



Transport
Roads & Maritime
Services

Central Coast Highway, Tumby Road Intersection Upgrade

Concept Design Report

Traffic Modelling

July 2021

Document Information

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Document registration

Document Title	Central Coast Highway, Tumbi Road Intersection Upgrade – Concept Design Report
Responsible Business Unit	Northern Project Office
Project Number	P.0044037
Document Number	60614070-P.0044037-RP-TR-0001
Document Author	Melinda Jiang, Ghizlane Chergaoui
Project Design Lead	Tim Rose
Project Design Manager	Tim Rose
Project Manager	Quan Nguyen

Document history and status

Revision	Date	Description	Written	Checked	Approved
1	12/05/2021	Traffic Modelling Report	Melinda Jiang, Ghizlane Chergaoui	Anoop Sridhar	Anoop Sridhar
2	24/06/2021	Traffic Modelling Report	Melinda Jiang, Ghizlane Chergaoui	Anoop Sridhar	Anoop Sridhar
3	28/07/2021	Traffic Modelling Report	Melinda Jiang, Ghizlane Chergaoui	Cameron Ward	Cameron Ward

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1. Introduction

The NSW government has committed to lane-duplication upgrades along Central Coast Highway between Bateau Bay and Wamberal. The Tumbi Road and Central Coast Highway intersection upgrade (the Project) is amongst a series of planned intersection upgrades along this section of the Central Coast Highway. The Tumbi Road intersection, which forms part of this corridor, is a known pinch point and has been fast-tracked for development.

This Traffic Modelling report forms part of the Concept Design Report. The purpose of this report is to enable optimisation of intersection layout and inform design decisions for the 80% Concept Design.

2. Methodology

The scope of the Project includes an assessment of the performance of the future upgrades at the Central Coast Highway and Tumbi Road intersection as well as an assessment of the impact of the proposed intersection upgrade compared to a 'Do Nothing' no upgrade scenario in the future. The Project scope also included reviewing the existing traffic network, as well as the active transport and public transport networks near the Project.

Intersection modelling has been undertaken using SIDRA INTERSECTION 9 and the analysis was conducted for the following seven scenarios, during the morning (AM) and afternoon (PM) peaks:

- Base Case 2021 Existing Conditions
- Future Year 2025 Do Nothing
- Future year 2025 Proposed Upgrades
- Future Year 2035 Do Nothing
- Future year 2035 Proposed Upgrades
- Future Year 2045 Do Nothing
- Future year 2045 Proposed Upgrades.

2.1 Data sources

The following data was used to inform this transport assessment:

- future traffic volumes from *Arcadis Central Coast Highway Upgrade, Tumbi Road to Bateau Bay Road Traffic Modelling Report, 2019*
- proposed intersection upgrade plans from *AECOM Central Coast Highway Tumbi Road Intersection Upgrade 20% Concept Design, November 2020*
- publicly available aerial photography and other GIS mapping information
- other documents and data, as referenced in this report.

2.2 Modelling assumptions

The assessment of intersection operational performance was based on the following assumptions:

- intersection was assessed as a standalone site using SIDRA INTERSECTION 9
- traffic volumes for the future year scenarios in 2025, 2035 and 2045 were taken from the Central Coast Highway Upgrade, Tumbi Road to Bateau Bay Road Traffic Modelling Report prepared by Arcadis in September 2019
- phasing and timing for the future year scenarios was determined in agreement with TfNSW
- intersection layouts were based on intersection design layouts
- modelling assumptions for the intersection were prepared and adopted in agreement with TfNSW and are as presented in Table 2-1:

Table 2-1 Modelling assumptions

Item	Assumptions
Validation and Calibration	<p>Existing model validation and calibration was based on Arcadis modelling report which contains VISSIM results, as no survey data was provided.</p> <p>The Arcadis report only included the 2025, 2035 and 2045 future base case. Since SIDRA and VISSIM operate differently, results have a marginal difference. However, the level of service for the intersection was validated using the Arcadis VISSIM results and Google Traffic data.</p> <p>Gap acceptance values for both AM and PM models were adjusted to achieve a Degree of Saturation less than or close to 1.0 during the existing base case to avoid exacerbating the existing level of congestion at the approaches.</p>
Existing layout	Existing layout was based on Google Maps as no survey was completed.
Future layout	The future proposed signalised intersection layout is adopted from the final signalised layout proposed for the 80% Concept Design and including signalised pedestrian crossings at the slip lanes as agreed in the VM workshop.
Approach lane configuration	<ol style="list-style-type: none"> 1. Base year (2021): Existing roundabout. 2. Future year (2025, 2035 and 2045) Do Nothing: As above. 3. Future year (2025, 2035 and 2045) Proposed Upgrades: <ol style="list-style-type: none"> a. 2 lanes for general traffic (Cycle lanes are proposed. However, bus lanes are not proposed). b. Signalised pedestrian crossings on all approaches.
Movement class	<p>LV and HV for base year model and future year Do Nothing models.</p> <p>LV, HV, Cyclists for future year, Proposed Upgrades models.</p>
Traffic volumes	<p>Traffic volumes from the strategic model included in the Arcadis report were used to determine the 2021 existing condition model, and all future scenarios during 2025, 2035 and 2045, where 2018 volumes were increased by a rate of 1.0% p.a. (per the background growth rate in the Arcadis modelling report).</p> <p>Traffic volumes included in the Arcadis report are assumed to be hourly volumes for the AM and PM peak hours.</p> <p>Note that model outputs only indicate the total volumes for the future scenarios. LV and HV splits are not available in the Arcadis report. These are assumed as discussed below.</p> <p>We propose to use 60minutes as the <i>Unit Time for Volumes</i> and adopt a <i>Peak Flow Period</i> of 30minutes in SIDRA.</p>
Peak hour factor	Peak flow factor of 100% is adopted.
Heavy vehicle %	<p>The traffic data from 2018 provided in the Arcadis report indicates heavy vehicle factors along the Central Coast Highway are 4% in the AM and 3% in the PM. However, heavy vehicle splits for Tumbi Road are not provided in the material supplied.</p> <p>In the absence of future traffic volumes by vehicle types, heavy vehicle factors for the Central Coast Highway were assumed to be 4% for Central Coast Highway to undertake a conservative assessment during both AM and PM peaks. In addition, 2% is proposed to be adopted for Tumbi Road based on a comparison of traffic volumes for the base year included in the Arcadis report.</p>
Pedestrian movements	Default pedestrian volumes of 50 peds/hr will be used. As traffic survey data show very pedestrian volumes in the vicinity of the intersection, 50 peds/hr is a conservative assumption.
Slip Lane Marked Foot	It is proposed to provide pedestrian activated signalled marked foot crossings on the slip lanes to provide to cyclist's activity. These operate similar to

