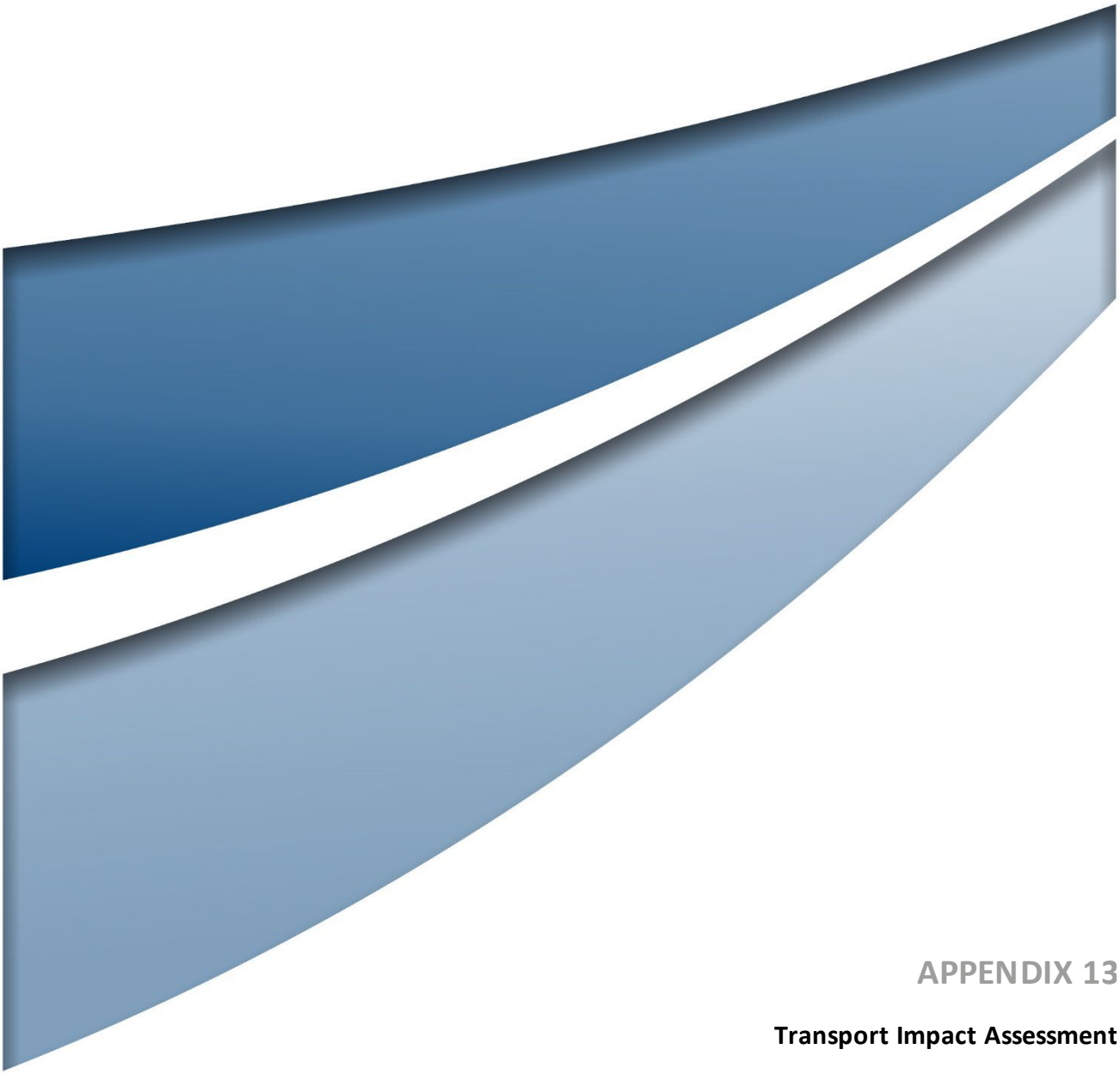


APPENDIX 13

Transport Impact Assessment

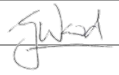
Stone Ridge Quarry

Transport Impact Assessment

Australian Resource Development Group Pty Limited

17 May 2023

→ **The Power of Commitment**

Status Code	Revision	Author	Reviewer		Approved for issue		
			Name	Signature	Name	Signature	Date
S4	0	M. Fletcher-Kennedy	M. Petrusma	On file	A. Sneddon	On file	08/11/22
S4	1	M. Petrusma	G. Wood	On file	A. Sneddon	On file	23/02/23
S4	2	M. Petrusma	G. Wood		A. Sneddon		17/05/23

GHD Pty Ltd | ABN 39 008 488 373

180 Lonsdale Street, Level 9

Melbourne, Victoria 3000, Australia

T +61 3 8687 8000 | **F** +61 3 8732 7046 | **E** melmail@ghd.com | **ghd.com**

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1. Introduction

1.1 Background and project overview

Australian Resource Development Group Pty Limited (ARDG) is seeking development consent for a new hard rock quarry known as Stone Ridge Quarry (the project). The project is located within Wallaroo State Forest at Balickera, NSW, approximately 25 kilometres north of Newcastle. The project is seeking to access a high quality, hard rock resource suitable for producing a wide range of quarry products for the Lower Hunter, Central Coast and northern Sydney construction materials market (ARDG 2020).

1.2 Related Development

ARDG has consulted extensively with Transport for NSW (TfNSW) regarding access to the Pacific Highway from Italia Road. As a result, and in conjunction with two other existing/proposed quarry operators using Italia Road (Boral and Eagleton Rock Syndicate), TfNSW has accepted in-principle a proposal by the three parties to improve road safety at the existing Italia Road and Pacific Highway intersection via construction of a dedicated left-turn northbound acceleration lane onto the Pacific Highway, which will remove the current left-turn merge movement with a safer downstream merge movement. This movement must be used by all quarry trucks. In addition, the northbound deceleration lane into Italia Road will be lengthened.

Following detailed consultation during 2022 between TfNSW, ARDG, Boral, Eagleton Rock Syndicate and Port Stephens Council, it has been determined that a separate Development Application will be lodged by Boral for an upgrade of the existing Italia Road-Pacific Highway intersection to meet TfNSW requirements. No quarry product will be transported from the site until these intersection works are completed to the satisfaction of Port Stephens Council / TfNSW.

1.3 Purpose of this report

GHD was engaged by ARDG to prepare a Transport Impact Assessment (TIA) to support the preparation of an Environmental Impact Statement (EIS) for the project.

This report addresses the relevant criteria in the NSW Secretary's Environmental Assessment Requirements (SEARs) for the project as outlined in Section 2.3 and assesses the transport impacts associated with the project.

This report focuses on the impact of transport that may arise during the project. Specifically, this report:

– Describes the existing environment with respect to the project
– Describes the transport aspects of the project
– Assesses the potential transport impacts of the project in relation to the public road network

1.4 Limitations

This report has been prepared by GHD for Australian Resource Development Group Pty Limited and may only be used and relied on by Australian Resource Development Group Pty Limited for the purpose agreed between GHD and Australian Resource Development Group Pty Limited.

GHD otherwise disclaims responsibility to any person other than Australian Resource Development Group Pty Limited arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Australian Resource Development Group Pty Limited and others who provided information to GHD (including Government authorities)], which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

1.5 Assumptions

This TIA was developed based on the following assumptions developed with ARDG, as well as other assumptions documented in this report:

– For the purposes of this assessment, it has been assumed that all material is transported to the south of the site to represent a 'worst case' scenario for access to the Pacific Highway.
– Material would be transported out of the site consistently while the quarry is operational, allowing traffic movements to be calculated based on the amount of material produced and the days worked.
– It is assumed that truck and dog combinations would be used to transport material out of the site, with each vehicle carrying 30 tonnes of material. This represents a conservative assessment compared to the potential use of B-double trucks, which would reduce the total volume of traffic generated.
– Over the next 10 years the Pacific Highway may experience 20% growth to the through volumes.

2. Legislative and policy context

2.1 Road and Related Facilities

The Department of Urban Affairs and Planning (NSW) prepared the *Roads and Related Facilities EIS Guideline* in 1991 which is still used as a guideline for undertaking impact assessments for EIS reports. As outlined within the guide, any impact assessment should include predictions of the nature and extent of potential impacts as well as the effectiveness of the proposed mitigation strategies. Furthermore, Section 6.E.2. outlines the specific construction and operation stage transport related impacts which should be addressed. Each of the relevant transport impacts has been assessed in this report, including:

– Traffic impacts on existing road network
– Predicted changes in usage characteristics including changes to light and heavy vehicle volumes
– The need for ancillary works to support the proposal
– Constraints on freight movements from the development and how these effect the external road network

2.2 Guide to Traffic Generating Developments

This TIA has been undertaken with reference to the *Guide to Traffic Generating Developments* (Roads and Maritime Services, 2002) (the Guide). The Guide provides a process and methodology to undertake the TIA. The traffic operation assessment process outlined in the Guide identifies the operating characteristics which need to be compared with agreed performance criteria.

The Guide states that existing daily traffic volumes on roads adjacent to a proposed development should be compared with estimated daily traffic volumes. This enables the functions of roads in the overall hierarchy of roads to be reviewed in the context of the proposed development. This TIA has been prepared based on this approach.

2.3 Austroads Guide to Traffic Management Part 12: Traffic Impacts of Development

This TIA has been undertaken with due regard for the steps and process to preparing a Traffic Impact Assessment, as outlined within Section 5.3 of the *Austroads Guide to Traffic Management Part 12*. This report outlines the Project, the existing and future year traffic conditions, assesses the traffic operation of the external road network and recommends impact-mitigation treatments and measures.

2.4 Secretary's Environmental Assessment Requirements

The Department of Planning and Environment (DPE) issued a series of secretary's environmental assessment requirements (SEARs) for the project, which were informed through consultation with Transport for New South Wales (TfNSW). The SEARs, together with a reference to where they are addressed in this report, are outlined in Table 2.1.

Table 2.1 Transport SEARs

Requirements	Where addressed in this report
Transport	
Current traffic counts for the Pacific Highway and Italia Road	Section 3.4
The anticipated additional vehicular traffic generated from both the construction and operational stages of the project	Section 5.1
The distribution on the road network of trips generated by the proposed development. It is requested that the predicted flows are shown diagrammatically.	Section 5.2 and Section 5.4.3
Consideration of the impact on the Pacific Highway and Italia Road intersection from the increase in trips resulting from the construction and operation of the quarry. The traffic impact shall also include the cumulative traffic impact of other proposed and operating developments in the area.	Section 5.4 and 5.6
Traffic assessment and analysis of the Pacific Highway at Italia Road is to include: – Current traffic counts and 10 year traffic growth projections – With and without development scenarios – 95th percentile back of queue lengths – Delays, degree of saturation and level of service on all legs for the relevant intersections – Modelling data files for TfNSW review	Section 5.4.5
Identify the necessary road network infrastructure upgrades that are required on both the local and classified road network for the development. (Comment – TfNSW raise concern regarding the increase in all vehicle usage of this intersection in its current form, and in particular heavy vehicle usage. TfNSW consider the ability for the intersection to accommodate additional vehicles is limited. Grade separation of the right turns should be considered to mitigate the impact of the development.)	Sections 5.3 and 5.5
Preliminary concept drawings shall be submitted with the EIS for any identified road infrastructure upgrades. However, it should be noted that any identified road infrastructure upgrades will need to be to the satisfaction of TfNSW and Council.	Appendix A
Identification of funding mechanisms to deliver any required road infrastructure.	Section 5.5
Any other impacts on the regional and state road network including consideration of pedestrian, cyclist and public transport facilities and provision for service vehicles.	Section 5.7

3. Existing conditions

3.1 Site location

The project site is located within the Wallaroo State Forrest, which is in the Port Stephens Local Government Area (LGA). The site is approximately 25km north of Newcastle, northeast of Italia Road and northwest of the Pacific Highway.

The site is generally surrounded by forest, with the Wallaroo National Park at the north and various land uses on the southwest side of Italia Road, including a recreational motorway, a paintball facility, and the Boral Seaham Quarry. The nearest residential lots are located approximately 1km to the west of the site on Italia Road, as well as approximately 1.5km to the east of the site off the Pacific Highway. Each of these lots are low density semi-rural in nature.

The project site is accessed from Italia Road, which connects to Pacific Highway.

An aerial view of the licence area, and the project site within is provided below in Figure 3.1, illustrating the location of the proposal in relation to the external road network. The project disturbance area would occupy approximately 79 hectares.

