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# Traffic Impact Assessment

Mornington Battery Energy Storage System

Prepared for Maoneng Australia Pty Limited  
February 2021

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# Traffic Impact Assessment

## Mornington Battery Energy Storage System

### Report Number

S200257 RP 2

### Client

Maoneng Australia Pty Limited

### Date

11 February 2021

### Version

Final

### Prepared by



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Traffic Engineer

11 February 2021

### Approved by



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11 February 2021

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# Executive Summary

## ES1 Introduction

Maoneng Australia Pty Limited (Maoneng) is proposing to develop the Mornington battery energy storage system (BESS) (the project).

The proposed BESS would be located at 17 Thornells Road, Tyabb and the associated overhead transmission line would traverse into a portion of the adjoining allotment at 21 Thornells Road (the site), which is the Tyabb substation (Figure 1.1 and Figure 1.2).

The BESS site has an approximate footprint of 6.6 hectares (ha) and is located off the unsealed Thornells Road on land previously used for horticultural activities.

The project aims to improve electricity grid reliability and network stability by drawing energy from the electricity grid during off-peak periods for battery storage and dispatching energy to the grid during peak periods. The Mornington BESS would have capacity to store up to 240 megawatts (MW) of energy.

The development would be constructed over a period of nine months with an average and peak construction workforce of 80 and 150 workers respectively. The Mornington BESS will operate for up to 30 years during which the typical workforce each day will be up to two employees.

## ES2 Summary

EMM Consulting Pty Limited (EMM) undertook a traffic impact assessment of the proposed works. The assessment was undertaken for the BESS site only, namely 17 Thornells Road. However, the subsequent introduction of the small portion of 21 Thornells Road to the subject site (ie the introduction of the transmission corridor) is not considered to impact the results of the traffic impact assessment. Throughout this report, the term 'site' refers to the proposed BESS site.

The key findings are as follows:

- The Dandenong-Hastings Road/Thornells Road intersection currently operates at Level of Service B during the peak hours, with minimal delays and queueing.
- With the proposed development and cumulative traffic, the Dandenong-Hastings Road/Thornells Road intersection will operate at LOS C and B in the AM and PM peak hour, with marginal increases in delays and queue lengths.
- Operational traffic would be minimal, with approximately 2 vehicle trips to the site per day (4 movements per day).
- Construction traffic would typically comprise 60 light vehicle trips and 5 heavy vehicle trips to the site per day (approximately 130 movements per day) during peak construction.
- The car parking spaces provided during the site construction and operation stages will be adequate and meet the forecast demand.
- Public transport services, pedestrian and cycling infrastructure will not be significantly impacted.

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## ES3 Recommendations

### ES3.1 Turning movements at Dandenong-Hastings Road/Thornells Road intersection

As traffic impacts will be short-term (nine months), the construction of a new turning lane at the Dandenong-Hastings Road/Thornells Road intersection is not warranted. To ensure safety, the CTMP will instead require that the number of left and right turning movements during the construction phase at the Dandenong-Hastings Road/Thornells Road intersection during peak hours (6 am – 7 am and 3.45 pm – 4.45 pm) is limited to five vehicles per hour (from both the left and the right). The CTMP will also consider applying a temporary speed reduction on Dandenong-Hastings Road, subject to approval from relevant authorities.

### ES3.2 Road maintenance

As traffic impacts on Thornells Road will be limited to the 650 m stretch between Dandenong-Hastings Road and the site access and will be short-term (nine months), sealing of the 650 m affected section of Thornells Road is not warranted. The CTMP will require the surface of Thornells Road is maintained at a safe and serviceable standard during construction period, in accordance with the ARRB guide. It will also require that the use of traffic controllers during the construction period is also considered, to ensure public safety.

The ARRB guide stipulates the following maintenance objectives for unsealed roads:

- Provide a good riding surface.
- Can carry heavy traffic loads in a safe and efficient manner.
- Meet community expectations.
- Minimise safety hazards to vehicular traffic.
- Provide a free draining surface to the formation.

The CTMP will include a requirement that pavement strength is determined, for example through a CBR<sup>1</sup> test at reasonable intervals (eg every 100 m between Dandenong-Hastings Road and the site access). The CBR results would be used to identify appropriate road maintenance measures, for example increased compaction or the application of spray seal etc. This could be completed prior to the CEMP, at Council's request.

### ES3.3 Sight distance

The CTMP will require that the tree shown in Photograph 6.1 be removed to improve the sight distance (for visibility to the right). It is understood that the removal of trees in the road reserve is the responsibility of the Council.

### ES3.4 Site access

The CTMP will require that the site access driveway be widened approximately 20–30 m to the east to improve manoeuvrability.

<sup>1</sup> California Bearing Ratio (CBR) test is a penetration test to evaluate the subgrade strength of roads and pavements



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# 1 Introduction

## 1.1 Background

Maoneng Australia Pty Limited (Maoneng) is proposing to develop the Mornington battery energy storage system (BESS) (the project) at 17 Thornells Road, Tyabb, Victoria (the site) (Figure 1.1 and Figure 1.2).

EMM Consulting Pty Limited (EMM) has been engaged by Maoneng to prepare a planning permit application for the project under the Victorian *Planning and Environment Act 1987* (P&E Act). This traffic impact assessment (TIA) has been prepared by EMM to support the planning permit application.

This traffic impact assessment was undertaken for the BESS site only, namely 17 Thornells Road. However, the subsequent introduction of the small portion of 21 Thornells Road to the subject site (ie the introduction of the transmission corridor) is not considered to impact the results of the traffic impact assessment. Throughout this report, the term 'site' refers to the proposed BESS site.

## 1.2 Project description

The project aims to improve electricity grid reliability and network stability by drawing energy from the electricity grid during off-peak periods for battery storage and dispatching energy to the grid during peak periods. The Mornington BESS would have capacity to store up to 240 megawatts (MW) of energy.

Australia's energy market is undergoing significant changes and utility scale batteries are pivotal to enabling the shift from a fossil fuel energy baseload to renewable energy. The Mornington BESS would connect to the electricity network via the existing AusNet Services Limited (AusNet) Tyabb Substation, which is located immediately west of the site.

The project conceptually comprises the following key components:

- Batteries housed within fully enclosed battery containers, with associated inverters and transformers and an underground cable network.
- An onsite 220 / 33 kilovolt (kV) or 66/33 kV substation.
- A switchroom.
- A control room.
- An underground or overhead transmission line connecting the onsite substation to the adjacent Tyabb substation.
- Internal access roads.
- A temporary construction laydown area.
- An operations and maintenance building.
- Security fencing and fire safety equipment.

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### 1.3 Site description

The site is located within the Mornington Peninsula Shire Local Government Area (LGA) and is zoned as Special Use Zone (SUZ) 1 (Port Related Uses) under the Mornington Peninsula Planning Scheme (MPPS).

The site was selected by Maoneng primarily due its proximity to the existing Tyabb substation. The site generally comprises topographically flat land that has largely been cleared of native woodland vegetation. The site has an approximate footprint of 6.6 hectares (ha).

