Australian Government

BUILDING OUR FUTURE

NSW GOVERNMENT

Coffs Harbour Bypass

Environmental Impact Statement

September 2019

VOLUME 3

Traffic and transport assessments

Appendix F

RMS.19.1315
ISBN: 978-1-925891-61-4

APPENDIX

F

Appendix F

Roads and Maritime Services

Coffs Harbour Bypass Environmental Impact Statement

Appendix F Traffic and Transport Assessment

REP_TA_01.5

Rev 7 |

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 248379

Arup
Arup Pty Ltd ABN 18 000 966 165

Arup
Level 4, 108 Wickham Street
Fortitude Valley
QLD 4006
GPO Box 685 Brisbane QLD 4001
Australia
www.arup.com

ARUP

Contents

			Page
1	**Introduction**		**1**
	1.1	Overview	1
	1.2	The project	1
	1.3	Project objectives	4
	1.4	Purpose of this report	4
2	**Existing traffic and transport environment**		**6**
	2.1	Road network	6
	2.2	Heavy and restricted access vehicles	12
	2.3	Historical traffic growth	14
	2.4	Crash data	15
	2.5	North Coast Railway	18
	2.6	Public transport	18
	2.7	Pedestrian and cyclist network	20
	2.8	Parking	22
3	**Existing road performance**		**24**
	3.1	Traffic surveys	24
	3.2	Traffic volumes	27
	3.3	Origin-destination survey	29
	3.4	Network operations	29
	3.5	Level of service	30
4	**Traffic modelling and forecasting**		**33**
	4.1	Traffic modelling approach	33
	4.2	Coffs Harbour Strategic Transport Model	35
	4.3	Coffs Harbour Traffic Model	36
	4.4	Detailed intersection analysis	36
	4.5	Forecast development	37
	4.6	Traffic forecasts	38
5	**Assessment of operational impacts**		**40**
	5.1	Operational impacts	40
	5.2	Network changes	40
	5.3	Traffic volumes on the project	42
	5.4	Traffic impacts on the existing road network	43
	5.5	Network performance	48
	5.6	Intersection performance	51
	5.7	Road safety	55
	5.8	Impacts on other travel modes	58

5.9 Property access 61
5.10 Parking 63

6 Assessment of construction impacts 65
6.1 Assessment methodology 65
6.2 Construction activities 65
6.3 Construction timing 67
6.4 Construction zones 68
6.5 Workforce and construction work hours 70
6.6 Location and use of ancillary sites 70
6.7 Construction traffic impacts 72

7 Management of traffic and transport impacts 85

8 References 86

9 Glossary 87

Appendices

Appendix A
Coffs Harbour Bypass Traffic Model Development Report

Appendix B
Kororo Public School Transport Observations

1 Introduction

1.1 Overview

Roads and Maritime Services (Roads and Maritime) is seeking approval for the Coffs Harbour Bypass (the project). The approval is being sought under Division 5.2 of the *NSW Environmental Planning and Assessment Act 1979* (EP&A Act) as Critical State Significant Infrastructure (CSSI).

The project complements the Pacific Highway upgrade program which, when complete, will provide free flowing dual carriageway conditions for the Pacific Highway between Hexham and the Queensland border. The benefits of the project include:

- Improve road safety by removing through traffic (light and heavy vehicles) and some local traffic from the existing road network will reduce conflicts and improve safety for all road users
- Improve travel time for through and local traffic, reducing through traffic travel times
- Improve transport efficiency of the existing Pacific Highway through Coffs Harbour, relieving congestion on the wider Coffs Harbour road network and providing an alternative route for some local trips. This improved transport efficiency and the resulting improvements to accessibility and amenity to the Coffs Harbour CBD would likely result in wider economic benefits for the Coffs Harbour region
- Improving freight efficiency for heavy vehicles by providing a high standard dual carriageway road to complement the National Land Transport Network, Future Transport Strategy 2056 and the recently upgraded Pacific Highway.

The Pacific Highway upgrade program also seeks to create public value and ensure safety of its workers and travelling public.

A concept design has been developed for the project, which forms the basis of this assessment. This traffic and transport assessment supports the environmental impact statement (EIS) prepared for the project.

1.2 The project

The project includes a 12 km bypass of Coffs Harbour from south of Englands Road to Korora Hill in the north and a 2 km upgrade of the existing highway between Korora Hill and Sapphire. The project would provide a four-lane divided highway that bypasses Coffs Harbour, passing through the North Boambee Valley, Roberts Hill and then traversing the foothills of the Coffs Harbour basin to the west and north to Korora Hill.

The key features of the project include:

- Four-lane divided highway from south of Englands Road roundabout to the dual carriageway highway at Sapphire
- Bypass of the Coffs Harbour urban area from south of Englands Road intersection to Korora Hill
- Upgrade of the existing Pacific Highway between Korora Hill and the dual carriageway highway at Sapphire
- Grade-separated interchanges at Englands Road, Coramba Road and Korora Hill
- A one-way local access road along the western side of the project between the southern tie-in and Englands Road, connecting properties to the road network via Englands Road
- A new service road, located east of the project, connecting Solitary Islands Way with James Small Drive and the existing Pacific Highway near Bruxner Park Road
- Three tunnels through ridges at Roberts Hill (around 190 m long), Shephards Lane (around 360 m long), and Gatelys Road (around 450 m long)
- Structures to pass over local roads and creeks as well as a bridge over the North Coast Railway
- A series of cuttings and embankments along the alignment
- Tie-ins and modifications to the local road network to enable local road connections across and around the alignment
- Pedestrian and cycling facilities, including a shared path along the service road tying into the existing shared path on Solitary Islands Way, and a new pedestrian bridge to replace the existing Luke Bowen footbridge with the name being retained
- Relocation of the Kororo Public School bus interchange
- Noise attenuation, including low noise pavement, noise barriers and at-property treatments as required
- Fauna crossing structures including glider poles, underpasses and fencing
- Ancillary work to facilitate construction and operation of the project, including:
  - Adjustment, relocation and/or protection of utilities and services
  - New or adjusted property accesses as required
  - Operational water quality measures and retention basins
  - Temporary construction facilities and work including compound and stockpile sites, concrete/asphalt batching plant, sedimentation basins and access roads (if required).

Legend

- Construction footprint
- Alignment
- North Coast Railway
- Watercourse

Coffs Harbour Bypass
Key features of the project
Figure 1

0 0.5 1 1.5 km

Scale @A4: 1:50,000
GDA 1994 MGA Zone 56

N

1.3 Project objectives

The Pacific Highway upgrade program aims to support regional development. The objectives of the program are to:

- Significantly reduce road crashes and injuries
- Reduce travel times
- Reduce freight transport costs
- Develop a route involving the community and considering its interests
- Provide a route supporting economic development
- Manage the upgrading of the route in accordance with the principles of ecologically sustainable development
- Provide the best value for money.

Specific objectives relating to the project are to:

- Provide travel time savings for through and local traffic, and business vehicles/freight
- Provide a road which supports and integrates with the broader transport network
- Provide sufficient road capacity to meet traffic demand on the Pacific Highway
- Provide safer road conditions for all road users on the new and existing road.

1.4 Purpose of this report

This traffic and transport assessment report has been prepared to address the Secretary's Environmental Assessment Requirements (SEARs) for the project for the purpose of seeking project approval under Division 5.2 of the EP&A Act. Table 1 identifies the SEARs which are relevant to this technical assessment.

Table 1 SEARs relevant to traffic and transport

SEARs relevant to this technical assessment	Where addressed in this technical assessment
Key Issues **1. Transport and traffic** 1. The Proponent must assess construction transport and traffic (vehicle, pedestrian and cyclists) impacts, including, but not necessarily limited to:	
(a) A considered approach to the identification of transport routes and movements, particularly outside standard construction hours	Section 6.4 and 6.7.4
(b) The indicative number, frequency and size of construction related vehicles (passenger, commercial and heavy vehicles, including spoil management movements)	Section 6.7.4
(c) Indicative construction worker parking requirements	Section 6.6
(d) the nature of existing traffic (types and number of movements) on construction access routes (including consideration of peak traffic times, land uses, in particular sensitive receivers, and parking arrangements)	Section 6.7.4
(e) Access constraints and impacts on public transport, pedestrians and cyclists	Section 6.6, 6.7.7
(f) Impacts on the operation of the North Coast railway line	Section 6.7.7
(g) The need to close, divert or otherwise reconfigure elements of the road and cycle network associated with construction of the project	Section 5.2, 6.7.5 and 6.7.7
(h) The cumulative traffic impacts of other major development projects preparing for or commencing construction in the vicinity of the proposal	Section 6.7.6
2. The Proponent must assess (and model) the operational transport impacts of the project including, but not necessarily limited to:	
(a) Forecast travel demand and traffic volumes for the project and the surrounding road, cycle and public transport network	Sections 2.1, 2.6, 2.7, 4.5, 4.6, 5.3 and 5.4
(b) Travel time analysis	Sections 3.4 and 5.5
(c) Performance of key interchanges and intersections by undertaking a level of service analysis at key locations	Sections 3.5 and 5.6
(d) Wider transport interactions and modifications (local and regional roads, cyclist, public and freight transport, and the North Coast railway line)	Sections 5.8
(e) Access to identified and future urban release areas, such as North Boambee Valley	Section 5.9.2
(f) Impacts on cyclists and pedestrian access and safety	Section 5.7 and 5.8.4
(g) Opportunities to integrate cycling and pedestrian elements with surrounding networks (existing and proposed) and within the project	Section 2.7 and 5.8.4

The area addressed for this assessment incorporates the project's construction and operational footprint and the surrounding road network that connects with the project. This is discussed further in Section 2.

The operational assessment presented in this report is primarily based on the findings of the *Coffs Harbour Bypass – Traffic Model Development Report* prepared by Arup (2018), as discussed further in Section 4.1. Updates to the traffic model to reflect design changes since the *Coffs Harbour Bypass – Traffic Model Development Report* was prepared have been included in the traffic model outputs and results presented in this report.

2 Existing traffic and transport environment

This chapter outlines the existing traffic and transport features and conditions relevant to the areas modelled (refer Figure 2). This chapter provides the regional and local context within which the assessment has been undertaken.

2.1 Road network

The Pacific Highway is the major interstate route between Sydney and Brisbane and is part of the National Highway. It is a key freight, bus and tourist route for the region, as well as a local route for Coffs Harbour. The Pacific Highway is a designated B-double heavy vehicle route and forms part of the Higher Mass Limit road freight network.

The traffic volumes on the Pacific Highway within the Coffs Harbour LGA are steadily increasing with a relatively high proportion of heavy vehicles, being approximately 12 to 15 per cent of daily traffic volumes. Within Coffs Harbour there are 12 sets of traffic signals and numerous intersections and property accesses along the existing highway that contribute to stop-start traffic conditions experienced by traffic using the highway. A substantial portion of the peak hour traffic travelling on the existing highway is through traffic conflicting with local trips.

Traffic congestion on the highway is predicted to intensify as a result of continuing population growth in the Coffs Harbour LGA, with developments being planned in North Boambee Valley and Korora Hill, providing housing for over 2,000 persons when fully developed. Long-term projections by the NSW Department of Planning predict that population in the Coffs Harbour will increase by around 20,000 people over the next 20 years.

In 2016, the Pacific Highway carried in the order of 37,000 vehicles through central Coffs Harbour per day in a typical weekday condition. Traffic volumes have increased steadily along the Pacific Highway since 2007. At Sapphire Beach, the traffic volumes on the Pacific Highway have been observed to increase at a rate of approximately three per cent (compound) per annum.

In addition to the Pacific Highway, regional roads carrying relatively high traffic demands (ie greater than 8,000 vehicles per day) within the Coffs Harbour LGA that have been addressed in this report. These include Stadium Drive, east of the Pacific Highway and Coramba Road, west of the Pacific Highway.

2.1.1 Pacific Highway

The existing Pacific Highway between the project extents is a four-lane highway with a divided carriageway. The Pacific Highway is a State Road, intersecting with regional and local roads at interchanges and at-grade intersections. There is a grade separated interchange where the Pacific Highway passes over Mastracolas Road and Arthur Street.

The existing Pacific Highway between Englands Road and West Kororo Road functions as an urban arterial road with direct access provided for residential, commercial and industrial properties, at-grade signalised and priority (stop or give-way controlled) intersections and a speed limit of 60km/h. Through central Coffs Harbour, footpaths are provided on either side of the highway and on-street parking is available. South of Combine Street a shared path is provided on the western side of the highway.

Between West Kororo Road and Solitary Islands Way, the posted speed limit of the Pacific Highway is 80km/h. Property access is restricted along this section of the highway although there a several at-grade intersections and there is an at-grade school bus interchange adjacent to Kororo Public School accessed from the Pacific Highway just south of the Old Coast Road intersection.

North of Solitary Islands Way, the posted speed limit increases to 110km/h and access to the highway is restricted.

2.1.2 Stadium Drive

Stadium Drive is a regional road to the south of Coffs Harbour providing an east-west link between the Pacific Highway and Hogbin Drive. Stadium Drive is located adjacent to the Coffs Coast Sports and Leisure Park and is mostly a two-lane, two-way undivided roadway with on-street cycle lanes and limited pedestrian facilities. Stadium Drive is an approved B-double route subject to certain travel conditions (ie B-doubles are not permitted to travel on this roadway between 8:00 to 9:00am and 2:30 to 4:00pm on school days).

2.1.3 Coramba Road

Coramba Road is a regional road which connects Coffs Harbour with Karangi (to the west of the project). Coramba Road (locally named West High Street) intersects with the Pacific Highway at a signalised intersection within the Coffs Harbour CBD. West of the CBD, Coramba Road is a two-lane, two-way undivided roadway with limited pedestrian and cyclist facilities. As part of Main Road 151, Coramba Road / Orara Way provides an alternative route between Coffs Harbour and Grafton via the Orara Valley.

2.1.4 Englands Road

Englands Road is the continuation of Stadium Drive west of the Pacific Highway. It provides an access to the industrial estate located north-west of the Englands Road interchange and to Coffs Coast Resource Recovery Park

Englands Road is a two-way, two lane road with a 50km/h posted speed limit. Between the Pacific Highway and Isles Drive (ie entry to the industrial estate) Englands Road is an approved B-double route.

Approximately 400m west of the Pacific Highway, Englands Road becomes a rural roadway with no shoulders, no kerbs and no active (ie pedestrian or cyclist) transport facilities. It predominately provides access to farmland and rural residential properties.

2.1.5 Bennetts Road

Bennetts Road intersects with Coramba Road west of Coffs Harbour, providing access to a number of rural private properties and development. Bennetts Road is a rural road with no kerb and channel, limited pavement marking, no active transport provisions and a posted speed limit of 60km/h.

2.1.6 Bruxner Park Road

Bruxner Park Road provides access to Ulidarra National Park and Sealy Lookout at the northern end of the project. Bruxner Park Road is a winding rural road with no kerb and channel and limited pavement marking. It is a designated local school bus route and cycle route and incorporates signage warning motorists of the occurrence of these vulnerable users (ie pedestrians and cyclists).

2.1.7 North Boambee Road

North Boambee Road is a two-way, two lane local road connecting to the Pacific Highway. It currently provides access to Bishop Druitt College; and commercial and urban residential development. The posted speed limit is 50km/h between the Pacific Highway and Bishop Druitt College; and 60km/h to the west of Bishop Druitt College where the land-use along this section of the road is predominately rural residential. At the western end of North Boambee Road is a quarry operated by Holcim, generating heavy vehicle movements to/from the Pacific Highway. There are limited pedestrian and cyclist facilities along the length of North Boambee Road.

North Boambee Road will intersect with the project approximately 1.5km north of the Englands Road interchange. The road provides access to the North Boambee Valley (east) urban release area and will provide access to the North Boambee Valley (west) future urban release area (refer to 4.5) to be developed west of the project.

2.1.8 Lakes Drive

Lakes Drive is located within the currently mostly developed North Boambee Valley (east) urban release area. Lakes Drive terminates just prior to the project. Lakes Drive is a local residential street which provides direct access to private properties within North Boambee Valley. The posted speed limit of Lakes Drive is 50km/h. Footpaths are provided predominantly on the eastern side of the road.

2.1.9 Spagnolos Road

Spagnolos Road intersects with Coramba Road east of Bennetts Road. Spagnolos Road is a short local residential street linking Coramba Road and Roselands Drive, and has no existing pedestrian or cyclist facilities. Where Spagnolos Road intersects with Coramba Road, a bus stop is provided for school bus services. The speed environment of Spagnolos Road is 50km/h.

2.1.10 Shephards Lane

Shephards Lane is a two-way, two lane residential street which connects Coramba Road to residents located in the western suburbs of Coffs Harbour. The posted speed limit of Shephards Lane is 50 km/h. Footpaths are provided intermittently along Shephards Lane, with no cycle provisions. West of Roselands Drive, Shephards Lane becomes a rural residential street with no kerb and channel and no shoulders. An overpass over the North Coast Railway is provided on Shephards Lane to continue to provide access to rural properties west of the rail line.

2.1.11 Mackays Road

Mackays Road is a predominately residential local road west of the existing Pacific Highway in the northwest suburbs of Coffs Harbour, with a 50km/h posted speed limit and limited pedestrian and cyclist facilities. The Baringa Private Hospital is accessed via Mackays Road north of Bray Street.

Mackays Road south of Bray Street forms part of a local bus route network. It intersects with the North Coast Railway at a level crossing. North of the level crossing, Mackays Road becomes a rural unsealed roadway providing access to a limited number of rural properties before terminating prior to the Ulidarra National Park.

2.1.12 West Korora Road

West Korora Road is a rural road with no kerb and channel, limited pavement marking and no pedestrian or cyclist provisions. The posted speed limit of West Korora Road is 50km/h. This road intersects with the existing Pacific Highway at an at-grade priority (give-way) all-movements intersection approximately 250m north of the Big Banana Fun Park. West Korora Road terminates just prior to the Ulidarra National Park.

2.1.13 Old Coast Road

Old Coast Road is a rural road with no kerb and channel and no pedestrian or cyclist provisions. Old Coast Road provides access to predominantly rural residential allotments, and north of Innes Road becomes unsuitable for longer vehicles. The speed environment of Old Coast Road is 50km/h.

Old Coast Road currently intersects with the Pacific Highway 40m south of Korora School Road, at an at-grade unsignalised T-intersection, which allows all turning movements. Approximately 80m west of its intersection with the Pacific Highway, there is a narrow one-lane bridge crossing on Old Coast Road over Pine Brush Creek.

2.1.14 Korora School Road

Korora School Road is a 500m one-way southbound road which diverges from the Pacific Highway approximately 40m north of Old Coast Road and terminates at a

priority-controlled T intersection with James Small Drive. Korora School Road provides access to the adjacent Kororo Public School and residential properties. The road has a restricted posted speed limit of 40km/h during school peak periods.

There is a 14-bay formalised on-street car park (including two disabled parking spaces) and an approximately 40m long parent drop-off area located on Korora School Road adjacent to the school. Alongside the drop-off area, there is a pedestrian pathway connecting to the pedestrian entry to the school. There is an existing children's crossing located just north of the on-street car park, providing access to the nearby school bus interchange on the Pacific Highway, and the Luke Bowen footbridge / cyclist overpass connecting to the service road on the western side of the Highway.

2.1.15 James Small Drive

James Small Drive is a former section of the Pacific Highway route and is a two-lane, two-way roadway that commences and terminates at the existing Pacific Highway within the project extents. James Small Drive currently intersects with the Pacific Highway at a priority-controlled left-in / left-out / right out intersection approximately 250m north of the Korora School Road diverge. James Small Drive continues south before terminating at the Pacific Highway opposite its intersection with Bruxner Park Road.

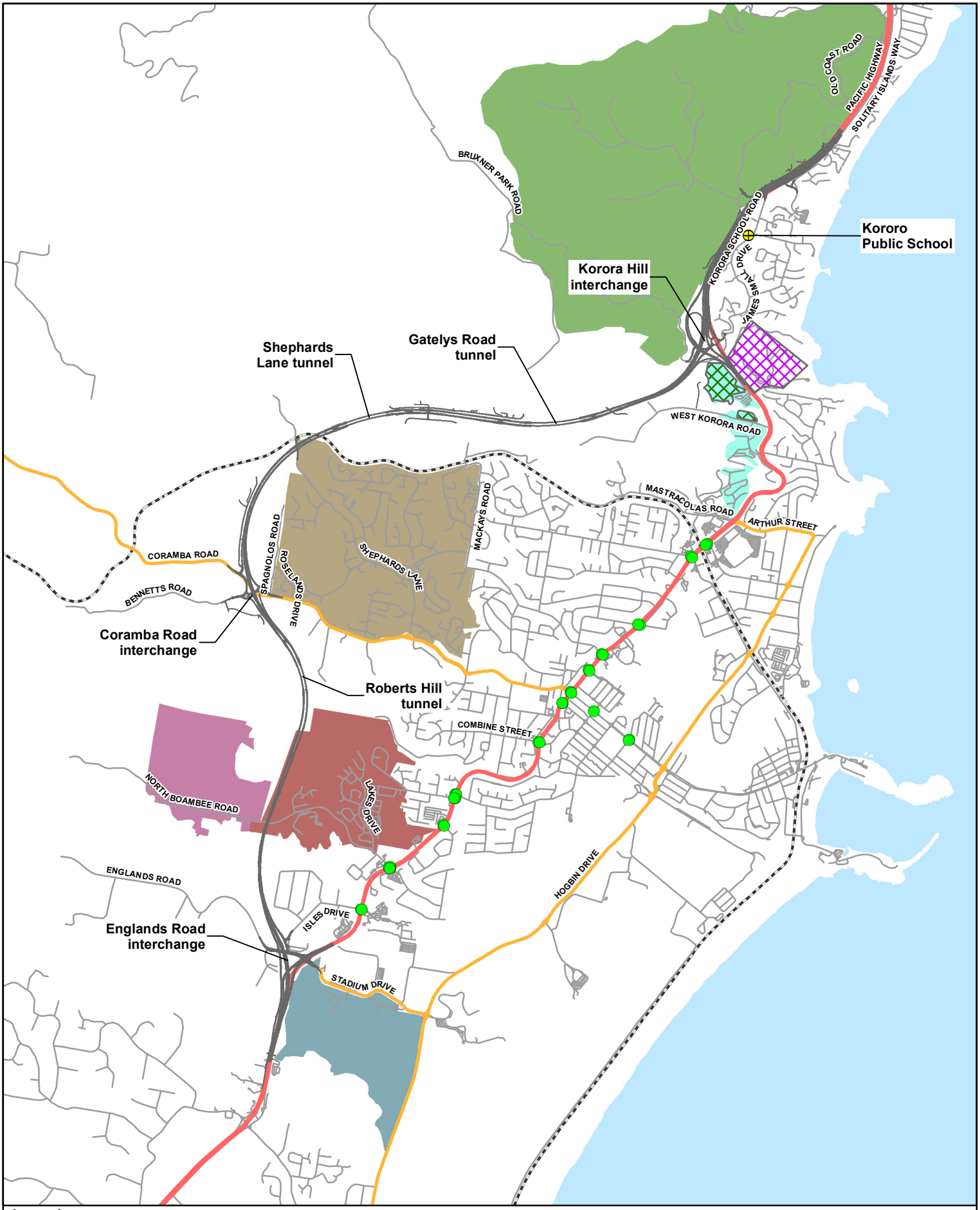
The posted speed limit of James Small Drive is 50km/h. There is a footpath on the western side of the road, north of its intersection with Korora Bay Drive. Adjacent to Kororo Public School, there is a children's crossing point providing a designated location for pedestrians to cross to reach parking on either side of the road.

2.1.16 Isles Drive

Isles Drive is a two-way, two-lane road through the Isles Industrial Park located just north of Englands Road. Given the surrounding industrial land uses, the carriageway is approximately 12.5m wide allowing for both parking on-street, and to cater for the turning movements of large commercial vehicles into industrial tenancies. Isles Drive is an approved B-double route, which is subject to certain travel conditions (ie B-doubles are not permitted to turn left into Isles Drive from the Pacific Highway). Additionally, it is noted that case-by-case permits for over dimensional vehicles to access the industrial estate are currently in place. For example, a permit exists for over dimensional vehicles to access the casting yard on Industrial Drive / Engineering Drive via the southern end of Isles Drive and Englands Road from the Pacific Highway.

Isles Drive intersects with Englands Road at a priority-controlled T intersection 180m west of the Pacific Highway. It also intersects with the Pacific Highway approximately 760m north of Englands Road, at a signalised four-way intersection.

The posted speed limit of Isles Drive is 50 km/h. There are limited pedestrian facilities along the length of Isles Drive with no dedicated cycling provisions.



Legend

- Design
- Existing Pacific Highway
- Regional roads
- Local roads
- North Coast Railway
- Traffic signals
- Kororo Public School

Urban release areas

- North Coffs URA
- Korora URA
- North Boambee Valley URA
- South Coffs URA
- West Coffs URA
- North Boambee Valley (West) URA

Furure and approved developments

- Pacific Bay Eastern lands
- Pacific Bay Western Lands

Coffs Harbour Bypass
Existing signalised intersections and road infrastructure
Figure 2

0 0.5 1 1.5 km

Scale @A4: 1:49,586
GDA 1994 MGA Zone 56

N

2.2 Heavy and restricted access vehicles

The national key freight network has been developed collaboratively by Commonwealth, state and territory governments and industry; to assist governments and industry to better understand, and plan for, critical freight flows. It provides a detailed illustration of the road and rail routes connecting Australia's nationally significant places for freight. Within the Coffs Harbour LGA, the Pacific Highway forms part of the national key freight route network (Department of Infrastructure and Regional Development, 2018*).*

Heavy vehicles are defined under the Heavy Vehicle National Law (which is administered by the National Heavy Vehicle Regulator) as a vehicle with a single, or combined (ie with trailer) mass of more than 4.5 tonnes. This includes many types of trucks and large vehicles such as buses.

Restricted access vehicles are any single or combined vehicle which when either empty or loaded exceeds the overall dimensions specified for heavy vehicles under the Heavy Vehicle National Law. These include vehicles such as B-doubles, road trains and vehicles over 4.6 metres in height.

Heavy vehicles with an overall length not greater than 19m are generally permitted to travel on all NSW roads with B-double trucks up to 25/26 metres being restricted. The approved NSW B-double routes within the Coffs Harbour LGA are illustrated in Figure 3.

Legend

- Design
- Regional roads
- Local roads
- North Coast Railway
- B-double vehicles (standard)
- Restricted access vehicles
- Restricted access vehicles (with travel conditions)

Coffs Harbour Bypass
B-double and restricted access vehicles
Figure 3

0 0.5 1 1.5 km

Scale @A4: 1:50,000
GDA 1994 MGA Zone 56

N

The following have been identified as existing routes for restricted access heavy vehicles:

- The existing Pacific Highway and Englands Road (from the existing Pacific Highway to Isles Drive) form part of the approved B-double network.
- Local access routes from the Pacific Highway along Orlando Drive, Hurley Drive and Cook Drive also form part of the approved B-double network.
- Isles Drive is an approved 25m B-double route with the restriction that the left-turn from the Pacific Highway is not permitted.
- Stadium Drive and parts of Hogbin Drive are approved 25m B-double routes but with travel conditions to prevent interference with peak school drop off and pick up times.
- The full length of the Pacific Highway is also an approved route for 4.6m high vehicles.

There are no approved routes for road trains within the Coffs Harbour LGA.

2.3 Historical traffic growth

Traffic volumes on the Pacific Highway through Coffs Harbour are mostly attributed to a combination of through traffic to regional centres, and local trips accessing commercial and retail centres throughout Coffs Harbour including Park Beach, Coffs Harbour CBD and North Boambee. Additional key generators of traffic along the existing Pacific Highway corridor include the industrial land uses at the Isles Drive and Cook Drive estates and the Coffs Harbour Health Campus.

Historical daily traffic data between 2007 and 2011 for historical count sites on the Pacific Highway were obtained from Roads and Maritime and are presented in Table 2 along with the current volumes from traffic surveys undertaken in June 2016. The table shows average weekday volumes and the per cent heavy vehicles.

Table 2 Historical and current traffic volumes (Source: Roads and Maritime Traffic Volume Viewer, Arup 2016 traffic counts)

Count Location	Two-way average weekday volume [vpd (per cent HV)]		
	2007	2011	2016
Pacific Highway - south of Coffs Harbour (1km south of Englands Road)	31,300 (-)	33,700 (-)	31,500 (14%)
Pacific Highway – Coffs Harbour CBD (north of Harbour Drive)	28,600 (-)	29,300 (-)	35,200 (15%)
Pacific Highway – north of Coffs Harbour (at 1km south of Moonee Beach Road)	18,600 (12%)	22,000 (13%)	24,200 (15%)

Key points to note from the above:

- Counts on the Pacific Highway north of Coffs Harbour show the percentage of heavy vehicles has increased between 2007 and 2016

- Since 2007, traffic volumes on the Pacific Highway in the Coffs Harbour CBD have risen by 6,600 vpd
- Similar increases were observed on the northern section of the Pacific Highway near Moonie Beach where traffic volumes have increased from 18,600 vpd (2007) to 24,200 vpd (2016)

Traffic volumes on the Pacific Highway in central Coffs Harbour and to the north of Coffs Harbour have been observed to increase at a rate of approximately 2.3 per cent to 3 per cent per annum between 2007 and 2016. The counts for the southern section of the Pacific Highway suggest that there hasn't been any growth in traffic volumes between 2007 and 2016. However, it is possible that the counts from the RMS Volume Viewer (2007 and 2011 counts) and the 2016 counts may have been affected differently by seasonal variations.

2.4 Crash data

There were 259 crashes recorded for the period from January 2014 to December 2018 on the Pacific Highway at Coffs Harbour between the southern tie-in at the Sawtell Road interchange the dual carriageway at Sapphire (crash data provided by Roads and Maritime 2019). Of these, two crashes were fatal, 39 crashes resulted in serious injury, 122 crashes resulted in moderate, minor or uncategorised injuries, and the remaining 96 were non-casualty (tow-away) incidents.

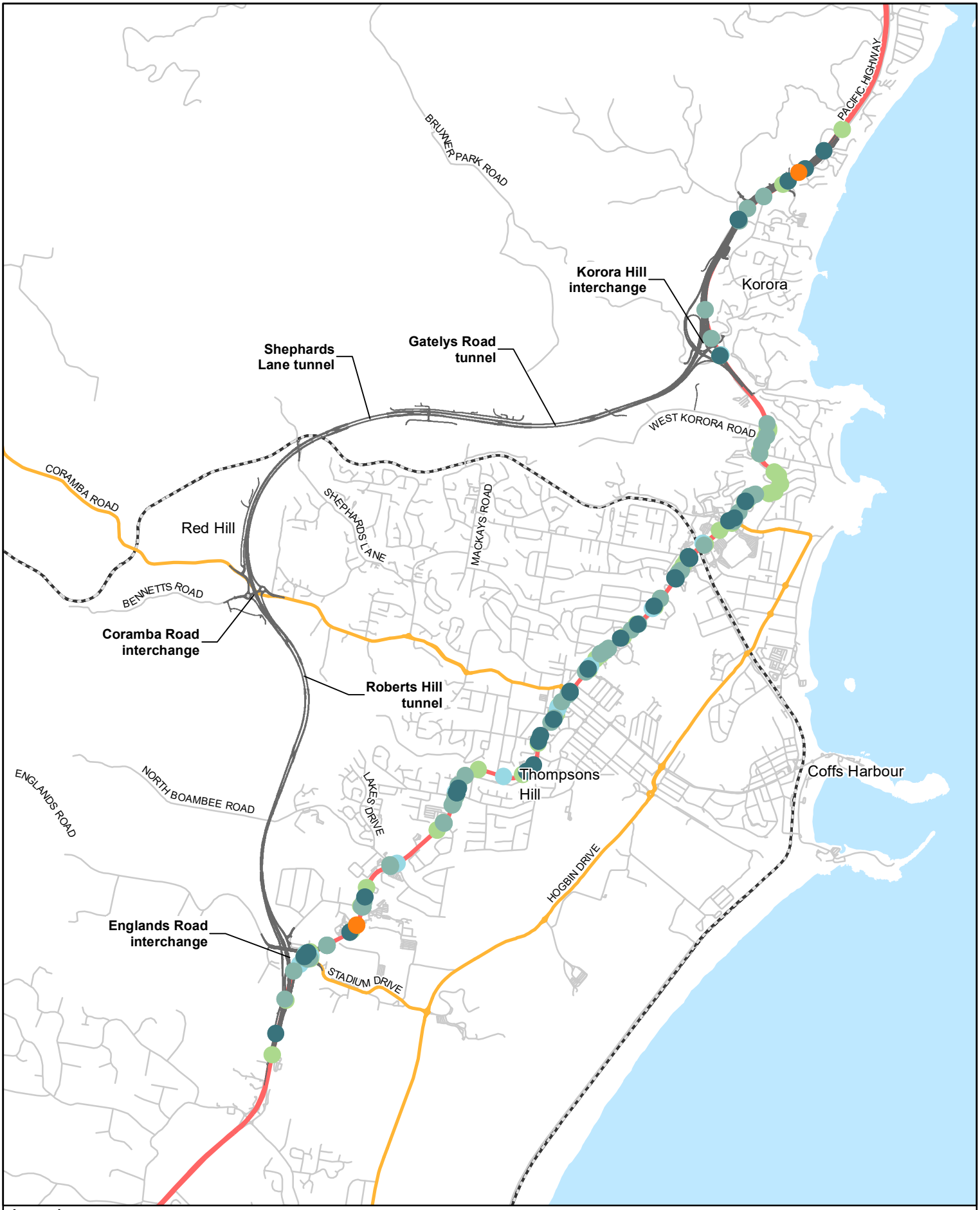
The most common crash types, by RUM (Road User Movement) code, in the dataset are presented in Table 3.

Table 3 Most common crash types by RUM code

RUM Code	Description	Count	Proportion of total
30	Rear-end	103	40%
21	Right Through	25	10%
10	Cross Traffic	18	7%
13	Right near	11	4%
35	Lane Change Left	10	4%
81	Off carriageway on right bend into object or parked vehicle	9	3%
33	Lane sideswipe	7	3%
73	Right off carriageway into object or parked vehicle	6	2%
85	Off carriageway on right bend into object or parked vehicle	6	2%
87	Off carriageway on left bend into object or parked vehicle	6	2%
-	All other crashes	58	23%

The key findings from the crash data include:

- The majority of crashes occurred in dry weather (78 per cent), rear-end (40 per cent), multi-vehicle (69 per cent) which indicate heavy traffic congestion along this route. Rear end crashes are more likely to occur with unstable flow on high speed roads, including disturbance to traffic flow such as from driveways and bus stops (Austroads *Guide to Road Safety Part 8 Treatment of Crash Locations*, August 2015)
- Another common type of crash during this period was right-through (ten per cent) incidents
- 67 per cent of crashes occurred at intersections, reflecting the large number of intersections and conflict points for traffic flow along this route
- 76 per cent of crashes occurred between 8am and 6pm, with the afternoon peak recording the highest number of crashes (i.e. 19% of crashes occurred between 3 to 5pm)
- There were nine cyclist crashes and nine pedestrian crashes which account for seven per cent of all crashes
- Around 14 per cent of crashes involved a heavy vehicle, for the section of the Pacific Highway. This is proportionate with the number of heavy vehicles currently using the network, as shown in Table 2
- The number of crashes increase as the existing Pacific Highway approaches the Coffs Harbour CBD with most crashes recorded within the Coffs Harbour CBD (Figure 4). This increase in crash numbers within the CBD is due to the increased number of conflict points between pedestrian, passenger and freight traffic. This would continue to be a safety issue as traffic volumes increase.



Legend

- Design
- Existing Pacific Highway
- Regional roads
- Local roads
- North Coast Railway

Crash points 2014-2018

- Fatal
- Serious Injury
- Moderate Injury
- Minor/Other Injury
- Non-casualty (towaway)

Coffs Harbour Bypass
Road crash data on the existing Pacific Highway (2014-2018)
Figure 4

0 0.5 1 1.5 km

Scale @A4: 1:50,000
GDA 1994 MGA Zone 56

N

2.5 North Coast Railway

The North Coast Railway is a major trunk line from NSW to Brisbane, Queensland and provides both passenger and freight services. The Coffs Harbour railway station is located on Angus McLeod Place east of the Pacific Highway and is on the North Coast NSW Line operated (for passenger services) by Transport for NSW. The line is the primary rail route in the Mid North Coast and Northern Rivers regions and forms part of the rail corridor between Sydney and Brisbane, servicing towns such as Casino, Grafton, Nambucca Heads, Taree and Maitland.

There are currently six daily (two-way) passenger rail services operating on the North Coast NSW Line, stopping at Coffs Harbour railway station. Additionally, there are approximately nine freight services daily (two-way) that run along the North Coast Railway through Coffs Harbour.

2.6 Public transport

Busways is the main public bus operator in Coffs Harbour, providing regular services within Coffs Harbour and the surrounding towns; including Bonville, Urunga, Valla Beach, Nambucca Heads and Macksville etc. Routes servicing Coffs Harbour are illustrated in Figure 5. Routes 360, 360M, 365, 366, 367 and 368 all travel along the existing Pacific Highway for portions of their service.

- Busways Route 360 – this bus service travels between Park Beach Plaza and Park Avenue via the Pacific Highway, with selected trips servicing the Coffs Harbour Base Hospital
- Busways Route 360M – this service travels between Park Beach Plaza and Park Avenue via the Pacific Highway. This service also operates through to Urunga, Nambucca Heads and Macksville
- Busways Route 365 – travels from Park Beach Plaza to Park Avenue via The Jetty
- Busways Route 366 – services Park Beach Plaza through to Park Avenue via Frances Street
- Busways Route 367 – this bus service travels between Park Beach Plaza and Park Avenue via Donn Patterson Drive, servicing the Baringa Private Hospital
- Busways Route 368 – this service travels between Park Beach Plaza and Park Avenue via Pearce Drive servicing the Baringa Private Hospital.

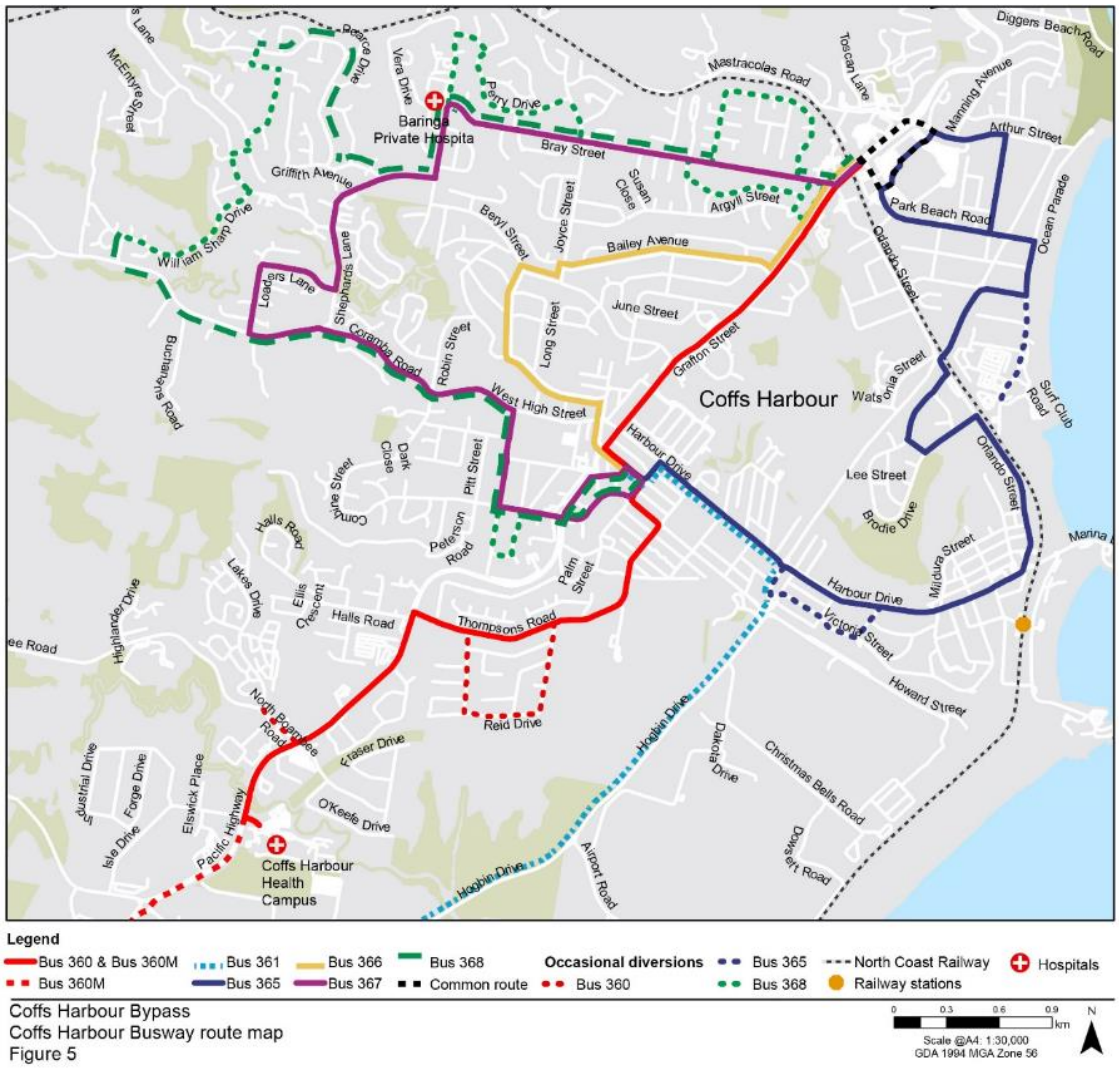


Figure 5 Coffs Harbour Busways route map (Source: Busways 2018)

A number of bus companies provide regular services to and from Coffs Harbour and towns and regional centres such as Woolgoolga, Grafton, Sawtell, Tamworth, Armidale, Urunga, Warwick, Toowoomba and Brisbane. Several local bus companies also provide school and charter services to Coffs Harbour.

The Kororo Public School bus interchange is an existing school bus interchange located on the Pacific Highway at Korora. A number of schools within and surrounding Coffs Harbour are serviced by the bus interchange, including Kororo Public School. Based on on-site observations, up to seven buses utilise the southbound interchange and one bus uses the northbound interchange simultaneously during the morning peak period. During the afternoon school peak period, buses arrive and depart independently of the other services. There is currently one bus shelter provided on the northbound platform with no shelter provided on the southbound platform.

In addition to the existing school bus interchange at Korora, there is also an existing informal school bus stop located on the corner of Spagnolos Road / Coramba Road. Site visit observations from Roads and Maritime indicated that a maximum of four buses were observed using the location at a given time.

2.7 Pedestrian and cyclist network

2.7.1 Pedestrian

At the southern end of the project, there is an existing north-south shared path on the eastern side of the Pacific Highway extending beyond Sawtell Road to the south. Linking to this is a local shared path connection on the northern side of Englands Road.

At the northern end of the project, there is an existing north-south shared path (Sapphire to Woolgoolga shared path) on the eastern side of Solitary Islands Way adjacent to the Pacific Highway. The shared path is located within the shoulder with a line-marked offset from the adjacent lane. The shared path becomes a cycle-only path just prior to the Pacific Highway / Solitary Islands Way interchange, where cyclists are provided the opportunity to either enter the highway or the local road network via a connection to Coachmans Close.

The Kororo Public School and the associated school bus interchange are located at the northern end of the project, adjacent to the Pacific Highway. The Luke Bowen footbridge is located north of Bruxner Park Road, providing access to the northbound and southbound school bus interchanges on the Pacific Highway at this location. The bridge also provides a pedestrian / cyclist connection from the property access road to the Kororo Public School over the Pacific Highway.

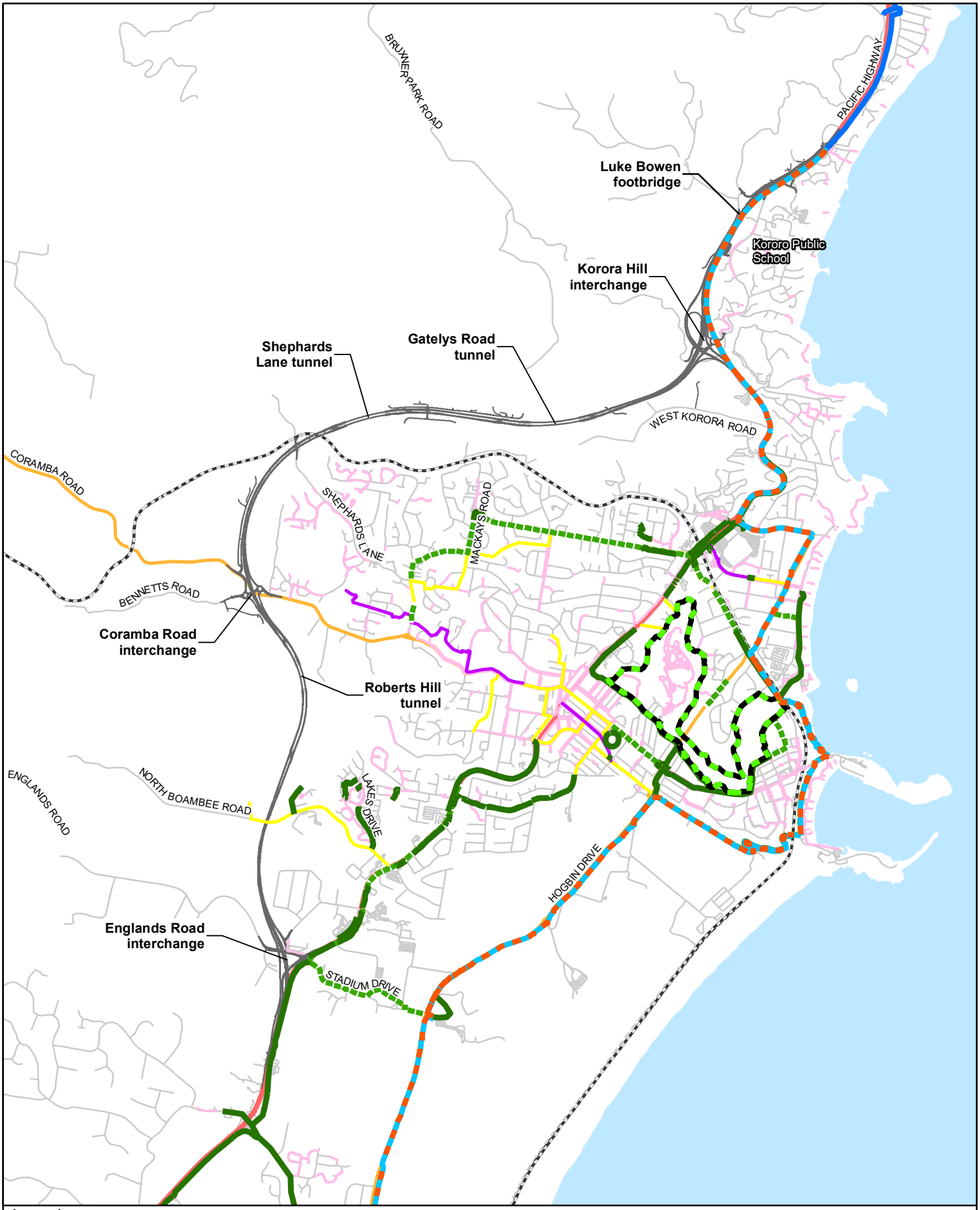
Along Korora School Road there is a pedestrian path adjacent to the school pick-up / drop-off zone. At the northern end of this set-down area, a children's crossing exists providing a safe crossing point on Korora School Road to exit the school grounds and access the Luke Bowen footbridge.

2.7.2 Cyclists

An illustration of cycleway infrastructure in and around Coffs Harbour is presented in Figure 6 and has been sourced from the CHCC *Bike Plan 2014-2019* (CHCC 2014). The plan, developed with Roads and Maritime, details the Coffs Harbour LGA cycling infrastructure and cycling programs for a five-year period. The objectives of the plan are:

- Plan and deliver a connected cycling network
- Improve cycling support facilities
- Make cycling safer
- Encourage greater participation.

Within the Coffs Harbour LGA, cyclists travel within the shoulder of the Pacific Highway with designated crossing points of entry and exit ramps at interchanges (ie Solitary Islands Way, Mastracolas Road and Pine Creek Way). On-street cycle lanes are provided on Stadium Drive linking to the shared path alongside the Pacific Highway. There is no other existing cycle-only infrastructure within the project (refer Section 2.7.1 for detail regarding shared paths).



Legend

- Design
- Existing Pacific Highway
- Regional roads
- Local roads
- North Coast Railway
- Existing footpath
- Coastline Cycleway
- Coffs Creek Trail
- Existing off-road shared user path
- Existing on-road cycle route
- Council proposed off-road shared user path
- Future plans (unfunded)
- Sapphire to Woolgoolga shared path

Coffs Harbour Bypass
Coffs Harbour Bike Plan 2014-2019
Figure 6

0 0.5 1 1.5 km

Scale @A4: 1:49,590
GDA 1994 MGA Zone 56

N

Separate to the above illustrated existing and proposed cycling infrastructure, there are a number of popular recreational cycle routes surrounding the project which are primarily provided on sealed roads or shared paths. As shown in Figure 7, Bruxner Park Road forms part of both the Bucca 'T' and Big Block scenic recreational cycle routes through banana farms, bushlands and farmlands. The Big Block route also loops south to Coramba Road.

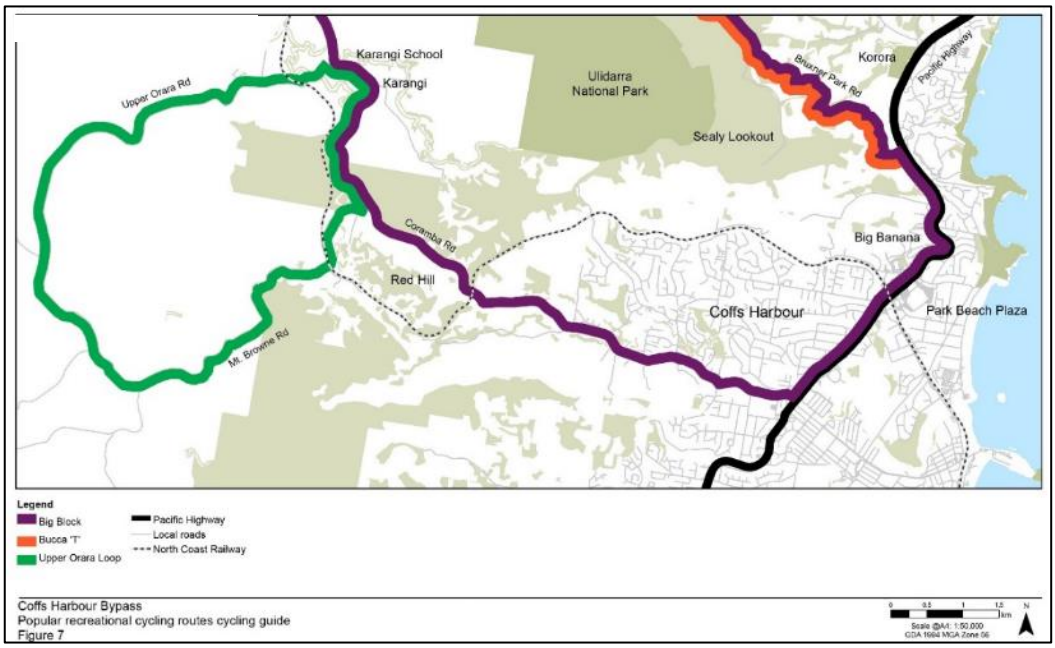


Figure 7 Popular recreational cycling routes cycling guide (Source: CHCC, Nambucca Valley Council & Bellingen Shire Council 2018).

2.8 Parking

On and off-street parking is available near the project where it connects to the existing road network. These areas are associated with Kororo Public School, adjacent the informal school bus stop at the intersection of Coramba Road and Spagnolos Road, Englands Road and the existing parking available at the OzGroup Packhouse at Isles Drive.

2.8.1 Kororo Public School

At the Kororo Public School, the following parking provisions are provided:

- A 14 bay formalised on-street car park (including two disabled parking spaces) on Korora School Road. Korora School Road (and subsequently the car park) at this location has one-way southbound operation
- Approximately 40m long drop-off area located immediately adjacent (west) of the school.

A parking demand and utilisation survey was carried out at and around the Kororo Public School to understand the existing on-street parking demand of the school.

Surrounding the school on Korora School Road, James Small Drive, Old Coast Road and the property access road, there is a total of 287 parking spaces (on-street) available for staff and students. This was split across four roads, as follows:

- Korora School Road – 82 parking space supply (includes formalised, short-term drop-off and on-street parking)
- James Small Drive – 80 parking space supply (includes short-term drop-off and on-street parking)
- Old Coast Road – 15 on-street parking space supply
- Property access road – 110 informal short-term parking space supply.

The parking occupancy results of the parking demand and utilisation survey (described in Section 3.1 and Appendix B) demonstrated:

- A steady increase in occupancy in all areas surveyed during the morning peak until 8:50am
- Full occupancy of the formalised car park on Korora School Road by 8:20am through to 8:50am
- Short intense parking peak during the afternoon between 2:50pm and 3:10pm
- Highest parking demand was observed during the afternoon peak of 158 vehicles.

3 Existing road performance

This chapter establishes the existing transport network performance of the road network. Results from traffic surveys and assessment of existing traffic performance are summarised in this chapter.

3.1 Traffic surveys

Extensive data collection was completed, which involved origin-destination (OD) surveys, travel time surveys, midblock counts, intersection turning movement counts, bus counts and parking demand and occupancy surveys. Three traffic survey data sets were collected in June 2016 (by Trans Traffic Survey), November 2016 (by Austraffic) and May 2017 (by Austraffic). This traffic data was the most up to date and comprehensive data-set available at the time of writing and is considered current for the purposes of the traffic and transport assessment.

The OD, mid-block and intersection turning movement count locations are shown on Figure 8. The results of these surveys are included in the network performance analysis in subsequent sections.

3.1.1 June 2016

Traffic surveys were carried out between 20 and 27 June 2016 at the locations shown in Figure 8. Travel time surveys were undertaken along four routes, mid-block counts at 60 locations and intersection turning movement counts at 69 locations. Table 4 lists survey type and locations. The survey data provided key inputs, particularly for the calibration and validation task, into the Coffs Harbour Strategic Transport Model (CHSTM) and Coffs Harbour Traffic Model (CHTM) developed for the project.

Table 4 June 2016 survey types and locations

Survey Type	Date / period	Locations
Travel time surveys	23 June 2016 4 routes	• Pacific Highway (north-south: between Old Coast Road and Lyons Road interchange) • Hogbin Drive (north-south: between Orlando Street / Pacific Highway intersections and Lyons Road interchange • Coramba Road (east-west: between Bennetts Road and Orlando Street / Harbour Drive intersection • Stadium Drive (west-east: between Pacific Highway / Stadium Drive roundabout and Hogbin Drive / Stadium Drive roundabout).
Mid-block surveys	20 – 27 June 2016 60 locations	Various locations as shown in Figure 8
Intersection turning movement counts	23 June 2016 6am to 6pm 69 locations	Various locations as shown in Figure 8

3.1.2 November 2016

To inform the design of the Pacific Highway upgrade near Kororo Public School, a number of surveys were carried out to understand the existing transport operations of the school. The surveys listed in Table 5 were carried out by Austraffic during the morning and afternoon school peak periods on Wednesday 30 November 2016 through to Friday 2 December 2016.

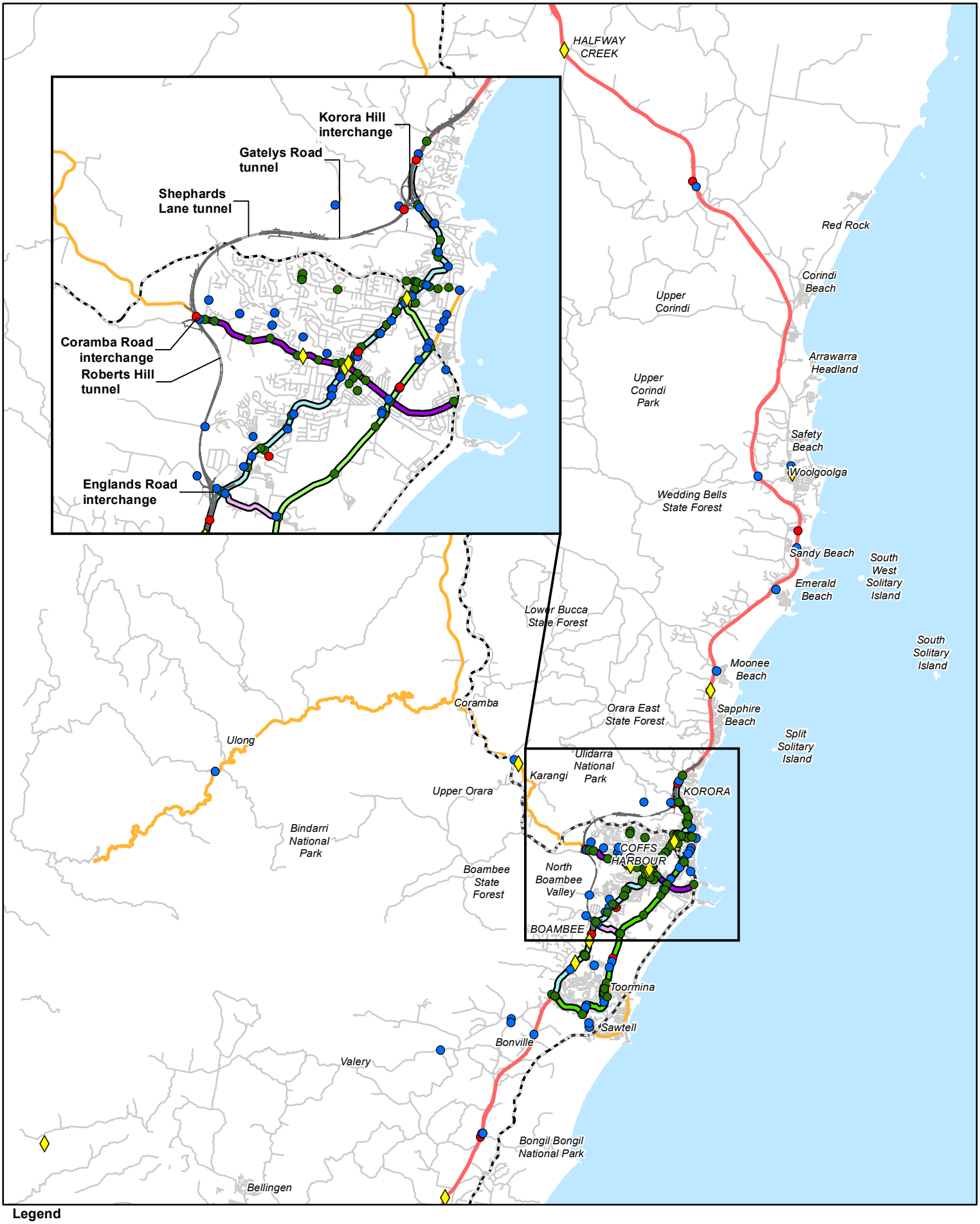
Table 5 November 2016 survey types and locations

Survey Type	Date / period	Locations
Intersection turning movement counts	30 November to 2 December 2016 7:30am to 9am 2:30pm to 4pm	• Pacific Highway / James Small Drive • Pacific Highway / Old Coast Road • Pacific Highway / Korora School Road • Korora School Road / James Small Drive • James Small Drive / Norman Hill Drive.
Bus counts	30 November to 2 December 2016 7:30am to 9am 2:30pm to 4pm	Pacific Highway adjacent to Kororo Public School • Northbound bus interchange • Southbound bus interchange
Parking demand and occupancy survey	30 November to 2 December 2016 7:30am to 9am 2:30pm to 4pm	• Korora School Road • James Small Drive (between Korora School Road and Russ Hammond Close) • Old Coast Road (between Pacific Highway and Pine Brush Creek) • Property access road (south of Old Coast Road)

3.1.3 May 2017

OD surveys were collected at 10 locations on Tuesday 16 May 2017 (24-hours) for further model refinement of the CHSTM. The surveys locations were:

- Pacific Highway (north of Old Pacific Highway / Pine Creek Way ramps)
- Hogbin Drive (500m north of Hi-Tech Drive)
- Pacific Highway (1,000m north of Lindsays Road)
- Coramba Road (70m west of Bennetts Road)
- Hogbin Drive (400m north of Harbour Drive)
- Pacific Highway (100m north of Coff Street)
- Bruxner Park Road (300m west of Pacific Highway)
- Pacific Highway (450m south of Old Coast Road)
- Pacific Highway (south of Hearnes Lake Road interchange)
- Pacific Highway (1,000m north of Range Road).



Legend

- Design
- Existing Pacific Highway
- Regional roads
- Local roads
- North Coast Railway

Counts

- Origin-destination survey site
- Midblock counts
- Turn counts
- Historical traffic count sites 2007-2011

Travel time routes

- T1 - Pacific Highway
- T2 - Hogbin Drive
- T3 - Coramba Road
- T4 - Stadium Drive

Coffs Harbour Bypass
Origin-destination survey and count locations
Figure 8

0 2.5 5 7.5 km

Scale @A4: 1:250,000
GDA 1994 MGA Zone 56

N

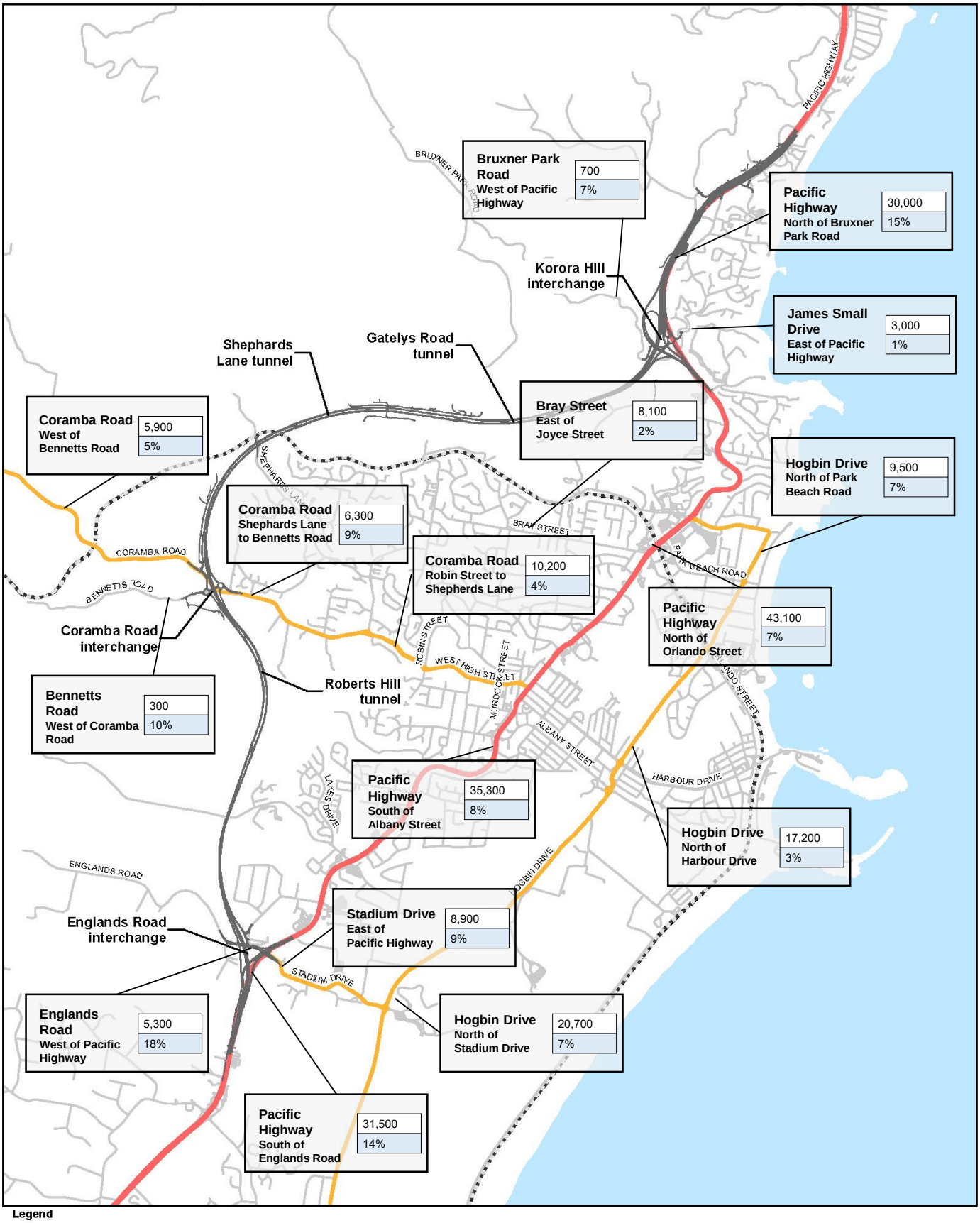
3.2 Traffic volumes

The existing (2016) average weekday traffic volumes (vpd) and classification of vehicles (ie proportion of heavy vehicles (HV)) sourced from the survey data are presented in Table 6 and Figure 9.

Table 6 Traffic volumes in Coffs Harbour (Source: 2016 traffic survey data)

Count location	2016 two-way daily average volume [vpd] (% HV)
Pacific Highway	
Pacific Highway (south of Englands Road)	31,500 (14%)
Pacific Highway (south of Albany Street)	35,300 (8%)*
Pacific Highway (north of Orlando Street)	43,100 (7%)*
Pacific Highway (north of Bruxner Park Road)	30,000 (15%)*
Local and regional road network	
Hogbin Drive (north of Park Beach Road)	9,500 (7%)*
Hogbin Drive (north of Harbour Drive)	17,200 (3%)
Hogbin Drive (north of Stadium Drive)	20,700 (7%)*
Stadium Drive (east of Pacific Highway)	8,900 (9%)
Englands Road (west of Pacific Highway)	5,300 (18%)
Bray Street (east of Joyce Street)	8,100 (2%)*
Coramba Road (from Robin Street to Shephards Lane)	10,200 (4%)*
Coramba Road (from Shephards Lane to Bennetts Road)	6,300 (9%)
Coramba Road (west of Bennetts Road)	5,900 (5%)*
Bennetts Road (west of Coramba Road)	300 (10%)
James Small Drive (east of Pacific Highway)	3,000 (1%)*
Bruxner Park Road (west of Pacific Highway)	700 (6%)

* These daily volumes are derived from 12-hour turning movement counts using conversion factors.



Coffs Harbour Bypass
2016 Surveyed traffic volumes
Figure 9

3.3 Origin-destination survey

An OD survey was conducted over a 24-hour period on Tuesday 16 May 2017 at 10 count stations within the Coffs Harbour LGA. Vehicle number plates were captured using video and an automated reading and matching process was used to produce the OD survey results.

The results of the survey were used to understand travel patterns, particularly 'through movements'. Through movements are vehicles which have travelled through Coffs Harbour along the Pacific Highway without stopping, and have been taken to be any vehicle which has taken the average travel time (plus up to 15 minutes) to travel between the south and north OD count locations that correspond to the project interchanges at Englands Road and Korora Hill.

Analysis of the OD survey data carried out by Austraffic (2017) found that:

- Two-way daily through traffic volumes between the Pacific Highway, (just south of Stadium Drive) and Pacific Highway (south of Bruxner Park Road), are approximately 4,410 vehicles
- Of traffic observed travelling to Coffs Harbour North and areas north of Coffs Harbour, around 6,700 trips originated from south of Englands Road
- Of traffic observed travelling to Coffs Harbour South and areas south of Coffs Harbour, around 6,300 originated from north of Korora
- Of traffic travelling on Hogbin Drive at Stadium Drive, 15 per cent travelled to/from the Pacific Highway north of Korora.

3.4 Network operations

3.4.1 Travel speeds

The Pacific Highway, between Kororo Hill and Englands Road is approximately 10 kilometres long. The speed limit of the Pacific Highway through this section is 60km/h. Through Coffs Harbour, the Pacific Highway provides direct access for residential, commercial and industrial properties, and passes through 12 sets of at-grade signalised intersections and multiple priority (stop or give-way controlled) intersections.

A summary of the travel time survey results and the resultant average speed of traffic along the Pacific Highway through Coffs Harbour during the morning, midday and afternoon peak hour periods is presented in Table 7.

Table 7 2016 Average speeds on Pacific Highway between Korora Hill and Englands Road (Source: 2016 traffic surveys)

Time		Northbound	Southbound
From	To	Average Speed	Average Speed
8am	9am	33.0 km/h	37.7 km/h
11am	12pm	26.9 km/h	33.1 km/h
4pm	5pm	33.5 km/h	33.7 km/h

As shown, during the morning peak period the average speed along the highway through Coffs Harbour is under 40km/h in both the northbound and southbound directions. During the midday peak period, the average speeds reduce even further, with northbound traffic slowing to under 27km/h. By the afternoon peak period, traffic in both directions has increased speed to approximately 34 km/h but remains slower than the morning peak period.

3.4.2 Travel times

A summary of the 2016 travel time on the Pacific Highway between Kororo Hill and Englands Road for the morning peak (8am to 9am), midday peak (11am to 12pm) and afternoon peak (4pm to 5pm), is presented in Table 8.

Table 8 2016 Travel times on Pacific Highway between Kororo Hill and Englands Road (Source: 2016 traffic surveys)

Time		Northbound		Southbound	
From	To	Max Time (min:sec)	Average Time (min:sec)	Max Time (min:sec)	Average Time (min:sec)
8am	9am	26:27	19:04	20:05	16:40
11am	12pm	32:55	23:23	22:42	19:00
4pm	5pm	24:32	18:48	26:54	18:38

As shown above, the average times to travel northbound through Coffs Harbour on the Pacific Highway currently (2016) varies between 18 to 24 minutes during the peak periods of the day. Southbound, the average time is slightly reduced to 16 to 19 minutes during the peak hours.

The maximum times recorded for travelling between Kororo Hill and Englands Road is 33 minutes northbound during the midday peak hour, and 27 minutes southbound during the afternoon peak hour period. This reflects the existing congested stop-start conditions for traffic on the Pacific Highway through the Coffs Harbour CBD.

3.5 Level of service

In order to quantify the current road network performance and locations of deficiency along the Pacific Highway, the existing traffic performance at key intersections was assessed for 2016 traffic conditions. The assessment involved the development and analysis of individual intersections using SIDRA intersection modelling software.

The performance of each intersection has been assessed by assigning a level of service (LOS) based on the average delay of vehicles at an intersection (refer Table 10). LOS has been reported in accordance with Roads and Maritime *Traffic Modelling Guidelines (2013)* where for signalised intersections, the average intersection delay is used for the LOS assessment. For roundabouts and priority-controlled intersections, the worst movement is used for the LOS assessment.

LOS can be correlated to a qualitative description of traffic conditions that includes speed, travel time, traffic interruptions, freedom to manoeuvre, safety,

driving comfort, convenience and operating costs. LOS ranges from A (very good) to F (unsatisfactory) as described in Table 9.

Table 9 Summary of Roads and Maritime LOS criteria

LOS	Average vehicle delay (sec)	Traffic signals and roundabouts
A	< 14	Free flowing traffic virtually unaffected by other road users
B	15 to 28	Steady flow of traffic allowing manoeuvrability
C	29 to 42	Stable flow of traffic restricting manoeuvrability
D	43 to 56	Limited stable flow and all drivers restricted in movement
E	57 to 70	Operating at capacity with unstable traffic flow
F	> 70	Traffic approaching the intersection exceeds ability for traffic to pass resulting in queueing

In general, the traffic capacity on the Pacific Highway is constrained, with analysis demonstrating the current LOS experienced by traffic within Coffs Harbour reaching LOS D, E and even F on some intersection approaches during peak periods. This indicates that the road has an unstable flow of traffic (ie where minor incidents can result in significant congestion and stop-and-go conditions) at a number of intersections.

Table 10 2016 Intersection performance of key Pacific Highway intersections

Intersection	Approach	AM	PM
Pacific Highway / Park Beach Road	South	A	A
	East	D	D
	North	B	B
	Overall	**B**	**B**
Pacific Highway / Orlando Street	South	C	D
	East	C	E
	North	C	D
	West	C	C
	Overall	**C**	**D**
Pacific Highway / Melittas Avenue	South	A	B
	East	C	D
	North	B	B
	West	C	D
	Overall	**B**	**B**
Pacific Highway / Beryl Street	South	B	A
	North	B	A
	West	C	E
	Overall	**B**	**A**
Pacific Highway / Coff Street	South	B	C
	East	E	E
	North	B	B
	West	E	D
	Overall	**C**	**C**
Pacific Highway / Harbour Drive	South	B	B
	East	D	D
	North	B	B
	West	D	D
	Overall	**B**	**B**
Pacific Highway / Moonee Street	South	C	C
	East	E	E
	North	B	B

Intersection	Approach	AM	PM
	West	D	D
	Overall	**C**	**C**
Pacific Highway / Albany Street	South	E	C
	East	E	D
	North	C	C
	West	E	D
	Overall	**D**	**C**
Pacific Highway / Halls Road	South	B	F
	North	A	A
	West	E	E
	Overall	**B**	**D**
Pacific Highway / Hurley Drive	South	A	A
	East	E	E
	North	A	B
	Overall	**A**	**A**
Pacific Highway / Cook Drive	South	C	C
	East	D	E
	North	C	C
	West	C	C
	Overall	**C**	**C**
Pacific Highway / Isles Drive	South	C	C
	East	E	E
	North	C	C
	West	E	E
	Overall	**C**	**D**
Pacific Highway / Stadium Drive	South	B	A
	East	B	D
	North	B	B
	West	B	B
	Overall	**B**	**D**

Deteriorating road performance is leading to road network congestion and resulting in long travel times (refer Table 8) and reducing reliability for freight and local, regional and national road users. Signalised intersections in Coffs Harbour lead to a high level of stop-starting for freight vehicles on the Pacific Highway resulting in increased noise levels, higher vehicle operating costs and higher fuel consumption. Vehicle operating costs are impacted due to the running costs for significant speed fluctuations from cruise speed and the additional fuel costs due to stopping such as queuing at traffic signals. Higher fuel consumption in congested conditions leads to higher greenhouse gas emissions; air pollution, increases in stop-start conditions and noise-related impacts.

4 Traffic modelling and forecasting

This chapter provides details of the traffic modelling and forecasting approach which has been adopted for the project operational performance assessment.

4.1 Traffic modelling approach

Traffic modelling for the project was carried out using a three-tiered approach with a regional strategic model being used to provide forecast traffic demands for the modelled area (detailed in the following sections). A more detailed project specific network model was completed to predict traffic distribution on the road network and performance of the road network with and without the project; and a detailed intersection capacity analysis was undertaken using microsimulation and intersection models. The development of the models is detailed in the *Coffs Harbour Bypass – Traffic Model Development Report* (2018) prepared by Arup. Model development was carried out with consideration to the Roads and Maritime Service *Traffic Modelling Guidelines (2013d)* and in direct consultation and with rigorous peer review with Roads and Maritime. The approach is illustrated in Figure 10 and the traffic modelling extents are shown in Figure 11.

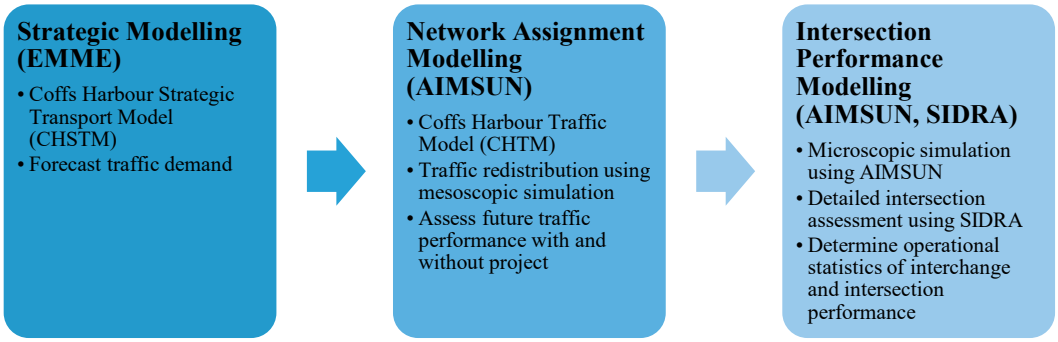
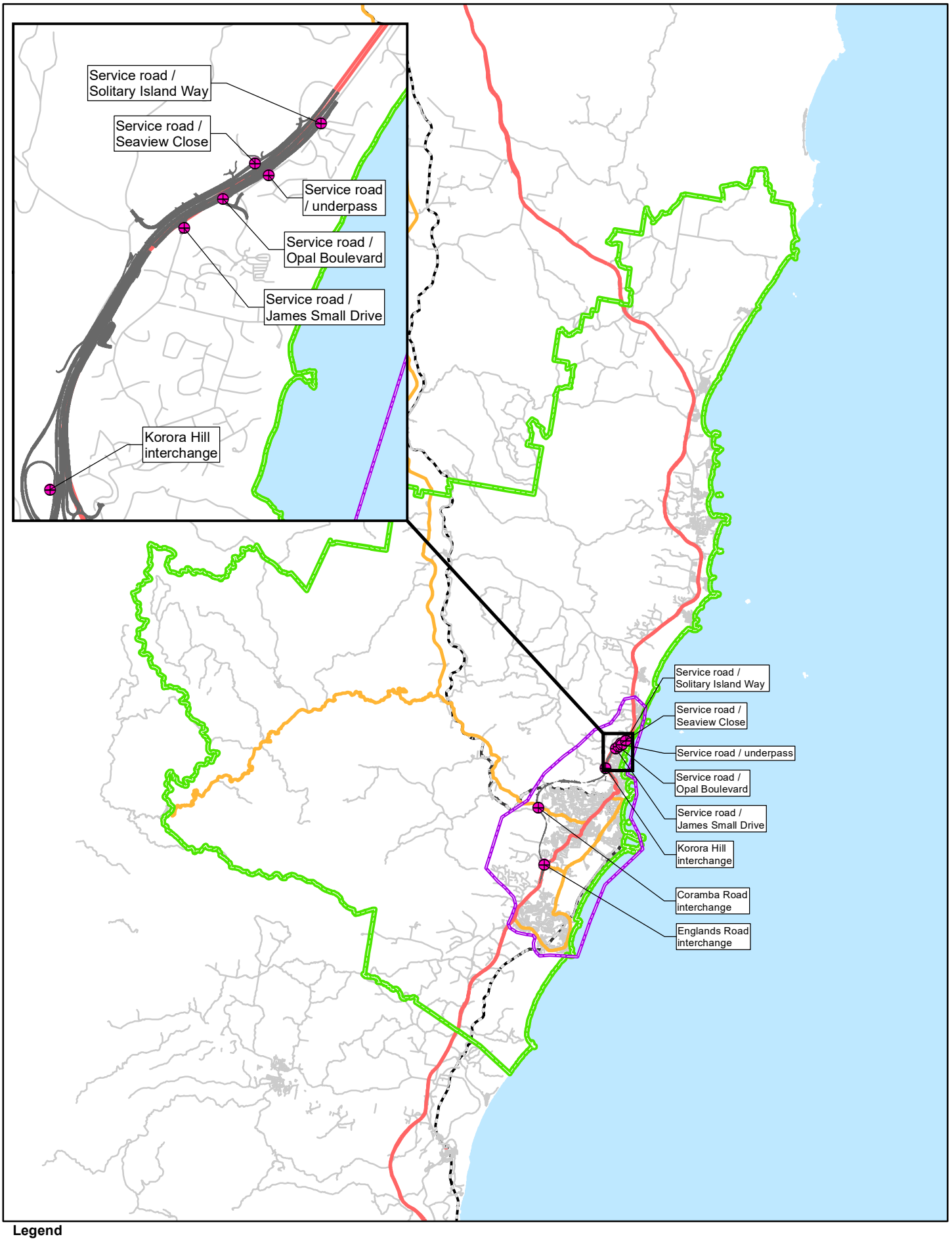


Figure 10 Modelling approach



Coffs Harbour Bypass
Traffic modelling extents
Figure 11

4.2 Coffs Harbour Strategic Transport Model

The Coffs Harbour Strategic Transport Model (CHSTM) was developed by Arup using EMME software. As shown in Figure 11, the CHSTM covers a similar area to the Coffs Harbour LGA, and includes 619 travel zones and all State-controlled highways, arterial distributor roads, local collector roads and key local roads. The process and methodology to develop the CHSTM is detailed in the *Coffs Harbour Bypass – Traffic Model Development Report* (Arup, 2018).

The modelling approach for the CHSTM follows a typical four-step strategic modelling process by which the number of trips is estimated and distributed among origin and destination zones based on land-use and demographics; then divided according to mode of travel and assigned to the road network. The CHSTM produces forecast traffic volumes for the morning peak, day time off-peak, afternoon peak and night time off-peak periods.

The CHSTM was used to produce forecast traffic demands based on land-use assumptions and predicted population and employment growth sourced from DP&E, the *North Coast Employment Land Review* (March, 2015) and *Coffs Harbour Land Use and Employment Strategies* (CHCC 2009c).

The CHSTM has been used to strategically assess the project options and forecast traffic demand for future years with and without the project (taking into account forecast traffic growth in the Coffs Harbour LGA), which supplied outputs to the detailed network assignment model.

The CHSTM has been calibrated and validated using the guideline criteria outlined in the Roads and Maritime's *Traffic Modelling Guidelines* for highway assignment models and the New Zealand Transport Authority's *Transport Model Development Guidelines*. The model has been validated against the survey data (including OD, travel time and counts) discussed in Section 3.1 of this report.

The calibration and validation process confirmed that:

- The CHSTM was well calibrated based on counts along screenlines
- The model reflects existing traffic patterns well in the key areas of interest
- The model validation achieved 95 per cent (15 out of 16) of the modelled travel time routes being within a travel time difference of +/- 15 per cent of the observed average, suggesting that the CHSTM provides a good reflection of observed travel times
- The model has a good representation of the 'through' traffic volumes observed in the 2017 OD survey between the north and south of Coffs Harbour (ie Pacific Highway just south of Englands Road and Pacific Highway north of Bruxner Park Road).

4.3 Coffs Harbour Traffic Model

The Coffs Harbour Traffic Model (CHTM) is a mesoscopic traffic model that has been developed to assess the operational performance of the project. As shown in Figure 11, the model is focussed on the area between Sapphire Beach and Sawtell and includes 544 internal travel zones. It provides detailed modelling of traffic conditions for the project and immediate road network and the modelled network includes all State-controlled highways, arterial roads, distributor roads, local collector roads and key local roads.

The CHTM has been developed using AIMSUN software which has informed the detailed assessment of the traffic network impacts of the project.

The purpose of the CHTM is to assign traffic demands to the road network to provide predictions of traffic volumes and delays on various links and turns. The model outputs have been used as inputs to the economic analysis comparing the future year project case (ie assuming that the bypass is operating) against a base case (ie assuming that the bypass has not been built).

An integral element of the traffic assessment relates to the development of a base model representing existing (2016) conditions in the peak morning (8 to 9am) and afternoon (4 to 5pm) periods. The model was calibrated and validated to the 2016 traffic data discussed in Section 3.1. The development of this base model is detailed in the *Coffs Harbour Bypass – Traffic Model Development Report* (2018) prepared by Arup.

The base traffic model was then used to develop future year scenarios for the assessment of the project options. The scenarios assessed using the CHTM were:

- 2024 (year of project opening) with and without project
- 2034 (10-year design horizon) with and without project
- 2044 (20-year design horizon) with and without project

The predicted traffic volumes, delays and network performance results from the CHTM presented in the EIS reflect the project design as described in the EIS. The results differ somewhat from those presented in the *Coffs Harbour Bypass – Traffic Model Development Report* (2018), which reflected the project concept design.

4.4 Detailed intersection analysis

Detailed intersection and interchange performance was assessed using both microscopic (AIMSUN) and detailed intersection (SIDRA Intersection) modelling tools. These models were developed to review the local traffic operational assessment to inform the design of interchanges and assess closely spaced intersections along the existing highway within the construction footprint.

SIDRA Intersection allows modelling of individual intersections to determine the intersection LOS and capacity, using the traffic demands sourced from the CHTM.

The intersection models were produced to determine the future intersection LOS at key interchanges and intersections with and without the project. Similar to the CHTM, the future years assessed were 2024 (project year of opening), 2034 (project 10-year design horizon) and 2044 (project 20-year design horizon) for the peak morning and afternoon hours (ie 8:00am to 9:00am, and 4:00pm to 5:00pm).

4.5 Forecast development

Future traffic volumes for this assessment were forecast taking into account population and employment forecasts sourced from CHCC, DP&E, the *North Coast Employment Land Review* (March 2015) and *Coffs Harbour Land Use and Employment Strategies*.

Forecasting of the future traffic volumes on the road network also considered a number of development related planning documents, proposals and transport assessment reports. The developments included in the forecast demands included:

- Korora Rural Residential Release Area (*Developer Contributions Plan*, dated 2017) – rural residential expansion on the western side of the existing Pacific Highway (between West Korora Road to The Mountain Way) to ultimately cater for a population of 1,500 people. Key access into the area will be provided by Old Coast Road and Bruxner Park Road
- Big Banana Development (*Big Banana Development Coffs Harbour – Access Options Assessment Paramics Modelling,* dated June 2011) – mixed development including residential apartments, retail and tourist attractions. It was assumed that the development would generate a total of 925 vehicles during the morning peak hour in 2025
- North Boambee Valley East / Lakes Estate (*North Boambee Valley East Development Control Plan*, dated July 2009) – residential subdivision development of approximately 282 lots located off North Boambee Road. Construction of this development has since commenced
- North Boambee Valley West (*Coffs Harbour City Council Planning Proposal – North Boambee Valley West Residential Investigation Area,* dated October 2013) - will provide residential housing for approximately 2,132 people and will be accessed via North Boambee Road west of the project. No proposed development time frame was indicated in the document sourced at the time of preparing the model
- Pacific Bay Western Lands and North Coffs Urban Release Area[1] (*Pacific Bay Western Lands Project Application – Environmental Assessment Report,* dated March 2010) – a total of 34 hectares of land located south along West Korora Road (including 7.7 hectare Big Banana site). Information provided by CHCC at the time indicated approximately 340 single detached dwellings. The development time-frame was unknown but was assumed to occur between 2020 to 2030.

[1] The Development Application for the Pacific Bay Western Lands has lapsed since the model forecasts were developed. However, it is understood that the proponent remains in consultation with CHCC.

The resultant forecasts of households, population and employment for the area modelled in the CHSTM are shown in Table 11.

Table 11 Forecast number of households, population and employment

	Forecasts				Average Growth Rate		
	2016	2024	2034	2044	2016 - 2024	2024 - 2034	2034 - 2044
Households	27,043	29,999	33,377	36,688	1.3%	1.1%	1.0%
Population	73,001	79,914	87,708	95,320	1.1%	0.9%	0.8%
Jobs	27,803	28,972	31,150	31,406	0.5%	0.7%	0.1%

The forecasts show that population in Coffs Harbour is predicted to increase by around 22,000 people, or 30 per cent between 2016 and 2044. Employment is predicted to increase by a lower rate with the number of jobs increasing by 3,600 or 13 per cent between 2016 and 2044.

4.6 Traffic forecasts

The forecast daily traffic volumes on the existing Pacific Highway and several locations on key local roads are shown in Table 12 for the base case (ie without project) at 2024, 2034 and 2044.

The forecast daily traffic volumes are derived by factoring the peak hour traffic forecasts from the CHTM to a daily volume. The factors are calculated for each individual link using results from the CHSTM, which produces traffic volume forecasts at both a peak and daily level. The CHTM peak hour volumes are used as the basis for the daily volume forecasts due to its higher degree of network assignment accuracy.

Table 12 Forecast daily volumes (two-way) without the project

Location	Two-way daily average volume [vpd]				Annual growth rate (%) 2016 - 2044
	2016	2024	2034	2044	
Existing Pacific Highway					
South of Englands Road	31,200	34,700	37,400	40,400	0.9%
South of Albany St (south of CBD)	28,400	31,700	33,300	33,500	0.6%
North of Orlando St (north of CBD)	40,300	43,900	47,300	49,900	0.8%
South of Bruxner Park Rd	34,800	38,000	42,600	45,900	1.0%
Local and Regional Road Network					
Hogbin Drive (north of Park Beach Road)	9,500	9,300	11,300	10,000	0.2%
Hogbin Drive (north of Harbour Drive)	17,500	18,300	19,500	19,200	0.3%
Hogbin Dive (north of Stadium Drive)	27,500	29,900	32,700	33,100	0.7%
Stadium Drive (east of Pacific Highway)	10,000	11,700	12,800	15,000	1.5%
Englands Road (west of Pacific Highway)	3,800	8,700	11,600	12,500	4.3%

Location	Two-way daily average volume [vpd]				Annual growth rate (%) 2016 - 2044
	2016	2024	2034	2044	
Bray Street (east of Joyce Street)	9,600	9,800	10,500	11,300	0.6%
Coramba Road (Robin Street to Shephards Lane)	10,800	11,300	12,000	12,700	0.6%
Coramba Road (Shephards Lane to Bypass)	7,700	8,300	8,600	9,000	0.6%
Coramba Road (west of Bypass)	6,200	6,700	7,000	7,100	0.5%
Bennetts Road (west of Coramba Road)	500	400	500	500	0.0%
James Small Drive (east of the Pacific Highway)	3,500	4,000	4,200	5,100	1.4%
Bruxner Park Road (west of Pacific Highway)	500	1,200	1,600	1,800	4.7%
Average Growth Rate					**0.8%**

The forecast traffic volumes demonstrate that:

- Combined daily traffic for the existing Pacific Highway and Local and Regional Road Network without the project is forecast to increase by approximately 27 per cent to 2044 from 2016 volumes. This is slightly less than the forecast population increase of 30 per cent discussed earlier
- Respective daily traffic on the existing Pacific Highway and the Local and Regional Road Network are forecast to increase at similar rates
- The largest growth period for the combined existing Pacific Highway and the Local and Regional Road Network is forecast to be between 2016 and 2024 (26,200 vpd increase), followed by 2024 to 2034 (24,900 vpd increase). The forecast increase between 2034 and 2044 is 14,100 vpd
- Daily traffic on the Pacific Highway south of Englands Road is expected to increase by approximately 29 per cent over the same time, which is slightly higher than average growth rate
- Traffic on the Pacific Highway just north of the CBD is expected to grow at a similar rate to the overall average growth rate to 2044.
- Traffic on the Pacific Highway south of Bruxner Park Road is expected to grow at a slightly higher rate than the average growth rate, of approximately 1.0 per cent per annum, or approximately 32 per cent between 2016 and 2044
- The roads with the higher forecast traffic growth are Englands Road and Bruxner Park Road; which are forecast to grow at 4.3 per cent and 4.7 per cent per annum respectively. This reflects expected future development that would be accessed using these roads.

5 Assessment of operational impacts

This section provides an assessment of the resulting traffic, transport and road safety impacts which are anticipated to occur from the operation of the project.

5.1 Operational impacts

The beneficial operational impacts to the Pacific Highway and the surrounding road network as a result of the project are extensive. Without the project, traffic increases of the magnitude forecast over the 28-year period (2016 to 2044), as shown in Table 12, would place significant demands on the existing Pacific Highway through Coffs Harbour. Additionally, without the project LOS would drop to F at a number of intersections and road conditions would continue to deteriorate with high congestion and stop-start conditions through Coffs Harbour CBD.

The deteriorating traffic conditions predicted for the Pacific Highway without the project is anticipated to result in increased noise levels, higher vehicle operating costs and higher fuel consumption for freight vehicles. Heavy vehicle operating costs are impacted due to the running costs for significant speed fluctuations from cruise speed and the additional fuel costs due to stopping such as queuing at traffic signals. Higher fuel consumption in congested conditions leads to higher greenhouse gas emissions; air pollution, increases in stop-start conditions and noise-related impacts.

The construction of the project will alleviate the current and future pressures on the road network through Coffs Harbour and as a result, assist in improving the issues relating to noise, pollution and heavy vehicle operating costs.

