

SOUTHERN LINKS 1 INDUSTRIAL DEVELOPMENT

INFRASTRUCTURE REPORT

PROJECT INFORMATION

PROJECT 298002

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1. STATEMENT OF EXPERIENCE

Author

My name is Sean McDonald. I am a Senior Engineer and Team Leader at Maven Waikato Ltd (“Maven”), a firm of consulting engineers and surveyors based in Hamilton. I have been employed by Maven since 2025. I hold a Bachelor of Engineering Technology (Highways) which I graduated from in 2006, hold a New Zealand Certificate of Engineering “Civil” (NZCE) and I am a member of Engineering New Zealand.

I have over 29 years of experience in the field of civil engineering including as a civil engineering technician, New Zealand army engineer, council engineer and consulting engineer, with over 20 years’ of experience post degree. Since obtaining my degree I have worked on a variety of civil projects including State Highway works, 3 Waters Infrastructure works, Residential Land Development, Commercial and Industrial Land Development and major Infrastructure projects such as the upgrade of the Port Boteny (Sydney) Naphtha Storage Facilities, the Transpower upgrade and extension of the Whakamuru Substation, the Central Government Rotorua Youth Justice Facility and Contact Energy’s new Tauhara Geothermal power station.

I confirm that I have read and understood the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note 2023, and agree to comply with its requirements.

I acknowledge that, as an expert, I have an overriding duty to assist the decision-maker impartially on matters within my area of expertise. In preparing this report, I have exercised my independent professional judgement, and the opinions expressed in this report are my own. I understand that my duty as an expert is not to advocate for the interests of the applicant or any other party.

I confirm that the matters addressed in this report are within my area of expertise, except where I expressly identify that I have relied upon information, assessments or opinions provided by others. I have made all reasonable enquiries and have not knowingly omitted any material facts known to me that might alter or detract from the opinions expressed in this report.

Reviewer

I am Min Shon, a Senior Civil Engineer with Maven Waikato Ltd. I hold a Master of Civil Engineering from the University of Auckland and am a Chartered Professional Engineer (CPEng) registered with Engineering New Zealand. I have over six (6) years of professional experience in civil engineering, with particular experience in land development, including earthworks, roading, and three waters infrastructure design.

I confirm that I have read and understood the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note 2023 and agree to comply with its requirements.

I acknowledge that, as an expert, I have an overriding duty to assist the decision-maker impartially on matters within my area of expertise. In preparing this report, I have exercised my independent professional judgement, and the opinions expressed in this report are my own. I understand that my duty as an expert is not to advocate for the interests of the applicant or any other party.

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2. EXECUTIVE SUMMARY

2.1. Purpose and Context

This Infrastructure Report (IR) supports the substantive resource consent application for the Southern Links 1 (SL1) Industrial Development — an approximately 60-hectare greenfield industrial site on Hamilton's southern fringe, delivering 22 industrial lots noting that 1 industrial lot is an existing Hamilton City Lot that is included within the proposal however is excluded from the infrastructure assessment below. The IR has been prepared in accordance with the Regional Infrastructure Technical Specifications (RITS V2, October 2025), relevant New Zealand and Austroads standards and the Waitawhiriwhiri Draft Integrated Catchment Management Plan (March 2026) and accompanies the application under the Fast-Track Approvals Act 2024.

The site is located at 160 Higgins Road, 20 Wickham Street, and 24 Wickham Street, Frankton — four parcels totalling approximately 60 hectares, currently in rural and light industrial use. It sits within the Waitawhiriwhiri drainage catchment, bounded by the KiwiRail corridor to the east. The defining site constraints — Holocene peat deposits across low-lying areas, a falling topography requiring significant earthworks, and a position within a wider floodplain system — have shaped the infrastructure strategy across all disciplines.

2.2. Design Philosophy and Targets

The infrastructure strategy adopts an integrated, multi-disciplinary approach with stormwater incorporating Water Sensitive Urban Design principles through a treatment train of on-lot devices, grass-lined swales, and constructed artificial wetlands. Core design targets are:

- Stormwater: Retention of the water quality volume (10 mm over new road seal) via on-lot tanks and soakage; swale treatment with minimum 9-minute residence time; attenuation of the 100-year ARI climate change event (RCP 8.5, 2081–2100) to no more than 80 percent of pre-development discharge.
- Wastewater: Gravity reticulation to two new pump stations, each with N+1 pumped duty, enhanced storage exceeding the RITS 9-hour minimum and rising main connection to the Dinsdale network.
- Water Supply: Staged connections achieving minimum 200 kPa at all nodes, with FW2/FW3 firefighting supply (12.5 L/s primary, 12.5 L/s secondary, 100 kPa minimum running pressure).
- Roading: Arterial, collector, and local roads to Austroads and RITS, with pavement subgrade improvement layers for compressible ground.
- Earthworks: Cut-to-fill platform creation with imported fill for the net shortfall, and preloading of infrastructure corridors to mitigate peat settlement.

2.3. Stormwater

Stormwater is managed through four stages:

Stage 1 On-Lot Retention: Detention/retention tanks on each lot to capture initial abstraction. Where site-specific soakage testing allows, soakage devices to provide groundwater recharge may be used.

Stage 2 Primary Conveyance: Grass-lined swales with check dams (minimum 9-minute residence time) and a piped network sized for the 10-year ARI event convey flows to the artificial wetlands. Overland flow within road corridors to pass the 100-year event; the maximum depth $\times$ velocity product of 0.15 m²/s is well within Austroads safety thresholds.

Stage 3 Treatment and Attenuation: Three artificial wetlands to provide sediment capture (via forebays), water quality treatment, extended detention, and flood attenuation:

<u>Wetland</u>	<u>Catchment</u>	<u>Type</u>	<u>Area (ha)</u>	<u>Ownership</u>
Wetland 1	A	Road Corridor Only	3.61	Private (vesting option)
Wetland 2	B	Lot Area Only	16.31	Private
Wetland 3	C	Road & Lot Combined	20.78	Public

Stage 4 Controlled Discharge; Treated flows discharge at 80 percent of pre-development rates: Wetland 1 to the HCC unlined drainage channel; Wetland 2 to the existing farm drainage network; and Wetland 3 to the HCC 1800 mm RC stormwater main, with secondary overland flow to the KiwiRail corridor. The system operates entirely by gravity with no stormwater pump stations.

2.4. Wastewater

Two wastewater pump stations (which have been designed with Aquate (a specialist engineering consultant firm specialising in water reticulation), provide internal conveyance across the development. Both stations are elevated with a minimum 300 mm freeboard above the 1% AEP flood level, provide N+1 pumped duty, and are contained within separate local purpose reserves (Lots 5001 and 5002).

- Pump Station A (Stage 1A): Serving 8.18 hectares (7 lots) with a peak design flow of 5.71 L/s. Combined storage of 164.25 m³ provides emergency redundancy and buffering capacity for off-peak discharge. Flows are pumped via a new 80 mm Ø rising main to the Karen Crescent pump station (SPS119) — the preferred of three assessed outfall options.
- Pump Station B (Stages 1B, 2, and 3): Serving 39.72 hectares (14 lots) with a peak design flow of 27.72 L/s. Flows are pumped to the Stage 1A gravity network, discharging via Pump Station A to Karen Crescent. Storage capacity of 81.25 m³ (Stage 1B) is expandable to 568.80 m³ at full development.
- Noting that the existing HCC lot has existing WW solutions onsite and has been excluded from the design calculations

Internal reticulation uses 225 mm Ø uPVC SN16 gravity pipelines. The design has been based on 45 persons per hectare in accordance with RITS V2 (October 2025).

The existing Dinsdale wastewater network has known capacity constraints. In response, the servicing strategy incorporates enhanced on-site storage significantly exceeding the RITS minimum of nine hours ADF together with off-peak pumping to the HCC network. This provides both robust emergency storage and controlled flow release that limits additional peak-period loading. The approach is proposed as an interim solution pending the developer's participation in the strategic network upgrade extending to the Whatawhata Road roundabout pump station, a project anticipated to be required by HCC independent of the proposed development. WSP is currently undertaking network capacity modelling to confirm the preferred servicing configuration. A fallback connection to the Higgins Road manhole (WWU16019) has been scoped and is technically feasible.

2.5. Water supply

The preferred Option 2 (Staged Development) balances investment with network capacity certainty:

- Stages 1A/1B: Supplied from existing Higgins Road mains, achieving 200 kPa at 250 kPa assumed network pressure.
- Stages 2/3: Supplied via a new DN350 bulk main from Kahikatea Drive along the HSL corridor, achieving 200 kPa at 280 kPa. A booster pump and/or temporary reservoir provides contingency.

Mott MacDonald's independent modelling confirms existing Hamilton South network pressure deficiencies are pre-existing and not attributable to the development.

2.6. Earthworks and Roding

Earthworks encompass 54.74 ha of disturbance, 790,603 m³ solid cut, 927,154 m³ fill, and a ~321,982 m³ imported fill shortfall (when allowing for a 1.2 Cut to Fill ratio), with preloading of road corridors over peat. Erosion and sediment control complies with TR2009-09. Pavement designs (50 mm DG10 asphaltic concrete over 422–475 mm granular pavement with 700 mm subgrade improvement layer) are based on CBR 5.0. The roding network — designed by BBO — delivers arterial connectivity via the Kahikatea Drive extension and new roundabout, a 25.5 m corridor collector road as the internal spine, and local roads with shared paths, footpaths, and indented parking.

2.7. Staging and Delivery

The development is structured across three stages, each designed to operate independently:

- Stage 1A: Wetland 1 (Catchment A), Pump Station A. Discharge to HCC unlined channel and Karen Crescent pump station.
- Stage 1B: Wetland 2 (Catchment B), Pump Station B. Discharge to farm drainage network; wastewater pumped to Stage 1A.
- Stages 2/3: Wetland 3 (Catchment C), Pump Station B extended. Discharge to HCC 1800 mm RC main; water via Kahikatea Drive bulk main.

Public assets (Wetland 3, road drainage, water mains) will be vested to Council; private assets (on-lot devices, Wetlands 1 and 2) remain in private ownership. Power and telecommunications will be underground within the road reserve, coordinated with WEL Networks and Tuatahi First Fibre.

2.8. Conclusion

The SL1 Industrial Development Infrastructure Report demonstrates a comprehensive, integrated servicing framework that addresses the site's defining constraints namely peat soils, falling topography, existing network pressure deficiencies, and a floodplain location. This has been achieved through a staged, gravity-preferring strategy that is compliant with RITS V2 (2025), the Waitawhiriwhiri Draft ICMP, and all relevant Council and regional standards. No engineering exceptions are proposed. Residual matters for detailed design including downstream wastewater network capacity confirmation, water supply pressure field verification, and refinement of localised overland flow depths, do not impact the feasibility of the strategy or the suitability of the site for the proposed industrial development.

3. Introduction

3.1. Background

Maven Waikato Ltd have been engaged to undertake Civil Design in support of the substantive application for the Southern Links 1 project (SL1 or the Project) under the Fast-track Approvals Act 2024 (FTAA). This report relates to the industrial portion of SL1, referred to as the Industrial Area and Industrial Development.

3.2. Purpose of this Report

The purpose of this report is to provide an infrastructure report (IR) for the Industrial Development at 160 Higgins Road, 20 Wickham Street and 24 Wickham Street, Frankton, Hamilton. The information provided herein outlines the methodology associated with the proposed earthworks and infrastructure onsite. This report is to be read in conjunction with the engineering drawings and is to accompany the Substantive Application under the FTAA.

3.3. Site Description and Project Summary

The Industrial Area is a contiguous industrial extension to the south of Hamilton, and forms part of the wider Southern Links Growth Cell (SL1 Growth Cell), a circa 440ha contiguous land area that stretches the south-western edge of Hamilton that includes the Hamilton Southern Links (RoNS) designation. The Industrial Development forms part of the listed SL1 Project, which includes both residential and industrial components and together comprises circa 106ha of the overall SL1 Growth Cell. The Industrial Development comprises 60ha and is currently used for a mix of rural and light industrial related activities. The landholding includes four parcels Lot 2 Deposited Plan 603134, Lot 1 Deposited Plan 603134 is circa 50ha, and Lot 1 Deposited Plan 584573 is 7.8ha and Lot 1 Deposited Plan 396081 and Lot 1 Deposited Plan 486522 is 2.1ha.

The Project seeks approval for a substantive application under the FTAA for a comprehensively master planned and staged industrial and residential development. This includes all necessary resource consents under the Resource Management Act 1991.

The Industrial Development provides for the establishment of 22 industrial lots, together with infrastructure devices including artificial wetlands and roading. The Industrial Development is underpinned by a series of design principles, with a focus on creating a well-connected, legible, and diverse industrial area on Hamilton's industrial fringe. This is supported via a coordinated and connected roading and pedestrian/cycle network, and stormwater outcomes, as well as varying industrial lot sizes which have been proposed to meet the growing and changing needs of Hamilton's industrial market to ensure there are options for future business adjacent to an existing industrial area.

The Industrial Development includes substantial enabling works to establish developable land, including:

- preloading of road corridors and bulk earthworks across the site;
- new wastewater and water supply infrastructure including new wastewater pumpstations;
- an integrated stormwater management system consisting of conveyance systems such as grass lined swales and piped stormwater infrastructure, as well as integrated detention/attenuation and treatment devices that will be combined into artificial wetlands, designed with the intent to discharge to ground water as relevant.

Access and integration with the surrounding Hamilton area is provided through a connected transport framework, including the establishment of intersections, roading, and walking and cycle networks, along with upgrades to existing transport infrastructure. The Industrial Development is proposed to be

served via a coordinated strategy, including the extension of the proposed Hamilton Southern Links (HSL) network, public networks, upgrades, and installation of appropriate infrastructure.

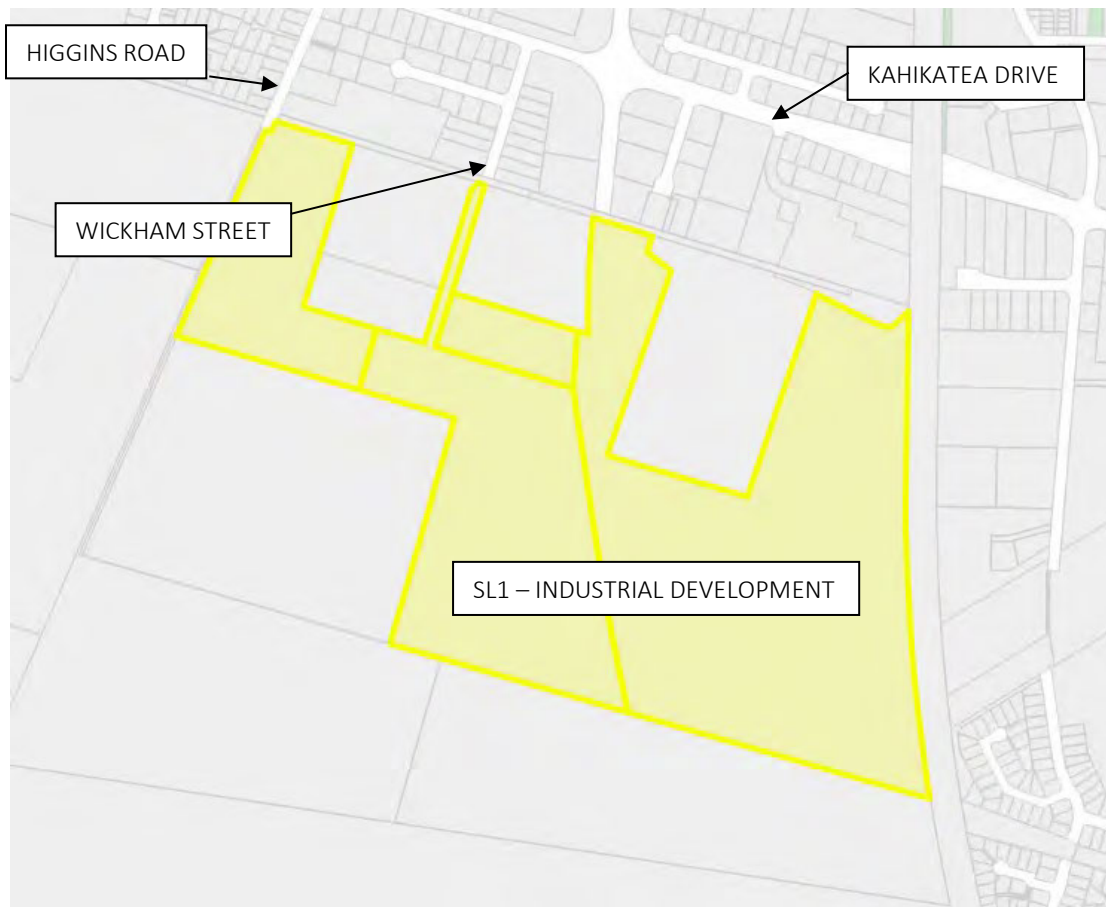


Figure 1: Site Locality

3.4. Legal Descriptions

The Industrial Area is currently split into four major parcels of land, which are summarised in Table 1 below:

Lot Description	Address	Area (Ha)
Lot 1 DP 584573	160 Higgins Road, Frankton, Hamilton	7.8866
Lot 1 DP603134	20 Wickham Street, Frankton, Hamilton	16.834
Lot 2 DP 603134	24 Wickham Street, Frankton, Hamilton	33.2747
Lot 1 DP 486522	16A Wickham Street, Frankton, Hamilton	2.1769

Table 1: Legal Descriptions

4. Earthworks

Earthworks will include preloading of road and infrastructure corridors, cut to fill operations for the construction of industrial lot areas, excavations for pavement construction, excavations for the artificial wetland construction, excavations for the wastewater pumpstations and associated drainage reticulation, formation of building platforms. The Industrial Area will contain specific erosion and sediment control measures suitable to control the earthworks area.

4.1. Geotechnical Investigation

Various site-specific geotechnical investigations have been conducted, and a geotechnical investigation report has been prepared by CMW, to support the application.

The report identifies the approximate distribution of prevailing landforms and geologies for the local area. The Industrial Development's geology consists of low-lying areas comprised of Holocene peat deposits. The peat is underlain by interbedded Silts and Sands of the Late Pleistocene alluvial deposits of the Hinuera formation, which is underlain by Early Pleistocene, fluvially reworked igneous silt/clay of the Walton Subgroup Formation which also form the base of the nearby hills outside the site. The exception is the imported gravel fill in the yard areas, the uncontrolled fill in the existing green waste site and the construction waste site in the north-eastern corner of the Industrial Area. Please refer to the Geotechnical Investigation Report- Revision 5 (Appendix E) for more information.

From the ground investigations undertaken by CMW, CMW summarised the site geology results in Table 2 below.

Geology	Unit Description	Top of Unit (mBGL)		Thickness (m)	
		Min	Max	Min	Max
Uncontrolled Fill	Stiff to very stiff Clayey Silt and medium dense Sand	0.0	0.2	0.5	3.2*
Peat (Swamp deposits)	Firm to very stiff fibrous organic Peat	0.1	1.0	0.3	12.0
Hinuera Formation	Loose to medium dense Sand with interbedded stiff to very stiff Silt, and lenses of Organic Silt	0.1	7.0	3.3	17.5
Walton Subgroup	Stiff to Hard Clay/Silt and dense to very dense Sand	5.2	19.8	0.2	>14.8
*Note: Unable to penetrate full depth, based on contours likely to be ~19m thick in the construction waste site					

Table 2: Summary of Strata Encountered

Upon completion of the proposed earthworks onsite, the geotechnical engineer will be required to prepare an Earthworks Completion Report. This report will certify the adequacy of the earthworks, and it will also provide recommendations for the foundation designs for the proposed lots within this development.

4.2. Bulk Earthworks

The total bulk earthworks for whole site is summarised in table 3 below:

Bulk Subgrade Earthworks (topsoil stripping exclusive)	
Total area of ground disturbance	547,400 m ² (54.74ha)
Total volume of CUT	790,603 m ³
Total volume of FILL	927,154 m ³
Total Volume of FILL with Compaction Factor (1.2)	1,112,585 m ³
Maximum CUT and FILL depth	5.26m FILL / 19.47m CUT
Total Volume (shortfall of FILL)	321,982m ³
Others	
Topsoil stripping (300 mm)	164,208 m ³

Table 3: Summary of Total Earthworks

4.3. Erosion and Sediment Control

Prior to commencing earthwork operations, it is anticipated that a pre-construction meeting with the Waikato Regional Council monitor team will take place. During this meeting, the erosion and sediment control measures will be discussed and confirmed to ensure that works are to be undertaken in accordance with relevant conditions of consent and the Construction Management Plan (CMP) to ensure earthworks and erosion are effectively mitigated.

Erosion and sediment control measures will be implemented in accordance with TR2009/09 – Guidelines for Soil Disturbing Activities in the Waikato Region. The proposed controls will include clean water diversion drains to prevent runoff entering disturbed areas, sediment retention devices to capture sediment-laden runoff, stabilised construction entrances to minimise sediment tracking onto public roads.

All erosion and sediment control measures have been designed to ensure compliance with TR2009-09 - Guidelines for Soil Disturbing Activities for the Waikato Region. For a comprehensive understanding of the specific application of sediment and erosion control measures for each area of earthworks, please consult the CMP which provides detailed guidance on these measures.

5. Roading

5.1. Design Standards

The proposed roads have been designed in accordance with Austroads and Waikato's Regional Infrastructure Technical Specifications (RITS). BBO are the lead Transportation Engineers for the Project and have provided the technical support with the roading design. The design provided is for resource consent purpose only and final design for the engineering approval stage will be necessary.

5.1.1. Engineering Exception Decisions

- No engineering exceptions are proposed for the Industrial Development.

5.2. Integrated Transportation Assessment

An Integrated Transportation Assessment (ITA) has been carried out by BBO and considers the traffic and transportation effects of the proposed Industrial Development. Please refer to the BBO Integrated Transportation Assessment Rev.1 (Appendix D) for further details.

5.3. Development Access

The Industrial Development will initially gain access via the following options (preferred option B in the ITA):

- A four-arm roundabout at Greenwood Street / Kahikatea Drive.
- An interim north-south access road between the Greenwood Street / Kahikatea Drive roundabout and Road 5.
- Extension of the interim access road further south to provide access to the eastern part of the Industrial Development.
- An east-west collector road forming the primary internal movement corridor through the site. A walking and cycling network connecting to the existing Greenwood Street shared path and wider active mode network.

Refer to Figure 2 below for more detail.

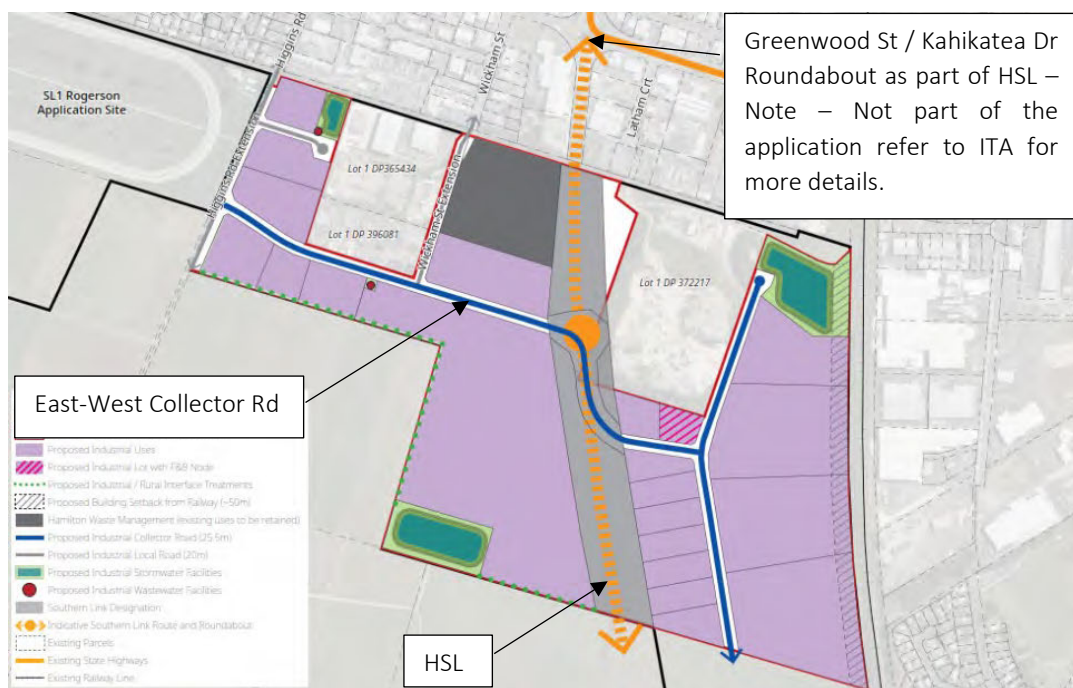


Figure 2: Site Access

Should HSL be delivered in the future, the Industrial Development has been designed so that it can integrate with the ultimate HSL transport network without precluding future infrastructure. Under the ultimate arrangement, the following infrastructure may be provided.

- A four-arm roundabout connection on HSL approximately 520 m south of the future Greenwood Street / Kahikatea Drive three-arm roundabout (refer to Section 8.1.1 of the ITA).
- Connection of the east-west collector road to the proposed HSL / SL1 roundabout.
- Access to the eastern part of the Industrial Development dependent on the future HSL network staging scenario. If the SL1 roundabout and associated HSL connection are delivered, access to the eastern area is proposed via a short section of HSL arterial and a local road connection to the north-south road in the eastern development area, as shown in Figure 2. In that scenario, following completion of HSL Stage 3 by NZTA, this local road connection is become a cul-de-sac.

Refer to the ITA (Appendix D) for further details.

5.4. Road Typology and Design

The Hamilton Southern Links extension of Kahikatea Drive design will be co-ordinated by BBO, NZTA and Hamilton City Council at the detailed design stage, including the interim and final proposed SL1 intersection design. The east-west orientated Collector Road and Local Industrial Roads (03 & 05) will be design as detailed in section 3.4.1, 3.4.2 and 3.4.3 below:

5.4.1. Collector Roads Typical Cross-section

The east-west orientated collector road (road 01 & 04) is proposed to have a 25.5m road corridor with the following features (refer to Figure 3 below):

- 11.5m carriageway width, comprised of
 - 4.5m traffic lanes, and
 - 2.2m flush median
- 7.6m northern berm width, comprised of
 - 2.6m grass lined conveyance swale
 - 3.0m shared footpath
 - 2.0m services berm
- 6.4m southern berm width, comprised of
 - 2.6m grass lined conveyance swale
 - 1.8m footpath
 - 2.0m services berm

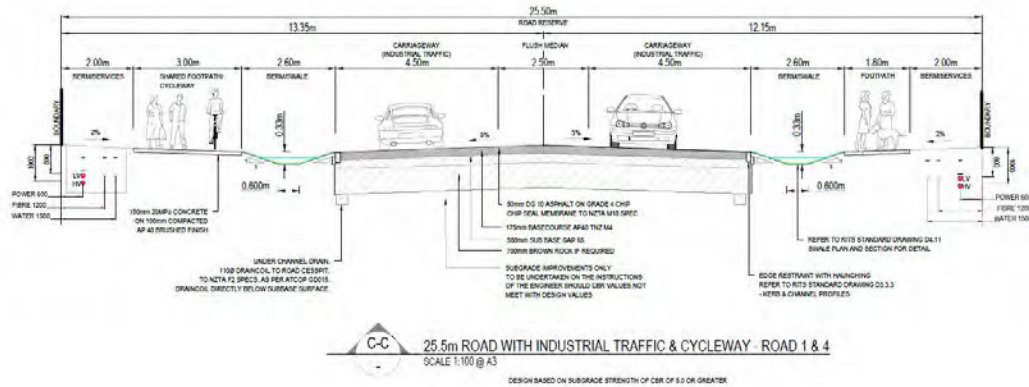


Figure 3: Collector Road Typical Cross-section

5.4.2. Local Roads Typical Cross-section

The new local roads (03 & 05) will be design to RITS and Hamilton District Plan local roads standards and is contained within 20.0m with the following features (refer to Figure 5 below):

- 9.0m carriageway width, comprised of
 - 4.5m traffic lanes, and
- 5.2m western/southern berm width, comprised of
 - 2.2m front berm/indented parking
 - 1.5m shared footpath
 - 1.5m services berm
- 5.8m eastern/northern berm width, comprised of
 - 2.8m grass lined conveyance swale
 - 1.5m footpath
 - 1.5m services berm

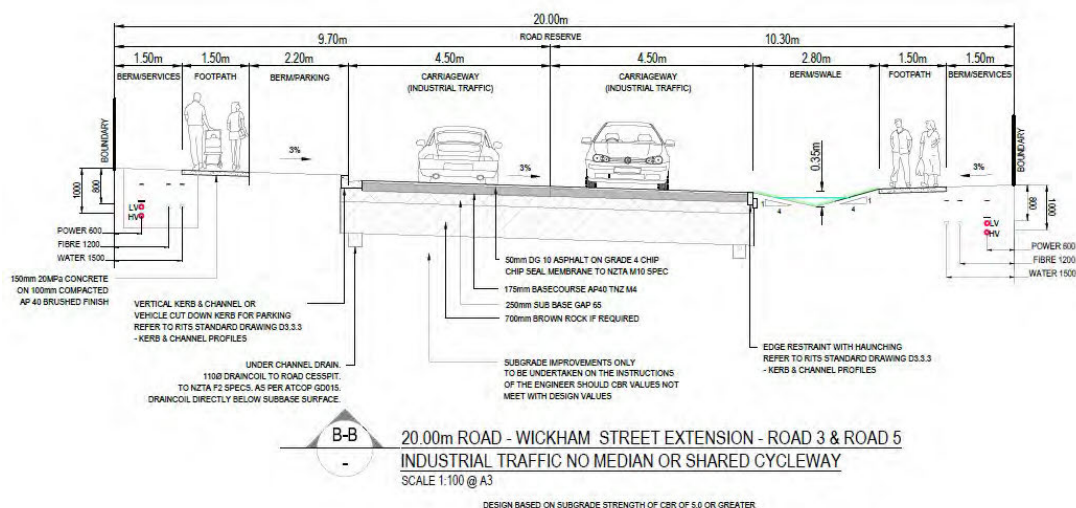


Figure 4: Local Road Typical Cross-section

5.4.3. 12.0m Right Of Way - Typical Cross-section

The industrial ROW (road 02) will be design to RITS and Hamilton District Plan private accessway standards and is contained within 12.0m with the following features (refer to Figure 5 below):

- 7.0m carriageway width, comprised of
 - 3.5m traffic lanes, and
- 2.5m western berm width, comprised of
 - 2.5m services berm
- 2.5m eastern berm width, comprised of
 - 2.5m services berm

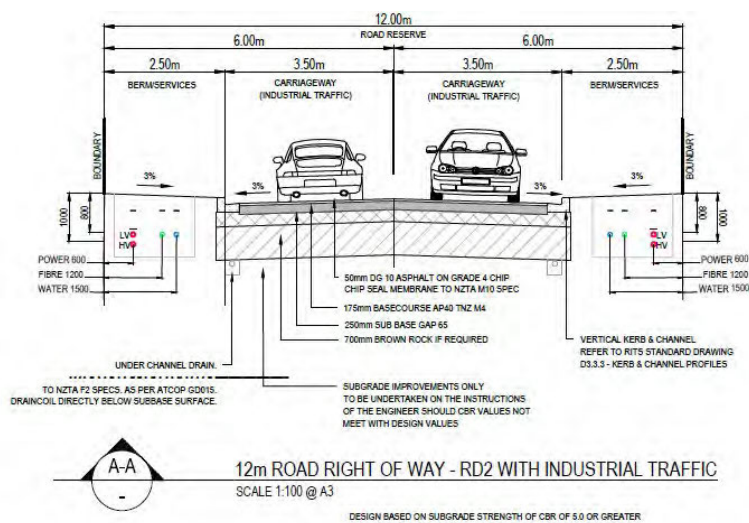


Figure 5: 12m ROW Typical Cross-section

5.4.4. Pavement Design

The east-west orientated collector road (road 01 & 04) is proposed to have the following pavement design:

- 50mm DG10 asphaltic concrete
- 475mm granular pavement of 175mm AP40 / 300mm GAP 65
- Subgrade improvement layer of 700mm brown rock If required
- Design based on a subgrade strength of CBR 5.0 or greater.

The new Local Roads 03 and 05 and the Industrial ROW (road 02) will have the following pavement design:

- 50mm DG 10 asphaltic concrete
- 425mm granular pavement of 175mm AP40 / 250mm Gap 65
- Subgrade improvement layer of 700mm brown rock if required
- Design based on a subgrade strength of CBR 5.0 or greater.

5.5. Parking

Dedicated indented car park bays will be provided on the southern side of Road 05, which allows for a stormwater conveyance and treatment swale on one side of the road corridor instead. This is considered acceptable given Road 05 is a short cul-de-sac private that only services 2 large industrial lots.

The east-west orientated collector is not proposed to have indented and/or on street due to the inclusion of the stormwater conveyance swale. The proposed industrial lots located off the east-west orientated collector are large enough to accommodate off street parking.

5.6. Walking and Cycling

The 25.5m wide east-west collector road will provide 3m wide shared path on one side and a 1.8m wide footpaths for pedestrian on the other. For the 20.0m wide Local Roads (Road 03 & 05) will provide 1.5m wide footpath on both sides.

6. Stormwater

The Industrial Development proposal has been developed in consultation with Hamilton City Council, and other/external technical consultants. The Industrial Development consists of three main stages that informs the post development catchment.

This section of the report provides further details of the Industrial Development, its stormwater strategies and options to meet regulatory requirements, RITS and ICMP as specified throughout the report and the attached Stormwater Management Plan.

Spanning approximately 60ha the Industrial Area includes 22 lots across the site, designed with mix of industrial lot sizes.

The key feature of the development is integrated stormwater treatment train approach utilising a combination of on-lot soakage and/or reuse devices, grass-lined swales, stormwater detention ponds forebays, designed to convey and attenuate overflows from the road and lot areas releasing at 80% of pre-development flows the Waitawhiriwhiri drainage catchment, which discharges into the Waikato River through a series of unlined drainage channels, gully systems and piped infrastructure.

6.1. Design Standards

The Hamilton City Council and Waikato Regional Council sets out design and construction standards for stormwater and requires all land development projects to be provided with a means of stormwater disposal.

Stormwater systems detailed in the Stormwater Assessment Report (SAR) and Stormwater Management Plan (SMP) have been designed in accordance with design guidelines and standards in the list below:

- Waitawhiriwhiri Integrated Catchment Management Plan – Draft – March 2026)
- Hamilton District Council Stormwater Guidelines and standards
- Waikato Regional Council Guidelines and standards
- RITS guidelines and specifications

6.1.1. Engineering Exception Decisions

- No engineering exceptions are proposed for this application.

6.2. Stormwater Management Plan (SMP)

A Stormwater Management Plan (SMP), has been prepared to support a discharge consent application for the three stages of the Industrial Development, as outlined below in Table 4 below:

Stage	Artificial Wetland	Catchment	Area (Ha)
1A	Wetland 1C	A	3.61
1B	Wetland 2B	B	16.31
2 & 3	Wetland 3A	C	20.78

Table 4: SW Wetland Catchments

Each stage has been assessed through hydrological and hydraulic modelling, incorporating the adopted 4°C climate-change scenario. The relevant design parameters, climate-change assumptions and modelling methodology are detailed in Section 6.1 of the Stormwater Assessment Report (SAR).

The proposed stormwater management system has been designed to provide the following:

- Water Quality Volume treatment and retention of the 10mm of new road seal runoff to maintain water naturality. Soakage Devices within lot areas have been utilised where it's viable to provide through site specific Geotechnical Investigation Report on lots prior to the lodgement of a Building Consent Application.
- Conveyance of flows up to the 100YR ARI storm events through proposed networks and overland flows within the road corridors which will be directed to the downstream artificial wetlands, for each of the stormwater catchments. Limit post-development peak discharges to no more than 80% of pre- development flows to the Waitawhiriwhiri drainage network.
- Preserve existing flow paths and discharge locations to avoid introducing new hydrological impacts.
- Account for external inflows and upstream catchments to ensure downstream impacts are not worsened under post-development conditions.
- Support future maintenance, accessibility, and ecological enhancement through features such as maintenance tracks and planting around the artificial wetland areas.

A flood model for the 2, 10 and 100-year events has been developed to establish existing conditions within upstream and downstream of the Industrial Development. The results of that modelling has informed the design within the development areas and provided a basis for analysing upstream and downstream impacts.

In addition, the model has been used to test a sensitivity scenario in which all primary stormwater devices are blocked during a 100-year event. Even under this worst-case condition the model demonstrates that the development maintains flood immunity with only minor exceedances and expected to be mitigated through detailed design refinements. These areas will be addressed during detailed design by refining finished ground and road levels, improving secondary overland flow paths, and optimising the stormwater drainage layout to safely convey exceedance flows while maintaining flood immunity for building platforms.

The SAR aligns with the requirements of the Waitawhiriwhiri Draft ICMP, Hamilton District Council and Waikato Regional Council.

6.3. Stormwater System

The Industrial Development will be serviced by the following stormwater infrastructures:

1. Detention/Retention Tanks
2. Primary Network – Pipe System
3. Swales
4. Artificial Wetlands

The proposed stormwater management system for the industrial development incorporates an integrated approach comprising on-lot stormwater controls, a piped drainage network, and surface conveyance and treatment systems. On-lot detention tanks are provided to attenuate runoff from individual properties, reducing post-development peak flows and maintaining discharge rates consistent with the Hamilton City Council Stormwater Guidelines and RITS requirements. The piped network has been designed to convey runoff from frequent storm events, while larger exceedance

events are managed via defined overland flow paths to maintain flood resilience. Stormwater quality treatment and initial abstraction are achieved through the use of treatment devices, including swales and Artificial Wetlands, which provide sediment removal, pollutant capture, and flow attenuation prior to discharge.

Due to low soakage results from site testing, tanks are proposed for lot areas to provide for initial abstraction and water quality mitigation requirements. Flows will surcharge into proposed stormwater connection or bubbles up onto the road outside the lot areas. Proposed Swales and Primary network provide conveyance of these flows including flows from road catchment areas to the Artificial Wetlands.

The downstream proposed artificial wetlands will function to treat a combination of lot and road runoffs, extended detention and provide full detention for events up to the 100-year CC depending on the proposed development catchment, as outlined in Table 5 below.

Please refer to the Appended Engineering Plans (Appendix A) for further details.

6.3.1. Artificial Wetland Ponds

The artificial wetland catchments have been designed to facilitate different treatment outcomes for each of the proposed catchments as outlined in Table 5 below:

Stage	Artificial Wetland	Catchment	Catchment Type	Ownership
1A	Wetland 1	A	Road Corridor Only	Private – with the option to Vest in the future
1B	Wetland 2	B	Lot Area Only	Private
2 & 3	Wetland 3	C	Road Corridor & Lot Area Combined	Public

Table 5: SW Wetland Catchments Break-down

The artificial wetlands have been strategically located (Refer to C400 plans for specific Wetland catchment Areas) to service specific development catchments and associated road corridors, as summarised in above table.

6.3.1.1. Artificial Wetland 1 – Catchment A

The artificial “Wetland 1” (catchment A) has been designed to provide treatment for the road networks within Stage 1A and 1B except for the Road 03 extension, which will have the initial abstraction and treatment provided for within a grass-lined swale along the eastern side of the Road 03.

Attenuation for the full catchment road corridor area will be accommodated within “Wetland 1”, with over attenuation within the artificial wetland to compensate for the Road 03 contours making overland flow back to “Wetland 1” unfeasible, and lack of viable space for larger attenuation devices along the Road 03 corridor.

Road 03 falls back towards the HCC drainage channel (to the north) at an approximate gradient of between 1.5% and 2.0%, check dams will be incorporated into the swale design to ensure that the minimum 9mins residence time is achieved.

6.3.1.2. Artificial Wetland 2 – Catchment B

The artificial stormwater “Wetland 2” (catchment B) has been designed to provide treatment proposed industrial Lot (29), and as such will be a private wetland pond with no public infrastructure connection. Initial abstraction, treatment and attenuation will be provided for fully within this artificial wetland, with additional peat recharge also occurring through the unlined pond, please refer to the appended WGA Hydrogeological Effects Assessment (Appendix F).

6.3.1.3. Artificial Wetland 3 – Catchment C

The artificial stormwater “Wetland 3” (catchment C) has been designed to provide treatment and attenuation for both the on-lot and road networks within Stage 2 and 3, which will have the initial abstraction and treatment provided for within a grass-lined swale along the eastern side of the Wickham Street extension.

Initial abstraction will be via grass-lined swales for the road corridors and on-lot rain-harvesting and reuse tanks, and on-lot soakage devices can be utilized where soakage testing allows.

Local roads fall back towards wetland 3 at an approximate gradient of between 0.5% and 0.6%, check dams will be incorporated into the swale design to ensure that the minimum 9mins residence time is achieved.

6.3.2. Existing Reticulation

Existing stormwater infrastructure within the Industrial Area is limited to farm drains to the south and west, council drainage channels and piped infrastructure to the north and Kiwi Rail drainage network to the east, that are all part of the Waitawhiriwhiri catchment drainage network. There are some culvert and farm bridge structures that facilitate farm access over the council drainage channel off both Higgins Road and Wickham Street that have been surveyed and incorporated in the modelling.

6.3.3. Lot Connections

All lots are serviced with lot connections as per RITS guidelines and specifications.

6.4. Overland Flow Paths (OLFPs)

With reference to Figure 6 below, additional branches of OLFPs will be created as roading corridors are formed. The following measures will be adopted to mitigate their effects of these overland flow paths on the proposed development:

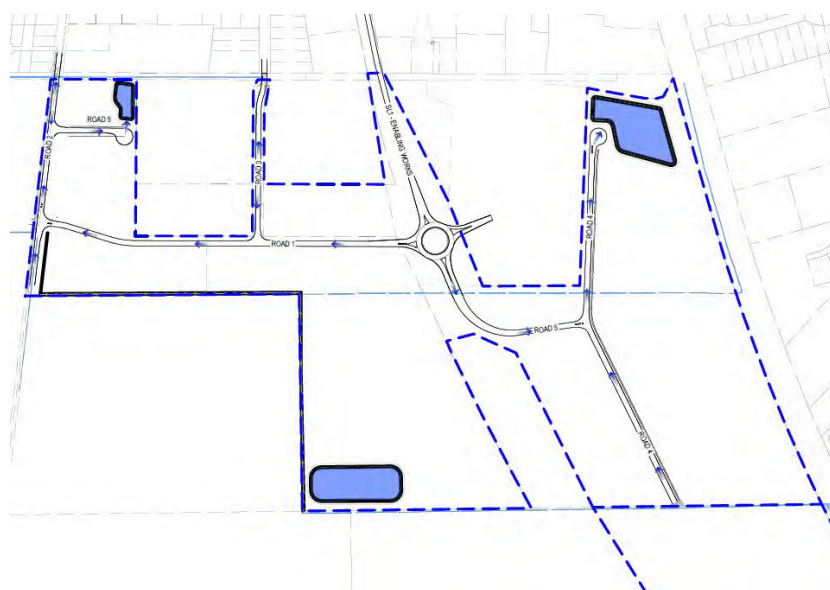


Figure 6: Proposed Overland Flow path

- Identify and maintain natural overland flow/watercourse locations to convey concentrated stormwater from the site. Utilise existing culverts (where possible) to maintain the same discharge locations, post development.
- Identify and retain any upstream OLFPs and/or watercourses to avoid any upstream flooding.
- Ensure OLFPs are to be designed where possible within the roading network and discharge into watercourses.

The preliminary OLFP design is provided in the SMP and an assessment of the post development OLFPs has been carried out to evaluate the behaviour of surface runoff in the road carriageway under the proposed stormwater management system. The design scenario is based on the 2081-2100 RCP8.5 climate change scenario, incorporating all proposed devices and the assessment is done through HEC-RAS 2D. The OLFPs represents the conveyance of surface runoff because of the proposed system during the 100-year storm event.

Flow depths and velocities were assessed at key locations such as low points or where catchment merge throughout the development covering all the various road/accessway typologies to ensure and confirm that the conveyance of the OLFP is viable through proposed carriageway. See below showing results at the key locations.

More than 80% road areas comply with standard design thresholds. However, these are isolated areas recorded maximum water depths above the 150mm guideline:

- Road 3: max depth = 200mm
- Road 4: max depth = 350mm
- Road 5: max depth = 200mm

These depths are likely to be reduced at further refined modelling at detailed design stage via applying some of the available options below:

- Advance the flood model by including catchpits and roading stormwater network
- Provide sensitivity analysis assuming catchpits are fully blocked
- Provide proprietary Megapits if required to alleviate ponding
- Increase vertical curvature length of the roading corridor to increase the spill weir and minimise ponding depth
- Mono camber transition in the carriageway and/or footpath berms to reduce the depth of spilling headwaters
- A combination of the solutions above.

The detailed design will be required to demonstrate compliance with the applicable RITS flood-depth criterion, or an alternative design accepted through the engineering approval process, while maintaining the intended secondary-flow-path function.

Highest velocity depth of 0.15 (m²/s) values remain below critical safety thresholds defined in Austroads 2012 Part 5, which specify:

- < 0.4m²/s for pedestrian safety
- < 0.6m²/s for vehicle safety

The highest recorded value was 0.15m²/s (Road 3) confirming safe flow conveyance for both pedestrians and vehicles under design conditions. Flow is primarily routed along proposed roads conveyed into roadside primary networks for the 10-year conveyance to the proposed wetlands.

6.5. Capacity and Quality

Stormwater Strategy for Lot Areas

Roof runoff is managed using inert roofing materials, while driveway runoff is accounted for either by over attenuation of the roof run-off volume and/or directed through a catch pit with a sump for pre-treatment before disposal to soakage device. Overflow is located in the catchpit system for flows surpassing the designed event within the lot areas. Excess flows will be diverted into the downstream system via the road carriageway.

Stormwater Strategy for Road Carriageway

The Water Quality volume (WQV) will be provided through the proposed wetland system with the initial abstraction is to be provided within lot areas and Swales.

Stormwater Strategy for proposed wetlands

The proposed artificial wetlands form critical part of the overall stormwater mitigation system. They have been sized to accommodate the 100-year event or excess flows from both the road carriageway and on lot flows exceeding the 10-year event. Additionally, these are also designed to provide treatment and attenuation of lower flow events. Please refer to SMP for more details.

6.6. Flooding

A 2D flood model has been developed for the site using HEC-RAS. The model has been used to assess existing, design and sensitivity scenarios.

Figure 7 below shows the contributing catchment of the Industrial Area during the 100-year event, delineated through QGIS/HEC HMS based on a 10m grid externally. Data used is comprised of localised site survey and LINZ data capturing the wider extent of the catchment.

The catchment extent is generally consistent with the ICMP catchment framework, however project specific catchment delineation has been undertaken as part of this assessment to refine upstream contributing areas based on current information for data and modelling.

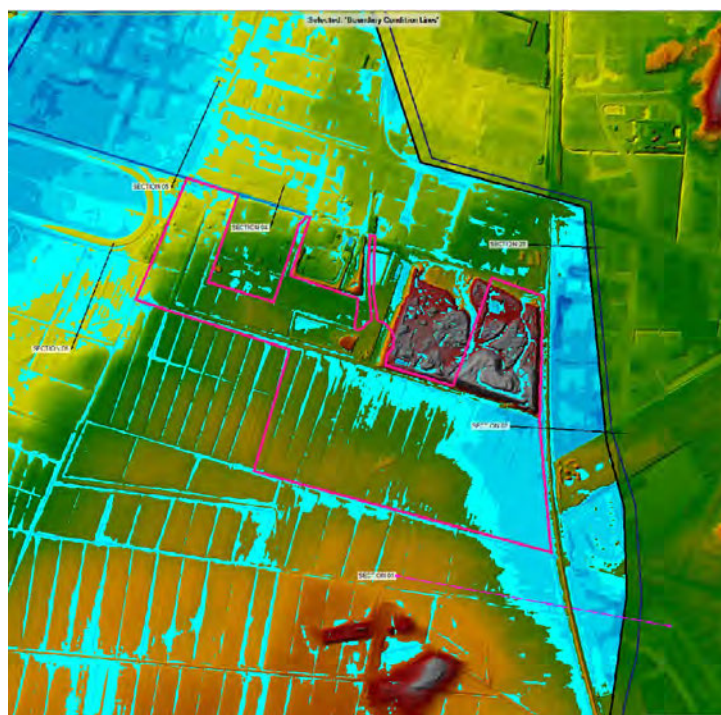


Figure 7: Existing Flood Extent in the 1% AEP Event (100mm)

HEC-RAS 2D modelling of the 100-year ARI climate change event (RCP 8.5) indicates that the Industrial Area is influenced by a number of existing flow paths and receiving environments.

The western portion of the site generally drains via the existing farm drainage network before discharging into the artificial channel located along the northern boundary of the site, which conveys flows westward. The north-western portion of the site is also influenced by this channel and associated drainage network.

The area adjacent to the railway corridor is noticeably elevated compared to the remainder of the site and appears to have been previously modified through earthworks activities. As a result, runoff and floodwaters from this raised area generally shed down the embankment towards the lower-lying portions of the site.

The railway corridor located along the eastern boundary of the site acts as a raised embankment and generally contains floodwaters on the western side of the corridor. However, further north, ground levels either side of the railway become more comparable, allowing floodwaters to cross the railway corridor and discharge towards the eastern catchment during larger flood events.

This has informed the proposed design approach, which focuses on conveyance through diversion channels, retaining drainage corridors, while incorporating artificial stormwater wetlands and storage to manage stormwater events up to the 100YR ARI within the site in line with RITS. The proposed approach is consistent with the objectives and recommendations of the Waitawhiriwhiri Integrated Catchment Management Plan (ICMP), including managing stormwater at a catchment scale, maintaining and enhancing existing flow paths, providing stormwater treatment and attenuation, and avoiding adverse increases in downstream flood risk.

The Sensitivity assessment assumed that all stormwater soakage attenuation devices have already reached their capacity. Even under this worst-case condition, the model demonstrates that the development maintains flood immunity, with only minor exceedances expected to be mitigated through detailed design refinements as mentioned above in Section 6.4 Overland Flow Paths (OLFPs).

6.7. Connection Points and Staging

- Stage 1A – This stage corresponds to catchment A, which is serviced by Artificial Wetland 1. Stormwater discharge up to the 100-year event at 80% predevelopment into HCC unlined drainage channel, before entering the Waitawhiriwhiri drainage network
- Stage 1B – This stage corresponds to catchment B, which is serviced by Artificial Wetland 2. Stormwater discharge up to the 100-year event at 80% predevelopment into existing farm drainage network to the south. A new drainage swale will be constructed to ensure the upper catchment flows from these farm drains will continue to discharge into the HCC unlined drainage channel to the north, before entering the Waitawhiriwhiri drainage network
- Stage 2 & 3 – This stage corresponds to catchment C, which is serviced by Artificial Wetland 3. Stormwater discharge up to the 100-year event at 80% predevelopment into HCC 1800mm RC stormwater main, before entering the Waitawhiriwhiri drainage network. Secondary overland flow paths beyond the HCC pipe capacity will discharge into the Kiwi Rail drainage corridor.

7. Wastewater

7.1. Design Standards

Wastewater systems have been designed in accordance with the Regional Infrastructure Technical Specifications (RITS V2, October 2025).

7.1.1. Engineering Exception Decisions

No engineering exceptions are proposed for this application.

7.2. Catchment Area

The proposed Industrial Development comprises 22 lots across approximately 51.66 hectares of industrial land excluding the HSL corridor. The total wastewater catchment area, excluding reserves, is 47.90 hectares, distributed as follows: Stage 1A (8.18 ha), Stage 1B (17.03 ha), and Stages 2 and 3 (22.69 ha). Wastewater generation has been estimated on the basis of 45 persons per hectare in accordance with RITS V2 (October 2025).

The development is served by two wastewater pump stations:

- Pump Station A (Stage 1A): Located within the designated wastewater reserve (Lot 5002), adjacent to the Stormwater 1 reserve. Serves a catchment of 8.18 hectares (7 industrial lots).
- Pump Station B (Stages 1B, 2, and 3): Located within the designated wastewater reserve (Lot 5001), opposite the Road 03 and Collector Road intersection. Serves a combined catchment of 39.72 hectares (14 industrial lots).

7.3. Design Flows

Wastewater demand calculations, prepared in accordance with RITS V2, yield the following peak wet weather flows:

- Stage 1A: 5.71 L/s
- Stage 1B: 11.89 L/s
- Stages 2 and 3: 15.84 L/s

Pump Station A is designed for a total peak flow of 5.71 L/s. Pump Station B is designed for a total peak flow of 27.72 L/s, comprising the combined Stage 1B, Stage 2, and Stage 3 catchments.

Refer to Appendix B (Engineering Calculations) for detailed flow derivations.

7.4. Reticulation

WSP has undertaken a wastewater capacity assessment for the proposed connection of the Industrial Area to the Dinsdale wastewater network via the Karen Crescent wastewater Pump Station (Asset ID: SPS119).

WSP has also undertaken a wastewater capacity assessment for the proposed connection of the Industrial Area to the Dinsdale wastewater network via the Higgins Road wastewater manhole (Asset ID: WWU16019), noting that this option may require additional upgrading of the Higgins Road wastewater main to a 225mmØ uPVC SN16 main through to Kahikatea Drive wastewater manhole (Asset ID: WWU16003).

At the time of application, WSP was progressing the Dinsdale wastewater network modelling, with the results to further inform and confirm the preferred servicing solution once available.

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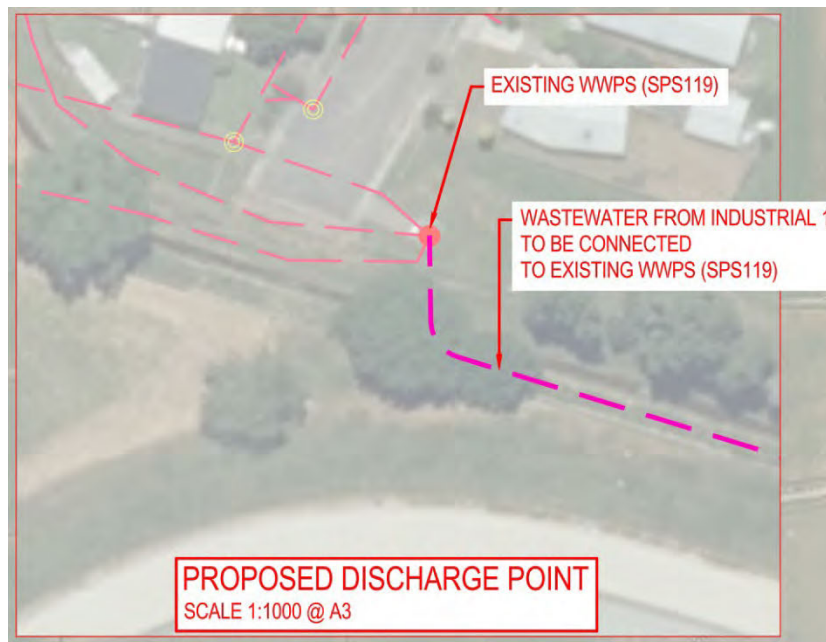


Figure 9: Proposed Karen Street Rising Main Connection

7.4.1. Existing Reticulation

The closet existing council reticulation network is a 150mmØ earthenware pipe located on Higgins Road, that connects to a 225mmØ earthenware trunk main located on Kahikatea Drive manhole connects to the Western Interceptor Main that runs along Tuhikaramaea Road and discharges to a wastewater pumpstation located at corner of Massey Street and Rifle Range Road (Asset ID: SPS021) (refer to Figure 10 below).

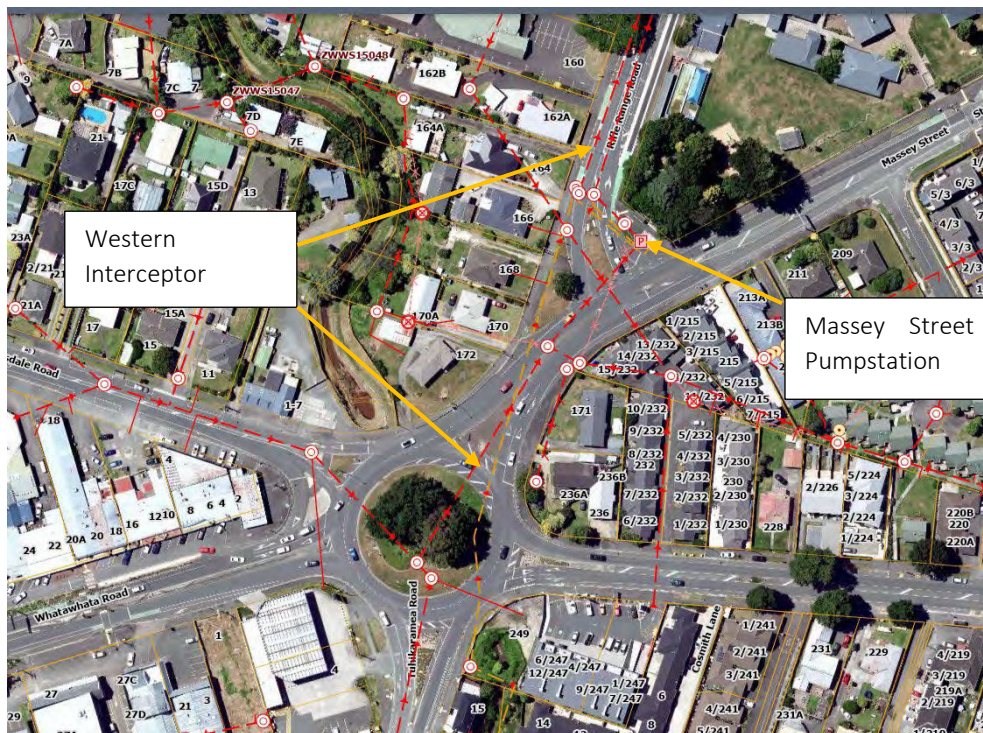


Figure 10: Massey Street Pump station

There is a secondary council 150mmØ pipe at the end of Wickham Street that connects back to the Higgins Road network (refer to Figure 11 below).

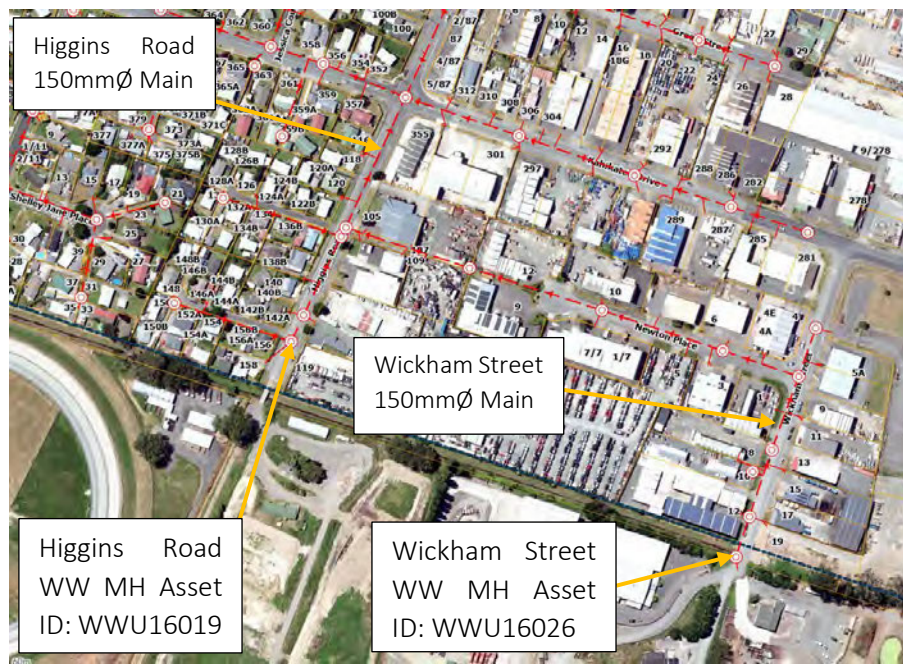


Figure 11: Higgins Road/Wickham Street WW Network

There is also a council pumpstation located at the end of Karen Crescent approximately 600m to the west of the end of Higgins Road (Asset ID: SPS119) that connects directly to downstream receiving Western Interceptor manhole for Massey Street and Rifle Range Road pumpstation (refer to Figure 12 below).

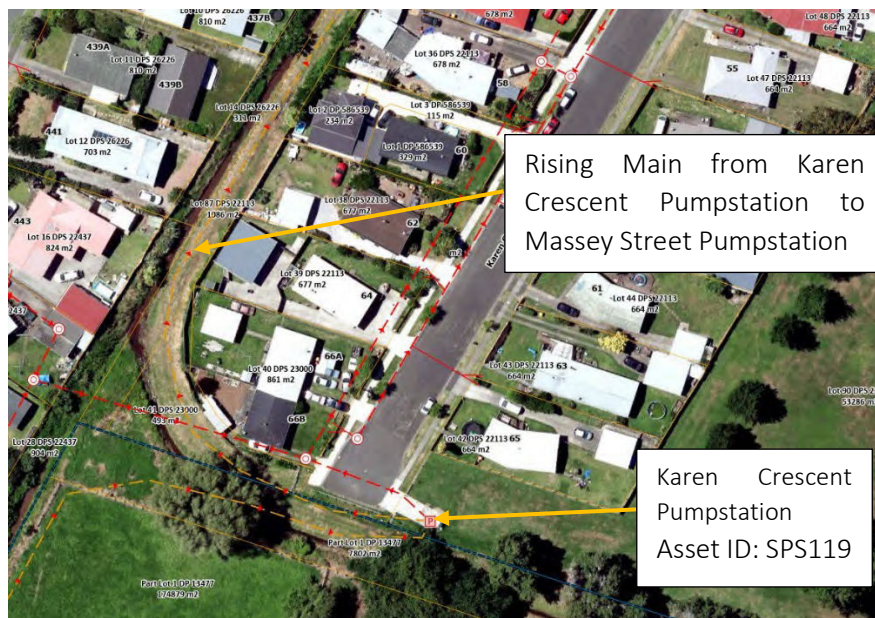


Figure 12: Karen Crescent Pumpstation

7.4.2. Proposed Reticulation

Internal wastewater reticulation for the Industrial Development will be provided via new 225 mm Ø uPVC SN16 gravity pipelines, installed across Stages 1 to 3. Two wastewater pump stations will be constructed to provide internal conveyance.

Downstream Network Capacity and Off-Peak Pumping Strategy

The existing Dinsdale wastewater network is subject to known capacity constraints. In response, the servicing strategy incorporates two complementary measures designed to minimise impact on the receiving network:

1. Enhanced on-site storage: Each pump station is provided with storage capacity significantly exceeding the RITS minimum of 9 hours average dry weather flow (ADF). The expanded storage volumes — summarised in Table 6 below — serve a dual function: providing robust emergency storage in the event of pump or power failure and enabling buffered retention of flows for controlled release to the network during off-peak periods.
2. Off-peak discharge: Pumping to the HCC network will be scheduled to occur outside peak network demand periods, thereby limiting additional loading at critical times while maintaining self-cleansing velocities within the rising main and receiving network during off-peak periods.

This approach is proposed as an interim servicing solution pending confirmation of the developer's participation in the strategic network upgrade extending to the Whatawhata Road roundabout pump station. The interim solution, with its inherent storage redundancy, presents a lower-risk servicing arrangement than direct peak-period discharge to a constrained network. WSP is currently undertaking detailed network capacity modelling to confirm the viability of this approach and to inform the preferred outfall configuration.

Staging

Stage 1A

Stage 1A serves seven industrial lots. Gravity pipelines convey flows to Pump Station A, to be constructed within wastewater reserve Lot 5002. Three outfall options have been identified for Pump Station A:

- Option 1 (Preferred): Connection to the Karen Crescent pump station (SPS119) via a new 250 mm Ø rising main, routed within the HCC drainage reserve (Part Lot 1 DP 13477) along the northern boundary of the development and extending westward to Karen Crescent.
- Option 2: Connection to Karen Crescent via a new 250 mm Ø rising main located within the future road reserve of the proposed residential/industrial development to the west.
- Option 3: Connection to the Higgins Road wastewater manhole (WWU16019) near the northern boundary of the development.

Connection to the Wickham Street manhole was assessed but not pursued, as it presents similar constraints to Option 3 with a longer pumping distance. The preferred option (Option 1) is favoured due to the shorter rising main length and direct connection to the Western Interceptor via SPS119.

Given the modest wastewater generation anticipated from seven industrial lots, it is expected that flows can be accommodated within the existing HCC network either directly (subject to WSP modelling confirmation) or via the enhanced on-site storage and off-peak pumping strategy described above.

Stage 1B

Stage 1B serves two industrial lots, one of which is anticipated to operate as a trucking yard with limited wastewater generation (the requirement for any future truck wash or similar high-strength discharge will be addressed through subsequent consenting processes at the Building Consent or trade waste stage). Gravity pipelines convey flows to Pump Station B, to be constructed within wastewater reserve Lot 5001. Flows from Pump Station B are pumped via a new rising main to the nearest gravity manhole on Collector Road 1 in Stage 1A, from which they discharge by gravity to Pump Station A and onward to the Karen Crescent connection.

Given the limited wastewater volume from two lots, Stage 1B flows are expected to be accommodated within the existing network without triggering capacity constraints.

Stage 2 and 3

Stages 2 and 3 serve twelve industrial lots. Wastewater is conveyed by gravity to Pump Station B, located within wastewater reserve Lot 5001.

At full development (Stages 2 and 3), strategic network upgrades within the wider Dinsdale catchment may be required. The WSP modelling will determine whether the additional flow can be accommodated via the enhanced storage and off-peak pumping strategy, or whether Stages 2 and 3 trigger the requirement for network augmentation — most notably, the construction of a larger rising main connection from the Karen Crescent pump station to the Whatawhata Road roundabout pump station. It is noted that this strategic upgrade is anticipated to be required by HCC independent of the proposed industrial development, driven by cumulative growth across the Southern Links, Dinsdale, and Temple View areas. The cost of such upgrades could be recovered through targeted wastewater development contributions or rates applied to all future developments within the catchment.

Refer to the Appended Engineering Plans (Appendix A) for the wastewater reticulation layout.

7.5. Lot Connections

All lots are provided with wastewater connections in accordance with RITS guidelines and specifications. Given the depth of some of the larger industrial lots, it may only be feasible to service the front portion of each lot — approximately 90 metres from the road boundary — assuming boundary lateral connections are limited to a maximum depth of 1.5 metres. Deeper portions of lots requiring wastewater servicing may necessitate private pump systems or raised building platforms, to be assessed at Building Consent stage.

7.6. Connection Points and Staging

- Stage 1A: Gravity reticulation discharging to Pump Station A (Lot 5002). Pumped discharge via a new 250 mm Ø rising main to the Karen Crescent pump station (SPS119) — preferred option.
- Stage 1B: Gravity reticulation discharging to Pump Station B (Lot 5001). Pumped discharge to the Stage 1A gravity network, then via Pump Station A to Karen Crescent.
- Stage 2: Gravity reticulation to Pump Station B (Lot 5001).
- Stage 3: Gravity reticulation to Pump Station B (Lot 5001).

7.7. Wastewater Pump Station

7.7.1. RITS Wastewater Pump Station Requirements

The specification and design of the proposed wastewater pump stations has been developed in conjunction with Aquate. Each pump station will comprise a collection manhole, inlet pipes, a wet well, valve chamber, control cabinet, odour biofilter, and emergency storage tanks. A staging summary is provided in Table 6. Please refer to Appendix G – AQUATE WWPS Specifications for more information.

Stage	Lots	Proposed Servicing	General Comment
Stage 1A	6 Industrial Lots	Construct WWPS 1A (Lot 5002) and a new 250 OD rising main to Karen Crescent Pumpstation.	Total emergency storage in wet well and emergency storage tank is 217.3m ³ so 9.2 hours storage to be provided.
Stage 1B	2 Industrial Lots	Construct WWPS 1B within the reserve (Lot 5001) and a new 160 OD rising main to the WWPS 1A.	Total emergency storage in wet well and emergency storage tank is 42.56m ³ so 9.65 hours storage to be provided.
Stage 2 – 3	13 Industrial Lots	Construct a gravity pipeline for each stage and wastewater will be conveyed to a WWPS 1B.	Modelling may trigger network upgrades and/or the requirement to expand emergency storage in wet well (WWPS 1B).

Table 6: Wastewater Staging

7.7.2. RITS Wastewater Pump Station Compliance

A compliance assessment against the RITS V2 (October 2025) pump station requirements is provided in Table 7.

Requirements	Requirements check
a) Area around the pump station shall be graded to prevent surface water flowing onto or over the pump station cover slabs.	The pump station areas have been elevated above the nearby roads, and they will grade back to the road areas.
b) Free of secondary flow paths for 1% AEP flood level, and the pump station lid levels shall be provided with a minimum freeboard of 300mm above the estimated flood level.	As the pump station will be sitting at a higher elevation than the nearby existing stream, this will ensure that the minimum freeboard will be achieved. The pump station lid level will be at least 300mm above the overland flow path on the road and 300mm above the 100yr flood level in the existing stream.
c) Pumping systems shall - Have a pumping capacity of N+1 with a minimum of two identical pedestal mounted submersible sewage pumps. - Each pump shall be capable of discharging the design peak wet weather flow rate from the catchment. - Include sufficient well volume to operate under normal conditions without surcharge to the incoming wastewater network.	The pumpstation is compliant with these conditions referring to the Aquate Pump Station for technical specifications for further details on how the pump station is designed.

d) The station shall be located to ensure that the entire design catchment can be serviced.	Northern wastewater pumpstation will manage all of Stage 1. The central wastewater pumpstation will manage pumped flows in Stage 2 and 3. The pump stations have been strategically placed in the catchment low points.
e) All stations shall be contained within a separate local purpose reserve - drainage title set out to provide safe and easy operation and maintenance of the site without impacting on public activities surrounding the site and is designated in accordance with the relevant district plan or vested as part of a subdivision.	A designated local purpose reserve for each pump station has been proposed to allow for the operation and maintenance of the pump station.
f) The station shall be designed to service the entire catchment area of land beyond the reach of the existing gravity system. Refer to Clause 5.1.6.	The wastewater pump stations have been designed to account for the whole stage.
g) In staged construction, guidance from the Council is required to ensure the correct sizing of the pump station and associated rising mains and storage facilities meet the short and long-term requirements of the catchment.	The pumpstations have been designed to cater for the short term and long-term requirements. There is allocated space to expand the underground wastewater storage if required to do so in the future.
h) A minimum emergency storage capacity of nine hours average dry weather flow, measured between the high-level alarm and the point of overflow.	The pump station has been designed to account for a minimum emergency storage capacity of 9 hours.

Table 7: WWPS RITS Requirements

7.7.3. Emergency Storage and Flow Buffering

The proposed pump stations are provided with storage capacity exceeding the RITS minimum of nine hours average dry weather flow (ADF). The enhanced storage volumes serve the following functions:

1. Emergency storage: Retention of wastewater in the event of pump failure or power outage, preventing uncontrolled overflow to the receiving environment.
2. Flow buffering: Retention of peak-period flows for controlled discharge to the HCC network during off-peak periods, minimising additional loading on a constrained downstream network and supporting self-cleansing velocities during off-peak discharge windows.

Storage volumes are distributed across the wet well, dedicated ancillary storage chambers, and upstream pipeline capacity. The ancillary storage chambers are connected to the collection manhole. A second water supply connection with a 24 VDC solenoid valve will be installed on the RPZ outlet to facilitate automated wash-down should storage chambers be activated.

The total storage volumes are as follows:

- Pump Station A (Stage 1A): 164.25 m³ — exceeding the RITS 9-hour minimum by a substantial margin and providing capacity for off-peak flow management across 7 industrial lots.
- Pump Station B (Stage 1B): 81.25 m³ — providing equivalent redundancy for 2 industrial lots.
- Pump Station B (Stages 2 and 3 ultimate): 568.80 m³ — expandable to accommodate the full 14-lot catchment. The reserve footprint (Lot 5001) includes provision for additional storage

chambers should network modelling or operational experience indicate a need for further expansion.

The storage volumes have been derived from the average daily flow calculations presented in Appendix B, with the 24-hour buffer factor applied as agreed with the project team.

7.7.4. External Services

The successful operation of the wastewater pump stations is dependent on the provision of the following external services, to be coordinated at detailed design stage:

Wash Water

A DN50 PE rider main, supplied from the proposed 63 mm OD water main in the adjacent road corridor, will provide the water supply required for pump station washdown purposes. In accordance with RITS Section 5.2.10.8(a), wastewater pump stations are classified as a High Hazard risk and require reduced pressure zone (RPZ) type backflow prevention devices installed above ground level adjacent to the electrical control cabinet.

Power

A reticulated underground power network will be designed and installed in the proposed adjacent roads to provide a dedicated point of connection for each pump station. Final electrical load requirements and connection arrangements will be confirmed with WEL Networks at detailed design stage.

Stormwater and Overland Flow

Each pump station platform is elevated above the surrounding ground level and situated clear of the identified overland flow paths and 1% AEP flood extent, ensuring free drainage of stormwater away from cabinet enclosures and well openings.

Electrical and Telemetry

The electrical and telemetry requirements for the proposed pump stations will be confirmed with Hamilton City Council at detailed design stage. The alarm and operational data control system, including level monitoring (low level, duty/standby start, high level, critical overflow, and storage-in-use alarms), will be installed by the developer or by Council at the developer's cost, in accordance with the control level settings prescribed in RITS Section 5.2.10.9

8. Water

8.1. Design Standards

The RITS sets out design and construction standards for water reticulation, potable water supply and firefighting supply in accordance with SNZPAS 4509:2008 (NZ Fire Service Fire Fighting Water Supply Code of Practice).

8.1.1. Engineering Exception Decisions

There are no engineering exception decisions.

8.2. Design Flows

Calculations for water demand indicate a calculated peak demand of 27.25l/s. Please refer to Engineering Calculations (Appendix B) for further details.

An EPANET model for the Industrial Development has been designed and it is concluded that the design nodes on the Industrial Area will achieve the required minimum 200kPa (20m head pressure) as required by RITS 6.1.3.1 On Demand Water Supply Area, assuming 300 kPa of supply pressure at the connection points from existing networks. Please find attached EPANET modelling report for more information (Appendix C).

8.3. Reticulation

Mott MacDonald has undertaken hydraulic modelling of the existing water supply network to assess the impact of the proposed North-East Industrial Development at the 2041 and 2061 planning horizons. The assessment considered performance across the wider Newcastle Gravity zone and specifically within the North-East Industrial Development area, with the results identifying the development stages at which the prescribed system performance criteria are not achieved.

The modelling confirms that the wider Newcastle Gravity zone has existing Level of Service deficiencies, including areas where the minimum pressure and head loss criteria are not achieved under the baseline scenario. These existing deficiencies can mask the incremental impact of the proposed North-East Industrial Development when assessing the network as a whole. Accordingly, the assessment also considered the section of the network between the reservoir and the proposed development, where changes in hydraulic performance can be more directly attributed to the Industrial Development. The modelling indicates that the proposed development does not solely cause the existing network constraints, with the observed deficiencies reflecting limitations already present within the wider network. The assessment provides the basis for identifying the network upgrades and servicing requirements necessary to accommodate the proposed Industrial Development while maintaining the required level of service.

