Appendix E – Traffic and Transport Assessment

ARCADIS Design & Consultancy for natural and built assets

Mandalong Road Upgrade, Concept Design and REF

Traffic and Transport Assessment Report

Incorporating Hyder

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Transport for NSW

Mandalong Road Upgrade, Concept Design and REF

Traffic and Transport Assessment Report

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REVISIONS

Revision	Date	Description	Prepared by	Approved by
A0		Internal reviews	MW, KN	MR
A	29 Aug 2024	Submitted to TfNSW for comments	MW, KN	MR
B	4 Oct 2024	Final report	MW, KN	MR
C	31 Oct 2024	Version for REF display	CG, AT	AT

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Glossary of terms and acronyms

Term/acronym	Definition
ADT	Average Daily Traffic. The total volume of traffic (24 hours) passing a roadside observation point over a sampled one-week period, divided by the number of days per week.
VISSIM	VISSIM is a microscopic multi-modal traffic flow simulation software package developed by PTV AG
AM peak hours	In operational VISSIM modelling, based on counts, AM peak refers to vehicle trips arriving at their destination during the average peak hour in the morning peak period from 8.15am to 9.15am on a normal working weekday
ATC	Automatic Traffic Count
Avg.	Average
AWT	Average Weekday Traffic. The total volume of traffic (24 hours) passing a roadside observation point over a sampled five-weekday (Monday to Friday) period, divided by the number of days.
BMDR	Base Model Development Report
Capacity	The nominal maximum number of vehicles which has a reasonable expectation of passing over a given section of a lane or roadway in one direction during a given time period under prevailing roadway conditions
Carriageway	The portion of a roadway used by vehicles including shoulders and ancillary lanes
Council	Macquarie City Council
Corridor	A substantial segment of the transport network, in which parallel, possibly competing, transport routes (and modes, where appropriate) operate between two locations
DA	Development application
Do minimum	A model scenario that does not incorporate the proposed project infrastructure
DPIE	NSW Department of Planning, Industry and Environment
EMME	Multimodal transport planning software being used to operate TfNSW Strategic Traffic Forecasting Model (STFM)
Gates	Gates are used in EMME software to define subarea boundary cut-off points in developing subarea travel demand entry and exit the cordoned area (i.e. Mandalong corridor) from wider-area model (i.e. STFM)
Heavy vehicles	A heavy vehicle is classified as a Class 3 vehicle (a two-axle truck) or larger, in line with the Austroads Vehicle Classification System
hr	Hour
Impact	Influence or effect exerted by a project or other activity on the natural, built and community environment
Interchange	An intersection of two or more roads that typically uses grade separation, and one or more ramps, to permit traffic on at least one carriageway to pass through the junction without directly crossing any other traffic stream
Local road	A road or street used primarily for access to properties in that road or street
LoS	Level of service
Midblock	A general location on a road between two intersections
NSW	New South Wales
Off ramp	A ramp by which one exits a limited access highway/tunnel
On ramp	A ramp by which one enters a limited access highway/tunne

Term/acronym	Definition
PM peak hours	In operational VISSIM modelling, based on counts, PM peak refers to vehicle trips arriving at their destination during the average peak hour in the afternoon peak period from 3.30pm to 4.30m on a normal working weekday
Public transport	Includes train and bus
Roundabout	An intersection where all traffic travels in one direction clockwise around a central island
sec	Seconds
STFM	Strategic Traffic Forecasting Model. The STFM developed and operated by TfNSW, provides a platform to understand changes in future traffic patterns under different land use, transport infrastructure scenarios
STM	The Sydney Strategic Travel Model
Strategic road network	The higher-order roads in the network that primarily serve a movement function connecting cities, ports, airports and other places of importance. The strategic road network is usually comprised of motorways and arterial roads generally used for long-distance travel
TCS	Traffic control signal
TN	Technical paper
Travel Zone	Travel Zones (TZs) are the spatial unit of geography defined by Transport Performance and Analytics (TPA), a business unit within Transport for NSW (TfNSW).
TZP22	The 2022 Travel Zone Projections. TfNSW produces Travel Zone Projections (TZP22) for population, workforce and employment for NSW Travel Zones as an input into a variety of travel models including the Strategic Travel Model (STM). The projections are developed to support a strategic view of NSW and are aligned with the NSW Government Common Planning Assumptions. The projections seek to represent a likely urban and regional future based on current data, trends, and an understanding of policy/structural changes that may impact the future. The TZP projections are not based on specific assumptions about future new transport infrastructure but do take into account known land-use developments underway or planned and strategic plans
Transport for NSW	Transport for New South Wales
TfNSW	Transport for NSW, Transport for New South Wales
Unreleased traffic	Traffic demand that goes unserved during the peak period
veh	Vehicles

1 Introduction

1.1 Report purpose

The Australian and NSW governments are investing in upgrades to Mandalong Road between the M1 Pacific Motorway and Ourimbah Street. During peak periods, motorists experience congestion and slow travel times on Mandalong Road. Planned residential, retail, industrial and commercial growth across Morisset and its surrounds will put further pressure on the road network. Transport for NSW has investigated upgrade options along this section to improve traffic flow and safety for all users, while helping meet the future needs of an increased population and employment in the Morisset area.

Mandalong Road between M1 Pacific Motorway and Ourimbah Street carried about 17,900 to 22,900 vehicles per day on an average weekday based on traffic data collected in August 2023. Mandalong Road provides access to industrial developments on Gateways Boulevard and Alliance Avenue. About 1,340 to 4,280 heavy vehicles used this section of Mandalong Road on an average weekday, representing about 8 to 20 per cent of total traffic volumes.

A preferred design has been developed for the proposed upgrade, which includes replacing the existing roundabout with new traffic lights at the Wyee Road / Freemans Drive intersection (the Proposal). The upgrade includes additional through lanes and additional turning lanes on all approaches. Active and public transport improvements would also be included as part of the upgrade.

This traffic and transport assessment aims to support the concept design and review of environmental factors (REF) for the proposal by assessing and reporting existing and future conditions.

1.2 Key features and benefits

The proposal will help meet the future needs of an increased population and employment in the Morisset area. The upgrade will investigate opportunities to increase capacity along Mandalong Road, seek solutions for safe pedestrian crossings, as well as focus on options to improve the Freemans Drive / Wyee Road intersection to support current and future needs. The upgrade will also look at opportunities to improve public transport services, as well as upgrade active transport (walking and cycling) links along Mandalong Road. These improvements will help provide options that support a shift to more sustainable modes of transport.

1.3 Proposal benefits

The proposed upgrade would:

- Improve safety for all road users, including cyclists and pedestrians
- Improve current and future traffic flows
- Provide more reliable travel times for motorists
- Improve cycling and pedestrian access increasing active transport connectivity
- Support significant residential, industrial and commercial growth.

1.4 Proposal area

Figure 1-1 shows Mandalong Road proposal area. The proposal includes Freemans Drive / Wyee Road intersection.

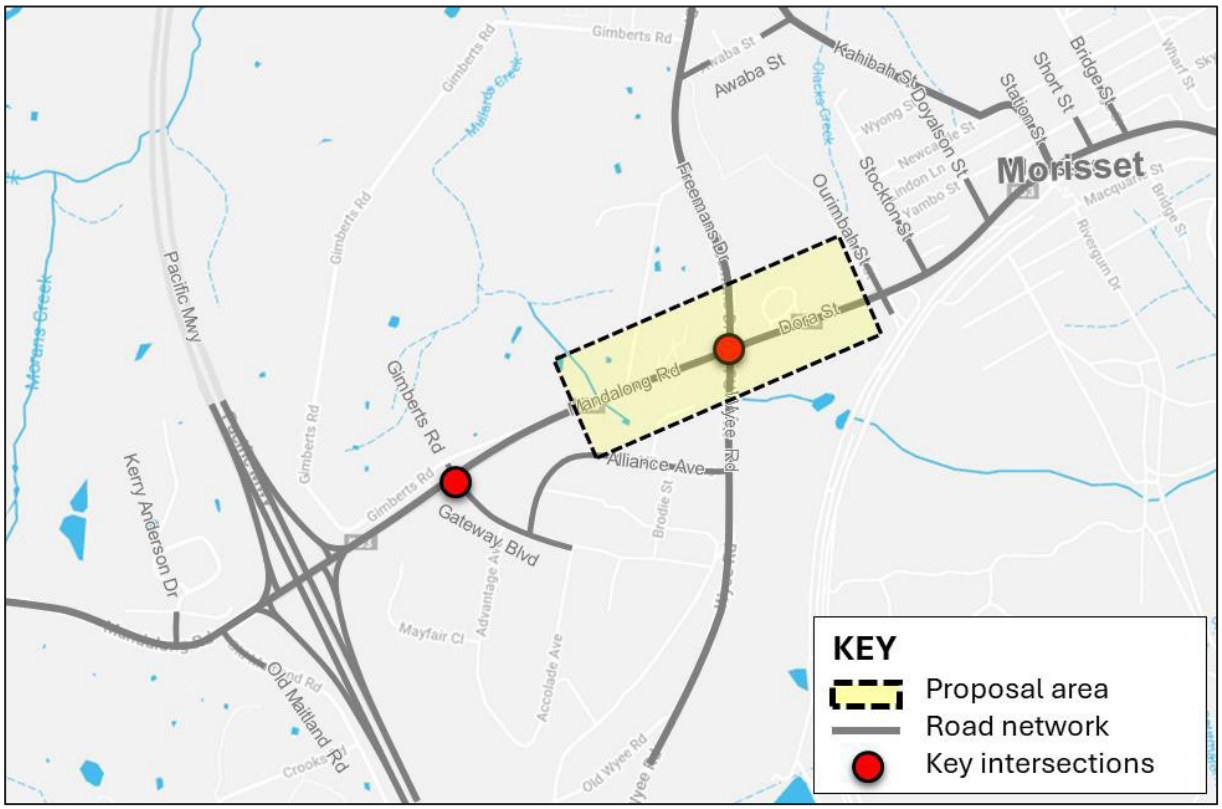


Figure 1-1 Proposal area

1.5 Report structure

This Traffic and Transport Assessment Report is structured into the following chapters:

- **Chapter 1: Introduction**: This chapter outlines the report purpose and project area
- **Chapter 2: Existing conditions**. This chapter outlines the existing traffic and transport environment for the broader road network
- **Chapter 3: Traffic modelling methodology**. This chapter provides an overview of the traffic modelling and methodology adopted for traffic and transport assessment
- **Chapter 4: Future traffic conditions without the Proposal**. This chapter outlines traffic conditions on the Mandalong Road for future years in 2029 and 2039
- **Chapter 5: Traffic performance of the Proposal**. This chapter documents traffic performance of the proposal including intersection performance and travel time savings
- **Chapter 6: Management and mitigation measures**. This chapter outlines mitigation measures that have been developed to manage traffic and transport impacts
- **Chapter 7: Summary and conclusions**.

2 Existing conditions

This section outlines the existing traffic and transport environment for the broader road network.

2.1 Modelling study area

Figure 2-1 shows the traffic modelling study area. The traffic modelling study area network is wider than the proposal area to capture upstream and downstream impact on Mandalong Road. The modelling study area extends from Moran's Creek to the west, Mandalong Road / Fishery Point Road intersection to the east, Freemans Drive (north of Stockton Street) to the north and Wyee Road / Old Wyee Road intersection to the south.

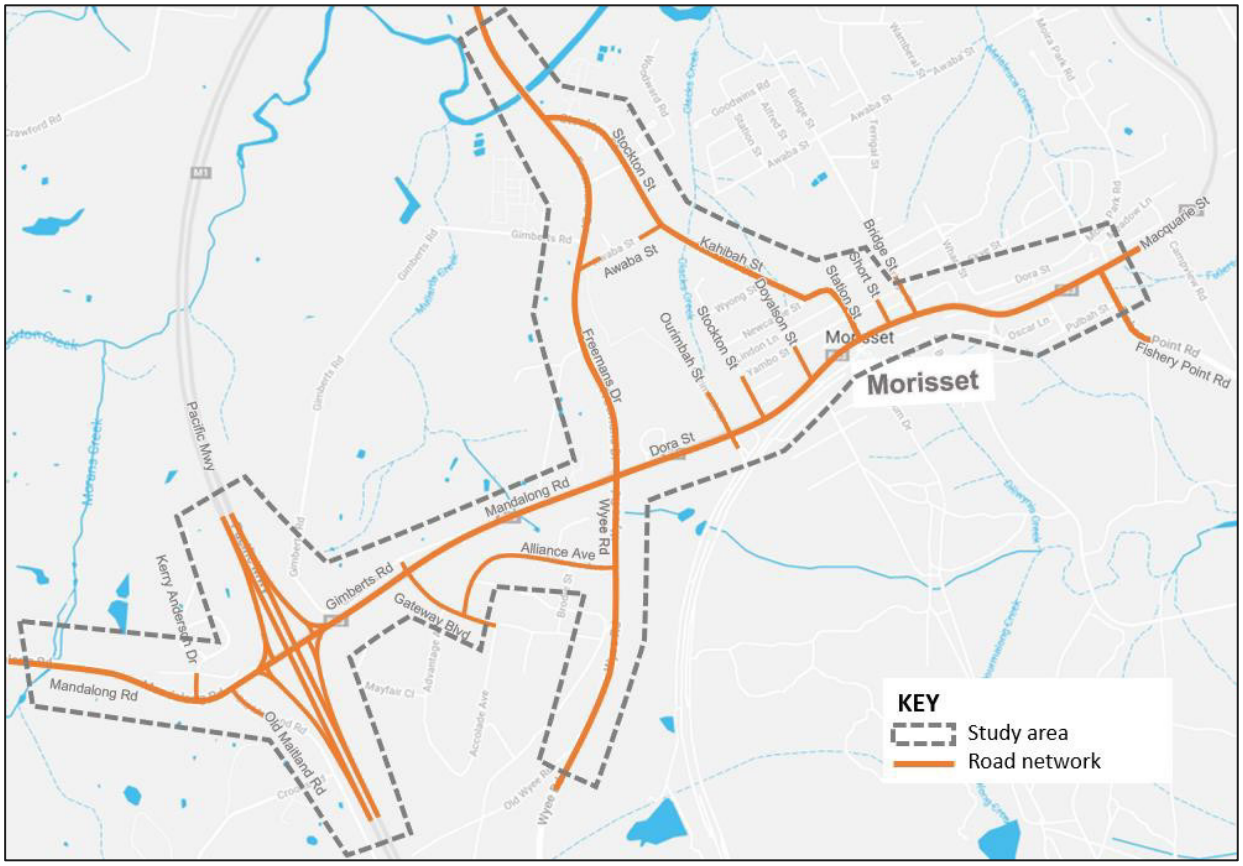


Figure 2-1 Traffic modelling study area

2.2 Land use

Figure 2-2 shows the current land use within and surrounding the study area. The study area includes a variety of land use zones. On the eastern side of the M1 Pacific Motorway, it encompasses zones for general industrial (E4), low to medium-density residential (R2, R3), and public recreation (RE1), reflecting a mix of urban and industrial functions. On the western side, land use is primarily characterised by rural landscapes, emphasising a more natural and less densely developed environment than the eastern portion.

