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State Highway 1 and State Highway 29 Intersection Upgrade

Traffic and Transportation Assessment

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New Zealand Upgrade Programme

WAKA KOTAHI NZ TRANSPORT AGENCY

New Zealand Government

wsp

150 YEARS IN AOTEAROA

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Disclaimers and Limitations

This report ('**Report**') has been prepared by WSP exclusively for NZ Transport Agency Waka Kotahi ('**Client**') in relation to an application for a notice of requirements and regional resource consents ('**Purpose**') and in accordance with our contract with the Client dated May 2020. The findings in this Report are based on and are subject to the assumptions specified in the Report. WSP accepts no liability whatsoever for any reliance on or use of this Report, in whole or in part, for any use or purpose other than the Purpose or any use or reliance on the Report by any third party.

Glossary of Abbreviations

Abbreviation/acronym	Term
AADT	Annual Average Daily Traffic
AEE	Assessment of Effects on the Environment
CAS	Crash Analysis System
CMP	Construction Management Plan
CoPTTM	Code of Practice for Temporary Traffic Management
HCV	Heavy Commercial Vehicles
km	Kilometres
LOS	Level of Service
m	Metres
m^2	Square Metres
m^3	Cubic Metres
MBCM	Monetised Benefits and Costs Manual
NZUP	NZ Government's New Zealand Upgrade Programme – Transport
ONRC	One Network Road Classification system
RIAWS	Rural Intersection Active Warning Signs
SH(x)	State Highway (number)
SIDRA	Signalised and un-signalised Intersection Design and Research Aid
TMP	Traffic Management Plan
TSL	Temporary Speed Limit
TTM	Temporary Traffic Management
vpd	Vehicles Per Day

1 Executive Summary

This report presents the traffic assessment of the State Highway 1 (SH1) and State Highway 29 (SH29) Intersection Upgrade Project (the Project).

The Project proposes the conversion of the intersection of SH1 and SH29 from a T-intersection to a two-lane roundabout with a 60 m diameter island. The proposed roundabout includes grade separated pedestrian and cyclist access under the intersection. The Project will be constructed off-line with construction within the existing carriageway limited to the locations where the proposed roundabout ties in with the existing carriageway.

This report forms part of the Project's Assessment of Effects on the Environment Report (AEE), and the suite of technical reports, being produced for Waka Kotahi New Zealand Transport Agency (Waka Kotahi) to support two Notice of Requirements (NoR) for alterations to designations.

Assessment of effects

Safety is the primary driver for the Project. The existing intersection has a high number of crashes, with 1.9 injury crashes per year, and it is expected that the operation will continue to deteriorate. The existing give-way controlled layout experiences significant delays on the SH29 approach, with delays in excess of 5 minutes in the weekend peak. These delays increase as traffic volumes through the intersection increase. This delay affects the safe operation of the intersection with drivers likely to accept increasingly smaller and less safe gaps in traffic.

The Project will result in a significant safety improvement and only minor or negligible adverse traffic effects, as listed below:

- Significantly improved safety, with a 93% reduction of injury crashes, resulting in lives saved.
- Improved level of service of the intersection, with reduced delays for SH29 traffic approaching the roundabout as a result of no longer needing to give-way to northbound SH1 traffic.
- Improved route resilience through additional pavement width that allows for lane closures during an incident or routine maintenance. Resilience is also improved through improved safety, which will result in fewer crashes that require full or partial closures of the road.
- Improved safety for residents accessing property A and property B.
- Safer pedestrian and cyclist crossing through provision of an underpass.
- Slightly increased travel times for traffic travelling along SH1 because of the need to slow to negotiate the roundabout and give-way at the roundabout. This additional delay is negligible for most through traffic when compared with their overall journey durations.
- Minor increase in travel time and distance for residents accessing property A and property B
- Slightly increased delays during construction from reduced posted speed limits.

Road freight and buses are affected in a similar way to general vehicular traffic, with significant safety improvement, reduction of delays for traffic approaching from SH29, and only minor additional delays to northbound and southbound freight and buses. The roundabout has been designed to accommodate Heavy Commercial Vehicles (HCVs) and over-dimension vehicles.

Mitigation of effects

The effects of construction are considered standard and are minimised through off-line construction of the roundabout. The traffic effects during construction of the Project include temporary posted speed reductions, additional HCVs on the road network to cart fill and water to and from site, and additional movements to and from the construction site access. We

recommend that a Construction Traffic Management Plan (CTMP) is implemented to mitigate the construction impacts.

Overall, the impact to traffic is positive with a significant safety improvement.

2 Purpose and scope of this report

This report forms part of a suite of technical reports prepared for Waka Kotahi NZ Transport Agency (Waka Kotahi) for the State Highway 1 (SH1) and State Highway 29 (SH29) Intersection Upgrade Project (the Project). The purpose of this Report is to inform the Assessment of Effects on the Environment Report (AEE) and support the two Notices of Requirement (NoRs) for alterations to designations to Matamata-Piako District Council (MPDC) and South-Waikato District Council (SWDC) and applications for regional resource consents to Waikato Regional Council (WRC).

A full description of the NoRs and regional resource consents required for the Project is provided in Section 6.6 of the AEE. A full description of the background and need for the Project is provided in Section 2 of the AEE.

The purpose of this report is to present the assessment of the effects of the Project on traffic during construction and operation.

3 Project Description

The Project is the construction and operation of a new two-lane roundabout connecting SH1 and SH29, north-west of the existing intersection of SH1 and SH29 at Piarere as illustrated in Figure 3-1. The key components of the Project are:

a) A two-lane roundabout with a 60 m diameter central island.

b) Realignment of parts of the SH1 and SH29 approaches to connect to the new roundabout.

c) The roundabout will be elevated approximately 3.5 m above the existing ground level to provide for cycle and pedestrian underpasses.

d) Construction activities, including a construction compound, lay down area and establishment of construction access.

A full description of the Project including its current design, construction and operation is provided in Section 4 of the AEE and shown in the Project Drawings in Volume 3: Drawing Set.

The final design of the Project (including the design and location of ancillary components such as stormwater treatment devices), will be refined and confirmed at the detailed design stage.

Figure 3-1: Proposed layout of the roundabout[1]

4 Context

4.1 Background

The SH1/SH29 intersection is among the most high crash risk locations on the New Zealand roading network. In the 5-year assessment period (1 December 2015 - 30 November 2020) there have been 35 crashes at this intersection; one of which was fatal. The SH1 and SH29 corridors are regionally important and together, form part of the strategic corridors (connecting Auckland, Waikato and the Bay of Plenty) identified within the current and draft 2021-2051 Waikato Regional Land Transport Plans.

4.2 The Intersection

The existing Intersection is a high-speed rural, give-way controlled T-intersection, with SH1 as the major road and SH29 as the minor road. This intersection is a key node for traffic on SH1, as the vehicle flows split with approximately 58% of vehicles continuing to the south on SH1, and 42% of vehicles traveling to/from Tauranga along SH29 to the east.

On the SH1 (north) approach to the intersection there is a high-angle left-turn slip-lane into SH29 separated from the through lane on SH1 by a large grassed splitter island; this slip-lane is approximately 110 m long and give-way controlled. From the south on SH1 there is a right-turn bay to facilitate right-turn movements into SH29. On the SH29 approach to the intersection, the right-turn out movement is the predominant movement as this caters for traffic traveling from Tauranga to the north towards Hamilton and Auckland. There is a 30 m long high-angle left-turn slip-lane for traffic traveling south from SH29; this is separated from the right-turn lane by a solid splitter island.

To help facilitate right-turning traffic out of SH29, there is a short (approx. 60 m) merge area on the SH1 (north) exit that allows vehicles traveling from SH29 to pull into when there is a gap in southbound traffic along SH1. However, most road users do not utilise this merge facility when

[1] (WSP, 2021a)

there is traffic approaching from the south, as observed by the assessment team during site surveys.

In early August 2019[2], to increase the safety of the intersection, Waka Kotahi installed rural intersection activated warning signs (RIAWS) on the SH1 approaches; approximately 180 m either side of the right-turn exit lane on SH29. The RIAWS are activated when there are vehicles approaching the Intersection on SH29 to warn road users approaching on SH1. The RIAWS illuminate with a temporary speed limit of 60 km/h for road users on SH1; reduced from the posted speed limit of 100 km/h.

Figure 4-1: Aerial imagery of the Intersection[3]

4.3 State Highway 1

SH1 is classified as a national high-volume road[4] under the current one road network classification (ONRC) with an Annual Average Daily Traffic (AADT) of 20,328 vehicles per day (vpd) and 10.4% Heavy Commercial Vehicles (HCV) to the north of SH29 and 11,757 vpd with 16.95% HCV to the south[5]. While SH1 caters heavily to the movement of through-traffic over long distances, from the termination of the Waikato Expressway to the south of Cambridge, SH1 also takes on an access role; providing access to private properties and minor local roads.

SH1 is the major transport corridor running north-south through New Zealand with the southern extent of the Waikato Expressway terminating approximately 17 km to the north of the intersection. When the Hamilton Section of the Waikato Expressway is completed in late 2021[6], the Expressway will provide safe and efficient travel along a four-lane dual-carriageway from Cambridge to the Auckland southern motorway in the north. As such, SH1 is travelled by a large range of vehicles including commercial tourism, freight vehicles, tourist vehicles and light vehicles. It is common for this route to experience high tourism and freight traffic volumes[7].

[2] (Waka Kotahi, 2019a)
[3] (WSP, 2021b)
[4] (Waka Kotahi, 2021a)
[5] (Waka Kotahi, 2019b)
[6] (Waka Kotahi, 2021b)
[7] (Waka Kotahi, 2021c)

4.4 State Highway 29

Similar to SH1, SH29 has an ONRC of national high-volume. SH29 experiences traffic volumes of 8,174 vpd with 16.85% HCV[5].

SH29 is a significant route which helps to connect Auckland, Waikato and Bay of Plenty in the upper North Island, known as the Golden Triangle. These three areas are home to over half of New Zealand's population[8] making this intersection a critical link for these areas. This route also provides the connection between the ports of Auckland and Tauranga, with vehicles travelling between the ports a large contributor to the high percentage of HCVs on this state highway.

4.5 Local road network

Horahora Road is located approximately 1 km south of the existing Intersection within the South Waikato District and is accessed from SH1. Horahora Road experiences traffic volumes of approximately 1,055 vpd with 20% HCV[9].

Maungatautari Road is approximately 1.6 km north of the intersection on SH1 with traffic volumes of approximately 720 vpd and 10% HCV[9]. Maungatautari Road is an alternative north-south route to SH1, but less direct as it travels via Karapiro Village. It has been required as a detour route in previous years when certain locations of SH1 have been blocked.

4.6 Pedestrian and cycle networks

The Intersection is currently an uncommon cyclist and pedestrian route because of the remote rural location, high traffic volumes, high speed environment, lack of safe facilities for active modes along either state highway (e.g. footpaths), and lack of safe crossing facilities at the intersection. Typically, the intersection experiences daily pedestrian and cyclist numbers that are negligible. However, Waka Kotahi's National cycling programme investment priorities and approach summary[10] indicates the potential for a number of trails to be linked in the vicinity of the intersection in the future; including the Waikato River Trail and the Hauraki Rail Trail.

Approximately 4 kilometres along Horahora Road is the starting location of the Waikato River Trail, which attracts pedestrians and cyclists. However, due to the rural low-density environment around the intersection and the presence of a carpark (Pokaiwhenua carpark) at the start of the trail it is expected that trail users generally drive to the trail to begin their route, as opposed to walking or cycling there. Separate from this Project, future planned cycle trails are proposed that will link to the Waikato River Trail via the SH1/SH29 intersection[11]. Consequently, the demand for cyclists in the vicinity of the intersection is expected to increase in the future.

