AECOM

Feasibility Study for West Belconnen Road Upgrade

Drake Brockman Drive and Stockdill Drive Upgrade

Prepared for Riverview Projects (ACT) Pty Ltd
26-Aug-2016

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Client: Riverview Projects (ACT) Pty Limited

ABN: 33 165 870 539

Prepared by

AECOM Australia Pty Ltd
Level 2, 60 Marcus Clarke Street, Canberra ACT 2600, Australia
T +61 2 6201 3000 F +61 2 6201 3099 www.aecom.com
ABN 20 093 846 925

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Executive Summary

The objective of the Drake Brockman and Stockdill Drive Upgrade project (the Project) is to provide design and construction management services for the Drake Brockman / Stockdill Drive road upgrade.

The Project covers Drake Brockman / Stockdill Drive east of the West Belconnen development, from the intersection of William Hovell Drive up to and including the section of Stockdill Drive approximately 250 m west of Britten-Jones Drive. The design of the Project integrates with the design for West Belconnen Avenue being undertaken as part of the Stage 1 EDP, as well as the approved design works for the Woodhaven Estate.

This report documents the outcome of the Feasibility Study and background investigations to support the Project. It has two volumes:

1. This document – an A4 report describing the background investigations and recommended design.
2. Design drawings – in A3 format.

The Feasibility Study covers the Stage 1, 2 and 3 road works. The Stage 1 works is the works recommended to proceed to construction in 2017. Future stages of the work will be triggered by changes in the traffic load that may occur along the corridor overtime.

Community Impacts

The expectations of the existing community need to be considered, especially residents whose homes front onto Drake Brockman Drive who will be directly impacted by the duplication. The key environmental considerations that will impact these residents include accessibility, visual, noise, as well as a potential loss of amenity.

Accessibility will require consideration and integration as part of the urban design, including access to residences fronting onto Drake Brockman Drive, connectivity to public transport, as well as coordination and upgrading of pedestrian, cyclist and recreational paths.

To mitigate any impacts, the Project will include new on road cycle ways and off road shared paths, pedestrian crossings, bus stops, landscape plan and it will maintain the continuity of the Bicentennial trail.

Road Safety Audit

To inform the design of the roadway an existing conditions road safety audit was undertaken. The highest safety risks that were identified in the audit are:

- Lack of adequate facilities for Pedestrians and cyclists (no pathway or on-road facilities, or adequate lighting) or connections to William Hovell Drive, Kingsford Smith Drive and Hawker.
- Lack of pedestrian links at bus stops and local suburbs exacerbated by wide roads, no crossing facilities, and lack of lighting.
- Poor road alignment and sight distance at intersection with Spofforth Street.
- Right turn and rear-end collisions at multiple intersections with no provision for right turns, turn volumes and speed.
- Poor protection of parked vehicles with wide unmarked pavement between Spofforth Street and Trickett Street, with no formal provision for cyclists or turning vehicles.
- Vehicles entering from Pine Ridge, Pegasus, and rural properties access and property access.
- Driveway accesses between Trickett Street and Macnaughton Street, especially in section

with rock retaining walls (124 to 142 Drake Brockman Drive) (poor sight distance).

— The roundabout at Kingsford Smith Drive and William Hovell Drive (poor southern approach alignment and small roundabout diameter).

The Project seeks to mitigate these issues through new turn lanes and intersection improvements, addition of service roads for local driveways, on road cycle ways and off road shared paths, and pedestrian crossings

Active Travel

An existing pedestrian footpath runs along the full length on the residential (north) side of Drake Brockman Drive, connecting to the broader Belconnen Town Centre cycleway and pedestrian network. The southern side of the road contains an equestrian trail connecting the open space and nature reserve activities. Reinforcing and enhancing these connections will be a key component of the Project, as well as to ensure integration with surrounding and future cyclist, recreation and pedestrian links.

Various options for the ultimate configuration of pedestrian and cyclist facilities were considered. The original concept involved a Copenhagen style arrangement at the intersections to give right of way to pedestrians and cyclists. This concept was dismissed due to safety, geometric constraints and staging practicalities. The construction of a cycleway on the southern side of Drake Brockman Drive was also considered as an option; however this concept was dismissed due to the low demand on the southern side of Drake Brockman Drive.

The following pedestrian and cycling facilities are proposed along the project road corridor:

— Stage 1 will include the addition of five pedestrian crossings and refuges.

— 2.0 m wide on-road cycle lanes on each carriageway to be developed as part of Stage 2 and 3

— 2.5 m wide shared paths on both verges of the corridor. The northern path will be constructed initially with the Stage 2 and Stage 3 works and the southern path when there is demand.

— Bus stops allocated on the downstream side of the intersections with Spofforth Street, Macnaughton Street and Kinsella Street with road crossings to and from the bus stops at these intersections via pedestrian / cycle signal controlled crossings.

The existing narrow pedestrian paths along the northern property boundaries between Spofforth Street and Kingsford Smith Drive will be maintained.

Equestrian Facilities

The Bicentennial National Trail (BNT) is located on the southern side of Stockdill Drive and Drake Brockman Drive. The proposed road upgrade will change the alignments and additional carriageways which will result in the relocation of the BNT further south.

The BNT will be relocated from the Stockdill Drive crossing point, sharing the new access to the Pine Ridge Equestrian Centre before becoming a generally 10 m wide naturally formed trail through to William Hovell Drive.

At the Drake Brockman Drive / William Hovell Drive intersection the proposal is to relocate the Trail along the ICON Water reservoir access track, along the east side of the reservoir and then via the water supply line easement to connect to the existing Trail at the William Hovell Drive underpass, as the upgraded intersection works requires the utilisation of land currently used for the Trail.

Public Transport

Drake Brockman Drive and Stockdill Drive are arterial roads that will be the primary traffic feeder for the future West Belconnen urban development. Relatively poor levels of public transport accessibility currently exist in the corridor. With the proposed urban development of West Belconnen, the demand for Drake Brockman Drive as a public transport route will increase and accessibility improved.

In the preliminary stages of the West Belconnen development interim local bus services will operate between West Belconnen and the Kippax Group Centre. During this stage the existing local bus services on Drake Brockman Drive will continue to operate. When the demand from the development of West Belconnen warrants the proposed rapid bus services the existing bus stops on Drake Brockman Drive will be removed and new indented bus stops will be introduced at Spofforth Street, Macnaughton Street and Kinsella Street.

Speed Environment

The road environment for the length of Drake Brockman Drive and to a lesser extent on Stockdill Drive, encourages travel speeds greater than the signposted speeds due to the generous curvilinear alignment and the wide pavement. The current sign posted speed limit on Drake Brockman Drive changes at Cussen Street where an 80 km/h speed limit exists east of Cussen Street and a 60 km/h speed limit to the west.

The proposed Stage 1 design for the upgrade of Drake Brockman Drive / Stockdill Drive involves minor civil works including the introduction of new line marking. To aid in the process of introducing the new line marking scheme and reduced speed environments predicted for the Stage 2 and 3, it is proposed to reduce the 80 km/h speed environment east of Cussen Street to 70 km/h and retain a 60 km/h speed limit west of Cussen Street.

It is planned to extend the 70 km/hr speed environment to Spofforth Street in the Stage 2 and 3 designs. Stage 2 will involve the development of a service road for residents on Drake Brockman Drive from Spofforth Street to Macnaughton Street allowing for a slightly increased speed in that section.

Road Design

Staging

Currently, the design is broken into three packages, Stage 1, 2, and 3. The trigger for the stages of work is dependent upon when certain traffic volumes are achieved. This increase in traffic volumes can be attributed to a variety of sources such as the Riverview Development, Woodhaven Estate, or other proposed developments that occur along the corridor.

Therefore, changes in traffic volumes should be reassessed over time as new developments may occur along the corridor.

Stage 3

Stage 3 of the upgrade works was determined initially to inform the designs for the Stage 1 and 2 works. The Stage 3 upgrade will involve a dual carriageway divided road with a service road between Spofforth Street and Macnaughton Street.

The alignment of the duplicated road (the westbound carriageway) will generally follow the curvature of the existing carriageway with the following exceptions:

- The existing 240 m radius curve on Stockdill Drive will be increased to 420 m to make it more constant with the radii of other curves encountered along the road. This shift of the new carriageway alignment will allow the gas mains and watermains required to service the West Belconnen Estate to be located on the northern side of the existing carriageway, where they are not affected by future earthworks.

Table 1 Triggers for Future Road Upgrades

Work	Triggers	Comment
Stage 1: Safety improvements	Safety Audit, community complaints, new development, construction works.	Will cater for future traffic growth, increased traffic access and reduce crash risks.
Stage 2: Service road	Safe access/egress to local properties. Desirable for volumes exceeding 500 veh/h adjacent to driveways. Highly desirable for traffic volumes exceeding 900 veh/h.	Will greatly improve access to local properties to alleviate increased traffic and longer delays accessing Drake Brockman Drive. Will improve intersection performance A number of other 2-way 2-lane roads with driveway access in ACT currently carry higher traffic volumes than 900 veh/h.
Stage 3: Duplication	Traffic congestion, dependent on intersection delays. Typically becomes an issue for traffic volumes exceeding 15,000 veh/day.	Intersections are the main constraint and resolution of intersection issues can delay the need for duplication, well beyond 15,000 veh/day. The intersection at William Hovell is the main constraint and this has ample capacity to carry higher volumes of traffic.

— The short arc radius 150 m curve at the western approach to Spofforth Street is to be replaced by a radius 450 m curve extending through the intersection to transition the duplicated roadway from the existing carriageway, to allow it to be converted to a service road.

— East of Macnaughton Street a 500 m radius curve has been introduced to transition the realigned eastbound carriageway back to the existing eastbound pavement.

The vertical alignment between the access to the West Belconnen Estate and a point about midway between Macnaughton Street and Cussen Street has been modified to resolve ASD deficiencies at intersections with Spofforth Street, Trickett Street and Macnaughton Street. Apart from providing ASD criteria the new geometry has considered the need to:

— Tie into the levels at existing intersections.

— Minimise construction of an elevated formation so as not to provide a barrier to the views from the residences located between Spofforth Street and Macnaughton Street, a desire expressed by those residents.

The cross section for the duplicated road will have the following configuration:

— 2.0 m wide on-road cycle lane;

— 4.0 m wide kerbside traffic lane catering for bus traffic;

— 3.5 m wide median side traffic lane; and

— 0.5 m wide median structural shoulder.

No kerbing is proposed on the median side of the carriageway so that pavement runoff can be directed to a bio-retention swale located in the depressed median to assist in meeting the ACT WSUD requirements. For similar reasons no kerbing is proposed on the interface of the verge and on-road cycle lane to allow stormwater runoff from the road pavement to flow to a bio-retention swale located on the southern of the off-road shared path

There will be provision a 5.5 m wide one-way eastbound service road between Spofforth Street and Macnaughton Street utilising the existing carriageway pavement and removal of redundant pavement. The service road will be ingressed off the intersections of Spofforth Street and Trickett Street whilst egress will be provided at Trickett Street and Macnaughton Street. Raised thresholds 3.2 m wide will be provided at each ingress / egress point to encourage slow speeds but also limit the potential for rat-running to bypass traffic signals on Drake Brockman Drive.

There will be 7.5 m wide verges flanking both carriageways, new and existing. These verges will grade towards the bio-retention swale to be located at the outside edge of the proposed 2.5 wide shared path. The verge will contain:

— Bus stops at Spofforth, Macnaughton and Kinsella Street intersections, located on the exit side of the intersections.

— Street lighting columns set-back 1.0 m from the edge of the on-road cycle lane (3.0 m from the edge of the traffic lane).

— 2.5 m wide shared path with 1.0 m clearance to light columns.

— Relocated / new utilities which may include a 600 mm diameter water supply mains, and a shared trench containing gas mains (size to be determined) low and high voltage electrical cables and communications cables.

— 4.4 m wide bio-retention swale with associated stormwater drainage pipes and sumps at outlets. This swale will be provided in both cut and fill conditions to ensure the optimum outcome are provided to meet the new WSUD guidelines.

Stage 1 upgrade

Stage 1 is proposed to the upgrade of line-marking to improve conditions for right-turning traffic into existing intersections and residential driveways. Five pedestrian refuges will be provided along the corridor.

Stage 2 upgrade

This stage will see the implementation of the works between the West Belconnen Estate access and Macnaughton Street as described previously in the Stage 3 works. Beyond Macnaughton Street and the transition to the existing carriageway, the Stage 1 work as described previously will be retained up to the Kingsford Smith Drive / William Hovell Drive intersection, apart from some minor improvements to the operational arrangements of the roundabout and potential signalisation of the Kinsella Street intersection.

Intersections

SIDRA modelling was undertaken for 7 intersections in the road corridor, based on 2016, 2021, 2031 and 2041 traffic forecasts from the CSTM and Commuter models, using the latest CSTM mode use assumptions.

Intersection Analysis and Traffic Forecasting was used to determine the future configurations and the triggers for signalisation and duplication.

Earthworks

Preliminary indications are that the earthworks to form the road will be relatively substantial given the need to:

- Construct the new westbound carriageway at a similar level to the existing carriageway as the relatively narrow median (6.5 m wide) does not allow any grade change between what will become the eastbound carriageway and the proposed westbound carriageway;
- Maintain levels at existing intersections to avoid level and grade changes when connecting the new westbound carriageway; and
- Construct the new westbound carriageway as low as possible to assist in noise amelioration at the existing residential properties located between Spofforth Street and Macnaughton Street as well as maintaining the present viewshed.

The Ultimate works will require 120,000 m^2 of cut and 45,000 m^2 of fill, resulting in 75,000 m2 of cut to be disposed elsewhere.

Property Access

Urban properties
There are 24 urban properties between Macnaughton Street and Spofforth Street which gain access from the north of Drake Brockman Drive.

The Stage 1 design will add a painted median between Spofforth Street and Macnaughton Street to improve the safety of ingressing vehicles travelling westbound into the existing residential driveways. A painted parking lane will be provided eastbound to assist safe ingress / egress to driveways.

The proposed Stage 2 works between Spofforth Street and Macnaughton Street will provide one-way (easterly direction) service road. The service road will provide good safety and operational conditions for the residents to access their driveways.

Rural properties
Significant safety improvements are proposed for accesses to Pine Ridge, Pegasus, the Molonglo Fire Brigade and Land's End properties. Accesses to all rural blocks will require work to be carried out within the leases to accommodate grading requirements due to the new westbound carriageway being primarily in cutting.

Services

A Dial Before You Dig (DBYD) enquiry showed evidence of the following utilities (aside from stormwater) located within the project limits: ActewAGL Electricity Network, Icon Water Network, Department of Finance (ICON Communications), Optus assets, Telstra NSW telecommunication cables, and Transact Communications infrastructure. A detailed survey of the project site has been completed and confirmed the location of these services. Potholing is proposed to be completed to provide more information for the next phase of design.

Water supply
The existing water main in the southern verge of the existing road will require an upgrade and relocation. It is proposed to upgrade the existing water main into a 600 mm diameter water main in the northern verge of Stockdill Drive and Drake Brockman Drive. The proposed water main is to be adjacent to and on the southern side of the existing stormwater main with varying offsets of approximately 8 – 10 m from the northern edge of the proposed on-road cycle lane. The timing and design of the main is dependent upon other factors and is not part of this project.

Electricity, telecommunications and street lighting
Due to the Boxgum Woodland areas through the whole extent of the road project overhead HV lines are recommended to be replaced by underground HV lines. It is proposed to have a shared trench containing 4 conduits (2 x HV and 2 x spare), streetlight conduit, and a telecommunications pit. It will be located underneath the future cycle path on the southern verge of the road project.

Gas
The existing 100 mm gas main in the southern verge of Stockdill Drive is proposed to be relocated on the northern verge of Stockdill Drive, behind the retaining wall of the proposed pedestrian / cycle path. The gas main is proposed to be located 2 m behind the retaining wall.

Stormwater
The existing stormwater system on Stockdill Drive consists of a minor culvert at Ch. 450 that discharges towards the Pine Ridge Equestrian Centre

Between Spofforth Street and Kingsford Smith Drive the existing stormwater system consists of sumps along the northern and southern kerb lines connected by small diameter pipes discharging to the north through residential blocks.

Given the issues of small diameter pipes and discharges through existing residential blocks with in most cases no overland paths for gap flows the proposed new drainage system not connect to the existing system and will drain to the south. The proposed stormwater management, combined with

WSUD measures is as follows for the Stage 3 of the work with some of system implemented in Stage 2.

It is proposed that this pipe system have collection sumps with upstream bio-filtration at regular intervals along the swale drain. Also the swale drain will assist in meeting WSUD requirements for the project as no kerbing is proposed on the road, except at intersections.

The depressed median will have sumps similar to the swale and connect to the swale longitudinal collector pipe system. The median will also contribute to meeting WSUD requirements as the road edges are not kerbed, except at intersections, as noted in this report and the new westbound carriageway is crowned to shed runoff towards the depressed median and southern swale.

Traffic Noise

General findings are:

- 29 receivers are predicted to exceed façade noise criteria by up to 4 dB at full development of West Belconnen, with the proposed geometric design and DGA pavement.
- 17 receivers (homes) are predicted to exceed façade noise criteria by up to 2 dB at full development of West Belconnen, with the proposed geometric design and SMA pavement.
- The private open spaces along Drake Brockman Drive generally comply with the private open space criteria.

In consideration of access requirements, visual amenity, cost and benefit, Stone Mastic Asphalt (SMA) road surface treatment is recommended. It should be noted that a 2 dB exceedance of criteria is considered 'minor', where a 2 dB change in noise levels is considered barely perceptible to the average person.

The extent of the exceedance, if any, will need to be monitored in future. Changes in vehicle technology and mode use may mean that no mitigation will be necessary, beyond the SMA road surface treatment

Environment

Biodiversity

The West Belconnen Strategic Assessment (SA), prepared by AT Adams Consulting (2016) detailed the key environmental considerations that would be impacted by the development. The primary outcome from the SA affecting the Project is that the removal of EPBC Act listed box-gum woodland along the road corridor cannot exceed 3.8 Ha.

In terms of biodiversity values protected under the NC Act, there is one area of box gum woodland identified within the road reserve corridor which meets the criteria for the listing under the NC Act. The quantum of impacts to this area has not been determined because mapping of this NC Act listed area has not been provided. It is recommended that the need for further survey should be confirmed by when the Project impact footprint has been finalised. This information should also be documented to support the application for a section 211 EIS exemption and satisfy the requirements under the PD Act with respect to consideration of the NC Act.

A tree survey is also recommended to be undertaken when the Project impact footprint has been finalised. This will inform the Conservator of Flora and Fauna's evaluation of a development application for any works involving tree removal, with consideration of the *Tree Protection Act 2005.*

Heritage

Initial consultation with ACT Heritage identified the requirement for a Cultural Heritage Assessment (CHA) to be undertaken as the land adjacent to Drake Brockman Drive / Stockdill Drive has potential to contain Aboriginal places and objects, and areas of low disturbance within the existing road corridors may also have potential for Aboriginal places to occur.

A CHA would determine the potential impact of the Project on heritage places and objects, recommend appropriate management strategies and enable the preparation of a Statement of Heritage Effect (SHE). The CHA and SHE would inform the ACT Heritage Council's evaluation of a section 211 EIS exemption with regard to the Project. The CHA and SHE should be submitted as soon as possible, prior to the section 211 EIS application.

Contamination

It is likely that an assessment of contamination would be required for the section 211 EIS exemption application which covers the Project impact footprint. It is recommended a PSI is completed to avoid potential delays.

Planning approvals program

The Project involves a number of planning approvals and consideration of their timing is critical.

Riverview intend to seek a section 211 EIS exemption under the ACT PD Act which covers the whole of the West Belconnen development including the Drake Brockman Drive / Stockdill Drive upgrade. A section 211 EIS exemption will enable a development application for the Project to be lodged without an EIS. The section 211 EIS exemption would need to be granted prior to lodging any development application for the Project, regardless of the nature of works the development application is seeking approval for.

In summary, the following items need to be completed prior to the submission of the section 211 EIS exemption.

- SA endorsement by the Commonwealth Minister for the Environment; anticipated to occur around January 2017.
- CHA and SHE (can be submitted for endorsement with the section 211 EIS exemption application) SHE; could take between three and eight months to prepare, depending on whether the need for further investigation is identified in the first phases of assessment.
- An assessment of contamination (a PSI is the first stage for this); would take approximately 1 to 2 months to prepare, but may take longer if a PSI identifies the requirement for further investigations.

The PD Act does not stipulate any statutory timeframes for the assessment of a section 211 EIS exemption application. However it is estimated the process could take 3 to 4 months from preparation of the application to an exemption being granted.

Box Gum Woodland Impacts

The maximum area of box gum woodland located on the southern side of the Stockdill Drive / Drake Brockman Drive road corridor that can be impacted by the West Belconnen Road Upgrade Works is 3.8 hectares. Initial calculations indicated that the area of disturbance would be approximately 4.5 hectares. As a consequence a retaining wall has been introduced along sections of the westbound carriageway verge to limit the impact of disturbance caused by earthworks on the box gum woodland. The length of this wall is approximately 1,800 m.

Opinion of Probable Costs

A preliminary assessment of probable costs has been calculated based on the three stages of development as follows (a 15% preliminary, 40% contingency and an escalation rate of 1% per year are applied in the assessment):

- **Stage 1**: Minor civil works including line marking and minor widening works to improve access to Pegasus. Assuming that the works will commence in 2017, the probable construction cost is $370,000 (excluding GST).
- **Stage 2**: Upgrade of Spofforth, Trickett and Macnaughton Street intersections to the ultimate arrangement with the signalisation of Macnaughton intersection and service road. Modification of Drake Brockman Drive/ Stockdill Drive west of Cussen Street. Assuming that works will commence in 2021, the probable construction cost is $28M (excluding GST).
- **Stage 3**: Duplication of whole extent of Drake Brockman Drive/Stockdill Drive. Upgrades to Cussen Street, Kinsella Street and Kingsford Smith Drive/William Hovell Drive intersection. Signalisation of Spofforth, Trickett and Kinsella intersections. Assuming that works will commence in 2031, the probable construction cost is $53M (excluding GST).

Cost Benefit Analysis

An economic evaluation was conducted on the following three design options against the base case do-nothing scenario:

- **Stage 1**: Minor line marking works to introduce turn pockets and reduce lane widths. Introduction of pedestrian refuge islands. (Optional reduction to 70km/h on Drake Brockman Drive east of Macnaughton Street)
- **Stage 2**: A new 2-way road with one lane in each direction and service road between Spofforth Street and Macnaughton Street, including reconstruction of intersections along this section of road and traffic signals at the Macnaughton Street intersection
- **Stage 3**: Duplication of the full extent of Drake Brockman Drive and Stockdill Drive including new traffic signals at Spofforth Street, Trickett Street and Kinsella Street. This includes Stage 2 works above.

The results of the appraisal are summarised as follows:

Option	NPV ($'000)	NPVI	BCR
Stage 1	-$4,693	-15.22	-6.14
Stage 2	-$26,031	-0.99	0.03
Stage 3	$172,136	4.13	5.05

The cost benefit appraisal comparing the net benefit of Option 2B, Option 3A and Option 3B against the do-nothing scenario found that Option 3B has a higher NPV and BCR and will provide the most benefits relative to costs.

Key Issues to be resolved

The Preliminary Sketch Plan (PSP) stage will follow. Key issues to be resolved in the PSP are:

1. A Cultural Heritage Assessment of land to be impacted by the road project.
2. Final Service locations
3. Refinement of extent of Stage 1 works
4. The provision of cycle facilities in the Stage 1 works.
5. Future provision and timing for off-road pedestrian and cycle facilities on the southern side of the road corridor.
6. Preparation of Traffic Control Device (TCD) Drawings, street-lighting design, pavement design, road safety design audit and Safety in Design report.

1.0 Introduction

1.1 Background

Riverview Projects (ACT) has identified the upgrade of Drake Brockman Drive and Stockdill Drive (the Project) as a high priority project to improve access to the future West Belconnen development. Riverview Projects (ACT) Pty Limited (Riverview) is the project manager for the planning of West Belconnen Estate, acting on behalf of a joint venture between the Australian Capital Territory represented by the Land Development Agency and Riverview Developments (ACT) Pty Limited.

The objective of the project is to provide design and construction management services for the Drake Brockman / Stockdill Drive road upgrade as part of the initial stage of the West Belconnen development.

The project covers Drake Brockman / Stockdill Drive east of the West Belconnen development, from the intersection of William Hovell Drive up to and including the section of Stockdill Drive approximately 250m west of Britten-Jones Drive. The design of the project integrates with the design for West Belconnen Avenue being undertaken as part of the Stage 1 EDP, as well as approved design works for the Woodhaven Estate.

This project is being delivered in three phases:

Phase 1: Feasibility Study

- Investigations to support the Feasibility Study; and
- Preliminary Sketch Plans (PSP).

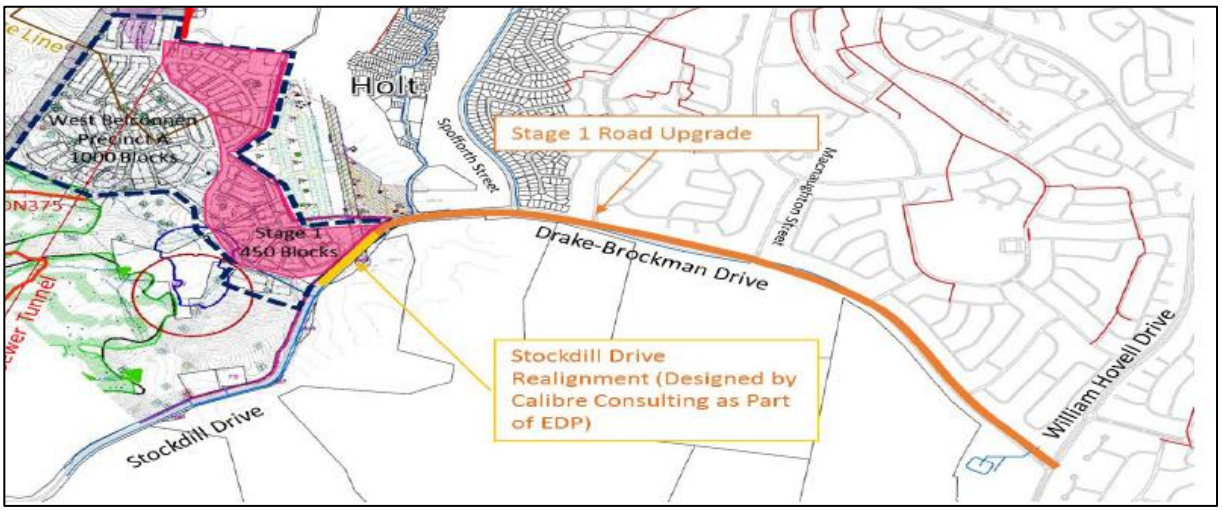
Phase 2: Stage 1 Upgrade:

- Value Management Workshop;
- Public Consultation;
- Development Application;
- Document Readiness; and
- Tender Documentation and Services.

Phase 3: Construction of Stage 1 works:

- Superintendence of construction works; and
- Site Surveillance

Figure 1 Project site



This report documents the outcome of the Feasibility Study and background investigations to support the first part of Phase 1. It is to be followed by a more detailed PSP design. This report has two volumes:

1. This document – an A4 report describing the background investigations and recommended design.
2. Design drawings – in A3 format.

The Feasibility Study covers the Stage 1, 2 and 3 road works. The Stage 1 works is recommended to proceed to construction in 2017. The Stage 1 work needs to minimise subsequent abortive work and has to be integrated with the Stage 1 EDP design. Future stages of the work will be triggered by changes in the traffic load that may occur along the corridor overtime.

Two options have been developed; one without a service road between Spofforth Street and Macnaughton Street and another with the service road.

1.2 Scope of Work

The Brief describes the scope of works for the Feasibility Study as follows:

- Obtain and review relevant background studies and data relevant to the study area.
- Confirm design requirements with TAMS.
- Review AECOM's report entitled "West Belconnen Technical Traffic Report, dated February 2015" and drawings and provide comments on any findings.
- Review Territory Plan DV 351 National Capital Plan DA 85 Report on matters raised during consultation period May – June 2015.
- Undertake constraint mapping to identify impact on existing and proposed services.
- Determine the extent / footprint of the Ultimate and Stage 1 road upgrade.
- Identify impact on existing land owners (i.e. area of land take) and residents.
- Determine the horizontal and vertical alignment for the Drake Brockman Drive / Stockdill Drive Ultimate and Stage 1 Upgrade.
- Determine the location, type and concept details of each intersection along Drake Brockman Drive / Stockdill Drive that needs to be upgraded (both Ultimate and Stage 1) for the proposed West Belconnen development.
- Identify the vertical and horizontal alignment requirements associated with each intersection, including the alignment requirements of the intersecting side roads (sufficient to confirm the alignment of the Drake Brockman Drive / Stockdill Drive Upgrade).
- Determine the road cross section requirements, including the location of services, parking, landscaping and total width of road reservation required.
- Confirm connection details of Drake Brockman Drive to William Hovell Drive and Stockdill Drive to West Belconnen Estate Entry Road.
- Determine location and size of all drainage work required for the upgrade of Drake Brockman Drive / Stockdill Drive.
- Advise on construction staging as well as recommend options to minimise abortive works.
- Prepare a P50 and P90 cost estimate in accordance with Department of Infrastructure and Planning "Best Practice Cost Estimation Standard for Publically Funded Road and Rail Construction" updated May 2011.
- Prepare and submit a Feasibility Study Report including the economic viability of options.

