JACOBS

Woden Bus Interchange and Road Layout Modifications

Transport Canberra

Preliminary Sketch Plan Report (Final)

IS26800-RP-RD-004 | Rev02

28 August 2019

TCLR-201-BRI-0006

Document history and status

Revision	Date	Description	By	Review	Approved
01	05/07/2019	Draft Preliminary Sketch Plan	[redacted]	[redacted]	[redacted]
02	28/08/2019	Final Preliminary Sketch Plan	[redacted]	[redacted]	[redacted]

Distribution of copies

Revision	Issue approved	Date issued	Issued to	Comments

Woden Bus Interchange and Road Layout Modifications

Project No:	IS268800
Document Title:	Preliminary Sketch Plan Report
Document No.:	IS26800-RP-RD-004
Revision:	Rev02
Date:	23 August 2019
Client Name:	Transport Canberra
Client No:	TCLR-201-BRI-0006
Project Manager:	Schedule 2.2(a)(ii) [redacted]
Author:	Schedule 2.2(a)(ii) [redacted]
File Name:	IS268800-RP-RD-004_PSP Design Report_Rev02.docx

Jacobs Group (Australia) Pty Limited
ABN 37 001 024 095
1/64 Allara Street,
Canberra City ACT 2600
PO Box 237, Civic Square ACT 2608
Australia
T +61 2 6246 2700
F +61 2 6246 2799
www.jacobs.com

Contents

Executive Summary

Jacobs has been engaged by Transport Canberra (TC) to conduct an options study and assessment, feasibility investigations and Preliminary Sketch Plan for a new on-street bus interchange in Woden Town Centre. The bus interchange should be able to operate independently of and integrate with the anticipated Woden light rail terminus which is proposed to be constructed as part of the Canberra Light Rail City to Woden (C2W) project.

The objective of the project is to create a vibrant Woden Town Centre, accommodate growth, and create strong bus and Light Rail connections to Canberra city centre. This work should support the transport objectives of the Woden Town Centre Master Plan, which are:

- Safer pedestrian and cycle connections into the city centre;
- A more convenient, safe and attractive bus interchange;
- A reserved corridor for rapid transit that reaches into the town centre; and
- To ensure the centre is accessible by car.

The project needs to balance the public transport needs and planning requirements with the urban design impacts and outcomes. A full understanding of the urban design considerations and the inter-relationships between the Light Rail, Bus interchange, adjacent commercial business and the needs and safety of the users of Woden Town Centre is vital to the success of the development of this project.

During the previous stage, the Concept Design stage, Jacobs has explored and reviewed with the different stakeholders several options through an extensive multi criteria analysis. **Option 3 Alternative Light Rail Alignment with the relocated Bradley Street** was chosen as the preferred option, this option is in line with the Woden Town Center Master Plan Review and Bus Interchange Strategy (**Arup Hassel October 2017**).

As directed by Transport Canberra, Jacobs has further explored the merits of retaining Bradley Street in its existing location as compared to relocating Bradley Street to the north, as depicted in the Woden Town Centre Master Plan. The recommendation of the study is that Bradley Street should be retained in its current location, subject to modifications to allow its integration into the works planned by the Woden Transport Hub, the current setting and context of the Woden Town Centre and the future development aspirations of the precinct.

The PSP scope has developed the amended **Option 3 Alternative Light Rail Alignment with retaining Bradley Street**.

Several studies have been completed at this stage to feed into the design including

- Traffic analysis and modelling
- Desktop geotechnical investigations
- Services review
- Pavement Option Review
- Light Rail Geometry Review
- Layover Option study
- Air Quality and Noise Assessment
- Woden Precinct Planning Report

Next Steps

Many unresolved issues that are still pending to be resolved in the next stages of the project – these are detailed in Section 10, this however can be summarised in:

- Completion of the consultation process to confirm design criteria, project boundaries and interfaces issues

- Confirmation of all design assumptions.
- Carry out a more comprehensive traffic counting program and traffic modelling to support the findings of the traffic modelling (Refer to Section 9.2).
- Carry out pedestrian traffic modelling (Refer to Section 9.2);
- Further stormwater design elements (Refer to Section 9.3);
- Implementation of WSUD and sustainability approaches ;
- Further utilities design and consultation (Refer to Section 9.4);
- Approvals (Refer to Section 9.5);
- Investigations and assessments (Refer to Section 9.6)
- The amended Light Rail Alignment as documented in the PSP was carried out by Jacobs at high level. The light rail alignment will need to be formalised and the safety of pedestrian movement addressed with the light rail crossing the footing path.

.

1. Introduction

1.1 Background

1.1.1 Overview

Transport Canberra have engaged Jacobs Group (Australia) Pty Ltd (Jacobs) to progress feasibility investigations and design for a new on-street bus interchange in Woden Town Centre to replace the existing Woden Bus Station. This includes required road alternations and alignment with both the City to Woden Light Rail (C2W) project and the objectives of the Woden Town Centre Master Plan (2015).

This investigation has built upon the findings of the Woden Town Centre Master Plan Review (2017) and Interchange Design Strategy. The extent of works is shown in **Figure 1.1**.

1.1.2 Context

An interim Woden Bus Interchange was established on Melrose Drive (across from Phillip Pool) in March 1968. This new interchange was set up due to the commencement of the Woden-City express route. The permanent interchange at Bradley Street, Phillip opened on 4 December 1972. This was one of the first purpose built off-street interchanges in the country. In 1982 the interchange was expanded to cater for new services to Tuggeranong. It was renamed to Woden Bus Station on 15 November 2010. This facility is now at the end of life after 45 years of operation and is in need of replacement.

In recognising the need for a bus interchange replacement at Woden, the ACT Government have committed funding to developing a business case in the 2018-19 budget papers. In addition, Transport Canberra and City Services (TCCS) have committed to undertaking pedestrian and cycling accessibility improvements at the Woden Town Centre as well as implementing the key priorities of the Woden Town Centre Master Plan. The Town Centre will act as both a hub for Southern Canberra's transport network, and as a vibrant town centre for the region.

The bus network in Canberra is evolving as the city continues to grow. In 2019 a new bus network was introduced, the ‘New Network’, that provides enhanced frequency and integration between services. As such, the future Woden Bus Interchange will need to be designed in a way that accommodates both efficient interchange between transport modes and services and is a vibrant environment for the Town Centre.

As such, the key functions that the interchange design must achieve are:

- Facilitate strong bus to bus connections in the short term (5yrs)
- Accommodate growth in the frequency of bus and passenger movements both on road and on platform.
- Facilitate bus to Light Rail connections in the medium term (10yrs)
- Provide strong access to the Town Centre
- Create a vibrant and active place
- Support the ambitions of the Woden Town Centre Master Plan, and
- Be operationally functional, safe and legible to navigate.

1.1.3 Woden Town Centre Masterplan

The *Woden Town Centre Master Plan (2015)* is a strategic policy document which provides a vision, planning principles and spatial framework to guide the development of Woden Town Centre. It highlights five planning principles for the development of Woden Town Centre. These include:

1) Further diversify land use and character precincts;
2) Improve the urban grain, streets and public spaces;

3) Develop a strong community;
4) Provide for pedestrians; and
5) Encourage a built form that positively contributes to the open spaces and streets.

These Planning Principles inform the 10 planning strategies for Woden town centre which are;

1) Improve the centre's sustainability through the design of buildings and the public domain;
2) Encourage buildings that provide a positive interface with the public domain;
3) Provide a well-connected centre for transport and movement;
4) Manage parking to ensure the centre is accessible;
5) Activate and enhance the public domain;
6) Retain sites for future offices and employment;
7) Improve the access to community sport and recreation facilities;
8) Encourage town centre living;
9) Improve connections and character of the Phillip Services Trades Area;
10) Provide a new vision for the Athllon Drive corridor that incorporates residential development and recreations uses.

The proposed on-street bus interchange at Woden aligns with many of these strategies as it provides a positive interface with the public domain and greatly improves the connectivity of transport in the area. It will also help to manage parking demand in the area with less people requiring a car to reach the town centre.

1.1.4 Previous studies

Several studies have been developed prior to this engagement that specifically review the Woden Bus Interchange in relation to the Woden Town Centre Master Plan, including the **ARUP + HASSELL** *City to Woden Light Rail Precinct Report* and the technical report **ARUP *Technical Note.***

The ARUP +HASSEL master plan had been developed to respond to an anticipated retail expansion being contemplated by Westfield. At that time, the ACT Government was keen to pursue a partnership based on the success of previous outcomes achieved elsewhere.

Discussions between Government and Westfield stalled shortly after the ARUP master plan was developed. It is understood from Jacobs discussions during the inter-directorate workshops that the proposed relocation of Bradley Street to the north is no longer being driven by a shopping centre expansion.

Woden Town Centre is experiencing renewal at numerous key sites. Westfield have recently opened the upgraded lifestyle precinct (food catering) south of the site on Bradley Street. Other changes in the urban context of Bradley Street include the approval of a new 26 story development on the former six story Medibank House site, a large precinct regeneration of the A & A Apartment project is due for completion this year.

Jacobs was requested by TC to undertake a high-level review to inform the preferred alignment of Bradley Street to better understand the potential for the blocks created through the design and implementation of works associated with the Woden Bus Interchange.

This Study has determined that Bradley Street should remain in its current location, subject to modifications, to allow its integration into the works planned by the Woden Bus Interchange, the current setting and context of the

Woden Town Centre and the future development aspirations of the precinct. Details of our study is in the memo attached in **Appendix B**.

Figure 1.1: Extent of works

1.2 Concept Options Report

During the previous stage, Jacobs conducted a background review of previous studies in the area, completed a desktop site assessment and Dial Before You Dig investigations.

To facilitate a discussion with key stakeholders, Jacobs facilitated an inter-directorate workshop where eight high-level design options were developed and presented (**Table 1.1**).

Table 1.1: Initial design options for Woden Bus Interchange

Option	Name	Description
Option A	Modified MRCagney Concept	An amended version of the concept provided by MRCagney which features all local bus bays on Callam Street next to the light rail terminal.
Option B	Light Rail Extension	The light rail terminal is extended with platforms positioned south of New Bradley Street. Bus bays remain on Callam Street between Matilda Street and New Bradley Street.
Option C	Light Rail – Bus Shared Space	Light rail and buses share road space to maximise space which can be utilised to provide bus pays and pedestrian concourses.
Option D	Alternative Light Rail Alignment	The light rail alignment diverts to the west to provide enhanced access to Woden Town Centre. Bus bays are located on either side of Callam Street.
Option E	Shared Light Rail Platform	The light rail platform is located centrally within Callam Street with northbound and southbound light rail s sharing the same platform.
Option F	Bus layover on Car Park	A bus layover area is located on the former car park of the Callam Street Offices. Bus bays and light rail alignment remains the same as in Option 1.
Option G	Light Rail on Verges	Light rail platforms are located on the verges of Callam Street.
Option H	Underground Bus Interchange	Locating the bus interchange underground beneath Callam Street. The light rail terminal would remain above ground on Callam Street.

A Multi-Criteria Analysis (MCA) and key criteria were developed with stakeholders and a high-level assessment completed during the workshop. As a result, four shortlisted design options were identified for further investigation. These were renamed as follows:

- Option 1: Modified MRCagney Concept
- Option 2: Light Rail Extension
- Option 3: Alternative Light Rail Alignment
- Option 4: Shared Light Rail Platform

These options were presented once more to Transport Canberra and stakeholders and two preferred options identified. Jacobs were given direction to complete a detailed investigation of the preferred options (Options 3 and 4) in light of traffic, safety, construction, environment, heritage and utility considerations and provide a recommendation on the way to move forward. The investigations determined that both shortlisted options have the following benefits:

- Excellent interchange between bus and light rail;
- Operational efficiency due to independent bus and light rail movement;
- High levels of accessibility through the Woden precinct; and
- Interchange consolidated within close proximity of town centre.

The recommended option was identified as **Option 3: Alternative Light Rail Alignment with the relocated Bradley Street** as per the Woden Town Centre Master Plan.

Jacobs was then requested to explore the merits of retaining Bradley Street in its existing location as compared to relocating Bradley Street to the north, as depicted in the Woden Town Centre Master Plan.

The recommendation of this investigation is that Bradley Street should be retained in its current location, subject to modifications, to allow its integration into the works planned by the Woden Bus Interchange, the current setting and context of the Woden Town Centre and the future development aspirations of the precinct.

The PSP scope has developed the amended **Option 3 Alternative Light Rail Alignment with retaining Bradley Street**.

1.3 Planning Review

The Woden Interchange initial planning review was prepared by Canberra Town Planning for Jacobs. It presents an initial planning review of two shortlisted options for the new Woden Interchange in the Concept Stage, both based on the New Bradley Street. The intention of this planning review is to summarise key planning considerations that are relevant to the options and identify whether the different options have different planning implications. The Woden Town Centre is not designated land, nor is it subject to special conditions, so only the broad planning principles of the national Capital Plan need to be considered. Woden is identified as an urban intensification locality and Adelaide Avenue is identified as a light rail land use investigation area. Overall from a planning perspective, both of the options are considered to be similar.

1.4 Report Structure

Section 1 – Introduction: Provides project background and describes previous phases of design, including future planning.

Section 2 – Investigations and Inputs: Description of the survey data and investigations undertaken to date.

Section 3 – Traffic Studies: Summarises traffic studies undertaken including bus network requirements.

Section 4 – Urban Design and Landscape: Description of the proposed urban design and landscaping approach.

Section 5 – Light Rail Coordination: A summary of the independent light rail geometry review and changes that will be made for Final PSP.

Section 6 – Civil Infrastructure: Description of each civil design discipline within the project including road geometry, pedestrian facilities, stormwater, utilities, pavements, traffic signals, construction staging, and property works.

Section 7 – Layover Facilities: Description of the required layover facilities for the Woden Bus Interchange.

Section 8 – Air Quality and Noise Assessment: A summary of the air quality and noise assessment results.

Section 9 – Items to be addressed in the next stage: Items that did not form part of the PSP design scope and must be addressed at later design stages.

2. Investigations and Inputs

2.1 Survey

Detailed ground survey was provided by Transport Canberra which was undertaken by Arup in 2018. In addition, Jacobs have sourced LiDAR data and aerial imagery from our internal GIS team to support the supplied information. Drainage survey of existing culverts, pits and pipes is also included in the Arup survey and has been utilised in the design.

No additional survey has been requested by the design team at this stage.

2.2 Geotechnical Investigations

Four geotechnical documents were provided by Transport Canberra outlining previous studies. The documents were prepared for the Canberra City to Woden Light Rail project, the alignment of which traverses Callam Street on the eastern boundary of the subject site. The documents contain information on historical geotechnical investigations undertaken close to the C2W alignment for other purposes, and site-specific investigations for the project undertaken in 2017. The following documents were provided:

- Geotechnical desktop study (ARUP, 2017a)
- Geotechnical investigation specification (ARUP, 2017b)
- Geotechnical investigation report (ARUP, 2017c)
- Geotechnical interpretive report (ARUP, 2017d)

Review of the above documents indicates no historical geotechnical information was available within or adjacent to the subject site. The review also indicates no site-specific geotechnical investigations were planned along Callam Street between Launceston Street and Hindmarsh Drive for the C2W project. However, site specific investigations were carried out immediately to the north and generally along the current alignment of Yarralumla Creek in the area between the Yarra Glen roundabout and Launceston Street.

Relevant investigations included two boreholes (Bores 5-BH53 and 56) drilled to depths of 15.3 metres and 5.6 metres respectively, and two test pits (Pits 5-TP54 and 55) excavated to depths of three metres and 2.9 metres respectively. Various laboratory tests were also performed on selected soil and rock samples recovered from these locations.

2.2.1 Summary of results

Subsurface conditions north of the subject site typically comprise surficial topsoil and localised clay fill to depths of up to 2.8 metres overlying variably stiff to hard, low to high plasticity alluvial and residual clays thence very high strength, moderately weathered to fresh, coarse grained sandstone bedrock below depths of 3.8 metres.

Groundwater was observed at a depth of five metres in Bore 5-BH56. No free groundwater was observed at any of the remaining locations whilst the bores and pits remained open. It is noted however, that groundwater levels can change over time and that longer-term monitoring of groundwater levels was not undertaken at these locations.

Laboratory test results indicate liquid limits in the range of 28 to 43 per cent for the clay samples tested, indicative of low to medium plasticity. The results also indicate 10-day soaked CBR and CBR swell values in the range of seven to 11 per cent and 0.7 to 1.2 per cent respectively, indicative of a low to moderate strength in the saturated condition and low expansive nature. The results further indicate field moisture contents range from two percentage points dry to six percentage points wet of respective optimum moisture contents.

2.2.2 Recommendations

2.2.2.1 Geotechnical Model

In the absence of site-specific investigations, the development of a geotechnical model for the site is premature at this stage. However, investigations undertaken for the LRS2 project in the vicinity are considered to provide a reasonable indication of subsurface conditions that could be encountered within the site. On this basis, soil profiles comprising localised clay fill and natural clays of at least stiff consistency and several metres in thickness could be expected. Sandstone bedrock can be anticipated underlying the overburden soils and if consistent with Bore 5-BH53, could be high to very high strength, and moderately weathered to fresh. Groundwater at or near the soil-rock interface could also be expected (i.e. several metres depth).

2.2.2.2 Design Subgrade

Available information in the vicinity of the site indicates subsurface conditions at design subgrade levels could comprise clay fill and/or stiff to hard, low to high plasticity alluvial and residual clay. The results of laboratory testing on three samples of these materials indicates soaked CBR and CBR swell values in the range of seven to 11 per cent and 0.7 to 1.2 per cent respectively, indicative of a low to moderate strength in the saturated condition and low expansive nature.

For further details, refer to the Geotechnical Desktop Study (IS268800-ME-GD-003) provided under Appendix C.

2.3 Stormwater System

A model of the existing pit and pipe network was built using existing surface level data and the TCCS stormwater GIS data, which provided;

- Pipe diameter, length, upstream and downstream invert levels
- Culvert height, width, length, upstream and downstream inverts
- Pit surface levels, downstream receiving channel levels

The model built from the GIS drainage information will need to be confirmed by survey and potholing, particularly the short section of box culvert such that any new connections can be detailed.

Other data that was used for the drainage surface elements, such as pit lids and catchments, includes;

- Detailed survey of the project site
- 1m Stromlo Lidar surface
- The aerial raster image Ausimage2018_10cm_WodenBusInterchange

2.4 Utility Investigations

A request for DBYD within the project area was carried out on the 22nd May 2019 to identify the subsurface utilities and their respective utility providers. The following utility service providers have been identified in the DBYD search.

- Evoenergy
- Icon Water
- iiNet (TransACT)
- NBN

- Optus
- Telstra
- Transport Canberra and City Services

A 3D Utility Model of the project area has been provided by Transport Canberra, with survey undertaken by Arup in 2018. The quality level of the model as per AS 5488-2013 Classification of Subsurface Utility Information ranges from QL-B to QL-D. There are no QL-A, which is the highest quality level and is usually carried out to verify the existing utility by potholing works or similar.

Following a review of the 3D Model, many QL-B levels were deemed to be inaccurate, therefore all assets have been treated as QL-D and a 2D model has been produced.

For further details, refer to **Section 6.6**.

3. Transport Studies

3.1 Overview

Several transport studies have been used to inform the design of Woden Bus Interchange. These include bus network and interchange requirement memos produced for TC by MRCagney, and traffic modelling using microsimulation software package VISSIM. This section provides a summary of these inputs which are included as Appendices to this report.

3.2 Bus network and interchange requirements

3.2.1 Overview

MRCagney were appointed by TC to identify the requirements for Woden Bus Interchange in relation to:

- Current and future bus network (services, routes, volumes);
- Bus stop route groupings;
- Number and size of bus bays; and
- Number of layover bays.

In total, four memos were produced by MRCagney which have been used to inform the design of Woden Bus Interchange.

3.2.2 Interchange requirements

As noted previously in this report, Woden Bus Interchange needs to function effectively both prior to and after the implementation of City to Woden Light Rail which is currently proposed to terminate in Woden Town Centre. The introduction of light rail will have a direct impact on the bus network which will be adjusted to both integrate with light rail and remove bus route duplication of light rail services. As such, MRCagney identified requirements for the bus interchange both before and after light rail.

The requirements were calculated based on the following principles:

- Rapid routes should stop separately from local routes;
- Local routes sharing common destinations should stop at common stops, so passengers bound for intermediate destinations can have access to higher frequency services from a single stop group;
- A single stop can cater for approximately 10 buses per hour, but this number varies on how many routes are using the stop;
- It is assumed that buses will drop-off on one side of the interchange, turnaround and layover off-site and depart from the opposite side of the interchange.

It is noted that across all options, Rapid stops should be designed to accommodate 17.75m articulated buses, and 14.5m tag-steer buses, while all other stops should be designed to accommodate 12.5m buses. All buses should be assumed to have front bicycle racks.

Before Light rail

Prior to the introduction of light rail, Woden Bus Interchange will require a total of 18 bus bays on Callam Street. In contrast to the operation of the current Bus Station, the Bus Interchange will function more like the City Interchange with separate stops for inbound and outbound services. A summary of the requirements for Woden Bus Interchange before light rail is included in **Table 3.1**.

Table 3.1: Woden Bus Interchange Requirements Before Light Rail

Stop group	Services	Terminate vs through	Stop requirements	Operation
Rapid	R4, R5	Through	3 northbound 3 southbound	Head of queue with independent exit
	R6	Terminate	1 northbound 1 southbound	Independent
South Canberra and Woden Valley	57, 58, 60, 61, 62, 63, 66	Terminate	2 northbound 2 southbound	Head of queue with independent exit
Cooleman Court	64, 65, 70, 71	Terminate	1 inbound 1 outbound	Independent
QCity / TbX	831, 842	Terminate	1 stop	Head of queue with independent exit
School buses		Mixed	3 stops	Head of queue with independent exit
TOTAL			**18 stops**	

Option 1 – Light Rail via Barton

Two route options are proposed for City to Woden Light Rail. As such, the future bus network will vary depending on which route is chosen. For Option 1 – Light Rail via Barton, a total of 18 bus bays are required. Requirements are outlined in **Table 3.2**.

Table 3.2: Woden Bus Interchange Requirements with Light Rail Option 1

Stop group	Services	Terminate vs through	Stop requirements	Operation
Rapid	R4	Through	1 northbound 1 southbound	Independent
	R6	Terminate	1 northbound 1 southbound	Independent
South Canberra and Woden Valley	57, 58, 60, 61, 62, 63, 66	Terminate	2 northbound 2 southbound	Head of queue with independent exit
Cooleman Court	64, 65, 70, 71	Terminate	1 northbound 1 southbound	Independent
Tuggeranong Locals	72, 73, 74, 75, 76, 77	Terminate	2 northbound 2 southbound	Head of queue with independent exit
QCity / TbX	831, 842	Terminate	1 stop	Independent
School buses		Mixed	3 stops	Head of queue with independent exit
TOTAL			**18 stops**	

Option 2 – Light Rail via State Circle

For Option 2 – Light Rail via State Circle a total of 18 bus bays are required, as detailed in **Table 3.3**.

Table 3.3: Woden Bus Interchange Requirements with Light Rail Option 2

Stop group	Services	Terminate vs through	Stop requirements	Operation
Rapid	R4	Through	1 northbound 1 southbound	Independent
	R6	Terminate	1 northbound 1 southbound	Independent
South Canberra and Woden Valley	57, 58, 60, 61, 62, 63, 66	Terminate	2 northbound 2 southbound	Head of queue with independent exit
Cooleman Court	64, 65, 70, 71	Terminate	1 northbound 1 southbound	Independent
Tuggeranong Locals	78, 79, 80, 81	Terminate	2 northbound 2 southbound	Head of queue with independent exit
QCity / TbX	831, 842	Terminate	1 stop	Independent
School buses		Mixed	3 stops	Head of queue with independent exit
TOTAL			**18 stops**	

3.2.3 Summary

While the existing network has slightly higher volumes in the morning peak than the proposed network, the same number of stops are required across all three options.

3.3 Traffic modelling

3.3.1 Overview

Microsimulation modelling has been completed as part of this study to:

- Support the development of the PSP design;
- Ensure the proposed design enables the bus interchange to operate effectively; and
- Understand the impacts of the bus interchange on the wider transport network.

Microsimulation modelling has been completed using PTV VISSIM (version 10.00-15). VISSUM was selected for this task as the software is efficient in modelling the individual interactions between different vehicles such as motor vehicles, buses, light rail and pedestrians. It is also helpful in assessing the performance of the road network by estimating the delays and queues occurring at intersections.

A *Traffic Modelling Report* has been prepared separately which provides a full summary of the model inputs, tasks undertaken and results. The report is provided in **Appendix D**.

3.3.2 Options testing

To understand how the bus interchange operates in the wider transport network under several different future scenarios, the following options have been modelled as part of this task:

- Base case (2019) – The existing bus network, road network and Bus Station;
- 2026 Do Nothing;

- 2026 LRT;
- 2036 Do Nothing; and
- 2036 LRT

The model calibration and validation was done which shows good results overall. The R^2 value for the AM peak is 0.96 and 0.95 for PM peak which meets the minimum required criteria. The journey time validation plots are shown in **Figure 3.1** and **Figure 3.2**.

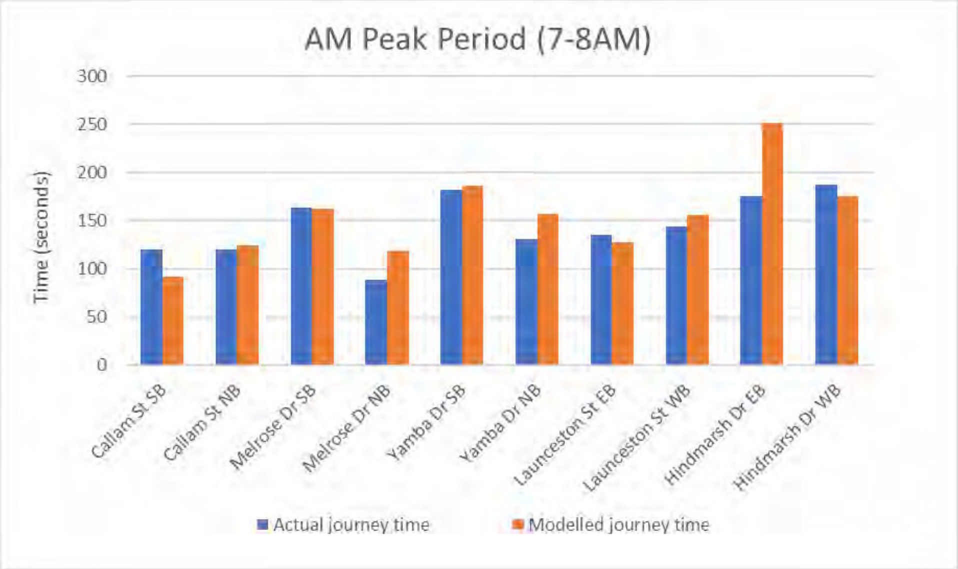


Figure 3.1: AM peak period Journey time comparison

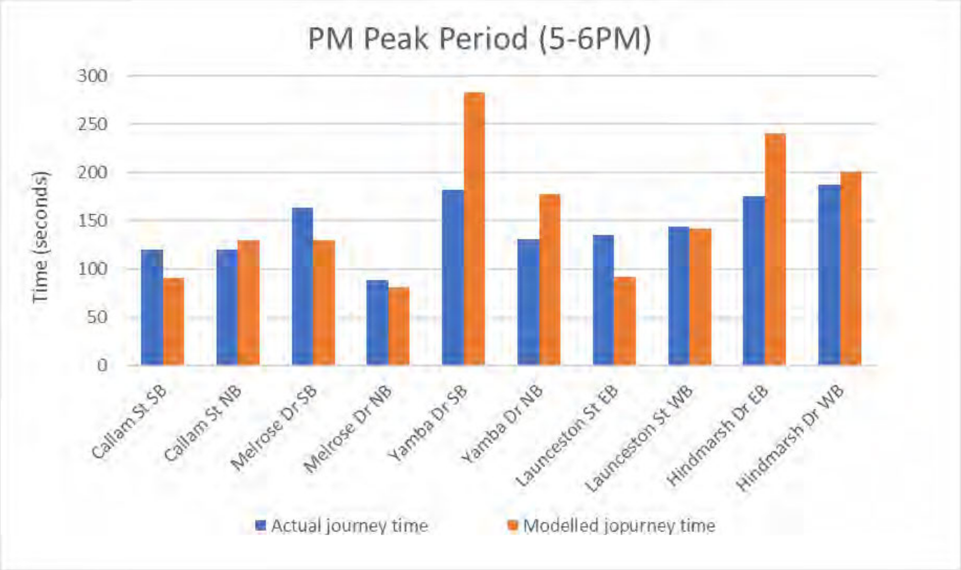


Figure 3.2: PM peak period Journey time comparison

Future models were developed for year 2026 and 2036 for the Do Nothing and Light Rail with State Circle options. The Future Do Nothing scenario was developed from the base model and only changes were made in the bus network (as per the new timetables). The details for Light Rail including the schedule, stops, operation and detailed alignment was not available and therefore was not included in the model. The impacts of Light Rail on the signal operations would be considered in more detail in the next stage of the project, with the focus here on changes to bus operations. The Future Do Nothing and LRT with State Circle scenarios were compared for the network performance in terms of network delay and journey times. Despite the closure of Callam Street, the LRT model did not reflect significant increased delay or travel time.

Table 3.4: Network Performance Comparison Summary

Network Statistics	Future 2026 Do Nothing		Future 2026 LRT		2036 Do Nothing		Future 2036 LRT	
	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
Total Vehicles Arrived	15000	14045	15016	13802	15488	14302	15251	14422
Total Distance (km)	38057	35902	38162	35194	39574	37173	39203	37222
Total Travel Time (hr)	1462	1278	1433	1256	1812	1594	1837	1461
Total Delay (hr)	823	677	792	666	1145	973	1176	839
Average Delay (secs)	175	156	169	157	230	214	238	187
Average Speed (kmph)	26	28	27	28	22	23	21	25
Latent Demand (no. of vehicles)	338	153	309	444	658	737	687	865

To summarise, the LRT with State Circle option did not show increased delay or travel time. With the closure of Callam St, Launceston St was carrying less traffic and contributed to improve total network delay and travel time. Callam Street traffic diverted to the local streets like Worgan St, Bowes St, Corinna St and Brewer St. With the LRT option, the congestion did not appear to be severe at major junctions. However, the local streets and area between Melrose Dr, Launceston St, Callam St and Hindmarsh Dr appeared to be congested and may require further attention to improve operations.

4. Urban Design and Landscape Architecture

This chapter will describe the Landscape and Urban Design considerations for the Woden Bus Interchange. This section sets out the:

- Approach to Urban Design
- Defines the Urban Design Principles; and
- Outlines the Urban Design Outcomes to be developed in the FSP.

4.1 Urban Design Approach

The Woden Town Centre Master Plan which was endorsed by the ACT Government in 2015 sets out the future aspirations for the broader Precinct. The vision for *Woden town centre is a major community and commercial hub for the Woden Valley and wider Canberra region. It will be a place that attracts people to live, work, socialise and enjoy throughout the day and evenings. The town square is the central focal point for social and community activity that will connect people to a network of safe and active streets and public parks.*

The broad principles and objectives to guide this aspiration, which are set out in Section 1.1.3 of this report have underpinned the preceding reviews and challenge design workshops that have informed the layout of the Woden Bus Interchange and will continue to guide the design development if this area in the context of the Woden Town Centre Master Plan and the future aspirations for this precinct.

In this context, the design and layout of the Woden Bus Interchange has considered the operational and safety requirements for the integration of transport, traffic and engineering that are balanced with best practice urban design, landscape architecture and architecture outcomes to deliver future places that are safe, functional, enjoyable, leaving a positive legacy for existing and future users of the Woden Town Centre.

This approach has seen urban design considered alongside the various technical considerations at the outset of the project. This approach has ensured that urban design is embedded into the project to capture opportunities and to address challenges and requirements as the project develops and that urban design is not a retrofit around transport outcomes.

The initial design (this scope) is developed in cognisance of the future development aspirations of the Woden Town Centre Masterplan which seek to activate the western edge of Callam Street through ground level retail uses that will contribute to a rich and energetic town center. This aspiration will include the light rail alignment within a richly detailed urban pedestrian plaza for future residents and visitors to the precinct.

4.2 Urban Design Principles

The following urban design principles have been adopted for the Woden Bus Interchange:

- Balance the current operational outcomes of the WBI with the future urban grain of the Woden Town Centre
- Creating connections and linkages to Woden Town Centre from current and future residential areas beyond the site and allowing for access and mobility across the WBI.
- Developing a strong sense community by planning for integration and inclusion through access, mobility and safety
- Allowing for the future integration of the Canberra Light Rail Stage 2 and precinct activation such as the recently constructed Eat Street and future retail development.

- Enhancing precinct amenity through high quality surface finishes, careful planting design and species selection and the integration and placement of proprietary and custom furniture elements.

4.3 Urban Design and Landscape Outcomes

This section sets out the urban design and landscape outcomes to be delivered through the development of the next stage of the design and guidance to achieving those outcomes. The outcomes are set-out in the themes:

- Movement and Access;
- Landscape and Public Realm; and
- Safety.

The key design elements of the Woden Bus interchange include:

- Integrating the operational requirements of the Bus Station into the existing and Woden Town Centre and the future aspirations for this precinct
- Plan for the integration of the Canberra Light Rail in to the Woden Bus Interchange
- Incorporate the high-quality landscape materials emerging throughout the streetscape and open space within public realm areas
- Contemplate future stages to allow for the creation of high amenity and seamless public realm outcomes
- Promote clear and legible pedestrian movement between points of origin, destination and between transport modes
- Allow for the net recruitment of tree canopies across the precinct
- Integrate station platforms and shelters into verges and the public realm

4.3.1 Movement and Access

Key considerations for movement and access in and around the Woden Bus Interchange access and desire lines and modality conflict between bus, light rail, cars, pedestrians and cyclists.

The WBI **Figure 4-1** Shows the proposed Woden Bus Interchange and movement systems.

Figure 4-1 Movement Systems

Callam Street will be restricted to bus's between Bradley Street to the south and Matilda Street to the north. Bowes street will be truncated east of its current intersection with Callam Street to create a new pedestrian plaza and promenade.

A new 3.0 m wide off-road cycle path will be constructed along the eastern edge of Callam Street. This requirement was identified early in the Multi-Criteria Analysis (MCA) and is consistence with the existing cycle path along Matilda Street. The new off-road cycle path will connect to the recently constructed cycle lanes along the northern edge of Matilda Street.

New bus shelters will be located along the eastern and western edges of Callam Street to align with the proposed bus pull in bays. A new bespoke shelter will be constructed in the location of the interchange area shared between the light rail and bus drop-off zones.

East-West connections, an urban grid, created by the road network between Callam and Bowes Street. A connection resides between the existing Woden Town Centre Plaza to the north of the Westfield Shopping Centre and Easty Street to the east of the Callam Offices. Current structure plans identify this as a key walking link to consider in future transit upgrades.

Pedestrian Movement

The overriding principle is to create a pedestrian-priority precinct where safety and amenity is managed through design interventions rather than signage and other applied measures.

The reconfigured bus station, light rail stop and future development will attract significant pedestrian movements across the precinct and between bus and light rail interchange area.

Transport users will seek the shortest route between the key areas, particularly the light rail and bus stops. In the short term this will be managed through pedestrian prioritisation, and features such as the strategic placement of planting, bollards and furniture items and the signalisation of the intersections at Matilda Street to the north and Bradley Street to the south.

Future considerations may include signalisation of the dedicated pedestrian crossing points at the eastern end of Bowes Street and the crossing immediately to the south. These will assist to formalise pedestrian movements and to prioritise bus movements during peak hours.

Raised planters are proposed at the northern and southern ends of Callam Street within the central median. These planters will be specifically designed to alert passenger cars of the bus only access at these locations. The raised planters were also considered desirable to be incorporate into one safety/vehicle deterrents to reduce visual clutter in the road environment.

Raised rumble strips and bollards will be included at key locations and intersections of pedestrian and cyclist confluences.

Safety

Safety considerations in the design of all publicly accessible areas including movement and access. This includes Crime Prevention Through Environmental Design (CPTED) principles and visibility to promote passive surveillance and safety.

Specific modality measures are described above. Other measures include the predominant use of tall, clear-trunked trees with low shrubs and ground covers to allow through precinct visibility and passive surveillance.

Wherever possible, low level lighting will compliment high-level pole lights to minimise nighttime glare, limiting through site visibility and while maintaining amenity and safety.

The off-road cycling path and pedestrian areas are to be further developed in accordance with the Design Standards for Urban Infrastructure, 13 Pedestrian and Cycle Facilities. The current design for the cycle path is for a dedicated 3.0 m wide off-road cycle path to the east of Callam Street.

Inclusion

Key design measures to promote inclusion and access is the removal or deletion of steps or steep changes in grade wherever practicable. With the exception of deliberate placement of bollards and raised planters, the majority of the ground plane seeks to limit vertical barriers and obstacles.

Permanent and fixed seating has been deliberately positioned with sufficient clear space to allow wheel chairs and personal mobility devices to share the same area and be included within intimate or group seated conversations.

The light rail interchange has been designed to enable direct roll on and roll of for personal mobility devices such as prams wheel chairs.

All public transport interchange and waiting stations are being developed to be accessible by all abilities.

Wayfinding

Access and ease of navigation throughout the precinct will be facilitated by clear and coherent signage at precinct entrances, decision and destination points. Signage will be developed in concert with TCCS Signage Standards.

4.3.2 Landscape and Public Realm

This section provides guidance to assist with developing a palette of materials, furnishings and plantings for public spaces within the Woden Bus Interchange precinct that will enhance the emerging character and development aspirations of the area.

It is important that the design and detailing of all public areas delivered by the WBI are undertaken in a coordinated way and through a restrained material palette that is consistent with the better examples in the area. This restrained and selective use of materials and furniture items will, overtime unify the precinct allowing the Future Woden Town Centre to read as a cohesive precinct, despite being delivered iteratively.

Design cues for the WBI will be taken from the recently completed Eat Street Precinct delivered along Bradley Street to the south west of Callam Street.

This considered approach will include integration of civil elements such as services, conduits, drainage and lighting and signage into the design of precinct.

Shade and Shelter

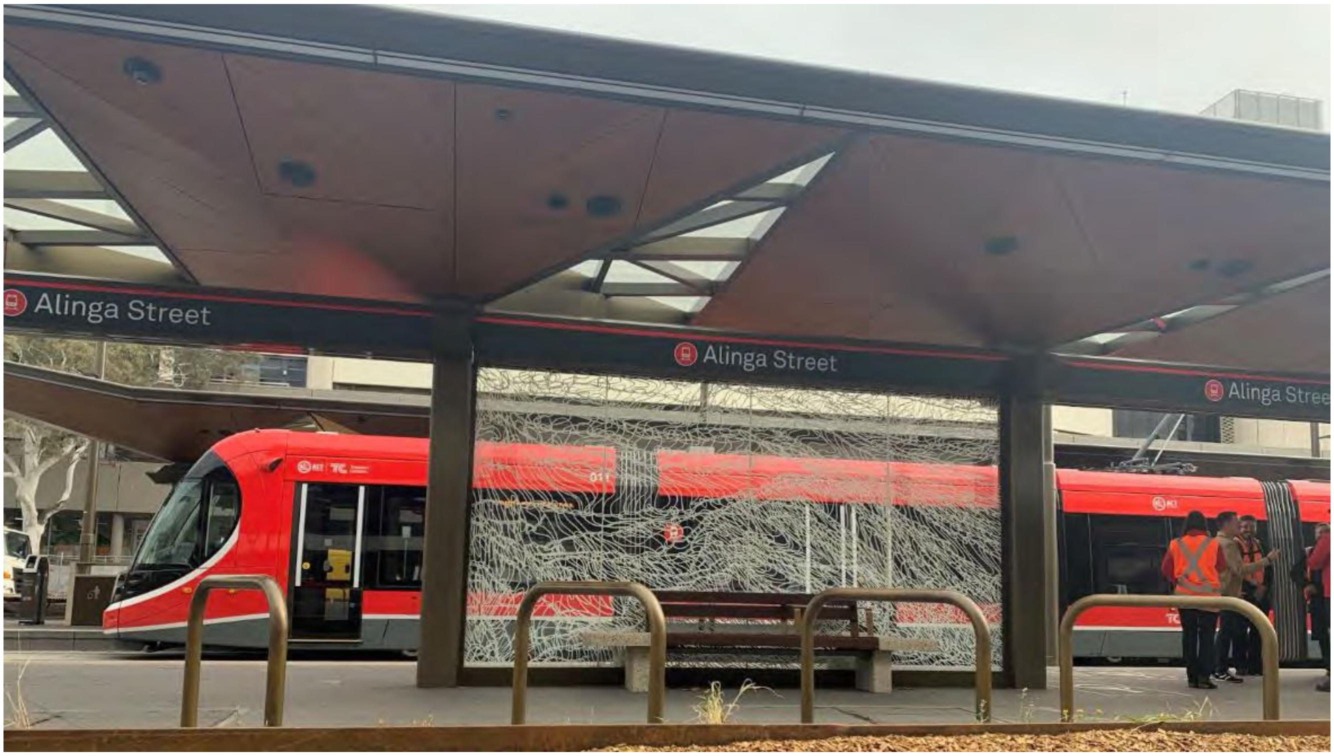
New shelters will be installed as key locations across the precinct including the dedicated bus drop off and pick up zones, shared light rail and bus platform roughly central to the site. The requirement for a second shelter to the western side of the light rail terminus will be explored in the future design stages.

Key criteria for the selection, design and placement of all shelters include:

- Protection from all-weather types across the waiting area;
- Facilitate safe pedestrian and cycle movement between the platform areas, foot and cycle paths;
- Consider where suitable, the potential for continuous shelter at transfer locations;
- Include seating and leaning opportunities;
- Balance the need for comfort and space required at anticipated peak demand; and
- Consider, where suitable, the use of Photovoltaic cells.

Wherever possible, shelters will adopt the TCLR standards shelters to ensure uniformity and consistency across the network. A custom shelter will be designed for the bus and light rail shared zone.

All shade and shelter will be provided in the short term by the inclusion of TCCs Standards shelters at identified passenger waiting areas. These structures will be similar to those being delivered as part of the Canberra Light Rail projects and similar to those shown in the figure below.



Over time, these structures will be supplemented through mature trees planted within this stage and more substantial structures delivered through successive stages.

4.3.3 Furniture and Urban Elements

A range or propriety urban furniture will include fixed seating and bench’s bins, bollards and bicycle hoops at key locations. Indicative locations for proprietary seats and bollards are shown in the DRAFT landscape plans. The final selection and location of these elements will be determined as the design progresses. Key considerations for the selection and location of these items include:

- Consistency with TCCS Maintenance regimes and access;
- Robustness and serviceability; and

- Being of a timeless design that will not date.

Opportunities for the inclusion of urban art and community events will be provided in future stages.

Hard Landscape Materials

Hard landscape materials will include a selection of finishes and materials that are appropriate for their location, function and intent.

Materials will be the best of their respective kinds and include a selection of natural stone large format paving in key pedestrian priority precincts, natural stone kerbs alongside the light rail platforms. The remainder of the precinct will comprise large forms sawn concrete.

Material selection and surface finishes for public areas will be partly based upon the recently installed areas within the Eat Street development.

Soft Landscape Material

The soft landscaping palette will be comprised of predominantly native trees and ground groundcovers with a restrained use of exotic species.

Native trees will comprise a mature habit of taller clear trunked species that promote an elevated canopy for shade and amelioration of winds and to allow through site visibility.

Exotics species will be limited to deciduous canopy trees to allow maximum sunlight through winter and to introduce seasonal color and diversity.

Ground level plants will comprise low shrubs and ground covers that are native to the area, flowering and of textural interest. Similar to the use of tall clear trunked trees, the use of low shrubs and ground covers will introduce softness to the area while retaining through site visibility and therefore passive surveillance.

4.3.4 Sustainability Considerations

Water Sensitive Urban Design

Water Sensitive Urban Design opportunities include the direction and capture of surface run-off to garden beds and areas of soft landscaping. Options include positive or drainage of the Callam Street Bus zone towards the central median and the many tree pits contemplated by the draft landscape plans. The grading of surfaces within the Bus Station is discussed in Section 6 of this report.

Proposed modifications to the stormwater network will have no impact upon existing WSUD measures.

5. Light rail coordination

The Woden Bus Interchange and Road Layout Modifications project has adopted and developed the “Preferred Option 3” outcome from the 2018 Concept Options Report. This option shows the Light Rail service running through the median north of Matilda Street, then shifting into the western verge south of Matilda Street up until Bradley Street, where it then returns to the median location. The Woden Bus Interchange project has assessed the proposed geometry of the light rail alignment and conducted a space-proofing exercise to facilitate the future light rail extension.

An independent review of the light rail integration and geometry was undertaken on 13 June 2019. The review assessed the light rail design criteria (extracted from “Appendix 17 – Trackwork Scope and Performance Requirements” provided by Transport Canberra), DKE + clearance requirements and horizontal clearance requirements.

As part of the design review, changes were required to the vertical geometry to comply with the LRV requirements. This included changes to the vertical curves and removal of non-compliant changes in grade lengths. Notes were also added to the horizontal rail alignment to show the typical DKE envelopes used. These have been updated and reflected in the relevant attachments within the review memorandum. It was highlighted that for the road geometry, the bus lane widths did comply with the scope performance requirements of the LRV and that ACT government requirements took precedence.

The independent review memorandum is included in **Appendix E**.

5.1 Light Rail Alignment for Final PSP

Comments on the light rail review memo and recommended changes were received on 28 June 2019.

The following changes have been proposed by the client in the draft PSP:

- Review of locations where horizontal and vertical curves occur simultaneously;
- Reviewing locations of proposed light rail crossovers to ensure these can fit adjacent to the bus interchange crossovers;
- Light Rail alignment to continue through the verge south of Bradley Street and only shift into the median at Neptune Street, as per Preferred Option 3;
- Pedestrian crossing at the northern end of bus interchange to be shifted south; and
- Western kerb between Matilda Street and Launceston Street to be shifted further west to accommodate larger DKE + clearance.

In review of the above, adopting the changes will shift the light rail alignment further south and push the pedestrian crossing approximately 20m south of the intersection. A superposition of the adjusted light rail alignment is shown in **Appendix E1**. These changes will impact pedestrian movement and safety, including removal of a bus shelter and a greater skew of the rail crossing the foothpath. The current rail alignment at draft PSP meets the absolute minimums for horizontal and vertical elements. Hence the above changes were considered and moderate changes were made to best suit the current rail alignment.

6. Civil Infrastructure

6.1 Design Criteria

Refer to **Appendix F** for details of the Design Criteria memorandum.

6.2 Bus Station Operations

The bus interchange on Callam Street has made provisions for the following in accordance with the latest traffic study:

- Eight (8) 15.7m tag steer buses; and
- Six (6) 17.75m articulated buses

The bus interchange on Bradley Street has made provisions for the following in accordance with the latest traffic study:

- One (1) 13m QCity bus; and
- Three (3) 12.5m school buses.

The bus interchange arrangement on Bradley Street has been designed under the assumption that the "Shared Zone" depicted in the Woden Master Plan will be operational when the Bradley Street bus interchange is constructed, and buses can utilise this facility.

6.3 Intersections

6.3.1 Intersection 1 - Matilda Street

Intersection 1 incorporates two northbound lanes (left turn only and right turn only) and three southbound lanes (left turn only, through bus only traffic and right turn only) on Callam Street to the north of Matilda Street. A chevroned northbound lane has also been provided to accommodate for the future light rail alignment within the median. South of Matilda Street shows one bus only lane in each direction through the interchange on Callam Street. Matilda Street incorporates one lane in each direction as per the existing arrangement.

6.3.2 Intersection 2 - Bowes Street

The Bowes Street intersection is proposed to be closed to general traffic as it intersects with the bus interchange and clashes with the future light rail alignment.

6.3.3 Intersection 3 - Bradley St

Intersection 3 incorporates one bus only lane in each direction through the interchange on Callam Street north of Bradley Street. One northbound lane and one left turn slip lane is provided in the northbound direction south of Bradley Street, and the existing southbound arrangement to the south of Bradley Street (two through lanes and one right turn lane) is to be retained.

Turning paths are shown in **Appendix L**.

6.4 Active Transport

6.4.1 Pedestrian Crossings

Pedestrian crossings have been provided throughout the interchange to facilitate bus-pedestrian connectivity and ensure that the design reflects the key active transport priorities of the Woden Town Centre Master Plan.

Three new pedestrian crossings have been provided at each leg of the Matilda Street intersection. Two pedestrian crossings through the bus interchange across Callam Street have been provided at Bowes Street and a location between Bowes Street and Bradley Street. These locations align with the Woden Bus Interchange Master Plan. Two new pedestrian crossings are provided at the Bradley Street intersection across the northern side of Callam Street and across Bradley Street. The existing crossing on the southern side of Callam Street is proposed to be retained.

The existing pedestrian crossing provisions at Bowes Street and at Bradley Street are to be removed.

6.4.2 Shared Active Transport

A 3.0m wide shared path has been provided on the eastern side of Callam Street adjacent to the bus interchange. This path connects the Matilda Street intersection with the Bradley Street intersection. The southern end of the shared path is slightly skewed to align with the existing crossing across the Woden Youth Centre car park entrance.

6.5 Stormwater

The pavement drainage design will follow the Local Authoirty and industry/Australian Standards, including but not limited to;

- Design Standards for Urban Infrastructure Edition 1, Rev 0
- Australian Rainfall and Runoff (2019)
- Austroads Guide to Road Design Part 5A: Drainage – Road Surface, Networks, Basins and Subsurface (2013)
- AGRD05B Drainage - Open Channels, Culverts & Floodways (2013)

The stormwater drainage design for the project consists of the following:

- Pavement drainage pit and pipe system;
- Existing outlets connecting to a channel alongside Callam street

Catchment Sketches are included as part of the drawing set.

6.5.1 Methodology

The existing drainage system consists of a pit and pipe network conveying the surface water from kerb and gutter inlets across Callem Street to a nearby concrete channel (Yarralumla Creek). The project works have not significantly altered the catchments and catchment flow in the project area. It is proposed that the drainage design will retain as much as the existing pit and pipe system as possible by connecting new pits into existing pipes and where possible modifying existing pits to new kerb levels.

The Woden area is considered a town area in the Design standard and therefore the Average Recurrence Interval (ARI) for the minor system design is 20 years or 5% Annual Exceedance Probability (AEP). The major system shall be designed up to and including the 100 year ARI or 1% AEP was not part of this stage of design.

At this stage of the design hydrologic and hydraulic calculations were carried out adopting the Rational Method to check pit locations for flow width compliance. The next stage of design will model the system dynamically taking into account partial area flows to optimize any new pipes.

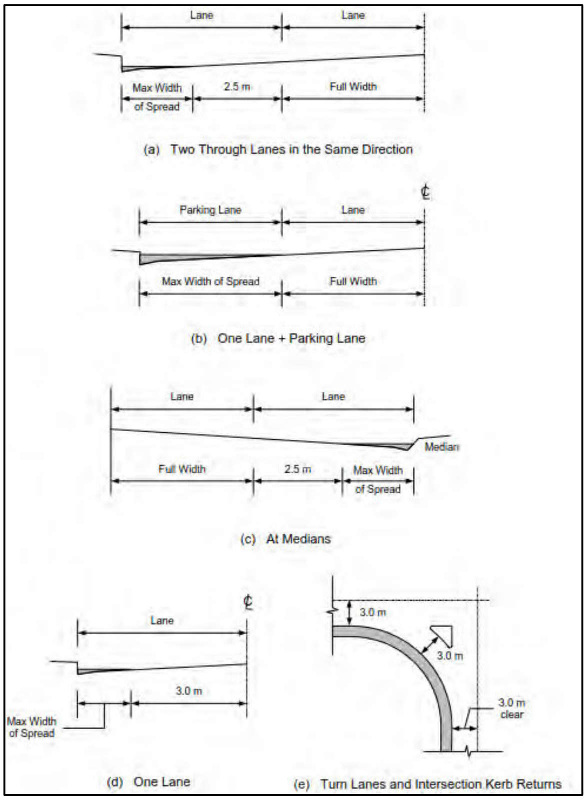
Hydrological and hydraulic parameters used include;

- Canberra IFD Input Data and Design Rainfall Intensities from BOM and cross checked with the Design Standard Table 1.13 and 1.14
- Design impervious area for Town Centres 90%
- Time of concentration minimum 5min, with no catchments larger than 5min
- Runoff coefficient C= 0.9

6.5.2 Surface Drainage Criteria

The key design criteria for Pavement Drainage obtained from the standards above and applied at this stage are summarised below with clarifications given where required.

- The pit and pipe network is to be designed for the peak flows produced for the 20 year ARI or 5% AEP event, for design parameters including freeboard, surcharge;
- Minimum cover from top of drainage element to finished surface level of 600mm ;
- Minimum pipe size of DN300;
- Minimum pipe grade of 0.5%;
- Minimum self-cleaning velocity >0.7m/s in the 1 year ARI storm;
- Maximum flow velocity of 6.0m/s;
- Freeboard minimum of 150mm; and
- Flow widths as per Design Standard, see **Figure 6.1**.



(a) Two Through Lanes in the Same Direction

(b) One Lane + Parking Lane

(c) At Medians

(d) One Lane

(e) Turn Lanes and Intersection Kerb Returns

Figure 6.1: Flow width criteria from Urban Services, Design Standards for Urban Infrastructure

6.5.3 Nonstandard Drainage Elements

Non-standard drainage elements included in the design are;

- Connection into box culverts on the north corner of Matilda and Callam Street
- Covered kerb drain
- Potentially non-standard pits to avoid services.

6.5.4 Design Assumptions

The following assumptions have been made for the pavement drainage design:

- Existing pits and pipes that are retained are structurally sound and adequate for connection with the proposed drainage system. Confirmation via CCTV inspection and subsequent structural assessments should be completed during detailed design.
- The Bus station kerbs are maintained as is and kerb inlet pits do not require treatment.
- The drainage design assumes that stormwater treatment to the pavement runoff of road catchments could be achieved at the outlets into the channel.
- The connection point of the property drainage system to be determined during detailed design stage.
- The drainage design assumes that the existing watercourse which runs parallel to Callan Street will be maintained, and it is assumed that it can cater for additional flows from the proposed road works. As more detailed survey is obtained, the capacity can be checked and modifications may be recommended as required.

6.5.5 Outstanding Issues

- The widening of the kerb around the northern corner of Matilda and Callam Street, requires new inlet pits. The clearance to these new pits needs to be confirmed with potholing as this area looks constrained by services.
- Check pipe cover to pavement design.
- The downstream receiving channel to be checked once more detailed survey is obtained, the capacity to be checked and modifications will be recommended as required.

6.5.6 Water Quality

Water quality treatments and Water Sensitive Urban Design (WSUD) has not formed part of the PSP design scope. Proprietary products such as Gross Pollutant Traps (GPT's) can be installed at the downstream end of the project catchment, and WSUD treatments through the median can be explored at further design stages.

6.6 Utilities and Services

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

6.7 Pavements

The following section summarises the pavement designs displayed on the PSP drawing set included in **Appendix A**. For details on the pavement design options process refer to the Pavement Options Report in **Appendix I**.

6.7.1 Bus Interchange

Following the development of the Pavement Options Report and whole of life cost analysis, the below two pavement options are considered likely to have the lowest whole-of-life cost and are preferred for this project.

Table 6.3: Pavement Type 1: Callam Street Interchange (Option 1A)

Thickness (mm)	Pavement Material	RMS Specification
195*	JRCP with SL82 mesh (60mm cover)	R83
-	Debonding treatment	R82
150	LCS	R82
-	7mm primerseal	R106
300	Selected material (CBR⩾33%)	R44, 3071
-	Subgrade (Design CBR⩾3%)	R44
645	**Total (mm)**	

***** Includes 10 millimetre construction tolerance and 10 millimetre grinding provision

Table 6.4: Pavement Type 2: Bradley Street Interchange (Option 2A)

Thickness (mm)	Pavement Material	RMS Specification
190*	JRCP with SL82 mesh (60mm cover)	R83
-	Debonding treatment	R82
125	LCS	R82
-	7mm primerseal	R106
300	Selected material (CBR⩾33%)	R44, 3071
-	Subgrade (Design CBR⩾3%)	R44
615	**Total (mm)**	

* Includes 10 millimetre construction tolerance and 10 millimetre grinding provision

6.7.2 Other Pavements

Table 6.5: Pavement Type 4: Mill and resheet

Thickness (mm)	Material	RMS specification
50	AC14HD AR450	R116
-	Tack coat	R116
-	Existing pavement*	M250
50	**Total (mm)**	

* Heavy patch where required prior

Table 6.6: Pavement Type 5: Raised Median

Thickness (mm)	Material	RMS specification
120	N25 concrete with SL82 mesh (50mm cover)	R53, R173
100	DGS20	R71, 3051
-	Subgrade	
220	**Total (mm)**	

Table 6.7: Pavement Type 6: Commercial Driveway

Thickness (mm)	Material	RMS specification
200	N32 concrete with SL82 mesh (80mm cover)	R53, R173
100	DGS20	R71, 3051
-	Subgrade	
300	**Total (mm)**	

Table 6.8: Pavement Type 7: Shared Path

Thickness (mm)	Material	RMS specification
150	N32 concrete with SL82 mesh (70mm cover)	R53, R173
100	DGS20	R71, 3051
-	Subgrade	
250	**Total (mm)**	

6.8 Traffic Signals

Four existing intersections along Callam Street will be impacted from the proposed road works. These intersections are:

- Launceston Street/Callam Street
- Callam Street/Matilda Street
- Callam Street/Bowes Street
- Callam Street/Bradley Street

Intersection of Launceston Street and Callam Street

The intersection of Launceston Street and Callam Street is a three-way intersection. A left-turn slip lane is provided on the Callam street approach. Due to the proposed road widening to the western verge of Callam Street, the existing traffic island at the south approach will need to be modified to suit the new left-turn slip lane and the right-turn lane to Launceston street. The existing traffic signal components on this island and the traffic controller on the southwest corner will need to be relocated. Signal phases will be retained as per the existing, unless there are some signal phase changes required from future traffic modelling. The existing traffic signal components (signal pedestal, signal lanterns, pedestrian push buttons and traffic controller) can be reused unless these signal components are identified to be in poor condition during the construction, or as requested by Roads ACT. A new signal loop will be required on the right-turn lane and a new counting loop will be required on the left-turn slip lane with the connection to the traffic controller. The signal components for the western and eastern approach on Launceston Street are not affected by the proposed road works.

Intersection of Callam Street and Matilda Street

The existing intersection of Callam Street and Matilda Street is an unsignalized three-way intersection. This intersection will be upgraded to a four-way signalised intersection with the new access to Callam Office carpark. The existing access to Callam Office carpark will be closed to accommodate the proposed bus interchange.

A new set of traffic signal components will be provided at this intersection to control all four approaches (northern and southern approach from Callam Street, western approach from Matilda Street and eastern approach from Callam Office carpark). Signalised pedestrian crossings are provided across each approach.

The new traffic controller will be in the western verge of Callam street, north of Matilda Street, adjacent to the property boundary. A separated signal phase will be provided for the left-turn traffic to Callam Office carpark access and the right-turn traffic to Matilda Street for the northern approach on Callam Street. A single signal phase will be provided for all other approaches. Right-turn from Matilda Street to Callam Street is not allowed. The related pavement marking (left-turn arrow) and signage will be required.

The layout of Callam Office carpark will need to be upgraded to suit the new signalised access. A proper queue lane should be provided at the carpark approach with reasonable sight distance to the traffic signal lanterns.

Intersection of Callam Street and Bowes Street

The intersection of Callam Street/Bowes Street will be removed from the proposed bus interchange on Callam Street. Access from Bowes Street to Callam Street will be closed. Instead, an unsignalized pedestrian crossing will be provided on Callam Street. The detailed upgrade of Bowes Street will be undertaken by others with consideration of existing bus interchange removal and the adjacent land development.

Intersection of Callam Street and Bradley Street

The existing intersection of Callam Street and Bradley Street is a signalized four-way intersection with northern and southern approach from Callam Street, western approach from Bradley Street and eastern approach from the Police Station back carpark. The signalised pedestrian crossing is provided across the southern, western and eastern approach.

The majority of the existing signal conduits and cables will be retained. A new conduit crossing of Bradley Street will be provided to suit the new pedestrian crossing. The existing traffic controller and the signal component for the southern and eastern approach will be retained.

The existing right-turn lane to Bradley Street from Callam Street will be removed. As a result, the separated right-turn signal phase is removed. It is assumed that the bus right-turn to Bradley Street from the interchange is not required. If this is required from the future bus route plan, a right-turn lane should be provided at the northern approach with the separated right-turn signal phase added to the signal system.

Left-turn from Bradley Street to Callam Street is not allowed, as well as the right-turn from the Police Station back carpark to Callam Street and right-turn from Callam Street to the Police Station back carpark. The related pavement marking (left-turn or right turn only arrow) and signage will be required.

Further investigations

The concept traffic signal design is based on the existing traffic control system and the engineering judgement on the proposed traffic request from the post experience. The required traffic modelling for the intersection performance based on the proposed intersection configuration was not available while the concept signal design was undertaken. The signal component (pedestals, lanterns, conduits, cables and loops) will need to be reviewed with the proposed signal phase based on the traffic modelling.

The decision for the proposed traffic signal component locations has considered the future light rail based on the concept light rail alignment in the design to minimize the future clashes/modification. The signal design should be reviewed in the next design stage with the up-to-date light rail design information.

6.9 Construction Staging

Each stage of construction and a description of works intended is provided in the following section. All intersections will require traffic control during construction.

Stage 1

Stage 1 consists of night works that must take place in order to begin construction of the bus interchange. Access to the existing bus interchange is maintained throughout this stage of works.

Construction works within Stage 1 will include:

- Demolishing existing medians and kerbs and providing temporary pavements
- Providing temporary linemarking
- Temporary pavement at new carpark driveway location
- Setting up temporary barriers around the central median between Matilda Street and Bradley Street

Stage 2

Stage 2 works include construction of the Callam St widening and eastern section of the bus interchange. Access to the existing bus interchange is maintained throughout this stage of works.

Construction works within Stage 2 will include:

- Full depth widening between Matilda Street and Launceston Street
- Ultimate eastern bus bay and verge works between Matilda Street and Bradley Street
- Traffic travelling on existing pavement throughout the western section of the bus interchange
- Temporary linemarking throughout the site

Stage 3

Stage 3 works show a traffic switch from the western side of the bus interchange to the previously completed eastern side. Access to the existing bus interchange is maintained throughout this stage of works, however it must be accessed via Bradley Street.

Construction works within Stage 3 will include:

- Construction of the new carpark driveway
- Ultimate western bus bay and verge works between Matilda Street and Bradley Street
- Temporary linemarking throughout the site

Stage 4

Stage 4 works include works to the central median, with traffic able to travel along the ultimate pavement in both the northbound and southbound directions. Access to the existing bus interchange is maintained throughout this stage of works, however it must be accessed via Bradley Street.

Construction works within Stage 4 will include:

- Construction of the ultimate central median
- Temporary linemarking to the north and south of the interchange location

Stage 5

Stage 5 works include the Bradley Street interchange and closing off Bowes Street. Access to the existing bus interchange is no longer possible, however the Callam Street interchange can now be utilised. General traffic can no longer travel down Callam Street between Matilda Street and Bradley Street, as this is now operating as the bus interchange.

Construction works within Stage 5 will include:

- New kerb works to close off Bowes Street to general traffic and buses
- Construction of the Bradley Street bus interchange, not accessible to traffic or buses
- Temporary linemarking to the north and south of the Callam Street bus interchange

Stage 6

Stage 6 works include the final pavement works (mill and resheet) and permanent linemarking from Launceston to Bradley Street (inclusive). This stage is to be undertaken at night.

7. Layover Facilities

7.1 Overview

At present, Woden Bus Station serves a role as both a transport interchange, and a layover hub for bus services which terminate at Woden. This includes the provision of 14 bus layover bays and a driver rest facility which includes a kitchen and restrooms. However, with the transition of Woden Bus Station into an on-street interchange, layover bays and facilities will no longer be available on site and will need to be provided elsewhere.

As such, Jacobs was engaged to complete an options assessment to identify a preferred site for the provision of layover facilities for bus services which will serve the future Woden Bus Interchange. The study focused on identifying suitable locations for up to 14 bus bays for medium (up to 15 minutes) and long-term (up to 60 minutes) bus layover. Since the completion of this study, the MRCagney Memo issued on 20 June 2019 noted that up to 10 bus layover spaces are likely to be required to serve both the existing and future bus network, with and without light rail.

Options identified as part of the layover study were assessed as part of a multicriteria analysis based on operational, capacity, constructability and land use criteria. Preferred sites were then identified.

The full study is included in **Appendix J**.

7.2 Key findings

The study identified that:

- Easty Street represents the most feasible location to provide medium-term layover facilities given the short travel time between Woden Bus Interchange and the site. However, the site does not provide driver restroom facilities which must be provided for this site to meet requirements; further investigation in relation to this aspect is required;
- While alternative options with sufficient capacity exist to provide medium-term layover facilities, return travel times to these sites are in excess of 8 minutes which considered to be too long to enable drivers to take the required rest time;
- Woden Bus Depot represents the most feasible location to provide long-term layover facilities given the available capacity to provide bus bays and the presence of the required driver facilities when constructed. The site requires a greater number of dead running kilometers compared to other options, but these will be accommodated outside peak periods so are unlikely to present a major operational constraint.

7.3 Next steps

The following next steps have been identified to progress this study:

- Concept design of medium-term layover bays at Easty Street;
- Investigate options to provide drivers with restroom facilities within close proximity of Easty Street;
- Investigate the implications of extending the scope of Woden Bus Depot to accommodate long-term layover bays.

8. Air Quality and Noise Assessment

8.1 Air quality

8.1.1 Construction

The activities with the highest potential to result in the generation of dust during construction include:

- Demolition of existing kerb and median: ‘Low risk’;
- Clearing and earthworks: ‘High risk’;
- Pavement construction: ‘Medium risk’;
- Interchange infrastructure: ‘Low risk’; and
- Line marking and re-sheeting: ‘Medium risk’.

The initial risk ratings above were generated for each of these activities based on metrics developed using guidance from *AS/NZS ISO 31000: 2009 Risk Management – Principles and Guidelines*.

8.1.2 Operations

Using the limited traffic data available for the assessment, the potential for operational air quality impacts at surrounding sensitive receiver locations was quantitatively reviewed using the NSW Roads and Maritime Services’ Tool for Roadside Air Quality (TRAQ) model. TRAQ considers emissions arising from combustion exhaust emissions, as well as particulates from braking and tyre wear.

The following results were predicted at the most-affected residential receiver location.

Table 8.1: Year of opening, preliminary worst-case results

Pollutant and averaging period	Incremental pollutant concentration at nearest sensitive receiver area (µg/m^3 unless stated)	Background concentration (µg/m^3 unless stated)	Background + incremental contribution (µg/m^3 unless stated)	Impact assessment criterion (µg/m^3 unless stated)
24-hour averaged PM_{10}	1	25	26	50
Annually averaged PM_{10}	0.4	13	13.4	25
24-hour averaged $PM_{2.5}$	1	18	18.1	25
Annually averaged $PM_{2.5}$	0.4	7	7.4	8
1-hour averaged NO_2,	3.2	80	83.2	246
Annually averaged NO_2	0.6	10	10.6	62
8-hour averaged CO	0 mg/m^3	1.8 mg/m^3	1.5 mg/m^3	10 mg/m^3

These results indicate that operational air quality impacts are not expected to be likely, although more detailed investigations should be completed. These investigations should consider:

- More detailed traffic information;
- Review the relative impact with and without the proposal to identify any deterioration or improvements in local air quality;

- Review impacts for different time scales (e.g. 10 years' after opening) to assess the potential for future issues.

8.2 Noise

8.2.1 Construction

During construction, it is likely that there will be temporal (i.e. shot-term) noise impacts at surrounding land uses. The relative potential magnitude from different phases of construction should be estimated during the environmental assessment, with commensurate avoidance, mitigation and management controls, and communication strategies developed.

8.2.2 Operations

With the limited available traffic data, CoRTN calculations were preformed to predict the resulting noise level at year of opening (2022) at the most-affect residential receive location. Key variables required for this calculation are the breakdown of traffic volume, speed and composition information for the periods from 7am to 10pm (Day), and 10pm to 7am (Night). Applying different day-time traffic flow percentages, the following indicative results were predicted:

Table 8.2: Indicative operational noise results

Day-time percentage traffic flow	Indicative $L_{AEq\ 15\text{-}hour}$ dB(A) at most-affected residential receiver
Pro-rata, i.e. (15/24), 63%	57 dB(A)
90%	58 dB(A)

As noted in the table above, the process of determining whether traffic noise levels are acceptable requires an understanding of existing traffic noise levels. To determine compliance and the need for mitigation will require the following steps during the environmental assessment:

- An understanding of existing local noise levels and traffic information; and
- Full traffic and layout details details consistent with CoRTN input requirements for with and without the proposal over multiple timescales (i.e. year of opening, 10 years' after opening).

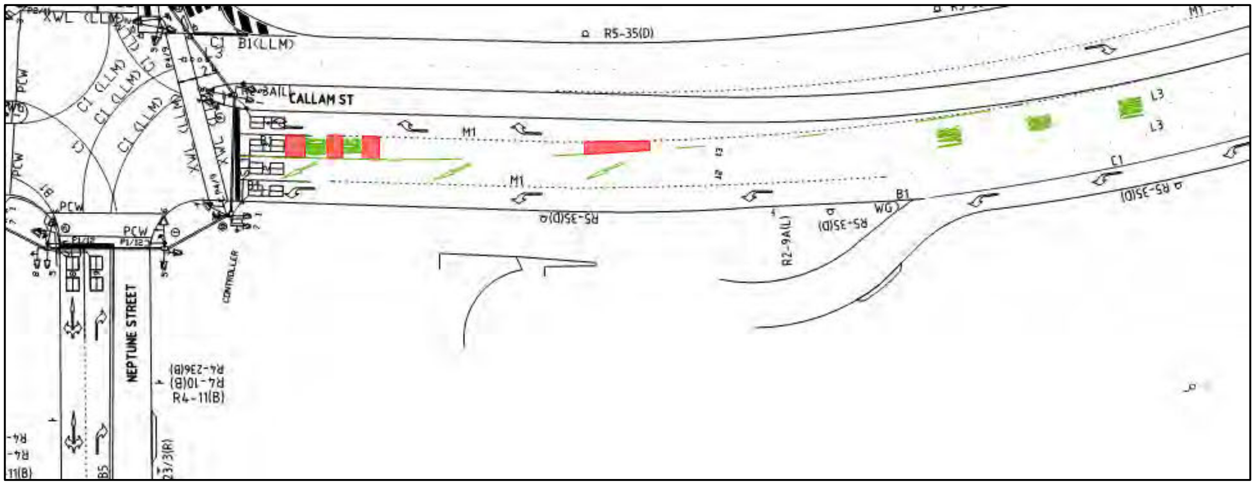
For more details on the air and noise assessment, refer to the memorandum included in **Appendix K**.

9. Items to be addressed in the next stage

The following section outlines items not within the scope of the PSP design, and will need to be investigated at further design stages.

9.1 Confirmation of Design Scope and Approach

- Confirmation of design criteria;
- Confirmation of pavement drainage assumption (refer to section 6.5.4);
- Review outstanding issues (refer to section 6.5.5);
- Implementation of WSUD approaches (refer to section 6.5.6);
- Development and agreement to the principals and design of the bus shelters. This will result in a platform structure being developed and coordinated with the utilities. As a result of the platform structure design;
- Confirmation of the treatment required to the local streets and area between Melrose Drive, Launceston Street, Callam Street and Hindmarsh Drive appeared to improve operations;
- Confirmation of the streetlighting design principles;
- Concept design of medium-term layover bays at Easty Street;
- Investigate options to provide drivers with restroom facilities within close proximity of Easty Street;
- Investigate the implications of extending the scope of Woden Bus Depot to accommodate long-term layover bays;
- Confirmation of the proposed staging strategy;
- Consultation with TCLR and potentially incorporate some of the Stage 2B Light Rail enabling works as part of this project to avoid disturbance to the area in the future;
- The signal component (pedestals, lanterns, conduits, cables and loops) to be reviewed with the proposed signal phase based on the traffic modelling;
- Development of signage strategy to the precinct;
- Finalization of the soft and hard landscaping selection;
- Confirmation on the southern limit of works. Currently the PSP Design has been based on the adopted ‘Preferred Option 3’ which extends to Neptune Street. The linemarking changes shown in the design between Neptune Street and Bradley Street depict the dedicated bus lane in the median lane and a left turn only lane for general traffic in the kerbside lane. This design is fit for purpose, however linemarking changes south of Neptune Street may be required to ensure all general traffic has merged into one lane prior to the Neptune Street stop line. See sketch below for details.



- New arrangement of the Callam Office car park to respond to the new proposed access location.

9.2 Traffic Modelling

- It is recommended that a more comprehensive traffic counting program is implemented to inform the next stage of the project. This would include a combination of SCATS and manual traffic count data to ensure all key locations are captured and can be used for model calibration.
- Floating car travel time surveys are also recommended to improve model validation performance and matching to ground conditions. Modelling can then be updated and fine-tuned further to confirm satisfactory operations for the future network.
- A detailed signalised junction analysis is recommended at major junctions impacted by the development. This would help to identify the capacity constraints and any potential mitigations.
- A detailed parking study is recommended to identify the exact demand on the parcels and the major trip generators to identify the traffic circulation pattern inside the study area.
- Light rail frequencies and signal operations also need to be determined so that signal operation can be optimised in the corridor as part of the light rail scenarios.
- Due to the closure of the Callam Street, the traffic would be diverting to Melrose Drive, Yamba Drive and Hindmarsh Drive. To access to the destinations, the traffic was observed to utilise Corrina Street, Worgan Street, Furzer Street, Matilda Street and so on, and these streets are generally more local, parking and pedestrian friendly streets. Further data on these streets should ideally be collected. More attention is necessary if additional traffic diversion is expected to occur through those streets. Attention related to traffic diversion analysis, unsignalised junction analysis, traffic pedestrian interactions (and safety), parking analysis and capacity analysis may be necessary.
- Trip generation surveys were not conducted as a part of this study. A detailed traffic generation and circulation study may help to understand the behaviours of the traffic in the study area along with the detailed entry and exits and impacts on the junctions at major streets nearby.

9.3 Stormwater

- Potholing to confirm existing service locations and potential clashes, particularly on the north corner of Matilda and Callam street;
- Confirmation of property connections and OSD;
- Dynamic modelling to optimize pipe sizes;
- Aquaplaning Checks;

- Interdisciplinary design coordination;
- Design or modification of pits within the existing bus station/ future light rail;
- Pit Schedule and long sections;
- Design of structural drainage elements;
- Yarralumla Creek channel capacity and potential downstream impacts;
- Development of drainage notes specific to design requirements;
- Drainage interface with future light rail and master plan;
- Confirmation of scope for water quality requirements and WSUD;
- Confirmation of scope for Flood study as required; and
- Confirmation of scope for Climate Change and Spill Containment.

9.4 Utility Design and Consultation

- Continued consultation with authorities throughout FSP;
- Potholing and GPR scanning with authority-approved locators to increase the level of confidence of the existing utility model;
- Telecommunications relocation design to be carried out by Utility provider or specialist;
- Watermain relocation design to be carried out by Utility provider or specialist;
- Electrical relocation design to be carried out by Utility provider or specialist;
- High pressure gas relocation design to be carried out by Utility provider or specialist;
- Sewer protection works design where required;
- Street lighting design and reticulation under project work area;
- There is an opportunity for the Woden Bus Interchange project to coordinate with the TCLR project by incorporating future utilities within the scope of works. By incorporating the future light rail utilities within the design, and factoring this into the construction staging, it could create less disturbance to the future interchange operations and avoid any abortive works, thereby providing a more effective construction methodology for the Stage 2B LR project.

9.5 Approvals

- Approval process with each utility provider will need to be undertaken
- Consultation with adjacent properties and stakeholders
- Consultation with Roads ACT

9.6 Investigations and Assessments

- Detailed survey data for project area, including channel invert levels downstream
- Review of the planning aspects to confirm no issues with the PSP alignment
- Detailed geotechnical investigation
- Contamination Study

9.7 Light Rail Alignment

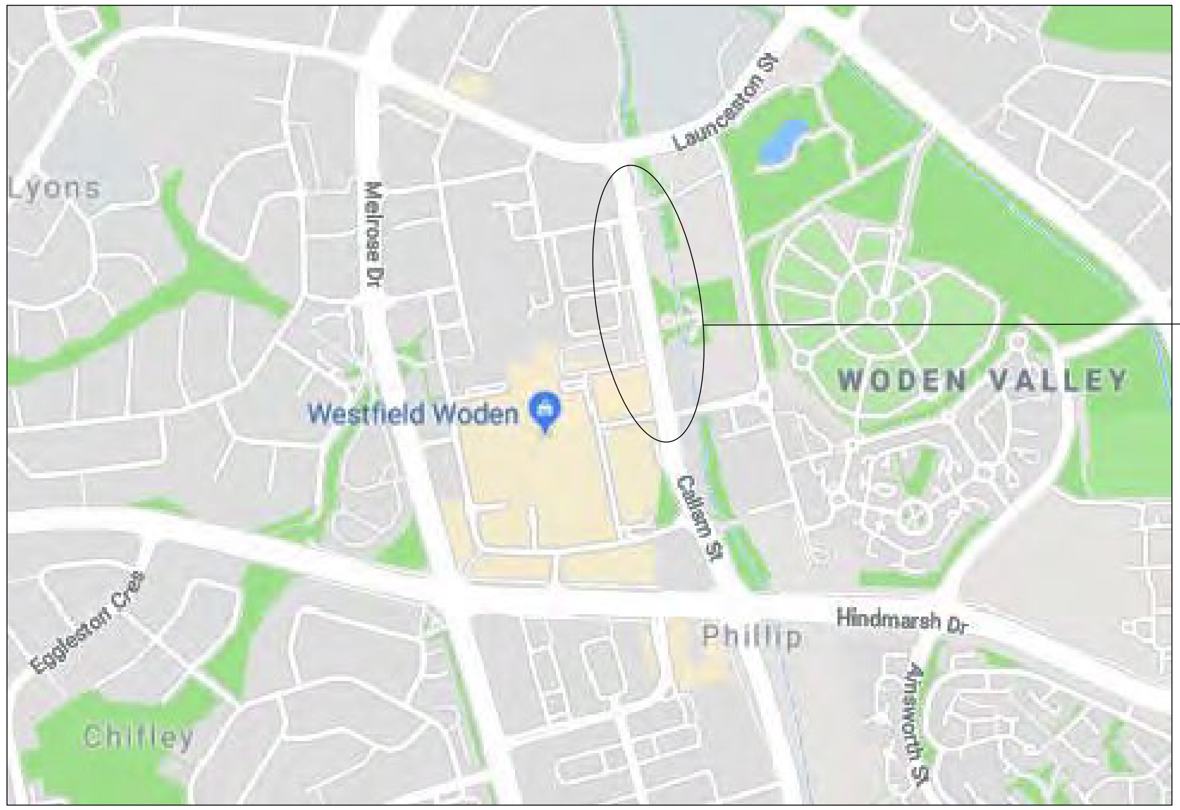
- Formalise light rail alignment;
- Consider safety of pedestrian movement and risk management approaches; and
- Pedestrian modelling on Legion or equivalent.

Appendix A. Final PSP Drawings

INFRASTRUCTURE, FINANCE AND CAPITAL WORKS

WODEN BUS INTERCHANGE AND ROAD LAYOUT MODIFICATIONS

ISSUED FOR FINAL PSP DESIGN



SITE OF WORK

LOCALITY PLAN
(NOT TO SCALE)

NOT FOR CONSTRUCTION

THIS DRAWING MAY BE PREPARED IN COLOUR AND MAY BE INCOMPLETE IF COPIED

0 5 10 15 20 25 30 35 40 45 50mm ON A3 SIZE ORIGINAL

DRAWING FILE LOCATION \ NAME - PLOT DATE \ TIME - PLOT BY
\\jacobs.com\anz\IE\Projects\03_Southern\IS268800\01 Design\Drawings\Civil\IS268800-DG-GE-0001.dwg - 27/08/2019 1:27:03 PM - imedii

DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING

REV	DATE	AMENDMENT / REVISION DESCRIPTION	APPROVAL
0	05.07.19	ISSUED FOR DRAFT PSP DESIGN	L.QASEM
1	28.08.19	ISSUED FOR FINAL PSP DESIGN	L.QASEM

PROJECT BREAKDOWN STRUCTURE

SCALES ON A3 SIZE DRAWING

STROMLO COORDINATE SYSTEM: AGD66
HEIGHT DATUM: AHD

JACOBS DOCUMENT NUMBER: IS268800-DG-GE-0001

DRAWINGS / DESIGN PREPARED BY

JACOBS
177 Pacific Highway
NORTH SYDNEY, NSW 2060
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PLOT DATE / TIME: 27/08/2019
PLOT BY: imedii

TITLE	NAME	DATE
DRAWN	I.IMEDI	28.08.19
DRG CHECK	S.GALLOWAY	28.08.19
DESIGN	R.TIRICOVSKI	28.08.19
DESIGN CHECK	D.HORWOOD	28.08.19
DESIGN MNGR	G.TRUNDLE	28.08.19
PROJECT MNGR	L.QASEM	28.08.19

CLIENT

ACT GOVERNMENT
WODEN BUS INTERCHANGE AND ROAD LAYOUT MODIFICATIONS
WODEN BUS INTERCHANGE

COVER SHEET

A3

ACT REGISTRATION No. TCLR-201-BRI-0006
PART

ISSUE STATUS: PSP DESIGN
EDMS No.
SHEET No.: GE-0001
REV: 1

DRAWING NUMBER	DRAWING TITLE
GENERAL	
GE-0001	COVER SHEET
GE-0011	DRAWING INDEX
GE-0021	GENERAL NOTES
ROAD GEOMETRY	
RD-0051	ROAD GEOMETRY TYPICAL SECTIONS
RD-0101	ROAD GEOMETRY PLAN SHEET 1 OF 5
RD-0102	ROAD GEOMETRY PLAN SHEET 2 OF 5
RD-0103	ROAD GEOMETRY PLAN SHEET 3 OF 5
RD-0104	ROAD GEOMETRY PLAN SHEET 4 OF 5
RD-0105	ROAD GEOMETRY PLAN SHEET 5 OF 5
RD-0201	ROAD GEOMETRY LONGITUDINAL SECTIONS - MC00 SHEET 1 OF 7
RD-0202	ROAD GEOMETRY LONGITUDINAL SECTIONS - MC01 SHEET 2 OF 7
RD-0203	ROAD GEOMETRY LONGITUDINAL SECTIONS - MC01 SHEET 3 OF 7
RD-0204	ROAD GEOMETRY LONGITUDINAL SECTIONS - MC02 SHEET 4 OF 7
RD-0205	ROAD GEOMETRY LONGITUDINAL SECTIONS - MC02 SHEET 5 OF 7
RD-0206	ROAD GEOMETRY LONGITUDINAL SECTIONS - MC10 SHEET 6 OF 7
RD-0207	ROAD GEOMETRY LONGITUDINAL SECTIONS - MC20 SHEET 7 OF 7
DRAINAGE	
SM-0101	DRAINAGE PLAN SHEET 1 OF 5
SM-0102	DRAINAGE PLAN SHEET 2 OF 5
SM-0103	DRAINAGE PLAN SHEET 3 OF 5
SM-0104	DRAINAGE PLAN SHEET 4 OF 5
SM-0105	DRAINAGE PLAN SHEET 5 OF 5
SM-0141	DRAINAGE CATCHMENT AREAS PLAN SHEET 1 OF 5
SM-0142	DRAINAGE CATCHMENT AREAS PLAN SHEET 2 OF 5
SM-0143	DRAINAGE CATCHMENT AREAS PLAN SHEET 3 OF 5
SM-0144	DRAINAGE CATCHMENT AREAS PLAN SHEET 4 OF 5
SM-0145	DRAINAGE CATCHMENT AREAS PLAN SHEET 5 OF 5
PAVEMENT	
PV-0101	PAVEMENT PLAN SHEET 1 OF 5
PV-0102	PAVEMENT PLAN SHEET 2 OF 5
PV-0103	PAVEMENT PLAN SHEET 3 OF 5
PV-0104	PAVEMENT PLAN SHEET 4 OF 5
PV-0105	PAVEMENT PLAN SHEET 5 OF 5
PV-0201	PAVEMENT PROFILES
UTILITIES COORDINATION FOR INFORMATION ONLY	
UT-0101	UTILITY COORDINATION PLAN SHEET 1 OF 5
UT-0102	UTILITY COORDINATION PLAN SHEET 2 OF 5
UT-0103	UTILITY COORDINATION PLAN SHEET 3 OF 5
UT-0104	UTILITY COORDINATION PLAN SHEET 4 OF 5
UT-0105	UTILITY COORDINATION PLAN SHEET 5 OF 5

DRAWING NUMBER	DRAWING TITLE
CONSTRUCTION STAGING	
CS-0101	CONSTRUCTION STAGING 1 - SHEET 1 OF 6
CS-0102	CONSTRUCTION STAGING 2 - SHEET 2 OF 6
CS-0103	CONSTRUCTION STAGING 3 - SHEET 3 OF 6
CS-0104	CONSTRUCTION STAGING 4 - SHEET 4 OF 6
CS-0105	CONSTRUCTION STAGING 5 - SHEET 5 OF 6
CS-0106	CONSTRUCTION STAGING 6 - SHEET 6 OF 6
LANDSCAPING	
LS-0101	LANDSCAPING PLAN
TCS	
TC-0101	TRAFFIC CONTROLE DEVICES PLAN SHEET 1 OF 5
TC-0102	TRAFFIC CONTROLE DEVICES PLAN SHEET 2 OF 5
TC-0103	TRAFFIC CONTROLE DEVICES PLAN SHEET 3 OF 5
TC-0104	TRAFFIC CONTROLE DEVICES PLAN SHEET 4 OF 5
TC-0105	TRAFFIC CONTROLE DEVICES PLAN SHEET 5 OF 5

THIS DRAWING MAY BE PREPARED IN COLOUR AND MAY BE INCOMPLETE IF COPIED

0 5 10 15 20 25 30 35 40 45 50mm ON A3 SIZE ORIGINAL

NOT FOR CONSTRUCTION

DRAWING FILE LOCATION \ NAME - PLOT DATE \ TIME - PLOT BY
\\jacobs.com\anz\IE\Projects\03_Southern\IS268800\01 Design\Drawings\Civil\IS268800-DG-GE-0011.dwg - 27/08/2019 1:03:36 PM - imedii

DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING

REV	DATE	AMENDMENT / REVISION DESCRIPTION	APPROVAL
0	05.07.19	ISSUED FOR DRAFT PSP DESIGN	L.QASEM
1	28.08.19	ISSUED FOR FINAL PSP DESIGN	L.QASEM

PROJECT BREAKDOWN STRUCTURE

SCALES ON A3 SIZE DRAWING

STROMLO COORDINATE SYSTEM: AGD66
HEIGHT DATUM: AHD

JACOBS DOCUMENT NUMBER
IS268800-DG-GE-0011

DRAWINGS / DESIGN PREPARED BY
JACOBS
177 Pacific Highway
NORTH SYDNEY, NSW 2060
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PLOT DATE / TIME: 27/08/2019
PLOT BY: imedii

TITLE	NAME	DATE
DRAWN	I.IMEDI	28.08.19
DRG CHECK	S.GALLOWAY	28.08.19
DESIGN	R.TIRICOVSKI	28.08.19
DESIGN CHECK	D.HORWOOD	28.08.19
DESIGN MNGR	G.TRUNDLE	28.08.19
PROJECT MNGR	L.QASEM	28.08.19

CLIENT
ACT Government
Transport Canberra

ACT GOVERNMENT
WODEN BUS INTERCHANGE AND ROAD LAYOUT MODIFICATIONS
WODEN BUS INTERCHANGE

DRAWING INDEX

A3

ACT REGISTRATION No. TCLR-201-BRI-0006
PART

ISSUE STATUS: PSP DESIGN
EDMS No.
SHEET No.: GE-0011
REV: 1

GENERAL

1. THESE NOTES SHALL BE READ IN CONJUNCTION WITH OTHER DRAWINGS, SPECIFICATIONS AND WRITTEN INSTRUCTIONS. ALWAYS REFER TO TECHNICAL SPECIFICATION FOR CLARIFICATION AND DETAILS.
2. ALL DIMENSIONS ON DETAILED DRAWINGS ARE IN METRES UNLESS NOTED OTHERWISE.