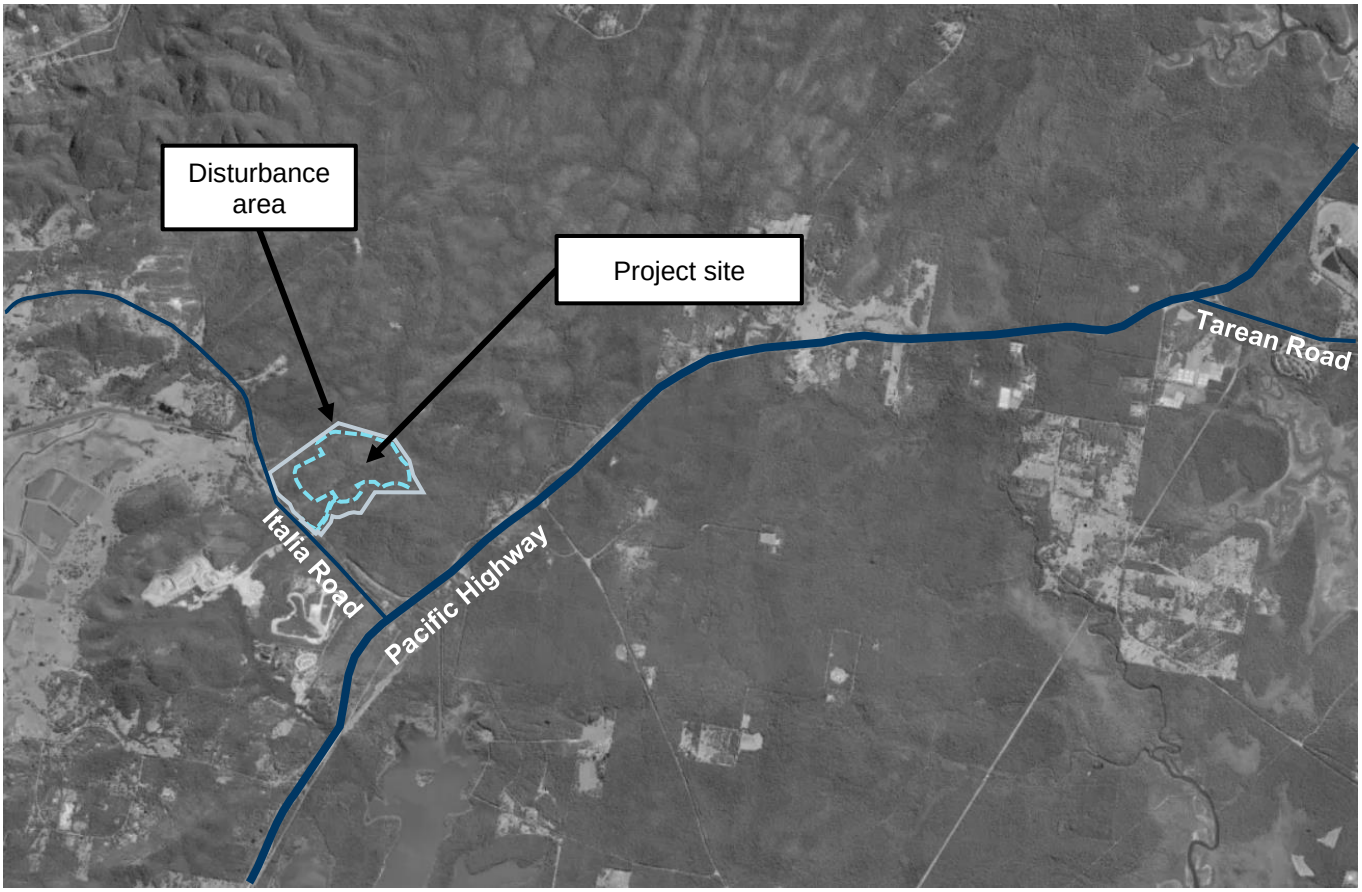

Figure 3.1 Existing site

Image source: MetroMap, accessed June 2022

3.2 Road network

3.2.1 Pacific Highway

The Pacific Highway is an arterial road generally aligned north-south, which runs along the east coast of Australia between Sydney and Brisbane. The Pacific Highway is an important freight corridor along the east coast and is accordingly approved for use by vehicles including 25/26m B-doubles without specific permit conditions.

The Pacific Highway has an average daily traffic volume of approximately 15,000-16,000 vehicles based on actual peak hour traffic count data factored up to a daily estimate (two-way northbound and southbound combined) with around 2,000 over those being trucks.

Publicly available daily traffic count data is highly variable for the Pacific Highway, with no recent data available near this location. The latest 7-day count data at Twelve Mile Creek from 2018, shows southbound only traffic volumes of around 10,700 vehicles and at Taree, some 30,000 vehicles two-way per day in 2023. Over the last 7 years, the Pacific Highway traffic volumes have seen approximately 2-3% growth per annum based on historic traffic volume data published by TfNSW.

The Pacific Highway is a divided road with two to three lanes in each direction. In this regard, two lanes are provided in each direction adjacent to Italia Road, with the acceleration lane in the southbound direction from Italia Road providing a third lane for approximately 1.2km. Sealed shoulders are provided on either side of the Highway with a width of 2.2-2.5m, allowing for vehicles to pull over if required.

No car parking or bicycle lanes are provided along the Pacific Highway in the vicinity of the site. A posted speed limit of 100km/h applies in the vicinity of the site, reducing to 60km/h through towns.

3.2.2 Italia Road

Italia Road is a local road generally aligned northwest-southeast, which runs northwest from the Pacific Highway for approximately 8.5km to the intersection with East Seaham Road.

At the southeast end of Italia Road, the Boral Seaham Quarry, Ringwood Park Motor Complex and Hunter Valley Paintball are located on the southern side of the road while the Wallaroo Forrest is located on the north side. To the northwest end of Italia Road, either side of the road is occupied by low density/semi-rural residential lots.

Italia Road is fully sealed and provides one traffic lane in each direction. No parking or bicycle lanes are provided along the length of Italia Road. A posted speed limit of 90km/h applies to Italia Road.

The intersection of Italia Road and Pacific Highway is shown below in Figure 3.2.

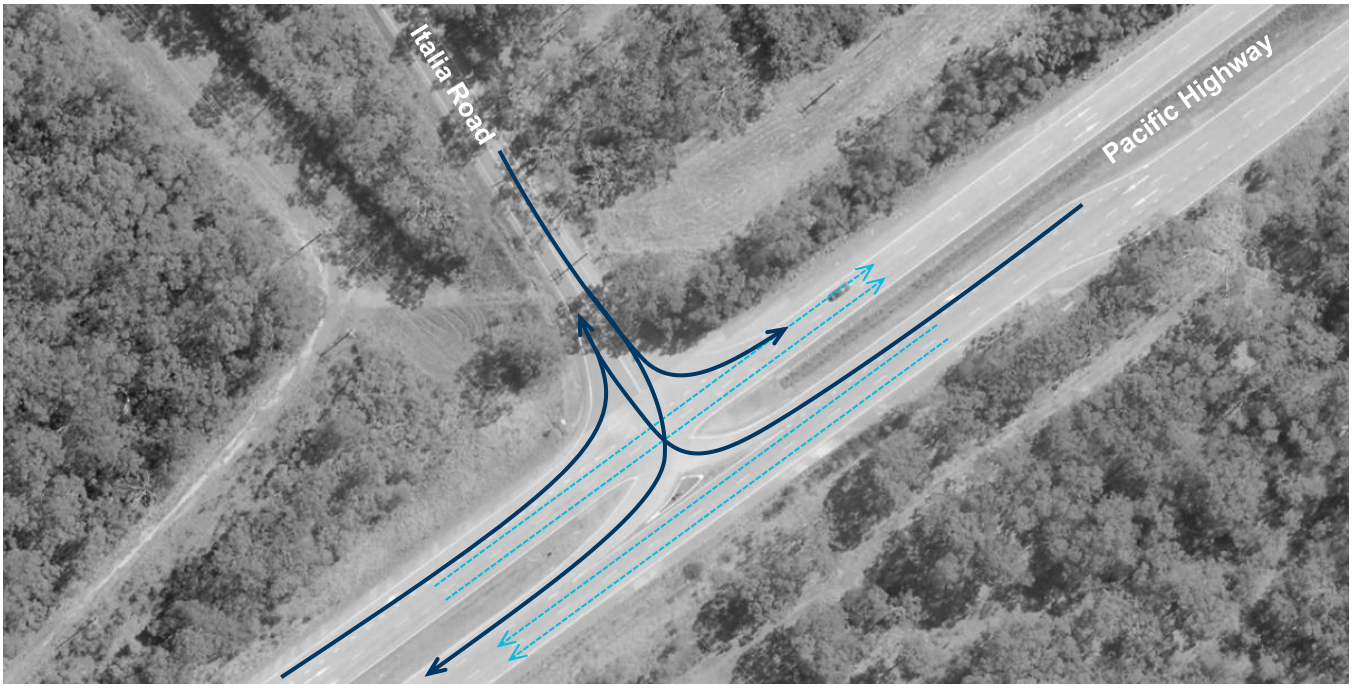

Figure 3.2 Italia Road / Pacific Highway intersection

Image source: MetroMap, accessed June 2022

The existing intersection of Italia Road and Pacific Highway is a seagull type intersection, with short right turn and left turn deceleration lanes. The intersection features a long acceleration lane for southbound vehicles turning right onto the Pacific Highway which forms a third lane on the Highway until it merges approximately 1.2km downstream of the intersection. This allows right turning vehicle to enter Pacific Highway giving way to traffic in the northbound direction and southbound vehicles turning right into Italia Road only.

3.2.3 Tarean Road

Tarean Road is a Council controlled local road which runs generally east-west through the town of Karuah, linking to the Pacific Highway at each end. The southern interchange at Pacific Highway provides for access to and from Tarean Road for areas south and west of the interchange only.

Tarean Road is configured as a two-lane two-way undivided road, with sealed shoulders. Furthermore, Tarean Road has a posted speed limit of 80km/h near the Pacific Highway, reducing to 60km/h through Karuah and at the Highway merge points.

No provision for car parking or cycle lanes is provided in the vicinity of the Pacific Highway.

3.2.4 Internal access tracks

Within the Wallaroo State Forest and the project site, access is currently provided by several unsealed tracks. These existing vehicle tracks are in relatively poor condition as they are used infrequently by four-wheel drive vehicles. As part of the quarry development, all access roads to be used by quarry vehicles would be either constructed or if existing, upgraded to accommodate quarry vehicle traffic.

3.3 Sustainable transport

Noting the rural nature of the area, there are currently no public transport services which service the site. Furthermore, no bicycle lanes or pedestrian/shared paths are provided along Italia Road, the Pacific Highway or any of the surrounding road network. As such, all access to the site and the surrounding land uses is typically undertaken by private vehicle.

It is noted that bus services for four schools have been identified (Irrawang Public School, Irrawang High School, Hunter River High School and Raymond Terrace Public School) with routes along Italia Road.

3.4 Traffic volumes

3.4.1 Italia Road

GHD commissioned Matrix Traffic and Transport Data to undertake two 7-day tube counts on Italia Road, commencing 14 June 2022. The locations of the tube counters are shown in Figure 3.3.

Figure 3.3 Tube counter locations

Image source: MetroMap, accessed June 2022

Based on the tube count results, Italia Road carries approximately 1376 vehicles per day on weekdays, including approximately 108 vehicles per hour in the AM peak and approximately 114 vehicles per hour in the PM peak. Heavy vehicles make up approximately 20-30% of the traffic stream.

The hourly traffic volumes surveyed at each counter are shown below in Figure 3.4 and Figure 3.5, illustrating the split between eastbound and westbound movements, whereby traffic peaks slightly later and more intensely in the eastbound direction. Furthermore, the curves for heavy vehicles at each counter are close to identical, demonstrating the surveyed heavy vehicles are travelling across both counters.

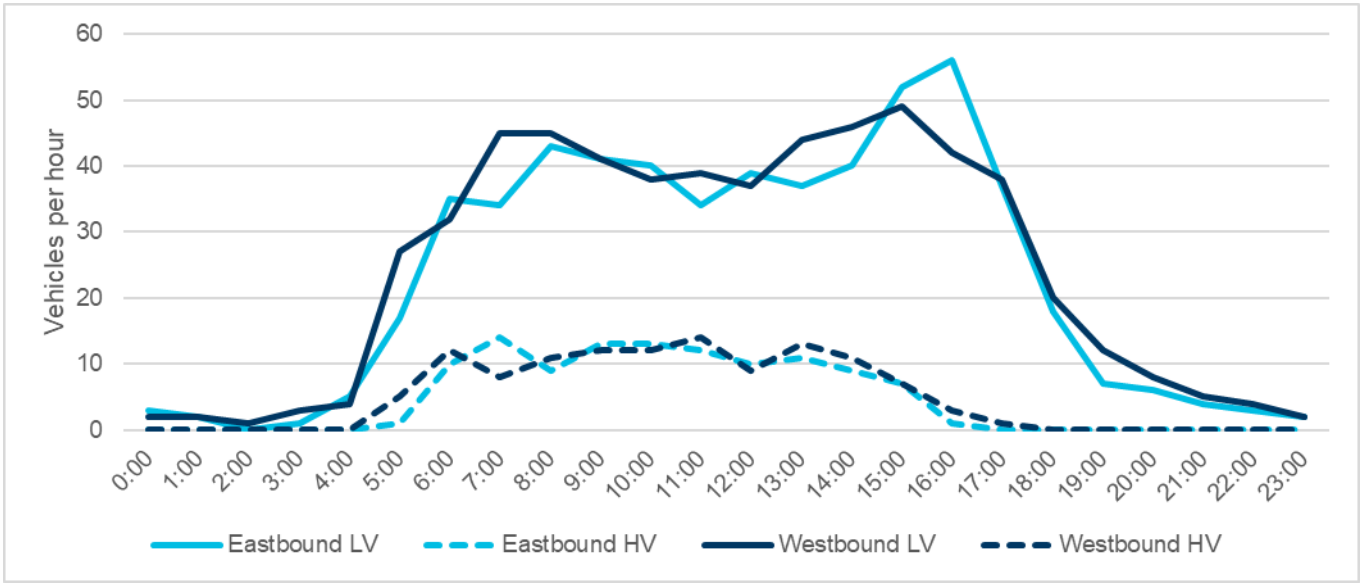

Figure 3.4 Counter 1 – Vehicles per hour

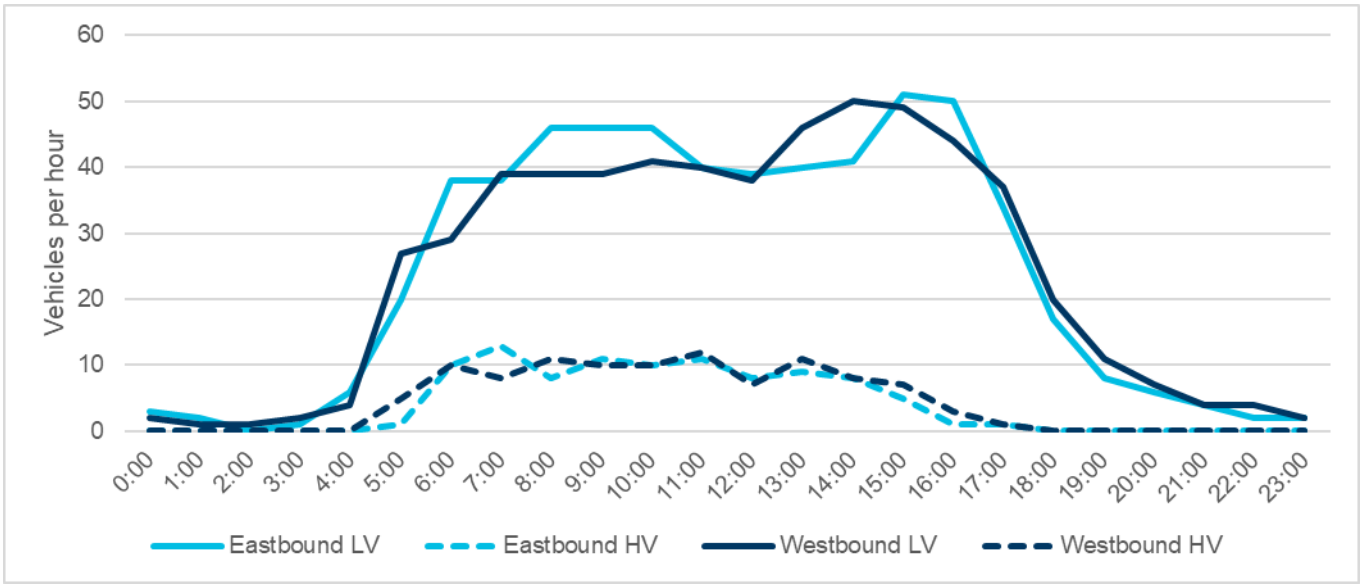

Figure 3.5 Counter 2 – Vehicles per hour

3.4.2 Italia Road / Pacific Highway

Turning movement count surveys were undertaken at the intersection of Italia Road and the Pacific Highway on Tuesday 14 June and Wednesday 15 June 2022. The turning movement counts were undertaken between 07:00 and 10:00 in the morning and again between 15:00 and 18:00 in the afternoon on each survey day. The peak hour results of each the Tuesday and Wednesday surveys are shown below in Figure 3.6 and Figure 3.7, separating light vehicle and heavy vehicle movements.