This report also documents a noise assessment, environmental studies and heritage studies undertaken as part of the Feasibility Study, public transport and active transport requirements. A topographical survey, traffic survey and a safety audit of the existing road has also been undertaken as part of the design.

Geotechnical surveys and services locations are planned to occur during the PSP Study, once the extent of Stage 1 works is agreed:

1.3 Key Project Inputs

Key inputs to this project are:

- The current design of West Belconnen Avenue for the Stage 1 EDP.
- The need to make provision in the design for a future 100 mm gas pipeline and 375 mm water pipeline from Spofforth Street to the West Belconnen Estate, and a 600 mm water pipeline from Macnaughton Street to the West Belconnen Estate.
- The approved intersection access design to the Woodhaven Estate and associated shared path linking to Spofforth Street on the north side of Stockdill Drive.
- A previous design and traffic analyses by AECOM in a report entitled "West Belconnen Technical Traffic Report", dated February 2015. This included road design criteria for the Stage 1 and Ultimate designs.

- A Strategic Assessment of the West Belconnen development under Part 10 of the *Environment Protection Biodiversity Conservation Act 1999*, including the road corridor for this project.
- A topographical survey, traffic survey and a safety audit of the existing road undertaken as part of this project to inform the design.
- Relevant design standards and guidelines from ACT Government, Austroads and Australian Standards.

1.4 Issues to be Resolved

Key issues to be resolved in the PSP are:

1. A Cultural Heritage Assessment of land to be impacted by the road project.
2. Final Service locations
3. Refinement of extent of Stage 1 works
4. The provision of cycle facilities in the Stage 1 works.
5. Future provision and timing for off-road pedestrian and cycle facilities on the southern side of the road corridor.
6. Preparation of Traffic Control Device (TCD) Drawings, street-lighting design, pavement design, road safety design audit and Safety in Design report.

2.0 Site Characteristics

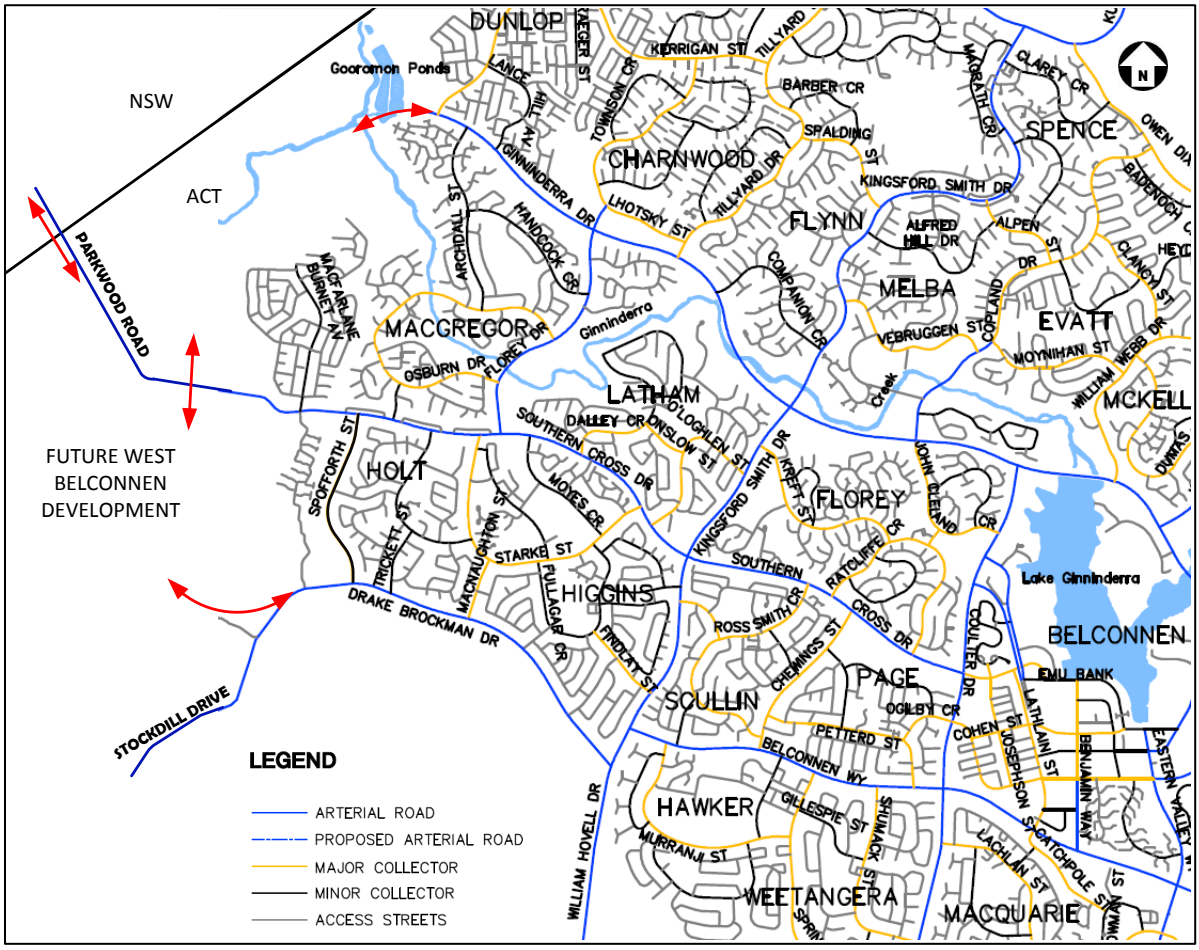
2.1 Context

The context of the project site can be viewed in a metropolitan or local context. The metropolitan context is how the road project fits into the overall land-use and transport plan for Canberra. This can be illustrated in a number of ways, including the road hierarchy or the public transport network; either existing or planned.

The road hierarchy is illustrated in

Figure 2. This shows Stockdill Drive and Drake Brockman Drive as arterial roads.

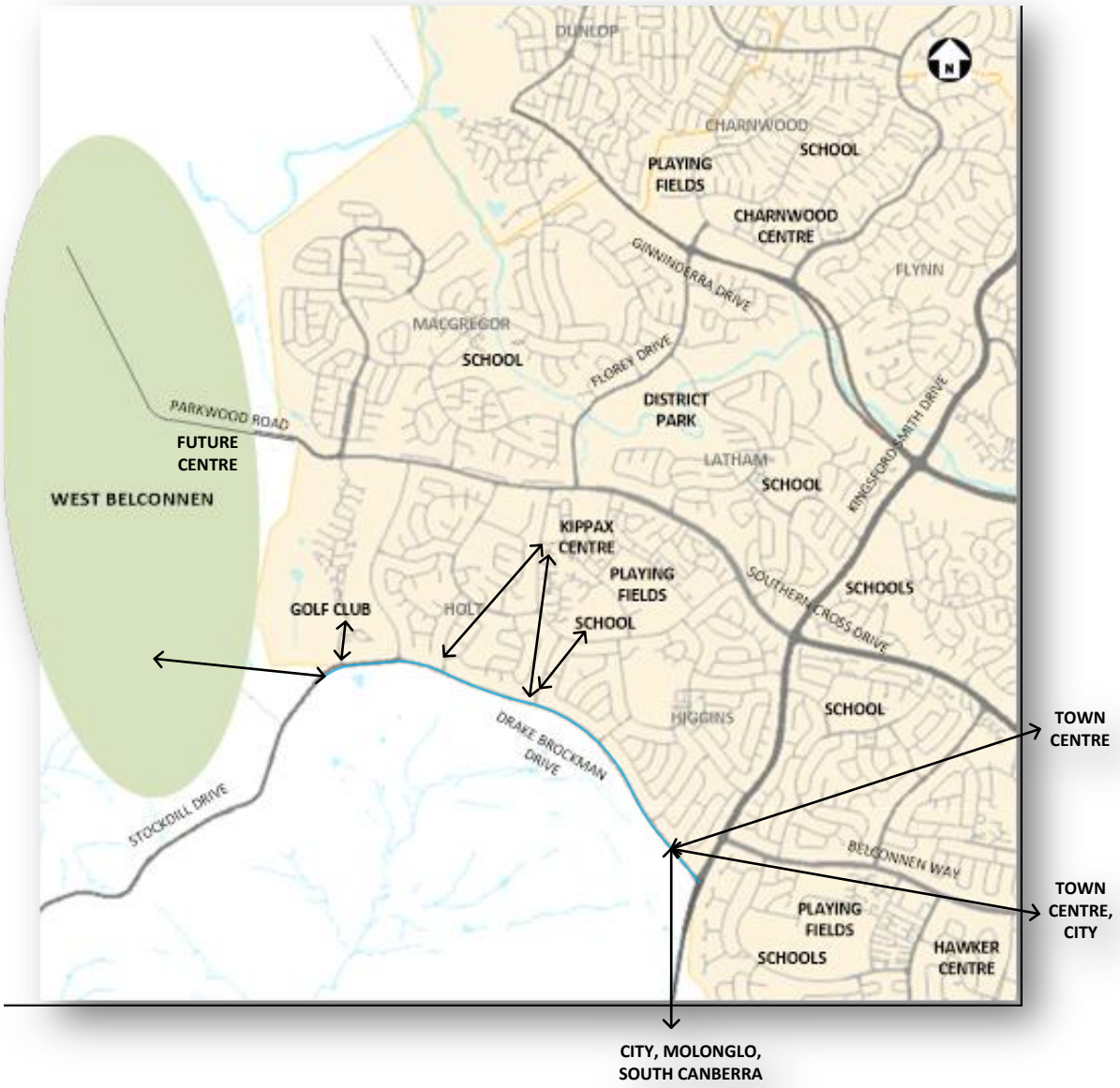
Figure 2 Road hierarchy



Source: TAMS 2013

The local context is how the road project serves the nearby local community. This can be illustrated in a number of ways, including adjoining land-uses, provision for active modes of travel and safe access to the transport network. This is illustrated in Figure 3. More details follow in Section 2.2 and Chapters 3 and 4.

Figure 3 Local context



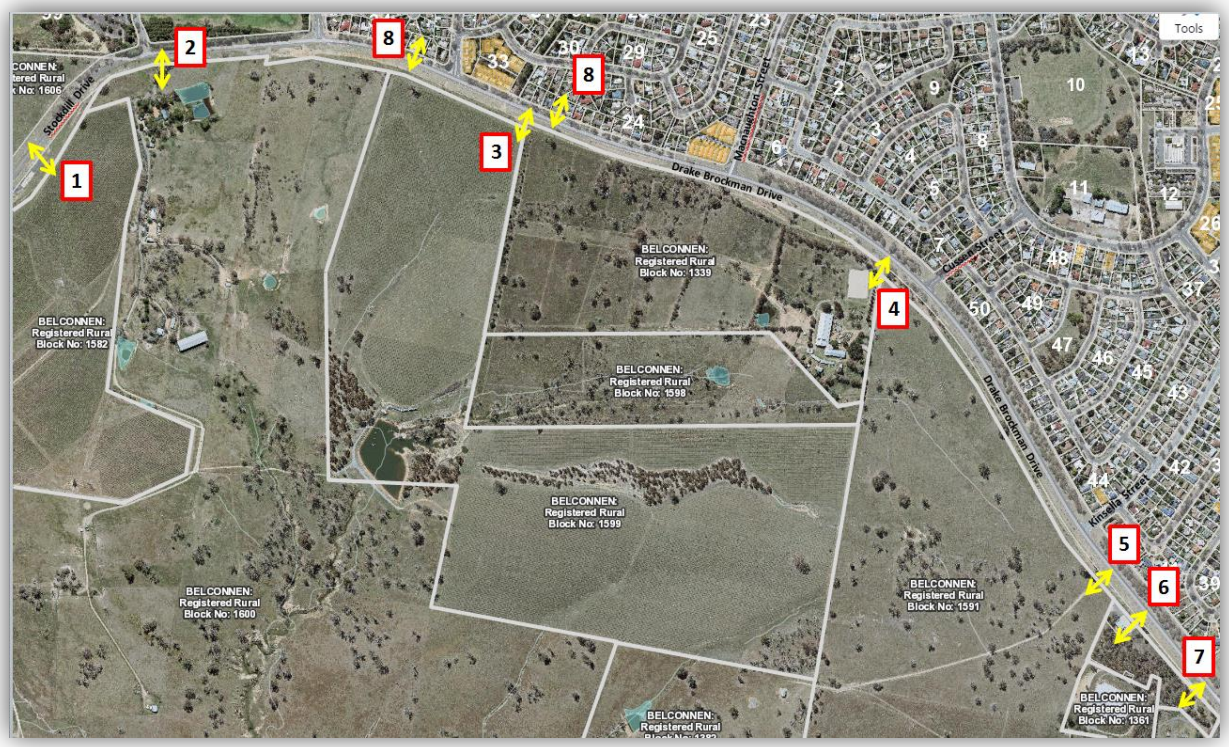
2.2 Adjoining Properties and Access

The adjoining properties and access points used in Table 2 the project road corridor are listed in Table 1 and their locations shown in Figure 4.

Table 2 Leaseholder access points to the Road corridor

Access Reference Point	District/Block	Description
1	Belconnen/Block 1469	ActewAGL Effluent Infrastructure
2	Belconnen/Block 1600	Pine Ridge and Kamberra Vineyard
3	Belconnen/Block 1599	Kambera Vineyards
4	Belconnen/Block 1339	Pegasus Riding for the Disabled
5	Belconnen/1382	Private leaseholder
6	Belconnen/Block 1564	Molonglo Brigade, ACT Rural Fire Service
7	Belconnen/Block 1592, 1591, 1565, 1361, 1372, 1382	Icon Water Reservoir, Land's End (LDA), Molonglo River
8	Parts of Holt Sections 24, 33 and 34	Residential dwellings to north of road corridor, between Spofforth Street and Macnaughton Street

Figure 4 Map of adjoining properties and access points to the Road corridor



Stakeholder consultation was held during May and June 2016 with various rural leaseholders. The purpose of the stakeholder consultation was to receive feedback regarding current and potential issues with property access points to the project road corridor. In this consultation, a number of issues regarding safety and ease of access were raised. Key outcomes from this consultation are tabulated in Table 3. The stakeholder consultation notes can be found in Appendix A.

Table 3 Access issues raised in stakeholder consultation

Access Reference Point	Description	Issues
1	**ActewAGL Effluent Infrastructure**	Nil
2	**Pine Ridge and Kamberra Vineyards**	— A number of near misses have occurred at the Pine Ridge driveway entrance. — Steep grade at the driveway entrance causes issues for drivers merging into traffic. — Poor sight distance, particularly to the west.
3	**Kamberra Vineyards**	Nil
4	**Pegasus Riding for the Disabled**	— No formal driveway to Pegasus resulting in issues for drivers slowing down to enter the area. — Current signage at entrance is poorly marked and Pegasus is currently looking at applying for a new sign via TCCS. — Poor sight distance when approaching the site. — Narrow drive requires vehicles to 'hug' the centre line when pulling in. There have been a few occurrences where vehicles have tried to pass on the left causing near misses.
5	**Private leaseholder**	Nil
6	**Molonglo Fire Brigade**	To be consulted
7	**Land's End (LDA) / BNT**	— Currently steep grade trail at William Hovell raised by the BNT. — Farm closure could mean that the trail could be pinched off. Full connection to William Hovell Drive is desired. — Construction conflict with riders using the trail should be considered.
8	**Drake Brockman Drive residents**	— Road safety, especially driveway access and pedestrian crossability — View to Molonglo Valley and Brindabella mountains and concerns regarding potential noise walls — Refer Appendix A for further details

2.3 Existing Topography

A contour map of the road corridor is given in Figure 5. Drake Brockman Drive is situated on a ridge with various high points located north and south of the road. The terrain along the road consists of steep slopes along the rural properties south of the road and milder slopes in the residential area north of the road. The rural properties south of the road have grassed terrain grading south towards the Molonglo River. The Golf Course and neighbouring residential blocks on Britten-Jones Drive are located at the crest of a hill with relatively steep downhill grades towards Stockdill Drive.

Figure 5 Existing Topography of West Belconnen Road

Source: ACTMapi (2016)

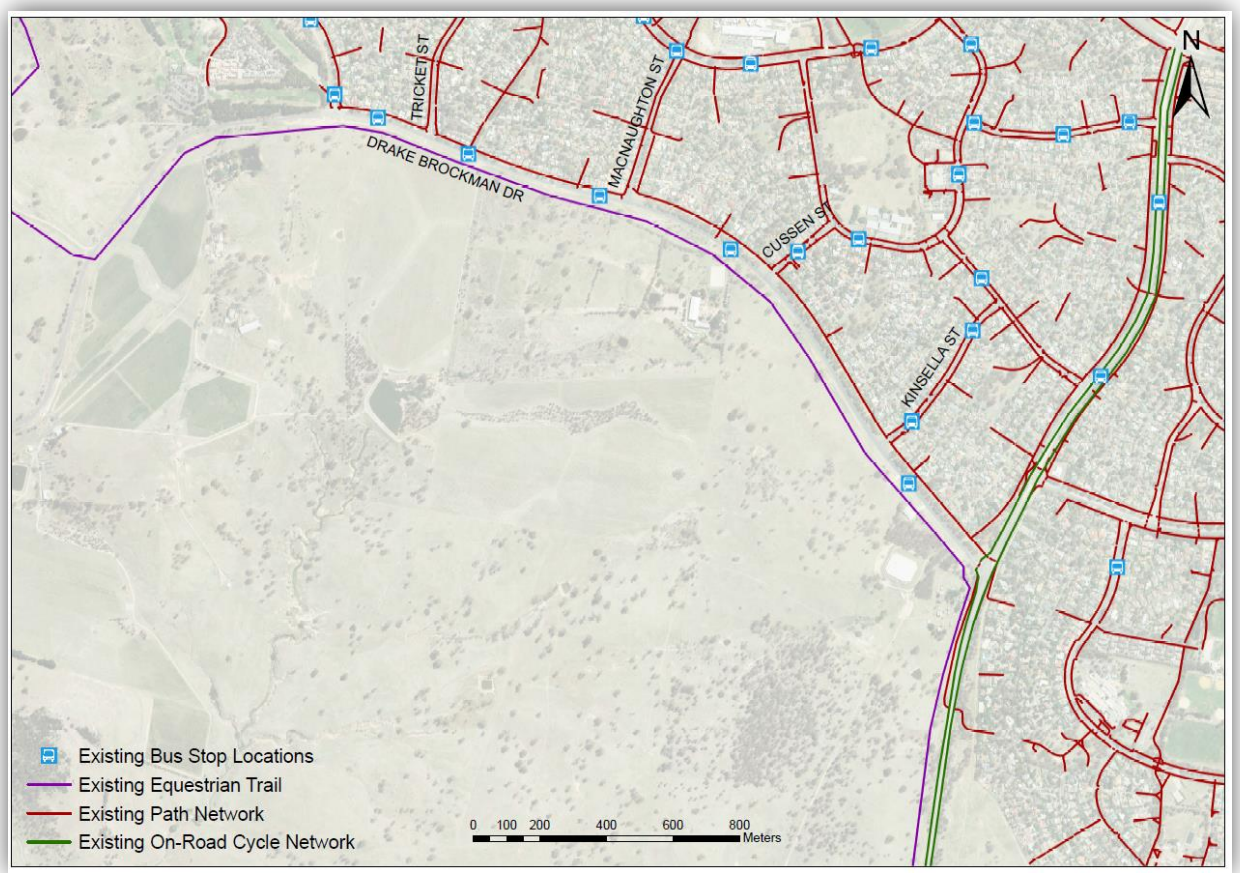
3.0 Active Travel

3.1 Pedestrian and Cyclist Facilities and Demand

3.1.1 Existing Facilities

The map in Figure 6 indicates existing pedestrian and cyclist facilities in the vicinity of the road project. Key deficiencies with these facilities have been identified in the road safety audit (Appendix B).

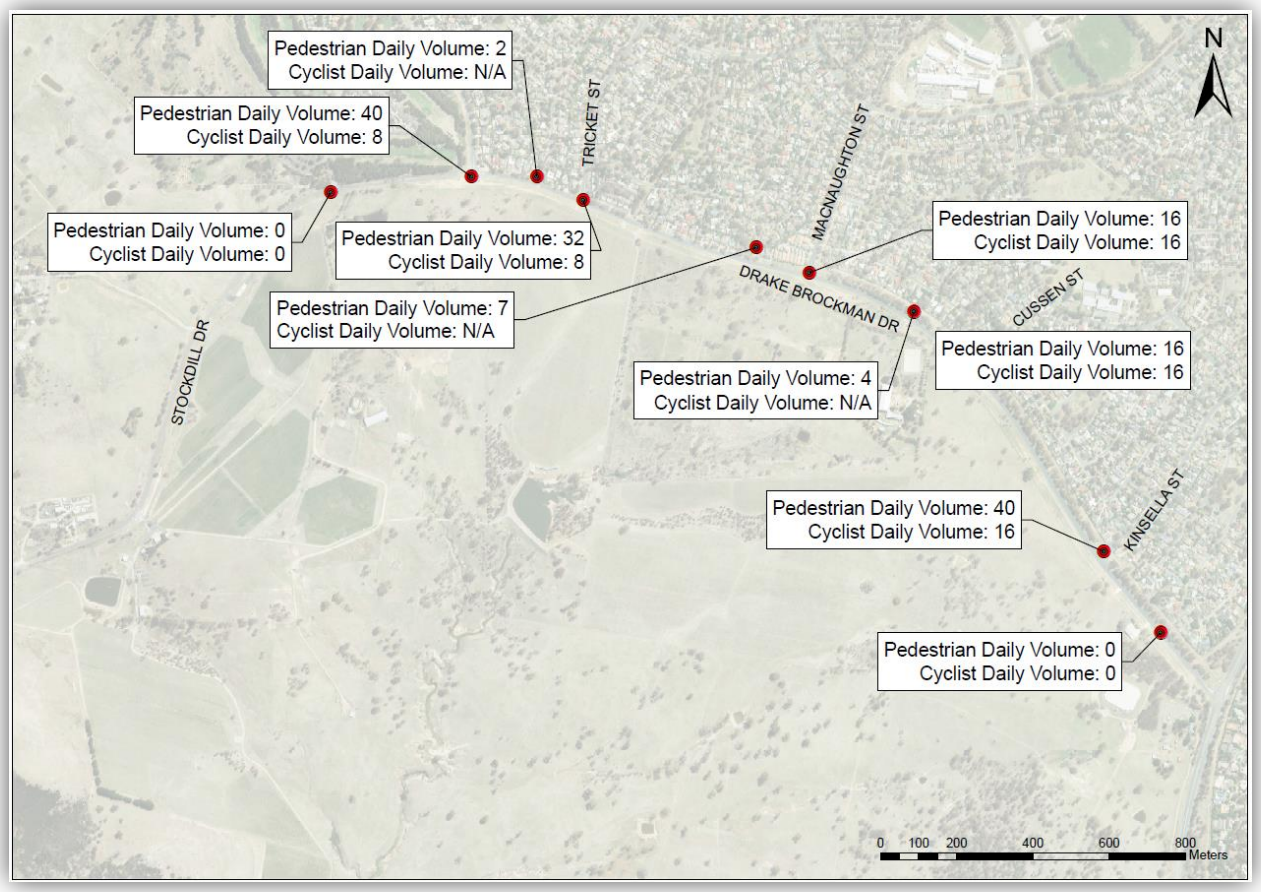
Figure 6 Existing Pedestrian and Cyclist Access Plan



3.1.2 Current Demand

The current demand for pedestrian and cyclist facilities was determined via data collected as part of traffic surveys undertaken in May 2016. A summary of the results of the surveys is shown in Figure 7. Daily pedestrian volumes vary along the length of Drake Brockman Drive, although higher at the key intersections. The volume of both pedestrians and cyclists at the eastern end of Drake Brockman Drive was observed to be zero, this is likely to be due to the low level of desirable cyclist / pedestrian connections near here.

Figure 7 Pedestrian and Cyclist Survey Results (May 2016)



3.1.3 Future Demand

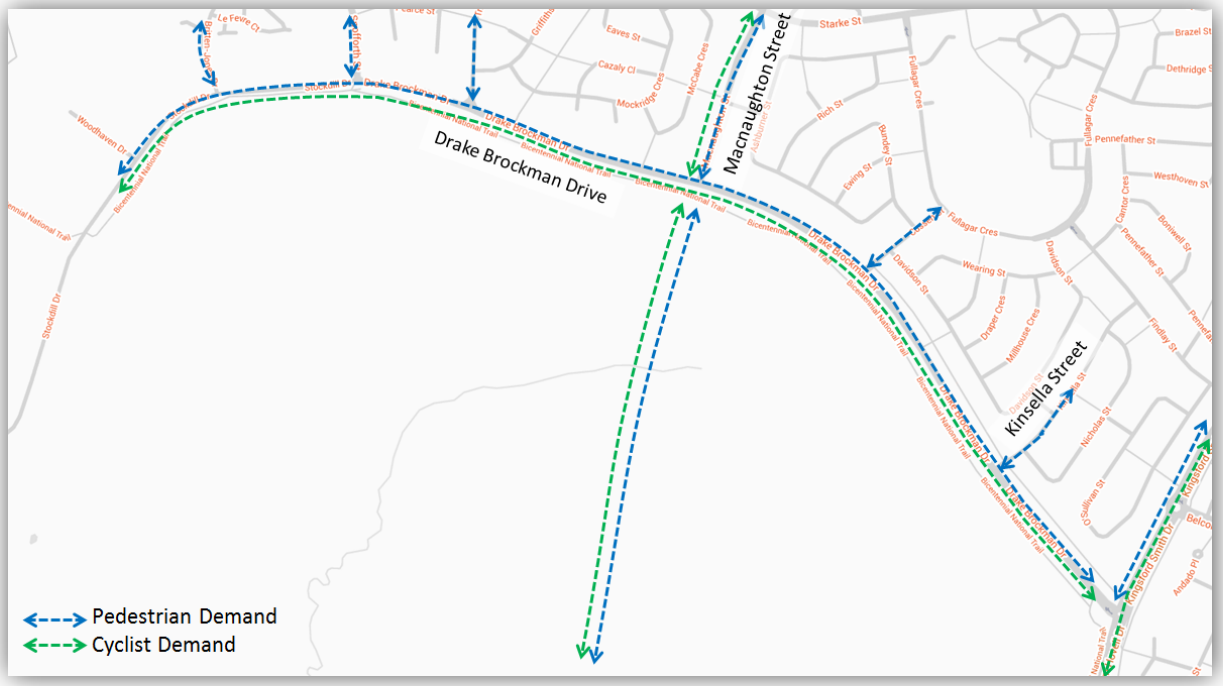
The future demand of pedestrians and cyclists on Drake Brockman Drive has been analysed in terms of the current and future desires and demands on the road and the surrounding network. Future pedestrian and cycle desire lines are shown in

Figure 8. Various options for the ultimate configuration of pedestrian and cyclist facilities were considered. The original concept involved a Copenhagen style arrangement at the intersections to give right of way to pedestrians and cyclists. This concept was dismissed due to safety, geometric constraints and staging practicalities. The construction of a cycleway on the southern side of Drake Brockman Drive was also considered as a development option; however this concept was dismissed due to the lower demand on the southern side of Drake Brockman Drive, potential future development to the south of Drake Brockman Drive could increase the demand of cyclists in this location.

The details of the proposed future staging are as follows:

- **2021**: Minor path connections at western end of Drake Brockman Drive, connecting Spofforth Street to Britten-Jones Drive in the northern verge of Drake Brockman Drive and the addition of pedestrian refuge at local crossings and bus stops.
- **2031**: Intersection improvements for the length of Drake Brockman Drive including improvements to pedestrian crossing facilities. Signalisation of Macnaughton Street and Kinsella Street intersections including signalised pedestrian crossings, improvements to the intersection of William Hovell Drive and Drake Brockman Drive and shared path in the northern verge of Drake Brockman Drive.
- **2041**: Signalisation of Spofforth Street and Trickett Street intersections including signalised pedestrian crossings.

Figure 8 Future Pedestrian and Cyclist Demand



3.1.4 Future Facilities

The strategy plan for future pedestrian and cyclist facilities for the road corridor are shown in Figure 9. It includes a potential future link to the south from Macnaughton Street.