PAVEMENT

1. EARTHWORKS TO BE CONSTRUCTED IN ACCORDANCE WITH TAMS STANDARD SPECIFICATION 02.
2. UNBOND PAVEMENT COURSE TO BE CONSTRUCTED IN ACCORDANCE WITH TAMS STANDARD SPECIFICATION 04.
3. SPRAYED SEALS TO BE CONSTRUCTED IN ACCORDANCE WITH TAMS STANDARD SPECIFICATION 04.
4. ASPHALT TO BE CONSTRUCTED IN ACCORDANCE WITH TAMS STANDARD SPECIFICATION 04.
5. LEAN-MIX CONCRETE SUBBASE TO BE CONSTRUCTED IN ACCORDANCE WITH TAMS STANDARD SPECIFICATION 05.
6. CONCRETE BASE TO BE CONSTRUCTED IN ACCORDANCE WITH TAMS STANDARD SPECIFICATION 05.
7. MINOR CONCRETE WORKS TO BE CONSTRUCTED IN ACCORDANCE WITH TAMS STANDARD SPECIFICATION 06.
8. COLD MILLING OF ROAD PAVEMENT MATERIALS TO BE IN ACCORDANCE WITH RMS R101.
9. HEAVY PATCHING OF FLEXIBLE PAVEMENTS TO BE CONSTRUCTED IN ACCORDANCE WITH RMS M250.
10. SHARED PATH JOINT DETAILS TO BE IN ACCORDANCE WITH RMS PAVEMENT STANDARD DRAWING DS2012/000293 (ED 1, REV 1).
11. ASPHALT JOINTS TO BE IN ACCORDANCE WITH RMS PAVEMENT STANDARD DRAWINGS DS2012/001329 (ED 1, REV 0).
12. JRCP DETAILS TO BE IN ACCORDANCE WITH RMS PAVEMENT STANDARD DRAWINGS DS2014/005559 (ED 2, REV 0).

PAVEMENT MARKING

1. PAVEMENT MARKING SHALL BE APPLIED IN ACCORDANCE WITH ACT SPECIFICATION.
2. RAISED PAVEMENT MARKERS SHALL BE PROVIDED ON ALL LANE, EDGE, CONTINUITY AND SEPARATION LINES. THE SPACING OF RAISED MARKERS SHALL BE IN ACCORDANCE WITH ACT SPECIFICATION.
3. NON-PROFILE THERMOPLASTIC LINES ARE TO BE USED FOR ALL LINE MARKING.
4. WATER BORNE PAINT IS TO BE USED FOR ALL ARROWS, NUMERALS AND CAR PARKS.
5. REDUNDANT PAVEMENT MARKING SHALL BE REMOVED FROM THE PAVEMENT. MASKING OF PAVEMENT MARKING IS NOT ACCEPTABLE.

UTILITIES

1. THE LOCATION OF UTILITIES SHOWN ARE INDICATIVE ONLY. THE CONTRACTOR SHALL, BEFORE COMMENCING ANY WORKS:
    (I) DETERMINE THE EXTENT OF EXISTING UTILITY SURVEY AND INFORMATION REFERENCED ON THESE DRAWINGS.
    (II) OBTAIN CURRENT DIAL BEFORE YOU DIG (DBYD) PLANS FROM THE DBYD WEBSITE.
    (III) UNDERTAKE POTHOLING TO CONFIRM THE EXACT LOCATION OF UTILITY SERVICES.
    (IV) ENSURE THE THE ADOPTED WORK METHOD WILL AVOID DAMAGE TO UTILITIES.
2. THE DIMENSIONS AND LOCATION OF EXISTING STRUCTURES SHALL BE CONFIRMED ON-SITE PRIOR TO CONSTRUCTION.
3. THE LOCATION AND LEVEL OF ALL SERVICES CROSSING PROPOSED STORMWATER LINES AND UTILITIES MUST BE OBTAINED PRIOR TO CONSTRUCTION. ALL LEVELS MUST BE CHECKED FOR CONFLICT WITH ANY SERVICES, AND ANY CONFLICTS TO BE RESOLVED WITH THE CONTRACTOR.
4. THE LOCATION AND LEVEL OF ALL SERVICES IN THE VICINITY OF FOOTINGS TO SIGNS, POLES, COLUMNS OR ANY OTHER STRUCTURE SHALL BE CHECKED FOR CONFLICT PRIOR TO CONSTRUCTION AND ANY CONFLICTS RESOLVED WITH THE CONTRACTOR. DUCT CONFIGURATION AND UTILITY SIZES ARE SUBJECT TO CHANGE UNTIL FINAL APPROVED DESIGNS HAVE BEEN RECEIVED FROM THE UTILITY AUTHORITIES.
5. THE CONTRACTOR SHALL REINSTATE ALL UTILITY CONNECTIONS TO ALL PROPERTIES (DETAILS NOT SHOWN ON PLANS).
6. SHEETS UT-0101 TO UT-0105 PRESENT THE LOCATION OF EXISTING UTILITIES PROVIDED BY TRANSPORT CANBERRA BASED ON THE CONFIDENCE OF THEIR SPATIAL POSITION AS DESCRIBED:
    (A) ACCURATE TO 0.05m PLAN, 0.05m VERT
    (B) ACCURATE TO 0.3m PLAN, 0.3m VERT
    (C) ACCURATE TO 1.0m PLAN, 1.0m VERT
    (D) SEVERAL METRES IN PLAN, NO VERT (DIGITISED FROM DIAL BEFORE YOUR DIG)

CONSTRUCTION STAGING

1. ALL INTERSECTIONS TO OPERATE UNDER TRAFFIC CONTROL DURING CONSTRUCTION
2. ACCESS TO THE EXISTING BUS INTERCHANGE TO BE MAINTAINED UNTIL CALLAM STREET INTERCHANGE IS OPERATIONAL

NOT FOR CONSTRUCTION

DRAWING FILE LOCATION \ NAME - PLOT DATE \ TIME - PLOT BY
\\jacobs.com\anz\IE\Projects\03_Southern\IS268800\01 Design\Drawings\Civil\IS268800-DG-GE-0021.dwg - 27/08/2019 1:28:29 PM - imedii

DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING

REV	DATE	AMENDMENT / REVISION DESCRIPTION	APPROVAL
0	05.07.19	ISSUED FOR DRAFT PSP DESIGN	L.QASEM
1	28.08.19	ISSUED FOR FINAL PSP DESIGN	L.QASEM

PROJECT BREAKDOWN STRUCTURE

SCALES ON A3 SIZE DRAWING

STROMLO COORDINATE SYSTEM: AGD66
HEIGHT DATUM: AHD

JACOBS DOCUMENT NUMBER: IS268800-DG-GE-0021

DRAWINGS / DESIGN PREPARED BY
JACOBS
177 Pacific Highway
NORTH SYDNEY, NSW 2060
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PLOT DATE / TIME: 27/08/2019
PLOT BY: imedii

TITLE	NAME	DATE
DRAWN	I.IMEDI	28.08.19
DRG CHECK	S.GALLOWAY	28.08.19
DESIGN	R.TIRICOVSKI	28.08.19
DESIGN CHECK	D.HORWOOD	28.08.19
DESIGN MNGR	G.TRUNDLE	28.08.19
PROJECT MNGR	L.QASEM	28.08.19

CLIENT
ACT Government | Transport Canberra

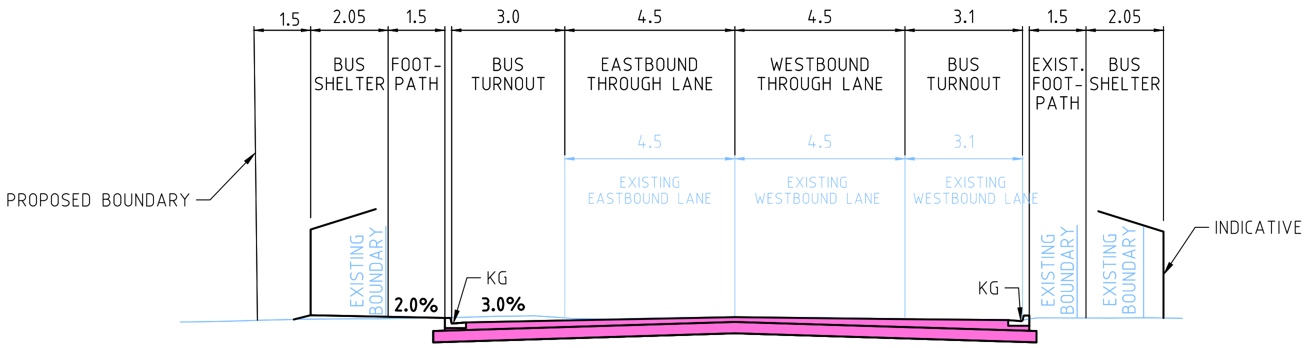
ACT GOVERNMENT
WODEN BUS INTERCHANGE AND ROAD LAYOUT MODIFICATIONS
WODEN BUS INTERCHANGE

GENERAL NOTES

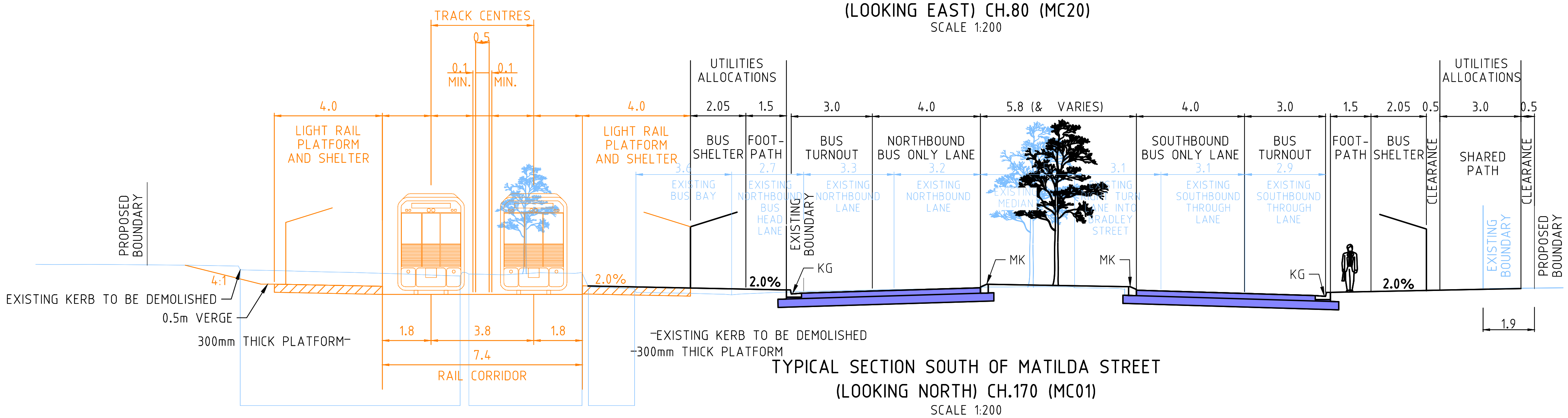
A3

ACT REGISTRATION No. TCLR-201-BRI-0006
PART

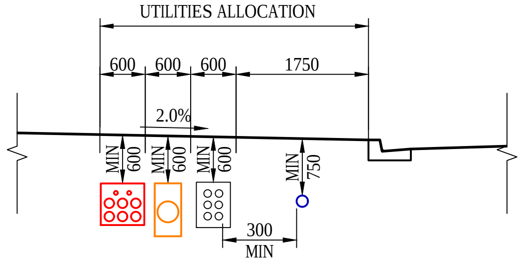
ISSUE STATUS: PSP DESIGN
EDMS No.
SHEET No.: GE-0021
REV: 1



TYPICAL SECTION BRADLEY STREET
(LOOKING EAST) CH.80 (MC20)
SCALE 1:200



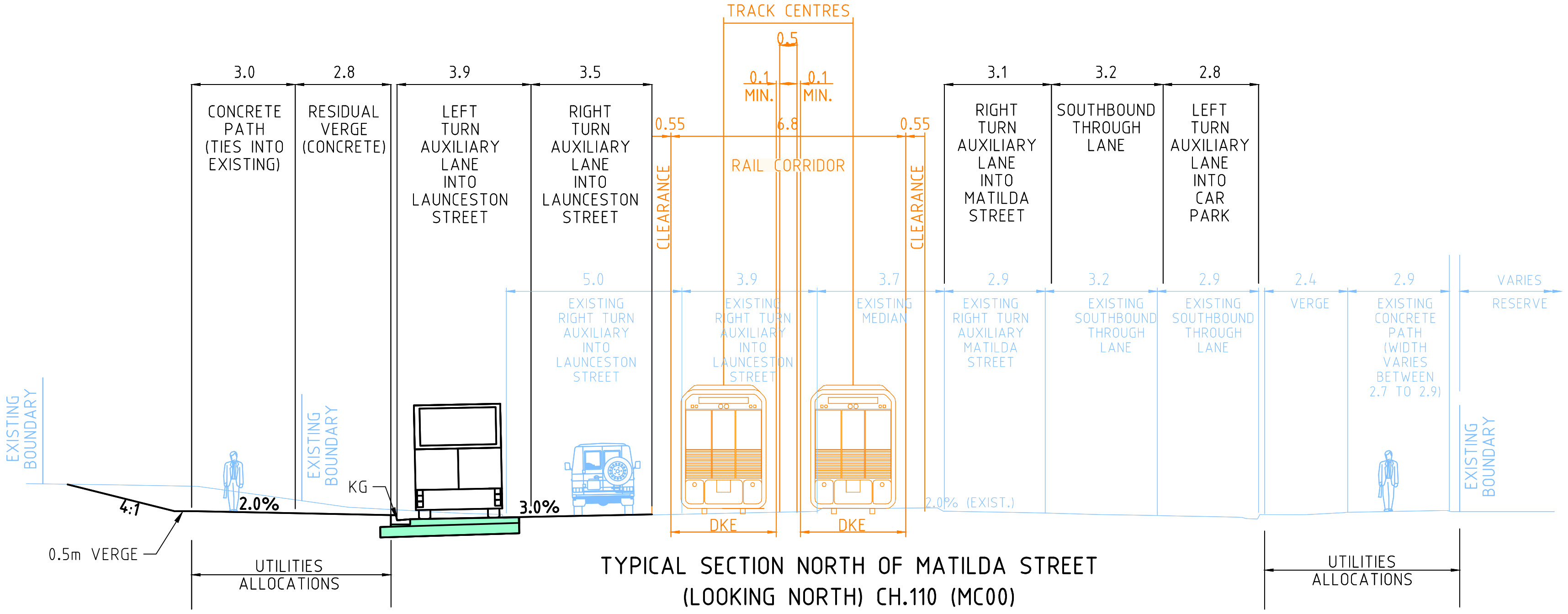
TYPICAL SECTION SOUTH OF MATILDA STREET
(LOOKING NORTH) CH.170 (MC01)
SCALE 1:200



TYPICAL SECTION OF UTILITIES ALLOCATION
SCALE 1:100

LEGEND

—	FUTURE WORKS
—	NEW BUS INTERCHANGE ADJUSTMENTS
—	EXISTING
🟦	TYPE 1 - CALLAM INTERCHANGE
🟪	TYPE 2 - BRADLEY INTERCHANGE
🟩	TYPE 3 - CALLAM WIDENING



TYPICAL SECTION NORTH OF MATILDA STREET
(LOOKING NORTH) CH.110 (MC00)
SCALE 1:200

THIS DRAWING MAY BE PREPARED IN COLOUR AND MAY BE INCOMPLETE IF COPIED

50mm ON A3 SIZE ORIGINAL

0 5 10 15 20 25 30 35 40 45

NOT FOR CONSTRUCTION

DRAWING FILE LOCATION \ NAME - PLOT DATE \ TIME - PLOT BY
\\jacobs.com\anz\IE\Projects\03_Southern\IS268800\01 Design\Drawings\Civil\ss\IS268800-DG-RD-0051.dwg - 28/08/2019 12:10:17 PM - imedii

DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING

REV	DATE	AMENDMENT / REVISION DESCRIPTION	APPROVAL
0	05.07.19	ISSUED FOR DRAFT PSP DESIGN	L.QASEM
1	28.08.19	ISSUED FOR FINAL PSP DESIGN	L.QASEM

PROJECT BREAKDOWN STRUCTURE

SCALES ON A3 SIZE DRAWING

STROMLO COORDINATE SYSTEM: AGD66
HEIGHT DATUM: AHD

JACOBS DOCUMENT NUMBER
IS268800-DG-RD-0051

DRAWINGS / DESIGN PREPARED BY

JACOBS
177 Pacific Highway
NORTH SYDNEY, NSW 2060
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PLOT DATE / TIME: 28/08/2019
PLOT BY: imedii

TITLE	NAME	DATE
DRAWN	I.IMEDI	28.08.19
DRG CHECK	S.GALLOWAY	28.08.19
DESIGN	R.TIRICOVSKI	28.08.19
DESIGN CHECK	D.HORWOOD	28.08.19
DESIGN MNGR	G.TRUNDLE	28.08.19
PROJECT MNGR	L.QASEM	28.08.19

CLIENT
ACT Government
Transport Canberra

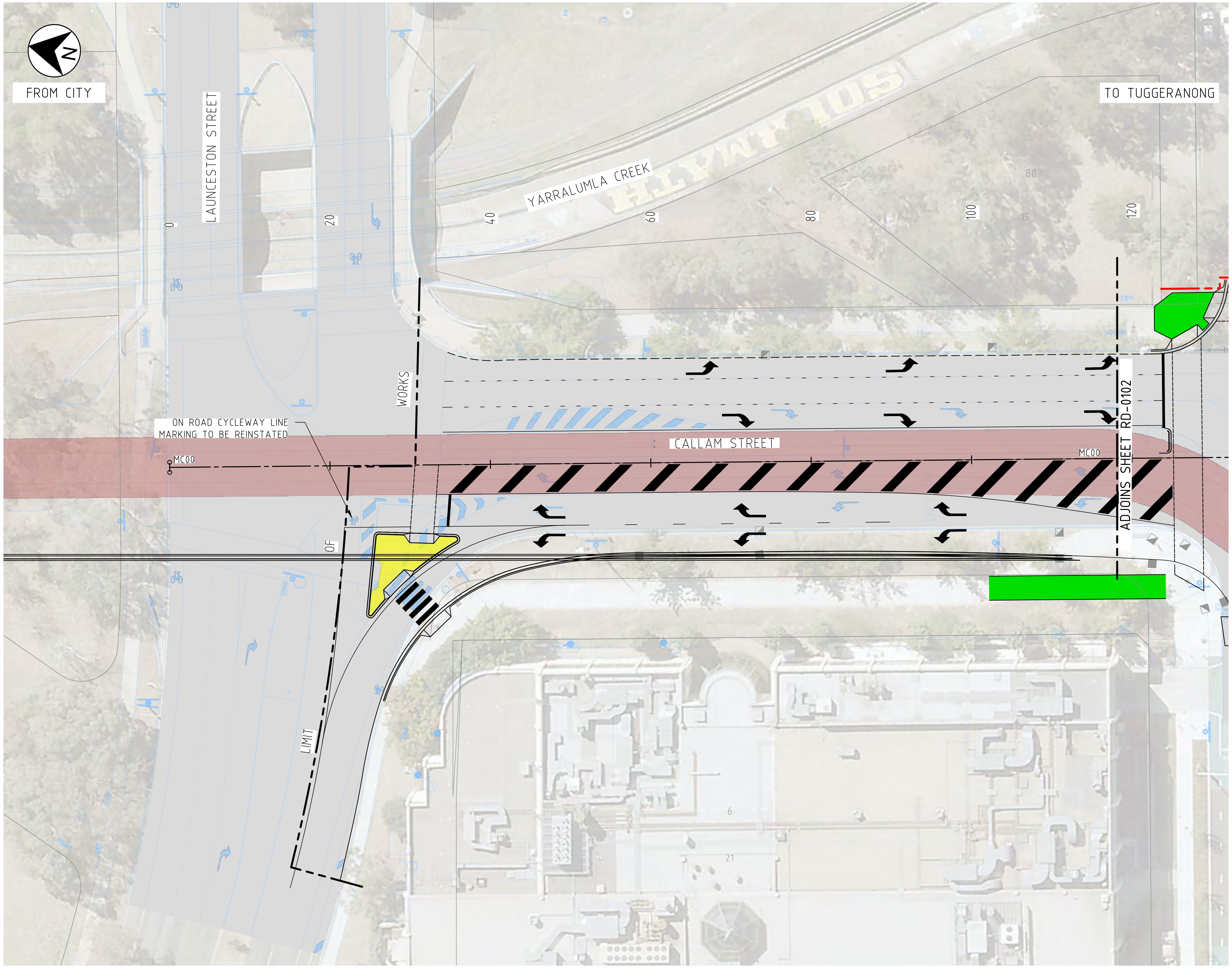
ACT GOVERNMENT
WODEN BUS INTERCHANGE AND ROAD LAYOUT MODIFICATIONS
WODEN BUS INTERCHANGE

ROAD GEOMETRY TYPICAL SECTIONS

A3

ACT REGISTRATION No. TCLR-201-BRI-0006
PART

ISSUE STATUS: PSP DESIGN
EDMS No.
SHEET No.: RD-0051
REV: 1



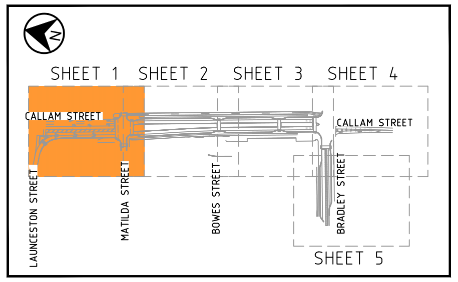
LEGEND

GENERAL

	SURVEY
30 80	CADASTRAL LOT AND DP NUMBER
—	EXISTING CADASTRIAL BOUNDARY
— · —	NEW PROJECT BOUNDARY
▨	EXISTING PAVEMENT
🟨	NEW RAISED MEDIAN
🟩	NEW SHARED PATH
▨	FOOTPATH/BUS SHELTER CORRIDOR
🟫	INDICATIVE LIGHT RAIL ALIGNMENT (BY OTHERS)
🟪	INDICATIVE BUS SHELTER
MC00	CONTROL LINE AND LABEL MAIN CARRIAGEWAY
	NEW TRANSVERSE DRAINAGE

NOTES

1. FOR GENERAL NOTES REFER SHEET No. GE-0021. TCLR-201-BRI-006.



KEY PLAN

NTS

NOT FOR CONSTRUCTION

DRAWING FILE LOCATION \ NAME - PLOT DATE \ TIME - PLOT BY
\\jacobs.com\anz\IE\Projects\03_Southern\IS268800\01 Design\Drawings\Civil\IS268800-DG-RD-0101-0105.dwg - 27/08/2019 3:35:57 PM - imedii

DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING

REV	DATE	AMENDMENT / REVISION DESCRIPTION	APPROVAL
0	05.07.19	ISSUED FOR DRAFT PSP DESIGN	L.QASEM
1	28.08.19	ISSUED FOR FINAL PSP DESIGN	L.QASEM

PROJECT BREAKDOWN STRUCTURE

SCALES ON A3 SIZE DRAWING

SCALE 1:500 5 0 5 10 AT A3

STROMLO COORDINATE SYSTEM AGD66

HEIGHT DATUM AHD

JACOBS DOCUMENT NUMBER
IS268800-DG-RD-0101

DRAWINGS / DESIGN PREPARED BY

JACOBS
177 Pacific Highway
NORTH SYDNEY, NSW 2060
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PLOT DATE / TIME 27/08/2019
PLOT BY imedii

TITLE	NAME	DATE
DRAWN	I.IMEDI	28.08.19
DRG CHECK	S.GALLOWAY	28.08.19
DESIGN	R.TIRICOVSKI	28.08.19
DESIGN CHECK	D.HORWOOD	28.08.19
DESIGN MNGR	G.TRUNDLE	28.08.19
PROJECT MNGR	L.QASEM	28.08.19

CLIENT

ACT Government | Transport Canberra

ACT GOVERNMENT
WODEN BUS INTERCHANGE AND ROAD LAYOUT MODIFICATIONS
WODEN BUS INTERCHANGE

A3

ROAD GEOMETRY PLAN

SHEET 1 OF 5

ACT REGISTRATION No. TCLR-201-BRI-0006

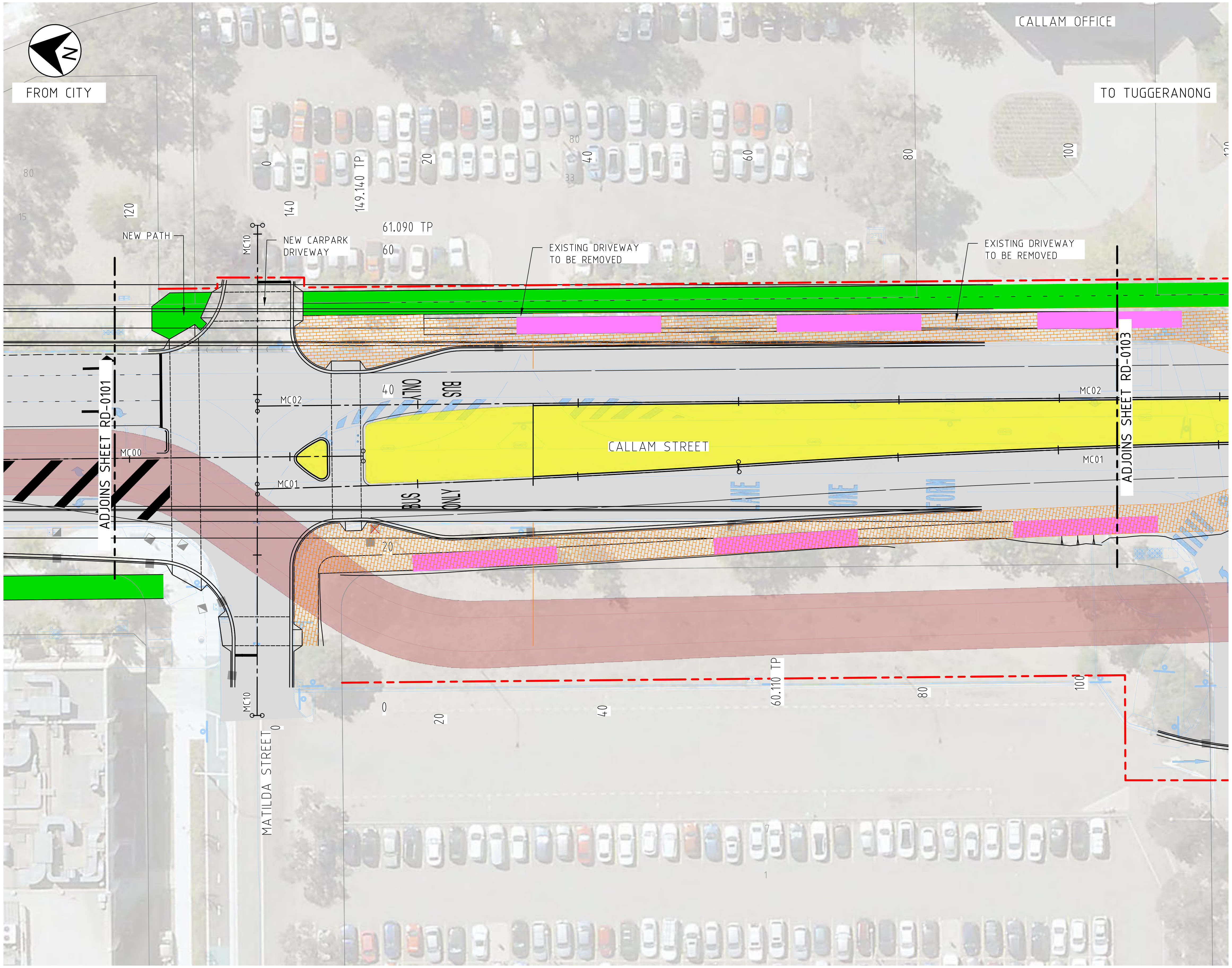
PART

ISSUE STATUS PSP DESIGN

EDMS No.

SHEET No. RD-0101

REV 1



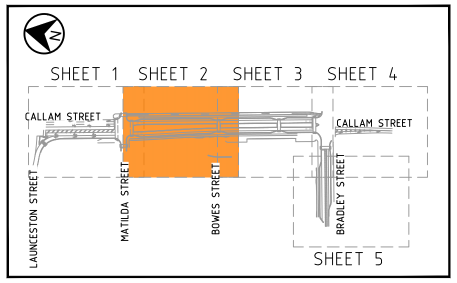
LEGEND

GENERAL

	SURVEY
30 80	CADASTRAL LOT AND DP NUMBER
	EXISTING CADASTRIAL BOUNDARY
— · —	NEW PROJECT BOUNDARY
▨	EXISTING PAVEMENT
🟨	NEW RAISED MEDIAN
🟩	NEW SHARED PATH
▨	FOOTPATH/BUS SHELTER CORRIDOR
🟥	INDICATIVE LIGHT RAIL ALIGNMENT (BY OTHERS)
🟪	INDICATIVE BUS SHELTER
MC00	CONTROL LINE AND LABEL MAIN CARRIAGEWAY
	NEW TRANSVERSE DRAINAGE

NOTES

1. FOR GENERAL NOTES REFER SHEET No. GE-0021. TCLR-201-BRI-006.



KEY PLAN

NTS

NOT FOR CONSTRUCTION

THIS DRAWING MAY BE PREPARED IN COLOUR AND MAY BE INCOMPLETE IF COPIED

50mm ON A3 SIZE ORIGINAL

DRAWING FILE LOCATION \ NAME - PLOT DATE \ TIME - PLOT BY
\\jacobs.com\anz\IE\Projects\03_Southern\IS268800\01 Design\Drawings\Civil\IS268800-DG-RD-0101-0105.dwg - 27/08/2019 3:36:02 PM - imedii

DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING

REV	DATE	AMENDMENT / REVISION DESCRIPTION	APPROVAL
0	05.07.19	ISSUED FOR DRAFT PSP DESIGN	L.QASEM
1	28.08.19	ISSUED FOR FINAL PSP DESIGN	L.QASEM

PROJECT BREAKDOWN STRUCTURE

SCALES ON A3 SIZE DRAWING

SCALE 1:500 (5 0 5 10) AT A3

STROMLO COORDINATE SYSTEM: AGD66
HEIGHT DATUM: AHD

JACOBS DOCUMENT NUMBER: IS268800-DG-RD-0102

DRAWINGS / DESIGN PREPARED BY

JACOBS
177 Pacific Highway
NORTH SYDNEY, NSW 2060
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PLOT DATE / TIME: 27/08/2019
PLOT BY: imedii

TITLE	NAME	DATE
DRAWN	I.IMEDI	28.08.19
DRG CHECK	S.GALLOWAY	28.08.19
DESIGN	R.TIRICOVSKI	28.08.19
DESIGN CHECK	D.HORWOOD	28.08.19
DESIGN MNGR	G.TRUNDLE	28.08.19
PROJECT MNGR	L.QASEM	28.08.19

CLIENT

ACT Government | Transport Canberra

ACT GOVERNMENT
WODEN BUS INTERCHANGE AND ROAD LAYOUT MODIFICATIONS
WODEN BUS INTERCHANGE

ROAD GEOMETRY PLAN

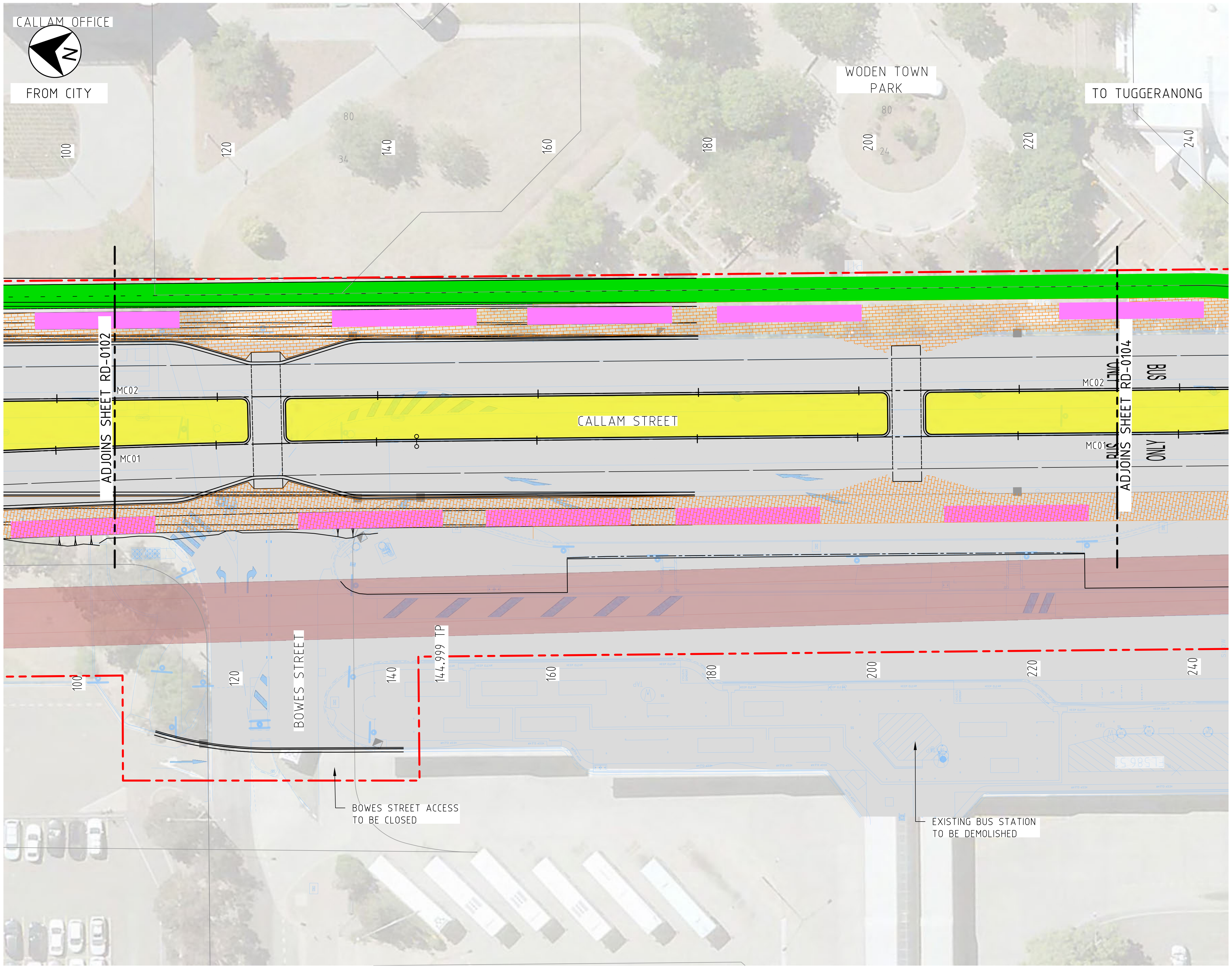
SHEET 2 OF 5

A3

ACT REGISTRATION No. TCLR-201-BRI-0006

PART

ISSUE STATUS: PSP DESIGN
EDMS No.
SHEET No.: RD-0102
REV: 1



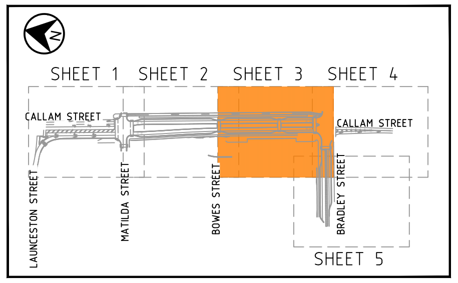
LEGEND

GENERAL

	SURVEY
30 80	CADASTRAL LOT AND DP NUMBER
	EXISTING CADASTRIAL BOUNDARY
	NEW PROJECT BOUNDARY
⬜	EXISTING PAVEMENT
🟨	NEW RAISED MEDIAN
🟩	NEW SHARED PATH
▨	FOOTPATH/BUS SHELTER CORRIDOR
🟫	INDICATIVE LIGHT RAIL ALIGNMENT (BY OTHERS)
🟪	INDICATIVE BUS SHELTER
MC00	CONTROL LINE AND LABEL MAIN CARRIAGEWAY
	NEW TRANSVERSE DRAINAGE

NOTES

1. FOR GENERAL NOTES REFER SHEET No. GE-0021. TCLR-201-BRI-006.



KEY PLAN

NTS

NOT FOR CONSTRUCTION

THIS DRAWING MAY BE PREPARED IN COLOUR AND MAY BE INCOMPLETE IF COPIED

50mm ON A3 SIZE ORIGINAL

DRAWING FILE LOCATION \ NAME - PLOT DATE \ TIME - PLOT BY

\\jacobs.com\anz\IE\Projects\03_Southern\IS268800\01 Design\Drawings\Civil\IS268800-DG-RD-0101-0105.dwg - 27/08/2019 3:36:10 PM - imedii

DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING

REV	DATE	AMENDMENT / REVISION DESCRIPTION	APPROVAL
0	05.07.19	ISSUED FOR DRAFT PSP DESIGN	L.QASEM
1	28.08.19	ISSUED FOR FINAL PSP DESIGN	L.QASEM

PROJECT BREAKDOWN STRUCTURE

SCALES ON A3 SIZE DRAWING

SCALE 1:500 AT A3

STROMLO COORDINATE SYSTEM AGD66

HEIGHT DATUM AHD

JACOBS DOCUMENT NUMBER IS268800-DG-RD-0103

DRAWINGS / DESIGN PREPARED BY

JACOBS
177 Pacific Highway
NORTH SYDNEY, NSW 2060
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PLOT DATE / TIME 27/08/2019

PLOT BY imedii

TITLE	NAME	DATE
DRAWN	I.MEDI	28.08.19
DRG CHECK	S.GALLOWAY	28.08.19
DESIGN	R.TIRICOVSKI	28.08.19
DESIGN CHECK	D.HORWOOD	28.08.19
DESIGN MNGR	G.TRUNDLE	28.08.19
PROJECT MNGR	L.QASEM	28.08.19

CLIENT

ACT Government
Transport Canberra

ACT GOVERNMENT
WODEN BUS INTERCHANGE AND ROAD LAYOUT MODIFICATIONS
WODEN BUS INTERCHANGE

ROAD GEOMETRY PLAN

SHEET 3 OF 5

A3

ACT REGISTRATION No. TCLR-201-BRI-0006

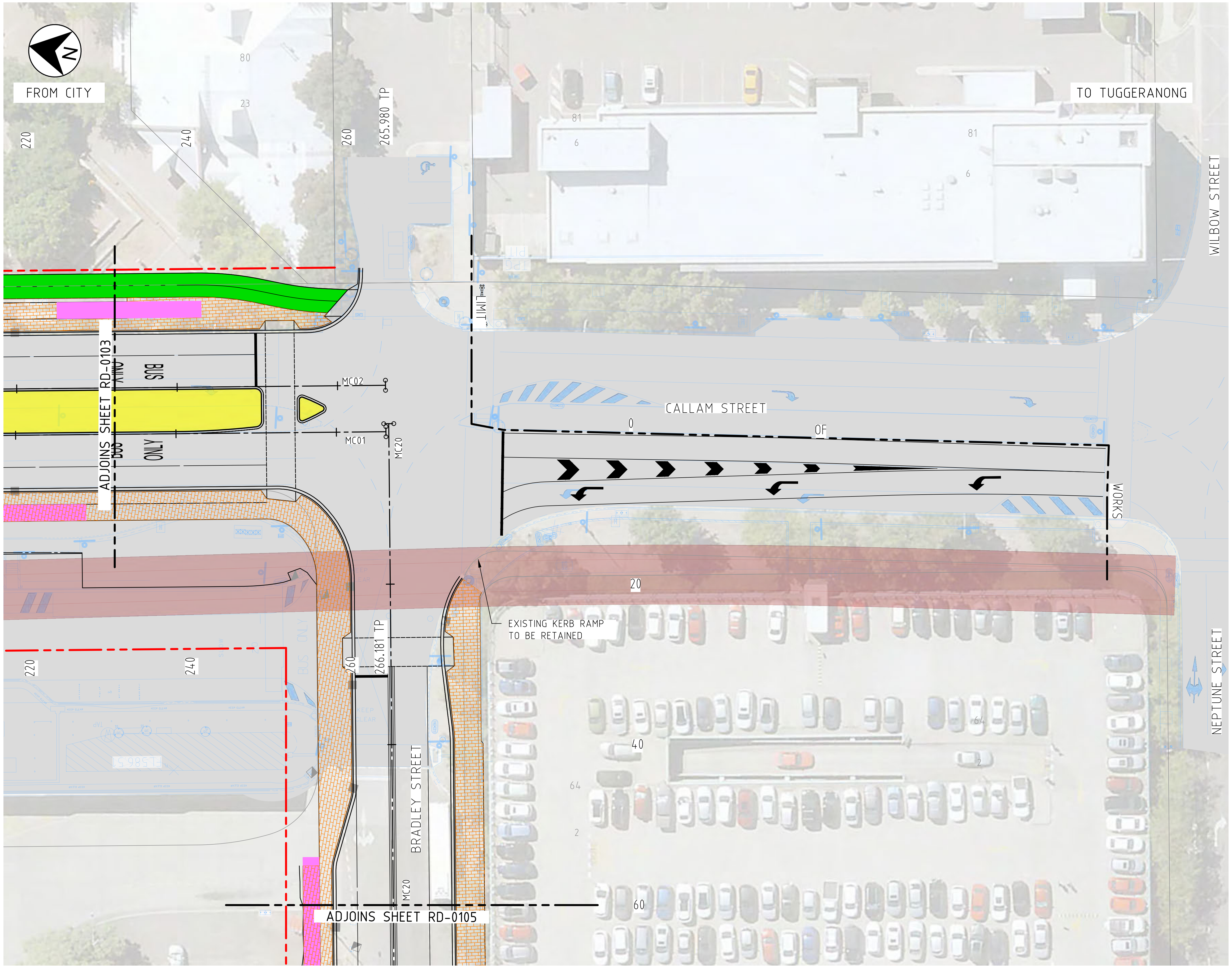
PART

ISSUE STATUS PSP DESIGN

EDMS No.

SHEET No. RD-0103

REV 1



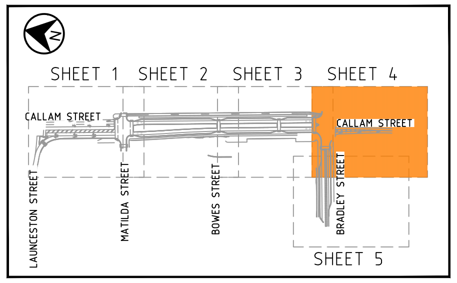
LEGEND

GENERAL

- SURVEY
- 30/80 CADASTRAL LOT AND DP NUMBER
- EXISTING CADASTRIAL BOUNDARY
- NEW PROJECT BOUNDARY
- ⬜ EXISTING PAVEMENT
- 🟨 NEW RAISED MEDIAN
- 🟩 NEW SHARED PATH
- ▨ FOOTPATH/BUS SHELTER CORRIDOR
- 🟥 INDICATIVE LIGHT RAIL ALIGNMENT (BY OTHERS)
- 🟪 INDICATIVE BUS SHELTER
- MC00 CONTROL LINE AND LABEL MAIN CARRIAGEWAY
- NEW TRANSVERSE DRAINAGE

NOTES

1. FOR GENERAL NOTES REFER SHEET No. GE-0021. TCLR-201-BRI-006.



KEY PLAN
NTS

NOT FOR CONSTRUCTION

THIS DRAWING MAY BE PREPARED IN COLOUR AND MAY BE INCOMPLETE IF COPIED

50mm ON A3 SIZE ORIGINAL

0 5 10 15 20 25 30 35 40 45

DRAWING FILE LOCATION \ NAME - PLOT DATE \ TIME - PLOT BY
\\jacobs.com\anz\IE\Projects\03_Southern\IS268800\01 Design\Drawings\Civil\IS268800-DG-RD-0101-0105.dwg - 27/08/2019 3:36:15 PM - imedii

DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING

REV	DATE	AMENDMENT / REVISION DESCRIPTION	APPROVAL
0	05.07.19	ISSUED FOR DRAFT PSP DESIGN	L.QASEM
1	28.08.19	ISSUED FOR FINAL PSP DESIGN	L.QASEM

PROJECT BREAKDOWN STRUCTURE

SCALES ON A3 SIZE DRAWING
SCALE 1:500 5 0 5 10 AT A3

STROMLO COORDINATE SYSTEM AGD66
HEIGHT DATUM AHD

JACOBS DOCUMENT NUMBER
IS268800-DG-RD-0104

DRAWINGS / DESIGN PREPARED BY
JACOBS
177 Pacific Highway
NORTH SYDNEY, NSW 2060
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PLOT DATE / TIME 27/08/2019
PLOT BY imedii

TITLE	NAME	DATE
DRAWN	I.IMEDI	28.08.19
DRG CHECK	S.GALLOWAY	28.08.19
DESIGN	R.TIRICOVSKI	28.08.19
DESIGN CHECK	D.HORWOOD	28.08.19
DESIGN MNGR	G.TRUNDLE	28.08.19
PROJECT MNGR	L.QASEM	28.08.19

CLIENT
ACT Government
Transport Canberra

ACT GOVERNMENT
WODEN BUS INTERCHANGE AND ROAD LAYOUT MODIFICATIONS
WODEN BUS INTERCHANGE

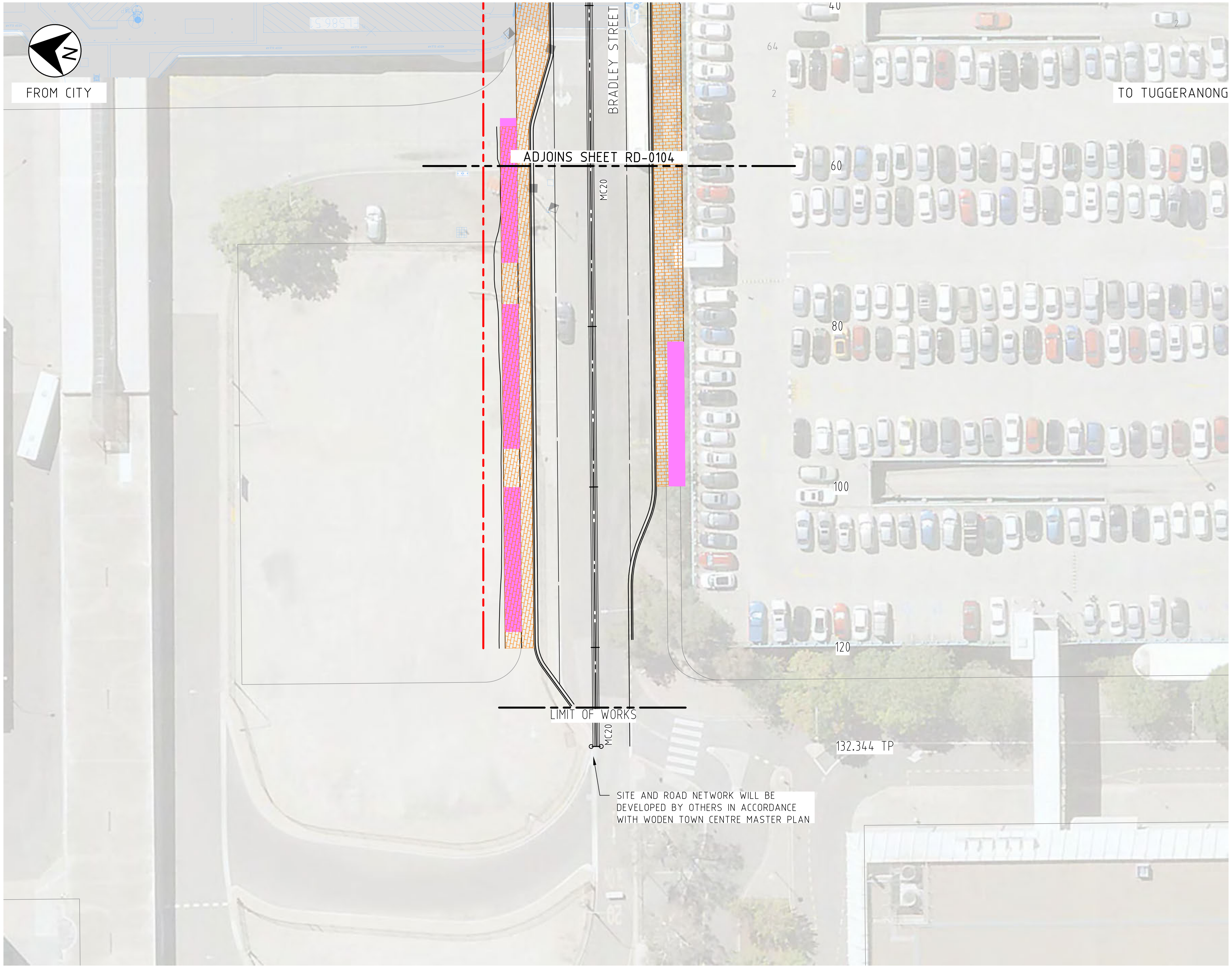
ROAD GEOMETRY PLAN

SHEET 4 OF 5

A3

ACT REGISTRATION No. TCLR-201-BRI-0006
PART

ISSUE STATUS PSP DESIGN
EDMS No.
SHEET No. RD-0104
REV 1

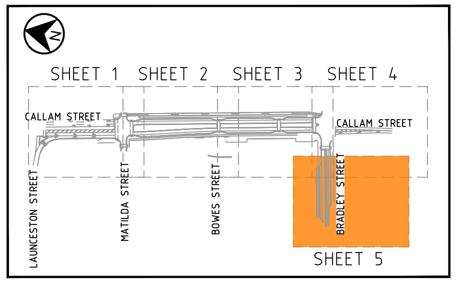


LEGEND

GENERAL

—	SURVEY
30 80	CADASTRAL LOT AND DP NUMBER
—	EXISTING CADASTRIAL BOUNDARY
— · —	NEW PROJECT BOUNDARY
▨	EXISTING PAVEMENT
🟨	NEW RAISED MEDIAN
🟩	NEW SHARED PATH
▨	FOOTPATH/BUS SHELTER CORRIDOR
🟥	INDICATIVE LIGHT RAIL ALIGNMENT (BY OTHERS)
▨	INDICATIVE BUS SHELTER
MC00	CONTROL LINE AND LABEL MAIN CARRIAGEWAY
▬ ▬ ▬	NEW TRANSVERSE DRAINAGE

NOTES
1. FOR GENERAL NOTES REFER SHEET No. GE-0021. TCLR-201-BRI-006.



KEY PLAN
NTS

NOT FOR CONSTRUCTION

DRAWING FILE LOCATION \ NAME - PLOT DATE \ TIME - PLOT BY
\\jacobs.com\anz\IE\Projects\03_Southern\IS268800\01 Design\Drawings\Civil\IS268800-DG-RD-0101-0105.dwg - 27/08/2019 3:36:18 PM - imedii

DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING

REV	DATE	AMENDMENT / REVISION DESCRIPTION	APPROVAL
0	05.07.19	ISSUED FOR DRAFT PSP DESIGN	L.QASEM
1	28.08.19	ISSUED FOR FINAL PSP DESIGN	L.QASEM

PROJECT BREAKDOWN STRUCTURE

SCALES ON A3 SIZE DRAWING
SCALE 1:500 5 0 5 10 AT A3

STROMLO COORDINATE SYSTEM AGD66
HEIGHT DATUM AHD

JACOBS DOCUMENT NUMBER
IS268800-DG-RD-0105

DRAWINGS / DESIGN PREPARED BY
JACOBS
177 Pacific Highway
NORTH SYDNEY, NSW 2060
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PLOT DATE / TIME 27/08/2019
PLOT BY imedii

TITLE	NAME	DATE
DRAWN	I.IMEDI	28.08.19
DRG CHECK	S.GALLOWAY	28.08.19
DESIGN	R.TIRICOVSKI	28.08.19
DESIGN CHECK	D.HORWOOD	28.08.19
DESIGN MNGR	G.TRUNDLE	28.08.19
PROJECT MNGR	L.QASEM	28.08.19

CLIENT
ACT Government
Transport Canberra

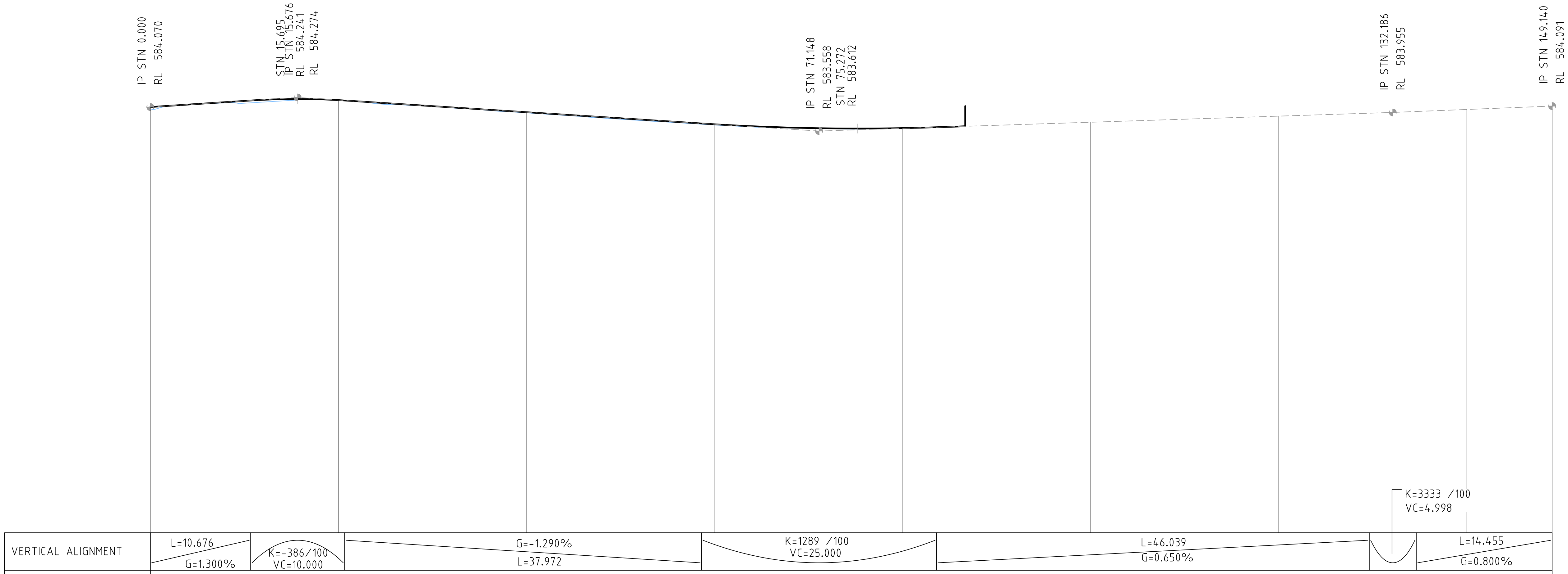
ACT GOVERNMENT
WODEN BUS INTERCHANGE AND ROAD LAYOUT MODIFICATIONS
WODEN BUS INTERCHANGE

ROAD GEOMETRY PLAN
SHEET 5 OF 5

A3

ACT REGISTRATION No. TCLR-201-BRI-0006
PART

ISSUE STATUS PSP DESIGN
EDMS No.
SHEET No. RD-0105
REV 1



HORIZONTAL ALIGNMENT: STRAIGHT

DESIGN LEVELS	584.070	584.209	584.217	584.209	583.960	583.719	583.703	583.621	583.639	583.746	583.876	583.939	583.975	584.017	584.091
EXISTING LEVELS	584.009		584.223		583.946		583.688	583.624		583.736	583.868			584.009	584.076
CHAINAGE	HTP VTP 0.000	VTP 10.676	20.000	VTP 20.676	40.000	VTP 58.648	60.000	80.000	VTP 83.648	100.000	120.000	VTP 129.687	VTP 134.686	140.000	HTP VTP 149.140

LONGITUDINAL SECTION ALONG CONTROL MC00 - CALLAM STREET
(BETWEEN LAUNCESTON STREET & MATILDA STREET)

NOT FOR CONSTRUCTION

THIS DRAWING MAY BE PREPARED IN COLOUR AND MAY BE INCOMPLETE IF COPIED
0 5 10 15 20 25 30 35 40 45 50mm ON A3 SIZE ORIGINAL

DRAWING FILE LOCATION \ NAME - PLOT DATE \ TIME - PLOT BY
\\jacobs.com\anz\IE\Projects\03_Southern\IS268800\01 Design\Drawings\Civil\IS268800-DG-RD-0201-0207.dwg - 27/08/2019 1:30:10 PM - imedii

DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING

REV	DATE	AMENDMENT / REVISION DESCRIPTION	APPROVAL
0	05.07.19	ISSUED FOR DRAFT PSP DESIGN	L.QASEM
1	28.08.19	ISSUED FOR FINAL PSP DESIGN	L.QASEM

PROJECT BREAKDOWN STRUCTURE

SCALES ON A3 SIZE DRAWING
HORIZ. 1:500 5 0 5 10
VERT. 1:100 1 0 1 2
AT A3

STROMLO COORDINATE SYSTEM: AGD66
HEIGHT DATUM: AHD

JACOBS DOCUMENT NUMBER
IS268800-DG-RD-0201

DRAWINGS / DESIGN PREPARED BY
JACOBS
177 Pacific Highway
NORTH SYDNEY, NSW 2060
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PLOT DATE / TIME: 27/08/2019
PLOT BY: imedii

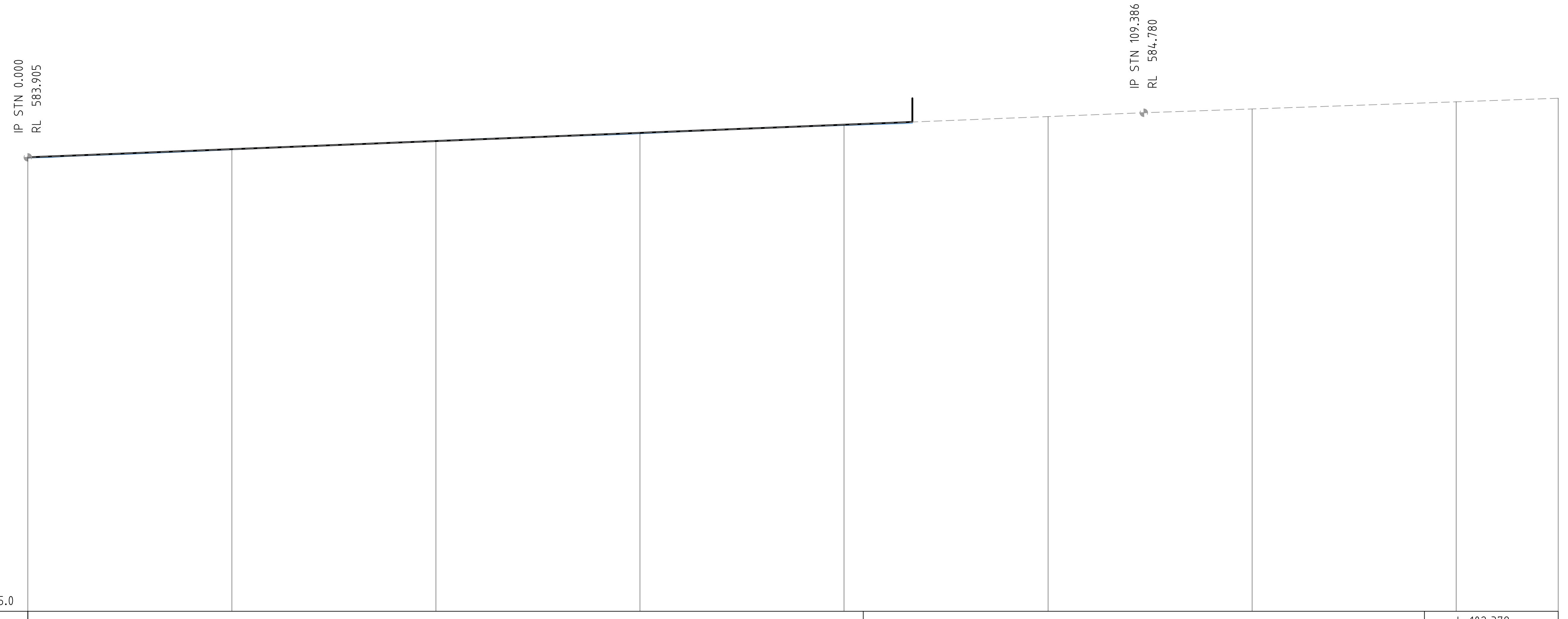
TITLE	NAME	DATE
DRAWN	I.MEDI	28.08.19
DRG CHECK	S.GALLOWAY	28.08.19
DESIGN	R.TIRICOVSKI	28.08.19
DESIGN CHECK	D.HORWOOD	28.08.19
DESIGN MNGR	G.TRUNDLE	28.08.19
PROJECT MNGR	L.QASEM	28.08.19

CLIENT
ACT Government
Transport Canberra

ACT GOVERNMENT
WODEN BUS INTERCHANGE AND ROAD LAYOUT MODIFICATIONS
WODEN BUS INTERCHANGE
ROAD GEOMETRY LONGITUDINAL SECTIONS - MC00
SHEET 1 OF 7
A3

ACT REGISTRATION No. TCLR-201-BRI-0006
PART

ISSUE STATUS: PSP DESIGN
EDMS No.
SHEET No.: RD-0201
REV: 1



VERTICAL ALIGNMENT	L=81.884 G=0.800%						VC=55.004 K=-55000 /100				L=102.379 G=0.700%	
HORIZONTAL ALIGNMENT	R=-1500.000			R=1500.000							STRAIGHT	
DESIGN LEVELS	583.905	584.065	584.225	584.385 584.386	584.545	584.560	584.702	584.852	584.973	584.994	585.029	585.064
EXISTING LEVELS	583.891	584.053	584.235	584.367	584.529		584.659	584.811		584.999		585.058
CHAINAGE	VTP 0.000 HTP	20.000	40.000	60.000 HTP 60.110	80.000	VTP 81.884	100.000	120.000	VTP 136.888	140.000	HTP 144.999	150.000

LONGITUDINAL SECTION ALONG CONTROL MC01 - CALLAM STREET
(NORTHBOUND CARRIAGEWAY BETWEEN MATILDA STREET & BRADLEY STREET)

NOT FOR CONSTRUCTION

THIS DRAWING MAY BE PREPARED IN COLOUR AND MAY BE INCOMPLETE IF COPIED

0 5 10 15 20 25 30 35 40 45 50mm ON A3 SIZE ORIGINAL

DRAWING FILE LOCATION \ NAME - PLOT DATE \ TIME - PLOT BY
\\jacobs.com\anz\IE\Projects\03_Southern\IS268800\01 Design\Drawings\Civil\IS268800-DG-RD-0201-0207.dwg - 27/08/2019 1:30:10 PM - imedi

DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING

REV	DATE	AMENDMENT / REVISION DESCRIPTION	APPROVAL
0	05.07.19	ISSUED FOR DRAFT PSP DESIGN	L.QASEM
1	28.08.19	ISSUED FOR FINAL PSP DESIGN	L.QASEM

PROJECT BREAKDOWN STRUCTURE

SCALES ON A3 SIZE DRAWING
HORIZ. 1:500 5 0 5 10
VERT. 1:100 1 0 1 2
AT A3

STROMLO COORDINATE SYSTEM: AGD66
HEIGHT DATUM: AHD

JACOBS DOCUMENT NUMBER
IS268800-DG-RD-0202

DRAWINGS / DESIGN PREPARED BY
JACOBS
177 Pacific Highway
NORTH SYDNEY, NSW 2060
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PLOT DATE / TIME: 27/08/2019
PLOT BY: imedi

TITLE	NAME	DATE
DRAWN	I.MEDI	28.08.19
DRG CHECK	S.GALLOWAY	28.08.19
DESIGN	R.TIRICOVSKI	28.08.19
DESIGN CHECK	D.HORWOOD	28.08.19
DESIGN MNGR	G.TRUNDLE	28.08.19
PROJECT MNGR	L.QASEM	28.08.19

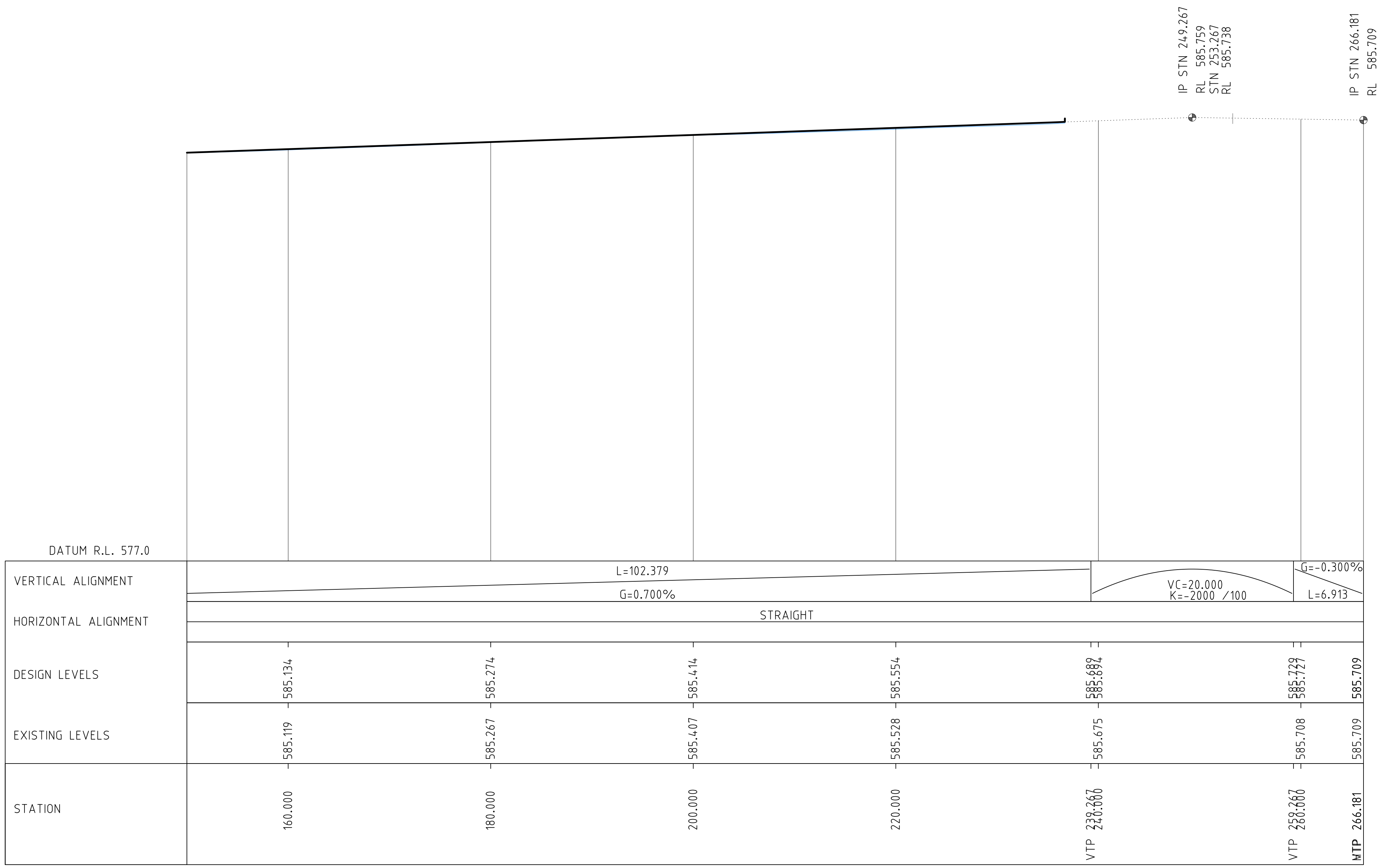
CLIENT
ACT Government
Transport Canberra

ACT GOVERNMENT
WODEN BUS INTERCHANGE AND ROAD LAYOUT MODIFICATIONS
WODEN BUS INTERCHANGE
ROAD GEOMETRY LONGITUDINAL SECTIONS - MC01
SHEET 2 OF 7

A3

ACT REGISTRATION No. TCLR-201-BRI-0006
PART

ISSUE STATUS: PSP DESIGN
EDMS No.
SHEET No.: RD-0202
REV: 1



STATION	DESIGN LEVELS	EXISTING LEVELS
160.000	585.134	585.119
180.000	585.274	585.267
200.000	585.414	585.407
220.000	585.554	585.528
VTP 239.267	585.689	
240.000	585.694	585.675
VTP 259.267	585.729	
260.000	585.727	585.708
VTP 266.181	585.709	585.709

LONGITUDINAL SECTION ALONG CONTROL MC01 - CALLAM STREET
(NORTHBOUND CARRIAGEWAY BETWEEN MATILDA STREET & BRADLEY STREET)

NOT FOR CONSTRUCTION

DRAWING FILE LOCATION \ NAME - PLOT DATE \ TIME - PLOT BY
\\jacobs.com\anz\IE\Projects\03_Southern\IS268800\01 Design\Drawings\Civil\IS268800-DG-RD-0201-0207.dwg - 27/08/2019 1:30:11 PM - imedii

DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING

REV	DATE	AMENDMENT / REVISION DESCRIPTION	APPROVAL
0	05.07.19	ISSUED FOR DRAFT PSP DESIGN	L.QASEM
1	28.08.19	ISSUED FOR FINAL PSP DESIGN	L.QASEM

PROJECT BREAKDOWN STRUCTURE

SCALES ON A3 SIZE DRAWING
HORIZ. 1:500
VERT. 1:100
5 0 5 10
1 0 1 AT A3 2

STROMLO COORDINATE SYSTEM: AGD66
HEIGHT DATUM: AHD

JACOBS DOCUMENT NUMBER
IS268800-DG-RD-0203

DRAWINGS / DESIGN PREPARED BY
JACOBS
177 Pacific Highway
NORTH SYDNEY, NSW 2060
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PLOT DATE / TIME: 27/08/2019
PLOT BY: imedii

TITLE	NAME	DATE
DRAWN	I.IMEDI	28.08.19
DRG CHECK	S.GALLOWAY	28.08.19
DESIGN	R.TIRICOVSKI	28.08.19
DESIGN CHECK	D.HORWOOD	28.08.19
DESIGN MNGR	G.TRUNDLE	28.08.19
PROJECT MNGR	L.QASEM	28.08.19

CLIENT
ACT Government
Transport Canberra

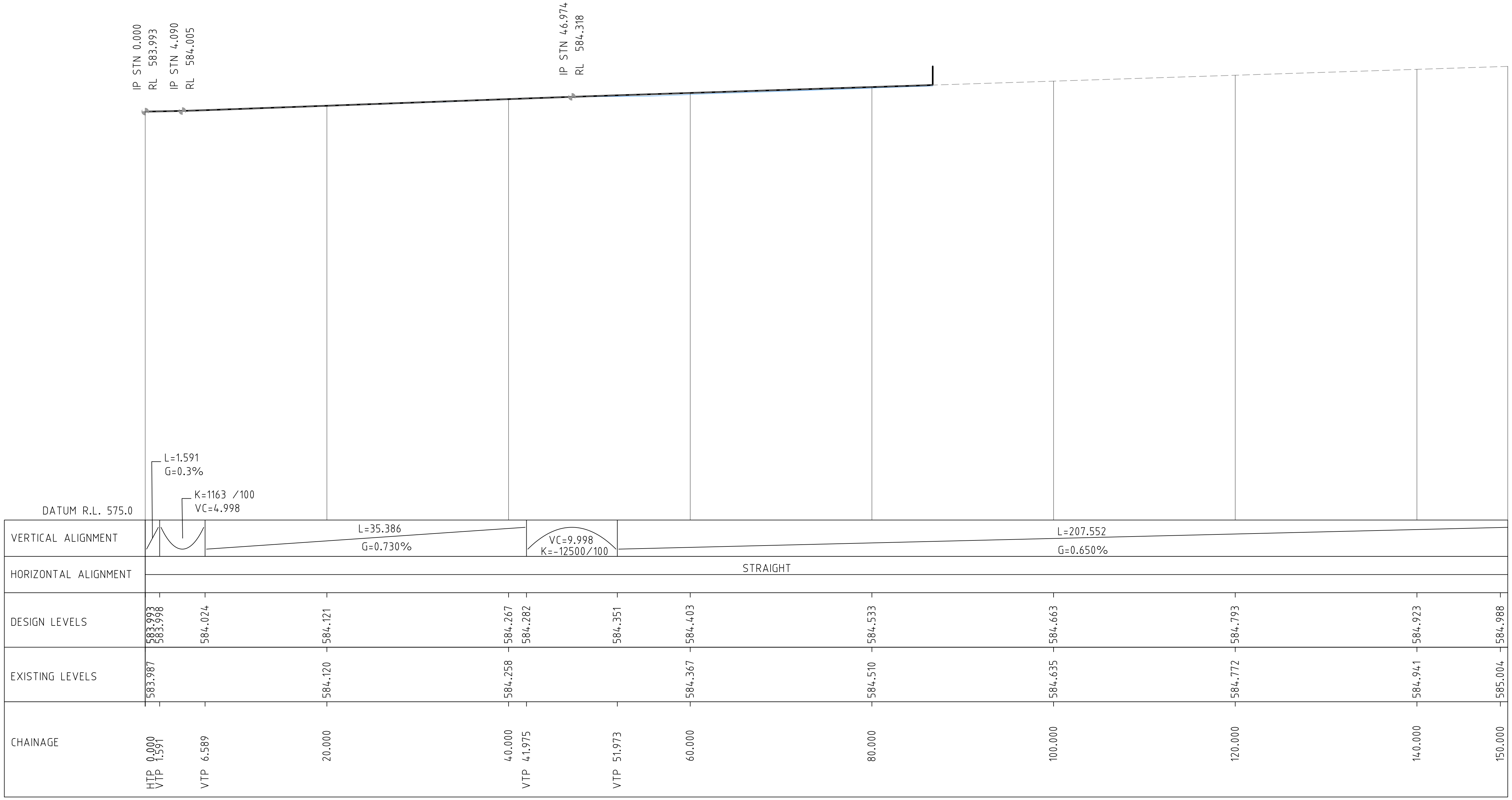
ACT GOVERNMENT
WODEN BUS INTERCHANGE AND ROAD LAYOUT MODIFICATIONS
WODEN BUS INTERCHANGE

A3

ROAD GEOMETRY LONGITUDINAL SECTIONS - MC01
SHEET 3 OF 7

ACT REGISTRATION No. TCLR-201-BRI-0006
PART

ISSUE STATUS: PSP DESIGN
EDMS No.
SHEET No.: RD-0203
REV: 1



LONGITUDINAL SECTION ALONG CONTROL MC02 - CALLAM STREET
(SOUTHBOUND CARRIAGEWAY BETWEEN MATILDA STREET & BRADLEY STREET)

NOT FOR CONSTRUCTION

DRAWING FILE LOCATION \ NAME - PLOT DATE \ TIME - PLOT BY
\\jacobs.com\anz\IE\Projects\03_Southern\IS268800\01 Design\Drawings\Civil\IS268800-DG-RD-0201-0207.dwg - 27/08/2019 1:30:12 PM - imedii

DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING	REV	DATE	AMENDMENT / REVISION DESCRIPTION	APPROVAL
	0	05.07.19	ISSUED FOR DRAFT PSP DESIGN	L.QASEM
	1	28.08.19	ISSUED FOR FINAL PSP DESIGN	L.QASEM

PROJECT BREAKDOWN STRUCTURE

SCALES ON A3 SIZE DRAWING
HORIZ. 1:500
VERT. 1:100
5 0 5 10
1 0 1 AT A3 2

STROMLO COORDINATE SYSTEM
AGD66

HEIGHT DATUM
AHD

JACOBS DOCUMENT NUMBER
IS268800-DG-RD-0204

DRAWINGS / DESIGN PREPARED BY
JACOBS
177 Pacific Highway
NORTH SYDNEY, NSW 2060
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PLOT DATE / TIME
27/08/2019

PLOT BY
imedii

TITLE	NAME	DATE
DRAWN	I.IMEDI	28.08.19
DRG CHECK	S.GALLOWAY	28.08.19
DESIGN	R.TIRICOVSKI	28.08.19
DESIGN CHECK	D.HORWOOD	28.08.19
DESIGN MNGR	G.TRUNDLE	28.08.19
PROJECT MNGR	L.QASEM	28.08.19

CLIENT
ACT Government
Transport Canberra

ACT GOVERNMENT
WODEN BUS INTERCHANGE AND ROAD LAYOUT MODIFICATIONS
WODEN BUS INTERCHANGE

A3

ROAD GEOMETRY LONGITUDINAL SECTIONS - MC02
SHEET 4 OF 7

ACT REGISTRATION No. TCLR-201-BRI-0006

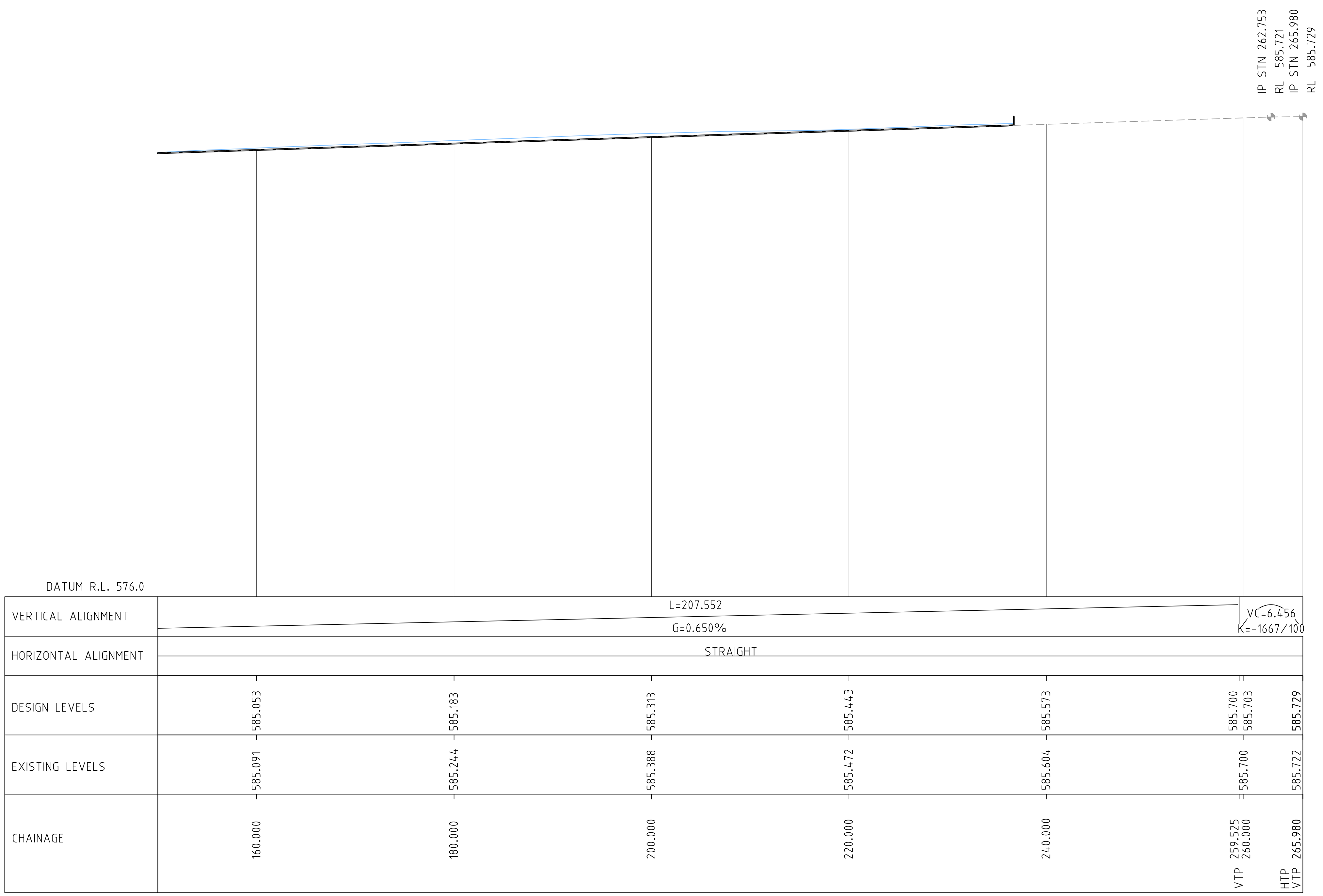
PART

ISSUE STATUS
PSP DESIGN

EDMS No.

SHEET No.
RD-0204

REV
1



LONGITUDINAL SECTION ALONG CONTROL MC02 - CALLAM STREET
(SOUTHBOUND CARRIAGEWAY BETWEEN MATILDA STREET & BRADLEY STREET)

NOT FOR CONSTRUCTION

DRAWING FILE LOCATION \ NAME - PLOT DATE \ TIME - PLOT BY
\\jacobs.com\anz\IE\Projects\03_Southern\IS268800\01 Design\Drawings\Civil\IS268800-DG-RD-0201-0207.dwg - 27/08/2019 1:30:12 PM - imedii

DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING

REV	DATE	AMENDMENT / REVISION DESCRIPTION	APPROVAL
0	05.07.19	ISSUED FOR DRAFT PSP DESIGN	L.QASEM
1	28.08.19	ISSUED FOR FINAL PSP DESIGN	L.QASEM

PROJECT BREAKDOWN STRUCTURE

SCALES ON A3 SIZE DRAWING
HORIZ. 1:500 5 0 5 10
VERT. 1:100 1 0 1 AT A3 2

STROMLO COORDINATE SYSTEM
AGD66

HEIGHT DATUM
AHD

JACOBS DOCUMENT NUMBER
IS268800-DG-RD-0205

DRAWINGS / DESIGN PREPARED BY
JACOBS
177 Pacific Highway
NORTH SYDNEY, NSW 2060
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PLOT DATE / TIME
27/08/2019

PLOT BY
imedii

TITLE	NAME	DATE
DRAWN	I.IMEDI	28.08.19
DRG CHECK	S.GALLOWAY	28.08.19
DESIGN	R.TIRICOVSKI	28.08.19
DESIGN CHECK	D.HORWOOD	28.08.19
DESIGN MNGR	G.TRUNDLE	28.08.19
PROJECT MNGR	L.QASEM	28.08.19

CLIENT
ACT Government
Transport Canberra

ACT GOVERNMENT
WODEN BUS INTERCHANGE AND ROAD LAYOUT MODIFICATIONS
WODEN BUS INTERCHANGE

A3

ROAD GEOMETRY LONGITUDINAL SECTIONS - MC02
SHEET 5 OF 7

ACT REGISTRATION No. TCLR-201-BRI-0006

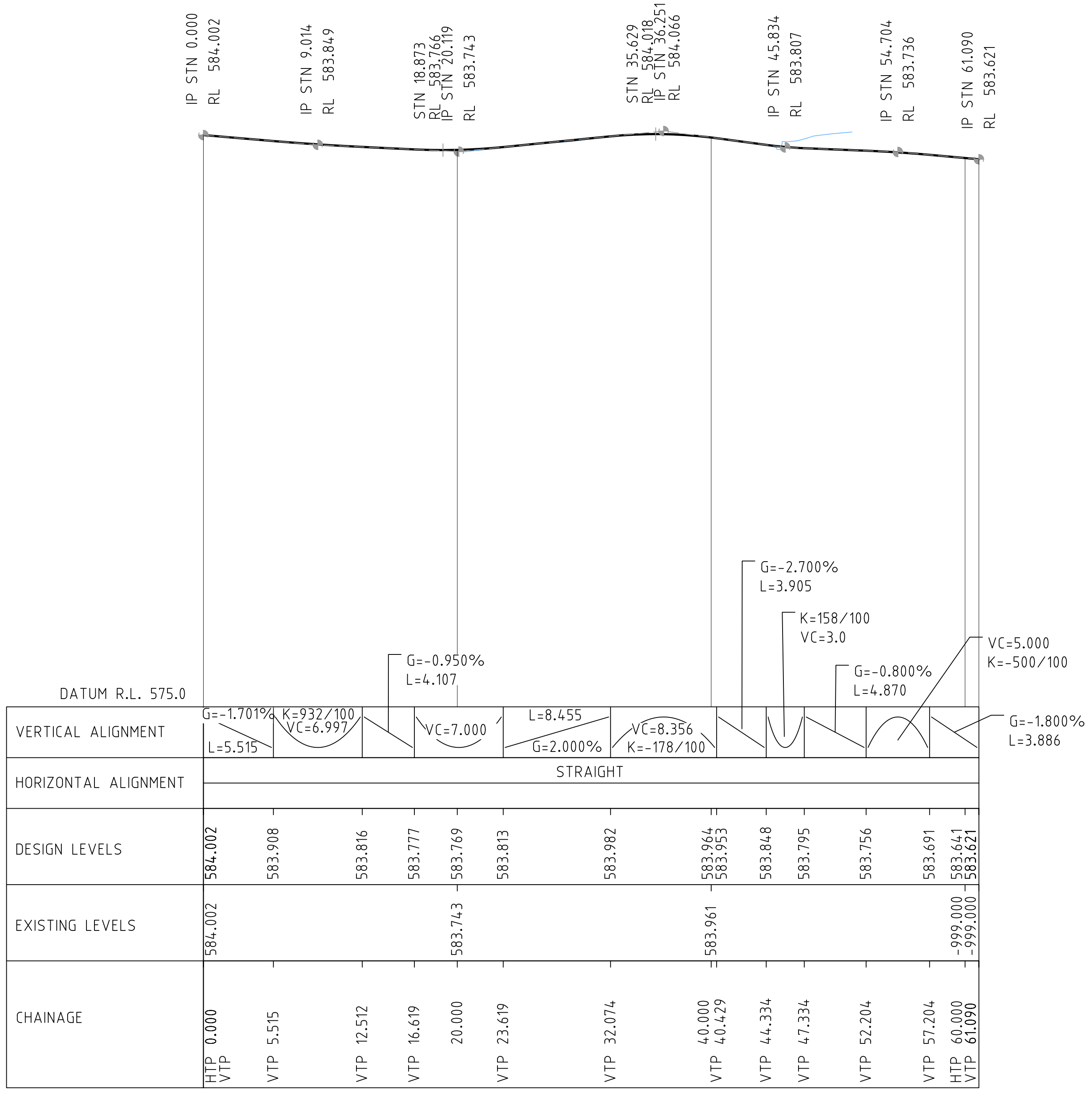
PART

ISSUE STATUS
PSP DESIGN

EDMS No.