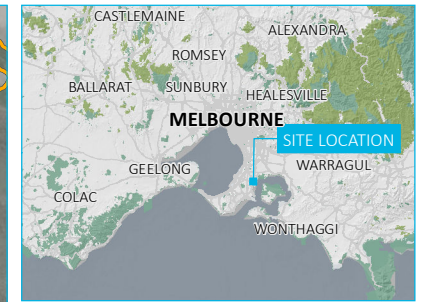
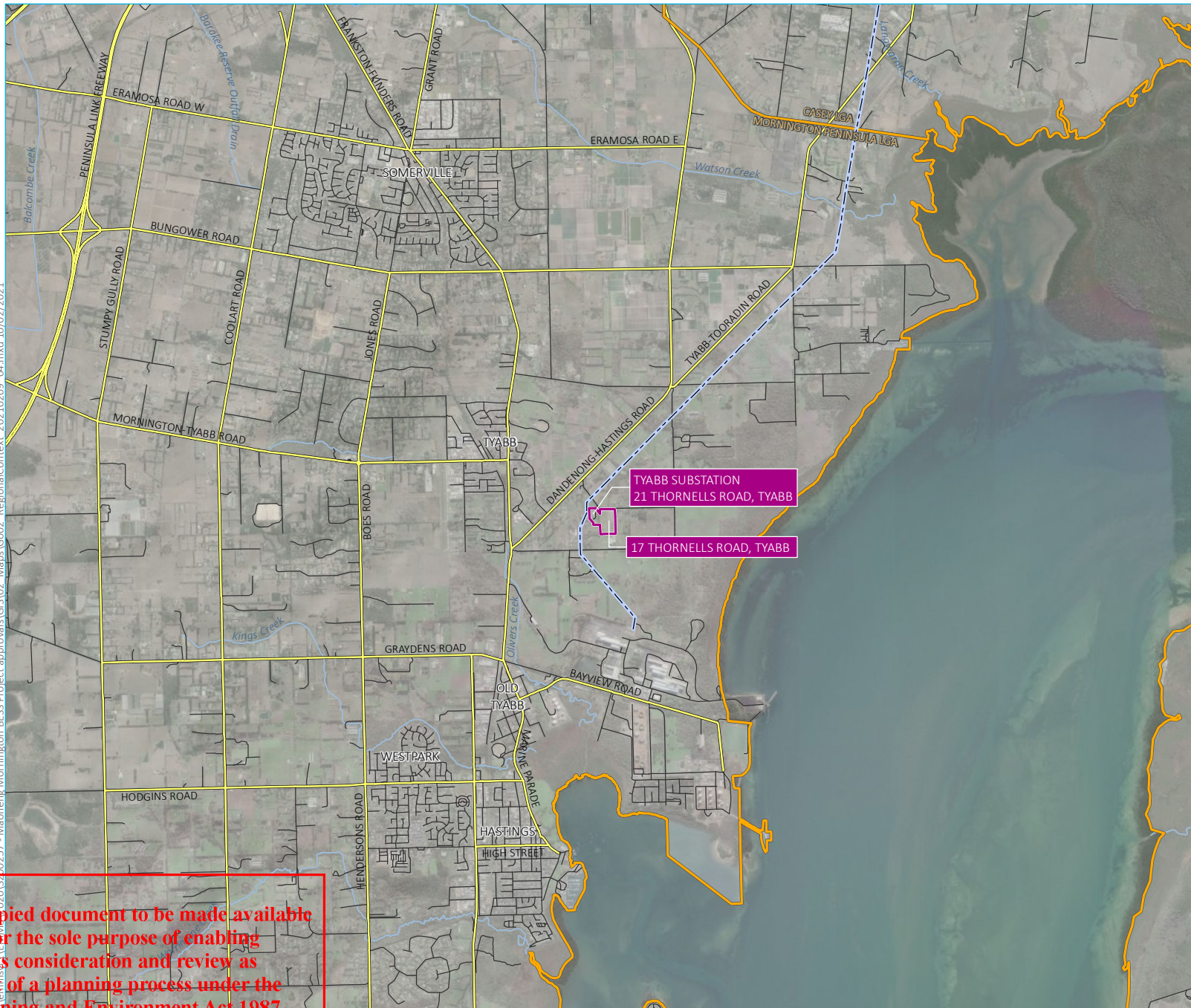
The site is located off the unsealed Thornells Road on land previously used for horticultural activities (fruit orchard). The surrounding land use is a mixture of rural residential dwellings on large allotments, several of which operate as 'hobby' farms, smaller tracts of agricultural land and a variety of commercial/industrial activities. Tyabb town centre is approximately 2 kilometres (km) from the site.

### 1.4 Objectives of this report

The key objectives of this report are to:

- describe the existing traffic and transport environment in the locality;
- assess proposed internal site traffic circulation and car parking;
- forecast project-related traffic;
- assess the potential impacts of the project on the external road network and intersections;
- assess the potential impacts of the project on traffic safety, public transport, pedestrian and cycling facilities; and
- provide recommendations on minimising and managing potential impacts.





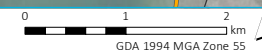
- KEY**
- Subject site
  - Existing 200 kV transmission line
  - Major road
  - Minor road
  - Named watercourse
  - Local government area
- INSET KEY**
- Major road
  - National park/reserve
  - State forest

Regional context

Maoneng Australia Pty Limited  
Mornington BESS  
Traffic impact assessment  
Figure 1.1



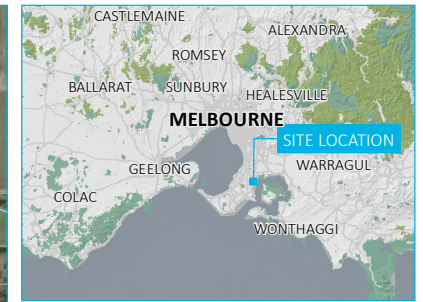
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Source: EMM (2021); Maoneng (2020); DELWP (2019); GA (2011); ASGC (2006)





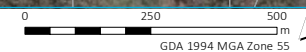
- KEY**
- Subject site
  - Cadastral boundary
  - Rail line
  - Major road
  - Watercourse/drainage line
- INSET KEY**
- Major road
  - National park/reserve
  - State forest

Local context

Maoneng Australia Pty Limited  
Mornington BESS  
Traffic impact assessment  
Figure 1.2



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Source: EMM (2021); Maoneng (2020); DELWP (2019); GA (2011); ASGC (2006)

## 2 Methods

### 2.1 Site visit

EMM conducted a site visit on 8 and 16 September 2020 to inspect the relevant road network, key intersection and site access connecting to the public road, and to undertake the intersection survey.

### 2.2 Desktop research and analysis

Traffic related information eg VicRoads, VicRoads crash data, Google Streetview and Public Transport Victoria has been reviewed in preparation of this TIA.

This TIA has been prepared in consultation with the relevant government authorities, including Mornington Peninsula Shire, and in accordance with the relevant government assessment requirements, guidelines and policies, including, but not limited to:

- Austroads Guide to Road Design Part 4: Intersections and Crossings General; and
- Austroads Guide to Road Design Part 4A: Unsignalised & Signalised Intersections.

### 2.3 Traffic count

EMM undertook a traffic count at the intersection of Thornells Road and the Dandenong-Hastings Road (Westernport Highway) (Section 3.3).

### 2.4 Assess road capacity (existing and forecast)

Intersection turning lane warrants have been assessed with reference to the relevant Austroads Guides.

The key intersection operating performance has been modelled with the SIDRA Intersection 9.0 software, a micro-analytical tool for individual intersections and linked intersection-network modelling (Appendix C and Appendix D). The existing intersection modelling was based on the existing traffic volumes. The future development and cumulative development modelling was based on the existing and forecast traffic volumes.

SIDRA provides the following intersection performance indicators:

- Degree of saturation (DOS) – the total usage of the intersection expressed as a factor of 1 with 1 representing 100% use/saturation (eg 0.8 = 80% saturation).
- Average delay (DEL) – the average delay in seconds encountered by all vehicles passing through the intersection. It is often important to review the average delay of each approach as a side road could have a long delay time, while the large free flowing major traffic will provide an overall low average delay.
- Level of service (LOS) – this is a categorisation of DEL, intended for simple reference.
- 95% queue length (Q95) – is defined to be the queue length in metres that has only a 5% probability of being exceeded during the analysed time period. It converts the average delay into measurable distance units.

The LOS is a good indicator of overall performance for individual intersections, with each level summarised in

Table 2.1

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**Table 2.1**      **Intersection LOS standards**

Level of service	Average delay (seconds per person)	
	Signalised intersections	Sign controlled intersections
A	<10	<10
B	10 to 20	10 to 15
C	20 to 35	15 to 25
D	35 to 55	25 to 35
E	55 to 80	35 to 50
F	>80	>50

Source: VicRoads Transport Modelling Guidelines Volume 5: Intersection Modelling (VicRoads 2020)

Details of the results of existing and “during development” intersection modelling are explained in Section 6.

## 2.5 Impacts of the road network due to the proposed construction activities

A detailed assessment of the traffic impact, road upgrade work and traffic management required due to the site construction activities has been undertaken. This is detailed in Section 6.

## 3 Existing traffic conditions

### 3.1 Road hierarchy

The Victorian administrative road hierarchy comprises the following road classifications, which align with the generic road hierarchy as follows:

- Freeways (VicRoads managed).
- Arterials (VicRoads manages the through traffic while council manages service roads, pathways, roadside).
- Non arterial State roads (Department of Environment, Land, Water and Planning (DELWP), Parks Victoria or VicRoads managed).
- Municipal roads (council managed).

The primary heavy vehicle haulage route for most site construction traffic travelling to and from the Melbourne area is expected to be via the South Gippsland Freeway, Dandenong-Hastings Road and then Thornells Road.