4.7 Traffic volumes

The closest Waka Kotahi State Highway traffic count sites to the intersection are:

- SH1 (North): 01N00580 - Karapiro Telemetry Site (13 km from Project)
- SH29: 02900069 – 200m south of Totman Road (5 km from Project)
- SH1 (South): 01N00594 – 400m south of SH29

Analysis of historic counts at the above sites indicates that there have been step changes in traffic flow on the approaches to the intersection as sections of the Waikato Expressway have opened. The underlying linear growth rate in traffic volumes between year 2006 and 2019 at the three count sites are described in Table 4-1 below, along with the 2019 average daily flows. Prior to the opening of the Cambridge Section of the Waikato Expressway in 2015, the growth rates were

[8] (Waka Kotahi, 2021d)
[9] (Mobile Road, 2021)
[10] (Waka Kotahi, 2017)
[11] (WSP, 2021c)

significantly lower than those described in Table 4-1 (between 0.5%-0.9%). Following the opening of the Cambridge Section in 2015, the growth rates increased significantly. The high growth rates between 2015 and 2019 are not expected to be sustained as any induced growth as a result of the completion of the Waikato Expressway is expected to occur in the years immediately following completion. It is expected the growth rates will revert to the linear growth rates between 2006 and 2019. The rate of 2.3% is conservative as it is greater than the underlying growth prior to the opening of the Cambridge Section of the Expressway.

Table 4-1: Historic traffic count data near the intersection[12]

	Average daily flow – 2019 (vpd)	Linear growth rate – 2006 to 2019
SH1 (North)	20,328	2.3%
SH29	8,174	2.3%
SH1 (South)	11,757	2.3%

Applying the growth rates described in Table 4-1 to the existing daily flows, the flows described in Table 4-2 are what could be expected on the approaches to the intersection in the future and is illustrated in Figure 4-2.

Table 4-2: Future predicted traffic volumes (vpd)

	Year 2021	Year 2031	Year 2061
SH1 (North)	21,253	25,878	39,754
SH29	8,550	10,430	16,071
SH1 (South)	12,309	15,072	23,359

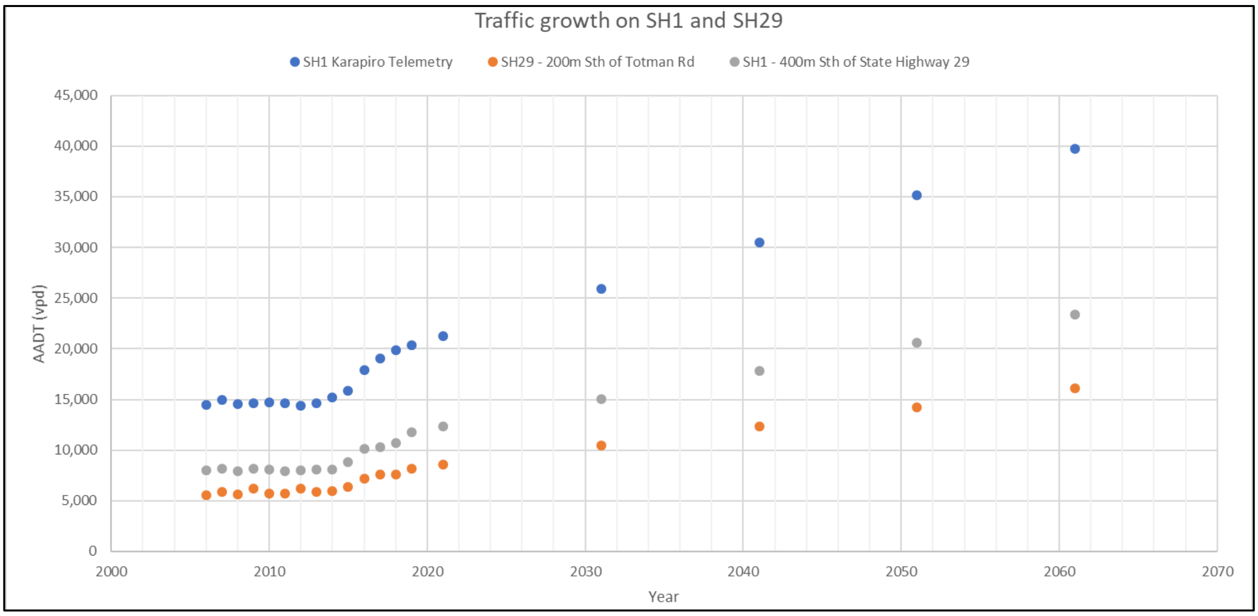

Figure 4-2: Historic traffic volumes and estimated future traffic growth on SH1 and SH29

Some additional flow is expected to be attracted to the SH1 route after the opening of the Hamilton Section of the Waikato Expressway; modelling indicates that this could be a further

[12] (Waka Kotahi, 2019b)

500 vpd[13]. While the 2.3% growth rate adopted does not specifically include this additional 500 vpd, it is deemed conservative enough to cover it.

5 Transportation Assessment Methodologies

5.1 Safety

Safety effects of the Project have been assessed using the Waka Kotahi Monetised Benefits and Costs Manual (MBCM) crash analysis methodologies, which utilise results of crash prediction models from the Waka Kotahi Crash Estimation Compendium and the recorded injury crash rate from the Waka Kotahi Crash Analysis System (CAS).

Safety of the current intersection has been assessed based on the recorded crashes over the past 5-year period extracted from the Waka Kotahi CAS. The 5-year period used in this assessment was from 1 December 2015 - 30 November 2020.

Safety of the Project has been assessed using Method B of the Waka Kotahi MBCM crash analysis methodologies. Method B predicts the number of crashes that will occur at an intersection based on the form of the intersection, the speed environment and the traffic volumes on the approaches to the intersection.

In early August 2019, RIAWS were implemented at the Intersection (within the 5-year assessment period). These signs provide a temporary speed limit of 60 km/h for traffic approaching the intersection on SH1 and are located approximately 180 m either side of the right-turn exit lane of SH29. Waka Kotahi guidance indicates that implementing RIAWS provides a 35% reduction in injury crashes[14].

When assessing the magnitude of the effects of the Project, the Project is compared against the existing form of the intersection. As the existing form of the intersection includes RIAWS, the 5-year assessment period has been divided into two periods; pre-RIAWS (prior to 1 August 2019) and post-RIAWS (post 1 August 2019) to account for the impact implementing the RIAWS has had on the crash records. To compare against the Project, the crash data prior to 1 August 2019 (pre-RIAWS) has been adjusted to account for if the RIAWS had been present over the entire 5-year period. A 35% reduction has been applied to the injury crash rate calculated for the recorded crash data prior to 1 August 2019 to account for the predicted benefit of implementing RIAWS[14].

5.2 Route efficiency

Route efficiency (travel times) on all approaches to the intersection was assessed using SIDRA Intersection software (version 9) and traffic survey data collected in February 2021[15].

The years modelled for the existing layout and the Project were 2021, 2024 and 2034. Year 2021 was modelled to understand the existing operation of the intersection, however, the roundabout is not expected to be operational until 2024 which has also been modelled. Year 2034 was chosen to compare the performance of the Project against the existing layout over a 10-year horizon.

[13] (Waka Kotahi, 2021e)
[14] (Waka Kotahi, 2013)
[15] Wednesday 10 February 2021 and Thursday 11 February 2021.

As this report only assesses the effects of the Project, it was not necessary to assess the travel times via a region-wide network model. Three time periods were assessed:

- Weekday AM peak (9-10am)
- Weekday PM peak (4-5pm)
- Weekend peak (Sunday 3-4pm)

The peak periods were identified using the survey data and they closely correspond to the peak periods identified within the traffic count data available from the Karapiro Telemetry Site[16]. As it is a telemetry site, the Karapiro Telemetry Site records continuously throughout the year as opposed to the other two count sites that only record up to four weeks per year. As illustrated in Figure 5-1 below, the hours with the highest recorded average hourly volumes were 3-4pm on a Sunday and 4-5pm on a Friday.

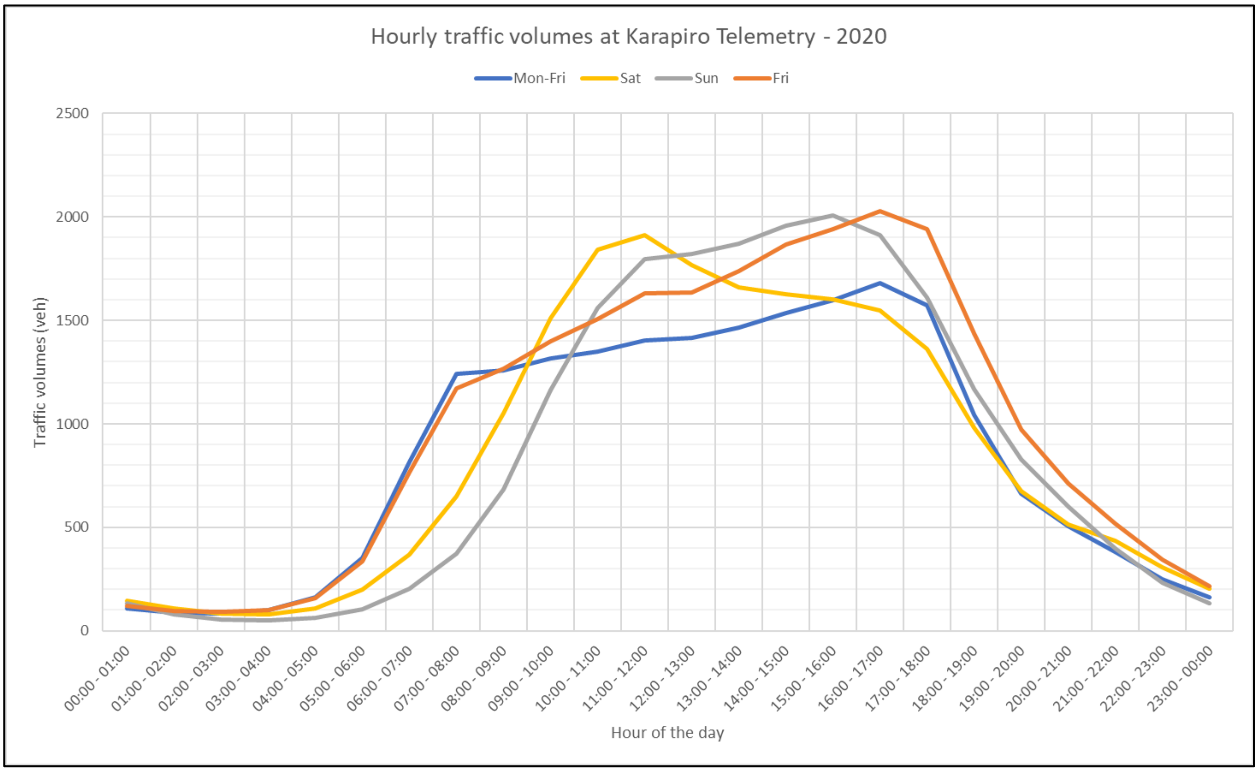

Figure 5-1: Hourly traffic volumes recorded at the Karapiro Telemetry Site in 2020

The intersection was assessed using current traffic volumes and future years of 2031 and 2061 based on a 2.3% growth rate. The growth rate of 2.3% was calculated using historic state highway traffic count data[17] as described in Section 4.7.

To calibrate the SIDRA models for the existing layout of the Intersection, WSP undertook a site visit on 17 March 2021 in the PM peak period to determine the maximum queue lengths experienced on SH29. On the day of the site visit (17 March 2021), the approaching traffic on SH29 was observed to be approximately 50 vehicles higher than the day surveyed. To calibrate the model and behavior of the drivers on SH29, a model was created of the turning volumes surveyed in February 2021 with an additional 15% of vehicles on each of the approaches and compared this against the maximum recorded queue length. Refer to Appendix A for the factors that were modified from the default within the SIDRA model to get similar queues to those observed.