On Tuesday the peak hours occurred between 08:30-09:30 and 15:15-16:15, while on the Wednesday the peak hours occurred from 08:15-09:15 and 15:00-16:00.

Based on the surveyed volumes, both the AM and PM peak hours on the Tuesday saw a greater volume of vehicles pass through the intersection. As such, for purposes of a more conservative assessment, the Tuesday volumes will be adopted as the existing conditions.

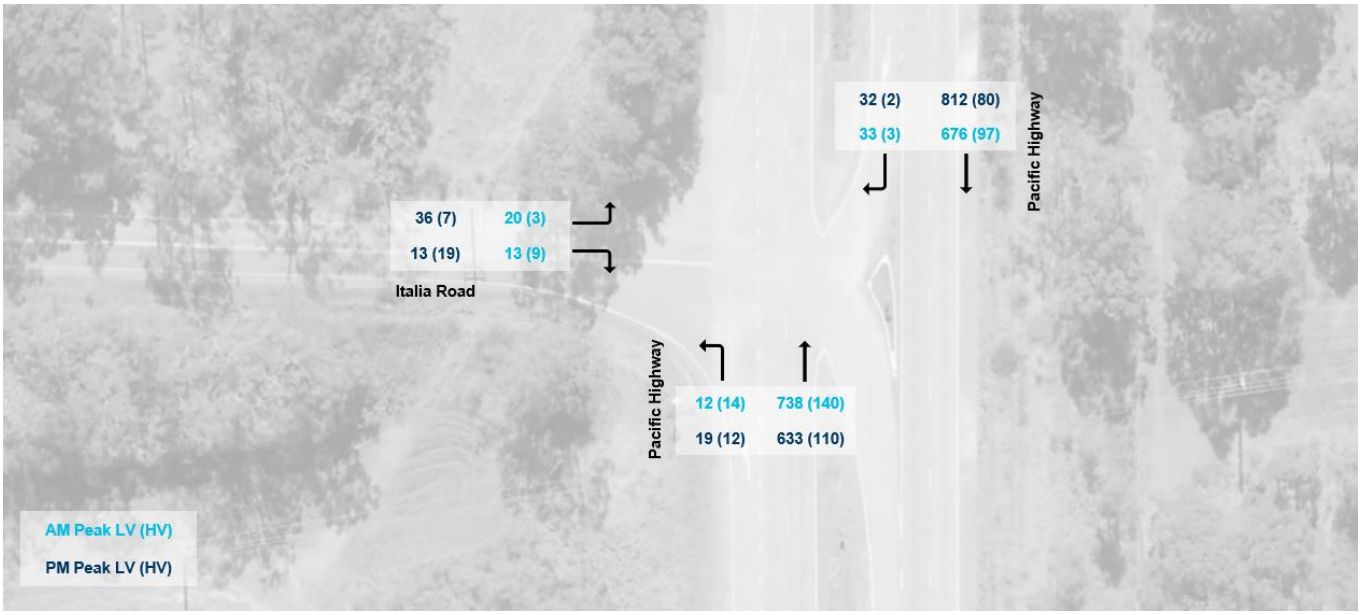

Figure 3.6 Italia Road / Pacific Highway – Tuesday survey

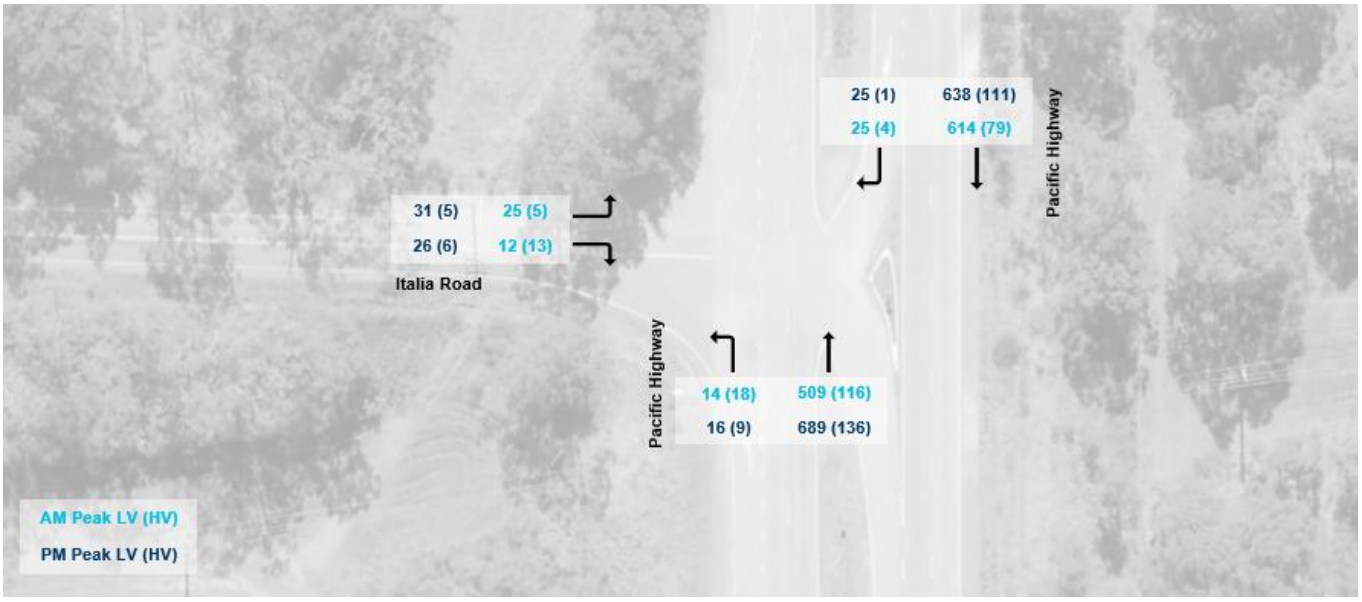

Figure 3.7 Italia Road / Pacific Highway – Wednesday survey

Base image source: MetroMap, accessed June 2022

3.5 Crash history

Road crash history for the five-year period from January 2016 to December 2020 was obtained from TfNSW Centre for Road Safety. Within this analysis period, there were a total of 10 recorded crashes. A summary of the extracted crash data is provided in Table 3.1 and Figure 3.8.

Six of the 10 crashes recorded within the last five years occurred at midblock locations, with the remaining four crashes occurring at the intersection with Italia Road. While there were no fatal crashes, one crash saw two people seriously injured in a head-on collision on Italia Road, near the Pacific Highway intersection. Five moderate and minor injuries were recorded at the other crashes. It is further noted that only one crash occurred in dark conditions, with the remainder occurring in daylight conditions.

Table 3.1 Summary of five-year crash data

Location	Number of crashes				Dominant crash type(s)
	Fatal	Serious	Other	Total	
Midblock					
Pacific Highway	0	0	5	5	Lane change right (2), off road right (1), off road left (2)
Italia Road	0	1	0	1	Head on (1)
Intersection					
Italia Road / Pacific Highway	0	0	4	4	Rear end (1), left near (1), right through (1), right near (1)
Nine Mile Road / Pacific Highway	0	0	0	0	
Total	0	1	9	10	

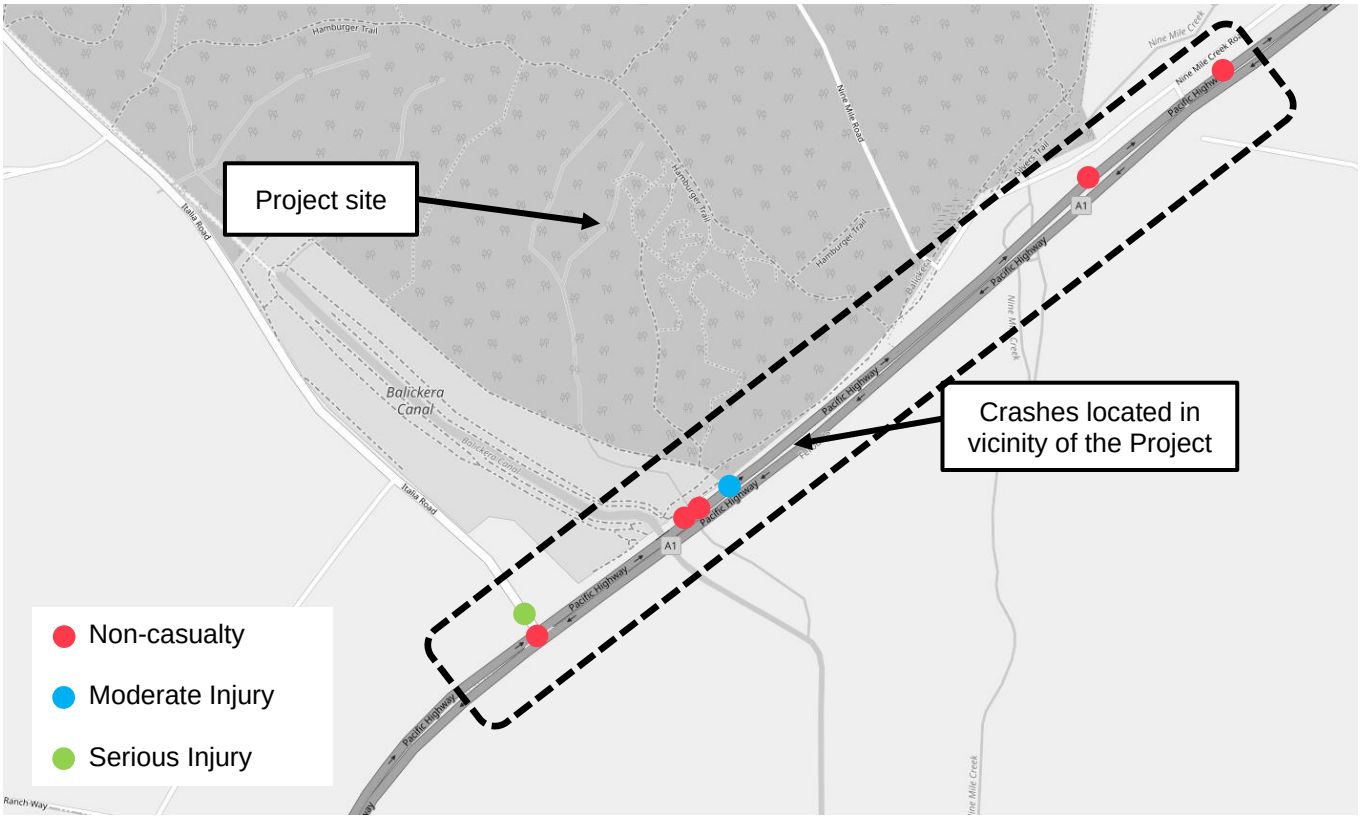

Figure 3.8 Crash history within vicinity of the project

Image source: Open Street Map, accessed June 2022

4. Project description

4.1 Overview

The Project involves the development of a new hard rock quarry known as Stone Ridge Quarry. The proposed lifetime of the quarry would be 30 years, with any extension to be subject to later approvals.

The proposed quarry is seeking approval to produce up to 1.5 million tonnes per annum (MTpa) of saleable quarry product across the lifetime of the project. The quarry product is expected to be used in construction projects across the Lower Hunter, Central Coast and northern Sydney areas.

Based on information supplied by the operator, the quarry would be staffed by 10 full time employees, with up to five part time employees assisting.

The proposed hours operating hours are:

- Quarrying and processing:
  - 07:00-18:00 Monday to Friday
  - 07:00-15:00 Saturdays
- Truck loading, product transport and maintenance:
  - 06:00-22:00 Monday to Friday
  - 07:00-15:00 Saturdays
- No operation on Sundays or public holidays.

4.2 Proposed access route

With due consideration of the location of the site in relation to the external road network, as well as the expectation that the bulk of materials produced by the site would be sent to regions to the south, it is expected that all truck movements to and from the site would be generated to/from the south. Following previous consultation with TfNSW, in conjunction with two other existing / proposed quarry operators using Italia Road, TfNSW has accepted in-principle a proposal to retain the existing priority-controlled intersection arrangement at Italia Road and Pacific Highway (with associated upgrades), and undertake left-in and left-out movements only at Italia Road. This proposal is subject to a separate development application process to Port Stephens Council (refer Section 1.2).