SHEET No.
RD-0205

REV
1



LONGITUDINAL SECTION ALONG CONTROL MC10 - MATILDA STREET

NOT FOR CONSTRUCTION

THIS DRAWING MAY BE PREPARED IN COLOUR AND MAY BE INCOMPLETE IF COPIED

0 5 10 15 20 25 30 35 40 45 50mm ON A3 SIZE ORIGINAL

DRAWING FILE LOCATION \ NAME - PLOT DATE \ TIME - PLOT BY
\\jacobs.com\anz\IE\Projects\03_Southern\IS268800\01 Design\Drawings\Civil\IS268800-DG-RD-0201-0207.dwg - 27/08/2019 1:30:13 PM - imedii

DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING	REV	DATE	AMENDMENT / REVISION DESCRIPTION	APPROVAL
	0	05.07.19	ISSUED FOR DRAFT PSP DESIGN	L.QASEM
	1	28.08.19	ISSUED FOR FINAL PSP DESIGN	L.QASEM

PROJECT BREAKDOWN STRUCTURE

SCALES ON A3 SIZE DRAWING
HORIZ. 1:500
VERT. 1:100
5 0 5 10
1 0 1 AT A3 2

STROMLO COORDINATE SYSTEM
AGD66
HEIGHT DATUM
AHD

JACOBS DOCUMENT NUMBER
IS268800-DG-RD-0206

DRAWINGS / DESIGN PREPARED BY
177 Pacific Highway
NORTH SYDNEY, NSW 2060
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PLOT DATE / TIME
27/08/2019
PLOT BY
imedii

TITLE	NAME	DATE
DRAWN	I.IMEDI	28.08.19
DRG CHECK	S.GALLOWAY	28.08.19
DESIGN	R.TIRICOVSKI	28.08.19
DESIGN CHECK	D.HORWOOD	28.08.19
DESIGN MNGR	G.TRUNDLE	28.08.19
PROJECT MNGR	L.QASEM	28.08.19

CLIENT

ACT GOVERNMENT
WODEN BUS INTERCHANGE AND ROAD LAYOUT MODIFICATIONS
WODEN BUS INTERCHANGE

ROAD GEOMETRY LONGITUDINAL SECTIONS - MC10
SHEET 6 OF 7

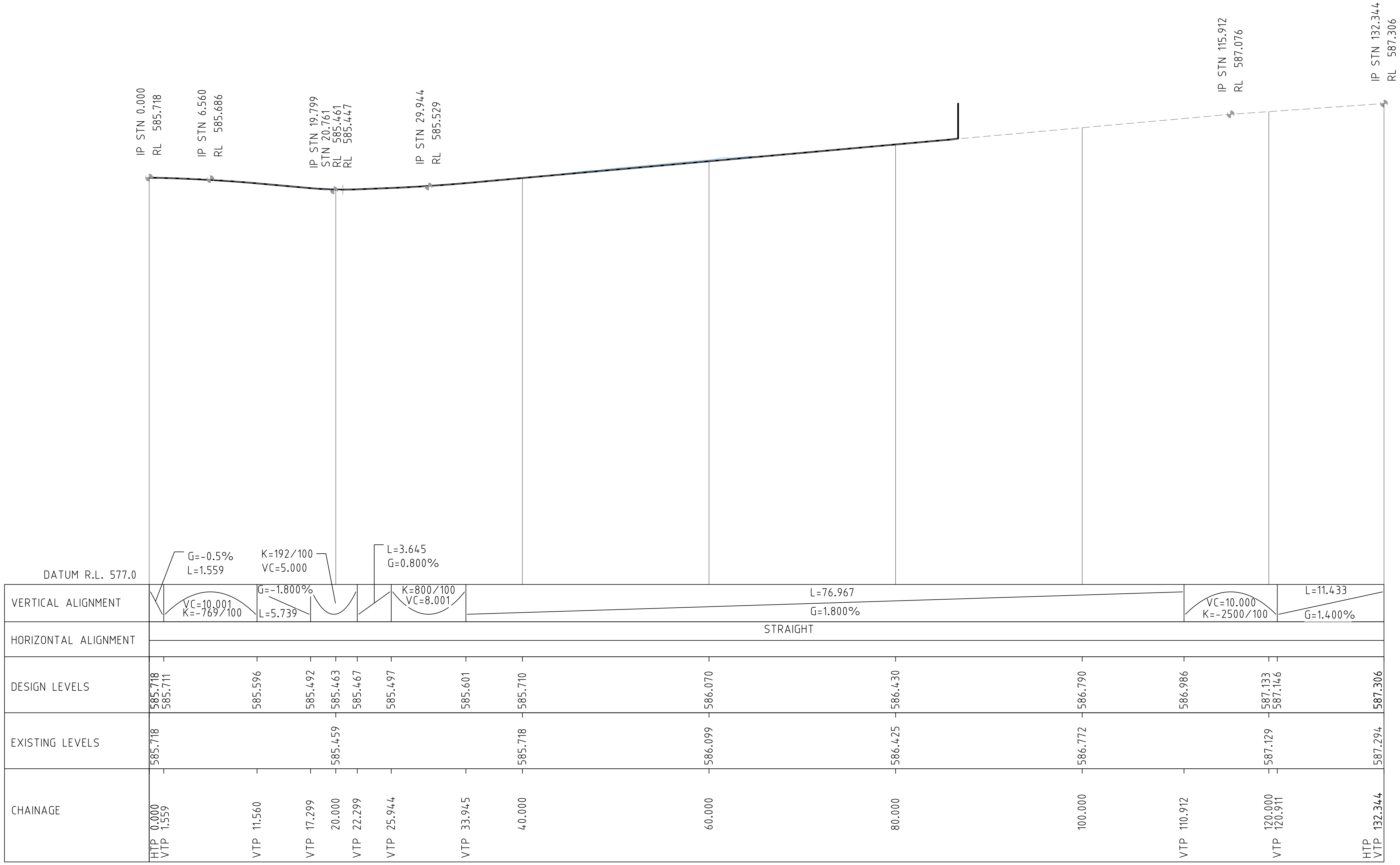
A3

ACT REGISTRATION No. TCLR-201-BRI-0006
PART

ISSUE STATUS
PSP DESIGN
EDMS No.
SHEET No.
RD-0206
REV
1

THIS DRAWING MAY BE PREPARED IN COLOUR AND MAY BE INCOMPLETE IF COPIED

50mm ON A3 SIZE ORIGINAL



LONGITUDINAL SECTION ALONG CONTROL MC20 - BRADLEY STREET

NOT FOR CONSTRUCTION

DRAWING FILE LOCATION \ NAME - PLOT DATE \ TIME - PLOT BY
\\jacobs.com\anz\IE\Projects\03_Southern\IS268800\01 Design\Drawings\Civil\IS268800-DG-RD-0201-0207.dwg - 27/08/2019 1:30:13 PM - imedii

DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING

REV	DATE	AMENDMENT / REVISION DESCRIPTION	APPROVAL
0	05.07.19	ISSUED FOR DRAFT PSP DESIGN	L.QASEM
1	28.08.19	ISSUED FOR FINAL PSP DESIGN	L.QASEM

PROJECT BREAKDOWN STRUCTURE

SCALES ON A3 SIZE DRAWING
HORIZ. 1:500
VERT. 1:100
AT A3

STROMLO COORDINATE SYSTEM
AGD66
HEIGHT DATUM
AHD

JACOBS DOCUMENT NUMBER
IS268800-DG-RD-0207

DRAWINGS / DESIGN PREPARED BY
JACOBS
177 Pacific Highway
NORTH SYDNEY, NSW 2060
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PLOT DATE / TIME
27/08/2019
PLOT BY
imedii

TITLE	NAME	DATE
DRAWN	I.IMEDI	28.08.19
DRG CHECK	S.GALLOWAY	28.08.19
DESIGN	R.TIRICOVSKI	28.08.19
DESIGN CHECK	D.HORWOOD	28.08.19
DESIGN MNGR	G.TRUNDLE	28.08.19
PROJECT MNGR	L.QASEM	28.08.19

CLIENT
ACT Government
Transport Canberra

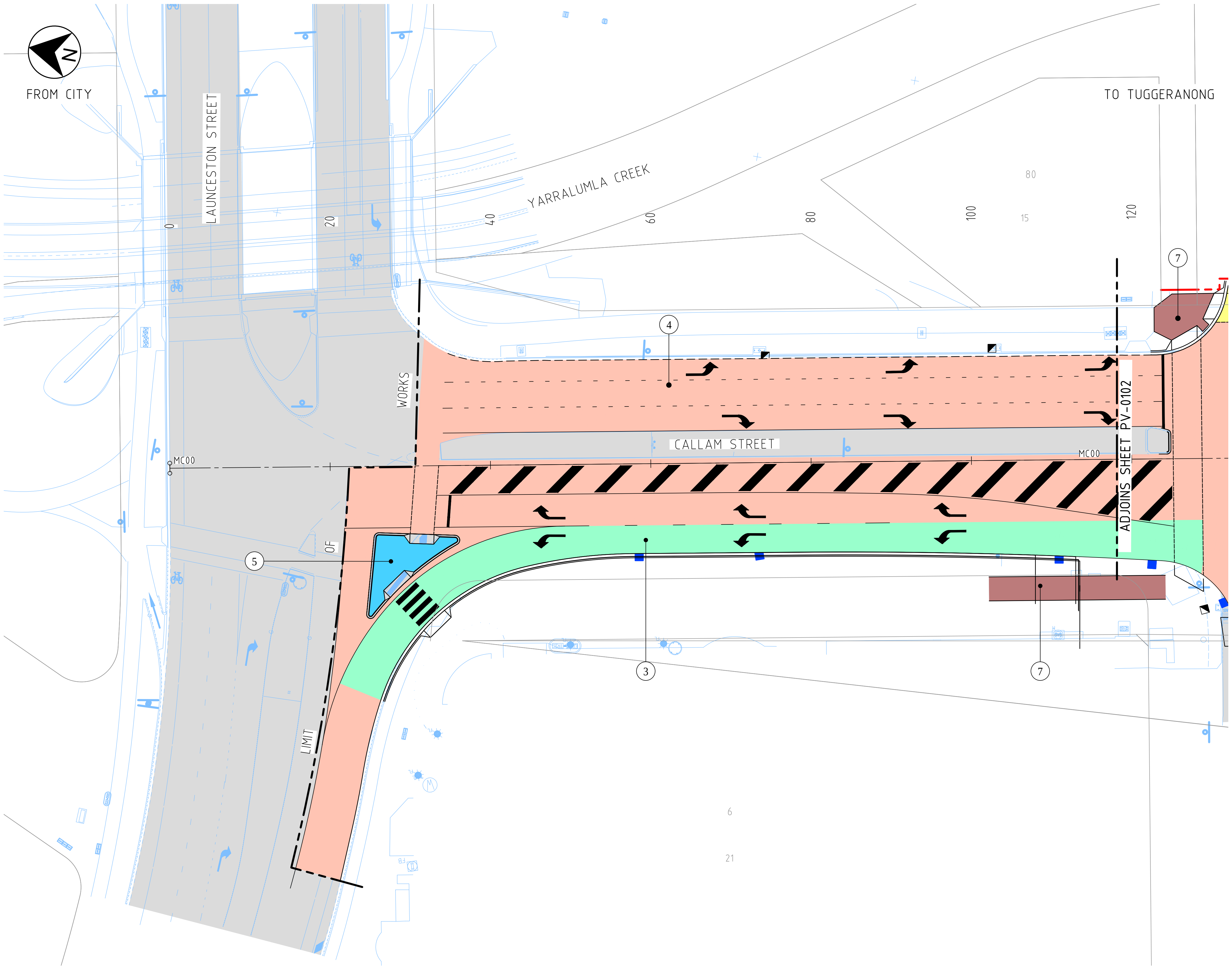
ACT GOVERNMENT
WODEN BUS INTERCHANGE AND ROAD LAYOUT MODIFICATIONS
WODEN BUS INTERCHANGE

A3

ROAD GEOMETRY LONGITUDINAL SECTIONS - MC20
SHEET 7 OF 7

ACT REGISTRATION No. TCLR-201-BRI-0006
PART

ISSUE STATUS
PSP DESIGN
EDMS No.
SHEET No.
RD-0207
REV
1



LEGEND

GENERAL

▬ · ▬	PROJECT BOUNDARY
─	CADASTRAL BOUNDARY
34 80	CADASTRAL LOT AND DP NUMBER
─	SURVEY
MCxx	CONTROL LINE

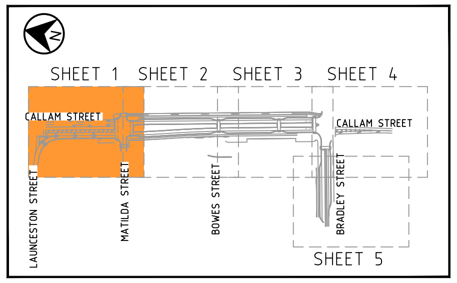
PAVEMENT

⬜	EXISTING PAVEMENT
▨	EXISTING PAVEMENT TO BE REMOVED
🟦	TYPE 1 - CALLAM INTERCHANGE
🟪	TYPE 2 - BRADLEY INTERCHANGE
🟩	TYPE 3 - CALLAM WIDENING
🟧	TYPE 4 - MILL AND RESHEET
🟦	TYPE 5 - RAISED MEDIAN
🟨	TYPE 6 - COMMERCIAL DRIVEWAY
🟫	TYPE 7 - SHARED PATH
(1)──●	PAVEMENT TYPE LABEL

DRAINAGE

▤	EXISTING PIT
◪	EXISTING PIT TO BE MODIFIED
■	NEW PIT

NOTES
1. FOR GENERAL NOTES REFER SHEET No. GE-0021.
2. FOR PAVEMENT PROFILES REFER SHEET PV-201.



KEY PLAN
NTS

NOT FOR CONSTRUCTION

THIS DRAWING MAY BE PREPARED IN COLOUR AND MAY BE INCOMPLETE IF COPIED

50mm ON A3 SIZE ORIGINAL

DRAWING FILE LOCATION \ NAME - PLOT DATE \ TIME - PLOT BY
\\jacobs.com\anz\IE\Projects\03_Southern\IS268800\01 Design\Drawings\Civil\IS268800-DG-PV-0101-0105.dwg - 28/08/2019 12:06:59 PM - imedi

DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING

REV	DATE	AMENDMENT / REVISION DESCRIPTION	APPROVAL
0	05.07.19	ISSUED FOR DRAFT PSP DESIGN	L.QASEM
1	26.08.19	ISSUED FOR FINAL PSP DESIGN	L.QASEM

PROJECT BREAKDOWN STRUCTURE

SCALES ON A3 SIZE DRAWING
SCALE 1:500
5 0 5 10
AT A3

STROMLO COORDINATE SYSTEM
AGD66

HEIGHT DATUM
AHD

JACOBS DOCUMENT NUMBER
IS268800-DG-PV-0101

DRAWINGS / DESIGN PREPARED BY
JACOBS
177 Pacific Highway
NORTH SYDNEY, NSW 2060
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PLOT DATE / TIME
28/08/2019

PLOT BY
imedii

TITLE	NAME	DATE
DRAWN	I.IMEDI	26.08.19
DRG CHECK	S.GALLOWAY	26.08.19
DESIGN	C.WING	26.08.19
DESIGN CHECK	B.CERECINA	26.08.19
DESIGN MNGR	G.TRUNDLE	26.08.19
PROJECT MNGR	L.QASEM	26.08.19

CLIENT
ACT Government
Transport Canberra

ACT GOVERNMENT
WODEN BUS INTERCHANGE AND ROAD LAYOUT MODIFICATIONS
WODEN BUS INTERCHANGE

A3

PAVEMENT PLAN

SHEET 1 OF 5

ACT REGISTRATION No. TCLR-201-BRI-0006

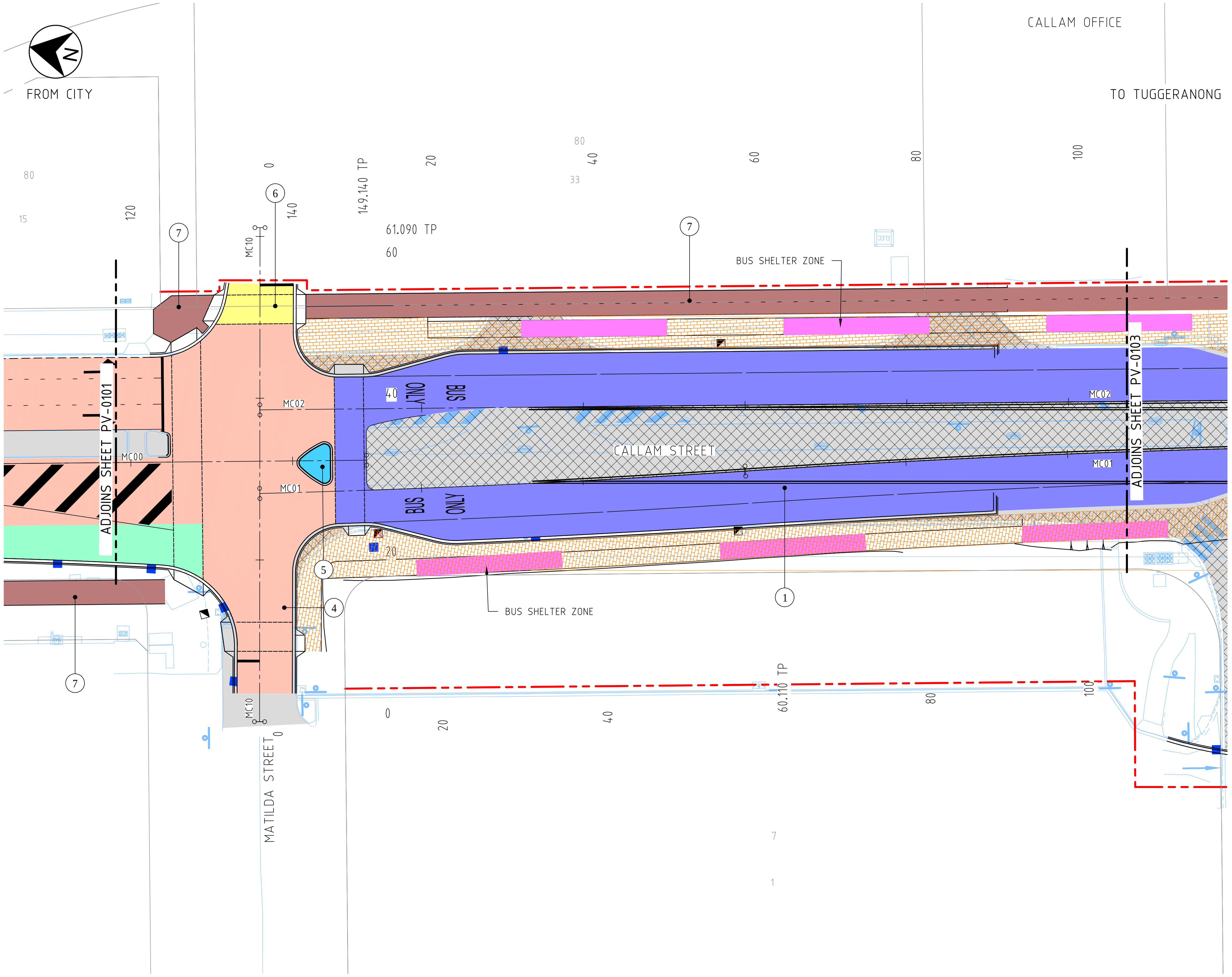
PART

ISSUE STATUS
PSP DESIGN

EDMS No.

SHEET No.
PV-0101

REV
1



LEGEND

GENERAL

‒ · ‒	PROJECT BOUNDARY
―	CADASTRAL BOUNDARY
34 80	CADASTRAL LOT AND DP NUMBER
―	SURVEY
MCxx	CONTROL LINE

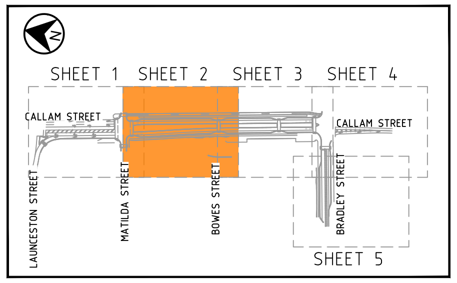
PAVEMENT

▨	EXISTING PAVEMENT
▩	EXISTING PAVEMENT TO BE REMOVED
▨	TYPE 1 - CALLAM INTERCHANGE
▨	TYPE 2 - BRADLEY INTERCHANGE
▨	TYPE 3 - CALLAM WIDENING
▨	TYPE 4 - MILL AND RESHEET
▨	TYPE 5 - RAISED MEDIAN
▨	TYPE 6 - COMMERCIAL DRIVEWAY
▨	TYPE 7 - SHARED PATH
①	PAVEMENT TYPE LABEL

DRAINAGE

▤	EXISTING PIT
◩	EXISTING PIT TO BE MODIFIED
■	NEW PIT

NOTES
1. FOR GENERAL NOTES REFER SHEET No. GE-0021.
2. FOR PAVEMENT PROFILES REFER SHEET PV-201.



KEY PLAN
NTS

NOT FOR CONSTRUCTION

THIS DRAWING MAY BE PREPARED IN COLOUR AND MAY BE INCOMPLETE IF COPIED
50mm ON A3 SIZE ORIGINAL

DRAWING FILE LOCATION \ NAME - PLOT DATE \ TIME - PLOT BY
\\jacobs.com\anz\IE\Projects\03_Southern\IS268800\01 Design\Drawings\Civil\IS268800-DG-PV-0101-0105.dwg - 28/08/2019 12:07:01 PM - imedi

DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING

REV	DATE	AMENDMENT / REVISION DESCRIPTION	APPROVAL
0	05.07.19	ISSUED FOR DRAFT PSP DESIGN	L.QASEM
1	26.08.19	ISSUED FOR FINAL PSP DESIGN	L.QASEM

PROJECT BREAKDOWN STRUCTURE

SCALES ON A3 SIZE DRAWING
SCALE 1:500 AT A3

STROMLO COORDINATE SYSTEM: AGD66
HEIGHT DATUM: AHD

JACOBS DOCUMENT NUMBER
IS268800-DG-PV-0102

DRAWINGS / DESIGN PREPARED BY
JACOBS
177 Pacific Highway
NORTH SYDNEY, NSW 2060
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PLOT DATE / TIME: 28/08/2019
PLOT BY: imedii

TITLE	NAME	DATE
DRAWN	I.IMEDI	26.08.19
DRG CHECK	S.GALLOWAY	26.08.19
DESIGN	C.WING	26.08.19
DESIGN CHECK	B.CERECINA	26.08.19
DESIGN MNGR	G.TRUNDLE	26.08.19
PROJECT MNGR	L.QASEM	26.08.19

CLIENT
ACT Government
Transport Canberra

ACT GOVERNMENT
WODEN BUS INTERCHANGE AND ROAD LAYOUT MODIFICATIONS
WODEN BUS INTERCHANGE

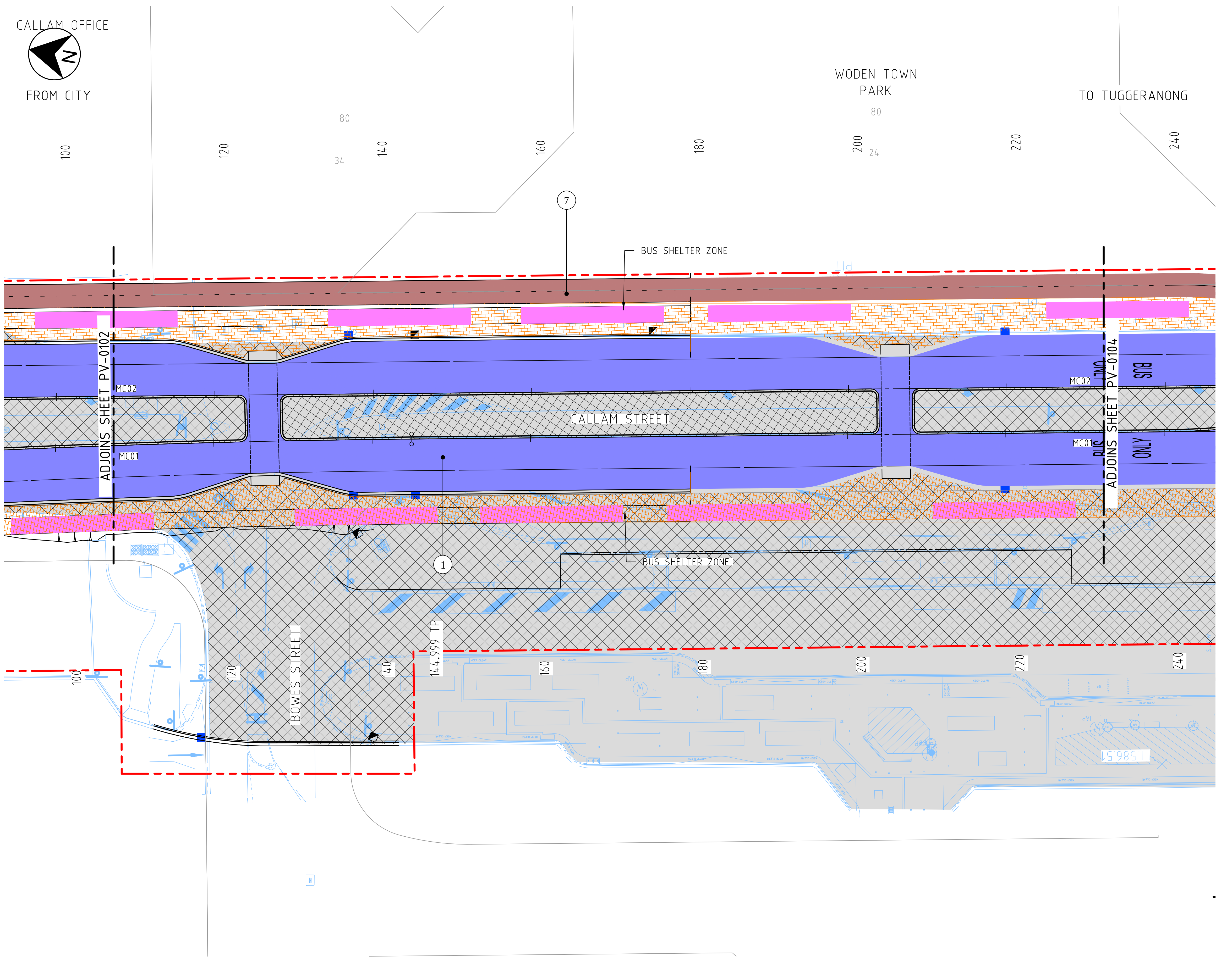
PAVEMENT PLAN

SHEET 2 OF 5

A3

ACT REGISTRATION No. TCLR-201-BRI-0006
PART

ISSUE STATUS: PSP DESIGN
EDMS No.
SHEET No.: PV-0102
REV: 1



LEGEND

GENERAL

- PROJECT BOUNDARY
- CADASTRAL BOUNDARY
- 34 80 CADASTRAL LOT AND DP NUMBER
- SURVEY CONTROL LINE (MCxx)

PAVEMENT

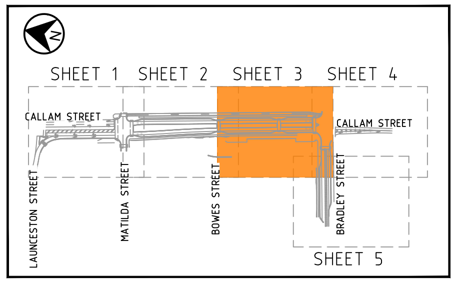
- EXISTING PAVEMENT
- ▨ EXISTING PAVEMENT TO BE REMOVED
- TYPE 1 - CALLAM INTERCHANGE
- TYPE 2 - BRADLEY INTERCHANGE
- TYPE 3 - CALLAM WIDENING
- TYPE 4 - MILL AND RESHEET
- TYPE 5 - RAISED MEDIAN
- TYPE 6 - COMMERCIAL DRIVEWAY
- TYPE 7 - SHARED PATH
- ① PAVEMENT TYPE LABEL

DRAINAGE

- EXISTING PIT
- ◪ EXISTING PIT TO BE MODIFIED
- ■ NEW PIT

NOTES

1. FOR GENERAL NOTES REFER SHEET No. GE-0021.
2. FOR PAVEMENT PROFILES REFER SHEET PV-201.



KEY PLAN
NTS

NOT FOR CONSTRUCTION

THIS DRAWING MAY BE PREPARED IN COLOUR AND MAY BE INCOMPLETE IF COPIED

50mm ON A3 SIZE ORIGINAL

DRAWING FILE LOCATION \ NAME - PLOT DATE \ TIME - PLOT BY
\\jacobs.com\anz\IE\Projects\03_Southern\IS268800\01 Design\Drawings\Civil\IS268800-DG-PV-0101-0105.dwg - 28/08/2019 12:07:02 PM - imedi

DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING

REV	DATE	AMENDMENT / REVISION DESCRIPTION	APPROVAL
0	05.07.19	ISSUED FOR DRAFT PSP DESIGN	L.QASEM
1	26.08.19	ISSUED FOR FINAL PSP DESIGN	L.QASEM

PROJECT BREAKDOWN STRUCTURE

SCALES ON A3 SIZE DRAWING
SCALE 1:500 (5 0 5 10) AT A3

STROMLO COORDINATE SYSTEM AGD66
HEIGHT DATUM AHD

JACOBS DOCUMENT NUMBER
IS268800-DG-PV-0103

DRAWINGS / DESIGN PREPARED BY
JACOBS
177 Pacific Highway
NORTH SYDNEY, NSW 2060
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PLOT DATE / TIME 28/08/2019
PLOT BY imedii

TITLE	NAME	DATE
DRAWN	I.IMEDI	26.08.19
DRG CHECK	S.GALLOWAY	26.08.19
DESIGN	C.WING	26.08.19
DESIGN CHECK	B.CERECINA	26.08.19
DESIGN MNGR	G.TRUNDLE	26.08.19
PROJECT MNGR	L.QASEM	26.08.19

CLIENT
ACT Government
Transport Canberra

ACT GOVERNMENT
WODEN BUS INTERCHANGE AND ROAD LAYOUT MODIFICATIONS
WODEN BUS INTERCHANGE

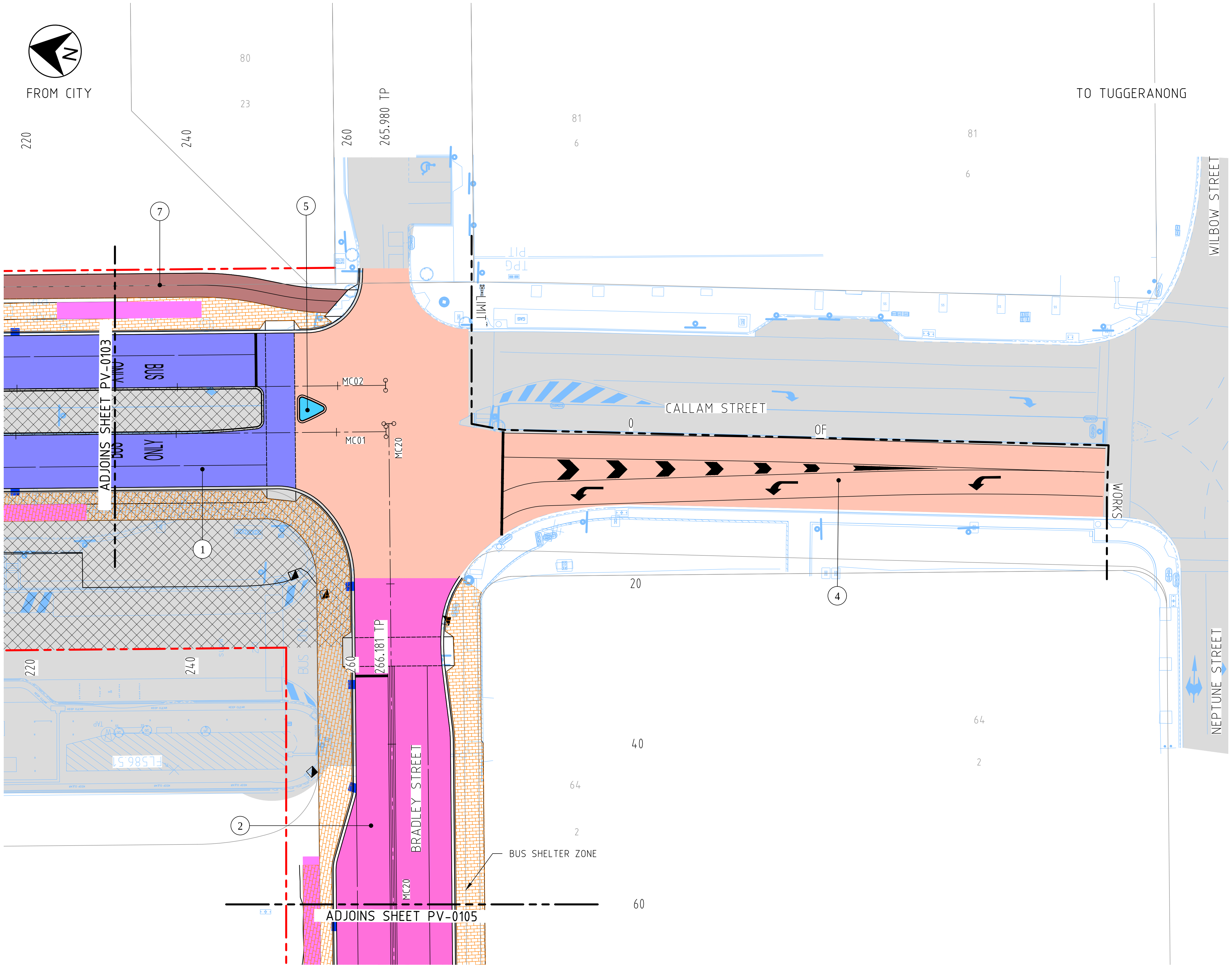
PAVEMENT PLAN

SHEET 3 OF 5

A3

ACT REGISTRATION No. TCLR-201-BRI-0006
PART

ISSUE STATUS PSP DESIGN
EDMS No.
SHEET No. PV-0103
REV 1



LEGEND

GENERAL

▬ · ▬	PROJECT BOUNDARY
──	CADASTRAL BOUNDARY
34 80	CADASTRAL LOT AND DP NUMBER
──	SURVEY
MCxx	CONTROL LINE

PAVEMENT

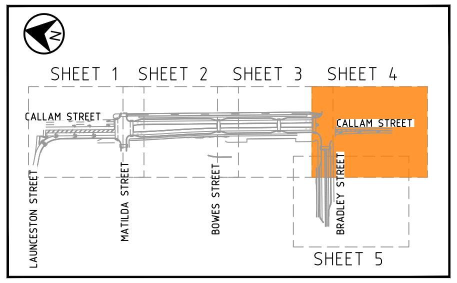
▒	EXISTING PAVEMENT
▨	EXISTING PAVEMENT TO BE REMOVED
🟦	TYPE 1 - CALLAM INTERCHANGE
🟪	TYPE 2 - BRADLEY INTERCHANGE
🟩	TYPE 3 - CALLAM WIDENING
🟧	TYPE 4 - MILL AND RESHEET
🟦	TYPE 5 - RAISED MEDIAN
🟨	TYPE 6 - COMMERCIAL DRIVEWAY
🟫	TYPE 7 - SHARED PATH
○	PAVEMENT TYPE LABEL

DRAINAGE

▤	EXISTING PIT
◪	EXISTING PIT TO BE MODIFIED
■	NEW PIT

NOTES

1. FOR GENERAL NOTES REFER SHEET No. GE-0021.
2. FOR PAVEMENT PROFILES REFER SHEET PV-201.



KEY PLAN
NTS

NOT FOR CONSTRUCTION

THIS DRAWING MAY BE PREPARED IN COLOUR AND MAY BE INCOMPLETE IF COPIED

50mm ON A3 SIZE ORIGINAL

DRAWING FILE LOCATION \ NAME - PLOT DATE \ TIME - PLOT BY
\\jacobs.com\anz\IE\Projects\03_Southern\IS268800\01 Design\Drawings\Civil\IS268800-DG-PV-0101-0105.dwg - 28/08/2019 12:07:04 PM - imedi

DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING

REV	DATE	AMENDMENT / REVISION DESCRIPTION	APPROVAL
0	05.07.19	ISSUED FOR DRAFT PSP DESIGN	L.QASEM
1	26.08.19	ISSUED FOR FINAL PSP DESIGN	L.QASEM

PROJECT BREAKDOWN STRUCTURE

SCALES ON A3 SIZE DRAWING
SCALE 1:500 — 5 0 5 10 — AT A3

STROMLO COORDINATE SYSTEM: AGD66
HEIGHT DATUM: AHD

JACOBS DOCUMENT NUMBER
IS268800-DG-PV-0104

DRAWINGS / DESIGN PREPARED BY
JACOBS
177 Pacific Highway
NORTH SYDNEY, NSW 2060
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PLOT DATE / TIME: 28/08/2019
PLOT BY: imedii

TITLE	NAME	DATE
DRAWN	I.IMEDI	26.08.19
DRG CHECK	S.GALLOWAY	26.08.19
DESIGN	C.WING	26.08.19
DESIGN CHECK	B.CERECINA	26.08.19
DESIGN MNGR	G.TRUNDLE	26.08.19
PROJECT MNGR	L.QASEM	26.08.19

CLIENT
ACT Government
Transport Canberra

ACT GOVERNMENT
WODEN BUS INTERCHANGE AND ROAD LAYOUT MODIFICATIONS
WODEN BUS INTERCHANGE

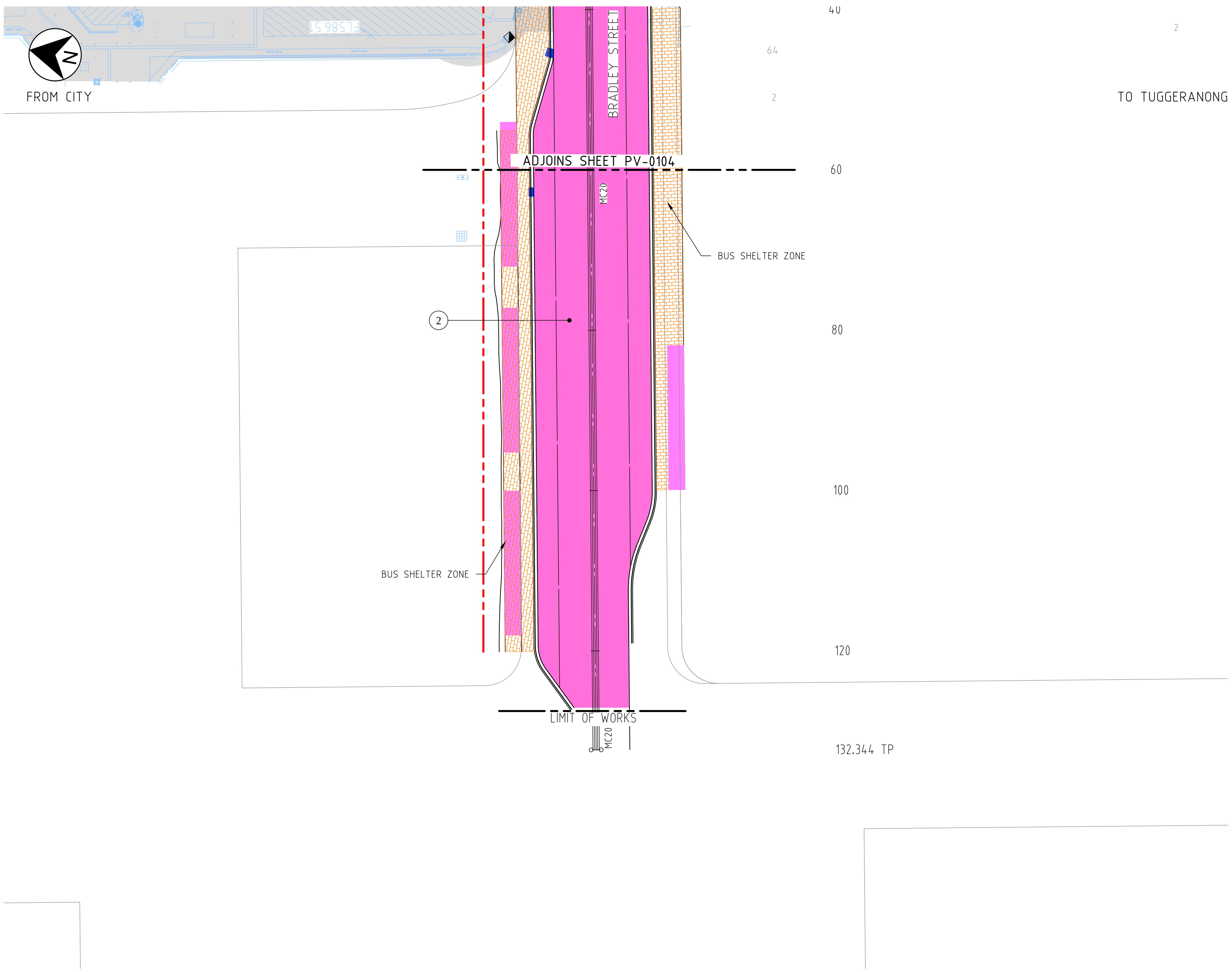
PAVEMENT PLAN

SHEET 4 OF 5

A3

ACT REGISTRATION No. TCLR-201-BRI-0006
PART

ISSUE STATUS: PSP DESIGN
EDMS No.
SHEET No.: PV-0104
REV: 1



LEGEND

GENERAL

🟥	PROJECT BOUNDARY
	CADASTRAL BOUNDARY
34 80	CADASTRAL LOT AND DP NUMBER
MCxx	SURVEY CONTROL LINE

PAVEMENT

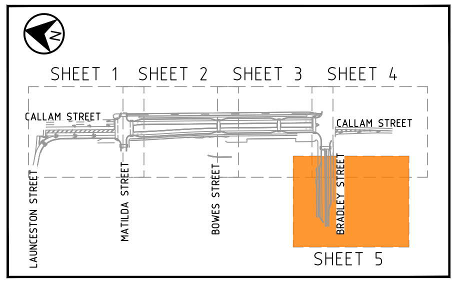
▨	EXISTING PAVEMENT
▨	EXISTING PAVEMENT TO BE REMOVED
🟦	TYPE 1 - CALLAM INTERCHANGE
🟪	TYPE 2 - BRADLEY INTERCHANGE
🟩	TYPE 3 - CALLAM WIDENING
🟧	TYPE 4 - MILL AND RESHEET
🟦	TYPE 5 - RAISED MEDIAN
🟨	TYPE 6 - COMMERCIAL DRIVEWAY
🟫	TYPE 7 - SHARED PATH
	PAVEMENT TYPE LABEL

DRAINAGE

▤	EXISTING PIT
◪	EXISTING PIT TO BE MODIFIED
■	NEW PIT

NOTES

1. FOR GENERAL NOTES REFER SHEET No. GE-0021.
2. FOR PAVEMENT PROFILES REFER SHEET PV-201.



KEY PLAN
NTS

NOT FOR CONSTRUCTION

THIS DRAWING MAY BE PREPARED IN COLOUR AND MAY BE INCOMPLETE IF COPIED

50mm ON A3 SIZE ORIGINAL

DRAWING FILE LOCATION \ NAME - PLOT DATE \ TIME - PLOT BY
\\jacobs.com\anz\IE\Projects\03_Southern\IS268800\01 Design\Drawings\Civil\IS268800-DG-PV-0101-0105.dwg - 28/08/2019 12:07:05 PM - imedi

DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING

REV	DATE	AMENDMENT / REVISION DESCRIPTION	APPROVAL
0	05.07.19	ISSUED FOR DRAFT PSP DESIGN	L.QASEM
1	26.08.19	ISSUED FOR FINAL PSP DESIGN	L.QASEM

PROJECT BREAKDOWN STRUCTURE

SCALES ON A3 SIZE DRAWING
SCALE 1:500 5 0 5 10
AT A3

STROMLO COORDINATE SYSTEM AGD66
HEIGHT DATUM AHD

JACOBS DOCUMENT NUMBER
IS268800-DG-PV-0105

DRAWINGS / DESIGN PREPARED BY

JACOBS
177 Pacific Highway
NORTH SYDNEY, NSW 2060
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PLOT DATE / TIME 28/08/2019
PLOT BY imedii

TITLE	NAME	DATE
DRAWN	I.IMEDI	26.08.19
DRG CHECK	S.GALLOWAY	26.08.19
DESIGN	C.WING	26.08.19
DESIGN CHECK	B.CERECINA	26.08.19
DESIGN MNGR	G.TRUNDLE	26.08.19
PROJECT MNGR	L.QASEM	26.08.19

CLIENT
ACT Government
Transport Canberra

ACT GOVERNMENT
WODEN BUS INTERCHANGE AND ROAD LAYOUT MODIFICATIONS
WODEN BUS INTERCHANGE

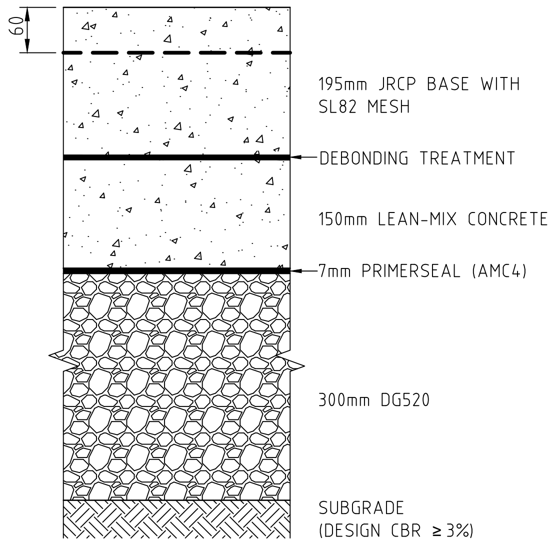
A3

PAVEMENT PLAN

SHEET 5 OF 5

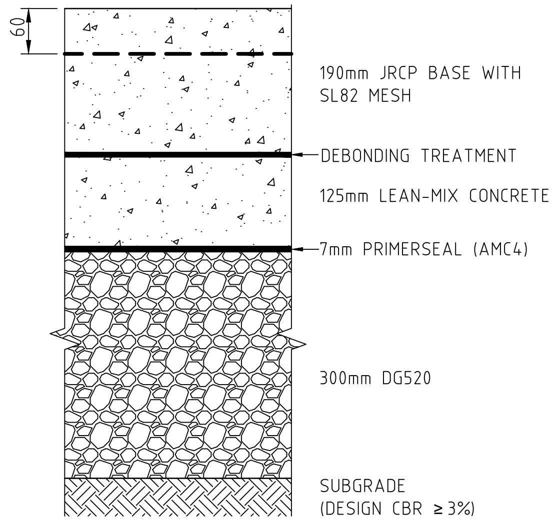
ACT REGISTRATION No. TCLR-201-BRI-0006
PART

ISSUE STATUS PSP DESIGN
EDMS No.
SHEET No. PV-0105
REV 1



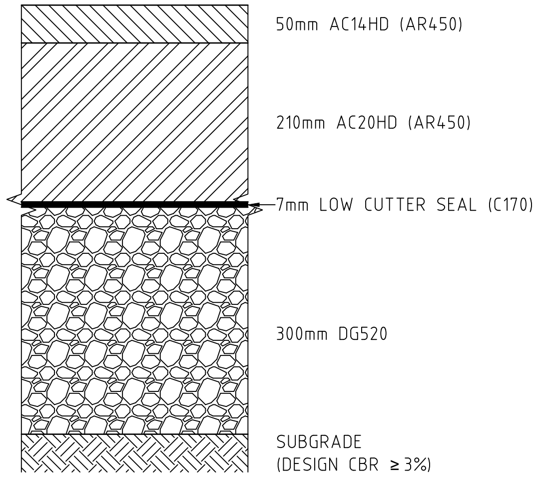
CALLAM INTERCHANGE

TYPE 1 🟦



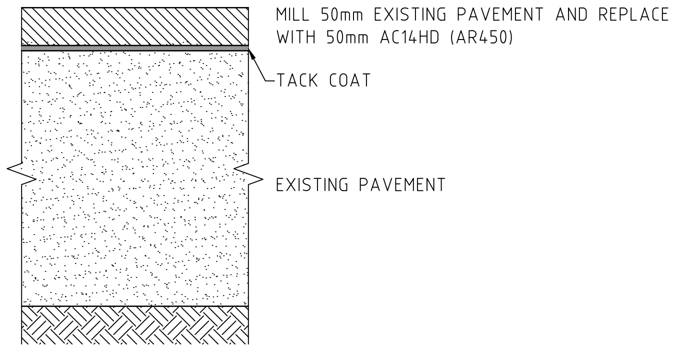
BRADLEY INTERCHANGE

TYPE 2 🟪



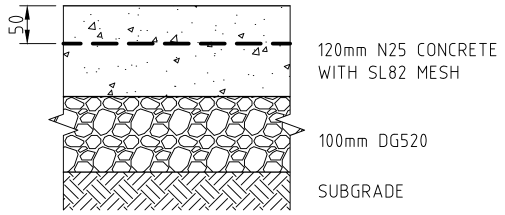
CALLAM WIDENING

TYPE 3 🟩



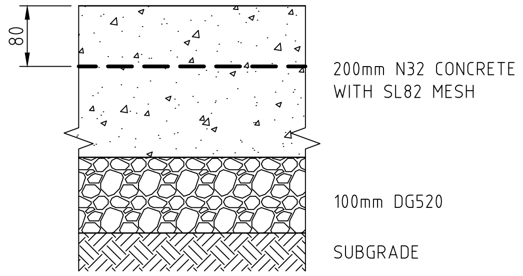
MILL AND RESHEET

TYPE 4 🟧



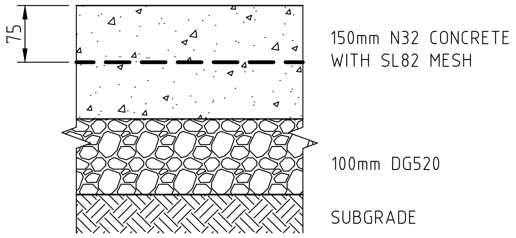
RAISED MEDIAN

TYPE 5 🟦



COMMERCIAL DRIVEWAY

TYPE 6 🟨



SHARED PATH

TYPE 7 🟫

NOTES

1. FOR GENERAL NOTES REFER SHEET No. GE-0021.

NOT FOR CONSTRUCTION

DRAWING FILE LOCATION \ NAME - PLOT DATE \ TIME - PLOT BY
\\Jacobs.com\ANZ\IE\Projects\03_Southern\IS268800\01 Design\Drawings\Civil\IS268800-DG-PV-0201.dwg - 28/08/2019 12:16:29 PM - imedii

DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING

REV	DATE	AMENDMENT / REVISION DESCRIPTION	APPROVAL
0	28.08.19	ISSUED FOR FINAL PSP DESIGN	L.QASEM

PROJECT BREAKDOWN STRUCTURE

SCALES ON A3 SIZE DRAWING
SCALE 1:10 0.1 0 0.1 0.2 AT A3

STROMLO COORDINATE SYSTEM
AGD66
HEIGHT DATUM
AHD

JACOBS DOCUMENT NUMBER
IS268800-DG-PV-0201

DRAWINGS / DESIGN PREPARED BY
JACOBS
177 Pacific Highway
NORTH SYDNEY, NSW 2060
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PLOT DATE / TIME
28/08/2019
PLOT BY
imedii

TITLE	NAME	DATE
DRAWN	I.IMEDI	28.08.19
DRG CHECK	S.GALLOWAY	28.08.19
DESIGN	C.WING	28.08.19
DESIGN CHECK	B.CERECINA	28.08.19
DESIGN MNGR	G.TRUNDLE	28.08.19
PROJECT MNGR	L.QASEM	28.08.19

CLIENT
ACT Government
Transport Canberra

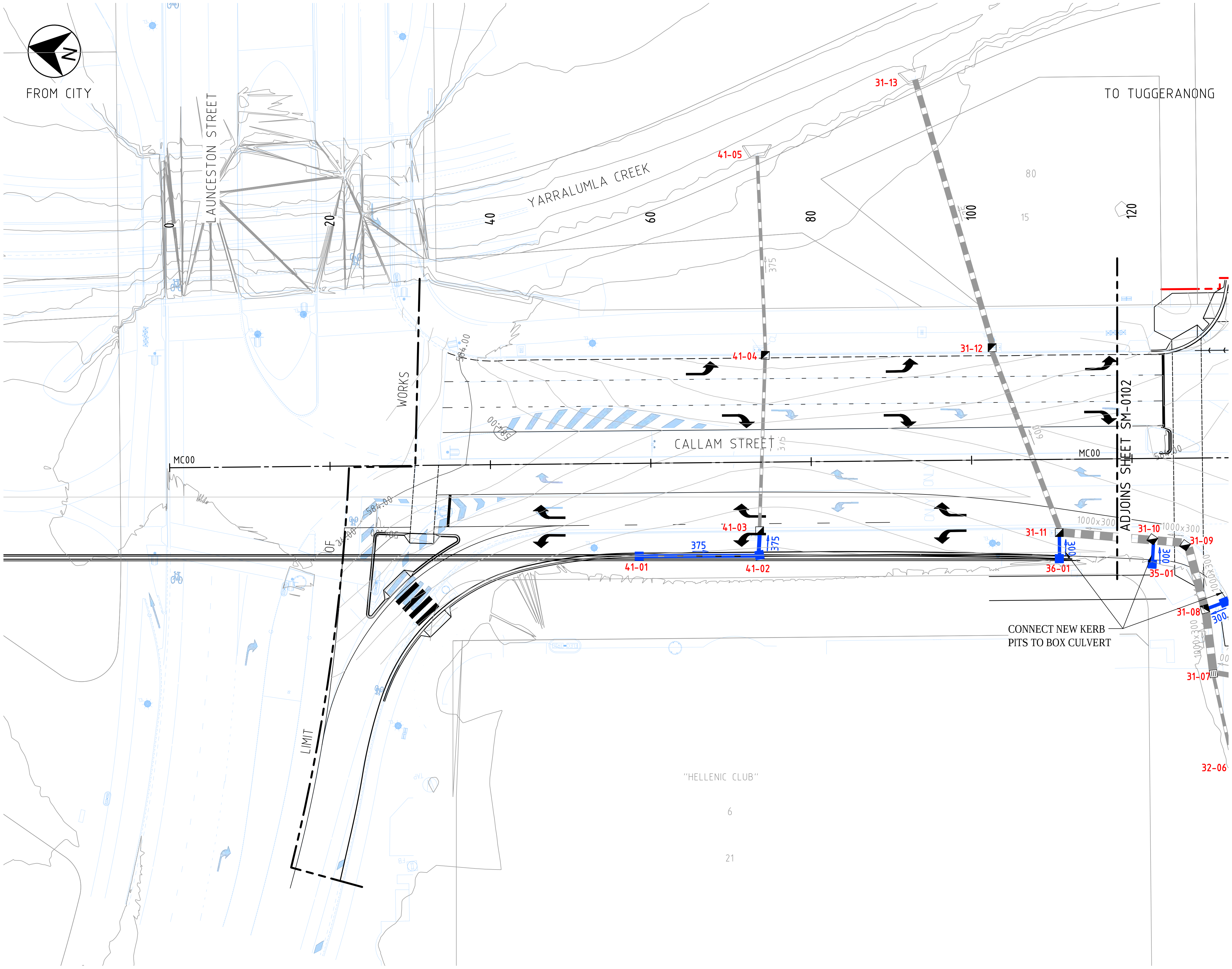
ACT GOVERNMENT
WODEN BUS INTERCHANGE AND ROAD LAYOUT MODIFICATIONS
WODEN BUS INTERCHANGE

PAVEMENT PROFILES

A3

ACT REGISTRATION No. TCLR-201-BRI-0006
PART

ISSUE STATUS
PSP DESIGN
EDMS No.
SHEET No.
PV-0201
REV
0



LEGEND

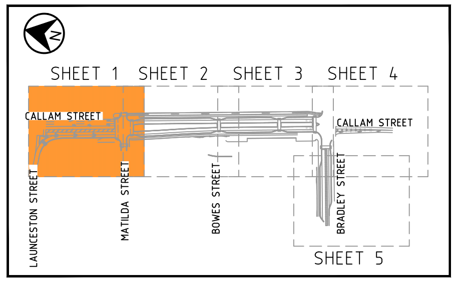
GENERAL
- SURVEY
- EXISTING CADASTRIAL BOUNDARY
- 99 MAJOR CONTOURS
- MINOR CONTOURS
- PROPOSED ROAD BOUNDARY

EXISTING DRAINAGE
- EXISTING STORMWATER PITS/PIPES TO BE REMOVED / ABANDONED
- EXISTING STORMWATER PITS / PIPES / HEADWALL - TO BE RETAINED
- ◪ EXISTING PIT TO BE MODIFIED

NEW DRAINAGE
- 450 NEW DRAINAGE PIPE / PIT / SIZE / HEADWALL
- 41-01 STORMWATER PIT LABEL
- PIT NUMBER
- DRAINAGE LINE NUMBER
- DISH DRAIN

NOTES

1. MAJOR CONTOURS ARE SHOWN AT 1.0m INTERVALS.
2. MINOR CONTOURS ARE SHOWN AT 0.1m INTERVALS.
3. CONDITION ASSESSMENT OF ALL EXISTING DRAINAGE INFRASTRUCTURE IS REQUIRED TO CONFIRM IT CAN BE RETAINED.



KEY PLAN

NTS

NOT FOR CONSTRUCTION

THIS DRAWING MAY BE PREPARED IN COLOUR AND MAY BE INCOMPLETE IF COPIED

50mm ON A3 SIZE ORIGINAL

DRAWING FILE LOCATION \ NAME - PLOT DATE \ TIME - PLOT BY
\\jacobs.com\anz\IE\Projects\03_Southern\IS268800\01 Design\Drawings\Civil\IS268800-DG-SM-0101-0105.dwg - 27/08/2019 1:30:38 PM - imedii

DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING

REV	DATE	AMENDMENT / REVISION DESCRIPTION	APPROVAL
0	05.07.19	ISSUED FOR DRAFT PSP DESIGN	L.QASEM
1	28.08.19	ISSUED FOR FINAL PSP DESIGN	L.QASEM

PROJECT BREAKDOWN STRUCTURE

SCALES ON A3 SIZE DRAWING
SCALE 1:1000 — 10 0 10 20 — AT A3

STROMLO COORDINATE SYSTEM: AGD66
HEIGHT DATUM: AHD

JACOBS DOCUMENT NUMBER
IS268800-DG-SM-0101

DRAWINGS / DESIGN PREPARED BY
JACOBS
177 Pacific Highway
NORTH SYDNEY, NSW 2060
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PLOT DATE / TIME: 27/08/2019
PLOT BY: imedii

TITLE	NAME	DATE
DRAWN	I.IMEDI	28.08.19
DRG CHECK	S.GALLOWAY	28.08.19
DESIGN	R.ROYLANCE	28.08.19
DESIGN CHECK	S.RUSCHEINSKY	28.08.19
DESIGN MNGR	G.TRUNDLE	28.08.19
PROJECT MNGR	L.QASEM	28.08.19

CLIENT
ACT Government | Transport Canberra

ACT GOVERNMENT
WODEN BUS INTERCHANGE AND ROAD LAYOUT MODIFICATIONS
WODEN BUS INTERCHANGE

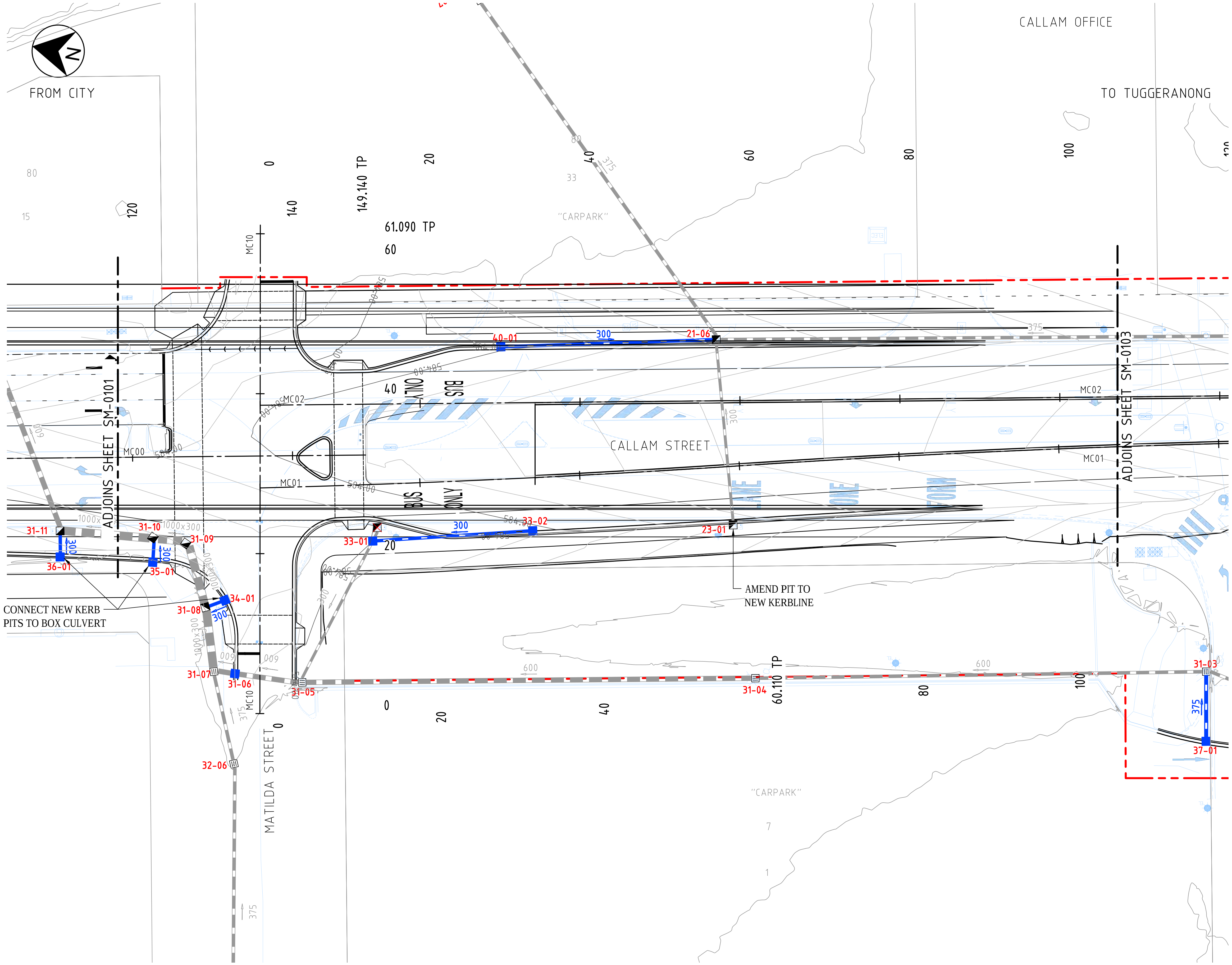
DRAINAGE PLAN

SHEET 1 OF 5

A3

ACT REGISTRATION No. TCLR-201-BRI-0006
PART

ISSUE STATUS: PSP DESIGN
EDMS No.
SHEET No.: SM-0101
REV: 1



LEGEND

GENERAL

- SURVEY
- EXISTING CADASTRIAL BOUNDARY
- 99 MAJOR CONTOURS
- MINOR CONTOURS
- PROPOSED ROAD BOUNDARY

EXISTING DRAINAGE

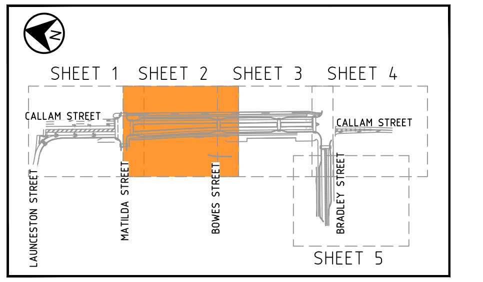
- EXISTING STORMWATER PITS/PIPES TO BE REMOVED / ABANDONED
- EXISTING STORMWATER PITS / PIPES / HEADWALL - TO BE RETAINED
- ◪ EXISTING PIT TO BE MODIFIED

NEW DRAINAGE

- 450 NEW DRAINAGE PIPE / PIT / SIZE / HEADWALL
- 41-01 STORMWATER PIT LABEL
- PIT NUMBER
- DRAINAGE LINE NUMBER
- DISH DRAIN

NOTES

1. MAJOR CONTOURS ARE SHOWN AT 1.0m INTERVALS.
2. MINOR CONTOURS ARE SHOWN AT 0.1m INTERVALS.
3. CONDITION ASSESSMENT OF ALL EXISTING DRAINAGE INFRASTRUCTURE IS REQUIRED TO CONFIRM IT CAN BE RETAINED.



KEY PLAN

NTS

NOT FOR CONSTRUCTION

DRAWING FILE LOCATION \ NAME - PLOT DATE \ TIME - PLOT BY
\\jacobs.com\anz\IE\Projects\03_Southern\IS268800\01 Design\Drawings\Civil\IS268800-DG-SM-0101-0105.dwg - 27/08/2019 1:30:40 PM - imedii

DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING

REV	DATE	AMENDMENT / REVISION DESCRIPTION	APPROVAL
0	05.07.19	ISSUED FOR DRAFT PSP DESIGN	L.QASEM
1	28.08.19	ISSUED FOR FINAL PSP DESIGN	L.QASEM

PROJECT BREAKDOWN STRUCTURE

SCALES ON A3 SIZE DRAWING
SCALE 1:1000 10 0 10 20 AT A3

STROMLO COORDINATE SYSTEM AGD66
HEIGHT DATUM AHD

JACOBS DOCUMENT NUMBER
IS268800-DG-SM-0102

DRAWINGS / DESIGN PREPARED BY
JACOBS
177 Pacific Highway
NORTH SYDNEY, NSW 2060
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PLOT DATE / TIME 27/08/2019
PLOT BY imedii

TITLE	NAME	DATE
DRAWN	I.IMEDI	28.08.19
DRG CHECK	S.GALLOWAY	28.08.19
DESIGN	R.ROYLANCE	28.08.19
DESIGN CHECK	S.RUSCHEINSKY	28.08.19
DESIGN MNGR	G.TRUNDLE	28.08.19
PROJECT MNGR	L.QASEM	28.08.19

CLIENT
ACT Government
Transport Canberra

ACT GOVERNMENT
WODEN BUS INTERCHANGE AND ROAD LAYOUT MODIFICATIONS
WODEN BUS INTERCHANGE

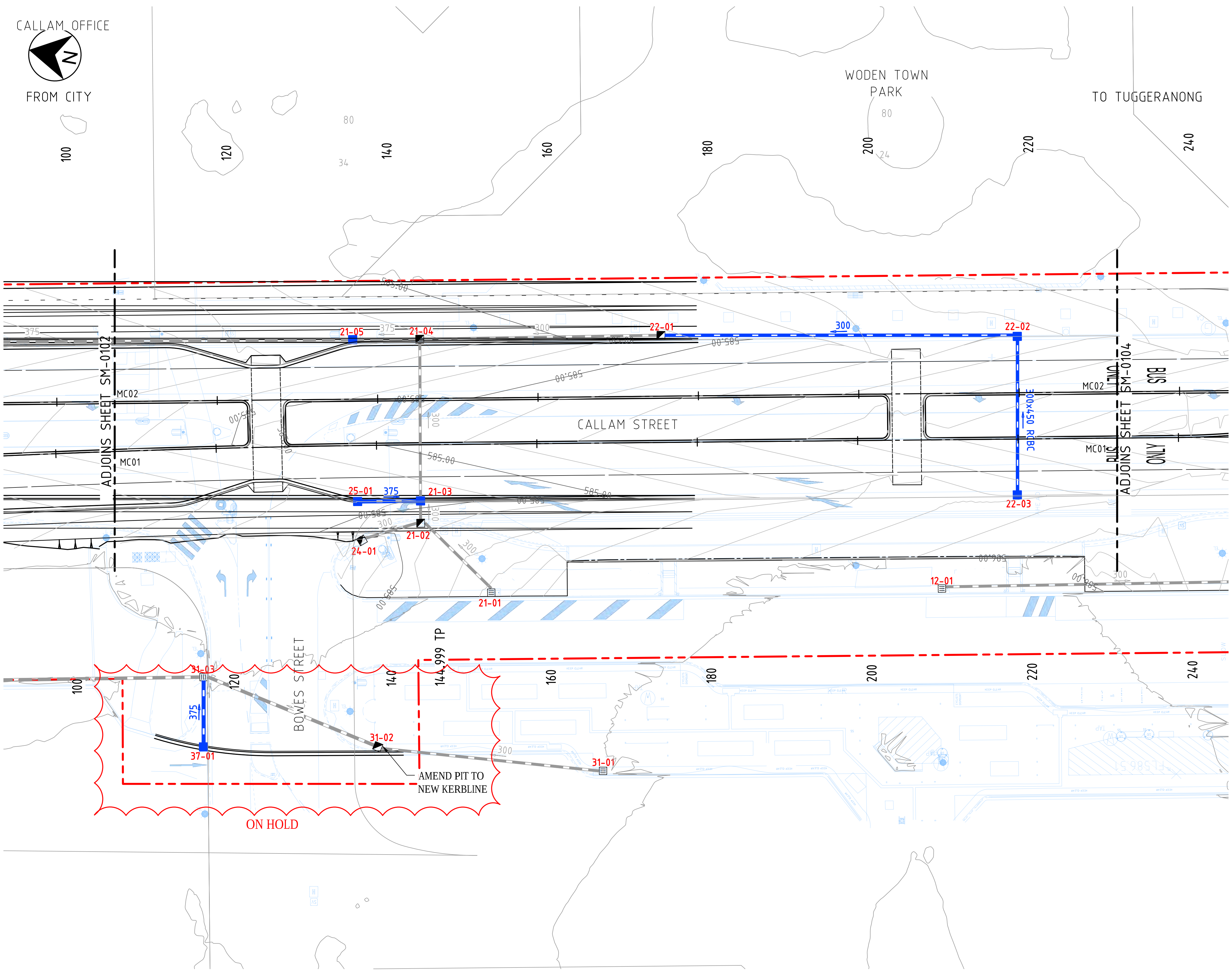
DRAINAGE PLAN

SHEET 2 OF 5

A3

ACT REGISTRATION No. TCLR-201-BRI-0006
PART

ISSUE STATUS PSP DESIGN
EDMS No.
SHEET No. SM-0102
REV 1



LEGEND

GENERAL

SURVEY
EXISTING CADASTRIAL BOUNDARY
99 MAJOR CONTOURS
MINOR CONTOURS
PROPOSED ROAD BOUNDARY

EXISTING DRAINAGE

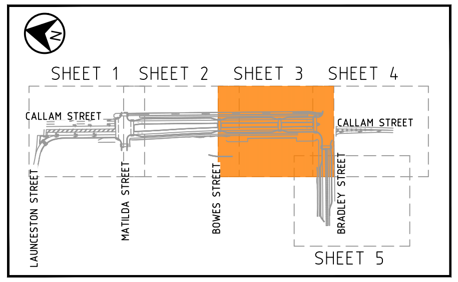
EXISTING STORMWATER PITS/PIPES TO BE REMOVED / ABANDONED
EXISTING STORMWATER PITS / PIPES / HEADWALL - TO BE RETAINED
◪ EXISTING PIT TO BE MODIFIED

NEW DRAINAGE

450 NEW DRAINAGE PIPE / PIT / SIZE / HEADWALL
41-01 STORMWATER PIT LABEL
PIT NUMBER
DRAINAGE LINE NUMBER
DISH DRAIN

NOTES

1. MAJOR CONTOURS ARE SHOWN AT 1.0m INTERVALS
2. MINOR CONTOURS ARE SHOWN AT 0.1m INTERVALS.
3. CONDITION ASSESSMENT OF ALL EXISTING DRAINAGE INFRASTRUCTURE IS REQUIRED TO CONFIRM IT CAN BE RETAINED.



KEY PLAN
NTS

NOT FOR CONSTRUCTION

THIS DRAWING MAY BE PREPARED IN COLOUR AND MAY BE INCOMPLETE IF COPIED

50mm ON A3 SIZE ORIGINAL

DRAWING FILE LOCATION \ NAME - PLOT DATE \ TIME - PLOT BY
\\jacobs.com\anz\IE\Projects\03_Southern\IS268800\01 Design\Drawings\Civil\IS268800-DG-SM-0101-0105.dwg - 27/08/2019 1:30:42 PM - imedii

DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING

REV	DATE	AMENDMENT / REVISION DESCRIPTION	APPROVAL
0	05.07.19	ISSUED FOR DRAFT PSP DESIGN	L.QASEM
1	28.08.19	ISSUED FOR FINAL PSP DESIGN	L.QASEM

PROJECT BREAKDOWN STRUCTURE

SCALES ON A3 SIZE DRAWING
SCALE 1:1000 10 0 10 20 AT A3

STROMLO COORDINATE SYSTEM AGD66
HEIGHT DATUM AHD

JACOBS DOCUMENT NUMBER
IS268800-DG-SM-0103

DRAWINGS / DESIGN PREPARED BY
JACOBS
177 Pacific Highway
NORTH SYDNEY, NSW 2060
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PLOT DATE / TIME 27/08/2019
PLOT BY imedii

TITLE	NAME	DATE
DRAWN	I.IMEDI	28.08.19
DRG CHECK	S.GALLOWAY	28.08.19
DESIGN	R.ROYLANCE	28.08.19
DESIGN CHECK	S.RUSCHEINSKY	28.08.19
DESIGN MNGR	G.TRUNDLE	28.08.19
PROJECT MNGR	L.QASEM	28.08.19

CLIENT
ACT Government | Transport Canberra

ACT GOVERNMENT
WODEN BUS INTERCHANGE AND ROAD LAYOUT MODIFICATIONS
WODEN BUS INTERCHANGE

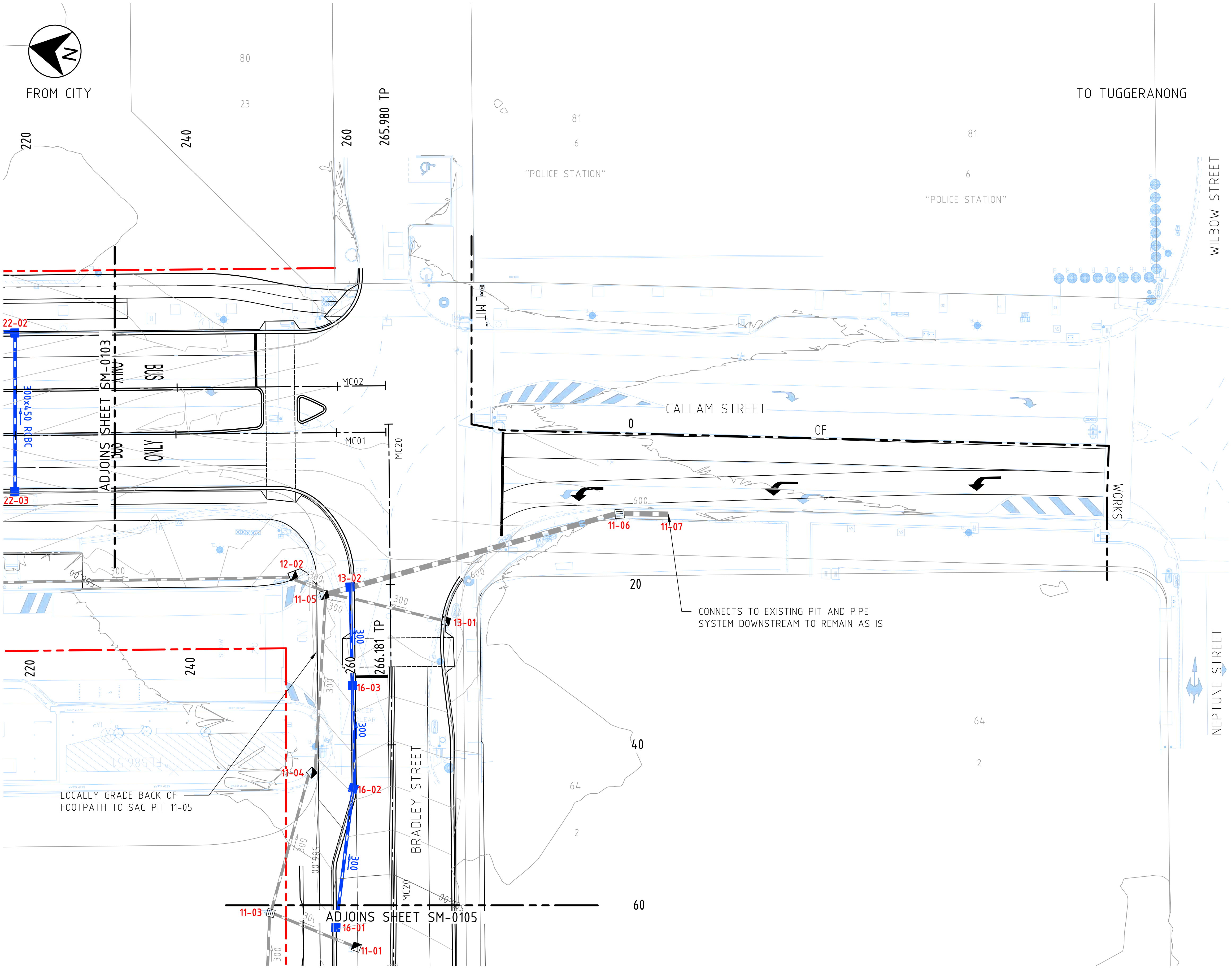
DRAINAGE PLAN

SHEET 3 OF 5

A3

ACT REGISTRATION No. TCLR-201-BRI-0006
PART

ISSUE STATUS PSP DESIGN
EDMS No.
SHEET No. SM-0103
REV 1



LEGEND

GENERAL

SURVEY
EXISTING CADASTRIAL BOUNDARY
99 MAJOR CONTOURS
MINOR CONTOURS
PROPOSED ROAD BOUNDARY

EXISTING DRAINAGE

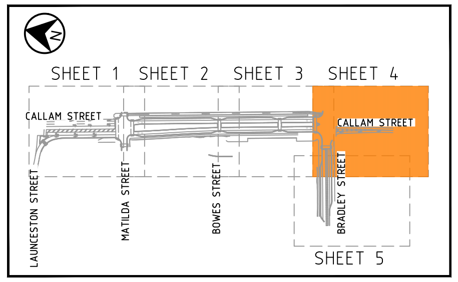
EXISTING STORMWATER PITS/PIPES TO BE REMOVED / ABANDONED
EXISTING STORMWATER PITS / PIPES / HEADWALL - TO BE RETAINED
EXISTING PIT TO BE MODIFIED

NEW DRAINAGE

450 NEW DRAINAGE PIPE / PIT / SIZE / HEADWALL
41-01 STORMWATER PIT LABEL
PIT NUMBER
DRAINAGE LINE NUMBER
DISH DRAIN

NOTES

1. MAJOR CONTOURS ARE SHOWN AT 1.0m INTERVALS
2. MINOR CONTOURS ARE SHOWN AT 0.1m INTERVALS.
3. CONDITION ASSESSMENT OF ALL EXISTING DRAINAGE INFRASTRUCTURE IS REQUIRED TO CONFIRM IT CAN BE RETAINED.



KEY PLAN
NTS

NOT FOR CONSTRUCTION

THIS DRAWING MAY BE PREPARED IN COLOUR AND MAY BE INCOMPLETE IF COPIED

0 5 10 15 20 25 30 35 40 45 50mm ON A3 SIZE ORIGINAL

DRAWING FILE LOCATION \ NAME - PLOT DATE \ TIME - PLOT BY
\\jacobs.com\anz\IE\Projects\03_Southern\IS268800\01 Design\Drawings\Civil\IS268800-DG-SM-0101-0105.dwg - 27/08/2019 1:30:43 PM - imedii

DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING

REV	DATE	AMENDMENT / REVISION DESCRIPTION	APPROVAL
0	05.07.19	ISSUED FOR DRAFT PSP DESIGN	L.QASEM
1	28.08.19	ISSUED FOR FINAL PSP DESIGN	L.QASEM

PROJECT BREAKDOWN STRUCTURE

SCALES ON A3 SIZE DRAWING
SCALE 1:1000 10 0 10 20 AT A3

STROMLO COORDINATE SYSTEM AGD66
HEIGHT DATUM AHD

JACOBS DOCUMENT NUMBER
IS268800-DG-SM-0104

DRAWINGS / DESIGN PREPARED BY
JACOBS
177 Pacific Highway
NORTH SYDNEY, NSW 2060
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PLOT DATE / TIME 27/08/2019
PLOT BY imedii

TITLE	NAME	DATE
DRAWN	I.MEDI	28.08.19
DRG CHECK	S.GALLOWAY	28.08.19
DESIGN	R.ROYLANCE	28.08.19
DESIGN CHECK	S.RUSCHEINSKY	28.08.19
DESIGN MNGR	G.TRUNDLE	28.08.19
PROJECT MNGR	L.QASEM	28.08.19

CLIENT
ACT Government
Transport Canberra

ACT GOVERNMENT
WODEN BUS INTERCHANGE AND ROAD LAYOUT MODIFICATIONS
WODEN BUS INTERCHANGE

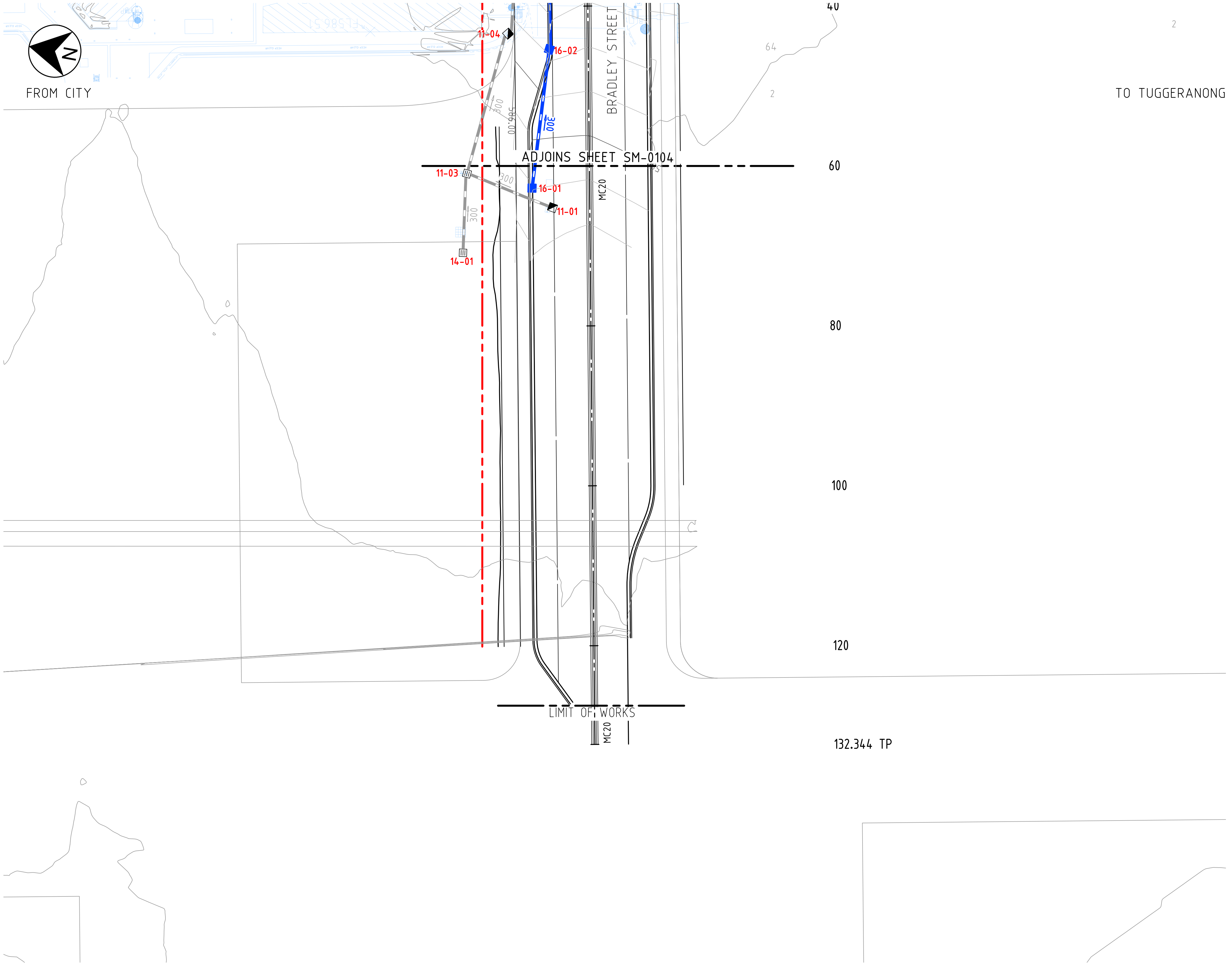
A3

DRAINAGE PLAN

SHEET 4 OF 5

ACT REGISTRATION No. TCLR-201-BRI-0006
PART

ISSUE STATUS PSP DESIGN
EDMS No.
SHEET No. SM-0104
REV 1



LEGEND

GENERAL

- SURVEY
- EXISTING CADASTRIAL BOUNDARY
- 99 MAJOR CONTOURS
- MINOR CONTOURS
- PROPOSED ROAD BOUNDARY

EXISTING DRAINAGE

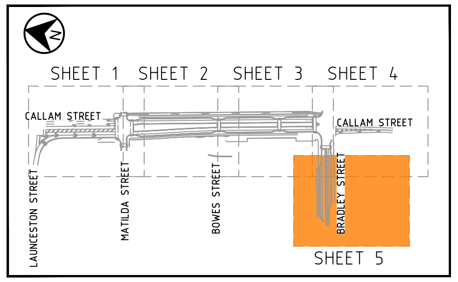
- EXISTING STORMWATER PITS/PIPES TO BE REMOVED / ABANDONED
- EXISTING STORMWATER PITS / PIPES / HEADWALL - TO BE RETAINED
- ◪ EXISTING PIT TO BE MODIFIED

NEW DRAINAGE

- 450 NEW DRAINAGE PIPE / PIT / SIZE / HEADWALL
- 41-01 STORMWATER PIT LABEL
- PIT NUMBER
- DRAINAGE LINE NUMBER
- DISH DRAIN

NOTES

1. MAJOR CONTOURS ARE SHOWN AT 1.0m INTERVALS.
2. MINOR CONTOURS ARE SHOWN AT 0.1m INTERVALS.
3. CONDITION ASSESSMENT OF ALL EXISTING DRAINAGE INFRASTRUCTURE IS REQUIRED TO CONFIRM IT CAN BE RETAINED.