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[16] (Waka Kotahi, 2021f)
[17] (Waka Kotahi, 2019b)

5.3 Route resilience

Resilience refers to the flexibility of a road network to cope with incidents, such as crashes or slips which cause road use limitations or closures. Resilience has been assessed in terms of:

- Availability of road space at the intersection for lane closures, and
- Availability and distance of alternative routes in the event of a full closure of the intersection.

As the Project has no effect on the detour routes available, travel times for detour routes have not been calculated.

5.4 Road freight performance

Road freight and bus performance is generally the same as general vehicular traffic performance, so has been assessed in the same way. The only differences between the performance of these larger vehicles and general vehicular traffic are:

- Negotiation of the roundabout – heavy vehicles have larger turning radii, so will negotiate the intersection at lower speeds and with larger turning paths than cars, and
- Over-dimension vehicles – require wider and higher clearance from obstructions than general traffic.

6 Existing Transportation Operation

6.1 Introduction

This section assesses the safety and efficiency of the existing form of the intersection as described in Section 4.2

6.2 Safety

Table 6-1 below illustrates the recorded crashes at the intersection over the past 5-year period[18], which are predominantly "lost control off road" or "crossing, turning" type crashes.

Table 6-1: Recorded crashes at the intersection from 1 December 2015 - 30 November 2020

	Fatal	Serious	Minor	Non-injury	Total
Rear End, Slow Vehicle	0	0	0	1	1
Lost Control off Road	0	0	3	11	14
Overtaking	0	0	0	1	1
Crossing, direct	0	0	0	0	0
Rear End, Queuing	0	0	2	0	2
Hit Object	0	0	1	0	1
Crossing, Turning	1	0	4	7	12
Rear End, Crossing	0	0	0	2	2
Head on	0	1	1	0	3
Total	1	1	11	22	35

In the 5-year assessment period there was one fatal crash, one serious injury crash and 11 minor injury crashes (13 reported injury crashes), corresponding to 2.6 reported injury crashes annually. This quantity of reported injury crashes is extremely high and indicates that this intersection operates with a level of safety service (LoSS) of "5" (on a scale of 1-5) which means that it has an injury crash rate in the 90th to 100th percentile. This reported crash rate is higher (worse) than that expected of at least 90% of similar intersections. These crashes resulted in 5 deaths and serious injuries (DSIs).

There have been no serious or fatal crashes recorded at the intersection since the RIAWS were installed in early August 2019. While the crash reduction predicted as a result of implementing RIAWS is a 35% reduction in injury crashes[19], it is too early to determine the specific crash reduction at the intersection.

[18] 1 December 2015 – 30 November 2020.
[19] (Waka Kotahi, 2013)

6.3 Travel times and route efficiency

The efficiency of the intersection was assessed using SIDRA Intersection 9.0 and based on traffic volumes recorded at the Intersection in February 2021[20]. The recorded traffic volumes indicated that the weekday AM peak period occurs between 9-10am, the weekday PM peak period occurs between 4-5pm and the weekend peak occurs between 3-4pm on a Sunday; these were the peak periods used in the modelling. The results of the modelling are described in Table 6-2 and Table 6-3 below. Table 6-2 and Table 6-3 also describes how the intersection is expected to perform in 2034 with the expected growth applied to the traffic volumes recorded. For the SIDRA movement summary sheets refer to Appendix B.

As through traffic on SH1 has priority at the Intersection, SIDRA does not model any delay for traffic travelling straight through the Intersection. However, there will be minor additional travel time due to the reduced speed limit on SH1 from the RIAWS; this change has been modelled by calculating the additional travel time required to travel through the Intersection at the reduced RIAWS speed of 60 km/h which adds approximately 9 seconds to the travel time.

[20] Wednesday 10 February 2021 and Thursday 11 February 2021.

Table 6-2: Year 2021, 2024 and 2034 Weekday peak period performance of the existing SH1-29 intersection

			Year 2021			Year 2024			Year 2034		
Period	Approach	Movement	Average delay (s)	LOS	95th percentile back of queue (m)	Average delay (s)	LOS	95th percentile back of queue (m)	Average delay (s)	LOS	95th percentile back of queue (m)
AM	SH1 (North)	Through	9	A	0	9	A	0	9	A	0
		Left	9	A	9	9	A	10	9	A	13
	SH29	Right	15	C	26	17	C	31	26	D	68
		Left	10	B	1	11	B	1	11	B	1
	SH1 (South)	Through	9	A	0	9	A	0	9	A	0
		Right	10	A	1	10	A	1	10	B	1
	All		10			10			12		
PM	SH1 (North)	Through	9	A	0	9	A	0	9	A	0
		Left	9	A	12	9	A	13	9	A	17
	SH29	Right	23	C	51	30	D	76	390	F	901
		Left	11	B	1	11	B	1	12	B	1
	SH1 (South)	Through	9	A	0	9	A	0	9	A	0
		Right	10	B	1	11	B	1	12	B	1
	All		12			13			84		

Table 6-3: Year 2021, 2024 and 2034 Weekend peak period performance of the existing SH1-29 intersection

			Year 2021			Year 2024			Year 2034		
Period	Approach	Movement	Average delay (s)	LOS	95th percentile back of queue (m)	Average delay (s)	LOS	95th percentile back of queue (m)	Average delay (s)	LOS	95th percentile back of queue (m)
Weekend Peak	SH1 (North)	Through	9	A	0	9	A	0	9	A	0
		Left	9	A	13	9	A	14	9	A	18
	SH29	Right	302	F	629	572	F	1043	2075	F	2281
		Left	11	B	1	11	B	1	12	B	1
	SH1 (South)	Through	9	A	0	9	A	0	9	A	0
		Right	10	B	3	11	B	3	12	B	4
	All		60			106			366		

Right-turning traffic out of SH29 is currently moderately delayed in the weekday AM and PM peaks in 2021 and operates at a LOS C with an average delay of 15 seconds and 95th percentile back of queue length of 26 m in the AM peak; and LOS C within an average delay of 23 seconds and 95th percentile back of queue length of 51 m in the PM peak. The SH29 approach continues to operate with moderate delays in the weekday peaks in 2024, however, by 2034, right-turning traffic out of SH29 is delayed almost 400 seconds in the weekday PM peak.

As described in Section 5.2 of this report, during queue length observations in the PM peak period, it was observed that approximately an additional 50 vehicles used the SH29 approach than on the surveyed date. However, the modelling results in Table 6-2 and Table 6-3 are based on the surveyed traffic volumes and do not include the 50 additional vehicles observed as a full traffic survey was not undertaken at that time so the traffic volumes on the SH1 approaches are unknown. This indicates that, while the modelling shows the SH29 approach currently operates at LOS C in the PM peak, there are periods where the SH29 approach will operate at a worse LOS. As described in Section 5.2, the two hours with the largest traffic volumes recorded at the Karapiro Telemetry site near the intersection in 2020 were Sunday 3-4pm and Friday 4-5pm. Anecdotal evidence indicates that the SH29 approach operates with significant delays and large queues in these periods. Although turning count data at the intersection was not available for a Sunday, the closest Waka Kotahi count sites to the intersection were used to provide an estimation of the traffic volumes through the intersection at 3-4pm on a Sunday afternoon by using the directional flows recorded at each of the count sites.

Notwithstanding the traffic volumes used within the Sunday model are only an approximation of the traffic volumes expected on site, the modelling results in Table 6-3 indicate that right-turning traffic is currently significantly delayed in the Sunday peak with average delays of over five minutes and a 95th percentile back of queue length of 629 m. By 2024, the average delay for right-turning traffic on SH29 in the Sunday peak is expected to be approximately 10 minutes with queues of over 1 km long.

The SIDRA modelling indicates that the left-turn movement out of SH29 operates with only minor delays, however, the slip-lane is only approximately 30 m long. In the weekday PM peak period and the weekend peak period, the queue of right-turning vehicles will extend past the diverge for the slip-lane, which may prevent left-turning traffic from entering the slip-lane until the queue has progressed. However, during WSP's queue length observations, it was observed that left-turning traffic would often travel along the shoulder to bypass the queue of right-turning traffic.

7 Assessment of effects on the environment

7.1 Operational traffic

7.1.1 *Introduction*

This section assesses the effects of the Project on the operation of traffic at the Intersection by comparing the existing operation and transport environment with the future operation of the Intersection, with and without the Project. The operational traffic effects assessed are:

- Safety (frequency and severity of crashes)
- Route efficiency and level of service (travel times)
- Reliability (variability of travel times)
- Route resilience (flexibility of a road network to cope with incidences such as road closures)
- Road freight performance (impacts of delay on freight traffic)

7.1.2 *Safety*

Taking into account the 100 km/h speed limit at the proposed roundabout, the typical crash rate was calculated to be **0.141 reported injury crashes per year.** The working undertaken to determine this figure is contained in Appendix C.

As described in Section 5.1, to compare against the Project, the existing crash data (prior to 1 August 2019) has been adjusted to account for if the RIAWS had been present over the entire 5-year period. Applying the predicted 35% reduction to injury crashes in the period 1 December 2015 – 1 August 2019 (pre-RIAWS), the injury crash rate for the 5-year assessment period at the intersection is reduced from 2.6 reported injury crashes annually to **1.9 reported injury crashes annually.** Refer to Table 7-1 below for a comparison of the annual reported injury crash rate calculated for the existing high-speed T-intersection with the Project (roundabout).

Table 7-1: Predicted annual crash rates for the Project and the existing Intersection

	Annual reported injury crash rate
Existing Intersection	1.9
The Project	0.141
Change (%)	-93%

The Project is estimated to result in a 93% reduction in reported injury crashes upon opening[21]. This is a significant positive effect of the Project and will be sustained in the future.

7.1.3 *Route efficiency*

The future operation of the proposed layout of the intersection has been modelled using SIDRA and by applying the growth rates described in Section 4.7 of this report to the traffic volumes recorded at the intersection in February 2021[22]. The weekday AM and PM peak period operation of the intersection has been modelled for year 2021, 2024 and year 2034; in addition to the weekend peak. Table 7-2 and Table 7-3 describe the performance of the proposed roundabout layout of the intersection at year 2021, 2024 and year 2034. Although the roundabout will not be operational in 2021, this year has been included in the modelling so that the operation of the

[21] 2021 volumes have been used to calculate the predicted annual crash rate for the Project to compare with the existing crash record. A similar reduction in reported injury crashes is expected upon opening.
[22] Wednesday 10 February 2021 and Thursday 11 February 2021.

roundabout (with 2021 traffic volumes) can be compared against the existing operation of the intersection.

Table 7-2: Year 2021, 2024 and 2034 Weekday AM and PM peak period performance of the Project

			Year 2021			Year 2024			Year 2034		
Period	Approach	Movement[23]	Average delay (s)	LOS	95th percentile back of queue (m)	Average delay (s)	LOS	95th percentile back of queue (m)	Average delay (s)	LOS	95th percentile back of queue (m)
AM	SH1 (North)	Through	16	B	13	16	B	14	16	B	19
		Left	8	A	10	8	A	11	8	A	14
	SH29	Right	10	B	10	11	B	11	12	B	17
		Left	9	A	10	9	A	11	10	B	17
	SH1 (South)	Through	8	A	15	8	A	17	8	A	23
		Right	17	B	1	17	B	1	18	B	1
	All		11	B		11	B		11	B	
PM	SH1 (North)	Through	16	B	18	16	B	20	16	B	28
		Left	8	A	13	8	A	14	8	A	19
	SH29	Right	12	B	15	13	B	17	17	B	32
		Left	11	B	15	11	B	17	15	B	32
	SH1 (South)	Through	8	A	21	8	A	24	9	A	35
		Right	17	B	1	17	B	1	18	B	1
	All		11	B		11	B		12	B	

[23] Movement naming convention is the same as used for the existing layout, however, we note that movement directions in the proposed layout are different (e.g. SH1 north through movement becomes a right turn movement at the proposed roundabout).