5.2 Network changes

The following permanent road / access closures will be provided as part of the project:

- Korora School Road would no longer exist as part of the project. Car parking and pick-up / drop-off for the Kororo School would be accessed via James Small Drive and the service road
- Access to the Pacific Highway from Old Coast Road will be permanently closed as part of the project
- Access to Coramba Road from Spagnolos Road will be permanently closed as part of the project
- There would be no access to Isles Drive from Englands Road. Traffic bound for Isles Drive would instead gain access via the existing intersection of Isles Drive and the Pacific Highway or directly from the southbound exit ramp (this would only be for southbound traffic on the bypass). The design allows over-dimensional vehicles to exit the re-aligned Isles Drive and to access the Pacific Highway through the interchange as per the current permit for the existing casting yard on Industrial Drive. Minor modifications to the left turn

from the Pacific Highway to Isles Drive may be needed to permit B-doubles to access Isles Drive. This will be investigated during detailed design in consultation with CHCC.

New network changes constructed as part of the project include:

- Construction of a one-way northbound property access road from a new exit from the existing Pacific Highway, just north of the Sawtell Road interchange northbound entry ramp, to the Englands Road interchange. The proposed road will provide access from existing properties to Englands Road. Traffic from the access road would be able to travel in any direction via the Englands Road interchange
- Construction of the service road from Solitary Islands Way to Korora Hill interchange. James Small Drive (north), Opal Boulevard, Seaview Close and Solitary Islands Way will no longer intersect directly with the Pacific Highway, and instead will be accessed via new intersections along the service road.

The Kororo Public School staff car park and the adjacent Kororo Public School bus interchange will all be provided via a new facility accessed via James Small Drive. Additional on-street parallel car parking for set-down and pick-up will also be provided along the service road adjacent to the school (refer Figure 12).

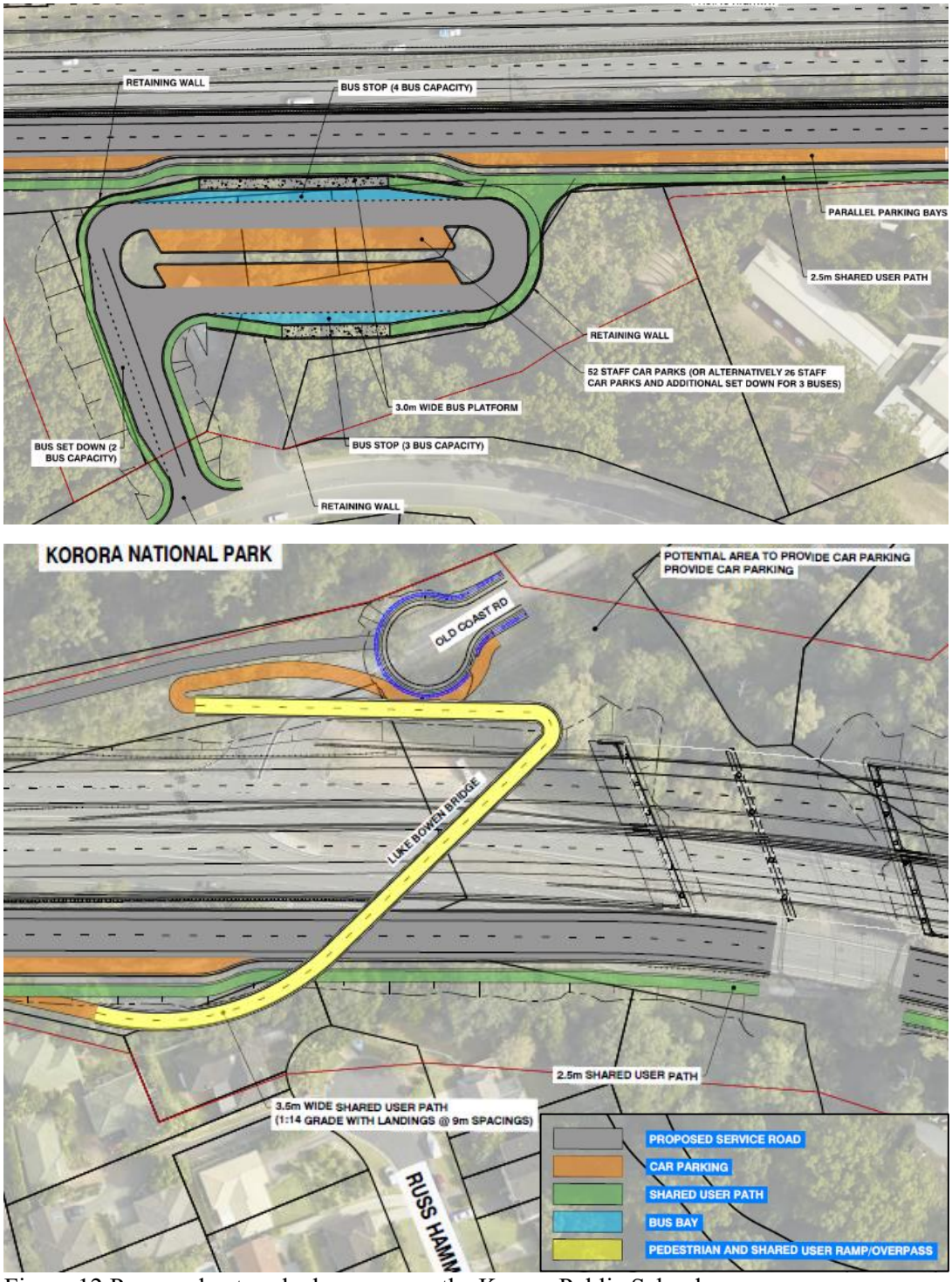


Figure 12 Proposed network changes near the Kororo Public School

5.3 Traffic volumes on the project

Forecast traffic volumes for the project for the 2024, 2034 and 2044 design years are summarised in Table 13. These volumes reflect the redistribution of traffic demand to the project during its operational phase.

Table 13 Forecast daily weekday volumes (two-way) for the project (source: CHTM)

Location	Two-way daily average volume [vpd (% HV)]		
	2024	2034	2044
Project, south of Coramba Road	23,400 (14%)	26,400 (14%)	27,900 (14%)
Project, north of Coramba Road	19,300 (15%)	22,300 (15%)	24,000 (16%)

The forecast data shows:

- The section of the project south of Coramba Road is expected to carry more vehicles than the northern section
- The proportion of heavy vehicles is expected to remain relatively static between 2024 and 2044 for both sections, with a slight increase on the northern section
- Overall traffic volumes on the project are anticipated to increase at a rate of approximately 1.0 per cent per annum from 2024 to 2044.

5.4 Traffic impacts on the existing road network

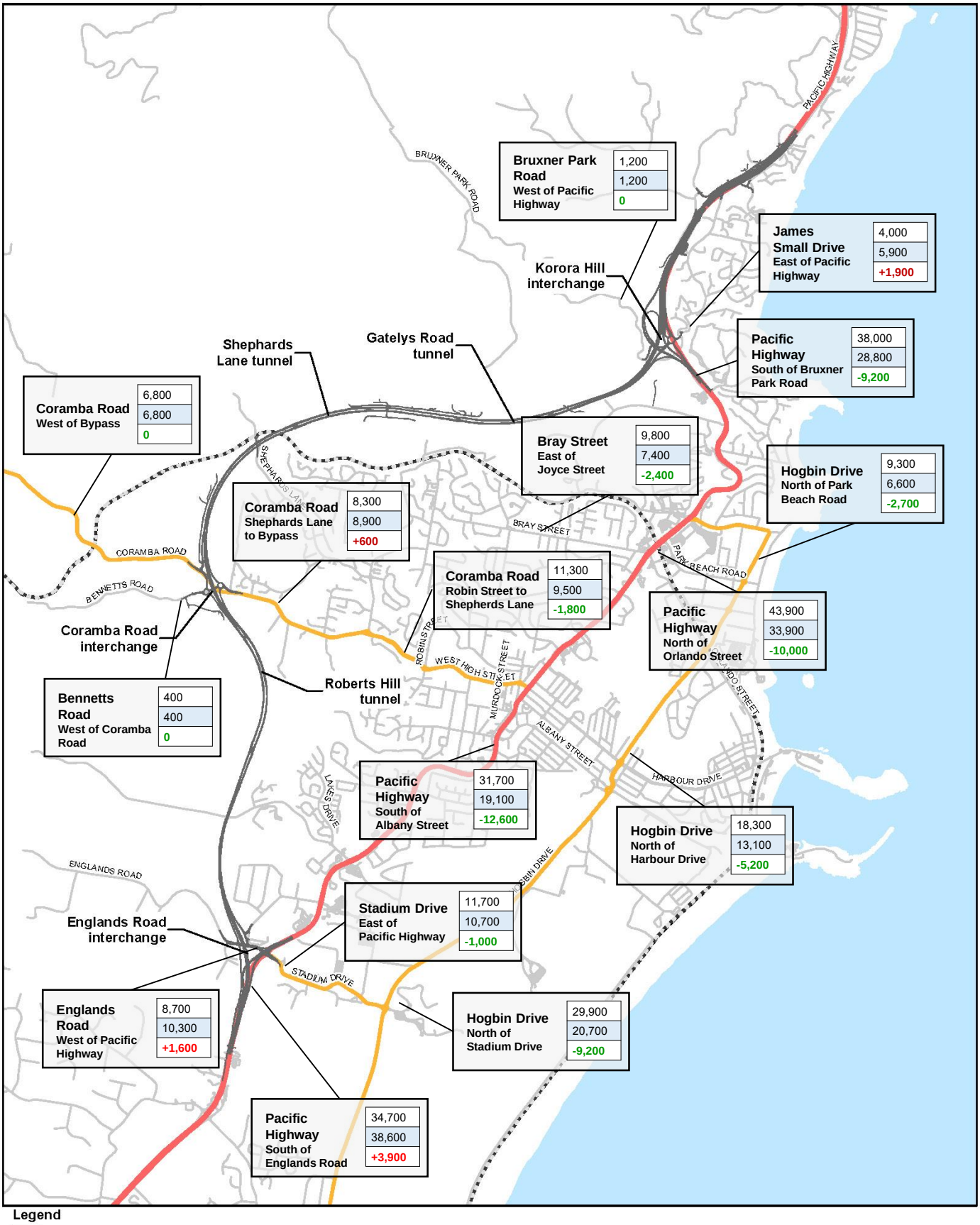
A comparison of traffic volumes with and without the project and changes to traffic patterns on existing roads has been carried out for future traffic conditions and is presented in Table 14Table 14.

Once constructed, the project would redistribute traffic to the Coffs Harbour Bypass from the north-south movements on the Pacific Highway and Hogbin Drive. Additionally, east-west movements on key local roads, including Coramba Road and Bray Street may be redistributed to the Coffs Harbour Bypass as a result of better traffic conditions along the new route.

The key findings shown in Table 14 and Figure 13 for opening year (2024) conditions include:

- The project is expected to increase traffic volumes on the Pacific Highway south of Englands Road by 3,900 vpd, which is an 11 per cent increase, as a result of some trips diverting from Hogbin Drive to the Pacific Highway corridor
- The project is expected to substantially decrease traffic volumes on the Pacific Highway south of Albany Street (just south of the CBD) by 12,600 vpd, which is a 40 per cent decrease
- The project is expected to substantially decrease traffic volumes on the Pacific Highway north of Orlando Street (just north of the CBD) by 10,000 vpd, which is a 23 per cent decrease
- The project is expected to substantially reduce traffic volumes on the Pacific Highway south of Bruxner Park Road by 9,200 vpd, which is a 24 per cent decrease

- The project is expected to decrease traffic volumes by up to approximately 9,200 vpd on Hogbin Drive north of Stadium Drive, which is a 31 per cent decrease
- The project is expected to decrease traffic on Stadium Drive by 1,000 vpd, which is a 9 per cent decrease
- The project is expected to increase traffic volumes on Englands Road between the bypass and the existing Pacific Highway by 1,600 vpd, which is an 18 per cent increase and is due to traffic using this short section of Englands Road to access the bypass
- The project is expected to reduce traffic on Coramba Road, between Robin Street and Shephards Lane, by 1,800 vpd, which is a 16 per cent decrease
- West of the bypass, traffic volumes on Coramba Road are not substantially affected by the project
- The project is expected to increase traffic at the southern end of James Small Drive by around 1900 vpd, which is a 48 per cent increase and is because of traffic from the north using the Korora Hill interchange to access James Small Drive from the southern end instead of using the northern end of James Small Drive. There is expected to be a corresponding decrease in traffic volumes at the northern end of James Small Drive.



Legend

- Design
- Existing Pacific Highway
- Regional roads
- Local roads
- North Coast Railway

Count Location	Without Project	With Project	Difference (+/-)

Coffs Harbour Bypass
Forecast daily volumes (average two-way)
Figure 13

0 0.5 1 1.5 km
Scale @A4: 1:50,000
GDA 1994 MGA Zone 56
N

Table 14 Forecast daily volumes (two-way)

Location	2024 daily volumes			2034 daily volumes			2044 daily volumes		
	Without Project	With Project	Change	Without Project	With Project	Change	Without Project	With Project	Change
Project									
South of Coramba Road	-	23,400	23,400	-	26,400	26,400	-	27,900	27,900
North of Coramba Road	-	19,300	19,300	-	22,300	22,300	-	24,000	24,000
Existing Pacific Highway									
South of Englands Road	34,700	38,600	3,900	37,400	43,100	5,700	40,400	45,800	5,400
South of Albany St (south of CBD)	31,700	19,100	-12,600	33,300	20,400	-12,900	33,500	20,600	-12,900
North of Orlando St (north of CBD)	43,900	33,900	-10,000	47,300	35,900	-11,400	49,900	38,000	-11,900
South of Bruxner Park Road	38,000	28,800	-9,200	42,600	31,500	-11,100	45,900	34,500	-11,400
Local and regional road network									
Hogbin Drive (north of Park Beach Road)	9,300	6,600	-2,700	11,300	7,800	-3,500	10,000	8,100	-1,900
Hogbin Drive (north of Harbour Drive)	18,300	13,100	-5,200	19,500	13,900	-5,600	19,200	14,300	-4,900
Hogbin Dive (north of Stadium Drive)	29,900	20,700	-9,200	32,700	20,900	-11,800	33,100	22,500	-10,600
Stadium Drive (east of Pacific Highway)	11,700	10,700	-1,000	12,800	11,900	-900	15,000	12,700	-2,300
Englands Road (west of Pacific Highway)	8,700	10,300	1,600	11,600	13,000	1,400	12,500	14,300	1,800
Bray Street (east of Joyce Street)	9,800	7,400	-2,400	10,500	7,300	-3,200	11,300	7,500	-3,800
Coramba Road (Robin Street to Shephards Lane)	11,300	9,500	-1,800	12,000	10,000	-2,000	12,700	10,700	-2,000
Coramba Road (Shephards Lane to Bypass)	8,300	8,900	600	8,600	9,600	1,000	9,000	10,500	1,500
Coramba Road (west of Bypass)	6,800	6,800	0	7,000	7,000	0	7,100	7,100	0
Bennetts Road (west of Coramba Road)	400	400	0	500	500	0	500	500	0

Location	2024 daily volumes			2034 daily volumes			2044 daily volumes		
	Without Project	With Project	Change	Without Project	With Project	Change	Without Project	With Project	Change
James Small Drive (east of Pacific Highway)	4,000	5,900	1,900	4,200	6,200	2,000	5,100	7,500	2,400
Bruxner Park Road (west of Pacific Highway)	1,200	1,200	0	1,600	1,600	0	1,800	1,800	0

5.5 Network performance

5.5.1 Network statistics

The CHTM was used to assess the impact of the project on the overall performance of the road network. Road network performance was measured with reference to:

- Total travel time: measure of the total travel time of all vehicles on the network during the modelled peak periods
- Total distance travelled: measure of the total distance travelled by all vehicles in the network during the modelled peak periods
- Average speed: recorded for all traffic in the network over the modelled peak periods.

The base and project scenarios were assessed for three design years; the project opening year (2024) and 10 and 20-year design horizons (2034 and 2044 respectively).

The total travel time predicted for each design year during the morning and afternoon peak hours is presented in Table 15 and Figure 14**.** The total travel time savings per day are calculated by taking the difference between the base and project case and converting the AM and PM peak hour total to a daily equivalent using expansion factors determined using strategic model (CHTM) outputs.

Table 15 Predicted network wide change in total travel time

Scenario	Total travel time (hours)					
	2024		2034		2044	
	AM	PM	AM	PM	AM	PM
Base case (without project)	3,427	3,116	4,008	3,659	4,607	4,152
Project case (with project)	2,995	2,794	3,240	3,141	3,554	3,336
Difference	-432	-322	-768	-518	-1053	-816
Travel time savings (hours per day)	**-4,142**		**-7,059**		**-10,262**	

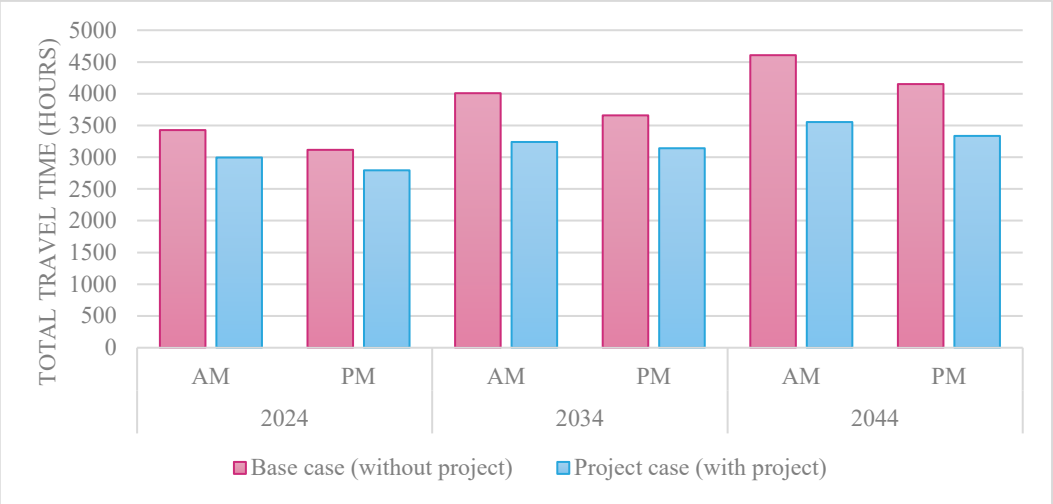


Figure 14 Total network travel time comparison

The total distance travelled predicted for each design year during the morning and afternoon peak hours is presented in Table 16 and Figure 15. As above, the total change in distance travelled has been calculated by converting AM and PM peak hour totals to a daily equivalent by using expansion factors.

Table 16 Predicted network wide change in total distance travelled

Scenario	Total distance travelled (km)					
	2024		2034		2044	
	AM	PM	AM	PM	AM	PM
Base case (without project)	141,665	136,461	152,709	151,250	160,679	159,041
Project case (with project)	150,333	142,804	163,758	159,831	176,030	169,310
Difference	8,667	6,343	11,049	8,581	15,351	10,269
Change in distance travelled (km per day)	**76,253**		**99,722**		**130,150**	

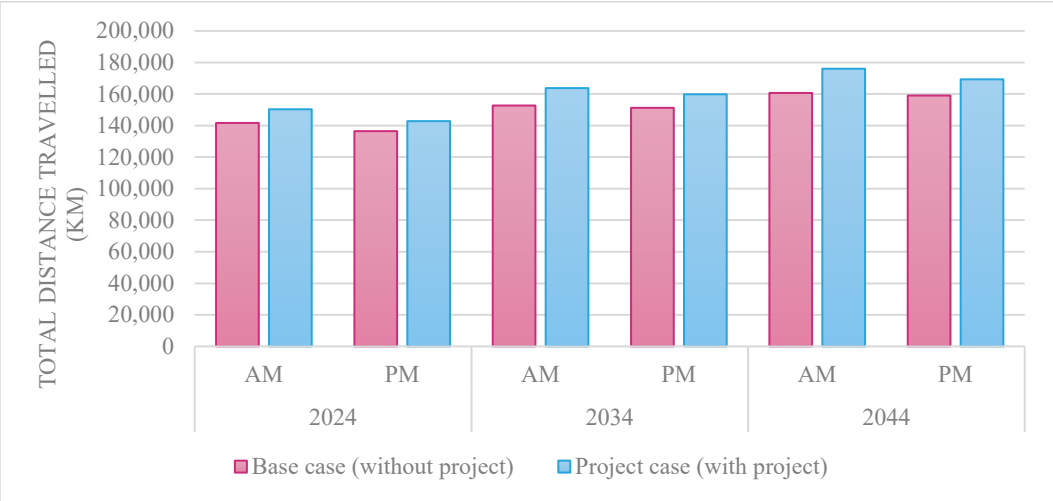


Figure 15 Total network distance travelled comparison

Table 17 presents the network statistics for average speed per vehicle type for the 2024, 2034 and 2044 design years during the morning and afternoon peak periods.

Table 17 Predicted network wide change in average speed

Scenario	Average speed (km/h)					
	2024		2034		2044	
	AM	PM	AM	PM	AM	PM
Base case (without project) - all vehicles	41	42	40	41	38	39
Base case (without project) - heavy vehicles	46	48	43	46	43	45
Project case (with project) - all vehicles	46	47	46	46	45	46
Project case (with project) - heavy vehicles	59	69	57	71	61	71
Difference - all vehicles	**5**	**5**	**6**	**6**	**7**	**7**
Difference – heavy vehicles	**13**	**21**	**14**	**25**	**18**	**26**

The network-wide performance statistics indicate that the project would have the following impacts:

- Reduced overall travel times in the project scenario, with estimated network wide travel time savings of approximately 12 per cent in 2024 and 21 per cent in 2044
- An increase in the total distance travelled due to the shift of traffic demand to the project. This is due to the bypass route being longer than the existing route. However, although the project route is longer, it is a more attractive as it is a faster alternative to the existing route, with free-flow conditions
- An increase in network-wide average travel speeds by 18 per cent at 2044 for all vehicles. This is expected due to the 110 km/h posted speed on the bypass, and the reduction of traffic congestion along routes through Coffs Harbour
- Heavy vehicles gain a larger overall increase in average speed as these vehicles mainly use the highway network and therefore gain a larger overall benefit per vehicle once shifted to the free-flow bypass. This is reflected in the results by the considerable increase in network-wide average travel speeds of 42 per cent to 58 per cent at 2044 for heavy vehicles.

5.5.2 Through traffic on Pacific Highway

The Pacific Highway serves as an important transport route, connecting regional towns and centres across NSW and Queensland. The project will provide an alternative route for traffic passing through Coffs Harbour. As detailed in Section 5.5.1, the project route is faster than the existing Pacific Highway as it avoids existing signalised intersections and the grade-separated interchanges creating uninterrupted flow for motorists on the highway. Table 18 presents the travel time savings for traffic going through Coffs Harbour calculated from the CHTM.

Table 18 Predicted travel time for vehicles passing through Coffs Harbour

Scenario	Direction	Travel times (minutes)					
		2024		2034		2044	
		AM	PM	AM	PM	AM	PM
Base case (without project)	Southbound	21.0	19.3	20.7	20.7	29.2	21.8
	Northbound	19.6	19.6	20.5	21.4	20.4	23.7
Project case (with project)	Southbound	8.5	8.6	8.6	8.6	8.6	8.6
	Northbound	8.3	8.4	8.4	8.5	8.5	8.5
Travel time savings	**Southbound**	**12.4**	**10.7**	**12.2**	**12.1**	**20.6**	**13.2**
	Northbound	**11.3**	**11.2**	**12.1**	**12.8**	**12.0**	**15.2**

The base case predictions show that average travel times along the existing Pacific Highway can be expected to increase from around 21 minutes in 2024 to 29 minutes by 2044 during the morning peak. However, as shown, the travel time savings for road users travelling through Coffs Harbour would be significant with the introduction of the project. By 2044, travel time savings of up to 20 minutes when travelling southbound along the Pacific Highway during the morning peak period are expected compared to the base case. This travel time saving reflects the higher posted speed and free-flow conditions of the project.

The results also demonstrate little change in travel times between the opening year (2024) and the 20-year design horizon (2044). This indicates the project will operate with free-flow conditions (ie without congestion) over the entire design duration.

5.6 Intersection performance

An assessment of the project's intersection operational performance was completed taking in account predicted traffic redistribution due to the project. The arrangement of each of the project interchanges were modelled as described in Table 19.

Table 19 Proposed interchange arrangements

Interchange	Proposed layout
Englands Road Interchange	Englands Road interchange will be grade-separated, incorporating two new signalised intersections at Englands Road / Bypass ramp / property access road; and Englands Road / Bypass ramp and a give-way controlled intersection at Isles Drive / Bypass ramp. The existing Pacific Highway / Stadium Drive/ Englands Road roundabout will be upgraded to a signalised intersection. The existing connection of Isles Drive to Englands Road will be replaced with a connection to the new southbound Bypass ramp, which will close access to Isles Drive from Englands Road. This will result in traffic redistributing to the Pacific Highway / Isles Drive intersection to access the Isles Industrial Park.
Coramba Road Interchange	Coramba Road interchange will be grade-separated with two roundabouts (Coramba West and Coramba East) and a give-way controlled intersection (Coramba NW) controlling bypass entry and exit traffic.
Korora Hill Interchange	Korora Hill interchange will replace the intersection at Bruxner Park Road / Pacific Highway / James Small Drive. The proposed layout contains two signalised intersections (Korora Hills West and Korora Hills East) along the new Pacific Highway alignment, and a roundabout (James Small Drive) connecting the service road to the Pacific Highway.

The project will remove all existing at-grade intersections along the Pacific Highway between the Korora Hill and Sapphire interchanges. The roads that currently connect directly to the Pacific Highway will instead be connected onto a service road that runs parallel to the highway. This will create five new intersections at: Solitary Island Way, Fernleigh Avenue, Seaview Close, Opal Boulevard and James Small Drive. The arrangements at these intersections are described in Table 20.

Table 20 Proposed intersection arrangements

Intersection	Proposed layout
Service road / Solitary Island Way	Solitary Island Way is to be connected to the service road instead of the Pacific Highway. Existing layout and give-way control is retained with modifications to the southern leg which now connects to the service road.
Service road / Underpass	Underpass connecting the service road to the Seaview Close is to be provided. Proposed layout is a T-intersection give-way control intersection with the service road as the major road.
Service road / Seaview Close	Seaview Close is to be connected to the service road instead of the Pacific Highway. Proposed layout is a T-intersection with give-way control.
Service road / Opal Boulevard	Opal Boulevard is to be connected to the service road instead of the Pacific Highway. Proposed layout is a T-intersection with give-way control.
Service road / James Small Drive	James Small Drive is to be connected to the service road instead of the Pacific Highway. Proposed layout is roundabout control.
James Small Drive Roundabout	New roundabout connecting James Small Drive and service road to the Korora Hill interchange

Traffic performance was assessed for the AM and PM peak hour periods using 100th highest hour design volumes (sourced by factoring the average weekday

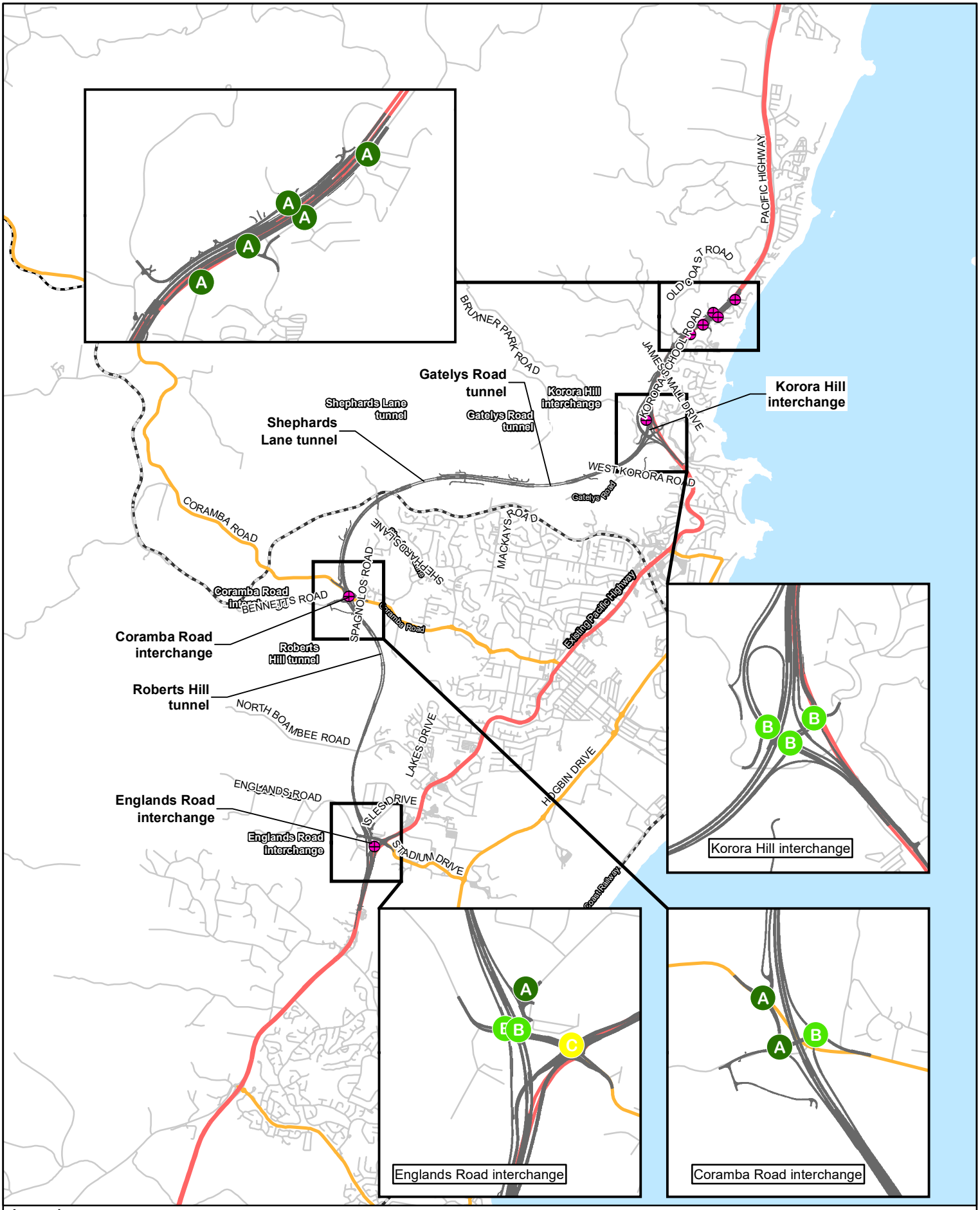
AM and PM peak hour volumes from the CHTM), and measured using LOS based on delay (refer Table 9).

Interchanges and intersections were designed to provide a minimum LOS C in accordance with the Pacific Highway Upgrade Guidelines. For signalised intersections, the LOS averaged over all movements is defined as the critical LOS for the assessment. For roundabouts and priority-controlled intersections, the worst turning movement at the intersection is defined as the critical LOS for the assessment. The interchange performance is considered satisfactory if all intersections within the interchange meet the LOS criteria in 2044 (20 years after opening) using 100th highest hourly volume.

A summary of the 2044 traffic analysis results is shown in Table 21 and Figure 16.

Table 21 Summary of 2044 intersection LOS

Intersection	Control	Overall LOS		Worst Movement LOS		Critical LOS
		AM	PM	AM	PM	
Englands Road Interchange						
Englands Road / Bypass Southbound Off-Ramp	Signals	A	B	B	B	B
Isles Drive / Bypass Southbound Off-Ramp	Priority	A	A	A	A	A
Englands Road / Bypass Northbound On-Ramp / Western Property Access Road	Signals	A	B	D	D	B
Pacific Highway / Englands Rd / Stadium Dr	Signals	C	C	D	D	C
Pacific Highway / Isles Drive	Signals	D	C	F	E	D
Coramba Road Interchange						
Coramba Road (east) roundabout	Roundabout	A	A	B	A	B
Coramba Road (west) roundabout	Roundabout	A	A	A	A	A
Coramba Road NW priority	Priority	-	-	A	A	A
Korora Hill Interchange						
Korora Hill (east) signals	Signals	A	B	D	E	B
Korora Hill (west) signals	Signals	B	B	D	E	B
James Small Drive roundabout	Roundabout	A	A	B	B	B
Service Road						
Service Road / James Small Drive	Roundabout	-	-	A	A	A
Service Road / Opal Boulevard	Priority	-	-	A	A	A
Service Road / Seaview Close	Priority	-	-	A	A	A
Service Road / Underpass	Priority	-	-	A	A	A
Service Road / Solitary Island Way	Priority	-	-	A	A	A



Coffs Harbour Bypass
Critical level of service at modelled intersections in 2044
Figure 16

The results demonstrate that the project interchanges and intersections under forecast traffic volumes perform as follows:

- Englands Road interchange is anticipated to operate at level of service C or better through to 2044
- The Pacific Highway / Isles Drive intersection is expected to operate with an overall LOS D at 2044
- The intersections associated with the Coramba Road interchange are anticipated to operate at level of service B or better through to 2044
- The Korora Hill interchange is anticipated to operate at level of service B or better through to 2044
- All Service Road intersections are anticipated to operate at level of service A over the 20-year design horizon

The analysis demonstrates that the proposed project intersections arrangements would meet the traffic and transport objectives for the project and the intersections would operate at an acceptable level of service over the 20-year design horizon.

5.6.1 Summary of operational performance of the project

In summary, the following conclusions can be derived from the predicted operational performance of the project:

- The project is predicted to provide major benefits for motorists using the bypass with substantial improvements in traffic flow and travel time for both northbound and southbound journeys, relative to the base case (without project)
- The project is predicted to improve travel times for north-south trips on the existing route
- The intersections and interchanges associated with the project are anticipated to operate within acceptable LOS limits over the 20-year design horizon.

5.7 Road safety

There are various elements of the project which will have a positive impact on road safety in the area, including:

- On the existing Pacific Highway, as rear-end, multi-vehicle crashes are the most common type of crash occurring and the frequency of these crashes increases during periods of traffic congestion, the reduction in congestion with the project that occurs along the existing Pacific Highway is anticipated to result in a substantial reduction in rear-end type crashes
- James Small Drive, Korora School Road, Opal Boulevard and Seaview Close will no longer connect directly with the Pacific Highway at four separate un-signalised intersections. Instead, access to these roads will be provided by the newly provided Service Road. This arrangement and removal of at-grade priority (stop or give-way) controlled intersections along the Pacific Highway,

would improve safety by reducing the number of conflict points (safety issues) along the highway

- Access to and from the project is to be provided via grade-separated interchanges, which reduces potential points of conflict between vehicles. Providing the interchanges as grade-separated will also result in free-flow conditions along the project, minimising the risk of congestion-related incidents
- Removal of the existing school bus interchange from the Pacific Highway would improve safety by removing the conflict points associated with the northbound and southbound interchange diverges and merges on the Highway. This also removes significant vehicle speed differentials between the buses (as they slow or accelerate to speed on the highway) and all other vehicles on the Pacific Highway
- Introduction of a one-way local access road adjacent to the existing Pacific Highway alignment at the southern end of the project (south of Englands Road interchange). This road eliminates direct access onto the highway from private properties and other access points (e.g. Lindsay Transport). This reduces the likelihood of collisions with vehicles travelling at high speed (100km/hr) on the highway, particularly with heavy vehicles accelerating to exit Lindsay Transport
- Crash data received from Roads and Maritime (2014-2018) indicated there have been a total of seven rollover crashes at the Pacific Highway / Stadium Drive / Englands Road roundabout during the years assessed. The roundabout will be upgraded to a signalised intersection as part of the project. It is anticipated this will minimise the occurrence of rollover incidents at this location.

The project introduces or changes the road user environment which may have an adverse impact on road safety for some users, including:

- Although the project provides an improved road safety situation than the existing situation, the proposed changes to the parking (staff and set-down) and the bus interchange at the Kororo Public School could lead to increased conflicts between users. This could be managed through bus driver awareness and training, as well as restricting staff vehicle movements to be outside of the peak periods of bus services
- The addition of traffic on Coramba Road between the project and Shephards Lane would increase the exposure rate of the opportunity for crashes to occur on this road segment. This is due to the marginal increase (600 vpd) on Coramba Road east of the project between the project and Shephards Lane. However, other segments of Coramba Road are anticipated to experience decreases in traffic.

In addition to the above, as a result of road safety concerns provided in community submissions during the 2018 concept design display, the use of James Small Drive as part of operation of the project has been investigated. The investigation considered the existing condition and configuration of James Small Drive and proposed use of the Kororo Public School bus interchange. A number

of traffic management improvement opportunities were identified, including restrictions to on-street parking installation of traffic barriers. These opportunities will be further evaluated and finalised during detailed design and in consultation with CHCC, Kororo Public School, Coffs Harbour Montessori Preschool and the adjacent community.

5.7.1 Crash reduction assessment

As discussed in Section 2.4, the existing Pacific Highway through Coffs Harbour is subject to a large number of crashes with 259 recorded over the period from 2014 to 2018. This is reflective of the large number of intersections, variable road conditions and traffic congestion that occurs currently along the Pacific Highway.

An assessment has been carried out to forecast the potential reduction in crashes on the Pacific Highway resulting from the operation of the project. The assessment includes analysis of the existing Pacific Highway and the main project alignment.

The assessment analysed the existing Pacific Highway in three segments:

- Segment 1: Pacific Highway between the bypass interchange at Korora Hill and the northern tie-in at Sapphire
- Segment 2: Pacific Highway from Englands Road interchange to Korora Hill interchange
- Segment 3: Pacific Highway between Englands Road and the southern tie-in at Boambee.

Table 22 shows the current crash rates (without project) based on crash data from the last five years for Segments 1 to 3. It also shows the expected crash rate for Segment 1 and 3 once upgraded as part of the project, and for the bypass. The crash rate for Segment 2 is assumed to remain at the same current rate as there would not be any changes to this segment as part of the project.

The predicted reduction in the number of crashes for the project in comparison to the without project scenario is summarised in Table 23. The number crashes are a product of the crash rate and the number of vehicles travelling along Segments 1 to 3 or the bypass.

Table 22 Crash rates with and without project

Road element	Crash rate (per 100 mvkt)		
	Without project	With project	Change
Segment 1	18.3	12.5	-5.8
Segment 2	39.2	39.2	-
Segment 3	8.1	8.1	-
Bypass	-	12.5	-

Table 23 Comparison of predicted crashes for the with and without project scenarios

Road element	Number of crashes in 2024			Number of crashes in 2044		
	Without project	With project	Change	Without project	With project	Change
Segment 1	6	4	-2	7	5	-2
Segment 2	49	38	-11	53	41	-12
Segment 3	2	2	0	2	2	0
Bypass	-	10	10	0	12	12
Total	**57**	**54**	**-3**	**62**	**60**	**-2**

The crash rate analysis demonstrates:

- The section of the Pacific Highway north of Englands Road (Segment 2) has a crash rate (without the project) of 39 per 100 million vehicle kilometres travelled (mvkt). With the project, the crash rate remains the same, however the number of crashes reduces due to the decrease in traffic volumes on the link
- The section of the Pacific Highway north of Korora Hill (Segment 1) has an existing crash rate (without the project) of 18.3 per 100 mvkt. With the project, the crash rate is predicted to reduce to 12.5 per 100 mvkt
- It is predicted the proposed bypass would demonstrate a crash rate of 12.5 per 100 mvkt, which is consistent with expectations for new highways constructed to a motorway standard
- The introduction of the bypass results in a reduction of 14 crashes on the Pacific Highway
- The analysis demonstrates that although a reduction of two crashes is forecast at 2044, the project attracts an additional 11,281 vpd to the road network assessed (ie Segments 1, 2 and 3 of the Pacific Highway and the project) due to a redistribution of traffic from key local roads to the project ie north-south movements on Hogbin Drive and east-west movements on Stadium Drive and Bray Street.

5.8 Impacts on other travel modes

5.8.1 Heavy vehicles

The existing conditions creates inefficient driving conditions for freight and heavy vehicles. This inefficiency occurs as a result of stop-start movements through 12 sets of traffic lights, and mixing with pedestrians, cyclists and local traffic.

The project would benefit freight and heavy vehicle movements by:

- Providing a more efficient free-flow freight route past Coffs Harbour
- Improving amenity for local regional traffic. Traffic analysis shows that there would be a reduction in heavy vehicles along the existing Pacific Highway, and a resultant increase along the bypass
- Reducing travel times and thus improving freight efficiency as heavy vehicles are redistributed to the bypass
- Improving the environment of the existing Pacific Highway through a reduction in truck-related noise, vibration and vehicle emissions.

5.8.2 North Coast Railway

The project will travel over (ie will be grade separated) the North Coast Railway near Shephards Lane to the north-west of the Coffs Harbour CBD. Once operational the bypass and the North Coast Railway will operate independently, with no impact to the rail passenger and freight operations anticipated.

5.8.3 Public transport

The project is not expected to generate the need for any additional bus stops for the existing services. The existing Busways and long-distance charter services would benefit from the improved traffic conditions due to the project, including reduced congestion on the existing Pacific Highway through Coffs Harbour.

The design of the Coramba Road interchange will impact the location of the existing, informal school bus stop at the intersection of Coramba Road and Spagnolos Road. The existing school bus stop would be replaced in consultation with CHCC and the bus operator.

As part of the project, Kororo Public School bus interchange will be relocated adjacent to the Kororo Public School and accessed via James Small Drive. The relocated bus interchange comprises two bus platforms, with capacity for either seven buses in nose-to-tail operation (ie seven buses arriving and departing in order) or up to four buses with independent operation (ie can arrive and depart separately). The design also includes an adjacent layby / waiting area for up to two buses. The total capacity is therefore nine buses, which is anticipated to cater for the observed existing demand of the interchange (i.e. maximum of eight buses at any one time). The relocated interchange will improve existing arrangements by providing bus shelters for waiting students for the full length of each of the two platforms.

Buses using the relocated Kororo Public School bus interchange would be required to use the service road to access James Small Drive when arriving from the north. When approaching the relocated bus interchange from the south, buses would need to access the service road via the Korora Hill interchange. The additional travel distance to access the service road and James Small Drive may result in added travel time.

The design of the Kororo Public School bus interchange has been developed in consultation with the Kororo Public School. Further consultation will be undertaken during the detailed design phase.

5.8.4 Pedestrians and cyclists

During operation, the project would not result in the severing of any existing pedestrian or cyclist routes.

The project includes provision for pedestrian and cyclist connectivity in the local area including:

- Providing more segregation between heavy vehicles, and pedestrians and cyclists thus reducing the likelihood of conflicts between these vulnerable road users and freight traffic through the Coffs Harbour CBD
- Cyclist provisions in the form of cycle lanes within the shoulder of the bypass in both the northbound and southbound directions
- Extension of the existing shared path on Solitary Islands Way. The shared path will extend for the length of the new service road
- Reinstatement of the existing shared path along the existing Pacific Highway south and through the Pacific Highway / Stadium Drive / Englands Road intersection.
- The project includes northbound and southbound links to the existing shared path along the Pacific Highway at the southern interchange of the bypass
- Provision of signalised pedestrian/cycle crossings of the existing Pacific Highway and Stadium Drive at the Pacific Highway/Stadium Drive/Englands Road intersection
- A new shared user path would be provided through the Korora Hill interchange connecting between the service road and Bruxner Park Road with a pedestrian/cycle crossing provided at the signalised intersections
- All local road underpasses would be wide enough to include provision for pedestrians and cyclists, separated from the local road
- The Coramba Road and Shephards Lane overpasses would include a footpath on one side of the bridges for pedestrian access across the project.

At the Kororo Public School, the following changes to the local pedestrian and cycle network are to be incorporated into the project:

- The Luke Bowen footbridge pedestrian / cyclist overpass is to be rebuilt and provide a link from the Kororo Public School to Old Coast Road west of the existing Pacific Highway
- A 2.5m wide pedestrian path to be constructed on the eastern side of the service road from James Small Drive (north) to the existing path on Solitary Islands Way. The pedestrian path will provide linkages to the overpass and runs adjacent to the on-street parallel car parks proposed on the service road adjacent to the school

- A 2.5m wide pedestrian ramp with 1:14 grade and landings at 9m intervals to be provided from James Small Drive to the relocated Kororo Public School bus interchange
- A 2.5m wide pedestrian path surrounding the Kororo Public School bus interchange and linking to the north-south path alongside the service road.

The proposed changes provide connections to the existing pedestrian and cycle network within the construction footprint and enhanced options for walking and cycling. This would improve safety for pedestrians and cyclists, particularly surrounding the Kororo Public School, providing for better connections between the existing off-road network. Additionally, by redistributing a significant proportion of heavy vehicles away from the Coffs Harbour CBD, conflict with these vulnerable users is reduced.

The project has three short tunnels through ridges at Roberts Hill (around 190 m long), Shephards Lane (around 360 m long), and Gatelys Road (around 450 m long). Each of these tunnels includes the following facilities for pedestrians and cyclists:

- A 1.5 metre wide pedestrian and cycle path (on both sides of each tunnel) with a concrete barrier to separate the path from the traffic lanes
- Emergency walkways for pedestrians, one metre wide and 2.1 m high, with a concrete barrier to separate the path from traffic lanes. Emergency walkways would provide a connection to the cross passages
- Cross passages provided as follows:
  - Roberts Hill tunnel: one cross passage located near the centre of the tunnel
  - Shephards Lane tunnel: two cross passages with a maximum spacing of 120m
  - Gatelys Road tunnel: three cross passages with a maximum spacing of 120m.
- Shoulder widths vary between a minimum width of one metre and maximum width is five metres (for the Shephards Lane and Gatelys Road tunnels). For Roberts Hill tunnel the outside shoulder widths are 2.5 metres southbound and 4.5 metres northbound.

5.9 Property access

5.9.1 Access to existing properties

During operation, the existing access to all properties (that have not been full acquisitioned) would be reinstated, with adjustments as required to suit the new road infrastructure. The design of access arrangements to affected properties will be refined during detailed design subject to consultation with affected property owners.

There is an existing large property at the northern end of Roselands Drive that will be divided in two with the introduction of the project. While the project will

provide access to both sides of the property, it is likely that the property owner would need to use the public Coramba Road interchange roads to travel between each side of their property.

In addition to property accesses, the existing access from the Solitary Rural Fire Service's shed to the Pacific Highway via Old Coast Road would be affected by the project. Consultation with the Solitary Rural Fire Service will be undertaken during detailed design to ensure the revised access arrangements during and after construction would be appropriate.

5.9.2 Access to urban release areas

South Coffs urban release area

The South Coffs urban release area is located to the south of Stadium Drive and to the east of the Pacific Highway. It is currently being developed as the Elements Estate and is accessed from Stadium Drive. Its access would not be impacted by the project.

North Boambee Valley East urban release area

The North Boambee Valley East urban release area is located to the east of the project and is accessed via North Boambee Road. Access will not be affected by the project.

North Boambee Valley (West) urban release area

North Boambee Valley (West) urban release area is located off North Boambee Road to the west of the project. During operation, access to the area would continue to be provided via North Boambee Road. The project would pass over North Boambee Road via an overpass. The overpass has been designed with consideration of a future upgrade of North Boambee Road by CHCC as part of the development of North Boambee Valley (West) urban release area. As such, access to this urban release area would not be impacted and traffic volumes on North Boambee Road would not be affected by the project.

West Coffs urban release area

The West Coffs urban release area is located to the west of Mackays Road, Donn-Patterson Drive and Shephards Lane. It is approximately bounded to the north by the rail line, to the south by Coramba Road and to the west by Spagnolos Road. The project passes to the north and west of the urban release area and access to the area would not be directly affected by the project.

Some roads used to access the area such as William Sharp Drive and Coramba Road are predicted to experience increased traffic volumes once the project is operational. This is due to local traffic movements accessing the project via the Coramba Road interchange. However, the increased traffic volumes are not expected impact access to the West Coffs area.

North Coffs urban release area

The North Coffs urban release area is located to north of Mastracolas Road, south of West Korora Road and to the west of the existing Pacific Highway. The urban release area is located south of the Korora Hill interchange. Access would not be affected by the project.

Korora rural residential release area

It is anticipated that access to the proposed Korora rural residential release area would be provided via Bruxner Park Road and/or Old Coast Road. Both of these roads currently connect with the Pacific Highway with at-grade priority-controlled intersections. The project design would connect Bruxner Park Road to the Englands Road interchange and Old Coast Road to a service road.

Pacific Bay Western Lands

Pacific Bay Western Lands is a proposed residential development located immediately south of the Korora Hill interchange. Consultation with CHCC and the proponent of the residential development will be undertaken during detailed design to ensure future access arrangements are considered as part of the project.

Pacific Bay Eastern Lands

Pacific Bay Eastern Lands includes approved residential developments as part of the Pacific Bay Resort on the eastern side of the Pacific Highway south of the Korora Hill interchange. Access to Pacific Bay Eastern Lands is provided via Charlesworth Bay Road/Bay Drive/Resort Drive. The existing intersection of Charlesworth Bay Road/Pacific Highway would not be affected by the project. However, consultation with the proponent has indicated that the further proposals are being investigated and further consultation with the proponent will be undertaken during detailed design to ensure any future access arrangements are considered as part of the project.

5.10 Parking

At the Kororo Public School, the following changes to the on-street parking supply as part of the project will be provided:

- A total of 66 parallel parking bays (including two persons with disability parking spaces) to be provided on the eastern side of the service road adjacent to the school
- Addition of 52 staff car parks within the proposed Kororo Public School bus interchange, accessed via James Small Drive
- A total of approximately 90 informal on-street parking spaces (similar to the existing arrangement) on the property access road (opposite the school) and on Old Coast Road.

As detailed in Section 2.8.1, the existing parking supply surrounding the school is 287 parking spaces. Based on a parking study however, the maximum parking demand during the school peak period observed was in the order of 158 spaces.

As part of the project, the total parking supply surrounding the school will be 236 spaces (including on-street parking on James Small Drive, service road and the property access road) and 52 staff parking spaces. This exceeds the existing parking demand of the school by 130 spaces and is anticipated to cater for the parking demand currently observed during the school peak.

6 Assessment of construction impacts

This section provides an assessment of the resulting transport-related impacts which are anticipated to occur during construction of the project.

6.1 Assessment methodology

The assessment of potential construction traffic impacts discussed in this section considers the:

- Construction processes, staging and timeframes
- Estimates of construction material quantities
- Locations of construction access routes
- Location of ancillary areas.

The assessment is based on potential and typical construction methodologies anticipated at this stage of concept design. Further development of the above-listed aspects would occur as the project progresses through detailed design and pre-construction stages.

6.2 Construction activities

Subject to approval, Roads and Maritime would consider and select the most suitable procurement method for project construction delivery. The preferred procurement method would be selected and implemented in compliance with the EIS and the conditions of approval for the project.

Detailed construction methodologies would be developed by the selected contractor(s) for the project. Roads and Maritime would be responsible for overseeing the construction, including inspections, monitoring and auditing work performed by the construction contractor(s).

Construction of the project is described in detail in the EIS and would generally involve the activities listed in Table 24.

Table 24 Construction activities

Type	Typical activities
Pre-construction and site establishment	• Property acquisition and adjustments, including property access changes • Detailed investigations and survey work including investigative drilling, contamination investigations and excavations • Condition surveys • General site clearance, site establishment work, fencing and signage • Establishment of temporary ancillary facilities and compound sites including the site office • Temporary traffic management arrangements including construction of minor access roads • Progressive installation of environmental controls including temporary or permanent fencing, and erosion and sediment control measures

Type	Typical activities
	• Construction of temporary drainage controls including temporary creek crossings • Clearing and removal of vegetation (non-threatened species) • Relocation and/or protection of utilities
Site preparation and bulk earthworks	• Clearing and grubbing of vegetation • Mulching of vegetation for re-use in landscaping activities, where possible • Stripping topsoil and stockpiling it for reuse in landscaping • Excavation of cuttings, including processing, stockpiling or haulage of material, and stabilisation of batters • Drilling of blast holes • Establishment of crushing plant • Crushing and screening excavated material • Hauling materials from excavated cuttings, borrow sites and external sources to fill embankment locations • Construction of fill embankments, including foundation drainage • Benching and stabilising cut and fill batter slopes
Drainage and structures	• Construction of drainage, including kerb and gutter (where required) • Installation of cross-drainage, including culverts and inlet and outlet work, such as channel diversions and scour protection • Installation of longitudinal and vertical drainage in cuttings and embankments • Construction of diversion and catch drains along the formation and sedimentation control basins or swales (where required) • Construction of subsurface drainage • Construction of any retaining walls • Installation of fauna connectivity structures
Bridge work	• Establishment of batching plant • Preparation of bridge work areas including temporary piling pads, access platforms • Installation of rock caissons or cofferdams or temporary access roads across waterways • Installation of bridge foundations (driven or bored piles, pile caps and footings) • Construction of new bridge abutments and piers • Construction of bridge superstructure including deck and pavement work (cast in-situ or pre-cast bridge elements) • Construction of scour protection (where required) • Construction of noise walls (where required)
Tunnel work	• Establishment of portal sites in preparation for tunnel excavation, including provision of temporary tunnel services • Excavation of tunnel portals • Excavation of mined tunnels using drilling and blasting equipment for hard rock • Excavation of cross passages • Finishing works in tunnel and provision of permanent tunnel services • Commissioning tunnel plant and equipment.
Demolition	• Demolition of bridges (Luke Bowen footbridge and northbound carriageway bridge over Pine Brush Creek)

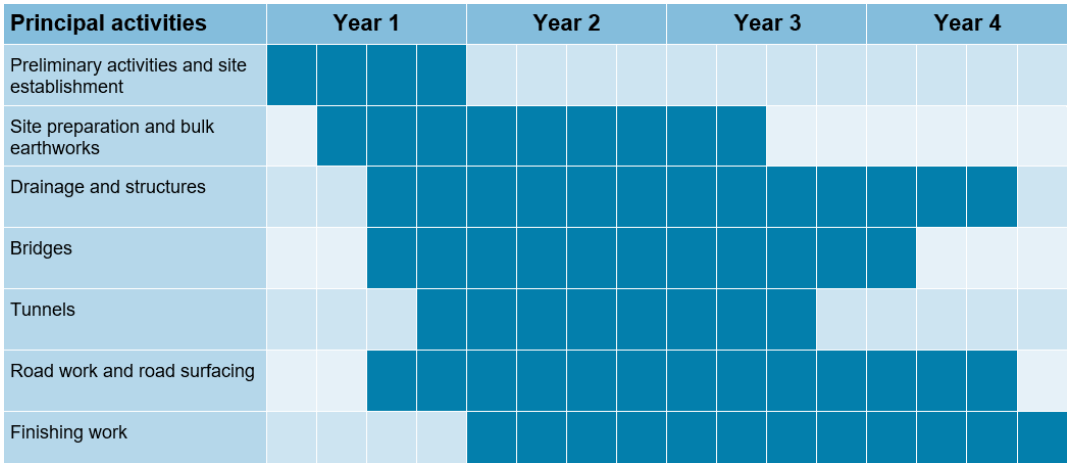
Type	Typical activities
	• Demolition of buildings (properties and sheds)
Road work and road surfacing	• Construction of temporary local traffic management diversions • Construction of base and select layers of materials • Construction of pavement layers • Construction of pavement drainage, including kerb and gutter (where required) • Construction of concrete barriers, wire rope fencing and guardrails • Installation of traffic signals, road markings, signposting, roadside furniture and lighting • Progressive landscaping and tree planting
Finishing work	• Remove temporary work • Restoration and landscaping of temporary sites • General site clean-up • Restoration of topsoil and revegetation of batters • Removal of temporary environmental controls • Site clean-up and demobilisation, including restoration of ancillary sites and construction access roads (where required)

6.3 Construction timing

Subject to planning approval, construction of the project is anticipated to start in 2020 and take around four years. The actual timing of construction, opening to traffic and completion would depend on the availability of construction funding, the preferred procurement method and wet weather.

The construction program shown in Table 25 is indicative only and may change based on further work during detailed design and changes to construction methods and/or materials as well as wet weather periods. The community would be kept informed of timing as the construction program is refined after project approval.

Table 25 Indicative construction timeline



Final construction staging and programming would be determined by the construction contractor in coordination with Roads and Maritime.

6.4 Construction zones

Three construction zones have been defined for the project during concept design development. These zones are based on separating the project into sections where construction issues or differences in construction methods are likely. This approach has mainly been developed as a planning tool and may be altered during construction. The locations and significant features of the three proposed construction zones are provided in Figure 17 and described in the following sections.

6.4.1 Zone 1 – Englands Road to Roberts Hill ridge

This construction zone covers the area of the project from the southern tie-in to the existing Pacific Highway, south of Englands Road, to the north of Roberts Hill ridge. Most of this construction zone would be constructed away from the existing Pacific Highway and across the Newports Creek flood plain. It includes the Englands Road interchange and the Roberts Hill tunnel.

Vehicular access to Zone 1 would be via the existing Pacific Highway, Englands Road and North Boambee Road.

6.4.2 Zone 2 – Roberts Hill ridge to Korora Hill

This construction zone covers the area of the project north of Roberts Hill ridge to south of the Korora Hill interchange. It traverses a number of minor ridges, with a series of cuts and fills along the project and includes the Shephards Lane and Gatelys Road tunnels. This construction zone also includes the Coramba Road interchange and a crossing of the North Coast Railway.

Vehicular access to Zone 2 would be via Coramba Road, Shephards Lane, Bray Street, Mackays Road and West Korora Road.

6.4.3 Zone 3 – Korora Hill to Sapphire

This construction zone covers the area of the project from south of Korora Hill interchange to the northern tie-in to the existing Pacific Highway at Sapphire. This construction zone is largely located along the existing Pacific Highway between Bruxner Park Road and the northern tie-in. It is located in a tightly constrained corridor, with key pinch points at the Kororo Nature Reserve and Kororo Public School. It comprises a continuation of the existing service road to the east (built as part of the Sapphire to Woolgoolga upgrade) from south of Sapphire to James Small Drive, and a local access road proposed to the west of the project to provide access to Old Coast Road and Seaview Close.

Vehicular access to Zone 3 would be via the existing Pacific Highway, Bruxner Park Road, Old Coast Road and James Small Drive.

Legend

- Construction footprint
- Construction Zone
- Construction site access
- Alignment
- North Coast Railway
- Watercourse

Coffs Harbour Bypass
Construction access routes
Figure 17

0 0.5 1 1.5 km

Scale @A4: 1:50,000
GDA 1994 MGA Zone 56

N

6.5 Workforce and construction work hours

The size and composition of the construction workforce would vary throughout the construction period depending on the activities being carried out.

An estimated peak workforce of about 400 to 520 people is anticipated. The average size of the construction workforce on site would be about 270 people including management staff and subcontractors.

The proposed normal construction working hours for the project are:

- Monday to Friday: 7am to 6pm
- Saturday: 8am to 1pm
- Sunday and public holidays: no work

The majority of construction would be carried out during the proposed working hours. However, certain activities would need to take place during the evening and night-time periods (that is, 'out of hours') due to technical considerations, to ensure the health and safety of the public and construction crews, and to minimise disruption to the travelling public.

The NSW *Interim Construction Noise Guideline* (DECC 2009) also recognises there are some situations where specific construction work may need to be carried out outside of the recommended standard construction hours. The following are the categories of work that may be carried out outside the recommended standard hours:

- Delivery of oversized plant or structures that the police or other authorities determine require special arrangement to transport along public roads
- Emergency work to avoid the loss of life or damage to property, or to prevent environmental harm
- Maintenance and repair of public infrastructure where disruption to essential services and/or considerations of worker safety do not allow work within standard hours
- Public infrastructure works that shorten the duration of construction and are supported by the affected community
- Work where a proponent demonstrates and justifies a need to operate outside the recommended standard construction hours.

6.6 Location and use of ancillary sites

A range of construction related facilities would be required to build the project and would be located on ancillary sites within the construction footprint. These ancillary facilities would include some or all of the following:

- Site compounds
- Concrete batching plant
- Asphalt batching plant

- Crushing plant
- Stockpile areas.

Potential locations of the ancillary facilities and the likely public local road by which they would be accessed, even outside typical construction hours, are shown in Table 26. Initial site work in these areas would involve site clearing, installing appropriate environmental controls and providing hardstand areas for storage, parking and access roads.

Table 26 Indicative ancillary sites

Site	Local Access Road	Main site compound	Secondary site compound	Concrete batch plant	Asphalt batch plant	Crushing plant	Stockpile site
1C	Englands Rd	✓	✓	✓	✓	✓	✓
1D	Englands Rd	✓	✓		✓		✓
1G	North Boambee Rd	✓	✓	✓	✓	✓	✓
1H	North Boambee Rd		✓			✓	✓
2A	Coramba Rd*	✓	✓				✓
2B	Coramba Rd*					✓	✓
2C	Shephards Ln		✓			✓	✓
2D	Mackays Rd		✓			✓	✓
2E	Mackays Rd		✓			✓	✓
2G	West Korora Rd		✓				✓
3B	Bruxner Park Rd	✓	✓			✓	✓
3C	Bruxner Park Rd		✓				✓
3D	Bruxner Park Rd						✓
3E	Pacific Hwy (direct)		✓				
3G	Pacific Hwy (direct)						✓

**Access would initially be via Spagnolos Road during site establishment and following this, the main line would be prioritised to access the site. It is envisaged that any potential impacts associated with the temporary short-term use of Spagnolos Road would be mitigated through a construction Traffic Management Plan (TMP) that the contractor will be required to provide.*

The final locations and layout of ancillary facilities would be determined by the construction contractor. Ancillary sites may, where necessary, include hardstand areas for parking of staff, site vehicles and visitors, particularly the main and secondary site compounds. To minimise on-street parking impacts on surrounding public local roads, temporary on-site parking areas will be designed to ensure that sufficient car parking provision is available for the peak construction period.

Parking spaces for a peak estimated construction workforce of around 520 workers would be required. The indicative number of parking spaces is estimated to be around 140 to 240 spaces at each of the main site compounds, which equates to a space requirement of about 3,600m^2 to 6,000m^2. For the other ancillary sites, it is estimated that parking for 15 to 25 spaces would be required, which equates to a space requirement of about 400m^2 to 700m^2. Potential impacts associated with construction worker parking would be managed through the implementation of a construction TMP and ensuring the above space is available.

6.7 Construction traffic impacts

6.7.1 General traffic impacts

Construction of the project is planned to occur over a four-year period and would result in some traffic and transportation impacts to the surrounding public road network during this time. These impacts would mostly relate to:

- Speed limit restrictions and traffic controls on existing roads adjacent to work sites
- Increased localised traffic due to construction activities, particularly from heavy vehicle movements
- Temporary changes to property access during the construction period
- Impacts to travel times, including public transport timetables, due to traffic controls being implemented
- Detours to pedestrian and cyclist movements due to construction works.

6.7.2 Construction traffic

Construction related traffic would use the surrounding road network to:

- Haul materials from quarries / borrow source to work site areas
- Provide access for the delivery of construction materials and removal of waste
- Provide access for the workforce to the various locations within the construction footprint, particularly to the compounds.

The most significant contributions to additional vehicle movements on the existing road network would occur at access points to the proposed construction ancillary sites and construction footprint access roads. The majority of construction traffic movements are expected to be contained within the project's construction footprint with the exception of deliveries to site, disposal of waste and staff travel.

6.7.3 Material haulage

Construction of the project would require a range of materials to be transported to and within the construction footprint and compound / stockpile areas. Typical materials that would be used for the construction of the project include:

- Earthwork materials, such as topsoil, general fill, and select fill
- Aggregates for drainage, and producing concrete and asphalt and spray seals
- Sand for drainage and concrete, and producing asphalt
- Cement and fly ash for producing concrete

- Concrete for drainage, road surfaces, tunnel work, bridge work and miscellaneous work such as barrier kerbs, kerbs and gutters, paving and signpost footings
- Road base for constructing flexible road surfaces
- Bitumen for spray seals and producing asphalt
- Precast concrete elements for drainage (culverts, pits and headwalls), bridge work (piles, girders and parapets) and miscellaneous work
- Steel for bridge girders, barrier railings, tunnel support, rock bolts and concrete reinforcement.

Once the project alignment has been cleared, the main haulage movements and construction vehicle movements are expected to be contained within the construction footprint. Fill material would be sourced from within the project where practicable, however some would need to be imported from local quarries. These materials would be hauled along identified local public roads and transported from quarries and along the existing Pacific Highway. Estimated peak heavy vehicle traffic movements required for materials that need to be sourced outside of the construction footprint are provided in Table 27.

Table 27 Haulage vehicle trip estimates

Construction activity	Quantity	Unit	Haulage vehicle trips (two-way per day)
Earthworks			
Earthwork (cut to fill) (bulked volume)	4,224,000[2]	m^3	-
Earthwork (dispose of excess material)	174,000	m^3	70
Earthwork (import select fill material)	378,000	m^3	69
Road work and road surfacing			
Concrete	100,000	m^3	159
Asphalt (external sources only)	53,000	m^3	59
Road base	55,000	m^3	25
Steel reinforcement	1,000	tonnes	2
Bridges			
Concrete	60,000	m^3	26
Steel	14,000	tonnes	5
Bridge deck wearing surface (m^3)	3000		1
Tunnels			
Concrete	60,000	m^3	87
Steel	20,600	tonnes	21
Drainage			
Concrete	9,000	m^3	8
Steel	200	tonnes	1
Retaining Walls			
Concrete (m3)	7,000	m^3	14
Steel reinforcement (tonnes)	400	tonnes	2
Finishing work			
Barriers / signs / lines	10,000	m^3	12

[2] Value includes bulking factor of 21.5% (factor determined based on geotechnical data for the project). Bulking factors are applied to the volume of excavated material to allow for a greater volume of material that would result from the excavation process.

The potential sources for the haulage materials are:

- Earthworks – existing, approved or potential queries near the project (refer Table 28)
- Concrete – cement and fly ash road or rail from Newcastle, Sydney or Brisbane
- Asphalt – existing large commercial plants in Coffs Harbour ie Boral Asphalt (Lot 1 O'Keefe Street, located 1.9km from project). Bitumen for asphalt production and spray sealing work sourced from refineries in Sydney or Brisbane
- Steel - Structural steel elements, such as bridge girders and bridge barrier railings and handrails, would be supplied from Roads and Maritime accredited steel fabricators in either Wollongong, Sydney or Brisbane, and brought to site by truck.

Table 28 Potential external fill sources

Quarry	Location	Materials	Distance to project
Coffs Harbour Quarry	Bennetts Road, Karangi, NSW		5.5km west of project
Karangi Mine	Karangi, NSW,		6km
T.G. Jung Quarries	530 Coramba Road, Coffs Harbour	Road base, landscape rock, fill	8km west of project
Flintstone Quarry	130 Taylors Creek Road, Central Bucca, NSW, 2450	Road base, rocks.	12km west of project
Woolgoolga Quarry	66A Morgans Road, Woolgoolga, NSW, 2456	Road base, crusher dust, blue metal, landscape rock, fill, gravel, aggregates and crushed rocks	20km north of project
Illabo Mine	Cat Trail, Lowanna, NSW, 2450	Open cut and underground gold mine	35km north-west of the project
Corindi Quarry	Corindi Beach, NSW, 2456		Approximately 35km north of the project

6.7.4 Construction traffic impacts

To provide an indication of the worst-case impacts of construction traffic on the current network, the estimated daily volume (including both light and heavy vehicles) that would use the existing road network has been detailed in Table 29. The construction traffic volumes represent peak construction traffic movements for the haulage of materials and access by construction workers and have been developed in consultation with Roads and Maritime. These volumes are dependent on the timing and duration of construction works and would need to be refined as the construction plan is further developed during detailed design. The final construction operations, staging and programming would be determined by the contractor in consultation with Roads and Maritime.

In order to determine the construction traffic volumes and the resultant impact, the following assumptions have been incorporated into the assessment:

- Application of a 30% increase to workforce numbers to account for uncertainty in estimates
- Each construction worker arrives and departs the site via private vehicle with a conservative occupancy rate of one worker per vehicle
- Light vehicles (ie construction workers) would be arriving and departing the worksite outside of peak traffic hours and heavy vehicle arrivals /departures would be evenly distributed throughout the day
- Only one main and/or secondary compound within each zone will be operational at any given time during construction
- Each local access road addressed in Table 29 has included the traffic demand associated with parking at a main compound site (ie the highest staff parking demand).

The delivery and removal of construction materials would occur during normal work hours (ie 7am to 6pm) and would be scheduled to avoid peak traffic conditions on the road network (such weekday peak school and commuter times and holiday periods). Additionally the use of public local roads for construction traffic, particularly in Zone 2, will be minimised where possible and managed through the implementation of the TMP.

The distribution of construction vehicle traffic on the public road network has been estimated based on the location of proposed ancillary sites in proximity to the nearest dedicated access road to the project corridor. The volume of traffic on the access roads would depend on the timing of construction activities, hence average construction traffic volumes will be lower than the peak volumes identified in Table 29 and some minor access roads (those with lower volumes) may not be used for the full construction duration.

Table 29 Construction traffic impacts

Road	Peak daily construction vehicles			2016 daily volumes [vpd]	Total with const. traffic [vpd]	% increase due to const. traffic
	No. HV [vpd]	No. LV [vpd]	Total [vpd]			
Englands Road	200	290	490	5,320	5,810	9%
North Boambee Road	240	290	530	6,980	7,510	8%
Coramba Road (West High Street)	470	520	990	10,160	11,150	10%
Shephards Lane	20	470	490	6,700	7,190	7%
Mackays Road	30	470	500	3,590	4,090	14%
Bray Street	30	470	500	8,100	8,600	6%
West Korora Road	260	470	730	270	1,000	270%
Bruxner Park Road	250	310	560	730	1,290	77%
James Small Drive	100	200	300	3,550	3,850	8%
Old Coast Road	100	200	300	2,160	2,460	14%
Pacific Highway (South of Englands Road)	200	290	490	36,000	36,490	1%
Pacific Highway (North of Bruxner Park Road)	250	310	560	30,000	30,560	2%

Englands Road

Englands Road construction access (for a length of 400m west from the Pacific Highway) has been classified as local sub-arterial road based on its movement function and the definition in *Development Specification Design 0041 Geometric Road Layout* (CHCC 2009b). This specification states that local sub-arterials have a nominal upper limit capacity of 10,000 vpd. The total predicted daily traffic volumes on Englands Road with the addition of construction traffic are 5,810 vpd, which is less than the nominal accepted capacity for a local sub-arterial road.

As the predicted volumes for Englands Road are less than the nominated acceptable capacity for a local sub-arterial, construction traffic is not anticipated to trigger adverse traffic impacts.

North Boambee Road and Shephards Lane

North Boambee Road and Shephards Lane would be classified as collector streets based on their existing cross-section and function, and the definitions in *Development Specification Design 0041 Geometric Road Layout* (CHCC 2009b). This specification states that collector streets have a nominal upper limit capacity of 6,000 vpd.

The total predicted daily traffic volumes on North Boambee Road and Shephards Lane with the addition of construction traffic would be approximately 7,510 vpd and 7,190 vpd respectively, which corresponds to a seven to eight per cent increase for these roads. This suggests that both roads would be operating at capacity during peak construction periods, although it should be noted that both roads were already operating above capacity based on 2016 volumes alone (6,980 vpd and 6,700 vpd respectively).

To mitigate potential traffic impacts to North Boambee Road and Shephards Lane, it is recommended that a TMP is developed to manage construction traffic. The TMP will be used to further address potential construction traffic impacts, manage community expectations, and may implement control measures to address construction traffic impacts by placing restrictions on certain movements during peak traffic periods, or modifying intersection traffic signals during peak construction periods (eg by adjusting phasing or timing).

The predicted volumes for North Boambee Road and Shephards Lane are greater than the nominated acceptable capacity for collector streets. However, with appropriate mitigation measures including those discussed above, construction traffic is not anticipated to impact significantly on the operation of North Boambee Road and Shephards Lane.

Given the location of Bishop Druitt College on North Boambee Road and proximity to the project, any traffic management measures would be developed in consultation with the college to ensure school operations and potential conflicts with school children are adequately considered.

Coramba Road (West High Street)

Coramba Road (West High Street) would be classified as local sub-arterial roads based on their existing cross-section and function, and the definitions in

Development Specification Design 0041 Geometric Road Layout (CHCC 2009b). This specification states that local sub-arterial roads have a nominal upper limit capacity of 10,000 vpd.

The total predicted daily traffic volumes on Coramba Road (West High Street) with the addition of construction traffic would be approximately 11,150 vpd, which corresponds to a ten per cent increase. This suggests that Coramba Road (West High Street) would be operating at capacity during peak construction periods, although it should be noted that the roads were already operating above capacity based on 2016 volumes alone (10,160 vpd).

To mitigate potential traffic impacts on Coramba Road (West High Street), similar measures to those proposed for North Boambee Road and Shephards Lane are recommended. These would include implementation of a TMP, potential modification to traffic signals and community consultation.

The predicted volumes for Coramba Road (West High Street)are greater than the nominated acceptable capacity for local sub-arterials. However, with appropriate mitigation measures including those discussed above, construction traffic is not anticipated to trigger adverse traffic impacts.

Additionally, as noted in Section 6.6, Spagnolos Road will initially be used during construction for site establishment (rather than Coramba Road). However, the proposed construction volumes are expected to be low and any short-term impacts are expected to be mitigated through the construction TMP.

Mackays Road

Mackays Road has been classified as a collector street based on the function of the road and the definitions in *Development Specification Design 0041 Geometric Road Layout* (CHCC 2009b). This specification states that collector streets have a nominal upper limit capacity of 6,000 vpd. The total predicted daily traffic volume on this road with the addition of construction traffic would be approximately 4,090 vpd which would be less than the nominal capacity for a collector street.

As the predicted volumes for Mackays Road are less than the nominated acceptable capacity for a collector street, construction traffic is not anticipated to significantly impact the operation of Mackays Road.

Bray Street

Bray Street construction access has been classified as a local sub-arterial road based on its movement function and the definition in *Development Specification Design 0041 Geometric Road Layout* (CHCC 2009b). This specification states that local sub-arterials have a nominal upper limit capacity of 10,000 vpd. The total predicted daily traffic volumes on Bray Street with the addition of construction traffic are 8,600 vpd. This would be less than the nominal capacity for a local sub-arterial road.

As the predicted volumes for Bray Street are less than the nominated acceptable capacity for a local sub-arterial, construction traffic is not anticipated to trigger adverse traffic impacts.

West Korora Road and Bruxner Park Road

West Korora Road and Bruxner Park Road would experience high percent increases in daily traffic volumes (270% and 77% respectively) as they currently carry low levels of traffic. The total predicted daily traffic volumes on these roads with the addition of construction traffic are expected to remain less than 2,000 vpd, which is the nominated design capacity of local streets within Coffs Harbour as per *Development Specification Design 0041 Geometric Road Layout* (CHCC 2009b). As such, these roads would be expected to operate with acceptable travel times and level of service.

As the predicted volumes for West Korora Road and Bruxner Park Road are less than the nominated acceptable capacity for a local street, construction traffic is not anticipated to significantly impact the operation of these roads.

James Small Drive

James Small Drive has been classified as a collector street based on the function of the road and the definitions in *Development Specification Design 0041 Geometric Road Layout* (CHCC 2009b). This specification states that collector streets have a nominal upper limit capacity of 6,000 vpd. The total predicted daily traffic volume on this road with the addition of construction traffic would be approximately 3,850 vpd which would be less than the nominal capacity for a collector street.

As the predicted volumes for James Small Drive are less than the nominated acceptable capacity for a collector street, construction traffic is not anticipated to significantly impact travel time or LOS on James Small Drive. However, consultation will be undertaken with Kororo Public School regarding access and parking requirements to develop appropriate traffic management measures to minimise impact on school operations and potential conflict with school children on James Small Drive.

Old Coast Road

Old Coast Road would be classified as a local street based on its existing cross-section and function, and the definitions in *Development Specification Design 0041 Geometric Road Layout* (CHCC 2009b). This specification states that collector streets have a nominal upper limit capacity of 2,000 vpd.

Vehicle class restrictions on Old Coast Road may be required as a result of the structural engineering inspections of both heritage bridges. This will be confirmed during detailed design. The construction impact assessment conservatively assumed that no restrictions would be placed on heavy vehicles, thus assessing the worst case scenario.

The total predicted daily traffic volumes on Old Coast Road with the addition of construction traffic would be approximately 2,460 vpd, which corresponds to a 14 per cent increase. This suggests that Old Coast Road would be operating at capacity during peak construction periods, although it should be noted that it was already operating above capacity based on 2016 volumes alone (2,160 vpd).

To mitigate potential traffic impacts on Old Coast Road, similar measures to those proposed for North Boambee Road and Shephards Lane are recommended. These would include implementation of a TMP, potential modification to traffic signals and community consultation.

The predicted volumes Old Coast Road are greater than the nominated acceptable capacity for local roads. However, with appropriate mitigation measures including those discussed above, construction traffic is not anticipated to impact significantly on the operation of Old Coast Road.

Pacific Highway

The increase in traffic volumes on the Pacific Highway due to the addition of construction traffic represent increases of less than five per cent of existing daily traffic volumes. This is considered to be a low level of impact and there would not be expected to be any noticeable impacts to travel time or level of service on the Pacific Highway.

6.7.5 Construction traffic management measures

Much of the project would be able to be constructed with minimal direct disruption to existing Pacific Highway traffic (ie the project alignment between Englands Road and Korora Hill). However, there are locations where construction activities would interact with the existing Pacific Highway traffic, including:

- At the tie-ins at the southern limit of the project to the north of the Englands Road interchange
- At the Korora Hill interchange where the project joins the alignment of the existing Pacific Highway
- Along the existing Pacific Highway between Korora Hill interchange and the tie-in at Sapphire.

Speed restrictions and traffic controls would be required to manage traffic during construction of the above sections of the project. This would likely include a minimum speed of 60 km/h and two lanes of traffic in each direction would be maintained in accordance with any ROL requirements. Given the existing traffic volumes on the Pacific Highway (about 30,000 vehicles per day between Korora Hill interchange and the tie-in at Sapphire), the ROL restrictions necessary to minimise road user delays and traffic queuing would likely require work to be undertaken outside the recommended standard hours. Detailed arrangements for works in these areas would be developed during detailed design.

All construction activities are expected to be completed in stages with multiple traffic switches likely to maintain through traffic on existing roads. There are no appropriate alternative temporary routes or diversions to the existing Pacific Highway that could be used during construction. Provision for traffic would be included in the construction sequencing and construction methodology for all sections of the project, consistent with the Roads and Maritime guideline, *Traffic Control at Work Sites* (RTA, 2010). In addition to undertaking multiple traffic switches to maintaining through traffic, construction traffic management measures could include:

- Modification to lane widths to facilitate the safe entry, exit and movement of plant and materials in close proximity to existing roads
- Placement of separation barriers to protect live traffic from the worksites
- Reducing speed zones where existing road conditions are adversely modified by construction works
- Reducing shoulder widths to allow for tie-in works to be completed
- The use of temporary directional and advisory signage as well as Variable Message Signs would be used through the surrounding road network where necessary.

There are several locations where construction activities would be required close to existing local roads and property access roads, including:

- North Boambee Road
- Coramba Road
- Bennetts Road
- Shephards Lane
- Mackays Road
- West Korora Road
- Bruxner Park Road
- James Small Drive
- Korora School Road
- Old Coast Road
- Opal Boulevard
- Coachmans Close
- Seaview Close.

Speed restrictions and traffic controls would be required to manage traffic during construction of the project when construction activities are being carried out near the above listed roads. Construction of the project would have impacts on road users of the above roads.

Haulage may also have an impact on local roads as it would include the transfer of fill material within and beyond the construction corridor. Haulage would also consider peak travel hours and times, particularly during school and public holiday periods, to minimise the potential for delays on the existing Pacific Highway to the travelling public and to minimise impacts to local roads.

Haulage of excavated material would be carried out along the project corridor. The construction program will prioritise the excavation of one tunnel tube at each ridge (starting at both portals) to establish the haul road for the project.

6.7.6 Cumulative traffic impacts

An assessment has been carried out to determine the potential cumulative impacts of construction activities associated with current and identified developments within Coffs Harbour. A summary of any potential impacts has been detailed in Table 30. Where impacts have been noted it is anticipated that they would be mitigated with short term traffic management measures.

Table 30 Cumulative construction traffic impacts

Programmed Works	Impacted local roads	Potential traffic impacts
Moonee Beach Residential Subdivision	Pacific Highway (north of project)	May interact with haulage of materials north of the project. Combined increase in construction vehicles not anticipated to impact significantly on the capacity of the Pacific Highway.
Korora Rural Residential Release Area	Bruxner Park Road Old Coast Road	Traffic management measures will be put in place to ensure access to Bruxner Park Road and Old Coast Road will be available during construction works. Old Coast Road access to Pacific Highway will be permanently closed as part of the project. Access to Old Coast Road will instead be provided via the service road.
Sunset Ridge Estate	Shephards Lane	Combined increase in construction vehicles not anticipated to impact significantly on the capacity of the Pacific Highway.
Seniors Housing, Arthur Street	Arthur Street	Located on the eastern side of the Pacific Highway where this is minimal construction traffic associated with the project. Therefore, limited cumulative impacts anticipated.
Coffs Central Shopping Centre Extension	Harbour Drive	Construction periods do not overlap therefore no cumulative impacts anticipated.
Coffs Harbour Hospital Campus Extension	Pacific Highway at southern end of project	Pacific Highway / Stadium Drive intersection is currently at LOS C. Traffic management measures to be put in place to monitor any excessive queuing or delays due to the potential combined increase in traffic demand due to construction activities.
North Boambee Valley Urban Release Area (Highlander Drive)	North Boambee Road	No significant impact to the capacity of North Boambee Road anticipated with the combined increase in traffic volumes. Should construction of the urban release area commence during bridge works over North Boambee Road, contractor to be consulted to minimise disruption to construction works.
North Boambee Valley (West) Residential Investigation Area	North Boambee Road	Construction timing currently unknown.
Elements Estate	Stadium Drive	Traffic management measures will be put in place to ensure access Stadium Drive will be available during construction works. Pacific Highway / Stadium Drive intersection is currently at LOS C. Traffic management measures to be put in place to monitor any excessive queuing

Programmed Works	Impacted local roads	Potential traffic impacts
		or delays due to the potential combined increase in traffic demand due to construction activities.
Stadium upgrade	Stadium Drive	Construction periods do not overlap therefore no cumulative impacts anticipated.
Lyons Road, Bonville Subdivision	Pacific Highway (south of project)	May interact with haulage of materials south of the project. Combined increase in construction vehicles not anticipated to impact significantly on the capacity of the Pacific Highway.
Warrell Creek to Urunga Pacific Highway Upgrade	Pacific Highway (south of project)	Works complete. No overlap of construction traffic therefore no cumulative impacts anticipated.
Woolgoolga to Ballina Pacific Highway upgrade	Pacific Highway (north of project)	No overlap of construction traffic therefore no cumulative impacts anticipated.

6.7.7 Impacts on other travel modes

Heavy vehicles

Temporary delays may occur for heavy and restricted vehicles travelling within the Coffs Harbour Local Government Area due to increased traffic levels and the implementation of temporary traffic management measures associated with construction of the project. Due to the low levels of additional traffic that would be generated by the construction of the project, impacts from this temporary increase in traffic volume is expected to have minor impacts for heavy vehicles along the Pacific Highway.

North Coast Railway

The bridge crossing over the North Coast Railway will be constructed as part of the bridge works phase in Construction Zone 2. Therefore, construction of the project could have short-term impacts on the North Coast Line rail services, which would not be able to run during possession (closure of the rail line). The duration of track possessions would be confirmed during detailed design and through consultation with the Australian Rail Track Corporation (ARTC).

To minimise impacts to rail passenger and freight operations, Roads and Maritime will consult with ARTC to schedule track possessions during planned ARTC rail network outages during off-peak periods, such as public holidays and long weekends.

Public transport

Temporary delays may occur for buses travelling within the Coffs Harbour Local Government Area due to the impact of temporary traffic management measures associated with construction of the project.

Some proposed construction access routes would be located along existing bus routes. The potentially affected bus routes would be:

- Routes 367 and 368 along Bray Street, Mackays Road and Coramba Road
- Route 360 along the Pacific Highway.

There may be impacts to bus travel times on the construction access routes due to the addition of construction traffic. It is recommended that liaison with Busways and school bus operators is undertaken to ensure potential impacts during construction are communicated.

The informal bus stop at the Coramba Road / Spagnolos Road intersection and the Kororo Public School bus interchange would be permanently relocated because of the project. Consultation would be carried out with the bus operators during detailed design to ensure changes to bus stops are communicated to bus users prior to commencement of construction.

No additional alterations or relocations of bus stops are expected for construction of the project.

Pedestrians and cyclists

Temporary delays and/or detours may be required where construction activities occur across existing cycling routes and shared paths. Locations that may be impacted include:

- The shared path along the eastern side of the Pacific Highway at the southern extents of the project
- The shoulder of the existing Pacific Highway used by cyclists along the northern extents of the project between Charlesworth Bay Road and Solitary Islands Way
- Bruxner Park Road recreational cycling route
- Pedestrian and shared path facilities surrounding Kororo Public School. The new Luke Bowen footbridge would be constructed prior to the removal of the existing bridge where possible with any disruptions to access occurring outside of school terms and in consultation with Kororo Public School and NSW Department of Education.

Alternative cycling and pedestrian routes will be developed during the detailed design phase and detours established as required during the construction period.

Parking

During construction, some existing parking areas at Kororo Public School will be permanently removed as part of the project. The affected areas include the formal parking area along Korora School Road as well as informal parking along Korora School Road and along the service road on the western side of the Pacific Highway. The replacement parking area to be provided as part of the project would need to be constructed prior to the removal of existing parking where possible or alternative arrangements agreed in consultation with Kororo Public School and NSW Department of Education.

Existing parking arrangements associated the informal school bus stop at the intersection of Coramba Road and Spagnolos Road, Englands Road and at the

OzGroup Packhouse at Isles Drive would also be affected during construction of the project. Consultation and further parking demand and use surveys will be undertaken at these locations to confirm the extent of temporary and/or permanent impacts and alternative arrangements where reasonable and feasible.

Property access

The permanent property access changes that would result from construction of the project are described in Section 5.9. It is not currently anticipated that any additional property access would be required during the construction period. However, should there be any temporary property access changes required as part of short term traffic management measures, the property owners will be consulted to ensure changes are communicated prior to construction.

7 Management of traffic and transport impacts

The following management and mitigation measures would be implemented to mitigate construction and operational traffic impacts from the project:

- Consultation with relevant stakeholders and community:
  - Kororo Public School regarding the changes to parking, vehicular and pedestrian / cyclist access, and bus interchange
  - school bus operators regarding the changes at the Kororo Public School bus interchange
  - school bus operators regarding the potential relocation of the school bus stop at the Coramba Road / Spagnolos Road intersection
  - affected landowners about changes to property access
- During detailed design, Roads and Maritime will conduct a project road safety audit in accordance with *Austroads Guide to Road Safety* to identify and address potential safety issues associated with the operation of the project
- If more detailed information regarding future traffic demand becomes available during detailed design of the project (e.g. from development applications, traffic counts, signalised intersection detector data etc.), Roads and Maritime will assess the suitability of incorporating the revised projections into the modelling
- A construction traffic management plan will be prepared (in accordance with *Traffic Control at Work Sites Manual* (Roads and Maritime, July 2018)) prior to commencement of construction, including:
  - Traffic control plans illustrating the access arrangements to ancillary sites and the location of traffic management signs and devices
  - Scheduling of construction works, particularly deliveries, to be completed outside of peak periods where possible
  - Requirements for notification of road users where traffic management measures are to be implemented
  - Access management plan to ensure access to properties can be maintained where it is safe and feasible during construction
  - Pedestrian and cyclist management plan where necessary to ensure access is maintained where it is safe and feasible during construction
  - Road safety audit requirements
  - Traffic performance review / observations during construction
- Pre-construction road dilapidation reports
- Vehicle movement plans for construction haulage routes.

8 References

Arup 2018, *Coffs Harbour Bypass – Traffic Model Development Report*

Austroads 2015, *Austroads Guide to Road Safety Part 8 Treatment of Crash Locations*

Roads and Maritime 2002, *Guide to Traffic Generating Developments*

Roads and Maritime 2013, *Traffic Modelling Guidelines (2013)*

DP&E 2015, *North Coast Employment Land Review*

Coffs Harbour Land Use and Employment Strategies

New Zealand Transport Authority 2014, *Transport Model Development Guidelines*

2016, *Planning Proposal – Korora Basin – Residue Land adjacent to the Pacific Highway*

2011, *Big Banana Development Coffs Harbour – Access Options Assessment Paramics Modelling*

2009, *North Boambee Valley East Development Control Plan*

2013, *Coffs Harbour City Council Planning Proposal – North Boambee Valley West Residential Investigation Area*

2010, *Pacific Bay Western Lands Project Application – Environmental Assessment Report*

Coffs Harbour City Council *Development Specification Design 0041 Geometric Road Layout*, 2009

9 Glossary

Table 31 Glossary of terms

Term	Definition
%	Per cent
AADT	Annual Average Daily Traffic
ARTC	Australian Rail Track Corporation
CBD	Central Business District
CHCC	Coffs Harbour City Council
CHSTM	Coffs Harbour Strategic Transport Model
CHTM	Coffs Harbour Traffic Model
CSSI	Critical State Significant Infrastructure
DP&E	Department of Planning and Environment
EIS	Environmental Impact Statement
EP&A Act	Environmental Planning and Assessment Act 1979
km	Kilometres
LGA	Local Government Area
LOS	Level of Service
m	Metres
mvkt	million vehicle kilometres travelled
OD	Origin-destination
Roads and Maritime	Roads and Maritime services
SEARs	Secretary's Environmental Assessment Requirements
The project	Coffs Harbour Bypass
TMP	Traffic Management Plan
veh/h	Vehicles per hour
vpd	Vehicles per day

Appendix A

Coffs Harbour Bypass Traffic Model Development Report

Roads and Maritime Services

Coffs Harbour Bypass

Traffic Model Development Report

Issue | 22 May 2018

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 248379-00

Arup
Arup Pty Ltd ABN 18 000 966 165

Arup
Level 4, 108 Wickham Street
Fortitude Valley
QLD 4006
GPO Box 685 Brisbane QLD 4001
Australia
www.arup.com

ARUP

Contents

		Page
1	**Introduction**	**1**
1.1	Purpose and Objectives	1
1.2	Model development history	1
2	**Model specification**	**3**
2.1	Model functionality	3
2.2	Model hierarchy	3
2.3	Coffs Harbour Strategic Transport Model	4
2.4	Network traffic model	7
3	**Data sources**	**10**
3.1	Overview	10
3.2	Household travel survey data sources	10
3.3	2011 and 2016 census demographic data	13
3.4	2011 census journey to work data	14
3.5	Enrolment data	18
3.6	Data for validation	18
4	**Strategic model development**	**20**
4.1	Zone system	20
4.2	Network	21
4.3	Trip generation	32
4.4	Trip distribution	37
4.5	Time of day and mode split	39
4.6	External demand	40
4.7	Special generators	41
4.8	Assignment	42
5	**Strategic model validation**	**43**
5.1	Approach to validation	43
5.2	Counts and screenline locations	43
5.3	Count validation statistics	45
5.4	Screenlines	45
5.5	Individual count validation	49
5.6	Journey time validation	55
5.7	Model vs O-D Survey	58
6	**Strategic model future years**	**59**
6.1	Data sources	59
6.2	Forecast procedure	59

6.3 Additional developments in Coffs Harbour 60
6.4 Population 62
6.5 Employment and workers 68
6.6 Model forecast outputs 74

7 Traffic model development 76
7.1 Introduction 76
7.2 Model network 76
7.3 Model assignment 79

8 Traffic model calibration and validation 81
8.1 Model calibration 81
8.2 Route choice calibration 81
8.3 Traffic demand calibration 82

9 Forecast traffic performance 97
9.1 Traffic growth rates 97
9.2 Do minimum improvements 97
9.3 Forecast volumes 98
9.4 Predicted travel times 99
9.5 Predicted travel time savings 101
9.6 Total distance travelled 101
9.7 Average travel speeds 102

10 Expansion factors 104
10.1 Peak to daily factors 104
10.2 Daily to annual factor 105

Appendices

Appendix A
Origin-Destination Traffic Survey

Appendix B
Strategic Model - Screenline Counts

Appendix C
Strategic Model - Count Scatter Plots

Appendix D
Strategic Model - Journey Time Comparisons

Appendix E

Traffic Model - Signal Timings Calibration

Appendix F

Traffic Model - Traffic Count Comparisons

Appendix G

CHSTM Model User Guide

Appendix H

CHTM - Model Plots

1 Introduction

Arup was engaged by Road and Maritime Services (Roads and Maritime) to prepare a business case, develop a concept design and undertake an Environmental Impact Statement (EIS) for the Coffs Harbour Bypass project (the Project). As a part of the scope, Arup was required to undertake traffic modelling which entailed developing a strategic demand forecasting model and a mesoscopic traffic assignment model.