The road hierarchy in the vicinity of the site is shown in Figure 3.1.







Detailed road descriptions and street views of the roads along the proposed transport routes are provided in Table 3.1 to Table 3.4 and Photograph 3.1 to Photograph 3.4.

**Table 3.1      Thornells Road**

Road classification and connectivity	Local road between Dandenong-Hastings Road and McKirdys Road
Alignment	Generally east-west
Number of lanes	One lane
Carriageway type	Unsealed, except 20 m section from Dandenong-Hastings Road which is sealed
Carriageway width	Varies between 3.5-5.8 m
Posted speed limit	Default speed limit of 100 kilometres per hour (km/h), however, speed limit is driven by road terrain condition
Heavy vehicle access	No heavy vehicle access, however, local traffic excepted (including heavy vehicles)
Traffic function	Provides access to commercial and residential properties



**Photograph 3.1      Thornells Road looking north towards Dandenong-Hastings Road**

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**Table 3.2      Dandenong-Hastings Road (A780) also now known as Westernport Highway**

Road classification and connectivity	Arterial road between South Gippsland Highway, Lynbrook and Frankston-Flinders Road, Tyabb
Alignment	Generally north-south, becomes north-east to south-west near Thornells Road
Number of lanes	Two lanes each way with central median north of North Road, Cranbourne South; one lane each way undivided south of North Road, Cranbourne South
Carriageway type	Sealed road with 1 m shoulder on both sides
Carriageway width	Generally, 6-7 m with travel lane approximately 3-3.5 m near Thornells Road
Posted speed limit	Posted speed limit of 100 km/h north of Thornells Road and 90 km/h south of Thornells Road
Heavy vehicle access	Approved for 40 tonne (t) Special Purpose Vehicle
Traffic function	Provides arterial connections between Lynbrook and Tyabb



Source: Google streetview

**Photograph 3.2      Dandenong-Hastings Road looking north-east from Thornells Road**

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**Table 3.3      Frankston-Flinders Road**

Road classification and connectivity	Arterial road between Hastings Road, Frankston and Rest Drive, Flinders
Alignment	Generally north-south
Number of lanes	One lane each way undivided south of Mornington Peninsula Freeway, Baxter; two lane northbound and one lane southbound undivided between Mornington Peninsula Freeway and Moorooduc Highway; three lanes each way with central median north of Moorooduc Highway
Carriageway type	Sealed road with 1 m shoulder near Dandenong-Hastings Road, Tyabb
Carriageway width	Approximately 7 m with travel lane 3.5 m wide near Dandenong-Hastings Road, Tyabb
Posted speed limit	Posted speed limit of 60 km/h at Tyabb town centre and 90 km/h outside the town centre
Heavy vehicle access	Approved for 40 t Special Purpose Vehicle
Traffic function	Provides arterial connections between Frankston and Flinders



Source: Google streetview

**Photograph 3.3      Frankston-Flinders Road looking north from Dandenong-Hastings Road**

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**Table 3.4      Mornington-Tyabb Road**

Road classification and connectivity	Arterial road between Nepean Highway, Mornington and Frankston-Flinders Road, Tyabb
Alignment	Generally east-west
Number of lanes	One lane each way
Carriageway type	Sealed road with 1 m wide shoulder on both sides
Carriageway width	Generally, 6.5 m with travel lane approximately 3.2 m
Posted speed limit	Posted speed limit of 60 km/h in Tyabb town centre and 80 km/h outside of Tyabb town centre
Heavy vehicle access	Approved for 40 t Special Purpose Vehicle
Traffic function	Provides arterial connections between Mornington and Tyabb



Source: Google streetview

**Photograph 3.4      Mornington-Tyabb Road looking east towards George Avenue**

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### 3.2 Key intersection

Based on the likely haulage routes, the Dandenong-Hastings Road/Thornells Road intersection is identified as the key intersection for the proposed development Figure 3.1.

### 3.3 Existing traffic volumes

An intersection traffic survey was undertaken for the Dandenong-Hastings Road/Thornells Road intersection on Tuesday 8 September 2020 from 6 am to 9 am and from 3 pm to 6 pm (Appendix A). Based on the traffic volumes, the following peak hours were identified:

- AM peak 6 am to 7 am
- PM peak 3.45 pm to 4.45 pm

Figure 3.2 presents the existing traffic volumes in the AM and PM peak hours. LV represents the peak hourly light vehicle traffic volumes while HV represents the peak hourly heavy vehicle traffic volumes. The figure shows that Dandenong-Hastings Road carried over 600 vehicles (two-way) in both the peak hours, however, the traffic volumes were very low in Thornells Road.

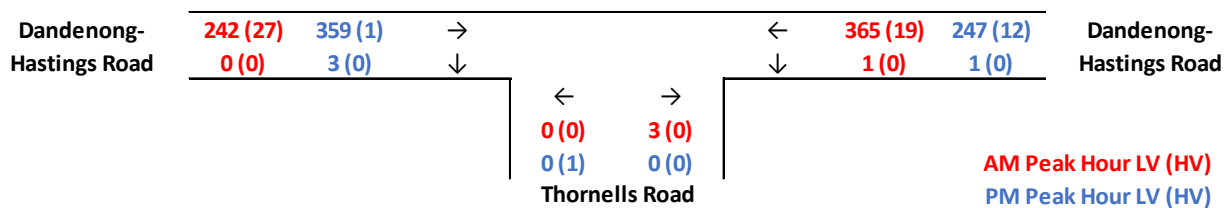


Figure 3.2 Existing traffic volumes

### 3.4 Crash history

VicRoads has a published crash history for Mornington Peninsula LGA for a six-year period from 2014–2019. Figure 3.3 presents the recorded crash history in the vicinity of the site.





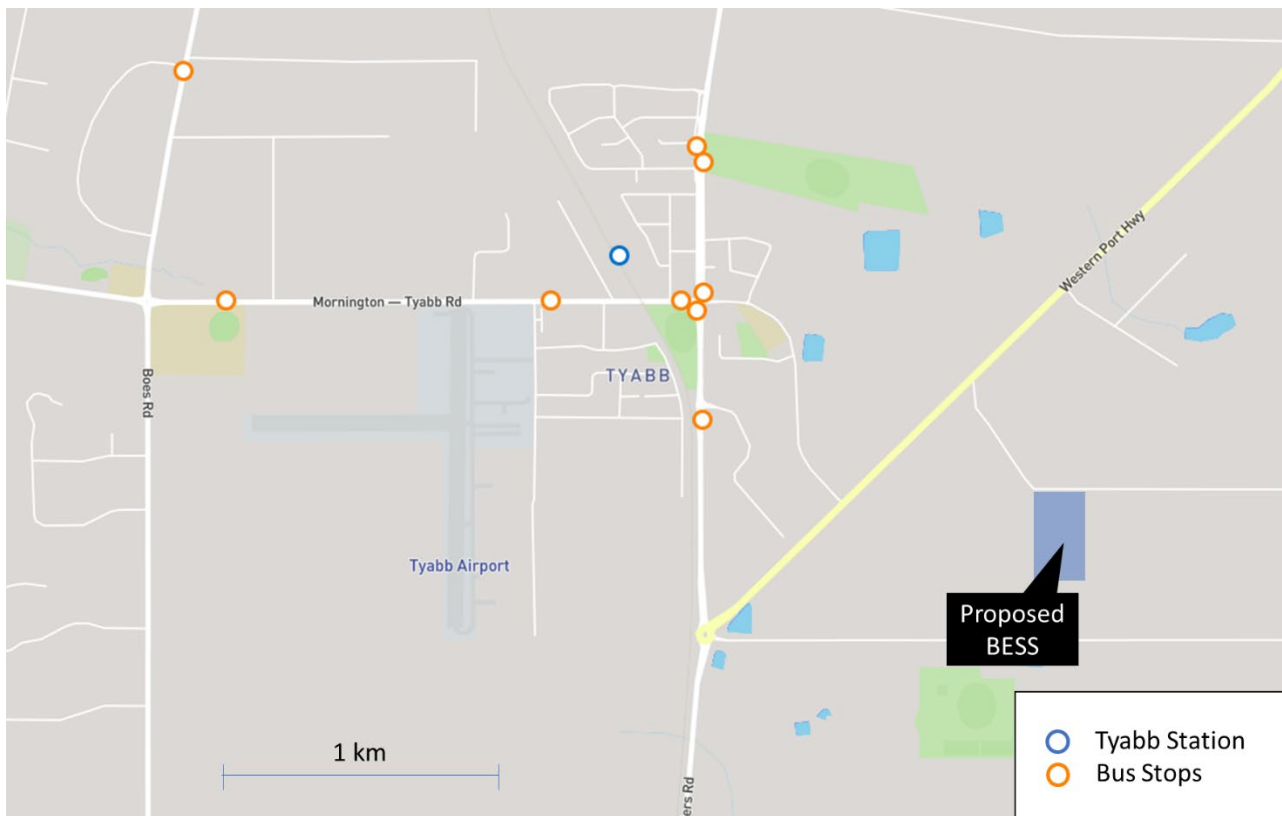
**Figure 3.3** Crash history (2014–2019)

The crash history data shows there was no crash on Thornells Road or at the Dandenong-Hastings Road/Thornells Road intersection over the six-year period 2014-2019.

