

APPENDIX C TRAFFIC AND TRANSPORT IMPACT ASSESSMENT (AECOM)

Traffic and Transport Impact Assessment

City of Sydney
Town Hall House
456 Kent Street
Sydney NSW 2000

Green Square to Ashmore Connector road between Botany Road and Bowden Street,
Alexandria



November 2017

Sydney2030/Green/Global/Connected

city of villages

AECOM



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CERTIFICATION

This report has been prepared and reviewed by the City of Sydney Council and AECOM as prescribed below.

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ABBREVIATIONS

The following abbreviations are used in this document.

Abbreviation	Meaning
A2MP	Alexandria to Moore Park Connectivity Upgrade
ASL	Above Sea Level
ATC	Automatic Traffic Count
CBD	Central Business District
Council	The City of Sydney's elected representatives
The City / City of Sydney	The City of Sydney organisation
CRU	Construction Regulation Unit
CTMP	Construction Traffic Management Plan
DCP	Development Control Plan
DOS	Degree of Saturation
EP&A Act	NSW Environmental Planning and Assessment Act 1979
GS2AC	Green Square to Ashmore Connector
GSC	Greater Sydney Commission
GSTC / the Town Centre	Green Square Town Centre
GSURA	Green Squad Urban Renewal Area
km	Kilometres
LGA	Local Government Area
LOS	Level of Service
LTTMP	Long Term Transport Master Plan
m	Metres
NSW BSA	NSW Bureau of Statistics and Analytics
REF	Review of Environmental Factors
ROL	Road Occupancy Licences
RL	Raised Level
Roads & Maritime	Roads & Maritime Services
Sqm	Square metres
TCP	Traffic Control Plan
TMAP	Transport Management and Accessibility Plan
TMC	Turning Movement Counts
TMP	Traffic Management Plan
the proposal	Green Square to Ashmore Connector



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EXECUTIVE SUMMARY

The City of Sydney (CoS) is currently undertaking the project delivery of Green Square Town Centre (GSTC) Essential Infrastructure and Public Domain (EIPD) works which are located in the City of Sydney Local Government area. The Green Square Town Centre is the core of the broader Green Square Renewal Area which involves the development of a large range of new infrastructure including, key roads, transport and community amenities to service a proposed 50,000 resident population and 20,000 workforce over a 20 year period up to 2030.

The proposed Green Square to Ashmore Connector (GS2AC) forms a significant part of the Green Square transport infrastructure strategy and will provide access for residents from the broader renewal area and the adjacent Ashmore Precinct to public amenities such as the Town Centre, library and aquatic centre. The project will provide a new east-west link between Bourke Road and Botany Road (linking Bowden Street to Geddes Avenue, currently under construction) and includes the introduction two new and one augmented signalised intersection, just south of the Green Square rail station. The road will provide one lane in each direction as well as a separated bi-directional cycleway.

CoS engaged AECOM to prepare a Traffic and Transport Impact Assessment (TTIA) report for the GS2AC in support of the Review of Environmental Factors. The TTIA report assess key transport and traffic design, construction and operation issues to ensure that the proposed road operates in a safe and efficient manner. The preparation of the TTIA report has involved consultation with Roads & Maritime Services (Roads and Maritime), Transport for NSW and UrbanGrowth NSW as well as key internal divisions within the CoS including City Access and City Infrastructure Traffic Operations.

The GS2AC has long been considered a road-based option to improve local transport access to, and support the growth of, the Green Square Town Centre (GSTC). Once complete, the GS2AC is predicted to improve multiple traffic and transport aspects within the vicinity of the site. The anticipated benefits include improvements to road network performance, active transport, and public transport.

The GS2AC provides an opportunity to significantly enhance pedestrian and cyclist safety and accessibility by providing two new signalised crossings at O'Riordan Street and Bourke Road, as well as the connection with the approved crossing at Botany Road. These crossings will allow pedestrians and cyclists to cross each road safely and conveniently and will assist in improving the east-west connectivity to the GSTC.

The report has identified the GS2AC will operate efficiently in the 2021 future year and will serve its function of improving accessibility for all road users to the proposed Green Square Town Centre. Furthermore, it is likely that the GS2AC will not impact on the existing road network, namely the state roads of Botany Road and O'Riordan Street which are already severely congested during the peak periods. Potential future restraints have been identified as the right turn out of Geddes Avenue and southern approach on Bourke Road. However, the congestion along the state roads will limit the volume of traffic accessing the GS2AC and therefore is likely to encourage the local use of the GS2AC.

The construction of the GS2AC is anticipated to take up to 22 months to complete, starting in mid 2018 to early 2020. Given the number of daily construction vehicles, overall the construction works could not be expected to significantly impact intersection operation external to the site.

As maintaining existing operation of the surrounding road network and active/ public transport throughout the construction of the GS2AC remaining a top priority, measures will be set in place to minimise disruptions. Mitigation measures include partial road closures, specific working hours, vehicle and pedestrian diversions, alternate access arrangements to properties, and appropriate signage.

The preparation of the Traffic and Transport Impact Assessment report has identified that the GS2AC will operate in a safe and efficient manner to improve accessibility to the proposed Green Square Town Centre.

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1. INTRODUCTION

The City of Sydney (the City) is proposing the Green Square to Ashmore Connector (the proposal), a new road to be located between Botany Road and Bowden Street in Alexandria, just south of Green Square Rail Station.

The City is the proponent for the proposal and is also the “determining authority” for the Review of Environmental Factors (REF) under Part 5 of the *NSW Environmental Planning and Assessment Act 1979* (EP&A Act).

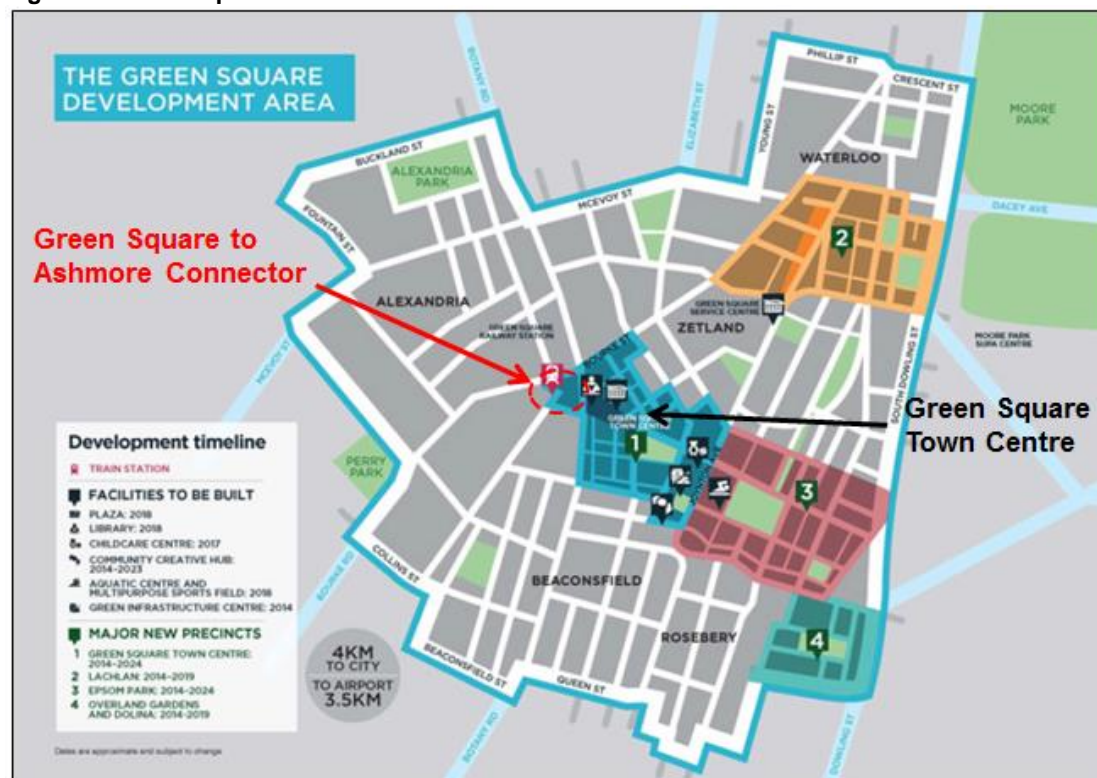
1.1 Green Square Urban Renewal Area

The Green Square Urban Renewal Area (GSURA) is located approximately 4 kilometres south of the Sydney Central Business District (CBD). It sits within the suburbs of Alexandria, Zetland, Waterloo and Beaconsfield and is part of the City of Sydney Local Government Area (LGA). The GSURA has bus, rail, road and cycle connections to other regions of Sydney.

Green Square lies within the Southern Employment Lands, which is predominately an industrial area dominated by large warehouse style developments, factory units, retail service centres and modern motor showrooms. The Southern Employment Lands are currently subject to urban renewal and recently proposed changes to planning controls are seeking to provide a more intense employment generating zone of high tech industry supported by creative services. The City owned lands in the GSURA are also being proposed for affordable housing.

Over the next 20 years, the population and employment numbers are anticipated to increase substantially in the Green Square and City South District: a village centre experiencing dynamic growth in the southern part of the City of Sydney LGA. The projected population is anticipated to increase from approximately 23,615 people to 57,675, an increase of almost 150 percent¹. The gross floor area of commercial and residential land uses is projected to increase by over 200,000 square metres. This development will place increasing pressures on the road network, both within and surrounding the study area.

Figure 1 Green Square Urban Renewal Area



Source: City of Sydney, modified by AECOM

¹ <http://www.cityofsydney.nsw.gov.au/business/business-support/business-in-your-local-area/green-square-and-city-south>

1. INTRODUCTION

1.2 Green Square to Ashmore Connector

The Green Square to Ashmore Connector (GS2AC) has long been considered a road-based option to improve local transport access to, and support the growth of, the Green Square Town Centre (GSTC). The road link was originally investigated in the *Green Square Street Structural Masterplan* (South Sydney Council, 1998) and throughout the 2000's as part of the *Green Square Transport Accessibility Plan* (2001), where a preliminary route alignment was suggested. In 2008, Transport for NSW's *Green Square Transport Management and Accessibility Plan* (TMAP) further identified the GS2AC as a transport strategy to improve road access to the Town Centre.

In 2009, the City released *Sustainable Sydney 2030* in response to the community's ideas for creating a better city. The GS2AC is consistent with *Sustainable Sydney 2030* which aims to increase connectivity and improve amenity as part of the future regional road management. GSURA must also be provided with improved access with safe and accessible roads and public transport.

The *Sydney Development Control Plan 2012* (DCP) includes the GS2AC as a proposed road link from Botany Road to Bowden Street, whilst in 2012 the *Green Square Town Centre Parking and Traffic Study* identified the need for improved east-west connections between Green Square and the Inner West.

The City is proposing the road link to provide local access for proposed development as well as provide transit capability for the future.

1.3 Project objectives

The delivery of the GS2AC will achieve the following project objectives:

- Provide a “gateway road” that improves road and transport access to the Green Square Town Centre and which improves east-west road and transport access in this part of Inner Southern Sydney.
- Achieve the integration of the GS2AC with the existing future road network.
- Provide an opportunity for conveyance of stormwater through the project site via a trunk drainage from Link Road to the Alexandra Canal.
- Achieve the integration and timely provision of future servicing infrastructure within the road corridor.
- Provide a road of high visual quality that incorporates modern design elements and landscape treatment.
- Provide a road which complies with relevant Australian, Council and Roads & Maritime Services road access and safety standards.
- A road corridor that integrates with adjoining development to achieve safe and accessible road connections.
- Provide a road of minimal engineering, environmental and planning impact.
- Ensure timely and accurate project communication and notification with key stakeholders and local residents during planning and construction.
- Minimise potential disruption to existing road users and adjoining property owners during the construction stage.

1. INTRODUCTION

1.4 Purpose of this report

This Traffic and Transport Impact Assessment Report has been developed to support the REF being prepared by the City, which provides an environmental impact assessment of the proposal.

The purpose of this report is to:

- Provide an assessment of the operational impacts of the proposal on the transport network including:
 - Road network performance
 - Walking and cycling
 - Public transport

Provide a strategic level assessment of the anticipated impacts of the proposal to the transport network during construction.

1.5 Report structure

This report has been structured into the following sections:

- **Section 2** outlines the State and Local Government planning and policy context for the area
- **Section 3** provides an overview of existing traffic and transport conditions
- **Section 4** provides a summary of the future transport context of the area
- **Section 5** outlines the proposal
- **Section 6** provides details of an appraisal of operational impacts of the proposal on the transport network including to active transport, public transport and road network performance
- **Section 7** provides a qualitative appraisal of likely construction impacts of the proposal
- **Section 8** provides an overview of the assessment, including key messages and outcomes

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2. PLANNING AND POLICY CONTEXT

2.1 NSW Government plans and policies

2.1.1 NSW Making it Happen

The recently released *NSW Making it Happen* is the NSW Government's plan for making NSW a better place to live. Thirty different priorities are identified to:

- Grow the economy
- Deliver infrastructure
- Improve health, education and other services.

The relevant priorities include building infrastructure, ensuring on-time running of public transport and improving road travel reliability: each of which are relevant to, and aligned with, the GS2AC project.

2.1.2 NSW Long Term Transport Master Plan

The *NSW Long Term Transport Master Plan* (LTTMP) is a comprehensive and integrated strategy for all modes of transport across NSW released by Transport for NSW in December 2012. The LTTMP identifies a clear direction for transport over the next 20 years by addressing key challenges around population growth, job creation and the need for a transport network that maximises the benefits to the economy and aligns with land use. It is also has a number of supporting documents including regional transport plans, modal plans and access strategies including most notably:

- *Sydney's Walking Future*
- *Sydney's Cycling Future*
- *Sydney's Bus Future*
- *Sydney's Rail Future*
- *NSW Freight and Ports Strategy*

Any proposed transport interventions specific to the Green Square area are highlighted as relevant in this report. The LTTMP recognises the future transport challenges in meeting the needs of the future residents and employees located in the area, highlighting that improved road and public transport access will be required to enable the economic and social benefits arising from the development. The GS2AC project has been identified and developed to help meet these needs.

2.1.1 Green Square Urban Renewal Area: Updated Transport Management and Accessibility Plan

In 2012, Transport for NSW also led the development of an update to the 2008 *Transport Management and Accessibility Plan* (TMAP) for the Green Square Urban Renewal Area (GSURA). The TMAP included a comprehensive assessment of the transport needs to support the growth of the GSTC, with a focus on sustainable transport modes.

2.1.1 A Plan for Growing Sydney

A Plan for Growing Sydney was released in December 2014 by the Department of Planning and Environment and is the NSW Government's 20-year plan for the Sydney Metropolitan Area. It provides direction for Sydney's productivity, environmental management, and liveability; and for the location of housing, employment, infrastructure and open space. The Plan's vision is to maintain Sydney's position as a strong global city and a great place to live.

The Plan reinforces the role of Green Square in Sydney's growth: identifying Green Square as a 'Strategic Centre' with a role in accommodating metropolitan-significant levels of urban renewal. The Plan identifies a key action to work with the City to provide capacity for additional mixed-use development in Green Square including offices, retail, services and housing. The nominated action specific to the GSTC is to facilitate delivery of around 4,000 dwellings and 90,000m² of commercial and retail area.

2. PLANNING AND POLICY CONTEXT

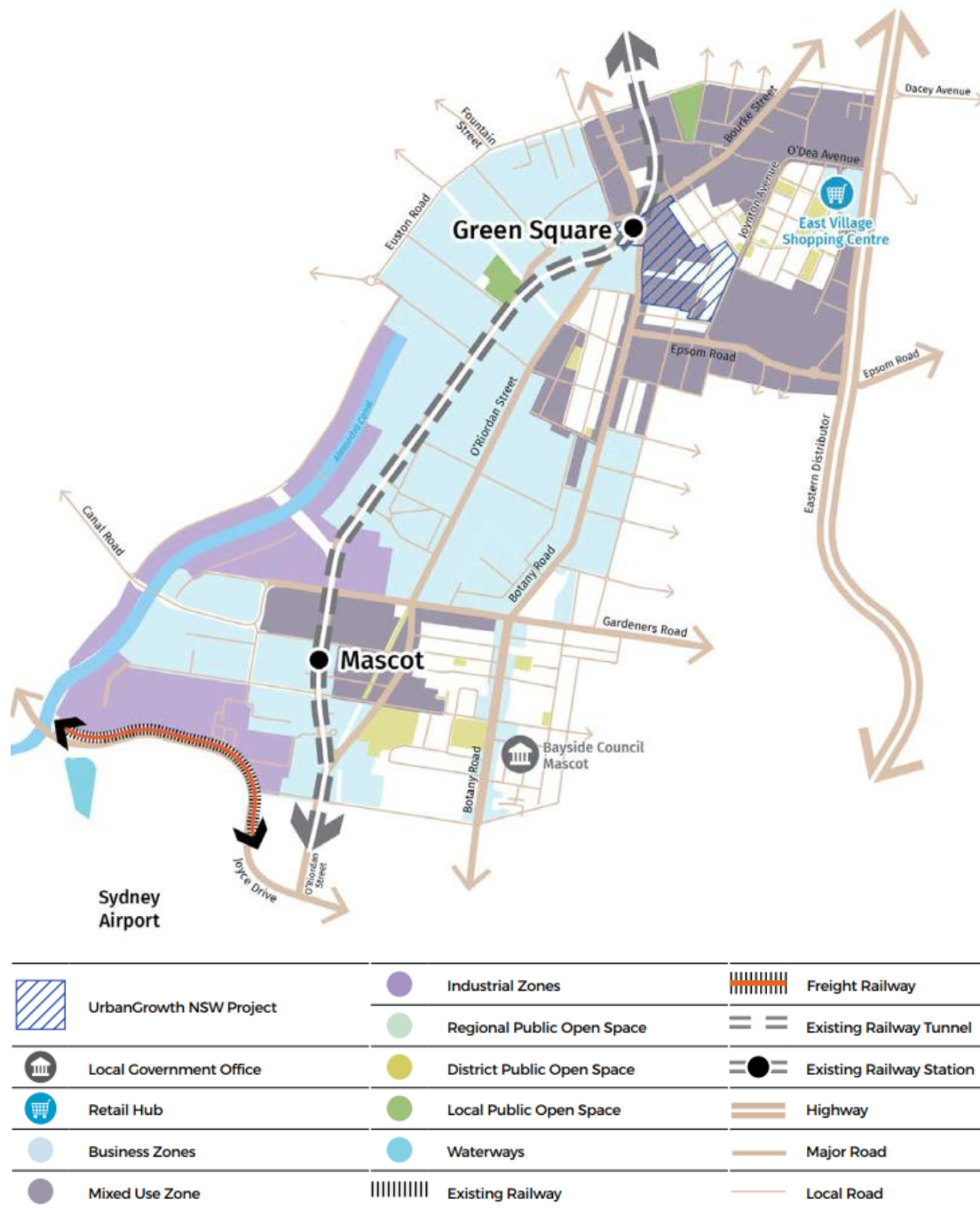
2.2 Draft Central District Plan

A *Plan for Growing Sydney* nominates 6 districts of Sydney, the district plans for which have recently been developed and released in draft, by the Greater Sydney Commission (GSC), to the public for consultation.

The *Draft Central District Plan* (GSC, 2016) sets out priorities and actions for the Central District. The Plan conveys the key messages that Green Square is a centre that will grow as a major new retail, community, cultural and residential centre, whilst Mascot is planned to grow as a mixed commercial employment hub around Mascot Station. A key priority in the Plan is to facilitate economic and jobs growth in the Green Square-Mascot 'Strategic Centre', setting a target to grow employment from 59,500 in 2016 to 75,000-80,000 by 2036 (25% to 35% increase). The identified planning activities in the Plan are illustrated in Figure 2.

2. PLANNING AND POLICY CONTEXT

Figure 2 Green Square-Mascot strategic centre



Source: Greater Sydney Commission (2016)

2. PLANNING AND POLICY CONTEXT

2.3 City of Sydney strategies and policies

2.3.1 Sustainable Sydney 2030

Sustainable Sydney 2030 is the principal strategic plan and policy document that applies to the City of Sydney LGA. *Sustainable Sydney 2030* contains Five Big Moves, 10 Strategic Directions and 10 Project Ideas that provide for the future planning of the LGA up to 2030. The relevant Five Big Moves, Strategic Directions and Project Ideas include:

- Big Move 2 – Integrated Transport
- Big Move 5 – Sustainable Renewal
- Direction 3 – Integrated transport for a connected City
- Direction 4 – A City for pedestrians and cyclists
- Direction 9 – Sustainable development, renewal and design
- Idea 8 – Housing for diverse population
- Idea 7 – Connecting Green Square
- Idea 8 – Affordable Housing

To achieve the plans set out in the document, the GSURA, and the Town Centre in particular, should be better connected to the wider region, including towards the Inner West of Sydney. The GS2AC will help provide this connection. Furthermore, the GS2AC will provide the opportunity for a new bus link that will increase the public transport accessibility of an area which has limited cross-regional connections.

2.3.2 Connecting our City

Connecting our City (2012) was prepared by the City to establish a world-class transport system through the development of more sustainable transport options over the next 20 years. Whilst the Strategy focuses on the Sydney CBD, a number of action plans relate to transport and access in the Green Square Town Centre and broader GSURA. The strategy largely focusses on sustainable transport options such as walking and cycling and managing the volume of cars in the street.

The Strategy also focuses on achieving a travel demand shift to public transport and active transport to respond to the ever increasing transport demands in the LGA. Relevant objectives and elements of the Strategy include:

- Move No.2 – *An integrated inner Sydney transport network including new sustainable transport connecting Inner Sydney Central Sydney and the City's villages.*
- Move No.3 – *A Liveable Green Network of continuous green corridors integrated with liveable streets and dedicated pedestrian and cycleway networks.*
- Move No.4 – *Centres as a focus for the City's Village community and transport*

Relevant elements of the Strategy include:

- Giving more priority to pedestrian and providing safer and more enticing streets in which to walk
- Improving the environment for cyclists through safe and accessible bike paths and routes
- Managing the volume of cars using our streets while maintaining access for commercial and delivery vehicles

In particular, *Connecting Our City* aims to develop the cycle routes between Green Square and the Sydney CBD. Enhanced walking and cycling choices to the Green Square Town Centre will enhance its vitality and connection to the surrounding areas. The principles have been used to drive the design of GS2AC.

2. PLANNING AND POLICY CONTEXT

2.3.3 Walking Strategy and Action Plan

The *Walking Strategy and Action Plan* released by the City in 2015 recognises that walking plays a major role in the local economy. With 29 percent of residents currently walking to work, CoS understands the importance of creating better walking environments through the provision of extra walking space and new connections through street blocks. CoS aims to accommodate the forecasted doubling in the number of pedestrians between 2006 and 2030 by:

- Making walking quick, convenient and easy
- Making walking inviting and interesting
- Making walking safe and comfortable
- Creating a strong walking culture

In line with the walking targets and strategy set out in the document, the Green Square Town Centre and broader Green Square Urban Renewal Area is looking to enhance the pedestrian environment in the region. The GS2AC assists this by reducing walking times and creating a safe walking route.

2.3.4 Cycle Strategy and Action Plan

The City's *Cycle Strategy and Action Plan* aims to ensure a more safe and comfortable cycling environment that encourages more people to cycle daily. It defines infrastructure and social initiatives to implement between 2007 and 2017, with some already in place. The City aims to make cycling a feasible transport choice for most residents, workers and visitors by 2017 by:

- Creating and maintaining a comfortable and bicycle friendly environment in Sydney to encourage more residents, visitors and workers onto bicycles
- Improving cycling safety
- Promoting the benefits of cycling
- Increasing the number of trips made by bicycle in Sydney.

The Strategy and Action Plan contains specific targets to increase cycle use as a percentage of total trips. Provision of cycleways that connect to the GSTC, such as the GS2AC, will assist in increasing cycle mode share.

3. EXISTING CONDITIONS

3.1 Land use

The route alignment of the proposed GS2AC goes through hardstand industrial areas and vacant employment generating land. The route goes through seven properties each of which are zoned for B7 'Business Park' land use (see Figure 3), of which only three are presently in use. These are located at 336-338 Botany Road, 9-13 O'Riordan Street and 44 Bourke Road. The properties are generally considered to be low intensity in terms of travel demand generation.

Other local land uses include R1 'General Residential' and B6 'Enterprise Corridor'. Areas coloured white along the eastern boundary of Botany Road represent the Green Square Town Centre which is understood to currently be predominantly zoned for B4 'Mixed Use'.

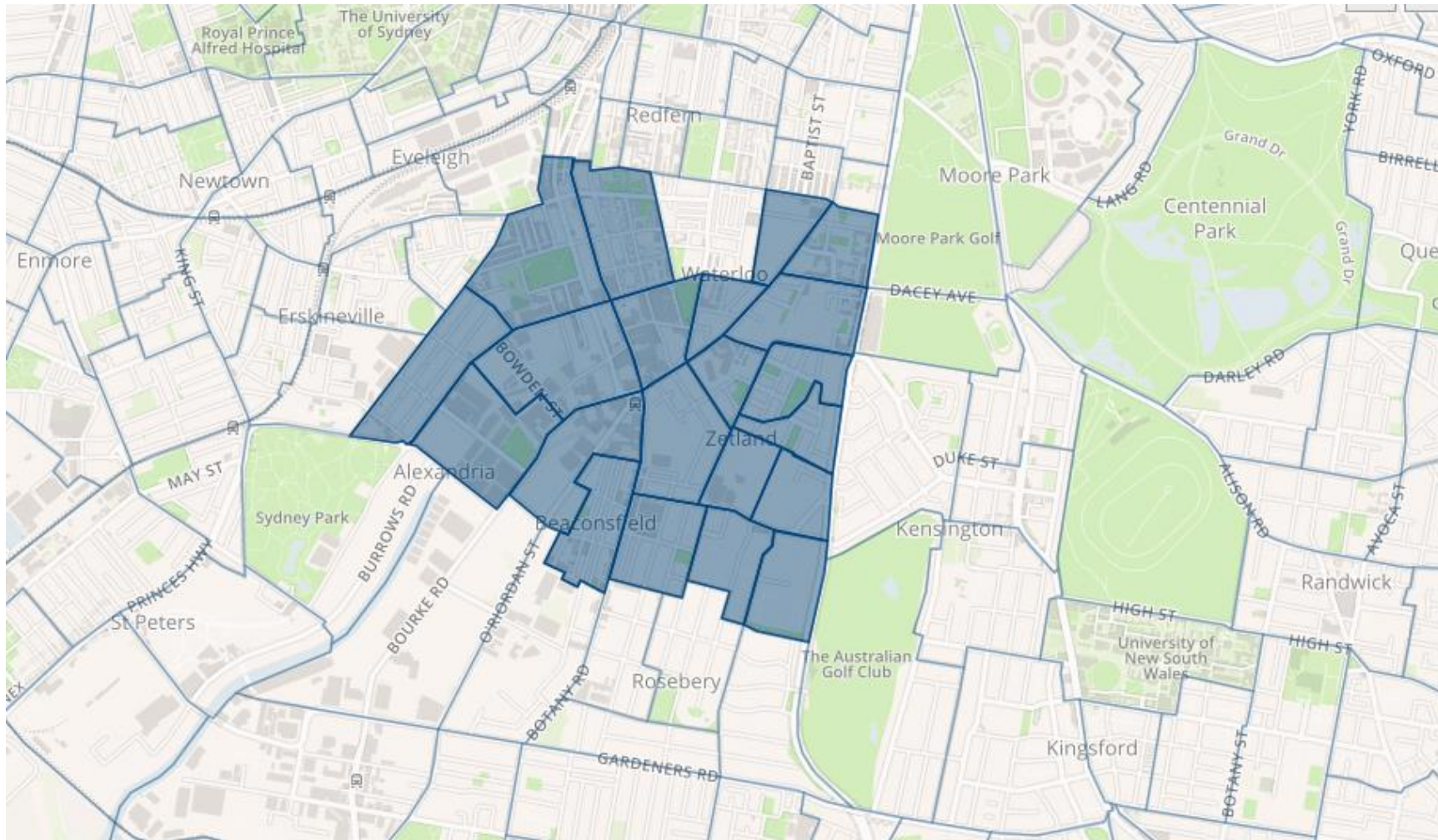
Figure 3 Existing land use zoning



Source: City of Sydney, modified by AECOM

The Green Square Development Area comprises approximately 21 travel zones as defined by the NSW Bureau of Statistics and Analytics (NSW BSA) (see Figure 4). Collectively, the data indicates the defined area had an estimated residential population of 23,615 and 21,700 employees in 2011, inferring a relative balance between trip origins and destinations in the area.

Figure 4 Travel Zones that comprise the Green Square Development Area



Source: NSW BSA, Travel Zone Explorer, 2017

3.2 Current route environment

A visual summary of the areas which the GS2AC will go through from east to west is provided below, demonstrating the current use and conditions of the environment through which the proposed corridor is aligned. The route grades vary from 15 metres above sea level (ASL) at Botany Road to 11 metres ASL at O’Riordan Street and 8 metres ASL at Bourke Road.

Figure 5 View west from Botany Road to 338 Botany Road



Figure 6 View west from 338 Botany Road to 20 O’Riordan Street



Figure 7 View southwest from 20 O’Riordan Street to Ausgrid site at 15 O’Riordan Street



Figure 8 View east from Ausgrid site at 15 O’Riordan Street to O’Riordan Street



Figure 9 View west from Ausgrid site at 15 O’Riordan Street to Hoya site at 44 Bourke Road



Figure 10 View southwest at the Bowden Street / Bourke Road intersection



Source: City of Sydney, 2015

3.3 Active transport

3.3.1 Walking

Local demand for walking has been observed to be relatively low, which is reflective of the local land uses, and reflected in the available infrastructure. The main local generator of walking trips is generated by the Green Square Station, and most roads in the local catchment have footpaths on either side which provides a reasonable element of pedestrian safety. However the pedestrian environment suffers due to poor public domain and a lack alternative route choice to key nodes due to the predominance of busy north-south oriented roads.

There is also a lack of safe pedestrian crossings at the key north-south roads in the area, especially with O’Riordan Street which has a 750 metre gap between existing pedestrian crossings near the Green Square Train Station and Collins Street. The same applies to Bourke Road, which has an 800 metre gap between existing pedestrian crossings at the Green Square Train Station and Collins Street. Under each scenario pedestrians are either forced to walk an additional 500 metres or more to cross safely at a signalised pedestrian crossing or cross each road against oncoming traffic, which comes with great personal risk.

3. EXISTING CONDITIONS

This distance is less acute along Botany Road, where there is a pedestrian crossing at Epsom Road. This is located approximately in the middle between the crossing near the Green Square Train Station and at Collins Street. In addition, a new intersection is currently being created at Geddes Avenue and is expected to be open by late 2017.

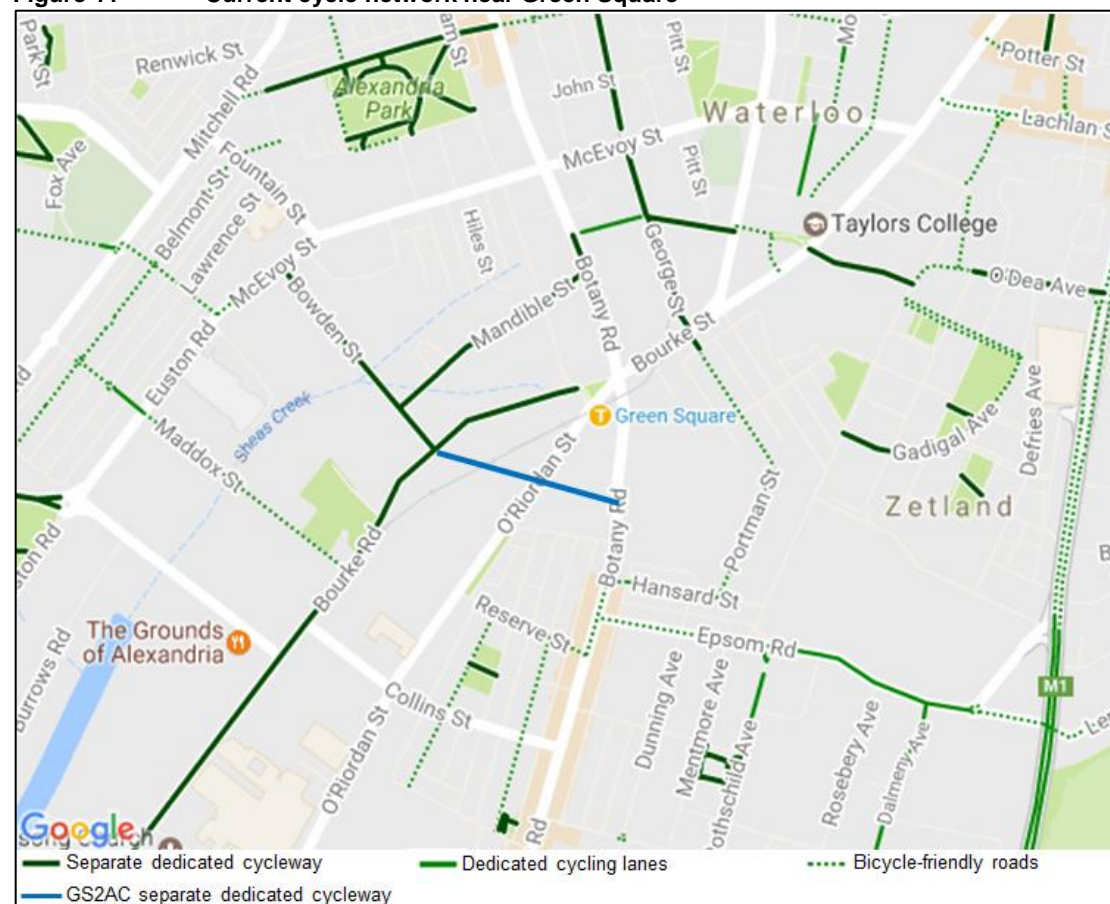
With the exception of the O’Riordan Street / Collins Street and Botany Road / Epsom Road intersections, pedestrian crossings are not provided at any intersections south of the existing pedestrian crossings near the Green Square Train Station.

3.3.2 Cycling

Green Square is connected to Sydney’s cycle network with a dedicated on-road separated cycleway which runs along Bourke Road and Bowden Street. These cycleways mainly provide linkages to the CBD in the north and Mascot and the airport to the south. The cycleway is also linked to bicycle friendly roads to the west. Linkages to the M1 and Kensington to the east are also provided from Green Square by a mixture of bicycle friendly roads and dedicated cycling lanes. Figure 11 shows the cycle network near the Green Square Town Centre.

However similar to the pedestrian environment there is a lack of safe crossings across key roads, poor route choices to key nodes and lack of safe and efficient east-west cycle links. This commonly results in cyclists using existing footpaths on Botany Road and O’Riordan Street, with impacts on pedestrian safety.

Figure 11 Current cycle network near Green Square



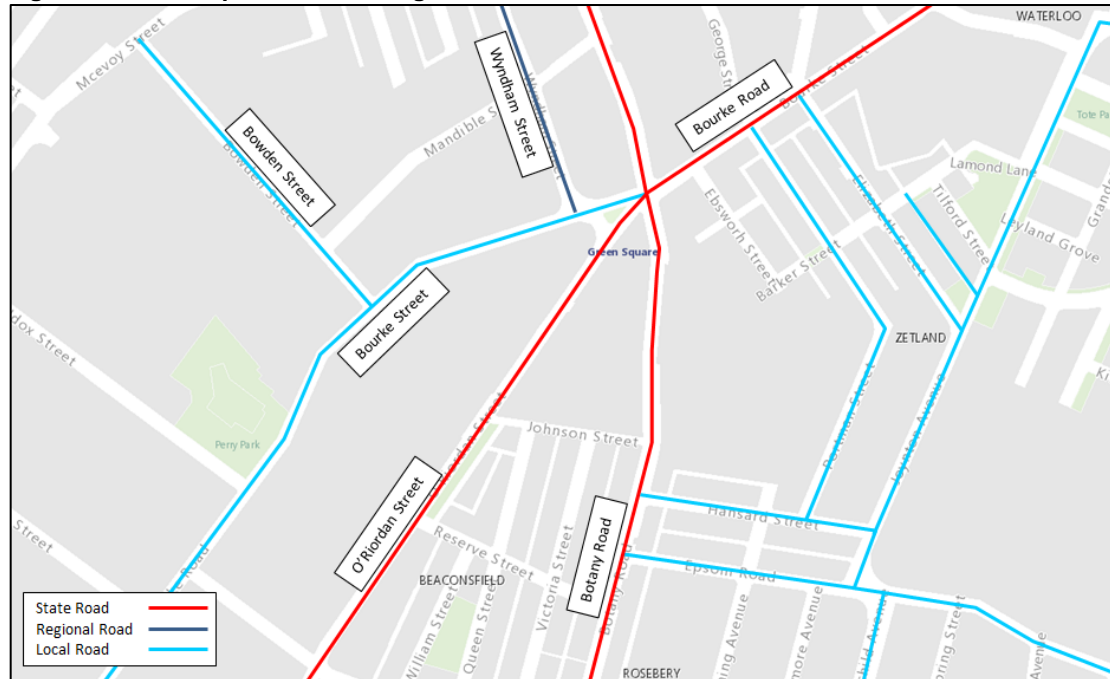
Source: Sydney Cycleways, 2017

3. EXISTING CONDITIONS

3.5 Road network

Figure 14 outlines the classification of the surrounding road network, with key links discussed following.

Figure 14 Green Square surrounding road network 1



Source: City of Sydney, modified by AECOM in accordance with *RMS Schedule of Classified Roads and Unclassified Regional Roads*

3.5.1 Key roads

Botany Road

Botany Road is a national freight corridor and forms part of an arterial route linking Sydney CBD with the Sydney Airport and Port Botany terminals. It is a designated B-Double truck route providing four lanes of undivided carriageways with two traffic lanes in each direction to accommodate high volumes of traffic during the peak periods. The corridor has been identified as a key transport corridor with plans to develop a Botany Road transit corridor noted in the City's *Sustainable Sydney 2030*. During peak periods, clearway restrictions are effective for the peak directional flow along Botany Road. In the vicinity of the study area Botany Road is signposted at 50 kilometres per hour.

In the immediate vicinity of the proposed GS2AC corridor, Botany Road has "No Stopping" restrictions on the kerbside lane in both directions. A bus stop exists on the western side. On the eastern side there is an access driveway to the former Waverley Council Depot (now owned by the City) and two access driveways to 336 and 338 Botany Road. The road contains a footpath on either side with electricity light poles and wires.

3. EXISTING CONDITIONS

Figure 15 Botany Road typical features (looking north near the proposed GS2AC)



Source: City of Sydney, 2015

O’Riordan Street

O’Riordan Street provides a similar level of functionality to Botany Road as an arterial connection and B-Double truck route between central and eastern Sydney to Sydney Airport and Port Botany. In the vicinity of the study area O’Riordan Street is signposted at 60 kilometres per hour. O’Riordan Street is characterised by two lanes in both directions of travel. During AM and PM peak periods, clearway restrictions are in place with limited kerbside parking being effective outside of the peak periods. As illustrated in Figure 15, the corridor has limited bus functionality in the GSTC area.

At the point where the GS2AC is proposed to cross O’Riordan Street, there are three driveways on the western side (two at 9-13 O’Riordan Street and one at 15 O’Riordan Street). On the eastern side there is one access driveway to 20 O’Riordan Street and one access to 22 O’Riordan Street. Established trees also line each side of the carriageway.

Figure 16 O’Riordan Street typical features (looking north near the proposed GS2AC)



Source: City of Sydney, 2015

Bourke Road

Bourke Road performs the role a collector road, aligned parallel to O’Riordan Street and provides access to commercial and industrial properties along the corridor as well as adjacent roads. Between O’Riordan Street and Gardeners Road, traffic is accommodated on a single traffic lane in each direction with a segregated bicycle lane along the western side of the road and kerbside parking along the eastern side of the corridor. Bourke Road has a sign posted speed of 50 kilometres per hour.

There are also street tree plantings along most sections of the road. Electricity light poles and wires also dominate the streetscape along Bourke Road.

3. EXISTING CONDITIONS

Figure 17 Bourke Street typical features (looking south near the proposed GS2AC)



Source: City of Sydney, 2015

Bowden Street

Bowden Street is a local east-west road providing connection between the higher order roads of Bourke Road and McEvoy Street. It provides two directional lanes with parking allowed only on the northern side. The sign-posted speed limit is 50 kilometres per hour. The road also has a separated on-road cycleway. There are street tree plantings along most section of the road with a footpath either side.