The purpose of this report is to document the model development and the level of calibration and validation achieved for the Coffs Harbour Strategic Transport Model (CHSTM), and the Coffs Harbour Traffic Model (CHTM).

1.1 Purpose and Objectives

The purpose of this report is to detail the modelling hierarchy structure and development methodology of the Coffs Harbour Strategic Transport Model (CHSTM), and Coffs Harbour Traffic Model (CHTM).

The strategic transport model will be used to carry out high-level travel demand forecasts and to provide traffic inputs for the mesoscopic model for more detailed traffic analysis. The CHSTM and CHTM model outputs will be used to:

- Provide input into an economic analysis for the business case considering the difference between a base case and project case in future years.
- Assess the future traffic performance of the concept design.
- Provide inputs to the assessment of traffic related impacts for an Environmental Impact Statement.

1.2 Model development history

The traffic models for the Project have been progressively developed since September 2016. The models have been utilised at various phases of the Project and have undergone various levels of reviews. A summary of key model development milestones are summarised below:

- June 2016 - traffic surveys undertaken in June 2016
- September 2016 – model development initiated
- February 2017 - an initial version of the CHSTM utilised for high level assessment of options for the bypass access strategy
- March 2017 – Models completed to (approximately) 90% calibration level and used for assessment of the Strategic Business Case
- March 2017 - Model development progress presented to RMS Road Network Analysis

- May 2017 – Peer review undertaken on models used for the Strategic Business Case.
- June 2017 – Gateway review undertaken by iNSW
- July to August 2017 – Models updated with new origin-destination survey data
- August 2017 – Land-use and demographic assumptions presented to Council for comment.
- November 2017 – Model development progress presented to RMS Road Network Analysis
- September 2017 to January 2018 – Models finalised with updated with 2016 Census data, land use comments from Council addressed, comments from the peer review addressed.
- February 2018 - Model development progress presented to RMS Road Network Analysis
- February 2018 – Models finalised and used for assessment of Stage 1 Final Business Case
- March 2018 – Model documentation (this report) submitted for comment.

2 Model specification

2.1 Model functionality

2.1.1 Business case

Transport modelling was required to inform the evaluation of the project and the problem definition. The model will need to provide future year traffic forecasts to identify the future traffic network operations and the impact the bypass will have on the Coffs Harbour road network and externalities. Outputs from the model will be used for the economic evaluation for the business case. For the purposes of the business case, the model needs to be capable of assessing or supporting the assessment of:

- Changes to travel demand due to land use growth in the Coffs Harbour region
- Temporal impacts on travel demand and traffic operation.
- The impact of different vehicle types including commercial vehicle demands
- Economic evaluation of the preferred bypass alignment.

2.1.2 Design

Detailed traffic operational analysis will be required to support concept design development including:

- Interchange options considering location, form and connectivity
- Construction staging
- Design of connection roads

2.1.3 Environmental impact statement

Transport modelling is required to input to a range of activities and assessments to support the EIS including:

- Traffic demand levels on the bypass
- Impact on the existing highway through Coffs Harbour and other surrounding roads
- Impact on amenity
- Air quality assessment
- Noise impact.

2.2 Model hierarchy

To undertake the work required in the specification, a suite of modelling tools were developed. A strategic model was developed in Emme to provide base and future year travel demand forecasts. This three-step model (excludes mode share

modelling) generates the traffic demand inputs for the detailed assignment mesoscopic model, built in AIMSUN. For detailed traffic performance analysis of intersections, AIMSUN microsimulation and/or SIDRA software was used, to which the mesoscopic model provided the relevant traffic volume inputs.

The modelling hierarchy adopted for the purposes of modelling the Coffs Harbour Bypass is shown in Figure 1.

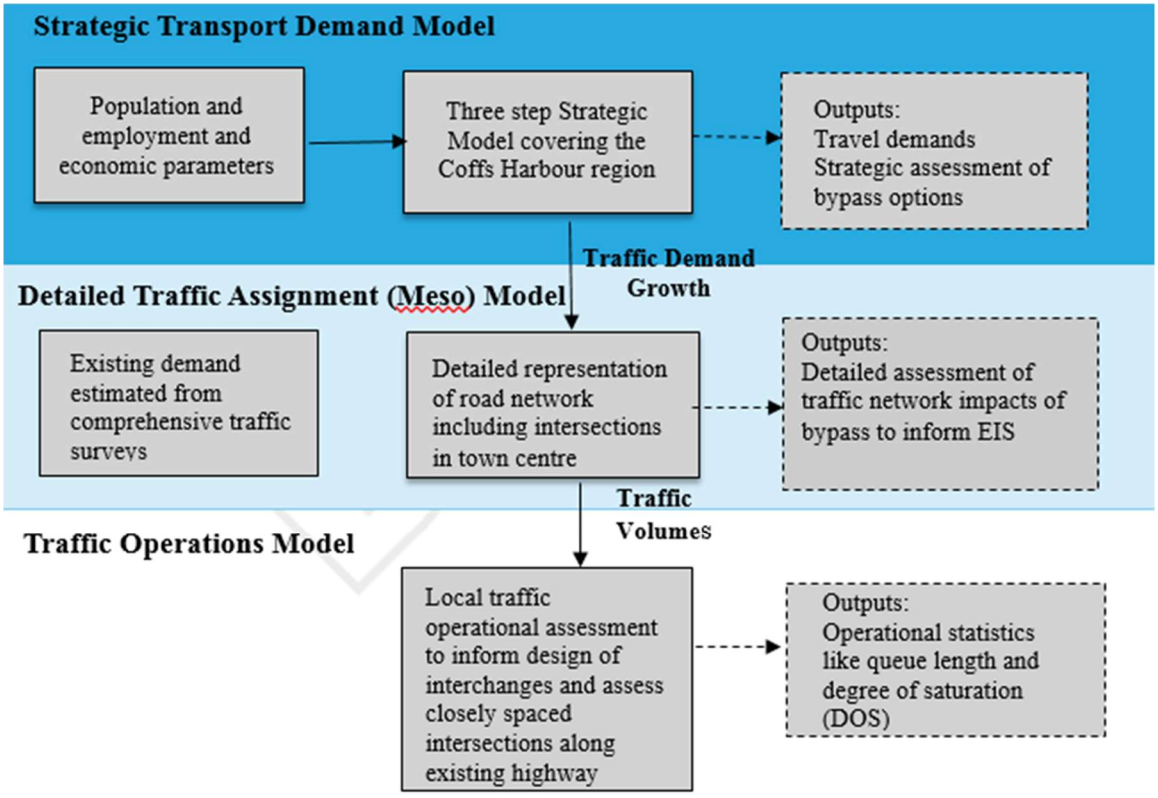


Figure 1 - Model hierarchy diagram

2.3 Coffs Harbour Strategic Transport Model

2.3.1 Summary of CHSTM key features

The key dimensions and features of the CHSTM are summarised in Table 1.

Table 1. Key features of the CHSTM

Key Feature	Description
Model Zones	CHSTM covers a similar area to the Coffs Harbour Local Government Area. 619 internal travel zones defined based on the combination of SA1 and mesh block boundaries from ABS. 7 external travel zones defined as external traffic demand feeds.
Model Network	All state controlled highways, arterial, distributor and local collector roads plus some important local roads.
Model Year	Calibrated to represent travel conditions in a 2016 base year.

Key Feature	Description
	Demographic forecasts and networks developed for forecast years 2024, 2034 and 2044.
Time Periods	24-hour demand split into 4 time periods: - AM (8-9am), - OP (9am-4pm), - PM (4-5pm), and - RD (5pm-8am).
Vehicle Classes	3 vehicle classes: - light vehicles (Austroads classification 1 and 2), - medium commercial vehicles (Austroads classification 3 – 5), and - heavy commercial vehicles (Austroads classification 6 – 12)
Trip Purposes	Travel demand segmented into 9 trip purposes: - HBW (home based work), - HBEPS (home based education primary and secondary), - HBET (home based education tertiary), - HBEs (home based escort), - HBS (home based shopping), - HBO (home based other purposes), - NHB (non-home based trips), - VHB (visitor home based), - VNHB (visitor non-home based) Plus - MCV (medium commercial vehicles), - HCV (heavy commercial vehicles)
Mode Choice	Fixed PT and active travel mode share
Public Transport	Bus services have not been included in the CHSTM due to the relatively low levels of bus service provision in Coffs Harbour.

2.3.2 Model coverage

The CHSTM covers the vast majority of the Coffs Harbour Local Government Area (LGA), with the exception of one unpopulated rural area due to the SA1 zone crossing the LGA boundary. The zone system was based primarily on 2011 ABS Census mesh blocks and SA1 zones, with a few large mesh block zones further subdivided into several land parcels to represent the proposed future land uses. The modelled road network includes all highway, arterial, distributor and local collector roads and some important local access roads.

The zonal detail and network coverage is presented Figure 2.

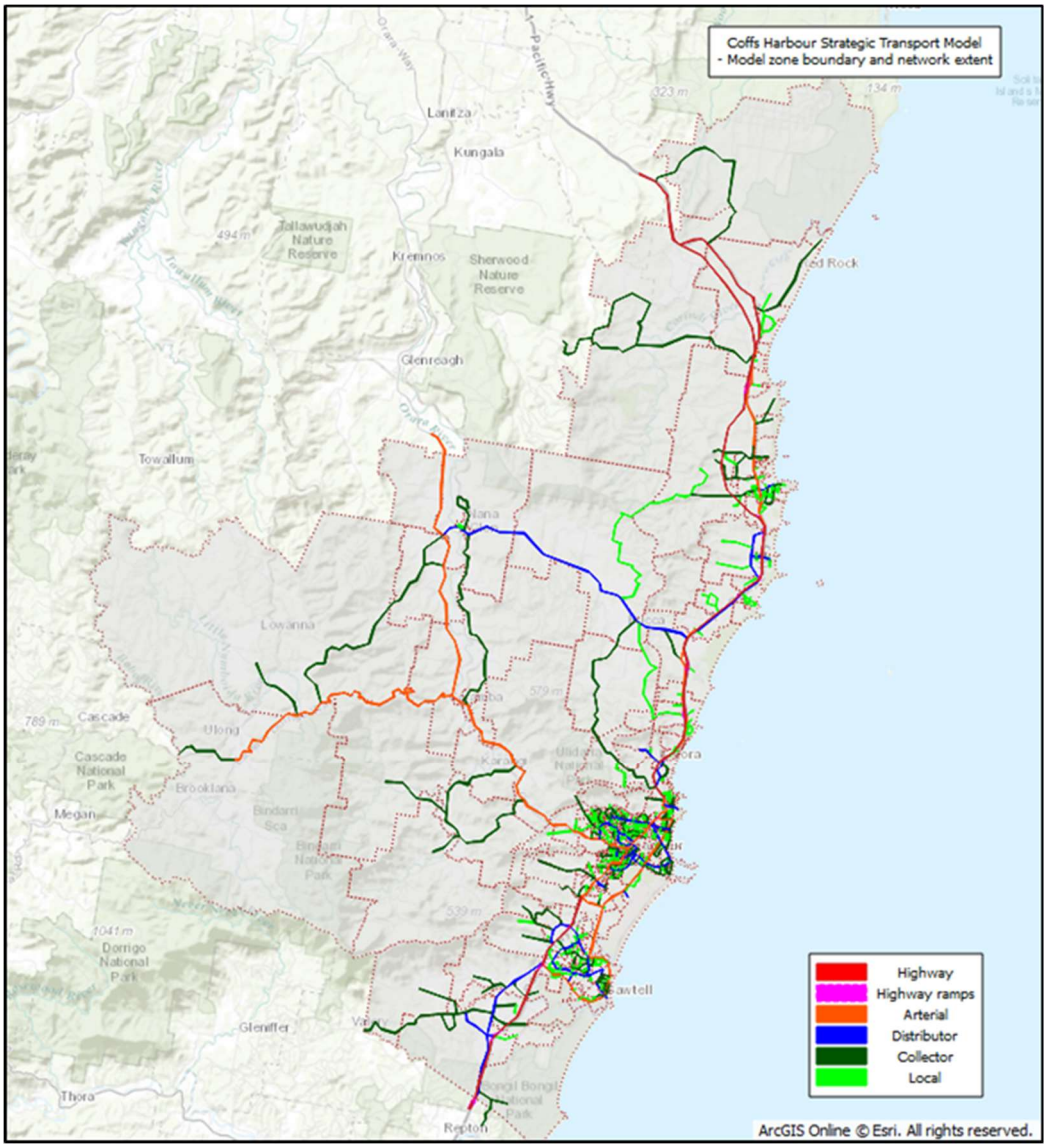


Figure 2 - Extent of CHSTM

2.3.3 Model structure

The model structure consists of a typical four-step strategic modelling approach, with a simplified mode choice module for the estimation of the car driver mode. A logit mode choice model was considered unnecessary for Coffs Harbour due to the very low public transport mode share. The CHSTM follows the procedure presented in the flowchart in Figure 3.

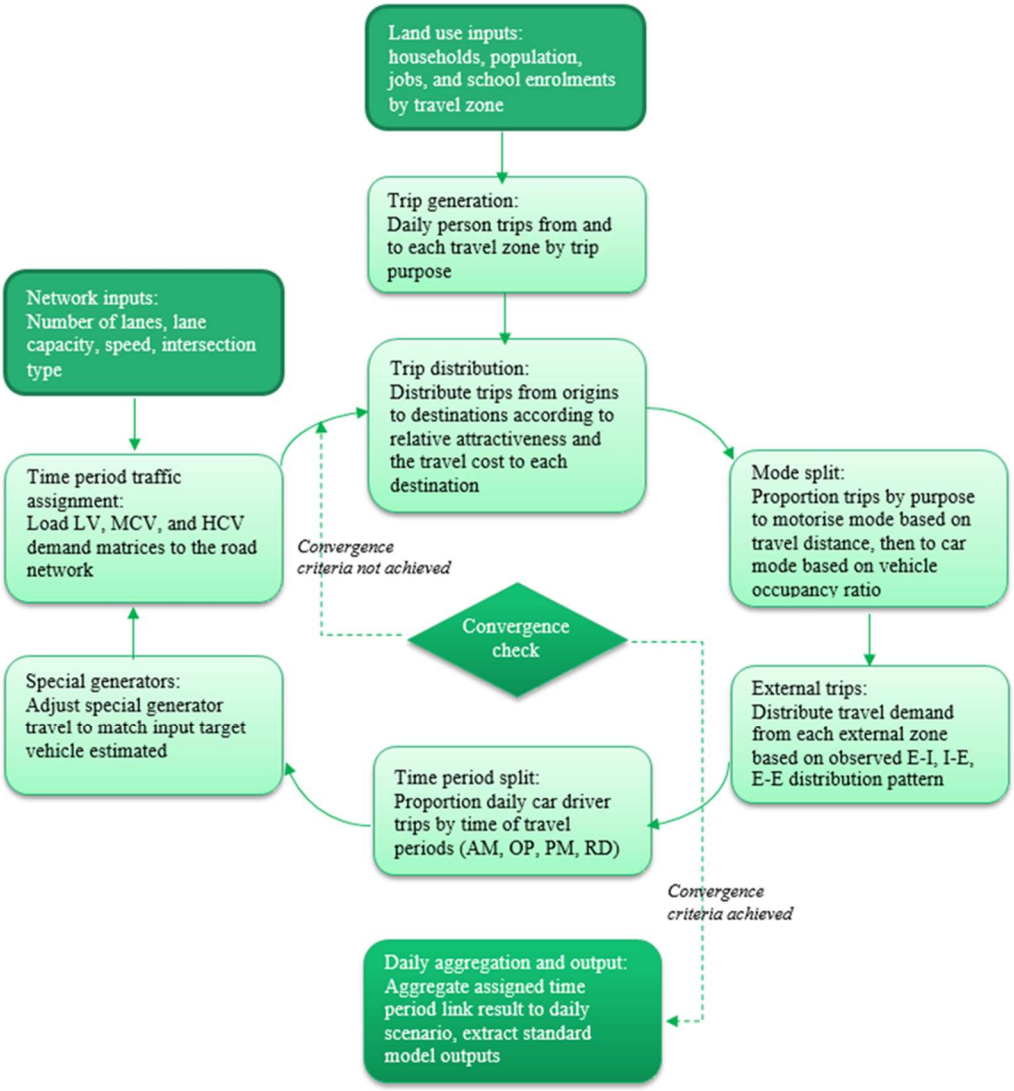


Figure 3 - CHSTM model procedure - four step model with fixed mode share

2.4 Network traffic model

2.4.1 Model overview

A network traffic assignment model in AIMSUN has been developed for the Coffs Harbour Bypass Project. The purpose of the Coffs Harbour Traffic Model (CHTM) was to assign traffic demands (outputs from the strategic transport model) to the road network to provide predictions of traffic volumes and delays on modelled road links and turns. The model outputs have been used as inputs to the economic analysis for the business case comparing a future year project case scenario against a base case scenario.

The key features of CHTM are summarised in Table 2.

Table 2. Key features of the network assignment model

Key Feature	Description
Model Zones	CHTM covers the central Coffs Harbour area from Sapphire Beach to Boambee East. A total of 544 internal travel zones were developed based on the combination use of SA1 and mesh block boundaries from ABS. A total of 7 external travel zones were defined as external traffic demand feeds.
Model Network	All state controlled highways, arterial, distributor and local collector roads and most local roads.
Model Year	Calibrated to represent travel conditions in a 2016 base year. Traffic demand forecasts and networks developed for forecast years 2024, 2034 and 2044.
Time Periods	Peak morning and afternoon one hour periods: AM (8-9am) and PM (4-5pm).
Vehicle Classes	3 vehicle classes - light vehicles (Austroads classification 1 and 2), - medium commercial vehicles (Austroads classification 3 – 5), and heavy commercial vehicles (Austroads classification 6 – 12)
Trip Purposes	Travel demand not defined by trip purpose
Public Transport	Bus services have not been included in the CHTM due to the relatively low levels of bus service provision in Coffs Harbour.

2.4.2 Model network

The CHTM road network is shown in Figure 4 bounded by the dashed red line. The model network was coded to represent the physical characteristics of the existing road network including functional hierarchy, number of lanes (including turning lanes) and free-flow speed. Intersections were also coded according to existing form and control type such as give-way, roundabout, merges and signalised intersections. The signalised intersections were coded using existing signal phase plans and timings.

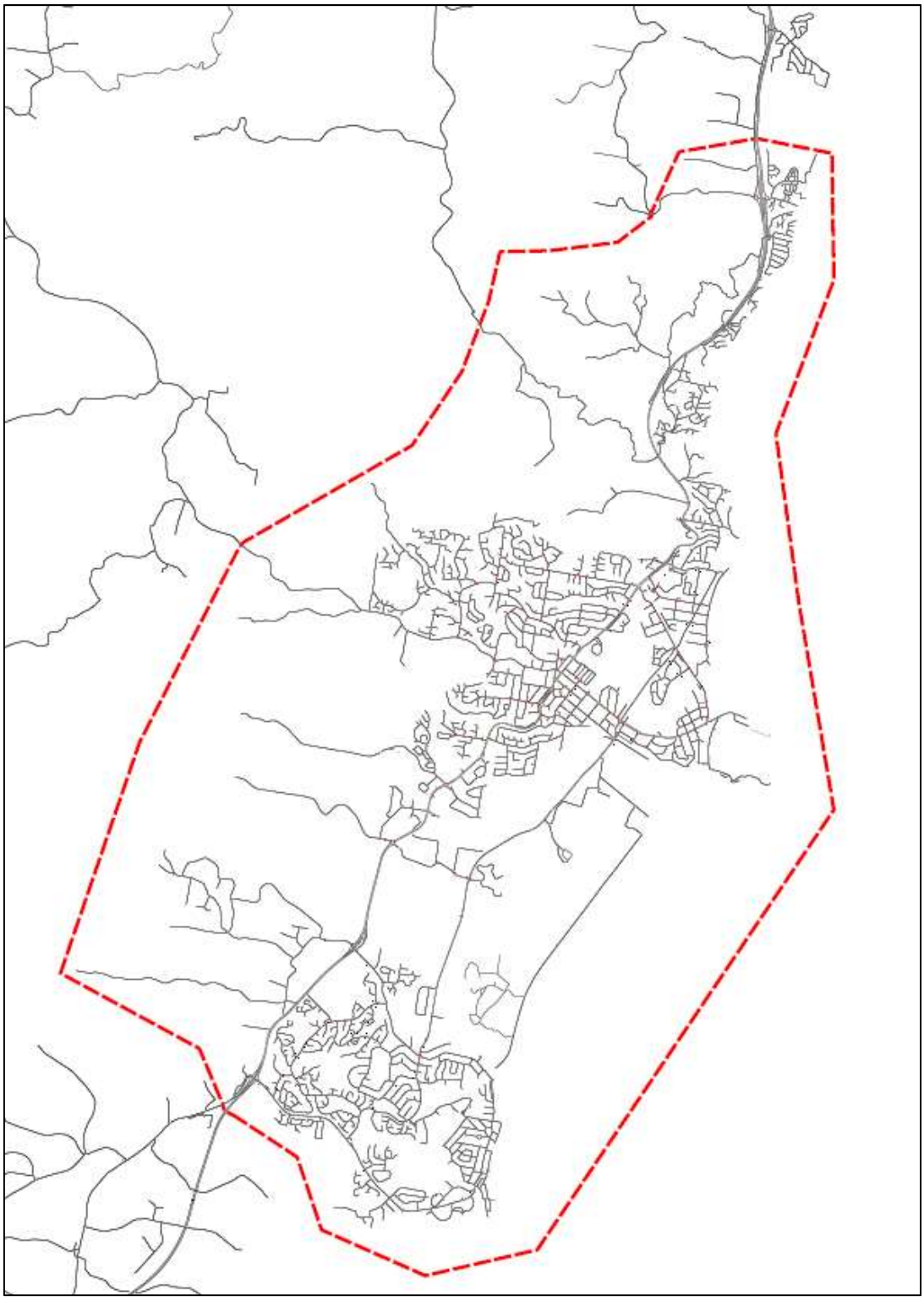


Figure 4 - Traffic model area

3 Data sources

3.1 Overview

Strategic transport models are reliant on travel survey data to calibrate travel forecasting functions used to estimate trip generation, distribution and mode choice characteristics against observed transport network demands and patterns as a basis to forecast future travel demand growth.

A comprehensive household travel survey (HTS) dataset was not available for Coffs Harbour. Undertaking a HTS for Coffs Harbour was explored but was considered not feasible within the study timeframe or budget of this project. The development of the model functionality was therefore based on other data, augmented by experience from other similar regional models – called in this report *the reference models*. The key data sources are summarised in the following subsections.

3.2 Household travel survey data sources

3.2.1 2012 Regional HTS – TfNSW

In 2012, Transport for NSW Bureau of Transport Statistics (BTS) carried out a regional Household Travel Survey (regional HTS) across 15 regional areas in Northern NSW including Coffs Harbour. As this survey covered multiple regions, the sample size of trips within Coffs Harbour was relatively small at 360. The data was lacking geographical details with recorded origins and destinations at the suburb level, which was ideally required at detailed SA1 level. As such, the data set was considered inadequate to develop representative functions and parameters for the region.

Additionally, the CHSTM required certain details that were not included in the regional HTS survey such as some key trip compositions (i.e. home based education trips, non-home based trips) and information relating to the time of day when travel was undertaken; . However, the regional HTS survey data has been used to assist in building the demand model for CHSTM, by applying a total regional analysis where appropriate and cross-referencing parameters developed from other data sources.

3.2.2 Local household travel survey

A local household travel survey dataset for Coffs Harbour was not available during the model development work. The option of undertaking a survey for the purposes of CHSTM development was explored, however it was deemed unfeasible within the study timeframe and budget.

3.2.3 Transferability of other model variables and approaches

Although it is important and recommended to have specified localised HTS data available for strategic transport model development, collecting such data is

normally costly and time consuming. With the absence of HTS data, the use of model variables from other models provided an alternative source of information. Care needed to be taken to ensure the transferred model variables were usable in the new context.

The Cairns Strategic Transport Model (based on the 2014 Cairns Household Travel Survey), a model with certain similarities in the urban context to Coffs Harbour, was selected as the source of model variables to support the development of the CHSTM. Some context similarities include but are not limited to the following:

- Similar urban layout with north-south expansions, as both are constrained by geometry with coastal frontage on the east and mountain area to the west.
- Both cities function as major urban centres with national highways servicing the area.
- Strong tourism industries (the overnight visitor to total population ratios were 8% in Coffs Harbour versus 11% in Cairns based on 2011 Census).
- Similar industry profiles (both cities have a majority of jobs in the service industry with 40% in Coffs Harbour and 37% in Cairns, followed by industrial jobs with 20% and 22%, then professional jobs with 18% and 21%).
- Low public transport mode shares with limited public transport system.

The population profile between the two cities differ to a certain degree with Coffs Harbour having a higher proportion of elderly population than Cairns (for persons aged 65 and above, 18% in Coffs Harbour and 10% in Cairns). In terms of working age population, Coffs Harbour has a 58% share while Cairns has 64%.

Despite both cities having other notable differences between each other, for example the total population of Cairns is double that of Coffs Harbour, the similarities in socio-economic characteristics shows that the Cairns Strategic Transport Model is a suitable model to be considered. Two additional reference models have also been used to cross check the outputs, and to update variables where appropriate. The additional models were Townsville Strategic Transport Model and the Rockhampton and Livingstone Strategic Transport Model.

3.2.3.1 Trip generation / attraction parameters

The first stage of a four-step model involves the estimation of the number of trips generated from and attracted to individual zones. The risk of adopting transferred trip generation parameters was considered small as the demographics and socio-economic characteristic in Australian small cities on the eastern sea-board are generally homogeneous. In addition to the above mentioned three reference models being used to cross check the outputs, a localisation process (using count data) has been followed to calibrate the parameters to fit the local context in Coffs Harbour.

Traffic counts at closed development cordons have been used to understand how well the generated vehicle trips match the traffic counts. Those closed cordons have been defined specifically to eliminate through-traffic in the traffic counts. The closed developments cordon captured 12 residential zones, 4 industrial zones, 1 mixed retail and residential zone, and the Southern Cross University zone. It can be seen in Figure 5 that the daily generated light vehicle trips matched well with the count data at the closed cordon locations.

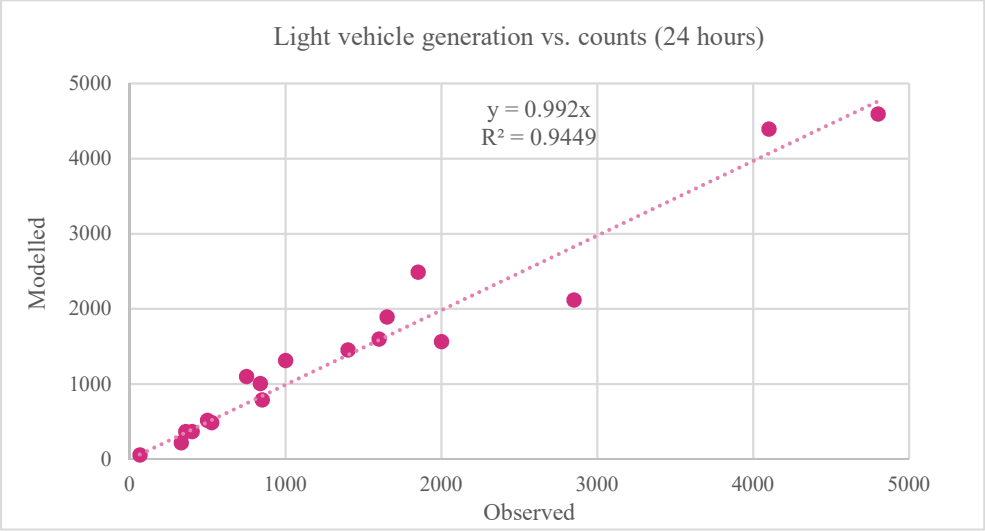


Figure 5 - Trip generation checks

The home based work trip generation parameters were estimated based on localised dataset as an exemption, that the 2011 NSW Bureau of Transport Statistics journey to work (JTW) data provides a good source to undertake such analysis.

3.2.3.2 Trip distribution coefficients

The second stage of the model development involves distributing the trips generated from each origin zone to each destination zone. A gravity model has been adopted whereby the distribution of trips is proportional to the attractive power of destinations and inversely to the friction (time and distance) between them. Because of this, the process does not directly follow / rely on observed trip patterns. As such the trip length distribution curves generally follow similar patterns based on the trip making purposes. Precise distribution may not be easily followed due to the unique land use pattern existing in each city. For example, the physical locations of tertiary institutes will largely influence the distribution curve of home based education tertiary trips.

The home based work trip distribution coefficients were calibrated to the 2011 NSW JTW data. The regional HTS survey did not provide enough local information to support trip distribution calibration for the other trip purposes. Therefore, the trip distribution of other trip purposes was calibrated to the trip length distribution curves in the Cairns Strategic Transport Model. The distribution was ultimately validated using traffic volumes at 14 screenline

locations across Coffs Harbour LGA which indicated the transferred coefficients fit well with the Coffs Harbour condition.

3.2.3.3 Mode split factors

Mode choice was considered as a deterministic step during the CHSTM development as choice behaviour differs by the cultural context and the provisions of facilities and services. Mode choice information was made available by the regional HTS for Coffs Harbour, form which the mode choice module was developed.

3.2.3.4 Time period factors / Route choice

The final stage of a typical four-step model is primarily related to route choice (traffic assignment). This step is unaffected by HTS data availability as information about route is generally not collected as part of a HTS.

Data regarding the choice of time of day travel are normally collected in a HTS to provide more detailed travel characteristics to build a transport model, but this information was unavailable in the regional HTS data for Coffs Harbour. Despite this, the time periods of travel characteristics do have some similarities in home base trips, as the trip makers are normally aiming to reach their destination at a certain committed time frame, for example, commuting trips normally happen during the peak hours. Although time period choice does vary by urban extent and the level of congestion in the network, these factors in the Cairns Strategic Transport Model were considered transferable for Coffs Harbour since both cities have similar spatial urban characteristics.

3.3 2011 and 2016 census demographic data

3.3.1 Population

The data used for this exercise was the available 2016 Census data, released on 27 June 2017. Note this data does not include the complete set of population and housing profiles collected with the 2016 Census. The information included:

- Characteristics of people, families and dwellings including age structure, education, income and housing at statistical area level 1 (SA1)
- Counts of dwelling and population totals at mesh block level (MB).

The next round of census data released is scheduled in October / November 2017, and is likely to include:

- Residential worker information in statistical area level 1
- Method of travel to work data at a higher aggregated level (statistical area level 2 (SA2))
- Estimated resident population at higher aggregated level (SA2)

Total population by mesh block was used in conjunction with detailed population categorisation by age group at SA1 level to produce an estimation of population at mesh block level. This was aggregated into the following age groups:

- Population total
- Population 0 – 17
- Population 18 – 64
- Population 65 +

3.3.2 Households

The number of households per traffic zone were estimated using 2016 census data, which provided the total number of dwellings per mesh block.

3.3.3 Workers

The number of resident workers was still unavailable in the 2016 census at the time of this study. Therefore, the 2011 census was used to provide the split of workers by industry category based on 2016 working age population at SA1 level. This data was prepared by five industry sectors, subdivided by blue collar and white collar categories, as follows:

- Service (blue collar/white collar)
- Professional (blue collar/white collar),
- Industry (blue collar/white collar),
- Retail (blue collar/white collar),
- Other (blue collar/white collar)

The correlation between jobs in detailed categorisation and the five main industry types is documented in Section 3.4.

3.3.4 Visitor data

Visitor data was available in the 2016 census at SA1 level. This data was used as the basis for modelling visitor trips within the model zones, split into mesh blocks based on using the total population split.

3.4 2011 census journey to work data

The 2011 NSW Bureau of Transport Statistics journey to work (JTW) data provides a good source for understanding home based work (HBW) travel distribution patterns in the Coffs Harbour Region.

This information was provided at the JTW sector level as a basis to calibrate HBW travel patterns. The average distance between different JTW sectors can be

calculated together with the total number of home based work trips to establish the trip length distribution profile. The time period of travel information was not available in this data source, hence was developed based on reference models.

The dataset also represented the best available source of information relating to the number of jobs by journey to work zone. This was provided by detailed industry and sector breakdowns. The information was aggregated into five industries and split by blue collar and white collar categories. This was achieved by using the correlations shown in Table 3 and

Table 4.

Table 3. Detailed industry to industry sector lookup

Detailed Industry type	Industry Sector
Accommodation and Food Services	Service
Administrative and Support Services	Professional
Agriculture, Forestry and Fishing	Other
Arts and Recreation Services	Service
Construction	Industry
Education and Training	Service
Electricity, Gas, Water and Waste Services	Other
Financial and Insurance Services	Professional
Health Care and Social Assistance	Service
Inadequately described or Not stated	Other
Information Media and Telecommunications	Industry
Manufacturing	Industry
Mining	Other
Other Services	Service
Professional, Scientific and Technical Services	Professional
Public Administration and Safety	Professional
Rental, Hiring and Real Estate Services	Professional
Retail Trade	Retail
Transport, Postal and Warehousing	Industry
Wholesale Trade	Retail

Table 4. Detailed job type to job category lookup

Detailed Job Type	Job Category
Clerical and Administrative Workers	White collar
Community and Personal Service Workers	Blue collar
Inadequately described or Not stated	Blue collar
Labourers	Blue collar
Machinery Operators and Drivers	Blue collar
Managers	White collar
Professionals	White collar
Sales Workers	White collar
Technicians and Trades Workers	Blue collar

The number of jobs per model zone was then estimated using the estimated gross floor area (GFA) in each zone to split the totals from journey to work zone by industry type. The process for undertaking this was as follows.

Step 1 - estimate GFA:

- Coffs Harbour City Council provided property information by land use type
- Filter out lots that are job related (land use type in relevant to business purposes, e.g. B1-B6 as business centres, IN1-3 as industrial areas, etc.)
- Sample measuring of roof areas and building floors to estimate GFAs.
- Calculate the average floor space ratio (FSR) by land use type (e.g. business centre, industry area, commercial core, special purposes, etc.)
- Apply the FSR back to derive GFAs based on land size by land use type, and constrained by Council's FSR limit.
- Aggregate calculated GFAs into JTW zone level (by land use type).

Step 2 - calculate GFA to job ratio:

- A regression model was developed to establish the relationship between GFAs and jobs, using total jobs by industry type at JTW level and GFAs by land use type at JTW level.
- Business surveys were also undertaken to confirm & supplement the relationships derived above.

The assumptions for the number of jobs by industry type generated by 1,000 sqm of each land use type are shown in Table 5. These were initially generated within the regression model, and then were reviewed against other sources including business surveys and guidance parameters; values were then adjusted where required.

Table 5. Job rates per 1000 m^2 GFA

Industry	Business Centre	Commercial Core	Industry Land	Isolated Business	Special Land Use
Service	7.0	11.1	12.0	12.8	11.7
Professional	3.6	13.8	0.0	3.7	0.3
Industry	2.0	1.5	6.3	1.0	1.6
Retail	9.4	13.3	7.7	3.6	0.0
Other	0.1	0.9	0.3	2.6	0.3
Total	**22.1**	**40.6**	**26.3**	**23.6**	**13.8**

Step 3 - calculate jobs for CHSTM zones:

- Forecast of 2016 jobs by industry type produced based on 2011 JTW data
- GFA to job ratios used to calculate jobs for each model zone in Coffs Harbour
- The 2016 forecasted JTW zone figures by industry type acted as control totals to further calibrate the total job numbers

The overall figure for growth between 2011 and 2016 was 0.3%, due to the modest forecast in workers; employment forecasts are controlled by the growth in the labour force within the LGA.

3.5 Enrolment data

3.5.1 School enrolment data

Data covering school enrolments in 2016 was sourced from the MySchool website for all of the primary and secondary schools within the Coffs Harbour LGA. This was used for estimating education trips.

The catchments for each school were defined using the NSW Schools Finder website. This then defined the growth areas for each school in the forecast years.

3.5.2 TAFE and university enrolment data

Enrolment data was obtained from TAFE and university campuses by contacting the institutions directly. Catchments for these establishments were assumed to be local government area wide.

3.6 Data for validation

A number data sources were available for the purposes of model development and validation, including origin-destination surveys, traffic counts and journey times.

3.6.1 Origin-destination surveys

An origin-destination (O-D) survey was carried out in May 2017 using number plate matching at 10 defined video camera sites. The purpose of this O-D survey was to understand the existing traffic distribution pattern for traffic entering and exiting the Coffs Harbour study area.

Videos were captured in both directions of travel at each camera site for 24 hours, covering each of the modelled time periods. Travel time cut-offs were specified for each O-D pair to exclude vehicles that stopped within Coffs Harbour The survey differentiated the vehicle classes into light vehicles and heavy vehicles.

The derived O-D distribution pattern was utilised to inform the external traffic distribution into the CHSTM, which included external to external, external to internal, and internal to external trips by light vehicles and heavy vehicles.

Further information regarding the O-D survey is contained in Appendix A.

3.6.2 Traffic counts

Traffic count data was collected at various locations throughout the Coffs Harbour study area in September 2016. Fourteen screenlines were defined for the purpose of model validation with over 120 count locations. The traffic count data consisted of two types of counts including:

- Automatic traffic counters (tubes), mainly on the screenlines; and
- Intersection turning counts mainly at the key intersection locations on the Pacific Highway and Hogbin Drive.

The tube counts were collected for 24 hours over a full week period whilst the intersection turning counts were collected for 12 hours between 6 am and 6 pm over one day. The intersection turning counts were mainly for the purpose of mesoscopic model calibration, though some counts were processed at the link level and expanded to 24 hours for the purpose of link validation in the CHSTM.

3.6.3 Journey times

A set of GPS journey time surveys were collected for 4 routes, bi directional during the AM and PM peak periods.

In addition, RMS supplied Google derived travel time data. However, after analysing this against other sources, it was concluded that this dataset considerably underestimated journey times, and as such this information was not used for model development or validation.

4 Strategic model development

This chapter explains the strategic model development process, including the zone system design, network development, and the 4-step demand modelling phases.

It should be noted that the strategic model serves the primary function of providing forecast demand for the mesoscopic model to use for detailed assignment modelling.

4.1 Zone system

The CHSTM zone system was developed using standard ABS zonal boundaries, primarily mesh blocks and some SA1 zones. In a small number of cases, due to there being substantial future development planned, greenfield mesh zones were further subdivided into several land parcels to represents the know future land uses. This allowed the new network loading points, as well as the forecast trips associated with these developments, to be more accurately modelled.

The zone system consisted of 619 internal and 7 external zones. The coverage and density of these are shown in Figure 6 below. Zones were numbered according to the parent SA2 under which they lay spatially. In addition, the node numbering system also followed this convention; the Pacific Highway was the exception, allocated to the range 9000-9999 to allow for easy analysis. Zonal configuration by SA2 sector is summarised in Table 6.

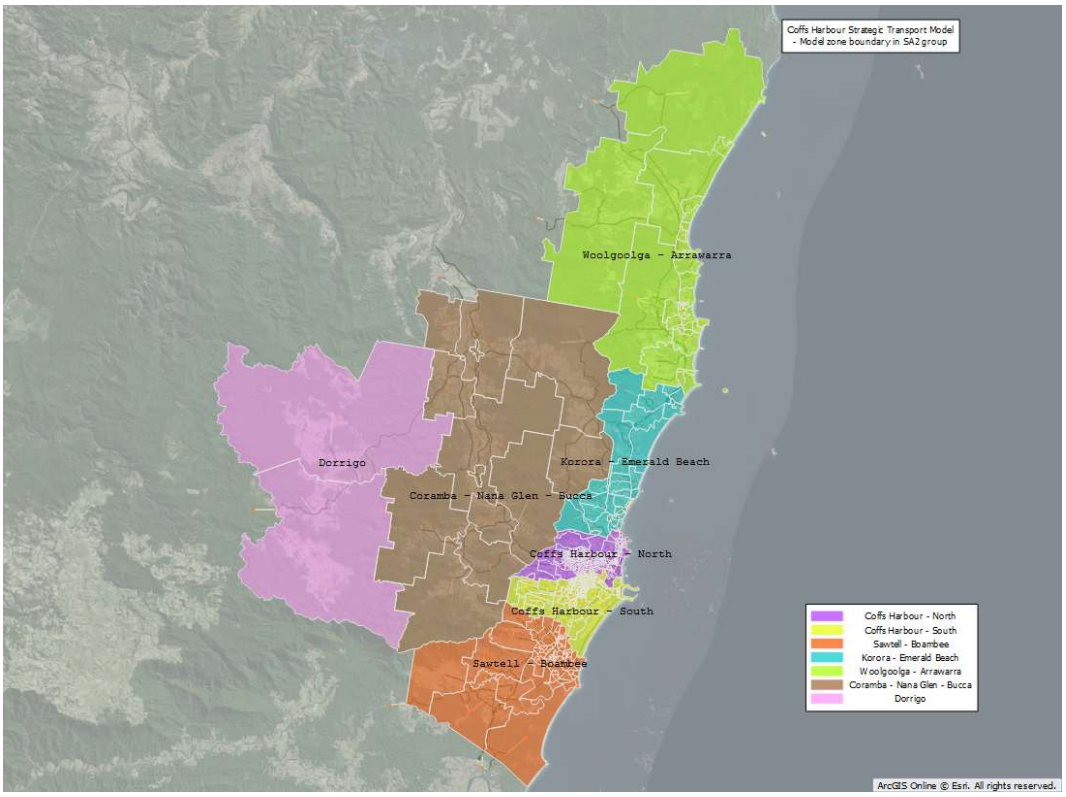


Figure 6 - CHSTM zone system

Table 6. Summary of CHSTM zones by SA2

SA2 Name	SA2 Number	Number of Zones	Zone Numbers	Node Numbers
Coffs Harbour - North	104021084	264	1-299	1000-2999
Coffs Harbour - South	104021085	172	300-499	3000-4999
Sawtell - Boambee	104021089	78	500-599	5000-5999
Korora - Emerald Beach	104021088	50	600-699	6000-6999
Woolgoolga - Arrawarra	104021091	40	700-799	7000-7999
Coramba - Nana Glen - Bucca	104021086	13	800-849	8000-8499
Dorrigo	104021087	2	850-899	8500-8899
Externals		7	900-999	8900-8999
Total zones		**626**		
Pacific Highway nodes				*9000-9999*

4.2 Network

4.2.1 Source dataset

The network was based on the latest available OpenStreetMap (OSM) vector GIS dataset covering the Coffs Harbour LGA. To prepare the GIS network for input to the Emme model, a number of processing steps were undertaken.

Select network based on road hierarchy

The network was developed based on selecting links within each road hierarchy class. All highway (and ramps), arterial, distributor and collector roads were included. In addition, a number of local roads were incorporated where additional detail was required.

All other links within the original GIS network were removed, including private streets, isolated links, small tracks and pedestrian and cycle only routes.

Merge separated directional links

Road sections which had separate links for individual directions, for example segregated single carriageways and dual carriageways, were merged together so that one GIS link represented both carriageway directions. The key reason for this was to simplify the representation of junctions, allowing the turning count data to be allocated accurately to arms.

Merge intersections into one node

Intersections represented by more than one node, primarily roundabouts, were imploded so that the junction was represented by only one node. This simplified representation allowing junctions to be more accurately modelled within Emme, and to align with the turning count data used for validation.

Consolidate links

Sections of network, particularly rural areas, where there were intermediate dummy nodes with only two arms (not representing intersections), were dissolved into one link. This simplified the network for modelling purposes.

The impacts of these consolidation processes are demonstrated below. Figure 7 shows an intersection before (left) and after (right) junction and network simplification, whilst Figure 8 shows the difference in an urban area.

Figure 7 - Intersection before (left) and after (right) simplification

Figure 8 - Urban network before (left) and after (right) consolidation

4.2.2 Zone connectors

Zone connectors were created for all internal and external zones, with more than one connection point being allocated on the network where appropriate. The length of connectors was calculated using the GIS geometry of the lines which were accurately digitised in GIS.

4.2.3 Network attributes

The network attributes allocated to the GIS links and forming the input to the modelling, were based on information from a variety of sources. These are summarised in Table 7.

Table 7. Network attributes and sources

Network Attribute	Source(s)
Road hierarchy classification	Coffs Harbour Council road hierarchy
Posted speed limit	OSM *Reviewed against Google Street View*
Number of lanes	OSM *Reviewed against Google aerial imagery*
Modes	No data sources available regarding banned HGV links *Assumed all vehicles are able to use all links*
Road impedance	Engineering judgement based on considerations including intersection controls, road side parking, property access density, road condition
Junction approach type	Determined using Google aerial imagery
Turn restrictions	Determined using Google aerial imagery

Network speeds

The posted speeds assigned to links were based on the attributes provided in the original OSM layer, reviewed against Google Street View imagery. These speeds formed the starting point for calculating the volume/delay functions discussed below; posted speed ranges by link type are summarised in Table 8.

Table 8. Count of link types by posted speed ranges

Speed (km/h)	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6	Type 9	Total
20						1		1
40			6	15	16		1,326	1,363
50			34	370	611	971		1,986
60		26	170	44	76	66		382
70			16	30	92	20		158

Speed (km/h)	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6	Type 9	Total
80	22	18	102	28	6			176
100	46							46
110	86							86
Total	**154**	**44**	**328**	**487**	**801**	**1,058**	**1,326**	**4,198**

Key: 1 - Highway, 2 – Highway ramps, 3 - Arterial, 4 - Distributor, 5 - Collector, 6 - Local, 9 - Centroid connector

Link capacities

Free-flow capacities by lane were based on Austroads guidance, reviewed in the context of other similar models in Australia. Some revisions were made to reflect local conditions. Capacities per lane were slightly different for single and multi-lane roads, as shown in Table 9.

Table 9. Base link capacities per lane

Road type	Multi-Lane Capacity (PCUs per hour)	Single-Lane Capacity (PCUs per hour)
Highway	1,900	1,800
Highway ramp	1,800	1,700
Arterial road	1,600	1,500
Distributor	1,350	1,300
Collector	1,150	1,100
Local	850	800

Base capacities per lane were then revised in line with road impedance levels, where these were defined as:

- Low – 100% capacity
- Medium – 90% capacity
- High – 80% capacity
- Rural – 95% capacity.

Links were assigned to these categories using engineering judgement, considering factors such as road side parking, topography, geometry, road surface condition, property access density and intersection approaches. Impedance values were then used in conjunction with lane capacities to generate the final matrix of link capacities presented in Table 10.

Table 10. Final capacities by road type based on impedance level

Link Type	Rural	Low	Medium	High
Highway single-lane	1,700	1,800	1,600	1,450
Highway multi-lane	1,800	1,900	1,700	1,500
Arterial single-lane	1,450	1,500	1,350	1,200
Arterial multi-lane	1,500	1,600	1,400	1,250
Distributor single-lane	1,250	1,300	1,150	1,050
Distributor multi-lane	1,300	1,350	1,250	1,100
Collector single-lane	1,050	1,100	1,000	900
Collector multi-lane	1,100	1,150	1,050	900
Local single-lane	750	800	700	650
Local multi-lane	800	850	750	650

Volume delay functions – link delay

Two sets of volume delay functions were used in model development; link based delay and junction approach delay, also assigned to links.

Link delay in the CHSTM was based on a function known as the Akcelik speed-flow curve, one of the most widely used curves in establishing speed flow relations.

The expression of the Akcelik curve is as follows:

$t = t_f + 0.25\ T_p\ [z + (z^2 + 8\ J_D\ (x - x_0) / (Q\ T_p))^{0.5}]$ for $x > x_0$

$= t_f$ for $x <= x_0$

Where:

t = travel time at a given degree of saturation x (h/km)

t_f = free-flow time or speed at x = 0 (h/km)

t_n = travel time at capacity (x=1) (h/km)

q_a = arrival flow (veh/h)

Q = capacity (veh/h)

x = degree if saturation, = q_a/Q (also known as volume/capacity or v/c ratio)

x_0 = degree of saturation below which the overflow delay is zero and travel time equals free-flow speed

T_p = duration of peak flow period (1 h)
J_D = shape or delay factor
z = (x -1)

J_D is known as the Akcelik parameter, which defines the shape of the function. There is always some uncertainty in estimating the capacity Q and the travel time at capacity t_n, both of which will affect the shape factor J_D.

The solution for J_D for uninterrupted traffic flow is set out below:
$J_D = 2\ Q\ (t_n - t_f)^2 / [T_p\ (1 - x_0)]$

During this project, literature reviews and analysis of reference models have been carried out to determine the J_D factor to be used for the CHSTM. Different link types have different characteristics in the speed flow relations, hence the J_D will be defined differently by link type.

The following J_D factors were used for uninterrupted traffic flow based on the link types, presented in Table 11.

Table 11. J_D values used for speed-flow curves by link type

Link Type	J_D Value
Highway	0.3
Highway ramps	0.3
Arterial road	0.6
Distributor	0.9
Collector	1.2
Local road	1.6

The shapes of the speed-flow curves by link type are presented in Figure 9.

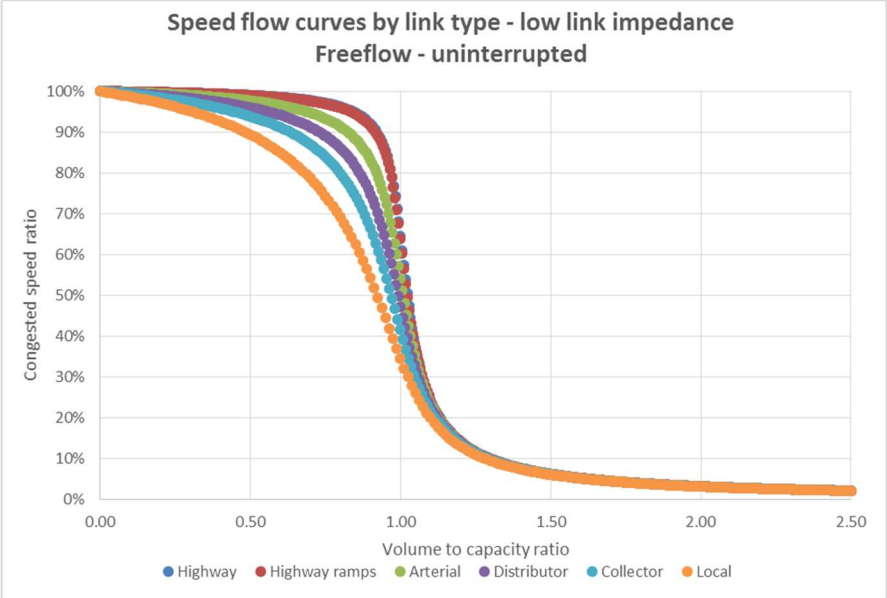


Figure 9 - Speed flow curves by link type

Comparisons have been made to check how the defined speed-flow curves fit with survey data points based on the relevant link type (where data exists). It can be seen in Figure 10 below that the curves generally fit well with survey data points.

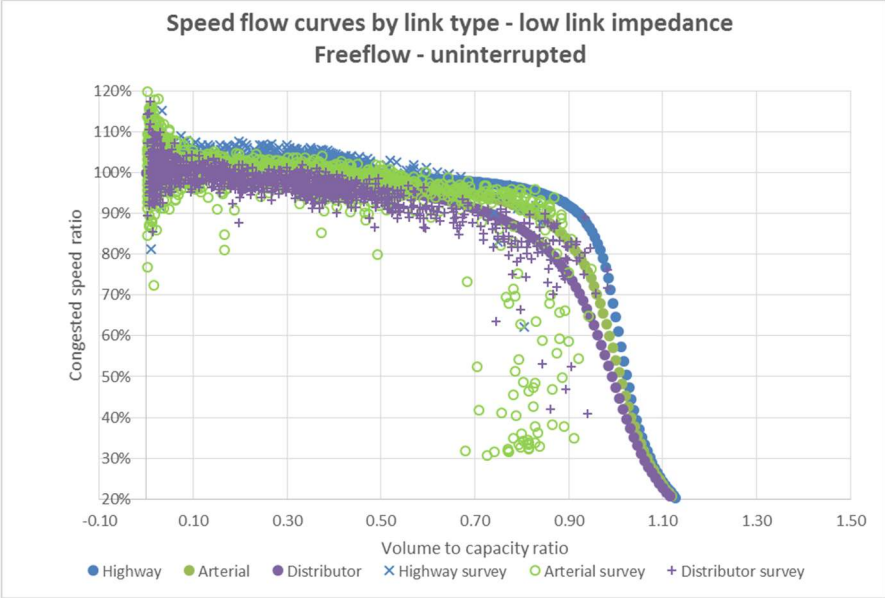


Figure 10 - Comparison of speed flow curves against observed data

Volume delay functions – junction approach delay

The standard volume delay functions used in strategic transport models do not include delays at intersections. With this limitation, it often underestimates delays on links with signals / roundabouts, in which case the route choice in the statistical assignment may not be correctly informed.

In the CHSTM, intersection delays are not explicitly modelled at nodes. Instead, a set of junction approach delays are assigned to links as a proxy for the delays at intersections. In addition to the uninterrupted speed flow relation, different functions were adopted for the two types of intersections; signals and roundabouts.

This approach caps the first 500 metre link segment towards a signalised / roundabout junction with a higher J_D value to reflect a more sensitive speed-flow relation. For links longer than 500 meters, the remaining section will follow the normal speed-flow relation as uninterrupted flow. This will avoid over estimating delays for long links in the network. The J_D value used for the intersection approach section is 20 for signals and 5 for roundabouts.

Figure 11 and Figure 12 show the speed flow curves with combined junction delays and uninterrupted section of links based on the link type.

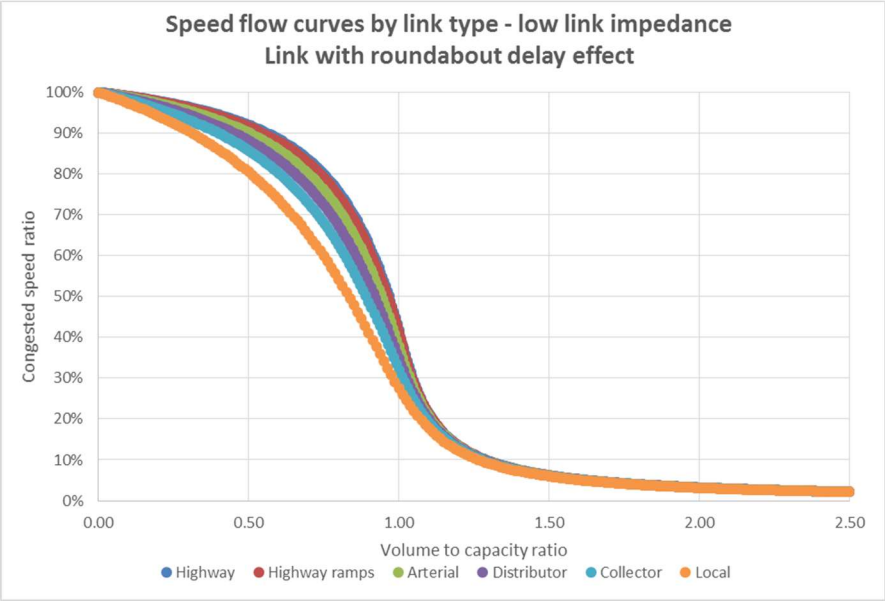


Figure 11 - Speed flow curves – roundabout delay effect

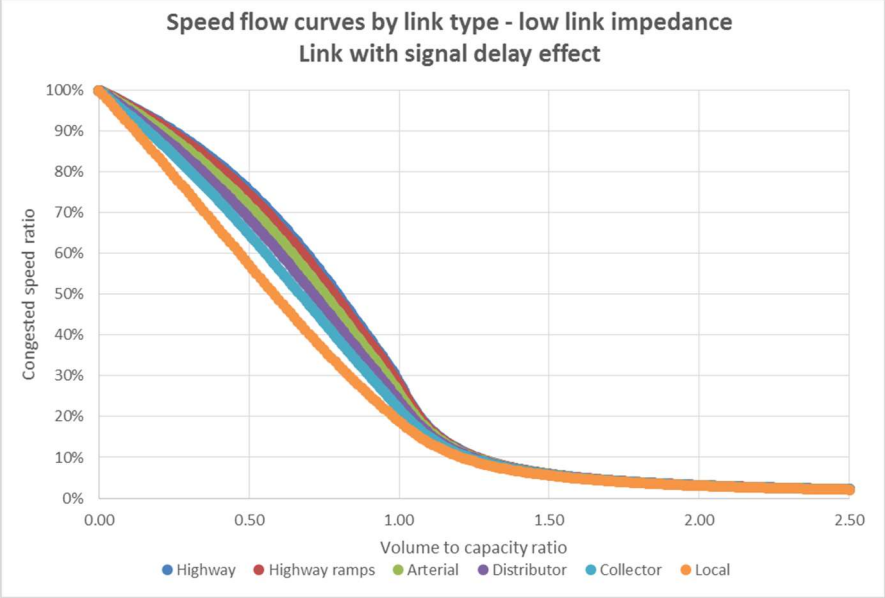


Figure 12 - Speed flow curves - signal delay effect

A comparison was made between the assumed speed-flow curves in the model and observed speed and volume data at roundabout approaches to observed data from the reference study. It can be seen that the curve generally fits in line with the survey data, as shown in Figure 13.

This data was not available for signalised approaches. The delays at signalised approaches are more sensitive to volume increases, whereby the congested speed drops quicker than roundabout approaches. However, there is a greater element of randomness when considering signal delays as such delays depend on the nature of signal operation when vehicles approach. The signal coordination would also affect the speed-flow relation considerably. For example, an optimised corridor would have good chance of obtaining a green signal when vehicle approaches –

similar to uninterrupted flow, whilst the opposite travel direction could be totally different. These details are not considered at this level of modelling.

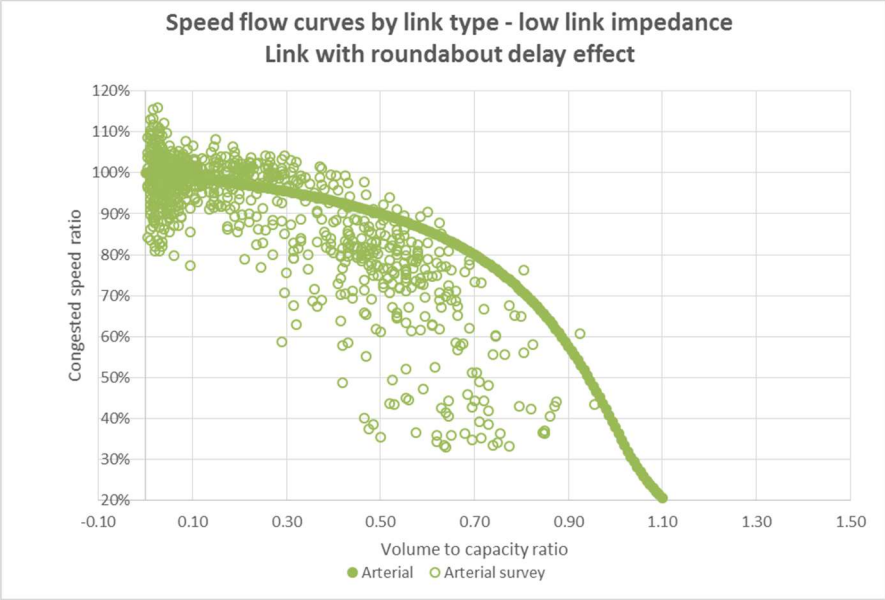


Figure 13 - Comparison of modelled against observed roundabout approach delays.

4.2.4 Base network overview

Based on the steps outlined in Chapter 4.2, the final input base network was created. Figure 14 and Figure 15 show the network coverage at a regional and Coffs Harbour city level respectively.

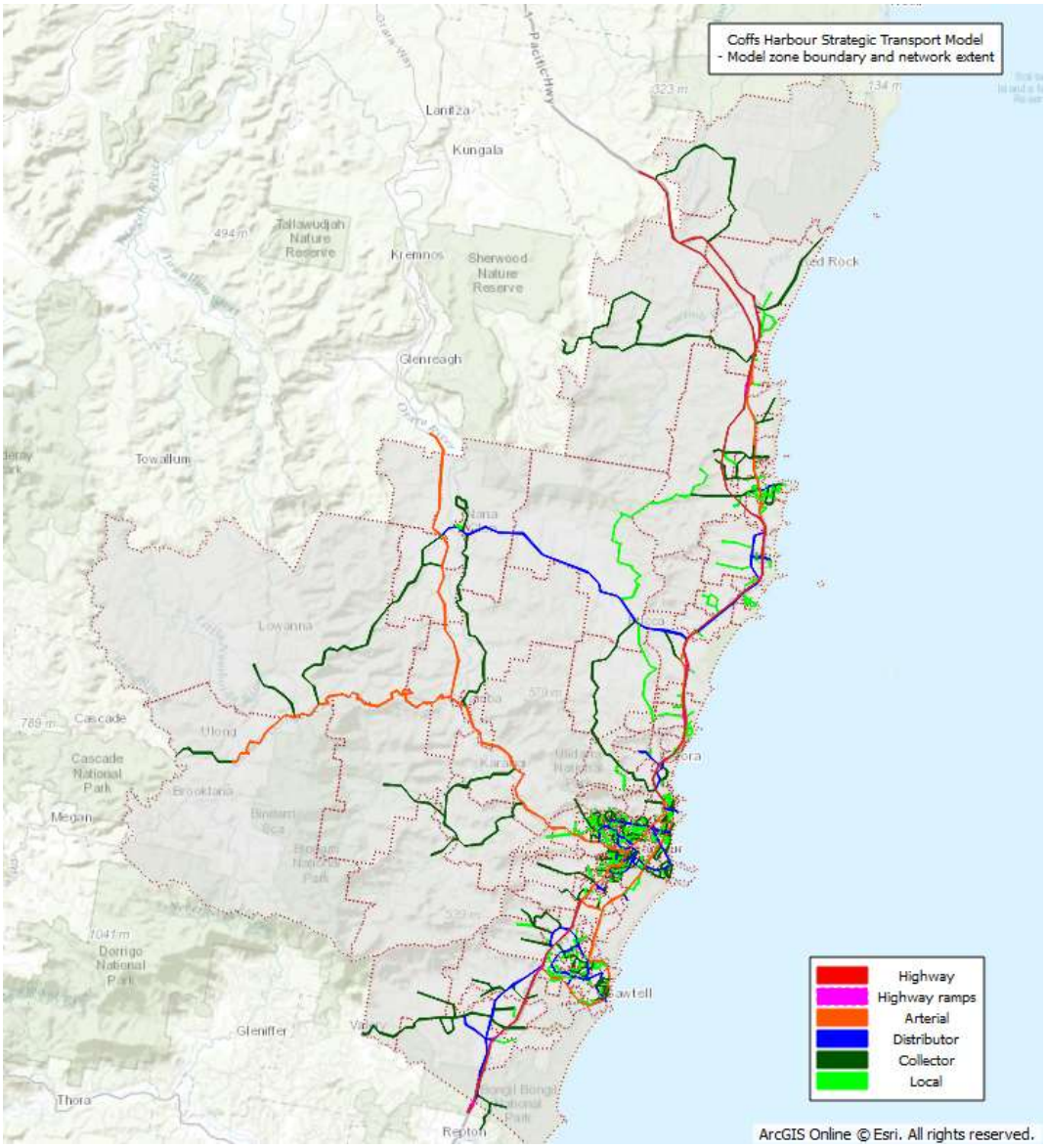


Figure 14 - CHSTM network coverage – LGA level

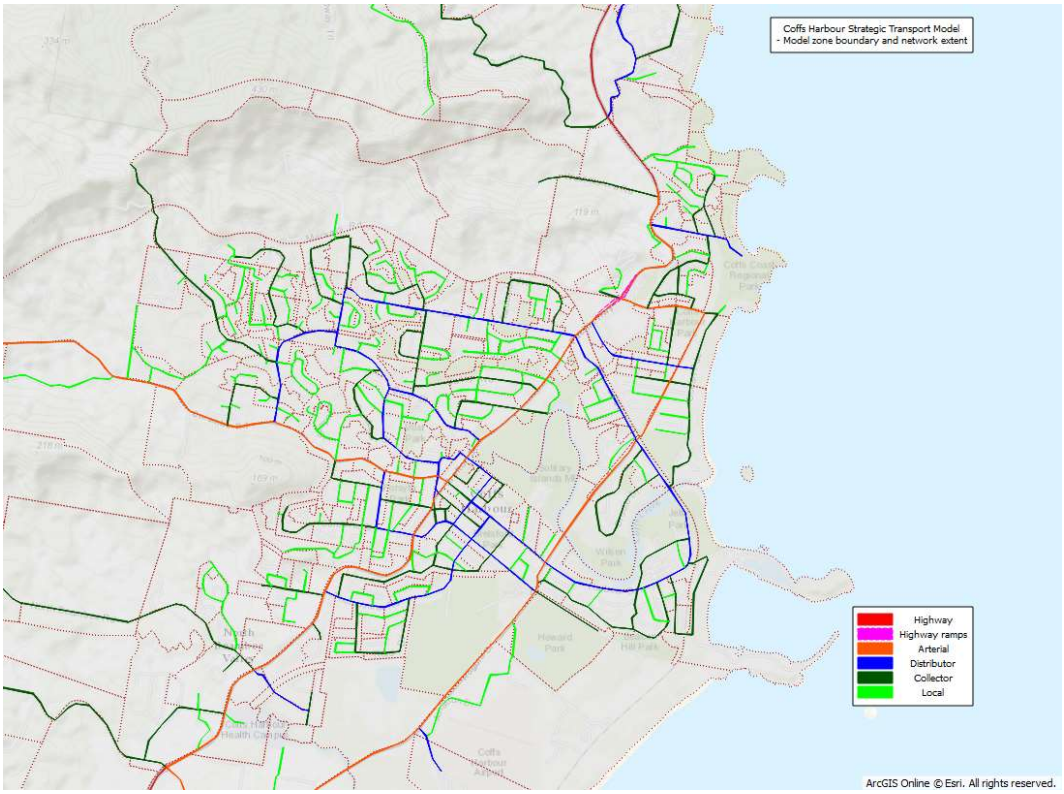


Figure 15 - CHSTM network coverage – Coffs Harbour city level

The data sources listed in Chapter 3 formed the basis of the land use inputs for the strategic model. For each of the model zones, the following land use data was produced and used as the basis for trip generation and attraction, and matrix development.

4.2.5 Population

The 619 model zones were allocated data for 2016 as follows:

- Occupied dwellings
- Population total
- Population 0 – 17
- Population 18 – 64
- Population 65 +
- Residential workers (blue and white collar workers, by industry)
- Domestic and international visitors.

Table 12 shows these numbers at a total level, for 2016 and how these compared to the 2011 data sources.

Table 12. Summary of demographic data totals

Demographic	2011	2016 Base Year
Occupied dwellings	26,099	27,435
Total population	68,434	70,371
Population 0 – 17	16,139	15,956
Population 18 – 64	39,917	40,345
Population 65+	12,378	14,068
Total residential workers	28,011	28,311
Visitors	5,148	5,377

4.2.6 Employment

After undertaking the employment regression modelling, described in Section 3.4, jobs by industry type and blue/white collar worker profession categories were estimated for each model zone. The total number of jobs by industry type calculated for 2016, in comparison to 2011, is presented in Table 13.

Table 13. Total jobs by industry type in 2016

Year	Service	Professional	Industry	Retail	Other	Total Jobs
2011 JTW data	11,662	4,872	4,667	4,651	1,690	27,541
2016 forecast total	11,138	4,757	5,669	4,477	1,926	27,966

4.3 Trip generation

The trip generation model is the first step of the traditional 4 step modelling process and is reliant on socio-economic and demographic inputs to model the number of trips produced and attracted to each designated travel zone in CHSTM.

This step requires the establishment of relationships between the demographics, and socio-economic variables, and the generated number of trip by the purposes of travel; these functions are usually informed by a HTS. However, due to the absence of local HTS data, and the NSW Regional HTS Pilot dataset lacking some of the required information for trip rate analysis, the trip generation rates from other reference models were reviewed and subsequently used for CHSTM development.

The demographics and socio-economic parameters in other comparable Australian regional towns of the eastern seaboard are generally homogeneous, so the trip making rates of Coffs Harbour can be predicted with reasonable accuracy using other models as a proxy. The reference models used for CHSTM development include:

- Cairns Strategic Transport Model
- Rockhampton and Livingstone Strategic Transport Model
- Townsville Strategic Transport Model

In addition to the above, other models were also used for sense checks in terms of trip composition and average trip rate. Those included the Mackay Area Transport Model, the Sunshine Coast Integrated Multi-Mode Model and the Brisbane Strategic Transport Model.

The home based work (HBW) trip generation was developed based on the 2011 JTW data in Coffs Harbour. The JTW information was released in January 2014 by TfNSW BTS, which provides a comprehensive set of information to establish the HBW trip relationship for Coffs Harbour.

The following set of trip purposes were defined in CHSTM:

- HBW (home based work trip)
- HBEPS (home based education primary and secondary trip)
- HBET (home based education tertiary trip)
- HBEs (home based escort trip)
- HBS (home based shopping trip)
- HBO (home based other trip)
- NHB (non-home based trip)
- VHB (visitor home based trip)
- VNHB (visitor non-home based trip)
- MCV (medium commercial vehicle trip)
- HCV (heavy commercial vehicle trip).

The daily trip generation and attraction rates by user class are shown in Table 14.

Table 14. Trip generation and attraction rates by trip purpose

	Trip Purpose	Equation
Production	HBW	1.294 household workers
	HBEPS	0.949 residents age 0-17
	HBET	0.026 residents age 18-64
	HBEs	0.359 residents age 0-17 + 0.341 residents age 18-64 + 0.072 resident age 65+
	HBS	0.27 residents age 0-17 + 0.67 residents age 18-64 + 1.6 resident age 65+
	HBO	0.665 total residents

	Trip Purpose	Equation
	NHB	0.104 total residents +1.641 primary enrolment + 0.77 secondary enrolment + 0.29 tertiary enrolment + 1.715 service jobs + 2.058 professional jobs + 0.686 industry jobs + 4.424 retail jobs +0.686 other jobs
	VHB	2.5 visitors
	VNHB	0.253 retail jobs (with expansion to 60% of VHB trips)
Attraction	HBW	1.226 service jobs + 1.389 professional jobs + 0.964 industry jobs + 1.274 retail jobs + 1.389 other jobs
	HBEPS	1.636 primary enrolment + 1.296 secondary enrolment
	HBET	1.7 tertiary enrolment
	HBEs	1.747 primary enrolment + 0.651 secondary enrolment
	HBS	1.37 white collar service jobs + 6.529 white collar retail jobs
	HBO	0.225 total residents + 0.882 primary enrolment + 0.882 secondary enrolment + 0.452 white collar service jobs + 0.452 white collar professional jobs + 0.452 white collar industry jobs +1.803 white collar retail + 0.452 white collar other
	NHB	0.104 total residents +1.641 primary enrolment + 0.77 secondary enrolment + 0.29 tertiary enrolment + 1.715 service jobs + 2.058 professional jobs + 0.686 industry jobs +4.424 retail jobs + 0.686 other jobs
	VHB	0.043 total population + 0.133 retail jobs + 0.085 other jobs
	VNHB	0.253 retail jobs (with expansion to 60% of VHB trips)

The HBW trip rate was calibrated to the JTW trip totals at the JTW zone level, as shown in Figure 16.

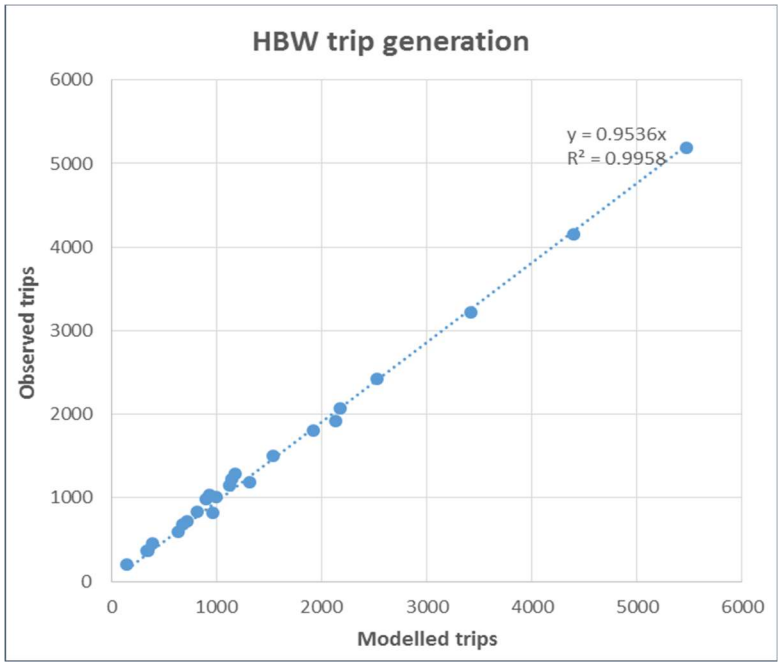


Figure 16 - HBW trip rate calibration against JTW data

Due to the lack of HTS data, observed total trips for other trip purposes were not available, so there were no comparable target values. However, the average daily trip rates by trip purpose were calculated based on the reference models listed above. These average rates are shown in Table 15. Forecast year trip rates per person and per household also included for comparison in Table 16 and Table 17.

Table 15. Average trip rates by purpose calibrated within model

Trip Purpose	Average Daily Trip Rate	Unit
HBW	0.443	per resident
HBEPS	0.271	per resident
HBET	0.080	per resident
HBEs	0.229	per resident
HBS	0.658	per resident
HBO	0.570	per resident
NHB	1.026	per resident
VHB	2.180	per visitor
VNHB	1.310	per visitor
Total Average	3.363	Excluding visitors

Table 16. Trip rates per person for all modelled years

Trip rate (per person)	2016	2024	2034	2044
Home based work	0.443	0.421	0.412	0.413
Home based education (primary & secondary)	0.271	0.281	0.286	0.288
Home based education (tertiary)	0.080	0.076	0.074	0.074
Home based escort	0.229	0.236	0.238	0.240
Home based shopping	0.658	0.672	0.675	0.667
Home based other	0.570	0.565	0.559	0.554
Non home based	1.113	1.094	1.094	1.108
Total trip rate	3.363	3.345	3.338	3.343

Table 17. Trip rates per household for all modelled years

Trip rate (per household)	2016	2024	2034	2044
Home based work	1.135	1.009	0.988	0.989
Home based education (primary & secondary)	0.695	0.672	0.685	0.689
Home based education (tertiary)	0.205	0.182	0.178	0.178
Home based escort	0.588	0.564	0.571	0.574
Home based shopping	1.688	1.609	1.616	1.598
Home based other	1.460	1.354	1.338	1.326
Non home based	2.853	2.621	2.622	2.653
Total trip rate	8.623	8.012	7.997	8.007

While there was no observed trip rate data available for Coffs Harbour, sense checks were carried out to compare modelled trip rates in the CHSTM to the trip rates estimated from the other reference models. The estimated car trip rate per person for the AM, PM and daily periods have been compared with the reference models in Table 18. The numbers were found to be generally close to the other models. Most of the reference models have modelled 2 hours peak periods, so the actual 1-hour peak rate would be higher if not just taking the average of the 2 hours.

Table 18. Car trip rate comparison

Models	AM	PM	Daily
Coffs Harbour Strategic Transport Model	0.26	0.26	2.66
Rockhampton & Livingston Strategic Transport Model	0.26	0.22	2.35
Mackay Area Transport Model (average rate of 2hr peak)	0.19	0.21	2.57
Cairns Strategic Transport Model (average rate of 2hr peak)	0.20	0.17	2.06
Townsville Strategic Transport Model (average rate of 2hr peak)	0.20	0.23	2.67
Sunshine Coast Integrated Multi-Mode Model (average rate of 2hr peak)	0.20	0.19	2.52

4.4 Trip distribution

Trip distribution is often the second stage of the four-step modelling process which distributes the trips between origins and destinations by trip purposes according to the relative attractiveness and the friction (travel cost including time and distance) to each destination. The parameters which determine the distribution pattern are generally considered unique due to the distinctive land use pattern in each city. However, there are often similarities in the travel distance profile which is determined by the mechanism of a gravity model. The gravity model process essentially assumes that people are more likely to choose their employment and/or residential locations based on the relative accessibility between them.

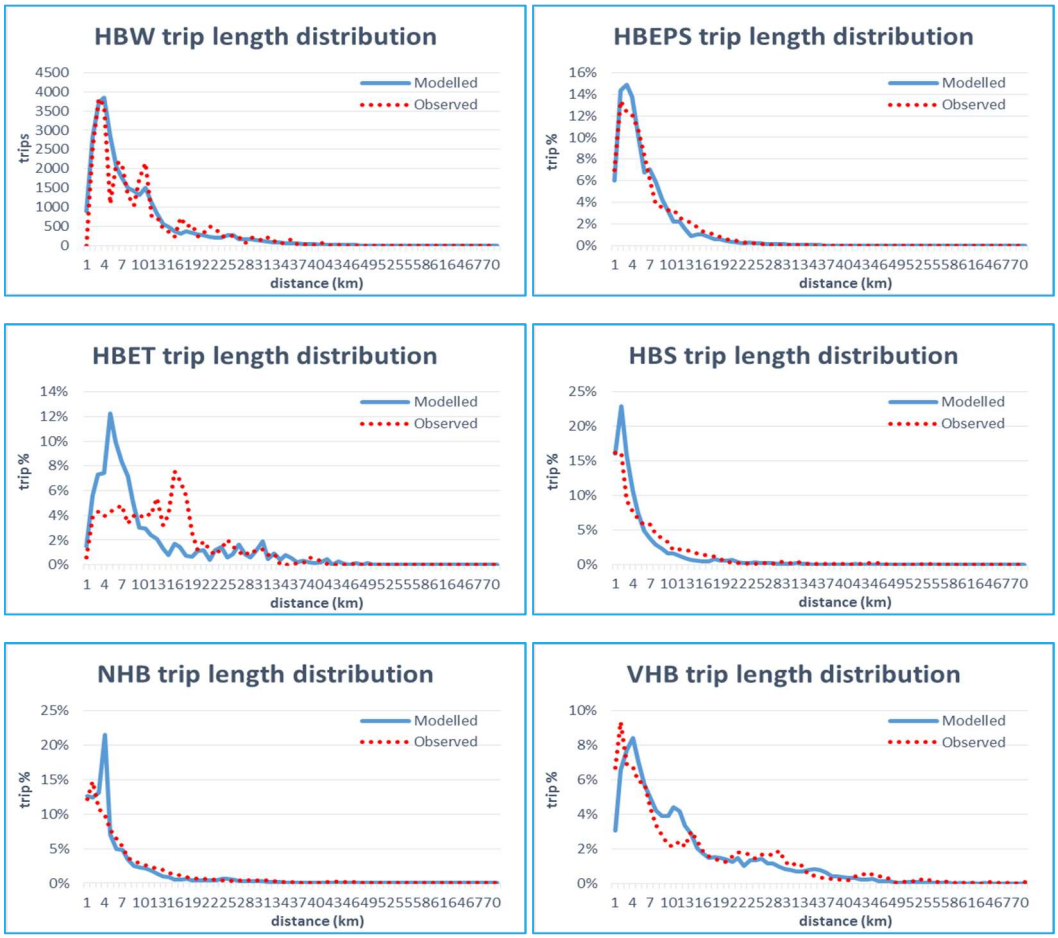
With inadequate information available in the pilot HTS dataset to inform such a relationship for Coffs Harbour, parameters from other models have been reviewed and adopted for use in CHSTM. The HBW trip distribution was informed by the 2011 JTW data, therefore the trip distribution was developed and calibrated against the JTW data in Coffs Harbour. Trips for other purposes have been calibrated to the trip length distribution indicated in the reference models. Trip distribution friction factors by purpose are shown in Table 19.

Table 19. Trip distribution friction factors by purpose

Trip Purpose	Alpha	Beta
HBW	-0.2	-0.003
HBEPS	-0.6	-0.005
HBET	-0.8	0
HBEs	-0.7	-0.005

Trip Purpose	Alpha	Beta
HBS	-2	-0.011
HBO	-0.7	-0.003
NHB	-0.35	-0.003
VHB	-0.3	-0.001
VNHB	-0.4	0

The comparison of modelled trip length distributions to the observed / target trends are shown in Figure 17. As discussed, the HBW trip distribution is calibrated to 2011 JTW data so the calibration was achieved for both trip volumes and distance. For other trip purposes, the calibration was undertaken for trip percentage travel by distance as the total trip volumes from the reference model were not directly comparable due to the difference in population size. The HBET (home based education tertiary) trip length is different to the reference model, because this particular trip purpose is very area specific depending on the location of the tertiary facilities and the city size.



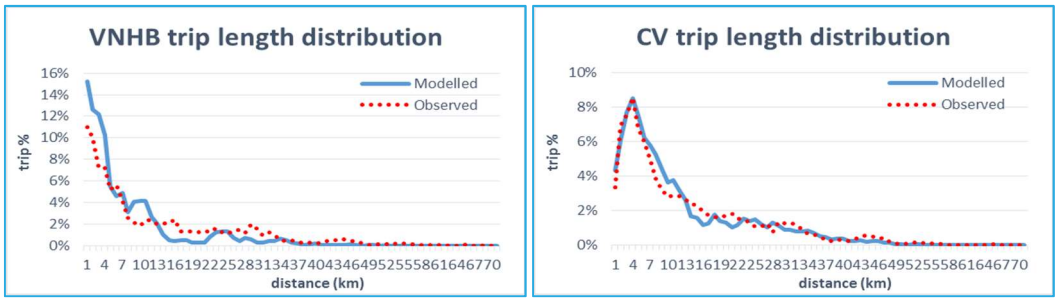


Figure 17 - Modelled v observed trip length distributions by trip purpose

4.5 Time of day and mode split

The third stage of the four-step modelling process involves separating the travel demand by purpose into various travel modes such as car drivers, car passengers, public transport and active transport. The mode share percentage information was derived from the pilot HTS dataset for most of the trip purposes. A very low share of public transport mode was observed in the dataset across all the surveyed regional towns including Coffs Harbour, consistent with known travel patterns in Coffs Harbour and other regional centres.

Importantly the reference models that have been used to benchmark parameters for this model also exhibited low public transport mode share. The range of data sources described above and the expectation that public transport mode share will not change significantly in the future suggested that the approach of applying fixed mode share is reasonable.

The mode share parameters were primarily calibrated to the pilot HTS data which included HBW, HBS, HBO, and HBEs trip purposes, while the remainder of the trip purposes were reviewed and compared to the reference models. The time of the day travel information was not included in the pilot HTS data provided, and as such this information has been reviewed and extracted from the reference models. The time of day travel is ultimately validated by screenline counts, as the model validation includes each of the modelled time periods.

Care was taken when considering trip purposes other than HBW and HBE trips. However, there is a risk of inaccuracy without an observed travel survey dataset to rely on. The similarities in travel profile characteristics between the cities of the reference models and the Coffs Harbour traffic surveys do provide confidence in the assumptions applied within the model. At the same time, the comprehensive traffic count dataset provides a strong point of comparison to validate the model against. Table 20 shows active travel mode share values used in the CHSTM, in addition to the calculated car occupancy rates.

Table 20. Calibrated mode share for active travel and car occupancy rates

Trip Purpose	Calibrated Active Travel Mode share	Pilot HTS Survey Active Travel Mode Share	Calibrated Car Occupancy Rate	Pilot HTS Survey Car Occupancy Rate
HBW	7.5%	7.6%	1.1	1.08
HBEPS	16.0%	*N/A*	65^	*N/A*
HBET	16.3%	*N/A*	1.3	*N/A*
HBEs	3.6%	3.5%	1.1	1.05
HBS	8.9%	9.7%	1.2	1.13
HBO	12.9%	10.7%	1.2	1.15
NHB	8.1%	*N/A*	1.1	*N/A*
VHB	15.3%	*N/A*	1.2	*N/A*
VNHB	8.5%	*N/A*	1.2	*N/A*

^ Car occupancy rate calculated as total trips over car trips

4.6 External demand

Following the development of the internal demand matrices, the external base year and future year demand matrices were estimated. Five bi-directional count sites were used to calculate origin and destination matrix control totals for the five model time periods. These count sites are located as per Table 21.

Table 21: External trip count site locations

Site ID	Location	Direction
1.1	Pacific Hwy *North Of Range Rd*	Northbound
		Southbound
1.3	Eastern Dorrigo Way *50m East of Lower Bobo Rd*	Westbound
		Eastbound
1.4	Glennifer Rd *40m West of Gordons Rd*	Westbound
		Eastbound
1.5	Pacific Hwy *North of Mailmans Track Rd*	Northbound
		Southbound
1.6	Pine Creek Way *North of Overhead Bridge Rd*	Northbound
		Southbound

For the internal-external (I2E) and external- internal (E2I) base and future year matrices, observed distribution factors (obtained from the Coffs Harbour O-D

survey) were applied to both the origin and destination matrix control totals. I2E and E2I matrices for all vehicle classes were subsequently adjusted to take into account a finer distribution at the zonal level.

For light vehicles, internal-internal (I2I) HBW, VHB and VNHB trip purpose matrices were used to scale the base and future year I2E and E2I matrices. Medium and heavy commercial vehicle I2E and E2I matrices were not adjusted by trip purpose.

A yearly growth factor of 1.4% was applied to the 2016 base year E2E demand matrix to obtain future year E2E demand matrices. The E2E, E2I and I2E matrices were then summed to form an external assignable matrix.

4.7 Special generators

Special generator traffic demand was developed based on eight special generator zones (see Table 22). Traffic count data from 14 bidirectional sites within these zones were used to create initial origin and destination base year traffic matrices.

Table 22: CHSTM special generators

Zone ID	Location
109	Baringa Private Hospital
123	Park Beach Plaza
222	Park Beach Home Base Homemaker Centre
314	Coffs Harbour Marina
315	Bunnings Coffs Harbour South
448	Coffs Harbour Airport
455	Coffs Harbour Health Campus
553	Toormina Shopping Centre

These initial base year origin and destination matrices were subsequently growthed by compound annual growth rates (CAGRs, see Table 23) to create future year special generator matrices. Initial CAGRs were used to develop future year matrices, however, following modifications to the demographic process these CAGRs were updated to align with population growth across the model year horizons. CHSTM iterations to come will include the updated special generator CAGRs with sensitivity tests having shown only minor differences in link flows between the initial and updated CAGRs.

Table 23: CHSTM special generator CAGRs

Years	Initial CAGR	Updated CAGR
2016	0.00%	0.00%
2016 - 2024	1.53%	1.10%
2024 - 2034	1.49%	0.90%
2034 - 2044	1.44%	0.80%

The assignable demand matrix was then filtered to the special generator zones to obtain a distribution and finally adjusted to meet the special generator origin and destination matrix control totals.

4.8 Assignment

The final stage of the four-step modelling is primarily related to the choice of travel routes on the road network. As detailed in Chapter 4.2, the CHSTM network hierarchy includes state controlled highways, arterial roads, distributor roads, collector roads. Some important local roads have also been included to form the connections between zone connectors and major roads and / or considered providing through traffic routes to the other local traffic feeders. Intersection delays of signals and roundabouts have also been taken into account in the delay functions during the network establishment.

The traffic assignment is performed on an hourly basis for each time period with a representation of similar level of congestion and route choice indicated by the traffic surveys (described in Chapter 3.6).

Assignment works on the basis that the cheapest, or least cost path is the route that travellers will choose. The Emme assignment module performs an equilibrium traffic assignment using the path-based traffic assignment method, until the state of Wardrop Equilibrium is reached. Once this state is achieved, based on a set of specified convergence criteria, the assignment is deemed to have achieved convergence.

- Max iterations: 50
- Relative gap: 0.0001
- Best relative gap: 0.01
- Normalised gap: 0.001

For assignment purposes, the vehicle to PCU values of 4 and 2 for HCV and MCV were used, as per RMS modelling guidelines[1].

[1] RMS Traffic Modelling Guidelines, Chapter 10.1.1

5 Strategic model validation

The model validation has been reported using the criteria outlined in the Roads and Maritime's Modelling Guidelines for highway assignment models and the New Zealand Transport Authority's (NZTA) Transport Model Development Guidelines. The NZTA's guidance has been used as the criteria recognises different types of models, from strategic or regional transport models through to project models.

The CHSTM serves primarily as a demand forecasting model, supplying outputs to the detailed traffic assignment model. Given this primary function, matrix-estimation has not been undertaken within the assignment Emme model. Validation statistics using the Emme assignment model have been provided to demonstrate the level of modelling accuracy achieved at a strategic level.

5.1 Approach to validation

Validation has been undertaken in both CHSTM, and also in the mesoscopic model; the latter is ultimately used as the assignment module within the 4-step process to inform the project. As such, the validation performance presented in this chapter is intended to demonstrate the extent to which the CHSTM performs against the RMS guidelines and the NZTA's criteria for regional models.

The CHSTM model has been validated against 14 screenlines with approximately 100 individual count locations (by direction) for each modelled time period (AM, OP, PM, RD) and the aggregated daily, and for each vehicle classes (LV, MCV, HCV). It also has been validated against four travel time routes by directions for and AM and PM peak periods.

5.2 Counts and screenline locations

The count and screenline data described in Chapter 3.6 was used to undertake model validation. This consisted of 100 individual sites and 14 screenlines, with the locations of screenlines shown in Figure 18 and Figure 19.