Item	Assumptions
Crossings	pedestrian (zebra) crossings as they only activate when there is pedestrian demand, independent from intersection operation. SIDRA INTERSECTION is unable to directly model this operation, however, a zebra crossing has been modelled on the slip lanes to represent an approximation of the delay.
Cyclist movements	On-road cycle lanes are included in the model and a volume of 10 cyclists per hour is included for both the approaches along Central Coast Highway.
Gap acceptance data	User-Given Parameters based on RMS Traffic Modelling Guide Appendix E were used for base case and Do Nothing models to suit pre-upgrade results in the Arcadis report. The critical gap and follow-up headway parameters were adjusted for both the AM and PM models such that the Degree of Saturation during the existing base case is less than or close to 1.0. The existing model was validated against Google traffic data as no survey data was provided. Similar gap acceptance data was then adopted for the future Do Nothing models in 2025, 2035 and 2045 and were validated against the Arcadis VISSIM results. Note that SIDRA and VISSIM operate differently, as such the model output results have a marginal difference.
Speed limit	On the Central Coast Highway, 60km/h is adopted on all approaches There is a school zone (40km/h) sign on Tumbi Road operating between 8am-9am and 2:30pm-4pm School Days. The weekday AM peak occurs between 8am and 9am as per the Arcadis report. As this is within the school zone time, 40km/h is adopted during the AM peak. The weekday PM peak occurs outside of these hours i.e. after 4PM per the Arcadis report. As such, 60km/h is retained along Tumbi Road during the PM peak hour.
Model scenarios	<ol style="list-style-type: none"> 1. Base Case (2021) – Central Coast Highway/Tumbi Road 2. Future Do Nothing (2025) – Central Coast Highway/Tumbi Road 3. Future Proposed Upgrades (2025) – Central Coast Highway/Tumbi Road 4. Future Do Nothing (2035) – Central Coast Highway/Tumbi Road 5. Future Proposed Upgrades (2035) – Central Coast Highway/Tumbi Road 6. Future Do Nothing (2045) – Central Coast Highway/Tumbi Road 7. Future Proposed Upgrades (2045) – Central Coast Highway/Tumbi Road.
Model layout	Site assessed individually.
Cycle and phase times	<ul style="list-style-type: none"> • TCS will be designed with 4 phases (repeat right turn phase into Tumbi) – depending on volumes whether repeat right turn will operate at certain times of the day. • SIDRA INTERSECTION optimised cycle times have been adopted the signalised intersection. Maximum SCATS cycle time of 130 seconds initially when site is commissioned in 2025 and 2035 (this should be the AM & PM Peak M-F values). This is increased in the future scenario in 2045 to a maximum 150 seconds, as demand warrants. • 6 or 7 second intergreens depending on width of intersection, distance between stop lines. • Pedestrian crossing (walk and flashing don't walk) times to be included in minimum phase times (phase times greater than 10 seconds with an associated signalised pedestrian crossing). • Pedestrian protection of 6 seconds was introduced where there is a pedestrian/vehicle conflict.
Basic saturation flow	<p>Basic saturation flow values were adopted as recommended by TfNSW for Central Coast projects. These values are as follows:</p> <ul style="list-style-type: none"> • 1800 vehicles/lane/hour for through and left turning lanes • 1500 vehicles/lane/hour for right turning lanes.

Item	Assumptions
Gradient	Grades provided as follows: <ul style="list-style-type: none">• CC Hwy northbound: - 2.5%• CC Hwy Southbound: 2.5%• Tumbi Road Eastbound: -0.5% (flat)
All other parameters	SIDRA Default
Software version	SIDRA INTERSECTION 9

3. Existing Conditions

3.1 Context

The Tumbi Road/Central Coast Highway intersection is located in Wamberal, a coastal suburb of Central Coast New South Wales. The Project sits along Central Coast Highway, the main arterial road servicing the Central Coast Region.

Central Coast Highway is undergoing a series of planned road upgrades between Bateau Bay and Wamberal. The Tumbi Road intersection is a known pinch point and has been fast-tracked for development.

The location of the Project is shown in Figure 3-1.



Figure 3-1 The Project location

Source: AECOM, 2021

3.2 Road Network

3.2.1 Central Coast Highway

Central Coast Highway is a State road (State Road 30) which traverses the Central Coast region of New South Wales, linking the M1 Pacific Motorway at Kariong in the south to Pacific Highway (State Road 10) at Doyalson in the north.

To the south of the Tumbi Road intersection, the highway currently operates with two-lanes in each direction, separated by a median. Whilst on the northern leg of the intersection Central Coast Highway becomes primarily single-laned in each direction, only forming two lanes in each direction as it approaches the Tumbi Road intersection. On both the northern and southern approach to the intersection, dedicated bus bays off the left turn lane have been provided on both sides of the road for bus zones. In the vicinity of the Project, the highway has a 60km/h speed limit.

3.2.2 Tumbi Road

Currently, Tumbi Road intersects Central Coast Highway at a two-lane roundabout. Tumbi Road is generally configured with one lane in each direction. As Tumbi Road approaches the intersection, the southbound lane forms two lanes, a dedicated left and right turn lane onto the roundabout. In the vicinity of the Project, Tumbi Road operates as a school zone, with a 40km/h speed limit during school times. The speed limit is 60km/h outside school hours.

3.3 Crash Data

The series of road and intersection upgrades along Central Coast Highway aim to improve road safety and travel efficiency. Interactive crash and casualty statistics by LGA was reviewed to obtain a general understanding of crash statistics at the intersection of the Central Coast Highway and Tumbi Road. These interactive crash statistics provided an overview of all crashes for the four-year period between 2015 and 2019 (the latest data available online).

Between 2015 and 2019, four crashes occurred at the intersection, averaging less than once per year. The crash severity ranged from moderate injury to minor and non-casualty (towaway). An additional 18 crashes occurred in the vicinity of the Project along Central Coast Highway, with all but two crashes resulting in moderate to minor and non-casualty (towaway) severity. Two crashes resulted in serious injury. The locations of the crashes are depicted in Figure 3-2.



Figure 3-2 Crash data in the local area between 2015 and 2019

Source: TfNSW, 2021 (Modified by AECOM)

3.4 Public Transport

The Project is not directly accessible by rail services. The closest railway station to the Project is Gosford Station, located 13km away to the west. Gosford Station is situated along the Central Coast Highway and may be accessible via connecting bus services. The station sits on the Central Coast and Newcastle Line, providing connectivity to Sydney and is a key origin/destination during peak periods.

The area is primarily serviced by the bus network, with several bus services providing connectivity to the Project. One bus route operates along Tumbi Road, servicing the Tumbi

Road at Central Coast Highway bus stop located just 45m from the Project. An additional seven bus services along Central Coast Highway, stopping at the Central Coast Highway bus stop opposite Ulamba Avenue, 60m from the Project.

Figure 3-3 shows the location of the bus stops near the Project. Table 3-1 details the local bus services in the vicinity of the Project.