Figure 18 Bowden Street typical features (looking west near the proposed GS2AC)



Source: City of Sydney, 2015

3.5.2 Intersections

The immediately adjacent road network is illustrated in Figure 19 and comprises six intersections:

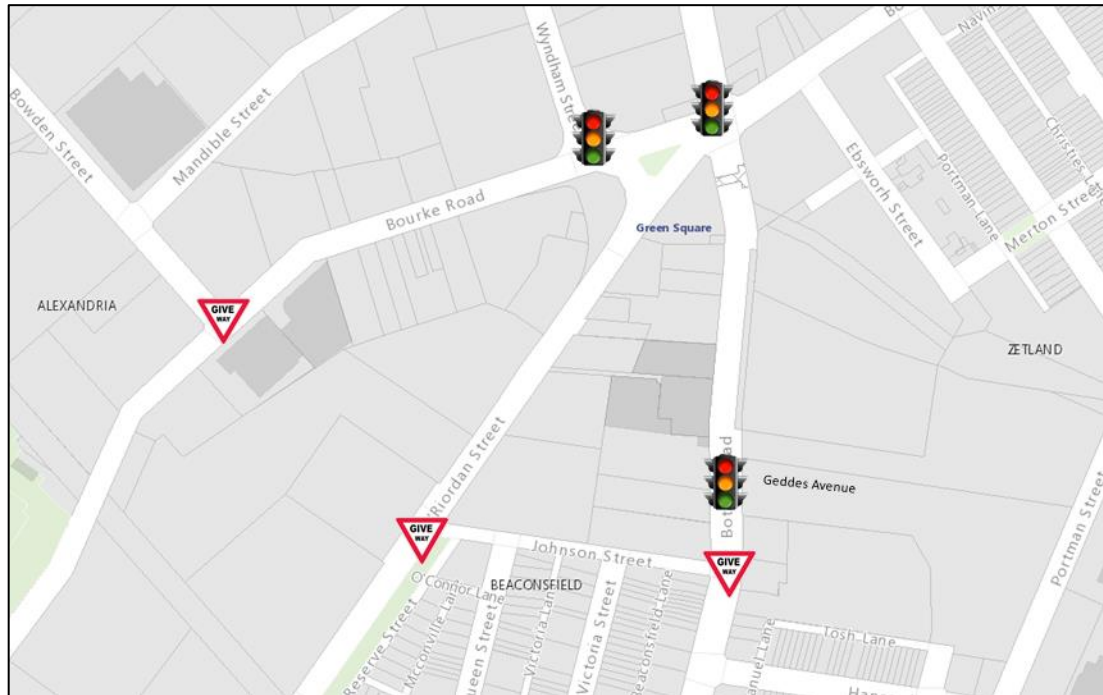
- Signalised intersections
 - Botany Road / Bourke Street / O’Riordan Street
 - Bourke Road / Wyndham Street
 - Botany Road / Geddes Avenue (under construction)
- Priority-controlled intersections
 - Bourke Road / Bowden Street
 - O’Riordan Street / Johnson Street
 - Botany Road / Johnson Street

3. EXISTING CONDITIONS

All movements are permitted at each intersection with the exception of the following right turns:

- From Bourke Road (eastbound) to O’Riordan Street (southbound)
- From O’Riordan Street (eastbound) to Botany Road (southbound)
- From Bourke Street (westbound) to Botany Road (northbound)
- From Botany Road (southbound) to O’Riordan Street or Bourke Road

Figure 19 Key intersections



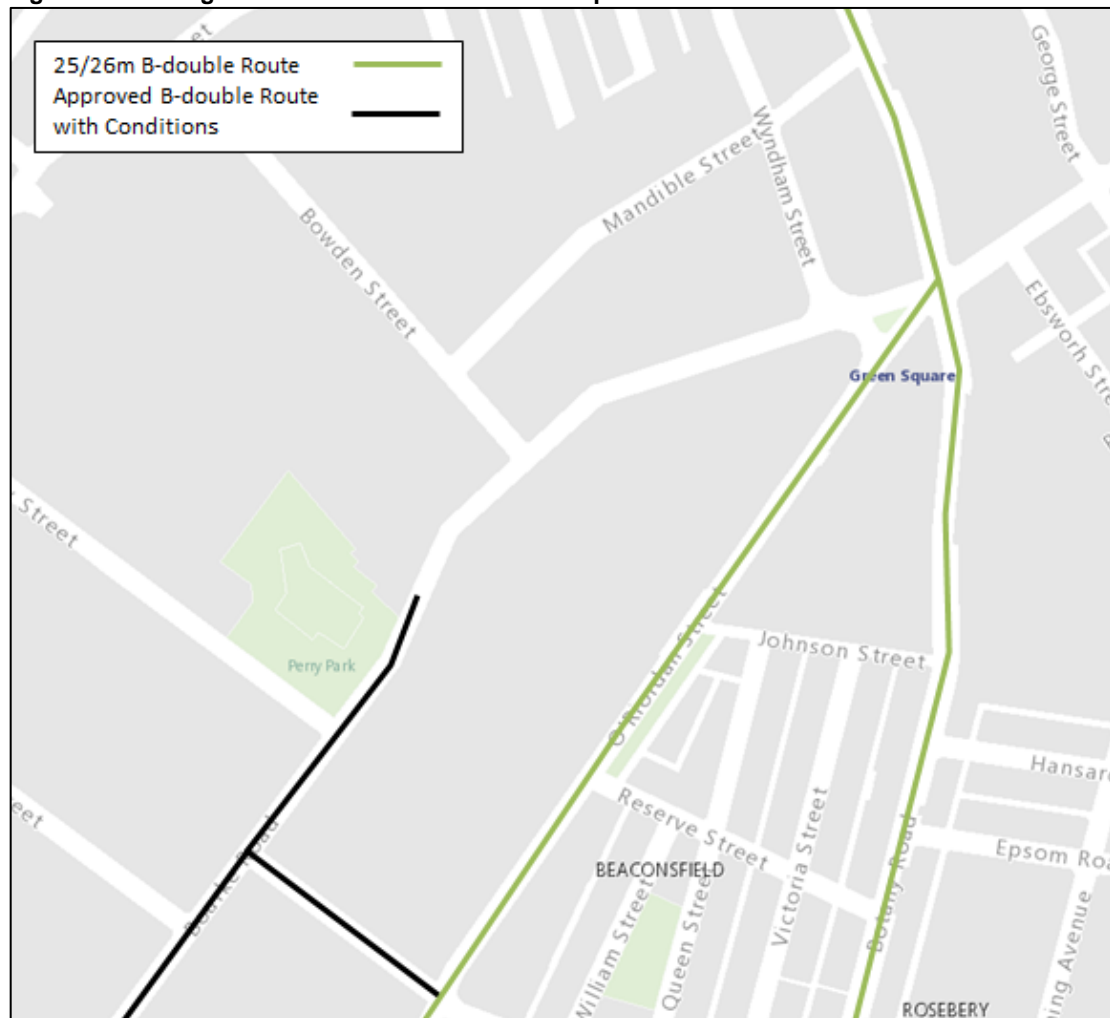
Source: City of Sydney modified by AECOM, 2017

3.5.3 B-Double Routes

The designated B-Double truck routes within the study area run along O’Riordan Street and Botany Road. Shown in Figure 20, these routes can accommodate trucks up to 25/26 metres in length. Sections of Collins Street and Bourke Street are also approved B-Double routes, subject to certain travel conditions.

3. EXISTING CONDITIONS

Figure 20 Existing B-Double Routes in the Green Square area



Source: City of Sydney, modified by AECOM in accordance with RMS RAV map, 2017

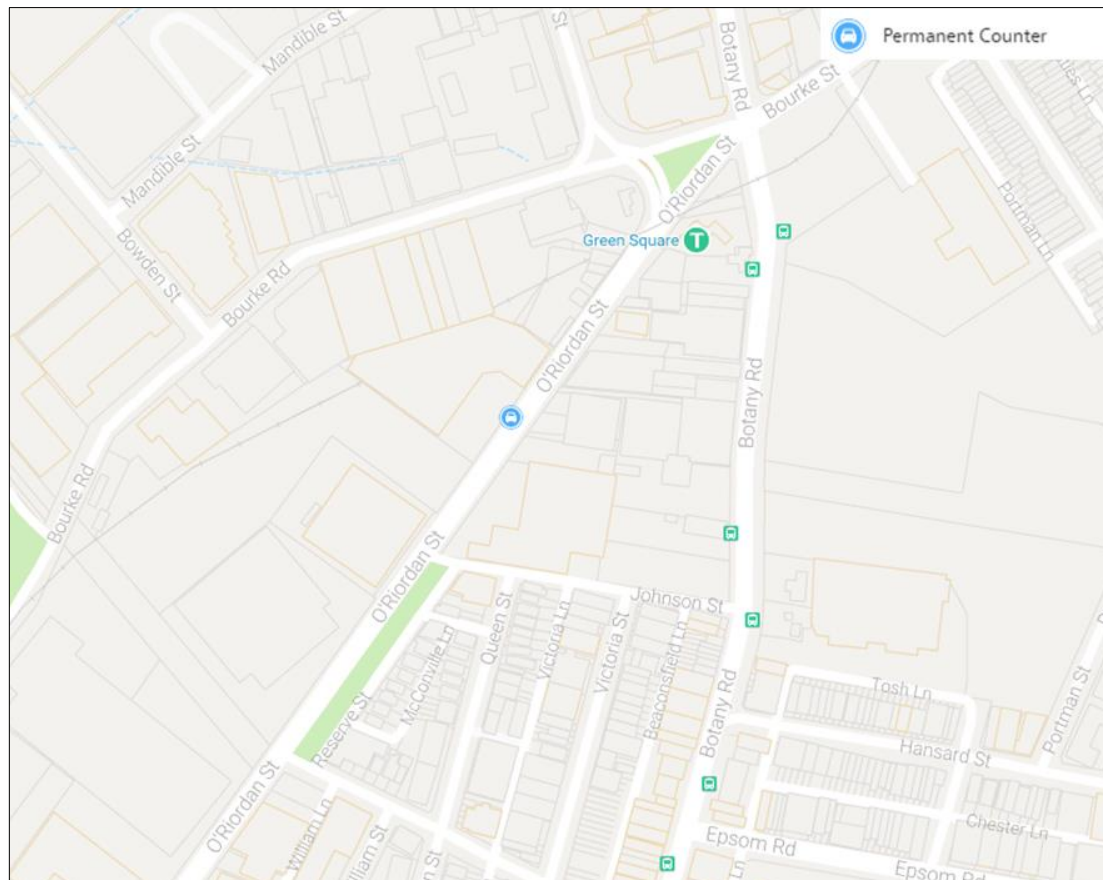
3.5.4 Traffic volumes

Historical traffic data

Roads and Maritime Services (RMS) has a permanent count station count station (Counting station 02309) on O'Riordan Street approximately 100 metres south of the intersection of O'Riordan Street / Wyndham Street as shown in Figure 21. Data for the northbound and southbound directions has been collected on a yearly basis between 2008 and 2017. The average weekday and weekend traffic volumes from these counts are presented in Figure 22 and Figure 23.

3. EXISTING CONDITIONS

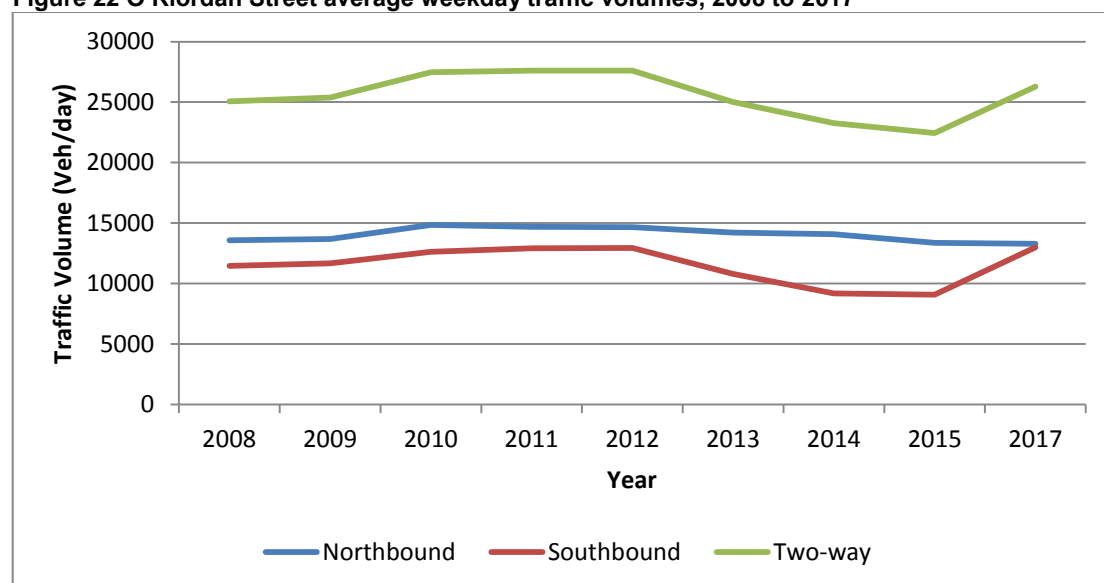
Figure 21 RMS Traffic Volume Counter Location



Source: Roads and Maritime Services, 2017

The weekday traffic volumes are seen to drop off after an increase from 2008 to 2012. The variation is driven by the southbound traffic volumes, which has more noticeable changes over time. Traffic in the northbound direction is the dominant movement across all years, and has remained relatively consistent over the last decade.

Figure 22 O'Riordan Street average weekday traffic volumes, 2008 to 2017

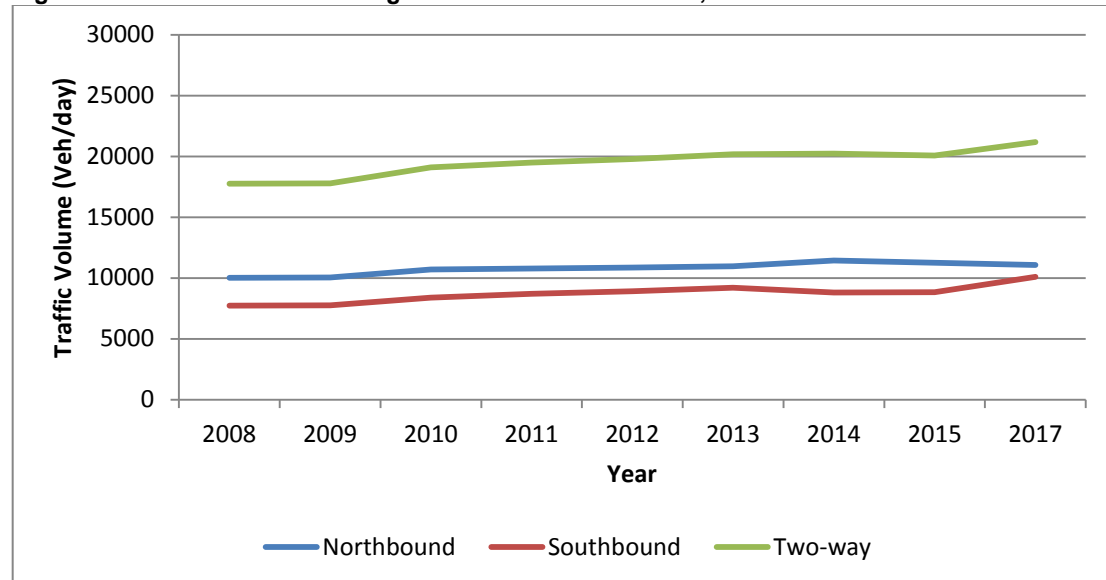


Source: Roads and Maritime Services, 2017

3. EXISTING CONDITIONS

The weekend traffic volumes presented in Figure 23 show a steady increase in traffic from 2008 through to 2017. The northbound and southbound traffic follows show a similar trend, with the northbound traffic once again the dominant movement.

Figure 23 O’Riordan Street average weekend traffic volumes, 2008 to 2017

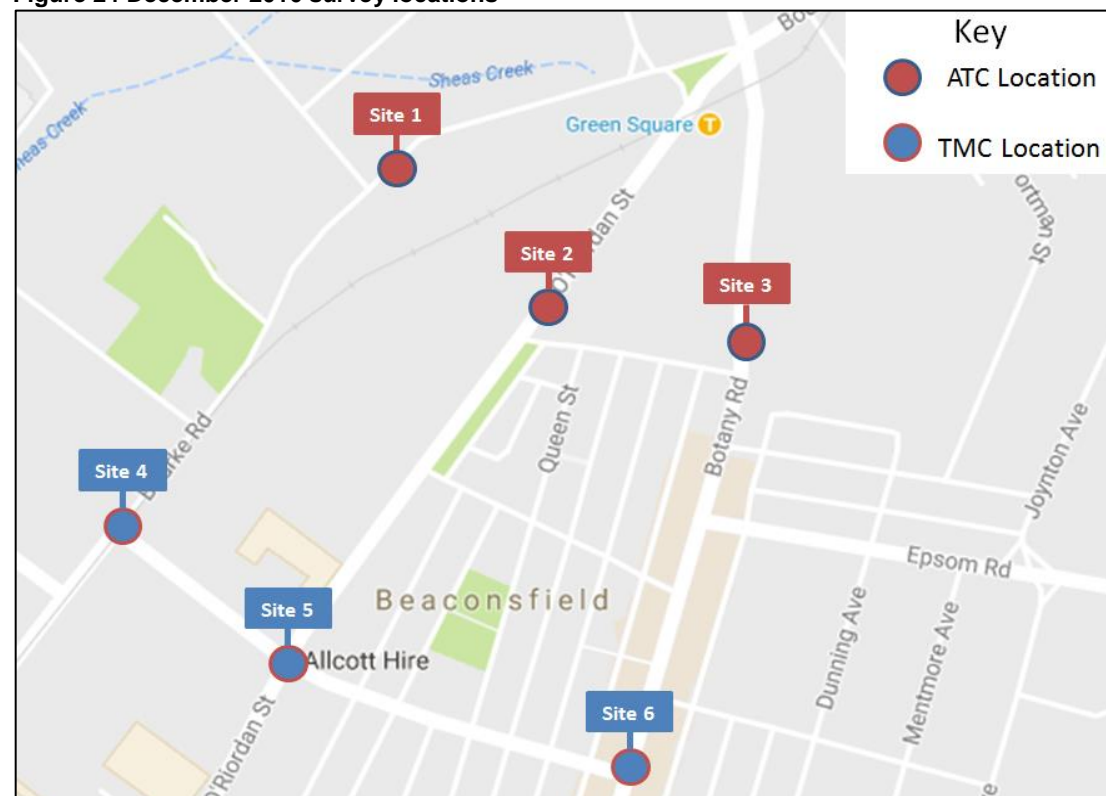


Source: Roads and Maritime Services, 2017

Automatic Traffic Counts

A comprehensive suite of surveys were completed in December 2016 to understand and analyse the existing traffic volumes and patterns within the study area. This involved automatic traffic count (ATC) tubes and intersection turning movement counts (TMC). The survey locations are shown in Figure 24.

Figure 24 December 2016 survey locations



Source: Google Maps, modified by AECOM

3. EXISTING CONDITIONS

Details of the average weekday traffic volumes recorded at each of the three ATC locations are presented in Figure 25 **Error! Reference source not found.** to Figure 27. The morning peak is considered to be between 8:00AM and 9:00AM and the evening peak between 5:00PM and 6:00PM.

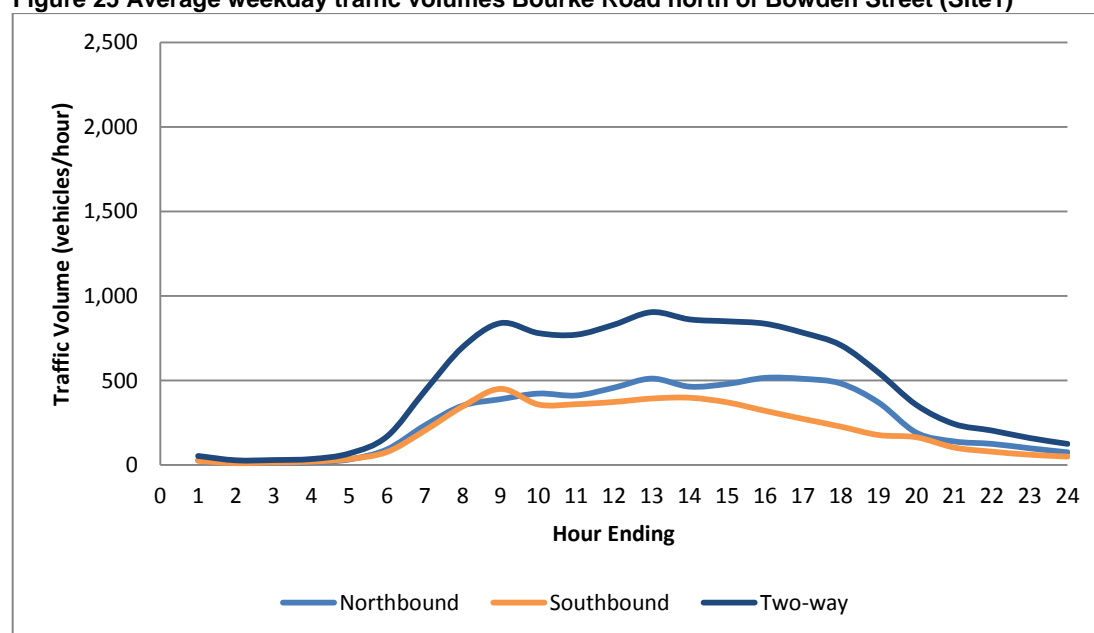
The majority of vehicles travel on Botany Road, with 47 percent and 53 percent of the total screenline traffic volumes in the AM and PM peaks respectively. In comparison, Bourke Road accounts for only 18 percent and 16 percent of the total screenline AM and PM volumes. This is because Bourke Road currently has less capacity (only one lane in each direction) when compared to parallel corridors and operates / is managed as a lower order road, with features such as speed bumps.

The two-way volumes on Bourke Road displayed in Figure 25 **Error! Reference source not found.** show a relatively “flat” profile, with an unusually large midday peak. This indicates that the road accommodates travel demand outside of the commuter peaks. This differs from the other sites, which have distinctive AM and PM peaks. The northbound volumes are larger than the southbound volumes during most time periods except around the AM peak. It is considered the directional demand for each corridor is strongly connected with that of the parallel M1 and A36 routes- which are not captured in the data set. It is also considered the north-south traffic volumes in this area in particular driven by the significant mix in surrounding land uses (retail, industrial, commercial, residential) as well as the opposing directionalities of travel demand generated by the Sydney CBD and Sydney Airport precinct.

The volume profile for O’Riordan Street in Figure 26 displays distinctive AM and PM peaks, with a drop in traffic between peaks. The northbound volumes have a fairly “flat” profile and again exceed the southbound volumes for most periods apart from the AM peak. The “flat” profile may be because O’Riordan Street as an alternative freight corridor, serving both Sydney Airport and Port Botany, and is likely to be at or close to capacity throughout the day.

The traffic profiles for Botany Road in Figure 27 shows that the volumes are significantly larger than the other sites, reinforcing the strategic significance of Botany Road as a major freight corridor to Port Botany and Sydney airport in addition to connecting the CBD to the southern suburbs. The shape of the profiles indicates that the traffic demand along Botany Road is heavily influenced by the commuter peaks. While the AM and PM peaks are prominent in both directions, there is a tidal shift in the traffic flows between these periods. Figure 27 illustrates the larger traffic volume travelling in the northbound direction towards the CBD during the AM peak and returning home during the PM peak.

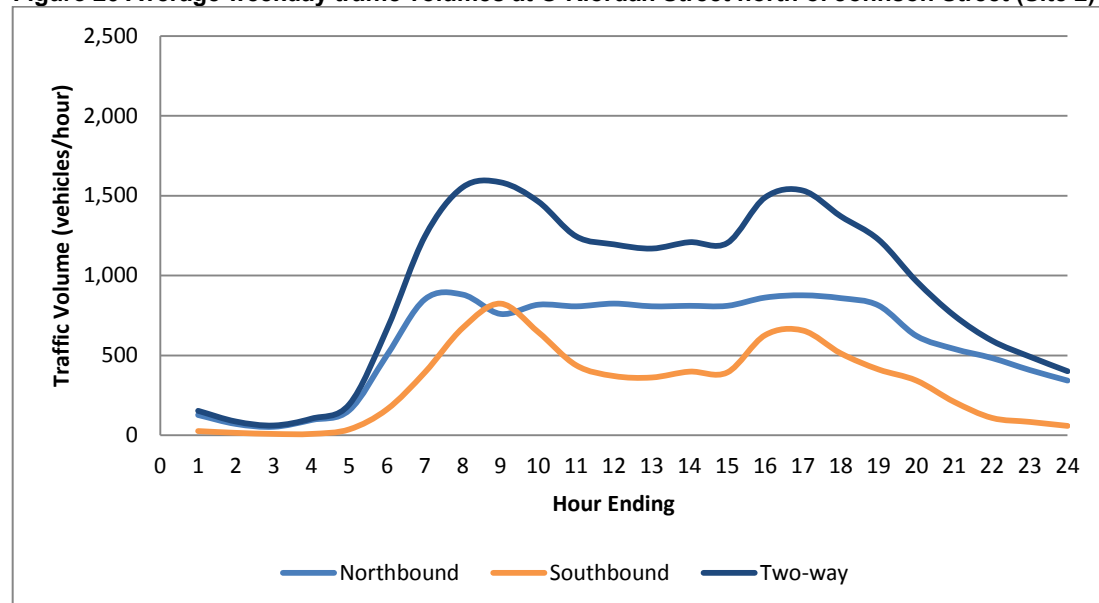
Figure 25 Average weekday traffic volumes Bourke Road north of Bowden Street (Site1)



Source: AECOM, 2017

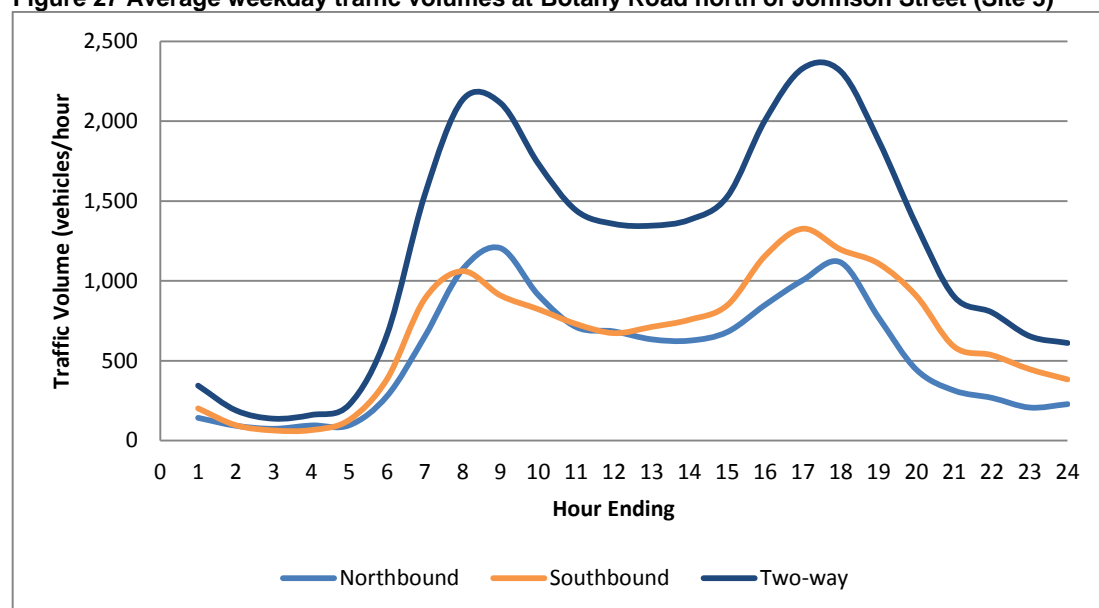
3. EXISTING CONDITIONS

Figure 26 Average weekday traffic volumes at O’Riordan Street north of Johnson Street (Site 2)



Source: AECOM, 2017

Figure 27 Average weekday traffic volumes at Botany Road north of Johnson Street (Site 3)



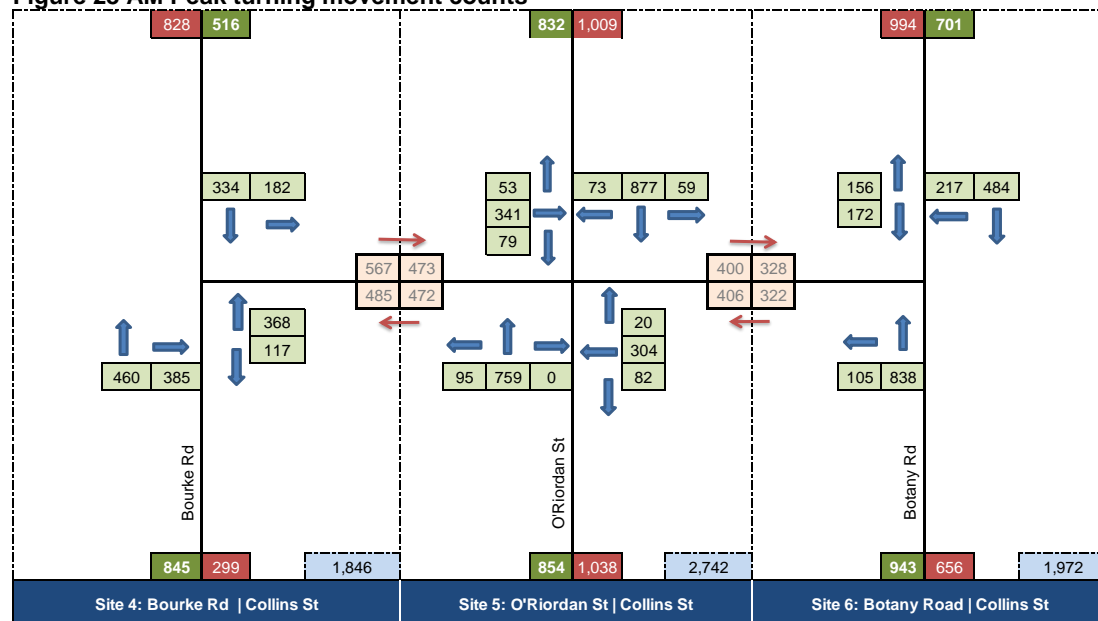
Source: AECOM, 2017

Turning Movement Counts

The turning movement counts for the AM and PM peaks are presented below in Figure 28 and Figure 29 respectively. Collins Street provides both local and regional trips with an east-west connection between the major north-south roads. Locally this includes a connection between the Bourke Road, O’Riordan Street and Botany Road corridors. More broadly, it forms part of a corridor facilitating cross-regional movements between the major traffic corridors of the Princes Highway, Southern Cross Drive (M1) and Anzac Parade.

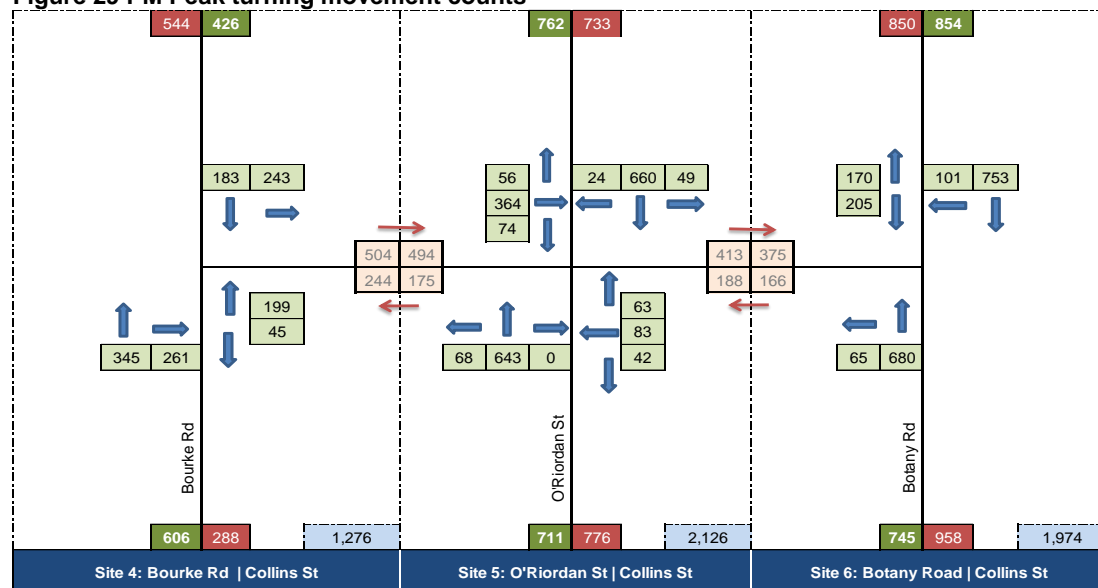
3. EXISTING CONDITIONS

Figure 28 AM Peak turning movement counts



Source: AECOM, 2017

Figure 29 PM Peak turning movement counts



Source: AECOM, 2017

3.5.5 Operational performance

A combination of site visits and previous traffic and transport studies (see Figure 30 and Figure 31) highlight that the following intersections in the immediately adjacent road network are currently at or approaching capacity:

- Botany Road / Bourke Street / O'Riordan Street intersection
- Bourke Street / Wyndham Road / Bourke Road intersection
- Botany Road / Epsom Road intersection

3. EXISTING CONDITIONS

Figure 30 2012 AM peak period LOS

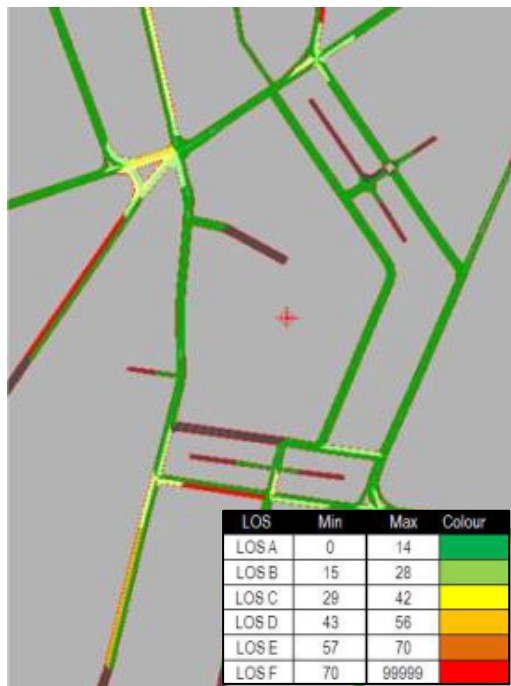
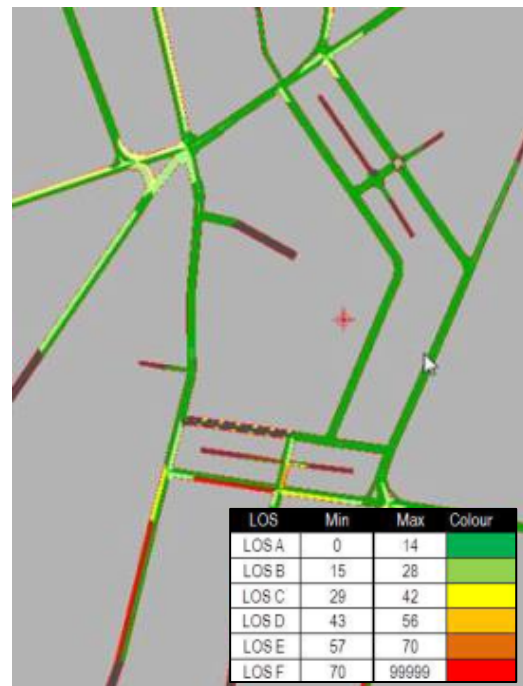


Figure 31 2012 PM peak period LOS



Note: The Level of Service (LOS) outputs illustrated are measured on a six-point scale (LOS A to LOS F), measured by average delay to vehicles, in accordance with RMS' *Guide to Traffic Generating Development* (2002)

Source: *Green Square Town Centre Parking and Traffic Study* (Bitzios Consulting, 2013)

Whilst the Bowden Street / McEvoy Street intersection is outside the immediate boundary of the proposed works, it is recognised that Bowden Street is an extension of GS2AC and will likely affect through traffic volumes along this link, as such a high level operational assessment of this intersection was undertaken in 2015 (during early planning works for the proposal).

Based on the intersection turn count surveys collected in 2015, an isolated intersection assessment of the intersection using Sidra Intersection is summarised in Table 2.

The results indicate that all movements at the intersection operate satisfactorily with the exception of the right turn movement from Bowden Street to McEvoy Street, presenting a safety and efficiency risk.

3. EXISTING CONDITIONS

Table 1 Bowden Street / McEvoy Street current (2015) intersection performance summary

Bowden Street / McEvoy Street		Traffic Volume (veh/hr)	Average delay per vehicle (sec)	Level of Service (LoS)	Traffic Volume (veh/hr)	Average delay per vehicle (sec)	Level of Service (LoS)	95% Back of Queue (m)
		AM Peak			PM Peak			
Bowden Street (Eastern arm)	Left	53	10.6	A	227	20.9	B	22.4
	Right	26	118.2	F	50	259.9	F	40.4
McEvoy Street (Northern arm)	Left	83	7.5	A	66	7.5	A	0
	Through	483	0.0	A	863	0.0	A	0
McEvoy Street (Southern arm)	Through	862	1.3	A	562	16.3	A	15.4
	Right	152	12.0	A	50	2.8	B	15.4
Total / Average		1,659	-	-	1,818	-	-	-

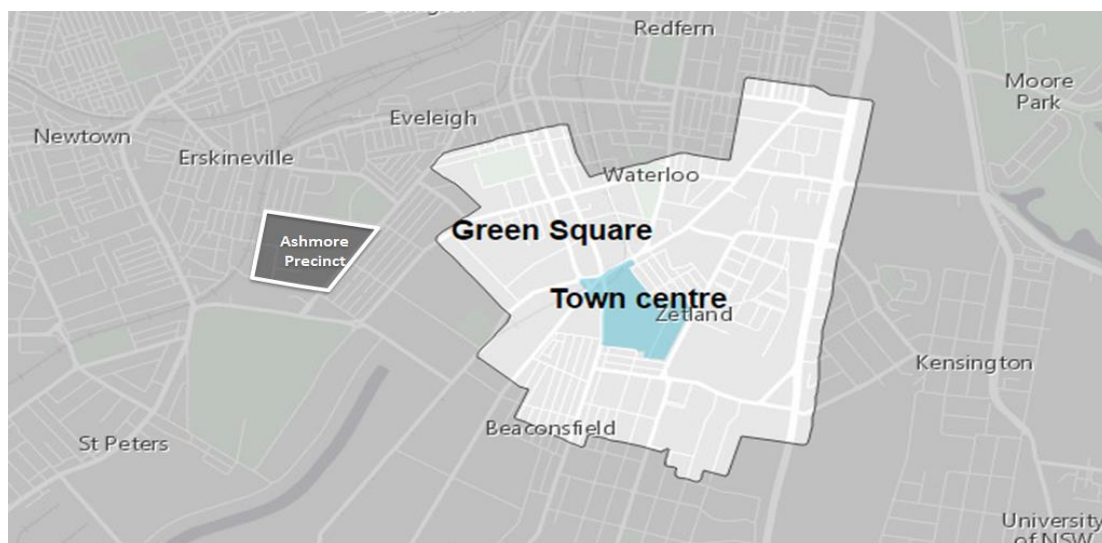
4. FUTURE CONTEXT

4.1 Land use

Of particular note in the context of the project, are the focal growth areas of Green Square, including its Town Centre, and the Ashmore Precinct (see Figure 32). The **Ashmore Precinct** is one of the City's biggest urban development projects and will eventually be home to approximately 6,000 residents, as development is staged over the next 10 years to 2027². **Green Square** is proposed to introduce 30,500 new dwellings by 2030, accommodating an additional 61,000 residents. The **Green Square Town Centre** includes 4,000 proposed new dwellings and 6,000 new jobs. Early stages of construction of the Town Centre are under way, with all stages expected to be complete by 2019³. The significant increase in local development to support this growth will significantly increase travel demand on local transport infrastructure and services, for all modes, as well as increasing the need for property access away from key "movement" corridors (e.g. Botany Road).

The City is also currently seeking to undertake the sustainable renewal of the **Northern Investigation Area (NIA)** precinct (20 hectares) at Alexandria (west of the Green Square Town Centre) to provide potential opportunities for private as well as affordable housing mixed with existing and future employment uses and public domain upgrades. A key strategic planning aim for the precinct is to link the area with the Green Square Town Centre. The City is currently undertaking initial engineering investigations to assess the future planning and development potential of the precinct and confirm its future access in relation to the Alexandria to Moore Park Connectivity Upgrade project (see Section 4.4.2). The City is working on an access and circulation plan for the NIA project (including Bowden Street, Bourke Street, McEvoy Street and Wyndham Street) to accommodate up to 1,500 people over a 10 year period. The proposed GS2AC will help link the NIA precinct to the Green Square Town Centre.

Figure 32 Green Square, Green Square Town Centre and Ashmore Precincts



Source: City of Sydney, modified by AECOM, 2017

² <http://www.cityofsydney.nsw.gov.au/vision/better-infrastructure/major-projects/ashmore-precinct>

³ <http://www.cityofsydney.nsw.gov.au/vision/green-square/construction>

4. FUTURE CONTEXT

4.2 Active transport

The *Draft Central District Plan* (GSC, 2016) identifies a principal cycling network, providing a metropolitan-wide strategic cycling plan to focus planning and investment in cycling infrastructure. In the study area however, the Plan identifies no new 'principal' links in the immediate area.

More locally, construction has commenced on important new bike links to Green Square. New cycleways planned by the City for the GSTC area are illustrated in Figure 33. It is noted the G2SAC forms part of the planned Marrickville to Randwick route.

The GSTC development will include additional cycling infrastructure, including notably a separated on-road cycleway along Geddes Avenue. The proposed intersection of Geddes Avenue / Botany Road (see Figure 36) will also provide new crossing opportunities.

Figure 33 Proposed regional bike network – Green Square area



Source: City of Sydney, 2016

4.3 Public transport

In regards to **rail**, customers travelling to and from Sydney Airport will benefit from more than 200 extra services per week in non-peak times on the T2 Airport Line from late 2017 in response to the noted significant recent increase in passenger demand⁴,

The construction of Sydney Metro City and Southwest will remove the T3 Bankstown Line from the City Circle in Sydney CBD. This will unlock additional capacity on the City Circle, allowing more services on the T2 Airport, Inner West and South Line into Sydney CBD. The additional services would help reduce forecast passenger loading issues, and increase capacity for development in Green Square. Growing demand for rail services, driven by future development, will increase the importance of good accessibility to train services – particularly for pedestrians, cyclists as well as buses.