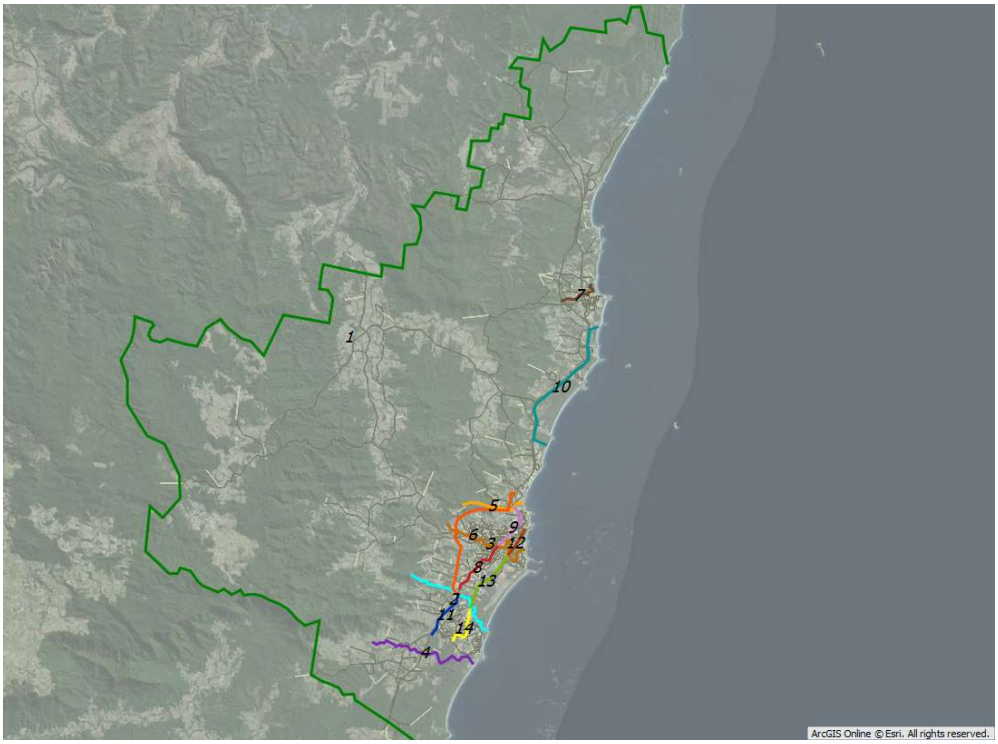


Figure 18 - Screenlines used in model validation – LGA wide

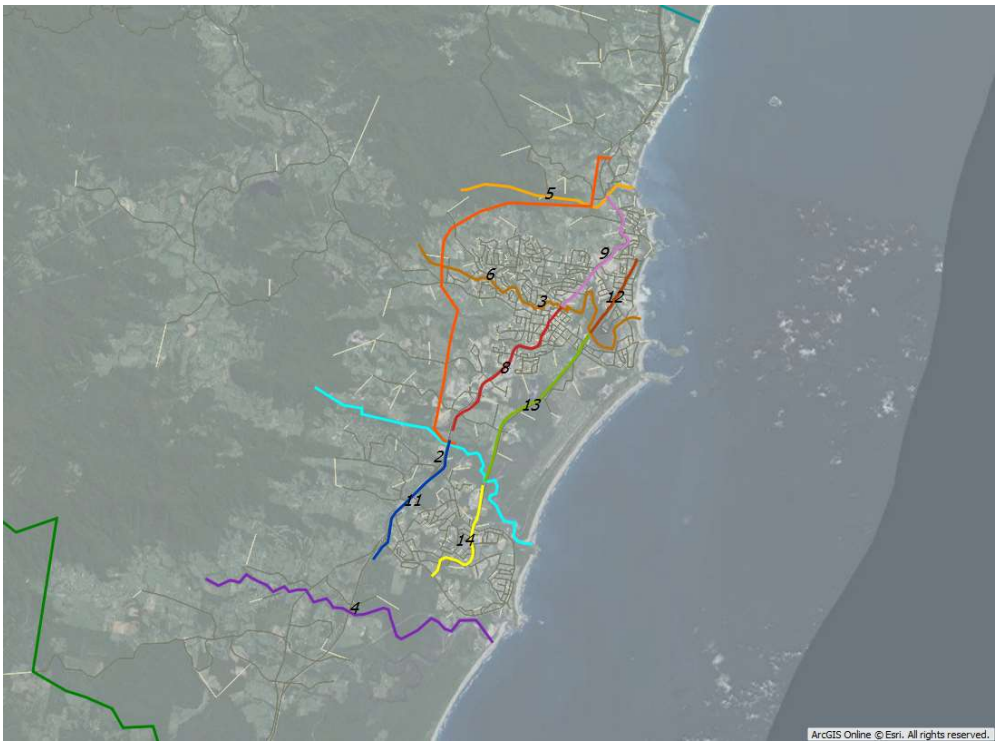


Figure 19 - Screenlines used in model validation - Coffs Harbour city area

5.3 Count validation statistics

The Roads and Maritime's model calibration and validation guidelines[2] were used with the NZTA EEM guidelines as the basis for assessing model validation performance. The Roads and Maritime's guidelines have been developed from a variety of sources, including the UK DMRB and NZTA's EEM. In summary, the guidance recommends that:

- 95% of individual link values to have a GEH <= 5.0
- 85% of individual turn values to have a GEH <= 5.0
- All individual link and turn volumes should have a GEH <= 10.0
- Plots of modelled versus observed hourly flows required, included R^2 values and slope equation
- All R^2 values >= 0.9 and counts RMSE <= 30.0
- Each directional screenline or cordon total to have GEH < 4.0.

Validation criteria are guidelines and should not be viewed as a pass/fail test of the model, but should be used to highlight the strength and weaknesses of the model in reflecting observed travel characteristics. They therefore inform the application of the model and future model development by providing information to assess model performance and suitability.

Note that:

- whilst overall, the model may achieve a level of acceptable fit, model users will still need to establish that the model performs satisfactorily in the local area of interest;
- the validity and currency of observed traffic count data should be take into account, day to day variation, impacts of road network construction as well as seasonal variation may be important in some applications.

5.4 Screenlines

In terms of screenline validation, the performance of CHSTM against RMS guidelines is shown in Table 24 and Table 25. The analysis suggests that the AM period has achieved a higher level of screenline validation than the PM period.

Table 24. AM screenline GEH – RMS target

Criteria	AM Count	AM %	Target %	RMS Criteria
GEH <= 4	26	93%	100%	N
Total	28			

[2] RMS Traffic Modelling Guidelines, Table 10.3

Table 25. PM screenline GEH – RMS target

Criteria	PM Count	PM %	Target %	RMS Criteria
GEH <= 4	22	79%	100%	N
Total	28			

It should be noted that these guidelines are intended for use with highway assignment models, and represent a stringent set of targets for a strategic model to achieve. Comparing the CHSTM to the strategic modelling requirements presented in the New Zealand Transport Agency Transport Model Development Guidelines[3] highlights that the CHSTM is performing well within the requirements of a model of this nature, as shown in Table 26 and Table 27.

Table 26. AM screenline GEH – NZ guidelines

Criteria	AM Count	AM %	Target %	NZ Criteria
GEH <= 5	26	93%	> 60%	Y
GEH <= 10	27	96%	> 90%	Y
Total	28			

Table 27. PM screenline GEH – NZ guidelines

Criteria	PM Count	PM%	Target%	NZ Criteria
GEH <= 5	25	89%	> 60%	Y
GEH <= 10	28	100%	> 90%	Y
Total	28			

Presenting the screenline data in scatter plots by vehicle type highlights the level to which each class validates against the observed data. The RMS guidelines does not state requirements for screenlines, therefore the New Zealand guidelines have been used for this purpose.

Figure 20 - Scatter plot - AM LV modelled v observed screenlines

Figure 20 to Figure 22 present scatter plots for LV, MCV and HCV in the AM peak, while Figure 23 to Figure 25 present corresponding information for the PM peak. The R^2 values and line of best fit for each vehicle class and time period are summarised in Table 28 below. The comparison highlights that the modelling of LV traffic and MCVs is very good across all time periods, with HCVs performing less well. It is worth noting that in the CHSTM, the former two vehicle classes represent 98% of the total network flow, suggesting that the overall representation of traffic volumes on the network is very good.

[3] https://www.nzta.govt.nz/assets/resources/transport-model-development-guidelines/docs/tmd.pdf

Table 28. Screenline R^2 values and line of best fit for each vehicle class and time period

Period	Measure (target)	LV	MCV	HCV	RMS Criteria
AM	R^2 (> 0.85)	0.95	0.86	0.55	Y Y N
	Line of best fit (y = 0.9x - 1.1x)	y = 0.95x	y = 0.99x	y = 0.99x	Y Y Y
OP	R^2 (> 0.85)	0.88	0.93	0.78	Y Y N
	Line of best fit (y = 0.9x - 1.1x)	y = 0.91x	y = 0.98x	y = 0.93x	Y Y Y
PM	R^2 (> 0.85)	0.93	0.90	0.64	Y Y N
	Line of best fit (y = 0.9x - 1.1x)	y = 1.02x	y = 1.01x	y = 0.94x	Y Y Y
RD	R^2 (> 0.85)	0.91	0.95	0.90	Y Y Y
	Line of best fit (y = 0.9x - 1.1x)	y = 0.95x	y = 0.97x	y = 1.02x	Y Y Y

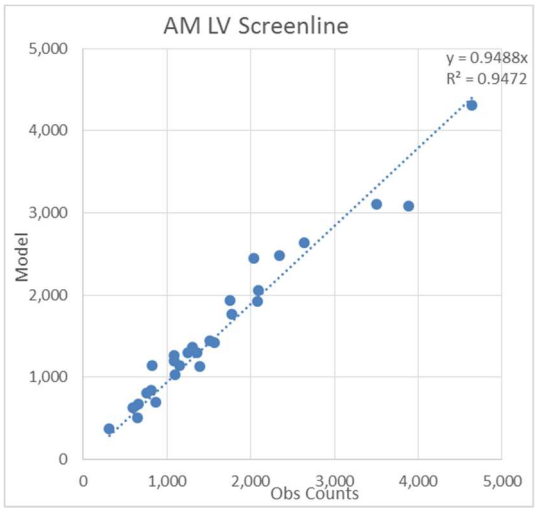


Figure 20 - Scatter plot - AM LV modelled v observed screenlines

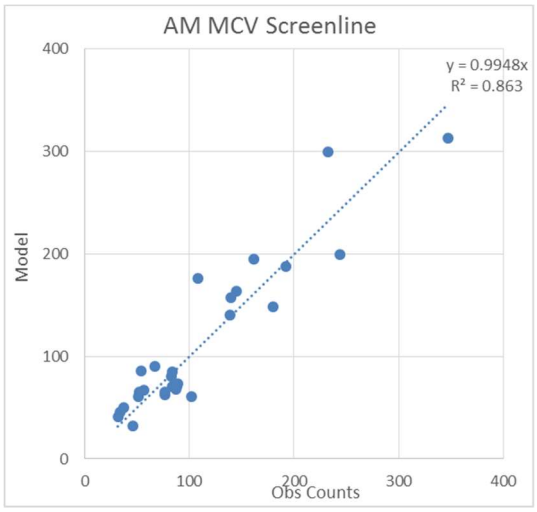


Figure 21 - Scatter plot – AM MCV modelled v observed screenlines

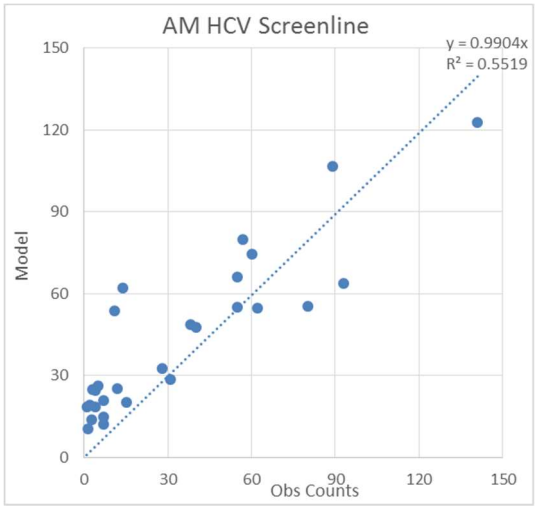


Figure 22 - Scatter plot - AM HCV modelled v observed screenlines

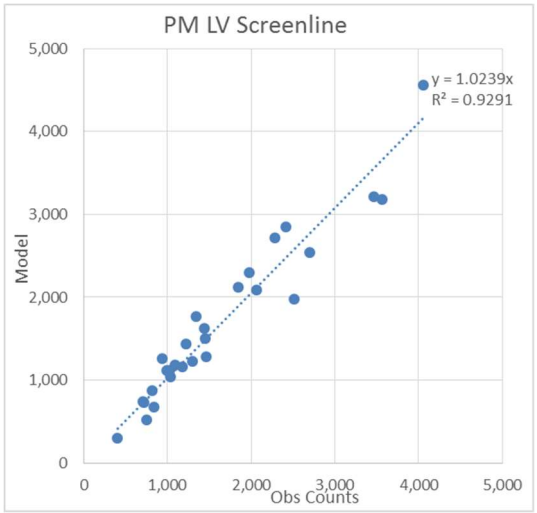


Figure 23 - Scatter plot – PM LV modelled v observed screenlines

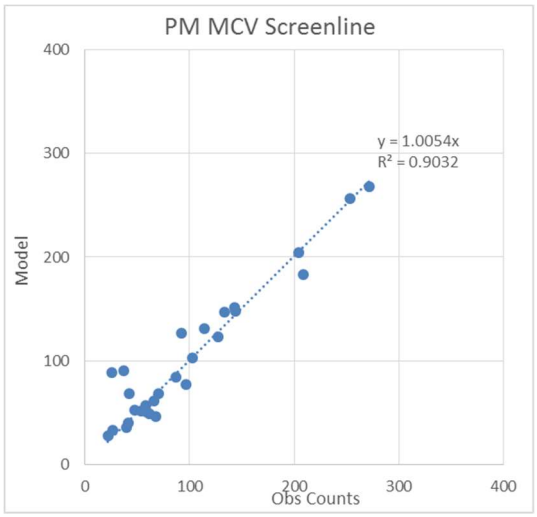


Figure 24 - Scatter plot – PM MCV modelled v observed screenlines

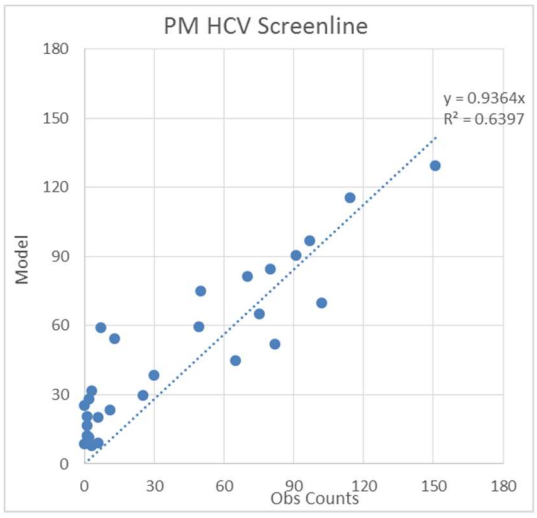


Figure 25 - Scatter plot – PM HCV modelled v observed screenlines

Full validation statistics, including graphs and performance against individual counts, are shown in 0 and 0.

5.5 Individual count validation

The CHSTM individual count validation following the RMS guidelines GEH criteria is shown in Table 29 and Table 30. The existing Pacific Highway corridor is well calibrated based on the counts available, with the model validation being weaker in some areas within the CBD.

Table 29. RMS GEH validation guidelines – AM individual counts

Criteria	AM Count	AM %	Target %	RMS Criteria
GEH <= 5	157	68%	95%	N

GEH <= 10	216	93%	100%	N
Total	232			

Table 30. RMS GEH validation guidelines – PM individual counts

Criteria	PM Count	PM %	Target %	RMS Criteria
GEH <= 5	170	73%	95%	N
GEH <= 10	211	91%	100%	N
Total	232			

The AM and PM peaks demonstrate very similar performance, both falling short of the assignment modelling criteria set by RMS. However, comparing the CHSTM validation against the New Zealand strategic model GEH requirements again demonstrates that it comfortably meets these measures, as shown in Table 31 and Table 32.

Table 31. AM individual counts GEH – NZ guidelines

Criteria	AM Count	AM %	Target %	NZTA Criteria
GEH <= 5	157	68%	65%	Y
GEH <= 10	216	93%	75%	Y
GEH <= 12	224	97%	85%	Y
Total	232			

Table 32. PM individual counts GEH – NZ guidelines

Criteria	PM Count	PM %	Target %	NZTA Criteria
GEH <= 5	170	73%	65%	Y
GEH <= 10	211	91%	75%	Y
GEH <= 12	216	93%	85%	Y
Total	232			

The New Zealand guidelines for strategic models also indicate that comparisons of observed versus modelled link counts should be summarised in bandings, to support the GEH statistics. This analysis is presented in Table 33, which shows both the AM and PM period count data comfortably surpassing the 70% requirement.

Table 33. Individual counts modelled versus observed – percentage difference

Criteria	Difference Criteria	AM	AM Achieved	PM	PM Achieved
Flow < 700 veh/hr	< 100 veh/hr	209	167	210	173
Flow 700 – 2700 veh/hr	< 15%	23	14	22	14
Flow > 2700 veh/hr	< 400 veh/hr	0	0	0	0
Total		232	181	232	187
Target >70% achieved			78%		81%

Plotting modelled flows against observed counts by time period shows the degree to which each individual count validates. Table 34 demonstrates that the RMS criteria are very close to being met in the four time periods, including the off-peak and rest of day periods. The New Zealand guidelines for strategic models are comfortably met in all time periods. Scatter plots for each time period are shown in Figure 26 to Figure 29, while scatter plots for each vehicle type are included in Appendix C.

Table 34. Individual count R^2 values and line of best fit for each time period

Period	RMS measure (NZ measure)	Total traffic	RMS Criteria	NZTA Criteria
AM	R^2 >0.9 (R^2>0.85)	0.89	**N**	**Y**
	Line of best fit (y = 0.9x - 1.1x)	y = 0.96x	*N/A*	**Y**
OP	R^2 >0.9 (R^2 >0.85)	0.91	**Y**	**Y**
	Line of best fit (y = 0.9x - 1.1x)	y = 0.97x	*N/A*	**Y**
PM	R^2 >0.9 (R^2 >0.85)	0.90	**Y**	**Y**
	Line of best fit (y = 0.9x - 1.1x)	y = 1.04x	*N/A*	**Y**
RD	R^2 >0.9 (R^2 >0.85)	0.89	**N**	**Y**
	Line of best fit (y = 0.9x - 1.1x)	y = 0.98x	*N/A*	**Y**

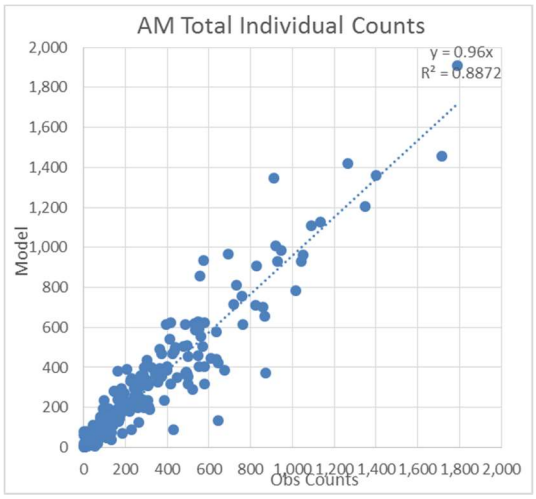


Figure 26 - Scatter plot – AM modelled v observed individual counts

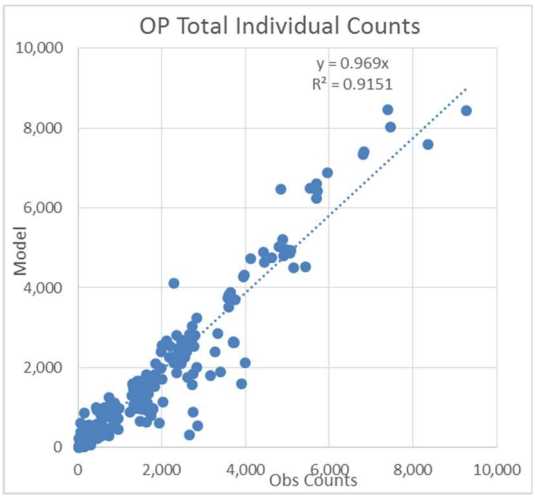


Figure 27 - Scatter plot – OP modelled v observed individual counts

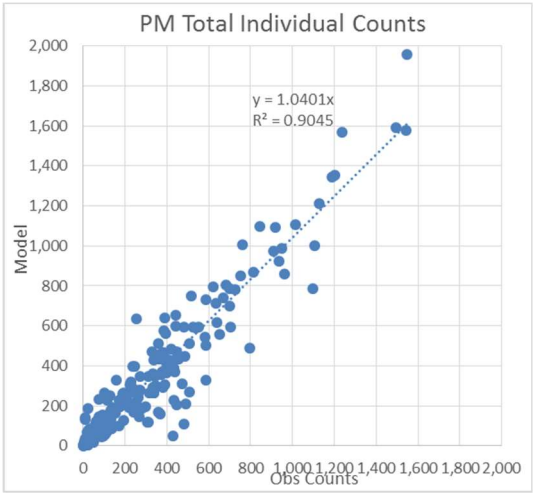


Figure 28 - Scatter plot – PM modelled v observed individual counts

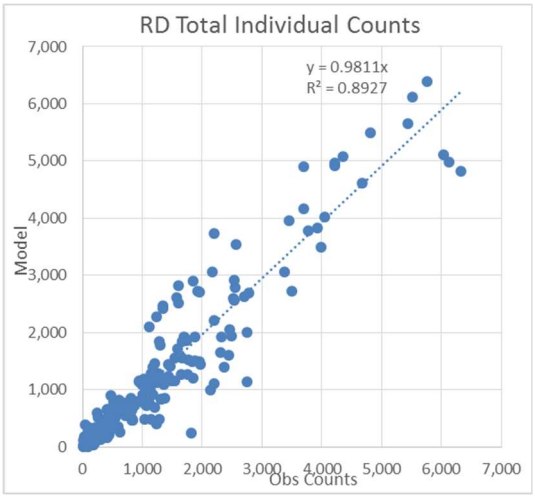


Figure 29 - Scatter plot – RD modelled v observed individual counts

As the primary purpose of the CHSTM development was to provide high level travel demand forecasts for the Coffs Harbour Bypass project, it is therefore important to understand how well the model performs in the locations of interest, especially the existing traffic corridors of Pacific Highway and Hogbin Drive.

Table 35 compares the modelled vehicle volumes to the observed volumes at the Pacific Highway and Hogbin Drive screenline count locations. It can be seen that the traffic volumes are reasonably well modelled along the Pacific Highway and Hogbin Drive. In the AM peak, 78% counts (out of 18) were achieved with a GEH of less than 5, and 94% with a GEH less than 10 and 12. In the PM peak, 83% counts were achieved with a GEH of less than 5, and 100% with a GEH of less than 10 and 12. This indicates that the model is reflecting existing traffic patterns well in the key areas of interest.

Table 35. Link volume validation at Pacific Hwy and Hogbin Dr locations

Screenline	Road Name	Dir.	AM Period			PM Period		
			Obs.	Mod.	GEH	Obs.	Mod.	GEH
SL1	Pacific Hwy *North of Range Rd*	NB	367	398	1.6	380	369	0.5
		SB	308	310	0.1	508	510	0.1
SL1	Pacific Hwy *North of Old Pacific Hwy Interchange*	NB	930	933	0.1	699	700	0.1
		SB	563	553	0.4	935	921	0.5
SL2	Pacific Hwy *At Boambee Ck*	NB	1,791	1,908	2.7	1,016	1,105	2.7
		SB	944	985	1.3	1,546	1,957	9.8
SL2	Hogbin Dr *At Boambee Ck*	NB	1,049	962	2.7	588	729	5.5
		SB	534	588	2.3	951	989	1.2
SL3	Pacific Hwy *At Coffs Harbour Ck*	NB	911	1,346	12.9	1,544	1,578	0.9
		SB	1,400	1,359	1.1	1,191	1,343	4.3
SL3	Hogbin Dr *At Coffs Harbour Ck*	NB	756	758	0.1	964	858	3.5
		SB	830	908	2.7	681	803	4.5
SL4	Pacific Hwy *At Bonville Ck*	NB	919	1,008	2.9	670	739	2.6
		SB	532	618	3.6	909	975	2.2
SL6	Pacific Hwy *Adjacent to Fern Tree Pl*	NB	692	968	9.6	1,494	1,590	2.4
		SB	1,715	1,456	6.5	918	1,091	5.5
SL7	Pacific Hwy *At Woolgoolga Ck*	NB	289	402	6.1	363	435	3.6
		SB	363	372	0.5	384	464	3.9

5.6 Journey time validation

A set of four journey time routes were used for validation, covering two directions and two time periods, giving 16 comparisons with modelled travel times. The locations of these are shown in Figure 30.

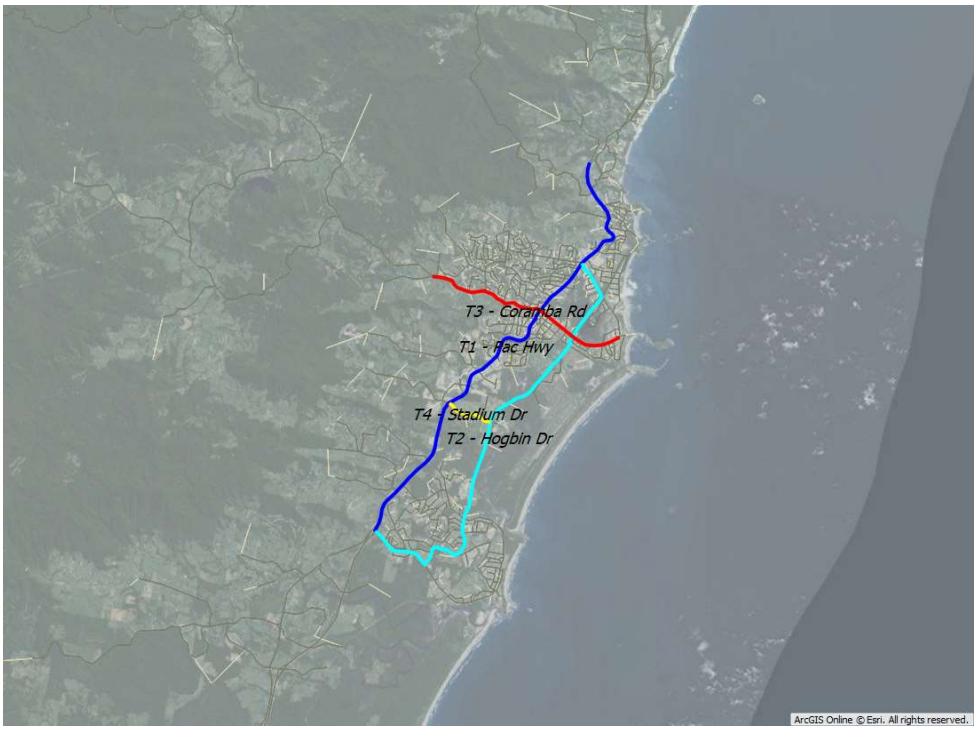


Figure 30 - Journey time routes used during validation

RMS modelling guidance recommends that 95% of modelled journey time routes should be within 15% or 1 minute (whichever is greater) of the observed values.

The model journey time validation is summarised in Figure 31, Figure 32 and Figure 33, with the performance of each route in the AM and PM shown in Table 36 and Table 37. A full breakdown of modelled against observed journey time comparison by segment is presented in Appendix D.

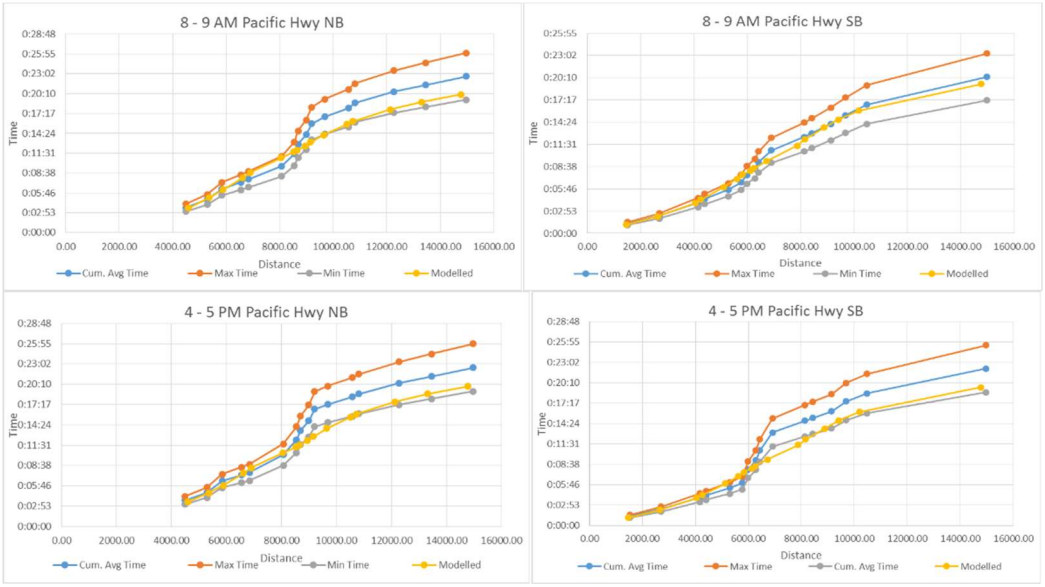


Figure 31. Journey time route 1 - Pacific Highway

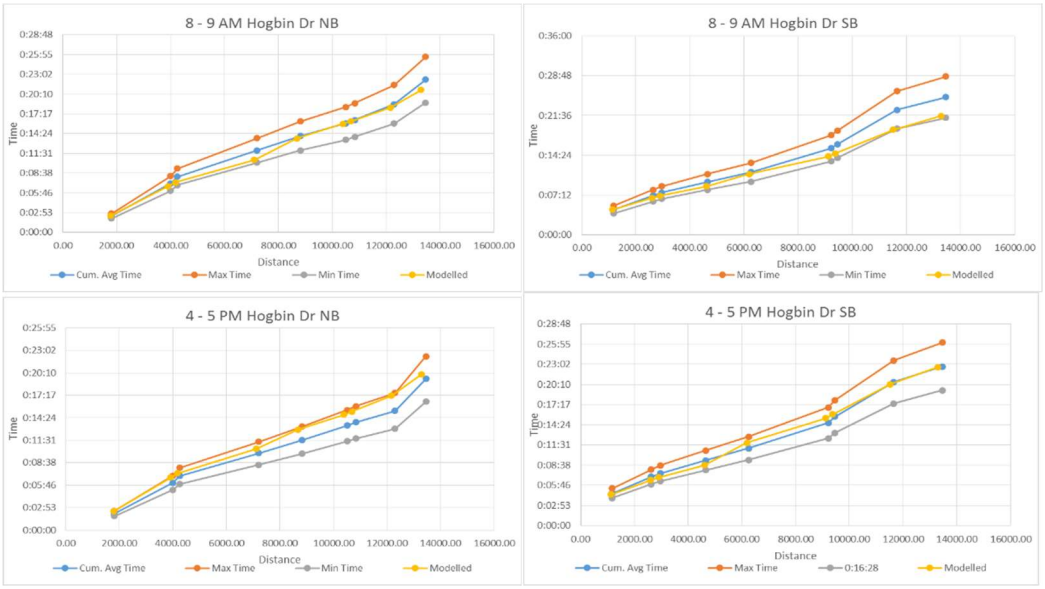


Figure 32. Journey time route 2 – Hogbin Drive

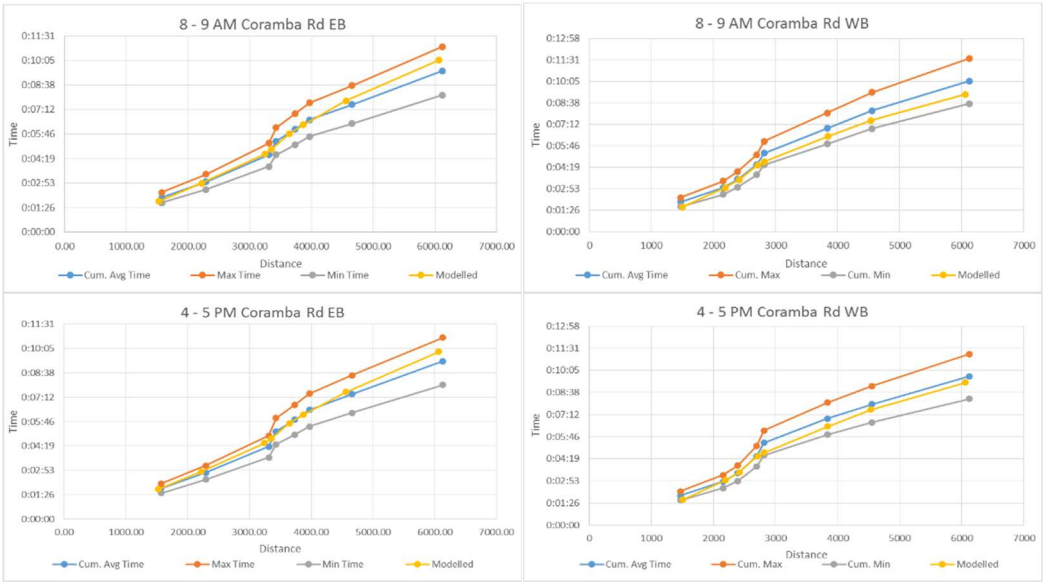


Figure 33. Journey time route 3 – Coramba Road

Route 4, Stadium Drive, only has one data point and therefore does not lend itself to being graphed.

Table 36. AM journey time route validation

Route	Direction	Obs. (mins)	Mod. (mins)	Diff. (Abs.)	Diff (%)	RMS Criteria
1	NB	22.68	19.92	-2.77	-12.2%	Y
1	SB	20.27	19.23	-1.04	-5.1%	Y
2	NB	22.28	20.61	-1.68	-7.5%	Y
2	SB	24.93	19.22	-5.71	-22.9%	N
3	NB	9.47	10.08	0.61	6.5%	Y
3	SB	10.63	9.92	-0.71	-6.7%	Y
4	NB	1.67	1.70	0.03	1.7%	Y
4	SB	2.10	2.13	0.03	1.3%	Y

Table 37. PM journey time route validation

Route	Direction	Obs. (mins)	Mod. (mins)	Diff. (Abs.)	Diff (%)	RMS Criteria
1	NB	22.53	19.87	-2.67	-11.8%	Y
1	SB	22.13	19.52	-2.61	-11.8%	Y
2	NB	19.38	20.65	1.27	6.5%	Y
2	SB	22.73	20.47	-2.27	-10.0%	Y
3	NB	9.32	9.95	0.63	6.8%	Y
3	SB	9.68	10.10	0.42	4.3%	Y

4	NB	1.68	1.68	0.00	0.1%	Y
4	SB	2.30	2.16	-0.14	-6.1%	Y

Overall, the model validation has achieved 94% (15 out of 16) of modelled routes being within a travel time difference of +/- 15% of the observed average. This conforms to the RMS guidelines against a target of 95%, suggesting that the CHSTM exhibits a very high level of validation against observed travel times.

5.7 Model vs O-D Survey

A select link analysis was undertaken for the Pacific Highway at O-D survey stations 3 and 8 using the CHSTM. This was compared to the 2017 O-D survey results to understand how closely the model reflected 'through' traffic volumes. The results of the comparison indicated the updated CHSTM has a good representation of through traffic between stations 3 and 8 as shown in Table 38.

Table 38 Through traffic analysis between station 8 and 3

	Model select link			Observed 2017 O-D		
NB through	**Total volume at station 8**	**Select link volume at station 3**	**% through**	**Total count at station 8**	**Matched count at station 3**	**% through**
Daily	15679	2498	16%	15661	2133	14%
AM	1732	132	8%	1887	134	7%
PM	1069	163	15%	1051	142	14%
SB through	**Total volume at station 3**	**Select link volume at station 8**	**% through**	**Total count at station 3**	**Matched count at station 8**	**% through**
Daily	14289	2396	17%	14596	2280	16%
AM	1396	135	10%	1911	137	7%
PM	1148	193	17%	922	183	20%

6 Strategic model future years

6.1 Data sources

6.1.1 Demographic data sources

The data sources used to carry out the demographic forecast are listed below:

For population and household forecast:

- ABS 2011 and 2016 Census Data (reported in URP)
- DPE population and household forecast 2011 – 2036 (reported in ERP)
- .ID population and household forecast 2011 – 2036 (reported in ERP)
- Planning documents, development proposals and other traffic study reports received from Coffs Harbour City Council.

For employment forecast:

- Working age population forecast derived from population and household forecast (reported in URP)
- Bureau of Transport Statistics 2011 Journey to Work
- Department of Employment – Labour Market Information Portal projection 2015 – 2020
- North Coast Employment Land Review 2011 – 2031
- Planning documents, development proposals and other traffic study reports received from Coffs Harbour City Council.

For enrolment forecast:

- My School website 2016 enrolment information, TAFE and university sources
- School age bracket forecast derived from population and household forecast (reported in URP).

This information was used to establish the base year 2016 demographics and estimate the future year demographics for 2024, 2034 and 2044 at detailed traffic analysis zone (TAZ) level in the CHSTM. Based on this information, the CHSTM can be used to forecast future year travel conditions on the road network in Coffs Harbour.

6.2 Forecast procedure

The process followed to develop the demographic forecasts is broadly outlined below and the procedure is briefly illustrated in the flowchart in Figure 34:

- Base year data (2016) developed at a traffic analysis zone level for population and households, worker and employment, and school enrolment. Base year

data based on information from both the 2011 and 2016 census data packs and 2016 My School enrolment data.

- Forecast growth rates, by 16 .ID sectors, determined based on .ID forecasts
- Additional developments and .ID forecast growth rates used to determine unconstrained population and household forecasts
- Forecasts by job industry from *Department of Employment: Labour Market Information Portal* and *North Coast Employment Land Review*, and forecast growth rates used to determine unconstrained worker and employment forecasts by job industry
- Forecast growth rates of school age population used to determine unconstrained school enrolment forecasts
- Total forecast growth rates provided by DPE used to constrain population and households, worker and employment, and school enrolment forecast.

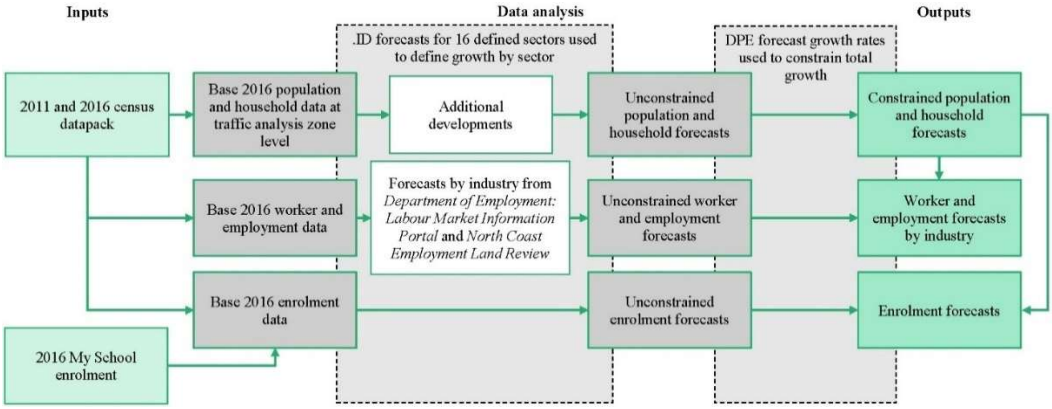


Figure 34: Demographic forecast procedure flowchart

6.3 Additional developments in Coffs Harbour

6.3.1 Planning documents

Coffs Harbour City Council provided a number of development related planning documents, proposals and transport assessment reports to inform the demographic forecast work. The development names, the supporting document titles and a brief description of each development are provided below:

- Korora Basin (referred in document *Planning Proposal – Korora Basin – Residue Land adjacent to the Pacific Highway, dated November 2016*): Residue land development – rezoning land to provide for 16 hectare of large lot (R5) from rural land use (RU) 40 hectare per lot to 1 hectare per lot, resulting in maximum 16 dwelling houses / 45 person in the area. The proposed opening date was June to August 2017.
- Big Banana Development (referred in document *Big Banana Development Coffs Harbour – Access Options Assessment Paramics Modelling, dated June*

2011): Mixed developments include residential apartments, retail and tourist attractions. There was no information about development size, but it assumed a total of 925 vehicles during the AM peak in 2025.

- North Boambee Valley East (referred in document *North Boambee Valley East Development Control Plan, dated July 2009*): Provided a target number of total 282 lots in the area. There was no proposed development time frame in this development control plan.
- North Boambee Valley West (referred in document *Coffs Harbour City Council Planning Proposal – North Boambee Valley West Residential Investigation Area, dated October 2013*): It noted the future resident population of the NBV (West) area will be approximately 2,130 people. No proposed development time frame was indicated in the document.
- Pacific Bay Western Lands (referred in document *Pacific Bay Western Lands Project Application – Environmental Assessment Report, dated March 2010*): Residential development contains 112 dwellings (19 townhouses and 93 single dwellings). No time frame was provided for the development but the consultant has assumed the site will be developed in a single phase and construction will take around two years by 2012.
- North Coffs Release Area (referred in document *Pacific Bay Western Lands Project Application – Environmental Assessment Report, dated March 2010*): A total of 34 hectares of land located south along West Korora Road (including 7.7 hectare of Big Banana Site). Information provided by the Council indicated approximately 340 lots, assumed all to be single detached dwellings. The development time frame is unknown.

6.3.2 Assumptions and process

The planning documents listed in Section 6.3.16.3.1 were reviewed and the proposed developments were compared with the initial development forecast contained with the .ID and DPE projections. It was found the North Boambee Valley (East) development was already captured in the initial forecast, with the forecasts showing an increase of households greater than the total dwellings proposed by the developments. The other developments were considered not to have been captured by the .ID and DPE forecasts.

Given that the majority of the development time frames were unclear or the initial proposed opening year had already passed with no development having taken place, assumptions were made for the development time frames for the relevant developments. Assumptions were also made for total development size which was not clearly stated. The additional residential development numbers and the assumed build out periods are shown in Table 39.

Table 39. Additional residential development assumptions

Additional Development	Total dwellings	Assumed time frame	Captured by initial forecast?
Korora Basin	16	2017	N
Big Banana Development	200	2020-2025	N
North Boambee Valley (East)	282	2020-2030	Y
North Boambee Valley (West)	900	2020-2030	N
Pacific Bay Western Lands	112	2020-2025	N
North Coffs Release Area	340	2020-2030	N

6.4 Population

6.4.1 Calculating household forecasts

To create population forecasts, the Forecast.ID household data was used as a starting point. Data covering all the assumed new residential sites within each of the 16 sectors in Coffs Harbour LGA was available in terms of site location description, quantum of development and temporal profile.

These sites were plotted in a GIS using a combination of automatic geocoding processes, and manual geo-referencing. Once geocoding was complete, the sites were assigned to CHSTM zones using a spatial join in the GIS. For sites without a specific spatial reference, such as infill development, these were allocated evenly across the CHSTM zones within the sector.

The next step was to calibrate this disaggregate model of development against the sector totals produced by .ID. To do this, the descriptions of the development size, and temporal profile relating to construction rate per year were used to estimate a build-out per annum profile for each site. This was an iterative process, with amendments made to profiles until the sector totals for 2024 and 2034 were within 1-2% of the forecasts.

The allocated total dwellings from the .ID forecast were converted into occupied dwellings, with each occupied dwelling representing a household. This conversion was carried out using the 2016 Census occupancy rate, and involved the following:

- Estimates were made at the TAZ level in CHSTM
- Occupancy rates from the 2016 Census were used for future years
- Model zones with no dwellings in the 2016 data were allocated an average occupancy rate based on the occupancy rate in the parent SA1 zone.

An additional feature was added to allow different dwelling build out scenarios to be modelled, because of uncertainties in projected future growth outcomes. This was implemented as a percentage factor to the total allocated dwellings within the .ID Forecasts as follows:

- High: 100% build out
- Medium: 75% build out
- Low: 50% build out.

These three dwelling forecast scenarios then formed the basis for generating unconstrained population projections. The medium build out scenario formed the core forecast, with high and low build out scenarios forming sensitivity tests.

6.4.2 Calculating total population forecasts

The 2016 Census total usual residence population to occupied private dwelling rate in each model zone was used to generate future population. This rate was approximately 2.7 total population per occupied private dwelling across the Coffs Harbour local government area in 2016. This is equivalent to 2.47 people living in each occupied private dwelling, with the remainder not residing in private dwellings. The relationship between usual residence population and occupied private dwelling in each zone was assumed to remain constant in future years.

The average household size is expected to change over time. The Forecast.ID future year population to dwelling ratios were used to inform these changes, whereby the percentage change in each .ID sector is applied to each of the TAZ zones within the relevant sector.

One enhancement made to the previous methodology related to instances where the Census data had calculated very high population to household ratios. These tended to be in the non-residential zones with very small base year populations, however the consequence of these very high rates was that significant future residential developments generated excessively high populations, e.g. 13 people per household in a large SA1 zone which includes the Coffs Harbour Health Campus and Southern Cross University Campus.

As such, a cap of 4 total population per occupied dwelling was applied to zones in future years which exceeded this value, to maintain a sensible population per household rate. This was applied to a total of three SA1 zones, and was based on analysis of identified outliers in the 2016 Census data.

6.4.3 Calculating age group profiles

The Forecast.ID age profile projections at the .ID sector level were used to calculate the forecast population by age category. The percentage point change in age group share at the .ID sector level was applied at TAZ zone level. For TAZ zones which had no population in the base year, the average age group profile for the .ID sector was used in future years to generate population splits from new developments.

There was one SA1 zone with exceptional age splits with dominant aged 65+ population, which was due to the current inclusion of an age care centre. The growth by age category was therefore assigned with sector average for forecast years to avoid age categories calculating extremely high / low shares in future.

The age group profiles for 2044 were calculated based on an extrapolated average 2024 – 2034 growth profile for each age group, which was consistent with the approach used for the household and population forecast.

6.4.4 Extrapolating to 2044

The .ID forecasts only extended to 2036. To produce estimates for the 2044, these forecasts were extrapolated. This involved the following:

- The compounded annual growth rates of households, and changes in average household size between 2024 and 2034 were calculated for each .ID sector, which had data points aligned with these forecast years
- Each TAZ zone then inherited the growth rates from the .ID sector in which it was located, to produce the projection of households and total population per household for 2044
- The 2044 values were calculated by extrapolating the 2034 values using the 2024 – 2034 calculated average growth rate.

6.4.5 DPE controlling totals

The methodology described above produced a set of unconstrained household and population forecasts. However, it was agreed with Roads and Maritime that the overall population growth should be consistent with DPE projections.

Applying control totals to the forecast years based on the absolute DPE forecasts was not considered to be appropriate because of the difference between the 2016 Census data and the DPE 2016 forecasts for households and population. The method used to constrain forecasts so they are consistent with DPE forecasts is broadly outlined below:

- Compound annual growth rates between forecast years, based on the DPE forecasts for the Coffs Harbour local government area, were used to generate controlling totals for the unconstrained forecasts
- Household and population values were adjusted up or down accordingly to replicate the DPE projected rates; these factors were applied globally across all CHSTM zones.

The DPE projections only extended to 2036, and the projection years did not correspond to the CHSTM horizon years. Interpolation and extrapolation was undertaken to estimate the controlling factors as follows:

- 2024 – compound annual growth rate for 2021 to 2026 used to calculate interpolated value
- 2034 – compound annual growth rate for 2031 to 2036 used to calculate interpolated value
- 2044 – compound annual growth rate for 2031 to 2036 used to calculate extrapolated value.

This process was undertaken for both household and population projections.

6.4.6 Final household and population forecasts

Based on the steps outlined above, a set of controlled land use forecasts were produced and used for input to the 4-step model. These totals are presented in Table 40. The distribution of population growth to 2044 is shown in Figure 35 and Figure 36.

Table 40. DPE controlled household and population forecasts

	Forecasts				Average Growth Rate		
	2016	2024	2034	2044	2016 - 2024	2024 - 2034	2034 - 2044
Households	27,043	29,999	33,377	36,688	1.3%	1.1%	1.0%
Population	73,001	79,914	87,708	95,320	1.1%	0.9%	0.8%

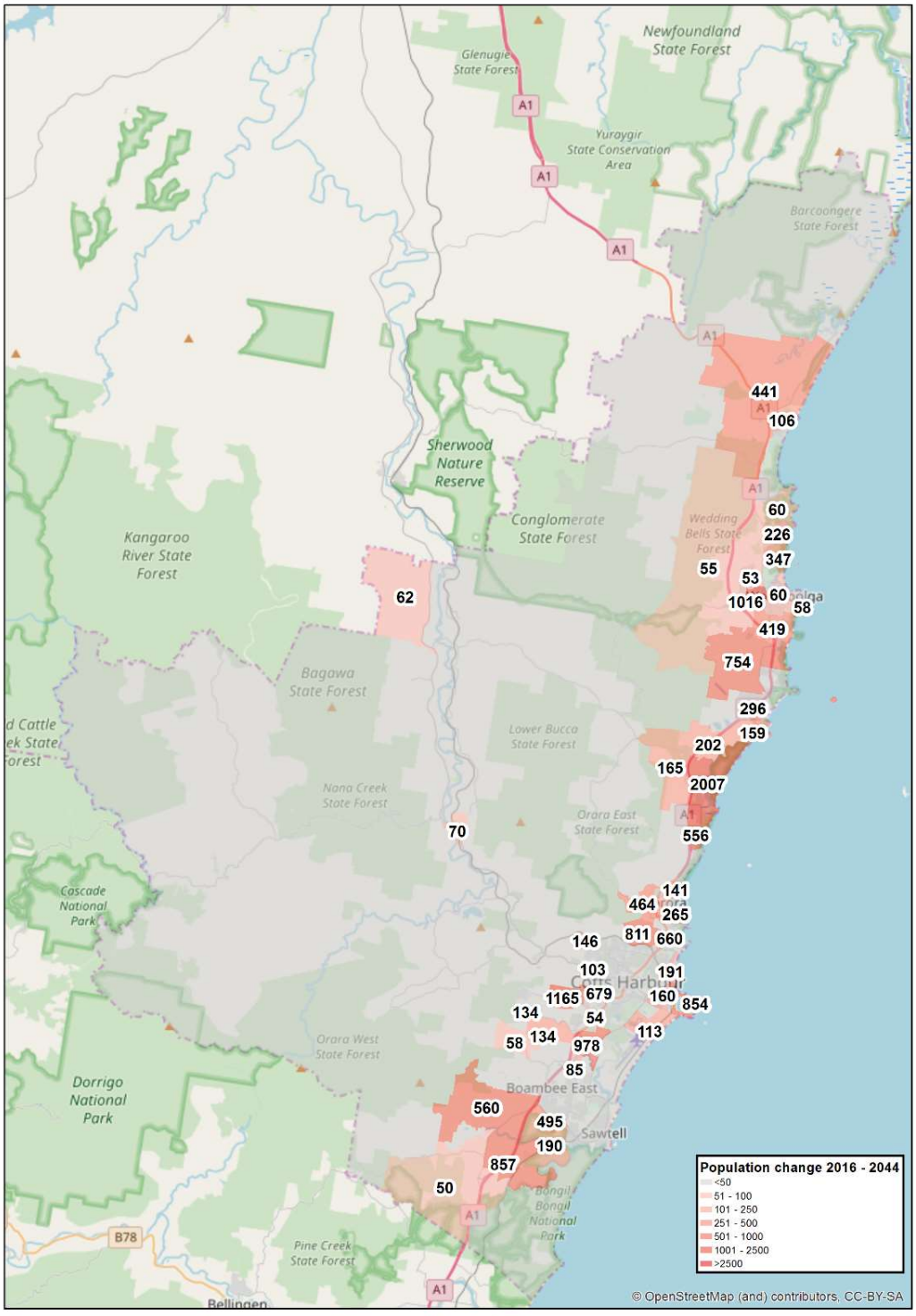


Figure 35 - Forecast population change between 2016 and 2044 – LGA wide

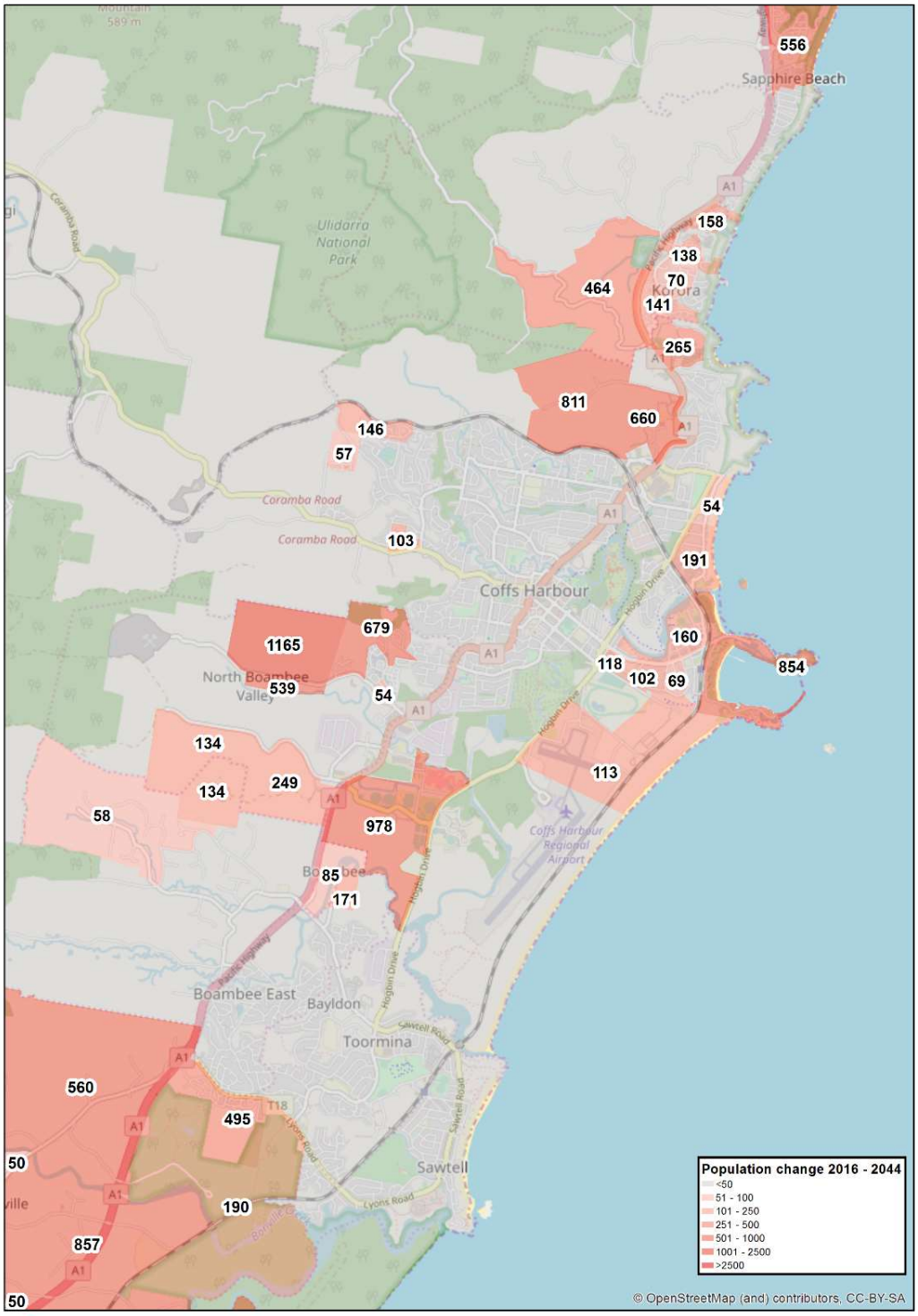


Figure 36 - Forecast population change between 2016 and 2044 – Coffs Harbour city

6.4.7 Enrolment and visitor forecasts

To calculate enrolment forecastsfor primary, secondary and tertiary educational establishments, the first task was to define the assumed catchments for each. Tertiary institutions were assumed to have an LGA wide catchment area.

Data covering school enrolments in 2016 was sourced from the MySchool website for all of the primary and secondary schools within the Coffs Harbour LGA. This was used to estimate equivalent catchments for each public school using the CHSTM zone system.

The method used to determine enrolment and visitors forecasts is outlined below:

- Growth rates were calculated based on the total change in the school age bracket (0-17) within these defined catchments of each school
- These growth rates were then applied to the appropriate school enrolments based on each school catchment area
- For tertiary educational establishments, the growth in total working age population (18-64) for the local government area was applied to the enrolment figures for each horizon year

The estimated 2016 visitor numbers were uplifted in line with the DPE controlled total population forecasts. Due to the regional nature of visitor demand, rates for each year were applied globally to all CHSTM zones; the relative distribution of visitor trips across zones was assumed to remain the same.

6.5 Employment and workers

6.5.1 Calculating growth rates by employment sector

The *North Coast Employment Land Review* (March 2015) provided information for future employment growth by industry type. Employment projections were based on a methodology which considered population projections by age, labour force status by age, industry composition and job self-sufficiency in the region, to estimate the number of jobs per industry. The projected growth rate in jobs by industry within this study has been used as the basis for the updated employment forecasts.

Forecast employment by industry type was available for 2021 and 2031, and the existing employment data by industry type was available for 2011 (2011 Census). Future year employment growth rates were estimated by:

- Interpolating for 2016 and 2024 employment numbers, based on the compound annual growth rates for 2011 to 2021, and 2021 to 2031 respectively
- Extrapolating the 2021 – 2031 compound annual growth rate to estimate 2034 and 2044 employment numbers.

Note the 2016 employment data from the 2016 Census was not available at the time of this update.

The growth rates calculated by industry for each model year are presented inTable 41.

Table 41. Growth rates by aggregate sector

Industry sector	% Change from 2016			CAGR		
	2024	2034	2044	2016 - 2024	2016 - 2024	2034 - 2044
Service	8%	20%	32%	1.0%	1.0%	1.0%
Professional	4%	9%	14%	0.5%	0.4%	0.4%
Industry	0%	3%	5%	0.0%	0.2%	0.2%
Retail	6%	15%	24%	0.7%	0.8%	0.8%
Other	-8%	-11%	-14%	-1.0%	-0.3%	-0.3%
Total all sectors	**5%**	**13%**	**21%**	**0.6%**	**0.7%**	**0.7%**

6.5.2 Key employment developments

The *North Coast Employment Land Review* and *North Boambee Traffic Study* (by GTA) were used to develop a list of the key employment development locations, including the hectares of land for each development. These were assigned to CHSTM model zones. Assumptions on construction dates were used to estimate build-out profiles for each site, equating to a percentage of the total site size for each model year.

As a part of the updated forecast, an additional assumption was made to include build out profiles / development staging of the new employment developments to allow for the progressive increase of employment over time, rather than allocating 100% of the proposed employments in one year. The development profiles for each identified development site are shown in Table 42.

Table 42. Assumed build out profiles for identified development sites

Name	CHSTM Zone	2024	2034	2044
Woolgoolga	700	25%	75%	100%
South Bonville West	562	25%	75%	100%
North Boambee - Isles Drive	453	25%	75%	100%
North Boambee - Cook Drive	316	25%	75%	100%
North Boambee Valley West Ind 1	464	50%	75%	100%
North Boambee Valley West Ind 2	465	50%	75%	100%

The number of jobs in future industrial land development areas were estimated based on the area of the site and the average area per job in industrial zones. The process followed is broadly outlined below:

- The average land area per job in industrial zoned land was estimated at 344 m^2 per job. This value was determined based on an estimation of the average industrial land area per job from Coffs Harbour base year employment data

- The total land area of the development and the average area per job were used to determine the total number of jobs (all sectors) for each development
- The total number of jobs were then divided across the six industry sectors based on the average proportion of jobs by industry type within existing industrial land (based on the average profile of industrial land in the base year model). The proportions used were as follows:
    - Service – 40%
    - Professional – 3%
    - Industry – 32%
    - Retail – 21%
    - Other – 4%

This split produced an estimate of jobs by sector for each industrial development zone identified, based on 100% build-out. The profiles in Table 42were used to produce forecast jobs for each forecast year.

6.5.3 Calculating employment forecasts

The growth rates in Table 41 were used to create employment forecasts for each CHSTM zone by industry sector. The 2016 employment values were uplifted in line with these factors, with the exception of the zones allocated to specific commercial development sites in Chapter 6.5.2. This produced a set of unconstrained employment forecasts for each year.

6.5.4 Calculating worker forecasts

Worker forecasts were also produced using the growth rates in Table 41. These values were applied by sector by year for all CHSTM zones. As an enhancement to the previous methodology, the number of workers in each zone were then controlled by the working age population forecast in that zone, by maintaining the 2016 workers to working age population rate in each zone. Where a rate did not exist in the base year, the average Coffs Harbour local government area rate was applied instead.

6.5.5 Controlling totals

The unconstrained forecasts in jobs and workers were initially produced independently of the population forecasts. However, population, workers and jobs within an area are intrinsically linked. As such, because the sources of population forecasts were more extensive, growth in employment and workers was controlled by the changes in working age population.

To do this, the relationship between jobs and working age population (18-64), and between workers and working age population was calculated using the 2011 Census data. However, analysis of worker participation rates through time highlighted the 2011 Census data was slightly higher than an average year within the period. As such, the rates applied for future forecasting were adjusted slightly lower to the following values:

- Jobs per working age person – 0.67
- Workers per working age person – 0.68.

The above factors were applied to the total working age population to calculate the total jobs and workers within Coffs Harbour local government area. The derived values were used to constrain the estimated total jobs and workers from the earlier forecast steps.

6.5.6 Final employment and worker forecasts

The methodology outlined above produced the following set of constrained employment and worker forecasts (Table 43). The distribution of job growth across CHSTM zones is shown in Figure 37 and Figure 38.

Table 43. Final controlled workers and jobs forecasts

	Forecasts				Average Growth Rate		
	2016	2024	2034	2044	2016 - 2024	2024 - 2034	2034 - 2044
Workers	28,218	29,405	31,615	31,875	0.5%	0.7%	0.1%
Jobs	27,803	28,972	31,150	31,406	0.5%	0.7%	0.1%

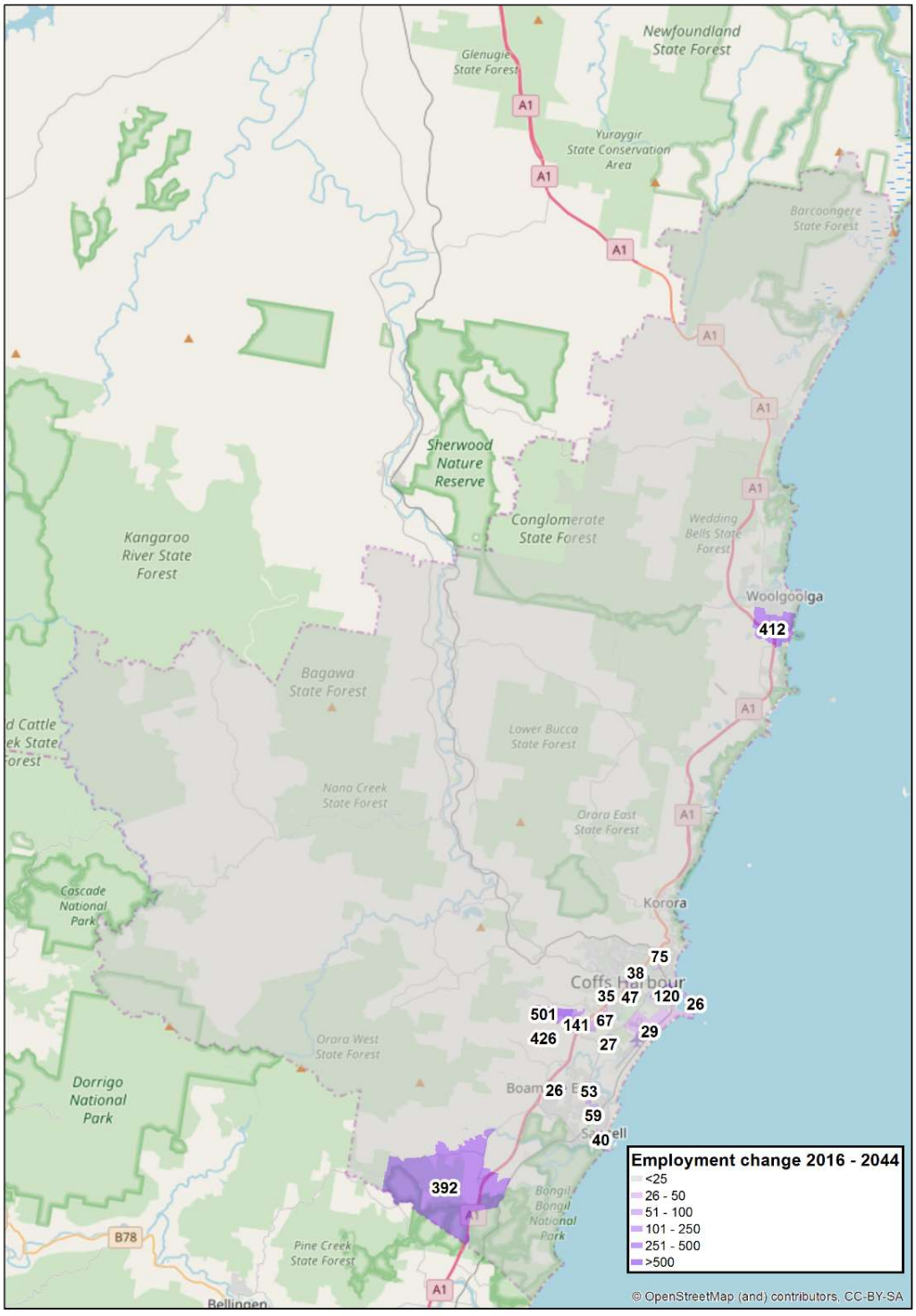


Figure 37 - Forecast employment change between 2016 and 2044 – LGA wide

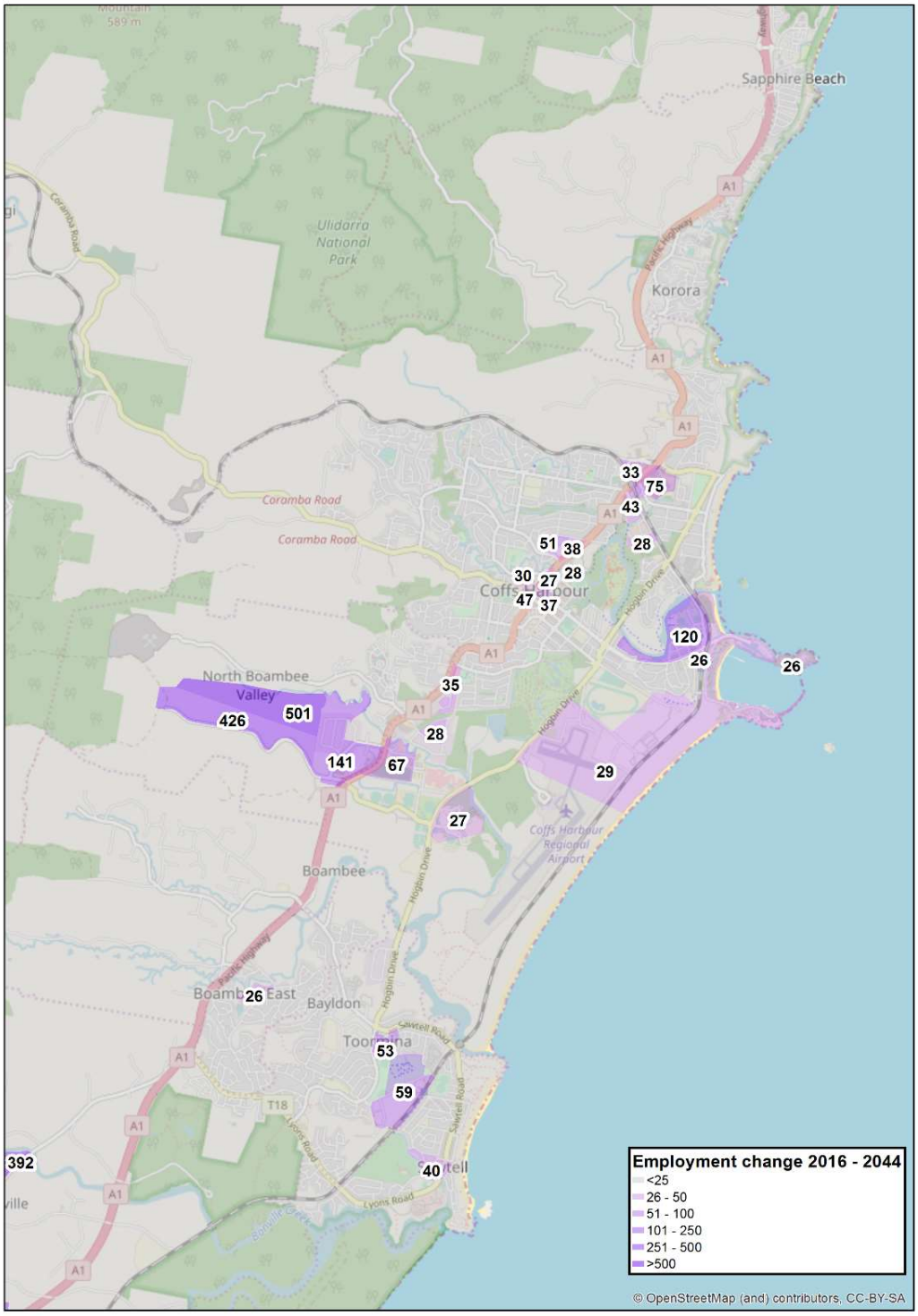


Figure 38 - Forecast employment change between 2016 and 2044 – Coffs Harbour city

6.6 Model forecast outputs

6.6.1 Demand outputs

The population and employment forecasts were used in the CHSTM to produce forecasts of traffic demand. The outputs of this are summarised by vehicle, time period and year in Table 44. It can be seen that total daily demand increases by around 13% between 2016 and 2024, before slowing to a rate of approximately 7% in the period thereafter. This reflects the population forecast growth rate profiles.

Table 44. Demand outputs (PCUs) by vehicle type, time period and year

Vehicle type and time period	2016	2024	2034	2044	2016-2024	2024-2034	2034-2044
AM LV	21,160	22,950	25,154	26,985	1.1%	1.0%	0.7%
AM MCV	2,528	2,838	3,069	3,183	1.5%	0.8%	0.4%
AM HCV	1,341	1,514	1,640	1,694	1.6%	0.8%	0.3%
Total AM	**25,029**	**27,302**	**29,863**	**31,862**	**1.1%**	**0.9%**	**0.7%**
OP LV	114,256	124,087	136,470	147,502	1.1%	1.0%	0.8%
OP MCV	16,209	18,193	19,724	20,456	1.5%	0.8%	0.4%
OP HCV	7,325	8,212	8,998	9,525	1.5%	1.0%	0.6%
Total OP	**137,790**	**150,492**	**165,192**	**177,483**	**1.2%**	**1.0%**	**0.7%**
PM LV	20,487	22,149	24,298	26,044	1.0%	1.0%	0.7%
PM MCV	2,395	2,688	2,911	3,025	1.5%	0.8%	0.4%
PM HCV	1,182	1,328	1,462	1,560	1.5%	1.0%	0.7%
Total PM	**24,064**	**26,165**	**28,671**	**30,629**	**1.1%**	**1.0%**	**0.7%**
RD LV	74,211	79,906	87,490	93,196	1.0%	0.9%	0.7%
RD MCV	9,501	10,655	11,565	12,009	1.5%	0.9%	0.4%
RD HCV	7,095	7,889	8,744	9,529	1.4%	1.1%	0.9%
Total RD	**90,807**	**98,450**	**107,799**	**114,734**	**1.1%**	**0.9%**	**0.6%**
Daily LV	230,114	249,092	273,412	293,727	1.0%	1.0%	0.7%
Daily MCV	30,633	34,374	37,269	38,673	1.5%	0.8%	0.4%
Daily HCV	16,943	18,943	20,844	22,308	1.5%	1.0%	0.7%
Total Daily	**277,690**	**302,409**	**331,525**	**354,708**	**1.1%**	**1.0%**	**0.7%**

6.6.2 Network statistics

A set of global network statistics provides a useful indication of network-wide performance in each modelled year. The network statistics by time period by year are shown in Table 45 below.

Table 45. Network statistics by time period by year

Network Statistics	2016	2024	2034	2044
AM vehicle kilometres travelled (km)	197,064	213,068	233,711	250,547
AM vehicle hours travelled (hours)	3,680	4,062	4,591	5,083
AM average speed (kph)	53.6	52.5	50.9	49.3
AM time lost to congestion (hours)	200	296	472	680
OP vehicle kilometres travelled (km)	1,143,959	1,237,696	1,359,551	1,469,723
OP vehicle hours travelled (hours)	20,474	22,408	25,010	27,421
OP average speed (kph)	55.9	55.2	54.4	53.6
OP time lost to congestion (hours)	992	1344	1934	2546
PM vehicle kilometres travelled (km)	203,153	218,538	239,513	257,169
PM vehicle hours travelled (hours)	3,709	4,060	4,603	5,062
PM average speed (kph)	54.8	53.8	52.0	50.8
PM time lost to congestion (hours)	215	300	490	658
RD vehicle kilometres travelled (km)	828,723	893,069	981,438	1,051,865
RD vehicle hours travelled (hours)	14,202	15,366	16,955	18,211
RD average speed (kph)	58.4	58.1	57.9	57.8
RD time lost to congestion (hours)	421	537	731	914
Daily vehicle kilometres travelled (km)	2,372,899	2,562,371	2,814,213	3,029,304
Daily vehicle hours travelled (hours)	42,065	45,896	51,159	55,777
Daily average speed (kph)	56.4	55.8	55.0	54.3
Daily time lost to congestion (hours)	1,828	2,477	3,626	4,798

7 Traffic model development

7.1 Introduction

A mesoscopic network assignment model has been developed in AIMSUN (version 8.2.2) for the Coffs Harbour Bypass Project.

The purpose of the Coffs Harbour Traffic Model (CHTM) is to assign traffic demands (from the strategic model) to the road network to provide predictions of traffic volumes and delays on various road links and turns. The model outputs have been used as inputs to the economic analysis for the business case comparing the future year project case against a base case.

The key features of CHTM are summarised in Table 46.

Table 46: Key features of the network assignment model

Key Feature	Description
Model Zones	CHTM covers the central Coffs Harbour area from Sapphire Beach to Boambee East. 544 internal travel zones were defined based on the combination of SA1 and mesh block boundaries from ABS. 7 external travel zones were defined as external traffic demand feeds. The zones represent a relatively high level of spatial detail suitable for a mesoscopic model.
Model Network	All state controlled highways, arterial, distributor local collector roads, and most local roads are modelled in CHTM.
Model Year	Calibrated to represent travel conditions in a 2016 base year. Traffic demand forecasts and networks developed for forecast years 2024, 2034 and 2044.
Time Periods	Peak morning and afternoon one hour periods: AM (8-9am) and PM (4-5pm).
Vehicle Classes	3 vehicle classes - light vehicles (Austroads classification 1 and 2), - medium commercial vehicles (Austroads classification 3 – 5), and - heavy commercial vehicles (Austroads classification 6 – 12)
Trip Purposes	Travel demand not defined by trip purpose
Public Transport	Bus services have not been included in the CHTM due to the relatively low levels of bus service provision in Coffs Harbour.

7.2 Model network

The CHTM road network is shown in Figure 39 bounded by a dashed red line. The model network was coded to represent the physical characteristics of the existing road network including functional hierarchy, number of lanes (including turning lanes) and free-flow speed. Intersections were also coded according to existing form and control type such as priority control, roundabout, merges and signalised intersections.

The signalised intersections were coded using existing signal phase plans and timings with adjustments made to suit the model demand flows.

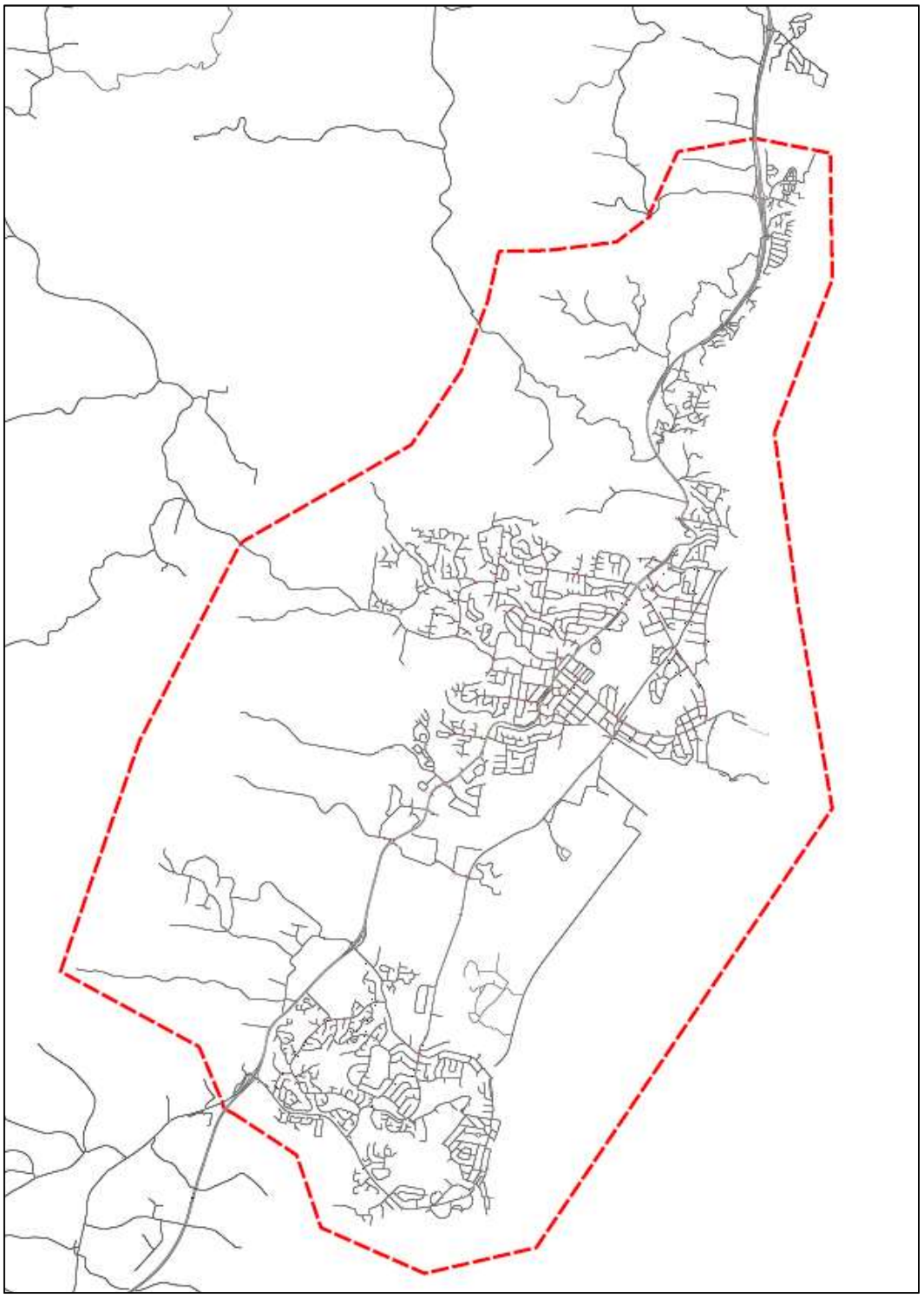


Figure 39 - AIMSUN model area

7.2.1 Road types

The road types are based off the existing road hierarchy of Coffs Harbour. They were developed from the default road types defined by Aimsun. Table 47 shows the 13 different road types and their main properties.

There are several locations where individual section properties have been changed. For example, there were changes to speed where free flow speed is expected to lower than the default due to high friction (e.g. shopping centres, car parking).

Table 47: Road types and main properties

Road Type	Jam Density (per Lane) (veh/km)	Lane Capacity (PCUs/h)	Lane Width (m)	Speed (km/h)	No. Sections in CHTM
Freeway	142	1800	3.5	100	209
Arterial	142	1200	3	60	2539
Road	142	1200	3	50	2
Regional 80	142	1200	3	80	35
Regional 70	142	1200	3	70	22
Regional	142	1200	3	60	193
Regional 50	142	1200	3	50	31
Regional 40	142	1200	3	40	6
Roundabout	250	1000	3.2	30	212
Distributor	142	1000	3	50	666
On/Off Ramp	142	900	3	60	87
Local Collector	142	800	3	50	1318
Street	142	300	3	40	2518

7.2.2 Intersections and signal timings

By default, turn speeds at intersections are automatically calculated by the AIMSUN program. These are generally considered to be higher than reality and therefor the speeds for left and right turns were globally revised to 20 and 30 km/h respectively.

Signalised intersections

There are 15 signalised intersections within the model area. All signals were coded as fixed time signals. Average cycle times and phase timings for the AM and PM peak hour period were calculated from SCATS IDM data. Minor adjustments were made to the signal timings to match modelled traffic demands and observed traffic performance. Signal offset information was not available but were calibrated based on travel time information.

A comparison of observed signal timings versus modelled signal timings is shown in Appendix E. In summary the comparison shows that:

- All modelled cycle times are within 10% of the average observed cycle time.
- Modelled phase times are within 10 seconds of the average observed phase time.
- Phases with an average observed phase time of less than seven seconds were not included in the model unless it contained a turning movement not included in the other phases.
- The modelled signals assume a minimum phase time of 11 seconds. This includes five seconds of green-time and 6 seconds of interphase. Phase C at Pacific Hwy / Isle Dr is an exception as this phase was modelled to only occur once every two cycles.
- The low frequency of some right-turn phases (Phase B) at Pacific Hwy/ Albany St and Pacific Hwy/ Beryl St means that the difference between modelled and observed phase times exceed 10 seconds.

Unsignalised intersections

Priority rules were added where necessary to reflect realistic constraints and delays to the road network. Due to the large scale of the model, priority rules were not added to local roads with the sole purpose of loading trips onto the network.

Give-way parameters remained unchanged for give-way and stop rules at priority intersections. For roundabouts, the initial and final safety margins were increased to 7 and 4 seconds respectively, and the visibility along mainstream was decreased to 20 metres. This is to simulate the lower vehicle speeds and increased breaking approaching roundabouts.

Stop-yields were used instead of give-ways at some approaches to reflect higher vehicle stopping were necessary. For example, this was applied to the north approach of Hogbin Drive/ Orlando Street roundabout to reflect restricted visibility approaching the roundabout.

7.2.3 Public transport

Public transport services were not modelled in the CHTM. The most frequent public transport route operates every half hour, and therefore would have a negligible impact on network operation.

7.3 Model assignment

The CHTM used a mesoscopic dynamic user equilibrium assignment to predict route choice in the model. A static equilibrium assignment was also used to determine initial paths for input to the dynamic user equilibrium assignment to

assist in achieving faster convergence. The key parameters for the dynamic assignment were as follows:

- Stopping criteria: relative gap of 1%
- Gradient-based equilibrium algorithm
- One-hour assignment period with a 30-minute warm-up (using scenario demand).
- Route choice paths calculated at 15 minute intervals.
- Attractiveness weight of three was used to increase the utility of higher order roads.

8 Traffic model calibration and validation

8.1 Model calibration

8.1.1 Vehicle types

There are three defined vehicle types used within the model:

1. Car (representing light vehicles)
2. Truck (rigid)
3. Heavy Truck (articulated and b-double)

8.1.2 Driver and vehicle calibration

Several adjustments were made to driver and vehicle parameters to better match overall traffic performance to site observations of travel time and queues. These included:

- Jam Density per lane reduced from the default value of 200 to 142 vehicles per kilometre. A change to this parameter reflects the overall larger vehicle fleet size and vehicle spacing in Australia (compared to Europe) and results in a lower traffic flow capacity. A jam density of 250 per lane was applied to sections shorter than seven metres long to prevent unrealistic blocking of the link.
- Driver reaction times were adjusted for each vehicle type with higher values compared to the default value. These higher reaction times better represent driver behaviour in regional areas as opposed to city areas. This change results in a lower traffic flow capacity.
- Higher values for reaction time were applied to truck and heavy truck to account for the slower acceleration of the heavier vehicle types.

Table 48: Mesoscopic model reaction time parameter

Vehicle Class	Reaction Time (sec)	Reaction Time at Traffic Light (sec)
Default (all vehicles)	1.2	1.6
Adjusted - Car	1.4	1.8
Adjusted - Truck	1.5	1.9
Adjusted - Heavy Truck	1.6	2.0

8.2 Route choice calibration

Route choice in the model was calibrated to match apparent route choice demonstrated by the traffic count data and a logic check undertaken. Key issues addressed in the calibration of route choice included the balance of traffic using the Pacific Highway versus Hogbin Drive and the reduction of traffic using lower

order streets instead of higher order streets. Route choice calibration was achieved through the adjustment of the following:

- Free-flow speeds adjusted lower. Some key examples include:
- Harbour Drive within the CBD reduced from 40km/h to 20km/h to reflect the shared zone and friction due to parking
- A range of streets in the CBD reduced from 50km/h or 40km/h to 30km/h to reflect friction effects caused by parking and pedestrian movement.
- Turn delays were applied at priority controlled intersections where modelled turning traffic was too high compared to traffic count data due to unrealistic rat running. These turns were:
- Elm Street to Bray Street
- Woolgoolga Road to Argyll Street
- Woolgoolga Road to Bailey Avenue
- Albany Street to Grafton Street
- Rose Avenue to Marcia Street
- Park Avenue to Earl Street
- Ocean Parade to Orlando Street

8.3 Traffic demand calibration

Base year (2016) traffic demand matrices from the strategic model where provided as initial demand inputs to the CHTM. A matrix adjustment process was then undertaken within AIMSUN to achieve a closer match between the modelled traffic volumes and the traffic counts. Controls were applied in the matrix adjustment process to limit the extent of the changes that could be made to the initial matrices. These controls included:

- Matrix elasticity value of 0.5 for AM and 0.7 for PM (a value of zero means no variation is permitted and a value of one permits a greater level of freedom).
- Maximum deviation of 20% permitted per matrix cell value for light vehicles.
- For AM peak, a matrix elasticity value of one and no maximum deviation was applied to the truck matrix.
- For PM peak, a matrix elasticity value of one and no maximum deviation was applied to the truck and heavy truck matrix.

The above controls allowed for some degree of elasticity without overly distorting the original matrix patterns.

The full process followed for calibrating the demand matrix was is outlined below:

1. Demand matrices were extracted from the strategic model and imported into the CHTM. These are the ‘seed’ matrices.

2. The seed matrices were assigned to the network and modelled volume was compared to traffic count data at cordon locations. External zone origin or destination totals were factored to better match the count data where GEH comparison values were greater than five. This produced a set of 'manually adjusted' matrices.
3. The manually adjusted demand matrices were passed through the AIMSUN matrix adjustment process.
4. The AIMSUN adjusted matrices were assigned to the network and modelled volumes checked against traffic count data leading to final manual adjustments to fine tune the matrices. These final adjustments were generally made to parts of the matrices where changes greater than the maximum 20% cell change where required to achieve an acceptable match result.

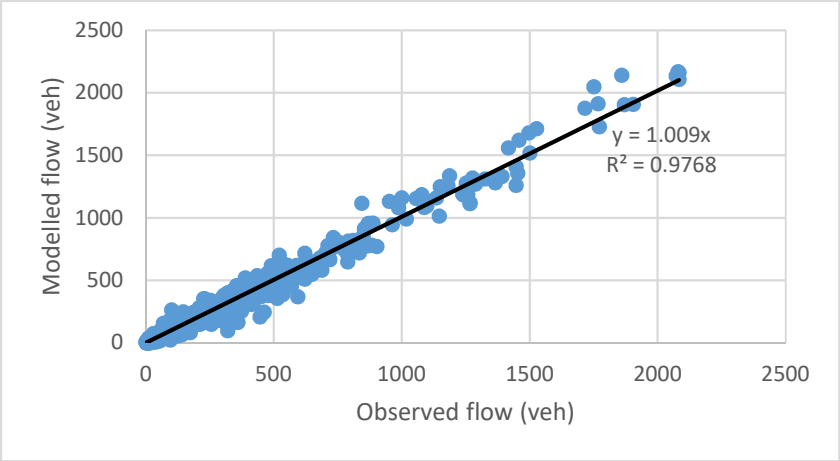
The results of the traffic demand calibration process have been assessed using the following:

- Scatter plot analysis;
- Link and turn volume analysis;
- Screenline volume analysis; and
- RMSE of counts versus model volumes.

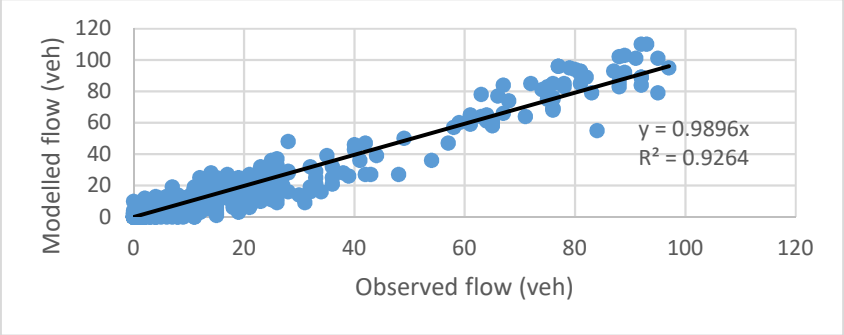
Scatter plot analysis

The results of the matrix adjustment process are shown in the volume scatter plots displayed in Figure 40 and Figure 41 for the AM and PM peaks, split by vehicle type. The scatter plots compare the modelled volumes on links to traffic count volumes.

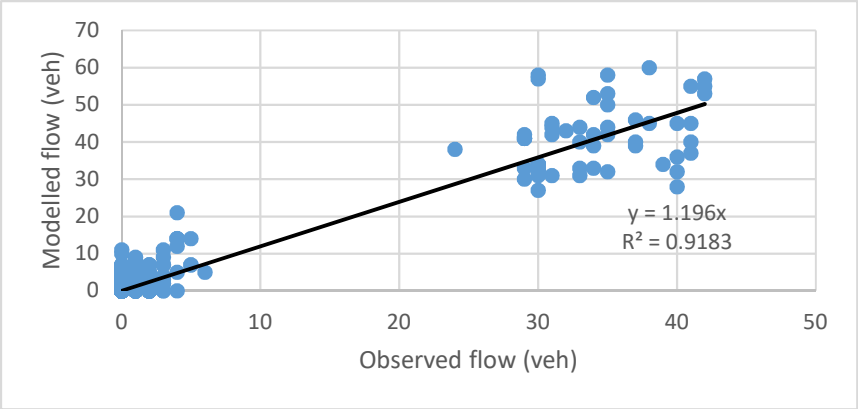
Both Figure 40 and 41 show the R^2 values being above 0.9. This satisfies the R^2 value criteria as specified within the RMS Traffic Modelling Guidelines.