Within 500 m of the Dandenong-Hastings Road/Thornells Road intersection, there was only one recorded crash, which is considered to be a low crash rate for a six-year period. This crash history does not indicate any major road safety issues for the Dandenong-Hastings Road in the vicinity of the site access to Thornells Road currently.

### 3.5 Public transport

Public bus services in the Tyabb area are operated by Ventura<sup>2</sup>. The nearest bus stop is located on Frankston-Flinders Road which is approximately 2.7 km away from the site (Figure 3.4). This is not considered to be a walkable distance to the site.



Source: Public Transport Victoria

**Figure 3.4** Bus stops in Tyabb

### 3.6 Walking and cycling

There are no pedestrian or cycling infrastructure on either side of the road along Dandenong-Hastings Road or Thornells Road due to the rural nature of the precinct.

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## 4 The proposed development

### 4.1 Construction workforce

There will be up to 150 workers on site at any given time during construction with an average workforce of 80 workers. Construction work will be undertaken in three stages over a total timeframe of approximately nine months, as summarised in Table 4.1.

**Table 4.1 Construction stages**

Construction stage	Details	Duration	Average number of employees
Stage 1	Site establishment, including demolition of existing farm shed, earthworks and any drainage requirements, construction of concrete hardstands, civil works	2 months	60
Stage 2	Delivery of BESS infrastructure	3 months	80
Stage 3	Installation of BESS infrastructure (containerised units, transformer, switch room, control room, and operations and maintenance) and electrical works	4 months	80
Total		9 months	

### 4.2 Construction traffic

The largest vehicles which are to be regularly used for the proposed construction access will be 26 m B-doubles. Typical daily construction traffic types and quantities are summarised in Table 4.2.

Access by approximately ten Over Size Over Mass (OSOM) vehicles will also be required at key stages during the construction period. This access will require a permit application to be made by the vehicle operator to the National Heavy Vehicle Regulator (NHVR).

**Table 4.2 Construction traffic types and quantities**

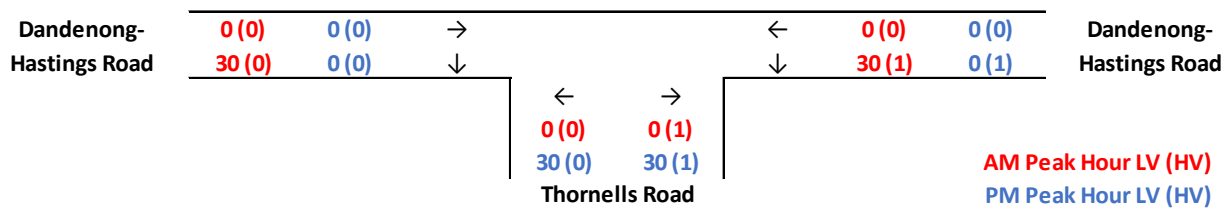
Work stage	Light vehicle trips per day	Heavy vehicle trips per day
Stage 1	40	7
Stage 2	60	5
Stage 3	60	5

It is expected that construction light vehicle arrivals and departures would align with the current AM and PM road network traffic peak hours while heavy vehicle deliveries would be spread across the day. It is assumed that peak hourly heavy vehicle traffic will comprise approximately 10% of the daily heavy vehicle traffic. Assuming an 11-hour working day there will typically be 1 heavy vehicle trip (1 inbound and 1 outbound movement) in each of the peak hours.

The primary heavy vehicle haulage route is expected to be via the Dandenong-Hastings Road and Thornells Road intersection. Figure 4.1 presents the additional traffic generation during construction at this intersection.

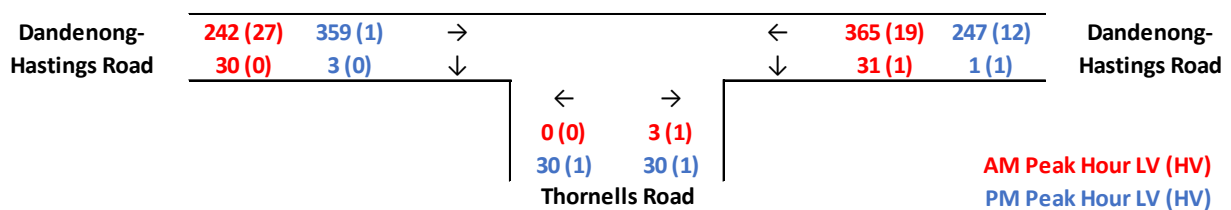
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**Figure 4.1 Additional traffic generation during site construction**

“Development” traffic is calculated by combining the surveyed traffic volumes (Figure 3.2) and the additional traffic generation during construction (Figure 4.1) as presented in Figure 4.2.



**Figure 4.2 Development traffic generation during construction**

### 4.3 Operational traffic

The project is expected to be operational for up to 30 years. During the 30 year operational life, there will be a maximum of 2 staff which will potentially generate 4 traffic movements (2 incoming and 2 outgoing movements) on a daily basis. As the site operational traffic is expected to be so much lower than the construction traffic, operational traffic impacts have not been assessed in detail in this assessment.

### 4.4 Car parking

The Mornington Peninsula Planning Scheme does not specify any car parking rates for the SUZ1 land use.

A temporary onsite parking arrangement for construction workers will be facilitated on the site. During the operational stage, staff vehicles will park on the site on gravel hardstand areas.

### 4.5 Swept path assessment

Existing site access is off Thornells Road (Photograph 4.1).

A swept path assessment was undertaken to assess manoeuvrability during construction for onsite vehicles and for vehicles entering and exiting the site (assumed to be 26 m B-doubles). The results show adequate vehicle manoeuvrability with a relocated and wider site access and adequate vehicle turning area within the site. The results are presented in Appendix B.



Photograph 4.1 Existing site access



## 5 Cumulative development

This section identifies the potential cumulative impact of the proposed development with the Holcim Australia Pty Limited (Holcim) concrete batching plant (CBP) located on Thornells Road, approximately 70 m south of the Dandenong-Hastings Road/Thornells Road intersection.

The CBP was not operational at the time of the site inspection (Tuesday 8 September 2020), possibly due to COVID-19 restrictions. When the restrictions are lifted, the operation of this facility may recommence at a date which is yet to be determined by Holcim.

Earlier in 2020, EMM undertook a traffic survey for a Holcim CBP located in Emu Plains, New South Wales. This is the closest comparable CBP traffic generation for which traffic generation data is available.

The Emu Plains CBP operates at a production rate of 25,740 cubic metres (m<sup>3</sup>) per annum. The hourly traffic movements are presented in Table 5.1 (EMM Consulting 2020).