8.3.1. Existing Reticulation

There is the following existing water supply infrastructure directly adjacent to the proposed Industrial Development, as follows:

- Higgins Road
 - DN150 OPVC water main, and
 - DN200 PPVC water main
- Wickham Street
 - DN150 AC water main, and
 - DN100 AC water main

There is the following existing water supply infrastructure in the near vicinity to the proposed Industrial Development, as follows:

- Kahikatea Drive
 - DN620 SSCL Bulk main – that runs along the northern side of Kahikatea Drive and turns north along Greenwood Street
 - DN250 HDPE Trunk main – that branches off the Bulk main and heads west long the northern side of Kahikatea Drive
 - DN200 AC water main – that links from the Trunk main to southern Kahikatea Drive water main
 - DN150 AC water main – that runs east/west along the southern side of Kahikatea Drive
- Latham Court
 - DN100 AC water main
 - DN150 AC water main
- Greenlea Lane
 - DN150 UPVC water main

HCC network pressure maps indicate that minimum pressure within the existing network is equal to or greater than 250kPa but is less than 500Kpa. For the purposes of the proposed modelling, it is considered reasonable to assume 300Kpa minimum pressure within the existing council network.

8.3.2. Proposed Reticulation

The proposed reticulation network comprises DN350 Bulk Main that would connect from Kahikatea Drive south along the HSL corridor and provide future connection to the west along the east-west orientated collector road to the proposed development between Tuhikaramaea Road and the Industrial Development. A Truck Main DN300 will run down one side of the collector road/Road 04 and either a DN200 or DN150 PE mains the other side of the collector road/Road 04 with sluice valves and hydrants provided at appropriate locations throughout. The remainder of local roads will be serviced by a combination of DN150, and DN200 water mains.

Please refer to C600 Engineering Plans (Appendix A) for further details.

8.4. Lot Connections

All lots will be serviced with lot connections as per RITS guidelines and specifications.

8.5. Possible Connection Options

Four potential water supply servicing options have been identified for the proposed Industrial Development and are discussed in detail below; however, the four options are ranked in order of preference as follows:

1. Option 2 (Preferred Option) - Staged Water connection
2. Option 1 – Full Water connection
3. Option 3 – Trickle-feed with Fire Fighting Supply
4. Option 4 – Fire Fighting Supply only (potable water supply on-lot)

8.5.1. Option 1 – Full Development

Option 1 involves a fully reticulated water supply network providing individual water connections to all lots. The network is designed to meet both potable and firefighting water demand requirements.

This scenario assumes a supply pressure of 275kPa from the existing network connecting off Kahikatea Drive along the HSL corridor with a 350mmØ Bulk watermain. EPANET modelling indicates that this

would be sufficient to service the full Industrial Development and achieve the required 200 kPa and 25 L/min at all network nodes. However, Mott MacDonald's modelling identified some areas within both the existing network and the proposed Industrial Development that do not meet these requirements.

The below table demonstrates the different scenarios for the existing network pressure within the council network and whether they meet the 200kPa and 25 L/min requirement.

Reservoir Total Head	Bulk Main (mm)	Trunk Main (mm)	Distribution Main (mm)	Minimum Pressure	Result	Stage 1A & 1B	Stage 2 & 3	Comment
26.5 m	450	350/315	200/150	20.11 m	Pass	Pass	Pass	Only passing option at 26.5 m
27.5 m	350	250/200	200/150	20.08 m	Pass	Pass	Pass	Most economical passing option
27.5 m	350	315/250	200/150	20.70 m	Pass	Pass	Pass	Better pressure margin
27.5 m	400	315/250	200/150	20.89 m	Pass	Pass	Pass	Larger bulk main
27.5 m	450	350/315	200/150	21.11 m	Pass	Pass	Pass	Highest pressure, but likely highest

Table 8: Water Supply Option 1 EPANET Summary

Further testing will be undertaken to confirm the existing network pressure achieved a minimum of 200kPa at detailed design stage with options as below proposed to help mitigate capacity losses.

8.5.2. Option 2 – Stage Development

Option 2 involves a staged development approach. Stage 1A and 1B are supplied through the existing water supply network via connection points located on Higgins Road. Stage 2 and 3 are supplied via construction a new connection from the Kahikatea Drive Trunk main along the proposed Hamilton South Links corridor – noting that this main can be sized to be extended to the south for further growth. It is recommended that while the modelling shows that Stage 1B can be supplied via the extension of the Stage 1A watermain, the construction of the Bulk main from Kahikatea Drive along the HSL corridor and connecting with the Higgins Road watermain extension (Stage 1A) is the recommended option. There is potential to connect to the existing water mains along Wickham Street following the extension of the road.

Table 8 below demonstrates the different scenarios for Stages 1A and 1B (ONLY) supplied from Higgins Road & Wickham Street, for the existing network pressure within the council network and whether they meet the 200 kPa and 25 L/min requirement.

Existing Council Pressure (Assumed)	Trunk Main	Bulk Main	Distribution Main	200kPa & 25l/s at each node
225 kPa	DN300	DN350	DN200/DN150	Fail
250 kPa	DN300	DN350	DN200/DN150	Fail
275 kPa	DN300	DN350	DN200/DN150	Pass
300 kPa	DN300	DN200	DN200/DN150	Pass

Table 9: Water Supply Stage 1A & 1B Option 2 EPANET Summary

Table 9 below demonstrates the different scenarios for Stages 2 and 3 (ONLY) supplied Kahikatea Drive, for the existing network pressure within the council network and whether they meet the 200 kPa and 25 L/min requirement.

Existing Council Pressure (Assumed)	Trunk Main	Bulk Main	Distribution Main	200kPa & 25l/s at each node
225 kPa	DN300	DN375	DN200/DN150	Fail

250 kPa	DN300	DN375	DN200/DN150	Fail
275 kPa	DN300	DN350	DN200/DN150	Pass
280 kPa	DN300	DN350	DN200/DN150	Pass
300 kPa	DN300	DN200	DN200/DN150	Pass

Table 10: Water Supply Stage 2 & 3 Option 2 EPANET Summary

This EPANET modelling demonstrates that a staged approach to the development would work for the stages to the west of the HSL corridor, and additional infrastructure such as a booster pump and/or temporary Reservoir within Stage 2 maybe required for the stages to the east of the HSL corridor. Additionally staging of the water infrastructure may allow future HCC upgrades to the existing network (such as the future proposed second Water Reservoir on SH3 beside the existing Hamilton South water reserve) to be constructed that would allow Stage 2 and 3 to be serviced without the additional water infrastructure stated above.

This is the preferred water supply connection option for the proposed SL1 Industrial Development, further testing will be undertaken to confirm the existing network pressure achieved a minimum of 250kPa within the Higgins Road/ Wickham Street network and 280kPa within the Kahikatea network at detailed design stage.

8.5.3. Option 3 – Trickle Feed Potable Connection & Fire Fighting Supply

Option 3 involves servicing the full development using trickle-feed connections to each lot, with a maximum flow rate of 1.3 L/min per connection. Under this arrangement, each property would be supplied via a restricted flow connection and would typically require on-site water storage to meet peak domestic demand. Firefighting water supply requirements would continue to be provided through the reticulated network.

Table 10 below demonstrates the different scenarios for the existing network pressure within the council network and whether they meet the 200 kPa and 25 L/min firefighting requirement.

Existing Council Pressure (Assumed)	Trunk Main	Bulk Main	Distribution Main	200kPa & 25l/s at each node
225 kPa	DN450	DN375	DN200/DN150	Fail
250 kPa	DN450	DN400	DN200/DN150	Fail
260 kPa	DN450	DN400	DN200/DN150	Fail
265 kPa	DN450	DN300	DN200/DN150	Pass
275 kPa	DN450	DN375	DN200/DN150	Pass
300 kPa	DN450	DN375	DN200/DN150	Pass

Table 11: Water Supply Option 3 EPANET Summary

Further testing will be undertaken to confirm the existing network pressure achieved a minimum of 265kPa at detailed design stage.

8.5.4. Option 4 – Full Development – Interim Water Reservoir

Option 4 involves on-lot rain harvesting tanks for potable water supply. Firefighting water supply requirements would continue to be provided through the reticulated network.

Table 11 below demonstrates the different scenarios for the existing network pressure within the council network and whether they meet the 200 kPa and 25 L/min firefighting requirement.

Existing Council Pressure (Assumed)	Trunk Main	Bulk Main	Distribution Main	200kPa & 25l/s at each node
260 kPa	DN450	DN400	DN200/DN150	Fail
265 kPa	DN450	DN375	DN200/DN150	Pass
275 kPa	DN450	DN375	DN200/DN150	Pass
300 kPa	DN450	DN375	DN200/DN150	Pass

Table 12: Water Supply Option 4 EPANET Summary

Further testing will be undertaken to confirm the existing network pressure achieved a minimum of 300kPa at detailed design stage.

8.6. Firefighting Supply

A principal main and associated hydrant is provided internal to the development to comply with the RITS and associated firefighting standards.

The minimum firefighting water supply classification for development in urban areas is FW2 and FW3 for the proposed commercial hub. The Industrial Development meets the following water supply requirements:

- A primary water flow of 12.5 litres/sec within a radial distance of 135m.
- An additional secondary flow of 12.5 litres/sec within a radial distance of 270m.
- The required flow can be achieved from a maximum of one or two hydrants operating simultaneously.
- A minimum running pressure of 100kPa.

9. Services

9.1. Power

Power will be provided by WEL Networks as the electricity distribution network utility operator for the Waikato region. The proposed power reticulation has been incorporated into the typical service cross section (per Drawing [CG46.1]), with the layout and connection arrangements to be confirmed through detailed design in accordance with WEL Networks' Network Connection Standard.

The site currently contains existing overhead power infrastructure (including distribution lines and poles) that will need to be transitioned to underground reticulation as part of the development works. All new power reticulation within the subdivision shall be installed underground, consistent with standard practice for new industrial subdivisions. Where new underground reticulation must connect to existing overhead lines at the periphery of the site, the detailed design of these transition points shall be developed in consultation with WEL Networks and the Council prior to finalising the system design noting that under standard subdivision codes, the details of connections between new underground and existing overhead systems must be discussed with Council before system design is finalised

Where existing overhead lines require removal or relocation to facilitate the development layout, all costs and programming shall be coordinated directly with WEL Networks. Service connection pillars shall be positioned at the road reserve boundary of each lot (point of supply), with locations confirmed on the engineering approval drawings

The developer shall be responsible for the following:

- Early engagement with WEL Networks (via their WELConnect portal) to lodge a subdivision connection application, providing site plans (DWG format), number of lots, and electrical capacity requirements per lot.
- Coordination with WEL Networks' appointed Tier 1 Delivery Partner (Downer or Ventia) for network design, scoping, and construction.
- Provision of any required electrical easements, including for transformers, switching stations, or ring main units to be located outside the road reserve in utility lots or reserves.
- Ensuring all electrical reticulation provides an adequate connection point as determined by WEL Networks, with cables laid parallel to surveyed street boundaries (horizontal tolerance ± 100 mm) and at minimum cover and separation distances per WEL Networks' specifications.
- Installation of ducts with draw-wires and end-caps under roads, footpaths, and entranceways where cabling is to be installed after surface completion, to avoid trenching through new surfaces. All carriageway crossings shall be ducted.
- Provision of as-built records and a certificate from WEL Networks confirming that all reticulation has been installed to their satisfaction, as a prerequisite to the issue of the 224(c) certificate

Where above-ground facilities such as transformers, switching stations, or ring main units are required by WEL Networks, these shall be located in consultation with both WEL Networks and Council. The preferred location is within a utility reserve provided as part of the subdivision, outside the road reserve. The location of all such facilities shall be shown on the plans submitted for engineering approval

9.2. Communications

Communications (telecommunications) will be provided by a service provider and has been incorporated into the typical service cross section per agreement with the service provider (per Drawing [CG46.1]).

The developer shall engage with the relevant telecommunications network utility operator (typically Tuatahi First Fibre for fibre services) early in the design process to confirm the reticulation layout. As best practice, the telecommunications layout should be developed once the electricity layout is substantially complete, as service trenches are generally shared wherever practicable to minimise the cross-sectional area occupied by utilities

Key requirements include:

- All telecommunications reticulation shall be installed underground within the road reserve, typically located in the berm/footpath zone as shown on the typical service cross section.
- Wherever possible, telecommunication ducting shall share the common service trench with power, noting that Chorus prefers co-location of the telecoms service point with power services where final positions permit
- Ducts shall be laid in straight lines parallel to kerb and property boundaries, with draw-wires installed and end-caps fitted. All ducting shall be left in a sealed, clean, and dry condition.
- Minimum separations from power cables shall be maintained in accordance with the NZCCPTS Cable Separation Guide (typically 300 mm parallel / 150 mm crossing for LV neutral-screened or armoured cables; 450 mm for non-screened or un-armoured LV; and 450 mm parallel / 150 mm crossing for HV with mechanical protection)
- A minimum clearance of 300 mm shall be maintained from water mains, stormwater drains, and sewer lines
- Service laterals shall be extended from the main communal network to a connection point at each lot boundary (typically a Channell hand hole located adjacent to the power service pillar).
- Where the development triggers Council requirements for broadband ducting (e.g., continuous duct-line on both sides of the street for future fibre), this shall be designed and installed to the approval of the telecommunications provider.

Prior to the issue of the 224(c) certificate, the developer shall provide a certificate from the telecommunications network utility operator confirming all works have been completed to their standards and that as-built information has been received. The developer is also responsible for obtaining any required Corridor Access Requests (CARs) for works within the legal road, including approved Traffic Management Plans

10. Conclusions

Based on the assessments documented in this infrastructure report and the appended specialist reports, the proposed SL1 Industrial Development can be serviced across all infrastructure disciplines without generating adverse effects beyond those addressed through the proposed mitigation measures.

Stormwater. An integrated treatment train — combining on-lot retention tanks, grass-lined conveyance swales with check dams, and three artificial wetlands — attenuates post-development peak discharges to no more than 80 percent of pre-development rates for the 100-year ARI climate change event, consistent with the Waitawhiriwhiri Draft Integrated Catchment Management Plan. HEC-RAS 2D flood modelling confirms that flood behaviour remains largely unchanged under post-development conditions, with only localised, less-than-minor residual effects. The stormwater system operates entirely by gravity, requiring no pump stations or mechanical plant.

Wastewater. Two wastewater pump stations, designed in accordance with RITS V2 (October 2025), provide internal conveyance via 225 mm Ø uPVC SN16 gravity pipelines. Enhanced on-site storage — significantly exceeding the RITS minimum of nine hours average dry weather flow — provides both robust emergency redundancy and buffering capacity to enable off-peak discharge to the constrained Dinsdale wastewater network. The preferred outfall option discharges to the existing Karen Crescent pump station (SPS119) via new rising mains. WSP is undertaking network capacity modelling to confirm the servicing configuration. The interim off-peak pumping strategy, coupled with the developer's participation in the strategic upgrade to the Whatawhata Road roundabout pump station, provides a lower-risk servicing arrangement than direct peak-period discharge to the existing network.

Water Supply. A staged connection strategy — supplying Stages 1A and 1B from existing Higgins Road mains, and Stages 2 and 3 via a new DN350 bulk main from Kahikatea Drive — achieves the required 200 kPa minimum pressure at all network nodes. EPANET modelling confirms that the preferred Option 2 is viable at assumed network pressures of 250 kPa (Stages 1A/1B) and 280 kPa (Stages 2/3), with field verification to be undertaken at detailed design stage. Firefighting supply meeting FW2/FW3 classification is provided throughout.

Roading. The roading network — designed by BBO in accordance with Austroads and RITS — delivers arterial connectivity via the Kahikatea Drive extension and new roundabouts, a 25.5-metre corridor collector road as the internal spine, and local roads incorporating shared paths, footpaths, and dedicated cycle facilities. Pavement designs incorporate subgrade improvement layers to address compressible ground conditions.

Earthworks. Enabling works comprise approximately 785,500 m³ of cut, 946,850 m³ of fill, and a net shortfall of approximately 351,000 m³ requiring imported fill. Preloading of road and infrastructure corridors will mitigate peat settlement. Erosion and sediment control will comply with TR2009/09 and be detailed in the Construction Management Plan.

Services. Power (WEL Networks) and telecommunications will be provided via underground reticulation within the road reserve, coordinated through early engagement with utility operators.

No engineering exceptions are proposed for the development. Residual matters for detailed design — including confirmation of downstream wastewater network capacity, field verification of water supply pressures, and refinement of localised overland flow depths — do not impact the feasibility of the infrastructure strategy or the suitability of the site for the proposed industrial development.

Information gathered to date confirms the site is suitable for the proposed development.

Appendix A – Engineering Plans (Bound Separately)

Appendix B – Engineering Calculations



Maven Associates

Job Number
298002

Sheet
1

Rev: A

Job Title
Calc Title

SL1 - Catchment C
Pre-development

Author
RK, SPAM

Date
21/05/2026

Checked

Wetland C
Total Catchment 36100

1. Runoff Curve Number (CN) and initial Abstraction (Ia)

CALCS to WRC TR2020/06

Soil name and classification	ID	Cover description (cover type, treatment, and hydrologic condition)	Curve Number CN*	Area (ha) 10000m ² = 1ha	Product of CN x area
C		Pervious (100%)	74	3.61	267.14
C		Impervious (0%)	98	0.00	0.00
					0.00
Totals =				3.61	267.14

$$CN \text{ (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{267.14}{3.610} = \boxed{74.0}$$

$$S = \frac{(1000}{CN} - 10) * 25.4 = \frac{(1000}{74.0} - 10) * 25.4 = \boxed{89.2} \text{ mm}$$

$$Ia = 0.05 * S = 0.05 * 89.2 = \boxed{4.5} \text{ mm}$$

2. Time of Concentration

Sheet and Shallow Flow (to be completed at detail design)

$$T = 100nL^{0.33}/S^{0.2}$$

Top Contour Level 41.4
Bottom Contour Level 35.7
Catchment Length 400

L= 400 m
S= 0.014 %
n= 0.035
T= mins

Concentrated Network Flow (to be completed at detail design)

Open Channel Flow

$$V = R^{2/3} S^{1/2} / n$$

$$R = A / Wp$$

0.33

w= 1
d= 1
l= 500

n= 0.04
S= 1%

V= 0.8498537 m/s
T= mins

$$Tc = T_{\text{sheet flow}} + T_{\text{concentrated flow}} + T_{\text{open channel flow}}$$

$$= 59.15 + 0.00 + 0.00 = 59.154 \text{ mins}$$

SCS Lag for HEC-HMS....

$$t_p = 2/3 t_c$$

= 0.9859017 hrs
= 0.661 hrs

OK use hrs

Worksheet 1: Runoff Parameters and Time of Concentration



Maven Associates

Job Number
298002.00

Sheet
2

Rev: A

Job Title SL1 - Catchment C
Calc Title Pre-development

Author
RK SPAM

Date
21/05/2026

Checked

- Data

Catchment Area	A=	0.0361 km ² (100ha =1km ²)
Runoff curve number	CN=	74.0 (from worksheet 1)
Initial abstraction	la=	4.5 mm (from worksheet 1)
Time of concentration	tc=	0.66 hrs (from worksheet 1)

- Calculate storage, $S = (1000/CN - 10)25.4$ = 89 mm

- Average recurrence interval, ARI

- 24 hour rainfall depth, P₂₄
*as per HIRDS Historical data

- Compute $c^* = P_{24} - 2la/P_{24} - 2la + 2S$

- Specific peak flow rate q^*

- Peak flow rate, $Q_p = q^* A P_{24}$

- Runoff depth, $Q_{24} = (P_{24} - la)^2 / (P_{24} - la) + S$

- Runoff volume, $V_{24} = 1000 \times Q_{24} \times A$

WQV 1/3 of 2yr	(yr)	2	10	100	yr
21.9	(mm)	65.6	99.2	152	(mm)
0.068		0.241	0.337	0.446	
0.022		0.070	0.097	0.116	
0.017	m ³ /s	0.166	0.332	0.629	m ³ /s
2.8		24.9	48.8	91.9	
103	m ³	897.29	1761.09	3318.69	m ³



Maven Associates

Job Number
298002

Sheet
1

Rev: A

Job Title
Calc Title

SL1 - Catchment C
Post development (Pervious)

Author
RK SPAM

Date
21/05/2026

Checked

Wetland C
Total Catchmer 36100

1. Runoff Curve Number (CN) and initial Abstraction (Ia)

CALCS to WRC TR2020/06

Soil name and classification	ID	Cover description (cover type, treatment, and hydrologic condition)	Curve Number CN*	Area (ha) 10000m2= 1ha	Product of CN x area
C		Pervious	30.0%	74	1.08
C		Impervious	70.0%	98	0.00
					0.00
Totals =				1.08	80.14

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{80.14}{1.083} = \boxed{74.0}$$

$$S = \frac{(1000}{\text{CN}} - 10) * 25.4 = \frac{(1000}{74.0} - 10) * 25.4 = \boxed{89.2} \text{ mm}$$

$$Ia = 0.05 * S = 0.05 * 89.2 = \boxed{4.5} \text{ mm}$$

2. Time of Concentration

Unnecessary for volume calculations



Maven Associates

Job Number
298002

Sheet
2

Rev: A

Job Title
Calc Title

SL1 - Catchment C
Post development (Pervious)

Author
RK SPAM

Date
21/05/2026

Checked

1. Data
- Catchment Area $A = 0.01083 \text{ km}^2$ (100ha $\approx 1\text{km}^2$)
- Runoff curve number $CN = 74.0$ (from worksheet 1)
- Initial abstraction $I_a = 4.5 \text{ mm}$ (from worksheet 1)
- Time of concentration $t_c = 0.17 \text{ hrs}$ (from worksheet 1)
2. Calculate storage, $S = (1000/CN - 10)/25.4$ = 89 mm

3. Average recurrence interval, ARI

4. 24 hour rainfall depth, P_{24}

*as per HIRDS RITS 6.0 2081-2100

5. Compute $c^* = P_{24} - 2I_a/P_{24} - 2I_a \times 2S$

6. Specific peak flow rate q^*

7. Peak flow rate, $q_p = q^* A \times P_{24}$

8. Runoff depth, $Q_{24} = (P_{24} - I_a)^2 / (P_{24} - I_a) + S$

9. Runoff volume, $V_{24} = 1000 \times Q_{24} \times A$

WQV				
1/3 of 2yr	(yr)	2	10	100
28.0	(mm)	84	131	204
		0.280	0.306	0.304
		0.198	0.107	0.114
		0.076	0.152	0.283
	m ³ /s	37.5	74.2	137.9
4.9		405.93	803.63	1493.17
53	m ³			



Maven Associates

Job Number
298002

Sheet
1

Rev: A

Job Title
Calc Title

SL1 - Catchment C
Post development (Impervious)

Author
RK SPAM

Date
21/05/2026

Checked

Wetland C
Total Catchmer 36100

1. Runoff Curve Number (CN) and initial Abstraction (Ia)

CALCS to WRC TR2020/06

Soil name and classification	ID	Cover description (cover type, treatment, and hydrologic condition)	Curve Number CN*	Area (ha) 10000m2= 1ha	Product of CN x area
C		Pervious	30.0%	74	0.00
C		Impervious	70.0%	98	2.53
					0.00
Totals =				2.53	247.65

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{247.65}{2.527} = \boxed{98.0}$$

$$S = \frac{(1000}{\text{CN}} - 10) * 25.4 = \frac{(1000}{98.0} - 10) * 25.4 = \boxed{5.2} \text{ mm}$$

$$Ia = 0.05 * S = 0.05 * 5.2 = \boxed{0.3} \text{ mm}$$

2. Time of Concentration

Unnecessary for volume calculations



Maven Associates

Job Number
298002.00

Sheet
2

Rev: A

Job Title
Calc Title

SL1 - Catchment C
Post development (Impervious)

Author
RK SPAM

Date
21/05/2026

Checked

1. Data
- Catchment Area $A=$ 0.02527 km²(100ha =1km²)
- Runoff curve number $CN=$ 98.0 (from worksheet 1)
- Initial abstraction $Ia=$ 0.3 mm (from worksheet 1)
- Time of concentration $t_c=$ 0.17 hrs (from worksheet 1)
2. Calculate storage, $S=(1000/CN - 10)/25.4$ = 5 mm

3. Average recurrence interval, ARI

4. 24 hour rainfall depth, P₂₄
*as per HIRDS RCP 6.0 2081-2100 data
5. Compute $c^* = P_{24} - 2Ia/P_{24} - 2Ia + 2S$

6. Specific peak flow rate q^*

7. Peak flow rate, $Q_p=q^*A \cdot P_{24}$

8. Runoff depth, $Q_{24} = (P_{24} - Ia)^2 / (P_{24} - Ia) + S$

9. Runoff volume, $V_{24} = 1000 \times Q_{24} \cdot A$

WQV		2	10	100	
<i>1/3 of 2yr</i>	(yr)				yr
28.0	(mm)	84	131	204	(mm)
0.726		0.896	0.976	0.997	
0.154		0.164	0.165	0.167	
0.109 m ³ /s		0.349	0.547	0.855	m ³ /s
23.4		78.9	125.8	198.7	
591 m ³		1992.77	3177.82	5020.79	m ³



Maven Associates

Job Number
298002

Sheet
1

Rev: A

Job Title
Calc Title

SL1 - Catchment C
Post development (whole site)

Author
RK

Date
21/05/2026

Checked
MHS

Wetland C
Total Catchment 36100

1. Runoff Curve Number (CN) and initial Abstraction (Ia)

CALCS to WRC TR2020/06

Soil name and classification	ID	Cover description (cover type, treatment, and hydrologic condition)	Curve Number CN*	Area (ha) 10000m ² =1 ha	Product of CN x area
C		Pervious	30.0%	74	1.08
C		Impervious	70.0%	98	2.53
Totals =					3.61 327.79

$$CN \text{ (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{327.79}{3.610} = \boxed{90.8}$$

$$S = \frac{(1000}{CN} - 10) * 25.4 = \frac{(1000}{90.8} - 10) * 25.4 = \boxed{25.7} \text{ mm}$$

$$Ia = 0.05 * S = 0.05 * 25.7 = \boxed{1.3} \text{ mm}$$

2. Time of Concentration

Sheet and Shallow Flow	(to be completed at detail design)	L=	560	m
$T = 100nL^{0.33}/S^{0.2}$	Top Contour Level	41.5	S=	0.010
	Bottom Contour Level	35.8	n=	0.015
	Catchment Length	560	T=	30.301 mins

Concentrated Network Flow (to be completed at detail design) 0

Open Channel Flow	$V = R^{2/3} S^{1/2} / n$	w=	1	n=	0.04
	$R = A / Wp$	d=	1	S=	1%
	0.33	l=	500		
(to be completed at detail design)		V=	0.8498537	m/s	
		T=	0.00	mins	

$$T_c = T_{\text{sheet flow}} + T_{\text{concentrated flow}} + T_{\text{open channel flow}}$$

$$= 30.3 + 0.00 + 0.00 = \boxed{30.301} \text{ mins}$$

$$\text{SCS Lag for HEC-HMS.... } t_p = 2/3 t_c = \boxed{0.000} \text{ hrs}$$

$$\text{NO GOOD use } \boxed{0.17} \text{ hrs}$$

Worksheet 2: Graphical Peak Flow Rate



Maven Associates

Job Number
298002.00

Sheet
2

Rev: A

Job Title
Calc Title

SL1 - Catchment C
WQV and ED

Author
RK SPAM

Date
21/05/2026

Checked

1. Data

Runoff volume (pervious)	$V_p =$	53 m ³	
Runoff volume (impervious)	$V_{ip} =$	591 m ³	
Combined volume	$V =$	643.8 m ³	
Pre-development initial abstraction	$I_{a0} =$	4.5 mm	
Post-development compacted pervious area CN		74	Class C
Post-development initial abstraction of pervious area	$I_{a0} =$	4.5 mm	
Post development Impervious area	$A_{ip} =$	2.53 ha.	
Post development compacted pervious areas	$A_{wp} =$	1.08 ha.	

2. Retention reduction

Impervious surface retention	$V_{rip} =$	112.8 m ³	
Pervious surface retention	$V_{rp} =$	0.0 m ³	

3. Water Quality Volume

WQV= 531.1 m³ Minimum Use this to Design RG

4. Extended Detention Volume

ED= 637 m³ Minimum Actual Volume of this within you

5. Pond/Wetland Volume

1904.16 m³ Minimum



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Job Number
298002.00

Sheet
2

Rev: A

Job Title
Calc Title

SL1 - Catchment C
Wetland Pond

Author
RK SPAM

Date
21/05/2026

Checked

Catchment Area	Area	36100	m ²		
WQV Volume	Vol	531.1	m ³		
Extended Detention Volume	Vol	637	m ³		
2yr 24hr Volume	Vol	1501.4	m ³		
10yr 24hr Volume	Vol	2220.4	m ³		
100yr 24hr Volume	Vol	3195.27	m ³	1291.11	Check
Pond Volume Check (3d EW volumes)	PWL	239.1	m ³		200mm
	WQV	519.651	m ³		200mm
	EDV	898.341	m ³		250mm
(assume 100mm spillway depth)	TOP POND	3176.8	m ³		1650mm
					Check
WQV Volume	Dead	239.13	m ³	-26.409	N/A
	Live	280.5	m ³	14.974	OK
	Total	519.65	m ³	-11.434	N/A
EDV Volume		659.2	m ³	21.905	OK
Total Pond Volume		2937.7	m ³	-257.567	0.919% of 100yr
				0.919	
Pond Permanent Surface Area					Check
WRC Recommended	%	4%			
	Area	1444	m ²		
TR2020-06 Calculated	Live Depth	0.20	m		
	Dead Depth	0.20	m		
	Total Depth	0.40	m		
	Area	1328	m ²	3.68%	
Design	Wetland Permant Surface Area	Area	1353.58	m ²	25.87
	Raingarden Permenant Surface Area	Area	0.00	m ²	
	Total Treatment Area	Area	1353.58	m ²	25.87



Maven Associates

Job Number
298002

Sheet
1

Rev: A

Job Title
Calc Title

SL1 - Catchment B
Pre-development

Author
RK, SPAM

Date
21/05/2026

Checked

Wetland C
Total Catchment 163100

1. Runoff Curve Number (CN) and initial Abstraction (Ia)

CALCS to WRC TR2020/06

Soil name and classification	ID	Cover description (cover type, treatment, and hydrologic condition)	Curve Number CN*	Area (ha) 10000m2= 1ha	Product of CN x area
C		Pervious (100%)	74	16.31	1206.94
C		Impervious (0%)	98	0.00	0.00
					0.00
Totals =				16.31	1206.94

$$CN \text{ (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{1206.94}{16.310} = \boxed{74.0}$$

$$S = \frac{(1000}{CN} - 10) * 25.4 = \frac{(1000}{74.0} - 10) * 25.4 = \boxed{89.2} \text{ mm}$$

$$Ia = 0.05 * S = 0.05 * 89.2 = \boxed{4.5} \text{ mm}$$

2. Time of Concentration

Sheet and Shallow Flow (to be completed at detail design)

$$T = 100nL^{0.33}/S^{0.2}$$

Top Contour Level	45.5	L=	465	m
Bottom Contour Level	41.8	S=	0.008	%
Catchment Length	465	n=	0.035	
		T=		$\boxed{69.852} \text{ mins}$

Concentrated Network Flow (to be completed at detail design)

$$T = \boxed{0} \text{ mins}$$

Open Channel Flow

$$V = R^{2/3} S^{1/2} / n$$

$$R = A / Wp = 0.33$$

w=	1	n=	0.04
d=	1	S=	1%
l=	500		

(to be completed at detail design)

$$V = 0.8498537 \text{ m/s}$$

$$T = \boxed{0.00} \text{ mins}$$

$$Tc = T_{\text{sheet flow}} + T_{\text{concentrated flow}} + T_{\text{open channel flow}}$$

$$= 69.85 + 0.00 + 0.00 = \boxed{69.852} \text{ mins}$$

$$1.1641971 \text{ hrs}$$

SCS Lag for HEC-HMS.... $t_p = 2/3 t_c$

$$= \boxed{0.780} \text{ hrs}$$

OK use $\boxed{0.78} \text{ hrs}$



Maven Associates

Job Number
298002.00

Sheet
2

Rev: A

Job Title SL1 - Catchment B
Calc Title Pre-development

Author
RK SPAM

Date
21/05/2026

Checked

- Data

Catchment Area	A=	0.1631 km ² (100ha =1km ²)
Runoff curve number	CN=	74.0 (from worksheet 1)
Initial abstraction	la=	4.5 mm (from worksheet 1)
Time of concentration	tc=	0.78 hrs (from worksheet 1)

- Calculate storage, $S = (1000/CN - 10)25.4$ = 89 mm

- Average recurrence interval, ARI

- 24 hour rainfall depth, P₂₄
*as per HIRDS Historical data

- Compute $c^* = P_{24} - 2la/P_{24} - 2la + 2S$

- Specific peak flow rate q^*

- Peak flow rate, $q_p = q^* A P_{24}$

- Runoff depth, $Q_{24} = (P_{24} - la)^2 / (P_{24} - la) + S$

- Runoff volume, $V_{24} = 1000 \times Q_{24} \times A$

WQV 1/3 of 2yr	(yr)	2	10	100	yr
21.9	(mm)	65.6	99.2	152	(mm)
0.068		0.241	0.337	0.446	
0.022		0.077	0.097	0.116	
0.077	m ³ /s	0.751	1.498	2.843	m ³ /s
2.8		24.9	48.8	91.9	
463	m ³	4053.97	7956.60	14993.87	m ³



Maven Associates

Job Number
298002

Sheet
1

Rev: A

Job Title
Calc Title

SL1 - Catchment B
Post development (Pervious)

Author
RK SPAM

Date
21/05/2026

Checked

Wetland C
Total Catchment 163100

1. Runoff Curve Number (CN) and initial Abstraction (Ia)

CALCS to WRC TR2020/06

Soil name and classification	ID	Cover description (cover type, treatment, and hydrologic condition)	Curve Number CN*	Area (ha) 10000m2= 1ha	Product of CN x area
C		Pervious	15.0%	74	2.45
C		Impervious	85.0%	98	0.00
					0.00
Totals =				2.45	181.04

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{181.04}{2.447} = \boxed{74.0}$$

$$S = \frac{(1000 - \text{CN})}{\text{CN}} \times 25.4 = \frac{(1000 - 74)}{74.0} \times 25.4 = \boxed{89.2} \text{ mm}$$

$$Ia = 0.05 \times S = 0.05 \times 89.2 = \boxed{4.5} \text{ mm}$$

2. Time of Concentration

Unnecessary for volume calculations



Maven Associates

Job Number
298002

Sheet
2

Rev: A

Job Title
Calc Title

SL1 - Catchment B
Post development (Pervious)

Author
RK SPAM

Date
21/05/2026

Checked

1. Data
- Catchment Area $A = 0.024465 \text{ km}^2$ (100ha $\approx 1\text{km}^2$)
- Runoff curve number $CN = 74.0$ (from worksheet 1)
- Initial abstraction $I_a = 4.5 \text{ mm}$ (from worksheet 1)
- Time of concentration $t_c = 0.17 \text{ hrs}$ (from worksheet 1)

2. Calculate storage, $S = (1000/CN - 10)/25.4 = 89 \text{ mm}$

3. Average recurrence interval, ARI

4. 24 hour rainfall depth, P_{24}

*as per HIRDS RITS 6.0 2081-2100

5. Compute $c^* = P_{24} - 2I_a/P_{24} - 2I_a \times 2S$

6. Specific peak flow rate q^*

7. Peak flow rate, $q_p = q^* A \times P_{24}$

8. Runoff depth, $Q_{24} = (P_{24} - I_a)^2 / (P_{24} - I_a) + S$

9. Runoff volume, $V_{24} = 1000 \times Q_{24} \times A$

WQV				
1/3 of 2yr	(yr)	2	10	100
28.0	(mm)	84	131	204
		0.280	0.306	0.350
		0.280	0.306	0.350
		0.172	0.344	0.639
	m ³ /s			
4.9		37.5	74.2	137.9
120	m ³	917.00	1815.40	3373.08



Maven Associates

Job Number
298002

Sheet
1

Rev: A

Job Title
Calc Title

SL1 - Catchment B
Post development (Impervious)

Author
RK SPAM

Date
21/05/2026

Checked

Wetland C
Total Catchment 163100

1. Runoff Curve Number (CN) and initial Abstraction (Ia)

CALCS to WRC TR2020/06

Soil name and classification	ID	Cover description (cover type, treatment, and hydrologic condition)	Curve Number CN*	Area (ha) 10000m2= 1ha	Product of CN x area
C		Pervious	15.0%	74	0.00
C		Impervious	85.0%	98	1358.62
					0.00
Totals =				13.86	1358.62

$$\text{CN (weighted)} = \frac{\text{total product} = 1358.62}{\text{total area} = 13.864} = \boxed{98.0}$$

$$S = \frac{(1000}{\text{CN}} - 10) * 25.4 = \frac{(1000}{98.0} - 10) * 25.4 = \boxed{5.2} \text{ mm}$$

$$Ia = 0.05 * S = 0.05 * 5.2 = \boxed{0.3} \text{ mm}$$

2. Time of Concentration

Unnecessary for volume calculations



Maven Associates

Job Number
298002.00

Sheet
2

Rev: A

Job Title
Calc Title

SL1 - Catchment B
Post development (Impervious)

Author
RK SPAM

Date
21/05/2026

Checked

1. Data
- Catchment Area $A= 0.138635 \text{ km}^2 (100\text{ha} = 1\text{km}^2)$
- Runoff curve number $CN= 98.0$ (from worksheet 1)
- Initial abstraction $Ia= 0.3 \text{ mm}$ (from worksheet 1)
- Time of concentration $t_c= 0.17 \text{ hrs}$ (from worksheet 1)
2. Calculate storage, $S = (1000/CN - 10)/25.4 = 5 \text{ mm}$

3. Average recurrence interval, ARI

4. 24 hour rainfall depth, P_{24}
*as per HIRDS RCP 6.0 2081-2100 data
5. Compute $c^* = P_{24} - 2Ia/P_{24} - 2Ia + 2S$

6. Specific peak flow rate q^*

7. Peak flow rate, $Q_p = q^* A P_{24}$

8. Runoff depth, $Q_{24} = (P_{24} - Ia)^2 / (P_{24} - Ia) + S$

9. Runoff volume, $V_{24} = 1000 \times Q_{24} \times A$

WQV		2	10	100	
<i>1/3 of 2yr</i>	(yr)				yr
28.0	(mm)	84	131	204	(mm)
0.726		0.896	0.976	0.997	
0.154		0.164	0.165	0.167	
0.596 m ³ /s		1.912	3.003	4.692	m ³ /s
23.4		78.9	125.8	198.7	
3240 m ³		10932.66	17434.02	27544.80	m ³



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Job Number
298002

Sheet
1

Rev: A

Job Title
Calc Title

SL1 - Catchment B
Post development (whole site)

Author
RK

Date
21/05/2026

Checked
MHS

Wetland C
Total Catchment: 163100

1. Runoff Curve Number (CN) and initial Abstraction (Ia)

CALCS to WRC TR2020/06

Soil name and classification	ID	Cover description (cover type, treatment, and hydrologic condition)	Curve Number CN*	Area (ha) 1000m2=1	Product of CN x area
C		Pervious	15.0%	74	2.45
C		Impervious	85.0%	98	13.86
Totals =				16.31	1539.66

$$CN \text{ (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{1539.66}{16.310} = \boxed{94.4}$$

$$S = \frac{(1000}{CN} - 10) * 25.4 = \frac{(1000}{94.4} - 10) * 25.4 = \boxed{15.1} \text{ mm}$$

$$Ia = 0.05 * S = 0.05 * 15.1 = \boxed{0.8} \text{ mm}$$

2. Time of Concentration

Sheet and Shallow Flow	(to be completed at detail design)	L=	450	m
$T = 100nL^{0.33}/S^{0.2}$	Top Contour Level	44	S=	0.006
	Bottom Contour Level	41.4	n=	0.015
	Catchment Length	450	T=	31.572 mins

Concentrated Network Flow (to be completed at detail design) 0

Open Channel Flow	$V = R^{2/3} S^{1/2} / n$	w=	1	n=	0.04
	$R = A / Wp$	d=	1	S=	1%
	0.33	l=	500		
(to be completed at detail design)		V=	0.8498537	m/s	
		T=	0.00	mins	

$$T_c = T_{\text{sheet flow}} + T_{\text{concentrated flow}} + T_{\text{open channel flow}}$$

$$= 31.57 + 0.00 + 0.00 = \boxed{31.57} \text{ mins}$$

$$\text{SCS Lag for HEC-HMS.... } t_p = 2/3 t_c = \boxed{0.000} \text{ hrs}$$

$$\text{NO GOOD use } \boxed{0.17} \text{ hrs}$$

Job Title	Calc Title
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SL1 - Catchment B
t development (whole site)

Author
RK SPAM

Date
21/05/2026

Checked

- | | | |
|--|-----|--|
| 1. Data | | |
| Catchment Area | A= | 0.1631 km ² (100ha = 1km ²) |
| Runoff curve number | CN= | 94.4 (from worksheet 1) |
| Initial abstraction | Ia= | 0.8 mm (from worksheet 1) |
| Time of concentration | tc= | 0.17 hrs (from worksheet 1) |
| 2. Calculate storage, S = (1000/CN - 10)25.4 | = | 15 mm |

3. Average recurrence interval, ARI

- 24 hour rainfall depth, P24
*as per HIRDS RCP 6.0 2081-2100 data
- Compute $c^* = P24 - 2Ia/P24 - 2Ia + 2S$

6. Specific peak flow rate q^*

7. Peak flow rate, $q_o = q^* A P_{24}$

8. Runoff depth, $Q_{24} = (P_{24} - I_a)^2 / (P_{24} - I_a) + S$

9. Runoff volume, $V_{24} = 1000 \times Q_{24} \times A$

WQV						yr
1/4 of 2yr	1/3 of 2yr	2	10	100	100	
21	28.0	84	131	204	204	(mm)
0.533	0.480	0.725	0.811	0.875	0.875	
0.500	0.417	0.500	0.417	0.417	0.417	
0.358	0.543	2.112	3.423	5.437	5.437	m ³ /s
						m ³

Pre development run off volume	4053.97	7956.60	14993.87	14993.87 m ³
Post development run off volume - Pervious	917.00	1815.40	3373.08	2567.03 m ³
Post development run off volume - Impervious	10932.66	17434.02	27544.80	22419.14 m ³
Post development run off volume - total	11849.66	19249.42	30917.88	24986.17 m ³

Volume	9992.30 m ³
--------	------------------------

Pre development flow rate	0.75	1.50	2.84	2.84 m ³ /s
Post development flow rate	2.11	3.42	5.44	5.44 m ³ /s

Target Flow Rates (80% Pre development)	0.60	1.20	2.27	2.27 m ³ /s
---	------	------	------	------------------------

Design Orifice that allows discharge out of your p



Maven Associates

Job Number
298002.00

Sheet
2

Rev: A

Job Title
Calc Title

SL1 - Catchment B
WQV and ED

Author
RK SPAM

Date
21/05/2026

Checked

1. Data

Runoff volume (pervious)

$V_p = 120 \text{ m}^3$

Runoff volume (impervious)

$V_{ip} = 3240 \text{ m}^3$

Combined volume

$V = 3360.5 \text{ m}^3$

Pre-development initial abstraction

$I_{a0} = 4.5 \text{ mm}$

Post-development compacted pervious area CN

74 Class C

Post-development initial abstraction of pervious area

$I_{a0} = 4.5 \text{ mm}$

Post development Impervious area

$A_{ip} = 13.86 \text{ ha.}$

Post development compacted pervious areas

$A_{wp} = 2.45 \text{ ha.}$

2. Retention reduction

Impervious surface retention

$V_{rip} = 618.6 \text{ m}^3$

Pervious surface retention

$V_{rp} = 0.0 \text{ m}^3$

3. Water Quality Volume

WQV= 2741.9 m³

Minimum

Use this to Design RG

4. Extended Detention Volume

ED= 3290 m³

Minimum

Actual Volume of this within you

5. Pond/Wetland Volume

9992.30 m³

Minimum



Maven Associates

Job Number
298002.00Sheet
2

Rev: A

Job Title
Calc TitleSL1 - Catchment B
Wetland PondAuthor
RK SPAMDate
21/05/2026

Checked

Catchment Area	Area	163100	m ²		
WQV Volume	Vol	2741.9	m ³		
Extended Detention Volume	Vol	3290	m ³		
2yr 24hr Volume	Vol	7795.7	m ³		
10yr 24hr Volume	Vol	11292.8	m ³		
100yr 24hr Volume	Vol	15924.01	m ³	5931.71	Check
Pond Volume Check (3d EW volumes)	PWL	1731.2	m ³		
	WQV	3567.26	m ³		
	EDV	542.436	m ³		
(assume 100mm spillway depth)	TOP POND	16174.0	m ³		
				Check	
WQV Volume	Dead	2086.30	m ³	715.338	N/A
	Live	1836.0	m ³	465.053	OK
	Total	3922.32	m ³	1180.391	N/A
EDV Volume		-1188.8	m ³	-4479.118	OK
Total Pond Volume		14442.8	m ³	-1481.256	91% of 100yr
				0.907	
Pond Permanent Surface Area				Check	
WRC Recommended	%	4%			
	Area	6524	m ²		
TR2020-06 Calculated	Live Depth	0.20	m		
	Dead Depth	0.20	m		
	Total Depth	0.40	m		
	Area	6855	m ²	4.20%	
Design	Wetland Permant Surface Area	Area	9057.93	m ²	2203.12
	Rainqarden Permenant Surface Area	Area	0.00	m ²	5.55%
	Total Treatment Area	Area	9057.93	m ²	2203.12

Worksheet 2: Graphical Peak Flow Rate



Maven Associates

Job Number
298002

Sheet
1

Rev: A

Job Title
Calc Title

SL1 - Catchment A
Pre-development

Author
RK, SPAM

Date
21/05/2026

Checked

Wetland C
Total Catchment 207800

1. Runoff Curve Number (CN) and initial Abstraction (Ia)

CALCS to WRC TR2020/06

Soil name and classification	ID	Cover description (cover type, treatment, and hydrologic condition)	Curve Number CN*	Area (ha) 10000m ² = 1ha	Product of CN x area
C		Pervious (100%)	74	20.78	1537.72
C		Impervious (0%)	98	0.00	0.00
					0.00
Totals =				20.78	1537.72

$$CN \text{ (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{1537.72}{20.780} = \boxed{74.0}$$

$$S = \frac{(1000}{CN} - 10) * 25.4 = \frac{(1000}{74.0} - 10) * 25.4 = \boxed{89.2} \text{ mm}$$

$$Ia = 0.05 * S = 0.05 * 89.2 = \boxed{4.5} \text{ mm}$$

2. Time of Concentration

Sheet and Shallow Flow (to be completed at detail design)

$$T = 100nL^{0.33}/S^{0.2}$$

Top Contour Level	61	L=	570	m
Bottom Contour Level	40.4	S=	0.036	%
Catchment Length	570	n=	0.035	
		T=		$\boxed{55.196}$ mins

Concentrated Network Flow (to be completed at detail design)

$$T = \boxed{0}$$

Open Channel Flow

$$V = R^{2/3} S^{1/2} / n$$

$$R = A / Wp = 0.33$$

w=	1	n=	0.04
d=	1	S=	1%
l=	500		

(to be completed at detail design)

$$V = 0.8498537 \text{ m/s}$$

$$T = \boxed{0.00} \text{ mins}$$

$$Tc = T_{\text{sheet flow}} + T_{\text{concentrated flow}} + T_{\text{open channel flow}}$$

$$= 55.2 + 0.00 + 0.00 = \boxed{55.196} \text{ mins}$$

SCS Lag for HEC-HMS.... $t_p = 2/3 t_c$

$$= \boxed{0.9199347} \text{ hrs}$$

OK use $\boxed{0.62} \text{ hrs}$



Maven Associates

Job Number
298002.00

Sheet
2

Rev: A

Job Title SL1 - Catchment A
Calc Title Pre-development

Author
RK SPAM

Date
21/05/2026

Checked

- Data

Catchment Area	A=	0.2078 km ² (100ha =1km ²)
Runoff curve number	CN=	74.0 (from worksheet 1)
Initial abstraction	la=	4.5 mm (from worksheet 1)
Time of concentration	tc=	0.62 hrs (from worksheet 1)
- Calculate storage, $S = (1000/CN - 10)25.4$ = 89 mm

- Average recurrence interval, ARI

- 24 hour rainfall depth, P₂₄
*as per HIRDS Historical data
- Compute $c^* = P_{24} - 2la/P_{24} - 2la + 2S$

- Specific peak flow rate q^*

- Peak flow rate, $Q_p = q^* A P_{24}$

- Runoff depth, $Q_{24} = (P_{24} - la)^2 / (P_{24} - la) + S$

- Runoff volume, $V_{24} = 1000 \times Q_{24} \times A$

WQV 1/3 of 2yr	(yr)	2	10	100	yr
21.9	(mm)	65.6	99.2	152	(mm)
0.068		0.241	0.337	0.446	
0.022		0.070	0.097	0.116	
0.098	m ³ /s	0.957	1.909	3.622	m ³ /s
2.8		24.9	48.8	91.9	
590	m ³	5165.03	10137.23	19103.17	m ³



Maven Associates

Job Number
298002

Sheet
1

Rev: A

Job Title
Calc Title

SL1 - Catchment A
Post development (Pervious)

Author
RK SPAM

Date
21/05/2026

Checked

Wetland C
Total Catchmer 207800

1. Runoff Curve Number (CN) and initial Abstraction (Ia)

CALCS to WRC TR2020/06

Soil name and classification	ID	Cover description (cover type, treatment, and hydrologic condition)	Curve Number CN*	Area (ha) 10000m2= 1ha	Product of CN x area
C		Pervious	15.0%	74	3.12
C		Impervious	85.0%	98	0.00
					0.00
Totals =				3.12	230.66

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{230.66}{3.117} = \boxed{74.0}$$

$$S = \frac{(1000}{\text{CN}} - 10) * 25.4 = \frac{(1000}{74.0} - 10) * 25.4 = \boxed{89.2} \text{ mm}$$

$$Ia = 0.05 * S = 0.05 * 89.2 = \boxed{4.5} \text{ mm}$$

2. Time of Concentration

Unnecessary for volume calculations



Maven Associates

Job Number
298002

Sheet
2

Rev: A

Job Title
Calc Title

SL1 - Catchment A
Post development (Pervious)

Author
RK SPAM

Date
21/05/2026

Checked

1. Data
- Catchment Area $A = 0.03117 \text{ km}^2$ (100ha $\approx 1\text{km}^2$)
- Runoff curve number $CN = 74.0$ (from worksheet 1)
- Initial abstraction $I_a = 4.5 \text{ mm}$ (from worksheet 1)
- Time of concentration $t_c = 0.17 \text{ hrs}$ (from worksheet 1)
2. Calculate storage, $S = (1000/CN - 10)/25.4 = 89 \text{ mm}$

3. Average recurrence interval, ARI

24 hour rainfall depth, P_{24}

*as per HIRDS RITS 6.0 2081-2100

5. Compute $c^* = P_{24} - 2I_a/P_{24} - 2I_a \times 2S$

6. Specific peak flow rate q^*

7. Peak flow rate, $q_p = q^* A \times P_{24}$

8. Runoff depth, $Q_{24} = (P_{24} - I_a)^2 / (P_{24} - I_a) + S$

9. Runoff volume, $V_{24} = 1000 \times Q_{24} \times A$

WQV		2	10	100
1/3 of 2yr	(yr)			
28.0	(mm)	84	131	204
		0.280	0.306	0.304
		0.198	0.197	0.194
	m ³ /s	0.219	0.438	0.814
4.9		37.5	74.2	137.9
153	m ³	1168.32	2312.94	4297.53



Maven Associates

Job Number
298002

Sheet
1

Rev: A

Job Title
Calc Title

SL1 - Catchment A
Post development (Impervious)

Author
RK SPAM

Date
21/05/2026

Checked

Wetland C
Total Catchmer 207800

1. Runoff Curve Number (CN) and initial Abstraction (Ia)

CALCS to WRC TR2020/06

Soil name and classification	ID	Cover description (cover type, treatment, and hydrologic condition)	Curve Number CN*	Area (ha) 10000m2= 1ha	Product of CN x area
C		Pervious	15.0%	74	0.00
C		Impervious	85.0%	98	1730.97
					0.00
Totals =				17.66	1730.97

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{1730.97}{17.663} = \boxed{98.0}$$

$$S = \frac{(1000}{\text{CN}} - 10) * 25.4 = \frac{(1000}{98.0} - 10) * 25.4 = \boxed{5.2} \text{ mm}$$

$$Ia = 0.05 * S = 0.05 * 5.2 = \boxed{0.3} \text{ mm}$$

2. Time of Concentration

Unnecessary for volume calculations



Maven Associates

Job Number
298002.00

Sheet
2

Rev: A

Job Title
Calc Title

SL1 - Catchment A
Post development (Impervious)

Author
RK SPAM

Date
21/05/2026

Checked

1. Data
- Catchment Area $A=$ 0.17663 km²(100ha =1km²)
- Runoff curve number $CN=$ 98.0 (from worksheet 1)
- Initial abstraction $Ia=$ 0.3 mm (from worksheet 1)
- Time of concentration $tc=$ 0.17 hrs (from worksheet 1)
2. Calculate storage, $S=(1000/CN - 10)/25.4$ = 5 mm

3. Average recurrence interval, ARI

4. 24 hour rainfall depth, P₂₄
*as per HIRDS RCP 6.0 2081-2100 data

5. Compute $c^* = P_{24} - 2Ia/P_{24} - 2Ia + 2S$

6. Specific peak flow rate q^*

7. Peak flow rate, $Q_p=q^*A^*P_{24}$

8. Runoff depth, $Q_{24} = (P_{24}-Ia)^2/(P_{24}-Ia)+S$

9. Runoff volume, $V_{24} = 1000 \times Q_{24} \times A$

WQV		2	10	100	
<i>1/3 of 2yr</i>	(yr)				yr
28.0	(mm)	84	131	204	(mm)
0.726		0.806	0.876	0.937	
0.154		0.164	0.184	0.197	
0.759 m ³ /s		2.436	3.826	5.978	m ³ /s
23.4		78.9	125.8	198.7	
4128 m ³		13928.92	22212.08	35093.87	m ³



Maven Associates

Job Number
298002

Sheet
1

Rev: A

Job Title
Calc Title

SL1 - Catchment A
Post development (whole site)

Author
RK

Date
21/05/2026

Checked
MHS

Wetland C
Total Catchment: 207800

1. Runoff Curve Number (CN) and initial Abstraction (Ia)

CALCS to WRC TR2020/06

Soil name and classification	ID	Cover description (cover type, treatment, and hydrologic condition)	Curve Number CN*	Area (ha) 1000m ² =1 ha	Product of CN x area
C		Pervious	15.0%	74	3.12
C		Impervious	85.0%	98	17.66
Totals =					20.78 1961.63

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{1961.63}{20.780} = \boxed{94.4}$$

$$S = \frac{(1000}{\text{CN}} - 10) * 25.4 = \frac{(1000}{94.4} - 10) * 25.4 = \boxed{15.1} \text{ mm}$$

$$Ia = 0.05 * S = 0.05 * 15.1 = \boxed{0.8} \text{ mm}$$

2. Time of Concentration

Sheet and Shallow Flow	(to be completed at detail design)	L=	740	m
$T = 100nL^{0.33}/S^{0.2}$	Top Contour Level	S=	0.005	%
	Bottom Contour Level	n=	0.015	
	Catchment Length	T=	38.948	mins

Concentrated Network Flow (to be completed at detail design) 0

Open Channel Flow	$V = R^{2/3} S^{1/2} / n$	w=	1	n=	0.04
	$R = A / Wp$	d=	1	S=	1%
	0.33	I=	500		
(to be completed at detail design)		V=	0.8498537	m/s	
		T=	0.00	mins	

$$T_c = T_{\text{sheet flow}} + T_{\text{concentrated flow}} + T_{\text{open channel flow}}$$

$$= 38.95 + 0.00 + 0.00 = \boxed{38.948} \text{ mins}$$

$$\text{SCS Lag for HEC-HMS.... } t_p = 2/3 t_c = \boxed{0.649138} \text{ hrs}$$

$$\text{NO GOOD use } \boxed{0.17} \text{ hrs}$$



Maven Associates

Job Number
298002.00

Sheet
2

Rev: A

Job Title
Calc Title

SL1 - Catchment A
WQV and ED

Author
RK SPAM

Date
21/05/2026

Checked

1. Data

Runoff volume (pervious)	$V_p =$	153	m^3
Runoff volume (impervious)	$V_{ip} =$	4128	m^3
Combined volume	$V =$	4281.5	m^3
Pre-development initial abstraction	$I_{a0} =$	4.5	mm
Post-development compacted pervious area CN		74	Class C
Post-development initial abstraction of pervious area	$I_{a0} =$	4.5	mm
Post development Impervious area	$A_{ip} =$	17.66	ha.
Post development compacted pervious areas	$A_{wp} =$	3.12	ha.

2. Retention reduction

Impervious surface retention	$V_{rip} =$	788.2	m^3
Pervious surface retention	$V_{rp} =$	0.0	m^3

3. Water Quality Volume

WQV= 3493.4 m^3 Minimum Use this to Design RG

4. Extended Detention Volume

ED= 4192 m^3 Minimum Actual Volume of this within you

5. Pond/Wetland Volume

12730.94 m^3 Minimum



Maven Associates

Job Number
298002.00Sheet
2

Rev: A

Job Title
Calc TitleSL1 - Catchment A
Wetland PondAuthor
RK SPAMDate
21/05/2026

Checked

Catchment Area	Area	207800	m ²		
WQV Volume	Vol	3493.4	m ³		
Extended Detention Volume	Vol	4192	m ³		
2yr 24hr Volume	Vol	9932.2	m ³		
10yr 24hr Volume	Vol	14387.8	m ³		
100yr 24hr Volume	Vol	20288.22	m ³	7557.38	Check
Pond Volume Check (3d EW volumes)	PWL	1845.6	m ³		
	WQV	3805.246	m ³		
	EDV	6844.981	m ³		
(assume 100mm spillway depth)	TOP POND	20236.4	m ³		
WQV Volume	Dead	1845.62	m ³	98.929	N/A
	Live	1959.6	m ³	212.927	OK
	Total	3805.25	m ³	311.857	N/A
EDV Volume		4999.4	m ³	807.290	OK
Total Pond Volume		18390.7	m ³	-1897.486	91% of 100yr
				0.906	
Pond Permanent Surface Area				Check	
WRC Recommended	%	4%			
	Area	8312	m ²		
TR2020-06 Calculated	Live Depth	0.20	m		
	Dead Depth	0.20	m		
	Total Depth	0.40	m		
	Area	8733	m ²	4.20%	
Design	Wetland Permant Surface Area	Area	9665.32	m ²	931.85
	Raingarden Permenant Surface Area	Area	60.00	m ²	
	Total Treatment Area	Area	9725.32	m ²	991.85

Worksheet 2: Graphical Peak Flow Rate



Maven Associates

Job Number
298002

Sheet
1

Rev: A

Job Title
Calc Title

SL1 INDUSTRIAL
Pre-development

Author
RK

Date
23/06/2026

Checked
SPAM

Catchment C
Total Catchment 60000

1. Runoff Curve Number (CN) and initial Abstraction (Ia)

CALCS to WRC TR2020/06

Soil name and classification	ID	Cover description (cover type, treatment, and hydrologic condition)	Curve Number CN*	Area (ha) 10000m2= 1ha	Product of CN x area
C		Pervious (100%)	74	6.00	444.00
C		Impervious (0%)	98	0.00	0.00
					0.00
Totals =				6.00	444.00

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{444.00}{6.000} = 74.0$$

$$S = \frac{(1000}{\text{CN}} - 10) * 25.4 = \frac{(1000}{74.0} - 10) * 25.4 = 89.2 \text{ mm}$$

$$Ia = 0.05 * S = 0.05 * 89.2 = 4.5 \text{ mm}$$

2. Time of Concentration (to be completed at detail design)

use 0.17 hrs



Maven Associates

Job Number
298002

Sheet
1

Rev: A

Job Title
Calc Title

SL1 INDUSTRIAL
Pre-development

Author
RK

Date
23/06/2026

Checked
SPAM

Catchment D
Total Catchment 21400

1. Runoff Curve Number (CN) and initial Abstraction (Ia)

CALCS to WRC TR2020/06

Soil name and classification	ID	Cover description (cover type, treatment, and hydrologic condition)	Curve Number CN*	Area (ha) 10000m2= 1ha	Product of CN x area
C		Pervious (100%)	74	2.14	158.36
C		Impervious (0%)	98	0.00	0.00
					0.00
Totals =				2.14	158.36

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{158.36}{2.140} = \boxed{74.0}$$

$$S = \frac{(1000}{\text{CN}} - 10) * 25.4}{74.0} = \boxed{89.2} \text{ mm}$$

$$Ia = 0.05 * S = 0.05 * 89.2 = \boxed{4.5} \text{ mm}$$

2. Time of Concentration (to be completed at detail design)

use $\boxed{0.17}$ hrs



Maven Associates

Job Number
298002

Sheet
1

Rev: A

Job Title
Calc Title

SL1 INDUSTRIAL
Pre-development

Author
RK

Date
23/06/2026

Checked
SPAM

Catchment Unmitigated A
Total Catchment 40600

1. Runoff Curve Number (CN) and initial Abstraction (Ia)

CALCS to WRC TR2020/06

Soil name and classification	ID	Cover description (cover type, treatment, and hydrologic condition)	Curve Number CN*	Area (ha) 10000m2= 1ha	Product of CN x area
C		Pervious (100%)	74	4.06	300.44
C		Impervious (0%)	98	0.00	0.00
					0.00
Totals =				4.06	300.44

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{300.44}{4.060} = 74.0$$

$$S = \frac{(1000}{\text{CN}} - 10) * 25.4 = \frac{(1000}{74.0} - 10) * 25.4 = 89.2 \text{ mm}$$

$$Ia = 0.05 * S = 0.05 * 89.2 = 4.5 \text{ mm}$$

2. Time of Concentration (to be completed at detail design)

use 0.17 hrs



Maven Associates

Job Number
298002

Sheet
1

Rev: A

Job Title
Calc Title

SL1 INDUSTRIAL
Pre-development

Author
RK

Date
23/06/2026

Checked
SPAM

Catchment Unmitigated A
Total Catchment 6210

1. Runoff Curve Number (CN) and initial Abstraction (Ia)

CALCS to WRC TR2020/06

Soil name and classification	ID	Cover description (cover type, treatment, and hydrologic condition)	Curve Number CN*	Area (ha) 10000m2=1ha	Product of CN x area
C		Pervious (100%)	74	0.62	45.95
C		Impervious (0%)	98	0.00	0.00
					0.00
Totals =				0.62	45.95

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{45.95}{0.621} = \boxed{74.0}$$

$$S = \frac{(1000}{\text{CN}} - 10) * 25.4 = \frac{(1000}{74.0} - 10) * 25.4 = \boxed{89.2} \text{ mm}$$

$$Ia = 0.05 * S = 0.05 * 89.2 = \boxed{4.5} \text{ mm}$$

2. Time of Concentration (to be completed at detail design)

use $\boxed{0.17}$ hrs



Maven Associates

Job Number
298002

Sheet
1

Rev: A

Job Title
Calc Title

SL1 INDUSTRIAL
Post development (whole site)

Author
RK

Date
23/06/2026

Checked
SPAM

Catchment C
Total Catchment 60000

1. Runoff Curve Number (CN) and initial Abstraction (Ia)

CALCS to WRC TR2020/06

Soil name and classification	ID	Cover description (cover type, treatment, and hydrologic condition)		Curve Number CN*	Area (ha) 1000m2=1 ha	Product of CN x area
C		Pervious	15.0%	74	0.90	66.60
C		Impervious	85.0%	98	5.10	499.80
Totals =					6.00	566.40

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{566.40}{6.000} = \boxed{94.4}$$

$$S = \frac{(1000}{\text{CN}} - 10) * 25.4 = \frac{(1000}{94.4} - 10) * 25.4 = \boxed{15.1} \text{ mm}$$

$$Ia = 0.05 * S = 0.05 * 15.1 = \boxed{0.8} \text{ mm}$$

2. Time of Concentration (to be completed at detail design)

NO GOOD use 0.17 hrs

Worksheet 1: Runoff Parameters and Time of Concentration



Maven Associates

Job Number
298002

Sheet
1

Rev: A

Job Title
Calc Title

SL1 INDUSTRIAL
Post development (whole site)

Author
RK

Date
23/06/2026

Checked
SPAM

Catchment E
Total Catchment: 21400

1. Runoff Curve Number (CN) and initial Abstraction (Ia)

CALCS to WRC TR2020/06

Soil name and classification	ID	Cover description (cover type, treatment, and hydrologic condition)		Curve Number CN*	Area (ha) 1000m2=1 ha	Product of CN x area
C		Pervious	15.0%	74	0.32	23.75
C		Impervious	85.0%	98	1.82	178.26
				Totals =	2.14	202.02

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{202.02}{2.140} = \boxed{94.4}$$

$$S = \frac{(1000}{\text{CN}} - 10) * 25.4 = \frac{(1000}{94.4} - 10) * 25.4 = \boxed{15.1} \text{ mm}$$

$$Ia = 0.05 * S = 0.05 * 15.1 = \boxed{0.8} \text{ mm}$$

2. Time of Concentration (to be completed at detail design)

NO GOOD

use

$\boxed{0.17}$ hrs



Maven Associates

Job Number
298002

Sheet
1

Rev: A

Job Title
Calc Title

SL1 INDUSTRIAL
Post development (whole site)

Author
RK

Date
23/06/2026

Checked
SPAM

Catchment Unmitigated A
Total Catchment 40600

1. Runoff Curve Number (CN) and initial Abstraction (Ia)

CALCS to WRC TR2020/06

Soil name and classification	ID	Cover description (cover type, treatment, and hydrologic condition)		Curve Number CN*	Area (ha) 10000m2=1 ha	Product of CN x area
C		Pervious	15.0%	74	0.61	45.07
C		Impervious	85.0%	98	3.45	338.20
Totals =					4.06	383.26

$$CN \text{ (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{383.26}{4.060} = \boxed{94.4}$$

$$S = \frac{(1000}{CN} - 10) * 25.4 = \frac{(1000}{94.4} - 10) * 25.4 = \boxed{15.1} \text{ mm}$$

$$Ia = 0.05 * S = 0.05 * 15.1 = \boxed{0.8} \text{ mm}$$

2. Time of Concentration (to be completed at detail design)

NO GOOD use 0.17 hrs



Maven Associates

Job Number
298002

Sheet
1

Rev: A

Job Title
Calc Title

SL1 INDUSTRIAL
Post development (whole site)

Author
RK

Date
23/06/2026

Checked
SPAM

Catchment Unmitigated A
Total Catchment 6210

1. Runoff Curve Number (CN) and initial Abstraction (Ia)

CALCS to WRC TR2020/06

Soil name and classification	ID	Cover description (cover type, treatment, and hydrologic condition)		Curve Number CN*	Area (ha) 1000m2=1 ha	Product of CN x area
C		Pervious	15.0%	74	0.09	6.89
C		Impervious	85.0%	98	0.53	51.73
				Totals =	0.62	58.62

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{58.62}{0.621} = \boxed{94.4}$$

$$S = \frac{(1000}{\text{CN}} - 10) * 25.4 = \frac{(1000}{94.4} - 10) * 25.4 = \boxed{15.1} \text{ mm}$$

$$Ia = 0.05 * S = 0.05 * 15.1 = \boxed{0.8} \text{ mm}$$

2. Time of Concentration (to be completed at detail design)

NO GOOD use 0.17 hrs

Worksheet 1: Runoff Parameters and Time of Concentration

 Maven Associates		Job Number 298001	Sheet 1	Rev A												
Job Title Calc Title	SL1 - I1 WW Demand Calc	Author MKS	Date 16/06/2026	Checked SM												
As per Waikato Local Authority RITS standards Domestic Average Daily Flow (Water Consumption)= 200 l/person/day Infiltration Allowance= 0 l/Ha/day Surface Water Ingress= 0 l/Ha/day																
Refer to C450-1 for catchment details Catchment area = 47.90 Ha Total Population 2156 Wastewater Peaking factor as per Table 5-2= 6.7 Wastewater Population Equivalent as per Table 91= 45 Using a population value person (max development scenario) Average Daily Flow (ADF)= 431.10 m³/day Peak Daily Flow (PDF)= 33.43 L/sec Peak Wet Weather Flow (PWWF)= 33.43 L/sec																
Pipe Ks (uPVC) = 0.60 <table border="1"> <thead> <tr> <th>PWW Flow l/s</th> <th>Pipe dia m</th> <th>Gradient %</th> <th>Capacity l/s</th> <th>Velocity m/s</th> <th>Check OK</th> </tr> </thead> <tbody> <tr> <td>33.43</td> <td>0.300</td> <td>0.33</td> <td>64.27</td> <td>0.91</td> <td>OK</td> </tr> </tbody> </table>					PWW Flow l/s	Pipe dia m	Gradient %	Capacity l/s	Velocity m/s	Check OK	33.43	0.300	0.33	64.27	0.91	OK
PWW Flow l/s	Pipe dia m	Gradient %	Capacity l/s	Velocity m/s	Check OK											
33.43	0.300	0.33	64.27	0.91	OK											

 Maven Associates		Job Number 298001	Sheet 1	Rev A												
Job Title Calc Title	SL1 - I1 WW Demand Calc	Author MKS	Date 15/06/2026	Checked SM												
As per Waikato Local Authority RITS standards Domestic Average Daily Flow (Water Consumption)= 200 l/person/day Infiltration Allowance= 0 l/Ha/day Surface Water Ingress= 0 l/Ha/day																
Refer to C450-1 for catchment details Catchment area = 8.18 Ha Total Population 368 Wastewater Peaking factor as per Table 5-2= 6.7 Wastewater Population Equivalent as per Table 91= 45 Using a population value person (max development scenario) Average Daily Flow (ADF)= 73.62 m³/day Peak Daily Flow (PDF)= 5.71 L/sec Peak Wet Weather Flow (PWWF)= 5.71 L/sec																
Pipe Ks (uPVC) = 0.60 <table border="1"> <thead> <tr> <th>PWW Flow l/s</th> <th>Pipe dia m</th> <th>Gradient %</th> <th>Capacity l/s</th> <th>Velocity m/s</th> <th>Check OK</th> </tr> </thead> <tbody> <tr> <td>5.71</td> <td>0.150</td> <td>0.55</td> <td>13.31</td> <td>0.75</td> <td>OK</td> </tr> </tbody> </table>					PWW Flow l/s	Pipe dia m	Gradient %	Capacity l/s	Velocity m/s	Check OK	5.71	0.150	0.55	13.31	0.75	OK
PWW Flow l/s	Pipe dia m	Gradient %	Capacity l/s	Velocity m/s	Check OK											
5.71	0.150	0.55	13.31	0.75	OK											

 Maven Associates		Job Number 298001	Sheet 1	Rev A												
Job Title SL1 - I1	Calc Title WW Demand Calc	Author MKS	Date 15/06/2026	Checked SM												
As per Waikato Local Authority RITS standards Domestic Average Daily Flow (Water Consumption)= 200 l/person/day Infiltration Allowance= 0 l/Ha/day Surface Water Ingress= 0 l/Ha/day																
Refer to C450-1 for catchment details Catchment area = 17.03 Ha Total Population 766 Wastewater Peaking factor as per Table 5-2= 6.7 Wastewater Population Equivalent as per Table 91= 45 Using a population value person (max development scenario) Average Daily Flow (ADF)= 153.27 m³/day Peak Daily Flow (PDF)= 11.89 L/sec Peak Wet Weather Flow (PWWF)= 11.89 L/sec																
Pipe Ks (uPVC) = 0.60 <table border="1"> <thead> <tr> <th>PWW Flow l/s</th> <th>Pipe dia m</th> <th>Gradient %</th> <th>Capacity l/s</th> <th>Velocity m/s</th> <th>Check OK</th> </tr> </thead> <tbody> <tr> <td>11.89</td> <td>0.225</td> <td>0.33</td> <td>30.10</td> <td>0.76</td> <td>OK</td> </tr> </tbody> </table>					PWW Flow l/s	Pipe dia m	Gradient %	Capacity l/s	Velocity m/s	Check OK	11.89	0.225	0.33	30.10	0.76	OK
PWW Flow l/s	Pipe dia m	Gradient %	Capacity l/s	Velocity m/s	Check OK											
11.89	0.225	0.33	30.10	0.76	OK											

 Maven Associates		Job Number 298001	Sheet 1	Rev A												
Job Title Calc Title	SL1 - I1 WW Demand Calc	Author MKS	Date 15/06/2026	Checked SM												
As per Waikato Local Authority RITS standards Domestic Average Daily Flow (Water Consumption)= 200 l/person/day Infiltration Allowance= 0 l/Ha/day Surface Water Ingress= 0 l/Ha/day																
Refer to C450-1 for catchment details Catchment area = 22.69 Ha Total Population 1021 Wastewater Peaking factor as per Table 5-2= 6.7 Wastewater Population Equivalent as per Table 91= 45																
Using a population value person (max development scenario) Average Daily Flow (ADF)= 204.21 m ³ /day Peak Daily Flow (PDF)= 15.84 L/sec Peak Wet Weather Flow (PWWF)= 15.84 L/sec																
Pipe Ks (uPVC) = 0.60 <table border="1"> <thead> <tr> <th>PWW Flow l/s</th> <th>Pipe dia m</th> <th>Gradient %</th> <th>Capacity l/s</th> <th>Velocity m/s</th> <th>Check OK</th> </tr> </thead> <tbody> <tr> <td>15.84</td> <td>0.225</td> <td>0.33</td> <td>30.10</td> <td>0.76</td> <td>OK</td> </tr> </tbody> </table>					PWW Flow l/s	Pipe dia m	Gradient %	Capacity l/s	Velocity m/s	Check OK	15.84	0.225	0.33	30.10	0.76	OK
PWW Flow l/s	Pipe dia m	Gradient %	Capacity l/s	Velocity m/s	Check OK											
15.84	0.225	0.33	30.10	0.76	OK											

 Maven Waikato Ltd		Job Number 298001	Sheet 1	Rev A																																				
Job Title SL1-IND	Author JPK	Date 4/09/2026	Checked SM																																					
Calc Title Overall - Water Demand																																								
<u>Water Catchment</u> As per RITS Standard 6.2.3 3 people per dwelling 260 l/person/day Demand Demand Rates Average Demand = 260 litres/person/day Peak Demand (5x) = 1300 litres/person/day <table border="0" style="width: 100%;"> <tr> <td>Population</td> <td>Dwellings</td> <td>People</td> <td>Occupancy</td> </tr> <tr> <td>Proposed Dwellings</td> <td></td> <td></td> <td>0</td> </tr> <tr> <td>Industrial Unit (45ppl per Ha)</td> <td>40.25</td> <td>45</td> <td>1811.25</td> </tr> <tr> <td>Total</td> <td></td> <td></td> <td>1811.25</td> </tr> </table> <table border="0" style="width: 100%;"> <tr> <td>Demand</td> <td>Persons</td> <td>Rate l/p/day</td> <td>Flow l/s</td> </tr> <tr> <td>AD Water</td> <td>1811.25</td> <td>260</td> <td>5.45</td> </tr> <tr> <td>PD Water</td> <td>1811.25</td> <td>1300</td> <td>27.25</td> </tr> </table> <table border="0" style="width: 100%;"> <tr> <td>Peak Demand</td> <td>Persons</td> <td>Rate l/p/day</td> <td>Flow l/s</td> </tr> <tr> <td>PD Water</td> <td>1811.25</td> <td>1300</td> <td>27.25</td> </tr> </table>					Population	Dwellings	People	Occupancy	Proposed Dwellings			0	Industrial Unit (45ppl per Ha)	40.25	45	1811.25	Total			1811.25	Demand	Persons	Rate l/p/day	Flow l/s	AD Water	1811.25	260	5.45	PD Water	1811.25	1300	27.25	Peak Demand	Persons	Rate l/p/day	Flow l/s	PD Water	1811.25	1300	27.25
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Peak Demand	Persons	Rate l/p/day	Flow l/s																																					
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Appendix C – EPANET Modelling

	Project number	Project	Date	Author	Checked
	298002	SL1-INDUSTRIAL	04-09-2026	JPK	DJM

SL1 – Industrial 1 - Water Supply Modelling – Hydrant Peak demand

Designed: JPK Date: 04/09/2026

Checked: DJM Date: 04/09/2026

Water Supply standards as per RITS,

6.1.3.1 On Demand Water Supply Area

The design of the network shall conform to the Code of Practice for Fire Fighting Water Supplies (SNZ PAS 4509), and shall be such that a water supply connection can be provided for each lot.

