un-mitigatable)

3 Assumptions/limitations

The following assumptions and limitations have been made when developing and assessing all options:

- The roading / RTC footprint and alignment has been determined based on the preferred option of the MCA and is the basis of the options proposed for walking and cycling facilities.
- The posted speed of SH20B (general traffic and the RTC) may be up to 80km/h
- Locations for crossing SH20B is restricted to the signalised intersections at Manukau Memorial Gardens (MMG) and Campana Road.
- The footprints provided do not include any earthworks or retaining batters/structures required for the construction of the SUP. These design and construction elements could impact assessment and scoring.
- That the future use of the adjacent land is highly likely to change between now and when the road/SUP is constructed, in accordance with the Future Urban zoning and the Puhinui Precinct Plan.
- That where the plans indicate the option will encroach on land that is beyond the corridor, particularly residential land, that any visual effects on such properties can be mitigated through the property purchase process.

4 Assessment

Using the above methodologies (and subject to the same assumptions /limitations above), the tables below assess each option/scenario within each section and provide justification of the colour and number attributed.

4.1 Section 1 - SH20 / SH20B Interchange to Memorial Gardens Intersection:

	Option 1A SUP on northern side (retention of existing)	**Option 1B** SUP on southern side + northern side (retention of existing)
Natural Character and Landscape Effects	N/A – existing [0]	Increases the overall width of the infrastructure corridor. But potentially there can be good separation between the road and the SUP, which would allow for planting in the corridor which would be a mitigating factor. [-1]
Visual Effects	N/A – existing [0]	Any future properties can be mitigated against with planting that is integral to the design. [-1]
Urban Design	Opportunities exist for urban design [2]	SUPs on both sides of the road present increased walking and cycling connectivity, and the southern side option is likely to increase in importance as the land to the south is developed. Potentially can be good separation between the road and the SUP. Ability for crossing between SUPs at MMG and SH20 intersections.

		[3]

4.2 Section 2: Manukau Memorial Gardens to Campana Road (incl. MMG intersection)

	Option 2A SUP on northern side (northern side of service road, SUP on existing SH20B road bridge + demolition of existing SUP bridge).	**Option 2B** SUP on northern side (southern side of service road + retention of existing SUP bridge).	**Option 2C** SUP on southern side (demolition of existing SUP bridge).
Natural Character and Landscape Effects	Option requires the removal of the existing SUP bridge Loss of amenity planting along MMG boundary which would require additional land to mitigate. Increases overall width of infrastructure, particularly with it being adjacent to the service road, which would be difficult to mitigate. [-1]	Option retains the existing SUP bridge Does not increase footprint across CMA (Waokauri Creek) and allows retention of native roadside vegetation. Loss of amenity planting along MMG boundary which would require additional land to mitigate. [-1]	Option requires the removal of the existing SUP bridge Increased footprint across CMA (Waokauri Creek) but is on southern side where natural character values are less significant. Retains amenity planting along MMG boundary. [-1]
Visual Effects	Alignment design indicates residential properties will need to be purchased, therefore mitigation is either not necessary or can be developed with landowners as required. Potential visual effects on MMG due to loss of boundary vegetation, which could only be	Alignment design indicates residential properties will need to be purchased, therefore mitigation is either not necessary or can be developed with landowners as required. Potential visual effects on MMG due to loss of boundary vegetation, which could only be	Alignment design indicates residential properties will need to be purchased, therefore mitigation is either not necessary or can be developed with landowners as required. Avoids additional visual effects on MMG as boundary vegetation can be retained.