As such, and as part of the proposal referred to above, all inbound truck movements to the project site would turn left into Italia Road and all outbound movements would turn left out, traveling to the Tarean Road interchange approximately 11km to the north to undertake a U-turn. The proposed U-turn movements is shown below in Figure 4.1. Further discussion regarding the use of the Tarean Road interchange is provided in Section 5.4 and Appendix B to this report.

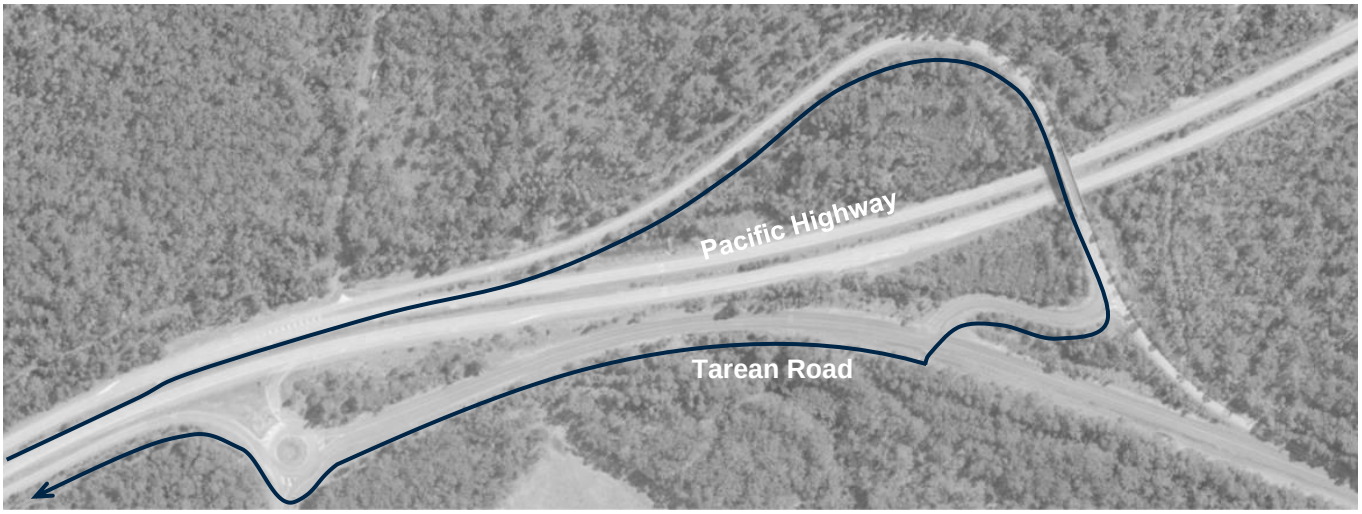

Figure 4.1 Tarean Road U-turn movement

Image source: MetroMap, accessed June 2022

5. Traffic assessment

5.1 Traffic generation

5.1.1 Operation

Light vehicles

It is understood that the site would be operated by 10 full time and up to five part time staff. While this level of staffing would be spread over six workdays, for purposes of this assessment, it is conservatively assumed that 15 staff may travel to and from the site each day. In this regard, 15 vehicles may arrive to the site in the morning, departing again at the end of the day for a total of 30 light vehicle movements. It is conservatively assumed that all movements occur during the peak hours.

Heavy vehicles

The proposed quarry would generate up to 1.5M tonnes of material each year over its 30-year lifetime. Based on a 6-day work week, and allowing for public holidays, the quarry can therefore be expected to generate an average of 5,016 tonnes of material per day.

Based on the transportation of materials using truck and dog combinations, which have a typical capacity of around 30 tonnes, there would be an average of 167 laden truck movements per day generated by the quarry.

Noting the above, it is conservatively assumed that on any given workday 167 truck movements would be generated to and from the site, equivalent to a total of 334 heavy vehicle movements. These heavy vehicle movements would generally be spread across the day. For purposes of this assessment, it is assumed that during particularly busy periods, up to 18% of the average daily movements might occur during the peak operating hours, equivalent to 30 inbound and 30 outbound movements.

It is also noted that the use of larger vehicles (e.g. B-doubles) would reduce the overall level of truck traffic to and from the site. This assessment has therefore considered a conservative or ‘worst case’ scenario.

Total operational traffic

Based on the light and heavy vehicle movements generated by the site, the total operational traffic generation during the peak hours is outlined in Table 5.1 below. It is noted for purposes of a conservative assessment, it has been assumed that peak traffic generation occurs concurrently to the road network peak.

Table 5.1 Peak hour traffic generation

	Inbound	Outbound
AM Peak		
Light vehicles	15	0
Heavy vehicles	17	17
Total	**32**	**17**
PM Peak		
Light vehicles	0	15
Heavy vehicles	17	17
Total	**17**	**32**

5.1.2 Construction

The Project includes clearing of vegetation across the project site to allow for quarrying as well as providing areas for stockpiling, storage of equipment and car parking for staff. In this regard, there would be minimal construction and development of the site, which would be limited to the development of an internal access road with a truck weighbridge and the construction of a site office.

Noting the requirements of the site set up, traffic generated during the construction phase of the project is expected to be limited and would not exceed the movements generated during the operation phase. As such, it is considered appropriate to assess only the operational phase of the project.

5.2 Traffic distribution

It has been assumed for the purpose of this report that all heavy vehicles transporting material out of the quarry would travel to a destination to the south of the site. This is to provide a conservative scenario for assessment of impacts at Pacific Highway.

As the intersection of Italia Road and the Pacific Highway is at-grade and unsignalised, undertaking right-turn movements from Italia Road to the south has been identified by TfNSW as a safety hazard during consultation for the Project. As such, and as an anticipated condition of consent, the right-turn movement out of Italia Road would be not be permitted for any heavy vehicle trips from the proposed quarry. As outlined within Section 4.2, trucks would instead be required to turn left out of Italia Road travelling to the Tarean Road interchange at the north to undertake a U-turn before heading south.

With due consideration of the housing density in the surrounding towns, of the light vehicle movements generated by staff, it would be assumed that 70% are directed to/from the south with the remaining 30% directed to/from the north. It is noted that some light vehicle trips may also use Italia Road towards Seaham, however this assessment assumes all light vehicles using Pacific Highway in the interest of assessing a conservative scenario.

Based on the above distribution, the peak hour traffic volumes at the intersection of Italia Road and Pacific Highway are shown below in Figure 5.1.

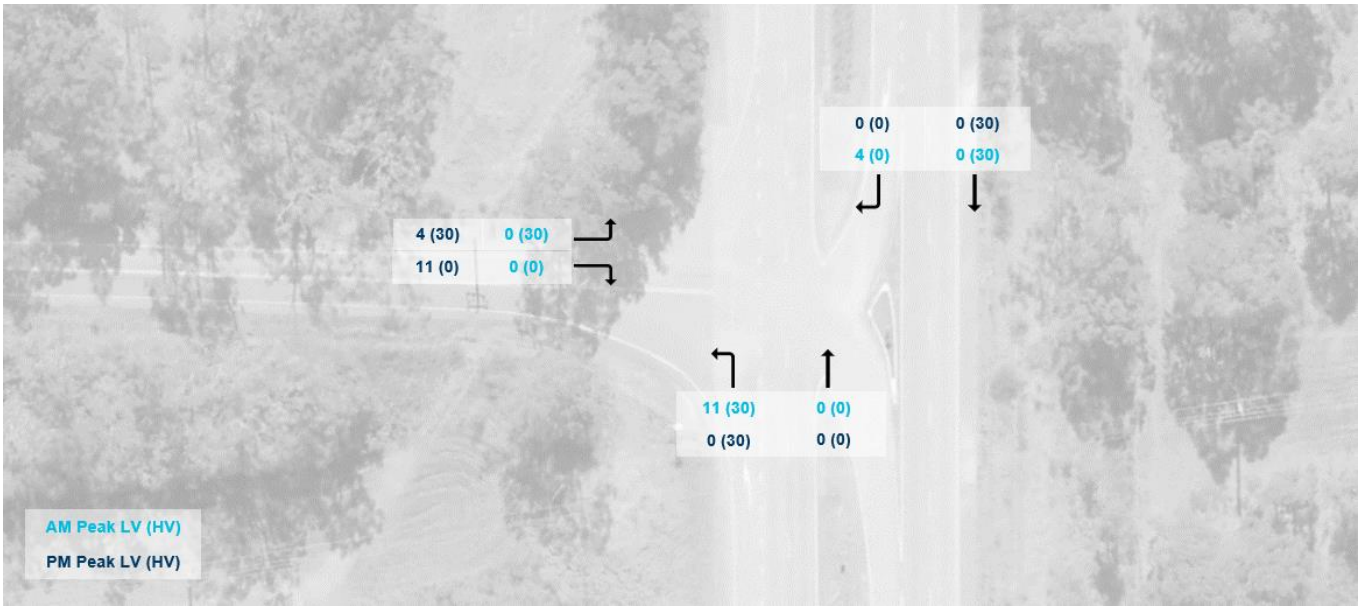

Figure 5.1 Italia Road / Pacific Highway – Quarry traffic generation

5.3 Site access arrangements

Two meetings have been held with relevant traffic engineering officers at Port Stephens Council, with the most recent meeting on 1 June 2022. At these meetings, the proposed site access arrangements were discussed. Feedback provided by Council officers has been incorporated into the final location and design of the access treatment.

The proposed quarry would provide a new access point located directly opposite the existing Boral Seaham Quarry access road on Italia Road. A Channelised Right Turn (CHR) treatment would be provided for right turns into the site. The access point would be Stop controlled, complete with all statutory line-marking and signage, and include Truck Warning signage. Vegetation would be cleared on the north-west side of the junction to provide sufficient safe intersection sight distance in accordance with the Austroads *Guide to Road Design Part 4A: Unsignalised and Signalised Intersections* (2021). The proposed access point treatment addresses the traffic generated by this proposal based on current Italia Road usage.

The turn lane warrants at the Italia Road access have been assessed using the Austroads *Guide to Traffic Management Part 6: Intersections, Interchanges and Crossings Management* (2020), as outlined below.

As discussed in Section 3.4.1, Italia Road is expected to carry up to 1376 vehicles per day along the frontage of the site, including 108 vehicles per hour in the AM peak and 114 vehicles per hour in the PM peak.

Based on the traffic generation projections, during the peak there may be up to 45 vehicles per hour accessing the site in the morning and 30 in the afternoon. Noting all vehicles are assumed to approach from the Pacific Highway and therefore turn right from Italia Road into the site, the turn lane warrants at the site access from Italia Road are shown below in Figure 5.2.

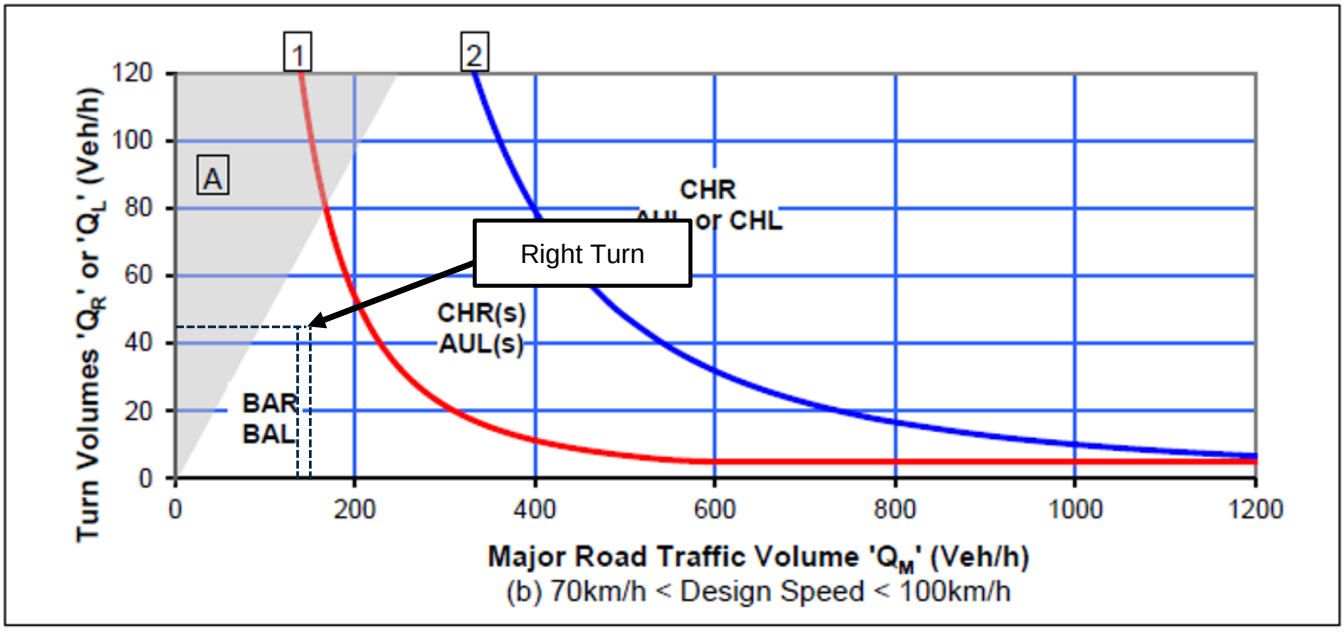

Figure 5.2 Warrants for Turn Treatments on Major Roads (70 to 100 km/h)

Source: Austroads

Based on the traffic volumes, the proposed provision of a Channelised Right Turn (or CHR) turn treatment exceeds the basic requirements as shown in the warrants. An indicative access design is provided in Appendix A to this report.