Table 7-3: Year 2021, 2024 and 2034 Weekend peak period performance of the proposed roundabout layout of the intersection

			Year 2021			Year 2024			Year 2034		
Period	Approach	Movement[24]	Average delay (s)	LOS	95th percentile back of queue (m)	Average delay (s)	LOS	95th percentile back of queue (m)	Average delay (s)	LOS	95th percentile back of queue (m)
Weekend Peak	SH1 (North)	Through	16	B	22	16	B	24	16	B	34
		Left	8	A	15	8	A	17	8	A	23
	SH29	Right	12	B	17	13	B	20	16	B	37
		Left	11	B	17	11	B	20	15	B	37
	SH1 (South)	Through	9	A	58	9	A	72	16	B	183
		Right	17	B	3	18	B	3	18	B	4
	All		**11**	**B**		**12**	**B**		**15**	**B**	

[24] Movement naming convention is the same as used for the existing layout, however, we note that movement directions in the proposed layout are different (e.g. SH1 north through movement becomes a right turn movement at the proposed roundabout).

As shown in the tables above, the proposed roundabout operates at LOS B in year 2021, 2024 and 2034 with all approaches operating with LOS B or better. The existing give-way controlled layout experiences significant delays on the SH29 approach in the Sunday peak with the current traffic volumes; as traffic volumes increase in the future, the operation of the intersection is expected to further deteriorate. By year 2034 the existing give-way controlled layout experiences significant delays on the SH29 approach with delays of almost 400 seconds for right-turning vehicles in the weekday PM peak and greater than 2000 seconds in the weekend peak. This delay significantly affects the operation of the intersection, with drivers likely to take increasingly smaller and less safe gaps in traffic, whereas the proposed roundabout continues to operate at no worse than LOS B as illustrated in Table 7-4.

Table 7-4: Year 2034 performance of the existing Intersection and the proposed layout

	Existing Intersection		Project	
Period	Intersection average delay (s)	LOS[25]	Intersection average delay (s)	LOS
Weekday AM	12	-	11	B
Weekday PM	84	-	12	B
Weekend Peak	366	-	15	B

7.1.4 *Property access*

7.1.4.1 General

There are two properties that gain direct access from the State Highway network as illustrated in Figure 7-1 below that will be affected by the Project. These are:

- A: 2 State Highway 1, Karapiro
- B: 5969B State Highway 29, Karapiro

Residents of these properties can currently enter from, and exit to, the right or the left on the State Highways as there are no turn restrictions in place. At the locations of the existing property accesses, both SH1 and SH29 have relatively wide sealed shoulders (>1.5 m), which mitigates the impact on the efficiency of through traffic caused by vehicles waiting at the centre-line to turn right into the accesses.

[25] Overall intersection LOS is not applicable to a give-way controlled intersection.

Figure 7-1: Existing property accesses near the intersection[26]

As part of the Project, the existing property accesses near the intersection will be altered to provide left-in, left-out access to properties A and B as illustrated in Figure 7-2. The proposed layout of the roundabout will not allow for right-turn movements to or from the property accesses A and B, due to the presence of the central median/barrier extending back (approximately 200 m) from the roundabout on the SH1 and SH29 approaches.

[26] (WSP, 2021b).

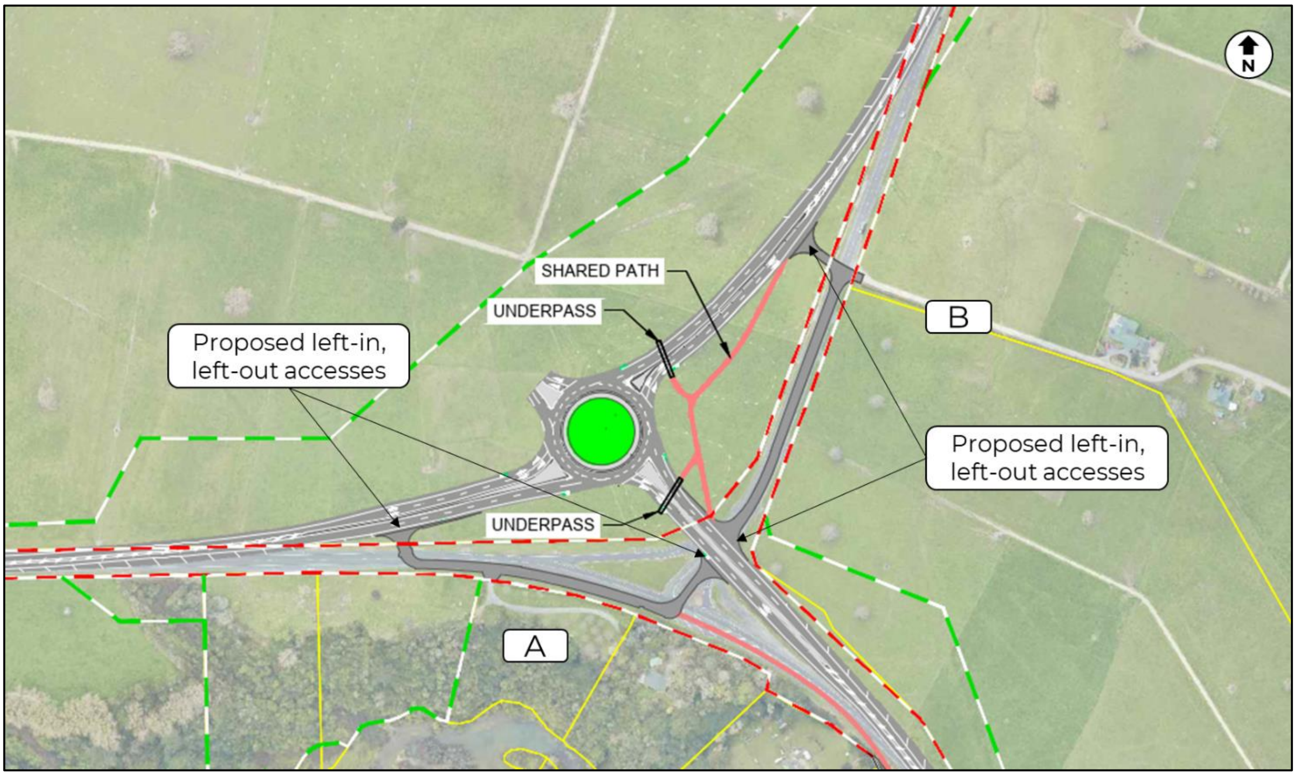

Figure 7-2: Proposed access layout for Access A and Access B[27]

7.1.4.2 Access

As the Project does not allow right-turn movements at the accesses for property A and B, each property will have an access on the two adjacent State Highways; SH1 (north and south) for property A, and SH29 and SH1 (south) for property B. Depending on the direction at which the residents intend to travel, they will be required to travel through the roundabout which will increase their travel distance by up to approximately 600 m. Two examples of the manoeuvres required of drivers approaching/exiting property A or B are:

- When approaching property B from SH1 (north), drivers will be required to enter the roundabout and take the SH1 (south) exit. They will then be able to left-turn into the property access on SH1 (south).
- When exiting property A to travel south towards Tirau, drivers will be required to turn left out of the property through the access on SH1 (south). They will then perform a "U-turn" at the roundabout and take the SH1 (south) exit and continue traveling south.

In addition to the increased distance travelled, the residents will be delayed at the roundabout as described in the Tables in Section 7.1.3. Although vehicles accessing property A and B will be delayed at the roundabout, it is likely that the presence of the roundabout will make it easier and safer for the residents of property A to travel towards SH29 and SH1 (south) in the peak periods as they no longer need to pick a gap in two opposing streams of traffic to turn right out of the access; this is similar for property B when exiting to travel east on SH29.

7.1.4.1 Safety

The proposed left in, left out accesses will eliminate the risk that is currently present for right-turning vehicles to be struck from behind as they wait at the centreline or struck by oncoming traffic as they perform the right-turn manoeuvre. Additionally, the proposed layout eliminates the risk of right-turning vehicles exiting the accesses having to cross two opposing streams of traffic; exiting vehicles will only need to find a gap in traffic in one direction.

27 (WSP, 2021a)

7.1.4.2 Rat-running

The proposed layout of the access to properties A and B has the potential to be used by vehicles approaching on SH29 travelling south on SH1 to bypass the roundabout, however, due to the relatively low delay at the roundabout for vehicles approaching on SH29 this is considered unlikely.

7.1.5 *Route resilience*

Crashes are discreet events that cause unforeseen delays to road users as traffic slows to avoid the crash site and there is sometimes the need for temporary traffic management (TTM). There have been 35 crashes recorded at the intersection in the past 5-year period many of which have created road closures. The Project provides an increase in resilience by improving the safety of this section of SH1 and SH29, therefore reducing the incidences of road closures. However, if there was a need for a road closure it is likely that this won't need to be for as long as currently experienced, due to the dual lanes on all approaches and around the central island provides more carriageway width. This additional carriageway width allows the potential of a full closure to be contained in a single lane closure, instead allowing the road users to travel in the other section of the road.

7.1.6 *Road freight performance*

Road freight (HCVs) and buses have similar performance to general vehicular traffic in terms of safety and efficiency, so the impacts of the Project described in Sections 7.1.1 to 7.1.5 above apply to most road freight and buses. There are some exceptions, notably:

- HCVs have wider turning circles than cars, so will negotiate the roundabout at a slower speed and with a wider turning circle than cars. The 60m diameter roundabout island with a mountable apron is sufficiently wide enough to allow safe manoeuvring of HCVs.

- Over-dimension vehicles require a wider and higher clearance compared to general traffic. The two-lane roundabout provides adequate horizontal and vertical clearance for over-dimension vehicles.

7.1.7 *Pedestrians and cyclists*

As described in Section 4.6, currently the intersection typically experiences negligible pedestrian and cyclist volumes. However, Waka Kotahi guidance[28] indicates that a number of future trails will be linked in the vicinity of the intersection in the future; including the Waikato River Trail and the Hauraki Rail Trail. By providing grade-separated crossings (underpasses) at the intersection, the Project will significantly improve the safety for pedestrians and cyclists crossing the State Highways. The underpasses below the State Highways will eliminate the risk of pedestrians and cyclists coming into conflict with motorised vehicles, significantly reducing the risk of death or serious injury.

7.2 Construction traffic

The construction of the Project will have effects on the transport network both at a regional and local level. The scale and duration of the potential impacts have been assessed, and the key issues considered were:

- The period of time that construction is expected to take;
- Locations of site accesses and staging areas required to carry out the works and the potential impacts of these sites on the transport network;
- The expected increase in the heavy vehicle traffic due to earthworks, pavement works and water supply; and

[28] (Waka Kotahi, 2017)

- The impact of traffic management measures on the operation of the intersection.

7.2.1 Background assumptions

WSP estimates it will take around 18 months to complete the construction works for this Project, with construction due to commence late 2022. While the construction contractor will determine the optimum construction sequence, it has been assumed that the Project will progress as follows:

- Pre-construction works, including relocating of utility services.
- Establishment of temporary traffic management on the SH1 northern approach, SH29 and SH1 southern approaches. It is expected that a single site office will be used for the Project.
- Site establishment including clearing and stripping the site.
- Culvert construction.
- Construction of pavement and servicing.
- Completion of remaining traffic service construction including delineation devices and safety barriers.
- Landscaping and planting in and around the roundabout.
- Tie in existing approaches.