The water supply network shall achieve the following standards:

- The residual pressure and flow at point of supply to residential lots shall be a minimum of 200 kPa (20m) and 25 L/min. Some specific areas may require a higher Level of Service – check with the relevant Council.
- The minimum fire supply service level shall be FW2 for residential areas and FW3 for all other areas. Some specific areas may require a higher level of service.

FW2 standards from SNZ PAS 4509:2008 – Table 2

Fire water classification	Reticulated water supply			Non-reticulated water supply	
	Required water flow within a distance of 135 m	Additional water flow within a distance of 270 m	Maximum number of fire hydrants to provide flow	Minimum water storage within a distance of 90 m (see Note 8)	
				Time (firefighting) (min)	Volume (m ³)
FW1	450 L/min (7.5 L/s) (See Note 3)	–	1	15	7
FW2	750 L/min (12.5 L/s)	750 L/min (12.5 L/s)	2	30	45

Requirement: All lots to have at least 200kPa (20m) of pressure at supply point while 2 x fire hydrant are consuming 12.5l/s of demand.

Assumptions: The calculation is modelled based on the assumption that the existing water supply connection points will be 275kPa.

Summary of Results

Required total flow for water supply = 27.25l/s

Required flow for firefighting = 25l/s

(Assuming 2 hydrants works at same time at 100kPa)

Minimum pressure required at SL1 Industrial – Proposed WS Connection Points= 275kPa

	Project number	Project	Date	Author	Checked
	298002	SL1-INDUSTRIAL	04-09-2026	JPK	DJM

Model results

Junctions (See attached water modelling map)

Water pressure head at supply point = Elevation + 27.5m (275kPa)

Node ID	Elevation m	Base Demand LPS	Head m	Pressure m
Junc n1	37.55	0	65.04	27.49
Junc n2	36.94	0.16	65.04	28.10
Junc n3	39.72	0.05	65.15	25.43
Junc n4	39.114	12.5	65.13	26.01
Junc n5	39.204	12.5	65.03	25.83
Junc n6	43.49	0	64.45	20.96
Junc n7	43.25	12.5	64.44	21.19
Junc n8	43.52	0	64.45	20.93
Junc n9	37.823	0.14	63.62	25.80
Junc n10	35.661	0.1	63.63	27.97
Junc n11	37.309	12.5	63.62	26.31
Junc n12	37.531	0.18	65.04	27.51
Junc n13	38.669	12.5	65.06	26.39
Junc n14	37.615	12.5	64.28	26.67
Junc n15	35.759	0	63.68	27.93
Junc n16	37.656	0.54	63.62	25.96
Junc n17	40.715	12.5	65.04	24.32
Junc n18	40.162	0.05	65.14	24.98
Junc n19	39.661	12.5	65.13	25.47
Junc n20	41.14	0	65.40	24.26
Junc n21	42.329	12.5	64.64	22.31
Junc n22	42.65	12.5	64.47	21.82
Junc n23	42.385	12.5	64.68	22.29
Junc n24	41.680	0	64.56	22.88
Junc n25	41.404	0	64.55	23.15
Junc n26	41.337	12.5	64.53	23.19
Junc n27	40.001	12.5	64.42	24.42
Junc n28	39.104	12.5	64.42	25.31
Junc n29	40.598	12.5	64.46	23.86
Junc n30	41.604	12.5	64.54	22.94
Junc n31	40.555	12.5	64.43	23.87
Junc n32	42.63	12.5	64.46	21.83
Junc n33	41.97	0.24	64.55	22.58
Junc n34	42.09	0	64.55	22.46

	Project number	Project	Date	Author	Checked
	298002	SL1-INDUSTRIAL	04-09-2026	JPk	DJM

Junctions (See attached water modelling map)

Node ID	Elevation m	Base Demand LPS	Head m	Pressure m
Junc n23	42.385	12.5	64.68	22.29
Junc n24	41.680	0	64.56	22.88
Junc n25	41.404	0	64.55	23.15
Junc n26	41.337	12.5	64.53	23.19
Junc n27	40.001	12.5	64.42	24.42
Junc n28	39.104	12.5	64.42	25.31
Junc n29	40.598	12.5	64.46	23.86
Junc n30	41.604	12.5	64.54	22.94
Junc n31	40.555	12.5	64.43	23.87
Junc n32	42.63	12.5	64.46	21.83
Junc n33	41.97	0.24	64.55	22.58
Junc n34	42.09	0	64.55	22.46
Junc n35	37.477	12.5	63.62	26.14
Junc n36	40.31	12.5	65.15	24.84
Junc n37	40.063	12.5	65.06	24.99
Junc n38	42.47	12.5	65.06	22.59
Junc n39	41.7	12.5	65.27	23.57
Junc n40	43.53	0	64.87	21.34
Junc n41	43.56	0.04	64.88	21.32
Junc n42	42.97	0.08	64.46	21.49
Junc n43	42.94	0	64.46	21.52
Junc n44	39.9	0	67.23	27.33
Junc n45	40.86	12.5	65.10	24.24
Junc n46	41.29	0	65.21	23.92
Junc n47	41.26	0	65.14	23.88
Junc n48	42.52	0	65.33	22.81
Junc n49	42.58	12.5	65.32	22.74
Junc n50	43.54	12.5	64.87	21.33
Junc n51	43.58	12.5	64.87	21.29
Junc n52	43.25	12.5	64.45	21.20
Junc n53	35.6	12.5	63.11	27.51
Resvr 1	65.05	#N/A	65.05	0.00
Resvr 21	67.4	#N/A	67.40	0.00
Resvr 2	63.1	#N/A	63.10	0.00

	Project number	Project	Date	Author	Checked
	298002	SL1-INDUSTRIAL	04-09-2026	JPK	DJM

Pipes (See attached water modelling map)

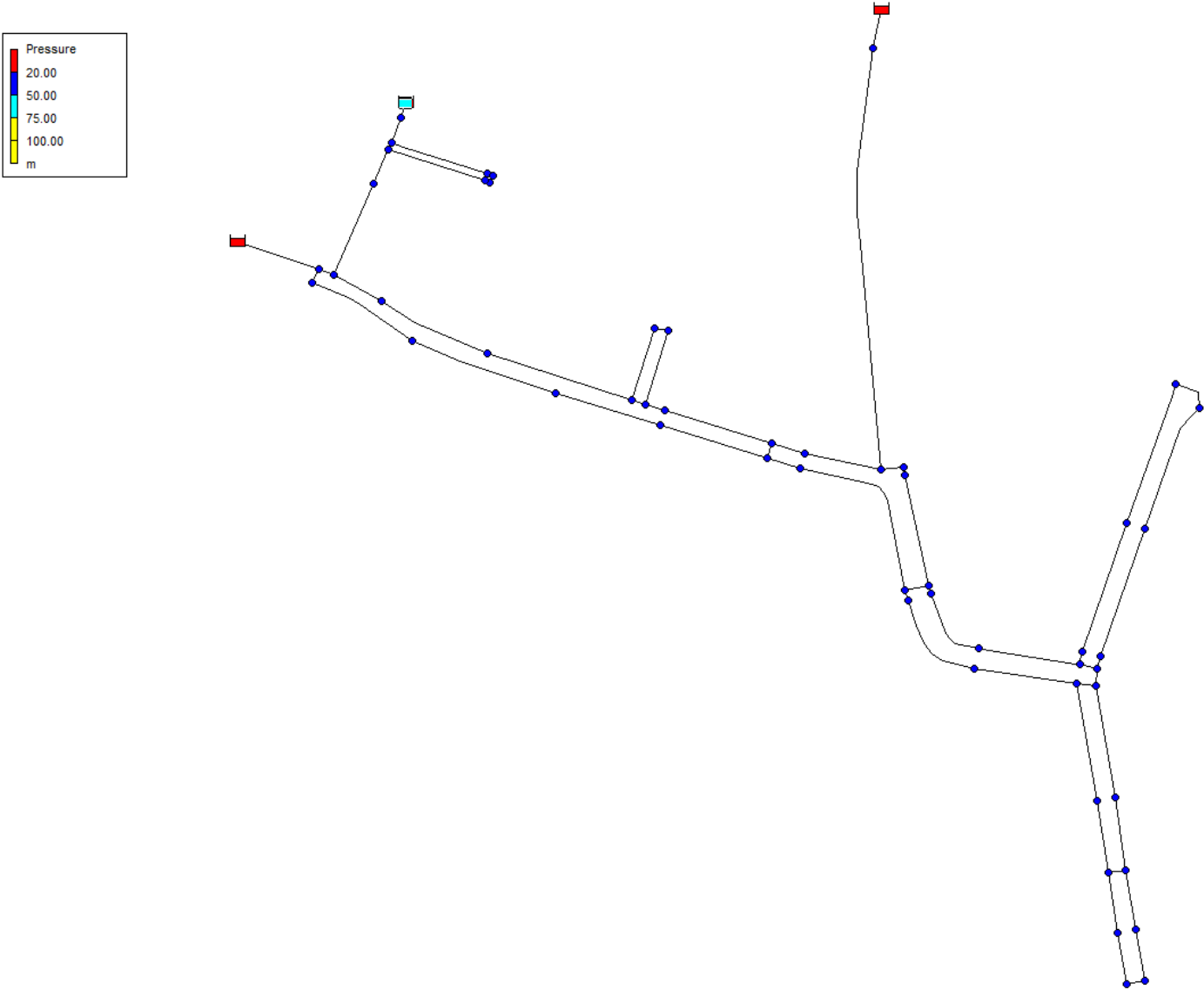
Link ID	Length m	Diameter mm	Flow LPS	Velocity m/s	Unit Headloss m/km	Friction Factor
Pipe p1	17.25	200	2.49	0.08	0.04	0.027
Pipe p2	90.54	150	2.71	0.15	0.21	0.026
Pipe p3	60.62	150	1.11	0.06	0.04	0.029
Pipe p4	21.5	150	1.11	0.06	0.04	0.029
Pipe p5	117.9	200	2.90	0.09	0.06	0.026
Pipe p6	85.74	200	-43.91	1.40	8.79	0.018
Pipe p7	80.04	200	-40.28	1.28	7.49	0.018
Pipe p8	9.676	200	-35.73	1.14	6.00	0.018
Pipe p9	24.91	200	-0.73	0.02	0.00	0.031
Pipe p10	17.01	350	-34.96	0.36	0.38	0.020
Pipe p11	121.2	250	24.55	0.50	1.01	0.020
Pipe p12	21.4	250	11.43	0.23	0.25	0.022
Pipe p13	14.1	150	8.63	0.49	1.75	0.022
Pipe p14	172.5	200	-5.87	0.19	0.21	0.024
Pipe p15	15.66	200	-13.12	0.42	0.94	0.021
Pipe p16	157	150	5.01	0.28	0.64	0.023
Pipe p17	158.2	150	1.38	0.08	0.06	0.028
Pipe p18	158.8	200	-9.49	0.30	0.52	0.022
Pipe p19	9.25	150	0.89	0.05	0.03	0.031
Pipe p20	89.05	200	4.54	0.14	0.13	0.025
Pipe p21	19.06	350	20.81	0.22	0.14	0.021
Pipe p22	46.29	150	-2.24	0.13	0.14	0.026
Pipe p23	139.80	200	-9.53	0.30	0.52	0.022
Pipe p24	119.26	200	-11.80	0.38	0.77	0.021
Pipe p25	133.42	150	-4.99	0.28	0.64	0.023
Pipe p26	20.45	150	2.80	0.16	0.22	0.026
Pipe p27	22.81	200	-2.20	0.07	0.03	0.027
Pipe p28	118.92	150	4.55	0.26	0.54	0.024
Pipe p29	24.86	150	0.93	0.05	0.03	0.030
Pipe p30	143.47	200	4.81	0.15	0.15	0.025
Pipe p31	10.7	350	-37.68	0.39	0.43	0.019
Pipe p32	23.06	200	-5.68	0.18	0.20	0.024
Pipe p33	22.5	150	1.14	0.06	0.04	0.029
Pipe p34	78.76	150	-1.37	0.08	0.06	0.028

	Project number	Project	Date	Author	Checked
	298002	SL1-INDUSTRIAL	04-09-2026	JKP	DJM

Pipes (See attached water modelling map)

Link ID	Length m	Diameter mm	Flow LPS	Velocity m/s	Unit Headloss m/km	Friction Factor
Pipe p30	143.47	200	4.81	0.15	0.15	0.025
Pipe p31	10.7	350	-37.68	0.39	0.43	0.019
Pipe p32	23.06	200	-5.68	0.18	0.20	0.024
Pipe p33	22.5	150	1.14	0.06	0.04	0.029
Pipe p34	78.76	150	-1.37	0.08	0.06	0.028
Pipe p35	78.81	200	5.90	0.19	0.21	0.024
Pipe p36	77.42	150	2.51	0.14	0.18	0.026
Pipe p37	10	250	23.29	0.47	0.92	0.020
Pipe p38	566.87	350	-111.47	1.16	3.23	0.017
Pipe p39	10	250	-111.47	2.27	16.65	0.016
Pipe p40	121.5	350	-23.15	0.24	0.18	0.021
Pipe p41	148.251	200	2.44	0.08	0.04	0.027
Pipe p42	161.6	350	-26.78	0.28	0.23	0.020
Pipe p43	143.9	350	-30.40	0.32	0.29	0.020
Pipe p44	154	200	-1.18	0.04	0.01	0.030
Pipe p45	119.5	350	-41.31	0.43	0.51	0.019
Pipe p46	49.86	350	-66.73	0.69	1.25	0.018
Pipe p47	199.53	200	-8.43	0.27	0.41	0.023
Pipe p48	49.82	200	16.99	0.54	1.51	0.020
Pipe p49	22.5	200	25.42	0.81	3.20	0.019
Pipe p50	15	150	0.92	0.05	0.03	0.030
Pipe p51	92.48	350	-70.35	0.73	1.38	0.018
Pipe p52	26	250	41.12	0.84	2.63	0.018
Pipe p53	4.44	250	41.12	0.84	2.63	0.018
Pipe p54	195.58	200	13.36	0.43	0.97	0.021
Pipe p55	3.92	200	19.05	0.61	1.87	0.020
Pipe p56	4.15	250	31.80	0.65	1.63	0.019
Pipe p57	200	250	37.49	0.76	2.21	0.019
Pipe p58	179.71	200	15.42	0.49	1.27	0.021
Pipe p59	148.26	250	28.17	0.57	1.30	0.019
Pipe p60	77	200	4.74	0.15	0.14	0.025
Pipe p61	60	200	1.11	0.04	0.01	0.030
Pipe p62	100	200	32.81	1.04	5.12	0.018
Pipe p63	10	250	29.18	0.59	1.39	0.019

WATER MODELLING MAP



Appendix D – BBO “SL1 Industrial and Residential Integrated Transportation Assessment”

SL1 Industrial and Residential

Integrated Transport Assessment

04 September 2026





Document control

Project identification	
Client	SL1 Consortium
Client representative	Robert Dol, Project Director (Colliers)
BBO details	Bloxam Burnett & Olliver Ltd (BBO) Level 5, Building E, Union Square, 192 Anglesea St, Hamilton
BBO representative	Cameron Inder, Transportation Engineering Manager
BBO rep. contact details	██████████ ██████████
Job number/s	149240 / 149340
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Contract numbers	N/A
Report name and number	Integrated Transport Assessment
Date / period ending	04 September 2026
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Checked by	Cameron Inder		04/09/2026
Approved for issue	Cameron Inder		04/09/2026

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V3			





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1. Statement of Qualifications and Experience

1.1 Sivakumaran Balachandran

My name is Sivakumaran Balachandran. I am a Senior Transportation Engineer at Bloxam Burnett & Olliver (“BBO”), a firm of consulting engineers, planners and surveyors based in Hamilton. I have been employed by BBO since 2017.

I hold a Bachelor of Engineering (Honours) degree in Civil Engineering from the Nanyang Technological University, Singapore (2014). I am a Chartered Professional Engineer (CPEng), a Chartered Member of Engineering New Zealand (CMEngNZ), and a member of the Engineering NZ Transportation Group.

I have over eleven years’ experience in transportation and traffic engineering, including eight years in New Zealand and three years in Singapore. My experience includes transportation planning, integrated transport assessments, traffic modelling, road safety engineering, subdivision design, active mode infrastructure, intersection design, and the assessment of transport effects for resource consent applications, plan changes and structure plans.

My experience relevant to this Project is as follows:

- I was the design lead for the Cambridge Pathways project for Waipā District Council, involving active mode infrastructure connecting the Te Awa River Ride path, Hamilton Road Cycleway, Victoria high-level bridge, schools, the Cambridge town centre and Leamington. My role includes design of protected cycling and walking facilities, raised safety platforms / intersections, contract documentation, stakeholder consultation, and catchment analysis to inform facility provision.
- I am the transportation assessment lead for the proposed Calcutta Farms Ltd industrial rezoning at Matamata, including assessment of effects on the local and state highway networks, consultation with Matamata-Piako District Council and NZ Transport Agency Waka Kotahi, intersection modelling, and concept design of SH24 roundabout upgrades.
- I was the traffic design engineer for the Ruakura Road urban upgrade for Hamilton City Council, including intersection review, complex intersection modelling, preliminary and detailed design inputs for two signalised intersections, full walking and cycling crossing provision, and preparation of signal design drawings.
- I was the traffic design engineer for the Peacocke Strategic Transport and Whatukooruru Drive projects, including detailed signal design and intended operations for multiple signalised intersections. The designs supported mode-neutral outcomes through fully separated walking and cycling crossings and bus priority.
- I authored and led the Integrated Transport Assessment for the Te Rapa Racecourse Medium Density Plan Change, including intersection modelling, preliminary intersection upgrade and signalised mid-block crossing designs, and presentation of expert transportation evidence at the Commissioner-led hearing in August 2023.
- I have led and been a member of Safe System Audit and Road Safety Audit teams for a range of projects, including Kihikihi Township, Te Kowhai Road and the Lockerbie residential subdivision.

I confirm that I have read and abided by the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note 2023 and referred to in the Fast-track Approvals Act 2024: Panel Convenors’ Practice and Procedure Guidance. This Integrated Transport Assessment has been prepared in compliance with that Code.



1.2 Cameron Beswick Inder

My name is Cameron Inder. I am a Principal Traffic and Transportation Engineer at BBO, a company of consulting engineers, project managers, planners and surveyors in Hamilton and Tauranga.

I hold a Bachelor of Engineering (Hons) from the University of Auckland and have 27 years' experience in traffic and transportation engineering. I am a Chartered Professional Engineer (CPEng) with Engineering New Zealand. I have extensive experience in transportation planning, modelling, and the design of urban and rural transport networks, with particular experience in large-scale infrastructure projects, intersection design, and the assessment of transport effects.

My experience relevant to this Project is as follows:

- I led all traffic and transportation assessments for Takitimu North Link Stage 2, authoring the Integrated Transport Assessment and numerous supporting assessments, and contributing to concept design development for the future four-lane expressway, interchanges, and tie-ins to the existing SH2 at both termini, including the link to Takitimu North Link Stage 1.
- I led transportation assessments for the rezoning of 176 ha at Ohinewai (Comfort Group), supporting a manufacturing / industrial business park and 1,100 residential units. Provided expert witness evidence, participated in joint witness conferencing and stakeholder consultation, and presented evidence at the Commissioner hearing (2020). Continuing to lead transport planning and design as the development progresses.
- I led traffic and transport assessments for the proposed rezoning of 130 ha north of Hamilton Airport. Responsibilities included ITA authorship, supplementary assessments, and concept design of new roundabout access at SH3 / Raynes Road and SH21. Prepared and presented expert evidence for the public hearing. Integrated multi-modal planning, including a strategic bi-directional cycle connection to the Peacocke growth area.
- I project managed the design and delivery of two new rural intersections on SH34 and 400 m of new access road for an industrial business park funded through the regional Infrastructure Fund in 2022. I led and co-ordinated all design inputs from concept through to detailed design, wrote the contract documentation, led the construction procurement phase, and provided design support during construction. I also managed all stakeholder engagement with NZ Transport Agency Waka Kotahi, NOC, Kawerau District Council, and safety auditors.
- Updated and extended the Te Rapa North VISSIM micro-simulation model for Hamilton City Council to assess network effects of a proposed Pak'nSave development. This included commissioning and analysing OD surveys, model calibration (2018 base), and future modelling (2031) with and without development scenarios.
- I led the traffic, walking, and cycling design for the Papamoa Eastern Interchange, including three signalised intersections. Delivered modelling and concept/preliminary design supporting a mode-neutral network, with strong emphasis on safe, fully separated walking and cycling infrastructure.
- I was the lead traffic design engineer for complex intersection modelling and design inputs for the Wairere Drive / Cambridge Road network and diamond interchange in Hamilton. The design integrated raised safety platforms (in collaboration with NZ Transport Agency Waka Kotahi trials), full pedestrian / cycle crossings, and future bus priority, with connections to key cycle networks.
- I reviewed transportation assessments and provided expert advice for a Board of Inquiry hearing relating to a proposed prison expansion, including consultation with Waipā District Council and NZ Transport Agency Waka Kotahi.



- I authored the Integrated Transport Assessment report for a private plan change for Hobbiton Movie Set Tours, assessing the transport effects of increasing permitted visitor numbers from 300,000 to 650,000 annually. I identified the required network and travel demand management responses to accommodate the significant visitor numbers, and I presented expert evidence for the applicant at the Commissioner-led hearing.
- I have extensive experience preparing Integrated Transport Assessments for resource consent applications and private plan changes, including regular attendance at hearings and provision of expert transportation evidence.

I confirm that I have read and abided by the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note 2023 and referred to in the Fast-track Approvals Act 2024: Panel Convenors' Practice and Procedure Guidance. This Integrated Transport Assessment has been prepared in compliance with that Code.



2. Executive Summary

This Integrated Transport Assessment (“ITA”) supports the Fast-track substantive consent application for the SL1 Project, which comprises the proposed Industrial Development and Residential Development on the southern edge of Hamilton. The assessment has been prepared with regard to Hamilton City Council and NZ Transport Agency Waka Kotahi requirements and assesses the transport effects of the Project in the context of the existing and planned transport network.

The Project comprises two related development areas:

- SL1 Industrial, comprising approximately 60 hectares (“ha”), of which approximately 40 ha are expected to be developable for industrial activities, with the balance associated with the Hamilton Southern Links (“HSL”) designation, proposed wetland areas and an existing developed lot.
- SL1 Residential, comprising approximately 46 ha, with an anticipated yield of approximately 938 dwellings, together with a small neighbourhood centre and local open space.

The assessment recognises that development at this scale cannot rely on unconstrained growth in private vehicle travel. Accordingly, the transport strategy incorporates a combination of road network improvements, public transport integration, walking and cycling infrastructure, and staged development controls intended to support a more balanced transport network over time.

HSL forms an important part of the future strategic transport context, but whilst a Road of National Significance its timing remains subject to future funding and delivery decisions. The ITA therefore considers both interim and future network scenarios and identifies staging controls and mitigation measures that respond to different levels of network delivery.

The ITA assesses the existing transport environment, including the road network, public transport services, walking and cycling facilities, traffic volumes and crash history. It also assesses site access arrangements, trip generation, strategic transport modelling using the Waikato Regional Transport Model (“WRTM”), and intersection performance using SIDRA Intersection software.

The key findings are:

- The proposed transport network incorporates walking, cycling and public transport infrastructure that supports the mode share assumptions adopted in the assessment and provides connectivity between the Developments and the wider transport network.
- HSL remains an important long-term component of the future transport network and would improve wider network performance and resilience once delivered. However, the transport strategy adopted for the Project does not rely on HSL being delivered within a specific timeframe, with interim access arrangements, transport infrastructure upgrades and staging measures identified to manage transport effects under interim network conditions.
- For the Industrial Development, Interim Option B has been identified as the preferred interim access strategy. The assessment demonstrates that the full assessed Industrial Development can proceed independently of HSL delivery, while maintaining flexibility to integrate with the ultimate HSL-based transport network should it be delivered in the future.
- For the Residential Development, the Ohaupo Road / Saxbys Road / Tomin Road roundabout represents the principal transport constraint within the assessed network. Subject to implementation of the transport infrastructure upgrades identified in this ITA, the assessment indicates that Residential Development can be accommodated with acceptable transport effects up to approximately 543 dwellings under a network scenario that does not rely on HSL delivery.



- Development beyond approximately 543 dwellings should be supported by a future transport reassessment to confirm whether the assumptions underpinning this ITA remain representative of the receiving transport environment at that time and to identify whether any additional mitigation measures or staging controls are required.

Overall, the ITA concludes that the SL1 Industrial and Residential Developments can proceed without unacceptable transport effects, subject to implementation of the transport infrastructure upgrades, staging framework and reassessment provisions identified in this report.



3. Introduction

The Project relates to land at the south-western edge of Hamilton and seeks to enable industrial and residential development, together with the associated transport infrastructure required to support that growth.

The Project has two distinct components, an Industrial Development area and a Residential Development area, both bordered in red in Figure 1. The Project will enable:

- Approximately 46 hectares (“ha”) of land with residential activities, resulting in an anticipated yield of 938 residential units, a small local neighbourhood centre and supporting infrastructure; and
- Approximately 60 ha of land with industrial activities and supporting infrastructure.

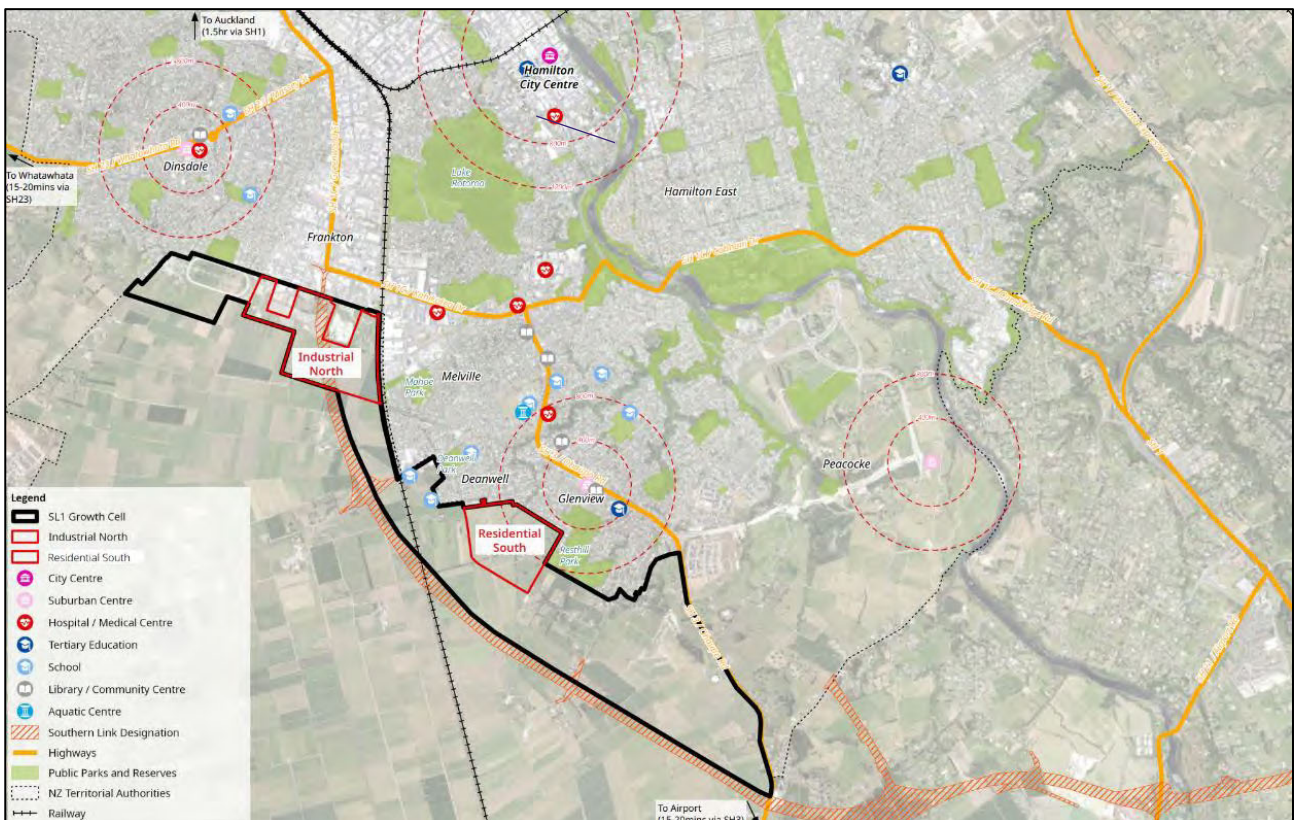


Figure 1: SL1 Industrial and Residential Sites

The Project will provide additional housing and industrial land within the southern Hamilton environs over the short, medium and long term due to the proposed Project size. It gives effect to a large-scale urban development growth cell recognised in Future Proof (“FP”) / Future Development Strategy (“FDS”) spatial planning documents.

The Project will integrate with the existing Hamilton urban fringe, facilitate improved connectivity and support the implementation of Hamilton Southern Links (“HSL”), which is designated and identified in the Government Policy Statement on land transport (“GPS 2024”) as a Road of National Significance (“RoNS”), to “unlock housing”.

The Project area is in the Waipā District, but forms part of the future southern Hamilton City growth area and will become part of Hamilton City in time. Neither of the development areas require access from existing Waipā District Council roads.



Accordingly, the Integrated Transport Assessment (“ITA”) primarily refers to the transport provisions of the Hamilton City Operative District Plan (“ODP”), planned transport infrastructure and the surrounding Hamilton transport network. This approach is appropriate given the direct urban integration of the Project, its intended future transport connections and the strategic planning framework applying to the area.

This ITA provides an overview of the traffic and transportation investigations undertaken to support the Project. It addresses:

- The existing transport environment in the vicinity of the sites, including the surrounding road network, public transport provision, walking and cycling facilities, traffic volumes and crash history.
- The nature and scale of the Project.
- The level of travel demand expected to be generated by the Project and its distribution on the surrounding network.
- The effects of development traffic on the adjacent road network, including localised intersection analysis at the sites’ interfaces with Ohaupo Road (SH3) and Greenwood Street (SH1C), to assess future roading infrastructure performance with development traffic added.
- The transport mitigation and infrastructure required to support the Project, including provision for active modes and public transport.

This ITA does not assume unconstrained growth in private vehicle travel. It recognises that public transport, walking and cycling will need to accommodate an increasing share of future travel demand as development proceeds. This will be supported through subdivision design, the provision of connected walking and cycling infrastructure, integration with the future public transport network, staged transport infrastructure delivery, and wider strategic transport investment.

4. Site Location

The Project area adjoins Hamilton City Council’s (“HCC”) south-western boundary. Located approximately 3.5 km southwest of Hamilton City Centre, the wider SL1 urban development growth cell site stretches from south Frankton to the southwestern edge of the Peacocke Structure Plan area. The Industrial and Residential sites are partially bounded by State Highway 3 (“SH3”) to the southeast, the North Island Main Trunk Rail (“NIMTR”) to the northeast and the HSL designation to the west.

The sites are currently zoned Rural under the Waipā District Plan and comprises a mix of rural, rural-residential and peri-urban land uses.

The Industrial Development area is located adjacent to the Frankton industrial area and is well positioned to connect to Greenwood Street (SH1C), Kahikatea Drive and the wider strategic freight network.

The Residential Development area adjoins the existing urban neighbourhoods of Glenview, Resthill and Deanwell and is connected to the surrounding network primarily via Ohaupo Road, Collins Road, Saxbys Road, MacMurdo Avenue and surrounding local streets. Hamilton Airport and Titanium Park industrial business precinct are approximately 4.5 km to the south-east and Waikato Hospital is approximately 3 km to the north.

The location of the SL1 Development areas is relevant to the transport assessment because it places the Project at the interface between the existing urban area and future growth areas, with access to established strategic transport corridors, public transport services and planned network upgrades to support future growth. The transport implications of that setting are outlined in the following section.



5. Existing Transportation Environment

5.1 Existing Road Network

The existing network of roads surrounding the Project are presented in Figure 2 and discussed in the following sub-sections.

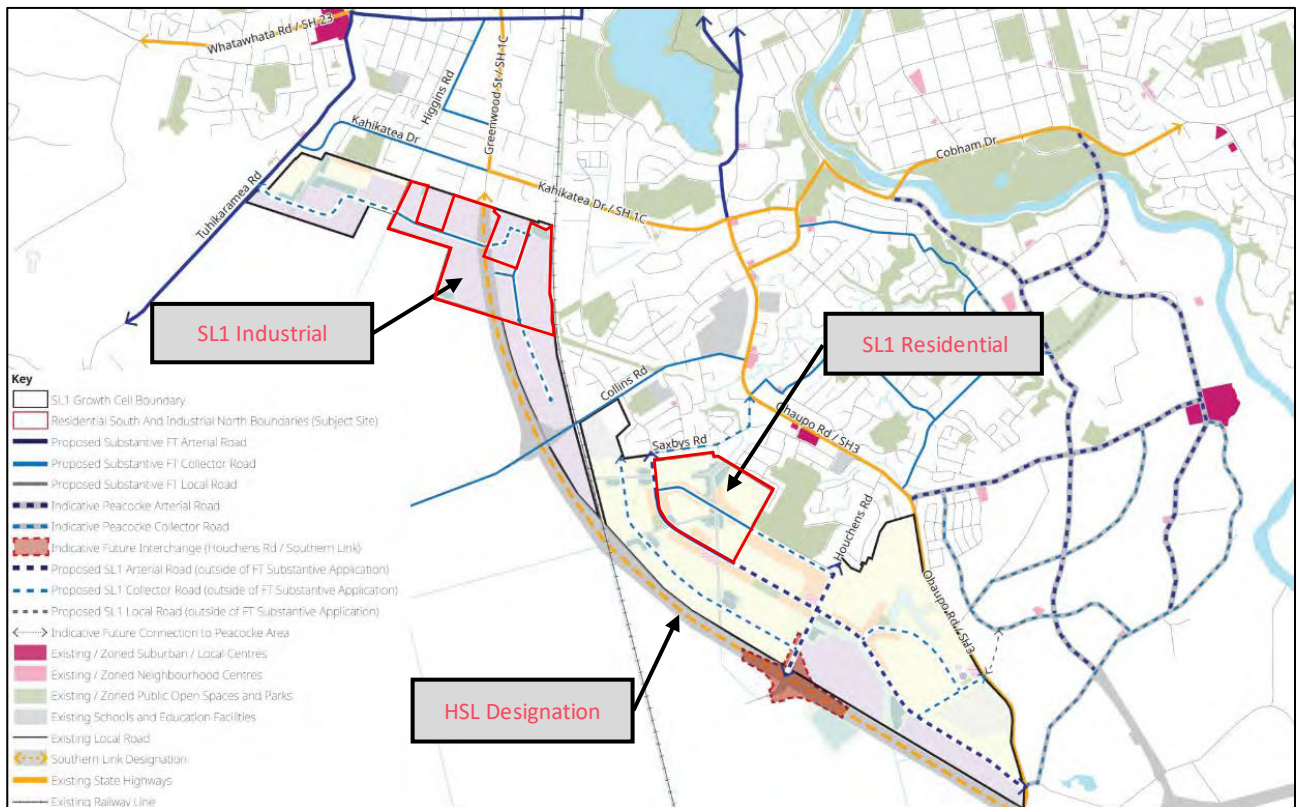


Figure 2: Adjoining Road Network (Existing and Planned / Proposed)

5.1.1 Industrial Development

The transport network adjacent to the Industrial Development area comprises local roads such as Higgins Road and Wickham Street. These roads connect to the primary network of Kahikatea Drive Extension (collector road), Kahikatea Drive and Greenwood Street (SH1C).

Table No: 1

Adjoining Road Network – Industrial Development				
Road	ONF ¹	Posted Speed Limit ²	Average Daily Traffic ³ ("ADT")	Heavy Commercial Vehicle ⁴ ("HCV") Proportion
Greenwood St (SH1C)	Transit Corridor	80 km/h	23,860 vpd	5.4%
Kahikatea Dr	Urban Connector	60 km/h	27,200 vpd	5.4%

¹ Based on NZTA MegaMaps

² Based on NZTA MegaMaps

³ Based on MobileRoad website

⁴ Based on MobileRoad website



Kahikatea Dr Extn	Urban Connector	50 km/h	5,260 vpd	15%
Higgins Rd (north of Kahikatea Dr Extn)	Urban Connector	50 km/h	4,511 vpd	14%
Wickham St	Local Street	50 km/h	1,800 vpd	5%

A known network capacity constraint in this locality is the Greenwood Street (SH1C) / Kahikatea Drive intersection. The intersection is a give-way controlled T-intersection that is proposed by NZ Transport Agency Waka Kotahi ("NZTA") to be replaced with a large urban three-arm roundabout as part of the HSL project. This is discussed further in Section 6.1.

5.1.2 Residential Development

The Residential Development area has connections to the existing transport network comprising primarily of local roads servicing the existing residential neighbourhoods of Deanwell and Glenview. These local roads connect to Collins Road (a collector road in the ODP) and Ohaupo Road (major arterial road).

Table No: 2

Adjoining Road Network – Residential Development				
Road	ONF ⁵	Posted Speed Limit ⁶	ADT ⁷	HCV ⁸ Proportion
Ohaupo Rd (north of Collins Rd)	Urban Connector / Activity St	60 km/h	30,996 vpd	6.6%
Ohaupo Rd (between Saxbys Rd and Lambert Ct)	Urban Connector	60 km/h	15,300 vpd	10.8%
Ohaupo Rd (between Resthill Cr and Houchens Rd)	Urban Connector	60 km/h	15,300 vpd	10.8%
Collins Rd (near SH3)	Urban Connector	50 km/h Variable speed limit = 30 km/h	6,786 vpd	3%
Saxbys Rd	Local Street	50 km/h	2,717 vpd	5%
Deanwell Ave	Local Street	50 km/h Variable speed limit = 30 km/h	2,050 vpd	5%
MacDonald Rd	Local Street	50 km/h	2,460 vpd	5%
MacMurdo Ave	Local Street	50 km/h	261 vpd	5%
Lambert Ct	Local Street	50 km/h	1,681 vpd	5%
Resthill Cres	Local Street	50 km/h	3,107 vpd	5%
Houchens Rd	Local Street	50 km/h	2,091 vpd	5%

Ohaupo Road is a major arterial corridor and designated SH3. It performs an important movement function for both local and inter-regional travel. It provides a primary connection between Hamilton and the wider south Waikato region, including Hamilton Airport, Te Awamutu, Otorohanga and, ultimately, New Plymouth. The proximity of these activity nodes to Hamilton means Ohaupo Road carries substantial commuter, business and inter-regional freight traffic in both peak periods. In the local context, Ohaupo Road also serves as a primary public transport corridor serving Glenview, Deanwell and Melville residential suburbs.

⁵ Based on NZTA MegaMaps

⁶ Based on NZTA MegaMaps

⁷ Based on MobileRoad website

⁸ Based on MobileRoad website



Ohaupo Road is a four-lane carriageway north of Saxbys Road and two-lanes south of Saxbys Road.

Existing intersections on Ohaupo Road with limited spare capacity during peak periods include Ohaupo Road / Saxbys Road / Tomin Road roundabout, Ohaupo Road / Lambert Court intersection, Ohaupo Road / Resthill Crescent intersection, and Ohaupo Road / Houchens Road intersection.

5.2 Existing Public Transport Network

5.2.1 Public Transport

The existing Hamilton public transport (“PT”) bus network is shown in Figure 3 (blue lines), while existing bus stop locations near the SL1 Development areas are identified in Figure 4.

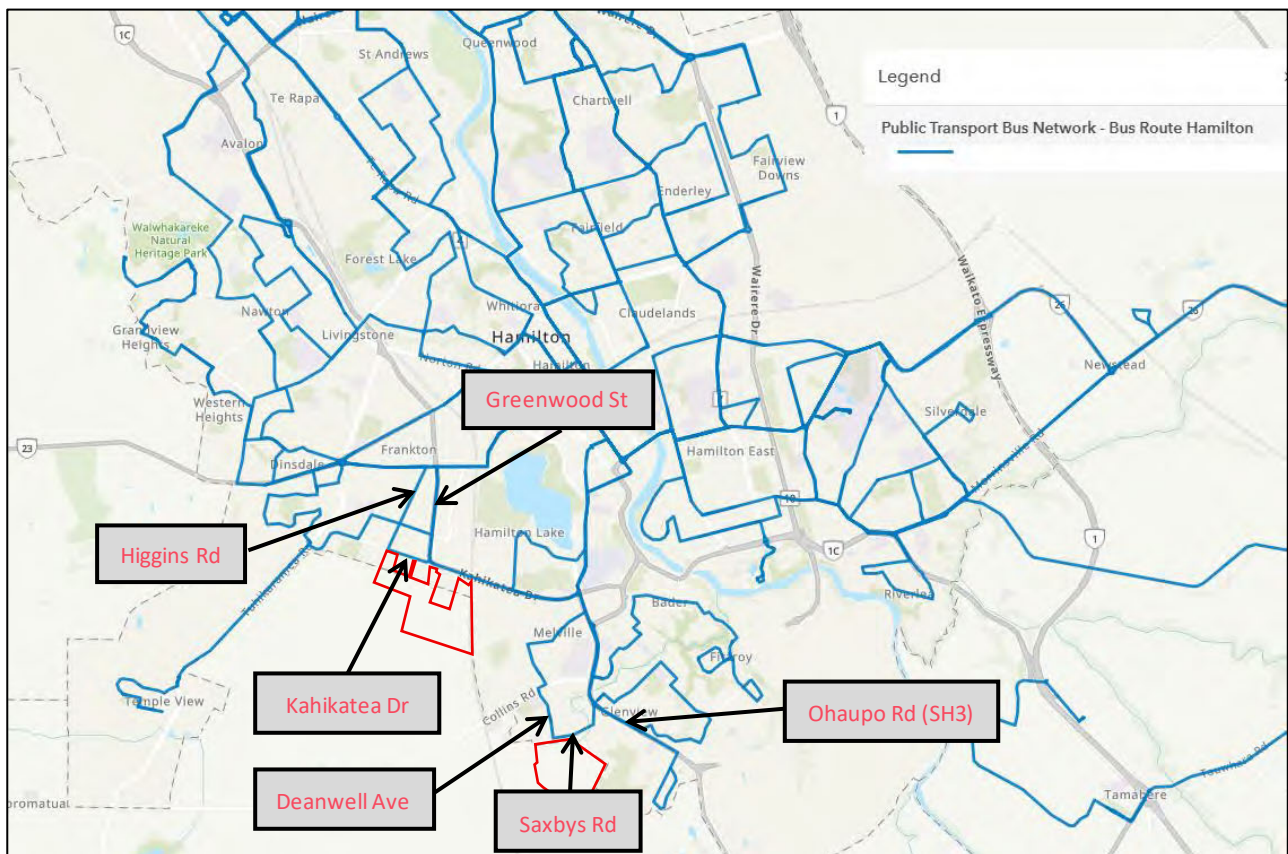


Figure 3: Existing PT Bus Network



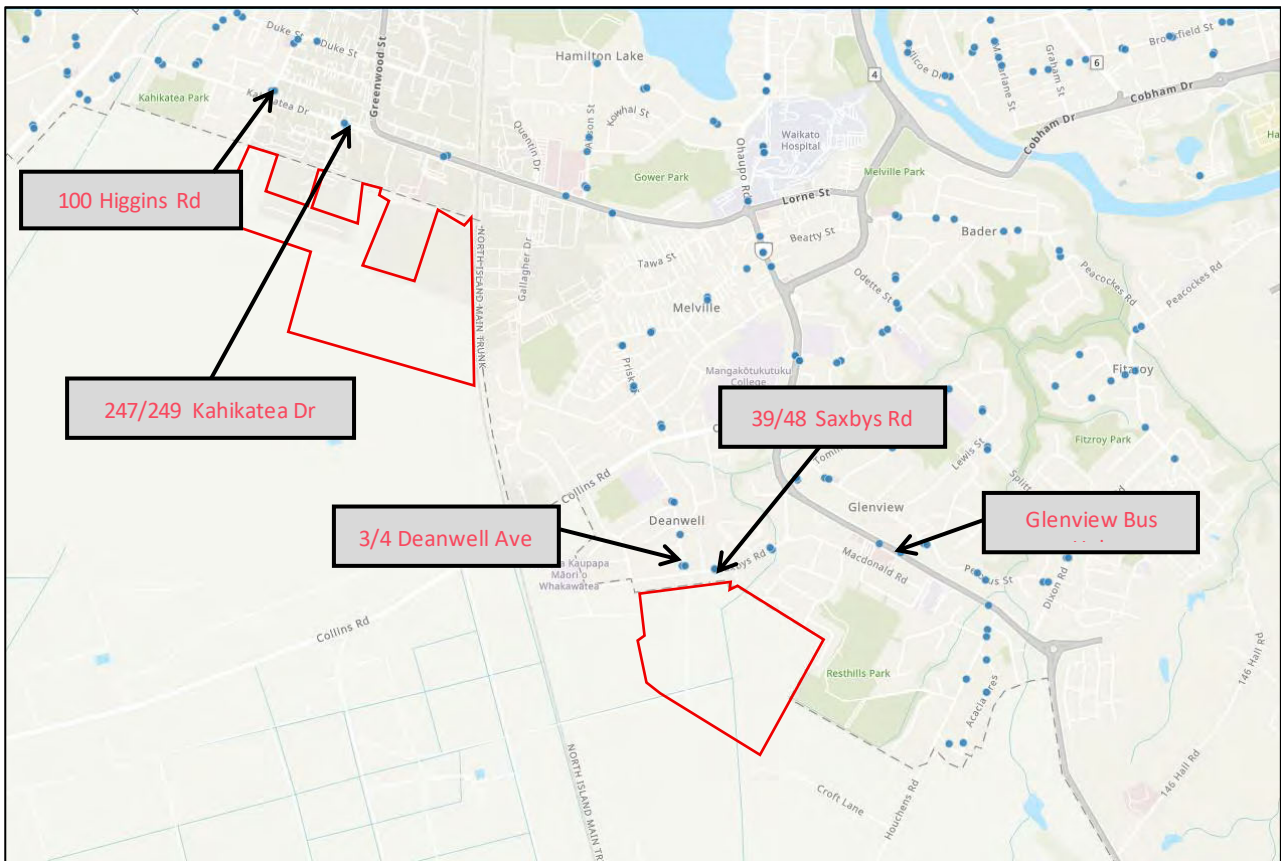


Figure 4: Existing PT Bus Stops

This demonstrates that both the Industrial Development and Residential Development areas are currently served by existing public transport services within reasonable walking distance of the sites.

5.2.2 Industrial Development

The nearest bus stops to the Industrial Development site are located at 274 / 279 Kahikatea Drive and 100 Higgins Road. These bus stops are currently served by the bus service '19 Bremworth / Temple View'. This service travels via alternative routes from the Hamilton Transport Centre, via Queens Avenue, Killarney Road and Kahikatea Drive – in both directions, seven days per week.

5.2.3 Residential Development

The nearest bus stops to the Residential Development site are located at 3 / 4 Deanwell Avenue, 39 / 48 Saxbys Road and the Glenview Bus Hub.

The bus stops at Deanwell Avenue and Saxbys Road are currently served by the Comet bus service. This is a high-frequency service⁹, which travels north-to-south through Hamilton city, approximately every 15 minutes, in both directions. South of the hospital, the Comet alternates trips in the Melville / Glenview area – stopping every 30 minutes in these areas.

The Glenview Bus Hub is currently served by the Comet, '24 Te Awamutu' and '26 Te Kūiti Connector' bus services. The '24 Te Awamutu' and '26 Te Kūiti Connector' bus services are regional buses. Route 24 operates between Hamilton Transport Centre and Kihikihi, serving key locations including Waikato Hospital, Glenview Bus Hub, Ōhaupō township, and Te Awamutu town centre, with additional weekday, term-time trips serving Hamilton Boys' High School and Southwell School. Route 26 operates on weekdays between Wintec

⁹ <https://www.busit.co.nz/hamilton-routes/comet/>



Rotokauri Campus and Te Kūiti, travelling via Hamilton Transport Centre, Glenview, Ōhaupō, Te Awamutu, Kihikihi and Ōtorohanga, and providing access to major employment, education, health and town-centre destinations along the corridor.

5.3 Existing Walking and Cycling Network

A mix of on-road, off-road and shared paths are provided in the immediate vicinity of the sites providing alternative routes and forms of transport between the proposed development areas, Dinsdale, Frankton and Hamilton Central to the north. These also provide links to key employment nodes and important destinations including Waikato Hospital, and Melville High School. Figure 5 presents the existing walking and cycling network surrounding the sites.

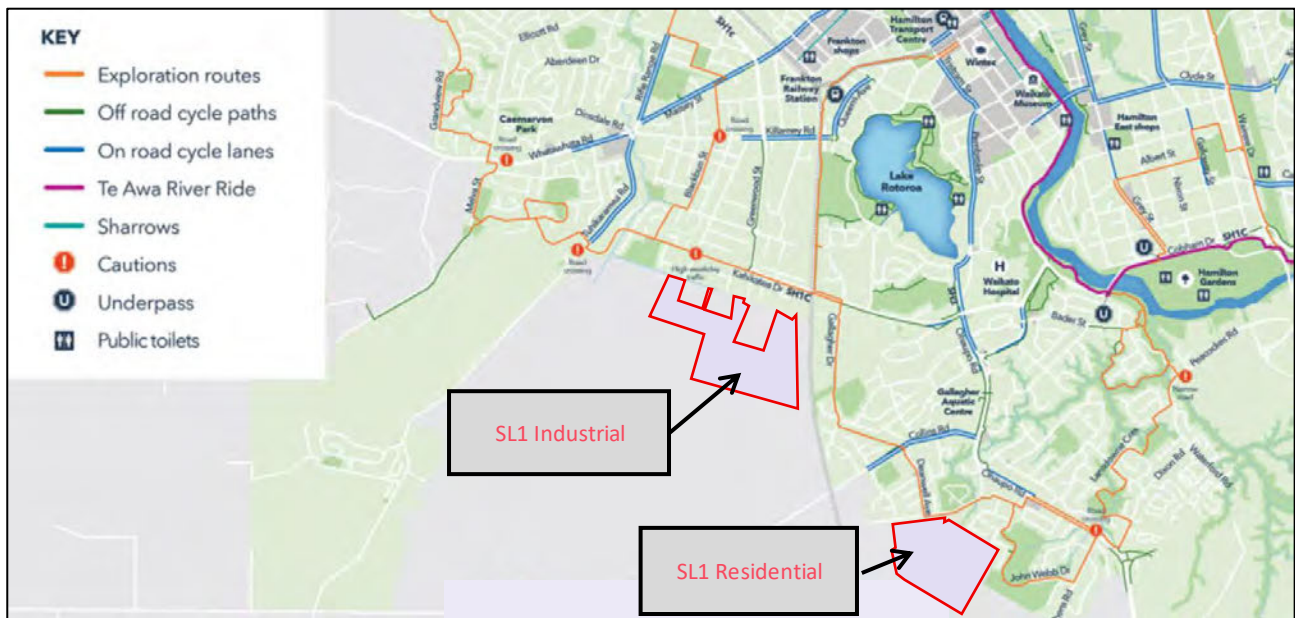
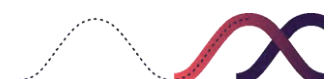


Figure 5: Existing Walking and Cycling Network

Table No: 3

Existing Walking and Cycling Provision on Adjoining Road Network	
Road	Existing Walking and Cycling Infrastructure
Greenwood St (SH1C)	3 m wide off-road walking and cycling shared path on the western side of the road - Sealed road shoulders for confident cyclists
Kahikatea Dr	3 m wide off-road walking and cycling shared path on the southern side of the road - Sealed road shoulders for confident cyclists
Kahikatea Dr Extn	1.2 m wide footpaths on both sides of the road
Higgins Rd (north of Kahikatea Dr Extn to Duke St)	2 m wide footpaths on both sides of the road
Wickham St	1.5 m wide footpath on eastern side of the road
Ohaupo Rd	3 m wide off-road walking and cycling shared path on southern/western side of Ohaupo Rd between Collins Rd and Houchens Rd. 3 m wide off-road walking and cycling shared path on eastern side of the Ohaupo Rd between Collins Rd and Saxbys Rd. - Neighbourhood greenway with sharrow markings on access road on the northern side of Ohaupo Rd between Saxbys Rd and Garden Heights Ave.



	• 3 m wide off-road walking and cycling shared path on northern side of the Ohaupo Rd between Garden Heights Ave and Houchens Rd. • 1.3 m – 1.5 m wide sealed road shoulders for confident cyclists
Collins Rd (near SH3)	• 1.5 m - 1.8 m wide on-road cycle lanes • 1.2 m wide footpath on the southern side of the road • 2.0 m wide footpath on the northern side of the road
Saxbys Rd	• 1.5 m – 1.8 m wide footpath on the northern side of the road between Deanwell Ave and MacDonald Rd
Deanwell Ave	• 1.2 m – 1.5 m wide footpaths on both sides of the road
MacDonald Rd	• 1.8 m wide footpaths on both sides of road between Saxbys Rd and Lambert Ct
MacMurdo Ave	• 1.2 m – 2 m wide footpaths on both sides of the road
Lambert Ct	• 1.8 m wide footpaths on both sides of road

5.4 Intersection Counts

Bloxam Burnett & Olliver Ltd (“BBO”) has undertaken intersection traffic counts as part of this ITA. The peak period traffic volumes are attached as Appendix D for the various intersections surveyed.

Table No: 4 summarises the surveyed data.

Table No: 4

2025 Surveyed Intersection Traffic Counts			
Road	ADT ¹⁰	Surveyed Average AM Peak Hour Two-way Volume (vph)	Surveyed Average PM Peak Hour Two-way Volume (vph)
Greenwood St (SH1C)	23,860 vpd	2,021	2,220
Kahikatea Dr	27,200 vpd	2,159	2,358
Kahikatea Dr Extn	5,260 vpd	469	571
Higgins Rd (north of Kahikatea Dr Extn)	4,511 vpd	283	342
Ohaupo Rd (north of Collins Rd)	30,996 vpd	2,210	2,663
Ohaupo Rd (between Saxbys Rd and Lambert Ct)	15,300 vpd	1,590	2,054
Ohaupo Rd (between Resthill Cr and Houchens Rd)	15,300 vpd	1,591	1,843
Collins Rd (near SH3)	6,786 vpd	782	719
Saxbys Rd	2,717 vpd	299	310
Lambert Ct	1,681 vpd	183	383
Resthill Cres	3,107 vpd	70	135
Houchens Rd	2,091 vpd	224	303

5.5 Crash History

Crash data was sourced from NZTA’s Crash Analysis System (CAS) over a ten-year period from 2016 – 2025. The study area includes all crashes within a 50 m radius of key intersections and sections of key roads in the vicinity of the Site.

¹⁰ Based on MobileRoad website



5.5.1 Industrial Development

Table No: 5

SL1 Industrial Development Crash History 2016 – 2025						
Location	Total # Crashes	Crash Severity				Comments
		Death	Serious Injury	Minor Injury	Non-injury	
Intersections						
Greenwood St / Kahikatea Dr	48	0	4	8	36	<u>Crossing crashes</u> One serious injury crash and three of the minor injury crashes involved a vehicle turning right onto Kahikatea Dr not giving way to a northbound vehicle on Kahikatea Dr. A minor injury crash involved a vehicle turning left onto Greenwood St not giving way to a northbound vehicle on Kahikatea Dr. One of the minor injury crashes involved a vehicle turning right onto Kahikatea Dr not giving way to a southbound vehicle on Greenwood St. <u>Cornering crashes</u> One serious injury crash involved a driver losing consciousness and accelerating off-road. Another serious injury crash involved a vehicle travelling northbound around the corner on Kahikatea Dr, losing control and colliding with a small retaining wall. <u>Head on crash</u> A serious injury crash involved a vehicle travelling southbound at speed, failing to manoeuvre the bend and colliding with another vehicle travelling in the opposite direction head-on.
Kahikatea Dr Extn / Wickham St	2	0	0	1	1	<u>Right turn against crashes</u> A minor injury crash involved a vehicle turning right into Wickham St failing to give way to a vehicle travelling westbound on Kahikatea Dr Extn.
Kahikatea Dr Extn / Higgins Rd	14	0	1	1	12	<u>Crossing (no turns) crashes</u> The serious injury crash involved a vehicle travelling eastbound on Kahikatea Dr failing to give way to a northbound vehicle on Higgins Rd. <u>Crossing (vehicle turning) crashes</u> The minor injury crash involved a vehicle travelling eastbound on Kahikatea Dr failing to give way to a vehicle turning right from Higgins Rd.
Tuhikaramea Rd / Kahikatea Dr Extn	5	0	0	0	5	-



Higgins Rd / Duke St	16	0	1	3	12	<u>Crossing (no turns) crashes</u> Both minor injury crashes involved a westbound vehicle on Duke St failing to stop and give way to a northbound vehicle on Higgins Rd. Another minor injury crash involved an eastbound cyclist on Duke St failing to stop and give way to a southbound vehicle on Higgins Rd. <u>Crossing (vehicle turning) crash</u> The serious injury crash involved a westbound vehicle waiting to turn right onto Higgins Rd failing to stop and give way to a southbound motorcyclist.
Road Sections						
Kahikatea Dr Extn (between Wickham St and Greenwood St)	4	0	1	0	3	<u>Overtaking / lane change crashes</u> The serious injury crash involved a police pursuit of two motorcyclists.
Kahikatea Dr Extn (between Higgins Rd and Wickham St)	1	0	0	0	1	-
Kahikatea Dr Extn (between Tuhikaramea Rd and Higgins Rd)	13	0	1	3	9	<u>Head on crash</u> The serious injury crash involved a bus going around a right-hand bend crashing into a stolen motorcycle. <u>Cornering crashes</u> A minor injury crash involved a motorcyclist losing control when going around a right turn bend and crashing into a fence. Another minor injury crash involved a westbound vehicle going around the bend at excessive speed, losing control and colliding with a parked vehicle and fence. <u>Pedestrian crash</u> A minor injury crash involved a vehicle reversing out of a driveway colliding with a cyclist on the footpath.
Higgins Rd (between Duke St and Kahikatea Dr Extn)	8		1	1	6	<u>Rear end crash</u> The serious injury crash involved a motorcyclist colliding with a vehicle that was waiting to turn right into a driveway. <u>Manoeuvring crashes</u> A minor injury crash involved a vehicle travelling northbound on Higgins Rd colliding with another vehicle attempting to perform a u-turn.

A review of the crash history indicates the following dominant crash patterns:

- Greenwood Street / Kahikatea Drive exhibits a combination of crossing, turning and lane-change related crashes consistent with the operational characteristics of a priority-controlled T-intersection



on a high-volume arterial corridor. HSL includes a three-arm roundabout at this location. When implemented, this treatment would remove priority-controlled crossing movements, reduce approach speeds and simplify driver decision-making. These changes would be expected to address the dominant crash patterns identified at this intersection.

- Kahikatea Drive Extension / Higgins Road and Higgins Road / Duke Street exhibit recurring crossing crash patterns typical of priority-controlled crossroads intersections, where crashes are generally associated with drivers failing to correctly assess or respond to conflicting traffic movements. The Project does not rely on these intersections as primary access points and therefore is not expected to materially increase exposure to the identified crash patterns. It is also noted that the current HSL concept design includes closure of the western arm of the Greenwood Street / Kahikatea Drive intersection and conversion of the Greenwood Street / Duke Street intersection to a left-in left-out arrangement, which would alter traffic movement patterns within the local road network.
- Kahikatea Drive Extension, particularly between Tuhikaramea Road and Higgins Road, exhibits a recurring loss-of-control and cornering crash pattern along the existing horizontal alignment, indicating a concentration of crashes associated with vehicles departing from their intended path. While the Project does not propose specific geometric modifications to this section of road, the future transport network, including HSL and the wider SL1 transport framework, is expected to alter travel patterns within the area and may reduce exposure to the identified crash pattern over time.
- Higgins Road between Duke Street and Kahikatea Drive extension exhibits manoeuvring-related crashes associated with driveway activity, turning movements and other access-related interactions. As the Project does not rely on Higgins Road as the primary means of access to the Industrial Development area, it is not expected to materially increase exposure to these crash patterns.

Overall, the crash history does not identify any dominant crash pattern that would preclude development of the Industrial Development area. The proposed access strategy directs traffic to the strategic road network and is not expected to materially exacerbate the identified crash patterns within the surrounding transport environment.

5.5.2 Residential Development

Table No: 6

Table 10-10

SL1 Residential Development Crash History 2016 – 2025						
Location	Total # Crashes	Crash Severity				Comments
		Death	Serious Injury	Minor Injury	Non-injury	
Intersections						
Ohaupo Rd / Ulrich Ave	14	0	0	5	9	<u>Crossing crashes</u> Four minor injury crashes involved vehicles turning right from Ulrich Ave colliding with a southbound vehicle on Ohaupo Rd. One crash involved a motorcycle. <u>Right turn against crashes</u> One minor injury crash involved a vehicle turning right into Ulrich Ave failing to give way to a southbound vehicle on Ohaupo Rd.
Ohaupo Rd / Collins Rd	27	0	0	6	21	<u>Rear end crashes</u> A minor injury crash involved a vehicle stopping at the limit line to allow a pedestrian to cross. The trailing vehicle



						could not stop in time and collided with the vehicle in front. <u>Pedestrian crashes</u> One of the minor injury crashes involved a vehicle travelling northbound on Ohaupo Rd colliding with a pedestrian who had ran in front of the vehicle. It is to be noted that there is no signalised pedestrian crossing on the southern arm of the intersection. Another minor injury crash involved a child crossing Ohaupo Rd when through movement on Ohaupo Rd had the right of way. The child was hit by a southbound vehicle. <u>Right turn against crashes</u> The minor injury crash involved a northbound vehicle on Ohaupo Rd failing to give way to a vehicle turning right into Collins Rd. <u>Cornering crashes</u> A minor injury crash involved when a vehicle turned right into Collins Rd too fast and mounted the kerb. Driver’s alcohol test was above limit. Another minor injury crash involved a motorcyclist turning right into Collins Rd and crashing into the traffic signals.
Ohaupo Rd / Saxbys Rd / Tomin Rd Roundabout	42	0	1	10	31	<u>Pedestrian crossing road crash</u> A serious injury crash involved when a southbound vehicle collided with a pedestrian crossing Ohaupo Rd via the roundabout splitter island on the south leg. <u>Cornering crashes</u> A minor injury crash which involved a driver blacking out and crashing into the median barrier. A minor injury crash which involved a vehicle crashing into the tree within the roundabout central island. A minor injury crash involved a vehicle travelling from Tomin Rd losing control and colliding with a parked vehicle on Saxbys Rd. <u>Crossing crashes</u> Four minor injury crashes involved vehicles on Tomin Rd failing to give way to vehicles travelling southbound on Ohaupo Rd. <u>Merging crashes</u> One minor injury crash involved a northbound vehicle on Ohaupo Rd entering the roundabout and colliding



						with another vehicle while attempting to change lanes. <u>Overtaking / lane change crashes</u> A minor injury crash involved a police chase. <u>Head on crash</u> A minor injury crash which involved a driver falling asleep, crossing the centre line crashing into oncoming vehicles.
Ohaupo Rd / Lambert Ct	6	0	0	1	5	<u>Right turn against crash</u> A minor injury crash involved a right turning vehicle colliding with a northbound vehicle on Ohaupo Rd.
Ohaupo Rd / Garden Heights Ave	7	0	0	1	6	<u>Crossing crashes</u> A minor injury crash involved a vehicle exiting Garden Heights Ave failing to give way to a southbound vehicle on Ohaupo Rd. Another non-injury crash involved a vehicle exiting Garden Heights Ave failing to give way to a southbound cyclist on Ohaupo Rd)
Ohaupo Rd / Resthill Cres	3	0	0	1	2	<u>Crossing crash</u> A minor injury crash involved a vehicle turning right out of Resthill Cres failing to give way to a northbound motorcycle.
Ohaupo Rd / Houchens Rd	4	0	0	0	4	-
Ohaupo Rd / Dixon Rd	7	0	0	1	6	<u>Merging crash</u> A minor injury crash involved a vehicle exiting Dixon Rd failing to give way to a southbound vehicle, accelerating and colliding with another vehicle.
Saxbys Rd / Macdonald Rd Roundabout	4	0	0	1	3	<u>Cornering crashes</u> One minor injury crash involved a vehicle travelling south on Saxbys Rd losing control at the roundabout and hitting a tree. Speed believed to be excessive.
Collins Rd / Deanwell Ave	3	0	0	1	2	<u>Head on crashes</u> A minor injury crash involved a police patrol car which was in pursuit of a motorcycle, colliding with a vehicle turning right out of Deanwell Ave.
Road Sections						
Ohaupo Rd – between Collins Rd and Saxbys Rd	11	0	2	3	6	<u>Crossing crashes</u> Serious and minor injury crashes involved vehicles exiting Urlich Shopping Centre colliding with a southbound vehicle on Ohaupo Rd. <u>Cornering crashes</u> A minor injury crash occurred when a driver travelling southbound on Ohaupo Rd lost control of the vehicle and hit the medial island and tree. Another minor injury crash involved a driver losing control and hitting the



						median island and tree while trying to avoid a cat. <u>Cyclist crash</u> A northbound vehicle on Ohaupo Rd collided with a cyclist travelling southbound on the adjacent footpath when the cyclist entered the carriageway.
Ohaupo Rd – between Saxbys Rd and Lambert Ct	15	0	0	6	9	<u>Rear end crashes</u> A minor injury crash involved a vehicle travelling northbound on Ohaupo Rd colliding with another vehicle that had stopped due to congestion ahead. A minor injury rear end crash due to congestion at Lambert Ct intersection. <u>Pedestrian crashes</u> A minor injury crash involved a pedestrian crossing the road colliding with a vehicle where the carriageway widens to two lanes closer to the roundabout. A minor injury crash involved a wheeled pedestrian on the footpath and a vehicle exiting 200 Ohaupo Rd (ABI Hamilton Inpatient and Residential Service). A minor injury crash involved northbound vehicle colliding with a pedestrian crossing the road at an undesignated location. <u>Head on crash</u> A minor injury crash involved a driver who was intoxicated crossing the centre line and crashing with oncoming vehicle.
Ohaupo Rd – between Lambert Ct and Garden Heights Ave	4	0	0	2	2	<u>Lost control / off road crashes</u> Two minor injury crashes happened when a driver fell asleep behind the wheel, going off road and colliding with the traffic signal pole / pedestrian fence.
Ohaupo Rd – between Resthill Cres and Houchens Rd	2	0	0	1	1	<u>Overtaking / lane change crashes</u> A minor injury crash involved a vehicle travelling southbound on Ohaupo Rd colliding with a vehicle merging into the carriageway from the adjacent grass berm.
Saxbys Rd – between Rhonda Ave and Macdonald Rd	11	0	1	4	6	<u>Overtaking / lane change crashes</u> A serious injury crash occurred at the Saxbys Rd / Stan Heather Dr intersection. Two cyclists travelling eastbound on Saxbys Rd performed evasive action when they noticed a vehicle approaching them from Stan Heather Dr. They hit each other. <u>Lost control / off road crashes</u> A minor injury crash involved a vehicle losing control and hitting a tree and house garage. <u>Right turn against crashes</u>



						A minor injury crash occurred at the Saxbys Rd / Deanwell Ave intersection. A cyclist riding eastbound on the footpath was hit by a vehicle turning right into Deanwell Ave. A minor injury crash occurred at the Saxbys Rd / Stan Heather Dr intersection. A westbound vehicle turning right into Stan Heather Dr failed to give way to an eastbound vehicle on Saxbys Rd. <u>Cornering crash</u> A minor injury crash involved a vehicle travelling west on Saxbys Rd going off-road and colliding with a fence and power pole having misjudged a bend.
Saxbys Rd – between Macdonald Rd and Ohaupo Rd	1	0	0	0	1	-

The crash history indicates the following key patterns relevant to the Residential Development area:

- Ohaupo Road / Collins Road exhibits strong patterns of rear-end, cornering and crossing crashes, which are characteristic of a high-volume signalised arterial intersection. However, the intersection already operates as a four-lane divided arterial with a dedicated right-turn lane, and the constrained corridor environment limits the scope for further major geometric widening or intersection expansion that would deliver proportional safety benefits.
- Ohaupo Road / Saxbys Road / Tomin Road roundabout exhibits a combination of crossing, merging, cornering and pedestrian-related crashes. While these crash types are not uncommon at urban roundabouts, the roundabout represents the principal transport constraint within the assessed network. The Project includes upgrades comprising four-laning of Ohaupo Road between Saxbys Road and Lambert Court, additional approach capacity on Saxbys Road and Tomin Road, and metering of the southbound Ohaupo Road approach. These measures are intended to improve the operational performance of the roundabout while maintaining an urban-speed environment.
- A lost control / off-road (straight) crash pattern on Saxbys Road, between Rhonda Avenue and Macdonald Road, suggests repeated departures from the roadway that may be associated with approach speed and the existing road environment. The proposed localised improvements on Saxbys Road (refer to Section 10.2.1) reinforce the role of Saxbys Road as an urban collector-type corridor rather than a high-speed local link.

Overall, the crash history does not identify any dominant crash pattern that would preclude development of the Residential Development area. The proposed intersection upgrades, active mode improvements and transport staging framework respond directly to the principal crash patterns identified within the study area and are expected to improve the safety and operation of the surrounding transport network

6. Changes in Transport Infrastructure

6.1 Hamilton Southern Links

HSL is a transport network improvement project for state highway and urban arterial routes linking SH1C from Kahikatea Drive in Hamilton to the Waikato Expressway at Tamahere and SH3 from Hamilton Airport to central and east Hamilton. The project aims to develop an effective transport network of state highway and



urban arterial routes to support Hamilton’s planned growth to the south. In 2024, HSL was identified in the GPS 2024 as a RoNS.

As outlined in the GPS 2024, HSL is intended to “*reduce congestion, improve safety, support housing development, boost economic growth, and provide a more resilient roading network*”, and specifically recognised as key infrastructure required to unlock land for significant new housing supply. In this context, HSL is particularly relevant to the Residential Development area because it has the potential to redistribute a proportion of future traffic demand away from the Ohaupo Road corridor and improve wider network connectivity within southern Hamilton.

NZTA completed an Investment Case for HSL. While the completed Investment Case identifies a preferred corridor and staging framework, the most recent NZTA Major Transport Projects Pipeline (“MTPP”)¹¹ identifies that HSL has not yet progressed to the pre-implementation phase and future progression remains subject to funding availability and National Land Transport Programme priorities. Accordingly, the delivery timing of HSL remains uncertain.

Notwithstanding, HSL remains an important component of the long-term transport plan for southern Hamilton and provides relevant strategic context for understanding the future operation of the transport network serving the SL1 Industrial and Residential Development areas.

Based on the completed Investment Case, the recommended staging framework for HSL comprises the following four stages as shown in Figure 6):

- Stage 1 – Greenwood Street to SL1 roundabout

This involves widening Greenwood Street from two lanes to four lanes from Kahikatea Drive to Killarney Road. A new three-arm roundabout is proposed at the Greenwood Street / Kahikatea Drive intersection with no access to Kahikatea Drive Extension. A roundabout is also proposed allowing access to the Industrial Development area.

- Stage 2 – SH1 to SH21

This includes a new interchange on SH1 Waikato Expressway between the Pickering Road overbridge and Tamahere Interchange, with the road heading west on a new bridge over the Waikato River to connect with a new interchange to be built where HSL meets SH21.

- Stage 3 – SL1 roundabout to SH3

The largest stage in road length, this connects the Industrial Development roundabout at Greenwood Street corner with SH3 and includes an overbridge of the NIMTR and SH3.

- Stage 4 – SH3 to SH21 including central interchange and north-south connection

The final stage completes the east-west connection, including building a new central interchange to connect to the Peacocke Structure Plan Area. It will also see a new stretch of road from the SH3 / SH21 roundabout to connect at the central interchange.

¹¹ <https://www.nzta.govt.nz/assets/projects-and-consultations/major-projects/major-transport-projects-pipeline-infographic.pdf>



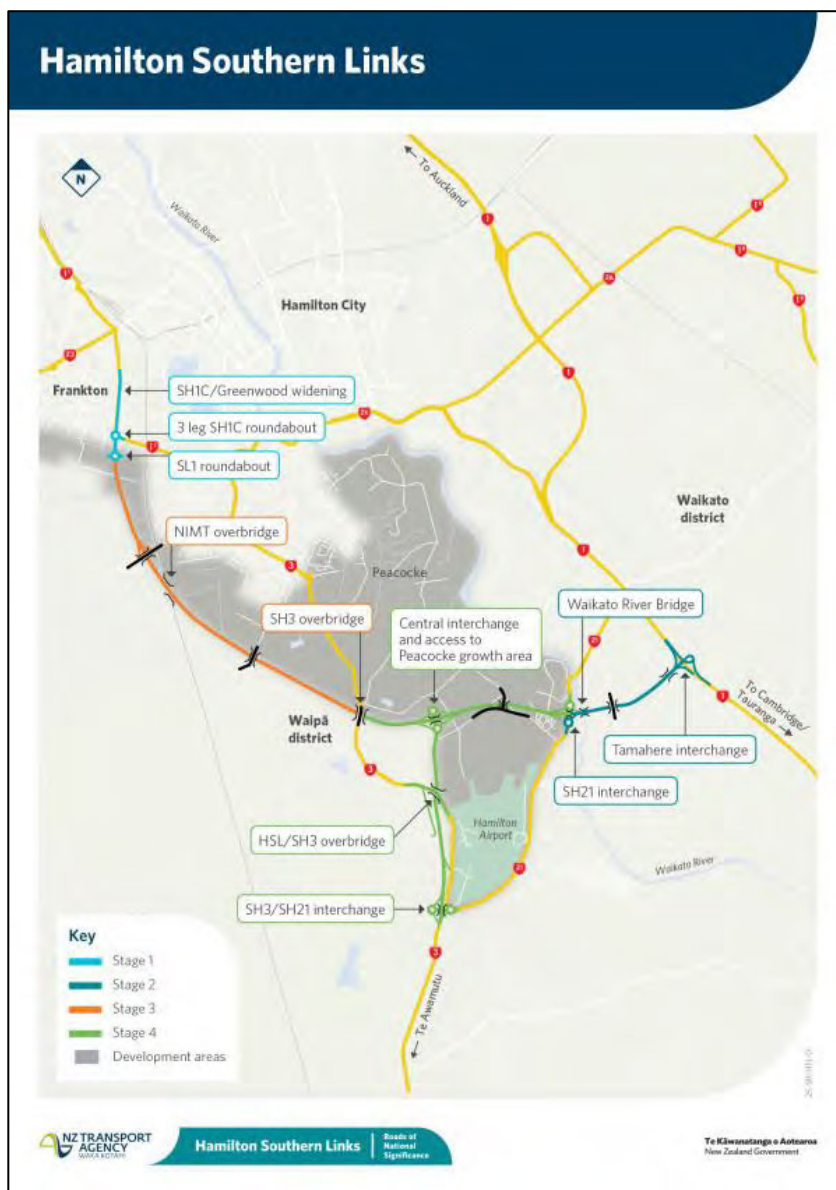


Figure 6: HSL Recommended Staging

The HSL designation borders the southwest edge of the Residential Development area. The HSL designation presently has no direct access to Glenview other than a half-diamond grade separated intersection with Collins Road. However, this location has limited accessibility to Glenview and the wider Hamilton network other than through the intersection of Ohaupo Road / Collins Road. Complicating accessibility matters is the existence of the Collins Road / NIMTR level crossing adjacent to the planned HSL half-diamond interchange.