5.4 Traffic modelling

5.4.1 Modelled scenarios

Italia Road / Pacific Highway

This section outlined the results from the SIDRA assessment of the intersection of Italia Road and Pacific Highway. Three SIDRA scenarios were developed as outlined below:

– Scenario 1: Existing conditions
– Scenario 2: Existing + 10 years of background traffic growth
– Scenario 3: Existing + 10 years of background traffic growth + development traffic

Each of the three scenarios were assessed under both the AM and PM peak hour conditions.

The following assumptions were made throughout the SIDRA analysis:

– The layouts were developed based on aerial photography sourced from MetroMap.
– The volumes surveyed on Tuesday 14 June were adopted as the existing traffic volumes.
– Scenario 3 includes intersection upgrades proposed as part of this project including a new Channelised Left Turn (CHL) treatment on Pacific Highway and new acceleration lane for left turns out of Italia Road (refer Appendix A).

Tarean Road / Pacific Highway

In addition to the Italia Road / Pacific Highway SIDRA modelling, previous modelling was undertaken at the Tarean Road interchange, where vehicles would be required to undertake a U-turn to travel south. The previous modelling assessed the interchange under three scenarios, including the existing surveyed conditions, a scenario where an additional 50 articulated trucks undertook a U-turn movement (such as that proposed for vehicles exiting the quarry) and under a third scenario where 20% growth was applied to the existing volumes and an additional 100 articulated trucks undertook a U-turn.

The modelling suggested that under all three scenarios the interchange would operate at a satisfactory level. Noting the proposal is only expected to generate 30 outbound heavy vehicle movements per hour, the future conditions are expected to perform better than the modelled future scenarios.

The report summarising the traffic modelling undertaken at the Tarean Road interchange is attached in Appendix B.

5.4.2 Background traffic growth

Traffic volumes along the Pacific Highway were obtained from the TfNSW Traffic Volume Viewer and assessed to determine the annual growth. Based on the historic volumes, 20% growth has been applied to the through volumes along the Pacific Highway in order to forecast the volumes in 10 years' time (2032). As such, the 2032 volumes are shown below in Figure 5.3.

Figure 5.3 Italia Road / Pacific Highway – 2032 traffic volumes

5.4.3 Future traffic volumes

The traffic volumes generated by the quarry have been superimposed against the 2032 traffic volumes, as shown below in Figure 5.4.

Figure 5.4 Italia Road / Pacific Highway – Future traffic volumes (2032 volumes + quarry generated volumes)

5.4.4 SIDRA parameters

SIDRA Intersection is a computer software program that was developed to design and analyse the performance of both signalised and unsignalised intersections. SIDRA Intersection is endorsed by the RTA Guide to Traffic Generating Developments and Austroads and is common use across all Australian jurisdictions for the purpose of intersection modelling. The parameters used to assess the intersections are summarised as follows:

Degree of Saturation (DoS) is a ratio of arrival (or demand) flow to capacity. A DoS above 1.0 represents oversaturated conditions and a DoS below 1.0 represents undersaturated conditions. The practical DoS thresholds for each intersection type are summarised in Table 5.2.

Table 5.2 Degree of Saturation thresholds

Unsignalised intersection	Roundabout	Signalised intersection
0.80	0.85	0.90

Source: Austroads Guide to Road Design Part 3: Transport Study and Analysis Methods, 2020

The **95th percentile queue length (95%ile queue)** is the value below which 95% of all observed cycle queue lengths fall, or 5% of all observed queue lengths exceed.

Average delay is the average time, in seconds, that vehicles can be expected to wait at an intersection. A Level of Service (LoS) classification is assigned based on the delay calculated. These ratings are shown in Table 5.3.

Table 5.3 Average delay based on Level of Service classification summary

Level of Service (LoS)	Average Delay (s)		
	Unsignalised intersection	Roundabout and give-way	Signalised intersection
A	≤ 10	≤ 10	≤ 10
B	10-15	10-20	10-20
C	15-25	20-35	20-35
D	25-35	35-50	35-55
E	35-50	50-70	55-80
F	>50	> 70	>80

Source: Table 7.7 of Austroads Guide to Road Design Part 3: Transport Study and Analysis Methods, 2020

5.4.5 SIDRA results

The SIDRA outputs for the existing Italia Road / Pacific Highway layout under each of the modelled scenarios is included below in Table 5.4.

Table 5.4 SIDRA results

Approach	Movement	DoS			Average delay (s)			Level of Service			95th Percentile Queue (m)		
		1	2	3	1	2	3	1	2	3	1	2	3
AM Peak													
Pacific Highway (westbound)	Through	0.23	0.27	0.28	0	0	0	**A**	**A**	**A**	0	0	0
	Right	0.17	0.25	0.14	23	33	21	**C**	**D**	**C**	4	6	4
Italia Road (southbound)	Left	0.03	0.04	0.04	11	12	11	**B**	**B**	**B**	1	1	0
	Right	0.31	0.56	0.44	63	132	98	**F**	**F**	**F**	9	16	13
Pacific Highway (eastbound)	Left	0.02	0.02	0.06	10	10	11	**A**	**A**	**B**	0	0	3
	Through	0.26	0.31	0.31	0	0	0	**A**	**A**	**A**	0	0	0

Approach	Movement	DoS			Average delay (s)			Level of Service			95th Percentile Queue (m)		
		1	2	3	1	2	3	1	2	3	1	2	3
PM Peak													
Pacific Highway (westbound)	Through	0.25	0.30	0.32	0	0	0	**A**	**A**	**A**	0	0	0
	Right	0.12	0.16	0.09	18	23	17	**C**	**C**	**C**	3	4	2
Italia Road (southbound)	Left	0.06	0.07	0.06	10	11	10	**B**	**B**	**B**	2	2	0
	Right	0.37	0.61	0.53	56	107	68	**F**	**F**	**F**	13	22	18
Pacific Highway (eastbound)	Left	0.02	0.02	0.06	9	9	11	**A**	**A**	**B**	0	0	3
	Through	0.22	0.26	0.26	0	0	0	**A**	**A**	**A**	0	0	0

5.4.6 Discussion

The SIDRA results demonstrate the traffic impact of adding 10 years of growth to the pacific highway through comparison of Scenario 1 and 2, as well as the impact of the proposed quarry and junction upgrades (refer Appendix A) through comparison of Scenario 2 and 3.

Based on the above results, the addition of ten years of growth to the volumes along Pacific Highway (and with no change to intersection configuration) results in worsening performance particularly for the right turn out of Italia Road with delays increasing from 63 seconds to 132 seconds in the AM peak and from 56 seconds to 107 seconds in the PM peak.

The proposed junction upgrades generally improve the performance of the intersection, reducing delays through the prioritisation of the right turn into Italia Road over left turns into Italia Road which give-way as part of the channelised treatment.

Notably, the performance of the left turn out of Italia Road improves even despite the increased heavy vehicle traffic.

It is noted that the above SIDRA modelling has included conservative estimates of the heavy vehicle traffic generated due to the Project. In practice there may be some B-doubles which transport material out of the site, which would reduce the number of heavy vehicle movements based on the greater carrying capacity.

The detailed SIDRA outputs are included in Appendix C.

5.5 Safety assessment

As outlined within previous sections, the right-turn movement out of Italia Road has been deemed a safety risk, particularly for long and heavy vehicles which require large gaps in the downstream traffic stream to cross and turn. As such, ARDG will commit to all heavy vehicles movements from the development turning left only from Italia Road onto the Pacific Highway such that no heavy vehicles associated with the Project would turn right.

To ensure left-turning vehicles are able to safely merge onto the Pacific Highway, it is proposed to provide an acceleration lane. The acceleration lane would allow left-turning northbound vehicles on the Pacific Highway to speed up to somewhere between 90km/h and the 110 km/h speed limit. As such, the left-turning vehicles would no longer have to wait for a gap in the through traffic volumes, instead undertaking a downstream merge. This geometry essentially removes the left-turn movement from the intersection.

An indicative design for the intersection upgrade at Italia Road and Pacific Highway is provided in Appendix A. Note that these works are not proposed as part of the Project and will be subject to a separate assessment and approval process. It is anticipated that the upgrade would be jointly funded by quarry proponents which have access via Italia Road (including this Project).

In addition to the turn out of Italia Road onto Pacific Highway, the turn into the site from Italia Road has also been considered, as outlined in Section 5.3. In this regard, a Channelised Right Turn (or CHR) treatment is proposed, which exceeds the basic requirement as calculated using Austroads turn treatment warrants.

5.6 Cumulative impacts assessment

As noted, the proposed quarry is on the northside of Italia Road, with the existing Boral Seaham quarry located on the south side of Italia Road. In addition, a new quarry, the 'Eagleton' quarry is proposed on the south side of Italia Road, to the east of the Boral Seaham quarry.

It is noted that quarries do not produce a high volume of light vehicle movements, with the volumes generated low enough to have little impact on the external road network. It is the heavy vehicle movements which are expected to have a more notable impact on the external road network. For this reason, the following sections focus on the heavy vehicle movements generated by each of the three quarries.

Boral Seaham Quarry

The Boral Seaham Quarry is currently in operation and therefore, any traffic movements generated by the use would have been included in the existing conditions traffic surveys conducted for this report. In 2011, Boral was granted a permit to increase the life of its quarry, however based on the existing material reserves and extraction rates it is not expected to continue operation for long past 2026 without further approval. As such, traffic which is currently generated by the Boral quarry (and included within the existing traffic volumes) may not continue through to 2032 when the future conditions assessment was undertaken. The SIDRA future conditions assessment documented in this report (refer Section 5.4) is therefore somewhat conservative as it assumes continuation of the Boral quarry operation.

Eagleton Quarry

The Traffic Impact Assessment (TIA) for the Eagleton Quarry, prepared by GHD in 2016, projected a total of 192 daily trips, including 170 heavy vehicle trips. Furthermore, the TIA projected 20 heavy vehicle trips may occur during the peak hours, equally split between inbound and outbound movements.

With the Eagleton Quarry projected to generate 10 outbound heavy vehicle movements in the peak hours plus the proposed Stone Ridge Quarry generating 30 outbound heavy vehicle movements, there may be up to 40 outbound movements in each of the peak hours. Based on the Tarean Road traffic modelling outlined in Section 1.1 and attached in Appendix B the external road network can comfortably accommodate this level of additional traffic.

Summary of cumulative impacts

Given that the Project, as well as the Boral Seaham Quarry and the Eagleton Quarry, would generate only low-impact traffic movements by heavy vehicles at the intersection of Pacific Highway and Italia Road (left-in and left-out), and that the Tarean Road traffic modelling (Appendix B) demonstrates adequate performance with up to 100 additional articulated trucks using this interchange, the road network can comfortably accommodate the Project operating in conjunction with other quarries in the area.

5.7 Impacts on other road users

There are no pedestrian or cycle paths along Italia Road or Pacific Highway. Based on the surrounding land uses, there is not expected to be a great demand for pedestrian or cycle paths along these roads.

Bus services for four schools have been identified with routes along Italia Road (refer Section 3.3). No material impacts are anticipated on the bus routes based on the following:

– AM bus movements head west along Italia Road and will follow vehicles along Italia Road who then turn right into the proposal site. There may be minor incidental delays due to truck movements required to give way to oncoming traffic for the right turn, however these would not be significant due to the low existing volumes.
– PM bus movements will have priority heading east along Italia Road with trucks exiting the proposal site yielding to traffic along Italia Road. Minor improvements in travel time may be experienced with an improved intersection left turn treatment at the Pacific Highway.

It is not proposed for trucks to queue on Italia Road for entry into the site.

With due consideration of the above, the proposal is not expected to impact any pedestrian, cyclist or public transport users.

6. Conclusions

This Traffic Impact Assessment report has investigated the potential traffic and transport related impacts associated with the proposed Stone Ridge Quarry to be developed on Italia Road, within the Wallaroo State Forrest. The key findings are summarised below.

Trip generation and distribution

- Based on the expected material output of the quarry, during operation, the development is expected to generate 167 heavy vehicle trips per day plus 15 light vehicle trips per day.
- During peak activity periods, the project may generate up to 30 inbound and 30 outbound heavy vehicle trips per hour.
- As the construction requirements to set up the quarry are minimal, the traffic generated by construction would not exceed that generated during operation.
- The quarry would be accessed via Italia Road, with all vehicles traveling via the Pacific Highway.
- Through consultation with TfNSW, the existing Italia Road / Pacific Highway intersection would be upgraded to address safety concerns. This will be a development undertaken by ARDG, Boral and Eagleton Quarry and subject to a separate assessment and approval process.
- Additionally, as part of the Project ARDG have committed to heavy vehicles associated with the Project turning left only at the Pacific Highway such that no heavy vehicles will turn right. All heavy vehicles with a destination to the south would undertake a U-turn movement at the Tarean Road interchange.

Traffic and safety impacts

- SIDRA modelling demonstrates 10 years' traffic growth is expected to have some impact to the capacity of the Italia Road/Pacific Highway intersection while the impact of the Project (in isolation) on the intersection is minimal.
- The cumulative impacts of the Project and surrounding quarry developments have been assessed and can be accommodated by the road network.
- The Project is not expected to impact pedestrians, cyclists or public transport users.

Mitigation measures

- To prevent any conflicts on the road network, no heavy vehicles associated with the Project will turn right out of Italia Road.
- An acceleration lane is to be provided onto the Pacific Highway, essentially removing the left-turn movement in favour of a downstream merge movement (subject to separate assessment and approval process).
- A Channelised Right Turn (CHR) treatment is to be provided on Italia Road at the site access, to enable safe right turns into the site.

Commitments

- No quarry product will be transported from the site until the upgrade works at Italia Road / Pacific Highway intersection are completed to the satisfaction of Port Stephens Council / TfNSW.