For Stage3 the following pedestrian and cycling facilities are proposed along the project road corridor:

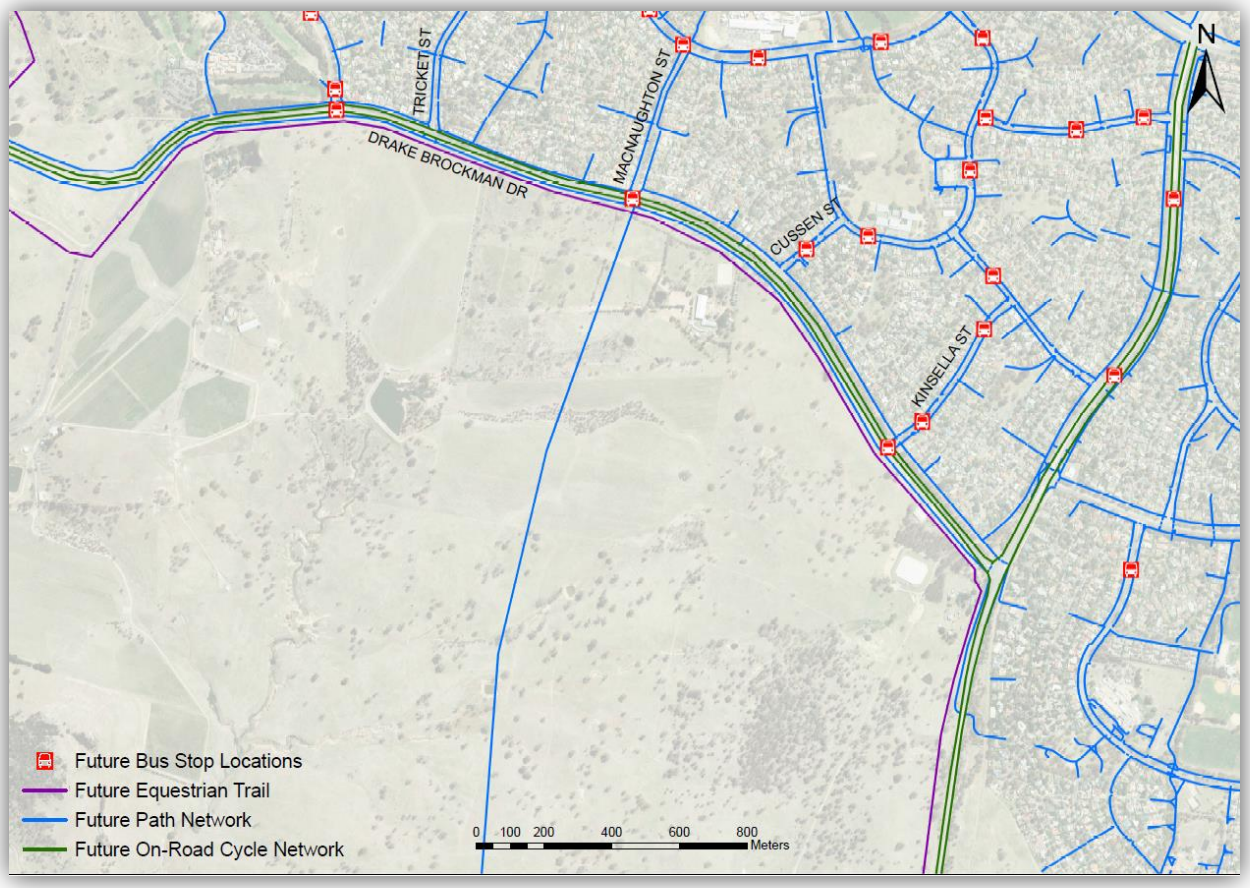
- 2.0 m wide on-road cycle lanes on each carriageway in Stage 2 and the Ultimate Stage.
- 2.5 m wide shared paths on both verges of the corridor. The northern side path will be constructed initially with the Stage 2 and 3 works and the southern side path when there is a demand.
- Bus stops allocated on the downstream side of the intersections with Spofforth Street, Macnaughton Street and Kinsella Street with road crossings to and from the bus stops at these intersections via pedestrian / cycle signal controlled crossings.

The existing narrow pedestrian paths along the northern property boundaries between Spofforth Street and Kingsford Smith Drive will be maintained.

At the upgraded roundabout at the intersection of Drake Brockman Drive, Kingsford Smith Drive and William Hovell Drive uncontrolled crossings are to be provided on the northern and western roundabout legs to provide north-south and east-west linkages. This will improve the facilities at the intersection, but further improvements will be needed to enhance links along William Hovell Drive, Kingsford Smith Drive and into Hawker to the east of the intersection.

At the access into the West Belconnen Estate there is a need to determine the form of the transition from the Copenhagen style bicycle and pedestrian paths to the proposed shared paths and on-road cycle lanes forming the active functions along Stockdill Drive and Drake Brockman Drive. The ideal location of this transition would be to the west of Spofforth Street at the first signalised intersection of the new West Belconnen development. In this location the neighbourhood development transitions from an urban to a rural environment and making this the preferred location to transition the cyclist path types.

Figure 9 Future Pedestrian and Cyclist Facilities



3.2 Equestrian Facilities

Consultations held with stakeholders and residents of Holt and Higgins indicated that the Bicentennial National Trail (BNT) is a well utilised path by pedestrians, cyclists and equestrian riders. The proposed road upgrade will require new road alignments to facilitate additional carriageways which will result in the relocation of the BNT further south.

The BNT is located on the southern side of Stockdill Drive and Drake Brockman Drive. At Stockdill Drive the BNT is located within Studio Road, the access to the Strathnairn Arts Association, a public road, and crosses to the southern side of Stockdill Drive. From that crossing point it runs roughly parallel to Stockdill Drive / Drake Brockman Drive.

The BNT will be impacted by the new westbound carriageway over its total length between the access into the West Belconnen Estate on Stockdill Drive and William Hovell Drive.

The BNT will be relocated from the Stockdill Drive crossing point to the northern end of Rural Block 1582 sharing the new access to the Pine Ridge Equestrian Centre before becoming a generally 10 m wide naturally formed trail beyond the limit of the Stockdill Drive / Drake Brockman Drive earthworks through to William Hovell Drive.

The BNT will pass through box gum woodland abutting the road and road cut / fill batters elsewhere. In certain areas within the box gum woodland impact area, retaining walls are required to reduce the impact of the road cut / fill batters. Advice has been received that the use of the box gum woodland for the relocated BNT is an acceptable use provided no disturbance is caused to the ground to create a formal track. Hence the users of the Trail will make their own “tracks” through the 10 m wide reserve controlled by fencing along the westbound carriageway batters / retaining walls and the southern edge forming the new road gazettal boundary.

Along William Hovell Drive south of Drake Brockman Drive the BNT is located on the west side of William Hovell Drive and is impacted by the upgrades to the existing roundabout as proposed in the Ultimate Stage of the road Upgrade works.

At the Drake Brockman Drive / William Hovell Drive intersection the proposal is to relocate the Trail along the ICON Water reservoir access track (Rural Block 1565), along the east side of the reservoir (Rural Block 1361) and then via the water supply line easement (Rural Block 1372) to connect to the existing Trail at the William Hovell Drive underpass, as the upgraded intersection works requires the utilisation of land currently used for the Trail. This is shown in Figure 10.

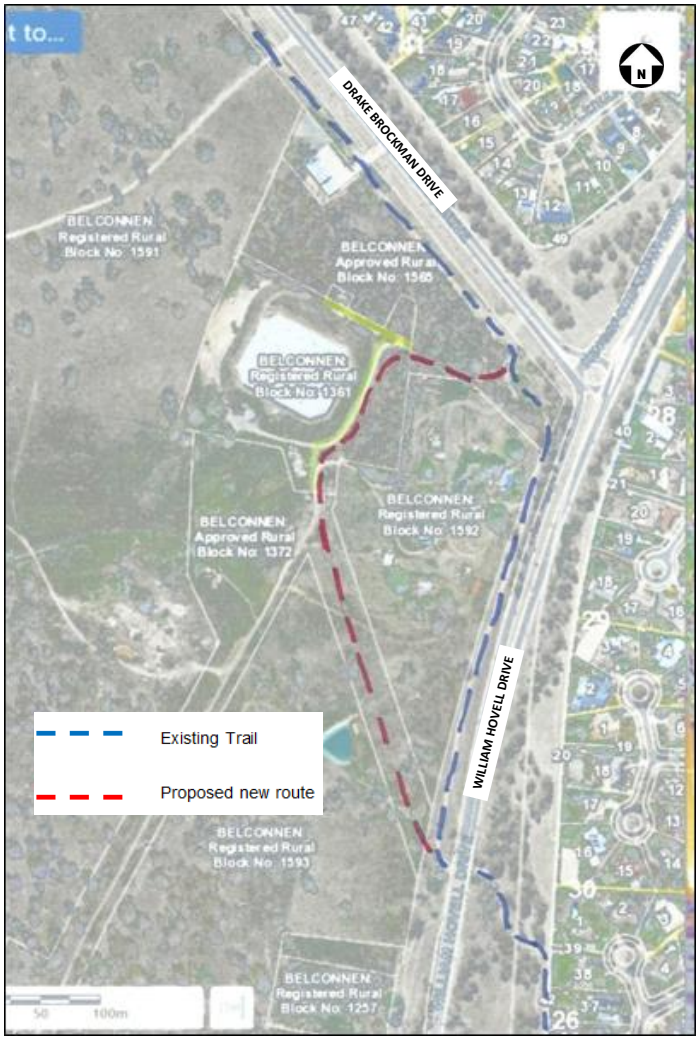


Figure 10 Existing and Proposed Bicentennial National Trail

4.0 Public Transport

4.1 Existing

4.1.1 Services

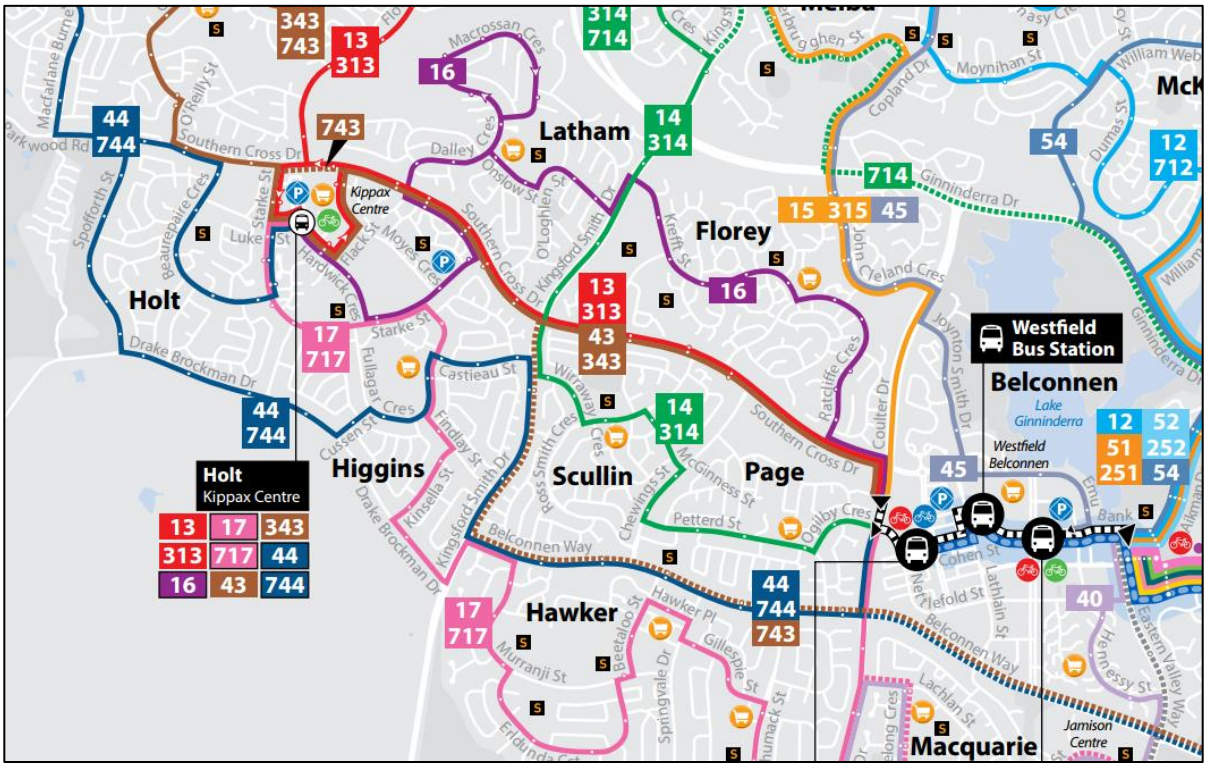
The existing bus services on Drake Brockman Drive are summarised in Table 4. The current frequency of buses in the AM inbound peak is 10 buses per hour.

The existing routes outlined in Table 4 are shown in the map in Figure 11. Routes 44 and 744 travel along the western end of Drake Brockman Drive, while routes 17 and 717 travel along the eastern end of Drake Brockman Drive.

Table 4 Existing Bus Services

Route No	Route Description	Frequency On / Off peak	AM Peak Hour Frequency City-bound	AM Peak Hour Frequency Local	PM Peak Hour Frequency City-bound	PM Peak Hour Frequency Local
17	Kippax Bus Station to National Circuit via Belconnen Community Bus Station	20min / 30min (6:37am – 10:32pm)	3	3	3	3
44	Kippax Bus Station to National Circuit via Belconnen Community Bus Station	20-30min / 60min (6:06am – 10:23pm)	3	2	3	2
717	Kippax Bus Station to National Circuit via Belconnen Community Bus Station	30min / - (7:01am – 6:43pm) (Three services in each peak)	2	0	0	2
744	Kippax Bus Station to National Circuit via Belconnen Community Bus Station	30min / - (6:42am – 6:24pm) (Three services in each peak)	2	0	0	2
		TOTAL	**10**	**5**	**6**	**9**

Figure 11 Existing Bus Services



4.1.2 Accessibility

Drake Brockman Drive has been analysed in terms of the existing level of accessibility to public transport for the surrounding blocks. The analysis was undertaken using the Public Transport Accessibility Level (PTAL) index developed by Transport for London. The index determines the walking distance and average wait time to a bus stop from each residential block in order to calculate levels or grades of public transport accessibility. An assessment grade of 1 to 6 is given to each of the residential blocks. A visual representation of the Drake Brockman Drive PTAL is illustrated in Figure 12. This shows that relatively poor levels of public transport accessibility currently exist in the corridor.

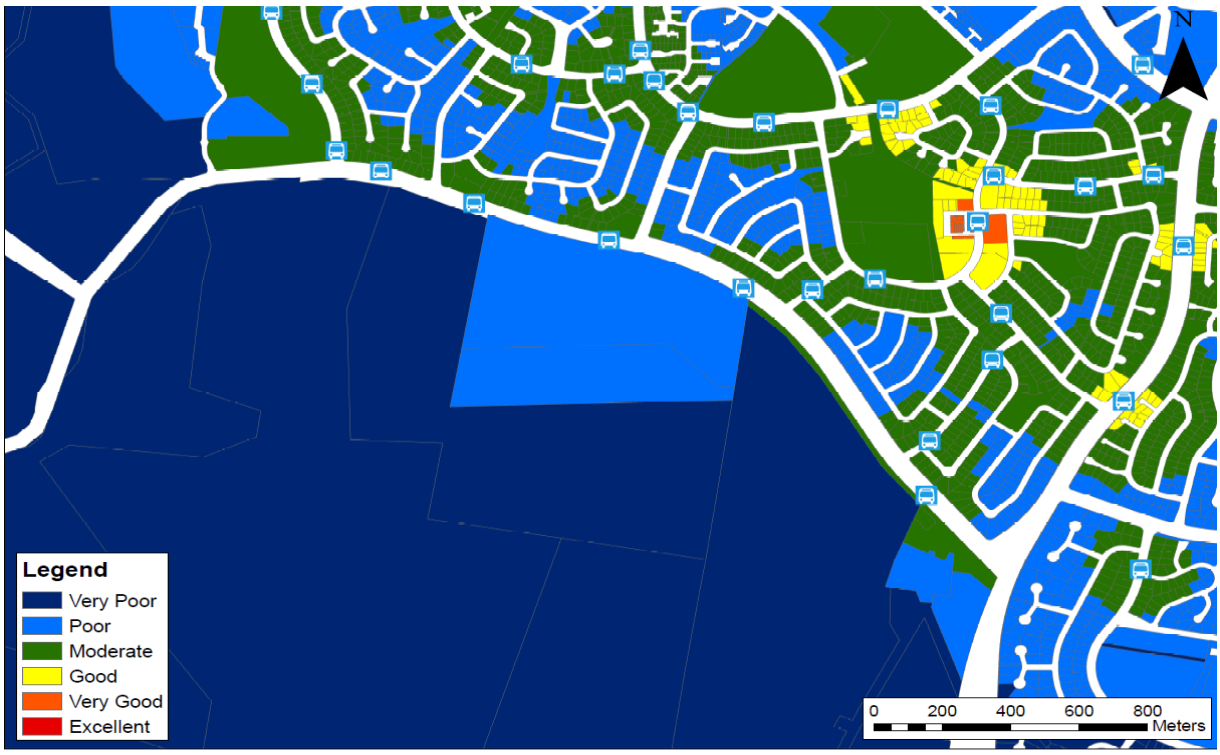


Figure 12 Existing Public Transport Accessibility Level

4.2 Future

4.2.1 Services

Future public transport routes and frequencies for Stockdill Drive and Drake Brockman Drive have been developed based upon the analysis undertaken by MRCagney as part of the Kippax Strategic Planning Review in 2014 and by AECOM as part of the Kippax Centre Traffic and Transport Study in 2016. The existing and future (Ultimate) bus services which are about double the current services are summarised in Table 5.

4.2.2 Accessibility

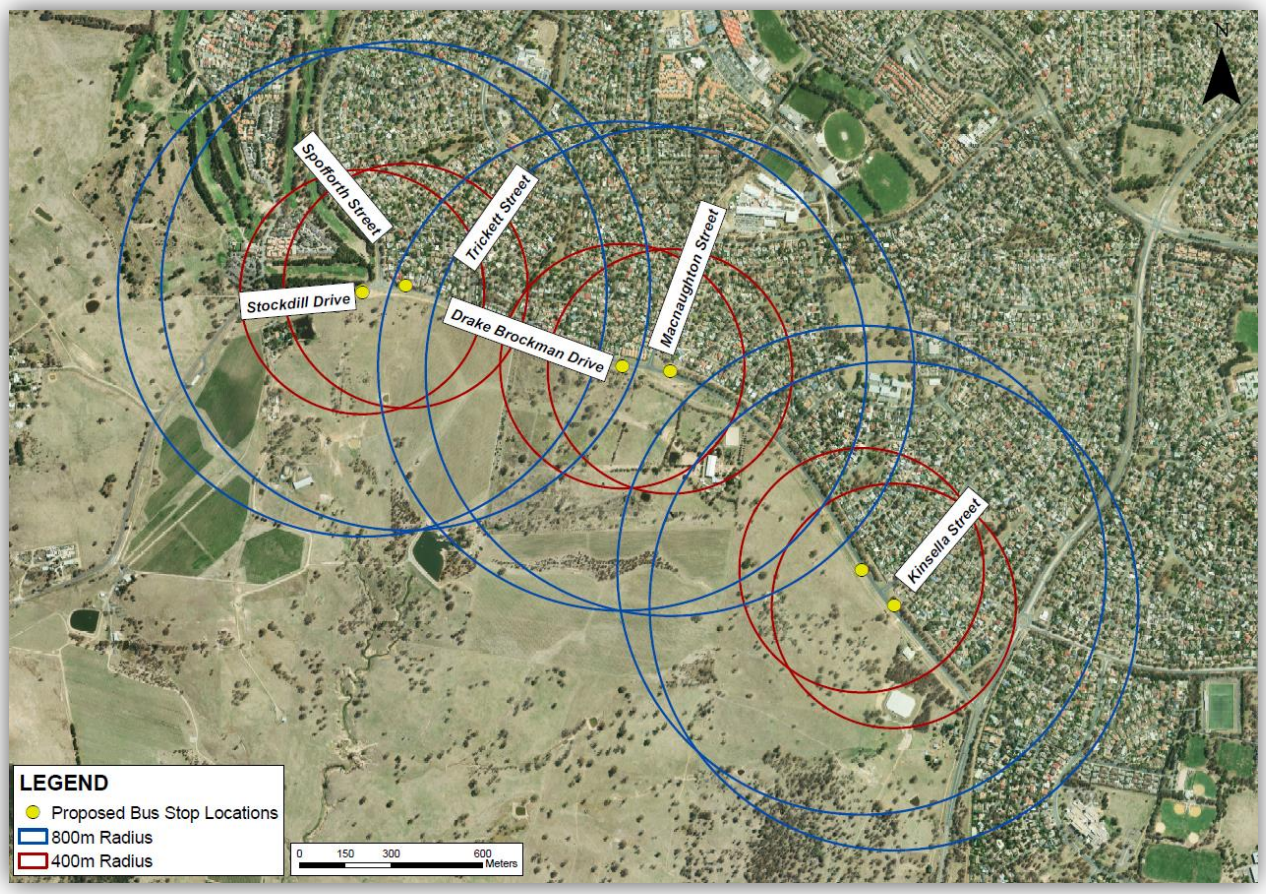
Bus stop locations on Drake Brockman Drive were identified based upon a number of design and transport criteria including:

- Preference to locate ACTION bus stops down stream of signalised intersections in a 70 km/hr road environment.
- Radial distance to the next nearest public transport facility (see Figure 13).
- The future Public Transport Accessibility Level.

Table 5 Future Bus Services

Services	Buses in AM Peak Hour	Buses in PM Peak Hour
Existing City-bound Services	10	6
Existing Local Coverage Routes	5	9
Future City-bound Services	8	8
Future Local Coverage Routes	8	8
Total	**31**	**31**

Figure 13 Proposed Bus Stop Locations



Weaknesses in the existing public transport accessibility along Drake Brockman Drive have been identified in the previous PTAL model which has been addressed by the proposed locations and future bus frequency along the Drake Brockman Drive corridor.

The bus locations shown in Figure 13 are proposed to be indented bus bays which can be easily entered and exited due to the platooning of the adjacent upstream signalised intersections.

Bus priority was considered at the intersection of Drake Brockman Drive and William Hovell Drive, however SIDRA analysis of the proposed dual lane roundabout intersection arrangement for 2041 design volumes indicated a maximum delay of 10 seconds at this intersection in the AM peak hour.

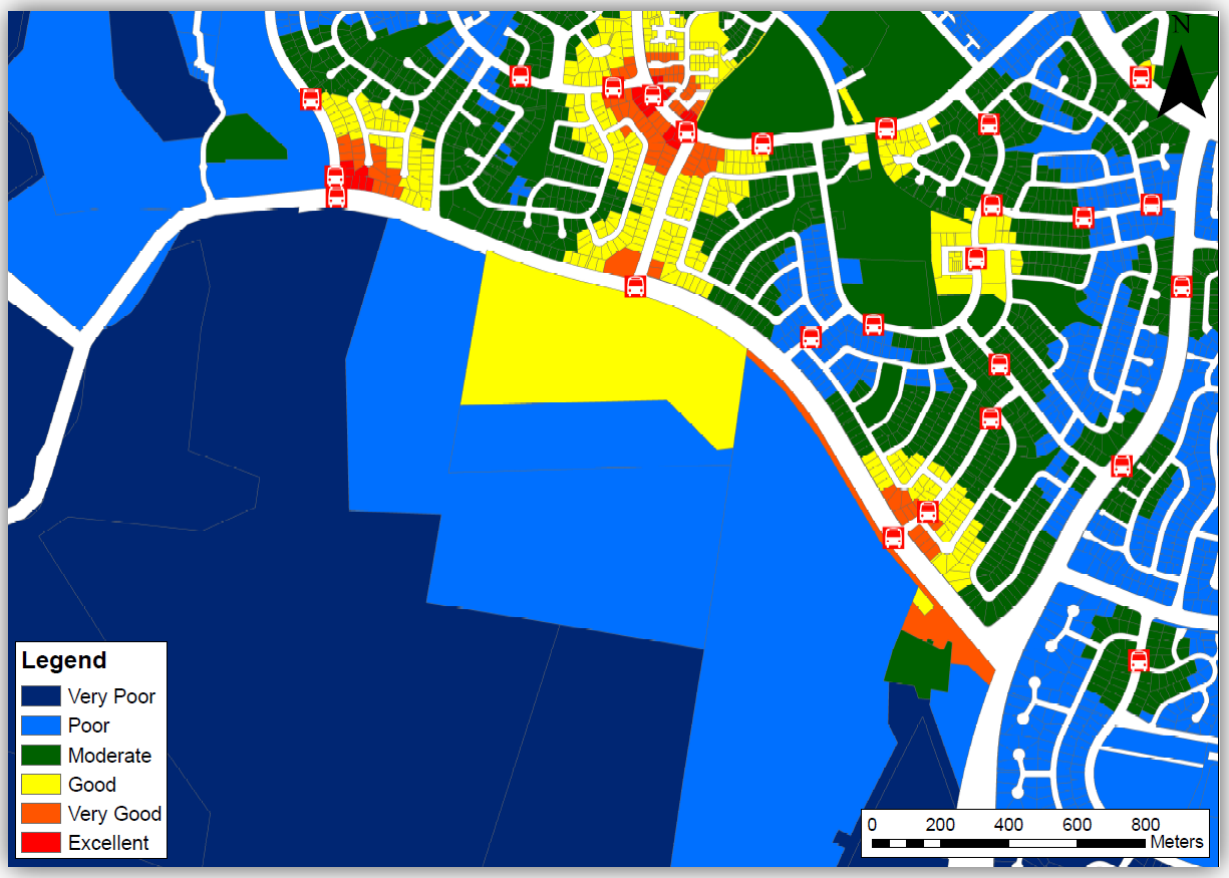
The 2041 bus frequencies for Drake Brockman Drive have been used to determine the PTAL for the future corridor. Figure 14 below gives a visual representation of the improvements to the PTAL for Drake Brockman Drive. The key improvements of note are towards the western end of Drake Brockman Drive due to the increased number of public transport facilities operating between West Belconnen and the Kippax Group Centre.

4.2.3 Operations

Future public transport operations on Stockdill Drive and Drake Brockman Drive will include the introduction of rapid bus services. In order for this bus service to operate effectively indented bus stops at Spofforth Street, Macnaughton Street and Kinsella Street will need to be operational to provide appropriate public transport accessibility. The operation of these bus stops is dependent on the future demands of the West Belconnen development and the timing of the rapid bus services. Prior to the introduction of this bus service, Drake Brockman Drive's posted speed limit will be reduced from 80 km/hr to 70 km/hr and the service roads between Macnaughton Street and Spofforth Street are required.

In the preliminary stages of the West Belconnen development interim local bus services will operate between West Belconnen and the Kippax Group Centre. During this stage the existing local bus services on Drake Brockman Drive will continue to operate. When the demand from the development of West Belconnen warrants the proposed rapid bus services the existing bus stops on Drake Brockman Drive will be removed and the Stage 3 public transport configuration of Drake Brockman Drive as shown in Figure 14 will accommodate these future services.

Figure 14 Ultimate Public Transport Accessibility Level



5.0 Intersection Analysis

5.1 Introduction

A detailed traffic modelling report was completed by AECOM for the West Belconnen Neighbourhood One EDP in April 2016. This analysis involved development and analysis of a Commuter microsimulation model for the proposed development of West Belconnen and surrounding suburbs. The model includes local streets and major arterial roads in the area - Drake Brockman Drive, William Hovell Drive, Southern Cross Drive, Kingsford Smith Drive and Ginninderra Drive. It has been used as the basis for the network analysis of the Drake Brockman Drive upgrade works. Further traffic operations along the road project have been analysed in more detail in terms of intersection capacity and operation using SIDRA Intersection 6.1.

5.2 Data and Key Assumptions

5.2.1 Data Sources

Intersection traffic counts were undertaken by BVY Traffic Survey in May 2016 for each of the seven intersections along Drake Brockman Drive (from Britten-Jones Drive to Kingsford Smith Drive inclusive). Classified traffic counts were also undertaken at three locations along the length of Drake Brockman Drive (east of Trickett Street, west of Cussen Street and east of Cussen Street) and also on William Hovell Drive (south of Drake Brockman Drive).

5.2.2 Key Assumptions

Traffic forecasts for the future Drake Brockman Drive have been developed using predictions developed from the ACT Government's strategic transport model (EMME) which was used to develop the previously undertaken microsimulation modelling (Commuter) for the future West Belconnen development. This microsimulation model was also used as a basis for the future traffic volumes predicted for the Drake Brockman Drive upgrade project works.

