Traffic Engineering Assessment

Ballarat Station Precinct Redevelopment at
Lydiard Street North, Ballarat

Prepared For
Pellicano Group

November, 2016
G21581R-01B
Traffic Engineering Assessment

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Lydiard Street North, Ballarat

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Table of Contents

1 Introduction ........................................................................................................................ 1
2 Background ......................................................................................................................... 1
3 Proposal ............................................................................................................................. 2
4 Existing Conditions ........................................................................................................... 3
  4.1 Subject Site .................................................................................................................... 3
  4.2 Land Use .......................................................................................................................... 5
  4.3 Road Network ................................................................................................................... 6
5 Car Parking Assessment ..................................................................................................... 7
  5.1 Commuter Parking Requirement .................................................................................... 7
  5.2 Statutory Car Parking Requirements – Commercial Component ................................ 8
  5.3 Car Parking Layout ......................................................................................................... 9
    5.3.1 Accessways ............................................................................................................... 9
    5.3.2 Car Space Dimensions .............................................................................................. 10
    5.3.3 Ramp Grades ............................................................................................................ 11
    5.3.4 Pedestrian Visibility & Safety .................................................................................. 11
6 Bicycle Parking .................................................................................................................. 11
7 Traffic Impact Assessment ................................................................................................. 12
  7.1 Traffic Generation .......................................................................................................... 12
  7.2 Traffic Distribution ........................................................................................................ 13
  7.3 Traffic Impact ................................................................................................................ 15
  7.4 Pedestrian Connectivity ................................................................................................. 17
8 Conclusions ....................................................................................................................... 18

List of Appendices

Appendix A: Cardno Report
Appendix B: Development Plans
Appendix C: SIDRA Output
Appendix D: Possible Future Station Access Road/Nolan Street intersection
1 Introduction

Traffix Group has been engaged by Pellicano Group to undertake a traffic engineering assessment and to prepare a report for the proposed redevelopment of Ballarat Railway Station.

This report provides a traffic engineering assessment of the proposal with particular attention to the car parking provisions, traffic generation and access impacts.

2 Background

VicTrack previously commissioned Cardno to:

- review the existing and parking and access conditions at Ballarat Train Station,
- undertake high level assessments based on a potential mixed-use development of the site,
- consider the potential to reconfigure the existing commuter parking and vehicle access in consultation with Public Transport Victoria and City of Ballarat, and
- provide design advice and recommendations.

Key outcomes and recommendations from the Cardno report (dated 21st January 2016) are as follows:

- The site has excellent access to a range of public transport services providing viable alternatives to the private motor vehicle for commuters.
- Site layout and internal roads should be designed to maximise car parking efficiency.
- The train station redevelopment should allow for future relocation of the bus interchange.
- Given the availability of on-street car parking, some reliance on off-site parking is considered appropriate.
- It is recommended that any development must ensure there is no net loss of commuter car spaces as a result of the proposed development.
- The driver sightline at the proposed access point onto Nolan Street can be improved with tree trimming, local area traffic management, and a reduced speed limit.
- The existing on-site car parks currently generate in the order of 150 – 250 vehicle movements during the peak periods.
- Based on the traffic queue survey at the railway crossing, the traffic queues on Lydiard Street North during the peak periods are manageable.
- Based on existing site operation characteristics and the proposed design concept, traffic generated by a similar type and scale of development is not expected to have a noticeable impact on the operation of the surrounding road network.
- The proposed access point for the commercial car park via Lydiard Street North is projected to generate minimal traffic movements during the peak periods, and will operate in the “excellent” category, with minimal queues and delays.
The proposed access point to Nolan Street also will operate in the “excellent” category, with minimal queues and delays.

Traffic volumes generated by a similar type and scale of development to the surrounding local road network are expected to remain below the daily traffic volumes suggested within Clause 56 of the Ballarat Planning Scheme.

Distribution of traffic via Lydiard Street North and Nolan Street will help ease congestion within the Station Precinct and surrounds, and

The analysed intersections in the vicinity of the Ballarat Train Station operate in the “excellent” category, with minimal queues and delays.

A copy of the Cardno report prepared for VicTrack is attached at Appendix A.

3 Proposal

The proposal is to redevelop the Ballarat Railway Station site, incorporating commuter car parking, hotel, public plaza and goods shed (for the purposes of a function centre and mixed retail uses) in accordance with the following schedule of uses:

<table>
<thead>
<tr>
<th>Lot</th>
<th>Use</th>
<th>Lot Area</th>
<th>Ownership</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Hotel</td>
<td>4,826 m²</td>
<td>Pellicano</td>
<td>46 apartments (77 rooms) and ancillary gym</td>
</tr>
<tr>
<td>2</td>
<td>Goods Shed</td>
<td>10,500 m²</td>
<td>Pellicano</td>
<td>Indoor function/convention centre with a 300 seat auditorium and a capacity of 240 in a banquet hall, with a retail component (1,302 m², of which approximately 378 m² is forecourt/circulation area and 924 m² is retail tenancies), and multi-purpose outdoor space</td>
</tr>
<tr>
<td>3</td>
<td>Public Plaza</td>
<td>3,012 m²</td>
<td>TBC</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Station Plaza</td>
<td>1,387 m²</td>
<td>VicTrack</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Commuter Carpark</td>
<td>4,448 m²</td>
<td>VicTrack</td>
<td>Multi-level commuter carpark, 272 spaces over two levels.</td>
</tr>
<tr>
<td>6</td>
<td>Council Road</td>
<td>2,496 m²</td>
<td>Council</td>
<td>Connecting between Lydiard Street North and Nolan Street with signalised intersections at both ends, providing access to commuter parking, private (hotel/function) parking and future bus interchange.</td>
</tr>
</tbody>
</table>

In addition to the 272 commuter parking spaces, there are a total of 147 spaces allocated to the commercial use, including 90 at-grade spaces, 54 basement spaces and a further 3 short-term spaces within a porte-cochere drop-off area in front of the hotel. There are also 14 indented on-street parking spaces proposed within Lot 6 (Council Road) which will be allocated for short-term use.

While the convention centre includes both a 300 seat auditorium and a banquet hall with a 240-seat capacity, these two areas will not be occupied concurrently, and the overall convention centre will have a maximum capacity for 300 people.
Access is proposed to be provided as follows:

- via the modified existing signalised intersection to Lydiard Street North immediately north of the railway line (permitting left in, left out and right out) providing access to the Council Road,
- via new/relocated crossovers to Lydiard Street North immediately south of the railway line (opposite Ararat Street) providing an “in only” and an “out only” for taxi drop-off,
- via a new two-way crossover to Nolan Street just east of Neill Street providing access to the car parking associated with the hotel and convention centre, and
- via a new intersection to Nolan Street located midblock between Neill and Ligar Streets providing access to the Council Road (and commuter car parking).

A copy of the proposed development plan is attached at Appendix B.

4 Existing Conditions

4.1 Subject Site

The site is bounded by Lydiard Street North to the west, Nolan Street to the northeast and the Ballarat railway line to the south, as shown in the locality plan at Figure 1 below.
An aerial view is provided at Figure 2 below.

Figure 2: Aerial View of the Site

Source: Nearmap – www.nearmap.com
4.2 Land Use

The subject site is located within the Special Use Zone – Schedule 16 (SUZ16), which is described at Clause 37.01 of the Ballarat Planning Scheme as “Ballarat Station Redevelopment Precinct – Stage 1”.

The site is also affected by Development Plan Overlay – Schedule 11 (DPO11) and Heritage Overlay 59 (HO59).

The surrounding land use includes residential development to the north and northwest, the Eastern Oval to the east and commercial development (Ballarat City Centre) to the south and southwest.

Figure 3: Land Use Zoning Map
4.3 Road Network

Lydiard Street North

Lydiard Street North is described in the Cardno report as follows:

- **Lydiard Street North** is a local road running in a north-south direction between Sturt Street and Normal Street. South of Sturts Street, Lydiard Street North continues south as Lydiard Street South and provides a connection to Dana Street.

- In the vicinity of the Ballarat train station, Lydiard Street North provides for a single traffic lane in each direction, and has provision for a bicycle lane and on-street parking along both kerbs. On-street car parking along Lydiard Street North is unrestricted on the east side, and restricted to 2P 9:00am – 5:30pm Monday to Friday on the west side.

- A bus zone is currently located along the eastern side of Lydiard Street North, adjacent to the Ballarat train station.

- Pedestrian operated signals are provided on each side of the railway crossing to facilitate controlled pedestrian access across Lydiard Street North. A 50km/h speed limit applies on Lydiard Street North in the vicinity of the Ballarat train station.

Nolan Street

Nolan Street is described in the Cardno report as follows:

- **Nolan Street** is a local road extending in a southeast direction from Lydiard Street North, which provides for a single traffic lane in each direction, and continues as Scott Parade to the east.

- A posted 60km/h speed restriction applies on Nolan Street adjacent to the Ballarat train station.

- Parking along Nolan Street is generally unrestricted. Indented angle parking is available on both sides of the carriageway adjacent to the Ballarat train station.
5 Car Parking Assessment

5.1 Commuter Parking Requirement

The Cardno report commissioned by VicTrack included a study of the existing car parking demands in the area surrounding the Ballarat Railway Station precinct, generated by commuters.

Surveys were undertaken between 7:00am-10:00am and 4:00pm-7:00pm on a typical weekday and between 11:00am-2:00pm on a typical Saturday.

The Cardno report identified the following:

- Cardno identified a supply of 331 parking spaces within the Ballarat Train Station Precinct including 23 spaces in the southern carpark and 308 spaces in the northern carpark.
- Public Transport Victoria advised that there are approximately 270 car spaces currently available for commuter use.
- The remaining spaces are a mix of short-term parking for pick-up, drop-off and reserved parking for staff.
- A total of 174 car space were already occupied at the beginning of the weekday survey at 7:00am.
- The highest observed demand was at 10:00am at which time there were 295 spaces occupied.
- The highest observed on-street parking demand was at 10:00am at which time there were 364 spaces occupied out of a supply of 616 spaces, corresponding to a 59% occupancy rate.
- The Saturday observations were lower than the weekday observations.

The Cardno report concludes that:

- Given the availability of on-street car parking, some reliance on off-site parking is considered appropriate.
- It is recommended that any development must ensure there is no net loss of commuter car spaces as a result of the proposed development.

We understand that it has been agreed that the commuter carpark must contain 270 spaces, consistent with the current provision of spaces for commuter use.

The proposed commuter carpark contains 272 across two levels of parking.

Given that there is potential for the commuter parking demand to exceed the commuter parking supply based on Cardno’s surveys, the following is recommended that:

- an electronic counter should be displayed at the carpark entrance to advise of the number of vacant spaces, so that vehicles don’t enter if the carpark is full (noting that there are dead-end aisles).
- the at-grade parking for the commercial component of the site should include restrictions sufficient to deter commuter parking in these spaces (such as half hour parking prior to 10am or the like).

It is noted that there is sufficient parking on surrounding streets to absorb any shortfall in commuter parking, as currently occurs.
5.2 Statutory Car Parking Requirements – Commercial Component

The Planning Scheme sets out the parking requirements for new developments and an increase to an existing use under Clause 52.06. The purpose of Clause 52.06 is:

- To ensure that car parking is provided in accordance with the State Planning Policy Framework and Local Planning Policy Framework.
- To ensure the provision of an appropriate number of car parking spaces having regard to the demand likely to be generated, the activities on the land and the nature of the locality.
- To support sustainable transport alternatives to the motor car.
- To promote the efficient use of car parking spaces through the consolidation of car parking facilities.
- To ensure that car parking does not adversely affect the amenity of the locality.
- To ensure that the design and location of car parking is of a high standard, creates a safe environment for users and enables easy and efficient use.

The relevant statutory car parking rates are as follows:

- Retail (Shop): 4 spaces per 100 m²
- Residential Hotel: No rate specified
- Function Centre: 0.3 spaces per patron permitted

While the convention centre (function centre use) includes both a 300 seat auditorium and a banquet hall with a 240-seat capacity, we understand that these two areas will not be occupied separately, and the overall convention centre will have a maximum capacity for 300 people.

The statutory car parking requirement for the proposed development is summarised in Table 2 below.

<table>
<thead>
<tr>
<th>Use</th>
<th>Measure</th>
<th>Rate</th>
<th>Requirement(1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retail (Shop)</td>
<td>923 m²</td>
<td>4 spaces per 100 m²</td>
<td>36 spaces</td>
</tr>
<tr>
<td>Residential Hotel</td>
<td>46 apartments (up to 77 rooms(2))</td>
<td>No Rate Specified(3)</td>
<td>34 spaces</td>
</tr>
<tr>
<td>Function Centre</td>
<td>300 patrons</td>
<td>0.3 spaces per patron</td>
<td>90 spaces</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>160 spaces</strong></td>
</tr>
</tbody>
</table>

Note (1): Clause 52.06-5 states ... “If in calculating the number of car spaces the result is not a whole number, the required number of car parking spaces is to be rounded down to the nearest whole number.”

Note (2): Some of the hotel apartments are “dual key”, with multiple bedrooms able to be either offered as a single apartment or as two separate studios. For the purpose of undertaking a conservative assessment, the parking rate will be applied to each bedroom, i.e. 77 rooms.