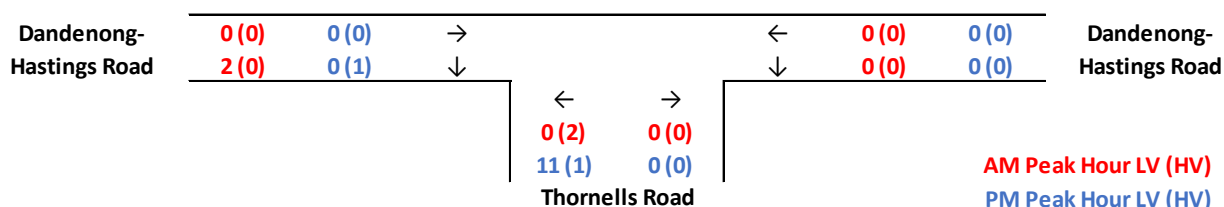
**Table 5.1 Emu Plains CBP hourly traffic movements**

Period	Hour	Light vehicles	Heavy vehicles
AM	0600 - 0700	2	2
	0700 - 0800	2	5
	0800 - 0900	0	11
PM	1500 - 1600	9	5
	1600 - 1700	10	2
	1700 - 1800	4	0

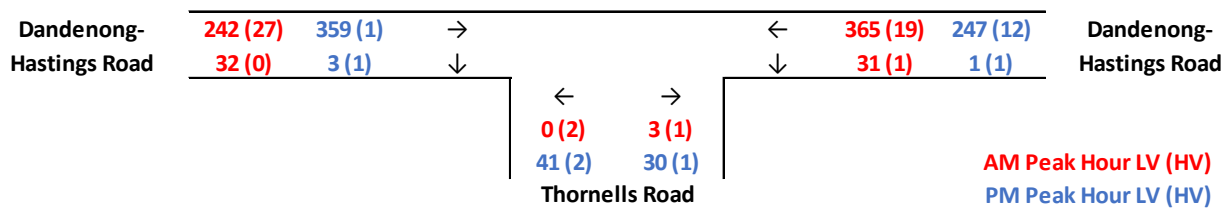
Source: EMM

It is assumed that future employees of the CBP would mainly be based in Tyabb and would mainly travel to and from work from the southwest via the Dandenong-Hastings Road/Thornells Road intersection.

The Tyabb road network peak hours are 6 am to 7 am and 3.45 pm to 4.45 pm. Therefore, the likely cumulative traffic generation from the CBP is presented in Figure 5.1. and overall development traffic including the CBP traffic generation is presented in Figure 5.2.



**Figure 5.1 CBP traffic generation during peak hours**



**Figure 5.2** Development traffic with cumulative traffic generation during peak hours

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## 6 Impact assessment

### 6.1 Intersection performance

The SIDRA results for the Dandenong-Hastings Road/Thornells Road intersection for the main existing and cumulative development traffic scenarios are summarised in Table 6.1, which presents the average delay for the most delayed movement at a priority-controlled intersection (usually the right turning movement from the minor road). Further details are provided in Appendix C and Appendix D.

**Table 6.1** SIDRA results

Peak hour	DOS		LOS		DEL (seconds)		Q95 (metres)	
	Existing	Development with cumulative	Existing	Development with cumulative	Existing	Development with cumulative	Existing	Development with cumulative
AM	0.215	0.232	B	C	10.4	15.1	0.1	2.6
PM	0.197	0.199	B	B	13.5	10.6	0.2	2.2

The results show that the intersection currently operates at LOS B in both AM and PM peak hours with ample spare capacity (over 75%) to accommodate additional traffic. The minor road approach (Thornells Road) experiences an average vehicle delay of less than 15 seconds in the peak hours.

With development and cumulative traffic, the intersection will operate at LOS C in the AM peak hour while keeping the same LOS in the PM peak hour. The intersection will still have over 75% spare capacity. The delays and queueing will only increase marginally but unlikely to be noticeable to the general road users.

### 6.2 Car and truck parking

As mentioned in Section 4, the site will be able to accommodate sufficient parking spaces to meet the parking. A temporary onsite parking arrangement for construction workers will be facilitated on the site. During the operational stage, staff vehicles will park on the site on gravel hardstand areas.

In terms of truck parking, all trucks will enter and exit the site within the same day (delivery trucks), therefore no overnight truck parking is anticipated.

### 6.3 Impact on public transport services, pedestrians and cyclists

The proposed site workforce is not anticipated to create a high demand for either pedestrian or cyclist access or public transport services within the Tyabb area.

The existing public transport service, as outlined in Section 3, is not expected to be impacted by the project.



## 6.4 Warrants for BA, AU and CH turn movements

Intersection operations are assessed from a combination of the peak hourly through and turning traffic movements that occur at each intersection. This determines the need for additional intersection turning lanes (eg basic, auxiliary lane and channelised) in accordance with intersection design standards *Guide to Road Design Part 4, Intersections and Crossings General* (Austroads 2017), where:

- Curve 1 (red line) represents the boundary between a basic right turn (BAR) and a channelised short right turn (CHR(S)) turn treatment and between a basic left turn (BAL) and an auxiliary short left turn (AUL(S)) turn treatment; and
- Curve 2 (blue line) represents the boundary between a CHR(S) and a full length CHR treatment and between an AUL(S) and a full length AUL or CHL treatment. The choice of CHL over an AUL will depend on factors such as the need to change the give way rule in favour of other manoeuvres at the intersection and the need to define more appropriately the driving path by reducing the area of bitumen surfacing.

If a particular turn from a major road is associated with some geometric minima (for example, limited sight distance, steep grade), consideration should be given to the adoption of a turn treatment of a higher order than that indicated by the warrants. For example, if the warrants indicate that a BAR turn treatment is acceptable for the relevant traffic volumes, but limited visibility is available to the right-turning vehicle, consideration should be given to the adoption of a CHR(S) or CHR turn treatment instead. Another example is a major road on a short steep downgrade where numerous heavy vehicles travel quickly down the grade, in which case it would not be appropriate to adopt a BAL turn treatment. Instead, an AUL(S) or an AUL would be a preferred treatment.

There are separate design charts for roads with different design speeds. Austroads recommends intersections should be designed for a travel speed 10 km/h greater than the posted speed limit. As Dandenong-Hastings Road has a speed limit of 100 km/h to the north and 90 km/h, to the south, the left and right turning lanes for the Dandenong-Hastings Road/Thornells Road intersection should be designed for 110 km/h and 100 km/h, respectively.

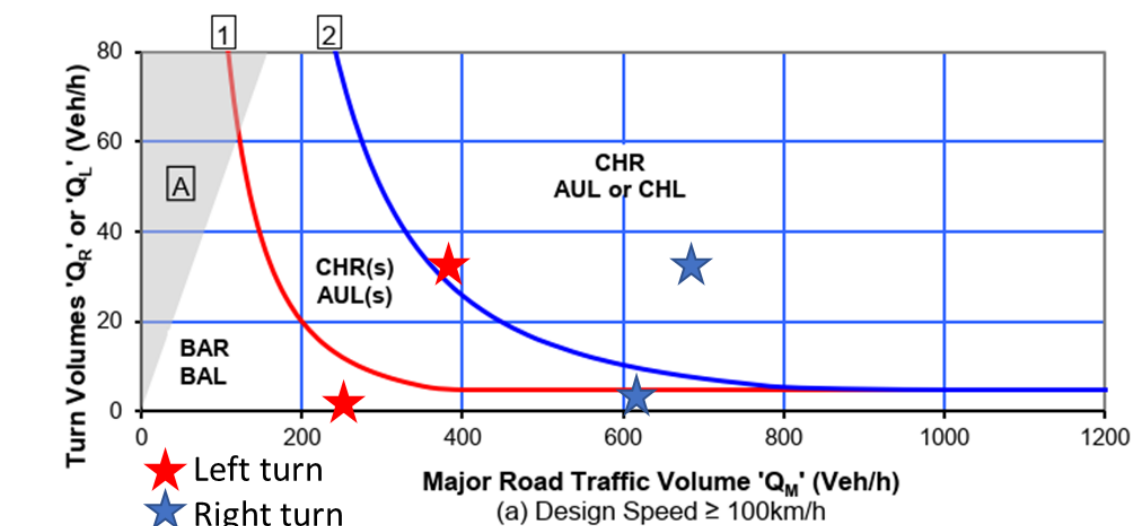


Figure 6.1 Austroads warrant design chart for rural intersection turning lanes

**Table 6.2 Intersection turn treatment warrant for development with cumulative traffic**

Movement	Major road traffic volume	Turning traffic volume	Turn treatment required
Left turn	384 (AM)/259 (PM)	32 (AM)/2 (PM)	AUL or CHL
Right turn	685 (AM)/621 (PM)	32 (AM)/4 (PM)	CHR

In accordance with *Guide to Road Design Part 4A* (Austroads 2017), for the AM peak hour traffic movement, a total 135 m-long left turn lane (100 m deceleration lane plus 35 m taper) and a 136 m long right turn lane (77 m deceleration lane plus 33 m taper and 26 m storage) will be required. For the PM peak, a channelised right turn lane is not warranted (Figure 6.1).

## 6.5 Warrant for rural road upgrades

The intersection survey data shows that Thornells Road carried 10 vehicles during the AM survey (6 to 9 am) and 12 vehicles during the PM survey (3 to 6 pm), totalling 22 vehicles over a six-hour window. Assuming this peak six-hour comprises approximately one third of the total daily traffic volume, there are approximately 66 **daily** vehicle movements on Thornells Road for general traffic excluding the CBP facility, which was not operating at the time of the traffic survey.