An alternative interchange arrangement at Houchens Road has been considered as part of strategic transport investigations to improve accessibility between the Residential Development area, Glenview, Deanwell and the wider transport network. The concept has been explored with NZTA and assessed using the Waikato Regional Transport Model ("WRTM") to understand its potential transport benefits. However, the ultimate form, location, timing and delivery of any future HSL interchange remains subject to future NZTA investigation, approvals, funding decisions and statutory processes.

For the purposes of this ITA, HSL has been considered as part of the future strategic transport environment. However, the transport conclusions contained within this assessment do not rely on HSL being delivered within any specific timeframe. Rather, the assessment identifies both interim and future network scenarios and recommends appropriate mitigation and staging measures under each scenario.



6.2 Waikato Metro Spatial Plan

The Waikato Metro Spatial Plan (“MSP”) identifies “Short list Option C”¹² as the recommended programme to “support a radical transport shift and support the transformative move to a Rapid Transit Network future” in Hamilton.

The MSP illustrates the Rapid Transit (“RT”) Network¹³ components of this programme as follows:



Figure 7: Proposed Rapid Transit Corridors (Source: MSP Business Case Executive Summary)

RT4 is one of four key rapid transit routes across Hamilton. It will service Waikato Hospital and Glenview West, with potential to be extended in the long-term to Te Awamutu. The Residential Development area is located adjacent to the RT4 corridor identified in the MSP and is therefore well positioned to access future rapid transit services envisaged within the wider Hamilton transport network.

The MSP describes RT4 (and RT3) as a service supporting Light Rail Transit (“LRT”) or Bus Rapid Transit (“BRT”) on RT1 and RT2 routes, by way of bus priority. This suggests RT4 is not envisaged as a BRT or LRT service itself

¹² Waikato Metro Spatial Plan Programme Business Case report. Revision D, Section 6.2.2

¹³ Waikato Metro Spatial Plan Executive Summary report. Revision C, Figure 1-8



but a frequent bus service on a route with bus priority measures including bus lanes and signal priority at intersections. The diagram suggests the route may use the Ohaupo Road corridor although that is not determined in the MSP business case report.

The use of the Ohaupo Road corridor by RT4 will require significant modifications to existing road infrastructure and space allocation, including bus priority upgrades at the key intersections identified earlier as network constraints.

One of the key requirements for BRT or LRT to be viable is sufficient medium to high-density residential population surrounding the transit route. The MSP states *“The routes designated as RT3 and RT4 will deal to increased density of existing neighbourhoods and aligns with the existing and proposed community facilities. Although these routes may not ultimately be able to achieve the demand for a full BRT – they are key routes that will require early investigation and investment to deliver bus lanes and bus priority for service functions and reliability.”*.

The above refers to existing neighbourhoods potentially not being dense enough to achieve the demand for full BRT. It should be noted that while the SL1 growth cell near the RT4 corridor is identified as a future growth cell in the MSP land-use framework, it is unlikely to reflect the proposed detailed land use understanding, density and residential typologies. These elements could potentially propel RT4 to be viable as a full BRT corridor.

The MSP also identifies a recommended timeframe to implement the programme as shown below. This indicates RT4 coming online from Year 20 onwards (year 1 is 2025).

Recommended Programme Accelerated Staging and Performance						
		YEARS 1 - 3	YEARS 3 - 10	YEARS 10 - 15	YEARS 15 - 20	YEARS 20 - 50+
Infrastructure and operations	PT Operations Span, frequency, vehicle type	Bus service 19 hour (12 hours peak) Peak: 15 min Off-peak: 20 min	Bus service+ priority 19 hour (12 hours peak) Peak: 10 min Off-peak: 15 min	BRT (RT1) 24 hour (19 hours peak) Peak: 5 min Off-peak: 15 min	BRT (RT1, RT2) 24 hour (19 hours peak) Peak: 5 min Off-peak: 15 min	BRT (RT1, 2, 3, 4) 24 hour (19 hours peak) Peak: 3 - 5 min Off-peak: 10 min
	Infrastructure Bus Priority BRT					
PT Performance	Patronage (AM peak/direction/hour) • Airport to Hamilton • Te Awa to Hamilton • Hamilton to Ruakura	-	930 650 1400	1450 1000 2150	1650 1150 2500	2250 1550 3350
	PT Travel Time (savings compared with general traffic) • Airport to Hamilton • Hamilton to Ruakura	23 min 19 min	22 min (-1 min) 10 min (-9 min)	22 min (-3 min) 10 min (-13 min)	22 min (-6 min) 10 min (-17 min)	22 min (-10 min) 10 min (-22 min)
	PT Reliability	Low	Medium	High	High	High
Micro-mobility	Micro-mobility network	Early implementation	10% of cycle network • Biking and micro-mobility 10 year programme • Develop city centre traffic circulation, plan and low traffic neighbourhoods • Facilitate safe and easy active mode access to stations	40% of cycle network • Extend cross city connections to more peripheral centres and growth cells – Rotorua, Dimsdale, Rotorua, Peacocke and H2 • Begin to fill out network with build-out of cross city connections, community links and local links • Improve Te Awa River Ride cycle path to Hāwea/Whānau and Cambridge	70% of cycle network • Active mode network in town centres and growth cells • Continue build-out of cross city connections, community links and local links	100% of cycle network • Complete build-out of cross city connections, community links and local links
Cost	Cost – CAPEX (per year)	146 million	138 million	162 million	62 million	5 million
	Existing LTP maintained (per year)	110 million	110 million	8 million	8 million	5 million
Cost	Cost – OPEX (per year)	24 million	27 million	35 million	38 million	66 million

Figure 8: Recommended RT Network Staging Approach (Source: MSP Business Case Executive Summary)

6.3 Hamilton Waikato Metro Spatial Plan - Public Transport Pathways

The *Hamilton Waikato Metro Spatial Plan - Public Transport Pathways Technical Report 2* (“PT Pathways Report”) identifies the Comet bus service as a strategic cross-city service linking Glenview, the central city, The Base and major growth areas including Peacocke and Te Awa Lakes. The report also identifies Ohaupo Road as an important future public transport corridor and supports the continued development of public transport services and infrastructure along the corridor. Future public transport improvements relevant to the Project are discussed further in Section 6.



The Comet is classified as a Tier 2 frequent service by 2030, transitioning to a Tier 1 frequent service by 2038, and is aligned in full with “Line 2” of the Bus Rapid Transit Proof of Concept. As a Tier 1 frequent route, the Comet service is expected to operate at a 10-minute peak frequency under the adopted service standards. The report further identifies Ohaupo Road (SH3) as a priority corridor for bus priority infrastructure, noting that such infrastructure is required to support higher-frequency services and improve speed and reliability, and that Tier 1 frequent routes are expected to transition to Bus Rapid Transit in the longer term, although BRT-level infrastructure is not assumed to be delivered within the twelve-year study period.

6.4 Waikato Regional Public Transport Plan 2022 - 2032

According to the Waikato Regional Public Transport Plan, it is projected that a future frequent network to be implemented over 10 years (refer to Figure 9) and a future ‘BRT lite’ network to be implemented over 30 years (refer to Figure 10) along Ohaupo Road.

For clarity, frequent services are described as “15-minute frequency or better, bus priority measures sufficient to enable competitive and reliable journey times regardless of traffic conditions. On board fare collection, zero emission vehicles, quality stops. Enables and requires moderate or greater land use.”, and BRT lite is described as “high service frequencies, extensive bus priority measures, traffic signal priority, may have off board fare collection, zero emission vehicles, high quality passenger stops. Enables and requires moderate to high intensity land use.”.

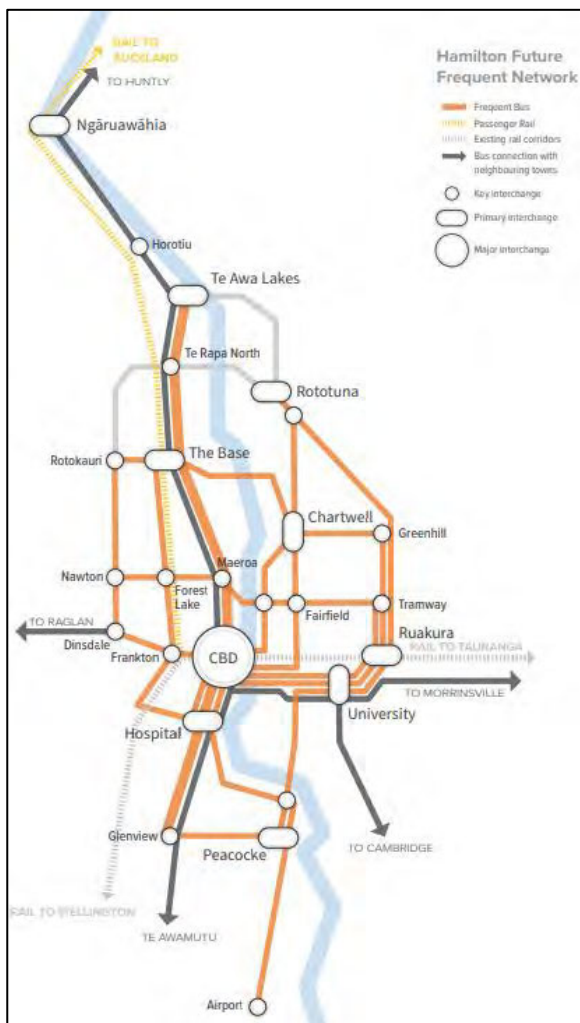


Figure 9: Future frequent network to be implemented over 10 years, 2022-2032 (Source: Waikato Regional Public Transport Plan Network Diagram 1)





Figure 10: Future frequent network to be implemented over 30 years, 2022-2052 (Source: Waikato Regional Public Transport Plan Network Diagram 2)



7. Project Overview

7.1 Industrial Development

The Industrial Development comprises circa 60 ha of presently rural land. The net developable area is estimated to be 40 ha with the balance accommodating the HSL designation, proposed wetland areas and existing Industrie Property Tahi Limited lot (Lot 1 DP 396081) that is developed and occupied in accordance with an existing resource consent.

The industrial subdivision will comprise a mix of lot sizes and industrial activities that will be supported by the proximity to HSL and the existing Frankton Industrial area. Access to the development area is proposed via an east – west collector road connection to HSL which is future-proofed for connectivity to Wickham Street, Higgins Road, and ultimately to Tuhikaramea Road as shown in Figure 11. While the Master Plan provides for integration with HSL when it is delivered in the future, the timing of Industrial Development is not dependent on HSL delivery.

The transport assessment has been undertaken based on the functionality of the access and road network arrangements shown on the Master Plan. The ITA does not seek to determine the ultimate ownership, funding arrangements or individual delivery responsibilities for infrastructure located within the HSL designation, as those matters will be addressed through separate infrastructure delivery and approval processes. For consenting purposes, the relevant transport considerations for this ITA are to show that the proposed interim and ultimate access arrangements can operate safely and efficiently and that they do not hinder delivery of the future HSL road infrastructure. Any infrastructure intended to form part of the future state highway network would be subject to the relevant NZTA design, review and approval processes prior to implementation.

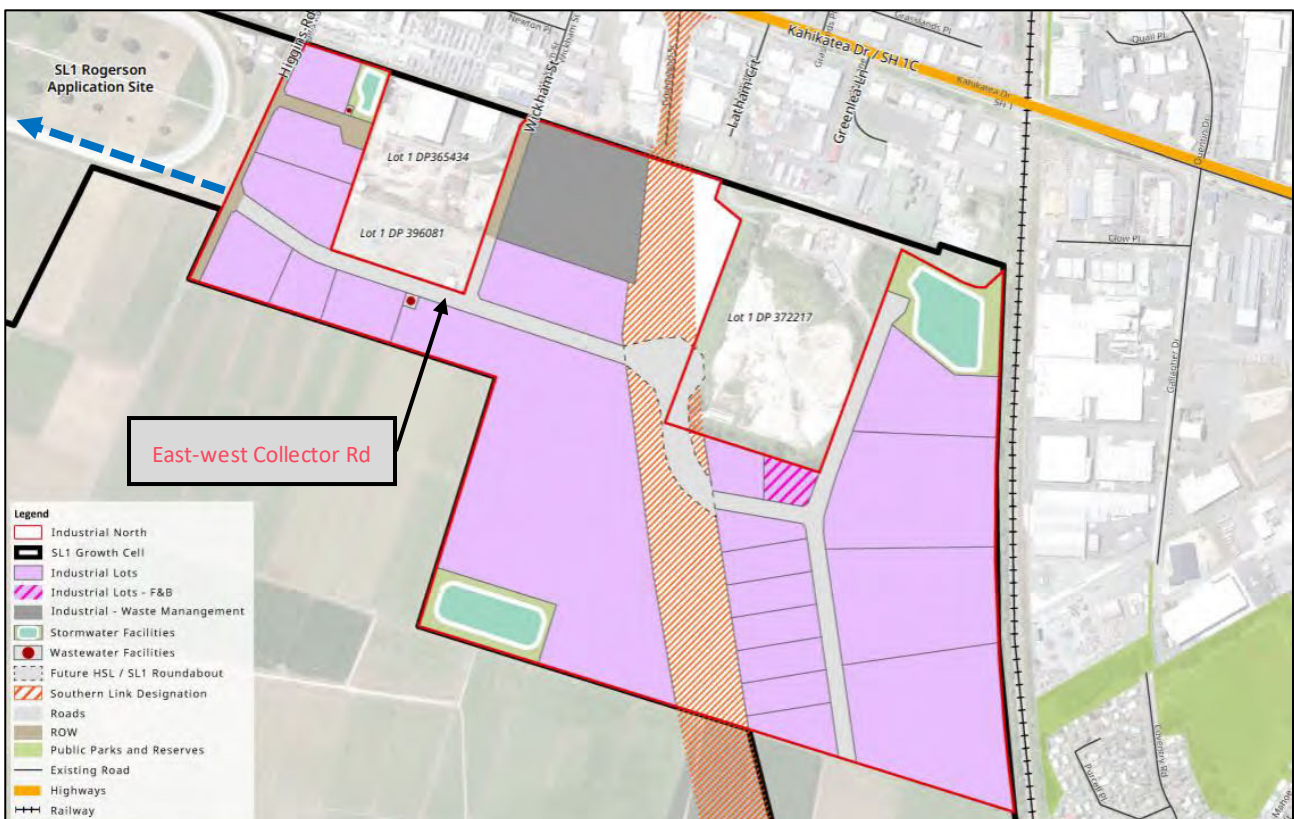


Figure 11: SL1 Industrial Development Master Plan



The Industrial Development is expected to occur progressively between 2030 and 2045. Access for the Industrial Development has been assessed “without” and “with” HSL, referred herein as the interim and ultimate network arrangements. Both are detailed further in Section 8.1.

7.2 Residential Development

The Residential Development forms part of the residential component of the wider SL1 Growth Cell. The Residential Development area is approximately 46 ha and comprises 938 residential units consisting of:

- 347 Low density dwellings (minimum 10 m lot width for detached or duplex dwellings)
- 298 Medium density dwellings (front-access terraced or duplex dwellings)
- 293 High density dwellings (rear-access lane terraced dwellings)

The Residential Development area also includes 1,000 m² of commercial land area for a neighbourhood centre and 3,200 m² for a neighbourhood park.

Access for the Residential Development has been assessed and detailed further in Section 8.2.

The Residential Development is underpinned by a comprehensive Master Plan which is illustrated in Figure 12.

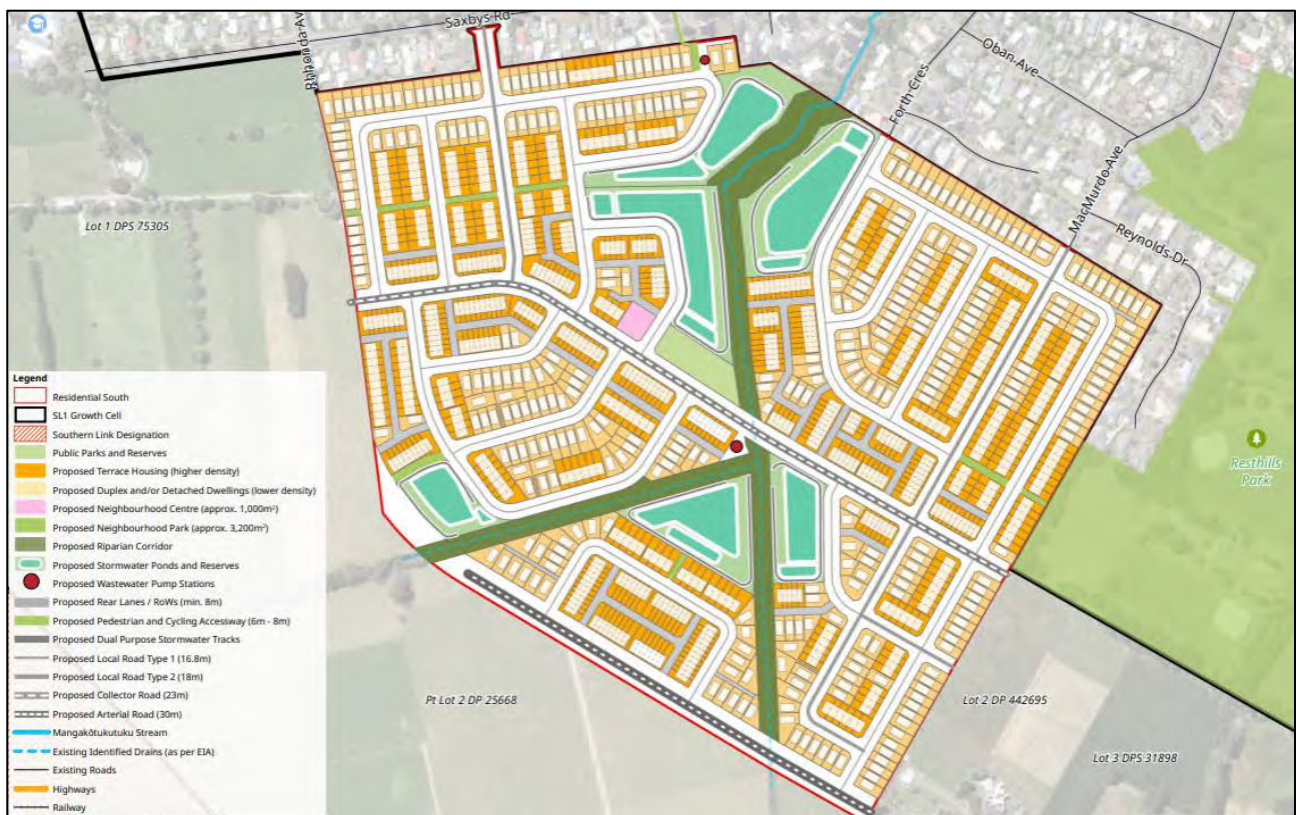


Figure 12: Residential Development Master Plan

Indicative development staging is presented in Figure 13 below.





Figure 13: Residential Development - Indicative Staging

Stage 1 is anticipated to be completed by 2030, Stages 2 and 3 are anticipated by 2035, and Stages 4 and 5 by 2045. These staging timeframes are indicative only and have been adopted for the purposes of the transport assessment.

8. Access Strategy

SL1 access arrangements have been designed to provide for the safe and efficient movement of people (and freight for the Industrial Development) with mode-choice including vehicles, walking, cycling, and public transport. A high degree of flexible transport choice is expected to assist in managing the transport effects of the development.

8.1 Industrial Development

Three access options were evaluated to assess how Industrial Development could proceed:

8.1.1 Option A: Ultimate Network Arrangement (once HSL Stage 1 is Delivered)

Once HSL is delivered in the future, the Industrial Development has been designed so that it can integrate with the ultimate HSL transport network without precluding future infrastructure. Under the ultimate arrangement, the following infrastructure may be provided:



- A four-arm roundabout connection on HSL approximately 520 m south of the future Greenwood Street / Kahikatea Drive three-arm roundabout (refer to Section 8.1.4).
- Connection of the east-west collector road to the proposed HSL / SL1 roundabout.
- Extension of Wickham Street into the site.
- Access to the eastern part of the Industrial Development is dependent on the future HSL network staging scenario. If the SL1 roundabout and associated HSL connection is delivered in HSL Stage 1, access to the eastern area is proposed via a short section of HSL arterial and a local road connection to the north-south road in the eastern development area, as shown in Figure 14. In that scenario, following completion of HSL Stage 3 by NZTA, this local road connection would become a cul-de-sac.
- Integration with the wider walking, cycling and strategic transport network associated with HSL.

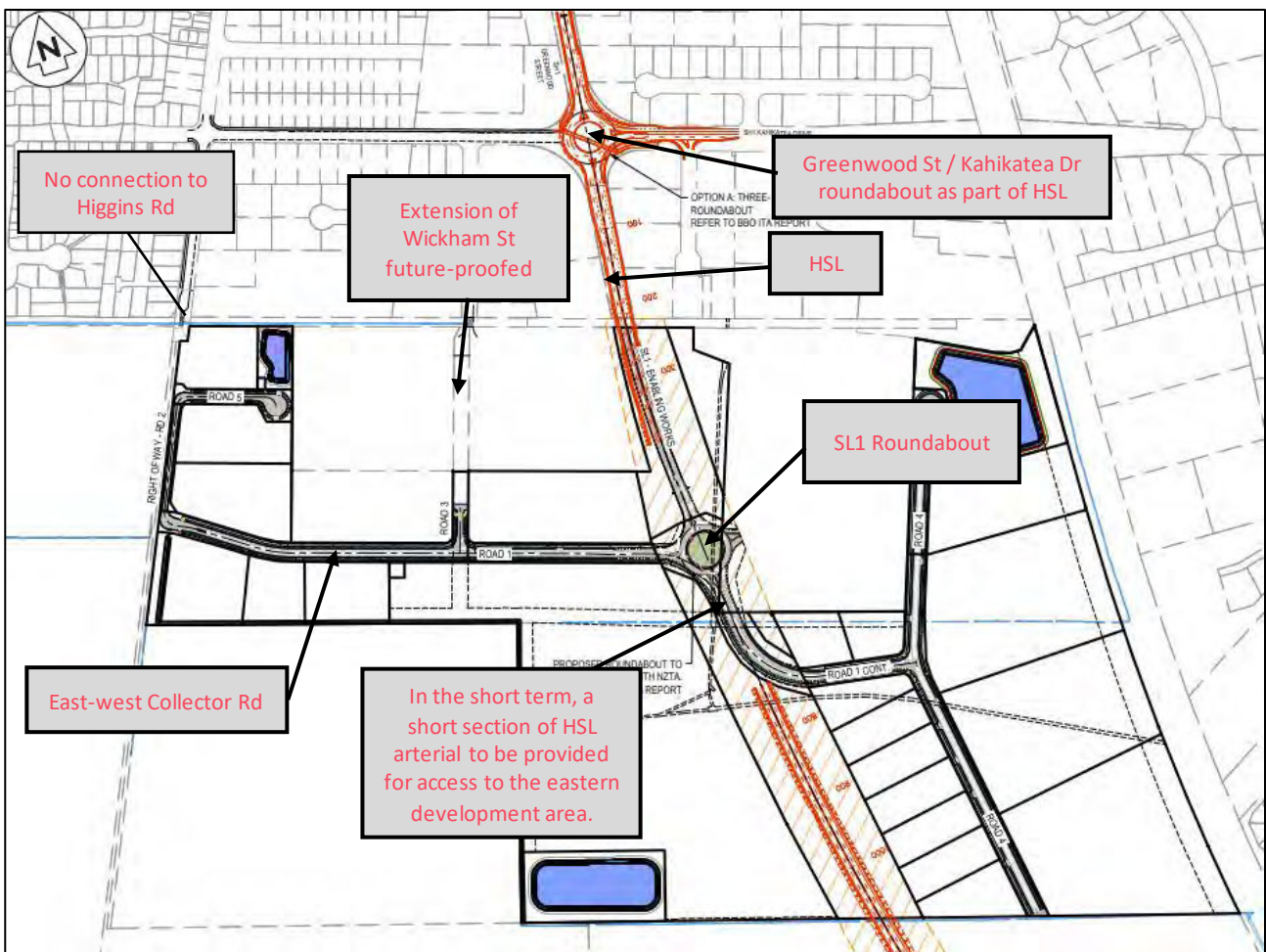


Figure 14: Option A - HSL Stage 1 constructed

8.1.2 Option B: Preferred Interim Option

The preferred access strategy (as shown in Figure 15) is Interim Option B, which does not rely on HSL Stage 1 being delivered. Under this arrangement, Industrial Development traffic is accommodated via:

- An interim four-arm roundabout at Greenwood Street / Kahikatea Drive, replacing the existing priority-controlled intersection and providing access from Greenwood Street and Kahikatea Drive.
- An interim access road between the Greenwood Street / Kahikatea Drive roundabout and east-west collector road, designed and staged so that it can transition to the ultimate HSL arrangement.



- An east-west collector road forming the primary internal movement corridor through the site.
- A temporary T-intersection on the HSL corridor connecting the interim access road to the east-west collector road.
- Extension of the interim access road further south to provide access to the eastern part of the Industrial Development.
- A walking and cycling network connecting to the existing Greenwood Street shared path and wider active mode network via Wickham Street.

These infrastructure requirements are necessary to ensure Industrial Development traffic is served by an appropriate intersection form and access route, rather than relying on the existing Greenwood Street / Kahikatea Drive priority-controlled intersection or on access through local industrial streets alone.

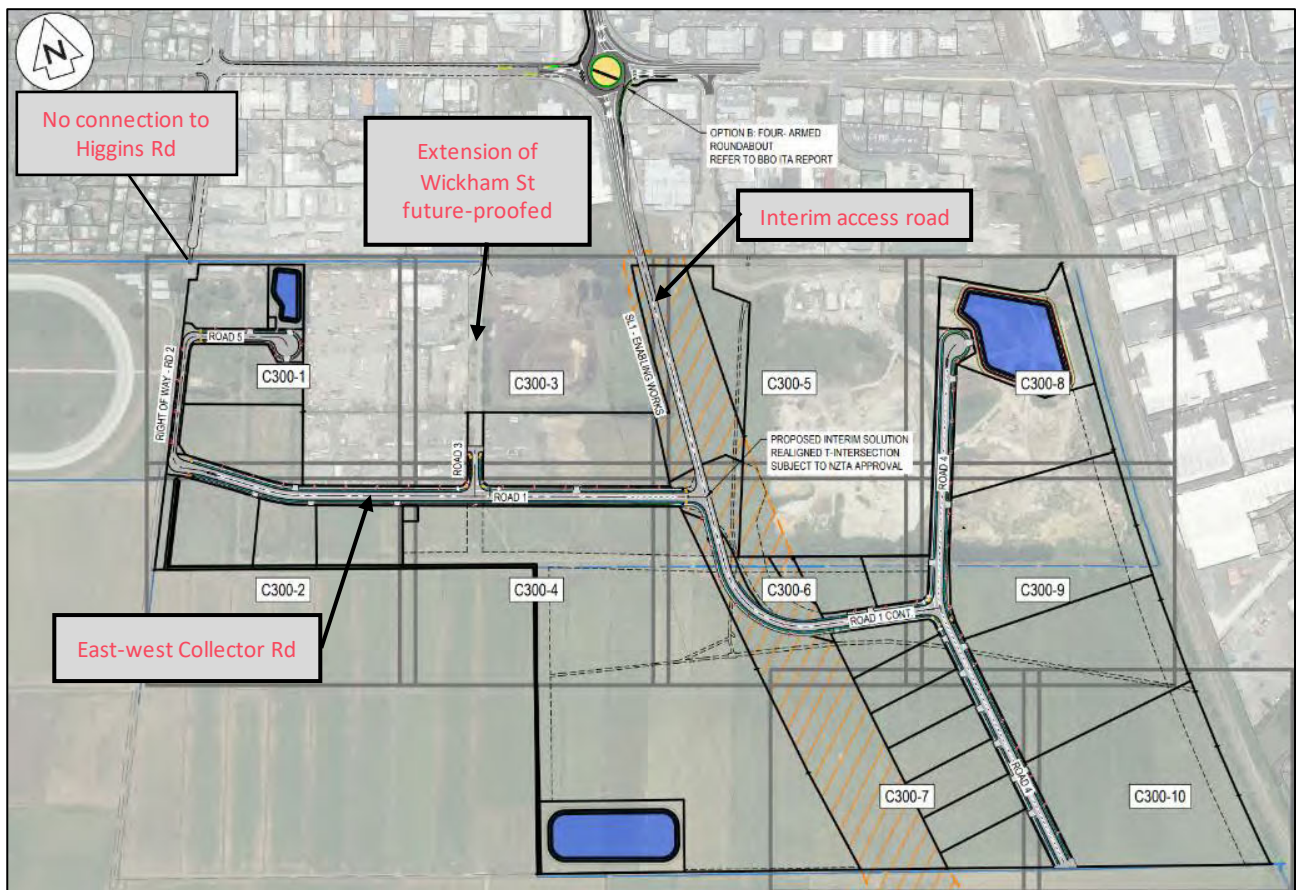
The Interim Option B access arrangement can accommodate the full assessed Industrial Development and is assessed in detail in Section 15.1.1.

A conceptual layout of the four-arm Greenwood Street / Kahikatea Drive roundabout is shown in Figure 16 and is based on the ultimate HSL roundabout arrangement to minimise rework in future. Interim Option B has been discussed with NZTA, who advised that, the option appears to be worth exploring. NZTA also noted that the interim roundabout would need to be sized consistently with the ultimate HSL layout and that any interim access road should be future-proofed so that it could be incorporated into the future state highway network without significant upgrading or utility relocation.

On that basis, the interim access road south to the east-west collector road would be designed and constructed to the required HSL standard, but with only the carriageway width required for an interim two-lane operation rather than the full four-lane divided carriageway. The central median and two additional traffic lanes would be delivered with the future HSL works. NZTA has not provided in-principal approval to Interim Option B, and the detailed form, staging, funding, ownership and transition to the ultimate HSL layout would remain subject to further design development, staging review and NZTA approval.

Access is intended to transition to the ultimate network arrangement when HSL is delivered in future by NZTA. The ultimate access arrangement is described in the following sections.





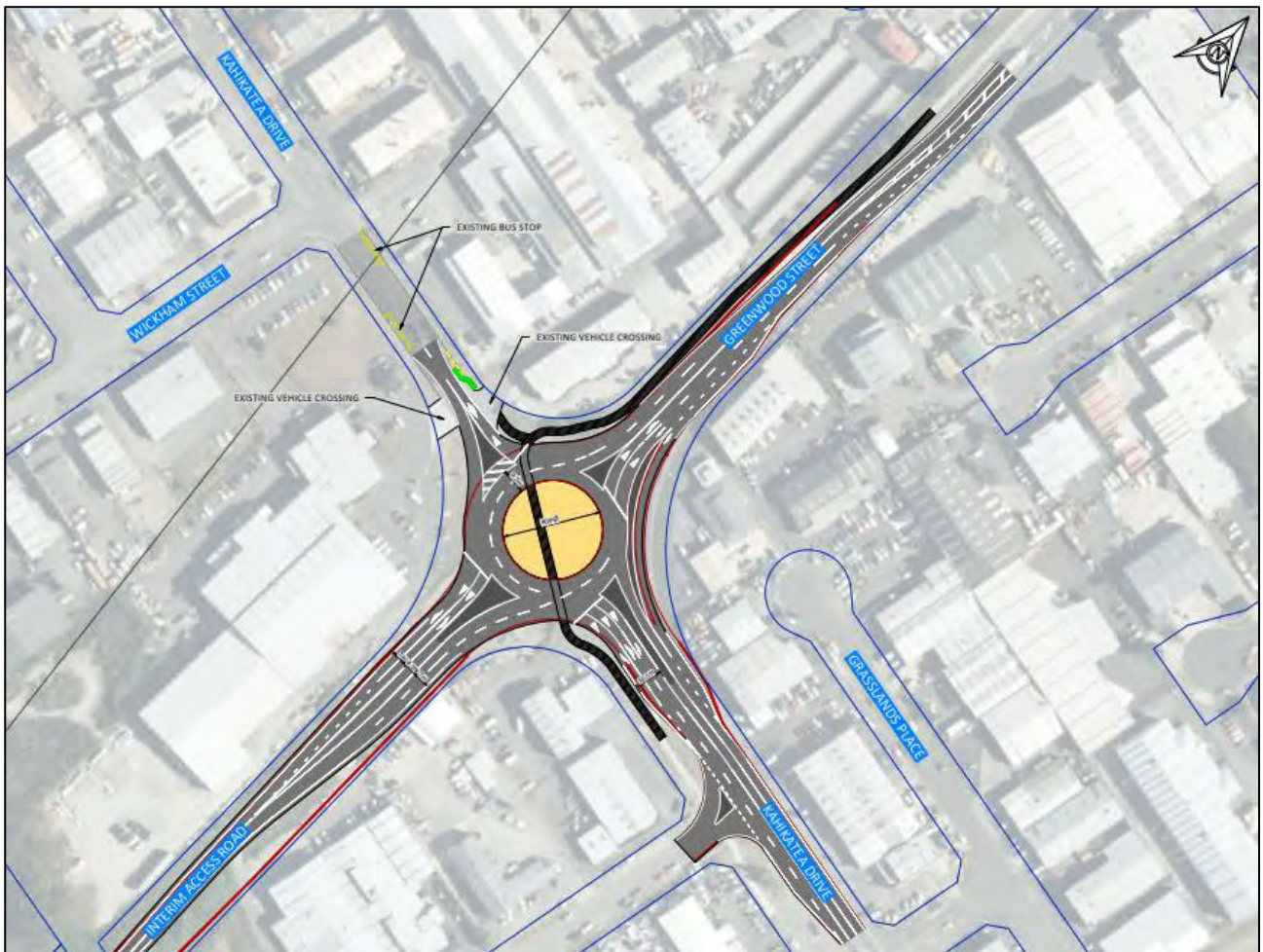


Figure 16: Interim Option B - Greenwood St (SH1C) / Kahikatea Dr Roundabout Concept Plan

8.1.3 Option C: Interim Option

Like Option B, this option is based on HSL Stage 1 construction commencing sometime after 2035.

This option involves upgrading Greenwood Street / Kahikatea Drive intersection to a three-arm roundabout as shown in Figure 17. with access to SL1 Industrial Development via Wickham Street extension.

However, this option has a developable area limitation of 23 ha due to capacity constraints with the three-arm roundabout. Development beyond 23 ha requires construction of either:

- HSL Stage 1; or
- Interim Option B four-arm roundabout arrangement and the interim access road on HSL corridor.

This is presented as Option C Stage 2 (represented by blue lines) in Figure 18.



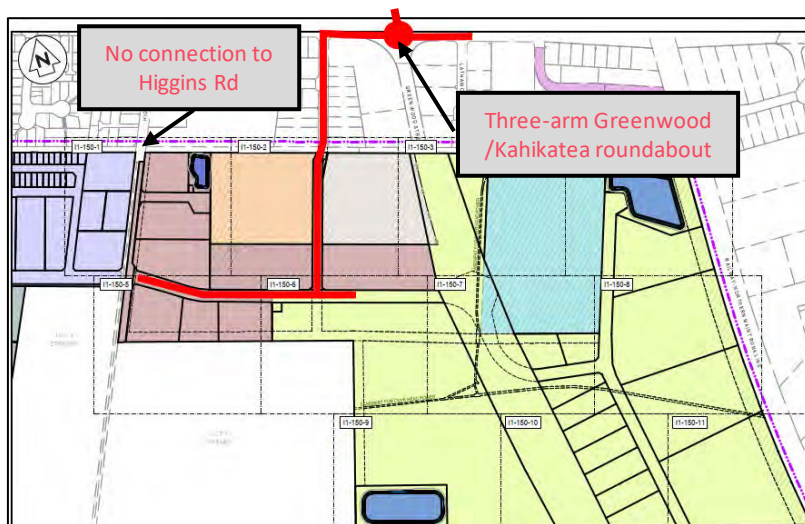


Figure 17: Option C – Stage 1 Proposed Transport Network

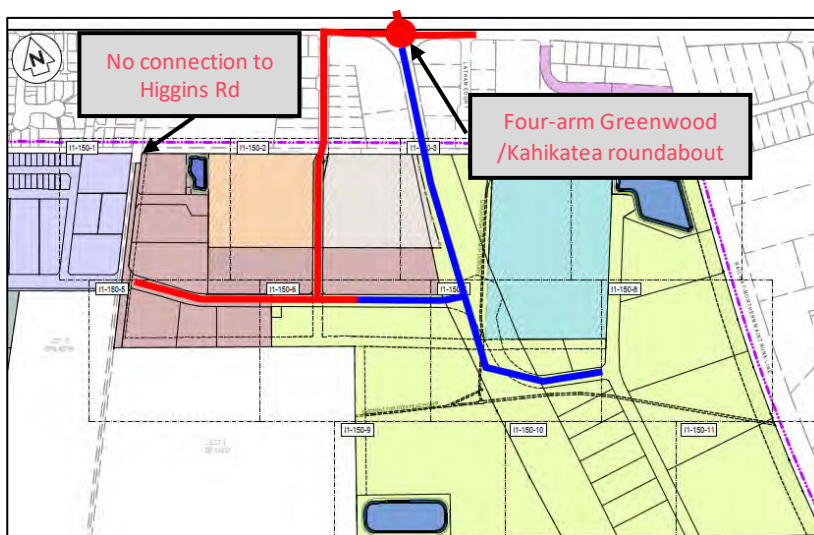


Figure 18: Option C – Stage 2 Proposed Transport Network

8.1.4 SL1 Roundabout

It was identified through consultation meetings with HCC that a direct connection from the proposed Industrial Development area to Kahikatea Drive would not be supported given the access challenges that already exist due to high traffic volumes. For this reason, HCC also advised that they have had discussions with NZTA about allowing a connection from the future HSL corridor to the Industrial Development site to avoid it becoming land-locked by the HSL designation. A direct connection to HSL enables freight and other commercial / industrial traffic to be minimised on the surrounding local roads.

A single point of access to the Industrial Development area is proposed, recognising that HSL is a RoNS where access and intersections are rationalised to maintain efficiency of the strategic road corridor.

The road connection to HSL is proposed to be a four-arm roundabout, which aligns with Safe System principles. A concept plan of the roundabout configuration is shown in Figure 19.



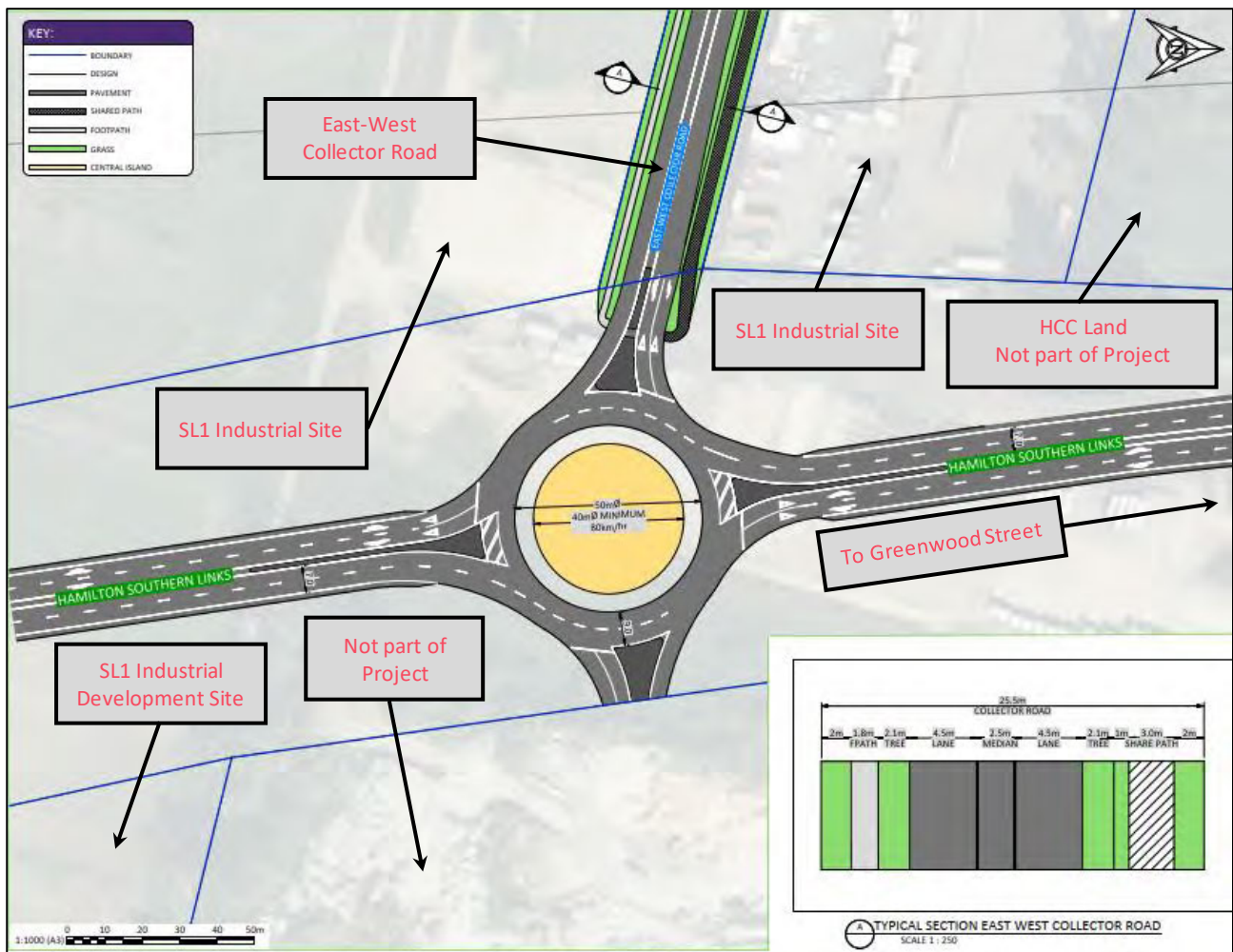


Figure 19: HSL / SL1 Roundabout Concept Design

The concept SL1 roundabout is designed in accordance with *Austrroads Guide to Road Design Part 4B: Roundabouts* ("AGRD Part 4B"). A design speed of 100 km/h has been adopted for the HSL approaches.

The central island radius is 25 m and the design accommodates the tracking curves of a 19.45 m HPMV semi-trailer (refer to Appendix A - Drawing 149340-00-0200). The concept layout has been modelled to demonstrate that the expected performance and capacity of the intersection is sufficient for the transport demands of the Project and future proofed volumes on HSL.

The concept design is therefore intended to demonstrate that the proposed access location and intersection form can be accommodated within the future HSL corridor without precluding the ultimate strategic transport function of HSL. The detailed geometric design, pavement design, drainage, utilities, safety barriers, tie-ins and any other state highway-specific requirements would be subject to further design development, safety audits and NZTA's approval process before being accepted as part of the state highway network.

The land required to form the eastern arm of the proposed roundabout is outside the SL1 Industrial Development area and is not part of the current Fast-track substantive consent application. Accordingly, the eastern arm is not proposed to be delivered as part of SL1 Industrial Development but the roundabout will be future proofed for it with a stub road to the east, sized and located so as not to preclude future extension when the adjoining land to the east is brought forward for development.

There is limited guidance on separation distance between highway intersections. The proposed position of the SL1 roundabout on HSL is approximately 520 m south of the future Greenwood Street / Kahikatea Drive roundabout that connects HSL to Greenwood Street and Kahikatea Drive.



The SL1 roundabout is proposed at this location for the following reasons:

- A position further south on HSL would result in less direct access between the Industrial Development area and the strategic road network. This may encourage some industrial traffic to utilise alternative local routes to travel north to Greenwood Street and Kahikatea Drive, which is inconsistent with the objective of directing industrial and freight traffic to the strategic road network.
- It supports a direct and intuitive east-west collector road corridor between Tuhikaramea Road and HSL, which in future will replace the existing function of Kahikatea Drive Extension that passes through a residential suburb. The new collector road route will maintain a strategic road connection between Hamilton's western fringe and the Frankton industrial area. Relocating the roundabout further south creates a convoluted alignment that risks rerouting some traffic north through residential streets.
- It allows the east-west collector road to be aligned strategically between two SL1 landowners' lots without dissecting lots to any owner's disadvantage. This provides important continuity for both applicants to progress their land development aspirations.

Intersection modelling for the SL1 roundabout and the future HSL roundabout at Greenwood Street / Kahikatea Drive intersection demonstrates that the proposed 520 m separation distance is suitable for both intersections to function well under the predicted future traffic volumes without causing adverse capacity and efficiency effects to the HSL network. Refer to Section 15.1.1.

It is acknowledged that NZTA is undertaking more detailed Aimsun modelling to inform future HSL design decisions, including the operation of Duke Street and the separation between the future Greenwood Street / Kahikatea Drive roundabout and the proposed SL1 roundabout. The modelling undertaken for this ITA demonstrates that the proposed separation distance is expected to function well from a capacity and queuing perspective under the assessed concept layout and traffic demands. However, the final form and location of infrastructure within the HSL corridor will remain subject to NZTA's future design development, modelling and approval processes to ensure that future HSL design options are not precluded.

8.2 Residential Development

Transport access for the Residential Development is designed to provide for the safe and efficient movement of people in a higher density living environment with mode-choice including vehicles, walking, cycling, and public transport. A high degree of flexible transport choice is expected to assist in managing the transport effects of the development.

Three road access points are proposed to the Residential Development area:

- Saxbys Road
- MacMurdo Avenue
- Forth Crescent

A new intersection on Saxbys Road will be formed at a location approximately 65 m west of Saxbys Road / Deanwell Avenue intersection.

MacMurdo Avenue and Forth Crescent are proposed to be extended into the site. Further details on each of these specific site connections is provided in the subsequent sections.





Figure 20: Proposed Site Accesses – Residential Development

8.2.1 MacMurdo Avenue Access

MacMurdo Avenue is currently a low volume no-exit road that stops at the north-eastern boundary of the site. MacMurdo Avenue is proposed to be extended further southwest connecting to the new north-south collector road at the southern end. The intersection between MacMurdo Avenue extension and the new collector road is proposed to be a roundabout.

MacMurdo Avenue extension is proposed to have an 18.0 m wide road reserve width as shown in Figure 21.

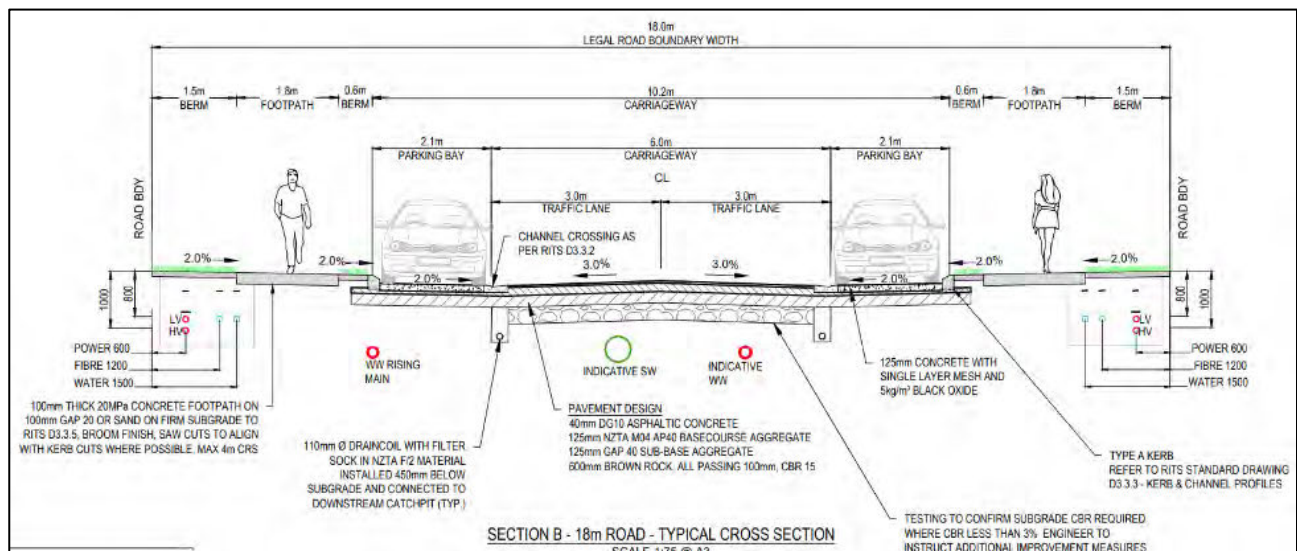


Figure 21: 18.0 m Wide MacMurdo Avenue Extension

8.2.2 Forth Crescent Access

Forth Crescent is currently a low volume road that stops at the north-eastern boundary of the Site. It is proposed to be extended further southeast connecting to MacMurdo Avenue extension at the eastern end.



Forth Crescent extension is proposed to have a 16.8 m wide road reserve width as shown in Figure 22.

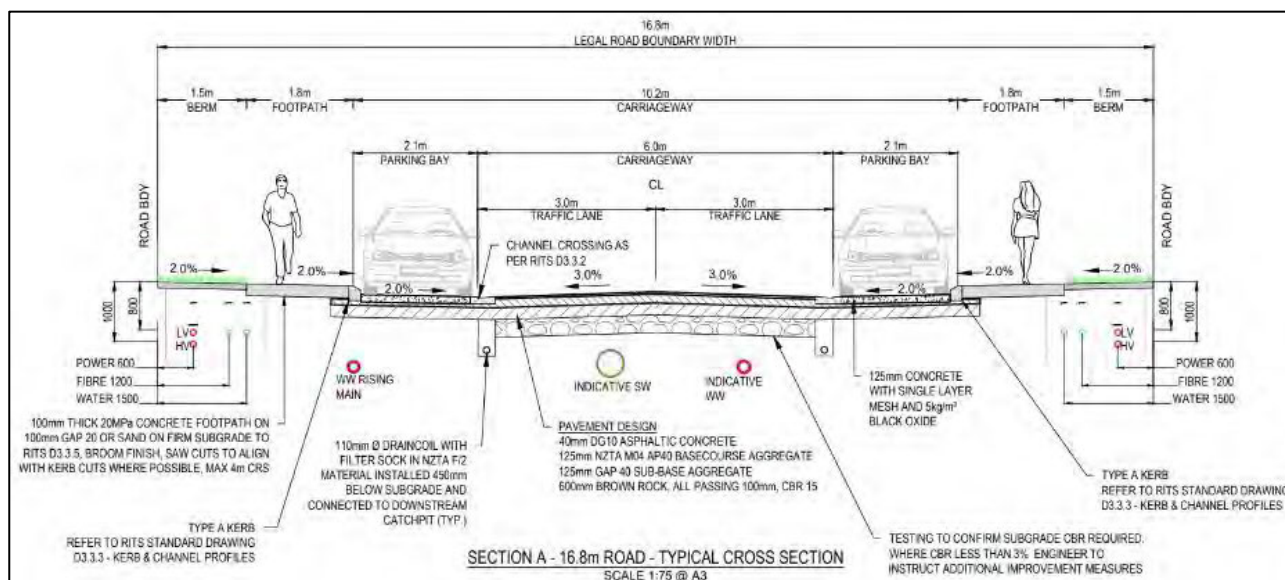


Figure 22: 16.8 m Wide Forth Cres Extension

8.2.3 Saxbys Road Access

The access intersection proposed on Saxbys Road will operate as a priority-controlled T-intersection. Traffic exiting the Residential Development will give way to traffic on Saxbys Road. Saxbys Road is closed at its western end and therefore functions as a no-exit local road.

A stop control may be required on the site access approach as preliminary assessment indicates that sight distance measured from a point 9 m back from the limit line may be restricted by the existing boundary fencing at 55 and 57 Saxbys Road. This will be confirmed through detailed design. Notwithstanding this potential constraint, the straight alignment of Saxbys Road provides available sight distances of approximately 300 m to the east and 400 m to the west. These distances exceed the minimum safe intersection sight distance (“SISD”) of 114 m specified in *Austroads Guide to Road Design Part 4A: Unsignalised and Signalised Intersections* (“AGRD Part 4A”), Table 3.2, for a 60 km/h design speed.

A review of the projected turning movement volumes at the proposed access, relative to the future through volumes on Saxbys Road in the 2045 full-development scenario (i.e. Modelling Scenario 4 in Section 13.2), indicates that auxiliary turning lanes or a channelised layout are not warranted under the relevant Austroads criteria¹⁴. Accordingly, the access intersection is expected to be appropriately designed in accordance with *Traffic Control Devices Manual Part 4* (“TCDM Part 4A”), Figure 4-14 or Figure 4-17.

The final form of control and detailed intersection layout will be confirmed at the detailed design stage.

9. Public Transport Provision

Public transport accessibility is a key component of the transport strategy for the proposed developments, particularly in managing future travel demand and reducing reliance on private vehicle travel. This section considers the extent to which the proposed Development layouts supports the existing and enables the planned bus networks identified through consultation with Waikato Regional Council (“WRC”).

¹⁴ Austroads Guide to Traffic Management Part 6, Figure 3.25



While the proposed development transport infrastructure and connections are designed to promote public transport accessibility so that public transport mode-share increases over time, the Applicants cannot require WRC to implement the necessary future services or amend exiting bus routes. The following are WRC's current plans, noting that the networks shown in Figure 23 and Figure 24 were developed in 2024 and do not fully account for all Fast-track growth cells in Hamilton, including SL1.

- WRC advised that, in the short term (to 2028), bus services are planned to continue using Saxbys Road, the olive-coloured route shown in Figure 23.
- In the medium-term (2037), the indicative bus network no longer shows services using Saxbys Road, as shown in Figure 24.
- The indicative network plans also do not show bus services using Higgins Road between Kahikatea Drive and Duke Street, which is likely to reflect the proposed closure of the Kahikatea Drive western leg at the future Greenwood Street / Kahikatea Drive intersection as part of HSL.

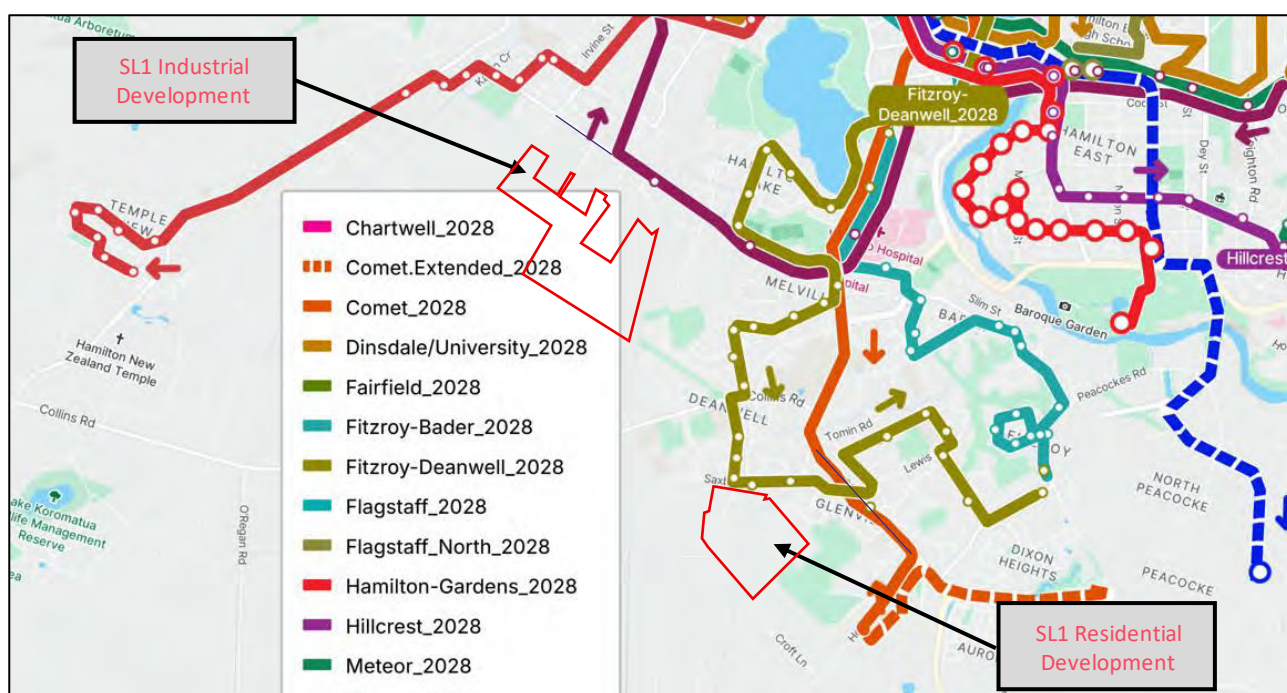


Figure 23: WRC 2028 Hamilton Bus Network Plan



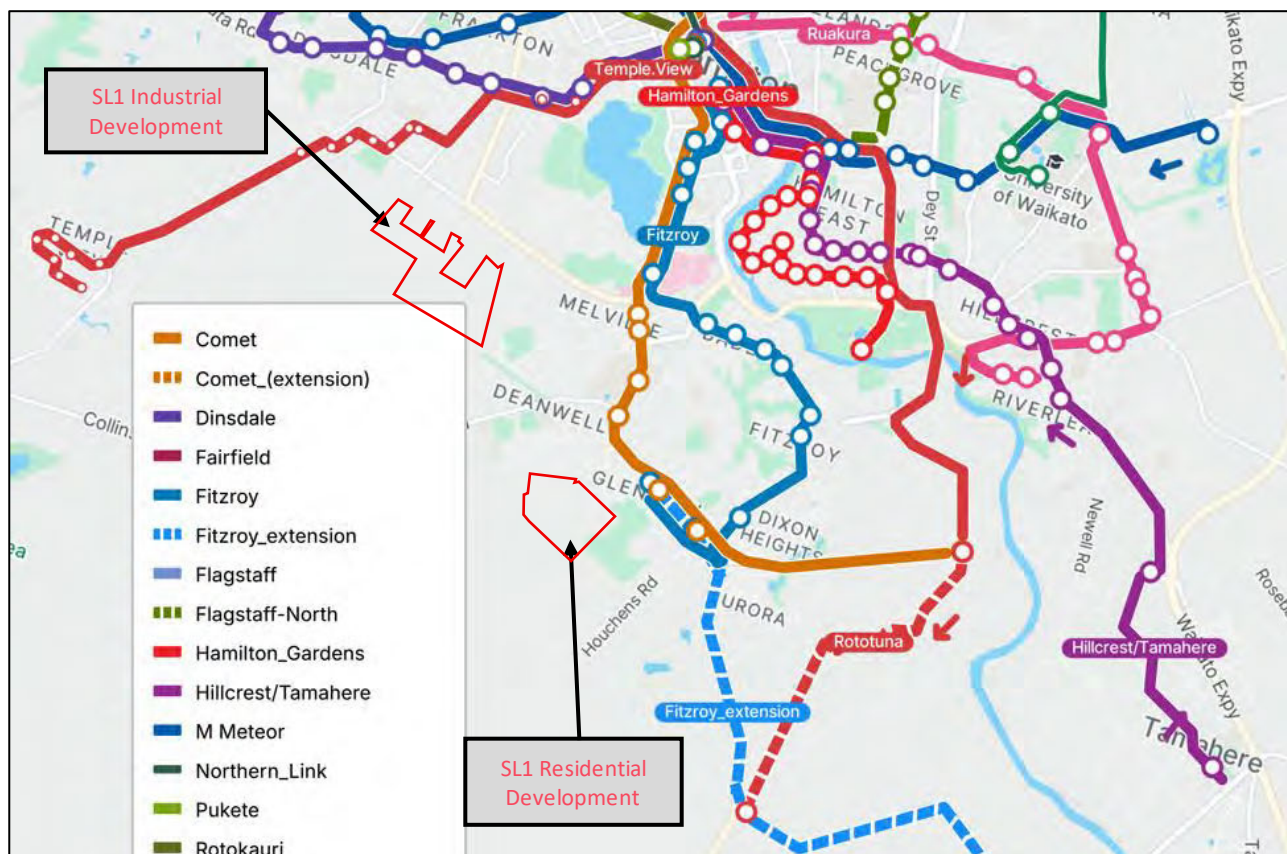


Figure 24: WRC 2037 Hamilton Bus Network Plan

9.1 Industrial Development

Public Transport services presently travel through Higgins Road and Kahikatea Drive as shown in Figure 3. This is likely to continue until the Kahikatea Drive Extension arm at the Greenwood Street / Kahikatea Drive intersection is closed as part of the HSL project. Following its closure, bus services are planned to travel via Lethborg Street.

The Industrial Development provides pedestrian access to existing and future public transport services via the proposed walking and cycling infrastructure and connections to the existing network. Future walking and cycling connections are discussed further in Section 10.1.

9.2 Residential Development

Figure 25 shows indicative bus routes through the proposed Residential Development. The proposed route represented by purple dashed lines demonstrates how it can integrate with WRC's short-term and medium-term proposed bus networks (Figure 23 and Figure 24) by looping through the subdivision and connecting back to Saxbys Road / MacDonald Road intersection.

The bus route represented by maroon dashed lines could potentially be implemented when the SL1 wider growth cell, south of the site, is developed, connecting Saxbys Road to Houchens Road via the extended minor arterial road.



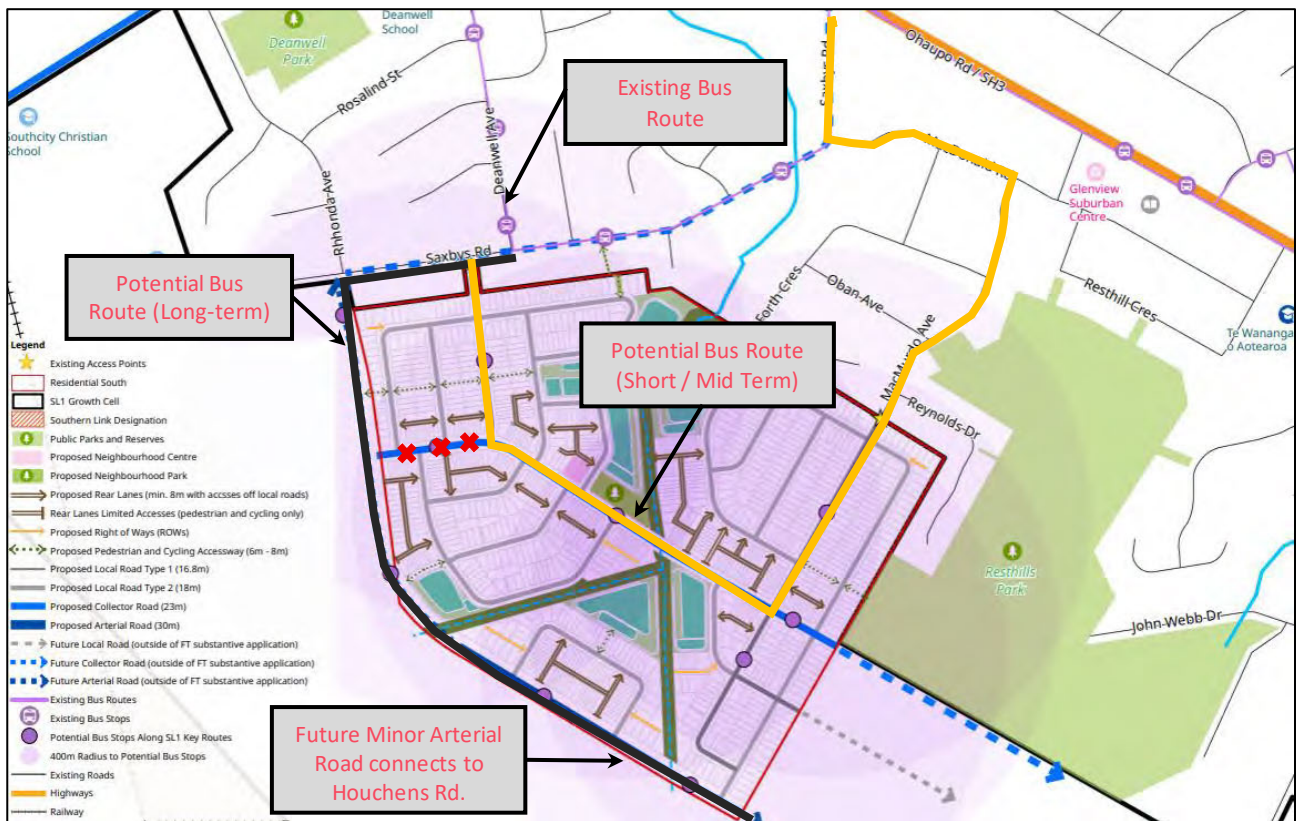


Figure 25: Proposed Bus Route through Residential Development

The Residential Development scheme plan aligns with this assessment by providing suitable road carriageway widths on:

- The minor arterial road (Figure 37) for future PT corridor.
- The internal collector road (Figure 38) for short and mid-term bus routes.
- MacMurdo Avenue extension (Figure 21)

In accordance with the ODP Table 15-5a_{ii}, all bus stops along the internal collector road will be in lane.

10. Walking and Cycling Connections

Walking and cycling infrastructure is an integral part of the SL1 transport network rather than an ancillary amenity. Increasing walking and cycling also supports increased public transport use which together, reduces reliance on private vehicles for local trips. The proposed network is designed to be direct and cohesive while prioritising safety by generally routing users away from higher-volume arterial roads to low speed, low volume roads where suitable alternative local routes exist.

Cycling infrastructure design for SL1 focuses on the following three trip types:

- Short neighbourhood trips within Glenview and Deanwell where walking may be undesirable due to distance. This would include trips to the Glenview Shopping Centre and schools (i.e. Deanwell School and Melville High School).
- Recreational trips within and potentially beyond the wider SL1 growth cell. This would likely connect to existing exploration routes such as the Western Rail Trail.



- Longer distance commuter / education trips, including between neighbourhoods and to employment nodes such as Waikato Hospital and Frankton Industrial area.

The proposed roading network provides a highly connected network of streets, which will enable walking trips to be made on direct routes within and beyond the development. Footpaths are provided to support walking accessibility throughout the Site.

The proposed network for pedestrians and cyclists is shown in Figure 26 and Figure 27. The proposed network is designed to provide direct and connected routes that support everyday trips and reduce dependence on private vehicle travel.

10.1 Industrial Development Walking and Cycling Connections

The indicative walking and cycling network for the Industrial Development is shown in Figure 26. The network has been developed to provide connections between the site, surrounding transport infrastructure, and the wider active mode network.

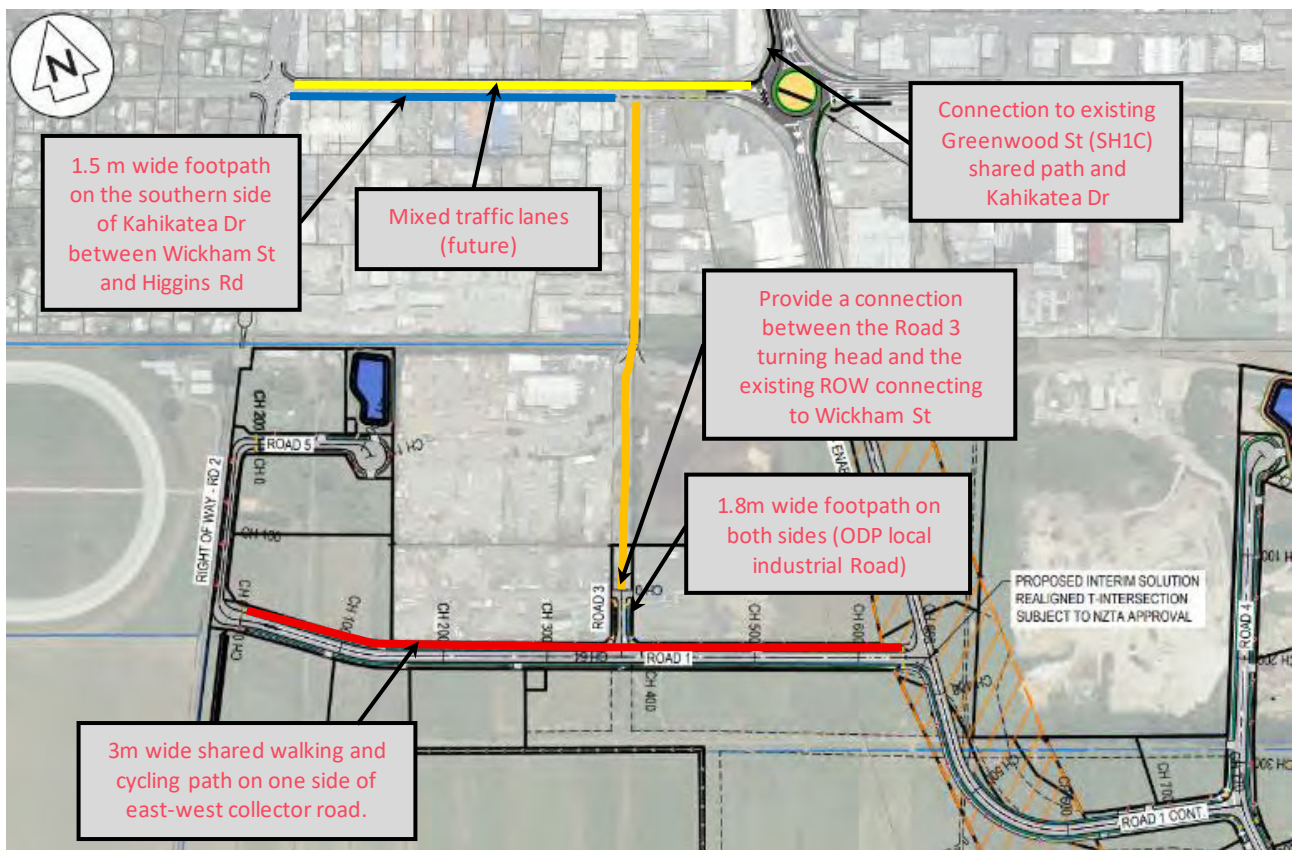


Figure 26: Industrial Development – Proposed Walking and Cycling Network

10.1.1 Shared Walking and Cycling Paths (Red Line)

A 3.0 m wide shared path is proposed along the northern side of the east-west collector road. This facility will form the primary active mode spine through the Industrial Development.

The shared path is intended to connect with the existing 3.0 m shared path on Greenwood Street via Wickham Street and the existing Right-of-Way ("ROW") south of Wickham Street (represented by orange lines in Figure 26). Cycling on Wickham Street and the existing ROW will be accommodated on-road in a shared traffic environment, as is the present case in alignment with the ODP. This arrangement provides



continuity of active mode access from the existing Greenwood Street shared path into the Industrial Development area.

In the longer term, the east-west collector road is expected to be extended westwards through the adjacent Rogerson Block towards Tuhikaramea Road. This would enable the shared path to form part of a broader east-west active mode corridor linking the Frankton industrial area, Greenwood Street shared path and cycling facilities on Tuhikaramea Road. While the timing and delivery of these wider connections are dependent on future development outside the Project area, the proposed shared path has been designed to support that future network integration.

10.1.2 New Footpath Connection (Blue Line)

A new 1.5 m wide footpath (in alignment with the ODP requirements for a collector industrial road) is proposed to provide pedestrian connectivity between the Industrial Development and existing public transport services west of the site. The footpath will enable pedestrians to access existing bus stops on Kahikatea Drive, Higgins Road and Lethborg Street and maintain connectivity to the surrounding pedestrian network.

10.1.3 Mixed Traffic Lanes (Yellow Line)

Kahikatea Drive Extension will experience substantially lower traffic volumes and operating speeds following its permanent closure at the Greenwood Street / Kahikatea Drive intersection as part of HSL Stage 1 implementation. This will create an environment suitable for mixed traffic lanes, providing an on-road cycling connection between the Industrial Development, Greenwood Street shared path and the wider active mode network. Supporting measures such as sharrow markings, wayfinding and traffic-calming treatments could be considered during the detailed design phase.

10.2 Residential Development Walking and Cycling Connections

Walking and cycling wider network connectivity general arrangement plans for the Residential Development are attached as Appendix A.

The proposed active mode network has been developed as an integrated network that connects the Residential Development to key destinations including Deanwell School, Waikato Hospital, the Western Rail Trail, MacDonald Road, Greenwood Street and the wider Hamilton cycling network. The proposed facilities have been selected having regard to corridor function, expected active mode demand, safety outcomes, and the physical constraints of the existing road reserve.

The form of facility varies by location, reflecting the surrounding street environment, available corridor width and the role each corridor performs within the wider network. Higher levels of separation are proposed where cyclist volumes, school travel demand or traffic exposure are expected to be greater, while lower-speed local roads are proposed to accommodate cyclists within the mixed traffic environment.



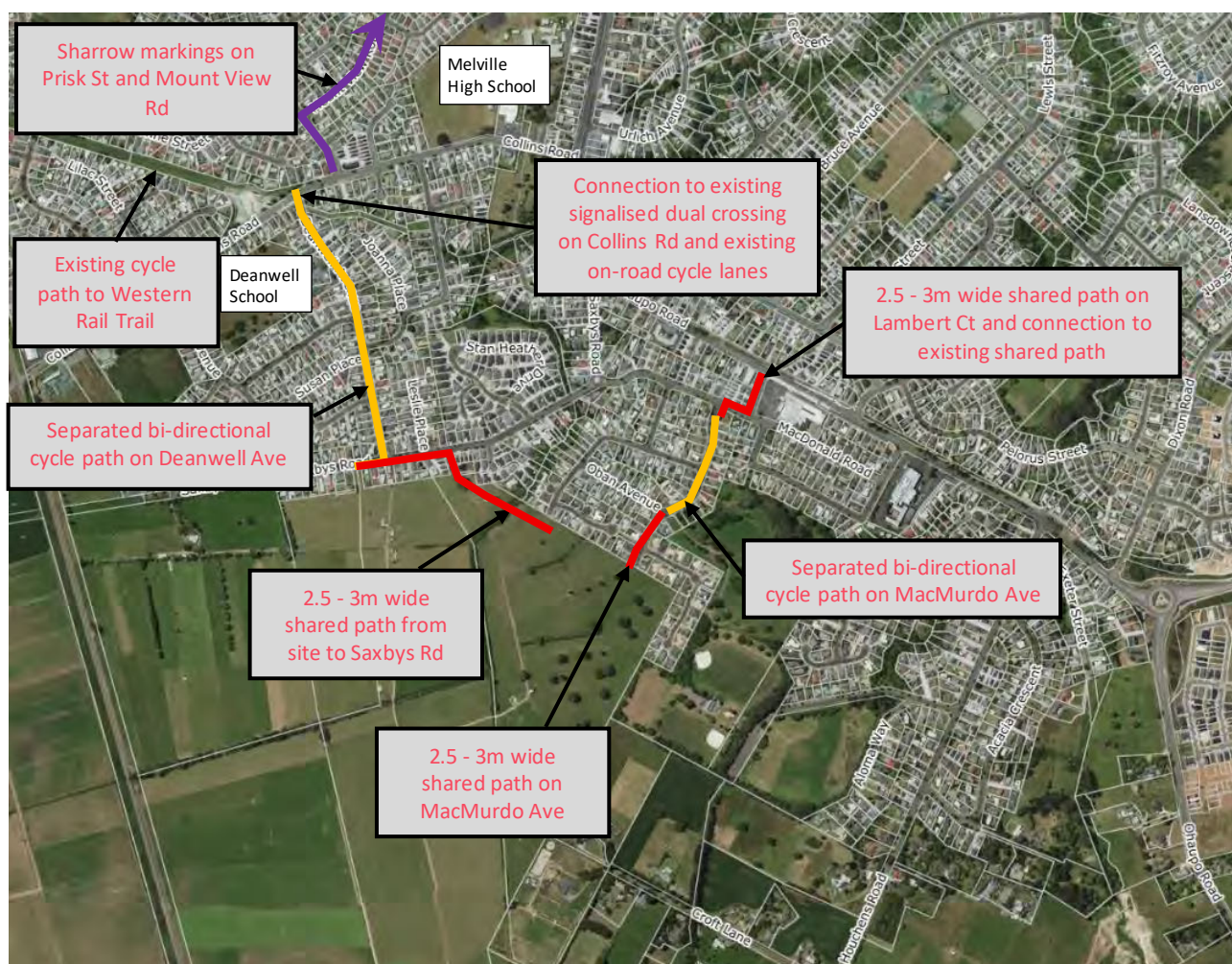


Figure 27: Residential – Proposed Walking and Cycling Network

The proposed walking and cycling network comprise three facility types:

- **Separated bi-directional cycle paths:** These are dedicated cycling facility on one side of the road accommodating cycling in both directions. They involve some form of physical separation (horizontal or vertical components) from motor traffic and pedestrians. In the Residential Development context, these facilities provide key connections to schools and local destinations and can generally be accommodated within the existing sealed carriageway width.
- **Shared walking and cycling paths:** Shared use facilities for pedestrians, cyclists, mobility devices and wheeled recreational devices, without physical separation between user types. These facilities provide a high level of separation from general traffic and are intended to support active mode trips on corridors where a shared path is appropriate.
- **Mixed traffic lanes:** Mixed traffic lanes are common to most roads, where no formal cycle facilities are provided and cyclists can share the roads with general traffic. Prisk Street and Mount View Road are proposed to operate in this manner, with sharrow markings, providing an alternative route to Ohaupo Road while maintaining connectivity to the existing on-road cycle lanes north of Normandy Avenue.