Note (3): In our experience, residential hotels typically generate car parking at a rate of 0.3 – 0.45 spaces per room. For the purpose of analysis, we have adopted the upper end of this range, however having regard to the site’s locality at the railway station, with excellent connecting bus services and within walking distance of the town centre, we acknowledge that the actual parking rate associated with the residential hotel component is likely to be less.

Note: Where a use is not included in Table 1 of Clause 5206-5, an adequate number of spaces must be provided to the satisfaction of the Responsible Authority.
Based on the table above, the development has a statutory requirement to provide 160 car spaces, assuming the adopted car parking rate for the Residential Hotel component is to the satisfaction of the Responsible Authority.

Excluding the 272 spaces provided for commuters, there are a total of 161 car spaces provided on the site, including 147 spaces on private land (90 at-grade spaces, 54 basement spaces and 3 porte-cochere drop-off spaces), and 14 spaces provided as indented parking within the future Council road connecting between Lydiard Street North and Nolan Street.

This parking provision exceeds the statutory car parking requirement.

In addition, it is noted that a sharing of car spaces will occur as follows:

- The 14 “on-street” indented parking spaces within the new Council road connecting between Lydiard Street North and Nolan Street are anticipated to include short-term restrictions, and are likely to be utilised for drop-off and pick-up before 9:00am and after 5:00pm on weekdays, and will be available for use by retail customers generally during business hours.

- At times when the convention centre use is at or near capacity (of 300 patrons), it is highly likely that a substantial proportion of the 77 hotel beds will be occupied in conjunction with the convention centre use. Accordingly, some convention centre guests who have chosen to drive will have an allocated car space within the hotel basement carpark, and will not require a space within the at-grade carpark, i.e. the assessment in Table 2 is likely to be double-counting some of the car parking demands, and the actual car parking demand at times when the convention centre and residential hotel are experiencing peak occupancy is likely to be less than 160 spaces.

Having regard to the preceding assessments, we are satisfied that the proposed car parking provision is appropriate, and there will not be any adverse off-site parking impacts as a result of the proposed redevelopment of the Ballarat Station Precinct.

5.3 Car Parking Layout

The proposed car parking layout has been reviewed against the design standards for car parking set out at Clause 52.06-8 of the Planning Scheme.

5.3.1 Accessways

Design Standard 1 of Clause 52.06-8 sets out statutory requirements in relation to accessways. These requirements are addressed in Table 3 below.

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Comment</th>
<th>Complies?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Accessways must be at least 3 metres wide.</strong></td>
<td>The proposed accessways are at least 3 metres wide.</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Accessways must have an internal radius of at least 4 metres at changes of direction or intersection or be at least 4.2 metres wide.</strong></td>
<td>The 85th percentile design vehicle manoeuvring on a 4 metre (minimum) radius can negotiate all internal intersections in a single manoeuvre.</td>
<td>✓</td>
</tr>
</tbody>
</table>
### Requirement

**Accessways must allow vehicles parked in the last space of a dead-end accessway in public car parks to exit in a forward direction with one manoeuvre.**

- **Comment:** A blind aisle extension of at least 1 metre has been provided at the end of dead-end access aisle in publicly accessible carparks to allow for improved vehicle egress.

- **Complies?** ✓

**Accessways must provide at least 2.1 metres headroom beneath overhead obstructions, calculated for a vehicle with a wheel base of 2.8 metres.**

- **Comment:** The headroom clearance exceeds 2.1 metres.

- **Complies?** ✓

**If the accessway serves four or more car spaces or connects to a road in a Road Zone, the accessway must be designed so that cars can exit the site in a forward direction.**

- **Comment:** All accessways serve more than four car spaces, and all vehicles can exit the site in a forward direction.

- **Complies?** ✓

**Accessways must provide a passing area at the entrance at least 5 metres wide and 7 metres long if the accessway serves ten or more car parking spaces and is either more than 50 metres long or connects to a road in a Road Zone.**

- **Comment:** All access points are in excess of 5 metres wide and provide for simultaneous two-way entry and exit.

- **Complies?** ✓

**If an accessway to four or more car parking spaces is from land in a Road Zone, the access to the car spaces must be at least 6 metres from the road carriageway.**

- **Comment:** Not applicable. Lydiard Street North and Nolan Street are not in a Road Zone.

- **Complies?** NA

**If entry to the car space is from a road, the width of the accessway may include the road.**

- **Comment:** Not applicable. All of the proposed car spaces are accessed from internal accessways, not directly from the road.

- **Complies?** NA

### 5.3.2 Car Space Dimensions

Design Standard 2 of Clause 52.06-8 sets out minimum dimensions for car parking spaces and accessways.

- The proposed at-grade car spaces for the commercial use are at least 2.6 metres wide and 4.9 metres long, accessed via a 6.4 metre wide aisle, which complies with Clause 52.06-8.

- The proposed car spaces within the multi-deck commuter carpark are typically 2.4 metres wide and 5.4 metres long, accessed via a 6.2 metre wide aisle. While the width of these spaces falls short of the Clause 52.06-8 requirements, we note that it complies with Australian Standard AS2890.1-2004 for User Class 1 (all-day commuter parking) as requested by VicTrack and accordingly is considered to be satisfactory.

- Adequate clearance diagrams have been provided within the multi-deck commuter carpark, and the location of columns complies with the relevant requirements at Figure 5.2 of AS2890.1-2004 (for 5.4 metre long car spaces).

- The proposed car spaces within the hotel basement comply with AS2890.1-2004 for User Class 1. While these spaces are acceptable for long-stay parking it would be desirable for use as a hotel that these spaces be in accordance with User Class 2.
5.3.3 Ramp Grades

The proposed ramps have a maximum gradient of 1:5, which complies with the requirements of Design Standard 3 of Clause 52.06-8 for public car parks which are 20 metres long or less.

In addition, 2.0 metre long transition sections are provided at the top and bottom of the ramp to prevent vehicles scraping or bottoming.

We are satisfied that the proposed ramps are appropriately designed and meet the relevant standards.

5.3.4 Pedestrian Visibility & Safety

Design Standard 1 of Clause 52.06-8 requires “…a corner splay or area at least 50% clear of visual obstructions extending at least 2 metres along the frontage road from the edge of an exit lane and 2.5 metres along the exit lane from the frontage, to provide a clear view of pedestrians on the footpath of the frontage road. The area clear of visual obstructions may include an adjacent entry or exit lane where more than one lane is proposed, or adjacent landscaped areas, provided the landscaping in those areas is less than 900mm in height”.

There is a substation located to the east of the secondary hotel carpark access point. This is located more than 2 metres from the edge of the crossover, and is located on the entrance side (rather than the departure side) of the accessway.

Accordingly, we are satisfied that the “corner splay” requirements are met at this access point.

The requirements are also easily met at the other proposed access points, subject to any visual obstruction (such as landscaping or signage) being less than 900mm in height.

6 Bicycle Parking

Statutory bicycle parking requirements are set out at Clause 52.34 of the Planning Scheme. The relevant rates are set out in Table 4 below.

Table 4: Statutory Bicycle Parking Requirements

<table>
<thead>
<tr>
<th>Use</th>
<th>Employee/Resident</th>
<th>Visitor/Shopper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential Hotel(1)</td>
<td>In developments of four or more storeys, one to each 10 lodging rooms</td>
<td>In developments of four or more storeys, one to each 10 lodging rooms</td>
</tr>
<tr>
<td>Function Centre (Place of Assembly)</td>
<td>1 to each 1,500 m$^2$ of net floor area</td>
<td>2 plus 1 to each 1,500 m$^2$ of net floor area</td>
</tr>
<tr>
<td>Retail (Shop)</td>
<td>1 to each 600 m$^2$ of leasable floor area if the leasable floor area exceeds 1,000 m$^2$</td>
<td>1 to each 500 m$^2$ of leasable floor area if the leasable floor area exceeds 1,000 m$^2$</td>
</tr>
</tbody>
</table>

Note (1): “Residential Hotel” is included in the broader “Residential Building” land use category under the provisions of Clause 74 of the Planning Scheme, for which there is a bicycle parking rate specified.

Based on the above rates, the commercial component of the redevelopment has a statutory requirement to provide 22 bicycle spaces, including:

- 16 spaces for the residential hotel (eight for employees and 8 for residents),
- 4 spaces for the function centre (one for employees and three for visitors), and
2 spaces for the retail (shop) component (both for shoppers), noting there is no staff bicycle parking requirement as the leasable floor area (within the proposed tenancies) is less than 1,000m².

In addition to the bicycle parking associated with the commercial component of the redevelopment, bicycle parking is required for commuters.

Notably, the Cardno report indicates that there is an existing “Parkiteer” secure bicycle parking facility (covered cage), as well as a number of existing bicycle hoops on the platform.

The Cardno report recommends that the existing level of commuter bicycle parking be retained (or replaced) on the site post redevelopment.

Bicycle parking is not shown on plans currently, however there are a number of suitable locations where it could be provided throughout the site.

Accordingly we are satisfied that bicycle parking provision can be addressed by way of a permit condition.

7 Traffic Impact Assessment

7.1 Traffic Generation

For the purposes of undertaking a high-level traffic impact assessment of the proposed Ballarat Station Redevelopment, the Cardno report adopted the following assumptions:

- Existing (surveyed) traffic generated by the northern carpark as well as the car and bus movements associated with the existing southern carpark will all be re-directed to a new access point onto Nolan Street.
- There will be 136 spaces for the commercial component, with 50% generating a movement during the peak hour (68 movements), evenly split between in/out/north/south, accessed via a separate crossover to Lydiard Street North.

The commercial component includes the following:

- 46 apartment (up to 77 single rooms) hotel,
- 1,302m² retail (of which 924m² is tenancies and the rest is circulation/forecourt/amenities), and
- a convention/function centre with capacity for up to 300 persons.

The retail component is anticipated to predominantly serve a walk-up catchment, and the other uses are unlikely to generate peak traffic during the road network peaks.

Accordingly, we agree with the Cardno assessment that approximately half of the car spaces associated with the commercial component of the development will generate a vehicle movement during the road network peak hours.

The proposed car parking provision is slightly higher than in the Cardno assessment.
The 147 spaces allocated to the commercial component are anticipated to generate in the order of 74 vehicle movements during the road network peak hours, based on the assumption that half the spaces generate a movement in the peak hour (consistent with the Cardno assumption).

We also agree with Cardno's broad assumption of 50% entering and 50% exiting associated with the commercial component of the site, for the purposes of analysis, having regard to the mix of uses. In particular, while the residential hotel component is likely to generate a higher proportion exiting during the AM peak hour and entering during the PM peak hour, the retail component is likely to have the opposite distribution.

In addition, Table 7.1 of the attached Cardno report indicates that the commuter carpark is anticipated to generate the following (based on surveyed existing conditions):

- 92 vehicles in and 49 vehicles out during the AM peak hour, and
- 72 vehicles in and 163 vehicles out during the PM peak hour.

These surveyed movements are in accordance with our expectations, with vehicles in the counter-peak direction associated with commuters being picked-up/dropped-off, and noting that the 272 space commuter carpark will fill (and empty) over a longer period than just the peak hour, with the lower volumes in the AM road network peak hour likely attributable to many commuters arriving earlier in the morning (outside of the road network peak).

Table 5 below summarises the traffic generation assumptions for the overall site.

Table 5: Peak Hour Traffic Generation

<table>
<thead>
<tr>
<th>User</th>
<th>AM Peak Hour</th>
<th>PM Peak Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>In</td>
<td>Out</td>
</tr>
<tr>
<td>Commuters</td>
<td>92 vph</td>
<td>49 vph</td>
</tr>
<tr>
<td>Commercial</td>
<td>37 vph</td>
<td>37 vph</td>
</tr>
<tr>
<td>TOTAL</td>
<td>129 vph</td>
<td>86 vph</td>
</tr>
</tbody>
</table>

### 7.2 Traffic Distribution

The Cardno report assumed that all of the commuter traffic would access the site via a single new access point to Nolan Street, and that the commercial component would take a separate (single) access to Lydiard Street North.

The proposed plan now includes two access points to the commuter carpark, including a new access to Nolan Street which is connected via a new public road (Station Access Road) to the existing signalised access point to Lydiard Street North.

The car parking for the commercial component is accessible via both of these intersections, as well as a proposed secondary access point to Nolan Street located immediately east of Neill Street.

For the purposes of providing a conservative analysis, the traffic volumes and splits adopted by Cardno at the proposed access point to Nolan Street have been adopted, and the remaining traffic has been
distributed to the signalised access point (on Lydiard Street North). We note that it is intended that the right IN at Lydiard Street North be banned as part of the development, however vehicles wishing to enter from the south can undertake a small loop (via Ararat Street/Armstrong Street North/Doveton Crescent) and enter the station precinct via the Lydiard Street North signalised intersection, with a separate phase allocated to vehicles entering from Doveton Street.  

Figure 4 below shows the adopted AM (PM) peak hour turning movements.

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3 We understand that Council engineers have concerns about vehicles queuing across the level crossing when making a right turn movement into the Station Access Road at the signals. Accordingly, while we believe that it would not be difficult to provide a signal phasing which would prevent this occurring, we have adopted the intersection layout on the basis that banning the right turn gives a safer outcome.
7.3 Traffic Impact

We have undertaken an assessment of the operation of the Nolan Street/Station Access Road and the Lydiard Street North/Station Access Road intersections with the turning movements shown in Figure 4, during the AM and PM road network peak hours using SIDRA Intersection analysis software.