Sydney's Bus Future (Transport for NSW, 2012) identifies Bourke Street and Botany Road as part of Sydney's 'Suburban **bus** routes' network, flagging the opportunity for new bus priority measures along Botany Road to improve travel times.

⁴ [More Trains, More Services Sydney Airport Line fact sheet](#), Transport for NSW (May 2017)

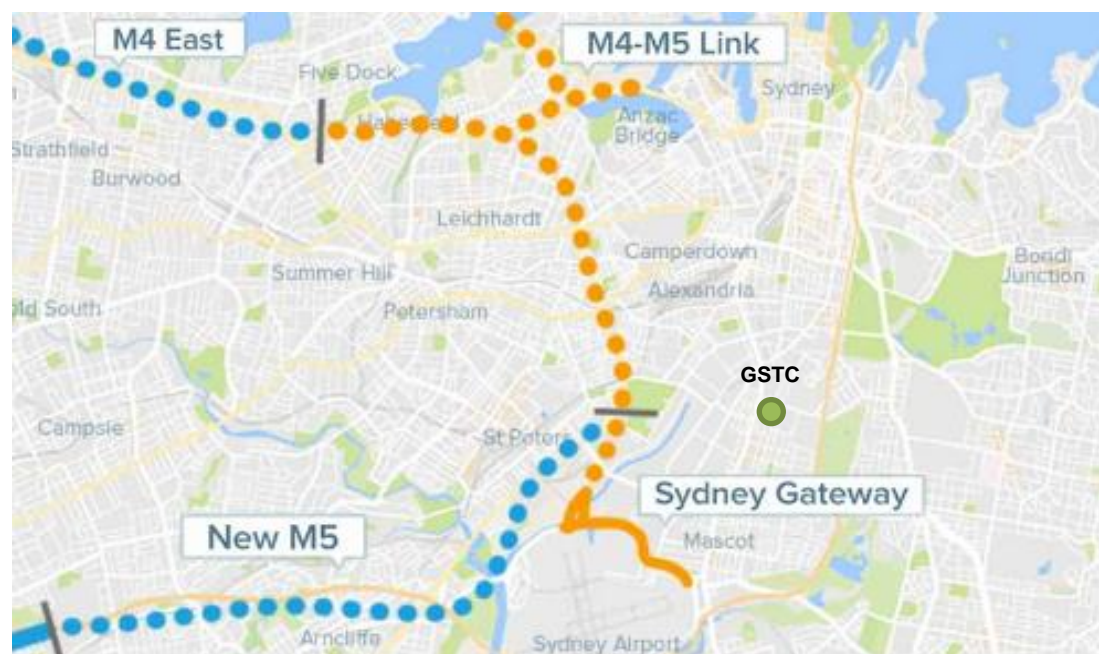
4. FUTURE CONTEXT

4.4 Road network

4.4.1 WestConnex

The WestConnex project (see Figure 34), in particular Stage 2 (New M5 Motorway) and Stage 3 (M4-M5 Link) of the proposed motorway network, are anticipated to significantly affect regional traffic patterns in the area. The M4-M5 Link will perform a parallel function with key local routes including the M1 and Botany Roads. However the presence of an interchange at St Peters may increase traffic flows on certain road links in the local area. Traffic forecasts produced to assess the impacts of WestConnex indicate that traffic volumes on nearby corridors such as Euston Road / McEvoy Street may significantly increase. This has been validated by subsequent Roads and Maritime traffic modelling showing traffic volumes on Euston Road north of Maddox Street will go from around 20,000 vehicles a day in 2016 to 40,000 vehicles a day in 2021⁵. The WestConnex project is programmed for completion in 2023.

Figure 34 WestConnex



Source: Roads and Maritime Services, 2017

4.4.2 Alexandria to Moore Park Connectivity Upgrade

RMS is investigating potential local road network and pedestrian and cyclist facility improvements as part of the Alexandria to Moore Park Connectivity (A2MP) Upgrade project. The upgrade works are being planned to integrate with the CBD and South East Light Rail and New M5 Motorway projects. Figure 35 illustrates the preliminary concept design of the proposal.

As illustrated by inset A of Figure 35, the study area includes proposed works at the McEvoy Street / Bowden Street intersection. The proposed works include construction of a new median in McEvoy Street allowing right turn in only at Bowden Street. Notably, the proposed median would physically restrict right turn movements out of Bowden Street. The impact of the respective works may hence increase southbound traffic volumes on Bowden Street, but decrease northbound volumes. It is considered that existing traffic using the right turn from Bowden Street to McEvoy Street would be displaced on to the parallel corridors of Maddox Street or Wyndham Street, depending on the origin and destination of impact trips.

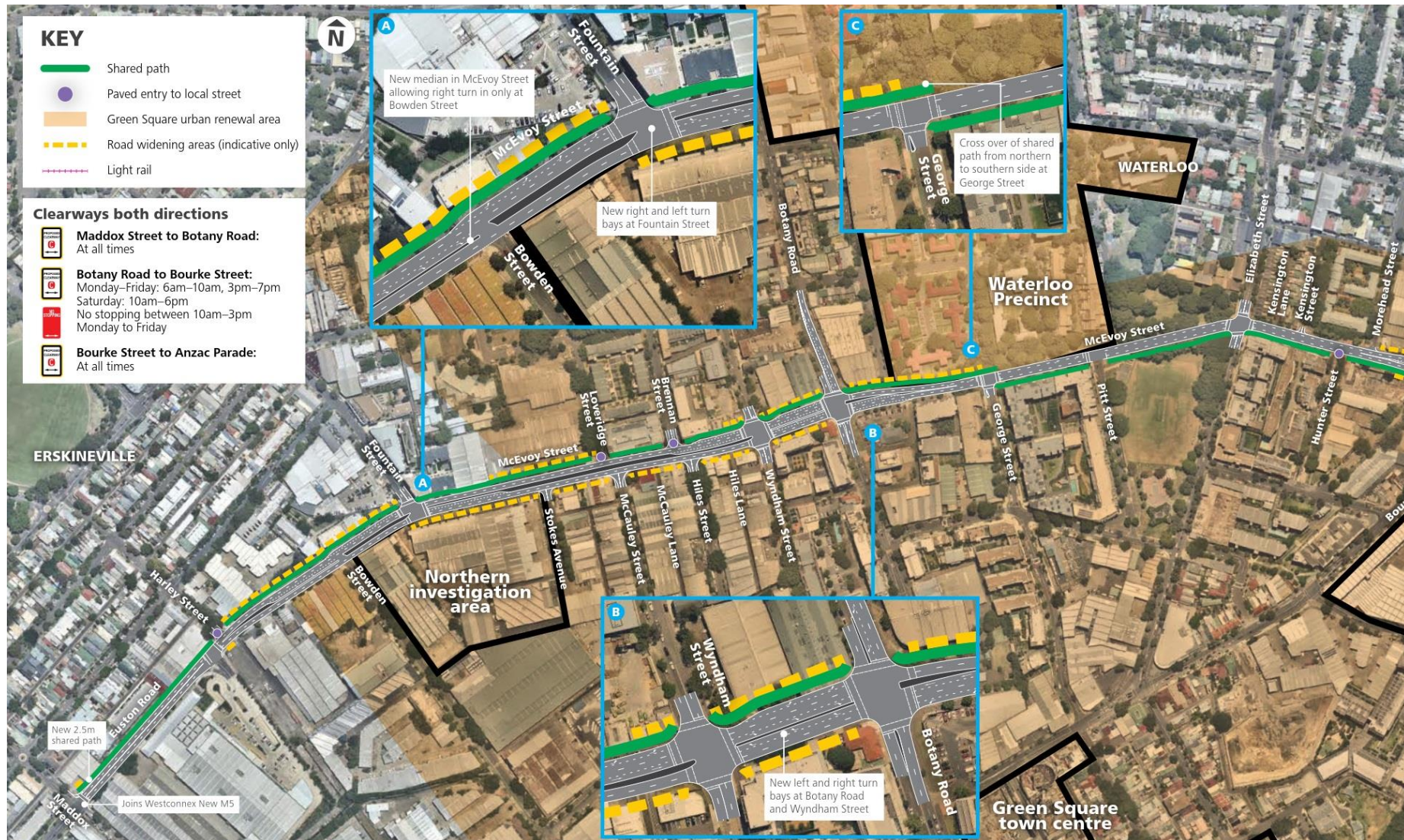
⁵ Alexandria to Moore Park Connectivity Upgrade Community Update – June 2017, Roads and Maritime Services

4. FUTURE CONTEXT

It is also noted that the proposal does not yet demonstrate integration with the City's planned cycleway facilities along Bowden Street, which should be addressed or considered in future iterations of the design development of A2MP.

It is understood the project is programmed for approval in late 2017 and be developed by early 2021.

Figure 35 Proposed Alexandria to Moore Park Connectivity Upgrade



Source: Roads and Maritime, 2017

4.4.3 Green Square Town Centre works

As construction continues and development grows in the GSTC, as will the supporting street network. Figure 36 illustrates the planned street network by current status of works. Critical to the context of the G2SAC is the alignment of Geddes Avenue, proposed to connect to and integrate with the G2SAC.

Figure 36 Proposed Green Square Town Centre street delivery plan



Source: City of Sydney, 2015, modified by AECOM, 2017

4.5 Consequences of no action

Our review of the performance of the existing road network indicates that some key intersections on the State road network are currently operating at or near capacity. Further, the evidence reviewed indicates that traffic volumes in the area will increase in the future. This is irrespective of, but varying depending on, the successful implementation of travel demand management interventions that encourage sustainable transport use and discourage private vehicle use.

The GSURA TAMP (Transport for NSW, 2012) highlights that the renewed Green Square would generate in the order of 13,050 to 19,450 additional car trips in the 2031 morning peak hour, depending on the degree to which mode share targets can be achieved. Whilst higher order road infrastructure proposed in the area as part of WestConnex may significantly decrease traffic volumes along certain corridors, forecasts indicate that traffic volumes on nearby corridors such as Euston Road / McEvoy Street may significantly increase. This is anticipated to place significant pressure on a road network already at capacity in several key locations.

Overall, the following are considered key issues should no action be taken in terms of a transport response:

- Land use
 - Should additional road connectivity and capacity not be provided, typical negative urban outcomes associated with congestion could be expected such as: reduced amenity, accessibility, and land desirability and value
 - Accessibility between Green Square and destinations or origins to the west such as Ashmore, Erskineville and Newtown will be constrained, potentially impacting growth and development of the precinct

4. FUTURE CONTEXT

- Active transport
 - The existing barriers to east-west movement in the area would continue, including to planned regional east-west cycle connections
- Public transport
 - Congestion of the road network, without suitable implementation of necessary bus priority measures, could lead to reduced journey times and reliability to passengers
 - Whilst rail services would continue to operate as per planned on the rail network, reduced accessibility to the train station could be expected for road-based modes, including buses and taxi's
- Road network
 - Congestion of the road network could impact function of the local and regional road network in the area, forming a barrier not just to local residents but to broader east-west and north-south functionality of the higher order road network
 - Opportunities for east-west connectivity and distribution of vehicle demand between critical higher order north-south corridors will be limited
 - Direct access to proposed development will be limited to that provided by the existing road network, which in the vicinity of the GS2AC is comprised heavily of busy State roads.

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5. THE PROPOSAL

The GS2AC will operate as an east-west transport link between Bowden Street and the proposed Geddes Avenue. The purpose of the GS2AC is to improve local connectivity between the proposed GSTC and Ashmore Precinct.

The GS2AC will provide additional east-west permeability and route choice for not just vehicle movements but also for cyclists. Pedestrian time savings will also be obtained through the increased efficiency of road crossings. It is recognised that the existing north-south roads of Botany Road, Bourke Road and O’Riordan Street provide important strategic and local functions. Therefore, the GS2AC has been developed to support and maintain the importance of these aforementioned roads.

General features of the project include:

- **Three new or augmented traffic signals** proposed at the following intersections, connected by a two-way carriageway:
 - Bowden Street / Bourke Road / GS2A C
 - O’Riordan Street / GS2AC
 - Botany Road / Geddes Avenue / GS2AC
- A **separated bi-directional cycleway**
- Kerbside space for **parking** and or **bus stops** / zones

5.1 Design

The GS2AC is designed as a two-way street with a design speed of 60km/hr, but sign posted at 50km/hr. The western section of the GS2AC runs between Bourke Road and O’Riordan Street and the eastern section runs between O’Riordan Street and Botany Road. The lengths of these sections of the road are approximately 220 metres and 150 metres, respectively. Figure 37 highlights the extents of the network and the relative distance between the intersections.

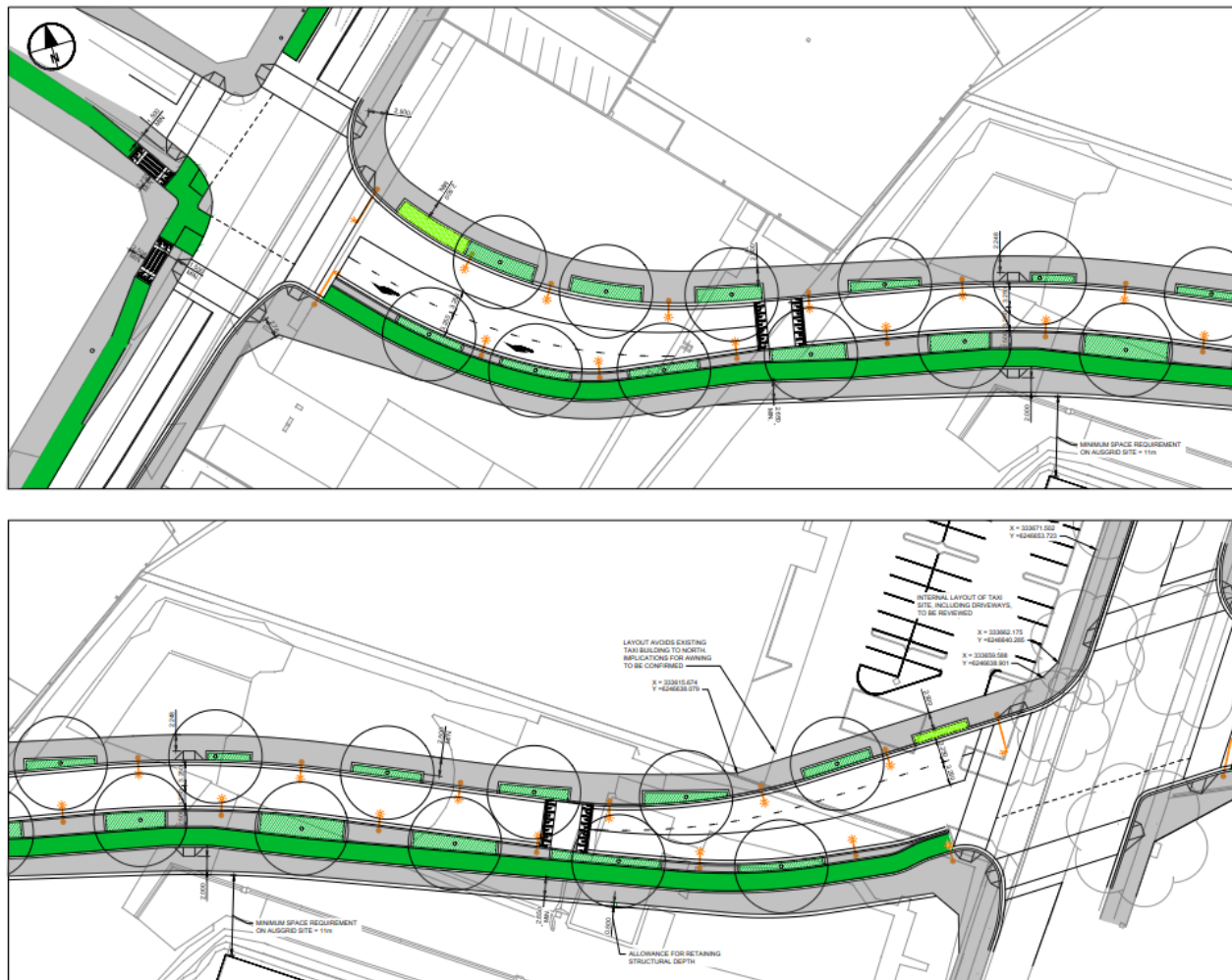
The GS2AC geometry and alignment have been designed in accordance with Austroads’ *Guide to Road Design* and associated RMS guidelines. The road reserve width is generally consistent with the width adopted for the proposed Geddes Avenue. Travel lanes are approximately 3.25 metres wide to facilitate buses. Figure 38 and Figure 39 illustrates the GS2AC road design between Bourke Road / O’Riordan Street and O’Riordan Street / Botany Road respectively. The separated bi-directional cycleway will tie in to the proposed cycleway on Geddes Avenue and the existing separated cycleway that exists on Bowden Street and Bourke Road.

Figure 37 Proposed GS2AC intersections and distances



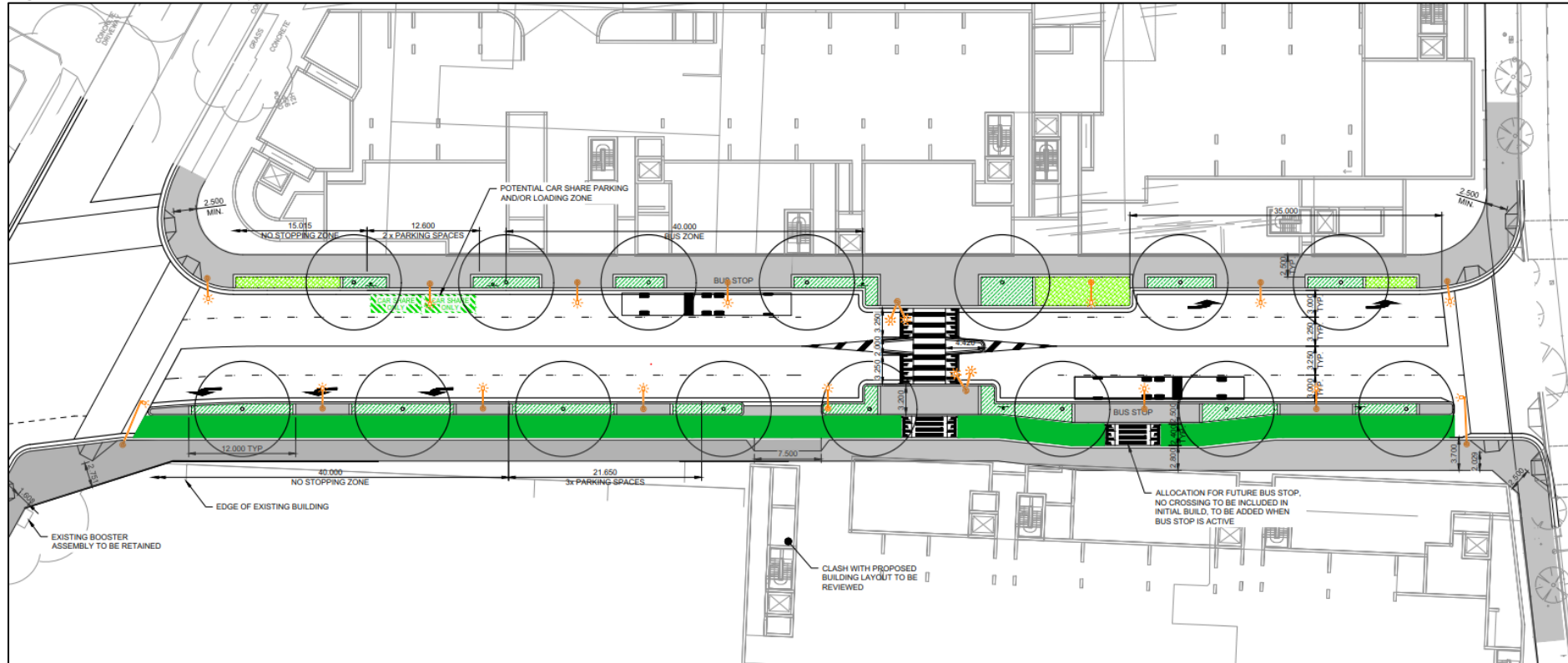
Source: City of Sydney, modified by AECOM, 2017

Figure 38 GS2AC West Layout Concept



Source: AECOM, 2017

Figure 39 GS2AC East Layout Concept



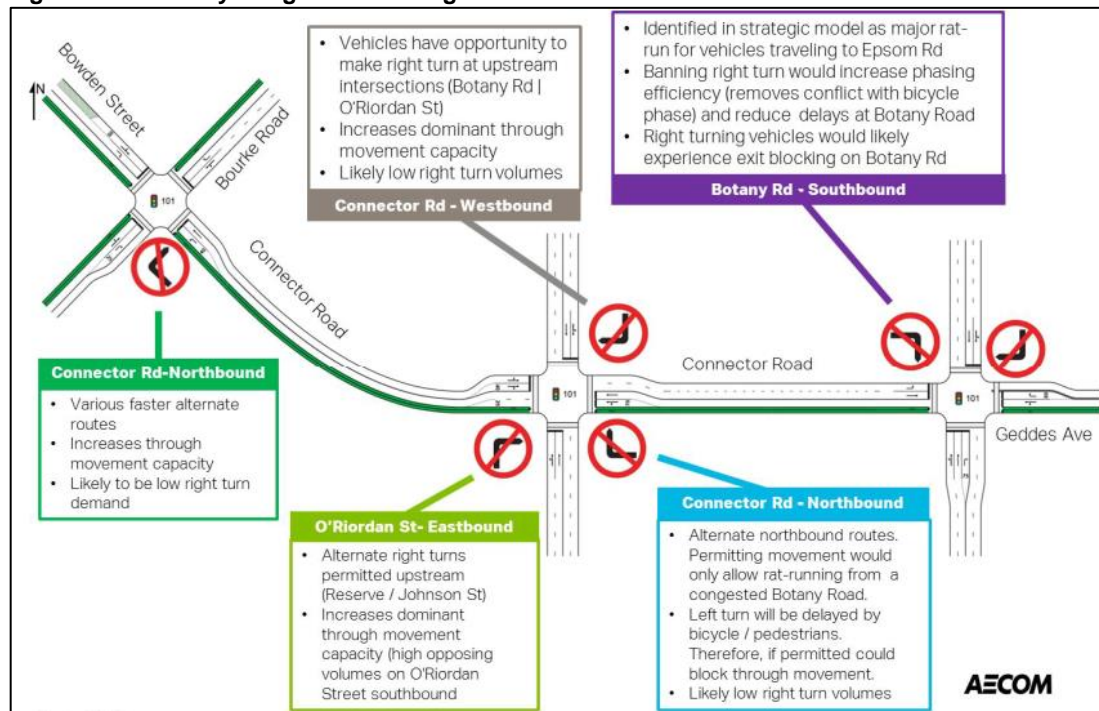
Source: AECOM, 2017

5.2 Function and route strategy

A vehicle route assessment and strategy was carried out by AECOM for the City, to review the proposed turning movement associated with the GS2AC. The primary function of the GS2AC is to provide a multi-modal east-west connection to the GSTC and to enhance the road and transport access in the area. In order to ensure this function could be achieved, without attracting broader cross-regional (east-west through) trips, a route strategy was developed.

A summary of the turn bans proposed to manage traffic flow, enabling a focus on east-west connectivity to GSTC, is provided in Figure 40.

Figure 40 Summary of right turns along GS2AC



Source: AECOM, 2017

6. OPERATIONAL IMPACTS

6.1 Active transport

6.1.1 Walking

The GS2AC provides an opportunity to significantly enhance pedestrian safety and accessibility by providing two new signalised pedestrian crossings at O’Riordan Street and Bourke Road, as well as the connection with the approved crossing at Botany Road. These crossings will allow pedestrians to cross each road safely and conveniently and will assist in improving the east-west connectivity to the GSTC. Figure 41 provides an indication of the distance and time saved by using the GS2AC.

In addition to providing a shorter east-west route, the GS2AC will contribute to an enhanced pedestrian experience. Pedestrians walking along the GS2AC will be exposed to less traffic than on the existing Bourke Road / Botany Road route.

Figure 41 East-west pedestrian route with and without GS2AC



Source: City of Sydney, modified by AECOM, 2017

The proposed intersection crossings will also enhance pedestrian access to the Green Square Train Station and Town Centre, especially for those people working in the vicinity of Perry Park. Safe and efficient pedestrian access to these locations is paramount and is a key element of the GS2AC design, which incorporates pedestrian crossings on all approaches to ensure with improved pedestrian access. It will also enhance pedestrian access to and between public transport services.

6.1.2 Cycling

Similar to the improvements in pedestrian accessibility, the GS2AC will enhance the east-west connectivity through the area. The GS2AC will encourage cycling by providing a separated two-way cycleway on the road. The infrastructure will also include bicycle crossings across the intersections with dedicated lights.

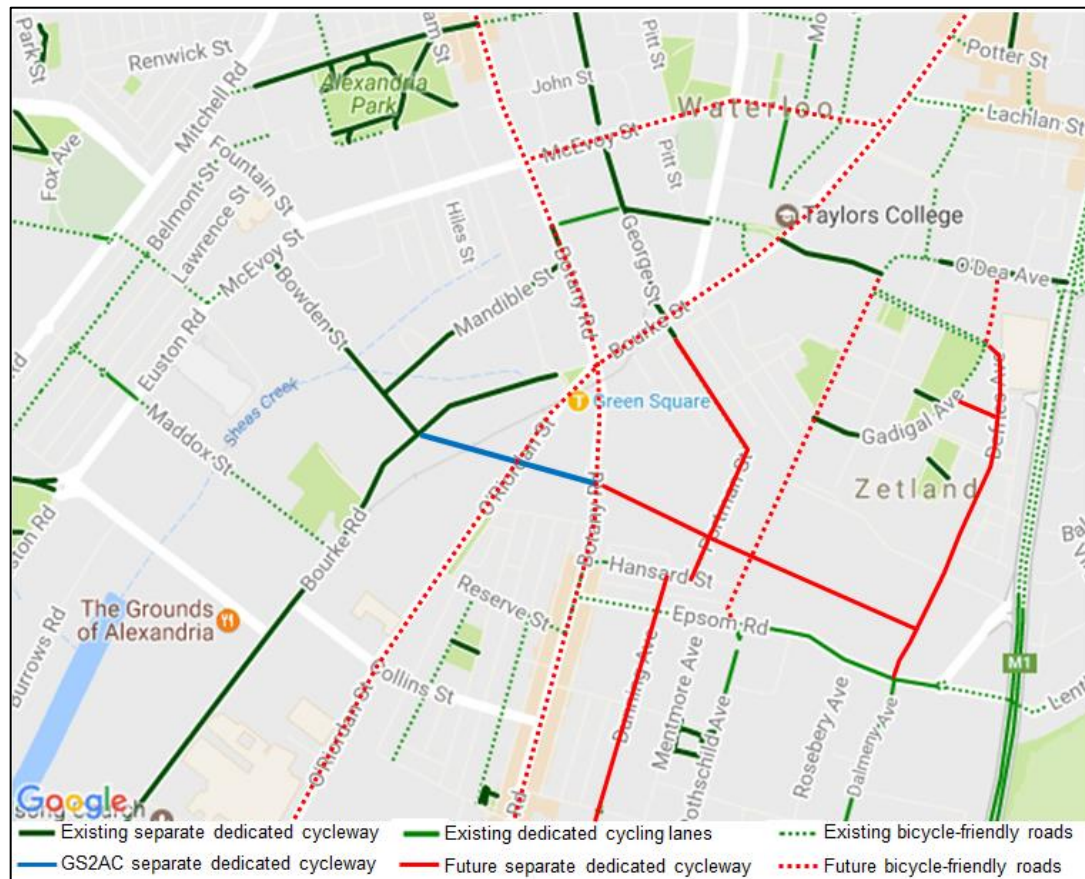
This route will be well linked to the surrounding local and strategic cycling network. The GS2AC cycleway is connected with the existing separated cycleways on Bourke Road and Bowden Street to the west, as well as the planned cycleway on Geddes Avenue to the east.

6. OPERATIONAL IMPACTS

Figure 40 shows the GS2AC cycleway in the context of existing cycleways and planned cycle paths from the City's proposed regional bike network.

As seen, the GS2AC cycleway will provide a strategic east-west link between two separate dedicated cycleways. The Bourke Road cycleway is a popular route for those travelling between the CBD and Mascot. Further, the route along Bowden Street will lead towards the Ashmore Precinct as well as to Newtown and the Inner West. Meanwhile, the cycleways on the eastern side will connect to the M1 Motorway and Kensington. The GS2AC cycleway will be vital in creating a safe route for cyclists and linking the Green Square Town Centre with the broader cycle network.

Figure 42 Existing and planned cycle network near Green Square



Source: Sydney Cycleways, modified by AECOM

6.2 Public transport

6.2.1 Train

The proposed GS2AC will have no direct impact on the train services provided at the Green Square Station. The broader GSTC development will increase rail patronage at the train station and the GS2AC will assist in facilitating improved access to the station from the interfacing surface transport network.

6.2.2 Bus

In December 2014, CoS met with TfNSW to discuss the future bus servicing requirements for the proposed GS2AC. At this stage, TfNSW did not indicate that the GS2AC will be nominated as a bus route.

6. OPERATIONAL IMPACTS

However to cater for potential use of the GS2AC by future eastern region buses, space has been provided for two new bus stops, on either side of the road near Botany Road. The GS2AC has been designed for use by buses with lengths up to 12.5 metres long, with considerations including swept paths. The road is also consistent with the principles established in the *Bus Infrastructure Guide* (2011).

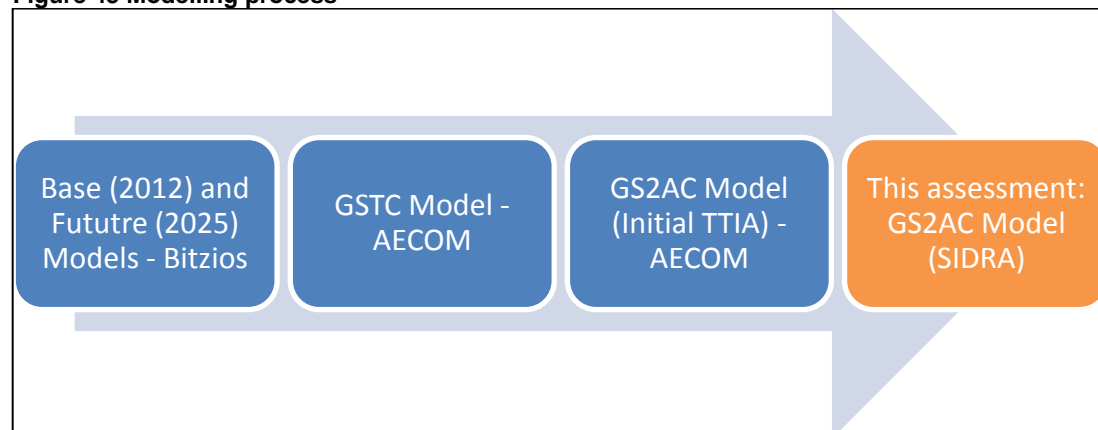
6.3 Road Network

The following section provides details of the traffic assessment of the proposal, in particular its operational performance during the 2021 AM and PM peak periods.

AECOM were previously commissioned by the City to provide a route strategy report for the GS2AC. This report provided a traffic assessment of the GS2AC and evaluated the proposed turning movements associated with GS2AC in the context of the City's broader access strategy for the GSTC. The modelling process utilised previously developed Paramics models for the area to determine traffic volumes, for input to Sidra Intersection models established to assess the proposed intersections (as illustrated in Figure 43). The design methodology was driven not necessarily by demonstrating the benefits to the broader network brought about by the introduction of available capacity, but to demonstrate the project can fulfil its local access function without significant impact to north-south movement in the area (i.e. proposed intersections operate within capacity, and have minimal impacts to north-south through movements).

The methodology was developed in consultation with RMS and the City, with further details provided as part of the route strategy report attached as Appendix B. The results of the assessment are summarised in the sections following.

Figure 43 Modelling process



Source: AECOM, 2017

6.3.1 Performance criteria

The commonly used measure of intersection performance, as defined by RMS, is vehicle delay. Sidra determines the average delay that vehicles encounter and provides an associated measure of the Level of Service (LOS).

Table 2 shows the criteria that Sidra adopts in assessing the LOS based on average delay, in accordance with RMS practise. It is considered typical RMS practise to implement a minimum performance target of LOS D.

6. OPERATIONAL IMPACTS

Table 2 Sidra Intersection - Level of Service Criteria – Average Delay

Level of Service (LOS)	Average delay per vehicle (seconds/vehicle)	Comment
A	Less than 14	Good operation
B	15 to 28	Good with acceptable delays and spare capacity
C	29 to 42	Satisfactory
D	43 to 56	Near capacity
E	57 to 70	At capacity, at signals incidents will cause excessive delays
F	Greater than 70	Extra capacity required

In addition, Table 3 shows the criteria that Sidra adopts for LOS with respect to Degree of Saturation (DOS) for a signalised intersection. The DOS represents the flow-to-capacity ratio for the most critical movement on each leg of the intersection. For signalised intersections, a DOS of around 0.95 is typically considered the 'acceptable' limit, as beyond this queues and delays increase disproportionately.

Table 3 Sidra Intersection - Level of Service Criteria – Degree of Saturation

Level of Service	Degree of Saturation (DOS)	Comment
A	≤ 0.60	Excellent
B	0.60-0.70	Very Good
C	0.70-0.90	Good
D	0.90-0.95	Acceptable
E	0.95-1.00	Poor
F	≥ 1.0	Very Poor

6.3.2 2021 network performance

The results for the AM Peak models show that all intersections are anticipated to perform at a Level of Service (LOS) C or better which indicates the network will have an acceptable level of performance. The results are summarised in Table 4 and Table 5 and discussed following.

6. OPERATIONAL IMPACTS

Table 4 AM Peak Sidra Intersection results

Approach	Volume	Delay (s/veh)	Level of Service (LOS)	Degree of Saturation (DOS)	95th percentile back of Queue (m)
Bowden Street / Bourke Road / GS2AC					
GS2AC (SE)	180	33	C	0.249	45
Bourke Road (NE)	471	33	C	0.478	82
Bowden Street (NW)	300	36	C	0.408	50
Bourke Road (SW)	423	38	C	0.694	143
Total Intersection	1,374	35	C	0.694	143
O'Riordan Street / GS2AC					
O'Riordan Street (S)	1,124	45	D	0.856	256
GS2AC (E)	227	58	E	0.680	66
O'Riordan Street (N)	1,142	9	A	0.444	108
GS2AC (W)	125	63	E	0.781	28
Total Intersection	2,619	31	C	0.856	256
Botany Road / GS2AC / Geddes Ave					
Botany Road (S)	1,027	13	A	0.425	106
Geddes Ave (E)	279	56	D	0.547	56
Botany Road (S)	1,008	21	B	0.525	146
GS2AC (W)	144	43	D	0.201	27
Total Intersection	2,459	23	B	0.547	146

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Table 5 PM Peak Sidra Intersection results

Approach	Volume	Delay (s/veh)	Level of Service (LOS)	Degree of Saturation (DOS)	95th percentile back of Queue (m)
Bowden Street / Bourke Road / GS2AC					
GS2AC (SE)	241	28	B	0.261	40
Bourke Road (NE)	340	30	C	0.271	57
Bowden Street (NW)	340	38	C	0.558	70
Bourke Road (SW)	456	33	C	0.696	152
Total Intersection	1,335	33	C	0.682	152
O'Riordan Street / GS2AC					
O'Riordan Street (S)	1,118	45	D	0.851	252
GS2AC (E)	269	61	E	0.815	94
O'Riordan Street (N)	1,006	8	A	0.395	92
GS2AC (W)	161	62	E	0.884	43
Total Intersection	2,555	33	C	0.851	252
Botany Road / GS2AC / Geddes Ave					
Botany Road (S)	876	12	A	0.357	85
Geddes Ave (E)	279	47	D	0.569	59
Botany Road (S)	1,219	22	B	0.629	191
GS2AC (W)	225	41	C	0.419	72
Total Intersection	2,599	23	B	0.629	191

The operational performance of the 2021 AM peak at the different intersections are summarised below:

- The **Bowden Street / Bourke Street / GS2AC Road** intersection operates at a satisfactory LOS C, with all of all the approaches operating at similar level of delay. Results indicate that the shared through / right lane from the Bowden Street approach will likely experience the largest amount of delay at the intersection. This is because the right turn movement conflicts with the opposing through movement from the GS2AC Road as well as being held for bicycle protection. It is envisaged that the bicycle phase will not be called every cycle and therefore the results represent a worst-case scenario. By making the kerbside lane on the Bowden Street approach an exclusive left turn bay, it adds capacity to the intersection by allowing a left turn to operate unopposed during the diamond phase for Bourke Road approaches.
- The **O'Riordan Street / GS2AC Road** intersection also operates at LOS C. Based on observed site visits during the AM peak, it is anticipated that the northbound lanes along O'Riordan Street will be heavily congested and vehicles exiting the leg on the north approach will likely experience exit blocking. However, the right turn from the eastern GS2AC Road approach is proposed to be banned and the volumes for the left turn from the western approach is anticipated to be low, therefore the exit blocking is not likely to have any significant impact on the intersections performance. The side arms of the GS2AC Road operate at a LOS E. This is mostly due to the movements that conflicted with the separated cycleway which increase delay. The north approach is expected to experience a minimal amount of delay, operating at a LOS A

6. OPERATIONAL IMPACTS

- The **Botany Road / Geddes Avenue / GS2AC Road** intersection is forecast to operate at LOS B. The performance of this intersection is also likely to be affected by upstream delays which occur at the intersection of Wyndham Street / Botany Road and O'Riordan Street which is observed to be heavily congested during the AM peak, however since the intersection is not included within the study area, it is difficult to forecast the amount of exit blocking delay that is imposed on the Geddes Avenue or the GS2AC Road. The Geddes Avenue approach is the worst performing approach because of a high demand for the right turn in to Botany Road which conflicts with both the northern pedestrian crossing and opposing through movements.

The operational performance of the 2021 PM peak at the different intersections is summarised below:

- The **Bowden Street / Bourke Street / GS2AC Road** intersection performs at a similar level of performance to the AM peak at LOS C with all approaches having a similar amount of delay. The south-west Bourke Road approach has the highest degree of saturation of 0.682.
- Similar to the AM peak, it is expected that exit blocking along **O'Riordan Street** will also occur in the PM peak. However, the north approach operates with no capacity restraints and receives minimal delays. Because of the higher flows on the O'Riordan Street, priority is given to these approaches over the Connector Road leading to a LOS E and D for the east and west approaches respectively.
- The **Botany Road / Geddes Avenue / GS2AC Road** is forecast to operate at LOS B. It was observed during the PM site visit that southbound queuing from the Epsom Road intersection extended back to the proposed location of Geddes Avenue. Therefore, the performance of this intersection is also likely to be affected by these upstream delays. The Epsom Street/ Botany Road intersection is not included within the study area and therefore it is difficult to forecast the amount of exit blocking and its impacts on Geddes Avenue or the GS2AC Road.

6.3.3 Post 2021 network performance

As highlighted previously, no updated strategic volumes have been made available for future year analysis of the traffic network beyond 2021. Therefore, in consultation with RMS, it was agreed that the growth rate of 1.1 percent compounding annual growth rate would be applied uniformly across the network to obtain a failure year and assess the location of any potential capacity restraints within the GS2AC.

Table 6 below shows the design life analysis of the three signalised intersections along the GS2AC. The failure year shown indicates when the intersection reaches capacity (degree of saturation approaches 100 percent) under a compounding annual growth rate of 1.1% from the 2021 year volumes.

Table 6 Design life analysis

Peak Period	Failure Year	Failure Approach	Failure Movement
Bowden Street / Bourke Road / GS2AC			
AM Peak	2052 (31 years)	Bourke Road (SW)	Through/Left
PM Peak	2038 (17 years)	Bourke Road (SW)	Through/Left
O'Riordan Street / GS2AC			
AM Peak	2042 (21 years)	GS2AC (West)	Right
PM Peak	2029 (8 years)	GS2AC (West)	Right
Botany Road / GS2AC / Geddes Ave			
AM Peak	2040 (19 years)	Geddes Ave (East)	Right
PM Peak	2037 (16 years)	Geddes Ave (East)	Right

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In the AM peak, results indicate that the Geddes Avenue approach will be the first intersection within the network to reach capacity, 19 years after the 2021 opening year. As one of the main egress points, the Geddes Avenue approach right turn movement in to Botany Road provides egress for the AM commuter trips generated by the Green Square Town Centre to the Sydney CBD.

It can be seen from the above results that the intersection that reaches capacity first is O’Riordan Street / GS2AC in the 2029 PM peak. The western approach right turn movement reaches capacity because of an increased volume of conflicting through movements from the eastern approach combined with the delay imposed by the cycle phase.