(a) AM Light Vehicles observed versus modelled flow

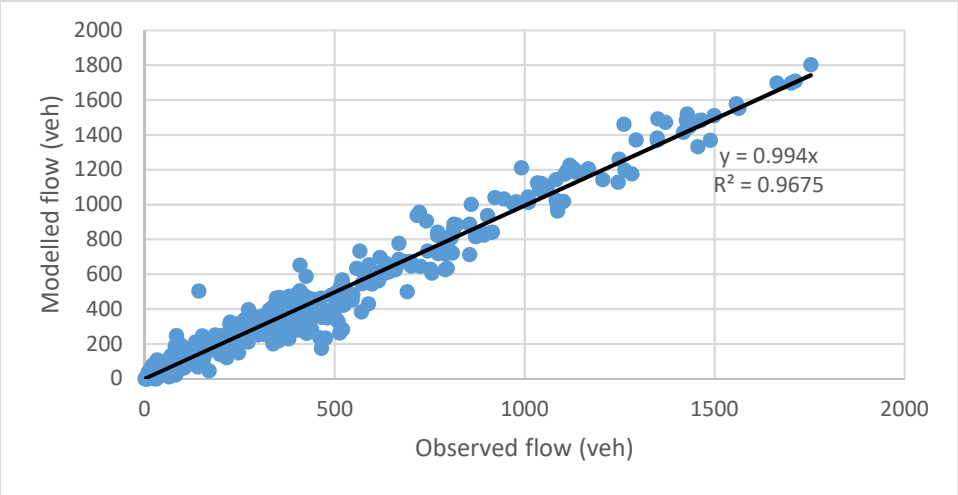


(b) AM Medium Commerical Vehicles observed versus modelled flow

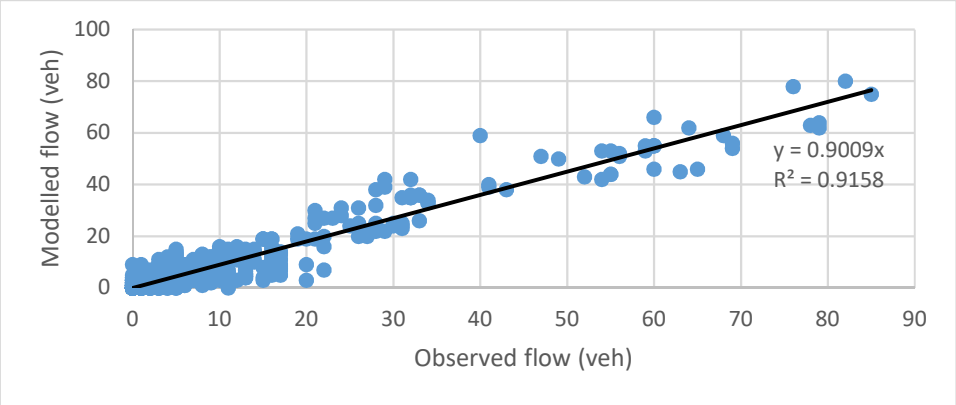


(c) AM Heavy Commercial Vehicles observed versus modelled flow

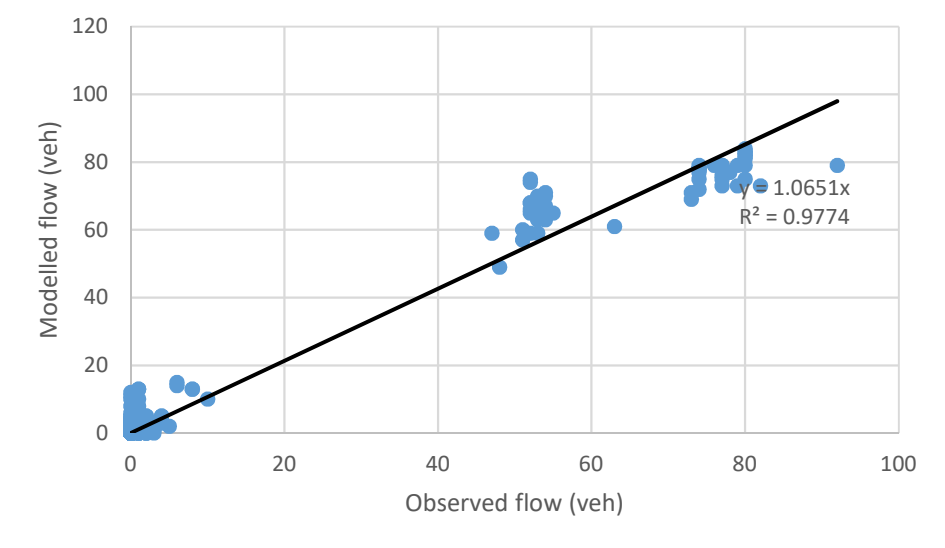
Figure 40 - Regression analysis of AM base year model (a) LV, (b) MCV, (c) HCV



(a) PM Light Vehicles observed versus modelled flow



(b) PM Medium Commercial Vehicles observed versus modelled flow



(c) PM Heavy Commercial Vehicles observed versus modelled flow

Figure 41 - Regression analysis of PM base year model (a) LV, (b) MCV, (c) HCV

Link and turn volume analysis

An assessment of the level of match between modelled link and turning volumes against traffic count data was undertaken using the GEH statistic. Summarised results of these comparisons are shown in Table 49 and Table 50.

The target percentage of counts passing each criteria are from the RMS *Traffic Modelling Guidelines*. The results show that the level of calibration does not achieve the RMS criteria. However, it is generally recognised that the GEH criteria from the RMS guidelines are too stringent for large scale mesoscopic model applications.

The Transport and Infrastructure and Regional Development has developed the *Australian Transport Assessment and Planning Guidelines* (ATAP) that provide calibration criteria for different categories of modelling, including mesoscopic modelling. As a comparison, we have provided a check of the level of calibration achieved using the criteria for a mesoscopic model in Table 51 and Table 53. These results show that the model calibration would meet or are very close to meeting the targets set-out in the ATAP guidelines for link and screenline GEH comparison.

Table 49: GEH calibration check using RMS criteria – link counts

Individual Link Counts GEH Statistic	Target %	AM Count	AM %	AM Pass Check	PM Count	PM %	PM Pass Check
< 5	95%	387	88%	N	373	85%	N
< 10	100%	434	98%	N	432	98%	N
Total		**441**			**441**		

Table 50: GEH calibration check using RMS criteria – turn counts

Individual Turn Counts GEH Statistic	Target %	AM Count	AM %	AM Pass Check	PM Count	PM %	PM Pass Check
< 5	85%	305	81%	N	302	81%	N
< 10	100%	365	97%	N	357	95%	N
Total		**375**			**375**		

Table 51: GEH calibration check using ATAP criteria – link counts

Individual Link Counts GEH Statistic	Target %	AM Count	AM %	AM Pass Check	PM Count	PM %	PM Pass Check
< 5	85%	387	88%	Y	373	85%	N
Total		441			441		

Table 52 shows the link counts with a GEH value greater than 10. The calibration results for these links have been accepted as outlined below. The ability of the model to predict traffic flows on the highway, regional road network or future bypass was not considered to be contingent on further improvement to the calibration of these links. :

- Links 1 to 3

  These links are used to connect the Park Beach Plaza zone onto the local network. This is a large zone which encompasses the plaza and surrounding businesses. Because of the size of the zone, it has been connected to the road network in four different areas. The calibration of individual accesses to Park Beach Plaza and the surrounding businesses did not meet the required criteria however the total number of trips into and out of the zone were correct.

- Link 4

  This link is a local access onto the Pacific Highway from the Park Beach Plaza. Flows on this link are related to the relative imbalance of flows on the various accesses to/from Park Beach Plaza as described above.

  Link 5

- This link is a minor road used by traffic accessing local zones from the Highway. This link sees a lower traffic volume due to the adjacent offloading links being more attractive. This is because the adjacent links are closer to the zone connectors for trips coming off the Pacific Highway.

  Links 6 to 12

- These links are used by vehicles accessing the CBD. Low calibration results were achieved in the CBD due to the limited detail in the structure of zones and zone connectors, and the number of parallel routes.

Table 52: Links with GEH value greater than 10.

Link No.	Intersection	Road	Approach	Direction	AM GEH	PM GEH
1	Shopping Centre and Arthur St	Shopping Centre	S	App	3.7	10.7
2	Park Beach Rd and Shopping Centre	Shopping Centre	E	App	7.0	12.2
3	Park Beach Rd and Shopping Centre	Shopping Centre	E	Dep	15.6	16.2
4	Pacific Hwy and Arthur St	Pacific Hwy Ramp	S	Dep	12.6	20.3
5	Pacific Hwy and Melittas Ave	Marcia St	W	Dep	2.2	12.6
6	Gordon St and Harbour Dr	Gordon St	S	Dep	12.3	12.8
7	Gordon St and Park Ave	Gordon St	N	App	10.9	8.8
8	Earl St and Harbour Dr	Harbour Dr	E	App	10.5	7.1
9	Earl St and Harbour Dr	Earl St	S	App	1.6	12.8
10	Earl St and Albany St	Albany St	W	App	12.0	7.2
11	Gordon St and Albany St	Albany St	E	App	13.5	12.2
12	Gordon St and Albany St	Gordon St	S	Dep	6.8	13.0

Screenline count analysis

Four screenlines were assessed for calibration purposes with the results compared to the ATAP guideline criteria. The ATAP criteria requires modelled volumes across a screenline to be within 10% of traffic count volumes and with a GEH statistic of less than four.

The screenlines are shown in Figure 42 and listed below:

1. North/south – north of Bruxner Park Road
2. North/south – across Coffs Creek
3. North/south – south of Englands Road
4. East/west – along western side of Hogbin Drive

Three of the screenlines report on north/south traffic movements with locations to the north and south of Coffs Harbour, and one through central Coffs Harbour. The fourth screenline reported on east/west travel between the Pacific Highway and Hogbin Drive.

The results of the screenline check showed that all screenlines except for Screenline 4 westbound in the PM peak achieved the guidance passing criteria. The results for Screenline 4 showed that modelled volumes were 11% lower than traffic counts with a GEH statistic of 6.1, which is slightly outside the guideline criteria. Overall, the comparison of traffic volumes across the screenlines demonstrated the model was well calibrated.

Table 53: GEH calibration check using ATAP criteria – screenline counts

Period	Screenline	Dir.	Obs.	Mod.	Diff (Abs.)	Diff (%)	GEH	Meets Criteria?
AM	1	NB	824	905	81	10%	2.8	Y
AM	1	SB	2178	2230	52	2%	1.1	Y
AM	2	NB	2645	2724	79	3%	1.5	Y
AM	2	SB	4313	4153	-160	-4%	2.5	Y
AM	3	NB	2831	2781	-50	-2%	0.9	Y
AM	3	SB	1854	1890	36	2%	0.8	Y
AM	4	EB	2795	2886	91	3%	1.7	Y
AM	4	WB	2924	2721	-203	-7%	3.8	Y
PM	1	NB	1718	1780	62	4%	1.5	Y
PM	1	SB	1011	957	-54	-5%	1.7	Y
PM	2	NB	3623	3833	210	6%	3.4	Y
PM	2	SB	3084	3087	3	0%	0.1	Y
PM	3	NB	2672	2638	-34	-1%	0.7	Y
PM	3	SB	1741	1759	18	1%	0.4	Y
PM	4	EB	2725	2660	-65	-2%	1.3	Y

Period	Screenline	Dir.	Obs.	Mod.	Diff (Abs.)	Diff (%)	GEH	Meets Criteria?
PM	4	WB	2839	2522	-317	-11%	6.1	N

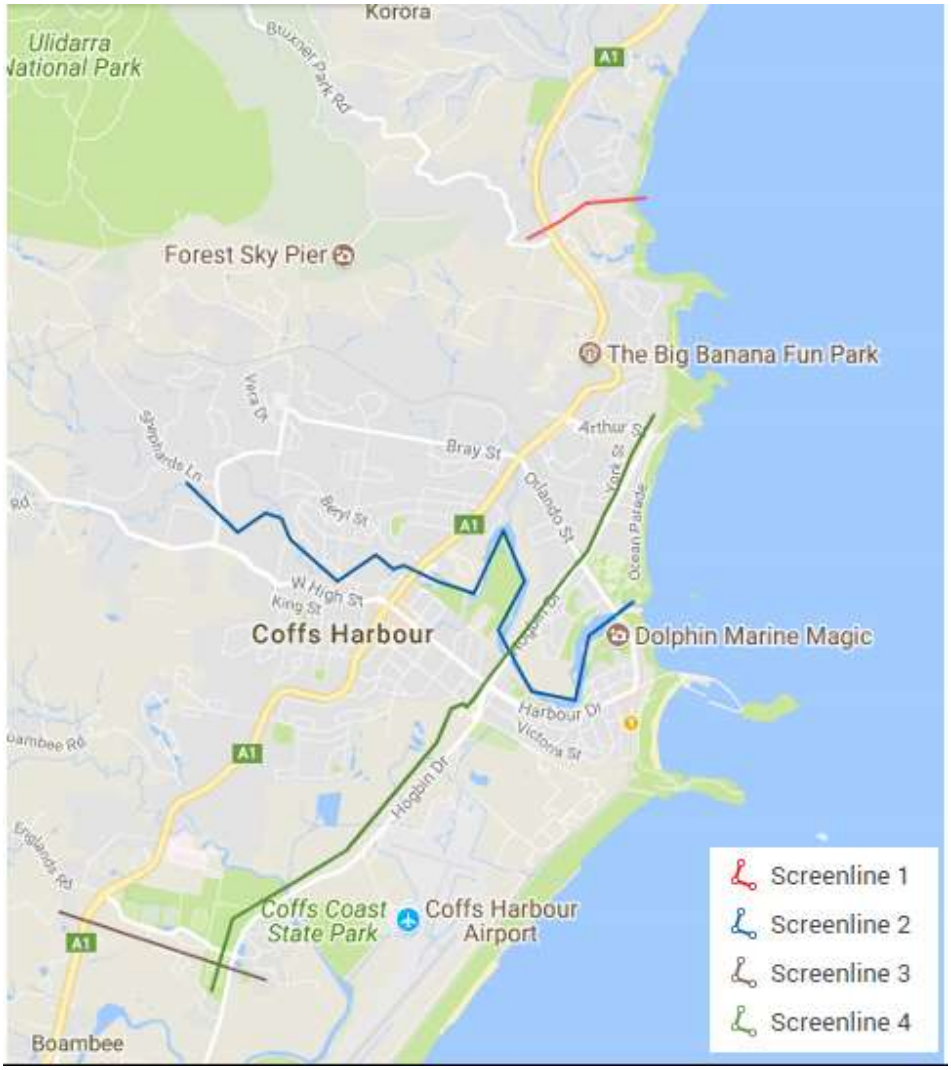


Figure 42 – CHTM screenlines

Count RMSE analysis

The Root Mean Square Error (RMSE) is used to measure the level of match using the entire count data set. RMS Traffic Modelling Guidelines specify that the all counts RMSE should be 30 or lower. The RMSE value for AM and PM were calculated to be 16 and 17 respectively, which satisfies the criteria.

Summary of calibration

Given the results of the traffic demand calibration of the CHTM, there are some limitations in the level of comparison of modelled volumes to count data across the network.

To better understand these limitations, plots showing the level of GEH calibration for the AM and PM peaks is shown in Figure 43 and Figure 44. A GEH of less than five are shown in green, GEH between five and ten are yellow and GEH greater than ten are red.

It can be seen that the Pacific Highway and the key routes of Hogbin Drive, Coramba Road and Bray Street are reasonably well matched to count data. Limitations on the demand calibration results include the CBD area, Park Beach retail area and some isolated locations on the local road network.

The level of calibration in the CBD area was particularly difficult to achieve due to the complexity of route choice and traffic movement due to:

- The distributed nature of on-street parking
- Circulation on streets to find parking spaces
- Location of off-street car parks.

Based on the results reported above we have concluded that the traffic flow calibration of the CHTM reached a level that was acceptable to proceed with testing of the Project Case in future years.

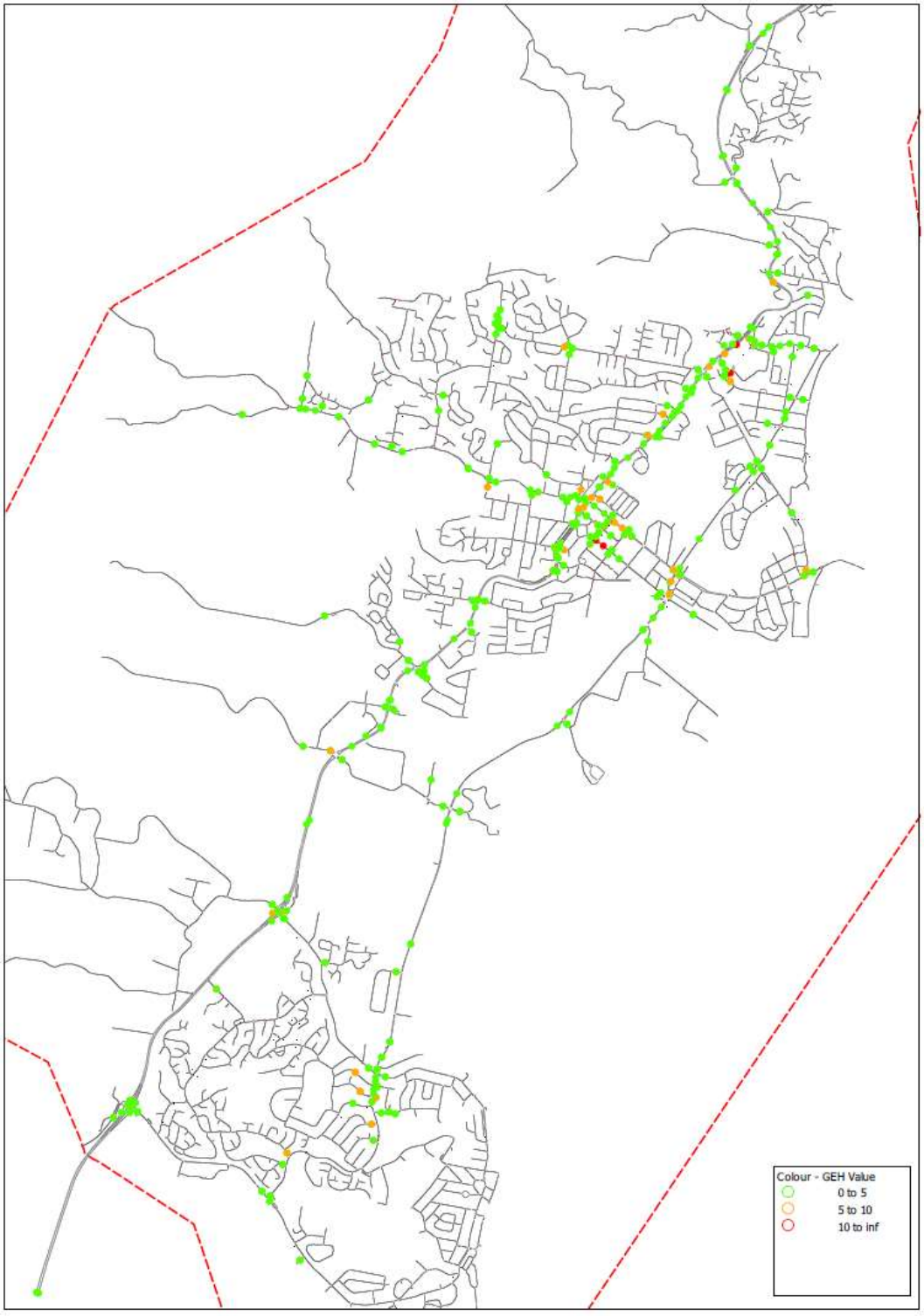


Figure 43: Mesoscopic model GEH calibration check – AM peak

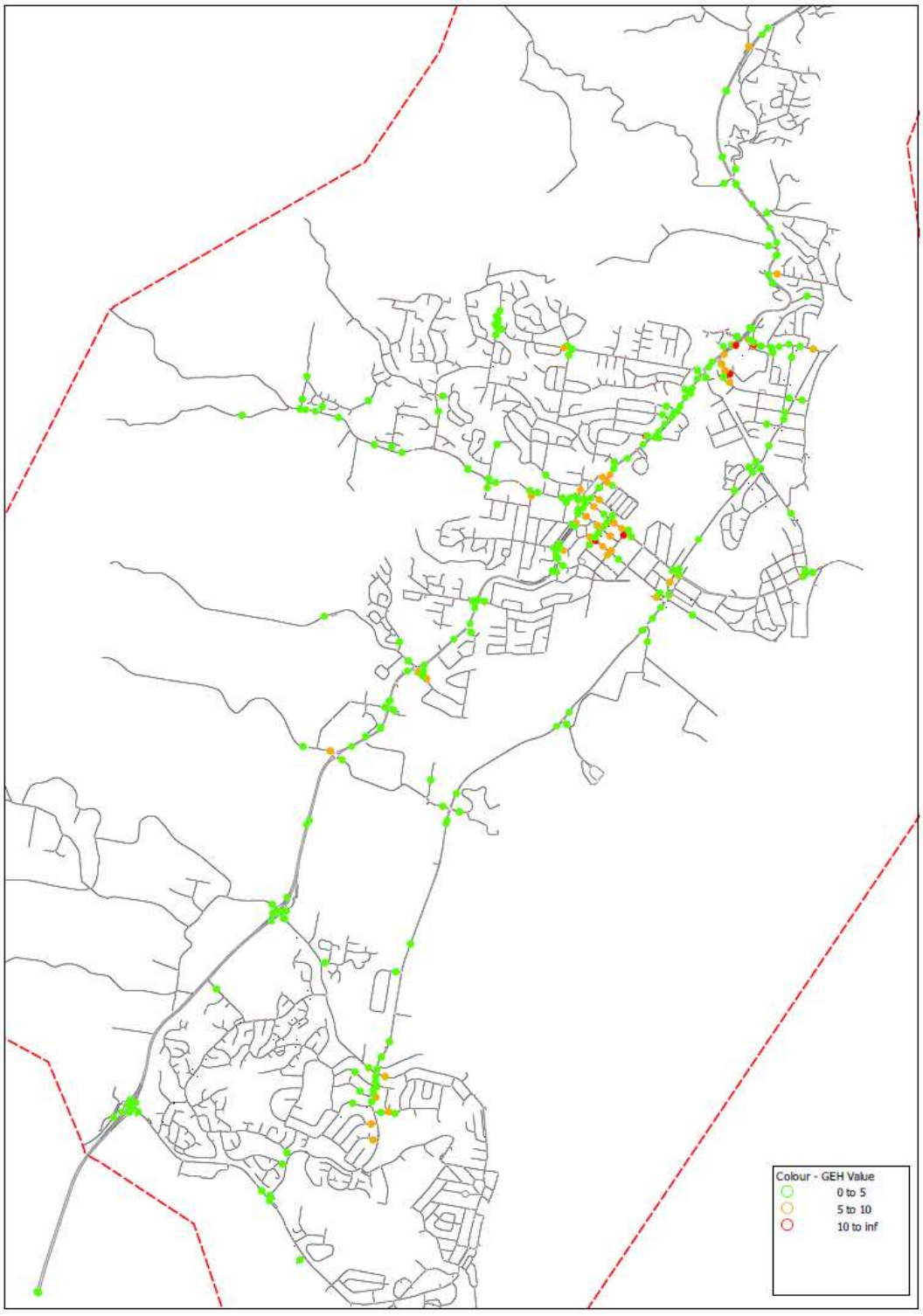


Figure 44: Mesoscopic model GEH calibration check – PM peak

8.3.1 Travel time validation

Modelled travel times along four key routes were compared to travel time survey data to validate the model results. The RMS Traffic Modelling Guidelines

recommend that 95% of modelled journey time routes should be within 15% or one minute (whichever is greater) of the observed values. The overall validation results for the CHTM are shown in Table 54 and Table 55. Graphs displaying the modelled travel times against distance are shown in Figure 45 to Figure 48. The graphs also show surveyed average travel time and the boundaries for 15% variance either side of the average.

Table 54: Travel time validation check for AM peak

Route	Direction	Obs.	Mod.	Diff (Abs.)	Diff (%)	Pass Check
1 Pacific Highway	NB	22.68	20.82	-1.86	-8%	Y
1 Pacific Highway	SB	19.70	19.71	0.01	0%	Y
2 Hogbin Drive	NB	10.58	9.38	-1.20	-11%	Y
2 Hogbin Drive	SB	11.15	10.02	-1.13	-10%	Y
3 Coramba Road	EB	9.47	10.60	1.13	12%	Y
3 Coramba Road	WB	9.88	9.16	-0.72	-7%	Y
4 Stadium Drive	EB	2.10	2.60	0.50	24%	Y
4 Stadium Drive	WB	1.67	1.90	0.23	14%	Y

Table 55: Travel time validation check for PM peak

Route	Direction	Obs.	Mod.	Diff (Abs.)	Diff (%)	Pass Check
1 Pacific Highway	NB	22.53	19.94	-2.60	-12%	Y
1 Pacific Highway	SB	21.03	19.56	-1.47	-7%	Y
2 Hogbin Drive	NB	8.33	8.64	0.31	4%	Y
2 Hogbin Drive	SB	10.03	8.88	-1.16	-12%	Y
3 Coramba Road	EB	9.32	10.26	0.95	10%	Y
3 Coramba Road	WB	9.68	9.74	0.05	1%	Y
4 Stadium Drive	EB	1.68	1.84	0.16	9%	Y
4 Stadium Drive	WB	2.30	2.35	0.05	2%	Y

Overall, the model validation was achieved for all routes with travel time difference +/- 15% or +/- 1 minute of the observed average.

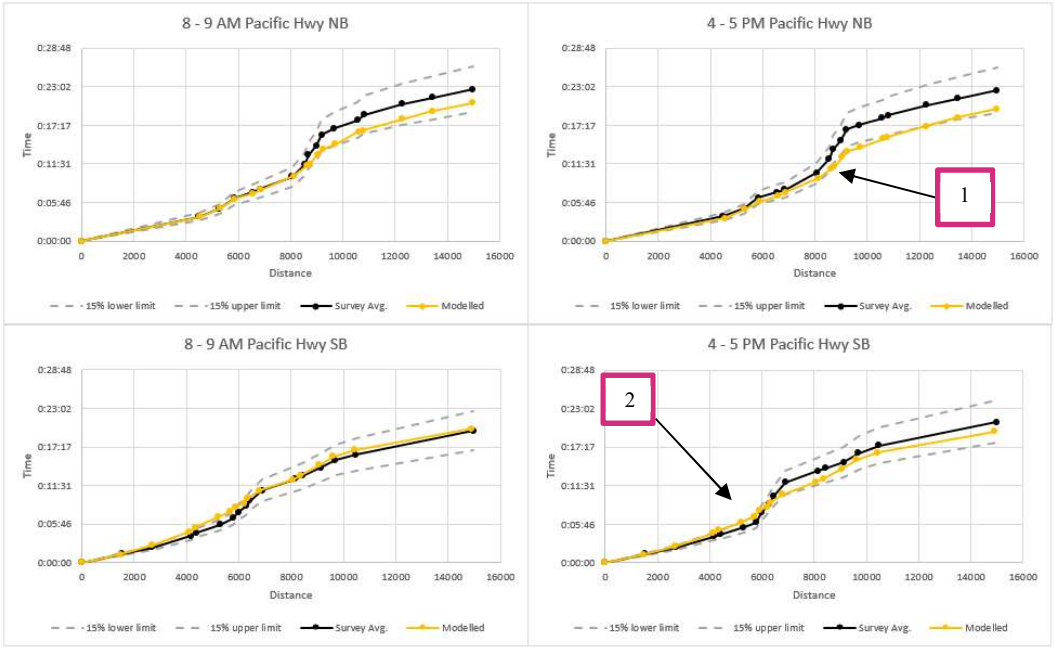


Figure 45: Journey time route 1 - Pacific Highway

Results for the travel time analysis showed that the modelled travel times exceeded the +/-15% boundary line at the numbered locations in the figures:

1. The observed travel times are influenced by outliers skewing the average upwards. These outliers are more common in the CBD area where an unfavourable signal could lead to a high amount of delays. Because of the small sample size, a few slow trips had a large impact on the average travel times. Removing these outliers would show a faster travel time which more closely matches the modelled travel time.
2. The modelled travel time was slightly higher due to delays caused by the signalised intersections. The observed travel times show minimal intersection delays as the average speed was just under posted speed. The differences were considered to be acceptable given the variability apparent in the sample data.

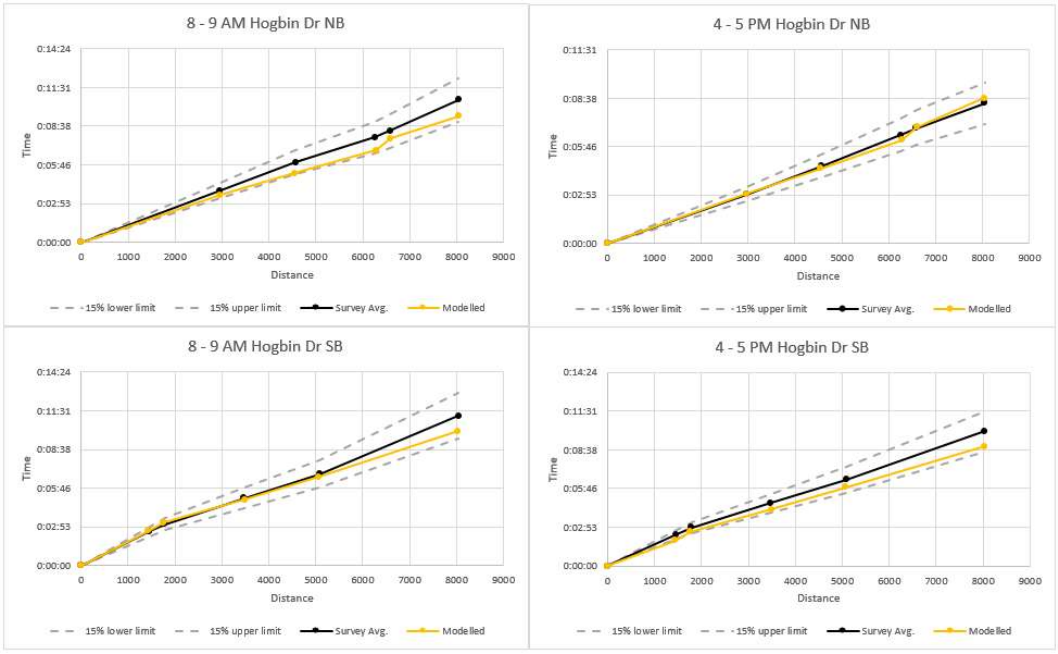


Figure 46: Journey time route 2 – Hogbin Drive

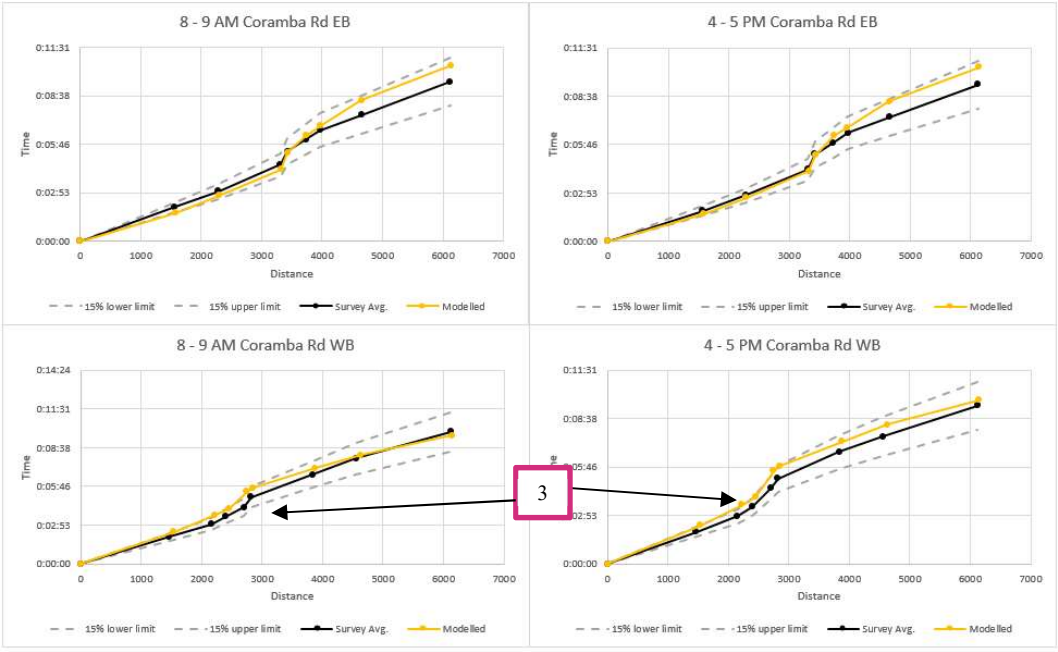


Figure 47: Journey time route 3 – Coramba Road

3. Higher modelled travel times are due to the model having to obey the reduced speeds zones (40km/h high pedestrian activity and school zones). This was not observed in the sample vehicles as the speed was shown to be higher than 40 km/h within the first two travel time sections. This causes the modelled travel times in the next few sections to exceed the tolerance limit.

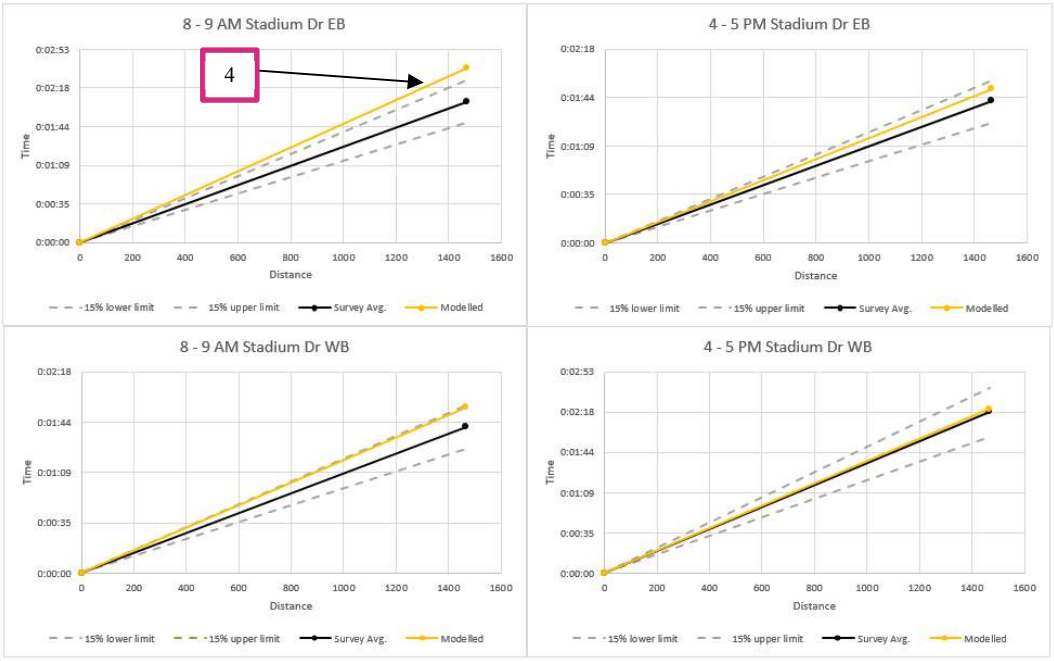


Figure 48: Journey time route 4 – Stadium Drive

4. The overall route travel time difference was considered acceptable as it was less than 60 seconds.

9 Forecast traffic performance

9.1 Traffic growth rates

Growth of traffic using the Pacific Highway will be influenced by growth in local traffic and inter-regional traffic movements. Growth in local traffic movements, which are traffic movements that have either an origin or destination within Coffs Harbour, will be largely governed by growth in population and employment. Population and employment are both forecast to grow by an average of 0.9% per annum between 2016 and 2044.

Inter-regional traffic movements, including freight traffic, was assumed to grow at 1.4% per annum, though it is noted historical traffic count data on the Pacific Highway near Sapphire indicates growth over the last 9 years has averaged 2.3% per annum (see Table 56).

Table 56: Pacific Highway traffic counts at Sapphire

Year	ADT	ADT Growth	HV	HV Growth
2007	18,420		2,122	
2011	20,464	2.8%	2,426	3.6%
2016	22,582	2.1%	3,188	6.3%

Source: Roads and Maritime counts

The assumed growth rate of 1.4% per annum for inter-regional traffic using the Pacific Highway was based on the following:

- Historic traffic growth on the Pacific Highway just north of Coffs Harbour was 2.3% over the last nine years (refer to Table 5 in Section 2.2)
- The *NSW Freight and Ports Strategy* (TfNSW, 2013), which notes the freight traffic on the Pacific Highway is set to almost double by 2031, from 2011
- The Sydney to Brisbane Corridor Strategy (DoTARS, 2007), which indicates heavy vehicle traffic is projected to grow by 1.4% per annum
- BTRE *Working Paper 66 (Demand Projections for AusLink Non-Urban Corridors: Methodology and Projections*), which provides a 1999 to 2025 forecast growth rate of 2.3% per annum. This paper does not provide forecasts beyond 2025.

9.2 Do minimum improvements

Modelling of a 'do nothing' infrastructure base case showed that traffic delays in some parts of the Coffs Harbour network would increase in future years to a point where extensive delays would be experienced. An approach was adopted where 'do minimum' improvements were assumed at individual locations where delays generally exceeded 4 minutes. Such improvements were limited to upgrades that could be implemented 'in corridor' (i.e. substantial land acquisition wouldn't be

required). These assumptions resulted in a base case which operates reasonably well in 2034 and 2044 with isolated locations of high delay.

Modelling of the project case also showed that some locations of the network would operate with high levels of delay. In such cases, do minimum upgrades were also assumed.

The infrastructure improvements assumed in the base case and project case are shown in Table 57.

Table 57: Intersection improvements and upgrade year adopted for the business case

Location	Description	Base Case			Project Case		
		2024	2034	2044	2024	2034	2044
Pacific Hwy / Solitary Island Way	2-way signalised intersection		✓	✓			
Pacific Hwy / Opal Boulevard	3-way signalised intersection		✓	✓			
Pacific Hwy / Bruxner Park Rd	4-way signalised intersection		✓	✓			
Pacific Hwy / Stadium Dr	Replace roundabout with four-way at-grade signalised intersection	✓	✓	✓			✓
Pacific Hwy / Cook Dr	Double right turn from minor street			✓			✓
Pacific Hwy / Boambee Rd	Double right turn from minor street			✓			✓
Pacific Hwy / Moonee St	Reconfigure intersection geometry and removal of right-turns from Pacific Highway			✓			

9.3 Forecast volumes

The forecast daily traffic volumes for the bypass, existing highway and several locations on key local roads are shown in Table 58. The daily volumes are derived from the CHTM by factoring the AM and PM peak flows by VKT factors determined from the CHSTM.

Plots showing the modelled AM and PM peak hour traffic flows for 2024 and 2044 are included in Appendix H, along with difference flow plots to show the change in traffic flow between the base case and project case and select link plots showing the origin and destinations of trips using the highway.

Table 58: Forecast daily volumes (two-way)

	Base Daily Volumes			Project Daily Volumes		
Location	**2024**	**2034**	**2044**	**2024**	**2034**	**2044**
Bypass						
North of Coramba Road	-	-	-	19,100	21,200	23,400
South of Coramba Road	-	-	-	24,600	27,100	29,300
Existing Pacific Hwy						
South of Bruxner Park Rd	38,600	43,300	46,500	33,400	36,600	40,000
North of Orlando St	45,800	49,700	52,000	35,000	37,700	39,600
South of Albany St	34,300	36,000	36,000	19,500	21,200	21,200
Local Network						
Hogbin Dr north of Park Beach Rd	8,900	11,000	10,000	6,500	8,000	8,400
Hogbin Dr north of Harbour Dr	18,000	19,100	18,800	13,800	14,800	15,100
Hogbin Dr north of Stadium Dr	28,900	31,300	31,700	20,700	21,800	22,600
Stadium Dr east of Pac Hwy	10,400	11,600	13,500	11,300	11,800	13,200
Bray St east of Joyce St	10,600	11,400	12,200	8,000	8,200	8,400
West High St west of Murdock St	9,000	10,500	11,800	9,500	10,200	10,600
Coramba Rd between Shephards Lane and Robin St	12,800	13,600	14,500	10,800	11,700	13,000
Coramba Rd between Bypass and Shephards Lane	9,200	9,500	9,900	9,900	10,900	12,600

9.4 Predicted travel times

Travel time surveys conducted in June 2016 showed that the current travel time between Korora Hill and Englands Road ranges from 13 minutes to 26 minutes in the morning peak hour, giving an average speed of around 35 km/h over a travel distance of around 10 km. The current travel times measured in the survey for the morning, midday and afternoon peak periods are shown in Table 59.

Table 59: 2016 Travel time survey results (minutes) between Korora Hill and England's Road

Time		Southbound			Northbound		
From	To	Max. Time	Avg. Time	Avg. Speed	Max. Time	Avg. Time	Avg. Speed
8:00 AM	9:00 AM	20:05	16:40	38 km/h	26:27	19:04	33 km/h
11:00 AM	12:00 PM	22:42	19:00	33 km/h	32:55	23:23	27 km/h
4:00 PM	5:00 PM	26:54	18:38	34 km/h	24:32	18:48	34 km/h

Travel times for the future 2024 and 2044 base case have been estimated using the AIMSUN model. The predicted base case travel times for the project extents (i.e. between Sapphire and 1 km south of Englands Road) in 2024 and 2044 are shown in Table 60. It was notable that the southbound travel time is predicted to increase substantially during and AM peak. Much of the additional delay was caused by

signalised intersections in south Coffs Harbour exceeding capacity even with the implementation of do minimum upgrades.

Table 60: Predicted future base case travel time (minutes) for project extents

	Travel times (minutes)			
	Southbound		Northbound	
	AM	PM	AM	PM
Predicted 2024	21.0	19.3	19.6	19.6
Predicted 2044	29.2	21.8	20.4	23.7

The travel time for traffic using the bypass was predicted using the Coffs Harbour AIMSUN model. The assumed posted speed for the bypass was 110 km/h, and the speed of heavy vehicles was limited to 100 km/h.

The predicted travel times for traffic using the proposed bypass compared to the base case travel times are shown in Table 61.

Table 61: Comparison of predicted base case and project case travel times (minutes) for project extents

	Direction	Travel times (minutes)			
		2024		2044	
		AM	PM	AM	PM
Existing Pacific Highway (Base Case)	Southbound	21.0	19.3	29.2	21.8
	Northbound	19.6	19.6	20.4	23.7
Bypass (Project Case)	Southbound	8.6	8.5	8.6	8.6
	Northbound	8.3	8.4	8.4	8.5
Bypass travel time savings	Southbound	12.4	10.7	20.6	13.2
	Northbound	11.3	11.2	12.0	15.2

9.5 Predicted travel time savings

The total travel times for each scenario was output from the CHTM as a network statistic and summarised in Table 62.

The total travel time savings predicted using the CHTM are a combination of:

- Travel time saved by vehicles using the bypass; plus
- The reduction in delays experienced by traffic using the existing highway and local road network that benefit from reduced traffic volumes.

Table 62: Predicted network wide travel time savings

	Total Travel Time (hours)			
	2024		2044	
	AM Hour	PM Hour	AM Hour	PM Hour
Base case	3,427	3,116	4,607	4,152
Project case	2,940	2,745	3,538	3,298
Difference	-487	-371	-1,069	-854
Travel time savings (hours/day)	-4,713		-10,558	

9.6 Total distance travelled

The total distance travelled predicted by the CHTM for the base and project cases are shown in Table 63 for 2024 and Table 64 for 2044. The total distance travelled was also split between 'highway' and 'non-highway' travel. These were used in the calculation of vehicle operating costs whereby highway travel was assumed to represent uninterrupted flow conditions and non-highway travel represents interrupted flow conditions.

The results show an increase in distance travelled in the project case as the bypass route is longer (but faster) than the existing route.

Table 63: Predicted network wide change in total distance travelled in 2024

	2024 Distance Travelled (km)					
	AM Hour			PM Hour		
	All	Highway	Non-Highway	All	Highway	Non-Highway
Base case	141,665	41,439	100,226	136,461	38,768	97,692
Project case	150,141	58,464	91,677	142,950	55,036	87,914
Difference	8,476	17,025	-8,549	6,489	16,268	-9,779
Change in distance travelled (km/day)	76,024					

Table 64: Predicted network wide change in total distance travelled in 2044

	2044 Distance Travelled (km)					
	AM Hour			PM Hour		
	All	Highway	Non-Highway	All	Highway	Non-Highway
Base case	160,679	44,714	115,965	159,041	44,133	114,908
Project case	175,068	69,566	105,502	168,812	68,508	100,304
Difference	14,389	24,853	-10,463	9,771	24,375	-14,604
Change in distance travelled (km/day)	122,737					

9.7 Average travel speeds

The average travel speeds of vehicles that travelled through the network for the base and project cases are shown in Table 65. The average speeds were also split between 'highway' and 'non-highway' travel. These were used in the calculation of vehicle operating costs whereby highway travel was assumed to represent uninterrupted flow conditions and non-highway travel represents interrupted flow conditions.

The results show an increase in speeds in the project case, which is expected due to the high speed bypass and the reduction of traffic congestion along routes through Coffs Harbour. Heavy vehicles gain a larger overall increase in average speed as these vehicles mainly use the highway network and therefore gain a larger overall benefit per vehicle.

Table 65: Predicted network wide change in average speed in 2024

	2024 Average Speed (km/h)					
	AM Hour			PM Hour		
	All	Highway	Non-Highway	All	Highway	Non-Highway
Base case - all vehicles	41	76	35	42	78	38
Base case – heavy trucks	46	77	30	48	90	32
Project case - all vehicles	47	87	40	47	88	41
Project case – heavy trucks	60	90	38	70	93	39
Difference - all vehicles	5	11	5	5	10	3
Difference – heavy trucks	14	12	7	22	3	7

Table 66: Predicted network wide change in average speed in 2044

	2044 Average Speed (km/h)					
	AM Hour			PM Hour		
	All	Highway	Non-Highway	All	Highway	Non-Highway
Base case - all vehicles	38	67	30	39	77	33
Base case – heavy trucks	43	71	24	45	78	27
Project case - all vehicles	45	87	38	46	87	40
Project case – heavy trucks	62	89	38	71	92	39
Difference - all vehicles	7	20	8	7	10	7
Difference – heavy trucks	19	19	14	27	14	12

10 Expansion factors

10.1 Peak to daily factors

Expansion factors to convert AM and PM peak hour model results from the mesoscopic model to total daily estimates were calculated using base year strategic model outputs. The factors were calculated separately for each vehicle type as the traffic volume profiles for each vehicle type were different throughout the day.

The difference in total network travel time (vehicle hours travelled) between the base and project scenarios for each modelled time period was used to calculate an expansion factor for travel time benefits. The factors to convert AM plus PM travel time benefits to a daily total are shown in Table 67.

Table 67: Peak to daily factors for travel time benefits

Vehicle Class	Travel Time Benefits
All vehicles	5.49
Light vehicles	5.20
Medium commercial vehicles	5.46
Heavy commercial vehicles	7.77

Factors to convert total distance travelled (vehicle kilometres travelled) were calculated separately for the base and project scenarios. Factors for highway and non-highway travel were also calculated separately to suit the calculation of vehicle operating costs. The factors to convert AM plus PM travel distance to a daily total are shown in Table 68.

Table 68: Peak to daily factors for total distance travelled

Vehicle Class	Link type	Base Case VKTs	Project Case VKTs
All vehicles	All travel	5.93	5.91
Light vehicles	Highway travel	6.26	6.22
Medium commercial vehicles		6.04	6.04
Heavy commercial vehicles		8.65	8.62
Light vehicles	Non-highway travel	5.53	5.48
Medium commercial vehicles		6.18	6.18
Heavy commercial vehicles		6.78	6.04

10.2 Daily to annual factor

An annualisation factor was calculated to convert daily travel benefits to yearly estimates. To calculate the annualisation factor, traffic counts from traffic signal detectors for 12 intersections along the Pacific Highway in Coffs Harbour were analysed.

Traffic count data for the day of traffic surveys (23 June 2016) was compared against detector count data for a full year.

All detector data were processed to take into account numerous errors and discrepancies within the traffic detectors at each site. For any date that involved 'BAD' and 'NA' data readings, the entire readings for that date were removed from the analysis for that particular site. For the survey date, only four sites (i.e. Site 647, 2808, 4205 and 4565) had complete data with no 'BAD' or 'NA' readings. Site 2808 was removed due to inconsistent readings during the survey date.

Following the preparation of the detector data, average daily traffic volumes were computed for an average day (i.e. weekdays and weekends) and the survey day. An annualisation factor was then calculated for all three sites by dividing the sum of average day traffic by the survey day traffic and multiplying by 365. The average annualisation factor across the three sites equated to 353. An annualisation factor of 350 was implemented for the cost benefit analysis.

Appendix A

Origin-Destination Traffic Survey

A1 Introduction

The Coffs Harbour Strategic Transport Model (CHSTM) was developed by Arup on behalf of Roads and Maritime for the Coffs Harbour bypass project. A first version of the model used to inform a strategic business case (SBC) for the bypass in early 2017. This version of the CHSTM was developed using traffic survey data (amongst other inputs) collected in July 2016, including an origin-destination (O-D) survey.

The O-D survey was conducted over a 24-hour period and consisted of 10 two-way survey stations covering a wide area across the Coffs Harbour local government area. Vehicle number plates were captured using video and an automated reading and matching process was used to produce the O-D survey results. The results of the survey where used to understand travel patterns, particularly 'through movements'. Some results of the survey, such as through movements (i.e. external movements) were used as direct inputs to the CHSTM, while other travel patterns within the modelled network (i.e. internal movements) where used to check and calibrate the model.

Over the course of the model development program, some of the results from the 2016 O-D survey were found to contain possible discrepancies that could not be adequately verified. As a result, a second, similar O-D survey was commissioned and the data was collected in May 2017.

The purpose of this Appendix is to discuss data analysis of the 2017 O-D survey.

A2 O-D Survey

A2.1 Survey locations

The O-D survey was carried out by a specialised traffic survey company from 1:00am on Tuesday 16th May 2017 to 2:00am on Wednesday 17th May 2017. The survey covered a total of 10 O-D stations capturing traffic movements in both travel directions at each station. Vehicles captured during the survey were classified into three vehicle classes including light vehicles (Austroads vehicle class 1-2), medium heavy vehicles (class 3-5), and articulated heavy vehicles (class 6-12).

The O-D stations are listed in Table 1 with indicative locations shown in Figure 1. An O-D sector system has been developed based on indicative cordons bounded by camera locations for the purpose of data analysis and model inputs. These sectors are also shown in Figure 49.

Table 69 O-D camera station location list

Station Number	Location Description
1 (N&S)	Pacific Hwy - 1000m north of Range Rd
2 (N&S)	Pacific Hwy - south of Hearnes Lake Road interchange

3 (N&S)	Pacific Hwy - 450m south of Old Coast Rd
4 (E&W)	Bruxner Park Rd - 300m west of Pacific Hwy
5 (N&S)	Pacific Hwy - 100m north of Coff St
6 (N&S)	Hogbin Dr - 400m north of Harbour Dr
7 (E&W)	Coramba Rd - 70m west of Bennetts Rd
8 (N&S)	Pacific Hwy - 1000m north of Lindsays Rd
9 (N&S)	Hogbin Dr - 500m north of Hi-Tech Dr
10 (N&S)	Pacific Hwy - north of Old Pacific Hwy/ Pine Creek Way ramps

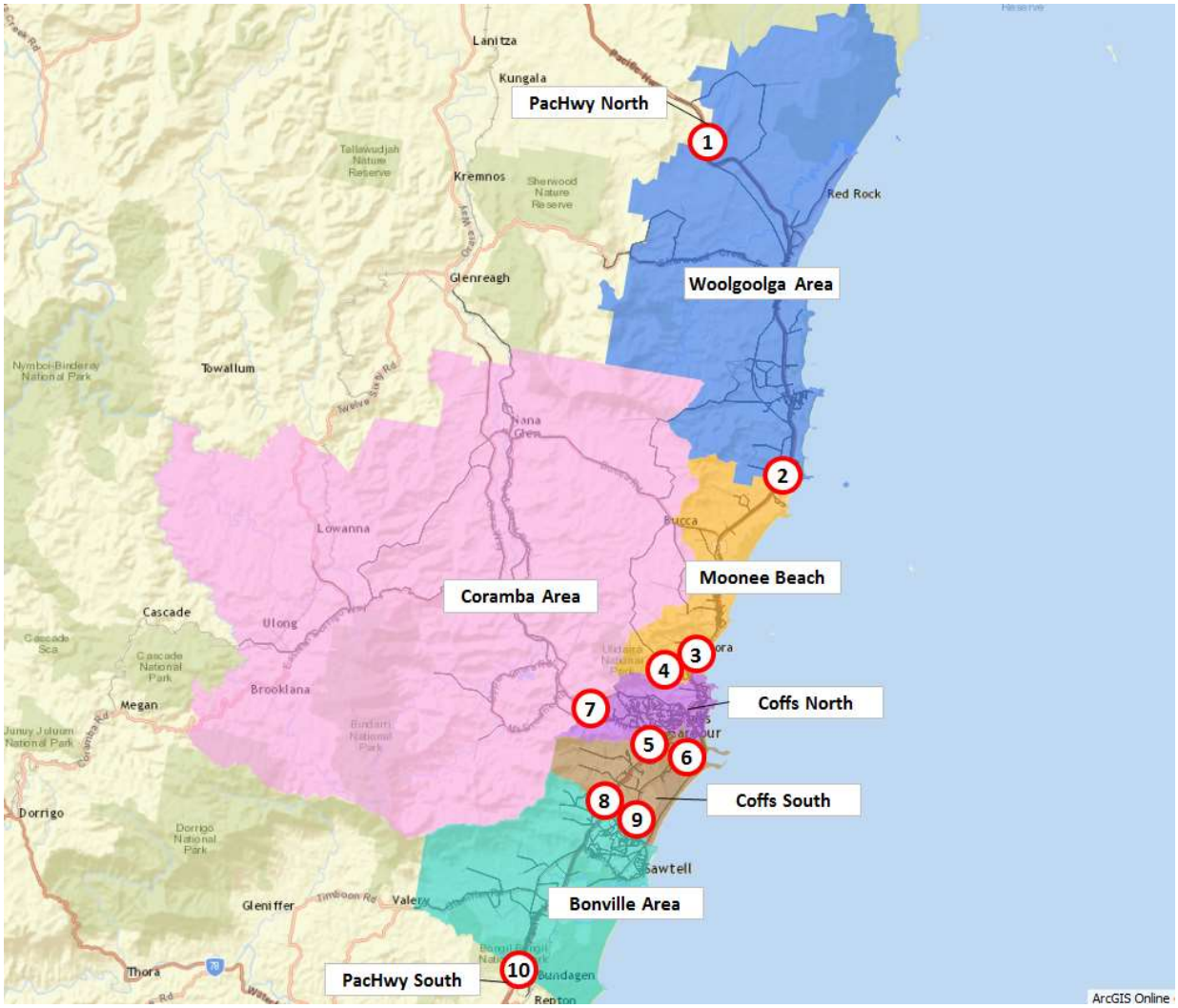


Figure 49 Indicative O-D camera locations and sector system

A2.2 Data process

The survey firm carried out the data processing and analysis based on the video footage recorded during the survey. The major steps involved in the data processing are summarised as follows:

1. Number plates recorded in the video were converted into a digital format with time stamp, station ID, travel direction, and vehicle class information. The number plate information were encoded by the survey firm for privacy reasons.
2. Number plates were matched based on logical time sequence between each station – station pair distinct by vehicle classes. The survey firm utilised a fuzzy matching approach to capture incomplete number plates with missing characters.
3. Number plate matching was initially carried out with no travel time cut-offs. The frequency count of the matches was inspected for cluster of matches to understand the data quality and to work out a practical travel time cut-offs for traffic O-D demand.
4. The travel time cut-offs were then applied to determine valid matches by O-D pairs by vehicle class. Matches with too small / too large travel time were excluded from the matched records. The matches with too large travel time will be considered as stopping trips (i.e. separated trips between the O-D).
5. The matched camera O-D demands were then converted by Arup into sector to sector O-D demands as the required input format for modelling processes and result analysis.

A2.3 Data analysis and discussion

The frequency count of number plate matches has been inspected for each O-D pair. This exercise was to understand the survey data quality as well as determine the travel time cut-off windows to derive the O-D demand. The following elements have been inspected and with findings summarised in Table 70.

Table 70 O-D match results check and findings

Check	Finding	Result
Presence of matches between each O-D pair	Each station pair has matched records with expected frequency between key stations on Pacific Highway	Pass
Duplication of matches	No duplication match record found	Pass
Presence of illogical travel time between each O-D pair (i.e. too small / negative)	No negative travel time calculated, error matches in small travel time window (i.e. smaller than its realistic travel time between certain O-D pair) is less than 1%	Pass
Relative travel time with similar distance between O-D pair	Travel time generally increased in a plausible manner with distance increase between the O-D stations	Pass
Reverse travel time of the same O-D pair	Comparisons were plausible	Pass
The highest frequent travel time compare to Google travel time	The highest frequent travel time was generally in line with Google measured travel time, except for O-D pairs with fewer records (i.e. camera 1 & 7), or parallel camera stations which did not form an ordinary through traffic route (i.e. camera 5 & 6)	Pass

Table 71 and Table 72 compare the highest frequent travel time[4] based on number plate matching with the Google measured travel time[5]. Both travel times were rounded to whole minutes and it can be seen the differences between the two sets of travel time data were generally small, with travel time differences typically less than 2 minutes.

The O-D pairs with large differences are highlighted yellow in Table 71 and Table 72. It was found some travel time records between certain O-D pairs were unrealistically low (i.e. the time difference from number plate matching was too low based on the distance and realistic travel speed between the sites). This suggested there could be some errors in the matching process. Key points to note are as follows:

- Differences in highest frequent travel time and Google measured travel time between O-D pairs were generally found where there were too few matching records between sites. These differences were generally associated with site 4 (Bruxner Park Road) and site 7 (Coramba Road). Note that the error matches for these O-D pairs (typically 1 or 2 records), were marginally more than the matched records in the time period that coincides with the Google measured travel time, and as such, the error matches show up as the highest frequent travel time
- The O-D pairs with a relatively large number of matching records all had travel times close to the Google measured travel time
- Matching errors exist in all O-D pairs but the matching error records were very few (an overall 0.42% out of 156,551 matched records)

It was also noted the highest frequent travel time between site 6 and site 5 was much larger than the ordinary travel time measured by Google. The route between site 6 and site 5 is not an ordinary travel route. Vehicles travelling along this route would need to travel through the CBD and it is very likely these vehicles would normally stop somewhere, and return via Hogbin Drive and via site 6. These trips should be treated as two separate trips because the highest frequent travel time between these two sites is so different to the Google measured travel time.

Table 71 Highest frequent travel time based on number plate matching

Highest Frequent time (minute)	1	2	3	4	5	6	7	8	9	10
1	-	17	27	28	32	33	2	40	38	47
2	17	-	10	11	16	16	22	24	22	29
3	26	10	-	1	6	7	12	14	12	21
4	27	11	2	-	7	7	11	14	13	21
5	32	15	6	6	-	4	6	8	9	15
6	33	17	7	7	52	-	21	7	6	14

[4] The travel time with the highest number of trips recorded. Travel time broken into each 1 minute intervals.
[5] Travel time measured in Google map between A and B in uncongested time period.

7	12	22	11	13	6	17	-	12	12	19
8	40	25	15	11	9	7	11	-	5	8
9	38	22	13	13	10	6	13	4	-	11
10	47	30	23	3	16	14	18	8	12	-

Table 72 Google measured travel time between O-D pairs (outside peak hours)

Google time (minute)	1	2	3	4	5	6	7	8	9	10
1	-	15	25	26	31	32	38	39	37	46
2	15	-	10	11	16	16	22	24	22	31
3	25	10	-	2	6	7	13	14	13	22
4	26	11	2	-	6	7	13	15	13	22
5	31	16	6	6	-	5	7	9	9	15
6	32	16	7	7	5	-	11	7	6	14
7	38	22	13	13	7	11	-	12	13	18
8	39	24	14	15	9	7	12	-	5	7
9	37	22	13	13	9	6	13	5	-	11
10	46	31	22	22	15	14	18	7	11	-

A2.4 Travel time cut-offs

The travel time cut-offs between each O-D pair were determined based on the highest frequent travel time and the Google measured travel time, with time buffers to capture faster / speeding vehicles and slower / short stopping vehicles in addition to the average travel condition. The cut-offs were applied consistently for all time periods during the day and the reverse travel directions. The adopted travel time cut-offs are shown in Table 73.

Table 73 Travel time cut-offs by O-D pairs

Cut-off time (minutes)	1	2	3	4	5	6	7	8	9	10
1	-	11 - 23	18 - 38	18 - 39	23 - 45	23 - 46	27 - 57	27 - 59	27 - 56	32 - 65
2	11 - 23	-	7 - 15	8 - 17	11 - 24	11 - 24	15 - 33	17 - 36	15 - 33	22 - 47
3	18 - 38	7 - 15	-	1 - 3	4 - 14	5 - 15	9 - 24	8 - 26	9 - 24	15 - 33
4	18 - 39	8 - 17	1 - 3	-	4 - 14	5 - 15	9 - 24	9 - 27	9 - 24	15 - 33
5	23 - 45	11 - 24	4 - 14	4 - 14	-	4 - 8	5 - 15	4 - 18	6 - 18	11 - 23
6	23 - 46	11 - 24	5 - 15	5 - 15	4 - 8	-	8 - 21	4 - 15	4 - 9	10 - 21
7	27 - 57	15 - 33	9 - 24	9 - 24	5 - 15	8 - 21	-	8 - 23	9 - 24	13 - 27
8	27 - 59	17 - 36	8 - 26	9 - 27	4 - 18	4 - 15	8 - 23	-	4 - 8	5 - 11
9	27 - 56	15 - 33	9 - 24	9 - 24	6 - 18	4 - 9	9 - 24	4 - 8	-	8 - 17
10	32 - 65	22 - 47	15 - 33	15 - 33	11 - 23	10 - 21	13 - 27	5 - 11	8 - 17	-

The derived statistics of number plate records between each O-D pair, based on the travel time cut-offs in Table 73, are presented in Table 74. It resulted in a total of 103,429 records between all O-D pairs. Matched records by time period and by vehicle class are tubulised in the following section.

Table 74 Daily matches for all vehicles based on defined travel time cut-offs

Daily matches all vehicles	1	2	3	4	5	6	7	8	9	10
1	0	2,837	2,726	7	1,965	168	4	1,548	134	1,510
2	3,394	0	5,393	11	3,078	501	34	1,843	343	1,729
3	3,165	5,853	0	15	5,050	1,185	95	2,280	702	1,934
4	11	23	49	0	53	13	2	16	6	10
5	2,231	3,156	4,452	48	0	37	82	3,624	413	2,718
6	173	501	1,061	18	30	0	15	493	2,176	320
7	9	25	73	2	101	22	0	160	104	80
8	1,660	1,843	2,133	16	3,211	533	195	0	57	5,538
9	107	263	557	11	376	2,260	87	36	0	143
10	1,610	1,769	1,921	6	2,480	377	96	6,268	65	0

A series of sensitivity tests were carried out to investigate the impact of varying travel time cut-offs to number plate matches. Table 75 summaries the changes of daily records by adopting the adjusted travel time cut-offs. The adjustments were made globally across all the O-D pairs.

Table 75 Sensitivity tests results by changing travel time cut-offs

Adjust lower limit of travel time cut-off	Result changes	Adjust upper limit of travel time cut-off	Result changes
Reduce 1 minute	Increase of 288 records (0.3%)	Increase 1 minute	Increase of 961 records (0.9%)
Reduce 2 minute	Increase of 357 records (0.3%)	Increase 2 minute	Increase of 2,662 records (2.6%)
Reduce 5 minute	Increase of 518 records (0.5%)	Increase 5 minute	Increase of 4,814 records (4.7%)
Reduce 10 minute	Increase of 656 records (0.6%)	Increase 10 minute	Increase of 7,712 records (7.5%)
Reduce 15 minute	Increase of 733 records (0.7%)	Increase 15 minute	Increase of 10,225 records (9.9%)
Take out lower limit completely	Increase of 805 records (0.8%)	Take out upper limit completely	Increase of 52,317 records (50.6%)

The sensitivity tests indicated the impact of reducing the lower limit of travel time cut-offs was minor with only 0.5% increase of records when the lower limit was reduced by 5 minutes. There was only 0.8% increase of records when removing the lower limit completely.

On the other hand, the impact of increasing the upper limit of travel time cut-offs was relatively large with around 5% increase in matches the upper limit was increased by another 5 minutes. The records increased by another 50% when the

upper limit was completely removed. This approach was only used as a sensitivity check but not considered viable for O-D demand recording as trips with large travel times between stations should be treated as two separate trips.

A2.5 Matched records by time period and vehicle class

AM - Light vehicle	1	2	3	4	5	6	7	8	9	10
1	0	142	144	0	68	8	2	49	8	52
2	179	0	491	2	168	52	5	59	21	58
3	164	289	0	2	490	165	7	114	70	79
4	0	1	5	0	4	2	0	0	0	0
5	60	96	129	0	0	5	3	178	24	121
6	20	39	81	2	0	0	0	43	144	27
7	2	4	10	0	14	4	0	14	13	6
8	73	87	108	1	155	95	6	0	6	317
9	9	15	38	2	28	248	2	11	0	12
10	66	77	81	0	91	48	2	561	7	0

AM - Medium heavy	1	2	3	4	5	6	7	8	9	10
1	0	18	17	0	14	0	0	5	0	4
2	15	0	23	0	17	1	0	3	1	2
3	19	30	0	0	27	3	1	5	2	2
4	0	0	0	0	0	0	0	0	0	0
5	9	14	18	0	0	0	2	17	3	5
6	1	0	4	0	0	0	0	1	6	1
7	0	1	2	0	0	0	0	2	1	1
8	6	6	7	0	14	1	4	0	1	20
9	0	0	0	0	2	5	0	0	0	1
10	2	3	3	0	5	0	2	25	0	0

AM - Articular vehicle	1	2	3	4	5	6	7	8	9	10
1	0	12	16	0	12	0	0	13	0	15
2	36	0	20	0	18	0	0	14	0	12
3	27	30	0	0	23	0	0	18	0	15
4	0	0	0	0	0	0	0	0	0	0
5	13	19	18	0	0	0	0	20	0	16
6	0	0	1	0	0	0	0	0	0	0
7	0	0	1	0	0	0	0	0	0	0
8	17	17	19	0	15	0	0	0	1	26
9	3	2	3	0	1	1	0	0	0	0
10	17	18	18	0	15	0	0	25	0	0

Inter peak - Light vehicle	1	2	3	4	5	6	7	8	9	10
1	0	1,025	1,087	7	656	85	0	458	66	498
2	1,328	0	2,043	5	967	201	6	493	154	479
3	1,249	2,422	0	6	1,767	425	30	683	289	599
4	8	18	31	0	20	5	0	10	1	5
5	772	1,145	1,682	23	0	18	36	1,275	204	1,002
6	70	200	413	7	18	0	12	196	990	143
7	2	5	21	1	45	11	0	48	29	21
8	578	632	727	10	1,353	255	93	0	22	2,101
9	33	93	187	5	171	1,033	38	8	0	77
10	554	603	644	3	1,026	195	46	2,855	32	0

Inter peak - Medium heavy	1	2	3	4	5	6	7	8	9	10
1	0	90	85	0	65	4	1	42	6	41
2	67	0	166	0	108	10	4	42	11	42
3	61	123	0	1	136	21	5	42	21	40
4	0	0	1	0	1	0	0	0	0	0
5	49	78	99	2	0	0	7	66	10	48
6	4	11	24	0	2	0	0	6	37	3
7	0	0	2	0	2	0	0	9	2	7
8	24	34	37	0	61	4	4	0	5	132
9	2	7	13	0	7	29	2	2	0	3
10	24	30	31	0	43	0	3	129	4	0

Inter peak - Articular vehicle	1	2	3	4	5	6	7	8	9	10
1	0	226	251	0	223	4	0	196	3	189
2	176	0	260	0	233	1	1	183	5	183
3	174	210	0	0	260	4	6	201	5	193
4	0	0	0	0	0	0	0	0	0	0
5	165	198	203	0	0	0	2	205	1	194
6	0	1	1	0	0	0	0	0	3	0
7	0	0	2	0	2	0	0	2	1	1
8	119	125	127	0	134	0	9	0	0	259
9	2	3	3	0	1	1	2	0	0	0
10	116	127	123	0	120	0	7	189	0	0

PM - Light vehicle	1	2	3	4	5	6	7	8	9	10
1	0	195	147	0	95	14	0	53	13	47
2	138	0	302	2	146	38	2	73	31	68
3	118	446	0	3	263	82	13	109	53	77
4	0	0	6	0	7	0	1	3	1	3
5	73	166	330	7	0	4	9	239	45	150
6	12	62	133	2	5	0	1	72	252	45
7	1	2	6	0	9	5	0	16	9	9
8	43	54	94	1	189	35	18	0	4	504
9	7	22	55	2	39	181	10	5	0	24
10	41	55	83	1	134	29	5	389	4	0

PM - Medium heavy	1	2	3	4	5	6	7	8	9	10
1	0	20	18	0	13	2	0	6	2	7
2	11	0	29	0	21	4	0	7	3	9
3	11	18	0	0	41	8	0	12	11	14
4	0	0	0	0	0	2	0	0	2	0
5	5	7	12	0	0	0	0	12	2	13
6	1	2	2	0	0	0	0	0	11	0
7	0	0	0	0	3	0	0	2	0	1
8	6	9	11	0	10	5	0	0	0	19
9	0	0	0	0	0	4	0	0	0	2
10	6	8	9	0	6	3	0	23	1	0

PM - Articular vehicle	1	2	3	4	5	6	7	8	9	10
1	0	77	71	0	72	1	0	72	0	69
2	37	0	74	0	76	1	0	73	1	70
3	40	40	0	0	66	0	0	62	1	59
4	0	0	0	0	0	0	0	0	0	0
5	44	47	48	0	0	0	1	69	1	60
6	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	1	0	1
8	36	36	37	0	41	0	0	0	0	75
9	0	0	0	0	0	0	0	0	0	0
10	40	40	40	0	43	0	0	45	0	0

Rest of day - Light vehicle	1	2	3	4	5	6	7	8	9	10
1	0	551	450	0	286	49	1	227	30	198
2	667	0	1,352	2	676	191	14	329	109	274
3	567	1,415	0	3	1,326	466	27	480	234	332
4	3	4	6	0	21	4	1	3	2	2
5	336	609	1,075	16	0	10	17	893	106	523
6	60	177	382	7	5	0	2	170	720	97
7	3	12	24	1	25	2	0	62	47	30
8	263	334	431	4	698	135	53	0	11	1,385
9	37	104	228	2	114	732	31	7	0	22
10	219	263	323	2	439	101	26	1,396	15	0

Rest of day - Medium heavy	1	2	3	4	5	6	7	8	9	10
1	0	66	77	0	54	1	0	41	2	44
2	143	0	104	0	84	1	2	56	2	55
3	85	123	0	0	98	9	4	63	10	84
4	0	0	0	0	0	0	0	0	0	0
5	78	89	138	0	0	0	5	89	10	62
6	5	8	19	0	0	0	0	5	11	4
7	1	1	3	0	1	0	0	3	2	3
8	72	53	57	0	59	3	6	0	1	113
9	8	11	23	0	5	25	1	1	0	1
10	69	52	41	0	38	1	3	100	1	0

Rest of day - Articular vehicle	1	2	3	4	5	6	7	8	9	10
1	0	415	363	0	407	0	0	386	4	346
2	597	0	529	0	564	1	0	511	5	477
3	650	707	0	0	553	2	2	491	6	440
4	0	0	0	0	0	0	0	0	0	0
5	627	688	700	0	0	0	0	561	7	524
6	0	1	1	0	0	0	0	0	2	0
7	0	0	2	0	0	0	0	1	0	0
8	423	456	478	0	482	0	2	0	6	587
9	6	6	7	0	8	1	1	2	0	1
10	456	493	525	0	520	0	2	531	1	0

A3 O-D Demand by Sectors

For the purpose of using the O-D survey data for model calibration and validation, the station to station survey results format was converted to sector to sector movements. The sector locations are shown on Figure 49 and the daily total sector to sector surveyed matches are presented in Table 76.

Table 76 Daily all vehicles sector to sector O-D matches

Daily all vehicles	Pac Hwy North	Woolgoolga Area	Moonee Beach	Coffs North	Coramba Area	Coffs South	Bonville Area	Pac Hwy South
Pac Hwy North	0	2,258	111	593	4	447	172	1,510
Woolgoolga Area	1,915	0	3,438	1,221	30	912	285	219
Moonee Beach	229	2,972	0	6,547	61	1,799	591	205
Coffs North	761	1,435	6,989	0	2	15,311	2,620	1,104
Coramba Area	9	16	48	48	0	2,443	184	80
Coffs South	628	898	1,224	17,417	2,335	0	14,810	2,563
Bonville Area	157	180	432	2,754	186	14,740	0	4,360
Pac Hwy South	1,610	159	152	936	96	3,380	3,819	0

The sector to sector results indicate significant demand exists between Coffs Harbour North and South sectors, and Coffs Harbour South and Bonville Area. The two-way daily through traffic volume between Pacific Highway north and Pacific Highway south is around 3,100 vehicles.

A4 Model vs O-D Survey Check

A select link analysis was undertaken for the Pacific Highway at O-D survey stations 3 and 8 using the CHSTM. This was compared to the 2017 O-D survey results to understand how closely the model reflected 'through' traffic volumes. The results of the comparison indicated the updated CHSTM has a good representation of through traffic between stations 3 and 8 as shown in Table 15.

Table 77 Through traffic analysis between station 8 and 3

	Model select link			Observed 2017 O-D		
NB through	**Total volume at station 8**	**Select link volume at station 3**	**% through**	**Total count at station 8**	**Matched count at station 3**	**% through**
Daily	15679	2498	16%	15661	2133	14%
AM	1732	132	8%	1887	134	7%
PM	1069	163	15%	1051	142	14%
SB through	**Total volume at station 3**	**Select link volume at station 8**	**% through**	**Total count at station 3**	**Matched count at station 8**	**% through**
Daily	14289	2396	17%	14596	2280	16%
AM	1396	135	10%	1911	137	7%
PM	1148	193	17%	922	183	20%

A5 Limitations

O-D survey data provides good data source to understand the travel demand distribution in the study area, especially with regards to the 'through' traffic component. However, there are limitations when using the O-D survey data.

- The O-D camera survey is usually conducted at major corridors only, in which case traffic using minor routes could be missed from the recorded O-D data. Hence the actual numbers observed from an O-D survey will under represent the total traffic numbers travelling between two points.
- To a certain degree, the split between through trips and terminating trips will be determined by travel time cut-offs. While it is difficult to determine an accurate cut-off time for continuous trips due to the variations in travel conditions, the processed trips from O-D survey may include a certain amount of "two part trips", and hence the amount of trips in the O-D matches may not be 100% accurate. The travel time cut-offs have been selected carefully to capture such potential situations.
- There are usually a certain proportion of matching errors in the process due to misread characters in number plate capturing, through system or human errors.

Understanding the above limitations, the O-D survey results should be used in conjunction with other available traffic survey data sources. The actual numbers obtained from O-D survey should be treated with care, as the O-D results should be used to inform the traffic distribution patterns, rather than on the magnitude of matched demands.

Appendix B

Strategic Model - Screenline Counts

B1 CHSTM – Screenline counts validation

B1.1 Screenline Validation Daily Totals

Daily												
Site ID	Road Name	Count Section	Dir.	LV obs	LV mod	MCV obs	MCV mod	HCV obs	HCV mod	TT obs	TT mod	TT %
SL1	**External Screenline**											
1.1	Pacific Hwy	Pacific Hwy (1.1) - North Of Range Rd	SB	5,012	5,060	640	647	494	496	6,146	6,203	1%
1.3	Eastern Dorrigo Way	Eastern Dorrigo Way (1.3) - 50m East Of Lower Bobo Rd	EB	64	64	2	2	0	0	66	66	0%
1.4	Glennifer Rd	Glennifer Rd (1.4) - 40m West Of Gordons Rd	EB	140	140	12	12	0	0	152	152	0%
1.5	Pacific Hwy	Pacific Hwy (1.5) - North of Mailmans Track Rd	NB	8,808	8,816	518	517	1,054	1,052	10,380	10,385	0%
1.6	Pine Creek Way	Pine Creek Way (1.6) - North Of Overhead Bridge Rd	NB	179	108	13	7	3	0	195	115	-41%
SL1	Sub-Total		IB	14,203	14,189	1,185	1,184	1,551	1,548	16,939	16,921	0%
1.1	Pacific Hwy	Pacific Hwy (1.1) - North Of Range Rd	NB	5,111	5,073	491	450	681	704	6,283	6,227	-1%
1.3	Eastern Dorrigo Way	Eastern Dorrigo Way (1.3) - 50m East Of Lower Bobo Rd	WB	61	56	2	1	1	1	64	58	-10%
1.4	Glennifer Rd	Glennifer Rd (1.4) - 40m West Of Gordons Rd	WB	133	132	11	11	0	0	144	143	-1%
1.5	Pacific Hwy	Pacific Hwy (1.5) - North of Mailmans Track Rd	SB	8,898	8,788	640	656	913	834	10,451	10,278	-2%
1.6	Pine Creek Way	Pine Creek Way (1.6) - North Of Overhead Bridge Rd	SB	158	114	11	7	0	1	169	122	-28%
SL1	Sub-Total		OB	14,361	14,163	1,155	1,126	1,595	1,539	17,111	16,827	-2%
SL1	**TOTAL**			28,564	28,351	2,340	2,310	3,146	3,087	34,050	33,749	-1%
SL2												
29.1	Pacific Hwy	Pacific Hwy (29.1) - 700m South Of Stadium Dr	NB	13,643	14,979	1,224	1,070	931	1,104	15,798	17,153	9%
2.2	Hogbin Dr	Hogbin Dr (2.2) - 300m North Of Hi-Tech Dr	NB	8,138	8,467	428	655	61	123	8,627	9,245	7%
SL2	Sub-Total		NB	21,781	23,446	1,652	1,726	992	1,227	24,425	26,398	8%
29.1	Pacific Hwy	Pacific Hwy (29.1) - 700m South Of Stadium Dr	SB	13,300	15,670	1,461	1,224	893	891	15,654	17,785	14%
2.2	Hogbin Dr	Hogbin Dr (2.2) - 300m North Of Hi-Tech Dr	SB	8,221	8,126	387	667	25	132	8,633	8,925	3%
SL2	Sub-Total		SB	21,521	23,797	1,848	1,891	918	1,022	24,287	26,710	10%
SL2	**TOTAL**			43,302	47,242	3,500	3,617	1,910	2,249	48,712	53,108	9%
SL3												
3.1	Spagnolos Rd	Spagnolos Rd (3.1) - 450m North Of Coramba Rd	NB	63	59	5	3	0	1	68	63	-8%
3.2	William Sharp Dr	William Sharp Dr (3.2) - 300m SW Of Sherpards Ln	NB	276	192	29	9	0	0	305	202	-34%
3.3	Shephards Ln	Shephards Ln (3.3) - 300m North Of Coramba Rd	NB	3,003	2,234	288	136	14	14	3,305	2,384	-28%
3.4	Robin St	Robin St (3.4) - 400m North Of Coramba Rd	NB	845	428	44	4	0	0	889	432	-51%
3.5	Gundagai St	Gundagai St (3.5) - 100m West Of Murdock St	WB	2,974	2,116	159	73	12	5	3,145	2,193	-30%
3.6	Pacific Hwy	Pacific Hwy (3.6) - 80m North Of Coffs St	NB	15,410	14,046	1,423	1,271	1,227	867	18,060	16,183	-10%
3.7	Hogbin Dr	Hogbin Dr (3.7) - 320m North Of Harbour Dr	NB	9,155	9,128	182	604	4	287	9,341	10,019	7%
3.8	Orlando St	Orlando St (3.8) - 50m South Of Vost St	NB	4,325	3,412	349	154	21	30	4,695	3,595	-23%
SL3	Sub-Total		NB	36,051	31,614	2,479	2,254	1,278	1,204	39,808	35,072	-12%
3.1	Spagnolos Rd	Spagnolos Rd (3.1) - 450m North Of Coramba Rd	SB	67	57	1	4	0	1	68	62	-9%
3.2	William Sharp Dr	William Sharp Dr (3.2) - 300m SW Of Sherpards Ln	SB	284	207	20	8	0	0	304	216	-29%
3.3	Shephards Ln	Shephards Ln (3.3) - 300m North Of Coramba Rd	SB	3,064	2,361	310	144	18	13	3,392	2,518	-26%
3.4	Robin St	Robin St (3.4) - 400m North Of Coramba Rd	SB	842	471	53	4	0	0	895	475	-47%
3.5	Gundagai St	Gundagai St (3.5) - 100m West Of Murdock St	EB	3,444	1,875	182	64	0	4	3,626	1,944	-46%
3.6	Pacific Hwy	Pacific Hwy (3.6) - 80m North Of Coffs St	SB	14,381	13,052	1,661	1,435	1,026	775	17,068	15,261	-11%
3.7	Hogbin Dr	Hogbin Dr (3.7) - 320m North Of Harbour Dr	SB	7,559	9,298	232	644	35	249	7,826	10,191	30%
3.8	Orlando St	Orlando St (3.8) - 50m South Of Vost St	SB	5,135	3,414	355	168	38	32	5,528	3,614	-35%
SL3	Sub-Total		SB	34,776	30,735	2,814	2,472	1,117	1,074	38,707	34,281	-11%
SL3	**TOTAL**			70,827	62,349	5,293	4,726	2,395	2,278	78,515	69,353	-12%
SL4												
4.1	N Bonville RD	N Bonville RD (4.1) - 150m North Of Pine Creek Way	NB	845	715	51	33	2	3	898	751	-16%
4.2	Pine Creek Way	Pine Creek Way (4.2) - 150m South Of N Bonville Rd	NB	1,467	1,780	148	115	6	24	1,621	1,920	18%
4.3	Pacific Hwy	Pacific Hwy (4.3) - 400m N Of Bonville Station Rd Overpass	NB	8,481	9,304	403	559	1,044	1,055	9,928	10,918	10%
SL4	Sub-Total		NB	10,793	11,799	602	707	1,052	1,082	12,447	13,589	9%
4.1	N Bonville RD	N Bonville RD (4.1) - 150m North Of Pine Creek Way	SB	853	728	49	35	2	3	904	766	-15%
4.2	Pine Creek Way	Pine Creek Way (4.2) - 150m South Of N Bonville Rd	SB	1,446	1,791	95	115	13	23	1,554	1,929	24%

Daily												
Site ID	Road Name	Count Section	Dir.	LV obs	LV mod	MCV obs	MCV mod	HCV obs	HCV mod	TT obs	TT mod	TT %
4.3	Pacific Hwy	Pacific Hwy (4.3) - 400m N Of Bonville Station Rd Overpass	SB	8,455	9,256	457	694	1,024	835	9,936	10,784	9%
SL4	Sub-Total		SB	10,754	11,774	601	843	1,039	861	12,394	13,478	9%
SL4	**TOTAL**			21,547	23,573	1,203	1,551	2,091	1,943	24,841	27,067	9%
SL5												
29.5	Bennetts Rd	Bennetts Rd	NB	130	146	12	13	0	3	142	163	15%
29.9	Pacific Hwy	Pacific Hwy	NB	12,919	13,064	1,111	1,241	1,024	767	15,054	15,072	0%
25-2	James Small Dr	James Small Dr	NB	1,623	1,963	23	46	0	2	1,646	2,011	22%
2.2	Hogbin Dr	Hogbin Dr (2.2) - 300m North Of Hi-Tech Dr	NB	8,138	8,467	428	655	61	123	8,627	9,245	7%
SL5	Sub-Total		NB	22,810	23,640	1,574	1,956	1,085	895	25,469	26,491	4%
29.5	Bennetts Rd		SB	124	137	15	13	0	3	139	153	10%
29.9	Pacific Hwy		SB	12,430	13,434	1,575	1,401	893	708	14,898	15,542	4%
25-2	James Small Dr	Pacific Hwy	SB	1,521	2,121	30	47	1	2	1,553	2,170	40%
2.2	Hogbin Dr	Hogbin Dr (2.2) - 300m North Of Hi-Tech Dr	SB	8,221	8,126	387	667	25	132	8,633	8,925	3%
SL5	Sub-Total		SB	22,296	23,819	2,007	2,128	919	844	25,223	26,791	6%
SL5	**TOTAL**			45,106	47,459	3,581	4,084	2,004	1,739	50,692	53,282	5%
SL6												
29.10	Pacific Hwy	Pacific Hwy (29.10) - Adjacent To End Of Coachmans Close	SB	12,430	13,434	1,575	1,401	893	708	14,898	15,542	4%
6.2	Bruxner Park Rd	Bruxner Park Rd (6.2) - 400m West Of Pacific Hwy	EB	329	235	21	27	0	14	350	277	-21%
29.4	Coramba Rd	Coramba Rd (29.4) - 250m East Of Bennetts Rd	EB	2,884	2,855	258	269	37	54	3,179	3,178	0%
29.2	N Boambee Rd	N Boambee Rd (29.2) - 100m West Of Highlander Dr	EB	197	85	9	8	6	1	212	94	-56%
6.5	Englands Rd	Englands Rd (6.5) - 400m West Of Isles Dr	EB	245	96	41	10	6	2	292	108	-63%
29.1	Pacific Hwy	Pacific Hwy (29.1) - 700m South Of Stadium Dr	NB	13,643	14,979	1,224	1,070	931	1,104	15,798	17,153	9%
2.2	Hogbin Dr	Hogbin Dr (2.2) - 300m North Of Hi-Tech Dr	NB	8,138	8,467	428	655	61	123	8,627	9,245	7%
SL6	Sub-Total		IB	37,866	40,151	3,556	3,440	1,934	2,006	43,356	45,597	5%
29.10	Pacific Hwy	Pacific Hwy (29.10) - Adjacent To End Of Coachmans Close	NB	12,919	13,064	1,111	1,241	1,024	767	15,054	15,072	0%
6.2	Bruxner Park Rd	Bruxner Park Rd (6.2) - 400m West Of Pacific Hwy	WB	351	212	26	28	0	11	377	251	-33%
29.4	Coramba Rd	Coramba Rd (29.4) - 250m East Of Bennetts Rd	WB	2,833	3,019	226	272	33	66	3,092	3,357	9%
29.2	N Boambee Rd	N Boambee Rd (29.2) - 100m West Of Highlander Dr	WB	181	94	8	8	15	2	204	104	-49%
6.5	Englands Rd	Englands Rd (6.5) - 400m West Of Isles Dr	WB	239	97	49	11	2	2	290	111	-62%
29.1	Pacific Hwy	Pacific Hwy (29.1) - 700m South Of Stadium Dr	SB	13,300	15,670	1,461	1,224	893	891	15,654	17,785	14%
2.2	Hogbin Dr	Hogbin Dr (2.2) - 300m North Of Hi-Tech Dr	SB	8,221	8,126	387	667	25	132	8,633	8,925	3%
SL6	Sub-Total		OB	38,044	40,284	3,268	3,451	1,992	1,869	43,304	45,604	5%
SL6	**TOTAL**			75,910	80,434	6,824	6,892	3,926	3,876	86,660	91,201	5%
SL7												
7.1	Pacific Hwy	300m NW Of Woolgoolga Creek Rd Overpass	NB	4,280	4,546	383	432	583	528	5,246	5,506	5%
7.2	Solitary Islands Way	Solitary Islands Way (7.2) - 100m North Of Dalgety St	NB	5,003	3,914	462	283	22	161	5,487	4,358	-21%
SL7	Sub-Total		NB	9,283	8,460	845	715	605	689	10,733	9,864	-8%
7.1	Pacific Hwy	300m NW Of Woolgoolga Creek Rd Overpass	SB	4,980	5,169	692	671	436	453	6,108	6,293	3%
7.2	Solitary Islands Way	Solitary Islands Way (7.2) - 100m North Of Dalgety St	SB	5,096	3,204	451	234	20	69	5,567	3,507	-37%
SL7	Sub-Total		SB	10,076	8,373	1,143	905	456	522	11,675	9,800	-16%
SL7	**TOTAL**			19,359	16,832	1,988	1,621	1,061	1,211	22,408	19,664	-12%
SL8												
25-10	Coff St	Pacific Hwy and Coff St, Coffs Harbour	WB	7,320	4,049	140	230	4	59	7,464	4,338	-42%
25-24	Vernon St	Pacific Hwy and Vernon St, Coffs Harbour	WB	1,327	582	27	16	0	10	1,354	609	-55%
25-11	Harbour Dr	Pacific Hwy and Harbour Dr, Coffs Harbour	WB	3,390	3,578	24	150	0	28	3,414	3,755	10%
25-12	Moonee St	Pacific Hwy and Moonee St, Coffs Harbour	WB	3,614	1,243	149	48	3	13	3,766	1,303	-65%
25-23	Market St	Pacific Hwy and Market St, Coffs Harbour	WB	563	439	60	20	1	10	624	469	-25%
25-13	Albany St	Pacific Hwy and Albany St, Coffs Harbour	WB	3,977	2,355	94	23	3	2	4,074	2,380	-42%
25-22	Valley St	Pacific Hwy and Grafton St and Valley St, Coffs Harbour	WB	104	652	4	66	0	36	109	754	594%
8.10	Thompsons Rd	Thompsons Rd (8.10) - 20m East Of Pacific Hwy	WB	2,556	1,936	250	112	5	28	2,811	2,076	-26%
25-15	Hurley Dr	Pacific Hwy and Hurley Dr, Coffs Harbour	WB	2,146	1,548	186	167	33	64	2,364	1,780	-25%
24-3	Cook Dr	Shopping Carpark and Cook Dr, Coffs Harbour	WB	4,806	5,171	350	385	94	147	5,250	5,703	9%
24-2	Isle Dr	Pacific Hwy and Isle Dr, Coffs Harbour	WB	2,906	2,678	96	88	0	6	3,001	2,771	-8%
8.13	Stadium Dr	Stadium Dr (8.13) - 20m East Of Pacific Hwy	WB	3,948	4,974	342	269	59	200	4,349	5,444	25%
SL8	Sub-Total		WB	36,657	29,205	1,722	1,573	203	603	38,581	31,381	-19%
25-10	Coff St	Pacific Hwy and Coff St, Coffs Harbour	EB	7,950	3,137	87	179	4	55	8,041	3,371	-58%