7. References

The following documents and materials were referred to during the preparation of this report:

– Roads and Related Facilities EIS Guideline, Department of Urban Affairs and Planning, 1996
– Guide to Traffic Management Part 12: Integrated Transport Assessments for Developments, Austroads, 2020
– Guide to Road Design Part 3: Transport Study and Analysis Methods, Austroads, 2020
– Guide to Road Design Part 4a: Unsignalised and Signalised Intersections, Austroads, 2021
– Guide to Traffic Generating Developments, Roads and Maritime Services, 2002
– Scoping Report – Stone Ridge Quarry, Australian Development Group Pty Limited, February 2020
– Eagleton Rock Syndicate Traffic Impact Assessment, GHD, 2016
– Centre for Road Safety, Crash and casualty statistics, Transport for New South Wales
– Traffic Volume Viewer, Transport for New South Wales
– Traffic volume surveys, Matrix, 2022

Appendices

Appendix A

Proposed road upgrades

N

ITALIA ROAD

HEAVY VEHICLES TO CONTINUE TO TAREAN ROAD INTERCHANGE TO RETURN SOUTH

TO KARUAH

NORTHBOUND BRIDGE OVER BALICKERA CANAL REQUIRES 3.5m WIDENING TO ACCOMMODATE NORTHBOUND ACCELERATION LANE

NORTHBOUND ACCELERATION LANE LENGTH = 610m INCLUDING MERGE

RURAL CHL LEFT TURN FREE FLOW SLIP LANE FROM ITALIA ROAD TO NORTHBOUND ACCELERATION LANE ON PACIFIC HIGHWAY.

RURAL CHL TREATMENT FROM PACIFIC HIGHWAY TO ITALIA ROAD.

NORTHBOUND CHL DECELERATION LANE LENGTH = 241m. EXISTING DECELERATION LANE LENGTHENED BY APPROXIMATELY 20m.

INSET

EXISTING RIGHT IN/RIGHT OUT MOVEMENTS TO AND FROM ITALIA ROAD REMAIN. SAFETY IMPROVEMENTS FOR RIGHT TURN MOVEMENTS ACHIEVED BY IMPLEMENTATION OF CHL TREATMENTS.

PACIFIC HIGHWAY

FROM RAYMOND TERRACE

PLAN
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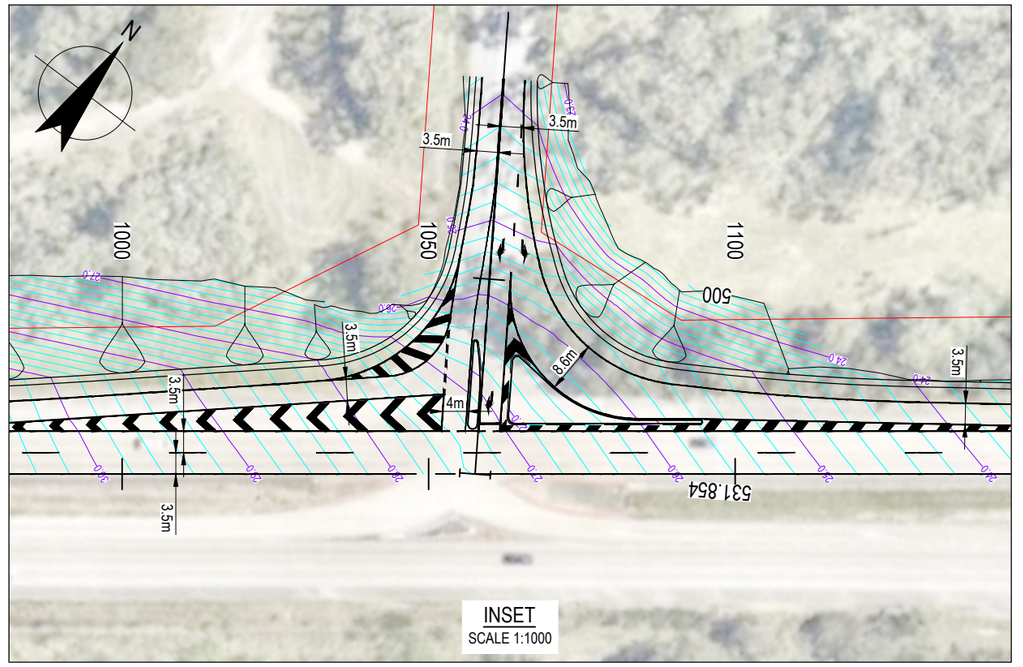

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PRELIMINARY

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SCALE 1:1000 AT ORIGINAL SIZE

0 20 40 60m
SCALE 1:2000 AT ORIGINAL SIZE

GHD Tower, Level 3 24 Honeysuckle Drive
Newcastle NSW 2300 Australia
PO Box 5403 Hunter Rgn Mail Cent. NSW 2310
T 61 2 4979 9999 **F** 61 2 4979 9988
E ntlmail@ghd.com **W** www.ghd.com

DO NOT SCALE

Drawn B.DREW | Designer N.HINCKS
Drafting Check | Design Check
Approved (Project Director)
Date
Scale AS SHOWN
This Drawing must not be used for Construction unless signed as Approved

Client **AUSTRALIAN RESOURCE DEVELOPMENT GROUP**
Project **ARDG / ERS / BORAL - ITALIA ROAD ACCESS ARRANGEMENTS**
Title **STRATEGIC CONCEPT DESIGN ALTERNATE OPTION 03**

Original Size **A3** Drawing No: **22-19467-SK110** Rev: **A**

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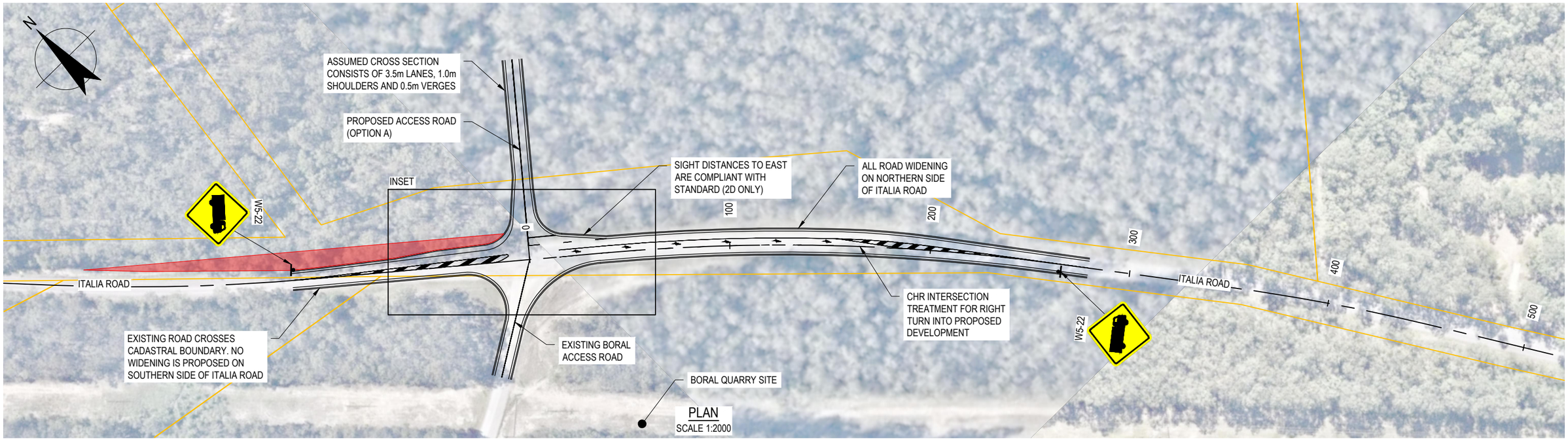

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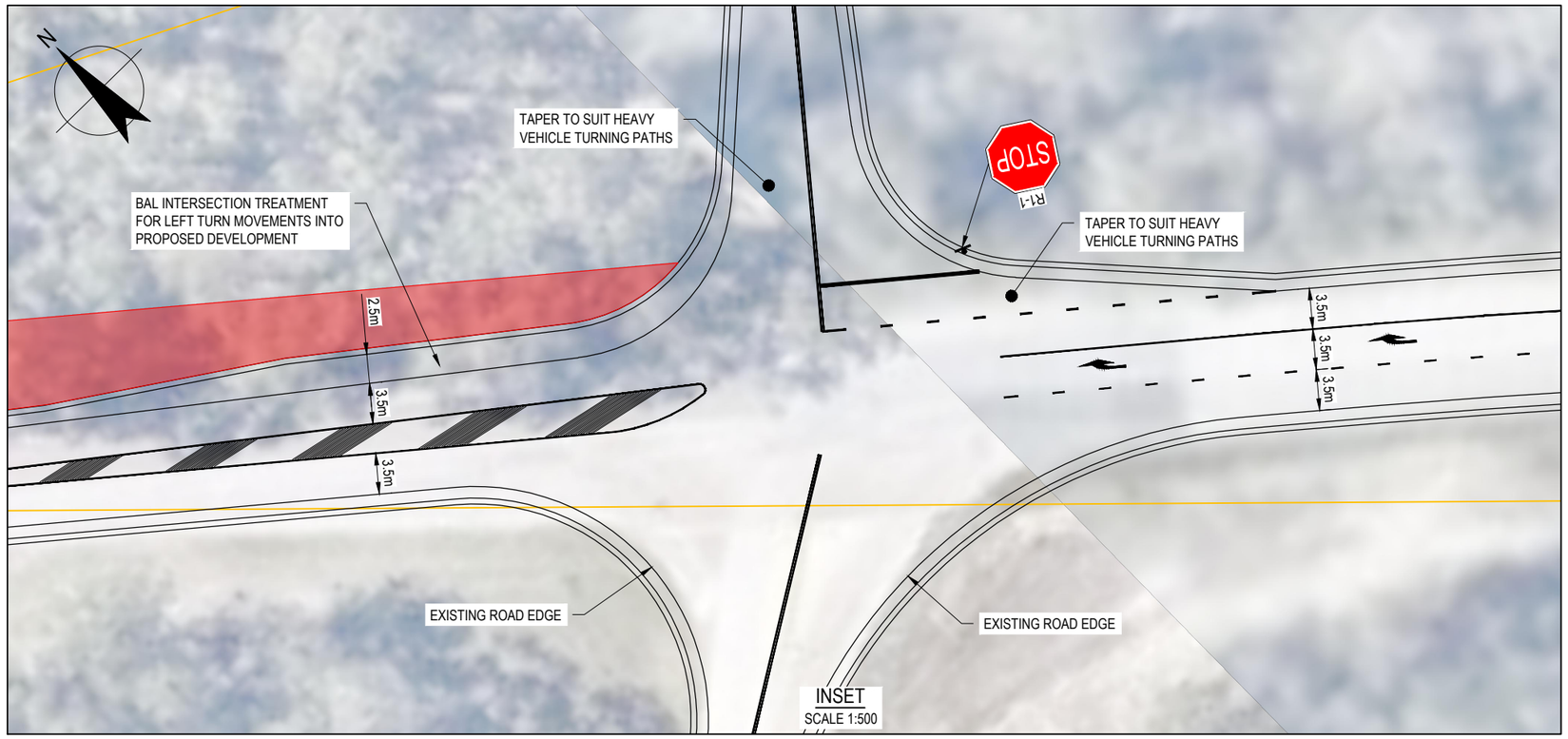

INSET
SCALE 1:500

NOTES

1. 2D CONCEPT DESIGN BASED ON 90KM/H POSTED SPEED LIMIT.
2. CENTERLINE OF EXISTING ROADS HAVE BEEN INFERRED FROM AERIAL IMAGERY.
3. INTERSECTION LAYOUT IS SUBJECT TO FURTHER DESIGN DEVELOPMENT.

LEGEND

CADASTRAL BOUNDARIES

CLEARING

THIS DRAWING INCLUDES COLOURED INFORMATION. IF YOU HAVE A BLACK AND WHITE COPY YOU DO NOT HAVE ALL THE INFORMATION. THIS NOTE IS COLOURED RED.

DIAL BEFORE YOU DIG www.1100.com.au

UTILITY INFORMATION SHOWN ON THESE PLANS DOES NOT DEPICT ANY MORE THAN THE PRESENCE OF A SERVICE, BASED ON AVAILABLE DOCUMENTARY EVIDENCE. THE PRESENCE OF A UTILITY SERVICE, IT'S SIZE AND LOCATION SHOULD BE CONFIRMED BY FIELD INSPECTION, PRIOR TO THE COMMENCEMENT OF ROADWORKS AND THE RELEVANT UTILITY PLANS OBTAINED BY DIALLING DIAL BEFORE YOU DIG '1100'. CAUTION SHOULD BE EXERCISED WHEN WORKING IN THE VICINITY OF ALL UTILITY SERVICES.

PRELIMINARY

No	Revision	Note: * indicates signatures on original issue of drawing or last revision of drawing	Drawn	Job Manager	Project Director	Date
A	FOR INFORMATION		B.D			27.05.22

0 5 10 15m
SCALE 1:500 AT ORIGINAL SIZE

0 20 40 60m
SCALE 1:2000 AT ORIGINAL SIZE

GHD
GHD Tower, Level 3 24 Honeysuckle Drive
Newcastle NSW 2300 Australia
PO Box 5403 Hunter Rgn Mail Cent. NSW 2310
T 61 2 4979 9999 F 61 2 4979 9988
E ntlmail@ghd.com W www.ghd.com

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Drawn B.DREW		Designer B.DREW	
Drafting Check		Design Check	
Approved (Project Director)			
Date			
Scale AS SHOWN	This Drawing must not be used for Construction unless signed as Approved		

Client ARDG
Project PACIFIC HIGHWAY INTERSECTION UPGRADE
Title ITALIA ROAD INTERSECTION OPTION A

Original Size A3
Drawing No: 22-19467-SK501
Rev: A

Plot Date: 27 May 2022 - 11:30 AM Plotted By: Blake Drew Cad File No: C:\12d\SW\data\P-00-12D-001\22-19467 - ARDG - Pac Hwy Intersection Upgrade_1297\CADD\AutoCAD\SKT\22-19467-SK501.dwg

Appendix B

Preliminary Traffic Modelling Report - Pacific Highway / Tarean Road Interchange

Preliminary Traffic Modelling Report

Pacific Highway / Tarean Road Interchange

Australian Resource Development Group Pty Limited

11 March 2022

→ **The Power of Commitment**

GHD Pty Ltd | ABN 39 008 488 373
180 Lonsdale Street, Level 9
Melbourne, Victoria 3000, Australia
T +61 3 8687 8000 | **F** +61 3 8732 7046 | **E** melmail@ghd.com | **ghd.com**

Document status

Status Code	Revision	Author	Reviewer		Approved for issue		
			Name	Signature	Name	Signature	Date
S3	0	M. Petrusma	T. Cooper	On file.	A. Sneddon		11/03/22

Contents

Table index

Figure index

1. Introduction

1.1 Purpose of this report

This report assesses the capacity of the existing western interchange at Pacific Highway and Tarean Road, Karuah, and its performance under additional, hypothetical heavy vehicle traffic loads. The purpose of the report is to inform ARDG of the interchange's potential capacity to assist in evaluation of access arrangement options for a confidential development proposal located to the south.