The proposed shared path network is intended to support active mode travel across the development for a broad range of users, while maintaining separation from general traffic lanes. This includes local trips by lower-speed users accessing destinations such as the neighbourhood centre, parks and schools.



Recognising general guidance for shared paths, the width of the shared path on the collector road is proposed at 3.5 m while the shared paths on existing residential streets are proposed at 3.0 m wide due to space constraints with existing trees and infrastructure. This is wider than the “desirable minimum width¹⁵” of 2.5 m for a local access path, and consistent with the typical maximum width included in Austroads Guide to Road Design Part 6A: Paths for Walking and Cycling Edition 2.1 (“AGRDR Part 6A”). The increased width supports the multi-user nature of the paths and reduces the risk of pedestrian – cyclist conflict.

10.2.1 Saxbys Road

Although Saxbys Road is identified as a local road in the ODP transport corridor hierarchy, it already performs a collector-type function by facilitating movement of people and goods between local destinations and higher-order corridors (i.e. Ohaupo Road). The Residential Development will reinforce that existing function, particularly following development beyond Stage 1, as Saxbys Road will provide the primary connection between the development’s internal collector road network and Ohaupo Road.

In this context, corridor-wide upgrades to fully achieve the ODP collector road cross-section are not considered necessary. Instead, targeted improvements are proposed, comprising the walking and cycling connections described in Section 10.2 and localised rationalisation of on-street parking where required to accommodate those facilities. These works are proposed to be delivered through the development staging framework and associated consent conditions and are to be completed prior to occupation of the relevant stage of Residential Development that relies on access via Saxbys Road. This is reflected in the recommended transport infrastructure staging framework set out in Table No: 44.

The ODP collector road standard recommends a 24.6 m (based on single direction separated cycle paths on both sides of the road) or 23.3 m (based on bi-directional cycle path on one side of the road) road reserve with 6.8 m wide carriageway, 2.1 m wide recessed parallel parking bays and 2 m wide footpaths on both sides of the road. However, given the existing 20.1 m road reserve and carriageway width of approximately 10 m to 12 m, it is not practicable to fully achieve all elements of that cross-section without significant widening and associated effects. In this instance, the Project adopts a targeted, network-based response that is proportionate to the corridor’s existing and future function.

Cycle facilities and a footpath on the southern side of Saxbys Road are not proposed as part of the upgrade. Instead, cycle movements are directed to an alternative parallel route via Deanwell Avenue, Mount View Road and Prisk Street, which provides a lower volume and lower speed environment that is more suitable for active mode users than the Ohaupo Road arterial corridor, while still providing direct access to key destinations including Waikato Hospital and the Western Rail Trail.

A pedestrian refuge island is proposed east of Leslie Place, as shown in Figure 24, to enable pedestrians to cross from the proposed shared path to the existing footpath on the opposite side of the road. This approach reflects a deliberate network design response that prioritises low speed and low volume routes for walking and cycling, rather than duplicating facilities on both sides of a constrained corridor.

As shown in Figure 28, a 3 m wide walking and cycling shared path could potentially be accommodated within the existing 4.5 m wide berm on the southern side of Saxbys Road between Leslie Place and Deanwell Avenue. This would likely require the removal or relocation of existing trees and power/communications feeder poles along approximately 150 m of the road corridor.

The final design and configuration of Saxbys Road will be confirmed at the detailed design stage, having regard to corridor constraints, safety outcomes, and input from HCC. The 3.0 m wide shared path along Saxbys Road, together with the associated wetland connection to the development, is to be delivered as part of Stage 1A and prior to occupation of any Stage 1A lots.

¹⁵ Austroads Guide to Road Design Part 6A: Paths for Walking and Cycling, Edition 2.1, Table 5.3





Figure 28: Indicative Alignment and Cross-section of Saxbys Rd

10.2.2 MacMurdo Avenue

MacMurdo Avenue forms an important local active mode connection between the Residential Development, MacDonald Road, Lambert Court and the wider network to the north and east. A shared path is proposed on MacMurdo Avenue between the site and Oban Avenue, transitioning to a separated bi-directional cycle path with adjoining footpath between Oban Avenue and MacDonald Road. This approach responds to the differing corridor constraints and network function along the route while maintaining continuity of connection for cyclists and pedestrians.

Between the site and Oban Avenue, where the road reserve narrows to approximately 17 m, a 3.0 m shared path can be accommodated within the existing corridor. Between Oban Avenue and MacDonald Road, a separated bi-directional cycle path is proposed so that the removal of mature trees in the eastern side road berm can be avoided. Accommodating that treatment within the existing road reserve requires removal of on-street parking along parts of the corridor and provision of localised recessed parking bays.

This response is consistent with HCC's Parking Policy (V2 March 2024)¹⁶, which gives greater priority to safe and efficient movement of people than to long-stay parking on residential streets. While some demand for on-street parking is expected, the Project retains as much parking as practicable through recessed bays while prioritising provision of the walking and cycling connection within the constrained existing road reserve.

¹⁶ <https://hamilton.govt.nz/assets/Uploads/Documents/Policies/Hamilton-City-Parking-Policy.pdf>



Location	Central City/ Commercial areas	Residential	Employment
Overarching Priority	Safety		
1 st Priority	Movement and place	Movement and place	Movement and place
2 nd priority	mobility parking spaces	mobility parking spaces	mobility parking spaces
3 rd priority	Bus stops	Bus stops	Loading and servicing
4 th priority	Loading and servicing	Residents' parking	Bus stops
5 th priority	Biking and micro-mobility parking	Biking and micro-mobility parking	Biking and micro-mobility parking
6 th Priority	Short to medium stay parking	Short to medium stay parking	Short to medium stay parking
7 th Priority	Long-stay/ commuter parking	Long-stay/ commuter parking	Long-stay/ commuter parking

Figure 29: Prioritisation of Road Space (HCC Parking Policy – Principle Two)

The walking and cycling connection along MacMurdo Avenue, and continuing to MacDonald Road and Lambert Court, is to be delivered prior to Stage 1C of the Residential Development (approximately 198 dwellings). This reflects the point at which active mode demand is expected to become more established, and the route begins to perform a stronger wider-network function.

This is on the basis that in Stage 1A and 1B, the demand for walking and cycling infrastructure is expected to still be low, whereas cycling trips in Stage 1C are expected to increase to more than 10 users per hour based on the calculation method described in Section 12.2.2 and an aspirational active mode share target of 11.4% (i.e. target for 2045 with full development within Residential Development).

AGRD Part 6A, Figure C1 identifies that fewer than 10 users (cyclists or pedestrians) per hour is considered low volume demand. As the path volumes (i.e. both pedestrians and cyclists) on MacMurdo Avenue are expected to range between 10 to 30 users per hour across all horizon years, the risk of conflict between pedestrians and cyclists is low and therefore does not justify a bi-directional cycle path separate from the footpath.





Figure 30: Indicative Alignment and Cross-section of MacMurdo Ave

10.2.3 Deanwell Avenue

Deanwell Avenue is an important transport corridor linking the Residential Development and wider Resthill residential area to Deanwell School and the Hamilton Cycle Network via the Western Rail Trail. The number of primary school aged children walking and cycling to Deanwell School is expected to increase significantly with the development of SL1, and Deanwell Avenue will also become a primary route for commuter cyclists travelling to and from Waikato Hospital and the CBD via Prisk Street and Mount View Road.

Therefore, for the safety of all cyclists, but particularly primary school aged students, a 3.0 m wide bi-directional cycle path is proposed on the western side Deanwell Avenue as shown in Figure 31.

The indicative cross-section demonstrates that a bi-directional cycle path can be accommodated within the existing 18.3 m wide road reserve. However, this involves the removal of on-street parking on the western side of the road and a reduction in traffic lane widths to 3.1 m. Existing Lane widths would be maintained on approaches and exits to existing roundabouts, while wider 3.4 m lanes are proposed adjacent to the existing bus stop shelter. There is also a 0.8 m wide buffer to allow properties to place their wheelie bins without obstructing both the path users as well as the traffic lanes.

It is recommended that the bi-directional cycle path on Deanwell Avenue and the sharrow markings on Prisk Street and Mount View Road be provided prior to Stage 3 (i.e. 725 dwellings). This is on the basis that a



moderate walking and cycling demand (i.e. approximately 30 cyclists plus 30 pedestrians per hour) is expected to be generated by the Residential Development on Deanwell Avenue based on the calculation method described in Section 12.2.2 and an aspirational active mode share target of 11.4% (i.e. target for 2045 with full development within the Residential Development). The path volumes (i.e. both pedestrians and cyclists) on Deanwell Avenue are expected to reach approximately 110 users per hour in 2045 and thus a separated cycle path is considered appropriate to limit the incidence of conflict between users.



Figure 31: Indicative Alignment and Cross-section of Deanwell Ave

11. Internal Road Network

The road networks in the Industrial and Residential developments are designed to encourage multi-modal transport in response to differing operational requirements. The proposed road hierarchy reflects expected



traffic volumes including heavy vehicles, active mode requirements, future access for public transport and the surrounding land use context. The subdivision layouts were assessed against Table 15-5a(ii) of the ODP, which provides indicative geometric standards for each road classification. Where appropriate, the proposed cross-sections have been refined to respond to the specific context, transport function and anticipated demand associated with the development.

11.1 Road Carriageway Widths

11.1.1 Industrial Development

Figure 32 illustrates the proposed road network for the Industrial Development, and the road hierarchy and widths are shown in the legend. The road corridor typologies are designed to appropriately cater for heavy vehicle traffic associated with industrial activities, along with safe provision for walking and cycling to provide travel-mode options for future workers in the area.

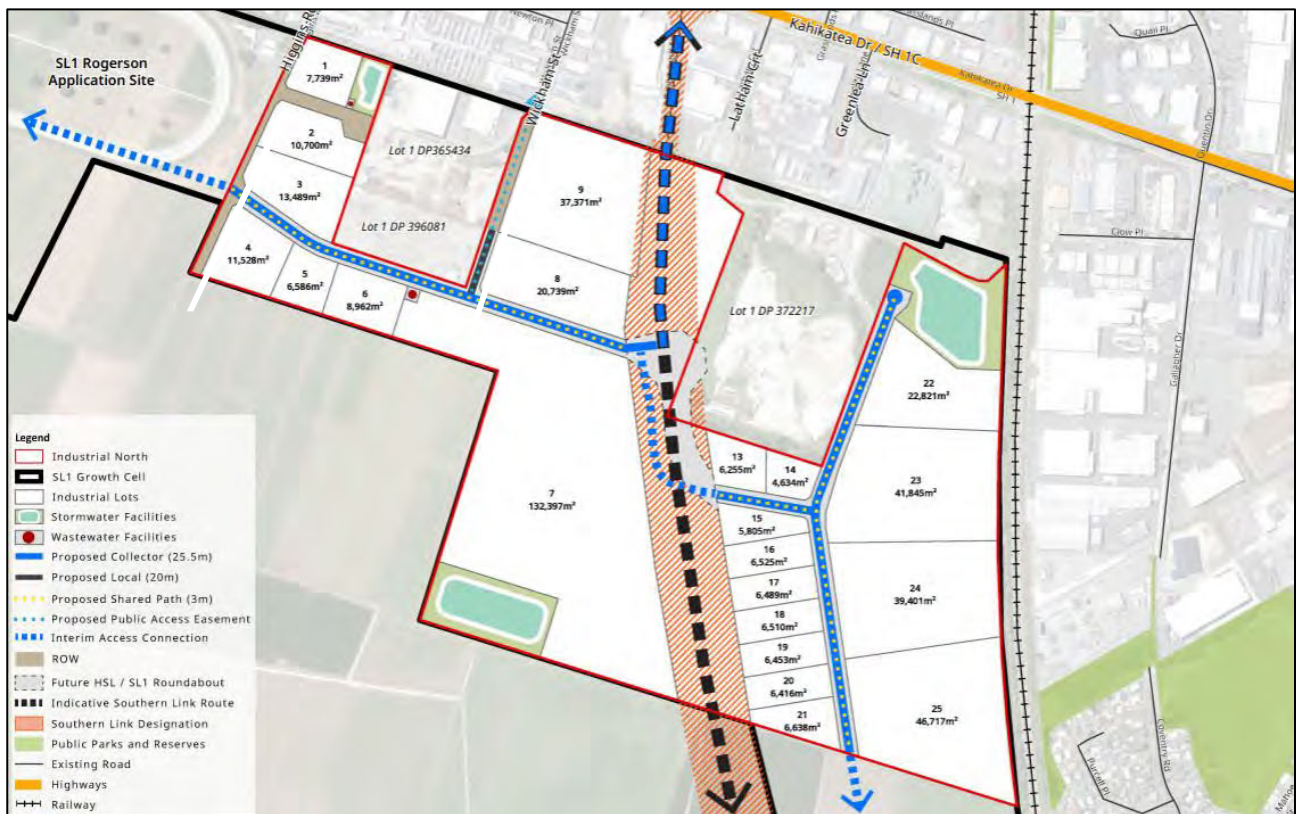


Figure 32: Industrial Development – Road Carriageway Width Hierarchy

Industrial Collector Road

The collector road will provide the principal movement corridor through the Industrial Development, with its primary connection via the SL1 roundabout on HSL. The position of the collector road future proofs it for extension west to Tuhikaramaea Road to provide an integrated collector road corridor through the adjacent SL1 Rogerson Block (a Fast-Track referred project) when that area is developed.

The proposed collector road cross-section is illustrated in Figure 33. It provides a carriageway width of 11.5 m inclusive of a 2.5 m wide flush median within a 25.5 m wide road reserve. A 3.0 m wide shared walking and cycling path is provided on the northern side of the road to support active mode access within the Industrial Development and connections to the wider walking and cycling network. Pockets of recessed parallel parking bays are provided on both sides of the carriageway.



However, the proposed collector road cross-section does not fully align with the ODP standard, which recommends a 27.8 m or 26.5 m wide road reserve and provision of a separated bi-directional cycleway and footpath on both sides of the road.

This assessment finds that a single 3.0 m wide shared walking and cycling path on one side of the road is sufficient active mode infrastructure because future use is unlikely to be high as through trips by walking and cycling are expected to be low in this location on the southeastern perimeter of Hamilton. Accordingly, a 25.5 m wide road reserve width is considered appropriate. Furthermore, a shared path facility is consistent with nearby active mode facilities, including the primary network path on Greenwood Street.

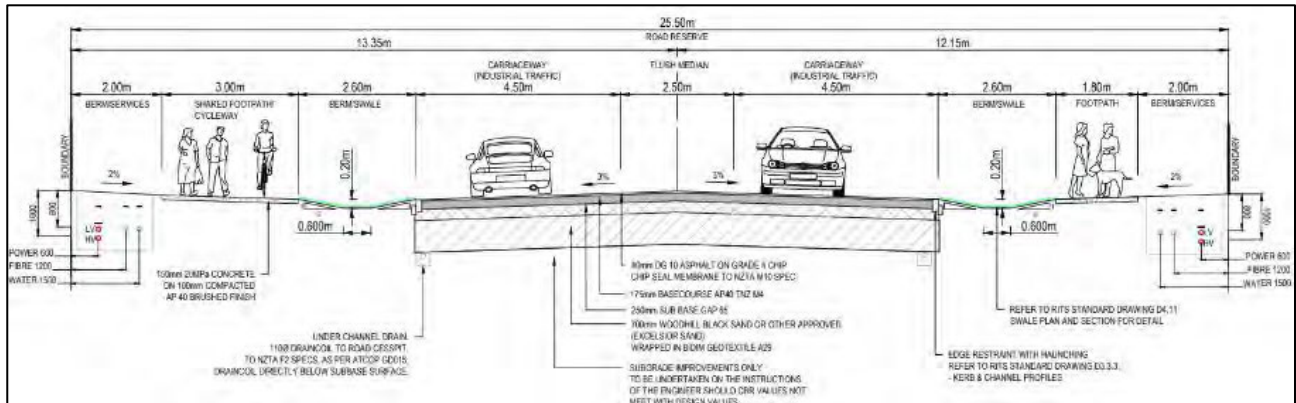


Figure 33: Industrial Development – Collector Road Indicative Typical Cross-section

Industrial Local Road

Local roads within the Industrial Development will fulfil ODP minimum requirements for a local industrial road as shown in Figure 34.

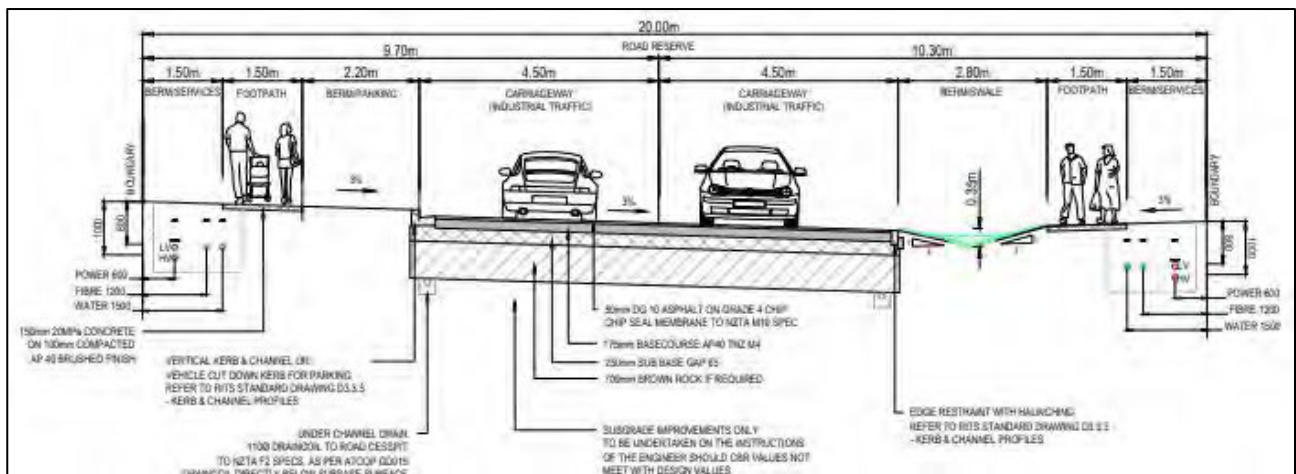


Figure 34: Industrial Local Road Indicative Typical Cross-Section

Industrial Private Right-of-Ways ("ROW") / Jointly Owned Access Lots ("JOAL")

All ROWs / JOALs are expected to be private roads. However, they have a carriageway width of 7 m which is in accordance with the Regional Infrastructure Technical Specifications V2 ("RITS"). The RITS Section 3.3.11.4 (c) specifies a minimum carriageway width of 6.4 m for an industrial private way serving two or more lots. The ROWs / JOALs can accommodate a 12.6 m rigid truck in accordance with RITS.



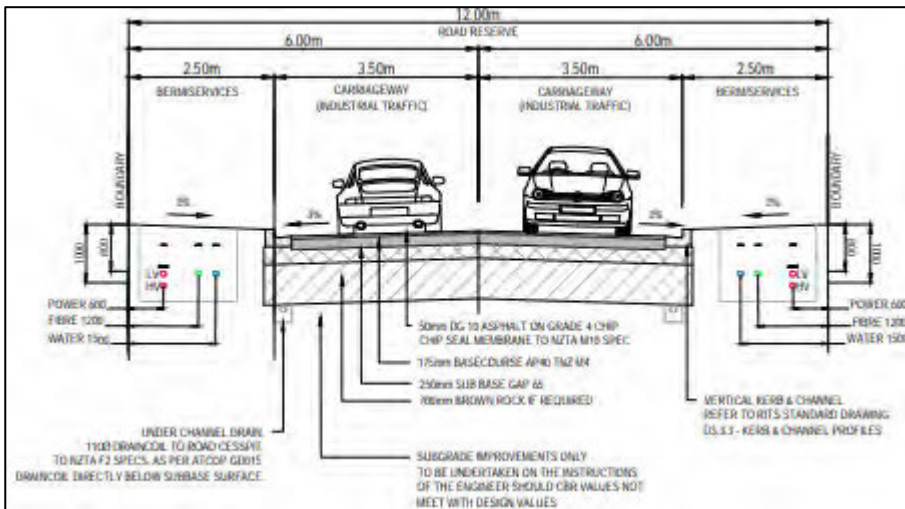


Figure 35: Industrial ROW Indicative Typical Cross-Section

11.1.2 Residential Development

Figure 36 illustrates the proposed road network for the Residential Development, and the road hierarchy and widths are shown in the legend. The road corridor typologies are designed to appropriately cater for vehicle traffic that is typically anticipated, along with safe provision for walking and cycling and PT.



Figure 36: Residential Development – Road Carriageway Width Hierarchy

Residential Minor Arterial Road

A 500 m long section of the minor arterial road is proposed to be constructed as part of the Residential Development along the southern boundary of the site. This road is expected to be extended northwards with a connection to Saxbys Road, and southwards towards Houchens Road when land surrounding the road (but not included in this Project) is developed in future.



The ODP requires minor arterial roads within a residential land use environment to be a two-lane transport corridor with a 3 m flush median. All bus stops along a minor arterial corridor are expected to be kerbside and separated cycle lanes on both sides or bi-directional off-road separated from carriageway one side is to be provided.

To maintain flexibility for the minor arterial road to potentially serve as a future bus route or frequent transit corridor, the corridor has been designed and safeguarded to enable future public transport priority measures, if required. This ITA does not assume or require dedicated public transport lanes as part of the Project. Figure 26 illustrates a representative typical cross-section.

Delivery of the full minor arterial road carriageway is not required to support the level of development proposed by the Residential Development. Accordingly, only one half of the ultimate carriageway (i.e. one lane in each direction) is proposed to be constructed initially. The balance of the carriageway can be delivered at a later stage when the wider SL1 growth cell to the south and west of the minor arterial road (not part of this Project) is developed. This will include connection of the minor arterial road to Saxbys Road and Houchens Road.

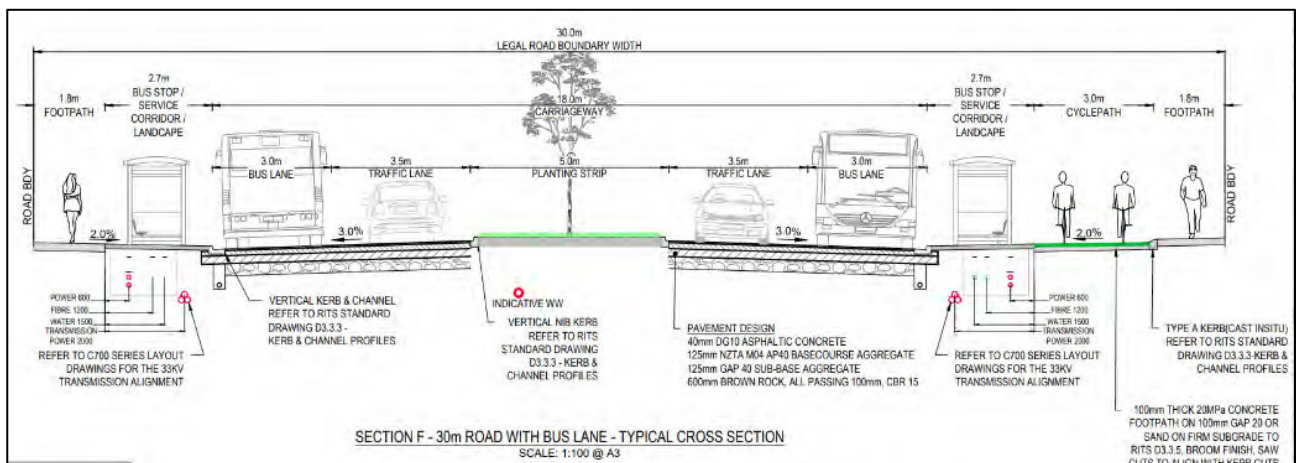


Figure 37: Residential Development – Minor Arterial Rd Indicative Typical Cross-section

Residential Collector Road

The primary access through the Residential Development is proposed via the north-south collector road. The indicative cross-section of the residential collector road is illustrated in Figure 38. This road typology provides a carriageway width of 7.0 m within a 23.0 m wide road reserve. Certain sections of the collector road include a 3.3 m wide flush median as shown in Figure 39 to facilitate right turning movements into side local roads

A 3.5 m wide shared walking and cycling path is provided on one side of the road and recessed parallel parking bays are provided on both sides of the carriageway. While separated cycleways (Table 15-5a(ii) of the ODP) were considered during development of the cross-sections, they were not preferred due to the existing walking and cycling shared paths in the adjoining road network. A shared path will ensure the continuity of the facility type.



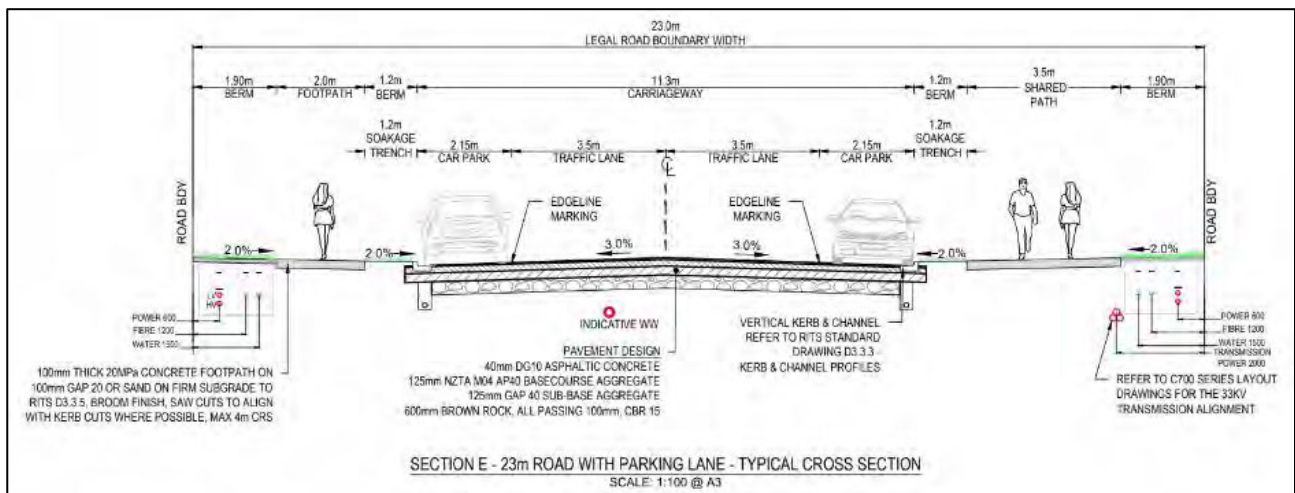


Figure 38: Residential Development – Collector Rd Indicative Typical Cross-section

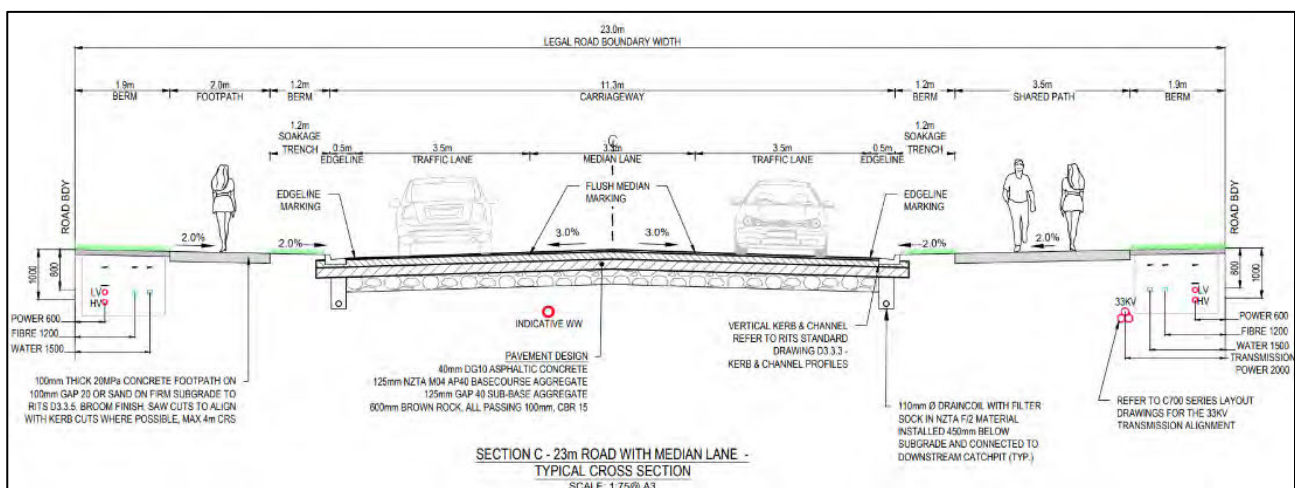


Figure 39: Residential Development – Collector Rd with Flush Median Indicative Typical Cross-section

Residential Local Road Type 1

Refer to Section 8.2.1 with regards to proposed MacMurdo Avenue extension.

Residential Local Road Type 2

All other internal roads will be designed as per the cross-section illustrated in Figure 40. This local residential road typology provides a carriageway width of 6 m within a 16.8 m wide road reserve in accordance with the ODP. 1.8 m wide footpaths and 2.1 m wide recessed parallel parking bays are provided on both sides of the carriageway. It is intended that cyclists can safely share the road with vehicles on local roads given the low vehicle speeds and volumes on these roads.



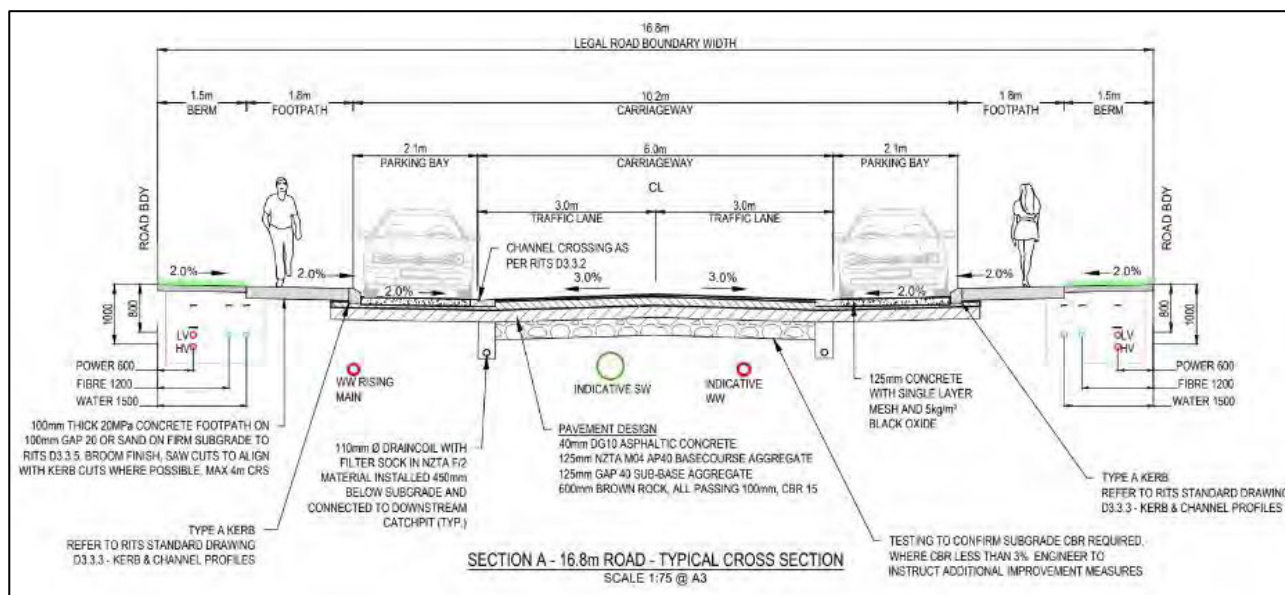


Figure 40: Residential Development – Local Rd Type 2 Indicative Typical Cross-section

JOAL / Rear Lanes

JOAL or rear lanes where proposed, will be designed in accordance with the ODP and confirmed through detailed design.

11.2 SL1 Development Intersections

The RITS requires the following separation distance between intersections. The proposed internal intersections fulfil these minimum requirements.

	LOCAL ROADS	COLLECTOR OR ARTERIAL ROADS	INDUSTRIAL ROADS
Same Side	60m	90m	200m
Opposite Side	30m	45m	100m

Figure 41: Minimum Intersection Spacing (Source: RITS)

Local road intersections are expected to be designed and constructed as priority-controlled intersections, either in the form of a T-intersection, or a crossroad with the side road giving way (or stopping). Kerb buildout could potentially be provided to support reduced pedestrian crossing lengths. This is a design detail that can be addressed at Engineer Plan Approval stage with HCC.

Specific intersections within the site will be in the form of a compact roundabout with a raised central island and mountable apron/collar.

Internal intersection designs will be addressed in detailed design phase.

Recommended Condition

All new road intersections shall be designed in accordance with the relevant Austroads Guide to Road Design and applicable Waikato Regional Infrastructure Technical Specifications, with final designs confirmed through the detailed design and engineering approval process.



12. Trip Generation

12.1 Travel Mode Splits

The future year periods assessed for the Project are 2030, 2035, 2045 and 2055. While the Project's transport effects are principally assessed through the 2030, 2035 and 2045 scenarios, a 2055 scenario has also been included to understand the longer-term performance of the wider transport network under a broader growth scenario. This scenario incorporates development beyond the Project, including other areas of the wider SL1 growth cell, and is intended to provide strategic context only.

Public Transport and active travel mode shares have been increased incrementally to take account of the increasing provision of walking and cycling facilities within the proposed development areas and on the adjoining road network. Table No: 7 and Table No: 8 below present the aspirational active mode and PT mode share targets for the various periods assessed.

The forecast mode shares should not be interpreted as guaranteed outcomes. Rather, they represent reasonable planning assumptions having regard to the proposed urban form, active mode connections, future public transport opportunities and strategic planning framework. Achievement of future mode share outcomes will be influenced by future transport investment, service provision, fuel price and travel behaviour trends.

12.1.1 Industrial Development Travel Mode Estimates

Travel mode splits in 2030 are estimated based on the 2023 Census data for travel to work in the Frankton Junction area of Hamilton (industrial zone).

The 2035 travel mode splits are based on 2023 Census data on how people travel to work in Riverlea and Ruakura (Hamilton). These statistical areas consist of industrial land use with good accessibility to walking and cycling, and PT networks to surrounding residential areas, therefore are considered reasonable proxies to anticipate the mid-term uptake of PT and active travel modes.

The 2055 travel mode splits are based on 2023 Census data on how people who work in Rongotai and Miramar South in Wellington travel to work. These statistical areas within Wellington consist of industrial land use and have high frequency routes currently servicing the areas as shown in Figure 42. This is also aligned with the Waikato Regional Transport Plan that indicates a frequent bus route is envisioned at the Kahikatea / Frankton area by 2032 (refer to Figure 9).

The 2045 travel mode splits for public transport and active modes have been adopted as reasonable and conservative assumptions having regard to the 2035 and 2055 mode share scenarios. They are intended to represent a gradual transition towards higher public transport and active mode use over time, rather than a direct interpolation between the two scenarios.

Table No: 7

Travel Mode Splits – Industrial Development				
Travel Mode	2030 ¹⁷	2035	2045	2055
Private Vehicle (Driver)	90.3%	84.5%	82.6%	78.2%
Public Transport	1.2%	2.2%	4.0%	6.8%

¹⁷ <https://tools.summaries.stats.govt.nz/places/SA2/frankton-junction#main-means-of-travel-to-work>



Active Mode	3.4%	8.4%	8.5%	10.1%
Private Vehicle (Passenger)	3.2%	3.2%	3.2%	3.2%
Working from Home	0.5%	0.5%	0.5%	0.5%
Other	1.2%	1.2%	1.2%	1.2%

The working from home component shown in Table No: 7 reflects Census travel-to-work reporting for the comparator industrial areas only. It has not been applied as a reduction to the adopted Industrial Development vehicle trip generation rate (refer to Section 12.2.1), as the adopted rate is based on observed vehicle trips per developable hectare and already reflects the operational characteristics of comparable industrial activity.

12.1.2 Residential Development Travel Mode Estimates

Travel mode splits in 2030 are estimated using 2023 Census data on how people who live in Resthill, Hamilton travel to work.

2035 PT and active mode shares are based on 2023 Census data from Peachgrove-Greensboro, Hamilton East and Hillcrest (all in Hamilton). These areas currently densely populated (approximately 7,000 to 10,000 population) with good accessibility to PT and walking and cycling connections.

2045 PT and active mode shares are based on 2023 Census data from statistical areas within Wellington comprising predominantly medium density residential land use and served by existing high frequency public transport routes (i.e. Island Bay, Lyall Bay and Miramar East). These areas are not in central Wellington and have been selected because they represent suburban residential environments where frequent public transport services support higher levels of public transport and active mode use (refer to Figure 42). For context, Table No: 9 below presents the typical service frequencies for the for the three high-frequency Metlink bus routes in Wellington, based on current Metlink / Transit App data (as of April 2026).

The Wellington comparator areas are not intended to directly predict future travel behaviour within the Residential Development area. Rather, they provide examples of mode share outcomes achieved in New Zealand urban environments that are served by frequent public transport corridors and supported by high-quality walking and cycling infrastructure.

Ohaupo Road (SH3) is identified in the PT Pathways Report as a bus priority transport corridor, serving Glenview with one frequent bus services (i.e. Comet – Tier 1 frequent service). By the long-term network (i.e. 2038), this route operates at a 10-minute peak frequency which equates to approximately 6 buses per hour per direction. This level of service is consistent with the frequencies of the Metlink bus routes identified above. Therefore, this assessment considers that the adopting Census data from the identified statistical areas within Wellington provides a reasonable proxy of the mode share split that can be expected in the year 2045. Frequent bus services provide substantial passenger-carrying capacity and enables a proportion of future travel demand to be accommodated by public transport rather than additional private vehicle movements.

2055 PT and active mode shares are aspirational mode-shift from car dependence during commuter peaks, but it is supported by the proposed medium-density residential in SL1 (reduced car parking and garaging) and aligns with the “transformational” shift to PT enabled by the Rapid Transit Network key moves envisaged in the Waikato Metro Spatial Plan. The MSP Programme Business Case states in Section 1.8 that “*The assessment of the public transport and active modes share in 2051, and based upon the preferred land use scenario 2a, has concluded that the region wide mode shift would be 20%; with the ability to achieve up to 44% (forecast as 32% for public transport and 12% for walking/cycling and micromobility) in the identified*



key BRT corridors of Hamilton City.”. This is further supported by the PT Pathways Report which states that the Comet – Tier 1 frequent route is expected to “eventually transition to BRT, which would have dedicated rights-of-way or continuous bus lanes, purpose-built bus stations, and dedicated traffic signalling at all locations”.

Table No: 8

Travel Mode Splits – Residential Development				
Travel Mode	2030 ¹⁸	2035	2045	2055
Private Vehicle (Driver)	77.2%	70.6%	59.2%	44.5%
Public Transport	3.9%	4.6%	13.9%	30%
Active Mode	3.4%	9.3%	11.4%	10%
Private Vehicle (Passenger)	3.7%	3.7%	3.7%	3.7%
Working from Home	10.8%	10.8%	10.8%	10.8%
Other	1.4%	1.4%	1.4%	1.4%

¹⁸ <https://tools.summaries.stats.govt.nz/places/SA2/resthill#main-means-of-travel-to-work>





Figure 42: Wellington City PT Network (Source: Wellington Regional Public Transport Plan, 2021 – 2031)

Table No: 9

Typical Service Frequencies for Metlink Bus Routes in Wellington			
Route	Core Corridor	Peak Frequency ¹⁹	Buses per peak hour (per direction) ²⁰
1	Johnsonville – CBD – Island Bay	8–10 min	6–8
2	Karori – CBD – Miramar/Seatoun	7–8 min	7–9

¹⁹ Relate to headways (minutes between buses)

²⁰ Calculated by converting documented peak headways (by Metlink and Transit App) into buses per direction per hour



3	Lyall Bay – Newtown – CBD	7–10 min	6-9
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12.2 Predicted Trip Generation

12.2.1 Industrial Development

The trip generation rates surveyed at the Central Precinct of the Airport Business Zone (Hamilton Airport - Titanium Park) are considered applicable to the proposed industrial land use in SL1. The Airport Business Zone has been gradually developed into one of the region's strategic industrial nodes and therefore provides a reasonable proxy to predict the number of trips that are likely to be generated by the proposed SL1 Industrial Development activities. Thus, a daily trip generation rate of 138.5 per developable hectare and a peak hour trip generation rate of 16.3 per developable hectare were adopted for this ITA.

It is recognised that the adopted trip generation rate pertains specifically to vehicles. It should be noted, however, that public transport accessibility as well as walking and cycling infrastructure are currently limited within the surveyed Central Precinct. As such, BBO considers that a proportion of these vehicle trips could transition to public transport or active modes, particularly in the context of the proposed Industrial Development area where new walking and cycling infrastructure linking to existing bus stops is recommended.

To recognise the potential for increased public transport and active mode uptake over time, a proportion of the vehicle trips derived from the Titanium Park surveys has been assumed to transition to public transport and active modes in future years. For the purposes of this assessment, an assumed mode shift of 5.8% has been applied in 2035, increasing to 7.7% in 2045 and 12.1% in 2055. The remaining vehicle trips were then assigned to the road network. Table No: 10 to Table No: 12 summarise the resulting trip generation assumptions.

Person-trip rates as outlined in the NSW Guide have not been adopted, as these are based on gross floor area (GFA) and the site coverage details for the Industrial Development remain unconfirmed at this time.

Table No: 10

Predicted Trip Generation – Industrial Development Year 2035 Scenarios 2 and 3					
Year	Dev Area (ha)	Peak Hour Vehicle Trip Gen Rate (veh trips / dev ha / hr)	Total no. of vehicle trips generated during peak hour	Assumed PT and Active Mode Shift (5.8%) (veh trips / hr)	Remaining Vehicle Trips (94.2%) (veh trips / hr)
2035	40	16.3	652	38	614
Total Trips Modelled in WRTM	35.8				536
					15%



Table No: 11

Predicted Trip Generation – Industrial Development Year 2045 – Scenario 4					
Year	Dev Area (ha)	Peak Hour Vehicle Trip Gen Rate (veh trips / dev ha / hr)	Total no. of vehicle trips generated during peak hour	Assumed PT and Active Mode Shift (7.7%) (veh trips / hr)	Remaining Vehicle Trips (92.3%) (veh trips / hr)
2045	40	16.3	652	50	602
Total Trips Modelled in WRTM	35.8				535
					12%

Table No: 12

Predicted Trip Generation – Industrial Development Year 2055 – Scenario 5					
Year	Dev Area (ha)	Peak Hour Vehicle Trip Gen Rate (veh trips / dev ha / hr)	Total no. of vehicle trips generated during peak hour	Assumed PT and Active Mode Shift (12.1%) (veh trips / hr)	Remaining Vehicle Trips (87.9%) (veh trips / hr)
2055	40	16.3	652	79	573
Total Trips Modelled in WRTM	35.8				507
					13%

WRTM modelling for the Project was undertaken at an earlier stage of the project using the best available land use assumptions at that time. As the Masterplan has subsequently been refined, the developable area within the Industrial Development has increased relative to the land use inputs adopted in the WRTM model runs.

A comparison of the refined trip generation calculations with the WRTM outputs indicates that the WRTM model runs represent lower Industrial Development traffic than that derived from the updated developable area and adopted trip generation assumptions. The difference ranges from approximately 12% to 15% across Scenarios 2 to 5, with an average difference of approximately 13%. To ensure the intersection assessments are based on a conservative demand scenario, the Industrial Development turning movements extracted from the WRTM were increased by 13% prior to undertaking the SIDRA assessments. The additional Industrial Development traffic was distributed across the assessed intersections in accordance with the WRTM trip distribution patterns. The magnitude of the adjustment (i.e. 13%) is relatively modest and does not materially alter the strategic distribution of trips within the network but ensures that intersection performance assessments are based on a conservative demand scenario.

Accordingly, the assessment adopts WRTM-derived trip distribution patterns together with locally refined trip generation assumptions based on the updated developable area. The application of a 13% uplift to the WRTM Industrial Development traffic ensures that the intersection assessments are conservative while maintaining consistency with the strategic traffic distribution represented within the WRTM.

12.2.2 Residential Development

As the number of low, medium and high-density lots are known, person-trip rates for each residential land use were adopted from the *NSW Government Guide to Transport Impact Assessment* ("NSW Guide") to estimate the number of trips generated by the proposed development during the peak hour. For the



purposes of trip generation calculation, the proposed high-density lots have been assessed using the medium-density person-trip rate, as they do not align with the NSW Guide definition of high-density residential dwellings.

Table No: 13 to Table No: 17 outline peak hour trip generation calculation for various development scenarios.

Table No: 13

Predicted Trip Generation – Residential Development – Scenarios 1A to 1E (Year 2030 Stage 1)							
Type of Residential Unit	No. of Units	Peak Hour Person Trip Gen Rate ²¹ (person trips / dwelling / hr)	Total no. of person trips generated during peak hour	PT (3.9%) (person trips / hr)	Active Modes (3.4%) (person trips / hr)	Private Veh ²² (80.9%) (veh trips / hr)	Calculated Vehicle Trip Generation Rate
Lower density	119	1.15	137	5	5	85	0.72
Medium density	202	1.09	220	9	7	137	0.68
Total	321	-	357	14	12	222	-

Table No: 14

Predicted Trip Generation – Residential Development – Scenario 2 (Year 2035 Stages 1 and 2)							
Type of Residential Unit	No. of Units	Peak Hour Person Trip Gen Rate (person trips / dwelling / hr)	Total no. of person trips generated during peak hour	PT (4.6%) (person trips / hr)	Active Modes (9.3%) (person trips / hr)	Private Veh (74.3%) (veh trips / hr)	Calculated Vehicle Trip Generation Rate
Lower density	200	1.15	230	11	21	131	0.66
Medium density	343	1.09	374	17	35	214	0.62
Total	543	-	604	28	56	345	-
Total Trips Modelled in WRTM						316	9% (Difference)

²¹ Based on NSW Guide. Rates are average of the AM and PM peak hour person trip generation rates.

²² Assumes a vehicle occupancy of 1.3 persons per vehicle in accordance with NSW Guide. Vehicle trips = (Person trips x car mode share %) / (Assumed vehicle occupancy)



Table No: 15

Predicted Trip Generation – Residential Development – Scenario 3 (Year 2035 Stages 1 to 3)							
Type of Residential Unit	No. of Units	Peak Hour Person Trip Gen Rate (person trips / dwelling / hr)	Total no. of person trips generated during peak hour	PT (4.6%) (person trips / hr)	Active Modes (9.3%) (person trips / hr)	Private Veh (74.3%) (veh trips / hr)	Calculated Vehicle Trip Generation Rate
Lower density	256	1.15	294	14	27	168	0.66
Medium density	474	1.09	517	24	48	295	0.62
Total	730	-	811	37	75	464	-
Total Trips Modelled in WRTM						419	11% (Difference)

Table No: 16

Predicted Trip Generation – Residential Development – Scenario 4 (Year 2045 Stages 1 to 5)							
Type of Residential Unit	No. of Units	Peak Hour Person Trip Gen Rate (person trips / dwelling / hr)	Total no. of person trips generated during peak hour	PT (13.9%) (person trips / hr)	Active Modes (11.4%) (person trips / hr)	Private Veh (62.9%) (veh trips / hr)	Calculated Vehicle Trip Generation Rate
Lower density	347	1.15	399	55	45	193	0.56
Medium density	591	1.09	644	90	73	312	0.53
Total	938	-	1,043	145	119	505	-
Total Trips Modelled in WRTM						446	13% (Difference)

Table No: 17

Predicted Trip Generation – Residential Development – Scenario 5 (Year 2055 Stages 1 to 5)							
Type of Residential Unit	No. of Units	Peak Hour Person Trip Gen Rate (person trips / dwelling / hr)	Total no. of person trips generated during peak hour	PT (30%) (person trips / hr)	Active Modes (10%) (person trips / hr)	Private Veh (48.2%) (veh trips / hr)	Calculated Vehicle Trip Generation Rate
Lower density	347	1.15	399	120	40	148	0.43
Medium density	591	1.09	644	193	64	239	0.40
Total	938	-	1,043	313	104	387	-
Total Trips Modelled in WRTM						357	8% (Difference)



Initial feedback from NZTA suggested that a 10.8% work from home factor (refer to Table No: 8) is likely to be excessive and that it would only be a justified reduction if the residential trip rates from the NSW Guide included 0% work from home factor.

The NSW Guide does not specify work-from-home assumptions. Accordingly, the resulting vehicle trip generation rates were compared against the NSW Guide vehicle trip rate benchmarks to confirm that the adopted assumptions produce reasonable transport outcomes.

Table No: 18 below provides a comparison between the NSW Guide vehicle trips rates against the calculated driver-only vehicle trip rates in Table No: 13 to Table No: 17.

Table No: 18

Vehicle Trip Generation Rates		
Type of Residential Unit	NSW Guide Vehicle Trip Rate	Calculated Vehicle Trip Rate from Table No: 13 to Table No: 17
Lower Density	0.83 – 0.84	0.43 – 0.72
Medium Density	0.41 – 0.60	0.40 – 0.68

As presented in Table No: 18, the calculated vehicle trip generation rates for lower density dwellings are below the NSW Guide vehicle trip rate range across all assessed scenarios. The difference increases in the later scenarios as greater levels of public transport and active mode uptake are assumed. This reflects the transport strategy adopted for the Residential Development, which seeks to reduce reliance on private vehicle travel through the provision of connected walking and cycling infrastructure, improved public transport accessibility and transport demand management measures.

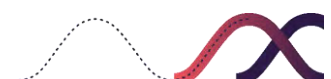
The NSW Guide notes that its lower-density residential vehicle trip rates are generally derived from surveys undertaken in areas with limited public transport accessibility. In contrast, the Residential Development is expected to be supported by progressively improved public transport access and frequency, and active mode connections over time. Accordingly, lower private vehicle trip generation rates are expected relative to the NSW Guide benchmark and are considered consistent with the transport outcomes sought for the Project.

For medium-density dwellings, the calculated vehicle trip generation rates are above the NSW Guide range in Scenario 1, generally within the NSW Guide range in Scenarios 2 to 4, and slightly below the range in Scenario 5. This reflects the increasing mode share assumptions for public transport and active modes in the later scenarios.

Data from Census 2023 indicates that Hamilton City and Glenview have work-from-home rates of approximately 12.5% and 10.0% respectively. These figures are broadly consistent with the assumptions adopted for the Residential Development trip generation calculations and support the inclusion of a work-from-home adjustment within the assessment methodology.

WRTM modelling for the Project was undertaken at an earlier stage of the project prior to final confirmation of the dwelling mix and typologies within the Residential Development. As the Masterplan has subsequently been refined, the residential yield and composition have been updated relative to the land use inputs adopted in the WRTM model runs.

Consistent with the approach adopted for the Industrial Development, a comparison of the refined trip generation calculations with the WRTM outputs indicates that the model represents slightly lower residential traffic, with an average difference of approximately 10% across Scenarios 2 to 5. To address this, the intersection modelling presented in Section 15 incorporates a 10% increase to the modelled residential trips.



The additional Residential Development traffic was applied to the relevant residential development-related turning movements at each assessed intersection, using the WRTM distribution patterns as the basis for assigning the uplift across the surrounding network. This adjustment is modest and does not materially alter the strategic distribution of trips within the network but ensures that the intersection assessments are based on a conservative demand scenario.

In addition, the site's urban context, proximity to local employment and services, and the provision of walking, cycling, and future public transport connections support reduced reliance on private vehicle travel over time. In this context, the adopted trip generation assumptions are considered appropriate and, when combined with the applied adjustment, provide a robust and proportionate basis for assessing transport effects at the intersection level.

13. Transport Modelling

BBO has undertaken a transport modelling exercise as a key input to this transport assessment. This task included undertaking trip generation calculations for the Project (refer to the previous Section 12.2), and transport modelling of those future trips on the surrounding network using the WRTM to assess the trip distribution and any resulting capacity or safety effects on affected intersections and the proposed accesses to the Site.

13.1 WRTM Validity

The WRTM is presently the most appropriate strategic transport planning tool for predicting transport demands of proposed and consented land-use activity zones in the Waikato.

BBO obtained the latest WRTM model run ("HSL Scenario 31") from CoLab that was developed for NZTA's Investment Case for HSL. HSL Scenario 31 included the following key network infrastructure for HSL:

- HSL Central interchange south of Peacocke, as designated
- North-south corridor (Greenwood Street), 2+2 lanes with 100 km/h posted speed limit
- SL1 at-grade roundabout, approximately 970 m south of Greenwood Street / Kahikatea Drive intersection
- Half-diamond interchange at Collins Road, as designated
- Greenwood Street / Duke Street left-in-left-out intersection
- Three-arm roundabout at Greenwood Street / Kahikatea Drive intersection with no access via Kahikatea Drive Extension.

BBO conducted a review of the WRTM network and zone structure surrounding the SL1 development areas and identified refinement work shown in Figure 43 was required to better reflect the future road network surrounding the sites.



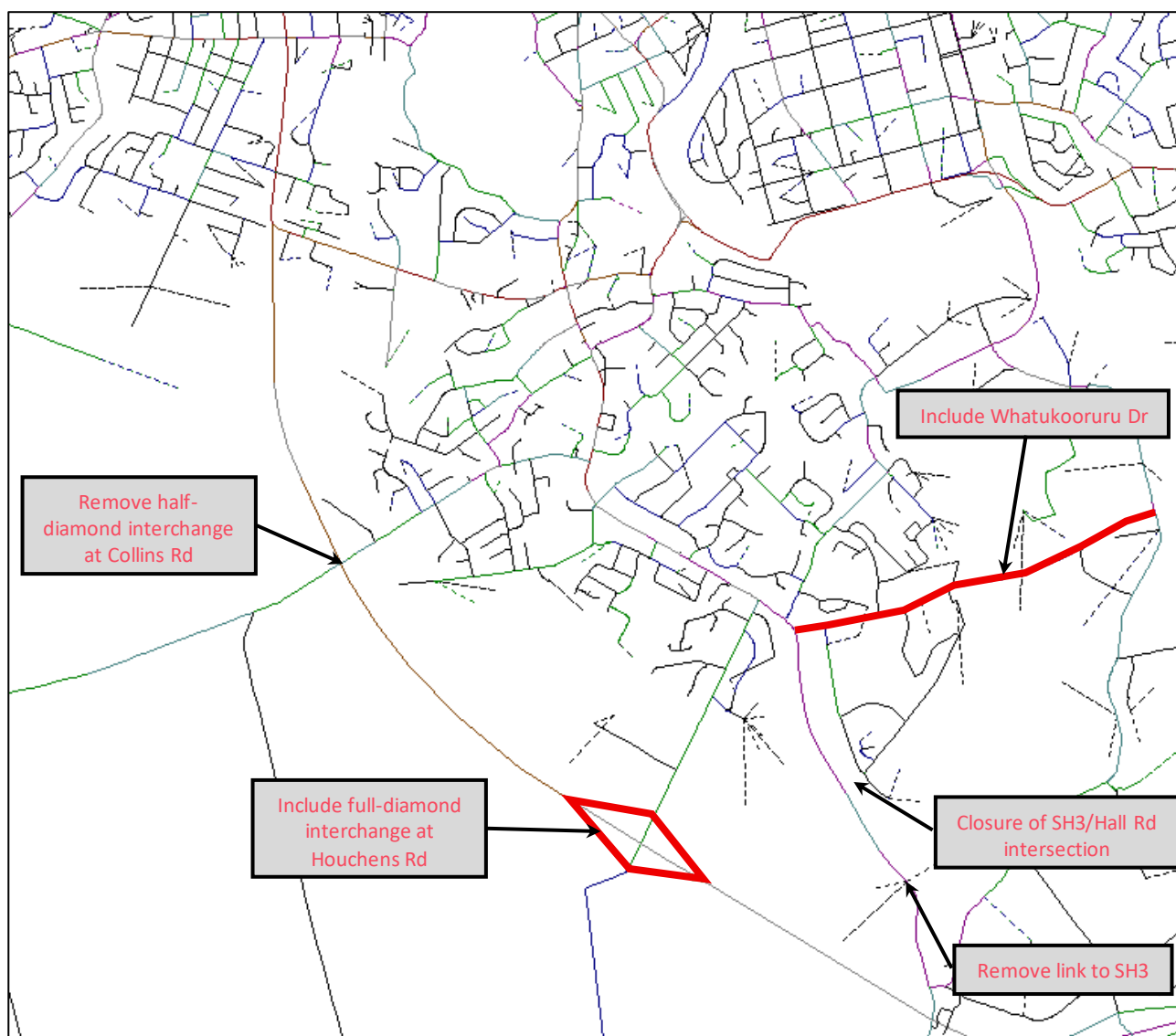


Figure 43: Required WRTM Network Amendments

13.2 Modelled Scenarios

Table No: 19 summarises the scenarios that have been assessed with the WRTM for this Project by incorporating the amendments mentioned in the preceding section.

The modelling scenarios incorporate assumptions regarding increased public transport use and active travel over time, consistent with planned investment and corridor-level improvements. Network performance improvements are therefore not attributable solely to new road infrastructure, but to the combined effects of connectivity, accessibility, and restrained growth in general traffic volumes through mode shift.

Table No: 19

Modelling Scenarios		
Scenarios	Transportation Infrastructure / Elements	Land Use Assumptions
2035 Baseline Scenario	No Southern Links	- No SL1 land use. - Land use within Airport Business Zone and Peacocke Structure Plan area to adopt Southern Links Scenario 31 model assumptions.
Scenario 1A (Year 2030)	No Southern Links	SL1 Residential Development = 59 dwellings



Scenario 1B (Year 2030)	No Southern Links	SL1 Residential Development = 123 dwellings
Scenario 1C (Year 2030)	No Southern Links	SL1 Residential Development = 198 dwellings
Scenario 1D (Year 2030)	No Southern Links	SL1 Residential Development = 271 dwellings
Scenario 1E (Year 2030)	No Southern Links	SL1 Residential Development = 321 dwellings
Scenario 2 (Year 2035)	- With Stage 1 Hamilton Southern Links (i.e. Greenwood St to SL1 roundabout) - Ohaupo Rd / Houchens Rd intersection to be signalised. - Ohaupo Rd / Resthill Cres intersection to be signalised - Collector Rd through SL1 Industrial Development area provided. - Collector Rd through SL1 Residential Development area provided.	- SL1 Residential: Development Stages 1 and 2 (575 dwellings) - SL1 Industrial: Full development (approx. 36ha developable area)
Scenario 3 (Year 2035)	- Full length of Southern Links - Remove partial interchange at Collins Rd and include full interchange at Houchens Rd. - Ohaupo Rd / Houchens Rd intersection to be signalised. - Ohaupo Rd / Resthill Cres intersection to be signalised - Collector Rd through SL1 Industrial Development area provided. - Collector Rd through SL1 Residential Development area provided.	- SL1 Residential: Stages 1 to 3 (776 dwellings) - SL1 Industrial: Full development (approx. 36ha developable area)
Scenario 4 (Year 2045)	- Full length of Southern Links - Remove partial interchange at Collins Rd and include full interchange at Houchens Rd. - Ohaupo Rd / Houchens Rd intersection to be signalised. - Ohaupo Rd / Resthill Cres intersection to be signalised - Minor arterial within SL1 Residential Development area provided.	- SL1 Residential Development: Full development (1,009 dwellings) - SL1 Industrial: Full development (approx. 36ha developable area)
Scenario 5 (Year 2055)	- Same as Scenario 4 plus: - SL1 Houchens proposed 3-arm roundabout on Ohaupo Rd. - HCVs to be banned on Houchens Rd. - Collector and Minor arterial roads within SL1 Houchens provided. - New roundabout connection on Tuhikaramea Rd providing access to SL1 Rogerson Block. - Collector Rd through Rogerson Block provided.	- Same as Scenario 4 plus: - Future Residential Areas within wider SL1 Growth Cell: 16ha industrial developable area + 4,000 dwellings - SL1 Rogerson Block: Full development (217 dwellings + 20ha industrial developable area) - SL1 Houchens: Full development (1,565 dwellings + 400 RV units + 47ha industrial developable area)

The modelling scenarios presented in Table No: 19 represent the transport modelling assumptions adopted within the WRTM and were intended to test a range of future network outcomes. They should not be interpreted as forecasts of HSL delivery timing or commitments regarding future infrastructure implementation.

The modelling scenarios have been developed to progressively assess the transport effects of the Project as development proceeds. The Rogerson Block and Houchens Development areas in the wider SL1 growth cell do not form part of this Project so were excluded in the earlier development modelling scenarios. These developments are introduced only in the 2055 scenario to test the future operation of the transport network under a broader growth scenario within the wider SL1 growth area.

While Scenarios 2 to 5 were modelled using the WRTM, Scenario 1A to 1D were based on manual distribution of traffic flows to minimise the time and cost of running numerous WRTM scenarios.



Scenarios 1A to 1E were analysed to determine if any development within the SL1 Residential Development area could be progressed in advance of HSL construction, and if so, identify the transportation infrastructure required to support the development. Scenarios 1A to 1E are assumed to be developed within the first five years (i.e. approximately 2030) which is sooner than the predicted timeline to construct HSL.

The 2030 baseline traffic volumes were derived from the surveyed peak hour traffic flows²³ and include an allowance for background traffic growth independent of the proposed development. This approach recognises that future traffic volumes on the state highway network will not be attributable solely to trips generated by the proposed developments. From the most recent data extracted from the NZTA TMS State Highway records, Greenwood Street and Ohaupo Road (SH3) have had an approximate average baseline growth of 1.2% and 1.5% per annum respectively.

A seasonal factor is applied to the surveyed traffic flows to account for traffic flow variation throughout the course of the year. To determine an appropriate factor, traffic counts from the Greenwood telemetry site on SH1C (i.e. site 97) and Ohaupo telemetry site on SH3 (i.e. site 119) have been assessed. Both telemetry sites indicate an average daily factor of 1.14 for the month of October 2025 during which the intersection count surveys were undertaken.

Additional traffic associated with the Residential Development area (i.e. Scenarios 1A to 1E) were then added to the 2030 baseline volumes to understand the effects on the intersections for a future year scenario.

13.3 Key Findings from WRTM Modelling

The following key findings have been drawn from the WRTM outputs and have informed the subsequent intersection capacity assessments in Section 15:

- **Ohaupo Road traffic distribution:**

Earlier HSL Scenario 31 outputs indicated that approximately 10% of traffic from the Residential Development zones would use the Ohaupo Road / Lambert Court intersection, compared with approximately 30% using the Ohaupo Road / Resthill Crescent intersection. On that basis, Ohaupo Road / Resthill Crescent was initially considered for signalisation. However, the subsequent SL1 project WRTM model runs indicate that a greater proportion of Residential Development traffic is distributed to Ohaupo Road / Lambert Court. Accordingly, the intersection capacity assessment in Section 15.2.3 identifies Ohaupo Road / Lambert Court as the appropriate location for signalisation, rather than Resthill Crescent. On this basis and noting the proposed signalisation of both Ohaupo Road / Lambert Court and Ohaupo Road / Houchens Road, together with the nearby mid-block signalised crossing on Ohaupo Road, signalisation of Ohaupo Road / Resthill Crescent is no longer proposed. Instead, the right-turn movement out of Resthill Crescent is proposed to be removed, with southbound traffic redirected via the signalised Lambert Court intersection. This is assessed further in Section 15.2.4.

- **Adjustment of modelled development traffic:**

Following consultation with NZTA and HCC, the updated trip generation calculations presented in Section 12 indicate that the development trips represented in the WRTM are lower than the refined estimates for both developments. Specifically, the WRTM modelled demand is approximately 13% lower for Industrial Development and approximately 10% lower for Residential Development. The modelled development trips have therefore been increased by these respective percentages for the intersection performance analyses presented in Section 15.

²³ Based on 2025 intersection count surveys undertaken by BBO.



- **Effect of HSL on baseline traffic volumes:**

Comparison of the 2035 baseline scenarios, with and without HSL and excluding SL1 growth cell, indicates that the full length of HSL is expected to materially reduce daily traffic volumes on key corridors adjacent to the sites. Particularly, daily traffic volumes are forecast to reduce by approximately 23% on Kahikatea Drive (between Kahikatea Drive Extension and Latham Court) and by approximately 39% on Ohaupo Road (between Saxbys Road and Houchens Road). These reductions create spare capacity to accommodate traffic from the later stages of the Project, therefore effectively fulfilling the purpose of HSL being a RoNS project, stated in the current GPS for Transport. By contrast, HSL is expected to increase daily traffic volumes on Greenwood Street north of Kahikatea Drive, on Houchens Road, and on Collins Road by approximately 34%, 74%, and 21% respectively.

14. Average Daily Traffic Volume Changes

Table No: 21 provides a comparison of the changes in ADT on strategic roads surrounding the sites in the various WRTM scenario modelling undertaken for this Project. Intersections that the WRTM model runs demonstrate will experience more than 10% volume change relative to the 2035 WRTM baseline scenario without HSL, have been carried through for further assessment.

14.1 Industrial Development

Table No: 20

Changes in ADT (vehicles per day)				
Road Section	2035 Baseline without HSL	2035 Scenario 2 (% Change)	2035 Scenario 3 (% Change)	2045 Scenario 4 (% Change)
Kahikatea Dr Extn (between Melanie Ct and Higgins Rd)	5,542	3,546 (-36.0%)	4,680 (-15.6%)	4,967 (-10.4%)
Higgins Rd (between Kahikatea Dr and Duke St)	3,737 ²⁴	4,030 (7.8%)	4,718 (26.3%)	5,407 (44.7%)
Duke St (between Higgins Rd and Greenwood St)	3,850	4,524 (17.5%)	3,664 (-4.8%)	4,731 (22.9%)
Greenwood St (between Killarney Rd and Duke St)	31,006	30,429 (-1.9%)	32,412 (4.5%)	42,280 (36.4%)
Greenwood St (between Duke St and Kahikatea Dr)	32,279	32,695 (1.3%)	36,266 (12.4%)	44,594 (38.2%)
Greenwood St (between Kahikatea Dr Latham Ct)	33,160	30,913 (-6.8%)	23,743 (-28.4%)	26,989 (-18.6%)
Killarney Rd (between Higgins Rd and Greenwood St)	21,328	23,342 (9.4%)	23,676 (11.0%)	23,647 (10.9%)
Killarney Rd (between	21,907	23,264 (6.2%)	24,002 (9.6%)	24,252 (10.7%)

²⁴ Based on classified traffic volume tube counts undertaken in May 2024. WRTM underestimates baseline volumes on Higgins Road (i.e. 2035 baseline volumes on Higgins Road = 979 vpd based on WRTM model run).



Tuhikaramea Rd and Higgins Rd)				
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The Higgins Road / Duke Street intersection and Greenwood Street / Duke Street intersection have not been assessed further despite traffic volumes increasing more than 10% with the proposed Industrial Development. This is because the Greenwood Street / Duke Street is already proposed to be upgraded to a left-in-left-out intersection as part of the HSL project.

14.2 Residential Development

Table No: 21

Changes in ADT (vehicles per day)				
Road Section	2035 Baseline without HSL	2035 Scenario 2 (% Change)	2035 Scenario 3 (% Change)	2045 Scenario 4 (% Change)
Ohaupo Rd (between Normandy Ave and Ulrich Ave)	28,450	29,986 (5.4%)	22,676 (-20.3%)	23,992 (-15.7%)
Ohaupo Rd (between Collins Rd and Saxbys Rd)	31,029	32,490 (4.7%)	25,577 (-17.6%)	28,066 (-9.5%)
Ohaupo Rd (between Saxbys Rd and Lambert Ct)	22,295	22,164 (-0.6%)	14,786 (-33.7%)	16,501 (-26.0%)
Ohaupo Rd (between Lambert Ct and Garden Heights Ave)	19,331	18,219 (-5.8%)	11,799 (-39.0%)	14,277 (-26.1%)
Ohaupo Rd (between Garden Heights Ave and Resthill Cres)	20,258	18,924 (-6.6%)	12,049 (-40.5%)	14,909 (-26.4%)
Ohaupo Rd (between Resthill Cres and Houchens Rd)	21,391	20,195 (-5.6%)	13,583 (-36.5%)	17,036 (-20.4%)
Ohaupo Rd (between Houchens Rd and Dixon Rd)	20,035	18,902 (-5.7%)	12,121 (-39.5%)	15,932 (-20.5%)
Collins Rd (between Ohaupo Rd and Anderson Rd)	4,740	4,863 (2.6%)	5,376 (13.4%)	6,245 (31.8%)
Collins Rd (between Deanwell Ave and Rhonda Ave)	8,967	9,188 (2.5%)	9,046 (0.9%)	9,568 (6.7%)
Saxbys Rd (between Ohaupo Rd and MacDonald Rd)	6,206	8,256 (33.0%)	9,118 (46.9%)	10,492 (69.1%)
Saxbys Rd (between Deanwell Ave and Leslie Pl)	2,689	4,045 (50.4%)	5,174 (92.4%)	7,110 (164%)
Saxbys Rd (between Rhonda Ave and Deanwell Ave)	2,606	2,840 (9%)	3,179 (22.0%)	3,211 (23.2%)



Deanwell Ave (between Collins Rd and Saxbys Rd)	3,239	3,287 (1.5%)	3,285 (1.4%)	3,376 (4.2%)
MacDonald Rd (between Saxbys Rd and MacMurdo Ave)	1,878	2,468 (31.4%)	2,540 (35.3%)	2,065 (10%)
MacDonald Rd (between Lambert Ct and Resthill Cres)	1,347	1,717 (27.5%)	1,865 (38.5%)	2,244 (66.6%)
MacMurdo Ave	2,072	3,835 (85.1%)	3,857 (86.1%)	2,731 (31.8%)
Lambert Ct	3,325	4,185 (25.9%)	4,314 (29.7%)	3,785 (13.8%)
Resthill Cres	1,627	1,877 (15.4%)	2,022 (24.3%)	2,402 (47.6%)
Houchens Rd	3,493	3,462 (-0.9%)	6,167 (76.6%)	5,678 (62.6%)

15. Intersection Capacity Performance

Based on Table No: 20 and Table No: 21, the area of influence of the Industrial and Residential Developments can be summarised as incorporating the following intersections which have been modelled using the industry-recognised SIDRA Intersection 10 software ("SIDRA") to assess the effects of traffic associated with this Project.

- Greenwood Street / Kahikatea Drive intersection
- SL1 Roundabout
- Kahikatea Drive / Higgins Road intersection
- Ohaupo Road / Collins Road signalised intersection
- Ohaupo Road / Saxbys Road / Tomin Road roundabout
- Ohaupo Road / Lambert Court intersection
- Ohaupo Road / Resthill Crescent intersection roundabout
- Ohaupo Road / Higgins Road intersection
- Houchens Road full-diamond interchange

SIDRA models were prepared for the key intersections assessed using the surveyed peak-hour turning movements as the base input. The base models were checked against observed queue lengths and general operating conditions from traffic surveys to confirm that the models reasonably represent existing intersection performance before future traffic demands were applied.

Future-year models were then developed using WRTM-derived traffic demands, adjusted where necessary to reflect the refined trip generation calculations set out in Sections 12.2.1 and 12.2.2. SIDRA movement summaries are provided in Appendix B to support review of the modelling outputs.

The capacity assessment results are summarised in the following sub-sections in terms of Level of Service ("LOS") with full SIDRA outputs provided in Appendix B. LOS is a standard measure for intersection performance and is based on the average delay experienced by drivers in each lane, by arm. In general, LOS levels A to C are considered acceptable, LOS D to E are considered permissible where reasonable improvements cannot be made, provided safety effects can be mitigated. LOS F is generally considered to be



an unsatisfactory level of service. Delay thresholds in seconds of delay for LOS A to F are given in Table No: 22 below.

Table No: 22

SIDRA Level of Service Definitions			
Level of Service	Average Control Delay per Vehicle (seconds)		
	Priority-Controlled Intersections	Signalised Intersections	Roundabout (SIDRA Roundabout LOS method)
A	≤ 10	≤ 10	≤ 10
B	10 – 15	10 - 20	10 - 20
C	15 – 25	20 – 35	20 – 35
D	25 – 35	35 – 55	35 – 50
E	35 – 50	55 – 80	50 – 70
F	> 50	> 80	> 70

15.1 Industrial Development

15.1.1 Greenwood Street / Kahikatea Drive Intersection

The existing intersection layout modelled within SIDRA is shown in Figure 44. The results of the intersection performance for all scenarios during the peak periods are presented in Table No: 23.