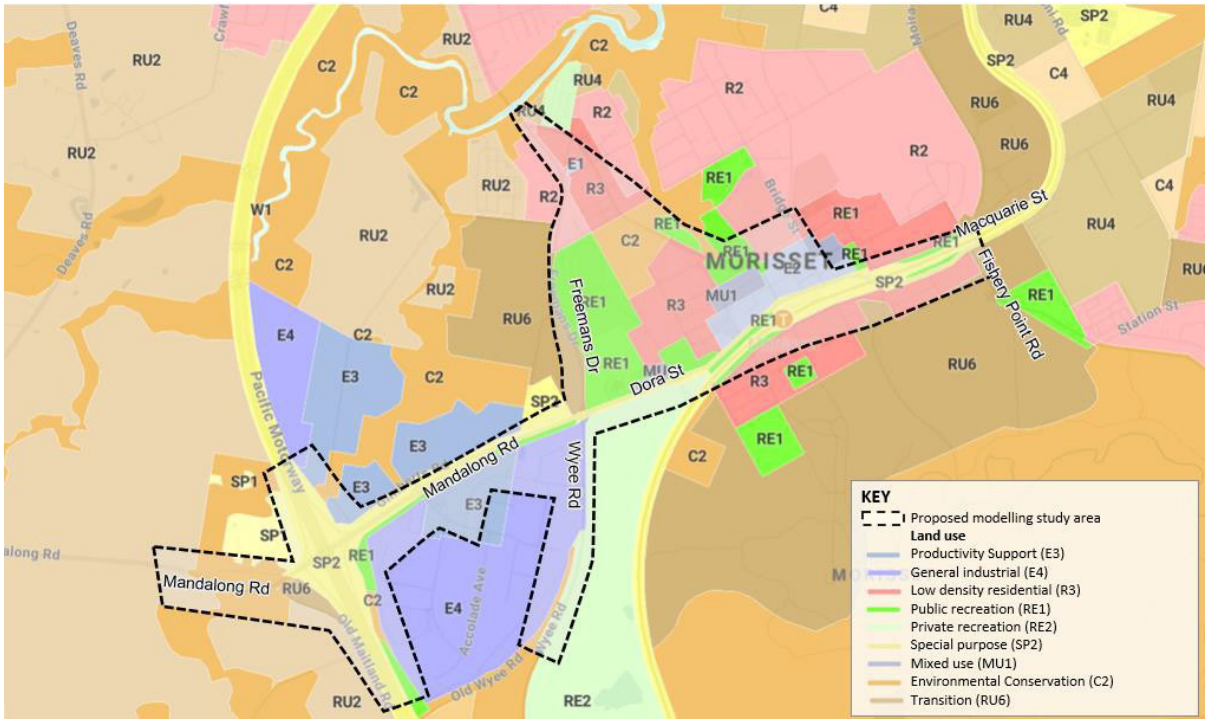


Figure 2-2 Existing land use within the study area (Source: Mecone)

2.3 Public transport

2.3.1 Bus services

The study area is serviced by seven bus routes. Table 2-1 summarises the bus services and frequencies within the study area. Figure 2-3 shows the bus routes on Mandalong Road within the study area.

During the weekday AM peak between 8.15am and 9.15am, there are about six bus services (two-way) which is equivalent to about 10 minutes for each bus. During the PM peak between 3.30pm to 4.30pm, there are about six bus services (two-way), equivalent to about 10 minutes for each bus. Currently, 11 bus stops are provided within the study area, including a transport interchange at Morisset Station.

Table 2-1 Existing bus services and frequencies

Route	Description	Bus service frequency (minutes) – Weekday	
		AM peak (8.15-9.15am)	PM peak (3.30-4.30pm)
95	Lake Haven to Morisset via Gwandalan & Mannering Park	1 service	-
163	Cessnock to Morisset via Kurri Kurri	1 service	-
275	Toronto to Wangi via Fishing Point & Rathmines	-	-
278	Morisset to Silverwater (Loop Service)	1 service	1 service
279	Morisset to Sunshine (Loop Service)	-	1 service
280	Cooranbong to Morisset	3 services (20 minutes)	4 services (15 minutes)
281	Lake Haven to Wangi Wangi	-	-

Sources: Transport for New South Wales

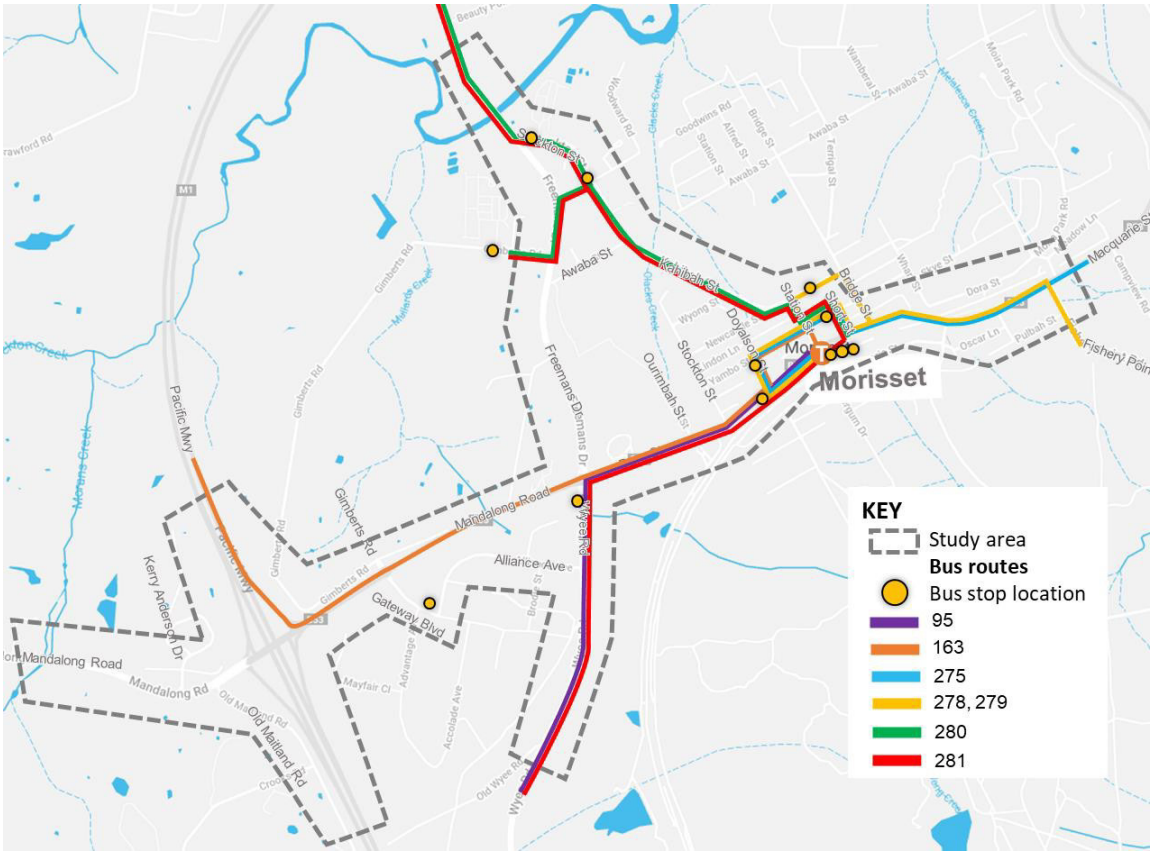


Figure 2-3 Bus routes within the study area

2.3.2 Rail services

The study area has direct rail service. Morisset Train Station is serviced by the Central Coast and Newcastle Line (CCN), which provides connections between Newcastle and Sydney.

Table 2-2 summarises the rail services and frequencies within the study area.

Table 2-2 Frequency of rail service to/from Morisset Station during weekday peak periods

Service	Rail service frequency - Weekday	
	AM peak (8.15-9.15am)	PM peak (3.30-4.30pm)
Morisset to Sydney	2 services (30 minutes)	2 services (30 minutes)
Sydney to Morisset	3 services (20 minutes)	3 services (40 minutes)
Morisset to Newcastle	1 service	2 services (30 minutes)
Newcastle to Morisset	2 services (30 minutes)	2 services (30 minutes)

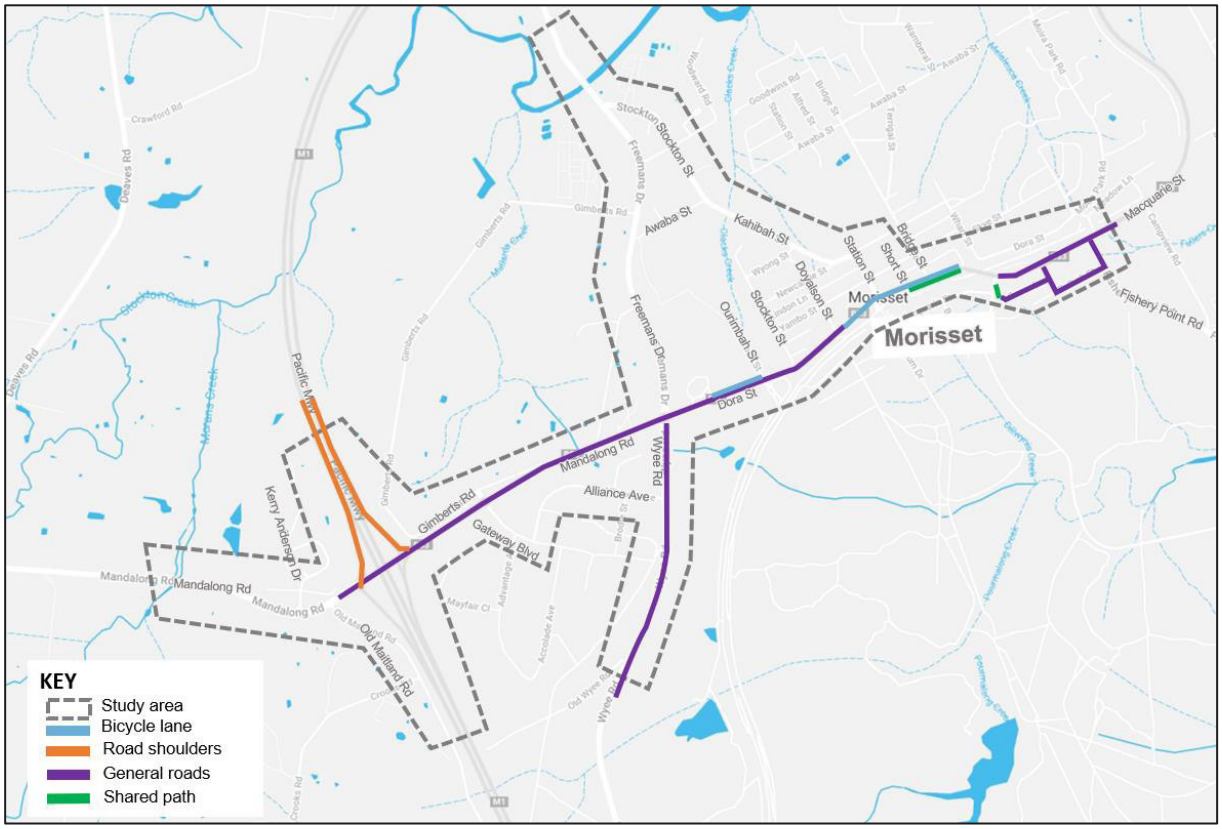
2.4 Active transport

2.4.1 Pedestrian facilities

Currently, footpaths are provided on Dora Street between Freemans Drive and Bakehouse Lane.

2.4.2 Cyclist facilities

Currently, cyclists on Mandalong Road between the M1 Pacific Motorway and Doyalson Street share the road with general traffic. A short section of bicycle lane is provided on Dora Street eastbound between Freemans Drive and Ourimbah Street.



Source: TfNSW Cycleway Finder (August 2023)

Figure 2-4 Existing cyclist facilities within the study area

The analysis identified the following connectivity issues on active transport facilities:

- No footpath and pedestrian crossing are provided along Mandalong Road between the M1 Pacific Motorway and Freemans Drive
- No bicycle paths are provided on Mandalong Road between the M1 Pacific Motorway and the town centre.

2.5 Crash data

TfNSW provided crash data from 2015 to 2022 on Mandalong Road. A review of crash data indicated that COVID-19 travel restrictions influenced data recorded between 2020 and 2022. Therefore, the five-year crash data from 2015 to 2019 are used to inform the current safety issues in the project area.

Table 2-3 summarises five-year crash data recorded from 2015 to 2019 on Mandalong Road from Gimberts Road to Ourimbah Street, classified by location and crash severity (including fatal, injury and non-casualty). Figure 2-6 shows the crash location and severity on Mandalong Road.

