

**BEFORE THE HEARINGS COMMISSIONERS FOR THE WAIKATO DISTRICT
COUNCIL**

UNDER	the Resource Management Act 1991
AND	
IN THE MATTER	of hearing submissions and further submissions on the Proposed Waikato District Plan
	<u>Hearing 25 – Zone Extents</u>
PARTIES REPRESENTED	POKENO WEST LIMITED (97)

**STATEMENT OF TRANSPORT EVIDENCE FROM LEO DONALD HILLS FOR
POKENO WEST LIMITED (97)**

FEBRUARY 2021

Counsel Instructed:

Peter Fuller
LLB, MPlan, DipEnvMgt, BHortSc.
Barrister
Quay Chambers
Level 7, 2 Commerce Street
PO Box 106215
Auckland 1143
021 635 682
Email: peter.fuller@quaychambers.co.nz

MAY IT PLEASE THE PANEL

INTRODUCTION

1. My full name is Leo Donald Hills. I am a Director at the firm Commute Transportation Consultants Ltd (Commute).

Qualifications and experience

2. I hold a Master of Civil Engineering (2000) and a Bachelor of Engineering with Honours (1996), both from the University of Auckland.
3. I am a Chartered Professional Engineer (CPEng) and a Chartered Member of Engineering New Zealand (CMEngNZ).
4. I am a director of Commute Transportation Limited (Commute) and have over 23 years' experience as a specialist traffic and transportation engineer. During that time, I have been engaged by local authorities and private companies/individuals to advise on traffic and development issues covering safety, management and planning matters of many kinds.

Involvement in project

5. I am providing Transport evidence in relation to the proposed rezoning sought by Pokeno West Limited¹ of land at 53 Munro Road (and various other properties near the vicinity) located in Pokeno (referred to as “**the site**”).
6. Commute prepared the Integrated Transportation Assessment Report (**ITA**) for this application dated 2nd July 2018. Further, I have provided input into the transport matters queried by Pokeno Village Holdings Limited (PVHL) dated 15th July 2019.
7. I am familiar with the application site and the surrounding locality. I have read the relevant part of the application material; submissions; and the Section 42A Report.

¹ Submitter 97 and further submitter 1261

Scope of Evidence

8. My evidence assesses the transport and traffic effects of the proposed rezoning at the site sought by Pokeno West Limited².
9. My evidence relies on and should be read in conjunction with that of:
 - The Integrated Transportation Assessment (**ITA**) prepared by Commute for the rezoning proposal, dated July 2018 (except in the situation where my evidence specifically outlines any amendments to that outlined in the **ITA**).
 - The response to Pokeno Village Holdings Limited Submission (#386) dated 15th July 2019.
 - The Pokeno Intersection Assessment Report prepared by Beca (**BECA report**), dated 21st December 2016.

Code of Conduct

10. I confirm that I have read the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note (2014) and I agree to comply with it. In that regard, I confirm that this evidence is written within my expertise, except where I state that I am relying on the evidence of another person. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

PROPOSAL AND EXISTING ENVIRONMENT

Proposal

11. The subject properties comprise a total area of some 160 ha and are located west of Helenslee Road and Munro Road respectively and north of Huia Road. The subject site largely consists of farmland with several dwellings scattered throughout the site (approximately 11 dwellings).
12. The site is located approximately 53 km south of Auckland, and 72 km north of Hamilton, therefore is still in a commutable distance from both these cities.

² Submitter 97 and further submitter 1261

13. The site is currently zoned “Rural” under the Operative District Plan (**ODP**), “Residential” in the Proposed District Plan (**PDP**) and is located directly west of the Pokeno Structure Plan boundary line.
14. The rezoning proposal, essentially aligns with the **PDP** zoning, seeking to alter the existing zoning from Rural to Residential Zone. I note that the concept plan indicates 1,377 dwellings within the site and therefore this has been used for the modelling assessment outlined within my evidence. It is however understood that the site has the potential to enable the development of approximately 1300 – 1600 dwellings (to be established in three stages) plus an associated neighbourhood centre. In this regard, the exact number, within this range, is unlikely to affect the rezoning decision and the ability to avoid remedy and mitigate adverse effects with the future road / intersection upgrades. I note that during the preparation of the **ITA**, a total of 1350 dwellings were being considered at the site.
15. A hierarchy of roads will be provided to support the development and will connect to the existing road network via five potential connections.
16. The zoning of **the site** within the **ODP** and **PDP** is shown in Figure 1 and Figure 2 below respectively.

Figure 1: Operative District Plan zoning

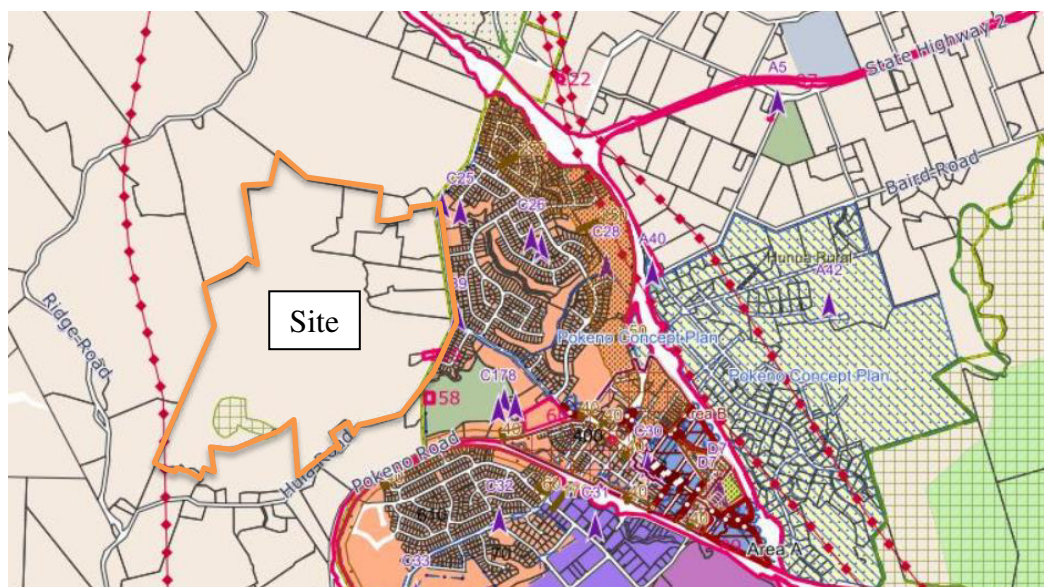
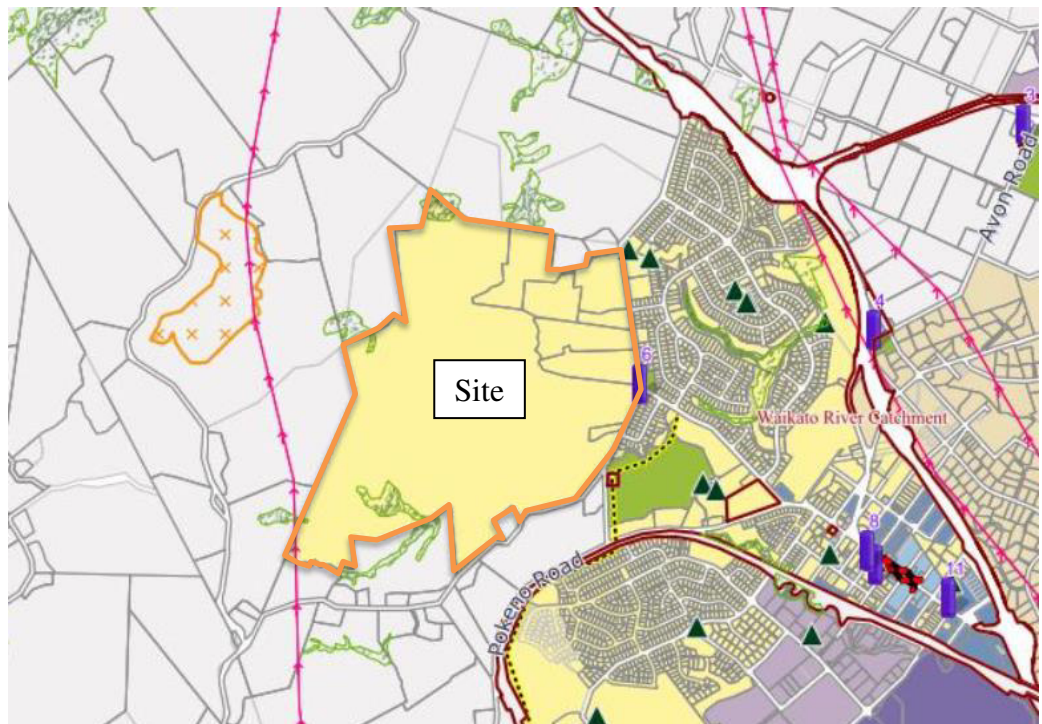


Figure 2: Proposed District Plan zoning

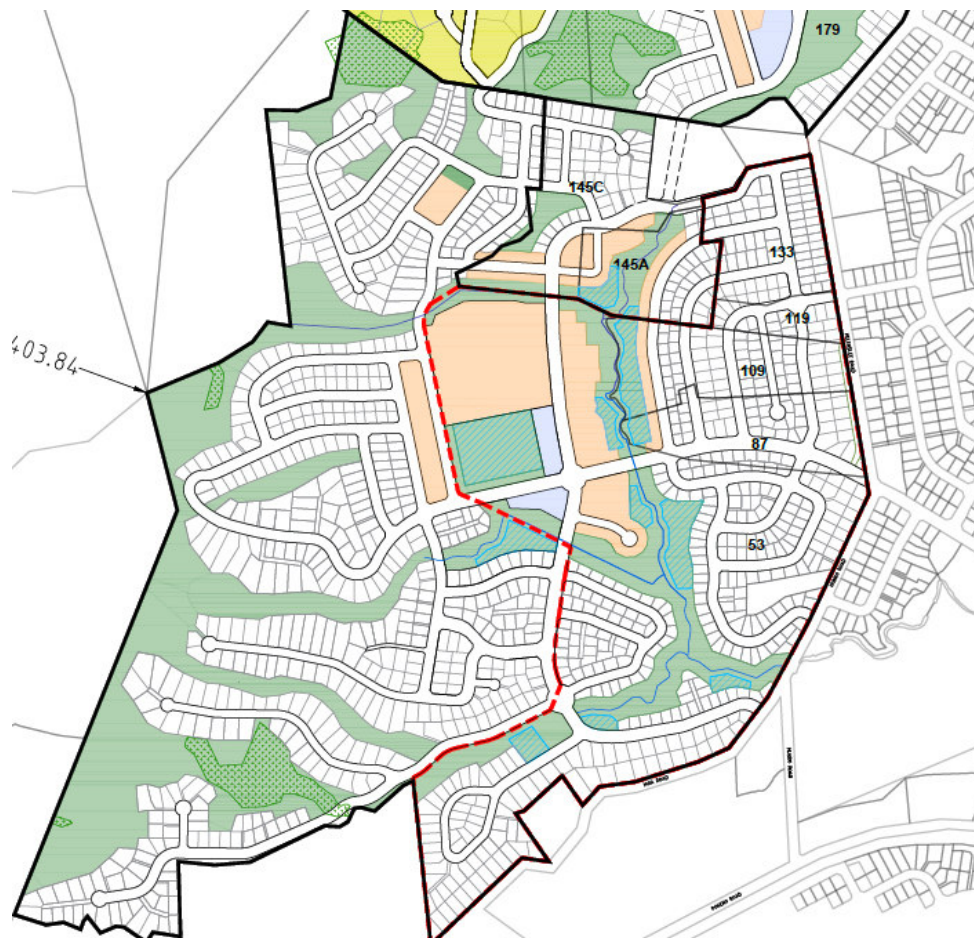


17. As shown in the figures above, the neighbouring site zoning varies in each direction, with the land to the east and southeast of the site zoned as Residential 2 in the **ODP** and Residential in the **PDP**. West, north and southwest of the site, the land is zoned as Rural (similar to the zoning of the site in the **ODP** and unchanged in the **PDP**). I note that a similar application has been made to rezone the land located directly to the north of **the site** at 179, 203 and 205 Helenslee Road from Rural to Residential and Country Living zoning.
18. A concept roading layout of **the site** has been developed and is provided in Figure 3 below including the location of the five potential connections to the existing road network. I note that the layout of the internal road network is subject to further design (to be undertaken as part of subsequent assessments) and therefore at this stage is considered 'indicative' only. I note that Attachment 9 of Mr I Munro's evidence provides a suggested Precinct Plan of the site which outlines the "Essential roads – exact alignment flexible" and the "Indicative intersection and access points". This layout shows four connections onto the existing roading network and generally aligns with the key roads shown in Figure 3 below, with the exception of the connection onto Gateshead Road being excluded, however as noted above, this is indicative.

19. I note that the road network shown in Figure 3 below differs slightly to that considered during the preparation of the **ITA**, including:

- Alignment of the roading connection to the northern site (at 179 & 205 Helenslee Road) and other minor internal road realignments.
- Potential reduction in the number of roundabouts along the main collector route.
- Provision of a park / open space reserve and extent of neighbourhood centre.
- One of the five connections proposed to the existing road network has been shifted slightly to the south (circled in black in Figure 3 below). This previously connected directly to the Thomason Crescent / Munro Road intersection.

Figure 3: Concept roading and lot layout



LOCAL TRANSPORT ENVIRONMENT

Walking and cycling

20. There are currently very limited walking and cycling provisions available near the vicinity of the site.
21. Helenslee Road and Munro Road provide a footpath along the eastern side of the road, largely where residential development has occurred. No footpaths are currently provided on Huia Road, Munro Road (along the western side and south of 42 Munro Road) or Helenslee Road (fronting the site).
22. Further information regarding the pedestrian and cycling facilities are provided in Section 2.4 and 2.5 respectively of the **ITA**.

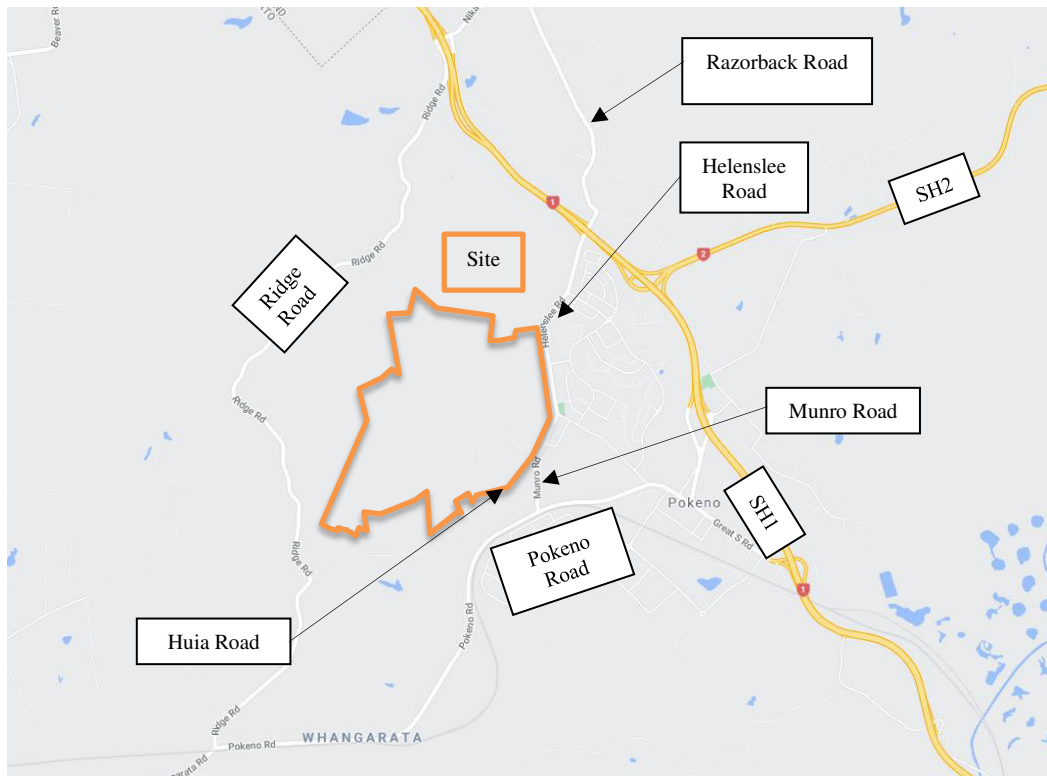
Public transport

23. There are currently very limited public transport services operating near the vicinity of the site. The known existing services cater for regional and sub-regional users rather than localised movement (e.g. within the Pokeno town centre).
24. Further information regarding the bus services available are provided in Section 2.3.2 of the **ITA**.

Road network

25. Figure 4 shows the existing road network near the vicinity of the site.

Figure 4: Existing road network



26. **The Site** currently has frontage onto Helenslee Road and Munro Road to the east and Huia Road to the south. The following sections provide a brief description of each road, largely extracted from the **ITA**.

- Munro Road runs in a general north-south direction connecting to Pokeno Road to the south via a give-way controlled “T” intersection and Helenslee Road to the north. Munro Road provides a single lane in both directions and generally does not provide centreline or edge line markings (south of Huia Road). A one-way bridge is located on Munro Road just north of the intersection with Huia Road. On the 2nd April 2018 the speed limit on Munro Road changed from 100 km/hr to 60 km/hr.
- Helenslee Road runs in a general north-south direction, connecting to the SH1 Razorback interchange (north facing ramps only) to the north and Pokeno Road to the south. Helenslee Road provides a single lane in each direction, separated by a centreline marking, and provides intermittent right turn bays at some intersections to facilitate vehicles turning right into adjacent side roads. Primarily where residential development has occurred, a

pedestrian footpath is provided along the eastern side of the road. On the 2nd April 2018, the speed limit on Munro Road changed from 100 km/hr to 60 km/hr.

- Huia Road is located near the southern boundary of **the site** and allows for two-way movement (no edge line or centreline markings, excluding at the intersection with Munro Road). Huia Road connects to Munro Road to the east and Ridge Road to the west (through what appears to be a driveway). The posted speed limit along Huia Road is 100 km/hr³. I note that Section 2.2.3 of the **ITA** outlines that *“With the new speed limit changes, it is anticipated that Huia Road will have a speed limit of 60 km/hr”*. As I have noted above, the speed limit along Munro Road was reduced from 100 km/hr to 60 km/hr on the 2nd April 2018. In my opinion, Huia Road, adjoining to Munro Road from the east, should also provide a similar speed limit of 60 km/hr should development occur along this corridor.
- Pokeno Road extends in a general east-west direction connecting to Great South Road to the east and Whangarata Road to the west. Pokeno Road extends past the Pokeno School and provides a pedestrian footpath along the southern side of the road (east of the Pokeno School). On the 2nd April 2018, the speed limit along Pokeno Road (between 100 m west of Munro Road to near 62 Pokeno Road reduced from 100 km/hr to 80 km/hr and east of this to 40-60 km/hr (40 km/hr during school times).

Traffic volumes

27. As outlined in Section 2.6 of the **ITA**, daily link volumes have been extracted from the **BECA report** (dated 2016). The Waikato District Council (**WDC**) also provides traffic volumes near the vicinity of the site therefore I have used the most up to date (known) count information available, this includes:

³ Waikato District Council Speed Limit Amendments

Table 1: Traffic volumes extracted from WDC

Road	Location	Date	ADT (vehicles per day)
Helenslee Road	Between Galston Court and Mark Ball Drive	2016	964
	Between Pokeno Road and Hill Park Drive	2019	1,621
Munro Road	Between Thomason Crescent Road and Helenslee Road	2019	1,279
Pokeno Road	Between Great South Road and Ford Street	2016	2,616
	Between Helenslee Road and Bridge (1st abutment)	2017	3,377

28. I note that based on an aerial view of the wider Pokeno area in October 2020⁴, the extent of land located within the PSP area is still developing therefore these traffic volumes are expected to increase to that existing.

⁴ Near maps image dated October 2020

Figure 5: Aerial view of Pokeno



OVERVIEW OF THE POKENO INTERSECTION ASSESSMENT REPORT (BECA REPORT)

29. The **BECA report** provides an assessment of the operation of intersections within Pokeno under the then current and future traffic demands and considers the appropriate future intersection forms for the future years 2022 and 2040. The **BECA report** provides an estimate of the level of traffic volumes predicted at each intersection for the future years 2022 and 2040 and the type of control warranted for various intersections within Pokeno.
30. The **BECA report** was provided to Commute from the **WDC** for the purpose of assisting in assessing the intersection forms required in Pokeno for the future years (2022 & 2040).
31. Throughout the **ITA**, the **BECA report** has largely been used to reference any existing or future traffic volumes estimated near the vicinity of **the site**.
32. I note that an initial review of the **ITA** was undertaken by Arrive (dated 6th September 2018) and was provided as part of the Pokeno Village Holdings Limited submission (dated 9th October 2018). Section 7 of the document

outlined that Arrive had previously undertaken a review of the **BECA report** which summarised the following: *“Our conclusion was that the future traffic volumes used in the Beca report were excessive, and that the recommendations for changes to intersections were based on incorrect data and incomplete assessment”*. If (as that submission suggests), the volumes outlined within the **BECA report** are excessive, the volumes used in the modelling in the **ITA** (and my evidence) are overrepresented for the future years and therefore the intersection forms / upgrades are conservative. As such, it is my opinion that the analysis undertaken in the **ITA** are essentially a worst case.

CHANGES TO THE PROPOSAL SINCE SUBMISSION

33. Since the assessment of the rezoning proposal and preparation of the **ITA** (dated 2nd July 2018), the following changes have been adopted:

- Slight increase in the potential number of dwellings from 1350 to 1377 (indicative). It is however understood that the site has the potential to enable the development of approximately 1300 – 1600 dwellings (to be established in three stages) plus an associated neighbourhood centre.
- Adjustment to the alignment of the potential internal road network. However, as I have noted above, the road network shown within the site is indicative only.
- Of the five potential connections to the existing road network, the proposal initially intended to establish a new connection to the Thomason Crescent / Munro Road ‘T’ intersection (existing) thereby forming a crossroad intersection. As a result, a roundabout control was being considered for this connection. The updated concept plan shows this connection has been shifted slightly south and now forms a new priority controlled ‘T’ intersection on Munro Road. In this regard, through additional assessments, any connections proposed to the existing road network will require compliance with the relevant Waikato District Plan rules including appropriate spacing to nearby intersections, appropriate sight distance etc.

- I note that some double counting was included within the traffic volumes detailed in the **ITA** and therefore a revised assessment has been undertaken of Section 7 - 9 of the **ITA** and is provided in **Attachment A** of my evidence.

34. I note that the original **ITA** does not outline the following items of the proposal, including:

- The potential cross-section for the primary corridor provides a solid median whereas a flush median is indicated within the ITA. In this regard, the effect of this can be considered at resource consent stage to determine whether a flush median is required. However, in my opinion, the adverse effects of providing a solid median can be managed by way of providing gaps within the median to allow for a right turn bay at intersections and / or the provision of roundabouts within the site to allow vehicles to U-turn.
- A shared space was proposed within the neighbourhood centre however based on the updated concept plan, this is no longer being considered and has been replaced by Medium Density Residential Zoning.

ASSESSMENT OF EFFECTS (SAFETY / ACTIVE MODES)

Road safety record

35. I have undertaken an updated assessment of the surrounding area's road safety record using the New Zealand Transport Agency (**NZTA**) Crash Analysis System (**CAS**) database for crashes within the site's vicinity over the five-year period 2015-2019 including all available data for 2020. The study area included all crashes recorded on the following roads:

- a. Helenslee Road
- b. Ridge Road
- c. Munro Road
- d. Huia Road
- e. Pokeno Road (between Ridge Road and Great South Road)

- f. Great South Road (between McDonald Road and the SH1 NBD ramps)
- g. SH1 Razorback Road, Great South Road, Pokeno Road and Nikau Road interchange (ramps only)

36. I note that the study area included within this evidence is significantly wider than that provided within the **ITA** which considers the crash history on Helenslee Road, Munro Road and Huia Road only.

37. In summary, a total of 48 crashes have been identified within the study area. These crashes are summarised in Table 2 below.

Table 2: Summary of crashes (2015-2020)

Location	No. of crashes / predominant crash type	Injuries
Helenslee Road & Helenslee Road / Munro Road intersection	8 crashes 75% loss of control 1 crash at the Munro Road / Helenslee Road intersection (fatigue was listed as a contributing factor)	5 minor injury related
Ridge Road & Nikau Road / Ridge Road intersection	7 crashes on Ridge Road 100% loss of control 1 missed intersection crash at Nikau Road / Ridge Road intersection (drug listed as contributing factor)	1 fatal injury related crash & 3 minor injury related crashes
Pokeno Road	17 crashes 65% loss of control	1 serious injury related crashes (total 3 injuries) 5 minor injury related crashes

Great South Road	4 crashes	1 minor injury related crash
Razorback Road	2 crashes 100% loss of control	1 fatal injury related crash
Great South Road / Pokeno Road SH1 ramps	8 crashes 100% loss of control	4 minor injury related crashes
Summary	48 crashes	2 fatal crashes 1 serious crash 18 minor injury crashes

38. Based on the above, a number of crashes have occurred within the general Pokeno area and are largely related to vehicles losing control (70%). Further, it is identified that a number of crashes have been reported along Pokeno Road (west of the intersection with Munro Road) and at the bend on Helenslee Road (near the northern boundary of the site). As the surrounding area develops, this will urbanise these areas that are currently rural in nature thus both reducing speed limit and improving overall road design.

Public transport

39. Currently Pokeno is not well served by public transport.

40. Section 10.2 of the **ITA** outlines several recommendations for public transport services within Pokeno, including:

- Bus services to the southern elected rail stations in Auckland, operating on the hour between 6:00am – 9am;
- Local public transport services: bus route starting from the Pokeno town centre which passes through **the site**, the Helenslee residential block (located directly east of the site) and concludes

back at the town centre. Of note, some thought should be given to connecting Tuakau and Pokeno via some means of public transport to encourage residents travelling to and from these destinations to utilise the public transport network;

- Lastly, given the recent improvements of connections between Hamilton and Pokeno (the Waikato expressway) the reduced travel time between the two areas is likely to encourage residents to commute to Hamilton. As such, consideration of an express bus route should be given for residents commuting between Pokeno and Hamilton.

41. In addition, I note that a number of projects are being considered within reasonable vicinity of the site, including the Papakura to Bombay Stage 1 improvements; this is expected to include a third lane in each direction between Papakura and just north of Ramarama as well as a shared walking and cycling path and allow for future dedicated public transport services. Stage 3 of this project will involve extending these provisions south to Bombay.

42. The NZ Upgrade Programme will provide funding for three projects that support growth – the extension of the electrified rail network from Papakura to Pukekohe, two new stations at Drury and a third line between Wiri and Quay Park (central Auckland).

43. Both Drury and Pukekohe are within some 15-minute driving distance from Pokeno. In this regard, with a significant portion of residents expected to commute to and from the north there is potential for **the site** as well as the surrounding area to benefit from the upgrades outlined above if the appropriate connector services can be provided. For example, I consider the following provisions should be considered when assessing the potential public transport provisions within Pokeno (in addition to that outlined within the **ITA**):

- Provision of a bus route from Pokeno to Pukekohe and Drury / Manukau respectively that operates at regular frequencies during the peak hours to encourage residents to utilise the Drury / Manukau or Pukekohe train line services. The recommended bus route should pass through the Pokeno town centre, **the site** as

well as the Helenslee residential block (located directly east of the site). Consideration should be given to incorporating the other growth cells located within the area.

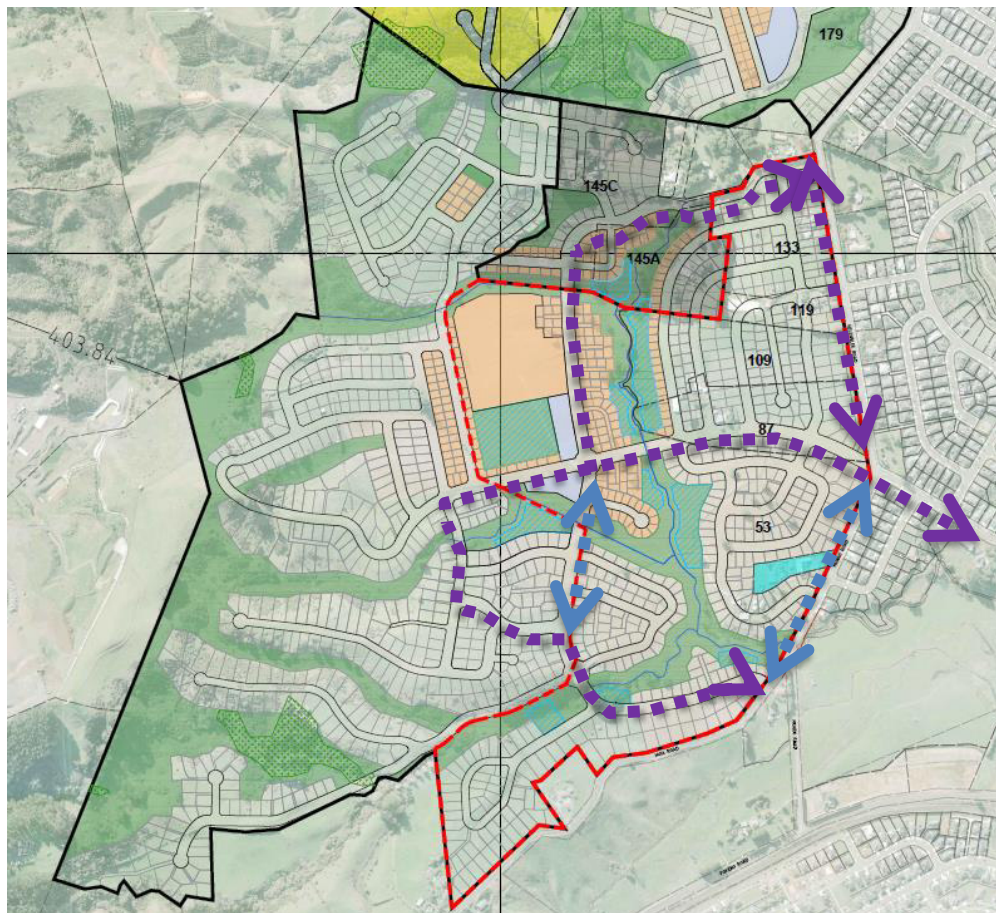
- Appropriate walking and cycling connections should be provided to these public transport facilities (e.g. to bus stops) to encourage active mode share within Pokeno.