Daily												
Site ID	Road Name	Count Section	Dir.	LV obs	LV mod	MCV obs	MCV mod	HCV obs	HCV mod	TT obs	TT mod	TT %
25-24	Vernon St	Pacific Hwy and Vernon St, Coffs Harbour	EB	383	404	0	19	0	7	383	430	12%
25-11	Harbour Dr	Pacific Hwy and Harbour Dr, Coffs Harbour	EB	3,346	3,403	23	99	0	25	3,369	3,527	5%
25-12	Moonee St	Pacific Hwy and Moonee St, Coffs Harbour	EB	5,143	655	190	25	3	8	5,336	688	-87%
25-23	Market St	Pacific Hwy and Market St, Coffs Harbour	EB	1,273	2,047	39	121	0	21	1,311	2,189	67%
25-13	Albany St	Pacific Hwy and Albany St, Coffs Harbour	EB	3,806	2,210	106	82	4	42	3,916	2,333	-40%
25-22	Valley St	Pacific Hwy and Grafton St and Valley St, Coffs Harbour	EB	90	218	3	19	0	1	93	238	157%
8.10	Thompsons Rd	Thompsons Rd (8.10) - 20m East Of Pacific Hwy	EB	2,748	2,212	314	114	8	38	3,070	2,364	-23%
25-15	Hurley Dr	Pacific Hwy and Hurley Dr, Coffs Harbour	EB	1,619	1,368	180	175	40	72	1,839	1,615	-12%
24-3	Cook Dr	Shopping Carpark and Cook Dr, Coffs Harbour	EB	4,807	4,888	333	387	79	159	5,219	5,434	4%
24-2	Isle Dr	Pacific Hwy and Isle Dr, Coffs Harbour	EB	3,230	2,786	107	108	0	8	3,337	2,901	-13%
8.13	Stadium Dr	Stadium Dr (8.13) - 20m East Of Pacific Hwy	EB	4,109	4,643	356	247	42	251	4,507	5,140	14%
SL8	Sub-Total		EB	38,503	27,969	1,737	1,575	180	687	40,420	30,231	-25%
SL8	**TOTAL**			75,160	57,174	3,459	3,148	383	1,289	79,001	61,612	-22%
SL9												
25-25	Bay Dr	Pacific Hwy and Bay Dr, Coffs Harbour	WB	1,096	562	51	14	0	2	1,147	578	-50%
22-1	Diggers Beach Rd	Pacific Hwy and Diggers Beach Rd, Coffs Harbour	WB	403	295	6	13	0	0	409	308	-25%
9.3	Macauleys Headland Dr	Macauleys Headland Dr (9.3) - 20m East Of Pacific Hwy	WB	38	404	0	10	0	0	38	415	991%
25-3	Arthur St	Pacific Hwy and Arthur St, Coffs Harbour	WB	7,556	7,779	111	494	4	75	7,671	8,348	9%
25-4	Park Beach Rd	Pacific Hwy and Park Beach Rd, Coffs Harbour	WB	6,410	5,283	166	144	4	15	6,580	5,442	-17%
25-5	Orlando St	Pacific Hwy and Orlando St, Coffs Harbour	WB	6,903	4,760	341	304	39	110	7,283	5,173	-29%
9.7	Rose Ave	Rose Ave (9.7) - Just East Of Pacific Hwy	NB	95	38	5	1	0	0	100	39	-61%
25-8	Melittas Ave	Pacific Hwy and Melittas Ave, Coffs Harbour	WB	129	1,078	0	81	0	41	129	1,200	833%
SL9	Sub-Total		WB	22,629	20,197	681	1,062	47	242	23,357	21,502	-8%
25-25	Bay Dr	Pacific Hwy and Bay Dr, Coffs Harbour	EB	926	603	49	16	0	2	974	620	-36%
22-1	Diggers Beach Rd	Pacific Hwy and Diggers Beach Rd, Coffs Harbour	EB	609	589	13	16	0	0	621	606	-3%
9.3	Macauleys Headland Dr	Macauleys Headland Dr (9.3) - 20m East Of Pacific Hwy	EB	319	57	18	5	0	0	337	62	-82%
25-3	Arthur St	Pacific Hwy and Arthur St, Coffs Harbour	EB	4,414	7,725	114	144	6	10	4,534	7,880	74%
25-4	Park Beach Rd	Pacific Hwy and Park Beach Rd, Coffs Harbour	EB	6,657	5,897	99	148	3	11	6,759	6,055	-10%
25-5	Orlando St	Pacific Hwy and Orlando St, Coffs Harbour	EB	6,916	5,008	321	701	19	183	7,256	5,891	-19%
9.7	Rose Ave	Rose Ave (9.7) - Just East Of Pacific Hwy	SB	318	154	16	12	0	3	334	169	-49%
25-8	Melittas Ave	Pacific Hwy and Melittas Ave, Coffs Harbour	EB	419	873	16	71	1	43	436	986	126%
SL9	Sub-Total		EB	20,577	20,905	645	1,112	29	252	21,251	22,269	5%
SL9	**TOTAL**			43,206	41,102	1,326	2,174	76	494	44,608	43,771	-2%
SL10												
10.1	Diamond Head Dr	Diamond Head Dr (10.1) - Just East Of Pacific Hwy	WB	2,053	1,371	73	69	1	1	2,126	1,442	-32%
10.2	Fiddaman Rd	Fiddaman Rd (10.2) - 100m West Of Lights St	WB	1,683	1,754	142	249	4	145	1,829	2,148	17%
10.3	Moonee Beach Rd	Moonee Beach Rd (10.3) - 200m West Of Estuary Dr	WB	1,768	929	114	37	18	15	1,900	981	-48%
SL10	Sub-Total		WB	5,504	4,054	329	355	23	161	5,855	4,571	-22%
10.1	Diamond Head Dr	Diamond Head Dr (10.1) - Just East Of Pacific Hwy	EB	1,989	1,404	117	72	3	1	2,108	1,477	-30%
10.2	Fiddaman Rd	Fiddaman Rd (10.2) - 100m West Of Lights St	EB	1,631	1,666	123	253	2	122	1,756	2,041	16%
10.3	Moonee Beach Rd	Moonee Beach Rd (10.3) - 200m West Of Estuary Dr	EB	2,855	1,852	168	125	16	44	3,039	2,021	-34%
SL10	Sub-Total		EB	6,475	4,922	408	450	21	166	6,903	5,539	-20%
SL10	**TOTAL**			11,978	8,977	736	806	44	328	12,758	10,110	-21%
SL11												
11.1	Sawtell Rd	Sawtell Rd (11.1) - 70m South-East Of Pacific Hwy	WB	4,555	5,096	257	320	43	99	4,855	5,515	14%
11.2	Bruce King Dr	Bruce King Dr (11.2) - 50m East Of Pacific Hwy	WB	424	398	29	5	4	0	457	404	-12%
11.3	Lyons Rd	Lyons Rd (11.3) - Just East Of Pacific Hwy (East Roundabout)	WB	4,062	3,780	129	120	7	29	4,198	3,929	-6%
SL11	Sub-Total		WB	9,041	9,273	415	445	54	129	9,510	9,847	4%
11.1	Sawtell Rd	Sawtell Rd (11.1) - 70m South-East Of Pacific Hwy	EB	3,771	4,579	210	250	50	80	4,031	4,908	22%
11.2	Bruce King Dr	Bruce King Dr (11.2) - 50m East Of Pacific Hwy	EB	1,717	1,952	105	117	4	26	1,826	2,094	15%
11.3	Lyons Rd	Lyons Rd (11.3) - Just East Of Pacific Hwy (East Roundabout)	EB	3,581	3,431	119	100	35	31	3,735	3,562	-5%
SL11	Sub-Total		EB	9,069	9,961	434	467	89	136	9,592	10,564	10%
SL11	**TOTAL**			18,110	19,234	849	912	143	265	19,102	20,411	7%
SL12												
12.1	Arthur St	Arthur St (12.1) - 40m West Of Hogbin Dr N	WB	4,341	5,241	311	421	5	69	4,657	5,731	23%
12.2	Park Beach Rd	Park Beach Rd (12.2) - 40m West Of Hogbin Dr N	WB	3,003	2,382	140	12	2	2	3,145	2,396	-24%

Daily												
Site ID	Road Name	Count Section	Dir.	LV obs	LV mod	MCV obs	MCV mod	HCV obs	HCV mod	TT obs	TT mod	TT %
12.3	Boultwood St	Boultwood St (12.3) - 30m West Of Hogbin Dr N	WB	287	1,344	9	84	0	53	296	1,481	400%
12.4	Prince St	Prince St (12.4) - 30m West Of Hogbin Dr N	WB	435	292	10	14	0	0	445	306	-31%
12.5	Orlando St	Orlando St (12.5) - 80m North-West Of Hogbin Dr N Roundaobut	WB	5,731	3,411	310	229	41	183	6,082	3,822	-37%
12.6	Watsonia Ave	Watsonia Ave (12.6) - 60m NE Of Gentlemen St	SB	17	0	0	0	0	0	17	0	-100%
12.7	Watsonia Ave	Watsonia Ave (12.7) - Just West of Hogbin Dr	WB	436	579	21	11	0	1	457	591	29%
SL12	Sub-Total		WB	14,250	13,248	801	770	48	308	15,099	14,326	-5%
12.1	Arthur St	Arthur St (12.1) - 40m West Of Hogbin Dr N	EB	4,140	4,946	260	59	6	5	4,406	5,010	14%
12.2	Park Beach Rd	Park Beach Rd (12.2) - 40m West Of Hogbin Dr N	EB	3,117	3,320	114	96	7	17	3,238	3,433	6%
12.3	Boultwood St	Boultwood St (12.3) - 30m West Of Hogbin Dr N	EB	255	34	16	1	0	22	271	57	-79%
12.4	Prince St	Prince St (12.4) - 30m West Of Hogbin Dr N	EB	513	279	12	16	0	0	525	295	-44%
12.5	Orlando St	Orlando St (12.5) - 80m North-West Of Hogbin Dr N Roundaobut	EB	5,617	4,282	472	643	26	231	6,115	5,156	-16%
12.6	Watsonia Ave	Watsonia Ave (12.6) - 60m NE Of Gentlemen St	NB	166	186	5	4	0	0	171	190	11%
12.7	Watsonia Ave	Watsonia Ave (12.7) - Just West of Hogbin Dr	EB	325	360	15	7	0	0	340	368	8%
SL12	Sub-Total		EB	14,133	13,407	894	826	39	275	15,066	14,509	-4%
SL12	**TOTAL**			28,383	26,655	1,695	1,597	87	583	30,165	28,835	-4%
SL13												
13.1	Harbour Dr	Harbour Dr (13.1) - Just West Of Hogbin Dr	WB	5,921	7,820	320	348	29	79	6,270	8,247	32%
13.2	Albany St	Albany St (13.2) - 60m West Of Hogbin Dr	WB	4,870	1,146	324	40	10	7	5,204	1,193	-77%
24-1	Stadium Dr	Hogbin Dr and Stadium Dr, Coffs Harbour	WB	4,746	6,177	281	305	33	200	5,060	6,682	32%
SL13	Sub-Total		WB	15,537	15,143	925	693	72	287	16,534	16,122	-2%
13.1	Harbour Dr	Harbour Dr (13.1) - Just West Of Hogbin Dr	EB	6,363	7,412	357	270	86	70	6,806	7,751	14%
13.2	Albany St	Albany St (13.2) - 60m West Of Hogbin Dr	EB	4,709	1,742	339	108	5	18	5,053	1,868	-63%
24-1	Stadium Dr	Hogbin Dr and Stadium Dr, Coffs Harbour	EB	4,263	5,670	236	277	36	251	4,534	6,198	37%
SL13	Sub-Total		EB	15,335	14,824	932	655	127	339	16,393	15,818	-4%
SL13	**TOTAL**			30,872	29,967	1,857	1,348	199	625	32,927	31,940	-3%
SL14												
14.1	Hi-Tech Dr	Hi-Tech Dr (14.1) - 30m West Of Hogbin Dr	WB	1,409	1,535	236	251	5	90	1,650	1,876	14%
14.2	Sawtell Rd	Sawtell Rd (14.2) - 30m West Of Hogbin Dr	WB	4,469	4,020	273	222	13	63	4,755	4,305	-9%
20-10	Coorabin Cres	Toormina Rd and Minorca Pl, Coffs Harbour	WB	930	1,179	21	30	0	1	951	1,210	27%
20-11	Bangalee Cres	Toormina Rd and Shopping Centre, Coffs Harbour	WB	934	437	30	11	0	1	964	449	-53%
14.5	Amaroo Cresent	Amaroo Cresent (14.5) - 30m West Of Toormina Rd	WB	871	1,817	26	60	0	0	897	1,877	109%
14.6	Kintorie Cresent	Kintorie Cresent (14.6) - 30m West Of Toormina Rd	WB	287	775	13	12	0	0	300	787	162%
14.7	Mirroola Cresent	Mirroola Cresent (14.7) - 30m west of Toormina Rd	WB	330	454	16	9	2	0	348	462	33%
14.8	Linden Ave	Linden Ave (14.8) - 30m West Of Toormina Rd	WB	1,580	2,272	116	61	5	18	1,701	2,351	38%
14.9	Playford Ave	Playford Ave (14.9) - 30m West of Toormina Rd	WB	491	305	28	7	0	0	519	312	-40%
26-6	Lyons Rd	Lyons Rd and Hogbin Dr, Coffs Harbour	WB	3,196	1,395	99	47	4	6	3,299	1,448	-56%
SL14	Sub-Total		WB	14,497	14,188	858	708	29	180	15,384	15,076	-2%
14.1	Hi-Tech Dr	Hi-Tech Dr (14.1) - 30m West Of Hogbin Dr	EB	1,401	1,664	238	252	5	86	1,644	2,002	22%
14.2	Sawtell Rd	Sawtell Rd (14.2) - 30m West Of Hogbin Dr	EB	4,687	4,612	305	243	11	69	5,003	4,924	-2%
20-10	Coorabin Cres	Toormina Rd and Minorca Pl, Coffs Harbour	EB	1,061	887	16	23	0	0	1,077	911	-15%
20-11	Bangalee Cres	Toormina Rd and Shopping Centre, Coffs Harbour	EB	986	621	29	14	0	1	1,014	636	-37%
14.5	Amaroo Cresent	Amaroo Cresent (14.5) - 30m West Of Toormina Rd	EB	939	1,845	16	63	0	1	955	1,908	100%
14.6	Kintorie Cresent	Kintorie Cresent (14.6) - 30m West Of Toormina Rd	EB	288	782	9	12	0	0	297	794	167%
14.7	Mirroola Cresent	Mirroola Cresent (14.7) - 30m west of Toormina Rd	EB	363	427	11	10	0	0	374	437	17%
14.8	Linden Ave	Linden Ave (14.8) - 30m West Of Toormina Rd	EB	1,642	2,207	82	60	0	18	1,724	2,285	33%
14.9	Playford Ave	Playford Ave (14.9) - 30m West of Toormina Rd	EB	602	301	25	9	1	0	628	309	-51%
26-6	Lyons Rd	Lyons Rd and Hogbin Dr, Coffs Harbour	EB	2,909	1,402	111	43	6	7	3,026	1,451	-52%
SL14	Sub-Total		EB	14,878	14,747	842	728	23	182	15,742	15,657	-1%
SL14	**TOTAL**			29,375	28,935	1,700	1,436	52	362	31,126	30,733	-1%
SL21		**Airport**										
21-1	Airport Dr	Airport Dr	WB	1,203	1,428	19	36	1	9	1,223	1,473	20%
21-2	Christmas Bells Rd	Christmas Bells Rd	WB	347	458	81	38	17	10	446	506	14%
SL21	Sub-Total		WB	1,550	1,886	100	74	19	18	1,669	1,979	19%
21-1	Airport Dr	Airport Dr	EB	1,316	1,497	19	35	1	10	1,336	1,542	15%
21-2	Christmas Bells Rd	Christmas Bells Rd	EB	397	429	80	35	16	10	493	473	-4%
SL21	Sub-Total		EB	1,713	1,926	99	70	17	20	1,829	2,015	10%

Daily												
Site ID	Road Name	Count Section	Dir.	LV obs	LV mod	MCV obs	MCV mod	HCV obs	HCV mod	TT obs	TT mod	TT %
SL21	**TOTAL**			3,263	3,812	199	144	36	38	3,497	3,994	14%
SL22	**Big Banana**											
22-1a	Diggers Beach Rd	Diggers Beach Rd	EB	540	120	6	5	1	1	547	125	-77%
22-2	Island View Close	Island View Close	EB	330	464	6	18	0	4	336	486	45%
SL22	Sub-Total		EB	870	584	11	23	1	5	883	611	-31%
22-1a	Diggers Beach Rd	Diggers Beach Rd	WB	453	416	4	13	0	5	457	433	-5%
22-2	Island View Close	Island View Close	WB	457	170	13	8	0	1	470	179	-62%
SL22	Sub-Total		WB	910	586	17	21	0	5	927	612	-34%
SL22	**TOTAL**			1,780	1,170	29	44	1	10	1,810	1,223	-32%
SL23	**Baringa Private Hospital**											
	Hospital	Departing	EB	617	664	7	9	0	3	624	676	8%
23-1	Mackays Rd	Approaching	EB	1,329	952	69	24	0	5	1,397	982	-30%
SL23	Sub-Total		EB	1,946	1,616	76	33	0	8	2,021	1,657	-18%
	Hospital		WB	604	629	9	11	0	2	613	642	5%
23-1	Mackays Rd		WB	1,400	907	74	26	0	4	1,474	937	-36%
SL23	Sub-Total		WB	2,004	1,536	83	37	0	6	2,087	1,579	-24%
SL23	**TOTAL**			3,950	3,152	159	70	0	14	4,109	3,236	-21%

B1.2 Screenline Validation AM & PM Peak

			AM (8-9)										PM (16-17)									
Site ID	Road Name	Dir.	LV obs	LV mod	MCV obs	MCV mod	HCV obs	HCV mod	**TT obs**	**TT mod**	TT %	GEH	LV obs	LV mod	MCV obs	MCV mod	HCV obs	HCV mod	**TT obs**	**TT mod**	TT %	GEH
SL1	**External Screenline**																					
1.1	Pacific Hwy	SB	259	260	37	38	12	12	308	310	1%	**0.1**	404	406	64	64	40	40	508	510	0%	**0.1**
1.3	Eastern Dorrigo Way	EB	6	6	0	0	0	0	6	6	0%	**0.0**	3	3	0	0	0	0	3	3	0%	**0.0**
1.4	Glennifer Rd	EB	18	18	1	1	0	0	19	19	0%	**0.0**	13	13	1	1	0	0	14	14	0%	**0.0**
1.5	Pacific Hwy	NB	844	845	44	45	42	43	930	933	0%	**0.1**	605	606	37	37	57	57	699	700	0%	**0.1**
1.6	Pine Creek Way	NB	23	17	2	1	1	0	26	18	-32%	**1.8**	12	7	1	1	0	0	13	7	-43%	**1.8**
SL1	Sub-Total	IB	1,150	1,146	84	85	55	55	1,289	1,285	0%	**0.1**	1,037	1,035	103	103	97	97	1,237	1,235	0%	**0.1**
1.1	Pacific Hwy	NB	302	333	37	36	28	29	367	398	8%	**1.6**	323	311	32	31	25	28	380	369	-3%	**0.5**
1.3	Eastern Dorrigo Way	WB	4	5	1	1	1	1	6	6	6%	**0.1**	10	9	0	0	0	0	10	9	-6%	**0.2**
1.4	Glennifer Rd	WB	10	9	1	1	0	0	11	10	-7%	**0.2**	15	14	1	1	0	0	16	15	-5%	**0.2**
1.5	Pacific Hwy	SB	488	486	42	42	33	25	563	553	-2%	**0.4**	817	807	52	52	66	62	935	921	-1%	**0.5**
1.6	Pine Creek Way	SB	7	7	2	1	0	0	9	7	-22%	**0.7**	18	16	2	1	0	0	20	16	-19%	**0.9**
SL1	Sub-Total	OB	811	840	83	80	62	55	956	975	2%	**0.6**	1,183	1,157	87	84	91	90	1,361	1,332	-2%	**0.8**
SL1	**TOTAL**		1,961	1,985	167	165	117	110	2,245	2,260	1%	**0.3**	2,220	2,192	190	187	188	188	2,598	2,566	-1%	**0.6**
SL2	**Boambee Creek Screenline**																					
29.1	Pacific Hwy	NB	1,635	1,748	103	104	53	57	1,791	1,908	7%	**2.7**	882	957	87	83	47	65	1,016	1,105	9%	**2.7**
SL2	Sub-Total	NB	2,635	2,633	145	163	60	74	2,840	2,871	1%	**0.6**	1,440	1,628	114	132	50	75	1,604	1,834	14%	**5.6**
29.1	Pacific Hwy	SB	796	856	112	95	36	34	944	985	4%	**1.3**	1,361	1,784	117	101	68	72	1,546	1,957	27%	**9.8**
2.2	Hogbin Dr	SB	504	512	28	63	2	14	534	588	10%	**2.3**	922	933	27	46	2	9	951	989	4%	**1.2**
SL2	Sub-Total	SB	1,300	1,367	140	157	38	49	1,478	1,573	6%	**2.4**	2,283	2,717	144	148	70	81	2,497	2,946	18%	**8.6**
SL2	**TOTAL**		3,935	4,000	285	321	98	123	4,318	4,444	3%	**1.9**	3,723	4,345	258	279	120	156	4,101	4,780	17%	**10.2**
SL3	**Creek Screenline**																					
3.1	Spagnolos Rd	NB	3	4	0	0	0	0	3	5	56%	**0.9**	8	7	0	1	0	0	8	7	-12%	**0.4**
3.2	William Sharp Dr	NB	38	24	3	1	0	0	41	26	-38%	**2.7**	22	18	3	1	0	0	25	19	-24%	**1.3**
3.3	Shephards Ln	NB	238	189	22	11	1	1	261	201	-23%	**4.0**	313	253	23	12	1	1	337	266	-21%	**4.1**
3.4	Robin St	NB	125	39	7	1	0	0	132	40	-70%	**10.0**	67	58	6	1	0	0	73	59	-20%	**1.8**
3.5	Gundagai St	WB	162	136	9	8	1	0	172	144	-17%	**2.3**	365	301	22	6	3	0	390	307	-21%	**4.4**
3.6	Pacific Hwy	NB	779	1,186	80	107	52	52	911	1,346	48%	**12.9**	1,332	1,427	116	104	96	47	1,544	1,578	2%	**0.9**
3.7	Hogbin Dr	NB	742	680	14	55	0	23	756	758	0%	**0.1**	954	793	10	47	0	19	964	858	-11%	**3.5**
3.8	Orlando St	NB	252	224	27	13	3	3	282	239	-15%	**2.6**	409	354	29	13	2	2	440	369	-16%	**3.5**
SL3	Sub-Total	NB	2,339	2,482	162	195	57	80	2,558	2,757	8%	**3.9**	3,470	3,210	209	183	102	70	3,781	3,463	-8%	**5.3**
3.1	Spagnolos Rd	SB	10	9	1	0	0	0	11	9	-19%	**0.7**	4	4	0	0	0	0	4	4	5%	**0.1**
3.2	William Sharp Dr	SB	24	22	1	1	0	0	25	23	-7%	**0.4**	30	22	3	1	0	0	33	23	-31%	**1.9**
3.3	Shephards Ln	SB	332	316	23	11	1	2	356	328	-8%	**1.5**	269	181	28	14	0	1	297	195	-34%	**6.5**
3.4	Robin St	SB	128	112	15	1	0	0	143	113	-21%	**2.7**	83	47	5	0	0	0	88	47	-47%	**5.0**
3.5	Gundagai St	EB	480	312	20	7	0	0	500	319	-36%	**9.0**	291	112	16	6	0	1	307	118	-61%	**12.9**
3.7	Hogbin Dr	SB	807	840	20	52	3	16	830	908	9%	**2.7**	661	721	16	55	4	27	681	803	18%	**4.5**
3.8	Orlando St	SB	531	299	42	14	5	3	578	316	-45%	**12.4**	359	276	20	13	3	2	382	291	-24%	**5.0**
SL3	Sub-Total	SB	3,506	3,112	244	199	93	64	3,843	3,375	-12%	**7.8**	2,699	2,536	204	204	80	85	2,983	2,824	-5%	**2.9**
SL3	**TOTAL**		5,845	5,594	406	394	150	144	6,401	6,132	-4%	**3.4**	6,169	5,745	413	387	182	154	6,764	6,287	-7%	**5.9**
SL4	**Bonville Creek Screenline**																					
4.1	N Bonville RD	NB	44	110	4	3	0	0	48	114	137%	**7.3**	93	45	5	3	1	0	99	48	-52%	**6.0**
4.2	Pine Creek Way	NB	190	172	23	11	0	3	213	186	-13%	**1.9**	131	182	11	9	0	2	142	193	36%	**4.0**
4.3	Pacific Hwy	NB	854	914	25	50	40	44	919	1,008	10%	**2.9**	590	642	32	41	48	57	670	739	10%	**2.6**
SL4	Sub-Total	NB	1,088	1,196	52	65	40	48	1,180	1,308	11%	**3.6**	814	869	48	52	49	60	911	980	8%	**2.3**
4.1	N Bonville RD	SB	107	42	5	3	0	1	112	46	-59%	**7.4**	57	96	6	3	0	0	63	99	57%	**4.0**
4.2	Pine Creek Way	SB	183	222	11	11	1	3	195	236	21%	**2.8**	122	164	10	9	2	2	134	176	31%	**3.3**
4.3	Pacific Hwy	SB	467	546	35	47	30	25	532	618	16%	**3.6**	810	856	26	57	73	63	909	975	7%	**2.2**
SL4	Sub-Total	SB	757	810	51	61	31	29	839	900	7%	**2.1**	989	1,116	42	68	75	65	1,106	1,250	13%	**4.2**
SL4	**TOTAL**		1,845	2,006	103	126	71	76	2,019	2,208	9%	**4.1**	1,803	1,985	90	120	124	125	2,017	2,230	11%	**4.6**
SL5	**Korora boundary**																					
29.5	Bennetts Rd	NB	6	11	1	1	0	0	7	12	76%	**1.7**	13	17	1	1	0	0	14	18	27%	**1.0**
29.9	Pacific Hwy	NB	579	808	65	111	48	48	692	968	40%	**9.6**	1,313	1,455	102	94	79	41	1,494	1,590	6%	**2.4**
25-2	James Small Dr	NB	163	236	0	4	0	0	163	239	47%	5.4	89	151	3	4	0	0	92	155	68%	5.6

			AM (8-9)										PM (16-17)									
Site ID	Road Name	Dir.	LV obs	LV mod	MCV obs	MCV mod	HCV obs	HCV mod	TT obs	TT mod	TT %	GEH	LV obs	LV mod	MCV obs	MCV mod	HCV obs	HCV mod	TT obs	TT mod	TT %	GEH
2.2	Hogbin Dr	NB	1,000	885	42	60	7	17	1,049	962	-8%	2.7	558	670	27	49	3	10	588	729	24%	5.5
SL5	Sub-Total	NB	1,748	1,940	108	176	55	66	1,911	2,181	14%	6.0	1,973	2,293	133	147	82	52	2,188	2,491	14%	6.3
29.5	Bennetts Rd	SB	13	20	2	1	0	0	15	21	41%	1.5	12	10	3	1	0	0	15	11	-26%	1.1
29.9	Pacific Hwy	SB	1,478	1,296	159	120	78	41	1,715	1,456	-15%	6.5	743	957	112	99	63	35	918	1,091	19%	5.5
25-2	James Small Dr	SB	97	230	3	4	0	0	100	234	134%	10.4	170	222	1	5	0	0	171	227	33%	3.9
2.2	Hogbin Dr	SB	504	512	28	63	2	14	534	588	10%	**2.3**	922	933	27	46	2	9	951	989	4%	**1.2**
SL5	Sub-Total	SB	2,092	2,057	192	187	80	55	2,364	2,299	-3%	**1.3**	1,847	2,121	143	151	65	45	2,055	2,318	13%	**5.6**
SL5	**TOTAL**		3,840	3,996	300	363	135	122	4,275	4,481	5%	**3.1**	3,820	4,414	276	298	147	97	4,243	4,809	13%	**8.4**
SL6	**North Ring Screenline**																					
29.10	Pacific Hwy	SB	1,478	1,296	159	120	78	41	1,715	1,456	-15%	**6.5**	743	957	112	99	63	35	918	1,091	19%	**5.5**
6.2	Bruxner Park Rd	EB	33	25	1	2	0	1	34	29	-16%	**0.9**	26	19	3	2	0	1	29	22	-24%	**1.4**
29.4	Coramba Rd	EB	446	338	37	25	3	7	486	370	-24%	**5.6**	170	234	19	22	1	5	190	261	37%	**4.7**
29.2	N Boambee Rd	EB	21	12	1	1	0	0	22	12	-44%	**2.3**	16	6	2	1	0	0	18	7	-61%	**3.1**
6.5	Englands Rd	EB	28	13	4	1	0	0	32	14	-57%	**3.8**	22	8	3	1	0	0	25	9	-65%	**4.0**
29.1	Pacific Hwy	NB	1,635	1,748	103	104	53	57	1,791	1,908	7%	**2.7**	882	957	87	83	47	65	1,016	1,105	9%	**2.7**
2.2	Hogbin Dr	NB	1,000	885	42	60	7	17	1,049	962	-8%	**2.7**	558	670	27	49	3	10	588	729	24%	**5.5**
SL6	Sub-Total	IB	4,641	4,316	347	313	141	123	5,129	4,751	-7%	**5.4**	2,417	2,852	253	256	114	116	2,784	3,223	16%	**8.0**
6.2	Bruxner Park Rd	WB	13	17	2	3	0	1	15	21	37%	**1.3**	41	22	1	3	0	1	42	26	-38%	**2.7**
29.4	Coramba Rd	WB	125	245	22	27	2	8	149	280	88%	**9.0**	377	339	20	22	1	5	398	367	-8%	**1.6**
29.2	N Boambee Rd	WB	10	5	0	1	1	0	11	6	-43%	**1.6**	15	10	1	0	1	0	17	10	-39%	**1.8**
6.5	Englands Rd	WB	13	7	4	1	0	0	17	8	-51%	**2.4**	25	12	4	1	0	0	29	14	-53%	**3.4**
29.1	Pacific Hwy	SB	796	856	112	95	36	34	944	985	4%	**1.3**	1,361	1,784	117	101	68	72	1,546	1,957	27%	**9.8**
2.2	Hogbin Dr	SB	504	512	28	63	2	14	534	588	10%	**2.3**	922	933	27	46	2	9	951	989	4%	**1.2**
SL6	Sub-Total	OB	2,040	2,449	233	300	89	107	2,362	2,856	21%	**9.7**	4,054	4,555	272	268	151	129	4,477	4,952	11%	**6.9**
SL6	**TOTAL**		6,681	6,765	580	613	230	229	7,491	7,607	2%	**1.3**	6,471	7,407	525	524	265	245	7,261	8,175	13%	**10.4**
SL7	**Woolgoolga Creek Screenline**																					
7.1	Pacific Hwy	NB	239	343	25	37	25	22	289	402	39%	**6.1**	319	388	20	27	24	19	363	435	20%	**3.6**
7.2	Solitary Islands Way	NB	622	352	52	26	3	10	677	388	-43%	**12.5**	394	356	39	24	1	10	434	390	-10%	**2.2**
SL7	Sub-Total	NB	861	695	77	63	28	33	966	790	-18%	**5.9**	713	745	59	51	25	30	797	826	4%	**1.0**
7.1	Pacific Hwy	SB	301	305	49	51	13	17	363	372	3%	**0.5**	302	374	54	57	28	33	384	464	21%	**3.9**
7.2	Solitary Islands Way	SB	358	364	39	19	2	4	399	387	-3%	**0.6**	543	302	43	20	2	6	588	328	-44%	**12.2**
SL7	Sub-Total	SB	659	668	88	70	15	20	762	759	0%	**0.1**	845	676	97	78	30	38	972	792	-19%	**6.1**
SL7	**TOTAL**		1,520	1,363	165	133	43	53	1,728	1,549	-10%	**4.4**	1,558	1,420	156	129	55	68	1,769	1,617	-9%	**3.7**
SL8	**South Screenline**																					
25-10	Coff St	WB	302	292	10	20	1	7	313	319	2%	**0.4**	791	466	4	19	0	5	795	490	-38%	**12.0**
25-24	Vernon St	WB.	56	28	0	2	0	1	56	31	-44%	**3.8**	124	78	0	1	0	1	124	80	-36%	**4.4**
25-11	Harbour Dr	WB	192	253	1	14	0	4	193	270	40%	**5.1**	336	416	2	10	0	2	338	429	27%	**4.6**
25-12	Moonee St	WB	220	82	9	5	0	2	229	88	-62%	**11.2**	360	153	7	4	0	1	367	158	-57%	**12.9**
25-23	Market St	WB	21	20	4	2	0	1	25	23	-9%	**0.5**	53	60	9	2	0	1	62	62	0%	**0.0**
25-13	Albany St	WB	302	188	14	2	0	0	316	190	-40%	**7.9**	426	224	9	2	0	0	435	226	-48%	**11.5**
25-22	Valley St	WB	8	51	0	7	0	3	8	61	657%	**9.0**	9	135	0	5	0	3	9	143	1485%	**15.3**
8.10	Thompsons Rd	WB	236	256	23	10	0	3	259	269	4%	**0.6**	225	156	16	8	0	3	241	167	-31%	**5.2**
25-15	Hurley Dr	WB.	102	83	15	16	0	7	117	106	-10%	**1.1**	203	194	5	13	1	6	209	212	2%	**0.2**
24-3	Cook Dr	WB	211	242	28	38	5	16	244	296	21%	**3.2**	380	597	8	30	4	13	392	640	63%	**10.9**
24-2	Isle Dr	WB	113	97	4	4	0	0	117	101	-14%	**1.5**	269	342	5	6	0	0	274	349	27%	**4.2**
8.13	Stadium Dr	WB	311	330	31	20	5	10	347	360	4%	**0.7**	386	362	27	26	2	24	415	411	-1%	**0.2**
SL8	Sub-Total	WB	2,074	1,921	139	140	11	54	2,224	2,114	-5%	**2.4**	3,562	3,181	92	127	7	59	3,661	3,367	-8%	**5.0**
25-10	Coff St	EB	866	350	7	17	0	6	873	373	-57%	**20.0**	501	250	5	14	0	5	506	268	-47%	**12.1**
25-24	Vernon St	EB	15	42	0	2	0	1	15	45	199%	**5.5**	27	31	0	2	0	0	27	33	23%	**1.1**
25-11	Harbour Dr	EB	287	353	1	8	0	2	288	363	26%	**4.2**	244	206	2	7	0	2	246	215	-13%	**2.0**
25-12	Moonee St	EB	403	84	25	4	1	1	429	89	-79%	**21.1**	419	47	11	2	0	1	430	50	-88%	**24.6**
25-23	Market St	EB	161	369	2	12	0	2	163	383	135%	**13.3**	74	220	3	10	0	2	77	232	201%	**12.4**
25-13	Albany St	EB	488	344	10	8	1	4	499	356	-29%	**6.9**	262	137	5	6	0	4	267	147	-45%	**8.3**
25-22	Valley St	EB.	1	19	0	3	0	0	1	22	2105%	**6.2**	8	36	0	2	0	0	8	38	369%	**6.2**
8.10	Thompsons Rd	EB	274	185	36	12	2	4	312	202	-35%	**6.9**	242	229	20	9	1	3	263	241	-8%	**1.4**
25-15	Hurley Dr	EB	131	143	22	16	2	8	155	166	7%	**0.9**	92	104	14	14	2	6	108	124	15%	**1.5**

			AM (8-9)										PM (16-17)									
Site ID	Road Name	Dir.	LV obs	LV mod	MCV obs	MCV mod	HCV obs	HCV mod	TT obs	TT mod	TT %	GEH	LV obs	LV mod	MCV obs	MCV mod	HCV obs	HCV mod	TT obs	TT mod	TT %	GEH
24-3	Cook Dr	EB	324	436	39	37	4	17	367	490	34%	**5.9**	209	354	29	31	8	14	246	399	62%	**8.5**
24-2	Isle Dr	EB	339	360	5	7	0	0	344	368	7%	**1.3**	124	101	10	9	0	1	134	111	-17%	**2.1**
8.13	Stadium Dr	EB	599	401	33	24	4	15	636	440	-31%	**8.5**	317	267	28	19	2	16	347	302	-13%	**2.5**
SL8	Sub-Total	EB	3,888	3,087	180	149	14	62	4,082	3,298	-19%	**12.9**	2,519	1,981	127	124	13	54	2,659	2,159	-19%	**10.2**
SL8	**TOTAL**		5,962	5,007	319	289	25	116	6,306	5,412	-14%	**11.7**	6,081	5,162	219	251	20	114	6,320	5,527	-13%	**10.3**
SL9	**North Screenline**																					
25-25	Bay Dr	WB	89	63	7	1	0	0	96	64	-34%	**3.6**	87	52	2	1	0	0	89	53	-40%	**4.2**
22-1	Diggers Beach Rd	WB	36	51	0	1	0	0	36	52	43%	**2.4**	26	17	0	1	0	0	26	18	-29%	**1.6**
9.3	Macauleys Headland Dr	WB	3	58	0	1	0	0	3	59	1876%	**10.1**	4	22	0	1	0	0	4	23	470%	**5.1**
25-3	Arthur St	WB	434	457	5	36	0	9	439	502	14%	**2.9**	717	735	11	43	0	5	728	784	8%	**2.0**
25-4	Park Beach Rd	WB	288	324	17	11	1	1	306	336	10%	**1.7**	520	573	17	12	0	7	537	592	10%	**2.3**
25-5	Orlando St	WB	389	279	25	28	4	13	418	320	-24%	**5.1**	696	562	7	25	0	9	703	595	-15%	**4.2**
9.7	Rose Ave	NB	7	1	0	0	0	0	7	1	-80%	**2.7**	9	4	0	0	0	0	9	4	-56%	**2.0**
25-8	Melittas Ave	WB	4	69	0	7	0	3	4	79	1883%	**11.7**	10	121	0	7	0	5	10	133	1233%	**14.6**
SL9	Sub-Total	WB	1,250	1,302	54	86	5	26	1,309	1,414	8%	**2.8**	2,069	2,086	37	91	0	25	2,106	2,202	5%	**2.1**
25-25	Bay Dr	EB.	86	49	6	2	0	0	92	50	-45%	**4.9**	95	60	1	1	0	0	96	61	-37%	**4.0**
22-1	Diggers Beach Rd	EB.	27	24	4	1	0	0	31	25	-19%	**1.1**	59	75	1	1	0	0	60	76	27%	**2.0**
9.3	Macauleys Headland Dr	EB	51	5	3	0	0	0	54	5	-91%	**9.0**	21	7	1	0	0	0	22	8	-66%	**3.8**
25-3	Arthur St	EB.	383	607	11	8	1	0	395	615	56%	**9.8**	251	616	3	18	0	1	254	635	150%	**18.1**
25-4	Park Beach Rd	EB	419	458	9	11	0	1	428	470	10%	**2.0**	480	587	3	9	0	1	483	596	23%	**4.9**
25-5	Orlando St	EB.	732	535	28	60	3	19	763	614	-20%	**5.7**	383	342	16	53	1	15	400	410	3%	**0.5**
9.7	Rose Ave	SB	39	11	4	1	0	0	43	12	-72%	**5.9**	20	15	1	1	0	0	21	16	-26%	**1.3**
25-8	Melittas Ave	EB	41	79	2	7	0	4	43	89	107%	**5.7**	29	72	0	6	0	3	29	81	178%	**7.0**
SL9	Sub-Total	EB	1,778	1,767	67	90	4	25	1,849	1,881	2%	**0.7**	1,338	1,772	26	89	1	20	1,365	1,881	38%	**12.8**
SL9	**TOTAL**		3,028	3,068	121	176	9	51	3,158	3,295	4%	**2.4**	3,407	3,858	63	179	1	46	3,471	4,084	18%	**10.0**
SL10	**Moonee Beach Screenline**																					
10.1	Diamond Head Dr	WB	255	216	12	7	0	0	267	223	-17%	**2.8**	132	80	3	6	0	0	135	86	-36%	**4.7**
10.2	Fiddaman Rd	WB	221	222	23	22	0	9	244	253	4%	**0.5**	111	127	9	19	0	8	120	153	28%	**2.8**
10.3	Moonee Beach Rd	WB	175	65	11	4	1	1	187	70	-63%	**10.4**	163	96	10	3	0	1	173	101	-42%	**6.2**
SL10	Sub-Total	WB	651	503	46	32	1	10	698	545	-22%	**6.1**	406	303	22	27	0	9	428	340	-21%	**4.5**
10.1	Diamond Head Dr	EB	79	84	9	7	1	0	88	90	2%	**0.2**	208	184	10	6	0	0	218	190	-13%	**2.0**
10.2	Fiddaman Rd	EB	68	118	11	24	0	10	79	151	91%	**6.7**	205	184	12	24	0	13	217	220	1%	**0.2**
10.3	Moonee Beach Rd	EB	161	174	12	11	2	4	175	190	9%	**1.1**	340	156	20	10	1	4	361	170	-53%	**11.7**
SL10	Sub-Total	EB	308	376	32	41	3	14	342	431	26%	**4.5**	753	523	42	40	1	16	796	580	-27%	**8.3**
SL10	**TOTAL**		959	878	78	74	4	24	1,041	976	-6%	**2.0**	1,159	827	64	67	1	25	1,224	919	-25%	**9.3**
SL11	**Boambee East Screenline**																					
11.1	Sawtell Rd	WB	389	576	21	35	6	12	416	624	50%	**9.1**	362	436	16	24	2	7	380	467	23%	**4.2**
11.2	Bruce King Dr	WB	29	44	2	1	1	0	32	45	41%	**2.1**	50	37	4	0	0	0	54	37	-32%	**2.5**
11.3	Lyons Rd	WB	400	524	14	14	0	3	414	540	31%	**5.8**	308	257	7	9	1	1	316	267	-16%	**2.9**
SL11	Sub-Total	WB	818	1,144	37	50	7	15	862	1,209	40%	**10.8**	720	730	27	33	3	8	750	771	3%	**0.8**
11.1	Sawtell Rd	EB	215	311	14	25	2	7	231	343	48%	**6.6**	374	537	19	19	3	6	396	561	42%	**7.6**
11.2	Bruce King Dr	EB	94	97	11	10	2	3	107	111	3%	**0.4**	215	294	10	10	0	2	225	306	36%	**5.0**
11.3	Lyons Rd	EB	284	220	9	10	3	2	296	232	-22%	**4.0**	347	434	11	7	3	1	361	442	23%	**4.1**
SL11	Sub-Total	EB	593	628	34	45	7	12	634	685	8%	**2.0**	936	1,265	40	36	6	9	982	1,310	33%	**9.7**
SL11	**TOTAL**		1,411	1,772	71	95	14	27	1,496	1,894	27%	**9.7**	1,656	1,994	67	69	9	17	1,732	2,081	20%	**8.0**
SL12	**Hogbin Dr North Screenline**																					
12.1	Arthur St	WB	349	320	20	33	1	9	370	362	-2%	**0.4**	330	468	28	37	1	5	359	510	42%	**7.3**
12.2	Park Beach Rd	WB	220	228	12	1	0	0	232	230	-1%	**0.1**	245	167	10	1	0	0	255	168	-34%	**6.0**
12.3	Boultwood St	WB	15	72	1	7	0	2	16	82	411%	**9.4**	23	178	0	5	0	3	23	186	708%	**15.9**
12.4	Prince St	WB	24	18	2	2	0	0	26	20	-23%	**1.3**	27	35	1	1	0	0	28	36	28%	**1.4**
12.5	Orlando St	WB	427	313	18	23	2	13	447	349	-22%	**4.9**	442	281	26	17	5	12	473	310	-34%	**8.2**
12.6	Watsonia Ave	SB	2	0	0	0	0	0	2	0	-100%	**2.0**	1	0	0	0	0	0	1	0	-100%	**1.4**
12.7	Watsonia Ave	WB	54	81	4	1	0	0	58	82	41%	**2.8**	22	53	1	1	0	0	23	54	133%	**4.9**
SL12	Sub-Total	WB	1,091	1,033	57	67	3	25	1,151	1,125	-2%	**0.8**	1,090	1,182	66	62	6	20	1,162	1,264	9%	**2.9**
12.1	Arthur St	EB	479	452	21	4	1	0	501	456	-9%	**2.0**	310	349	23	12	0	0	333	361	9%	**1.5**
12.2	Park Beach Rd	EB	207	201	8	8	0	1	215	210	-2%	**0.4**	221	312	7	5	0	0	228	317	39%	**5.4**

			AM (8-9)										PM (16-17)									
Site ID	Road Name	Dir.	LV obs	LV mod	MCV obs	MCV mod	HCV obs	HCV mod	TT obs	TT mod	TT %	GEH	LV obs	LV mod	MCV obs	MCV mod	HCV obs	HCV mod	TT obs	TT mod	TT %	GEH
12.3	Boultwood St	EB	17	6	2	0	0	0	19	6	-70%	**3.8**	22	2	1	0	0	1	23	3	-89%	**5.7**
12.4	Prince St	EB	48	51	1	1	0	0	49	52	7%	**0.5**	35	15	1	2	0	0	36	17	-53%	**3.7**
12.5	Orlando St	EB	589	350	52	54	3	17	644	421	-35%	**9.7**	409	396	37	49	2	27	448	472	5%	**1.1**
12.6	Watsonia Ave	NB	13	22	3	0	0	0	16	22	37%	**1.4**	11	16	0	0	0	0	11	16	44%	**1.3**
12.7	Watsonia Ave	EB	39	46	0	1	0	0	39	47	21%	**1.2**	16	32	1	1	0	0	17	32	90%	**3.1**
SL12	Sub-Total	EB	1,392	1,128	87	68	4	18	1,483	1,214	-18%	**7.3**	1,024	1,122	70	68	2	28	1,096	1,218	11%	**3.6**
SL12	**TOTAL**		2,483	2,160	144	135	7	43	2,634	2,338	-11%	**5.9**	2,114	2,304	136	130	8	48	2,258	2,482	10%	**4.6**
SL13	**Hogbin Dr South Screenline**																					
13.1	Harbour Dr	WB	519	812	34	34	3	10	556	856	54%	**11.3**	495	718	20	26	3	7	518	752	45%	**9.3**
13.2	Albany St	WB	606	131	35	4	2	1	643	136	-79%	**25.7**	452	107	28	3	0	1	480	111	-77%	**21.5**
24-1	Stadium Dr	WB	443	474	33	23	2	10	478	507	6%	**1.3**	355	407	10	28	0	24	365	459	26%	**4.6**
SL13	Sub-Total	WB	1,568	1,418	102	61	7	21	1,677	1,499	-11%	**4.5**	1,302	1,232	58	57	3	32	1,363	1,321	-3%	**1.1**
13.1	Harbour Dr	EB	448	579	32	27	6	8	486	613	26%	**5.4**	602	690	25	19	8	6	635	715	13%	**3.1**
13.2	Albany St	EB	491	275	29	13	2	2	522	290	-44%	**11.5**	461	202	30	8	1	1	492	211	-57%	**15.0**
24-1	Stadium Dr	EB	414	442	16	25	4	15	434	481	11%	**2.2**	396	393	13	20	2	16	411	430	5%	**0.9**
SL13	Sub-Total	EB	1,353	1,295	77	65	12	25	1,442	1,385	-4%	**1.5**	1,459	1,285	68	46	11	24	1,538	1,355	-12%	**4.8**
SL13	**TOTAL**		2,921	2,713	179	125	19	46	3,119	2,884	-8%	**4.3**	2,761	2,518	126	103	14	55	2,901	2,676	-8%	**4.3**
SL14	**Toomina Rd Screenline**																					
14.1	Hi-Tech Dr	WB	146	162	20	25	0	9	166	196	18%	**2.2**	92	124	17	19	0	7	109	150	37%	**3.6**
14.2	Sawtell Rd	WB	248	328	25	23	2	7	275	359	30%	**4.7**	469	433	17	13	0	4	486	450	-8%	**1.7**
20-10	Coorabin Cres	WB	81	93	3	3	0	0	84	96	14%	**1.3**	94	138	1	2	0	0	95	140	48%	**4.2**
20-11	Bangalee Cres	WB	55	20	12	1	0	0	67	21	-69%	**6.9**	104	57	0	1	0	0	104	58	-44%	**5.1**
14.5	Amaroo Cresent	WB	103	78	4	6	0	0	107	85	-21%	**2.3**	96	261	4	4	0	0	100	265	165%	**12.2**
14.6	Kintorie Cresent	WB	15	67	1	1	0	0	16	68	325%	**8.0**	33	88	2	1	0	0	35	88	153%	**6.8**
14.7	Mirroola Cresent	WB	36	35	1	1	0	0	37	36	-2%	**0.1**	40	61	2	1	0	0	42	62	47%	**2.7**
14.8	Linden Ave	WB	172	267	14	5	0	2	186	274	47%	**5.8**	157	187	11	4	1	1	169	192	14%	**1.7**
14.9	Playford Ave	WB	25	15	1	1	0	0	26	15	-41%	**2.4**	54	41	4	1	0	0	58	41	-29%	**2.4**
26-6	Lyons Rd	WB	200	200	8	7	0	1	208	208	0%	**0.0**	308	114	4	3	1	0	313	118	-62%	**13.3**
SL14	Sub-Total	WB	1,081	1,266	89	73	2	19	1,172	1,358	16%	**5.2**	1,447	1,503	62	49	2	11	1,511	1,563	3%	**1.3**
14.1	Hi-Tech Dr	EB	87	92	22	26	0	11	109	128	18%	**1.8**	167	207	22	19	0	6	189	233	23%	**3.0**
14.2	Sawtell Rd	EB	349	440	26	22	0	6	375	469	25%	**4.6**	404	466	17	16	0	5	421	486	15%	**3.0**
20-10	Coorabin Cres	EB	126	113	0	2	0	0	126	115	-8%	**1.0**	71	65	0	2	0	0	71	67	-5%	**0.4**
20-11	Bangalee Cres	EB	126	73	6	1	0	0	132	74	-44%	**5.7**	57	43	2	1	0	0	59	44	-25%	**2.0**
14.5	Amaroo Cresent	EB	184	239	2	5	0	0	186	245	32%	**4.0**	62	120	1	4	0	0	63	125	98%	**6.4**
14.6	Kintorie Cresent	EB	49	85	2	1	0	0	51	86	68%	**4.2**	19	68	1	1	0	0	20	69	245%	**7.3**
14.7	Mirroola Cresent	EB	50	59	1	1	0	0	51	60	18%	**1.3**	36	30	1	1	0	0	37	30	-18%	**1.1**
14.8	Linden Ave	EB	211	171	11	6	0	1	222	178	-20%	**3.1**	121	245	5	4	0	1	126	249	98%	**9.0**
14.9	Playford Ave	EB	74	48	4	1	0	0	78	49	-37%	**3.6**	48	18	2	1	0	0	50	18	-63%	**5.4**
26-6	Lyons Rd	EB	255	122	10	5	1	0	266	127	-52%	**9.9**	242	177	3	3	1	0	246	181	-26%	**4.4**
SL14	Sub-Total	EB	1,511	1,442	84	71	1	18	1,596	1,532	-4%	**1.6**	1,227	1,439	54	52	1	12	1,282	1,503	17%	**5.9**
SL14	**TOTAL**		2,592	2,708	173	144	3	38	2,768	2,889	4%	**2.3**	2,674	2,941	116	101	3	24	2,793	3,066	10%	**5.0**
SL21	**Airport**																					
21-1	Airport Dr	WB	71	82	1	3	0	1	72	85	19%	**1.5**	118	149	1	2	0	1	119	152	28%	**2.8**
21-2	Christmas Bells Rd	WB	20	29	8	4	1	1	29	34	16%	**0.8**	40	57	0	3	0	1	40	61	53%	**3.0**
SL21	Sub-Total	WB	91	111	9	6	1	2	101	119	18%	**1.7**	158	207	1	5	0	2	159	214	34%	**4.0**
21-1	Airport Dr	EB	81	108	0	2	0	1	81	111	36%	**3.0**	92	102	0	1	0	1	92	104	13%	**1.2**
21-2	Christmas Bells Rd	EB	26	47	8	3	2	1	36	51	43%	**2.3**	15	35	2	3	2	1	19	39	104%	**3.7**
SL21	Sub-Total	EB	107	155	8	5	2	2	117	162	38%	**3.8**	107	137	2	5	2	2	111	143	29%	**2.8**
SL21	**TOTAL**		198	266	17	11	3	4	218	281	29%	**4.0**	265	343	3	10	2	3	270	356	32%	**4.9**
SL22	**Big Banana**																					
22-1a	Diggers Beach Rd	EB	12	9	1	1	0	0	13	10	-25%	**1.0**	45	15	0	0	0	0	45	15	-66%	**5.4**
22-2	Island View Close	EB	11	43	0	2	0	0	11	45	306%	**6.4**	26	44	0	2	0	1	26	46	78%	**3.4**
SL22	Sub-Total	EB	23	52	1	2	0	0	24	54	127%	**4.9**	71	59	0	2	0	1	71	62	-13%	**1.1**
22-1a	Diggers Beach Rd,	WB	14	33	0	1	0	0	14	35	151%	**4.3**	18	39	0	1	0	0	18	41	127%	**4.2**
22-2	Island View Close	WB	20	15	1	1	0	0	21	16	-23%	**1.1**	19	15	0	1	0	0	19	16	-16%	**0.7**
SL22	Sub-Total	WB	34	49	1	2	0	0	35	51	47%	**2.5**	37	55	0	2	0	0	37	57	53%	**2.9**

			AM (8-9)										PM (16-17)									
Site ID	Road Name	Dir.	LV obs	LV mod	MCV obs	MCV mod	HCV obs	HCV mod	**TT obs**	**TT mod**	TT %	GEH	LV obs	LV mod	MCV obs	MCV mod	HCV obs	HCV mod	**TT obs**	**TT mod**	TT %	GEH
SL22	**TOTAL**		57	101	2	4	0	1	59	106	79%	**5.2**	108	114	0	4	0	1	108	119	10%	**1.0**
SL23	**Baringa Private Hospital**																					
	Hospital	EB	60	61	1	1	0	0	61	63	3%	**0.2**	29	31	0	0	0	0	29	32	9%	**0.5**
23-1	Mackays Rd	EB	111	79	6	3	0	0	117	82	-30%	**3.5**	86	70	5	1	0	0	91	72	-21%	**2.1**
SL23	Sub-Total	EB	171	140	7	4	0	0	178	145	-19%	**2.6**	115	102	5	1	0	1	120	103	-14%	**1.6**
	Hospital	WB	25	26	1	1	0	0	26	27	5%	**0.3**	51	53	0	0	0	0	51	53	5%	**0.3**
23-1	Mackays Rd	WB	88	74	6	2	0	0	94	77	-18%	**1.8**	109	70	6	2	0	1	115	72	-37%	**4.4**
SL23	Sub-Total	WB	113	101	7	4	0	0	120	104	-13%	**1.5**	160	123	6	2	0	1	166	126	-24%	**3.3**
SL23	**TOTAL**		284	241	14	8	0	1	298	249	-16%	**2.9**	275	224	11	3	0	1	286	229	-20%	**3.5**

B1.3 Screenline Validation Off-Peak and Rest of Day

			OP (9-16)									RD (17-8)								
Site ID	Road Name	Dir.	LV obs	LV mod	MCV obs	MCV mod	HCV obs	HCV mod	TT obs	TT mod	TT %	LV obs	LV mod	MCV obs	MCV mod	HCV obs	HCV mod	TT obs	TT mod	TT %
SL1	**External Screenline**																			
1.1	Pacific Hwy	SB	2,265	2,280	325	331	207	209	2,797	2,820	1%	2,084	2,114	214	214	235	235	2,533	2,563	1%
1.3	Eastern Dorrigo Way	EB	33	33	1	1	0	0	34	34	0%	22	22	1	1	0	0	23	23	0%
1.4	Glennifer Rd	EB	75	75	7	7	0	0	82	82	0%	34	34	3	3	0	0	37	37	0%
1.5	Pacific Hwy	NB	4,377	4,381	270	268	325	322	4,972	4,971	0%	2,982	2,984	167	167	630	630	3,779	3,781	0%
1.6	Pine Creek Way	NB	100	46	10	4	0	0	110	49	-55%	44	39	0	2	2	0	46	41	-11%
SL1	Sub-Total	IB	6,850	6,815	613	610	532	531	7,995	7,956	0%	5,166	5,193	385	387	867	865	6,418	6,445	0%
1.1	Pacific Hwy	NB	2,330	2,327	246	242	180	201	2,756	2,769	0%	2,156	2,102	176	143	448	446	2,780	2,690	-3%
1.3	Eastern Dorrigo Way	WB	33	27	1	1	0	0	34	28	-19%	14	15	0	0	0	0	14	15	4%
1.4	Glennifer Rd	WB	66	66	5	5	0	0	71	71	1%	42	43	4	4	0	0	46	46	1%
1.5	Pacific Hwy	SB	4,233	4,166	319	319	353	305	4,905	4,790	-2%	3,360	3,329	227	243	461	442	4,048	4,014	-1%
1.6	Pine Creek Way	SB	88	55	7	3	0	0	95	58	-39%	45	37	0	3	0	0	45	40	-11%
SL1	Sub-Total	OB	6,750	6,641	578	569	533	506	7,861	7,716	-2%	5,617	5,525	407	392	909	888	6,933	6,805	-2%
SL1	**TOTAL**		13,600	13,456	1,191	1,179	1,065	1,037	15,856	15,672	-1%	10,783	10,718	792	779	1,776	1,753	13,351	13,250	-1%
SL2	**Boambee Creek Screenline**																			
29.1	Pacific Hwy	NB	6,556	7,104	641	566	277	343	7,474	8,013	7%	4,570	5,170	393	317	554	640	5,517	6,127	11%
2.2	Hogbin Dr	NB	4,204	4,235	232	349	26	57	4,462	4,641	4%	2,376	2,677	127	198	25	38	2,528	2,913	15%
SL2	Sub-Total	NB	10,760	11,339	873	915	303	400	11,936	12,654	6%	6,946	7,847	520	515	579	678	8,045	9,039	12%
29.1	Pacific Hwy	SB	6,331	7,502	742	625	332	330	7,405	8,458	14%	4,812	5,529	490	403	457	454	5,759	6,386	11%
2.2	Hogbin Dr	SB	4,378	4,343	245	356	9	59	4,632	4,758	3%	2,417	2,339	87	202	12	49	2,516	2,589	3%
SL2	Sub-Total	SB	10,709	11,846	987	981	341	389	12,037	13,216	10%	7,229	7,867	577	605	469	503	8,275	8,975	8%
SL2	**TOTAL**		21,469	23,185	1,860	1,897	644	789	23,973	25,870	8%	14,175	15,714	1,097	1,120	1,048	1,181	16,320	18,015	10%
SL3	**Creek Screenline**																			
3.1	Spagnolos Rd	NB	25	25	3	2	0	0	28	27	-2%	27	23	2	0	0	1	29	24	-18%
3.2	William Sharp Dr	NB	126	82	12	5	0	0	138	86	-38%	90	68	11	3	0	0	101	71	-29%
3.3	Shephards Ln	NB	1,443	1,057	149	74	9	7	1,601	1,138	-29%	1,009	736	94	39	3	5	1,106	780	-30%
3.4	Robin St	NB	456	253	23	3	0	0	479	255	-47%	197	79	8	1	0	0	205	79	-61%
3.5	Gundagai St	WB	1,464	953	83	40	5	1	1,552	994	-36%	983	726	45	19	3	3	1,031	748	-27%
3.6	Pacific Hwy	NB	7,951	7,505	791	660	538	270	9,280	8,435	-9%	5,348	3,928	436	400	541	497	6,325	4,824	-24%
3.7	Hogbin Dr	NB	4,929	4,449	124	320	4	100	5,057	4,869	-4%	2,530	3,206	34	183	0	146	2,564	3,534	38%
3.8	Orlando St	NB	2,519	1,750	210	79	10	13	2,739	1,842	-33%	1,145	1,085	83	49	6	12	1,234	1,145	-7%
SL3	Sub-Total	NB	18,913	16,072	1,395	1,183	566	391	20,874	17,646	-15%	11,329	9,850	713	693	553	663	12,595	11,205	-11%
3.1	Spagnolos Rd	SB	25	23	0	2	0	0	25	26	4%	28	22	0	1	0	0	28	23	-19%
3.2	William Sharp Dr	SB	128	88	8	5	0	0	136	92	-32%	102	76	8	2	0	0	110	78	-29%
3.3	Shephards Ln	SB	1,408	1,000	145	77	13	6	1,566	1,083	-31%	1,055	865	114	42	4	5	1,173	912	-22%
3.4	Robin St	SB	423	215	26	3	0	0	449	218	-52%	208	98	7	1	0	0	215	98	-54%
3.5	Gundagai St	EB	1,652	751	99	34	0	2	1,751	787	-55%	1,021	701	47	17	0	1	1,068	720	-33%
3.6	Pacific Hwy	SB	7,047	6,605	821	713	487	262	8,355	7,580	-9%	5,138	4,070	602	493	382	417	6,122	4,980	-19%
3.7	Hogbin Dr	SB	3,949	4,267	140	350	24	122	4,113	4,739	15%	2,142	3,470	56	187	4	84	2,202	3,741	70%
3.8	Orlando St	SB	2,946	1,705	208	91	19	15	3,173	1,811	-43%	1,299	1,135	85	51	11	12	1,395	1,197	-14%
SL3	Sub-Total	SB	17,578	14,653	1,447	1,275	543	407	19,568	16,335	-17%	10,993	10,436	919	793	401	519	12,313	11,748	-5%
SL3	**TOTAL**		36,491	30,725	2,842	2,458	1,109	798	40,442	33,981	-16%	22,322	20,285	1,632	1,486	954	1,182	24,908	22,953	-8%
SL4	**Bonville Creek Screenline**																			
4.1	N Bonville RD	NB	422	298	31	18	0	1	453	317	-30%	286	262	11	10	1	1	298	273	-8%
4.2	Pine Creek Way	NB	764	811	81	63	4	11	849	885	4%	382	615	33	32	2	8	417	655	57%
SL4	Sub-Total	NB	5,578	5,713	334	373	273	334	6,185	6,421	4%	3,313	4,022	168	217	690	641	4,171	4,879	17%
4.1	N Bonville RD	SB	440	341	24	21	0	1	464	363	-22%	249	249	14	8	2	1	265	258	-3%
4.2	Pine Creek Way	SB	703	787	49	59	7	11	759	857	13%	438	618	25	35	3	8	466	661	42%
4.3	Pacific Hwy	SB	4,251	4,373	229	340	317	305	4,797	5,018	5%	2,927	3,480	167	251	604	442	3,698	4,173	13%
SL4	Sub-Total	SB	5,394	5,501	302	420	324	316	6,020	6,238	4%	3,614	4,347	206	294	609	451	4,429	5,092	15%
SL4	**TOTAL**		10,972	11,215	636	793	597	651	12,205	12,658	4%	6,927	8,368	374	511	1,299	1,092	8,600	9,971	16%
SL5	**Korora boundary**																			
29.5	Bennetts Rd	NB	65	69	6	7	0	1	71	77	9%	46	50	4	4	0	1	50	55	10%
29.9	Pacific Hwy	NB	5,899	6,483	579	665	361	258	6,839	7,406	8%	5,128	4,318	365	372	536	419	6,029	5,109	-15%

			OP (9-16)									RD (17-8)								
Site ID	Road Name	Dir.	LV obs	LV mod	MCV obs	MCV mod	HCV obs	HCV mod	TT obs	TT mod	TT %	LV obs	LV mod	MCV obs	MCV mod	HCV obs	HCV mod	TT obs	TT mod	TT %
25-2	James Small Dr	NB	781	985	11	23	0	1	792	1,008	27%	590	592	9	16	0	2	599	609	2%
2.2	Hogbin Dr	NB	4,204	4,235	232	349	26	57	4,462	4,641	4%	2,376	2,677	127	198	25	38	2,528	2,913	15%
SL5	Sub-Total	NB	10,949	11,772	828	1,043	387	317	12,164	13,133	8%	8,140	7,636	505	590	561	460	9,206	8,685	-6%
29.5	Bennetts Rd	SB	60	56	8	7	0	2	68	64	-6%	39	52	2	4	0	1	41	57	38%
29.9	Pacific Hwy	SB	5,678	6,422	764	695	376	228	6,818	7,344	8%	4,531	4,760	540	487	376	405	5,447	5,651	4%
25-2	James Small Dr	SB	759	1,032	10	27	1	1	770	1,060	38%	495	638	16	12	0	1	512	650	27%
2.2	Hogbin Dr	SB	4,378	4,343	245	356	9	59	4,632	4,758	3%	2,417	2,339	87	202	12	49	2,516	2,589	3%
SL5	**TOTAL**		21,824	23,625	1,855	2,129	773	606	24,452	26,359	8%	15,622	15,424	1,150	1,294	949	915	17,722	17,633	-1%
SL6	**North Ring Screenline**																			
29.10	Pacific Hwy	SB	5,678	6,422	764	695	376	228	6,818	7,344	8%	4,531	4,760	540	487	376	405	5,447	5,651	4%
6.2	Bruxner Park Rd	EB	179	106	13	14	0	4	192	124	-36%	91	84	4	9	0	9	95	102	8%
29.4	Coramba Rd	EB	1,360	1,285	123	145	27	24	1,510	1,454	-4%	908	998	79	78	6	18	993	1,094	10%
29.2	N Boambee Rd	EB	108	38	6	4	5	0	119	43	-64%	52	29	0	2	1	1	53	31	-41%
6.5	Englands Rd	EB	122	40	23	5	3	1	148	47	-68%	73	36	11	3	3	1	87	39	-55%
29.1	Pacific Hwy	NB	6,556	7,104	641	566	277	343	7,474	8,013	7%	4,570	5,170	393	317	554	640	5,517	6,127	11%
2.2	Hogbin Dr	NB	4,204	4,235	232	349	26	57	4,462	4,641	4%	2,376	2,677	127	198	25	38	2,528	2,913	15%
SL6	Sub-Total	IB	18,207	19,231	1,802	1,778	714	657	20,723	21,666	5%	12,601	13,753	1,154	1,094	965	1,110	14,720	15,957	8%
29.10	Pacific Hwy	NB	5,899	6,483	579	665	361	258	6,839	7,406	8%	5,128	4,318	365	372	536	419	6,029	5,109	-15%
6.2	Bruxner Park Rd	WB	202	92	15	14	0	3	217	110	-49%	95	81	8	9	0	5	103	95	-8%
29.4	Coramba Rd	WB	1,311	1,402	113	146	24	28	1,448	1,576	9%	1,020	1,033	71	77	6	24	1,097	1,134	3%
29.2	N Boambee Rd	WB	100	44	6	5	9	1	115	50	-57%	56	35	1	2	4	1	61	37	-39%
6.5	Englands Rd	WB	118	46	29	6	1	1	148	53	-64%	83	32	12	3	1	1	96	36	-63%
29.1	Pacific Hwy	SB	6,331	7,502	742	625	332	330	7,405	8,458	14%	4,812	5,529	490	403	457	454	5,759	6,386	11%
2.2	Hogbin Dr	SB	4,378	4,343	245	356	9	59	4,632	4,758	3%	2,417	2,339	87	202	12	49	2,516	2,589	3%
SL6	Sub-Total	OB	18,339	19,914	1,729	1,817	736	681	20,804	22,411	8%	13,611	13,365	1,034	1,068	1,016	953	15,661	15,385	-2%
SL6	**TOTAL**		36,546	39,145	3,531	3,594	1,450	1,338	41,527	44,077	6%	26,212	27,118	2,188	2,161	1,981	2,063	30,381	31,342	3%
SL7	**Woolgoolga Creek Screenline**																			
7.1	Pacific Hwy	NB	2,050	2,073	195	229	151	152	2,396	2,453	2%	1,672	1,742	143	140	383	334	2,198	2,216	1%
7.2	Solitary Islands Way	NB	2,580	1,810	241	154	14	57	2,835	2,021	-29%	1,407	1,396	130	79	4	83	1,541	1,559	1%
SL7	Sub-Total	NB	4,630	3,883	436	383	165	209	5,231	4,474	-14%	3,079	3,138	273	219	387	418	3,739	3,775	1%
7.1	Pacific Hwy	SB	2,131	2,318	340	334	185	178	2,656	2,831	7%	2,246	2,172	249	229	210	226	2,705	2,626	-3%
SL7	Sub-Total	SB	4,624	3,754	564	457	194	204	5,382	4,416	-18%	3,948	3,275	394	301	217	259	4,559	3,834	-16%
SL7	**TOTAL**		9,254	7,637	1,000	839	359	414	10,613	8,890	-16%	7,027	6,413	667	520	604	677	8,298	7,609	-8%
SL8	**South Screenline**																			
25-10	Coff St	WB	3,912	1,979	71	122	2	26	3,985	2,126	-47%	2,315	1,312	55	69	1	22	2,371	1,402	-41%
25-24	Vernon St	WB	722	280	17	8	0	5	739	293	-60%	425	197	10	4	0	4	435	205	-53%
25-11	Harbour Dr	WB	1,726	1,675	12	83	0	12	1,738	1,770	2%	1,136	1,234	9	43	0	9	1,145	1,286	12%
25-12	Moonee St	WB	1,860	590	82	24	2	6	1,944	620	-68%	1,174	419	51	14	1	5	1,226	437	-64%
25-23	Market St	WB	301	213	26	10	1	5	328	228	-31%	188	147	21	6	0	4	209	156	-25%
25-13	Albany St	WB	1,975	1,121	41	11	2	1	2,018	1,132	-44%	1,274	823	30	9	1	1	1,305	832	-36%
25-22	Valley St	WB	54	326	3	35	0	16	57	377	562%	33	140	1	19	0	14	35	173	400%
8.10	Thompsons Rd	WB	1,376	875	151	60	4	12	1,531	948	-38%	719	650	60	33	1	9	780	692	-11%
25-15	Hurley Dr	WB	1,140	776	86	90	16	28	1,242	894	-28%	701	497	80	48	16	24	796	568	-29%
24-3	Cook Dr	WB	2,635	2,969	158	206	47	65	2,840	3,240	14%	1,580	1,362	156	111	38	54	1,774	1,527	-14%
24-2	Isle Dr	WB	1,545	1,355	52	46	0	2	1,597	1,404	-12%	979	884	35	32	0	3	1,013	918	-9%
8.13	Stadium Dr	WB	2,005	2,003	205	151	34	101	2,244	2,256	1%	1,246	2,279	79	72	18	66	1,343	2,417	80%
SL8	Sub-Total	WB	19,251	14,162	904	846	108	278	20,263	15,286	-25%	11,770	9,941	587	460	77	212	12,433	10,613	-15%
25-10	Coff St	EB	3,862	1,475	42	94	2	24	3,906	1,593	-59%	2,721	1,062	33	55	2	20	2,756	1,136	-59%
25-24	Vernon St	EB	219	188	0	11	0	2	219	201	-8%	122	142	0	5	0	3	122	151	24%
25-11	Harbour Dr	EB	1,651	1,487	9	48	0	12	1,660	1,547	-7%	1,164	1,356	11	37	0	9	1,175	1,401	19%
25-12	Moonee St	EB	2,575	298	83	12	1	4	2,659	313	-88%	1,746	227	71	8	1	2	1,818	236	-87%
25-23	Market St	EB	605	926	18	70	0	9	623	1,006	61%	433	532	16	29	0	7	448	568	27%
25-13	Albany St	EB	1,726	917	52	46	1	18	1,779	982	-45%	1,330	812	39	22	2	16	1,371	849	-38%
25-22	Valley St	EB	46	85	2	8	0	0	48	94	96%	35	79	1	6	0	0	36	85	137%
8.10	Thompsons Rd	EB	1,474	1,046	186	60	5	18	1,665	1,125	-32%	758	752	72	32	0	13	830	797	-4%
24-3	Cook Dr	EB	2,539	2,769	146	208	37	68	2,722	3,045	12%	1,735	1,330	119	112	30	59	1,884	1,501	-20%

			OP (9-16)									RD (17-8)								
Site ID	Road Name	Dir.	LV obs	LV mod	MCV obs	MCV mod	HCV obs	HCV mod	TT obs	TT mod	TT %	LV obs	LV mod	MCV obs	MCV mod	HCV obs	HCV mod	TT obs	TT mod	TT %
24-2	Isle Dr	EB	1,565	1,248	52	53	0	3	1,617	1,304	-19%	1,202	1,076	40	39	0	4	1,242	1,119	-10%
8.13	Stadium Dr	EB	2,054	1,904	212	131	23	81	2,289	2,116	-8%	1,139	2,070	83	74	13	139	1,235	2,283	85%
SL8	Sub-Total	EB	19,081	12,995	883	836	90	270	20,054	14,102	-30%	13,015	9,906	547	467	63	300	13,625	10,672	-22%
SL8	**TOTAL**		38,332	27,158	1,787	1,682	198	548	40,317	29,388	-27%	24,785	19,847	1,134	927	140	512	26,058	21,285	-18%
SL9	**North Screenline**																			
25-25	Bay Dr	WB	531	289	26	8	0	1	557	298	-47%	389	158	16	4	0	1	405	163	-60%
22-1	Diggers Beach Rd	WB	196	133	3	8	0	0	199	141	-29%	145	94	3	3	0	0	148	97	-34%
9.3	Macauleys Headland Dr	WB	22	215	0	5	0	0	22	221	903%	9	109	0	3	0	0	9	112	1143%
25-3	Arthur St	WB	3,908	3,980	49	260	2	37	3,959	4,277	8%	2,497	2,607	46	154	2	23	2,545	2,784	9%
25-4	Park Beach Rd	WB	3,520	3,442	76	74	1	5	3,597	3,521	-2%	2,082	944	56	47	2	3	2,140	993	-54%
25-5	Orlando St	WB	3,522	2,426	170	167	20	53	3,712	2,646	-29%	2,296	1,492	139	85	15	35	2,450	1,612	-34%
9.7	Rose Ave	NB	57	20	5	1	0	0	62	21	-66%	22	12	0	0	0	0	22	12	-44%
25-8	Melittas Ave	WB	69	543	0	44	0	20	69	607	779%	46	345	0	23	0	13	46	381	736%
SL9	Sub-Total	WB	11,825	11,050	329	567	23	116	12,177	11,732	-4%	7,485	5,760	261	319	19	75	7,765	6,154	-21%
25-25	Bay Dr	EB	427	312	23	8	0	1	450	321	-29%	318	183	19	5	0	1	336	189	-44%
22-1	Diggers Beach Rd	EB	310	328	3	10	0	0	313	338	8%	213	162	5	4	0	0	217	166	-24%
9.3	Macauleys Headland Dr	EB	142	23	9	3	0	0	151	26	-83%	105	22	5	1	0	0	110	23	-79%
25-3	Arthur St	EB	2,222	4,045	56	67	2	5	2,280	4,116	81%	1,558	2,458	44	52	3	4	1,605	2,514	57%
25-4	Park Beach Rd	EB	3,596	3,797	47	77	1	6	3,644	3,880	6%	2,162	1,055	40	51	2	4	2,204	1,109	-50%
25-5	Orlando St	EB	3,173	2,402	158	377	7	82	3,338	2,862	-14%	2,628	1,728	119	210	8	66	2,755	2,005	-27%
9.7	Rose Ave	SB	197	80	9	7	0	1	206	88	-57%	62	49	2	4	0	2	64	54	-16%
25-8	Melittas Ave	EB	199	446	8	39	1	16	208	501	141%	150	277	6	19	0	20	156	315	103%
SL9	**TOTAL**		22,091	22,483	642	1,154	34	226	22,767	23,864	5%	14,680	11,692	500	665	32	172	15,212	12,528	-18%
SL10	**Moonee Beach Screenline**																			
10.1	Diamond Head Dr	WB	859	592	35	36	1	0	895	628	-30%	807	483	22	21	0	1	830	505	-39%
10.2	Fiddaman Rd	WB	788	755	68	124	4	39	860	918	7%	563	651	42	85	0	89	605	825	36%
10.3	Moonee Beach Rd	WB	879	424	59	19	12	5	950	448	-53%	551	344	34	11	5	8	590	363	-39%
SL10	Sub-Total	WB	2,526	1,771	162	179	17	44	2,705	1,994	-26%	1,921	1,478	98	116	5	98	2,025	1,692	-16%
10.1	Diamond Head Dr	EB	904	687	58	38	1	0	963	726	-25%	798	450	40	21	1	0	838	472	-44%
10.2	Fiddaman Rd	EB	780	727	60	131	2	44	842	901	7%	578	638	40	75	0	56	618	769	24%
10.3	Moonee Beach Rd	EB	1,528	863	94	65	9	17	1,631	944	-42%	826	659	42	39	4	19	872	717	-18%
SL10	Sub-Total	EB	3,212	2,276	212	234	12	61	3,436	2,571	-25%	2,202	1,747	122	135	5	75	2,328	1,957	-16%
SL10	**TOTAL**		5,738	4,047	374	413	29	105	6,141	4,565	-26%	4,123	3,225	220	252	10	173	4,353	3,649	-16%
SL11	**Boambee East Screenline**																			
11.1	Sawtell Rd	WB	2,301	2,488	145	175	24	45	2,470	2,707	10%	1,503	1,596	75	86	11	36	1,589	1,717	8%
11.2	Bruce King Dr	WB	202	182	13	3	3	0	218	186	-15%	143	135	10	1	0	0	153	137	-11%
11.3	Lyons Rd	WB	1,926	1,633	79	65	4	13	2,009	1,710	-15%	1,428	1,366	29	32	2	13	1,459	1,411	-3%
SL11	Sub-Total	WB	4,429	4,303	237	243	31	57	4,697	4,603	-2%	3,074	3,097	114	119	13	49	3,201	3,265	2%
11.1	Sawtell Rd	EB	2,052	2,370	119	135	31	36	2,202	2,541	15%	1,130	1,361	58	71	14	31	1,202	1,463	22%
11.2	Bruce King Dr	EB	807	925	52	62	1	12	860	999	16%	601	636	32	35	1	9	634	679	7%
11.3	Lyons Rd	EB	1,753	1,613	63	59	21	15	1,837	1,686	-8%	1,197	1,165	36	24	8	13	1,241	1,201	-3%
SL11	Sub-Total	EB	4,612	4,908	234	256	53	62	4,899	5,226	7%	2,928	3,161	126	130	23	53	3,077	3,343	9%
SL11	**TOTAL**		9,041	9,211	471	499	84	119	9,596	9,829	2%	6,002	6,257	240	249	36	102	6,278	6,608	5%
SL12	**Hogbin Dr North Screenline**																			
12.2	Park Beach Rd	WB	1,748	1,529	84	6	2	2	1,834	1,536	-16%	790	458	34	4	0	0	824	461	-44%
12.3	Boultwood St	WB	150	817	6	42	0	15	156	874	460%	99	276	2	30	0	33	101	339	236%
12.4	Prince St	WB	234	142	7	8	0	0	241	149	-38%	150	97	0	4	0	0	150	101	-33%
12.5	Orlando St	WB	3,192	1,709	183	124	27	61	3,402	1,894	-44%	1,670	1,107	83	65	7	97	1,760	1,268	-28%
12.6	Watsonia Ave	SB	8	0	0	0	0	0	8	0	-100%	6	0	0	0	0	0	6	0	-100%
12.7	Watsonia Ave	WB	221	254	12	6	0	0	233	261	12%	139	191	4	4	0	0	143	195	36%
SL12	Sub-Total	WB	7,960	6,592	472	408	31	111	8,463	7,112	-16%	4,109	4,440	206	234	8	152	4,323	4,826	12%
12.1	Arthur St	EB	2,301	2,065	155	27	5	2	2,461	2,094	-15%	1,050	2,080	61	17	0	2	1,111	2,098	89%
12.2	Park Beach Rd	EB	1,770	2,045	67	54	6	1	1,843	2,101	14%	919	761	32	30	1	14	952	805	-15%
12.3	Boultwood St	EB	132	16	10	1	0	21	142	38	-73%	84	11	3	0	0	0	87	11	-87%
12.4	Prince St	EB	262	113	6	8	0	0	268	122	-55%	168	100	4	5	0	0	172	104	-40%
12.5	Orlando St	EB	2,978	1,939	284	353	14	109	3,276	2,401	-27%	1,641	1,597	99	188	7	78	1,747	1,863	7%

			OP (9-16)									RD (17-8)								
Site ID	Road Name	Dir.	LV obs	LV mod	MCV obs	MCV mod	HCV obs	HCV mod	TT obs	TT mod	TT %	LV obs	LV mod	MCV obs	MCV mod	HCV obs	HCV mod	TT obs	TT mod	TT %
12.6	Watsonia Ave	NB	89	94	1	2	0	0	90	96	7%	53	55	1	1	0	0	54	56	4%
12.7	Watsonia Ave	EB	171	163	10	4	0	0	181	167	-8%	99	119	4	2	0	0	103	121	18%
SL12	Sub-Total	EB	7,703	6,436	533	449	25	134	8,261	7,019	-15%	4,014	4,722	204	242	8	95	4,226	5,058	20%
SL12	**TOTAL**		15,663	13,028	1,005	857	56	246	16,724	14,130	-16%	8,123	9,163	410	475	16	246	8,549	9,884	16%
SL13	**Hogbin Dr South Screenline**																			
13.1	Harbour Dr	WB	3,392	3,595	188	187	18	35	3,598	3,817	6%	1,515	2,695	78	102	5	26	1,598	2,823	77%
13.2	Albany St	WB	2,647	512	194	21	8	3	2,849	537	-81%	1,165	395	67	12	0	3	1,232	410	-67%
24-1	Stadium Dr	WB	2,215	2,549	132	170	16	101	2,363	2,820	19%	1,733	2,746	106	84	15	66	1,854	2,896	56%
SL13	Sub-Total	WB	8,254	6,656	514	377	42	140	8,810	7,173	-19%	4,413	5,836	251	198	20	95	4,684	6,129	31%
13.1	Harbour Dr	EB	3,508	3,531	203	140	51	33	3,762	3,704	-2%	1,805	2,612	97	85	21	23	1,923	2,720	41%
13.2	Albany St	EB	2,558	812	198	64	2	8	2,758	884	-68%	1,199	454	82	23	0	7	1,281	483	-62%
24-1	Stadium Dr	EB	1,982	2,447	125	148	17	81	2,124	2,675	26%	1,471	2,389	82	84	13	139	1,565	2,612	67%
SL13	Sub-Total	EB	8,048	6,790	526	352	70	121	8,644	7,262	-16%	4,475	5,454	261	192	34	169	4,769	5,815	22%
SL14	**Toomina Rd Screenline**																			
14.1	Hi-Tech Dr	WB	689	718	150	134	2	41	841	893	6%	482	531	49	73	3	34	534	637	19%
14.2	Sawtell Rd	WB	2,406	2,118	149	119	6	28	2,561	2,265	-12%	1,346	1,142	82	66	5	24	1,433	1,231	-14%
20-10	Coorabin Cres	WB	442	586	10	15	0	1	452	602	33%	313	362	7	10	0	1	320	372	16%
20-11	Bangalee Cres	WB	479	234	8	5	0	0	487	239	-51%	296	127	10	4	0	0	306	131	-57%
14.5	Amaroo Cresent	WB	421	982	13	31	0	0	434	1,014	134%	251	496	5	18	0	0	256	514	101%
14.6	Kintorie Cresent	WB	150	380	6	6	0	0	156	386	148%	89	240	4	5	0	0	93	244	163%
14.7	Mirroola Cresent	WB	152	233	8	5	1	0	161	238	48%	102	125	5	2	1	0	108	127	17%
14.8	Linden Ave	WB	759	1,040	65	34	2	8	826	1,082	31%	492	778	26	18	2	8	520	803	54%
14.9	Playford Ave	WB	235	152	19	4	0	0	254	156	-39%	177	98	4	2	0	0	181	100	-45%
26-6	Lyons Rd	WB	1,586	611	49	24	1	2	1,636	637	-61%	1,102	470	38	13	2	3	1,142	485	-58%
SL14	Sub-Total	WB	7,319	7,054	477	378	12	80	7,808	7,512	-4%	4,650	4,366	230	209	13	69	4,893	4,643	-5%
14.1	Hi-Tech Dr	EB	794	818	146	137	1	40	941	995	6%	353	546	48	71	4	30	405	647	60%
14.2	Sawtell Rd	EB	2,589	2,372	175	128	5	32	2,769	2,532	-9%	1,345	1,334	87	77	6	27	1,438	1,437	0%
20-10	Coorabin Cres	EB	479	387	10	12	0	0	489	399	-18%	385	322	6	7	0	0	391	329	-16%
20-11	Bangalee Cres	EB	473	344	11	8	0	0	484	353	-27%	330	161	10	4	0	0	339	165	-51%
14.5	Amaroo Cresent	EB	452	910	12	32	0	0	464	943	103%	241	576	1	20	0	0	242	596	146%
14.6	Kintorie Cresent	EB	137	390	3	7	0	0	140	397	184%	83	239	3	3	0	0	86	242	182%
14.7	Mirroola Cresent	EB	173	203	7	5	0	0	180	208	16%	104	134	2	4	0	0	106	138	30%
14.8	Linden Ave	EB	817	1,084	49	32	0	9	866	1,125	30%	493	707	17	18	0	8	510	733	44%
14.9	Playford Ave	EB	288	135	10	4	0	0	298	139	-53%	192	100	9	3	1	0	202	103	-49%
26-6	Lyons Rd	EB	1,426	635	57	23	1	3	1,484	662	-55%	986	468	41	11	3	3	1,030	481	-53%
SL14	Sub-Total	EB	7,628	7,280	480	389	7	84	8,115	7,754	-4%	4,512	4,585	224	217	14	67	4,749	4,869	3%
SL14	**TOTAL**		14,947	14,335	957	767	19	165	15,923	15,266	-4%	9,162	8,951	454	426	27	136	9,642	9,512	-1%
21-1	Airport Dr	WB	637	744	8	17	0	4	645	765	19%	377	453	9	14	1	4	387	471	22%
21-2	Christmas Bells Rd	WB	171	218	40	20	9	4	220	243	10%	116	154	33	11	7	4	157	168	7%
SL21	Sub-Total	WB	808	962	48	38	9	8	865	1,008	16%	493	607	42	25	9	7	544	639	18%
21-1	Airport Dr	EB	710	782	10	19	1	5	721	806	12%	433	505	9	13	0	4	442	522	18%
21-2	Christmas Bells Rd	EB	190	194	38	18	7	4	235	216	-8%	166	154	32	10	5	3	203	167	-18%
SL21	Sub-Total	EB	900	976	48	37	8	9	956	1,022	7%	599	659	41	23	5	7	645	689	7%
SL21	**TOTAL**		1,708	1,938	96	74	17	17	1,821	2,029	11%	1,092	1,265	83	48	14	14	1,188	1,328	12%
SL22	**Big Banana**																			
22-1a	Diggers Beach Rd	EB	307	55	3	3	1	0	311	58	-81%	176	40	2	1	0	0	178	41	-77%
22-2	Island View Close	EB	181	234	4	10	0	2	185	245	33%	112	144	2	5	0	1	114	150	32%
SL22	Sub-Total	EB	488	289	7	12	1	2	496	304	-39%	288	184	3	6	0	2	292	191	-34%
22-1a	Diggers Beach Rd	WB	280	221	3	6	0	2	283	230	-19%	141	122	1	4	0	2	142	127	-10%
22-2	Island View Close	WB	273	75	7	4	0	0	280	79	-72%	145	65	5	3	0	0	150	68	-55%
SL22	Sub-Total	WB	553	296	10	11	0	2	563	309	-45%	286	186	6	7	0	3	292	195	-33%
SL22	**TOTAL**		1,041	586	17	23	1	4	1,059	613	-42%	574	370	10	13	0	4	584	386	-34%
SL23	**Baringa Private Hospital**																			
	Hospital	EB	295	322	4	5	0	1	299	328	10%	233	250	2	2	0	2	235	253	8%
23-1	Mackays Rd	EB	648	458	34	14	0	2	682	474	-30%	484	345	24	6	0	3	507	354	-30%
SL23	Sub-Total	EB	943	781	38	19	0	2	981	802	-18%	717	594	26	8	0	5	742	607	-18%

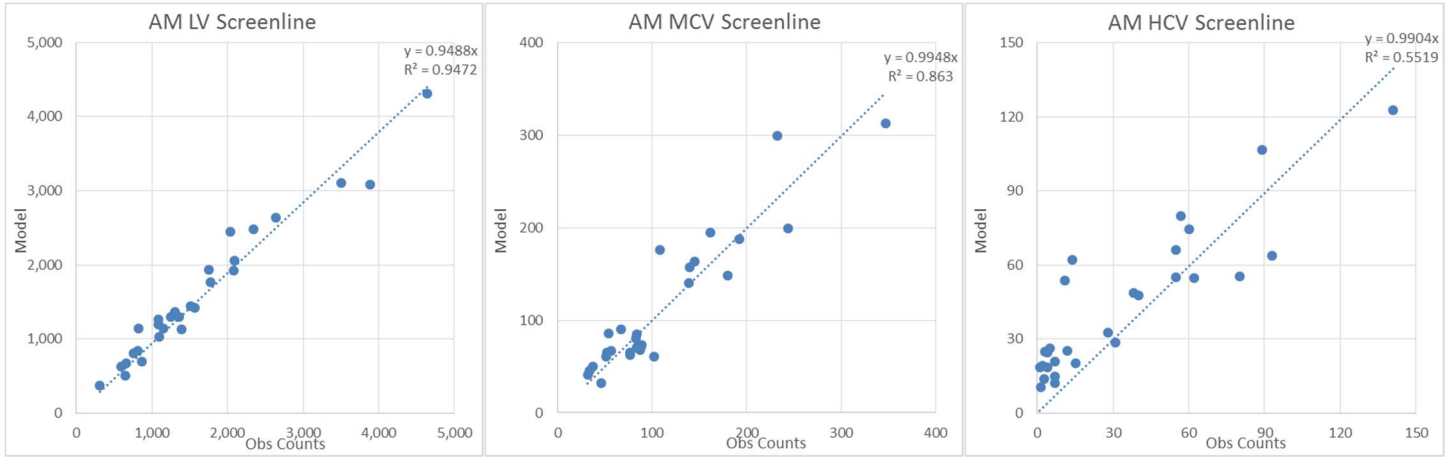
			OP (9-16)									RD (17-8)								
Site ID	Road Name	Dir.	LV obs	LV mod	MCV obs	MCV mod	HCV obs	HCV mod	**TT obs**	**TT mod**	**TT %**	LV obs	LV mod	MCV obs	MCV mod	HCV obs	HCV mod	**TT obs**	**TT mod**	**TT %**
	Hospital	WB	326	336	4	5	0	1	330	342	4%	202	214	4	4	0	1	206	219	6%
23-1	Mackays Rd	WB	730	445	33	14	0	2	763	461	-40%	473	317	29	8	0	1	502	327	-35%
SL23	Sub-Total	WB	1,056	781	37	19	0	3	1,093	804	-26%	675	531	33	13	0	2	708	546	-23%
SL23	**TOTAL**		1,999	1,562	75	38	0	5	2,074	1,606	-23%	1,392	1,125	59	21	0	7	1,451	1,152	-21%