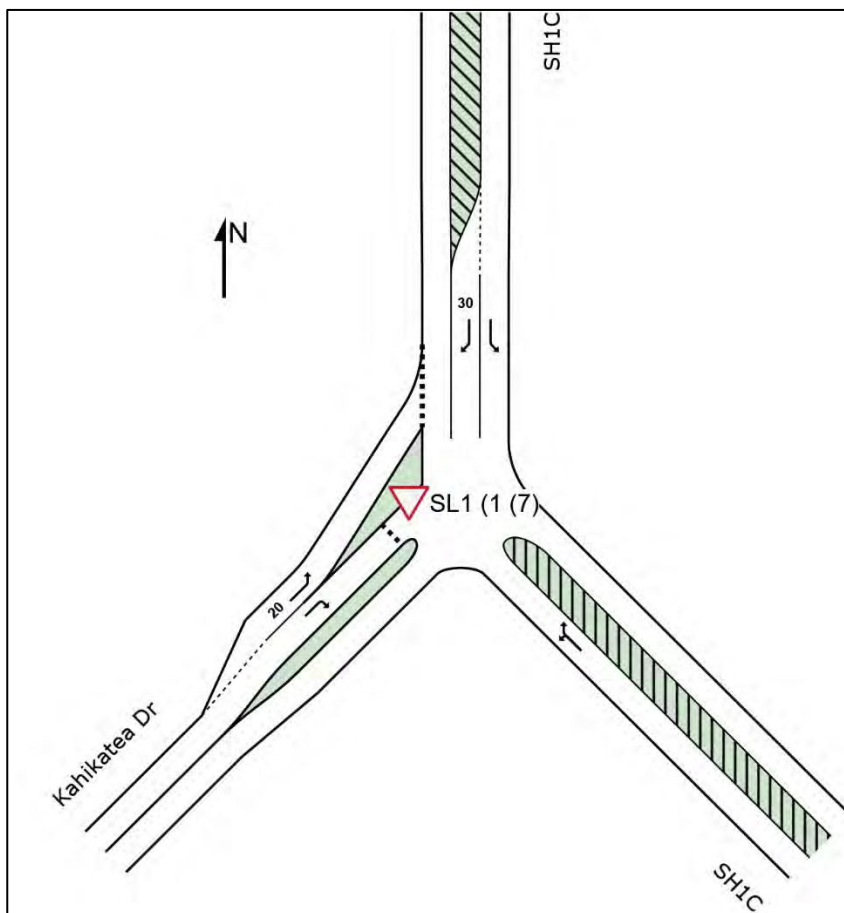


Figure 44: Existing Greenwood St (SH1C) / Kahikatea Dr Intersection Layout



Table No: 23

Existing Greenwood St / Kahikatea Dr Intersection									
Scenario	Peak	Intersection Average				Worst Movements (based on delay)			
		V/C	Ave Delay (s)	95 th % Queue (m)	LOS	Movement	Ave Delay (s)	95 th % Queue (m)	LOS
2030 Baseline	AM	0.86	10.1	27.7 Kahikatea Dr (W)	NA	RT from Greenwood St (N)	60.4	18.3	F
	PM	0.77	8.0	23.1 Kahikatea Dr (W)	NA	RT from Greenwood St (N)	49.6	17.1	E
2030 Baseline + 1 ha Industrial	AM	0.89	10.6	30.5 Kahikatea Dr (W)	NA	RT from Greenwood St (N)	66.6	20.3	F
	PM	0.77	8.1	22.9 Kahikatea Dr (W)	NA	RT from Greenwood St (N)	51.0	17.6	F

The modelling indicates that the right turn movement from Greenwood Street fails (LOS F) in the 2030 baseline scenario during the AM peak hour.

A sensitivity check was undertaken to determine the amount of developable land that can be practically and safely serviced before the average delay for the right-turn movement increases by more than 10 seconds per vehicle. A change of this magnitude is considered material in the context of the SIDRA level of service definitions presented in Table No: 22, where the delay ranges for each level of service are generally of the order of 10 seconds per vehicle. On that basis, the sensitivity testing indicates that approximately 1 ha of land within the Industrial Development can be accommodated before further transport infrastructure upgrades are required.

The three access options described in Section 8.1 were evaluated to assess how further Industrial Development could proceed.

Option A: Ultimate Network Arrangement (once HSL Stage 1 is Delivered)

Figure 45 presents NZTA's conceptual design of the Greenwood Street / Kahikatea Drive upgrade proposed as part of HSL Stage 1. However, an alternative roundabout configuration was tested for this intersection (Figure 46) to minimise potential adverse safety and capacity effects of traffic weaving from the southbound continuous left turn exit lane to the right turn lane at the proposed HSL / SL1 roundabout positioned approximately 520 m to the south.



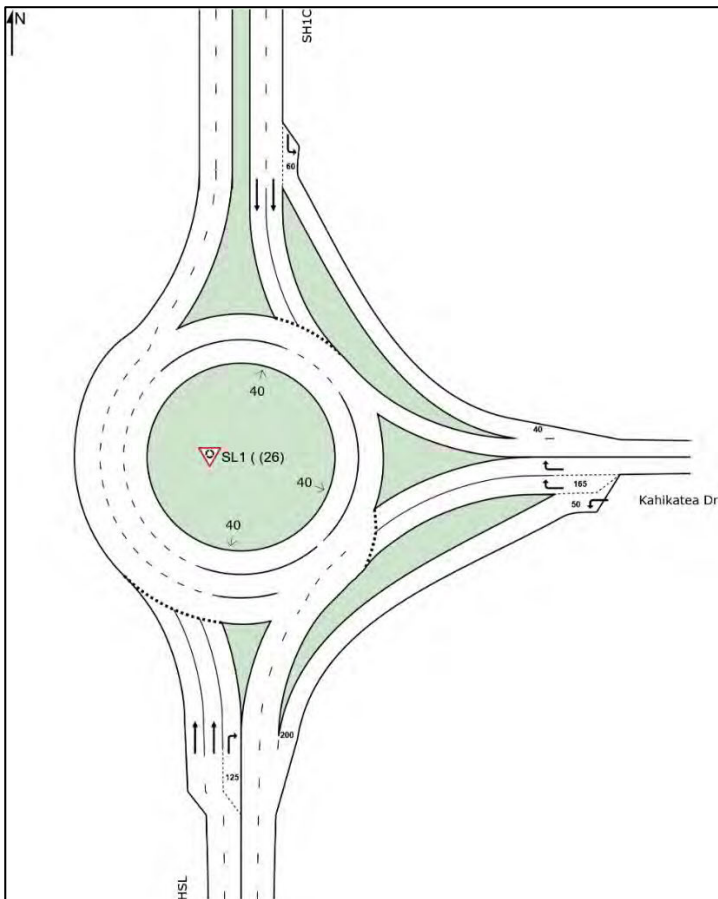


Figure 45: Greenwood St (SH1C) / Kahikatea Dr Roundabout Indicative Layout – NZTA Concept

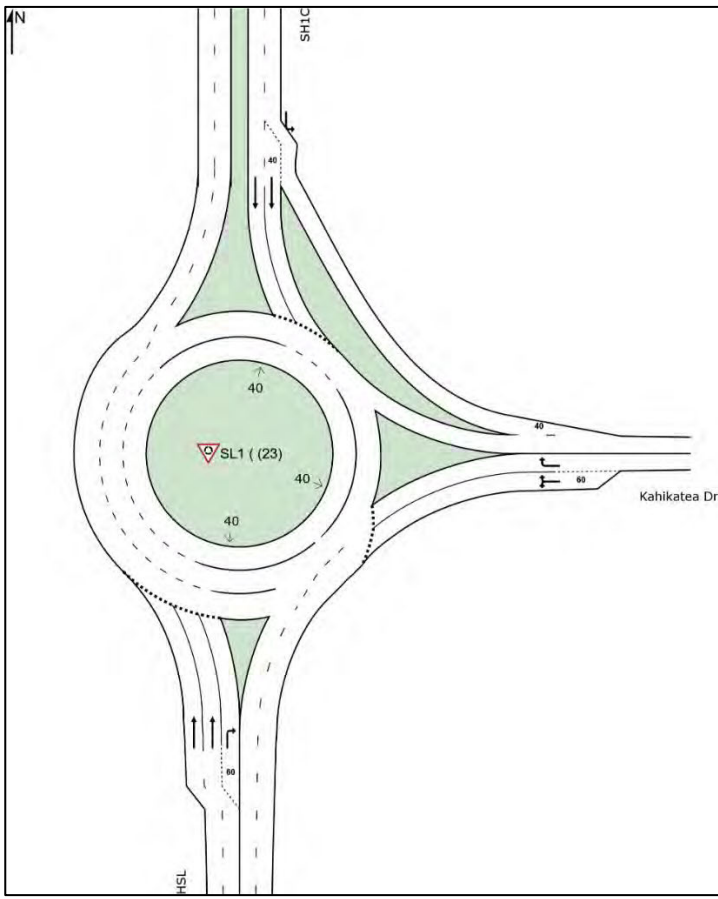


Figure 46: Greenwood St (SH1C) / Kahikatea Dr Roundabout Indicative Layout – SL1 Recommended Design



The SL1 recommended roundabout layout in Figure 46 was modelled using SIDRA for the AM and PM peak periods. It is modelled as a network with the proposed HSL / SL1 roundabout in all options. The performance results for the various model scenarios are presented in Table No: 24.

Table No: 24

Option A - Future Greenwood St / Kahikatea Dr Roundabout Recommended Design									
Scenario	Peak	Intersection Average				Worst Movements (based on delay)			
		V/C	Ave Delay (s)	Average Queue (m)	LOS	Movement	Ave Delay (s)	Average Queue (m)	LOS
2	AM	0.78	6.5	9.9 Kahikatea Dr (E)	A	RT from HSL (S)	17.1	0.7	B
	PM	0.58	6.8	12.4 Kahikatea Dr (E)	A	RT from HSL (S)	16.2	2.7	B
3	AM	0.62	8.1	13.5 Kahikatea Dr (E)	A	RT from HSL (S)	15.0	3.5	B
	PM	0.85	10.2	29.2 Kahikatea Dr (E)	B	RT from Kahikatea Dr (E)	18.7	29.2	B
4	AM	0.77	9.0	21.5 Kahikatea Dr (E)	A	RT from HSL (S)	16.8	3.3	B
	PM	0.75	9.1	20.1 Kahikatea Dr (E)	A	RT from Kahikatea Dr (E)	16.5	20.1	B
5	AM	0.90	12.1	37.5 Kahikatea Dr (E)	B	RT from Kahikatea Dr (E)	24.1	37.5	C
	PM	0.74	8.9	20.0 Kahikatea Dr (E)	A	RT from HSL (S)	15.1	4.1	B

The results show that the alternative proposed concept layout of the Greenwood Street / Kahikatea Drive three-arm roundabout operates efficiently without NZTA's proposed continuous southbound left turn lane exiting the Greenwood Street / Kahikatea Drive roundabout. The results indicate:

- Acceptable operational performance is achieved across all assessed scenarios, with intersection average delays ranging from 6.5 to 12.1 seconds per vehicle and LOS A to B overall.
- The assessed design continues to accommodate forecast traffic demand through to the 2055 scenario, although higher levels of utilisation are observed in the most demanding future year scenarios.
- Queue lengths remain manageable on all approaches, with the highest average queue of 37.5 m occurring on the Kahikatea Drive eastbound approach in the 2055 AM peak scenario.
- Enhances safety by minimising weaving effects that an added southbound lane could potentially introduce.

A sensitivity test has also been undertaken using NZTA HSL Scenario 31 2055 traffic volumes to test the proposed spacing between the future Greenwood Street / Kahikatea Drive roundabout and the proposed HSL / SL1 roundabout. This represents a conservative sensitivity test because NZTA HSL Scenario 31 includes a higher level of wider land use growth, including a higher level of residential development than the core assessment scenarios relied upon in this ITA.



The results indicate that the future Greenwood Street / Kahikatea Drive roundabout would operate with an overall LOS B in both peak periods. The PM peak hour is the critical period, with a degree of saturation of approximately 0.95 and the worst movement operating at LOS D, indicating that the roundabout would operate close to practical capacity under the conservative 2055 sensitivity demand. However, the modelled average queue remains approximately 49 m and does not indicate unacceptable queuing interaction between the Greenwood Street / Kahikatea Drive roundabout and the proposed HSL / SL1 roundabout.

The high degree of saturation in the PM peak should also be interpreted in the context of the conservative Scenario 31 2055 land use assumptions and is not representative of the core staging scenarios used to determine the development triggers in this ITA.

Accordingly, the sensitivity test does not identify a spacing-related constraint that would preclude the proposed 520 m separation under the assessed Scenario 31 2055 traffic demands. The final spacing and detailed form of the HSL corridor infrastructure would remain subject to NZTA's future design development, modelling and approval processes.

Table No: 25

NZTA HSL Scenario 31 – Future Greenwood St / Kahikatea Dr Roundabout Recommended Design									
Scenario	Peak	Intersection Average				Worst Movements (based on delay)			
		V/C	Ave Delay (s)	Average Queue (m)	LOS	Movement	Ave Delay (s)	Average Queue (m)	LOS
2055 Volumes	AM	0.82	10.8	24.1 Kahikatea Dr (E)	B	RT from Kahikatea Dr (E)	17.5	24.1	B
	PM	0.95	14.3	49.2 Kahikatea Dr (E)	B	RT from Kahikatea Dr (E)	38.4	49.2	D

Option B: Preferred Interim Option

Aside from the fourth arm, the key difference between this option and the three-arm roundabout proposed as part of HSL (Figure 46) is that three approach lanes are required on the eastern arm of Kahikatea Drive. While right-turn volumes from Kahikatea Drive remain similar to those forecast under the ultimate HSL layout (Option A), the interim arrangement introduces an additional movement to the access road and increases total demand on the eastern approach. The third lane is therefore required to accommodate the additional movement and maintain acceptable lane utilisation, queueing and overall roundabout performance.

The modelling indicates that Option B can accommodate the completed Industrial Development under the 2035 pre-HSL scenario.

The peak period intersection performance results for the 2035 scenario (excluding HSL) are presented in Table No: 26.



Table No: 26

Option B - Greenwood St / Kahikatea Dr Four-arm Roundabout									
Scenario	Peak	Intersection Average				Worst Movements (based on delay)			
		V/C	Ave Delay (s)	95 th % Queue (m)	LOS	Movement	Ave Delay (s)	95 th % Queue (m)	LOS
2035 baseline + 40 ha Industrial Dev	AM	0.82	9.2	47.8 Kahikatea Dr (W)	A	RT from Industrial Dev Access Rd (S)	26.9	5.8	C
	PM	0.71	10.1	55.8 Kahikatea Dr (E)	B	RT from Kahikatea Dr (W)	39.4	42.5	D

Option C: Interim Option

Option C has a developable area limitation of 23 ha (net developable area) due to capacity constraints with the three-arm roundabout, evident by the intersection degree of saturation exceeding 0.90.

The three-arm Greenwood Street / Kahikatea Drive roundabout that was modelled in SIDRA is presented in Figure 47.

The peak period modelling result for the three-arm roundabout under the 2035 scenario with 23 ha of Industrial Development are presented in Table No: 27.

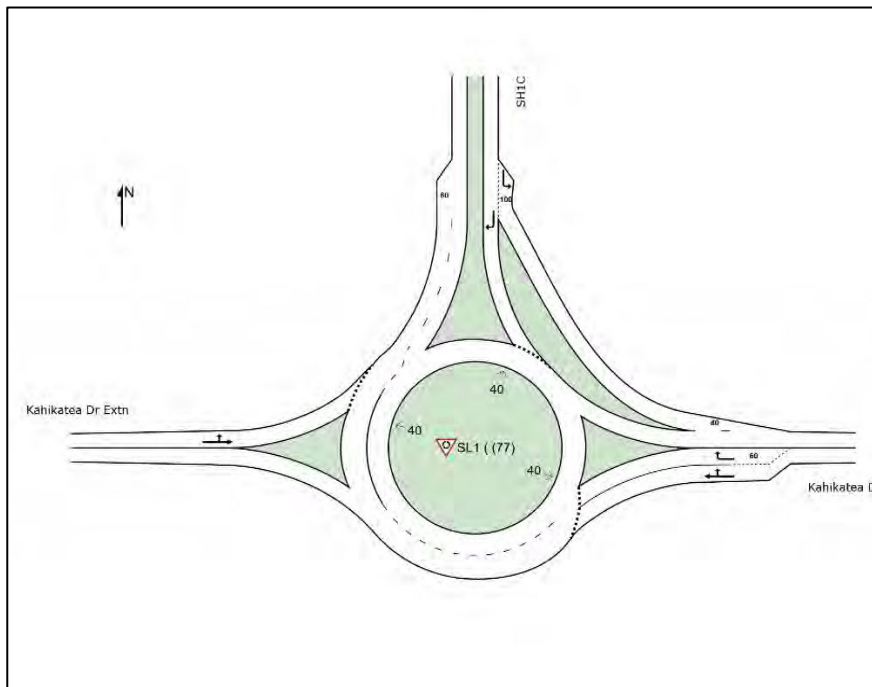


Figure 47: Option C - Greenwood St (SH1C) / Kahikatea Dr Three-arm Roundabout Indicative Layout



Table No: 27

Interim Option C - Greenwood St / Kahikatea Dr Three-arm Roundabout									
Scenario	Peak	Intersection Average				Worst Movements (based on delay)			
		V/C	Ave Delay (s)	95 th % Queue (m)	LOS	Movement	Ave Delay (s)	95 th % Queue (m)	LOS
2035 baseline + 23 ha Industrial Dev	AM	0.82	8.2	17.4 Kahikatea Dr (E)	A	Thru from Kahikatea Dr (W)	22.3	17.2	C
	PM	0.90	10.3	34.8 Kahikatea Dr (W)	B	LT from Kahikatea Dr (W)	38.2	34.8	D

For the interim access assessments, the development area quantum was varied to identify the scale of development that could be accommodated under each access arrangement.

The background and wider network traffic demands remained unchanged, including the Residential Development assumption adopted in Scenario 2 (543 dwellings). This approach isolates the operational effect of Industrial Development staging while retaining robust surrounding network traffic demands.

The interim assessments demonstrate that Industrial Development can progress independently of HSL delivery, subject to the implementation of the recommended interim access arrangement and associated staging triggers.

Recommended / Preferred Interim Access Strategy

The interim access option assessments indicate that both Option B and Option C can accommodate Industrial Development under pre-HSL conditions.

However, Option B is recommended as the preferred interim access strategy because it enables a greater extent of Industrial Development to proceed prior to HSL delivery while maintaining acceptable intersection performance under the assessed traffic demands.

Given the uncertainty regarding HSL delivery timing, Option B provides the most practical and flexible interim access solution for SL1 Industrial. The timing and staging of Industrial Development are therefore not dependent on HSL delivery, provided the recommended transport infrastructure staging framework set out in Table No: 43 is implemented.

15.1.2 HSL / SL1 Roundabout Connection

The HSL / SL1 roundabout layout depends on the extent of HSL delivered at each stage. Scenario 2 assumes only HSL Stage 1 is delivered, so the intersection operates as a three-arm roundabout, per Figure 48.



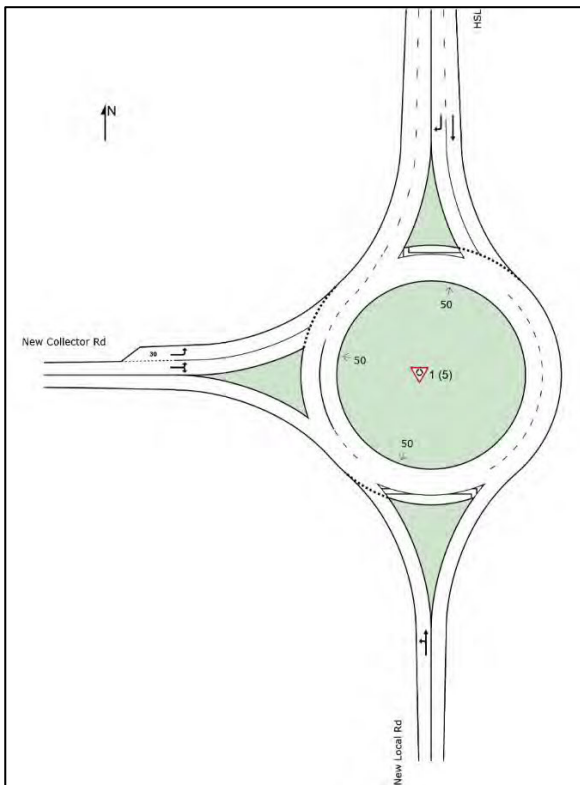


Figure 48: Proposed SL1 Roundabout Connection Scenario 2

When HSL Stage 3 is delivered, the eastern arm at the roundabout will provide access to the eastern side of the Industrial Development while HSL extends south of the SL1 collector road. at which point the intersection operates as a four-arm roundabout (Figure 49).

It is to be noted that the HSL / SL1 roundabout was modelled in SIDRA as part of a network with the proposed layout for future Greenwood Street / Kahikatea Drive three-arm roundabout (Figure 46). The results of the intersection performance for the various modelling scenarios during the peak periods are presented in Table No: 28.



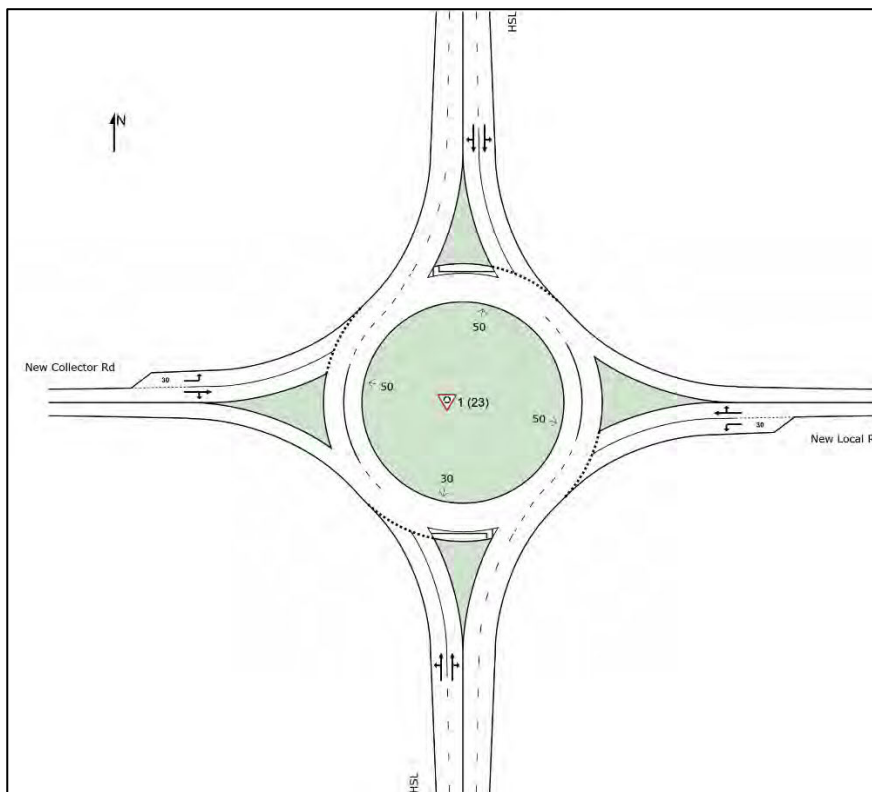


Figure 49: Proposed SL1 Roundabout Connection Scenarios 3 - 5

Table No: 28

Proposed SL1 Roundabout Connection									
Scenario	Peak	Intersection Average				Worst Movements (based on delay)			
		V/C	Ave Delay (s)	Ave Queue (m)	LOS	Movement	Ave Delay (s)	Ave Queue (m)	LOS
2	AM	0.14	5.9	2.3 HSL (N)	A	RT from HSL (N)	13.0	2.2	B
	PM	0.14	2.6	2.2 Access Rd (S)	A	RT from HSL (N)	13.0	0.8	B
3	AM	0.36	7.4	7.2 HSL (S)	A	RT from HSL (S)	16.2	7.0	B
	PM	0.46	6.6	11.1 HSL (N)	A	RT from HSL (S)	16.1	6.3	B
4	AM	0.37	7.2	7.7 HSL (N)	A	RT from HSL (S)	16.2	7.4	B
	PM	0.53	6.8	14.2 HSL (N)	A	RT from HSL (S)	16.2	7.7	B
5	AM	0.69	10.6	24.7 HSL (S)	B	RT from HSL (S)	20.4	24.1	C
	PM	0.59	9.2	13.7 Collector Rd (W)	A	RT from HSL (S)	18.5	12.9	B

Overall, the model results demonstrate that the proposed HSL / SL1 roundabout performs satisfactorily with the three-arm roundabout layout of the Greenwood Street / Kahikatea Drive.



15.1.3 Kahikatea Drive / Higgins Road Intersection

The existing crossroads intersection was modelled in SIDRA as shown in Figure 50. The results of the intersection performance for all various modelling scenarios during the peak periods are presented in Table No: 29.

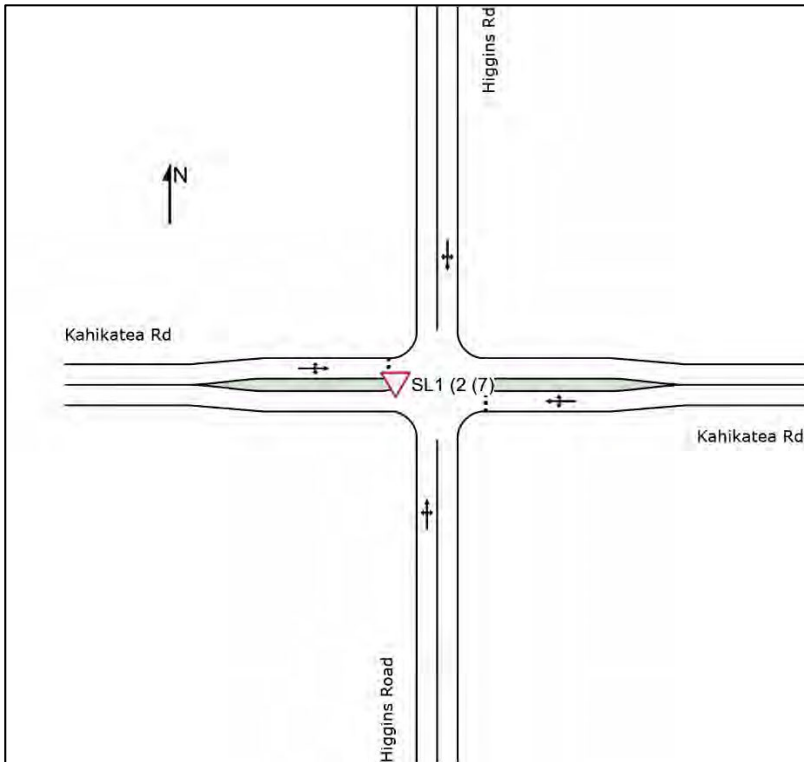


Figure 50: Existing Kahikatea Dr / Higgins Rd Intersection Layout

Table No: 29

Existing Kahikatea Dr / Higgins Rd Intersection									
Scenario	Peak	Intersection Average				Worst Movements (based on delay)			
		V/C	Ave Delay (s)	95 th % Queue (m)	LOS	Movement	Ave Delay (s)	95 th % Queue (m)	LOS
2035 Baseline	AM	0.33	5.1	11.8 Kahikatea Dr (W)	NA	RT from Kahikatea Dr (E)	10.8	10.2	B
	PM	0.68	7.1	57.0 Kahikatea Dr (E)	NA	RT from Kahikatea Dr (E)	13.2	57.0	B
2	AM	0.21	4.7	7.1 Kahikatea Dr (W)	NA	RT from Kahikatea Dr (E)	9.0	1.7	A
	PM	0.23	5.1	8.9 Higgins Rd (N)	NA	RT from Kahikatea Dr (E)	9.3	6.4	A
3	AM	0.20	4.8	7.0 Higgins Rd (N)	NA	RT from Kahikatea Dr (E)	9.8	1.9	A



Existing Kahikatea Dr / Higgins Rd Intersection									
Scenario	Peak	Intersection Average				Worst Movements (based on delay)			
		V/C	Ave Delay (s)	95 th % Queue (m)	LOS	Movement	Ave Delay (s)	95 th % Queue (m)	LOS
4	PM	0.32	5.7	13.9 Higgins Rd (N)	NA	RT from Kahikatea Dr (E)	14.1	10.6	B
	AM	0.24	4.9	8.6 Kahikatea Dr (W)	NA	RT from Kahikatea Dr (E)	11.0	2.2	B
	PM	0.34	5.9	14.0 Higgins Rd (N)	NA	RT from Kahikatea Dr (E)	14.7	12.4	B
5	AM	0.34	4.7	11.8 Kahikatea Dr (W)	NA	RT from Kahikatea Dr (E)	8.3	1.9	A
	PM	0.52	6.3	17.3 Kahikatea Dr (E)	NA	RT from Kahikatea Dr (W)	25.9	13.8	D

The assessment indicates that the existing Higgins Road / Kahikatea Drive intersection continues to operate with a high level of service under all assessed future year scenarios. Intersection average delays remain low, ranging from 4.7 to 6.3 seconds per vehicle.

While some increases in queue lengths and delays are observed as traffic volumes increase, the results indicate that the intersection retains substantial operational capacity. The highest degree of saturation occurs in Scenario 5 during the PM peak period (V/C = 0.52), which remains well below practical capacity.

The results therefore indicate that the Higgins Road / Kahikatea Drive intersection is expected to continue operating acceptably under the assessed growth scenarios, including the wider network growth represented by Scenarios 4 and 5. No upgrade of the intersection is identified as being required based on the modelling undertaken.

15.2 Residential Development

15.2.1 Ohaupo Road / Collins Road Intersection

The existing intersection layout modelled within SIDRA is shown in Figure 51. The results of the intersection performance for the modelling scenarios during the peak periods are presented in Table No: 30.



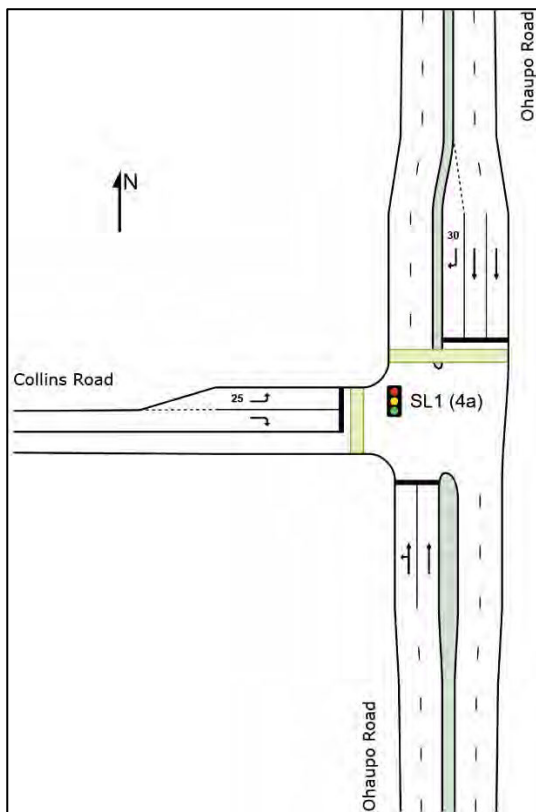


Figure 51: Existing Ohaupo Rd / Collins Rd Signalised Intersection Layout

Table No: 30

Ohaupo Rd / Collins Rd Signalised Intersection									
Scenario	Peak	Intersection Average				Worst Movements (based on delay)			
		V/C	Ave Delay (s)	95 th % Queue (m)	LOS	Movement	Ave Delay (s)	95 th % Queue (m)	LOS
2030 Baseline	AM	0.88	22.0	132 Ohaupo Rd (S)	C	RT from Collins Rd	37.2	49.0	D
	PM	0.91	17.5	83.5 Ohaupo Rd (S)	B	RT from Collins Rd	41.1	36.9	D
1A	AM	0.88	22.5	136 Ohaupo Rd (S)	C	RT from Collins Rd	37.0	50.0	D
	PM	0.92	17.7	85 Ohaupo Rd (S)	B	RT from Collins Rd	43.9	39.1	D
1B	AM	0.88	22.9	140 Ohaupo Rd (S)	C	RT from Collins Rd	37.5	51.2	D
	PM	0.93	17.9	85.9 Ohaupo Rd (S)	B	RT from Collins Rd	45.5	40.2	D
1C	AM	0.88	23.4	146 Ohaupo Rd (S)	C	RT from Collins Rd	38.3	53.0	D
	PM	0.95	18.4	87.3 Ohaupo Rd (S)	B	RT from Collins Rd	53.2	45.7	D
1D	AM	0.89	24.1	153 Ohaupo Rd (S)	C	RT from Ohaupo Rd (N)	39.6	73.8	D
	PM	0.97	18.8	88.3 Ohaupo Rd (S)	B	RT from Collins Rd	58.0	49.0	E



Ohaupo Rd / Collins Rd Signalised Intersection									
Scenario	Peak	Intersection Average				Worst Movements (based on delay)			
		V/C	Ave Delay (s)	95 th % Queue (m)	LOS	Movement	Ave Delay (s)	95 th % Queue (m)	LOS
1E	AM	0.89	24.5	156 Ohaupo Rd (S)	C	RT from Ohaupo Rd (N)	40.7	75.3	D
	PM	0.93	19.1	93.7 Ohaupo Rd (S)	B	RT from Collins Rd	46.2	43.7	D
2035 Baseline	AM	0.76	15.5	187 Ohaupo Rd (S)	B	RT from Collins Rd	39.0	37.3	D
	PM	0.81	15.8	114 Ohaupo Rd (S)	B	RT from Collins Rd	32.1	27.3	C
2	AM	0.79	16.2	125 Ohaupo Rd (S)	B	RT from Collins Rd	40.5	22.7	D
	PM	0.58	19.7	108 Ohaupo Rd (N)	B	RT from Ohaupo Rd (N)	47.2	10.1	D
3	AM	0.76	19.1	113 Ohaupo Rd (S)	B	RT from Ohaupo Rd (N)	39.4	18.6	D
	PM	0.76	18.0	62.6 Ohaupo Rd (N)	B	RT from Ohaupo Rd (N)	33.5	5.7	C
4	AM	0.83	22.6	128 Ohaupo Rd (S)	C	RT from Collins Rd	42.0	37.2	D
	PM	0.75	22.0	82.8 Ohaupo Rd (N)	C	RT from Ohaupo Rd (N)	39..8	6.6	D
5	AM	0.84	20.8	133 Ohaupo Rd (S)	C	RT from Ohaupo Rd (N)	38.2	17.1	D
	PM	0.60	17.4	102 Ohaupo Rd (N)	B	RT from Ohaupo Rd (N)	37.9	7.5	D

The SIDRA modelling indicates that the Ohaupo Road / Collins Road signalised intersection operates with acceptable performance across all modelled scenarios, typically achieving LOS B to C with intersection average delays generally in the order of 15 to 25 seconds per vehicle in both peak periods.

The results also indicate that right turn movements from Ohaupo Road and Collins Road consistently perform at LOS D, with the Collins Road right-turn movement operating at LOS E in Scenario 1D during the PM peak period. However, the average delay per vehicle on each approach to the intersection is no greater than 55 seconds during peak periods which aligns with the ODP Appendix 15 Table 15-2b guidance on efficiency.

Additionally, the 95th percentile queue length results for Ohaupo Road (south approach) are significant in several scenarios, however, there is no queue spillback to the Ohaupo Road / Saxbys Road / Tomin Road roundabout. On this basis, the modelling demonstrates that the intersection can accommodate the forecast traffic demand associated with the assessed development scenarios without requiring physical upgrades.



15.2.2 Ohaupo Road (SH3) / Saxbys Road / Tomin Road Roundabout

The existing roundabout layout modelled within SIDRA is shown in Figure 52. The results of the intersection performance for the modelling scenarios during the peak periods are presented in Table No: 31.

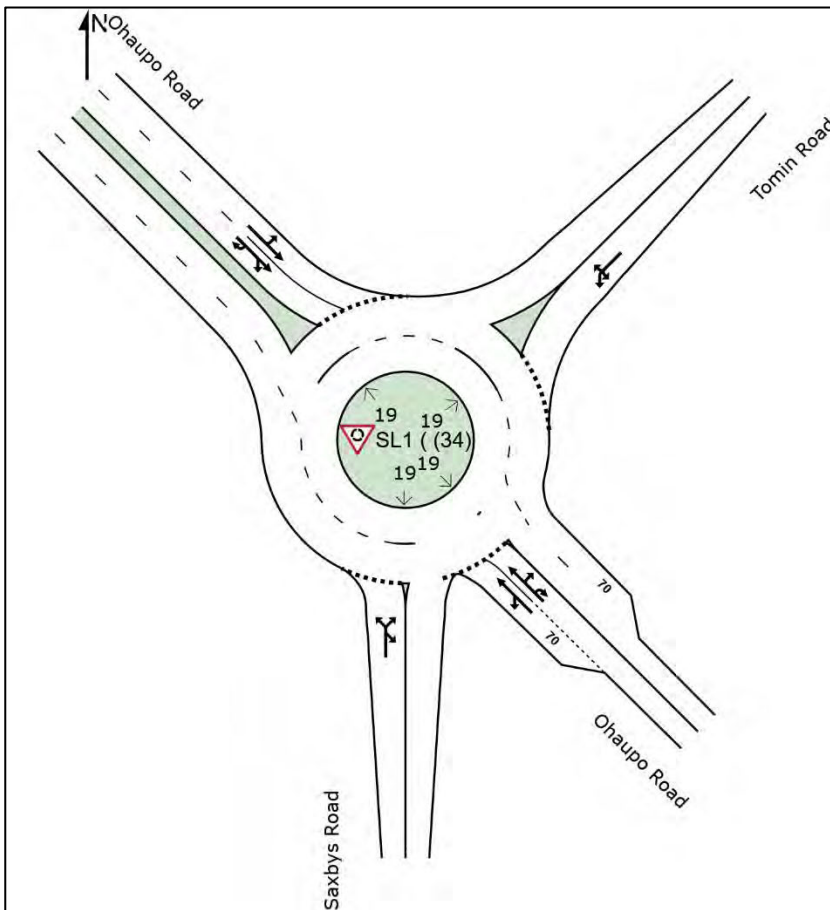


Figure 52: Existing Ohaupo Rd / Saxbys Rd / Tomin Rd Roundabout Layout

Table No: 31

Existing Ohaupo Rd / Saxbys Rd / Tomin Rd Roundabout									
Scenario	Peak	Intersection Average				Worst Movements (based on delay)			
		V/C	Ave Delay (s)	95 th % Queue (m)	LOS	Movement	Ave Delay (s)	95 th % Queue (m)	LOS
2030 Baseline	AM	0.84	10.3	49.5 Tomin Rd	B	RT from Saxbys Rd	30.5	31.4	C
	PM	0.78	8.4	38.5 Tomin Rd	A	RT from Tomin Rd	38.2	38.5	D
1A	AM	0.84	10.7	50.8 Tomin Rd	B	RT from Saxbys Rd	32.9	33.9	C
	PM	0.80	8.7	41.1 Tomin Rd	A	RT from Tomin Rd	41.3	41.1	D
1B	AM	0.85	11.1	51.8 Tomin Rd	B	RT from Saxbys Rd	35.7	36.7	D
	PM	0.82	9.2	44.4 Tomin Rd	A	RT from Tomin Rd	45.3	44.4	D



Existing Ohaupo Rd / Saxbys Rd / Tomin Rd Roundabout									
Scenario	Peak	Intersection Average				Worst Movements (based on delay)			
		V/C	Ave Delay (s)	95 th % Queue (m)	LOS	Movement	Ave Delay (s)	95 th % Queue (m)	LOS
1C	AM	0.88	11.8	53.4 Tomin Rd	B	RT from Saxbys Rd	40.9	41.8	D
	PM	0.85	9.8	48.8 Tomin Rd	A	RT from Tomin Rd	50.8	48.8	E
1D	AM	0.92	12.7	55.4 Tomin Rd	B	RT from Saxbys Rd	47.9	48.3	D
	PM	0.88	10.5	55.2 Tomin Rd	B	RT from Tomin Rd	58.7	55.2	E

In Scenario 1C (198 dwellings), the average delay for right turning vehicles from Tomin Rd has increased by more than 10 seconds per vehicle (i.e. approximately 13seconds) during the PM peak period resulting in the LoS to deteriorate to E. However, the average delay per vehicle is 55 seconds during peak periods on the approaches to the intersection which aligns with the maximum desirable delay in the ODP Appendix 15 Table 15-2b guidance on intersection movement efficiency.

In Scenario 1D (271 dwellings), the average delay per vehicle on Tomin Road approach exceeds 55 seconds during the PM peak period which exceeds the ODP Appendix 15 Table 15-2b guidance for minimum efficiency. The primary capacity constraint in this case is the two-to-one lane merge on the Ohaupo Road southbound exit for the roundabout.

Therefore, the capacity of the roundabout is proposed to be increased by upgrading the southbound exit to two full length lanes from the roundabout to Ohaupo Road / Lambert Court intersection, as shown in Figure 53.



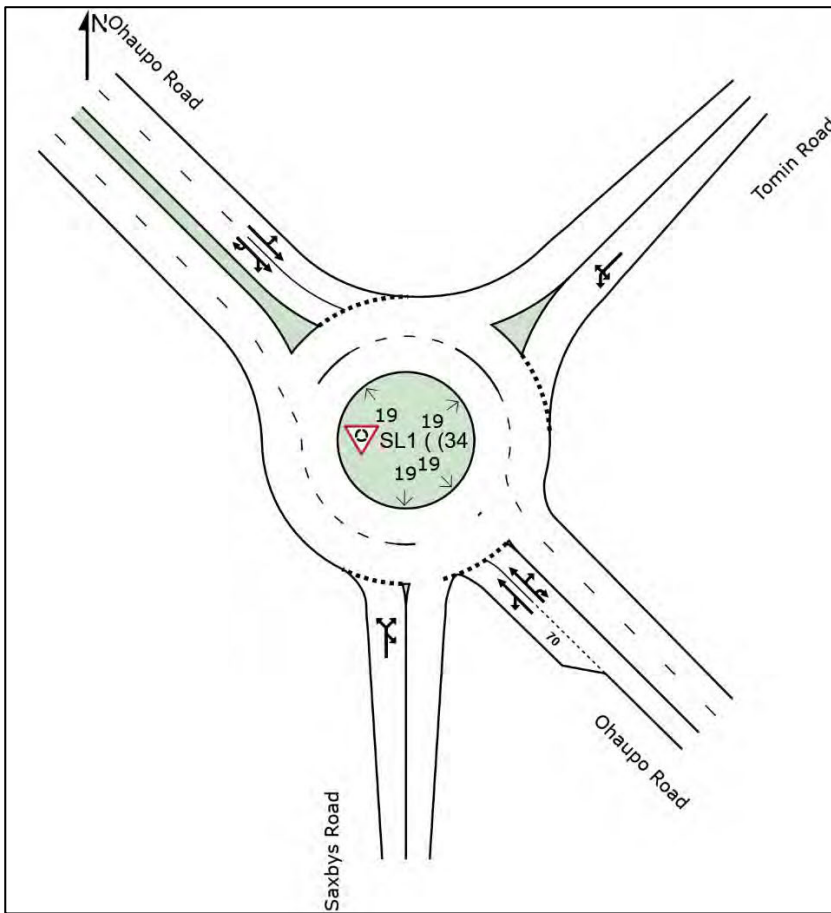


Figure 53: Ohaupo Rd / Saxbys Rd / Tomin Rd Roundabout with Proposed Dual Southbound Exit Lanes on Ohaupo Rd

Table No: 32

Proposed Ohaupo Rd / Saxbys Rd / Tomin Rd Roundabout – 2 Southbound Exit Lanes									
Scenario	Peak	Intersection Average				Worst Movements (based on delay)			
		V/C	Ave Delay (s)	95 th % Queue (m)	LOS	Movement	Ave Delay (s)	95 th % Queue (m)	LOS
1D	AM	0.92	11.5	47.9 Ohaupo Rd (S)	B	RT from Saxbys Rd	47.4	47.9	D
	PM	0.79	7.7	29.0 Saxbys Rd	A	RT from Saxbys Rd	31.2	29.0	C
1E	AM	0.95	12.3	54.6 Saxbys Rd	B	RT from Saxbys Rd	54.5	54.6	E
	PM	0.80	7.9	30.5 Saxbys Rd	A	RT from Saxbys Rd	32.4	30.5	C
2	AM	2.97	273	1,381 Saxbys Rd	F	RT from Saxbys Rd	1,801	1,381	F
	PM	1.32	30.3	271 Saxbys Rd	C	RT from Saxbys Rd	318	271	F

The additional southbound exit lane improves roundabout performance through Scenarios 1D and 1E. However, the modelling indicates that the roundabout returns to an unacceptable level of performance under Scenario 2 (543 dwellings). Under this scenario, average intersection delay increases to approximately



273 seconds per vehicle during the AM peak period, with 95th percentile queues increasing to approximately 1,381 m.

It is important to note the modelling shows the roundabout could experience significant congestion by 2035 even without traffic generated by the Residential Development. The SIDRA modelling indicates that both the Saxbys Road and Tomin Road approaches are forecast to experience high delays under future background traffic conditions. This suggests that some form of upgrade is likely to be required irrespective of the Residential Development, with the Residential Development primarily influencing the timing at which those upgrades become necessary. To address this constraint, an alternative roundabout configuration has been assessed comprising:

- Four-laning of Ohaupo Road between Saxbys Road and Lambert Court.
- Additional approach lanes on Saxbys Road and Tomin Road.
- Metering of the Ohaupo Road southbound approach during the AM peak period.

The assessed layout is shown in Figure 54, with the modelling results presented in Table No: 33.

The primary constraint at the roundabout is the high northbound traffic demand on Ohaupo Road during the AM peak period, which restricts opportunities for vehicles from Saxbys Road to enter the circulating carriageway. Metering of the southbound Ohaupo Road approach creates gaps within the circulating traffic stream, improving entry opportunities for vehicles from Tomin Road. This in turn increases opportunities for vehicles from Saxbys Road to enter the roundabout as northbound vehicles on Ohaupo Road will have to give way to the right (i.e. Tomin Road approach). The additional approach lanes on Saxbys Road and Tomin Road, together with four-laning of Ohaupo Road between Saxbys Road and Lambert Court, further improve the capacity and operation of the intersection.

The SIDRA modelling indicates that metering is only required during the AM peak period when southbound traffic demand on Ohaupo Road is highest. The PM peak period continues to operate at an acceptable level without requiring metering.

The metering arrangement assessed in SIDRA represents a conceptual operational treatment intended to create acceptable gaps in the circulating traffic stream. The detailed signal phasing, timing parameters, detection strategy and operational settings would be determined through subsequent design and consultation with NZTA.



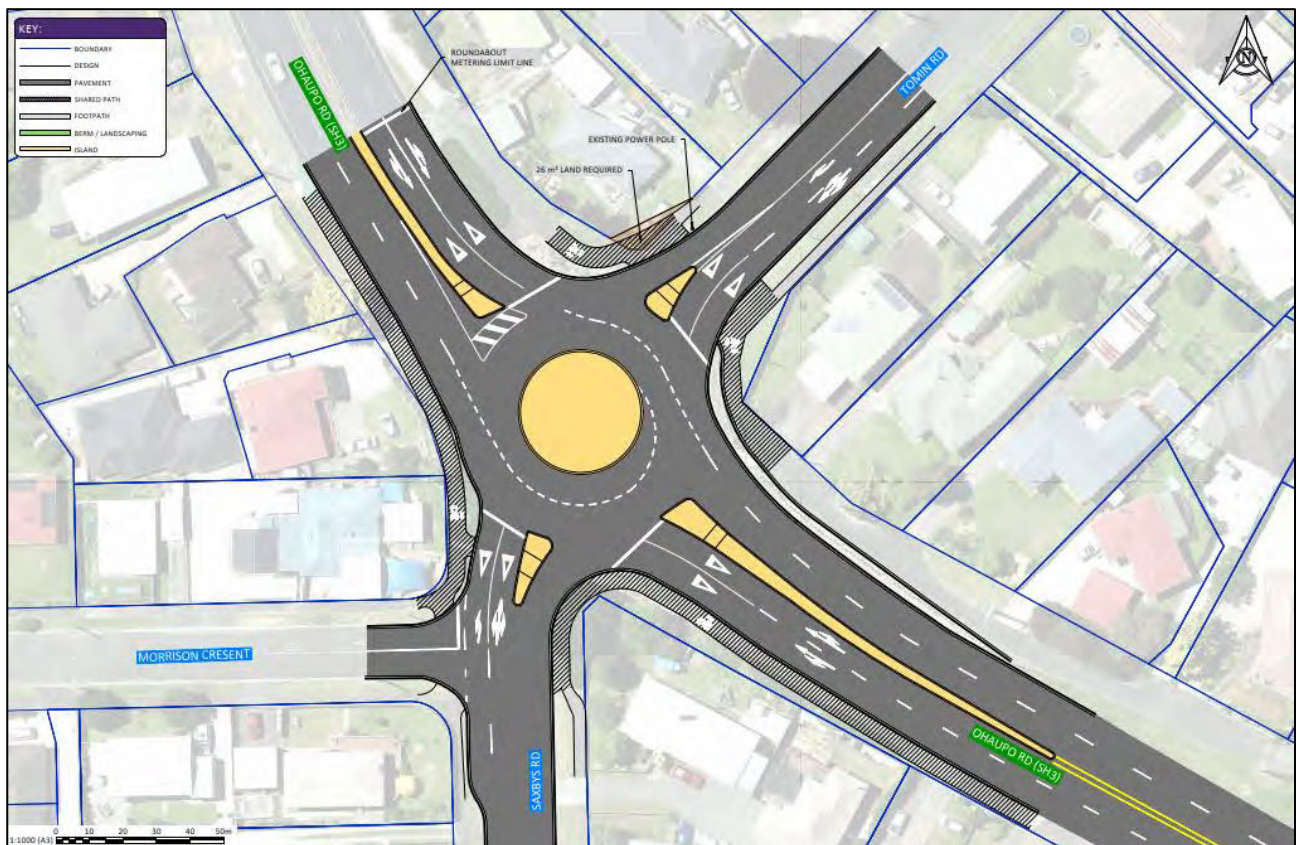


Figure 54: Ohaupo Rd / Saxbys Rd / Tomin Rd Alternative Roundabout Layout with Four Lanes on Ohaupo Rd (South), Additional Lanes on Saxbys Rd and Tomin Rd and Metering on Northern Approach

Table No: 33

Ohaupo Rd / Saxbys Rd / Tomin Rd Roundabout Metering ()									
Scenario	Peak	Intersection Average				Worst Movements (based on delay)			
		V/C	Ave Delay (s)	95 th % Queue (m)	LOS	Movement	Ave Delay (s)	95 th % Queue (m)	LOS
2	AM	1.04	19.3	126 Ohaupo Rd (N)	B	RT from Saxbys Rd	49.6	50	D
	PM	0.78	9.7	63.7 Ohaupo Rd (S)	A	RT from Tomin Rd	26.1	14.2	C
3	AM	0.86	8.6	46.9 Ohaupo Rd (N)	A	RT from Ohaupo Rd (N)	19.3	46.9	B
	PM	0.52	7.4	12.5 Ohaupo Rd (S)	A	RT from Ohaupo Rd (S)	16.4	12.1	B
4	AM	1.19	45.1	96.3 Saxbys Rd	D	RT from Saxbys Rd	182	96.3	F
	PM	0.57	7.9	15.4 Ohaupo Rd (S)	A	RT from Saxbys Rd	17.6	5.7	B
5	AM	1.39	88.2	175 Saxbys Rd	F	RT from Saxbys Rd	360	175	F
	PM	0.66	9.5	22.3 Ohaupo Rd (S)	A	RT from Ohaupo Rd (S)	24.3	20.9	C



The metered roundabout substantially improves performance under Scenario 2 in addition to the two southbound exit lane option assessed in Table No: 32. The average intersection delay reduces from approximately 273 seconds to 19 seconds per vehicle and the 95th percentile queue reduces from approximately 1,381 m to 126 m. This demonstrates that the identified capacity constraint can be effectively managed through the proposed metering and lane improvements.

The modelling indicates that the upgraded roundabout continues to operate at an acceptable level under Scenario 2. While the Saxbys Road approach experiences unacceptable delays in Scenarios 4 and 5 during the AM peak period, these scenarios either assume that HSL is operational or represent development levels beyond those assessed under a without-HSL network scenario. The PM peak period continues to operate at an acceptable level in all assessed scenarios.

Based on the assessment undertaken, the Residential Development can be demonstrated to operate with acceptable transport effects up to approximately 543 dwellings (Scenario 2) under a network scenario that does not rely on the delivery of HSL, subject to the transport infrastructure upgrades identified in this ITA being delivered. The modelling indicates that the identified roundabout constraint can be managed through the proposed upgrades at this level of development.

While Scenario 3 (730 dwellings) demonstrates that the wider transport network can continue to operate efficiently, this scenario assumes that HSL is in place and therefore does not provide a direct assessment of higher residential yields under a without-HSL network scenario.

The WRTM scenarios assessed as part of this ITA demonstrate that the operation of Ohaupo Road intersections is influenced by broader land use, transport infrastructure and travel behaviour assumptions. These include the scale and timing of development within the Airport Business Zone, Peacocke Structure Plan area and other growth areas, together with assumptions regarding HSL delivery, public transport uptake and active mode uptake. Further discussion of these matters is provided in Table No: 45 in Section 15.5.2.

Accordingly, the results of this assessment should not be interpreted as indicating that development cannot proceed beyond 543 dwellings prior to HSL being delivered. Rather, the assessment demonstrates that development up to approximately 543 dwellings can be accommodated under a without-HSL scenario based on the assumptions adopted for the current modelling.

To ensure that those assumptions remain representative of the receiving transport environment as development progresses, a further ITA should be prepared before development exceeds approximately 543 dwellings. The purpose of that assessment would be to reassess the operation of the Ohaupo Road corridor, having regard to the transport network conditions, land use development, travel behaviour and transport infrastructure (existing and committed at the time (including HSL)), and to identify any further mitigation measures available to support development beyond 543 dwellings if HSL delivery remains uncertain.

This assessment requirement should be regarded as a transport reassessment trigger rather than a permanent development limit. Its purpose is to provide a mechanism for confirming whether the assumptions underpinning the current assessment remain appropriate as development progresses and whether any additional transport mitigation is required.

The reassessment trigger relates specifically to the performance of the Ohaupo Road (SH3) corridor and should not be interpreted as a constraint on the operation of the recommended Industrial Development access arrangements, or the wider strategic transport network.



15.2.3 Ohaupo Road / Lambert Court Intersection

The modelling of this intersection was based on the existing priority-controlled crossroads intersection as shown in Figure 55. The modelling results are presented in the table below.

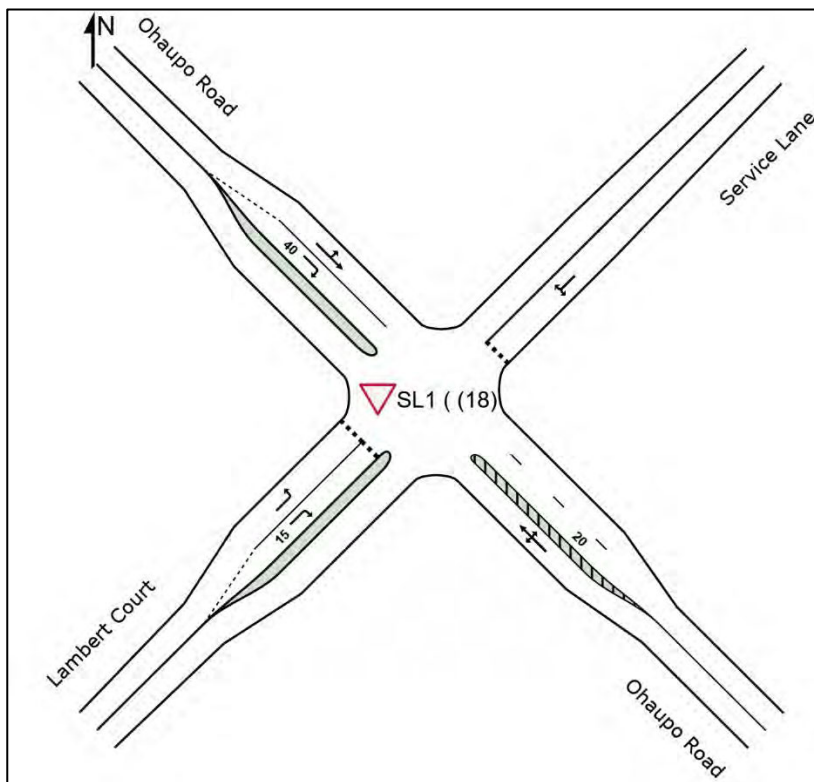


Figure 55: Existing Ohaupo Rd / Lambert Ct Intersection Layout

Table No: 34

Ohaupo Rd / Lambert Court Existing Intersection									
Scenario	Peak	Intersection Average				Worst Movements (based on delay)			
		V/C	Ave Delay (s)	95 th % Queue (m)	LOS	Movement	Ave Delay (s)	95 th % Queue (m)	LOS
2030 Baseline	AM	0.63	6.1	15.8 Lambert Ct	NA	RT from Lambert Ct	109	10.6	F
	PM	0.80	8.3	26.3 Lambert Ct	NA	RT from Service Ln	495	15.6	F
1A	AM	0.90	10.3	33.2 Lambert Ct	NA	RT from Lambert Ct	154	17.6	F
	PM	0.82	8.7	28.0 Lambert Ct	NA	RT from Service Ln	514	16.2	F

Scenario 1A represents the initial stage of Residential Development and comprises approximately 59 dwellings. This scenario was assessed because these dwellings are expected to utilise the Ohaupo Road / Lambert Court intersection from the commencement of development. The assessment was undertaken to determine whether the existing priority-controlled intersection could continue to operate with less than minor effects on intersection performance once Residential Development commences and traffic is introduced via the Lambert Court corridor.



The right turn movements from Lambert Court and the residential service lane fail (LOS F) in the 2030 baseline scenario. The average delay experience by these movements only worsens in Scenario 1A when the development traffic (59 dwellings) is added to the adjoining road network. Accordingly, an upgrade of the intersection to signal control is necessary before trips are generated by the first stage of Residential Development. Figure 56 presents the upgraded intersection layout.

The separation distance between the proposed Ohaupo Road / Lambert Court intersection and the existing signalised mid-block crossing is approximately 105 m. It is not unusual to have closely spaced signal-controlled intersections as these can operate with coordinated signal timings. Below are some examples of reduced separation distances²⁵ between other signalised intersections in Auckland and Hamilton:

- Teed Street to Remuera Road (Newmarket, Auckland) = 53 m
- Ward Street to Bryce Street (Hamilton Central, Hamilton) = 115 m
- Sky City Hamilton to Collingwood Street (Hamilton Central, Hamilton) = 144 m

The close spacing between the proposed signalised intersection and the existing pedestrian crossing can be managed through coordinated signal operation. The pedestrian crossing is demand responsive and only interrupts traffic flow when activated.

Table No: 35 presents the modelled performance results and Figure 59 presents the optimised phase sequence.

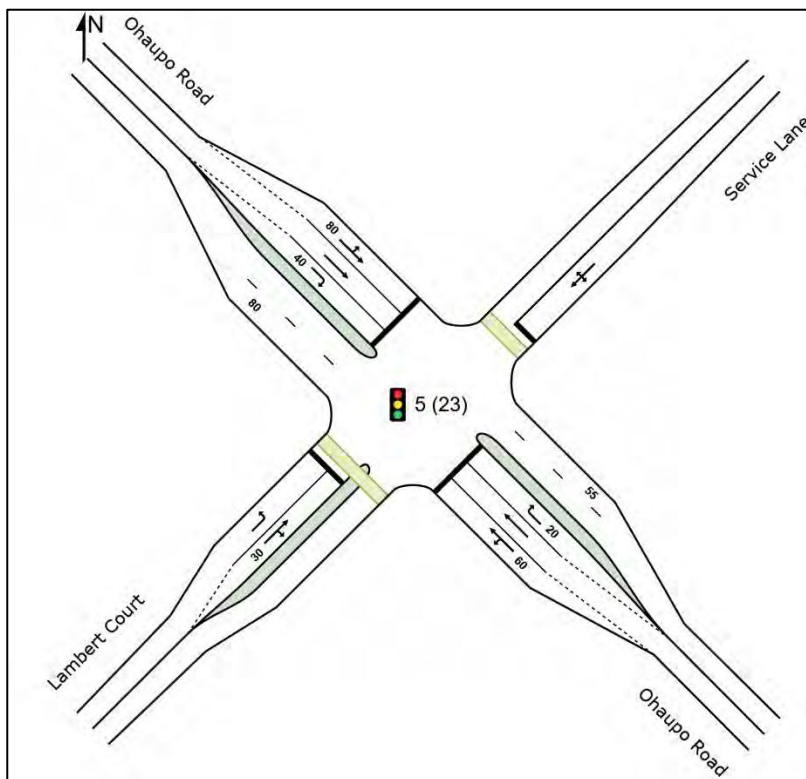


Figure 56: Proposed Ohaupo Rd / Lambert Ct Signalised Intersection Layout – Scenario 1A to 1C

²⁵ Separation distance is measured between primary signal displays of both the upstream and downstream signalised intersections in the same approach.



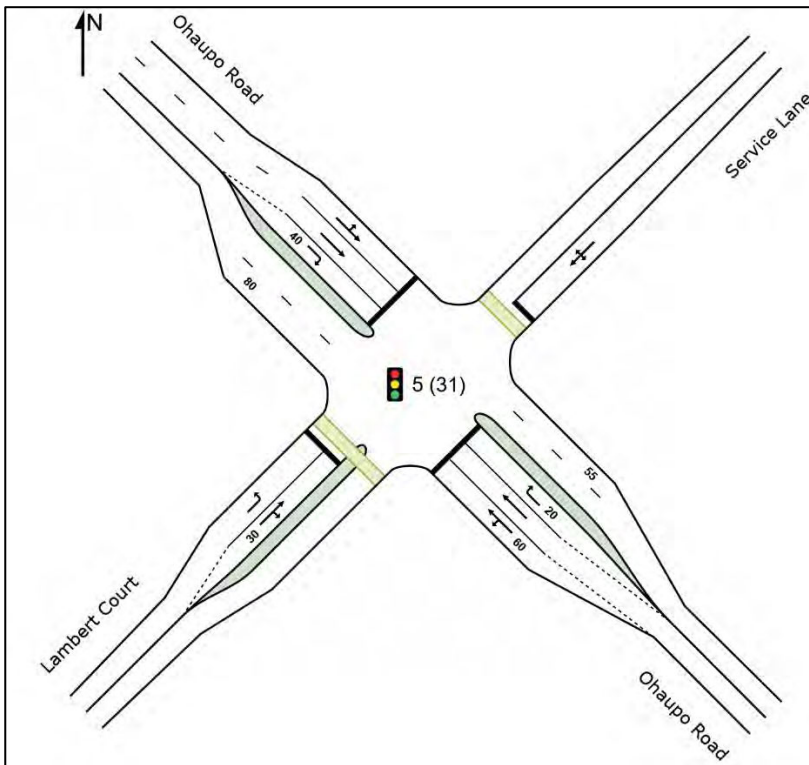


Figure 57: Proposed Ohaupo Rd / Lambert Ct Signalised Intersection Layout – Scenario 1D



Figure 58: Proposed Ohaupo Rd / Lambert Ct Signalised Intersection Layout – Scenarios 2 to 5



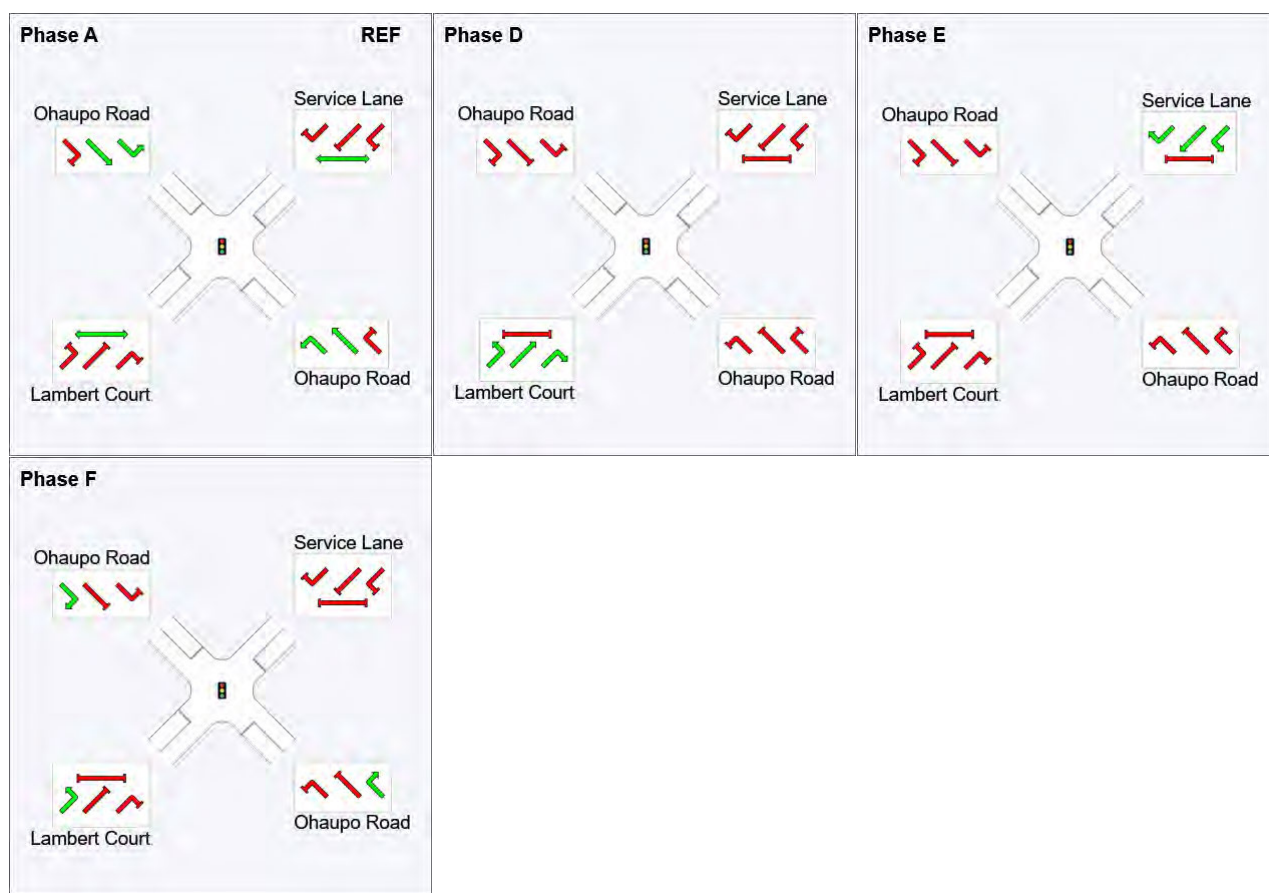


Figure 59: Proposed Ohaupo Rd / Lambert Ct Signalised Intersection Phase Sequence

Table No: 35

Ohaupo Rd / Lambert Ct Signalised Intersection									
Scenario	Peak	Intersection Average				Worst Movements (based on delay)			
		V/C	Ave Delay (s)	95 th % Queue (m)	LOS	Movement	Ave Delay (s)	95 th % Queue (m)	LOS
2030 Baseline	AM	0.53	14.9	118 Ohaupo Rd (S)	B	RT from Ohaupo Rd (N)	55.9	21.8	E
	PM	0.75	23.6	169 Ohaupo Rd (N)	C	RT from Lambert Ct	48.0	10.5	D
1A	AM	0.54	15.5	118 Ohaupo Rd (S)	B	RT from Ohaupo Rd (N)	54.5	21.5	D
	PM	0.76	23.7	169 Ohaupo Rd (N)	C	RT from Lambert Ct	48.1	10.8	D
1B	AM	0.54	16.0	118 Ohaupo Rd (S)	B	RT from Ohaupo Rd (N)	53.9	21.7	D
	PM	0.76	23.8	169 Ohaupo Rd (N)	C	RT from Lambert Ct	48.2	11.5	D
1C	AM	0.55	16.6	118 Ohaupo Rd (S)	B	RT from Ohaupo Rd (N)	53.4	21.8	D
	PM	0.76	23.9	169 Ohaupo Rd (N)	C	RT from Lambert Ct	48.3	12.5	D



Ohaupo Rd / Lambert Ct Signalised Intersection									
Scenario	Peak	Intersection Average				Worst Movements (based on delay)			
		V/C	Ave Delay (s)	95 th % Queue (m)	LOS	Movement	Ave Delay (s)	95 th % Queue (m)	LOS
1D	AM	0.56	17.3	118 Ohaupo Rd (S)	B	RT from Ohaupo Rd (N)	51.8	22.1	D
	PM	0.72	22.2	169 Ohaupo Rd (N)	C	RT from Lambert Ct	53.6	14.2	D
1E	AM	0.56	17.7	118 Ohaupo Rd (S)	B	RT from Ohaupo Rd (N)	51.2	22.2	D
	PM	0.75	24.0	170 Ohaupo Rd (N)	C	RT from Lambert Ct	49.0	13.6	D
2	AM	0.60	21.4	59.8 Ohaupo Rd (S)	C	RT from Ohaupo Rd (N)	37.5	12.7	D
	PM	0.92	32.8	170 Ohaupo Rd (N)	C	RT from Lambert Ct	54.2	34.1	D
3	AM	0.44	22.8	42.5 Ohaupo Rd (S)	C	RT from Ohaupo Rd (N)	35.8	12.4	D
	PM	0.77	17.3	59.7 Ohaupo Rd (N)	B	RT from Lambert Ct	33.7	23.1	C
4	AM	0.61	12.5	33.1 Ohaupo Rd (N)	B	RT from Lambert Ct	30.0	16.8	C
	PM	0.89	24.6	104 Ohaupo Rd (N)	C	RT from Lambert Ct	42.6	33.7	D
5	AM	0.62	19.8	38.8 Ohaupo Rd (S)	B	RT from Lambert Ct	28.6	10.1	C
	PM	0.83	28.6	130 Ohaupo Rd (N)	C	RT from Ohaupo Rd (N)	57.7	14.9	E

The modelling results are based on the right turn movement from Resthill Crescent being banned in Scenario 2 (as discussed in Section 15.2.4). The SIDRA modelling indicates that the proposed Ohaupo Road / Lambert Court signalised intersection would operate at an acceptable level across all modelled scenarios, achieving LOS B to C with intersection-average delays generally ranging from approximately 14 to 33 seconds per vehicle in both the AM and PM peak periods. Degrees of saturation remain below capacity in all scenarios, indicating sufficient practical spare capacity at the proposed signalised intersection.

The analysis shows that the worst-performing movements are typically right-turn movements from Ohaupo Road (northern approach) or Lambert Court, which operate predominantly at LOS D and, in isolated PM peak scenario (i.e. Scenario 5), at LOS E (i.e. average delay greater than 55 seconds per vehicle). Notwithstanding this, the average delay per vehicle on each approach remains below 55 seconds during peak periods, consistent with the efficiency criteria set out in ODP Appendix 15, Table 15-2b.

The 95th percentile queue lengths achieved on all approaches do not extend to or spill back to adjacent intersections. However, the 95th percentile queue length achieved on the southern approach of Ohaupo Road reaches approximately 120 m in Scenarios 1A to 1E, extending beyond the existing mid-block signalised crossing which is 105 m from the Ohaupo Road / Lambert Court intersection. While the modelled 95th percentile queue extends beyond the pedestrian crossing in some scenarios, the average queue length is



approximately 75 m, indicating that such occurrences are infrequent and not representative of typical operating conditions. On this basis, the modelling demonstrates that the proposed Ohaupo Road / Lambert Court signalised intersection can accommodate the forecast traffic demand.

It is noted that a signalised intersection form supports Ohaupo Road being a bus priority corridor in the future. Detailed signal phasing, pedestrian crossing arrangements, geometric design and visibility requirements will be confirmed during subsequent engineering design phases.

Consideration has been given to removing access to the Ohaupo Road service lane (northern leg of the Ohaupo Road / Lambert Court intersection), since an alternative is already provided further north on Ohaupo Road. However, it is expected that the likelihood of crashes at the alternative northern access could potentially increase as vehicles exiting and heading north will have to cut across two lanes (i.e. one southbound lane + flush medium existing arrangement and two southbound lanes future arrangement) to merge with through traffic. Similarly, vehicles turning right into the access will have to cut across two lanes.

To mitigate the safety risk, a central median island could be introduced on Ohaupo Rd at the alternative northern access limiting movements at the access to left-in-left-out. However, this could in return increase unsafe U-turn movements at both signalised intersections (i.e. Saxbys Rd and Lambert Ct) on either end of this section of road.

On balance, retaining the service lane as the fourth leg of the signalised intersection is considered preferable to closing the access, having regard to the operational and safety implications associated with diverting movements to the alternative northern access.

15.2.4 Ohaupo Road / Resthill Crescent Intersection

The existing intersection layout modelled within SIDRA is shown in Figure 60. The results of the intersection performance during the peak periods are presented in Table No: 36.

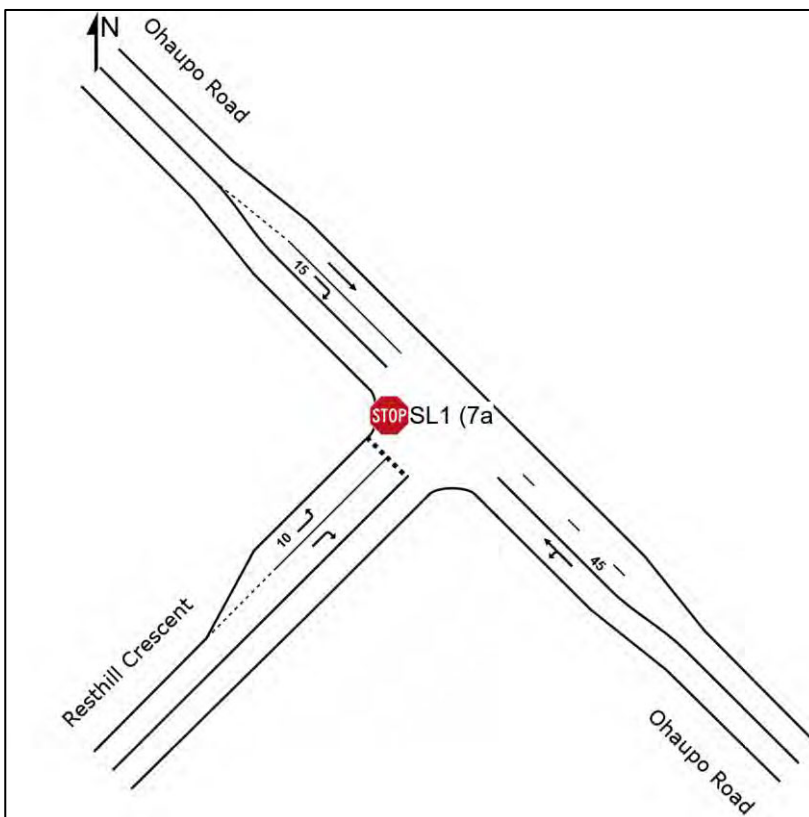


Figure 60: Existing Ohaupo Rd / Resthill Cres Intersection Layout



Table No: 36

Existing Ohaupo Rd / Resthill Cres Intersection									
Scenario	Peak	Intersection Average				Worst Movements (based on delay)			
		V/C	Ave Delay (s)	95 th % Queue (m)	LOS	Movement	Ave Delay (s)	95 th % Queue (m)	LOS
2030 Baseline	AM	0.54	3.2	9.3 Resthill Cres	NA	LT from Resthill Cres	140	9.3	F
	PM	0.66	4.0	18.2 Resthill Cres	NA	LT from Resthill Cres	89.5	18.2	F
1A	AM	0.54	3.3	9.3 Resthill Cres	NA	LT from Resthill Cres	140	9.3	F
	PM	0.66	4.1	18.3 Resthill Cres	NA	LT from Resthill Cres	90.2	18.3	F
1E	AM	0.55	3.8	9.3 Resthill Cres	NA	LT from Resthill Cres	140	9.3	F
	PM	0.69	4.7	19.2 Resthill Cres	NA	LT from Resthill Cres	96.8	19.2	F

Although the left turn movement from Resthill Crescent fails in the 2030 baseline scenario, there is negligible increase in the average delay (i.e. less than 10 seconds per vehicle) for all movements for Scenarios 1A to 1E. Therefore, the Ohaupo Road / Resthill Crescent intersection is proposed to be upgraded (i.e. right turn movement out removed) prior to Scenario 2 as shown in Figure 61.