KEY PLAN

NTS

NOT FOR CONSTRUCTION

DRAWING FILE LOCATION \ NAME - PLOT DATE \ TIME - PLOT BY
\\jacobs.com\anz\IE\Projects\03_Southern\IS268800\01 Design\Drawings\Civil\IS268800-DG-SM-0101-0105.dwg - 27/08/2019 1:30:45 PM - imedii

DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING

REV	DATE	AMENDMENT / REVISION DESCRIPTION	APPROVAL
0	05.07.19	ISSUED FOR DRAFT PSP DESIGN	L.QASEM
1	28.08.19	ISSUED FOR FINAL PSP DESIGN	L.QASEM

PROJECT BREAKDOWN STRUCTURE

SCALES ON A3 SIZE DRAWING

SCALE 1:1000 10 0 10 20 AT A3

STROMLO COORDINATE SYSTEM AGD66

HEIGHT DATUM AHD

JACOBS DOCUMENT NUMBER IS268800-DG-SM-0105

DRAWINGS / DESIGN PREPARED BY

JACOBS
177 Pacific Highway
NORTH SYDNEY, NSW 2060
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PLOT DATE / TIME 27/08/2019

PLOT BY imedii

TITLE	NAME	DATE
DRAWN	I.IMEDI	28.08.19
DRG CHECK	S.GALLOWAY	28.08.19
DESIGN	R.ROYLANCE	28.08.19
DESIGN CHECK	S.RUSCHEINSKY	28.08.19
DESIGN MNGR	G.TRUNDLE	28.08.19
PROJECT MNGR	L.QASEM	28.08.19

CLIENT

ACT Government | Transport Canberra

ACT GOVERNMENT
WODEN BUS INTERCHANGE AND ROAD LAYOUT MODIFICATIONS
WODEN BUS INTERCHANGE

DRAINAGE PLAN

SHEET 5 OF 5

A3

ACT REGISTRATION No. TCLR-201-BRI-0006

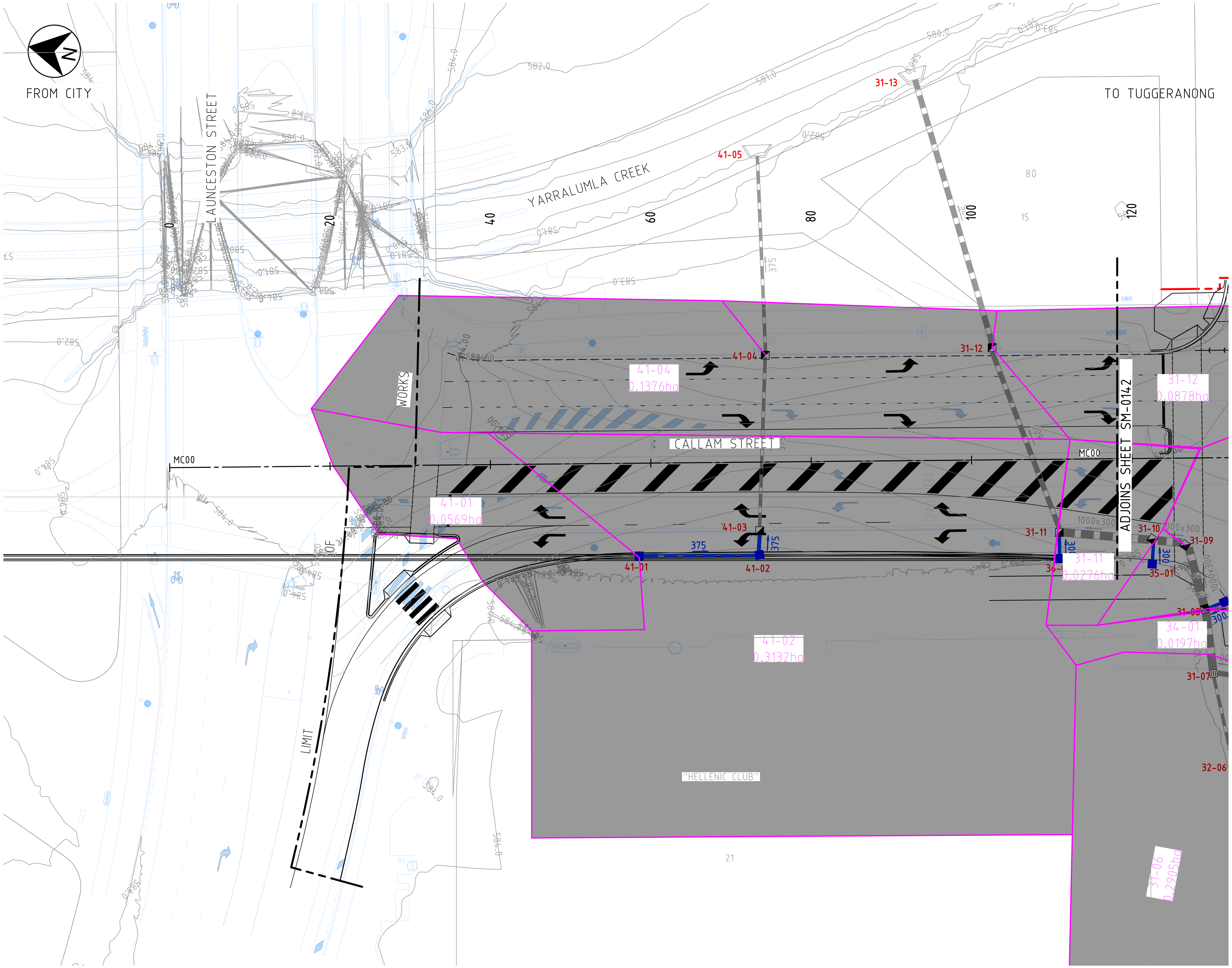
PART

ISSUE STATUS PSP DESIGN

EDMS No.

SHEET No. SM-0105

REV 1



LEGEND

GENERAL

	SURVEY
99	MAJOR CONTOURS
	MINOR CONTOURS
	EXISTING CADASTRIAL BOUNDARY
	NEW ROAD BOUNDARY
23-02	PIT NUMBER
0.1988ha	CATCHMENTS AREA
	CATCHMENTS BOUNDARY
▨	CATCHMENTS HATCH

EXISTING DRAINAGE

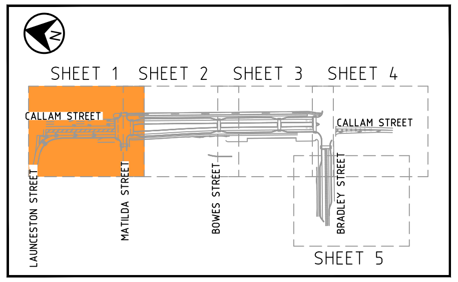
	EXISTING STORMWATER PITS/PIPES TO BE REMOVED / ABANDONED
	EXISTING STORMWATER PITS / PIPES / HEADWALL - TO BE RETAINED
◩	EXISTING PIT TO BE MODIFIED

PROPOSED DRAINAGE

450	NEW DRAINAGE PIPE / PIT / SIZE / HEADWALL
41-01	STORMWATER PIT LABEL
	PIT NUMBER
	DRAINAGE LINE NUMBER

NOTES

1. MAJOR CONTOURS ARE SHOWN AT 1.0m INTERVALS
2. MINOR CONTOURS ARE SHOWN AT 0.1m INTERVALS.
3. CONDITION ASSESSMENT OF ALL EXISTING DRAINAGE INFRASTRUCTURE IS REQUIRED TO CONFIRM IT CAN BE RETAINED.



KEY PLAN

NTS

NOT FOR CONSTRUCTION

THIS DRAWING MAY BE PREPARED IN COLOUR AND MAY BE INCOMPLETE IF COPIED

50mm ON A3 SIZE ORIGINAL

DRAWING FILE LOCATION \ NAME - PLOT DATE \ TIME - PLOT BY
\\jacobs.com\anz\IE\Projects\03_Southern\IS268800\01 Design\Drawings\Civil\IS268800-DG-SM-0141-0145.dwg - 27/08/2019 1:31:13 PM - imedii

DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING

REV	DATE	AMENDMENT / REVISION DESCRIPTION	APPROVAL
0	05.07.19	ISSUED FOR DRAFT PSP DESIGN	L.QASEM
1	28.08.19	ISSUED FOR FINAL PSP DESIGN	L.QASEM

PROJECT BREAKDOWN STRUCTURE

SCALES ON A3 SIZE DRAWING
SCALE 1:1000 10 0 10 20 AT A3

STROMLO COORDINATE SYSTEM AGD66
HEIGHT DATUM AHD

JACOBS DOCUMENT NUMBER
IS268800-DG-SM-0141

DRAWINGS / DESIGN PREPARED BY

JACOBS
177 Pacific Highway
NORTH SYDNEY, NSW 2060
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PLOT DATE / TIME 27/08/2019
PLOT BY imedii

TITLE	NAME	DATE
DRAWN	I.IMEDI	28.08.19
DRG CHECK	S.GALLOWAY	28.08.19
DESIGN	R.ROYLANCE	28.08.19
DESIGN CHECK	S.RUSCHEINSKY	28.08.19
DESIGN MNGR	G.TRUNDLE	28.08.19
PROJECT MNGR	L.QASEM	28.08.19

CLIENT
ACT Government | Transport Canberra

ACT GOVERNMENT
WODEN BUS INTERCHANGE AND ROAD LAYOUT MODIFICATIONS
WODEN BUS INTERCHANGE

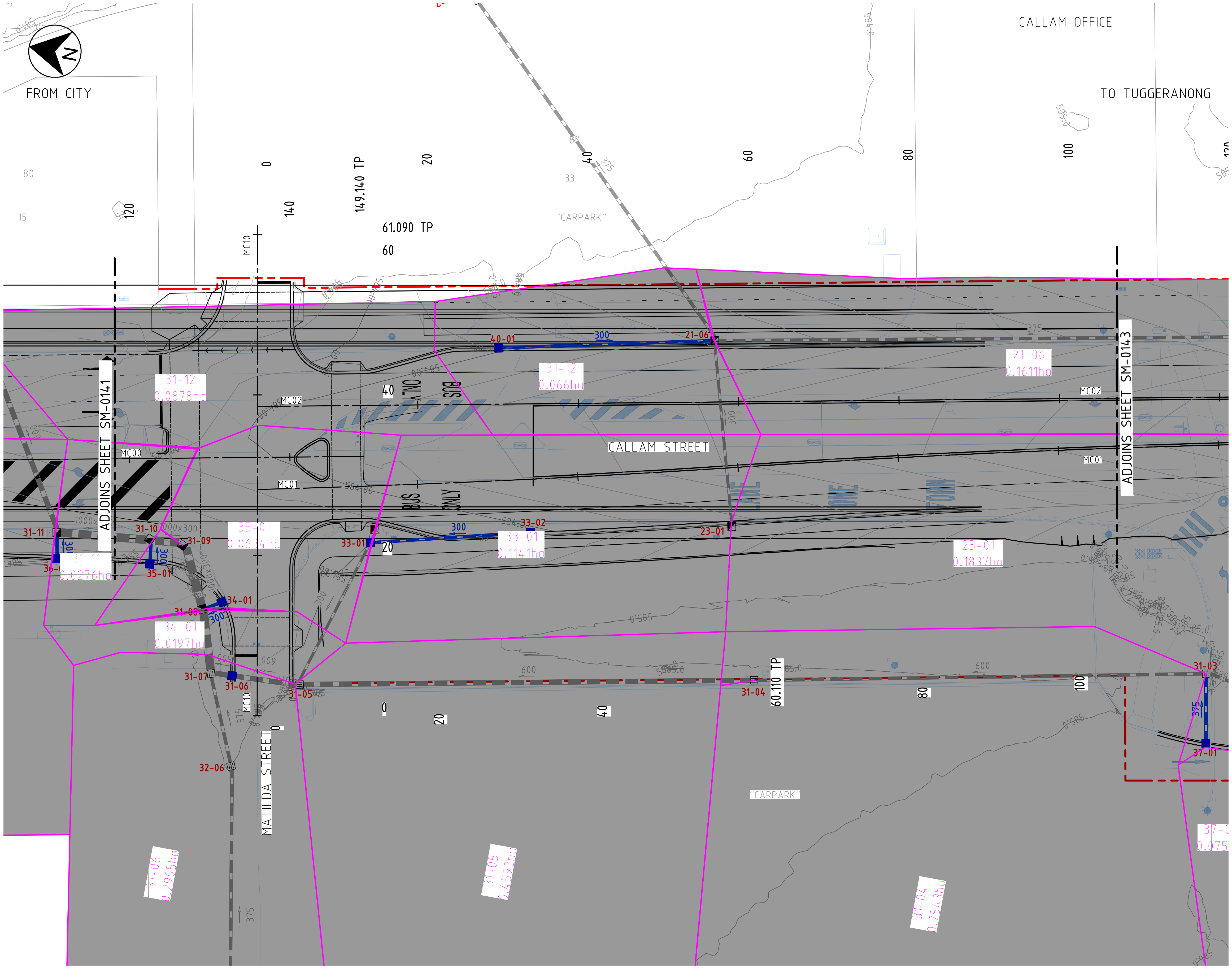
A3

DRAINAGE CATCHMENT PLAN

SHEET 1 OF 5

ACT REGISTRATION No. TCLR-201-BRI-0006
PART

ISSUE STATUS PSP DESIGN
EDMS No.
SHEET No. SM-0141
REV 1



LEGEND

GENERAL

	SURVEY
99	MAJOR CONTOURS
	MINOR CONTOURS
	EXISTING CADASTRIAL BOUNDARY
	NEW ROAD BOUNDARY
23-02	PIT NUMBER
0.1988ha	CATCHMENTS AREA
	CATCHMENTS BOUNDARY
▨	CATCHMENTS HATCH

EXISTING DRAINAGE

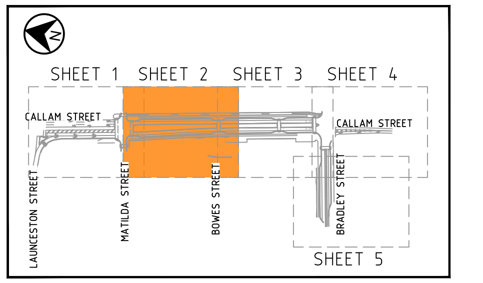
☒	EXISTING STORMWATER PITS/PIPES TO BE REMOVED / ABANDONED
▤	EXISTING STORMWATER PITS / PIPES / HEADWALL - TO BE RETAINED
◪	EXISTING PIT TO BE MODIFIED

PROPOSED DRAINAGE

450	NEW DRAINAGE PIPE / PIT / SIZE / HEADWALL STORMWATER PIT LABEL
41-01	PIT NUMBER
	DRAINAGE LINE NUMBER

NOTES

1. MAJOR CONTOURS ARE SHOWN AT 1.0m INTERVALS
2. MINOR CONTOURS ARE SHOWN AT 0.1m INTERVALS.
3. CONDITION ASSESSMENT OF ALL EXISTING DRAINAGE INFRASTRUCTURE IS REQUIRED TO CONFIRM IT CAN BE RETAINED.



KEY PLAN

NTS

NOT FOR CONSTRUCTION

THIS DRAWING MAY BE PREPARED IN COLOUR AND MAY BE INCOMPLETE IF COPIED

50mm ON A3 SIZE ORIGINAL

DRAWING FILE LOCATION \ NAME - PLOT DATE \ TIME - PLOT BY
\\jacobs.com\anz\IE\Projects\03_Southern\IS268800\01 Design\Drawings\Civil\IS268800-DG-SM-0141-0145.dwg - 27/08/2019 1:31:16 PM - imedii

DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING

REV	DATE	AMENDMENT / REVISION DESCRIPTION	APPROVAL
0	05.07.19	ISSUED FOR DRAFT PSP DESIGN	L.QASEM
1	28.08.19	ISSUED FOR FINAL PSP DESIGN	L.QASEM

PROJECT BREAKDOWN STRUCTURE

SCALES ON A3 SIZE DRAWING

SCALE 1:1000 (10 0 10 20) AT A3

STROMLO COORDINATE SYSTEM: AGD66
HEIGHT DATUM: AHD

JACOBS DOCUMENT NUMBER
IS268800-DG-SM-0142

DRAWINGS / DESIGN PREPARED BY

JACOBS
177 Pacific Highway
NORTH SYDNEY, NSW 2060
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PLOT DATE / TIME: 27/08/2019
PLOT BY: imedii

TITLE	NAME	DATE
DRAWN	I.IMEDI	28.08.19
DRG CHECK	S.GALLOWAY	28.08.19
DESIGN	R.ROYLANCE	28.08.19
DESIGN CHECK	S.RUSCHEINSKY	28.08.19
DESIGN MNGR	G.TRUNDLE	28.08.19
PROJECT MNGR	L.QASEM	28.08.19

CLIENT

ACT Government
Transport Canberra

ACT GOVERNMENT
WODEN BUS INTERCHANGE AND ROAD LAYOUT MODIFICATIONS
WODEN BUS INTERCHANGE

DRAINAGE CATCHMENT PLAN

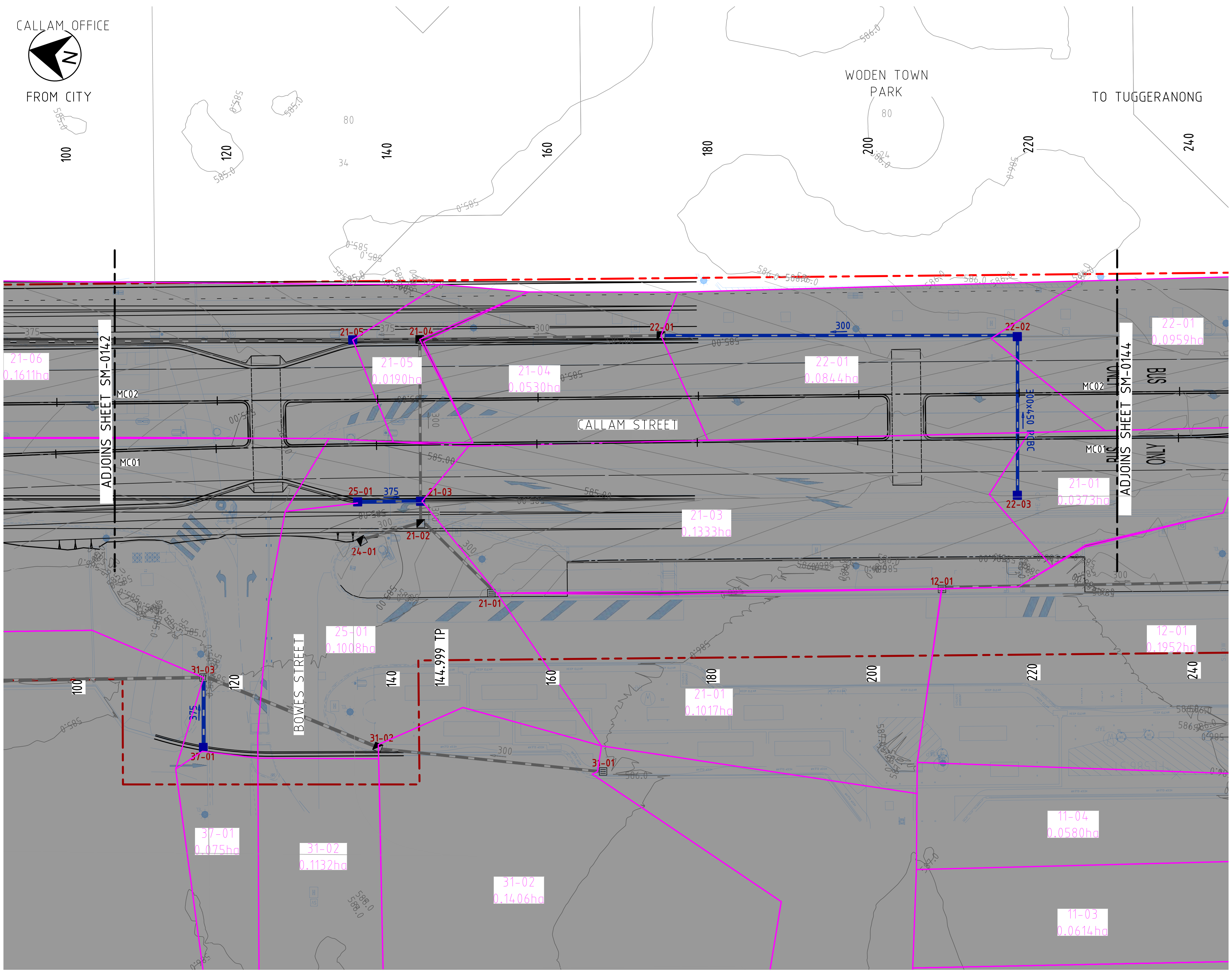
SHEET 2 OF 5

A3

ACT REGISTRATION No. TCLR-201-BRI-0006

PART

ISSUE STATUS: PSP DESIGN
EDMS No.
SHEET No.: SM-0142
REV: 1



LEGEND

GENERAL

- SURVEY
- 99 MAJOR CONTOURS
- MINOR CONTOURS
- EXISTING CADASTRIAL BOUNDARY
- NEW ROAD BOUNDARY
- 23-02 PIT NUMBER
- 0.1988ha CATCHMENTS AREA
- CATCHMENTS BOUNDARY
- CATCHMENTS HATCH

EXISTING DRAINAGE

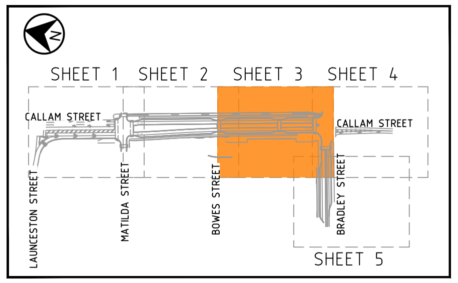
- EXISTING STORMWATER PITS/PIPES TO BE REMOVED / ABANDONED
- EXISTING STORMWATER PITS / PIPES / HEADWALL - TO BE RETAINED
- ◪ EXISTING PIT TO BE MODIFIED

PROPOSED DRAINAGE

- 450 NEW DRAINAGE PIPE / PIT / SIZE / HEADWALL
- 41-01 STORMWATER PIT LABEL
- PIT NUMBER
- DRAINAGE LINE NUMBER

NOTES

1. MAJOR CONTOURS ARE SHOWN AT 1.0m INTERVALS
2. MINOR CONTOURS ARE SHOWN AT 0.1m INTERVALS.
3. CONDITION ASSESSMENT OF ALL EXISTING DRAINAGE INFRASTRUCTURE IS REQUIRED TO CONFIRM IT CAN BE RETAINED.



KEY PLAN

NTS

NOT FOR CONSTRUCTION

THIS DRAWING MAY BE PREPARED IN COLOUR AND MAY BE INCOMPLETE IF COPIED

50mm ON A3 SIZE ORIGINAL

DRAWING FILE LOCATION \ NAME - PLOT DATE \ TIME - PLOT BY
\\jacobs.com\anz\IE\Projects\03_Southern\IS268800\01 Design\Drawings\Civil\IS268800-DG-SM-0141-0145.dwg - 27/08/2019 1:31:18 PM - imedii

DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING

REV	DATE	AMENDMENT / REVISION DESCRIPTION	APPROVAL
0	05.07.19	ISSUED FOR DRAFT PSP DESIGN	L.QASEM
1	28.08.19	ISSUED FOR FINAL PSP DESIGN	L.QASEM

PROJECT BREAKDOWN STRUCTURE

SCALES ON A3 SIZE DRAWING
SCALE 1:1000 10 0 10 20 AT A3

STROMLO COORDINATE SYSTEM AGD66
HEIGHT DATUM AHD

JACOBS DOCUMENT NUMBER
IS268800-DG-SM-0143

DRAWINGS / DESIGN PREPARED BY
JACOBS
177 Pacific Highway
NORTH SYDNEY, NSW 2060
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PLOT DATE / TIME 27/08/2019
PLOT BY imedii

TITLE	NAME	DATE
DRAWN	I.MEDI	28.08.19
DRG CHECK	S.GALLOWAY	28.08.19
DESIGN	R.ROYLANCE	28.08.19
DESIGN CHECK	S.RUSCHEINSKY	28.08.19
DESIGN MNGR	G.TRUNDLE	28.08.19
PROJECT MNGR	L.QASEM	28.08.19

CLIENT
ACT Government
Transport Canberra

ACT GOVERNMENT
WODEN BUS INTERCHANGE AND ROAD LAYOUT MODIFICATIONS
WODEN BUS INTERCHANGE

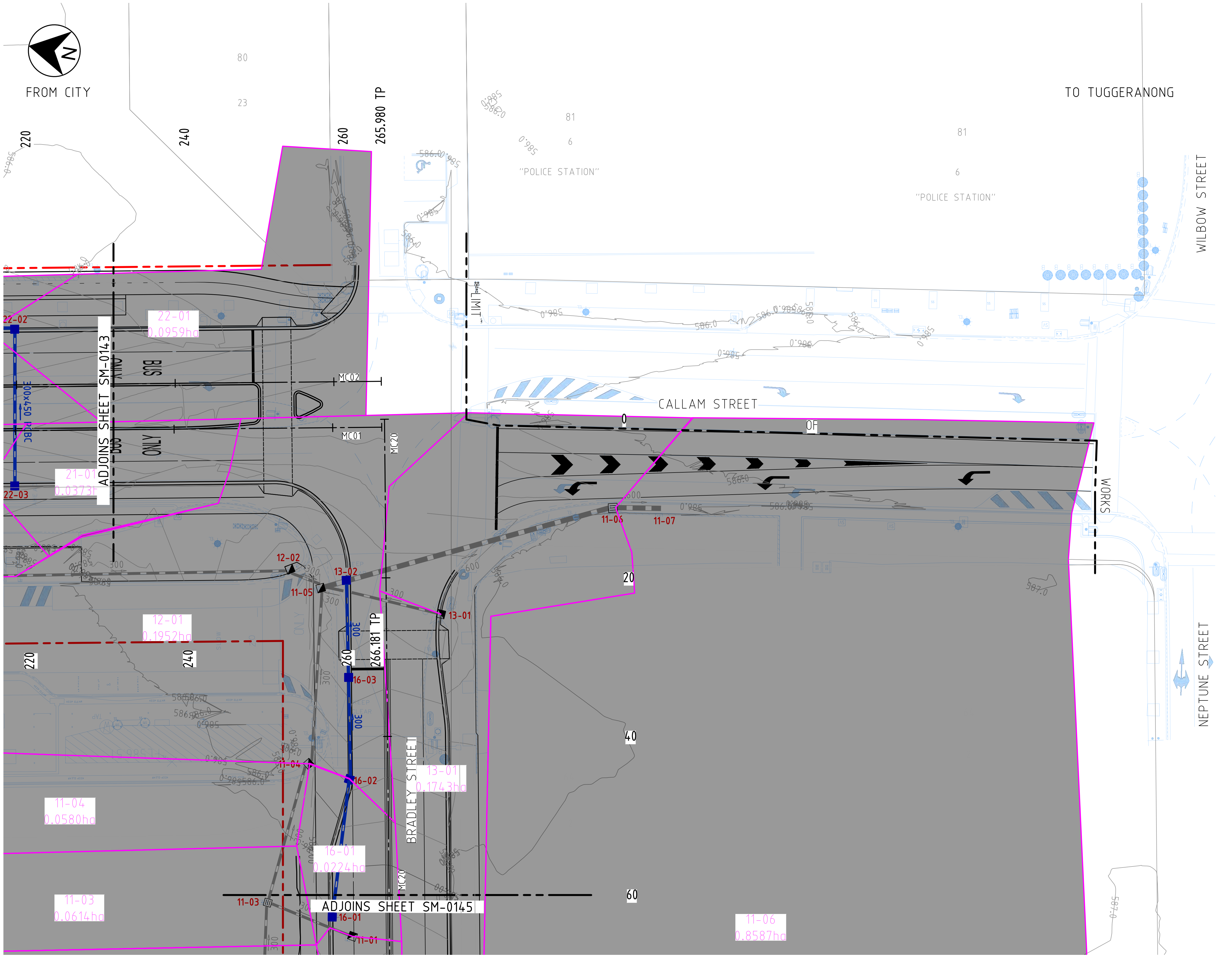
DRAINAGE CATCHMENT PLAN

SHEET 3 OF 5

A3

ACT REGISTRATION No. TCLR-201-BRI-0006
PART

ISSUE STATUS PSP DESIGN
EDMS No.
SHEET No. SM-0143
REV 1



LEGEND

GENERAL

99	SURVEY MAJOR CONTOURS
	MINOR CONTOURS
	EXISTING CADASTRIAL BOUNDARY
	NEW ROAD BOUNDARY
23-02	PIT NUMBER
0.1988ha	CATCHMENTS AREA
	CATCHMENTS BOUNDARY
▨	CATCHMENTS HATCH

EXISTING DRAINAGE

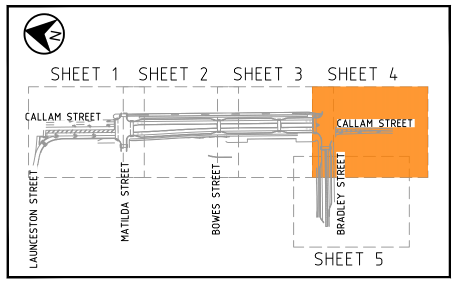
	EXISTING STORMWATER PITS/PIPES TO BE REMOVED / ABANDONED
	EXISTING STORMWATER PITS / PIPES / HEADWALL - TO BE RETAINED
◪	EXISTING PIT TO BE MODIFIED

PROPOSED DRAINAGE

450	NEW DRAINAGE PIPE / PIT / SIZE / HEADWALL
41-01	STORMWATER PIT LABEL
	PIT NUMBER
	DRAINAGE LINE NUMBER

NOTES

1. MAJOR CONTOURS ARE SHOWN AT 1.0m INTERVALS.
2. MINOR CONTOURS ARE SHOWN AT 0.1m INTERVALS.
3. CONDITION ASSESSMENT OF ALL EXISTING DRAINAGE INFRASTRUCTURE IS REQUIRED TO CONFIRM IT CAN BE RETAINED.



KEY PLAN

NTS

NOT FOR CONSTRUCTION

THIS DRAWING MAY BE PREPARED IN COLOUR AND MAY BE INCOMPLETE IF COPIED

50mm ON A3 SIZE ORIGINAL

DRAWING FILE LOCATION \ NAME - PLOT DATE \ TIME - PLOT BY
\\jacobs.com\anz\IE\Projects\03_Southern\IS268800\01 Design\Drawings\Civil\IS268800-DG-SM-0141-0145.dwg - 27/08/2019 1:31:21 PM - imedii

DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING

REV	DATE	AMENDMENT / REVISION DESCRIPTION	APPROVAL
0	05.07.19	ISSUED FOR DRAFT PSP DESIGN	L.QASEM
1	28.08.19	ISSUED FOR FINAL PSP DESIGN	L.QASEM

PROJECT BREAKDOWN STRUCTURE

SCALES ON A3 SIZE DRAWING
SCALE 1:1000 10 0 10 20 AT A3

STROMLO COORDINATE SYSTEM AGD66
HEIGHT DATUM AHD

JACOBS DOCUMENT NUMBER
IS268800-DG-SM-0144

DRAWINGS / DESIGN PREPARED BY
JACOBS
177 Pacific Highway
NORTH SYDNEY, NSW 2060
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PLOT DATE / TIME 27/08/2019
PLOT BY imedii

TITLE	NAME	DATE
DRAWN	I.IMEDI	28.08.19
DRG CHECK	S.GALLOWAY	28.08.19
DESIGN	R.ROYLANCE	28.08.19
DESIGN CHECK	S.RUSCHEINSKY	28.08.19
DESIGN MNGR	G.TRUNDLE	28.08.19
PROJECT MNGR	L.QASEM	28.08.19

CLIENT
ACT Government | Transport Canberra

ACT GOVERNMENT
WODEN BUS INTERCHANGE AND ROAD LAYOUT MODIFICATIONS
WODEN BUS INTERCHANGE

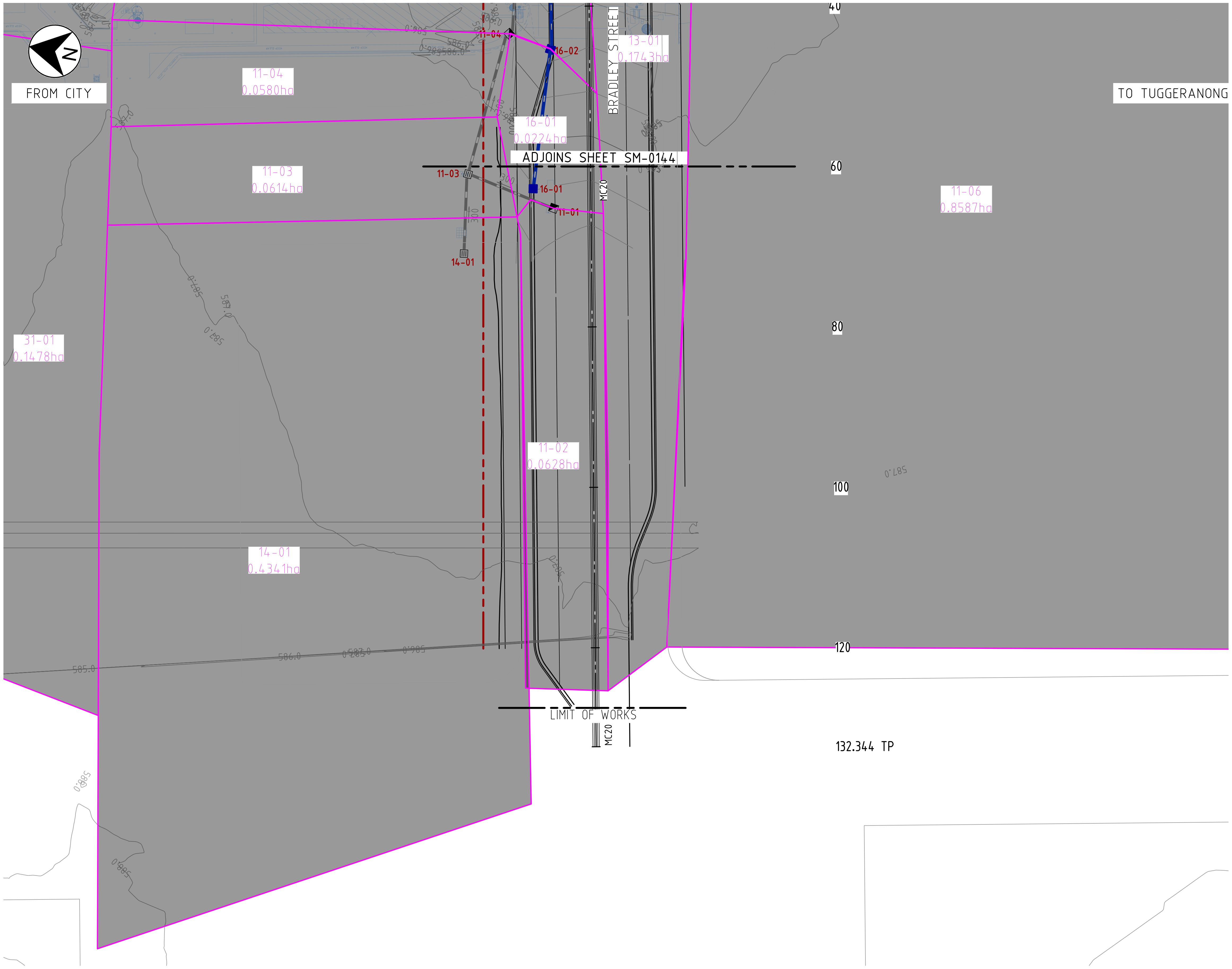
A3

DRAINAGE CATCHMENT PLAN

SHEET 4 OF 5

ACT REGISTRATION No. TCLR-201-BRI-0006
PART

ISSUE STATUS PSP DESIGN
EDMS No.
SHEET No. SM-0144
REV 1



LEGEND

GENERAL

	SURVEY
99	MAJOR CONTOURS
	MINOR CONTOURS
	EXISTING CADASTRIAL BOUNDARY
	NEW ROAD BOUNDARY
23-02	PIT NUMBER
0.1988ha	CATCHMENTS AREA
	CATCHMENTS BOUNDARY
▨	CATCHMENTS HATCH

EXISTING DRAINAGE

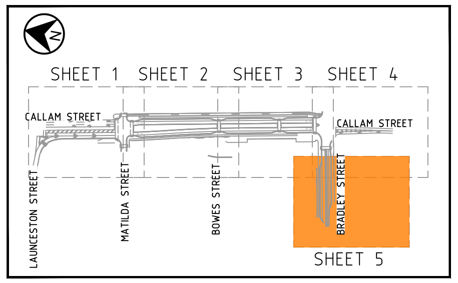
	EXISTING STORMWATER PITS/PIPES TO BE REMOVED / ABANDONED
	EXISTING STORMWATER PITS / PIPES / HEADWALL - TO BE RETAINED
◪	EXISTING PIT TO BE MODIFIED

PROPOSED DRAINAGE

450	NEW DRAINAGE PIPE / PIT / SIZE / HEADWALL
41-01	STORMWATER PIT LABEL
	PIT NUMBER
	DRAINAGE LINE NUMBER

NOTES

1. MAJOR CONTOURS ARE SHOWN AT 1.0m INTERVALS.
2. MINOR CONTOURS ARE SHOWN AT 0.1m INTERVALS.
3. CONDITION ASSESSMENT OF ALL EXISTING DRAINAGE INFRASTRUCTURE IS REQUIRED TO CONFIRM IT CAN BE RETAINED.



KEY PLAN

NTS

NOT FOR CONSTRUCTION

THIS DRAWING MAY BE PREPARED IN COLOUR AND MAY BE INCOMPLETE IF COPIED

50mm ON A3 SIZE ORIGINAL

DRAWING FILE LOCATION \ NAME - PLOT DATE \ TIME - PLOT BY
\\jacobs.com\anz\IE\Projects\03_Southern\IS268800\01 Design\Drawings\Civil\IS268800-DG-SM-0141-0145.dwg - 27/08/2019 1:31:24 PM - imedii

DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING

REV	DATE	AMENDMENT / REVISION DESCRIPTION	APPROVAL
0	05.07.19	ISSUED FOR DRAFT PSP DESIGN	L.QASEM
1	28.08.19	ISSUED FOR FINAL PSP DESIGN	L.QASEM

PROJECT BREAKDOWN STRUCTURE

SCALES ON A3 SIZE DRAWING

SCALE 1:1000 10 0 10 20 AT A3

STROMLO COORDINATE SYSTEM
AGD66

HEIGHT DATUM
AHD

JACOBS DOCUMENT NUMBER
IS268800-DG-SM-0145

DRAWINGS / DESIGN PREPARED BY

JACOBS
177 Pacific Highway
NORTH SYDNEY, NSW 2060
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PLOT DATE / TIME
27/08/2019

PLOT BY
imedii

TITLE	NAME	DATE
DRAWN	I.IMEDI	28.08.19
DRG CHECK	S.GALLOWAY	28.08.19
DESIGN	R.ROYLANCE	28.08.19
DESIGN CHECK	S.RUSCHEINSKY	28.08.19
DESIGN MNGR	G.TRUNDLE	28.08.19
PROJECT MNGR	L.QASEM	28.08.19

CLIENT

ACT Government | Transport Canberra

ACT GOVERNMENT
WODEN BUS INTERCHANGE AND ROAD LAYOUT MODIFICATIONS
WODEN BUS INTERCHANGE

DRAINAGE CATCHMENT PLAN

SHEET 5 OF 5

A3

ACT REGISTRATION No. TCLR-201-BRI-0006

PART

ISSUE STATUS
PSP DESIGN

EDMS No.

SHEET No.
SM-0145

REV
1

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

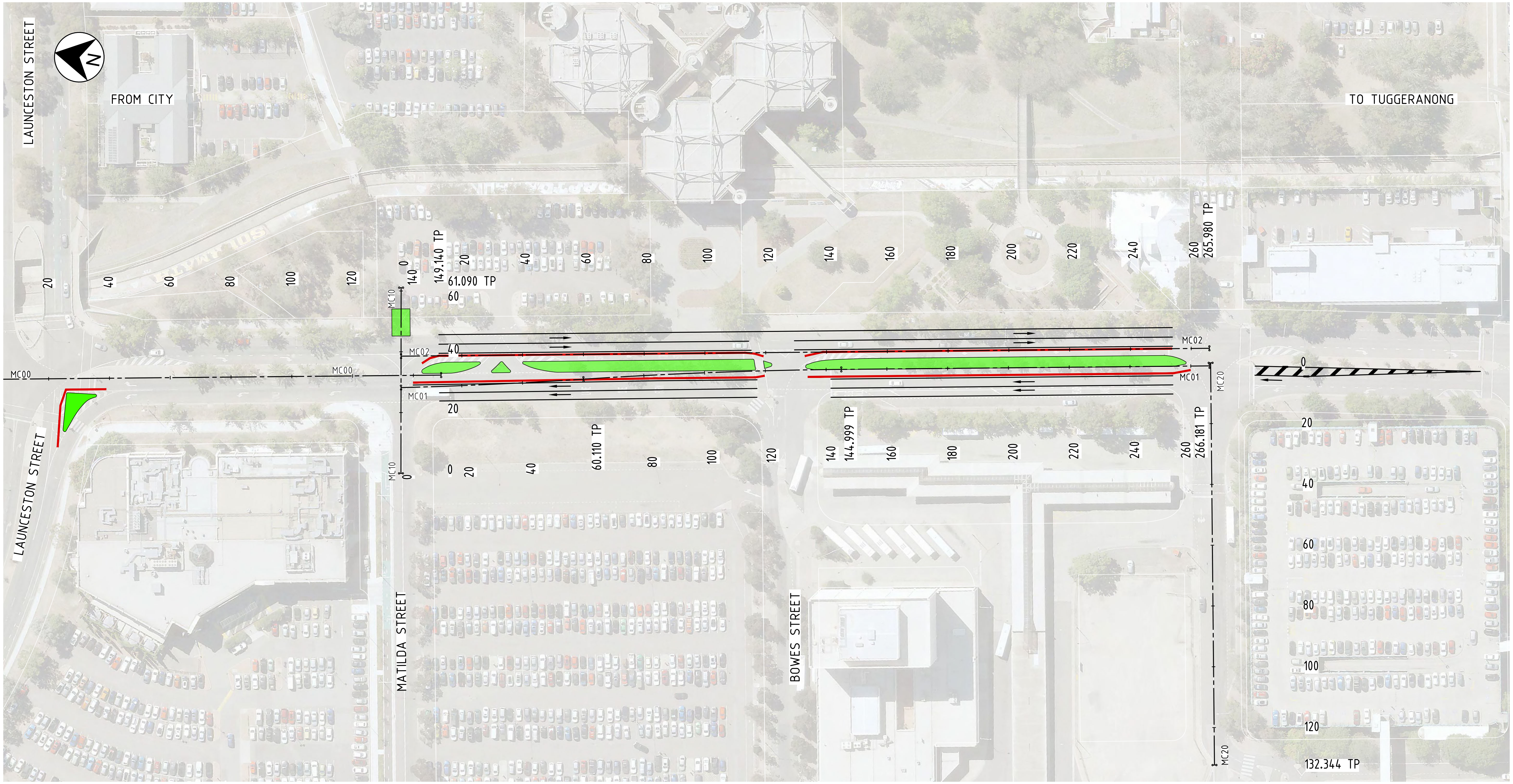
[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]



STAGE 1 WORKS (NIGHT WORKS)

SCALE 1:1250

LEGEND

- DIGITAL CADASTRE
- 🟩 DEMOLISH EXISTING MEDIAN / KERB AND PROVIDE TEMPORARY PAVEMENT
- STAGE 1 LINEMARKING (UNDER TRAFFIC CONTROL)
- SAFETY BARRIER

NOT FOR CONSTRUCTION

DRAWING FILE LOCATION \ NAME - PLOT DATE \ TIME - PLOT BY
\\jacobs.com\anz\IE\Projects\03_Southern\IS268800\01 Design\Drawings\Civil\IS268800-DG-CS-0101.dwg - 27/08/2019 1:25:57 PM - imedii

DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING

REV	DATE	AMENDMENT / REVISION DESCRIPTION	APPROVAL
0	05.07.19	ISSUED FOR DRAFT PSP DESIGN	L.QASEM
1	28.08.19	ISSUED FOR FINAL PSP DESIGN	L.QASEM

PROJECT BREAKDOWN STRUCTURE

SCALES ON A3 SIZE DRAWING

STROMLO COORDINATE SYSTEM
AGD66

HEIGHT DATUM
AHD

JACOBS DOCUMENT NUMBER
IS268800-DG-CS-0101

DRAWINGS / DESIGN PREPARED BY

JACOBS
177 Pacific Highway
NORTH SYDNEY, NSW 2060
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PLOT DATE / TIME
27/08/2019

PLOT BY
imedii

TITLE	NAME	DATE
DRAWN	I.IMEDI	28.08.19
DRG CHECK	S.GALLOWAY	28.08.19
DESIGN	R.TIRICOVSKI	28.08.19
DESIGN CHECK	D.HORWOOD	28.08.19
DESIGN MNGR	G.TRUNDLE	28.08.19
PROJECT MNGR	L.QASEM	28.08.19

CLIENT

ACT Government

Transport Canberra

ACT GOVERNMENT
WODEN BUS INTERCHANGE AND ROAD LAYOUT MODIFICATIONS
WODEN BUS INTERCHANGE

CONSTRUCTION STAGE 1

SHEET 1 OF 6

A3

ACT REGISTRATION No. TCLR-201-BRI-0006

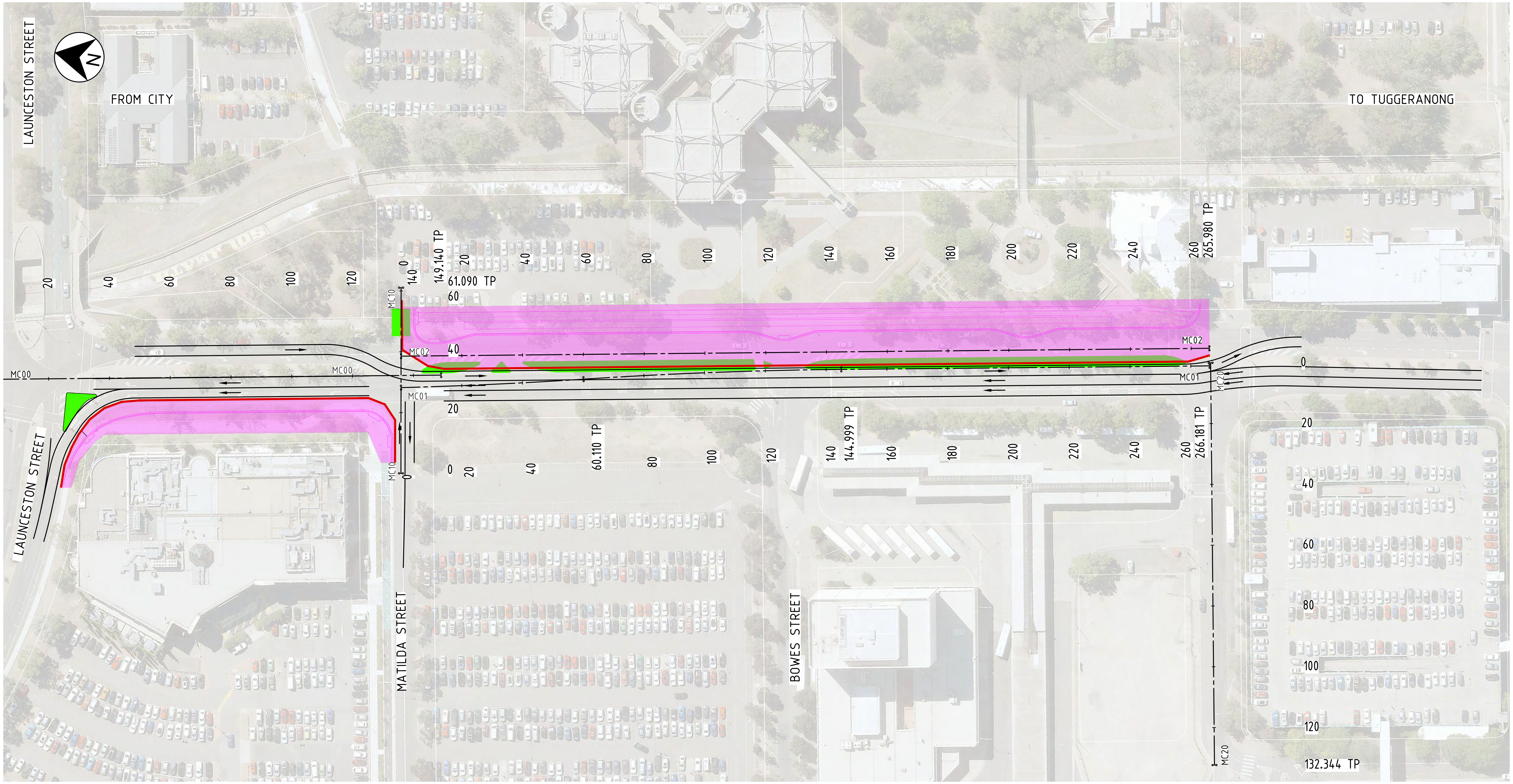
PART

ISSUE STATUS
PSP DESIGN

EDMS No.

SHEET No.
CS-0101

REV
1



STAGE 1 WORKS (NIGHT WORKS)

SCALE 1:1250

LEGEND

—	DIGITAL CADASTRE
🟩	TEMPORARY PAVEMENT FROM STAGE 1
🟪	STAGE 2 CONSTRUCTION ZONE
—	STAGE 2 LINEMARKING
🟥	SAFETY BARRIER

NOT FOR CONSTRUCTION

THIS DRAWING MAY BE PREPARED IN COLOUR AND MAY BE INCOMPLETE IF COPIED

50mm ON A3 SIZE ORIGINAL

DRAWING FILE LOCATION \ NAME - PLOT DATE \ TIME - PLOT BY
\\jacobs.com\anz\IE\Projects\03_Southern\IS268800\01 Design\Drawings\Civil\IS268800-DG-CS-0102.dwg - 27/08/2019 1:26:09 PM - imedii

DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING

REV	DATE	AMENDMENT / REVISION DESCRIPTION	APPROVAL
0	05.07.19	ISSUED FOR DRAFT PSP DESIGN	L.QASEM
1	28.08.19	ISSUED FOR FINAL PSP DESIGN	L.QASEM

PROJECT BREAKDOWN STRUCTURE

SCALES ON A3 SIZE DRAWING
SCALE 1:20000 200 0 200 400 AT A3

STROMLO COORDINATE SYSTEM AGD66
HEIGHT DATUM AHD

JACOBS DOCUMENT NUMBER
IS268800-DG-CS-0102

DRAWINGS / DESIGN PREPARED BY
JACOBS
177 Pacific Highway
NORTH SYDNEY, NSW 2060
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PLOT DATE / TIME 27/08/2019
PLOT BY imedii

TITLE	NAME	DATE
DRAWN	I.IMEDI	28.08.19
DRG CHECK	S.GALLOWAY	28.08.19
DESIGN	R.TIRICOVSKI	28.08.19
DESIGN CHECK	D.HORWOOD	28.08.19
DESIGN MNGR	G.TRUNDLE	28.08.19
PROJECT MNGR	L.QASEM	28.08.19

CLIENT
ACT Government
Transport Canberra

ACT GOVERNMENT
WODEN BUS INTERCHANGE AND ROAD LAYOUT MODIFICATIONS
WODEN BUS INTERCHANGE

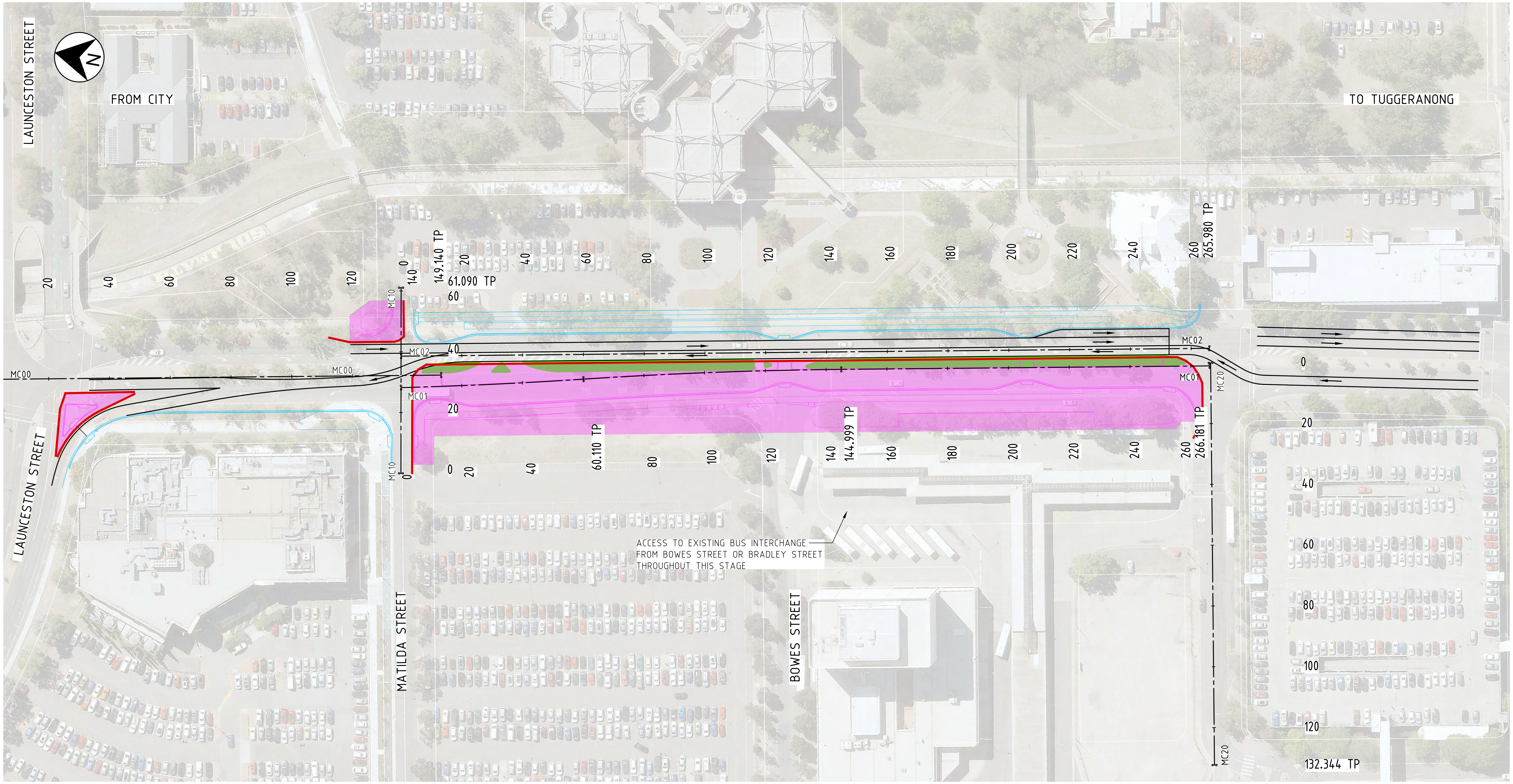
CONSTRUCTION STAGE 2

SHEET 2 OF 6

A3

ACT REGISTRATION No. TCLR-201-BRI-0006
PART

ISSUE STATUS PSP DESIGN
EDMS No.
SHEET No. CS-0102
REV 1



ACCESS TO EXISTING BUS INTERCHANGE
FROM BOWES STREET OR BRADLEY STREET
THROUGHOUT THIS STAGE

STAGE 3 WORKS

SCALE 1:1250

LEGEND	
───	DIGITAL CADASTRE
🟩	TEMPORARY PAVEMENT FROM STAGE 1
🟪	STAGE 3 CONSTRUCTION ZONE
───	COMPLETED WORKS FROM STAGE 2
───	STAGE 3 LINEMARKING
🟥	SAFETY BARRIER

THIS DRAWING MAY BE PREPARED IN COLOUR AND MAY BE INCOMPLETE IF COPIED

50mm ON A3 SIZE ORIGINAL

NOT FOR CONSTRUCTION

DRAWING FILE LOCATION \ NAME - PLOT DATE \ TIME - PLOT BY
\\jacobs.com\anz\IE\Projects\03_Southern\IS268800\01 Design\Drawings\Civil\IS268800-DG-CS-0103.dwg - 27/08/2019 1:26:18 PM - imedii

DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING

REV	DATE	AMENDMENT / REVISION DESCRIPTION	APPROVAL
0	05.07.19	ISSUED FOR DRAFT PSP DESIGN	L.QASEM
1	28.08.19	ISSUED FOR FINAL PSP DESIGN	L.QASEM

PROJECT BREAKDOWN STRUCTURE

SCALES ON A3 SIZE DRAWING
SCALE 1:20000 200 0 200 400
AT A3

STROMLO COORDINATE SYSTEM AGD66
HEIGHT DATUM AHD

JACOBS DOCUMENT NUMBER
IS268800-DG-CS-0103

DRAWINGS / DESIGN PREPARED BY
JACOBS
177 Pacific Highway
NORTH SYDNEY, NSW 2060
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PLOT DATE / TIME 27/08/2019
PLOT BY imedii

TITLE	NAME	DATE
DRAWN	I.IMEDI	28.08.19
DRG CHECK	S.GALLOWAY	28.08.19
DESIGN	R.TIRICOVSKI	28.08.19
DESIGN CHECK	D.HORWOOD	28.08.19
DESIGN MNGR	G.TRUNDLE	28.08.19
PROJECT MNGR	L.QASEM	28.08.19

CLIENT
ACT Government
Transport Canberra

ACT GOVERNMENT
WODEN BUS INTERCHANGE AND ROAD LAYOUT MODIFICATIONS
WODEN BUS INTERCHANGE

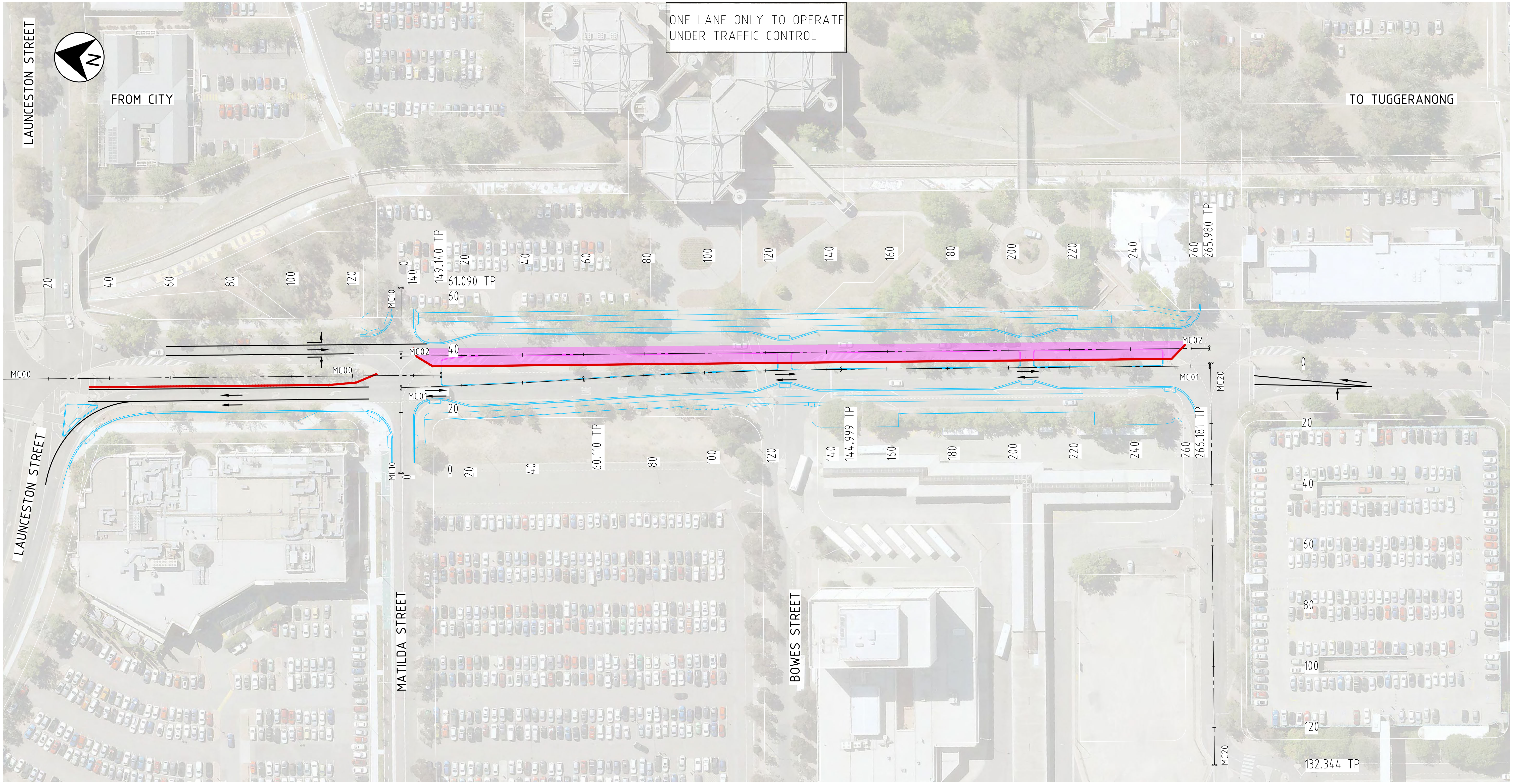
CONSTRUCTION STAGE 3

SHEET 3 OF 6

A3

ACT REGISTRATION No. TCLR-201-BRI-0006
PART

ISSUE STATUS PSP DESIGN
EDMS No.
SHEET No. CS-0103
REV 1



STAGE 4 WORKS (NIGHT WORKS)
SCALE 1:1250

LEGEND

─	DIGITAL CADASTRE
🟪	STAGE 4 CONSTRUCTION ZONE (NIGHT WORKS)
─	COMPLETED WORKS FROM STAGE 2 & 3
─	STAGE 4 LINEMARKING (UNDER TRAFFIC CONTROL)
─	SAFETY BARRIER

NOT FOR CONSTRUCTION

THIS DRAWING MAY BE PREPARED IN COLOUR AND MAY BE INCOMPLETE IF COPIED

50mm ON A3 SIZE ORIGINAL

0 5 10 15 20 25 30 35 40 45

DRAWING FILE LOCATION \ NAME - PLOT DATE \ TIME - PLOT BY
\\jacobs.com\anz\IE\Projects\03_Southern\IS268800\01 Design\Drawings\Civil\IS268800-DG-CS-0104.dwg - 27/08/2019 1:26:29 PM - imedii

DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING

REV	DATE	AMENDMENT / REVISION DESCRIPTION	APPROVAL
0	05.07.19	ISSUED FOR DRAFT PSP DESIGN	L.QASEM
1	28.08.19	ISSUED FOR FINAL PSP DESIGN	L.QASEM

PROJECT BREAKDOWN STRUCTURE

SCALES ON A3 SIZE DRAWING
SCALE 1:20000 200 0 200 400
AT A3

STROMLO COORDINATE SYSTEM
AGD66

HEIGHT DATUM
AHD

JACOBS DOCUMENT NUMBER
IS268800-DG-CS-0104

DRAWINGS / DESIGN PREPARED BY
JACOBS
177 Pacific Highway
NORTH SYDNEY, NSW 2060
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PLOT DATE / TIME
27/08/2019

PLOT BY
imedii

TITLE	NAME	DATE
DRAWN	I.IMEDI	28.08.19
DRG CHECK	S.GALLOWAY	28.08.19
DESIGN	R.TIRICOVSKI	28.08.19
DESIGN CHECK	D.HORWOOD	28.08.19
DESIGN MNGR	G.TRUNDLE	28.08.19
PROJECT MNGR	L.QASEM	28.08.19

CLIENT
ACT Government
Transport Canberra

ACT GOVERNMENT
WODEN BUS INTERCHANGE AND ROAD LAYOUT MODIFICATIONS
WODEN BUS INTERCHANGE

CONSTRUCTION STAGE 4

A3

SHEET 4 OF 6

ACT REGISTRATION No. TCLR-201-BRI-0006

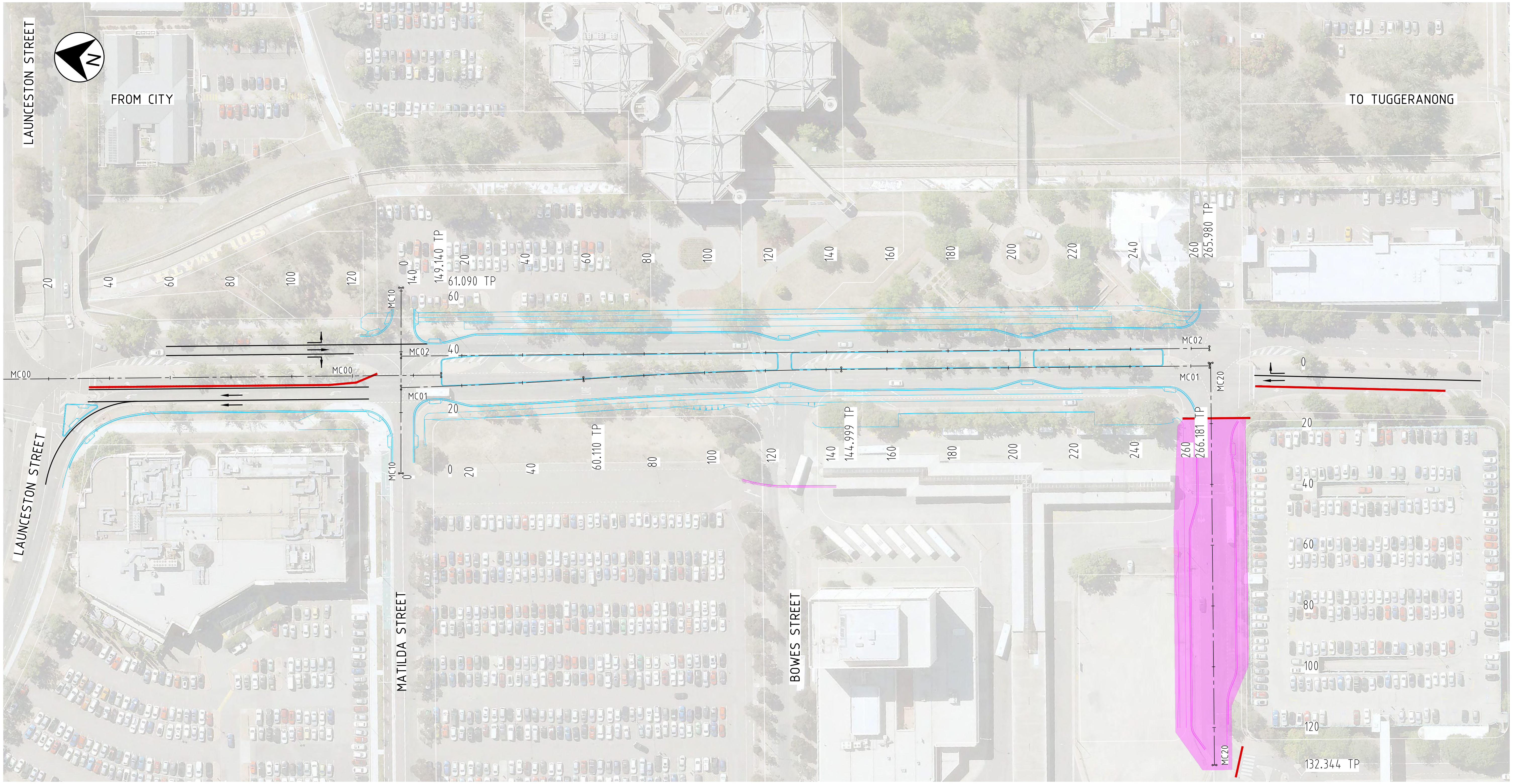
PART

ISSUE STATUS
PSP DESIGN

EDMS No.

SHEET No.
CS-0104

REV
1



STAGE 5 WORKS
SCALE 1:1250

LEGEND

- DIGITAL CADASTRE
- 🟪 STAGE 5 CONSTRUCTION ZONE
- COMPLETED WORKS FROM STAGE 2, 3 & 4
- STAGE 5 LINEMARKING (UNDER TRAFFIC CONTROL)
- SAFETY BARRIER

NOT FOR CONSTRUCTION

THIS DRAWING MAY BE PREPARED IN COLOUR AND MAY BE INCOMPLETE IF COPIED

50mm ON A3 SIZE ORIGINAL

DRAWING FILE LOCATION \ NAME - PLOT DATE \ TIME - PLOT BY
\\jacobs.com\anz\IE\Projects\03_Southern\IS268800\01 Design\Drawings\Civil\IS268800-DG-CS-0105.dwg - 27/08/2019 1:26:44 PM - imedii

DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING

REV	DATE	AMENDMENT / REVISION DESCRIPTION	APPROVAL
0	05.07.19	ISSUED FOR DRAFT PSP DESIGN	L.QASEM
1	28.08.19	ISSUED FOR FINAL PSP DESIGN	L.QASEM

PROJECT BREAKDOWN STRUCTURE

SCALES ON A3 SIZE DRAWING
SCALE 1:20000 200 0 200 400 AT A3

STROMLO COORDINATE SYSTEM AGD66
HEIGHT DATUM AHD

JACOBS DOCUMENT NUMBER
IS268800-DG-CS-0105

DRAWINGS / DESIGN PREPARED BY
JACOBS
177 Pacific Highway
NORTH SYDNEY, NSW 2060
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PLOT DATE / TIME 27/08/2019
PLOT BY imedii

TITLE	NAME	DATE
DRAWN	I.IMEDI	28.08.19
DRG CHECK	S.GALLOWAY	28.08.19
DESIGN	R.TIRICOVSKI	28.08.19
DESIGN CHECK	D.HORWOOD	28.08.19
DESIGN MNGR	G.TRUNDLE	28.08.19
PROJECT MNGR	L.QASEM	28.08.19

CLIENT
ACT Government
Transport Canberra

ACT GOVERNMENT
WODEN BUS INTERCHANGE AND ROAD LAYOUT MODIFICATIONS
WODEN BUS INTERCHANGE

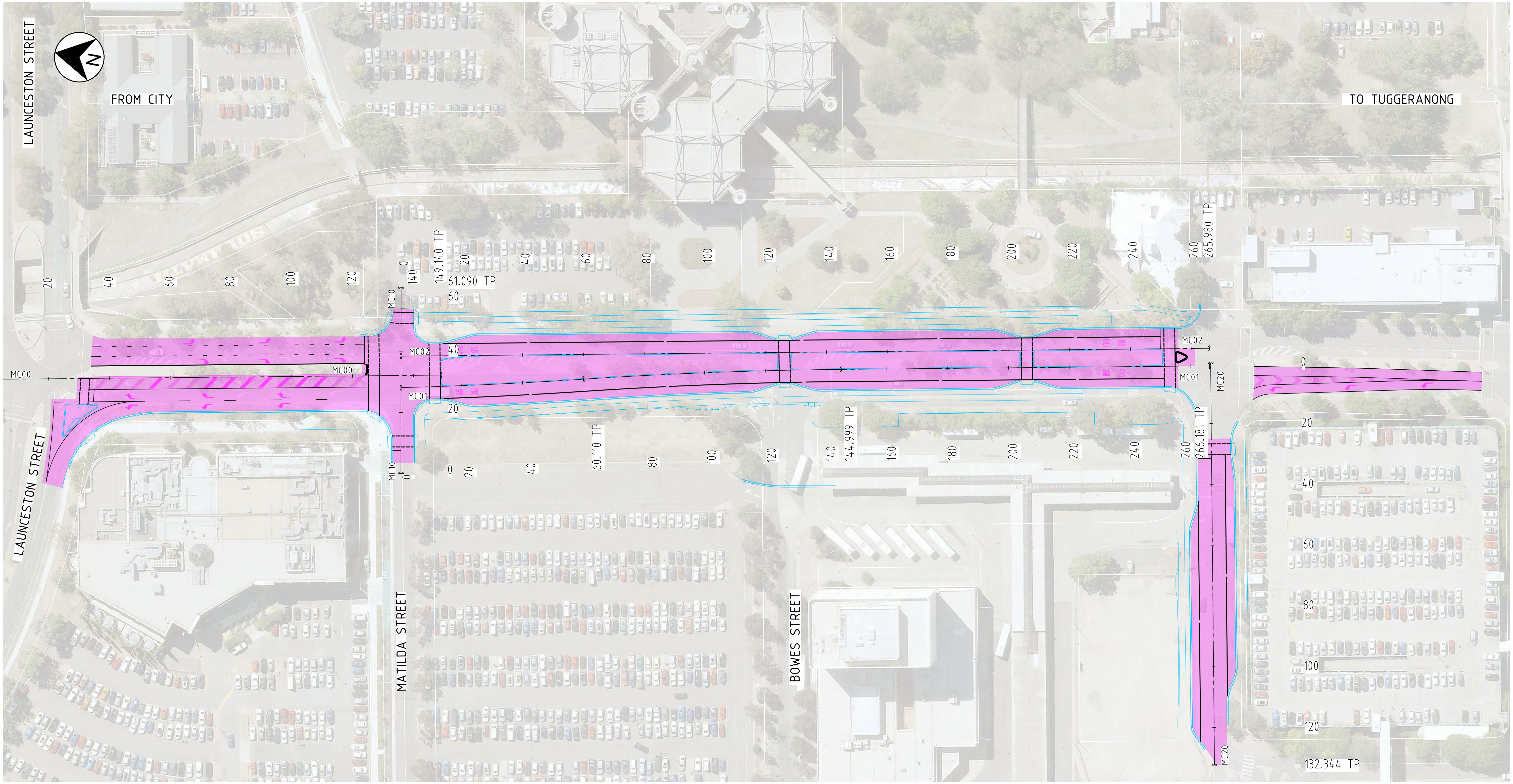
CONSTRUCTION STAGE 5

SHEET 5 OF 6

A3

ACT REGISTRATION No. TCLR-201-BRI-0006
PART

ISSUE STATUS PSP DESIGN
EDMS No.
SHEET No. CS-0105
REV 1



STAGE 6 WORKS (NIGHT WORKS)

SCALE 1:1250

LEGEND

DIGITAL CADASTRE

MCxx CONTROL LINE

🟪 STAGE 6 CONSTRUCTION ZONE: LINEMARKING & MILL / RESHEET (NIGHT WORKS & UNDER TRAFFIC CONTROL)

COMPLETED WORKS FROM STAGE 2, 3, 4 & 5

NOT FOR CONSTRUCTION

THIS DRAWING MAY BE PREPARED IN COLOUR AND MAY BE INCOMPLETE IF COPIED

50mm ON A3 SIZE ORIGINAL

0 5 10 15 20 25 30 35 40 45

DRAWING FILE LOCATION \ NAME - PLOT DATE \ TIME - PLOT BY
\\jacobs.com\anz\IE\Projects\03_Southern\IS268800\01 Design\Drawings\Civil\IS268800-DG-CS-0106.dwg - 27/08/2019 1:26:55 PM - imedii

DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING

REV	DATE	AMENDMENT / REVISION DESCRIPTION	APPROVAL
0	05.07.19	ISSUED FOR DRAFT PSP DESIGN	L.QASEM
1	28.08.19	ISSUED FOR FINAL PSP DESIGN	L.QASEM

PROJECT BREAKDOWN STRUCTURE

SCALES ON A3 SIZE DRAWING
SCALE 1:20000 200 0 200 400 AT A3

STROMLO COORDINATE SYSTEM AGD66
HEIGHT DATUM AHD

JACOBS DOCUMENT NUMBER
IS268800-DG-CS-0106

DRAWINGS / DESIGN PREPARED BY
JACOBS
177 Pacific Highway
NORTH SYDNEY, NSW 2060
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PLOT DATE / TIME 27/08/2019
PLOT BY imedii

TITLE	NAME	DATE
DRAWN	I.IMEDI	28.08.19
DRG CHECK	S.GALLOWAY	28.08.19
DESIGN	R.TIRICOVSKI	28.08.19
DESIGN CHECK	D.HORWOOD	28.08.19
DESIGN MNGR	G.TRUNDLE	28.08.19
PROJECT MNGR	L.QASEM	28.08.19

CLIENT
ACT Government
Transport Canberra

ACT GOVERNMENT
WODEN BUS INTERCHANGE AND ROAD LAYOUT MODIFICATIONS
WODEN BUS INTERCHANGE

CONSTRUCTION STAGE 6

SHEET 5 OF 6

A3

ACT REGISTRATION No. TCLR-201-BRI-0006
PART

ISSUE STATUS PSP DESIGN
EDMS No.
SHEET No. CS-0106
REV 1

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

EXISTING CARPARK

Surface Finishes Schedule

	SYMBOL	SECTION
GARDEN BEDS	■	75mm 38 minus Mulch as approved Debco or similar approved potting mix. Drainage layer as per planter type details
DECORATIVE GRAVEL	⁘	75mm Selected toppings or approved sterile loose gravel Subgrade.
SAWN/FINISHED CONCRETE	▧	Finished Concrete - Colour and Finish TBC FCR Sub Base to engineers details
PAVING TYPE 1	□	50 mm Natural Stone Paving (TBC) Mortar Concrete Slab
PAVING TYPE 2	⊠	50 mm Natural Stone Paving (TBC) Mortar Concrete Slab
CYCLE LANE	🟩	TO MATCH EXISTING
PROPRIETRY SEATING	⊠	TBC
BOLLARDS	⌖ B	TBC
LOW LEVEL LIGHTING	⌖ LB	TBC
CUSTOM PLANTERS	🟧	Custom raised planters with integrated downward lighting and seating

Shelter - Type 1

Shared Light rail bus

S1

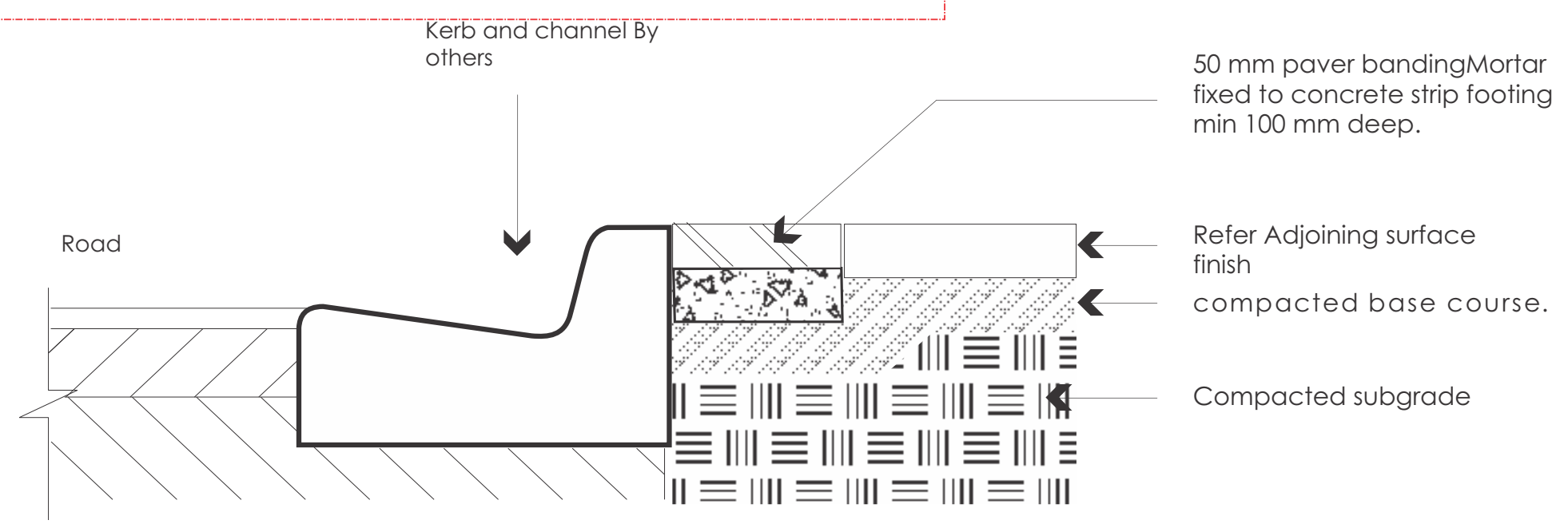
Shelter - Type 2

Standalone

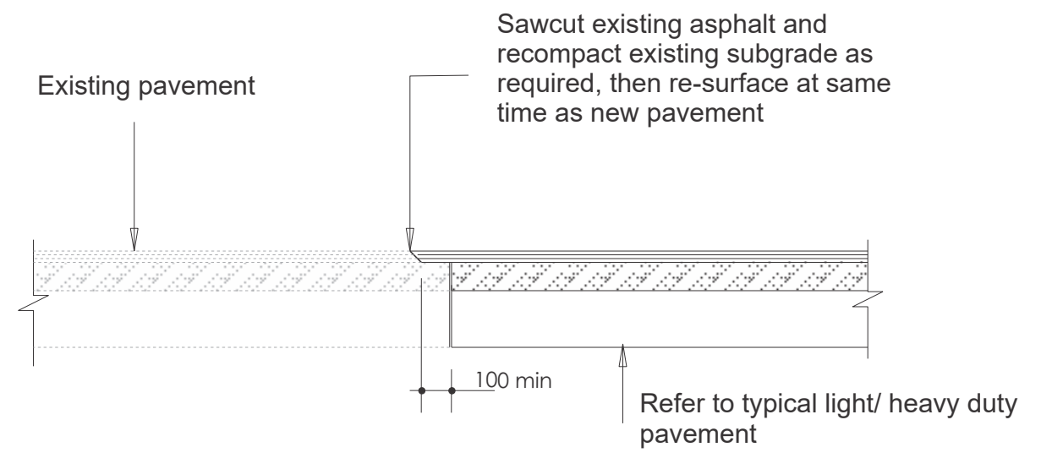
S2

Indicative Shelters

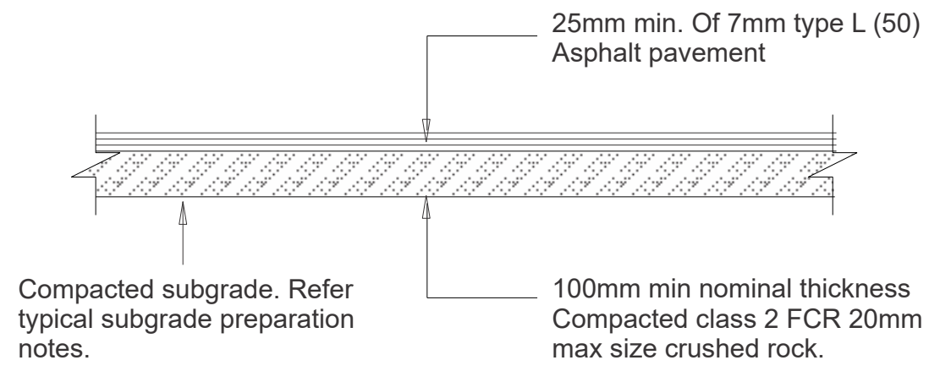
Rosanna Station - Jacobs 2018
Image Source - https://www.stoddart.com.au/infrastructure_references



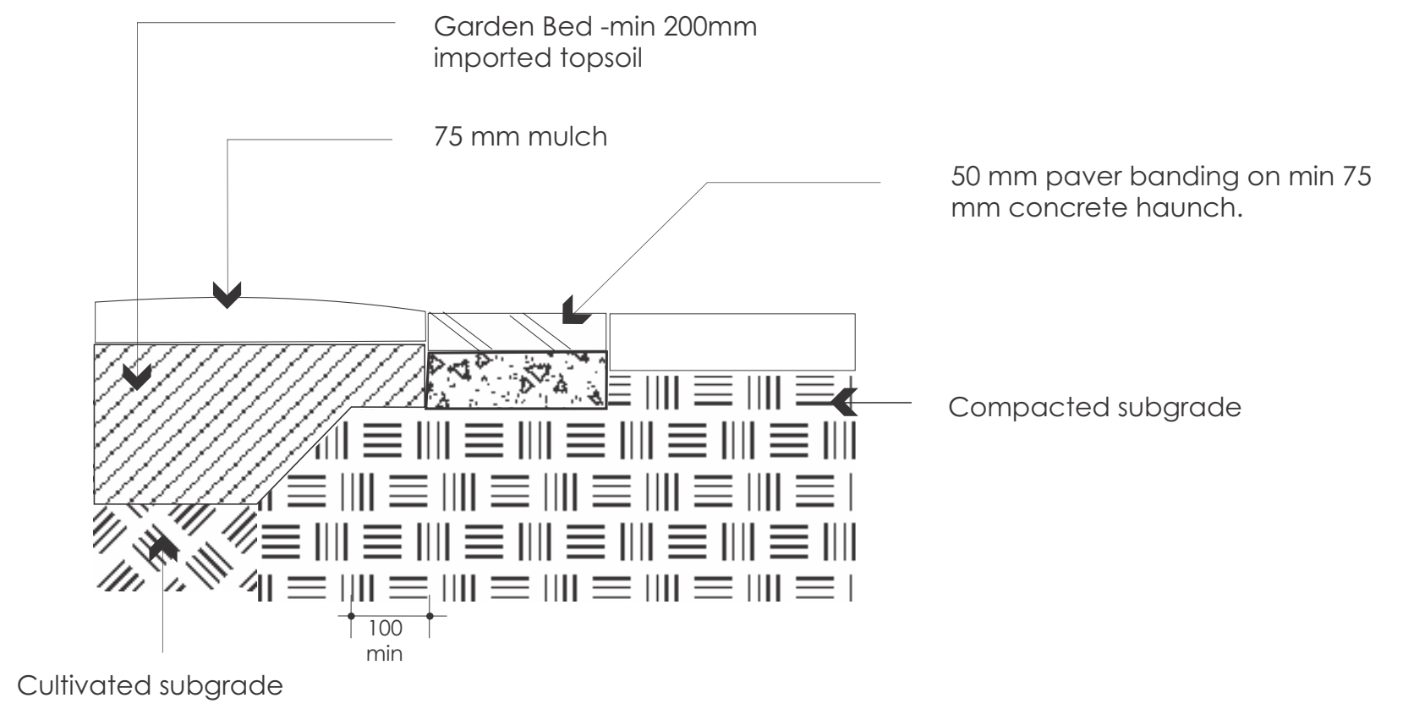
1 PAVER BANDING TO REAR OF CONCRETE KERB
Scale 1 : 10



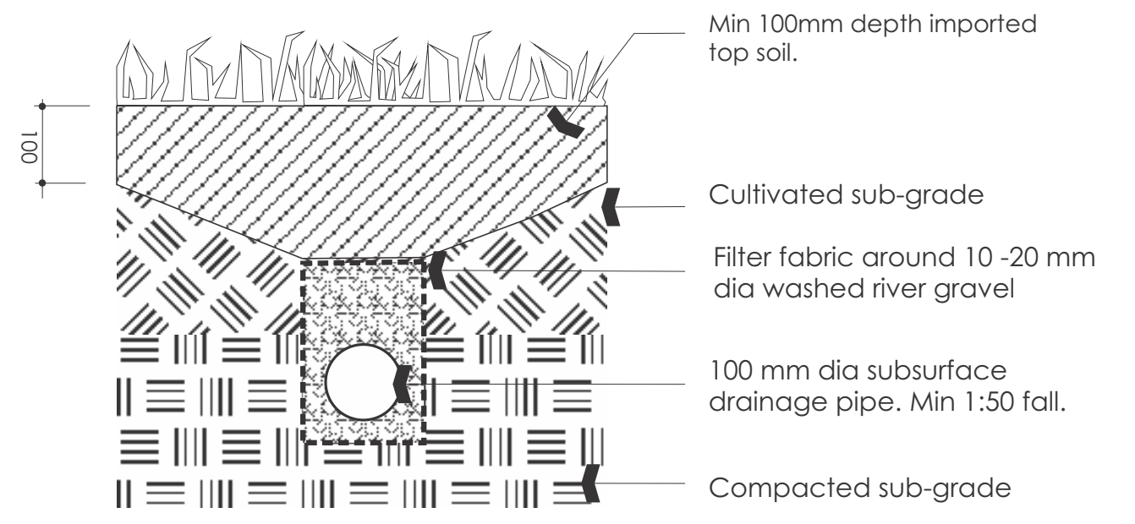
2 NEW PAVEMENT / EXISTING PAVEMENT
Scale 1 : 20



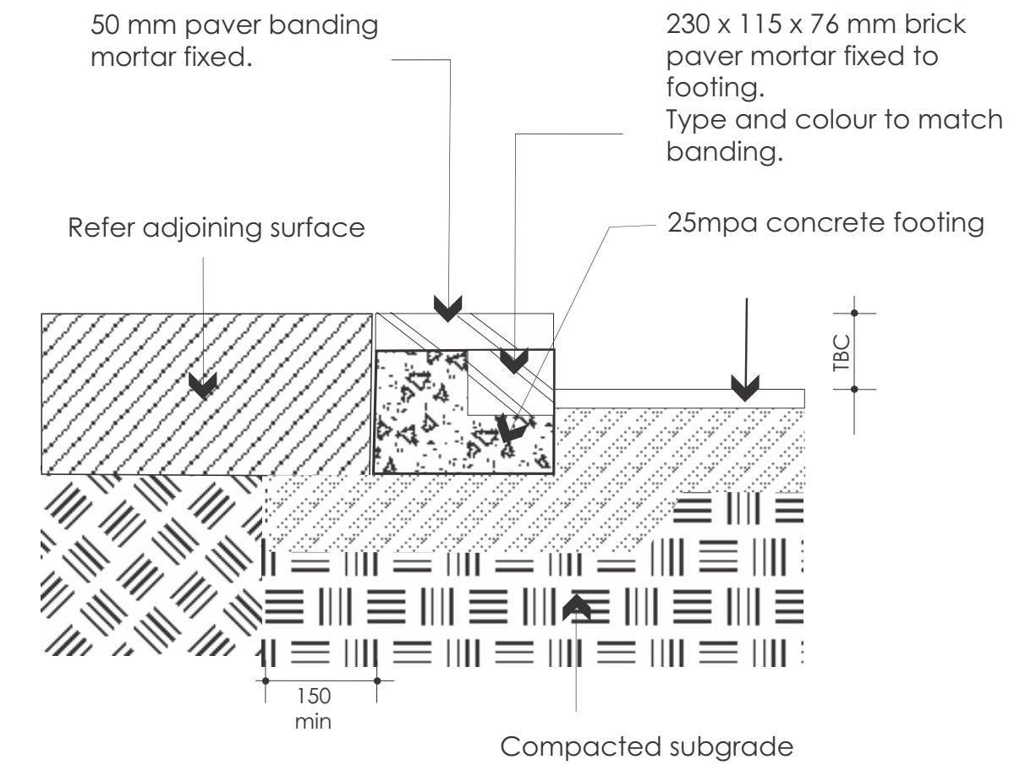
3 ASPHALT CYCLWAY WITH APPLIED FINISH
Scale 1 : 10



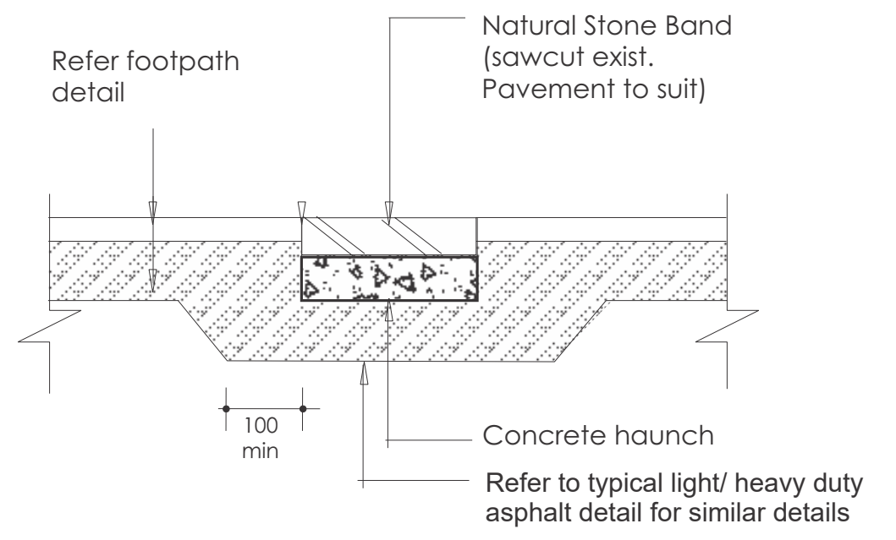
4 GARDEN / PAVER BANDING
Scale 1 : 10



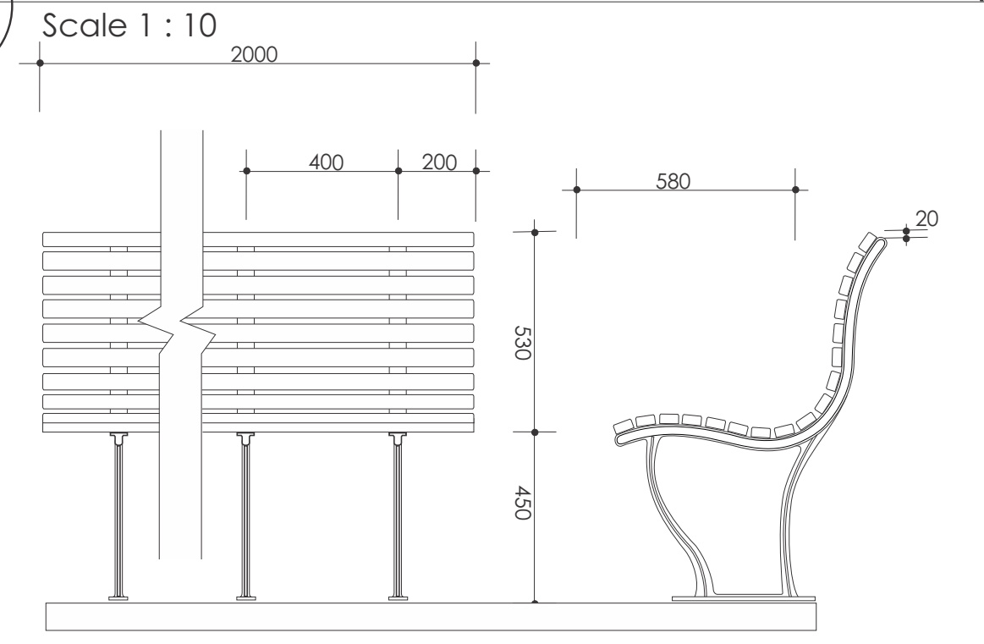
5 DRAINAGE TO CENTRAL MEDIAN SWALE (TBC
Scale 1 : 10



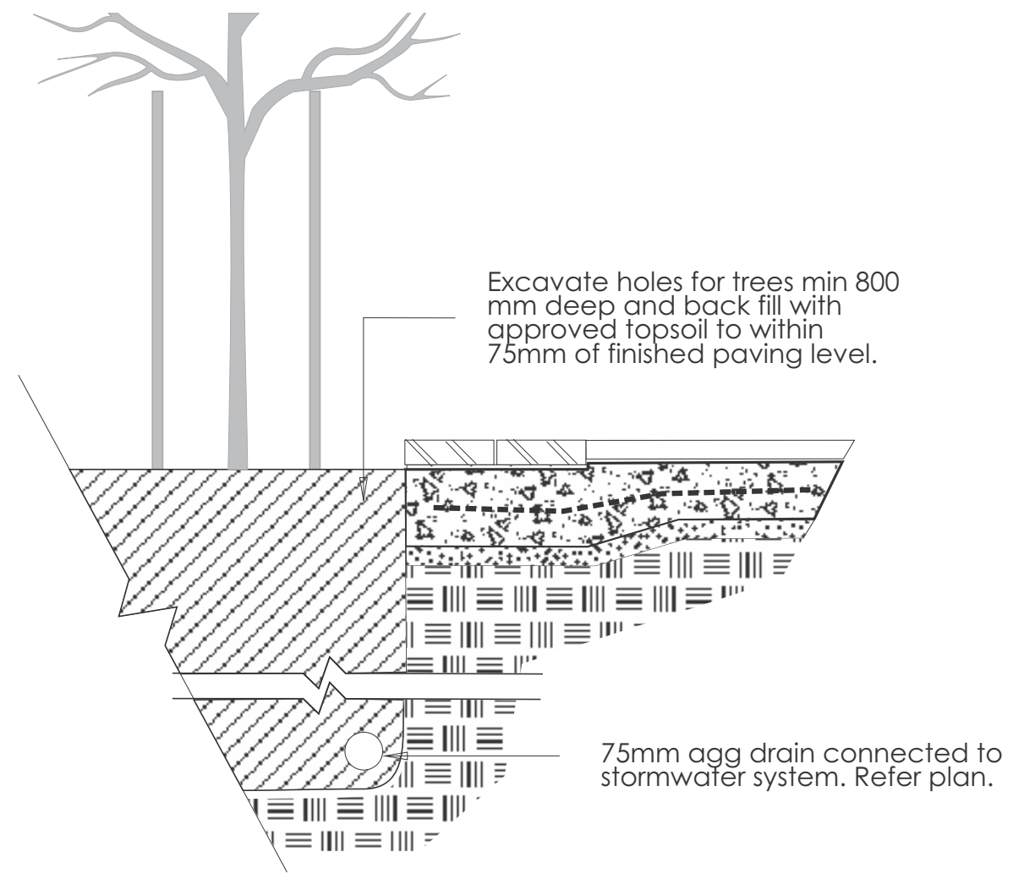
6 STONE KERB TO LIGHT RAIL PLATFORM
Scale 1 : 10



7 PAVER BANDING IN FOOTPATH
Scale 1 : 10



8 SEATING DETAIL
Scale 1 : 20



9 ADVANCED TREE IN PAVING
Scale 1:10

NORTH

DRAFT

Revisions

Ls1a - 03.07.2019
Ls1a - 27.08.2019

Drawn By	Checked By	Drawing No	Revision No	Scale
HB		Ls1	-	1:250@A0

0 2.5 5.0 7.5 10

WODEN BUS INTERCHANGE
PSP Landscape Drawings

Landscape Architecture & Urban Design
Level 11, 452 Flinders Street
Melbourne
Victoria 3000
Australia
P: +61-3 8668 3000

Project No. IS268800
June 2019

JACOBS

Appendix B. Woden Interchange Initial Planning Review

[redacted]

Memorandum

1/64 Allara Street,
Canberra City ACT 2600
PO Box 237, Civic Square ACT 2608
Australia
T +61 2 6246 2700
F +61 2 6246 2799
www.jacobs.com

Subject **Bradley Street Review** **Project Name** Woden Bus Interchange

Attention Schedule 2.2(a)(ii)

From Schedule 2.2(a)(ii)

Date February 20, 2019

Copies to Schedule 2.2(a)(ii)

Jacobs have been engaged by Transport Canberra to undertake a high-level review of preferred alignment of Bradley Street, Woden to better understand the potential for the blocks created through the design and implementation of works associated with the Woden Transport Hub.