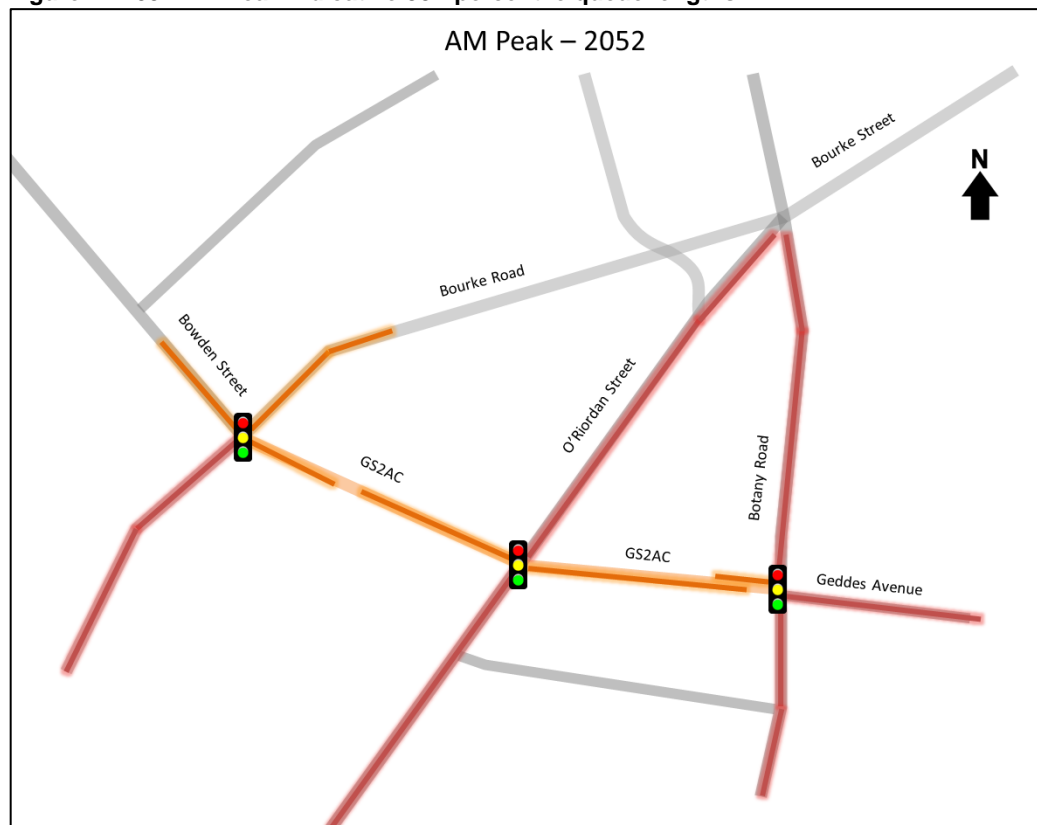
The intersection of Bourke Road / GS2AC is shown to approach capacity after the two intersections during both the AM and PM peak periods. Analysis shows the Bourke Street south-western approach is expected to reach capacity in the through/left lane as the increased demand from this approach is delayed by the left turn conflicting pedestrian / bicycle movements, starving the through movements of effective green time.

6.3.4 Queuing analysis

A potential concern which arose in the analysis of the GS2AC was that the queue along the GS2AC may extend back to either Botany Road or O’Riordan street and therefore causing these roads to experience exit blocking as a result. Further analysis has been carried out to investigate the location and extent of queueing to assist in determining the future characteristics and operation the GS2AC.

Figure 44 and Figure 45 below indicates the 95th percentile queue lengths for the AM and PM peak periods for what was determined to be the ultimate failure year. The ultimate failure year is determined by the above design life analysis and is when the last intersection with the GS2AC network is expected to reach capacity. These are 2052 and 2038 for the AM and PM peaks, respectively. These future years have been chosen as they provide a robust, worst-case scenario for the network.

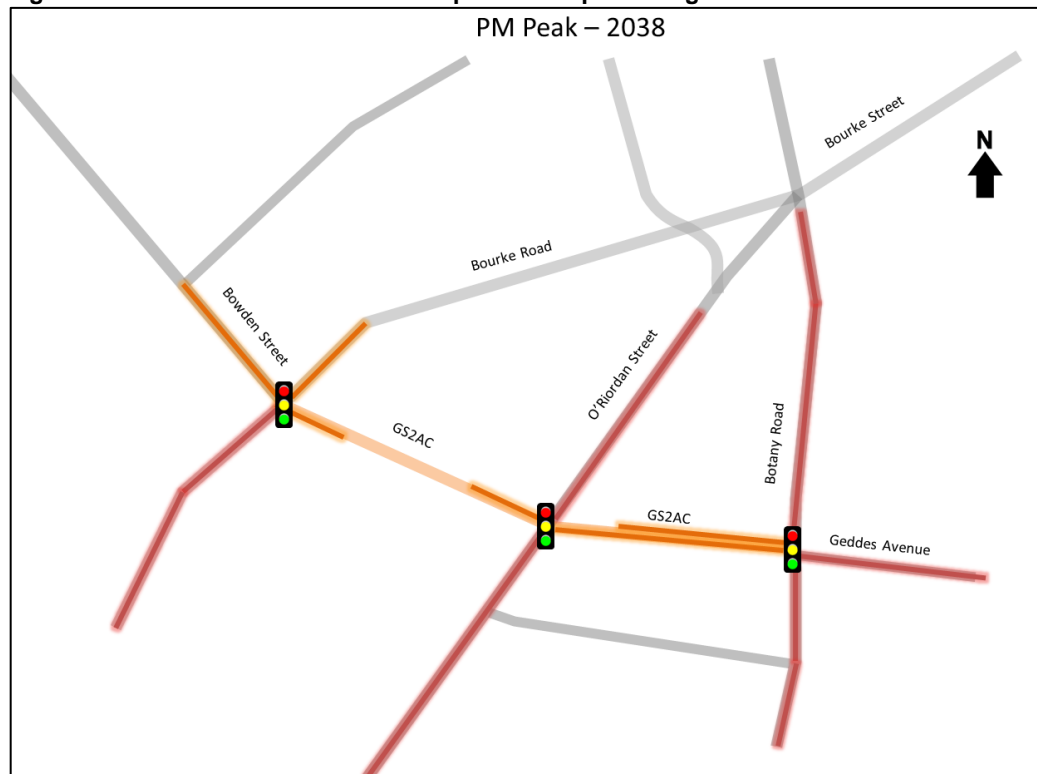
Figure 44 2052 AM Peak indicative 95th percentile queue lengths



Note: not to scale and diagrams are representative only from Sidra outputs
Source: AECOM, 2017

6. OPERATIONAL IMPACTS

Figure 45 2052 PM Peak indicative 95th percentile queue lengths



Note: not to scale and diagrams are representative only from Sidra outputs
Source: AECOM, 2017

The figures above show that the main State roads are expected to be heavily congested in the future years. This is expected as indicated by the extensive queueing that was observed during both the AM and PM peak site visits. It is likely these queues would form in the absence of the GS2AC because of upstream/downstream intersection capacity restraints.

During the AM peak, it can be seen that the south approach on Bourke Road at the Bowden Street / Bourke Road / GS2AC intersection experiences extensive queueing. This is because of a high volume of competing movements between the through movements from the south and the right turn movement from the north. Furthermore, additional delay caused by cyclist and pedestrian protection for the left turn from the south approach further reduces capacity. The GS2AC approaches at the O'Riordan Street / GS2AC intersection are shown not to queue back to their respective upstream intersections. However, the figure indicates that eastern approach queue length comes close to extending back to the Botany Road / GS2AC intersection. The increased volume of through traffic and left turn queue starving the adjacent through lane is the likely reason for the formation of this queue.

The PM peak shows a similar evaluation, however increased queueing is shown on the GS2AC mid-block between O'Riordan Street and Botany Road in both directions. This is because of the increased volumes as a result of trips generated in to the GSTC. In the westbound direction, the queue is predicted to extend back to Botany Road. This is likely because of a high level of demand from Epsom Road. However, since the O'Riordan / GS2AC intersection conservatively assumes 11 seconds bicycle incurred delay every cycle for the left turner, the queue for the eastern approach may be significantly lower. Extended delays are also expected northbound along Botany Road as a result of queueing extending from the Botany Road / Bourke Street / O'Riordan Street signalised intersection which may in turn reduce the desire for vehicles from Epsom Road to turn right from Epsom Road to access the GS2AC and use the alternative Collins Street route.

6. OPERATIONAL IMPACTS

From the above analysis of queue lengths, it can be seen that in both peak periods the GS2AC has smaller queue lengths when compared the north-south routes. Importantly, the mid-blocks of the GS2AC between Bourke Road, O’Riordan Street and Botany Road do not show extensive queueing with the exception of the eastern approach to the O’Riordan Street / GS2AC intersection. However, it is anticipated that the congested Botany Road and Geddes Avenue roads will restrict the amount of vehicles able to flow through the approach and limit queueing. It is also important to note that the above queuing diagrams are indicative only and represent a worst case 95th percentile queue length.

7. PRELIMINARY CONSTRUCTION ASSESSMENT

7.1 Overview of Construction Activities

The following indicative construction staging is proposed for the purposes of the concept design. After site establishment the proposal would be implemented in the following 10 stages, which are likely to be refined and determined during the detailed design phase and could be influenced by the availability of funding:

The Principal Contractor would be responsible for developing a detailed construction staging plan. However, for the purposes of the concept design it is anticipated that the works would be undertaken in the following key stages.

- Stage 1: site set-up and establishment of environmental controls implement traffic management measures
- Stage 2: Survey and set out. Services identification
- Stage 3: Commence bulk earthworks. Sort, stockpile, load, transport material
- Stage 4: Excavate, cut and fill to design levels
- Stage 5: Install pipe drainage
- Stage 6: Import pavement material and compact.
- Stage 7: Pour kerbs, retaining walls, construct pavement sub base, commence street trees, lighting and paving and traffic signals installation
- Stage 8: Install asphalt wearing course, line marking and signage
- Stage 9: Complete landscaping, street furniture and commission traffic signals
- Stage 10: Demobilise, site clean and remove traffic management and environmental controls

Plant and equipment required to undertake the works would likely consist of a combination of:

- Tracked excavators (10 tonnes, 15 tonnes and 30 tonnes);
- Tipper trucks;
- Tree trimmers and mulchers;
- Compaction equipment such as drum, vibrating rollers and plate compactors;
- Air compressors;
- Pumping equipment;
- Crushing / screening plant; and
- Smaller tools and equipment such as concrete and paver cutting equipment, jack hammers and miscellaneous hand held tools.

7.2 Timing of Construction Activities

Construction of the GS2AC is anticipated to up to 22 months to complete, starting in late 2018 to mid 2020.

7.3 Concurrent works

It is understood that several other construction activities will also be carried out within the Green Square Town Centre concurrently with the subject works. The sections below summarise these projects, their construction programs and the construction access arrangements proposed by the City. The individual construction sites are also shown along with and the progress of other adjacent works at the completion of the Package 3 of GSTC street construction which represents the approximate proposed commencement date for the GS2AC.

7. PRELIMINARY CONSTRUCTION ASSESSMENT

Figure 46 – Adjacent Sites



Source: City of Sydney

7.3.1 Access via Ebsworth Street/Bourke Street/Botany Road

Work on Sites 6 and 5A/5B commenced in 2016 and are expected to be complete by mid-2018. Sites 7, 15, 17 and 18 are then expected to commence construction in 2018-2019 with construction complete in 2020-2021. Each of these developments will overlap with the subject works.

It is anticipated that construction access for each of these sites will be directly from Bourke Street (both using an existing driveway and the new Ebsworth Street).

The City has also commenced construction on Green Square Plaza in Q2 2015 with completion expected in 2018. Access for this construction site will be directly from Botany Road.

7.3.2 Access via Dunning Avenue or Botany Road

Bridgehill will commence construction on the following sites:

- Site 12A: Commenced. Complete 2018
- Site 12B: Commenced. Complete 2018
- Site 9A: Commence tbc. Complete tbc
- Site 9B: Commence tbc. Complete tbc

Lateral Corp will commence construction on the following sites:

- Site 10A: Commence Q1 2017. Complete Q2 2019
- Site 10B: Commence Q1 2017. Complete Q2 2019
- Site 11A: Commence Q1 2017. Complete Q2 2019
- Site 11B: Commence Q1 2017. Complete Q2 2019
- Site 11C: Commence Q1 2017. Complete Q2 2019

7. PRELIMINARY CONSTRUCTION ASSESSMENT

7.3.3 Additional Developments

- 200 affordable housing development at northern side of GS2AC at 330-336 Botany Road
- 100 affordable housing development at southern side of GS2AC at 338 Botany Road
- [## timelines to be provided by CoS ##]

7.4 Construction traffic management

7.4.1 Overall Principles of Construction Traffic Management

The overall principles of traffic management during the construction activity would include:

- provide an appropriate and convenient environment for pedestrians
- minimise the impact on pedestrian movements
- maintain appropriate capacity for pedestrians at all times on footpaths around the site
- maintain appropriate public transport access
- maintain permanent access to/ from the emergency hospital access point for ambulances
- restrict construction vehicle movements to designated routes to/ from the site
- manage and control construction vehicle activity in the vicinity of the site
- minimise impacts to general traffic in the vicinity of the site.

7.4.2 General Requirements

In accordance with Road and Maritime Services (RMS) requirements, all vehicles transporting loose materials will be required to have the entire load covered and/or secured to prevent any large items, excess dust or debris being deposited onto the roadway during travel to and from the site. All subcontractors and suppliers must be inducted by the Principal Contractor(s) to ensure that the procedures are met for all vehicles entering and exiting the construction sites. The Principal Contractor(s) will monitor the roads leading to and from the site and take all necessary steps to clean any debris deposited by construction vehicles.

Vehicles operating to, and from and within the site shall do so in a manner, which does not create unreasonable or unnecessary noise or vibration.

No tracked vehicles will be permitted on any paved roads. Public roads and access points will not be obstructed by any materials, vehicles, refuse skips or the like, under any circumstances.

7.4.3 Working Hours

It is understood that construction activity would be restricted to the standard hours of construction as follows:

- Monday to Friday: 7:30am to 5:30pm
- Saturdays: 7:30am to 3:30pm
- Sundays or public holidays: no work permitted

The Principal Contractor(s) will be responsible for instructing and controlling all sub-contractors regarding the hours of work. Any work outside the proposed construction hours will be subject to specific prior approval from the appropriate authorities.

7.4.4 Construction Worker Parking

It is anticipated that there will be a limited quantity of parking provided within the work site for accommodation of construction worker's vehicles. It is assumed that the parking location would be varied during the works to keep the parking clear of active worksites, e.g. excavation, remediation and roadwork sites, truck access routes, etc.

7. PRELIMINARY CONSTRUCTION ASSESSMENT

Given the site's proximity to high frequency public transport services, all workers are to be encouraged to use public transport to access the site, with appropriate tool/ equipment drop-off arrangements made. This will be incorporated into the site induction program. Workers will be directed not to use on-street parking within the vicinity of the site. The Principal Contractor(s) is to take appropriate action if informed of this activity occurring.

As such, there would be no impact on existing on-street parking, which would remain available for existing users.

7.4.1 Access Arrangements

Access to the works sites will be directly from Bourke Street, O'Riordan Street and Botany Road. It is anticipated that the following conditions will be placed on these access:

GS2AC West (Bourke Road to O'Riordan Street)

- Bourke Road: All movements
- O'Riordan Street: Left-in/ Left-out

GS2AC East (O'Riordan Street to Botany Road)

- O'Riordan Street: Left-in/ Left-out
- Botany Road: Left-in/ left or right out (signalised)

The current staging for the intersection of Geddes Avenue / Botany Road indicates signalisation approximately 12 months prior to the GS2AC construction commencement. Due to traffic volumes on Botany Road and potential safety issues associated with priority control turn arrangements, it is proposed that this intersection is utilised to provide safe and controlled access from the road network to the eastern section of GS2AC construction site.

7.4.2 Construction Traffic Volumes

Traffic generated by the construction works includes construction worker light vehicles (including utility vans), as well as heavy vehicles for periodic delivery and removal of materials, including plant and equipment. Vehicle types and sizes would vary depending on the required use, but include medium and large rigid vehicles and articulated vehicles for import of bulk materials or minor spoil removal, as well as concrete trucks.

Although the level of construction vehicle activity is unknown at this stage, the volumes are expected to be up to 60 vehicles per day (120 one-way trips).

A summary of the anticipated traffic generation per stage of works is presented in Table 7.

Table 7 Construction Traffic Generation

Name	Duration (weeks)	Start	Finish	Vehicle Trips (Duration)	Vehicle Trips (per day)
GS2AC East	54	03/04/18	04/10/19		
Remediation and Excavation and in-ground services other than trunk	16	31/08/18	21/12/18	750	9
Retaining wall/batters	12	07/01/19	01/04/19	450	7
Sub-grade	8	02/04/19	30/05/19	600	14
Kerb & gutter	8	31/05/19	26/07/19	400	9
Footpaths	6	29/07/19	06/09/19	700	21
Pavement Lanes Surfacing	4	09/09/19	04/10/19	600	28
Taxi Building Demolition (if Required)	26	03/04/18	03/10/18	-	-

7. PRELIMINARY CONSTRUCTION ASSESSMENT

Name	Duration (weeks)	Start	Finish	Vehicle Trips (Duration)	Vehicle Trips (per day)
GS2AC West	54	07/01/19	06/02/20		
Remediation and Excavation	16	07/01/19	02/05/19	700	8
Retaining wall/batters	12	03/05/19	26/07/19	450	7
Sub-grade	8	29/07/19	20/09/19	600	14
Kerb & gutter	8	23/09/19	18/11/19	400	9
Footpaths	6	19/11/19	09/01/20	700	21
Pavement Lanes Surfacing	4	10/01/20	06/02/20	600	28

7.4.3 Haulage Routes

The origin and destination of truck movements is currently not known. Generally, construction vehicles will have origins and destinations from a wide variety of locations throughout Sydney. However, all construction vehicles are to be restricted to the State and Regional Road network, where possible. No construction vehicles are to use Geddes Avenue, Wyndham Street, Johnson Street or Maddox Street to Access the site. In addition construction traffic must not access the site via Elizabeth Street, Hansards Street and Joynton Avenue.

As such, likely construction vehicle routes have been developed with the aim to provide the shortest distances to/from the arterial road network, whilst minimising the impact of construction traffic on streets in the vicinity of the site. Alternative routes would not be used without specific prior approval from the appropriate stakeholders.

In general, construction vehicle routes via Bourke Street will not be supported. Vehicles routed should generally be via Lachlan Street, McEvoy Street, Botany Road and Epsom Road.

It is noted that during the early bulk earthworks and materials phases some of the exported material may be used at the Green Square Aquatic Centre Development. Vehicles accessing this site will do so via Collins Street/ Botany Road, Epsom Road and Johnston Avenue.

7.5 Impact

7.5.1 Traffic

Given the number of daily construction vehicles, overall the construction works could not be expected to significantly impact intersection operation external to the site.

This includes the Botany Road, O'Roiridon Street and the arterial network more broadly. This also assumes that construction vehicle activity outside typical weekday AM and PM peak hours.

Any works on weekends would not present significant traffic related impacts, with no known specific restrictions limiting access and/ or the work hours as specified.

All works within the site and associated vehicle movements will be restricted to the permitted working hours of the site.

7. PRELIMINARY CONSTRUCTION ASSESSMENT

7.5.2 Signalised Intersection Works

The installation of two new signalised intersections (Bourke Road/ GS2AC and O’Riordan Street) as well as modification to the signalized intersection at Botany Road/ Geddes Avenue will require works to be completed within the completed road reserve. This includes fitting and connection of loop detectors as well as painting of linemarking. These works would likely require the closure of two trafficable lanes at any one time. The closure of two lanes should allow the remaining two open lanes to facilitate traffic in both directions. This will require a contraflow operation if the lane closures occupy either both the northbound or southbound lanes. It is anticipated that these works would be carried out as night works to minimise the impact on these roads.

7.5.3 Active Transport

Existing pedestrian footpaths on Bourke Road, Botany Road and O’Riordan Street form part of the construction of GS2AC and pedestrians would also need to be diverted to temporary pedestrian paths whilst the upgrades are undertaken.

During the closure, it is expected that pedestrians use the temporary pedestrian footpaths which would be provided at all street interfaces to maintain pedestrian connectivity. Further to this, the appointed contractor is to ensure that appropriate wayfinding/detour signage is installed so pedestrians are informed of the temporary closures and are directed to a safe, alternate crossing point during construction hours. Truck drivers should be alerted to the need to give way to pedestrians crossing the footpath at site access locations.

Approval from the City and RMS will be obtained for Temporary Works on the public way and Road Opening Permits prior to work being undertaken on site. These applications will include associated Traffic Control Plans (TCPs). The TCP will ensure that existing pedestrian access routes are maintained at all times.

Cyclists are permitted to travel in a traffic lane on Botany Road and O’Riordan Street. The separated cycleway on Burke Road is to be maintained. Temporary diversion or closure for short periods of time may be required during the works, at which time a suitable alternative facility would be provided.

Traffic controllers are required on site to monitor and supervise the safe movements for trucks, pedestrian and cyclists past the median worksites, provide priority for emergency services or monitor access to the driveways opposite.

7.5.4 Public Transport

It is not anticipated that bus services in the vicinity of the study area will be impacted upon during construction of the proposal. Minor impacts may occur during off peak times resulting in reduced speeds however it is anticipated that buses would continue to use Botany Road at all times. In the scenario where bus movements will be impacted by construction works, the State Transit Authority will require notification.

7.5.5 Property Access

Minimising the impact of construction works on, and maintaining the amenity of, businesses in and around the GS2AC is a top priority for the City. Throughout the construction period, vehicle access will be maintained at all times to properties within the vicinity of the works.

Affected property access locations adjacent to the proposed work site includes:

- 13 CABS, 9-13 O’Riordan Street; and
- Perfect Auto Body, 22 O’Riordan Street.

Both properties have alternate access points which with minor adjustments, will be able to service both inbound and outbound movements. If required, staged construction within the affected area is a possibility. It is understood that the City will consult with both 13 CABS and Perfect Auto Body to come to an agreement regarding maintaining access to both businesses. As such, property access would be maintained at all times, and any impacts would be short-term.

7. PRELIMINARY CONSTRUCTION ASSESSMENT

7.6 Contractor requirements

7.6.1 Construction Traffic Management Plan

Prior to the commencement of construction, a detailed Construction Traffic Management Plan (CTMP) is to be prepared by the Principal Contractor. The CTMP would include the guidelines, general requirements and procedures to be used when activities or areas of work have a potential impact on existing traffic arrangements. The approval of the CTMP is to be sort by the appropriate authorities.

The CTMP, at a minimum, will address the following:

- consultation with the consent Authorities and relevant approvals
- the likely construction vehicle numbers and frequency
- approach and departure routes
- anticipated special out of hours or escorted deliveries
- parking access arrangements during construction
- construction work zone locations
- site entry and exit points
- proposed traffic control signage
- proposed traffic management at critical locations
- provision of acceptable pedestrian management measures.

The Principal Contractor will implement, update and maintain the CTMP throughout the construction period and until completion.

7.6.2 Staff Induction

All workers and subcontractors engaged on-site would be required to undergo a site induction. The induction should include permitted access routes to and from the construction site for all vehicles, as well as standard environmental, WHS, driver protocols and emergency procedures. Additionally, the Principal Contractor will organise regular scheduled site inductions as required)

Any workers required to undertake works or traffic control within the public domain would be suitably trained and covered by adequate and appropriate insurances. All traffic control personnel would be required to hold RMS accreditation in accordance with Section 8 of Traffic Control at Work Sites.

7.6.3 Contact Details of the Site Manager(s)

Contact details should be provided by the Principal Contractor as part of their CTMP for the project.

7.6.4 Occupational Health and Safety

Any workers required to undertake works or traffic control within the public domain shall be suitably trained and will be covered by adequate and appropriate insurances. All traffic control personnel will be required to hold RMS accreditation in accordance with Section 8 of 'Traffic Control at Worksites'.

7. PRELIMINARY CONSTRUCTION ASSESSMENT

7.7 Authority approvals

7.7.1 Sydney City Council

Bourke Street is controlled by the City, the following principles in relation to traffic control plans and road occupancy licences are outlined below:

- A "Traffic Control Plan" must be prepared by a suitably qualified RMS accredited work site traffic designer for all works that are carried out in or adjacent to a public road. The Plan must satisfy all the requirements of AS 1742.3 – 2002 and City of Sydney's Guide and Standard Requirements (attached in Appendix A).
- It is the sole responsibility of the Principle Contractor(s) to have in place and maintain traffic facilities, i.e. barricades, signs, lights, etc, at all times, day and night, seven (7) days a week for the duration of the works in accordance with the Plan.
- These traffic facilities must be installed and maintained by appropriately qualified RMS accredited work site traffic controllers.
- If it comes to the attention of the City that Traffic Control Devices are insufficient or inoperable (particularly in an after-hours situation), then the City may arrange to reinstate the Traffic Control Devices and recoup the costs from the Contractor.
- Any changes to the approved Traffic Control Plan must be approved by the City before implementation.
- The contractor will apply to the City to organise appropriate approvals for any partial or temporary road closures.
- All regional and local road closures require separate applications and approval from the City's Traffic Works Coordinator.
- Night works require approval from the City's Construction Regulation Unit (CRU) under a road opening permit and Road Occupancy Licences (ROL).

7.7.2 Road and Maritime Services/Transport Management Centre

O'Riordan Street and Botany Road are classified State Roads. Any impacts on these roads would require RMS approval / road occupancy licence (RMS Form D) and speed zone authorisation, in accordance with RMS NSW Transport Management Centre, Road Occupancy Manual, January 2012. A minimum of 10 working days for processing an application is required.

In accordance with the RMS manual, "The proponent has a responsibility to undertake a risk assessment of the activities described in the road occupancy application, per the Occupational Health and Safety Act 2000.

Some of the risks that may be taken into account are listed below. If any of these risks are applicable, please address them in "The Traffic Management Plan (TMP)" (page 9).

- Proximity of work site to live traffic.
- Speed and volume of traffic.
- Type of traffic (clear lane width is applicable to traffic flow).
- Noise levels (Office of Environment & Heritage has certain restrictions / requirements).
- Heavy weather and other delays to project programming.

Note: RMS assesses these risks from the viewpoint of potential impacts on traffic, not from the viewpoint of the proponents risk management. However, RMS will reject plans that are unprofessionally prepared or poorly presented.

7. PRELIMINARY CONSTRUCTION ASSESSMENT

As a minimum, applications for road occupancy would be submitted by the contractor and include:

- Brief details of the works to be undertaken.
- Design drawings of the works, where relevant.
- Program of the works.
- TCPs (Reference to RMS standard TCPs and/ or modified/ design TCP to suit particular works).
- Speed zoning authorisation application, as applicable.
- Nominated site contact person.
- Evidence of any agreement, where consultation with adjoining businesses residents and emergency service providers has been undertaken.

A copy of the ROL must be provided to the City.

7.8 Communications

The Principal Contractor(s) is to prepare a communication plan to manage and provide updates to businesses and residents on in the immediate vicinity throughout the works. Appropriate site, warning and wayfinding signage are to be provided as necessary and existing businesses and residents are to be notified of the upcoming works potentially impacting on access.

The Principal Contractor(s) is to provide a designated person(s) as a point of contact at all times prior to and during the works, which would permit residents and others to advise of any particular concerns and/or access requirements. This would be undertaken prior to the proposed road occupancy or speed restriction application, which would, by implication, require consultation and notifications in excess of 10 days prior to the proposed start of works.

A summary of the key notifications and timeframes follows:

- Notifying emergency services and relevant sections of the community and transport industry:

For works, which result in significant traffic disruption, such as stop/go operation and diversions, an appropriate advertisement would be placed in local newspapers 1 week prior to the works. The timing of the notice would be dependent on authority approvals / agreement that the works may proceed.

This may be supplemented by VMS notifying of upcoming works, where warranted.

Emergency service providers would be notified, once road occupancy approval is granted. The local Police Traffic Officer would be advised on the any traffic changes and speed zoning authorisations, in particular. For works with more significant traffic impacts, prior consultation with ambulance service, fire brigade and Police would be undertaken to confirm agreement and any particular requirements, before submitting the road occupancy application.

- Notifying residents and businesses affected by disruption to property access or by night works:

For works adjacent to roads but not affecting access, a letter box-drop at least three working days before the proposed date.

For works restricting access, requiring detours or side tracks, a letter box drop at least 5-10 working days before the proposed date.

Notifications would detail the dates and times of the proposed access restrictions and a designated contact.

7. PRELIMINARY CONSTRUCTION ASSESSMENT

- Lodging any road occupancy licence application and speed zoning authorisation, as early as possible (not less than 10 working days before the work) for any major works.

Noting, however, there may be exemptions for emergencies and hazards requiring an initial response, prior to emergency services arriving on site.

- Promptly advising the City/TMC of any unexpected delays or incidents affecting Bourke Street.

7.9 Implications of concurrent works

The implications of concurrent works in the local area during the proposed construction period, is to be confirmed by the Principal Contractor(s), once the works program / scheduling of roadworks is known.

8. CONCLUSION

This report has been prepared to assess the traffic safety and access issues affecting the construction and operation of the Green Square to Ashmore Connector (GS2AC), a new road to be located between Botany Road and Bowden Street in Alexandria, just south of Green Square Rail Station.

The GS2AC has long been considered a road-based option to improve local transport access to, and support the growth of, the Green Square Town Centre. Once complete, the GS2AC is predicted to improve multiple traffic and transport aspects within the vicinity of the site. The GS2AC provides an opportunity to significantly enhance pedestrian and cyclist safety and accessibility by providing two new signalised crossings at O'Riordan Street and Bourke Road, as well as the connection with the approved crossing at Botany Road.

The assessment has confirmed that the GS2AC is consistent with key State and local transport planning strategy and policy including Sustainable Sydney 2030. The design of the road also complies with relevant Australian standards such as Austroads and Roads & Maritime Services and Transport for NSW requirements.

The assessment has determined, in line with the objectives of the connector, that the GS2AC will fulfill its local access function without significantly impacting the north-south movements in the area (i.e. proposed intersections operate within capacity, and have minimal impacts to north-south through movements). To ensure GS2AC functions as a multi-modal east-west connection improving transport access to the Green Square Town Centre, without attracting broader cross-regional (east-west through) trips, a route strategy was developed. This includes restricting certain turning movements at each of the intersections.

The proposed separated two-way cycleway will be well linked to the surrounding local and strategic cycling network. The GS2AC cycleway is connected with the existing separated cycleways on Bourke Road and Bowden Street to the west, as well as the planned cycleway on Geddes Avenue to the east. As such, providing a vital link in the network.

Further approvals will be obtained from the RMS to enable the integration and approval of the proposed two signalised intersections as well as approvals from other utility agencies to provide key services within the GS2AC road reservation. Construction mitigation measures will also be implemented and will include the preparation of a traffic management plan.

The preparation of the Traffic and Transport Impact Assessment report has identified that the GS2AC will operate in a safe and efficient manner to improve accessibility to the proposed Green Square Town Centre.

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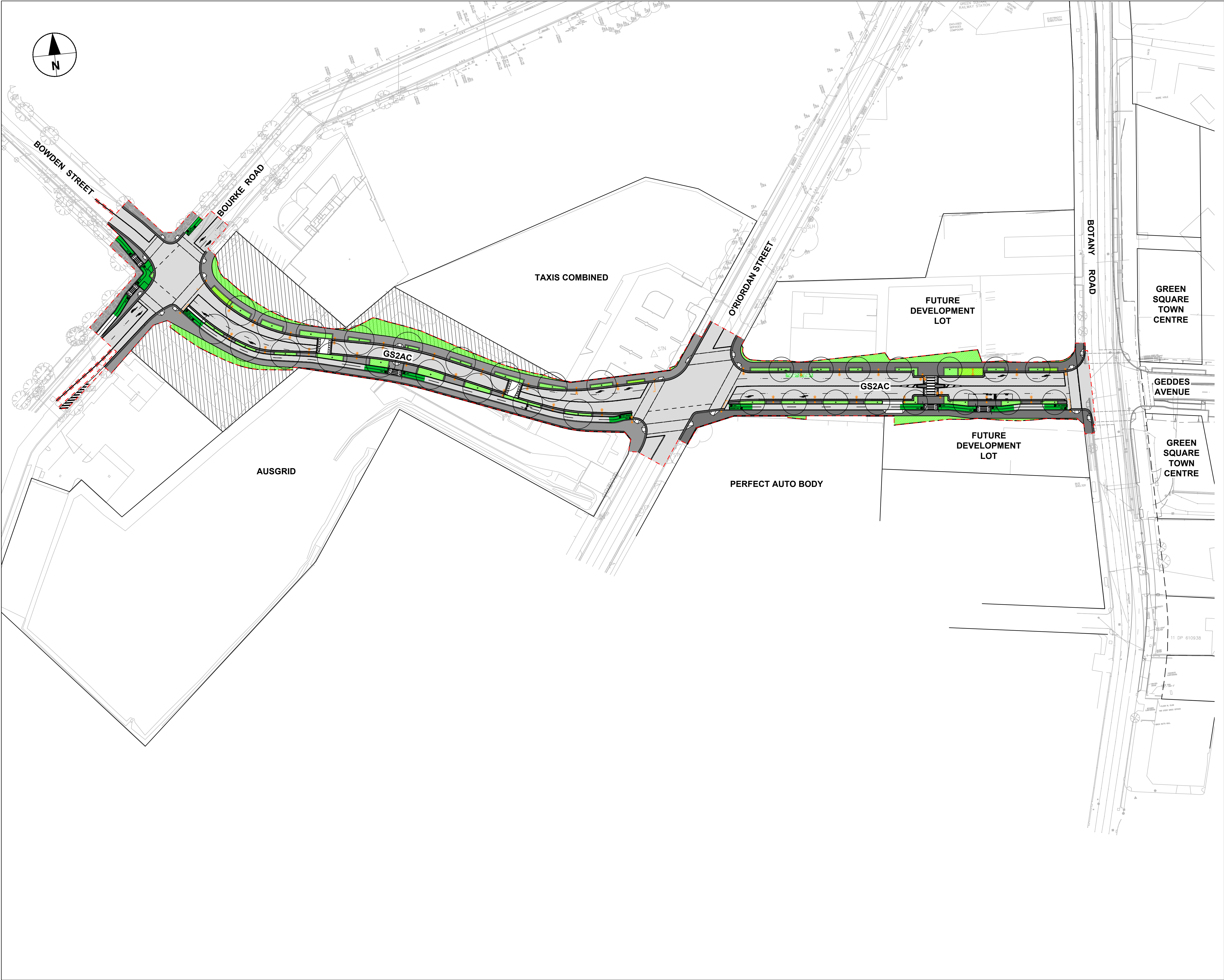
REFERENCES

The following references have been used as part of the preparation of this transport impact assessment for the Green Square to Ashmore Connector road

- Sydney Local Environmental Plan 2012 (Green Square Town Centre) 2013 (City of Sydney, 2012)
- Sydney Local Environmental Plan 2012 (City of Sydney, 2012)
- Green Square Town Centre Town Centre Development Control Plan (City of Sydney, 2012)
- Sydney Development Control Plan 2012 (City of Sydney, 2012)

APPENDIX A GS2AC CONCEPT DESIGN

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PROJECT

GREEN SQUARE
TO ASHMORE
CONNECTOR

CLIENT



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LEGEND

- EXTENT OF WORKS
- CONCRETE UNIT PAVING
- CONCRETE PAVING
- FLEXIBLE ROAD PAVEMENT
- CYCLEWAY ROAD PAVEMENT
- SOFT LANDSCAPE
- RAIN GARDEN
- RESIDUE LOT
- PROPOSED STREET TREE
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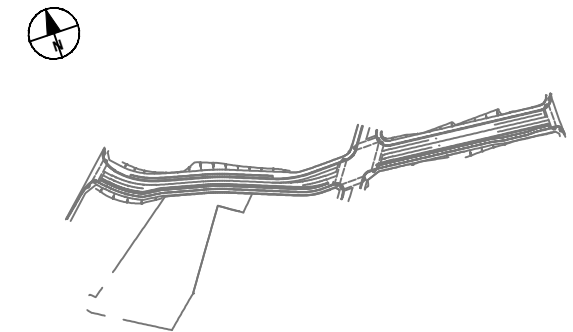
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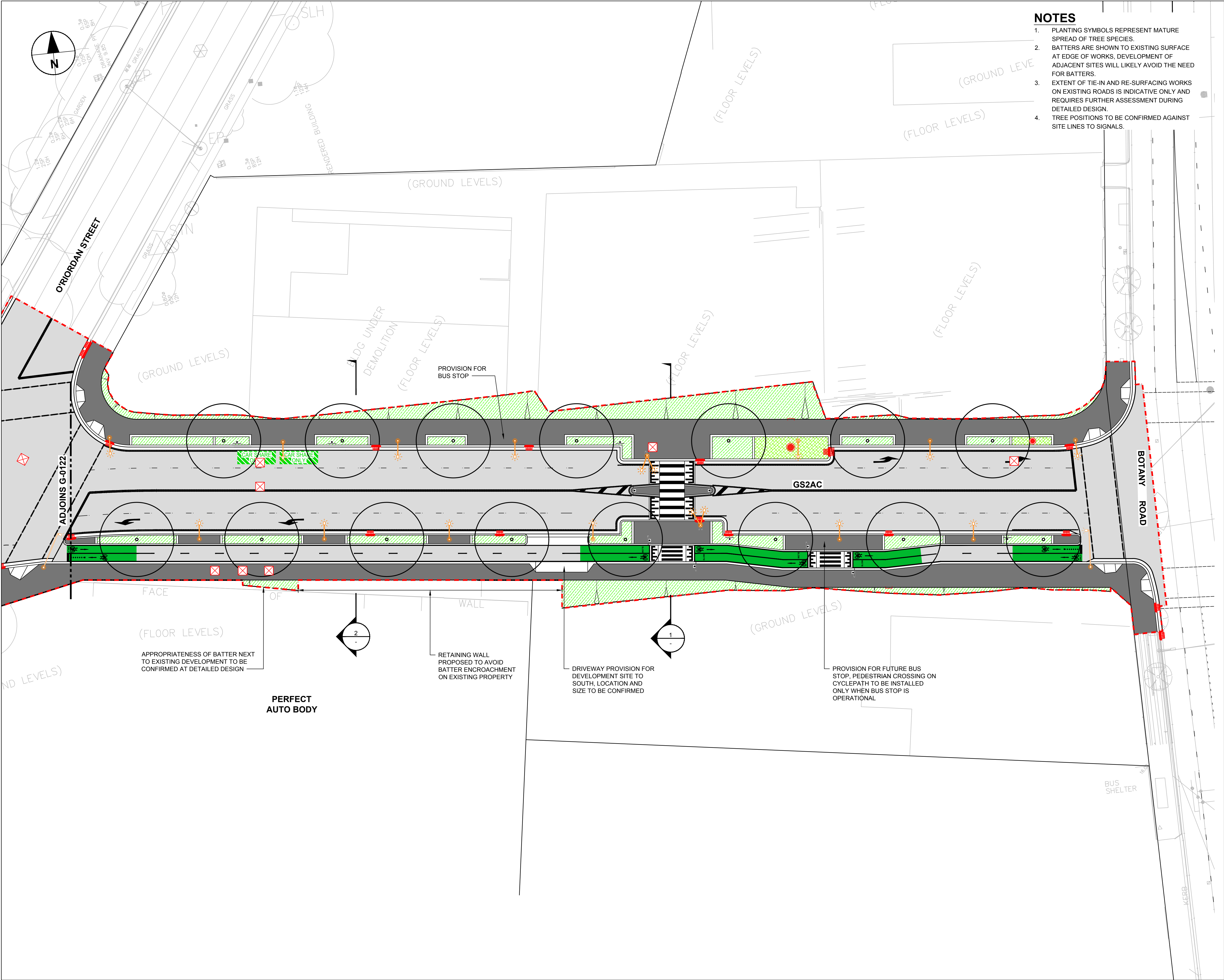
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- NOTES**
1. PLANTING SYMBOLS REPRESENT MATURE SPREAD OF TREE SPECIES.
 2. BATTERS ARE SHOWN TO EXISTING SURFACE AT EDGE OF WORKS, DEVELOPMENT OF ADJACENT SITES WILL LIKELY AVOID THE NEED FOR BATTERS.
 3. EXTENT OF TIE-IN AND RE-SURFACING WORKS ON EXISTING ROADS IS INDICATIVE ONLY AND REQUIRES FURTHER ASSESSMENT DURING DETAILED DESIGN.
 4. TREE POSITIONS TO BE CONFIRMED AGAINST SITE LINES TO SIGNALS.