A Degree of Saturation (DOS) for an intersection is a measure of the proportion of capacity (saturation) reached. The lower the DOS value, the better the operating conditions.

A DOS of up to 0.9 is considered to be good operating conditions for signalised intersections, while a lesser value of 0.8 is good for a sign-controlled intersection. Higher values for each case are representative of poorer operating conditions with a DOS approaching 1.00 indicating queues and delays increasing disproportionately.

Lydiard Street North/Station Access Road

Table 6 below summarises the SIDRA output for the intersection during the road network peak hours. Full SIDRA output is included as part of Appendix C.

<table>
<thead>
<tr>
<th>Approach</th>
<th>Degree of Saturation</th>
<th>Average Delay (sec)</th>
<th>95th Percentile Queue</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AM</td>
<td>PM</td>
<td>AM</td>
</tr>
<tr>
<td>Lydiard Street North (S)</td>
<td>0.182</td>
<td>0.301</td>
<td>6.3 sec</td>
</tr>
<tr>
<td>Station Access Road (W)</td>
<td>0.200</td>
<td>0.300</td>
<td>30.5 sec</td>
</tr>
<tr>
<td>Lydiard Street North (N)</td>
<td>0.210</td>
<td>0.143</td>
<td>7.3 sec</td>
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</table>

Table 6 indicates that the existing signalised intersection of Lydiard Street North/Station Access Road will operate well within acceptable limits based on the existing intersection layout which includes a single northbound and two southbound lanes, but noting that right turns into Station Access Road will be banned.

Station Access Road/Nolan Street

The proposed intersection of the Station Access Road with Nolan Street has been shown on the development plan as an uncontrolled intersection. Both our assessment and that of Cardno recognise that this arrangement is satisfactory from a congestion/operational perspective.

Table 7 below provides a summary for the intersection during the road network peak hours. The full SIDRA output is included as part of Appendix C.
Table 7: SIDRA Output – Station Access Road/ Nolan Street

<table>
<thead>
<tr>
<th>Approach</th>
<th>Degree of Saturation</th>
<th>Average Delay (sec)</th>
<th>95th Percentile Queue</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AM</td>
<td>PM</td>
<td>AM</td>
</tr>
<tr>
<td>Station Access Road (S)</td>
<td>0.079</td>
<td>0.262</td>
<td>11.0 sec</td>
</tr>
<tr>
<td>Nolan Street (E)</td>
<td>0.204</td>
<td>0.174</td>
<td>0.0 sec</td>
</tr>
<tr>
<td>Nolan Street (W)</td>
<td>0.162</td>
<td>0.224</td>
<td>0.0 sec</td>
</tr>
</tbody>
</table>

Table 7 indicates that this simple uncontrolled intersection of Station Access Road/Nolan Street would operate well within acceptable limits.

The City of Greater Ballarat has raised issues in relation to speed of traffic on Nolan Street together with the limitation on sight distance between the proposed intersection and west bound vehicles caused by the vegetation and embankment (opposite Ligar Street). This issue was also noted in the Cardno report.

We agree that it would be desirable to reduce the speed limit along Nolan Street from 60km/h to 50km/h in this section and to remove the vegetation opposite Ligar Street. These measures will require the involvement of both Council and VicRoads. In particular, the removal of the vegetation obscuring the view for westbound vehicles will give sight distance of in the order of 80 metres for vehicles exiting the precinct, i.e. in excess of 5 seconds travel time for vehicles travelling at 50km/h. This exceeds the critical gap required for a right turn movement and therefore, there is no reason that the intersection would be expected to not work safely with a reduced speed limit of 50km/h.

The Landscape Concept Plan provided as part of the development proposal shows landscaping of the embankment opposite Ligar Street. This landscaping will need to be maintained so that it does not restrict sight distance by encroaching on or overhanging the footpath at this location.

We note that in the future when the bus terminus is developed on the north side of the station with buses taking access from the Station Access Road, it may be desirable to provide a controlled intersection at Nolan Street. A possible layout and analysis is attached at Appendix D. Significantly, the possible future signalised treatment at Nolan Street discussed at Appendix D is predicated on there being two approach lanes (one for left turns OUT and one for right turns OUT). Accordingly, we recommend that the proposed development works and plan of sub-division provide for this eventuality to avoid the need for any acquisition in the future.

**Summary**

We are satisfied that the level of traffic anticipated to be generated by the Ballarat Station Redevelopment can easily be accommodated on the surrounding road network and access taken from:-

- the existing intersection at Lydiard Street North,
- a new driveway to Nolan Street for the hotel carpark, and
- a new uncontrolled access for the Station Access Road on Nolan Street (subject to a reduction in the speed limit on Nolan Street to 50km/h and the removal of the vegetation opposite Ligar Street).
7.4 Pedestrian Connectivity

Figure 5 below shows the primary pedestrian desire lines and connectivity through the site.

Notably, footpaths/walkways will be provided along both sides of the new Council road within the site, as well as between key destinations such as the hotel lobby, plaza areas, goods shed and commuter carpark.

In addition, the section of roadway between the public plaza and station forecourt area will operate as a low speed shared zone.

Figure 5: Internal Pedestrian Network

We are satisfied that appropriate consideration is made for pedestrian connectivity throughout the site.
8 Conclusions

Having inspected the site, perused relevant documents and plans, provided design advice and undertaken traffic engineering assessments, we are of the opinion that:

a) the total parking provided on-site meets the statutory requirements as well as providing 272 commuter spaces,

b) the car parking areas have been designed in accordance with the requirements of Clause 52.06-8 of the Greater Ballarat Planning Scheme and/or Australian Standard AS2890.1-2004 (User Class 1),

c) the car parking layouts and column locations are in accordance with appropriate standards and all spaces are readily accessible however, we recommend that the spaces in the hotel basement carpark conform to User Class 2,

d) bicycle parking in accordance with the requirements of Clause 52.34 of the Planning Scheme can be addressed via a permit condition and there is adequate space to provide the required number of spaces,

e) adequate provision is made for pedestrian connectivity throughout the site,

f) traffic generated by the proposed development can be accommodated on the surrounding road network without any adverse impacts having regard to the proposed access arrangements (subject to a reduction in the speed limit on Nolan Street to 50km/h and the removal of the vegetation opposite Ligar Street), and

g) there are no traffic engineering reasons why a permit should not be granted for the proposed redevelopment of the Ballarat Station Precinct.
Appendix A: Cardno Report
# Table of Contents

1. **Introduction**  
   
2. **Background and Context**  
   2.1 Location  
   2.2 Ballarat Planning Scheme  
   2.3 Ballarat Station Precinct Master Plan (Adopted by Council April 2014)  
   2.4 Making Ballarat Central: The CBD Strategy (2010)  
   2.5 Ballarat Activity Centres Strategy (2012)  
   2.6 Road Network  
   2.6.1 Lydiard Street North  
   2.6.2 Nolan Street  

3. **Survey Results and Observations**  
   3.1 Commuter Car Park Usage  
   3.2 On-Street Car Parking  
   3.3 Vehicle Traffic  
   3.3.1 Existing Traffic Volumes and Speed (Nolan Street)  
   3.3.2 Existing Traffic Volumes (Peak Hours)  
   3.3.3 Existing Intersection Operation  
   3.4 Environmental Operation  
   3.5 Existing Commuter Traffic  
   3.6 Level Crossing Observations  
   3.7 Bus Transport Services  
   3.8 Train Services  

4. **Schematic Design Concept**  
   4.1 General  
   4.2 Vehicle Access  

5. **Car Parking Considerations**  
   5.1 Commuter Car Parking  
   5.2 Commercial Car Parking  
   5.2.1 Statutory Requirements – Clause 52.06  

6. **Design Considerations**  
   6.1 Nolan Street  
   6.2 Vehicle Sight Lines  
   6.2.1 Options to Improve Vehicle Sight Lines  
   6.3 Internal Access Road  
   6.4 Car Parking  

7. **Traffic Considerations**  
   7.1 Potential Nolan Street Access Point  
   7.2 Intersection Operation  
   7.3 Potential Modifications to Lydiard Street Access Point  
   7.4 Intersection Operation  
   7.5 Surrounding Road Network  

8. **Bicycle Parking Considerations**  
   8.1 Commuter Bicycle Parking  
   8.2 Commercial Bicycle Parking  

9. **Loading Considerations**  

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Traffic and Transport Assessment  
Ballarat Station Precinct  

21 January 2016  
Cardno  

iii
## 10 Conclusions / Recommendations

### Tables

- Table 3-1 Nolan Street Traffic Volume Summary (Weekday Average – 24 August 2015) 25
- Table 3-2 Nolan Street Vehicle Speed Summary 25
- Table 3-3 Rating of Degrees of Saturation 28
- Table 3-4 Analysed Intersections – Existing Conditions (Network Peak Hours) 28
- Table 3-5 Estimated Daily Volumes 28
- Table 3-6 Existing Car Park Traffic Generation 29
- Table 3-7 Queue Length Survey Results 29
- Table 3-8 Bus Transport Provision 30
- Table 3-9 Public Transport Provision 32
- Table 5-1 Planning Scheme Car Parking Requirements – Clause 52.06-5 and 52.06-5A 35
- Table 7-1 Proposed Nolan Street Access Point 38
- Table 7-2 Proposed Access / Nolan Street Intersection – Post Development Conditions 38
- Table 7-3 Proposed Lydiard Street Access Point 39
- Table 7-4 Proposed Access / Nolan Street Intersection – Post Development Conditions 39
- Table 8-1 Planning Scheme Bicycle Parking Requirements – Clause 52.34 42
- Table 9-1 Planning Scheme Loading Requirements – Clause 52.07 43

### Figures

- Figure 2-1 Site Location 8
- Figure 2-2 Aerial Photograph 9
- Figure 2-3 Ballarat Activity Centre Hierarchy 10
- Figure 2-4 Bus Interchange & Rail Environment Detailed Plan 11
- Figure 2-5 South Station Forecourt Detailed Plan 12
- Figure 2-6 Proposed Mixed Use Railway Station at Ballarat 13
- Figure 2-7 Ballarat CBD Opportunities and Constraints 14
- Figure 2-8 Lydiard Street North looking north adjacent to the Ballarat train station 16
- Figure 2-9 Lydiard Street North looking south towards the Ballarat train station 17
- Figure 2-10 Nolan Street looking northwest adjacent the Ballarat train station 18
- Figure 2-11 Nolan Street looking southeast adjacent the Ballarat train station 19
- Figure 3-1 Weekday Commuter Car Parking Profile – Thursday 6 August 2015 20
- Figure 3-2 Weekend Commuter Car Parking Profile – Saturday 8 August 2015 21
- Figure 3-3 On-Street Car Parking Survey Map 21
- Figure 3-4 On-Street Parking Profile (Thursday 6th August 2015) 22
- Figure 3-5 On-Street Parking Profile (Saturday 8th August 2015) 22
- Figure 3-6 On-Street Car Parking Survey Map – Reduced Survey Area 23
- Figure 3-7 On-Street Parking Profile – Reduced Survey Area (Thursday 6th August 2015) 24
- Figure 3-8 On-Street Parking Profile – Reduced Survey Area (Saturday 8th August 2015) 24
- Figure 3-9 Traffic Survey Locations 25
| Figure 3-10  | Existing Traffic Volumes - AM Peak Hour - Thursday 6 August 2015 | 26 |
| Figure 3-11  | Existing Traffic Volumes – PM Peak Hour - Thursday 6 August 2015 | 27 |
| Figure 3-12  | Public Transport Map | 31 |
| Figure 3-13  | V-Line Services Network Map | 33 |
| Figure 4-1   | Proposed Concept Design | 34 |
| Figure 8-1   | Existing Bicycle Cage | 41 |
| Figure 8-2   | Existing Visitor Bicycle Hoops | 42 |
1 Introduction

Cardno has been engaged by VicTrack to:

> Review the existing parking and access conditions at Ballarat Train Station;

> Consider the traffic and transport implications of the proposed redevelopment of part of the Ballarat Station Precinct, for a mixed use development including a hotel, function centre and complimentary uses;

> In consultation with Public Transport Victoria and City of Ballarat, consider the potential to reconfigure the existing commuter parking and vehicle access; and

> Liaise with project team and provide design advice on concept design iterations.

In the course of preparing this assessment, the subject site and its environs have been inspected, current car parking demands have been surveyed, and traffic volume data at surrounding key intersections has been collected and analysed.
2 Background and Context

2.1 Location

The subject site is located immediately north of the Ballarat CBD, comprising land bounded by Nolan Street to the north, Peel St to the east, Mair Street to the south and Lydiard Street to the west, as shown in Figure 2-1.

The subject land forms part of a larger precinct which includes the Ballarat Train Station, a number of commuter and public car parks, a bus interchange as well as a large goods shed (a significant building). Furthermore, a number of additional commuter car parks are available off-site, located to the west along Doveton Street North and Doveton Crescent.

There is a bus interchange and a number of short-term parking spaces located south of the rail track, accessible via two crossovers onto Lydiard Street, while the northern commuter car parking is accessible via a separate crossover onto Lydiard Street (north of the rail track). Additionally, a further gated access point onto Nolan Street provides service vehicle access to the north section of the subject site, however this is not typically open and available for use by the public.