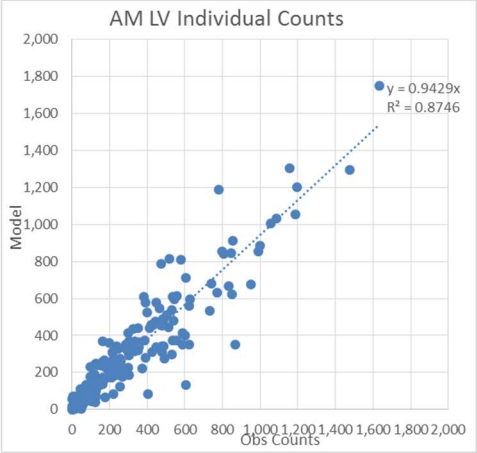
Appendix C

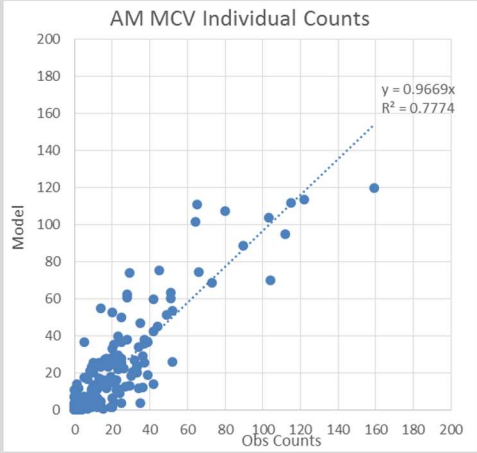
Strategic Model - Count Scatter Plots

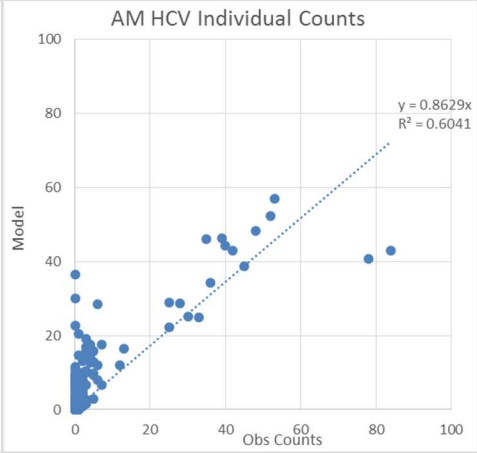
C1 CHSTM – Traffic Count Scatter Plots

1. AM Scatter Plots

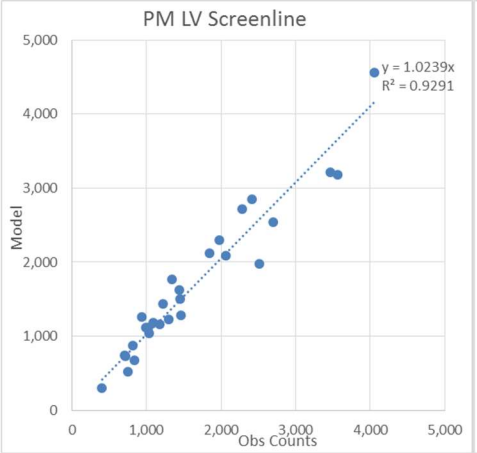


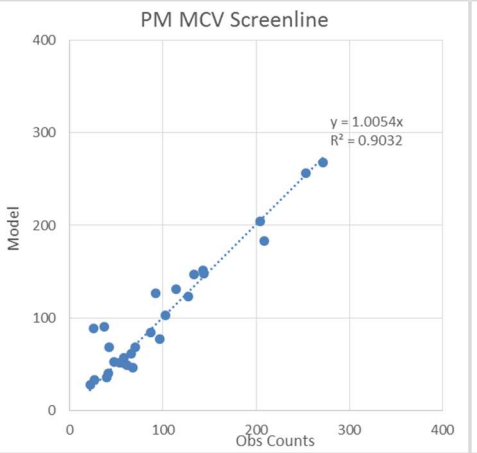


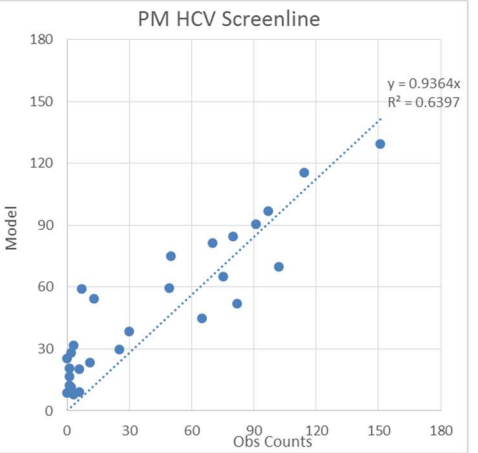


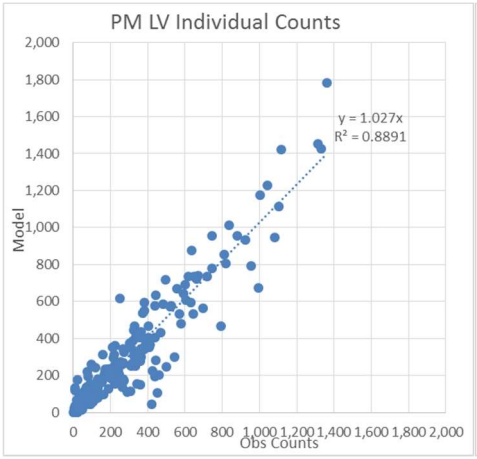


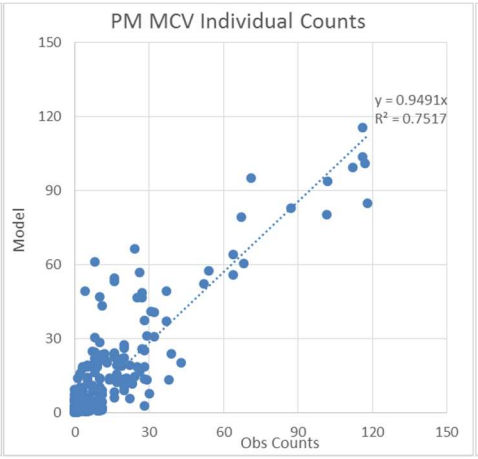
2. PM Scatter Plots

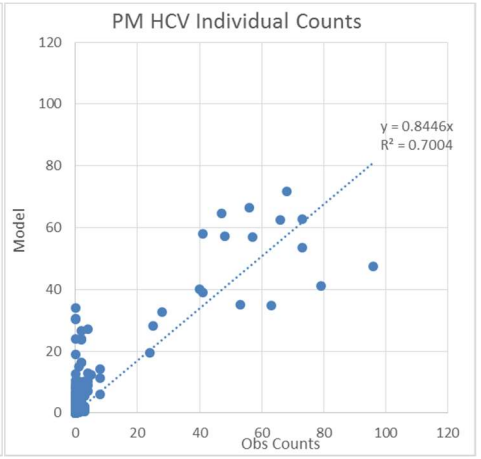




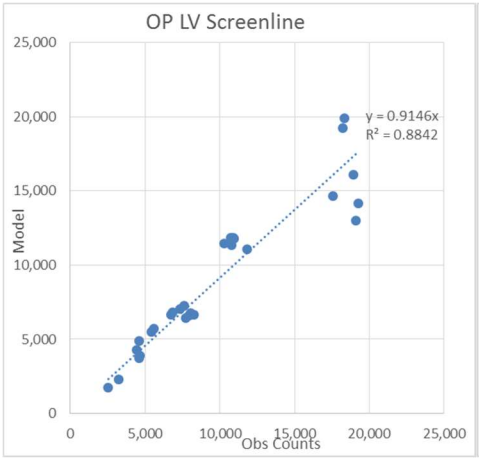


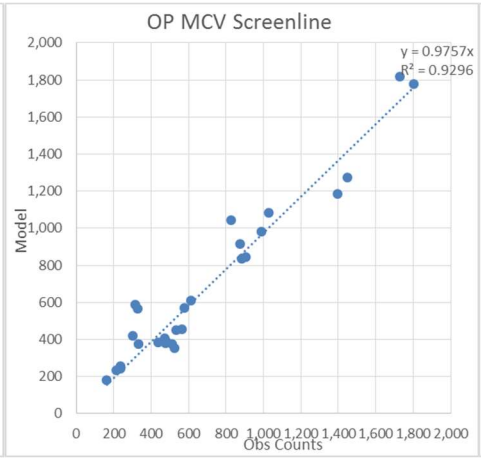


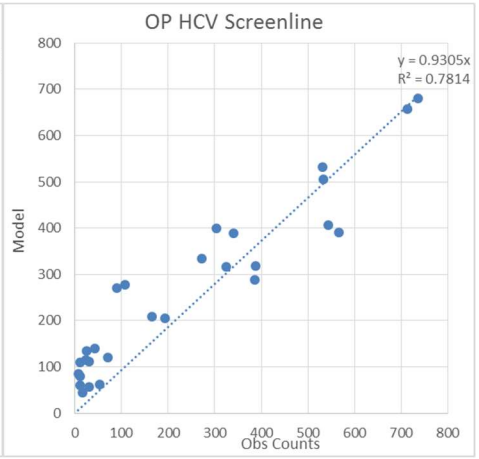


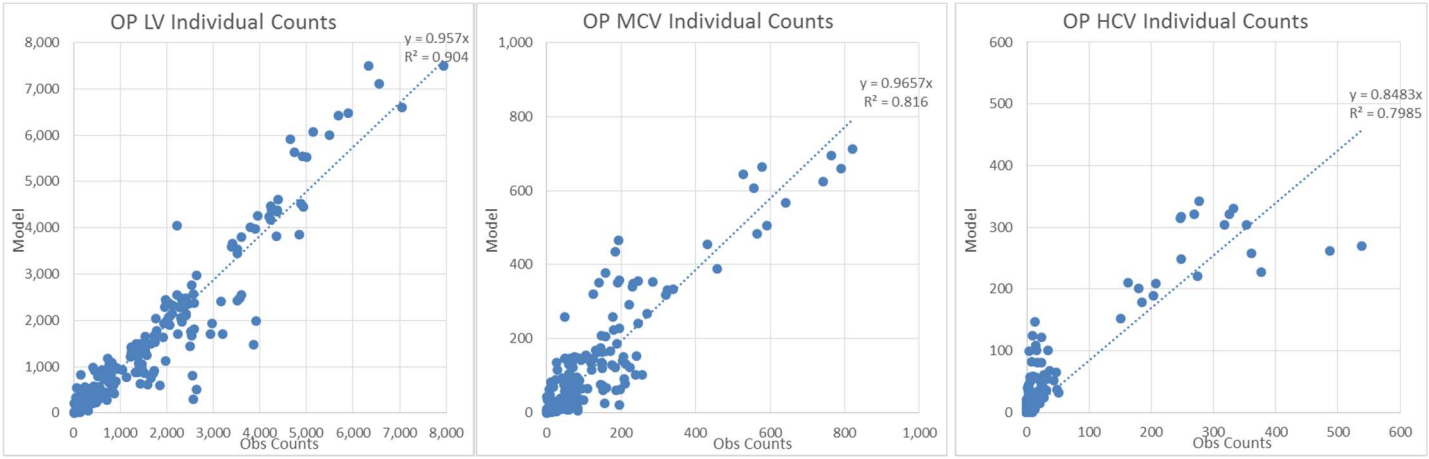


3. OP Scatter Plots

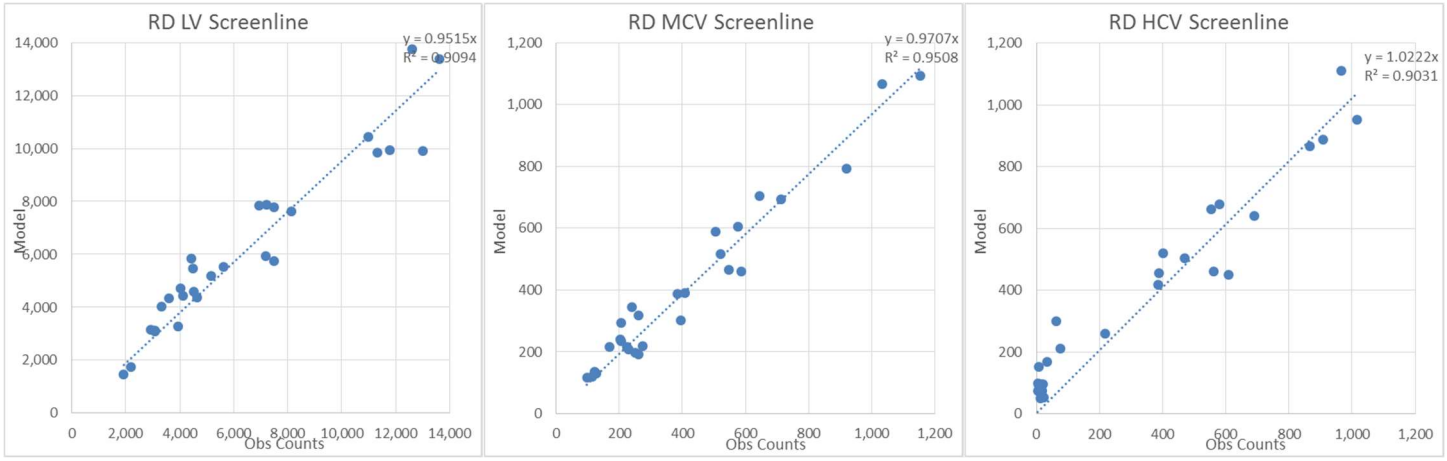


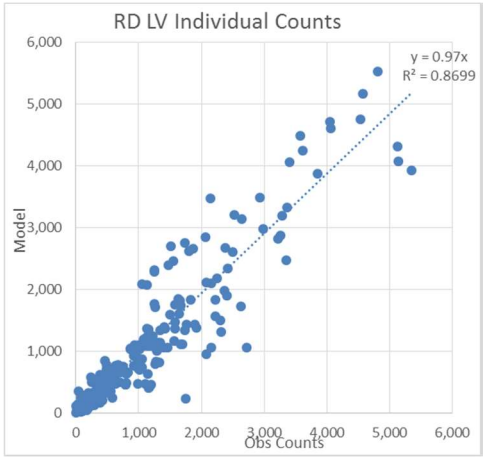


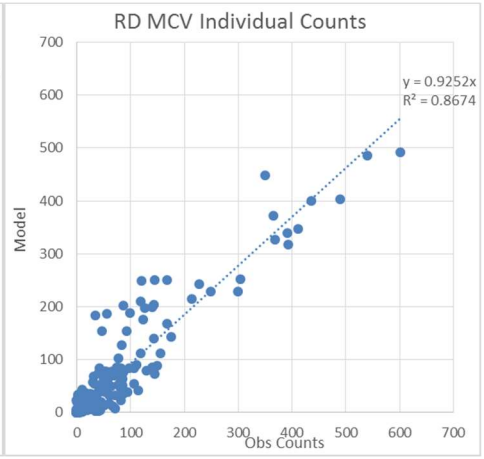


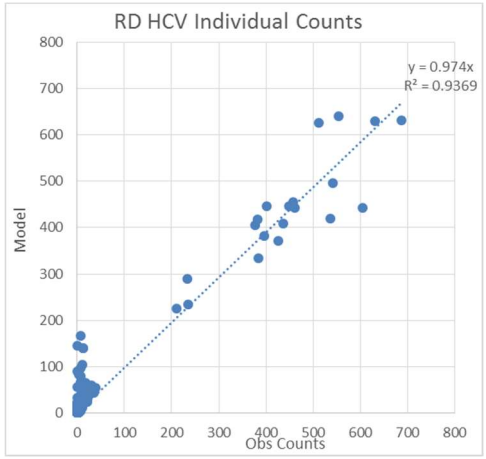


4. RD Scatter Plots




RD LV Individual Counts
y = 0.97x
R² = 0.8699
Model
Obs Counts
0
1,000
2,000
3,000
4,000
5,000
6,000

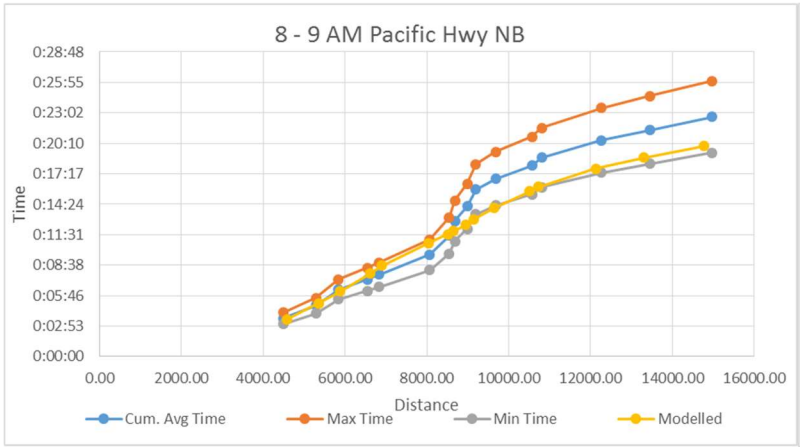

RD MCV Individual Counts
y = 0.9252x
R² = 0.8674
Model
Obs Counts
0
100
200
300
400
500
600
700

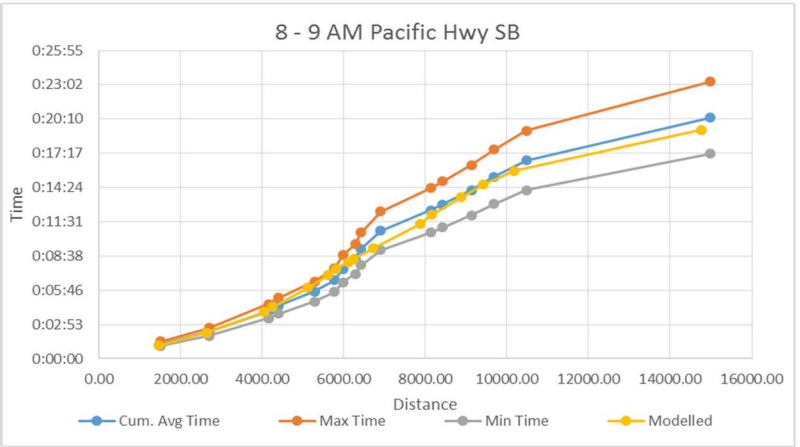

RD HCV Individual Counts
y = 0.974x
R² = 0.9369
Model
Obs Counts
0
100
200
300
400
500
600
700
800

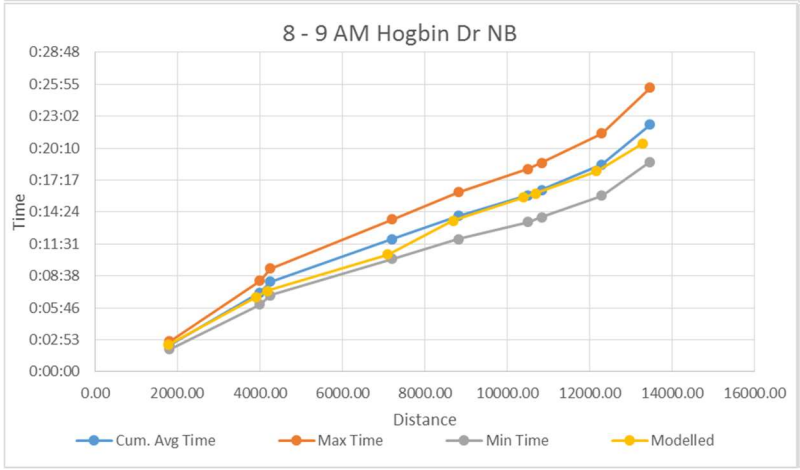
Appendix D

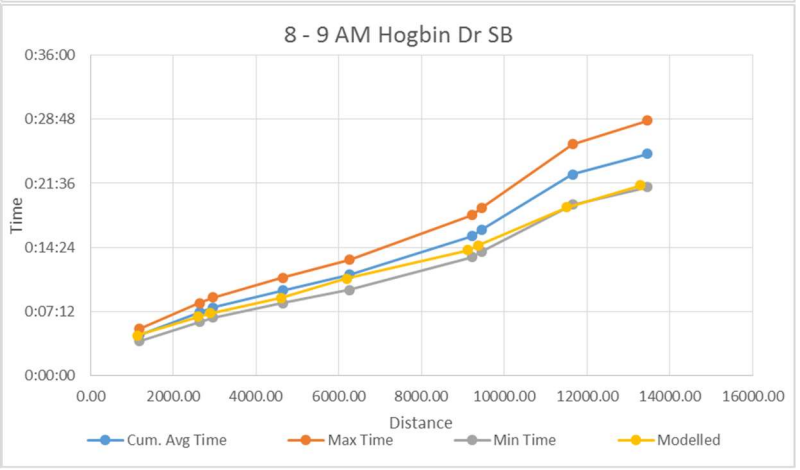
Strategic Model - Journey Time Comparisons

D1 AM Peak travel time comparisons (CHSTM)

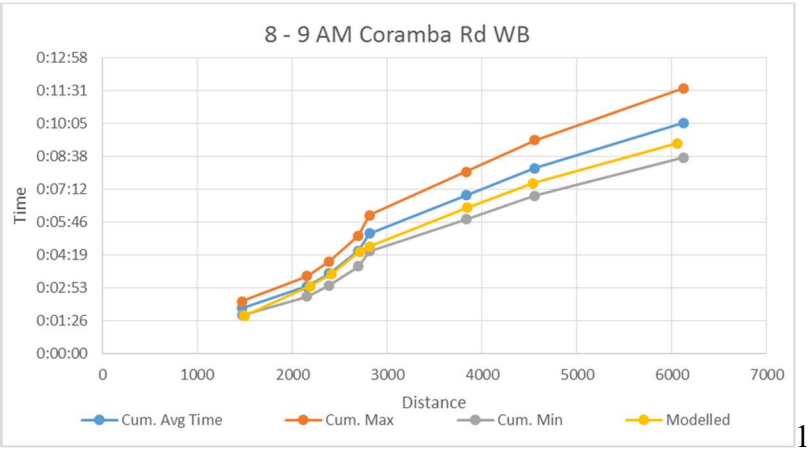




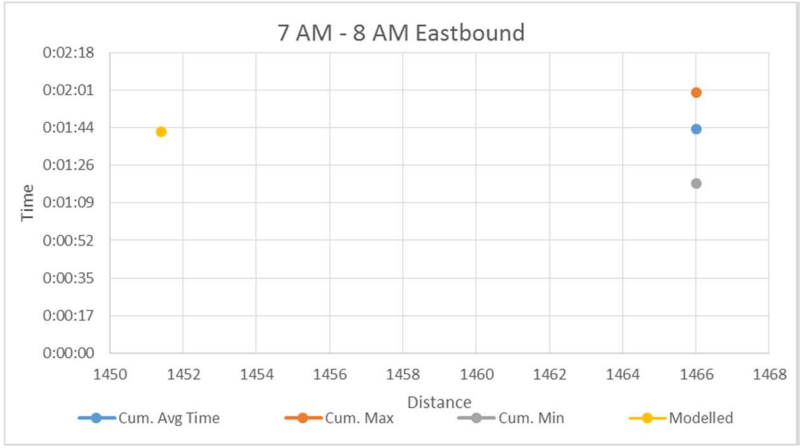


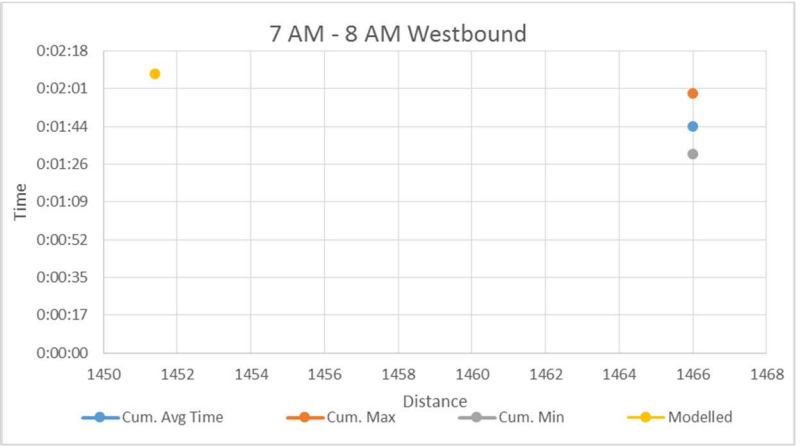


8 - 9 AM Coramba Rd EB
Time
0:11:31
0:10:05
0:08:38
0:07:12
0:05:46
0:04:19
0:02:53
0:01:26
0:00:00
0.00
1000.00
2000.00
3000.00
4000.00
5000.00
6000.00
7000.00
Distance
Cum. Avg Time
Max Time
Min Time
Modelled

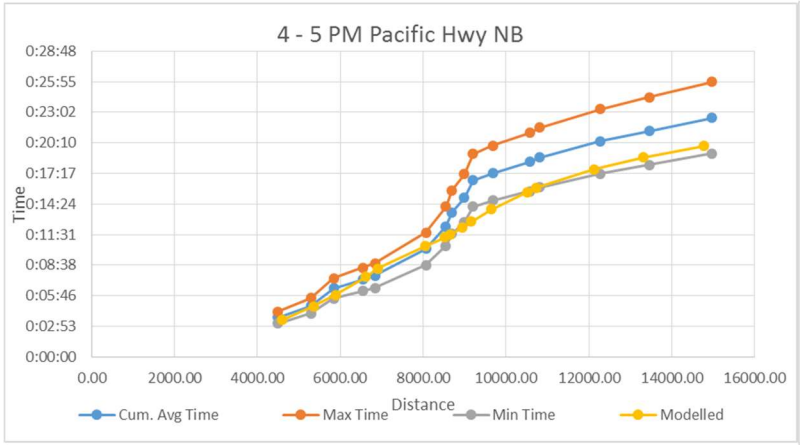

8 - 9 AM Coramba Rd WB
Time
0:12:58
0:11:31
0:10:05
0:08:38
0:07:12
0:05:46
0:04:19
0:02:53
0:01:26
0:00:00
0
1000
2000
3000
4000
5000
6000
7000
Distance
Cum. Avg Time
Cum. Max
Cum. Min
Modelled

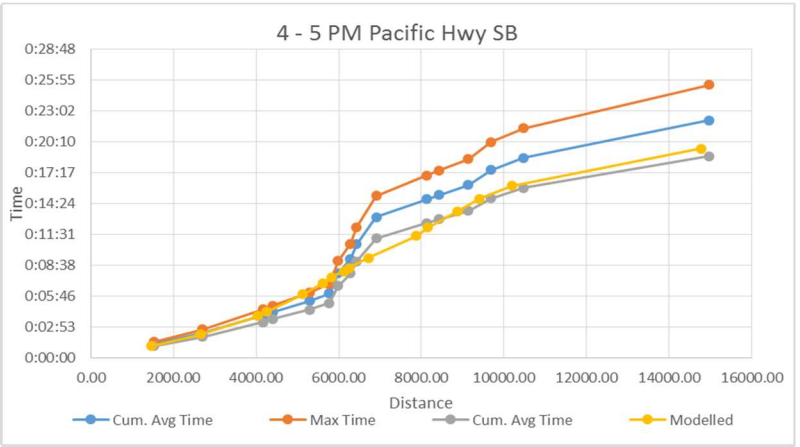
10.5

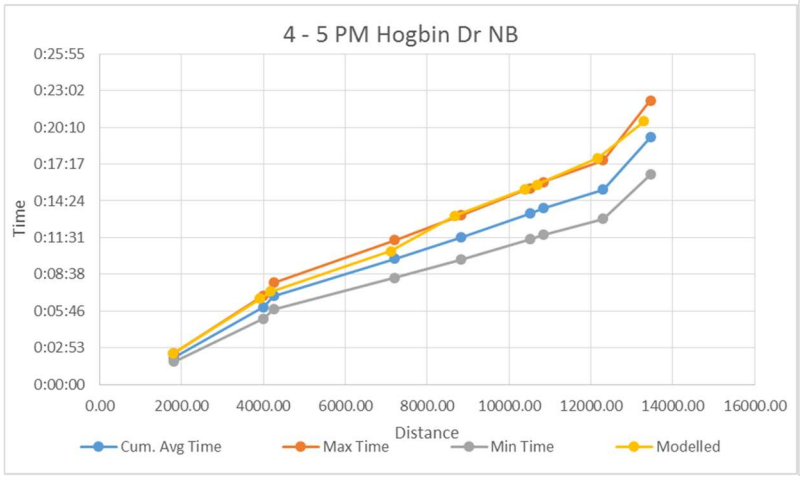

7 AM - 8 AM Eastbound
Time
0:02:18
0:02:01
0:01:44
0:01:26
0:01:09
0:00:52
0:00:35
0:00:17
0:00:00
1450
1452
1454
1456
1458
1460
1462
1464
1466
1468
Distance
Cum. Avg Time
Cum. Max
Cum. Min
Modelled

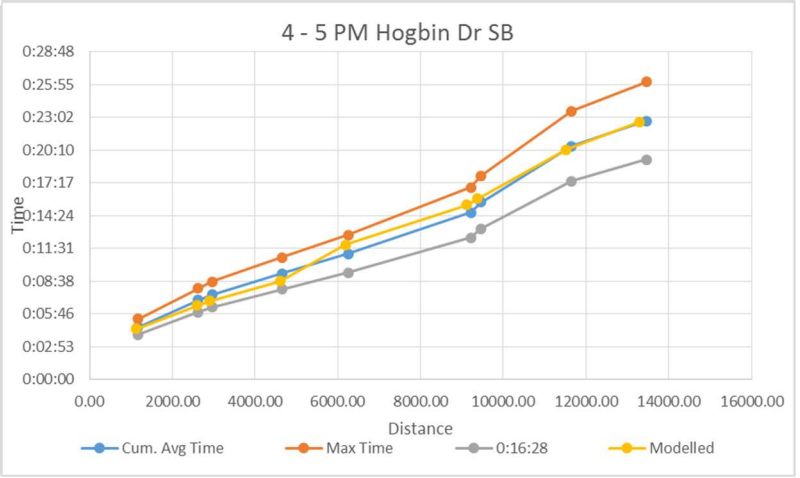

7 AM - 8 AM Westbound
Time
0:02:18
0:02:01
0:01:44
0:01:26
0:01:09
0:00:52
0:00:35
0:00:17
0:00:00
1450
1452
1454
1456
1458
1460
1462
1464
1466
1468
Distance
Cum. Avg Time
Cum. Max
Cum. Min
Modelled

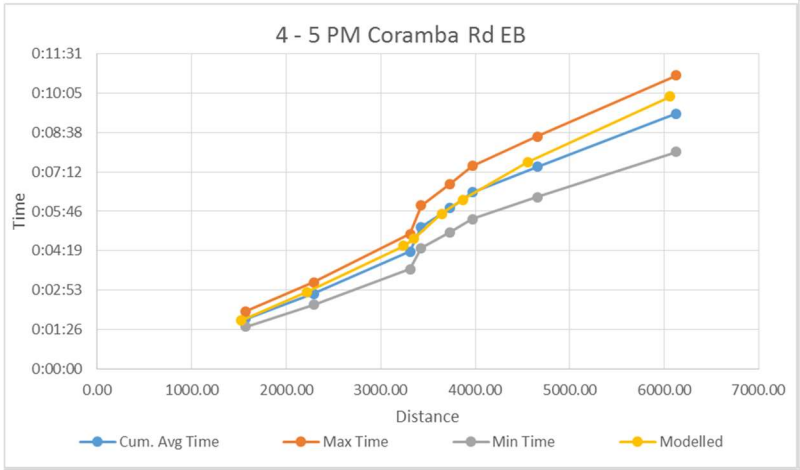
D2 PM peak travel time comparisons (CHSTM)

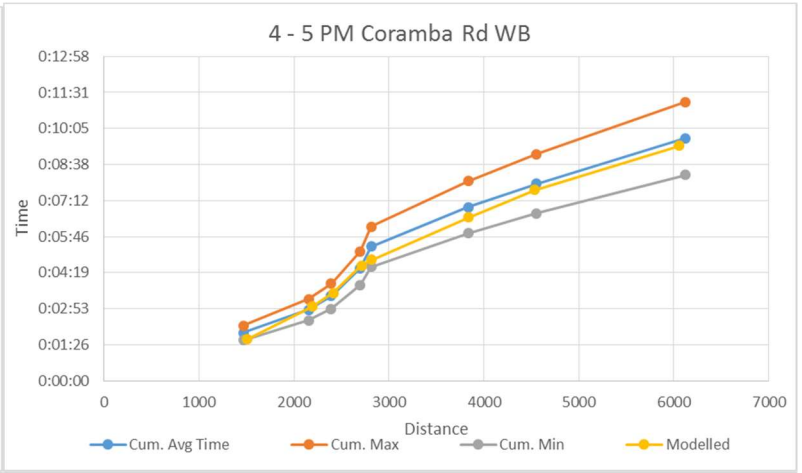


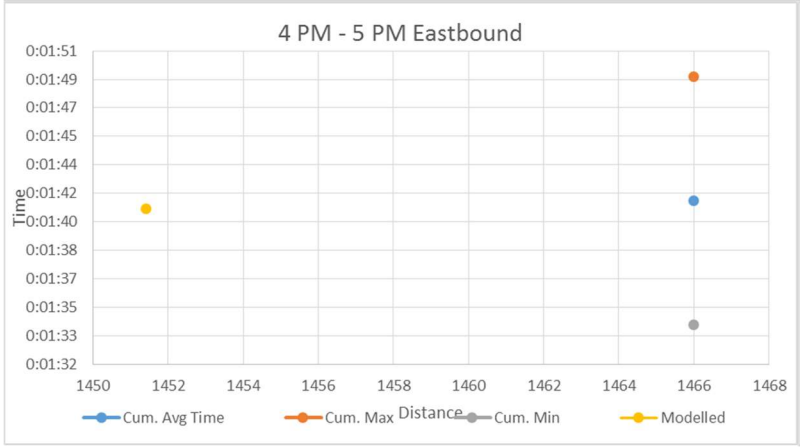


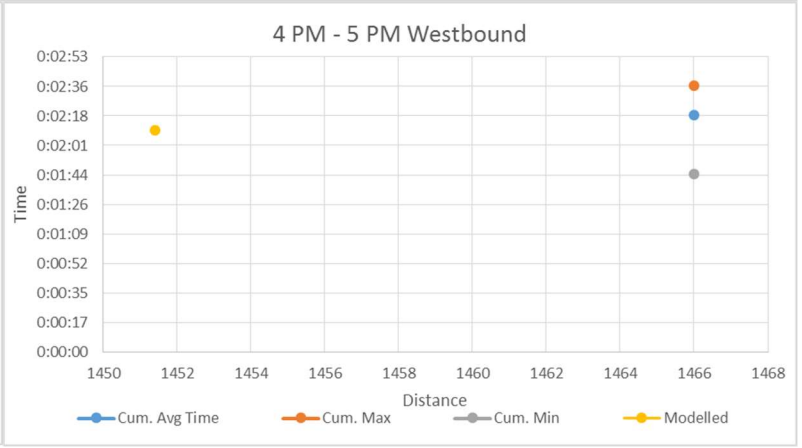





4 - 5 PM Coramba Rd EB
Time
0:11:31
0:10:05
0:08:38
0:07:12
0:05:46
0:04:19
0:02:53
0:01:26
0:00:00
0.00
1000.00
2000.00
3000.00
4000.00
5000.00
6000.00
7000.00
Distance
Cum. Avg Time
Max Time
Min Time
Modelled


4 - 5 PM Coramba Rd WB
Time
0:12:58
0:11:31
0:10:05
0:08:38
0:07:12
0:05:46
0:04:19
0:02:53
0:01:26
0:00:00
0
1000
2000
3000
4000
5000
6000
7000
Distance
Cum. Avg Time
Cum. Max
Cum. Min
Modelled


4 PM - 5 PM Eastbound
Time
0:01:51
0:01:49
0:01:47
0:01:45
0:01:44
0:01:42
0:01:40
0:01:38
0:01:37
0:01:35
0:01:33
0:01:32
1450
1452
1454
1456
1458
1460
1462
1464
1466
1468
Distance
Cum. Avg Time
Cum. Max
Cum. Min
Modelled


4 PM - 5 PM Westbound
Time
0:02:53
0:02:36
0:02:18
0:02:01
0:01:44
0:01:26
0:01:09
0:00:52
0:00:35
0:00:17
0:00:00
1450
1452
1454
1456
1458
1460
1462
1464
1466
1468
Distance
Cum. Avg Time
Cum. Max
Cum. Min
Modelled

Appendix E

Traffic Model - Signal Timings Calibration

E1 Traffic Model - Signal Timings Calibration

The tables below provide a comparison between observed signal timings extracted from SCATS IDM data (June 2016) and the timings assumed in the 2017 Coffs Harbour Traffic Model.

Intersection	TCS	AM						
		Cycle Time (s)			Phase Timings (s)			
		Observed	Modelled	Difference	Phase	Observed	Modelled	Absolute Difference
Pacific Hwy / Harbour Dr	657	127	130	2%	A	74	69	-5
					B	19	21	2
					C	34	40	6
					D	0	0	
					E	0	0	
					F	0	0	
					G	0	0	
Pacific Hwy / Coff St	1501	127	130	2%	A	66	60	-6
					B	0	0	
					C	0	0	
					D	25	22	-3
					E	18	22	4
					F	19	26	7
					G	0	0	
Pacific Hwy / Orlando St	1554	132	130	-2%	A	50	50	0
					B	0	0	
					C	1	0	-1
					D	30	30	0
					E	26	26	0
					F	24	24	0
					G	0	0	
Pacific Hwy / Albany St	1582	128	130	2%	A	49	41	-8
					B	6	18	12
					C	0	0	
					D	36	38	2
					E	19	20	1
					F	19	13	-6
					G	0	0	

Intersection	TCS	AM						
		Cycle Time (s)			Phase Timings (s)			
		Observed	Modelled	Difference	Phase	Observed	Modelled	Absolute Difference
Pacific Hwy / Park Beach Rd	1723	131	130	-1%	A	83	78	-5
					B	22	30	8
					C	20	22	2
					D	7	0	-7
					E	0	0	
					F	0	0	
					G	0	0	
Pacific Hwy / Park Ave	2808	128	130	2%	A	60	59	-1
					B	1	0	-1
					C	0	0	
					D	32	28	-4
					E	19	27	8
					F	15	16	1
					G	0	0	
Pacific Hwy / Marcia St	3548	Missing Data	80	N/A	A	0	50	
					B	0	0	
					C	0	0	
					D	0	18	
					E	0	12	
					F	0	0	
					G	0	0	
Pacific Hwy / Cook Dr	3550	131	130	-1%	A	66	63	-3
					B	1	0	-1
					C	0	0	
					D	26	25	-1
					E	9	13	4
					F	0	0	
					G	30	29	-1
Pacific Hwy / Isle Dr	3565	131	130	-1%	A	68	68	0
					B	0	0	
					C	7	6	-1
					D	17	17	0
					E	17	20	3
					F	21	19	-2
					G	0	0	

Intersection	TCS	AM						
		Cycle Time (s)			Phase Timings (s)			
		Observed	Modelled	Difference	Phase	Observed	Modelled	Absolute Difference
Harbour Dr / Curacoa St	3763	65	65	0%	A	42	44	2
					B	23	21	-2
					C	0	0	
					D	0	0	
					E	0	0	
					F	0	0	
					G	0	0	
Pacific Hwy / Hurley Dr	4205	127	130	2%	A	90	87	-3
					B	22	23	1
					C	15	20	5
					D	0	0	
					E	0	0	
					F	0	0	
					G	0	0	
Pacific Hwy / Beryl St	4565	127	130	2%	A	98	73	-25
					B	3	17	14
					C	27	40	13
					D	0	0	
					E	0	0	
					F	0	0	
					G	0	0	
Pacific Hwy / Halls Rd	Missing TCS	Missing Data	130	N/A	A		96	
					B		12	
					C		22	
					D			
					E			
					F			
					G			
Pacific Hwy / Bangale Cres	Missing TCS	Missing Data	90	N/A	A		27	
					B		27	
					C		18	
					D		18	
					E			
					F			

Intersection	TCS	AM						
		Cycle Time (s)			Phase Timings (s)			
		Observed	Modelled	Difference	Phase	Observed	Modelled	Absolute Difference
					G			

Intersection	TCS	PM						
		Cycle Time (s)			Phase Timings (s)			
		Observed	Modelled	Difference	Phase	Observed	Modelled	Absolute Difference
Pacific Hwy / Harbour Dr	657	124	130	5%	A	64	65	1
					B	20	25	5
					C	38	40	2
					D	0	0	
					E	0	0	
					F	0	0	
					G	0	0	
Pacific Hwy / Coff St	1501	124	130	5%	A	60	60	0
					B	0	0	
					C	0	0	
					D	31	34	3
					E	15	17	2
					F	19	19	0
					G	0	0	
Pacific Hwy / Orlando St	1554	138	130	-6%	A	51	54	3
					B	0	0	
					C	1	0	-1
					D	30	28	-2
					E	30	27	-3
					F	25	21	-4
					G	0	0	
Pacific Hwy / Albany St	1582	124	130	5%	A	57	56	-1
					B	2	12	10
					C	0	0	
					D	24	23	-1
					E	22	22	0
					F	17	17	0
					G	0	0	

Intersection	TCS	PM						
		Cycle Time (s)			Phase Timings (s)			
		Observed	Modelled	Difference	Phase	Observed	Modelled	Absolute Difference
Pacific Hwy / Park Beach Rd	1723	139	130	-6%	A	83	78	-5
					B	25	23	-2
					C	19	18	-1
					D	11	11	0
					E	0	0	
					F	0	0	
					G	0	0	
Pacific Hwy / Park Ave	2808	123	130	6%	A	54	60	6
					B	7	0	-7
					C	0	0	
					D	26	25	-1
					E	20	27	7
					F	16	18	2
					G	0	0	
Pacific Hwy / Marcia St	3548	131	130	-1%	A	86	85	-1
					B	1	0	-1
					C	0	0	
					D	28	28	0
					E	17	17	0
					F	0	0	
					G	0	0	
Pacific Hwy / Cook Dr	3550	123	130	6%	A	64	64	0
					B	1	0	-1
					C	0	0	
					D	26	26	0
					E	9	16	7
					F	0	0	
					G	23	24	1
Pacific Hwy / Isle Dr	3565	124	130	5%	A	61	65	4
					B	0	0	
					C	4	0	-4
					D	24	26	2
					E	16	17	1
					F	21	22	1
					G	0	0	

Intersection	TCS	PM						
		Cycle Time (s)			Phase Timings (s)			
		Observed	Modelled	Difference	Phase	Observed	Modelled	Absolute Difference
Harbour Dr / Curacoa St	3763	Missing Data	65	N/A	A	0	42	
					B	0	23	
					C	0	0	
					D	0	0	
					E	0	0	
					F	0	0	
					G	0	0	
Pacific Hwy / Hurley Dr	4205	123	130	6%	A	87	90	3
					B	16	17	1
					C	20	23	3
					D	0	0	
					E	0	0	
					F	0	0	
					G	0	0	
Pacific Hwy / Beryl St	4565	125	130	4%	A	98	78	-20
					B	6	19	13
					C	21	33	12
					D	0	0	
					E	0	0	
					F	0	0	
					G	0	0	
Pacific Hwy / Halls Rd	Missing TCS	Missing Data	130	N/A	A		94	
					B		14	
					C		22	
					D			
					E			
					F			
					G			
Pacific Hwy / Bangale Cres	Missing TCS	Missing Data	90	N/A	A		27	
					B		27	
					C		18	
					D		18	
					E			
					F			

Intersection	TCS	PM						
		Cycle Time (s)			Phase Timings (s)			
		Observed	Modelled	Difference	Phase	Observed	Modelled	Absolute Difference
					G			

Appendix F

Traffic Model - Traffic Count Comparisons

F1 Link Volume Comparisons

Intersection	Road	App	Dir	AM			PM		
				Obs	Mod	GEH	Obs	Mod	GEH
Pacific Hwy and Shopping Centre Access	Shopping Centre Access	W	Dep	109	124	1.4	63	88	2.9
Shopping Centre and Arthur St	Arthur St	E	App	394	496	4.8	454	464	0.5
Shopping Centre and Arthur St	Arthur St	E	Dep	356	314	2.3	365	279	4.8
Shopping Centre and Arthur St	Shopping Centre	S	App	111	153	3.7	409	656	10.7
Shopping Centre and Arthur St	Shopping Centre	S	Dep	370	432	3.1	381	433	2.6
Shopping Centre and Arthur St	Arthur St	W	App	617	628	0.4	614	559	2.3
Shopping Centre and Arthur St	Arthur St	W	Dep	396	530	6.2	731	967	8.1
Shopping Centre and Arthur St	Arthur St	E	App	364	462	4.8	458	467	0.4
Shopping Centre and Arthur St	Shopping Centre	S	App	25	14	2.5	105	107	0.2
Shopping Centre and Arthur St	Shopping Centre	S	Dep	64	73	1.1	61	62	0.1
Shopping Centre and Arthur St	Arthur St	W	App	353	311	2.3	321	260	3.6
Shopping Centre and Arthur St	Arthur St	W	Dep	328	407	4.1	453	465	0.6
Park Beach Rd and Shopping Centre	Park Beach Rd	N	App	421	336	4.4	505	358	7.1
Park Beach Rd and Shopping Centre	Park Beach Rd	N	Dep	299	298	0.1	537	429	4.9
Park Beach Rd and Shopping Centre	Shopping Centre	E	App	146	73	7.0	534	287	12.2
Park Beach Rd and Shopping Centre	Shopping Centre	E	Dep	324	97	15.6	465	175	16.2
Park Beach Rd and Shopping Centre	Park Beach Rd	S	App	283	266	1.0	295	310	0.9
Park Beach Rd and Shopping Centre	Park Beach Rd	S	Dep	214	298	5.3	360	481	5.9
Park Beach Rd and Shopping Centre	Walter Morris Cl	W	App	163	159	0.3	180	240	4.1
Park Beach Rd and Shopping Centre	Walter Morris Cl	W	Dep	176	139	2.9	152	107	4.0
Hogbin Dr and Shopping Centre	Hogbin Dr	N	App	511	487	1.1	1066	1126	1.8
Hogbin Dr and Shopping Centre	Hogbin Dr	N	Dep	1175	1270	2.7	664	637	1.1
Hogbin Dr and Shopping Centre	Hogbin Dr	S	App	1202	1271	2.0	658	637	0.8
Hogbin Dr and Shopping Centre	Hogbin Dr	S	Dep	515	490	1.1	1074	1125	1.5
Toormina Rd and Minorca Pl	Toormina Rd	N	App	555	530	1.1	886	833	1.8

Intersection	Road	App	Dir	AM			PM		
				Obs	Mod	GEH	Obs	Mod	GEH
Toormina Rd and Minorca Pl	Minorca Pl	E	App	10	22	3.0	68	128	6.1
Toormina Rd and Minorca Pl	Minorca Pl	E	Dep	193	199	0.4	387	422	1.7
Toormina Rd and Minorca Pl	Toormina Rd	S	App	719	694	0.9	523	525	0.1
Toormina Rd and Minorca Pl	Coorabin Cres	W	App	126	210	6.5	71	103	3.4
Toormina Rd and Minorca Pl	Coorabin Cres	W	Dep	84	152	6.3	95	139	4.1
Toormina Rd and Shopping Centre	Toormina Rd	N	App	310	288	1.3	500	490	0.4
Toormina Rd and Shopping Centre	Shopping Centre	E	App	155	160	0.4	507	418	4.1
Toormina Rd and Shopping Centre	Shopping Centre	E	Dep	143	71	7.0	141	68	7.1
Toormina Rd and Shopping Centre	Toormina Rd	S	App	671	556	4.6	366	357	0.5
Toormina Rd and Shopping Centre	Toormina Rd	S	Dep	339	273	3.8	664	641	0.9
Toormina Rd and Shopping Centre	Bangalee Cres	W	App	132	56	7.8	59	31	4.2
Toormina Rd and Shopping Centre	Bangalee Cres	W	Dep	67	21	6.9	104	62	4.6
Shopping Centre and Minorie Dr	Shopping Centre	N	App	29	47	2.9	167	165	0.2
Shopping Centre and Minorie Dr	Shopping Centre	N	Dep	100	126	2.4	104	176	6.1
Shopping Centre and Minorie Dr	Minorie Dr	E	App	72	103	3.3	90	158	6.1
Shopping Centre and Minorie Dr	Minorie Dr	E	Dep	77	68	1.1	157	180	1.8
Shopping Centre and Minorie Dr	Minorie Dr	W	App	132	93	3.7	158	134	2.0
Shopping Centre and Minorie Dr	Minorie Dr	W	Dep	56	49	1.0	154	102	4.6
Hogbin Dr and Airport Dr	Hogbin Dr	N	App	1144	1181	1.1	1033	1041	0.2
Hogbin Dr and Airport Dr	Airport Dr	E	App	72	77	0.6	119	135	1.4
Hogbin Dr and Airport Dr	Airport Dr	E	Dep	81	115	3.4	92	96	0.4
Hogbin Dr and Airport Dr	Hogbin Dr	S	App	1305	1351	1.3	1026	1055	0.9
Hogbin Dr and Christmas Bells Rd	Hogbin Dr	N	App	1127	1235	3.1	1002	1047	1.4
Hogbin Dr and Christmas Bells Rd	Christmas Bells Rd	E	App	29	25	0.8	40	99	7.1
Hogbin Dr and Christmas Bells Rd	Christmas Bells Rd	E	Dep	36	44	1.3	19	46	4.7
Hogbin Dr and Christmas Bells Rd	Hogbin Dr	S	App	1363	1343	0.5	1059	1094	1.1
Hogbin Dr and Christmas Bells Rd	Hogbin Dr	S	Dep	1098	1201	3.0	992	1035	1.4

Intersection	Road	App	Dir	AM			PM		
				Obs	Mod	GEH	Obs	Mod	GEH
Pacific Hwy and Diggers Beach Rd	Diggers Beach Rd	E	App	36	19	3.2	26	90	8.4
Pacific Hwy and Diggers Beach Rd	Diggers Beach Rd	E	Dep	31	26	0.9	60	108	5.2
Pacific Hwy and Diggers Beach Rd	Diggers Beach Rd	W	Dep	14	28	3.1	18	42	4.4
Pacific Hwy and Island View Close	Island View Close	W	App	11	37	5.3	26	33	1.3
Pacific Hwy and Island View Close	Island View Close	W	Dep	21	24	0.6	19	20	0.2
Mackays Rd and Hospital	Mackays Rd	N	App	83	93	1.1	86	67	2.2
Mackays Rd and Hospital	Mackays Rd	S	App	117	101	1.5	91	117	2.5
Mackays Rd and Hospital	Hospital	W	App	14	11	0.8	30	37	1.2
Mackays Rd and Hospital	Hospital	W	Dep	40	41	0.2	21	24	0.6
Mackays Rd and Hospital	Mackays Rd	N	App	71	81	1.1	71	45	3.4
Mackays Rd and Hospital	Mackays Rd	N	Dep	68	43	3.4	76	83	0.8
Mackays Rd and Hospital	Mackays Rd	S	App	87	59	3.3	78	91	1.4
Mackays Rd and Hospital	Hospital	W	App	12	14	0.6	21	27	1.2
Mackays Rd and Hospital	Hospital	W	Dep	21	19	0.4	8	12	1.3
Mackays Rd and Bray St	Mackays Rd	N	App	94	104	1.0	115	103	1.1
Mackays Rd and Bray St	Bray St	E	App	205	183	1.6	411	391	1.0
Mackays Rd and Bray St	Bray St	E	Dep	435	371	3.2	305	254	3.1
Mackays Rd and Bray St	Mackays Rd	S	App	462	392	3.4	285	282	0.2
Mackays Rd and Bray St	Mackays Rd	S	Dep	209	205	0.3	415	404	0.5
Hogbin Dr and Stadium Dr	Hogbin Dr	N	App	1128	1126	0.1	1126	1048	2.4
Hogbin Dr and Stadium Dr	Stadium Dr	E	App	137	192	4.3	267	287	1.2
Hogbin Dr and Stadium Dr	Stadium Dr	E	Dep	354	403	2.5	109	113	0.4
Hogbin Dr and Stadium Dr	Hogbin Dr	S	App	1038	1109	2.2	633	710	3.0
Hogbin Dr and Stadium Dr	Hogbin Dr	S	Dep	816	781	1.2	1108	1049	1.8
Hogbin Dr and Stadium Dr	Stadium Dr	W	App	434	503	3.2	411	425	0.7
Hogbin Dr and Stadium Dr	Stadium Dr	W	Dep	478	395	4.0	365	254	6.3
Pacific Hwy and Isle Dr	Pacific Hwy	N	App	1253	1128	3.6	1403	1334	1.9
Pacific Hwy and Isle Dr	Pacific Hwy	N	Dep	1571	1381	4.9	1376	1282	2.6
Pacific Hwy and Isle Dr	Isle Dr	E	App	117	101	1.5	274	248	1.6
Pacific Hwy and Isle Dr	Isle Dr	E	Dep	344	292	2.9	134	131	0.3
Pacific Hwy and Isle Dr	Pacific Hwy	S	App	1339	1271	1.9	888	903	0.5
Pacific Hwy and Isle Dr	Pacific Hwy	S	Dep	940	897	1.4	1333	1269	1.8
Pacific Hwy and Isle Dr	Isle Dr	W	App	380	295	4.6	455	358	4.8
Pacific Hwy and Isle Dr	Isle Dr	W	Dep	234	218	1.1	177	161	1.2
Shopping Carpark and Cook Dr	Shopping Carpark	N	App	9	0	4.2	4	0	2.8

Intersection	Road	App	Dir	AM			PM		
				Obs	Mod	GEH	Obs	Mod	GEH
Shopping Carpark and Cook Dr	Shopping Carpark	N	Dep	11	0	4.7	2	0	2.0
Shopping Carpark and Cook Dr	Cook Dr	E	App	175	212	2.7	236	327	5.4
Shopping Carpark and Cook Dr	Cook Dr	E	Dep	260	285	1.5	116	222	8.2
Shopping Carpark and Cook Dr	Bunnings	S	App	67	44	3.1	156	141	1.2
Shopping Carpark and Cook Dr	Bunnings	S	Dep	103	91	1.2	132	85	4.5
Shopping Carpark and Cook Dr	Cook Dr	W	App	367	312	3.0	246	245	0.1
Shopping Carpark and Cook Dr	Cook Dr	W	Dep	244	197	3.2	392	409	0.8
Apollo Dr and Bray St	Apollo Dr	N	App	129	150	1.8	91	60	3.6
Apollo Dr and Bray St	Apollo Dr	N	Dep	69	54	1.9	142	129	1.1
Apollo Dr and Bray St	Bray St	E	App	374	350	1.3	527	574	2.0
Apollo Dr and Bray St	Bray St	E	Dep	549	469	3.5	414	361	2.7
Apollo Dr and Bray St	Joyce St	S	App	119	162	3.6	190	246	3.8
Apollo Dr and Bray St	Joyce St	S	Dep	308	374	3.6	176	167	0.7
Apollo Dr and Bray St	Bray St	W	App	548	412	6.2	349	260	5.1
Apollo Dr and Bray St	Bray St	W	Dep	244	179	4.5	425	480	2.6
Pacific Hwy and Old Coast Rd	Pacific Hwy	N	App	1824	2006	4.2	875	856	0.6
Pacific Hwy and Old Coast Rd	Pacific Hwy	N	Dep	699	708	0.3	1518	1536	0.5
Pacific Hwy and Old Coast Rd	Pacific Hwy	S	App	713	755	1.6	1543	1574	0.8
Pacific Hwy and Old Coast Rd	Pacific Hwy	S	Dep	1878	2039	3.6	902	846	1.9
Pacific Hwy and Old Coast Rd	Old Coast Rd	W	App	100	81	2.0	64	11	8.7
Pacific Hwy and Old Coast Rd	Old Coast Rd	W	Dep	60	71	1.4	62	50	1.6
Pacific Hwy and James Small Dr	Pacific Hwy	N	App	2015	2033	0.4	919	846	2.5
Pacific Hwy and James Small Dr	Pacific Hwy	N	Dep	724	758	1.2	1547	1577	0.8
Pacific Hwy and James Small Dr	James Small Dr	E	App	163	197	2.5	92	111	1.9
Pacific Hwy and James Small Dr	James Small Dr	E	Dep	100	147	4.2	171	203	2.3
Pacific Hwy and James Small Dr	Pacific Hwy	S	App	816	896	2.7	1747	1790	1.0
Pacific Hwy and James Small Dr	Pacific Hwy	S	Dep	2193	2235	0.9	1027	957	2.2
Pacific Hwy and James Small Dr	Bruxner Park Rd	W	App	39	31	1.4	32	18	2.8
Pacific Hwy and James Small Dr	Bruxner Park Rd	W	Dep	16	18	0.5	45	26	3.2
Pacific Hwy and Arthur St	Pacific Hwy	N	App	438	487	2.3	182	188	0.4
Pacific Hwy and Arthur St	Pacific Hwy	N	Dep	228	268	2.5	733	650	3.2
Pacific Hwy and Arthur St	Arthur St	E	App	439	551	5.0	728	947	7.6
Pacific Hwy and Arthur St	Arthur St	E	Dep	592	625	1.3	580	560	0.8
Pacific Hwy and Arthur St	Pacific Hwy	S	App	258	338	4.6	297	368	3.9
Pacific Hwy and Arthur St	Pacific Hwy	S	Dep	101	273	12.6	146	515	20.3
Pacific Hwy and Arthur St	Matrascolas Rd	W	App	104	96	0.8	438	432	0.3

Intersection	Road	App	Dir	AM			PM		
				Obs	Mod	GEH	Obs	Mod	GEH
Pacific Hwy and Arthur St	Matrascolas Rd	W	Dep	318	306	0.7	186	205	1.4
Pacific Hwy and Park Beach Rd	Pacific Hwy	N	App	1862	2172	6.9	1130	1351	6.3
Pacific Hwy and Park Beach Rd	Park Beach Rd	E	App	306	298	0.5	537	429	4.9
Pacific Hwy and Park Beach Rd	Park Beach Rd	E	Dep	428	335	4.8	483	358	6.1
Pacific Hwy and Park Beach Rd	Pacific Hwy	S	App	1251	1302	1.4	1838	1904	1.5
Pacific Hwy and Orlando St	Pacific Hwy	N	App	1984	2273	6.3	1503	1632	3.3
Pacific Hwy and Orlando St	Orlando St	E	App	418	492	3.5	703	691	0.5
Pacific Hwy and Orlando St	Orlando St	E	Dep	763	898	4.7	400	421	1.0
Pacific Hwy and Orlando St	Pacific Hwy	S	App	973	1085	3.5	1459	1570	2.9
Pacific Hwy and Orlando St	Bray St	W	App	688	618	2.7	553	461	4.1
Pacific Hwy and Orlando St	Bray St	W	Dep	418	392	1.3	713	655	2.2
Pacific Hwy and Carpark	Pacific Hwy	N	App	1645	1850	4.9	1263	1364	2.8
Pacific Hwy and Carpark	Carpark	E	App	7	12	1.6	13	34	4.3
Pacific Hwy and Carpark	Carpark	E	Dep	8	24	4.0	7	16	2.7
Pacific Hwy and Carpark	Pacific Hwy	S	App	997	1089	2.8	1515	1620	2.7
Pacific Hwy and Carpark	Argyll St	W	App	22	29	1.4	23	16	1.6
Pacific Hwy and Carpark	Argyll St	W	Dep	65	44	2.8	79	108	3.0
Pacific Hwy and Bailey Ave	Pacific Hwy	N	App	1577	1747	4.2	1257	1323	1.8
Pacific Hwy and Bailey Ave	Pacific Hwy	S	App	940	938	0.1	1500	1510	0.3
Pacific Hwy and Bailey Ave	Bailey Ave	W	App	95	184	7.5	49	90	4.9
Pacific Hwy and Bailey Ave	Bailey Ave	W	Dep	66	134	6.8	98	98	0.0
Pacific Hwy and Melittas Ave	Pacific Hwy	N	App	1617	1816	4.8	1274	1340	1.8
Pacific Hwy and Melittas Ave	Melittas Ave	E	App	4	4	0.0	10	16	1.7
Pacific Hwy and Melittas Ave	Melittas Ave	E	Dep	43	66	3.1	29	30	0.2
Pacific Hwy and Melittas Ave	Pacific Hwy	S	App	993	1086	2.9	1511	1584	1.9
Pacific Hwy and Melittas Ave	Wentworth Ave	W	App	13	6	2.3	16	29	2.7
Pacific Hwy and Melittas Ave	Wentworth Ave	W	Dep	4	0	2.8	7	0	3.7
Pacific Hwy and Melittas Ave	Pacific Hwy	N	App	1534	1674	3.5	1176	1243	1.9
Pacific Hwy and Melittas Ave	Melittas Ave	E	App	112	115	0.3	114	146	2.8
Pacific Hwy and Melittas Ave	Melittas Ave	E	Dep	134	133	0.1	126	87	3.8
Pacific Hwy and Melittas Ave	Pacific Hwy	S	App	935	936	0.0	1543	1428	3.0
Pacific Hwy and Melittas Ave	Marcia St	W	App	190	116	6.0	143	112	2.7
Pacific Hwy and Melittas Ave	Marcia St	W	Dep	148	122	2.2	186	49	12.6
Pacific Hwy and Beryl St	Pacific Hwy	N	App	1605	1624	0.5	1305	1326	0.6
Pacific Hwy and Beryl St	Pacific Hwy	S	App	1133	1106	0.8	1642	1690	1.2
Pacific Hwy and Beryl St	Beryl St	W	App	540	435	4.8	232	299	4.1
Pacific Hwy and Beryl St	Beryl St	W	Dep	206	217	0.8	275	274	0.1

Intersection	Road	App	Dir	AM			PM		
				Obs	Mod	GEH	Obs	Mod	GEH
Pacific Hwy and Coff St	Pacific Hwy	N	App	1979	2032	1.2	1397	1594	5.1
Pacific Hwy and Coff St	Coff St	E	App	313	210	6.4	795	637	5.9
Pacific Hwy and Coff St	Coff St	E	Dep	873	787	3.0	506	504	0.1
Pacific Hwy and Coff St	Pacific Hwy	S	App	828	875	1.6	980	1026	1.5
Pacific Hwy and Coff St	Pacific Hwy	S	Dep	1203	1206	0.1	945	1009	2.0
Pacific Hwy and Coff St	Coff St	W	App	220	169	3.7	216	136	6.0
Pacific Hwy and Harbour Dr	Pacific Hwy	N	App	1056	1242	5.5	991	1123	4.1
Pacific Hwy and Harbour Dr	Harbour Dr	E	App	193	169	1.8	338	222	6.9
Pacific Hwy and Harbour Dr	Pacific Hwy	S	App	821	844	0.8	929	976	1.5
Pacific Hwy and Harbour Dr	W High St	W	App	327	353	1.4	318	355	2.0
Pacific Hwy and Harbour Dr	W High St	W	Dep	278	215	4.0	458	368	4.4
Pacific Hwy and Moonee St	Pacific Hwy	N	App	951	1228	8.4	875	1029	5.0
Pacific Hwy and Moonee St	Moonee St	E	App	229	242	0.8	367	419	2.6
Pacific Hwy and Moonee St	Moonee St	E	Dep	429	495	3.1	430	322	5.6
Pacific Hwy and Moonee St	Pacific Hwy	S	App	816	751	2.3	927	797	4.4
Pacific Hwy and Moonee St	Pacific Hwy	S	Dep	1066	1048	0.6	947	980	1.1
Pacific Hwy and Moonee St	Moonee St	W	App	433	321	5.8	303	283	1.2
Pacific Hwy and Moonee St	Moonee St	W	Dep	129	159	2.5	187	246	4.0
Pacific Hwy and Albany St	Pacific Hwy	N	App	926	881	1.5	940	888	1.7
Pacific Hwy and Albany St	Albany St	E	App	316	180	8.6	435	265	9.1
Pacific Hwy and Albany St	Albany St	E	Dep	499	596	4.1	267	344	4.4
Pacific Hwy and Albany St	Pacific Hwy	S	App	1380	1238	3.9	1436	1489	1.4
Pacific Hwy and Albany St	Combine St	W	App	722	746	0.9	405	336	3.6
Pacific Hwy and Albany St	Combine St	W	Dep	387	272	6.3	631	573	2.4
Pacific Hwy and Halls Rd	Pacific Hwy	N	App	1580	1521	1.5	1414	1420	0.2
Pacific Hwy and Halls Rd	Pacific Hwy	N	Dep	1565	1545	0.5	1645	1667	0.5
Pacific Hwy and Halls Rd	Pacific Hwy	S	App	1484	1409	2.0	1579	1622	1.1
Pacific Hwy and Halls Rd	Halls Rd	W	App	228	226	0.1	162	115	4.0
Pacific Hwy and Halls Rd	Halls Rd	W	Dep	125	112	1.2	137	139	0.2
Pacific Hwy and Hurley Dr	Pacific Hwy	N	App	1519	1493	0.7	1295	1349	1.5
Pacific Hwy and Hurley Dr	Hurley Dr	E	App	117	123	0.5	209	272	4.1
Pacific Hwy and Hurley Dr	Hurley Dr	E	Dep	155	188	2.5	108	136	2.5
Pacific Hwy and Hurley Dr	Pacific Hwy	S	App	1418	1410	0.2	1376	1480	2.8
Pacific Hwy and Cook Dr	Pacific Hwy	N	App	1375	1431	1.5	1295	1342	1.3
Pacific Hwy and Cook Dr	Cook Dr	E	App	227	197	2.1	372	403	1.6
Pacific Hwy and Cook Dr	Cook Dr	E	Dep	274	312	2.2	162	246	5.9
Pacific Hwy and Cook Dr	Pacific Hwy	S	App	1397	1393	0.1	1200	1279	2.2
Pacific Hwy and Cook Dr	Cook Dr	W	App	378	337	2.2	378	324	2.9
Pacific Hwy and Cook Dr	Cook Dr	W	Dep	496	466	1.4	246	271	1.6
Pacific Hwy and Stadium Dr	Pacific Hwy	N	App	984	886	3.2	1377	1251	3.5
Pacific Hwy and Stadium Dr	Stadium Dr	E	App	336	289	2.7	419	293	6.7
Pacific Hwy and Stadium Dr	Stadium Dr	E	Dep	627	582	1.8	363	326	2.0

Intersection	Road	App	Dir	AM			PM		
				Obs	Mod	GEH	Obs	Mod	GEH
Pacific Hwy and Stadium Dr	Englands Rd	W	App	195	95	8.3	347	215	7.9
Pacific Hwy and Stadium Dr	Englands Rd	W	Dep	229	225	0.3	100	106	0.6
Pacific Hwy and Lindsays Rd	Pacific Hwy	N	Dep	669	671	0.1	286	321	2.0
Pacific Hwy and Lindsays Rd	Lindsays Rd	E	App	680	666	0.5	459	456	0.1
Pacific Hwy and Lindsays Rd	Pacific Hwy	S	App	72	161	8.2	75	121	4.6
Pacific Hwy and Lindsays Rd	Lindsays Rd	W	App	411	330	4.2	152	173	1.6
Pacific Hwy and Lindsays Rd	Lindsays Rd	W	Dep	249	229	1.3	247	244	0.2
Pacific Hwy and Lindsays Rd	Pacific Hwy	N	App	326	264	3.6	466	443	1.1
Pacific Hwy and Lindsays Rd	Pacific Hwy	N	Dep	16	0	5.7	18	7	3.1
Pacific Hwy and Lindsays Rd	Lindsays Rd	E	App	603	591	0.5	377	343	1.8
Pacific Hwy and Lindsays Rd	Lindsays Rd	E	Dep	374	351	1.2	408	406	0.1
Pacific Hwy and Lindsays Rd	Pacific Hwy	S	Dep	104	92	1.2	111	101	1.0
Pacific Hwy and Lindsays Rd	Lindsays Rd	W	App	245	253	0.5	153	182	2.2
Pacific Hwy and Lyons Rd	Pacific Hwy	N	Dep	506	458	2.2	245	289	2.7
Pacific Hwy and Lyons Rd	Lyons Rd	E	App	497	448	2.3	357	352	0.3
Pacific Hwy and Lyons Rd	Pacific Hwy	S	App	107	140	3.0	139	95	4.1
Pacific Hwy and Lyons Rd	Pine Creek Way	W	App	321	246	4.5	195	194	0.1
Pacific Hwy and Lyons Rd	Pine Creek Way	W	Dep	217	163	3.9	243	202	2.7
Pacific Hwy and Lyons Rd	Pacific Hwy	N	App	228	256	1.8	326	373	2.5
Pacific Hwy and Lyons Rd	Lyons Rd	E	App	441	407	1.7	348	403	2.8
Pacific Hwy and Lyons Rd	Lyons Rd	E	Dep	291	355	3.6	353	401	2.5
Pacific Hwy and Lyons Rd	Pacific Hwy	S	Dep	82	75	0.8	159	170	0.9
Pacific Hwy and Lyons Rd	Lyons Rd	W	App	201	216	1.0	203	150	4.0
Pacific Hwy and Grafton St and Valley St	Pacific Hwy	N	App	1364	1324	1.1	1245	1139	3.1
Pacific Hwy and Grafton St and Valley St	Grafton St	N	App	2	3	0.6	7	1	3.0
Pacific Hwy and Grafton St and Valley St	Valley St	E	App	8	6	0.8	9	6	1.1
Pacific Hwy and Grafton St and Valley St	Valley St	E	Dep	1	5	2.3	8	7	0.4
Pacific Hwy and Grafton St and Valley St	Ridge St	S	App	1	8	3.3	3	5	1.0
Pacific Hwy and Grafton St and Valley St	Ridge St	S	Dep	6	19	3.7	10	38	5.7
Pacific Hwy and Grafton St and Valley St	Pacific Hwy	S	App	1380	1229	4.2	1436	1474	1.0
Pacific Hwy and Grafton St and Valley St	Pacific Hwy	S	Dep	1368	1314	1.5	1246	1109	4.0
Pacific Hwy and Market St	Market St	E	App	25	19	1.3	62	47	2.0

Intersection	Road	App	Dir	AM			PM		
				Obs	Mod	GEH	Obs	Mod	GEH
Pacific Hwy and Market St	Market St	E	Dep	163	172	0.7	77	145	6.5
Pacific Hwy and Market St	Market St	W	App	69	99	3.3	60	41	2.7
Pacific Hwy and Market St	Market St	W	Dep	15	27	2.6	5	6	0.4
Pacific Hwy and Vernon St	Vernon St	E	App	56	40	2.3	124	120	0.4
Pacific Hwy and Vernon St	Vernon St	E	Dep	15	0	5.5	27	0	7.3
Pacific Hwy and Bay Dr	Pacific Hwy	N	App	2183	2263	1.7	1020	967	1.7
Pacific Hwy and Bay Dr	Bay Dr	E	App	96	87	0.9	89	71	2.0
Pacific Hwy and Bay Dr	Bay Dr	E	Dep	92	71	2.3	96	56	4.6
Pacific Hwy and Bay Dr	Pacific Hwy	S	App	856	929	2.4	1785	1786	0.0
Pacific Hwy and W Korora Rd	Pacific Hwy	N	App	2190	2290	2.1	1049	974	2.4
Pacific Hwy and W Korora Rd	Pacific Hwy	S	App	838	930	3.1	1792	1799	0.2
Pacific Hwy and W Korora Rd	Pacific Hwy	S	Dep	2187	2298	2.3	1046	973	2.3
Pacific Hwy and W Korora Rd	W Korora Rd	W	App	11	14	0.8	12	2	3.8
Pacific Hwy and W Korora Rd	W Korora Rd	W	Dep	7	3	1.8	17	19	0.5
Hogbin Dr and Orlando St	Hogbin Dr	N	App	648	653	0.2	541	522	0.8
Hogbin Dr and Orlando St	Hogbin Dr	N	Dep	591	589	0.1	830	896	2.2
Hogbin Dr and Orlando St	Orlando St	E	App	325	392	3.5	412	501	4.2
Hogbin Dr and Orlando St	Orlando St	E	Dep	430	420	0.5	337	346	0.5
Hogbin Dr and Orlando St	Hogbin Dr	S	App	692	680	0.5	882	821	2.1
Hogbin Dr and Orlando St	Hogbin Dr	S	Dep	806	731	2.7	625	631	0.2
Hogbin Dr and Orlando St	Orlando St	W	App	566	484	3.6	436	404	1.6
Hogbin Dr and Orlando St	Orlando St	W	Dep	404	474	3.3	479	377	4.9
Orlando St and Marina Dr	Orlando St	N	App	402	406	0.2	368	304	3.5
Orlando St and Marina Dr	Orlando St	N	Dep	244	356	6.5	281	361	4.5
Orlando St and Marina Dr	Marina Dr	E	App	145	185	3.1	274	264	0.6
Orlando St and Marina Dr	Marina Dr	E	Dep	162	206	3.2	265	266	0.1
Orlando St and Marina Dr	Orlando St	S	App	247	360	6.5	283	407	6.7
Orlando St and Marina Dr	Orlando St	S	Dep	388	393	0.3	379	349	1.6
Hogbin Dr and Harbour Dr	Hogbin Dr	N	App	799	756	1.5	651	645	0.2
Hogbin Dr and Harbour Dr	Hogbin Dr	N	Dep	696	705	0.3	782	846	2.2
Hogbin Dr and Harbour Dr	Harbour Dr	E	App	549	374	8.1	580	390	8.6
Hogbin Dr and Harbour Dr	Harbour Dr	E	Dep	575	651	3.1	587	586	0.0
Hogbin Dr and Harbour Dr	Hogbin Dr	S	App	879	781	3.4	788	827	1.4
Hogbin Dr and Harbour Dr	Hogbin Dr	S	Dep	823	676	5.4	782	626	5.9
Hogbin Dr and Harbour Dr	Harbour Dr	W	App	513	652	5.8	688	681	0.3
Hogbin Dr and Harbour Dr	Harbour Dr	W	Dep	646	526	5.0	556	491	2.8
Albany St and Hogbin Dr and City Hill Dr	Albany St	N W	App	478	464	0.6	431	462	1.5
Albany St and Hogbin Dr and City Hill Dr	Albany St	N W	Dep	708	605	4.0	478	389	4.3
Albany St and Hogbin Dr and City Hill Dr	Hobgin Dr	N	App	848	806	1.5	817	659	5.8

Intersection	Road	App	Dir	AM			PM		
				Obs	Mod	GEH	Obs	Mod	GEH
Albany St and Hogbin Dr and City Hill Dr	Hobgin Dr	N	Dep	938	788	5.1	821	822	0.0
Albany St and Hogbin Dr and City Hill Dr	Howard St	E	App	49	32	2.7	53	60	0.9
Albany St and Hogbin Dr and City Hill Dr	Howard St	E	Dep	38	35	0.5	40	61	3.0
Albany St and Hogbin Dr and City Hill Dr	Hogbin Dr	S	App	1412	1361	1.4	1103	1151	1.4
Albany St and Hogbin Dr and City Hill Dr	City Hill Dr	W	App	11	1	4.1	31	0	7.9
Albany St and Hogbin Dr and City Hill Dr	City Hill Dr	W	Dep	8	2	2.7	3	6	1.4
Hogbin Dr and Sawtell Rd	Hogbin Dr	N	App	514	505	0.4	1074	1117	1.3
Hogbin Dr and Sawtell Rd	Hogbin Dr	N	Dep	1205	1278	2.1	658	642	0.6
Hogbin Dr and Sawtell Rd	Sawtell Rd	E	App	570	631	2.5	397	382	0.8
Hogbin Dr and Sawtell Rd	Sawtell Rd	E	Dep	229	306	4.7	429	595	7.3
Hogbin Dr and Sawtell Rd	Hogbin Dr	S	App	819	833	0.5	521	537	0.7
Hogbin Dr and Sawtell Rd	Sawtell Rd	W	App	454	490	1.7	439	403	1.8
Hogbin Dr and Sawtell Rd	Sawtell Rd	W	Dep	366	347	1.0	475	370	5.1
Lyons Rd and Hogbin Dr	Lyons Rd	N	App	266	245	1.3	246	259	0.8
Lyons Rd and Hogbin Dr	Lyons Rd	N	Dep	208	183	1.8	313	314	0.1
Lyons Rd and Hogbin Dr	Hogbin Dr	E	App	158	115	3.7	386	368	0.9
Lyons Rd and Hogbin Dr	Hogbin Dr	E	Dep	355	333	1.2	216	189	1.9
Lyons Rd and Hogbin Dr	Lyons Rd	S	App	359	324	1.9	255	232	1.5
Lyons Rd and Hogbin Dr	Lyons Rd	S	Dep	220	167	3.8	358	355	0.2
York St and Arthur St	Arthur St	E	App	324	382	3.1	390	373	0.9
York St and Arthur St	Arthur St	E	Dep	342	289	3.0	323	266	3.3
York St and Arthur St	York St	S	App	42	79	4.8	61	94	3.7
York St and Arthur St	York St	S	Dep	24	23	0.2	55	36	2.8
York St and Arthur St	Arthur St	W	App	357	309	2.6	368	296	4.0
Spagnolos Rd and Corramba Rd	Spagnolos Rd	N	App	7	23	4.1	3	2	0.6
Spagnolos Rd and Corramba Rd	Spagnolos Rd	N	Dep	9	7	0.7	5	10	1.8
Spagnolos Rd and Corramba Rd	Corramba Rd	E	App	145	158	1.1	385	379	0.3
Spagnolos Rd and Corramba Rd	Corramba Rd	W	App	494	514	0.9	197	208	0.8
Spagnolos Rd and Corramba Rd	Corramba Rd	W	Dep	146	153	0.6	386	370	0.8
Roselands Dr and Coramba Rd	Roselands Dr	N	App	70	50	2.6	22	15	1.6
Roselands Dr and Coramba Rd	Roselands Dr	N	Dep	25	35	1.8	48	30	2.9
Roselands Dr and Coramba Rd	Coramba Rd	E	App	155	161	0.5	420	405	0.7
Roselands Dr and Coramba Rd	Coramba Rd	E	Dep	555	556	0.0	216	218	0.1
Roselands Dr and Coramba Rd	Coramba Rd	W	App	502	538	1.6	203	210	0.5
Loaders Ln and Coramba Rd	Loaders Ln	N	App	42	53	1.6	23	15	1.8
Loaders Ln and Coramba Rd	Loaders Ln	N	Dep	20	19	0.2	38	32	1.0

Intersection	Road	App	Dir	AM			PM		
				Obs	Mod	GEH	Obs	Mod	GEH
Loaders Ln and Coramba Rd	Coramba Rd	E	App	183	195	0.9	454	457	0.1
Loaders Ln and Coramba Rd	Coramba Rd	E	Dep	610	651	1.6	236	251	1.0
Loaders Ln and Coramba Rd	Coramba Rd	W	App	579	600	0.9	224	238	0.9
Loaders Ln and Coramba Rd	Coramba Rd	W	Dep	174	177	0.2	427	427	0.0
Robin St and Coramba Rd	Robin St	N	App	179	130	3.9	100	123	2.2
Robin St and Coramba Rd	Robin St	N	Dep	210	190	1.4	94	68	2.9
Robin St and Coramba Rd	Coramba Rd	E	App	327	338	0.6	639	613	1.0
Robin St and Coramba Rd	Coramba Rd	E	Dep	860	742	4.2	341	408	3.5
Robin St and Coramba Rd	Gailer Dr	S	App	97	24	9.4	96	69	3.0
Robin St and Coramba Rd	Gailer Dr	S	Dep	121	183	5.0	83	23	8.2
Robin St and Coramba Rd	Coramba Rd	W	App	866	883	0.6	334	323	0.6
Robin St and Coramba Rd	Coramba Rd	W	Dep	278	263	0.9	651	625	1.0
Azalea Ave and Coramba Rd	Coramba Rd	E	App	154	233	5.7	383	476	4.5
Azalea Ave and Coramba Rd	Coramba Rd	E	Dep	588	590	0.1	253	318	3.8
Azalea Ave and Coramba Rd	Azalea Ave	S	App	259	196	4.2	446	291	8.1
Azalea Ave and Coramba Rd	Azalea Ave	S	Dep	385	288	5.3	282	224	3.6
Azalea Ave and Coramba Rd	Coramba Rd	W	App	871	791	2.8	352	428	3.8
Azalea Ave and Coramba Rd	Coramba Rd	W	Dep	311	342	1.7	646	647	0.0
Lyster St and Coramba Rd	Coramba Rd	E	App	206	241	2.3	386	462	3.7
Lyster St and Coramba Rd	Lyster St	S	App	96	80	1.7	158	191	2.5
Lyster St and Coramba Rd	Lyster St	S	Dep	156	179	1.8	109	158	4.2
Lyster St and Coramba Rd	Coramba Rd	W	App	638	548	3.7	337	318	1.0
Lyster St and Coramba Rd	Coramba Rd	W	Dep	225	228	0.2	443	446	0.1
Moonee St and Coramba Rd	Moonee St	N	App	347	248	5.7	387	233	8.7
Moonee St and Coramba Rd	Moonee St	S	App	398	325	3.8	443	416	1.3
Moonee St and Coramba Rd	Coramba Rd	W	App	526	463	2.8	364	369	0.3
Gordon St and Harbour Dr	Gordon St	N	App	561	553	0.3	674	692	0.7
Gordon St and Harbour Dr	Gordon St	N	Dep	718	682	1.4	705	675	1.1
Gordon St and Harbour Dr	Harbour Dr	E	App	583	460	5.4	700	505	7.9
Gordon St and Harbour Dr	Gordon St	S	App	446	426	1.0	470	465	0.2
Gordon St and Harbour Dr	Gordon St	S	Dep	372	170	12.3	522	267	12.8
Gordon St and Harbour Dr	Harbour Dr	W	App	285	304	1.1	262	241	1.3
Gordon St and Park Ave	Gordon St	N	App	342	168	10.9	520	337	8.8
Gordon St and Park Ave	Gordon St	N	Dep	495	521	1.2	477	400	3.7
Gordon St and Park Ave	Park Ave	E	App	113	123	0.9	156	254	6.8
Gordon St and Park Ave	Park Ave	E	Dep	187	210	1.6	249	152	6.9
Gordon St and Park Ave	Gordon St	S	App	510	461	2.2	388	326	3.3
Gordon St and Park Ave	Gordon St	S	Dep	380	309	3.8	453	440	0.6
Gordon St and Park Ave	Park Ave	W	App	368	446	3.9	503	384	5.7
Gordon St and Park Ave	Park Ave	W	Dep	271	158	7.7	388	308	4.3
Earl St and Harbour Dr	Earl St	N	App	59	53	0.8	248	253	0.3
Earl St and Harbour Dr	Earl St	N	Dep	119	171	4.3	185	253	4.6

Intersection	Road	App	Dir	AM			PM		
				Obs	Mod	GEH	Obs	Mod	GEH
Earl St and Harbour Dr	Harbour Dr	E	App	620	384	10.5	597	435	7.1
Earl St and Harbour Dr	Harbour Dr	E	Dep	653	751	3.7	759	634	4.7
Earl St and Harbour Dr	Earl St	S	App	439	407	1.6	476	235	12.8
Earl St and Harbour Dr	Earl St	S	Dep	314	193	7.6	312	264	2.8
Earl St and Harbour Dr	Harbour Dr	W	App	542	729	7.4	576	737	6.3
Earl St and Albany St	Earl St	N	App	225	263	2.4	292	331	2.2
Earl St and Albany St	Earl St	N	Dep	496	545	2.1	385	282	5.6
Earl St and Albany St	Albany St	E	App	626	548	3.2	521	475	2.1
Earl St and Albany St	Albany St	E	Dep	515	555	1.7	438	470	1.5
Earl St and Albany St	Earl St	S	App	406	444	1.8	357	222	7.9
Earl St and Albany St	Earl St	S	Dep	260	203	3.7	314	334	1.1
Earl St and Albany St	Albany St	W	App	488	256	12.0	423	287	7.2
Gordon St and Albany St	Gordon St	N	App	329	299	1.7	437	435	0.1
Gordon St and Albany St	Gordon St	N	Dep	549	447	4.6	379	321	3.1
Gordon St and Albany St	Albany St	E	App	454	208	13.5	464	235	12.2
Gordon St and Albany St	Gordon St	S	App	164	161	0.2	65	67	0.2
Gordon St and Albany St	Gordon St	S	Dep	153	250	6.8	84	253	13.0
Gordon St and Albany St	Albany St	W	App	547	561	0.6	350	473	6.1
Gordon St and Albany St	Albany St	W	Dep	289	265	1.4	427	342	4.3
Pacific Hwy (16.1) - 1km South Of Moonee Beach	Pacific Hwy		NB	573	675	4.1	1128	1207	2.3
Pacific Hwy (16.1) - 1km South Of Moonee Beach	Pacific Hwy		SB	1296	1451	4.2	765	783	0.6
Hogbin Dr (2.2) - 300m North Of Hi-Tech Dr	Hogbin Dr		NB	1044	1186	4.3	578	647	2.8
Hogbin Dr (2.2) - 300m North Of Hi-Tech Dr	Hogbin Dr		SB	544	575	1.3	951	1059	3.4
Bruce King Dr (11.2) - 50m East Of Pacific Hwy	Bruce King Dr		WB	32	83	6.7	54	76	2.7
Bruce King Dr (11.2) - 50m East Of Pacific Hwy	Bruce King Dr		EB	107	159	4.5	225	251	1.7
Pacific Hwy (4.3) - 400m North Of Bonville Station Rd Overpass	Pacific Hwy		NB	919	976	1.9	670	739	2.6
Pacific Hwy (4.3) - 400m North Of Bonville Station Rd Overpass	Pacific Hwy		SB	532	546	0.6	909	815	3.2
Spagnolos Rd (3.1) - 450m North Of Coramba Rd	Spagnolos Rd		NB	3	15	4.0	8	17	2.5
Spagnolos Rd (3.1) - 450m North Of Coramba Rd	Spagnolos Rd		SB	11	33	4.7	4	4	0.0
William Sharp Dr (3.2) - 300m SW Of Sherpards Ln	William Sharp Dr		NB	41	45	0.6	25	17	1.7

Intersection	Road	App	Dir	AM			PM		
				Obs	Mod	GEH	Obs	Mod	GEH
William Sharp Dr (3.2) - 300m SW Of Sherpards Ln	William Sharp Dr		SB	25	18	1.5	33	28	0.9
Shephards Ln (3.3) - 300m North Of Coramba Rd	Shephards Ln		NB	241	245	0.3	317	303	0.8
Shephards Ln (3.3) - 300m North Of Coramba Rd	Shephards Ln		SB	336	313	1.3	277	237	2.5
Robin St (3.4) - 400m North Of Coramba Rd	Robin St		NB	132	85	4.5	73	58	1.9
Robin St (3.4) - 400m North Of Coramba Rd	Robin St		SB	143	113	2.7	88	65	2.6
Gundagai St (3.5) - 100m West Of Murdock St	Gundagai St		WB	172	233	4.3	390	417	1.3
Gundagai St (3.5) - 100m West Of Murdock St	Gundagai St		EB	500	450	2.3	307	266	2.4
Orlando St (3.8) - 50m South Of Vost St	Orlando St		NB	271	350	4.5	419	519	4.6
Orlando St (3.8) - 50m South Of Vost St	Orlando St		SB	556	489	2.9	364	280	4.7
Macauleys Headland Dr (9.3) - 20m East Of Pacific Hwy	Macauleys Headland Dr		WB	3	0	2.4	4	0	2.8
Macauleys Headland Dr (9.3) - 20m East Of Pacific Hwy	Macauleys Headland Dr		EB	54	62	1.1	22	9	3.3
Thompsons Rd (8.10) - 20m East Of Pacific Hwy	Thompsons Rd		WB	259	219	2.6	241	338	5.7
Thompsons Rd (8.10) - 20m East Of Pacific Hwy	Thompsons Rd		EB	312	342	1.7	263	199	4.2
Arthur St (12.1) - 40m West Of Hogbin Dr N	Arthur St		WB	356	387	1.6	523	563	1.7
Arthur St (12.1) - 40m West Of Hogbin Dr N	Arthur St		EB	482	389	4.5	371	276	5.3
Park Beach Rd (12.2) - 40m West Of Hogbin Dr N	Park Beach Rd		WB	232	198	2.3	283	275	0.5
Park Beach Rd (12.2) - 40m West Of Hogbin Dr N	Park Beach Rd		EB	215	258	2.8	304	303	0.1
Boultwood St (12.3) - 30m West Of Hogbin Dr N	Boultwood St		WB	16	14	0.5	37	46	1.4
Boultwood St (12.3) - 30m West Of Hogbin Dr N	Boultwood St		EB	19	10	2.4	21	46	4.3
Prince St (12.4) - 30m West Of Hogbin Dr N	Prince St		WB	26	34	1.5	53	66	1.7
Prince St (12.4) - 30m West Of Hogbin Dr N	Prince St		EB	49	59	1.4	39	22	3.1

Intersection	Road	App	Dir	AM			PM		
				Obs	Mod	GEH	Obs	Mod	GEH
Watsonia Ave (12.6) - 60m NE Of Gentlemen St	Watsonia Ave		NB	16	22	1.4	23	20	0.6
Watsonia Ave (12.6) - 60m NE Of Gentlemen St	Watsonia Ave		SB	2	0	2.0	2	0	2.0
Watsonia Ave (12.7) - Just West of Hogbin Dr	Watsonia Ave		WB	58	88	3.5	65	61	0.5
Watsonia Ave (12.7) - Just West of Hogbin Dr	Watsonia Ave		EB	39	67	3.8	24	41	3.0
Pacific Hwy (29.1) - 700m South Of Stadium Dr	Pacific Hwy		NB	1887	1828	1.4	1051	1131	2.4
Pacific Hwy (29.1) - 700m South Of Stadium Dr	Pacific Hwy		SB	944	953	0.3	1621	1507	2.9
N Boambee Rd (29.2) - 100m West Of Highlander Dr	N Boambee Rd		WB	11	8	1.0	17	12	1.3
N Boambee Rd (29.2) - 100m West Of Highlander Dr	N Boambee Rd		EB	22	26	0.8	18	1	5.5
Bennetts Rd (29.5) - 200m West Of Coramba Rd	Bennetts Rd		WB	7	2	2.4	14	31	3.6
Bennetts Rd (29.5) - 200m West Of Coramba Rd	Bennetts Rd		EB	15	41	4.9	15	18	0.7
Englands Rd (6.5) - 400m West Of Isles Dr	Englands Rd		WB	17	31	2.9	29	42	2.2
Englands Rd (6.5) - 400m West Of Isles Dr	Englands Rd		EB	32	40	1.3	25	30	1.0
Blacker Close (15.1) - 50m East Of Donn-Patterson Dr	Blacker Close		WB	77	84	0.8	45	36	1.4
Blacker Close (15.1) - 50m East Of Donn-Patterson Dr	Blacker Close		EB	32	28	0.7	62	81	2.2
Lamberts Rd (15.2) - 30m East Of Sawtell Rd	Lamberts Rd		WB	136	129	0.6	68	61	0.9
Lamberts Rd (15.2) - 30m East Of Sawtell Rd	Lamberts Rd		EB	59	54	0.7	115	94	2.1
Royal Palm Dr (15.3) - 20m West Of Lyons Rd	Royal Palm Dr		WB	33	27	1.1	70	58	1.5
Royal Palm Dr (15.3) - 20m West Of Lyons Rd	Royal Palm Dr		EB	73	74	0.1	42	34	1.3
Lake Dr (15.5) - 50m North Of N Boambee Rd	Lake Dr		NB	46	43	0.4	80	79	0.1
Lake Dr (15.5) - 50m North Of N Boambee Rd	Lake Dr		SB	107	78	3.0	58	57	0.1
Hi-Tech Dr (14.1) - 30m West Of Hogbin Dr	Hi-Tech Dr		WB	166	265	6.7	109	117	0.8

Intersection	Road	App	Dir	AM			PM		
				Obs	Mod	GEH	Obs	Mod	GEH
Hi-Tech Dr (14.1) - 30m West Of Hogbin Dr	Hi-Tech Dr		EB	109	103	0.6	189	194	0.4
Amaroo Cresent (14.5) - 30m West Of Toormina Rd	Amaroo Cresent		WB	107	87	2.0	100	193	7.7
Amaroo Cresent (14.5) - 30m West Of Toormina Rd	Amaroo Cresent		EB	186	244	4.0	63	81	2.1
Kintorie Cresent (14.6) - 30m West Of Toormina Rd	Kintorie Cresent		WB	16	10	1.7	35	107	8.5
Kintorie Cresent (14.6) - 30m West Of Toormina Rd	Kintorie Cresent		EB	51	13	6.7	20	76	8.1
Mirroola Cresent (14.7) - 30m west of Toormina Rd	Mirroola Cresent		WB	37	7	6.4	42	42	0.0
Mirroola Cresent (14.7) - 30m west of Toormina Rd	Mirroola Cresent		EB	51	67	2.1	37	12	5.1
Linden Ave (14.8) - 30m West Of Toormina Rd	Linden Ave		WB	186	148	2.9	169	130	3.2
Linden Ave (14.8) - 30m West Of Toormina Rd	Linden Ave		EB	222	149	5.4	126	179	4.3
Playford Ave (14.9) - 30m West of Toormina Rd	Playford Ave		WB	26	17	1.9	58	51	0.9
Playford Ave (14.9) - 30m West of Toormina Rd	Playford Ave		EB	78	65	1.5	50	34	2.5
Hogbin Drive mid block between Prince St and Boultwood St	Hogbin Drive		SB	568	575	0.3	538	483	2.4
Hogbin Drive mid block between Prince St and Boultwood St	Hogbin Drive		NB	549	505	1.9	679	789	4.1
Park Beach Road mid block Hogbin Drive to Ocean Parade	Park Beach Road		WB	80	111	3.2	74	134	5.9
Park Beach Road mid block Hogbin Drive to Ocean Parade	Park Beach Road		EB	94	78	1.7	134	129	0.4
BP service Stn entrance Pacific Hwy 300m north of Englands Rd	Kindell Place		NB	88	73	1.7	71	65	0.7
Phil Hawthorne Drive 200m north of Stadium Drive	Phil Hawthorne Drive		SB	25	27	0.4	192	170	1.6
Phil Hawthorne Drive 200m north of Stadium Drive	Phil Hawthorne Drive		NB	159	183	1.8	25	25	0.0

F2 Screenline Volume Comparisons

Screenline	Direction	Location	Observed	Modelled	Difference	% Difference	GEH
1 North/south - north of Bruxner Park Road (AM)	Northbound	Pacific Hwy	724	758	34	5%	1.2
	Northbound	James Small Dr	100	147	47	47%	4.2
	Northbound	**TOTAL**	**824**	**905**	**81**	**10%**	**2.8**
	Southbound	Pacific Hwy	2015	2033	18	1%	0.4
	Southbound	James Small Dr	163	197	34	21%	2.5
	Southbound	**TOTAL**	**2178**	**2230**	**52**	**2%**	**1.1**
	Overall	**TOTAL**	**3002**	**3135**	**133**	**4%**	**2.4**

Screenline	Direction	Location	Observed	Modelled	Difference	% Difference	GEH
2 North/south - across Coffs Creek (AM)	Northbound	Shephards Ln	241	245	4	2%	0.3
	Northbound	Robin St	132	85	-47	-36%	4.5
	Northbound	Gundagai St	172	233	61	35%	4.3
	Northbound	Pacific Hwy	1133	1106	-27	-2%	0.8
	Northbound	Hogbin Dr	696	705	9	1%	0.3
	Northbound	Orlando St	271	350	79	29%	4.5
	Northbound	**TOTAL**	**2645**	**2724**	**79**	**3%**	**1.5**
	Southbound	Shephards Ln	336	313	-23	-7%	1.3
	Southbound	Robin St	143	113	-30	-21%	2.7
	Southbound	Gundagai St	500	450	-50	-10%	2.3
	Southbound	Pacific Hwy	1979	2032	53	3%	1.2
	Southbound	Hogbin Dr	799	756	-43	-5%	1.5
	Southbound	Orlando St	556	489	-67	-12%	2.9
	Southbound	**TOTAL**	**4313**	**4153**	**-160**	**-4%**	**2.5**
	Overall	**TOTAL**	**6958**	**6877**	**-81**	**-1%**	**1.0**

Screenline	Direction	Location	Observed	Modelled	Difference	% Difference	GEH
3 North/south - south of Englands Road (AM)	Northbound	Pacific Hwy	1887	1828	-59	-3%	1.4
	Northbound	Hogbin Dr	944	953	9	1%	0.3
	Northbound	**TOTAL**	**2831**	**2781**	**-50**	**-2%**	**0.9**
	Southbound	Pacific Hwy	1038	1109	71	7%	2.2
	Southbound	Hogbin Dr	816	781	-35	-4%	1.2
	Southbound	**TOTAL**	**1854**	**1890**	**36**	**2%**	**0.8**
	Overall	**TOTAL**	**4685**	**4671**	**-14**	**0%**	**0.2**

Screenline	Direction	Location	Observed	Modelled	Difference	% Difference	GEH
4 East/west along western side of Hogbin Drive (AM)	Eastbound	Arthur St	482	389	-93	-19%	4.5
	Eastbound	Park Beach Rd	215	258	43	20%	2.8
	Eastbound	Boultwood Dr	19	10	-9	-47%	2.4
	Eastbound	Prince St	49	59	10	20%	1.4
	Eastbound	Orlando St	566	484	-82	-14%	3.6
	Eastbound	Watsonia Ave	39	67	28	72%	3.8
	Eastbound	Harbour Dr	513	652	139	27%	5.8
	Eastbound	Albany St	478	464	-14	-3%	0.6
	Eastbound	Stadium Dr	434	503	69	16%	3.2
	Eastbound	**TOTAL**	**2795**	**2886**	**91**	**3%**	**1.7**
	Westbound	Arthur St	356	387	31	9%	1.6
	Westbound	Park Beach Rd	232	198	-34	-15%	2.3
	Westbound	Boultwood Dr	16	14	-2	-13%	0.5
	Westbound	Prince St	26	34	8	31%	1.5
	Westbound	Orlando St	404	474	70	17%	3.3
	Westbound	Watsonia Ave	58	88	30	52%	3.5
	Westbound	Harbour Dr	646	526	-120	-19%	5.0
	Westbound	Albany St	708	605	-103	-15%	4.0
	Westbound	Stadium Dr	478	395	-83	-17%	4.0
	Westbound	**TOTAL**	**2924**	**2721**	**-203**	**-7%**	**3.8**
	Overall	**TOTAL**	**5719**	**5607**	**-112**	**-2%**	**1.5**

Screenline	Direction	Location	Observed	Modelled	Difference	% Difference	GEH
1 North/south - north of Bruxner Park Road (PM)	Northbound	Pacific Hwy	1547	1577	30	2%	0.8
	Northbound	James Small Dr	171	203	32	19%	2.3
	Northbound	**TOTAL**	**1718**	**1780**	**62**	**4%**	**1.5**
	Southbound	Pacific Hwy	919	846	-73	-8%	2.5
	Southbound	James Small Dr	92	111	19	21%	1.9
	Southbound	**TOTAL**	**1011**	**957**	**-54**	**-5%**	**1.7**
	Overall	**TOTAL**	**2729**	**2737**	**8**	**0%**	**0.2**

Screenline	Direction	Location	Observed	Modelled	Difference	% Difference	GEH
2 North/south - across Coffs Creek (PM)	Northbound	Shephards Ln	317	303	-14	-4%	0.8
	Northbound	Robin St	73	58	-15	-21%	1.9
	Northbound	Gundagai St	390	417	27	7%	1.3
	Northbound	Pacific Hwy	1642	1690	48	3%	1.2

	Northbound	Hogbin Dr	782	846	64	8%	2.2
	Northbound	Orlando St	419	519	100	24%	4.6
	Northbound	**TOTAL**	**3623**	**3833**	**210**	**6%**	**3.4**
	Southbound	Shephards Ln	277	237	-40	-14%	2.5
	Southbound	Robin St	88	65	-23	-26%	2.6
	Southbound	Gundagai St	307	266	-41	-13%	2.4
	Southbound	Pacific Hwy	1397	1594	197	14%	5.1
	Southbound	Hogbin Dr	651	645	-6	-1%	0.2
	Southbound	Orlando St	364	280	-84	-23%	4.7
	Southbound	**TOTAL**	**3084**	**3087**	**3**	**0%**	**0.1**
	Overall	**TOTAL**	**6707**	**6920**	**213**	**3%**	**2.6**

Screenline	Direction	Location	Observed	Modelled	Difference	% Difference	GEH
3 North/south - south of Englands Road (PM)	Northbound	Pacific Hwy	1051	1131	80	8%	2.4
	Northbound	Hogbin Dr	1621	1507	-114	-7%	2.9
	Northbound	**TOTAL**	**2672**	**2638**	**-34**	**-1%**	**0.7**
	Southbound	Pacific Hwy	633	710	77	12%	3.0
	Southbound	Hogbin Dr	1108	1049	-59	-5%	1.8
	Southbound	**TOTAL**	**1741**	**1759**	**18**	**1%**	**0.4**
	Overall	**TOTAL**	**4413**	**4397**	**-16**	**0%**	**0.2**

Screenline	Direction	Location	Observed	Modelled	Difference	% Difference	GEH
4 East/west along western side of Hogbin Drive (PM)	Eastbound	Arthur St	371	276	-95	-26%	5.3
	Eastbound	Park Beach Rd	304	303	-1	0%	0.1
	Eastbound	Boultwood Dr	21	46	25	119%	4.3
	Eastbound	Prince St	39	22	-17	-44%	3.1
	Eastbound	Orlando St	436	404	-32	-7%	1.6
	Eastbound	Watsonia Ave	24	41	17	71%	3.0
	Eastbound	Harbour Dr	688	681	-7	-1%	0.3
	Eastbound	Albany St	431	462	31	7%	1.5
	Eastbound	Stadium Dr	411	425	14	3%	0.7
	Eastbound	**TOTAL**	**2725**	**2660**	**-65**	**-2%**	**1.3**
	Westbound	Arthur St	523	563	40	8%	1.7
	Westbound	Park Beach Rd	283	275	-8	-3%	0.5
	Westbound	Boultwood Dr	37	46	9	24%	1.4
	Westbound	Prince St	53	66	13	25%	1.7
	Westbound	Orlando St	479	377	-102	-21%	4.9
	Westbound	Watsonia Ave	65	61	-4	-6%	0.5
	Westbound	Harbour Dr	556	491	-65	-12%	2.8
	Westbound	Albany St	478	389	-89	-19%	4.3
	Westbound	Stadium Dr	365	254	-111	-30%	6.3
	Westbound	**TOTAL**	**2839**	**2522**	**-317**	**-11%**	**6.1**
	Overall	**TOTAL**	**5564**	**5182**	**-382**	**-7%**	**5.2**

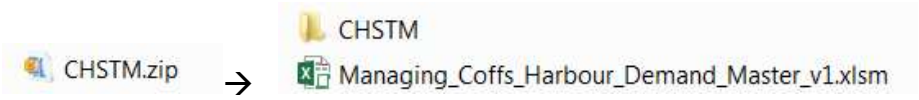
Appendix G

CHSTM Model User Guide

G1 How to install

The Coffs Harbour Strategic Transport Model (CHSTM) was developed in python scripts utilising the EMME platform in version 4.2.7. The model should be compatible with slightly earlier version of EMME, but it is suggested to operate the model in EMME v4.2.7 or later versions.