1.2 Scope and limitations

This report: has been prepared by GHD for Australian Resource Development Group Pty Limited and may only be used and relied on by Australian Resource Development Group Pty Limited for the purpose agreed between GHD and Australian Resource Development Group Pty Limited as set out in section 1.1 of this report.

GHD otherwise disclaims responsibility to any person other than Australian Resource Development Group Pty Limited arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible. GHD expressly forbids the use of this report by any other party.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

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2. Existing conditions

2.1 Site

The site is the Tarean Road interchange at Pacific Highway, west of Karuah. It comprises an eastbound off ramp and westbound on and off ramps. Westbound ramps connect to both Tarean Road and Swan Bay Road at a four-leg roundabout. The eastbound off ramp allows right turns onto Tarean Road at a stop-controlled intersection.

An aerial photograph of the existing interchange is provided in Figure 2.1.

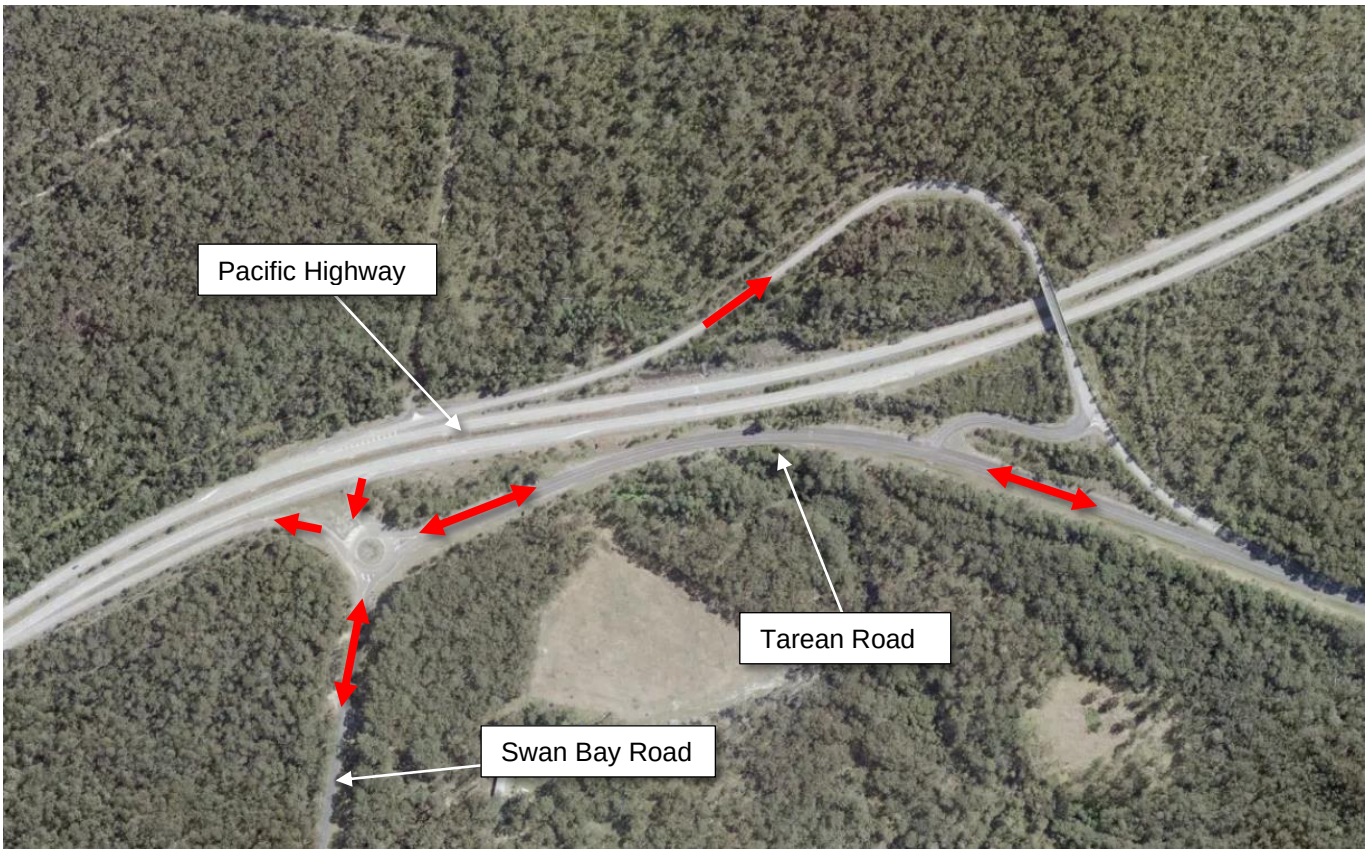

Figure 2.1 Existing site

Image obtained from Metromap © Mapbox © OpenStreetMap

Key dimensions have been measured from aerial photography and are as follows:

– Roundabout diameter 24 metres
– Westbound on-ramp merge length 140 metres

2.2 Traffic volumes

GHD commissioned Matrix Traffic and Transport Data to undertake traffic surveys at the interchange ramps on Tuesday 22 February 2022 and Wednesday 23 February 2022 between 7:00 AM and 10:00 AM and between 3:00 PM and 6:00 PM.

The peak periods were identified as:

– Morning peak Tuesday 7:45 AM to 8:45 AM, Wednesday 7:30 AM to 8:30 AM
– Afternoon peak Both days 3:00 PM to 4:00 PM

A summary of surveyed traffic volumes is provided in Figure 2.2, Table 2.1 and Table 2.2.

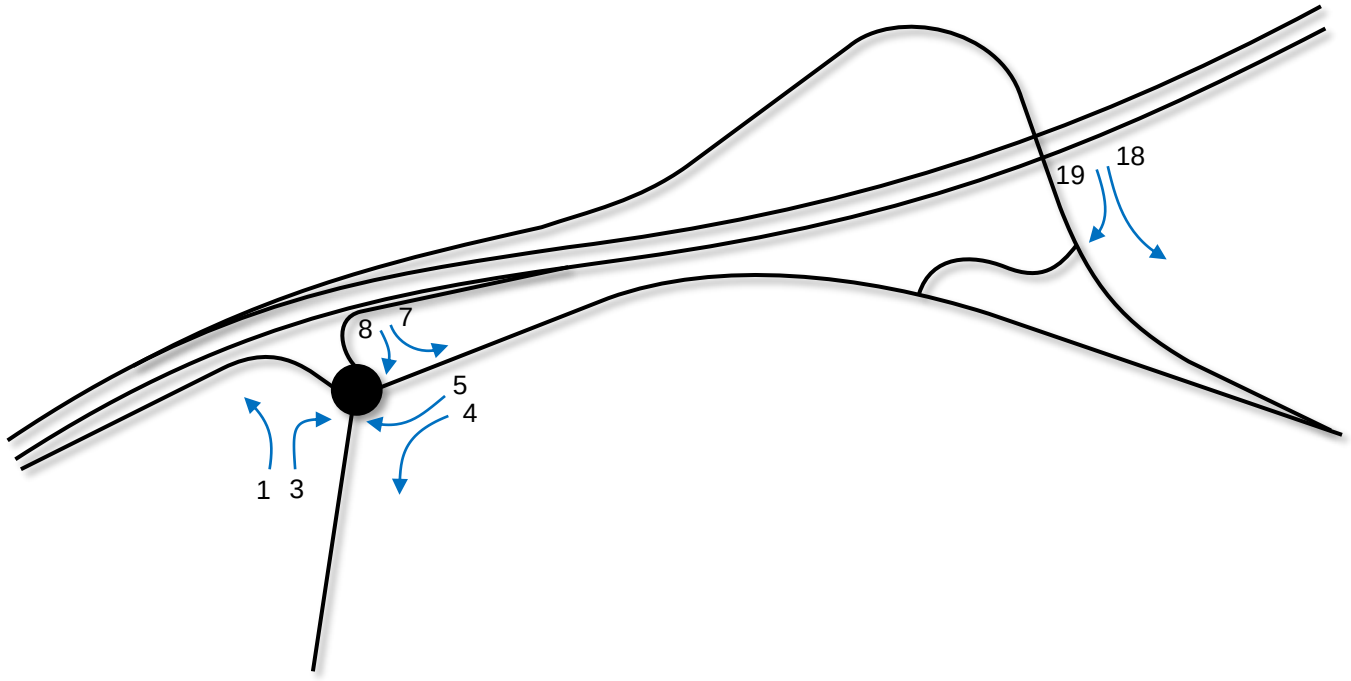

Figure 2.2 Movement numbering (for volume tables)

Table 2.1 Existing traffic volumes (Tuesday 22nd February 2022) (vehicles per hour)

No.	Movement	AM Peak (7:45 – 8:45)				PM Peak (3:00 – 4:00)			
		LV	RV	AV	Total	LV	RV	AV	Total
1	Swan Bay Rd Left Turn	26	0	1	27	8	3	0	11
3	Swan Bay Rd Right Turn	9	1	0	10	6	0	0	6
4	Tarean Rd Left Turn	8	1	1	10	28	1	2	31
5	Tarean Rd Through	114	5	1	120	82	4	0	86
7	WB Off-Ramp Left Turn	0	0	0	0	1	0	0	1
8	WB Off-Ramp Through	2	1	0	3	1	0	2	3
18	EB Off-Ramp Through	70	1	2	73	116	7	0	123
19	EB Off Ramp Right Turn	11	3	1	15	21	0	1	22

* LV = Light vehicle RV = Rigid vehicle AV = Articulated vehicle

Table 2.2 Existing traffic volumes (Wednesday 23rd February 2022) (vehicles per hour)

No.	Movement	AM Peak (7:30 – 8:30)				PM Peak (3:00 – 4:00)			
		LV	RV	AV	Total	LV	RV	AV	Total
1	Swan Bay Rd Left Turn	26	1	0	27	11	0	0	11
3	Swan Bay Rd Right Turn	5	1	0	6	19	0	0	19
4	Tarean Rd Left Turn	11	1	0	12	28	2	0	30
5	Tarean Rd Through	111	6	1	118	95	2	0	97
7	WB Off-Ramp Left Turn	0	0	0	0	0	0	0	0
8	WB Off-Ramp Through	2	0	0	2	1	0	0	1
18	EB Off-Ramp Through	59	6	0	65	121	1	0	122
19	EB Off Ramp Right Turn	10	1	0	11	26	3	1	30

* LV = Light vehicle RV = Rigid vehicle AV = Articulated vehicle

Existing traffic volumes for the Pacific Highway for the purpose of estimating merge capacity have been adopted from the southbound RMS traffic counter located west of Twelve Mile Creek (approximately 5.5 km from the interchange). Volumes most recently collected in 2018 and factored up by 3.0% p.a. to 2022 volumes suggest peak hour southbound traffic flows as follows:

– Weekday AM peak (8:00 am – 9:00 am) 674 LV per hour + 54 HV per hour
– Weekday midday peak (11:00 am – 12:00 pm) 844 LV per hour + 70 HV per hour
– Weekday PM peak (3:00 pm – 4:00 pm) 732 LV per hour + 68 HV per hour

These volumes are generally consistent with the volumes for Pacific Highway reported in the *Pacific Highway Intersection and Service Road Strategy Review* (GHD 2019), originally collected by Port Stephens Council in October 2015.

3. Traffic modelling

3.1 Model development

SIDRA Intersection 9.0 was used to model the two intersections at the interchange:

– Site 1 Roundabout at Tarean Road and Swan Bay Road
– Site 2 Stop control at Eastbound Off-ramp and Tarean Road

The following scenarios were modelled:

– Existing conditions:
  - Average from two days of peak period traffic surveys plus an additional +20% to all movements to account for variability in existing volumes.
– Proposed scenario:
  - Representing three quarries operating with a combined traffic volume of +50 Articulated Trucks per hour undertaking U-turn movements using the interchange on and off ramps (Pacific Highway eastbound to Pacific Highway westbound) in addition to existing +20% traffic volumes.
– Sensitivity test:
  - Approximately double the number of trucks generated by quarries (+100 Articulated Trucks per hour) in addition to existing +20% traffic volumes.

Model parameters were adjusted to reflect the higher impact of articulated trucks compared to rigid trucks including negotiation speeds and gap acceptance criteria.

3.2 Model outputs

Outputs from SIDRA Intersection modelling have been described in terms of three performance metrics for each of the four 'give-way' points in the local network:

– Average delay:
  - Measured in seconds, this represents the average delay experienced by all vehicles. Average delays are comprised of in-queue delay, stop-line delay and geometric delay due to turning. Larger vehicles (such as articulated trucks) generally experience higher geometric delays and where the proportion of trucks is high, this can affect average delays reported in the model.
– Level of service (LOS):
  - A qualitative description of traffic performance measured in six levels: LOS A to LOS F. An intersection or approach is considered to be operating over capacity if the level of service is LOS F. The typical target level of service is LOS D or better.
– 95th percentile queue length:
  - Measured in metres (or in vehicles) this is a probabilistic output that represents the queue length not exceeded 95% of the time.

Traffic model outputs for each of the three scenarios are provided in Table 3.1.