44. The above recommendations are indicative and should be considered in conjunction with the community and any future land use developments to ensure the correct commuter areas are being incorporated.

Active modes

45. Section 6 of the **ITA** outlines the cycle provisions proposed within and near the vicinity of **the site** (indicative). Figure 6 indicates the potential shared path considered within the site (in purple). I also consider that cycling provision should be incorporated along the blue lines.

Figure 6: Potential shared path



46. As I have noted above, appropriate walking and cycling connections should be provided to connect the residential developments being considered within Pokeno to the town centre as well potential public transport facilities (e.g. to bus stops) to encourage active mode share within Pokeno.
47. It is noted that the shared off-road (3m) path outlined along the collector road network is likely to be provided along the western side of the corridor (as opposed to the eastern side as outlined within the **ITA**) as the eastern side of Helenslee Road is already fairly developed. Appropriate connections should be provided along this corridor to mitigate cyclists crossing Helenslee Road at potential conflict points.
48. In my opinion, given the level of development being considered within Pokeno, it is important to plan now for a comprehensive walking / cycling and public transport network to ensure that any development that occurs within the area does not preclude active mode facilities being provided.

ASSESSMENT OF TRAFFIC GENERATION EFFECTS

General

49. Section 7 - 9 of the **ITA** outlines an assessment of the potential trip generation at **the site** and includes the distribution of these volumes on the surrounding road network and the potential intersection controls / layout required at the surrounding intersections to cater for the future volumes.
50. For that assessment, traffic volumes were extracted from the **BECA report** to assess the performance of the surrounding intersections for the future years 2022 and 2040 (with the potential development volumes).
51. As noted above, the number of dwellings has changed and further the proposed future traffic volumes outlined within the **ITA** (including the potential development) included some double counting and therefore I have revised Section 7 - 9 of the **ITA** accordingly. This is provided in **Attachment A** of my evidence and supersedes Section 7 – 9 of the **ITA**.

Trip generation

52. The RTA Guide is commonly used by traffic engineering practitioners in Australasia to assess the traffic generating potential of various land uses. In New Zealand, the RTA Guide is frequently used for assessing residential developments. The proposed size of the residential dwellings are considered to be best represented by “dwelling houses” in the RTA Guide. For these types of dwellings, the RTA predicts trip generation rates of 0.85 trips / dwelling in the peak hours.

53. Using the trip generation rates detailed above (0.85 trips / dwelling), results in a total anticipated trip generation of 1,170 vehicles per hour (vph) for the 1,377 dwellings. This is outlined in Table 3 below.

Table 3: Potential trip generation

Activity	Number of dwellings (indicative)	RTA trip rate	Peak hour trip generation
53 Munro Road (the site)	1377	0.85 trips per dwelling during the peak hour	1170
Total	1791 dwellings		1170 trips

Trip distribution

54. All trips associated with the potential 1377 dwellings at **the site** have been added to the existing road network.

55. Section 8.2 of the original **ITA** outlines that the traffic distribution rates from the **BECA report** were calibrated to represent the directional vehicle movement proportions to and from Auckland, Pokeno and Waikato (west) during the AM and PM peak hours respectively. These rates were used in the **PSP** paramics model specifically for the residential area on Helenslee Road and are summarised in Table 6 and Table 7 of the **ITA**.

56. The revised modelling results are provided in **Attachment A** of this evidence and now includes an assessment of the existing SH1 Razorback Road off-ramp (with and without the potential development volumes).

57. In addition, sensitivity testing has been undertaken which considers the following assessment,

- a 2040 scenario (with development) which in comparison to the **ITA**, assumes:
 - i. a higher proportion of volumes travel to and from Auckland (60% vs. some 26-42% in original **ITA**).
 - ii. 20% of movements travel to / from the Pokeno and Waikato (Tuakau) areas respectively; and
 - iii. the distribution of movements at each intersection connecting to the site depends on the location of the intersection in relation to the desired destination.

58. Table 4 outlines the level of traffic expected to travel to and from the wider areas.

Table 4: Directional split of vehicle movements (sensitivity)

Activity	To/from Auckland	Total trips	Directional split of vehicle movements
Auckland	60%	1170 trips	702 trips
Pokeno	20%		234 trips
Waikato / Tuakau	20%		234 trips
		Total	1170 trips

59. The total 1,170 trips have been distributed at each of the five potential connections at **the site**.

60. As part of the original **ITA** assessment, it was assumed that one-third of traffic entering/leaving the site will utilise the Munro Road / Helenslee Road intersection with the remainder of the trips evenly distributed throughout the remaining four intersections to the site (approximately 17% each).

61. The following assumptions have been made in relation to trips to and from the surrounding areas:

- For trips to and from Auckland (60%): vehicles are expected to utilise the Razorback Road interchange to connect to SH1.
- For trips to and from Hamilton and the Pokeno Town Centre (20%): vehicles will likely utilise Munro Road or Helenslee Road to connect to Pokeno Road.
- For trips to and from Tuakau (20%): vehicles will utilise Munro Road to connect to Pokeno Road.
- Typical residential inbound / outbound splits of 20% / 80% in the morning peak hour 80% / 20% in the evening peak hour are assumed.
- The Razorback Road (off-ramp) intersection has been assessed using the volumes predicted to the north of the site for the future year 2040.

179 & 205 Helenslee Road rezoning request

62. I note that a submission has been made to rezone the area of land located directly to the north of **the site** (Submission #89) from Rural zoning to Residential and Country Living zoning to allow for the development of some 413 lots (indicative).

63. Given that this information is known and the travel patterns of that site are likely similar to that of the subject site, I have included the potential volumes generated by both sites (i.e. at 53 Munro Road and 179, 203 & 205 Helenslee Road).

64. The level of vehicle movements generated by the adjacent site has been distributed in a similar manner to that outlined above, with the exception of:

- For trips to and from Auckland (60%): the adjacent site development has the potential to provide connections onto Ridge Road as well as Helenslee Road, therefore vehicle movements associated with any development within that site (to / from

Auckland) are assumed to be split between the Nikau Road interchange and Razorback Road interchange respectively to connect to SH1.

- Traffic volumes associated with the neighbouring site are included as through volumes only i.e., no volumes are considered to turn to and from the subject site.

65. Using the trip distribution assumptions detailed above, the following provides an assessment of the following key intersections and identifies the typical (indicative) layout required to cater for these volumes.

66. The following intersections located south of the site (connecting to Pokeno / Tuakau and further southern suburbs) have been included:

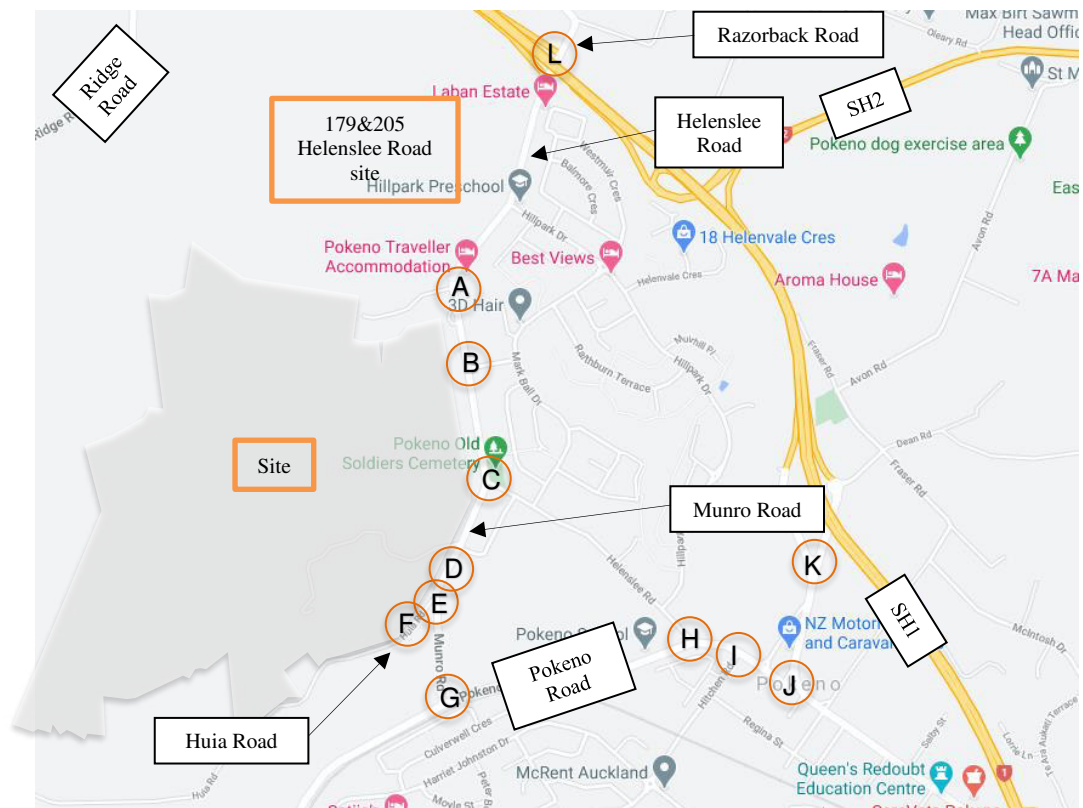
- Helenslee Road / Munro Road (give-way control)
- Pokeno Road / Helenslee Road (give-way control)
- Munro Road / Pokeno Road (give-way control)
- Hitchen Road / Pokeno Road (give-way control)
- Great South Road / Pokeno Road (give-way control)
- Great South Road / SH1 Northbound on-ramp

67. The following intersections located north of the site (connecting to Auckland and further northern suburbs) have been included:

- SH1 Southbound Razorback off-ramp / Razorback Road (stop control)

68. Figure 7 outlines the location of the existing and potential intersections in relation to the site.

Figure 7: Location of key intersections near the vicinity of the site



Intersection modelling

69. The traffic effects of the sites trip generation have been assessed using the traffic modelling software SIDRA. The results presented in **Attachment A and B** include the Degree of Saturation, which is a measure of available capacity and the Level of Service (LOS), which is a generalised function of delay. LOS A and B are very good and indicative of free-flow conditions; C is good; D is acceptable; and E and F are indicative of congestion and unstable conditions.
70. For signal-controlled intersections, a Degree of Saturation less than 0.9 is considered acceptable. For priority (sign) controlled intersections, a degree of saturation of less than 0.8 is considered to be acceptable. Of note, a degree of saturation of 0.85 is the typical threshold of a roundabout.
71. It is important to note that this evidence only assesses the traffic effects at the key local intersections, considered relevant to the proposal and any intersection layouts outlined in this report are indicative only and subject to change of demand.

72. The SIDRA results of the sensitivity analysis are detailed in **Attachment B**.

Table 5 summarises the expected performance of the existing intersections for the future year 2040 (including development), this includes:

- Degree of saturation of intersection during the peak hours;
- Level of service (LOS) range for all approaches
- Worst performing approach / lane (based on the 95%ile back of queue length).

73. It is noted that the upgraded layouts considered as part of the original **ITA** have generally been used for the purpose of these assessments (except in the case where the number of approaches at the intersection has changed e.g. intersection D). Table 6 summaries the SIDRA results.

Table 5: Summary of SIDRA results - sensitivity analysis (2040 with upgrades)

Intersection (2040)			Intersection degree of saturation (DoS)	LOS range for all approaches	Worst performing approach / lane (based on 95%ile back of queue length)
A	Site access / Helenslee Road (give-way)	AM	0.370	A-B	Western approach (Site) Queue length=7.3m DoS=0.258 LOS A
		PM	0.537	A-B	Northern approach (Helenslee Rd) Queue length=24.9m DoS=0.537 LOS A/B
B	Site access / Helenslee Road / Gateshead Road (roundabout)	AM	0.486	A-B	Northern approach (Helenslee Rd) Queue length=31.9m DoS=0.452 LOS A
		PM	0.613	A-B	Northern approach (Helenslee Rd) Queue length=52.8m DoS=0.613 LOS A
C	Site access / Helenslee Road / Munro Road (signals)	AM	0.583	C-E	Northern (LT) approach (Helenslee Rd) Queue length=127.5m DoS=0.583 LOS C
		PM	0.580	D-E	Northern (TH) approach (Helenslee Rd) Queue length=108.6m

					DoS=0.565 LOS D
D	Site access / Munro Road (give-way)	AM	0.131	A	Western approach (Site) Queue length=3.0m DoS=0.118 LOS A
		PM	0.194	A	Northern approach (Munro Road) Queue length=5.1m DoS=0.194 LOS A
E	Munro Road / Huia Road (give-way)	AM	0.167	A	Western approach (Huia Road) Queue length=2.8m DoS=0.115 LOS A
		PM	0.211	A	Northern approach (Munro Road) Queue length=4.8m DoS=0.164 LOS A
F	Huia Road / Site access (give-way)	AM	0.109	A	Northern approach (Site) Queue length=3.4m DoS=0.109 LOS A
		PM	0.102	A	Eastern approach (Huia Road) Queue length=3.7m DoS=0.102 LOS A
G	Munro Road / Pokeno Road Existing (give-way control)	AM	0.347	A	Northern approach (Munro Road) Queue length=9.9m DoS=0.347 LOS A
		PM	0.440	A-B	Eastern approach (Pokeno Road) Queue length=19.7m DoS=0.440 LOS A/B
	Munro Road / Pokeno Road (roundabout)	AM	0.454	A-B	Eastern approach (Pokeno Road) Queue length=27.4m DoS=0.454 LOS A/B
		PM	0.559	A-B	Western approach (Pokeno Road) Queue length=44.3m DoS=0.559 LOS A
H	Helenslee Road / Pokeno Road (signals)	AM	0.533	A-D	Northern approach (Helenslee Road) Queue length=111.1m DoS=0.533 LOS B-D
		PM	0.903	A-E	Western approach (Pokeno Road) Queue length=109.3m DoS=0.903

					LOS E
I	Hitchen Road / Pokeno Road (signals)	AM	0.611	A-D	Eastern approach RT (Pokeno Road) Queue length=85.8m DoS=0.611 LOS B-C
		PM	0.889	A-E	Southern approach RT (Hitchen Road) Queue length=92.6 m DoS=0.889 LOS E
J	Pokeno Road / Great South Road (signals)	AM	0.607	A-D	Northern approach LT (Great South Road) Queue length=121.7m DoS=0.543 LOS C
		PM	0.805	A-D	Eastern approach RT (Pokeno Road) Queue length=186.8m DoS=0.772 LOS C
K	SH1 Great South Road (on-ramp) (roundabout)	AM	0.499	A-B	Northern approach (Great South Road) Queue length=33.3 m DoS=0.454 LOS A
		PM	0.793	A-B	Southern approach LT (Great South Road) Queue length=81.4m DoS=0.793 LOS A
L	Razorback Road interchange (SH1-off ramp only) (stop-control) (Existing volumes)	AM	0.062	A	Northern approach (SH1-off ramp) Queue length=1.2m DoS=0.062 LOS A
		PM	0.199	A	Northern approach (SH1-off ramp) Queue length=4.4m DoS=0.199 LOS A
	Razorback Road interchange (SH1-off ramp only) (stop-control) (Future volumes)	AM	0.344	A	Northern approach (SH1-off ramp) Queue length=8.8m DoS=0.344 LOS A
		PM	0.601	A	Northern approach (SH1-off ramp) Queue length=26.9m DoS=0.601 LOS A

Modelling Summary

74. Based on the above, the following is concluded:

- Widening / upgrades are likely required at the following intersections to accommodate additional lanes and cater for future traffic volumes, this includes:
 - i. Site access / Helenslee Road / Munro Road intersection (required as part of site access)
 - ii. Pokeno Road / Helenslee Road intersection
 - iii. Pokeno Road / Hitchen Road intersection
 - iv. Great South Road / Pokeno Road intersection
 - v. SH1 on-ramp / Great South Road intersection
- Right turn bays are likely required at several intersections (subject to demand for right turn movement);
- A number of signalised intersections are required along Pokeno Road. In this regard, the phasing time with nearby intersections should be synced to improve the performance of these intersections and reduce delays and congestion.

75. It is important to note that my evidence only assesses the traffic effects at the key local intersections, considered relevant to the rezoning proposal. The traffic generated by this rezoning proposal has been taken into account. However, I understand that there are several other submissions seeking rezoning within Pokeno (including residential). It is difficult to ascertain the number or size of these submissions, the traffic expected to be generated, the traffic patterns and therefore the traffic effects to the wider surrounding road network.

76. In this regard I consider that, at this point in time, Council's 42A Framework report provides the best basis for determining the appropriate future environment. In the report the Council appears to be supporting rezoning of the various growth cells for Pokeno identified in Waikato 2070 and listed in Appendix 8 to the section 42A report.

77. My assessments have shown that there are likely upgrades required for intersections / roads in the wider Pokeno area to serve cumulative development. In my opinion these upgrades (other than ones directly related to gain access to individual sites) should be constructed by the Council as part of its management of the network with any contribution from Pokeno West Limited being paid through the development charges or targeted rates. I consider this to be consistent with the fact that upgrades are the result of cumulative effects from multiple sites (and so hard to attribute to any one rezoning).

78. Significantly, from my analysis, while there are intersection upgrades required relating to this (and other zone requests), there are engineering solutions that could be found in the future (ie intersection upgrades) to enable the rezoning to occur.

COUNCIL 42A REPORT

79. The section 42A framework report has very little discussion about roading and transport however there is discussion of Waikato 2070 (from paragraphs 123 onwards) and the servicing required for the Growth Nodes. The report describes how Council (including its roading team) is currently preparing Asset Management Plans to inform the 30-year Infrastructure Plan and the Long-Term Plan (LTP) and is considering the growth capacity and timing of growth cells to determine servicing and costs. The LTP process will determine the exact timing of projects and the developments contributions that are levied to pay for them.

80. This aligns with my comments above where I consider there are upgrades required to the wider network, however these upgrades should be constructed by the Council as part of its management and upgrade of the transport network with any contribution from Pokeno West Limited (and other areas) being paid through the development charges or targeted rates.

CONCLUSION

81. Based on the modelling and assessment outlined in the ITA and my evidence, I consider that the full extent of development enabled by plan change can be appropriately supported by the existing and upgraded road network (as I have

detailed above), to maintain appropriate levels of safety and efficiency on the surrounding road network.

82. While there are intersection upgrades required relating to this (and other zone requests), there are engineering solutions that could be found in the future to enable the rezoning to occur.

83. Accordingly, I conclude that there is no traffic engineering or transportation planning reason to preclude acceptance of the proposed rezoning.

Leo Hills
Commute

17 February 2021

ATTACHMENT A – REVISED SIDRA ANALYSIS

53 MUNRO ROAD REVISED MODELLING NOTE

The following provides a revised assessment of Section 7-9 of an Integrated Transport Assessment (ITA) prepared by Commute (dated 2nd July 2018) for a proposed plan change (PPC) at 53 Munro Road (referred to as the **original ITA**). This report supersedes both sections of the original ITA.

1 TRIP GENERATION

1.1 GUIDELINES

The RTA Guide¹ provides traffic generation rates that are considered to be appropriately applied to the potential residential facility at 53 Munro Road in Pokeno.

The potential residential units were assessed and is most similar to in concept / location of a 'dwelling house'. As such, the RTA Guide predicts a peak hour trip rate of 0.85 trips / dwelling and daily trip rate of 9 trips / dwelling.

1.2 PROPOSED LEVEL OF TRIP GENERATION

1.2.1 RESIDENTIAL COMPONENT

The likely trip generation for the site is defined as follows:

Table 1: Expected trip generation

Activity	RTA Rate	Number / GFA	Peak Hour Vehicle Trips	Daily vehicle Trips
Dwelling House	<i>'0.85 trips / dwelling for peak hour & 9.0 trips / dwelling for daily trips'</i>	1377 x lots	1,171	12,393

As shown above, the proposed development is likely to generate in the order of 1,171 trips during the peak hour and 12,393 trips daily.

1.2.2 NEIGHBOURHOOD CENTRE

The neighbourhood centre proposed as part of the potential development will be located within the centre of the residential development. As such, it is considered that these shops will typically cater for

¹ The Roads and Traffic Authority of New South Wales – Guide to Traffic Generating Developments (RTA)

the surrounding residential dwellings and is not likely to generate additional vehicle movements external to the site and therefore has not been assessed within the following sections.

1.3 POKENO INTERSECTION ASSESSMENT VOLUMES

The PSP paramics model volumes were used to inform the PSP and have been accepted by the Waikato District Council. Section 3.1 of the Pokeno Intersection Assessment report² outlines that the *“intersection traffic volumes were extracted from the 2022 Paramics model, with some redistribution to accommodate the following differences between the current assumptions and those in the model:*

- *Ford Street was not closed in the model*
- *The NIMT crossing was modelled as High Street, not Mclean Street*
- *Hill Park Drive was modelled as connecting directly to Pokeno Road, whereas it has been built intersecting with Helenslee Road.”*

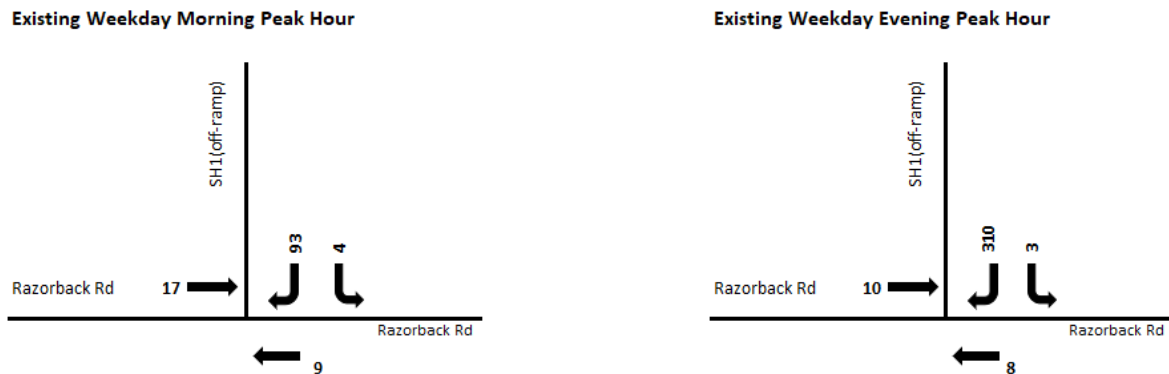
The Pokeno Intersection Assessment report also identified two new developments comprising a total of 430 dwellings which are expected to be completed in parallel with the PSP. Both developments are expected to be fully completed by 2040. In this regard, it is understood that the future year 2040 traffic demands have been estimated by combining the 2022 PSP Paramics model with traffic demands from two new developments (totalling 430 additional residential dwellings), as well as background traffic growth. The 2022 scenario traffic volumes outlined in the Beca report has been estimated by taking half of the full development traffic volumes. For the purpose of this assessment, the 2040 traffic volumes have been used as the base scenario (without development scenario).

1.4 SURVEYED VOLUMES

The Pokeno Intersection Assessment report does not provide any traffic volume data for the SH1 Razorback Road interchange. As such, traffic surveys have been undertaken at the Razorback Road SH1 (off-ramp) / Razorback Road intersection during the morning and afternoon commuter peak hours to understand the existing level of volumes at this intersection (as shown in Figure 1 below).

² Pokeno Intersection Assessment report (2016) prepared by BECA

Figure 1: Razorback Road (off-ramp) / Razorback Road interchange 2020 survey results



2 NETWORK ANALYSIS

The Pokeno Intersection Assessment report provides indicative intersection forms for the year 2022 and 2040 for existing intersections within Pokeno. That assessment has been undertaken using the existing surveyed volumes and the volumes estimated for the future year 2022 and 2040 respectively and is shown in Figure 2 below.

Figure 2: Traffic volumes extracted from the Beca report for the year 2022 and 2040

Table 6: Modelled Daily Traffic Flows

Modelled Approach VPD	Approach					Warrant
2016	N	E	S	W	Total	
Pokeno Road / Munro Road	400	1,100	-	1,600	3,100	Give-way
Pokeno Road / Helenslee Road	600	1,400	-	1,300	3,300	Give-way
Pokeno Road / McLean Street	-	-	-	-	0	Give-way
Pokeno Road / Great South Road	1,100	-	1,900	1,200	4,200	Give-way
Great South Road / SH1 NB On-Ramp	1,700	-	1,400	5	3,100	Give-way
½ Development, 2022	N	E	S	W	Total	
Pokeno Road / Munro Road	800	2,900	-	3,500	7,200	Give-way / Roundabout
Pokeno Road / Helenslee Road	1800	4,100	-	2,900	8,800	Signals/Roundabout
Pokeno Road / McLean Street	-	4,900	2,700	3,500	11,100	Signals/Roundabout
Pokeno Road / Great South Road	5,700	-	5,100	5,300	16,100	Signals/Roundabout
Great South Road / SH1 NB On-Ramp	3,700	100	6,000	0	9,800	Signals/Roundabout
Full Development, 2040	N	E	S	W	Total	
Pokeno Road / Munro Road	1,100	4,800	-	5,300	11,200	Give-way / Roundabout
Pokeno Road / Helenslee Road	3,000	6,700	-	4,600	14,300	Signals/Roundabout
Pokeno Road / McLean Street	-	9,900	5,400	7,100	22,400	Signals/Roundabout
Pokeno Road / Great South Road	10,400	-	8,400	9,400	28,200	Signals/Roundabout
Great South Road / SH1 NB On-Ramp	5,600	200	11,100	0	16,900	Signals/Roundabout

As shown above, all the intersections (potentially excluding the Pokeno Road / Munro Road intersection) will require some form of mitigation by the year 2022. Of note, no detailed designs / layouts of these intersections are available.

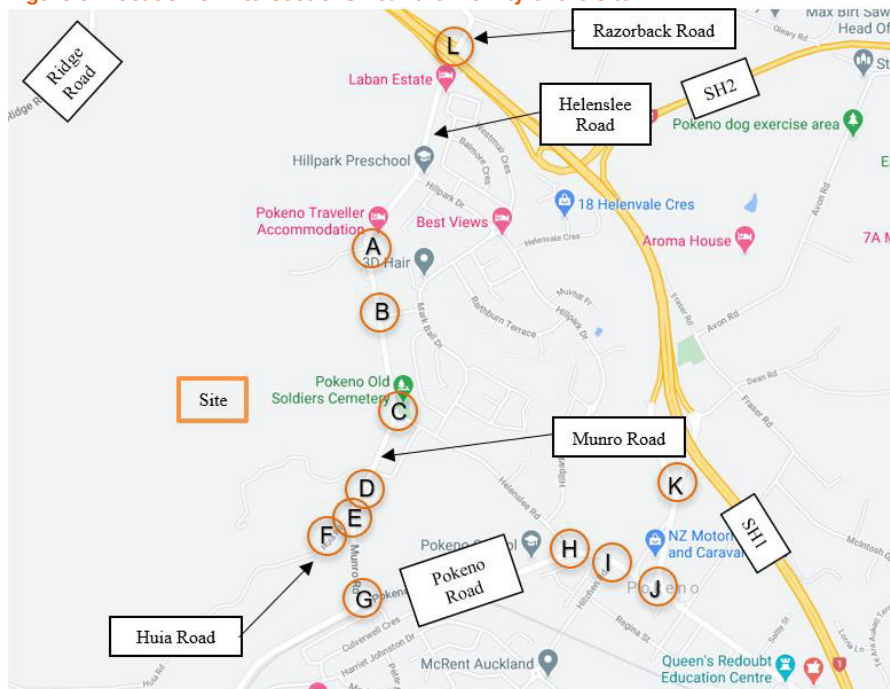
As such the following sections assess the intersection layouts required to cater for the future development volumes (planned and proposed) for the year 2040. It is noted that the recommended intersection layouts outlined in this report are indicative only and subject to change of demand.

In this regard, an assessment on the surrounding road network has been undertaken using SIDRA analysis to determine the intersection performance as a result of the predicted traffic volumes for the years 2040. In addition to the five new (indicative) intersections considered as part of the **PPC** (Intersections A-D & F), the following intersections located near the vicinity of the site have also been assessed, including:

- (E) Munro Road / Huia Road intersection (give-way control)
- (G) Munro Road / Pokeno Road (give-way control)
- (H) Pokeno Road / Helenslee Road (give-way control)
- (I) Hitchen Road / Pokeno Road (give-way control)
- (J) Great South Road / Pokeno Road (give-way control)
- (K) Great South Road / SH1 Northbound on-ramp
- (L) SH1 Razorback Road off-ramp / Razorback Road (stop control)

Figure 3 sets out the location of each intersection in relation to the surrounding environment.