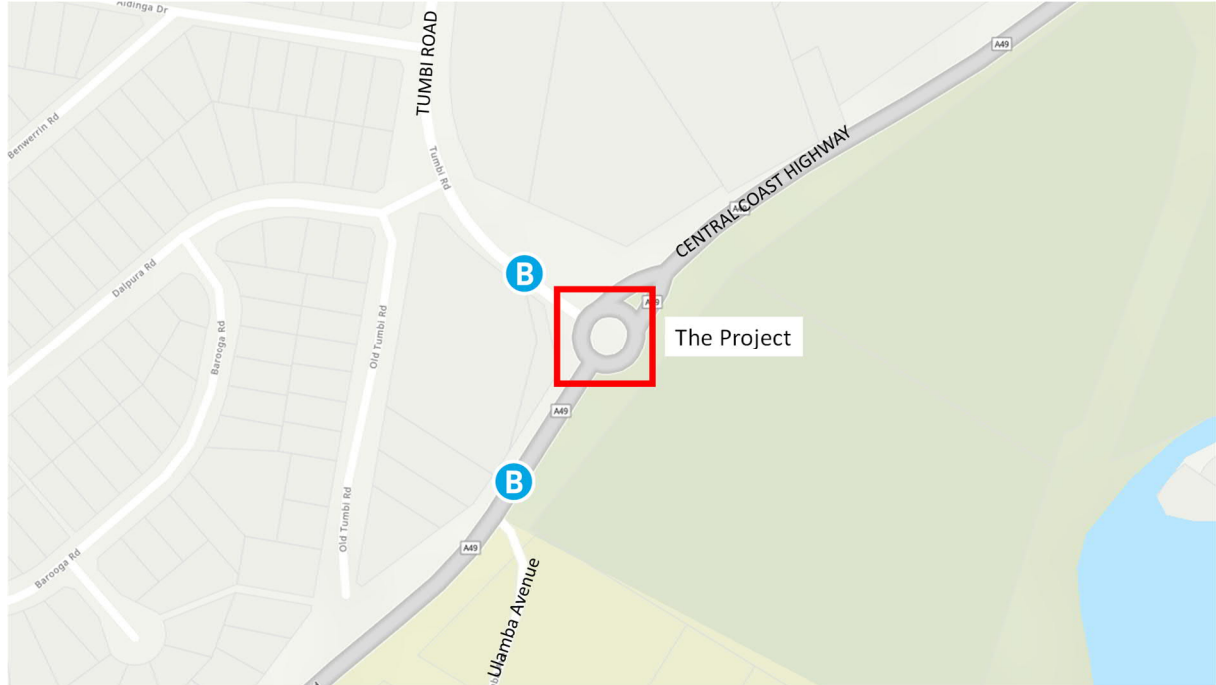


Figure 3-3 Bus stop locations near the Project

Source: AECOM, 2021

Table 3-1 Local bus services

Route	Route Description	Frequency	Bus Stop	Distance from The Project (m)
48	Bay Village to Tumby Umbi (Loop Service)	Once every 2 hours	Tumby Road at Central Coast Highway	45
17	The Entrance North to Gosford	7 services per day on weekdays, every 45 minutes in the morning and afternoon	Central Coast Highway opposite Ulamba Avenue	60
18	The Entrance to Gosford	3 services per day on weekdays, every 30 minutes in the morning	Central Coast Highway opposite Ulamba Avenue	60
19	Wyong to Gosford	Once hourly	Central Coast Highway opposite Ulamba Avenue	60
21	The Entrance North to Gosford via Bateau Bay East	Once hourly	Central Coast Highway opposite Ulamba Avenue	60
22	The Entrance to Gosford via	Once hourly	Central Coast Highway opposite	60

Route	Route Description	Frequency	Bus Stop	Distance from The Project (m)
	Killarney Vale		Ulamba Avenue	
23	The Entrance to Gosford via Bateau Bay West	Once hourly	Central Coast Highway opposite Ulamba Avenue	60
28	The Entrance to Gosford via Springfield	3 services per day on weekdays, every hour at night	Central Coast Highway opposite Ulamba Avenue	60

3.5 Active Transport

The Project has moderate access to cycleways, with existing cycleways available along Central Coast Highway to the south of the Tumby Road/Central Coast Highway intersection.

The local cycle network is presented in Figure 3-4.

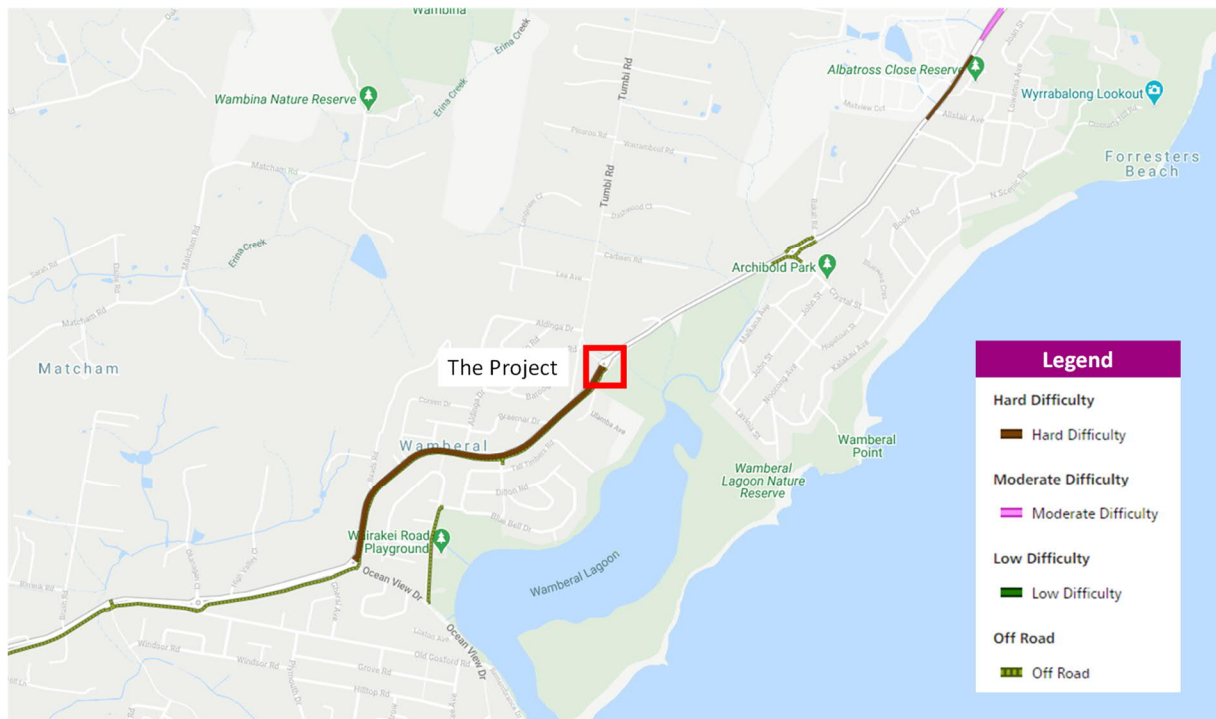


Figure 3-4 Cycle network in the vicinity of the Project

Source: TfNSW, 2021 (Modified by AECOM)

4. Design Layout Assessment

4.1 Proposed Road Upgrades

Lane duplication and intersection upgrades have been planned for Central Coast Highway between Bateau Bay and Wamberal.