Table 2-3 Recorded crashes on Mandalong Road between 2015 to 2019

Road section	Period	Casualty				Non-casualty (towaway)	Total
		Fatal	Serious Injury	Moderate Injury	Minor/ Other Injury		
Mandalong Road from Gimberts Road to Ourimbah Street	2015-2019	0	2	2	2	1	7
	(5 years)	0%	29%	29%	29%	14%	100%

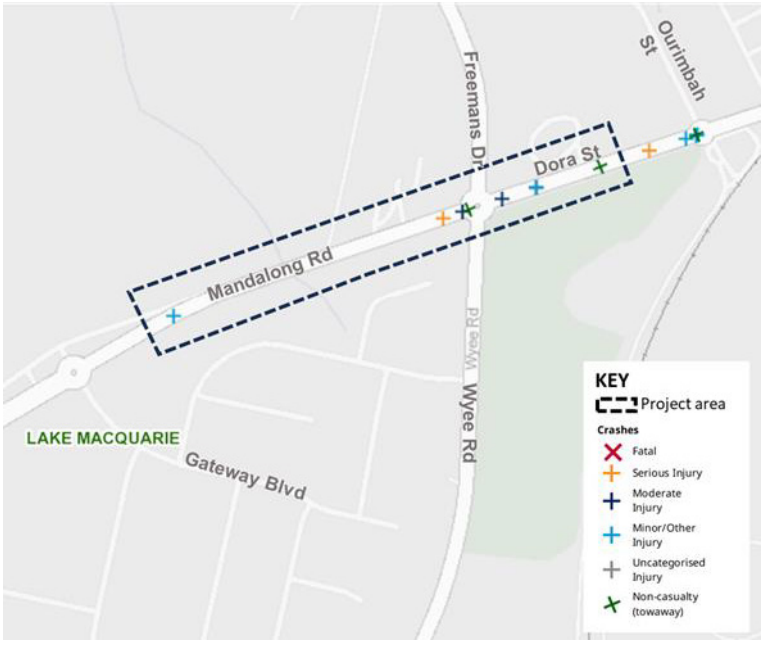


Figure 2-5 Spatial distribution of crashes on Mandalong Road corridor

Between 2015 and 2019 (a five-year period), about seven crashes were recorded on Mandalong Road from Gimberts Road to Ourimbah Street. No fatal crash was recorded. About six crashes were casualty crashes that resulted in injury. Of these, two crashes involved serious injury. Two crashes involved moderate injury. Four crashes were recorded as non-casualty (towaway). Of the seven crashes recorded, six crashes were Rear-end collisions. Another crash was a U-turn collision.

Of the seven recorded crashes, two crashes were recorded at Freemans Drive / Wyee Road roundabout. Five crashes were recorded on Mandalong Road midblock sections. Table 2-4 shows intersections where these crashes occurred.

Table 2-4 Crashes recorded at key intersections with Mandalong Road

Intersections along Mandalong Road, Dora Street	Crashes
Gimberts Road / Gateway Blvd roundabout	0
Mandalong Road between Gimberts Road and Freemans Drive	2
Freemans Drive / Wyee Road roundabout	2
Mandalong Road between Freemans Drive and Ourimbah Street	3
Total	**7**

2.6 Traffic volumes

2.6.1 Daily traffic volumes

Figure 2-6 shows the average weekday daily traffic volumes on Mandalong Road based on traffic data collected in August 2023. Average weekday traffic volumes are highlighted in blue.

With in the proposal area, Mandalong Road between M1 Pacific Motorway and Ourimbah Street carried about 17,900 to 22,900 vehicles per day on an average weekday. Wyee Road carried about 16,500 vehicles per day. Freemans Drive carried about 6,700 per day.

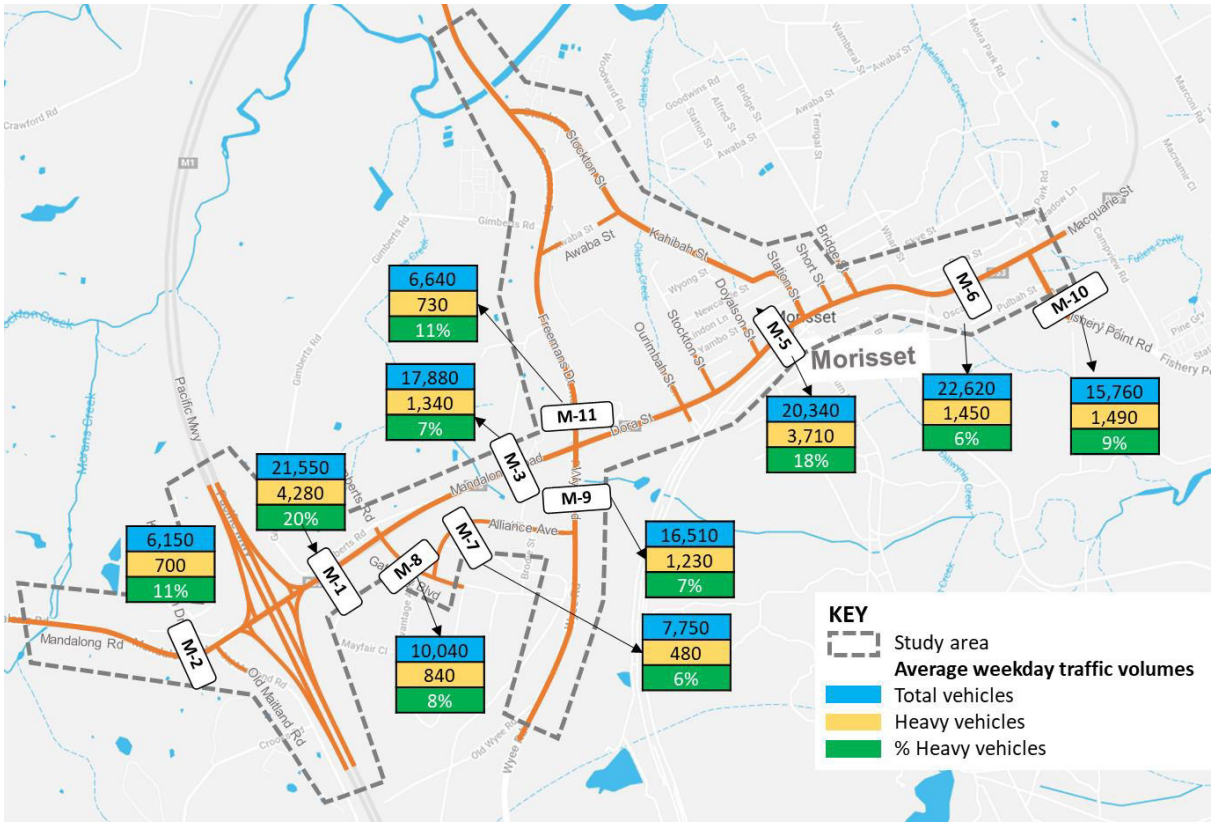


Figure 2-6 Average weekday daily traffic volumes on Mandalong Road and Dora Street in 2023

2.6.2 Heavy vehicles

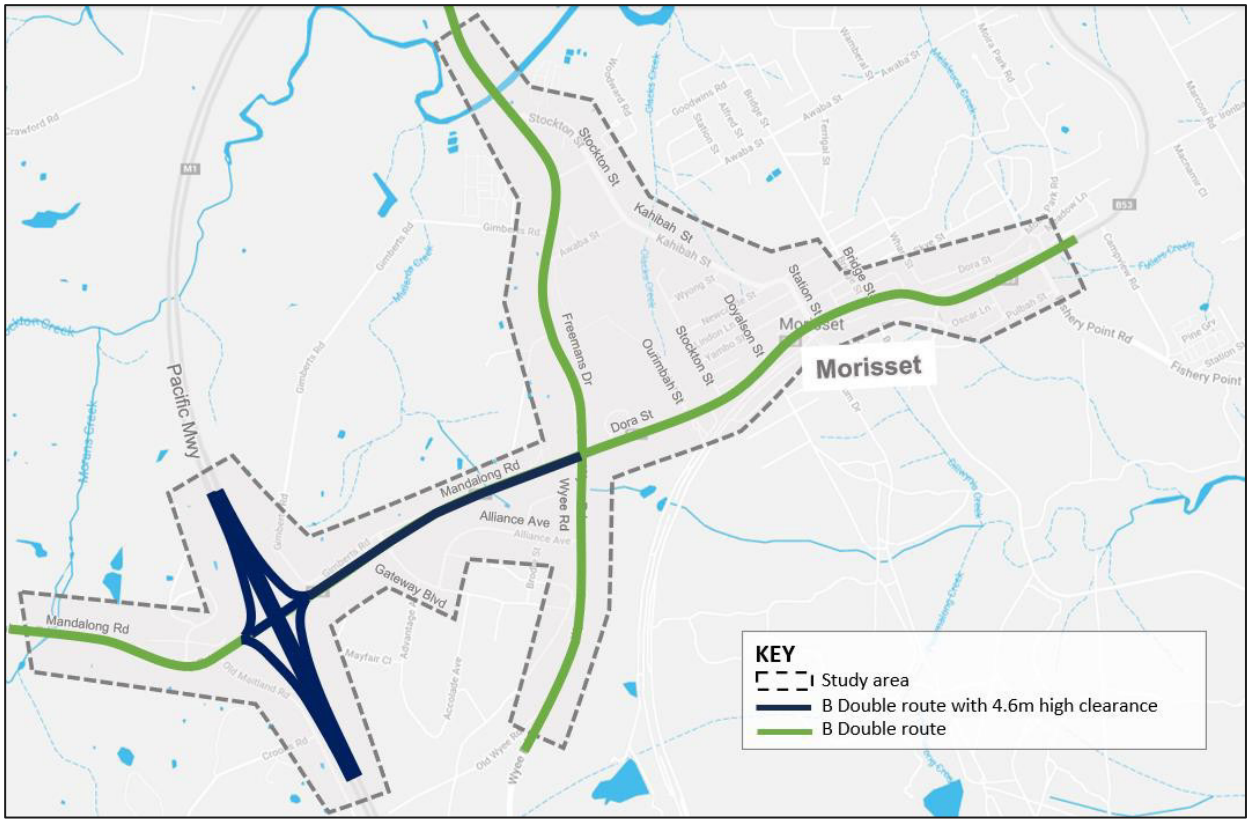
Mandalong Road between the M1 Pacific Motorway and Freemans Drive / Wyee Road is a dedicated B-double (up to 25 metres) and 4.6-metre-high vehicle route (shown in blue in Figure 2-8). The rest of the network (shown in green in Figure 2-8) is a dedicated B-double route (up to 25 metres).

Figure 2-8 shows daily heavy vehicle volumes and the percentage of heavy vehicles to total traffic in the study area on an average weekday from the August 2023 traffic survey. Average weekday heavy volumes are highlighted in yellow. Proportions of heavy vehicles to total traffic are highlighted in green.

Within the proposal area, Mandalong Road between M1 Pacific Motorway and Ourimbah Street carried between 1,340 to 4,280 heavy vehicles per day, representing about 8 to 20 per cent of total traffic volumes.

The highest heavy vehicle volume was recorded on Mandalong Road between the M1 Pacific Motorway and Gimberts Road, with about 4,280 heavy vehicles per day representing about 20 per cent of total traffic volumes. This is contributed by industrial developments on Gateways Boulevard and Alliance Avenue. About 3,700 heavy vehicles per day were recorded on east of Freemans Drive, representing about 18 per cent of total traffic volumes.

Wyee Road, Gateway Boulevard and Alliance Avenue carried about 900 to 1,500 heavy vehicles per day, which are about 6 to 8 per cent of total traffic volumes.



source: https://maps.transport.nsw.gov.au/egeomaps/load-carrying-vehicles-network/

Figure 2-7 Designated heavy vehicle routes within study area

2.6.3 Peak hour traffic volumes

The intersection turning movement counts were used to determine the AM and PM peak hours. On average, traffic data shows that:

- Weekday AM peak hour occurred from 8.15am and 9.15am
- Weekday PM peak hour occurred from 3.30pm and 4.30pm.

Figure 2-9 and Figure 2-10 show directional traffic flows on Mandalong Road and Dora Street in the AM peak one hour (8.15am to 9.15am) and the PM peak one hour (3.30pm to 4.30pm). The red arrows show the peak traffic direction.

During the peak hour, Mandalong Road and Dora Street carried up to 1,000 vehicles per hour in the peak direction depending on locations. In the AM peak, higher traffic volumes were observed in the westbound direction towards the M1 Pacific Motorway. In the PM peak, higher traffic volumes were observed in the eastbound direction towards the town centre.

Wyee Road carried about 800 vehicles per hour. Freemans Drive carried about 400 vehicles per hour.