Land uses in the vicinity of the site are mixed, with retail and commercial uses operating to the south and west along Mair Street and Lydiard Street, while land use to the north and east is generally residential in nature.

Ballarat Train Station has two platforms (inbound and outbound), and is the penultimate station on the Ballarat Line. The Ballarat Line is operated by V-Line. Figure 2-2 shows an aerial photograph of the site.
Figure 2-1 Site Location
Figure 2-2  Aerial Photograph
2.2 Ballarat Planning Scheme

Clauses 21 and 22 of the Ballarat Planning Scheme sets out the framework for the local Planning Policy. Various clauses throughout the local Planning Policy Framework relate to the Ballarat Central Business District (CBD) and its future development.

Figure 2-3 Ballarat Activity Centre Hierarchy

As can be seen in Figure 2-3, the Ballarat Railway Station is located within the CBD and therefore is part of the Principal Activity Centre.

The vision set out by the City of Ballarat for all Activity Centres is:

"A strong and diverse network of Activity Centres that provide vibrant, sustainable and accessible shopping, employment, entertainment, social and community focal points throughout the City, which meet the needs of the existing and future population of the City of Ballarat, the broader region and visitors to Ballarat.

A network of centres that reinforce the primacy of the Ballarat Central Business District and which have the potential to accommodate future growth in retail, employment, entertainment, social and community services and facilities as a consequence of future population growth, changing socio-economic characteristics, and changing retail and economic trends.

Flexibility for centres to change over time to accommodate the changing needs of their communities, with the opportunity for local communities and business groups to be involved in determining the distinctive identity which evolves for each centre."

By definition a Principal Activity Centre has a large catchment zone typically encapsulating several suburbs and local government areas, to support this large catchment area the Centre must be well served by multiple public transport routes. In conjunction with this the activities available in the centre must generate a high number of trips and have a focus on the broader community.

The local planning framework also aims to create a liveable city, measures on which it hopes to do this by relate to many different topics. Particularly of note are issues in relation to safety, aiming to avoid conflict points, promoting safe vehicle speeds in the road network, separating pedestrian and vehicle traffic as well as providing dedicated bicycle paths within road reserves.
As Ballarat continues to expand, it not only hopes to do so via population growth but also plans to expand through its unique tourism draw cards. Clause 21.04-6, Strategy 1.4 explicitly states that the planning scheme wishes to encourage the use of land within the Ballarat Railway Precinct for tourism related purposes.

2.3 Ballarat Station Precinct Master Plan (Adopted by Council April 2014)

The Ballarat Station Precinct Master Plan, which was adopted by Council in April 2014, contemplates the urban renewal and transport oriented development of the precinct. This would contribute to facilitating the strengthening and development of Ballarat’s CBD. To achieve this, the Master Plan seeks to:

> Create a gateway to Ballarat;
> Cultivate a multi-use destination; Celebrate, revitalise and capitalise on Ballarat’s heritage buildings;
> Develop an efficient regional transport hub;
> Enhance connections; and
> Craft public spaces that engage.

The Master Plan highlights the inefficiency of the existing informal commuter car park, and notes that in particular the bus interchange does not efficiently meet the current and future operational requirements. Additionally, the existing site provides minimal pedestrian amenity due to conflict points where vehicle movements are currently prioritised along key pedestrian connection routes.

As a major transport hub for the region, the Plan envisages significant improvement of the station to provide safe and exceptional passenger experience which will encourage people to travel by public transport.

Additionally, a new access point onto Nolan Street is considered by the Master Plan to provide direct access for buses, commuter parking and kiss and ride, as well as improving the safety and capacity along Lydiard Street. With pick up and drop off movements being relocated to the north of the station, the south side of the station will be able to provide safer movement for pedestrians to access the city centre.

Figure 2-4 and Figure 2-5 illustrate the Stage 01 transport improvements as considered by the Master Plan.

**Figure 2-4  Bus Interchange & Rail Environment Detailed Plan**

Source: “Ballarat Station Precinct: Masterplan (April 2014)”
2.4 Making Ballarat Central: The CBD Strategy (2010)

The Ballarat CBD strategy provides the direction for the City of Ballarat for the next 20-25 years. It draws together ideas from the local community as well as current and future design proposals. The strategy outlines ideas on how to achieve its overall vision for Ballarat.

Ballarat’s Vision incorporates ideas such as:

> Making Ballarat a premier regional centre in Australia;
> Making Ballarat accessible to people of all abilities, ages and by any means of transport;
> A vibrant centre attracting a variety of recreational and commercial uses;
> An ecologically sustainable centre; and
> Maintain its proud heritage in built from and character.

Specifically in relation to the Ballarat Station Precinct the plan sets out a variety of key criterion that Council would like to have implemented within the next 25 years. The report recognises that the station is an important Victorian era building, with the surrounding buildings of varying degrees of cultural significance.
It should be noted that the Ballarat train station is one of the key gateways into the city, and despite minor works to upgrade the station, more work is required to improve upon its heritage features and re-open the upper levels to the public.

Further to the station, the plan aims to improve the overall access to the site and further transform it into not only a central point for the City of Ballarat but into a regional transport hub.

The long term aspirations for the Station Precinct are to provide the following:

- Bluestone sheds: markets, performance spaces, gallery, art workshops such as Melbourne’s Meat Market, microbrewery;
- Residential infill, offering a variety of dwelling types, styles and affordability;
- Community spaces such as meeting places, community centres or community gardens;
- Retail spaces that serve the residential population without competing with the retail role of the CBD;
- Cafés, dining and entertainment;
- Markets (art, food, antiques), performance and exhibition spaces;
- Art workshops or incubator spaces;
- Tourism opportunities such as a ‘Rail Interpretive Centre’ or history centre; and
- Light industrial or service business uses.

Furthermore, the Ballarat CBD strategy (2010) encourages the consideration of a reduction to the car parking requirements for new development, due to the site being part of a multi-modal transport hub in the heart of the CBD.

The plans aim to incorporate a range of open space through the precinct, as well as incorporating environmentally sustainable initiatives throughout the site.
2.5 Ballarat Activity Centres Strategy (2012)

It is currently anticipated that the City of Ballarat is likely to experience significant growth relating to population and lifestyle requirements in the coming 20 years. Subsequently as a result of population growth the demand for services will be increased. The Ballarat Activity Centres Strategy was written to address how the CBD and the wider community can adapt to meet this expected growth.

The core of the strategy revolves around the adoption of 24 principles for Ballarat’s Activity Centres. It is noted that the principles have moved away from a purely retail and commercial foundation to Activity Centres and provides a more holistic approach to them, consistent with previous reports and policies written.

Specifically, Ballarat Railway Station is located on the outer edge of the Ballarat CBD and is subsequently located in the Principal Activity Centre. As part of the Principal Activity Centre a wide range of retail, commercial, entertainment and tourism functions are expected to be placed there.

In the preparation of the strategy it was frequently noted that local residents saw the need to consolidate the area that is known as the Ballarat CBD. This is due to the fact that a lack of pedestrian interconnectivity of the CBD currently doesn’t encourage pedestrians to walk between locations in the CBD, instead encourages them to drive between the attraction points. It is therefore proposed to upgrade pedestrian facilities throughout the CBD to encourage pedestrian traffic in the yellow highlighted areas of Figure 2-7.

Figure 2-7 Ballarat CBD Opportunities and Constraints
The strategy highlights the importance that infrastructure improvement can have on Activity Centres, noting that various improvements can be warranted based on input from the local community. Improvements can be in such fields as the provision of:

- Shelter and weather protection;
- Street tree planting;
- Street furniture and seating;
- Improvements to pedestrian access, particularly for those with limited mobility;
- Improved pedestrian crossings, particularly across busy roads;
- Improved public transport generally and better public transport connections between centres;
- Improvement or the establishment of footpaths in many centres;
- Public toilets;
- Centre branding, signage and feature lighting;
- Lighting;
- Community notice boards;
- Access for deliveries;
- Car parking; and
- Local area traffic management within and around centres.

It is anticipated that if improvements such as these are implemented the Ballarat CBD will be able to sustain and encourage growth into the future.
2.6 Road Network

2.6.1 Lydiard Street North

Lydiard Street North is a local road running in a north-south direction between Sturt Street and Norman Street. South of Sturt Street, Lydiard Street North continues south as Lydiard Street South and provides a connection to Dana Street.

In the vicinity of the Ballarat train station, Lydiard Street North provides for a single traffic lane in each direction, and has provision for a bicycle lane and on-street parking along both kerbs. On-street car parking along Lydiard Street North is unrestricted on the east side, and restricted to 2P 9:00am - 5:30pm Monday to Friday on the west side.

A bus zone is currently located along the eastern side of Lydiard Street North, adjacent to the Ballarat train station.

Pedestrian operated signals are provided on each side of the railway crossing to facilitate controlled pedestrian access across Lydiard Street North. A 50km/h speed limit applies on Lydiard Street North in the vicinity of the Ballarat train station.

Figure 2-8 illustrates the typical cross section of Lydiard Street North looking north adjacent to the Ballarat train station, and Figure 2-9 shows Lydiard Street north looking south towards the Ballarat train station.
Figure 2-9 Lydiard Street North looking south towards the Ballarat train station
2.6.2 Nolan Street

Nolan Street is a local road extending in a southeast direction from Lydiard Street North, which provides for a single traffic lane in each direction, and continues as Scott Parade to the east. A posted 60 km/hr speed restriction applies on Nolan Street adjacent to the Ballarat train station.

Parking along Nolan Street is generally unrestricted. Indented angle parking is available on both sides of the carriageway adjacent to the Ballarat train station. Cross sections of Nolan Street are provided in Figure 2-10 and Figure 2-11.

Figure 2-10 Nolan Street looking northwest adjacent the Ballarat train station
Figure 2-11 Nolan Street looking southeast adjacent the Ballarat train station
3 Survey Results and Observations

3.1 Commuter Car Park Usage

In order to determine existing parking demands, car parking occupancy surveys were undertaken on Thursday 6th and Saturday 8th August 2015. The survey periods were between 7:00am – 10:00am and 4:00pm – 7:00pm on the Thursday, and between 11:00am – 2:00pm on the Saturday.

The parking surveys identified a total supply of approximately 331 parking spaces within the Ballarat Train Station Precinct, including a mix of short and long term parking. There are approximately 23 spaces in the southern car park, and approximately 308 car spaces within the northern car park. Public Transport Victoria has advised that there are approximately 270 car spaces available for commuter use. The remaining car spaces are a mix of short term car parking for pick-up and drop-off, and reserved parking for staff.

It should be noted that there is a range of parking restrictions in the area, including reserved parking for V-line staff, bus and taxi parking and permit zones. The results of the car parking surveys demonstrate the following:

- A total of 174 car spaces were already occupied at the beginning of the survey at 7:00am;
- Parking demands continued steadily until 9:00am as commuters continued to arrive at the station;
- The car park reached peak occupancy at 10:00am, when 295 car parking spaces were occupied; and
- The car park began to empty quickly from 4:30pm onwards, with the majority of commuters leaving between 5:00pm – 7:00pm, by the end of which there remained 58 occupied car spaces.

A weekday profile of the occupancy of weekday commuter car parking is shown in Figure 3-1.

Car parking occupancy surveys were also undertaken on Saturday 8 August 2015, with the results revealing a considerably lower demand for commuter car parking when compared against the weekday results, as shown in Figure 3-2.

Figure 3-1 Weekday Commuter Car Parking Profile – Thursday 6 August 2015
3.2 On-Street Car Parking

In addition to the on-site commuter car parking provided within Ballarat Train Station, the car parking surveys also included surrounding on-street car parking as shown in Figure 3-3. The survey area generally contains long term and unrestricted parking during the day. At other times in the evening and during the weekend, on-street parking in the area is typically unrestricted.

Figure 3-3 On-Street Car Parking Survey Map
In the vicinity of the Ballarat Train Station, the surveys identified up to 616 suitable spaces for visitor parking, including 46 spaces located along Nolan Street, and 113 spaces along Lydiard Street. On-street car parking along Lydiard Street North is unrestricted on the east side, and restricted to 2P 9am-5:30pm Monday to Friday on the west side. On-Street parking along Nolan Street is unrestricted.

The parking profiles of available spaces within the survey area are shown in Figure 3-4 to Figure 3-5. The survey results illustrate that the peak parking demand on the Thursday occurred at 10:00am in the morning when 364 of 615 spaces were occupied. At this time, a minimum of 251 parking spaces remained vacant (59% occupancy).

On the Saturday, the peak parking demand occurred at 12:30pm when 275 parking spaces were occupied. At this time, a minimum of 341 parking spaces in the area remained vacant (45% occupancy). At all other times, between 347 and 373 car spaces were available in the area during the survey.

Figure 3-4 On-Street Parking Profile (Thursday 6th August 2015)

Figure 3-5 On-Street Parking Profile (Saturday 8th August 2015)
The scope of the on-street car parking surveys was further reduced to only include car parking along Nolan Street and Lydiard Street, as shown in Figure 3-6.

These surveys within the reduced scope identified up to 93 suitable spaces for visitor parking, including 46 spaces located along Nolan Street, and 47 spaces along Lydiard Street.