7.2.2 Staging Area and Site Access

The site length is short enough that it will be possible for the contractor to have a single staging area. However, it is expected that the contractor will split the Project into multiple phases due to the ability to complete some tasks with minimal disruption to state highway traffic due to the offline location of the Project.

The SH1 northern approach requires Level 2 TTM. Due to the high costs associated with providing TTM in this environment, it is expected that the contractor would minimise disruption on the existing SH1 alignment. One of the ways this can be achieved is ensuring any direct access off SH1 from the north has appropriate turning bays (including deceleration) and/or turn restrictions such as left in/out only.

Because the Project is not located near any local roads, they are not a viable option for site access, therefore, the site access placement will be along the State Highway network. There will be a total of three site accesses for the Project, one for the staging area and the remaining two at the beginning of the haul road at SH1 and the end of the haul road at SH29.

7.2.3 Earthworks traffic

Table 7-8 below gives an indication of the quantities and volumes required for the construction of the Project:

Table 7-5: Expected construction volumes

Component	Volume
Total site area (including existing road corridor)	198,750 m^2
Total earthworks footprint	79,000 m^2
Topsoil strip/stockpile/re-spread	24,000 m^3
Imported fill	90,000 - 95,000 m^3
Granular pavement and surfacing	45,000 m^3

Earthwork assumptions include:

- There will be less than 10,000 m^3 of unsuitable fill that will need to be disposed of offsite.
- Stripped suitable topsoil will be stored onsite for re-use onsite.

It is assumed that the contractor will select a quarry located in close proximity to the Project such as Taotaoroa Quarries on Taotaoroa Road, or Whitehall Quarry on Whitehall Road. Safe access to the site from the quarry will need to be outlined within a construction Traffic Management Plan for the Project. The route that trucks will use between the project site and quarries will be a combination of local roads such as Taotaoroa Road, Karapiro Road, Whitehall Road and both SH1 and SH29.

During the import fill stage, it is assumed there will be truck and trailer units in the range of 12 - 24 units per day with an assumption of 13 m^3 of fill per truck and 13 m^3 of fill per trailer. Using the upper range in order to consider the worst-case scenario this equates to an additional 48 vehicles on the road network between the quarries and Project site per day. In order to gain a conservative estimation of the impact that these truck volumes have on the existing local road network and state highway network, the roads with the lowest volumes are used. Taotaoroa Road has an AADT of 500 vehicles with 38% being HCV and as stated earlier SH29 has an AADT of 8,174 with a HCV percentage of 16.85%. Therefore, the maximum percentage increase in daily traffic volumes when importing fill is less than 10% on the local road network and less than 1% on the state highway network. This increase is considered to be a less than minor effect on the load road network and a negligible effect on the state highway network.

7.2.4 *Temporary Speed*

For majority of the construction works, SH1 and SH29 will be able to remain at operational posted speed limits. However, the contractor may choose to adopt a temporary speed reduction as a safety precaution to accommodate vehicles slowing down to turn into the site and those exiting a site access. Given that most of this construction will occur offline from the existing state highway alignment, the speed reduction required is less than that typically required from a more constrained work site. In the later stages of construction, the implementation of a standard lowered posted speed limit will be required at the connecting points and overlap of the new alignment with the existing state highway network.

It is expected that the construction contractor will minimise traffic management costs and road user delays by minimising the time that the lowered speed limit is implemented for. Due to the relatively short duration of this speed restriction, and the small increase in travel time by the reduction in speed limit along the site compared to the general overall travel time of a road user travelling through the Project site, this means the impact from construction on road users is considered negligible.

8 Mitigation of effects on the environment

This section describes the measures to avoid, remedy, or mitigate the actual or potential adverse effects of the Project.

8.1 Operational effects mitigation

Adverse operational effects are negligible or minor and effectively outweighed by the positive safety effects; therefore, no operational effects management is recommended over and above the design standards already incorporated into the Project, such as designing the roundabout to ensure safe tracking of heavy vehicles. The only adverse operational effects are delays to some SH1 traffic movements, which is caused by the need for northbound and southbound traffic to slow to negotiate the roundabout and give-way to some traffic that they currently do not need to. However, these lower speeds also positively contribute to the significant improvement in safety.

8.2 Construction effects mitigation

Any traffic effects arising during the construction period can be suitably mitigated through the appropriate development of a suitable Construction Traffic Management Plan (CTMP). We recommend that the CTMP be prepared in accordance with CoPTTM and include the following:

- methods to manage the effects of temporary traffic management activities on traffic;
- measures to manage the safety of all transport users;
- the estimated numbers, frequencies, routes and timing of traffic movements, including any specific non-working or non-movement hours to manage vehicular traffic or to manage traffic congestion;
- site access routes and access points for heavy vehicles, the size and location of parking areas for plant, construction vehicles and the vehicles of workers and visitors;
- identification of detour routes and other methods for the safe management and maintenance of traffic flows, including cyclists, on existing roads;
- methods to maintain vehicle access to property where practicable, or to provide alternative access arrangements when it will not be;
- the management approach to loads on heavy vehicles, including covering loads of fine material, the use of wheel-wash facilities at site exit points and the timely removal of any material deposited or spilled on public roads;
- methods that will be undertaken to communicate traffic management measures to affected road users such as residents/public/emergency services;
- Auditing, monitoring and reporting requirements relating to traffic management activities shall be undertaken in accordance with Waka Kotahi's Code of Practice for Temporary Traffic Management.

9 Conclusion and recommendations

9.1 Operational Traffic Effects

Overall, the operational traffic effects are positive with a significant safety improvement and only minor delays to SH1 traffic and property access, as listed below:

- Significantly improved safety, with a 93% reduction of injury crashes.
- Improved overall performance of the intersection, with significantly reduced delays for traffic approaching from SH29 and only minor increase of delays for SH1 northbound and southbound traffic.
- Minor increase in travel time and distance for residents accessing property A and property B.
- Improved safety for residents accessing property A and property B.
- Improved pedestrian and cycling crossing safety through provision of an underpass
- Improved network resilience through additional space for lane closures and fewer crashes requiring partial or full closures.

9.2 Construction Traffic Effects

Construction traffic effects are standard and minimised through off-line construction. Construction traffic effects include temporary posted speed reduction, minor increase in HCV volumes carting fill and water to site, and minor increase in turning traffic into and out of construction site. These are standard construction effects and it is recommended that they be mitigated through the implementation of a construction Traffic Management Plan.

10 References

We referred to the following sources when preparing this assessment:

1 Mobile Road, 2021, *Online* - https://mobileroad.org/desktop.html, accessed 20 April 2021

2 Waka Kotahi (Waka Kotahi NZ Transport Agency), 2013, *High-risk intersections guide, Appendix 6,* Waka Kotahi

3 Waka Kotahi (Waka Kotahi NZ Transport Agency), 2017, *National cycling programme investment priorities and approach summary*, Waka Kotahi

4 Waka Kotahi (Waka Kotahi NZ Transport Agency), 2019a, *Online - https://www.nzta.govt.nz/media-releases/speed-signs-now-live-at-four-waikato-intersections/* accessed 9 March 2021

5 Waka Kotahi (Waka Kotahi NZ Transport Agency), 2019b, *2015-2019 AADT by region,* State highway volumes by region (in Excel format)

6 Waka Kotahi (Waka Kotahi NZ Transport Agency), 2021a, *Online - https://nzta.maps.arcgis.com/apps/webappviewer/index.html?id=95fad5204ad243c39d84c37701f614b0* accessed 9 March 2021

7 Waka Kotahi (Waka Kotahi NZ Transport Agency), 2021b, *Online - https://www.nzta.govt.nz/projects/waikato-expressway/hamilton/* accessed 10 March 2021

8 Waka Kotahi (Waka Kotahi NZ Transport Agency), 2021c, *Online - https://www.nzta.govt.nz/planning-and-investment/nz-upgrade/waikato-and-bay-of-plenty-package/sh1sh29-intersection/* accessed 9 March 2021

9 Waka Kotahi (Waka Kotahi NZ Transport Agency), 2021d, *Online - https://nzta.govt.nz/planning-and-investment/nz-upgrade/waikato-and-bay-of-plenty-package/* accessed 10 March 2021

10 Waka Kotahi (Waka Kotahi NZ Transport Agency), 2021e, *SH1: Cambridge to Piarere (C2P) Long Term Improvements Detailed Business Case (DBC),* Issue 4 Final, page 4

11 Waka Kotahi (Waka Kotahi NZ Transport Agency), 2021f, *Online (secure) - https://tms.nzta.govt.nz/login* accessed 12 March 2021

12 WSP, 2021a, *State highway 1/29 Intersection Upgrade Overall Layout Plan - Draft*

13 WSP, 2021b, *Online - https://nz-maps.wsp.com/portal/home/webmap/viewer.html?useExisting=1* accessed 11 March 2021

14 WSP, 2021c, *SH1 underpass connection to Horohora Road,* Rev A – Design report for review, prepared by WSP dated 28 May 2021

Appendix A
SIDRA calibration factors

1 SH1-29 Sidra assumptions for model calibration

To calibrate the Sidra models for the existing layout of the Intersection, WSP undertook a site visit on 17 March in the PM peak period to determine the maximum queue lengths experienced on SH29. On the day of the site visit, the approaching traffic on SH29 was observed to be approximately 50 vehicles higher than the day surveyed.

To calibrate the model and behavior of the drivers on SH29, we have created a model of the turning volumes surveyed with an additional 15% of vehicles on each of the approaches and compared this against the maximum recorded queue length.

The factors that we have modified from the default within the Sidra model to get similar queues to those observed are as follows:

Input parameter	Value used	Reason
Exiting flow effect	10%	There is a long slip-lane on the SH1 north approach so chance of vehicle exiting SH29 mistakenly giving way to left-turning traffic is low.
Extra bunching	30%	While extra bunching is generally used for upstream signalised intersections, we have applied it to simulate the bunching that occurs behind heavy vehicles.
Queue space	10 m (light vehicles)	During our queue length observations, it was observed that vehicles generally left much more space behind the vehicle in front than would be expected at an urban intersection.
Critical gap (right-turn from SH29)	4.5 s	It was observed that vehicles would enter smaller than normal gaps when waiting at the limit line.
Follow up headway (right-turn from SH29)	2.5 s	It was observed that vehicles would often follow very closely behind the vehicle in front when entering a gap.

After calibrating the model using the additional 15% of vehicles on each approach, the adjusted parameters above were applied to the standard model.

Appendix B
SIDRA modelling results

1 SH1-29 Sidra modelling results - notes

As through traffic on SH1 has priority at the Intersection, SIDRA does not model any delay for traffic travelling straight through the Intersection. However, there will be minor additional travel time due to the reduced speed limit on SH1 from the RIAWS; this change has been modelled by calculating the additional travel time required to travel through the Intersection at the reduced RIAWS speed of 60 km/h which adds approximately 9 seconds to the travel time.

As SIDRA does not model this delay to through traffic, the through traffic delays in the modelling results (and as a result, the “all movement” delay) within this Appendix do not align with those described in Table 6-2, Table 7-4 and Table 7-5. The “all movement” delays have been calculated separately.