	mitigated by taking more land. [-2]	mitigated by taking more land. [-2]	[0]
Urban Design	Alignment of SUP has tight corners which is not ideal for faster cycling, and may create some CPTED issues. SUP on northern side has smaller catchment of future users than southern side. Crossing opportunities at MMG and Campana Road. However Campana Road more difficult to get to from south due to P&R facility, and requires crossing several roads/lanes in a somewhat untidy manner and diminishes walking/ cycling priorities. Consider a separated grade crossing to avoid pedestrians/ cyclists in Campana Road intersection. [-1]	Alignment of SUP has tight corners which is not ideal for faster cycling, and may create some CPTED issues. SUP on northern side has smaller catchment of future users than southern side. Crossing opportunities at MMG and Campana Road. However Campana Road more difficult to get to from south due to P&R facility, but has better overall design than Option 2A. Walking and Cycling is still given reduced priority at this intersection. Consider a separated grade crossing to avoid pedestrians/ cyclists in Campana Road intersection. Alignment between SUP and Service Lane would likely diminish the user experience on the path – feeling of being sandwiched between roads. [-1]	Overall alignment is better than other options in terms of fast cycle use and reduction of potential CPTED issues. SUP on southern side has larger catchment for future users than northern side. Crossing opportunities at MMG and Campana Road. Users from north joining at Campana Road not affected by P&R facility, but does require crossing several roads/lanes and diminishes walking/ cycling priorities. Consider a separated grade crossing to avoid pedestrians/ cyclists in Campana Road intersection. Better user experience can be delivered with increased planting and setback from road. [+2]

4.3 Section 3: Campana Road to Orrs Road (incl. Campana Road intersection)

	Option 3A SUP on northern side (northern side of service road).	**Option 3B** SUP on northern side (southern side of service road).	**Option 3C** SUP on southern side (southern side of RTC).	**Option 3D** SUP on southern side (retention of existing).
Natural Character and Landscape Effects	No natural character effects. Increases overall width of infrastructure, but appears to be additional space to north which could allow for greater separation between SUP and roads to allow for planting mitigation. [0]	No natural character effects. Increases overall width of infrastructure, and due to SUP being between roads would be more difficult to mitigate. [-1]	No natural character effects. Increases overall width of infrastructure, but appears to be additional space to south which could allows for greater separation between SUP and roads to allow for planting mitigation. [0]	No natural character effects. Increases overall width of infrastructure, and due to SUP being between road and RTN would be more difficult to mitigate. [-1]
Visual Effects	Alignment design indicates residential properties will need to be purchased, therefore mitigation is either not necessary or can be developed with landowners as required. [0]	Alignment design indicates residential properties will need to be purchased, therefore mitigation is either not necessary or can be developed with landowners as required. [0]	Alignment design indicates residential properties will need to be purchased, therefore mitigation is either not necessary or can be developed with landowners as required. [0]	Alignment design indicates residential properties will need to be purchased, therefore mitigation is either not necessary or can be developed with landowners as required. [0]
Urban Design	SUP on northern side has smaller catchment of future users than southern side.	SUP on northern side has smaller catchment of future users	SUP on southern side has larger catchment for future users	Alignment between SH20B and RTN would likely diminish the user

	Only a single crossing opportunity at Campana Road, which requires crossing several roads/lanes in an untidy manner and diminishes walking/ cycling priorities. Consider a separated grade crossing to avoid pedestrians/ cyclists in Campana Road intersection. SUP alignment is good for faster cycling and good CPTED outcomes. [0]	than southern side. Only a single crossing opportunity at Campana Road, which requires crossing several roads/lanes in an untidy manner and diminishes walking/ cycling priorities. Consider a separated grade crossing to avoid pedestrians/ cyclists in Campana Road intersection. Alignment between SH20 and Service Lane would likely diminish the user experience on the path – feeling of being sandwiched between roads. SUP alignment is good for faster cycling and good CPTED outcomes. [-1]	than northern side. Only a single crossing opportunity at Campana Road. Users from north joining at Campana Road not affected by P&R facility, but does require crossing several roads/lanes and diminishes walking/ cycling priorities. Consider a separated grade crossing to avoid pedestrians/ cyclists in Campana Road intersection. SUP alignment is good for faster cycling and good CPTED outcomes. [2]	experience on the path – feeling of being sandwiched between roads. Reduces user safety from CPTED perspective. Also significantly diminishes opportunities for southern connections to SUP. Campana Road not affected by P&R facility, but does require crossing several roads/lanes and diminishes walking/ cycling priorities. Consider a separated grade crossing to avoid pedestrians/ cyclists in Campana Road intersection. SUP alignment is good for faster cycling. [-2]

Approved by:

Title	Name	Qualification	Signature	Date

Author	[redacted]	Registered Landscape Architect	[redacted]	15 July 2019
Reviewer				

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Memorandum

To		From	
Copy		Reference	**501094**
Date	**2019-07-19**	Pages (including this page)	**8**
Subject	**20Connect: SH20B Walking and Cycling Optioneering – Social Impact**		

1 Introduction

The purpose of this technical memorandum is to provide a high-level assessment of the potential social impact of the walking and cycling options for SH20B. The extent of the proposed work is along the SH20B corridor between the SH20/20B interchange (including the interchange) and Orrs Road, Wiri.