5.3 Roads and Traffic

5.3.1 Roads

The key roads are outlined below and detailed in terms of their road hierarchy, purpose and design. A road hierarchy summary is provided in Table 6.

Table 6 Road Hierarchy

Name	Road Hierarchy
Drake Brockman Drive	Arterial Road
Stockdill Drive	Arterial Road
William Hovell Drive	Arterial Road
Kingsford Smith Drive	Arterial Road
Kinsella Street	Access Street
Cussen Street	Access Street
Macnaughton Street	Major Collector
Trickett Street	Minor Collector
Spofforth Street	Major Collector
Britten-Jones Drive	Access Street

Drake Brockman Drive is an arterial road located between William Hovell Drive and Spofforth Street. It is a two-lane single-carriageway road with a single lane in each direction. Lane widths are generally between 3.5 and 6 m, with a total pavement width of around 12 m. Daily traffic volumes are up to about 9,100 vpd. There are four minor roads to the north of Drake Brockman Drive and approximately four rural property access locations to the south of the road.

Stockdill Drive is an arterial road located between the western extent of Drake Brockman Drive and the Lower Molonglo Water Quality Control Centre. It is a two-lane single-carriageway with a single lane in each direction. Lane widths are generally around 3.5 m, with a total pavement width of around 7 m. Daily traffic volumes are up to 700 vpd. There is an access road to the Magpies Golf Club (Britten-Jones Drive) to the north of the road and approximately nine rural property access locations on the road.

William Hovell Drive is an arterial road which connects the Glenloch Interchange in the south to Kingsford Smith Drive in the north. In close proximity to Drake Brockman Drive, it is generally a three-lane single-carriageway with two lanes northbound and a single southbound lane, the carriageway separates on approach to the Drake Brockman Drive roundabout. Lane widths are generally around 4 m, with a varying total pavement width for the length of the road. Daily traffic volumes are up to 17,800 vpd in proximity to Drake Brockman Drive.

Kingsford Smith Drive is an arterial road which connects William Hovell Drive in the south to Kuringa Drive in the north. In close proximity to Drake Brockman Drive, it is generally a four-lane dual-carriageway with two lanes in each direction. Lane widths are generally around 3.5 m, with an 11 m median island. Daily traffic volumes are about 17,400 vpd in proximity to Drake Brockman Drive.

Kinsella Street is an access street which connects to the north of Drake Brockman Drive. It provides access to the Higgins residential area. It is a two-lane single-carriageway road with a single lane in each direction. Lane widths are generally around 5 m. Daily traffic volumes are up to 800 vpd in proximity to Drake Brockman Drive.

Cussen Street is an access street which connects to the north of Drake Brockman Drive. It provides access to the Higgins residential area. It is a two-lane single-carriageway road with a single lane in each direction. Lane widths are generally around 5 m. Daily traffic volumes are up to 1,600 vpd in proximity to Drake Brockman Drive.

Macnaughton Street is a major collector road which connects to the north of Drake Brockman Drive. It provides access to the Holt residential area. It is a two-lane single-carriageway road with a single lane in each direction. Lane widths are generally around 5m. Daily traffic volumes are up to 3,300 vpd in proximity to Drake Brockman Drive.

Trickett Street is a minor collector road which connects to the north of Drake Brockman Drive. It provides access to the Holt residential area. It is a two-lane single-carriageway road with a single lane in each direction. Lane widths are generally around 5 m. Daily traffic volumes are up to 3,000 vpd in proximity to Drake Brockman Drive.

Spofforth Street is a minor collector road which connects to the north of Drake Brockman Drive. It provides access to the Holt residential area and connectivity to Southern Cross Drive. It is a two-lane single-carriageway road with a single lane in each direction. Lane widths are generally around 5 m. Daily traffic volumes are up to 1,800 vpd in proximity to Drake Brockman Drive.

Britten-Jones Drive is an access street which connects to the north of Drake Brockman Drive. It provides access to the Magpies Golf Club and residential areas. It is a two-lane single-carriageway road with a single lane in each direction. Lane widths are generally around 3.5 m. Daily traffic volumes are up to 1,000 vpd in proximity to Drake Brockman Drive.

5.3.2 Traffic

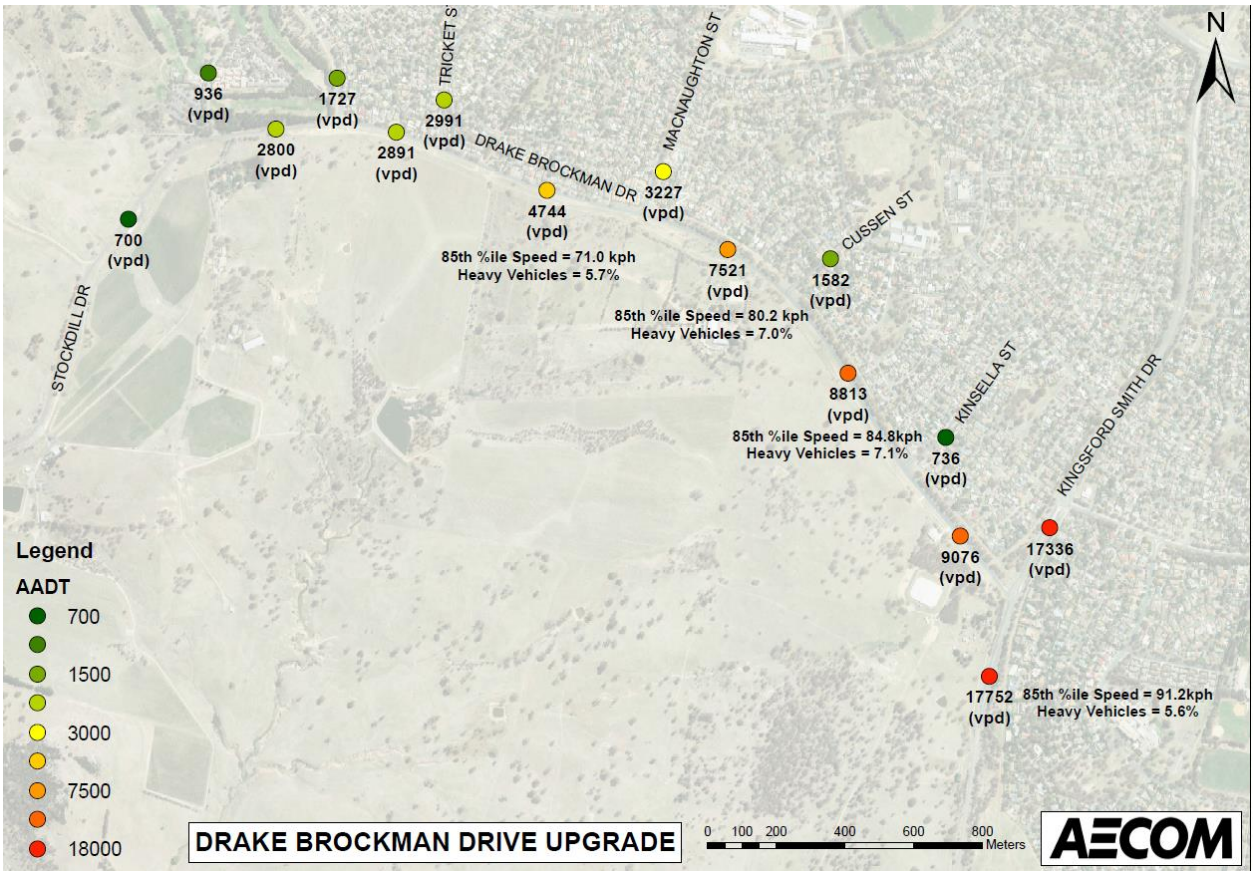
Existing daily traffic volumes for Drake Brockman Drive and the surrounding road network were collected as part of traffic surveys undertaken in May 2016. The results of this survey (including the recorded 85th%ile speed and % of heavy vehicles in four locations) are summarised in Figure 15.

5.3.3 Road safety audit

To inform the design of the roadway an existing conditions road safety audit was undertaken. The Audit was undertaken by qualified roads safety auditors who are independent of the design. It was conducted in accordance with the Austroads Guide to Road Safety requirements and the safe system framework outlined by the Institute of Public Works Engineers Australia.

Some potential remedial measures have been suggested to address crash risks at various locations along the subject road. These can either be addressed via routine maintenance (ACT government) or as part of the Stage 1 and Stage 2 designs.

Figure 15 Average Annual Daily Traffic



The highest safety risks that were identified in the audit are:

- Pedestrians and cyclists on Stockdill Drive (no pathway or on-road facilities, nor adequate lighting).
- Poor road alignment and sight distance at intersection with Spofforth Street.
- Pedestrians crossing at bus stop and major pedestrian links to suburbs (wide roads and no crossing facilities, including lack of lighting).
- Right turn and rear-end collisions at the intersections with Trickett Street, Macnaughton Street, Cussen Street and Kinsella Street (no provision for right turns, turn volumes and speed).
- Poor protection of parked vehicles with wide unmarked pavement between Spofforth Street and Trickett Street, with no formal provision for cyclists or turning vehicles.
- Wide sweeping road between Macnaughton Street and William Hovell Drive, with no formal provision for cyclists or turning vehicles.
- Vehicles entering from Pine Ridge access and property access just west of William Hovell Drive (poor sight distance and speed).
- Vehicles entering Pegasus access, especially trucks or large vehicles (eg., cars towing horse floats).
- Vehicles entering or exiting rural property accesses generally, especially in the 80 km/h section.
- Driveway accesses between Trickett Street and Macnaughton Street, especially in section with rock retaining walls (124 to 142 Drake Brockman Drive) (poor sight distance).
- The roundabout at Kingsford Smith Drive and William Hovell Drive (poor southern approach alignment and small roundabout diameter).
- Pedestrian and cycle facilities connecting to William Hovell Drive, Kingsford Smith Drive and Hawker

More details are provided in Appendix B.

5.4 Crash Analysis

5.4.1 General

The recorded crashes were obtained from Territory and Municipal Services for the five year period from January 2009 until December 2013. The crashes recorded were reviewed to identify any crash patterns and trends and also assist in understanding the contributory causes of the crashes. There were no ambiguities or anomalies of note found in the data supplied.

The following section summarises the intersections and mid-block locations of notable concern and interest in terms of the operation, safety and amenity of Drake Brockman Drive. A summary of all analysed crashes within the study area is provided in Appendix C.

A general overview of the crash data for the entire Drake Brockman Drive corridor is as follows:

- 48 crashes between 1st January 2009 and 31st December 2013;
- 0 fatal crashes, 6 injury crashes (12%), 42 property damage only crashes (88%);
- Most common crash type: Rear end collision (65%);
- 15% of crashes occurred during inclement weather;
- 87% of crashes occurred during daylight hours;
- 81% of crashes occurred at intersections. 9 crashes occurred in April (19%), 89% of these crashes occurred in the AM (100% of crashes in fine weather conditions); and
- 9 crashes occurred in November (19%), 67% of these crashes occurred in the PM (100% of crashes in fine weather conditions).

Figure 16 indicates the location of all of the 48 crashes observed on Drake Brockman Drive between 1st January 2009 and 31st December 2013.

Figure 16 Crash Locations (2009-2013)

A summary of the number of crashes at each intersection is shown in Figure 17. Maps showing the nature, location and details of the crashes that occurred in the five year period between 1st January 2009 and 31st December 2013 are presented in Appendix C.

Figure 17 Intersection Crash Frequency (2009-2013)

Summary crash statistics for each intersection follows.

Drake Brockman Drive / Trickett Street Intersection

- 4 crashes between 1st January 2009 and 31st December 2013.
- 100% of crashes were rear end collisions.
- 25% of crashes occurred during inclement weather.

Drake Brockman Drive / Macnaughton Street Intersection

- 9 crashes between 1st January 2009 and 31st December 2013.
- 89% of crashes were rear end collisions.

Drake Brockman Drive / Cussen Street Intersection

- 3 crashes between 1st January 2009 and 31st December 2013.
- 100% of crashes were rear end collisions.

Drake Brockman Drive / Kinsella Street Intersection

- 7 crashes between 1st January 2009 and 31st December 2013.
- 86% of crashes were rear end collisions.
- 43% of crashes involved injury.

Drake Brockman Drive / William Hovell Drive / Kingsford Smith Drive Intersection

- 16 crashes between 1st January 2009 and 31st December 2013.
- 38% of crashes were rear end collisions.
- 32% of crashes were same direction side swipes.
- 19% of crashes were right angle collisions.
- 25% of crashes were during inclement weather.

Mid-block

- 9 crashes between 1st January 2009 and 31st December 2013.
- 56% of crashes were rear end collisions.
- 22% of crashes involved injury.

Sun glare

From onsite observations it is apparent that the current alignment of Drake Brockman Drive between the entry to Pegasus and Spofforth Street aligns with the sun's movement during peak AM and PM peak periods. Table 7 indicates the approximate time of day in which the sun is aligned with Drake Brockman Drive between Pegasus and Spofforth Street on the first day of each month.

Table 7 Suns Alignment with DBD between Pegasus and Spofforth Street

Sun Alignment with DBD between Pegasus and Spofforth Street		
	AM	PM
Jan	7:55	3:10
Feb	7:10	4:00
Mar	6:50	4:55
Apr	-	5:45
May to Aug	-	-
Sep	-	5:05
Oct	-	3:55
Nov	6:30	3:50
Dec	7:35	3:10

Of the 16 crashes that occurred between the Pegasus access and Spofforth Street, 13 were rear end collisions (81%) and 6 crashes (38%) occurred within a 60 minute window of the times of day / year shown in Table 7 above. The crash types and crash times in this section of Drake Brockman Drive indicate that sun glare impeding a driver's vision is likely a contributing factor to the number of crashes in this location. This theory is further supported by Figure 18 below which indicates that it is less likely for a crash to occur on Drake Brockman Drive in the middle of the year, which correlates with the time of year when the sun's glare is less likely to be a problem.

Further analysis was undertaken as to the time of day in which crashes occurred on Drake Brockman Drive. Figure 19 indicates that the number of crashes generally correlates with the hourly volumes on Drake Brockman Drive. The higher the volume, the higher the crash risk.

5.4.2 Speed analysis

Vehicle speed was surveyed in three locations along the length of Drake Brockman Drive. The posted speed limit of Drake Brockman Drive east of Cussen Street is 80km/hr and west of Cussen Street 60 km/hr. For the 80 km/hr section of Drake Brockman Drive, 85th%ile speeds were observed to be 82.5 km/hr on average and for the 60 km/hr section 85th%ile speeds were observed to be 71.0 km/hr.

The speeding observed on Drake Brockman Drive may be attributed to the existing road environment. The existing large radius bends and wide travel lanes provide a travel environment for the driver which encourage travelling at speeds greater than the posted limit.

Figure 18 Crashes by Month of the Year (2009-2013)

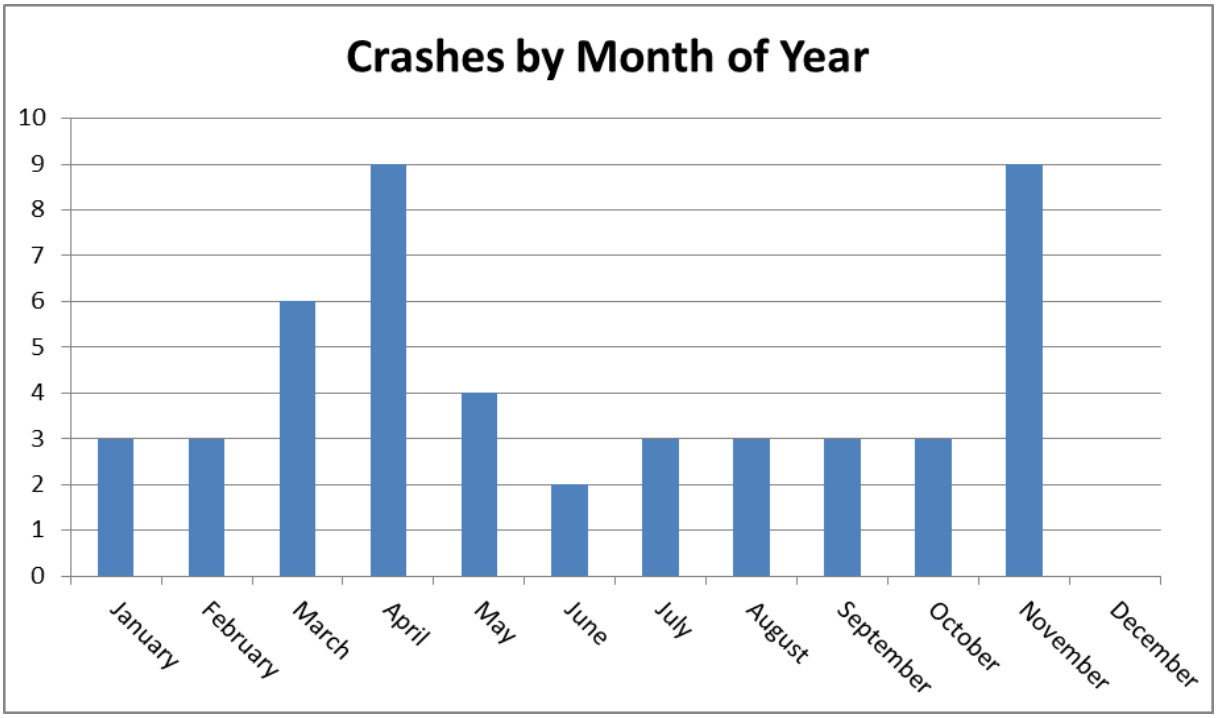
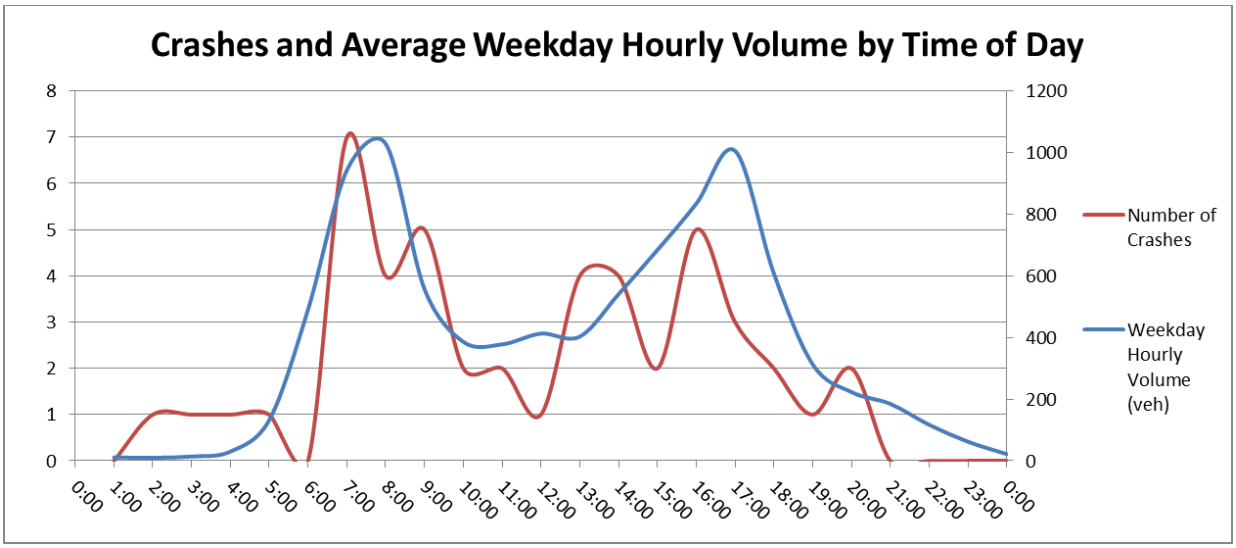


Figure 19 Crashes and Hourly Volumes by Time of Day (2009-2013)



5.4.3 Crash analysis summary

The above analysis has outlined the key statistics of the recorded crashes on Drake Brockman Drive between 1st January 2009 and 31st December 2013. The most common crash type is rear end collisions (65%) which is likely contributed to by speeding and sun glare. Other contributing factors to the crashes on Drake Brockman Drive include inclement weather and driver error (side swipe / struck object).

5.5 Drake Brockman Drive Intersections

5.5.1 Network Development and Trip Distribution

The Drake Brockman Drive intersection analysis modelling has been developed based on the surveys undertaken in May 2016 and the Commuter model developed for the future West Belconnen development. The Commuter model was analysed using future origin-destination matrices for 2021, 2031 and 2041 models in the AM and PM peak periods. A network model was developed using the 2016 survey and Commuter model outputs to determine the turning movements for each of intersection in the Drake Brockman Drive corridor.

The overall linked SIDRA network models for 2016, 2021, 2031 and 2041 are shown in Figure 20 to Figure 23. More details for each intersection follow these figures.

Figure 20 2016 SIDRA network

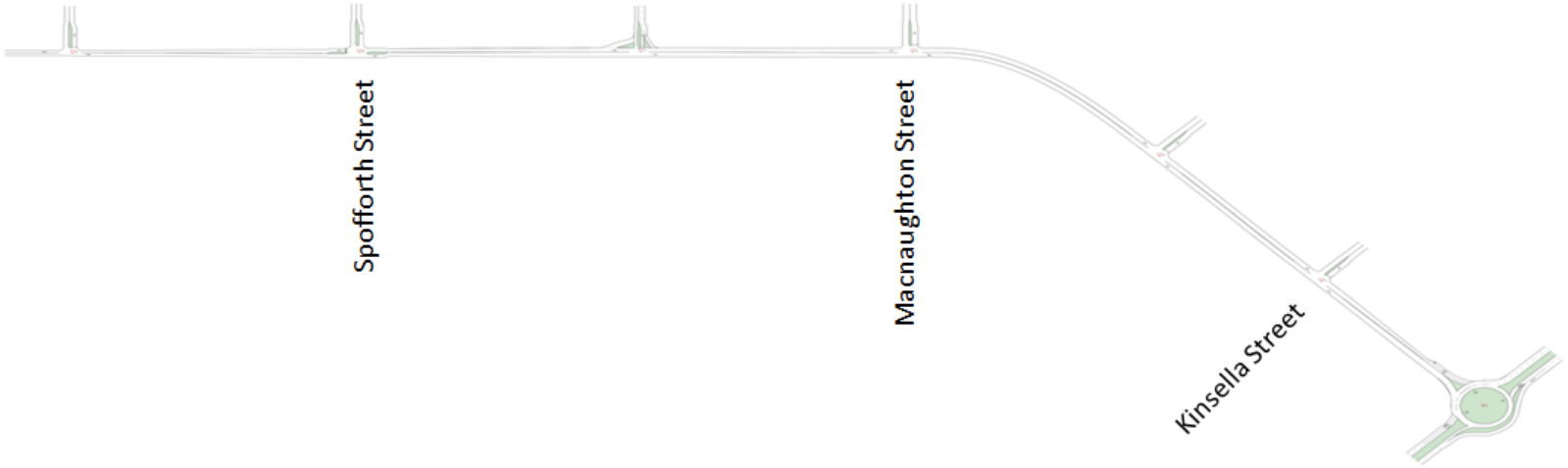


Figure 21 2021 SIDRA network

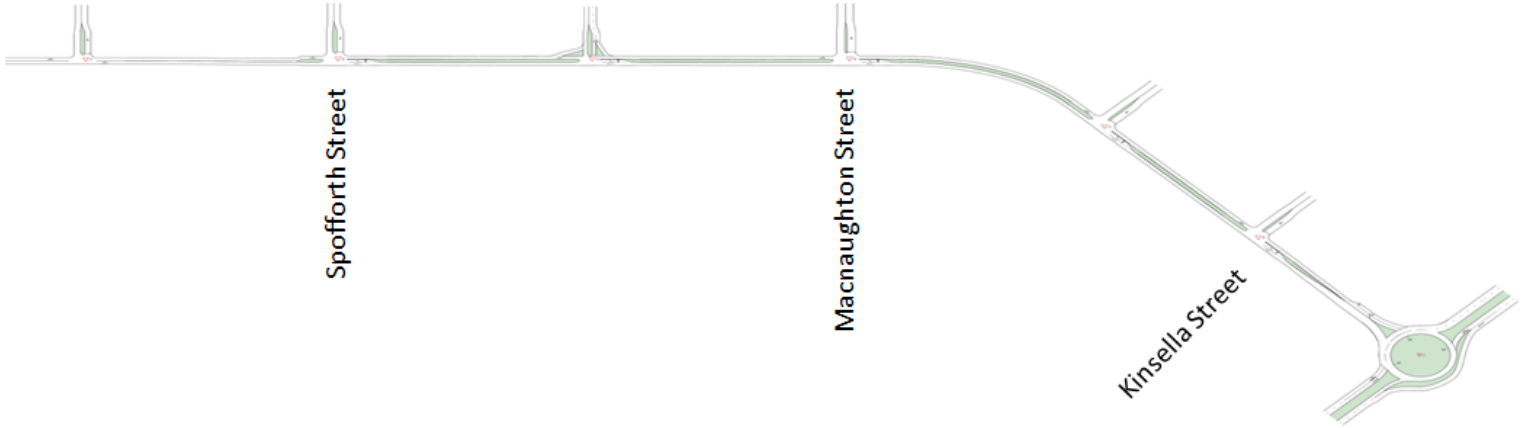
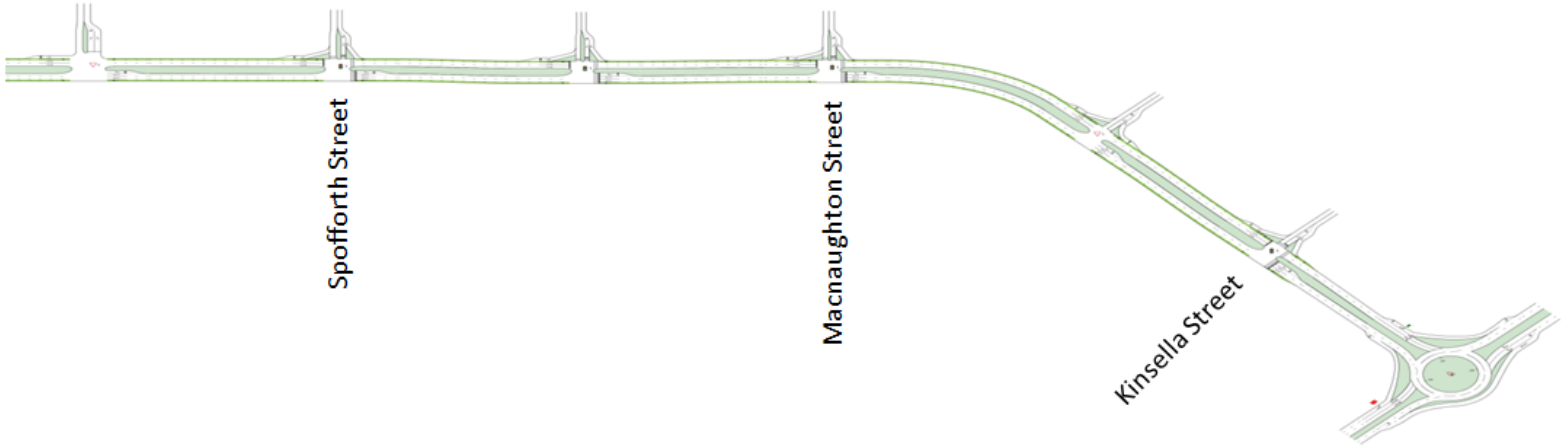


Figure 22 2031 SIDRA network

Figure 23 2041 SIDRA network



5.5.2 Kingsford Smith Drive / William Hovell Drive / Drake Brockman Drive Intersection

The intersection of Kingsford Smith Drive / William Hovell Drive / Drake Brockman Drive is currently a roundabout with a dual lane approach from William Hovell Drive and Drake Brockman Drive. It has a single lane approach to the roundabout from Kingsford Smith Drive, for right turning traffic, and a north to south bypass to William Hovell Drive for through traffic.

The future arrangements for the intersection of Kingsford Smith Drive / William Hovell Drive / Drake Brockman Drive are shown in Table 8.

Details of the future arrangements are as follows:

- **2021**: Retain the existing roundabout intersection geometric arrangement.
- **2031**: Retain the existing roundabout intersection geometric arrangement, but install roundabout metering at the intersection. It is proposed to meter William Hovell Drive in the AM peak and Drake Brockman Drive in the PM peak.
- **2041**: Improve the intersection arrangement by increasing the size of the roundabout to include two lanes from all directions and the addition of left turn slip lanes from William Hovell Drive and Drake Brockman Drive. Note that the design of the east to northbound slip lane is important in relation to weave manoeuvres onto Kingsford Smith Drive. This is addressed in Section 6.7.2.6.