Figure 3: Location of intersections near the vicinity of the site



2.1 TRIP DISTRIBUTION / MODEL GENERATION

2.1.1 PROPOSED DEVELOPMENT DISTRIBUTION ASSUMPTIONS

All trips associated with the 1,377 dwellings have been added to the existing road network.

The RTA Guide suggests that 80% of the trips by a residential development during the morning peak hour are exit movements and 20% are entry movements with the reverse occurring during the afternoon peak hour. Therefore, a total of 936 egress movements and 234 ingress movements are expected during the morning peak hour respectively with the reverse occurring during the afternoon peak hour.

Vehicle movements to and from the site (during the morning and afternoon peak hour) via the five proposed intersections, are assumed to be distributed as shown in Table 2 below.

Table 2: Distribution of vehicle movements at internal intersections

Activity	Distribution of vehicle movements
Intersection A	17%
Intersection B	17%
Intersection C	33%
Intersection D	17%
Intersection F	17%

Traffic distribution rates from the Pokeno Intersection Assessment report were calibrated to represent the directional vehicle movement proportions to and from Auckland, Pokeno and Waikato (west) during the morning and afternoon peak hours respectively. It is understood that these rates were used in the PSP paramics model, specifically for the residential area on Helenslee Road, and are summarised in Table 3 and Table 4 below.

Table 3: Morning peak hour distribution

Activity	Auckland	Pokeno	Waikato (west)	Total
In from	26%	47%	26%	100%
Out to	36%	52%	12%	100%

Table 4: Afternoon peak hour distribution

Activity	Auckland	Pokeno	Waikato (west)	Total
In from	42%	41%	17%	100%
Out to	34%	39%	27%	100%

As can be seen above, during the morning peak hour the majority of commuters are expected to travel to Pokeno and Auckland with a small proportion of residents expected to commute to the wider Waikato (west) region.

The direction of the vehicle movements and the route that commuters were likely to take was determined according to their destinations (Auckland, Pokeno and Waikato-west). When distributing traffic at each of the proposed intersections, the following assumptions were made:

- For trips to and from Auckland
 - Vehicles are expected to use the northern SH1 off-ramp when entering the site therefore will approach the site from the north;
 - similarly, vehicles exiting to Auckland will utilise the northern on-ramp and therefore will travel north on Helenslee Road.
- For trips to and from Hamilton and the Pokeno town centre;
 - All vehicles leaving the site will head south along Helenslee road or Munro Road towards the town centre or SH1 southbound on-ramp (vice versa for vehicles movements into the site);
- For trips to and from Waikato (west):
 - All vehicles leaving the site will head south along Munro Road towards Pokeno Road with the reverse occurring for vehicles entering the site from the west.

In summary, the trips generated by the potential residential development at the site comprising of some 1,377 dwellings can be distributed accordingly to the inbound / outbound percentage (80% / 20% split) to estimate the number of vehicles travelling into and out of the site for each morning and afternoon peak hours. The directional proportions outlined within the Pokeno Intersection Assessment report (shown in All trips associated with the 1,377 dwellings have been added to the existing road network.

The RTA Guide suggests that 80% of the trips by a residential development during the morning peak hour are exit movements and 20% are entry movements with the reverse occurring during the afternoon peak hour. Therefore, a total of 936 egress movements and 234 ingress movements are expected during the morning peak hour respectively with the reverse occurring during the afternoon peak hour.

Vehicle movements to and from the site (during the morning and afternoon peak hour) via the five proposed intersections, are assumed to be distributed as shown in Table 2 below.

Table 2: Distribution of vehicle movements at internal intersections

Activity	Distribution of vehicle movements
Intersection A	17%
Intersection B	17%

Intersection C	33%
Intersection D	17%
Intersection F	17%

Traffic distribution rates from the Pokeno Intersection Assessment report were calibrated to represent the directional vehicle movement proportions to and from Auckland, Pokeno and Waikato (west) during the morning and afternoon peak hours respectively. It is understood that these rates were used in the PSP paramics model, specifically for the residential area on Helenslee Road, and are summarised in Table 3 and Table 4 below. (Table 4 above) can then be used to determine the number of trips expected to travel to and from Auckland, Pokeno and Waikato (west) during the morning and afternoon peak hours which are shown in Table 5 and Table 6 below.

Table 5: Morning peak hour distribution

Activity	Auckland	Pokeno	Waikato (west)	Total
In from	62	110	62	234
Out to	340	482	114	936

Table 6: Afternoon peak hour distribution

Activity	Auckland	Pokeno	Waikato (west)	Total
In from	397	381	159	936
Out to	80	91	63	234

As shown above, the morning peak hour vehicle movement consists of a total of 234 inbound movements and 936 outbound movements with the reverse occurring during the afternoon peak hour.

3 ASSESSMENT OF EFFECTS

3.1 ASSESSMENT METHODOLOGY

The traffic effects of the potential development have been assessed using the traffic modelling software SIDRA Intersection. The results presented in this report include the Degree of Saturation, which is a measure of available capacity and the Level of Service ("LOS"), which is a generalised function of delay. For signal-controlled intersections, a Degree of Saturation less than 0.9 is considered acceptable. LOS A and B are very good and indicative of free-flow conditions; C is good; D is acceptable; and E and F are indicative of congestion and unstable conditions.

As noted, this assessment assesses the intersection layout required to cater for the impact of the potential residential development on the surrounding road network and if the additional

volumes trigger a change to the intersection form than that recommended in the Pokeno Intersection Assessment report. As noted, the recommended intersection layouts outlined in this report are indicative only and subject to change of demand.

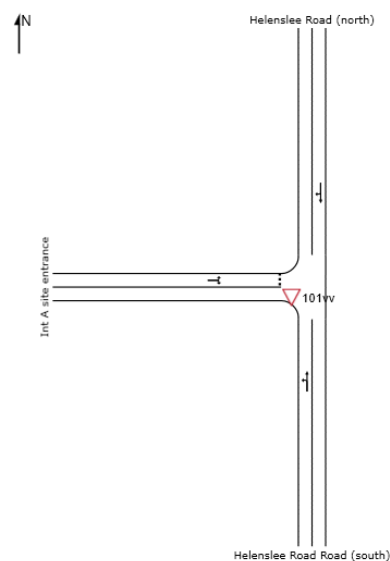
Of note, for the purpose of this assessment, the traffic volumes have been assessed for the future year 2040 for which the full development (comprising 1377 dwellings) have been included (potential scenario).

3.2 INTERSECTION A – SITE ENTRANCE / HELENSLEE ROAD (PROPOSED)

This is a new intersection that will be established as part of the potential residential subdivision and as such no layout is outlined in the Pokeno Intersection Assessment report.

This intersection has been assessed as a give-way control intersection with priority afforded to traffic along Helenslee Road. The layout of the intersection is set out in Figure 4 below.

Figure 4: Intersection A - Potential layout (indicative)



The expected performance of Intersection A during the morning and afternoon peak hour for the future year 2040 is shown in Figure 5 and Figure 6 respectively.

Figure 5: Intersection A Movement summary 2040 AM

MOVEMENT SUMMARY

▽ Site: 101vv [Revised test Int A 2040 AM]

New Site
Giveaway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Helenslee Road Road (south)											
1	L2	31	5.0	0.296	5.6	LOS A	0.0	0.0	0.00	0.03	57.8
2	T1	526	5.0	0.296	0.0	LOS A	0.0	0.0	0.00	0.03	59.6
Approach		557	5.0	0.296	0.3	NA	0.0	0.0	0.00	0.03	59.5
North: Helenslee Road (north)											
8	T1	447	5.0	0.248	0.1	LOS A	0.2	1.1	0.04	0.01	59.7
9	R2	11	5.0	0.248	8.9	LOS A	0.2	1.1	0.04	0.01	57.2
Approach		458	5.0	0.248	0.3	NA	0.2	1.1	0.04	0.01	59.6
West: Int A site entrance											
10	L2	60	5.0	0.157	8.1	LOS A	0.5	3.7	0.47	0.77	51.9
12	R2	104	5.0	0.157	7.2	LOS A	0.5	3.7	0.47	0.77	51.4
Approach		164	5.0	0.157	7.5	LOS A	0.5	3.7	0.47	0.77	51.6
All Vehicles		1179	5.0	0.296	1.3	NA	0.5	3.7	0.08	0.13	58.3

Figure 6: Intersection A Movement summary 2040 PM

MOVEMENT SUMMARY

▽ Site: 101vv [Revised test Int A 2040 PM]

New Site
Giveaway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Helenslee Road Road (south)											
1	L2	95	5.0	0.230	5.6	LOS A	0.0	0.0	0.00	0.13	57.0
2	T1	334	5.0	0.230	0.0	LOS A	0.0	0.0	0.00	0.13	58.8
Approach		428	5.0	0.230	1.3	NA	0.0	0.0	0.00	0.13	58.4
North: Helenslee Road (north)											
8	T1	632	5.0	0.398	0.6	LOS A	1.1	8.3	0.17	0.07	58.7
9	R2	69	5.0	0.398	8.5	LOS A	1.1	8.3	0.17	0.07	56.3
Approach		701	5.0	0.398	1.4	NA	1.1	8.3	0.17	0.07	58.4
West: Int A site entrance											
10	L2	14	5.0	0.038	6.8	LOS A	0.1	0.8	0.38	0.69	52.2
12	R2	27	5.0	0.038	7.2	LOS A	0.1	0.8	0.38	0.69	51.7
Approach		41	5.0	0.038	7.1	LOS A	0.1	0.8	0.38	0.69	51.9
All Vehicles		1171	5.0	0.398	1.5	NA	1.1	8.3	0.11	0.11	58.2

As shown above, all movements operate at a LOS A during the morning and afternoon peak hour respectively. The maximum average delay is 8.9 seconds during the morning peak hour and 8.5 seconds (afternoon peak) and occurs at the northern approach (right turn movement). The maximum 95%ile back of queue length is 8.3 m (1-2 vehicles) and occurs during the afternoon peak

hour on the northern approach. Based on the potential traffic volumes predicted at this intersection, the proposed layout is considered adequate to cater for the predicted traffic volumes in 2040.

It is noted that the level of right turn movements predicted at this intersection potentially warrants a right turn bay on Helenslee Road. In this regard, this will need to be considered during the design stage of the intersection as part of subsequent stages.

3.3 INTERSECTION B – SITE ENTRANCE / HELENSLEE ROAD / GATESHEAD CRESCENT (PROPOSED)

The existing Helenslee Road / Gateshead Crescent intersection is give-way controlled. As a result of the proposal, the proposed road connecting to this intersection (from the site) will form a cross-road intersection. As such, the proposal intends to establish a roundabout control to mitigate any safety concerns of a crossroad intersection. Figure 7 shows the typical layout for a single lane roundabout.

Figure 7: Intersection B layout (indicative)

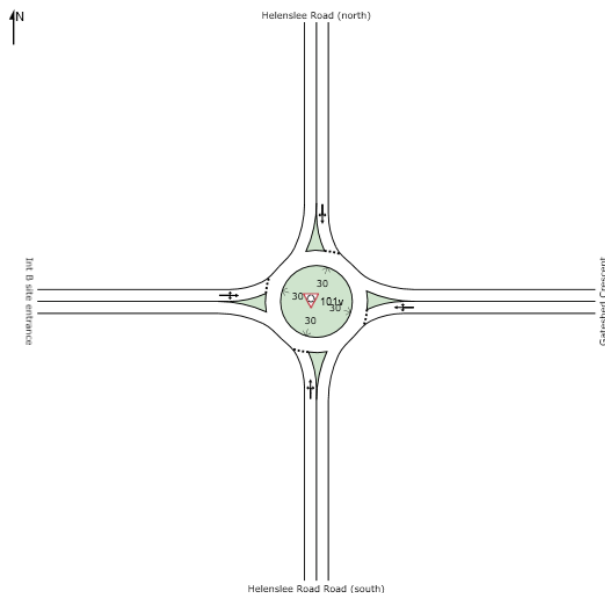


Figure 8 and Figure 9 show the expected performance of Intersection B for the morning and afternoon peak hours respectively.

Figure 8: Intersection B Movement summary 2040 AM

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Helenslee Road Road (south)											
1	L2	31	5.0	0.397	3.9	LOS A	3.5	25.9	0.35	0.40	54.7
2	T1	497	5.0	0.397	3.7	LOS A	3.5	25.9	0.35	0.40	56.3
3	R2	31	5.0	0.397	9.6	LOS A	3.5	25.9	0.35	0.40	56.5
Approach		558	5.0	0.397	4.0	LOS A	3.5	25.9	0.35	0.40	56.2
East: Galeshed Crescent											
4	L2	104	5.0	0.227	8.3	LOS A	1.5	11.1	0.78	0.79	51.0
5	T1	1	5.0	0.227	8.1	LOS A	1.5	11.1	0.78	0.79	52.5
6	R2	60	5.0	0.227	14.0	LOS B	1.5	11.1	0.78	0.79	52.6
Approach		165	5.0	0.227	10.4	LOS B	1.5	11.1	0.78	0.79	51.6
North: Helenslee Road (north)											
7	L2	11	5.0	0.442	4.5	LOS A	3.9	28.2	0.50	0.46	54.1
8	T1	541	5.0	0.442	4.3	LOS A	3.9	28.2	0.50	0.46	55.7
9	R2	11	5.0	0.442	10.2	LOS B	3.9	28.2	0.50	0.46	55.9
Approach		562	5.0	0.442	4.4	LOS A	3.9	28.2	0.50	0.46	55.7
West: Int B site entrance											
10	L2	60	5.0	0.208	7.6	LOS A	1.3	9.8	0.73	0.77	50.6
11	T1	1	5.0	0.208	7.4	LOS A	1.3	9.8	0.73	0.77	52.0
12	R2	104	5.0	0.208	13.3	LOS B	1.3	9.8	0.73	0.77	52.1
Approach		165	5.0	0.208	11.2	LOS B	1.3	9.8	0.73	0.77	51.5
All Vehicles		1451	5.0	0.442	5.7	LOS A	3.9	28.2	0.50	0.51	54.9

Figure 9: Intersection B Movement summary 2040 PM

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Helenslee Road Road (south)											
1	L2	95	5.0	0.435	4.1	LOS A	3.8	27.9	0.38	0.45	54.2
2	T1	415	5.0	0.435	3.8	LOS A	3.8	27.9	0.38	0.45	55.8
3	R2	95	5.0	0.435	9.8	LOS A	3.8	27.9	0.38	0.45	56.0
Approach		604	5.0	0.435	4.8	LOS A	3.8	27.9	0.38	0.45	55.6
East: Galeshed Crescent											
4	L2	27	5.0	0.061	8.1	LOS A	0.4	2.8	0.75	0.71	51.4
5	T1	1	5.0	0.061	7.8	LOS A	0.4	2.8	0.75	0.71	52.8
6	R2	14	5.0	0.061	13.8	LOS B	0.4	2.8	0.75	0.71	53.0
Approach		42	5.0	0.061	9.9	LOS A	0.4	2.8	0.75	0.71	51.9
North: Helenslee Road (north)											
7	L2	69	5.0	0.550	4.6	LOS A	5.3	38.6	0.51	0.48	53.9
8	T1	589	5.0	0.550	4.3	LOS A	5.3	38.6	0.51	0.48	55.4
9	R2	69	5.0	0.550	10.3	LOS B	5.3	38.6	0.51	0.48	55.6
Approach		728	5.0	0.550	4.9	LOS A	5.3	38.6	0.51	0.48	55.3
West: Int B site entrance											
10	L2	14	5.0	0.050	6.6	LOS A	0.3	2.2	0.65	0.67	51.2
11	T1	1	5.0	0.050	6.4	LOS A	0.3	2.2	0.65	0.67	52.6
12	R2	27	5.0	0.050	12.3	LOS B	0.3	2.2	0.65	0.67	52.8
Approach		42	5.0	0.050	10.3	LOS B	0.3	2.2	0.65	0.67	52.2
All Vehicles		1417	5.0	0.550	5.2	LOS A	5.3	38.6	0.47	0.48	55.2

As shown above, all movements operate at a LOS A or B during the morning and afternoon peak hour respectively. The maximum average delay is 14.0 seconds during the morning peak hour and 13.8 seconds during the afternoon peak hour. The maximum 95%ile back of queue length is 38.6 m (5-6 vehicles) and occurs during the afternoon peak hour on the northern approach (Helenslee Road).

As such, based on the above assessment, a single lane roundabout is considered adequate to cater for the predicted future traffic demands (planned and proposed) in 2040.

3.4 INTERSECTION C – SITE ENTRANCE / HELENSLEE ROAD / MUNRO ROAD (PROPOSED)

The Helenslee Road / Munro Road intersection is currently a give-way controlled intersection with priority afforded to traffic along Helenslee Road (north) / Munro Road. Of note, this intersection is not identified within the Pokeno Intersection Assessment report.

As a result of the potential development at the site, a new collector road will connect directly from the site to this intersection (western approach) thereby forming a cross-road intersection. The proposal intends to signalise this intersection comprising a diamond phasing sequence. A traffic signal control is considered appropriate in this location due to the potential high volumes of pedestrians and cyclists anticipated.

Figure 10 outlines the potential layout for Intersection C.

Figure 10: Intersection C layout (indicative)

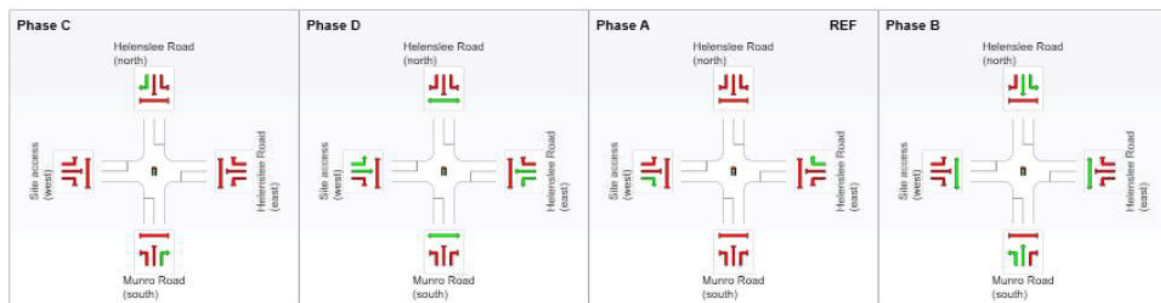
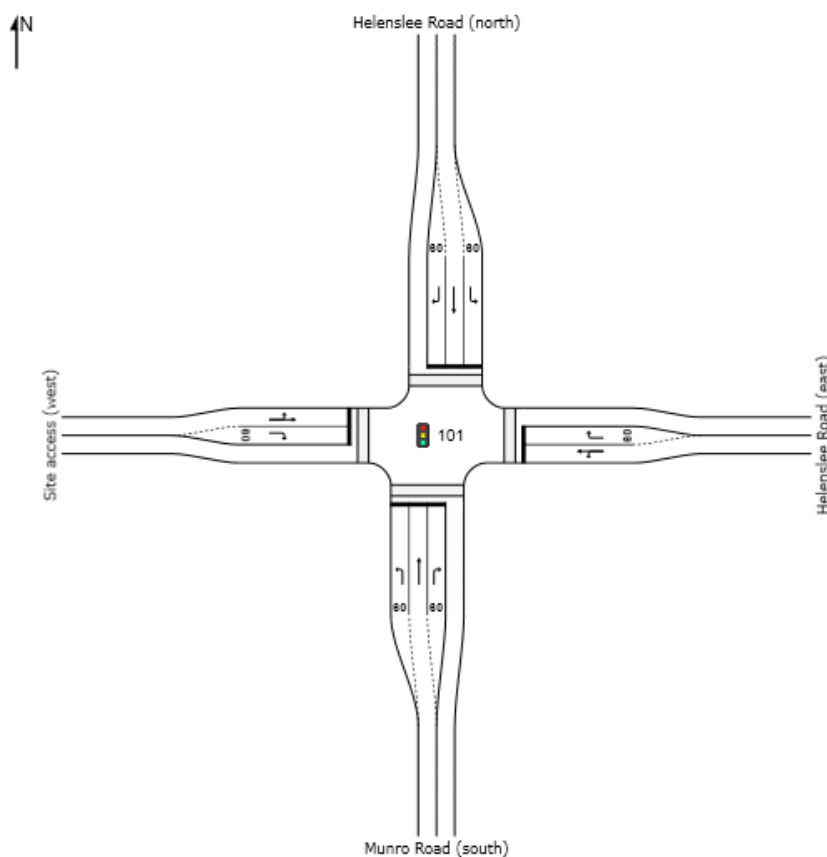


Figure 11 and Figure 12 show the expected performance of Intersection C for the morning and afternoon peak hours respectively.

Figure 11: Intersection C Movement summary 2040 AM

MOVEMENT SUMMARY

Site: 101 [Revised test Int C 2040 AM]

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Cycle Time)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Munro Road (south)											
1	L2	22	5.0	0.030	28.0	LOS C	0.8	5.5	0.62	0.68	40.3
2	T1	215	5.0	0.278	25.2	LOS C	8.3	60.5	0.71	0.60	42.4
3	R2	36	5.0	0.399	69.5	LOS E	2.2	15.9	1.00	0.73	27.5
Approach		273	5.0	0.399	31.2	LOS C	8.3	60.5	0.74	0.62	39.4
East: Helenslee Road (east)											
4	L2	4	5.0	0.102	45.2	LOS D	2.0	14.6	0.83	0.64	35.5
5	T1	39	5.0	0.102	39.6	LOS D	2.0	14.6	0.83	0.64	36.2
6	R2	193	5.0	0.716	60.7	LOS E	11.3	82.3	1.00	0.85	29.6
Approach		236	5.0	0.716	57.0	LOS E	11.3	82.3	0.97	0.81	30.6
North: Helenslee Road (north)											
7	L2	461	5.0	0.705	35.9	LOS D	21.4	156.1	0.85	0.84	37.0
8	T1	162	5.0	0.210	24.4	LOS C	6.1	44.2	0.69	0.57	42.8
9	R2	22	5.0	0.247	68.6	LOS E	1.3	9.7	0.99	0.71	27.7
Approach		645	5.0	0.705	34.1	LOS C	21.4	156.1	0.82	0.77	37.9
West: Site access (west)											
10	L2	119	5.0	0.704	52.7	LOS D	15.8	115.7	0.98	0.85	32.6
11	T1	169	5.0	0.704	47.1	LOS D	15.8	115.7	0.98	0.85	33.2
12	R2	40	5.0	0.149	54.0	LOS D	2.1	15.1	0.90	0.73	31.3
Approach		328	5.0	0.704	49.9	LOS D	15.8	115.7	0.97	0.83	32.7
All Vehicles		1482	5.0	0.716	40.7	LOS D	21.4	156.1	0.86	0.76	35.6

Figure 12: Intersection C Movement summary 2040 PM

MOVEMENT SUMMARY

Site: 101 [Revised test Int C 2040 PM]

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Cycle Time)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Munro Road (south)											
1	L2	56	5.0	0.113	40.4	LOS D	2.4	17.7	0.78	0.73	35.4
2	T1	164	5.0	0.316	37.1	LOS D	7.6	55.7	0.84	0.69	37.2
3	R2	23	5.0	0.103	56.5	LOS E	1.2	8.9	0.92	0.71	30.5
Approach		243	5.0	0.316	39.7	LOS D	7.6	55.7	0.83	0.70	36.1
East: Helenslee Road (east)											
4	L2	14	5.0	0.627	61.2	LOS E	8.5	61.9	1.00	0.81	30.7
5	T1	134	5.0	0.627	55.6	LOS E	8.5	61.9	1.00	0.81	31.3
6	R2	317	5.0	0.627	43.2	LOS D	15.6	114.0	0.90	0.83	34.5
Approach		464	5.0	0.627	47.3	LOS D	15.6	114.0	0.93	0.82	33.4
North: Helenslee Road (north)											
7	L2	175	5.0	0.354	43.3	LOS D	8.2	60.1	0.85	0.79	34.5
8	T1	302	5.0	0.619	40.5	LOS D	15.3	111.8	0.92	0.78	36.0
9	R2	139	5.0	0.620	61.2	LOS E	8.0	58.4	1.00	0.81	29.4
Approach		616	5.0	0.620	46.0	LOS D	15.3	111.8	0.92	0.79	33.8
West: Site access (west)											
10	L2	28	5.0	0.261	58.0	LOS E	3.3	23.8	0.94	0.74	31.0
11	T1	32	5.0	0.261	52.4	LOS D	3.3	23.8	0.94	0.74	31.5
12	R2	22	5.0	0.040	36.4	LOS D	0.9	6.5	0.73	0.69	36.9
Approach		82	5.0	0.261	50.0	LOS D	3.3	23.8	0.89	0.72	32.6
All Vehicles		1405	5.0	0.627	45.6	LOS D	15.6	114.0	0.90	0.78	34.0

In summary, using the volumes predicted at this intersection for the future year 2040, the modelling results suggest a maximum queue length of 156.1 m (21-22 vehicles) on the northern approach (Helenslee Road) during the morning peak hour and 114 m during the afternoon peak hour respectively (eastern approach). The maximum degree of saturation for any approach is 0.716 and

occurs on the eastern approach (right turn); this particular movement operates at a LOS E with an average delay is 60.7 seconds therefore indicating this approach experiences some level of congestion however still operates below capacity (0.9).

3.5 INTERSECTION D – SITE ENTRANCE / MUNRO ROAD INTERSECTION

This intersection was previously expected to connect to the Thomason Road / Munro Road intersection. In this regard, the location of this potential connection has since shifted to the south and now forms a 'T' intersection on Munro Road, south of the existing Munro Road / Thomason Road intersection.

A give-way control layout has been used to assess the performance of this intersection as shown in Figure 13 below.

Figure 13: Intersection D potential layout (indicative)

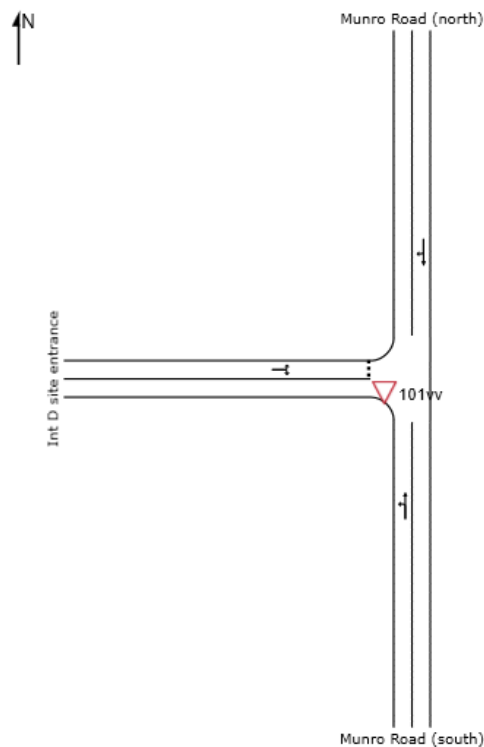


Figure 14 and Figure 15 show the expected performance of Intersection D for the morning and afternoon peak hours respectively.

Figure 14: Intersection D - Movement summary 2040 AM

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Munro Road (south)											
1	L2	26	5.0	0.118	5.6	LOS A	0.0	0.0	0.00	0.07	57.5
2	T1	195	5.0	0.118	0.0	LOS A	0.0	0.0	0.00	0.07	59.3
Approach		221	5.0	0.118	0.7	NA	0.0	0.0	0.00	0.07	59.1
North: Munro Road (north)											
8	T1	192	5.0	0.112	0.1	LOS A	0.1	0.9	0.06	0.04	59.4
9	R2	15	5.0	0.112	6.3	LOS A	0.1	0.9	0.06	0.04	56.9
Approach		206	5.0	0.112	0.5	NA	0.1	0.9	0.06	0.04	59.2
West: Int D site entrance											
10	L2	77	5.0	0.112	6.3	LOS A	0.4	2.8	0.27	0.61	52.6
12	R2	87	5.0	0.112	6.0	LOS A	0.4	2.8	0.27	0.61	52.1
Approach		164	5.0	0.112	6.1	LOS A	0.4	2.8	0.27	0.61	52.3
All Vehicles		592	5.0	0.118	2.1	NA	0.4	2.8	0.10	0.21	57.1

Figure 15: Intersection D - Movement summary 2040 PM

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Munro Road (south)											
1	L2	81	5.0	0.165	5.6	LOS A	0.0	0.0	0.00	0.16	56.8
2	T1	226	5.0	0.165	0.0	LOS A	0.0	0.0	0.00	0.16	58.6
Approach		307	5.0	0.165	1.5	NA	0.0	0.0	0.00	0.16	58.1
North: Munro Road (north)											
8	T1	255	5.0	0.201	0.5	LOS A	0.7	5.2	0.25	0.16	57.7
9	R2	83	5.0	0.201	6.9	LOS A	0.7	5.2	0.25	0.16	55.4
Approach		338	5.0	0.201	2.1	NA	0.7	5.2	0.25	0.16	57.1
West: Int D site entrance											
10	L2	17	5.0	0.030	6.3	LOS A	0.1	0.7	0.29	0.61	52.6
12	R2	24	5.0	0.030	6.2	LOS A	0.1	0.7	0.29	0.61	52.1
Approach		41	5.0	0.030	6.3	LOS A	0.1	0.7	0.29	0.61	52.3
All Vehicles		686	5.0	0.201	2.1	NA	0.7	5.2	0.14	0.18	57.2

In summary, using the volumes predicted at the intersection for the future year 2040, the modelling indicates that the lanes are likely to perform at a LOS A during the morning and afternoon peak hours respectively. The maximum degree of saturation for any approach is 0.201 therefore indicating it is expected to perform well below capacity (0.8). The maximum 95%ile back of queue is 5.2 m (less than 1 vehicle) and occurs at the northern approach (Munro Road) during the afternoon peak hour.