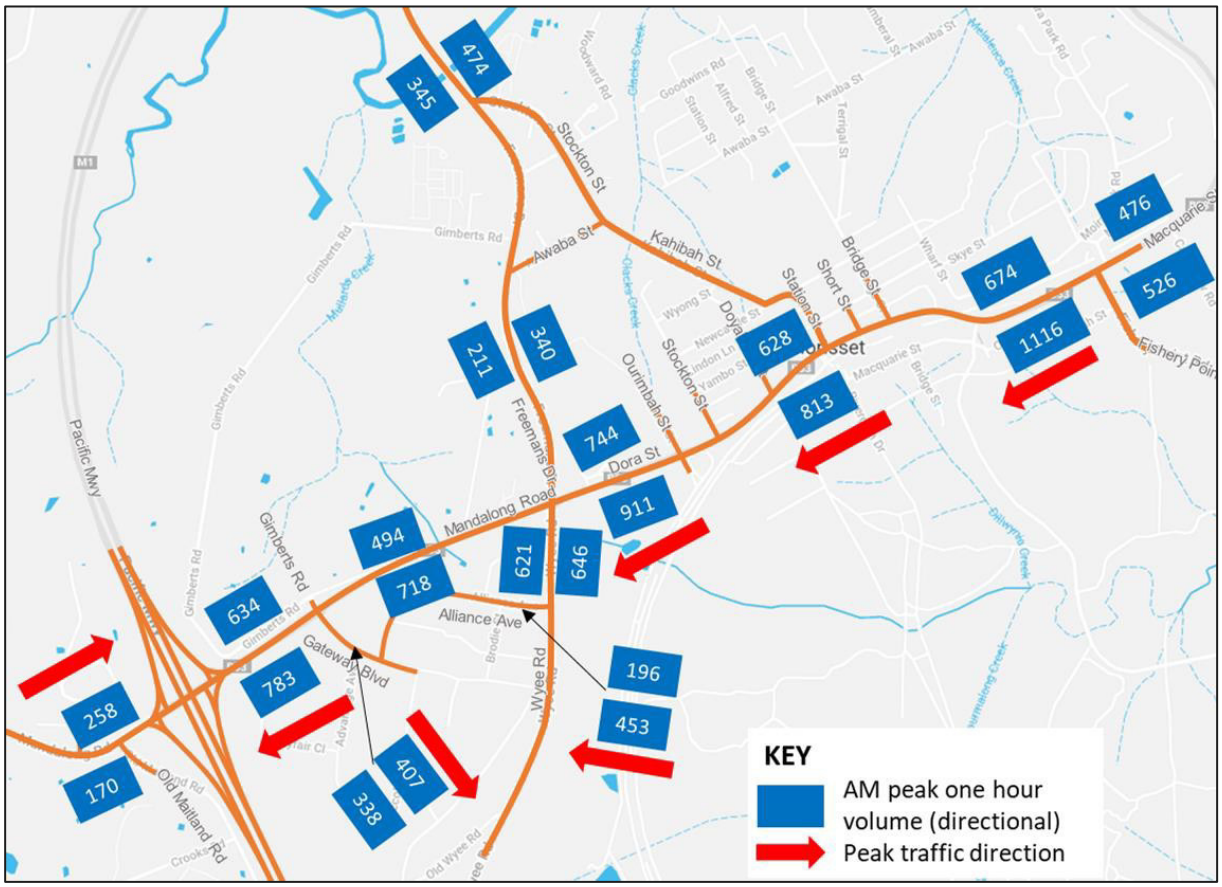


Figure 2-8 Observed peak hour traffic in AM peak (8.15am to 9.15am) within study area

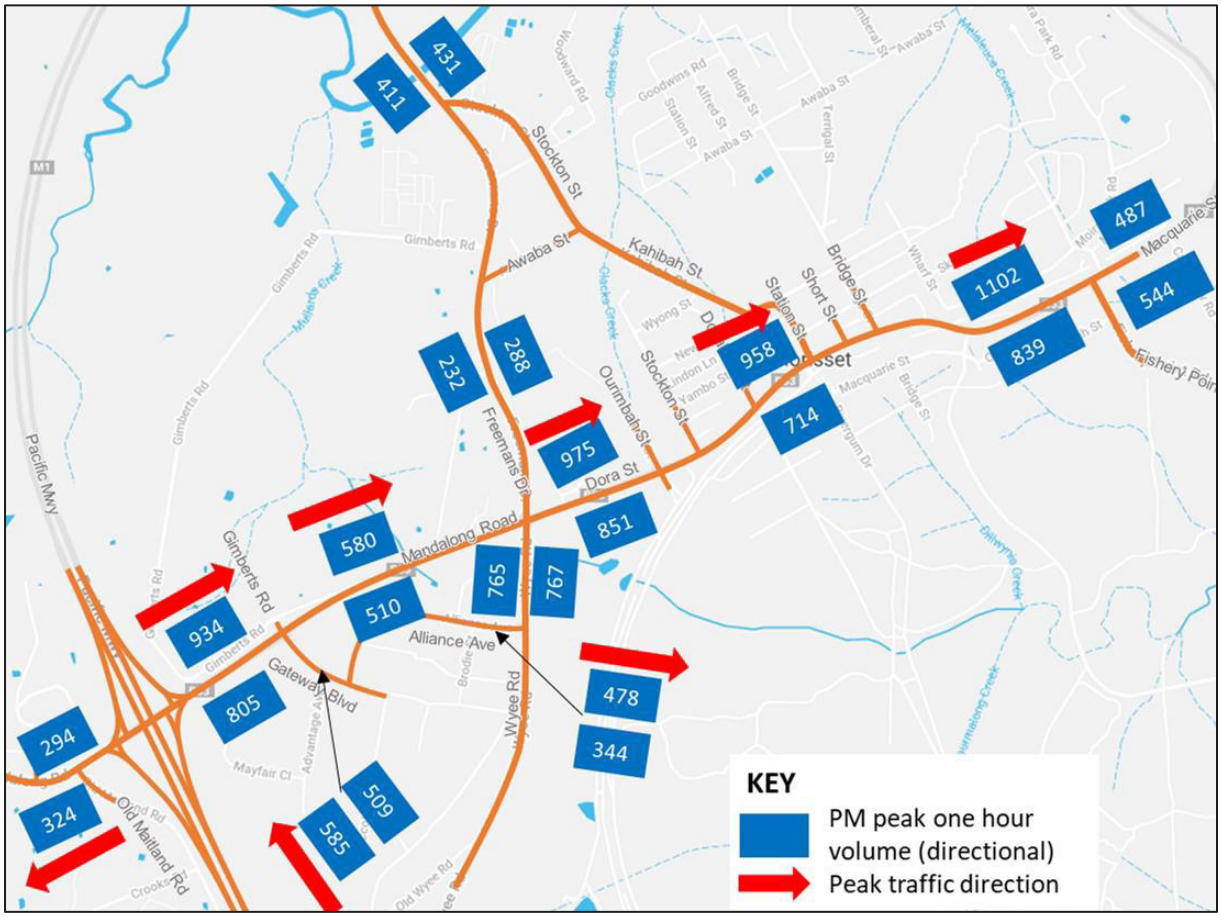


Figure 2-9 Observed peak hour traffic in PM peak (3.30pm to 4.30pm) within study area

2.7 Speed environment

Figure 2-11 shows the existing speed limits within the study area. Mandalong Road has posted speed limits varying from 60 km/h to 80 km/h. Mandalong Road has a posted speed of 80 km/h west of the M1 Pacific Motorway. Between the M1 Pacific Motorway and Freemans Drive, Mandalong Road has a posted speed limit of 60 km/h. The 60 km/h posted speed limit is applied on Dora Street between Freemans Drive and Doyalson Street and reduces to 50 km/h between Doyalson Street and Wharf Street.

M1 Pacific Motorway through the study area has a posted speed limit of 110 km/h on the mainline and 60 km/h on the entry and exit ramps. School Zones with reduced speed limits of 40km/h during school hours is applied on certain sections of Doyalson Street, Newcastle Street, and Bridge Street.

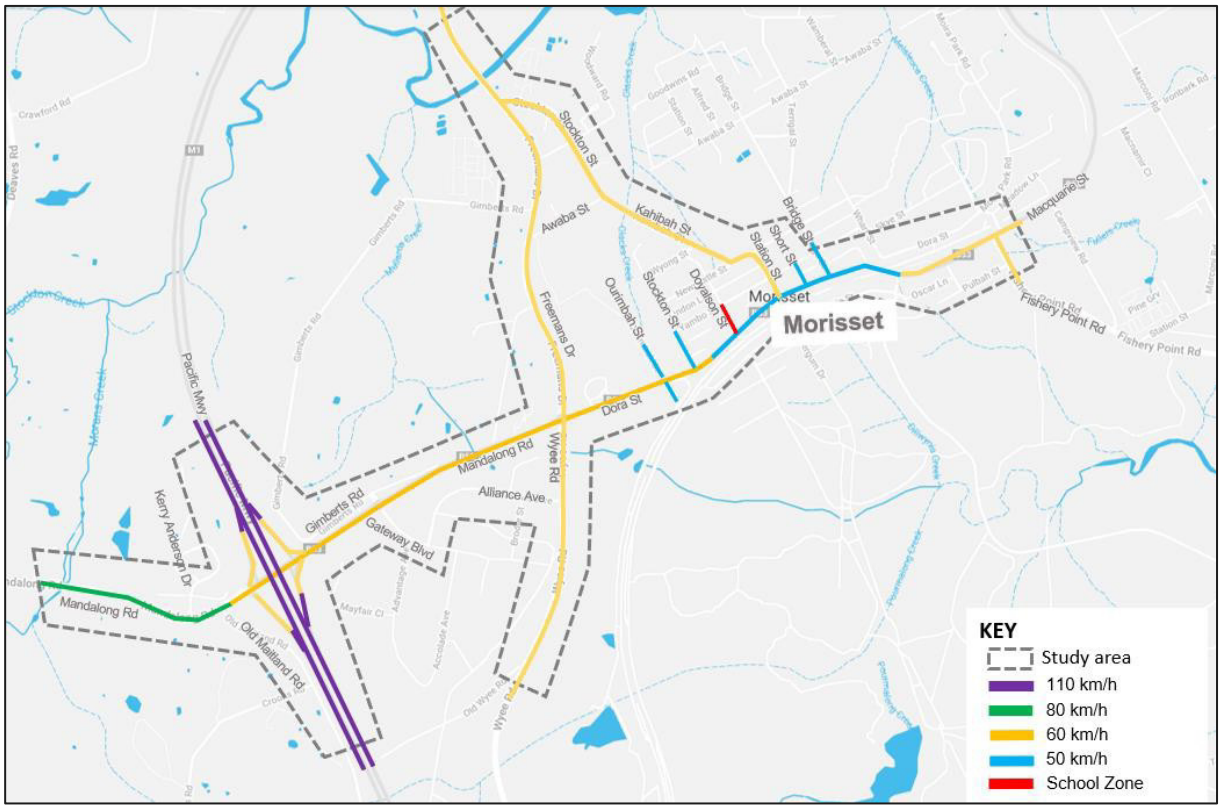


Figure 2-10 Posted speed limits within the study area

2.8 Intersection level of service

The existing level of service is reported for Freemans Drive / Wyee Road intersection. The intersection level of service (LoS) is reported in accordance with *TfNSW Traffic Modelling Guidelines* (Version 1.0, February 2013).

Table 2-5 below shows the TfNSW standard level of service (LoS) criteria for intersection operation. The guide recommends that the level of service is determined by the critical movement with the highest delay for priority intersections such as roundabouts and sign-controlled intersections. With these intersection controls (roundabout, Stop and Give Way sign controls), some movements may experience high levels of delay while others may experience a minimal delay.

The level of service criteria for a signalised intersection is related to the average intersection delay measured in seconds per vehicle.

Level of service categorises the average delay into bands LoS A to LoS F, with LoS A representing the best operation and LoS F representing the worst operation. The LoS band of categories are shown in Table 2-5.

Table 2-5 Level of service criteria for intersections

Level of Service (LoS)	Average Delay per Vehicle (seconds per vehicle)	Traffic Signals, Roundabout	Give Way & Stop Signs
A	Less than 14	Good operation	Good operation
B	More than 14 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	More than 28 to 42	Satisfactory	Satisfactory, but accident study required
D	More than 42 to 56	Operating near capacity	Near capacity & accident study required
E	More than 56 to 70	At capacity; at signals, incidents will cause excessive delays Roundabouts require other control mode	At capacity, requires other control mode
F	More than 70	Unsatisfactory with excessive queuing	Unsatisfactory with excessive queuing

Source: TfNSW' Traffic Modelling Guidelines, Version 1.0, February 2013

Table 2-6 shows the existing delays and level of service for Freemans Drive / Wyee Road intersection by approaches.

Table 2-6 Existing (2023) delay and level of service by approach at Freemans Drive / Wyee Road intersection

Intersection	Approach	AM		PM	
		Delay (sec)	Volume (veh/h)	Delay (sec)	Volume (veh/h)
Freemans Drive / Wyee Road	Freemans Dr (N)	22 (B)	340	29 (C)	288
	Dora St (E)	95 (F)	896	48 (D)	851
	Wyee Rd (S)	59 (E)	621	82 (F)	765
	Mandalong Rd (W)	17 (B)	494	234 (F)	580
	Overall	**95 (F)**	**2,351**	**234 (F)**	**2,484**

Congestion and delay – in 2023, VISSIM model shows level of service F at Freemans Drive / Wyee Road roundabout with delays between 95 seconds (AM) and 234 seconds (PM).

- Freemans Drive / Wyee Road roundabout provides connections to the industrial developments on Wyee Road and residential developments on Freemans Drive. The roundabout has a single circulating lane and is identified as a pinch point with level of service F in both AM and PM peaks. In the AM peak, westbound traffic on Dora Street is being delayed by southbound traffic from Freemans Drive. In the PM peak, eastbound traffic on Mandalong Road is delayed by high right turning traffic from Wyee Road.

Mandalong Road queuing - the current single lane roundabout arrangement leads to congestion on Mandalong Road and Dora Street. Figure 2-12 and Figure 2-13 show existing queues on Mandalong Road and Dora Street in the 2023 AM and PM peak hours sourced from the VISSIM model developed for the proposal area.

- AM peak queues were observed on Dora Street westbound (towards M1 Pacific Motorway) at Freemans Drive roundabout (refer to Figure 2-12). Westbound queues on Dora Street extend about 800 metres from Freemans Drive to Doyalson Street. At Freemans Drive roundabout, queues are also observed on Wyee Road southern approach (about 310 metres up to Alliance Avenue).
- PM peak queues were observed on Mandalong Road eastbound (towards Morisset) at Freemans Drive roundabout (refer to Figure 2-13). Eastbound queues on Mandalong Road extend more than 700 metres from Freemans Drive to Gateway Boulevard. At Freemans Drive roundabout, queues were also observed on the Wyee Road southern approach (about 480 metres extended beyond Alliance Avenue).