The parking profiles of available spaces within the survey area are shown in Figure 3-7 and Figure 3-8. The survey results illustrate that the peak parking demand on the Thursday occurred at 10:00am in the morning when 62 of 93 spaces were occupied. At this time, a minimum of 31 parking spaces remained vacant (67% occupancy).

On the Saturday, the peak parking demand occurred between 11:30am and 12:00pm when 44 parking spaces were occupied. At this time, a minimum of 49 parking spaces in the area remained vacant (47% occupancy).

Figure 3-6  On-Street Car Parking Survey Map – Reduced Survey Area
Figure 3-7  On-Street Parking Profile – Reduced Survey Area (Thursday 6th August 2015)

Figure 3-8  On-Street Parking Profile – Reduced Survey Area (Saturday 8th August 2015)

3.3 Vehicle Traffic

3.3.1 Existing Traffic Volumes and Speed (Nolan Street)

Within the survey area in the vicinity of the Ballarat train station, Nolan Street is the main circulation local road that provides east-west connection to adjacent residential catchments. Automatic tube counts were undertaken on behalf of Council (as part of a different study) on Nolan Street between Neil Street and Ligar Street from 24 August 2015 and 30 August 2015. The results of this survey have been sourced and reviewed to establish existing traffic volumes on Nolan Street within the study area, and are summarised in Table 3-1.

Vehicle speeds were also recorded over the one-week period, as summarised in Table 3-2. The results indicate that the average and 85th percentile vehicle speed on Nolan Street is less than the speed limit of 60km/h.
### Table 3-1 Nolan Street Traffic Volume Summary (Weekday Average – 24 August 2015)

<table>
<thead>
<tr>
<th>Volume Description (Weekday Peak)</th>
<th>AM Peak Hour</th>
<th>PM Peak Hour</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>8am – 9am</td>
<td>5pm – 6pm</td>
<td></td>
</tr>
<tr>
<td>Northbound</td>
<td>344 vph</td>
<td>281 vph</td>
<td></td>
</tr>
<tr>
<td>Southbound</td>
<td>211 vph</td>
<td>370 vph</td>
<td></td>
</tr>
<tr>
<td>Total Volume (2 Way)</td>
<td>555 vph</td>
<td>645 vph</td>
<td></td>
</tr>
</tbody>
</table>

### Table 3-2 Nolan Street Vehicle Speed Summary

<table>
<thead>
<tr>
<th>Speed Description</th>
<th>Northbound</th>
<th>Southbound</th>
<th>Combined</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>54 km/h</td>
<td>52 km/h</td>
<td>53 km/h</td>
</tr>
<tr>
<td>85th Percentile</td>
<td>60 km/h</td>
<td>58 km/h</td>
<td>59 km/h</td>
</tr>
</tbody>
</table>

#### 3.3.2 Existing Traffic Volumes (Peak Hours)

To determine the existing traffic conditions in the vicinity of the site, a series of turning movement count surveys were organised at key surrounding intersections and car park access points on Thursday 6 August, 2015 between 7:00am – 10:00am and 4:00pm – 7:00pm.

The traffic survey locations are shown in Figure 3-9.

#### Figure 3-9 Traffic Survey Locations

The road network AM and PM peak hours (provided in Figure 3-10) were observed to occur between 8:15am – 9:15am and 4:45pm – 5:45pm respectively.
Figure 3-10 Existing Traffic Volumes - AM Peak Hour - Thursday 6 August 2015
3.3.3 Existing Intersection Operation

The operation of the intersections at Peel Street / Scott Parade, Neill Street / Nolan Street and Lydiard Street / Seymour Street have been analysed using SIDRA Intersection (Signalised & Unsignalised Intersection Design and Research Aid). This computer package, originally developed by the Australian Road Research Board, provides information about the capacity of an intersection in terms of a range of parameters, as described below:

Degree of Saturation (D.O.S.) is the ratio of the volume of traffic observed making a particular movement compared to the maximum capacity for that movement. Various values of degree of saturation and their rating are shown in Table 3-3.
Table 3-3  Rating of Degrees of Saturation

<table>
<thead>
<tr>
<th>D.O.S.</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 0.6</td>
<td>Excellent</td>
</tr>
<tr>
<td>0.6 to 0.7</td>
<td>Very Good</td>
</tr>
<tr>
<td>0.7 to 0.8</td>
<td>Good</td>
</tr>
<tr>
<td>0.8 to 0.9</td>
<td>Fair</td>
</tr>
<tr>
<td>0.9 to 1.0</td>
<td>Poor</td>
</tr>
<tr>
<td>Above 1.0</td>
<td>Very Poor</td>
</tr>
</tbody>
</table>

It is considered acceptable for some critical movements in an intersection to operate in the range of 0.9 to 1.0 during the high peak periods, reflecting actual conditions in a significant proportion of suburban signalised intersections.

The **95th Percentile (95%ile) Queue** represents the maximum queue length, in metres, that can be expected in 95% of observed queue lengths in the peak hour; and

**Average Delay** is the delay time, in seconds, which can be expected over all vehicles making a particular movement in the peak hour.

The results of the SIDRA Intersection analysis are summarised in Table 3-4. These results show that all analysed intersections operate under “excellent” conditions, with minimal queues and delays.

Table 3-4  Analysed Intersections – Existing Conditions (Network Peak Hours)

<table>
<thead>
<tr>
<th>Intersection</th>
<th>AM Peak D.O.S.</th>
<th>95%ile Queue (m)</th>
<th>Average Delay (s)</th>
<th>PM Peak D.O.S.</th>
<th>95%ile Queue (m)</th>
<th>Average Delay (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peel Street / Scott Parade</td>
<td>0.45</td>
<td>24.0</td>
<td>7.7</td>
<td>0.40</td>
<td>18</td>
<td>7.8</td>
</tr>
<tr>
<td>Neill Street / Nolan Street</td>
<td>0.18</td>
<td>0.2</td>
<td>0.1</td>
<td>0.20</td>
<td>0.1</td>
<td>0.3</td>
</tr>
<tr>
<td>Lydiard Street / Seymour Street</td>
<td>0.45</td>
<td>22.0</td>
<td>6.7</td>
<td>0.38</td>
<td>20.5</td>
<td>7.7</td>
</tr>
</tbody>
</table>

3.4  Environmental Operation

In order to understand the environmental operation of key surrounding roads, peak hour volumes have been analysed and extrapolated to estimate existing daily traffic volumes, as shown below in Table 3-5. For the purposes of this assessment, it is assumed that 10% of the daily volumes occur during the peak hours.

Table 3-5  Estimated Daily Volumes

<table>
<thead>
<tr>
<th>Road</th>
<th>AM Peak (8:15-9:15am)</th>
<th>PM Peak (4:45-5:45pm)</th>
<th>Daily</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lydiard Street North</td>
<td>531</td>
<td>521</td>
<td>~ 5,500 vehicles</td>
</tr>
<tr>
<td>Nolan Street</td>
<td>560</td>
<td>640</td>
<td>~ 6,000 vehicles</td>
</tr>
<tr>
<td>Neill Street</td>
<td>6</td>
<td>16</td>
<td>~ 200 vehicles</td>
</tr>
<tr>
<td>Scott Parade</td>
<td>550</td>
<td>667</td>
<td>~ 6,000 vehicles</td>
</tr>
<tr>
<td>Peel Street North</td>
<td>594</td>
<td>740</td>
<td>~ 6,700 vehicles</td>
</tr>
</tbody>
</table>

Review of the above table indicates that the traffic volumes on Lydiard Street North and Nolan Street in the vicinity of Ballarat Station are consistent with their designated function as Connector Roads.

In relation to Nolan Street, it provides access to Scott Parade to the east, and operates as a collector road for surrounding residential dwellings and commercial uses. Given the good accessibility to the surrounding road network, some commuters are likely to already travel along Nolan Street on-route to Ballarat Station.
3.5 Existing Commuter Traffic

At the existing station commuter car parks (both the northern and southern access), turning movement counts show combined peak hour traffic volumes of 165 and 231 vehicle movements respectively during the AM and PM peak. These traffic volumes include all commuter car parking, pick-up, drop-off, taxi and bus movements, and are shown in Table 3-6.

Table 3-6 Existing Car Park Traffic Generation

<table>
<thead>
<tr>
<th>Ballarat Train Station</th>
<th>AM Peak (8:15-9:15am)</th>
<th>PM Peak (4:45-5:45pm)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Northern Access</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In</td>
<td>44</td>
<td>8</td>
</tr>
<tr>
<td>Out</td>
<td>7</td>
<td>86</td>
</tr>
<tr>
<td>Total</td>
<td>51</td>
<td>94</td>
</tr>
</tbody>
</table>

| **Southern Access**    |                       |                       |
| In                     | 61                    | 75                    |
| Out                    | 53                    | 90                    |
| Total                  | 114                   | 165                   |

| **Combined**           |                       |                       |
| In                     | 105                   | 83                    |
| Out                    | 60                    | 176                   |
| Total                  | 165                   | 259                   |

3.6 Level Crossing Observations

In addition to the traffic volume counts within the survey area, queue surveys identifying the number of cars waiting in the traffic queue on Lydiard Street at the railway crossing were recorded at 5 minute intervals to determine the back of queue length. The longest queues at the railway crossing during the survey period (between 7:00am-10:00am and 4:00pm-7:00pm on the Thursday, and between 11:00am-2:00pm on the Saturday) are shown in Table 3-7.

Table 3-7 Queue Length Survey Results

<table>
<thead>
<tr>
<th>Intersection</th>
<th>Peak Period</th>
<th>Max Queue (Cars)</th>
<th>Max Queue Length (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>North of the Railway Crossing</td>
<td>AM</td>
<td>9 (8:50-8:55am)</td>
<td>54m</td>
</tr>
<tr>
<td>(southbound lane)</td>
<td>PM</td>
<td>11(5:50-5:55pm)</td>
<td>66m</td>
</tr>
<tr>
<td>South of the Railway Crossing</td>
<td>AM</td>
<td>6 (7:50-7:55am)</td>
<td>36m</td>
</tr>
<tr>
<td>(northbound lane)</td>
<td>PM</td>
<td>10 (5:30-5:35pm)</td>
<td>60m</td>
</tr>
</tbody>
</table>

Observations of the video surveys undertaken at northern commuter car park access points during the peak road network periods revealed that vehicles typically enter and depart the car park with minimum queues and delays experienced by drivers.

3.7 Bus Transport Services

The site has excellent access to public transport provided by a number of bus routes with stops adjacent to the subject site.

The details of public transport services in the proximity of the site are provided in Table 3-8 and illustrated in Figure 3-12.
<table>
<thead>
<tr>
<th>Service</th>
<th>Route No's</th>
<th>Route</th>
<th>Nearest Stop(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bus</td>
<td>1</td>
<td>Ballarat - Wendouree West</td>
<td>Ballarat Station Bus Interchange</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Ballarat - Wendouree</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Ballarat Library/Market St</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Ballarat - Invermay</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Ballarat - Black Hill</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>Ballarat - Webbcona</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>Ballarat - Brown Hill</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>Ballarat - Eureka</td>
<td></td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>Ballarat - Canadian</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>Ballarat - Buninyong</td>
<td></td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>Ballarat - Sebastopol</td>
<td></td>
</tr>
<tr>
<td></td>
<td>13</td>
<td>Ballarat - Delacombe via Pleasant Street</td>
<td></td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>Ballarat - Delacombe via Sutton Street</td>
<td></td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>Northam Way/Sturt St</td>
<td></td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>Ballarat - Lake Gardens</td>
<td></td>
</tr>
<tr>
<td></td>
<td>18</td>
<td>Ballarat - Alfredton</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ballarat – Station to Sovereign Hill (Goldrush Service)</td>
<td></td>
</tr>
</tbody>
</table>
Figure 3-12 Public Transport Map
3.8 Train Services
Several V-Line train routes operate at Ballarat Station, as detailed in Table 3-9, with a map of the V-Line services shown in 0.

Table 3-9 Public Transport Provision

<table>
<thead>
<tr>
<th>Service</th>
<th>Route</th>
<th>Nearest Stop(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Train</td>
<td>Ballarat – Melbourne via Melton</td>
<td>Ballarat Station</td>
</tr>
<tr>
<td></td>
<td>Halls Gap – Melbourne via Stawell &amp; Ballarat</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mount Gambier – Melbourne via Hamilton &amp; Ballarat</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ouyen – Melbourne via Warracknabeal &amp; Ballarat</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Warrnambool – Melbourne via Ballarat</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Adelaide – Melbourne via Horsham, Ballarat &amp; Geelong</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mildura – Melbourne via Ballarat &amp; Donald</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ararat – Melbourne via Ballarat</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nhill – Melbourne via Ararat &amp; Ballarat</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Daylesford – Melbourne via Ballarat</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Maryborough – Melbourne via Ballarat</td>
<td></td>
</tr>
</tbody>
</table>
Figure 3-13 V-Line Services Network Map
4 Schematic Design Concept

4.1 General
The hypothetical concept design by SJB Urban includes a 100 room hotel, as well as a 330 patron function centre (utilising the existing goods shed). Additionally, a 40 patron café and an 80 patron restaurant are also proposed, with all of these land uses complementing each other. A level of retail is also anticipated on-site. The proposal also contemplates reconfiguring and formalising on-site commuter car parking.