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PROJECT

GREEN SQUARE TO ASHMORE CONNECTOR

CLIENT

CITY OF SYDNEY

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- LIGHTING COLUMNS
- DRAINAGE PITS

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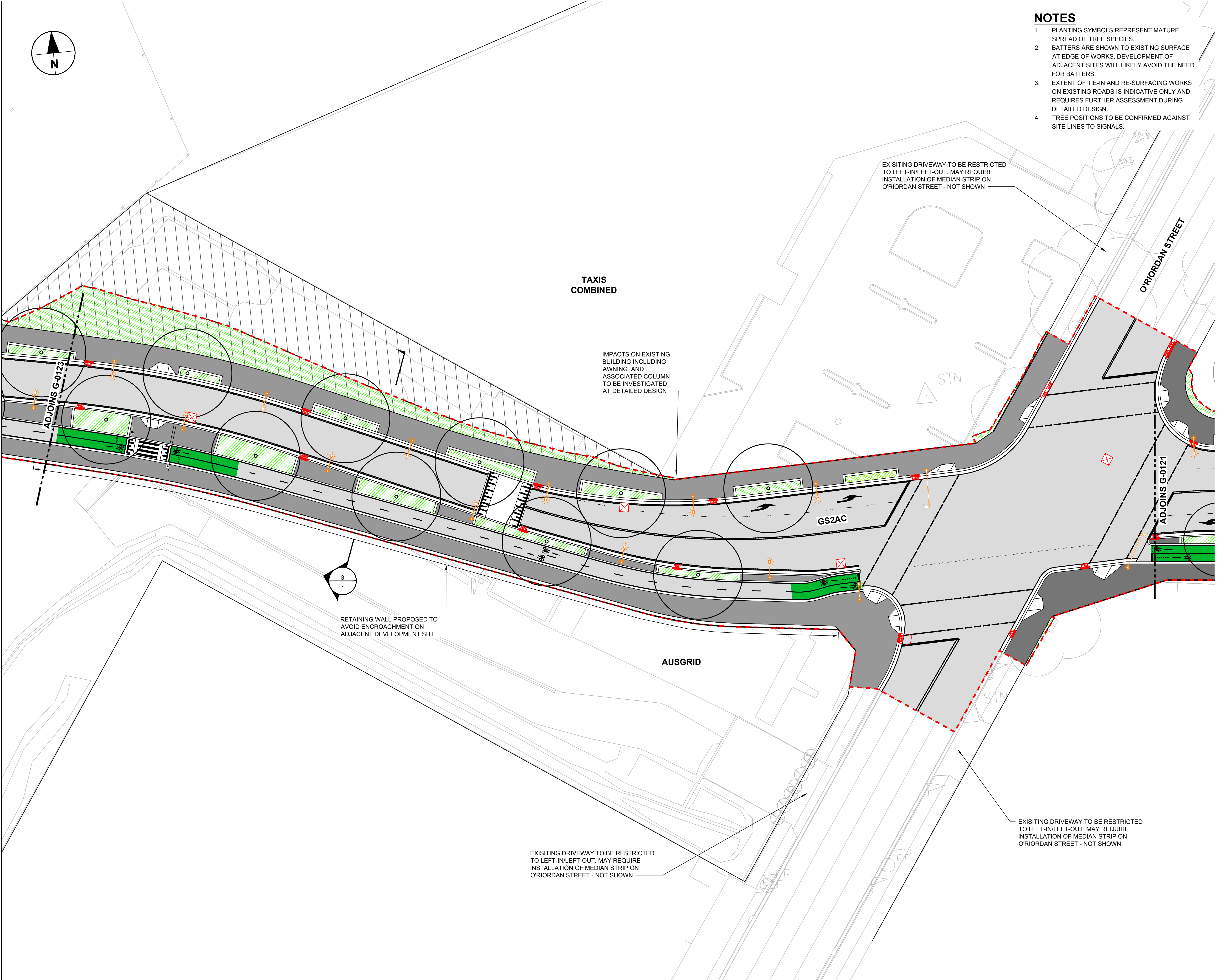
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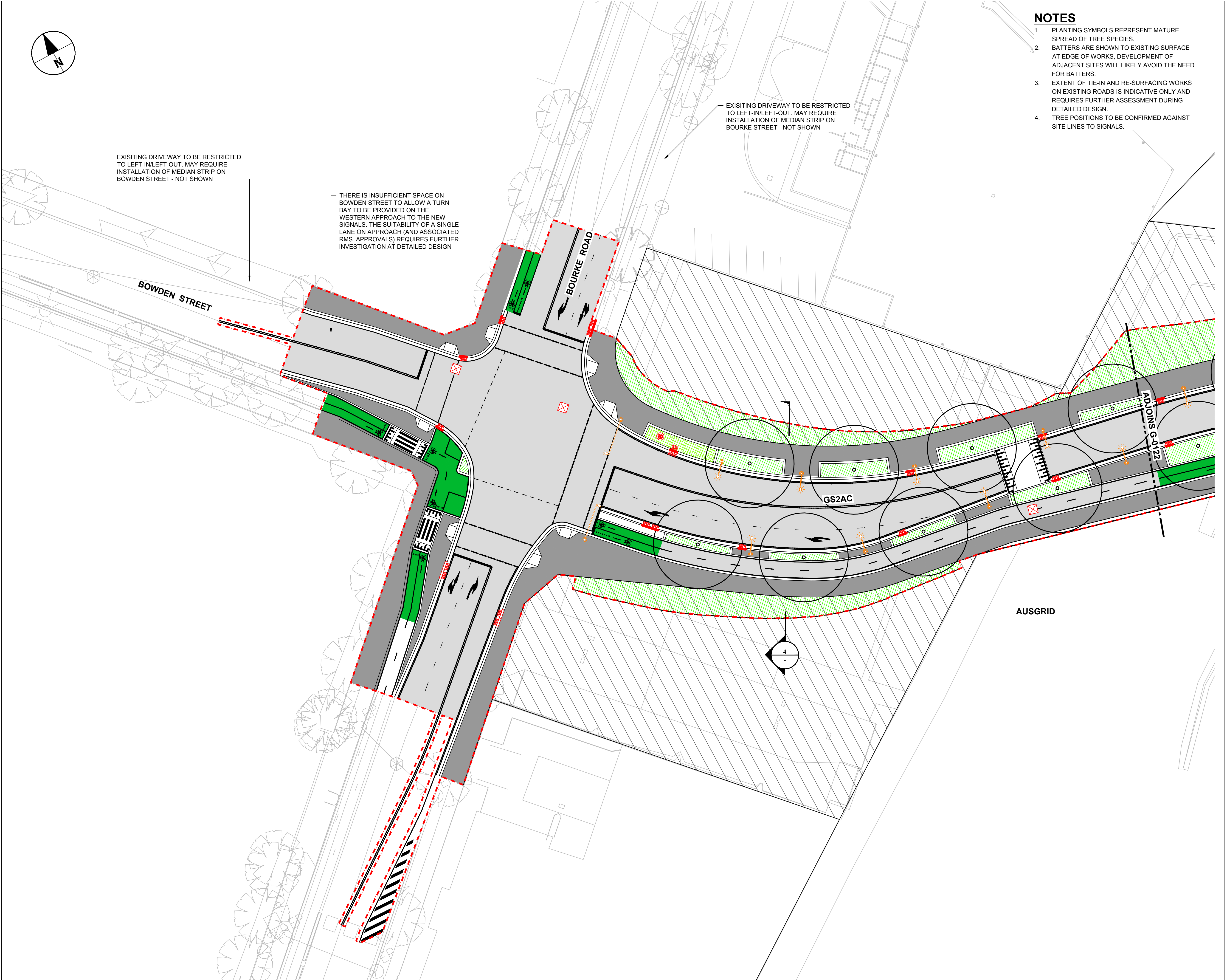
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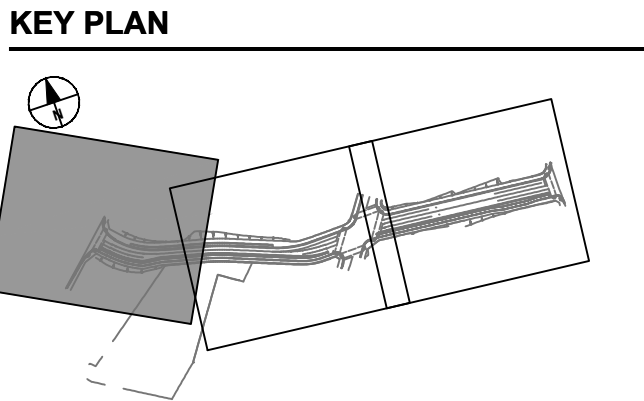
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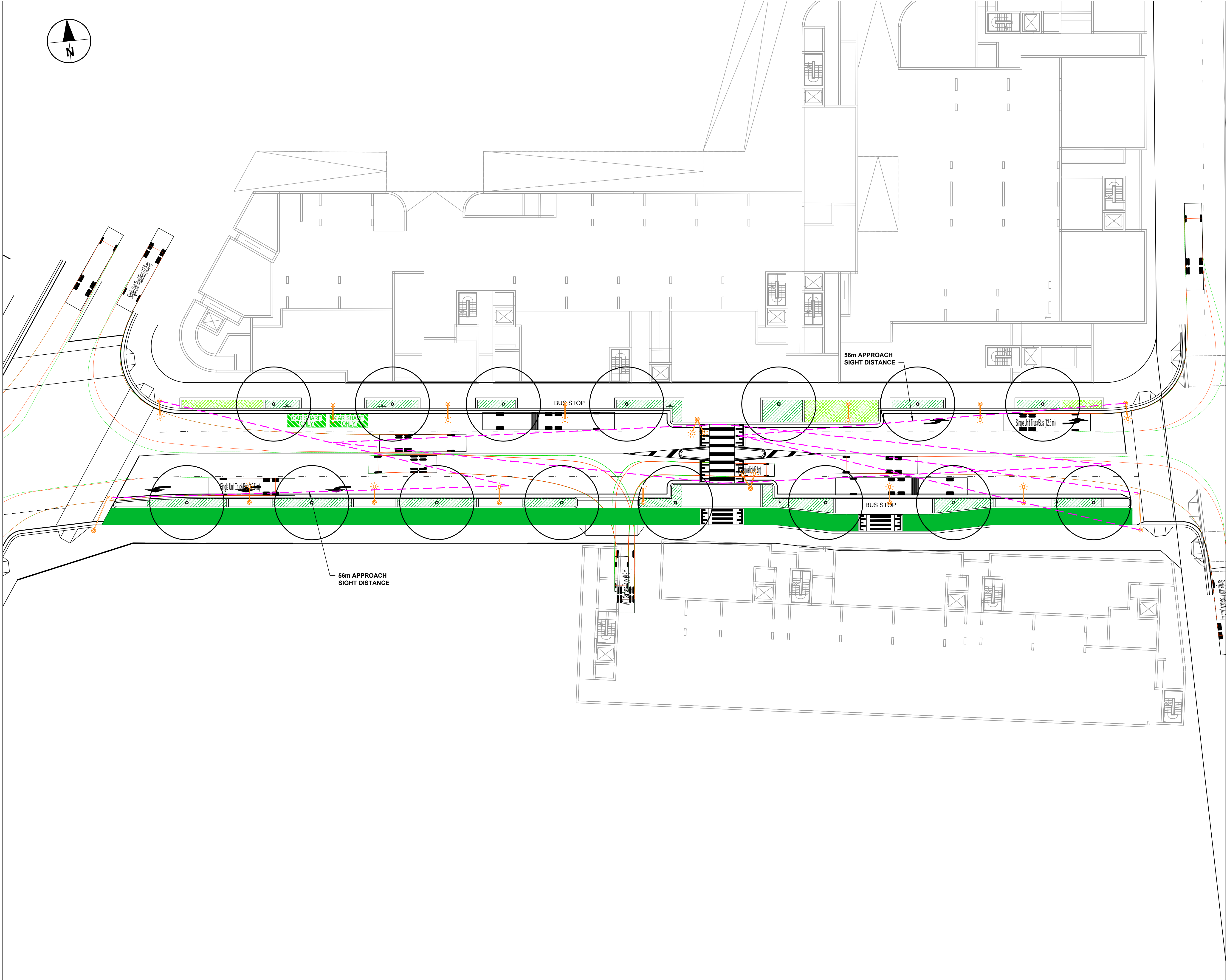
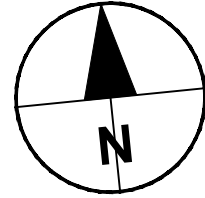
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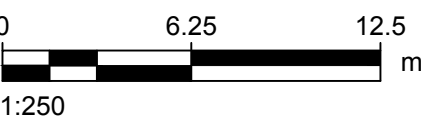
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- PROPOSED TREE
- CYCLEPATH

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 $R_T = 1.5s$ SSD = 56m

$R_T = 1.5s$ ADOPTED BASED ON GS2AC SEEKING
TO ACHIEVE "ALERT DRIVING CONDITIONS"
BEING BUILT-UP AREA, RESTRICTED LOW SPEED
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GEOMETRIC DESIGN SECTION 5.2 SIGHT
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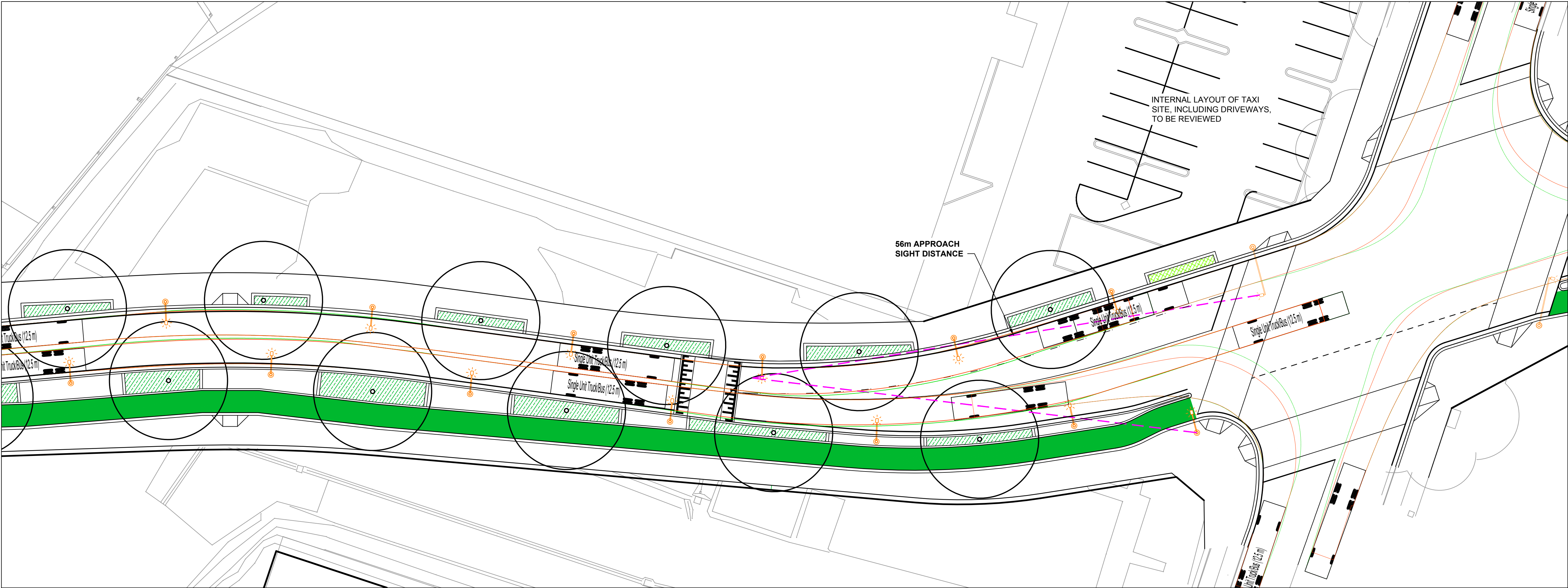
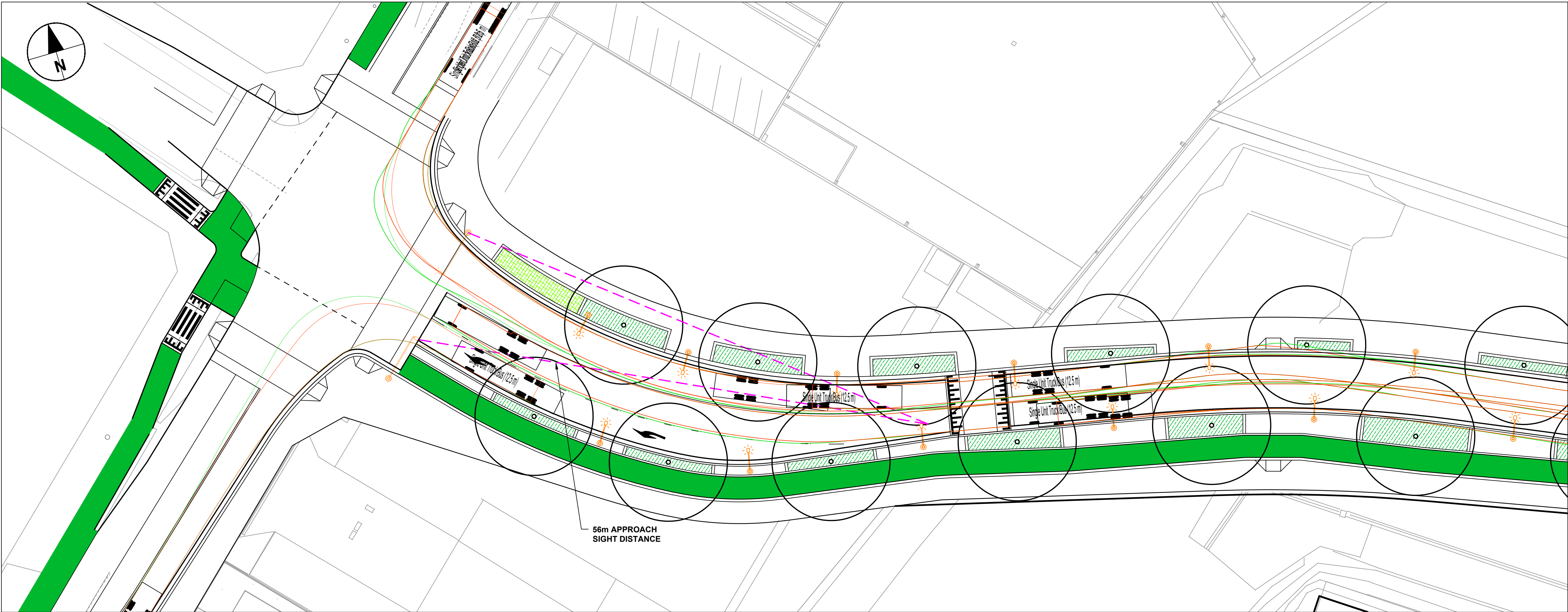
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TOWN CENTRE
EIPD - PHASE 02

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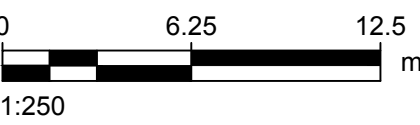
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CONNECTOR
EASTERN LAYOUT
OPTION 4 PLAN

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APPENDIX B GS2AC ROUTE STRATEGY

Green Square to Ashmore Connector Route Strategy Assessment



Green Square to Ashmore Connector Route Strategy Assessment

Client: City of Sydney Council

ABN: 22 636 550 790

Prepared by

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Quality Information

Document Green Square to Ashmore Connector Route Strategy Assessment

Ref 60300384

Date 17-Nov-2017

Prepared by Ben Krygsman

Reviewed by Andy McGregor

Revision History

Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
A	03-Apr-2017	Draft	Rob Mason Associate Director	
B	17-Nov-2017	Final	Rob Mason Associate Director	

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Executive Summary

The City of Sydney (CoS) is currently undertaking the project delivery of Green Square Town Centre (GSTC) Essential Infrastructure and Public Domain (EIPD) works which are located in the City of Sydney Local Government area. The Green Square Town Centre is the core of the broader Green Square Renewal Area which involves the development of a large range of new infrastructure including, key roads, transport and community amenities to service a proposed 50,000 resident population and 20,000 workforce over a 20 year period up to 2030.

The proposed Green Square to Ashmore Connector (GS2AC) forms a significant part of the Green Square transport infrastructure strategy and will provide access for residents from the broader renewal area and the adjacent Ashmore Precinct to public amenities such as the Town Centre, library and aquatic centre. The project will provide a new east-west link between Bourke Road and Botany Road (linking Bowden Street to Geddes Avenue, currently under construction) and includes the introduction three signalised intersections, just south of the Green Square rail station. The road will provide one lane in each direction as well as a separated bi-directional cycleway.

AECOM was previously commissioned by the City of Sydney to assist in the preparation of the Traffic and Transport Impact Assessment (TTIA) for the GS2AC which was produced in 2015 and was based on the Green Square Town Centre Paramics model. Since then, it is understood that the upgrade of the intersection of Bourke Street / Botany Road and O'Riordan Street to the 'H-intersection' design has been delayed, impacting the traffic context of the GS2AC.

The purpose of this report is to inform the proposed concept design of the GS2AC and the proposed turning movements at the three signalised intersections as well as develop a route strategy. The route strategy has identified the main routes the GS2AC will generate as well as advising on turning restrictions that may help to mitigate strategic trips 'rat-running' through the network and focus the GS2AC's function of a local east-west connector road.

This report has been drafted using information contained in the previous Paramics modelling used in the TTIA and preparation of the report has involved consultation with Roads and Maritime Services (RMS) as well as key internal divisions within the City of Sydney. The modelling involved the use of SIDRA INTERSECTION (SIDRA) traffic modelling to assess the 2021 AM and PM peak periods and to identify potential future year capacity restraints.

The report has identified the GS2AC will operate efficiently in the 2021 future year and will serve its function of improving accessibility for all road users to the proposed Green Square Town Centre. Furthermore, it is likely that the GS2AC will not impact on the existing road network, namely the state roads of Botany Road and O'Riordan Street which are already severely congested during the peak periods. Potential future restraints have been identified as the right turn out of Geddes Avenue and southern approach on Bourke Road, however the congestion along the state roads will limit the volume of traffic accessing the GS2AC and therefore is likely to encourage the local use of the GS2AC.

1.0 Introduction

1.1 Background

AECOM has been commissioned by the City of Sydney (CoS) to provide a preferred vehicle route strategy and traffic assessment of the Green Square to Ashmore Connector (GS2AC) in context of the broader CoS access strategy for Green Square. The GS2AC seeks to provide a localised connection between Bourke Road and Portman Street as part of the Green Square Renewal Area. The GS2AC would introduce an eastern arm at the signalised intersection of Bowden Street / Bourke Road as well as additional signalised intersections at the O'Riordan Street and Botany Road corridors. The proposed alignment of the GS2AC corridor is shown in Figure 1.1.

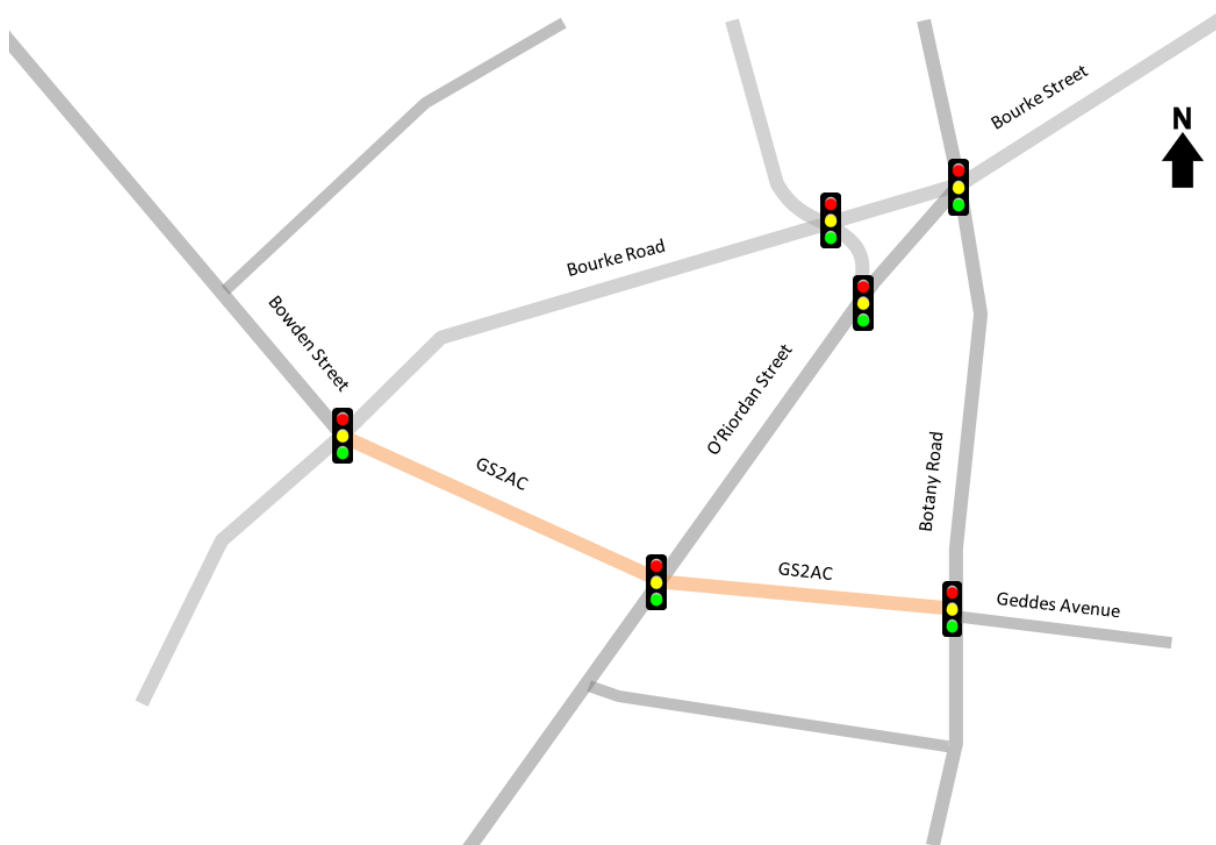


Figure 1.1 Site Overview and proposed GS2AC

The purpose of this report is to assess the proposed turning movements associated with the GS2AC and develop a route strategy for the GS2AC in consultation with Roads and Maritime Services (RMS) and do this in the context of the broader CoS access strategy for Green Square.

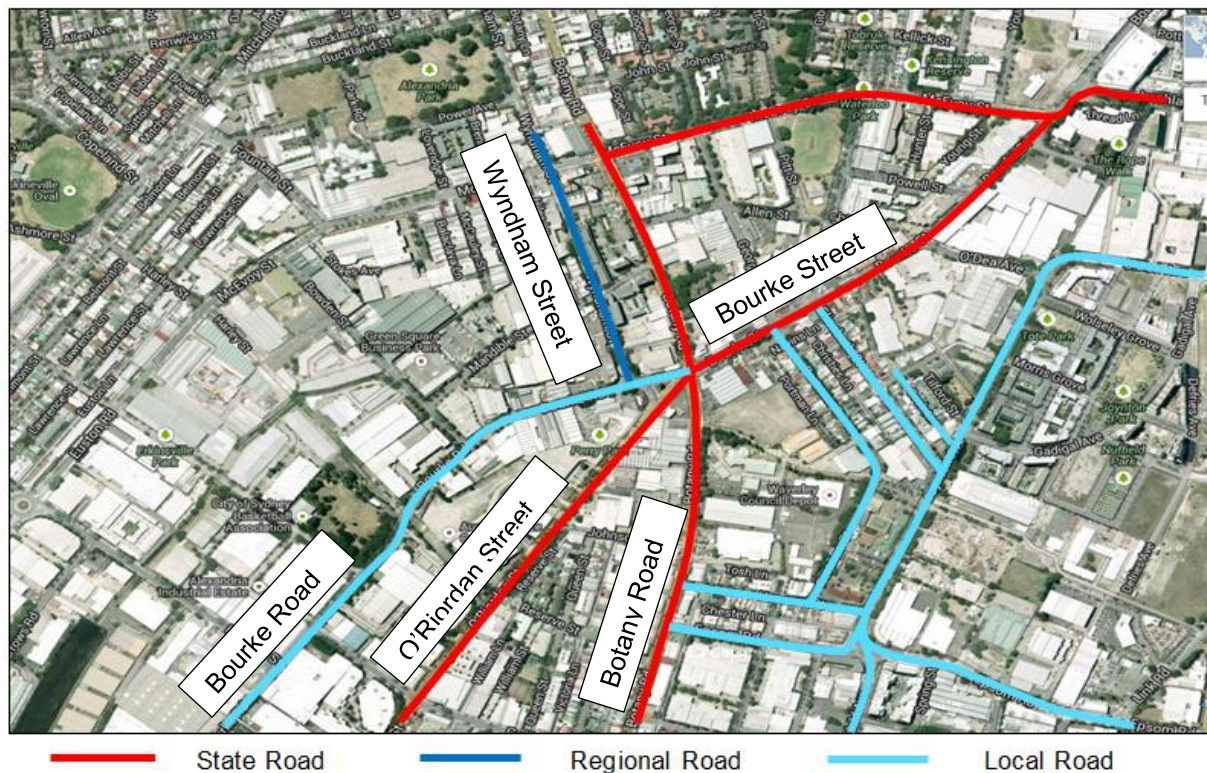
In order to evaluate the proposed design and permitted movements of the GS2AC, traffic modelling was carried out using SIDRA INTERSECTION (Version 7.0) software for the proposed opening 2021 future year and also to assess any future capacity restraints of the three proposed signalised intersections.

2.0 Existing Traffic and Transport Conditions

2.1 Existing Conditions

The GS2AC is to be located between Bourke Road and the proposed Geddes Avenue, intersecting with O’Riordan Street. Figure 2.1 below outlines the classification of the surrounding road network.

Figure 2.1 Classification of Road Network



2.1.1 Botany Road

Botany Road is a national freight corridor and forms part of a route linking Sydney CBD with Sydney Airport and Port Botany terminals. Botany Road provides four lanes of undivided carriageways with two traffic lanes in each direction to accommodate high volumes of traffic during the peak periods. The corridor has been identified as a key transport corridor with plans to develop a Botany Road transit corridor noted in City of Sydney Council's 'Sustainable Sydney 2030'. During peak periods, clearway restrictions are effective for the peak directional flow along Botany Road. In the vicinity of the study area Botany Road is signposted at 50km/h.

2.1.2 O’Riordan Street

O’Riordan Street provides a similar level of functionality to Botany Road in that it provides an arterial connection from central/eastern Sydney to Sydney Airport and Port Botany. In the vicinity of the study area O’Riordan Street is signposted at 60km/h. O’Riordan Street is characterised by two lane approach and departure lanes in both directions of travel. During AM and PM peak periods, clearway restrictions are in place with limited kerbside parking being effective outside of the peak periods.

2.1.3 Bourke Road

Bourke Road is a collector road, aligned parallel to O’Riordan Street and provides access to commercial and industrial properties along the corridor as well as adjacent roads. Between O’Riordan Street and Gardeners Road, traffic is accommodated on a single traffic lane in each direction with a

segregated bicycle lane along the western side of the road and kerbside parking along the eastern side of the corridor. Bourke Road has a sign posted speed of 50km/hr.

2.1.4 Population and Employment

Over the next 20 year time period the population and employment numbers are anticipated to increase substantially in the Green Square and City South District. The projected population is anticipated to increase by approximately 35,000 people to 58,000, an increase of almost 150 per cent. (Population and Household Forecasts, April 2013). The gross floor area of commercial and residential land uses is projected to increase by over 200,000m². This development will place increasing pressures on the road network surrounding and including the study area.

2.2 Traffic Volumes and Patterns

A comprehensive suite of automatic traffic count (ATC) and intersection turning count surveys were completed in December 2016 to understand and analyse existing traffic volumes and patterns within the study area. Specifically, ATC tubes recorded classified hourly traffic volumes at the following three locations identified below (see Figure 2.2) over a one week survey period:

- Site 1: Bourke Road (north of Bowden Street) - ATC
- Site 2: O’Riordan Street (north of Johnson Street) - ATC
- Site 3: Botany Road (north of Johnson Street) - ATC
- Site 4: Bourke Street / Collins Street –Turning Movement Count
- Site 5: O’Riordan Street / Collins Street –Turning Movement Count
- Site 6: Botany Road / O’Riordan Street –Turning Movement Count

Figure 2.2 ATC and turning movement count locations (Source: Google Maps, modified by AECOM, 2017)

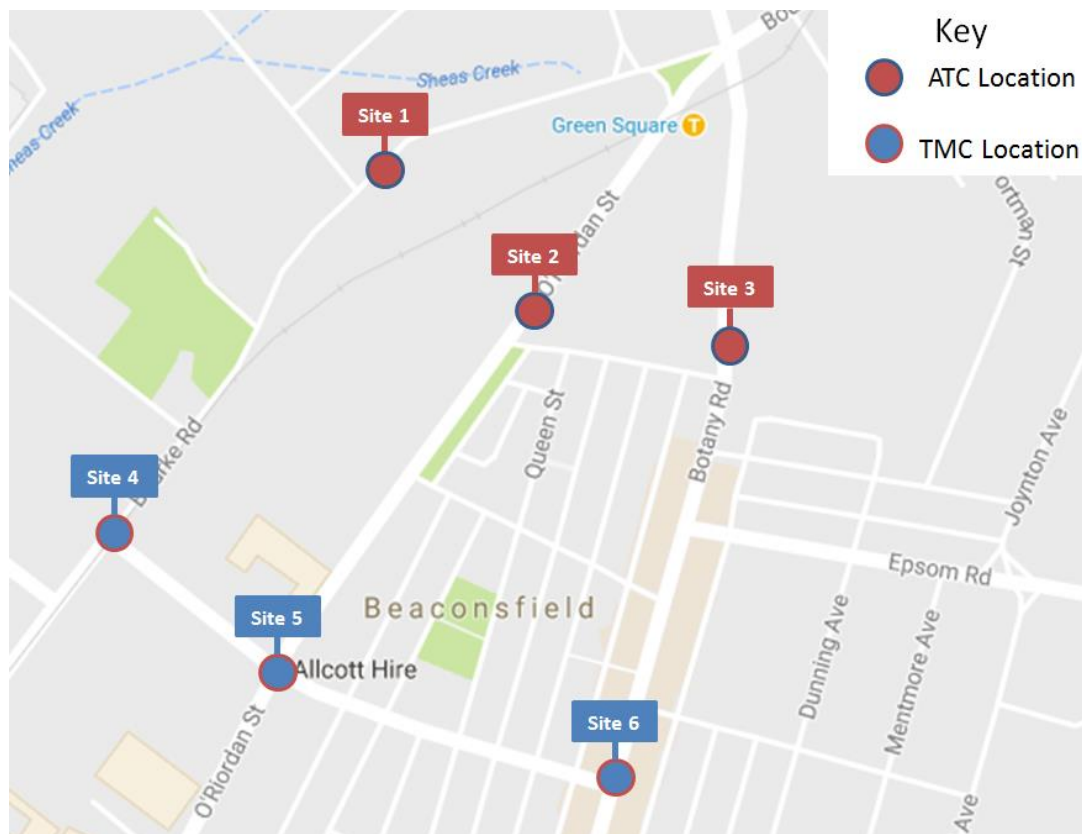


Table 2.1 to Table 2.3 below show details of the average peak and daily traffic volumes recorded at each of the three ATC locations, by direction and in combination. In addition, each table displays traffic volumes and patterns for an average daily and weekly profile based on the following key statistics:

- Morning AM peak: all vehicle traffic volume recorded between 8:00-9:00am
- Evening PM peak: all vehicle traffic volume recorded between 5:00-6:00pm
- Average Weekday Traffic (AWT) volume: daily traffic volume derived from 24 hour period traffic counts recorded between Monday and Friday during the survey peak

Northbound		Southbound		Two-way	
AM Peak:	389	AM Peak:	450	AM Peak:	839
PM Peak:	482	PM Peak:	227	PM Peak:	709
AWT:	6,425	AWT:	4,887	AWT:	11,312

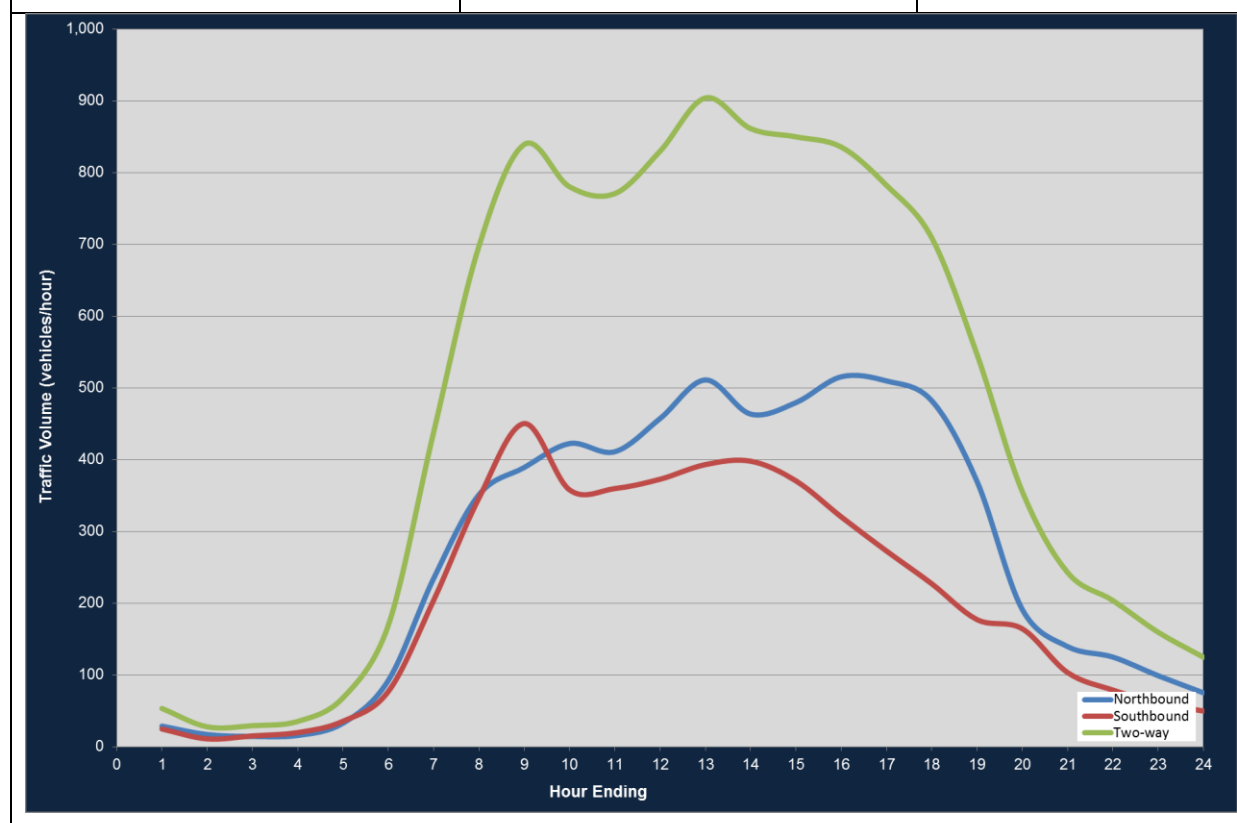


Table 2.1 Site 1: Bourke Road north of Bowden Street

Table 2.1 above shows the patterns and volumes for Bourke Road north of Bowden Street. The key findings for the existing traffic volumes are as follows:

- The two-way AWT volume on Bourke Road show a relatively “flat” profile, with an unusually large midday peak which indicates that the road accommodates travel demand outside of the commuter peaks. This differs from the other sites which have distinctive AM and PM peaks.
- The northbound AWT of 6,425 is slightly larger than the 4,887 southbound AWT. Interestingly, during the morning peak, the southbound traffic is higher than northbound traffic which suggests that more vehicles are heading towards the CBD in the evening. This is clearly shown in the above graph.

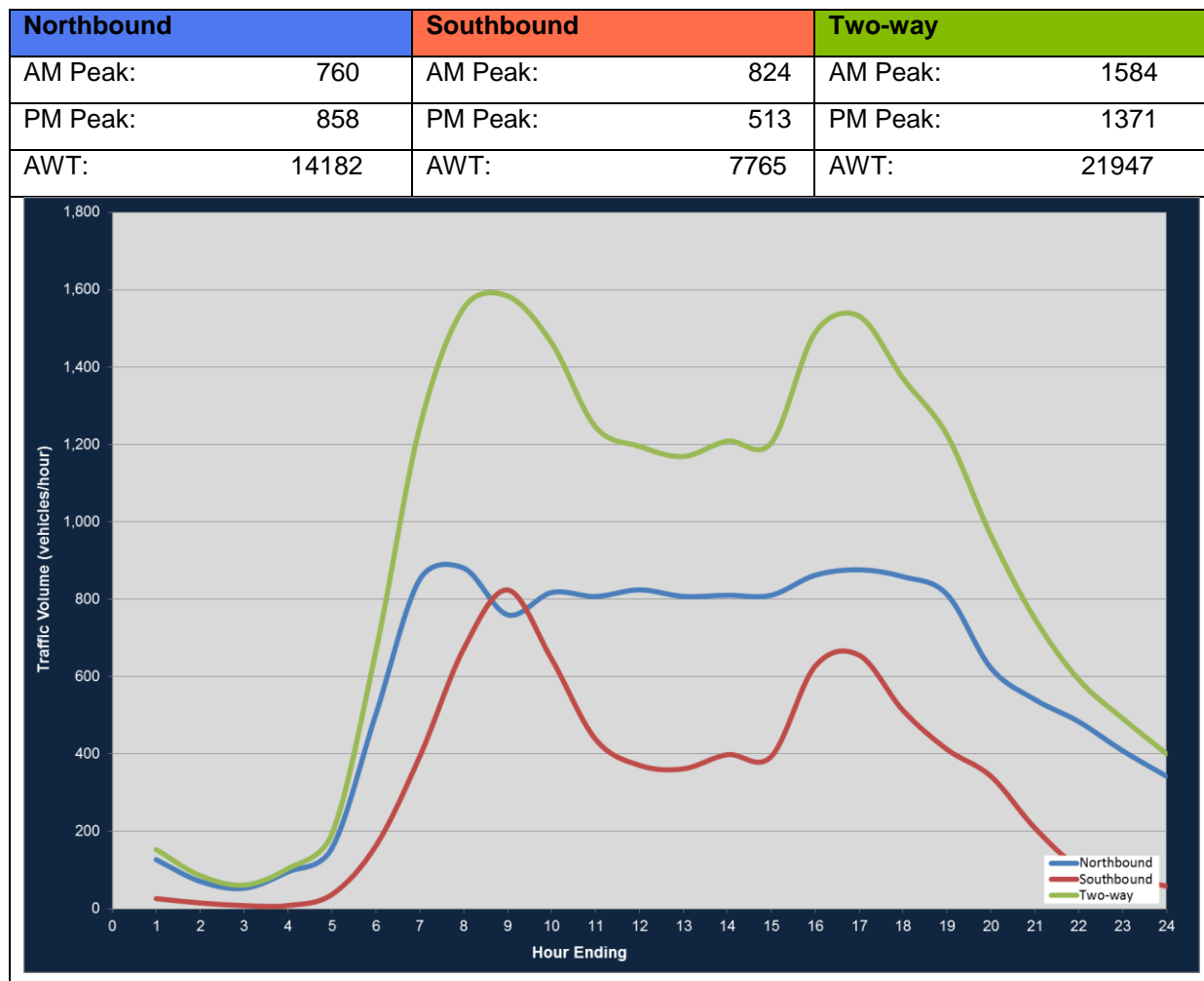


Table 2.2 Site 2: O’Riordan Street north of Johnson Street

Table 2.2 above shows the patterns and volumes for O’Riordan Street north of Johnson Street. The key findings for the existing traffic volumes are as follows:

- The AWT volumes for northbound and southbound recorded on O’Riordan Street were 14182 and 7765 respectively, indicating a significant bias in flow.
- Importantly, the graphic shows a fairly “flat” profile of traffic throughout the day for the northbound direction which shows that traffic volumes on O’Riordan Street are consistent throughout the average weekday, both during the conventional morning and evening commuter peaks. This is likely because O’Riordan Streets function as an alternative freight corridor, serving both Sydney Airport and Port Botany and is likely to be at or close to capacity throughout the day.