This Study has determined that Bradley Street should remain in its current location, subject to modifications to allow its integration into the works planned by the Woden Transport Hub, the current setting and context of the Woden Town Centre and the future development aspirations of the precinct.

A summary of the investigations and reasons to support this finding are provided below.

1. Background

Transport Canberra Light Rail (TCLR) is responsible for the design, integration and delivery of the Canberra Light Rail Project. Stage 1 has been delivered and is now in testing and operation. C2W is planned to extend the light rail network to the Woden town centre.

Prior to commencing PSP design for the Woden interchange and light rail terminus, TCLR engaged Jacobs to undertake a strategic review of the Woden Town Centre (Master Plan Review and Interchange Design Strategy dated October 2017) and ARUP Technical Note Woden Interchange - Bus and pedestrian methodology.

A design options workshop was organized on January 17th, 2019. Eight high level options were presented and discussed during the workshop. Each option was reviewed through a detailed Multi-Criteria Analysis (MCA). The top four scoring options arising from the MCA were selected to be further investigated.

A second inter-directorate options workshop was undertaken to narrow the four shortlisted options to two and for further assessment. The included:

- An *Alternative light rail alignment which include* Light rail services run through a pedestrianised concourse which allows passengers to cross the light rail lines at any point between Matilda Street and New Bradley Street to access bus services on Callam Street and

- *A Central shared light rail platform* running along Callam Street and terminating at a shared platform located in the central median.

The options assessments considered future commercial development in Woden, bus connectivity, future light rail connectivity and pedestrian connectivity. The assessment resulted in a preferred option (Option 3). This option described an offset light rail alignment due to improved public realm and land use optimization along Callam Street. All options adopted the recommendation within the 2017 ARUP master plan to relocate Bradley Street to the north of its current alignment.

The ARUP master plan had been developed to respond to an anticipated retail expansion being contemplated by Westfield. At that time, the government was keen to pursue a partnership based on the success of previous outcomes achieved elsewhere.

Discussions between Government and Westfield stalled shortly after the ARUP master plan was developed. Until the Woden Bus Interchange design commencement, there had been no requirement for the ARUP master plan to be revisited, particularly the continued relevancy of the proposed re-alignment of Bradley Street.

It is understood from Jacobs discussions during the inter-directorate workshops that the proposed relocation of Bradley street to the north is no longer being driven by a shopping centre expansion.

In addition, the Woden Town Centre is experiencing a renewal of numerous key sites. Westfield have recently opened the upgraded the Bradley Street Dining precinct south of the site on Bradley St. Other changes in the urban context of Bradley Street include the approval of a new 26 story development on the former six story Medibank House site, a large precinct regeneration of the A & A Apartment project is due for completion this year.

2. Precinct analysis

Currently, the majority of retail and shopping tenancies are located within the Westfield complex to the south east of the precinct, in an enclosed mall format. Office spaces and employment uses occupy the majority of the area to the north west of the precinct. Passive open spaces and civic administration / services are located across Callam Street.

Figure 2-1 shows the key observations for the Woden precinct.

[redacted]

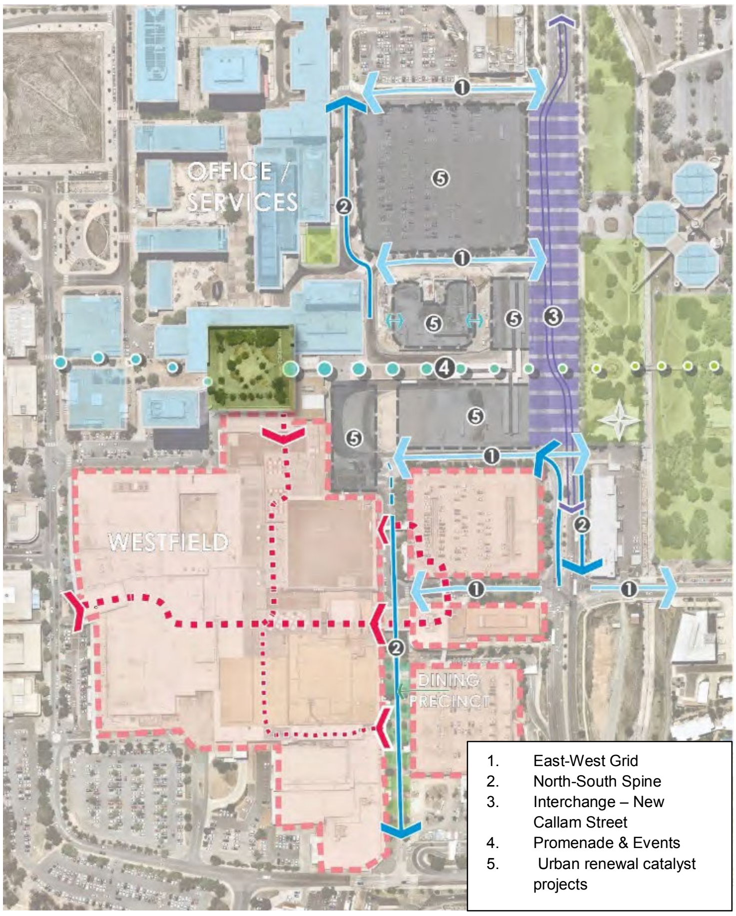


Figure 2-1 Existing Urban Structure and Movement

The majority of the land to the east of Bowes Street is currently used for at grade carparking.

The development patterns illustrate a greater diversity of uses including residential developments are attracted to the centre. It is anticipated that this shift in balance will continue to the north and west of the precinct through the redevelopment of office buildings and surface car-parks.

3. Access and Circulation.

There are several strong East-West connections, an urban grid, created by the road network between Callum and Bowes Street. A connection resides between the existing Woden Town Centre Plaza to the north of the Westfield Shopping Centre and Easty Street to the east of the Callam Offices. Current structure plans identify this as a key walking link to consider in future transit upgrades.

Transit services are located in a large central bus interchange, impacting on the function and amenity of the primary east-west link.

Bowes Street currently marks the eastern edges of retail development within the town centre. Through new and subsequent developments this area will serve as a strong North-South spine internal to the precinct.

Callam Street currently marks the eastern edge of development within the Woden Town Centre. This is likely to shift with re-development opportunities around the Callam Offices.

3. Key Urban Design Principles

Urban design principles provide a structure and framework upon which to analyse the appropriateness of design response at a precinct level.

The study investigated the opportunities which could be catalyzed following the introduction of a consolidated light rail and bus transit interchange on Callam Street.

An overall objective was to create energy, vibrancy and substantiality critical to the success of a precinct through a diversity of land use.

For this study, the following Urban Design principles respond to the placemaking objective:

- Define an urban structure which supports a diverse mixed-use precinct;
- Identify and improve access to key elements to enhance the public activity in the CBD heart;
- Integrate a new transit interchange with a connected public realm network;
- Improve public place activity through the legibility of public attractors.

4. Key precinct directions.

Design and urban planning strategies have been considered as tools towards delivering meaningful progress towards the above urban design principles. The transit interchange was identified as a major element for the town centre and should be subject to a separate urban design strategy to inform its functional transport design.

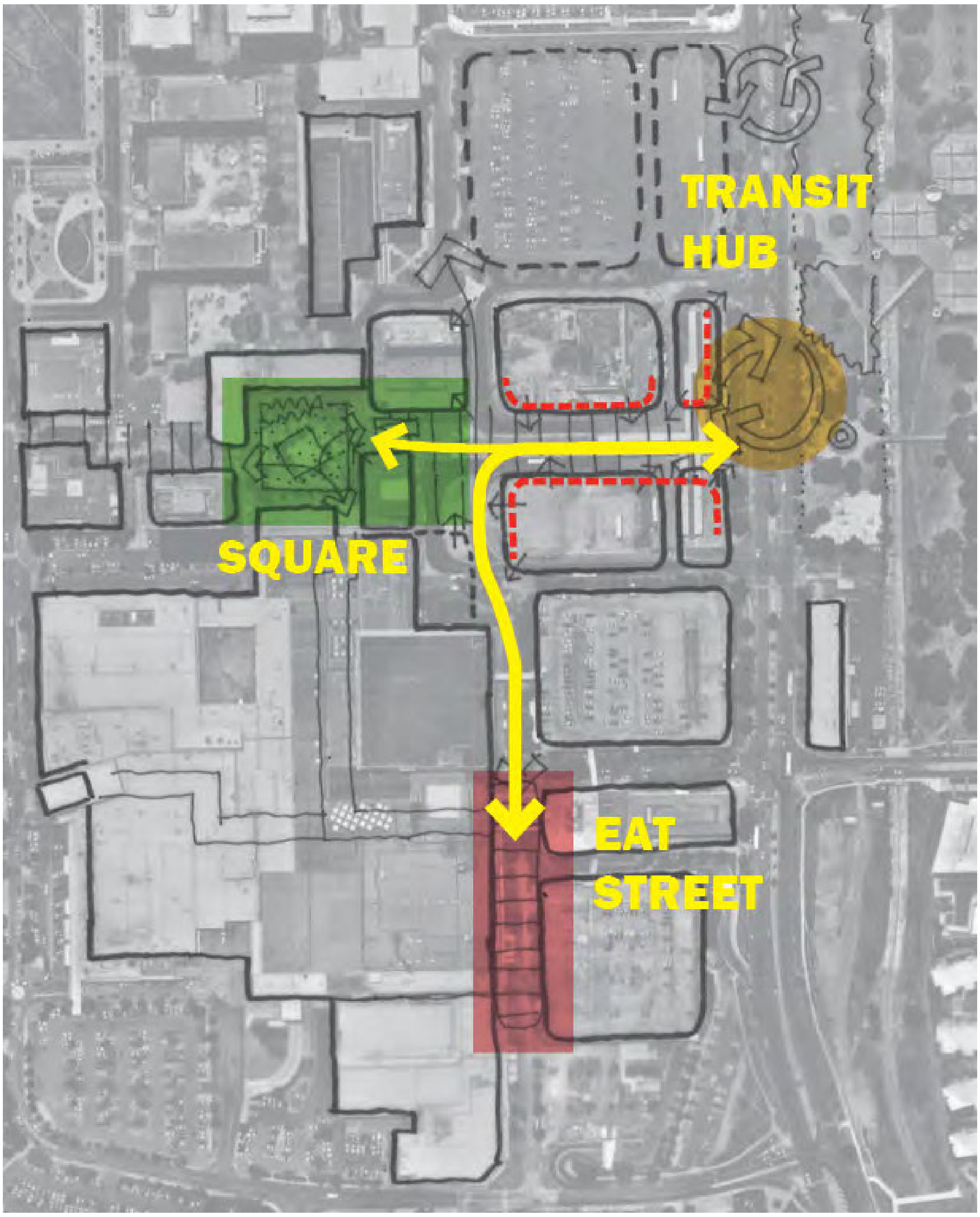
Activity nodes are those areas within and around the precinct that create footfall and add vibrancy to the public realm. Further land use opportunities which improve the ‘all hours’ liveliness and passive surveillance of the area have been prioritised. The activity nodes are consolidated between the new transit and existing square and retail anchors. Additional activity areas are anticipated to emerge upon completion of the transit hub and in-conjunction with other development site opportunities.

Activity nodes identified that may influence the Bradley Street Alignment include:

- Footfall activity between the transit hub and retail core.
- Green spaces and dwell spaces including sites for new pocket parks and Arabanoo Park

- Convenience retail opportunities (larger supermarket attractors)
- Lobbies, major entries (malls, apartments).
- Transit lounge & Tickets opportunities.
- Food Catering – local sun traps

Refer diagram below for Catalyst Activity Nodes.



5. Bradley Street and Development Lots

Key considerations for the location and preferred alignment include the:

- Impacts and considerations for the continued use of existing land uses
- Access, circulation
- Amenity; and
- Future uses for Lot B shown below

Figure 5-1 shows the two Bradley Street alignments.

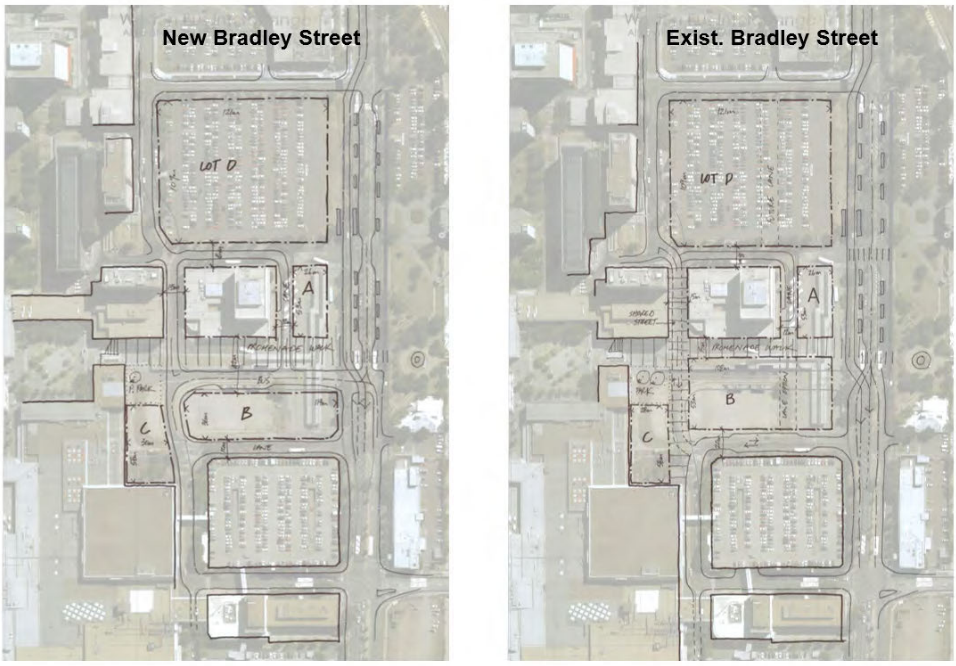


Figure 5-1 Bradley Configurations

Figure 5-2 Shows and enlargement showing the proposed alignment of New Bradley Street.

Figure 5-2 Enlargement of the "New Bradley Street"

This option contemplates a shared promenade and roadway between the approved Grand Central development to the north and Lot B would be created between the existing Westfield carpark to the south.

In this option a laneway would be required to be preserved for access to the rear (south side) of Lot B. This laneway would also be required for firetruck access for the carpark and Lot B and retention of the emergency egress from the Carpark.

The dimensions of Lot be would be approximately 36 m deep (north – south) by 114 m wide (east to west).

Figure 5-3 shows an enlargement of the same area with Bradley Street retained in its current alignment.

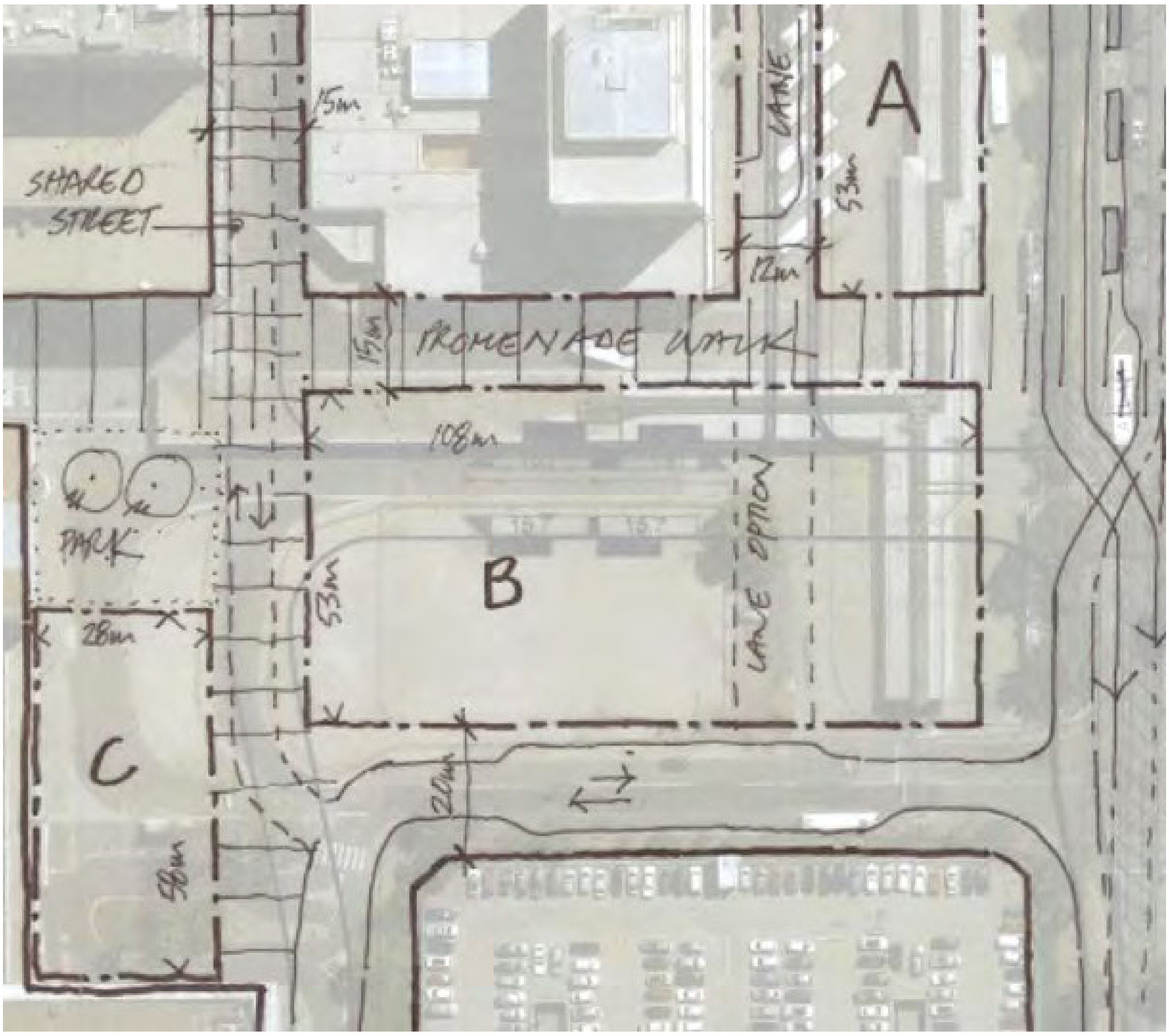


Figure 5-3 Enlargement of the "Existing Bradley Street"

This option contemplates a dedicated pedestrian promenade between the approved Grand Central development to the north and Lot B. The retained Bradley Street continues to function as a street with minor modifications to support bus stops for school bus and inter-city coach interchange. An improved Bradley Street landscaping outcome is possible in this arrangement.

The dimensions of Lot be would be approximately 53 m deep (north – south) by 108 m wide (east to west). These dimensions are similar to the lot within which the approved Grand Central Development is located and the legacy lot to the to the east of that site.

These dimensions of Lot B in this option provide for a wide range of uses to be accommodated within the development footprint including but not limited to:

- Retail (including a small supermarket such as Aldi)
- Residential at high level
- Short Stay or serviced office suites.
- Student Residential

Other advantages identities through retaining Bradley Street in its current location include:

- Reduce construction cost by reuse of existing pavement, drainage networks, utilities and traffic signal components;
- Maintain full access to the police station with no consequent impact on police operations;
- Greater flexibility to relocate the proposed bus stops on Bradley Street for school buses or local bus routes to the Callam Street bus interchange to create a full integrated bus interchange;
- Additional bus stops can be provided on the existing Bradley Street if required;
- Add additional land to Section 35, Block 1 and 4 to increase land value for the future land development.
- Maintains a north-south vehicle permeability, with consideration for low speed movements across the promenade walk.
- A prioritised east-west promenade link continuing the walking priority environment intended for the light rail interchange.

Other considerations which have been addressed include vehicle access loop for the new Grand Central.

6. Conclusion

Based on the above, it is considered that Bradley Street should be retained in its current location, subject to modifications to allow its integration into the works planned by the Woden Transport Hub, the current setting and context of the Woden Town Centre and the future development aspirations of the precinct.

Further studies and investigations which have been identified from this study include:

- Review public vehicle movements for vehicles travelling from the north wishing to access Westfield carparks adjacent Callam Street.
- Review efficiency and coordination of both light rail and bus stop usage to encourage an optimal place response.
- Review co-development initiatives with major ‘public’ facilities or sites such as improved activation of Westfield frontage to Bradley St (north), proposed community centre next to Callam St offices and development uses on Lot D.
- Investigate a precinct wide development yield and public realm structure in conjunction with the next phase of the Light Rail infrastructure project. Prepare a place based volumetric framework in response to public realm objectives (addressing overshadowing impacts).
- Review customer experience opportunities using transit facilities prioritising active travel modal access to the hub.

Appendix C. Geotechnical Desktop Study

Memorandum

JACOBS

Level 7, 177 Pacific Highway
North Sydney NSW 2060 Australia
PO Box 632 North Sydney
NSW 2059 Australia
T +61 2 9928 2100
F +61 2 9928 2444
www.jacobs.com

Subject Geotechnical Desktop Study

Project Name Woden Bus Interchange and Road Layout Modifications

Attention Schedule 2.2(a)(ii)

Project No. IS268800

From Schedule 2.2(a)(ii)

Date 11 June 2019

Copies to Project team

---

1. Introduction

This report presents the results of a geotechnical desktop study undertaken for the proposed Woden Bus Interchange and Road Layout Modifications project. The works were undertaken at the request of Transport Canberra, road authority, and were carried out in liaison with various members of the Jacobs design team.

It is understood that a new bus interchange and upgrades to surrounding roads is required. Proposed works include demolition of the existing off-street bus interchange, construction of a new on-street bus interchange, localised road widenings and upgrades to the verges of Callam, Matilda, Bowes, Bradley and Neptune Streets. The design is illustrated on the drawing included as Attachment A.

The study was carried out to provide preliminary design inputs for pavement design works which form part of the preliminary sketch plan (PSP) submission. The works comprised a desktop review of regional mapping and client supplied information for the area followed by engineering analysis and reporting. Details of the work undertaken and the results obtained are provided herein.

2. Project background

An interim bus interchange was first established in the area in 1968 on Melrose Drive, near Phillip Swimming and Ice Skating Centre, and was created to cater for the commencement of the Woden-City express route. A permanent interchange was later established in 1972 on Callam Street, between Bowes Street and Bradley Street, and was one of the first off-street bus interchanges in Australia. The interchange was expanded in 1982 to cater for new services to Tuggeranong and more recently, was renamed Woden Bus Station in 2010.

After 47 years of operation, the facility has reached design life and requires replacement to enable future light rail integration and to align with the objectives of the Woden Master Plan (ACT, 2015). The objectives include improved pedestrian connections, both physically and visually, between the town square and Woden Town Park to the east, and enabling new retail development opportunities fronting the interchange to the west, which are understood to form part of the proposed expansion of Westfied Woden.

3. Site description

The overall site comprises an approximate rectangular shaped area of some 5.6 hectares with maximum north-south and east-west dimensions of 375 metres and 150 metres, respectively. The site is bounded to the west by commercial development and to the east, north and south by Callam, Matilda and Neptune Streets, respectively.

At the time of report preparation, the existing off-street bus interchange was located within the central portion with the remainder comprising on-grade and multi-storey car parks, the latter of which forms part of the adjoining Westfield Woden. Existing road pavements within the site appear to be flexible with an asphalt wearing course whilst rigid pavements appear to be present within the bus interchange.

4. Regional mapping

4.1 Soil landscape

Reference to the Canberra 1:100 000 soil landscape map (DLWC, 2000) indicates the site is underlain by the Williamsdale soil landscape group (TRwi) but is close to the western boundary of the Ginninderra Creek group (ALgc) which runs in an approximate north-south direction along the alignment of Callam Street.

The Williamsdale group comprises transferral soils that occur on undulating rises, fans, valley flats and depressions in the Canberra Lowlands whilst the Ginninderra Creek group comprises alluvial soils which occur on near level to gently sloping flats of the Canberra Lowlands. Both groups are described as deep (i.e. greater than one metre) and typically comprise brown and yellow podzolic soils which are erodible and subject to seasonal waterlogging.

4.2 Geology

Reference to the Canberra 1:100 000 geological map (BMR, 1992) indicates the site is underlain by Deakin Volcanics (Sud) belonging to the Red Hill Group of early Silurian age. This formation comprises tuff, tuffaceous sandstone, shale and ashstone which typically weather to form clays of medium to high plasticity.

5. Client supplied information

5.1 Reference documents

Four geotechnical documents were provided by Transport Canberra for the desktop study. The documents were prepared for the Canberra Light Rail Stage 2 (LRS2) project, the alignment of which traverses Callam Street on the eastern boundary of the subject site. The documents contain information on historical geotechnical investigations undertaken close to the LRS2 alignment for other purposes, and site specific investigations for the project undertaken in 2017. The following documents were provided:

- Geotechnical desktop study (ARUP, 2017a)
- Geotechnical investigation specification (ARUP, 2017b)
- Geotechnical investigation report (ARUP, 2017c)
- Geotechnical interpretive report (ARUP, 2017d)

5.2 Relevant information

Review of the above documents indicates no historical geotechnical information was available within or adjacent to the subject site. The review also indicates no site specific geotechnical investigations were planned along Callam Street between Launceston Street and Hindmarsh Drive for the LRS2 project. However, site specific investigations were carried out immediately to the north and generally along the current alignment of Yarralumla Creek in the area between the Yarra Glen roundabout and Launceston Street.

Relevant investigations included two boreholes (Bores 5-BH53 and 56) drilled to depths of 15.3 metres and 5.6 metres respectively, and two test pits (Pits 5-TP54 and 55) excavated to depths of three metres and 2.9 metres respectively. Various laboratory tests were also performed on selected soil and rock samples recovered from these locations. The locations of the field investigations are shown on the plan included as Attachment B. A summary of the data is provided in Section 5.3.

5.3 Investigation results

5.3.1 Subsurface conditions

The borehole and test pit logs are included as Attachment C. A summary of subsurface conditions encountered is provided in Table 1.

Table 1 – Summary of subsurface conditions

Unit	Depth range (mbgl*)	Summarised description
Topsoil	0.0 – 0.3	Brown low plasticity sandy silt and dark brown medium to high plasticity clay, dry to moist, in Pits 5-TP54 and 55, and Bore 5-BH56.
Fill	0.0 – 2.8	Brown and grey, medium to high plasticity clay, silty clay and sandy clay, dry to moist, in Bores 5-BH53 and 56, and Pits 5-TP54 and 55.
Alluvium	1.1 – 3.0	Stiff to hard, grey and dark grey, low to high plasticity clay and silty clay, moist, in Pits 5-TP54 and 55.
Residual	0.7 – 5.6	Stiff to very stiff, grey, low to high plasticity clay and sandy clay, moist, in Bore 5-BH53 and Pits 5-TP54 and 55.
Bedrock	3.8 – 15.3	High to very high strength, moderately weathered to fresh, fractured to slightly fractured, grey coarse grained sandstone in Bore 5-BH53.

* metres below ground level

In summary, subsurface conditions north of the subject site typically comprise surficial topsoil and localised clay fill to depths of up to 2.8 metres overlying variably stiff to hard, low to high plasticity alluvial and residual clays thence very high strength, moderately weathered to fresh, coarse grained sandstone bedrock below depths of 3.8 metres.

Groundwater was observed at a depth of five metres in Bore 5-BH56. No free groundwater was observed at any of the remaining locations whilst the bores and pits remained open. It is noted however, that groundwater levels can change over time and that longer-term monitoring of groundwater levels was not undertaken at these locations.

5.3.2 Laboratory testing

The laboratory test reports are included as Attachment D. A summary of the test results is provided in Table 2.

Table 2 – Summary of laboratory test results

ID	Sample depth (m)	Material	Moisture content (%)	Liquid limit (%)	Optimum moisture content (%)	Maximum dry density (t/m^3)	California bearing ratio (%)	Swell after soaking (%)
5-TP54	0.6 – 0.8	Silty clay	12.9	43	15.0	1.81	11	0.7
5-TP54	1.1 – 1.3	Silty clay	21.2	37	15.2	1.75	9	1.2
5-TP55	1.0 – 1.2	Clay	17.5	41	16.7	1.75	7	0.8
5-BH56	1.0 – 1.3	Clay		28				

The results indicate liquid limits in the range of 28 to 43 per cent for the clay samples tested, indicative of low to medium plasticity. The results also indicate 10-day soaked CBR and CBR swell values in the range of seven to 11 per cent and 0.7 to 1.2 per cent respectively, indicative of a low to moderate strength in the saturated condition and low expansive nature. The results further indicate field moisture contents range from two percentage points dry to six percentage points wet of respective optimum moisture contents.

6. Recommendations

6.1 Geotechnical model

In the absence of site specific investigations, the development of a geotechnical model for the site is premature at this stage. However, investigations undertaken for the LRS2 project in the vicinity are considered to provide a reasonable indication of subsurface conditions that could be encountered within the site.

On this basis, soil profiles comprising localised clay fill and natural clays of at least stiff consistency and several metres in thickness could be expected. Sandstone bedrock can be anticipated underlying the overburden soils and if consistent with Bore 5-BH53, could be high to very high strength, and moderately weathered to fresh. Groundwater at or near the soil-rock interface could also be expected (i.e. several metres depth).

6.2 Design subgrade

The road design indicates the vertical alignment of existing roads will generally remain unchanged necessitating excavation depths of up to one metre to facilitate pavement boxing for localised widenings and reconstructions. As such, the design subgrade CBR value will be a function of the strength properties of the existing near-surface soils.

Available information in the vicinity of the site indicates subsurface conditions at design subgrade levels could comprise clay fill and/or stiff to hard, low to high plasticity alluvial and residual clay. The results of laboratory testing on three samples of these materials indicates soaked CBR and CBR swell values in the range of seven to 11 per cent and 0.7 to 1.2 per cent respectively, indicative of a low to moderate strength in the saturated condition and low expansive nature.

When less than five test results are available, the lowest test result is commonly adopted as the design subgrade CBR value. In this case however, a value of seven per cent is considered high for clay material and not sufficiently conservative in the absence of site specific test results. As such, an assumed design subgrade CBR value of three per cent is recommended.

As liquid limit values are all less than 70 per cent and CBR swell values are less than 2.5 per cent, provision of an impervious capping layer is not recommended at this stage.

6.3 Further work

A site specific geotechnical investigation is recommended once the project progresses beyond the PSP stage. The investigation should include a combination of deflection testing and shallow borehole drilling (i.e. up to two metres depth) for existing pavements proposed to be retained, shallow drilling in widening areas and laboratory testing of recovered samples.

Shallow boreholes should be drilled at around 300 millimetres diameter and 100 metre maximum spacings. Laboratory testing should include, as a minimum, moisture content, plasticity index, maximum dry density and 10-day soaked CBR. Deeper drilling, including bedrock coring, should be undertaken for proposed structures including shelters and sign supports, as necessary. A scope for the above can be developed by the undersigned when required.

It is noted that geotechnical design inputs may change following completion of the above. As such, all recommendations provided in this report must be considered as preliminary and subject to the outcomes of site specific investigations at a later stage.

I trust that the above is in accordance with current requirements and confirms our recent discussions. Please contact the undersigned should you require any further information on the above.

Yours sincerely,

Schedule 2.2(a)(ii) [redacted]

Schedule 2.2(a)(ii) [redacted]
Principal Pavement Engineer
Schedule 2.2(a)(ii) [redacted]

References:

ACT Government (2015), *Woden Town Centre, Master Plan*, November 2015.

ARUP (2017a), *Transport Canberra & City Services, Canberra Light Rail Stage 2, Geotechnical Desk Study*, Draft 1, 13 June 2017.

ARUP (2017b), *Transport Canberra & City Services, Canberra Light Rail Stage 2, Geotechnical Investigation Specification*, Draft 1, 13 June 2017.

ARUP (2017c), *Transport Canberra & City Services, Canberra Light Rail Stage 2, Geotechnical Factual Report*, Issue 1, 20 November 2017.

ARUP (2017d), *Transport Canberra & City Services, Canberra Light Rail Stage 2, Geotechnical Interpretive Report*, Issue 1, 7 December 2017.

Canberra Bureau of Mineral Resources (1992), *Canberra 1:100 000 Geological Map*, Sheet 8727.

NSW Department of Land and Water Conservation (2000), *Canberra 1:100 000 Soil Landscape Map,* Sheet 8727.

Attachments:

Attachment A – Concept design drawing
Attachment B – Site investigation plan
Attachment C – Borehole and test pit logs
Attachment D – Laboratory test reports

Attachment A – Concept design drawing

Woden Bus Interchange

Alternative Light Rail Alignment

OPTION 3

JACOBS

WODEN BUS INTERCHANGE

PREPARED BY: SM
SHEET: 1
DATE: 29/4/2019

Attachment B – Site investigation plan

Legend

Design Sections

- — Design Section 200 - 19/10/2017
- — Design Section 300 - 19/10/2017
- — Design Section 400 - 19/10/2017
- — Design Section 500 - 19/10/2017

Arup 2017 GI - LRS2

- ⊕ BH
- ● DCP
- 🟩 TP

Client
Transport Canberra and City Services

Job Title
Light Rail Stage 2

Figure Title
LRS2 Geotechnical Investigation Location Sheet 2 of 2

Metres
0 200 400 600

D1	14/11/2017	DM	-	-
Issue	Date	By	Chkd	Appd

ARUP

Level 10, 201 Kent Street
Sydney, NSW 2000
Tel +61 (2)9320 9320 Fax +61 (2)9320 9321
www.arup.com

Scale at A3
1:15,000

Figure Status
Issue 1

Coordinate System
AGD 1966 ACT Standard Grid

Job No
254319-00

Figure No
06

J:\254000\254319-00 Canberra Light Rail\Work\Internal\Design\GIS\03_Map\01_Desktop\Geotechnical_Master_GFR_GIR.mxd

Attachment C – Borehole and test pit logs

BOREHOLE RECORD

ARUP

5-BH53

SHEET 1
OF 3

CLIENT	Transport Canberra and City Services	LOGGED BY	[redacted]
PROJECT	Light Rail Stage 2	CHECKED BY	
		DRILLED DATE	29-Aug-17

CONTRACTOR	[redacted]	ANGLE	-90°	GROUND LEVEL	RL 578.43mOD
DRILL MODEL	Hydropower scout	BEARING	-	LOCATION	206900.7 E 597741.48 N
DRILLER	[redacted]	HOLE DIAMETER	Spiral Auger	ELEVATION DATUM	Australian Height Datum (AHD)
LOCATION	Section 500, 500+233			COORDINATE SYSTEM	National Grid

DRILLING	STRATA				MATERIAL DESCRIPTION	CONDITION		OBSERVATION
SAMPLE, TEST, BIT, SUPPORT, ETC.	R.L. mOD	DEPTH m	GROUP SYMBOL	LEGEND	SOIL TYPE Colour, Plasticity/Grain Size, Minor Components	WATER / MOISTURE	CONSISTENCY COHESIVE VS S F ST VST H / NON COHESIVE VL L MD D VD	Comments / Penetration Rate
			CI		FILL: Sandy CLAY, brown with grey patches, medium plasticity, medium to coarse grained sand, with igneous, sub angular, fine to medium gravel, MC<PL	SM		FILL
SPT N=12* 5;6/150								
SPT N=46* 16;23/150					... 1.50m cemented igneous gravel, medium to coarse grained, inferred to be constructed as part of bridge abutment			Continued as wash boring
SPT N=12* 4;6/150 pulled out prior to last seat	581.18	2.75	CI		Sandy CLAY: pale grey, mottled orange, medium plasticity, fine to medium grained sand, MC>PL		F	RESIDUAL SOIL
	582.23	3.80			Continued as cored borehole			

Depth scale: 1 2 3 4 5 6 7 8 9 10

NOTES	See explanatory notes for details of abbreviations and basis of descriptions	JOB 254319

gINT v8.30.004 Licenced to Arup
Project : j:\254000\254319-00 canberra light rail\work\internal\design\geotech\geotech investigation\02 site work\03 gint\01 database\03 master database\20171115_254319_lrs2_master gint.gpj
Library : j:\254000\254319-00 canberra light rail\work\internal\design\geotech\geotech investigation\02 site work\03 gint\02 library\arup_aus_v0.1.10_working.glb
Script file: j:\254000\254319-00 canberra light rail\work\internal\design\geotech\geotech investigation\02 site work\03 gint\05 scripts\20171012_output\output_borehole_log.gsc
Log: 1.0.2 AUS GENERAL BOREHOLE LOG (RMS) (rev 17Nov17)
gINT output page 1 of 1. Made 17Nov17 14:37

ARUP

CORED BOREHOLE RECORD

5-BH53

SHEET 2

OF 3

CLIENT	Transport Canberra and City Services
PROJECT	Light Rail Stage 2
CONTRACTOR	Schedule 2.2(a)(ii)
DRILL MODEL	Hydropower scout
DRILLER	Schedule 2.2(a)(ii)
LOCATION	Section 500, 500+233
ANGLE	-90°
BEARING	-
HOLE DIAMETER	NMLC
LOGGED BY	Schedule 2.2(a)(ii)
CHECKED BY	
DRILLED DATE	29-Aug-17
GROUND LEVEL	RL 578.43mOD
LOCATION	206900.7 E 597741.48 N
ELEVATION DATUM	Australian Height Datum (AHD)
COORDINATE SYSTEM	National Grid

DRILLING

TCR % (Drill rate)	SCR % / (RQD %)	FLUSH RETURN % (TYPE)
102	75/(54)	(Polymer) 100
100	90/(53)	(Polymer) 100
100	87/(72)	(Polymer) 100
100	78/(69)	(Polymer) 100

SAMPLES (CaCO₃, SPT, UCS, etc): C, C, C, C, C, C, C, C, UCS=63.5MPa, C, C, C, C

STRATA

R.L. mOD	DEPTH m
582.23	3.80

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

MATERIAL DESCRIPTION

ROCK TYPE
Colour, Grain Size, Texture/Fabric, Minor Components

Continued from borehole

SANDSTONE: orange-brown, coarse grained, massive

... 4.65m colour change to grey slightly metophorphised, with quartz veins

WEATHERING: MW; F

ESTIMATED ROCK STRENGTH: VL L M H VH EH

Is 50 (MPa)
A 0.42 D 1.99
D 6.65
A 1.76
A 3.02
D 10.89
A 7.39 D 7.16
D 5.59 A 1.42
A 3.09 D 5.52

SPACING (mm): 20 40 100 300 1000 3000

DISCONTINUITIES

TYPE	ANGLE	THICKNESS (mm)	GENERAL DESCRIPTION Planarity, Roughness, Coating, Infill
DB			
SM	10	20	PL, Ro, C, S
DB			
HB			
Jo	60	2	PL, Ro, CL
Jo	10	3	PL, Ro, C
SM	10	40	PL, Ro, C
Jo	30	3	PL, Ro, S
We	20	150	PL, Ro, C, S
Cr	15	20	PL, Ro, C, G
Jo	40	2	PL, Ro, S
Jo	50	2	PL, healed
Jo	35		PL, Ro, C
Jo	10		CU, healed
DB	40		PL, Ro, S
Jo			
Jo	50	2	PL, Ro, C
Jo	10	1	PL, Ro, CL
Jo	55	2	PL, Ro, C
Jo	10	1	PL, Ro, C
HB			
Jo	80		CU, healed
Jo	40	2	PL, Ro, C, S
Jo	40	3	PL, Ro, S
HB			
Jo	45	1	PL, Ro, S
Jo	40	1	PL, Ro, S
Jo	40	1	PL, Ro, C
DB			
DB	30	1	PL, Ro, C
Jo	70	2	PL, Ro, C
Jo	60		PL, healed
Jo	15	2	PL, Ro, C
Jo			
HB	80	2	PL, Ro, S
Jo	10	1	PL, Ro, S
Jo	10	3	PL, Ro, C, S
Jo	55	1	PL, Ro, CL
Jo			
HB	15	2	PL, Ro, C, S
DB			
Jo			
DB	15	2	PL, Ro, S
Jo			
Jo	15	5	PL, Ro, C, S
Jo	10	4	PL, Ro, C, S
Jo	85	1	UN, Ro, S
HB			
HB			
HB			
HB			
HB			
DB			
Jo	25	1	PL, Ro, C
DB			
Jo	25		PL, healed
Jo	5	2	PL, Ro, C
Jo	10	4	PL, Ro, C, S
We	25	80	PL, Ro, C, S
We	30	20	PL, Ro, C, S
Jo	20	2	PL, Ro, C
Jo	35	1	PL, Ro, S
Jo	40	2	PL, Ro, C, S
Jo	40	3	PL, Ro, S
Jo	75	1	PL, Ro, CL
Jo	65	1	PL, Ro, C
Jo	10	1	PL, Ro, C, x14

NOTES

See explanatory notes for details of abbreviations and basis of descriptions

JOB
254319

gINT v8.30.004 Licenced to Arup
Project : j:\254000\254319-00 canberra light rail\work\internal\design\geotech\geotech investigation\02 site work\03 gint\01 database\03 master database\20171115_254319_lrs2_master gint.gpj
Library : j:\254000\254319-00 canberra light rail\work\internal\design\geotech\geotech investigation\02 site work\03 gint\02 library\arup_aus_v0.1.10_working.glb
Script file: j:\254000\254319-00 canberra light rail\work\internal\design\geotech\geotech investigation\02 site work\03 gint\05 scripts\20171012_output\output_borehole_log.gsc
Log: 1.2.1 AUS ROTARY CORE LOG (AS1726 2017) (rev 17Nov17)
gINT output page 1 of 2. Made 17Nov17 14:37

ARUP

CORED BOREHOLE RECORD

5-BH53

SHEET 3
OF 3

CLIENT	Transport Canberra and City Services	LOGGED BY CHECKED BY	[redacted]
PROJECT	Light Rail Stage 2	DRILLED DATE	29-Aug-17

CONTRACTOR	[redacted]	ANGLE	-90°	GROUND LEVEL	RL 578.43mOD
DRILL MODEL	Hydropower scout	BEARING	-	LOCATION	206900.7 E 597741.48 N
DRILLER	[redacted]	HOLE DIAMETER	NMLC	ELEVATION DATUM	Australian Height Datum (AHD)
LOCATION	Section 500, 500+233			COORDINATE SYSTEM	National Grid

DRILLING

TCR % (Drill rate)	SCR % / (RQD %)	FLUSH RETURN % (TYPE)	SAMPLES ($CaCO_3$, SPT, UCS, etc)
100	78/(69)	(Polymer) 100	C C C C
100	96/(92)	(Polymer) 100	C C C C
100	96/(31)	(Polymer) 100	C C

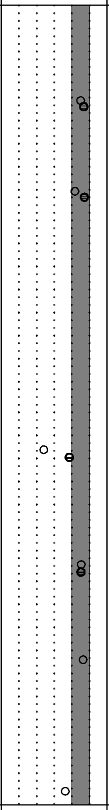
STRATA

R.L. mOD	DEPTH m	GRAPHIC LOG	ROCK TYPE Colour, Grain Size, Texture/Fabric, Minor Components	WEATHERING
593.72	15.29	· · ·	SANDSTONE: orange-brown, coarse grained, massive *(continued)*	F
			End of borehole at 15.29m Termination: Target depth Groundwater: Not Observed	

DEPTH scale: 11, 12, 13, 14, 15, 16, 17, 18, 19, 20

MATERIAL DESCRIPTION

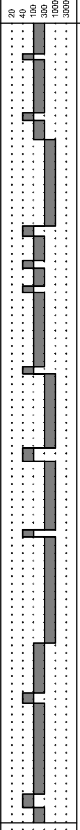
ESTIMATED ROCK STRENGTH



Is 50 (MPa)
D 5.29 A 6.50
D 3.64 A 6.76
D 0.48 A 2.55
D 5.55 A 5.43
D 6.22
D 1.95

DISCONTINUITIES

SPACING (mm)



VISUAL

SPECIFIC TYPE	SPECIFIC ANGLE	SPECIFIC THICKNESS (mm)	GENERAL DESCRIPTION Planarity, Roughness, Coating, Infill
Jo	45	2	PL, Ro, CL
Jo	25	4	PL, Ro, C, S
Jo	30	2	PL, Ro, CL
Jo	20	3	PL, Ro, S
Jo	15	3	PL, Ro, C, S
Jo	15	1	PL, Ro, S
Jo	30	3	PL, Ro, S
HB			
Jo	40		PL, Ro, sC, vaneer
Jo	35		PL, Ro, sC, vaneer
Jo	30		PL, Ro, STN, C Vaneer
Jo	30		PL, Ro, STN
Jo	25		CU, VRF, STN
Jo	25		UN, VRF, STN
Jo	10		UN, VRF, STN, C Vaneer
Jo	60	2	PL, Ro, S
Jo	25	2	PL, Ro, S
Jo	25	2	PL, Ro, S
DB			
Jo	15	2	PL, Ro, C, S
Jo	20	3	PL, Ro, C, S
DB			
HB			
DB			
Jo	30	1	PL, Ro, C, S
Jo	60	10	PL, Ro, C, S
DB			
DB			
DB			
Jo	35	2	PL, Ro, CL
Jo	50	2	PL, Ro, CL
DB			
Jo	65	2	PL, Ro, C
Jo	70	2	PL, Ro, C, S
DB			
Jo	45	2	PL, Ro, CL
Jo	45	2	PL, Ro, CL
Jo	55	2	PL, Ro, CL
Jo	50	2	PL, Ro, C, S
Jo	45	4	PL, Ro, C, S

NOTES

See explanatory notes for details of abbreviations and basis of descriptions

JOB
254319

gINT v8.30.004 Licenced to Arup
Project : j:\254000\254319-00 canberra light rail\work\internal\design\geotech\geotech investigation\02 site work\03 gint\01 database\03 master database\20171115_254319_lrs2_master gint.gpj
Library : j:\254000\254319-00 canberra light rail\work\internal\design\geotech\geotech investigation\02 site work\03 gint\02 library\arup_aus_v0.1.10_working.glb
Script file: j:\254000\254319-00 canberra light rail\work\internal\design\geotech\geotech investigation\02 site work\03 gint\05 scripts\20171012_output\output_borehole_log.gsc
Log: 1.2.1 AUS ROTARY CORE LOG (AS1726 2017) (rev 17Nov17)
gINT output page 2 of 2. Made 17Nov17 14:37

ARUP

CORE PHOTO RECORD

5-BH53

SHEET 1 OF 1

CLIENT	Transport Canberra and City Services	LOGGED BY CHECKED BY	Schedule 2.2(a)(ii)
PROJECT	Light Rail Stage 2	DRILLED DATE	29-Aug-17

CONTRACTOR	Schedule 2.2(a)(ii)	ANGLE	-90°	GROUND LEVEL	RL 578.43mOD
DRILL MODEL	Hydropower scout	BEARING	-	LOCATION	206900.7 E 597741.48 N
DRILLER	Schedule	HOLE DIAMETER	NMLC	ELEVATION DATUM	Australian Height Datum (AHD)
LOCATION	Section 500, Chainage 500+233			COORDINATE SYSTEM	National Grid

5-BH53 Depth Range: 8.00 - 13.10 m

5-BH53 Depth Range: 13.10 - 15.29 m

NOTES

See explanatory notes for details of abbreviations and basis of descriptions

JOB
254319

gINT v8.30.004 Licenced to Arup
Project : j:\254000\254319-00 canberra light rail\work\internal\design\geotech\geotech investigation\02 site work\03 gint\01 database\03 master database\20171115_254319_lrs2_master gint.gpj
Library : j:\254000\254319-00 canberra light rail\work\internal\design\geotech\geotech investigation\02 site work\03 gint\02 library\arup_aus_v0.1.10_working.glb
Script file: j:\254000\254319-00 canberra light rail\work\internal\design\geotech\geotech investigation\02 site work\03 gint\05 scripts\20171012_output\output_borehole_log.gsc
GrfcTbl: ARUP PHOTO CORE BOX 2 PER PAGE (rev 1Sep16)
gINT output page 1 of 1. Made 17Nov17 14:37

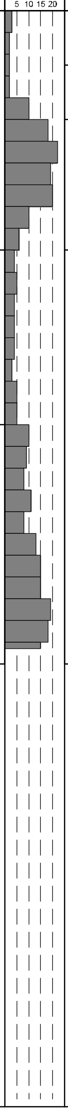
TEST PIT RECORD

5-TP54

SHEET 1 OF 1

CLIENT	Transport Canberra and City Services	LOGGED BY	Schedule 2.2(a)(ii) [redacted]
PROJECT	Light Rail Stage 2	CHECKED BY	
		EXCAVATION DATE	29-Aug-17
CONTRACTOR	Schedule 2.2(a)(ii) [redacted]	GROUND LEVEL	RL 579.05m
EQUIPMENT	CAT 8t excavator, 300mm bucket	LOCATION	206943.9 E 597602.24 N
OPERATOR	Schedule 2.2(a)(ii) [redacted]	ELEVATION DATUM	Australian Height Datum (AHD)
LOCATION	Section 500, 500+379	COORDINATE SYSTEM	National Grid

SAMPLES AND TESTS	STRATA				MATERIAL DESCRIPTION	CONDITION			DCP	OBSERVATIONS
SAMPLE TYPE AND TEST RESULTS	R.L. mOD	DEPTH m	GROUP SYMBOL	LEGEND	SOIL TYPE Plasticity / Grain Size, Colour, Minor Components	CEMENTATION/ WEATHERING	MOISTURE	CONSISTENCY	BLOWS 5 10 15 20	FIELD RECORDS / COMMENTS
D	579.30	0.25	SM		TOP SOIL / FILL: Sandy SILT, brown, low plasticity, fine grained sand, with roots and root fibres, MC<PL		D to M			TOP SOIL / FILL
B V=53.0/18.0kPa PP=120kPa PP=150kPa PP=220kPa	579.55	0.50	CI		FILL: Silty CLAY, grey, medium plasticity, trace fine to medium, sub-rounded gravel, trace roots and root fibres, MC<PL					FILL
B D	580.15	1.0 1.10	CI		FILL: Sandy silty CLAY, pale brown and pale grey, medium plasticity, medium to coarse grained sand, with fine to medium, sub-angular gravel ... 0.90m 0.90m: fines content increasing		D			FILL
B PP>450kPa	582.05	2.0 3.00	CL		Silty CLAY: grey speckled dark grey and orange-brown, low plasticity, with fine to medium grained sand, MC<PL ... 2.00m - 3.00m MC=PL		SM M	St H		ALLUVIUM firm resistance from 1.1m
		3.0 4.0 5.0			Test pit terminated at 3m depth Target depth					



Remarks

Vane shear test carried out on test pit side wall

Groundwater

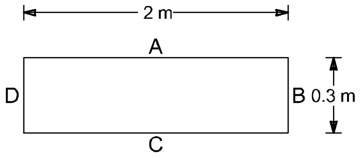
No groundwater observed

Shoring/Support

None

Stability

good



NOTES Consistency categorisation based on a combination of field observations and in situ testing if available

See explanatory notes for details of abbreviations and basis of descriptions

JOB 254319

gINT v8.30.004 Licenced to Arup
Project : j:\254000\254319-00 canberra light rail\work\internal\design\geotech\geotech investigation\02 site work\03 gint\01 database\03 master database\20171115_254319_lrs2_master gint.gpj
Library : j:\254000\254319-00 canberra light rail\work\internal\design\geotech\geotech investigation\02 site work\03 gint\02 library\arup_aus_v0.1.10_working.glb
Script file: j:\254000\254319-00 canberra light rail\work\internal\design\geotech\geotech investigation\02 site work\03 gint\05 scripts\20171012_output\output_test_pits.gsc
Log: 1.32 AUS TEST PIT RECORD TYPE 2 (RMS) (rev 17Nov17)
gINT output page 1 of 1. Made 17Nov17 15:11

TEST PIT PHOTO RECORD

5-TP54

SHEET 1
OF 2

CLIENT	Transport Canberra and City Services
PROJECT	Light Rail Stage 2
LOGGED BY CHECKED BY	Schedule 2.2(a)(ii)
EXCAVATION DATE	29-Aug-17
CONTRACTOR	Schedule 2.2(a)(ii)
EQUIPMENT	CAT 8t excavator, 300mm bucket
OPERATOR	Schedule
LOCATION	Section 500
BEARING	
GROUND LEVEL	RL 579.05mOD
LOCATION	206943.9 E 597602.24 N
ELEVATION DATUM	Australian Height Datum (AHD)
COORDINATE SYSTEM	National Grid

5-TP54 - 1

5-TP54 - 2

NOTES Vane shear test carried out on test pit side wall

See explanatory notes for details of abbreviations and basis of descriptions

JOB 254319

gINT v8.30.004 Licenced to Arup
Project : j:\254000\254319-00 canberra light rail\work\internal\design\geotech\geotech investigation\02 site work\03 gint\01 database\03 master database\20171115_254319_lrs2_master gint.gpj
Library : j:\254000\254319-00 canberra light rail\work\internal\design\geotech\geotech investigation\02 site work\03 gint\02 library\arup_aus_v0.1.10_working.glb
Script file: j:\254000\254319-00 canberra light rail\work\internal\design\geotech\geotech investigation\02 site work\03 gint\05 scripts\20171012_output\output_test_pits.gsc
GrfcTbl: ARUP PHOTO TEST PIT 2 PER PAGE (rev 27Jul15)
gINT output page 1 of 2. Made 17Nov17 15:11

ARUP

TEST PIT PHOTO RECORD

5-TP54

SHEET 2 OF 2

CLIENT	Transport Canberra and City Services	LOGGED BY CHECKED BY	Schedule 2.2(a)(ii)
PROJECT	Light Rail Stage 2	EXCAVATION DATE	29-Aug-17
CONTRACTOR	Schedule 2.2(a)(ii)	GROUND LEVEL	RL 579.05mOD
EQUIPMENT	CAT 8t excavator, 300mm bucket	LOCATION	206943.9 E 597602.24 N
OPERATOR	Schedule 2.2(a)	ELEVATION DATUM	Australian Height Datum (AHD)
LOCATION	Section 500	COORDINATE SYSTEM	National Grid
BEARING			

5-TP54 - 3

5-TP54 - 4

NOTES Vane shear test carried out on test pit side wall

See explanatory notes for details of abbreviations and basis of descriptions

JOB 254319

gINT v8.30.004 Licenced to Arup
Project : j:\254000\254319-00 canberra light rail\work\internal\design\geotech\geotech investigation\02 site work\03 gint\01 database\03 master database\20171115_254319_lrs2_master gint.gpj
Library : j:\254000\254319-00 canberra light rail\work\internal\design\geotech\geotech investigation\02 site work\03 gint\02 library\arup_aus_v0.1.10_working.glb
Script file: j:\254000\254319-00 canberra light rail\work\internal\design\geotech\geotech investigation\02 site work\03 gint\05 scripts\20171012_output\output_test_pits.gsc
GrlcTbl: ARUP PHOTO TEST PIT 2 PER PAGE (rev 27Jul15)
gINT output page 2 of 2. Made 17Nov17 15:11

ARUP

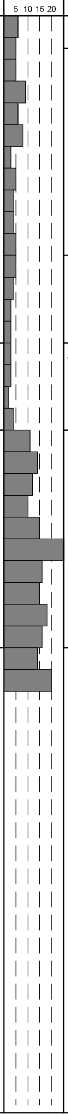
TEST PIT RECORD

5-TP55

SHEET 1 OF 1

CLIENT	Transport Canberra and City Services	LOGGED BY CHECKED BY	[redacted]
PROJECT	Light Rail Stage 2	EXCAVATION DATE	12-Sep-17
CONTRACTOR	[redacted]	GROUND LEVEL	RL 580.85m
EQUIPMENT	CAT 8t excavator, 450mm bucket	LOCATION	206976.7 E 597448.09 N
OPERATOR	[redacted]	ELEVATION DATUM	Australian Height Datum (AHD)
LOCATION	Section 500, 500+536	COORDINATE SYSTEM	National Grid

SAMPLES AND TESTS	STRATA				MATERIAL DESCRIPTION	CONDITION			DCP	OBSERVATIONS
SAMPLE TYPE AND TEST RESULTS	R.L. mOD	DEPTH m	GROUP SYMBOL	LEGEND	SOIL TYPE Plasticity / Grain Size, Colour, Minor Components	CEMENTATION/ WEATHERING	MOISTURE	CONSISTENCY	BLOWS 5 10 15 20	FIELD RECORDS / COMMENTS
D B	581.00	0.15	CI-CH		TOP SOIL / FILL: CLAY, dark brown, medium to high plasticity, with fine grained sand, trace fine angular gravel, with rootlets		D			TOP SOIL / FILL
D B	581.95	1.10	CH		FILL: CLAY, brown, high plasticity, with fine to coarse sand, trace angular, fine to coarse grained gravel, trace cobbles					FILL
	582.35	1.50	CI-CH		FILL: CLAY, grey, medium to high plasticity, with fine grained sand ... 1.40m becoming moist		SM			FILL
	582.75	1.90	CH		CLAY: dark grey, high plasticity, trace coarse sand			St		ALLUVIUM
D B	583.75	2.90	CL-CI		Sandy CLAY: pale grey mottled with orange, low to medium plasticity, medium to coarse grained sand			VSt		RESIDUAL SOIL
					... 2.90m becoming hard Test pit terminated at 2.9m depth Target depth					



Remarks

Groundwater

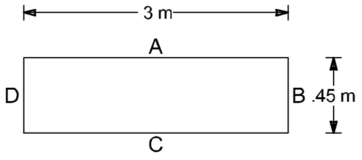
No groundwater observed

Shoring/Support

None

Stability

good



NOTES Consistency categorisation based on a combination of field observations and in situ testing if available

See explanatory notes for details of abbreviations and basis of descriptions

JOB 254319

gINT v8.30.004 Licenced to Arup
Project : j:\254000\254319-00 canberra light rail\work\internal\design\geotech\geotech investigation\02 site work\03 gint\01 database\03 master database\20171115_254319_lrs2_master gint.gpj
Library : j:\254000\254319-00 canberra light rail\work\internal\design\geotech\geotech investigation\02 site work\03 gint\02 library\arup_aus_v0.1.10_working.glb
Script file: j:\254000\254319-00 canberra light rail\work\internal\design\geotech\geotech investigation\02 site work\03 gint\05 scripts\20171012_output\output_test_pits.gsc
Log: 1.32 AUS TEST PIT RECORD TYPE 2 (RMS) (rev 17Nov17)
gINT output page 1 of 1. Made 17Nov17 14:52

TEST PIT PHOTO RECORD

5-TP55

SHEET 1 OF 2

CLIENT Transport Canberra and City Services
PROJECT Light Rail Stage 2

LOGGED BY [redacted]
CHECKED BY
EXCAVATION DATE 12-Sep-17

CONTRACTOR [redacted]
EQUIPMENT CAT 8t excavator, 450mm bucket
OPERATOR [redacted]
LOCATION Section 500
BEARING

GROUND LEVEL RL 580.85mOD
LOCATION 206976.7 E 597448.09 N
ELEVATION DATUM Australian Height Datum (AHD)
COORDINATE SYSTEM National Grid

5-TP55 - 1

5-TP55 - 2

NOTES

See explanatory notes for details of abbreviations and basis of descriptions

JOB 254319

TEST PIT PHOTO RECORD

5-TP55

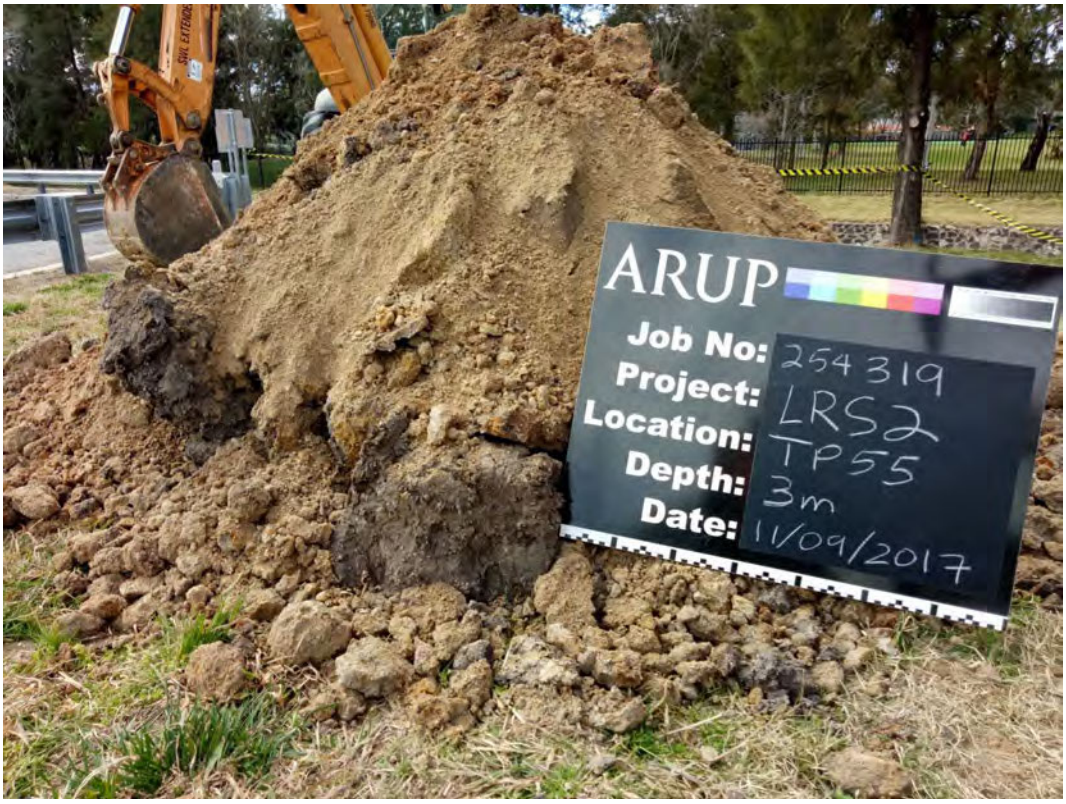
SHEET 2 OF 2

CLIENT Transport Canberra and City Services
PROJECT Light Rail Stage 2

LOGGED BY Schedule 2.2(a)(ii)
CHECKED BY
EXCAVATION DATE 12-Sep-17

CONTRACTOR Schedule 2.2(a)(ii)
EQUIPMENT CAT 8t excavator, 450mm bucket
OPERATOR Schedule 2.2(a)(ii)
LOCATION Section 500
BEARING

GROUND LEVEL RL 580.85mOD
LOCATION 206976.7 E 597448.09 N
ELEVATION DATUM Australian Height Datum (AHD)
COORDINATE SYSTEM National Grid



5-TP55 - 3

NOTES

See explanatory notes for details of abbreviations and basis of descriptions

JOB 254319

gINT v8.30.004 Licenced to Arup
Project : j:\254000\254319-00 canberra light rail\work\internal\design\geotech\geotech investigation\02 site work\03 gint\01 database\03 master database\20171115_254319_lrs2_master gint.gpj
Library : j:\254000\254319-00 canberra light rail\work\internal\design\geotech\geotech investigation\02 site work\03 gint\02 library\arup_aus_v0.1.10_working.glb
Script file: j:\254000\254319-00 canberra light rail\work\internal\design\geotech\geotech investigation\02 site work\03 gint\05 scripts\20171012_output\output_test_pits.gsc
GrfcTbl: ARUP PHOTO TEST PIT 2 PER PAGE (rev 27Jul15)
gINT output page 2 of 2. Made 17Nov17 14:53

ARUP

BOREHOLE RECORD

5-BH56

SHEET 1

OF 1

CLIENT	Transport Canberra and City Services	LOGGED BY CHECKED BY	[redacted]
PROJECT	Light Rail Stage 2	DRILLED DATE	29-Aug-17

CONTRACTOR	[redacted]	ANGLE	-90°	GROUND LEVEL	RL 581.79mOD
DRILL MODEL	Hanjin 8D	BEARING	-	LOCATION	206985.1 E 597309.08 N
DRILLER	[redacted]	HOLE DIAMETER	Spiral Auger	ELEVATION DATUM	Australian Height Datum (AHD)
LOCATION	Section 500, 500+679			COORDINATE SYSTEM	National Grid

DRILLING	STRATA				MATERIAL DESCRIPTION	CONDITION			OBSERVATION
SAMPLE, TEST, BIT, SUPPORT, ETC.	R.L. mOD	DEPTH m	GROUP SYMBOL	LEGEND	SOIL TYPE Colour, Plasticity/Grain Size, Minor Components	WATER / MOISTURE	CONSISTENCY COHESIVE VS S F ST VST H	CONSISTENCY NON COHESIVE VL L MD D VD	Comments / Penetration Rate
B 0.5m	581.89	0.10			TOP SOIL / FILL: TOPSOIL	D			TOP SOIL / FILL
D SPT N=29 6;12,17			CI		FILL: CLAY, brown with some pockets of dark brown, medium plasticity, trace fine grained sand				FILL
U50 0.25m	582.49	0.70	CL		CLAY: pale brown mottled with red-brown and dark brown, low plasticity, trace fine to medium, possibly dacite gravel		ST		RESIDUAL SOIL
SPT N=15 7;7,8					... 2.00m colour change to light grey mottled orange brown		F		
SPT N=19 2;7,12	585.29	3.50	CH		Sandy CLAY: pale grey mottled orange-brown, high plasticity, medium grained sand, trace fine to medium angular gravel, possibly of dacite gravel	SM	F		RESIDUAL SOIL
SPT N=16 3;7,9	586.79 ▽ 29/08/2017	5.00	SP		SAND: brown, medium grained sand, trace clay	W		MD	RESIDUAL SOIL
	587.39	5.60			End of borehole completed at 5.6m Termination: Target depth Groundwater: Encountered				

NOTES

See explanatory notes for details of abbreviations and basis of descriptions

JOB 254319

gINT v8.30.004 Licenced to Arup
Project : j:\254000\254319-00 canberra light rail\work\internal\design\geotech\geotech investigation\02 site work\03 gint\01 database\03 master database\20171115_254319_lrs2_master gint.gpj
Library : j:\254000\254319-00 canberra light rail\work\internal\design\geotech\geotech investigation\02 site work\03 gint\02 library\arup_aus_v0.1.10_working.glb
Script file: j:\254000\254319-00 canberra light rail\work\internal\design\geotech\geotech investigation\02 site work\03 gint\05 scripts\20171012_output\output_borehole_log.gsc
Log: 1.0.2 AUS GENERAL BOREHOLE LOG (RMS) (rev 17Nov17)
gINT output page 1 of 1. Made 17Nov17 14:38

Attachment D – Laboratory test reports

MOISTURE CONTENT TEST REPORT

Client:	Arup	**Job No:**	S17370
Address:	Level 10, 201 Kent Street, Sydney 2000 Australia	**Report No:**	S27404-MC
Project:	Canberra Light Rail Stage 2 (254319)		

Test Procedure:

☑ AS 1289 2.1.1 Soil moisture content tests - Determination of the moisture content of a soil - Oven drying method (Standard method).
☐ AS4133 1.1.1 Rock moisture content tests - Determination of the moisture content of rock - Oven drying method (standard method)
☐ RMS T120 Moisture content of road construction materials (Standard method)
☐ RMS T262 Determination of moisture content of aggregates (Standard method)

Sampling: Sampled by Client
Date Sampled: Unknown
Preparation: Prepared in accordance with the test method

Sample No.	Source	Sample Description	Moisture Content %
S27404	1-TP4 0.4-0.75m	Silty CLAY: trace of Gravel	**14.0**
S27407	1-TP05 0.7-1.2m	Silty CLAY	**20.2**
S27411	2-TP10 1.7-2.2m	Sandy Silty CLAY	**16.8**
S27413	2-TP9 0.5-1m	Sandy Silty CLAY: trace of Gravel	**12.5**
S27414	3-TP22 0.15-0.5m	Silty CLAY: trace of Sand	**16.4**
S27426	4-TP27 0.3-0.8m	Sandy CLAY: with Silt, trace of Gravel	**10.8**
S27427	4-TP37 0.1-0.6m	Gravelly SAND: trace of Clay	**9.5**
S27429	4-TP38 1.3-1.5m	Sandy CLAY: with Silt, trace of Gravel	**10.8**
S27430	4-TP39 0.9-1.1m	Silty CLAY: with Sand, trace of Gravel	**14.0**
S27432	4-TP42 0.9-1.4m	Sandy CLAY: with Silt, trace of Gravel	**19.3**
S27433	4-TP42 1.8-2.3m	Silty CLAY: with Sand, trace of Gravel	**19.0**
S27435	4-TP47 0.5-0.7m	Sandy Silty CLAY	**10.5**
S27436	4-TP47 1.3-1.5m	Silty CLAY: trace of Sand and Gravel	**20.5**
S27438	4-TP48 0.4-0.6m	CLAY: with Sand, Silt and Gravel	**14.9**
S27440	4-TP49 0.6-0.8m	SAND: with Silt and Clay	**14.6**
S27442	4-TP50 0.5-0.7m	Silty CLAY: with Sand	**11.0**
S27443	4-TP50 1.2-1.4m	Silty Clayey SAND	**13.9**
S27456	5-TP54 0.6-0.8m	SAND: with Silt and Clay	**12.9**
S27457	5-TP54 1.1-1.3m	Silty CLAY: trace of Sand	**21.2**
S27459	5-TP55 1-1.2m	CLAY: with Silt and Sand, Trace of Gravel	**17.5**

Notes:

NATA

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. Accredited for compliance with ISO/IEC 17025. This document shall not be reproduced, except in full.

NATA Accredited Laboratory Number: 14874

Authorised Signatory:
Schedule 2.2(a)(ii)
[redacted]

28/10/2017
Date:

MACQUARIE GEOTECH

Macquarie Geotechnical
U8 10 Bradford Street
Alexandria NSW 2015

SOIL CLASSIFICATION REPORT

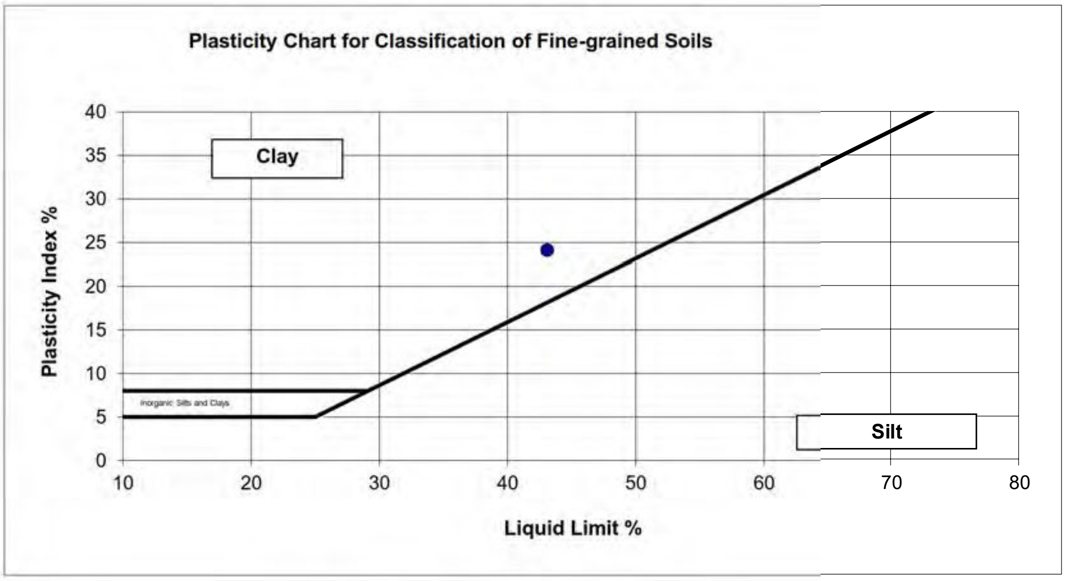
Client:	Arup	**Source:**	5-TP54 0.6-0.8m
Address:	Level 10, 201 Kent Street, Sydney 2000 Australia	**Sample Description:**	SAND: with Silt and Clay
Project:	Canberra Light Rail Stage 2 (254319)	**Report No:**	S27456-PI
Job No:	S17370	**Lab No:**	S27456

Test Procedure:

☐ AS1289 2.1.1 Soil moisture content tests (Oven drying method)
☑ AS1289 3.1.1 Soil classification tests - Determination of the liquid limit of a soil - Four point casagrande method
☐ AS1289 3.1.2 Soil classification tests - Determination of the liquid limit if a soil - One point Casagrande method (subsidiary method)
☑ AS1289 3.2.1 Soil classification tests - Determination of the plastic limit of a soil - Standard method
☑ AS1289 3.3.1 Soil classification tests - Calculation of the plasticity Index of a soil
☑ AS1289 3.4.1 Soil classification tests - Determination of the linear shrinkage of a soil - Standard method

Sampling:	Sampled by Client	**Date Sampled:**	Unknown
Preparation:	Prepared in accordance with the test method		

Liquid Limit (%): 43
Linear Shrinkage (%): 10.5
Plastic Limit (%): 19
Plastic Index: 24



Soil Preparation Method: Dry Sieved
Soil History: Oven Dried
Soil Condition: Curling Occuring

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. Accredited for compliance with ISO/IEC 17025. This document shall not be reproduced, except in full.

NATA Accredited Laboratory Number: 14874

Authorised Signatory:
Schedule 2.2(a)(ii)
[redacted]

19/10/2017
Date:

Macquarie Geotechnical
U8 10 Bradford Street
Alexandria NSW 2015

DRY DENSITY / OPTIMUM MOISTURE CONTENT REPORT

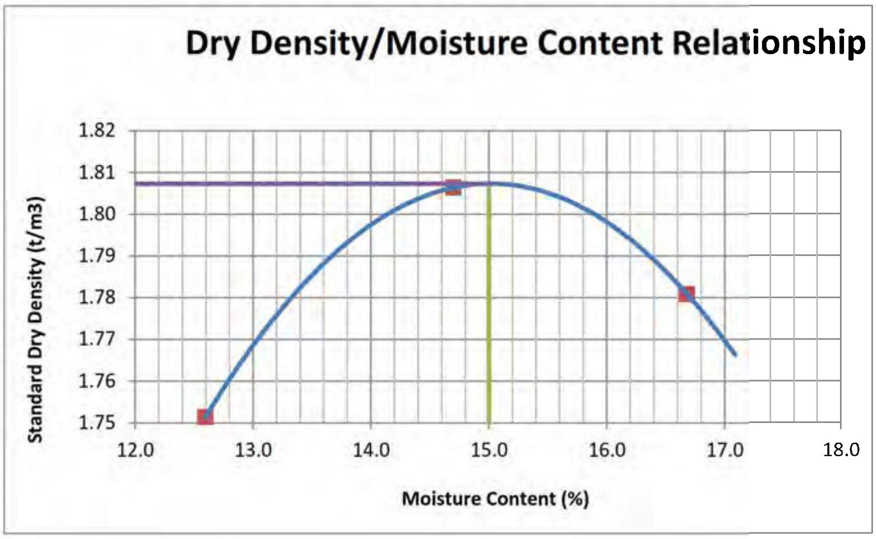
Client:	Arup	**Source:**	5-TP54 0.6-0.8m
Address:	Level 10, 201 Kent Street, Sydney 2000 Australia	**Sample Description:**	SAND: with Silt and Clay
Project:	Canberra Light Rail Stage 2 (254319)	**Report No:**	S27456-MDD
Job No:	S17370	**Lab No:**	S27456

Test Procedure: ☑ AS1289.5.1.1 Determination of the dry density/moisture content relation of a soil using standard compactive effort

☑ AS1289.2.1.1 Determination of the moisture content of a soil - Oven drying method (Standard method)

Sampling: Sampled by Client **Date Sampled:** Unknown

Preparation: Prepared in accordance with the test method



Maximum Dry Density (t/m^3)	1.807
Optimum Moisture Content (%)	15.0
Percentage Oversize on 19mm sieve (%)	0
Percentage Oversize on 37.5mm sieve (%)	0

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. Accredited for compliance with ISO/IEC 17025. This document shall not be reproduced, except in full.

NATA Accredited Laboratory Number: 14874

Authorised Signatory:

Schedule 2.2(a)(ii)

[redacted]

19/10/2017

Date:

Macquarie Geotechnical
U8 10 Bradford Street
Alexandria NSW 2015

CALIFORNIA BEARING RATIO REPORT

Client:	Arup	**Source:**	5-TP54 0.6-0.8m
Address:	Level 10, 201 Kent Street, Sydney 2000 Australia	**Sample Description:**	SAND: with Silt and Clay
Project:	Canberra Light Rail Stage 2 (254319)	**Report No.:**	S27456-CBR
Job No.:	S17370	**Lab No.:**	S27456

Test Procedure:

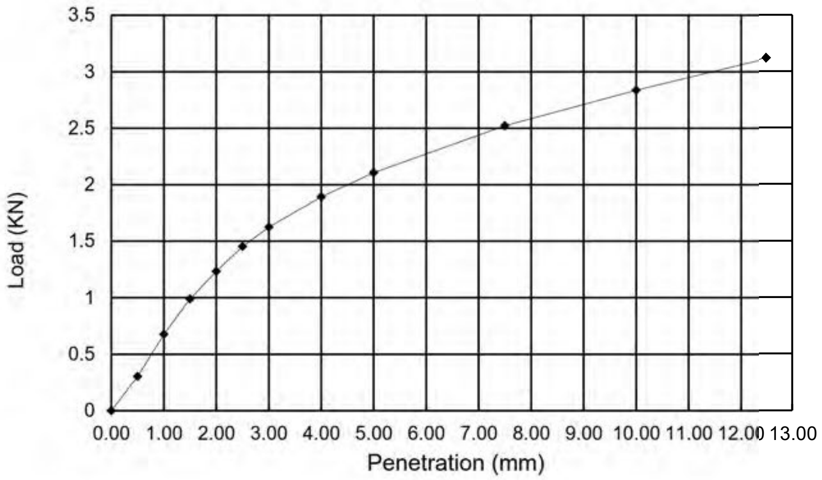
☑ AS1289 6.1.1 Soil strength and consolidation tests - Determination of the California Bearing Ratio of a soil - Standarc laboratory method for a remoulded specimen

☑ AS1289 5.1.1 Soil compaction and density tests - Determination of the dry density/moisture content relationship of a soil using standard compactive effort

☑ AS1289 2.1.1 Soil moisture content tests - Determination of the moisture content of a soil - Oven drying method (standard method

Sampling: Sampled by Client **Date Sampled:** Unknown

Preparation: Prepared in accordance with the test method



Compaction and Placement Data

Compaction Used	Standard	Dry Density			
Maximum Dry Density t/m^3	1.81	At Compaction	1.81 t/m^3	100.0 % Comp.	
Optimum Moisture Content %	15.0	After Soaking	1.80 t/m^3	100.0 % Comp.	
No. of Layers	3	Moisture Content			Moisture Ratio (%)
Blows per Layer	53	At Compaction	%	15.1	100
Drop of Rammer mm	300	After Soaking	%	17.9	119
Mass of Rammer kg	2.7	After Penetration (Top 30mm)	%	18.8	126
Surcharge Used kg	4.5	After Penetration (Entire Depth)	%	16.5	110
% Ret. 19mm Sieve	0	Swell After 10 Days Soaking	%	0.7	

Note: material coarser than +19mm Sieve was discarded (as per test method)

California Bearing Ratio

CBR (10-day Soaked) = 11.0 % at 2.5 mm Penetration

Notes:

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. Accredited for compliance with ISO/IEC 17025. This document shall not be reproduced, except in full.