The existing two-laned roundabout at the Tumbi Road/Central Coast Highway intersection will be upgraded to a signalised intersection. Cycling facilities will be provided utilising existing road shoulders near the intersection and dedicated turn bays will provide additional capacity for turning vehicles.

The proposed upgraded intersection layout is shown in Figure 4-1.

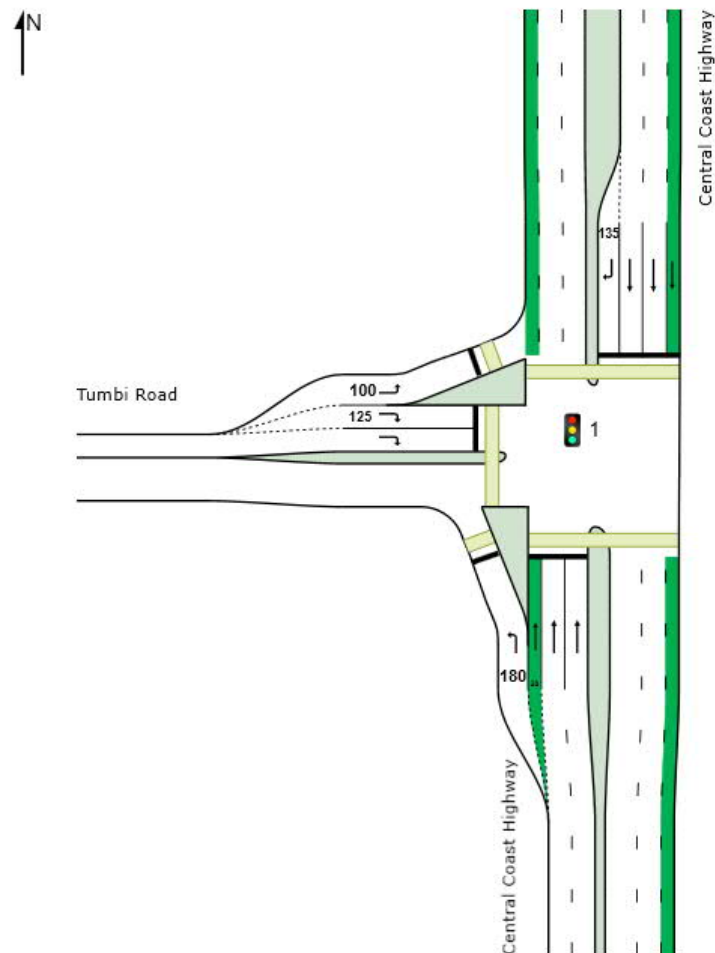


Figure 4-1 Proposed intersection layout

Source: AECOM, 2021

4.2 Operational Assessment

4.2.1 Traffic Demand

Base Case Scenario

The base model is based on the estimated traffic demands taken from the Central Coast Highway Upgrade, Tumbi Road to Bateau Bay Road Traffic Modelling Report prepared by

Arcadis in 2019. The 2018 traffic demands were increased by a growth rate of 1 per cent per annum to reflect existing conditions in 2021.

The existing traffic volumes adopted for Tumbi Road/Central Coast Highway intersection are presented in Figure 4-2.

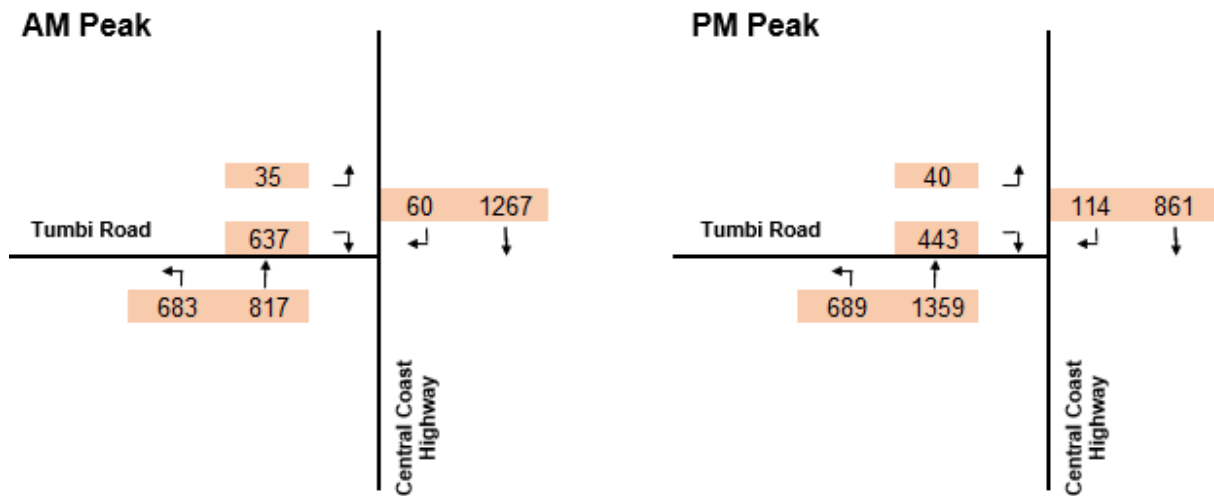


Figure 4-2 2021 Traffic Volumes – AM and PM Peak

Future Case Scenarios

Future traffic demands are taken from the Central Coast Highway Upgrade, Tumbi Road to Bateau Bay Road Traffic Modelling Report prepared by Arcadis in 2019 for future years 2025, 2035 and 2045. It is understood that the future traffic volumes have been estimated based on a growth rate of 1 per cent per annum.

The anticipated traffic volumes adopted for Tumbi Road/Central Coast Highway intersection are presented in Figure 4-3.