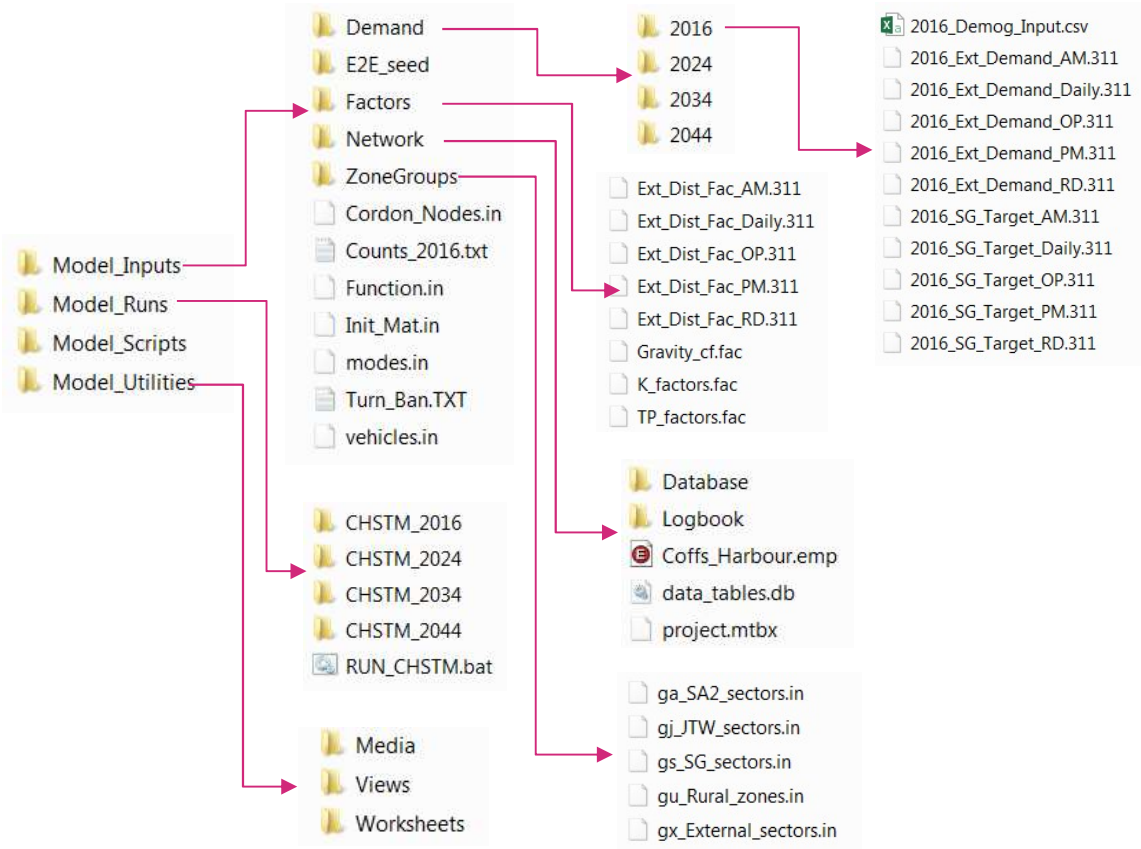
The delivered model will come with a single zip file named "CHSTM.zip" around 18 MB. Unzip the file to a desire folder location and it will create a model folder named "CHSTM" and an excel spreadsheet named "Managing_Coffs_Harbour_Demand_Master_v1.xlsm".



This document discusses about the model file structure and how to operate the model. For model structure and other detailed technical specifications, please refer to the main document of "Model Development Report".

G2 Model file structure

In folder "CHSTM", it has the following **Main Folders** illustrated in figure below.



Model_Inputs folder contains all the necessary model input files just in this location. It includes demand inputs of each model year in the "Demand" subfolder, scenario networks in the "Network" subfolder, factors, coefficients, and parameters in the "Factors" subfolder, and zone partition files in the "ZoneGroups" subfolder. This "Model_Inputs" folder also contains all the important transaction files to establish the database including modes, vehicles, and functions.

Model_Runs folder are the location to save all the model run scenarios generated for projects / studies based on defined input files. This folder currently does not contain any completed model run from the supplied model zip file. However it will be discussed in the following contents about how to establish scenario model runs.

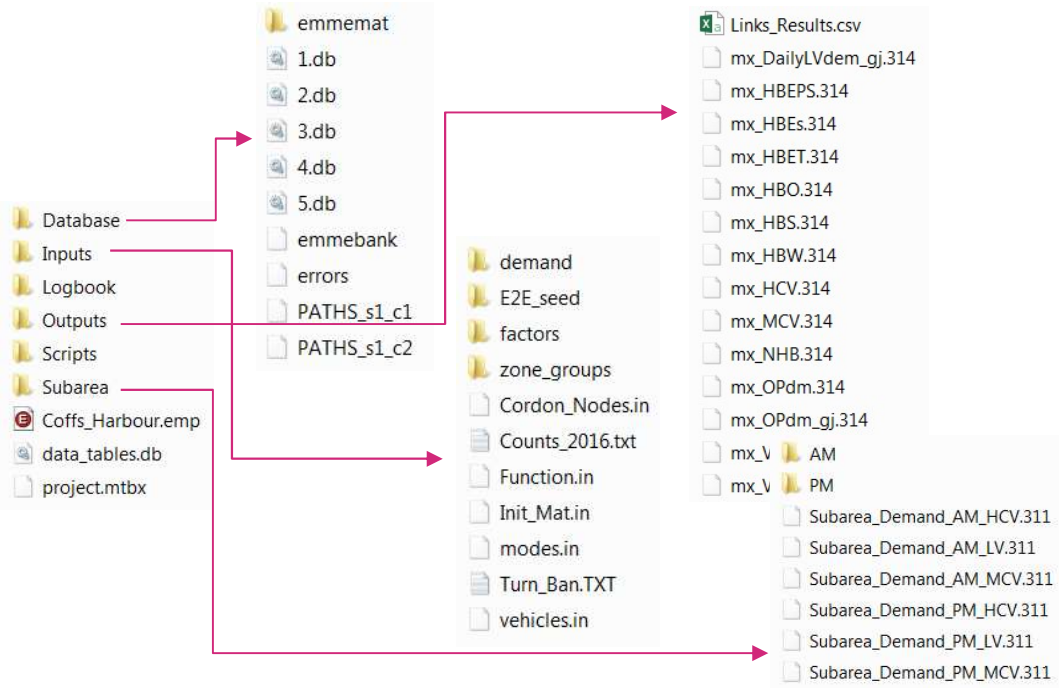
Model_Scripts folder contains all the developed python scripts to carry out the model runs. The scripts were named in a numerical order following the procedures of the model run.

Script group	Script name	Description
Group 0 – build model	C0_0_build_databank	Batchin volume delay functions, vehicles
	C0_1_prepare_network_TP	Create time period scenarios from selected network
	C0_2_initialise_all_matrices	Initialise all matrices to allow a clean model run
	C0_3_prepare_matrices	Prepare required matrices for a model run
Group 1 – trip generation	C1_0_import_demog	Batchin demographic inputs from selected demand files
	C1_1_trip_generation	Process trip generations (production & attraction)
Group 2 – trip distribution, mode split, external demand process	C2_0_transfer_generalised_cost	Transfer generalised cost from current to previous (not run in the initial run loop)
	C2_1_gravity_model	Process trip distribution (running gravity model)
	C2_2_mode_calculation	Process mode split (using fixed mode share factors by distance)
	C2_3_external_model	Process external traffic demand from selected demand files
Group 3 – time period split, special generator process	C3_1_aggregate_demand_TP	Aggregate demand by purpose into vehicle classes
	C3_2_special_generator	Process special generator demand from selected demand files
	C3_3_add_external_TP	Aggregate external demand to overall demand by vehicle class to be ready for assignment of each time period
Group 4 –traffic assignment, calculate generalised cost convergence check	C4_1_prepare_initial_skim	Assign unit matrix to get initial network cost skims (only run once during model establishment)
	C4_2_assignment_TP	Process traffic assignment by vehicle class by time period
	C4_3_calculate_generalised_cost	Calculate generalised cost of each time period
	C4_4_convergence_check	Check model run convergence for each time period
Group 5 – result aggregation and export	C5_1_aggregate_result_Daily	Aggregate time period model results to the daily total scenario
	C5_2_export_model_results	Export model link results of each time period and daily totals
	C5_3_export_e2e_seed	Export external to external demand seeds (only for 2016)
	C5_4_calculate_mat_sum	Summarise matrix totals by purpose
Group 9 – other utility scripts	C9_0_copy_scenario	Utility script to copy scenario within the databank
	C9_0_select_link_TP	Utility script to undertake selectlink analysis

	C9_0_subarea_process	Utility script to extract subarea cordon demand after model run

Model_Utilities folder contains the established worksheets in the "Worksheets" subfolder, supporting shape files in the "Media" subfolder, and predefined view extent in the "Views" subfolder. Files in here are publicly accessible from each scenario model run for easy file maintenance.

Up on the completion of each full model run, a scenario model folder will be generated under the **Model_Runs** folder. Each scenario model will has its own folder following the EMME standard structure. The scenario folder structure is illustrated in the following figure.



Database folder contains the modelled scenario emmebank, network shape database files, path files from the assignment process, and the "emmemat" folder contains all the full emme matrices.

Inputs folder contains the relevant input files to establish the scenario model run. The files here are generally copies from the main **Model_Inputs** folder with relevant demand inputs from the selected demand scenarios.

Logbook folder contains the model run logs. This will be discussed in more details in the later section of this Appendix.

Outputs folder saves the model run output files including link results, trip matrices by each trip purposes.

Script folder is empty by default but scripts can be saved in this location to perform model runs or processes on an established databank. Model runs through batch file will be based on script in the **Model_Scripts** folder.

Subarea folder saves the subarea model databank and extracted subarea demand matrices for mesoscophic model inputs.

G3 Manage model inputs

The demand and network are the two input variables used to establish model run scenarios during this study. The input files relate to the demand side include demographic and land use data, external traffic demand, and special generators traffic demand. The network include two scenarios as with or without bypass options which are the 2016 base case network to reflect the existing travel condition in 2016, and with Coffs Harbour Bypass built on top of the 2016 base case.

G3.1 Manage demographic and land use scenarios

The demand inputs are managed in a single spreadsheet named "Managing_Coffs_Harbour_Demand_Master_v1.xlsm". This spreadsheet include the base year demographic and land use of Coffs Harbour in 2016 and the future year forecasts of 2024, 2034, and 2044. It also summarises the totals of each year for comparison and growth rate calculation in tab "Summary_Check". The detailed population and land use categorisation and the process of future year forecast has been documented in the main model development report.

Traffic counts at the external cordon have been used as the external demand inputs into the model. The 2016 traffic counts have been used for the 2016 scenario. The demand of future years has been estimated based on the same population growth rate and used as each relevant future year input.

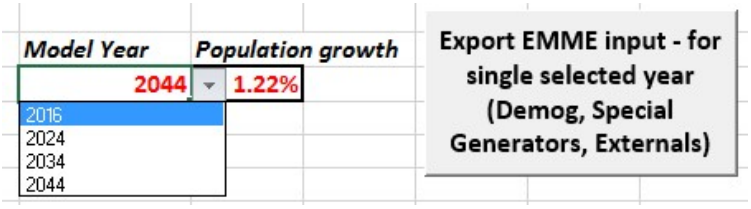
Similarly, traffic counts at the special generator locations have been used as the special generator inputs into the model. The inputs are used as control totals to control the total vehicle demand in and out of the special generator zones. The 2016 traffic counts have been used for the 2016 scenario. The same population growth rate has been used to estimate the future year demand at special generators.

All the above demand data will be managed and processed in the same spreadsheet, and be exported into the EMME compatible input format for model batchin. Should the user needs to make any updates to the future demographic forecast for Coffs Harbour, the changes should be made in the relevant tab of the model year (e.g. tab "Demog_2044"). The spreadsheet will automatically calculate the new growth rate based on new population forecast, and update the external and special generators demand for the relevant model year.

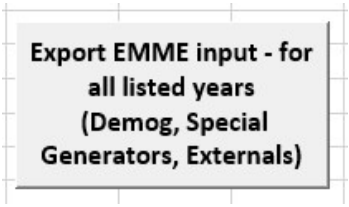
To export demand inputs data for EMME, the user will need to ensure a valid folder location to save the files. The desire location will be .\Model_Inputs\Demand with model year subfolders exist for the relevant model years. Files saved in the location will be accessible during the modelling process.

Then the desire output location need to be specified in cell B2 in tab "Summary_Check". The user then can select the interested model year from a dropdown list in cell B22. Cell C22 will show the calculated population growth rate (compounding growth from base year 2016) for sense checks. Once the model

year is selected, click the button “Export EMME input – for single selected year”, the excel will save all the demand inputs in EMME format into the folder of the selected year.



User can also click button “Export EMME input – for all listed years” to export the demand for all years at once into each folder of the listed years. It is also ok for the user to insert new model years. However, the same data structure should be maintained.



G3.2 Manage network scenarios

The network scenarios of CHSTM are managed in a particular EMME databank in the **Network** folder under **Model_Inputs**.

The current model only include two network scenarios as in the following:

- 1011 – 2016 Base Case network
- 1012 – 2016 Base Case network + Coffs Harbour Bypass

The interested network scenario can be specified by inputting the scenario ID (e.g. 1011) in the model specifications prior to the model run. Additional network scenarios can be added to the database for testing.

G4 How to run

There are two ways to run the CHSTM.

1. Batch run

To run a model without an existing databank, it requires to run the model through specifications in the model run batch file. Model run will be undertaken in non-GUI.

2. Modeller shell run

To run a model with an existing databank, it requires to run the model through modeller shell. Model run will be undertaken with opening EMME GUI.

G4.1 Perform batch run (standard model run)

This approach allows user to run the CHSTM for multiple models in a sequence. It runs a little faster as the model run process does not require opening EMME GUI (non-GUI run). The model run will access the python scripts saved in the **Model_Scripts** folder.

Firstly, make sure all the relevant input files are available to undertake the model runs. For example, all the demand inputs are available in the Model_Inputs/Demand folder for model batchin, and the all the relevant network scenarios exist in the network scenario management databank.

Then, open the batch file "RUN_CHSTM.bat" in the **Model_Runs** folder using text editing tool (**DO NOT double click**). Specify the variables for each model run scenario. Examples are shown in the following figure with one line representing one scenario model run (line 12 to 19).

```
1  @echo off
2  :: IMPORTANT NOTE
3  :: ensure that %EMMEPATH% is set correctly in the environment variables (to the version used for this model run)
4
5  :: SYNTAX
6  :: %1    %2    %3    %4    %5    %6    %7    %8
7  :: [python path]    [script name]    [model_id]    [model_year]    [network_scen]  [max_loop]  [Convergence_critieria] [exte
8  :: To process subarea matrice at the end of model run(s), put "subarea" for variable 9, any other string to not run, cannot l
9  :: Make sure all nodes inside subarea are tagged in file "Cordon_Nodes.in"
10 ::::::::::::::::::::::::::::::::::::::::::::::::::
11
12 "%EMMEPATH%\Python27\python.exe" "..\Model_Scripts\_batchrun_CHSTM.py" CHSTM_2016 2016 1011 10 0.001 0.014 subarea
13 "%EMMEPATH%\Python27\python.exe" "..\Model_Scripts\_batchrun_CHSTM.py" CHSTM_2024 2024 1011 10 0.001 0.014 subarea
14 "%EMMEPATH%\Python27\python.exe" "..\Model_Scripts\_batchrun_CHSTM.py" CHSTM_2034 2034 1011 10 0.001 0.014 subarea
15 "%EMMEPATH%\Python27\python.exe" "..\Model_Scripts\_batchrun_CHSTM.py" CHSTM_2044 2044 1011 10 0.001 0.014 subarea
16 "%EMMEPATH%\Python27\python.exe" "..\Model_Scripts\_batchrun_CHSTM.py" CHSTM_2016_BP 2016 1012 10 0.001 0.014 no_subarea
17 "%EMMEPATH%\Python27\python.exe" "..\Model_Scripts\_batchrun_CHSTM.py" CHSTM_2024_BP 2024 1012 10 0.001 0.014 no_subarea
18 "%EMMEPATH%\Python27\python.exe" "..\Model_Scripts\_batchrun_CHSTM.py" CHSTM_2034_BP 2034 1012 10 0.001 0.014 no_subarea
19 "%EMMEPATH%\Python27\python.exe" "..\Model_Scripts\_batchrun_CHSTM.py" CHSTM_2044_BP 2044 1012 10 0.001 0.014 no_subarea
20
21 pause
22 ::cd ..\
23 :end
```

The variables are listed in the following table.

ID	Variable	Description
1	Python patch	Emmepath location to execute python application (DO NOT change)
2	Script name	Location and name of main model runs script (DO NOT change)
3	Model name	Model scenario name – scenario run folder will be created under this name
4	Model year	Mode year for demand inputs, also used as the title of scenario (i.e. 2044)
5	Network scenario	Selected network scenario ID for model run (i.e. 1011)
6	Maximum loop	The maximum loops for model run if convergence is not achieved (i.e. 10)
7	Convergence criteria	The convergence criteria to exit the demand loop if achieved (i.e. 0.001)
8	External to external demand growth	Defined a fixed growth rate for external to external growth (i.e. 0.014)
9	Extract subarea demand	Whether to extract subarea demand after model run (set "subarea" to extract, or any other string to not extract, DO NOT leave blank)

Lastly, save the changes made to the batch file and double click the file to undertake model runs. The model run time will depend on machine specifications and the model convergence status. The base year 2016 model in the tested machine took 3 loops to converge with ~10 minutes run time. The future year

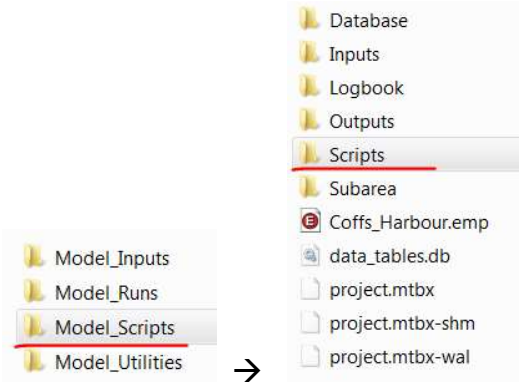
2044 base case do nothing scenario on the same machine took 7 loops to converge with ~20 minutes run time.

Please note, if a scenario name is defined as the same name of an existing model scenario in the same **Model_Runs** folder, the existing model folder will be deleted and then immediately re-created for the new run. Please make a backup copy of the model if it needs to be retained.

G4.2 Perform modeller shell run (customised model run)

Alternatively, the user can undertake a full or partial model run using an existing databank. This requires to open the existing databank, and open EMME prompt tool. This approach will allow user to customise the model with different inputs (non-standard), test different factors and / or parameters for sensitivities. This also allows user to develop customised python scripts for model run or model testing purposes.

This approach does not have access to the python scripts saved in the **Model_Scripts** folder by default. User will need to respecify the python path location in EMME options. Alternatively, all the python scripts in the **Model_Scripts** folder can be copied into the **Scripts** folder in the scenario model for process.



Firstly, copy all the scripts in **Model_Scripts** folder to the **Scripts** folder of the interested scenario. Make changes to the model inputs in the scenario folder if required.

Then, open script “Full_Model_Run.py” in text editing tool, change the model run specifications (similar as the variables described in the other method).

Lastly, open the scenario databank, and open EMME prompt tool. Type in: execfile(“Full_Model_Run.py”) to perform a full model run in EMME GUI.

Please note, each scripts can be run individually in this way. For example, calling execfile(“C4_2_assignment_TP.py”) in the EMME prompt tool it can run the assignment process. Some scripts require specification for variables, so make sure

the variables to be changed to the desire values. Otherwise it will run the process based on the default variables (predefined in the scripts).

G5 Model tools

Some additional tools have been developed during this project for the purpose of result analysis. Those include python scripts to export model outputs, established worksheets for model results checks in geographic format.

G5.1 Utility Scripts

The utility scripts are those included in script group 5 and group 9 for result exporting, and model post processing including selectlink analysis, and subarea process.

Script group	Script name	Description
Group 5 – result aggregation and export	C5_1_aggregate_result_Daily	Aggregate time period model results to the daily total scenario
	C5_2_export_model_results	Export model link results of each time period and daily totals
	C5_3_export_e2e_seed	Export external to external demand seeds (only for 2016)
	C5_4_calculate_mat_sum	Summarise matrix totals by purpose
Group 9 – other utility scripts	C9_0_copy_scenario	Utility script to copy scenario within the databank
	C9_0_select_link_TP	Utility script to undertake selectlink analysis
	C9_0_subarea_process	Utility script to extract subarea cordon demand after model run

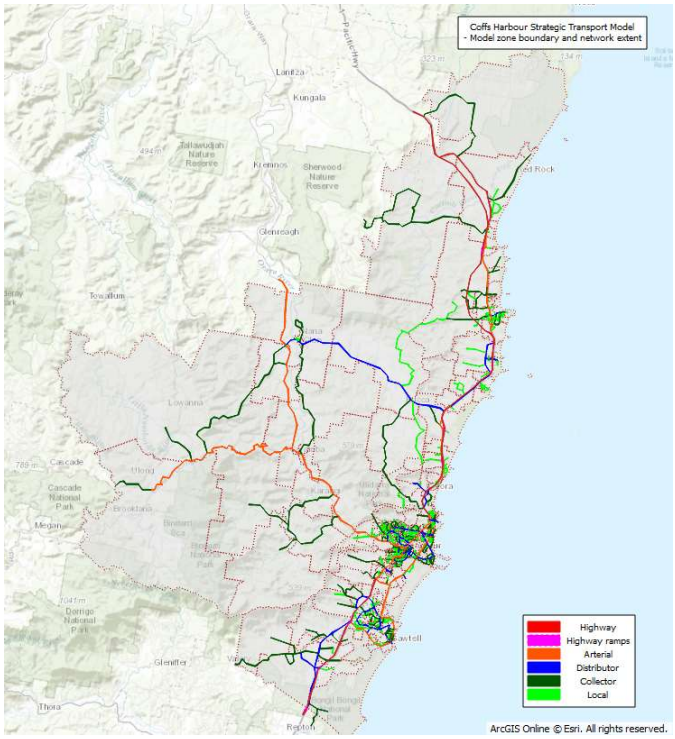
G5.2 Worksheets

The following table lists the worksheets developed for model result checking.

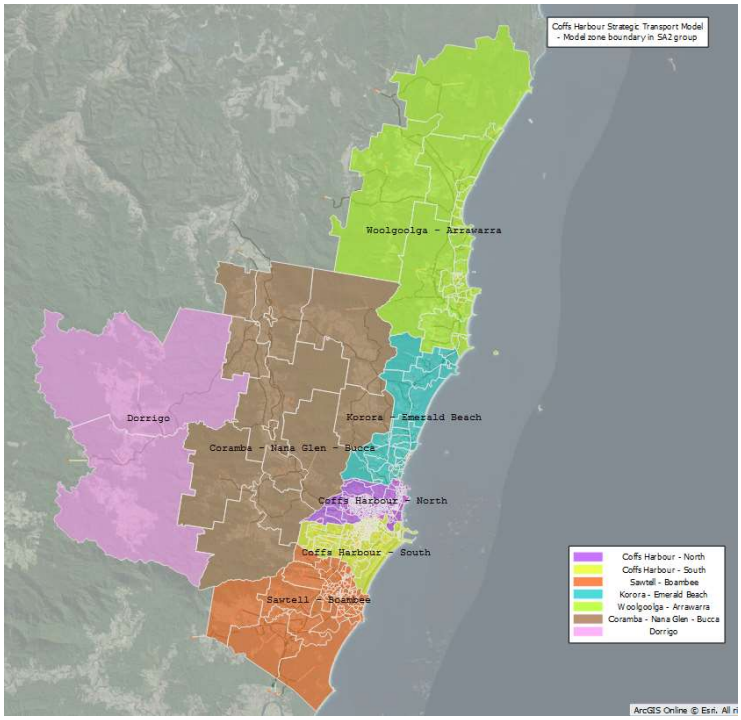
Worksheet	Description
Model_zone_network_overview.emw	Check CHSTM modelled network and zones extent
Road_Hierarchy_plot.emw	Check network cording – link hierarchy
Road_impedance_plot.emw	Check network coding – link impedance
Road_lanes_plot.emw	Check network coding – number of lanes
Check_Zone_groups.emw	Check model zone groups
CheckK_Zone_values.emw	Check zone values in horizontal bars (i.e. total population, employment)
Compare_to_counts.emw	Compare modelled traffic volumes to base year 2016 traffic counts by each time period or daily

Link_Volume_AM.emw	Link volume plot to display modelled AM, PM, daily link volumes.
Link_Volume_PM.emw	
Link_Volume_Daily.emw	
Link_VOC_Plot.emw	Plot link volume over capacity ratio
Compare_sceanrios_link_volume_AM.emw	Compare modelled AM, PM, daily traffic volume between two scenarios (require import the reference case scenario to undertake comparison – import scenario 5 from the other databank as the result include all time periods and daily
Compare_sceanrios_link_volume_PM.emw	
Compare_sceanrios_link_volume_Daily.emw	
Select_Link_12_bin.emw	Check selectlink volumes (need to perform selectlink process first)

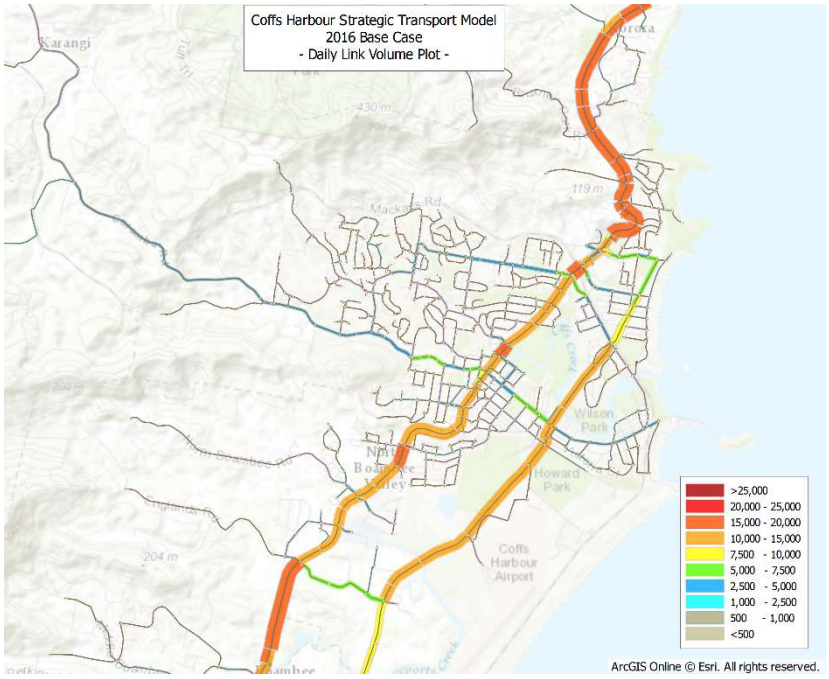
Some examples of the above worksheets are presented below to show the network view of the relevant worksheet.



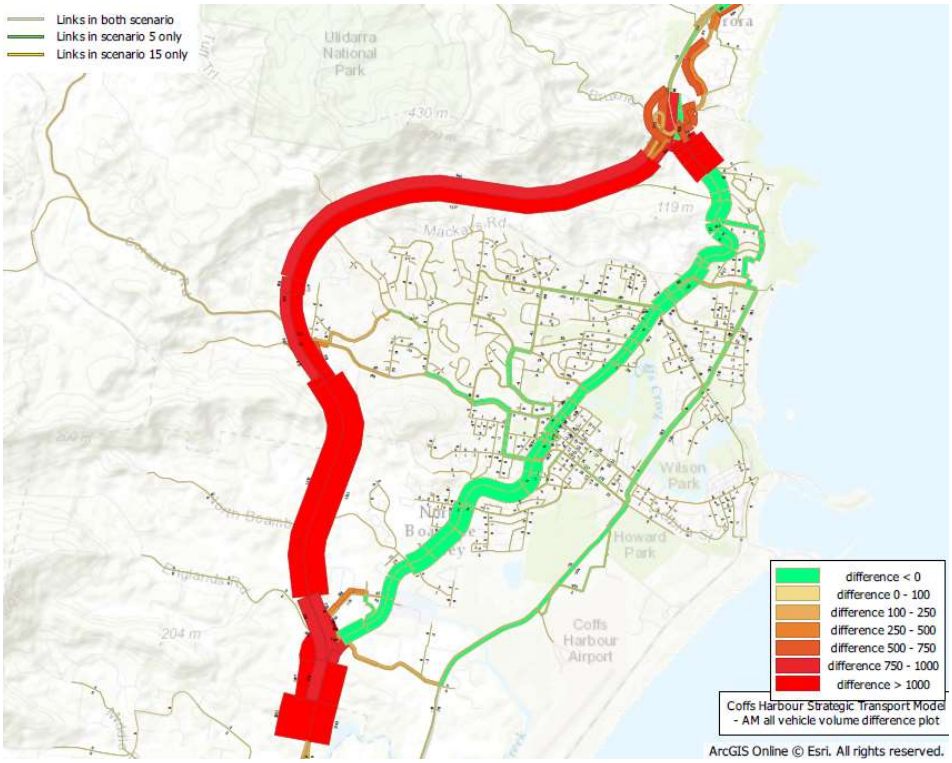
Model zone and network overview worksheet



Zone group worksheet



Daily link volume worksheet



Link volume difference worksheet

G6 Model run logs

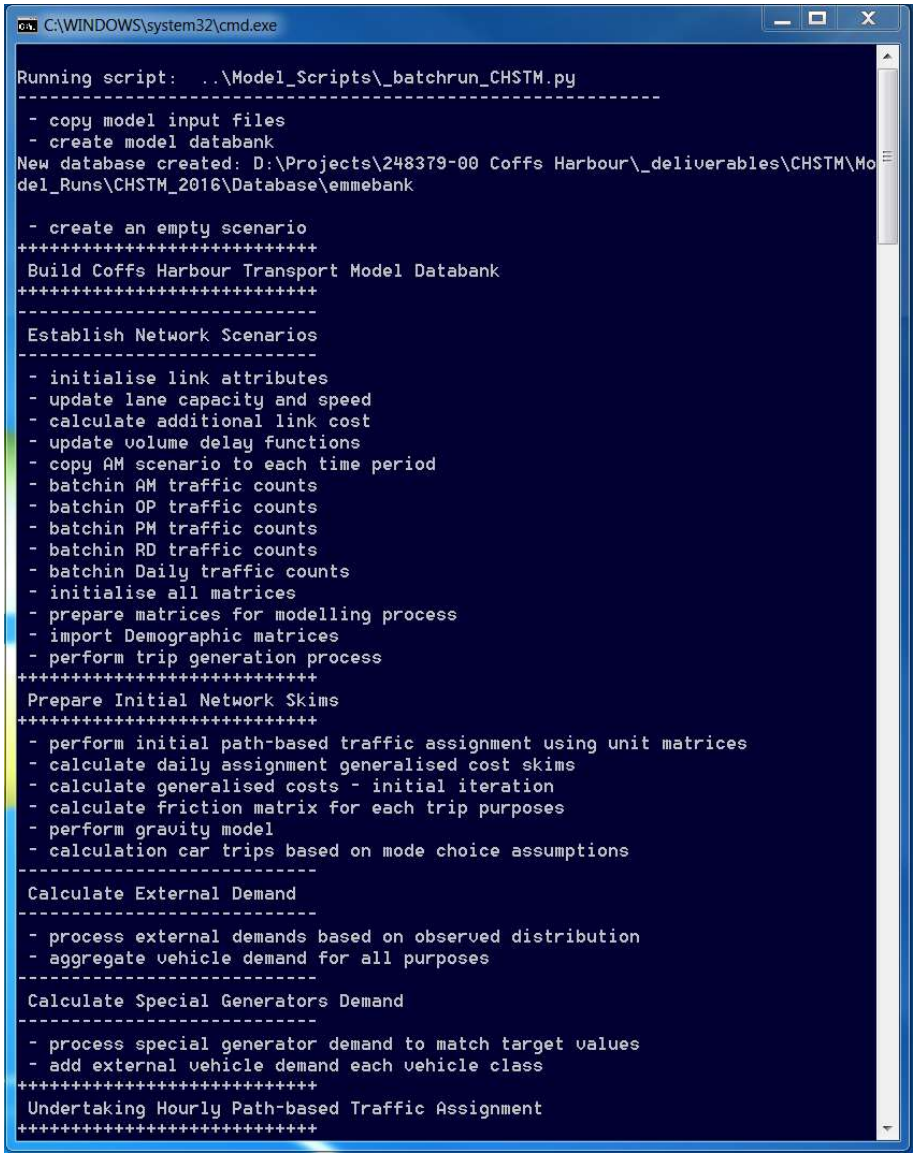
Model run logs will be displayed and recorded during the model runs either through batch run process or modeller shell process.

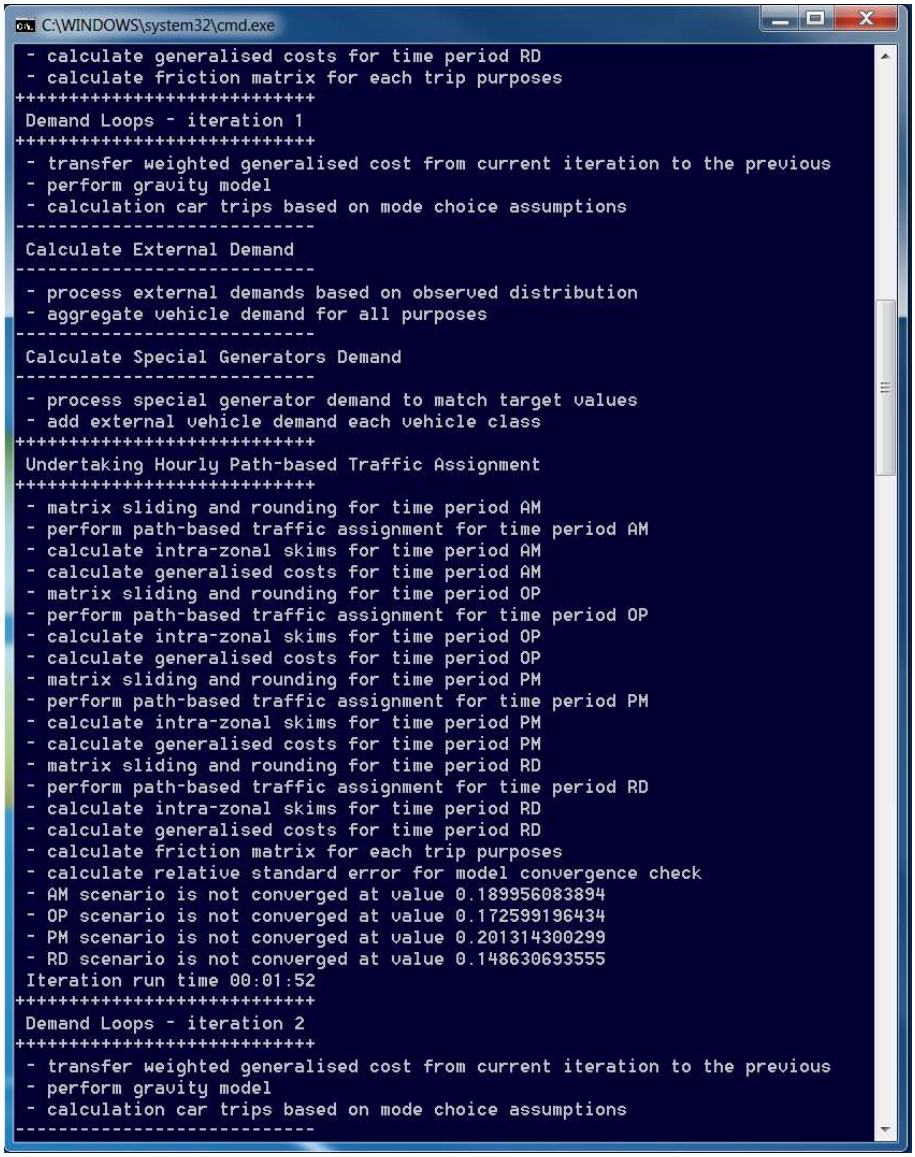
G6.1 Screen prints

During model run (either through batch run process or modeller shell process), the model run status messages will be printed in the prompt window. It prints each key step of the model processes so that the user can know the completed and current steps of the model run. This will help user to debug errors with quickly identify the process which stuck with the error.

It also record the time taken for each model iteration as well as the total run time after completion. It displays the model convergence status so that user can estimate the remaining time may be required to achieve model convergence.

Example screenshots of the screen prints are presented in figures below.


C:\WINDOWS\system32\cmd.exe
Running script: ..\Model_Scripts_batchrun_CHSTM.py
- copy model input files
- create model databank
New database created: D:\Projects\248379-00 Coffs Harbour_deliverables\CHSTM\Model_Runs\CHSTM_2016\Database\emmebank
- create an empty scenario
Build Coffs Harbour Transport Model Databank
Establish Network Scenarios
- initialise link attributes
- update lane capacity and speed
- calculate additional link cost
- update volume delay functions
- copy AM scenario to each time period
- batchin AM traffic counts
- batchin OP traffic counts
- batchin PM traffic counts
- batchin RD traffic counts
- batchin Daily traffic counts
- initialise all matrices
- prepare matrices for modelling process
- import Demographic matrices
- perform trip generation process
Prepare Initial Network Skims
- perform initial path-based traffic assignment using unit matrices
- calculate daily assignment generalised cost skims
- calculate generalised costs - initial iteration
- calculate friction matrix for each trip purposes
- perform gravity model
- calculation car trips based on mode choice assumptions
Calculate External Demand
- process external demands based on observed distribution
- aggregate vehicle demand for all purposes
Calculate Special Generators Demand
- process special generator demand to match target values
- add external vehicle demand each vehicle class
Undertaking Hourly Path-based Traffic Assignment

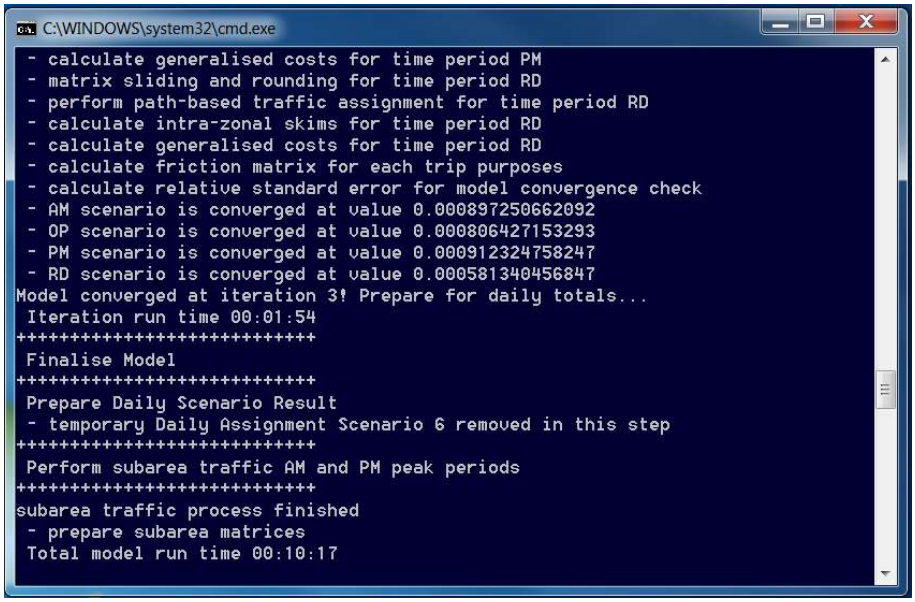

C:\WINDOWS\system32\cmd.exe
- calculate generalised costs for time period RD
- calculate friction matrix for each trip purposes
++++++++++++++++++++++++++++
Demand Loops - iteration 1
++++++++++++++++++++++++++++
- transfer weighted generalised cost from current iteration to the previous
- perform gravity model
- calculation car trips based on mode choice assumptions

Calculate External Demand

- process external demands based on observed distribution
- aggregate vehicle demand for all purposes

Calculate Special Generators Demand

- process special generator demand to match target values
- add external vehicle demand each vehicle class
++++++++++++++++++++++++++++
Undertaking Hourly Path-based Traffic Assignment
++++++++++++++++++++++++++++
- matrix sliding and rounding for time period AM
- perform path-based traffic assignment for time period AM
- calculate intra-zonal skims for time period AM
- calculate generalised costs for time period AM
- matrix sliding and rounding for time period OP
- perform path-based traffic assignment for time period OP
- calculate intra-zonal skims for time period OP
- calculate generalised costs for time period OP
- matrix sliding and rounding for time period PM
- perform path-based traffic assignment for time period PM
- calculate intra-zonal skims for time period PM
- calculate generalised costs for time period PM
- matrix sliding and rounding for time period RD
- perform path-based traffic assignment for time period RD
- calculate intra-zonal skims for time period RD
- calculate generalised costs for time period RD
- calculate friction matrix for each trip purposes
- calculate relative standard error for model convergence check
- AM scenario is not converged at value 0.189956083894
- OP scenario is not converged at value 0.172599196434
- PM scenario is not converged at value 0.201314300299
- RD scenario is not converged at value 0.148630693555
Iteration run time 00:01:52
++++++++++++++++++++++++++++
Demand Loops - iteration 2
++++++++++++++++++++++++++++
- transfer weighted generalised cost from current iteration to the previous
- perform gravity model
- calculation car trips based on mode choice assumptions

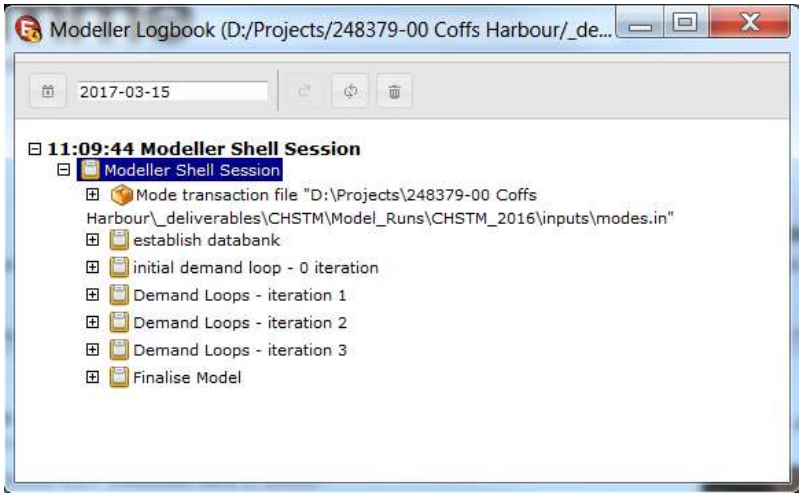

C:\WINDOWS\system32\cmd.exe
- calculate generalised costs for time period PM
- matrix sliding and rounding for time period RD
- perform path-based traffic assignment for time period RD
- calculate intra-zonal skims for time period RD
- calculate generalised costs for time period RD
- calculate friction matrix for each trip purposes
- calculate relative standard error for model convergence check
- AM scenario is converged at value 0.000897250662092
- OP scenario is converged at value 0.000806427153293
- PM scenario is converged at value 0.000912324758247
- RD scenario is converged at value 0.000581340456847
Model converged at iteration 3! Prepare for daily totals...
Iteration run time 00:01:54
++++++++++++++++++++++++++++
Finalise Model
++++++++++++++++++++++++++++
Prepare Daily Scenario Result
- temporary Daily Assignment Scenario 6 removed in this step
++++++++++++++++++++++++++++
Perform subarea traffic AM and PM peak periods
++++++++++++++++++++++++++++
subarea traffic process finished
- prepare subarea matrices
Total model run time 00:10:17

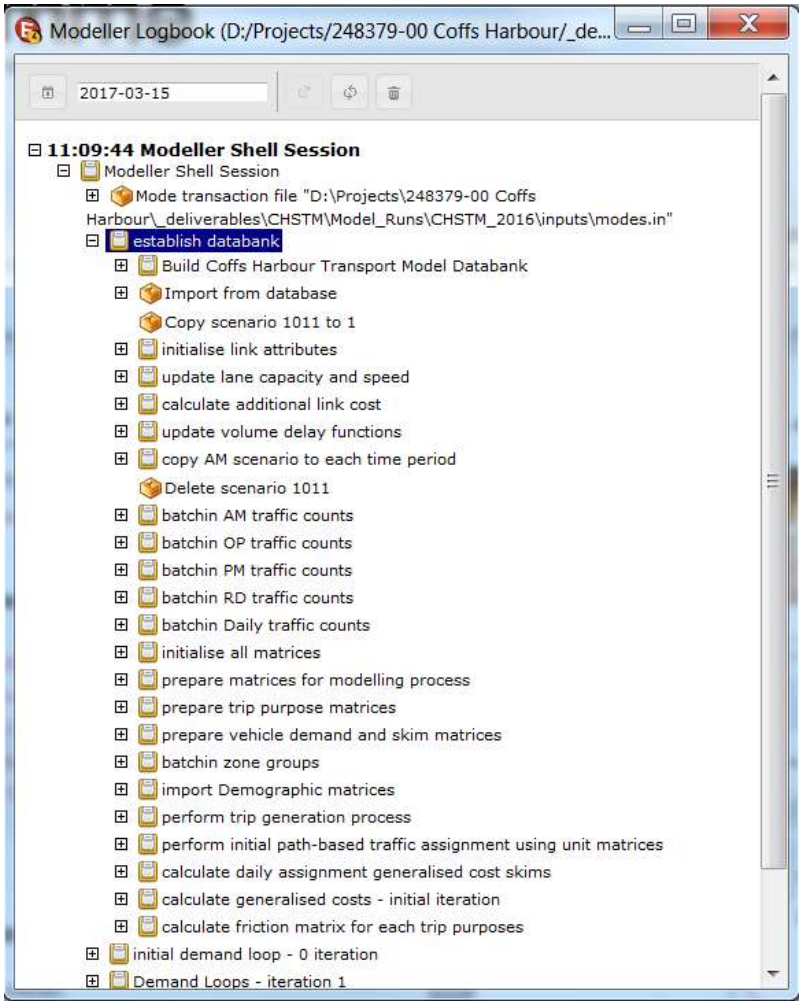
G6.2 Model logbook

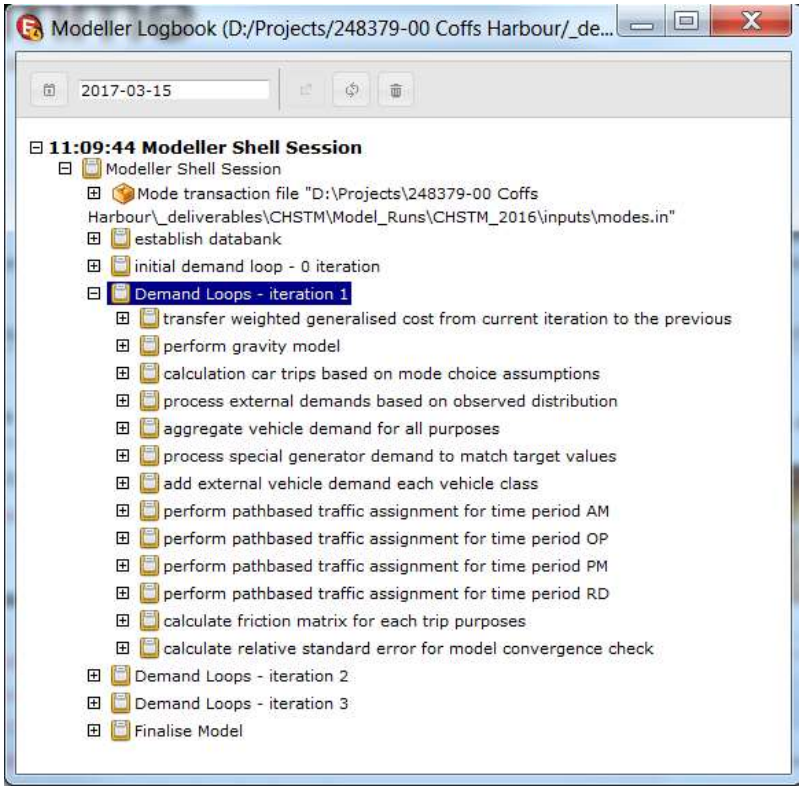
The process also saves the model run logs simultaneously during each model run. User can open the modeller logbook (during or after model runs in either batch run or modeller shell process) to check the status of the current or completed scenario model run.

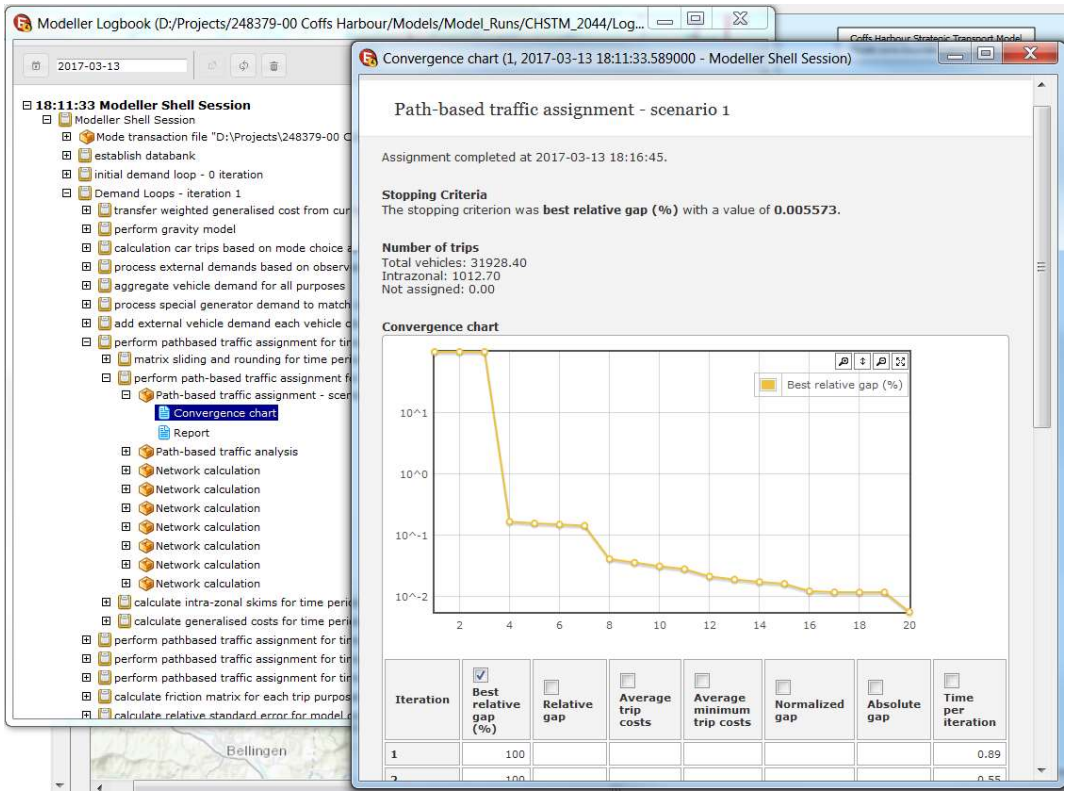
It also allows the user to check result stepwise to understand the model process, or for the purpose of model diagnoses.

The example screenshots blow illustrate the file structure of the established model logbook. Each scenario model run will have its own logbook for model run status and results checking.




Modeller Logbook (D:/Projects/248379-00 Coffs Harbour/_de...
2017-03-15
11:09:44 Modeller Shell Session
Modeller Shell Session
Mode transaction file "D:\Projects\248379-00 Coffs Harbour_deliverables\CHSTM\Model_Runs\CHSTM_2016\inputs\modes.in"
establish databank
Build Coffs Harbour Transport Model Databank
Import from database
Copy scenario 1011 to 1
initialise link attributes
update lane capacity and speed
calculate additional link cost
update volume delay functions
copy AM scenario to each time period
Delete scenario 1011
batchin AM traffic counts
batchin OP traffic counts
batchin PM traffic counts
batchin RD traffic counts
batchin Daily traffic counts
initialise all matrices
prepare matrices for modelling process
prepare trip purpose matrices
prepare vehicle demand and skim matrices
batchin zone groups
import Demographic matrices
perform trip generation process
perform initial path-based traffic assignment using unit matrices
calculate daily assignment generalised cost skims
calculate generalised costs - initial iteration
calculate friction matrix for each trip purposes
initial demand loop - 0 iteration
Demand Loops - iteration 1


Modeller Logbook (D:/Projects/248379-00 Coffs Harbour/_de...
2017-03-15
11:09:44 Modeller Shell Session
Modeller Shell Session
Mode transaction file "D:\Projects\248379-00 Coffs Harbour_deliverables\CHSTM\Model_Runs\CHSTM_2016\inputs\modes.in"
establish databank
initial demand loop - 0 iteration
Demand Loops - iteration 1
transfer weighted generalised cost from current iteration to the previous
perform gravity model
calculation car trips based on mode choice assumptions
process external demands based on observed distribution
aggregate vehicle demand for all purposes
process special generator demand to match target values
add external vehicle demand each vehicle class
perform pathbased traffic assignment for time period AM
perform pathbased traffic assignment for time period OP
perform pathbased traffic assignment for time period PM
perform pathbased traffic assignment for time period RD
calculate friction matrix for each trip purposes
calculate relative standard error for model convergence check
Demand Loops - iteration 2
Demand Loops - iteration 3
Finalise Model


Modeller Logbook (D:/Projects/248379-00 Coffs Harbour/Models/Model_Runs/CHSTM_2044/Log...
Convergence chart (1, 2017-03-13 18:11:33.589000 - Modeller Shell Session)
Path-based traffic assignment - scenario 1
Assignment completed at 2017-03-13 18:16:45.
Stopping Criteria
The stopping criterion was best relative gap (%) with a value of 0.005573.
Number of trips
Total vehicles: 31928.40
Intrazonal: 1012.70
Not assigned: 0.00
Convergence chart
Best relative gap (%)
10^1
10^0
10^-1
10^-2
2
4
6
8
10
12
14
16
18
20
Iteration
Best relative gap (%)
Relative gap
Average trip costs
Average minimum trip costs
Normalized gap
Absolute gap
Time per iteration
1
100
0.89
Bellingen

Appendix H

CHTM - Model Plots

H1 CHTM Model Plots

Plot list from the Coffs Harbour Traffic Model:

1. 2024 AM Do Minimum – Network Flow
2. 2024 PM Do Minimum – Network Flow
3. 2024 AM Project – Network Flow
4. 2024 PM Project – Network Flow
5. 2024 AM Do Minimum versus 2024 AM Project – Network Flow
6. 2024 PM Do Minimum versus 2024 PM Project – Network Flow
7. 2044 AM Do Minimum – Network Flow
8. 2044 PM Do Minimum – Network Flow
9. 2044 AM Project – Network Flow
10. 2044 PM Project – Network Flow
11. 2044 AM Do Minimum versus 2044 AM Project – Network Flow
12. 2044 PM Do Minimum versus 2044 PM Project – Network Flow
13. 2016 AM Base – Select Link Flow for Pacific Hwy north of Bruxner Park Rd
14. 2016 PM Base – Select Link Flow for Pacific Hwy north of Bruxner Park Rd
15. 2016 AM Base – Select Link Flow for Pacific Hwy south of Englands Rd
16. 2016 PM Base – Select Link Flow for Pacific Hwy south of Englands Rd
17. 2016 AM Project – Select Link Flow for Pacific Hwy north of Bruxner Park Rd
18. 2016 AM Project – Select Link Flow for Bypass north of Coramba Rd
19. 2016 AM Project – Select Link Flow for Bypass south of Coramba Rd
20. 2016 AM Project – Select Link Flow for Bypass south of Englands Rd

Appendix B

Kororo Public School Transport Observations

File Note

ARUP

Level 4, 108 Wickham Street
Fortitude Valley
QLD 4006
GPO Box 685 Brisbane QLD 4001
Australia
www.arup.com

t +61 7 3023 6000
f +61 7 3023 6023

Project title	Coffs Harbour Bypass	Job number	248379-40
cc		File reference	
Prepared by	Catherine Bennie	Date	24 May 2019
Subject	Kororo Public School transport observations		

1 Introduction

A site visit to the Kororo Public School was carried out on Wednesday 29 November 2016 to better understand the parking operations surrounding the school. On the day of the site visit, Austraffic were carrying out road user surveys at multiple locations within the site area. The purpose of this technical note is to detail both the site visit findings and to confirm the results of the traffic demand surveys. A diagrammatical site layout is shown in the figure below.

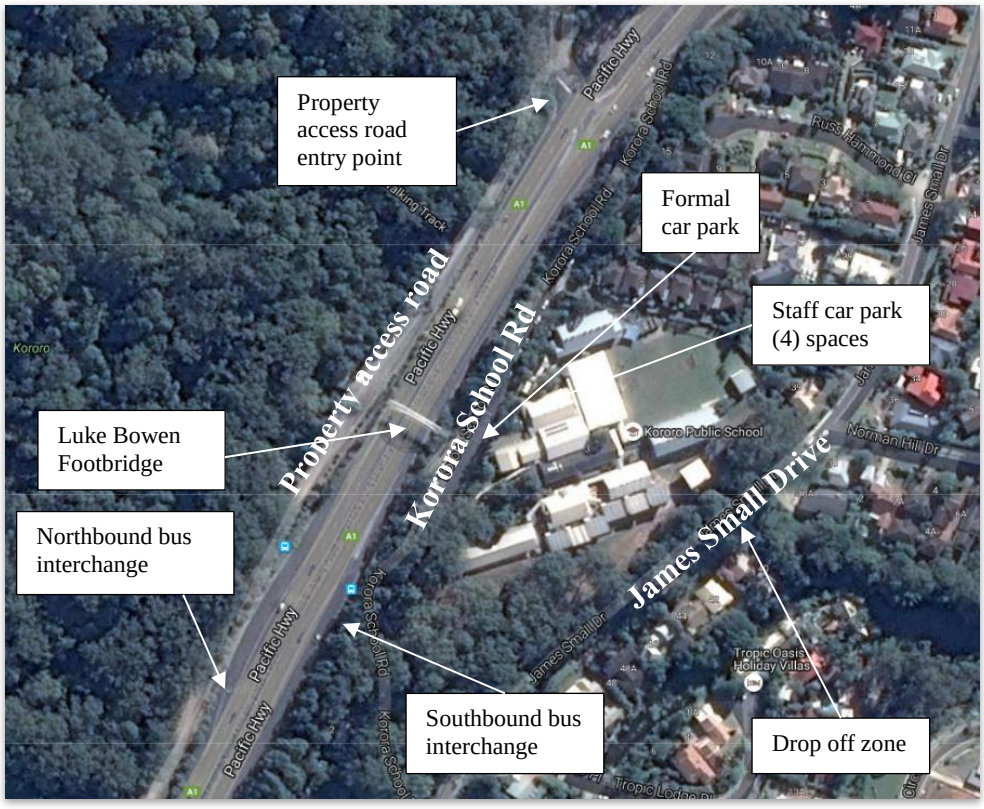


Figure 1 - Site area

2 Site visit findings

2.1 James Small Drive

James Small Drive is a two lane, two-way road way with parking lanes provided on both sides. A pedestrian footpath is located on the western (i.e. alongside Kororo Public School) side of James Small Drive. There are two drop-off / pick-up areas on James Small Drive adjacent to the Kororo Public School, with one on either side of the road. James Small Drive intersects with the Pacific Highway just north of the Kororo Public School and reconnects again with the Pacific Highway further south.

During the morning peak, it was observed that James Small Drive was used for both quick drop-off (mostly at the designated areas), or parents would park and then accompany their child to school. Observations however also demonstrated that James Small Drive appeared to be used for both the Kororo Public School and the nearby bus interchange. The drop-off / pick-up area on the northern side of James Small Drive was mostly used for access to the school, however earlier in the morning peak there were instances when it was being used for drop-offs for the nearby bus interchange on the Pacific Highway.

2.2 Korora School Road

Korora School Road is a one lane, one-way road (southbound) connecting the Pacific Highway to James Small Drive. At the Kororo Public School, there is a drop-off / pick-up area along the school frontage with a formal car park opposite, and a small (four spaces) staff parking area within the school. The main entrance to the school is located just north of the drop-off / pick-up area. There is a pedestrian overpass, Luke Bowen Footbridge, which connects the property access road and Korora School Road opposite the main entrance to the school. There are no footpaths provided on Korora School Road north or south of the formal car parking area and drop-off / pick-up area.

The drop-off / pick-up area alongside the school frontage is signed to restrict long term parking during school peaks i.e. 8:00-9:30am and 2:30-4:00pm. During the morning peak, at this drop off zone, it was observed that generally the driver remains in their vehicle as their children walk into the school.

During the morning peak, typically cars park briefly in the formal car parking area and parents then walk the children into the school. Once the car parking area is at capacity, vehicles start parking informally south-west of the drop-off / pick-up area on both sides of the road and stay for extended periods. There were also at least six instances of cars parking informally north of the car park on Korora School Road. In both of these instances, it is possible that these were cars driven by staff, as the vehicles were not observed to depart until after the afternoon peak period.

During the afternoon peak period, for an approximate 10-minute period (just after the school bell rings), vehicles start to wait within Korora School Road for an available parking space. As Korora School Road is a one lane, one-way road, this results in vehicles queuing north towards the Pacific Highway. During the site visit however, queuing was not observed to reach the intersection of Pacific Highway / Korora School Road.

2.3 Bus interchange

There are two existing bus stops (one northbound and one southbound) adjacent to the Pacific Highway, just south of the Kororo Public School. Buses can access the stops directly from the Pacific Highway, with both areas being separated from the highway by concrete barriers. Each bus zone is approximately 120m in length. Multiple buses utilise the interchange to pick-up / drop-off students to the Kororo Public School and to also provide an opportunity for students to change buses to reach their appropriate destination. It should be noted that there is no timetable present at these bus interchanges and hence is not used for public transport outside of school use.

During the morning peak, a maximum of seven buses were parked at the southbound interchange simultaneously. No buses were observed to use the northbound interchange during the morning peak period.

During the afternoon peak, multiple groups of Kororo Public School children were walked over the bridge to the buses by a school representative. Children alighting the arriving northbound buses either waited at the interchange for their bus or were picked up from either the property access road or James Small Drive.

It should be noted that not all school buses stopped at the interchanges during the morning and afternoon peak periods.

2.4 Property access road

The property access road is located to the west of the Pacific Highway, adjacent to the northbound bus interchange and just north of the Luke Bowen Footbridge. It is a short, dead-end road and is wide enough for vehicles to carry out a 3-point turn. No footpaths are provided on the property access road.

Occasionally throughout the morning peak, the property access road was used by vehicles as an informal short-term drop-off / pick-up area, with only a small number of parents parking and walking their younger children over the Pacific Highway using the Luke Bowen Footbridge. The service road was observed as being utilised mostly for the students accessing the bus interchange, with the remainder attending Kororo Public School.

Majority of vehicles utilising the property access road were travelling northbound on Pacific Highway and drop in to the service road briefly before continuing on their trip. During the morning peak, the property access road remained mostly empty due to the quick turnover of vehicles. However, during the evening peak period, the property access road was more heavily utilised by vehicles to pick-up children.

2.5 AM peak observations

- 7:30am – James Small Drive: four cars parked
- 7:45am – Korora School Road drop-off / pick-up area: six car parked
- 7:50am – Property access road: vehicles start to use for drop-off / pick-up
- 7:58 am – Southbound bus interchange: first school bus arrives
- 8:15 am – Southbound bus interchange: six buses stored, all waiting with children in each

File Note

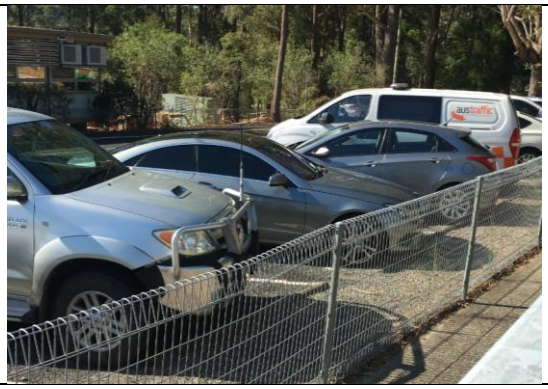
248379-40 24 May 2019

- 8:20am – Korora School Road formal car park: at capacity (excluding persons with disability PWD spaces)
- 8:25 am – Southbound bus interchange: all buses depart
- 8:40 am – School bell to signify start of the school day.

<table>
<tr><td>
</td><td> </td></tr>
<tr><td>Korora School Road Car Park 7:40am (facing SB)</td><td>Korora School Road Car Park 7:40am (facing NB)</td></tr>
<tr><td> </td><td> </td></tr>
<tr><td>Staff car park entrance 7:40am</td><td>Korora School Road north of Car Park 7:40am (facing SB)</td></tr>
<tr><td> </td><td>
</td></tr>
<tr><td>Bus interchange 7:45am (facing SB from Luke Bowen Footbridge)</td><td>Southbound bus interchange at 8:15am</td></tr>
</table>

File Note

248379-40 24 May 2019

	
Korora School Road Car Park 8:20am (facing SB)	Korora School Road south of car park 8:30am (facing SB)
Korora School Road north of Car Park 8:30am (facing NB) – assumed staff parking	Korora School Road 8:40 am south of Car Park (facing NB)
Korora School Road 8:40am south of car park (facing SB)	James Small Drive 8:40am north of Korora School Road (facing NB)
James Small Drive drop-off / pick-up alongside School 8:45am (facing SB)	Property access road 9am (facing NB)

File Note

248379-40 24 May 2019

2.6 PM peak observations

- 2:20pm – James Small Drive: at least five of the parked vehicles were early parents waiting
- 2:30pm – Korora School Road: at least two of the parked vehicles were early parents waiting
- 2:35pm – property access road: at least three of the parked vehicles were early parents
- 2:50pm – Korora School Road: vehicles parked (parents waiting) along entire length of Korora School Road
- 3:00pm – Parents leave cars and walk towards the school to pick up children
- 3:00pm – Korora School Road drop-off / pick-up: vehicles start parking in the designated area
- 3:10pm – School bell to signify the completion of the school day. All car parks (formal and informal) are taken, vehicles stop and wait for an available space within Korora School Road resulting in vehicles queuing back towards the Highway
- 3:20pm – significantly less vehicles were present surrounding the school, with a portion of the formal car parking spaces vacated and no more queuing of vehicles on Korora School Road towards the Pacific Highway. Majority of cars parked on property access road have departed
- 3:20pm – Northbound bus interchange: two buses stopped and wait for Kororo Public School children to board before departing
- 3:35pm – Northbound bus interchange: bus arrives to pick up / drop off children. Bus departs after children have finished boarding
- 3:35pm – Southbound bus interchange: bus arrives to pick up Kororo Public School children and departs shortly after
- 3:40pm – Northbound bus interchange: final bus arrives to pick up / drop off school children
- 3:40pm – Southbound bus interchange: final bus arrives to pick up / drop off school children.

James Small Drive at 2:20pm (facing NB)	Korora School Road at 2:30pm south of school entrance (facing SB)

File Note

248379-40 24 May 2019

Korora School Road at 2:30pm north of School entrance (facing NB)	Property access road at 2:35pm north of Luke Bowen Footbridge (facing SB)
Property access road at 2:35pm north of Luke Bowen Footbridge (facing NB)	Korora School Road at 2:45pm south of School car park (facing SB)
Korora School Road at 2:45pm south of car park (facing SB)	Korora School Road at 2:45pm south of car park (facing NB)
James Small Drive at 2:50pm at Korora School Road intersection (facing NB)	Property access road at 3pm (facing NB)

File Note

248379-40 24 May 2019

Korora School Road at 3:10pm north of school entrance (facing NB)

Korora School Road at 3:15pm at formal car park (facing NB)

James Small Drive at 3:15pm at Korora School Road intersection (facing NB)

Students crossing Luke Bowen Footbridge at 3:20pm from eastern side of Pacific Highway

Korora School Road at 3:45pm south of school entrance (facing NB)

James Small Drive at 3:45pm at Korora School Road intersection (facing NB)

3 Traffic count summary

A number of surveys were carried out by Austraffic during the morning and afternoon school peak periods on Wednesday 30 November 2016 through to Friday 2 December 2016:

- Intersection counts (including pedestrian and cyclists)
- Bus counts
- Parking occupancy surveys.

A summary of each of the counts carried out is detailed in this section of the report with count data results provided as an appendix.

3.1 Intersection counts

The intersection counts carried out by Austraffic, were located at the following locations:

- Pacific Highway / James Small Drive
- Pacific Highway / Old Coast Road
- Pacific Highway / Korora School Road
- Korora School Road / James Small Drive
- James Small Drive / Norman Hill Drive.

The results of the intersection counts demonstrate that the majority of pedestrian / cyclist movements occurred at the James Small Drive intersections surveyed, with little to no pedestrians observed at the Pacific Highway intersection. This is commensurate with what would be expected considering the road typologies and relative speeds of adjacent vehicles.

A summary of the traffic volumes observed surrounding the school are as follows:

- James Small Drive (north of Korora School Road) – 190 to 220 vehicles per hour (vph) (two-way)
- Korora School Road – 100 to 115vph (one-way)
- Old Coast Road – 105 to 175vph (two-way) with busiest periods observed during the Friday surveys.

3.2 Bus counts

Bus counts were carried out at the northbound and southbound bus interchanges adjacent to the Kororo Public School on the Pacific Highway.

The results of the bus counts demonstrate similar findings to the site visit:

- Heavy usage of the southbound interchange during the morning peak, and northbound interchange during the afternoon peak
- Maximum of seven buses parked simultaneously at either interchanges in one direction

- Morning peak is between 8:00 to 8:20am
- Afternoon peak is between 3:30 to 3:50pm.

3.3 Parking demand

Parking demand / occupancy surveys were undertaken by Austraffic within the following areas:

- Zone Group A: Korora School Road – 82 parking space supply
- Zone Group B: James Small Drive – 80 parking space supply
- Zone Group C: Old Coast Road – 15 parking space supply
- Zone Group D: Property access road – 110 parking space supply.

These parking zones are shown in Figure 2.

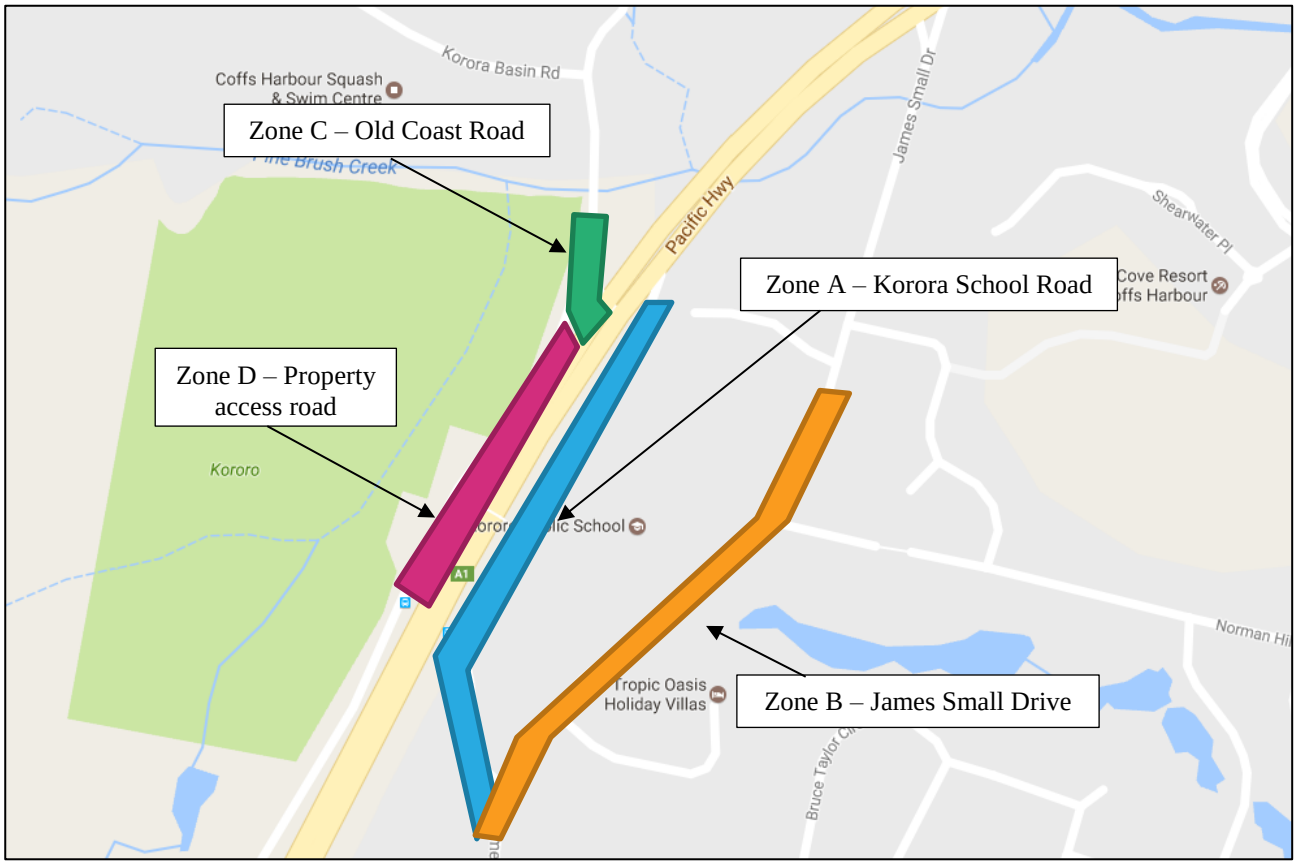


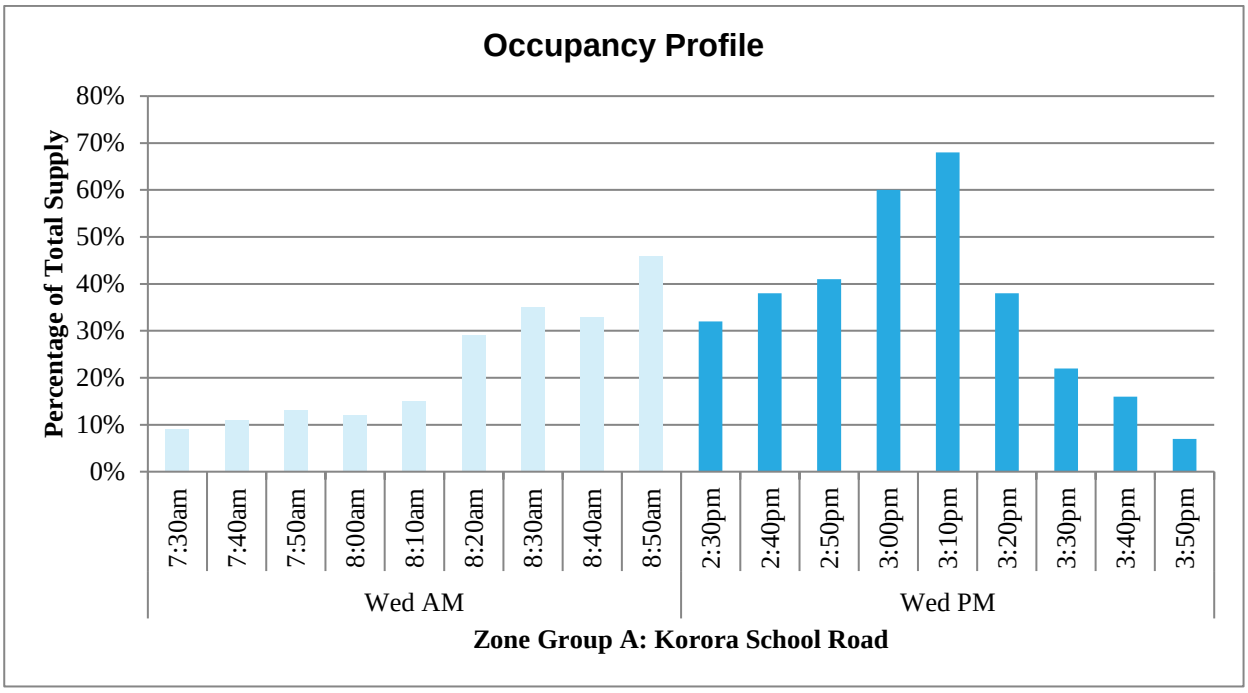
Figure 2 – Austraffic surveyed areas

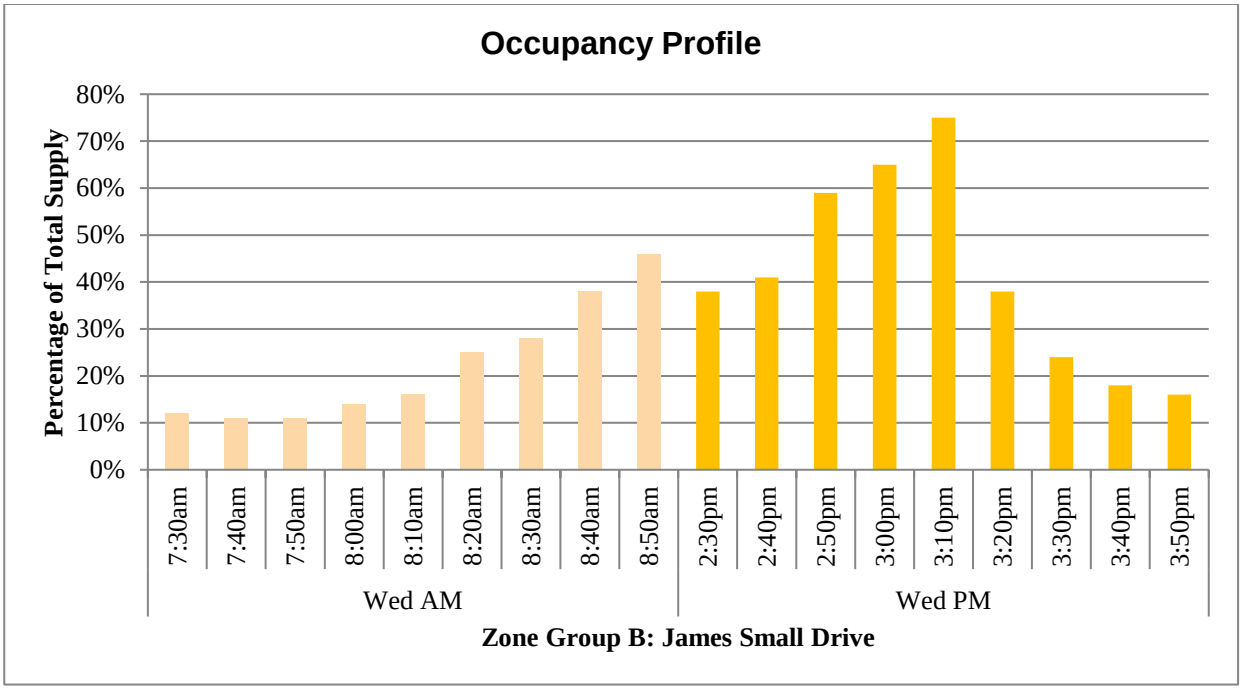
The parking occupancy results of the survey during the same day as the site visit are presented in the following graphs. The results of the parking occupancy survey are similar to the findings of the site visit:

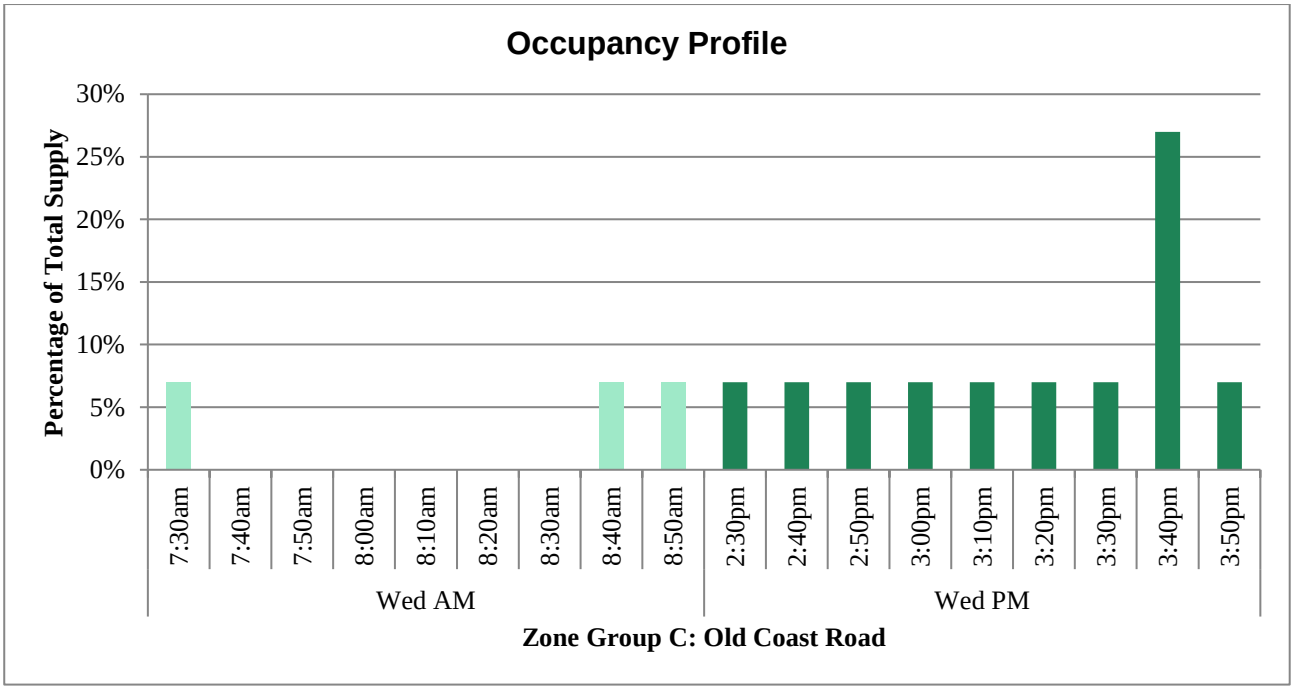
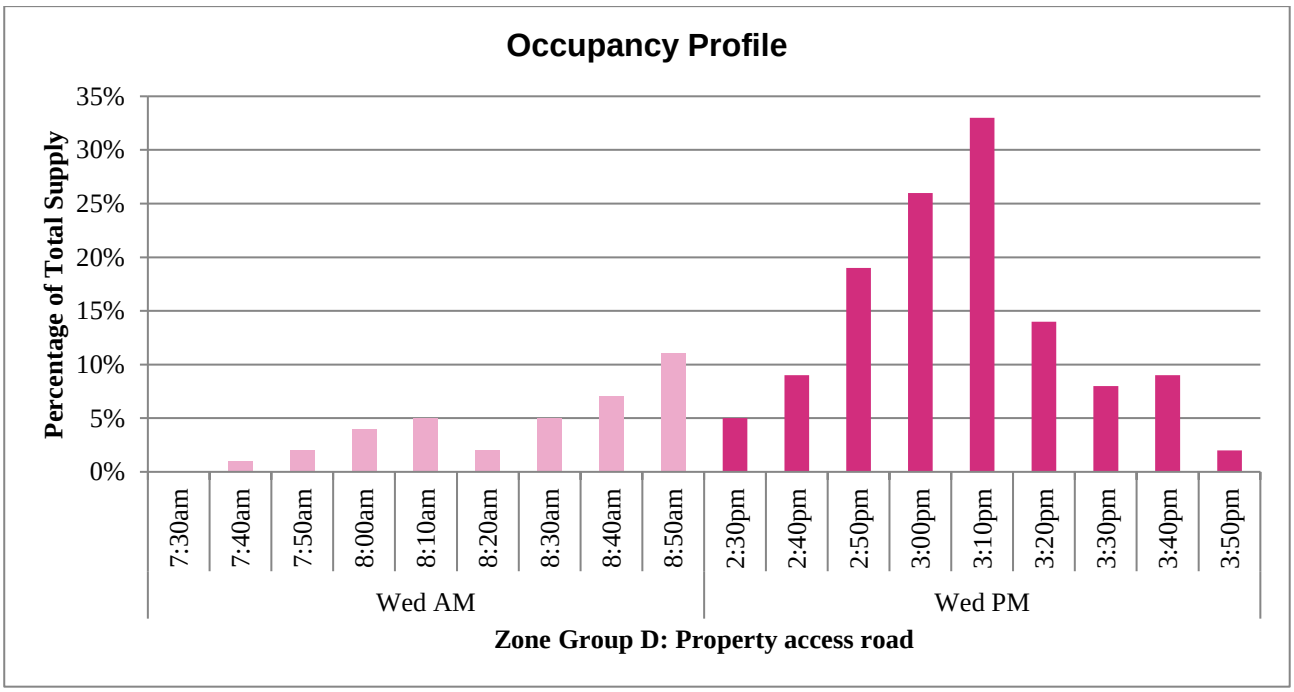
- A steady increase in occupancy at all locations during the morning peak until 8:50am;
- Short intense peak during the afternoon between 2:50pm and 3:10pm
- Formal car park 100% occupied by 8:20am through to 8:50am

- All areas surveyed demonstrated that parking demand was greatest during the evening peak surrounding the Kororo Public School.

It is noted that the parking occupancy results over all three days surveyed demonstrate similar parking patterns.





File Note

248379-40 24 May 2019