NATA Accredited Laboratory Number: 14874

Authorised Signatory:

Schedule 2.2(a)(ii)

[redacted]

19/10/2017

Date:

Macquarie Geotechnical
U8 10 Bradford Street
Alexandria NSW 2015

SOIL CLASSIFICATION REPORT

Client:	Arup	**Source:**	5-TP54 1.1-1.3m
Address:	Level 10, 201 Kent Street, Sydney 2000 Australia	**Sample Description:**	Silty CLAY: trace of Sand
Project:	Canberra Light Rail Stage 2 (254319)	**Report No:**	S27457-PI
Job No:	S17370	**Lab No:**	S27457

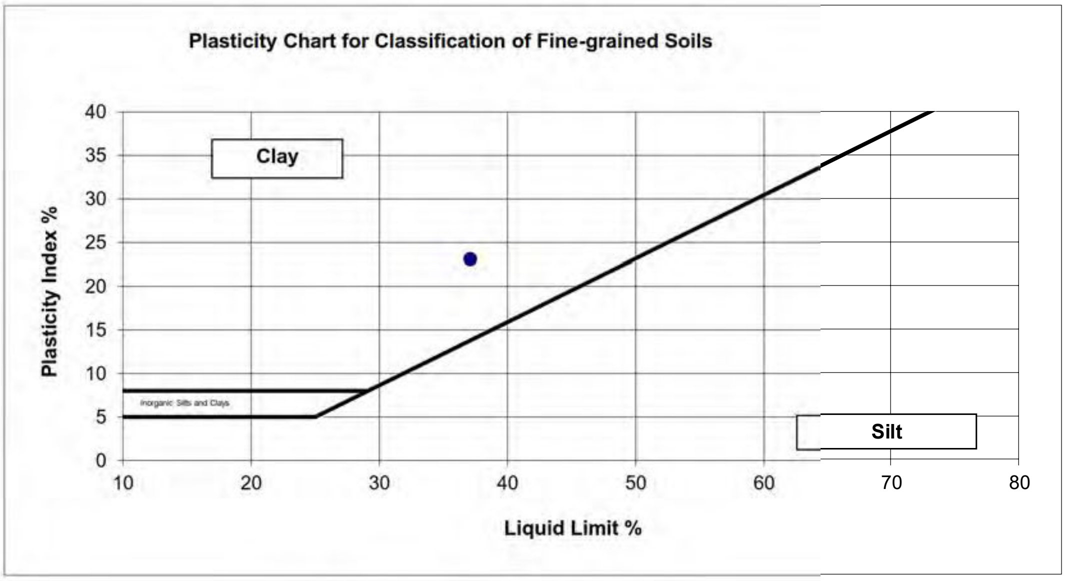
Test Procedure:

☐ AS1289 2.1.1 Soil moisture content tests (Oven drying method)
☑ AS1289 3.1.1 Soil classification tests - Determination of the liquid limit of a soil - Four point casagrande method
☐ AS1289 3.1.2 Soil classification tests - Determination of the liquid limit if a soil - One point Casagrande method (subsidiary method)
☑ AS1289 3.2.1 Soil classification tests - Determination of the plastic limit of a soil - Standard method
☑ AS1289 3.3.1 Soil classification tests - Calculation of the plasticity Index of a soil
☑ AS1289 3.4.1 Soil classification tests - Determination of the linear shrinkage of a soil - Standard method

Sampling: Sampled by Client | **Date Sampled:** Unknown

Preparation: Prepared in accordance with the test method

Liquid Limit (%): 37
Linear Shrinkage (%): 11.5
Plastic Limit (%): 14
Plastic Index: 23



Soil Preparation Method: Dry Sieved
Soil History: Oven Dried
Soil Condition: Linear

NATA Accredited Laboratory Number: 14874

Authorised Signatory:

Schedule 2.2(a)(ii)

[redacted]

19/10/2017

Date:

Macquarie Geotechnical
U8 10 Bradford Street
Alexandria NSW 2015

DRY DENSITY / OPTIMUM MOISTURE CONTENT REPORT

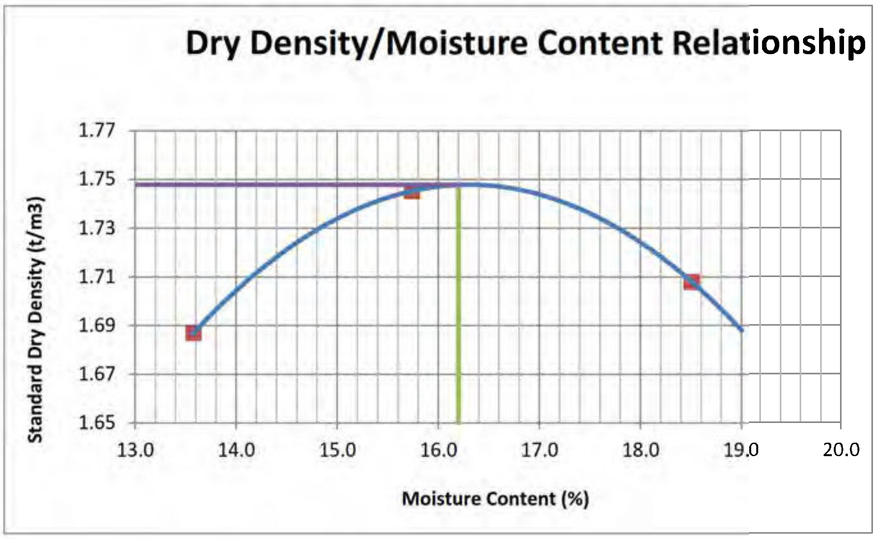
Client:	Arup	**Source:**	5-TP54 1.1-1.3m
Address:	Level 10, 201 Kent Street, Sydney 2000 Australia	**Sample Description:**	Silty CLAY: trace of Sand
Project:	Canberra Light Rail Stage 2 (254319)	**Report No:**	S27457-MDD
Job No:	S17370	**Lab No:**	S27457

Test Procedure: ☑ AS1289.5.1.1 Determination of the dry density/moisture content relation of a soil using standard compactive effort

☑ AS1289.2.1.1 Determination of the moisture content of a soil - Oven drying method (Standard method)

Sampling: Sampled by Client **Date Sampled:** Unknown

Preparation: Prepared in accordance with the test method



Maximum Dry Density (t/m^3)	1.748
Optimum Moisture Content (%)	16.2
Percentage Oversize on 19mm sieve (%)	0
Percentage Oversize on 37.5mm sieve (%)	0

NATA

NATA Accredited Laboratory Number: 14874

Authorised Signatory:

Schedule 2.2(a)(ii)

[redacted]

19/10/2017

Date:

MACQUARIE GEOTECH

Macquarie Geotechnical
U8 10 Bradford Street
Alexandria NSW 2015

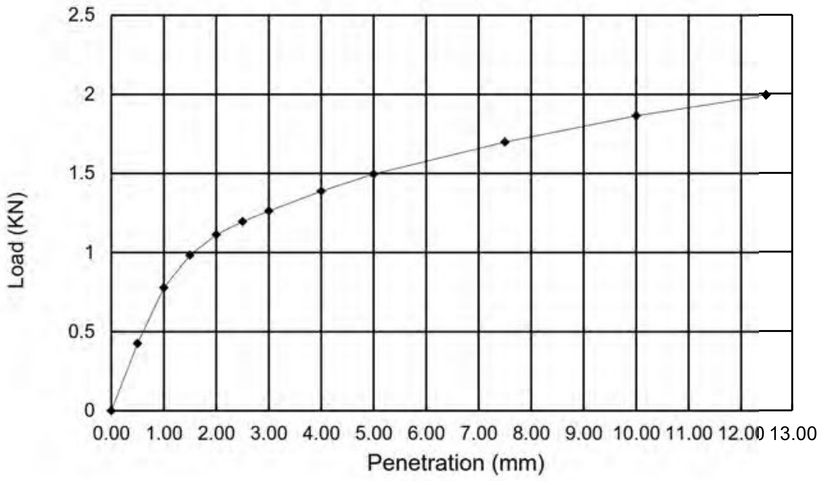
CALIFORNIA BEARING RATIO REPORT

Client:	Arup	**Source:**	5-TP54 1.1-1.3m
Address:	Level 10, 201 Kent Street, Sydney 2000 Australia	**Sample Description:**	Silty CLAY: trace of Sand
Project:	Canberra Light Rail Stage 2 (254319)	**Report No.:**	S27457-CBR
Job No.:	S17370	**Lab No.:**	S27457

Test Procedure:
☑ AS1289 6.1.1 Soil strength and consolidation tests - Determination of the California Bearing Ratio of a soil - Standarc laboratory method for a remoulded specimen
☑ AS1289 5.1.1 Soil compaction and density tests - Determination of the dry density/moisture content relationship of a soil using standard compactive effort
☑ AS1289 2.1.1 Soil moisture content tests - Determination of the moisture content of a soil - Oven drying method (standard method

Sampling:	Sampled by Client	**Date Sampled:**	Unknown

Preparation: Prepared in accordance with the test method



Compaction and Placement Data

Compaction Used	Standard	Dry Density				
Maximum Dry Density t/m^3	1.75	At Compaction	1.75 t/m^3	100.0 % Comp.		
Optimum Moisture Content %	16.2	After Soaking	1.72 t/m^3	98.0 % Comp.		
No. of Layers	3	Moisture Content				Moisture Ratio (%)
Blows per Layer	53	At Compaction		%	16.3	100
Drop of Rammer mm	300	After Soaking		%	19.5	120
Mass of Rammer kg	2.7	After Penetration (Top 30mm)		%	21.5	133
Surcharge Used kg	4.5	After Penetration (Entire Depth)		%	18.1	111
% Ret. 19mm Sieve	0	Swell After 10 Days Soaking		%	1.2	

Note: material coarser than +19mm Sieve was discarded (as per test method)

California Bearing Ratio

CBR (10-day Soaked) = 9.0 % at 2.5 mm Penetration

Notes:

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. Accredited for compliance with ISO/IEC 17025. This document shall not be reproduced, except in full.

NATA Accredited Laboratory Number: 14874

Authorised Signatory:

Schedule 2.2(a)(ii)
[redacted]

19/10/2017

Date:

Macquarie Geotechnical
U8 10 Bradford Street
Alexandria NSW 2015

SOIL CLASSIFICATION REPORT

Client:	Arup	**Source:**	5-TP55 1-1.2m
Address:	Level 10, 201 Kent Street, Sydney 2000 Australia	**Sample Description:**	CLAY: wth Silt and Sand, Trace of Gravel
Project:	Canberra Light Rail Stage 2 (254319)	**Report No:**	S27459-PI
Job No:	S17370	**Lab No:**	S27459

Test Procedure:

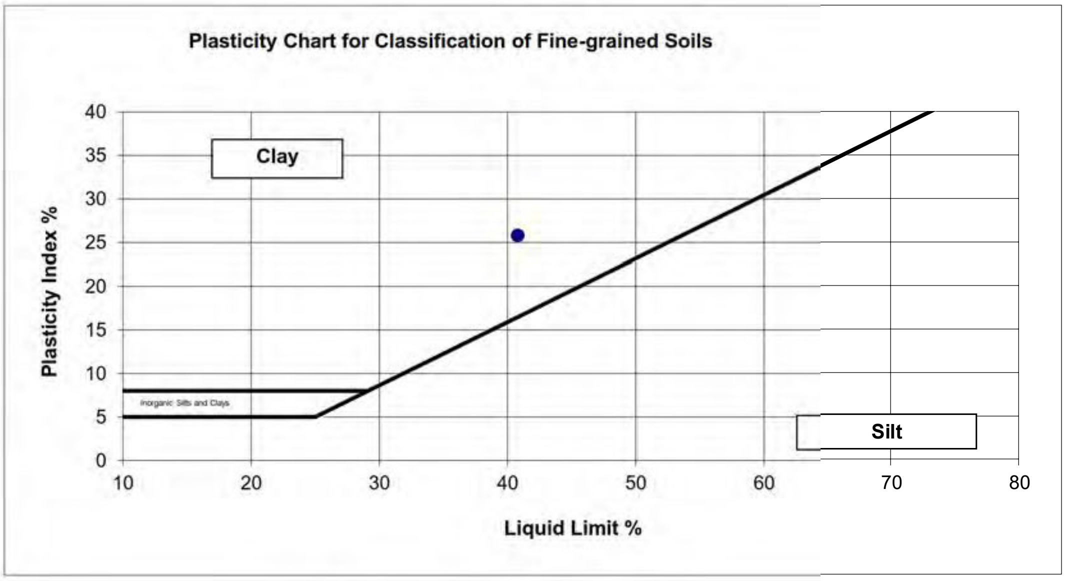
☐ AS1289 2.1.1 Soil moisture content tests (Oven drying method)
☑ AS1289 3.1.1 Soil classification tests - Determination of the liquid limit of a soil - Four point casagrande method
☐ AS1289 3.1.2 Soil classification tests - Determination of the liquid limit if a soil - One point Casagrande method (subsidiary method)
☑ AS1289 3.2.1 Soil classification tests - Determination of the plastic limit of a soil - Standard method
☑ AS1289 3.3.1 Soil classification tests - Calculation of the plasticity Index of a soil
☑ AS1289 3.4.1 Soil classification tests - Determination of the linear shrinkage of a soil - Standard method

Sampling: Sampled by Client **Date Sampled:** Unknown

Preparation: Prepared in accordance with the test method

Liquid Limit (%): 41 **Linear Shrinkage (%):** 11.5

Plastic Limit (%): 15 **Plastic Index:** 26



Soil Preparation Method: Dry Sieved
Soil History: Air Dried
Soil Condition: NA

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. Accredited for compliance with ISO/IEC 17025. This document shall not be reproduced, except in full.

NATA Accredited Laboratory Number: 14874

Authorised Signatory:

Schedule 2.2(a)(ii)

[redacted]

28/10/2017

Date:

Macquarie Geotechnical
U8 10 Bradford Street
Alexandria NSW 2015

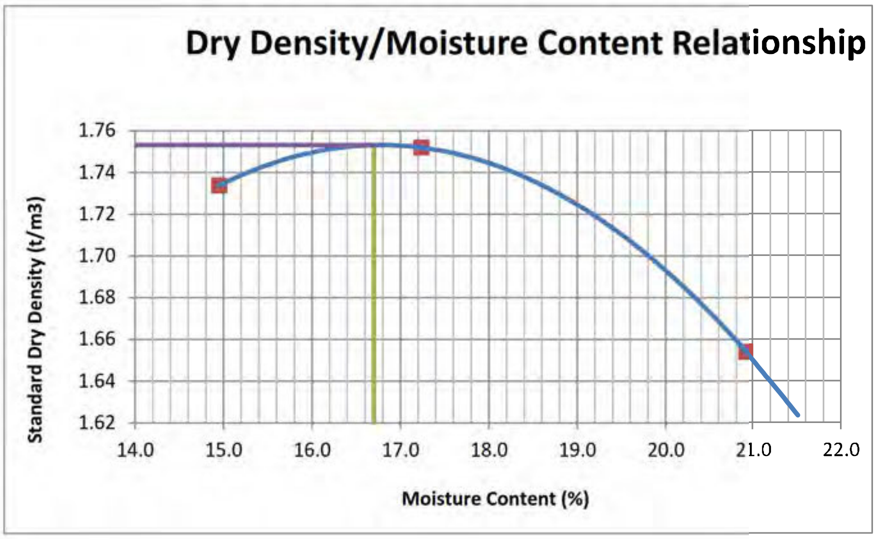
DRY DENSITY / OPTIMUM MOISTURE CONTENT REPORT

Client:	Arup	**Source:**	5-TP55 1-1.2m
Address:	Level 10, 201 Kent Street, Sydney 2000 Australia	**Sample Description:**	CLAY: with Silt and Sand, Trace of Gravel
Project:	Canberra Light Rail Stage 2 (254319)	**Report No:**	S27459-MDD
Job No:	S17370	**Lab No:**	S27459

Test Procedure: ☑ AS1289.5.1.1 Determination of the dry density/moisture content relation of a soil using standard compactive effort

☑ AS1289.2.1.1 Determination of the moisture content of a soil - Oven drying method (Standard method)

Sampling:	Sampled by Client	**Date Sampled:**	Unknown
Preparation:	Prepared in accordance with the test method		



Maximum Dry Density (t/m^3)	1.753
Optimum Moisture Content (%)	16.7
Percentage Oversize on 19mm sieve (%)	1
Percentage Oversize on 37.5mm sieve (%)	0

NATA

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. Accredited for compliance with ISO/IEC 17025. This document shall not be reproduced, except in full.

NATA Accredited Laboratory Number: 14874

Authorised Signatory:

Schedule 2.2(a)(ii)

[redacted]

28/10/2017

Date:

MACQUARIE GEOTECH

Macquarie Geotechnical
U8 10 Bradford Street
Alexandria NSW 2015

CALIFORNIA BEARING RATIO REPORT

Client:	Arup	**Source:**	5-TP55 1-1.2m
Address:	Level 10, 201 Kent Street, Sydney 2000 Australia	**Sample Description:**	CLAY: with Silt and Sand, trace of Gravel
Project:	Canberra Light Rail Stage 2 (254319)	**Report No.:**	S27459-CBR
Job No.:	S17370	**Lab No.:**	S27459

Test Procedure:

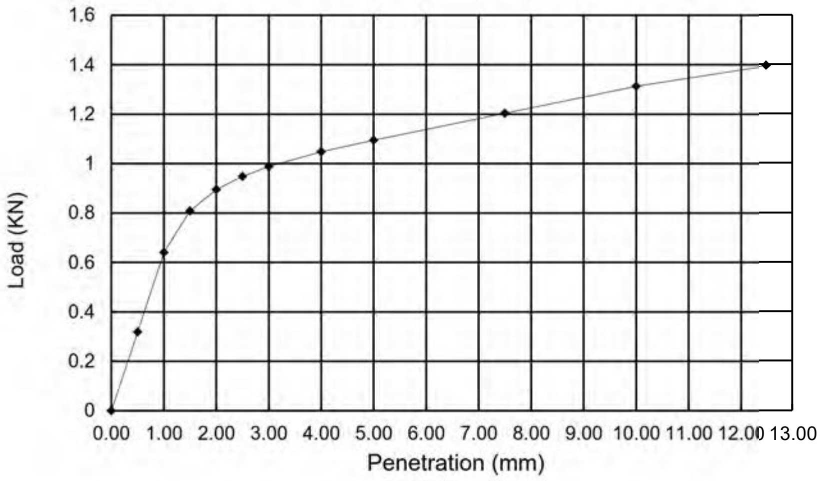
☑ AS1289 6.1.1 Soil strength and consolidation tests - Determination of the California Bearing Ratio of a soil - Standarc laboratory method for a remoulded specimen

☑ AS1289 5.1.1 Soil compaction and density tests - Determination of the dry density/moisture content relationship of a soil using standard compactive effort

☑ AS1289 2.1.1 Soil moisture content tests - Determination of the moisture content of a soil - Oven drying method (standard method

Sampling: Sampled by Client **Date Sampled:** Unknown

Preparation: Prepared in accordance with the test method



Compaction and Placement Data

Compaction Used	Standard	Dry Density				
Maximum Dry Density t/m³	1.75	At Compaction	1.75 t/m³	100.0 % Comp.		
Optimum Moisture Content %	16.7	After Soaking	1.73 t/m³	99.0 % Comp.		
No. of Layers	3	Moisture Content				Moisture Ratio (%)
Blows per Layer	53	At Compaction		%	16.9	101
Drop of Rammer mm	300	After Soaking		%	18.8	112
Mass of Rammer kg	2.7	After Penetration (Top 30mm)		%	21.5	129
Surcharge Used kg	4.5	After Penetration (Entire Depth)		%	18.7	112
% Ret. 19mm Sieve	1	Swell After 10 Days Soaking		%	0.8	

Note: material coarser than +19mm Sieve was discarded (as per test method)

California Bearing Ratio

CBR (10-day Soaked) = 7.0 % at 2.5 mm Penetration

Notes:

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. Accredited for compliance with ISO/IEC 17025. This document shall not be reproduced, except in full.

NATA Accredited Laboratory Number: 14874

Authorised Signatory:

Schedule 2.2(a)(ii)
[redacted]

28/10/2017

Date:

Macquarie Geotechnical
U8 10 Bradford Street
Alexandria NSW 2015

SOIL CLASSIFICATION REPORT

Client:	Arup	**Source:**	5-BH56 1-1.25m
Address:	Level 10, 201 Kent Street, Sydney 2000 Australia	**Sample Description:**	Gravelly Sandy CLAY
Project:	Canberra Light Rail Stage 2 (254319)	**Report No:**	S27453-PI
Job No:	S17370	**Lab No:**	S27453

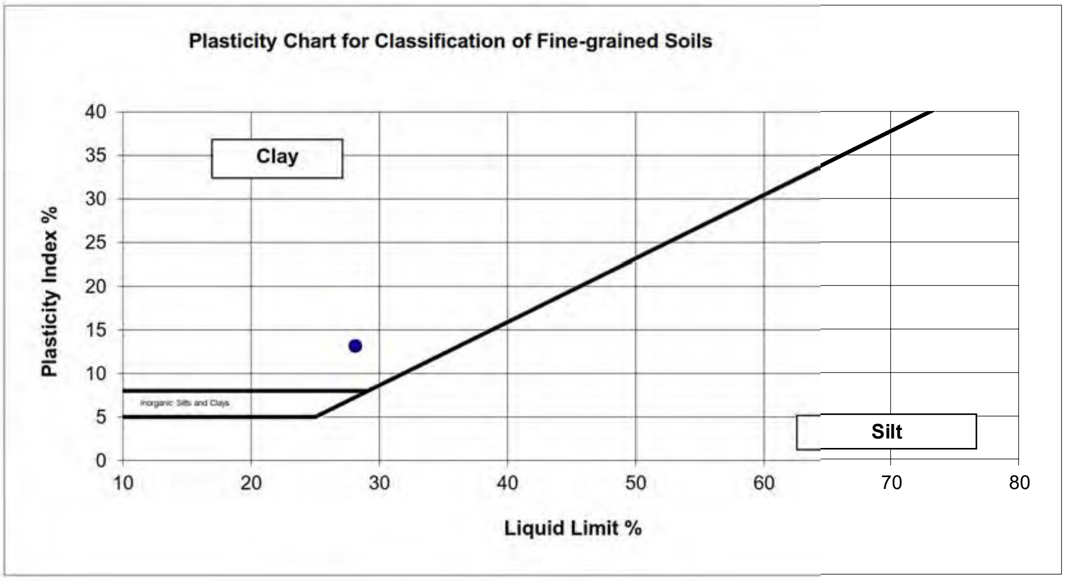
Test Procedure:

☐ AS1289 2.1.1 Soil moisture content tests (Oven drying method)
☐ AS1289 3.1.1 Soil classification tests - Determination of the liquid limit of a soil - Four point casagrande method
☑ AS1289 3.1.2 Soil classification tests - Determination of the liquid limit if a soil - One point Casagrande method (subsidiary method)
☑ AS1289 3.2.1 Soil classification tests - Determination of the plastic limit of a soil - Standard method
☑ AS1289 3.3.1 Soil classification tests - Calculation of the plasticity Index of a soil
☑ AS1289 3.4.1 Soil classification tests - Determination of the linear shrinkage of a soil - Standard method

Sampling: Sampled by Client **Date Sampled:** Unknown

Preparation: Prepared in accordance with the test method

Liquid Limit (%):	28	**Linear Shrinkage (%):**	7.0
Plastic Limit (%):	15	**Plastic Index:**	13



Soil Preparation Method: Dry Sieved
Soil History: Air Dried
Soil Condition: Linear

NATA Accredited Laboratory Number: 14874

Authorised Signatory:
Schedule 2.2(a)(ii)
[redacted]

3/10/2017
Date:

Macquarie Geotechnical
U8 10 Bradford Street
Alexandria NSW 2015

Appendix D. Traffic Modelling Report

Woden Bus Interchange and Road Layout Modifications

Transport Canberra

Transport Modelling Report

IS2688100.01 | 2

5 July 2019

Transport Modelling Report

Woden Bus Interchange and Road Layout Modifications

Project No: IS268800
Document Title: Transport Modelling Report
Document No.: IS2688100.01
Revision: 2
Date: 5 July 2019
Client Name: Transport Canberra
Project Manager: [redacted]
Author: [redacted]
File Name: Woden-Transport Modelling Report-04July19.docx

Jacobs Australia Pty Limited

1/64 Allara Street,
Canberra City ACT 2600
PO Box 237, Civic Square ACT 2608
Australia
T +61 2 6246 2700
F +61 2 6246 2799
www.jacobs.com

Document history and status

Revision	Date	Description	By	Review	Approved
01	13.05.2019	Draft	[redacted]	[redacted]	[redacted]
02	05.07.2019	Updated draft	[redacted]	[redacted]	[redacted]

Contents

1. Introduction

1.1 Background

Jacobs Group (Australia) Pty Ltd (Jacobs) has been engaged by Transport Canberra to progress an options study and assessment, feasibility investigations and concept design (Preliminary Sketch Plan) for a new on-street bus interchange in Woden Town Centre.

Woden Town Centre is a major community and commercial hub which serves the Woden Valley and wider Canberra region. Identified as a priority area for redevelopment, this project will contribute to the renewal of this key urban centre through the design of an integrated on-street transport hub which enables the efficient operation of multiple bus services alongside the proposed delivery of Light Rail Stage 2.

The initial phase of this project identified a number of proposed bus interchange options which, following a multi-criteria analysis and feasibility study, have been reduced to one preferred project option. The preferred option consists of a bus / light rail interchange situated on Callam Street, between Matilda Street and New Bradley Street.

1.2 Purpose of this report

This report documents the development of and results obtained from the microsimulation modelling completed to understand the transport network impacts of the preferred interchange design option. The report is intended to provide sufficient detail such that Transport Canberra can be confident that the modelling outputs (for base and future scenarios) are sufficiently robust for input into further studies or business case development.

The report is structured as follows:

- **Chapter 2** provides an overview of the modelling approach and sets out the general modelling specifications
- **Chapter 3** documents the traffic data received and used to develop and calibrate the base model
- **Chapter 4** sets out the results of the base model calibration and validation process
- **Chapter 5** discusses the development of Future Year Refence Case (2026 / 2036)
- **Chapter 6** discusses the project option testing undertaken and performance
- **Chapter 7** concludes the report by summarising transport network impact

2. Modelling specification

2.1 General approach

The microsimulation models have been developed using PTV Vissim (version 10.00-15), a micro-simulation software package developed by PTV Planung Transport Verkehr AG (PTV Group). The software is efficient in modelling the individual interactions between different vehicles such as motor vehicles, buses, light rail and pedestrians. It is also helpful in assessing the performance of the road network by estimating the delays and queues occurring at intersections.

The overall traffic modelling approach is outlined below and shown in Figure 2.1. The key components are:

- Network development – Base year network was developed based on aerial imagery, signal data, public transport information and previously available models
- Demand development – Demand was estimated by utilising the 2017 Aimsun mesoscopic model to extract the sub area matrices for the identified study area and adjusting the demand for reflecting the current travel pattern
- Model calibration – The process of iteratively adjusting model parameters and inputs (including matrix adjustments) until the model represents the existing conditions of traffic levels, travel speeds, delays in morning and evening peak periods
- Model validation – Comparing the model outcomes with an independent data source to check that the model can appropriately forecast traffic conditions – in this case travel time data

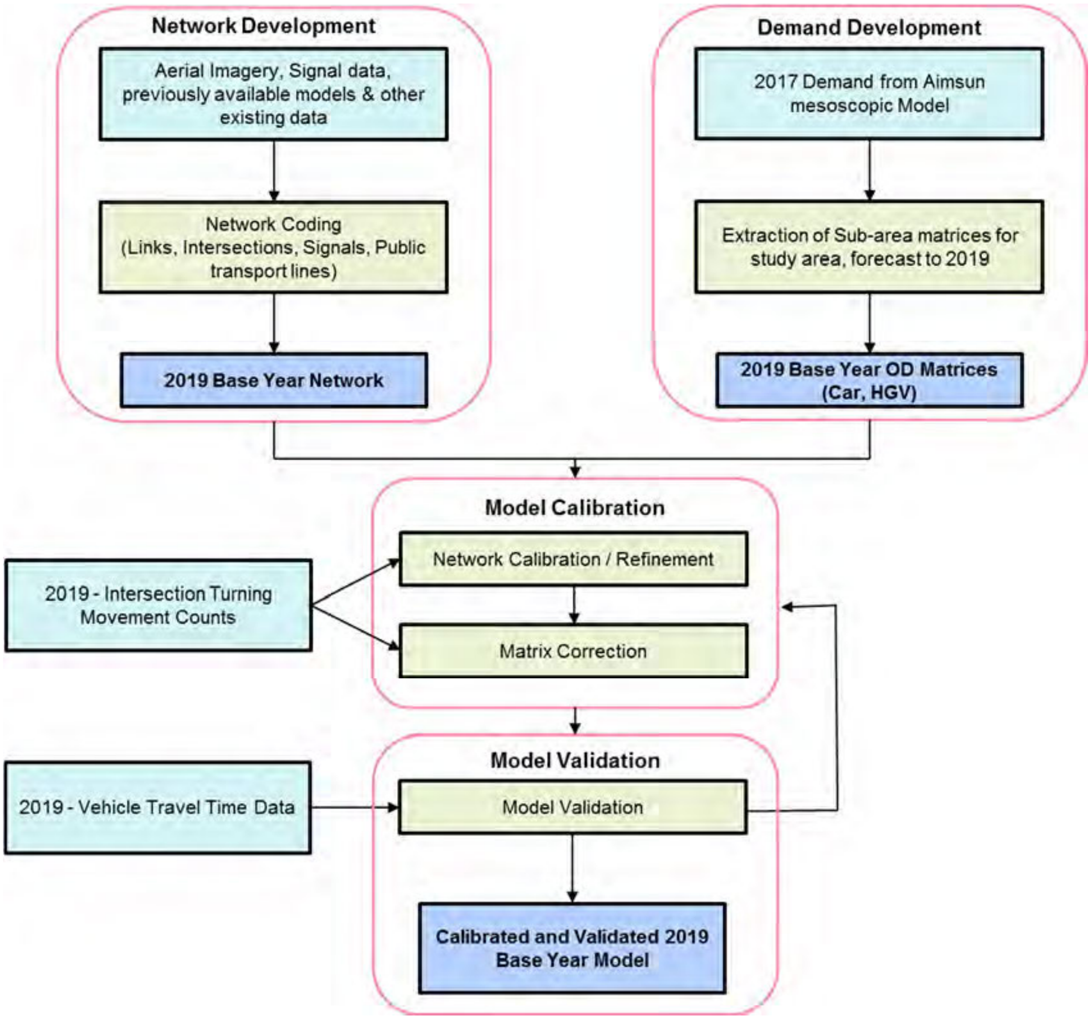


Figure 2.1: Base Year Traffic Modelling Approach

2.2 Study area

Study area is finalised based on the location of bus interchange, the key access roads providing access/dispersal of traffic at the interchange. The study area with the major access roads and intersections surrounding the Woden bus interchange area as shown in Figure 2.2. The extents of the study area are Yamba Drive/Melrose Drive/Yarra Glen Roundabout in the North, Yamba Drive in the East, Melrose Drive in the West and Hindmarsh Drive in the South.

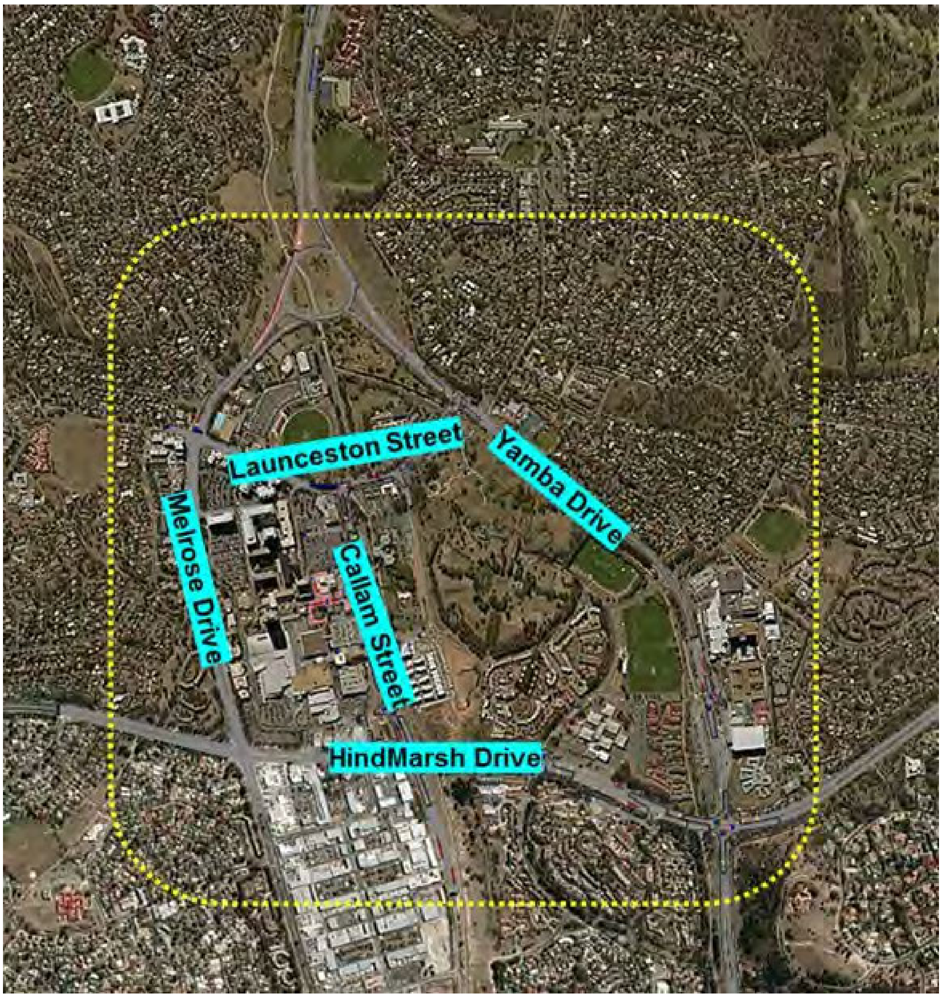


Figure 2.2: Extents of Study Area

The major roads in the study area are Melrose Drive, Launceston Street, Yamba Drive, Hindmarsh Drive and Callam Street. All of the important internal roads connecting these major roads were also considered as part of the study road network and added to the model. 18 signalised intersections in total are included in the model. This was an increase of 8 intersections from the previous model provided, and therefore required additional SCATS data to inform model development. 11 critical intersections were identified as being important to analyse and report on in the context of this study. These intersections include all major junctions along Callam Street in addition to the key intersection crossings of Launceston Street, Melrose Drive, Hindmarsh Drive and Yamba Drive.

2.3 Time periods and forecast years

The base year traffic models were developed for existing condition to represent a typical weekday for the following time periods, considered based on the peak periods modelled in Aimsun mesoscopic model.

- · AM peak model: 8:00 to 9:00 hours
- · PM peak model: 17:00 to 18:00 hours

Additionally, a half hour warmup period was included for both the AM (07:30 to 08:00) and PM (16:30 to 17:00) peak models to ensure that traffic builds up on the network prior to the peak hour, therefore reflecting appropriate travel times during the core modelled 1 hr period.

2.4 Other modelling parameters

Other features of the base Vissim model developed are as follows:

- Traffic demand was modelled at 15-minute intervals throughout each peak period using origin-destination (OD) matrices and the dynamic assignment module of the software
- All bus operations (including bus stops) in peak periods have been included using static routing and published timetable information
- Light vehicles and heavy vehicles have been defined separately
- Vissim's Vehicle Actuated Programming (VAP) module has been used to best replicate demand-actuated signal operations
- Reduced speed areas on all turns at intersections have been coded
- All reported results are from the average of 5 simulation runs
- A random seed of 42 was used with an increment of 50

3. Data inputs

3.1 Overall Model development (Base year 2019)

3.1.1 Network Development

The road network was developed based on the previous Vissim model (2017), and aerial imagery. To assess the impacts of the proposed future bus interchange in the Woden Town Centre, a number of internal roads and major road links such as Melrose Drive which were missing from the earlier model have now been coded as per their existing configurations. The modelled network extends from Yamba Drive/Melrose Drive roundabout in the north including Melrose Drive in the west, Yamba Drive in the east and Hindmarsh Drive in the south. The coded network in Vissim is shown in Figure 3.1 below.

Figure 3.1: Woden Area Network

3.1.1.1 Intersection Coding

All the major intersections that are required for the validation process have been coded in the model. The network consists of different types of intersections such as signalised, priority controlled /yield on both major and minor roads. Each intersection was coded in detail considering the exact lane configurations, short lanes, bus lanes, pedestrian crossings, detectors etc. The vehicle speeds were reduced for the turning movements and desired speed decisions were applied on the approach links based on the posted speed limits.

The priority-controlled intersections are generally T-intersections, roundabout and the internal road junctions. These were modelled with a combination of priority rules and conflict areas. In the study area 18 signalised intersections are included, and they were all considered for the calibration and validation process, requiring SCATS data to be provided for model input. The list of the intersections along with SCATS identification number are given in Table 3.1 below.

Table 3.1: Major Signalised Intersections in Study area

S.No.	Intersection	SCATS ID
1	Launceston Street / Melrose Drive	25
2	Callam Street / Launceston Street	75
3	Yamba Drive / Launceston Street / Wisdom Street	152
4	Bowes Street / Callam Street	155
5	Bradley Street / Callam Street	60
6	Neptune Street / Callam Street / Wilbow Street	116
7	Corinna Street / Callam Street	168
8	Melrose Drive / Worgan Street	295
9	Melrose Drive / Corinna Street	296
10	Melrose Drive / Brewer Street	167
11	Melrose Drive / Hindmarsh Drive	16
12	Hindmarsh Drive / Ball Street	166
13	Hindmarsh Drive / Botany Street	34
14	Hindmarsh Drive / Callam Street	93
15	Hindmarsh Drive / Ainsworth Street	17
16	Hindmarsh Drive / Yamba Drive	37
17	Yamba Drive / Bateson Rd	150
18	Yamba Drive / Kitchener Street	42

3.1.1.2 Signal Coding

The signalised junctions have been coded based on the latest existing signal operation data (dated February 2019) extracted from SCATS signal phasing history. It comprises of phase times (min, max, average), frequencies, pedestrian phase times and cycle lengths for 15 min intervals for a typical day in February.

The signalised intersections were coded as vehicle actuated i.e. operating based on actual demand. The modelling of signals was done using VisVAP (Vissim Vehicle Actuated Programming) module to replicate a closer representation of a realistic network operation scenario. All the signals were updated based on the latest signal data extracted from SCATS in terms of phase times for vehicles and also for pedestrians.

3.1.2 Demand Development

3.1.2.1 Zoning

The Aimsun mesoscopic model developed in 2017 was taken as the basis for updating of the zone system in the study area. A sub area network of Woden was extracted for both the AM and PM peak periods in AIMSUN. A total of 62 zones were identified as part of the extracted sub-area network in AIMSUN. The sub-area network is shown in Figure 3.2. Based on the network connectivity and location, the sub-area zones extracted from AIMSUN were regrouped and a new numbering system was adopted for finalising the zones of the Vissim model. A total of 43 zones were identified in the study area network of which 10 zones are external while the remaining are internal. The final zones adopted in Vissim model are shown in Figure 3.3 and Table 4.2 below. Note – some zones were aggregated from the Aimsun model where practical (and sensible) to do so for the purposes of the Vissim model development.

Figure 3.2: Sub-area network extracted in AIMSUN

Table 3.2: List of Zones in the Vissim Model

No.	Name	Type
101	Philip Oval	Internal
102	Canberra College North SB	Internal
103	Easty Street	Internal
104	Callam Offices	Internal
105	Woden Cemetery	Internal
106	Guardian Pl	Internal
107	Port Jackson Circuit North	Internal
108	Chaseling St	Internal
109	Port Jackson Circuit South	Internal
110	Albermale Pl	Internal
111	Hospital Car Park	Internal
112	Corrina St Car Park	Internal
113	Westfield Woden East	Internal
114	Westfield Woden South	Internal
115	Westfield Woden West	Internal
116	Furzer St	Internal
117	Bradley St West	Internal
118	Furzer St Car Park	Internal
119	Atlantic St	Internal
120	Matilda St	Internal
121	Woden Tradesmen club	Internal
122	Worgan St	Internal
123	Yarra Glen	External
124	Wisdom St	External
125	Kitchener St	External
126	Canberra Hospital	Internal
127	Hindmarsh Dr East	External
128	Yamba Dr South	External
129	Butters Dr South	Internal
130	Ainsworth St South	Internal
131	Athllon Dr South	External
132	Botany St	Internal
133	Melrose Dr South	External
134	Hindmarsh Dr West	External
135	Woden Gardens /Melrose Dr	Internal
136	Corinna St/ Melrose Dr	Internal
137	Launceston St	External
138	Theodore St	External
139	Spoering St, Philip Oval	Internal
140	Eddison Skate Park	Internal
141	Bowes St	Internal
142	Callam St Car Park	Internal
143	ACT Police	Internal

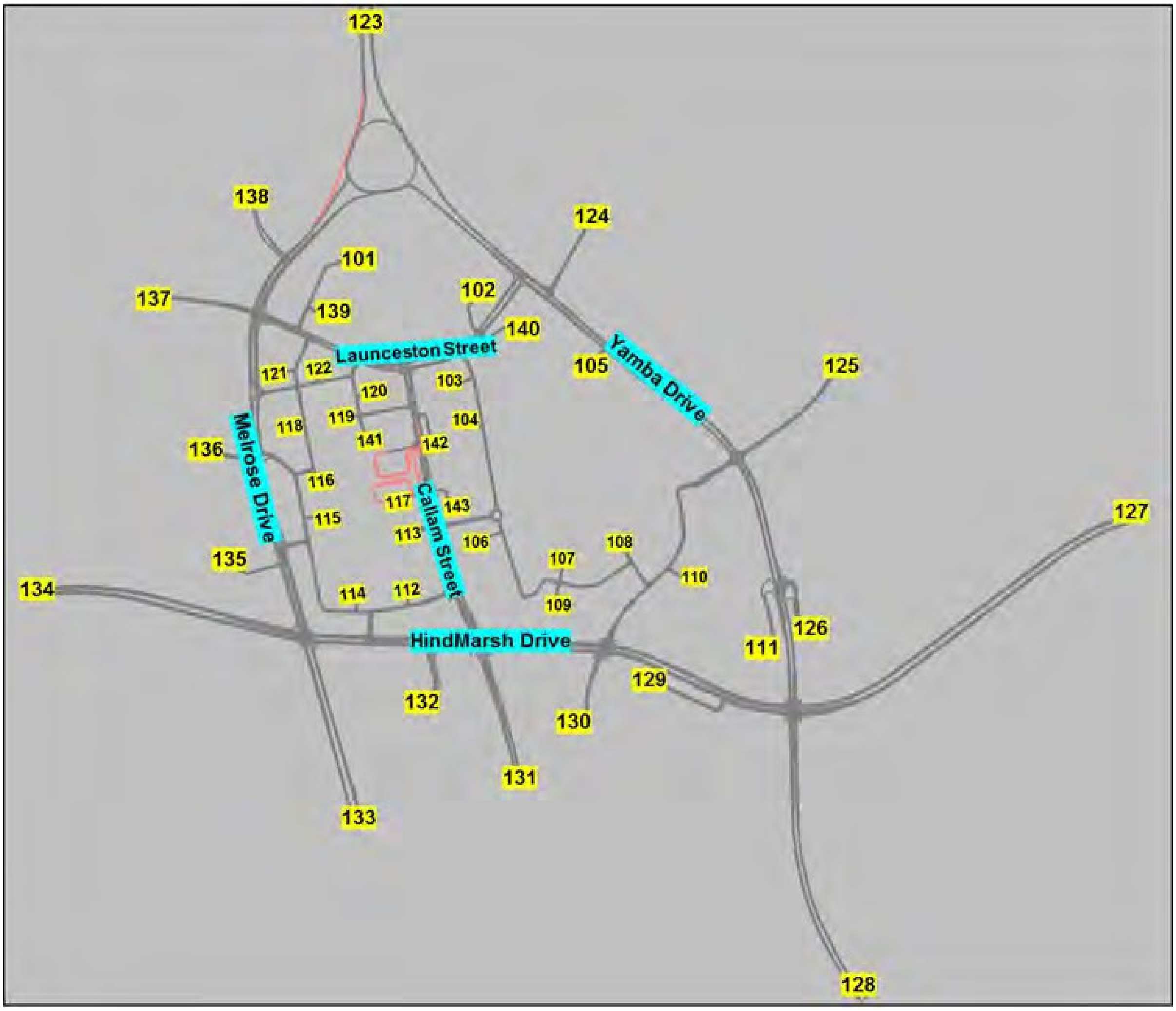


Figure 3.3: Final Zones Adopted in VISSIM Model

The sub-area network extracted in AIMSUN was used for estimating the base year demand. Using the static traversal tool in AIMSUN, 2017 demand matrices for Car and HGV were obtained for the sub-area. These matrices served as the initial seed for running the Vissim model and later during the calibration process further matrix adjustments were undertaken to represent observed travel pattern and assist in model validation.

3.1.2.2 Matrix Development

Demand was estimated by utilising the 2017 Aimsun mesoscopic model to extract the sub area matrices for the identified study area and adjusting the demand for reflecting the current travel pattern. The sub-area network extracted in AIMSUN was used for estimating the base year demand. Using the static traversal tool in AIMSUN, 2017 demand matrices for Car and HGV were obtained for the sub-area. These matrices served as the initial seed for running the Vissim model and later during the calibration process further matrix adjustments were undertaken to represent observed travel pattern and assist in model validation.

3.2 Signal data

3.2.1 SCATS IDM Data

SCATS IDM data were extracted from the system. Vissim VAP programming was developed to model the signal operation from the SCATS signal operation history data considering the minimum, maximum and average timings of the signal phases.

3.2.2 SCATS Signal and turning movement Data

SCATS signal data and turning movements for the following intersections were provided for February 2019. From the detector counts, 15 min data on each lane of an approach was obtained. Using these the hourly approach volumes were estimated for each intersection by direction of movement and the peak hour volumes were used for the calibration process.

Figure 3.4: SCATS data locations in the study area

3.2.3 Travel Times

The travel times for base year were measured from Google maps (through their background API and python scripted processes to extract travel times during the week 20-26 March 2019) and the sections considered are as shown in Figure 5.1: Bus services in the study area (Source: Transport Canberra) and listed below in Table 3.3.

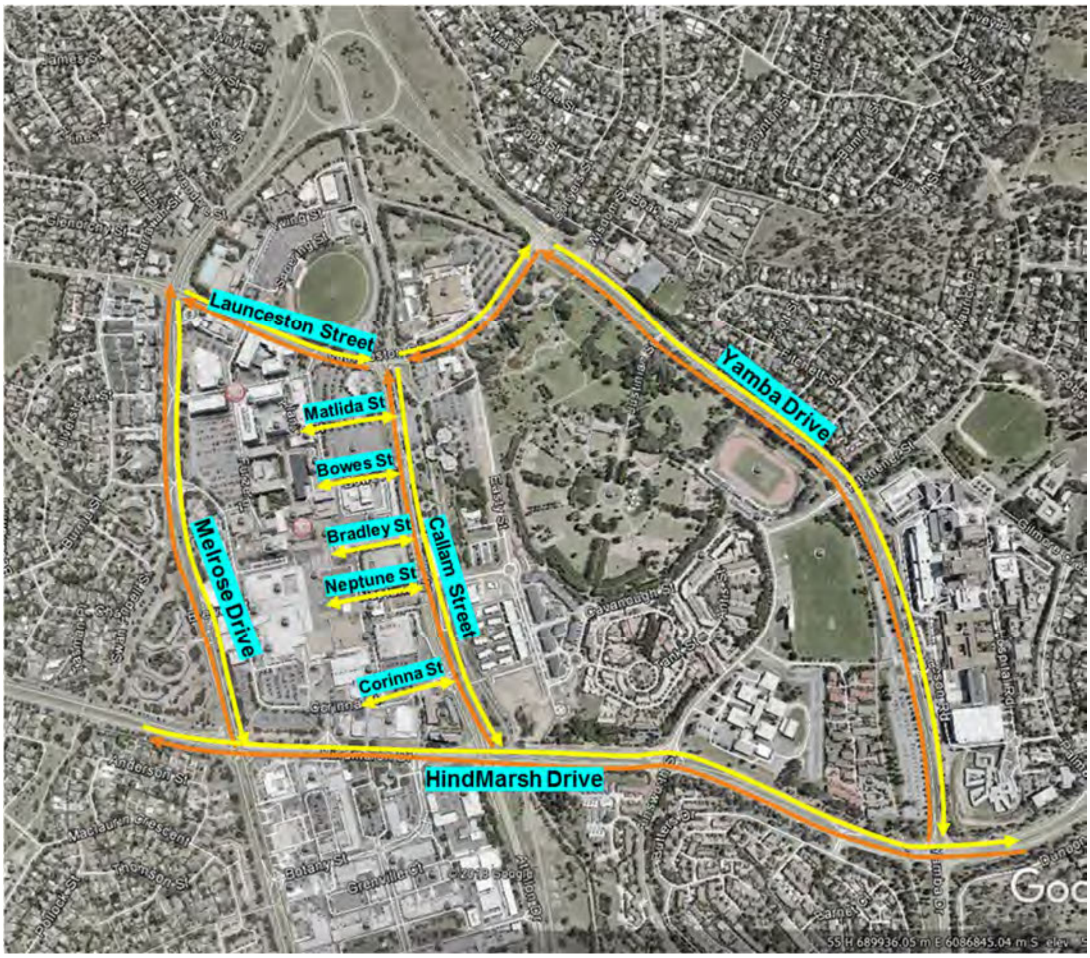


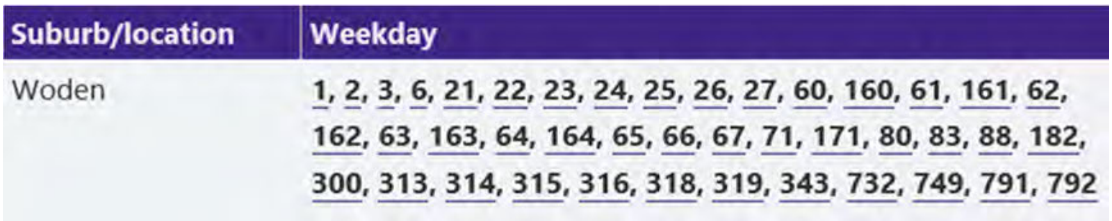
Figure 3.5: Travel time sections in the study area

Table 3.3: Travel Time Sections

Street/ Section	From /to			
Melrose Dr			**Hindmarsh Dr**	
1	Launceston St to Hindmarsh Dr		1	Melrose Dr to Yamba Dr
2	Hindmarsh Dr to Launceston St		2	Yamba Dr to Melrose Dr
Yamba Dr			**Callam St**	
1	Launceston St to Hindmarsh Dr (left turn)		1	Launceston St to Hindmarsh Dr
2	Hindmarsh Dr to Launceston St		2	Hindmarsh Dr to Launceston St
Launceston St				
1	Melrose Dr to Yamba Dr			
2	Yamba Dr to Melrose Dr			

3.3 Bus operations

As the major focus area of the project is around the Woden Bus Interchange, all the public transport services utilising road network within the model study area were considered. The information on the bus services such as the route followed and the timetables on a typical weekday were extracted from the Transport Canberra website as shown in Figure 3.6 below, analysed and coded in the model.



Suburb/location	Weekday
Woden	1, 2, 3, 6, 21, 22, 23, 24, 25, 26, 27, 60, 160, 61, 161, 62, 162, 63, 163, 64, 164, 65, 66, 67, 71, 171, 80, 83, 88, 182, 300, 313, 314, 315, 316, 318, 319, 343, 732, 749, 791, 792

Figure 3.6: Woden Area Bus routes on a Weekday

Source: https://www.transport.act.gov.au/getting-around/find-a-stop-or-map

Based on the information available from the website, a total of 43 different bus routes were identified to be active on roads in the study area. The public transport lines were coded in the model based on the route information and departure times according to the timetables published. Since a half hour warmup period is included in the model, the timetables between 07:30 AM and 09:00 AM were considered for the morning peak and timetables between 4:30 PM and 6:00 PM for evening peak. The departure times for all the routes were adjusted based on the travel time from the entry point of the network in the study area to Woden bus interchange. The bus routes considered for base year model are listed in Table 3.4. Note, a new timetable came into effect in Canberra from 29 April 2019. Since this occurred after the initial model development had occurred, and since study area counts and data were taken from before this date, the “old” timetable is still in place for the base model developed.

Table 3.4: Bus Routes considered for base year model

Route No.	Details
1	Dickson Shops / Cowper St - Woden Bus Station via Parliament House
2	Dickson Shops / Cowper St - Woden Bus Station via Barton Bus station
3	Cohen St Bus Station - Woden Bus Station
6	Marcus Clarke St -Woden Bus Station
21	Woden - Mawson - Woden
22	Woden - Mawson - Woden
23	Woden - Mawson - Woden via Canberra Hospital
24	Woden - Mawson - Woden via Canberra Hospital
25	Cooleman Court - Woden Bus Station
26	Weston Creek Terminus - Woden Bus Station
27	Cooleman Court - Woden Bus Station
60	Tuggeranong Bus Station - City Bus Station via Woden
61	Tuggeranong Bus Station - City Bus Station via Woden
62	Tuggeranong Bus Station - City Bus Station via Woden
63	Tuggeranong Bus Station - City Bus Station via Woden
64	Tuggeranong Bus Station - City Bus Station via Woden
65	Tuggeranong Bus Station - Woden Bus Station
66	Tuggeranong Bus Station - Woden Bus Station

Route No.	Details
67	Tuggeranong Bus Station - Woden Bus Station
71	Tuggeranong Bus Station - City West Bus Station via Woden
80	City Bus Station - Woden Bus Station
83	Cooleman Court - Woden Bus Station
88	Woden - Hume - Woden
160	Tuggeranong Bus Station - City Bus Station via Woden
161	Tuggeranong Bus Station - City Bus Station via Woden
162	Tuggeranong Bus Station - City Bus Station via Woden
163	Tuggeranong Bus Station - City Bus Station via Woden
164	Tuggeranong Bus Station - City Bus Station via Woden
171	Tuggeranong Bus Station - City West Bus Station via Woden
182	City Bus Station - Woden Bus Station
300	Kippax Bus Station - Lanyon Marketplace via Woden
313	Fraser Terminus - Lanyon Marketplace via Woden
314	Fraser Terminus - Tuggeranong Bus station via Woden
315	Spence Terminus - Tuggeranong Bus station via Woden
316	Kippax Bus Station - Tuggeranong Bus station via Woden
318	Lanyon Marketplace - Cohen st Bus station via Woden
319	Lanyon Marketplace -Kippax Bus Station via Woden
343	Fraser Terminus - Lanyon Marketplace via Woden
720 (Bypass)	Farrer Terminus - London St
732	City Bus Station - Woden Bus Station
749	Cohen St Bus Station - Centrelink/ Athillion Dr via Woden
791	Woden Bus Station - Fairbairn park
792	Woden Bus Station - Fairbairn park

4. Model Calibration and Validation

4.1 Base model calibration

The calibration of the model was based on the SCATS detector data for the turning movement flows. The SCATS data was missing the slip left turn flows in most of the instances and was unable to separate the left turn flows from the shared through movements. The comparison was made with the flows where the conclusive flows were received. Generally, SCATS data is not exact but may have 5-10% variations from the actual traffic. However, in absence of any other traffic counts, SCATS detector data was used for the calibration. The trip matrices were taken from the large area Aimsun model, which had the limitation of not projecting traffic in micro zones inside the study area to support accurate calibration of the microscopic model. The trips were manually distributed in to smaller traffic zones (to reflect car park access and the like). The limitation of the Aimsun model along with the non-availability of the traffic counts introduced several challenges to model calibration. Considering the situation, the intention of calibration of the model was to compare the traffic flows mainly through the main corridors, i.e. Melrose Drive, Hindmarsh Drive, Yamba Drive, Launceston Street and Callam Street in segments and major turns. However, an effort was made to calibrate all flows reasonably meeting the following criteria:

- 85% achieving GEH < 5
- 100% achieving GEH <10
- R^2 value > 0.95

The calibration results have been summarised in Table 4.1. The R^2 value for the AM peak is 0.96 and 0.95 for PM peak which meets the minimum required criteria as shown in the figures below. There are a few outliers which do not qualify the GEH test due to unavailability of data at some locations, but the majority of the calibration results are quite good.

Table 4.2: Calibration GEH test results

GEH Criteria	Target	AM		PM	
		Number	%	Number	%
GEH < 5	85%	86	80%	69	64%
GEH < 10	100%	103	96%	98	92%
GEH > 10	0%	4	4%	9	8%

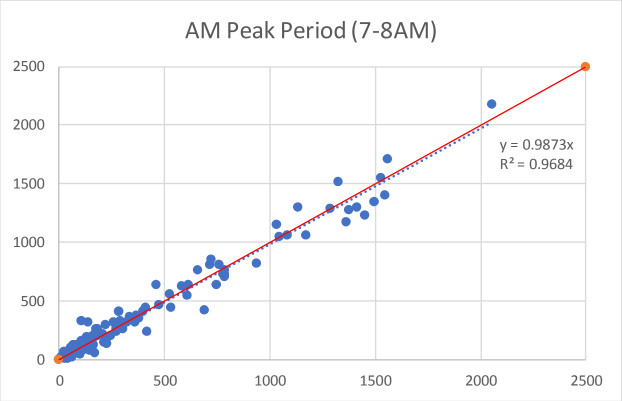


Figure 4.1: Regression analysis-AM Peak

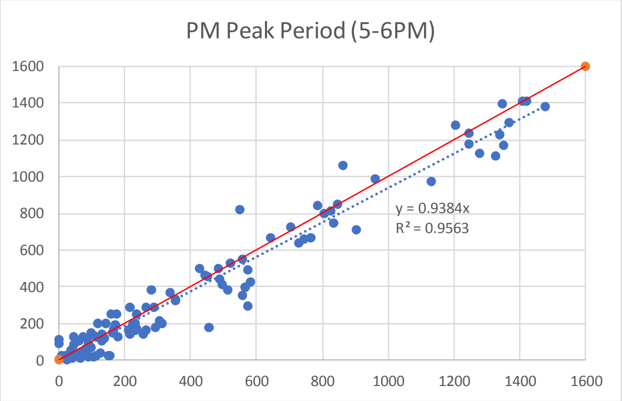


Figure 4.2: Regression analysis-PM Peak

4.2 Base model validation

Base model validation was based on the journey times extracted from Google to reasonably match the model with ground conditions. A sense check of queue length was also performed to support the validation. Queues observed at the field matched sensibly with the calibrated model. In some instances, the journey times were off due to short distances, non-availability of the actual data on the traffic data collection day, potential biases in the Google data due to user types (e.g. bus passengers versus car passengers experience different travel times), and the limitation of the model to simulate the SCATS controllers in Vissim. The following tables summarize the journey time validations for AM and PM peaks. The variation of journey times is expected due to seasonal variation of traffic throughout the year which is not captured in the Google travel time. **The aim is to have a difference of not more than 60 seconds or 15% between the observed and modelled journey time values**.

Table 4.3: Journey Time Validation Summary - AM Peak

JT Route	Distance (m)	Observed		Modelled		Diff (s)	Diff (%)
		Average Travel Time (sec)	Average Speed (km/hour)	Average Travel Time (sec)	Average Speed (km/hour)		
Callam St SB	858	120	26	92	34	-28	-24%
Callam St NB	850	120	26	124	25	4	4%
Melrose Dr SB	1009	164	22	162	22	-2	-1%
Melrose Dr NB	990	89	40	119	30	30	33%
Yamba Dr SB	1648	182	33	186	32	4	2%
Yamba Dr NB	1627	131	45	157	37	26	19%
Launceston St EB	952	135	25	128	27	-6	-5%
Launceston St WB	948	144	24	156	22	13	9%
Hindmarsh Dr EB	1507	175	31	251	22	76	43%
Hindmarsh Dr WB	1538	187	30	175	32	-12	-6%

Table 4.4: Journey Time Validation Summary - PM Peak

JT Route	Distance (m)	Observed		Modelled		Diff (s)	Diff (%)
		Average Travel Time (sec)	Average Speed (km/hour)	Average Travel Time (sec)	Average Speed (km/hour)		
Callam St SB	858	120	26	91	34	-29	-24%
Callam St NB	850	120	26	130	23	11	9%
Melrose Dr SB	1009	164	22	130	28	-34	-21%
Melrose Dr NB	990	89	40	81	44	-8	-9%
Yamba Dr SB	1648	182	33	283	21	101	55%
Yamba Dr NB	1627	131	45	178	33	47	36%
Launceston St EB	952	135	25	92	37	-43	-32%
Launceston St WB	948	144	24	142	24	-1	-1%
Hindmarsh Dr EB	1507	175	31	240	23	65	37%
Hindmarsh Dr WB	1538	187	30	200	28	14	7%

The graphs shown in Figure 4.3 and Figure 4.4 below show the actual v/s modelled average journey times for the AM and PM peaks.

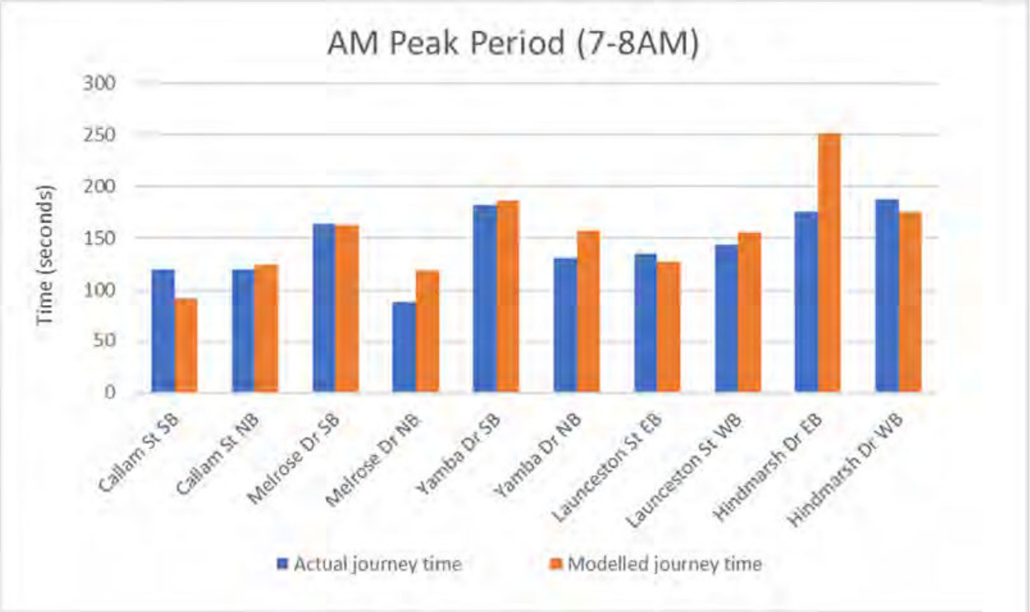


Figure 4.3: AM peak period Journey time comparison

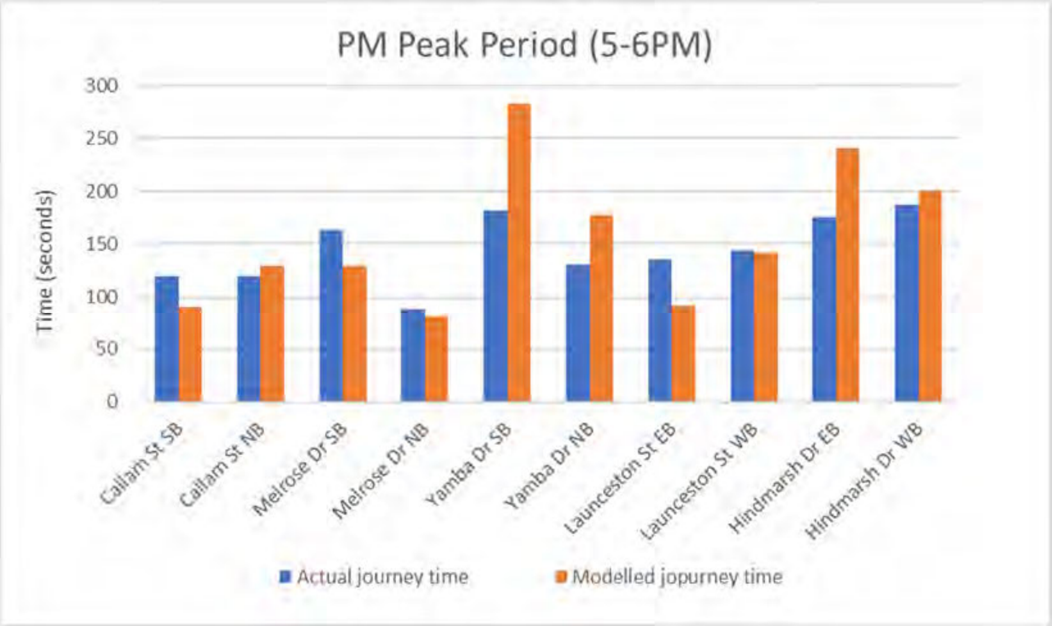


Figure 4.4: PM peak period Journey time comparison

5. Options assessment

5.1 Development of future year reference case

For future scenarios, the following options were considered and modelled.

- Future Do Nothing Scenarios
- Future Light Rail along with future bus network options via State Circle

Future Light Rail along with future bus network options via Barton was not a preferred option and was not modelled.

Both the options were analysed for year 2026 and 2036 AM and PM peak hours. The Light Rail will directly replace some of the Rapid bus services that currently run via Woden Interchange. However, the Light Rail option also introduces new local buses from Tuggeranong, that will terminate at Woden for connection to the light rail. Overall, the volume of buses and the number of bus stops required will remain broadly similar to the Do Nothing network. Peak bus volumes at Woden terminal are slightly reduced for the Light Rail option, but only by 5 to 10 buses per hour at peak times, due to the requirement to terminate extra services from south of Woden.

5.2 Future Bus network

The future bus network has been modelled using bus route and frequency assumptions provided by MRCagney in a memo dated 12 April 2019. Two future bus networks were considered as part of this project which reflect two route options for Light Rail Stage 2. Figure 5.1 illustrates the bus routes.

- Option 1: City to Woden via Barton
- Option 2: City to Woden via State Circle

A summary of routes and frequencies for the future bus networks are included in Table 5.1 (Barton) and Table 5.2 (State Circle).

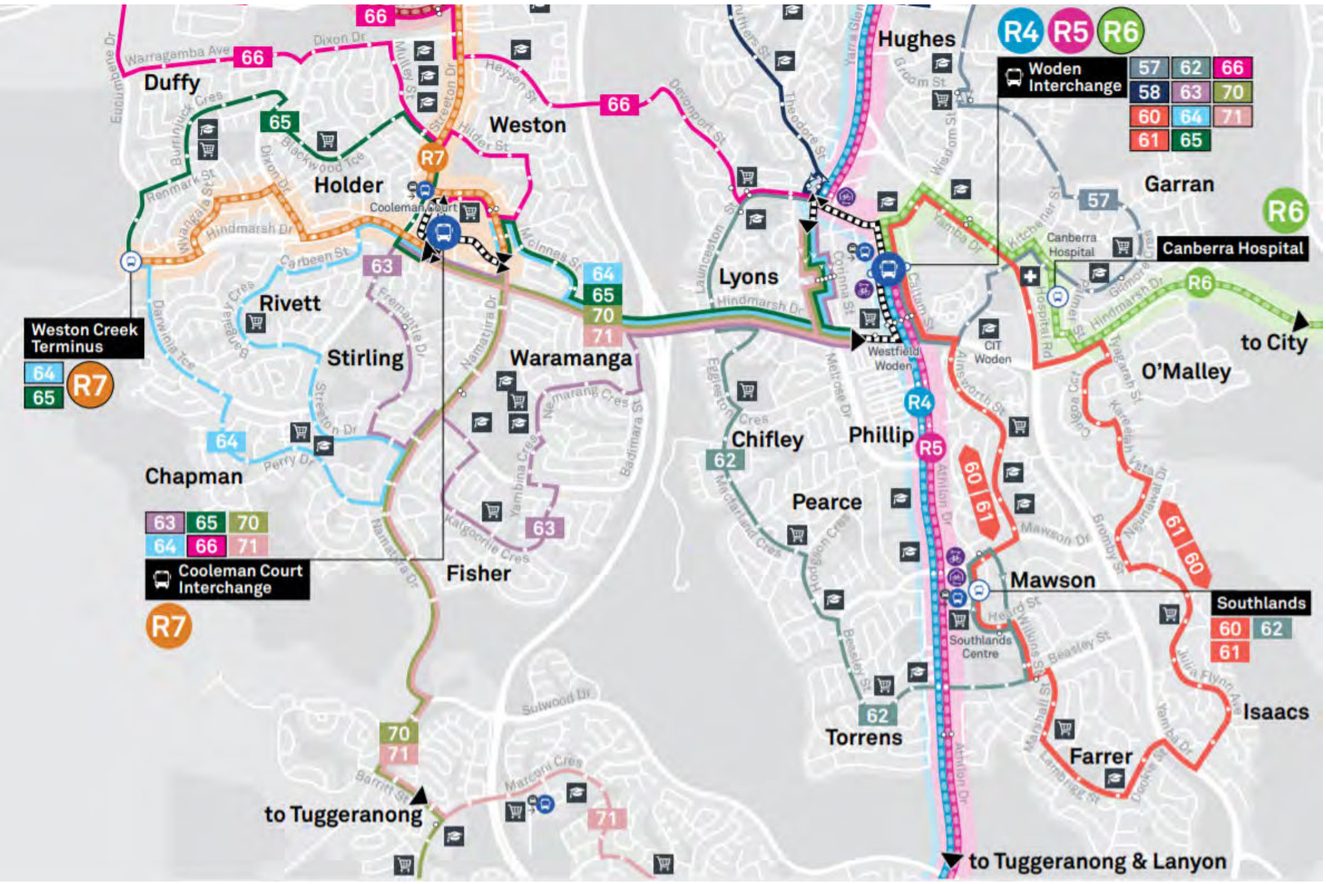


Figure 5.1: Bus services in the study area (Source: Transport Canberra)

Table 5.1: Future bus network frequencies - Option 1

No.	Route	Buses per hour	
		Peak	Off-peak
4 – Rapid	Belconnen to Tuggeranong via City	10	10
6 – Rapid	Woden to City via Kingston	4	4
57	Woden to City via Yarralumba	2	2
60	Mawson Loop via O'Malley and Farrer	2	2
61	Mawson Loop Farrer and O'Malley	2	2
62	Torrens Loop via Chifley and Mawson	2	2
63	Cooleman Court to Woden via Stirling and Fisher	3	2
64	Weston Creek to Woden via Rivett and Cooleman Court	2	1
65	Weston Creek to Woden via Duffy and Cooleman Court	2	1
66	Cooleman Court to Woden via Denman Prospect and Lyons	3	1
70	Tuggeranong to Woden via Kambah West and Cooleman Court	2	1
71	Tuggeranong to Woden via Kambah East and Cooleman Court	2	1
72	Erindale Loop via Oxley and Monash	2	2
73	Erindale Loop via Monash and Oxley	2	2
74	Greenway to Woden	2	2
75	Tuggeranong to Woden via Erindale	2	2

No.	Route	Buses per hour	
		Peak	Off-peak
76	Calwell to Tuggeranong via Chishold and Erindale	2	2
77	Erindale to Tuggeranong via Gowrie and Monash	2	2

Table 5.2: Future bus network frequencies - Option 2

No.	Route	Buses per hour	
		Peak	Off-peak
5 – Rapid	Lanyon to City via Erindale and Russel	6	6
6 – Rapid	Woden to City West via Kingston	4	4
57	Woden to City via Hughes and Yarralumbla	2	2
58	Woden to City via Curtin and Deakin	2	2
60	Mawson Loop via O’Malley and Farrer	2	2
61	Mawson Loop Farrer and O’Malley	2	2
62	Torrens Loop via Chifley and Mawson	2	2
63	Cooleman Court to Woden via Stirling and Fisher	3	2
64	Weston Creek to Woden via Rivett and Cooleman Court	2	1
65	Weston Creek to Woden via Duffy and Cooleman Court	2	1
66	Cooleman Court to Woden via Denman Prospect and Lyons	3	1
70	Tuggeranong to Woden via Kambah West and Cooleman Court	2	1
71	Tuggeranong to Woden via Kambah East and Cooleman Court	2	1
78	Chisholm to Tuggeranong via Isabella Plains and Bonython	4	2
79	Calwell to Tuggeranong via Theodore and Isabella Plains	2	2
80	Lanyon to Tuggeranong via Condor and Banks	4	2
81	Lanyon to Tuggeranong via Gordon and Bonython	2	2

6. Future model development

Future models were developed for year 2026 and 2036 with Do Nothing and Light Rail with State Circle option. The Future Do Nothing scenario was developed from the base model and only changes were made in the bus network. The details for light rail including the schedule, stops, operation and detailed alignment was not available and was not included in the model. Light rail modelling would be considered in the next stage of the project, to gain a better understanding of the impact of light rail on signal operations. Figure 6.1 shows the light rail alignment.

Figure 6.1: Available alignment of Light rail

6.1 Road network changes

The future Do Nothing year services are based on the "new" timetable which came into operation from 29 April 2019. The new timetable was not incorporated in the base model as during the model development the new schedule was not implemented. The Future Light Rail option (with State Circle) was developed by introducing the new bus routes, schedules and sizes. The Future Light Rail option also includes the closure of the Callam Street between Matilda Street and Bradley Street (also shown in Figure 6.1).

6.2 Network performance comparison

The Future Do Nothing and LRT with State Circle scenarios were compared for the network performance in terms of network delay and journey times. Despite the closure of Callam Street, the LRT model did not reflect increased delay or travel time. The network performance summary is presented in the following table and shown in the graphic images below. It is noted however that in the future year models, some latent demand was present due to congestion within the study area. Latent demand are vehicles that haven't been able to enter the network due to congestion. For future stages of the project a "cool down" period in the Vissim model and further refinement of the future year scenarios is recommended to allow vehicles to complete their trips through the network.

Table 6.1: Network Performance Comparison Summary

Network Statistics	Future 2026 Do Nothing		Future 2026 LRT		2036 Do Nothing		Future 2036 LRT	
	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
Total Vehicles Arrived	15000	14045	15016	13802	15488	14302	15251	14422
Total Distance (km)	38057	35902	38162	35194	39574	37173	39203	37222
Total Travel Time (hr)	1462	1278	1433	1256	1812	1594	1837	1461
Total Delay (hr)	823	677	792	666	1145	973	1176	839
Average Delay (secs)	175	156	169	157	230	214	238	187
Average Speed (kmph)	26	28	27	28	22	23	21	25
Latent Demand (no. of vehicles)	338	153	309	444	658	737	687	865

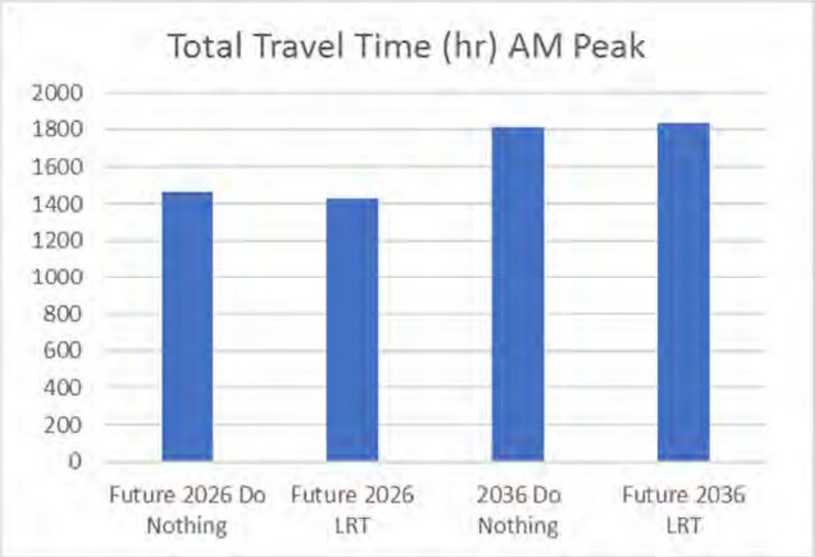


Figure 6.2: Total Travel time comparison across scenarios AM peak

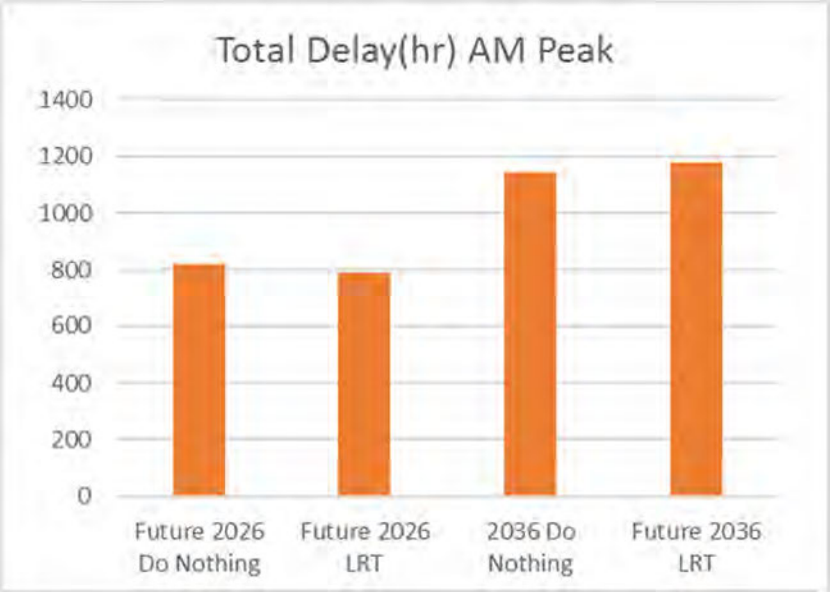


Figure 6.3: Total Delay comparison across scenarios AM peak

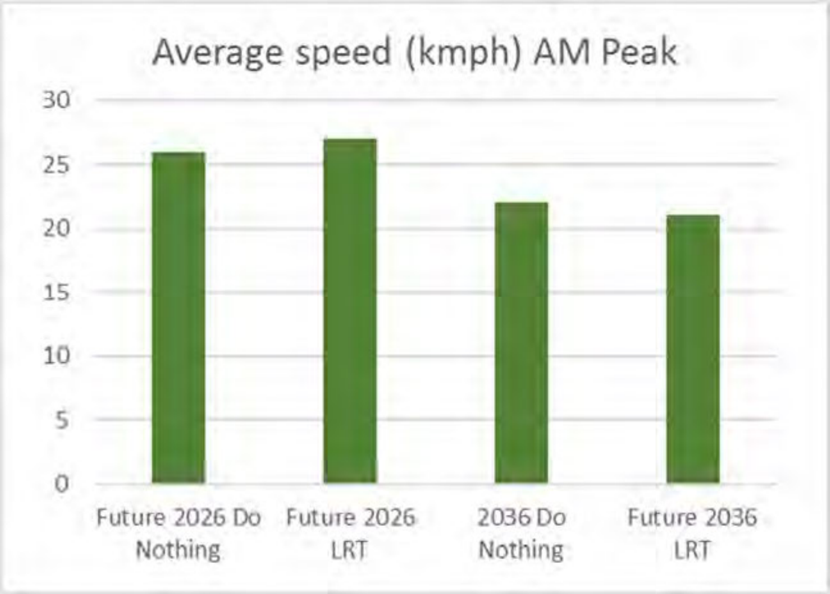


Figure 6.4: Average Speed comparison across scenarios AM peak

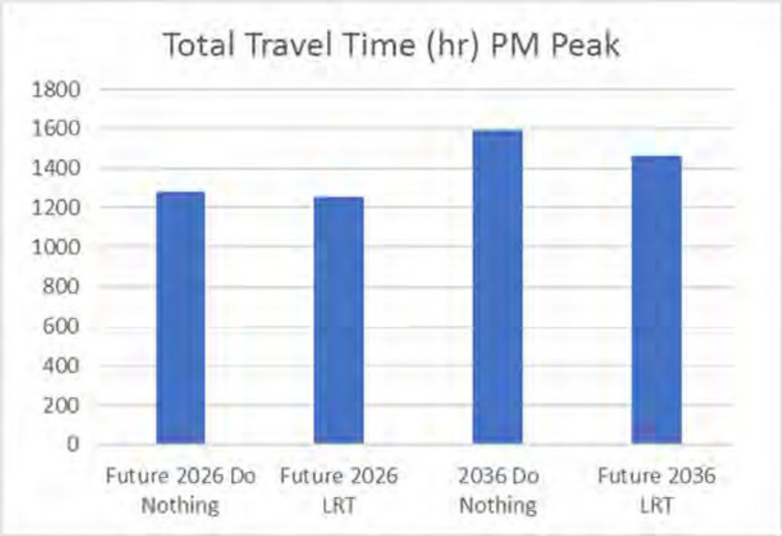


Figure 6.5: Total Travel time comparison across scenarios PM peak

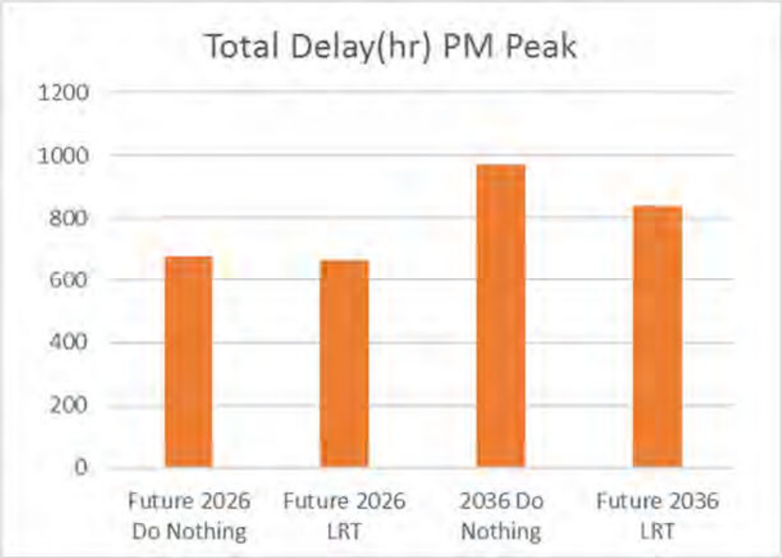


Figure 6.6: Total Delay comparison across scenarios PM peak

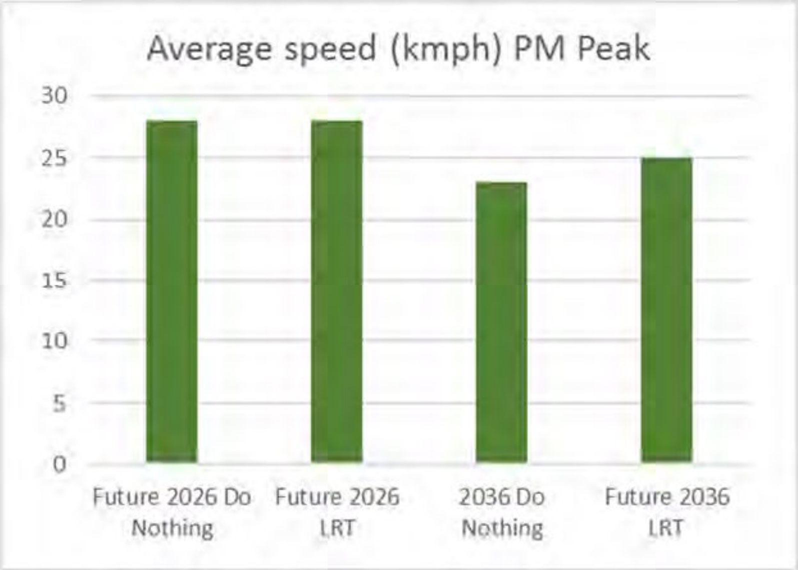


Figure 6.7: Average Speed comparison across scenarios PM peak

7. Conclusions

The LRT with State Circle option did not show increased delay and travel time compared to the Future Do Nothing scenario. With the closure of Callam St, Launceston St was carrying less traffic and contributed to improve total network delay and travel time. Callam Street traffic diverted to the local streets like Worgan St, Bowes St, Corinna St and Brewer St. With LRT option, the congestion did not appear to be severe in major junctions. However, the local streets and area between Melrose Dr, Launceston St, Callam St and Hindmarsh Dr appeared to be congested and may require further attention to improve.

7.1 Next Stage recommendations

- It is recommended that a more comprehensive traffic counting program is implemented to inform the next stage of the project. This would include a combination of SCATS and manual traffic count data to ensure all key locations are captured and can be used for model calibration. Floating car travel time surveys are also recommended to improve model validation performance and matching to ground conditions. Modelling can then be updated and fine-tuned further to confirm satisfactory operations for the future network.

- Light rail frequencies and signal operations also need to be determined so that signal operation can be optimised in the corridor as part of the light rail scenarios.

- A detailed signalised junction analysis is recommended at major junctions impacted by the development. This would help to identify the capacity constraints and any potential mitigations.

- A detailed parking study is recommended to identify the exact demand on the parcels and the major trip generators to identify the traffic circulation pattern inside the study area.

- Due to the closure of Callam Street, the traffic would be diverting to Melrose Dr, Yamba Dr and Hindmarsh Dr. To access to the desired destinations, traffic was observed to utilise Corrina St, Worgan St, Furzer St, Matilda St and so on, and these streets are generally more local, parking and pedestrian friendly streets. Further data on these streets should ideally be collected. More attention is necessary if additional traffic diversion is expected to occur through those streets. Attention related to traffic diversion analysis, unsignalised junction analysis, traffic pedestrian interactions (and safety), parking analysis and capacity analysis may be necessary.

- Trip generation surveys were not conducted as a part of this study. A detailed traffic generation and circulation study may help to understand the behaviours of the traffic in the study area along with the detailed entry and exits and impacts on the junctions at major streets nearby.

- Inclusion of cool down period and further refinement of future year models. This is recommended once an improved base calibration can be achieved with better input data for calibration (as per the first recommendation identified).