Equivalent traffic generation data from a comparable Holcim CBP facility at Emu Plains in NSW indicates the Tyabb CBP, when fully operational, would generate approximately 12 and 15 vehicle trips (22 and 30 vehicle movements) in the AM and PM 3-hour peak periods (Table 5.1). Assuming these traffic volumes represent 50% of daily CBP site traffic (with 12 operational hours per day), the **daily** CBP site traffic would potentially be 52 vehicle trips per day (104 vehicle movements), using Thornells Road, over the short section between Dandenong-Hastings Road and the CBP access.

The additional site generated **daily** vehicle movements using Thornells Road during peak construction periods of the Maoneng project will be 65 vehicle trips (130 daily vehicle movements), as shown in Table 4.2.

### 6.5.1 Assessment of Thornells Road

*Austroads Guide to Road Design Part 3: Geometric Design* refers to Australian Road Research Board ([ARRB Best Practice Guide for Unsealed Roads](#) (ARRB 2009) for assessment of unsealed rural roads. According to the manual, Thornells Road falls under Road Class 4B (minor road with a daily traffic between 50 to 150) which provides connection between local centres of population and links to the primary network. The minimum carriageway width for this type of road is 5.5 m.

The forecast daily traffic volume during site construction for Thornells Road, for the short initial section between Dandenong-Hastings Road and the CBP access is 300 daily traffic movements during the nine-month construction period (comprising 66 existing traffic movements, 104 CBP traffic movements and 130 project related construction traffic movements). The daily traffic volume over the remainder of Thornells Road, between the CBP access and the BESS site access would be much lower (196 daily vehicle movements) without the CBP traffic.

At both locations, the forecast daily traffic would exceed the normal daily 150 vehicle threshold for sealing of a rural road, if the traffic volumes were sustained over a long-term period. However due to the short-term duration (approximately nine months) of the construction work, a short-term road maintenance strategy will be more appropriate to provide safe construction access for the project in combination with continuing access by other users. This strategy is outlined in further detail in Section 7.

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## 6.6 Sight distance and safety

Dandenong-Hastings Road and Thornells Road have a good safety record with only one recorded crash in the past six years. With development traffic, the Dandenong-Hastings Road/Thornells Road intersection will continue to operate with a satisfactory level of service (LOS C or better) for all periods of the day, with minimal traffic delays, including during the morning and afternoon peak hours.

In accordance with *Austrroads Guide to Road Design Part 4A (Unsignalised and Signalised Intersections)* (Austrroads 2017), as Thornells Road has a speed limit of 110 km/h, the minimum safe intersection sight distance (SISD) required for a general minimum two second driver reaction time is 285 m. However, due to the road conditions of Thornells Road, vehicles are unlikely to travel at a speed of 100 km/h. Assuming a vehicle could travel up to 50 km/h, the required SISD for a two-second driver reaction time is 97 m.

Sight distance along Thornells Road to the left of the site access is 106 m and to the right is 81 m (Figure 6.2). Required sight distance from the site access is 97 m in both directions. Sight distance to the right is hindered by a tree in the road reserve, approximately 81 m from the site access (Photograph 6.1). This can be addressed by removal of the tree .

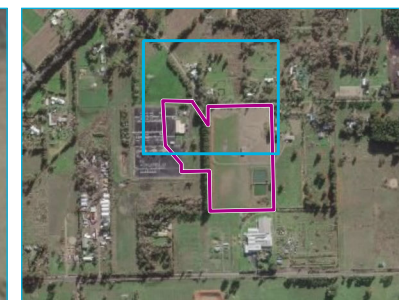
Sight distance at the Dandenong-Hastings Road/Thornells Road intersection is satisfactory. To the left, sight distance is 351 m and to the right it is 1,040 m (Figure 6.3). Required sight distance from the intersection is 285 m.

Elsewhere in the locality, the roads also have a generally good safety record and the proposed increase in the construction related daily truck traffic movements will not significantly impact their traffic safety. Hence, no traffic safety related road improvements are required for the project construction access.



Photograph 6.1 Tree requiring removal on Thornells Road





Sight distance at site access

Maoneng Australia Pty Limited  
Mornington BESS  
Traffic impact assessment  
Figure 6.2







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KEY

-  Subject site
-  Sight distance to the left (351 m)\*
-  Sight distance to the right (1,040 m)\*
-  Cadastral boundary

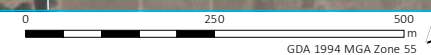
\* Required site distance: 285 m

Sight distance at intersection

Maoneng Australia Pty Limited  
Mornington BESS  
Traffic impact assessment  
Figure 6.3



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# 7 Summary and recommendations

## 7.1 Summary

Maoneng proposes to develop the Mornington BESS at 17 Thornells Road, Tyabb, Victoria. The development would be constructed over a period of nine months with an average and peak construction workforce of 80 and 150 workers respectively. The Mornington BESS will operate for up to 30 years during which the workforce will be up to two employees.

The key findings of the TIA are as follows:

- The Dandenong-Hastings Road/Thornells Road intersection currently operates at Level of Service B during the peak hours, with minimal delays and queueing.
- With the proposed development and cumulative traffic, the Dandenong-Hastings Road/Thornells Road intersection will operate at LOS C and B in the AM and PM peak hour, with marginal increases in delays and queue lengths.
- Operational traffic would be minimal, with approximately 2 vehicle trips to the site per day (4 movements per day).
- Construction traffic would typically comprise 60 light vehicle trips and 5 heavy vehicle trips to the site per day (approximately 130 movements) during peak construction.
- The car parking spaces provided during the site construction and operation stages will be adequate and meet the forecast demand.
- Public transport services, pedestrian and cycling infrastructure will not be significantly impacted.

## 7.2 Recommendations

### 7.2.1 Turning traffic movements at Dandenong-Hastings Road/Thornells Road intersection

As traffic impacts will be short-term (nine months), the construction of a new turning lane at the Dandenong-Hastings Road/Thornells Road intersection is not warranted. To ensure safety, the CTMP will instead require that the number of left and right turning movements during the construction phase at the Dandenong-Hastings Road/Thornells Road intersection during peak hours (6 am – 7 am and 3.45 pm – 4.45 pm) is limited to five vehicles per hour (from both the left and the right). The CTMP will also consider applying a temporary speed reduction on Dandenong-Hastings Road, subject to approval from relevant authorities.

### 7.2.2 Road maintenance

As traffic impacts on Thornells Road will be limited to the 650 m stretch between Dandenong-Hastings Road and the site access and will be short-term (nine months), sealing of the 650 m affected section of Thornells Road is not warranted. The CTMP will require the surface of Thornells Road is maintained at a safe and serviceable standard during construction period, in accordance with the ARRB guide. It will also require that the use of traffic controllers during the construction period is also considered, to ensure public safety.

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The ARRB guide stipulates the following maintenance objectives for unsealed roads:

- Provide a good riding surface.
- Can carry heavy traffic loads in a safe and efficient manner.
- Meet community expectations.
- Minimise safety hazards to vehicular traffic.
- Provide a free draining surface to the formation.

The CTMP will include a requirement that pavement strength is determined, for example through a CBR<sup>3</sup> test at reasonable intervals (eg every 100 m between Dandenong-Hastings Road and the site access). The CBR results would be used to identify appropriate road maintenance measures, for example increased compaction or the application of spray seal etc. This could be completed prior to the CEMP, at Council's request.

### 7.2.3 Sight distance deficiency

The CTMP will require that the tree shown in Figure 6.1 be removed to improve the sight distance (for visibility to the right). It is understood that the removal of trees in the road reserve is the responsibility of the Council.

### 7.2.4 Site access

The CTMP will require that the site access driveway be widened approximately 20-30 m to the east to improve manoeuvrability.

<sup>3</sup> California Bearing Ratio (CBR) test is a penetration test to evaluate the subgrade strength of roads and pavements

## 8 References

ARRB. 2009. "Best Practice Guide for Unsealed Roads."

Austrroads. 2017. *Guide to Road Design Part 4: Intersections and Crossings General*.

—. 2017. *Guide to Road Design Part 4A: Unsignalised & Signalised Intersections*.

EMM Consulting. 2020. "Holcim Emu Plains Concrete Batching Plant Traffic Impact Assessment."