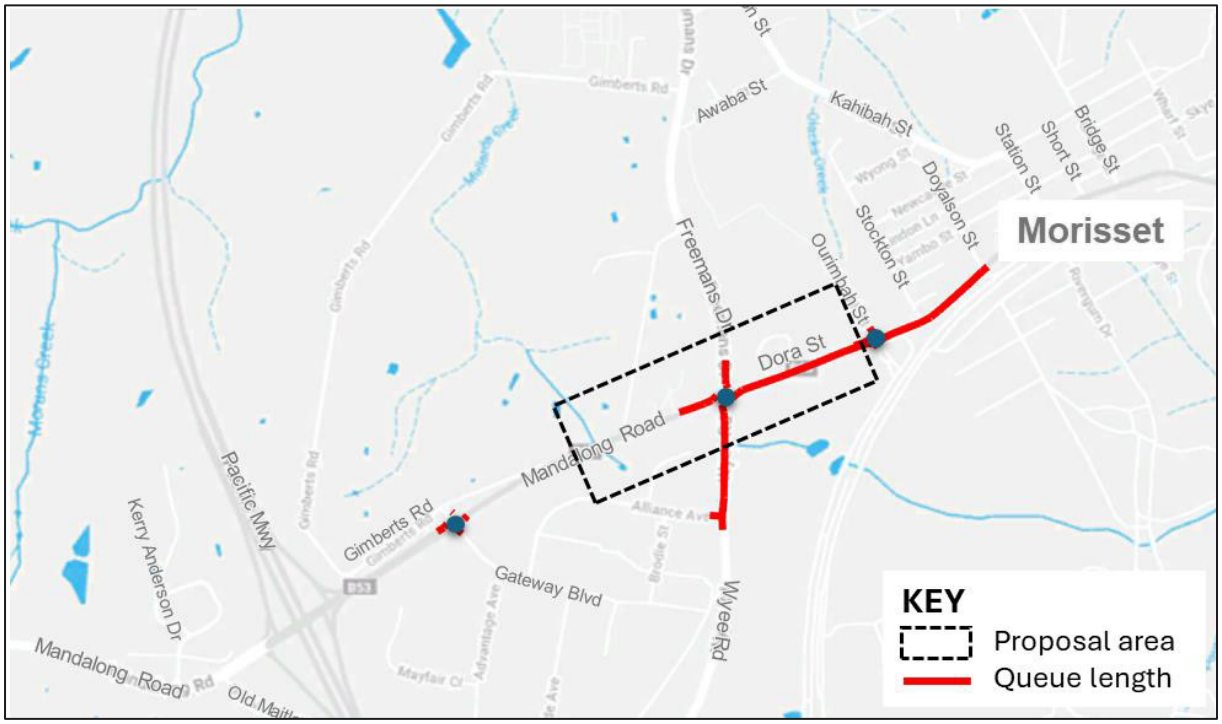


Figure 2-11 Existing approach queues on Mandalong Road in AM peak

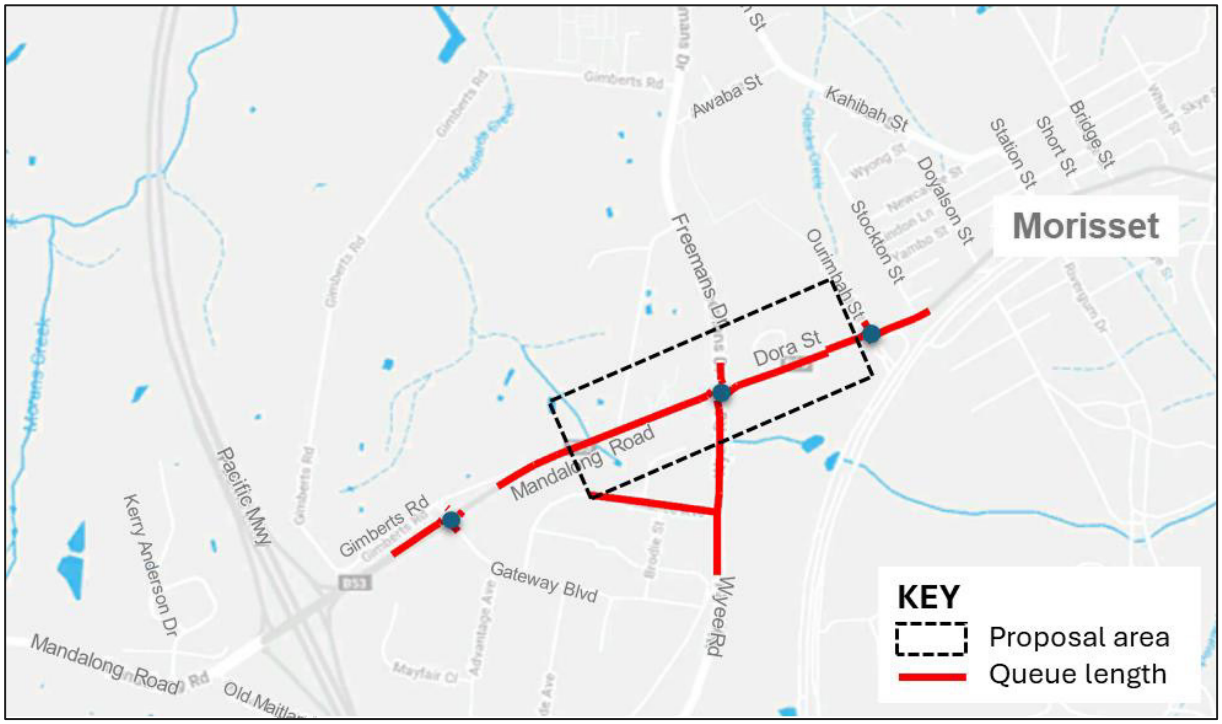


Figure 2-12 Existing approach queues on Mandalong Road in PM peak

2.9 Travel time

The existing travel time and travel speed on Mandalong Road are reported for a 4.3-kilometre section between Moran's Creek crossing (Point A) and Fishery Point Road (Point B) which is longer than project area to capture upstream and downstream congestions (refer to Figure 2-14).

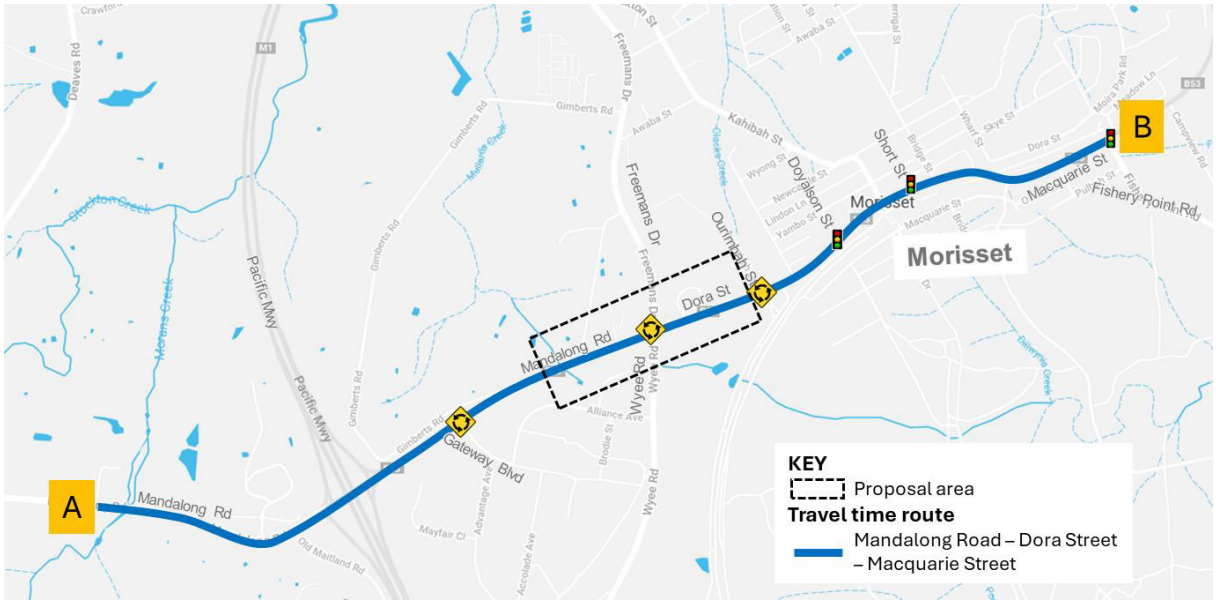


Figure 2-13 Travel time route

Table 2-7 shows existing (in 2023) travel time and travel speed on Mandalong Road between Moran's Creek crossing and Fishery Point Road. Travel time are reported for the westbound peak traffic direction (towards M1) for the AM peak and eastbound peak traffic direction (towards Morisset) for the PM peak.

Table 2-7 Existing travel time and travel speed on Mandalong Road in 2023

Peak period / peak direction	Average travel time (minutes)	Average travel speed (km/h)
AM peak westbound (towards M1)	8.1	32
PM peak eastbound (towards Morisset)	10.2	25

During the weekday peak hour, motorist took about 8.1 to 10.2 minutes to travel on Mandalong Road from the M1 Pacific Motorway to Fishery Point Road. The average travel speed on Mandalong Road is about 32 km/h in the AM westbound direction and 25 km/h in the PM eastbound direction, which are substantially lower than the posted speed on Mandalong Road in the project area (varies between 50 km/h and 60 km/h).

The low travel speed data on Mandalong Road is contributed by capacity constraints at Freemans Drive / Wyee Road intersection at both morning and afternoon peak periods.

3 Traffic modelling methodology

This section provides an overview of the traffic modelling and analysis methodology that has been adopted for the traffic and transport assessment. The objective was to make the best use of available traffic count data and modelling software to determine the base and future conditions for the proposal in terms of generating vehicle volumes and assessing the operational performance, both with and without the proposal.

3.1 Relevant guidelines

The following guidelines were referenced in carrying out this assessment:

- *TfNSW Traffic Modelling Guideline, version 1, February 2013*
- *TfNSW Technical Direction (TTD 2017/001) Operational Modelling Reporting Structure, May 2017*
- *TfNSW Technical Direction (TTD 2018/002) Traffic Signals in Microsimulation Modelling, November 2018*

3.2 Traffic modelling approach

Two levels of traffic modelling were undertaken for this study which included Strategic Traffic Forecasting Model (STFM) and operational traffic modelling (VISSIM).

The STFM operated by TfNSW provides strategic road traffic forecasts to inform the project definition and evaluation as input into more detailed operation traffic modelling. STFM modelling was undertaken by TfNSW. The VISSIM developed for the study area by Arcadis provides operational road network performance relevant to the project.

3.2.1 Strategic traffic forecasting model (STFM)

The Strategic Traffic Forecasting Model (STFM), developed and operated by TfNSW, provides a platform to understand the change in future traffic patterns under different land use and transport infrastructure scenarios.

The following key inputs and assumptions are made in the STFM by TfNSW including:

- Updated land use assumptions based on Travel Zone Projections 2022 land use (STM STM3.91, FMM7.1)
- The existing road infrastructure for the 2021 base year is consistent with the census year
- TfNSW provided STFM demand data for 2021 base year and 2031, 2041 and 2051 future years

The STFM traffic demand data and key input assumptions were provided by TfNSW and used to estimate future traffic growth for the proposal study area.

3.2.2 Operational modelling (VISSIM)

Operational modelling was carried out for the study area using the software package VISSIM.

3.3 Base VISSIM model

An operational microsimulation traffic model was developed using VISSIM software (version 2023) for the 4.3-kilometre section of Mandalong Road, Dora Street, Macquarie Street between Moran's Creek (west of the M1 Pacific Motorway) and Fishery Point Road. The VISSIM network is longer than the proposal area to capture upstream and downstream congestions on Mandalong Road. The base model contains about 29 travel zones. Figure 3-1 shows the base VISSIM road network and travel zones.

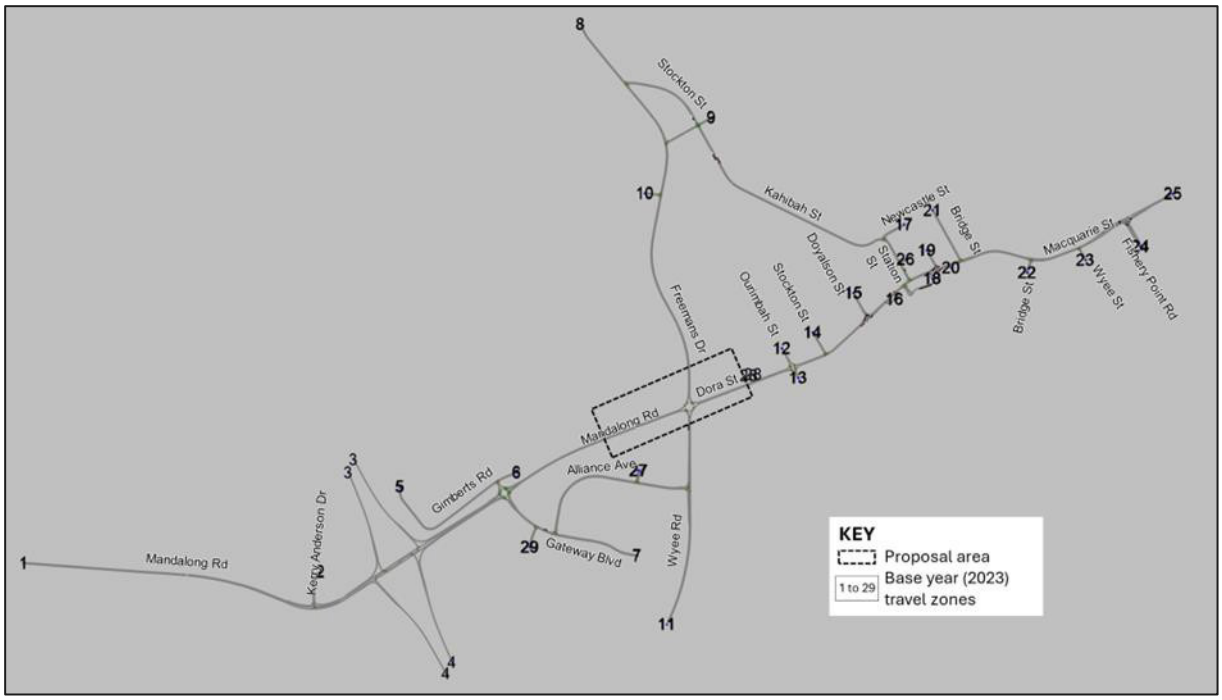


Figure 3-1 VISSIM base network and travel zone system

The base model represents 2023 traffic conditions. The base model (AM and PM) was calibrated to ensure an acceptable correlation between modelled and observed traffic data. This was followed by validation of model by comparing a secondary set of modelled and observed results – in this case, travel time data and intersection queue length data were used in model validation data set.