Overall, a give-way control intersection is considered adequate to accommodate the predicted traffic volumes for the future year 2040. It is however noted that, through additional assessments, any connections proposed to the existing road network will require compliance with the relevant Waikato District Plan rules including appropriate spacing to nearby intersections, appropriate sight distance etc.

Similar to Intersection A, there is potential for the level of right turn movements at this intersection to warrant a right turn bay on Munro Road; this will need to be considered at subsequent stages.

3.6 INTERSECTION E – MUNRO ROAD / HUIA ROAD INTERSECTION (EXISTING)

The existing Huia Road / Munro Road intersection is priority controlled with priority afforded to traffic along Munro Road. This intersection does not connect directly to the site, however it does serve as the only access, via the existing road network, to the southernmost site access (Intersection F) on Huia Road. This intersection is not mentioned within the Pokeno Intersection Assessment report. As such, modelling has been undertaken using the existing layout (give-way controlled) to determine whether an upgrade is warranted.

Figure 16 shows the existing layout of this intersection.

Figure 16: Intersection E Existing layout (indicative)

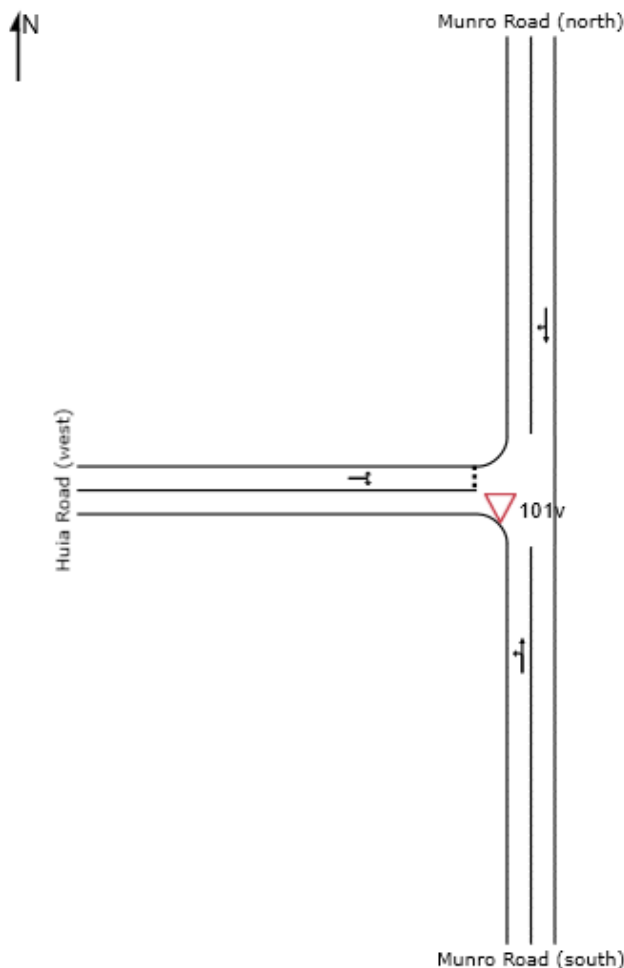


Figure 17 and Figure 18 show the expected performance of Intersection E for the morning and afternoon peak hours respectively.

Figure 17: Intersection E - Movement summary 2040 AM

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Munro Road (south)											
1	L2	35	5.0	0.105	5.6	LOS A	0.0	0.0	0.00	0.10	57.2
2	T1	162	5.0	0.105	0.0	LOS A	0.0	0.0	0.00	0.10	59.0
Approach		197	5.0	0.105	1.0	NA	0.0	0.0	0.00	0.10	58.7
North: Munro Road (north)											
8	T1	268	5.0	0.150	0.0	LOS A	0.1	0.7	0.03	0.03	59.6
9	R2	12	5.0	0.150	6.3	LOS A	0.1	0.7	0.03	0.03	57.1
Approach		280	5.0	0.150	0.3	NA	0.1	0.7	0.03	0.03	59.5
West: Huia Road (west)											
10	L2	60	5.0	0.110	6.2	LOS A	0.4	2.6	0.25	0.61	52.7
12	R2	104	5.0	0.110	6.1	LOS A	0.4	2.6	0.25	0.61	52.2
Approach		164	5.0	0.110	6.1	LOS A	0.4	2.6	0.25	0.61	52.4
All Vehicles		641	5.0	0.150	2.0	NA	0.4	2.6	0.08	0.20	57.3

Figure 18: Intersection E - Movement summary 2040 PM

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Munro Road (south)											
1	L2	100	5.0	0.211	5.6	LOS A	0.0	0.0	0.00	0.15	56.8
2	T1	294	5.0	0.211	0.0	LOS A	0.0	0.0	0.00	0.15	58.6
Approach		394	5.0	0.211	1.4	NA	0.0	0.0	0.00	0.15	58.1
North: Munro Road (north)											
8	T1	209	5.0	0.173	0.8	LOS A	0.6	4.7	0.29	0.17	57.5
9	R2	71	5.0	0.173	7.3	LOS A	0.6	4.7	0.29	0.17	55.2
Approach		280	5.0	0.173	2.4	NA	0.6	4.7	0.29	0.17	56.9
West: Huia Road (west)											
10	L2	14	5.0	0.030	6.6	LOS A	0.1	0.7	0.32	0.62	52.5
12	R2	27	5.0	0.030	6.3	LOS A	0.1	0.7	0.32	0.62	52.0
Approach		41	5.0	0.030	6.4	LOS A	0.1	0.7	0.32	0.62	52.2
All Vehicles		715	5.0	0.211	2.1	NA	0.6	4.7	0.13	0.18	57.3

In summary, using the existing layout (give-way control) and the volumes predicted at this intersection for the future year 2040, the modelling indicates that the lanes are likely to perform at a LOS A during the morning and afternoon peak hours respectively. The maximum degree of saturation of the intersection is 0.211 therefore it is expected to perform well below capacity (0.8).

Similar to Intersection A, there is potential for the level of right turn movements at this intersection to warrant a right turn bay on Munro Road; this will need to be considered at subsequent stages.

3.7 INTERSECTION F – SITE ENTRANCE / HUIA ROAD (PROPOSED)

This intersection is proposed to connect the potential residential development directly to Huia Road. A local road is proposed to connect to Huia Road from the north forming a T-intersection. A give-way control intersection is recommended as shown in Figure 19 below.

Figure 19: Intersection F layout (indicative)

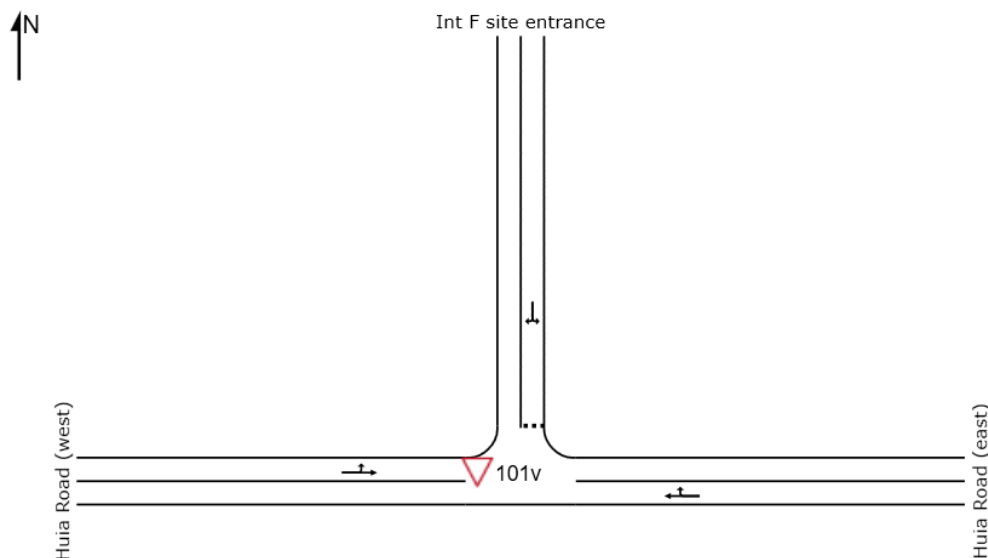


Figure 20 and Figure 21 show the expected performance of Intersection F for the morning and afternoon peak hours respectively.

Figure 20: Intersection F - Movement summary 2040 AM

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Huia Road (east)											
5	T1	6	5.0	0.027	0.0	LOS A	0.1	0.9	0.02	0.52	55.6
6	R2	41	5.0	0.027	5.5	LOS A	0.1	0.9	0.02	0.52	53.4
Approach		47	5.0	0.027	4.8	NA	0.1	0.9	0.02	0.52	53.7
North: Int F site entrance											
7	L2	164	5.0	0.104	5.6	LOS A	0.4	3.3	0.01	0.57	53.4
9	R2	1	5.0	0.104	5.6	LOS A	0.4	3.3	0.01	0.57	52.8
Approach		165	5.0	0.104	5.6	LOS A	0.4	3.3	0.01	0.57	53.4
West: Huia Road (west)											
10	L2	1	5.0	0.001	5.6	LOS A	0.0	0.0	0.00	0.29	55.7
11	T1	1	5.0	0.001	0.0	LOS A	0.0	0.0	0.00	0.29	57.4
Approach		2	5.0	0.001	2.8	NA	0.0	0.0	0.00	0.29	56.5
All Vehicles		215	5.0	0.104	5.4	NA	0.4	3.3	0.01	0.55	53.5

Figure 21: Intersection F - Movement summary 2040 PM

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Huia Road (east)											
5	T1	6	5.0	0.097	0.0	LOS A	0.5	3.5	0.02	0.57	55.2
6	R2	164	5.0	0.097	5.5	LOS A	0.5	3.5	0.02	0.57	53.0
Approach		171	5.0	0.097	5.3	NA	0.5	3.5	0.02	0.57	53.1
North: Int F site entrance											
7	L2	41	5.0	0.026	5.6	LOS A	0.1	0.8	0.01	0.57	53.4
9	R2	1	5.0	0.026	5.7	LOS A	0.1	0.8	0.01	0.57	52.9
Approach		42	5.0	0.026	5.6	LOS A	0.1	0.8	0.01	0.57	53.4
West: Huia Road (west)											
10	L2	1	5.0	0.001	5.6	LOS A	0.0	0.0	0.00	0.29	55.7
11	T1	1	5.0	0.001	0.0	LOS A	0.0	0.0	0.00	0.29	57.4
Approach		2	5.0	0.001	2.8	NA	0.0	0.0	0.00	0.29	56.5
All Vehicles		215	5.0	0.097	5.3	NA	0.5	3.5	0.02	0.57	53.2

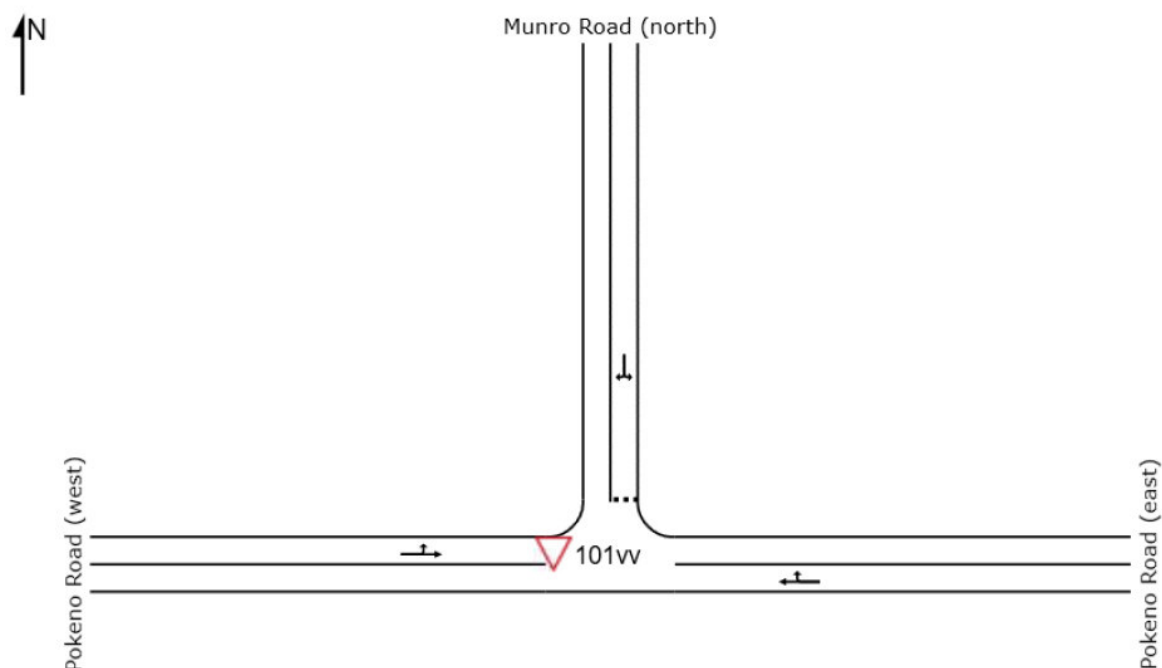
In summary, using the volumes predicted at this intersection for the future year 2040, the modelling indicates that all lanes are expected to operate at a LOS A during the morning and afternoon peak hours. The maximum degree of saturation of the intersection is 0.104 therefore indicating that the intersection is expected to perform well below capacity (0.8).

Similar to Intersection A, there is potential for the level of right turn movements at this intersection to warrant a right turn bay on Huia Road; this will need to be considered at subsequent stages.

3.8 INTERSECTION G – MUNRO ROAD / POKENO ROAD INTERSECTION (EXISTING)

The existing Munro Road / Pokeno Road intersection is give-way controlled with priority afforded to traffic along Pokeno Road. The Pokeno Intersection Assessment report indicates that this intersection may warrant a roundabout by the year 2022 or 2040. In this regard the intersection has initially been assessed using the existing layout (give-way) with upgrades made if required. Figure 22 sets out the layout of the existing intersection.

Figure 22: Intersection G existing layout



The performance of Intersection G, during the morning and afternoon peak hours, for the future year 2040 is summarised in Figure 23 and Figure 24 respectively.

Figure 23: Intersection G - Movement summary 2040 AM – existing layout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Pokeno Road (east)											
5	T1	436	5.0	0.277	0.7	LOS A	0.7	4.9	0.16	0.06	58.6
6	R2	40	5.0	0.277	9.5	LOS A	0.7	4.9	0.16	0.06	56.2
Approach		476	5.0	0.277	1.4	NA	0.7	4.9	0.16	0.06	58.4
North: Munro Road (north)											
7	L2	159	5.0	0.346	8.2	LOS A	1.5	10.7	0.50	0.81	51.6
9	R2	214	5.0	0.346	7.7	LOS A	1.5	10.7	0.50	0.81	51.1
Approach		373	5.0	0.346	7.9	LOS A	1.5	10.7	0.50	0.81	51.3
West: Pokeno Road (west)											
10	L2	157	5.0	0.326	5.6	LOS A	0.0	0.0	0.00	0.15	56.7
11	T1	451	5.0	0.326	0.0	LOS A	0.0	0.0	0.00	0.15	58.5
Approach		607	5.0	0.326	1.5	NA	0.0	0.0	0.00	0.15	58.1
All Vehicles		1456	5.0	0.346	3.1	NA	1.5	10.7	0.18	0.29	56.3

Figure 24: Intersection G - Movement summary 2040 PM - existing layout

Movement Performance - Vehicles												
Mov ID	OD Mov	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h	
East: Pokeno Road (east)												
5	T1	567	5.0	0.478	3.2	LOS A	3.5	25.4	0.47	0.16	55.5	
6	R2	124	5.0	0.478	13.0	LOS B	3.5	25.4	0.47	0.16	53.3	
Approach		692	5.0	0.478	4.9	NA	3.5	25.4	0.47	0.16	55.1	
North: Munro Road (north)												
7	L2	36	5.0	0.257	8.0	LOS A	0.8	6.0	0.57	0.84	51.4	
9	R2	200	5.0	0.257	8.4	LOS A	0.8	6.0	0.57	0.84	50.9	
Approach		236	5.0	0.257	8.3	LOS A	0.8	6.0	0.57	0.84	50.9	
West: Pokeno Road (west)												
10	L2	269	5.0	0.399	5.6	LOS A	0.0	0.0	0.00	0.22	56.2	
11	T1	471	5.0	0.399	0.1	LOS A	0.0	0.0	0.00	0.22	58.0	
Approach		740	5.0	0.399	2.1	NA	0.0	0.0	0.00	0.22	57.3	
All Vehicles		1667	5.0	0.478	4.2	NA	3.5	25.4	0.27	0.28	55.4	

In summary, using the existing layout and the volumes predicted at this intersection for the future year 2040, the modelling results indicate that the lanes are likely to perform at a LOS A or B during the morning and afternoon peak hours. The maximum degree of saturation of the intersection is 0.478 thereby indicating that the intersection operates well below capacity (0.8) and a give-way control layout can serve the potential volumes from a capacity perspective.

Using a roundabout control, the performance of Intersection G, during the morning and afternoon peak hours for the future year 2040 is summarised in Figure 26 and Figure 27 respectively.

Figure 25: Potential future layout (indicative)

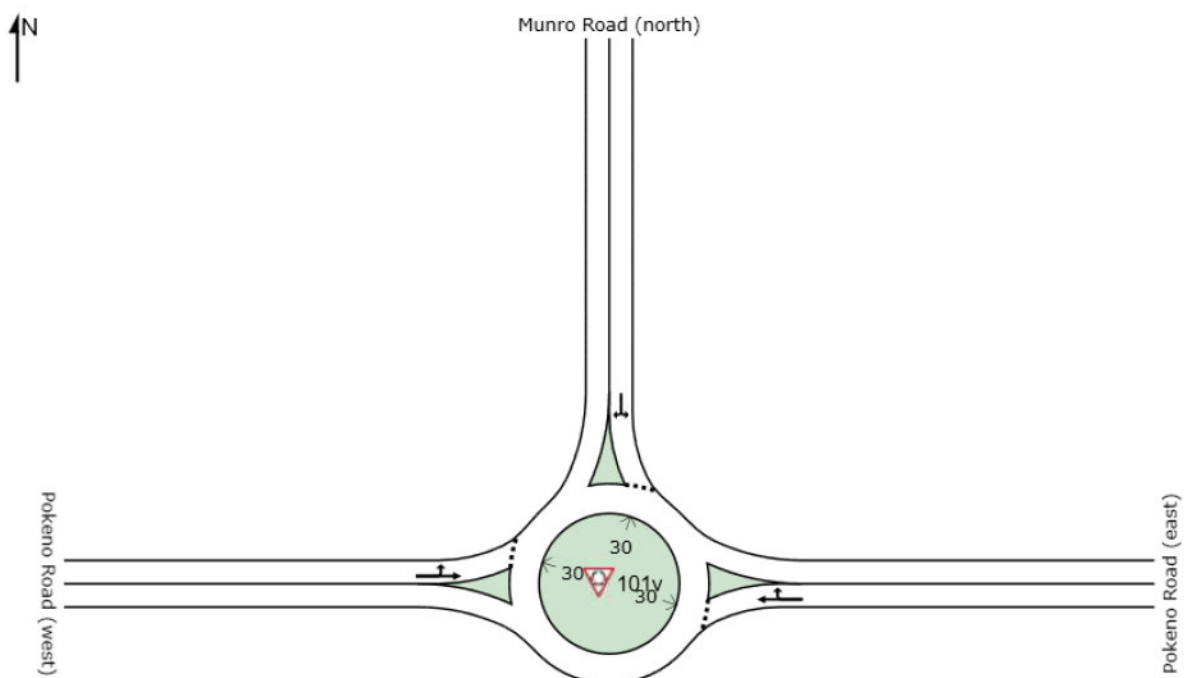


Figure 26: Intersection G - Movement summary 2040 AM - potential future layout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Pokeno Road (east)											
5	T1	436	5.0	0.423	4.9	LOS A	3.5	25.7	0.61	0.54	55.0
6	R2	40	5.0	0.423	10.8	LOS B	3.5	25.7	0.61	0.54	55.1
Approach		476	5.0	0.423	5.4	LOS A	3.5	25.7	0.61	0.54	55.0
North: Munro Road (north)											
7	L2	159	5.0	0.410	7.1	LOS A	2.9	21.5	0.73	0.77	51.1
9	R2	214	5.0	0.410	12.8	LOS B	2.9	21.5	0.73	0.77	52.7
Approach		373	5.0	0.410	10.4	LOS B	2.9	21.5	0.73	0.77	52.0
West: Pokeno Road (west)											
10	L2	157	5.0	0.403	3.7	LOS A	3.7	27.0	0.26	0.36	55.4
11	T1	451	5.0	0.403	3.4	LOS A	3.7	27.0	0.26	0.36	57.1
Approach		607	5.0	0.403	3.5	LOS A	3.7	27.0	0.26	0.36	56.6
All Vehicles		1456	5.0	0.423	5.9	LOS A	3.7	27.0	0.49	0.53	54.8

Figure 27: Intersection G - Movement summary 2040 - potential future layout

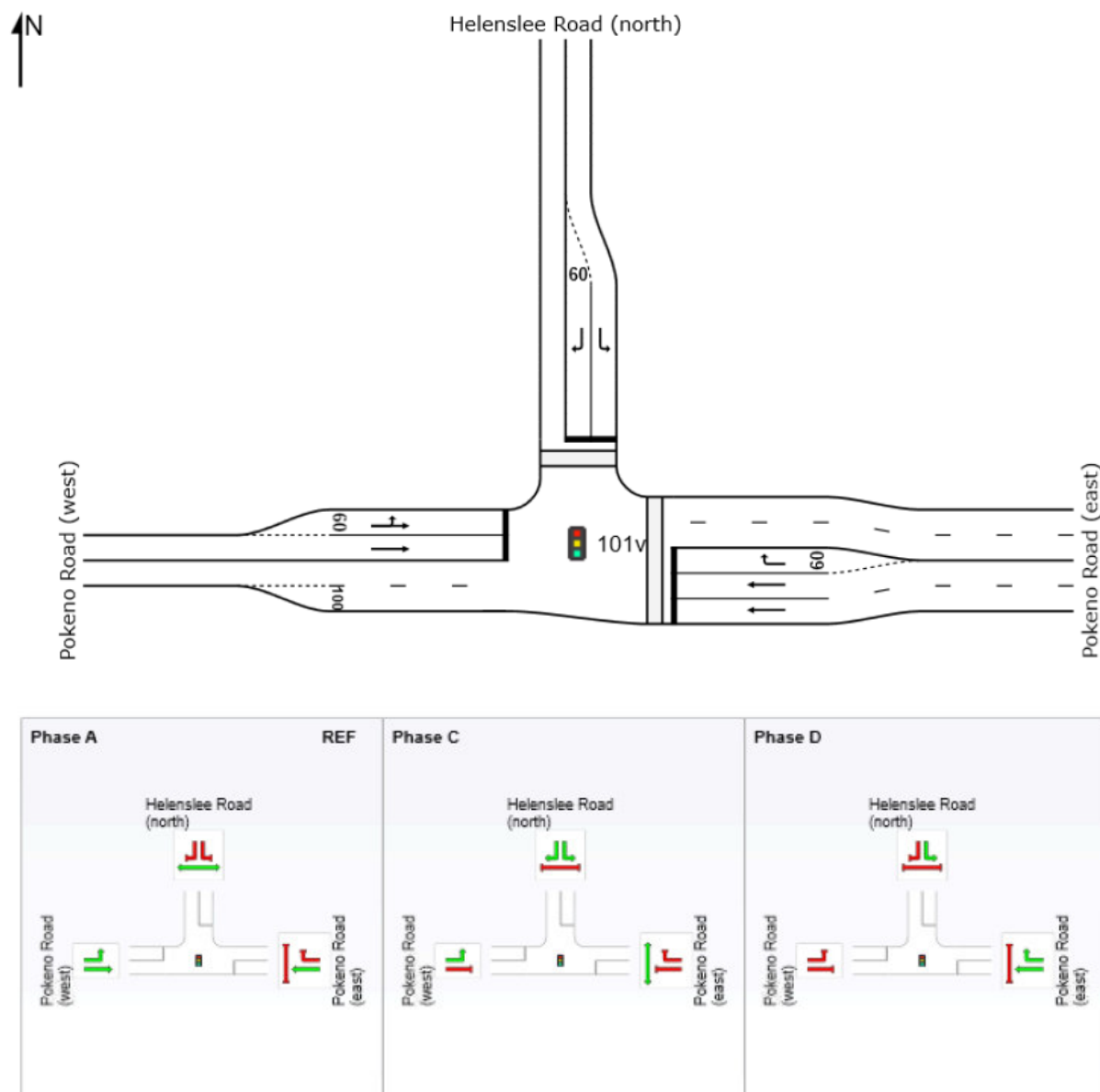
Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Pokeno Road (east)											
5	T1	567	5.0	0.592	5.1	LOS A	6.0	43.9	0.70	0.58	54.3
6	R2	124	5.0	0.592	11.1	LOS B	6.0	43.9	0.70	0.58	54.4
Approach		692	5.0	0.592	6.2	LOS A	6.0	43.9	0.70	0.58	54.3
North: Munro Road (north)											
7	L2	36	5.0	0.276	6.8	LOS A	1.9	13.9	0.72	0.77	50.4
9	R2	200	5.0	0.276	12.5	LOS B	1.9	13.9	0.72	0.77	51.9
Approach		236	5.0	0.276	11.7	LOS B	1.9	13.9	0.72	0.77	51.6
West: Pokeno Road (west)											
10	L2	269	5.0	0.568	4.6	LOS A	6.1	44.2	0.57	0.49	54.0
11	T1	471	5.0	0.568	4.4	LOS A	6.1	44.2	0.57	0.49	55.6
Approach		740	5.0	0.568	4.5	LOS A	6.1	44.2	0.57	0.49	55.0
All Vehicles		1667	5.0	0.592	6.2	LOS A	6.1	44.2	0.65	0.57	54.2

Using a single lane roundabout layout and the volumes predicted at this intersection for the future year 2040, the modelling results indicate that the lanes continue to perform at a LOS A or B during the peak hours. The maximum degree of saturation increases to 0.592 (afternoon peak hour) however remains within capacity (0.85). As such, a single lane roundabout is considered sufficient to cater for the volumes predicted at this intersection for the future year 2040 (subject to changes in demand).

3.9 INTERSECTION H – POKENO ROAD / HELENSLEE ROAD INTERSECTION

The Helenslee Road / Pokeno Road intersection is currently give-way controlled with priority afforded to traffic along Pokeno Road. The Pokeno Intersection Assessment report indicates this intersection warrants a signal / roundabout intersection form for the future year 2022 and 2040. In this regard, a signalised layout has been used and is shown in Figure 28 below.

Figure 28: Intersection H - signalised intersection layout (indicative)



The performance of Intersection H during the morning and afternoon peak hour, for the future year 2040, is shown in Figure 29 and Figure 30 below respectively.