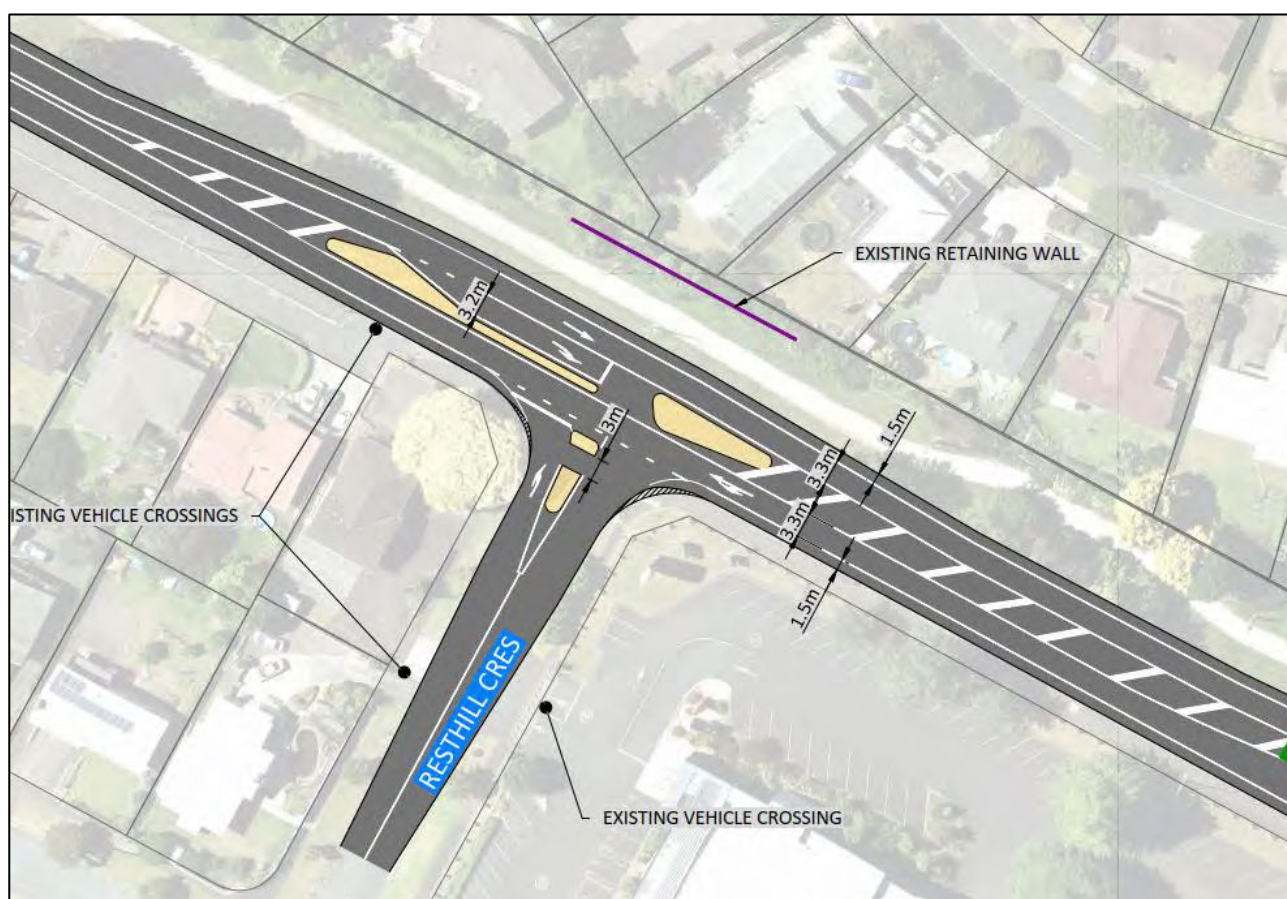


Figure 61: Proposed Ohaupo Rd / Resthill Cres Intersection Upgrade



Table No: 37

Ohaupo Rd / Resthill Cres Intersection – RT from Resthill Cres Removed									
Scenario	Peak	Intersection Average				Worst Movements (based on delay)			
		V/C	Ave Delay (s)	95 th % Queue (m)	LOS	Movement	Ave Delay (s)	95 th % Queue (m)	LOS
2	AM	0.54	1.4	1.9 Ohaupo Rd (N)	NA	LT from Resthill Cres	168	1.3	F
	PM	0.58	1.6	3.2 Ohaupo Rd (N)	NA	RT from Ohaupo Rd (N)	57.2	3.2	F
3	AM	0.35	0.7	0.5 Ohaupo Rd (N)	NA	LT from Resthill Cres	29.7	0.2	D
	PM	0.37	1.0	1.1 Ohaupo Rd (N)	NA	LT from Resthill Cres	21.8	0.3	C
4	AM	0.44	0.7	0.4 Ohaupo Rd (N)	NA	LT from Resthill Cres	49.8	0.4	E
	PM	0.47	1.0	0.8 Ohaupo Rd (N)	NA	RT from Ohaupo Rd (N)	32.5	0.8	D
5	AM	0.41	0.6	0.3 Ohaupo Rd (N)	NA	LT from Resthill Cres	43.8	0.3	E
	PM	0.56	0.7	0.7 Ohaupo Rd (N)	NA	LT from Resthill Cres	23.6	0.4	C

The SIDRA modelling indicates that the Ohaupo Road / Resthill Crescent intersection, with the right-turn movement from Resthill Crescent removed, operates with low intersection-average delays, generally less than 2 seconds per vehicle in both the AM and PM peak periods. Degree of saturation remain well below capacity in all scenarios, confirming substantial practical spare capacity on the Ohaupo Road approaches.

The analysis shows that the worst-performing movements are left-turn movement from Resthill Crescent or right-turn movement from Ohaupo Road. While these movements achieve LOS D to F in some scenarios, the associated traffic volumes are low, with the left-turn movement from Resthill Crescent carrying approximately 3 to 7 vehicles per hour and the right-turn movement from the northern Ohaupo Road approach carrying approximately 10 to 35 vehicles per hour. Accordingly, the movement-specific delays reflect limited gap availability for a small number of vehicles rather than a broader operational constraint affecting intersection performance.

The 95th percentile queue lengths achieved on all approaches are considered negligible, generally less than 3 m following removal of the right-turn movement from Resthill Crescent. The modelling therefore indicates that the intersection can accommodate the forecast traffic demand without adverse operational effects on the surrounding transport network.

It is also noted that the right-turn movement from Resthill Crescent, which is removed as part of the proposed upgrade, carries approximately 20 vehicles per hour during the AM peak period and approximately 120 vehicles per hour during the PM peak period. These movements are reassigned through the proposed Ohaupo Road / Lambert Court signalised intersection, which has been demonstrated through the modelling presented in Section 15.2.3 to operate at an acceptable level under the assessed development scenarios.



15.2.5 Ohaupo Road (SH3) / Houchens Road Intersection

The existing intersection layout modelled within SIDRA is shown in Figure 62. The results of the intersection performance during the peak periods are presented in Table No: 38.

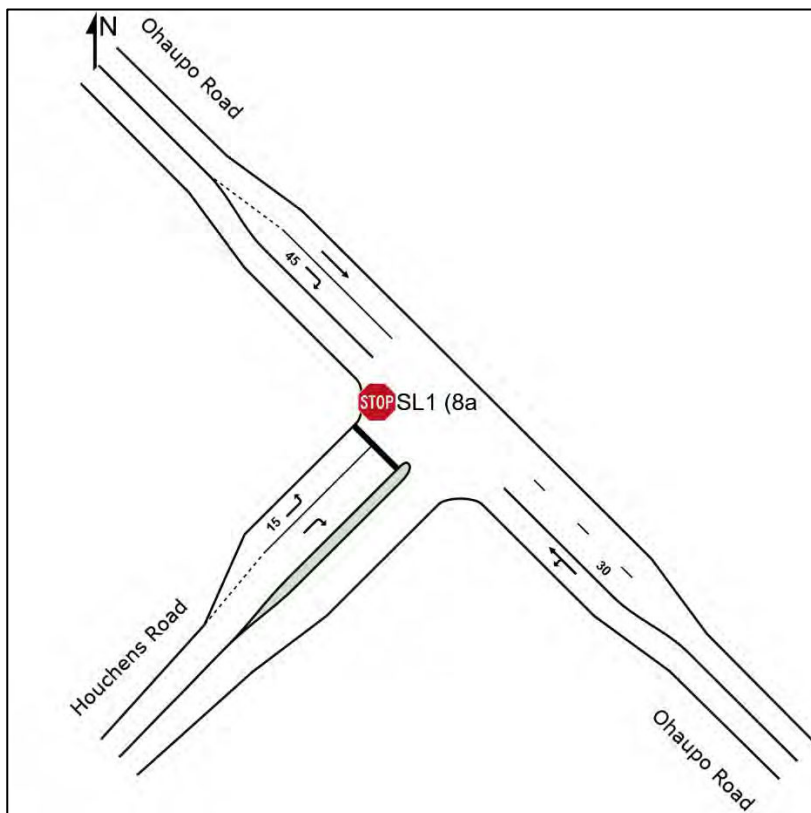


Figure 62: Existing Ohaupo Rd / Houchens Rd Intersection Layout

Table No: 38

Existing Ohaupo Rd / Houchens Rd Intersection									
Scenario	Peak	Intersection Average				Worst Movements (based on delay)			
		V/C	Ave Delay (s)	95 th % Queue (m)	LOS	Movement	Ave Delay (s)	95 th % Queue (m)	LOS
2030 Baseline	AM	0.70	7.2	25.8 Houchens Rd	NA	RT from Houchens Rd	61.2	16.6	F
	PM	0.63	5.9	23.6 Ohaupo Rd (N)	NA	RT from Houchens Rd	107	11.5	F
1A	AM	0.71	7.3	26.0 Houchens Rd	NA	RT from Houchens Rd	64.4	17.2	F
	PM	0.65	6.1	24.2 Ohaupo Rd (N)	NA	RT from Houchens Rd	110	11.8	F
1B	AM	0.71	7.4	26.3 Houchens Rd	NA	RT from Houchens Rd	67.9	17.9	F



Existing Ohaupo Rd / Houchens Rd Intersection									
Scenario	Peak	Intersection Average				Worst Movements (based on delay)			
		V/C	Ave Delay (s)	95 th % Queue (m)	LOS	Movement	Ave Delay (s)	95 th % Queue (m)	LOS
1C	PM	0.66	6.2	24.8 Ohaupo Rd (N)	NA	RT from Houchens Rd	115	12.2	F
	AM	0.74	7.7	26.8 Houchens Rd	NA	RT from Houchens Rd	73.0	18.8	F
	PM	0.67	6.5	25.6 Ohaupo Rd (N)	NA	RT from Houchens Rd	121	12.6	F

Although the right turn movement from Houchens Road operates at LOS F in the 2030 baseline scenario, there is negligible increase in the average delay (i.e. less than 10 seconds per vehicle) for Scenarios 1A and 1B. However, in Scenario 1C, the average delay for right turning vehicles from Houchens Rd increases by more than 10 seconds per vehicle during the peak periods. Therefore, the intersection is recommended to be upgraded to a signalised intersection prior to Scenario 1C (i.e. 198 dwellings).

The signalised intersection layout modelled within SIDRA is shown in Figure 63. The results of the intersection performance for Scenarios 2 to 5 during the peak periods are presented in Table No: 39.



Figure 63: Proposed Ohaupo Rd / Houchens Rd Signalised Intersection Layout



Figure 64: Proposed Ohaupo Rd / Houchens Rd Phase Sequence.

Table No: 39

Proposed Ohaupo Rd / Houchens Rd Signalised Intersection									
Scenario	Peak	Intersection Average				Worst Movements (based on delay)			
		V/C	Ave Delay (s)	95 th % Queue (m)	LOS	Movement	Ave Delay (s)	95 th % Queue (m)	LOS
1C	AM	0.42	11.7	69.1 Ohaupo Rd (S)	B	RT from Ohaupo Rd (N)	42.7	8.1	D
	PM	0.58	12.8	83.0 Ohaupo Rd (N)	B	RT from Ohaupo Rd (N)	30.0	29.8	C
1D	AM	0.42	11.6	69.5 Ohaupo Rd (S)	B	RT from Ohaupo Rd (N)	42.7	8.1	D
	PM	0.58	12.8	83.2 Ohaupo Rd (N)	B	RT from Ohaupo Rd (N)	30.0	29.8	C
1E	AM	0.65	12.8	119 Ohaupo Rd (S)	B	RT from Ohaupo Rd (N)	41.5	7.8	D
	PM	0.67	13.1	95.2 Ohaupo Rd (S)	B	RT from Ohaupo Rd (N)	35.7	34.3	D
2	AM	0.50	11.1	45.3 Ohaupo Rd (S)	B	RT from Houchens Rd	31.9	8.5	C
	PM	0.58	10.3	54.5 Ohaupo Rd (S)	B	RT from Houchens Rd	34.3	5.6	C
3	AM	0.42	16.1	33.6 Ohaupo Rd (S)	B	RT from Houchens Rd	35.5	14.3	D
	PM	0.60	17.0	31.3 Ohaupo Rd (S)	B	RT from Ohaupo Rd (N)	31.7	26.7	C



Proposed Ohaupo Rd / Houchens Rd Signalised Intersection									
Scenario	Peak	Intersection Average				Worst Movements (based on delay)			
		V/C	Ave Delay (s)	95 th % Queue (m)	LOS	Movement	Ave Delay (s)	95 th % Queue (m)	LOS
4	AM	0.61	15.3	36.4 Ohaupo Rd (S)	B	RT from Ohaupo Rd (N)	32.5	21.8	C
	PM	0.67	16.7	45.0 Ohaupo Rd (S)	B	RT from Ohaupo Rd (N)	35.1	29.4	D
5	AM	0.61	14.3	36.0 Ohaupo Rd (S)	B	RT from Houchens Rd	25.3	17.2	C
	PM	0.61	17.8	55.4 Ohaupo Rd (S)	B	RT from Houchens Rd	45.5	30.5	D

The SIDRA modelling indicates that the proposed Ohaupo Road / Houchens Road signalised intersection operates at an acceptable level across all modelled scenarios, achieving LOS B with average delays generally in the order of approximately 12 to 18 seconds per vehicle in both the AM and PM peak periods. Degree of saturation remain below capacity in all scenarios, indicating that the intersection provides sufficient practical spare capacity to accommodate the forecast traffic demand.

The worst-performing movements are identified as right turn movements from Ohaupo Road and Houchens Road, which operate predominantly at LOS C to D across the assessed scenarios. However, the associated average delays for these movements remain moderate, and the average delay per vehicle on each approach to the intersection remains well below 55 seconds during peak periods, consistent with the efficiency criteria set out in ODP Appendix 15, Table 15-2b.

The 95th percentile queue lengths on the Ohaupo Road approaches are relatively modest, and do not give rise to any queue spillback or interaction with adjacent intersections.

15.2.6 Future Houchens Road Full-Diamond Interchange

The suggested Houchens Road full-diamond interchange is not part of this Project. It has been assessed because it is a potential future network intervention that could materially influence traffic distribution and long-term network performance for the Residential Development area and the wider SL1 growth cell. Its inclusion is therefore for scenario-testing purposes only and does not form part of the works proposed on for this Project.

The suggested Houchens Road full-diamond interchange was analysed as a network in SIDRA with a pair of roundabouts as illustrated in Figure 56. The interchange performance results for all modelling scenarios 3 to 5 during peak periods are presented in Table No: 40 and Table No: 41.



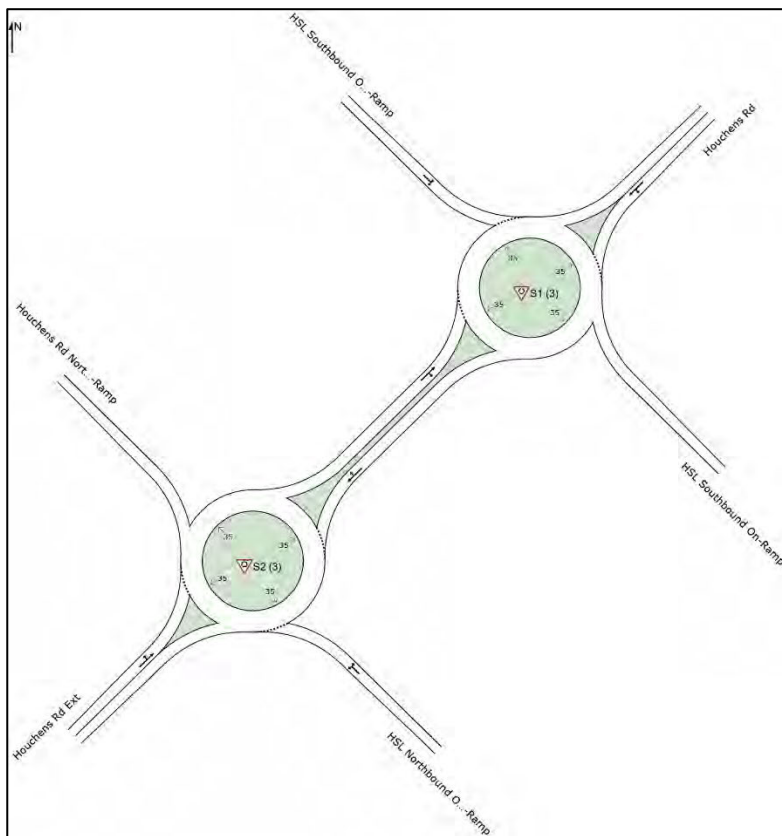


Figure 65: Future Houchens Rd Full-Diamond Interchange Layout

Table No: 40

Houchens Rd Interchange – Northern Roundabout									
Infrastructure Scenarios	Peak	Intersection Average				Worst Movements (in terms of delay)			
		V/C	Ave Delay (s)	95 th % Queue (m)	LOS	Movement	Ave Delay (s)	95 th % Queue (m)	LOS
3	AM	0.18	3.0	2.9 Houchens Rd	A	RT from HSL SB Off-ramp	12.9	1.1	B
	PM	0.22	3.8	3.6 HSL SB Off-ramp	A	RT from HSL SB Off-ramp	13.2	3.6	B
4	AM	0.15	3.5	2.1 Houchens Rd	A	RT from HSL SB Off-ramp	12.6	1.1	B
	PM	0.26	4.3	4.4 HSL SB Off-ramp	A	RT from HSL SB Off-ramp	12.9	4.4	B
5	AM	0.69	3.5	25.6 Houchens Rd	A	RT from HSL SB Off-ramp	14.1	7.1	B
	PM	0.67	5.7	22.9 HSL SB Off-ramp	A	RT from HSL SB Off-ramp	21.1	22.9	C



Table No: 41

Houchens Rd Interchange – Southern Roundabout									
Infrastructure Scenarios	Peak	Intersection Average				Worst Movements (in terms of delay)			
		V/C	Ave Delay (s)	95 th % Queue (m)	LOS	Movement	Ave Delay (s)	95 th % Queue (m)	LOS
3	AM	0.14	7.4	2.0 HSL NB Off-ramp	A	RT from HSL NB Off-ramp	12.6	2.0	B
	PM	0.16	8.2	2.5 HSL NB Off-ramp	A	RT from HSL NB Off-ramp	12.5	2.5	B
4	AM	0.09	6.7	1.3 HSL NB Off-ramp	A	RT from HSL NB Off-ramp	12.5	1.3	B
	PM	0.12	7.5	1.8 HSL NB Off-ramp	A	RT from HSL NB Off-ramp	12.5	1.8	B
5	AM	0.37	8.2	6.1 HSL NB Off-ramp	A	RT from HSL NB Off-ramp	16.4	6.1	B
	PM	0.49	10.5	10.6 HSL NB Off-ramp	A	RT from HSL NB Off-ramp	13.9	10.6	B

The SIDRA modelling indicates that both roundabouts forming the suggested Houchens Road full-diamond interchange operate at a high level of service across all assessed scenarios. The northern roundabout achieves intersection average delays of approximately 3 to 6 seconds per vehicle, while the southern roundabout achieves intersection average delays of approximately 7 to 11 seconds per vehicle during the peak periods.

Degrees of saturation remain well below practical capacity at both roundabouts in all scenarios, indicating substantial spare capacity is available. The worst-performing movements generally operate at LOS B, with isolated LOS C conditions occurring at the northern roundabout in Scenario 5 during the PM peak period. Notwithstanding this, movement delays remain low and do not indicate any operational constraints.

The 95th percentile queue lengths are also modest, remaining below approximately 26 m at the northern roundabout and 11 m at the southern roundabout across all assessed scenarios. The modelling therefore indicates that the future Houchens Road full-diamond interchange would operate efficiently and accommodate the forecast traffic demand associated with the assessed development scenarios.

15.3 Bus Route Modelling

Bus route modelling has been undertaken to assess the operational performance of future public transport services operating along Ohaupo Road corridor under the 2035 and 2045 modelled network conditions (i.e. Scenarios 2 to 4).

This assessment is important because the future Comet service is expected to operate as a frequent public transport corridor serving Glenview, the Residential Development and the wider southern Hamilton growth area. The assessment provides an indication of the relative performance of buses, light vehicles and heavy commercial vehicles under the future transport network scenarios considered within this ITA.



Figure 66 illustrates the future 2035 and 2045 Comet bus routes, aligned with the WRC 2028 and 2037 Network Plans (refer to Figure 23 and Figure 24). Table No: 42 compares route performance for buses, light vehicles and heavy commercial vehicles using four indicators: average travel speed, average control delay, degree of saturation and effective stop rate. These indicators collectively describe travel efficiency, delay exposure, capacity resilience and stop-start operating conditions along the corridor.

The modelling indicates that bus services generally achieve travel performance comparable to, and in many cases better than, light vehicles and heavy commercial vehicles across the assessed scenarios. Bus movements typically experience lower average control delays and lower effective stop rates than other vehicle classes, indicating reduced exposure to stop-start conditions and supporting improved service reliability.

In Scenario 2 (2035 without HSL), the corridor experiences its most constrained operating conditions, particularly in the Houchens Road to Saxbys Road direction during the AM peak and the Saxbys Road to Houchens Road direction during the PM peak. Despite these conditions, buses continue to achieve comparable or higher travel speeds than general traffic and generally experience lower delays.

The introduction of HSL in Scenarios 3 and 4 generally reduces corridor degrees of saturation and provides additional network capacity, reflecting the redistribution of traffic across the wider transport network. While changes in travel speed and delay vary by direction and time period, buses continue to perform competitively relative to light vehicles and heavy commercial vehicles under all assessed scenarios.

The effective stop-rate results also indicate that buses generally experience fewer stop-start events than other vehicle classes across most scenarios. This supports smoother progression through the corridor and contributes to travel time reliability for future public transport services.

It is noted that the assessed network includes transport interventions that support public transport operation at key locations along the corridor. However, the purpose of this assessment is not to confirm the detailed design of future bus-priority measures. Rather, it is to assess the relative performance of future bus services within the wider transport network scenarios considered by the ITA.

Overall, the route travel performance results indicate that future public transport services can operate efficiently within the assessed transport network. While HSL provides additional network capacity and generally reduces corridor saturation, the modelling demonstrates that bus services remain a competitive transport option across all assessed scenarios, achieving travel speeds and operating conditions that are comparable to, and often better than, general traffic.



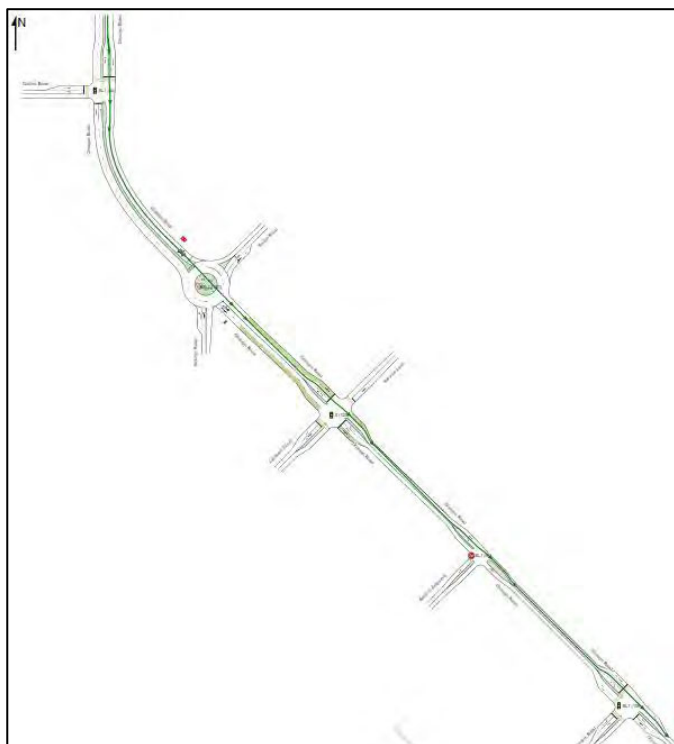


Figure 66: 2035 / 2045 Comet Bus Route – Based on WRC Network Plans

Table No: 42

Route Travel Performance												
Performance Indicators	Average Travel Speed (km/h)			Average Control Delay (seconds)			Degree of Saturation			Effective stop rate		
Vehicle Class	Buses	LV	HCV	Buses	LV	HCV	Buses	LV	HCV	Buses	LV	HCV
Scenario 2: 2035 AM Peak Saxbys Rd to Houchens Rd	36	35	35	7.9	8.5	10.4	0.81	0.81	0.81	0.38	0.47	0.46
Scenario 2: 2035 AM Peak Houchens Rd to Saxbys Rd	33	29	29	8.5	14.5	14.8	0.87	0.87	0.87	0.50	0.72	0.74
Scenario 2: 2035 PM Peak Saxbys Rd to Houchens Rd	38	27	27	6.4	17.1	18.8	0.57	0.97	0.97	0.29	0.51	0.52
Scenario 2: 2035 PM Peak Houchens Rd to Saxbys Rd	30	27	27	12.1	16.7	17.9	0.94	0.94	0.94	0.52	0.66	0.64
Scenario 3: 2035 AM Peak Saxbys Rd to Houchens Rd – With HSL	31	36	36	13.4	8.0	9.7	0.66	0.66	0.66	0.61	0.46	0.46
Scenario 3: 2035 AM Peak Houchens Rd to	33	32	32	11.8	13.9	13.9	0.79	0.82	0.82	0.74	0.70	0.71



Route Travel Performance												
Performance Indicators	Average Travel Speed (km/h)			Average Control Delay (seconds)			Degree of Saturation			Effective stop rate		
Vehicle Class	Buses	LV	HCV	Buses	LV	HCV	Buses	LV	HCV	Buses	LV	HCV
Saxbys Rd – With HSL												
Scenario 3: 2035 PM Peak Saxbys Rd to Houchens Rd – With HSL	35	32	32	6.6	12.6	12.9	0.49	0.86	0.86	0.32	0.55	0.55
Scenario 3: 2035 PM Peak Houchens Rd to Saxbys Rd – With HSL	34	28	28	9.2	17.7	18.7	0.67	0.79	0.79	0.47	0.69	0.69
Scenario 4: 2045 AM Peak Saxbys Rd to Houchens Rd – With HSL	36	35	35	7.9	8.4	10.0	0.64	0.72	0.72	0.35	0.46	0.46
Scenario 4: 2045 AM Peak Houchens Rd to Saxbys Rd – With HSL	35	30	30	8.1	16.7	16.8	0.84	0.92	0.92	0.48	0.77	0.78
Scenario 4: 2045 PM Peak Saxbys Rd to Houchens Rd – With HSL	35	29	29	7.3	16.1	17.0	0.54	0.95	0.95	0.31	0.54	0.54
Scenario 4: 2045 PM Peak Houchens Rd to Saxbys Rd – With HSL	31	27	27	12.9	20.0	21.1	0.76	0.76	0.76	0.50	0.69	0.69

15.4 Summary of Traffic Modelling

The intersection modelling indicates that development accessing Ohaupo Road (SH3) will progressively increase demand on the surrounding transport network, particularly during the peak periods. Except for the Ohaupo Road / Saxbys Road / Tomin Road roundabout, the assessed intersections are expected to continue operating at acceptable levels of service in the future year scenarios, provided the recommended intersection upgrades are implemented. These upgrades are required to maintain acceptable operational performance, support efficient movement along the corridor, and accommodate future growth within the wider SL1 area.

The modelling identifies the Ohaupo Road / Saxbys Road / Tomin Road roundabout as the principal transport constraint within the assessed network. The assessment demonstrates that Residential Development can be accommodated with acceptable transport effects up to 543 dwellings under a network scenario that does not rely on delivery of HSL, subject to the transport infrastructure upgrades identified in this ITA being



implemented. As discussed in Sections 15.2.2 and 15.5.2, development beyond this level should be subject to a future transport reassessment.

The assessment also demonstrates the importance of a coordinated transport strategy incorporating targeted intersection upgrades, improvements for public transport, and connected walking and cycling infrastructure. While the future form and extent of public transport priority measures will be subject to further investigation and design, the route performance assessment indicates that public transport services can operate efficiently within the assessed transport network and achieve reliable route performance under the assessed scenarios.

HSL remains an important component of the long-term strategic transport context for southern Hamilton. The modelling demonstrates that HSL improves corridor performance by redistributing a proportion of through-traffic away from Ohaupo Road and improving the efficiency of the wider transport network. However, the transport strategy adopted for this Project does not rely on HSL being delivered within a specific timeframe. Instead, the assessment identifies interim and staged mitigation measures capable of managing transport effects as development progresses.

The assessment also reinforces the importance of delivering a connected walking and cycling network. As outlined elsewhere in this ITA, the proposed active mode improvements are intended to provide safe and efficient connections between the proposed developments and the wider transport network, supporting both local trips and longer-distance journeys.

15.5 Staging of Transportation Infrastructure Improvements

Table No: 43 and Table No: 44 provide a summary of the recommended infrastructure improvements and development triggers / staging from the preceding section.

Development staging has been informed by both road network capacity and the timing of public transport and active mode infrastructure. Delivery of walking, cycling, and public transport-enabling infrastructure is a core component of the staging framework and is fundamental to supporting development without disproportionate reliance on further road capacity expansion.

Given the uncertainty surrounding the timing of HSL delivery, the transport staging framework distinguishes between infrastructure that is dependent on HSL and infrastructure that can be delivered independently of HSL. Where HSL delivery has not occurred, interim access arrangements have been identified and assessed.

15.5.1 Industrial Development Transport Infrastructure Improvements

Table No: 43

Interim Option B (Pre-HSL) - Intersections		
Intersection	Infrastructure Upgrade	When?
Greenwood St / Kahikatea Dr Interim 4-arm Roundabout (Interim Option B)	Upgrade to a four-arm roundabout Interim Option B assumes a similar Greenwood St / Kahikatea Dr roundabout footprint as the ultimate arrangement. Final staging, cross-section and transition arrangements to be confirmed	To be completed prior to completion of any subdivision beyond 1 ha within SL1 Industrial Development area.



	through detailed design and NZTA review / approval.	
Interim Option B (Pre-HSL) - Transport Corridors		
Road	Infrastructure Upgrade	When?
North-South Access Rd between Greenwood St / Kahikatea Dr intersection and east-west collector road	A new access road between Kahikatea Dr and east-west collector road to be designed and constructed, including the intersection of the access road with the east-west collector road. The interim access road should be designed to be compatible with the ultimate HSL corridor. Initially, only a two-lane carriageway is required, with the final cross-section and staging to be confirmed through detailed design and NZTA review / approval.	To be completed prior to completion of any subdivision beyond 1 ha within SL1 Industrial Development area.
East-West Collector Rd	A new public road constructed in general accordance with the typical cross-section in Figure 33, including the intersection of the east-west collector road with Wickham St extension.	To be completed prior to any industrial activity being able to generate traffic within the Industrial Development.
Walking and Cycling Connection	Provide a connection between the Road 3 turning head and the existing ROW connecting to Wickham Street.	To be completed prior to any industrial activity being able to generate traffic within the Industrial Development.

15.5.2 Residential Development Transport Infrastructure Improvements

The Residential Development infrastructure staging framework is summarised below. The timing of these upgrades reflects the assessed development staging so that the transport network continues to operate at an acceptable level of service (performance) as development progresses.

Table No: 44

Staging of Transportation Infrastructure Improvements - Intersections		
Intersection	Infrastructure Upgrade	When?
Ohaupo Rd / Saxbys Rd / Tomin Rd Roundabout	Provide southbound dual exit lanes on Ohaupo Rd from Saxbys Rd roundabout to Lambert Ct signalised intersection.	To be completed prior to Stage 1D (271 dwellings)
	Four laning of Ohaupo Rd between Saxbys Rd and Lambert Ct.	To be completed prior to Stage 2 (543 dwellings)



	Additional lanes on Saxbys Rd and Tomin Rd approaches in general accordance with Drawing 149240-00-0215. Ohaupo Rd southbound approach Signal Meter for the AM peak period.	
Ohaupo Rd / Lambert Ct	Upgrade to a four-arm signalised intersection in general accordance with Drawing 149240-00-0220.	To be completed prior to completion of residential lot subdivision.
Ohaupo Rd / Resthill Cres	Upgrade to remove right turn movement out of Resthill Cres in general accordance with Drawing 149240-00-0230.	To be completed prior to Stage 2 (543 dwellings)
Ohaupo Rd / Houchens Rd	Upgrade to a signalised T-intersection in general accordance with Drawing 149240-00-0240.	To be completed prior to Stage 1C (198 dwellings)

Staging of Transportation Infrastructure Improvements – Transport Corridors

Road	Infrastructure Upgrade	When?
MacMurdo Avenue	Extension of MacMurdo Ave providing access to the Residential Development. To be designed and constructed in general accordance with the typical cross-section in Figure 21.	To be completed prior to any residential activity being able to generate traffic that gains access off MacMurdo Ave.
Forth Crescent	Extension of Forth Cres providing access to the to the Residential Development. To be designed and constructed in general accordance with the typical cross-section in Figure 22.	To be completed prior to any residential activity being able to generate traffic that gains access off Forth Cres.
MacMurdo Ave, MacDonald Rd and Lambert Ct	Provide a shared walking and cycling path and separated bi-directional cycle path in general accordance with Drawing 149240-00-0270 to 0275.	To be completed prior to Stage 1C (198 dwellings)
Saxbys Rd	Provide a minimum 3m wide shared walking and cycling path on southern side of Saxbys Road between Site and Deanwell Ave, a safe road crossing facility near Saxbys Rd /Deanwell Ave intersection and a pedestrian refuge island east of Saxbys Rd/Leslie Pl in general accordance with Drawing 149240-00-0250.	To be completed prior to Stage 1A.
Deanwell Ave, Saxbys Rd	Provide a minimum 3 m wide separated bi-directional cycle path on the western side of	To be completed prior to Stage 3 (730 dwellings)



	the road in general accordance with Drawing 149240-00-0260 - 0267.	
Prisk St, Mount View Rd	Provide cycle sharrow markings to highlight the shared low speed environment.	To be completed prior to Stage 3 (730 dwellings)

Sections 15.2.2 and 15.4 of this ITA demonstrate that Residential Development of up to 543 dwellings can be accommodated, with acceptable transport effects and without HSL delivery provided the transport infrastructure upgrades identified in the above table are implemented per the timing criteria. Subdivision exceeding 543 dwellings should be subject to a further ITA having regard to the transport environment at that time and implementation of any further identified mitigation and/or development caps recommended in the ITA.

The reassessment requirement recognises that future network performance may be influenced by a range of variables affecting other developments and land use, future transport infrastructure delivery and travel behaviour assumptions. Illustrative examples of such variables are provided in Table No: 45.

Table No: 45

Illustrative Variables for Residential Development Reassessment Beyond 543 Dwellings			
Variable	Current Assessment Assumption in Scenario 2	Example Alternative Assumption	Indicative Change to Assessment
Residential vehicle trip generation	Scenario 2 (543 dwellings) generates approximately 345 vehicle trips per peak hour (0.66 veh / low density dwelling and 0.62 veh / medium density dwelling)	If the lower range of vehicle trip rates were adopted from the NSW Guide: low density dwelling = 0.83 veh / dwelling Medium density dwelling = 0.41 veh / dwelling A lower vehicle trip rate is likely to capture some combination of higher PT use, higher active mode use, trip chaining, internal trip, and lower vehicle ownership.	By way of illustration, if lower vehicle trip generation rates were realised in practice, the Residential Development could generate materially fewer peak-hour vehicle trips than assumed in Scenario 2. This could increase the number of dwellings accommodated before the development generates the same peak-hour traffic demand (345 vph) assessed for Scenario 2. Indicatively, this difference is equivalent to approximately 94 additional medium-density dwellings based on vehicle trip generation alone, and assuming the same trip distribution patterns as adopted in the current assessment. This does not represent a reassessment of network capacity or intersection performance.
Airport Business Zone ("ABZ") Development	Land use / employment assumptions in the ABZ is based on HSL Scenario 31 model runs undertaken by NZTA.	Development does not progress as assumed in WRTM Scenarios 2-5.	Potential reduction or increase in traffic volumes on Ohaupo Rd and change in traffic distribution at critical intersections.
Peacocke Structure Plan Development	Land use / employment assumptions in the Peacocke Structure Plan area is based on HSL Scenario 31 model runs undertaken by NZTA.	Development does not progress as assumed in WRTM Scenarios 2-5.	Potential reduction or increase in traffic volumes on Ohaupo Rd and change in traffic distribution at critical intersections.



HSL delivery	Stage 1 of HSL (section between Kahikatea Dr and Killarney Rd) is assumed to be completed in Scenario 2.	HSL fully delivered and operational.	Potential change in route choice, traffic distribution and demand on the Ohaupo Rd corridor
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The examples presented in Table No: 45 are provided to illustrate how changes in key assumptions may influence the transport effects associated with future stages of the Residential Development.

For example, if the lower residential vehicle trip generation rates identified in Table No: 45 were realised, the Residential Development would generate materially fewer peak-hour vehicle trips than assumed in Scenario 2. On a trip-generation basis only, and assuming the same trip distribution patterns adopted in the current assessment, the equivalent peak-hour vehicle demand assessed in Scenario 2 would not be reached until approximately 640 dwellings.

It is also noted that the traffic forecasts adopted in the WRTM scenarios are influenced by assumptions regarding the scale and timing of development within the Airport Business Zone and Peacocke Structure Plan area. If development within these areas were to occur at a slower rate than assumed in the WRTM scenarios, traffic demand on the Ohaupo Road corridor may be lower than that adopted in the current assessment. While the magnitude of any reduction cannot be reliably quantified without further strategic transport modelling, such changes could improve the operation of the Ohaupo Road / Saxbys Road / Tomin Road roundabout, thereby potentially enabling more SL1 Residential Development before HSL is delivered.

Accordingly, the examples presented in Table No: 45 should not be interpreted as defining a fixed development limit or a fixed measure of network capacity. Rather, they illustrate how changes in key assumptions may influence the transport effects associated with future stages of development and reinforce the importance of reviewing the transport environment at the time development progresses beyond 543 dwellings.

Accordingly, a consent condition aligned with the following, is recommended:

“Prior to the construction of development exceeding 543 dwellings within the Residential Development, the Consent Holder shall submit an updated Integrated Transport Assessment (ITA) prepared by a suitably qualified and experienced transport engineer.

No dwelling above the 543-dwelling threshold shall be constructed until the updated ITA has been certified by NZ Transport Agency Waka Kotahi, Hamilton City Council and Waipā District Council and any required mitigation or staging controls identified through that assessment have been confirmed

The updated ITA shall assess the transport effects of further development having regard to the best reasonably available transport information at the time, including, where relevant:

- actual residential development yield, dwelling typology, land use and trip generation;*
- observed and forecast traffic volumes on Ohaupo Road, Collins Road, Saxbys Road, Lambert Court, Resthill Crescent and Houchens Road;*
- updated turning movement volumes, heavy vehicle proportions, crash history and observed congestion;*
- development completed or committed within relevant surrounding growth areas;*
- committed or constructed transport infrastructure upgrades on Ohaupo Road since preparation of 2026 ITA;*



- the status, timing and form of HSL, including any relevant connections to SH3 or the local transport network, and any resulting changes to route choice and network capacity;
- public transport provision, mode share, and any implemented public transport priority measures;
- walking and cycling network delivery and active mode uptake;
- whether the right-turn restriction at Ohaupo Road / Resthill Crescent identified in the 2026 ITA remains necessary and, if so, its appropriate timing; and
- updated intersection modelling and safety effects, including average delay, 95th percentile queue lengths and degree of saturation.

Where actual land use, infrastructure delivery, traffic growth, trip generation or travel behaviour differs from the assumptions adopted in the 2026 ITA, the updated ITA shall identify whether those differences materially increase or reduce available network capacity and confirm whether any additional mitigation or staging controls are required before further dwellings are constructed.”

16. District Plan Compliance

While the Project is presently located within the Waipā District, the ITA has focused on the Hamilton City ODP transport rules and requirements given the Project's intended urban form, its direct integration with the Hamilton transport network, and because it is identified within the future southern Hamilton growth area.

The Project has been assessed against the transport rules relevant to the transport network, subdivision, use and development in Section 25.14 of the ODP. The rules are listed below with comments on compliance of the Project with each rule. Where there is non-compliance, further assessment has been undertaken against the criteria set out in the ODP.

Several ODP transport rules are ultimately applied at the individual lot and vehicle crossing level and therefore cannot be fully confirmed until detailed engineering and land use design has been completed. Accordingly, this assessment focuses on those transport rules most likely to influence the subdivision layout or result in transport-related non-compliances at the subdivision stage, including vehicle crossing separation distances, sight distance requirements and access design considerations.

The exceptions involve access design for ROWs / JOALs, sight distances at vehicle crossing, and location of vehicle crossings. Overall, the planned road network is designed to create a slower-speed urban setting, and the required housing density makes it impractical for the Development layout to avoid every instance of non-compliance.

Table No: 46

District Plan Compliance		
Transport Rule in District Plan	Compliance	Comments
Vehicle Crossings and Internal Vehicle Access		
25.14.4.1 a. Distance between vehicle crossings on the same transport corridor frontage i. Where the posted speed of the adjoining road is 60km/h or less the distance between vehicle crossings on the same side of the road shall be either: A. Less than 2m (provided no more than 2 vehicle crossings adjoin each other); or B. More than 7.5m	Yes	Both the Industrial and Residential Developments are expected to comply with this rule. There is reliance on the ODP exemption that where the separation requirements cannot be achieved the vehicle crossing shall be separated as far as possible from any other proposed vehicle crossing. This will be confirmed during detailed design stage.



iii. On local roads with a posted speed of 50km/h or less where compliance with i. or ii. above cannot be achieved as part of any land use activity the proposed vehicle crossing shall be separated as far as possible from any other existing or proposed crossing.		
25.14.4.1 c. Minimum distance between any vehicle crossing and a transport corridor intersection. Vehicle crossings shall meet the following relevant separation requirements in the tables below. The distance should be measured in accordance with the figure below. For vehicle access onto local roads with a posted speed limit of 50km/h or less and serving a listed permitted activity where the separation requirements cannot be achieved the vehicle crossing shall be located as close as reasonably practicable to the furthest site boundary from the intersection (as relevant to the property boundary indicated in the figure below). Note: The examples of exceptions can include where the property boundary frontage is less than 30m and there is no other available access point, or the topography would make it impractical to construct an access in a complying location.	No	Refer to Section 16.1.
25.14.4.1 d. Minimum distance from a dedicated pedestrian crossing facility (e.g. pedestrian crossing, mid-block pedestrian signals, refuge islands, kea crossings) The closest edge of the vehicle crossing shall be at least 7m from the centre of the pedestrian crossing facility measured in accordance with the diagram below.	Yes	Both the Industrial and Residential Developments are expected to comply with this rule. This will be confirmed during detailed design stage.
25.14.4.1 e. Minimum sight distance from any vehicle crossing Vehicle crossings shall meet and be measured in accordance with the relevant sight distance requirements below. On local roads with a posted speed limit of 50km/h or less where compliance with the sight distance is not possible, the proposed vehicle crossing shall be located to achieve the maximum sight distance possible.	No	Refer to Section 16.2
Quantity		
25.14.4.1 f. Maximum number of vehicle crossings to the transport corridor any site within a Residential Zone One, or nil where vehicle access is provided by a rear lane	Yes	The Residential Development is expected to comply with this rule. This will be confirmed during detailed design stage and addressed at land use development.
25.14.4.1 g. Maximum number of vehicle crossings to the transport corridor for any site, not within a Residential Zone i. One per frontage that is equal to or less than 20 m wide	Yes	Industrial Development is expected to comply with this rule. This will be confirmed during detailed design stage and addressed at land use development.



ii. Two per frontage that is more than 20 m wide (excluding frontages to the strategic network or arterial transport corridor) iii. One per frontage to a strategic network or arterial transport corridor		
Design and Access Width		
25.14.4.1 h. Vehicle crossing and internal vehicle access shall: i. Comply with the relevant dimensions identified in the Tables below. ii. Be formed and drained with a permanent sealed or paved all weather, dust-free surface and in a manner suitable for the type and quantity of vehicles using the site. iii. Be designed and configured to meet the relevant requirements of Table 15-5ai and Table 15-6b in Appendix 15. iv. For fee simple subdivision, any internal vehicle access, other than a rear lane, serving 10 or more residential units will be required to be formed and vested in Hamilton City Council as a public road.	Yes	The widths of vehicle crossings to individual lots, vehicle access from a private way and rear lanes are expected to comply with this rule. This will be confirmed during detailed design and addressed at land use development.
25.14.4.1 i. Any internal vehicle access shall: i. Have a minimum unobstructed width at vehicle entrances and between buildings of no less than 3.5m. ii. Not be used for carparking or storage of materials, landscaping, fencing or other obstructions that would restrict access by emergency vehicles. iii. Have a minimum height clear of buildings and other obstructions of 4.0m. iv. Have splays of 2m x 2m which are clear of structures higher than 1m at any vehicle entranceway or where vision of pedestrians or oncoming vehicles is restricted.	Yes	Both the Industrial and Residential Developments are expected to comply with this rule. This will be confirmed during detailed design stage and addressed at land use development.
25.14.4.1 j. Any rear lane must: i. Have a minimum legal width of 7m and provide for a two-way vehicle movements. ii. Have a minimum unobstructed width at vehicle entrances and between buildings or structures of no less than 3.5m. iii. Not be used for carparking or storage of materials, landscaping, fencing or other obstructions that would restrict access by emergency vehicles. iv. Have a minimum height clear of buildings and other obstructions of 4.0m. v. Be connected by unrestricted access to a transport corridor in at least two locations. vi. Have a legal mechanism for ownership and ongoing maintenance of the rear lane. vii. Have a maximum length of 250m. viii. Have a maximum longitudinal grade of 1:5.	Yes	This rule applies to the Residential Development only and is expected to be complied with. This will be confirmed during detailed design stage and addressed at land use development.
25.14.4.1 m. To ensure that drivers exiting the site have clear visibility to pedestrians, cyclists, and micro-mobility users, splays	Yes	Both the Industrial and Residential Developments are expected to comply with this rule. This will be confirmed



of 5m by 2m which are clear of structures higher than 1.2m must be provided at all vehicle crossings.		during detailed design stage and addressed at land use development.
25.14.4.1 n. Where a driveway joins a transport corridor it must have an on-site platform at least 6m long and with gradient no steeper than 1 in 20 (5 per cent) so that vehicles can stop safely and check for pedestrians, cyclists, micro-mobility users, and other vehicles before entering the transport corridor.	Yes	Both the Industrial and Residential Developments are expected to comply with this rule. This will be confirmed during detailed design stage and addressed at land use development.
25.14.4.2 Parking, Loading Spaces, On-Site Drop-off Car Spaces and Manoeuvring Areas 25.14.4.2a End-of-Journey Facilities 24.14.4.2b EV Charging	N/A	These rules will be addressed at land use development.
25.14.4.3 Integrated Transport Assessment Requirements Any activity that requires an ITA under this rule is also subject to Rule 25.14.3.a. (a) A Simple or Broad Integrated Transport Assessment (ITA) shall be prepared for activities as required by this rule, in accordance with the following trigger thresholds.	Yes	Traffic generation exceeds thresholds and hence the Broad ITA has been prepared.
24.14.4.3a Travel Plan Requirements A Travel Plan must be prepared and implemented for industrial activities (including warehouses) (excluding trade and industry training facilities) where the activity status is other than permitted and the GFA is >2,500m ² GFA.	N/A	This rule will be addressed at land use development of the Industrial Development.

16.1 Rule 25.14.4.1 (c) Minimum Distance between any Vehicle Crossing and a Transport Corridor Intersection

The identified non-compliances generally arise on corner lots, and lots located adjacent to intersections, where achieving the specified separation distances is inherently difficult within a higher-density urban subdivision form.

The ODP requires the following minimum separation distances in a posted speed limit of 60 km/h or less environment:

- Local road frontage: 15 m separation from vehicle crossing to intersecting collector road
- Local road frontage: 20 m separation from vehicle crossing to intersecting minor arterial road
- Collector road frontage: 15 m separation from vehicle crossing to intersecting local road

These requirements are not fulfilled within the proposed Residential Development. In a development of the density proposed, it is not practical to develop a subdivision with lots that can fully comply with the rule at the outset. That would necessitate significant use of rear lots anywhere near intersections. There is reliance on the ODP exemption that where the separation requirements cannot be achieved the vehicle crossing shall be located as close as reasonably practicable to the furthest site boundary from the intersection.



16.2 Rule 25.14.4.1 (e) Minimum Sight Distance from any Vehicle Crossing

The ODP requires the following minimum sight distances:

- 45 m on a 40 km/h posted speed limit local road.
- 60 m on a 50 km/h posted speed limit local road.
- 70 m on a 50 km/h posted speed limit collector road.

Potential non-compliances with this rule are generally associated with lots located adjacent to intersections, on the inside of horizontal curves, or on corner sites where achieving the minimum sight distance requirements can be challenging within a higher-density urban subdivision layout. The precise compliance position for individual vehicle crossings will depend on their final location and detailed engineering design.

Table 15-5aⁱⁱ of the ODP specifies target operating and design speeds of 40 km/h or lower for all local and collector roads. For this reason, the rule appears to mandate a sight distance that exceeds what is necessary given the proposed operating speed.

A more practical approach is to reference the stopping sight distance (“SSD”) specified in Austroads Guide to Road Design Part 3: Geometric Design (“AGRDR Part 3”). A minimum SSD of 22 m and 34 m are required for 30 km/h and 40 km/h operating speed environment based on 1.5 seconds reaction time. These minimum requirements are expected to be fulfilled by the proposed development scheme layouts.

The sight distance from a vehicle crossing on a minor road downstream from an intersection is mainly influenced by turning speed, which depends on the kerb corner radius and carriageway widths. Based on Austroads GTRD Part 3, a turning speed of 15–20 km/h corresponds to a stopping sight distance of 9–13 m. This sight distance requirement is generally expected to be achieved, or alternatively the location of the vehicle crossing can be optimised through detailed design.

Similarly, vehicle crossings located adjacent to horizontal curves are expected to operate safely due to the reduced vehicle operating speeds typically associated with curved alignments. Any reduction in operating speed correspondingly reduces the stopping sight distance required.

The identified non-compliances are generally associated with urban subdivision design rather than locations where material safety concerns are anticipated. The ODP specifically recognises that compliance may not always be achievable on local roads and provides an exception pathway requiring vehicle crossings to be located to achieve the maximum sight distance possible. Having regard to the proposed low-speed road environment, the anticipated departures are not expected to result in material safety or operational effects and can be appropriately managed through detailed engineering design.

16.3 Reversing onto Local Roads

The proposed front-loaded terrace, duplex and detached typologies within the Residential Development will, in some instances, result in vehicles reversing from residential lots onto adjoining roads. This is a typical and accepted outcome for higher-density residential development and is common within the Hamilton urban environment.

The potential effects of reversing manoeuvres have been assessed in the context of the receiving road environment. The majority of affected lots will access low-speed local roads, where traffic volumes and operating speeds are expected to be low, and where driver awareness of frontage activity is high. In this context, occasional reversing movements can be undertaken safely and do not give rise to significant transport effects.



It is recognised that reversing manoeuvres are generally avoided on higher-order roads. However, the Residential Development scheme plan and access arrangements are primarily oriented to local roads, with no reliance on direct access to arterial routes. The Project is therefore consistent with the intent of the ODP in managing vehicle manoeuvring effects.

Overall, the proposed access arrangements are considered appropriate for the scale and typology of development and are not expected to result in adverse safety or operational effects on the surrounding road network.

17. Construction Traffic

The sites are currently vacant. To facilitate bulk earthworks and associated construction traffic, further assessment will be undertaken following resource consent to confirm staging arrangements and access points for construction vehicles, including heavy vehicle movements.

The proposed development will be undertaken in stages. Detailed design and construction sequencing will be confirmed following resource consent approval and appointment of a construction contractor.

As is typical for developments of this scale, a Construction Traffic Management Plan (“CTMP”) will be required as a condition of consent. The CTMP will be prepared as part of the Construction and Earthworks Management Plan (“CEMP”) and submitted to the relevant road controlling authorities for approval or certification, as required by consent conditions. The CTMP will outline construction staging, access arrangements, haul routes, anticipated construction traffic volumes for each stage, and the associated traffic management measures.

It is anticipated that construction access to the Industrial Development will primarily be provided via the proposed Greenwood Street / Kahikatea Drive interim four-arm roundabout and associated north-south access road. Wickham Street and the existing right-of-way may be used as a secondary construction access where required, subject to confirmation through the final CTMP and any necessary approvals. Construction access to the Residential Development is anticipated to be provided via Saxbys Road, Forth Crescent and MacMurdo Avenue.

The site will be managed to enable vehicles, where practicable, to enter and exit in a forward direction without reversing onto the adjoining road network. Where site constraints or delivery requirements necessitate temporary traffic management measures, these will be implemented in accordance with approved procedures and to the satisfaction of NZTA and HCC. The CTMP will include, but not be limited to:

- timing and sequencing of construction activities
- anticipated traffic volumes and access arrangements for each stage
- haul routes and heavy vehicle routing arrangements
- measures to maintain safe and efficient pedestrian and vehicle movements
- wheel washing and debris management
- route management for heavy and over-dimension vehicles
- temporary traffic management arrangements, including impacts on parking, servicing and adjacent land uses
- contact details for key site personnel.



All temporary traffic management measures will be designed and implemented in accordance with the *New Zealand Guide to Temporary Traffic Management* (“NZGTTM”). Appropriate signage and traffic control will be provided to safely manage construction impacts on the surrounding network.

It is to be noted that construction activities are temporary in nature and, with the implementation of appropriate management measures through the CEMP and CTMP, potential construction-related effects on the surrounding transport network are expected to be appropriately managed such that any adverse effects are no more than minor.

18. Transport Strategies and Policy

18.1 Government Policy Statement on Land Transport 2024 – 34

GPS 2024 was confirmed in June 2024, and it outlines the coalition Government’s priorities for expenditure from the National Land Transport Fund over the next 10 years. It also provides guidance to decision-makers about where the Government will focus resources, consistent with the purpose of the Land Transport Management Act 2003, which is:

“To contribute to an effective, efficient, and safe land transport system in the public interest.”²⁶

The four Strategic Priorities of GPS 2024 are:

- Economic Growth and Productivity
- Increased maintenance and resilience
- Safety
- Value for Money

The expected outcomes of the GPS 2024 are defined further as follows:

- Economic Growth and Productivity:
 - Reduced journey times and increased travel time reliability.
 - Less congestion and increased patronage on public transport.
 - Improved access to markets, employment and areas that contribute to economic growth.
 - More efficient supply chains for freight.
 - Unlocked access to greenfield land for housing development and supporting greater intensification.
- Increased Maintenance and Resilience:
 - More kilometres of the road network resealed and rehabilitated each year.
 - Fewer potholes.
 - A more resilient road and rail network.
- Improved Safety:
 - Reduction in deaths and serious injuries.

²⁶ Section 3 of the Land Transport Management Act 2003



- Increased enforcement.
- The primary focus of this priority is to make transport substantially safer for all.
- Value for money:
 - Better use of existing capacity.
 - Less expenditure on temporary traffic management.

The Project is generally consistent with the GPS 2024, particularly the strategic priorities of Economic Growth and Productivity, Safety, and Value for Money. It supports the release of industrial and residential land within an identified future growth area, enables improved access to employment and freight networks, and incorporates a staged transport response that focuses on targeted upgrades, mode shift, and efficient use of existing and planned infrastructure including interim transport solutions that enable development to proceed independently of HSL delivery. The Project also aligns with the resilience objectives of GPS 2024 by maintaining flexibility to integrate with future strategic transport improvements, including HSL, should those improvements proceed.

18.2 NZ Transport Agency Waka Kotahi Statement of Intent 2024 – 2028

This statement of intent (“SOI”) presents a new strategic direction for NZTA and sets out how it will respond to the expectations of GPS 2024 for the next four years. The following system outcomes are the long-term changes to the transport system that NZTA is focusing on to realise its vision:

- *Meeting current and future needs - Enabler of other system outcomes and is about ensuring that the way NZTA works enables it to meet the needs of current and future users and aligns to the priorities of GPS 2024.*
- *Effectively and efficiently moving people and freight - Ensuring networks are available and reliable at consistent levels of service with a focus on increasing the uptake of efficient, cost-effective, low carbon transport options.*
- *Safe - Ensuring no one is killed or seriously injured when using or working on the transport system.*
- *Environmentally sustainable - Reducing harm to and improving the environment, with a focus on reducing greenhouse gas emissions and climate change adaptation, including reflecting expectations on NZTA set by the Carbon Neutral Government Programme.*

The Project is consistent with the SOI by supporting the outcomes of meeting current and future needs, effectively and efficiently moving people and freight, safety, and environmental sustainability. The Project provides for planned residential and industrial growth within an identified future growth area, while adopting a staged transport response that integrates with existing and planned strategic infrastructure, including HSL. It also supports improved travel choice through provision for public transport, walking and cycling, and identifies the transport upgrades required to maintain safe and efficient network operation as development occurs over time.

18.3 Waikato Regional Land Transport Plan 2024 – 2054

The Waikato Regional Land Transport Plan (2024 – 2054) (“WRLTP”) sets out the strategic direction for land transport in the Waikato region over the next 30 years. The WRLTP is built around the region’s key transport issues, namely:

- *Climate Change: an environmentally sustainable, energy efficient and low-carbon transport system that delivers emissions reductions and enhances communities’ long-term resilience to the effects of climate change.*



- *Resilience: an efficient and resilient land transport system that ensures communities have route security and access to essential services.*
- *Growth and Economic Development: an integrated transport system that supports compact urban form and planned future growth; AND an efficient and resilient strategic corridor network that advances regional economic and social wellbeing.*
- *Accessibility and Transport Options: an integrated transport system that provides transport options for differing community access and mobility needs.*
- *Safety: a safe, accessible transport system in the Waikato region where no one is killed or seriously injured.*

The Project is aligned with the WRLTP because it supports planned growth in a way that integrates with the strategic transport network, improves travel choice, responds to identified safety and resilience issues, and supports a gradual shift toward public transport and active modes over time.

19. Stakeholder Engagement

To date, engagement with NZTA has been undertaken around the extent of assessment required to understand the traffic impacts arising from the proposed developments' traffic on the operation of the adjacent state highway corridor, trip generation calculation and assumptions as well as form and design of the proposed intersection upgrades. These discussions have informed the scope of the traffic analysis reported in this ITA. Comments from NZTA on the draft ITA (dated 19 March 2026 and 23 June 2026) are attached as Appendix C.

Similarly, discussions have also been held with HCC, Waipā District Council and WRC to ensure this ITA appropriately addresses the key transport matters.

Continued liaison with all stakeholders is expected during the Fast-track process and subsequently as the detailed design for the proposed transport infrastructure is refined.

20. Conclusions

This ITA has assessed the transport effects of the proposed Industrial and Residential Developments with regard to existing transport conditions, committed and planned network upgrades, and the relevant national, regional and local transport policy framework.

The assessment is informed by site access design, staged trip generation analysis, strategic transport modelling using the WRTM, and detailed intersection capacity assessments using SIDRA Intersection software.

The key conclusions of the assessment are as follows:

- Industrial Development
 - o The preferred interim access strategy is Interim Option B. This arrangement enables the full assessed Industrial Development to proceed independently of HSL delivery through provision of a four-arm Greenwood Street / Kahikatea Drive roundabout, an interim access road on the HSL corridor, and delivery of the proposed internal collector road network.
 - o The assessed interim access arrangement provides a practical and flexible transport solution given the uncertainty surrounding the timing of HSL delivery.



- When HSL is delivered in future, the Industrial Development transitions to the ultimate access arrangement via the proposed HSL / SL1 roundabout and east-west collector road.
- Residential Development
 - The Residential Development can be accommodated through a staged transport infrastructure framework comprising intersection upgrades, walking and cycling improvements, and provision for future public transport services.
 - The assessment indicates that Residential Development can be accommodated with acceptable transport effects up to 543 dwellings under a network scenario that excludes HSL delivery, subject to implementation of the transport infrastructure upgrades identified in this ITA.
 - Subdivision exceeding 543 dwellings should be supported by a further / updated ITA to confirm the assumptions underpinning this ITA (2026 ITA) remain relevant for the receiving transport environment and to determine whether any additional mitigation measures or factors exist to enable further development if HSL delivery remains uncertain.
- Multi-modal transport network
 - The proposed transport network has been designed to support increased travel choice and reduce reliance on private vehicle travel over time.
 - The proposed walking, cycling and public transport infrastructure provides a high level of connectivity in and between the Development areas with the surrounding transport network. The infrastructure proposed is comprehensive and necessary to support the increasing mode share rates that support the effects assessment.
- Hamilton Southern Links
 - HSL remains an important long-term component of the future transport network for southern Hamilton. Modelling shows it will improve the distribution of traffic through southern Hamilton, provide network resilience and spare capacity on Ohaupo Road through Glenview.
 - However, the transport strategy adopted for the Project does not rely on HSL being delivered within a specific timeframe. Interim access arrangements, transport infrastructure upgrades and staging measures have been identified to manage transport effects under both interim and future network conditions.

Subject to implementation of the recommended transport infrastructure upgrades, staging measures and reassessment provisions identified in this ITA, the proposed Industrial and Residential Developments can proceed without resulting in unacceptable transport effects.

21. Recommendations

The following recommendations are made based on the findings of this ITA. Detailed infrastructure staging and upgrade requirements are summarised in Table No: 43 and Table No: 44.

- Development should proceed in accordance with the staged transport infrastructure framework assessed in this ITA, with the access, intersection and corridor upgrades identified in Table No: 43 and Table No: 44 delivered at the relevant development stages.
- Up to 1 ha of Industrial Development may be occupied prior to any upgrade at the existing Greenwood Street / Kahikatea Drive intersection, relying on the existing local industrial road network and existing access arrangements.



- Where HSL Stage 1A has not been delivered, occupation of Industrial Development beyond the initial 1 ha threshold should be supported by Interim Option B. Prior to occupation beyond this threshold, the following infrastructure should be delivered and operational:
 - an interim four-arm Greenwood Street / Kahikatea Drive roundabout;
 - an east-west collector road forming the primary internal movement corridor through the site.
 - an interim access road between Greenwood Street / Kahikatea Drive and the east-west collector road; and
 - the interim access road / east-west collector road connection required to serve the Industrial Development.
- Interim Option B should be designed and staged to remain compatible with the ultimate HSL-integrated transport network and not preclude future implementation of the HSL / Greenwood Street layout.
- Residential Development should proceed generally in accordance with the infrastructure staging framework identified in Table No: 44, including delivery of the identified intersection, corridor and active mode improvements at the relevant stages of development.
- Prior to construction of any dwelling that would result in more than 543 dwellings being established within the Residential Development, an updated ITA should be prepared by a suitably qualified and experienced transport engineer in accordance with the reassessment framework outlined in Section 15.5.2. The updated ITA should confirm whether further Residential Development can be accommodated within the receiving transport environment at that time and identify any additional mitigation measures or staging controls that may be required.
- Walking and cycling infrastructure, public transport-enabling road cross-sections, and provision for future bus routing and in-lane stops should be delivered in accordance with the staging framework relied on in this ITA.
- Detailed design should be undertaken in consultation with the relevant road controlling authorities to confirm the final form, timing and layout of the identified transport improvements, while maintaining consistency with the infrastructure and staging framework assessed in this ITA.
- A CTMP should be prepared for the relevant stages of works to manage temporary access arrangements, construction vehicle routing, effects on the surrounding road network, and protection of vulnerable road users.



Appendix A – Intersection Upgrade and Walking and Cycling Wider Connectivity Concept Plans



Appendix B – SIDRA Movement Summaries



Appendix C – Responses to NZTA and MPDC Comments

Responses in Table No: 47 and Table No: 48, are superseded by the information provided in the ITA.

Table No: 47

NZTA Comments dated 19 March 2026		
S/No	Comment	BBO Response
1	BBO scenarios modelled are significantly different to NZTA/Future Proof Scenario across all the SL1/Rogerson Blocks (especially households – order of 1500 households less under BBO scenario). Currently unresolved issue around significant differences in the traffic flows being predicted by WRTM for the different scenarios.	The land use within the proposed SL1 Industrial Development, Residential Development, Rogerson Block and Houchens development area are more refined now that comprehensive Masterplans have been prepared for each of these areas. As with all Masterplans, they will continue to evolve to respond to opportunities and constraints as they are identified through subsequent resource consent processes. Please refer to Attachment 1 for the WRTM land use input differences between futureproof projections and BBO's assumptions. The main differences being the Rogerson Block change of land use (previously assumed to be residential and now assumed predominantly to be industrial) and the broader refined yield within the SL1 Consortium (not the entire growth cell).
2.	Under several scenarios, Hamilton Southern Links is assumed to be operational by 2025. There is currently no construction funding so this cannot be assumed. Any mitigation (especially as it relates to SH3) may be deficient on that basis; we would expect that any infrastructure triggers will need to be framed in way whereby beyond a certain yield development cannot proceed unless Hamilton Southern Links is in place.	It is to be noted that no 2025 scenarios were modelled in the WRTM. Four development scenarios were tested for the future year 2035: 1) Year 2035 with Stage 1 HSL • SL1 Residential Development: Stages 1 and 2 (575 dwellings) • SL1 Industrial Development: Full development (approx. 36ha developable area) 2) Year 2035 with Stage 1 HSL • SL1 Residential Development: Stages 1 and 2 (575 dwellings) • SL1 Industrial Development: Full development (approx. 36ha developable area) • Rogerson Block: 90 dwellings + 7.8ha industrial • SL1 Houchens: 400 dwellings + 400 retirement village units 3) Year 2035 with Full HSL • SL1 Residential Development: Stages 1 to 3 (776 dwellings) • SL1 Industrial Development: Full development (approx. 36ha developable area) 4) Year 2035 with Full HSL • SL1 Residential Development: Stages 1 to 3 (776 dwellings) • SL1 Industrial Development: Full development (approx. 36ha developable area) • Rogerson Block: 90 dwellings + 7.8ha industrial • SL1 Houchens: 400 dwellings + 400 retirement village units + 13ha industrial Although HSL remains an important long-term strategic transport improvement, its implementation timing is



NZTA Comments dated 19 March 2026		
S/No	Comment	BBO Response
		currently uncertain and remains subject to future funding decisions and NLTP priorities. The 2035 WRTM modelling included scenarios with different assumed HSL network stages, including Stage 1 of HSL and the full HSL network, to test the sensitivity of the Project's transport effects under different future network conditions. For that reason, the ITA does not rely on HSL being delivered by a specific year. Rather, the assessment identifies both interim and future network scenarios and recommends staging controls, infrastructure triggers and further assessment requirements to manage transport effects as development progresses.
3.	Section 11.1.1 of the ITA states that the residential trip rate has been derived from the RTA Trip Generation Guide, taking the average for medium density flats and "dwelling houses". The above average is due to the lack of knowledge, currently, about the likely residential types. Therefore, we are unclear if the average is OK – if we end up with greater numbers of persons per household than currently assumed, the trip rate may be higher. More fundamentally, the RTA trip rates used were for vehicles, whereas the ITA assumes them to be person trips. Given the subsequent corrections for mode change over time, this means that the residential trip predictions currently included in the ITA significantly underestimate the likely outcome.	Following the meeting on 26th March 2026, BBO has undertaken trip generation calculations for the SL1 Residential Development using person-trip rates. Now that the number of low-, medium- and high-density lots can be estimated, person-trip rates for each residential land use were adopted from the NSW Government <i>Guide to Transport Impact Assessment</i> (NSW Guide). For the purposes of trip generation, the proposed high-density lots have been assessed using the medium-density person-trip rate, as they do not meet the NSW Guide definition of high-density residential dwellings. Refer to trip generation calculations in Attachment 2. Please note this is based on refined yield in the latest Masterplan. The trip generation calculation indicates that WRTM loaded networks underestimates the trips generated by the residential zones by approximately 20-60 vph in the various scenarios. BBO will increase the traffic volumes in the respective SIDRA models by 10% to address the shortfall.
4.	Section 11.1.2 states that the observed trip rates for the Hamilton Airport central precinct have been used for the employment uses. Presumably these trip rates were based on traffic counts, which will give vehicle trip rates, not person trip rates. If our assumption is correct, the subsequent corrections for mode change will again mean that the trip predictions are underestimates.	The vehicle trip rate, established through surveys in the Central Precinct of the Airport Business Zone (Hamilton Airport – Titanium Park), is deemed representative and suitable for the proposed industrial land use. BBO recognises that the adopted trip generation rate pertains specifically to vehicles. It should be noted, however, that public transport accessibility as well as walking and cycling infrastructure are currently limited within the surveyed Central Precinct. As such, BBO considers that a proportion of these vehicle trips could transition to public transport or active modes, particularly in the context of the proposed Industrial Development area where new walking and cycling infrastructure linking to existing bus stops is recommended. Person-trip rates as outlined in the NSW Guide have not been adopted, as these are based on gross floor area (GFA) and the site coverage details for the Industrial Development remain unconfirmed at this time. Please refer to Attachment 3 which includes trip generation calculations and assumed travel mode distributions.
5.	Some mode change (relative to the existing situation) is likely to be very reasonable.	Travel mode splits for Residential Development:



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	However, while the future (2055) trip rate for the industrial components is predicted to be around 86% of the existing (2023) trip rate, the figure for the residential components is around 59%. The more significant reductions are based around the assumptions that the PT mode share for this part of Hamilton will be equivalent to the existing mode share in central Wellington – this seems to be overly optimistic. Resolving the traffic generation rates will have a flow on effects on the traffic modelling presented in the ITA. As a result, the proposed mitigation measures presented in the ITA may change.	2035 PT and active mode shares are based on 2023 Census data from Peachgrove-Greensboro, Hamilton East and Hillcrest (all in Hamilton). These areas currently densely populated (approximately 7,000 to 10,000 population) with good accessibility to PT and walking and cycling connections 2045 PT and active mode shares have now been updated to 13.9% (PT) and 11.4% (active mode). The draft ITA indicated 13% (PT) and 13% (active mode). These splits are based on statistical areas within Wellington that consist of medium density residential land use and high frequency routes currently servicing the areas (i.e. Island Bay, Lyall Bay and Miramar East). These areas are not in central Wellington. 2055 PT and active mode shares have now been updated to 30% (PT) and 10% (active mode). This is an aspirational mode-shift from car dependence during commuter peaks, but it is supported by the proposed medium-density residential in SL1 (restricted car parking and garaging) and aligns with the “transformational” shift to PT enabled by the Rapid Transit Network key moves envisaged in the Waikato Metro Spatial Plan. The MSP Programme Business Case states in Section 1.8 that <i>“The assessment of the public transport and active modes share in 2051, and based upon the preferred land use scenario 2a, has concluded that the region wide mode shift would be 20%; with the ability to achieve up to 44% (forecast as 32% for public transport and 12% for walking/cycling and micromobility) in the identified key BRT corridors of Hamilton City.”</i> Travel mode splits for Industrial Development: 2055 PT and active mode shares are lower than those assumed for residential land use. This is based on statistical areas within Wellington that consist of industrial land use and high frequency routes currently servicing the areas (i.e. Rongotai and Miramar South). This is also aligned with Waikato Regional Transport Plan that indicates a frequent bus route is envisioned at the Kahikatea / Frankton area.
6.	<u>SL1 Roundabout and SH1C Intersection Spacing</u> - The modelling by BBO for the SL1 developers concludes that the roundabouts will operate satisfactorily without free flow left turn lanes - The modelling by Aecom for NZTA concluded that free flow left turn lanes will be required. This introduces a merge and weave movement on the midblock between Kahikatea Drive and SL1, leading NZTA to conclude that the current spacing is inadequate.	We consider the following as key reasons for the volume differences between our model runs and the NZTA Scenario 31 model runs: - The presence of the half-diamond interchange at Colins Road in the NZTA S31 WRTM model runs compared with the full diamond interchange further south at Houchens Road in the BBO WRTM model runs. The Collins Road half diamond draws a significant volume of traffic through the northern part of SL1 development via Rhonda Ave and Colins Road, which is not present in the BBO WRTM model runs. - The difference in quantum of trips generated by SL1 Industrial Development, Residential Development and Rogerson Block. The difference is due to refined



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	- The spacing issue relates to weaving, for example (for southbound traffic): - Vehicles turning left from SH1C onto HSL will merge with mainline traffic between the intersections, with some traffic then changing lanes to enter the centre lane to turn right at the SL1 roundabout - Some southbound vehicles on SH1C passing straight through the Kahikatea roundabout will have to change lanes to enter the left turn lane to turn left at the SL1 roundabout - As a result, the predicted operation of the two roundabouts is critical, as this determines the need for free flow left turn lanes. - Our recent comparisons between the 2018 modelled flows and observed flows indicates that the modelled flows are high during the critical weekday evening peak. Addressing the land use/trip generations is critical. - At the current time, NZTA is unable to confirm the acceptability of the free flow left turn lanes or the current separation distance presented. - Please also note that NZTA is working through whether a 4th leg may be feasible at the Kahikatea Drive/SH1C proposed roundabout for a period prior to the current investment case design (3 leg arrangement). Addressing trip and land use assumptions (see earlier comments) will factor into this analysis.	and reduced development areas that is achievable in these areas based on further assessments that have been undertaken as part of this substantive Project. Also, some of that difference is likely due to our target PT and active mode shares adopted in the BBO WRTM model runs. This is explained in the earlier responses. The modelling undertaken by us indicates that the HSL / Kahikatea Dr roundabout operates effectively without requiring an additional southbound acceleration lane between the HSL / Kahikatea Dr roundabout and the SL1 roundabout. However, we have also undertaken a sensitivity check using the volumes obtained from the NZTA Scenario 31 model runs. The results indicate that both roundabouts perform satisfactorily with all movements performing no worse than LOS D (i.e. average delay less than 40s/veh). 95th percentile queue on Kahikatea Drive reaches approximately 120 m while 95th percentile queue on the northern approach to SL1 roundabout (i.e. HSL section between two roundabouts) reaches approximately 175 m during the PM peak period. In our opinion, the queue length on HSL is not significant considering the separation distance of 520m between both roundabouts. The queue length achieved on Kahikatea Dr will extend beyond Latham Ct. However, Latham Ct is a no-exit, low volume local road and the effects at the intersection is not expected to be more than minor. There are a few reasons why the SL1 roundabout connection is proposed approximately 520 m from the HSL / Kahikatea Dr 3-arm roundabout. - Shifting the SL1 roundabout connection further south is likely to result in trips from SL1 industrial area heading south before getting onto HSL to head north. This has the potential to add more industrial traffic to Higgins Rd which is a local road providing access to residential land use further north and therefore was not preferred. - The proposed location of the SL1 roundabout connection allows the new east-west collector road to be a straight through road from Tuhikarama Rd to HSL. This is considered a positive for the key collector industrial connector between the western fringe and the urban Hamilton industrial environment of Frankton. If the SL1 roundabout connection is proposed further south, then the east-west collector alignment will be convoluted considering that it needs to run through Rogerson Block to provide access to industrial and residential land use. - The proposed location of the SL1 roundabout connection allows the east-west collector road to be aligned strategically between two landowners' lots without dissecting a single landowner's lot into two. This provides important continuity for how both applicants can progress with their land use aspirations.
7.	Figure 8 of the ITA indicates that in the short term, before the rest of HSL is constructed, the Application site to the east of the HSL designation is proposed to be connected via	The current position indicates that the timing of HSL delivery remains uncertain and may extend beyond the assessment period considered in this ITA. Accordingly, Industrial Development should not be prevented from proceeding



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	a short section of HSL arterial (ultimate form or sacrificial interim form). A local road connection east to the north / south road in the eastern development area is shown. In the long term that road is proposed to become a cul-de-sac when NZTA completes HSL (which is Stage 3). We are unclear how this proposal will transition from a “sacrificial road” to the ultimate HSL solution. In theory this situation could be avoided if the ultimate HSL cross section is provided at the outset, rather than a sacrificial form, but this would still appear to lead to problems as the intersection forms transition from short to long term. This is a concern for NZTA; we want to avoid a future scenario whereby we end up funding the relocation of a portion of the internal roading network.	solely because HSL has not been funded or programmed for delivery within a defined timeframe. On this basis, the ITA identifies Interim Option B as the preferred interim access strategy, enabling Industrial Development to proceed independently of HSL delivery while retaining the ability to transition to the ultimate HSL-based network arrangement if and when HSL is implemented.
8.	Ideally, U turn restrictions should be implemented at all intersections proposing to be signalised on Ohaupo Road (SH3).	This will be included as recommendations in the ITA if the proposed phase sequence at intersections prohibits U-turn movements.
9.	<u>Wickham St Access</u> - The proposed cross section (Figure 12 of the ITA) shows a 1.8 m wide shared user path on the western side of Wickham Street. - For the path to function as a shared path, it should be widened to be at least 2.5m (minimum) or 3m (desirable). - If widening of the path is not feasible due to the existing road reserve, the path should function as a footpath only, with cyclists mixing with general traffic.	The typical section was incorrect and has since been updated as shown below. There is no shared path proposed on Wickham St.
10.	<u>Ohaupo Rd / Resthill Cres</u> - The proposed concept plan will force westbound cyclists on Ohaupo Road to merge into the adjacent traffic lane at the intersection of Ohaupo Road / Resthill Crescent, which create a safety risk. - Consider shifting the proposed traffic island on Resthill Crescent south to allow sufficient room for a cyclist to travel across the intersection without merging with general traffic. - In addition to the above, it is recommended that green painted pavement markings with cycle symbols across the intersection as per the	The concept designs shared are draft versions and are still a work in progress. Westbound cyclists are expected to use the off-road shared path on both sides of Ohaupo Rd (between Saxbys Rd and Houchens Rd). Cycle on and off-ramps will be proposed on either end. This accommodates the proposed intersection upgrades along this corridor which typically involve adding more lanes within the road reserve.