RTA. 2002. *Guide to Traffic Generating Developments*.

VicRoads. 2020. "Transport Modelling Guidelines Volume 5: Intersection Modelling."



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Appendix A

# Intersection Survey Results

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Client : Maoneng Australia  
Job No/Name : S200257  
Day/Date : 8/9/2020

PEDS	EAST	SOUTH	WEST	
Time Per	D-H Rd	Thron Rd	D-H Rd	TOT
0600 - 0615				0
0615 - 0630				0
0630 - 0645				0
0645 - 0700				0
0700 - 0715				0
0715 - 0730				0
0730 - 0745				0
0745 - 0800				0
0800 - 0815				0
0815 - 0830				0
0830 - 0845				0
0845 - 0900				0
Per End	0	0	0	0

PEDS	EAST	WEST	SOUTH	
Peak Per	D-H Rd	Thron Rd	D-H Rd	TOT
0600 - 0700	0	0	0	0
0615 - 0715	0	0	0	0
0630 - 0730	0	0	0	0
0645 - 0745	0	0	0	0
0700 - 0800	0	0	0	0
0715 - 0815	0	0	0	0
0730 - 0830	0	0	0	0
0745 - 0845	0	0	0	0
0800 - 0900	0	0	0	0

PEAK HR	0	2	0	2
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Lights	EAST	SOUTH	WEST	
Time Per	D-H Rd	Thron Rd	D-H Rd	TOT
0600 - 0615	63		68	131
0615 - 0630	96	1	55	152
0630 - 0645	118	1	69	189
0645 - 0700	88	1	50	139
0700 - 0715	62		58	120
0715 - 0730	62		60	122
0730 - 0745	65	1	48	114
0745 - 0800	68		31	100
0800 - 0815	46	1	35	82
0815 - 0830	66		36	103
0830 - 0845	58	1	30	89
0845 - 0900	61	1	37	99
Per End	853	4	577	1440

Heavies	EAST	SOUTH	WEST	
Time Per	D-H Rd	Thron Rd	D-H Rd	TOT
0600 - 0615	5		7	12
0615 - 0630	5		7	12
0630 - 0645	4		7	11
0645 - 0700	5		6	11
0700 - 0715	6		4	10
0715 - 0730	6		7	13
0730 - 0745	10		5	15
0745 - 0800	4		5	9
0800 - 0815	7		4	11
0815 - 0830	6		9	15
0830 - 0845	3		6	9
0845 - 0900	9		6	15
Per End	70	0	73	143

Combined	EAST	SOUTH	WEST	
Time Per	D-H Rd	Thron Rd	D-H Rd	TOT
0630 - 0645	68	0	75	143
0645 - 0700	101	1	62	164
0700 - 0715	122	1	76	200
0715 - 0730	93	1	56	150
0730 - 0745	68	0	62	130
0745 - 0800	68	0	67	135
0800 - 0815	75	1	53	129
0815 - 0830	72	0	36	109
0830 - 0845	53	1	39	93
0845 - 0900	72	0	45	118
0900 - 0915	61	1	36	98
0915 - 0930	70	1	43	114
Per End	923	4	650	1583

Lights	EAST	SOUTH	WEST	
Peak Per	D-H Rd	Thron Rd	D-H Rd	TOT
0600 - 0700	365	3	242	611
0615 - 0715	364	3	232	600
0630 - 0730	330	2	237	570
0645 - 0745	277	2	216	495
0700 - 0800	257	1	197	456
0715 - 0815	241	1	174	418
0730 - 0830	245	1	150	399
0745 - 0845	238	2	132	374
0800 - 0900	231	2	138	373

Heavies	EAST	SOUTH	WEST	
Peak Per	D-H Rd	Thron Rd	D-H Rd	TOT
0600 - 0700	19	0	27	46
0615 - 0715	20	0	24	44
0630 - 0730	21	0	24	45
0645 - 0745	27	0	22	49
0700 - 0800	26	0	21	47
0715 - 0815	27	0	21	48
0730 - 0830	27	0	23	50
0745 - 0845	20	0	24	44
0800 - 0900	25	0	25	50

Combined	EAST	SOUTH	WEST	
Peak Per	D-H Rd	Thron Rd	D-H Rd	TOT
0600 - 0700	384	3	269	657
0615 - 0715	384	3	256	644
0630 - 0730	351	2	261	615
0645 - 0745	304	2	238	544
0700 - 0800	283	1	218	503
0715 - 0815	268	1	195	466
0730 - 0830	272	1	173	449
0745 - 0845	258	2	156	418
0800 - 0900	256	2	163	423

PEAK HR				
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PEAK HR				
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PEAK HR				
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Client : Maoneng Australia  
Job No/Name : S200257  
Day/Date : 8/9/2020

PEDS	EAST	SOUTH	WEST	
Time Per	D-H Rd	Thron Rd	D-H Rd	TOT
1500 - 1515				0
1515 - 1530				0
1530 - 1545				0
1545 - 1600				0
1600 - 1615				0
1615 - 1630				0
1630 - 1645				0
1645 - 1700				0
1700 - 1715				0
1715 - 1730				0
1730 - 1745				0
1745 - 1800				0
Per End	0	0	0	0

PEDS	EAST	WEST	SOUTH	
Peak Per	D-H Rd	Thron Rd	D-H Rd	TOT
1500 - 1600	0	0	0	0
1515 - 1615	0	0	0	0
1530 - 1630	0	0	0	0
1545 - 1645	0	0	0	0
1600 - 1700	0	0	0	0
1615 - 1715	0	0	0	0
1630 - 1730	0	0	0	0
1645 - 1745	0	0	0	0
1700 - 1800	0	0	0	0

PEAK HR	0	2	0	2
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Lights	EAST	SOUTH	WEST	
Time Per	D-H Rd	Thron Rd	D-H Rd	TOT
1500 - 1515	42		71	113
1515 - 1530	46		62	108
1530 - 1545	70		88	160
1545 - 1600	57	1	78	138
1600 - 1615	63		86	149
1615 - 1630	56		89	146
1630 - 1645	71		106	177
1645 - 1700	51	1	76	128
1700 - 1715	48	1	78	127
1715 - 1730	60		32	92
1730 - 1745	56		52	108
1745 - 1800	49	1	41	92
Per End	669	2	859	1538

Heavies	EAST	SOUTH	WEST	
Time Per	D-H Rd	Thron Rd	D-H Rd	TOT
1500 - 1515	4		8	12
1515 - 1530	2		7	9
1530 - 1545	3		10	13
1545 - 1600	6		2	8
1600 - 1615	1	1	5	7
1615 - 1630	2		3	6
1630 - 1645	3		5	8
1645 - 1700	1		2	3
1700 - 1715	2		2	4
1715 - 1730	2		2	4
1730 - 1745	1		3	4
1745 - 1800	1			1
Per End	28	1	49	79

Combined	EAST	SOUTH	WEST	
Time Per	D-H Rd	Thron Rd	D-H Rd	TOT
1500 - 1515	46	0	79	125
1515 - 1530	48	0	69	117
1530 - 1545	73	0	98	173
1545 - 1600	63	1	80	146
1600 - 1615	64	1	91	156
1615 - 1630	58	1	92	152
1630 - 1645	74	0	111	185
1645 - 1700	52	1	78	131
1700 - 1715	50	1	80	131
1715 - 1730	62	0	34	96
1730 - 1745	57	0	55	112
1745 - 1800	50	1	41	93
Per End	697	3	908	1617

Lights	EAST	SOUTH	WEST	
Peak Per	D-H Rd	Thron Rd	D-H Rd	TOT
1500 - 1600	215	0	299	519
1515 - 1615	236	0	314	555
1530 - 1630	246	0	341	593
1545 - 1645	247	0	359	610
1600 - 1700	241	1	357	600
1615 - 1715	226	2	349	578
1630 - 1730	230	2	292	524
1645 - 1745	215	2	238	455
1700 - 1800	215	1	203	419

Heavies	EAST	SOUTH	WEST	
Peak Per	D-H Rd	Thron Rd	D-H Rd	TOT
1500 - 1600	15	0	27	42
1515 - 1615	12	0	24	37
1530 - 1630	12	1	20	34
1545 - 1645	12	1	15	29
1600 - 1700	7	1	15	24
1615 - 1715	8	1	12	21
1630 - 1730	8	0	11	19
1645 - 1745	6	0	9	15
1700 - 1800	6	0	7	13