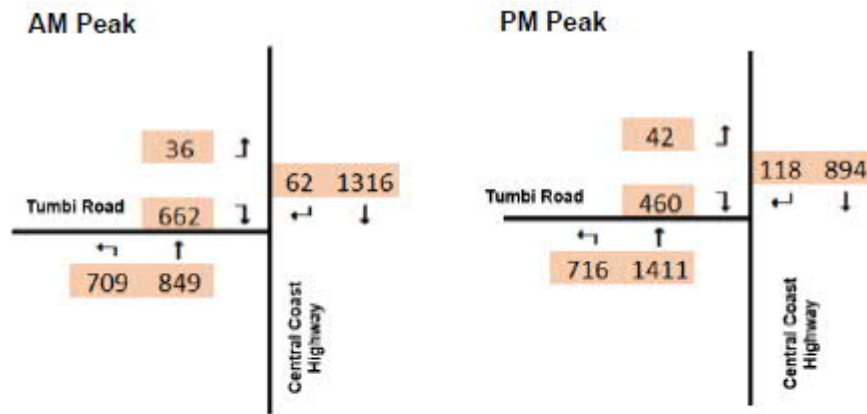


Figure 3-2 2025 Future traffic volume - AM and PM peak

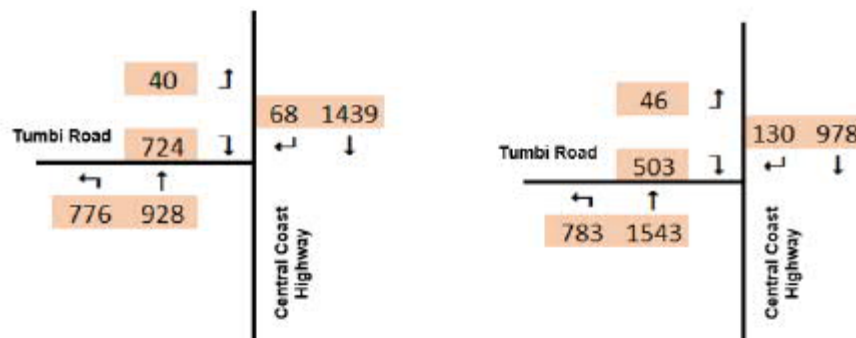


Figure 3-3 2035 Future traffic volume - AM and PM peak

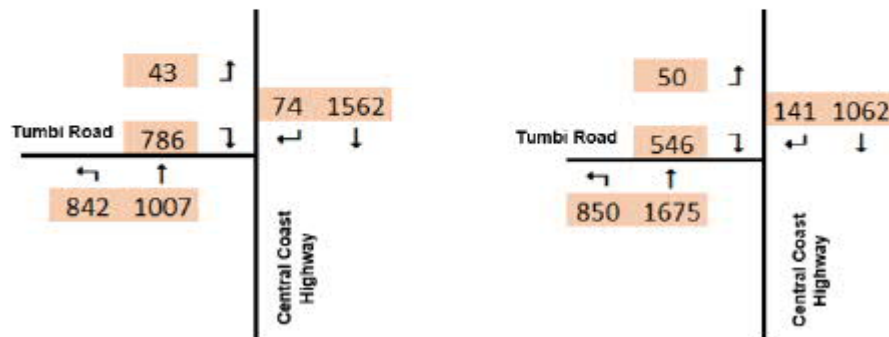


Figure 3-4 2045 Future traffic volume - AM and PM peak

Figure 4-3 Anticipated traffic volumes 2025, 2035 and 2045

Source: Arcadis, 2019

4.2.2 Assessment criteria

The operation of the key intersections within the study area have been assessed using SIDRA INTERSECTION 9, a computer-based modelling package that calculates intersection performance.

The commonly used measure of intersection performance, as defined by TfNSW, is vehicle delay. SIDRA INTERSECTION determines the average delay that vehicles encounter and provides a measure of the level of service.

Table 4-1 shows the criteria that the modelling adopts in assessing the level of service.

Table 4-1 SIDRA Intersection level of service criteria

Level of service (LOS)	Average delay per vehicle (secs/veh)	Traffic signals, roundabout	Give way and stop sign
A	Less than 14	Good operation	Good operation
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Near capacity	Near capacity, accident study required
E	57 to 70	At capacity, at signals incidents will cause excessive delays	At capacity, requires other control mode
F	Greater than 70	Extra capacity required	Extreme delay, major treatment required

Source: Roads and Traffic Authority (2002) Guide to Traffic Generating Developments

4.2.3 Intersection Performance Analysis

Table 2 presents the summary of the Base Case existing operation of the intersection in 2021.

Table 2 Existing intersection performance

Scenario	Degree of Saturation (DOS)	Average Delay ¹ (sec)	95th Percentile Queue (m)	Level of Service ¹ (LOS)
2021 AM Peak				
South: Central Coast Highway	0.53	4.6	42	A
West: Tumbi Road	0.98	69.5	257	E
North: Central Coast Highway	0.93	43.3	43	D
Intersection	0.98	69.5	257	E
2021 PM Peak				
South: Central Coast Highway	0.36	9.8	301	A
West: Tumbi Road	1.06	108	233	F
North: Central Coast Highway	0.48	11.6	32	A
Intersection	1.06	108	233	F

Note: For roundabouts, the delay and level of service are based on the critical movement with the highest delay.

Table 4-1 indicates that the intersection operates poorly at LOS F due to the delay experienced along Tumbi Road. The right turn from Tumbi Road experiences the highest delay. This may be due to the significant northbound and southbound traffic volumes limiting opportunities for the eastbound right turn movement to find gap in traffic. In future years, delays are expected worsen with the increasing demand of traffic resulting from background growth. Tumbi Road queues observed from Google Traffic Data are comparable to the results presented.

Table 3 presents the future do-nothing scenarios without upgrade at the intersection compared to future intersection performance with proposed upgrades.

Table 3 Future Do Nothing and Future Proposed Upgrade Results

Year	Scenario	Degree of Saturation (DOS)	Average Delay ¹ (sec)	95th Percentile Queue (m)	Level of Service ¹ (LoS)
AM Peak					
2025	Do Nothing	1.08	133	456	F
	Proposed Upgrade	0.88	35	297	C
2035	Do Nothing	1.38	378	1091	F
	Proposed Upgrade	0.96	48	406	D
2045	Do Nothing	1.78	732	1771	F
	Proposed Upgrade	0.99	63	584	E
PM Peak					
2025	Do Nothing	3.23	>1000	1657	F
	Proposed Upgrade	0.82	28	255	B
2035	Do Nothing	3.53	>1000	1844	F
	Proposed Upgrade	0.88	33	341	C
2045	Do Nothing	3.83	>1000	2070	F
	Proposed Upgrade	0.90	38	440	C

Note:

1. For roundabouts, the delay and level of service are based on the critical movement with the highest delay. For traffic signals, the average movement delay and level of service over all movements is taken.
2. Longest 95% Back of Queue at the intersection for the North approach through movement.
3. Longest 95% Back of Queue at the intersection for the South approach through movement.

Intersection modelling indicates the intersection continues to operate poorly at LOS F in the Do Nothing scenarios in 2025, 2035 and 2045 due to the delay experienced along Tumbi Road. The right turn from Tumbi Road continues to experience the highest delay due to the significant northbound and southbound traffic volumes, which increase as a result of background growth, limiting opportunities for traffic to find a gap to turn. Note that delays on the north approach improve as the delay on the Tumbi Road increase significantly due to over saturated conditions, allocating more time to the north approach as a result of background growth.