The future signalisation of this intersection was also considered as an option as part of this feasibility study. This arrangement would have required three right turn lanes from Drake Brockman Drive in the AM peak to accommodate this movement in the 2041 scenario. The ultimate footprint of the signalised intersection arrangement was comparable to the ultimate footprint of the proposed future dual lane roundabout. It is preferred to retain this intersection as a roundabout in order for the continued operation of this intersection in conjunction with the adjacent roundabout at the intersection of Kingsford Smith Drive / Belconnen Way. Finally, the maximum queuing and delay of a dual lane roundabout was found to be low and would not significantly impact the public transport service through this intersection, compared to signals.

The results of the linked SIDRA analysis are shown in Table 9 . They reveal no significant queuing or delays for the proposed intersection arrangements in the future scenarios. The greatest delays and queues will occur during the 2031 PM peak, with delays up to 19.8 s and queues up to 76 m on Drake Brockman Drive. The proposed intersection arrangements have an average level of service of A in all scenarios.

Table 8 Kingsford Smith Drive / William Hovell Drive / Drake Brockman Drive Intersection SIDRA Layouts

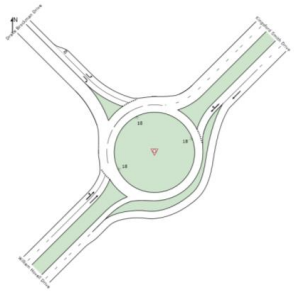
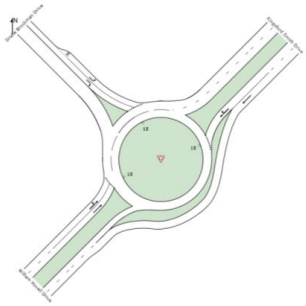
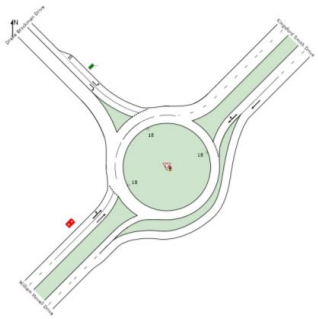
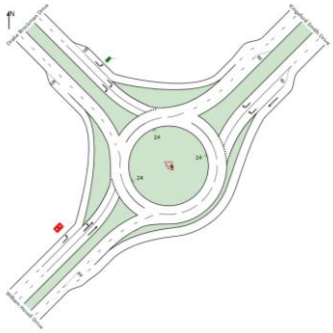
2016	2021
	
2031	**2041**
	

Table 9 DBD / WHD / KSD SIDRA Results

Scenario	DBD / WHD / KSD			
	LOS	DOS	Avg Delay (s)	Comment
2016 AM	A	0.472	6.5	-
2016 PM	A	0.714	7.9	-
2021 AM	A	0.541	6.7	-
2021 PM	A	0.657	8.3	-
2031 AM	A	0.814	9.4	-
2031 PM	C	0.916	26.5	-
2041 AM	A	0.858	6.7	-
2041 PM	A	0.977	15.3	-

5.5.3 Drake Brockman Drive / Kinsella Street Intersection

The intersection of Drake Brockman Drive and Kinsella Street is currently a priority controlled T-intersection. It has a single lane approach from all directions. The main road is Drake Brockman Drive, which is met by the minor road, Kinsella Street, at the junction.

The future arrangements for the intersection of Drake Brockman Drive and Kinsella Street are shown in Table 10.

Details of the future arrangements here are as follows:

- **2021**: Line marking and delineation for Drake Brockman Drive. The intersection would operate as a two-staged crossing from Kinsella Street in a "seagull" intersection arrangement, including the addition of a right turn lane from Drake Brockman Drive into Kinsella Street. This arrangement utilises the existing Drake Brockman Drive pavement width.
- **2031**: Signalisation of the intersection including dual vehicle lane approaches, on-road cycle lanes and high angle left turns. This arrangement tapers back to a single lane in each direction to match into the existing Drake Brockman Drive.
- **2041**: Duplication of Drake Brockman Drive.

  The signalisation of this intersection is proposed to be undertaken in 2031 in order to improve the operation of the right turn movements from Kinsella Street and redistribute traffic from Cussen Drive. Secondly, signalisation would allow for a bus stop to be located downstream of the intersection in 2031, improving the public transport service in this location.

The results of the linked SIDRA analysis in Table 11 indicated delays for the right turn movements from Kinsella Street would be up to 128 s in the PM peak period. It should be noted that in the 2021 model only 2 vehicles make this movement in the PM peak hour. Signalisation of this intersection from 2031 onwards removed the delays associated with this movement. The 2041 model shows that the intersection would approach capacity in the PM peak hour; however it would still operate satisfactorily with generally acceptable peak delays. The worst delays will be for the right turn movement from Drake Brockman Drive in the PM peak, with a delay of up to 56 s.

Table 10 Drake Brockman Drive / Kinsella Street Intersection SIDRA Layouts

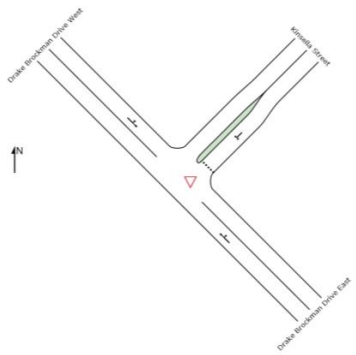
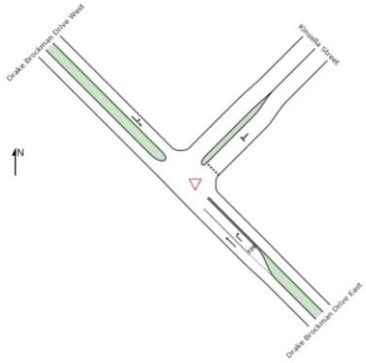
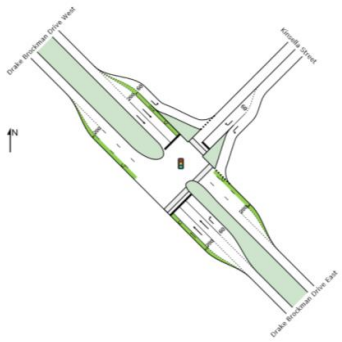
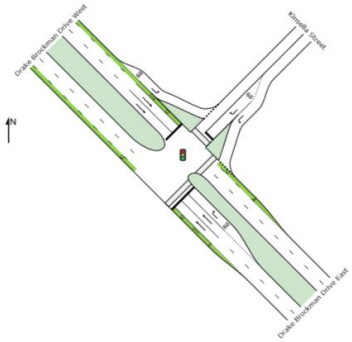
2016	2021
	
2031	2041
	

Table 11 DBD / Kinsella Street SIDRA Results

Scenario	DBD / Kinsella Street			
	LOS	DOS	Avg Delay (s)	Comment
2016 AM	-	0.409	0.8	-
2016 PM	-	0.391	0.7	-
2021 AM	-	0.579	1.1	Kinsella RT 52 s delay
2021 PM	-	0.680	0.7	Kinsella RT 128 s delay
2031 AM	B	0.621	12.8	-
2031 PM	A	0.553	6.2	-
2041 AM	B	0.820	12.8	-
2041 PM	C	0.948	25.2	DBD E RT 56 s delay

5.5.4 Drake Brockman Drive / Cussen Street

The intersection of Drake Brockman Drive and Cussen Street is currently a priority controlled T-intersection. It has a single lane approach from all directions.

The future arrangements for this intersection are shown in Table 12.

Details of the future arrangements are as follows:

- **2021**: Line marking and delineation along Drake Brockman Drive. The intersection would operate as a two-staged crossing from Cussen Street in a "seagull" intersection arrangement, including the addition of a right turn lane from Drake Brockman Drive into Cussen Street. This arrangement utilises the existing Drake Brockman Drive pavement width.
- **2031**: As per the 2021 scenario intersection arrangement. The signalisation of the adjacent intersections of Macnaughton Street and Kinsella Street will lead to a redistribution of the right turning vehicles from Cussen Street.
- **2041**: Duplication of Drake Brockman Drive including on-road cycle lanes and high angle left turns.

The results of the linked SIDRA analysis in Table 13 indicated delays for the right turn movements from Cussen Street would be up to 52 s in the 2021 scenario and up to 291 s in the 2031 scenario. However, in the 2021 model only 4 vehicles make this movement in the PM peak hour and in the 2041 scenario only one vehicle makes this movement in the peak period due to the redistribution of the right turning vehicles to Macnaughton Street or Kinsella Street. The worst delays in the 2041 scenario will be for the right turn movement from Cussen Street in the PM peak with delays of up to 33 s.

Table 12 Drake Brockman Drive / Cussen Street Intersection SIDRA Layouts

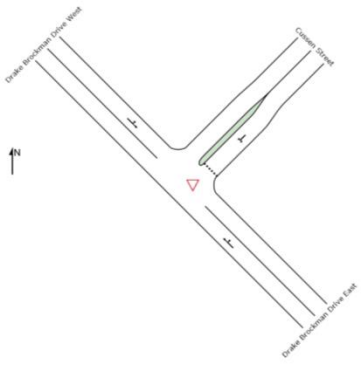
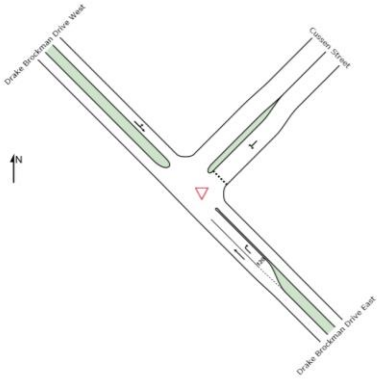
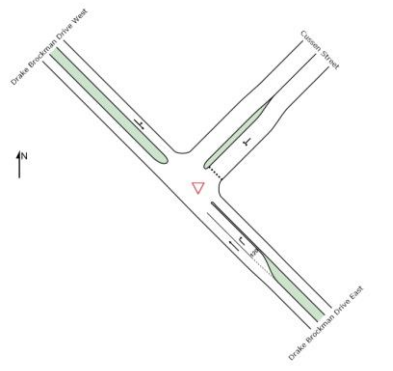
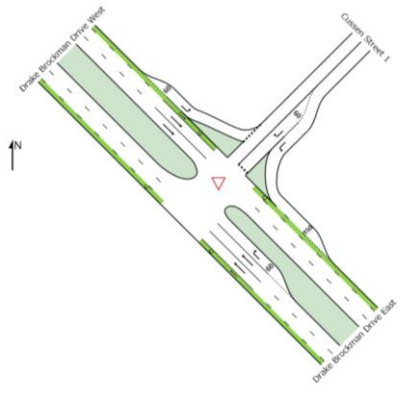
2016	2021
	
2031	2041
	

Table 13 DBD / Cussen Street SIDRA Results

Scenario	DBD / Cussen Street			
	LOS	DOS	Avg Delay (s)	Comment
2016 AM	-	0.350	1.8	-
2016 PM	-	0.388	1.4	-
2021 AM	-	0.579	2.6	Cussen RT 52 s delay
2021 PM	-	0.557	1.1	Cussen RT 52 s delay
2031 AM	-	0.820	2.8	Cussen RT 291 s delay
2031 PM	-	0.742	1.0	Cussen RT 253 s delay
2041 AM	-	0.675	0.5	-
2041 PM	-	0.710	0.5	-

5.5.5 Drake Brockman Drive / Macnaughton Street

The intersection of Drake Brockman Drive and Macnaughton Street is currently a priority controlled T-intersection. It has single lane approaches from all directions. The main road is Drake Brockman Drive, which is met by the minor road, Macnaughton Street, at the junction.

The future arrangements for the intersection of Drake Brockman Drive and Macnaughton Street are shown in Table 14.

Details of the future arrangements are as follows:

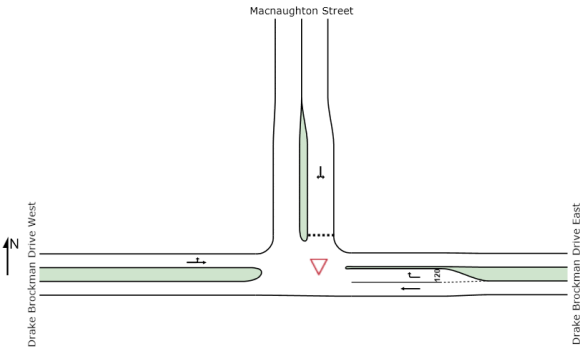
- **2021**: Line marking and delineation for Drake Brockman Drive. The intersection would operate as a two-staged crossing from Macnaughton Street in a “seagull” intersection arrangement, including the addition of a right turn lane from Drake Brockman Drive into Macnaughton Street. This arrangement utilises the existing Drake Brockman Drive pavement width.
- **2031**: Signalisation of the intersection including dual lanes on the Drake Brockman Drive approach, on-road cycle lanes and high angle left turns to/from Macnaughton Street. This arrangement tapers back to a single lane in each direction on Drake Brockman Drive. The signals will assist the safe movement of buses and pedestrians at this intersection, as well as overall intersection performance.
- **2041**: Duplication of Drake Brockman Drive, which matches into the proposed signalised intersection arrangement.

The results of the linked SIDRA analysis in Table 15 indicates there would be a delay for the right turn movements from Macnaughton Street of up to 53 s in the 2031 AM peak period. The worst delays will be in the 2041 AM scenario with delays of up to 84 s for the right turning movement from Macnaughton Street. The intersection will be approaching capacity in the AM 2041 scenario.

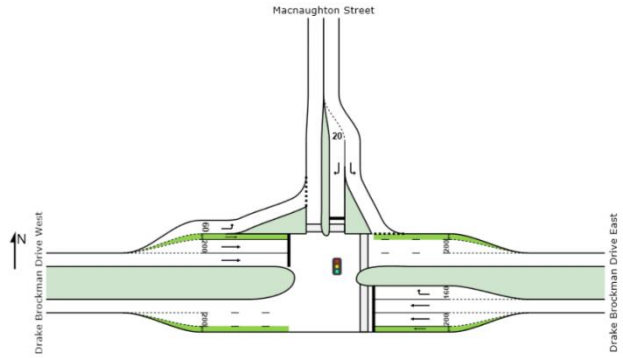
Table 14 Drake Brockman Drive / Macnaughton Street Intersection SIDRA Layouts

2016

2021



2031



2041

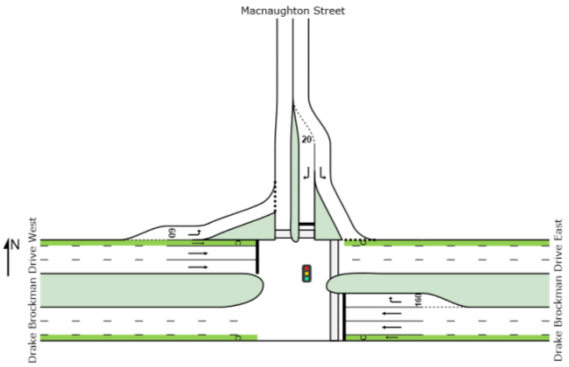


Table 15 DBD / Macnaughton Street SIDRA Results

Scenario	DBD / Macnaughton Street			
	LOS	DOS	Avg Delay (s)	Comment
2016 AM	-	0.263	3.1	-
2016 PM	-	0.358	2.8	-
2021 AM	-	0.568	4.3	-
2021 PM	-	0.370	2.2	-
2031 AM	B	0.569	10.5	Macnaughton RT 53 s delay
2031 PM	B	0.477	10.4	-
2041 AM	B	0.895	15.0	Macnaughton RT 84 s delay
2041 PM	A	0.846	6.3	DBD E RT 57 s delay

5.5.6 Drake Brockman Drive / Trickett Street

The intersection of Drake Brockman Drive and Trickett Street is currently a priority controlled T-intersection. It has single lane approaches on Drake Brockman Drive.

The future arrangements for the intersection of Drake Brockman Drive and Trickett Street are shown in Table 16.

Details of the future arrangements are as follows:

- **2021**: Line marking and delineation for Drake Brockman Drive. The intersection would operate as a two-staged crossing from Trickett Street in a "seagull" intersection arrangement, including the addition of a right turn lane from Drake Brockman Drive into Trickett Street. This arrangement utilises the existing Drake Brockman Drive pavement width.
- **2031**: As per the 2021 scenario intersection arrangement. The signalisation of the adjacent intersection of Macnaughton Street will lead to a redistribution of the right turning vehicles from Trickett Street in this scenario.
- **2041**: Signalisation of the intersection including the duplication of Drake Brockman Drive, on-road cycle lanes and high angle left turns to / from Trickett Street.

The results of the linked SIDRA analysis in Table 17 indicates there would be a delay for the right turn movements from Trickett Street of up to 65 s in the 2031 AM peak period. The worst delays will occur in the 2041 AM scenario with delays of up to 85 s for the right turning movement from Trickett Street. The intersection will operate with a level of service of A with low average delays in the 2041 models.

Table 16 Drake Brockman Drive/Trickett Street Intersection SIDRA Layouts

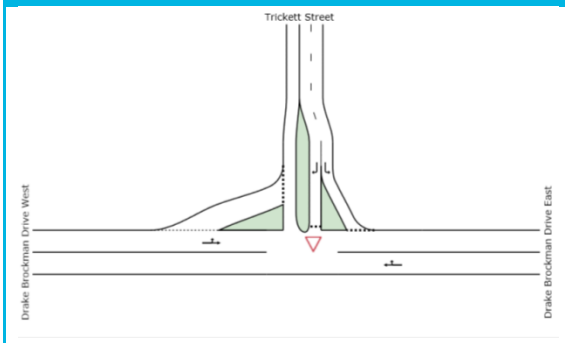
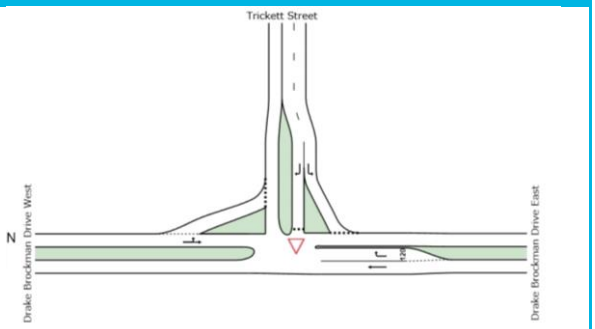
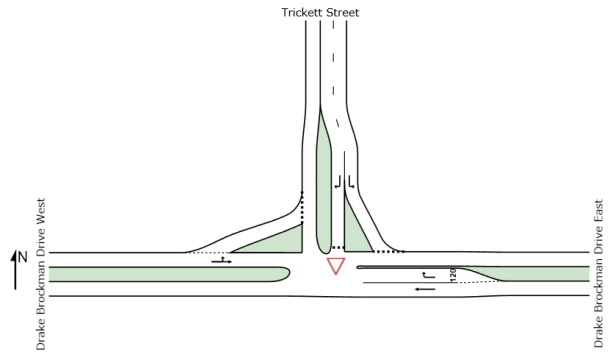
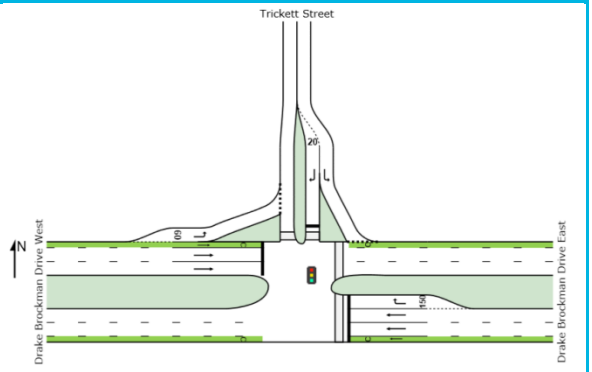
2016	2021
	
2031	2041
	

Table 17 DBD / Trickett Street SIDRA Results

Scenario	DBD / Trickett Street			
	LOS	DOS	Avg Delay (s)	Comment
2016 AM	-	0.199	3.7	-
2016 PM	-	0.214	3.3	-
2021 AM	-	0.342	3.5	-
2021 PM	-	0.236	2.8	-
2031 AM	-	0.980	11.2	Trickett RT 65 s delay
2031 PM	-	0.466	2.1	-
2041 AM	A	0.781	8.1	Trickett RT 85 s delay
2041 PM	A	0.818	5.8	DBD E RT 57 s delay

5.5.7 Drake Brockman Drive/Spofforth Street

The intersection of Drake Brockman Drive and Spofforth Street is currently a priority controlled T-intersection. The intersection has single lane approaches from all directions.

The future arrangements for the intersection of Drake Brockman Drive and Spofforth Street are shown in Table 18.

Details of the future arrangements are as follows:

- **2021**: Line marking and delineation for Drake Brockman Drive. The intersection would operate as a two-staged crossing from Spofforth Street in a "seagull" intersection arrangement, the movement from Drake Brockman Drive to Stockdill Drive would become the primary movement. This arrangement would include the addition of a right turn lane from Drake Brockman Drive into Spofforth Street. This arrangement utilises the existing Drake Brockman Drive and Stockdill Drive pavement width.
- **2031**: As per the 2021 scenario intersection arrangement.
- **2041**: Signalisation of the intersection including the duplication of Drake Brockman Drive and Stockdill Drive, on-road cycle lanes and high angle left turns to/from Spofforth Street.

The results of the linked SIDRA analysis in Table 19 indicates there would be a delay for the right turn movements from Spofforth Street of up to 22 s in the 2031 PM peak period. The worst delays will occur in the 2041 AM scenario with delays of up to 78 s for the right turning movement from Spofforth Street. The intersection will operate with minimal delays in the 2021 and 2031 models.

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Table 18 Drake Brockman Drive/Spofforth Street Intersection SIDRA Layouts

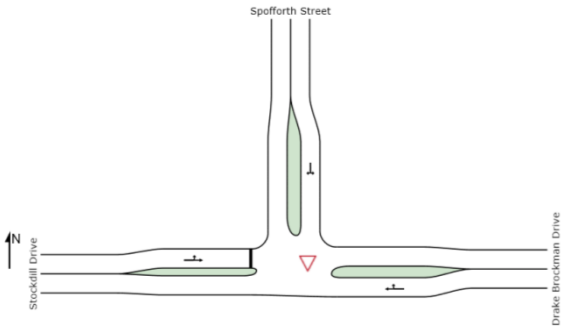
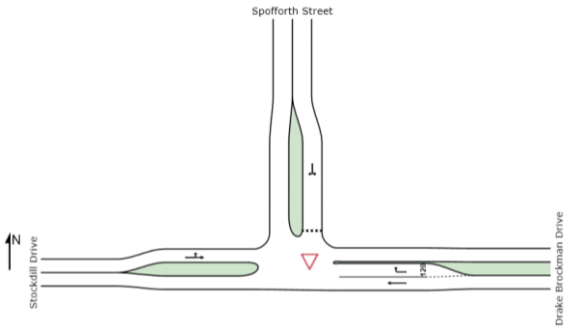
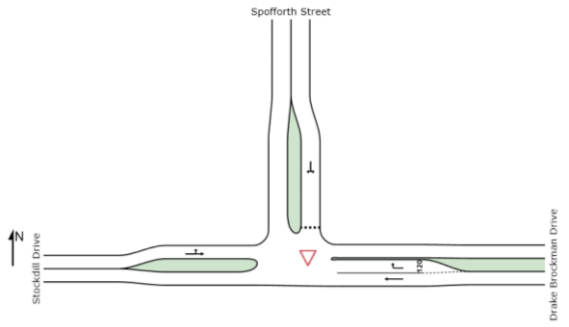
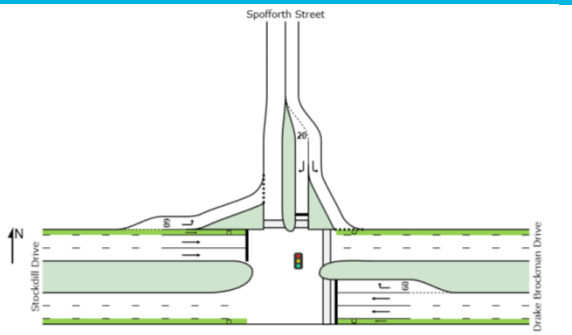
2016	2021
	
2031	2041
	

Table 19 DBD / Spofforth Street SIDRA Results

Scenario	DBD / Spofforth Street			
	LOS	DOS	Avg Delay (s)	Comment
2016 AM	-	0.056	4.2	-
2016 PM	-	0.143	6.5	-
2021 AM	-	0.279	4.4	-
2021 PM	-	0.283	2.7	-
2031 AM	-	0.595	4.7	-
2031 PM	-	0.497	2.8	-
2041 AM	B	0.881	14.7	DBD E RT 78 s delay
2041 PM	A	0.801	6.7	DBD E RT 57 s delay

5.5.8 Stockdill Drive / Britten-Jones Drive

The intersection of Stockdill Drive and Britten-Jones Drive is currently a priority controlled T-intersection. The intersection has single lane approaches from all directions. The main road is the continuous movement along Stockdill Drive, which is met by the minor road, Britten-Jones Drive, at the junction.

The future arrangements for the intersection of Stockdill Drive and Britten-Jones Drive are shown in Table 20.

Details of the future arrangements are as follows:

- **2021**: As per the 2016 scenario intersection arrangement.
- **2031**: As per the 2016 scenario intersection arrangement with the addition of a right turn short lane from Drake Brockman Drive into Britten-Jones Drive.
- **2041**: Duplication of Stockdill Drive including on-road cycle lanes, dedicated turn lanes and a wide central median.

The results of the linked SIDRA analysis in Table 21 indicates there would be a delay for the right turn movements from Britten-Jones Drive of up to 42 s in the 2031 AM peak period. A level of service of D was found for the Britten-Jones Drive approach in the 2041 AM model with delays up to 28 s.

Table 20 Stockdill Drive/Britten-Jones Drive Intersection SIDRA Layouts

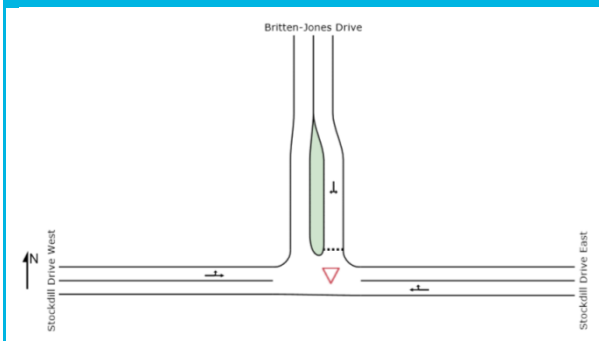
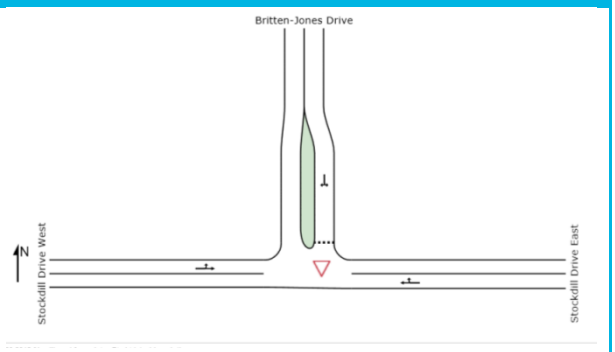
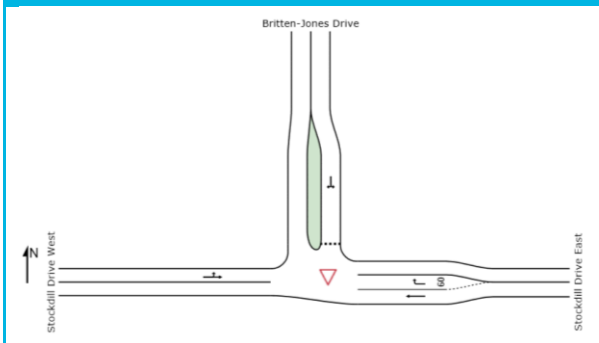
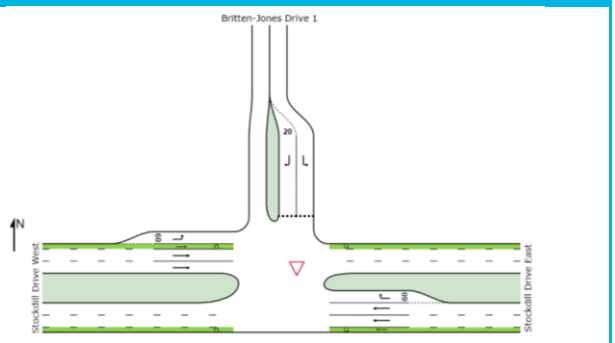
2016	2021
	
2031	2041
	

Table 21 Stockdill Drive / Britten-Jones Drive SIDRA Results

Scenario	Stockdill Drive / Britten-Jones Drive			
	LOS	DOS	Avg Delay (s)	Comment
2016 AM	-	0.039	3.3	-
2016 PM	-	0.038	3.4	-
2021 AM	-	0.272	1.2	-
2021 PM	-	0.415	3.8	-
2031 AM	-	0.587	1.2	BJD RT 73s delay
2031 PM	-	0.449	1.2	-
2041 AM	-	0.934	2.0	-
2041 PM	-	0.650	0.9	-

6.0 Road Design

6.1 Background

Drake Brockman Drive in its present condition was constructed in two stages, namely:

- Macnaughton Street to Kingsford Smith Drive, circa 1969 (to service the suburb of Higgins); and
- Spofforth Street to Macnaughton Street, circa 1972 (to service the suburb of Holt).