Figure 29: Intersection H - Movement summary 2040 AM - potential future layout

MOVEMENT SUMMARY

 Site: 101v [Revised test Int H 2040 AM - signals]

New Site
Signals - Fixed Time Coordinated Cycle Time = 100 seconds (User-Given Cycle Time)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Pokeno Road (east)											
5	T1	434	5.0	0.199	0.3	LOS A	0.3	2.4	0.03	0.02	59.7
6	R2	248	5.0	0.315	14.9	LOS B	4.2	30.5	0.37	0.68	47.0
Approach		682	5.0	0.315	5.6	LOS A	4.2	30.5	0.15	0.26	54.4
North: Helenslee Road (north)											
7	L2	736	5.0	0.675	18.0	LOS B	22.3	162.8	0.68	0.80	45.2
9	R2	37	5.0	0.158	48.3	LOS D	1.6	12.0	0.92	0.73	32.8
Approach		773	5.0	0.675	19.4	LOS B	22.3	162.8	0.69	0.80	44.4
West: Pokeno Road (west)											
10	L2	25	5.0	0.665	41.8	LOS D	13.9	101.8	0.95	0.81	36.7
11	T1	603	5.0	0.665	36.5	LOS D	14.0	102.0	0.95	0.81	37.4
Approach		628	5.0	0.665	36.7	LOS D	14.0	102.0	0.95	0.81	37.4
All Vehicles		2083	5.0	0.675	20.1	LOS C	22.3	162.8	0.59	0.63	44.6

Figure 30: Intersection H - Movement summary 2040 PM - potential future layout

MOVEMENT SUMMARY

 Site: 101v [Revised test Int H 2040 PM - signals]

New Site
Signals - Fixed Time Coordinated Cycle Time = 100 seconds (User-Given Cycle Time)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Pokeno Road (east)											
5	T1	676	5.0	0.310	0.3	LOS A	0.6	4.4	0.03	0.03	59.7
6	R2	562	5.0	0.580	9.2	LOS A	5.7	41.6	0.23	0.65	50.7
Approach		1238	5.0	0.580	4.3	LOS A	5.7	41.6	0.12	0.31	55.3
North: Helenslee Road (north)											
7	L2	255	5.0	0.195	10.1	LOS B	3.8	28.0	0.34	0.67	50.1
9	R2	17	5.0	0.072	47.5	LOS D	0.7	5.4	0.91	0.69	33.0
Approach		272	5.0	0.195	12.4	LOS B	3.8	28.0	0.37	0.67	48.6
West: Pokeno Road (west)											
10	L2	24	5.0	0.914	66.3	LOS E	15.5	112.8	1.00	1.09	29.4
11	T1	496	5.0	0.914	60.6	LOS E	15.5	112.8	1.00	1.09	30.0
Approach		520	5.0	0.914	60.9	LOS E	15.5	112.8	1.00	1.09	30.0
All Vehicles		2029	5.0	0.914	19.9	LOS B	15.5	112.8	0.38	0.56	44.8

In summary, the lanes operate at a Level of service A - E. The maximum degree of saturation for any approach is 0.914 and occurs during the afternoon peak hour on the western approach (Pokeno Road) therefore indicating this lane experiences some level of congestion and reaches capacity. The maximum 95%ile back of queue length for this approach is 102 m (14 vehicles) during the morning peak hour and 113 m (15-16 vehicles) during the afternoon peak hour. It is noted that the maximum 95%ile back of queue for any approach is 162 m (LOS B) and occurs during the morning peak hour

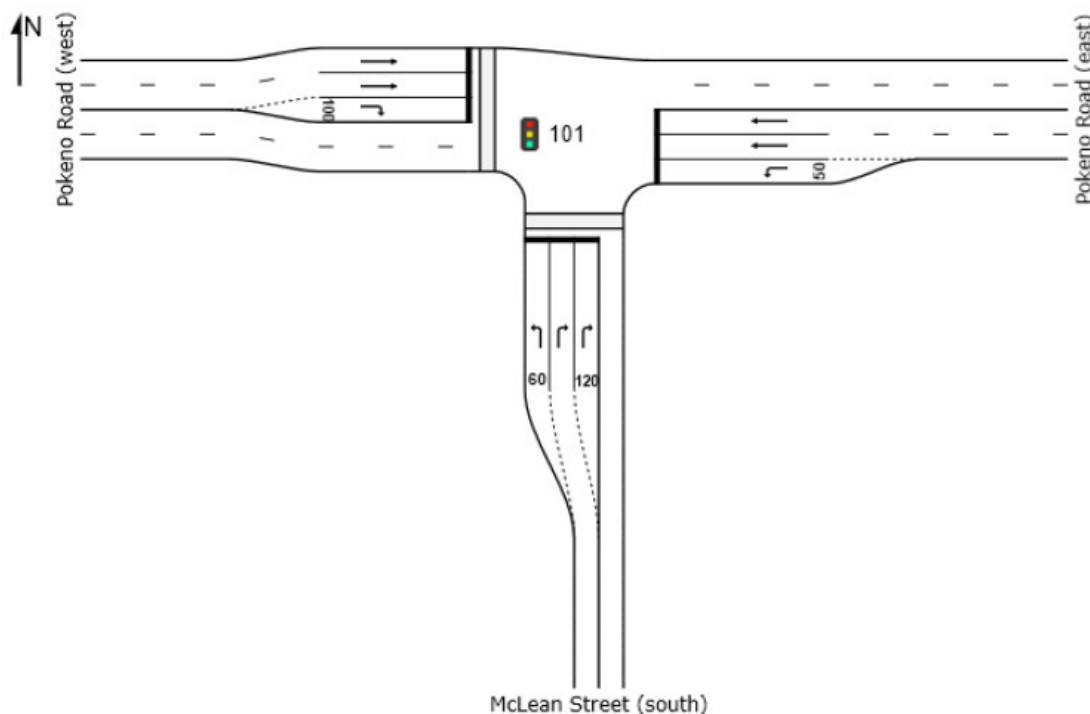
on the northern approach; the maximum degree of saturation for this approach is 0.675 therefore operates below capacity (0.9).

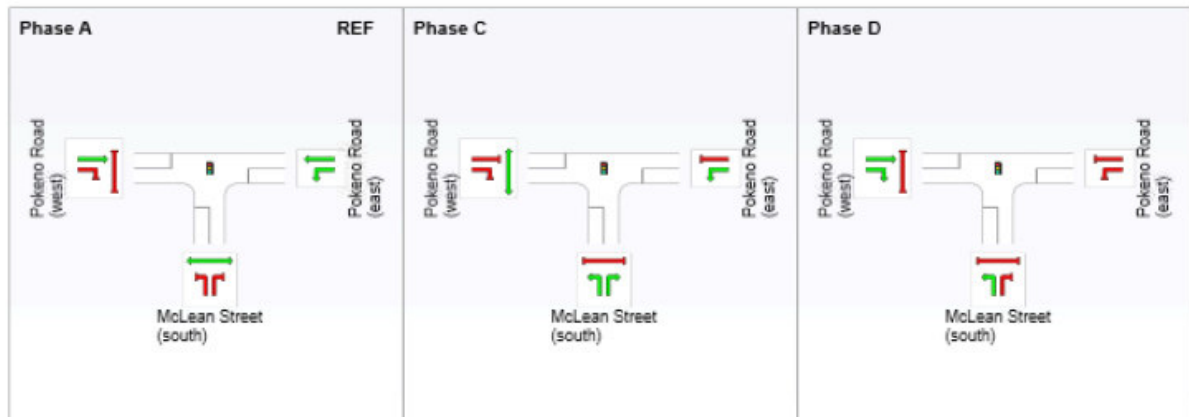
Overall, the modelling results agree with the recommendations outlined in the Pokeno Intersection Assessment report to provide signals at this intersection. It is however noted that the western approach is expected to reach capacity during the afternoon peak hour (LOS E) however is within acceptable levels.

3.10 INTERSECTION I – HITCHEN ROAD / POKENO ROAD INTERSECTION (EXISTING)

This intersection is currently give-way controlled with priority afforded to traffic along Pokeno Road. The Pokeno Intersection Assessment report indicates that traffic signals or a roundabout is recommended for this intersection by the year 2022. Given the layout of traffic volumes expected at this intersection, the following layout has been modelled.

Figure 31: Intersection I - potential signalised layout (indicative)





It is noted that the Pokeno Intersection Report outlines a high number of turning movements occurring left in and right out from this intersection. South of this intersection, the area is zoned as a mix of residential and business in the PSP therefore this is considered acceptable.

The performance of the Hitchen Road / Pokeno Road intersection during the morning and afternoon peak hour, for the future year 2040, is shown in Figure 32 and Figure 33 below respectively.

Figure 32: Intersection I - Movement summary 2040 AM - potential future layout

MOVEMENT SUMMARY

Site: 101 [Revised test Int I 2040 AM]

New Site
Signals - Fixed Time Coordinated Cycle Time = 100 seconds (User-Given Cycle Time)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: McLean Street (south)											
1	L2	186	5.0	0.176	15.5	LOS B	4.1	29.9	0.49	0.70	46.6
3	R2	264	5.0	0.567	51.4	LOS D	6.3	46.0	0.99	0.80	32.0
Approach		451	5.0	0.567	36.6	LOS D	6.3	46.0	0.78	0.76	36.8
East: Pokeno Road (east)											
4	L2	460	5.0	0.611	18.2	LOS B	11.8	85.8	0.56	0.75	45.1
5	T1	568	5.0	0.579	26.9	LOS C	10.6	77.5	0.80	0.68	41.6
Approach		1028	5.0	0.611	23.0	LOS C	11.8	85.8	0.70	0.71	43.1
West: Pokeno Road (west)											
11	T1	894	5.0	0.315	0.3	LOS A	0.6	4.5	0.03	0.03	59.7
12	R2	444	5.0	0.576	17.2	LOS B	10.4	76.2	0.52	0.73	45.9
Approach		1338	5.0	0.576	5.9	LOS A	10.4	76.2	0.19	0.26	54.3
All Vehicles		2817	5.0	0.611	17.1	LOS B	11.8	85.8	0.47	0.50	46.4

Figure 33: Intersection I - Movement summary 2040 PM - potential future layout

MOVEMENT SUMMARY

Site: 101 [Revised test Int I 2040 PM]

New Site
Signals - Fixed Time Coordinated Cycle Time = 100 seconds (User-Given Cycle Time)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: McLean Street (south)											
1	L2	296	5.0	0.471	32.9	LOS C	11.3	82.3	0.83	0.81	38.2
3	R2	446	5.0	0.889	63.3	LOS E	12.7	92.6	1.00	0.99	29.0
Approach		742	5.0	0.889	51.2	LOS D	12.7	92.6	0.93	0.92	32.1
East: Pokeno Road (east)											
4	L2	294	5.0	0.244	6.0	LOS A	0.4	2.7	0.03	0.58	53.1
5	T1	1223	5.0	0.648	6.6	LOS A	10.7	78.3	0.39	0.35	54.2
Approach		1517	5.0	0.648	6.5	LOS A	10.7	78.3	0.32	0.40	53.9
West: Pokeno Road (west)											
11	T1	543	5.0	0.194	0.3	LOS A	0.3	2.3	0.03	0.02	59.7
12	R2	206	5.0	0.639	41.6	LOS D	9.0	65.6	0.92	0.81	35.1
Approach		749	5.0	0.639	11.7	LOS B	9.0	65.6	0.27	0.24	50.0
All Vehicles		3008	5.0	0.889	18.8	LOS B	12.7	92.6	0.46	0.49	45.4

Using the traffic volumes predicted at the intersection for the future year 2040, the modelling indicates the following:

- widening is likely required along Pokeno Road and Hitchen Road to accommodate additional lanes to cater for the future traffic volumes;
- during the morning peak hour, the maximum degree of saturation is 0.611 and occurs at the left turn movement (eastern approach). This approach is expected to operate at a LOS B and comprises a 95%ile back of queue length of 86 m (12 vehicles);
- During the afternoon peak hour, the maximum degree of saturation is 0.889 (LOS E) and occurs on the southern approach (right turn movement). The maximum 95%ile queue length for this approach is 93 m (12-13 vehicles); this is considered typical of a major arterial road intersection.
- The maximum degree of saturation for any approach is 0.889 therefore indicating the intersection operates below capacity (0.9).

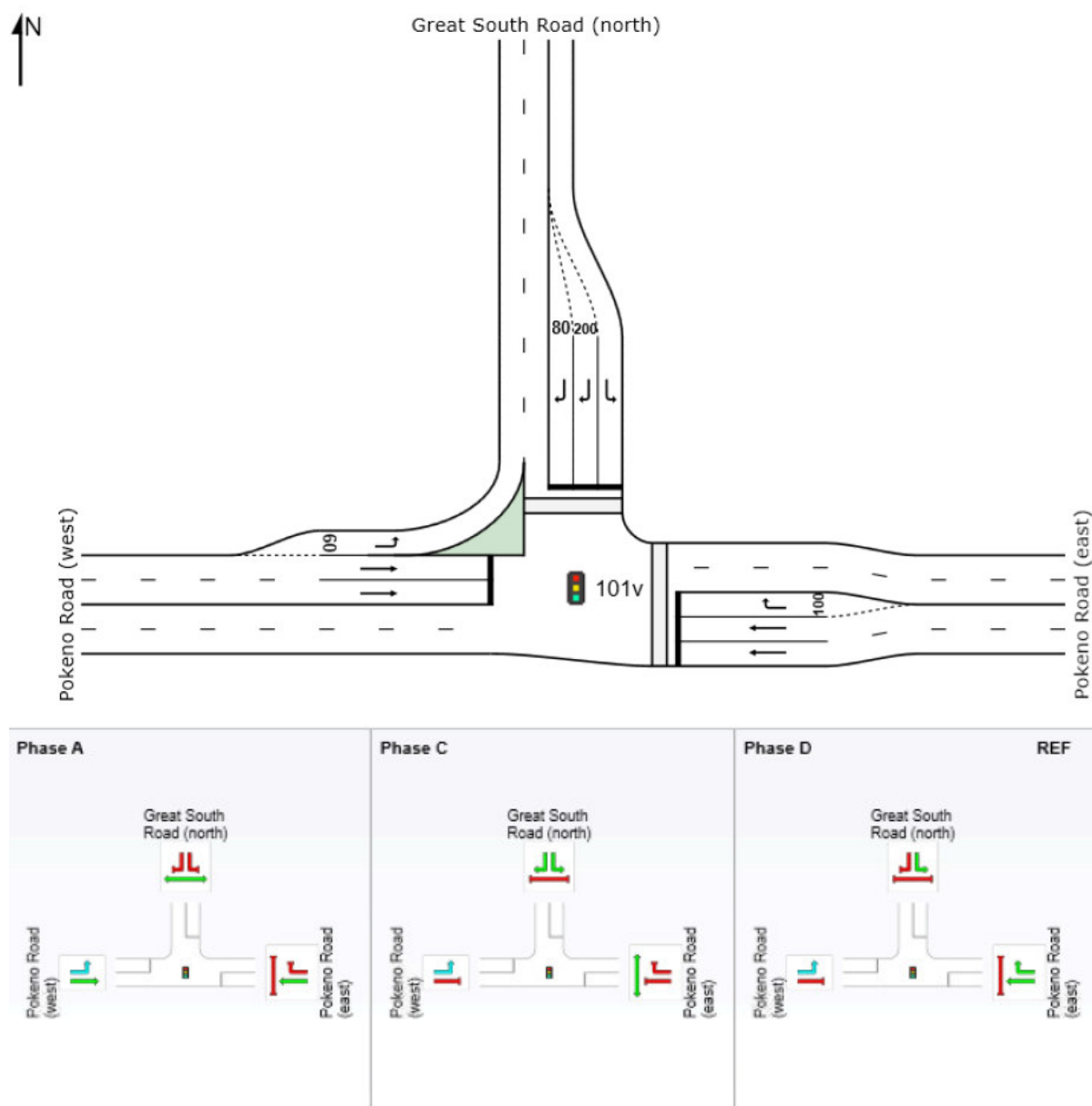
Based on the above, with the volumes predicted for the future year 2040, the performance of this intersection is expected to operate below capacity (0.9). It is noted that the phasing time with nearby intersections should be synced to improve the performance of this intersection and reduce delays and congestion.

3.11 INTERSECTION J – GREAT SOUTH ROAD / POKENO ROAD INTERSECTION

This intersection currently operates as a give-way control intersection.

The Pokeno Intersection Assessment report identifies that this intersection warrants a roundabout or signals by the year 2022 and 2040. In this regard, a signalised intersection layout has been used to model the traffic volumes predicted for the future year 2040 and is shown in Figure 34 below.

Figure 34: Intersection J potential layout (indicative)



The performance of Intersection J during the morning and afternoon peak hours in 2040 is shown in Figure 35 and Figure 36 below.

Figure 35: Intersection J - Movement summary 2040 AM - potential future layout

MOVEMENT SUMMARY

Site: 101v [Revised test Int J 2040 AM - signals]

New Site
Signals - Fixed Time Isolated Cycle Time = 100 seconds (User-Given Cycle Time)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Pokeno Road (east)											
5	T1	325	5.0	0.151	10.7	LOS B	3.7	26.8	0.50	0.41	51.1
6	R2	204	5.0	0.712	51.3	LOS D	10.0	73.1	1.00	0.86	32.1
Approach		529	5.0	0.712	26.4	LOS C	10.0	73.1	0.69	0.59	41.6
North: Great South Road (north)											
7	L2	603	5.0	0.635	23.4	LOS C	20.7	151.2	0.76	0.82	42.4
9	R2	798	5.0	0.718	39.5	LOS D	17.7	129.0	0.95	0.86	35.9
Approach		1401	5.0	0.718	32.6	LOS C	20.7	151.2	0.87	0.84	38.4
West: Pokeno Road (west)											
10	L2	502	5.0	0.280	5.7	LOS A	0.0	0.0	0.00	0.53	54.7
11	T1	800	5.0	0.605	28.9	LOS C	16.1	117.9	0.88	0.77	40.7
Approach		1302	5.0	0.605	20.0	LOS B	16.1	117.9	0.54	0.67	45.2
All Vehicles		3233	5.0	0.718	26.5	LOS C	20.7	151.2	0.71	0.73	41.5

Figure 36: Intersection J - Movement summary 2040 PM - potential future layout

MOVEMENT SUMMARY

Site: 101v [Revised test Int J 2040 PM - signals]

New Site
Signals - Fixed Time Isolated Cycle Time = 100 seconds (User-Given Cycle Time)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Pokeno Road (east)											
5	T1	993	5.0	0.375	6.5	LOS A	9.7	70.7	0.44	0.39	54.3
6	R2	664	5.0	0.787	27.7	LOS C	26.1	190.6	0.84	0.86	40.6
Approach		1657	5.0	0.787	15.0	LOS B	26.1	190.6	0.60	0.58	47.8
North: Great South Road (north)											
7	L2	311	5.0	0.231	9.6	LOS A	4.5	32.8	0.32	0.67	50.5
9	R2	533	5.0	0.825	54.8	LOS D	14.0	102.1	1.00	0.93	31.2
Approach		843	5.0	0.825	38.2	LOS D	14.0	102.1	0.75	0.84	36.3
West: Pokeno Road (west)											
10	L2	875	5.0	0.488	5.7	LOS A	0.0	0.0	0.00	0.53	54.7
11	T1	347	5.0	0.707	48.0	LOS D	8.6	63.1	1.00	0.86	33.6
Approach		1222	5.0	0.707	17.7	LOS B	8.6	63.1	0.28	0.62	46.5
All Vehicles		3722	5.0	0.825	21.1	LOS C	26.1	190.6	0.53	0.65	44.2

Using the traffic volumes predicted at the intersection for the future year 2040, the modelling indicates the following:

- widening is likely required along Pokeno Road and Great South Road to accommodate additional lanes to cater for the future traffic volumes;
- during the morning peak hour, the maximum degree of saturation is 0.718 and 0.825 during the afternoon peak hour respectively;
- The maximum 95%ile queue length ranges from 151.2 m to 190.6 m during the morning and afternoon peak hour respectively.

As such, the modelling results agree with the Pokeno Intersection Assessment report that a signalised intersection is required to cater for the predicted volumes in 2040. It is noted that, prior to 2040, upgrades are required to ensure that the intersection continues to perform at an acceptable level of service. It is noted that the phasing time with nearby intersection should be synced to improve the performance of this intersection and reduce delays and congestion.

3.12 INTERSECTION K – SH1 GREAT SOUTH ROAD ON-RAMP

This intersection is existing and currently forms a give-way control intersection. The Pokeno Intersection Assessment report identifies that this intersection requires a roundabout or signals by the year 2022. As such, a single lane roundabout has been modelled as shown in Figure 37 below.

Figure 37: Intersection K – potential layout (indicative)

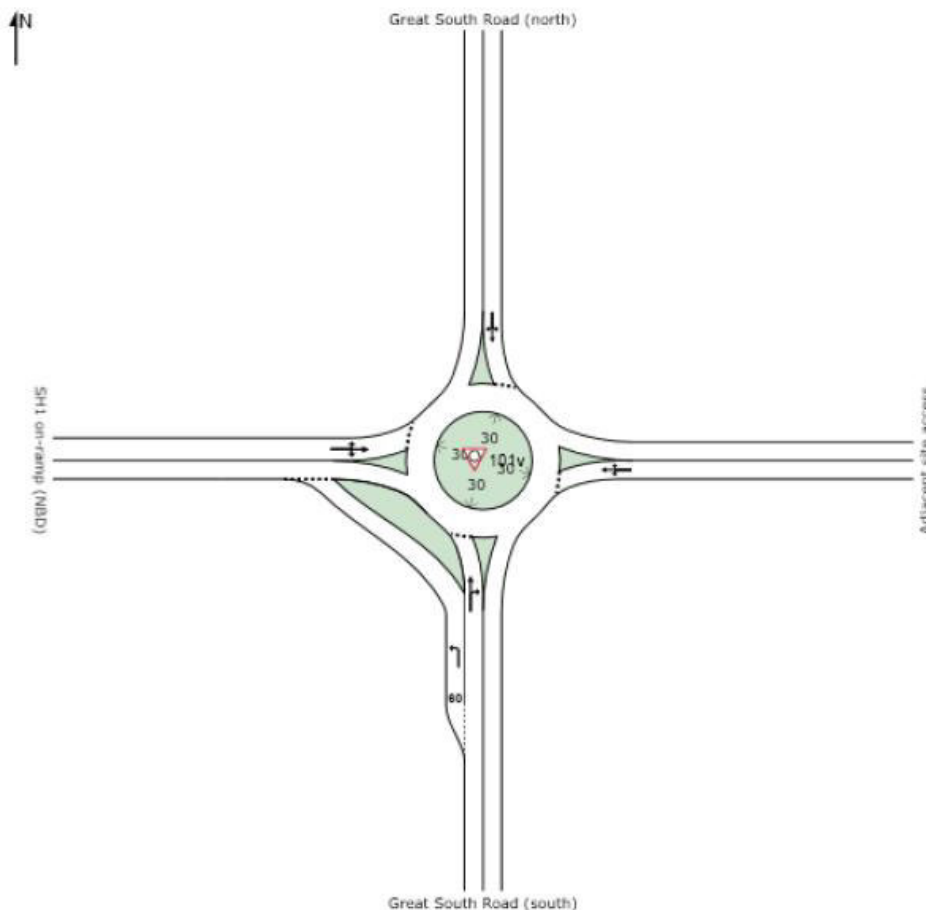


Figure 38: Intersection K – Movement summary 2040 AM

MOVEMENT SUMMARY

Site: 101v [Revised test Int K 2040 AM]

New Site
Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Great South Road (south)											
1	L2	102	5.0	0.082	4.8	LOS A	0.5	3.5	0.49	0.53	54.7
2	T1	645	5.0	0.520	5.6	LOS A	4.3	31.4	0.68	0.61	54.8
3	R2	11	5.0	0.520	11.5	LOS B	4.3	31.4	0.68	0.61	55.0
Approach		758	5.0	0.520	5.6	LOS A	4.3	31.4	0.68	0.60	54.8
East: Adjacent site access											
4	L2	26	5.0	0.065	8.7	LOS A	0.4	2.9	0.73	0.68	52.1
5	T1	19	5.0	0.065	8.5	LOS A	0.4	2.9	0.73	0.68	53.7
6	R2	1	5.0	0.065	14.4	LOS B	0.4	2.9	0.73	0.68	53.8
Approach		46	5.0	0.065	8.8	LOS A	0.4	2.9	0.73	0.68	52.8
North: Great South Road (north)											
7	L2	7	5.0	0.457	3.5	LOS A	4.6	33.8	0.14	0.48	54.1
8	T1	421	5.0	0.457	3.2	LOS A	4.6	33.8	0.14	0.48	55.7
9	R2	324	5.0	0.457	9.2	LOS A	4.6	33.8	0.14	0.48	55.8
Approach		753	5.0	0.457	5.8	LOS A	4.6	33.8	0.14	0.48	55.7
West: SH1 on-ramp (NBD)											
10	L2	1	5.0	0.004	6.8	LOS A	0.0	0.2	0.71	0.56	52.1
11	T1	1	5.0	0.004	6.5	LOS A	0.0	0.2	0.71	0.56	53.6
12	R2	1	5.0	0.004	12.4	LOS B	0.0	0.2	0.71	0.56	53.8
Approach		3	5.0	0.004	8.6	LOS A	0.0	0.2	0.71	0.56	53.2
All Vehicles		1560	5.0	0.520	5.8	LOS A	4.6	33.8	0.41	0.54	55.2

Figure 39: Intersection K – Movement summary 2040 PM

MOVEMENT SUMMARY

Site: 101v [Revised test Int K 2040 PM]

New Site
Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Great South Road (south)											
1	L2	1165	5.0	0.792	5.6	LOS A	11.1	81.1	0.77	0.59	53.7
2	T1	479	5.0	0.348	4.2	LOS A	2.5	18.5	0.44	0.46	55.9
3	R2	23	5.0	0.348	10.1	LOS B	2.5	18.5	0.44	0.46	56.1
Approach		1667	5.0	0.792	5.3	LOS A	11.1	81.1	0.67	0.55	54.4
East: Adjacent site access											
4	L2	13	5.0	0.026	6.3	LOS A	0.1	1.1	0.60	0.56	53.7
5	T1	9	5.0	0.026	6.0	LOS A	0.1	1.1	0.60	0.56	55.3
6	R2	1	5.0	0.026	12.0	LOS B	0.1	1.1	0.60	0.56	55.4
Approach		23	5.0	0.026	6.4	LOS A	0.1	1.1	0.60	0.56	54.4
North: Great South Road (north)											
7	L2	18	5.0	0.325	3.6	LOS A	2.6	19.0	0.17	0.45	54.4
8	T1	324	5.0	0.325	3.3	LOS A	2.6	19.0	0.17	0.45	56.0
9	R2	165	5.0	0.325	9.3	LOS A	2.6	19.0	0.17	0.45	56.2
Approach		507	5.0	0.325	5.3	LOS A	2.6	19.0	0.17	0.45	56.0
West: SH1 on-ramp (NBD)											
10	L2	1	5.0	0.004	5.7	LOS A	0.0	0.1	0.58	0.52	52.8
11	T1	1	5.0	0.004	5.5	LOS A	0.0	0.1	0.58	0.52	54.3
12	R2	1	5.0	0.004	11.4	LOS B	0.0	0.1	0.58	0.52	54.5
Approach		3	5.0	0.004	7.5	LOS A	0.0	0.1	0.58	0.52	53.8
All Vehicles		2201	5.0	0.792	5.3	LOS A	11.1	81.1	0.56	0.53	54.8

Using the volumes predicted at this intersection for the future year 2040, the modelling indicates that the lanes are expected to perform at a LOS A or B during the peak hours. The maximum degree of saturation is 0.792 and occurs during the afternoon peak hour on the southern approach (left turn movement onto the State highway). The 95%ile back of queue for this approach is 81.1 m (11-12 vehicles) with an average delay of 5.6 seconds per vehicle (LOS A).

As such, the modelling results agree with the Pokeno Intersection Assessment report that a roundabout is warranted at this intersection by the year 2040. The modelling also shows that a left turn slip lane is required prior to 2040 to allow the intersection to perform at an acceptable LOS.

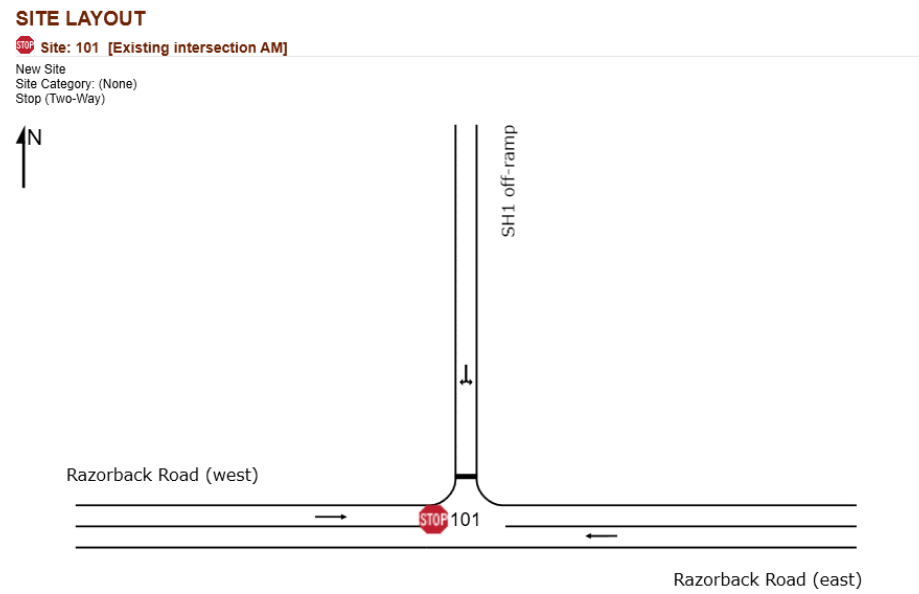
3.13 INTERSECTION L – SH1 RAZORBACK ROAD OFF-RAMP

The Razorback Road off-ramp is currently stop-controlled with priority afforded to traffic along Razorback Road. Traffic surveys were undertaken at this intersection on Wednesday 28th October

2020 during the morning and afternoon commuter peak hours; the results of this are provided in Figure 1 above.

The existing layout of the SH1 off-ramp / Razorback Road intersection is shown in Figure 40 below.

Figure 40: Intersection L - existing layout



To assess the performance of this intersection for the future year 2040, it is conservatively assumed that 90% of volumes travelling to and from the north are expected to turn to and from SH1 ramps respectively and 10% continues via Razorback Road (east of the SH1 ramps); this results in a significant number of vehicles turning right onto Razorback Road during the afternoon peak hour (from the off-ramp).