Appendix A. Calibration Summary

1. Junction Turning Flows Comparison Summary - AM Peak

From Road	To Road	Observed JTC		Difference-Total	GEH
		Vehicles	Total		
Melrose Dr N	Melrose Dr S	400	415	-15	0.75
	Launceston St W	45	81	-36	4.48
Launceston St E	Melrose Dr N + Launceston St W	358	319	39	2.11
Melrose Dr S	Melrose Dr N + Launceston St W	1135	1298	-163	4.67
	Launceston St E	163	207	-43	3.18
Launceston St W	Launceston St E + Melrose Dr S	612	636	-24	0.94
Yamba Dr E	Yamba Dr W	1286	1289	-3	0.08
Launceston Street S	Yamba Dr E	368	380	-12	0.64
Yamba Dr W	Yamba Dr E	581	627	-46	1.88
	Launceston Street S	182	264	-82	5.46
Wisdom Street N	Yamba Drive W	128	154	-26	2.15
Yamba Drive E	Wisdom Street N	222	293	-71	4.40
	Yamba Drive W	1543	1401	142	3.71
Yamba Drive W	Yamba Drive E	787	733	54	1.96
Yamba Dr N	Yamba Dr S	305	259	46	2.72
	Hindmarsh W	64	83	-18	2.15
Hindmarsh E	Yamba Dr N	175	235	-60	4.19
	Hindmarsh W	937	827	110	3.70
Yamba Dr S	Yamba Dr N	1494	1346	148	3.93
	Hindmarsh E	776	731	46	1.67
Hindmarsh W	Hindmarsh E	1172	1055	117	3.51
	Yamba Dr S	77	128	-51	5.04
Callam St N	Hindmarsh Dr E	133	194	-60	4.72
	Athllon Dr S	212	148	63	4.73
	Hindmarsh Dr W	75	66	9	1.12
Hindmarsh Dr E	Callam St N	286	410	-124	6.64
	Athllon Dr S	226	136	90	6.67
	Hindmarsh Dr W	783	765	18	0.65
Athllon Dr S	Callam St N	660	766	-106	3.97
	Hindmarsh Dr E	285	263	21	1.29
	Hindmarsh Dr W	79	67	12	1.38
Hindmarsh Dr W	Callam St N	208	218	-9	0.64
	Hindmarsh Dr E	1363	1174	189	5.31
	Athllon Dr S	35	23	13	2.34
Melrose Dr N	Melrose Dr S	288	327	-39	2.24
	Hindmarsh Dr W	143	85	58	5.41
Hindmarsh Dr E	Hindmarsh Dr W + Melrose Dr N	525	561	-36	1.54
Melrose Dr S	Melrose Dr N + Hindmarsh Dr E	1033	1146	-113	3.42
Hindmarsh Dr W	Melrose Dr N	785	710	75	2.74

From Road	To Road	Observed JTC		Difference-Total	GEH
		Vehicles	Total		
	Hindmarsh Dr E + Melrose Dr S	2052	2178	-126	2.74
Launceston Street E	Callam St S	164	126	39	3.22
	Launceston St W	416	238	178	9.83
Callam St S	Launceston St E	243	203	39	2.64
Launceston Street W	Launceston St E	691	423	268	11.36
	Callam St S	150	190	-41	3.11
Callam St N	Callam St S	322	322	0	0.02
	Bowes St W	6	9	-3	0.94
Callam St S	Callam St N	757	809	-52	1.86
	Bowes St W	12	20	-8	1.94
Bowes St W	Callam St S	16	23	-7	1.59
Callam St N	Callam St S	273	296	-24	1.40
	Bradley St W	67	51	17	2.19
Callam St S	Callam St N	716	811	-96	3.46
	Bradley St W	61	56	4	0.55
Bradley St W	Callam St N + Callam St S	63	20	43	6.60
Callam St N	Callam St S	268	259	9	0.55
	Neptune St W	21	24	-2	0.51
Wilbow St E	Callam St S	109	117	-8	0.75
	Neptune St W + Callam St N	22	15	8	1.81
Callam St S	Callam St N	724	853	-128	4.57
	Wilbow St E	142	119	23	2.01
	Neptune St W	104	159	-55	4.79
Neptune St W	Callam St N + Wilbow St E + Callam St S	89	81	8	0.82
Callam St N	Callam St S	378	358	19	1.00
	Corinna St W	35	59	-24	3.49
Callam St S	Callam St N	1080	1061	18	0.56
	Corinna St W	105	331	-225	15.26
Corinna St W	Callam St N	110	87	23	2.32
	Callam St S	53	48	5	0.73
Kitchener St N	Kitchener St S + Yamba Dr E	259	326	-67	3.92
Yamba Dr E	Kitchener St N	138	321	-183	12.06
	Yamba Dr W	1416	1305	110	2.99
Kitchener St S	Kitchener St N + Yamba Dr E	180	206	-26	1.90
Yamba Dr W	Kitchener St S	106	117	-11	1.08
Yamba Dr N	Bateson Rd E	170	223	-52	3.72
	Yamba Dr S	462	642	-180	7.66
Bateson Rd E	Yamba Dr N	52	110	-59	6.52
Yamba Dr S	Yamba Dr N	1525	1545	-20	0.52
	Bateson Rd E	234	201	33	2.26
Ainsworth St N	Hindmarsh Dr W + Ainsworth St S	172	269	-97	6.52
Hindmarsh Dr E	Ainsworth St N	77	117	-40	4.04

From Road	To Road	Observed JTC		Difference-Total	GEH
		Vehicles	Total		
	Hindmarsh Dr W	1044	1044	27	0.83
Ainsworth St S	Ainsworth St N + Hindmarsh Dr E	272	239	33	2.06
Hindmarsh Dr W	Ainsworth St S	66	124	-58	5.96
Hindmarsh St E	Hindmarsh St W	749	635	114	4.32
Botany St S	Hindmarsh Dr E	166	196	-30	2.22
Hindmarsh Dr W	Hindmarsh Dr E	1454	1237	217	5.92
	Botany St S	28	64	-36	5.33
Ball St N	Hindmarsh Dr W	27	28	-1	0.19
Hindmarsh Dr E	Ball St N	140	125	15	1.29
	Hindmarsh Dr W	606	551	55	2.29
Hindmarsh Dr W	Hindmarsh Dr E	1376	1273	103	2.83
Melrose Dr N	Worgan St E	169	59	110	10.32
	Melrose Dr S	471	474	-3	0.14
Worgan St E	Melrose Dr N	20	27	-7	1.48
	Melrose Dr S	37	27	10	1.72
Melrose Dr S	Melrose Dr N	1327	1512	-184	4.89
	Worgan St E	335	363	-29	1.54
Melrose Dr N	Corinna St E	99	49	50	5.83
	Melrose Dr S	531	450	81	3.66
Corinna St E	Melrose N	30	10	19	4.29
	Melrose Dr S	36	11	25	5.15
Melrose Dr S	Melrose Dr N	1560	1714	-154	3.80
	Corinna St E	25	66	-41	6.07
Melrose Dr N	Melrose Dr S	412	444	-32	1.56
Brewer St E	Melrose N	39	15	24	4.59
Melrose Dr S	Brewer St E	154	104	50	4.40

2. Junction Turning Flows Comparison Summary - PM Peak

From Road	To Road	Observed JTC		Difference-Total	GEH
		Vehicles	Total		
Melrose Dr N	Melrose Dr S	864	1057	-193	6.23
	Launceston St W	86	119	-33	3.26
Launceston St E	Melrose Dr N + Launceston St W	828	808	20	0.69
Melrose Dr S	Melrose Dr N + Launceston St W	703	722	-18	0.68
	Launceston St E	64	41	23	3.24
Launceston St W	Launceston St E + Melrose Dr S	308	212	97	5.99
Yamba Dr E	Yamba Dr W	557	546	12	0.49
Launceston Street S	Yamba Dr E	356	329	26	1.43
Yamba Dr W	Yamba Dr E	1204	1280	-77	2.17
	Launceston Street S	237	170	67	4.67
Wisdom Street N	Yamba Drive W	132	106	26	2.36
Yamba Drive E	Wisdom Street N	98	68	30	3.29
	Yamba Drive W	767	665	102	3.83

From Road	To Road	Observed JTC		Difference-Total	GEH
		Vehicles	Total		
Yamba Drive W	Yamba Drive E	1418	1406	12	0.31
Yamba Dr N	Yamba Dr S	1338	1229	109	3.04
	Hindmarsh W	173	189	-17	1.25
Hindmarsh E	Yamba Dr N	131	128	3	0.28
	Hindmarsh W	1132	973	160	4.92
Yamba Dr S	Yamba Dr N	353	323	30	1.63
	Hindmarsh E	264	287	-23	1.41
Hindmarsh W	Hindmarsh E	902	706	197	6.93
	Yamba Dr S	217	284	-67	4.22
Callam St N	Hindmarsh Dr E	340	366	-25	1.35
	Athllon Dr S	558	353	205	9.60
	Hindmarsh Dr W	232	203	29	1.98
Hindmarsh Dr E	Callam St N	223	192	31	2.13
	Athllon Dr S	233	160	73	5.23
	Hindmarsh Dr W	1246	1179	67	1.94
Athllon Dr S	Callam St N	314	200	114	7.12
	Hindmarsh Dr E	213	163	50	3.64
	Hindmarsh Dr W	108	14	94	12.02
Hindmarsh Dr W	Callam St N	180	125	55	4.45
	Hindmarsh Dr E	787	843	-56	1.96
	Athllon Dr S	107	135	-27	2.49
Melrose Dr N	Melrose Dr S	847	848	-1	0.03
	Hindmarsh Dr W	549	821	-272	10.38
Hindmarsh Dr E	Hindmarsh Dr W + Melrose Dr N	1346	1394	-48	1.29
Melrose Dr S	Melrose Dr N + Hindmarsh Dr E	454	454	0	0.02
Hindmarsh Dr W	Melrose Dr N	266	160	106	7.27
	Hindmarsh Dr E + Melrose Dr S	961	987	-26	0.83
Launceston Street E	Callam St S	218	139	78	5.87
	Launceston St W	575	292	283	13.57
Callam St S	Launceston St E	167	169	-2	0.15
Launceston Street W	Launceston St E	160	249	-89	6.22
	Callam St S	455	178	277	15.58
Callam St N	Callam St S	566	393	173	7.91
	Bowes St W	16	13	3	0.84
Callam St S	Callam St N	522	529	-7	0.31
	Bowes St W	9	25	-16	3.76
Bowes St W	Callam St S	23	21	2	0.38
Callam St N	Callam St S	513	383	130	6.15
	Bradley St W	72	29	43	6.00
Callam St S	Callam St N	486	499	-14	0.61
	Bradley St W	53	23	30	4.88
Bradley St W	Callam St N + Callam St S	57	106	-50	5.49

From Road	To Road	Observed JTC		Difference-Total	GEH
		Vehicles	Total		
Callam St N	Callam St S	498	414	83	3.90
	Neptune St W	41	8	33	6.61
Wilbow St E	Callam St S	239	252	-12	0.79
	Neptune St W + Callam St N	27	2	25	6.55
Callam St S	Callam St N	429	501	-72	3.32
	Wilbow St E	86	23	63	8.57
	Neptune St W	91	17	75	10.14
Neptune St W	Callam St N + Wilbow St E + Callam St S	256	141	116	8.20
Callam St N	Callam St S	836	748	88	3.14
	Corinna St W	85	25	60	8.07
Callam St S	Callam St N	582	428	154	6.83
	Corinna St W	0	91	-91	0.00
Corinna St W	Callam St N	0	112	-112	0.00
	Callam St S	294	177	117	7.62
Kitchener St N	Kitchener St S + Yamba Dr E	283	385	-102	5.58
Yamba Dr E	Kitchener St N	98	147	-49	4.41
	Yamba Dr W	574	493	81	3.49
Kitchener St S	Kitchener St N + Yamba Dr E	144	196	-52	4.02
Yamba Dr W	Kitchener St S	121	200	-79	6.23
Yamba Dr N	Bateson Rd E	63	102	-38	4.23
	Yamba Dr S	1407	1411	-3	0.09
Bateson Rd E	Yamba Dr N	141	121	20	1.71
Yamba Dr S	Yamba Dr N	490	442	48	2.22
	Bateson Rd E	73	128	-56	5.57
Ainsworth St N	Hindmarsh Dr W + Ainsworth St S	443	463	-20	0.95
Hindmarsh Dr E	Ainsworth St N	40	56	-16	2.26
	Hindmarsh Dr W	1327	1107	220	6.31
Ainsworth St S	Ainsworth St N + Hindmarsh Dr E	81	62	20	2.32
Hindmarsh Dr W	Ainsworth St S	92	89	3	0.34
Hindmarsh St E	Hindmarsh St W	1277	1125	152	4.39
Botany St S	Hindmarsh Dr E	289	290	-1	0.04
Hindmarsh Dr W	Hindmarsh Dr E	807	797	10	0.37
	Botany St S	86	44	43	5.28
Ball St N	Hindmarsh Dr W	178	250	-72	4.91
Hindmarsh Dr E	Ball St N	153	25	128	13.60
	Hindmarsh Dr W	1246	1234	11	0.32
Hindmarsh Dr W	Hindmarsh Dr E	645	663	-17	0.67
Melrose Dr N	Worgan St E	19	19	-1	0.14
	Melrose Dr S	1351	1168	183	5.16
Worgan St E	Melrose Dr N	46	123	-78	8.45
	Melrose Dr S	165	152	13	1.06
Melrose Dr S	Melrose Dr N	728	636	92	3.52

From Road	To Road	Observed JTC		Difference-Total	GEH
		Vehicles	Total		
	Worgan St E	47	82	-35	4.41
Melrose Dr N	Corinna St E	155	28	127	13.28
	Melrose Dr S	1366	1293	73	2.01
Corinna St E	Melrose N	68	12	56	8.81
	Melrose Dr S	132	139	-7	0.62
Melrose Dr S	Melrose Dr N	746	659	87	3.27
	Corinna St E	33	9	24	5.18
Melrose Dr N	Melrose Dr S	1476	1380	96	2.54
Brewer St E	Melrose N	128	36	92	10.12
Melrose Dr S	Brewer St E	115	22	93	11.29

Appendix E. Light Rail Geometry Review


LEGEND
CURRENT ROAD DESIGN
PROPOSED ROAD DESIGN AMENDMENTS (DUE TO LIGHT RAIL RE-ALIGNMENT)
CURRENT LIGHT RAIL ALIGNMENT
PROPOSED LIGHT RAIL RE-ALIGNMENT
MEDIAN SPACE - LANDSCAPED / RAISED / CHEVRONED?

Appendix F. Design Criteria

[redacted]

Memorandum

Level 7, 177 Pacific Highway
North Sydney NSW 2060 Australia
PO Box 632 North Sydney
NSW 2059 Australia
T +61 2 9928 2100
F +61 2 9928 2444
www.jacobs.com

Subject	**Geometric Design Criteria**	**Project Name**	Woden Bus Interchange PSP Design
Attention	Schedule 2.2(a)(ii)	**Project No.**	IS268800
From	Schedule 2.2(a)(ii)		
Date	12 June 2019		
Copies to	Nil		

1.1 Design Standards and Units

The geometric road design will be developed in accordance with the design standards and units listed in Table 1.

Table 1: Standards and Units

Standards / Units	Reference
Standards	Design standards in decreasing order of precedence: • Design Standards for Urban Infrastructure – Territory and Municipal Services (TaMS) • Austroads Guide to Road Design • Roads and Maritime Specifications; • Australian Standards • Other sources, as agreed with Client representative
Units	SI units
Datum	Design levels on Australian Height Datum (AHD)
Coordinate System	Canberra Map Grid (Stromlo)

1.2 Geometric Road Design Parameters

The geometric road design will be undertaken in accordance with the parameters listed in Table 2.

Table 2: Geometric Road Design Criteria

Design Parameter	Value	Notes
Posted speed limit	60km/h	Callam Street
	40km/h	Bradley Street
	40km/h	Matilda Street
	20km/h	Callam Street (within bus interchange)
	40km/h	Callam St (at bus interchange approaches)

Design speed	70km/h 50km/h 50km/h 20km/h 40km/h	Callam Street Bradley Street Matilda Street Callam Street (within bus interchange) Callam St (at bus interchange approaches)
Reaction time	1.5sec	
Minimum general traffic lane width	3.5m	
Minimum bus lane width	4.0m	
Minimum bus turnout width	3.00m	Area where bus will pickup and drop off passengers
Minimum grade	Follow existing surface profiles	Accommodating for drainage, verge, medians, raised pedestrian crossings and intersecting roads.
Minimum crossfall	Follow existing surface profiles	Accommodating for drainage, verge, medians, raised pedestrian crossings and intersecting roads.
Maximum grade	3%	DS03 Road Design
Design Vehicle	15.7m Tag Steer Bus	
Check Vehicle	19m Semi	Allow for full occupation of road carriageway.
Two-way Off-road Cycle Path Width	3.0m	
Two-way Shared Path Width	3.0m	

1.3 Light Rail Design Parameters

The light rail design review will be undertaken in accordance with the parameters listed in Table 3 and Table 4.

The criteria has been extracted from “Appendix 17 – Trackwork Scope and Performance Requirements” which has been provided by the Client.

Table 3: Light Rail Design Review Criteria

Design Parameter	Value	Notes
Design vehicle	33m long LRV	
Platform minimum Width/length	Side Platforms 4.0m width/33.0m length Island Platforms 5.5m width/33.0m length	
Minimum horizontal curve radius	25m	
Minimum horizontal element length	12m (absolute) 15m (desirable)	
Minimum vertical curve radius	500m (absolute) 600m (desirable)	All vertical curves must be parabolic vertical curves having a constant rate of change in grade
Minimum vertical curve length	12m (absolute) 20m (desirable)	
Maximum Grades	3.5% (desirable-mainline track) 7% (absolute-mainline track) 0.5% (desirable-stops) 2.5% (absolute-stops)	

Table 4: Light Rail Horizontal Clearance Requirements

Item	Comment	Value (From DKE)
DKE to DKE	Two LRV's passing	100mm
OLE pole between tracks	Assume OLE pole has 350mm dia.	100mm
Nearest edge of Sign / traffic signal mounted at least 2.1m high		100mm
Isolated mast / structure in side reservation not exceeding 500mm in length	In Public Realm In Depot	200mm 100mm
Continuous structure greater than 500mm in length, located in the carriageway or side reservations – include street furniture	Absolute minimum – to provide a survivable space only to provide a maintenance walkway / emergency egress (without LRVs running)	600mm 850mm
Nearest face of traffic lane	V≤60km/h V>60km/h	300mm 550mm

Nearest face of cycleway / footpath without separation	V≤ 30km/h V>30km/h Where possible separate the footpath from the rail corridor either using; raised kerb, planting, textured paving or an intermittent bollard every 3.0m – discuss options with urban design and rail regulator.	300mm 550mm
To any object in a pedestrianised precinct		1400mm (300mm outside DKE, plus 800mm textured paving and visually – contrasting band, plus 300mm clearance)
Platform coping edge	To give a 50mm maximum horizontal stepping distance To give 50mm maximum vertical stepping distance	1375mm from track centre line 300mm above rail (subject to rolling stock selection)

Appendix G. Utilities Conflicts Register

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Schedule 2.2(a)(iii)

[redacted]

Appendix I. Pavement Options Report

JACOBS

Memorandum

Level 7, 177 Pacific Highway
North Sydney NSW 2060 Australia
PO Box 632 North Sydney
NSW 2059 Australia
T +61 2 9928 2100
F +61 2 9928 2444
www.jacobs.com

Subject Pavement Options Report

Project Name Woden Bus Interchange and Road Layout Modifications

Attention [redacted]

Project No. IS268800

From [redacted]

Date 25 June 2019

Copies to Project team

---

1. Introduction

This report presents the results of pavement design works and provides design options for the proposed Woden Bus Interchange and Road Layout Modifications project. The works were undertaken at the request of Transport Canberra, road authority, and were carried out in liaison with various members of the Jacobs design team. Details of the work undertaken and the results obtained are provided herein.

This report should be read in conjunction with the Geotechnical Desktop Study (GDS) prepared under separate cover (Jacobs, 2019a). The GDS includes commentary on regional mapping and relevant investigation data for the region, and provides recommendations for these works.

2. Design description

A new bus interchange and upgrades to surrounding roads is proposed. Associated works include demolition of the existing off-street bus interchange, construction of a new on-street bus interchange, localised road widenings and upgrades to the verges of Callam, Matilda, Bowes, Bradley and Neptune Streets. The master plan is illustrated on the drawing included as Attachment A.

Project development is currently at the preliminary sketch plan (PSP) stage, the scope of which comprises design of a new on-street bus interchange on Callam and Bradley Streets, widening of Callam Street between Matilda and Launceston Streets, and upgrades to adjoining verges. Other works illustrated on the master plan form part of subsequent design stages and as such, are not addressed in this submission.

3. Design criteria

3.1 Reference documents

Pavement designs were prepared in accordance with Territory and Municipal Services (TAMS) Trunk Road Infrastructure Standard 06 (TAMS, 2012). The standard requires design in accordance with the 2012 version of the Austroads guide (Austroads, 2012) and 2011 version of the RMS Austroads supplement (RMS, 2011), both of which are now superseded.

As the standard is yet to be revised to support use of the new Austroads guide (Austroads, 2017), the specified version of the guide and most recent applicable version of the RMS Austroads supplement were adopted. Details of the reference documents used are provided below.

- TAMS (2012), *Trunk Road Infrastructure Standard No. 06, Pavement Design, Supplement to Austroads Guide: Pavement Technology*, Publication No. TRIS06, henceforth referred to as TRIS06-12.
- Austroads (2012), *Guide to Pavement Technology, Part 2: Pavement Structural Design,* Publication No. AGPT02-12, henceforth referred to as AGPT02-12.
- RMS (2015), *RMS Austroads Supplement for Guide to Pavement Technology – Part 2: Pavement Structural Design*, Publication No. 11.050, Version 2.2, henceforth referred to as RMSAGS-15.

The above should be reviewed in subsequent design stages when project specific requirements are confirmed and if TRIS06-12 is revised.

3.2 Project reliability

A project reliability factor was adopted in accordance with Table 2.1 of AGPT02-12. A value of 95 per cent was considered appropriate.

3.3 Design period

A design period was adopted in accordance with Table 7.2 of AGPT02-12. A value of 40 years was considered appropriate.

3.4 Design traffic

Design traffic loadings were calculated using Equation 14 of AGPT02-12. Due to the absence of project specific data in the brief, calculations were based on forecast future average daily traffic (ADT) volumes obtained from the Aimsun traffic model. Heavy vehicle proportions and annual growth rates were also obtained from the model. Where the model indicated forecast growth of less than one per cent per annum, a minimum rate of one per cent was adopted in accordance with Section 7.4 of RMSAGS-15.

As a project specific axle group load distribution was also omitted from the brief, the number of heavy vehicle axle groups per heavy vehicle (N_{HVAG}) was calculated using the presumptive urban axle group load distribution provided as Table 17 in RMSAGS-18. A copy of the distribution is included as Attachment B. A summary of the input parameters used for the calculations is provided in Table 1.

Table 1 – Input parameters for design traffic calculations

Road name	AADT* (vehicles)	DF	HV (%)	LDF	R (%)	P (years)	CGF	N_{HVAG}
Callam Street	10,000	0.5	4.5	1.0	1.0	40	48.9	2.71
Bradley Street	2,000	0.5	17.9	1.0	1.0	40	48.9	2.71

* Forecast future ADT assumed equal to AADT for calculation

A traffic load distribution (TLD) was calculated using the presumptive urban axle group load distribution. The axle group proportions and TLD are summarised in Tables 2 and 3, respectively.

Table 2 – Axle group proportions

Axle group type and proportion					
SAST	**SADT**	**TAST**	**TADT**	**TRDT**	**QADT**
0.3474	0.1665	0.0214	0.3116	0.1515	0.0016

Table 3 – Traffic load distribution

Material	Damage type	Damage exponent (m)	Damage index	TLD
Pavement	Overall	4	ESA/HVAG	1.04
			ESA/HV	2.82
Asphalt	Fatigue	5	SAR_5/ESA	1.17
Subgrade	Rutting and shape loss	7	SAR_7/ESA	1.75
Cemented	Fatigue	12	SAR_{12}/ESA	6.84

The input parameters and TLD were then used to calculate design traffic loadings for pavement design. The loadings are provided in Table 4.

Table 4 – Design traffic loadings for pavement design

Road name	First year	Design traffic loading				
		HVAG	**DESA**	**$DSAR_5$**	**$DSAR_7$**	**$DSAR_{12}$**
Callam Street	2022	1.09E+07	1.13E+07	1.27E+07	1.90E+07	7.44E+07
Bradley Street	2022	8.66E+06	9.00E+06	1.01E+07	1.51E+07	5.92E+07

3.5 Design subgrade

A design subgrade CBR value was adopted in accordance with the recommendations provided in Section 6.2 of the GDS (Jacobs, 2019a). A value of three per cent is specified.

4. Design methodology

4.1 Design strategy

The PSP drawings (Jacobs, 2019b) indicate an upgrade to Callam and Bradley Streets is proposed. The upgrade necessitates typical brownfield works including widening, level correction and resurfacing but most notably, a change in function for the subject roads. The general through-traffic arrangement which characterises the existing condition changes to numerous stop-start movements of heavy vehicles proceeding through an on-street bus interchange.

Whilst the composition and remaining life of the existing pavements is unknown at this stage, it is likely that the pavements were not designed for the application now proposed. On this basis, it is unlikely that the pavements are sufficiently robust and contain adequate structural capacity to accommodate future traffic loadings. For this reason, full reconstruction was adopted for the interchange supplemented by localised widening and resurfacing, where necessary.

The above should be reviewed in subsequent design stages when the results of site specific investigations become available.

4.2 Option descriptions

A total of nine pavement design options were developed. Eight options were developed for the interchange on Callam Street (Options 1A to 1D) and Bradley Street (Options 2A to 2D). A single option (Option 3) was developed for Callam Street widening.

Typical heavy duty pavement configurations were considered appropriate. A description of the options is provided in Table 5.

Table 5 – Description of pavement design options

Option number	Option name	Description	Pavement type
1A	Callam Interchange	Bus interchange between Matilda and Bradley Streets	JRCP
1B			Thick asphalt over LCS
1C			Thick asphalt over HBM
1D			Full depth asphalt
2A	Bradley Interchange	Bus interchange between Callam and Neptune Streets	JRCP
2B			Thick asphalt over LCS
2C			Thick asphalt over HBM
2D			Full depth asphalt
3	Callam Widening	Widening of Callam Street between Matilda and Launceston Streets	Full depth asphalt

5. Design details

5.1 Rigid pavement

5.1.1 Design subgrade strength

A design subgrade strength (CBR_E) was calculated using Equation 25 of AGPT02-12. The calculation was based on a multi-layered subgrade system, details of which are provided in Table 6.

Table 6 – Multi-layered subgrade system

Layer number	Depth below subbase (m)	Layer thickness (m)	Material description	Soaked CBR (%)
1	0.0 – 0.3	0.3	Selected material	33
2	0.3 – 1.0	0.7	Residual clay	3

Based on the above, a design subgrade strength of eight per cent was calculated.

5.1.2 Subbase type

A subbase type was adopted in accordance with Table 9.1 of AGPT02-12. Based on the design traffic loadings in Table 4, a subbase type comprising 150 millimetres and 125 millimetres of lean-mix concrete (LCS) was adopted for Options 1 and 2, respectively.

5.1.3 Effective subgrade strength

An effective subgrade strength was adopted in accordance with Figure 9.1 of AGPT02-12. A value of 75 per cent was calculated for both Options 1 and 2 based on the design subgrade strength (i.e. eight per cent) and subbase type (i.e. LCS).

5.1.4 Base concrete strength

A base concrete strength was adopted in accordance with Section 9.3.3 of AGPT02-12. A minimum characteristic 28-day flexural strength of 4.5 MPa is nominated. Additional reference to Table R83.7 in RMS R83 (RMS, 2017) indicates 28-day compressive strength must not be less than 40 MPa for non-SCM mixes.

5.1.5 Concrete shoulders

Thickness design based on ‘with shoulder’ criteria was undertaken in accordance with Section 9.3.5 of AGPT02-12. As the proposed pavement will include Type KG kerb and gutter of similar strength grade to the base (i.e. 32 MPa) and tied to the base for load transfer, with shoulder support was considered appropriate.

5.1.6 Load safety factor

A load safety factor (L_{SF}) was adopted in accordance with Table 9.2 of AGPT02-12. A value of 1.2 is specified based on the project reliability factor (i.e. 95 per cent) and pavement type (i.e. JRCP).

5.2 Flexible pavement

5.2.1 Asphalt

The following types of asphalt were used in the design:

- Stone mastic asphalt: SMA10 A15E
- Dense graded asphalt: AC14HD AR450
- Dense graded asphalt: AC20HD AR450

Asphalt modulus values were calculated in accordance with the guidelines included in Section 6.5.3 of RMSAGS-15. Calculations were performed using version 6B of the RMS AC Modulus program and the default volumetric and binder properties specified. The volumetric inputs and binder properties adopted are provided in Tables 7 and 8, respectively.

Table 7 – Volumetric inputs for asphalt modulus calculations

Mix description	Bulk density of mineral aggregate (t/m^3)	Binder density (t/m^3)	Total binder content (% by mass)	Binder absorption (%)	Design air voids (%)
SMA10 A15E	2.65	1.043	6.7	0.3	6.0
AC14HD AR450	2.65	1.043	5.2	0.3	6.0
AC20HD AR450	2.65	1.043	4.9	0.3	6.0

Table 8 – Binder penetration and viscosity properties

Binder class	Penetration at 25ºC (0.1mm)	Viscosity at 60ºC (Pa.s)
AR450	31*	970*

* Value after rolling thin film oven test (RTFOT) treatment

Heavy vehicle load speeds were adopted in accordance with Table 13 of RMSAGS-15. A weighted mean annual pavement temperature (WMAPT) was adopted using data from Appendix B of AGPT02-12. The load speed and temperature properties adopted are provided in Table 9.

Table 9 – Load speed and temperature properties

Road name	Posted speed limit (km/h)	Average longitudinal grade (%)	Heavy vehicle load speed (km/h)	WMAPT (ºC)
Callam Street	40	<3	20	23
Bradley Street	40	<3	20	23

The input variables outlined in Tables 7 to 9 were then used to calculate modulus values for the asphalt mixes. Commensurate with the requirements of Section 6.5.3 of RMSAGS-15, design values were rounded to two significant figures. The detailed calculation sheets are included as Attachment C. Asphalt modulus values for pavement design are provided in Table 10.

Table 10 – Asphalt modulus values for pavement design

Mix ID	Mix description	Nominal mix modulus (MPa)	Modulus adjustment factor	Design mix modulus (MPa)	Poisson's ratio	Performance constant (k)
1	SMA10 A15E	1,811	0.75	1,800	0.40	0.006084
2	AC14HD AR450	3,519	1.00	3,500	0.40	0.003816
3	AC20HD AR450	3,799	1.00	3,800	0.40	0.003522

5.2.2 Cemented material

Presumptive values for modulus and Poisson's ratio were adopted for lean-mix concrete subbase (LCS) and heavily bound material (HBM) in accordance with Table 6.7 of AGPT02-12. Values for the performance constant were calculated using Equation 7 of AGPT02-12. The values adopted are provided in Table 11.

Table 11 – Design properties for cemented materials

Material	Design modulus (MPa)	Poisson's ratio	Performance constant (k)
LCS	10,000	0.20	0.000260
HBM	5,000	0.20	0.000310

5.2.3 Selected material

The modulus of selected material was adopted as the minimum of 150 MPa and the values calculated from Equations 2 and 19 of AGPT02-12. A presumptive value of Poisson's ratio was adopted in accordance with Table 6.3 of AGPT02-12. The performance constant was calculated using Equation 3 of AGPT02-12. The values adopted are provided in Table 12

Table 12 – Design properties for selected material

Design modulus (MPa)	Poisson's ratio	Performance constant (k)
120	0.35	0.009300

5.2.4 Subgrade

Subgrade modulus was calculated using Equation 2 of AGPT02-12. A presumptive value of Poisson's ratio was adopted in accordance with Section 5.6 of AGPT02-12. The performance constant was calculated using Equation 3 of AGPT02-12. The values adopted are provided in Table 13.

Table 13 – Design properties for subgrade

Design modulus (MPa)	Poisson's ratio	Performance constant (k)
30	0.45	0.009300

5.3 Thickness designs

Options 1A and 2A were designed in accordance with the procedure outlined in Section 9.4.2 of AGPT02-12. The calculations were performed using an in-house spreadsheet and the input variables outlined in Sections 3 and 5.1. The calculation outputs are included as Attachment D. A 10 millimetre construction tolerance and an additional 10 millimetre grinding provision were added to the thickness of the critical layer in accordance with Section 2.2 of RMSAGS-15.

All other options were designed using CIRCLY software (version 6.0) and the input variables outlined in Sections 3 and 5.2. The CIRCLY design outputs are included as Attachment E. A 10 millimetre construction tolerance was added to the thickness of the critical layer in accordance with Section 2.2 of RMSAGS-15. The thickness designs are presented in Tables 14 to 22. Pavement plans are included as Attachment F.

Table 14 – Pavement Type 1: Callam Interchange (Option 1A)

Thickness (mm)	Pavement material	RMS specification
195*	JRCP with SL82 mesh (60mm cover)	R83
-	Debonding treatment	R82
150	LCS	R82
-	7mm primerseal	R106
300	Selected material (CBR≥33%)	R44, 3071
-	Subgrade (Design CBR≥3%)	R44
645	**Total (mm)**	

* Includes 10 millimetre construction tolerance and 10 millimetre grinding provision

Table 15 – Pavement Type 1: Callam Interchange (Option 1B)

Thickness (mm)	Material	RMS specification
45	SMA10 A15E	R121
45	AC14HD AR450	R116
85	AC20HD AR450	R116
-	7mm low cutter seal (C170)	R106
175*	LCS	R82
-	7mm primer seal (C170)	R106
300	Selected material (CBR≥33%)	R44, 3071
-	Subgrade (Design CBR≥3%)	R44
650	**Total (mm)**	

* Includes 10 millimetre construction tolerance

Table 16 – Pavement Type 1: Callam Interchange (Option 1C)

Thickness (mm)	Material	RMS specification
45	SMA10 A15E	R121
45	AC14HD AR450	R116
85	AC20HD AR450	R116
-	7mm low cutter seal (C170)	R106
220*	HBM	R73
-	7mm primer seal (C170)	R106
300	Selected material (CBR≥33%)	R44, 3071
-	Subgrade (Design CBR≥3%)	R44
695	**Total (mm)**	

* Includes 10 millimetre construction tolerance

Table 17 – Pavement Type 1: Callam Interchange (Option 1D)

Thickness (mm)	Material	RMS specification
45	SMA10 A15E	R121
45	AC14HD AR450	R116
180*	AC20HD AR450	R116
-	7mm low cutter seal (C170)	R106
300	Selected material (CBR≥33%)	R44, 3071
-	Subgrade (Design CBR≥3%)	R44
570	**Total (mm)**	

* Includes 10 millimetre construction tolerance

Table 18 – Pavement Type 2: Bradley Interchange (Option 2A)

Thickness (mm)	Pavement material	RMS specification
190*	JRCP with SL82 mesh (60mm cover)	R83
-	Debonding treatment	R82
125	LCS	R82
-	7mm primerseal	R106
300	Selected material (CBR≥33%)	R44, 3071
-	Subgrade (Design CBR≥3%)	R44
615	**Total (mm)**	

* Includes 10 millimetre construction tolerance and 10 millimetre grinding provision

Table 19 – Pavement Type 2: Bradley Interchange (Option 2B)

Thickness (mm)	Material	RMS specification
45	SMA10 A15E	R121
45	AC14HD AR450	R116
85	AC20HD AR450	R116
-	7mm low cutter seal (C170)	R106
170*	LCS	R82
-	7mm primer seal (C170)	R106
300	Selected material (CBR≥33%)	R44, 3071
-	Subgrade (Design CBR≥3%)	R44
645	**Total (mm)**	

* Includes 10 millimetre construction tolerance

Table 20 – Pavement Type 2: Bradley Interchange (Option 2C)

Thickness (mm)	Material	RMS specification
45	SMA10 A15E	R121
45	AC14HD AR450	R116
85	AC20HD AR450	R116
-	7mm low cutter seal (C170)	R106
215*	HBM	R73
-	7mm primer seal (C170)	R106
300	Selected material (CBR≥33%)	R44, 3071
-	Subgrade (Design CBR≥3%)	R44
690	**Total (mm)**	

* Includes 10 millimetre construction tolerance

Table 21 – Pavement Type 2: Bradley Interchange (Option 2D)

Thickness (mm)	Material	RMS specification
45	SMA10 A15E	R121
45	AC14HD AR450	R116
175*	AC20HD AR450	R116
-	7mm low cutter seal (C170)	R106
300	Selected material (CBR≥33%)	R44, 3071
-	Subgrade (Design CBR≥3%)	R44
565	**Total (mm)**	

* Includes 10 millimetre construction tolerance

Table 22 – Pavement Type 3: Callam Widening (Option 3)

Thickness (mm)	Material	RMS specification
50	AC14HD AR450	R116
210*	AC20HD AR450	R116
-	7mm low cutter seal (C170)	R106
300	Selected material (CBR≥33%)	R44, 3071
-	Subgrade (Design CBR≥3%)	R44
560	**Total (mm)**	

* Includes 10 millimetre construction tolerance

5.4 Preferred options

At the time of report preparation, cost estimation works had not been completed. As such, an indicative capital cost for each respective option was not known. Based on experience with similar design and D&C contracts however, JRCP and thick asphalt over LCS pavement types are expected to be of highest capital cost with thick asphalt over HBM likely to be the lowest.

In the selection of preferred options, consideration must be given to both the upfront capital cost and whole-of-life cost with options having the lowest whole-of-life costs typically preferred. Maintenance costs, which are a function of the longer-term performance of the pavement, can constitute an appreciable component of the whole-of-life cost. For this reason, low maintenance costs are preferable.

Maintenance requirements for thick asphalt and full depth asphalt options are generally similar and comprise localised heavy patching and replacement of the wearing and upper intermediate courses every eight to 12 years. In the case of the JRCP option however, maintenance requirements are likely to be limited to occasional resealing of joints and a single grinding operation to improve surface texture and ride quality, and reduce dynamic loading (if necessary). On this basis, the JRCP option is likely to have the lowest maintenance cost.

In this case however, the proposed interchange necessitates numerous stop-start movements of heavy vehicles which will apply constant and consistent breaking and acceleration forces to the pavement. Experience indicates thick asphalt and full depth asphalt pavements can experience difficulty in resisting this type of load pattern and as a result, can exhibit premature distress in the form of deformation (i.e. rutting) early in the design life. High volumes of heavy vehicles also increase the likelihood of oil drips and diesel spills which can cause binder softening and reduced skid resistance. Consequently, these pavements would be expected to require additional interventions to those outlined above for such application.

With the above in mind, Options 1A and 2A (i.e. JRCP) are considered likely to have the lowest whole-of-life cost and for this reason, are preferred. The JRCP pavement type is considered common for such facilities and is well suited to short lengths, irregular shapes and construction under traffic where piecemeal progress is required.

The above should be reviewed in subsequent design stages when cost estimates are completed and when comparison with the funding allocation can be made.

5.5 Other pavements

The PSP drawings (Jacobs, 2019b) indicate other pavements are necessary for applications including resurfacing, raised medians, driveways and footways. Design of these pavements was based on various ACT Government design guidelines and standard drawings, and relevant RMS documents. Applicable references are included below with thickness designs presented in Tables 23 to 26. It is noted that the pavements were not mechanistically designed and that construction tolerances have not been applied.

Table 23 – Pavement Type 4: Mill and resheet

Thickness (mm)	Material	RMS specification
50	AC14HD AR450	R116
-	Tack coat	R116
-	Existing pavement*	M250
50	**Total (mm)**	

* Heavy patch where required prior

Table 24 – Pavement Type 5: Raised median

Thickness (mm)	Material	RMS specification
120	N25 concrete with SL82 mesh (50mm cover)	R53, R173
100	DGS20	R71, 3051
-	Subgrade	
220	**Total (mm)**	

Table 25 – Pavement Type 6: Commercial driveway

Thickness (mm)	Material	RMS specification
200	N32 concrete with SL82 mesh (80mm cover)	R53, R173
100	DGS20	R71, 3051
-	Subgrade	
300	**Total (mm)**	

Table 26 – Pavement Type 7: Shared path

Thickness (mm)	Material	RMS specification
150	N32 concrete with SL82 mesh (70mm cover)	R53, R173
100	DGS20	R71, 3051
-	Subgrade	
250	**Total (mm)**	

It is noted that an alternate flexible pavement was considered for Pavement Type 7. Reference to ACT Government Standard Drawing ACTSC-0501 (TAMS, 2018) indicates a 225 millimetre thick flexible pavement with 25 millimetre thick fine gap graded asphalt surfacing could be used. In this case however, the path is proposed to be flanked by stands of trees (refer Attachment A). As thin flexible pavements can experience rapid deterioration in such circumstances, have higher maintenance costs and are typically unfavoured by asset managers, a rigid pavement was adopted.

6. Limitations

This report has been prepared in the absence of detailed traffic, geotechnical and cost estimate data. As such, the contents of this report must be considered preliminary and requiring review in subsequent design stages when further information becomes available.

I trust that the above is in accordance with current requirements and confirms our recent discussions. Please contact the undersigned should you require any further information on the above.

Yours sincerely,

Schedule 2.2(a)(ii)

Schedule 2.2(a)(ii)

Principal Pavement Engineer

Schedule 2.2(a)(ii)

References:

Austroads (2017), *Guide to Pavement Technology Part 2: Pavement Structural Design*, Publication No. AGPT02-17, December 2017.

Austroads (2012), *Guide to Pavement Technology, Part 2: Pavement Structural Design*, Publication No. AGPT02-12, February 2012.

Jacobs (2019a), *Woden Bus Interchange and Road Layout Modifications, Geotechnical Desktop Study*, Document No. IS268800-ME-GD-003_Rev01, June 2019.

Jacobs (2019b), *ACT Government, Woden Bus Interchange and Road Layout Modifications, PSP Design, July 2019.*

RMS (2019), *QA Specification R121, Stone Mastic Asphalt*, Edition 3, Revision 1, May 2019.

RMS (2018), *RMS Supplement to Austroads Guide to Pavement Technology Part 2: Pavement Structural Design*, Publication No. 11.050, Version 3.0, August 2018.

RMS (2018), *QA Specification R71, Construction of Unbound and Modified Pavement Course*, Edition 5, Revision 0, August 2018.

RMS (2018), *QA Specification 3051, Granular Base and Subbase Materials for Surfaced Road Pavements*, Edition 7, Revision 0, August 2018.

RMS (2018), *QA Specification R82, Lean-mix Concrete Subbase*, Edition 4, Revision 0, March 2018.

RMS (2017), *QA Specification R83, Concrete Pavement Base*, Edition 3, Revision 1, October 2017.

RMS (2017), *QA Specification R73, Construction of Plant Mixed Heavily Bound Pavement Course*, Edition 3, Revision 1, August 2017.

RMS (2017), *QA Specification R173, General Concrete Paving*, Edition 2, Revision 3, June 2017.

RMS (2017), *QA Specification 3071, Selected Material for Formation Layers*, Edition 2, Revision 1, May 2017.

RMS (2015), *RMS Austroads Supplement for Guide to Pavement Technology – Part 2: Pavement Structural Design*, Publication No. 11.050, Version 2.2, January 2015.

RMS (2014), *QA Specification R44, Earthworks*, Edition 5, Revision 0, September 2014.

RMS (2013), *QA Specification M250, Heavy Patching (Flexible Pavement),* Edition 2, Revision 0, November 2013.

RMS (2013), *QA Specification R116, Heavy Duty Dense Graded Asphalt*, Edition 8, Revision 4, July 2013.

RMS (2013), *Pavement Standard Drawings, Rigid Pavement, Bicycle Path Design – 3.0m Wide, Slab Plan and Details*, Edition 1, Revision 0, July 2013.

RMS (2013), *QA Specification R53, Concrete (For General Use), Mortar and Grout*, Edition 2, Revision 2, June 2013.

RMS (2012), *QA Specification R106, Sprayed Bituminous Surfacing (with Cutback Bitumen)*, Edition 4, Revision 1, October 2012.

RMS (2011), *RMS Austroads Supplement for Guide to Pavement Structural Design*, Publication No. 11.050, Version 1.0, January 2011.

TAMS (2019), *Design Standards for Urban Infrastructure, 6 Pavement Design*, Edition 1, Revision 0, undated.

TAMS (2019), *ACT Government Standard Drawing, Heavy Duty Driveways*, Drawing No. ACTSD-0702, Draft No. 151123, undated.

TAMS (2018), *ACT Government Standard Drawing, Paths Standard Details*, Drawing No. ACTSD-0501, September 2018.

TAMS (2012), *Trunk Road Infrastructure Standard No. 06, Pavement Design, Supplement to Austroads Guide: Pavement Technology*, Publication No. TRIS06, October 2012.

TAMS (2010), *Design Standards for Urban Infrastructure, 5 Driveways*, Edition 1, Revision 1, March 2010.

TAMS (2002), *ACT Government Standard Drawing, Kerb & Gutter Standard Details*, Drawing No. DS3-01 and 2, Sheets 1 and 2, August 2002.

Attachments:

Attachment A – Master plan
Attachment B – Axle group load distribution
Attachment C – Asphalt modulus calculations
Attachment D – JRCP design output
Attachment E – CIRCLY design output
Attachment F – Pavement plans

Attachment A – Master plan

Woden Bus Interchange

Alternative Light Rail Alignment

OPTION 3

Legend

- Bus Bay
- Light Rail Track
- 🟩 Bus Shelter
- 🟨 Light Rail Shelter
- 🟧 Dual Light Rail/Bus Shelter
- Accessibility Ramp
- ● Street Trees
- ▨ Pedestrian Crossing
- ▨ Paving
- Arbour Shelters
- Bike Path

JACOBS

WODEN BUS INTERCHANGE

PREPARED BY: SM
SHEET: 1
DATE: 29/4/2019

Attachment B – Axle group load distribution

Presumptive Urban Axle Group Load Distribution (Table 17, RMSAGS-18)

Axle group load	Axle group type					
	SAST	SADT	TAST	TADT	TRDT	QADT
(kN)	%	%	%	%	%	%
10	0.0000	1.6515	0.0000	0.0231	0.0000	0.0000
20	0.3561	4.0040	0.0000	0.3002	0.0150	0.0111
30	13.3571	12.9448	0.0994	0.8502	0.0543	0.0000
40	12.7317	19.9020	0.2239	2.4396	0.2766	0.0111
50	21.0980	16.8290	1.1010	4.5192	0.8964	0.0222
60	37.5276	14.0346	4.4791	6.8000	2.0169	0.1441
70	14.1590	10.8988	11.8182	8.5507	3.6390	0.8646
80	0.6755	8.4266	17.1939	8.9734	5.1633	2.2611
90	0.0670	6.1059	18.0200	7.9581	6.4251	5.1984
100	0.0280	3.4667	17.6748	6.3826	6.6290	8.3906
110	0	1.2478	13.8650	5.3969	5.9452	9.8647
120	0	0.3592	7.4612	5.1905	4.9118	9.2552
130	0	0.1064	3.0661	5.5013	4.4113	6.2625
140	0	0.0227	1.8617	6.2101	4.1930	3.9459
150	0	0	1.8641	6.8837	4.3453	3.9348
160	0	0	1.2716	7.2850	4.5746	3.6134
170	0	0	0	7.1770	4.8813	3.1368
180	0	0	0	5.4063	5.2969	3.2698
190	0	0	0	2.7516	5.7355	3.4915
200	0	0	0	0.9769	6.2336	4.0900
210	0	0	0	0.2961	6.4650	4.4779
220	0	0	0	0.0899	6.0455	4.7218
230	0	0	0	0.0294	4.8250	4.0789
240	0	0	0	0.0082	3.2879	3.0814
250	0	0	0	0	1.9568	2.3055
260	0	0	0	0	1.0135	2.1281
270	0	0	0	0	0.4719	2.0727
280	0	0	0	0	0.1916	2.1392
290	0	0	0	0	0.0806	1.8843
300	0	0	0	0	0.0181	1.8732
310	0	0	0	0	0	1.1527
320	0	0	0	0	0	0.7537
330	0	0	0	0	0	0.6096
340	0	0	0	0	0	0.4323
350	0	0	0	0	0	0.4101
360	0	0	0	0	0	0.1108
370	0	0	0	0	0	0
380	0	0	0	0	0	0
390	0	0	0	0	0	0
400	0	0	0	0	0	0
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

Group proportions	**0.3474**	**0.1665**	**0.0214**	**0.3116**	**0.1515**	**0.0016**

Attachment C – Asphalt modulus calculations

DESIGN ASPHALT MODULUS

Project details: IS268800.1_SMA10_A15E_20km/h

Date: 14 June 2019

Designer: [redacted] Schedule 2.2(a)(ii)

AC Modulus version: 6B (01 March 2018)

Design references: Roads and Maritime Supplement to Austroads Part 2
Roads and Maritime asphalt and material specifications
Austroads Part 2: Pavement Structural Design (AGPT02-17)

Inputs

Mix type: SMA10

Binder grade: A15E

Modulus adjustment factor: 0.75

Total binder content (by mass): 6.7%

Binder absorption: 0.3%

Binder density: 1.043 tonnes/m3

Insitu air voids: 6.0%

Combined bulk density of mineral aggregate: 2.65 tonnes/m3

Bitumen penetration at 25° C (0.1 mm): 31 (after RTFO)

Bitumen viscosity at 60° C: 970 Pa.s (after RTFO)

Loading speed: 20 km/h

WMAPT: 23.0° C

Results

Time of loading: 0.05 seconds

Bitumen T800 pen: 58.1° C

Bitumen Penetration Index: -0.4

Binder stiffness: 24.1 MPa

Binder volume: 14.0%

Aggregate volume: 80.0%

Nominal mix modulus: 1,811 MPa

Adjusted mix modulus: 1,800 MPa

CIRCLY (k) value: 0.006084

DESIGN ASPHALT MODULUS

Project details:	IS268800.2_AC14_AR450_20km/h
Date:	14 June 2019
Designer:	Schedule 2.2(a)(ii)
AC Modulus version:	6B (01 March 2018)
Design references:	Roads and Maritime Supplement to Austroads Part 2 Roads and Maritime asphalt and material specifications Austroads Part 2: Pavement Structural Design (AGPT02-17)

Inputs

Mix type:	AC14
Binder grade:	C450
Modulus adjustment factor:	1
Total binder content (by mass):	5.2%
Binder absorption:	0.3%
Binder density:	1.043 tonnes/m3
Insitu air voids:	6.0%
Combined bulk density of mineral aggregate:	2.65 tonnes/m3
Bitumen penetration at 25° C (0.1 mm):	31 (after RTFO)
Bitumen viscosity at 60° C:	970 Pa.s (after RTFO)
Loading speed:	20 km/h
WMAPT:	23.0° C

Results

Time of loading:	0.05 seconds
Bitumen T800 pen:	58.1° C
Bitumen Penetration Index:	-0.4
Binder stiffness:	24.1 MPa
Binder volume:	10.9%
Aggregate volume:	83.1%
Nominal mix modulus:	3,519 MPa
Adjusted mix modulus:	3,500 MPa
CIRCLY (k) value:	0.003816

DESIGN ASPHALT MODULUS

Project details:	IS268800.3_AC20_AR450_20km/h
Date:	14 June 2019
Designer:	[redacted] Schedule 2.2(a)(ii)
AC Modulus version:	6B (01 March 2018)
Design references:	Roads and Maritime Supplement to Austroads Part 2 Roads and Maritime asphalt and material specifications Austroads Part 2: Pavement Structural Design (AGPT02-17)

Inputs

Mix type:	AC20
Binder grade:	C450
Modulus adjustment factor:	1
Total binder content (by mass):	4.9%
Binder absorption:	0.3%
Binder density:	1.043 tonnes/m3
Insitu air voids:	6.0%
Combined bulk density of mineral aggregate:	2.65 tonnes/m3
Bitumen penetration at 25° C (0.1 mm):	31 (after RTFO)
Bitumen viscosity at 60° C:	970 Pa.s (after RTFO)
Loading speed:	20 km/h
WMAPT:	23.0° C

Results

Time of loading:	0.05 seconds
Bitumen T800 pen:	58.1° C
Bitumen Penetration Index:	-0.4
Binder stiffness:	24.1 MPa
Binder volume:	10.3%
Aggregate volume:	83.7%
Nominal mix modulus:	3,799 MPa
Adjusted mix modulus:	3,800 MPa
CIRCLY (k) value:	0.003522

Attachment D – JRCP design output

JRCP BASE THICKNESS DESIGN
Design procedure: Section 9.4.2 (Austroads, 2012)
Callum Interchange (Option 1A)

INPUT FACTORS

Base pavement type	Dowelled	(Dowelled/Undowelled)
Concrete shoulders?	Yes	(Yes/No)
Source of load data	RMSAGS-18 (Table 17)	

Design traffic	1.09E+07	(HVAG)

Axle group proportions

SAST	0.3474
SADT	0.1665
TAST	0.0214
TADT	0.3116
TRDT	0.1515
QADT	0.0016

Design subgrade strength	8	(%)
Subbase thickness	150	(mm)
Subbase type	LMC	(LMC/Bound)
Effective subgrade CBR	75	(%)
28 day flexural strength	4.50	(MPa)
28 day compressive strength	40	(MPa)
Project reliability	95	(%)
Load safety factor	1.2	
Trial base thickness	171	(mm)

RESULTS

Total Fatigue	**99.8%**
Total Erosion	**37.2%**

Base Thickness Design Method	Thickness (greater of)
- Section 9.4.2 (Austroads, 2012) - Rounded up to nearest 5mm - Plus 10mm construction tolerance (RMS, 2015) - Plus 10mm grinding provision (RMS, 2015)	195mm
- Table 9.7 (Austroads, 2012)	180mm

JRCP BASE THICKNESS DESIGN
Design procedure: Section 9.4.2 (Austroads, 2012)
Bradley Interchange (Option 2A)

INPUT FACTORS

Base pavement type	Dowelled ▼	(Dowelled/Undowelled)
Concrete shoulders?	Yes ▼	(Yes/No)
Source of load data	RMSAGS-18 (Table 17)	

Design traffic	8.66E+06	(HVAG)

Axle group proportions

SAST	0.3474
SADT	0.1665
TAST	0.0214
TADT	0.3116
TRDT	0.1515
QADT	0.0016

Design subgrade strength	8	(%)
Subbase thickness	125	(mm)
Subbase type	LMC	(LMC/Bound)
Effective subgrade CBR	75	(%)
28 day flexural strength	4.50	(MPa)
28 day compressive strength	40	(MPa)
Project reliability	95	(%)
Load safety factor	1.2	
Trial base thickness	170	(mm)

RESULTS

Total Fatigue	**93.7%**
Total Erosion	**31.6%**

Base Thickness Design Method	Thickness (greater of)
- Section 9.4.2 (Austroads, 2012) - Rounded up to nearest 5mm - Plus 10mm construction tolerance (RMS, 2015) - Plus 10mm grinding provision (RMS, 2015)	**190mm**
- Table 9.7 (Austroads, 2012)	**150mm**

Attachment E – CIRCLY design output

```
CIRCLY Pro - Version 6.0 (30 January 2015)

Job Title: IS268800_WBI_Type_1_Callum_Interchange (Option 1B)

Damage Factor Calculation

Assumed number of damage pulses per movement:
   Combined pulse for gear (i.e. ignore NROWS)

Traffic Spectrum Details:

   Load   Load                   Movements
   No.    ID
    1     ESA750-Full            1.09E+07

Details of Load Groups:

   Load   Load                  Load                  Load            Radius    Pressure/    Exponent
   No.    ID                    Category              Type                      Ref. stress
    1     ESA750-Full           ESA750-Full           Vertical Force     92.1    0.75         0.00

   Load Locations:
   Location   Load                  Gear          X          Y      Scaling     Theta
   No.        ID                    No.                             Factor
    1         ESA750-Full            1          -165.0        0.0   1.00E+00      0.00
    2         ESA750-Full            1           165.0        0.0   1.00E+00      0.00
    3         ESA750-Full            1          1635.0        0.0   1.00E+00      0.00
    4         ESA750-Full            1          1965.0        0.0   1.00E+00      0.00

Layout of result points on horizontal plane:
   Xmin:  0   Xmax:  165   Xdel:  165
   Y:     0

Details of Layered System:

   ID: IS268800.1B Title: WBI_Type_1_Callum_Interchange (Option 1B)

   Layer  Lower    Material               Isotropy   Modulus    P.Ratio
   No.    i/face   ID                                (or Ev)    (or vvh)  F          Eh         vh
    1     rough    IS268800_AC1           Iso.       1.80E+03   0.40
    2     rough    IS268800_AC2           Iso.       3.50E+03   0.40
    3     rough    IS268800_AC3           Iso.       3.80E+03   0.40
    4     rough    Cemen10000             Iso.       1.00E+04   0.20
    5     rough    Sel_CBR33c             Aniso.     1.20E+02   0.35      8.89E+01   6.00E+01   0.35
    6     rough    Sub_CBR3               Aniso.     3.00E+01   0.45      2.07E+01   1.50E+01   0.45

   Performance Relationships:
   Layer  Location Material               Component  Perform.   Perform.  Traffic
   No.             ID                                Constant   Exponent  Multiplier
    1     bottom   IS268800_AC1           ETH         0.006084    5.000     1.170
    2     bottom   IS268800_AC2           ETH         0.003816    5.000     1.170
    3     bottom   IS268800_AC3           ETH         0.003522    5.000     1.170
    4     bottom   Cemen10000             ETH         0.000260   12.000     6.840
    5     top      Sel_CBR33c             EZZ         0.009300    7.000     1.750
    6     top      Sub_CBR3               EZZ         0.009300    7.000     1.750

   Reliability Factors:
   Project Reliability: Austroads 95%
   Layer  Reliability  Material
    No.   Factor       Type
    1      1.00       Asphalt
    2      1.00       Asphalt
    3      1.00       Asphalt
    4      1.00       Cement Stabilised
    5      1.00       Subgrade (Selected Material)
    6      1.00       Subgrade (Austroads 2004)

   Details of Layers to be sublayered:
   Layer no.  5:  Austroads (2004) sublayering

Results:

   Layer  Thickness  Material               Load                    Critical       CDF
   No.               ID                     ID                      Strain
    1       45.00    IS268800_AC1           ESA750-Full             -4.23E-06      2.06E-09
    2       45.00    IS268800_AC2           ESA750-Full             -1.75E-05      2.59E-05
    3       85.00    IS268800_AC3           ESA750-Full              3.03E-06      1.28E-30
    4      165.00    Cemen10000             ESA750-Full             -5.63E-05      7.94E-01
    5      300.00    Sel_CBR33c             ESA750-Full              9.50E-05      2.22E-07
    6        0.00    Sub_CBR3               ESA750-Full              2.08E-04      5.36E-05
```

```
CIRCLY Pro - Version 6.0 (30 January 2015)

Job Title: IS268800_WBI_Type_1_Callum_Interchange (Option 1C)

Damage Factor Calculation

Assumed number of damage pulses per movement:
   Combined pulse for gear (i.e. ignore NROWS)

Traffic Spectrum Details:

   Load   Load                   Movements
   No.    ID
    1     ESA750-Full            1.09E+07

Details of Load Groups:

   Load   Load                  Load                  Load            Radius    Pressure/    Exponent
   No.    ID                    Category              Type                      Ref. stress
    1     ESA750-Full           ESA750-Full           Vertical Force     92.1    0.75         0.00

   Load Locations:
   Location   Load                  Gear          X          Y      Scaling     Theta
   No.        ID                    No.                             Factor
    1         ESA750-Full            1         -165.0        0.0   1.00E+00      0.00
    2         ESA750-Full            1          165.0        0.0   1.00E+00      0.00
    3         ESA750-Full            1         1635.0        0.0   1.00E+00      0.00
    4         ESA750-Full            1         1965.0        0.0   1.00E+00      0.00

Layout of result points on horizontal plane:
   Xmin:  0   Xmax:  165   Xdel:  165
   Y:     0

Details of Layered System:

   ID: IS268800.1C Title: WBI_Type_1_Callum_Interchange (Option 1C)

   Layer  Lower    Material               Isotropy   Modulus    P.Ratio
   No.    i/face   ID                                (or Ev)    (or vvh)  F          Eh         vh
    1     rough    IS268800_AC1           Iso.       1.80E+03   0.40
    2     rough    IS268800_AC2           Iso.       3.50E+03   0.40
    3     rough    IS268800_AC3           Iso.       3.80E+03   0.40
    4     rough    Cement5000             Iso.       5.00E+03   0.20
    5     rough    Sel_CBR33c             Aniso.     1.20E+02   0.35      8.89E+01   6.00E+01   0.35
    6     rough    Sub_CBR3               Aniso.     3.00E+01   0.45      2.07E+01   1.50E+01   0.45

   Performance Relationships:
   Layer  Location Material               Component  Perform.   Perform.  Traffic
   No.             ID                                Constant   Exponent  Multiplier
    1     bottom   IS268800_AC1           ETH         0.006084    5.000     1.170
    2     bottom   IS268800_AC2           ETH         0.003816    5.000     1.170
    3     bottom   IS268800_AC3           ETH         0.003522    5.000     1.170
    4     bottom   Cement5000             ETH         0.000310   12.000     6.840
    5     top      Sel_CBR33c             EZZ         0.009300    7.000     1.750
    6     top      Sub_CBR3               EZZ         0.009300    7.000     1.750

   Reliability Factors:
   Project Reliability: Austroads 95%
   Layer  Reliability  Material
    No.   Factor       Type
    1      1.00       Asphalt
    2      1.00       Asphalt
    3      1.00       Asphalt
    4      1.00       Cement Stabilised
    5      1.00       Subgrade (Selected Material)
    6      1.00       Subgrade (Austroads 2004)

   Details of Layers to be sublayered:
   Layer no.  5:  Austroads (2004) sublayering

Results:

   Layer  Thickness  Material               Load                    Critical       CDF
   No.               ID                     ID                      Strain
    1       45.00    IS268800_AC1           ESA750-Full             -4.24E-06      2.10E-09
    2       45.00    IS268800_AC2           ESA750-Full             -1.84E-05      3.35E-05
    3       85.00    IS268800_AC3           ESA750-Full             -5.03E-06      7.58E-08
    4      210.00    Cement5000             ESA750-Full             -6.83E-05      9.81E-01
    5      300.00    Sel_CBR33c             ESA750-Full              9.97E-05      3.11E-07
    6        0.00    Sub_CBR3               ESA750-Full              2.04E-04      4.74E-05
```

```
CIRCLY Pro - Version 6.0 (30 January 2015)

Job Title: IS268800_WBI_Type_1_Callum_Interchange (Option 1D)

Damage Factor Calculation

Assumed number of damage pulses per movement:
   Combined pulse for gear (i.e. ignore NROWS)

Traffic Spectrum Details:

   Load   Load                   Movements
   No.    ID
    1     ESA750-Full            1.09E+07

Details of Load Groups:

   Load   Load                  Load                  Load            Radius    Pressure/    Exponent
   No.    ID                    Category              Type                      Ref. stress
    1     ESA750-Full           ESA750-Full           Vertical Force     92.1    0.75         0.00

   Load Locations:
   Location   Load                  Gear          X          Y      Scaling     Theta
   No.        ID                    No.                             Factor
    1         ESA750-Full            1          -165.0        0.0   1.00E+00      0.00
    2         ESA750-Full            1           165.0        0.0   1.00E+00      0.00
    3         ESA750-Full            1          1635.0        0.0   1.00E+00      0.00
    4         ESA750-Full            1          1965.0        0.0   1.00E+00      0.00

Layout of result points on horizontal plane:
   Xmin:  0   Xmax:  165   Xdel:  165
   Y:     0

Details of Layered System:

   ID: IS268800.1D Title: WBI_Type_1_Callum_Interchange (Option 1D)

   Layer  Lower    Material               Isotropy   Modulus    P.Ratio
   No.    i/face   ID                                (or Ev)    (or vvh)  F          Eh         vh
    1     rough    IS268800_AC1           Iso.       1.80E+03   0.40
    2     rough    IS268800_AC2           Iso.       3.50E+03   0.40
    3     rough    IS268800_AC3           Iso.       3.80E+03   0.40
    4     rough    Sel_CBR33c             Aniso.     1.20E+02   0.35      8.89E+01   6.00E+01   0.35
    5     rough    Sub_CBR3               Aniso.     3.00E+01   0.45      2.07E+01   1.50E+01   0.45

   Performance Relationships:
   Layer  Location Material               Component  Perform.   Perform.  Traffic
   No.             ID                                Constant   Exponent  Multiplier
    1     bottom   IS268800_AC1           ETH         0.006084    5.000     1.170
    2     bottom   IS268800_AC2           ETH         0.003816    5.000     1.170
    3     bottom   IS268800_AC3           ETH         0.003522    5.000     1.170
    4     top      Sel_CBR33c             EZZ         0.009300    7.000     1.750
    5     top      Sub_CBR3               EZZ         0.009300    7.000     1.750

   Reliability Factors:
   Project Reliability: Austroads 95%
   Layer  Reliability  Material
    No.   Factor       Type
    1      1.00       Asphalt
    2      1.00       Asphalt
    3      1.00       Asphalt
    4      1.00       Subgrade (Selected Material)
    5      1.00       Subgrade (Austroads 2004)

   Details of Layers to be sublayered:
   Layer no.  4:  Austroads (2004) sublayering

Results:

   Layer  Thickness  Material               Load                   Critical       CDF
   No.               ID                     ID                     Strain
    1       45.00    IS268800_AC1           ESA750-Full             1.68E-05      1.28E-30
    2       45.00    IS268800_AC2           ESA750-Full            -1.25E-05      4.89E-06
    3      170.00    IS268800_AC3           ESA750-Full            -1.33E-04      9.88E-01
    4      300.00    Sel_CBR33c             ESA750-Full             2.06E-04      5.05E-05
    5        0.00    Sub_CBR3               ESA750-Full             3.78E-04      3.51E-03
```

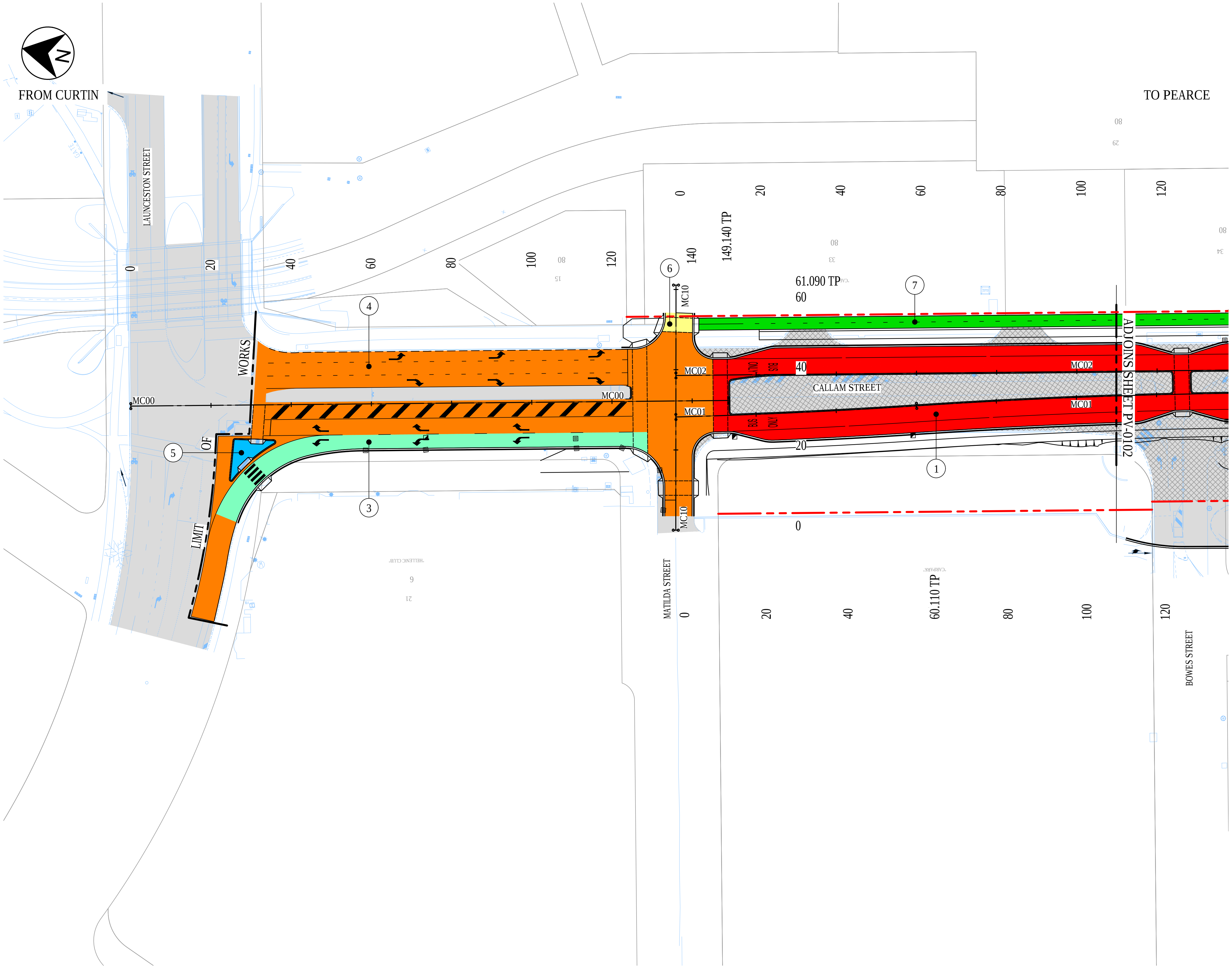
```
CIRCLY Pro - Version 6.0 (30 January 2015)

Job Title: IS268800_WBI_Type_2_Bradley_Interchange (Option 2B)

Damage Factor Calculation

Assumed number of damage pulses per movement:
   Combined pulse for gear (i.e. ignore NROWS)

Traffic Spectrum Details:

   Load   Load                   Movements
   No.    ID
    1     ESA750-Full            8.66E+06

Details of Load Groups:

   Load   Load                  Load                  Load            Radius    Pressure/    Exponent
   No.    ID                    Category              Type                      Ref. stress
    1     ESA750-Full           ESA750-Full           Vertical Force     92.1    0.75         0.00

   Load Locations:
   Location   Load                  Gear          X          Y      Scaling     Theta
   No.        ID                    No.                             Factor
    1         ESA750-Full            1          -165.0        0.0   1.00E+00      0.00
    2         ESA750-Full            1           165.0        0.0   1.00E+00      0.00
    3         ESA750-Full            1          1635.0        0.0   1.00E+00      0.00
    4         ESA750-Full            1          1965.0        0.0   1.00E+00      0.00

Layout of result points on horizontal plane:
   Xmin:  0   Xmax:  165   Xdel:  165
   Y:     0

Details of Layered System:

   ID: IS268800.2B Title: WBI_Type_2_Bradley_Interchange (Option 2B)

   Layer  Lower    Material               Isotropy   Modulus    P.Ratio
   No.    i/face   ID                                (or Ev)    (or vvh)  F          Eh         vh
    1     rough    IS268800_AC1           Iso.       1.80E+03   0.40
    2     rough    IS268800_AC2           Iso.       3.50E+03   0.40
    3     rough    IS268800_AC3           Iso.       3.80E+03   0.40
    4     rough    Cemen10000             Iso.       1.00E+04   0.20
    5     rough    Sel_CBR33c             Aniso.     1.20E+02   0.35      8.89E+01   6.00E+01   0.35
    6     rough    Sub_CBR3               Aniso.     3.00E+01   0.45      2.07E+01   1.50E+01   0.45

   Performance Relationships:
   Layer  Location Material               Component  Perform.   Perform.  Traffic
   No.             ID                                Constant   Exponent  Multiplier
    1     bottom   IS268800_AC1           ETH         0.006084    5.000     1.170
    2     bottom   IS268800_AC2           ETH         0.003816    5.000     1.170
    3     bottom   IS268800_AC3           ETH         0.003522    5.000     1.170
    4     bottom   Cemen10000             ETH         0.000260   12.000     6.840
    5     top      Sel_CBR33c             EZZ         0.009300    7.000     1.750
    6     top      Sub_CBR3               EZZ         0.009300    7.000     1.750

   Reliability Factors:
   Project Reliability: Austroads 95%
   Layer  Reliability  Material
    No.   Factor       Type
    1      1.00       Asphalt
    2      1.00       Asphalt
    3      1.00       Asphalt
    4      1.00       Cement Stabilised
    5      1.00       Subgrade (Selected Material)
    6      1.00       Subgrade (Austroads 2004)

   Details of Layers to be sublayered:
   Layer no.  5:  Austroads (2004) sublayering

Results:

   Layer  Thickness  Material               Load                    Critical       CDF
   No.               ID                     ID                      Strain
    1       45.00    IS268800_AC1           ESA750-Full             -3.53E-06      6.68E-10
    2       45.00    IS268800_AC2           ESA750-Full             -1.71E-05      1.85E-05
    3       85.00    IS268800_AC3           ESA750-Full              2.85E-06      1.01E-30
    4      160.00    Cemen10000             ESA750-Full             -5.77E-05      8.45E-01
    5      300.00    Sel_CBR33c             ESA750-Full              9.77E-05      2.14E-07
    6        0.00    Sub_CBR3               ESA750-Full              2.13E-04      5.02E-05
```

```
CIRCLY Pro - Version 6.0 (30 January 2015)

Job Title: IS268800_WBI_Type_2_Bradley_Interchange (Option 2C)

Damage Factor Calculation

Assumed number of damage pulses per movement:
   Combined pulse for gear (i.e. ignore NROWS)

Traffic Spectrum Details:

   Load   Load                   Movements
   No.    ID
    1     ESA750-Full            8.66E+06

Details of Load Groups:

   Load   Load                  Load                  Load            Radius    Pressure/    Exponent
   No.    ID                    Category              Type                      Ref. stress
    1     ESA750-Full           ESA750-Full           Vertical Force     92.1    0.75         0.00

   Load Locations:
   Location   Load                  Gear          X          Y      Scaling     Theta
   No.        ID                    No.                             Factor
    1         ESA750-Full            1          -165.0        0.0   1.00E+00      0.00
    2         ESA750-Full            1           165.0        0.0   1.00E+00      0.00
    3         ESA750-Full            1          1635.0        0.0   1.00E+00      0.00
    4         ESA750-Full            1          1965.0        0.0   1.00E+00      0.00

Layout of result points on horizontal plane:
   Xmin:  0   Xmax:  165   Xdel:  165
   Y:     0

Details of Layered System:

   ID: IS268800.2C Title: WBI_Type_2_Bradley_Interchange (Option 2C)

   Layer  Lower    Material               Isotropy   Modulus    P.Ratio
   No.    i/face   ID                                (or Ev)    (or vvh)  F          Eh         vh
    1     rough    IS268800_AC1           Iso.       1.80E+03   0.40
    2     rough    IS268800_AC2           Iso.       3.50E+03   0.40
    3     rough    IS268800_AC3           Iso.       3.80E+03   0.40
    4     rough    Cement5000             Iso.       5.00E+03   0.20
    5     rough    Sel_CBR33c             Aniso.     1.20E+02   0.35      8.89E+01   6.00E+01   0.35
    6     rough    Sub_CBR3               Aniso.     3.00E+01   0.45      2.07E+01   1.50E+01   0.45

   Performance Relationships:
   Layer  Location Material               Component  Perform.   Perform.  Traffic
   No.             ID                                Constant   Exponent  Multiplier
    1     bottom   IS268800_AC1           ETH         0.006084    5.000     1.170
    2     bottom   IS268800_AC2           ETH         0.003816    5.000     1.170
    3     bottom   IS268800_AC3           ETH         0.003522    5.000     1.170
    4     bottom   Cement5000             ETH         0.000310   12.000     6.840
    5     top      Sel_CBR33c             EZZ         0.009300    7.000     1.750
    6     top      Sub_CBR3               EZZ         0.009300    7.000     1.750

   Reliability Factors:
   Project Reliability: Austroads 95%
   Layer  Reliability  Material
    No.   Factor       Type
    1      1.00       Asphalt
    2      1.00       Asphalt
    3      1.00       Asphalt
    4      1.00       Cement Stabilised
    5      1.00       Subgrade (Selected Material)
    6      1.00       Subgrade (Austroads 2004)

   Details of Layers to be sublayered:
   Layer no.  5:  Austroads (2004) sublayering

Results:

   Layer  Thickness  Material               Load                     Critical       CDF
   No.               ID                     ID                       Strain
    1       45.00    IS268800_AC1           ESA750-Full              -3.76E-06      9.12E-10
    2       45.00    IS268800_AC2           ESA750-Full              -1.82E-05      2.50E-05
    3       85.00    IS268800_AC3           ESA750-Full              -5.24E-06      7.36E-08
    4      205.00    Cement5000             ESA750-Full              -6.98E-05      1.00E+00
    5      300.00    Sel_CBR33c             ESA750-Full               1.02E-04      2.88E-07
    6        0.00    Sub_CBR3               ESA750-Full               2.08E-04      4.31E-05
```

```
CIRCLY Pro - Version 6.0 (30 January 2015)

Job Title: IS268800_WBI_Type_2_Bradley_Interchange (Option 2D)

Damage Factor Calculation

Assumed number of damage pulses per movement:
   Combined pulse for gear (i.e. ignore NROWS)

Traffic Spectrum Details:

   Load   Load                   Movements
   No.    ID
    1     ESA750-Full            8.66E+06

Details of Load Groups:

   Load   Load                  Load                  Load            Radius    Pressure/    Exponent
   No.    ID                    Category              Type                      Ref. stress
    1     ESA750-Full           ESA750-Full           Vertical Force     92.1    0.75         0.00

   Load Locations:
   Location   Load                  Gear          X          Y      Scaling     Theta
   No.        ID                    No.                             Factor
    1         ESA750-Full            1          -165.0        0.0   1.00E+00      0.00
    2         ESA750-Full            1           165.0        0.0   1.00E+00      0.00
    3         ESA750-Full            1          1635.0        0.0   1.00E+00      0.00
    4         ESA750-Full            1          1965.0        0.0   1.00E+00      0.00

Layout of result points on horizontal plane:
   Xmin:  0   Xmax:  165   Xdel:  165
   Y:     0

Details of Layered System:

   ID: IS268800.2D Title: WBI_Type_2_Bradley_Interchange (Option 2D)

   Layer  Lower    Material               Isotropy   Modulus    P.Ratio
   No.    i/face   ID                                (or Ev)    (or vvh)  F          Eh         vh
    1     rough    IS268800_AC1           Iso.       1.80E+03   0.40
    2     rough    IS268800_AC2           Iso.       3.50E+03   0.40
    3     rough    IS268800_AC3           Iso.       3.80E+03   0.40
    4     rough    Sel_CBR33c             Aniso.     1.20E+02   0.35      8.89E+01   6.00E+01   0.35
    5     rough    Sub_CBR3               Aniso.     3.00E+01   0.45      2.07E+01   1.50E+01   0.45

   Performance Relationships:
   Layer  Location Material               Component  Perform.   Perform.   Traffic
   No.             ID                                Constant   Exponent  Multiplier
    1     bottom   IS268800_AC1           ETH         0.006084    5.000     1.170
    2     bottom   IS268800_AC2           ETH         0.003816    5.000     1.170
    3     bottom   IS268800_AC3           ETH         0.003522    5.000     1.170
    4     top      Sel_CBR33c             EZZ         0.009300    7.000     1.750
    5     top      Sub_CBR3               EZZ         0.009300    7.000     1.750

   Reliability Factors:
   Project Reliability: Austroads 95%
   Layer  Reliability  Material
    No.   Factor       Type
    1      1.00       Asphalt
    2      1.00       Asphalt
    3      1.00       Asphalt
    4      1.00       Subgrade (Selected Material)
    5      1.00       Subgrade (Austroads 2004)

   Details of Layers to be sublayered:
   Layer no.  4:  Austroads (2004) sublayering

Results:

   Layer  Thickness  Material               Load                    Critical       CDF
   No.               ID                     ID                      Strain
    1       45.00    IS268800_AC1           ESA750-Full              1.80E-05      1.01E-30
    2       45.00    IS268800_AC2           ESA750-Full             -1.24E-05      3.70E-06
    3      165.00    IS268800_AC3           ESA750-Full             -1.37E-04      8.98E-01
    4      300.00    Sel_CBR33c             ESA750-Full              2.13E-04      5.08E-05
    5        0.00    Sub_CBR3               ESA750-Full              3.89E-04      3.39E-03
```

```
CIRCLY Pro - Version 6.0 (30 January 2015)

Job Title: IS268800_WBI_Type_3_Callum_Widening (Option 3)

Damage Factor Calculation

Assumed number of damage pulses per movement:
   Combined pulse for gear (i.e. ignore NROWS)

Traffic Spectrum Details:

   Load   Load                   Movements
   No.    ID
    1     ESA750-Full            1.13E+07

Details of Load Groups:

   Load   Load                  Load                  Load            Radius    Pressure/    Exponent
   No.    ID                    Category              Type                      Ref. stress
    1     ESA750-Full           ESA750-Full           Vertical Force     92.1    0.75         0.00

   Load Locations:
   Location   Load                  Gear          X          Y      Scaling     Theta
   No.        ID                    No.                             Factor
    1         ESA750-Full            1          -165.0        0.0   1.00E+00      0.00
    2         ESA750-Full            1           165.0        0.0   1.00E+00      0.00
    3         ESA750-Full            1          1635.0        0.0   1.00E+00      0.00
    4         ESA750-Full            1          1965.0        0.0   1.00E+00      0.00

Layout of result points on horizontal plane:
   Xmin:  0   Xmax:  165   Xdel:  165
   Y:     0

Details of Layered System:

   ID: IS268800.3 Title: WBI_Type_3_Callum_Widening (Option 3)

   Layer  Lower    Material               Isotropy   Modulus    P.Ratio
   No.    i/face   ID                                (or Ev)    (or vvh)  F          Eh         vh
    1     rough    IS268800_AC2           Iso.       3.50E+03   0.40
    2     rough    IS268800_AC3           Iso.       3.80E+03   0.40
    3     rough    Sel_CBR33c             Aniso.     1.20E+02   0.35      8.89E+01   6.00E+01   0.35
    4     rough    Sub_CBR3               Aniso.     3.00E+01   0.45      2.07E+01   1.50E+01   0.45

   Performance Relationships:
   Layer  Location Material               Component  Perform.   Perform.  Traffic
   No.             ID                                Constant   Exponent  Multiplier
    1     bottom   IS268800_AC2           ETH         0.003816    5.000     1.170
    2     bottom   IS268800_AC3           ETH         0.003522    5.000     1.170
    3     top      Sel_CBR33c             EZZ         0.009300    7.000     1.750
    4     top      Sub_CBR3               EZZ         0.009300    7.000     1.750

   Reliability Factors:
   Project Reliability: Austroads 95%
   Layer  Reliability  Material
    No.   Factor       Type
    1      1.00       Asphalt
    2      1.00       Asphalt
    3      1.00       Subgrade (Selected Material)
    4      1.00       Subgrade (Austroads 2004)

   Details of Layers to be sublayered:
   Layer no.  3:  Austroads (2004) sublayering

Results:

   Layer  Thickness  Material               Load                   Critical       CDF
   No.               ID                     ID                     Strain
    1       50.00    IS268800_AC2           ESA750-Full            -1.09E-05      2.52E-06
    2      200.00    IS268800_AC3           ESA750-Full            -1.32E-04      9.95E-01
    3      300.00    Sel_CBR33c             ESA750-Full             2.03E-04      4.67E-05
    4        0.00    Sub_CBR3               ESA750-Full             3.66E-04      2.87E-03
```

Attachment F – Pavement plans



LEGEND

GENERAL

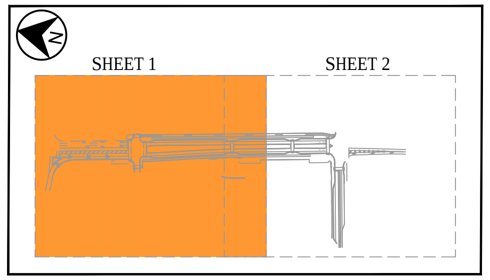
🟥 — · —	PROJECT BOUNDARY
———	CADASTRAL BOUNDARY
34 / 80	CADASTRAL LOT AND DP NUMBER
———	SURVEY
MCxx	CONTROL LINE

PAVEMENT

▒	EXISTING PAVEMENT
▨	EXISTING PAVEMENT TO BE REMOVED
🟥	TYPE 1 - CALLAM INTERCHANGE
▆	TYPE 2 - BRADLEY INTERCHANGE
▆	TYPE 3 - CALLAM WIDENING
🟧	TYPE 4 - MILL AND RESHEET
🟦	TYPE 5 - RAISED MEDIAN
🟨	TYPE 6 - COMMERCIAL DRIVEWAY
🟩	TYPE 7 - SHARED PATH
① —●	PAVEMENT TYPE LABEL

DRAINAGE

▤	EXISTING PIT
◪	NEW STOMWATER PIT



KEY PLAN
NTS

NOT FOR CONSTRUCTION

DRAWING FILE LOCATION \ NAME - PLOT DATE \ TIME - PLOT BY
\\jacobs.com\anz\IE\Projects\03_Southern\IS268800\01 Design\Drawings\Sketches\IS268800-SK-PV-0101-0102.dwg - 25/06/2019 4:03:01 PM - imedii

DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING	REV	DATE	AMENDMENT / REVISION DESCRIPTION	APPROVAL
	0	25.06.19	ISSUED FOR PSP DESIGN	L.QASEM

PROJECT BREAKDOWN STRUCTURE

SCALES ON A3 SIZE DRAWING
SCALE 1:1000 (10 0 10 20) AT A3

STROMLO COORDINATE SYSTEM: AGD66
HEIGHT DATUM: AHD

JACOBS DOCUMENT NUMBER
IS268800-SK-PV-0101

DRAWINGS / DESIGN PREPARED BY
JACOBS
177 Pacific Highway
NORTH SYDNEY, NSW 2060
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PLOT DATE / TIME: 25/06/2019
PLOT BY: imedii

TITLE	NAME	DATE
DRAWN	I.IMEDI	25.06.19
DRG CHECK	S.GALLOWAY	25.06.19
DESIGN	C.WING	25.06.19
DESIGN CHECK	B.CERECINA	25.06.19
DESIGN MNGR	G.TRUNDLE	25.06.19
PROJECT MNGR	L.QASEM	25.06.19

CLIENT
ACT Government | Transport Canberra

ACT GOVERNMENT
WODEN BUS INTERCHANGE AND ROAD LAYOUT MODIFICATIONS
WODEN BUS INTERCHANGE

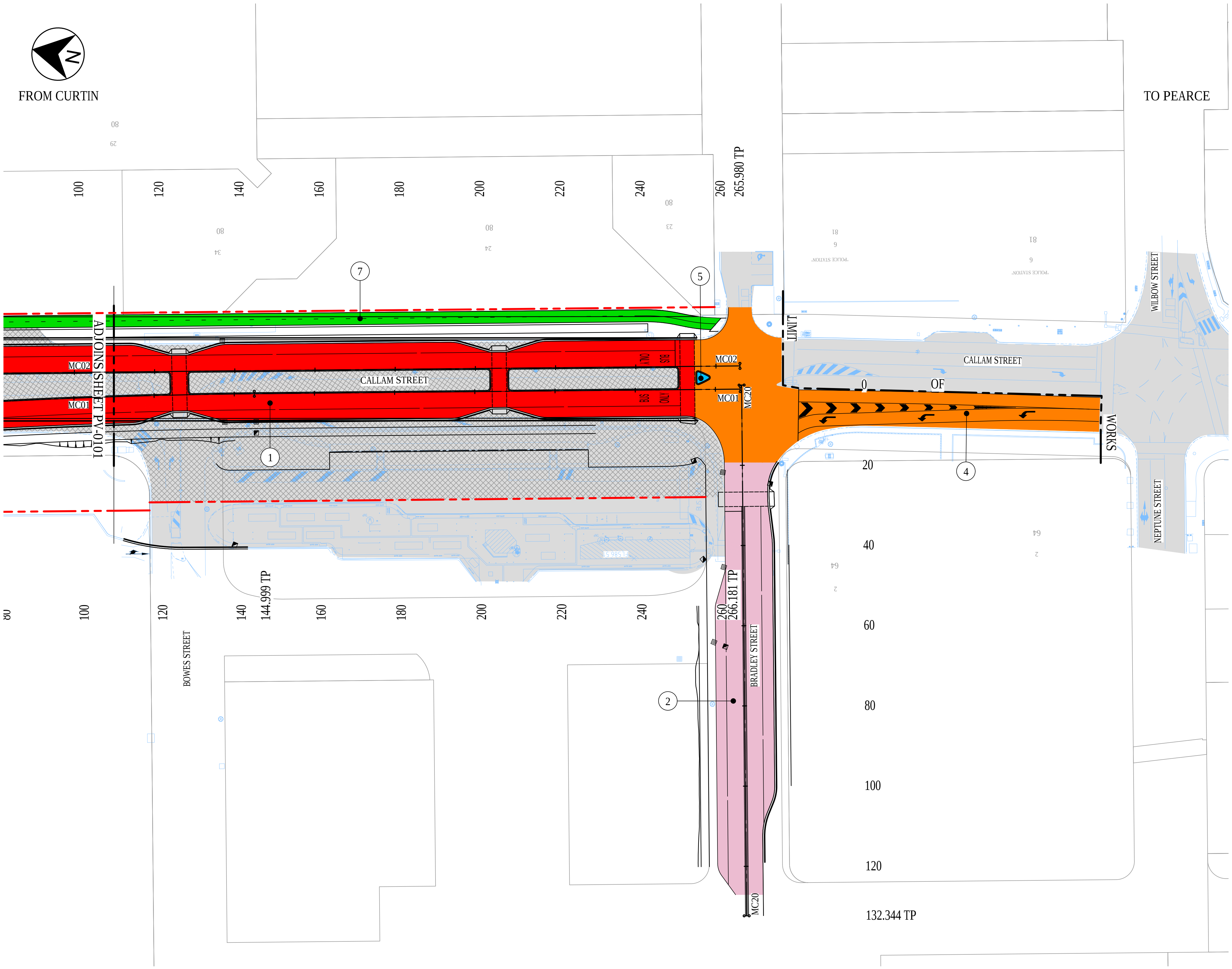
PAVEMENT PLAN

SHEET 1 OF 2

A3

ACT REGISTRATION No. TCLR-201-BRI-0006
PART

ISSUE STATUS: PSP DESIGN
EDMS No.
SHEET No.: PV-0101
REV: 0



LEGEND

GENERAL

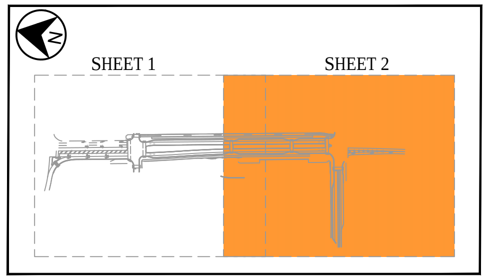
PROJECT BOUNDARY
CADASTRAL BOUNDARY
34 80 CADASTRAL LOT AND DP NUMBER
SURVEY
MCxx CONTROL LINE

PAVEMENT

- EXISTING PAVEMENT
- ▨ EXISTING PAVEMENT TO BE REMOVED
- 🟥 TYPE 1 - CALLAM INTERCHANGE
- TYPE 2 - BRADLEY INTERCHANGE
- 🟩 TYPE 3 - CALLAM WIDENING
- 🟧 TYPE 4 - MILL AND RESHEET
- 🟦 TYPE 5 - RAISED MEDIAN
- 🟨 TYPE 6 - COMMERCIAL DRIVEWAY
- 🟩 TYPE 7 - SHARED PATH
- ① PAVEMENT TYPE LABEL

DRAINAGE

- EXISTING PIT
- NEW STOMWATER PIT



KEY PLAN
NTS

NOT FOR CONSTRUCTION

THIS DRAWING MAY BE PREPARED IN COLOUR AND MAY BE INCOMPLETE IF COPIED

50mm ON A3 SIZE ORIGINAL

DRAWING FILE LOCATION \ NAME - PLOT DATE \ TIME - PLOT BY
\\jacobs.com\anz\IE\Projects\03_Southern\IS268800\01 Design\Drawings\Sketches\IS268800-SK-PV-0101-0102.dwg - 25/06/2019 4:03:02 PM - imedii

DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING

REV	DATE	AMENDMENT / REVISION DESCRIPTION	APPROVAL
0	25.06.19	ISSUED FOR PSP DESIGN	L.QASEM

PROJECT BREAKDOWN STRUCTURE

SCALES ON A3 SIZE DRAWING
SCALE 1:1000
10 0 10 20
AT A3

STROMLO COORDINATE SYSTEM AGD66
HEIGHT DATUM AHD

JACOBS DOCUMENT NUMBER
IS268800-SK-PV-0102

DRAWINGS / DESIGN PREPARED BY
JACOBS
177 Pacific Highway
NORTH SYDNEY, NSW 2060
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PLOT DATE / TIME 25/06/2019
PLOT BY imedii

TITLE	NAME	DATE
DRAWN	I.IMEDI	25.06.19
DRG CHECK	S.GALLOWAY	25.06.19
DESIGN	C.WING	25.06.19
DESIGN CHECK	B.CERECINA	25.06.19
DESIGN MNGR	G.TRUNDLE	25.06.19
PROJECT MNGR	L.QASEM	25.06.19

CLIENT
ACT Government
Transport Canberra

ACT GOVERNMENT
WODEN BUS INTERCHANGE AND ROAD LAYOUT MODIFICATIONS
WODEN BUS INTERCHANGE

A3

PAVEMENT PLAN

SHEET 2 OF 2

ACT REGISTRATION No. TCLR-201-BRI-0006
PART

ISSUE STATUS PSP DESIGN
EDMS No.
SHEET No. PV-0102
REV 0

Appendix J. Layover Options Assessment

Woden Bus Interchange

Transport Canberra

Bus Layover Options Assessment

IS268800.01 | 1.2

21 May 2019

Bus Layover Options Assessment

Woden Bus Interchange

Project No:	IS268800
Document Title:	Bus Layover Options Assessment
Document No.:	IS268800.01
Revision:	1.2
Date:	21 May 2019
Client Name:	Transport Canberra
Project Manager:	Schedule 2.2(a)(ii)
Author:	Schedule 2.2(a)(ii)

Jacobs Australia Pty Limited

Floor 11, 452 Flinders Street
Melbourne VIC 3000
PO Box 312, Flinders Lane
Melbourne VIC 8009 Australia
T +61 3 8668 3000
F +61 3 8668 3001
www.jacobs.com

Document history and status

Revision	Date	Description	By	Review	Approved
1.0	07.05.2019	Initial draft	Schedule 2.2(a)(ii)	[redacted]	[redacted]
1.2	21.05.2019	Final draft	Schedule 2.2(a)(ii)	[redacted]	[redacted]

Contents

1. Introduction

1.1 Overview

Jacobs Group Australia Pty Ltd (Jacobs) has been engaged by Transport Canberra to progress an options study and assessment, feasibility investigations and concept design (Preliminary Sketch Plan) for a new on-street bus interchange in Woden Town Centre.