MOVEMENT SUMMARY

▽ Site: 102 [2021 - AM period SH1/29 Intersection (Site Folder: Existing layout)]

Project: 2-A0012.04 C2P
Traffic flows: based on 2021 IC survey site data on SH29 and SH1,
Exiting flow effect: 10%, Extra bunching: 30%, Queue space: 10m light vehicles, Critical gap (right turn from SH29): 4.5 s, Follow up headway (right turn from SH29): 2.5 s
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: SH1 (South)														
5	T1	364	17.0	376	17.0	0.216	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	99.9
6	R2	19	17.0	20	17.0	0.017	9.7	LOS A	0.1	0.8	0.32	0.63	0.32	66.5
Approach		383	17.0	396	17.0	0.216	0.5	NA	0.1	0.8	0.02	0.03	0.02	97.5
North: SH29														
7	L2	17	16.9	17	16.9	0.017	10.4	LOS B	0.1	0.7	0.30	0.62	0.30	66.9
9	R2	281	16.9	289	16.9	0.467	15.2	LOS C	2.5	25.9	0.68	0.95	0.91	60.5
Approach		298	16.9	306	16.9	0.467	14.9	LOS B	2.5	25.9	0.66	0.94	0.88	60.8
West: SH1 (North)														
10	L2	257	10.4	271	10.4	0.177	8.7	LOS A	0.9	9.1	0.06	0.62	0.06	70.5
11	T1	366	10.4	387	10.4	0.212	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	99.9
Approach		623	10.4	658	10.4	0.212	3.6	LOS A	0.9	9.1	0.03	0.25	0.03	85.2
All Vehicles		1304	13.8	1360	13.8	0.467	5.2	NA	2.5	25.9	0.17	0.34	0.21	80.8

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 102 [2021 - PM period SH1/29 Intersection (Site Folder: Existing layout)]

Project: 2-A0012.04 C2P
Traffic flows: based on 2021 IC survey site data on SH29 and SH1,
Exiting flow effect: 10%, Extra bunching: 30%, Queue space: 10m light vehicles, Critical gap (right turn from SH29): 4.5 s, Follow up headway (right turn from SH29): 2.5 s
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: SH1 (South)														
5	T1	459	17.0	502	17.0	0.286	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	99.8
6	R2	11	17.0	12	17.0	0.012	10.4	LOS B	0.0	0.5	0.40	0.64	0.40	65.7
Approach		470	17.0	514	17.0	0.286	0.3	NA	0.0	0.5	0.01	0.02	0.01	98.6
North: SH29														
7	L2	19	16.9	21	16.9	0.023	11.1	LOS B	0.1	0.9	0.39	0.65	0.39	66.0
9	R2	306	16.9	337	16.9	0.722	23.0	LOS C	4.9	51.0	0.87	1.14	1.62	53.5
Approach		325	16.9	358	16.9	0.722	22.3	LOS C	4.9	51.0	0.84	1.11	1.54	54.1
West: SH1 (North)														
10	L2	321	10.4	334	10.4	0.217	8.6	LOS A	1.1	11.7	0.05	0.62	0.05	70.6
11	T1	484	10.4	504	10.4	0.276	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	99.8
Approach		805	10.4	838	10.4	0.276	3.5	LOS A	1.1	11.7	0.02	0.25	0.02	85.6
All Vehicles		1600	13.6	1710	13.7	0.722	6.5	NA	4.9	51.0	0.19	0.36	0.34	79.1

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 102 [2021 - Weekend Peak SH1/29 Intersection (Site Folder: Existing layout)]

Project: 2-A0012.04 C2P
Traffic flows estimated using 2020 Waka Kotahi directional count data and applying 1 years growth at 2.3%
Exiting flow effect: 10%, Extra bunching: 30%, Queue space: 10m light vehicles, Critical gap (right turn from SH29): 4.5 s, Follow up headway (right turn from SH29): 2.5 s, Assume 98% PFF because higher flows than weekday and assumed flatter profile, Assume lower HCV than weekday
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: SH1 (South)														
5	T1	819	10.0	836	10.0	0.459	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	99.7
6	R2	58	10.0	59	10.0	0.057	10.3	LOS B	0.2	2.5	0.41	0.68	0.41	67.7
Approach		877	10.0	895	10.0	0.459	0.7	NA	0.2	2.5	0.03	0.05	0.03	96.6
North: SH29														
7	L2	15	10.0	15	10.0	0.016	10.9	LOS B	0.1	0.6	0.39	0.64	0.39	68.0
9	R2	368	10.0	376	10.0	1.297	301.9	LOS F	61.1	629.4	1.00	3.58	12.97	10.4
Approach		383	10.0	391	10.0	1.297	290.5	LOS F	61.1	629.4	0.98	3.47	12.48	10.8
West: SH1 (North)														
10	L2	348	7.0	355	7.0	0.235	8.8	LOS A	1.2	12.6	0.12	0.61	0.12	71.2
11	T1	519	7.0	530	7.0	0.284	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	99.8
Approach		867	7.0	885	7.0	0.284	3.5	LOS A	1.2	12.6	0.05	0.24	0.05	85.9
All Vehicles		2127	8.8	2170	8.8	1.297	54.0	NA	61.1	629.4	0.21	0.74	2.28	39.0

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 102 [2024 - AM period SH1/29 Intersection (Site Folder: Existing layout)]

Project: 2-A0012.04 C2P
Traffic flows: based on 2021 IC survey site data on SH29 and SH1, with a 2.3% growth rate applied for 3 years
Exiting flow effect: 10%, Extra bunching: 30%, Queue space: 10m light vehicles, Critical gap (right turn from SH29): 4.5 s, Follow up headway (right turn from SH29): 2.5 s
Site Category: (None)
Give-Way (Two-Way)
Design Life Analysis (Final Year): Results for 3 years

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: SH1 (South)														
5	T1	364	17.0	402	17.0	0.231	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	99.9
6	R2	19	17.0	21	17.0	0.019	9.9	LOS A	0.1	0.8	0.33	0.64	0.33	66.3
Approach		383	17.0	423	17.0	0.231	0.5	NA	0.1	0.8	0.02	0.03	0.02	97.4
North: SH29														
7	L2	17	16.9	19	16.9	0.018	10.5	LOS B	0.1	0.7	0.32	0.63	0.32	66.7
9	R2	281	16.9	308	16.9	0.531	16.6	LOS C	3.0	31.4	0.73	0.99	1.05	59.1
Approach		298	16.9	327	16.9	0.531	16.2	LOS C	3.0	31.4	0.71	0.97	1.01	59.5
West: SH1 (North)														
10	L2	257	10.4	290	10.4	0.190	8.7	LOS A	1.0	9.8	0.06	0.62	0.06	70.5
11	T1	366	10.4	413	10.4	0.226	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	99.9
Approach		623	10.4	703	10.4	0.226	3.6	LOS A	1.0	9.8	0.03	0.25	0.03	85.2
All Vehicles		1304	13.8	1454	13.8	0.531	5.5	NA	3.0	31.4	0.18	0.35	0.25	80.3

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 102 [2024 - PM period SH1/29 Intersection (Site Folder: Existing layout)]

Project: 2-A0012.04 C2P
Traffic flows: based on 2021 IC survey site data on SH29 and SH1, with a 2.3% growth rate applied for 3 years
Exiting flow effect: 10%, Extra bunching: 30%, Queue space: 10m light vehicles, Critical gap (right turn from SH29): 4.5 s, Follow up headway (right turn from SH29): 2.5 s
Site Category: (None)
Give-Way (Two-Way)
Design Life Analysis (Final Year): Results for 3 years

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: SH1 (South)														
5	T1	459	17.0	537	17.0	0.305	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	99.8
6	R2	11	17.0	13	17.0	0.013	10.6	LOS B	0.1	0.6	0.42	0.65	0.42	65.4
Approach		470	17.0	549	17.0	0.305	0.3	NA	0.1	0.6	0.01	0.02	0.01	98.6
North: SH29														
7	L2	19	16.9	22	16.9	0.025	11.3	LOS B	0.1	1.0	0.42	0.66	0.42	65.7
9	R2	306	16.9	360	16.9	0.843	30.4	LOS D	7.2	75.8	0.93	1.30	2.30	48.3
Approach		325	16.9	383	16.9	0.843	29.3	LOS D	7.2	75.8	0.90	1.26	2.19	49.0
West: SH1 (North)														
10	L2	321	10.4	357	10.4	0.232	8.6	LOS A	1.2	12.7	0.05	0.62	0.05	70.6
11	T1	484	10.4	539	10.4	0.295	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	99.8
Approach		805	10.4	896	10.4	0.295	3.5	LOS A	1.2	12.7	0.02	0.25	0.02	85.6
All Vehicles		1600	13.6	1828	13.7	0.843	7.9	NA	7.2	75.8	0.20	0.39	0.47	76.7

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 102 [2024 - Weekend Peak SH1/29 Intersection (Site Folder: Existing layout)]

Project: 2-A0012.04 C2P
Traffic flows estimated using 2020 Waka Kotahi directional count data and applying 4 years growth at 2.3%
Exiting flow effect: 10%, Extra bunching: 30%, Queue space: 10m light vehicles, Critical gap (right turn from SH29): 4.5 s, Follow up headway (right turn from SH29): 2.5 s, Assume 98% PFF because higher flows than weekday and assumed flatter profile, Assume lower HCV than weekday
Site Category: (None)
Give-Way (Two-Way)
Design Life Analysis (Final Year): Results for 3 years

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: SH1 (South)														
5	T1	819	10.0	893	10.0	0.491	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	99.6
6	R2	58	10.0	63	10.0	0.064	10.6	LOS B	0.3	2.8	0.44	0.70	0.44	67.4
Approach		877	10.0	957	10.0	0.491	0.8	NA	0.3	2.8	0.03	0.05	0.03	96.5
North: SH29														
7	L2	15	10.0	16	10.0	0.018	11.1	LOS B	0.1	0.7	0.42	0.65	0.42	67.7
9	R2	368	10.0	401	10.0	1.603	572.0	LOS F [11]	101.2	1042.8	1.00	4.60	18.08	5.9
Approach		383	10.0	418	10.0	1.603	550.1	LOS F [11]	101.2	1042.8	0.98	4.44	17.39	6.1
West: SH1 (North)														
10	L2	348	7.0	380	7.0	0.252	8.8	LOS A	1.4	13.8	0.13	0.61	0.13	71.2
11	T1	519	7.0	566	7.0	0.304	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	99.8
Approach		867	7.0	946	7.0	0.304	3.5	LOS A	1.4	13.8	0.05	0.24	0.05	85.9
All Vehicles		2127	8.8	2320	8.8	1.603	100.8	NA	101.2	1042.8	0.21	0.92	3.16	25.9

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

11 Level of Service is worse than the Level of Service Target specified in the Parameter Settings dialog.

MOVEMENT SUMMARY

▽ Site: 102 [2034 - AM period SH1/29 Intersection (Site Folder: Existing layout)]

Project: 2-A0012.04 C2P
Traffic flows: based on 2021 IC survey site data on SH29 and SH1, with a 2.3% growth rate applied for 13 years
Exiting flow effect: 10%, Extra bunching: 30%, Queue space: 10m light vehicles, Critical gap (right turn from SH29): 4.5 s, Follow up headway (right turn from SH29): 2.5 s
Site Category: (None)
Give-Way (Two-Way)
Design Life Analysis (Final Year): Results for 13 years

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: SH1 (South)														
5	T1	364	17.0	489	17.0	0.281	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	99.8
6	R2	19	17.0	26	17.0	0.025	10.4	LOS B	0.1	1.1	0.40	0.66	0.40	65.6
Approach		383	17.0	514	17.0	0.281	0.5	NA	0.1	1.1	0.02	0.03	0.02	97.3
North: SH29														
7	L2	17	16.9	23	16.9	0.024	11.1	LOS B	0.1	1.0	0.39	0.65	0.39	66.0
9	R2	281	16.9	375	16.9	0.800	26.0	LOS D	6.4	67.7	0.90	1.23	1.99	51.3
Approach		298	16.9	397	16.9	0.800	25.1	LOS D	6.4	67.7	0.87	1.20	1.90	52.0
West: SH1 (North)														
10	L2	257	10.4	353	10.4	0.231	8.7	LOS A	1.2	12.6	0.08	0.61	0.08	70.4
11	T1	366	10.4	502	10.4	0.275	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	99.8
Approach		623	10.4	855	10.4	0.275	3.6	LOS A	1.2	12.6	0.03	0.25	0.03	85.1
All Vehicles		1304	13.8	1767	13.8	0.800	7.6	NA	6.4	67.7	0.22	0.40	0.45	76.9