Figure 41: Intersection L - Movement summary Existing 2020 AM

Movement Performance - Vehicles												
Mov ID	Turn	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Razorback Road (east)												
5	T1	9	5.0	0.005	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
Approach		9	5.0	0.005	0.0	NA	0.0	0.0	0.00	0.00	0.00	50.0
North: SH1 off-ramp												
7	L2	4	5.0	0.062	7.7	LOS A	0.2	1.2	0.06	0.96	0.06	45.1
9	R2	98	5.0	0.062	7.1	LOS A	0.2	1.2	0.06	0.96	0.06	44.6
Approach		102	5.0	0.062	7.2	LOS A	0.2	1.2	0.06	0.96	0.06	44.6
West: Razorback Road (west)												
11	T1	18	5.0	0.009	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
Approach		18	5.0	0.009	0.0	NA	0.0	0.0	0.00	0.00	0.00	50.0
All Vehicles		129	5.0	0.062	5.7	NA	0.2	1.2	0.05	0.76	0.05	45.7

Figure 42: Intersection L - Movement summary Existing 2020 PM

Movement Performance - Vehicles												
Mov ID	Turn	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Razorback Road (east)												
5	T1	8	5.0	0.004	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
Approach		8	5.0	0.004	0.0	NA	0.0	0.0	0.00	0.00	0.00	50.0
North: SH1 off-ramp												
7	L2	3	5.0	0.199	7.7	LOS A	0.6	4.4	0.05	0.97	0.05	45.2
9	R2	326	5.0	0.199	7.1	LOS A	0.6	4.4	0.05	0.97	0.05	44.6
Approach		329	5.0	0.199	7.1	LOS A	0.6	4.4	0.05	0.97	0.05	44.6
West: Razorback Road (west)												
11	T1	11	5.0	0.006	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
Approach		11	5.0	0.006	0.0	NA	0.0	0.0	0.00	0.00	0.00	50.0
All Vehicles		348	5.0	0.199	6.8	NA	0.6	4.4	0.05	0.91	0.05	44.9

Figure 43 and Figure 44 shows the expected performance of the intersection during the morning and afternoon peak hours respectively, for the future year 2040.

Figure 43: Intersection L - Movement summary potential 2040 AM

Movement Performance - Vehicles												
Mov ID	Turn	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Razorback Road (east)												
5	T1	46	5.0	0.025	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
Approach		46	5.0	0.025	0.0	NA	0.0	0.0	0.00	0.00	0.00	50.0
North: SH1 off-ramp												
7	L2	6	5.0	0.266	7.9	LOS A	0.9	6.3	0.15	0.92	0.15	45.2
9	R2	413	5.0	0.266	7.3	LOS A	0.9	6.3	0.15	0.92	0.15	44.6
Approach		419	5.0	0.266	7.3	LOS A	0.9	6.3	0.15	0.92	0.15	44.6
West: Razorback Road (west)												
11	T1	59	5.0	0.031	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
Approach		59	5.0	0.031	0.0	NA	0.0	0.0	0.00	0.00	0.00	50.0
All Vehicles		524	5.0	0.266	5.9	NA	0.9	6.3	0.12	0.74	0.12	45.6

Figure 44: Intersection L - Movement summary potential 2040 PM

Movement Performance - Vehicles												
Mov ID	Turn	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Razorback Road (east)												
5	T1	71	5.0	0.037	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
Approach		71	5.0	0.037	0.0	NA	0.0	0.0	0.00	0.00	0.00	50.0
North: SH1 off-ramp												
7	L2	5	5.0	0.403	7.8	LOS A	1.5	11.1	0.18	0.92	0.18	45.2
9	R2	632	5.0	0.403	7.4	LOS A	1.5	11.1	0.18	0.92	0.18	44.6
Approach		637	5.0	0.403	7.4	LOS A	1.5	11.1	0.18	0.92	0.18	44.6
West: Razorback Road (west)												
11	T1	33	5.0	0.017	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
Approach		33	5.0	0.017	0.0	NA	0.0	0.0	0.00	0.00	0.00	50.0
All Vehicles		740	5.0	0.403	6.3	NA	1.5	11.1	0.15	0.79	0.15	45.3

Using the volumes assumed near the northern end of the site for the future year 2040, the modelling results indicate a maximum degree of saturation of 0.403 during the afternoon peak hour on the

northern approach. The maximum 95%ile back of queue on the off-ramp is 11.1 m (2-3 vehicles). The off-ramp is some 190 m in length therefore this level of queuing is not expected to interfere with SH1 through traffic.

ATTACHMENT B - SIDRA ANALYSIS SENSITIVITY TEST

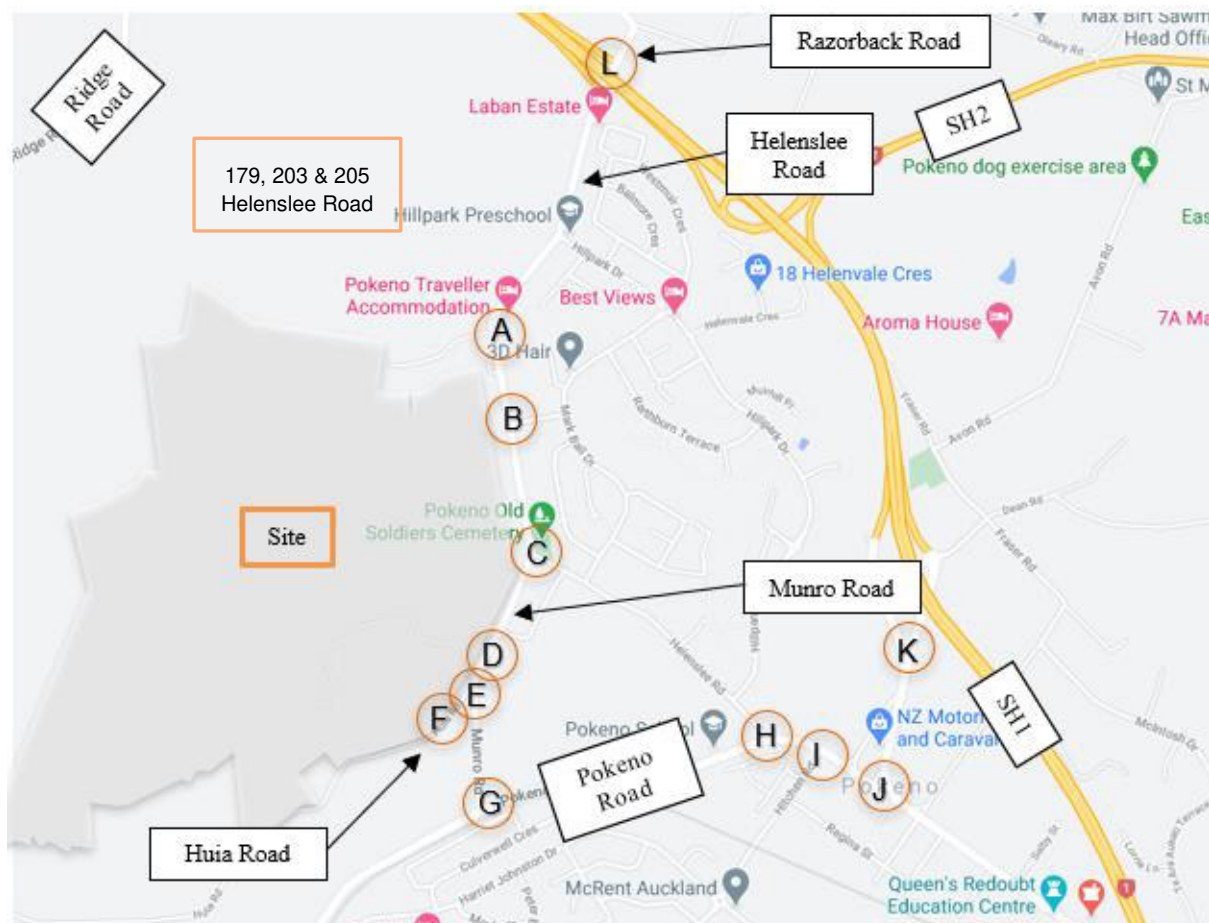
53 MUNRO ROAD SENSITIVITY ANALYSIS (MOVEMENT SUMMARY RESULTS)

The following memo outlines the results of a sensitivity assessment undertaken as part of a rezoning request proposed at 53 Munro Road in Pokeno. This document supplements the Transport evidence¹ provided for the site (dated 17th February 2021) and should be read in conjunction with that document.

1 GENERAL

Figure 1 outlines the location of each intersection assessed in relation to the site.

Figure 1: Location of each intersection in relation to the site



¹ Statement of transport evidence from Leo Donald Hills for Pokeno West Limited (97)

2 MOVEMENT SUMMARY RESULTS

2.1 INTERSECTION A – SITE ACCESS / HELENSLEE ROAD

Figure 2: Intersection A layout (indicative)

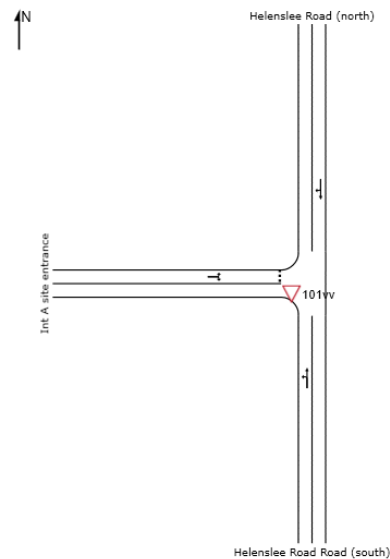


Figure 3: Intersection A - Movement summary 2040 AM

MOVEMENT SUMMARY

▽ Site: 101vv [Sensitivity test Int A 2040 AM]

New Site
Giveaway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Helenslee Road Road (south)											
1	L2	13	5.0	0.370	5.6	LOS A	0.0	0.0	0.00	0.01	57.9
2	T1	686	5.0	0.370	0.1	LOS A	0.0	0.0	0.00	0.01	59.8
Approach		699	5.0	0.370	0.2	NA	0.0	0.0	0.00	0.01	59.8
North: Helenslee Road (north)											
8	T1	563	5.0	0.347	0.8	LOS A	0.9	6.4	0.15	0.04	58.6
9	R2	37	5.0	0.347	11.3	LOS B	0.9	6.4	0.15	0.04	56.2
Approach		600	5.0	0.347	1.5	NA	0.9	6.4	0.15	0.04	58.4
West: Int A site entrance											
10	L2	147	5.0	0.258	9.9	LOS A	1.0	7.3	0.62	0.86	50.5
12	R2	49	5.0	0.258	8.4	LOS A	1.0	7.3	0.62	0.86	50.0
Approach		197	5.0	0.258	9.5	LOS A	1.0	7.3	0.62	0.86	50.4
All Vehicles		1496	5.0	0.370	1.9	NA	1.0	7.3	0.14	0.14	57.8

Figure 4: Intersection A - Movement summary 2040 PM

MOVEMENT SUMMARY

▽ Site: 101vv [Sensitivity test Int A 2040 PM]

New Site
Giveaway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Helenslee Road Road (south)											
1	L2	49	5.0	0.257	5.6	LOS A	0.0	0.0	0.00	0.06	57.5
2	T1	434	5.0	0.257	0.0	LOS A	0.0	0.0	0.00	0.06	59.4
Approach		483	5.0	0.257	0.6	NA	0.0	0.0	0.00	0.06	59.2
North: Helenslee Road (north)											
8	T1	742	5.0	0.537	1.6	LOS A	3.4	24.9	0.33	0.13	57.2
9	R2	147	5.0	0.537	10.0	LOS B	3.4	24.9	0.33	0.13	54.9
Approach		889	5.0	0.537	3.0	NA	3.4	24.9	0.33	0.13	56.8
West: Int A site entrance											
10	L2	37	5.0	0.051	7.3	LOS A	0.2	1.3	0.43	0.68	51.9
12	R2	13	5.0	0.051	8.2	LOS A	0.2	1.3	0.43	0.68	51.4
Approach		49	5.0	0.051	7.5	LOS A	0.2	1.3	0.43	0.68	51.8
All Vehicles		1422	5.0	0.537	2.4	NA	3.4	24.9	0.22	0.13	57.4

This is a new intersection being considered at the site. A give-way control layout has been used to assess the performance of the intersection.

In summary, using the volumes predicted at the intersection for the future year 2040 indicates that the lanes are likely to perform at a Level of service (LOS) A or B during the morning and afternoon peak hours respectively. A maximum 95%ile back of queue length of 24.9 m (3-4 vehicles) occurs during the afternoon peak hour on the northern approach (Helenslee Road); the degree of saturation for this approach is 0.537.

The maximum degree of the saturation for the overall intersection is 0.537 therefore is below capacity (0.8).

It is noted that the level of right turn movements predicted at this intersection potentially warrants a right turn bay on Helenslee Road. In this regard, this will need to be considered during the design stage of the intersection as part of subsequent stages.

2.2 INTERSECTION B – SITE ACCESS/ HELENSLEE ROAD / GATESHEAD ROAD

Figure 5: Intersection B layout (indicative)

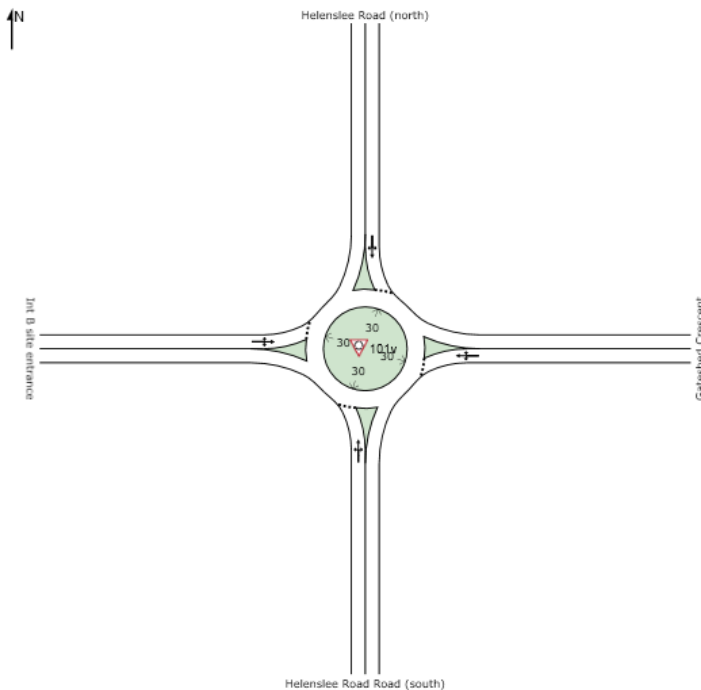


Figure 6: Intersection B - Movement summary 2040 AM

MOVEMENT SUMMARY

Site: 101v [Sensitivity test Int B 2040 AM]

New Site
Roundabout

Movement Performance - Vehicles												
Mov ID	OD Mov	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h	
South: Helenslee Road Road (south)												
1	L2	13	5.0	0.486	5.0	LOS A	4.3	31.7	0.60	0.52	53.6	
2	T1	551	5.0	0.486	4.8	LOS A	4.3	31.7	0.60	0.52	55.2	
3	R2	13	5.0	0.486	10.7	LOS B	4.3	31.7	0.60	0.52	55.4	
Approach		576	5.0	0.486	4.9	LOS A	4.3	31.7	0.60	0.52	55.2	
East: Gateshead Crescent												
4	L2	49	5.0	0.268	8.5	LOS A	1.8	13.2	0.79	0.82	49.6	
5	T1	1	5.0	0.268	8.3	LOS A	1.8	13.2	0.79	0.82	50.9	
6	R2	147	5.0	0.268	14.3	LOS B	1.8	13.2	0.79	0.82	51.0	
Approach		198	5.0	0.268	12.8	LOS B	1.8	13.2	0.79	0.82	50.7	
North: Helenslee Road (north)												
7	L2	37	5.0	0.452	3.9	LOS A	4.4	31.9	0.35	0.39	54.7	
8	T1	576	5.0	0.452	3.7	LOS A	4.4	31.9	0.35	0.39	56.3	
9	R2	37	5.0	0.452	9.6	LOS A	4.4	31.9	0.35	0.39	56.5	
Approach		649	5.0	0.452	4.0	LOS A	4.4	31.9	0.35	0.39	56.2	
West: Int B site entrance												
10	L2	147	5.0	0.293	9.1	LOS A	2.1	15.1	0.84	0.84	50.9	
11	T1	1	5.0	0.293	8.9	LOS A	2.1	15.1	0.84	0.84	52.3	
12	R2	49	5.0	0.293	14.8	LOS B	2.1	15.1	0.84	0.84	52.5	
Approach		198	5.0	0.293	10.5	LOS B	2.1	15.1	0.84	0.84	51.3	
All Vehicles		1621	5.0	0.486	6.2	LOS A	4.4	31.9	0.55	0.54	54.5	

Figure 7: Intersection B - Movement summary 2040 PM
MOVEMENT SUMMARY

Site: 101v [Sensitivity test Int B 2040 PM]

New Site
Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Helenslee Road Road (south)											
1	L2	49	5.0	0.454	5.0	LOS A	3.7	27.2	0.55	0.53	53.7
2	T1	446	5.0	0.454	4.7	LOS A	3.7	27.2	0.55	0.53	55.3
3	R2	49	5.0	0.454	10.7	LOS B	3.7	27.2	0.55	0.53	55.4
Approach		545	5.0	0.454	5.3	LOS A	3.7	27.2	0.55	0.53	55.1
East: Gateshead Crescent											
4	L2	13	5.0	0.078	9.0	LOS A	0.5	3.7	0.79	0.76	49.3
5	T1	1	5.0	0.078	8.7	LOS A	0.5	3.7	0.79	0.76	50.7
6	R2	37	5.0	0.078	14.7	LOS B	0.5	3.7	0.79	0.76	50.8
Approach		51	5.0	0.078	13.1	LOS B	0.5	3.7	0.79	0.76	50.4
North: Helenslee Road (north)											
7	L2	147	5.0	0.613	4.1	LOS A	7.2	52.8	0.42	0.43	54.0
8	T1	606	5.0	0.613	3.8	LOS A	7.2	52.8	0.42	0.43	55.6
9	R2	147	5.0	0.613	9.8	LOS A	7.2	52.8	0.42	0.43	55.8
Approach		901	5.0	0.613	4.8	LOS A	7.2	52.8	0.42	0.43	55.4
West: Int B site entrance											
10	L2	37	5.0	0.062	6.7	LOS A	0.4	2.8	0.67	0.66	52.6
11	T1	1	5.0	0.062	6.5	LOS A	0.4	2.8	0.67	0.66	54.2
12	R2	13	5.0	0.062	12.4	LOS B	0.4	2.8	0.67	0.66	54.3
Approach		51	5.0	0.062	8.1	LOS A	0.4	2.8	0.67	0.66	53.1
All Vehicles		1547	5.0	0.613	5.4	LOS A	7.2	52.8	0.49	0.49	55.0

This intersection is currently a give-way controlled 'T' intersection with priority afforded to traffic along Helenslee Road. The proposal intends to establish a connection to the existing Gateshead Road / Helenslee Road intersection from the west thereby forming a crossroad intersection. Should this occur, the control of the intersection is proposed to be upgraded to a roundabout control intersection. For the purpose of this assessment, a single lane roundabout has been used to assess the performance of this intersection for the future year 2040.

It is noted that the turning volumes to and from Gateshead Road were estimated using the turning volumes to/from the subject site as these were unknown.

In summary, using the volumes predicted at the intersection for the future year 2040 indicates that the lanes are likely to perform at a LOS A or B during the morning and afternoon peak hours. A maximum 95%ile back of queue length of 52.8m (7-8 vehicles) occurs during the afternoon peak hour on the northern approach (Helenslee Road); the degree of saturation for this approach is 0.613 therefore is below capacity (0.85).

As such, a single lane roundabout is considered sufficient to cater for the turning volumes proposed at this intersection.

2.3 INTERSECTION C – SITE ACCESS / HELENSLEE ROAD / MUNRO ROAD

Figure 8: Intersection C layout (indicative)

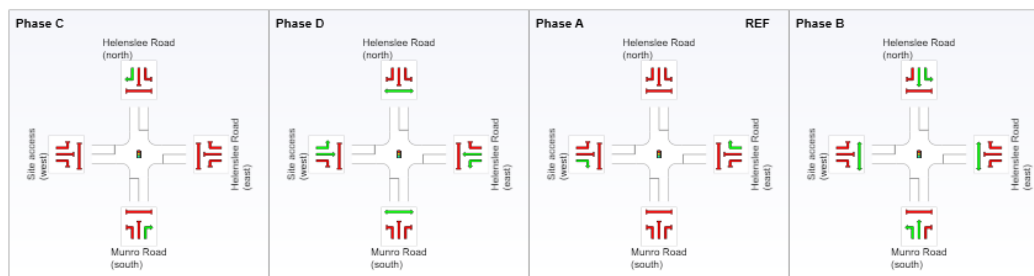
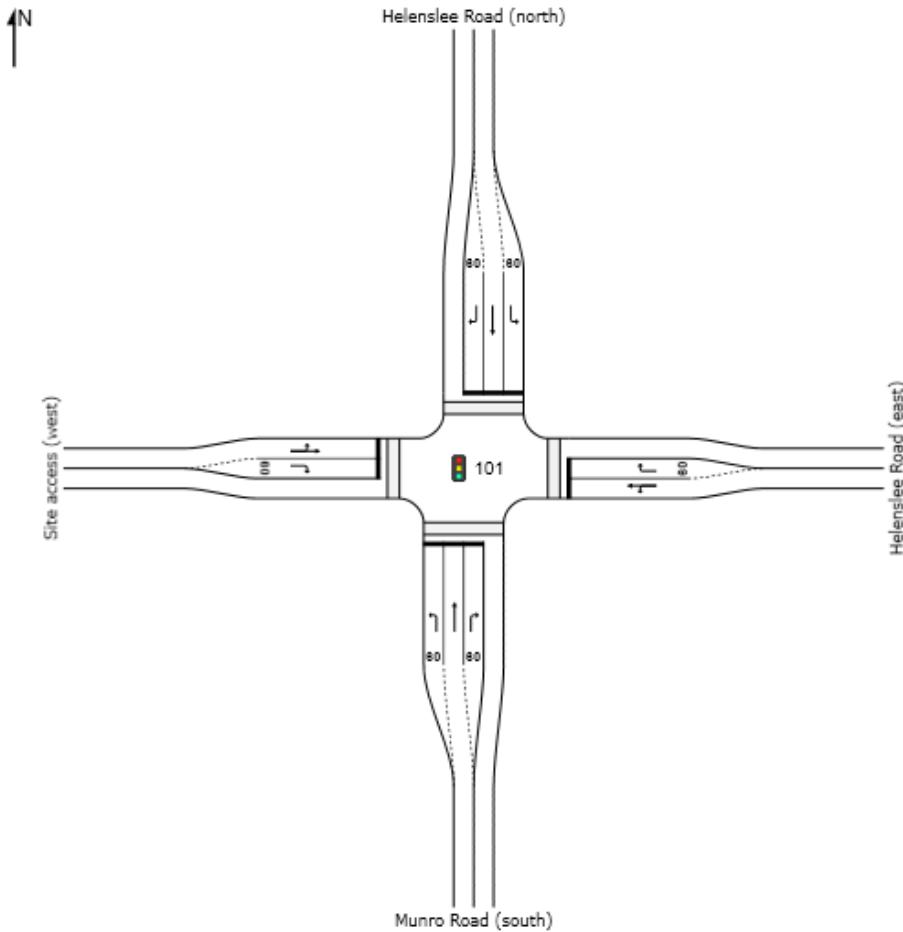


Figure 9: Intersection C - movement summary 2040 AM

MOVEMENT SUMMARY

Site: 101 [Sensitivity test Int C 2040 AM]

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Cycle Time)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Munro Road (south)											
1	L2	13	5.0	0.017	27.2	LOS C	0.4	3.1	0.61	0.66	40.6
2	T1	234	5.0	0.297	24.8	LOS C	9.0	65.7	0.71	0.60	42.6
3	R2	28	5.0	0.317	69.0	LOS E	1.7	12.6	1.00	0.72	27.6
Approach		275	5.0	0.317	29.5	LOS C	9.0	65.7	0.73	0.62	40.3
East: Helenslee Road (east)											
4	L2	2	5.0	0.041	47.9	LOS D	0.7	5.1	0.84	0.61	34.5
5	T1	13	5.0	0.041	42.3	LOS D	0.7	5.1	0.84	0.61	35.1
6	R2	181	5.0	0.577	55.5	LOS E	9.9	72.5	0.97	0.81	30.9
Approach		196	5.0	0.577	54.6	LOS D	9.9	72.5	0.96	0.80	31.2
North: Helenslee Road (north)											
7	L2	400	5.0	0.583	33.7	LOS C	17.5	127.5	0.80	0.82	37.9
8	T1	187	5.0	0.238	24.1	LOS C	7.0	51.2	0.69	0.57	43.0
9	R2	37	5.0	0.411	69.5	LOS E	2.2	16.4	1.00	0.73	27.5
Approach		624	5.0	0.583	32.9	LOS C	17.5	127.5	0.78	0.74	36.4
West: Site access (west)											
10	L2	147	5.0	0.565	53.7	LOS D	10.6	77.5	0.96	0.81	31.8
11	T1	49	5.0	0.565	46.1	LOS D	10.6	77.5	0.96	0.81	32.3
12	R2	49	5.0	0.158	51.2	LOS D	2.5	18.1	0.89	0.74	32.1
Approach		246	5.0	0.565	52.1	LOS D	10.6	77.5	0.94	0.80	31.9
All Vehicles		1341	5.0	0.583	38.9	LOS D	17.5	127.5	0.83	0.73	36.2

Figure 10: Intersection C - movement summary 2040 PM

MOVEMENT SUMMARY

Site: 101 [Sensitivity test Int C 2040 PM]

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Cycle Time)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Munro Road (south)											
1	L2	49	5.0	0.095	38.6	LOS D	2.1	15.3	0.76	0.72	36.0
2	T1	167	5.0	0.304	35.5	LOS D	7.6	55.4	0.82	0.68	37.9
3	R2	23	5.0	0.091	54.3	LOS D	1.2	8.7	0.90	0.71	31.1
Approach		240	5.0	0.304	37.9	LOS D	7.6	55.4	0.82	0.69	36.7
East: Helenslee Road (east)											
4	L2	9	5.0	0.291	60.2	LOS E	3.3	23.9	0.96	0.73	30.9
5	T1	49	5.0	0.291	54.6	LOS D	3.3	23.9	0.96	0.73	31.4
6	R2	292	5.0	0.558	44.4	LOS D	14.5	105.8	0.90	0.83	34.1
Approach		351	5.0	0.558	46.3	LOS D	14.5	105.8	0.91	0.81	33.6
North: Helenslee Road (north)											
7	L2	171	5.0	0.326	41.4	LOS D	7.8	57.0	0.83	0.78	35.1
8	T1	301	5.0	0.565	38.6	LOS D	14.9	108.6	0.90	0.77	36.7
9	R2	147	5.0	0.580	58.9	LOS E	8.3	60.6	0.98	0.81	29.9
Approach		619	5.0	0.580	44.2	LOS D	14.9	108.6	0.90	0.78	34.4
West: Site access (west)											
10	L2	37	5.0	0.251	60.0	LOS E	2.7	20.0	0.95	0.74	30.1
11	T1	13	5.0	0.251	54.4	LOS D	2.7	20.0	0.95	0.74	30.6
12	R2	13	5.0	0.024	37.7	LOS D	0.5	3.8	0.74	0.67	36.4
Approach		62	5.0	0.251	54.3	LOS D	2.7	20.0	0.91	0.72	31.3
All Vehicles		1272	5.0	0.580	44.1	LOS D	14.9	108.6	0.89	0.77	34.4

The Munro Road / Helenslee Road intersection is currently give-way controlled with priority afforded to traffic along Munro Road / Helenslee Road (north). The rezoning proposal intends to establish a connection to the Munro Road / Helenslee Road intersection from the west. As a result, the proposed intersection will be upgraded to a signalised intersection.

In summary, using the volumes predicted at this intersection for the future year 2040, the modelling results suggest a maximum queue length of 127.5 m on the northern approach (Helenslee Road) during the morning peak hour and 108.6 m during the afternoon peak hour respectively. The maximum degree of saturation for this approach is 0.583 therefore indicating this approach performs below capacity (0.9). It is noted that several lanes are expected to operate at a LOS E; the degree of saturation for these approaches is well below capacity of 0.9 therefore is considered acceptable.

The Pokeno Village Holdings Limited submission included a memo prepared by Arrive (dated 6th September 2018) which indicates the level of volumes provided in the **BECA report** (for which is used

in the above assessment) are excessive. If the Arrive report is correct, the volumes at the intersections will be lower than that predicted and therefore a lower scale of mitigation could be sufficient.