With the proposed signalisation of the intersection, which includes intersection upgrades such as the provision of an additional eastbound right turn lane at Tumbi Road, the intersection performance is expected to improve from LOS F to LOS C or better with acceptable delays and spare capacity in 2025. The performance of the intersection in the PM peak would slightly drop in the 2035 scenario to LOS D, reaching capacity in the 2045 scenario. The performance of the intersection is impacted by the call rate of the southern pedestrian crossing. As a conservative approach a call every cycle has been assumed. However, given the environment a lower call rate would be expected which would result in better intersection performance. Queueing is also anticipated to be accommodated within the lanes of the intersections with the proposed upgrades, compared to the Do-Nothing scenario.

Detailed SIDRA results are provided in Attachment B.

5. Summary

The intersection upgrade comprises conversion of the existing two-lane roundabout at the Tumbi Road junction to a signalised intersection, with new cycling facilities on both sides of the Central Coast Highway. Upgraded lane configurations including the provision of adequate turning bays will provide improved travel efficiency and safety to the intersection.

To assess the operational performance of the intersection due to the proposed upgrades, SIDRA Intersection analysis has been undertaken for three future year scenarios in 2025, 2035 and 2045 during both the morning and afternoon peaks. Based on intersection modelling results, the intersections perform satisfactorily at LOS D or better for 2025 and 2035 scenarios, reaching capacity in the 2045 scenario.

Modelling results also indicate that without proposed upgrades, in future 'Do Nothing' scenarios, the Central Coast Highway and Tumbi Road intersection performs poorly at LoS F for all future years in 2025, 2035 and 2045 during both peak periods.

Finally, modelling assessments indicate that queue lengths within the turning bays are not expected to exceed the capacity of the short lanes. As such, overflow of turning traffic onto adjacent through lanes is not likely to occur at the intersection.

Attachment A: SIDRA Modelling Outputs

MOVEMENT SUMMARY

 **Site: 1 [Central Coast Highway/Tumbi Road AM - 2025 (Site Folder: 2025)]**

Central Coast Highway/Tumbi Road

Site Category: Future Conditions 2

Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 125 seconds (Site Optimum Cycle Time - Minimum Delay)

Vehicle Movement Performance														
Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total veh/h	HV] %	[Total veh/h	HV] %				[Veh. veh	Dist] m				
South: Central Coast Highway														
1	L2	709	4.0	709	4.0	0.580	7.6	LOS A	8.0	57.8	0.31	0.65	0.31	44.7
2	T1	859	4.0	859	4.0	0.546	27.4	LOS B	19.0	137.3	0.79	0.69	0.79	39.0
Approach		1568	4.0	1568	4.0	0.580	18.5	LOS B	19.0	137.3	0.57	0.67	0.57	41.7
North: Central Coast Highway														
8	T1	1326	4.0	1326	4.0	* 0.866	41.3	LOS C	41.0	297.1	0.96	0.95	1.07	33.1
9	R2	62	4.0	62	4.0	* 0.158	27.9	LOS B	2.3	16.8	0.67	0.72	0.67	33.0
Approach		1388	4.0	1388	4.0	0.866	40.7	LOS C	41.0	297.1	0.95	0.94	1.05	33.1
West: Tumbi Road														
10	L2	36	2.0	36	2.0	0.038	7.0	LOS A	0.5	3.6	0.29	0.51	0.29	40.9
12	R2	662	2.0	662	2.0	* 0.881	64.9	LOS E	22.9	163.1	1.00	1.03	1.26	25.8
Approach		698	2.0	698	2.0	0.881	61.9	LOS E	22.9	163.1	0.96	1.01	1.21	26.2
All Vehicles		3654	3.6	3654	3.6	0.881	35.2	LOS C	41.0	297.1	0.79	0.84	0.87	34.2

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

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.

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.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance												
Mov ID	Crossing	Input Vol.	Dem. Flow	Aver. Delay	Level of Service	AVERAGE BACK OF QUEUE		Prop. Que	Effective Stop Rate	Travel Time	Travel Dist.	Aver. Speed
		ped/h	ped/h	sec		[Ped ped	Dist] m			sec	m	m/sec
South: Central Coast Highway												
P1	Full	50	53	56.8	LOS E	0.2	0.2	0.95	0.95	244.0	224.7	0.92
North: Central Coast Highway												
P3	Full	50	53	56.8	LOS E	0.2	0.2	0.95	0.95	244.4	225.2	0.92
West: Tumbi Road												
P4	Full	50	53	56.8	LOS E	0.2	0.2	0.95	0.95	237.9	217.3	0.91
All Pedestrians		150	158	56.8	LOS E	0.2	0.2	0.95	0.95	242.1	222.4	0.92

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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MOVEMENT SUMMARY

 **Site: 1 [Central Coast Highway/Tumbi Road PM - 2025 (Site Folder: 2025)]**

Central Coast Highway/Tumbi Road

Site Category: Future Conditions 2

Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 115 seconds (Site Optimum Cycle Time - Minimum Delay)

Vehicle Movement Performance														
Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total veh/h	HV %	[Total veh/h	HV %				[Veh. veh	Dist] m				
						v/c	sec							km/h
South: Central Coast Highway														
1	L2	716	4.0	716	4.0	0.585	10.6	LOS A	13.3	96.3	0.46	0.71	0.46	50.7
2	T1	1421	4.0	1421	4.0	* 0.819	29.3	LOS C	35.2	255.1	0.92	0.86	0.96	38.0
Approach		2137	4.0	2137	4.0	0.819	23.0	LOS B	35.2	255.1	0.77	0.81	0.79	42.0
North: Central Coast Highway														
8	T1	904	4.0	904	4.0	0.523	21.6	LOS B	17.2	124.2	0.74	0.65	0.74	42.1
9	R2	118	4.0	118	4.0	* 0.385	41.0	LOS C	5.8	42.2	0.90	0.80	0.90	32.9
Approach		1022	4.0	1022	4.0	0.523	23.8	LOS B	17.2	124.2	0.76	0.67	0.76	40.8
West: Tumbi Road														
10	L2	42	2.0	42	2.0	0.057	15.9	LOS B	1.0	6.8	0.48	0.66	0.48	45.0
12	R2	460	2.0	460	2.0	* 0.808	59.9	LOS E	13.7	97.5	1.00	0.93	1.19	30.1
Approach		502	2.0	502	2.0	0.808	56.2	LOS D	13.7	97.5	0.96	0.91	1.13	30.9
All Vehicles		3661	3.7	3661	3.7	0.819	27.8	LOS B	35.2	255.1	0.79	0.78	0.83	39.5

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

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.