Table 3.1 SIDRA Intersection modelling outputs – Average delay (s) [Level of Service] – 95th percentile queue length (m)

Approach	AM Peak			PM Peak		
	Existing	+50 Trucks	+100 Trucks	Existing	+50 Trucks	+100 Trucks
Roundabout: Swan Bay Road	5.7 s [A] 0.5 m	6.4 s [A] 0.6 m	7.1 s [A] 0.7 m	7.0 s [A] 0.3 m	7.6 s [A] 04 m	8.3 s [A] 0.4 m
Roundabout: Tarean Road	3.9 s [A] 1.2 m	4.1 s [A] 3.9 m	4.3 s [A] 7.6 m	3.9 s [A] 0.9 m	4.2 s [A] 3.5 m	4.3 s [A] 7.1 m

Approach	AM Peak			PM Peak		
	Existing	+50 Trucks	+100 Trucks	Existing	+50 Trucks	+100 Trucks
Roundabout: Pacific Hwy Off ramp	6.9 s [A] 0.1 m	6.9 s [A] 0.1 m	6.9 s [A] 0.1 m	6.8 s [A] 0.1 m	6.8 s [A] 0.1 m	6.8 s [A] 0.1 m
Give-way: Right turn to Tarean Rd	9.1 s [A] 0.2 m	15.2 s [C] 5.5 m	17.5 s [C] 14.6 m	8.5 s [A] 0.4 m	13.1 s [B] 4.9 m	15.0 s [B] 12.1 m

Based on the outputs from traffic modelling, the two intersections at the Pacific Highway / Tarean Road interchange are expected to perform adequately under increased traffic loads of up to 100 additional large trucks per hour performing U-turn movements from Pacific Highway eastbound to Pacific Highway westbound. With the worst level of services being LOS C and queue lengths not exceeding the length of one vehicle.

3.3 Highway ramp capacity

The capacity of the Pacific Highway westbound on ramp was assessed using the methodology provided in Section 5.4.2 of *Austroads Guide to Traffic Management Part 3: Transport Study and Analysis Methods* (2020). For ramp merging, the level of service is evaluated using the density of traffic, based on 'passenger cars per kilometre per lane' or 'pc/km/ln', in the two kerb-side lanes within a 450 metre distance of the entry ramp.

The formula used to estimate density is:

$$D_R = 3.402 + 0.00456V_R + 0.0048V_{12} - 0.01278L_A$$

Where:

D_R = density of merge influence area (pc/km/ln)

V_R = on-ramp peak 15-min flow rate (pc/h)

V_{12} = flow rate entering ramp influence area (pc/h)

L_A = Length of acceleration lane

For the purpose of this assessment, rigid trucks are assigned a value of 2 pc/vehicle and larger articulated trucks are assigned a value of 3 pc/vehicle.

The level of service criteria for freeway merge segments are provided in Table 3.2.

Table 3.2 Level of service criteria for freeway merge segments

LOS	Density (pc/km/ln)
A	≤ 6
B	> 6-12
C	> 12-17
D	> 17-22
E	> 22
F	Demand exceeds capacity

Source: Austroads 2020

The ramp level of service under each of the scenarios described in this report is calculated in Table 3.3.

Table 3.3 Ramp level of service calculation

Scenario	V_R	V_{12}	L_A	D_R	Level of service
AM Peak					
Existing	186 pc/h	974 pc/h	140 m	7.135	LOS B
+50 Trucks per hour	336 pc/h	974 pc/h	140 m	7.819	LOS B
+100 Trucks per hour	486 pc/h	974 pc/h	140 m	8.503	LOS B

Scenario	V_R	V_{12}	L_A	D_R	Level of service
Midday Peak					
Existing	157 pc/h	1,222 pc/h	140 m	8.194	LOS B
+50 Trucks per hour	307 pc/h	1,222 pc/h	140 m	8.878	LOS B
+100 Trucks per hour	457 pc/h	1,222 pc/h	140 m	9.562	LOS B
PM Peak					
Existing	128 pc/h	1,084 pc/h	140 m	7.401	LOS B
+50 Trucks per hour	278 pc/h	1,084 pc/h	140 m	8.085	LOS B
+100 Trucks per hour	428 pc/h	1,084 pc/h	140 m	8.769	LOS B

Based on the ramp level of service calculations provided in Table 3.3, the ramp and merge onto Pacific Highway would operate at LOS B under all scenarios. There is sufficient capacity within the ramp to accommodate the additional loads of up to 100 large trucks per hour.

4. Conclusion

This report has investigated the capacity of the existing western interchange at Pacific Highway and Tarean Road, Karuah, and with respect to its performance under additional heavy vehicle traffic loads. Existing traffic volumes were surveyed on Tuesday 22 and Wednesday 23 February 2022 and factored up to 20% to account for peak variability and potential background traffic growth.

The two scenarios assessed involve the addition of +50 and +100 large trucks using the Tarean Road interchange to perform a U-turn manoeuvre from Pacific Highway eastbound to Pacific Highway westbound.

Traffic modelling found that the interchange would operate at a satisfactory level of service under the increased traffic loads.

Note that no allowance has been made to assess whether traffic volumes have been influenced by the COVID-19 pandemic, however surveyed traffic volumes have been factored up by 20% to reflect future change in conditions, and the modelling demonstrates significant spare capacity in the interchange.

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Appendix C

SIDRA Outputs

MOVEMENT SUMMARY

Site: 101 [1. Italia Rd / Pacific Hwy AM Peak Existing (Site Folder: Existing Conditions)]

Intersection of Italia Road and Pacific Highway
Existing Conditions
AM Peak (8:30 - 9:30)
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] veh/h	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: Pacific Highway														
5	T1	773	97	814	12.5	0.225	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	109.9
6	R2	36	3	38	8.3	0.168	23.1	LOS C	0.5	3.9	0.80	0.94	0.81	55.6
Approach		809	100	852	12.4	0.225	1.0	NA	0.5	3.9	0.04	0.04	0.04	105.3
North: Italia Road														
7	L2	23	3	24	13.0	0.034	10.6	LOS B	0.1	0.9	0.49	0.72	0.49	61.8
9	R2	22	9	23	40.9	0.313	62.6	LOS F	1.0	9.1	0.92	1.00	1.05	32.0
Approach		45	12	47	26.7	0.313	36.0	LOS E	1.0	9.1	0.70	0.86	0.76	42.4
West: Pacific Highway														
10	L2	26	14	27	53.8	0.020	9.8	LOS A	0.0	0.0	0.00	0.68	0.00	61.7
11	T1	878	140	924	15.9	0.259	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	109.9
Approach		904	154	952	17.0	0.259	0.3	NA	0.0	0.0	0.00	0.02	0.00	107.5
All Vehicles		1758	266	1851	15.1	0.313	1.6	NA	1.0	9.1	0.03	0.05	0.04	102.5

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: 101 [1. Italia Rd / Pacific Hwy PM Peak Existing (Site Folder: Existing Conditions)]

Intersection of Italia Road and Pacific Highway
Existing Conditions
PM Peak (3:15 - 4:15)
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] veh/h	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: Pacific Highway														
5	T1	892	80	939	9.0	0.253	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	109.9
6	R2	34	2	36	5.9	0.118	18.4	LOS C	0.4	2.7	0.72	0.91	0.72	60.6
Approach		926	82	975	8.9	0.253	0.7	NA	0.4	2.7	0.03	0.03	0.03	106.7
North: Italia Road														
7	L2	43	7	45	16.3	0.059	10.2	LOS B	0.2	1.6	0.45	0.72	0.45	61.8
9	R2	32	19	34	59.4	0.374	55.9	LOS F	1.2	13.1	0.91	1.01	1.10	33.3
Approach		75	26	79	34.7	0.374	29.7	LOS D	1.2	13.1	0.65	0.84	0.73	45.3
West: Pacific Highway														
10	L2	31	12	33	38.7	0.022	9.3	LOS A	0.0	0.0	0.00	0.67	0.00	64.1
11	T1	743	110	782	14.8	0.218	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	109.9
Approach		774	122	815	15.8	0.218	0.4	NA	0.0	0.0	0.00	0.03	0.00	106.9
All Vehicles		1775	230	1868	13.0	0.374	1.8	NA	1.2	13.1	0.04	0.06	0.04	101.0

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: 101 [1. Italia Rd / Pacific Hwy AM Peak Forecast (+20%) (Site Folder: Forecast Conditions)]

Intersection of Italia Road and Pacific Highway
Forecast Conditions (+20% traffic)
AM Peak (8:30 - 9:30)
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] veh/h	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: Pacific Highway														
5	T1	927	116	976	12.5	0.270	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	109.9
6	R2	36	3	38	8.3	0.249	33.0	LOS D	0.8	5.8	0.88	0.97	0.97	48.4
Approach		963	119	1014	12.4	0.270	1.2	NA	0.8	5.8	0.03	0.04	0.04	104.9
North: Italia Road														
7	L2	23	3	24	13.0	0.040	11.5	LOS B	0.1	1.0	0.53	0.77	0.53	60.8
9	R2	22	9	23	40.9	0.561	131.8	LOS F	1.7	16.3	0.97	1.04	1.25	19.9
Approach		45	12	47	26.7	0.561	70.3	LOS F	1.7	16.3	0.75	0.90	0.88	30.4
West: Pacific Highway														
10	L2	26	14	27	53.8	0.020	9.8	LOS A	0.0	0.0	0.00	0.68	0.00	61.7
11	T1	1054	168	1109	15.9	0.311	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	109.9
Approach		1080	182	1137	16.9	0.311	0.3	NA	0.0	0.0	0.00	0.02	0.00	107.9
All Vehicles		2088	313	2198	15.0	0.561	2.2	NA	1.7	16.3	0.03	0.04	0.04	101.0

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: 101 [1. Italia Rd / Pacific Hwy PM Peak Forecast (+20%) (Site Folder: Forecast Conditions)]

Intersection of Italia Road and Pacific Highway
Forecast Conditions (+20% traffic)
PM Peak (3:15 - 4:15)
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] veh/h	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: Pacific Highway														
5	T1	1070	96	1126	9.0	0.304	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	109.9
6	R2	34	2	36	5.9	0.158	22.8	LOS C	0.5	3.6	0.80	0.93	0.80	56.4
Approach		1104	98	1162	8.9	0.304	0.7	NA	0.5	3.6	0.02	0.03	0.02	106.8
North: Italia Road														
7	L2	43	7	45	16.3	0.066	10.9	LOS B	0.2	1.8	0.50	0.76	0.50	61.1
9	R2	32	19	34	59.4	0.609	107.1	LOS F	2.1	21.9	0.96	1.06	1.35	22.7
Approach		75	26	79	34.7	0.609	51.9	LOS F	2.1	21.9	0.70	0.89	0.86	35.5
West: Pacific Highway														
10	L2	31	12	33	38.7	0.022	9.3	LOS A	0.0	0.0	0.00	0.67	0.00	64.1
11	T1	892	132	939	14.8	0.261	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	109.9
Approach		923	144	972	15.6	0.261	0.3	NA	0.0	0.0	0.00	0.02	0.00	107.3
All Vehicles		2102	268	2213	12.7	0.609	2.4	NA	2.1	21.9	0.04	0.06	0.04	99.8

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: 101 [1. Italia Rd / Pacific Hwy AM Peak Proposed Future (Site Folder: Proposed Conditions)]

Intersection of Italia Road and Pacific Highway
Proposed Conditions (Future)
AM Peak (8:30 - 9:30)
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] veh/h	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: Pacific Highway														
5	T1	957	146	1007	15.3	0.283	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	109.9
6	R2	40	3	42	7.5	0.144	20.6	LOS C	0.5	3.6	0.81	0.94	0.81	58.3
Approach		997	149	1049	14.9	0.283	0.8	NA	0.5	3.6	0.03	0.04	0.03	106.1
North: Italia Road														
7	L2	53	33	56	62.3	0.043	10.7	LOS B	0.0	0.0	0.00	0.60	0.00	54.4
9	R2	22	9	23	40.9	0.443	97.5	LOS F	1.4	12.9	0.96	1.02	1.15	24.5
Approach		75	42	79	56.0	0.443	36.1	LOS E	1.4	12.9	0.28	0.72	0.34	40.2
West: Pacific Highway														
10	L2	66	44	69	66.7	0.059	10.8	LOS B	0.2	2.7	0.14	0.60	0.14	54.5
11	T1	1054	168	1109	15.9	0.311	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	109.9
Approach		1120	212	1179	18.9	0.311	0.7	LOS A	0.2	2.7	0.01	0.04	0.01	103.6
All Vehicles		2192	403	2307	18.4	0.443	2.0	NA	1.4	12.9	0.03	0.06	0.03	99.2

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: 101 [1. Italia Rd / Pacific Hwy PM Peak Proposed Future (Site Folder: Proposed Conditions)]

Intersection of Italia Road and Pacific Highway
Proposed Conditions (Future)
PM Peak (3:15 - 4:15)
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] veh/h	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: Pacific Highway														
5	T1	1099	125	1157	11.4	0.318	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	109.9
6	R2	34	2	36	5.9	0.087	16.5	LOS C	0.3	2.2	0.73	0.91	0.73	62.8
Approach		1133	127	1193	11.2	0.318	0.5	NA	0.3	2.2	0.02	0.03	0.02	107.4
North: Italia Road														
7	L2	77	37	81	48.1	0.058	10.1	LOS B	0.0	0.0	0.00	0.60	0.00	57.5
9	R2	43	19	45	44.2	0.526	68.0	LOS F	1.9	18.1	0.94	1.05	1.28	30.4
Approach		120	56	126	46.7	0.526	30.9	LOS D	1.9	18.1	0.34	0.76	0.46	43.7
West: Pacific Highway														
10	L2	61	42	64	68.9	0.055	10.8	LOS B	0.2	2.5	0.13	0.61	0.13	54.1
11	T1	892	132	939	14.8	0.261	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	109.9
Approach		953	174	1003	18.3	0.261	0.7	LOS A	0.2	2.5	0.01	0.04	0.01	103.0
All Vehicles		2206	357	2322	16.2	0.526	2.2	NA	1.9	18.1	0.03	0.07	0.04	97.8

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.

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