At Spofforth Street Drake Brockman Drive connected to Old Weetangera Road at its junction with Charnwood Road. Old Weetangera Road formerly ran through the aforementioned suburbs, and continued to the south west, primarily serving the homesteads of Pine Ridge and Strathnairn.

In circa 1974 Old Weetangera Road was upgraded, generally along its existing alignment, to serve as access for the construction of the Lower Molonglo Water Quality Control Centre, carried out in the period between 1974 and 1978. The road was renamed Stockdill Drive in 1982.

The standard of construction between the two roads varies considerably. The 2.47 km long Drake Brockman Drive between Spofforth Street and Kingsford Smith Drive has a kerb to kerb width of 12.8 m and has a flexible pavement surfaced with asphaltic concrete whilst the 0.63 km section of Stockdill Drive subject to this feasibility study, has a 7 m wide flexible pavement with a bitumen seal surface and narrow, gravel shoulders.

Drake Brockman Drive was envisaged to be extended over the NSW Border into the area known as Gooromon as suggested in the 1967 Y-Plan. Hence existing horizontal geometry of Drake Brockman Drive consists of generous radius horizontal curves ranging in radii from 500 m to 1,400 m suitable for high speed traffic with no development frontages to the road as would be associated with an urban arterial road classification.

6.2 Design Certification

The West Belconnen Road upgrade Feasibility Study complies with all relevant standards unless specified otherwise in this report and supporting documentation.

6.3 Design Standards

The standards adopted for the design in this project comply with the provisions contained within the following Standards and Guidelines:

- ACT Government (March 2016), Municipal Infrastructure Standards 05: Active Travel Facilities Design
- Australian Standards AS/NZS 1158 – Lighting for Roads and Public Spaces
- AUSTROADS Guide to Road Design Part 3: Geometric Design
- AUSTROADS Guide to Road Design Part 4: Intersections and Crossings – General
- AUSTROADS Guide to Road Design Part 4A: Unsignalised and Signalised Intersections
- AUSTROADS Guide to Traffic Management Part 6: Intersections, Interchanges and Crossing
- NSW Rural Fire Service (December 2006), Planning for Bushfire Protection
- Territory and Municipal Standards (June 2007), Design Standards for Urban Infrastructure 3: Road Design Edition 1 Revision 0
- Territory and Municipal Standards (June 2007), Design Standards for Urban Infrastructure 12: Street Lighting Edition 1 Revision 1
- Territory and Municipal Standards (June 2007), Design Standards for Urban Infrastructure 13: Pedestrian and Cycle Facilities Edition 1 Revision 1
- Territory and Municipal Standards (June 2007), Design Standards for Urban Infrastructure 20: Urban Edge Management Zone Edition 1 Revision 0
- Territory and Municipal Standards (June 2011), Design Standards for Urban Infrastructure – Standard Drawings DS9 Traffic Control Devices Revision A

6.4 Design Criteria

The design criteria have been tabulated for all design parameters derived from the relevant Standards and Guidelines, to provide guidance to the road design of the West Belconnen Road. A number of Standards and Guidelines were used to produce the Design Criteria for each stage of the road project, as listed in Section 6.3. The design criteria table is provided in Appendix D.

6.5 Proposed Function of Road

The function of the proposed West Belconnen Road (Drake Brockman Drive / Stockdill Drive) is to provide improved amenities for current users and the West Belconnen development. The 2041 design of the road is to cater for the increase in traffic generated by the establishment of the new development. The Stage 3 design of the road will consist of additional traffic lanes, unsignalised and signalised intersections to increase traffic movements, frequent bus services, service roads for residents along the road corridor and active travel facilities.

6.6 Speed Environment

The road environment for the length of Drake Brockman Drive and to a lesser extent on Stockdill Drive, encourages travel speeds greater than the signposted speeds due to the generous curvilinear alignment and the wide pavement. These aspects are discussed further in Section 1.1, Proposed Road Geometry.

The current sign posted speed limit on Drake Brockman Drive changes at Cussen Street where an 80 km/h speed limit exists east of Cussen Street and a 60 km/h speed limit to the west. The speed limit to the west of Macnaughton Street is a recognition of the presence of residential driveways fronting Drake Brockman Drive.

The proposed Stage 1 design for the upgrade of Drake Brockman Drive / Stockdill Drive involves minor civil works including the introduction of new line marking. To aid in the process of introducing the new line marking scheme and reduced speed environments predicted for the Stage 2 and the 3 design, it is proposed to reduce the 80 km/h speed environment east of Cussens Street to 70 km/h and retain a 60 km/h speed limit west of Cussens Street.

It is planned to extend the 70 km/hr speed environment to Spofforth Street in the Stage 2 and 3 designs. Stage 2 will involve the development of a service road for residents on Drake Brockman Drive from Spofforth Street to Macnaughton Street.

The speed environments for each stage are tabulated below in Table 22.

Table 22 Speed Environment for each stage

Stage	Speed Environment (km/hr)	From	To
Current (existing)	80	William Hovell Drive	Cussen Street
	60	Cussen Street	Stockdill Drive
1	70	William Hovell Drive	Cussens Street
	60	Cussen Street	Stockdill Drive
2 & 3	70	William Hovell Drive	Spofforth Street
	60	Spofforth Street	Stockdill Drive

6.7 Road Geometry

A description of the existing and proposed geometry for the road project follows.

The proposed geometry is described for three future stages of construction:

- Stage 1 incorporates the road works proposed to coincide with the commencement of development of West Belconnen, involving minor safety and amenity improvements to assist the carriage of additional traffic on the existing road.
- Stage 2 incorporates major changes to the road alignment from Spofforth Street to Macnaughton Street, including changes to intersection priority and road alignment at the Spofforth Street intersection, a new road and service road between Spofforth Street and Macnaughton Street, and new signals at the Macnaughton Street and Kinsella Street intersections.
- Stage 3 incorporates full duplication of the road project, including upgrades to all intersections and new signals at the Spofforth Street and Trickett Street intersections.

6.7.1 Existing conditions

6.7.1.1 Existing road

Drake Brockman Drive has a 12.8 m wide carriageway flanked by kerb and gutter with associated drainage sumps incorporated into the kerb lines.

The road does not have any superelevated curves as they are of sufficient radii not to be warranted. The carriageway is crowned on the centreline with crossfalls to the flanking kerb and gutter.

Whilst the initial stage of the present road, as noted in Section 6.4, generally meet urban arterial road classification design principles, the second stage of the present road reflects a philosophical change in its character with development occurring on the road frontage and a vertical geometry more associated with a collector road classification following, more or less, the existing topography.

This change in design philosophy has brought about a number of issues with the safe operation of the road, namely:

- Generous horizontal curvature and wide pavement on Drake Brockman Drive encouraging high traffic speeds despite regulatory signage.
- Potentially unsafe ingress and egress from driveways to the residential properties fronting the road between Spofforth Street and Macnaughton Street due to lack of sight distance from vehicles egressing to approaching traffic (driveways in cutting, verge vegetation and the curvature of the road exacerbate the situation), no median storage for residents making right-turns into driveways and sun glare as discussed below.
- The Spofforth Street to Macnaughton Street alignment generally being on a bearing of approximately 110 degrees makes it susceptible, at certain times of the year, to the impacts of sun glare during the morning and evening peak hours. An exacerbating issue is the vertical alignment over this section as the rolling nature of the road exposes the motorist to extra hazards as the rising and falling gradients are negotiated and create a greater exposure to the glare caused by the rising / setting sun.
- The lack of adequate sight distance on the approaches to the intersections of Spofforth Street, Trickett Street and Macnaughton Street. The connection of Stockdill Drive to Drake Brockman Drive at Spofforth Street occurs on the crest of 4% approach gradient and a 5% departure gradient with a short connecting vertical curve resulting in less than adequate sight distance for both Stopping Sight Distance (SSD) and intersection Approach Sight Distance (ASD). The existing conditions equate to 60 km/h for SSD and 50 km/h for ASD.
- At Trickett Street and Macnaughton Street both intersections are on or adjacent to crests with the vertical curves joining lesser approach and departure gradients than at the Spofforth Street intersection. These crest vertical curves provide SSD requirements for an 80 km/h signposted speed and the ASD requirements equate to about a 65 km/h signposted speed.

The section of Stockdill Drive subject to this feasibility study is formed by an upgrade of a former rural access road as noted previously. The horizontal curve radii over this section vary from 240 m near the Britten-Jones Drive intersection to about 150 m at the approach to Spofforth Street. The vertical curve at Spofforth Street is sub-standard for a 50 km/h signposted speed limit. The only other vertical curve is at Britten-Jones Drive and this curve meets SSD and ASD requirements for the signposted speed limit of 60 km/h.

6.7.1.2 Intersections

There are seven existing intersections along the road to the east of the proposed access into the West Belconnen Estate, as follows:

- Britten-Jones Drive; Priority controlled T Junction;
- Spofforth Street; Priority controlled T Junction with priority on the Drake Brockman Drive to Spofforth Street traffic movement, i.e. Stockdill Drive traffic gives way to turning traffic at the junction;
- Trickett Street; Priority controlled T Junction;
- Macnaughton Street; Priority controlled T Junction;
- Cussen Street; Priority controlled T Junction;
- Kinsella Street; Priority controlled T Junction; and
- Kingsford Smith Drive / William Hovell Drive; Priority controlled roundabout with southbound slip lane connecting Kingsford Smith Drive to William Hovell Drive.

One new intersection is proposed for access to the Woodhaven Estate which is approved for construction. This intersection will be a priority controlled junction with the existing Stockdill Drive and will be constructed within the next 6 months.

6.7.2 Stage 3 upgrade

The design of the Stage 3 upgrade works was determined initially to inform the designs for the Stage 1 and 2 works, and any sub-stage improvements. The Stage 3 upgrade will involve a dual carriageway divided road with a service road between Spofforth Street and Macnaughton Street.

6.7.2.1 Design speed

The design speeds for the West Belconnen Road upgrade are:

- Stockdill Drive; West Belconnen Estate access to Spofforth Street: 70 km/h with the exception to the east and west approach to Spofforth Street which will be designed to suit an 80 km/h design speed for Approach Sight Distance as the design speed should not be changed through the intersection.
- Drake Brockman Drive; Spofforth Street to Kingsford Smith Drive / William Hovell Drive: 80 km/h.

6.7.2.2 Horizontal alignment

The alignment of the duplicated road (the westbound carriageway) will generally follow the curvature of the existing carriageway as described previously with the following exceptions:

- The existing 240 m radius curve on Stockdill Drive will be increased to 420 m to make it more constant with the radii of other curves encountered along the road. This curve improvement has the added advantage of improving entry conditions from the proposed Woodhaven access and Britten-Jones Drive, where present sight lines are restricted by vegetation, as the road moves to the south by about 10 m.

  This shift of the new carriageway alignment also allows for the gas mains and watermains required to service the West Belconnen Estate to be located on the northern side of the existing carriageway, where they are not affected by future earthworks.
- The short arc radius 150 m curve at the western approach to Spofforth Street is to be replaced by a radius 450 m curve extending through the intersection to transition the duplicated roadway from the existing carriageway, to allow it to be converted to a service road.
- East of Macnaughton Street a 500 m radius curve has been introduced to transition the realigned eastbound carriageway back to the existing eastbound pavement.

6.7.2.3 Superelevation

The proposed and existing horizontal curves are of adequate radii to avoid the need for superelevation (refer Design Criteria table, Appendix D).

Not providing superelevation allows the proposed new carriageways to be crowned on the lane line marking separating the median and kerbside traffic lanes. Two-way crossfalls of 3% are to be provided on the pavement to drain runoff to the median and verge bio-retention swales and in so doing assist in meeting the new WSUD guidelines as they apply to roadways of the nature of Stockdill Drive / Drake Brockman Drive.

As noted previously the existing carriageway is built with two-way crossfall.

6.7.2.4 Vertical alignment

The vertical alignment between the access to the West Belconnen Estate and a point about midway between Macnaughton Street and Cussen Street has been modified to resolve ASD deficiencies at intersections with Spofforth Street, Trickett Street and Macnaughton Street. The revised grading on Stockdill Drive at the Woodhaven Estate access and Britten-Jones Drive is adjusted to provide ASD requirements.

Apart from providing ASD criteria the new geometry has considered the need to:

— Tie into the levels at existing intersections.

— Minimise construction of an elevated formation so as not to provide a barrier to the views from the residences located between Spofforth Street and Macnaughton Street, a desire expressed by those residents.

6.7.2.5 Cross section

The cross section for the duplicated road is described in detail as follows:

— A new westbound carriageway from the access into the West Belconnen Estate to the Kingsford Smith Drive / William Hovell Drive intersection configured as follows:

- 2.0 m wide on-road cycle lane;
- 4.0 m wide kerbside traffic lane catering for bus traffic;
- 3.5 m wide median side traffic lane; and
- 0.5 m wide median structural shoulder.

No kerbing is proposed on the median side of the carriageway so that pavement runoff can be directed to a bio-retention swale located in the depressed median to assist in meeting the ACT WSUD requirements.

For similar reasons no kerbing is proposed on the interface of the verge and on-road cycle lane to allow stormwater runoff from the road pavement to flow to a bio-retention swale located on the southern of the off-road shared path

— A new eastbound carriageway from the access into the West Belconnen Estate to Macnaughton Street.

- 2.0 m wide on-road cycle lane;
- 4.0 m wide kerbside traffic lane catering for bus traffic;
- 3.5 m wide median side traffic lane; and
- 0.5 m wide median side structural shoulder.

— Between Macnaughton Street and Southern Cross Drive / William Hovell Drive the existing two-lane / two-way 12.8 m wide carriageway will be modified to provide

- 2.0 m wide on-road cycle lane;
- 4.0 m wide kerbside traffic lane catering for bus traffic;
- 3.5 m wide median side traffic lane; and
- 0.5 m wide median side structural shoulder.

The reduced width of 10 m requires the removal of 2.8 m width of redundant pavement. Whilst the existing barrier kerb located on the northern edge of the pavement will be retained no kerbing is proposed on the median side of the carriageway so that pavement runoff can flow to a bio-retention swale located in the depressed median to assist in meeting the ACT WSUD requirements.

— Provision a 5.5 m wide one-way eastbound service road between Spofforth Street and Macnaughton Street utilising the existing carriageway pavement and removal of redundant pavement (7.3 m in width). The service road will be ingressed off the intersections of Spofforth Street and Trickett Street whilst egress will be provided at Trickett Street and Macnaughton Street. Raised thresholds 3.2 m wide will be provided at each ingress / egress point to encourage slow speeds but also limit the potential for rat-running to bypass traffic signals on Drake Brockman Drive.

— Provision of a 6.5 m wide median consisting of 0.5 m wide structural shoulder to each carriageway edge and a 5.5 m wide depressed median forming a bio-retention swale with associated stormwater drainage pipes and sumps at outlets.

— Provision of 7.5 m wide verges flanking both carriageways, new and existing. These verges will grade towards the bio-retention swale to be located at the outside edge of the proposed 2.5 wide shared path. The verge will contain:

- Bus stops at Spofforth, Macnaughton and Kinsella Street intersections, located on the exit side of the intersections.
- Street lighting columns set-back 1.0 m from the edge of the on-road cycle lane (3.0 m from the edge of the traffic lane).
- 2.5 m wide shared path with 1.0 m clearance to light columns. Initially only the northern shared path will be constructed with the southern path provided when demands dictate its provision.

- Relocated / new utilities which are envisaged to include 600 mm diameter water supply mains, and a shared trench containing gas mains (size to be determined) low and high voltage electrical cables and communications cables.
- 4.4 m wide bio-retention swale with associated stormwater drainage pipes and sumps at outlets. This swale will be provided in both cut and fill conditions to ensure the optimum outcome is provided to meet the new WSUD guidelines.

6.7.2.6 Intersections

In the Stage 3 configuration of the road the intersections will be upgraded to suit the duplicated roadway. The revised form of the intersections is outlined below.

Woodhaven access

This intersection (yet to be constructed as previously noted) will be adjusted to align with the duplicated Stockdill Drive and will become left-in / left out in the Stage 1 design.

The 12.5 m long Heavy Rigid Vehicle (HRV) is the design vehicle for turning movements at this intersection.

Britten-Jones Drive

This intersection will be adjusted to align with the duplicated Stockdill Drive and will remain as a priority controlled junction.

The junction will provide for all turning movements and will include a 3.5 m wide, 115 m long right-turn lane on the Stockdill Drive westbound approach (including 25 m long taper and 15 m of storage at the hold line), together with a 150 m long left-turn acceleration lane for vehicles entering Stockdill Drive from Britten-Jones Drive.

The 12.5 m long Heavy Rigid Vehicle (HRV) is the design vehicle for turning movements at this intersection.

Spofforth Street

This intersection will be adjusted to align with the duplicated Drake Brockman Drive and will be signalised with the existing priority arrangement changed to suit Stockdill Drive/Drake Brockman Drive traffic.

The junction will provide for all turning movements with a right-turn lane provided on Drake Brockman Drive westbound approach and a left-turn lane provided on the Drake Brockman Drive eastbound approach. Both of these lanes are 3.5 m wide and 115 m long, including 25 m long taper and 15 m of storage at the hold line.

Spofforth Street will have a widened median to allow ingress to the one-way (eastbound direction) service road via a priority controlled right-turn movement. The right-turn pocket has adequate length to store a 12.5 m long HRV vehicle making the manoeuvre.

The 25 m long B-Double Vehicle (B-DV) is the design vehicle for this intersection, for movements between Drake Brockman Drive and Stockdill Street. B-DV's cannot use Spofforth Street.

Bus stops are to be provided on the eastbound and westbound carriageways of Drake Brockman Drive on the departure side of the intersection with pedestrian / bicycle access to and from the westbound stop via the traffic signals.

Trickett Street

This intersection will be adjusted to align with the duplicated Drake Brockman Drive and will be signalised.

The junction will provide for all turning movements with a right-turn lane provided on Drake Brockman Drive westbound approach and a left-turn lane provided on the Drake Brockman Drive eastbound approach. Both of these lanes are to be 3.5 m wide and 115 m long, including 25 m long taper and 15 m of storage at the hold line.

Trickett Street will have a widened median to allow access to and from the one-way (eastbound direction) service road via a priority controlled right-turn movement. The right-turn pocket formed will have adequate length to store a 12.5 m long HRV vehicle making the manoeuvre.

The 19 m long Single Articulated Vehicle (AV) is the design vehicle for the intersection.

Macnaughton Street

This intersection will be adjusted to align with the duplicated Drake Brockman Drive and will be signalised.

The junction will provide for all turning movements with a right-turn lane provided on Drake Brockman Drive westbound approach and a left-turn lane provided on the Drake Brockman Drive eastbound approach. Both of these lanes are to be 3.5 m wide and 115 m long, including 25 m long taper and 15 m of storage at the hold line.

Macnaughton Street will have a widened median to allow egress from the one-way (eastbound direction) service road via a priority controlled right-turn movement. The right-turn pocket formed will have adequate length to store a 12.5 m long HRV vehicle making the manoeuvre.

The 25 m long B-Double Vehicle (B-DV) is the design vehicle for the intersection.

Bus stops are to be provided on the eastbound and westbound carriageways of Drake Brockman Drive on the departure side of the intersection with bicycle access to and from the westbound stop via the traffic signals.

Cussen Street

This intersection will be adjusted to align with the duplicated Drake Brockman Drive and will be an unsignalised priority controlled intersection.

The junction will provide for all turning movements with a right-turn lane to be provided on the Drake Brockman Drive westbound approach and a left-turn lane to be provided on the Drake Brockman Drive eastbound approach. Both of these lanes are to be 3.5 m wide and 115 m long, including 25 m long taper and 15 m of storage at the hold line.

A 3.5 m wide, 220 m long right-turn acceleration lane is to be provided for vehicles entering Drake Brockman Drive from Cussen Street.

The 19 m long Single Articulated Vehicle (AV) is the design vehicle for the intersection.

Kinsella Street

This intersection will be adjusted to align with the duplicated Drake Brockman Drive and will be signalised.

The junction will provide for all turning movements with a right-turn lane provided on Drake Brockman Drive westbound approach and a left-turn lane provided on the Drake Brockman Drive eastbound approach. Both of these lanes are 3.5 m wide and 115 m long, including 25 m long taper and 15 m of storage at the hold line.

The 19 m long Single Articulated Vehicle (AV) is the design vehicle for the intersection.

Bus stops are to be provided on the eastbound and westbound carriageways of Drake Brockman Drive on the departure side of the intersection with pedestrian/bicycle access to and from the westbound stop via the traffic signals.

Kingsford Smith Drive / William Hovell Drive

The existing single lane roundabout will be upgraded to a dual lane roundabout with a 25 m diameter central island and 11.5 m circulating lanes catering for a B-Double Vehicle and a car turning simultaneously.

- ***Eastbound Traffic***: Two traffic lanes will continue eastward from Drake Brockman Drive and form two right-turn lanes into William Hovell Drive southbound. A 5 m wide left-turn slip lane flanked by a 2 m wide on-road cycle lane is to be provided to connecting Drake Brockman Drive with Kingsford Smith Drive. This slip-lane will have a 60 m centre radius (design speed: 50 km/h) and 80 m entry and exit radii (design speed 60 km/h). These 80 m radius curves provide the entry and exit speed transitions.

Three options were investigated for the merge:

1. Acceleration Lane and Merge Taper

There is insufficient space to the Belconnen Way roundabout for left-turn traffic to accelerate to the design speed of Kingsford Smith Drive (90 km/h) which is similar for traffic exiting the roundabout from William Hovell Drive and it is estimated that the latter traffic will only accelerate to about 70 km/h before decelerating to a stop at the Belconnen Way roundabout, a total travel distance of 225 m which generally matches the available distance of 240 m. As left turn traffic would require 150 m to accelerate to 70 km/h, plus a merge of 70 m, the merge would end at the Belconnen Way roundabout hold line. This would be unsafe and create operational issues, particularly if the Drake Brockman Drive traffic needed to make a right-turn into Belconnen Way.

2. Visibility Criteria and Merge Taper

As the traffic exiting the roundabout and the left-turn lane traffic exiting the transition curve (refer Option 1) are travelling at similar speeds at the nose of the separation island given drivers in each lane would have sight of each other, the 4 second visibility criteria was applied as outlined in Table 7.2, Austroads Part 4C, Interchanges which equates to 80 m of parallel running and a merge taper of 70 m. The end of the merge taper under this option is 70 m from the Belconnen Way roundabout hold line. The ability for drivers to weave to the right-hand lane over 70 m would be problematic immediately after completing the merge and hence this option is considered unsafe and would create operational issues.

3. Dedicated Left-turn Lane Entry to Kingsford Smith Drive

This option would require the northbound traffic from William Hovell Drive to merge to a single lane after leaving the Drake Brockman Drive roundabout. The left-turn lane from Drake Brockman Drive would join the Kingsford Smith Drive carriageway in a dedicated lane about 115 m from the Belconnen Way roundabout hold line. This option, notwithstanding the relatively short weave distance of 115 m, offers the best solution for the left-turn traffic from Drake Brockman Drive to make a right-turn into Belconnen Way as has been adopted.

- ***Southbound traffic***: The existing southbound slip lane will be retained for traffic travelling from Kingsford Smith Drive to William Hovell Drive southbound.
- ***Northbound traffic***: The existing two northbound traffic lanes on William Hovell Drive will continue to pass through the roundabout, albeit in its reconfigured form, as presently occurs. A 4.0 m wide left-turn slip lane, flanked by a 2 m wide on-road cycle lane,

is provided to connect to Drake Brockman Drive. This lane will have a dedicated lane entering into Drake Brockman Drive. A 120 m diverge lane is provided from William Hovell Drive into the left-turn slip lane.

Access is provided to the Land's End property located on the corner of William HovellDrive and Drake Brockman Drive and the abutting ICON Water reservoir from the left-turn slip lane via a 100 m long deceleration lane.

***Westbound Traffic**:* Two right-turn lanes will enter the roundabout from Kingsford Smith Drive for westbound traffic turning into Drake Brockman Drive. These two right-turn exit lanes will merge into a single lane prior to the join with the William Hovell Drive to Drake Brockman Drive left-turn slip lane. Access is to be provided to the Land's End property, located on the corner of William HovellDrive and Drake Brockman Drive, and the abutting ICON Water reservoir from the left-hand lane at its exit from the roundabout. This access is 5 m wide with sufficient storage for a HRV and has a stop condition prior to crossing the left-turn slip lane from William Hovell Drive into Drake Brockman Drive via gated stop signs.

The exit from the Land's End property/ICON Water reservoir is left-turn only onto the slip lane. To provide adequate sight lines for left-turning vehicles from the access, a 5 second critical acceptance gap and a 80 km/h approach speed has been adopted as noted in Table 3.5, Austroads Part 4A, Unsignalised and Signalised Intersections giving a gap sight distance of 111 m. A retaining wall approximately 2 m high and 200 m long is required to limit impacts on the Land's End Rural Lease as well as providing for the required sight lines. Preliminary design indicates this wall will be located about 7 m from an existing dwelling on the Land's End property, requiring fencing to be incorporated into the top of the wall.

Refer to plans in Volume II of this report for further details.

6.7.3 Stage 1 upgrade

Stage 1 is proposed to be limited to: Upgrade of line-marking to improve conditions for right-turning traffic into existing intersections and residential driveways. The works are proposed as follows:

— Spofforth Street to Macnaughton Street:

- A 2.5 m wide painted median in which right-turning traffic can store whilst awaiting a gap in the traffic to access respective intersections and residential driveways.
- 2 m wide buffer lane on the northern side of the carriageway (as presently exists) to improve sight lines for traffic egressing the driveways as well as providing some space clear of the through carriageway to reduce speed prior to turning into the driveways.
- Provision of 4.0 m and 4.3 m wide eastbound and westbound through lanes respectively.

— Macnaughton Street and Southern Cross Drive/William Hovell Drive:

- A 3.0 m wide painted median which will allow for right-turn lanes to be created at intersections.
- 4.9 m wide through traffic lanes, both eastbound and westbound.

— Pegasus Riding School Access:

- Provision of a short left-turn lane at the entrance driveway on the westbound through lane to allow left-turn traffic to reduce speed clear of the through traffic lane.

— Intersection arrangements will remain as presently exists as follows:

- ***Woodhaven Estate***: Priority controlled T Junction with left-in and left-out traffic movements only catered for.
- ***Britten-Jones Drive***: Priority controlled T Junction.
- ***Spofforth Street***: Priority controlled T Junction with priority on the Drake Brockman Drive to Spofforth Street traffic movement, i.e. Stockdill Drive traffic will continue to give way to turning traffic at the junction. The 2.5 m wide painted median will continue up to the turn line into Spofforth Street, i.e. the westbound and right-turn traffic will be accommodated on the single westbound lane.

  Given the issues with the existing Stopping Sight Distance (50 km/h as noted previously) on the eastbound approach to the intersection it is recommended that improvements be made once traffic from the West Belconnen Estate begins to use Stockdill Drive, i.e. there is an increase in traffic on Stockdill Drive attributed to the residential estate
- ***Trickett Street:*** Priority controlled T Junction with a 2.5 m wide and 115 m long, including 25 m long taper and 15 m of storage at the hold line, right-turn lane created in the proposed 2.5 m wide painted median.

- ***Macnaughton Street****:* Priority controlled T Junction with a 2.5 m wide and 115 m long, including 25 m long taper and 15 m of storage at the hold line, right-turn lane created in the proposed 2.5 m wide painted median.
- ***Cussen Street****:* Priority controlled T Junction with a 2.5 m wide and 115 m long, including 25 m long taper and 15 m of storage at the hold line, right-turn lane created in the proposed 3.0 m wide painted median.
- ***Kinsella Street****:* Priority controlled T Junction with a 2.5 m wide and 115 m long, including 25 m long taper and 15 m of storage at the hold line, right-turn lane created in the proposed 3.0 m wide painted median.
- **Southern *Cross Drive/William Hovell Drive****:* Priority controlled roundabout with southbound slip lane.

The status-quo will be maintained for the vertical alignment for the length of the road, and no on-road cycle lanes will be provided in this stage apart from the 2 m wide buffer lane between Spofforth Street and Macnaughton Street which defaults as an on-road cycle lane.

Refer to plans in Volume II of this report for further details.