The calibration and validation of the base models were carried out in accordance with *the Traffic Modelling Guidelines (*TfNSW, version 1, February 2013*) and Technical Director (TTD 2017/001) Operational modelling reporting structure (TfNSW Technical Directions, May 2017*).

The base model (AM and PM) development including calibration and validation was accepted by TfNSW.

3.4 Future modelling years

The proposal was assessed for future year traffic conditions in 2029 and 2039.

3.5 Future land use projection (TZP22)

The future road network performance modelling was undertaken based on Travel Zone Projections 2022 (TZP22) population and employment projections.

TfNSW produces Travel Zone Projections (TZP) for population, workforce and employment for NSW travel zones, as an input into a variety of travel models including Strategic Traffic Forecasting Model (STFM). The projections are developed to support a strategic view of NSW and are aligned with the NSW Government Common Planning Assumptions.

TfNSW updated Strategic Traffic Forecasting Model (STFM) using TZP22 (Travel Zone Projections) land use projection (STM STM3.91, FMM7.1).

3.6 Reference case traffic demand

Future traffic demand was estimated from Strategic Traffic Forecasting Model (STFM) and traffic generation from approved and proposed development applications (DA's) in the study area. The reference case demand provides a land use scenario that reflects known updates following the release of TZP22 and current planning assumptions by TfNSW.

In consultation with TfNSW, traffic generation from the following five future developments were included in future demand, including:

- Morisset Bulky Goods
- Gimberts industrial subdivision
- Other E3 Zoned Gimberts Road land
- Biraban/Landcom Land North residential development
- Cedar Mill Event, Restaurant and Caravan Park lifestyle living/tourist accommodation.

3.7 Future base case / Do minimum network

The Do minimum network reflects the future road network conditions in the event the proposal is not constructed.

In consultation with TfNSW, the following upgrades are assumed for the future Do minimum network including:

- Gimberts Road / Gateway Boulevard roundabout upgrade. It is proposed to provide a new dedicated left turn from Gimberts Road onto Mandalong Road, making two lanes on the Gimberts Road approach
- New left in/left out access on Mandalong Road between Gimberts Road and Freemans Drive
- New dual circulate lane roundabout at Wyee Road / Alliance Avenue intersection
- New single circulate lane roundabout at Wyee Road / Gateway intersection.

Table 3-1 shows future Do minimum network assumptions in 2029 and2039. For comparison, the existing network as of 2023 is also shown in Table 3-1.

Table 3-1 Summary of future Do minimum network assumptions

Map ref.	Future network assumption for Do minimum network	Existing network 2023	Future Do minimum network (2029, 2039)
1	Mandalong Road, M1 to Ourimbah Street including the existing two lanes merges west of Gimberts Road	Single carriageway (one lane in each direction)	No change
2	New left in/left out access on Mandalong Road between Gimberts Road and Freemans Drive	n/a	New left in/left out access
3	Gimberts Road / Gateway Blvd roundabout	Dual lane roundabout	a new dedicated left turn from Gimberts Road onto Mandalong Road
4	Freemans Drive / Wyee Road roundabout	Single lane roundabout	No change
5	Dora Street / Ourimbah St roundabout	Single lane roundabout	No change
6	Wyee Road / Alliance Avenue roundabout	n/a	New dual circulate lane roundabout
7	Wyee Road / Gateway Blvd roundabout	n/a	New single circulate lane roundabout

Figure 3-2 shows the location of proposed upgrades assumed in the future year reference / Do minimum network.

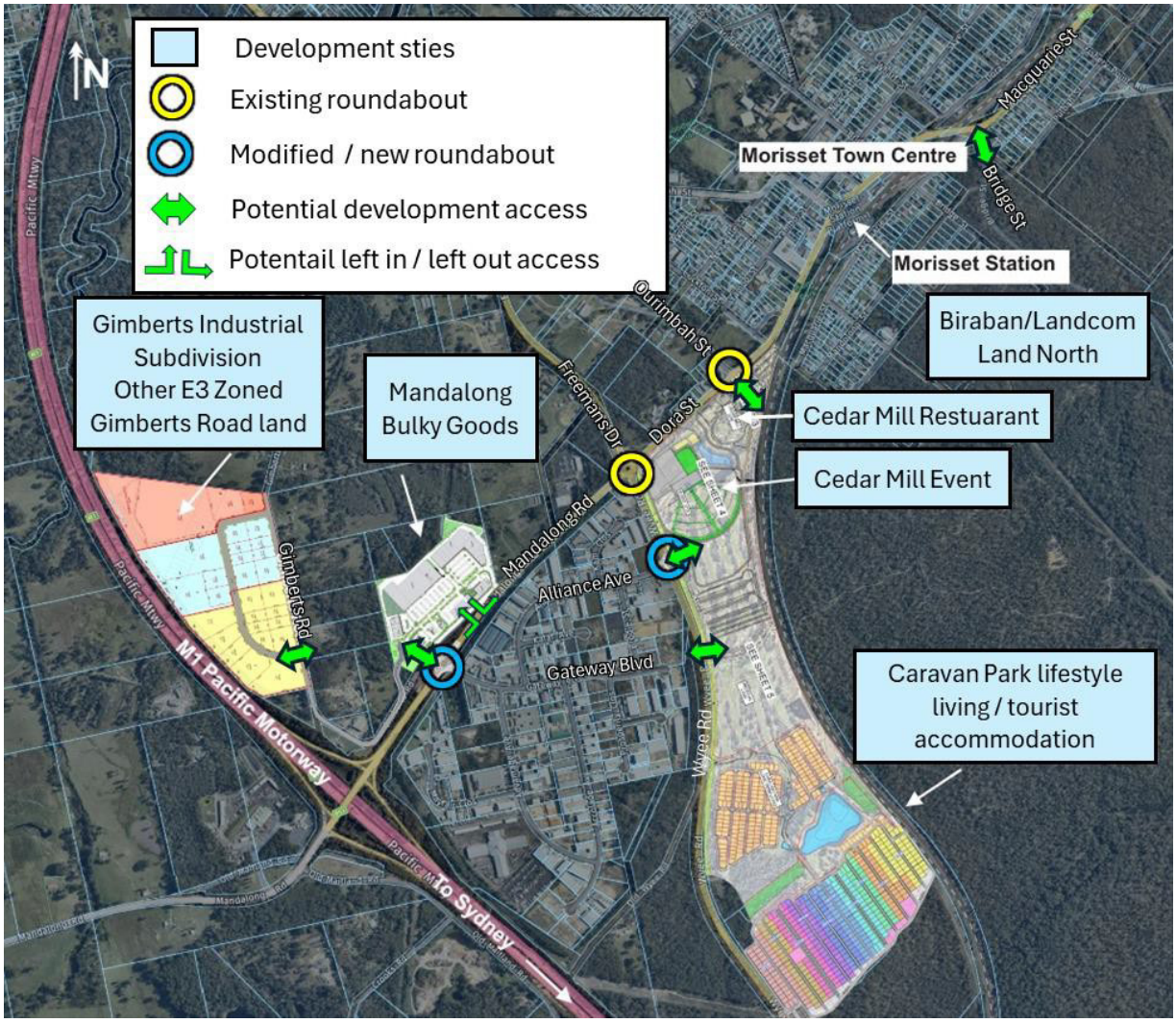


Figure 3-2 Future upgrades assumed in future Do minimum network

3.8 Assessment criteria

The operation of the modelled road network provides an overview of the performance of the road network and is used to identify the impact of the proposal. This impact was assessed across the network and at intersection level:

- At a network level. This includes average travel speed, total distance travelled, and total time travelled within the modelled network
- At an intersection level. The performance of an intersection and its level of service (LoS) is determined by the average delay per vehicle. The performance criteria for intersections are shown in Table 2-5.

3.8.1 Network performance criteria

Road network performance statistics are extracted from VISSIM traffic models for AM and PM peak periods, and the statistics used in this assessment are defined as follows:

- Total vehicle hours travelled in the study area (VHT)
- Total vehicle kilometres travelled across the study area (VKT)
- Average network travel speed – which is the average speed (kilometres per hour) of vehicles in the study area during the modelled periods
- Total stops – which is the cumulative total of every instance when a vehicle comes to a stop within the network. A stop is defined as a vehicle's speed dropping below five kilometres per hour until it accelerates to above ten kilometres per hour
- Latent demand – which is the total number of vehicles that cannot enter the model due to model constraints such as congestion.

4 Future traffic conditions without the Proposal

This section outlines the future traffic conditions without the proposal, including traffic growth rates and forecast traffic volumes on Mandalong Road in 2029 and 2039.

4.1 TZP22 population and employment projections

Table 4-1 shows the TZP22 population and employment projections for the study catchment area in 2021, 2031, 2041, and 2051. The study catchment area includes nine travel zones, as shown in yellow dotted lines in Figure 4-2. The red line in Figure 4-2 shows the VISSIM modelling study area. The VISSIM study area represents a small area in the context of the broader catchment area.

Table 4-1 TZP22 land use projections – population and employment between 2021 and 2051

	TZP22 land use projections				Population / employment growth per annum
	2021	2031	2041	2051	2021-2051 (30 years)
Population	22,527	28,233	33,592	38,496	2.4%
Employment	7,925	9,388	10,114	10,926	1.3%

TZP22 data in Table 4-1 shows that the broader catchment area would experience population growth of 2.4 per cent per annum for the next 30 years between 2021 and 2051. Population in the broader catchment area is predicted to increase by 16,000 by 2051, primarily towards the east and north of the study area.

Figure 4-2 shows the projected dwellings increase for 30 years between 2021 and 2051 by travel zones. STFM data indicates residential growth primarily at Cooranbong, Morisset Park, and Wyee Point and Martinsville travel zones being outside of the VISSIM model study area boundary (refer to Figure 4-2).

Employment growth is predicted to be about 1.3 per cent per annum over the next 30 years (between 2021 and 2051). About 3,000 new jobs are projected by 2051. Figure 4-3 shows employment increase for 30 years between 2021 and 2051 by travel zones. TZP22 suggests employment (jobs) growth primarily in Morisset town centre and Cooranbong.

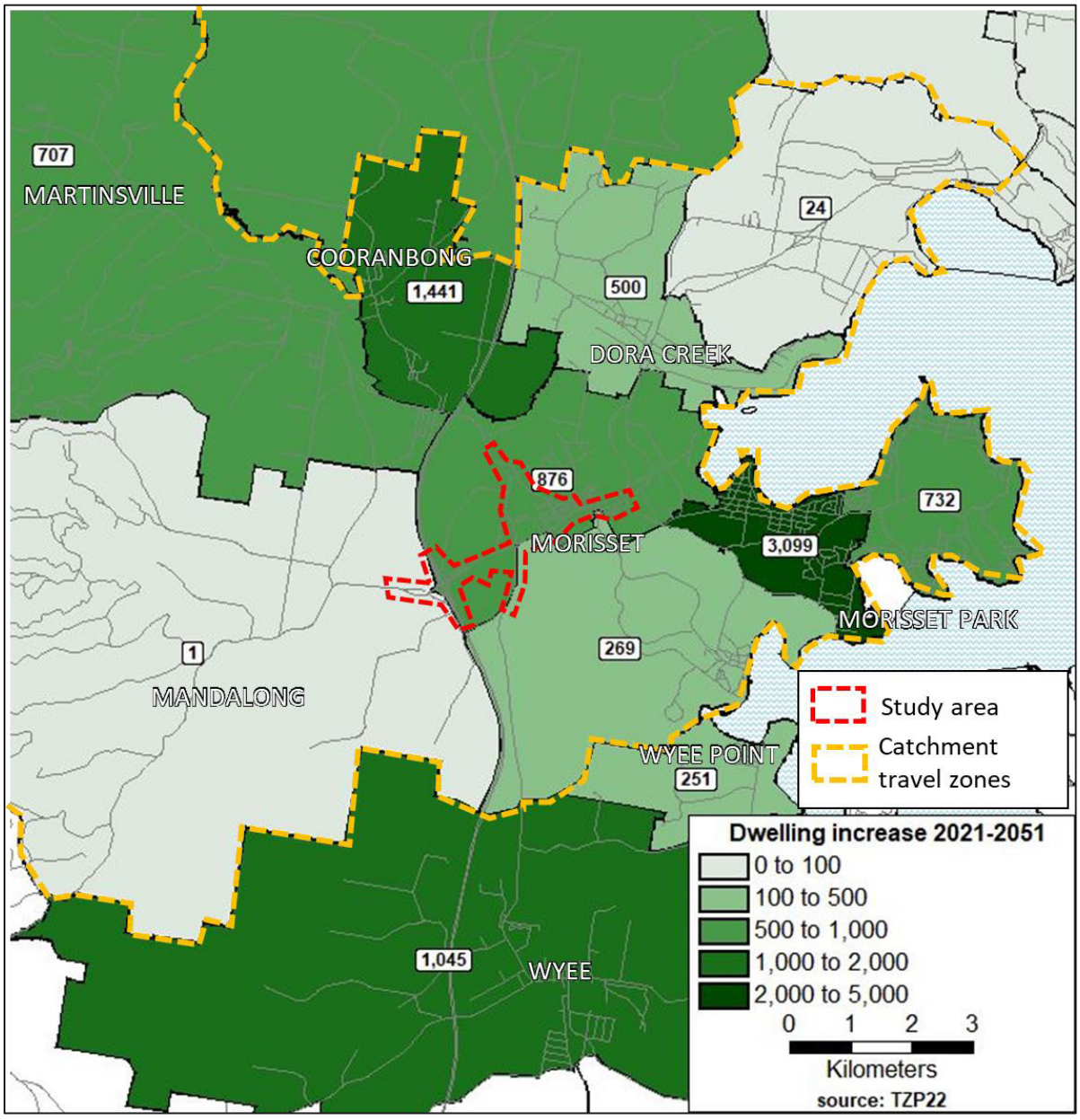


Figure 4-1 Dwellings increase by travel zones between 2021 and 2051 (30 years)