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 102 [2034 - PM period SH1/29 Intersection (Site Folder: Existing layout)]

Project: 2-A0012.04 C2P
Traffic flows: based on 2021 IC survey site data on SH29 and SH1, with a 2.3% growth rate applied for 13 years
Exiting flow effect: 10%, Extra bunching: 30%, Queue space: 10m light vehicles, Critical gap (right turn from SH29): 4.5 s, Follow up headway (right turn from SH29): 2.5 s
Site Category: (None)
Give-Way (Two-Way)
Design Life Analysis (Final Year): Results for 13 years

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: SH1 (South)														
5	T1	459	17.0	652	17.0	0.374	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	99.7
6	R2	11	17.0	16	17.0	0.019	11.6	LOS B	0.1	0.8	0.51	0.69	0.51	64.3
Approach		470	17.0	668	17.0	0.374	0.3	NA	0.1	0.8	0.01	0.02	0.01	98.5
North: SH29														
7	L2	19	16.9	27	16.9	0.036	12.3	LOS B	0.1	1.3	0.50	0.71	0.50	64.6
9	R2	306	16.9	438	16.9	1.401	389.7	LOS F [11]	85.8	901.2	1.00	4.34	16.14	8.3
Approach		325	16.9	465	16.9	1.401	367.6	LOS F [11]	85.8	901.2	0.97	4.13	15.22	8.8
West: SH1 (North)														
10	L2	321	10.4	434	10.4	0.283	8.7	LOS A	1.6	16.5	0.06	0.62	0.06	70.5
11	T1	484	10.4	655	10.4	0.358	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	99.8
Approach		805	10.4	1089	10.4	0.358	3.5	LOS A	1.6	16.5	0.02	0.25	0.02	85.5
All Vehicles		1600	13.6	2221	13.7	1.401	78.8	NA	85.8	901.2	0.22	0.99	3.20	30.6

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

11 Level of Service is worse than the Level of Service Target specified in the Parameter Settings dialog.

MOVEMENT SUMMARY

Site: 102 [2034 - Weekend Peak SH1/29 Intersection (Site Folder: Existing layout)]

Project: 2-A0012.04 C2P
Traffic flows estimated using 2020 Waka Kotahi directional count data and applying 14 years growth at 2.3%
Exiting flow effect: 10%, Extra bunching: 30%, Queue space: 10m light vehicles, Critical gap (right turn from SH29): 4.5 s, Follow up headway (right turn from SH29): 2.5 s, Assume 98% PFF because higher flows than weekday and assumed flatter profile, Assume lower HCV than weekday
Site Category: (None)
Give-Way (Two-Way)
Design Life Analysis (Final Year): Results for 13 years

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: SH1 (South)														
5	T1	819	10.0	1086	10.0	0.598	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	99.4
6	R2	58	10.0	77	10.0	0.091	11.6	LOS B	0.4	3.8	0.53	0.75	0.53	66.1
Approach		877	10.0	1162	10.0	0.598	0.9	NA	0.4	3.8	0.04	0.05	0.04	96.2
North: SH29														
7	L2	15	10.0	20	10.0	0.025	12.0	LOS B	0.1	0.9	0.50	0.70	0.50	66.6
9	R2	368	10.0	488	10.0	3.279	2074.6	LOS F [11]	221.5	2281.1	1.00	5.20	22.28	1.7
Approach		383	10.0	508	10.0	3.279	1993.8	LOS F [11]	221.5	2281.1	0.98	5.02	21.43	1.8
West: SH1 (North)														
10	L2	348	7.0	461	7.0	0.310	8.9	LOS A	1.8	18.1	0.15	0.60	0.15	71.0
11	T1	519	7.0	688	7.0	0.369	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	99.8
Approach		867	7.0	1149	7.0	0.369	3.6	LOS A	1.8	18.1	0.06	0.24	0.06	85.8
All Vehicles		2127	8.8	2819	8.8	3.279	360.8	NA	221.5	2281.1	0.22	1.02	3.90	9.1

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

11 Level of Service is worse than the Level of Service Target specified in the Parameter Settings dialog.

MOVEMENT SUMMARY

Site: 101 [2021 - AM period SH1/29 Roundabout (Site Folder: Roundabout option - pre C2P)]

Project: 2-A0012.04 C2P
Traffic flows: based on 2021 IC survey site data on SH29 and SH1
Dimensions measured off plan in folder, Extra bunching: 30%, Queue space: 10m light vehicles,
Site Category: (None)
Roundabout

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: SH1 (North)														
2	T1	257	10.4	271	10.4	0.193	8.0	LOS A	0.9	9.8	0.07	0.48	0.07	78.6
3	R2	366	10.4	385	10.4	0.232	15.9	LOS B	1.3	12.9	0.07	0.69	0.07	68.9
Approach		623	10.4	656	10.4	0.232	12.6	LOS B	1.3	12.9	0.07	0.60	0.07	72.5
East: SH1 (South)														
4	L2	364	17.0	383	17.0	0.296	7.7	LOS A	1.4	15.0	0.29	0.58	0.29	72.7
6	R2	19	17.0	20	17.0	0.023	17.2	LOS B	0.1	0.8	0.26	0.68	0.26	66.3
Approach		383	17.0	403	17.0	0.296	8.1	LOS A	1.4	15.0	0.29	0.58	0.29	72.3
North: SH29														
7	L2	17	16.9	18	16.9	0.138	8.9	LOS A	0.9	9.7	0.36	0.53	0.36	70.5
8	T1	281	16.9	296	16.9	0.138	10.3	LOS B	0.9	9.7	0.36	0.53	0.36	74.2
Approach		298	16.9	314	16.9	0.138	10.2	LOS B	0.9	9.7	0.36	0.53	0.36	73.9
All Vehicles		1304	13.8	1373	13.8	0.296	10.8	LOS B	1.4	15.0	0.20	0.58	0.20	72.8

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [2021 - PM period SH1/29 Roundabout (Site Folder: Roundabout option - pre C2P)]

Project: 2-A0012.04 C2P
Traffic flows: based on 2021 IC survey site data on SH29 and SH1
Dimensions measured off plan in folder, Extra bunching: 30%, Queue space: 10m light vehicles,
Site Category: (None)
Roundabout

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: SH1 (North)														
2	T1	321	10.4	338	10.4	0.238	8.0	LOS A	1.2	12.8	0.05	0.49	0.05	78.8
3	R2	484	10.4	509	10.4	0.298	15.8	LOS B	1.8	18.3	0.05	0.69	0.05	69.1
Approach		805	10.4	847	10.4	0.298	12.7	LOS B	1.8	18.3	0.05	0.61	0.05	72.5
East: SH1 (South)														
4	L2	459	17.0	483	17.0	0.381	7.8	LOS A	2.0	21.1	0.33	0.60	0.33	72.4
6	R2	11	17.0	12	17.0	0.014	17.3	LOS B	0.0	0.5	0.28	0.68	0.28	66.2
Approach		470	17.0	495	17.0	0.381	8.1	LOS A	2.0	21.1	0.33	0.60	0.33	72.2
North: SH29														
7	L2	19	16.9	20	16.9	0.163	10.6	LOS B	1.4	14.5	0.46	0.54	0.46	69.1
8	T1	306	16.9	322	16.9	0.163	12.1	LOS B	1.4	14.5	0.46	0.54	0.46	72.3
Approach		325	16.9	342	16.9	0.163	12.0	LOS B	1.4	14.5	0.46	0.54	0.46	72.1
All Vehicles		1600	13.6	1684	13.6	0.381	11.2	LOS B	2.0	21.1	0.22	0.59	0.22	72.4

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [2021 - Weekend Peak SH1/29 Roundabout (Site Folder: Roundabout option - pre C2P)]

Project: 2-A0012.04 C2P
Traffic flows estimated using 2020 Waka Kotahi directional count data and applying 1 years growth at 2.3%
Dimensions measured off plan in folder,Extra bunching: 30%, Queue space: 10m light vehicles
Site Category: (None)
Roundabout

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: SH1 (North)														
2	T1	348	7.0	366	7.0	0.272	8.2	LOS A	1.5	15.1	0.14	0.49	0.14	78.4
3	R2	519	7.0	546	7.0	0.340	16.0	LOS B	2.1	21.9	0.15	0.67	0.15	69.2
Approach		867	7.0	913	7.0	0.340	12.9	LOS B	2.1	21.9	0.15	0.60	0.15	72.5
East: SH1 (South)														
4	L2	819	10.0	862	10.0	0.668	8.8	LOS A	5.7	58.3	0.48	0.68	0.52	72.7
6	R2	58	10.0	61	10.0	0.072	17.4	LOS B	0.3	2.7	0.31	0.72	0.31	67.5
Approach		877	10.0	923	10.0	0.668	9.4	LOS A	5.7	58.3	0.47	0.68	0.51	72.3
North: SH29														
7	L2	15	10.0	16	10.0	0.192	10.6	LOS B	1.7	17.2	0.49	0.55	0.49	70.2
8	T1	368	10.0	387	10.0	0.192	12.1	LOS B	1.7	17.2	0.49	0.56	0.49	73.4
Approach		383	10.0	403	10.0	0.192	12.0	LOS B	1.7	17.2	0.49	0.56	0.49	73.3
All Vehicles		2127	8.8	2239	8.8	0.668	11.3	LOS B	5.7	58.3	0.34	0.62	0.36	72.6

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [2024 - AM period SH1/29 Roundabout (Site Folder: Roundabout option - pre C2P)]

Project: 2-A0012.04 C2P
Traffic flows: based on 2021 IC survey site data on SH29 and SH1, with a 2.3% growth rate applied for 3 years
Dimensions measured off plan in folder, Extra bunching: 30%, Queue space: 10m light vehicles,
Site Category: (None)
Roundabout
Design Life Analysis (Final Year): Results for 3 years

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: SH1 (North)														
2	T1	257	10.4	289	10.4	0.207	8.0	LOS A	1.0	10.7	0.07	0.48	0.07	78.6
3	R2	366	10.4	412	10.4	0.248	15.9	LOS B	1.4	14.1	0.07	0.69	0.07	68.9
Approach		623	10.4	701	10.4	0.248	12.6	LOS B	1.4	14.1	0.07	0.60	0.07	72.5
East: SH1 (South)														
4	L2	364	17.0	410	17.0	0.320	7.8	LOS A	1.6	16.5	0.30	0.59	0.30	72.6
6	R2	19	17.0	21	17.0	0.025	17.3	LOS B	0.1	0.9	0.27	0.69	0.27	66.2
Approach		383	17.0	431	17.0	0.320	8.2	LOS A	1.6	16.5	0.30	0.59	0.30	72.2
North: SH29														
7	L2	17	16.9	19	16.9	0.150	9.2	LOS A	1.0	11.0	0.38	0.53	0.38	70.3
8	T1	281	16.9	316	16.9	0.150	10.6	LOS B	1.0	11.0	0.38	0.53	0.38	73.9
Approach		298	16.9	335	16.9	0.150	10.5	LOS B	1.0	11.0	0.38	0.53	0.38	73.7
All Vehicles		1304	13.8	1467	13.8	0.320	10.9	LOS B	1.6	16.5	0.21	0.58	0.21	72.7

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [2024 - PM period SH1/29 Roundabout (Site Folder: Roundabout option - pre C2P)]