6.7.4 Stage 2 upgrade

This stage will see the implementation of the part of the Stage 3 upgrade works between the West Belconnen Estate access and Macnaughton Street as described previously in the Stage 3 works. Beyond Macnaughton Street and the transition of the Stage 3 works to the existing carriageway, the Stage 1 work as described previously will be retained up to the Kingsford Smith Drive/William Hovell Drive intersection, apart from some minor improvements to the operational arrangements of the roundabout and the signalisation of the Kinsella intersection.

A summary of the works are:

1. West Belconnen Estate Access to end of Westbound Carriageway Transition east of Macnaughton Street
    - Full formation earthworks.
    - Provision of kerbside westbound and eastbound carriageway lanes and abutting on-road cycle lanes except at Macnaughton Street where the Stage 3 intersection arrangement of two lanes eastbound and westbound will be built over approximately 200 m each side of the intersection.
    - Adjustments to existing intersections, namely Woodhaven Access, Britten-Jones Drive, Spofforth Street, Trickett Street and Macnaughton Street to provide their Stage 3 arrangements as shown in the Stage 3 drawings, including right and left-turn lanes, the former built on the Stage 3 kerbside lane.
    - Provision a 5.5 m wide one-way kerbed service road between Spofforth Street and Macnaughton Street and removal of redundant pavements (7.3 m in width).
    - WSUD median and verge bio-retention swales and associated stormwater drainage.
    - Street lighting located on the verges.
    - Bulk utilities and utility relocations into the westbound carriageway verge.
    - Revised location for the Pine Ridge equestrian centre access.
    - Temporary connection to the Stage 1 works immediately east of Macnaughton Street.

2. Kinsella Street

   - Signal existing intersection maintaining one eastbound and one westbound traffic lane with a 2.5 m wide 115 m long right-turn lane for westbound traffic turning into Kinsella Street, ie. a Type CHR arrangement (Austroads Part 4A).

3. Kingsford Smith Drive/William Hovell Drive Intersection

   - Installation of part-time traffic signals on the Drake Brockman Drive Eastbound approach.

Refer to plans in Volume II of this report for further details.

6.8 Box Gum Woodland Impacts

The maximum area of box gum woodland located on the southern side of the Stockdill Drive / Drake Brockman Drive road corridor that can be impacted by the West Belconnen Road Upgrade Works is 3.8 hectares. Initial calculations with 4 (horizontal) to 1 (vertical) batters indicated that the area of disturbance would be approximately 4.5 hectares without mitigating measures.

As a consequence a retaining wall has been introduced along sections of the westbound carriageway verge to limit the impact of disturbance caused by earthworks on the box gum woodland. The length of this wall is approximately 1,800 m. The locations of the retaining walls are shown in Table 23.

Excluded from these wall locations is the retaining wall on the William Hovell Drive to Drake Brockman Drive left-turn slip lane. This wall is described in the Stage 3 works.

Table 23 Locations of required retaining walls

Chainage	Condition		Length (m)	Maximum Height (m)
	Cut	Fill		
440 to 540	N	Y	100	4.5
540 to 680	Y	N	140	3.0
680 to 800	N	Y	120	2.0
1,100 to 1,500	N	Y	400	1.5
1,500 1,700	Y	N	200	3.5
1,820 to 2,200	Y	N	200	3.5
2,300 to 2,400	Y	N	100	1.0
2,520 to 2,800	Y	N	280	3.0
2,800 to 3060	Y	N	260	2.5
William Hovell Drive / Drake Brockman Drive south-west corner	Y	N	200	2.0

6.9 New Road Boundaries

Existing road gazettal boundaries are impacted on the south side of Stockdill Drive and Drake Brockman Drive and thus will affect existing leases.

The impacted leases are:

Land Resumption (m2)	
1,962	Rural Block 1582, Belconnen
15,567	Rural Block 1600, Belconnen (Pine Ridge Equestrian Centre)
9,013	Rural Block 1599, Belconnen
31,900	Rural Block 1339, Belconnen (Pegasus Riding School)
21,680	Rural Block 1565, Belconnen
80,122	**Total**

The new road gazettal boundary will be located on the southern edge of the 10 m wide Bicentennial National Trail 38m form the proposed centreline. In the south-west sector of the Drake Brockman Drive / William Hovell Drive intersection the new road boundary is formed by the chamfer of the existing gazettal boundary described previously.

6.10 Pavements

6.10.1 Likely Geological Subsurface Conditions

Based on the 1:50,000 Map of the Geology of Canberra, Queanbeyan and Environs, the entire length of Drake Brockman Drive is located within the Walker Volcanics geological unit, comprising dacitic crystal tuff.

The subsurface conditions expected within this unit comprise residual clays of low to medium plasticity, probably less than 2 m thick, overlying variably weathered tuff rock. Corestones of relatively unweathered, hard rock may be encountered within the profile, sometimes occurring at shall depth.

Accordingly, shallow excavations up to about 1 m depth are not expected to encounter difficulties but if corestones are encountered then large equipment or rock hammering may be required to excavate the rock.

It should be noted that this assessment of geological conditions is preliminary only, and must be confirmed by geotechnical investigations.

6.10.2 Likely Pavement Conditions

Based on the above discussion, design CBR values for pavements are likely to be about 5%. Difficult subgrade conditions are not expected unless the exposed subgrade is allowed to become wet.

In line with Territory guidelines, the new mainline pavement may comprise either relatively thin asphalt over granular base and subbase materials or thick asphalt over a granular working platform, depending on the design traffic. Localised widening of the existing pavement or for turning into existing side streets are expected to comprise thin asphalt over granular base and subbase materials.

6.11 Typical Cross Sections

Two options were considered for managing stormwater runoff from the road corridor. These options are termed WSUD and Non-WSUD and describe below.

Non-WSUD Option

This option does not have any WSUD measures incorporated into the design in that the carriageway has a one-way crossfall to the verge. The median edge is kerbed and the verge edge flanked by kerb and gutter with stormwater sumps and piping connected to the existing stormwater system.

WSUD Inclusive Option

For this option the road is crowned on the centre lane line to direct stormwater runoff towards a bio-retention swale located in the median and a bio-retention swale located on the outer edge of the verge.

The option adopted for the feasibility study is the WSUD option as the stormwater management using non-kerbed road edges assists in meeting the new ACT WSUD Code. The cross sectional arrangements for the incorporation of WSUD measures in the duplicated road are described in detail as follows.

— A new westbound carriageway from the access into the West Belconnen Estate to the Kingsford Smith Drive/William Hovell Drive intersection configured as follows:

- 2.0 m wide on-road cycle lane;
- 4.0 m wide kerbside traffic lane catering for bus traffic;
- 3.5 m wide median side traffic lane; and
- 0.5 m wide median structural shoulder.

No kerbing is proposed on the median side of the carriageway so that pavement runoff can be directed to a bio-retention swale located in the depressed median to assist in meeting the ACT WSUD requirements.

For similar reasons no kerbing is proposed on the interface of the verge and on-road cycle lane to allow stormwater runoff from the road pavement to flow to a bio-retention swale located on the southern of the off-road shared path

— A new eastbound carriageway from the access into the West Belconnen Estate to Macnaughton Street:

- 2.0 m wide on-road cycle lane;
- 4.0 m wide kerbside traffic lane catering for bus traffic;

- 3.5 m wide median side traffic lane; and
- 0.5 m wide median side structural shoulder.

— Between Macnaughton Street and Southern Cross Drive / William Hovell Drive the existing two-lane/two-way 12.8 m wide carriageway will be modified to provide:

- 2.0 m wide on-road cycle lane;
- 4.0 m wide kerbside traffic lane catering for bus traffic;
- 3.5 m wide median side traffic lane; and
- 0.5 m wide median side structural shoulder.

The reduced width of 10 m requires the removal of 2.8 m width of redundant pavement. Whilst the existing barrier kerb located on the northern edge of the pavement will be retained no kerbing is proposed on the median side of the carriageway so that pavement runoff can flow to a bio-retention swale located in the depressed median to assist in meeting the ACT WSUD requirements.

— Provision of a 5.5 m wide one-way service road between Spofforth Street and Macnaughton Street utilising the existing carriageway pavement and removal of redundant pavement (7.3 m in width).

The service road is ingressed off the intersections of Spofforth Street and Trickett Street whilst egress is provided at Trickett Street and Macnaughton Street.

Raised thresholds 3.2 m wide are provided at each ingress/egress point to encourage slow speeds but also limit the potential for rat-running to bypass traffic signals on Drake Brockman Drive.

— Provision of a 6.5 m wide median consisting of 0.5 m wide structural shoulder to each carriageway edge and a 5.5 m wide depressed median forming a bio-retention swale with associated stormwater drainage pipes and sumps at outlets.

— Provision of 7.5 m wide verges flanking both carriageways, new and existing. These verges grade towards the bio-retention swale located at the outside edge of the proposed 2.5 wide shared path as previously mentioned. The verge contains:

- Bus stops at Spofforth, Macnaughton and Kinsella Street intersections located on the exit side of the intersections.
- Street lighting columns set-back 1.0 m from the edge of the on-road cycle lane (3.0 m from the edge of the traffic lane).
- 2.5 m wide shared path with 1.0 m clearance to light columns. Initially only the northern shared path will be constructed with the southern path provided when demands dictate its provision.
- Relocated/new utilities which are envisaged to include 600 mm diameter water supply mains, and a shared trench containing gas mains (size to be determined) low and high voltage electrical cables, communications cables.
- 4.4 m wide bio-retention swale with associated stormwater drainage pipes and sumps at outlets. This swale will be provided in both cut and fill conditions to ensure the optimum outcome is provided to meet the new WSUD guidelines.

6.12 Property Access

The existing arrangement of Drake Brockman Drive involves a number of property access locations to both urban and rural properties. The urban access points are located on the northern side of Drake Brockman Drive between Macnaughton Street and Spofforth Street and the rural access points are located on the southern side of Drake Brockman Drive for the length of the road corridor.

A number of accesses to residential and rural leases are required to be modified as part of the design.

6.12.1 Urban Properties

The urban properties between Macnaughton Street and Spofforth Street which gain access from the north of Drake Brockman Drive total 24 properties.

The Stage 1 design will not affect accesses to existing leases per se. However as mentioned previously the addition of a painted median between Spofforth Street and Macnaughton Street will improve the safety of ingressing vehicles travelling from the east into the existing residential driveways by allowing them to temporarily halt within the median whilst awaiting the opportunity to access driveways.

The proposed Stage 2 works will provide the Stage 3 arrangement between Spofforth Street and Macnaughton Street with the creation of the one-way (easterly direction) service road. The service road will provide good safety and operational conditions for the residents to access their driveways.

A number of options were considered for the proposed service roads between Macnaughton Street and Spofforth Street which are summarised as follows:

Option 1: Two two-way service roads with accesses from Macnaughton Street and Trickett Street respectively. Each service road has a cul-de-sac at the western end of the access road.

Option 2: Two two-way service roads with accesses from Trickett Street and Spofforth Street respectively. Each service road has a cul-de-sac at the eastern end of the access road.

Option 3: Two one-way service roads operating eastbound which are accessed from the western-most side road (Spofforth Street and Trickett Street) and exited from the eastern-most side road (Trickett Street and Macnaughton Street).

Service road options 1 and 2 were reviewed geometrically; however width constraints of the proposed access roads and cul-de-sacs indicated that these options were less desirable in terms of geometric design.

Option 3 was seen as the preferred option, dependent on the side road access design.

For an example of the proposed access road layout, refer to the drawings. This arrangement operates in a 'teardrop' design which reduces potential conflicts in this location whilst still providing storage for right turning vehicles from the minor road into the proposed service road. The operation of this design should be perceived as a wide median which gives priority to the minor road through movements whilst allowing for ingress / egress movements from the access roads.

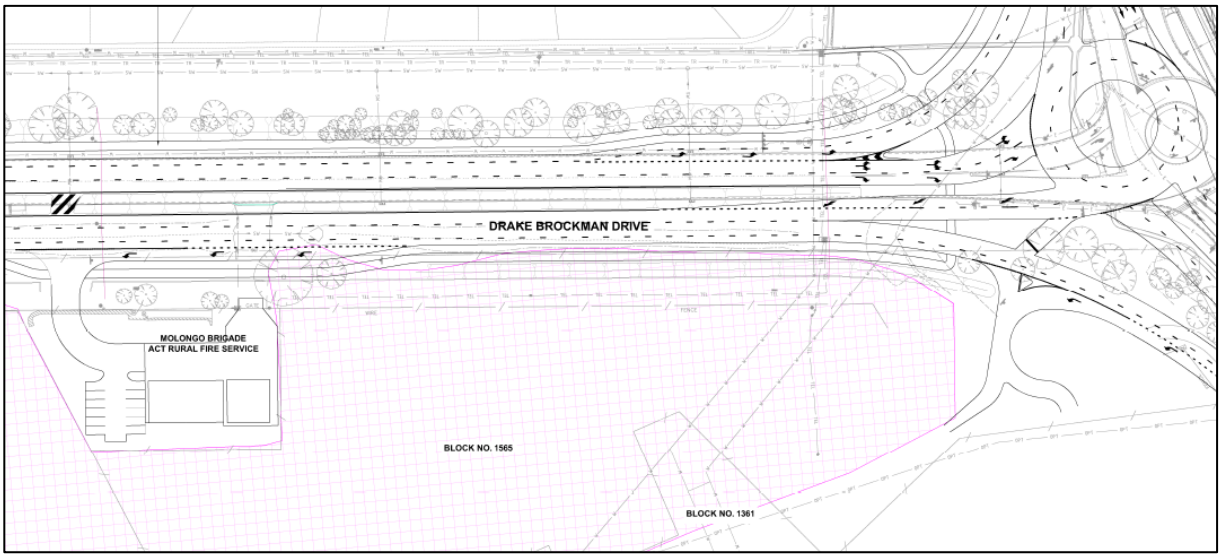
6.12.2 Rural Properties

A number of rural property access points exist on the southern side of Drake Brockman Drive. The driveway future access options for key accesses to the Molonglo Brigade ACT Rural Fire Service, Pegasus Riding School and Pine Ridge Equestrian Centre are detailed in the following section. Details for recommended access arrangements for other accesses follow in Section 6.12.2.5

6.12.2.1 Molonglo Brigade ACT Rural Fire Service and Land's End

The proposed access arrangement for the Molonglo Brigade ACT Rural Fire Service is designed as a left-in left-out intersection arrangement. It will involve a left-turn deceleration lane from Drake Brockman Drive westbound and an access driveway approximately 25 m in width. The driveway will also provide access to the adjacent rural property on the corner of William Hovell Drive and Drake Brockman Drive. This access arrangement is shown in Figure 24.

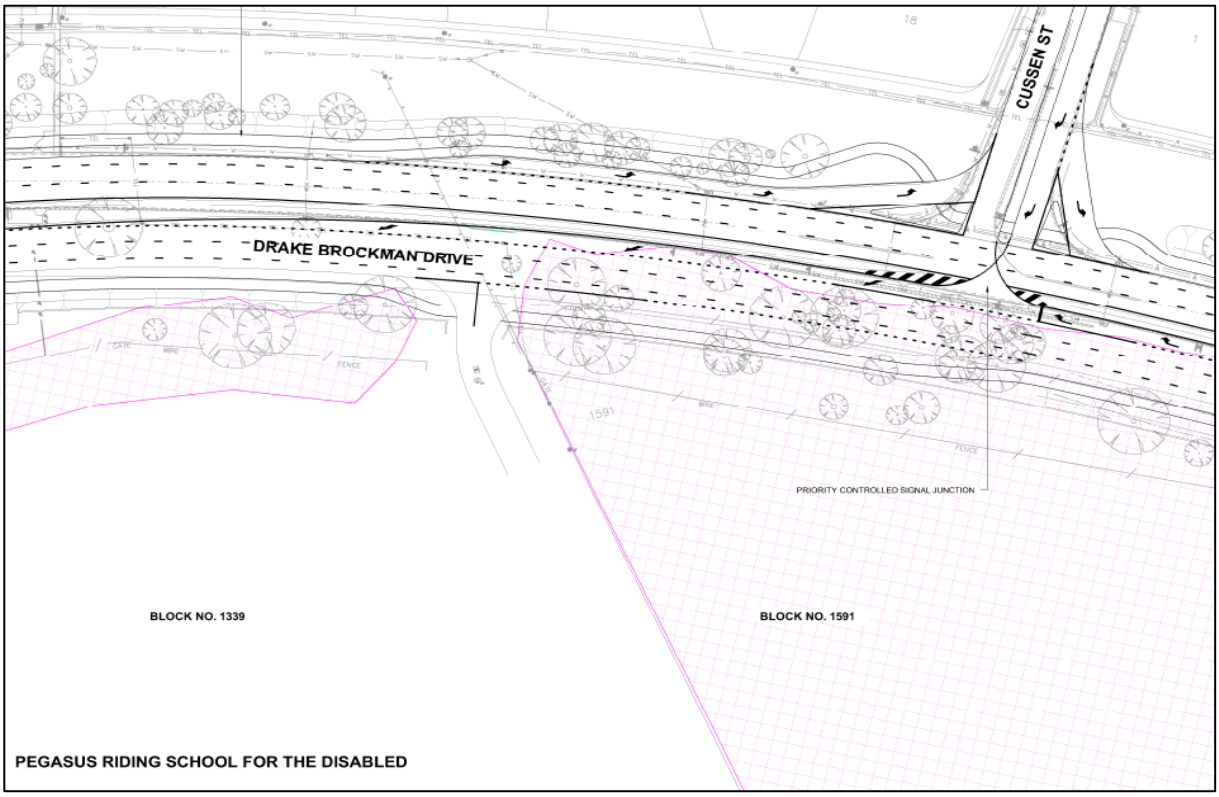
Figure 24 Molonglo Brigade ACT Rural Fire Service Access Arrangement



6.12.2.2 Pegasus Riding School

The proposed access arrangement for the Pegasus Riding School is designed as a left-in left-out intersection arrangement. It will involve a left-turn deceleration lane from Drake Brockman Drive westbound and an access driveway. This access arrangement is shown in Figure 25 for the Stage 3 design arrangement. However, it is proposed to improve this access as part of Stage 1 works.

Figure 25 Pegasus Riding School Access Arrangement



6.12.2.3 Pine Ridge Equestrian Centre

Access for the Pine Ridge Equestrian Centre is proposed to be provided via a new southern leg to the proposed intersection of Stockdill Drive and a new Collector Road, shown in Figure 26. The Pine Ridge Equestrian Centre access will be required to provide access for heavy vehicles and horse floats.

Alternate design options were considered to provide access to Pine Ridge. These options included a roundabout at the intersection of Drake Brockman Drive and Spofforth Street and a T-intersection to the east of Spofforth Street. These options were dismissed primarily due to the constraints associated with the existing level of the intersection of Drake Brockman Drive and Stockdill Drive and the associated drainage issues.

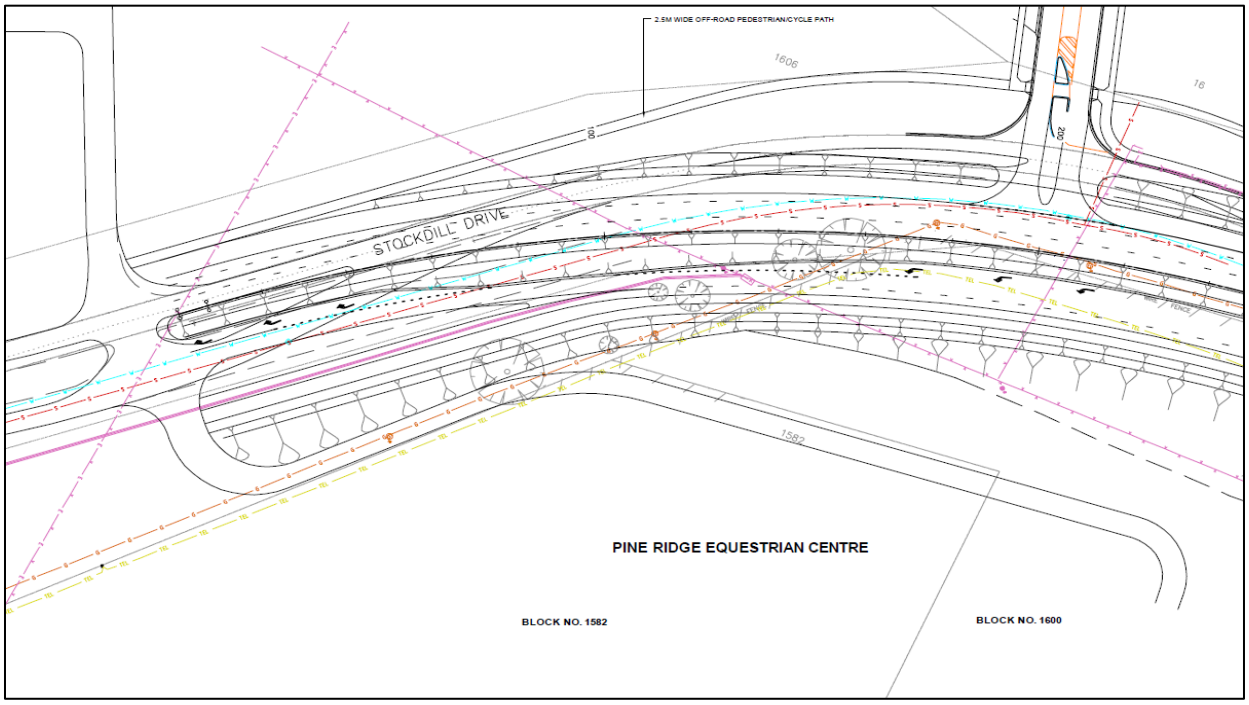
The relocated Pine Ridge Equestrian Centre (Rural Block 1600) access will require the construction of approximately 250 m of 5.0 m wide gravel pavement. The intersection arrangement with Stockdill Drive will be determined as part of the West Belconnen Estate works. This access to Pine Ridge, located within the Stockdill Drive road reserve will also serve as the Bicentennial National Trail route from the point of crossing Stockdill Drive at Studio Road, the access to Strathnairn Arts Association to the northern end of Rural Block 1582.

6.12.2.4 Other rural leases

Other rural lease accesses that will require adjustment and the type of driveway to be provided in Stage3 are:

- Rural Block 1599, Belconnen: TAMS standard 6.0 m wide commercial driveway Type HD2
- Rural Block 1339, Belconnen (Pegasus Riding School): 100 m long deceleration lane and 7.0 m wide TAMS standard driveway Type HDR
- Rural Block 1591, Belconnen: TAMS standard 6.0 m wide commercial driveway Type HD2
- Rural Block 1564, Belconnen (ACT Bush Fire Service, Molonglo Brigade): 100 m long deceleration lane and 8.0 m wide TAMS standard driveway Type HDR
- Rural Block 1361, Belconnen (ICON Water Reservoir). This access is combined with that for Rural Block 1565. Refer previous description of the access provided in the Stage 3works at the intersection of Drake Brockman Drive with Kingsford Smith Drive and William Slim Drive
- Rural Block 1565, Belconnen (Land's End): This access is combined with that for Rural Block 1361. Refer previous description of the access provided in the Stage 3 works at the intersection of Drake Brockman Drive with

Figure 26 Pine Ridge Access Arrangement



Accesses to Rural Blocks 1599, 1399, 1591 and 1594 are designed to conform to TAMS design Standards within the verge and the requirements of the AS 2890-2, Off-Street Parking Guide for Commercial Vehicles, beyond the verge. The design vehicle for the vertical alignments and horizontal alignments for the driveways is as nominated in AS 2890.2 with the HRV being the design vehicle.

It should be noted that accesses to all rural blocks will require work to be carried out within the leases to accommodate grading requirements due to the new westbound carriageway being primarily in cutting.

7.0 Earthworks

Preliminary indications are that the earthworks to form the road will be relatively substantial given the need to:

- Construct the new westbound carriageway at a similar level to the existing carriageway as the relatively narrow median (6.5 m wide) does not allow any grade change between what will become the eastbound carriageway and the proposed westbound carriageway;
- Maintaining levels at existing intersections to avoid level and grade changes when connecting the new westbound carriageway;
- Providing the required clear zones; and
- Constructing the new westbound carriageway as low as possible to assist in noise amelioration at the existing residential properties located between Spofforth Street and Macnaughton Street as well as maintaining the present viewshed.

The approximate earthwork volumes are shown in Table 24.

Table 24 Approximate Earthwork Volumes

Stage	Cut (m^3)	Fill (m^3)	Disposal (m^3)	Import (m^3)
Stage 3	120,000	45,000	75,000	
Stage 2	80,000	40,000	60,000	
Stage 1	2,000			2,000
Stage 1B		6,000		6,000

Notes:

1. Stage 3 earthwork volumes are for the total project irrespective of any staging.
2. Stage 3 and Stage 2 earthwork volumes make no allowance for any earthworks constructed in Stage 1B.
3. Stage 1B earthwork volumes are for an improvement at the western approach to Spofforth Street to provide 70 km/h SSD.

8.0 Existing Utility Services

A Dial Before You Dig (DBYD) enquiry showed evidence of the following utilities (aside from stormwater) located within the project limits: ActewAGL Electricity Network, Icon Water Network, Department of Finance (ICON Communications), Optus assets, Telstra NSW telecommunication cables, and Transact Communications infrastructure. A detailed survey of the project site has been completed and confirmed the location of these services. Potholing is proposed to be completed to provide more information for the next phase of design.

Drawings showing the location of services are provided in Volume II of this report.

8.1 Water Supply

According to the detail survey information and the DBYD enquiries there are Icon Water assets within the project boundary. There is a 225 mm diameter distribution main in the southern verge of Stockdill Drive and Drake Brockman Drive from west of the project site, through to Trickett Street. Along this segment of pipe, there is a 225 mm diameter reticulation main which travels north along the western verge of Britten-Jones Drive. There is also a water tie off the distribution main to the south, servicing Block 1600 Belconnen (Pine Ridge), and a hydrant midway between Britten-Jones Drive and Spofforth Street. Between Spofforth Street and Macnaughton Street there is an additional 100 mm diameter reticulation main in the northern verge of Drake Brockman Drive with multiple hydrants and ties to the adjacent residential properties.

At the Trickett Street / Drake Brockman Drive intersection, a 150 mm main is end-capped in the southern verge of Drake Brockman Drive. A 225 mm diameter distribution main crosses under the road pavement, connecting into the 100 mm diameter reticulation main in the northern verge of Drake Brockman Drive.

Between Trickett Street and Macnaughton Street, the 225 mm distribution main in the southern verge of Drake Brockman Drive increases into a 375 mm diameter main. There is an additional 150 mm reticulation main connecting the two parallel mains along Drake Brockman Drive mid-way between Trickett Street and Macnaughton Street. Just west of Macnaughton Street, the 100 mm distribution main in the northern verge of Drake Brockman Drive crosses under the road pavement to join the 375 mm distribution main.

A 450 mm diameter distribution main exists in the northern verge of Macnaughton Street, joining into the 375 mm main continuing east on Drake Brockman Drive, and is fed by the 600 mm diameter distribution main in the northern verge of Drake Brockman Drive that exists between Macnaughton Street and just west of Kingsford Smith Drive. This distribution main is fed by a 900 mm distribution main from the Icon Water reservoir south-west of Drake Brockman Drive and the Kingsford Smith Drive roundabout (Block 1361).

The 900 mm distribution main originating from the Icon Water reservoir crosses under Drake Brockman Drive and continues along the property boundary line north along Kingsford Smith Drive.

There is a 225 mm reticulation main along the property boundary line north of Drake Brockman Drive. This originates from the eastern side of Kingsford Smith Drive and continues to the eastern verge of Cussen Street.

There is also a 675 mm bulk supply main that exists, from the reservoir site, and passes diagonally under Drake Brockman Drive close to the roundabout with Kingsford Smith Drive, then continues north within the median of Kingsford Smith Drive.

8.2 Electricity and Street Lighting

8.2.1 Electricity

According to the DBYD information, the majority of electricity cables present on the proposed West Belconnen Road upgrade site consist of high voltage (HV) and streetlight cables.

Overhead HV cables exist along the majority of Stockdill Drive and Drake Brockman Drive within the project area. Overhead HV cables can be found in the following areas:

— Overhead HV cable extending across Block 1606, Stockdill Drive and encroaches into Block 1600. This overhead HV cable continues to extend along the southern verge of Drake Brockman Drive until it crosses the road at the Drake Brockman Drive / Macnaughton Street intersection. The overhead HV cable continues to extend east on the northern verge of Drake Brockman Drive and crosses Kingsford Smith Drive.

  Some of the diversions from this line include:

  - Pole # 84989 where it extends north across Stockdill Drive where it supplies underground HV cables into Britten-Jones Drive.
  - The Drake Brockman Drive / Spofforth Street intersection where it diverts north at Pole # 31086. The overhead HV cable extends north along the eastern verge of Spofforth Street.
  - Pole # 30525 where it extends south across Drake Brockman Drive and into Pegasus Riding School for the Disabled (Block 1339).