The walking and cycling optioneering follows on from the optioneering process undertaken for the road elements, which included the Rapid Transit Corridor. Therefore, this assessment only considers the extent of the footprint over and above that already assessed as part of the above previous optioneering phase.

The information provided to assist assessment is limited to the following drawing sets:

- 501094-4403-SKT-0364 – 0370;
- 501094-4403-SKT-0374 – 0380;
- 501094-4403-SKT-0384 – 0390; and
- 501094-4403-SKT-0394 – 0400.

The corridor is assessed in three sections. This is based on the available crossing and intersection locations. The options assessed are described as follows.

Section 1: SH20/20B Interchange to Manukau Memorial Gardens (MMG)

- Option 1A – Shared Use Path (SUP) on northern side (retention of existing).
- Option 1B – SUP on southern side and northern side (retention of existing).

Section 2: Manukau Memorial Gardens (MMG) to Campana Road (including the intersection with the MMG)

- Option 2A – SUP on northern side (northern side of service road, SUP on existing SH20B road bridge and demolition of existing SUP bridge).
- Option 2B – SUP on northern side (southern side of service road and retention of existing SUP bridge).
- Option 2C – SUP on southern side (demolition of existing SUP bridge).

Section 3: Campana Road to Orrs Road (including the intersection with Campana Road)

The options assessed in Section 3 are as follows:

- Option 3A – SUP on northern side (northern side of service road).
- Option 3B – SUP on northern side (southern side of service road).
- Option 3C – SUP on southern side (southern side of RTC).

- Option 3D – SUP on southern side (retention of existing).

2 Methodology

2.1 Scoring

The scoring of each option considers the potential social impact with relation to consentability and programme. A traffic light methodology and a seven-point scale is used to score each option. Therefore, each option is assigned both a colour and a number.

Low risk (to consentability / programme); no or very minor issues.	Medium risk (to consentability / programme); a few issues or an issue with moderate difficulty.	High risk (to consentability / programme), fatal flaw, significant difficulties.

Scoring scale
3 (Significant positive)
2 (Moderate positive)
1 (Minor positive)
0 (Neutral)
-1 (Minor/moderate adverse)
-2 (Significant adverse)
-3 (Significant adverse/unmitigable)

2.2 Social environment

The following provides a high-level overview of the existing social environment and the 'study area' used to assess potential social impacts.

The 'study area' specific to the assessment of potential social impacts is located between the SH20/ SH20B interchange and Orrs Road – the extent of SH20B corridor. The social effects study area is located in the Otara-Papatoetoe Local Board area. Compared with New Zealand, the local board area is characterised by a young population and a high proportion of couples with children. The main occupation is labourers, machinery operators and drivers and professionals. This suggests that many people travel out of the area to access employment. Many do so currently by using a private motor vehicle. The local board area is ethnically diverse with a high proportion of Pacific peoples, followed by Asian and European.

SH20B is surrounded to the north and south by pasture land, horticulture activities and scattered houses.

Future land use changes as indicated in the Auckland Unitary Plan Operative in Part is likely to include light industrial use to the north and south, future urban and special purpose (cemetery) to the north by virtue of the zones and the Puhinui Precinct.

The main social infrastructure of note along the project extent is Manukau Memorial Gardens at 361 Puhinui Road, Wiri to the north of SH20B. While not directly within the corridor being assessed, there

is a scenic lookout further along the corridor to the west. The scenic lookout is provided by Auckland International Airport Ltd (AIAL) on Puhinui Road, Mangere and appears to be popular with locals, those waiting for arrivals and aviation enthusiasts.

The Manukau Memorial Gardens provide an important space for chapel services, cremation and large funeral functions with up to 250 people being accommodated.