2.4 INTERSECTION D – SITE ACCESS / MUNRO ROAD

Figure 11: Intersection D layout (indicative)

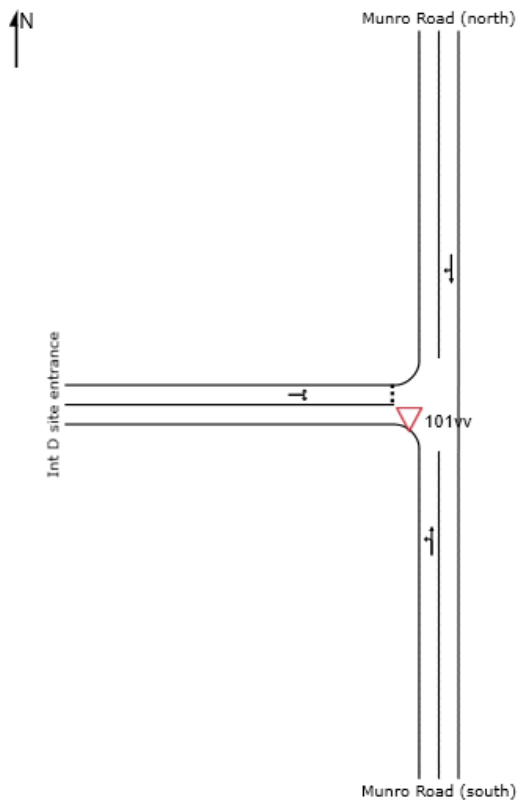


Figure 12: Intersection D - Movement summary 2040 AM

MOVEMENT SUMMARY

▽ Site: 101vv [Sensitivity test Int D 2040 AM]

New Site
Giveaway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Munro Road (south)											
1	L2	22	5.0	0.113	5.6	LOS A	0.0	0.0	0.00	0.06	57.6
2	T1	191	5.0	0.113	0.0	LOS A	0.0	0.0	0.00	0.06	59.4
Approach		213	5.0	0.113	0.6	NA	0.0	0.0	0.00	0.06	59.2
North: Munro Road (north)											
8	T1	218	5.0	0.131	0.1	LOS A	0.2	1.2	0.07	0.05	59.2
9	R2	21	5.0	0.131	6.3	LOS A	0.2	1.2	0.07	0.05	56.7
Approach		239	5.0	0.131	0.7	NA	0.2	1.2	0.07	0.05	59.0
West: Int D site entrance											
10	L2	84	5.0	0.118	6.3	LOS A	0.4	3.0	0.27	0.61	52.6
12	R2	88	5.0	0.118	6.1	LOS A	0.4	3.0	0.27	0.61	52.1
Approach		173	5.0	0.118	6.2	LOS A	0.4	3.0	0.27	0.61	52.4
All Vehicles		624	5.0	0.131	2.2	NA	0.4	3.0	0.10	0.21	57.1

Figure 13: Intersection D - Movement summary 2040 PM

MOVEMENT SUMMARY

▽ Site: 101vv [Sensitivity test Int D 2040 PM]

New Site
Giveaway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Munro Road (south)											
1	L2	88	5.0	0.165	5.6	LOS A	0.0	0.0	0.00	0.17	56.6
2	T1	218	5.0	0.165	0.0	LOS A	0.0	0.0	0.00	0.17	58.4
Approach		306	5.0	0.165	1.6	NA	0.0	0.0	0.00	0.17	57.9
North: Munro Road (north)											
8	T1	240	5.0	0.194	0.6	LOS A	0.7	5.1	0.26	0.17	57.6
9	R2	84	5.0	0.194	6.9	LOS A	0.7	5.1	0.26	0.17	55.3
Approach		324	5.0	0.194	2.2	NA	0.7	5.1	0.26	0.17	57.0
West: Int D site entrance											
10	L2	21	5.0	0.031	6.3	LOS A	0.1	0.7	0.28	0.60	52.6
12	R2	22	5.0	0.031	6.2	LOS A	0.1	0.7	0.28	0.60	52.1
Approach		43	5.0	0.031	6.3	LOS A	0.1	0.7	0.28	0.60	52.3
All Vehicles		674	5.0	0.194	2.2	NA	0.7	5.1	0.14	0.20	57.1

The potential location of this connection has shifted when compared to the concept layout outlined in the ITA. The revised location now intends to establish a new 'T' controlled intersection on Munro Road, south of the existing Munro Road / Thomason Crescent intersection.

A give-way control layout has been used to assess the performance of this intersection.

In summary, using the volumes predicted at the intersection for the future year 2040, the modelling indicates that the lanes are likely to perform at a LOS A during the morning and afternoon peak hours. The maximum degree of saturation of the intersection is 0.194 therefore is expected to perform well below capacity (0.8).

Similar to Intersection A, there is potential for the level of right turn movements at this intersection to warrant a right turn bay on Munro Road; this will need to be considered at subsequent stages.

2.5 INTERSECTION E – MUNRO ROAD / HUIA ROAD

Figure 14: Intersection E layout (indicative)

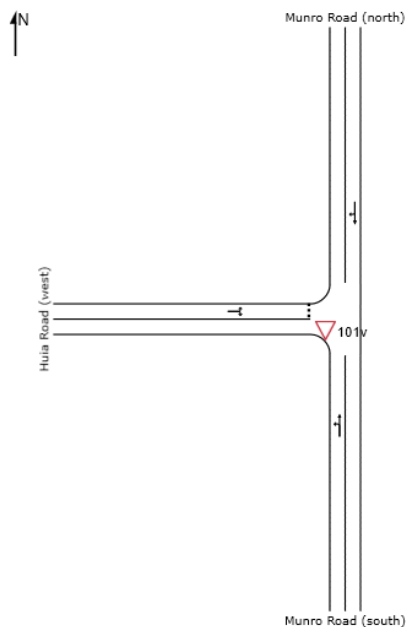


Figure 15: Intersection E Movement summary 2040 AM

MOVEMENT SUMMARY

▽ Site: 101v [Sensitivity test Int E 2040 AM]

New Site
Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Munro Road (south)											
1	L2	29	5.0	0.090	5.6	LOS A	0.0	0.0	0.00	0.10	57.2
2	T1	139	5.0	0.090	0.0	LOS A	0.0	0.0	0.00	0.10	59.0
Approach		168	5.0	0.090	1.0	NA	0.0	0.0	0.00	0.10	58.7
North: Munro Road (north)											
8	T1	288	5.0	0.167	0.1	LOS A	0.2	1.2	0.05	0.04	59.4
9	R2	20	5.0	0.167	6.2	LOS A	0.2	1.2	0.05	0.04	57.0
Approach		308	5.0	0.167	0.5	NA	0.2	1.2	0.05	0.04	59.3
West: Huia Road (west)											
10	L2	74	5.0	0.115	6.1	LOS A	0.4	2.8	0.23	0.60	52.8
12	R2	99	5.0	0.115	6.1	LOS A	0.4	2.8	0.23	0.60	52.2
Approach		173	5.0	0.115	6.1	LOS A	0.4	2.8	0.23	0.60	52.5
All Vehicles		649	5.0	0.167	2.1	NA	0.4	2.8	0.08	0.21	57.2

Figure 16: Intersection E Movement summary 2040 PM

MOVEMENT SUMMARY

▽ Site: 101v [Sensitivity test Int E 2040 PM]

New Site
Giveaway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Munro Road (south)											
1	L2	104	5.0	0.211	5.6	LOS A	0.0	0.0	0.00	0.16	56.7
2	T1	288	5.0	0.211	0.0	LOS A	0.0	0.0	0.00	0.16	58.5
Approach		393	5.0	0.211	1.5	NA	0.0	0.0	0.00	0.16	58.1
North: Munro Road (north)											
8	T1	187	5.0	0.164	0.9	LOS A	0.7	4.8	0.31	0.19	57.3
9	R2	75	5.0	0.164	7.3	LOS A	0.7	4.8	0.31	0.19	55.0
Approach		262	5.0	0.164	2.7	NA	0.7	4.8	0.31	0.19	56.6
West: Huia Road (west)											
10	L2	19	5.0	0.032	6.6	LOS A	0.1	0.7	0.32	0.62	52.5
12	R2	24	5.0	0.032	6.2	LOS A	0.1	0.7	0.32	0.62	52.0
Approach		43	5.0	0.032	6.4	LOS A	0.1	0.7	0.32	0.62	52.2
All Vehicles		698	5.0	0.211	2.3	NA	0.7	4.8	0.14	0.20	57.1

The Munro Road / Huia Road intersection is a priority-controlled intersection with priority afforded to traffic along Munro Road. This intersection does not connect directly to **the site** however it does serve as the only access, via the existing road network, to the southernmost access (Intersection F) on Huia Road.

In summary, using the existing layout (give-way control) and the volumes predicted at this intersection for the future year 2040, the modelling indicates that the lanes are likely to perform at a LOS A during the morning and afternoon peak hours. The maximum degree of saturation of the intersection is 0.211 therefore it is expected to perform well below capacity (0.8).

Similar to Intersection A, there is potential for the level of right turn movements at this intersection to warrant a right turn bay on Munro Road; this will need to be considered at subsequent stages.

2.6 INTERSECTION F – SITE ACCESS / HUIA ROAD

Figure 17: Intersection F layout (indicative)

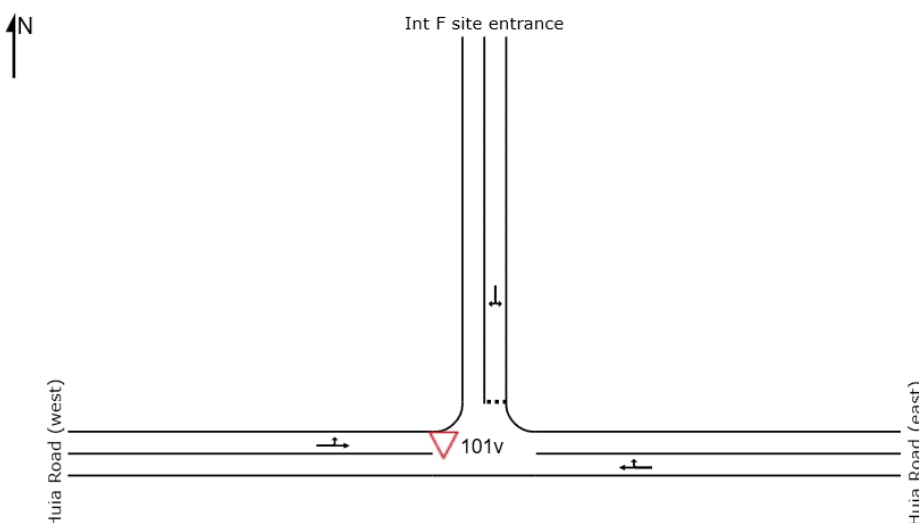


Figure 18: Intersection F Movement summary 2040 AM

MOVEMENT SUMMARY

Site: 101v [Sensitivity test Int F 2040 AM]

New Site
Giveaway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Huia Road (east)											
5	T1	6	5.0	0.028	0.0	LOS A	0.1	0.9	0.02	0.52	55.6
6	R2	43	5.0	0.028	5.5	LOS A	0.1	0.9	0.02	0.52	53.4
Approach		49	5.0	0.028	4.8	NA	0.1	0.9	0.02	0.52	53.7
North: Int F site entrance											
7	L2	173	5.0	0.109	5.6	LOS A	0.5	3.4	0.01	0.57	53.4
9	R2	1	5.0	0.109	5.6	LOS A	0.5	3.4	0.01	0.57	52.8
Approach		174	5.0	0.109	5.6	LOS A	0.5	3.4	0.01	0.57	53.4
West: Huia Road (west)											
10	L2	1	5.0	0.001	5.6	LOS A	0.0	0.0	0.00	0.29	55.7
11	T1	1	5.0	0.001	0.0	LOS A	0.0	0.0	0.00	0.29	57.4
Approach		2	5.0	0.001	2.8	NA	0.0	0.0	0.00	0.29	56.5
All Vehicles		225	5.0	0.109	5.4	NA	0.5	3.4	0.01	0.56	53.5

Figure 19: Intersection F Movement summary 2040 PM

MOVEMENT SUMMARY

Site: 101v [Sensitivity test Int F 2040 PM]

New Site
Giveaway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Huia Road (east)											
5	T1	6	5.0	0.102	0.0	LOS A	0.5	3.7	0.02	0.57	55.1
6	R2	173	5.0	0.102	5.5	LOS A	0.5	3.7	0.02	0.57	53.0
Approach		179	5.0	0.102	5.3	NA	0.5	3.7	0.02	0.57	53.1
North: Int F site entrance											
7	L2	43	5.0	0.028	5.6	LOS A	0.1	0.8	0.01	0.57	53.4
9	R2	1	5.0	0.028	5.7	LOS A	0.1	0.8	0.01	0.57	52.9
Approach		44	5.0	0.028	5.6	LOS A	0.1	0.8	0.01	0.57	53.4
West: Huia Road (west)											
10	L2	1	5.0	0.001	5.6	LOS A	0.0	0.0	0.00	0.29	55.7
11	T1	1	5.0	0.001	0.0	LOS A	0.0	0.0	0.00	0.29	57.4
Approach		2	5.0	0.001	2.8	NA	0.0	0.0	0.00	0.29	56.5
All Vehicles		225	5.0	0.102	5.4	NA	0.5	3.7	0.02	0.57	53.2

This intersection forms one of the five potential connections to the existing road network. A give-way control layout has been used to assess the performance of this intersection (similar to that considered in the original **ITA**).

In summary, using the volumes predicted at this intersection for the future year 2040, the modelling indicates that all lanes are expected to operate at a LOS A during the morning and afternoon peak hour respectively.

The maximum degree of saturation of the intersection is 0.109 thereby indicating that the intersection will perform well below capacity (0.8).

Similar to Intersection A, there is potential for the level of right turn movements at this intersection to warrant a right turn bay on Huia Road; this will need to be considered at subsequent stages.

2.7 INTERSECTION G – MUNRO ROAD / POKENO ROAD (EXISTING LAYOUT)

Figure 20: Intersection G existing layout (indicative)

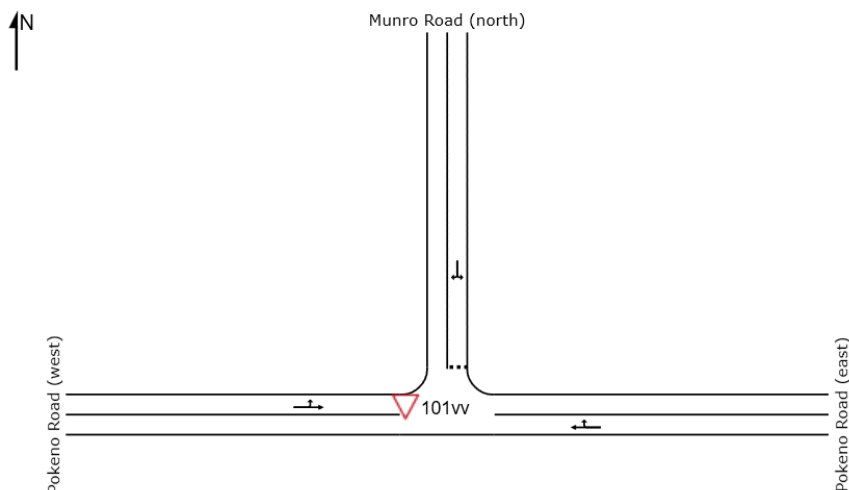


Figure 21: Intersection G Movement summary 2040 AM

MOVEMENT SUMMARY

▽ Site: 101vv [Sensitivity test Int G 2040 AM Existing layout]

New Site
Giveaway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Pokeno Road (east)											
5	T1	436	5.0	0.262	0.4	LOS A	0.4	3.2	0.11	0.04	59.1
6	R2	27	5.0	0.262	9.3	LOS A	0.4	3.2	0.11	0.04	56.6
Approach		463	5.0	0.262	1.0	NA	0.4	3.2	0.11	0.04	58.9
North: Munro Road (north)											
7	L2	95	5.0	0.347	8.2	LOS A	1.4	9.9	0.50	0.82	51.7
9	R2	292	5.0	0.347	7.6	LOS A	1.4	9.9	0.50	0.82	51.2
Approach		386	5.0	0.347	7.8	LOS A	1.4	9.9	0.50	0.82	51.4
West: Pokeno Road (west)											
10	L2	141	5.0	0.317	5.6	LOS A	0.0	0.0	0.00	0.14	56.8
11	T1	451	5.0	0.317	0.0	LOS A	0.0	0.0	0.00	0.14	58.6
Approach		592	5.0	0.317	1.4	NA	0.0	0.0	0.00	0.14	58.2
All Vehicles		1441	5.0	0.347	3.0	NA	1.4	9.9	0.17	0.29	56.4

Figure 22: Intersection G Movement summary 2040 PM

MOVEMENT SUMMARY

▽ Site: 101vv [Sensitivity test Int G 2040 PM Existing layout]

New Site
Giveaway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Pokeno Road (east)											
5	T1	567	5.0	0.440	2.6	LOS A	2.7	19.7	0.39	0.11	56.2
6	R2	93	5.0	0.440	13.2	LOS B	2.7	19.7	0.39	0.11	54.0
Approach		660	5.0	0.440	4.1	NA	2.7	19.7	0.39	0.11	55.9
North: Munro Road (north)											
7	L2	29	5.0	0.228	7.9	LOS A	0.7	5.1	0.56	0.83	51.5
9	R2	183	5.0	0.228	8.2	LOS A	0.7	5.1	0.56	0.83	51.0
Approach		213	5.0	0.228	8.1	LOS A	0.7	5.1	0.56	0.83	51.1
West: Pokeno Road (west)											
10	L2	299	5.0	0.416	5.7	LOS A	0.0	0.0	0.00	0.23	56.1
11	T1	471	5.0	0.416	0.1	LOS A	0.0	0.0	0.00	0.23	57.8
Approach		769	5.0	0.416	2.2	NA	0.0	0.0	0.00	0.23	57.1
All Vehicles		1642	5.0	0.440	3.7	NA	2.7	19.7	0.23	0.26	55.8

The Munro Road / Pokeno Road intersection is currently give-way controlled. The **BECA report** indicates that this intersection warrants a give-way control (existing) or roundabout by the year 2022 and 2040. In this regard, two model runs have been undertaken for this intersection and include the existing layout (give-way control) and a roundabout control respectively.

In summary, using the existing layout and the volumes predicted at this intersection for the future year 2040, the modelling results indicate that the lanes are likely to perform at a LOS A or B during the morning and afternoon peak hours. The maximum degree of saturation of the intersection is 0.440 thereby indicating that the intersection operates below capacity (0.8) and a give-way control layout can serve the proposed volumes from a capacity perspective.

2.8 INTERSECTION G - MUNRO ROAD / POKENO ROAD (POTENTIAL LAYOUT)

Figure 23: Intersection G potential layout (indicative)

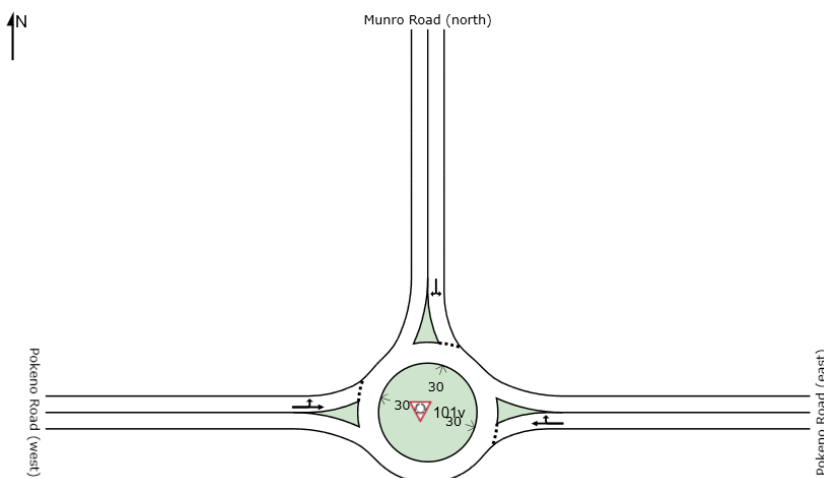


Figure 24: Intersection G Movement summary 2040 AM

MOVEMENT SUMMARY

Site: 101v [Sensitivity test Int G 2040 AM rab]

New Site
Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Pokeno Road (east)											
5	T1	436	5.0	0.454	5.6	LOS A	3.8	27.4	0.70	0.61	54.6
6	R2	27	5.0	0.454	11.6	LOS B	3.8	27.4	0.70	0.61	54.7
Approach		463	5.0	0.454	6.0	LOS A	3.8	27.4	0.70	0.61	54.6
North: Munro Road (north)											
7	L2	95	5.0	0.423	7.1	LOS A	3.0	22.2	0.73	0.78	50.5
9	R2	292	5.0	0.423	12.9	LOS B	3.0	22.2	0.73	0.78	52.0
Approach		386	5.0	0.423	11.5	LOS B	3.0	22.2	0.73	0.78	51.6
West: Pokeno Road (west)											
10	L2	141	5.0	0.380	3.6	LOS A	3.5	25.7	0.21	0.35	55.6
11	T1	451	5.0	0.380	3.3	LOS A	3.5	25.7	0.21	0.35	57.3
Approach		592	5.0	0.380	3.4	LOS A	3.5	25.7	0.21	0.35	56.9
All Vehicles		1441	5.0	0.454	6.4	LOS A	3.8	27.4	0.51	0.55	54.6

Figure 25: Intersection G Movement summary 2040 PM

MOVEMENT SUMMARY

Site: 101v [Sensitivity test Int G 2040 PM rab]

New Site
Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Pokeno Road (east)											
5	T1	567	5.0	0.553	4.9	LOS A	5.4	39.6	0.65	0.55	54.6
6	R2	93	5.0	0.553	10.8	LOS B	5.4	39.6	0.65	0.55	54.8
Approach		660	5.0	0.553	5.7	LOS A	5.4	39.6	0.65	0.55	54.6
North: Munro Road (north)											
7	L2	29	5.0	0.246	6.7	LOS A	1.7	12.1	0.70	0.76	50.4
9	R2	183	5.0	0.246	12.4	LOS B	1.7	12.1	0.70	0.76	51.9
Approach		213	5.0	0.246	11.7	LOS B	1.7	12.1	0.70	0.76	51.7
West: Pokeno Road (west)											
10	L2	299	5.0	0.559	4.3	LOS A	6.1	44.3	0.49	0.44	54.3
11	T1	471	5.0	0.559	4.0	LOS A	6.1	44.3	0.49	0.44	56.0
Approach		769	5.0	0.559	4.1	LOS A	6.1	44.3	0.49	0.44	55.3
All Vehicles		1642	5.0	0.559	5.7	LOS A	6.1	44.3	0.58	0.53	54.5

Using a single lane roundabout layout and the volumes predicted at this intersection for the future year 2040, the modelling results indicate that the lanes continue to perform at a LOS A or B during the peak hours. The maximum degree of saturation increases to 0.559 (afternoon peak hour) however remains within capacity (0.85). As such, a single lane roundabout is considered sufficient to cater for the volumes predicted at this intersection for the year 2040 (subject to changes in demand).

2.9 INTERSECTION H – HELENSLEE ROAD / POKENO ROAD

Figure 26: Intersection H layout (indicative)

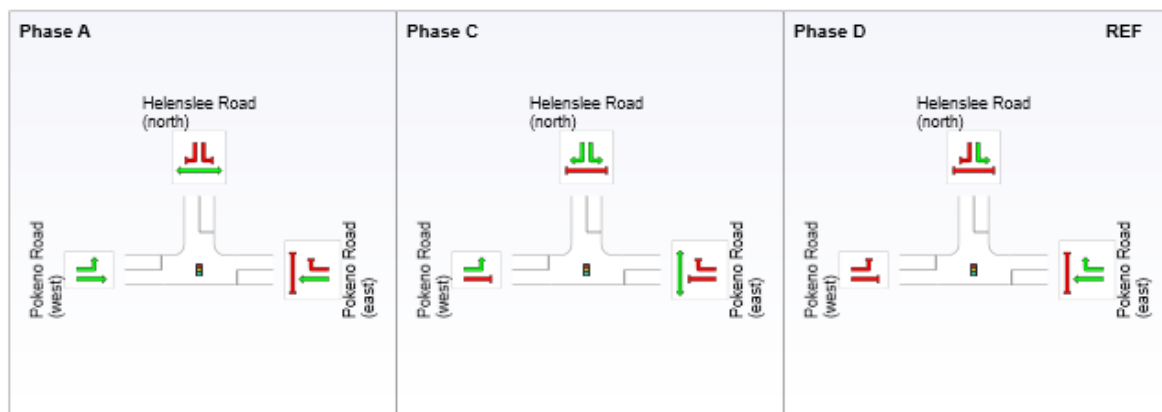
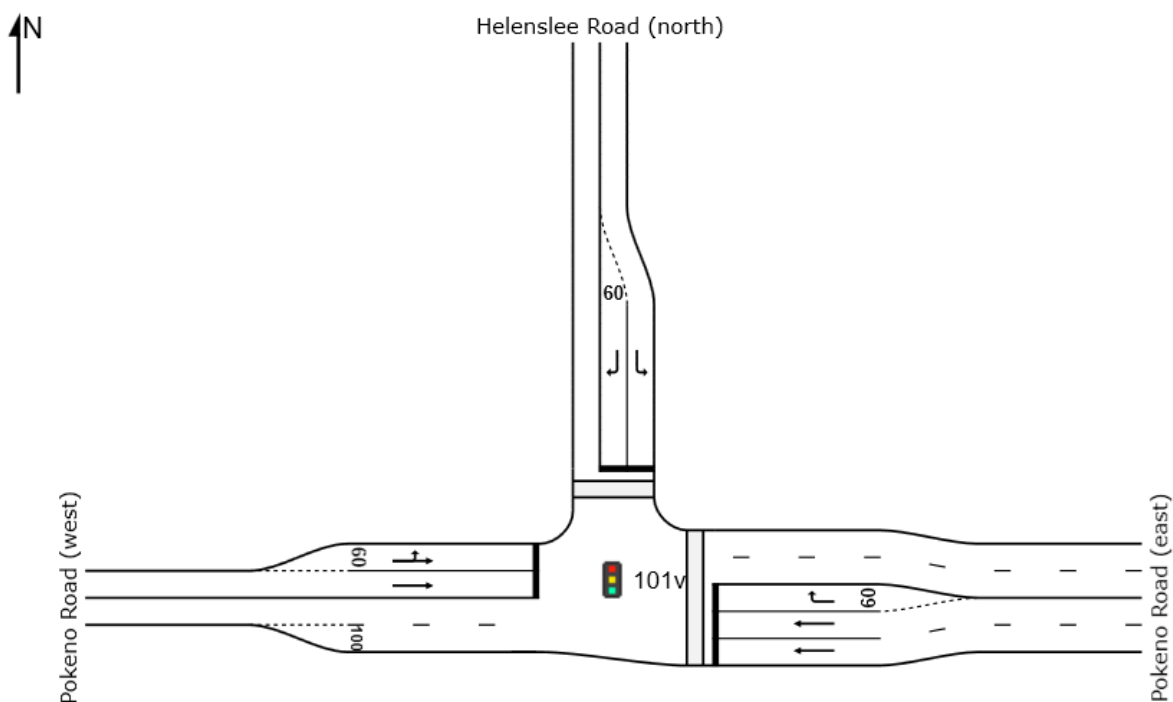



Figure 27: Intersection H Movement summary 2040 AM

MOVEMENT SUMMARY

 Site: 101v [Sensitivity test Int H 2040 AM - signals]

New Site

Signals - Fixed Time Coordinated Cycle Time = 100 seconds (User-Given Cycle Time)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Pokeno Road (east)											
5	T1	421	5.0	0.193	0.3	LOS A	0.3	2.4	0.03	0.02	59.7
6	R2	209	5.0	0.285	16.9	LOS B	4.0	29.2	0.42	0.69	45.8
Approach		631	5.0	0.285	5.8	LOS A	4.0	29.2	0.16	0.24	54.2
North: Helenslee Road (north)											
7	L2	547	5.0	0.533	17.9	LOS B	15.2	111.1	0.62	0.77	45.3
9	R2	37	5.0	0.158	48.3	LOS D	1.6	12.0	0.92	0.73	32.8
Approach		584	5.0	0.533	19.8	LOS B	15.2	111.1	0.64	0.77	44.2
West: Pokeno Road (west)											
10	L2	25	5.0	0.533	38.0	LOS D	11.7	85.3	0.89	0.76	38.1
11	T1	539	5.0	0.533	32.8	LOS C	11.7	85.7	0.90	0.76	38.9
Approach		564	5.0	0.533	33.0	LOS C	11.7	85.7	0.90	0.76	38.9
All Vehicles		1779	5.0	0.533	19.0	LOS B	15.2	111.1	0.55	0.58	45.2

Figure 28: Intersection H Movement summary 2040 PM

MOVEMENT SUMMARY

 Site: 101v [Sensitivity test Int H 2040 PM - signals]

New Site

Signals - Fixed Time Coordinated Cycle Time = 100 seconds (User-Given Cycle Time)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Pokeno Road (east)											
5	T1	644	5.0	0.295	0.3	LOS A	0.6	4.1	0.03	0.02	59.7
6	R2	448	5.0	0.463	8.9	LOS A	3.7	27.1	0.18	0.63	51.0
Approach		1093	5.0	0.463	3.8	LOS A	3.7	27.1	0.09	0.27	55.8
North: Helenslee Road (north)											
7	L2	229	5.0	0.175	6.1	LOS A	0.4	2.6	0.03	0.58	53.0
9	R2	17	5.0	0.072	47.5	LOS D	0.7	5.1	0.86	0.69	33.0
Approach		246	5.0	0.175	8.9	LOS A	0.7	5.1	0.09	0.59	50.9
West: Pokeno Road (west)											
10	L2	24	5.0	0.903	64.3	LOS E	15.0	109.3	1.00	1.07	29.9
11	T1	489	5.0	0.903	58.7	LOS E	15.0	109.3	1.00	1.07	30.5
Approach		514	5.0	0.903	59.0	LOS E	15.0	109.3	1.00	1.07	30.4
All Vehicles		1853	5.0	0.903	19.8	LOS B	15.0	109.3	0.34	0.54	44.9

The Helenslee Road / Pokeno Road intersection is existing and controlled by a give-way control intersection. The **BECA report** indicates that this intersection warrants an upgrade to a signal or roundabout intersection form by the year 2022 and 2040.