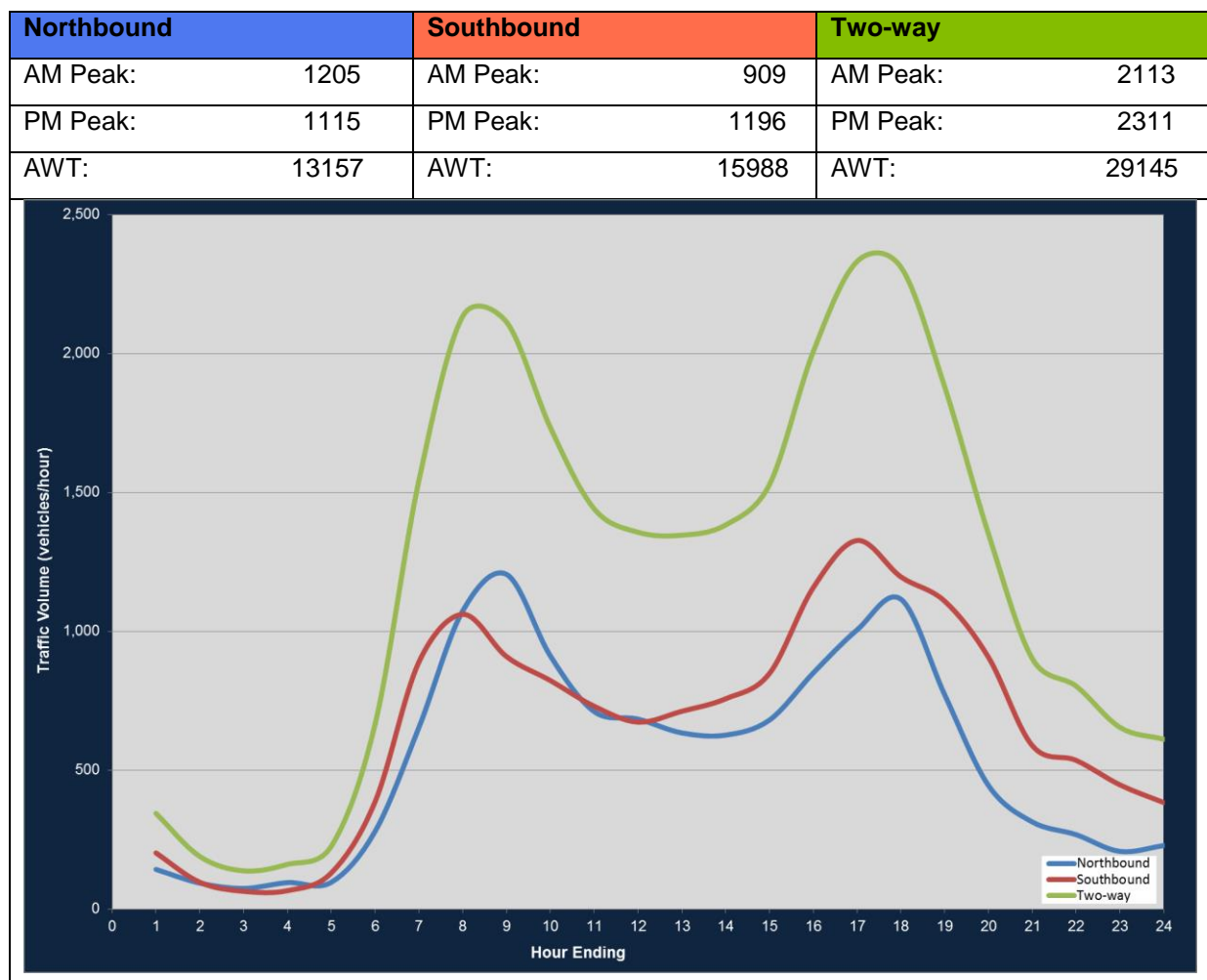


Table 2.3 Site 1: Bourke Road north of Bowden Street

Table 2.3 above shows the patterns and volumes for Botany Road north of Johnson Street. The key findings for the existing traffic volumes are as follows:

- When compared to the other sites, the AWT of 29,145 is significantly larger, reinforcing the strategic significance of Botany Road as a major freight corridor to Port Botany and Sydney Airport as well as connecting the CBD to southern suburbs.
- The shape of the graphic indicates that the traffic demand along Botany Road is heavily influenced by commuter peaks. This is further demonstrated in the tidal direction of the main flow, with the majority of traffic switching from an AWT of 1205 northbound to 1196 southbound in the PM peak.

2.2.1 AWT Screenline Analysis

Figure 2.3 shows the location of the 3 ATC sites which form a screenline, a theoretical boundary to collectively analyse directional and two way traffic volume outputs from the available data to capture the north-south movements along the three major roads in the study area.

Figure 2.3 Screenline Location

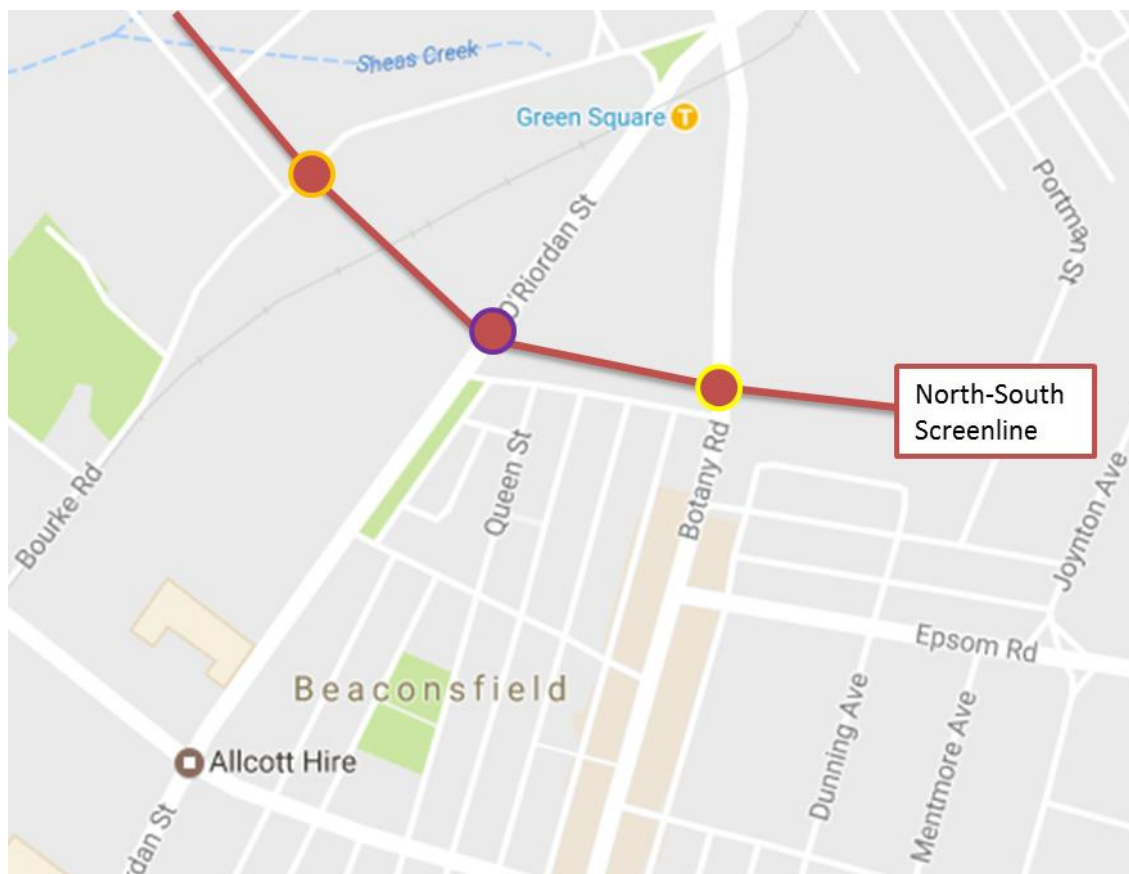


Table 2.4 presents the AWT volumes for individual screenline locations and provides screenline proportions (SL%) for each road location. The screenline proportions help determine the proportion of north-south travelling vehicles in the study area travelling on the three major roads that will run through the GS2AC.

Road Location	2016 - AM Peak (1 hour)						2016 - PM Peak (1 hour)					
	Northbound		Southbound		Two-way		Northbound		Southbound		Two-way	
	Volume	SL %	Volume	SL %	Volume	SL %	Volume	SL %	Volume	SL %	Volume	SL %
Bourke Road	389	17%	450	21%	839	18%	482	20%	227	12%	709	16%
O'Riordan Street	760	32%	824	38%	1,584	35%	858	35%	513	26%	1,371	31%
Botany Road	1,205	51%	909	42%	2,114	47%	1,115	45%	1,196	62%	2,311	53%
Total	2,354		2,183		4,537		2,455		1,936		4,391	

Table 2.4 Screenline Analysis Results

As can be seen from the screenline results in Table 2.4, a majority of vehicles currently travel on Botany Road with 47% and 53% of total traffic in the AM and PM peak respectively. The AM and PM two-way volumes are similar; however, the total number of northbound vehicles is consistently larger than the southbound direction.

Bourke Road only accounts 18% and 16% of the total AM and PM volumes. This is because Bourke Road currently facilitates one lane in each direction and therefore has less capacity when compared to the two lanes that O'Riordan Street and Botany Road offer.

2.2.2 Turning Movement Count Analysis

In conjunction with the ATC surveys, turning movement counts were also conducted along Collins Street at the signalised intersections of Bourke Road, O’Riordan Street and Botany Road. The AM and PM peak total volumes can be found in Figure 2.4 and Figure 2.5 below.

Figure 2.4 AM Peak Volumes

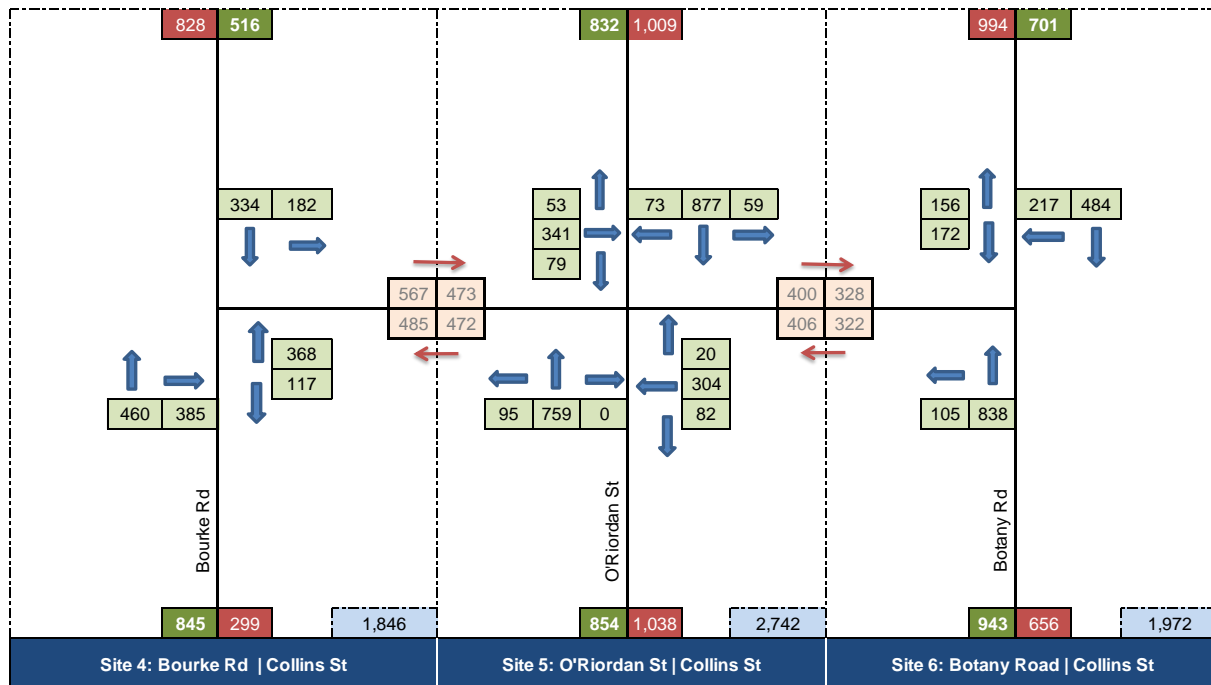
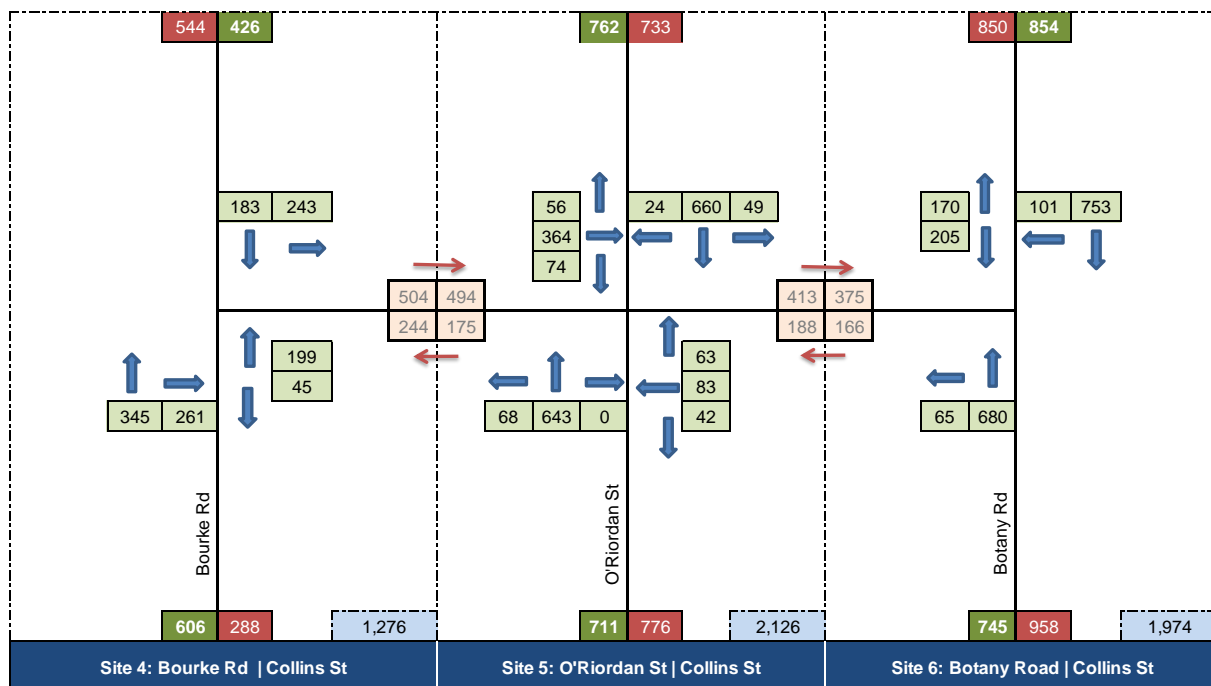


Figure 2.5 PM Peak Volumes



Collins Street provides both local and regional trips with an east-west connection between the major north-south roads of Bourke Road, O’Riordan Street and Botany Road. Importantly, it also facilitates traffic movements between major traffic corridors of the Princes Highway to the West with Southern Cross Drive which connects to both the M1 and M5 motorways.

2.2.3 Site Observations / Traffic Conditions

Site visits were conducted during both the AM and PM peak periods on the 1st February 2017 to assess existing conditions within the traffic network and to gain an understanding of travel routes and patterns. The following observations were noted:

AM Peak

The priority intersection of Bourke Road and Bowden Street was observed to have periods of reduced traffic volumes as seen in Figure 2.6 below.

Figure 2.6 Priority intersection of Bowden Street and Bourke Road



Bicycle volumes were observed to be low. The current design presented safety issues for cyclists with site lines of vehicles on Bourke Road to the cycle lanes restricted by queuing vehicles on Bowden Street

Sydney Water construction works on Huntley Street have resulted in the extended closure of Huntley Street westbound. This has caused traffic to re-route on to surrounding local roads, namely Maddox Street. Figure 2.7 below shows the eastbound queue extending from the priority intersection of Maddox Street and Bourke Road. Furthermore, it is likely that traffic also used Bowden Street to avoid the congested network surrounding Huntley Street.

Figure 2.7 Priority intersection of Maddox Street and Bourke Road



At the signalised intersections of Bourke Road / Collins Street and Bourke Road / Huntley Street, the dog leg eastbound movement from Huntley Street to Collins Street was observed to facilitate a high volume of vehicles. This would often lead to the queue extending back in to Huntley Street and ineffective green time. This is shown in Figure 2.8.

Figure 2.8 Northbound queue at Collins Street / Bourke Road intersection



Congested conditions were observed along O’Riordan Street in the northbound direction. Figure 2.9 below shows the northbound queue from the Bourke Road/ O’Riordan Street / Botany Road intersection.

Figure 2.9 Extensive queues along O’Riordan Street in the northbound direction



The intersection of Epsom Road and Botany Road was observed to experience congested conditions. The queue for the right turn movement from Botany Road in to Epsom Road extended back as far as Collins Street.

Minimal traffic was observed on Reserve Road and Johnson Street which could be used as an eastbound rat run to avoid congestion on Collins Street for the East-West movement.

PM Peak

As mentioned previously, the closure of Huntley Street in the westbound direction caused the rerouting of vehicle movements within the study area. This was particularly the case when periods of congestion were observed on alternate routes such as along Maddox Street and Bowden Street. Figure 2.10 illustrates the congestion observed during the PM peak. It is envisaged that the re-opening of Huntley Street would significantly increase the capacity of the road network for the west to east movements.

Further congestion was also observed in the northbound direction on O’Riordan Street that was similar to the AM peak. This is because of the high volumes of competing movements at the intersection of Bourke Road / Botany Road and O’Riordan Street.

Because of the northbound queueing that forms on O’Riordan Street, vehicles were observed to use Johnson Street as alternate route to transfer on to Botany Road where delays were shorter than those experienced on O’Riordan Street.

Figure 2.11 below demonstrates the extensive queueing that was observed along Botany Road in the southbound direction, directly upstream of the intersection with Epsom Street.

Figure 2.10 Congestion experienced on Maddox Street in the westbound direction



Figure 2.11 Queueing along Botany Road southbound



The left turn movement at the Collins Street / Botany Road intersection produced a queue that extended back approximately 10 vehicles. A large majority of these left turning vehicles would then make the immediate right turn at the Epsom Street. This “dog-leg” movement serves a major east-west movement during both peak periods.

To avoid delays associated with the Collins Street / Botany Road intersection, a number of vehicles wishing to travel west would turn further upstream on the intersection at Beaconsfield Street and then turn left on to Collins Street.

Epsom Street had high volumes of right turners in to Botany Road. Vehicles are most likely to originate from Lenthall Street or Southern Cross Drive as an alternative westbound route to Lachlan Street and O'Dea Avenue which is congested during the PM peak period. An example of the queues that formed on Epsom Street for the right turn is shown in Figure 2.12.

Figure 2.12 Queueing along Epsom Road westbound



3.0 The Proposal

The GS2AC will operate as an east-west link between Bowden Street and Geddes Avenue. The purpose of the GS2AC is to improve the local connectivity of the Green Square Town Centre to the proposed Ashmore Precinct located to the west. The GS2AC will also provide additional east-west permeability and route choice for not just vehicle movements but also for pedestrians and cyclists. It is recognised that the existing north-south roads of Botany Road, Bourke Road and O’Riordan Street also provide important strategic and local connections. Therefore, the GS2AC has been assessed in keeping with the importance of these aforementioned roads.

The GS2AC geometry and alignment have been designed in accordance with AUSTROADS – Guide to Road Design and associated RMS guidelines. The road reserve width is generally consistent with the width adopted for Geddes Avenue. The existing land use of the area is mostly industrial. Travel lanes are approximately 3.25m wide to facilitate industrial vehicles. On-street parking is also to be provided along sections of the Connector Road.

New traffic signals are proposed at the following intersections:

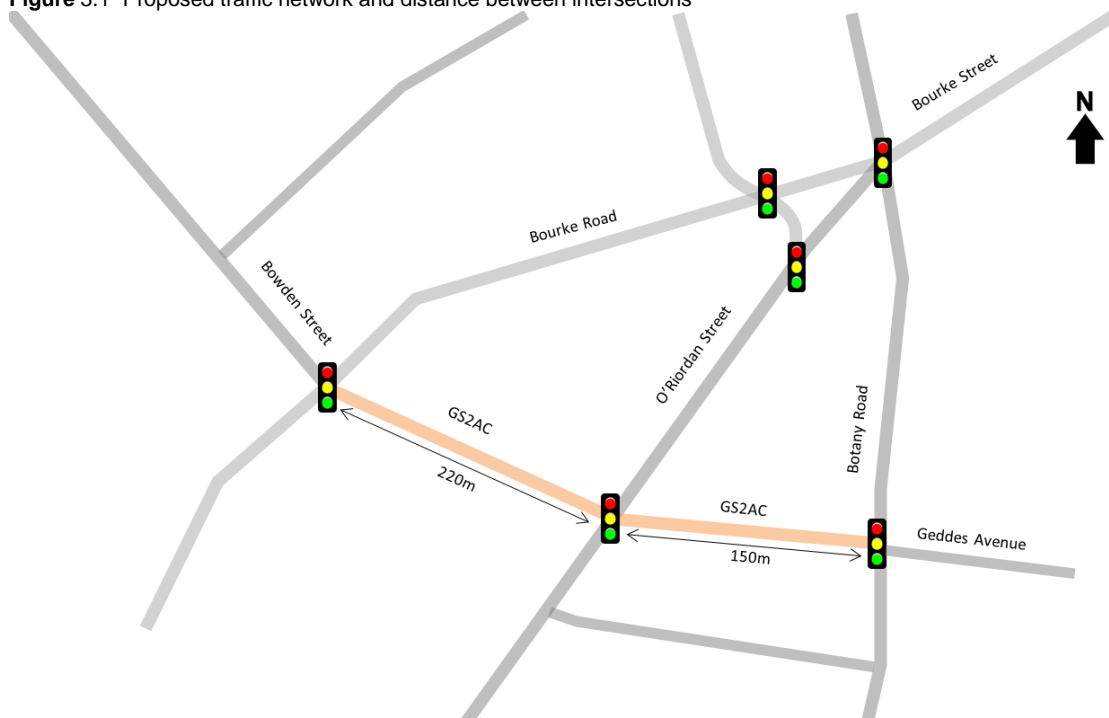
- Bowden Street / Bourke Road / GS2AC
- O’Riordan Street / GS2AC
- Botany Road / Geddes Avenue / GS2AC

The proposed three arm intersection at Botany Road / Geddes Avenue is being delivered as part of the GSTC Essential Infrastructure project and a fourth western leg will be added for the GS2AC.

The GS2AC is designed as a two way street with a design speed of 60km/hr, but sign posted at 50km/hr. The western section of the GS2AC runs between Bourke Road and O’Riordan Street and the eastern section runs between O’Riordan Street and Botany Road. The lengths of these sections of the road are approximately 220m and 150m, respectively. Figure 3.1 highlights the extents of the network and the relative distance between the intersections.

A separated bi-directional cycleway has been incorporated in to the GS2AC design and will tie in to the proposed cycleway on Geddes Avenue and the existing separated cycleway that exists on Bowden Street and Bourke Road.

Figure 3.1 Proposed traffic network and distance between intersections



4.0 Vehicle Route Assessment Strategy

4.1 Introduction

The purpose of the following vehicle route assessment is to review the proposed turning movements associated with the GS2AC in the context of the broader City of Sydney access strategy for Green Square. The main function of the GS2AC is to provide east-west connectivity for the GSTC and enhance road and transport access to the area. With the forecast population growth within the region, the east-west connection will provide crucial local permeability for vehicles, pedestrians and cyclists.

As mentioned previously, the main function of the GS2AC is to provide the Green Square Town Centre with an east-west connection. However, it is also recognised that this may present an attractive alternate route to the current east-west network that currently exists along Collins Street and Epsom Road (see section 2.3.3). This predicted rat-run would also see a higher volume of traffic travelling through GSTC which would be undesirable. Therefore, to deter this rat-run, the route assessment considers the introduction of numerous right turn bans at the three intersections along the GS2AC that will also provide operational efficiency and add capacity to the route. The evaluation of right turn bans will be in line with Roads and Maritime Services guidelines, in particular *Traffic Signal Design – Section 7 Phasing and Signal Group Display Sequence* which states that “banning the right turn should be avoided unless the right turn flows are low and a suitable alternative route is available.” Consequently, each proposed right turn ban will be assessed in terms of projected future volumes and alternate routes available.

Currently, the north-south routes are highly congested during the AM and PM peaks and queues along O’Riordan Street and Botany Road were observed to queue back through the proposed GS2AC intersection locations. With the addition of future growth within the network, it is expected that particular turning movements will encounter exit blocking as a result of the extensive queueing on the north-south routes. The following route analysis has taken in to account the predicted exit blocking by appraising, where possible, designated turn bays so that the primary through movements experience minimal delay as a result of being starved by the adjacent turn bays.

4.2 Bourke Road / GS2AC

The proposed Bourke Road / GS2AC intersection comprises the following key features:

- Signalisation of Bourke Road / GS2AC and the introduction of an eastern approach with dedicated right turn bays provided for the north and south approaches of Bourke Road.
- Introduction of two-way cycleway on the southern side of the eastern approach that connects to the existing separated cycleway network along Bowden Street and Bourke Road
- All movements have been permitted with the exception of the right turn from the eastern approach to Bourke Road northbound.

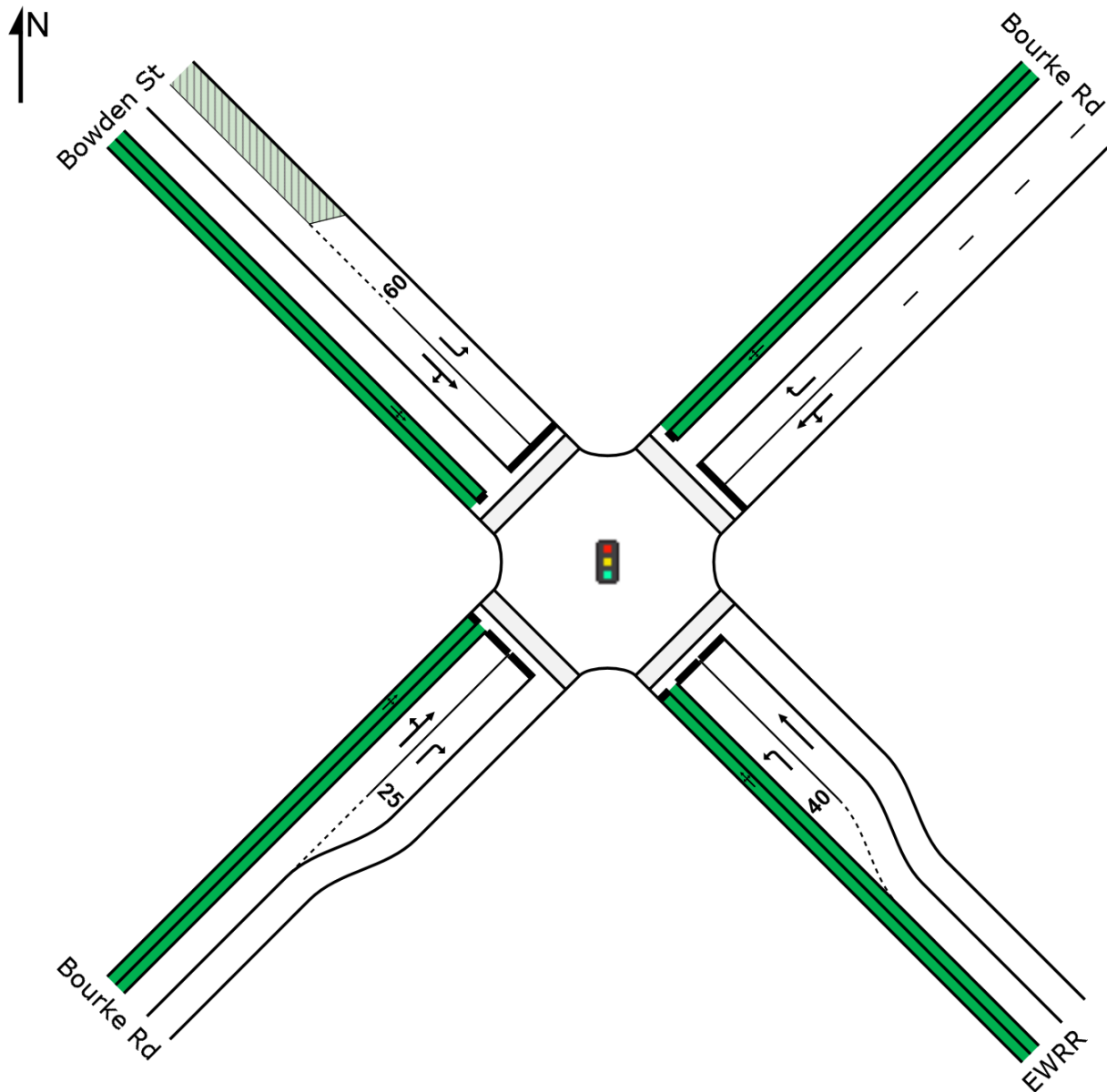


Figure 4.1 Proposed Intersection of Bourke Road | GS2AC | Bowden Street

A right turn ban for the GS2AC eastern approach to Bourke Road is the only turn ban proposed at this intersection. The right has been banned for the following reasons:

- There is likely to be a low demand for the right turn movement at this location because of sufficient alternate routes which provide a faster, less congested travel path. For example, for vehicles travelling northbound on either Botany Road or O’Riordan Street, the dog leg movement would be counter-intuitive and is likely to increase travel times.
- There are numerous alternate routes that provide sufficient capacity for vehicles wishing to travel northbound on Bourke Road. In particular, strategic trips are well facilitated by the intersection of O’Riordan Street / Botany Road / Bourke Road. Local trips with a destination along Bourke Road also have alternative routes and may experience faster travel times. These alternate routes are highlighted in Figure 4.2.

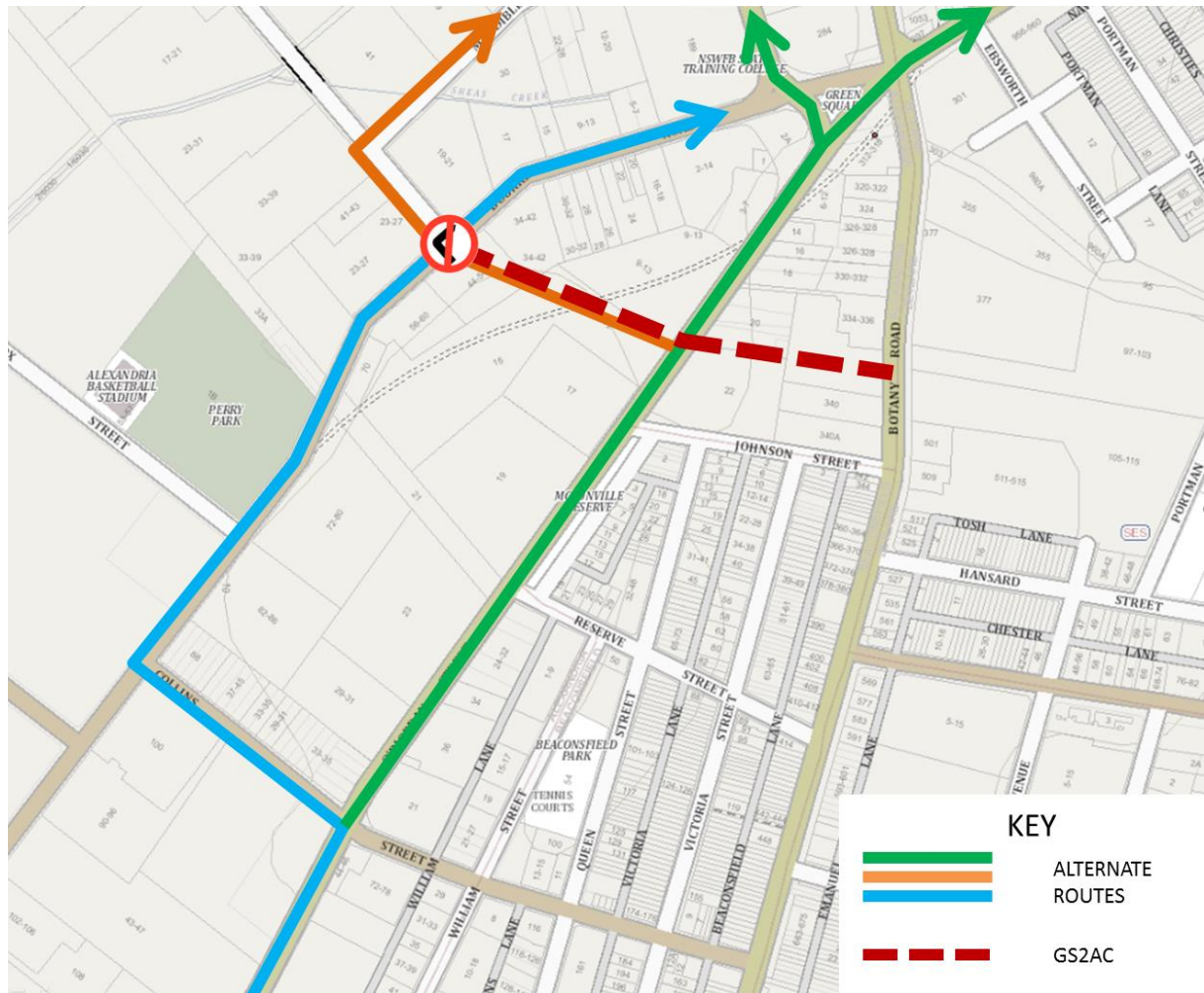


Figure 4.2 Alternate routes for the proposed banned right turn movement

4.3 O’Riordan Street / GS2AC

The proposed O’Riordan Street / GS2AC intersection comprises the following key features:

- Introduction of signalisation intersection at O’Riordan Street / GS2AC
- Introduction of two-way cycleway along the southern side of the GS2AC.
- The right turn movements from both O’Riordan Street approaches have been banned. Further, the right turn from the eastern approach to O’Riordan Street north has also been banned. All other movements have been permitted.

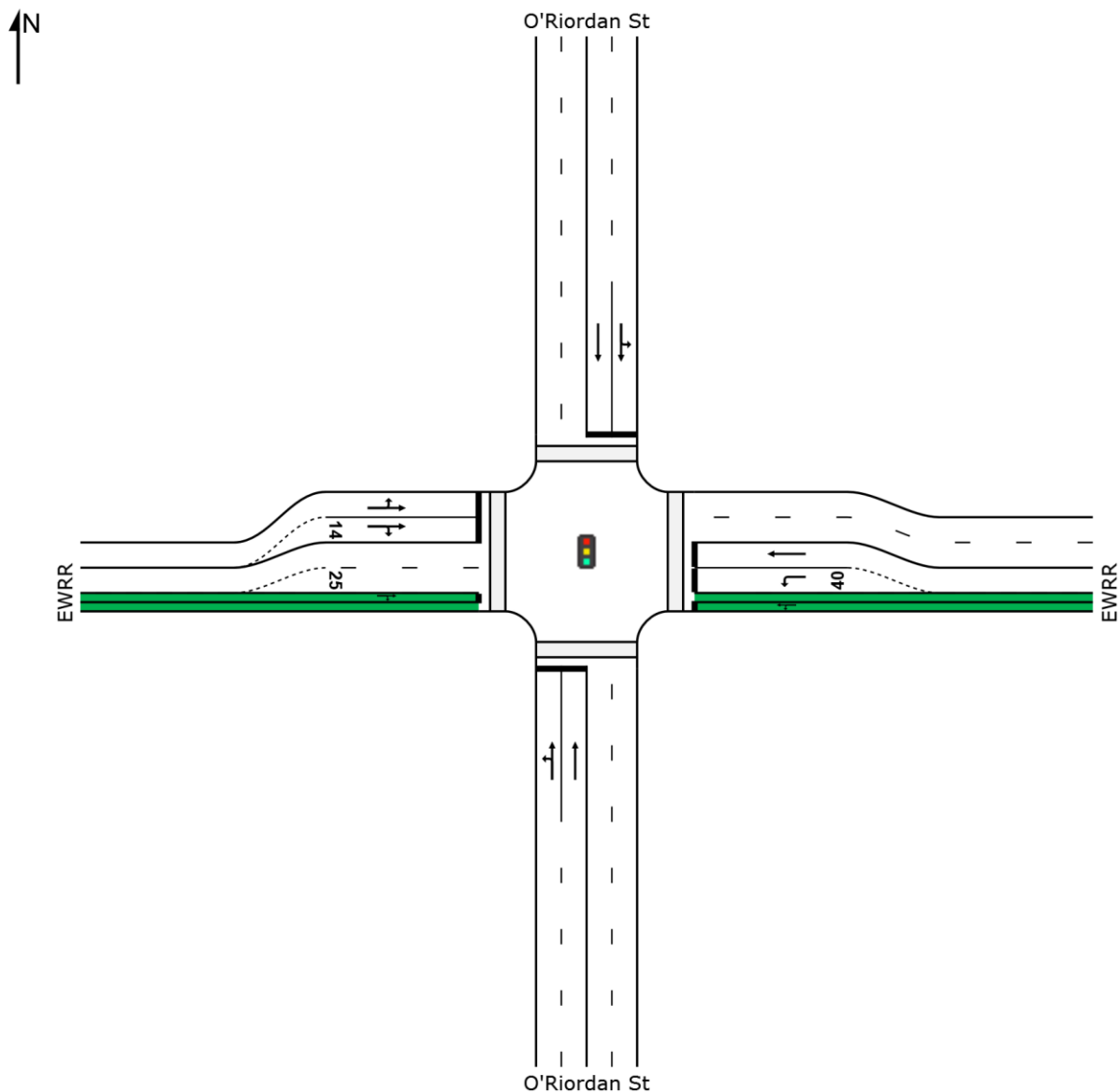


Figure 4.3 Proposed Intersection of O'Riordan Street | GS2AC

The right turn bans identified above have been restricted at the approaches listed below for the following reasons.

O'Riordan Street north approach: Demand for the right turn movement from the northern approach is likely to be minimal. This is because vehicles approaching from the north have sufficient opportunity to turn right at the upstream intersection of Botany Road / O'Riordan Street / Bourke Road. Further, the Collins Street / O'Riordan Street intersection provides an alternate right turn movement opportunity. Lastly, O'Riordan Street caters for large north-south demand and permitting the right turn movement to filter would lead to limited opportunity for the movement to filter against a high volume of opposing traffic thus reducing the capacity of the southbound movement along O'Riordan Street.

O'Riordan Street south approach: Similar to the north approach, demand for the right turn movement from the southern approach is likely to be minimal. Despite this, vehicles are permitted to turn right at Johnson Street located just upstream of the proposed intersection which provides an adequate alternative route. Further, if the right turn was permitted, it would potentially promote vehicles travelling northbound to avoid upstream congestion on O'Riordan Street by making the right turn in to the GS2AC. The right turn ban will discourage vehicles travelling along the main north-south routes from accessing the parallel corridors in an attempt to avoid congestion further downstream and will promote the function of the GS2AC as a local connector road for east-west movements.

GS2AC east approach: There is likely to be a low demand for the right turn movement at this location because of sufficient alternate routes which provide a faster, less congested travel path. This is evident through turning movement counts at the Collins Street | O’Riordan Street intersection further south which shows right turn volumes of approximately 20 and 60 vehicles in the AM and PM peaks respectively. Additionally, there are numerous alternate routes that provide sufficient capacity for vehicles wishing to travel northbound on O’Riordan Street. In particular, strategic trips are well facilitated by the intersection of O’Riordan Street / Botany Road / Bourke Road. Lastly, if permitted, right turning vehicles at this approach would likely block the higher volume through traffic along with the left turning vehicles which are delayed by crossing pedestrians and/or cyclists, drastically reducing the capacity of this approach.