The initial phase of this project identified a number of proposed bus interchange options which, following a multi-criteria analysis and feasibility study, have been reduced to one preferred project option. The preferred option consists of a bus interchange with bus bays on either side of Callam Street, between Matilda Street and Bradley Street.

To support the operation of the bus interchange, and to provide bus drivers with adequate rest breaks, bus layover facilities are required to provide bus bays for short, medium and long-term time periods. This study will identify up to four site options for the provision of medium and long-term layover bays.

1.2 Project objectives

The stated objectives of the Woden Town Centre bus interchange design project are to:

- Support the ambitious of the Woden Town Centre Master Plan;
- Facilitate strong bus to bus connections in the short term (5 years);
- Accommodate growth in the frequency of bus and passenger movements both on street and on platform;
- Facilitate bus to light rail connections in the medium-term (10 years);
- Provide strong access to Woden Town Centre;
- Create a vibrant and active place; and
- Be operationally functional, safe and legible to navigate.

1.3 Purpose of this report

This report documents the tasks completed as part of an options assessment to identify a preferred site for the provision of layover facilities for bus services which will serve the future Woden bus interchange. With a focus on the provision of facilities for medium-term and long-term layovers, the study will identify up to four site options which will be short-listed via a multi-criteria analysis.

The report is structured as follows:

- **Chapter 2** outlines the background to this study, highlights the study objectives and presents the requirements for layover facilities.
- **Chapter 3** details the process undertaken to identify site options.
- **Chapter 4** provides details about the selected site options for medium-term layover facilities in relation to key features and benefits and constraints.
- **Chapter 5** provides details about the selected site options for long-term layover facilities in relation to key features and benefits and constraints.
- **Chapter 6** outlines the methodology and results of the multi-criteria analysis.
- **Chapter 7** concludes the study and provides rationale for the preferred site options.

2. Background

2.1 Context

Jacobs has been engaged to complete an options assessment and concept design for a new on-street bus interchange in Woden Town Centre. The preferred option for the on-street interchange, illustrated in Figure 2.1, will be located on Callam Street and replace the existing Bus Station, located west of Callam Street between Bradley Street and Matilda Street.

The bus interchange will feature bus bays for local bus services on the east and west kerbs of Callam Street, bus bays for intercity bus services kerb side on the northern edge of Bradley Street, and bus bays for school bus services kerb side on the southern edge of Bradley Street. To provide optimal opportunities for interchange between bus services and light rail, the light rail track will run through a pedestrianised concourse on the western edge of Callam Street to allow users to cross the light rail at any point between Matilda Street and Bradley Street to access bus services.

At present, Woden Bus Station serves a role as both a transport interchange, and a layover hub for bus services which terminate at Woden. This includes provision of 14 layover bus bays and driver rest facility including kitchen and restrooms. However, with the transition of Woden Bus Station into an on-street interchange, layover bays and facilities will no longer be available on site and will need to be provided elsewhere.

Figure 2.1: Preferred design option for Woden Bus Interchange

2.2 Bus layover guidelines

There are no guidelines in relation to the provision of bus layover facilities in the context of the Australian Capital Territory. As such, this study has used the *Guidelines for the Planning of Bus Layover Parking (2018)* developed by Transport for New South Wales (TfNSW) as a guide to the requirements for layover facilities at Woden Bus Interchange.

2.2.1 Strategic principles

The TfNSW Guidelines outline the following strategic principles in relation to the provision of layover facilities:

The location of bus layover supports productive places. The location of bus layovers has a direct impact on the amenity, liveability and economic success of places. As such, layover facilities should be located outside of centres where compact form and walkability are key features. When located within a centre, layover facilities should be located away from streets with high levels of active frontages and areas of pedestrian activity.

Layover is a function of service delivery. Bus layover requirements should be determined to enable better service delivery and should be reviewed each time the bus network is reviewed.

Layovers are flexible and adaptable for future requirements. The need for bus layovers will change depending on changes to land use, increased demand in some areas and the changing nature of the bus network. As such, layover facilities should remain flexible and adaptable to change where possible.

2.2.2 When is layover required?

According to the TfNSW Guidelines, bus layover facilities are required when a bus is required to dwell between services either:

- When a service terminates;
- Where recovery time is scheduled;
- Where a meal break is scheduled;
- When there is a combination of any of the above.

2.2.3 Location of layovers

The Guidelines for TfNSW identify a number of key criteria to consider when identifying an appropriate location for bus layover facilities. Accordingly, the location of layover facilities should:

- Minimise bus circulation and unnecessary vehicle kilometres (dead running);
- Provide safe walking routes for staff;
- Be sensitive to local land use, and consider future changes to land use;
- Provide access to appropriate driver facilities including toilets, a kitchen and dining facilities.

2.3 Layover study objectives

In line with the TfNSW Guidelines, and the specific requirements of this project, the following objectives have been developed for the provision of medium and long-term layover facilities at Woden Bus Interchange:

- Optimise bus schedule reliability;
- Minimise dead running time on travel to and from layover facilities;
- Free up on-street kerb space on Callam Street and within the Woden Town Centre precinct;
- Provide clean and safe facilities for bus driver rest breaks.

2.4 Woden Bus Interchange layover requirements

2.4.1 Number of bus bays

This study will identify up to four site options to provide layover facilities for up to 14 buses serving the Woden Bus Interchange. This number is equal to the existing level of provision at Woden Bus Station. However, it is noted that further work being undertaken by MRCagney in April 2019 may reveal that layover facilities can be rationalised. As such, provision for 14 layover bays is considered to provide more than sufficient capacity to accommodate requirements, both before and after the introduction of light rail services to Woden.

2.4.2 Type of layover bays

Discussions with Transport Canberra have determined that three types of layover facilities are required at Woden Bus Interchange:

- **Short-term layover** - This represents turnaround time of up to 5 minutes between buses arriving and departing from stops in the interchange. It is assumed that sufficient recovery time will be built into bus route timetables at key timing points to ensure services have minimal turnaround time at Woden Bus Interchange, particularly in peak periods.
- **Medium-term layover** - This represents time for a short driver comfort break for a period of up to 15 minutes. It is assumed that medium-term layover bays may be required during both peak and off peak periods. Medium-term layover bays are required to be within close proximity of restroom facilities.
- **Long-term layover** - This represents time for driver rest breaks for a period of up to 60 minutes. It is assumed that long-term layover bays will only be required outside of peak periods. Long-term layover bays are required to be within close proximity of restroom facilities, a kitchen and dining facilities to accommodate driver rest breaks.

Given that short-term layover is only required for short periods of time, it is proposed that short-term layover (turnaround time) be accommodated at bus stops at Woden Bus Interchange. However, given the wider project objectives require the interchange to be at the heart of a ‘vibrant and active place’ which ‘support the ambitions of the Woden Town Centre Master Plan’, bays to accommodate medium and long-term layover must be located away from the proposed bus interchange. This recommendation is in line with the TfNSW Guidelines which note that, where possible, long-term layover facilities should be located off-street and outside of urban centres.

2.4.3 Size requirements

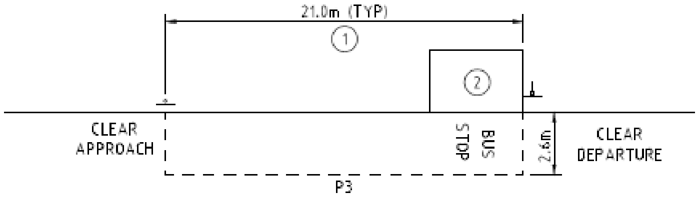
The size of the site required will depend on the proposed layout of bus layover facilities. An initial assessment has identified the size requirements for three parking options. The assessment provides space to accommodate all bus sizes anticipated to serve the Canberra bus network into future years including:

- Articulated buses with bike racks (17.5m);
- Buses with bike racks (15.7m); and
- QCity / TbX buses without bike racks (13m).

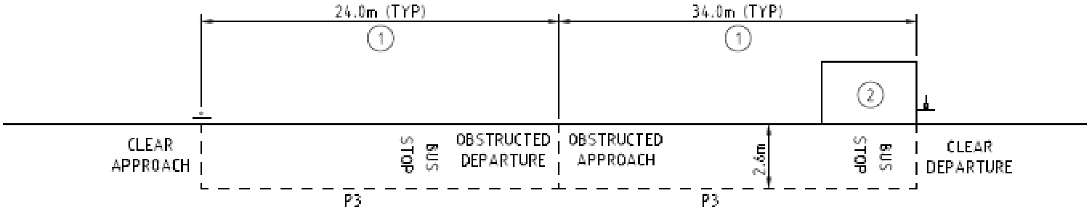
It is noted that a high-level swept path analysis has been conducted on each site included within this assessment to ensure the site has sufficient space to accommodate bus movements.

Head to tail parking

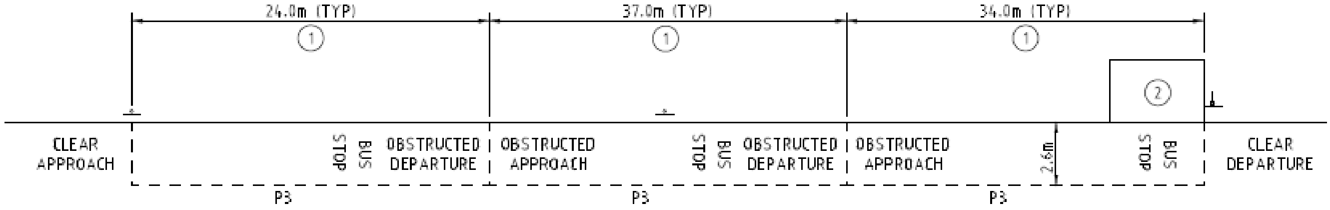
Head to tail parking offers the most flexibility to accommodate bus parking on-street across a number of locations. This option also requires the least space and does not require drivers to reverse. A summary of head to tail parking space requirements is included in Figure 2.2.



SINGLE BUS STOP



DOUBLE BUS STOP



TRIPLE BUS STOP

Figure 2.2: Head to tail bus parking size requirements (Source: ACT Government)

90 degree parking

As Figure 2.3 illustrates, the minimum bus bay envelope for a bus parking at 90 degrees from entry point is 21m x 3.1m. However, the minimum site size is estimated to be 88m x 52m. This includes separate entry and exit points to the proposed site.

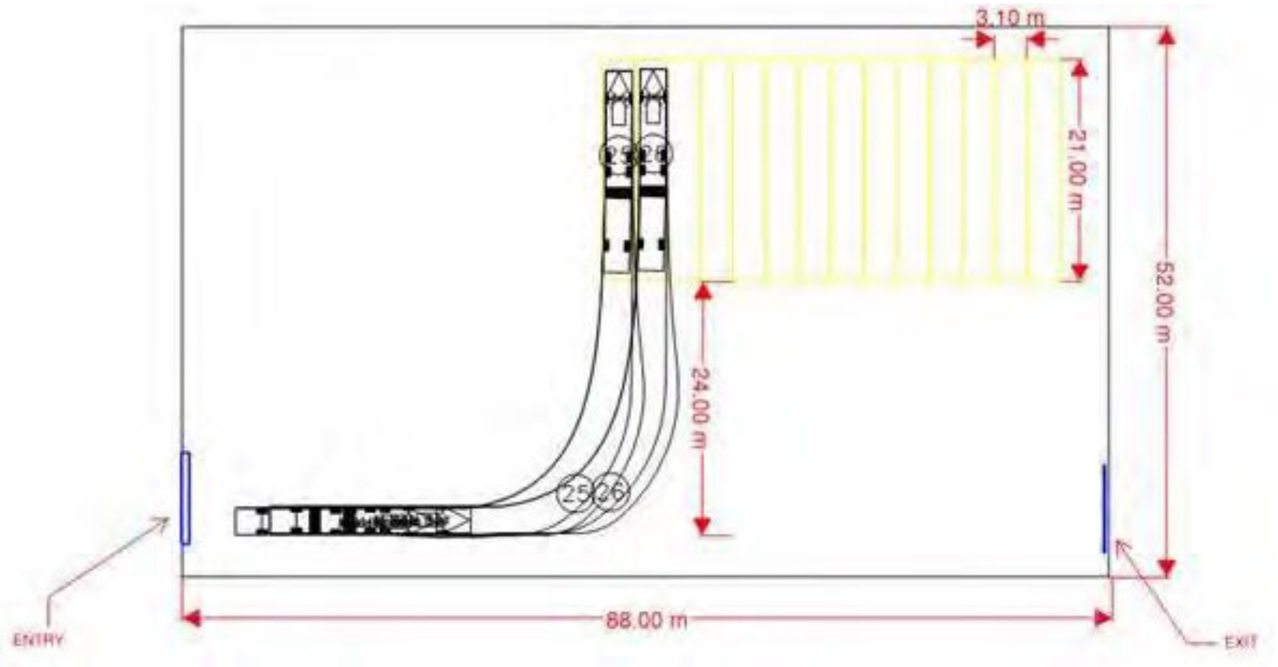


Figure 2.3: 90 degree parking size requirements

30 degree parking

As Figure 2.4 illustrates, the minimum bus bay envelope required for a bus parking at 30 degrees from their entry point is 17m x 4m. The minimum site size required is estimated to be 31m x 84m. This includes separate entry and exit points to the proposed site.

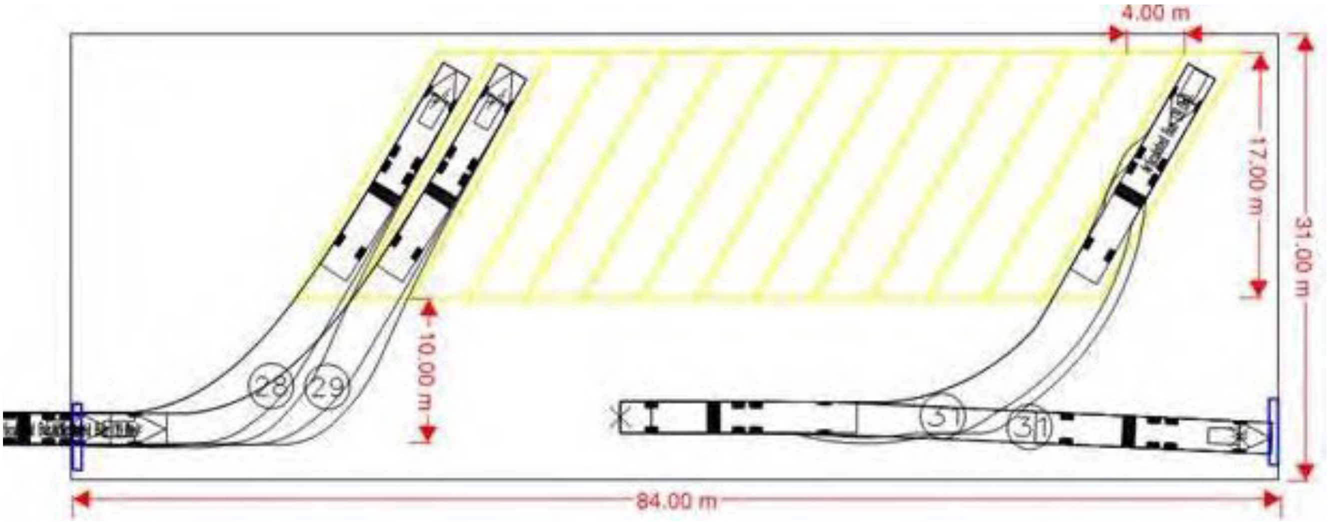


Figure 2.4: 30 degree parking size requirements

3. Options development

3.1 Study area

Given the objectives of this study, two defined study areas have been identified in relation to medium-term and long-term layover facilities. As Figure 3.1 illustrates, the search for a site for long-term layover facilities will extend to a distance of 1.5km from Woden Bus Interchange, a one-way travel time of up to 5 minutes. In contrast, and where possible, sites for medium-term layover facilities will be restricted, where possible, to a 0.7km radius of Woden Bus Station. One-way travel times within this radius are anticipated to be under 5 minutes.

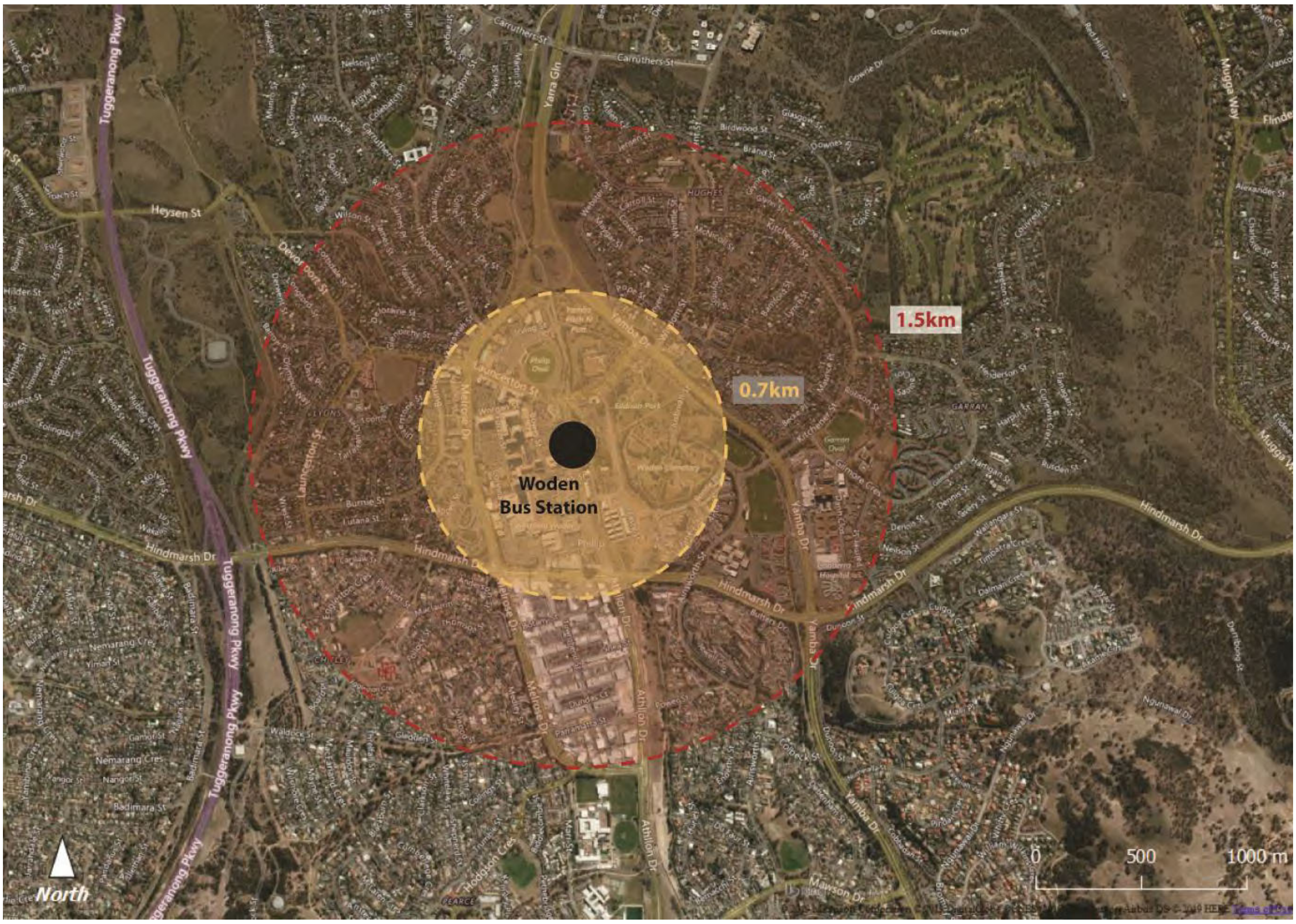


Figure 3.1: Medium vs. long-term layover study areas

3.2 Selection of options

Site options for both medium-term and long-term layover facilities were selected using a desk-based search of the study area. Sites were selected based on the requirements outlined in Section 2.4. A number of site options were discounted at this stage. A summary of discounted sites, and the rationale for their exclusion, is included in the following Table 1.

Table 3.1: Discounted site options

Location	Type	Location	Rationale
Townshend Street	Medium-term	On-street	Parking opportunities are spaced out in an ad hoc manner across numerous blocks and are situated directly adjacent to shop frontages. Given the 'out of town' location of the shops in this area, a loss of adjacent car parking spaces is likely to have a detrimental impact on businesses.
Corinna Street	Medium-term	On-street	Despite having been considered as a layover parking option in the MRCagney Concept (December 2018), this option has been excluded due to insufficient road reserve to accommodate bus parking.
Furzer Street	Medium-term	On-street	Parking opportunities are located within the defined town centre precinct. As such, the location of bus parking in this area is likely to have a detrimental impact on the public realm and is considered to be a poor use of urban space.
Launceston Street	Long-term	On-street	Parking opportunities exist on-street next to the playing facilities on Launceston Street. However, there is no opportunity for buses to turn to make a return journey to Woden Bus Interchange as the existing roundabout is too small, with limited road reserve to augment this.
Empty Lot (40 & 41)	Long-term	Off-street	A vacant lot is present between 82-86 Paramatta Street. However, this lot is earmarked for future development, and given its location fronting both Paramatta Street and Athllon Drive, is likely to represent high value real estate.

The location of sites discounted as part of the assessment is presented in Figure 3.2.

Figure 3.2: Discounted site locations

4. Medium-term layover site options

The desktop study identified four site options for medium-term layover parking (Figure 4.1). It is noted that one of these sites sit outside the defined study area for medium-term layover facilities. This site was included in the assessment given the lack of other viable alternatives. It is also considered to offer a number of benefits, in spite of the location further from the bus interchange.

Figure 4.1: Medium-term layover site options

A high-level summary of each option is presented in Table 4.1 with a summary of approximate travel times to each site presented in Table 4.2. A more detailed description of each option is featured below.

Table 4.1: Medium-term layover site option summary

Option	Type	Available space	Approx. capacity	Distance from interchange	Distance to driver facilities[1]	Total dead running kilometres
Option 1-A - Easty Street	On-street	530 m	20 bays	0.75 km	5 min	2.7 km
Option 1-B - Irving Street	On-street	300 m	14 bays	0.75 km	1 min	5.6 km
Option 1-C - Phillip Oval Car Park	Off-street	165 m	7 bays	1.0 km	1 min	5.7 km
Option 1-D - Woden Bus Depot	Off-street	Unknown	Unknown	1.4 km	N/A	7.2 km

---

[1] Note driver facilities are different for each site and are detailed below under the descriptions of each option.

Table 4.2: Travel time to medium-term layover site options[2]

Option	Northbound services			Southbound services		
	To	From	TOTAL	To	From	Total
Option 1-A - Easty Street	2 min	2 min	4 min	1 min	1 min	2 min
Option 1-B - Irving Street	3 min	6 min	9 min	5 min	4 min	9 min
Option 1-C - Phillip Oval Car Park	3 min	5 min	8 min	5 min	3 min	8 min
Option 1-D - Woden Bus Depot	6 min	4 min	10 min	4 min	6 min	10 min

4.1 Option 1-A: Easty Street

Easty Street runs parallel to Callam Street with access easily achieved for northbound bus services, via Launceston Street, and southbound bus services via Wilbow Street. Easty Street is bounded by car parks which serve government employers on its western edge, and Woden Cemetery on its eastern edge. At present, the road primarily functions as an access road for government employees accessing workplaces on Easty Street, and residents accessing residential developments at the roads southern extent.

With up to 530m available on the eastern and western verges of Easty Street, it is proposed that head to tail bus parking could provide space for up to 20 buses in this location. Land acquisition is likely to be required to provide layover parking on the western kerb side. Given its close proximity to Callam Street, which can be reached in a travel time of under 2 minutes, Easty Street presents a prime location to locate medium-term layover bays with minimal dead running kilometres. Its suitability is further compounded by the local land uses which do not conflict with temporary bus parking.

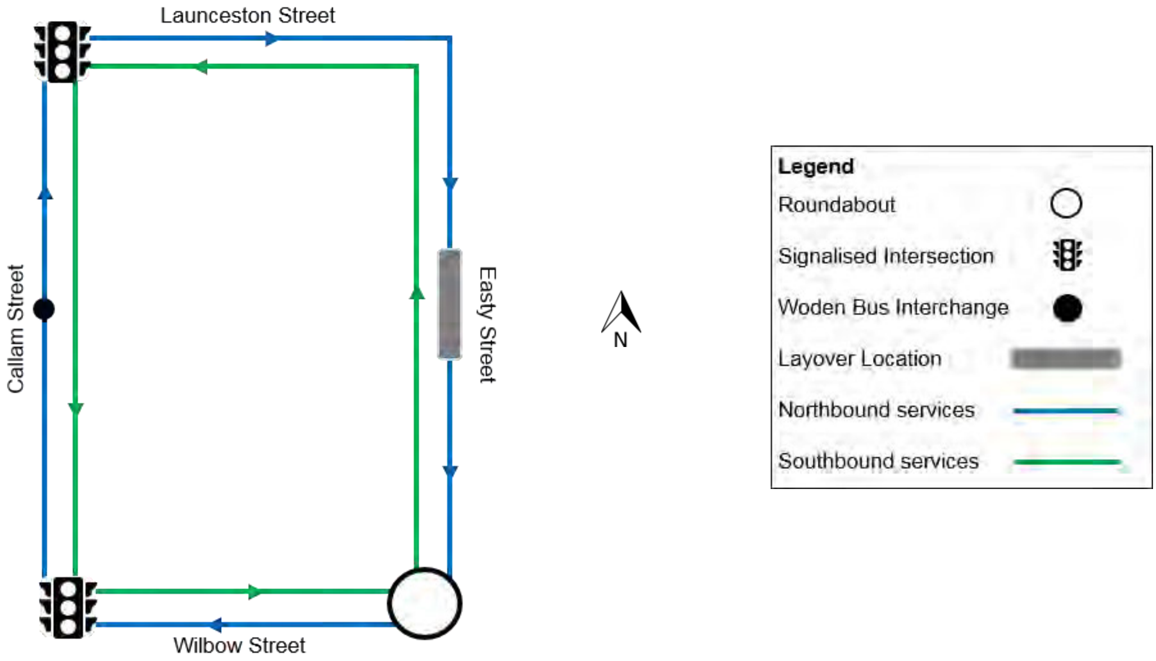


Figure 4.2: Easty Street bus circulation

---

[2] Travel times were taken from Google Maps and represent the average travel time during off-peak periods. The times include estimates for delays at intersections.

Table 4.3 outlines the benefits and constraints identified in relation to Option 1-A.

Table 4.3: Option 1-A: Benefits and constraints

Benefits	Constraints
• Close proximity to Woden Bus Interchange • Total travel time between 2-4 minutes (return) • Low dead running kilometres (2.7km) • Low traffic volumes so limited interaction with general traffic • Good opportunities for turning at roundabout intersection • Large capacity for up to 20 vehicles • Flexibility for both northbound and southbound services • Future-proofed space • Good constructability	• Extended distance to restroom facilities (7 min walk) • Land acquisition may be required on the western verge • Minor works to align footpath required • Future urbanisation of Easty Street

4.2 Option 1-B: Irving Street

Irving Street is situated north of Launceston Street and is bounded by Phillip Swimming and Ice Skating Centre and a residential development on its western edge, and a large car park on its eastern edge. It is proposed that up to 300m of kerb side parking could be removed on both Irving Street and Spoering Street to provide head to tail parking for up to 14 buses in this location.

The location is close to Woden Bus Interchange, however travel times are extended at 9 minutes for a return trip and up to 5.6km of dead running required. Intersections along the proposed routes, outlined in Figure 4.3, provide sufficient space for buses to turn, however minor works will be required to accommodate right turning buses at the intersection of Launceston Street and Irving Street.

Land uses in this location are not considered to conflict with temporary on-street bus parking given that a high proportion of space is already allocated to car parking. No public restroom facilities are situated near to this location; however, it is likely facilities could be available at the Phillip Swimming and Ice Skating Centre.

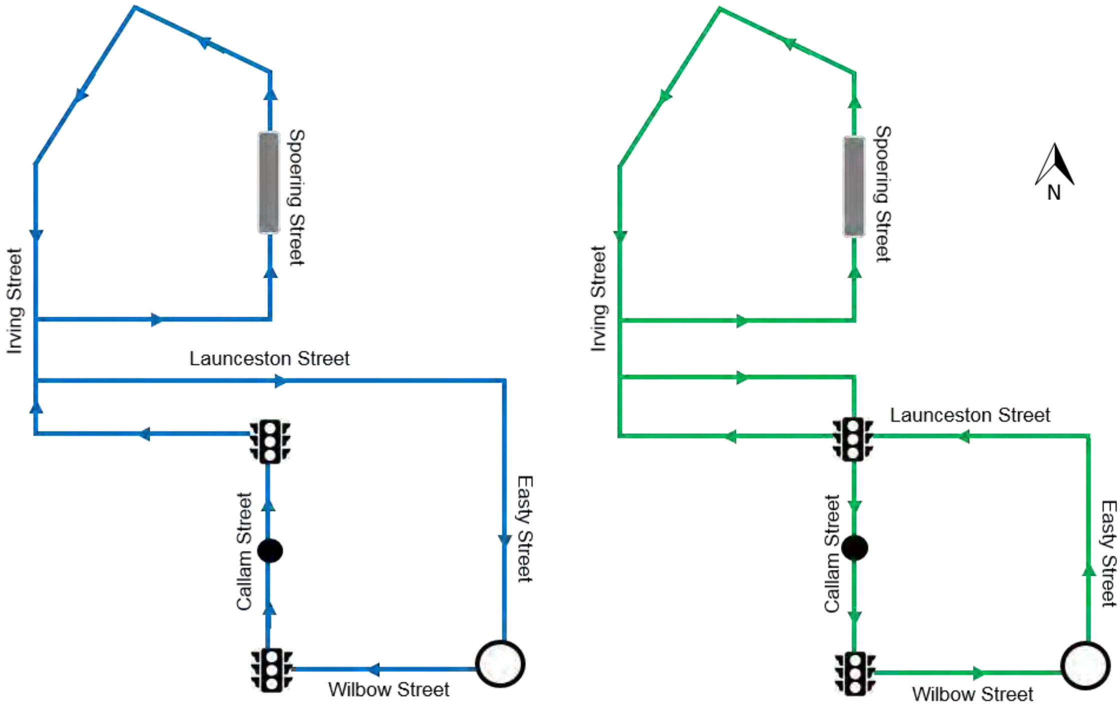


Figure 4.3: Irving Street bus circulation

Table 4.4 outlines the benefits and constraints of Option 1-B.

Table 4.4: Option 1-B: Benefits and constraints

Benefits	Constraints
• Opportunity to accommodate 14 bus bays • Minimal works required to provide bus bays • Low traffic volumes so limited interaction with general traffic • No conflict with surrounding land uses • Future-proofed space	• Extended travel times of up to 9 minutes return • Minor works required to accommodate right turning buses at Launceston Street / Irving Street intersection • No signals or bus priority at Launceston Street / Irving Street intersection • Loss of public car parking • No dedicated restroom facilities • Extended travel route via Easty Street could introduce delays

4.3 Option 1-C: Phillip Oval Car Park

Phillip Oval (Phillip 3) is located on Spoering Street within the Woden Town Centre precinct. The oval is home to the head office of Cricket ACT and features a full-size Australian Rules playing surface and cricket pitch, with associated pavilion, changing facilities and restrooms. The site also features a large car park with parking for approximately 193 vehicles. The site is situated a short drive from the Woden Bus Interchange, however, is heavily used for AFL and cricket matches, particularly at weekends. As such, there is a significant conflict of use issue which would likely reduce the flexibility and availability of the site at particular times.

It is proposed that a proportion of the car park in this location could be utilised for medium-term bus layover parking, with drivers able to use the facilities at the oval. With approximately 165m of space available, it is estimated that this location could provide head to tail parking for up to 7 buses. Buses would enter the site via Spoering Road, park on the eastern edge of the approach road and use the southern end of the car park to turn and return back to Woden Bus Interchange, as illustrated in Figure 4.4.

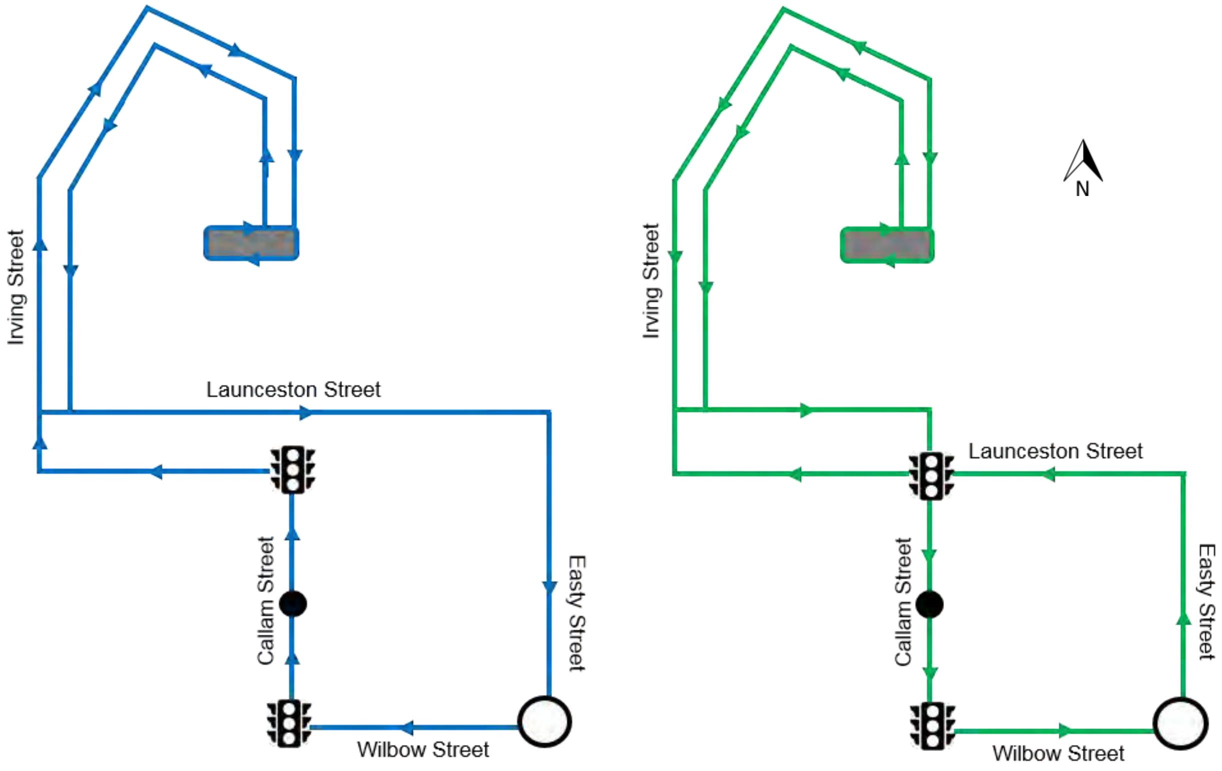


Figure 4.4: Phillip Oval bus circulation

Table 4.5 outlines the benefits and constraints of Option 1-C.

Table 4.5: Option 1-C: Benefits and constraints

Benefits	Constraints
• Close proximity to Woden Bus Interchange • Access to nearby restroom facilities • Opportunity to extend car park to enhance manoeuvrability	• Extended travel time up to 8 minutes return • Conflict of uses with cricket and AFL matches • Pavement widening required at entrance • Central median and tree removals required • Minor works required to accommodate right turning buses at Launceston Street / Irving Street intersection • No signals or bus priority at Launceston Street / Irving Street intersection • Extended travel route via Easty Street could introduce delays • Land acquisition may be required

4.4 Option 1-D: Woden Bus Depot

Woden Bus Depot is situated on the corner of Athllon Drive and Parramatta Street. The depot is currently undergoing an extensive redevelopment to expand facilities towards Parramatta Street to create a site with an approximate total area of 26,500m^2[3]. Initial plans indicate the new depot will provide a large bus shelter, an operations building, a washing and refuelling station and workshop building as well as fuel storage. The sites footprint is illustrated in Figure 4.5.

Figure 4.5: Option 1-D: Woden Bus Depot

---

[3] Estimate based on Google Satellite Image

Woden Bus Interchange is situated off the road network, however, vehicles will be faced with a return travel time of up to 9 minutes and dead running kilometres of approximately 7.2km. While the number of bus parking bays which could be accommodated at the site is currently unknown, the large size of the site suggests the depot would be able to accommodate up to 14 bus bays.

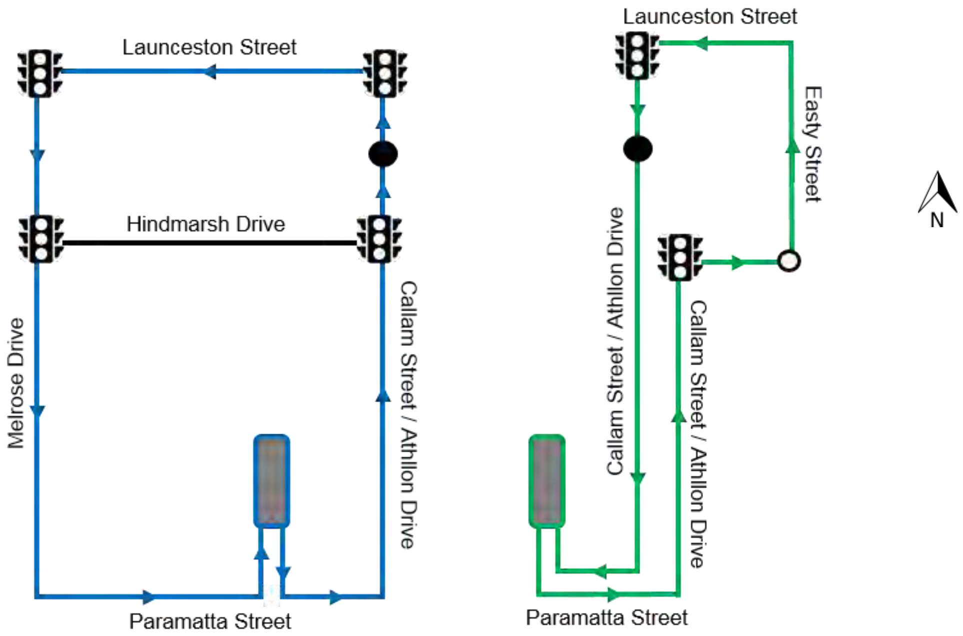


Figure 4.6: Woden Bus Depot bus circulation

Further, and unlike other sites identified as part of this exercise, the depot is likely to provide the required driver dining, kitchen and restroom facilities in-house. The site is also owned by the ACT Government and therefore no land acquisition will be required.

Table 4.6 outlines the benefits and constraints of Option 1-D.

Table 4.6: Option 1-D: Benefits and constraints

Benefits	Constraints
• Use of existing asset • Driver facilities provided in-house • No conflict with existing land uses • No land acquisition required • Works to be accommodated as part of wider redevelopment of the site	• Extended distance and travel time (up to 10 minutes return) • Dead running kilometres are high (9 km) • Unknown number of bus bays • Shared space with other bus activities • Minor works required

5. Long-term layover site options

The desktop study identified four site options for long-term layover parking (Figure 5.1). A high-level summary of each option is presented in Table 5.1 with a summary of approximate travel times to each site in Table 5.2.

Figure 5.1: Long-term layover site options

Table 5.1: Long-term layover site option summary

Option	Existing use	Dimensions	Distance from interchange	Total dead running kilometres	Existing facilities
Option 2-A: Irving Street Car Park	Car park	33 x 85 m	0.75 km	5.6 km	No
Option 2-B: Corrina Street Car Park	Car park	36 x 140 m	0.7 km	4.8 km	No
Option 2-C: Parramatta Street	On-street parking	175 m	1.3 km	7.5 km	Yes
Option 2-D: Woden Bus Depot	Bus depot	100 x 250m	1.4 km	9.0 km	Yes

Table 5.2: Approximate travel times to long-term layover sites

Option	Northbound services			Southbound services		
	To	From	TOTAL	To	From	TOTAL
Option 2-A: Irving Street Car Park	3 min	6 min	9 min	5 min	4 min	9 min
Option 2-B: Corrina Street Car Park	5 min	3 min	8 min	3 min	5 min	8 min
Option 2-C: Parramatta Street	5 min	5 min	10 min	5 min	7 min	12 min
Option 2-D: Woden Bus Depot	6 min	4 min	10 min	4 min	6 min	10 min

5.1 Option 2-A: Irving Street Car Park

Irving Street Car Park is a Government-owned public car park located on Irving Street. The car park currently provides long-stay car parking for up to 412 vehicles with access via Spoering Street. The study area in relation to this project covers a large proportion of the car park, an area of approximately 5,600m^2, as illustrated in Figure 5.2.

It is proposed that this section of the car park could be sectioned off and utilised to provide long-term bus layover parking for up to 14 buses. However, this would result in the loss of approximately 153 public car parking spaces. It is noted that there is also capacity to provide additional bus parking bays by removing on-street parking on both sides of Spoering Street, as discussed in Section 4.2.

Figure 5.2: Option 2-A: Irving Street Car Park

The Irving Street Car Park site is situated within close proximity of Woden Bus Interchange, with return travel times of up to 9 minutes. Variability in travel times is likely due to the extended route which buses must take via Easty Street to ensure they return from the layover in the required direction of travel. As a result, dead running kilometres total 5.6 km for both northbound and southbound services.

A swept path analysis has determined there is sufficient space within the confines of the site for buses to safely manoeuvre. However, to fit the required number of bus bays into the site, buses will be required to reverse out of their bays. The swept path analysis also determined that there is sufficient space on the surrounding road network for buses to make the required turns. However, modifications will need to be made to provide sufficient storage space for buses turning right from Launceston Street into Irving Street.

A summary of benefits and constraints associated with Option 2-A is provided in Table 5.3.

Table 5.3: Option 2-A: Benefits and constraints

Benefits	Constraints
• Ability to accommodate required number of bus bays • Within close proximity of Woden Bus Interchange • Relatively low travel times (up to 9 minutes return) • Dead running kilometres are low (5.6 km) • No conflict with existing land uses • No land acquisition required • No major constructability issues	• Travel time variability due to extended route via Easty Street • Extended route introduces potential for delays • Buses required to reverse out of bus bays • Loss of car parking bays and associated revenue • Minor works required at Launceston Street / Irving Street intersection • No signals or bus priority at Launceston Street / Irving Street intersection • No existing driver facilities

5.2 Option 2-B: Corinna Street Car Park

Corinna Street Car Park is a Government-owned public car park situated in the south west corner of the Woden Town Centre precinct. The car park currently provides long-stay car parking for up to 290 vehicles with access via Corinna Street. The study area in relation to this project covers a large proportion of the car park, an area of approximately 6,100m^2, as illustrated in Figure 5.3. However, there is scope to expand the site by extending the parking area onto the adjacent grass verges to the south and east.

Figure 5.3: Option 2-B: Corinna Street Car Park

It is estimated that this site could accommodate up to 14 bus bays, with a 30° parking arrangement, and a purpose-built driver kitchen, dining and restroom facility. This will result in the loss of approximately 205 car parking bays and require minor works to realign parking bays and provide sufficient space for buses to safely manoeuvre. Minor works will also be required to augment the entry / exit onto Corinna Street to provide sufficient space for buses to perform left and right turns.

While the site is situated only 700m from Woden Bus Interchange, travel times are likely to reach up to 8 minutes (return), with buses routing via Easty Street to maintain their required direction of travel (Figure 5.4). This route, combined with the direct route via Callam Street, requires a total of 4.8 km of dead running for both northbound (2.4km) and southbound (2.4 km) services.

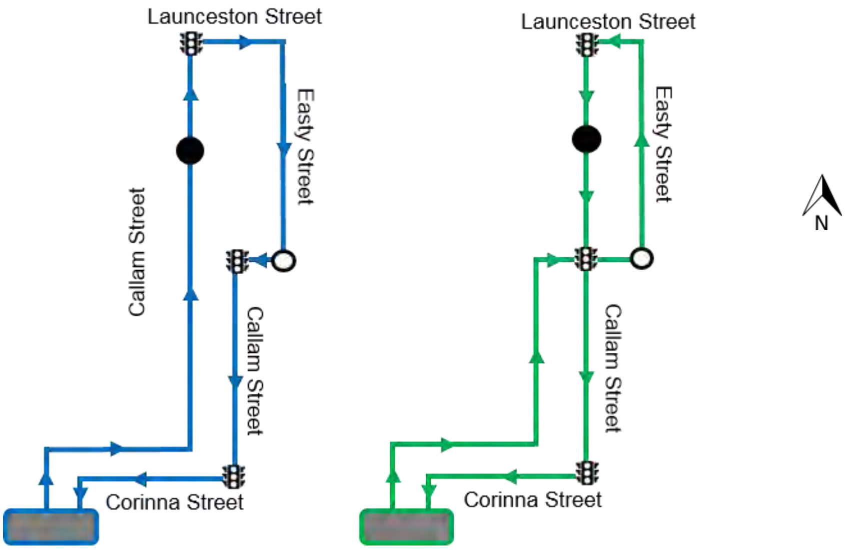


Figure 5.4: Corinna Street Car Park bus circulation

Table 5.4 outlines the benefits and constraints in relation to Option 2-B.

Table 5.4: Option 2-B: Benefits and constraints

Benefits	Constraints
• Close proximity to Woden Bus Interchange • Travel time of up to 8 minutes (return) • Low dead running kilometres (4.8km) • Capacity for up to 14 buses • Opportunity to extend site if required • No land acquisition required	• Extended route via Easty Street may lead to delays • Loss of public car parking • Works required to augment entry at Corrina Street • New exit required to Ball Street • Requires construction of a dedicated driver facility • May present some challenges in relation to manoeuvrability

5.3 Option 2-C: Paramatta Street Car Park

Parramatta Street is aligned east-west between Melrose Drive and Athllon Drive and is bounded by light industrial land uses and car sales lots. The proposed site covers an area of approximately 3,366m^2 and is currently used for informal car parking (Figure 5.5).

It is estimated the site could provide up to 9 bus bays with a 30 degree parking arrangement, with further space to accommodate up to 3 bus bays in a head to tail arrangement next to the adjacent lot in an area currently used as informal on-street parking. A swept path analysis has determined that there is sufficient space for buses to enter the site via Bellona Court and exit via Townsend Street

With Woden Bus Depot situated a short walk from the proposed site, it is noted that bus drivers would be able to utilise the restroom and meal room facilities situated at the depot. Ownership of the site is unknown, and as such it is likely that land acquisition may be required.

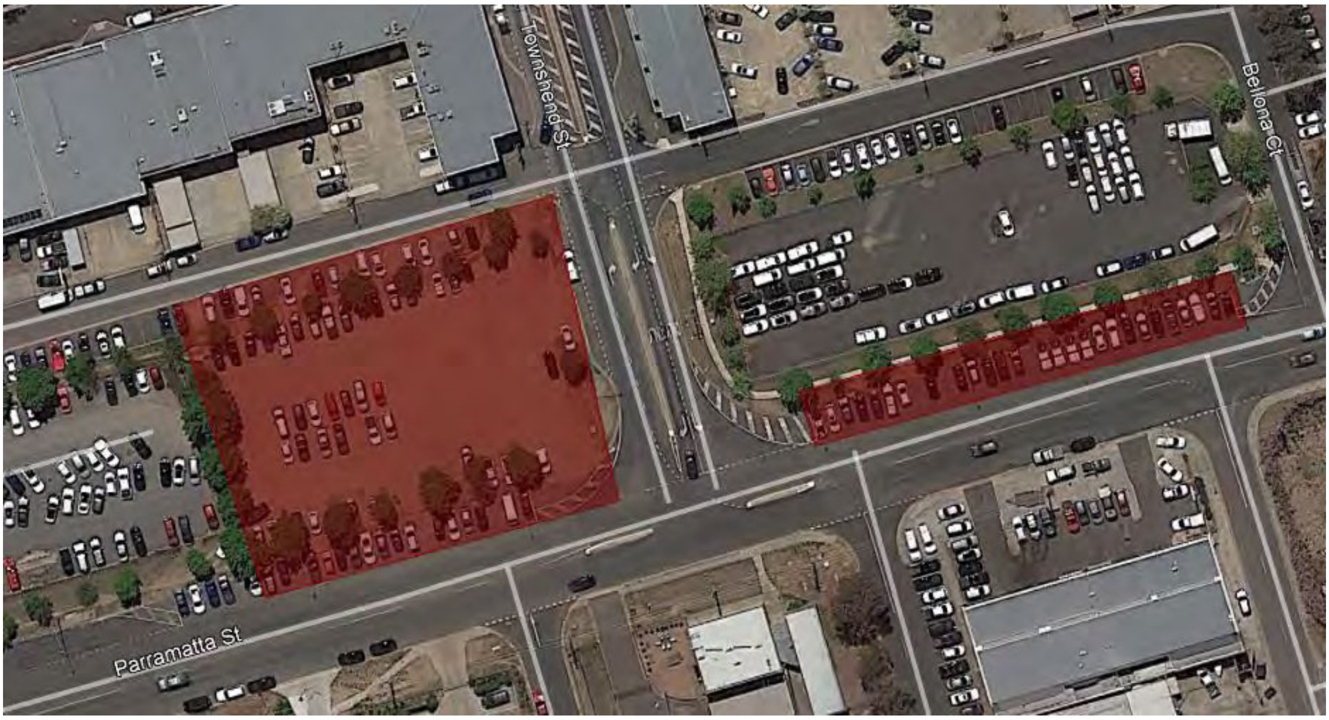


Figure 5.5: Option 1-C: Paramatta Street Car Park

The proposed site is located 1.3km from Woden Bus Interchange with return travel times of up to 12 minutes. However, given the location of the entry and exits to the site, both northbound and southbound buses must take extended and indirect routes to ensure they return to Callam Street in the required direction of travel (Figure 5.6). As a result, this option has dead running kilometres which total 8.6 km and a number of potential sources of delay.

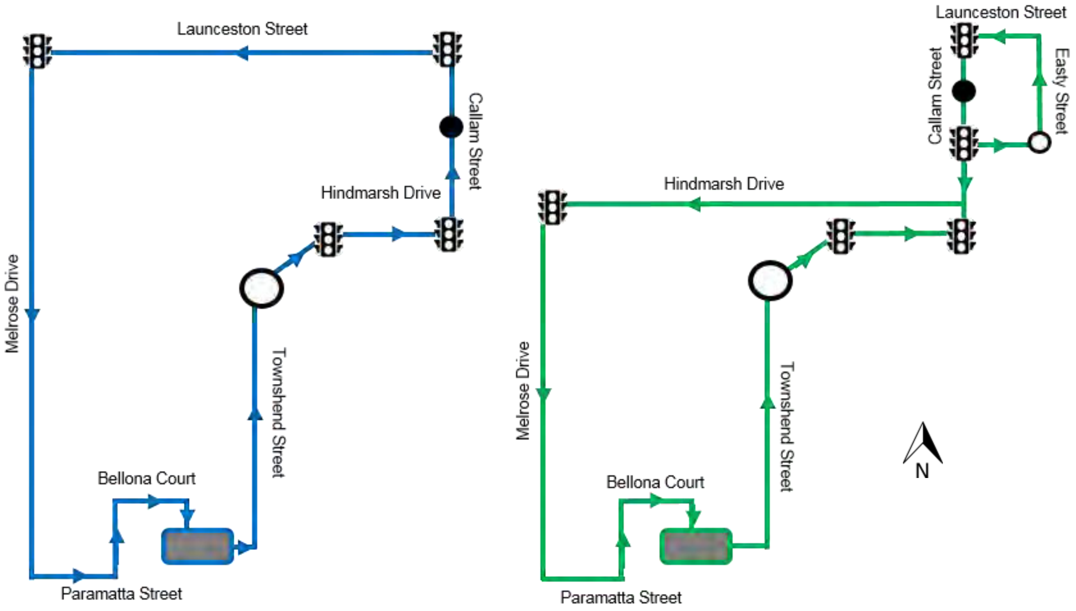


Figure 5.6: Paramatta Street bus circulation

Table 5.5 outlines the benefits and constraints of Option 2-C.

Table 5.5: Option 2-C: Benefits and constraints

Benefits	Constraints
• Limited conflict with existing land uses • Facilities available at nearby Woden Bus Depot	• Extended distance and travel time (up to 12 minutes return) • Dead running kilometres are high (8.6 km) • Extended travel routes with potential for delay • Loss of on-street car parking • Constraints on manoeuvrability • Land acquisition may be required • Tree removal required to accommodate bus movements

5.4 Option 2-D: Woden Bus Depot

See detailed description in Section 4.4.

6. Multi-criteria analysis

6.1 Methodology

A multi-criteria analysis was completed to enable the shortlisting of one preferred site option for medium-term and long-term layover facilities to serve Woden Bus Interchange. To undertake the multi-criteria analysis, an assessment framework was developed and approved by Transport Canberra. The assessment framework was used as part of a qualitative analysis to determine the extent to which each site option contributes towards each individual criterion. The assessment criteria used as part of the analysis are presented in Table 6.1.

Table 6.1: Assessment criteria

Criteria	Description
Operational	This criterion relates to the extent to which the site supports the efficient operation of bus services. This includes the number of dead running kilometres which is a function of distance. Travel time is also considered as part of this criterion.
Size	The ability of the site to provide sufficient space to deliver against requirements. This includes the physical space / capacity and also the extent to which vehicles can easily and safely manoeuvre into, out of and around the site.
Constructability	The ease of construction of the layover facilities, including whether existing facilities can be repurposed. This criterion also includes cost.
Land use	The extent to which the site optimises the use of urban space within the surrounding area, including whether land acquisition is required.

In relation to each criterion, site options were scored on a five-point scale using the scoring system outlined in Table 6.2. The scoring process is based on existing evidence, where available, and judgements based on experience to allow a qualitative approach to be adopted. The five-point scale aims to provide consistency in the approach to appraising each solution, and across disciplines.

Table 6.2: Rating scale

Rating	Interpretation
5	Major positive impact
4	Positive impact
3	No distinct positive or negative
2	Negative impact
1	Major negative impact

6.2 Results

6.2.1 Medium-term-layover

The results of the multi-criteria analysis for the medium-term layover site options is presented in Table 6.3.

Table 6.3: Medium-term layover results

	Dead running	Size	Constructability	Land Use	TOTAL
Option 1-A – Easty Street	5	5	4	4	**18**
Option 1-B – Irving Street	2	5	3	3	13
Option 1-C – Phillip Oval Car Park	3	2	2	1	8
Option 1-D – Woden Bus Depot	1	5	5	5	16

Given its close proximity to Callam Street, its ability to accommodate a large number of bus layover bays and the relative ease of construction, Option 1-A Easty Street is considered to be the preferred location for medium-term bus layover bays. This site is also the only site with return travel times under 5 minutes, providing sufficient time for drivers to have a rest break. However, this site does not have good access to driver facilities which will need to be considered.

Option 1-D Woden Bus Depot scores as the second most favourable option for medium-term layover facilities. While this option has a relatively high number of dead running kilometres and extended travel times compared with other options, it is considered to be the most practical option given the availability of driver facilities on site and no conflicts with existing land uses. Nevertheless, given that medium-term layover facilities will provide rest breaks for periods of up to 15 minutes, Woden Bus Depot is deemed to be situated too far from Woden Bus Interchange to provide a feasible site.

Option 1-B Irving Street has the required space to accommodate the required number of bus bays and has relatively low dead running kilometres. However, this site requires more significant civil works to accommodate turning vehicles from Launceston Street, has no confirmed access to driver facilities and extended travel times of up to 9 minutes return. Given the extended travel times, this site is also not considered to be a feasible option.

Option 1-C Phillip Oval Car Park is the least favourable option, largely given its inflexibility in relation to land use due to conflicts with the existing use of the site, coupled with constructability challenges.

6.2.2 Long-term layover

The results of the multi-criteria analysis for the long-term layover site options is presented in Table 6.4.

Table 6.4: Long-term layover results

	Dead running	Size	Constructability	Land Use	TOTAL
Option 2-A – Irving Street Car Park	4	5	2	3	13
Option 2-B – Corinna Street Car Park	5	5	2	2	15
Option 2-C – Parramatta Street	1	2	4	3	10
Option 2-D – Woden Bus Depot	1	5	5	5	**16**

Option 2-D Woden Bus Depot is scored as the most favourable option to provide long-term layover facilities. This option scores high in relation to constructability as it assumed layover provision can be made alongside the current redevelopment of the site. In addition, there are no land use conflicts given the site will already accommodate buses and bus movements. This site will also provide the required driver facilities with no need for additional construction, and therefore come at a limited upfront cost when compared to other options. While Option 2-D does require a high number of dead running kilometres and extended travel times when compared to other options, given meal breaks will take place outside of peak periods, peak bus requirements will not be impacted.

Option 2-B Corinna Street Car Park scored as the second most favourable option to provide long-term layover facilities. While the use of the site will result in the loss of public car parking and negative impacts on visual amenity of the edge of the town centre precinct, the site provides the required capacity and is situated close to Woden Bus Interchange. It therefore generates the lowest number of dead running kilometres and has the shortest travel times. This site will require some works to widen the entrance from Corinna Street and create a new exit on to Ball Street, as well as the construction of a dedicated driver facility. As such, while the upfront cost may be high, the ongoing operational cost will be reduced given the relatively low dead running kilometres.

Option 2-A Irving Street Car Park is the third most favourable option according to the multi-criteria analysis. While it requires additional dead running kilometres when compared with Corinna Street, the site has the required capacity and scope to add additional capacity where required. Minor works are required to widen the entry / exit points and provide sufficient space for right turning vehicles from Launceston Street.

The least favourable option for long-term layover facilities is Option 1-C Paramatta Street. This site has the greatest number of dead running kilometres and is unable to offer the required bus bay capacity. Travel times are also extended due to a complex route, and manoeuvrability into and out of the site is highly constrained.

7. Conclusions

7.1 Overview

This study has identified locations for both medium-term (up to 15 minutes) and long-term (up to 60 minutes) layover bus parking facilities within the vicinity of Woden Bus Interchange. The study has identified that:

- Easty Street represents the most feasible location to provide medium-term layover facilities given the short travel time between Woden Bus Interchange and the site. However, the site does not provide driver restroom facilities which must be provided for this site to meet requirements; further investigation in relation to this aspect is required;
- While alternative options with sufficient capacity exist to provide medium-term layover facilities, return travel times to these sites are in excess of 8 minutes which is considered to be too long to enable drivers to take the required rest time;
- Woden Bus Depot represents the most feasible location to provide long-term layover facilities given the available capacity to provide bus bays and the presence of the required driver facilities when constructed. The site requires a greater number of dead running kilometres compared to other options, but these will be accommodated outside peak periods so are unlikely to present a major operational constraint.

7.2 Next steps

The following steps have been identified to progress this study:

- Concept design of medium-term layover bays at Easty Street;
- Investigate options to provide drivers with restroom facilities within close proximity of Easty Street;
- Investigate the implications of extending the scope of Woden Bus Depot to accommodate long-term layover bays.

Appendix K. Air Quality and Noise Assessment

[redacted]

Memorandum

Level 4, 12 Stewart Avenue
Newcastle West NSW 2302 Australia
PO Box 2147 Dangar NSW 2309 Australia
T +61 2 4979 2600
F +61 2 4979 2666
www.jacobs.com

Subject	**Preliminary Air Quality and Noise Review**	**Project Name**	Woden Bus Interchange
Attention	Schedule 2.2(a)(ii)	**Project No.**	IS268800
From	Schedule 2.2(a)(ii)		
Date	3 July 2019		
Copies to	Schedule 2.2(a)(ii)		

---

1. Introduction

This memorandum provides a preliminary review of potential air quality and noise requirements and constraints associated with the proposed Woden Bus Interchange Project.

2. Air quality

2.1 Primary considerations

Potential air quality impacts may arise during the construction and operational phases of the proposal. Dust is expected to be the primary air quality-related risk during construction. Dust is a general term used to describe particulate matter in the form of total suspended solids (TSS) or particulate matter with a smaller aerodynamic diameter (PM_{10} and $PM_{2.5}$). When not properly managed, elevated airborne dust levels have the potential to cause adverse health or nuisance impacts. High dust levels can also cause physical and chemical impacts to vegetation (Farmer, 1993).

Exhaust emission from the combustion of fossil fuels in construction plant and equipment represent another air quality risk during construction, along with odours arising from uncovered contaminated and/or hazardous materials, and airborne hazardous materials (e.g. asbestos and fungal spores).

Emissions from traffic along roads is a key source of air pollution in Australian cities. In the ACT, major sources of emissions are transportation and from non-industrial activities (ACT Government, 1999). The ‘Australia: State of the Environment 2016 – Atmosphere’ (SoE 2016) report (Keywood, Hibberd & Emmerson, 2017) lists carbon monoxide (CO), oxides of nitrogen (NO_x) including nitrogen dioxide (NO_2) and particulate matter (PM_{10} and $PM_{2.5}$) as the primary pollutants associated with motor vehicle emissions. Volatile organic compounds (VOCs) are also noted to be a key pollutant associated with motor vehicle exhaust emissions.

In other geographies, sulfur dioxide (SO_2) is another key pollutant associated with road vehicles, although this isn’t generally the case in Australia owing to the relatively low sulfur content in Australian fuels (DEC, 2005). Ozone (O_3) is another notable pollutant connected to emissions from traffic, although it is secondary pollutant, formed through chemical reactions of NO_2 in the atmosphere.

2.2 Regulatory requirements

The quality of ambient air in the ACT is protected by provisions contained in the *Environment Protection Act 1997* (ACT) and the *Air – Environment Protection Policy*. Although emissions from motor vehicles are not explicitly subject to these statutes, there is a general aim to ensure that air quality in the ACT meets national standards. These standards are contained in the *National Environment Protection (Ambient Air Quality) Measure* (NEPM AAQ) and are re-produced below in **Table 2-1**.

Table 2-1 NEPM AAQ standards

Column 1 Item	Column 2 Pollutant	Column 3 Averaging period	Column 4 Maximum concentration standard	Column 5 Maximum allowable exceedances
1	Carbon monoxide	8 hours	9.0 ppm	1 day a year
2	Nitrogen dioxide	1 hour 1 year	0.12 ppm 0.03 ppm	1 day a year None
3	Photochemical oxidants (as ozone)	1 hour 4 hours	0.10 ppm 0.08 ppm	1 day a year 1 day a year
4	Sulfur dioxide	1 hour 1 day 1 year	0.20 ppm 0.08 ppm 0.02 ppm	1 day a year 1 day a year None
5	Lead	1 year	0.50 µg/m^3	None
6	Particles as PM_{10}	1 day 1 year	50 µg/m^3 25 µg/m^3	None None
7	Particles as $PM_{2.5}$	1 day 1 year	25 µg/m^3 8 µg/m^3	None None

At 0 degrees Celsius, the maximum concentration standards for CO and NO_2 equate to:

- 8-hour averaged CO: 9.0 ppm is equivalent to 11 mg/m^3;
- 1-hour averaged NO_2: 0.12 ppm is equivalent to 246 µg/m^3; and
- Annually averaged NO_2: 0.03 ppm is equivalent to 62 µg/m^3.

2.3 Existing environment

2.3.1 Surrounding receivers

The Territory Plan sets out approved land uses throughout the ACT. Land uses around the proposal are displayed below in **Figure 2-1**. The primary guideline for assessing potential air quality impacts in NSW, the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (NSW

Environment Protection Authority, 2016), identifies sensitive receivers as locations where ‘people are likely to work or reside; this may include a dwelling, school, hospital, office or public recreational area’.

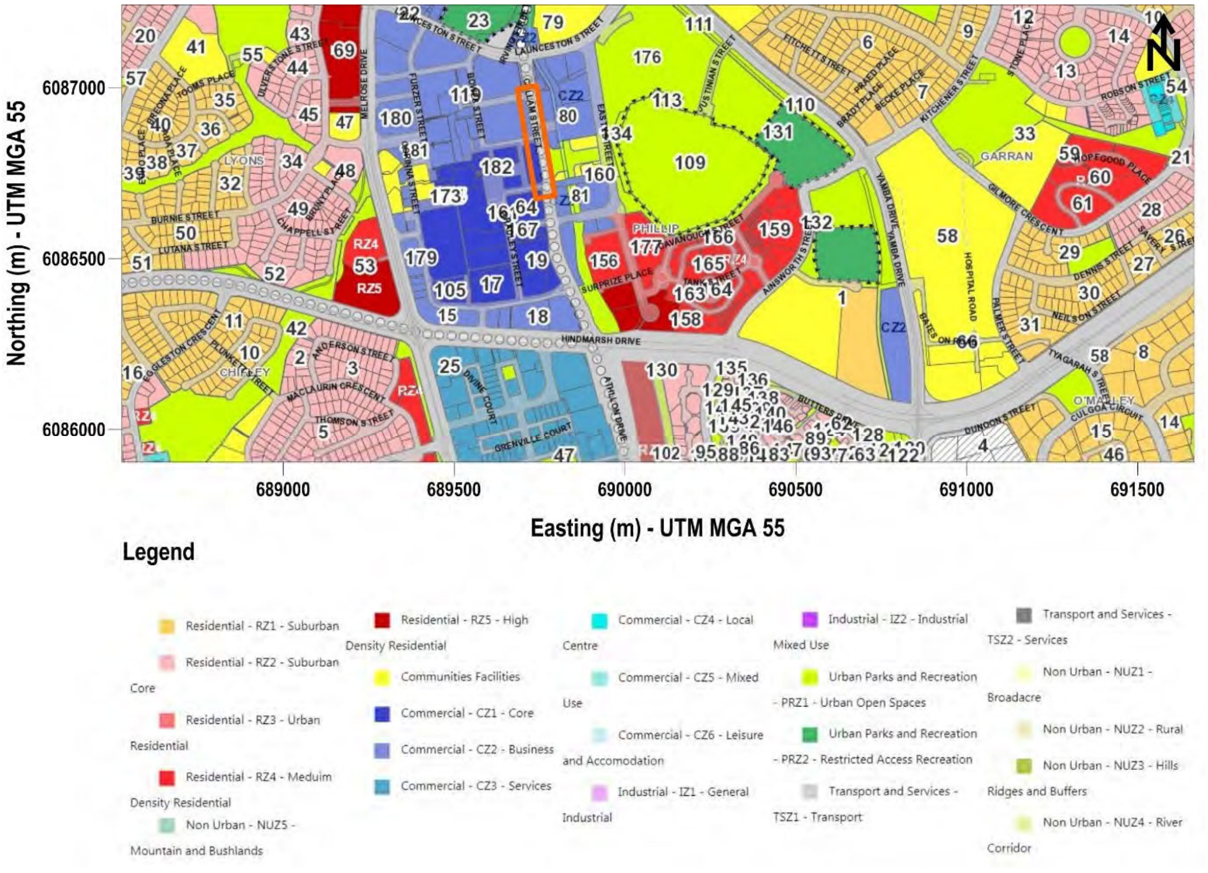


Figure 2-1 Approved land uses (ACT Territory Plan)

As shown in **Figure 2-1**, the nearest sensitive receivers in relation to the proposal are:

- Residential receivers located approximately 200 metres to the southeast off Wilbow Street and Easty Street.
- Woden Town Park recreational area located around 70 metres to the east.
- Residential receivers off Bowes Street, approximately 150 metres to the west.
- Commercial premises adjacent to the proposal along Callam Street, Bradely Street and Matilda Street.

2.3.2 Climate and meteorology

Climate and meteorological conditions are important for determining the direction and rate at which emissions from a source will disperse. The nearest weather station with long-term historical records operated by the Bureau of Meteorology (BoM) is the Tuggeranong (Isabella Plains) automatic weather station (AWS) no. 070339. This station is located approximately 8 kilometres to the south of the proposal. Long-term temperature and rainfall averages recorded at this station from its date of commission in 1996 to June 2019 are summarised below.

Table 2-2 Long-term climate data, BoM Tuggeranong (Isabella Plains), 1996 to June 2019

Month	Mean maximum temperature (°C)	Mean minimum temperature (°C)	Mean rainfall (mm)	Mean number of rain days (> 1 mm)
January	29.7	14.5	53.9	5.3
February	28.1	14.2	69.6	5.6
March	25.3	11.4	52.5	4.8
April	21.1	6.9	32.4	3.7
May	16.6	2.5	24.8	3.6
June	13.1	1.3	54.3	5.9
July	12.3	-0.1	39.4	5.6
August	14.1	0.9	47.1	5.8
September	17.6	3.7	59.4	6
October	21	6.4	50.4	6.2
November	24.3	9.9	76.5	7.5
December	27.2	12.4	70.2	6
Annual	**20.9**	**7**	**620**	**66**

These data indicate that the locality around the proposal experiences warm summers with mean daily maximum temperatures of around 28 degrees Celsius. The driest period of the year is between April and July when the average monthly rainfall around 38 millimetres (mm) per month; below the annual average of 52 mm/month. It is during periods of dry, higher temperature conditions that the potential for dust generation is greatest.

Long-term (2013 to 2015) meteorological data collected at the Tuggeranong (Isabella Plains) AWS are shown below in **Figure 2-2**. As shown, calm conditions (i.e. where wind speed is less than 0.5 metres per second) occur around 22% of the time annually. Winds blowing from the east are most common annually, with winds from the north, south and west also common. In summer, winds from the east were most common. Autumn prevailing trends were generally consistent with annual conditions. In winter, winds blowing from the north occurred most frequently. Finally, in spring, winds from the south and west were most common.

These data indicate that receivers in all directions would experience winds blowing in the direction from the proposal. The frequency of winds blowing from the sector from west to north indicates that the residential receivers to the southeast off Wilbow Street and Easty Street

Annual
Calms = 22.2%

Summer
Calms = 15.1%

Autumn
Calms = 27.4%

Winter
Calms = 26.1%

Spring
Calms = 19.8%

Figure 2-2 Annual and seasonal wind roses, 2013 to 2015 BoM Tuggeranong (Isabella Plains)

2.3.3 Background air quality

The ACT Government monitors ambient air quality data throughout the ACT. The monitoring network comprises of three stations located at Civic, Florey and Monash. These data are publicly available at https://www.data.act.gov.au/Environment/Air-Quality-Monitoring-Data/94a5-zqnn. Data collected at these stations in 2018 are summarised below:

Table 2-3 Ambient air quality monitoring data, ACT 2018

Year	Station			NEPM AAQ Criteria
	Civic	Florey	Monash	
Maximum 24-hour averaged PM_{10}				
2018	167 µg/m^3	163 µg/m^3	133 µg/m^3	50 µg/m^3
95th-percentile 24-hour averaged PM_{10}				
2018	25 µg/m^3	25 µg/m^3	23 µg/m^3	50 µg/m^3
Annually averaged PM_{10}				
2018	13 µg/m^3	12 µg/m^3	12 µg/m^3	25 µg/m^3
Maximum 24-hour averaged $PM_{2.5}$				
2018	35 µg/m^3	28 µg/m^3	31 µg/m^3	25 µg/m^3
95th-percentile 24-hour averaged $PM_{2.5}$				
2018	11 µg/m^3	17 µg/m^3	18 µg/m^3	25 µg/m^3
Annually averaged $PM_{2.5}$				
2018	6 µg/m^3	7 µg/m^3	7 µg/m^3	8 µg/m^3
1-hour averaged NO_2				
2018	-	80 µg/m^3	80 µg/m^3	246 µg/m^3
Annually averaged NO_2				
2018	-	10 µg/m^3	9 µg/m^3	62 µg/m^3
8-hour averaged CO				
2018	-	1.7 mg/m^3	1.8 mg/m^3	11 mg/m^3

Considering these data, the following background concentrations were conservatively adopted for the review:

- 24-hour averaged PM_{10}: 25 µg/m^3;
- Annually averaged PM_{10}: 13 µg/m^3;
- 24-hour averaged $PM_{2.5}$: 18 µg/m^3;
- Annually averaged $PM_{2.5}$: 7 µg/m^3;
- 1-hour averaged NO_2: 80 µg/m^3;
- Annually averaged NO_2: 10 µg/m^3; and
- 8-hour averaged CO: 1.8 mg/m^3.

2.4 Preliminary review of potential impacts

2.4.1 Construction

The activities with the highest potential to result in the generation of dust during construction include:

- Demolition of existing kerb and median: ‘Low risk’;
- Clearing and earthworks: ‘High risk’;
- Pavement construction: ‘Medium risk’;
- Interchange infrastructure: ‘Low risk’; and
- Line marking and re-sheeting: ‘Medium risk’.

The initial risk ratings above were generated for each of these activities based on metrics developed using guidance from *AS/NZS ISO 31000: 2009 Risk Management – Principles and Guidelines* shown below.

Table 2-4 Environmental risk evaluation matrix (AS/NZS ISO 31000: 2009)

Consequences	Likelihood				
	Very unlikely	Unlikely	Possible	Likely	Almost certain
Catastrophic	15	19	22	24	25
Major	10	14	18	21	23
Moderate	6	9	13	17	20
Minor	3	5	8	12	16
Insignificant	1	2	4	7	11

Table 2-5 Method for determining likelihood (probability), (AS/NZS ISO 31000: 2009)

Likelihood	Definition	Probability
Almost certain	The event is almost certain to occur in the course of normal or abnormal construction / operational circumstances.	Greater than 90%
Likely	The event is more likely than not to occur in the course of normal construction / operational circumstances.	51 to 90%
Possible	The event may occur in the course of normal construction / operational circumstances.	26 to 50%
Unlikely	The event is unlikely to occur in the course of normal construction / operational circumstances.	5 to 25%
Very unlikely	The event may occur in exceptional construction / operational circumstances only.	Less than 5%

Table 2-6 Method for determining consequence (severity), (AS/NZS ISO 31000: 2009)

Consequence level	Definition
Catastrophic	Long term (greater than three months) and irreversible impacts. Resulting in a major prosecution under relevant environmental legislation.

Consequence level	Definition
Major	Medium term (between one and three months) and potentially irreversible impacts. Resulting fine or equivalent penalty notice under relevant environmental legislation.
Moderate	Moderate and reversible impacts or medium term (between one and three months).
Minor	Minor and reversible, or short term impacts (less than one month)
Insignificant	Minor, negligible impacts.

Table 2-7 Method for evaluating the significance of calculated risks

Risk rating score	Risk category	Comments
1 to 7	Low	Negligible effect or implication on the environment. No injury, insignificant financial loss (i.e. less than $5,000), minimal environmental damage, no complaints. Environmental impact that would not be of concern to a reasonable person.
8 to 12	Medium	Minor effect or implication on the environment. First-aid required, on site damage immediately contained with no long-term impacts, minor financial loss (greater than $5,000 but less than $50,000), occasional complaints, possible media interest. Localised and reversible damage to the environment.
13 to 18	High	Moderate, medium-term effect or implication on the environment. Medical treatment required, containable localised damage on-site, moderate financial loss (greater than $50,000 but less than $5,000,000), low likelihood of prosecution, minimal fines, occasional complains and possible media interest. Extensive and reversible or localised and irreversible environmental damage.
19 to 22	Very High	Long-term effect or implication on the environment. Extensive injuries, project suspensions for a period of days, major financial loss (greater than $5,000,000 but less than $100,000,000), significant on-site environmental damage, very bad media coverage, community discontent, possible prosecution. Extensive and reversible or localised and irreversible environmental damage.
23 to 25	Extreme	Irreversible, extensive implications on the environment. Death, project suspensions for a period of weeks, massive financial loss (greater than $100,000,000), significant off-site environmental damage, sustained bad media coverage, sustained complaints and community discontent, probable prosecution.

Measures to effectively manage these risks would need to be developed as part of the environmental impact assessment.

2.4.2 Operations

Using the limited traffic data available for the assessment (refer to **Table2-8** below), the potential for operational air quality impacts at surrounding sensitive receiver locations was quantitatively reviewed using the NSW Roads and Maritime Services' Tool for Roadside Air Quality (TRAQ) model. TRAQ considers emissions arising from combustion exhaust emissions, as well as particulates from braking and tyre wear.

Table 2-8 Available traffic inputs

Road	Year of opening (2022) interpolated data				
	Daily traffic	AM peak, traffic flow	PM peak, traffic flow	Design speed (km/hr)	% Heavy Vehicles
Callam Street	10,000	974	1019	60	4.5%
Matilda Street	3,300	532	184	40	2.4%
Bradley Street	2,000	178	173	40	17.9%
Neptune Street	5,900	235	472	20	2.4%
Wilbow Street	3,100	127	307	40	2.2%

Using these limited data with appropriate TRAQ default parameters, the following results were predicted at the most-affected residential receiver location.

Table 2-9 Year of opening, preliminary worst-case results

Pollutant and averaging period	Incremental pollutant concentration at nearest sensitive receiver area ($\mu g/m^3$ unless stated)	Background concentration ($\mu g/m^3$ unless stated)	Background + incremental contribution ($\mu g/m^3$ unless stated)	Impact assessment criterion ($\mu g/m^3$ unless stated)
24-hour averaged PM_{10}	1	25	26	50
Annually averaged PM_{10}	0.4	13	13.4	25
24-hour averaged $PM_{2.5}$	1	18	18.1	25
Annually averaged $PM_{2.5}$	0.4	7	7.4	8
1-hour averaged NO_2,	3.2	80	83.2	246
Annually averaged NO_2	0.6	10	10.6	62
8-hour averaged CO	0 mg/m^3	1.8 mg/m^3	1.5 mg/m^3	10 mg/m^3

These results indicate that operational air quality impacts are not expected to be likely, although more detailed investigations should be completed. These investigations should consider:

- More detailed traffic information;
- Review the relative impact with and without the proposal to identify any deterioration or improvements in local air quality;
- Review impacts for different time scales (e.g. 10 years' after opening) to assess the potential for future issues.

3. Noise

3.1 Primary considerations

Key noise considerations associated with the proposal include changes in traffic noise levels resulting from changes in traffic conditions, as well as noise impacts arising during construction.

3.2 Regulatory requirements

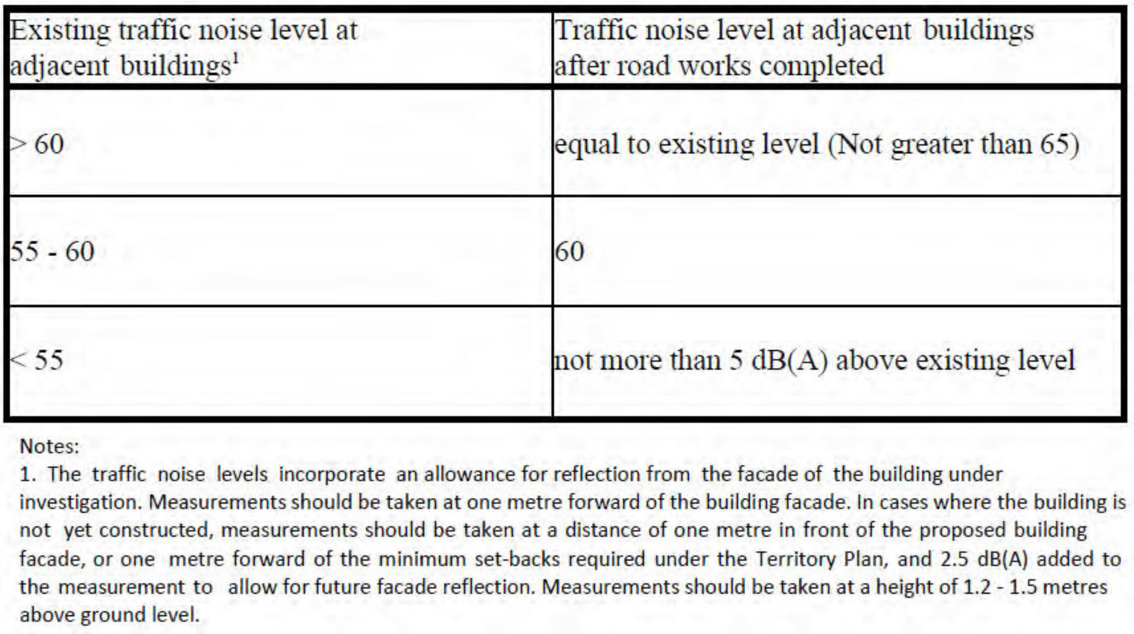
3.2.1 Construction noise

Schedule 2, Part 2.3 of the Environment Protection Regulation 2005 (ACT) notes that there are no requirements to quantitatively assess noise ‘emitted in the course of constructing or maintaining a major road’, and that there are only work restrictions for such works not identified as ‘major roads’ in the Territory Plan.

3.2.2 Operational noise

Traffic noise in the ACT is regulated in accordance with the Roads ACT Noise Management Guidelines. For ‘upgrading to existing roads in existing areas’, the following guidance is provided:

Table 3-1 Traffic levels resulting from upgraded roads in existing areas of noise-sensitive land use, expressed as L_{Aeq} dB(A), ground level



Existing traffic noise level at adjacent buildings[1]	Traffic noise level at adjacent buildings after road works completed
> 60	equal to existing level (Not greater than 65)
55 - 60	60
< 55	not more than 5 dB(A) above existing level

Notes:

1. The traffic noise levels incorporate an allowance for reflection from the facade of the building under investigation. Measurements should be taken at one metre forward of the building facade. In cases where the building is not yet constructed, measurements should be taken at a distance of one metre in front of the proposed building facade, or one metre forward of the minimum set-backs required under the Territory Plan, and 2.5 dB(A) added to the measurement to allow for future facade reflection. Measurements should be taken at a height of 1.2 - 1.5 metres above ground level.

3.3 Existing environment

3.3.1 Noise-sensitive receivers

The nearest sensitive receivers are described above in **Section 2.3.1**.

3.4 Preliminary review of potential impacts

3.4.1 Construction

During construction, it is likely that there will be temporal (i.e. shot-term) noise impacts at surrounding land uses. The relative potential magnitude from different phases of construction should be estimated during the environmental assessment, with commensurate avoidance, mitigation and management controls, and communication strategies developed.

3.4.2 Operations

With the limited available traffic data (refer to **Table 2-8**), CoRTN calculations were preformed to predict the resulting noise level at year of opening (2022) at the most-affect residential receive location. Key variables required for this calculation are the breakdown of traffic volume, speed and composition information for the periods from 7am to 10pm (Day), and 10pm to 7am (Night). Applying different day-time traffic flow percentages, the following indicative results were predicted:

Table 3-2 Indicative operational noise results

Day-time percentage traffic flow	Indicative $L_{AEq\ 15\text{-}hour}$ dB(A) at most-affected residential receiver
Pro-rata, i.e. (15/24), 63%	57 dB(A)
90%	58 dB(A)

As noted in **Table 3-1**, the process of determining whether traffic noise levels are acceptable requires an understanding of existing traffic noise levels. To determine compliance and the need for mitigation will require the following steps during the environmental assessment:

- An understanding of existing local noise levels and traffic information; and
- Full traffic and layout details consistent with CoRTN input requirements for with and without the proposal over multiple timescales (i.e. year of opening, 10 years' after opening).

Appendix L. Vehicle Turning Paths


Service Vehicle (8.8 m) 9m radius
3
16
16
BUS ONLY
BUS ONLY
Long Rigid Bus (14.5 m)
12
Long Rigid Bus (14.5 m)
BUS ONLY
BUS ONLY
13
Long Rigid Bus (14.5 m)
19
19
Long Rigid Bus (14.5 m)
19