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.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance												
Mov ID	Crossing	Input Vol.	Dem. Flow	Aver. Delay	Level of Service	AVERAGE BACK OF QUEUE		Prop. Que	Effective Stop Rate	Travel Time	Travel Dist.	Aver. Speed
		ped/h	ped/h	sec		[Ped ped	Dist] m			sec	m	m/sec
South: Central Coast Highway												
P1	Full	50	53	51.8	LOS E	0.2	0.2	0.95	0.95	239.0	224.7	0.94
North: Central Coast Highway												
P3	Full	50	53	51.8	LOS E	0.2	0.2	0.95	0.95	239.4	225.2	0.94
West: Tumbi Road												
P4	Full	50	53	51.8	LOS E	0.2	0.2	0.95	0.95	232.9	217.3	0.93
All Pedestrians		150	158	51.8	LOS E	0.2	0.2	0.95	0.95	237.1	222.4	0.94

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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MOVEMENT SUMMARY

 **Site: 1 [Central Coast Highway/Tumbi Road AM - 2035 (Site Folder: 2035)]**

Central Coast Highway/Tumbi Road

Site Category: Future Conditions 2

Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 125 seconds (Site Optimum Cycle Time - Minimum Delay)

Vehicle Movement Performance														
Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total veh/h	HV] %	[Total veh/h	HV] %				[Veh. veh	Dist] m				
South: Central Coast Highway														
1	L2	776	4.0	776	4.0	0.634	8.3	LOS A	10.8	78.1	0.36	0.67	0.36	44.4
2	T1	938	4.0	938	4.0	0.596	28.2	LOS B	21.4	154.6	0.81	0.72	0.81	38.6
Approach		1714	4.0	1714	4.0	0.634	19.2	LOS B	21.4	154.6	0.61	0.70	0.61	41.3
North: Central Coast Highway														
8	T1	1449	4.0	1449	4.0	* 0.948	62.5	LOS E	56.1	406.2	1.00	1.13	1.28	26.9
9	R2	68	4.0	68	4.0	* 0.184	29.9	LOS C	2.7	19.5	0.70	0.73	0.70	32.3
Approach		1517	4.0	1517	4.0	0.948	61.0	LOS E	56.1	406.2	0.98	1.11	1.25	27.1
West: Tumbi Road														
10	L2	40	2.0	40	2.0	0.044	7.5	LOS A	0.6	4.3	0.31	0.52	0.31	40.6
12	R2	724	2.0	724	2.0	* 0.964	88.6	LOS F	30.0	213.5	1.00	1.19	1.49	22.1
Approach		764	2.0	764	2.0	0.964	84.4	LOS F	30.0	213.5	0.96	1.15	1.43	22.6
All Vehicles		3995	3.6	3995	3.6	0.964	47.5	LOS D	56.1	406.2	0.82	0.94	1.01	30.3

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

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.

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.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance												
Mov ID	Crossing	Input Vol.	Dem. Flow	Aver. Delay	Level of Service	AVERAGE BACK OF QUEUE		Prop. Que	Effective Stop Rate	Travel Time	Travel Dist.	Aver. Speed
		ped/h	ped/h	sec		[Ped ped	Dist] m			sec	m	m/sec
South: Central Coast Highway												
P1	Full	50	53	56.8	LOS E	0.2	0.2	0.95	0.95	244.0	224.7	0.92
North: Central Coast Highway												
P3	Full	50	53	56.8	LOS E	0.2	0.2	0.95	0.95	244.4	225.2	0.92
West: Tumbi Road												
P4	Full	50	53	56.8	LOS E	0.2	0.2	0.95	0.95	237.9	217.3	0.91
All Pedestrians		150	158	56.8	LOS E	0.2	0.2	0.95	0.95	242.1	222.4	0.92

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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MOVEMENT SUMMARY

 **Site: 1 [Central Coast Highway/Tumbi Road PM - 2035 (Site Folder: 2035)]**

Central Coast Highway/Tumbi Road

Site Category: Future Conditions 2

Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 125 seconds (Site Optimum Cycle Time - Minimum Delay)

Vehicle Movement Performance														
Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total veh/h	HV %	[Total veh/h	HV %				[Veh. veh	Dist] m				
						v/c	sec							km/h
South: Central Coast Highway														
1	L2	783	4.0	783	4.0	0.640	10.1	LOS A	13.8	99.8	0.48	0.73	0.48	51.2
2	T1	1553	4.0	1553	4.0	* 0.879	38.3	LOS C	47.1	341.3	0.96	0.96	1.06	34.2
Approach		2336	4.0	2336	4.0	0.879	28.9	LOS C	47.1	341.3	0.80	0.88	0.87	39.1
North: Central Coast Highway														
8	T1	988	4.0	988	4.0	0.562	23.3	LOS B	20.7	149.5	0.75	0.67	0.75	41.1
9	R2	130	4.0	130	4.0	* 0.459	51.2	LOS D	7.1	51.6	0.92	0.88	0.92	29.7
Approach		1118	4.0	1118	4.0	0.562	26.6	LOS B	20.7	149.5	0.77	0.69	0.77	39.3
West: Tumbi Road														
10	L2	46	2.0	46	2.0	0.064	19.1	LOS B	1.3	9.0	0.52	0.67	0.52	42.9
12	R2	503	2.0	503	2.0	* 0.850	67.2	LOS E	16.8	119.7	1.00	0.96	1.23	28.4
Approach		549	2.0	549	2.0	0.850	63.2	LOS E	16.8	119.7	0.96	0.93	1.17	29.1
All Vehicles		4003	3.7	4003	3.7	0.879	32.9	LOS C	47.1	341.3	0.82	0.84	0.88	37.2

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

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.

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.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance												
Mov ID	Crossing	Input Vol.	Dem. Flow	Aver. Delay	Level of Service	AVERAGE BACK OF QUEUE		Prop. Que	Effective Stop Rate	Travel Time	Travel Dist.	Aver. Speed
		ped/h	ped/h	sec		[Ped ped	Dist] m			sec	m	m/sec
South: Central Coast Highway												
P1	Full	50	53	56.8	LOS E	0.2	0.2	0.95	0.95	244.0	224.7	0.92
North: Central Coast Highway												
P3	Full	50	53	56.8	LOS E	0.2	0.2	0.95	0.95	244.4	225.2	0.92
West: Tumbi Road												
P4	Full	50	53	56.8	LOS E	0.2	0.2	0.95	0.95	237.9	217.3	0.91
All Pedestrians		150	158	56.8	LOS E	0.2	0.2	0.95	0.95	242.1	222.4	0.92

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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MOVEMENT SUMMARY

 **Site: 1 [Central Coast Highway/Tumbi Road AM - 2045 (Site Folder: 2045)]**

Central Coast Highway/Tumbi Road

Site Category: Future Conditions 2

Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 150 seconds (Site Optimum Cycle Time - Minimum Delay)