4.2 Vehicle Access
The concept designs propose to reposition the main commuter vehicle access point from Lydiard Street (north of the rail track) to Nolan Street, as shown in Figure 4-1. The existing access point for the northern carpark onto Lydiard Street would be converted to a one-way, and exit only access point.

While the proposed intersection and internal access road onto Nolan Street has been designed to accommodate bus movements, a potential bus interchange located to the north of the rail track is to be considered as part of a future assessment, and at such a time the existing southern car park is to be converted to solely accommodate a taxi rank. In the meantime, the existing southern car park is not proposed to be altered as part of this assessment, and will therefore continue to operate as a bus interchange and provide short-term parking opportunities.

Figure 4-1 Proposed Concept Design

![Figure 4-1 Proposed Concept Design](image-url)
5 Car Parking Considerations

5.1 Commuter Car Parking

The results of the car parking occupancy surveys discussed in Section 3.1 reveal that the commuter car parking is currently well utilised. Therefore, it is recommended that any development must ensure there is no net loss of commuter car spaces as a result of the proposed development.

The concept design makes provision for 270 commuter car spaces to the north of the goods shed. The concept design also makes provision for 168 car spaces for the proposed commercial uses in a multi-level car park.

Additional on-site commercial car parking will need to be provided for the proposed hotel and exhibition/convention centre and associated uses.

5.2 Commercial Car Parking

5.2.1 Statutory Requirements – Clause 52.06

Clause 52.06 of the Ballarat Planning Scheme specifies the parking provision requirements with regard to the different components of the proposed development, as shown in Table 5-1.

<table>
<thead>
<tr>
<th>Use</th>
<th>No./Area</th>
<th>Parking Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential Hotel</td>
<td>100 rooms</td>
<td>Not included in Table 1 of Clause 52.06-5 therefore car parking spaces must be provided to the satisfaction of the responsible authority</td>
</tr>
<tr>
<td>Retail (Shop)</td>
<td>To be confirmed</td>
<td>4 / 100m²</td>
</tr>
<tr>
<td>Restaurant</td>
<td>80 Patrons</td>
<td>0.4 per patron</td>
</tr>
<tr>
<td>Café</td>
<td>40 Patrons</td>
<td>0.4 per patron</td>
</tr>
<tr>
<td>Function Centre</td>
<td>330 Patrons</td>
<td>0.3 per patron</td>
</tr>
</tbody>
</table>

'Residential hotel' is not a land use definition with a specific car parking requirement at Clause 52.06. There is a rate for 'Motel' which is a type of Residential hotel however this is not a use that is contemplated. The car parking requirement for 'Motel' in Clause 52.06 is 1 car space to each unit which is likely to be greater than the parking demand generated by a Residential hotel located at a railway station.

The Planning Scheme parking rates are an appropriate starting point for car parking assessments, however Clause 52.06-6 of the Planning Scheme also allows for a permit to be issued to reduce (including to reduce to zero) the number of spaces required under Clause 52.06-5.

A detailed car parking assessment has not been undertaken at this stage as the ultimate mix of land uses is yet to be determined. Any development proposal for the site will need to be informed by a Car Parking Demand Assessment which assesses the car parking demand likely to be generated by the proposed uses having regard to the following matters to the satisfaction of the responsible authority:

- The likelihood of multi-purpose trips within the locality which are likely to be combined with a trip to the land in connection to the proposed use.
- The variation of car parking demand likely to be generated by the proposed use over time.
- The short-stay and long-stay parking demand likely to be generated by the proposed use.
- The availability of public transport in the locality of the land.
- The convenience of pedestrian and cyclist access to the land.
- The provision of bicycle parking and end trip facilities for cyclists in the locality of the land.
• The anticipated car ownership rates of likely or proposed visitors to or occupants (Residents or employees) of the land.
• Any empirical case study.
6 Design Considerations

6.1 Nolan Street
As discussed in Section 4.2, the concept design proposes to reconfigure the site so that the main vehicle access point for commuter car parking is onto Nolan Street.

6.2 Vehicle Sight Lines
Given the existing road alignment of Nolan Street adjacent to the subject site, a preliminary investigation has been undertaken relating to vehicle sight lines relating to the proposed access point onto Nolan Street.

Nolan Street operates at a posted speed limit of 60 km / hr Austroads Guide to Road Design – Part 4A: Unsignalised and Signalised Intersections specifies the safe intersection sight distance (SISD), and for 60 km / hr roads with a driver reaction time of 1.5 seconds, the recommended SISD is 114 metres.

The proposed site access location provides less than the recommended SISD, due to the meandering nature of Nolan Street as well as nearby topological features (including an embankment to the southwest of the proposed access point).

6.2.1 Options to Improve Vehicle Sight Lines
To improve driver sight lines for the proposed access point onto Nolan Street, the redevelopment of the site should include measures such as (but not limited to) those listed as follows:

> Trim existing street trees and bushes;
> Warning signage such as “concealed driveway”;
> Ban on-street parking along Nolan Street near the proposed access point;
> Introduction of a central painted median along Nolan Street (with a view to reducing through lane widths, encouraging slower driver speeds);
> Introduced reduced speed limits of 50km/h along Nolan Street near the proposed site access point; and
> Relocate the proposed access point further north-west to increase driver sight lines.

6.3 Internal Access Road
The internal access road has a cross section of approximately 10 metres, and has been designed to accommodate up to a 14.5m bus to provide for the potential future bus interchange located north of the rail track.

6.4 Car Parking
A multi-level car park is contemplated as part of the master plan to provide car parking for the commercial components of the site. The layout and operation of this car park will be further investigated as part of the detailed design, with a view to be provided in accordance with the requirements of the Australian Standard for off-street parking (AS/NZS 2890.1:2004) and Clause 52.06 of the Planning Scheme. The following general items should be considered as part of the design process:

> Design of car park access points and internal access roads to allow for adequate circulation;
> Car parking modules to meet the dimension requirements of the relevant standards;
> Car park ramps to be graded suitably to prevent vehicles scraping;
> Adequate head height clearances to be provided throughout the car park;
> Consideration of pedestrian and cyclist amenity throughout the car park; and
> Provision of adequate visibility for drivers, pedestrians and cyclists in and around the car parking facility.
7 Traffic Considerations

7.1 Potential Nolan Street Access Point

The existing traffic generated by the northern car park, as well as the car and bus movements associated with the southern car park are proposed to be re-directed to a new access point onto Nolan Street, in order to model the operation of this proposed access point.

It has been assumed that vehicles currently entering the site via the north or south via Lydiard Street have been assumed to travel both east and west at a 50/50 split at the potential access point onto Nolan Street. The anticipated post-development volumes are shown in Table 7-1.

<table>
<thead>
<tr>
<th>AM Peak – Anticipated Post Development Volumes – Site Access</th>
<th>PM Peak – Anticipated Post Development Volumes – Site Access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nolan Street (SE)</td>
<td>0.20</td>
</tr>
<tr>
<td>Nolan Street (NW)</td>
<td>0.19</td>
</tr>
<tr>
<td>Site Access (SW)</td>
<td>0.13</td>
</tr>
<tr>
<td>Nolan Street (SE)</td>
<td>0.17</td>
</tr>
<tr>
<td>Nolan Street (NW)</td>
<td>0.24</td>
</tr>
<tr>
<td>Site Access (SW)</td>
<td>0.44</td>
</tr>
</tbody>
</table>

7.2 Intersection Operation

The estimated post redevelopment traffic movements have been analysed using SIDRA Intersection, and the subsequent results are shown in Table 7-2.

<table>
<thead>
<tr>
<th>Approach</th>
<th>Degree of Saturation</th>
<th>95th%ile Queue (metres)</th>
<th>95th%ile Queue (cars)</th>
<th>Average Delay (seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM Peak</td>
<td>Nolan Street (SE)</td>
<td>0.20</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>Nolan Street (NW)</td>
<td>0.19</td>
<td>4.5</td>
<td>0.6</td>
</tr>
<tr>
<td></td>
<td>Site Access (SW)</td>
<td>0.13</td>
<td>3.2</td>
<td>0.4</td>
</tr>
<tr>
<td>PM Peak</td>
<td>Nolan Street (SE)</td>
<td>0.17</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>Nolan Street (NW)</td>
<td>0.24</td>
<td>3.4</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td>Site Access (SW)</td>
<td>0.44</td>
<td>16.3</td>
<td>2.3</td>
</tr>
</tbody>
</table>

The above results indicate a maximum of 1 car is expected to be queuing to turn left or right into the subject site during both the AM and PM peak periods, with a minimal average delay of approximately 1-2 seconds. Based on the foregoing analysis, it is concluded that dedicated stand up turn lanes are not required along Nolan Street from a traffic impact perspective.
7.3 Potential Modifications to Lydiard Street Access Point

The concept designs allocate approximately 136 car spaces for the commercial component of the development within a multi-deck car park accessed via a new crossover onto Lydiard Street.

For the purposes of this assessment, it has been assumed that 50% of these spaces will turnover during the peak periods, evenly split between inbound and outbound movements. Furthermore, it is assumed that the traffic will travel to the north and south along Lydiard Street with a 50/50 split. The anticipated post-development volumes are shown in Table 7-3.

### Table 7-3 Proposed Lydiard Street Access Point

<table>
<thead>
<tr>
<th>AM Peak – Anticipated Post Development Volumes – Site Access</th>
<th>PM Peak – Anticipated Post Development Volumes – Site Access</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM Peak: Lydiard Street (S) 0.13 1.6 0.2 0.9</td>
<td>PM Peak: Lydiard Street (S) 0.22 1.5 0.2 0.4</td>
</tr>
<tr>
<td>Site Access (E) 0.09 2.2 0.3 12.6</td>
<td>Site Access (E) 0.10 2.3 0.3 13.2</td>
</tr>
<tr>
<td>Lydiard Street (N) 0.22 0.0 0.0 0.3</td>
<td>Lydiard Street (N) 0.16 0.0 0.0 0.3</td>
</tr>
</tbody>
</table>

The above results indicate that a maximum of 1 car is expected to be queuing to turn left or right into the subject site during both the AM and PM peak periods. Based on the foregoing analysis, it is concluded that dedicated stand up turn lanes are not required along Lydiard Street North from a traffic impact perspective.

7.4 Intersection Operation

The estimated post redevelopment traffic movements have been analysed using SIDRA Intersection, and the subsequent results are shown in Table 7-4.

### Table 7-4 Proposed Access / Nolan Street Intersection – Post Development Conditions

<table>
<thead>
<tr>
<th>Approach</th>
<th>Degree of Saturation</th>
<th>95th%ile Queue (metres)</th>
<th>95th%ile Queue (cars)</th>
<th>Average Delay (seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM Peak: Lydiard Street (S)</td>
<td>0.13</td>
<td>1.6</td>
<td>0.2</td>
<td>0.9</td>
</tr>
<tr>
<td>AM Peak: Site Access (E)</td>
<td>0.09</td>
<td>2.2</td>
<td>0.3</td>
<td>12.6</td>
</tr>
<tr>
<td>AM Peak: Lydiard Street (N)</td>
<td>0.22</td>
<td>0.0</td>
<td>0.0</td>
<td>0.3</td>
</tr>
<tr>
<td>PM Peak: Lydiard Street (S)</td>
<td>0.22</td>
<td>1.5</td>
<td>0.2</td>
<td>0.4</td>
</tr>
<tr>
<td>PM Peak: Site Access (E)</td>
<td>0.10</td>
<td>2.3</td>
<td>0.3</td>
<td>13.2</td>
</tr>
<tr>
<td>PM Peak: Lydiard Street (N)</td>
<td>0.16</td>
<td>0.0</td>
<td>0.0</td>
<td>0.3</td>
</tr>
</tbody>
</table>

The above results indicate that a maximum of 1 car is expected to be queuing to turn left or right into the subject site during both the AM and PM peak periods. Based on the foregoing analysis, it is concluded that dedicated stand up turn lanes are not required along Lydiard Street North from a traffic impact perspective.

7.5 Surrounding Road Network

Based on the foregoing, it is expected the distribution of traffic via Lydiard Street North and Nolan Street will help to ease congestion within the Station Precinct and surrounds.

As detailed in Section 3.3, the key surrounding 3 intersections (Peel Street / Scott Parade, Neill Street / Nolan Street and Lydiard Street / Seymour Street) operate under “excellent” conditions. It is noted that the existing commuter traffic is already included within the surveyed existing volumes. Consequently, the results demonstrate that these intersections have significant capacity for additional traffic.
The traffic associated with the proposed redevelopment is anticipated to be comfortably accommodated by the surrounding road network. Future volumes on Nolan Street and Lydiard Street North are expected to remain below 7,000 vehicles per day suggested within Clause 56 of the Ballarat Planning Scheme for connector streets.
8 Bicycle Parking Considerations

8.1 Commuter Bicycle Parking

Ballarat Station currently provides on-site bicycle parking facilities, as shown in Figure 8-1 and Figure 8-2. It is recommended that the existing level of commuter bicycle parking provided on-site is retained post-development.

Figure 8-1 Existing Bicycle Cage
8.2 Commercial Bicycle Parking

Clause 52.34 of the Ballarat Planning Scheme specifies bicycle parking provision requirements for each commercial component of the proposed development as shown in Table 8-1.

Subject to consultation with the relevant Planning Responsible Authority, the proposed development is expected to provide an appropriate level of bicycle parking to meet the likely demands generated by the proposal.