Colin Dale Park is located to the south, at the end of Prices Road. This site is proposed as a speedway car racing track.

The Auckland Airport is located to the west, providing an important employment centre for the surrounding community as well as an important transport link for passenger travel (domestic and international) and freight.

3 Assumptions/limitations

The following assumptions and limitations have been made when developing and assessing all options:

- The roading / RTC footprint and alignment has been determined based on the preferred option of the MCA and is the basis of the options proposed for walking and cycling facilities.
- The posted speed of SH20B (general traffic and the RTC) may be up to 80km/h.
- Locations for crossing SH20B is restricted to the signalised intersections at Manukau Memorial Gardens (MMG) and Campana Road.
- The footprints provided do not include any earthworks or retaining batters/structures required for the construction of the SUP. These design and construction elements could impact assessment and scoring.
- The assessment of potential social impacts is restricted to the assessment of the 'proposed shared path', as shown on the drawings described above. It does not include an assessment of the 'SUP additional area for assessment' or 'reduced land impact for assessment' as shown on the drawings.
- A SUP is operational on the southern side of Puhinui Road to the intersection with SH20B.
- The assessment is mainly based on the potential impact on existing social infrastructure and businesses. Comment is made on potential future land use only but does not influence the scoring and impact assessment. It is acknowledged that businesses may change through future development via the Puhinui Precinct or zoning.
- Potential impact to private property is considered from a social impact perspective only. Direct impact (acquisition) is considered separately.
- The assessment of the bridge structures ('existing' and proposed) assumes that grades are sufficient for the movement of a wheelchair, pram or other small mobility device.

4 Assessment

Using the above methodologies (and subject to the same assumptions /limitations above), the tables below assess each option/scenario within each section and provide justification of the colour and number attributed.

The following criteria is used to assess the options.

Accessibility	Extent and degree of effects on the community concerning accessibility to/from facilities, services, properties and businesses.
Community	Extent and degree of change to groups and activities, including sense of community and to known aspirations and plans.
Health and safety	Extent and degree of effects on human health and safety.

4.1 Section 1 - SH20 / SH20B Interchange to Memorial Gardens Intersection:

	Option 1A SUP on northern side (retention of existing)	**Option 1B** SUP on southern side + northern side (retention of existing)
Accessibility	Not assessed as it is assumed that the SUP on the northern side is operational. [0]	SUP along the north and south would provide more transport choice for those travelling from Puhinui Station. The southern SUP would also provide continuity for people walking or cycling on the SUP from Puhinui Station and would require less time and complexity of crossing Puhinui Road. [3]
Community	Not assessed as it is assumed that the SUP on the northern side is operational. [0]	May encourage improved sense of community, with the addition of future business land to the south. May also improve community connections because of transport choice to adjacent employment areas. [1]
Health and Safety	Not assessed as it is assumed that the SUP on the northern side is operational. [0]	Potential to encourage active transport through the provision of a continuous SUP along the southern side. This could contribute to positive human health outcomes. Personal safety to cross the intersection a concern. Personal safety also a concern for different ages and gender, depending on the future adjacent land use along the south.

	Option 1A SUP on northern side (retention of existing)	Option 1B SUP on southern side + northern side (retention of existing)
		[1]

4.2 Section 2: Manukau Memorial Gardens to Campana Road (incl. MMG intersection)

	Option 2A SUP on northern side (northern side of service road, SUP on existing SH20B road bridge + demolition of existing SUP bridge).	Option 2B SUP on northern side (southern side of service road + retention of existing SUP bridge).	Option 2C SUP on southern side (demolition of existing SUP bridge).
Accessibility	Access maintained to existing social infrastructure and businesses [1]	Access generally maintained to existing social infrastructure and businesses. North-south movement restricted. East-west movement maintainted. SUP bridge maintains continuity of movement. [1]	Access maintained to existing social infrastructure and businesses. SUP bridge maintains continuity of movement. [1]
Community	Potential impacts on sense of community not anticipated. [0]	Potential impacts on sense of community not anticipated. Connection to Waokauri Creek may be enhanced for people walking and cycling. [0]	Connection to Waokauri Creek may be enhanced for people walking and cycling. [0]
Health and Safety	Crossing of access lane to MMG and proposed slip lane would be a risk to the safety of a person walking or cycling. General traffic and walking and cycling	Crossing of access lane to MMG and proposed slip lane would be a risk to the safety of a person walking or cycling. SUP diverts away from road alignment in parts. From a	Crossing of Campana Road (south) could be a risk to the safety of a person walking or cycling, depending on the crossing type. [-1]