Vehicle Movement Performance														
Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total veh/h	HV] veh/h	[Total veh/h	HV] %				[Veh. veh	Dist] m				
South: Central Coast Highway														
1	L2	842	34	842	4.0	0.688	9.2	LOS A	16.4	118.9	0.40	0.69	0.40	44.0
2	T1	1027	40	1027	3.9	0.625	32.4	LOS C	27.9	201.6	0.81	0.73	0.81	36.6
Approach		1869	74	1869	4.0	0.688	21.9	LOS B	27.9	201.6	0.63	0.71	0.63	40.0
North: Central Coast Highway														
8	T1	1572	62	1572	4.0	* 0.992	89.5	LOS F	80.6	583.6	1.00	1.20	1.35	21.8
9	R2	74	3	74	4.0	* 0.222	37.9	LOS C	3.8	27.2	0.74	0.75	0.74	29.8
Approach		1646	65	1646	4.0	0.992	87.2	LOS F	80.6	583.6	0.99	1.18	1.32	22.0
West: Tumbi Road														
10	L2	43	1	43	2.0	0.049	8.9	LOS A	0.8	5.9	0.32	0.53	0.32	39.9
12	R2	786	16	786	2.0	* 0.993	113.0	LOS F	40.7	290.0	1.00	1.20	1.50	19.3
Approach		829	17	829	2.0	0.993	107.6	LOS F	40.7	290.0	0.96	1.16	1.44	19.7
All Vehicles		4344	156	4344	3.6	0.993	63.0	LOS E	80.6	583.6	0.83	0.97	1.05	26.6

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

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.

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.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance												
Mov ID	Crossing	Input Vol.	Dem. Flow	Aver. Delay	Level of Service	AVERAGE BACK OF QUEUE		Prop. Que	Effective Stop Rate	Travel Time	Travel Dist.	Aver. Speed
		ped/h	ped/h	sec		[Ped ped	Dist] m			sec	m	m/sec
South: Central Coast Highway												
P1	Full	50	53	69.3	LOS F	0.2	0.2	0.96	0.96	256.5	224.7	0.88
North: Central Coast Highway												
P3	Full	50	53	69.3	LOS F	0.2	0.2	0.96	0.96	256.9	225.2	0.88
West: Tumbi Road												
P4	Full	50	53	69.3	LOS F	0.2	0.2	0.96	0.96	250.4	217.3	0.87
All Pedestrians		150	158	69.3	LOS F	0.2	0.2	0.96	0.96	254.6	222.4	0.87

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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MOVEMENT SUMMARY

 **Site: 1 [Central Coast Highway/Tumbi Road PM - 2045 (Site Folder: 2045)]**

Central Coast Highway/Tumbi Road

Site Category: Future Conditions 2

Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 150 seconds (Site Optimum Cycle Time - Minimum Delay)

Vehicle Movement Performance														
Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total veh/h	HV %	[Total veh/h	HV %				[Veh. veh	Dist] m				
						v/c	sec							km/h
South: Central Coast Highway														
1	L2	850	4.0	850	4.0	0.695	11.2	LOS A	17.7	128.5	0.54	0.75	0.54	50.5
2	T1	1685	4.0	1685	4.0	* 0.899	43.0	LOS D	60.8	440.1	0.97	0.96	1.05	32.5
Approach		2535	4.0	2535	4.0	0.899	32.3	LOS C	60.8	440.1	0.83	0.89	0.88	37.6
North: Central Coast Highway														
8	T1	1072	4.0	1072	4.0	0.574	25.4	LOS B	26.0	188.0	0.73	0.66	0.73	40.0
9	R2	142	4.0	142	4.0	* 0.561	67.1	LOS E	9.6	69.7	0.96	0.95	0.96	25.7
Approach		1214	4.0	1214	4.0	0.574	30.3	LOS C	26.0	188.0	0.76	0.69	0.76	37.5
West: Tumbi Road														
10	L2	50	2.0	50	2.0	0.074	23.9	LOS B	1.8	12.6	0.55	0.68	0.55	40.2
12	R2	546	2.0	546	2.0	* 0.899	85.1	LOS F	22.9	163.3	1.00	0.99	1.28	25.0
Approach		596	2.0	596	2.0	0.899	79.9	LOS F	22.9	163.3	0.96	0.96	1.22	25.7
All Vehicles		4345	3.7	4345	3.7	0.899	38.3	LOS C	60.8	440.1	0.83	0.85	0.89	35.1

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

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.

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.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance												
Mov ID	Crossing	Input Vol.	Dem. Flow	Aver. Delay	Level of Service	AVERAGE BACK OF QUEUE		Prop. Que	Effective Stop Rate	Travel Time	Travel Dist.	Aver. Speed
		ped/h	ped/h	sec		[Ped ped	Dist] m			sec	m	m/sec
South: Central Coast Highway												
P1	Full	50	53	69.3	LOS F	0.2	0.2	0.96	0.96	256.5	224.7	0.88
North: Central Coast Highway												
P3	Full	50	53	69.3	LOS F	0.2	0.2	0.96	0.96	256.9	225.2	0.88
West: Tumbi Road												
P4	Full	50	53	69.3	LOS F	0.2	0.2	0.96	0.96	250.4	217.3	0.87
All Pedestrians		150	158	69.3	LOS F	0.2	0.2	0.96	0.96	254.6	222.4	0.87

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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Attachment B: Queueing results

Anticipated queueing at the intersection of the Central Coast Highway/ Tumbi Road has been reviewed to ensure anticipated queues can be accommodated within the proposed short lanes. Table 5-1 shows the anticipated queues at the proposed signalised intersection.

Queueing is not expected to overflow the short turning lanes at the intersection. As such, overflow of turning traffic onto adjacent lanes is not expected at the intersection.

Table 5-1 Queue lengths on short turning lanes

Approach	95th Percentile Queue (m)	Turning Bay Length (m)
2025 AM Peak		
Central Coast Highway (South)	58	180
Central Coast Highway (North)	17	135
Tumbi Road (West, Left turn)	4	100
Tumbi Road (West, Right turn)	163	125
2025 PM Peak		
Central Coast Highway (South)	96	180
Central Coast Highway (North)	42	135
Tumbi Road (West, Left turn)	7	100
Tumbi Road (West, Right turn)	98	125
2035 AM Peak		
Central Coast Highway (South)	78	180
Central Coast Highway (North)	20	135
Tumbi Road (West, Left turn)	4	100
Tumbi Road (West, Right turn)	214	125
2035 PM Peak		
Central Coast Highway (South)	100	180
Central Coast Highway (North)	52	135
Tumbi Road (West, Left turn)	9	100
Tumbi Road (West, Right turn)	120	125
2045 AM Peak		
Central Coast Highway (South)	119	180
Central Coast Highway (North)	27	135
Tumbi Road (West, Left turn)	6	100
Tumbi Road (West, Right turn)	286	125
2045 PM Peak		
Central Coast Highway (South)	129	180
Central Coast Highway (North)	70	135
Tumbi Road (West, Left turn)	13	100
Tumbi Road (West, Right turn)	163	125