4.4 Botany Road / GS2AC / Geddes Avenue

The proposed O’Riordan Street / GS2AC intersection comprises the following key features:

- Introduction of fourth western leg at Botany Road | Geddes Avenue with dedicated right turn bay for all approaches. Geddes Avenue will already have been constructed as part of the GSTC road network.
- Introduction of two-way cycleway on the southern side of the western approach which will connect to the existing separated cycleway network along Geddes Avenue.
- Both the right turn from Botany Road in to the GS2AC and the right turn from the GS2AC in to Botany Road are proposed to be banned.

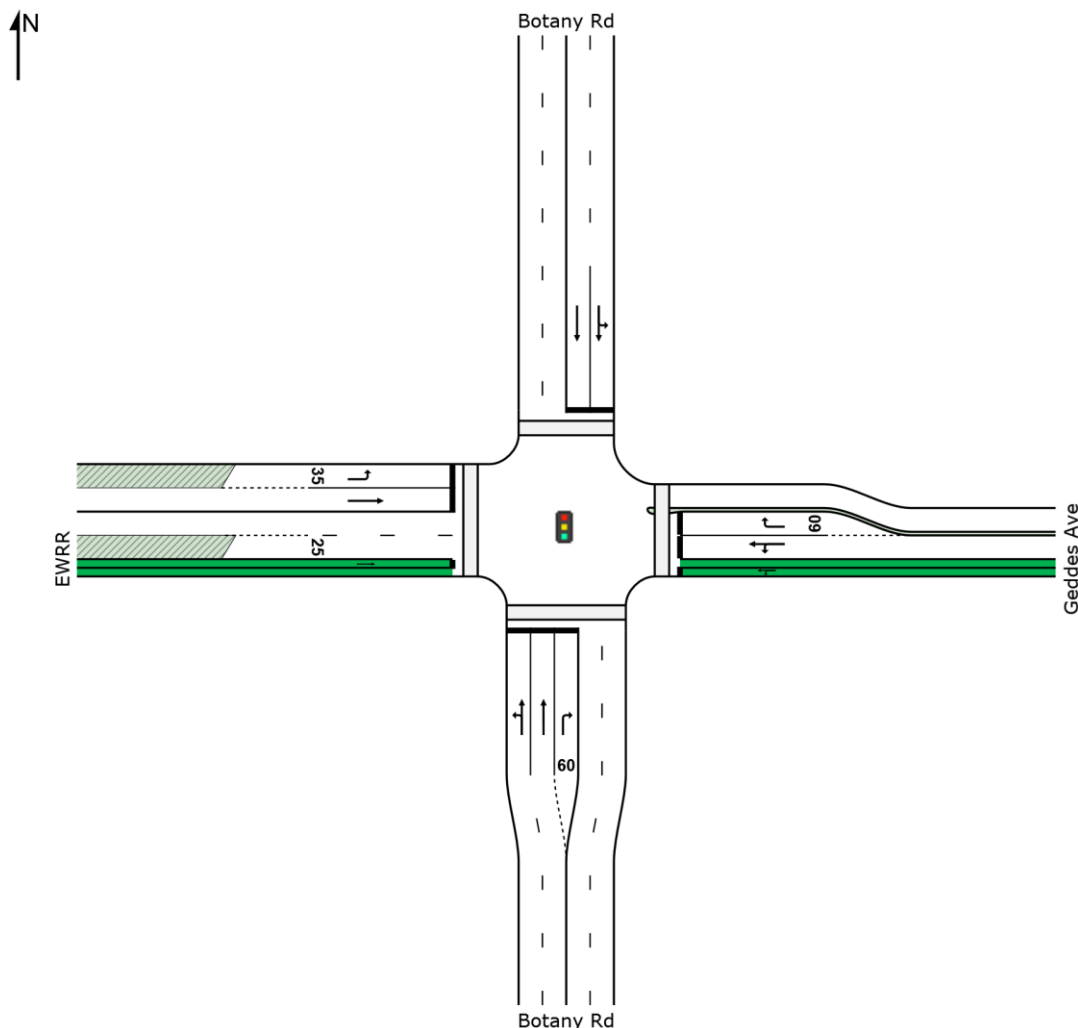


Figure 4.4 Proposed Intersection of Botany Road | GS2AC

The right turn bans listed above have suggested for the below approaches for the following reasons:

GS2AC west approach: If permitted, the right turn from the GS2AC to Botany Road is likely to facilitate a high volume of traffic which is supported in the strategic volume link analysis which show that a high proportion of vehicles that travel eastbound on the GS2AC may make this right hand turn at the intersection of Botany Road and then left at Epsom Road. The GS2AC provides an attractive alternate connection from the west to Epsom Road when compared to the Collins Street route. These routes are outlined in Figure 4.5 below. This is because the left turn in to Epsom Road from Botany Road will receive additional green time means that vehicles are likely to experience reduced delays when compared to the right turn to Epsom that the Collins Street route allows. Therefore, to limit the amount of vehicles along the GS2AC and prioritise local access, it is proposed that this movement be restricted so that the GS2AC retains its function as a local connector road between Green Square and Ashmore and does not become an alternative strategic route for vehicles wishing to travel to Epsom Road.

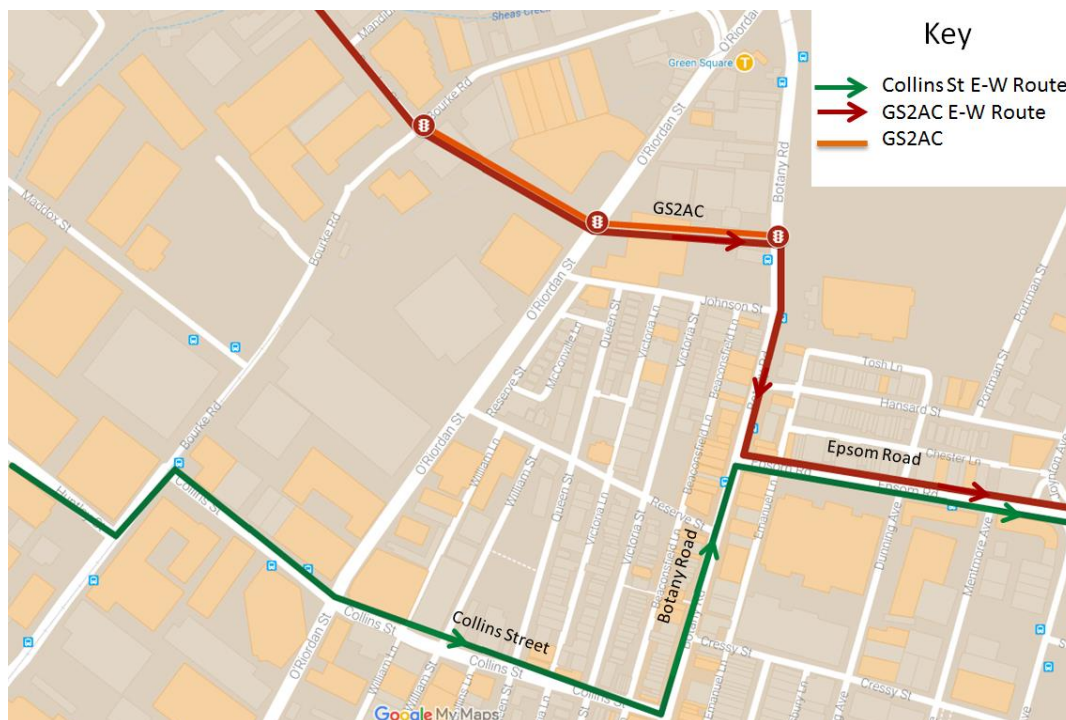
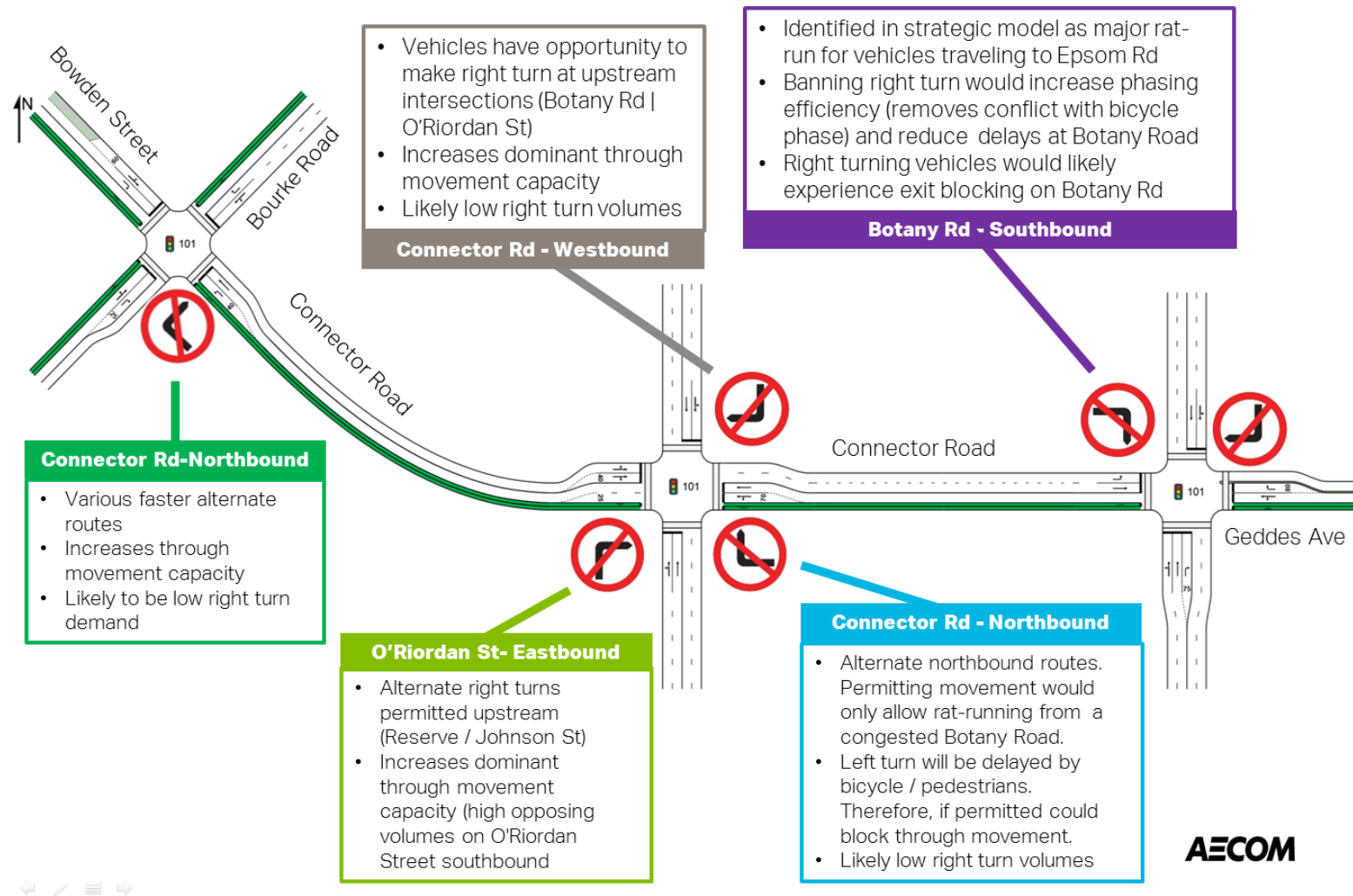


Figure 4.5 East to West routes to Epsom Road

Alternative routes exist for vehicles wishing to travel east using the GS2AC, however these will likely cause greater travel times than the existing route options. One of these alternative routes is to weave through the GSTC precinct. This will involve passing through at least 5 signalised intersections which will significantly increase drivers travel time and therefore does not present as an attractive alternate route for vehicles wishing to connect to Epsom Road or O'Dea Avenue. Similarly, a possible alternative route for the west to east movement is to perform a right turn from the GS2AC to O'Riordan Street south and then re-join the existing network. Drivers will also likely experience an increase in travel times compared to the existing east west route which is facilitated by Collins Street because of the delay incurred for the right turn filter movement at the GS2AC and O'Riordan Street intersection.

Botany Road north approach: Demand for the right turn movement from the northern approach is likely to be minimal as indicated by the provided strategic model. However, vehicles are permitted to turn right at the Mandible Street intersection located just upstream of the proposed intersection which provides an alternative route. Alternatively, if vehicles originate from Bourke Street, a more convenient route would be to continue straight to either O'Riordan Street or Bourke Road rather than perform the right turn on Botany Road. If the right turn were permitted, it would require a turn bay to not significantly impact the southbound movement along Botany Road. This would require significant civil works and therefore is not proposed.

Figure 4.6 below gives an outline of the proposed right turn bans and their locations along the GS2AC.



AECOM

Figure 4.6 Summary of right turns along GS2AC

5.0 Future Year Traffic Assessment

The following section provides details of the traffic impact assessment that was undertaken for the 2021 operational impacts for the AM and PM peak periods. A Traffic and Transport Impact Assessment (TTIA) was previously prepared for the GS2AC in support of a review of environmental factors (REF). This assessment was based on the Green Square Town Centre Traffic Study (Bitzios Consulting, 2012) and the traffic modelling involves the use of the software tool, Paramics, to generate a 2021 operating timeframe.

Traffic assessment tool SIDRA INTERSECTION (Version 7.0.5) was used to assess the updated concept design of the GS2AC Road for the 2021 future year. The inputs in to the SIDRA models were based on the GSTC Paramics models used in the TTIA and analysed the following intersections:

- Bourke Road / Bowden Street / GS2AC Road
- O’Riordan Street / GS2AC Road
- Botany Road / GS2AC Road

Because of the absence of an updated strategic model that takes in to account the impacts of an array of changes to the surrounding network in future years beyond 2021, in consultation with RMS, it was agreed to grow the 2021 strategic forecast traffic volumes by an agreed compounding growth rate until the network reached capacity so as to evaluate where congestion was likely to occur.

A majority of the modelling assumptions from the TTIA were carried over in to this assessment of the GS2AC. A list of these assumptions is listed below.

5.1 Modelling Assumptions

The following assumptions have been applied to the development of the SIDRA models for the 2021 future year assessment.

5.1.1 Intersection Phasing | Cycle Times

In consultation with RMS, all of the traffic signals within the major road corridors have been modelled with a 120 second cycle time. The three intersections assessed will be coordinated to prioritise the north-south movement along the major state roads of Botany Road and O’Riordan Street. The GS2AC intersections are not proposed to be coordinated for the east-west movements and are therefore assessed as single intersections, not as a coordinated network as agreed with RMS. SIDRA was made to optimise the phase timings.

Cycleways and pedestrianised environments play a key role in the functionality of the GSTC precinct and surrounding road network. Their impact on the operation of the proposed design has been modelled as follows:

- A six second delay has been applied to conflicting vehicle movements for the intersection of O’Riordan Street / Wyndham Street / Bourke Road at the commencement of a pedestrian phase.
- An eleven second delay has been applied to conflicting vehicle movements for the intersection of Botany Road / Bourke Road / Bourke Street at the commencement of a pedestrian phase.
- A six second delay has been applied to conflicting vehicle movements for the intersection of Bourke Road / Bowden Street / GS2AC at the commencement of a pedestrian phase.
- A six second delay has been applied to conflicting vehicle movements for the intersection of O’Riordan Street / GS2AC at the commencement of a pedestrian phase.
- A six second delay has been applied to conflicting vehicle movements for the intersection of Botany Road / Geddes Avenue / GS2AC at the commencement of a pedestrian phase.

As per the proposed turn bans presented in Section 4 above, the phasing operation of the three intersections has been updated. Figures Figure 5.1 to Figure 5.3 below display the phasing for the intersections proposed as part of the GS2AC Road.

Bourke Road | Bowden Street | GS2AC

The proposed signalised intersection of Bowden Street / Bourke Street and GS2AC Road will operate as a single diamond overlap with bicycle protection for the two cycleways. This gives the SCATS operation of the intersection the ability to adapt to fluctuations in traffic demand between the right turns on Bourke Road.

It is assumed that cyclists both the right turn from the Connector Road into Bourke Road and the left turn from Bourke Road into the Connector Road will perform a “hook turn” using facilities on the north west corner. The layout of the interchange between the cyclepaths is currently being investigated separately to align with the phasing proposed.

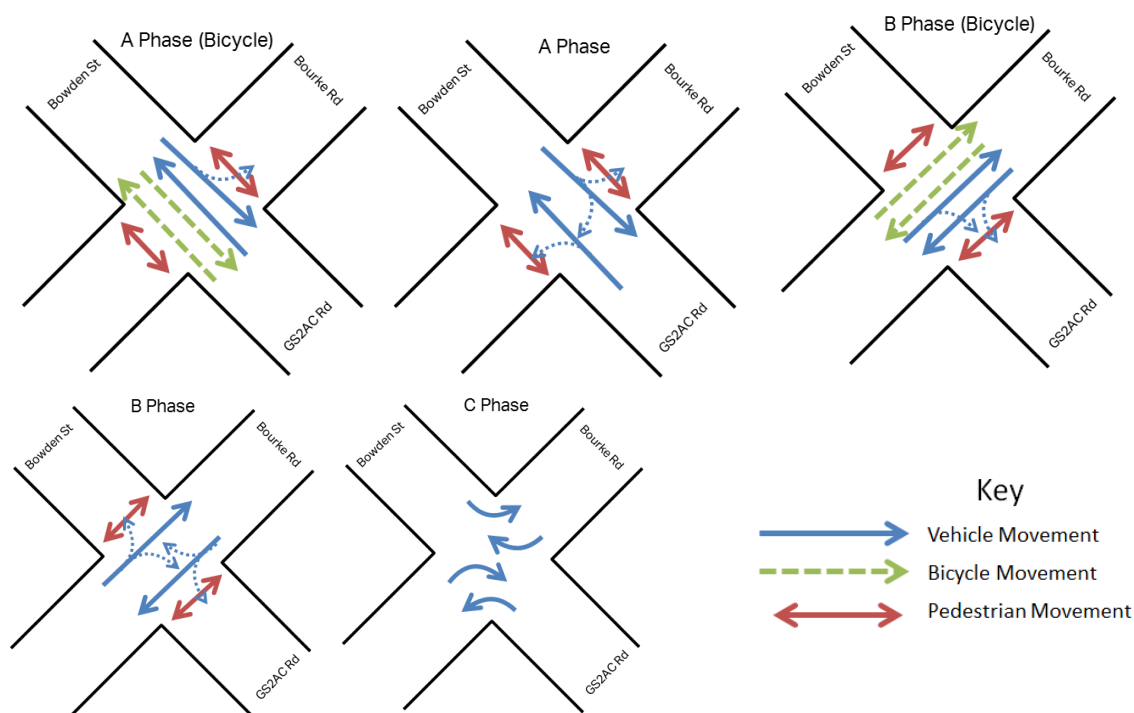


Figure 5.1 Proposed Phasing for Bourke Road / Bowden Street / GS2AC

O’Riordan Street | GS2AC

The proposed signalised intersection of O’Riordan Street and GS2AC Road will operate as a simple two phase with red arrow protection for the separated cycleway on the southern side of the GS2AC.

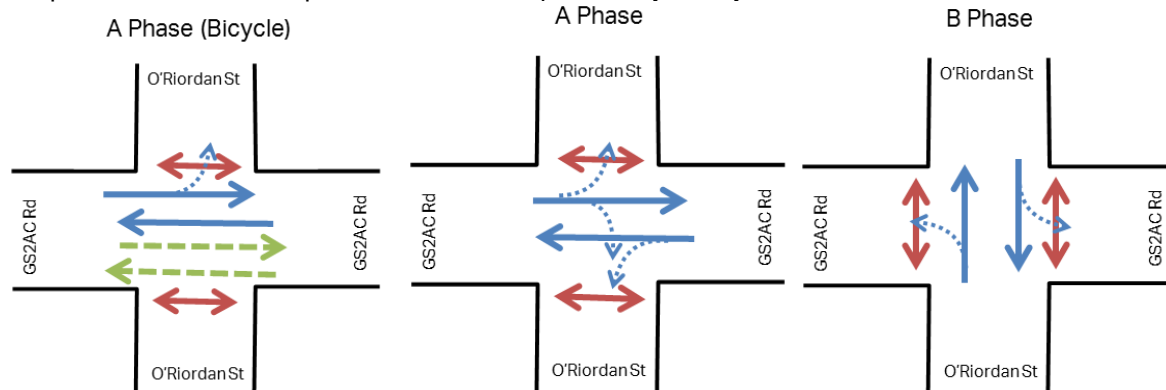


Figure 5.2 Proposed Phasing for O’Riordan Street / GS2AC

Botany Road | GS2AC | Geddes Avenue

The proposed signalised intersection of Botany Road / Geddes Avenue and the GS2AC will operate as a leading right turn phase from the Botany Road south approach. Red arrow protection is provided for the separated cycleway on the southern side of the Connector Road and Geddes Avenue.

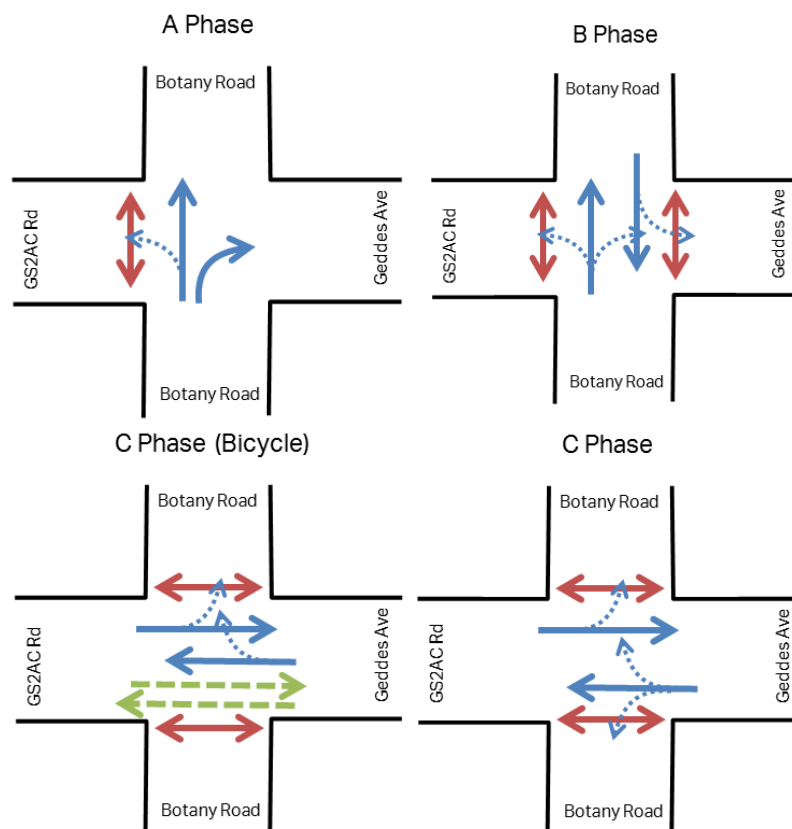


Figure 5.3 Proposed Phasing for O'Riordan Street / GS2AC

5.1.2 Traffic Generation

Traffic generation from developments shown in has been considered in the assessment.

Table 5.1 Traffic Generating Developments

Development	Dwellings	Commercial GFA (m ²)	Retail GFA (m ²)
Green Square Town Centre ^	4,218	67,204	12,760
Epsom Precinct	2,886	19,678	-
Developments along GS2AC	58	75,434	-
Site 1	-	27,130	160
"Woolworths Development"	-	2,533	8,920

The following assumptions were made with respect to traffic generation as per the TTIA:

- The applied residential generation rate is 0.19 trips per unit (AM peak) and 0.15 trips per unit (PM peak) in accordance with the RMS 'Guide to Traffic Generating Developments Updated Traffic Surveys' TFT2013/14.

Retail and commercial trip generation rates have been maintained in accordance with the rates identified in the 2013 'Green Square Parking and Traffic Study'. These are as follows:

- Retail AM/PM peak 3.53 trips per 100m² of GFA
- Commercial AM/PM peak 0.55 trips per 100m² of GFA

5.1.3 Traffic Volumes / Distribution

Upon consultation with RMS, it was determined that no updated strategic model was available to inform future year volumes within the network. Therefore, the turning volumes used within the previous TTIA Paramics model were used as input to the SIDRA models. These volumes have been informed by the above traffic generation and the aforementioned strategic models. Furthermore, the proportion of heavy and light vehicles within the network has been assumed to remain consistent for future years and therefore has been kept consistent with results produced from automated traffic counts.

As a result of the above vehicle route selection assessment, right turn bans have been proposed to improve the efficiency of the GS2AC and to deter rat-running, however a number of these right turn bans have not been included in the strategic model. Therefore, the following assumptions have been made for the proposed banned right turns that exist within the strategic model and the relevant redistribution of traffic expected to occur.

North Approach – Botany Road | Geddes Ave | GS2AC: It is envisaged that traffic will maintain the current patterns from access to Bourke Road. It is noted that the extent of the modelling undertaken for this assessment is limited to the immediate GSTC area and as such can not assess the alternative routes traffic may take, however there is no change to right turn provisions upstream on Botany Road. Further analysis is provided in technical memorandum prepared by AECOM and located in Appendix B.

West Approach – Botany Road | Geddes Ave | GS2AC: Select link analysis from the strategic model provided by RMS shows that during both AM and PM peak periods, a large volume of vehicles is expected to perform the right turn from the Connector Road to Botany Road south and then make the left turn to Epsom Road heading east. Volumes from the 2021 strategic model are summarised in Table 5.2 below.

Table 5.2 Traffic Generating Developments

Peak Period	Right Turn volumes provided within strategic models
AM	301
PM	127

This route provides an alternative west-east connection between McEvoy Street and to major trip generators/attractors in the east such as the M1/M2 motorways and the University of New South Wales. Therefore, by banning the right turn movement, it removes a significant proportion of vehicles from the connector road that will be forced to take alternative routes which has been described in the route strategy above. Because a strategic model that incorporates this right turn ban does not exist, a number of assumptions have been made regarding the distribution of the banned right turning vehicles that then access Epsom Road. It is likely the demand for the right turn movement at the upstream intersection of O'Riordan Street / GS2AC Road will be larger than indicated by the strategic model as vehicles use either Johnson Street or Reserve Road to access Epsom Road. Figure 5.4 below illustrates the alternative routes available.

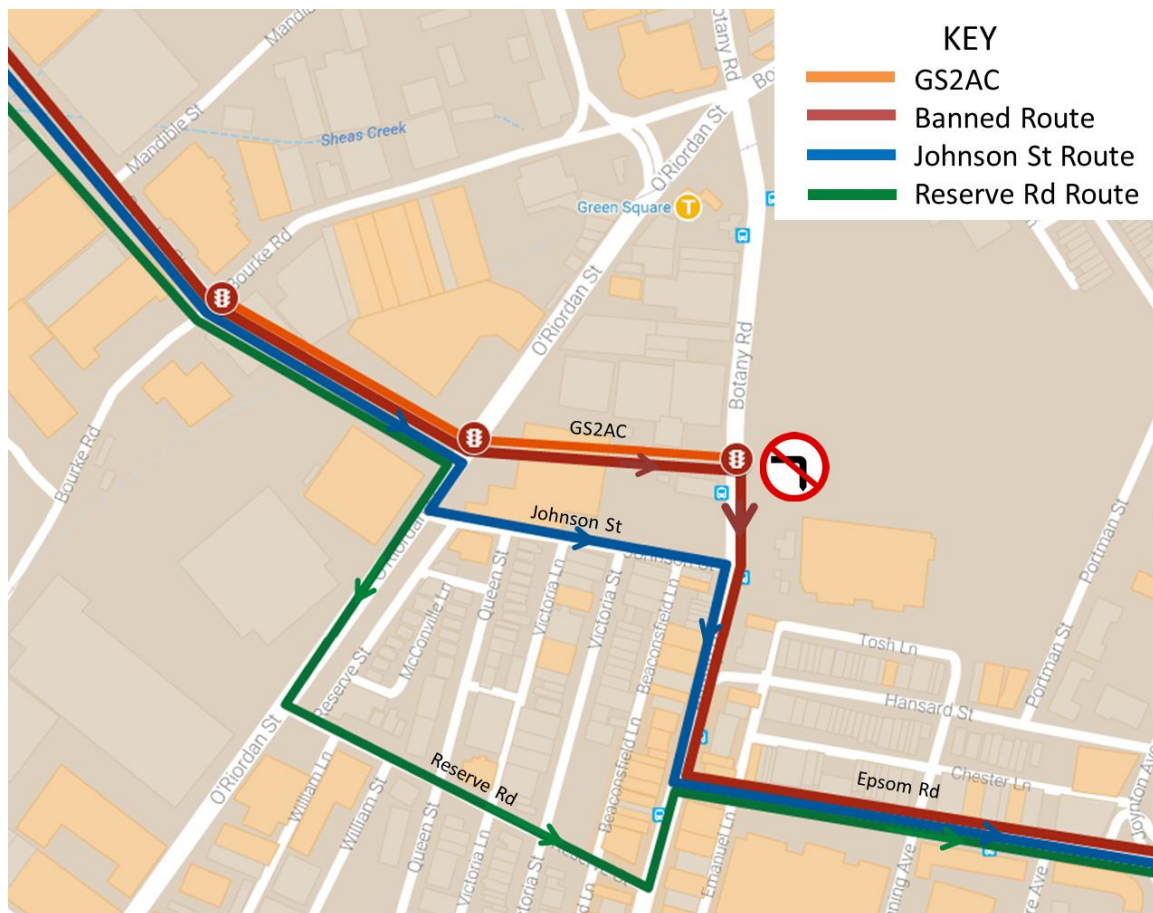


Figure 5.4 Alternate Routes for east-west route

It is important to note that vehicles that turn right from Johnson Street at the priority intersection with Botany Road are required to filter in to the heavily trafficked Botany Road and therefore would be expected to experience high delays due to an inability to find substantial gaps in conflicting traffic. Similarly, the Reserve Street alternative requires vehicles to turn left and then immediately merge in to the right lane to turn in to Epsom Road. It was observed that during the peak periods, this movement was difficult to perform because the right turn queue from Botany Road to Epsom Road consistently extends past the Reserve Road and tends to prevent vehicles from entering the right turn lane.

The available strategic models only show a volume of 29 and 10 vehicles making the right turn movement from the Connector Road to Botany Road in the AM and PM peak respectively. Based on the above assumptions, additional traffic is expected to make this right turn movement. The O'Riordan Street / Collins Street intersection facilitates similar turning movements and therefore the right turn volumes attained from turning movement surveys were analysed to obtain a comparable expectation as to the volume of vehicles to make the right turn. For a robust analysis, a volume of 50 vehicles has been assumed to make the right turn from GS2AC to O'Riordan Street which is significantly higher than those volumes provided in the strategic model.

North Approach – O'Riordan Street | GS2AC: The proposed banning of the right turn from O'Riordan Street north to the GS2AC is predicted not to adversely impact redistribution of vehicles as vehicles wishing to access Bourke Road will maintain their current travel routes. Strategic forecasts, which permit this movement, show a low demand of 4 and 9 vehicles in the AM and PM peaks respectively. Further, this right turn movement is facilitated at the Collins Street intersection approximately 500 metres south along O'Riordan Street.

South Approach – O'Riordan Street | GS2AC: Similarly, to the north approach, the proposed right turn ban from the O'Riordan Street south approach is not expected to cause any redistribution of traffic within the study area. Upstream side roads, Johnson Street and Reserve Street, allow for an alternate route for vehicles wishing to travel east from O'Riordan Street.

5.1.4 Background Growth Application

As no strategic growth model for the study area exists, it was concluded in consultation with RMS that the annual growth rate of 1.1% be applied from the 2021 future year. This growth rate has been extracted from the previous GSTC Paramics models which encapsulate the study area associate with the GS2AC Road. The growth rate of 1.1% is linked with employment and population forecasts available from the Bureau of Transport Statistics. These indicate growth rates in the area immediately adjacent to the study area were on average approximately 1.0 to 1.2% per annum. (Bitzios; 2013)

5.2 Traffic Modelling and Assessment

The commonly used measure of intersection performance, as defined by RMS, is vehicle delay. SIDRA determines the average delay that vehicles encounter and provides a measure of the Level of Service (LOS).

Table 5.3 shows the criteria that SIDRA adopts in assessing the level of service.

Table 5.3 SIDRA INTERSECTION - Level of Service Criteria - Delay

Level of Service (LOS)	Average delay per vehicle (seconds/vehicle)	Comment
A	Less than 14	Good operation
B	15 to 28	Good with acceptable delays and spare capacity
C	29 to 42	Satisfactory
D	43 to 56	Near capacity
E	57 to 70	At capacity, at signals incidents will cause excessive delays
F	Greater than 70	Extra capacity required

In addition, Table 5.4 shows the criteria that SIDRA adopts for LOS with respect to Degree of Saturation (DOS) for a signalised intersection. The DOS represents the flow-to-capacity ratio for the most critical movement on each leg of the intersection. For signalised intersections, a DOS of around 0.95 is typically considered the 'acceptable' limit, as beyond this queues and delays increase disproportionately.

Table 5.4 SIDRA INTERSECTION - Level of Service Criteria - Degree of Saturation

Level of Service (LOS)	Intersection Degree of Saturation (DOS)	Comment
A	≤ 0.60	Excellent
B	0.60-0.70	Very Good
C	0.70-0.90	Good
D	0.90-0.95	Acceptable
E	0.95-1.00	Poor
F	≥ 1.0	Very Poor

5.2.1 2021 SIDRA Intersection Performance

The results for the AM Peak models show that all intersections are anticipated to perform at a Level of Service (LOS) C or better.

The operational performance of the 2021 AM peak at the different intersections are summarised below:

- The Bowden Street / Bourke Street / GS2AC Road intersection operates at a satisfactory LoS C, with all of all the approaches operating at LoS C. Results indicate that the shared through / right lane from the Bowden Street approach will likely experience the largest amount of delay at the intersection. This is because the right turn movement conflicts with the opposing through movement from the GS2AC Road as well as being held for bicycle protection. It is envisaged that the bicycle phase will not be called every cycle and therefore the results represent a worst-case scenario. By making the kerbside lane on the Bowden Street approach an exclusive left turn bay, it adds capacity to the intersection by allowing a complimentary left turn during the diamond phase for Bourke Road approaches.
- The O’Riordan Street / GS2AC Road intersection also operates at LoS C. Based on observed site visits during the AM peak, it is anticipated that the northbound lanes along O’Riordan Street will be heavily congested and vehicles exiting the leg on the north approach will likely experience exit blocking. However, the right turn from the eastern GS2AC Road approach is proposed to be banned and the volumes for the left turn from the western approach is anticipated to be low, therefore the exit blocking is not likely to have any significant impact on the intersections performance. The side arms of the GS2AC Road operate at a LoS E. This is mostly due to the movements that conflicted with the separated cycleway which increase delay. The north approach is expected to experience a minimal amount of delay, operating at a LoS A
- The Botany Road / Geddes Avenue / GS2AC Road is forecast to operate at LoS B. The performance of this intersection is also likely to be affected by upstream delays which occur at the intersection of Wyndham Street / Botany Road and O’Riordan Street which is observed to be heavily congested during the AM peak, however since the intersection is not included within the study area, it is difficult to forecast the amount of exit blocking delay that is imposed on the Geddes Avenue or the GS2AC Road. The Geddes Avenue approach is the worst performing approach because of a high demand for the right turn in to Botany Road which conflicts with both the northern pedestrian crossing and opposing through movements.

The operational performance of the 2021 PM peak at the different intersections is summarised below:

- The Bowden Street / Bourke Street / GS2AC Road intersection performs at a similar level of performance to the AM peak at LoS C with all approaches having a similar amount of delay. The south-west Bourke Road approach has the highest degree of saturation of 0.682.
- Similar to the AM peak, it is expected that exit blocking along O’Riordan Street will also occur in the PM peak. However, the north approach operates with no capacity restraints and receives minimal delays. Because of the higher flows on the O’Riordan Street, priority is given to these approaches over the Connector Road leading to a Los E and D for the east and west approaches respectively.
- The Botany Road / Geddes Avenue / GS2AC Road is forecast to operate at LoS B. It was observed during the PM site visit that southbound queuing from the Epsom Road intersection extended back to the proposed location of Geddes Avenue. Therefore, the performance of this intersection is also likely to be affected by these upstream delays. The Epsom Street/ Botany Road intersection is not included within the study area and therefore it is difficult to forecast the amount of exit blocking and its impacts on Geddes Avenue or the GS2AC Road.

AM Peak

Table 5.5 AM Peak SIDRA INTERSECTION Results

Bowden Street | Bourke Road | GS2AC

Approach	AM Peak				
	Volume	Delay	LoS	DoS	Queue (m)
- GS2AC (SE)	180	33	C	0.249	45
- Bourke Road (NE)	471	33	C	0.478	82
- Bowden Street (NW)	300	36	C	0.408	50
- Bourke Road (SW)	423	38	C	0.694	143
- Total Intersection	1,374	35	C	0.694	143

O'Riordan Street | GS2AC

Approach	AM Peak				
	Volume	Delay	LoS	DoS	Queue (m)
- O'Riordan Street (S)	1,124	45	D	0.856	256
- GS2AC (E)	227	58	E	0.680	66
- O'Riordan Street (N)	1,142	9	A	0.444	108
- GS2AC (W)	125	63	E	0.781	28
- Total Intersection	2,619	31	C	0.856	256

Botany Road | GS2AC | Geddes Ave

Approach	AM Peak				
	Volume	Delay	LoS	DoS	Queue (m)
- Botany Road (S)	1,027	13	A	0.425	106
- Geddes Ave (E)	279	56	D	0.547	56
- Botany Road (S)	1,008	21	B	0.525	146
- GS2AC (W)	144	43	D	0.201	27
- Total Intersection	2,459	23	B	0.547	146

PM Peak

Table 5.6 PM Peak SIDRA INTERSECTION Results

Bowden Street | Bourke Road | GS2AC

Approach	PM Peak				
	Volume	Delay	LoS	DoS	Queue (m)
- GS2AC (SE)	241	28	B	0.261	40
- Bourke Road (NE)	340	30	C	0.271	57
- Bowden Street (NW)	340	38	C	0.558	70
- Bourke Road (SW)	456	33	C	0.696	152
- Total Intersection	1,335	33	C	0.682	152

O'Riordan Street | GS2AC

Approach	PM Peak				
	Volume	Volume	Volume	Volume	Volume
- O'Riordan Street (S)	1,118	45	D	0.851	252
- GS2AC (E)	269	61	E	0.815	94
- O'Riordan Street (N)	1,006	8	A	0.395	92
- GS2AC (W)	161	62	E	0.884	43
- Total Intersection	2,555	33	C	0.851	252

Botany Road | GS2AC | Geddes Ave

Approach	AM Peak				
	Volume	Delay	LoS	DoS	Queue (m)
- Botany Road (S)	876	12	A	0.357	85
- Geddes Ave (E)	279	47	D	0.569	59
- Botany Road (S)	1,219	22	B	0.629	191
- GS2AC (W)	225	41	C	0.419	72
- Total Intersection	2,599	23	B	0.629	191

5.3 Post 2021 - Future Year Traffic Assessment

As mentioned previously, no updated strategic volumes are available for future year analysis of the traffic network. Therefore, in consultation with RMS, it was agreed that the growth rate of 1.1% compounding annual growth rate would be applied uniformly across the network to obtain a failure year and assess the location of any potential capacity restraints within the GS2AC.

Table 5.7 below shows the design life analysis of the three signalised intersections along the GS2AC. The failure year shown indicates when the intersection reaches capacity (degree of saturation approaches 100%) under a compounding annual growth rate of 1.1% from the 2021 year volumes.

Table 5.7 Design Life Analysis

	AM Peak		
	Bourke Road GS2AC	O'Riordan Street GS2AC	Botany Road GS2AC
Failure Year	2052 (31 years)	2042 (21 years)	2040 (19 years)
Failure Approach	Bourke Road (SW)	GS2AC (West)	Geddes Ave (East)
Failure Movement	Through/Left	Right	Right

	PM Peak		
	Bourke Road GS2AC	O'Riordan Street GS2AC	Botany Road GS2AC
Failure Year	2038 (17 years)	2029 (8 years)	2037 (16 years)
Failure Approach	Bourke Road (SW)	GS2AC (West)	Geddes Ave (East)
Failure Movement	Through/Left	Right	Right

In the AM peak, results indicate that the Geddes Avenue approach will be the first intersection within the network to reach capacity, 19 years after the 2021 opening year. As one of the main egress points, the Geddes Avenue approach right turn movement in to Botany Road provides egress for the AM commuter trips generated by the Green Square Town Centre to the Sydney CBD.

It can be seen from the above results that the intersection that reaches capacity first is O'Riordan Street / GS2AC in the 2029 PM peak. The western approach right turn movement reaches capacity because of an increased volume of conflicting through movements from the eastern approach combined with the delay imposed by the cycle phase.

The intersection of Bourke Road / GS2AC is shown to approach capacity after the two intersections during both the AM and PM peak periods. Analysis shows the Bourke Street south-western approach is expected to reach capacity in the through/left lane as the increased demand from this approach is delayed by the left turn conflicting pedestrian / bicycle movements, starving the through movements of effective green time.

5.3.1 Queuing analysis

A potential concern which arose in the analysis of the GS2AC was that the queue along the GS2AC may extend back to either Botany Road or O'Riordan street and therefore causing these roads to experience exit blocking as a result. Further analysis has been carried out to investigate the location and extent of queueing to assist in determining the future characteristics and operation the GS2AC.

Figure 5.5 below indicates the 95th percentile queue lengths for the AM and PM peak periods for what was determined to be the ultimate failure year. The ultimate failure year is determined by the above design life analysis and is when the last intersection with the GS2AC network is expected to reach capacity. These are 2052 and 2038 for the AM and PM peaks, respectively. These future years have

been chosen as they provide a robust, worst-case scenario for the network.