Table 8-1 Planning Scheme Bicycle Parking Requirements – Clause 52.34

<table>
<thead>
<tr>
<th>Use</th>
<th>Parking Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential Hotel (Residential Building other than listed)</td>
<td>1 to each 10 lodging rooms for employees&lt;br&gt;1 to each 10 lodging rooms for visitors</td>
</tr>
<tr>
<td>Retail (Shop)</td>
<td>1 space per 600m$^2$ for employees&lt;br&gt;1 space per 500m$^2$ for visitors</td>
</tr>
<tr>
<td>Restaurant</td>
<td>1 space per 100m$^2$ for employees&lt;br&gt;2 plus 1 space per 200 m$^2$ if the floor area exceeds 400m$^2$ for visitors</td>
</tr>
<tr>
<td>Café</td>
<td>1 space per 100m$^2$ for employees&lt;br&gt;1 space per 50 m$^2$ for visitors</td>
</tr>
<tr>
<td>Function Centre</td>
<td>1 per 1500m$^2$ for employees&lt;br&gt;2 plus 1 per 1500m$^2$ for visitors</td>
</tr>
</tbody>
</table>
9 Loading Considerations

Clause 52.07 of the Ballarat Planning Scheme outlines the requirements for the loading and unloading of vehicles, and specifies loading requirements for developments which include the manufacture, servicing, storage or sale of goods or materials.

As a mixed use commercial facility, the proposed development generates a statutory requirement for loading facilities.

 Clause 52.07 of the Ballarat Planning Scheme outlines the requirements for the loading and unloading of vehicles. It specifies that:

> No building or works may be constructed for the manufacture, servicing, storage or sale of goods or materials unless:

> Space is provided on the land for loading and unloading vehicles as specified in Table 9-1;

> The driveway that provides access to the loading bay is at least 3.6 metres wide.

Table 9-1 Planning Scheme Loading Requirements – Clause 52.07

<table>
<thead>
<tr>
<th>Floor Area of Building</th>
<th>Minimum Loading Bay Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,600 m² or less in single operation</td>
<td>Area 27.4 m²</td>
</tr>
<tr>
<td></td>
<td>Length 7.6 m</td>
</tr>
<tr>
<td></td>
<td>Width 3.6 m</td>
</tr>
<tr>
<td></td>
<td>Height clearance 4.0 m</td>
</tr>
<tr>
<td>For every additional 1,800 m² or part</td>
<td>Additional 18 m²</td>
</tr>
</tbody>
</table>

Any redevelopment of the site will need to include loading facilities to service the commercial uses. The concept design includes provision for loading facilities to the north-east of the hotel, which will be capable of meeting the above Planning Scheme requirements.
10 Conclusions / Recommendations

Based on the reference scheme and foregoing assessment, it is concluded that:

> The site has excellent access to a range of public transport services providing viable alternatives to the private motor vehicle for commuters;
> Site layout and internal roads should be designed to maximise car parking efficiency;
> The train station redevelopment should allow for future relocation of the bus interchange;
> Given the availability of on-street car parking, some reliance on off-site parking is considered appropriate;
> It is recommended that any development must ensure there is no net loss of commuter car spaces as a result of the proposed development;
> The driver sightline at the proposed access point onto Nolan Street can be improved with tree trimming, local area traffic management, and a reduce speed limit.
> The existing on-site car parks currently generate in the order of 150-250 vehicle movements during the peak periods;
> Based on the traffic queue survey at the railway crossing, the traffic queues on Lydiard Street North during the peak periods are manageable;
> Based on existing site operation characteristics and the proposed design concept, traffic generated by a similar type and scale of development is not expected to have a noticeable impact on the operation of the surrounding road network;
> The proposed access point for the commercial car park via Lydiard Street North is projected to generate minimal traffic movements during the peak periods, and will operate in the “excellent” category, with minimal queues and delays;
> The proposed access point to Nolan Street also will operate in the “excellent” category, with minimal queues and delays;
> Traffic volumes generated by a similar type and scale of development to the surrounding local road network are expected to remain below the daily traffic volumes suggested within Clause 56 of the Ballarat Planning Scheme;
> Distribution of traffic via Lydiard Street North and Nolan Street will help to ease congestion within the Station Precinct and surrounds; and
> The analysed intersections in the vicinity of the Ballarat Train Station operate in the “excellent” category, with minimal queues and delays.
Appendix B: Development Plans
OVERALL CONCEPT MASTERPLAN

- PUBLIC PLAZA
- INTERNAL ROAD
- HOTEL & GOODS SHED COURTYARD
- GOODS SHED
- HOTEL
- CAR PARK
- MULTI-DECK CAR PARK
- FUTURE BUS TERMINAL
- FUTURE TAXI DROP-OFF

NOT PART OF SCOPE OF WORKS:
NOTE: DESIGN DEVELOPMENT PROCESS MAY NECESSITATE
MINOR DIMENSIONAL CHANGES TO FLOOR PLANS
PARKING SUMMARY

L1 = 136 SPACES
L2 = 136 SPACES
272 TOTAL CAR PARKING SPACES
MULTI DECK CAR PARK LEVEL 2

PARKING LEVEL 2
136 PARKING SPACES
AREA = 3695 SQM

RAMP DOWN TO LEVEL 1

FIRE EXIT 1

FIRE EXIT 2

FIRE EXIT 3

1:250 A3
Appendix C:
SIDRA Output
Site: Lydiard Street/Station Access Road Signalised Intersection - AM Peak

Lydiard Street/Station Access Road Signalised Intersection
AM Peak
Signals - Fixed Time Isolated Cycle Time = 70 seconds (User-Given Cycle Time)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

### Movement Performance - Vehicles

<table>
<thead>
<tr>
<th>Mov ID</th>
<th>OD Mov</th>
<th>Demand Flows Total veh/h</th>
<th>HV %</th>
<th>Deg. Satn v/c</th>
<th>Average Delay sec</th>
<th>Level of Service</th>
<th>95% Back of Queue Veh</th>
<th>Queue Distance m</th>
<th>Prop. Queued</th>
<th>Effective Stop Rate per veh</th>
<th>Average Speed km/h</th>
</tr>
</thead>
<tbody>
<tr>
<td>South: Lydiard Street (S)</td>
<td>2 T1</td>
<td>214</td>
<td>3.0</td>
<td>0.182</td>
<td>6.3</td>
<td>LOS A</td>
<td>3.1</td>
<td>22.6</td>
<td>0.46</td>
<td>0.39</td>
<td>54.4</td>
</tr>
<tr>
<td>Approach</td>
<td>214</td>
<td>3.0</td>
<td>0.182</td>
<td>6.3</td>
<td>LOS A</td>
<td>3.1</td>
<td>22.6</td>
<td>0.46</td>
<td>0.39</td>
<td>54.4</td>
<td></td>
</tr>
<tr>
<td>East: Station Access Road (W)</td>
<td>4 L2</td>
<td>39</td>
<td>3.0</td>
<td>0.200</td>
<td>30.5</td>
<td>LOS C</td>
<td>2.2</td>
<td>16.1</td>
<td>0.86</td>
<td>0.75</td>
<td>39.2</td>
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<tr>
<td>6 R2</td>
<td>39</td>
<td>3.0</td>
<td>0.200</td>
<td>30.5</td>
<td>LOS C</td>
<td>2.2</td>
<td>16.1</td>
<td>0.86</td>
<td>0.75</td>
<td>39.0</td>
<td></td>
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<tr>
<td>Approach</td>
<td>78</td>
<td>3.0</td>
<td>0.200</td>
<td>30.5</td>
<td>LOS C</td>
<td>2.2</td>
<td>16.1</td>
<td>0.86</td>
<td>0.75</td>
<td>39.1</td>
<td></td>
</tr>
<tr>
<td>North: Lydiard Street (N)</td>
<td>7 L2</td>
<td>78</td>
<td>3.0</td>
<td>0.210</td>
<td>12.0</td>
<td>LOS B</td>
<td>3.6</td>
<td>26.1</td>
<td>0.47</td>
<td>0.50</td>
<td>51.5</td>
</tr>
<tr>
<td>8 T1</td>
<td>411</td>
<td>3.0</td>
<td>0.210</td>
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<td>LOS A</td>
<td>3.7</td>
<td>26.5</td>
<td>0.47</td>
<td>0.44</td>
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<tr>
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<td>LOS A</td>
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<td>26.5</td>
<td>0.51</td>
<td>0.46</td>
<td>51.7</td>
<td></td>
</tr>
</tbody>
</table>

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

### Movement Performance - Pedestrians

<table>
<thead>
<tr>
<th>Mov ID</th>
<th>Description</th>
<th>Demand Flow ped/h</th>
<th>Average Delay sec</th>
<th>Level of Service</th>
<th>Average Back of Pedestrian ped</th>
<th>Queue Distance m</th>
<th>Prop. Queued</th>
<th>Effective Stop Rate per ped</th>
</tr>
</thead>
<tbody>
<tr>
<td>P2</td>
<td>East Full Crossing</td>
<td>53</td>
<td>7.8</td>
<td>LOS A</td>
<td>0.0</td>
<td>0.0</td>
<td>0.47</td>
<td>0.47</td>
</tr>
<tr>
<td>All Pedestrians</td>
<td>53</td>
<td>7.8</td>
<td>LOS A</td>
<td>0.47</td>
<td>0.47</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.
MOVEMENT SUMMARY

Site: Lydiard Street/Station Access Road Signalised Intersection - PM Peak

Lydiard Street/Station Access Road Signalised Intersection
PM Peak
Signals - Fixed Time Isolated Cycle Time = 70 seconds (User-Given Cycle Time)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

### Movement Performance - Vehicles

<table>
<thead>
<tr>
<th>Mov ID</th>
<th>OD Mov</th>
<th>Demand Flows</th>
<th>Deg. Satn</th>
<th>Average Delay</th>
<th>Level of Service</th>
<th>95% Back of Queue Distance</th>
<th>Prop. Queued</th>
<th>Effective Stop Rate per veh</th>
<th>Average Speed km/h</th>
</tr>
</thead>
<tbody>
<tr>
<td>South: Lydiard Street (S)</td>
<td>2</td>
<td>T1</td>
<td>395</td>
<td>3.0</td>
<td>0.301</td>
<td>4.7</td>
<td>LOS A</td>
<td>5.3</td>
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</tr>
<tr>
<td>Approach</td>
<td>395</td>
<td>3.0</td>
<td>0.301</td>
<td>4.7</td>
<td>LOS A</td>
<td>5.3</td>
<td>38.0</td>
<td>0.42</td>
<td>0.37</td>
</tr>
<tr>
<td>East: Station Access Road (W)</td>
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<td>L2</td>
<td>39</td>
<td>3.0</td>
<td>0.300</td>
<td>35.9</td>
<td>LOS D</td>
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<td>18.0</td>
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<tr>
<td>6</td>
<td>R2</td>
<td>39</td>
<td>3.0</td>
<td>0.300</td>
<td>35.9</td>
<td>LOS D</td>
<td>2.5</td>
<td>18.0</td>
<td>0.93</td>
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<tr>
<td>Approach</td>
<td>78</td>
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<td>LOS D</td>
<td>2.5</td>
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<tr>
<td>North: Lydiard Street (N)</td>
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<td>L2</td>
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<td>0.143</td>
<td>9.7</td>
<td>LOS A</td>
<td>2.2</td>
<td>15.5</td>
</tr>
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<td>8</td>
<td>T1</td>
<td>294</td>
<td>3.0</td>
<td>0.143</td>
<td>4.1</td>
<td>LOS A</td>
<td>2.2</td>
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<td>0.37</td>
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<td>Approach</td>
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<tr>
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<td>38.0</td>
<td>0.45</td>
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</tbody>
</table>

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

### Movement Performance - Pedestrians

<table>
<thead>
<tr>
<th>Mov ID</th>
<th>Description</th>
<th>Demand Flow ped/h</th>
<th>Average Delay sec</th>
<th>Level of Service</th>
<th>Average Back of Queue Distance m</th>
<th>Prop. Queued</th>
<th>Effective Stop Rate per ped</th>
</tr>
</thead>
<tbody>
<tr>
<td>P2</td>
<td>East Full Crossing</td>
<td>53</td>
<td>5.6</td>
<td>LOS A</td>
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<tr>
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<td>LOS A</td>
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</tr>
</tbody>
</table>

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.
### MOVEMENT SUMMARY

**Site:** Nolan Street/Station Access Road Intersection AM Peak Stop (Two-Way)

#### Movement Performance - Vehicles

<table>
<thead>
<tr>
<th>Mov ID</th>
<th>OD Mov</th>
<th>Demand Flows</th>
<th>Deg. Satn</th>
<th>Average Delay</th>
<th>Level of Service</th>
<th>95% Back of Queue</th>
<th>Prop. Queued</th>
<th>Effective Stop Rate</th>
<th>Average Speed</th>
<th>Total HV</th>
<th>Vehicles Distance</th>
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<tbody>
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<td>Total veh/h</td>
<td>v/c</td>
<td>sec</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>km/h</td>
<td>veh</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South: Station Access Road (S)</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<td>LOS B</td>
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<td>0.48</td>
<td>0.93</td>
<td>50.0</td>
</tr>
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<td>East: Nolan Street (E)</td>
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<td></td>
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<tr>
<td>4</td>
<td>L2</td>
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<td>0.00</td>
<td>0.06</td>
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</tr>
<tr>
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<td>R2</td>
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<td>1.9</td>
<td>0.03</td>
<td>0.15</td>
<td>58.2</td>
</tr>
</tbody>
</table>

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.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.