	Option 2A SUP on northern side (northern side of service road, SUP on existing SH20B road bridge + demolition of existing SUP bridge).	Option 2B SUP on northern side (southern side of service road + retention of existing SUP bridge).	Option 2C SUP on southern side (demolition of existing SUP bridge).
	integrated at the Waokauri Bridge. This could result in personal safety impacts. [-2]	personal safety perspective this is not favourable as the 'eyes on the path' is removed. The crossing of Campana Road requires a person walking or cycling to divert from a SH20B and cross further up Campana Road. This poses safety risks as people are likely to take risks to maintain a straightforward route. Potential human health benefits of active transport could be jeopardised should the route not consider the design issues raised above. [-2]	

4.3 Section 3: Campana Road to Orrs Road (incl. Campana Road intersection)

	Option 3A SUP on northern side (northern side of service road).	Option 3B SUP on northern side (southern side of service road).	Option 3C SUP on southern side (southern side of RTC).	Option 3D SUP on southern side (retention of existing).
Accessibility	Access maintained to existing social infrastructure and businesses. [0]	Access maintained to existing social infrastructure and businesses. [0]	Access maintained to existing social infrastructure and businesses. [0]	SUP located between SH20B and service road could restrict north-south accessibility. East-west accessibility maintained. [-1]

	Option 3A SUP on northern side (northern side of service road).	Option 3B SUP on northern side (southern side of service road).	Option 3C SUP on southern side (southern side of RTC).	Option 3D SUP on southern side (retention of existing).
Community	Potential impacts on sense of community not anticipated. [0]	Potential impacts on sense of community not anticipated. [0]	Potential impacts on sense of community not anticipated. [0]	Potential impacts on sense of community not anticipated. [0]
Health and Safety	Potential personal safety impacts because of the SUP running to the north of the service road ('eyes on the path' reduced). Crossing of Campana Road could result in potential safety concerns for people walking or cycling across Campana Road. [-1]	Crossing of Campana Road could result in potential safety concerns for people walking or cycling across Campana Road. [-1]	Crossing of Campana Road (south) could be a risk to the safety of a person walking or cycling, depending on the crossing type. [-1]	Potential personal safety impacts because of the SUP running between the service road and SH20B ('eyes on the path' reduced). [-1]

5 Summary

Overall most options present minimal potential social impact. Multiple options present concern for potential to impact personal safety, particularly those that require crossing of local roads. Options that follow the RTC and/or road alignment are more favourable from a personal safety perspective.

Accessibility: Access to existing social infrastructure and businesses is generally maintained.

Community: Potential impacts on the sense of community are not anticipated for most options. Crossing points in the north-south direction are limited. As such this could result in segregation, depending on the future land use that is developed to the north and south of SH20B.

Health and safety: As the SUP route is currently shown, crossing Campana Road (north and south) (east-west direction), SH20B (north-south direction) poses a potential risk to the safety of people walking or cycling on the SUP. This is because multiple crossings are required or the crossing requires the person walking or cycling to divert away from the most direct route, which may result in risk taking. Options that follow the RTC and/or carriageway are more favourable from a personal safety perspective.

Approved by:

Title	Name	Qualification	Date
Author	[redacted]	BPlan (Hons)	10/07/2019
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Memorandum

To	[redacted]	From	[redacted]
Copy	[redacted]	Reference	**501094**
Date	**2019-07-01**	Pages (including this page)	**5**
Subject	**20Connect: SH20B Walking and Cycling Optioneering – PROPERTY**		

1 Introduction

The purpose of this technical memorandum is to assess the walking and cycling options for SH20B from a property perspective. The extents of the study are along the SH20B corridor between the SH20/20B interchange (including the interchange) and Orrs Road.