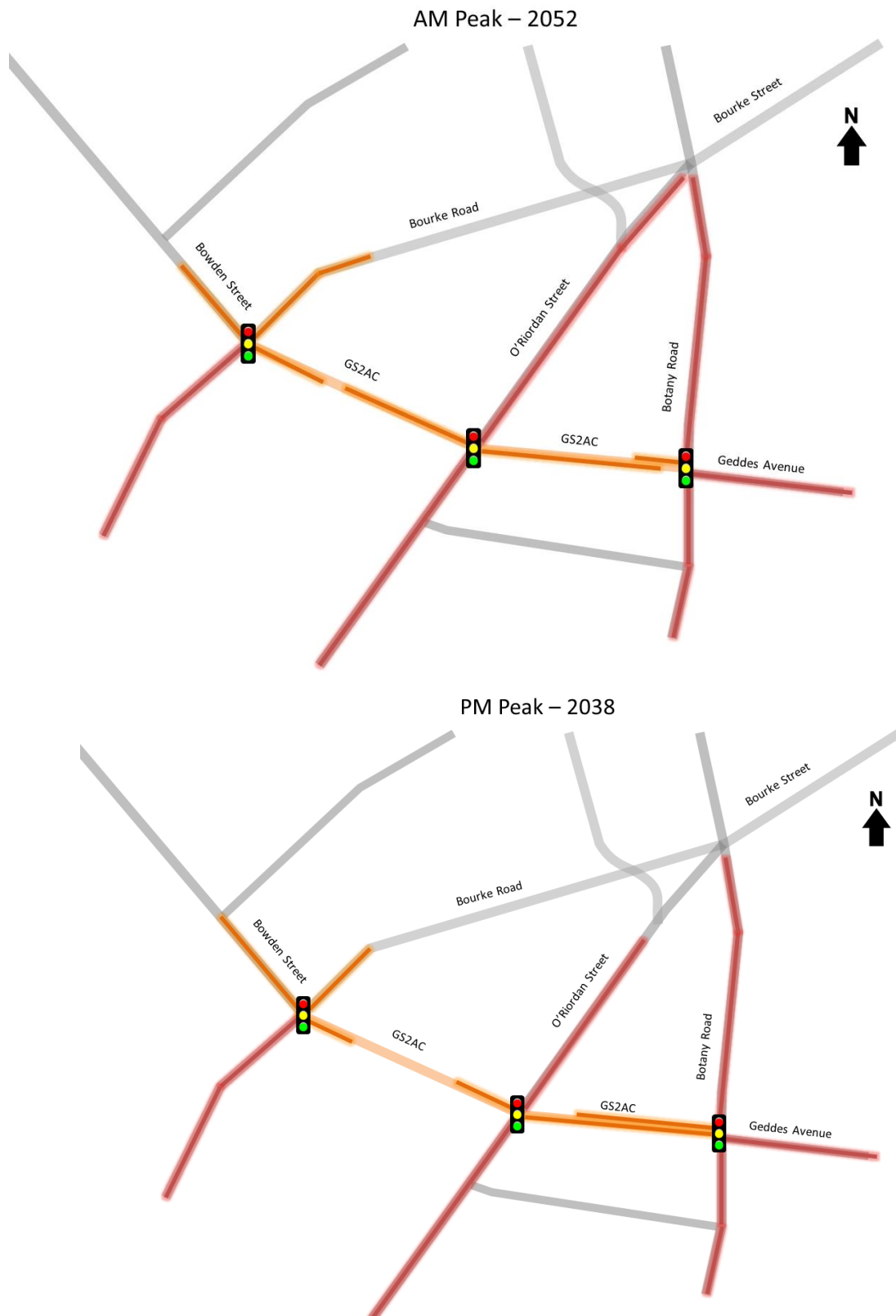


Figure 5.5 Indicative 95th Percentile Queue Lengths (Not to Scale and diagrams are representative only from SIDRA outputs)

Figure 5.5 above show that the main State Roads are expected to be heavily congested in the future years. This is expected as indicated by the extensive queueing that was observed during both the AM and PM peak site visits. It is likely these queues would form in the absence of the GS2AC because of upstream/downstream intersection capacity restraints.

During the AM peak, it can be seen that the south approach on Bourke Road at the Bowden Street/ Bourke Road/ GS2AC intersection experiences extensive queueing. This is because of a high volume of competing movements between the through movements from the south and the right turn movement from the north. Furthermore, additional delay caused by cyclist and pedestrian protection for the left turn from the south approach further reduces capacity. The GS2AC approaches at the O’Riordan Street / GS2AC intersection are shown not to queue back to their respective upstream intersections. However, the figure indicates that eastern approach queue length comes close to extending back to the Botany Road /GS2AC intersection. The increased volume of through traffic and left turn queue starving the adjacent through lane is the likely reason for the formation of this queue.

The PM peak shows a similar evaluation, however increased queueing is shown on the GS2AC mid-block between O’Riordan Street and Botany Road in both directions. This is because of the increased volumes as a result of trips generated in to the GSTC. In the westbound direction, the queue is predicted to extend back to Botany Road. This is likely because of a high level of demand from Epsom Road. However, since the O’Riordan / GS2AC intersection conservatively assumes 11 seconds bicycle incurred delay every cycle for the left turner, the queue for the eastern approach may be significantly lower. Extended delays are also expected northbound along Botany Road as a result of queueing extending from the Botany Road / Bourke Street / O’Riordan Street signalised intersection which may in turn reduce the desire for vehicles from Epsom Road to turn right from Epsom Road to access the GS2AC and use the alternative Collins Street route.

From the above analysis of queue lengths, it can be seen that in both peak periods the GS2AC has smaller queue lengths when compared the north-south routes. Importantly, the mid-blocks of the GS2AC between Bourke Road, O’Riordan Street and Botany Road do not show extensive queueing with the exception of the eastern approach to the O’Riordan Street / GS2AC intersection. However, it is anticipated that the congested Botany Road and Geddes Avenue roads will restrict the amount of vehicles able to flow through the approach and limit queueing. It is also important to note that the above queueing diagrams are indicative only and represent a worst case 95th percentile queue length.

6.0 Conclusion

This report has been prepared to assess the potential route options for the proposed GS2AC which is planned to provide increased accessibility for vehicles, pedestrians and cyclists to the Green Square Town Centre. The assessment of the 2021 future year peak periods was undertaken using existing RMS strategic models and inputs in to a previously prepared TTIA.

The GS2AC will operate in a highly congested network where it was observed the existing north-south connections along O’Riordan Street and Botany Road are subject to extensive queueing. SIDRA traffic modelling was undertaken to evaluate the performance of the GS2AC after the route assessment was undertaken. The following findings were made based on analysis of the 2021 AM and PM peak results:

- All intersections are expected to operate at a LoS C or better during both AM and PM peak periods. State roads Botany Road and O’Riordan Street are expected to be heavily congested in the AM and PM peak. This is likely to cause exit blocking for vehicles turning from the GS2AC in to these roads heading north in to the CBD.
- For all intersections, analysis indicates that the queues forming on the midblock the GS2AC between Bourke Road, O’Riordan Street and Botany Road do not queue back and block adjacent intersections and therefore will likely not impact these strategically important corridors.

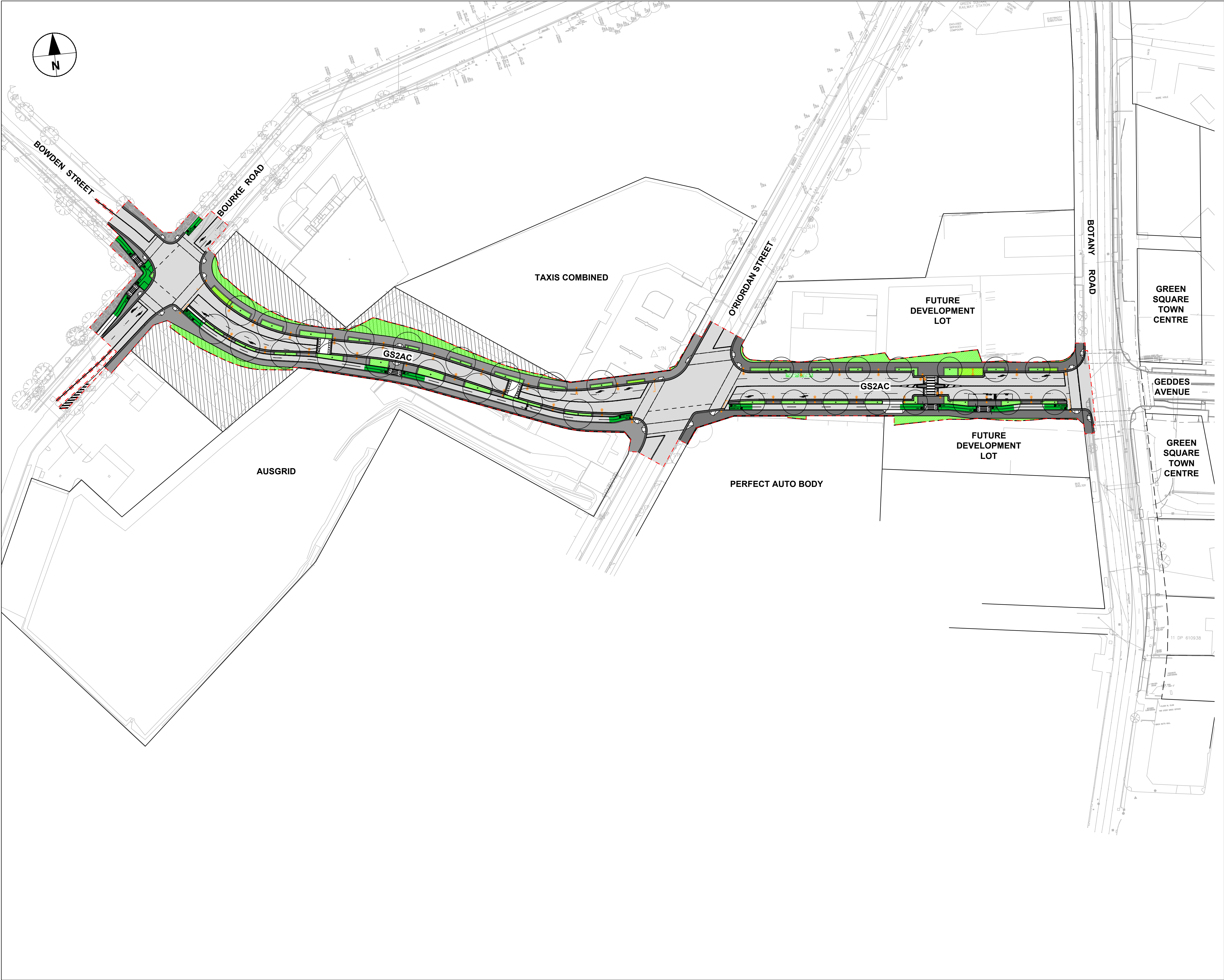
In the years following the opening of the GS2AC, background growth within the area is expected to increase. Analysis of the capacity restraints of the GS2AC showed the following:

- The intersections that are first expected to reach capacity are Geddes Avenue / Botany Road / GS2AC in 2040 and O’Riordan Street / GS2A in 2021 during the AM and PM peaks, respectively.
- The 2038 PM peak queue results show that the GS2AC midblock between O’Riordan Street and Botany Road is anticipated to experience extensive queue lengths in both directions. However, vehicles are likely to be restricted by congestion elsewhere in the network such as Botany Road northbound which will make alternate routes more attractive.

In conclusion, the GS2AC will provide additional capacity to the surrounding road network. This route strategy has highlighted proposed turning movement bans which will improve the efficiency of the GS2AC as a local east-west connection from the Ashmore Precinct to Green Square Town Centre. The GS2AC will also provide crucial connectivity for cyclists and will a dedicated cycleway and pedestrian footpaths.

Appendix A

GS2AC Concept Design



PROJECT

GREEN SQUARE TO ASHMORE CONNECTOR

CLIENT



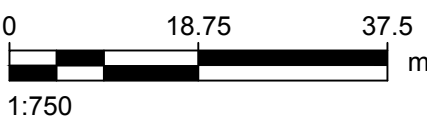
CONSULTANT

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LEGEND

- EXTENT OF WORKS
- CONCRETE UNIT PAVING
- CONCRETE PAVING
- FLEXIBLE ROAD PAVEMENT
- CYCLEWAY ROAD PAVEMENT
- SOFT LANDSCAPE
- RAIN GARDEN
- RESIDUE LOT
- PROPOSED STREET TREE
- VEHICLE CROSSING (REFER TO DETAIL)
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- STREET SIGNS
- LIGHTING COLUMNS
- DRAINAGE PITS

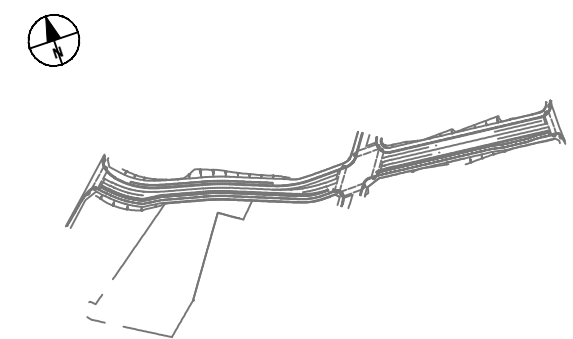
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ISSUE/REVISION

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KEY PLAN



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SHEET TITLE

PACKAGE 6
GENERAL ARRANGEMENT
PLAN
SHEET 1

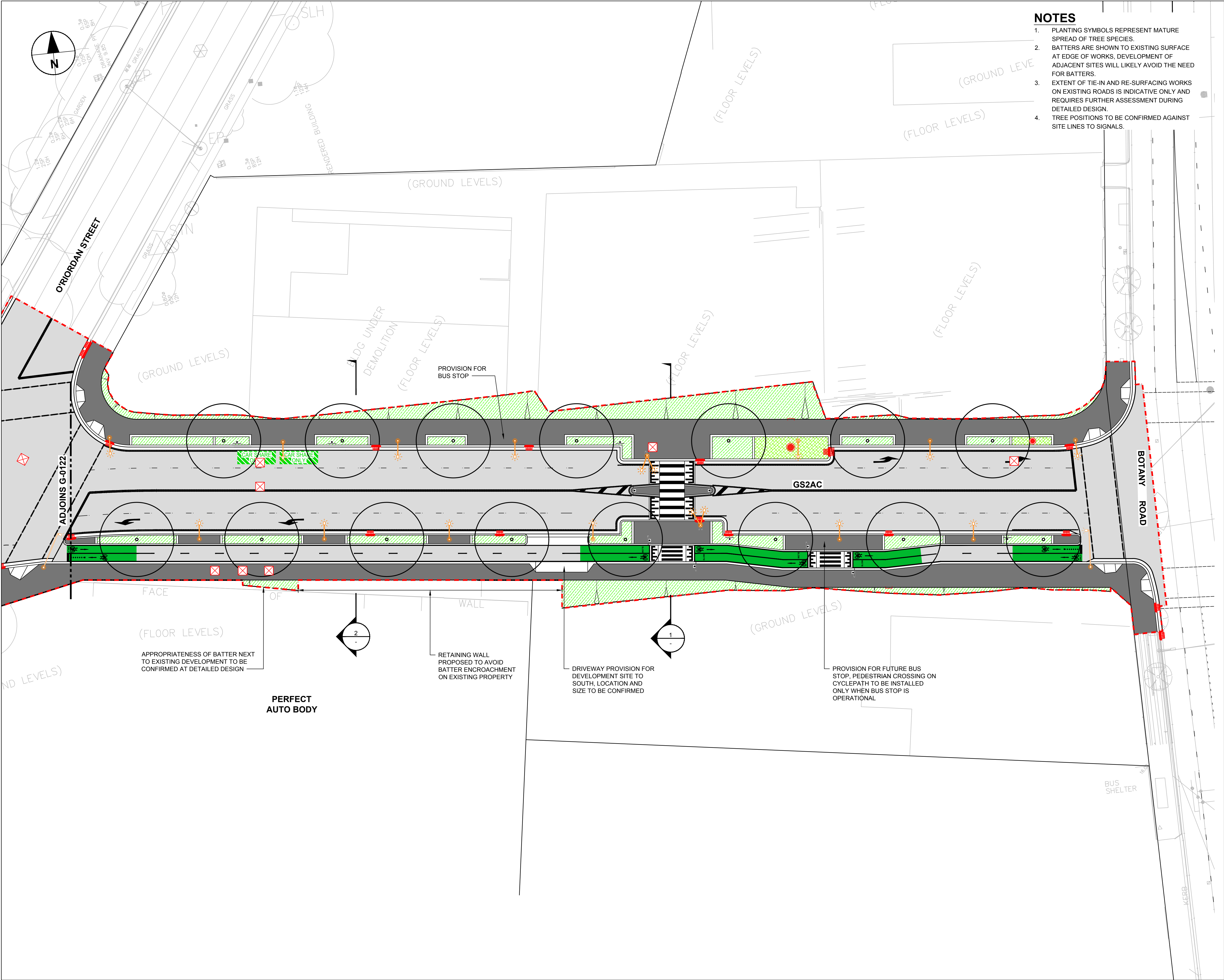
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Checked:
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- NOTES**
1. PLANTING SYMBOLS REPRESENT MATURE SPREAD OF TREE SPECIES.
 2. BATTERS ARE SHOWN TO EXISTING SURFACE AT EDGE OF WORKS, DEVELOPMENT OF ADJACENT SITES WILL LIKELY AVOID THE NEED FOR BATTERS.
 3. EXTENT OF TIE-IN AND RE-SURFACING WORKS ON EXISTING ROADS IS INDICATIVE ONLY AND REQUIRES FURTHER ASSESSMENT DURING DETAILED DESIGN.
 4. TREE POSITIONS TO BE CONFIRMED AGAINST SITE LINES TO SIGNALS.

AECOM

PROJECT

GREEN SQUARE TO ASHMORE CONNECTOR

CLIENT

CITY OF SYDNEY

CONSULTANT

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ISSUE/REVISION

01	16.10.17	CONCEPT DESIGN
I/R	DATE	DESCRIPTION

KEY PLAN

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PUBLIC DOMAIN
PLAN
SHEET 1

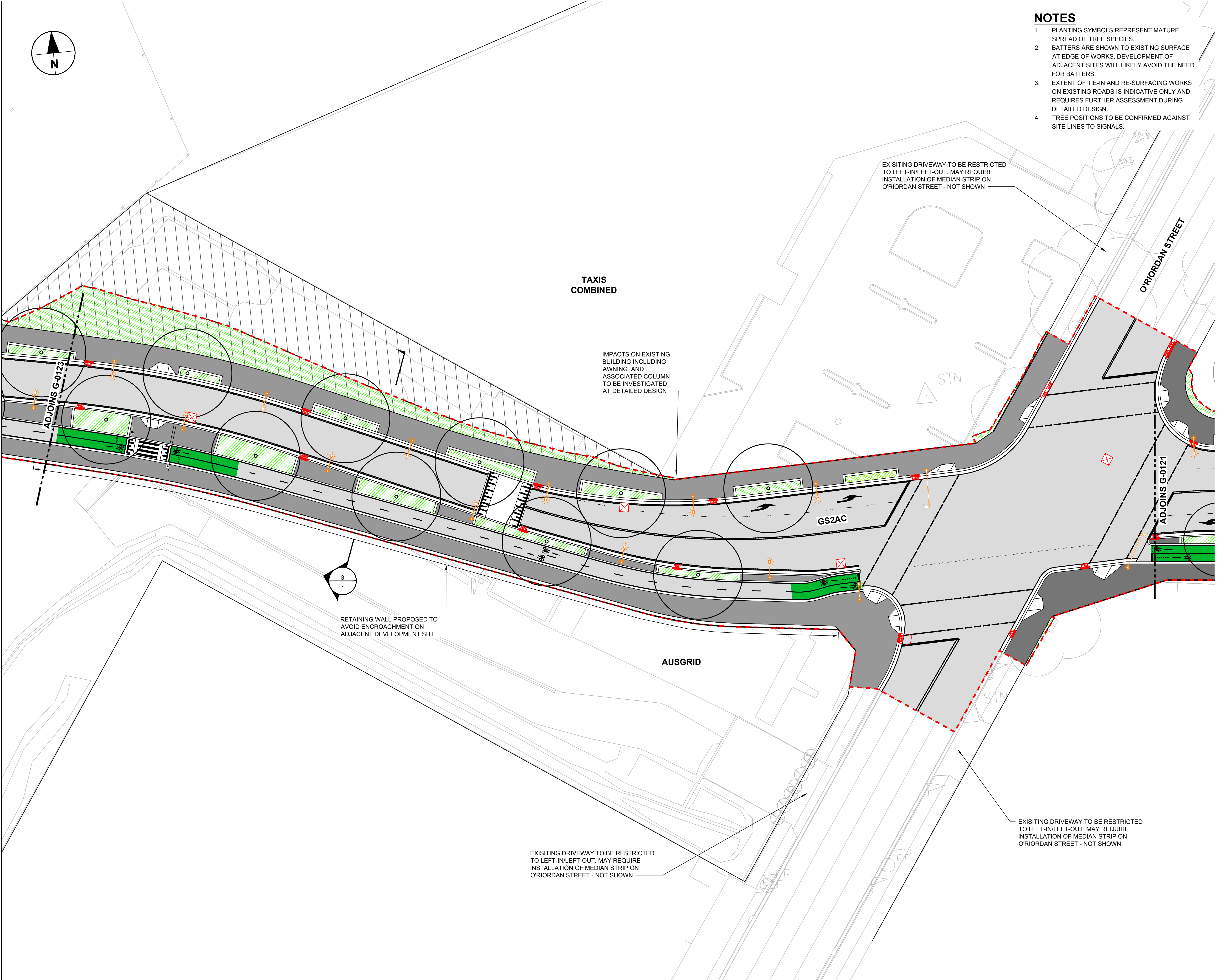
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Designer: JC
Project Management Initials:
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PROJECT

GREEN SQUARE TO ASHMORE CONNECTOR

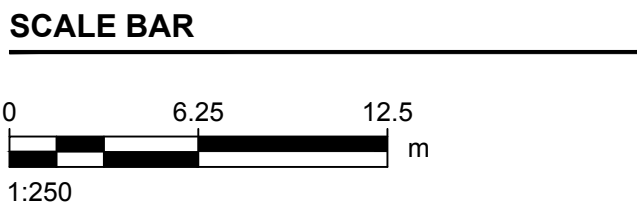
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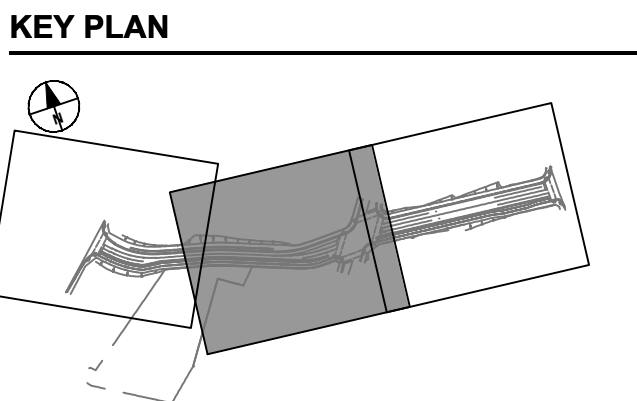
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SHEET TITLE

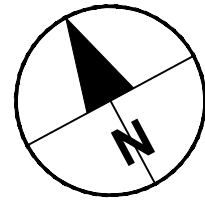
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PUBLIC DOMAIN
PLAN
SHEET 2

SHEET NUMBER

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REV

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EXISTING DRIVEWAY TO BE RESTRICTED
TO LEFT-IN/LEFT-OUT. MAY REQUIRE
INSTALLATION OF MEDIAN STRIP ON
BOWDEN STREET - NOT SHOWN

— THERE IS INSUFFICIENT SPACE ON BOWDEN STREET TO ALLOW A TURN BAY TO BE PROVIDED ON THE WESTERN APPROACH TO THE NEW SIGNALS. THE SUITABILITY OF A SINGLE LANE ON APPROACH (AND ASSOCIATED RMS APPROVALS) REQUIRES FURTHER INVESTIGATION AT DETAILED DESIGN

EXISTING DRIVEWAY TO BE RESTRICTED
TO LEFT-IN/LEFT-OUT. MAY REQUIRE
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BOURKE STREET - NOT SHOWN

NOTES

1. PLANTING SYMBOLS REPRESENT MATURE SPREAD OF TREE SPECIES.
2. BATTERS ARE SHOWN TO EXISTING SURFACE AT EDGE OF WORKS, DEVELOPMENT OF ADJACENT SITES WILL LIKELY AVOID THE NEED FOR BATTERS.
3. EXTENT OF TIE-IN AND RE-SURFACING WORKS ON EXISTING ROADS IS INDICATIVE ONLY AND REQUIRES FURTHER ASSESSMENT DURING DETAILED DESIGN.
4. TREE POSITIONS TO BE CONFIRMED AGAINST SITE LINES TO SIGNALS.



PROJECT

GREEN SQUARE TO ASHMORE CONNECTOR











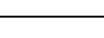



CLIENT



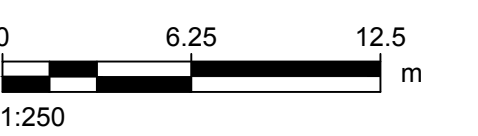
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LEGEND

- | | |
|---|---------------------------------------|
|  | EXTENT OF WORKS |
|  | CONCRETE UNIT PAVING |
|  | CONCRETE PAVING |
|  | FLEXIBLE ROAD PAVEMENT |
|  | CYCLEWAY ROAD PAVEMENT |
|  | SOFT LANDSCAPE |
|  | RAIN GARDEN |
|  | RESIDUE LOT |
|  | PROPOSED STREET TREE |
|  | VEHICLE CROSSING
(REFER TO DETAIL) |
|  | PRAM RAMP (REFER
TO DETAIL) |
|  | STREET SIGNS |
|  | LIGHTING COLUMNS |
|  | DRAINAGE PITS |

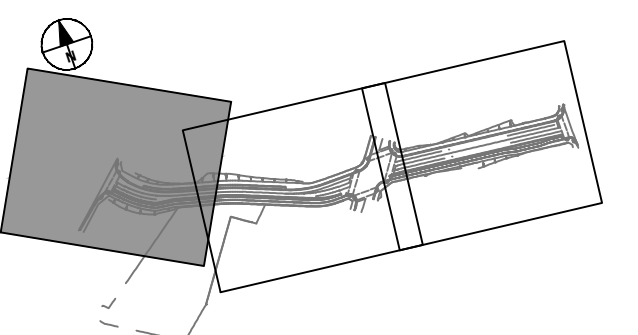
SCALE BAR



ISSUE/REVISION

01	16.10.17	CONCEPT DESIGN
I/R	DATE	DESCRIPTION

KEY PLAN



PROJECT NUMBER

60300384

SHEET TITLE

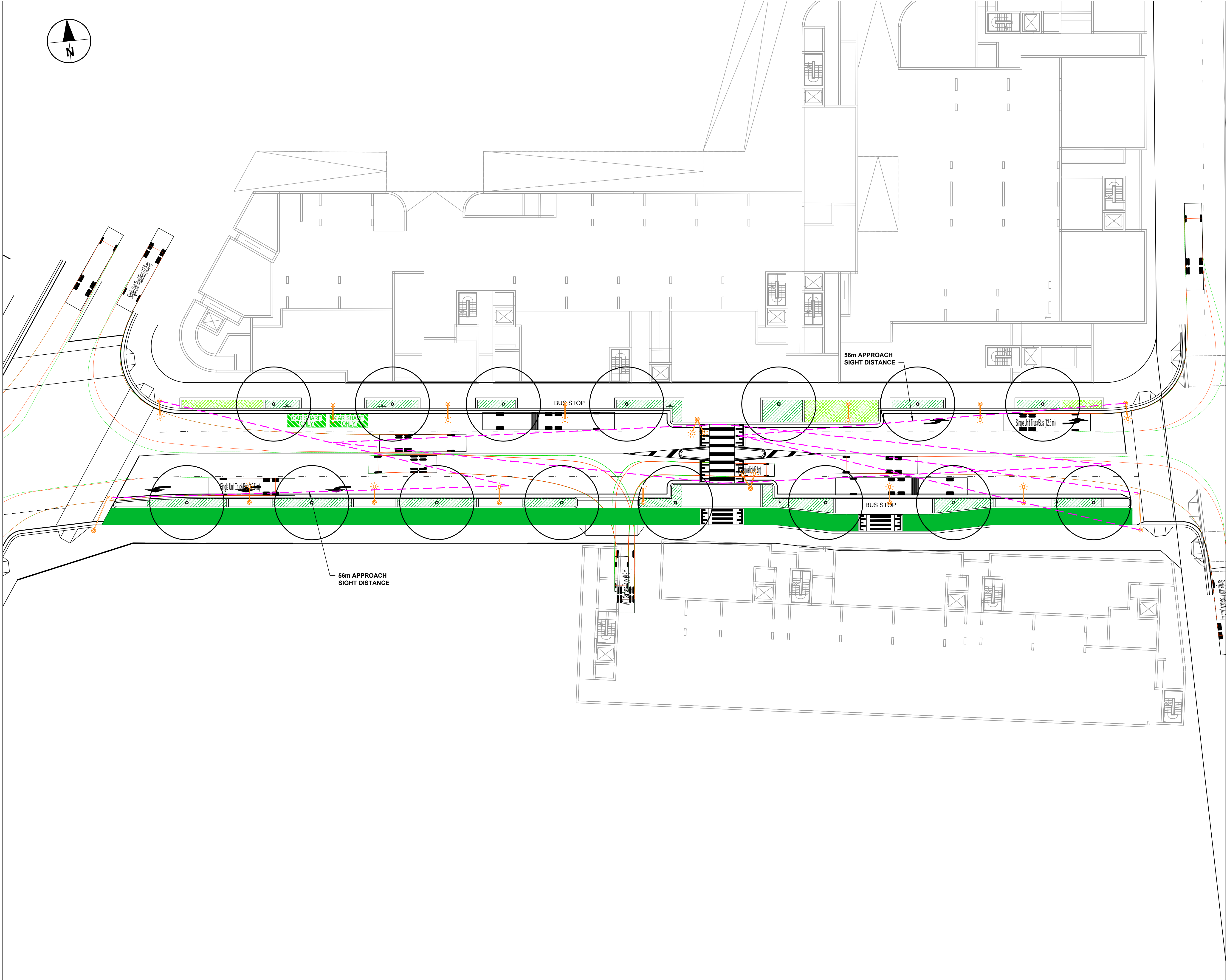
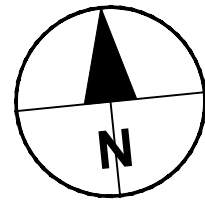
PACKAGE 6
PUBLIC DOMAIN
PLAN
SHEET 3

SHEET NUMBER

60300384-SHT-02-06-G-0123

EV

01



PROJECT

GREEN SQUARE
TOWN CENTRE
EIPD - PHASE 02

CLIENT



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LEGEND

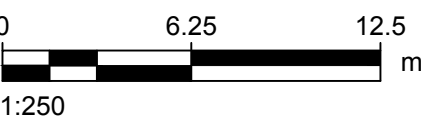
- SOFT LANDSCAPE
- RAINGARDEN
- PROPOSED TREE
- CYCLEPATH

NOTES:

SSD (50km/hr POSTED, 60km/hr DESIGN) - LOWER
VOLUME ROADS
 $R_T = 2.0s$ SSD = 64m
 $R_T = 1.5s$ SSD = 56m

$R_T = 1.5s$ ADOPTED BASED ON GS2AC SEEKING
TO ACHIEVE "ALERT DRIVING CONDITIONS"
BEING BUILT-UP AREA, RESTRICTED LOW SPEED
URBAN ENVIRONMENT, HIGH EXPECTANCY OF
STOPPING DUE TO TRAFFIC SIGNALS (AS PER
AUSTRROADS GUIDE TO ROAD DESIGN PART 3
GEOMETRIC DESIGN SECTION 5.2 SIGHT
DISTANCE PARAMETERS.

SCALE BAR



ISSUE/REVISION

I/R	DATE	DESCRIPTION
01	04.09.2017	ISSUED FOR REF

KEY PLAN

PROJECT NUMBER

60300384

SHEET TITLE

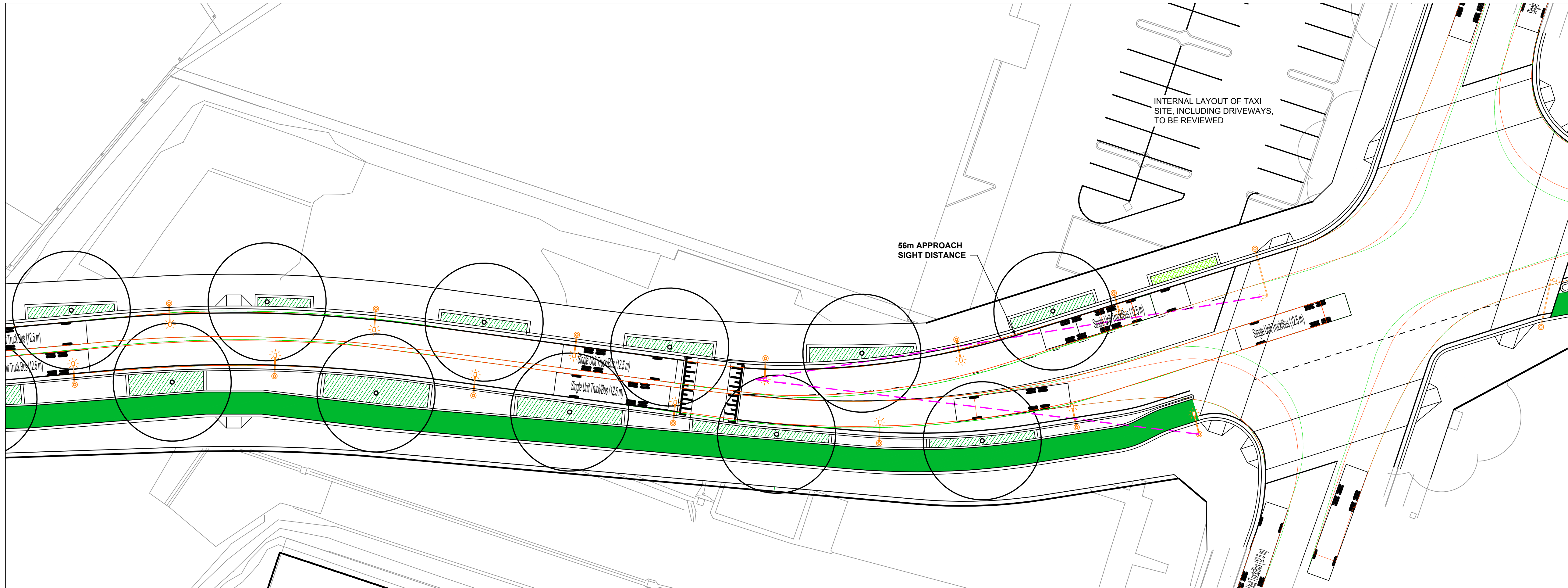
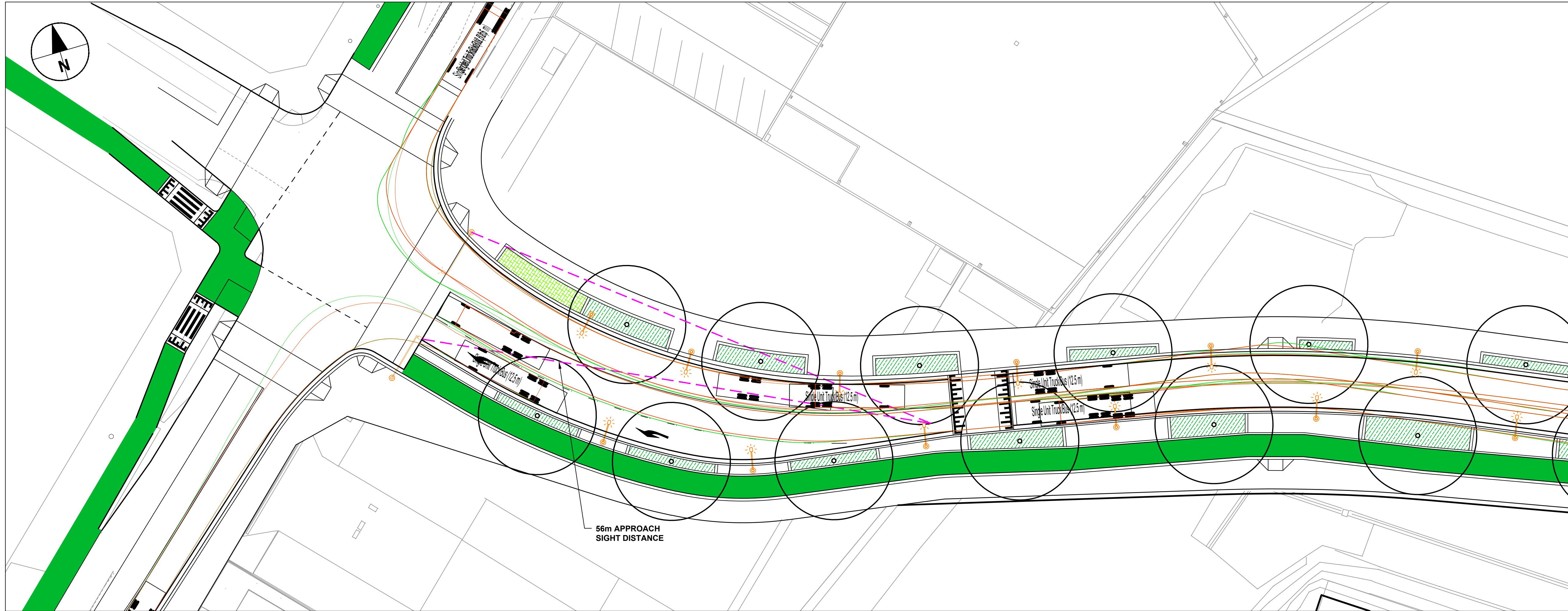
GREEN SQUARE TO ASHMORE
CONNECTOR
EASTERN LAYOUT
OPTION 4 PLAN

SHEET NUMBER

60300384-SKE-02-06-G-0040

REV

01



Appendix B

Technical Memorandum

Project	Green Square Town Centre	Job No:	60300384
Subject:	Right Turn Provision at Botany Road/Geddes Avenue/EWRR		
Created by:	Daniel Lee	Date:	05/05/2015
Reviewed by:	Seamus Christley	Date	05/05/2015
Approved by:	Rob Mason	Date	11/05/2015

Botany Road / Geddes Avenue / EWRR – Right Turn Provision

It is understood that the right turn provision from Botany Road (north) to East West Relief Road (EWRR) (west) at the proposed intersection of Botany Road / Geddes Avenue / EWRR is currently under review for the interim period (that is, following the completion of the EWRR but prior to completion of the final H-intersection works).

At our recent meeting (23 April 2015), it was suggested by RMS that this movement may not be required in the interim period with limited impacts on the broader network (noting that this movement is not currently accommodated). RMS confirmed that this right turn movement is required as part of the final intersection layout, once the final H-intersection layout is delivered.

Assessment of the traffic forecast to use the EWRR as part of the traffic modelling for Green Square Town Centre (GSTC) Essential Infrastructure and Public Domain (EIPD) project identified that the volumes for this movement would be relatively low, in comparison to the remainder of the intersection movements.

The volumes forecast for the right turn movement within the GSTC EIPD modelling are summarised in **Table 1**.

Table 1: GSTC EIPD modelled right turn volumes from Botany Road to EWRR

Peak Hour Period	Initial assessed volumes in Paramics modelling
2021 AM	31
2021 PM	23

On 20th March 2015, RMS issued 2-hour traffic forecast flow outputs from their *strategic model* for the EWRR (as part of the Traffic Impact Assessment work for the EWRR Review of Environmental Factors (REF)). These model outputs provided two scenarios of “without the EWRR” and “with EWRR” traffic flow conditions and shows that the EWRR does not induce traffic within the adjacent road network.

Based on the “with EWRR” forecasts (factored to represent the peak hour – 0.55 of the 2 hour peak), the right turn demand at the intersection of Botany Road / Geddes Avenue / EWRR for the movement from Botany Road to EWRR is summarised in **Table 2**.

Table 2: Right turn volumes from Botany Road to EWRR identified in the RMS Strategic Model

Peak Hour Period	Strategic volumes identified in the RMS Strategic Model
2021 AM	78
2021 PM	93

Table 2 shows that the *Strategic Model* suggests higher traffic flows for the right turn movement at the intersection Botany Road / Geddes Avenue / EWRR than originally assessed in the GSTC EIPD modelling in consultation with & approval of RMS. Impacts on intersection performance and extent of storage required for this additional traffic volume has not been tested as part of the GSTC EIPD modelling. As such, restricting this movement for the interim stage may improve the performance of this intersection, under the *Strategic Model* flow conditions.

Restricting the right turn movement from Botany Road (north) to EWRR (west) would not impact the performance of this intersection, rather it would improve the performance, under the “with EWRR” scenario. However this

demand would need to be facilitated at an adjacent location, similar to the current operations where there is no EWRR facility and hence no right turn provision.

It is noted that the extent of the modelling undertaken for this assessment is limited to the immediate GSTC area and as such cannot assess the alternative routes this traffic may take. However, it is envisaged that traffic will maintain the current patterns for access to Bourke Road.

Facilitating the right turn movement at an adjacent location would be no worse than the “without EWRR” conditions, since EWRR by itself does not induce traffic within the adjacent road network.