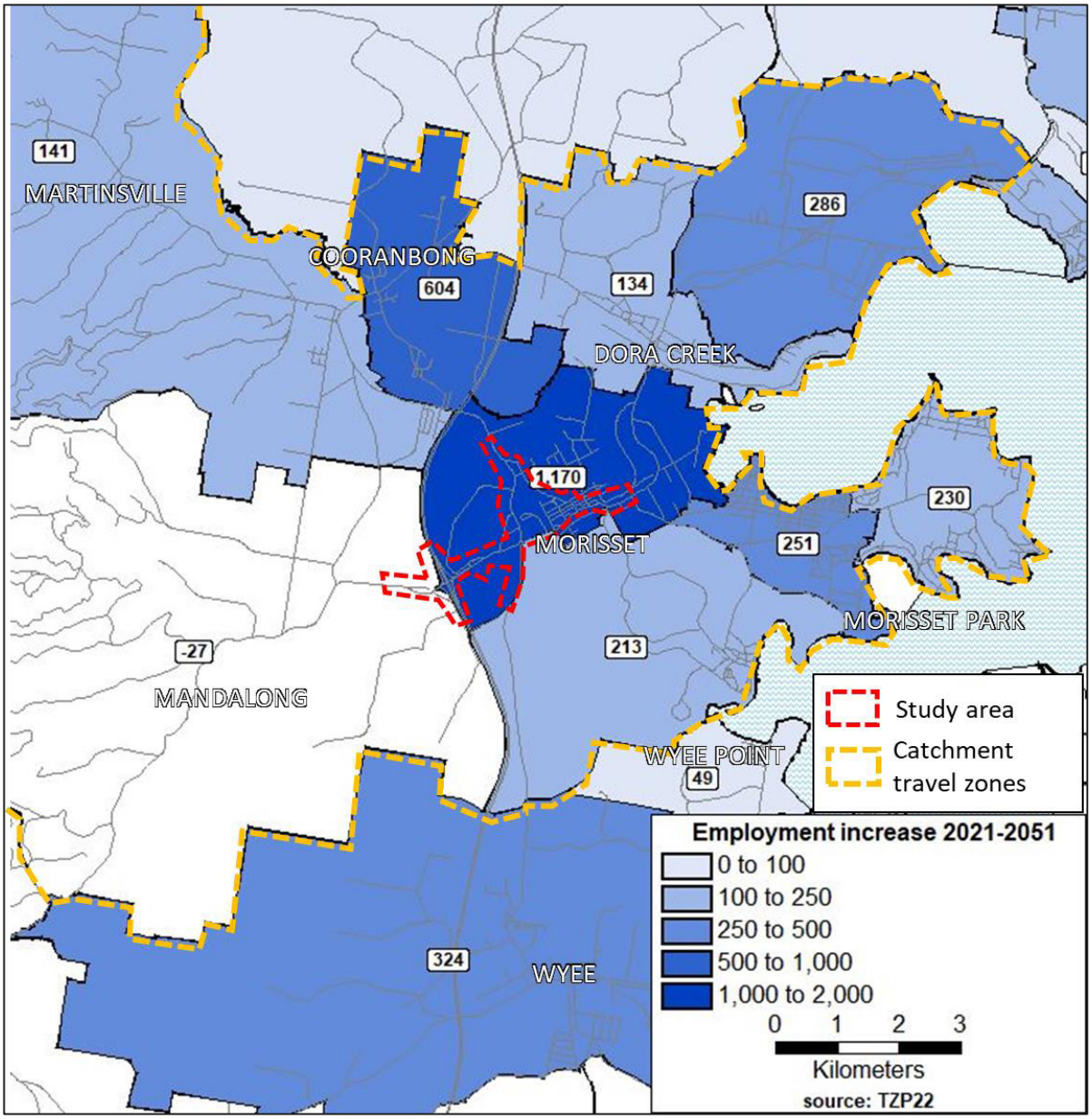


Figure 4-2 Employment increase by travel zones between 2021 and 2051 (30 years)

4.2 Future traffic volumes on Mandalong Road

The average weekday daily traffic volumes (AWT) on Mandalong Road between the M1 Pacific Motorway and Ourimbah Street in 2029 and 2039 are shown in Table 4-2.

Daily traffic volumes on Mandalong Road are predicted to increase from 17,900 to 22,900 vehicles per day in 2023 to 27,000 to 30,500 vehicles per day in 2039, equivalent to an increase of 33 to 75 per cent from 2023 traffic volumes.

Table 4-2 Average weekday traffic volumes on Mandalong Road in 2029, 2039 and 2049

Road section	Counts	Average weekday traffic volumes	
	2023	2029	2039
Mandalong Road, west of Gimberts Road	21,600	25,100	28,400
Mandalong Road, west of Freemans Road	17,900	23,000	27,000
Dora Street, west of Ourimbah Road	22,900	27,000	30,500
Average three sections	**20,800**	**25,000**	**28,600**

Figure 4-3 shows traffic growth on Mandalong Road for future years in 2029, 2039 and 2049. Growth rate on Mandalong Road is forecast to be about 3.4 per cent per annum until 2029 followed by 1.4 per cent per annum until 2039 and 1.8 per cent per annum until 2049.

On average, the growth rate on Mandalong Road for the next 26 years (until 2049) is estimated to be about 2.4 per cent per annum.

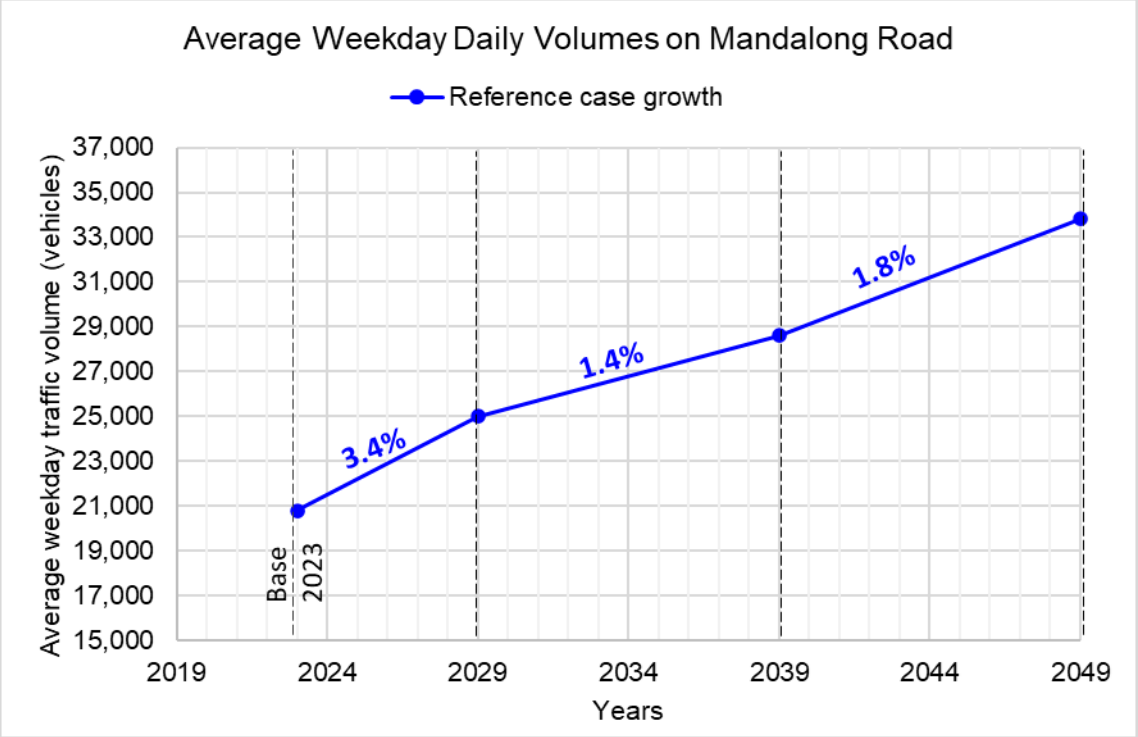


Figure 4-3 Future traffic growth on Mandalong Road in 2029, 2039 and 2049

4.3 Consequences of inaction or delay

There is a significant need to address the constraints and issues associated with the existing Mandalong Road configuration to minimise avoidable costs to road users, provide an acceptable level of road transport infrastructure consistent to its classification as a movement corridor catering to both existing and future growth.

The traffic demand on Mandalong Road is predicted to intensify (forecast to be approximately 2.4 per cent per annum). The consequences of deferral, inaction or delay in upgrading this section of road, in association with this forecast growth, includes:

- Continued poor performance of Mandalong Road, particularly at Freemans Drive / Wyee Road intersection under peak traffic conditions. Over time, traffic congestion will increase, and intersection performance will decrease due to failure to accommodate increased traffic growth
- Loss of opportunity to improve accessibility and efficiency for public and active transport
- Increased constructability challenges of working adjacent to higher traffic volumes.

As Freemans Drive / Wyee Road intersection already performs at poor level of service (LoS F) in booth AM and PM peak, the forecast growth in traffic demand between 2029 and 2039 will only serve to exacerbate the delay and congestion associated with this intersection.

Table 4-3 shows predicted delay and level of service at Freemans Drive / Wyee Road intersection in 2029 and 2039 without the proposal.

Table 4-3 Delay and level of service at Freemans Drive / Wyee Road intersection in 2029 and 2039 (without proposal)

Intersection	Approaches	Without proposal			
		2029		2039	
		Delay (sec)	Volume (veh/hr)	Delay (sec)	Volume (veh/hr)
AM Peak					
Freemans Drive / Wyee Road	Freemans Dr (N)	71 (E)	375	534 (F)	409
	Dora St (E)	104 (F)	1009	112 (F)	1117
	Wyee Rd (S)	101 (F)	727	170 (F)	827
	Mandalong Rd (W)	25 (B)	624	50 (D)	725
	Overall	104 (F)	**2735**	534 (F)	**3,078**
PM Peak					
Freemans Drive / Wyee Road	Freemans Dr (N)	61 (E)	334	166 (F)	368
	Dora St (E)	99 (F)	1,007	109 (F)	1122
	Wyee Rd (S)	182 (F)	830	197 (F)	891
	Mandalong Rd (W)	203 (F)	798	216 (F)	965
	Overall	203 (F)	**2,969**	216 (F)	**3,347**

The future years Do minimum scenario (without proposal) indicated substantial impact at Freemans Drive / Wyee Road intersection.

In 2029, Freemans Drive / Wyee Road intersection would operate with poor level of service F. By 2039, delays at Freemans Drive / Wyee Road roundabout would increase to 534 seconds due to capacity constraints on Mandalong Road.

4.4 Impact on travel times on Mandalong Road

Table 4-4 and Table 4-5 show modelled travel time and travel speed on Mandalong Road between Moran's Creek crossing and Fishery Point Road (about 4.3 kilometres) in 2029 and 2039.

Table 4-4 Predicted travel time on Mandalong Road in 2029and 2039 'Do minimum'

Direction	Average travel time (minutes)		
	2023	Do minimum	
		2029	2039
AM peak westbound (towards M1)	8.1	10.8	13.6
Changes from 2023		2.7	5.5
% changes from 2023		*33%*	*68%*
PM peak eastbound (towards Morisset)	10.2	10.8	20.3
Changes from 2023		0.6	10.1
% changes from 2023		*6%*	*99%*

Table 4-5 Predicted travel time on Mandalong Road in 2029 and 2039 'Do minimum'

Direction	Average travel speed (km/h)		
	2023	Do minimum	
		2029	2039
AM peak westbound (towards M1)	32	24	19
Changes from 2023		-8	-13
% changes from 2023		*-25%*	*-40%*
PM peak eastbound (towards Morisset)	25	24	13
Changes from 2023		-1	-13
% changes from 2023		*-6%*	*-50%*

In 2029, average travel time on Mandalong Road would increase to 10.8 minutes (both AM westbound and PM eastbound). The average travel speed on Mandalong Road would reduce to 24 km/h (both AM westbound and PM eastbound).

In 2039, single lane capacity constraints at both Freemans Drive / Wyee Road and Gimberts Road / Gateway Boulevard roundabouts would increase travel time on Mandalong Road up to 20.3 minutes (PM, westbound). The average travel speed on Mandalong Road is expected to reduce to 13 km/h (PM, westbound).

Compared to 2023 travel time, model indicates up to 99 per cent travel time increase on Mandalong Road (PM eastbound) and about 68 per cent travel time increase in AM eastbound direction.

The single lane capacity roundabout constraints on Mandalong Road between the M1 Pacific Motorway and Ourimbah Street would substantially increase travel time on Mandalong Road during both morning and afternoon peak periods. In the event capacity is not improved, travel speed on Mandalong Road is expected to be reduced substantially at below 10 km/h.