A signalised intersection form has been used to assess the performance of this intersection.

In summary, the lanes are expected to operate at a LOS A-E. The maximum degree of saturation for any approach is 533 during the morning peak hour and 0.903 during the afternoon peak hour and occurs on the western approach (Pokeno Road). The maximum 95%ile back of queue length for this approach is 109.3m (15 vehicles). Based on the above assessment, this intersection is expected to experience a minor level of congestion on the western approach (0.903) during the afternoon peak hour only by the future year 2040, however is within acceptable levels.

2.10 INTERSECTION I – HITCHEN ROAD / POKENO ROAD

Figure 29: Intersection I layout (indicative)

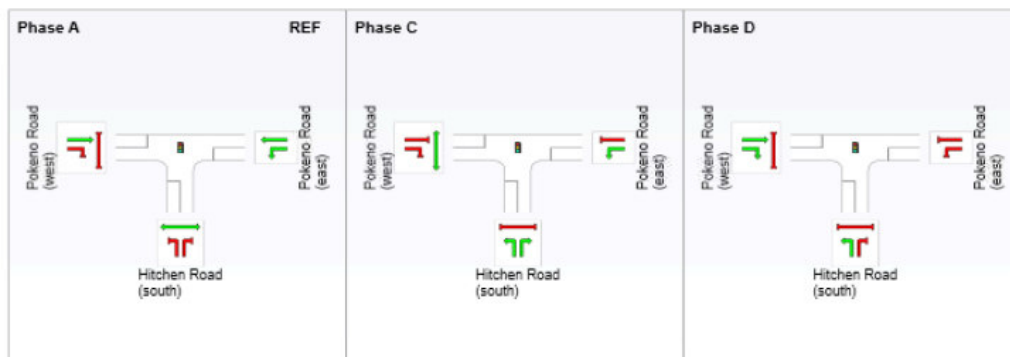
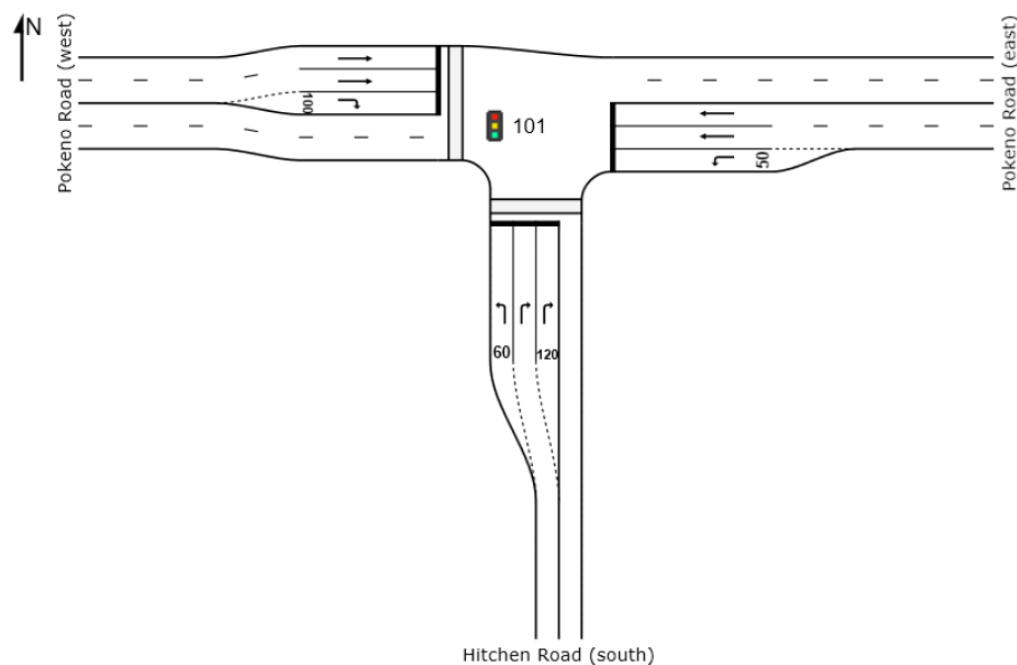


Figure 30: Intersection I Movement summary 2040 AM

MOVEMENT SUMMARY

Site: 101 [Sensitivity test Int I 2040 AM]

New Site
Signals - Fixed Time Coordinated Cycle Time = 100 seconds (User-Given Cycle Time)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: McLean Street (south)											
1	L2	181	5.0	0.171	15.5	LOS B	4.0	28.9	0.48	0.70	46.7
3	R2	264	5.0	0.567	51.4	LOS D	6.3	46.0	0.99	0.80	32.0
Approach		445	5.0	0.567	36.8	LOS D	6.3	46.0	0.78	0.76	36.7
East: Pokeno Road (east)											
4	L2	460	5.0	0.611	18.2	LOS B	11.8	85.8	0.56	0.75	45.1
5	T1	522	5.0	0.532	26.5	LOS C	9.5	69.3	0.78	0.66	41.8
Approach		982	5.0	0.611	22.6	LOS C	11.8	85.8	0.68	0.70	43.3
West: Pokeno Road (west)											
11	T1	667	5.0	0.236	0.3	LOS A	0.4	3.0	0.03	0.02	59.7
12	R2	419	5.0	0.543	16.9	LOS B	9.5	69.1	0.50	0.72	46.0
Approach		1086	5.0	0.543	6.7	LOS A	9.5	69.1	0.21	0.29	53.5
All Vehicles		2514	5.0	0.611	18.3	LOS B	11.8	85.8	0.49	0.53	45.6

Figure 31: Intersection I Movement summary 2040 PM

MOVEMENT SUMMARY

Site: 101 [Sensitivity test Int I 2040 PM]

New Site
Signals - Fixed Time Coordinated Cycle Time = 100 seconds (User-Given Cycle Time)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: McLean Street (south)											
1	L2	281	5.0	0.435	31.8	LOS C	10.4	76.1	0.81	0.80	38.6
3	R2	446	5.0	0.889	63.3	LOS E	12.7	92.6	1.00	0.99	29.0
Approach		727	5.0	0.889	51.1	LOS D	12.7	92.6	0.93	0.92	32.1
East: Pokeno Road (east)											
4	L2	294	5.0	0.248	6.0	LOS A	0.4	2.7	0.03	0.58	53.1
5	T1	1093	5.0	0.590	7.0	LOS A	9.4	68.4	0.38	0.34	53.8
Approach		1386	5.0	0.590	6.8	LOS A	9.4	68.4	0.31	0.39	53.6
West: Pokeno Road (west)											
11	T1	515	5.0	0.184	0.3	LOS A	0.3	2.2	0.03	0.02	59.7
12	R2	203	5.0	0.596	40.1	LOS D	8.6	62.6	0.89	0.80	35.7
Approach		718	5.0	0.596	11.6	LOS B	8.6	62.6	0.27	0.24	50.1
All Vehicles		2832	5.0	0.889	19.4	LOS B	12.7	92.6	0.46	0.49	45.1

The **BECA report** indicates that this intersection warrants signals or a roundabout control by the year 2022 (currently give-way controlled).

A signalised intersection form has been used to assess the performance of this intersection.

Using the traffic volumes predicted at the intersection for the future year 2040, the modelling indicates the following:

- widening is likely required along Pokeno Road and Hitchen Road to accommodate additional lanes to cater for the future traffic volumes;
- during the morning peak hour, the maximum degree of saturation is 0.611 and occurs at the left turn movement (eastern approach). This approach is expected to operate at a LOS B and comprises a 95%ile back of queue length of 86 m (11-12 vehicles);


- During the afternoon peak hour, the maximum degree of saturation is 0.889 (LOS E) and occurs on the southern approach (right turn). The maximum 95%ile queue length for this approach is 93 m (12-13-vehicles).

Based on the above, with the volumes predicted for the future year 2040, the modelling results indicates that this intersection is expected to experience some level of congestion (on the right turn lane on the southern approach) however is expected to operate below capacity (0.9).

2.11 INTERSECTION J – GREAT SOUTH ROAD / POKENO ROAD

Figure 32: Intersection J layout (indicative)

SITE LAYOUT

 Site: 101v [Sensitivity test Int J 2040 PM - signals]

New Site
Signals - Fixed Time Isolated

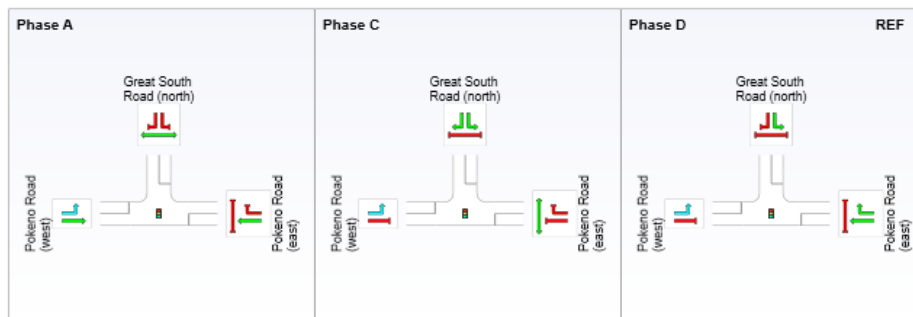
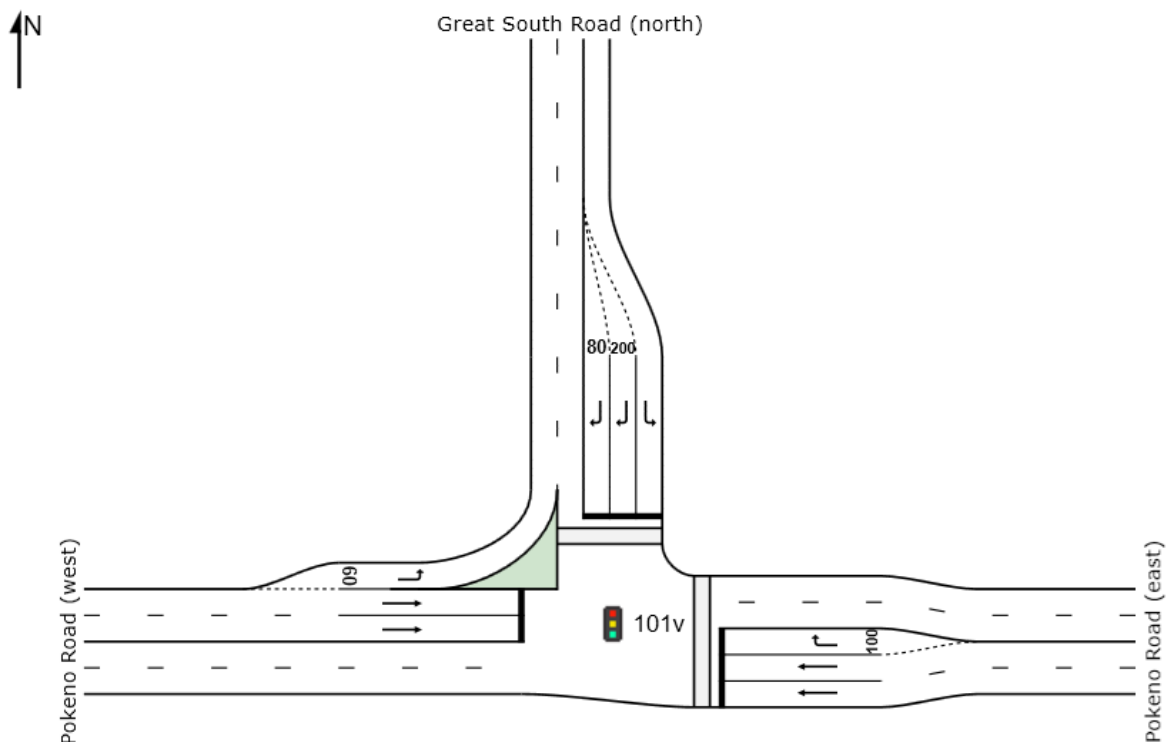


Figure 33: Intersection J Movement summary 2040 AM

MOVEMENT SUMMARY

 Site: 101v [Sensitivity test Int J 2040 AM - signals]

New Site
Signals - Fixed Time Isolated Cycle Time = 100 seconds (User-Given Cycle Time)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Pokeno Road (east)											
5	T1	283	5.0	0.147	13.8	LOS B	3.6	26.3	0.56	0.46	49.0
6	R2	204	5.0	0.599	46.5	LOS D	9.3	68.2	0.97	0.82	33.6
Approach		487	5.0	0.599	27.5	LOS C	9.3	68.2	0.73	0.61	41.1
North: Great South Road (north)											
7	L2	603	5.0	0.543	17.2	LOS B	16.7	121.7	0.62	0.78	45.7
9	R2	793	5.0	0.597	33.1	LOS C	15.7	114.6	0.86	0.83	38.2
Approach		1396	5.0	0.597	26.2	LOS C	16.7	121.7	0.76	0.81	41.1
West: Pokeno Road (west)											
10	L2	480	5.0	0.268	5.7	LOS A	0.0	0.0	0.00	0.53	54.7
11	T1	596	5.0	0.607	35.4	LOS D	12.9	94.4	0.93	0.79	38.0
Approach		1076	5.0	0.607	22.2	LOS C	12.9	94.4	0.52	0.67	44.0
All Vehicles		2959	5.0	0.607	25.0	LOS C	16.7	121.7	0.67	0.73	42.1

Figure 34: Intersection J Movement summary 2040 PM

MOVEMENT SUMMARY

 Site: 101v [Sensitivity test Int J 2040 PM - signals]

New Site
Signals - Fixed Time Isolated Cycle Time = 100 seconds (User-Given Cycle Time)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Pokeno Road (east)											
5	T1	875	5.0	0.331	6.2	LOS A	8.2	59.7	0.42	0.37	54.5
6	R2	664	5.0	0.772	26.8	LOS C	25.6	186.8	0.84	0.86	40.9
Approach		1539	5.0	0.772	15.1	LOS B	25.6	186.8	0.60	0.58	47.7
North: Great South Road (north)											
7	L2	311	5.0	0.231	9.6	LOS A	4.5	32.8	0.32	0.67	50.5
9	R2	520	5.0	0.805	53.6	LOS D	13.4	97.9	1.00	0.92	31.5
Approach		831	5.0	0.805	37.1	LOS D	13.4	97.9	0.75	0.82	36.7
West: Pokeno Road (west)											
10	L2	872	5.0	0.486	5.7	LOS A	0.0	0.0	0.00	0.53	54.7
11	T1	321	5.0	0.654	46.9	LOS D	7.8	57.2	1.00	0.83	34.0
Approach		1193	5.0	0.654	16.8	LOS B	7.8	57.2	0.27	0.61	47.0
All Vehicles		3562	5.0	0.805	20.8	LOS C	25.6	186.8	0.52	0.65	44.4

This intersection currently operates as a give-way control intersection.

The **BECA report** identifies that this intersection warrants a roundabout or signals by the year 2022 and 2040. In this regard, a signalised intersection layout has been used to model the traffic volumes predicted at this intersection for the future year 2040.

Using the traffic volumes predicted at the intersection for the future year 2040, the modelling indicates the following:

- widening is likely required along Pokeno Road and Great South Road to accommodate additional lanes to cater for the future traffic volumes;
- during the morning peak hour, the maximum degree of saturation is 0.607 and 0.805 during the afternoon peak hour respectively;

- The maximum 95th percentile queue length ranges from 121.7 m to 186.8 m during the morning and afternoon peak hour respectively.
- Based on the above, with the volumes predicted at this intersection for the future year 2040, the modelling indicates that this intersection is expected to operate below capacity (0.9).

2.12 INTERSECTION K – SH1 GREAT SOUTH ROAD (ON-RAMP) INTERCHANGE

Figure 35: Intersection K layout (indicative)

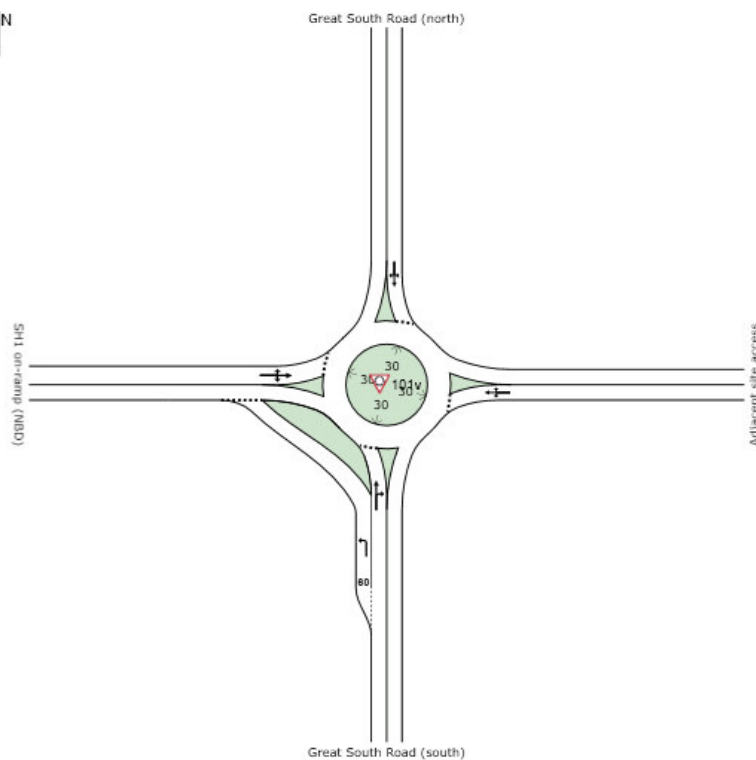


Figure 36: Intersection K Movement summary 2040 AM

MOVEMENT SUMMARY

Site: 101v [Sensitivity test Int K 2040 AM]

New Site
Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Great South Road (south)											
1	L2	107	5.0	0.086	4.9	LOS A	0.5	3.7	0.49	0.53	54.7
2	T1	618	5.0	0.499	5.5	LOS A	4.0	29.5	0.67	0.60	54.9
3	R2	11	5.0	0.499	11.5	LOS B	4.0	29.5	0.67	0.60	55.0
Approach		736	5.0	0.499	5.5	LOS A	4.0	29.5	0.64	0.59	54.8
East: Adjacent site access											
4	L2	26	5.0	0.065	8.7	LOS A	0.4	2.8	0.73	0.68	52.2
5	T1	19	5.0	0.065	8.4	LOS A	0.4	2.8	0.73	0.68	53.7
6	R2	1	5.0	0.065	14.4	LOS B	0.4	2.8	0.73	0.68	53.9
Approach		46	5.0	0.065	8.7	LOS A	0.4	2.8	0.73	0.68	52.8
North: Great South Road (north)											
7	L2	7	5.0	0.454	3.5	LOS A	4.6	33.3	0.14	0.48	54.1
8	T1	416	5.0	0.454	3.2	LOS A	4.6	33.3	0.14	0.48	55.7
9	R2	324	5.0	0.454	9.2	LOS A	4.6	33.3	0.14	0.48	55.8
Approach		747	5.0	0.454	5.8	LOS A	4.6	33.3	0.14	0.48	55.7
West: SH1 on-ramp (NBD)											
10	L2	1	5.0	0.004	6.6	LOS A	0.0	0.2	0.69	0.55	52.3
11	T1	1	5.0	0.004	6.3	LOS A	0.0	0.2	0.69	0.55	53.8
12	R2	1	5.0	0.004	12.2	LOS B	0.0	0.2	0.69	0.55	53.9
Approach		3	5.0	0.004	8.4	LOS A	0.0	0.2	0.69	0.55	53.3
All Vehicles		1533	5.0	0.499	5.8	LOS A	4.6	33.3	0.40	0.54	55.2

Figure 37: Intersection K Movement summary 2040 PM

MOVEMENT SUMMARY

Site: 101v [Sensitivity test Int K 2040 PM]

New Site
Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Great South Road (south)											
1	L2	1166	5.0	0.793	5.6	LOS A	11.1	81.4	0.77	0.59	53.7
2	T1	475	5.0	0.345	4.2	LOS A	2.5	18.3	0.44	0.46	55.9
3	R2	23	5.0	0.345	10.1	LOS B	2.5	18.3	0.44	0.46	56.1
Approach		1664	5.0	0.793	5.3	LOS A	11.1	81.4	0.67	0.55	54.4
East: Adjacent site access											
4	L2	13	5.0	0.026	6.2	LOS A	0.1	1.1	0.59	0.55	53.7
5	T1	9	5.0	0.026	5.9	LOS A	0.1	1.1	0.59	0.55	55.3
6	R2	1	5.0	0.026	11.9	LOS B	0.1	1.1	0.59	0.55	55.5
Approach		23	5.0	0.026	6.3	LOS A	0.1	1.1	0.59	0.55	54.5
North: Great South Road (north)											
7	L2	18	5.0	0.318	3.6	LOS A	2.5	18.3	0.17	0.45	54.4
8	T1	312	5.0	0.318	3.3	LOS A	2.5	18.3	0.17	0.45	56.0
9	R2	195	5.0	0.318	9.3	LOS A	2.5	18.3	0.17	0.45	56.2
Approach		495	5.0	0.318	5.3	LOS A	2.5	18.3	0.17	0.45	56.0
West: SH1 on-ramp (NBD)											
10	L2	1	5.0	0.004	5.7	LOS A	0.0	0.1	0.58	0.52	52.8
11	T1	1	5.0	0.004	5.4	LOS A	0.0	0.1	0.58	0.52	54.3
12	R2	1	5.0	0.004	11.4	LOS B	0.0	0.1	0.58	0.52	54.5
Approach		3	5.0	0.004	7.5	LOS A	0.0	0.1	0.58	0.52	53.9
All Vehicles		2185	5.0	0.793	5.3	LOS A	11.1	81.4	0.56	0.53	54.7

This intersection is existing and currently allows free flow movement for vehicles turning left onto the SH1 and requires vehicles to give-way (for right turn movements). The **BECA report** identifies that this intersection requires a roundabout or signals by the year 2022 and 2040. As such, a single lane roundabout has been modelled with an additional lane provided on the southbound approach to facilitate vehicles turning left onto the SH1 northbound on-ramp.

Using the volumes predicted at this intersection for the future year 2040, the modelling indicates that the lanes are expected to perform at a LOS A or B during the peak hours. The maximum degree of saturation is 0.793 and occurs during the afternoon peak hour on the southern approach (left turn movement onto the State highway). The 95%ile back of queue for this approach is 82 m (11-12 vehicles) with an average delay of 5.6 seconds per vehicle.

2.13 INTERSECTION L – RAZORBACK ROAD INTERCHANGE (SH1 SOUTHBOUND OFF-RAMP)

The Razorback Road off-ramp is currently stop-controlled with priority afforded to traffic along Razorback Road.

Traffic surveys were undertaken at this intersection on Wednesday 28th October 2020 during the morning and afternoon commuter peak hours; the results of this are provided in **Attachment A**.

To assess the performance of this intersection for the future year 2040, it is conservatively assumed that 90% of volumes travelling to and from the north are expected to turn to and from SH1 ramps respectively and 10% continues via Razorback Road (east of the SH1 ramps); this results in a significant number of vehicles turning right onto Razorback Road during the afternoon peak hour (from the off-ramp).

Figure 38: Intersection L layout (indicative)

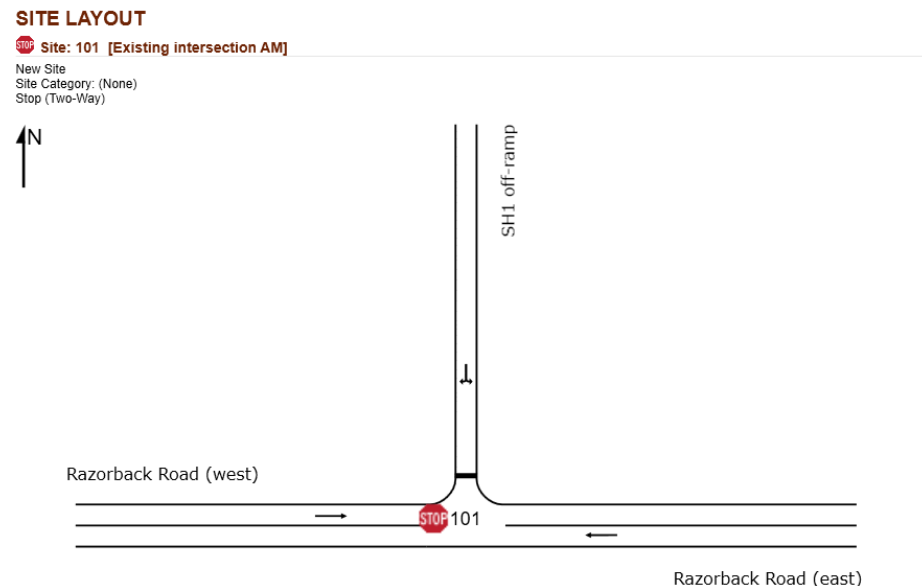


Figure 39: Intersection L Movement summary 2040 AM_ Existing

MOVEMENT SUMMARY

 Site: 101 [Existing intersection AM]

New Site
Site Category: (None)
Stop (Two-Way)

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Razorback Road (east)												
5	T1	9	5.0	0.005	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
Approach		9	5.0	0.005	0.0	NA	0.0	0.0	0.00	0.00	0.00	50.0
North: SH1 off-ramp												
7	L2	4	5.0	0.062	7.7	LOS A	0.2	1.2	0.06	0.96	0.06	45.1
9	R2	98	5.0	0.062	7.1	LOS A	0.2	1.2	0.06	0.96	0.06	44.6
Approach		102	5.0	0.062	7.2	LOS A	0.2	1.2	0.06	0.96	0.06	44.6
West: Razorback Road (west)												
11	T1	18	5.0	0.009	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
Approach		18	5.0	0.009	0.0	NA	0.0	0.0	0.00	0.00	0.00	50.0
All Vehicles		129	5.0	0.062	5.7	NA	0.2	1.2	0.05	0.76	0.05	45.7

Figure 40: Intersection L Movement summary 2040 AM_ Existing

MOVEMENT SUMMARY

 Site: 101 [Existing intersection PM]

New Site
Site Category: (None)
Stop (Two-Way)

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Razorback Road (east)												
5	T1	8	5.0	0.004	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
Approach		8	5.0	0.004	0.0	NA	0.0	0.0	0.00	0.00	0.00	50.0
North: SH1 off-ramp												
7	L2	3	5.0	0.199	7.7	LOS A	0.6	4.4	0.05	0.97	0.05	45.2
9	R2	326	5.0	0.199	7.1	LOS A	0.6	4.4	0.05	0.97	0.05	44.6
Approach		329	5.0	0.199	7.1	LOS A	0.6	4.4	0.05	0.97	0.05	44.6
West: Razorback Road (west)												
11	T1	11	5.0	0.006	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
Approach		11	5.0	0.006	0.0	NA	0.0	0.0	0.00	0.00	0.00	50.0
All Vehicles		348	5.0	0.199	6.8	NA	0.6	4.4	0.05	0.91	0.05	44.9

Figure 41: Intersection L Movement summary 2040 AM_ Potential

MOVEMENT SUMMARY

Site: 101 [Sensitivity test_Razorback Road off-ramp intersection AM]

New Site
Site Category: (None)
Stop (Two-Way)

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Razorback Road (east)												
5	T1	58	5.0	0.031	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
Approach		58	5.0	0.031	0.0	NA	0.0	0.0	0.00	0.00	0.00	50.0
North: SH1 off-ramp												
7	L2	6	5.0	0.344	8.2	LOS A	1.2	8.8	0.21	0.91	0.21	45.2
9	R2	521	5.0	0.344	7.5	LOS A	1.2	8.8	0.21	0.91	0.21	44.6
Approach		527	5.0	0.344	7.5	LOS A	1.2	8.8	0.21	0.91	0.21	44.6
West: Razorback Road (west)												
11	T1	98	5.0	0.052	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
Approach		98	5.0	0.052	0.0	NA	0.0	0.0	0.00	0.00	0.00	50.0
All Vehicles		683	5.0	0.344	5.8	NA	1.2	8.8	0.16	0.71	0.16	45.7

Figure 42: Intersection L Movement summary 2040 PM_ Potential

MOVEMENT SUMMARY

Site: 101 [Sensitivity test_Razorback Road off-ramp intersection PM]

New Site
Site Category: (None)
Stop (Two-Way)

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Razorback Road (east)												
5	T1	103	5.0	0.055	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
Approach		103	5.0	0.055	0.0	NA	0.0	0.0	0.00	0.00	0.00	50.0
North: SH1 off-ramp												
7	L2	5	5.0	0.601	8.2	LOS A	3.7	26.9	0.28	0.90	0.31	45.0
9	R2	923	5.0	0.601	7.8	LOS A	3.7	26.9	0.28	0.90	0.31	44.5
Approach		928	5.0	0.601	7.8	LOS A	3.7	26.9	0.28	0.90	0.31	44.5
West: Razorback Road (west)												
11	T1	45	5.0	0.024	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
Approach		45	5.0	0.024	0.0	NA	0.0	0.0	0.00	0.00	0.00	50.0
All Vehicles		1077	5.0	0.601	6.7	NA	3.7	26.9	0.25	0.77	0.26	45.2

Using the volumes assumed near the northern end of the site for the future year 2040, the modelling results indicate a maximum degree of saturation of 0.601 during the afternoon peak hour on the northern approach. The maximum 95%ile back of queue on the off-ramp is 27 m (3-4 vehicles). The off-ramp is some 190 m in length therefore this level of queuing is not expected to interfere with SH1 through traffic.