Combined	EAST	SOUTH	WEST	
Peak Per	D-H Rd	Thron Rd	D-H Rd	TOT
1500 - 1600	230	0	326	561
1515 - 1615	248	0	338	592
1530 - 1630	258	1	361	627
1545 - 1645	259	1	374	639
1600 - 1700	248	2	372	624
1615 - 1715	234	3	361	599
1630 - 1730	238	2	303	543
1645 - 1745	221	2	247	470
1700 - 1800	219	1	210	432

PEAK HR				
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PEAK HR				
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Appendix B

# Swept Path Assessment Results

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B-Double (26.0m)

DRAWING TITLE:  
Swept path assessment  
Site access

REV: 1

REV	DATE	COMMENT	DRAWN	REVIEWED	REV	DATE	COMMENT	DRAWN	REVIEWED
1	06/11/20	FOR INFORMATION	FL	ALI					

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B-Doukpe (26.0m)

CLIENT:	Maoneng Australia Pty Ltd		
DRG. #:	EMM-002	<b>REV: 1</b>	
PROJECT #:	S200257		
SCALE:	1:250		

REV: 1

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Appendix C

## Existing SIDRA Analysis Results

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# MOVEMENT SUMMARY

Site: 101 [Dandenong-Hastings Rd/Thornells Rd Ex AM (Site Folder: General)]

Site Category: (None)  
Give-Way (Two-Way)

Vehicle Movement Performance														
Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[ Total veh/h	HV ] veh/h	[ Total veh/h	HV ] %				[ Veh. veh	Dist ] m				
South: Thornells Road (S)														
1b	L3	1	0	1	0.0	0.006	10.3	LOS B	0.0	0.1	0.48	0.68	0.48	69.7
3a	R1	3	0	3	0.0	0.006	10.4	LOS B	0.0	0.1	0.48	0.68	0.48	71.2
Approach		4	0	4	0.0	0.006	10.4	LOS B	0.0	0.1	0.48	0.68	0.48	70.8
NorthEast: Dandenong-Hastings Road (NE)														
24a	L1	1	0	1	0.0	0.215	7.3	LOS A	0.0	0.0	0.00	0.15	0.00	86.1
5	T1	384	19	404	4.9	0.215	1.0	LOS A	0.0	0.0	0.00	0.15	0.00	97.6
Approach		385	19	405	4.9	0.215	1.0	NA	0.0	0.0	0.00	0.15	0.00	97.6
SouthWest: Dandenong-Hastings Road (SW)														
11	T1	269	27	283	10.0	0.156	0.0	LOS A	0.0	0.1	0.00	0.00	0.00	94.7
32b	R3	1	0	1	0.0	0.156	9.4	LOS A	0.0	0.1	0.00	0.00	0.00	84.0
Approach		270	27	284	10.0	0.156	0.0	NA	0.0	0.1	0.00	0.00	0.00	94.7
All Vehicles		659	46	694	7.0	0.215	0.7	NA	0.0	0.1	0.00	0.09	0.00	96.2

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

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# MOVEMENT SUMMARY

Site: 102 [Dandenong-Hastings Rd/Thornells Rd Ex PM (Site Folder: General)]

Site Category: (None)  
Give-Way (Two-Way)

Vehicle Movement Performance														
Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[ Total veh/h	HV ] veh/h	[ Total veh/h	HV ] %				[ Veh. veh	Dist ] m				
South: Thornells Road (S)														
1b	L3	1	1	1	100.0	0.003	13.5	LOS B	0.0	0.1	0.43	0.64	0.43	46.8
3a	R1	1	0	1	0.0	0.003	10.0	LOS B	0.0	0.1	0.43	0.64	0.43	68.7
Approach		2	1	2	50.0	0.003	11.8	LOS B	0.0	0.1	0.43	0.64	0.43	55.6
NorthEast: Dandenong-Hastings Road (NE)														
24a	L1	1	0	1	0.0	0.145	7.3	LOS A	0.0	0.0	0.00	0.15	0.00	86.1
5	T1	259	12	273	4.6	0.145	1.0	LOS A	0.0	0.0	0.00	0.15	0.00	97.6
Approach		260	12	274	4.6	0.145	1.0	NA	0.0	0.0	0.00	0.15	0.00	97.6
SouthWest: Dandenong-Hastings Road (SW)														
11	T1	360	1	379	0.3	0.197	0.0	LOS A	0.0	0.2	0.01	0.01	0.01	94.7
32b	R3	3	0	3	0.0	0.197	8.7	LOS A	0.0	0.2	0.01	0.01	0.01	83.9
Approach		363	1	382	0.3	0.197	0.1	NA	0.0	0.2	0.01	0.01	0.01	94.6
All Vehicles		625	14	658	2.2	0.197	0.5	NA	0.0	0.2	0.01	0.07	0.01	95.6

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

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Appendix D

# Proposed SIDRA Intersection Analysis Results

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# MOVEMENT SUMMARY

Site: 201 [Dandenong-Hastings Rd/Thornells Rd Dev AM (Site Folder: General)]

Site Category: (None)  
Give-Way (Two-Way)

Vehicle Movement Performance														
Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[ Total veh/h	HV ] veh/h	[ Total veh/h	HV ] %				[ Veh. veh	Dist ] m				
South: Thornells Road (S)														
1b	L3	2	2	2	100.0	0.012	15.1	LOS C	0.0	0.4	0.54	0.74	0.54	45.8
3a	R1	4	1	4	25.0	0.012	12.8	LOS B	0.0	0.4	0.54	0.74	0.54	59.7
Approach		6	3	6	50.0	0.012	13.6	LOS B	0.0	0.4	0.54	0.74	0.54	54.2
NorthEast: Dandenong-Hastings Road (NE)														
24a	L1	32	1	34	3.1	0.232	7.4	LOS A	0.0	0.0	0.00	0.19	0.00	83.5
5	T1	384	19	404	4.9	0.232	1.0	LOS A	0.0	0.0	0.00	0.19	0.00	96.4
Approach		416	20	438	4.8	0.232	1.5	NA	0.0	0.0	0.00	0.19	0.00	95.2
SouthWest: Dandenong-Hastings Road (SW)														
11	T1	269	27	283	10.0	0.186	0.4	LOS A	0.3	2.6	0.14	0.08	0.14	91.1
32b	R3	32	0	34	0.0	0.186	9.6	LOS A	0.3	2.6	0.14	0.08	0.14	81.1
Approach		301	27	317	9.0	0.186	1.3	NA	0.3	2.6	0.14	0.08	0.14	89.9
All Vehicles		723	50	761	6.9	0.232	1.5	NA	0.3	2.6	0.06	0.15	0.06	92.4

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

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Queue Model: SIDRA Standard.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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# MOVEMENT SUMMARY

Site: 202 [Dandenong-Hastings Rd/Thornells Rd Dev PM (Site Folder: General)]

Site Category: (None)  
Give-Way (Two-Way)

Vehicle Movement Performance														
Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[ Total veh/h	HV ] veh/h	[ Total veh/h	HV ] %				[ Veh. veh	Dist ] m				
South: Thornells Road (S)														
1b	L3	43	2	45	4.7	0.087	10.1	LOS B	0.3	2.2	0.40	0.71	0.40	68.4
3a	R1	31	1	33	3.2	0.087	10.6	LOS B	0.3	2.2	0.40	0.71	0.40	69.8
Approach		74	3	78	4.1	0.087	10.3	LOS B	0.3	2.2	0.40	0.71	0.40	69.0
NorthEast: Dandenong-Hastings Road (NE)														
24a	L1	2	1	2	50.0	0.146	8.7	LOS A	0.0	0.0	0.00	0.16	0.00	65.5
5	T1	259	12	273	4.6	0.146	1.0	LOS A	0.0	0.0	0.00	0.16	0.00	97.6
Approach		261	13	275	5.0	0.146	1.0	NA	0.0	0.0	0.00	0.16	0.00	97.3
SouthWest: Dandenong-Hastings Road (SW)														
11	T1	360	1	379	0.3	0.199	0.0	LOS A	0.0	0.3	0.01	0.01	0.01	94.6
32b	R3	4	1	4	25.0	0.199	9.7	LOS A	0.0	0.3	0.01	0.01	0.01	72.3
Approach		364	2	383	0.5	0.199	0.1	NA	0.0	0.3	0.01	0.01	0.01	94.3
All Vehicles		699	18	736	2.6	0.199	1.5	NA	0.3	2.2	0.05	0.14	0.05	91.8

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

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