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

**Site:** Nolan Street/Station Access Road Intersection PM Peak

Stop (Two-Way)

<table>
<thead>
<tr>
<th>Movement Performance - Vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mov</strong></td>
</tr>
<tr>
<td>--------</td>
</tr>
<tr>
<td><strong>South: Station Access Road (S)</strong></td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td><strong>Approach</strong></td>
</tr>
<tr>
<td><strong>East: Nolan Street (E)</strong></td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td><strong>Approach</strong></td>
</tr>
<tr>
<td><strong>West: Nolan Street (W)</strong></td>
</tr>
<tr>
<td>11</td>
</tr>
<tr>
<td>12</td>
</tr>
<tr>
<td><strong>Approach</strong></td>
</tr>
<tr>
<td><strong>All Vehicles</strong></td>
</tr>
</tbody>
</table>

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.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.


HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Appendix D:
Possible Future Station Access
Road/Nolan Street Intersection
Possible Future Signalised Intersection
Station Access Road/Nolan Street

As a consequence of the suggested reduction in the speed limit for Nolan Street and restricted sight distance, it may be desirable to consider controlling the Station Access Road/Nolan Street intersection in the future when the bus terminus is constructed to the north of the station.

Accordingly, while not part of the proposed development application, we have assessed a possible signalisation of the Station Access Road/Nolan Street intersection. At this location, Nolan Street is constrained by the embankment on the railway land on one side and heritage bluestone gutters and street trees on the other. Therefore, a minimum treatment only has been assessed whereby each movement would have a separate phase. This arrangement works satisfactorily as the predicted volumes are low but requires two stand-up lanes to be provided on the development site. A copy of the Functional Layout Plan is included in this Appendix (Ref: G21581-A-01) and allows for the manoeuvring requirements of a 14.5 metre coach.

A SIDRA analysis for the signalised intersection has been undertaken (based on a 90 second cycle time) and the results are summarised in Table D1 below. (The full SIDRA output is also included in this Appendix.)

<table>
<thead>
<tr>
<th>Approach</th>
<th>Degree of Saturation</th>
<th>Average Delay (sec)</th>
<th>95th Percentile Queue</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AM</td>
<td>PM</td>
<td>AM</td>
</tr>
<tr>
<td>Station Access Road (S)</td>
<td>0.261</td>
<td>0.538</td>
<td>51.4 sec</td>
</tr>
<tr>
<td>Nolan Street (E)</td>
<td>0.512</td>
<td>0.586</td>
<td>22.6 sec</td>
</tr>
<tr>
<td>Nolan Street (W)</td>
<td>0.503</td>
<td>0.593</td>
<td>27.8 sec</td>
</tr>
</tbody>
</table>

Table D1 indicates that this minimum treatment signalised intersection of Station Access Road/Nolan Street would operate well within acceptable limits based on separate phases for each movement and two stand-up lanes on the development site.
## MOVEMENT SUMMARY

**Site: Nolan Street/Station Access Road Signalised Intersection AM Peak**

Nolan Street/Station Road Signalised Intersection  
AM Peak  
Signals - Fixed Time Isolated  
Cycle Time = 90 seconds (User-Given Cycle Time)  
Variable Sequence Analysis applied. The results are given for the selected output sequence.

### Movement Performance - Vehicles

<table>
<thead>
<tr>
<th>Mov ID</th>
<th>OD Mov</th>
<th>Demand Flows</th>
<th>Deg. Satn</th>
<th>Average Delay</th>
<th>Level of Service</th>
<th>95% Back of Queue Distance</th>
<th>Prop. Queued</th>
<th>Effective Stop Rate</th>
<th>Average Speed</th>
<th>Total HV Vehicles Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Total wv/h</td>
<td>HV %</td>
<td>veh/c</td>
<td>sec</td>
<td>veh</td>
<td>m</td>
<td>per veh</td>
<td>km/h</td>
<td>veh</td>
</tr>
<tr>
<td>South: Station Access Road (S)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>L2</td>
<td>26 3.0</td>
<td>0.261</td>
<td>53.0</td>
<td>LOS D</td>
<td>1.2</td>
<td>8.6</td>
<td>0.99</td>
<td>0.71</td>
<td>31.6</td>
</tr>
<tr>
<td>3</td>
<td>R2</td>
<td>25 3.0</td>
<td>0.179</td>
<td>49.7</td>
<td>LOS D</td>
<td>1.1</td>
<td>7.9</td>
<td>0.97</td>
<td>0.71</td>
<td>32.2</td>
</tr>
<tr>
<td>Approach</td>
<td></td>
<td>52 3.0</td>
<td>0.261</td>
<td>51.4</td>
<td>LOS D</td>
<td>1.2</td>
<td>8.6</td>
<td>0.98</td>
<td>0.71</td>
<td>31.9</td>
</tr>
<tr>
<td>East: Nolan Street (E)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>4</td>
<td>L2</td>
<td>42 3.0</td>
<td>0.512</td>
<td>27.6</td>
<td>LOS C</td>
<td>12.9</td>
<td>92.4</td>
<td>0.81</td>
<td>0.71</td>
<td>42.8</td>
</tr>
<tr>
<td>5</td>
<td>T1</td>
<td>345 3.0</td>
<td>0.512</td>
<td>22.0</td>
<td>LOS C</td>
<td>12.9</td>
<td>92.4</td>
<td>0.81</td>
<td>0.71</td>
<td>43.8</td>
</tr>
<tr>
<td>Approach</td>
<td></td>
<td>387 3.0</td>
<td>0.512</td>
<td>22.6</td>
<td>LOS C</td>
<td>12.9</td>
<td>92.4</td>
<td>0.81</td>
<td>0.71</td>
<td>43.6</td>
</tr>
<tr>
<td>West: Nolan Street (W)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>T1</td>
<td>253 3.0</td>
<td>0.503</td>
<td>26.8</td>
<td>LOS C</td>
<td>11.0</td>
<td>79.1</td>
<td>0.86</td>
<td>0.75</td>
<td>41.2</td>
</tr>
<tr>
<td>12</td>
<td>R2</td>
<td>55 3.0</td>
<td>0.503</td>
<td>32.3</td>
<td>LOS C</td>
<td>11.0</td>
<td>79.1</td>
<td>0.86</td>
<td>0.75</td>
<td>40.2</td>
</tr>
<tr>
<td>Approach</td>
<td></td>
<td>307 3.0</td>
<td>0.503</td>
<td>27.8</td>
<td>LOS C</td>
<td>11.0</td>
<td>79.1</td>
<td>0.86</td>
<td>0.75</td>
<td>41.0</td>
</tr>
<tr>
<td>All Vehicles</td>
<td></td>
<td>746 3.0</td>
<td>0.512</td>
<td>26.7</td>
<td>LOS C</td>
<td>12.9</td>
<td>92.4</td>
<td>0.84</td>
<td>0.73</td>
<td>41.5</td>
</tr>
</tbody>
</table>

Level of Service (LOS) Method: Delay (HCM 2000).  
Vehicle movement LOS values are based on average delay per movement.  
Intersection and Approach LOS values are based on average delay for all vehicle movements.  
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.  
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

### Movement Performance - Pedestrians

<table>
<thead>
<tr>
<th>Mov ID</th>
<th>Description</th>
<th>Demand Flow ped/h</th>
<th>Average Delay sec</th>
<th>Level of Service</th>
<th>Average Back of Queue Distance m</th>
<th>Prop. Queued</th>
<th>Effective Stop Rate per ped</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>South Full Crossing</td>
<td>53</td>
<td>22.1</td>
<td>LOS C</td>
<td>0.1</td>
<td>0.70</td>
<td>0.70</td>
</tr>
<tr>
<td>P4</td>
<td>West Full Crossing</td>
<td>53</td>
<td>39.3</td>
<td>LOS D</td>
<td>0.1</td>
<td>0.94</td>
<td>0.94</td>
</tr>
<tr>
<td>All Pedestrians</td>
<td></td>
<td>105</td>
<td>30.7</td>
<td>LOS D</td>
<td>0.82</td>
<td>0.82</td>
<td></td>
</tr>
</tbody>
</table>

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)  
Pedestrian movement LOS values are based on average delay per pedestrian movement.  
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.
## MOVEMENT SUMMARY

### Site: Nolan Street/Station Access Road Signalised Intersection PM Peak

Nolan Street/Station Road Signalised Intersection  
PM Peak  
Signals - Fixed Time Isolated  
Cycle Time = 90 seconds (User-Given Cycle Time)  
Variable Sequence Analysis applied. The results are given for the selected output sequence.

### Movement Performance - Vehicles

<table>
<thead>
<tr>
<th>Mov ID</th>
<th>OD Mov</th>
<th>Demand Flows Total veh/h</th>
<th>HV %</th>
<th>Deg. Satn v/c</th>
<th>Average Delay sec</th>
<th>Level of Service</th>
<th>95% Back of Queue Distance m</th>
<th>Prop. Queued</th>
<th>Effective Stop Rate per veh</th>
<th>Average Speed km/h</th>
</tr>
</thead>
<tbody>
<tr>
<td>South: Station Access Road (S)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>L2</td>
<td>98</td>
<td>3.0</td>
<td>0.538</td>
<td>49.5</td>
<td>LOS D</td>
<td>4.3</td>
<td>31.1</td>
<td>0.99</td>
<td>0.78</td>
</tr>
<tr>
<td>3</td>
<td>R2</td>
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<td>0.76</td>
</tr>
<tr>
<td>Approach</td>
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<td>3.0</td>
<td>0.538</td>
<td>48.0</td>
<td>LOS D</td>
<td>4.3</td>
<td>31.1</td>
<td>0.98</td>
<td>0.77</td>
<td>32.9</td>
</tr>
<tr>
<td>East: Nolan Street (E)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>L2</td>
<td>36</td>
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<td>0.586</td>
<td>34.7</td>
<td>LOS C</td>
<td>12.5</td>
<td>89.9</td>
<td>0.90</td>
<td>0.78</td>
</tr>
<tr>
<td>5</td>
<td>T1</td>
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<td>0.586</td>
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<td>LOS C</td>
<td>12.5</td>
<td>89.9</td>
<td>0.90</td>
<td>0.78</td>
</tr>
<tr>
<td>Approach</td>
<td>332</td>
<td>3.0</td>
<td>0.586</td>
<td>29.7</td>
<td>LOS C</td>
<td>12.5</td>
<td>89.9</td>
<td>0.90</td>
<td>0.78</td>
<td>40.2</td>
</tr>
<tr>
<td>West: Nolan Street (W)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>11</td>
<td>T1</td>
<td>386</td>
<td>3.0</td>
<td>0.593</td>
<td>24.3</td>
<td>LOS C</td>
<td>15.1</td>
<td>108.3</td>
<td>0.86</td>
<td>0.76</td>
</tr>
<tr>
<td>12</td>
<td>R2</td>
<td>40</td>
<td>3.0</td>
<td>0.593</td>
<td>29.8</td>
<td>LOS C</td>
<td>15.1</td>
<td>108.3</td>
<td>0.86</td>
<td>0.76</td>
</tr>
<tr>
<td>Approach</td>
<td>426</td>
<td>3.0</td>
<td>0.593</td>
<td>24.8</td>
<td>LOS C</td>
<td>15.1</td>
<td>108.3</td>
<td>0.86</td>
<td>0.76</td>
<td>42.5</td>
</tr>
<tr>
<td>All Vehicles</td>
<td>929</td>
<td>3.0</td>
<td>0.593</td>
<td>30.8</td>
<td>LOS C</td>
<td>15.1</td>
<td>108.3</td>
<td>0.90</td>
<td>0.77</td>
<td>39.6</td>
</tr>
</tbody>
</table>

**Level of Service (LOS) Method: Delay (HCM 2000).**  
Vehicle movement LOS values are based on average delay per movement  
Intersection and Approach LOS values are based on average delay for all vehicle movements.  
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.  
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

### Movement Performance - Pedestrians

<table>
<thead>
<tr>
<th>Mov ID</th>
<th>Description</th>
<th>Demand Flow ped/h</th>
<th>Average Delay sec</th>
<th>Level of Service</th>
<th>Average Back of Pedestrian ped</th>
<th>Queue Distance m</th>
<th>Prop. Queued</th>
<th>Effective Stop Rate per ped</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>South Full Crossing</td>
<td>53</td>
<td>28.9</td>
<td>LOS C</td>
<td>0.1</td>
<td>0.1</td>
<td>0.80</td>
<td>0.80</td>
</tr>
<tr>
<td>P4</td>
<td>West Full Crossing</td>
<td>53</td>
<td>39.3</td>
<td>LOS D</td>
<td>0.1</td>
<td>0.1</td>
<td>0.94</td>
<td>0.94</td>
</tr>
<tr>
<td>All Pedestrians</td>
<td>105</td>
<td>34.1</td>
<td>LOS D</td>
<td>0.87</td>
<td>0.87</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay).**  
Pedestrian movement LOS values are based on average delay per pedestrian movement.  
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.