Project: 2-A0012.04 C2P
Traffic flows: based on 2021 IC survey site data on SH29 and SH1, with a 2.3% growth rate applied for 3 years
Dimensions measured off plan in folder, Extra bunching: 30%, Queue space: 10m light vehicles,
Site Category: (None)
Roundabout
Design Life Analysis (Final Year): Results for 3 years

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	INPUT VOLUMES HV] %	DEMAND FLOWS [Total veh/h	DEMAND FLOWS HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	95% BACK OF QUEUE Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: SH1 (North)														
2	T1	321	10.4	361	10.4	0.255	8.0	LOS A	1.4	14.0	0.06	0.48	0.06	78.8
3	R2	484	10.4	545	10.4	0.319	15.9	LOS B	2.0	20.2	0.06	0.69	0.06	69.0
Approach		805	10.4	906	10.4	0.319	12.7	LOS B	2.0	20.2	0.06	0.61	0.06	72.5
East: SH1 (South)														
4	L2	459	17.0	516	17.0	0.414	8.0	LOS A	2.2	23.6	0.35	0.61	0.35	72.2
6	R2	11	17.0	12	17.0	0.015	17.4	LOS B	0.1	0.5	0.29	0.68	0.29	66.1
Approach		470	17.0	529	17.0	0.414	8.2	LOS A	2.2	23.6	0.35	0.61	0.35	72.0
North: SH29														
7	L2	19	16.9	21	16.9	0.178	11.3	LOS B	1.6	17.3	0.50	0.54	0.50	68.2
8	T1	306	16.9	344	16.9	0.178	12.8	LOS B	1.6	17.3	0.49	0.55	0.49	71.4
Approach		325	16.9	366	16.9	0.178	12.7	LOS B	1.6	17.3	0.49	0.55	0.49	71.2
All Vehicles		1600	13.6	1800	13.6	0.414	11.4	LOS B	2.2	23.6	0.23	0.60	0.23	72.1

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [2024 - Weekend Peak SH1/29 Roundabout (Site Folder: Roundabout option - pre C2P)]

Project: 2-A0012.04 C2P
Traffic flows estimated using 2020 Waka Kotahi directional count data and applying 4 years growth at 2.3%
Dimensions measured off plan in folder,Extra bunching: 30%, Queue space: 10m light vehicles
Site Category: (None)
Roundabout
Design Life Analysis (Final Year): Results for 3 years

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: SH1 (North)														
2	T1	348	7.0	392	7.0	0.292	8.2	LOS A	1.6	16.6	0.15	0.49	0.15	78.3
3	R2	519	7.0	584	7.0	0.365	16.0	LOS B	2.4	24.3	0.16	0.67	0.16	69.1
Approach		867	7.0	976	7.0	0.365	12.9	LOS B	2.4	24.3	0.16	0.60	0.16	72.5
East: SH1 (South)														
4	L2	819	10.0	922	10.0	0.726	9.4	LOS A	7.0	72.2	0.55	0.72	0.63	72.1
6	R2	58	10.0	65	10.0	0.078	17.5	LOS B	0.3	2.9	0.33	0.73	0.33	67.3
Approach		877	10.0	987	10.0	0.726	9.9	LOS A	7.0	72.2	0.54	0.72	0.61	71.8
North: SH29														
7	L2	15	10.0	17	10.0	0.211	11.2	LOS B	2.0	20.4	0.53	0.56	0.53	69.4
8	T1	368	10.0	414	10.0	0.211	12.8	LOS B	2.0	20.4	0.52	0.57	0.52	72.5
Approach		383	10.0	431	10.0	0.211	12.7	LOS B	2.0	20.4	0.52	0.57	0.52	72.3
All Vehicles		2127	8.8	2393	8.8	0.726	11.6	LOS B	7.0	72.2	0.38	0.64	0.41	72.2

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [2034 - AM period SH1/29 Roundabout (Site Folder: Roundabout option - pre C2P)]

Project: 2-A0012.04 C2P
Traffic flows: based on 2021 IC survey site data on SH29 and SH1, with a 2.3% growth rate applied for 13 years
Dimensions measured off plan in folder, Extra bunching: 30%, Queue space: 10m light vehicles,
Site Category: (None)
Roundabout
Design Life Analysis (Final Year): Results for 13 years

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: SH1 (North)														
2	T1	257	10.4	351	10.4	0.253	8.1	LOS A	1.3	13.8	0.09	0.48	0.09	78.4
3	R2	366	10.4	500	10.4	0.303	15.9	LOS B	1.8	18.6	0.09	0.68	0.09	68.8
Approach		623	10.4	852	10.4	0.303	12.7	LOS B	1.8	18.6	0.09	0.60	0.09	72.4
East: SH1 (South)														
4	L2	364	17.0	498	17.0	0.405	8.1	LOS A	2.2	22.7	0.36	0.62	0.36	72.1
6	R2	19	17.0	26	17.0	0.032	17.5	LOS B	0.1	1.2	0.31	0.70	0.31	66.0
Approach		383	17.0	524	17.0	0.405	8.5	LOS A	2.2	22.7	0.36	0.62	0.36	71.8
North: SH29														
7	L2	17	16.9	23	16.9	0.194	10.4	LOS B	1.6	17.0	0.46	0.55	0.46	69.3
8	T1	281	16.9	384	16.9	0.194	11.9	LOS B	1.6	17.0	0.46	0.55	0.46	72.6
Approach		298	16.9	407	16.9	0.194	11.8	LOS B	1.6	17.0	0.46	0.55	0.46	72.4
All Vehicles		1304	13.8	1783	13.8	0.405	11.3	LOS B	2.2	22.7	0.25	0.60	0.25	72.2

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [2034 - PM period SH1/29 Roundabout (Site Folder: Roundabout option - pre C2P)]

Project: 2-A0012.04 C2P
Traffic flows: based on 2021 IC survey site data on SH29 and SH1, with a 2.3% growth rate applied for 13 years
Dimensions measured off plan in folder, Extra bunching: 30%, Queue space: 10m light vehicles,
Site Category: (None)
Roundabout
Design Life Analysis (Final Year): Results for 13 years

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	INPUT VOLUMES HV] %	DEMAND FLOWS [Total veh/h	DEMAND FLOWS HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	95% BACK OF QUEUE Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: SH1 (North)														
2	T1	321	10.4	439	10.4	0.310	8.0	LOS A	1.8	18.5	0.07	0.48	0.07	78.6
3	R2	484	10.4	662	10.4	0.389	15.9	LOS B	2.7	27.5	0.07	0.69	0.07	68.9
Approach		805	10.4	1101	10.4	0.389	12.7	LOS B	2.7	27.5	0.07	0.61	0.07	72.4
East: SH1 (South)														
4	L2	459	17.0	628	17.0	0.531	8.5	LOS A	3.3	34.8	0.45	0.67	0.47	71.4
6	R2	11	17.0	15	17.0	0.019	17.7	LOS B	0.1	0.7	0.34	0.70	0.34	65.8
Approach		470	17.0	643	17.0	0.531	8.7	LOS A	3.3	34.8	0.45	0.67	0.46	71.3
North: SH29														
7	L2	19	16.9	26	16.9	0.236	15.0	LOS B	3.1	32.2	0.64	0.54	0.64	64.0
8	T1	306	16.9	418	16.9	0.236	16.6	LOS B	3.1	32.2	0.63	0.55	0.63	66.8
Approach		325	16.9	444	16.9	0.236	16.5	LOS B	3.1	32.2	0.63	0.55	0.63	66.6
All Vehicles		1600	13.6	2188	13.6	0.531	12.3	LOS B	3.3	34.8	0.30	0.61	0.30	70.8

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [2034 - Weekend Peak SH1/29 Roundabout (Site Folder: Roundabout option - pre C2P)]

Project: 2-A0012.04 C2P
Traffic flows estimated using 2020 Waka Kotahi directional count data and applying 14 years growth at 2.3%
Dimensions measured off plan in folder,Extra bunching: 30%, Queue space: 10m light vehicles
Site Category: (None)
Roundabout
Design Life Analysis (Final Year): Results for 13 years

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	INPUT VOLUMES HV] %	DEMAND FLOWS [Total veh/h	DEMAND FLOWS HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	95% BACK OF QUEUE Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: SH1 (North)														
2	T1	348	7.0	476	7.0	0.359	8.3	LOS A	2.2	22.5	0.19	0.49	0.19	77.9
3	R2	519	7.0	710	7.0	0.448	16.1	LOS B	3.3	34.1	0.19	0.67	0.19	68.9
Approach		867	7.0	1186	7.0	0.448	13.0	LOS B	3.3	34.1	0.19	0.60	0.19	72.2
East: SH1 (South)														
4	L2	819	10.0	1120	10.0	0.938	15.5	LOS B	17.8	183.2	0.89	1.05	1.41	64.8
6	R2	58	10.0	79	10.0	0.102	17.8	LOS B	0.4	3.8	0.40	0.76	0.40	66.9
Approach		877	10.0	1199	10.0	0.938	15.6	LOS B	17.8	183.2	0.86	1.03	1.34	64.9
North: SH29														
7	L2	15	10.0	21	10.0	0.285	14.6	LOS B	3.6	36.9	0.67	0.58	0.67	65.4
8	T1	368	10.0	503	10.0	0.285	16.2	LOS B	3.6	36.9	0.66	0.59	0.66	68.1
Approach		383	10.0	524	10.0	0.285	16.2	LOS B	3.6	36.9	0.66	0.59	0.66	68.0
All Vehicles		2127	8.8	2908	8.8	0.938	14.7	LOS B	17.8	183.2	0.55	0.77	0.75	68.4

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Appendix C
Safety assessment

ACCIDENT RATE ANALYSIS - Option **WORKSHEET A6.5**

Project:	SH1-29 Intersection				
Project Option :	Roundabout				
Option Posted Speed Limit :	100	**Traffic Growth :**	2.30%	Modification to traffic growth rate	-2.00%
Road Category:	RS	**Time Zero :**	2021		

ACCIDENT PREDICTION MODEL				
1	Model used	Method B, 6.4 high speed (rural)Roundabouts) 80 km/h		
2	Approach from:	SH1 North	SH1 South	SH29
3	Qapproach	21253	12309	8550
4	bo	4.33E-04	4.33E-04	4.33E-04
5	b1	0.53	0.53	0.53
6	Typical Accident Rate Per Approach	8.51E-02	6.37E-02	5.25E-02
7	Typical Accident Rate (Accidents per Year)	0.201		
		Proceed to Step 8		
EXPOSURE BASED ACCIDENT PREDICTION EQUATION				
1a	Method / Table Used:	Method B, 6.4 high speed (rural)Roundabouts) >= 80 km/h		
2a	Coefficient b0 (/10^8 veh-kms or /10^8 vehicles)			
3a	Cross-section adjustment factor from table A6.13 (1.0 no adjustment)			
4a	Adjusted coefficient **(2a)** x **(3a)**			
5a	Exposure at Time Zero (10^8 veh-kms or 10^8 vehicles)			
7	Typical Accident Rate (Accidents per Year), Atdm **(4a)** x **(5a)**			
8	Accident trend factor for adjusting Typical Accident rate, ft (appendix A6.4 method B)	-0.02	Method B adjustment	
9	Adjustment factor (1 + **(8)** x (time zero year - 2006)) (appendix A6.4 method B)	0.700		
10	Typical Accident Rate per year adjusted for accident trends At **(7)** x **(9)****	0.141		
ACCIDENT COSTS			70	100
11	Cost per Reported Injury Accident (Table A6.22)	$ 545,000.00	$ 340,000	$ 545,000
12	Total Accident Cost per Year **(10)** x **(11)**	**$ 76,825**		

(14)** For midblock analysis, the typical ax rate **(15)** must be divided by the length in km wsp.com/nz