The walking and cycling optioneering follows the optioneering process undertaken for the roading elements (including the Rapid Transit Corridor). Therefore, this assessment only considers the extent of the footprint over and above that already assessed as part of the previous phase.

The information provided to assist assessment is limited to the following drawing sets:

- 501094-4403-SKT-0364 – 0370;
- 501094-4403-SKT-0374 – 0380;
- 501094-4403-SKT-0384 – 0390; and
- 501094-4403-SKT-0394 – 0400.

The corridor has been divided into three sections (based on the available crossing/intersection locations). The options assessed are described:

Section 1: SH20/20B Interchange to Manukau Memorial Gardens

- Option 1A – SUP on northern side (retention of existing)
- Option 1B – SUP on southern side + northern side (retention of existing)

Section 2: Manukau Memorial Gardens to Campana Road (incl. MMG intersection)

- Option 2A – SUP on northern side (northern side of service road, SUP on existing SH20B road bridge + demolition of existing SUP bridge).
- Option 2B – SUP on northern side (southern side of service road + retention of existing SUP bridge).
- Option 2C – SUP on southern side (demolition of existing SUP bridge).

Section 3: Campana Road to Orrs Road (incl. Campana Road intersection)

The options assessed in Section 3 are as follows:

- Option 3A – SUP on northern side (northern side of service road).
- Option 3B – SUP on northern side (southern side of service road).
- Option 3C – SUP on southern side (southern side of RTC).
- Option 3D – SUP on southern side (retention of existing).

2 Methodology

Scoring has been undertaken two ways, a traffic light methodology and a more nuanced seven-point scale in accordance with the below. Therefore, each option will be assigned both a colour and a number.

Low risk (to consentability / programme); no or very minor issues.	Medium risk (to consentability / programme); a few issues or an issue with moderate difficulty.	High risk (to consentability / programme), fatal flaw, significant difficulties.

Scoring scale
3 (Significant positive)
2 (Moderate positive)
1 (Minor positive)
0 (Neutral)
-1 (Minor/moderate adverse)
-2 (Significant adverse)
-3 (Significant Adverse/Un-mitigatable)

3 Assumptions/limitations

The following assumptions and limitations have been made when developing and assessing all options:

- The roading / RTC footprint and alignment has been determined based on the preferred option of the MCA and is the basis of the options proposed for walking and cycling facilities.
- The posted speed of SH20B (general traffic and the RTC) may be up to 80km/h
- Locations for crossing SH20B is restricted to the signalised intersections at Manukau Memorial Gardens (MMG) and Campana Road.
- The footprints provided do not include any earthworks or retaining batters/structures required for the construction of the SUP. These design and construction elements could impact assessment and scoring.
- The property effects are based on the options footprints (properties and areas) provided by Aurecon for the purposes of this study only. Therefore, the assessments are subject to review once further detail is known.
- The analysis has been on a desktop basis only, based on initial information provided.
- The property assessment is completed as at July 2019, no development consents, property files or further details have been assessed.
- No effect on lessees or business was considered in the criteria analysis.

- No injurious affection is included for the purposes of this assessment. It is noted that this could add a significant cost to the Project.
- Impacts to utilities and their property requirements has not been assessed.
- The cost information has been prepared on a very limited, mass appraisal basis. It is suggested that this be updated once further information is known about the Project.
- A 25% contingency allowance has been added to the cost assessed for the Project.
- Costs exclude any assessment on lessee's compensation, section 66 or 72 entitlements under the Public Works Act 1981 (PWA) and any consultancy fees or costs in relation to the acquisition.
- Costs exclude any compensation payable for coastal land (including tidal land) or transfer of road.
- No allowance has been made for costs of severance land. Severance land is land where there is such an effect of the property from the requirement that the remainder is no longer viable.
- The land areas provided do not include any provision for temporary occupation land for construction, this will be an additional property cost.
- The costs provided are an indication of the relative cost of each option only. They include the exclusions above, which could significantly change and affect the overall Project cost.
- It is recommended the costs and option classification be reviewed when further detailed design is available.

4 Assessment

Using the above methodologies (and subject to the same assumptions /limitations above), the tables below assess each option/scenario within each section and provide justification of the colour and number attributed.