5 Traffic performance of the Proposal

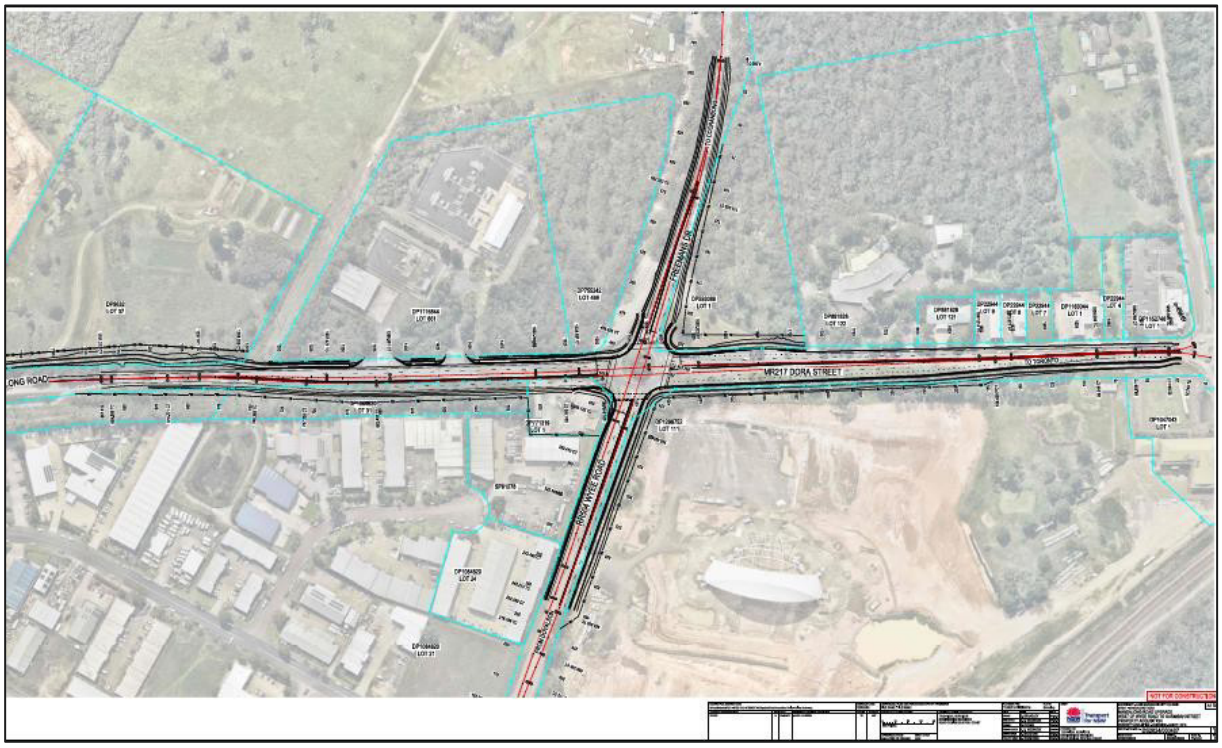
This section documents traffic modelling and analysis of future conditions with the proposal.

5.1 The proposal

The proposal includes:

- Replacing the existing roundabout at Wyee Road / Freemans Drive intersection with new traffic lights
  - Providing pedestrian and cyclist crossings on all approaches
  - Providing two through lanes in both directions on Mandalong Road / Dora Street
  - Providing turning lanes on all approaches to the intersection
  - Providing a central raised median on all approaches to the intersection
- Providing a shared path along Mandalong Road / Dora Street for pedestrians and cyclists
- Providing two new bus stops on Dora Street

Figure 5-1 shows proposed upgrade at Wyee Road / Freemans Drive intersection.



Source: TfNSW, DS2024/000407

Figure 5-1 Proposed upgrade at Wyee Road / Freemans Drive intersection

5.2 Post-upgrade intersection level of service

A new traffic signal is proposed at Freemans Drive / Wyee Road intersection. The new traffic signal at Freemans Drive / Wyee Road intersection would provide level of service E or better up to 2039.Table 5-1 shows delay and level of service at Freemans Drive / Wyee Road intersection in 2029 and 2039.

Table 5-1 Post upgrade level of service at Freemans Drive / Wyee Road intersection in 2029 and 2039

Intersection	Approaches	Post upgrade level of service			
		2029		2039	
		Delay (sec)	Volume (veh/hr)	Delay (sec)	Volume (veh/hr)
AM Peak					
Freemans Drive / Wyee Road	Freemans Dr (N)	61 (E)	375	63 (E)	409
	Dora St (E)	44 (D)	1009	51 (D)	1117
	Wyee Rd (S)	41 (C)	727	42 (C)	827
	Mandalong Rd (W)	51 (D)	624	52 (D)	725
	Overall	**47 (D)**	**2735**	**50 (D)**	**3,078**
PM Peak					
Freemans Drive / Wyee Road	Freemans Dr (N)	65 (E)	334	65 (E)	368
	Dora St (E)	48 (D)	1,007	50 (D)	1122
	Wyee Rd (S)	47 (D)	830	99 (F)	891
	Mandalong Rd (W)	53 (D)	798	64 (E)	965
	Overall	**51 (D)**	**2,969**	**68 (E)**	**3,347**

5.3 Travel time savings

Travel time savings by the proposal are reported for a 4.3-kilometre section between Moran's Creek crossing and Fishery Point Road which is longer than proposal area to capture upstream and downstream congestions (refer to Figure 2-14).

Table 5-2 shows average travel times (minutes) for the base case (without proposal) and the project case (with proposal) in 2029 and 2039. Travel time are reported for the westbound peak traffic direction (towards M1) for the AM peak and eastbound peak traffic direction (towards Morisset) for the PM peak.

Table 5-2 Travel time savings on Mandalong Road in 2029 and 2039

Year	Peak period	Direction	Average travel time (minutes)		
			Base case (without proposal)	Project case (with proposal)	Change/ Savings
2029	AM peak	Westbound (towards M1)	10.8	7	-3.8
	PM peak	Eastbound (towards Morisset)	10.8	6.9	-3.9
2039	AM peak	Westbound (towards M1)	13.6	7.9	-5.7
	PM peak	Eastbound (towards Morisset)	20.3	8.5	-11.8

In 2029, the proposal is expected to reduce journey times on Mandalong Road, between Moran's Creek crossing and Fishery Point Road, by up to 3.8 to 3.9 minutes during peak periods. By 2039, the travel time savings are estimated to increase to up to 11.8 minutes during peak periods.

5.4 Impact on other modes

5.4.1 Bus services

The proposal would not impact current bus routes. The proposal would improve bus travel time reliability due to reduced congestion and improved intersection performance.

It is proposed to remove one bus stop on Wyee Road (Stop ID 2264166) and adding two new bus stops on Dora Street near the new traffic signals as well as upgrades the pedestrian crossing facilities.

5.4.2 Pedestrian and cyclist

The proposal aims to increase and upgrade pedestrian crossing facilities along Mandalong Road and Dora Street at the new traffic signals. The proposal includes:

- Providing pedestrian and cyclist crossing on all approaches at new traffic signals with Wyee Road / Freemans Drive
- Providing a shared path along Mandalong Road eastbound between Gimberts Road and Freemans Drive, Dora Street westbound between Ourimbah Street and Wyee Road and Wyee Road northbound between Alliance Avenue and Dora Street.

These improvements to the pedestrian and cyclist network are expected to enhance active transport connectivity, improve cycling and pedestrian access, and provide safer access to bus stops.

5.4.3 Parking

Currently, there is no designated parking provided in the proposal area. The proposal would have no impact on the Council's designated parking.

6 Management and mitigation measures

6.1 Construction

During construction, traffic impact on the Mandalong Road is likely to increase depending on stages and locations. However, these impacts are expected to be minor and would not impact the operational performance of Mandalong Road. The construction staging would maintain the existing traffic lane and accessibility on Mandalong Road. Traffic management plans and construction staging would be progressively developed and refined during construction to facilitate the safe and efficient movement of traffic through and around the proposal area and to and from construction locations and ancillary facilities.

Measures to be implemented to manage potential traffic impacts during construction are:

- A Traffic Management Plan (TMP) will be prepared and implemented for traffic as part of the Construction Environmental Management Plan (CEMP) for the construction phase of the proposal. This will adhere to *Traffic Control at Worksites, Technical Manual, Issue No. 6, Transport, September 2020 and QA Specification G10 Traffic Management (Transport, August 2020)*. This will include details on:
  - Measures to maintain access to properties and local roads
  - Site specific traffic control measures to manage and regulate traffic movement
  - Requirement and methods to consult and inform the local community of impacts on the local road network
  - Measures to maintain pedestrian and cyclist access
  - Access to ancillary sites including entry and exit locations and measures to prevent construction vehicles queuing on public roads
  - A response plan for any construction road traffic incident
  - Consideration of other developments which may be under construction to minimise traffic conflict and congestion that may occur due to the cumulative increase in construction vehicle traffic
  - Monitoring, review and amendment mechanisms.
- Traffic management plans would be prepared for the construction area and progressively updated as the works progress. The plans would be prepared and implemented by suitably qualified personnel
- Schedule partial and full road closures to avoid peak periods
- Undertake consultation with local and regional bus companies prior to and during construction
- Undertake consultation with emergency services prior to and during construction to confirm any diversions during construction and any operational road network changes
- Undertake consultation with property owners and occupiers regarding changes to access arrangements
- Undertake consultation with local Council regarding potential impacts to parking during the construction period.

6.2 Operation

Measures to manage potential traffic impacts and changes during operation include:

- Review incident management plan in the event the road may be temporarily closed due to scheduled maintenance or accident
- Consult with residents who may be affected by the temporary closure due to scheduled maintenance or accident.

7 Summary and conclusions

7.1 Overview

This report documents the traffic and transport assessment of the proposed Mandalong Road upgrade at the Wyee Road / Freemans Drive intersection. This involves an assessment of the existing traffic conditions, future traffic growth analysis and modelling concept design for future years. During preparing this report, relevant documents associated with the proposal have been reviewed, and the potential traffic impacts on the study area road network have been assessed.

There is a significant need to address the constraints and issues associated with the existing Mandalong Road configuration in order to minimise avoidable costs to road users, provide an acceptable level of road transport infrastructure consistent with its classification as a movement corridor catering to both existing and future growth.

A preferred design has been developed for the proposed upgrade, which includes replacing the existing roundabout with new traffic lights at the Wyee Road / Freemans Drive intersection (the Proposal). The upgrade includes additional through lanes and additional turning lanes on all approaches. Active and public transport improvements would also be included as part of the upgrade.

For traffic assessment purposes, traffic models were built using VISSIM software. Future traffic conditions on the Mandalong Road were modelled for 2029 and 2039 for both morning (AM) and afternoon (PM) peak periods.

This traffic and transport assessment report has been prepared to support the concept design and review of environmental factors (REF) for the proposal.

7.2 Existing traffic conditions

Mandalong Road provides a critical link from the M1 Pacific Motorway to Morisset and the southern part of Lake Macquarie local government area. Mandalong Road between the M1 Pacific Motorway and Ourimbah Street is currently two lane (one lane in each direction). Traffic data collected in August 2023 shows that on average Mandalong Road carried about 17,900 to 22,900 vehicles per day on average weekday. Mandalong Road provides as access to industrial developments on Gateways Boulevard and Alliance Avenue. About 1,340 to 4,280 heavy vehicles used this section of Mandalong Road on an average weekday, representing about 8 to 20 per cent of total traffic volumes.

The posted speed on Mandalong Road between M1 Pacific Motorway and Ourimbah Street is 60 km/h. The 2023 survey data indicates travel speed of about 25 km/h to 32 km/h on Mandalong Road during peak periods which is substantially lower than posted speed. The low travel speed on Mandalong Road is contributed to by its single lane with capacity constraints at Freemans Drive / Wyee Road intersection in morning and afternoon peak periods.

Currently, the Freemans Drive / Wyee Road roundabout is identified as a pinch point with poor level of service F (over capacity) during both morning and afternoon peak periods. In the morning peak, westbound queues extend more than 800 metres from Freemans Drive to Doyalson Street. In the afternoon peak, eastbound queues extend more than one kilometre from Ourimbah Street to Gateway Boulevard. The current single lane roundabout leads to congestion on Mandalong Road and Dora Street and overflow queuing at Freemans Drive Ourimbah Street roundabouts.

7.3 Future traffic conditions without the Proposal

Over the next 16 years (between 2023 and 2039), traffic volumes on the Mandalong Road are predicted to grow by 2.4 per cent per annum. In 2039, traffic volumes on the Mandalong Road are predicted to increase to 27,000 to 30,500 vehicles per day, equivalent to an increase of 33 to 50 per cent from 2023 traffic volumes.

The consequences of deferral, inaction or delay in upgrading this section of road, in association with this forecast growth, include:

- Continued poor performance on Mandalong Road particularly at Freemans Drive / Wyee Road roundabouts under peak conditions (level of service F). Over time, traffic congestion would increase, and intersection performance would decrease due to failure to accommodate increased traffic growth.
- Major congestion on Mandalong Road would substantially reduce travel speed during morning and afternoon peak period. By 2039, travel speed on Mandalong Road is expected to be reduced to 13 km/h.
- Loss of opportunity to improve accessibility and efficiency for public and active transport.
- Incur ultimate cost escalations due to inflation and increased constructability challenges of working adjacent to higher traffic volumes.

7.4 Traffic performance of the Proposal

The proposal would improve intersection accessibility and level of service. The proposed new traffic signal at Freemans Drive / Wyee Road intersection would provide level of service E or better up to 2039.

In 2029, the proposal would reduce journey time on the Mandalong Road by up to 3.8 to 3.9 minutes during peak periods. In 2039, travel time savings by the proposal are estimated to be up to 15.4 minutes during peak periods.

Overall, the proposal would increase lane capacity and improve intersection operation for vehicles traveling east-west along the Mandalong Road. The proposed upgrade would address capacity issues along a key strategic network including intersections and improve local community accessibilities.