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	Lambert Court / Ohaupo Road intersection (refer to the screenshot below).	
11.	<u>Ohaupo Rd / Saxbys Rd</u> - Section 14.2.2 of the ITA states that the intersection would be upgraded in two stages: - The first stage to upgrade the existing roundabout to include a second through departure lane on the southern leg - The second stage is to upgrade the existing roundabout to a set of signals. - However, the ITA indicates that the signals would fail under Scenarios 2 to 5 and it suggests that this may be OK as the intersection has been designed to support Ohaupo Road as a bus priority corridor. However, we note that the traffic assumptions already include a high proportion of public transport trips (see yesterday's email). The ITA suggests that a further mitigation measure would be to add additional traffic lanes to increase intersection capacity. To our knowledge, no traffic modelling has been undertaken to determine an appropriate intersection layout. - Undertake additional traffic modelling to confirm an appropriate layout for the signals. The provision of additional traffic lanes may require land acquisition.	The matter has been assessed in Section 15.2.2 of the ITA.
12.	<u>Ohaupo Rd / Saxbys Rd</u> - The proposed length of the dedicated right turn lane at the Saxbys Road approach will only provide storage for one vehicle. This could result in vehicles overflowing into the adjacent traffic lane, and blocking right turns into Morrison Crescent. - Consider lengthening the length of the dedicated right turn lane on Saxbys Road – however this would still appear likely to lead to challenges for vehicles exiting the signalised intersection and turning into Morrison Crescent.	The concept designs shared are draft versions and are still a work in progress. The concept design has been updated to address this matter and the revised arrangement is reflected in the current application drawings and ITA.
13.	<u>Ohaupo Rd / Saxbys Rd</u>	Westbound cyclists are expected to use the off-road shared path on both sides of Ohaupo Rd (between Saxbys Rd and Houchens Rd). Cycle on and off-ramps will be proposed on



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	- The proposed concept plan removes the on-road cycle lanes on Ohaupo Road at the Ohaupo Road / Saxbys Road intersection. - Consider installing cycle ramps in advance of the intersection to allow non-confident cyclists to use the shared user path on Ohaupo Road.	either end. This accommodates the proposed intersection upgrades along this corridor which typically involve adding more lanes within the road reserve.
14.	<u>Ohaupo Rd / Lambert Ct</u> - The proposed concept design includes converting the existing unsignalised intersection to signals, maintaining access to service lane which provides access to residential properties as the northern leg of the intersection. - Consideration should be given to closing the access to and from the service lane at this location, since queueing will extend both to the north and south. - Consider removing access to the Ohaupo Road service lane (northern leg of the Ohaupo Road / Lambert Court intersection), since an alternative is already provided (see below).	This has been considered. However, it is expected that the likelihood of crashes at the alternative northern access could potentially increase as vehicles exiting and heading north will have to cut across two lanes (i.e. one southbound lane + flush medium existing arrangement and two southbound lanes future arrangement) to merge with through traffic. Similarly, vehicles turning right into the access will have to cut across two lanes. To mitigate the safety risk, a central median island could be introduced on Ohaupo Rd at the alternative northern access limiting movements at the access to left-in-left-out. However, this could in return increase unsafe U-turn movements at both signalised intersections (i.e. Saxbys Rd and Lambert Ct) on either end of this section of road. Hence, this assessment considered maintaining this intersection as a four-arm intersection safer than closing the service lane access.
15.	The ITA has undertaken intersection modelling using SIDRA Intersection software, analysing each intersection in isolation without considering corridor wide impacts. Consider undertaking a network-wide model using microsimulation or SIDRA Network, for situations with closely spaced intersections, to allow the assessment to identify the potential for queueing back.	We do not consider it necessary to undertake a network-wide model. The SIDRA models have been calibrated using surveyed peak hour traffic flows and observed 95th percentile queue lengths at intersections. This ensures that the intersections are modelled as closely as possible to how they currently operate in the existing network.
16.	<u>Ohaupo Rd / Lambert Ct</u> - The proposed merge in the southbound direction after the proposed signals is very short, and within the queuing area for the pedestrian signals [may need to consider moving the pedestrian signals to the proposed traffic signal location – this will need to be considered in the context of the location of the bus stop(s). - At closely spaced signalised intersections queues can form back to the previous signals and block them, and there is a high risk of drivers missing a red light at the first signalised intersection because they can see the	- As stated in the ITA, the separation distance between the proposed Ohaupo Road / Lambert Court intersection and the existing signalised mid-block crossing is approximately 105 m. This equates to approximately 7 seconds of travel time based on a 50 km/h operating speed. It is unlikely that speed between both intersection will be more than 40 km/h given the proximity which increases the travel time to 9 seconds. In comparison, the separation distance between Bryce St and Claudelands Rd signalised intersections on Victoria St is approximately 60 m. - Cyclists are expected to use the off-road alternatives on either side of Ohaupo Rd (between Saxbys Rd and Houchens Rd).



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	green light at the next signalised intersection. - Guidance provided in Austroads suggests that intersections should be separated by at least five seconds of travel time at the design speed to provide time for drivers to process information. - The proposed signalised intersection does not appear to cater for cyclists.	
17.	Can the applicant please give consideration to providing another road link from the site to Saxbys Road, so more of the development traffic can use the SH3 Ohaupo Road/Saxbys Road intersection instead of adding additional traffic to the SH3 Ohaupo Road/Lambert Court intersection? Please see red line in the below picture	We do not support another vehicle link from the site to Saxbys Rd for the following reasons: - The intersection modelling that has been undertaken indicate that the existing Ohaupo Rd / Saxbys Rd roundabout and the future signalised intersection perform worse in comparison to the proposed Ohaupo Rd / Lambert Ct signalised intersection based on current WRTM trip distribution to both intersections. Adding more traffic to the Saxbys Rd roundabout will only exacerbate the effects. - Adding a vehicle link will result in multiple closely spaced intersections which increases the number of conflicting movements within a short section of Saxbys Rd. This increases the likelihood of crashes. Therefore, we consider a single access to Saxbys Road as a practical solution from a safety and network capacity / efficiency perspective. However, the ITA does recommend this link to be an active mode connection from the site.



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1	Modified mode split assumptions, including not making a correction for work from home trips (for the industrial uses)	The ITA distinguishes between residential and industrial trip generation. A work-from-home (WFH) correction has been applied only to residential trip generation, as set out in Section 12.2.2. This is appropriate because WFH primarily affects home-based work travel associated with residential land use. No WFH correction has been applied to industrial land uses. This is appropriate because the adopted industrial trip generation rate is vehicle-based and was derived from comparable industrial activity, where trips are associated with on-site employment, servicing, freight and business activity rather than home-based trip generation. Accordingly, applying a WFH reduction to the industrial vehicle trip rate would not be appropriate.
2.	We are unclear about the wording on page 58, which appears to imply that work from home corrections should be made, but they have not.	A WFH correction has been applied only to residential trip generation, as shown in Table No: 13 to Table No: 17. The residential mode split components for private vehicles, public transport and active modes do not sum to 100% because a 10.8% WFH allowance has been included separately in all residential scenarios.
3.	We retain our view that a 2055 scenario with higher traffic flows (i.e. with some, but not significant mode change) needs to be assessed, to ensure suitable roundabout spacing	The ITA's 2055 scenario already includes substantial future land use beyond the Applicant's developments, including future SL1 residential areas, the Rogerson Block and SL1 Houchens land uses. NZTA has also acknowledged that it may not be the developer's responsibility to demonstrate the operation of the transport network with other uncommitted land use changes. The ITA assesses Scenarios 2 to 5 using WRTM outputs. Scenario 5 includes future land use well beyond the Industrial and Residential Developments and therefore provides a broad strategic assessment of future network conditions. Subsequent to NZTA's comment, a sensitivity assessment has been undertaken using NZTA Scenario 31 Year 2055 traffic volumes to test the operation of the proposed SH1C/HSL and HSL/SL1 roundabout arrangement under a materially higher traffic demand scenario than that adopted in the Project modelling. The NZTA Scenario 31 model includes approximately 1,500 additional households within the wider SL1 growth area and also captures a level of future development beyond the proposed Developments, including growth that may proceed through other referred projects and future growth areas within the wider SL1 growth cell. Therefore, the NZTA Scenario 31 model represents a conservative assessment of the proposed roundabout spacing relative to the proposed Developments. The results of the sensitivity assessment confirm that the proposed roundabout spacing remains appropriate under this higher-demand scenario. Accordingly, no further strategic traffic modelling is considered necessary for the purposes of assessing the Project.
4.	The report refers to the difference between the new trip predictions and the earlier	As set out in Sections 12.2.1 and 12.2.2 of the ITA, the WRTM outputs were reviewed against the refined trip generation



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	WRTM outputs. It claims that corrections have then been made, but we have not seen how these have been applied. Also, the report summarises the results of SIDRA analysis, but no SIDRA printouts are provided within Appendix C.	estimates for Industrial and Residential Developments. The comparison identified that the WRTM outputs represented slightly lower development traffic than the refined trip generation calculations. To address this, the intersection modelling incorporated a 13% increase over the WRTM Industrial Development volumes and a 10% increase over the WRTM Residential Development volumes. These adjustments were applied to the relevant development-related turning movements at key intersections, with distribution based on the movement patterns observed in the WRTM outputs. SIDRA movement summaries have now been included in Appendix B.
5.	Have the delays in the base SIDRA model been calibrated to existing conditions?	Yes. The base SIDRA models have been calibrated with reference to observed queue lengths from the traffic surveys. This calibration process was used to confirm that the base models reasonably reflect existing intersection operating conditions before applying future year traffic demands.
6.	There is a safety concern around any increase in traffic turning into or out from Kahikatea Drive west, with the existing layout	The ITA's existing-layout assessment relates only to a very limited initial development quantum. The assessment indicates that 1 ha of industrial development would increase traffic at the intersection by approximately 16 vehicle trips in the peak hour. This represents a minor increase in turning movement exposure relative to existing traffic volumes.
7.	Through our recent work for NZTA we have recognized the potential for significant U turning at this roundabout, due to the proposed ban on right turns at the Greenwood Street/Duke Street intersection. It now appears that the WRTM run carried out for BBO did not allow U turns at the SH1C/HSL intersection, and this will adversely affect the operation of the roundabout.	On this basis, the additional operational and safety effect associated with 1 ha of industrial development is considered marginal and would not justify requiring an upgrade to the intersection at that early development stage. BBO did not restrict U-turn movements at the SH1C / HSL intersection in the project modelling. The project model runs were developed using NZTA's Scenario 31 model outputs as the base. Accordingly, any U-turn movements included in the NZTA Scenario 31 model coding would have been carried through into the project assessment. NZTA's concern regarding potential U-turning associated with the proposed right-turn ban at Greenwood St/Duke St relates to the wider HSL network strategy rather than being a direct consequence of the Applicants' development.
8.	We accept that there does not appear to be much benefit in the proposed free flow left turn lane from Kahikatea Drive east, as vehicles are likely to be inhibited from reaching this lane, due to queueing in adjacent lanes.	Noted. No further response is required.
9.	The report considers a number of interim layouts, with and then without access to the SL1 Industrial North area from the southern leg (the future HSL). These have been assessed for the year 2035, with the scenario without a connection via the southern leg at the HSL/SH1C roundabout tested up to 23 hectares of development, at which time a volume/capacity ratio of 90% is predicted to be reached.	SIDRA movement summaries have now been included in Appendix B. For the interim layout assessments, the development quantum for Industrial Development has been varied to test the level of industrial development that can be accommodated under each access arrangement. The background traffic volumes on SH1C have been retained on a conservative basis, reflecting the Residential Development assumption of 575 dwellings. Only the Industrial Development trip generation and associated access



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	We would like to see the traffic flow calculations, and the SIDRA runs, to allow us to consider these proposed layouts, as the 2035 scenario with HSL Stage 1 only that was run through WRTM was based on 36 ha for SL1 North Industrial and 575 dwellings at the Mexted development	arrangements have been updated to reflect the revised development quantum and layout being tested.
10.	The ITA indicates that the existing signalized layout will continue to operate with satisfactory delays. However, the volume/capacity (V/C) ratios are stated as being quite high, i.e. very close to 100%. It is interesting to note that the V/C ratio in the 2030 PM peak is predicted to be 97% with scenario 1D (280 households), but 93% with scenario 1E (320 households). It is then predicted to improve further by 2035 (scenario 2, with 575 households), presumably due to the assumed completion of the first phase of HSL.	All 2030 scenarios are based on surveyed traffic volumes, with appropriate growth and development traffic added to the current road network. The 2035 scenarios have been assessed using WRTM outputs and include different network assumptions. In particular, Scenario 2 assumes delivery of Stage 1 HSL, while later scenarios include wider HSL-related changes, including the full length of HSL. Accordingly, variations in V/C ratios between scenarios are not inherently inconsistent. They reflect differences in network configuration, route choice and traffic redistribution between the modelled scenarios.
11.	The new ITA considers the level of upgrade required, but the layout shown in Figure 56 is fairly remarkable, with four through lanes in each direction on Ohaupo Road, but no widening on the two side roads. It seems highly unlikely that such a layout would be progressed. The ITA accepts this, noting that “this solution is not practical or operationally viable”. We therefore respectfully question why such a layout was included in the ITA	The layout was included as a sensitivity test to understand the scale of intervention that would theoretically be required to accommodate the modelled traffic demand at the Ohaupo Rd/Collins Rd intersection. NZTA had requested clarity on the level of upgrade that would be required, and the layout was presented to inform that discussion. Its inclusion in the ITA does not mean BBO recommends the layout. The ITA expressly notes that the layout is not practical.
12.	We note that the other intersections along SH3 have been tested for scenarios beyond this 320 threshold, and we wonder if the predicted outcome at Ohaupo Road/Collins Road invalidates the assessment of these other intersections (as presumably the poor levels of service at the Ohaupo Road/Collins Road intersection could affect the assignment of traffic in this area	The comment appears to be under the Ohaupo Rd/Saxbys Rd section but refers to the Ohaupo Rd / Collins Rd intersection. Please confirm whether the comment is intended to refer to Ohaupo Rd/Collins Rd or Ohaupo Rd / Saxbys Rd. If the comment relates to Ohaupo Rd / Collins Rd, Section 15.2.1 of the ITA indicates that the signalised intersection operates at an acceptable level across the modelled scenarios. If the comment relates to Ohaupo Rd/Saxbys Rd, BBO considers that the WRTM assignment accounts for network conditions at a strategic level. The Residential Development is primarily served by the Ohaupo Rd corridor, with limited alternative access options available to redistribute traffic. The performance of the Ohaupo Rd/Saxbys Rd intersection therefore represents a genuine network constraint rather than an outcome of the modelling process. The ITA addresses this constraint through a transport reassessment trigger currently identified at approximately 543 dwellings. The purpose of the trigger is not to establish a permanent development cap, but rather to identify the point at which further transport assessment of the Ohaupo Rd corridor is required having regard to the network conditions, transport improvements and travel behaviour existing at that time. This approach ensures that



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		development beyond the currently demonstrated threshold is subject to reassessment of transport effects and consideration of any further mitigation that may be available or reasonably practicable at that time. On that basis, the identified constraint does not invalidate the assessment of other intersections, rather, it informs the staging and mitigation framework recommended in the ITA.C
13.	Also, we wonder how this 320 threshold affects the conclusions for the HSL/SH1C roundabout, as the 2035 scenario used for the intersections of relevance to the SL1 North Industrial development is based on 575 households.	The transport reassessment trigger has been updated to 543 dwellings. It is a localised staging control associated with the Residential Development and the performance of the Ohaupo Rd corridor. It does not govern the operation of the SH1C/HSL roundabout or the staging of the Industrial Development. The current transport reassessment trigger associated with the Ohaupo Rd corridor does not undermine or invalidate the SH1C/HSL roundabout assessment.
14.	This second version of the ITA still retains access from the service road into the intersection. As advised previously, there appear to be significant design challenges with this, including tight U turns, and an inability for drivers using the service road to see the signal heads when approaching from the east or west. This intersection is one of those assessed where future signalized layouts have not included full pedestrian crossings. These should be assumed to be essential.	The Ohaupo Rd/Lambert Ct intersection currently operates as an unsignalised cross-road intersection, with multiple conflict points and reliance on gap acceptance for side-road movements. The proposed signalisation of the intersection would provide a materially greater level of control by formalising vehicle movements, reducing conflict uncertainty and providing controlled pedestrian crossing opportunities where appropriate. The detailed geometric design, including the service road arrangement, U-turn movements and signal head visibility, will be resolved through the detailed design process. However, from a transport safety and operational perspective, signalisation in principle represents an improvement over the existing priority-controlled layout. Section 15.2.3 of the ITA also identifies potential safety concerns associated with removing access to the Ohaupo Rd service lane, given that an alternative access is available further north on Ohaupo Road. BBO does not agree that full pedestrian crossings on all legs of every future signalised intersection must be assumed at this stage. There is an existing signalised mid-block pedestrian crossing approximately 100 m east of the intersection. Pedestrian provision at the intersection will be confirmed through detailed design, having regard to pedestrian desire lines, safety, spacing and the existing crossing provision.
15.	Section 15.3 considers bus priority modelling, indicating that this is likely to adversely affect the operation of the route for other vehicles. This is to be expected, but without being able to review the analysis (i.e. with no SIDRA printouts provided), it is unclear if the high V/C ratios of around 140% at several locations, which implies significant spill back, will adversely affect buses.	SIDRA movement summaries have now been included in Appendix C. The purpose of the bus priority modelling is to understand the trade-off between improved bus movement and the effect on general traffic operation. The ITA recognises that reallocating road space to support bus priority is likely to increase delay for some general traffic movements. That outcome is not unexpected where priority is being given to higher-occupancy public transport movements. High V/C ratios for general traffic do not, in themselves, undermine the public transport strategy, provided that future bus priority measures are designed to protect bus travel time and reliability. The ITA adopts this approach by embedding public transport through future bus routing, road



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		cross-sections capable of accommodating in-lane bus stops, and safeguarding of corridors for future public transport provision. However, the detailed design of any bus priority treatment will need to confirm that queues and spillback do not materially compromise bus travel time reliability at key locations.



Appendix D – Intersection Traffic Counts



Appendix E – Draft Construction Traffic Management Plan



Appendix E – CMW “Geotechnical Investigation Report” (Bound Separately)

Appendix F – WGA “South Park Agri Development Limited – Southern Links 1, Industrial Stage 1, Northern Block Hydrogeological Effects Assessment”



Southern Links 1 Residential Stage 1 Southern Block Hydrogeological Effects Assessment

ASSESSMENT OF EFFECTS

WGA242463

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APPENDIX E ARTIFICIAL WETLAND DRAWDOWN CONTOURS

APPENDIX F WASTEWATER INFRASTRUCTURE DRAWDOWN MODELLING

1 EXECUTIVE SUMMARY

This Hydrogeological Effects Assessment has evaluated the potential groundwater effects associated with the Southern Links 1 Residential Development. The assessment has focused on temporary stormwater and wastewater infrastructure construction dewatering and longer-term groundwater diversion associated with the proposed Artificial Wetlands.

Site specific investigations and groundwater monitoring have confirmed the presence of a shallow unconfined aquifer overlying a deeper confined aquifer, separated by a thin, laterally persistent low permeability aquitard. Confined groundwater levels exhibit seasonal variability and indicate the deeper aquifer is hydraulically connected to local drains and the headwaters of the Mangakōtukutuku Stream, which act as key discharge features within the catchment.

Analytical modelling indicates that groundwater drawdown effects associated with the construction of artificial wetlands and wastewater infrastructure will be localised, temporary, and minor with the implementation of proposed management measures. Conservative assumptions have been adopted throughout the assessment, including the appropriate use of seasonal groundwater levels to support the effects assessment and worst-case construction scenarios. The accompanying Geotechnical Assessments (CMW 2026c) has used these results to undertake ground settlement assessments.

Where dewatering temporarily intercepts groundwater that would otherwise contribute to local drains or stream baseflow, effects can be effectively managed through controlled abstraction and return of flows upstream of works (as proposed in consent conditions), maintaining surface water continuity during construction. With the Residential Development's proposed management measures, surface water effects have been assessed as minor and temporary.

In the operational phase, the proposed artificial wetlands will function as permanent hydraulic features that intercept and redistribute groundwater discharge within the catchment. This represents a modification of groundwater flow paths rather than a net loss of groundwater from the system. Long-term effects on groundwater levels, nearby bores, natural wetlands, and connected surface water bodies are assessed as less than minor.

Overall, based on the investigations undertaken, modelling completed, and mitigation measures proposed, WGA considers that the groundwater effects associated with the construction and operation of the Residential Development can be appropriately managed and will be no more than minor. No additional permanent groundwater or surface water monitoring is considered necessary, with standard construction-phase environmental controls, as proposed, providing sufficient verification of predicted effects.

2 INTRODUCTION

2.1 Background

Wallbridge Gilbert Aztec (WGA) has been engaged for technical services in relation to the substantive application for the Southern Links 1 (“SL1”) development (the “Project”) under the Fast-track Approvals Act 2024 (“FTAA”). The Project is to provide a range of housing typologies and land tenure opportunities to provide affordable housing, and to boost the industrial capability of the region (Figure 1). This assessment of hydrogeological effects focuses on the residential portion of the Project (the “Residential Area” and the “Residential Development”).

2.2 Site Description

The entire SL1 Project area is approximately 440 ha in size and is situated between the established Hamilton suburbs of Dinsdale, Frankton, Deanwell and Glenview to the northeast, and rural land within Waipa to the southwest. The SL1 area is currently zoned rural under the Waipa District Plan and consists of lots in pasture, rural lifestyle, equine industry, and peri-industrial use.

The wider SL1 Project will consist of both residential and industrial areas with green spaces throughout the development. Stormwater across the SL1 area will be managed by naturalised streams, rain gardens and constructed wetlands. The SL1 site has been divided into two areas, known as the Residential Area and the Industrial Area. This assessment of effects focuses only on the Residential Development (Figure 1).

The Residential Area is a 46 Ha block of rural dairy farmland to the south of Saxbys Road. The proposed development is for subdivision for residential development. This includes 938 lots, and a 1,000 m² commercial lot, 3,200 m² neighbourhood park and associated infrastructure and riparian planting.

2.3 Proposed Activity

For the Residential Development, six wetlands are proposed to be constructed to manage stormwater in the development. Additionally, two wastewater pump stations (WWPS) and site-wide wastewater pipeline infrastructure need to be constructed to support the development (Figure 2).

The Residential Development has two main groundwater-related components that have the potential to influence catchment water balances:

1. **Short-term temporary dewatering during construction earthworks**, for proposed Artificial Wetlands and wastewater infrastructure (site-wide pipelines and two wastewater pumping stations). Dewatering is anticipated to be localised and temporary, with groundwater managed and discharged in accordance with the site erosion and sediment control framework (namely the ESCP) and relevant consent condition requirements.
2. **Long-term groundwater interception and diversion to the proposed Artificial Wetlands**, which will act as persistent hydraulic features within the developed catchment.

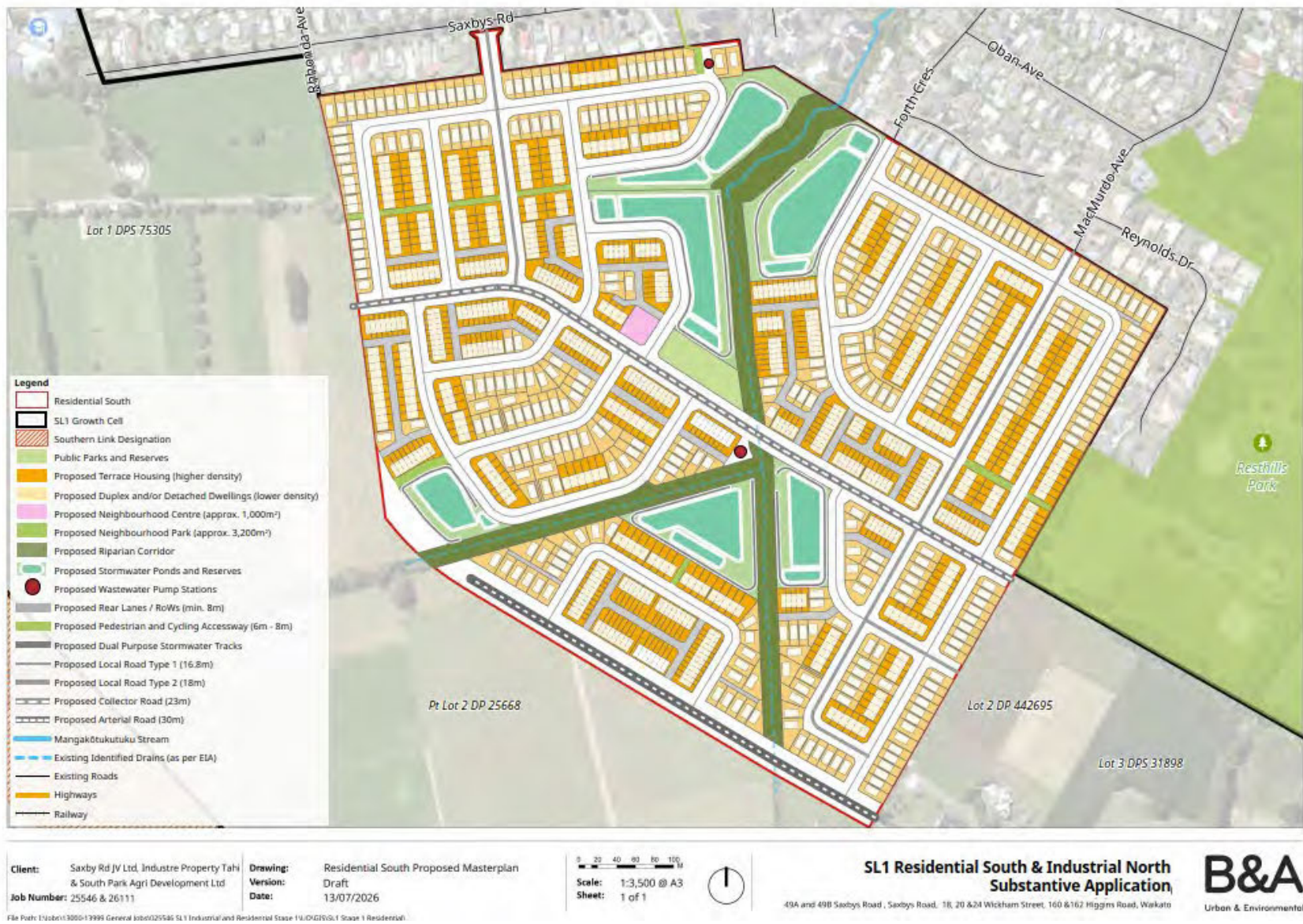
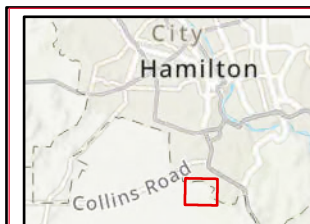
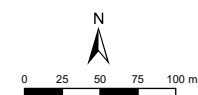


Figure 1: Residential Development Master Plan



LEGEND

-  WWPS
-  Proposed Wastewater Infrastructure
-  Proposed Artificial Wetlands
-  Residential Development
-  Southern Links Boundary
-  1m Contours



Scale 1:5,000 @ A4

Coordinate System: NZGD 2000 Mount Eden Circuit

WGA

Figure 2

Southern Links Stage 1

Proposed

Artificial Wetlands and Wastewater Infrastructure

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3 EXISTING ENVIRONMENT

3.1 Rainfall

Rainfall data are recorded at the Ruakura Weather Station, which is located approximately 6.2 km northeast of the proposed development. The available record spans from November 2005 to the present, with a peak daily rainfall of 87.8 mm recorded during this period (Figure 3). The long-term mean annual rainfall at the station is approximately 1,121 mm.

During the period of groundwater level monitoring undertaken at the Residential Area for this assessment (July 2025 to January 2026; see Section 3.5.3), the peak daily rainfall recorded at Ruakura was 42.4 mm. Total rainfall over this monitoring period was approximately 620 mm. When annualised, this equates to an annual rainfall of approximately 1,048 mm/year, which is similar to the long-term mean annual rainfall. Overall, rainfall conditions during the monitoring period are considered to be broadly representative of average long-term conditions.

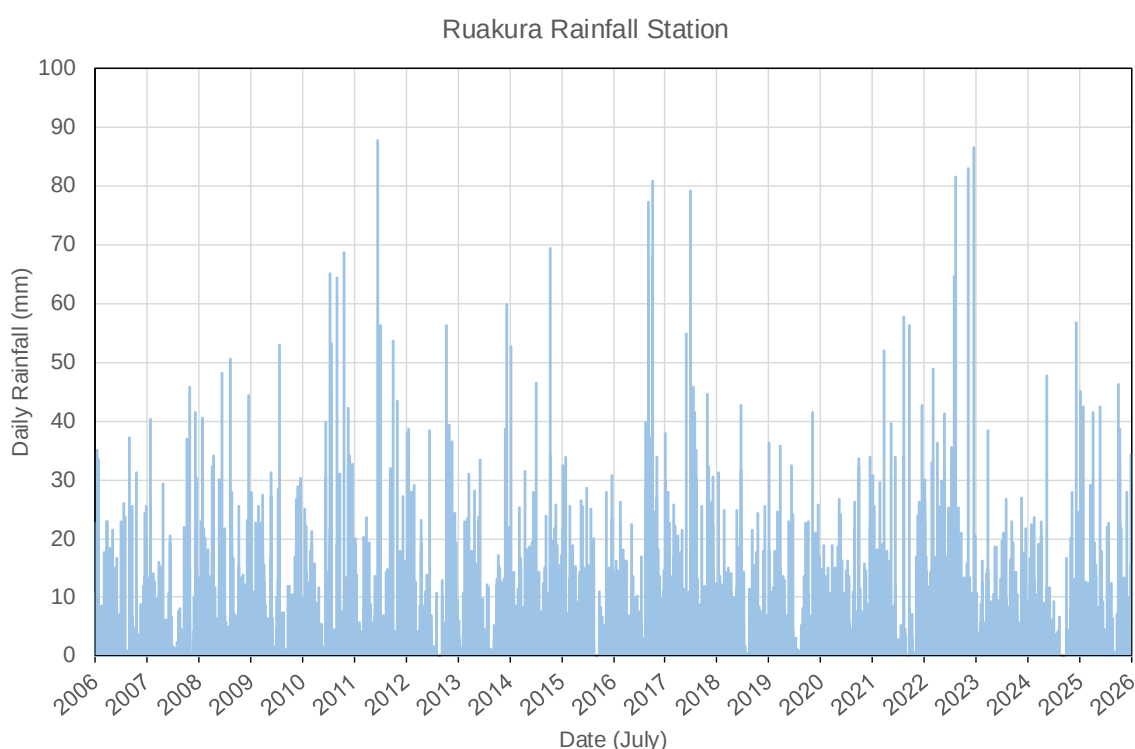
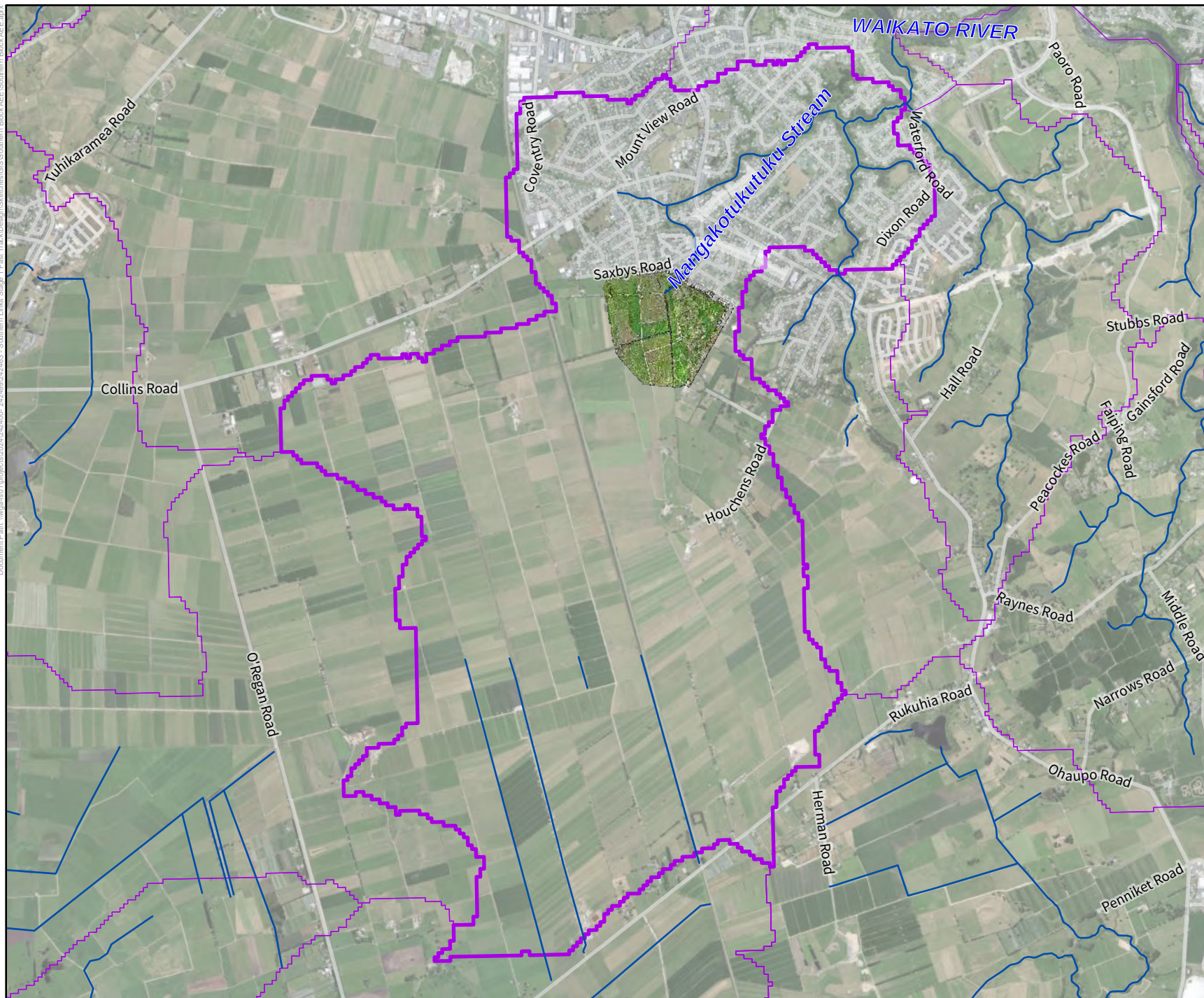


Figure 3: Rainfall Record at Ruakura (6.2 km northeast)

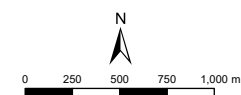
3.2 Surface Water Bodies and Catchment Boundary

The site is characterised by two converging drains (receiving water from a network of surrounding farmland drains). These two drains are approximately 1 to 2 m deep and have “moderate” ecological habitat (EcoLogical Solutions, 2025). The drains are flanked by riparian plantings, which are to be maintained during the construction period and as part of the proposed development. The drains flow into the headwaters of the Mangakōtuketuku Stream, which extends 150 m into the north-eastern end of the site (Figure 4). During project-specific field investigations, EcoLogical Solutions (2025) surveyed stream widths of between 2.6 to 4.2 m, with water depths ranging from 0.45 to 0.87 m and velocities of 0.1 to 0.9 m/s.



LEGEND

- River
- WRC Catchment Outlines
- Mangakotukutuku Stream Catchment
- Site Specific Drains



Scale 1:40,000 @ A4
Coordinate System: NZGD 2000 Mount Eden Circuit

WGA

Figure 4

Southern Links Stage 1 WRC Catchments Map of Mangakotukutuku Stream

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The site exists within the Mangakōtukutuku catchment, which is approximately 2,677 ha in area (AECOM, 2020). The catchment is bound to the north and east by the Peacocke Riverside catchment and to the west by the Waitawhiriwhiri catchment (AECOM, 2020). The Mangakōtukutuku stream discharges into the Waikato River approximately 2.5 km to the northeast of the site (Figure 4). Stormwater from the site will be discharged into planned artificial wetlands that will connect to the existing drains and the Mangakōtukutuku Stream.

Two existing natural wetlands were also identified within the site by EcoLogical Solutions Ltd (2025). One of these wetlands is located on the northeastern boundary of the site (approximately 285 m² in area) and the other is located in the upper reaches of the Mangakōtukutuku Stream (approximately 50 m²).

3.3 Geology and Hydrogeology

3.3.1 Regional Geology and Hydrogeology

The Hamilton Basin, in which the Residential Development is located, is a large tectonic basin centred on Hamilton City with an area of approximately 2,000 km² and traversed by the Waikato River. The basin is surrounded by ranges of Mesozoic (Manaia Hill Group) and Tertiary age rocks (Te Kuiti and Waitemata Groups). At depth, basement greywacke underlies the sedimentary deposits that infill the basin (GNS, 2005).

The basin is infilled with Tauranga Group alluvial sediments, dating from the Pliocene to the middle Holocene. The Tauranga Group sediments are up to 300 m thick and include gravels, sands, silt, muds and peats of fluvial, lacustrine and distal ignimbritic origin. Underlying the low hills within the basin are older ignimbrites, tephra fall deposits and alluvium of the Walton Subgroup (Lowe 2021; Figure 5).

The younger Hinuera Formation of the Tauranga Group underlies much of the Hamilton basin (Figure 6). This formation was deposited by braided river systems of the Waikato River, initiated by the supply of large volumes of sediment from volcanism in the Taupo Volcanic Zone (Petch, 1987). Within this formation, the most productive aquifers consist of well-sorted coarse sands and gravels. Discontinuous sequences of rhyolitic and pumiceous gravelly sands and gravels are interspersed with pumiceous silt, clay and peat layers. Lithological variability generally results in zones of higher permeability within the formation rather than a single, continuous aquifer (Scholfield, 1972). Low-lying areas comprise younger Holocene Swamp Deposits of the Tauranga Group, such as the Piako Subgroup, locally consisting of peat.

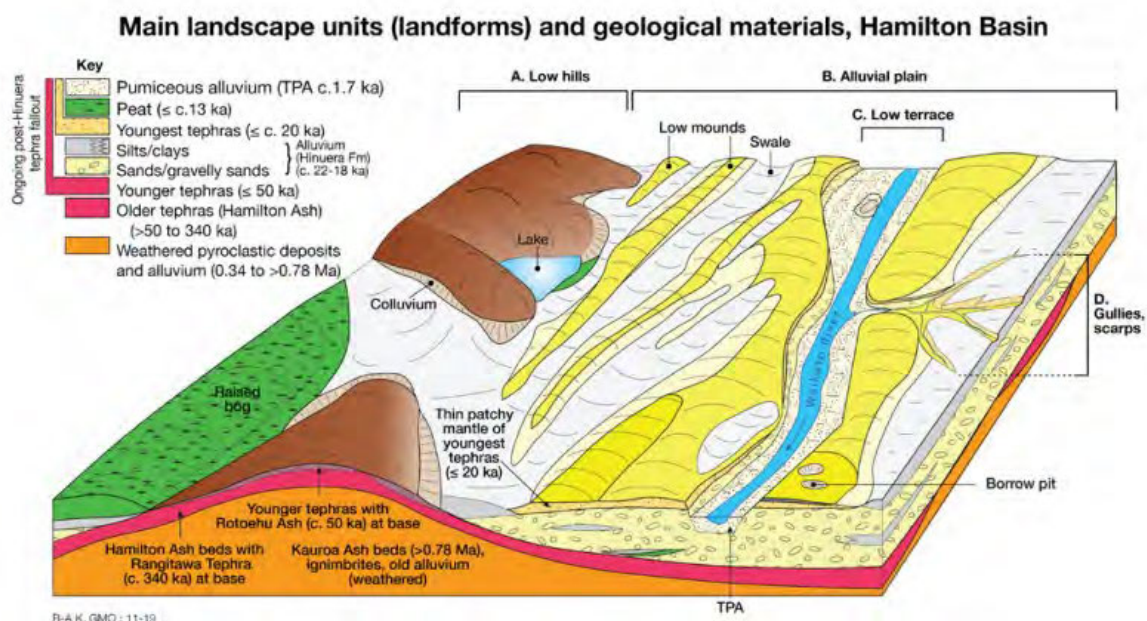
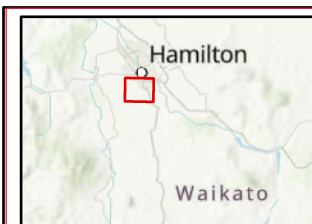
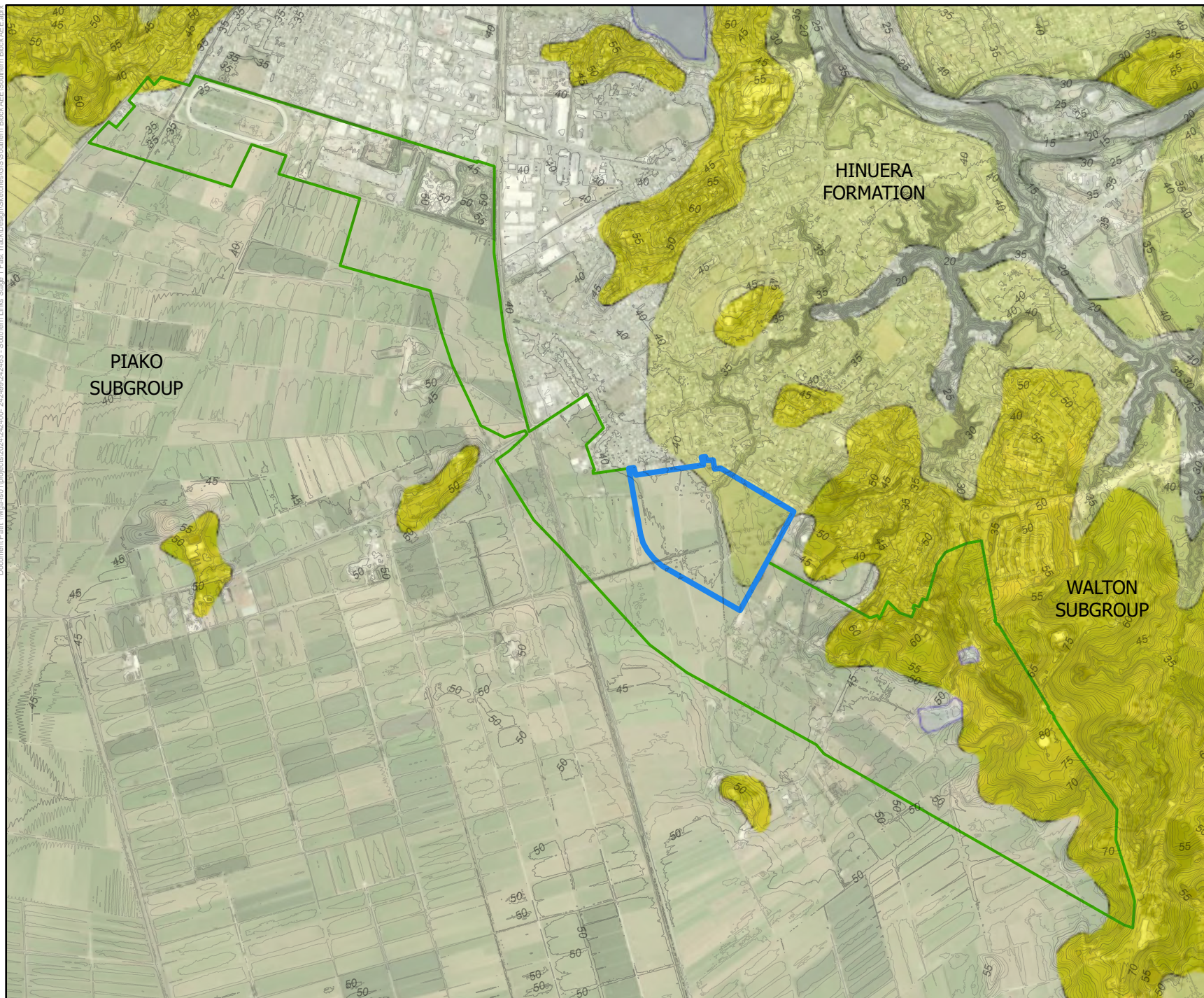
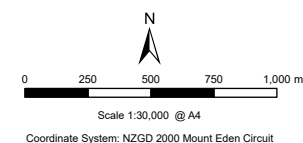


Figure 5: Geological Setting of the Hamilton Basin (Lowe, 2021)



LEGEND

- Residential Development
- Southern Links Growth Cell
- 1m Contours



WGA

Figure 6

Southern Links Stage 1
Underlying Geological Units

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3.3.2 Local Shallow Lithology

The site is predominantly underlain by sediments of the Hinuera Formation. The Hinuera Formation consists of Late Pleistocene river deposits, including cross-bedded pumice sand, silt and gravel with interbedded peat. GNS Science Web Geology mapping (Figure 6) shows Piako Subgroup Holocene sediments are overlying the Hinuera Formation sediments at the site. However, based on the onsite observations of CMW (2026), the site is completely underlain by Hinuera Formation soils and the Piako Subgroup Holocene sediments (peat swamp deposits) are located further to the south-west, outside the Residential Area (CMW, 2026). A summary of the underlying geology encountered from the investigation is presented in Table 1.

Table 1: Stratigraphic Units of the Residential Area (CMW, 2026)

UNIT	DEPTH TO TOP OF SOIL UNIT (m)		THICKNESS (m)	
	Min	Max	Min	Max
Topsoil	0		0.1	0.5
Interbedded loose to dense Sands and firm to very stiff Silts (Hinuera Formation)	0.1	0.5	1.9	18.0
Stiff to very stiff Clayey Silt (Hamilton Ash/Walton Subgroup) ⁽¹⁾	1.9	18.0	5.0 to 10.0 +	

Note:

⁽¹⁾ Base of unit not encountered.

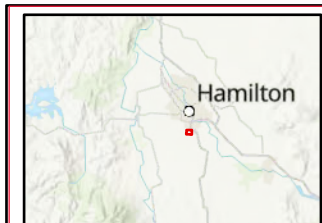
3.3.3 Local Hydrogeology

In July 2025, WGA oversaw the installation of five piezometers at four locations at the site (Figure 7). An overview of piezometer as-built layouts is provided in Table 2. Piezometers P1, P3 and P4 were installed at a target depth of 6 m. Two piezometers were installed at the P2 location (Figure 8), the deeper one screened from 8.5 to 10 m below ground level (bgl; P2D) and the shallow piezometer was screened from 3.5 to 5 m bgl (P2S, Figure 7).

Drilling provided sediment core samples for each drilling location. Samples were logged on-site by CMW in order to have consistent results with other geological tests undertaken at the site. Comprehensive drill logs and core photos are provided in Appendix A.

Table 2: Piezometer Construction Details

PIEZOMETER	DEPTH (m bgl)	CASING DIAMETER (mm)	SCREEN LENGTH (m)	EASTING (NZTM)	NORTHING (NZTM)
P1	6.14	40	1.5	1800593	5811145
P2S	5.14	40	1.5	1800673	5811072
P2D	10.06	40	1.5	1800670	5811073
P3	6.02	40	1.5	1800589	5811047
P4	5.92	40	1.5	1800595	5810750

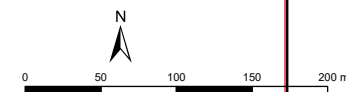


LEGEND

- Piezometric Surface
- Contour 1m
- Residential Development
- Southern Links Boundary

Subsurface Testing

- Cone Penetration Testing
- Hand Auger
- Piezometer
- Test Pit



Scale 1:5,000 @ A4

Coordinate System: NZGD 2000 Mount Eden Circuit

WGA

Figure 7

Southern Links Stage 1
Investigation Locations
Piezometric Surface

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Figure 8: Twin Bore Headworks for P2S (Shallow) and P2D (Deep), Screened Above and Below the Low Permeability Aquitard Layer

Sites P1, P2 and P3 were all characterized by coarse sand, typical of the Hinuera Formation, with a thin clayey silt layer (referred to as a low permeability aquitard layer) appearing between 36 and 36.5 m RL.

Piezometer P4 was characterized by approximately 1 m of silt toward the top of the bore in addition to the low permeability aquitard layer at 37.4 m RL (metres Relative Level, or metres above mean sea level).

Across the four sites, the low permeability aquitard layer varied in thickness from 0.13 m to 0.45 m but appeared to be relatively persistent and to have an effect on the groundwater characteristics of the site. During drilling, after penetrating the low permeability aquitard layer, sand tended to rapidly flow into the borehole from below (called flowing sands by the drillers). This is evidence that the low permeability aquitard layer has a confining effect on the underlying deep aquifer, which is under some degree of pressure. The layer appears to be continuous across the site, appearing clearly in the majority of the geotechnical investigation sites. CMW have prepared a summary map illustrating this and presented in Appendix A.

WGA observed that sand layers above the aquitard had an orange-brown coloration while below the layer they tended to be entirely grey (Figure 9). This indicates that water levels above the low permeability aquitard layer fluctuate seasonally, while sediment below the low permeability aquitard layer is saturated year-round, providing further evidence to the confining effect of the aquitard.

Groundwater across the site is also likely strongly influenced by the two major drains (tributaries of Mangakōtukutuku Stream) running through the farm. From the observations taken during site visits these drains appear to have significant flow for the catchment size, indicating that they are at least partially groundwater fed. This is also supported by the brown discolouration of the drain, known locally to be caused by groundwater discharge and iron oxidation. In general, groundwater levels are likely drawn down to the water level in the incised drains.

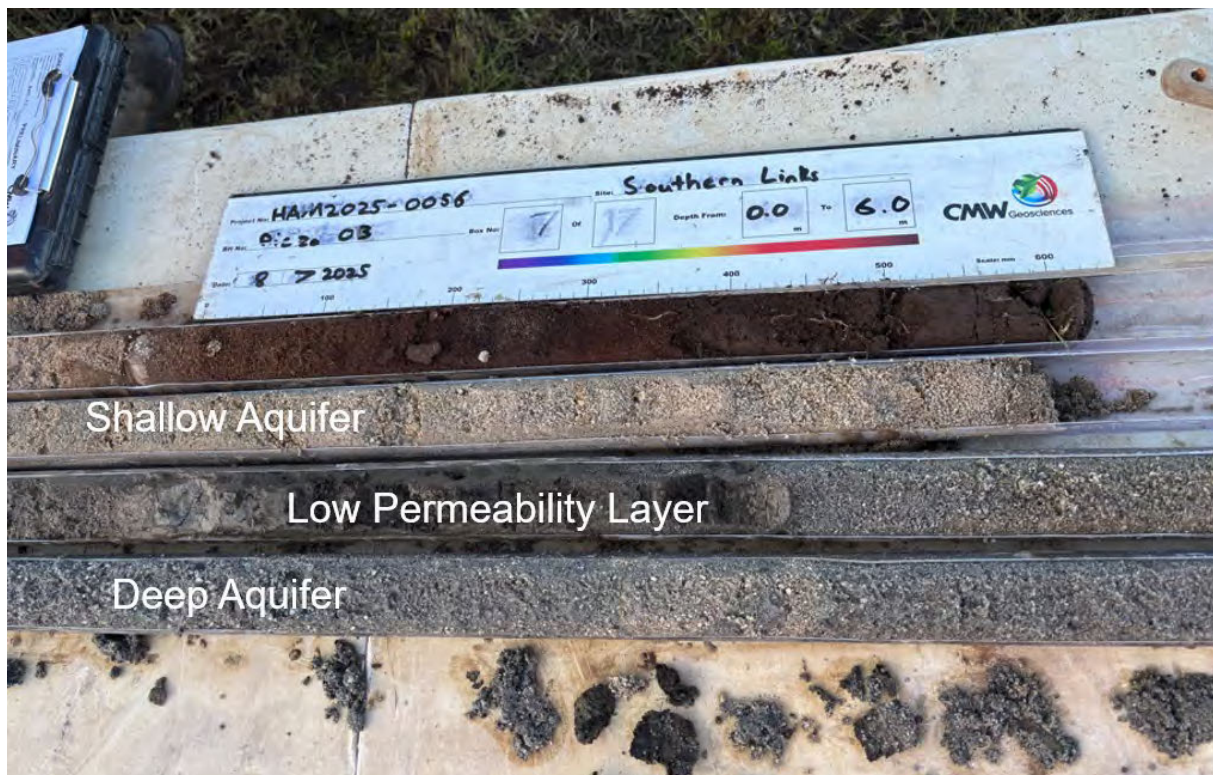


Figure 9: Field Identification of Lithological Units Present at Bore P3

3.4 Hydrogeological Parameters

The hydraulic conductivity of the geological layers found at the site has been determined by WGA. Hydraulic conductivities were determined by the analysis of hydraulic slug tests performed on-site. These analysis results were compared to the results from soakage testing undertaken by CMW, and decisions were made on appropriate hydraulic conductivity values for each of the sedimentary units listed in Table 3. For lithological units with no data available for hydraulic test analysis, appropriate literature values have been applied.

The hydraulic conductivity for the Hinuera Formation sediments found at the site has been determined by hydraulic slug tests performed in each of the five piezometers. Both falling head and rising head slug tests were analysed where data was available. Methods and results of each test are presented in Appendix B. The groundwater at each site reacted very rapidly, typically recovering within a few seconds of each test. For the Hinuera Formation screened beneath the low permeability aquitard layer, resulting hydraulic conductivities were on average $4 \times 10^{-4} \text{ m/sec}$, which is considered a representative value for the site. This value is consistent with the hydraulic conductivity determined from pumping tests in the same aquifer, completed as part of hydrogeological investigations at a site 800 m north-west at Collins Road (Earthtech, 2025).

One of the five piezometers tested by WGA was screened above the low permeability aquitard layer. To consider the hydraulic conductivity of the Hinuera Formation above the low permeability aquitard layer, the hydraulic slug test analysis results were compared to the results from soakage tests undertaken by CMW. A decision was then made on an appropriate hydraulic conductivity value for above the low permeability aquitard layer of 2.5×10^{-5} .

WGA notes that due to the rapid recovery of the slug tests, resulting hydraulic conductivities should be treated as minimum values as they may represent the screen and filter pack characteristics rather than those of the target aquifer. Similarly, CMW notes that during soakage testing, water emptied from four soakage test locations faster than they could be filled, indicating the resulting permeabilities may be higher than recorded values (CMW, 2026a). However, the consistency of the results with recent hydrogeological studies conducted by Earthtech (2025) offers confidence in the validity of the findings.

A hydraulic conductivity range of $7.5 \times 10^{-6} \text{ m/s}$ to $2 \times 10^{-8} \text{ m/s}$ was determined for the low permeability aquitard layer characterised as organic silt with low plasticity. This range was produced from calibrated hydrogeological modelling at the nearby Collins Road investigation (Earthtech, 2025) and testing completed by WGA at the nearby Rotokauri Project (Table 3; WGA 2023). An assumed vertical hydraulic conductivity $4 \times 10^{-9} \text{ m/s}$ was adopted for modelling purposes.

3.5 Catchment Water Balance

3.5.1 Recharge

The shallow groundwater and surface water bodies of the catchment are predominantly recharged directly by local rainfall. Differences in the observed responses between the shallow and deep groundwater levels indicate that the deep aquifer has a direct connection with the rainfall influenced fluctuations in the nearby drain

WRC estimates that annual rainfall recharge (soil drainage) is 22% to 40% of rainfall in the Waikato region¹. Based on an average annual rainfall for Waikato of 1,072 mm, this results in a recharge rate in the range of 235 mm to 428 mm. For the purposes of this assessment, a recharge value at the lower end of the estimated range (250 mm) was adopted for groundwater modelling purposes, to provide a conservative assessment of potential groundwater drawdown and associated dewatering effects.

Table 3: Hydraulic Conductivities of the Residential Area

MATERIAL NAME	HYDRAULIC CONDUCTIVITY RANGE (m/s)	HYDRAULIC CONDUCTIVITY ADOPTED FOR MODELLING (m/s)
Unsaturated zone Hinuera Formation ⁽¹⁾	$1.27 \times 10^{-6} - 1.43 \times 10^{-4}$	2.5×10^{-5}
Upper Interbedded loose to dense sands and firm to very stiff silts Hinuera Formation ⁽²⁾	$1.25 \times 10^{-4} - 1.83 \times 10^{-4}$	
Low permeability aquitard layer. Organic silt with low plasticity. Hinuera Formation ^(3,4,5)	$7.5 \times 10^{-6} \text{ (4)} - 2 \times 10^{-8} \text{ (3)}$	$K_h = 2 \times 10^{-8}$ $K_v = 4 \times 10^{-9} \text{ (5)}$
Lower Interbedded loose to dense sands and firm to very stiff silts Hinuera Formation ⁽²⁾	$8.75 \times 10^{-5} - 1.03 \times 10^{-3}$	4×10^{-4}

Notes:

⁽¹⁾ Range derived from CMW soakage tests (1 - 1.7 m deep) considered to underestimate the hydraulic conductivity of the unit (CMW, 2026a).

⁽²⁾ Average derived from WGA aquifer hydraulic slug testing is considered to underestimate the hydraulic conductivity of the unit (Appendix B).

⁽³⁾ Derived through separate investigations by WGA (2023). Assessed from the testing of unit 2b Hinuera Formation: Soft to firm SILT, some organics, low plasticity.

⁽⁴⁾ Earthtech (2025) value used for hydrogeological modelling of the local confining unit.

⁽⁵⁾ K_v (vertical hydraulic conductivity) = K_h (horizontal hydraulic conductivity)/5 = $2 \times 10^{-8}/5$.¹

¹ [https://www.waikatoregion.govt.nz/environment/water/groundwater-monitoring/flow5a-report/#:~:text=Pr%20%3D%20estimate%20of%20rainfall,percent\)%20in%20the%20Waikato%20region.](https://www.waikatoregion.govt.nz/environment/water/groundwater-monitoring/flow5a-report/#:~:text=Pr%20%3D%20estimate%20of%20rainfall,percent)%20in%20the%20Waikato%20region.)

3.5.2 Groundwater and Surface Water Flow Paths

Groundwater within the Mangakōtukutuku catchment is closely connected to surface water bodies, providing sustained flow to nearby drains, wetlands, and streams. In the upper catchment, which is characterised by rural land use and peat-rich soils, infiltrating rainfall that then flows to drains provides baseflows to surface water features. This groundwater–surface water interaction controls local groundwater flow paths and underpins the maintenance of baseflows through the catchment, ultimately contributing to flows in the Waikato River.

Groundwater levels have been measured and monitored by WGA and CMW at the Residential Development site. Site observations and an array of geotechnical investigations undertaken in the area since 2011 were used to estimate a preliminary winter piezometric surface (Figure 7). WGA notes that much of the geotechnical groundwater data used to produce the piezometric surface does not align temporally. Consequently, the surface created is based on our interpretation of the data and general understanding of the site's hydrogeological setting. Interpreted groundwater flow directions discharge to local drains and the headwaters of the Mangakōtukutuku Stream.

3.5.3 Groundwater Levels

Groundwater levels were recorded by WGA manually from the installed piezometers on 18 July 2025 (Table 4). Measurements from the deeper piezometers indicate the aquifer underlying the thin organic silt layer is confined, with recorded groundwater levels being above the low permeability aquitard described in Section 3.3.3. Water level measurements were made by CMW at numerous investigation sites in April 2025. Recorded groundwater level measurements ranged from 1.7 to 5.5 m bgl (refer to Table A1 in Appendix A).

Table 4: Manual Static Water Level Measurements in Each Piezometer (18 July 2025)

PIEZOMETER	STATIC WATER LEVEL (m bgl)	STATIC WATER LEVEL (m RL)	TOP OF AQUITARD LAYER (m RL)
P1	2.38	37.80	36.39
P2S	3.43	38.10	36.56
P2D	3.88	37.70	36.56
P3	2.07	37.90	36.32
P4	1.42	38.40	37.53

Downhole continuous groundwater level monitoring was installed in all five piezometers to record fluctuations between dry and wet periods from July 2025 to January 2026. The continuous monitoring also confirmed the confined nature of the aquifer beneath the low permeability aquitard layer (Figure 10; P1, P2D, P3 and P4), compared to the aquifer responses observed in the shallower P2S.

The shallower P2S aquifer shows only small water table fluctuations in response to rainfall. The strong groundwater level fluctuations exhibited in the deeper bores (Figure 10; P1, P2D, P3 and P4) indicate the confined aquifer is directly connected to the nearby drains. Water level responses in these drains to storm events cause similar responses in the confined aquifer, as recorded in the deep piezometers. This interpretation aligns with the observation that the drain is groundwater fed. Figure 11 shows the discolouration of the drain water due to oxidation of dissolved iron carried in groundwater discharges.

The maximum groundwater level height experienced during monitoring at Residential Area was 38.73 mRL in the southernmost piezometer, P4. During the summertime, levels dropped as low as 36.96 mRL in the northernmost piezometer, P1.

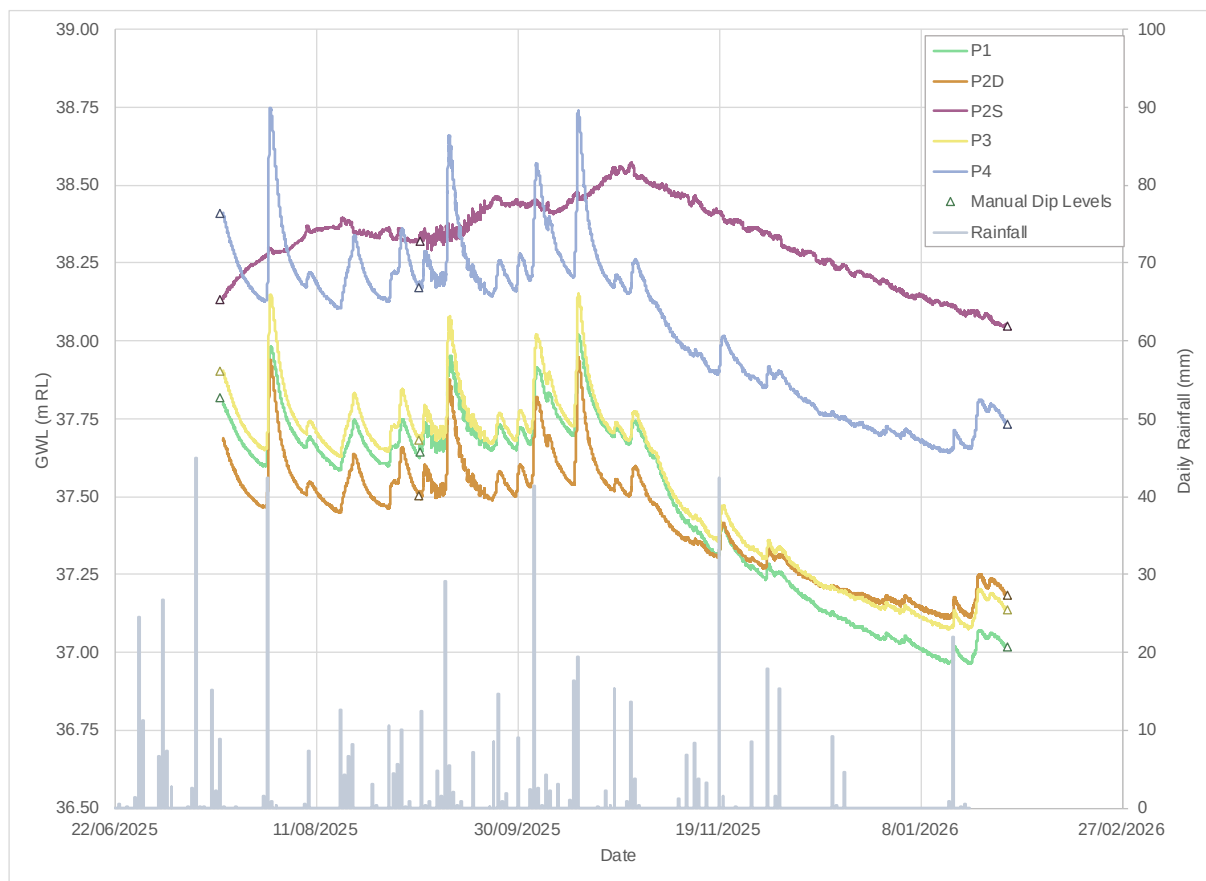


Figure 10: Residential Area Piezometer Groundwater Level Responses to Rainfall



Figure 11: Discolouration in Drain Due to Iron Oxidation from Groundwater Discharge

3.6 Surrounding Groundwater Users

Water supply bores (as listed in Appendix A) and groundwater abstraction consents within one kilometre of the Residential Development site are shown in Figure 12, with the consents summarised in Table 5. At the time of writing, according to the WRC consents database, there are four groundwater abstraction consents within one kilometre of the site. Of these, two are related to agricultural supplies. The remaining two are related to dewatering activities that are considered to be 'zero' net takes. The two consents related to agriculture are upgradient of the proposed Residential Development activities (south of the Residential Area).

Table 5: Nearby Groundwater Takes

CONSENT NUMBER	USER	PERMITTED VOLUME (m ³ /day)	PURPOSE
AUTH125828.01.01	Golden Valley Farm Limited	28	Agricultural farming - dairy
AUTH140970.01.01	The land Tahi Farm Group Limited AgVice Limited (Holders' Representative)	66	Agricultural farming - dairy
AUTH145510.02.01	Hamilton City Council AECOM New Zealand Limited (Auckland) (Holders' Representative)	0 (Zero net take)	Land development (Groundwater Diversion/ Dewatering)
AUTH147036.01.01	Hamilton City Council Potentialis Limited (Holders' Representative)	0 (Zero net take)	Waste treatment/disposal (Dewatering)

4 DRAWDOWN EFFECTS OF ARTIFICIAL WETLANDS

4.1 Introduction

The proposed Artificial Wetlands (Section 2.3) are designed to intersect the existing groundwater levels. WGA has modelled the drawdown effects of the proposed Artificial Wetlands using analytical methods, drawing on parameters from on-site testing (Section 3.4) and the Residential Development design provided by Maven Limited (Maven; Drawing no. R1-C440 Rev C). The analytical pit modelling was used to assess any drawdown impacts of the Artificial Wetlands extending to neighbouring properties and the drains of the Mangakōtukutuku stream headwaters.

WGA has depicted monitored high and low groundwater levels on Maven Drawing no. R1-C440 Rev C, included in Appendix C. Maven has verified that stormwater soakage is not required as a component of the wetland function. Furthermore, the operational “permanent” water levels in the wetlands are below the existing surrounding groundwater levels. Therefore, groundwater mounding is not expected to occur as a result of the Artificial Wetland operations.

The analytical assessments presented in this report are intended to evaluate groundwater inflows, dewatering requirements and groundwater drawdown effects. Assessment of the implications of artesian pressures on wetland stability and associated geotechnical design requirements is addressed separately by CMW within the geotechnical assessment (CMW 2026b and CMW 2026c).

4.2 Analytical Pit Modelling Methodology for Artificial Wetlands

An assessment of potential groundwater inflows to each of the planned Artificial Wetlands within Residential Development has been undertaken using a published method of estimating groundwater inflows to open-cut pits (Marinelli & Niccoli 2000). This methodology uses analogue equations to approximate horizontal groundwater inflows through the sides of the pit and vertical groundwater inflows through the floor of the pit (Appendix D).

This method adopts a conservative conceptual model in which the proposed wetlands are assumed to be hydraulically connected to the underlying groundwater system. The analytical pit modelling does not rely on the presence of the low-permeability aquitard to restrict groundwater inflows or drawdown and instead applies the representative hydraulic conductivity of the Hinuera Formation (4×10^{-4} m/s) throughout the assessment.

The equations used by this methodology assume laterally radial groundwater flows toward a circular pit. In applying this methodology to the proposed Artificial Wetlands, their layouts needed to be simplified by converting them to equivalent circular ponds. This has been done by taking the full footprint area of each wetland, including forebays and rain gardens, assuming the area is circular and calculating the radius of the “equivalent” area. The effective radii for the wetlands derived using this “equivalent” calculation are presented in Table 6.

Table 6: Inputs for Pit Models Representing Each of the Artificial Wetlands

ARTIFICIAL WETLAND NUMBER	EXISTING GROUND ELEVATION (mRL) ⁽¹⁾	EXISTING WINTER GROUNDWATER LEVEL (mRL) ⁽²⁾	DESIGN PERMANENT WATER ELEVATION (mRL) ⁽³⁾	DESIGN INVERT ELEVATION (mRL) ⁽¹⁾	DESIGN EXCAVATION DEPTH (m)	DESIGN AREA AT RIM FLOW ELEVATION (m ²) ⁽¹⁾	EFFECTIVE RADIUS AT OVERFLOW ELEVATION (m) ⁽⁴⁾
A	41.74	38.57	37.50	37.00	4.74	8,700	53
B	39.95	38.57	37.40	36.90	2.69	4,200	37
C	39.74	38.57	37.40	37.35	2.39	6,700	46
D	39.74	38.75	37.95	37.48	2.26	5,000	40
E	41.02	38.75	37.90	37.46	3.56	4,350	37
F	40.24	39.20	38.80	38.40	1.84	3,400	33

Notes:

⁽¹⁾ Existing and deepest design levels provided by Maven (Appendix C).

⁽²⁾ 38.57 mRL (P2S, 28/10/2025). 38.75 mRL (P4, 30/07/2025). 39.20 mRL (Level recorded in CMW CPT).

⁽³⁾ As provided by Maven (Drawing: C440 SW Wetland).

⁽⁴⁾ Assuming ponded area is treated as a circle.

For long-term scenarios, the Artificial Wetlands have been modelled with an operational 'pit lake' representing the permanent water level. To assess inflows during the construction phase, the base of the Artificial Wetland has been modelled as dry. Both models used surrounding winter groundwater levels as the starting conditions to identify peak inflow rates. For those wetlands near existing housing or buried infrastructure, an additional scenario has been run using summer groundwater levels as the starting conditions. The drawdowns derived from this summer drawdown assessment are intended to inform ground settlement calculations.

4.3 Results

4.3.1 Drawdown Effects of Artificial Wetlands on Groundwater

The projected drawdown effects have been modelled for each of the Artificial Wetlands, (as detailed in Appendix D) and the results summarised in Table 7. The groundwater inflows (groundwater abstraction during construction) at each of the Artificial Wetlands have been calculated assuming the drawdowns generated by each of the wetlands do not intersect during individual construction. The radius of groundwater drawdown influence and the groundwater inflows are presented separately for construction (dry pit) and for long-term (operational permanent water level) effects in Table 7.

Maps identifying long-term Artificial Wetland effects on groundwater drawdown contours of the operational Artificial Wetlands are provided in Appendix E, with the 'de-minimis' contour being defined as 0.25 m drawdown. Drawdown below that magnitude is considered to be effectively indistinguishable from natural fluctuations. Drawdown assessments were conducted using winter groundwater levels to provide a conservative estimate of inflows. Drawdown contours do not intersect hydraulic boundaries such as the farm drains and streams, with the exception of the drain currently between proposed Artificial Wetland B and C, which WGA understands will be removed. This drain will be filled and existing flows will be diverted via a pipe (Maven Drawing no. C400-1 for plan view and C420-37 for long sections).

In addition, summer groundwater level scenarios were simulated for Artificial Wetlands A and B to demonstrate how seasonality affects drawdown results. These Artificial Wetlands were chosen for the summer scenarios because they are located closest to existing residences. For Artificial Wetland A, drawdown impacts at the nearest building reduce from 1.06 m in winter to 0.45 m in summer. Wetland B shows a similar pattern, with drawdown impacts at the nearest building reducing from 0.91 m in winter to 0.31 m in summer. The accompanying drawdown contour figures (Appendix E) illustrate this difference. The larger drawdown beneath housing in winter includes approximately 0.6 m attributed to the existing seasonal variance in natural groundwater levels. The accompanying Geotechnical Assessment (CMW 2026c) has used these results to undertake ground settlement assessments.

4.3.2 Drawdown Effects of Artificial Wetlands on Surface Water

Artificial Wetlands D and E are expected to temporarily cause stream depletion effects during construction due to their design base levels being lower than the surveyed bed level of the adjacent farm drain (Table 8). Groundwater that would otherwise discharge to the drain will be captured by construction dewatering. To manage this effect, groundwater intercepted during construction dewatering shall be discharged to the receiving drain upstream of the works, as proposed through the Residential Development consent conditions, to maintain surface water flows and mitigate temporary stream depletion effects.

Interception of shallow groundwater contributions to the neighbouring drains/stream baseflow is also anticipated during construction of the remaining Artificial Wetlands; however, to a lesser extent, because the other Artificial Wetlands do not extend deeper than the drains/stream (Table 8). Any intercepted groundwater from these works can likewise be returned to the local drainage network or stream.