There are small sections of underground HV cables, within the project area. These exist in:

— The northern verge of Drake Brockman Drive for 50 m west of Britten-Jones Drive, crossing under Britten-Jones Drive and continuing east in the northern verge.

— At the Drake Brockman Drive / Spofforth Street intersection, underground HV cable originate in the southern verge of Drake Brockman Drive in two locations; one cable crosses under Drake Brockman Drive, just east of the Macnaughton Street intersection and continues in the northern verge of Drake Brockman Drive, adjacent to the property boundary. The second HV cable continues in the southern verge of Drake Brockman Drive until Macnaughton Street where it crosses under Drake Brockman Drive extending east in the northern verge of Macnaughton Street, and for a small section along the property boundary on Drake Brockman Drive to the north.

— A small section of underground HV cable exists within the eastern verge of Kinsella Street, this extends for a small section along the property boundary south of Kinsella Street along Drake Brockman Drive.

There are underground low voltage (LV) cables along the property boundaries along Drake Brockman Drive and Trickett Street for the extent of Section 33 Higgins.

Overhead LV cables along the property boundary in the northern verge of Drake-Brockman Drive between Macnaughton Street and Kingsford Smith Drive, where it crosses Drake-Brockman Drive once to service the Rural Fire Brigade Depot.

8.2.2 Street Lighting

There is underground street light cabling and street light columns along part of Drake-Brockman Drive. Street lighting exists at all intersections within the project area, and along the northern verge of Drake-Brockman Drive from Spofforth Street to Macnaughton Street.

8.3 Gas

A 100 mm steel gas main exists in the southern verge of Stockdill Drive from west of the project boundary to the Stockdill Drive / Spofforth Street intersection. This main crosses under Stockdill Drive just west of this intersection and continues north in the western verge of Spofforth Street.

A 32 mm Nylon main exists in the northern verge of Stockdill Drive, originating from a 75 mm main in the eastern verge of Britten-Jones Drive, the 32 mm main passes under the Drake Brockman Drive / Spofforth Street intersection and continues within the northern verge of Drake Brockman Drive remaining in the verge of Drake Brockman Drive until Macnaughton Street, where it continues north within the western verge of Macnaughton Street.

No other gas infrastructure exists within the project site from Macnaughton Street to Kingsford Smith Drive.

A 100 mm steel gas main in the gas easement on Block 1469 is currently not in use and is end-capped further east on the southern verge of Stockdill Drive near the Stockdill Drive / Britten-Jones Drive intersection.

8.4 Telecommunications

8.4.1 ICON Communications

An ICON communications cable enters the site from a pathway to the north of Drake Brockman Drive midway between Cussen Street and Kinsella Street. This ICON cable crosses under Drake Brockman Drive and continues east within the southern verge of Drake Brockman Drive until it crosses under William Hovell Drive and continues south in the eastern verge of William Hovell Drive.

8.4.2 iiNet (TransACT)

There is an iiNet pit in the southern verge of Drake Brockman Drive at the Trickett Street intersection. The iiNet conduit passes under Drake Brockman Drive and continues north along the western verge of Trickett Street.

There is a small section of 100 mm diameter iiNet conduit located in the northern verge of Drake Brockman Drive between Kinsella Street and Kingsford Smith Drive along the property boundary.

8.4.3 Optus

There is a one Optus conduit within the project site. This conduit originates in the eastern verge of Kingsford Smith Drive, crossing under it just south of the roundabout before entering into Block 1361 Belconnen, south of Drake Brockman Drive.

8.4.4 Telstra

The majority of the site consists of Telstra cables in the northern verge of Drake Brockman Drive adjacent to the property boundary line. There is also Telstra cable that follows the road line on the southern verge of Stockdill Drive and Drake Brockman Drive, until Trickett Street. The Telstra cable then crosses under Drake Brockman Drive into a Telstra pit where it continues north on the western verge of Trickett Street and east along the northern verge of Drake Brockman Drive until Macnaughton Street. This line extends across Macnaughton Street and continues to align east on the northern verge of Drake Brockman Drive.

Telstra cables cross under Drake Brockman Drive just to the west of the roundabout with Kingsford Smith Drive, servicing the block to the south of Drake Brockman Drive. This Telstra cable extends east on the southern verge of Drake Brockman Drive which provides services to the blocks south of the road including to the Molonglo Fire Brigade.

9.0 Proposed Utility Services

The proposed locations of future utility services are shown in the drawings in Volume II of this report. A description service relocations and new services follow.

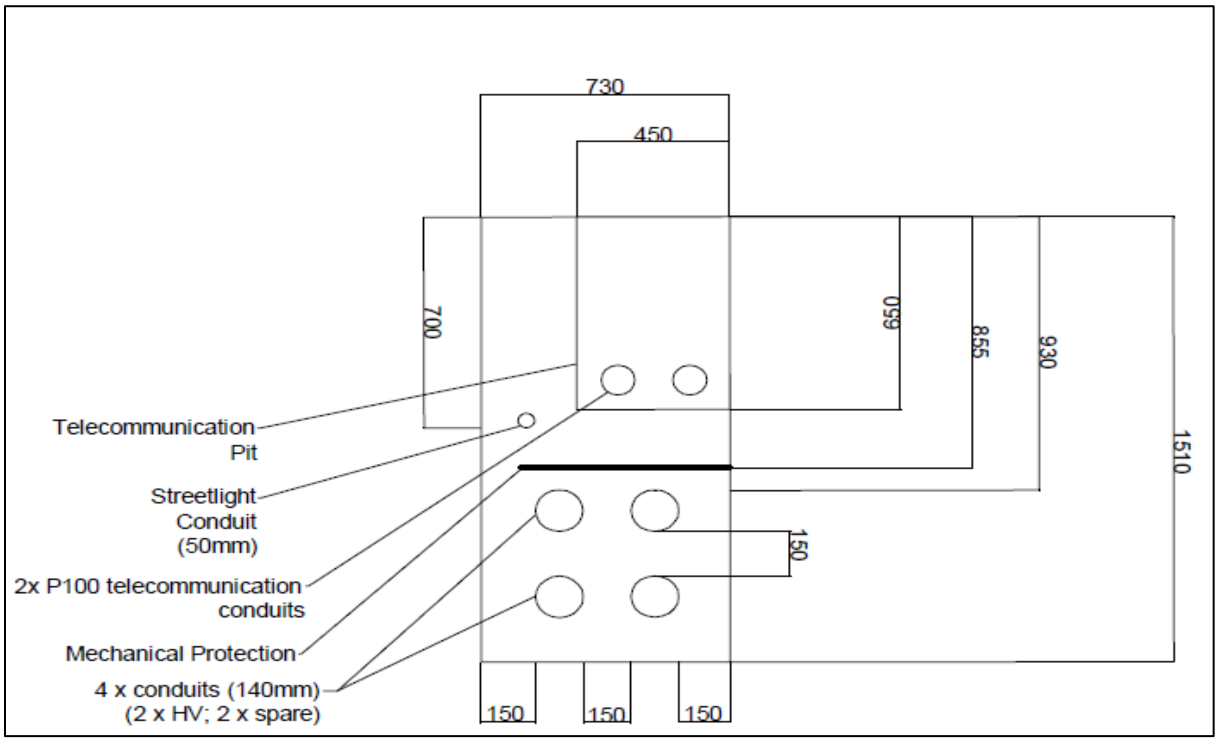
9.1 Water Supply

The existing water main in the southern verge of the existing road will require an upgrade and relocation. It is proposed to upgrade the existing 375 mm diameter water main into a 600 mm diameter water main in the northern verge of Stockdill Drive and Drake Brockman Drive. The proposed water main is to be adjacent to and on the southern side of the existing stormwater main with varying offsets approximately 8 – 10 m from the northern edge of the proposed on-road cycle lane. The levels of the proposed water main are to suit future levels for the area. This is subject for confirmation with Calibre Consulting.

9.2 Electricity and Street Lighting

Due to the Boxgum Woodland areas through the whole extent of the road project overhead HV lines are recommended to be replaced by underground HV lines. It is proposed to have a shared trench containing 4 conduits (2 x HV and 2 x spare), streetlight conduit, and a telecommunications pit. It is proposed that the shared trench is to be located underneath the future cycle path on the southern verge of the road project. The shared trench detail is illustrated in Figure 27.

Figure 27 Shared Trench Detail (Electricity, Streetlight and Telecommunications)



9.3 Gas

The existing 100 mm gas main in the southern verge of Stockdill Drive is proposed to be relocated on the northern verge of Stockdill Drive, behind the retaining wall of the proposed pedestrian / cycle path. The gas main is proposed to be located 2 m behind the retaining wall. The exact location of this gas main is to be determined by Calibre Consulting.

9.4 Telecommunications

A shared trench consisting of electricity, streetlight and telecommunication conduits are proposed to be instated in the southern verge of the road project where required, as shown in Figure 27. This will require the relocation of Telstra conduits into the proposed shared trench within a telecommunications pit of approximate size 650 mm x 450 mm.

9.5 Stormwater

The existing stormwater system on Stockdill Drive consists of a 450 mm diameter culvert at Ch. 450 with a sump in the table drain on the uphill side of the road draining the lowpoint between Britten-Jones Drive and Spofforth Street. This culvert discharges towards the Pine Ridge Equestrian Centre.

Between Spofforth Street and Kingsford Smith Drive, the existing stormwater system consists of sumps along the northern and southern kerb lines connected by small diameter pipes discharging to the north through residential blocks. The existing discharge points and pipe diameters are:

- 600 mm diameter pipe at Ch. 800, the lowpoint between Spofforth Street and Trickett Street, draining through Block 41, Section 34, Holt (No.176 Drake Brockman Drive). It appears this pipe carries through to Bardsley Place. No formed overland flow paths are visible for any gap flows from this lowpoint.
- 300 mm diameter pipe at Trickett Street flowing northward along this street
- 300 mm diameter pipe at Ch. 1100, draining through Block 15, Section 24, Holt (No.150 Drake Brockman Drive) between Trickett Street and Macnaughton Street. It appears this pipe carries through to Mockridge Crescent. This pipe is a relief pipe in the Drake Brockman Drive system and is not located at a lowpoint.
- 450 mm diameter pipe at Ch. 1220, draining through Block 9, Section 24, Holt (No.150 Drake Brockman Drive). It appears this pipe carries through to Cazaly Close. This pipe is a relief pipe in the Drake Brockman Drive system and is not located at a lowpoint.
- 450 mm diameter pipe at Ch. 1820, at the lowpoint draining through Block 24, Section 6, Higgins (No.23 Ashburner Street) Macnaughton Street and Cussen Street. It appears this pipe carries through to Ashburner Street. The walkway in Block 25, Section 6 Higgins would act as a floodway for any gap flows
- 450 mm diameter pipe at Ch. 2160, draining through Block 7, Section 50, Higgins (No.14 Davidson Street) between Cussen Street and Kinsella Street. It appears this pipe carries through to Davidson Street. This pipe is a relief pipe in the Drake Brockman Drive system and is not located at a lowpoint.
- 525 mm diameter pipe at Ch. 2360, draining through Block 4, Section 44, Higgins (No.30 Davidson Street) between Cussen Street and Kinsella Street. It appears this pipe carries through to Davidson Street. This pipe is a relief pipe in the Drake Brockman Drive system and is not located at a lowpoint.

Given the issues of small diameter pipes and discharges through existing residential blocks with in most cases no overland paths for gap flows the proposed new drainage system not connect to the existing system and will drain to the south. The proposed stormwater management, combined with WSUD measures is as follows for the Stage 3 of the work with some of system implemented in Stage 2.

- A longitudinal pipe system located under the southern grass lined swale drain with discharge points to the south at:
  - Ch. 420
  - Ch. 720
  - Ch. 1440

It is proposed that this pipe system have collection sumps with upstream bio-filtration at regular intervals along the swale drain. Also the swale drain will assist in meeting WSUD requirements for the project as no kerbing is proposed on the road, except at intersections, as noted in this report.

The depressed median will have sumps similar to the swale and connect to the swale longitudinal collector pipe system. The median will also contribute to meeting WSUD requirements as the road edges are not kerbed, except at intersections, as noted in this report and the new westbound carriageway is crowned to shed runoff towards the depressed median and southern swale.

10.0 Utilities Relocation

The proposed relocation of existing utilities for the upgrade of Stockdill Drive and Drake Brockman Drive will require the relocation of utility connections to rural and land's end lease properties.

10.1 Water Supply

Water supply connections to rural and land's end properties will require new water service ties in the areas described below.

10.1.1 Pine Ridge

Pine Ridge currently has a water service tie connected to the existing 225 mm diameter water distribution main on the southern verge of Stockdill Drive. The proposed realignment and upgrade of this distribution main will require a new road crossing water service connection into Pine Ridge. With the alteration to the rural property boundaries, this will also require the removal of the existing stopcock valve and water meter. These items will be re-installed as required for the water service connection to Pine Ridge.

10.1.2 Kamberra Vineyards (Block 1599)

A 150 mm diameter reticulation main with a blank flange exists on the southern verge of the existing Drake Brockman Drive. This reticulation main is connected directly to the existing 375 mm diameter distribution main currently extending along the southern verge of Drake Brockman Drive. The proposed realignment and upgrade of this distribution main will require removal of the reticulation main. The blank flange on the reticulation main suggests that it may exist for future connections and thus under the assumption that this reticulation main is to be used for future water services, it is proposed to install a 150 mm reticulation main with a blank flange from the proposed 600 mm diameter water main to the Block 1599 property boundary.

10.1.3 Pegasus Riding for the Disabled

A water service tie currently provides water service to Pegasus. This service tie is connected to the existing 600 mm diameter water distribution main in the northern verge of Drake Brockman Drive. The service tie may require extension which is dependent on the alignment of the batter proposed in the Stage 3 road design.

A reticulation main with a blank flange is connected to the 375 mm diameter water distribution main in the southern verge of Drake Brockman Drive. The reticulation main exists south of the Drake Brockman Drive / Macnaughton Street intersection. Assuming that the reticulation main is to be retained for future development, the proposed realignment and upgrade of the distribution main will require the removal of the reticulation main and a new reticulation 375 mm diameter main to be installed and connected to the proposed 600 mm diameter distribution main.

10.1.4 Molonglo Brigade

A water service tie connects to the existing 225 mm diameter reticulation main on the northern verge of Drake Brockman Drive. This service tie extends across Drake Brockman Drive and connects into the Molonglo Fire Brigade providing service to the property. This service tie may be rearranged to comply with the Icon Water Standards in the Stage 3 road design.

10.1.5 Icon Water Reservoir

A 900 mm diameter water trunk main is currently connected to the Icon Water Reservoir (the Reservoir). This trunk main is a major water main which extends across Drake Brockman Drive and provides water supply to various water mains including the 600 mm diameter trunk main on the northern verge of Drake Brockman Drive. Impacts of the road upgrade are to be determined and relocation options assessed.

A 675 mm diameter bulk supply main is also connected to the Reservoir. This bulk supply main extends north crossing Drake Brockman Drive and into the median of Kingsford Smith Drive. Impacts to this bulk supply main by the road upgrade are to be determined and relocation options assessed.

10.1.6 Land's End Properties (Block 1592)

Two reticulation mains extend into Block 1592 from a 100 mm diameter reticulation main on the east side of William Hovell Drive (Hawker). The two reticulation mains extend across William Hovell Drive and one connects into a stopcock valve and water meter, and the other has an endcap. The proposed upgrade to William Hovell Drive in the Stage 3 design suggests that the two reticulation mains may need to be extended to accommodate the left turn lane on the William Hovell Drive approach to the roundabout from the south. Impacts to the reticulation mains in the Stage 3 road design are to be determined and assessed.

10.2 Gas

10.2.1 Pine Ridge

The existing 100 mm steel gas main in the southern verge of Stockdill Drive provides gas services to Pine Ridge. The proposed relocation of this gas main to the northern verge of Stockdill Drive will require the removal of the existing gas tie and the installation of a road crossing to the 100 mm diameter gas main.

10.3 Electricity and Street Lighting

10.3.1 Pine Ridge

Pine Ridge is currently serviced by an overhead HV line from Pole #16270. In the Stage 3 design, it is proposed to convert the overhead HV line extending along the southern side of Stockdill Drive and Drake Brockman Drive to underground HV lines, which will ultimately align in the southern verge of the road. It is thus required to connect a service line from the proposed underground HV line to the Pine Ridge service point.

10.3.2 Pegasus

Pegasus is currently serviced by an underground service line connected from an overhead HV line on Pole #84508. This overhead HV line extends over the proposed road and will require the overhead HV line to be converted into an underground line to extend underneath the proposed road upgrade. The proposed underground HV line will only extend from Pole #3052 to Pole #84509.

10.3.3 Molonglo Brigade

The Molonglo Brigade is currently serviced by an underground service line connected from an overhead LV line on Pole #84507. The overhead LV line and poles will require removal where an underground LV line will need to be reinstated from Pole #84505 to Pole #84507, assuming that Pole #84505 will be clear of the proposed cycle path on the northern verge.

10.3.4 Icon Water Reservoir and Block 1531

The Reservoir is currently serviced by an underground service line connected to an overhead LV line on Pole #84504. Block 1531 is serviced by an underground service line connected an overhead LV Pole #84501. This overhead LV line extends across Drake Brockman Drive and connects to Pole #30487 on the northern verge of Drake Brockman Drive. This overhead LV line and Pole #30488 will require removal and an underground LV line will need to be instated from Pole #30487 to Pole #84500 extending underneath Drake Brockman Drive.

11.0 Noise Assessment

11.1 Introduction

This project was previously assessed in a preliminary assessment in 2014 by SLR Consulting Australia Pty Ltd (SLR). Additional noise modelling has been undertaken to include a more detailed assessment of the impact of road traffic noise on sensitive receivers adjacent to Drake Brockman Drive as part of the refined design of the proposed road.

It includes an assessment using the latest traffic forecasts and design. The road noise assessment has been conducted using the criteria in the ACT's Noise Management Guidelines (Draft, March 1996). While the guidelines have been superseded by various Codes under the Territory Plan, the criteria are still applied to major road projects as a matter of planning practice in ACT.

The scope of this noise assessment covers:

- Attended and unattended noise measurements undertaken to determine existing road traffic noise levels;
- Establishment of operational road traffic noise criteria;
- Methodology to assess operational road noise;
- Identification of sensitive receivers potentially affected by road traffic noise from the proposed redeveloped road; and
- Predictions of road traffic noise levels and discussion on mitigation options where necessary.

A glossary of acoustic terminology is provided in Appendix E.

11.2 Existing Noise Environment

11.2.1 Site location

Figure 28 shows the location of the proposed works and other nearby major roads.

Figure 28 Project area for noise assessment

11.2.2 Overview

The study area comprises predominantly residential buildings, in addition to a golf course and a small number of commercial buildings. Generally the existing noise environment throughout the project area is dominated by road traffic noise from arterial roads; however there is also some noise contribution from local roads. The existing noise environment within the study area is generally dependent on the proximity to existing roads.

11.2.3 Receivers

Residential receivers are located north of Drake Brockman Drive. The first row of receivers represents those worst affected receivers by traffic noise from Drake Brockman Drive. Compliance at these receivers is considered to demonstrate compliance since traffic noise will decrease as distance from the alignment increases.

Approximately half of residences east of Macnaugton Street comprise single story houses located about 30 metres from the road, with the rear of the residences facing the road. Receivers between Spofforth street and Macnaughton Street are generally single story and front-facing.

A list of the residential assessment locations is presented in Appendix H.

Three commercial receivers are located near the road project and could be impacted by traffic noise from the project, as indicated in Table 25.

Table 25 Non-residential receivers

Receiver	Address
Pegasus riding for the disabled	119 Drake Brockman Dr, Holt
Magpies Belconnen Golf Club	Cnr of Stockdill Drive & Spofforth St, Holt
Pine Ridge Horse Agistment	Stockdill Drive, Holt

There are existing fences which provide some mitigation effects and the locations of these fences are highlighted in the design drawings in Volume II of this report.

11.3 Existing Noise Measurements

Ambient noise monitoring was undertaken at two locations in the study area in May 2016. This included both unattended long term monitoring and short-term attended measurements.

11.3.1 Instrumentation

The noise loggers used for long term monitoring and their locations are presented in Table 26. The sound level meter used to conduct attended surveys was a Bruel & Kjaer 2270 (Serial Number 3000860).

All the acoustic instrumentation employed during the noise measurements comply with the requirements of "*AS IEC 61672.1-2004 Electroacoustics – Sound level meters – Specifications*" and were calibrated prior to and after the monitoring session with a drift in calibration not exceeding ± 0.5 dB.

All instruments used were within their current National Association of Testing Authorities, Australia (NATA) certified in-calibration period (i.e. calibrated in the last 2 years).

11.3.2 Unattended measurements

Road traffic noise monitoring was undertaken at two locations to determine existing noise levels from Drake Brockman Drive within a private open space area and also at a residential building facade. Noise logging was undertaken over a period of seven days.

Noise logging locations were to represent typical residential façade and rear yard noise impacts. A noise logger measures the noise level over the sample period and then determines L_{A1}, L_{A10}, L_{A90}, L_{Amax} and L_{Aeq} levels of the noise environment. The L_{A1}, L_{A10} and L_{A90} levels are the levels exceeded for one per cent, 10 per cent and 90 per cent of the sample period respectively. The L_{A1} is indicative of typical maximum noise levels. The L_{A90} is taken as the background noise level. The L_{Aeq} is the energy averaged noise level over a defined period. The $L_{A10(18hour)}$ is the noise level exceeded 10% of the time between 6 am and 12 am, which is the noise index used in the ACT.

A summary of noise logging results is presented in Table 27. A full set of logging results is presented Appendix F.

The measurement results in Table 27 suggest that receivers do not currently exceed the maximum traffic noise criterion. It is likely that worst affected receivers located along the extent of the project have similar noise levels, as the distance from and exposures to Drake Brockman Drive are similar to the logger location.

The noise logger located at 38 Davidson Street was located in the backyard of a property with the rear facing David Brockman Drive. The logger was placed behind a corrugated iron fence, nearest to David Brockman Drive to represent typical noise levels in rear yards.

11.3.3 Attended noise monitoring

Attended monitoring was conducted at the two unattended monitoring locations on 19 May 2016. Each measurement was conducted over a 15 minute period. Weather conditions were fine on the day of monitoring. The results of this monitoring is summarised in Table 28.

Table 26 Noise monitoring details

Logger	Location	Model	Serial number
NL1	**130 Drake Brockman Drive**	Rion NL-21	765699
NL2	**38 Davidson Street**	Svan 957	27540

Table 27 Drake Brockman Drive noise logging results summary

Measurement location	Location on property	Sound Pressure Level, $L_{A10(18hour)}$ dB(A)
130 Drake Brockman Drive	Front Façade	62
38 Davidson Street	Backyard	52

Table 28 Attended noise monitoring results

Monitoring Location	Date	Time	Description	Attended measurement results, dB(A)			
				$L_{max, 15min}$	$L_{10, 15min}$	$L_{eq, 15min}$	$L_{90, 15min}$
130 Drake Brockman Drive	19.05.16	11:34	• Intermittent traffic (light vehicles and trucks) on 80 km/h road • Some wind noise through trees	75	64	60	48
38 Davidson Street	19.05.16	12:22	• Wind noise through trees dominates background noise • Intermittent traffic flow also audible	70	54	52	47

11.4 Operational Noise Criteria

The operational road noise assessment criteria for road development were established within the ACT's Noise Management Guidelines (Draft, March 1996). The criteria apply to building facades and also for the private open spaces. The applicable criteria for the affected sensitive receivers adjacent to a new road carriageway are provided in Table 29

It is appreciated that many residential dwellings on Drake Brockman Drive are positioned such that the façade of a house is the first point of exposure to road traffic noise. As provided in Table 29,the *Noise Management Guidelines (Draft), 1996* recognises backyards, courtyards and similar areas as private open spaces for which an additional criterion of a maximum of 58 dB(A) $L_{10,\ 18\ hour}$, measured one metre inside the nearest boundary, must be met. This criterion is applicable to the following three scenarios:

- new development on existing road (in which case any acoustic requirements are the responsibility of the lessee);
- development of new road in new areas; and
- development of new road in existing areas.

Table 29 Maximum traffic noise levels, expressed as $L_{A10\ (18\ hour)}$ dB(A) (From the ACT's *Noise Management Guidelines (Draft)*, March 1996, Table 3.2)

Type of usage	Maximum traffic noise level $L_{10\ (18\ hour)}$, at 1m in front of the building facade[1]
Residential buildings	63
Private open space[2]	58

Notes:

1. *The acceptable traffic noise levels incorporate an allowance for reflection from the façade of the building under investigation. Measurements should be taken at one metre forward of the building façade. In cases where the building is not yet built, measurements should be taken at a distance of one metre in front of the proposed building façade, and 2.5 dB(A) added to the measurement to allow for future façade reflection. Measurements should be taken at a height of 1.2 – 1.5 metres above ground level.*
2. *This criterion is also applied to useable private outdoor space of attached houses or apartments. Where the outdoor is divided in to two or more separate areas, at least one of these areas should meet this criterion. Measurements should be taken at a point one metre from the nearest boundary of the area of identified private open space at a height of 1.2 – 1.5 metres above ground level.*

11.5 Road Noise Assessment

11.5.1 Road Traffic Scenarios

Two noise models were created as part of the road noise assessment; the existing traffic noise assessment (2016) and the design noise assessment (Stage 3).

11.5.2 Traffic volumes

Road traffic counting was conducted by Trans Traffic Survey at two locations from 19 May 2016 to 27 May 2016. Traffic counts are summarised in Table 30.

The road traffic levels have been calculated based on traffic counts in Table 30. The surveys indicated that the current percentage of heavy vehicles on Drake Brockman Drive is typically in the range of 6 to 7% of all vehicles. Most of these vehicles are 2-axle small vans or mini-buses (5 to 6% of all vehicles).

Future traffic volumes in Stage 3 are forecasts from AECOM's Commuter model. Heavy vehicles have been assumed to constitute 7% of the total traffic per day and are considered to be conservative assumptions as it will most likely decrease in later years. The modelled traffic volumes used in the model are detailed in Table 31.

Table 30 Traffic count volumes

Location	Direction	Year 2016 veh/day	
		Light	Heavy
Drake Brockman Drive adjacent to 156 Drake Brockman Drive, Holt – West of Macnaughton Street	Eastbound	2315	192
	Westbound	2311	109
Drake Brockman Drive adjacent to 24 Davidson Street, Holt – East of Macnaughton Street	Eastbound	4202	340
	Westbound	4065	290

Table 31 Forecast Drake Brockman Drive traffic flows

Section	Direction	Year 2041 veh/day[1]	
		Light	Heavy
Stockdill Drive to Britten-Jones Drive	Westbound	20,392	1,427
	Eastbound	6,704	469
Britten-Jones Drive to Spofforth Street	Westbound	20,496	1,435
	Eastbound	7,296	511
Spofforth Street to Trickett Street	Westbound	21,184	1,483
	Eastbound	7,296	511
Trickett Street to Macnaughton Street	Westbound	21,536	1,508
	Eastbound	7,488	524
Macnaughton Street to Cussen Street	Westbound	22,328	1,563
	Eastbound	8,192	573
Cussen Street to Kinsella Street	Westbound	23,592	1,651
	Eastbound	6,800	476
Kinsella Street to Kingsford Smith / William Hovell Drive	Westbound	23,784	1,665
	Eastbound	6,456	452

Note:

1. *24 hour traffic volumes assumed a conversion factor of 8 times peak hour volumes, where PM peak hour volumes were higher than AM peak hour volumes.*

11.5.3 Modelling

Road traffic noise levels were calculated using SoundPLAN software, which implements the Calculation of Road Traffic Noise (CoRTN) algorithm. The UK Department of Transport devised the CoRTN algorithm and with suitable corrections, this method has been shown to give accurate predictions of road traffic noise under Australian conditions.

Generally assuming no change in the traffic mix or average speed, a doubling of the traffic volume is required to produce a 3 dB(A) increase in the resultant noise.

Modelling parameters used in the model are presented in Table 32.

Table 32 Modelling noise parameters

Parameter	Comment
Road design	The modelled road alignment file *60501930-REF-00-0000-CA-ULTIMATE_PLAN_option 1* (AECOM, June 2016) was used for the alignment design.
Traffic volumes and mix	As outlined in Section 11.5.1.
Traffic speeds	Modelled traffic speeds along the project extent were based on posted speed limits. These were 60 km/h west of Cussen Street and 80 km/h east of Cussen Street, for existing calibration; 60 km/h west of Spofforth Street and 70 km/h east of Spofforth Street for Stage 3 design.
Traffic noise source heights	The noise modelling has incorporated a single source height 0.5 m above the ground (in accordance with the CoRTN algorithm).
Roadway gradient	Road traffic noise levels vary dependent on the gradient of the roadway compared with a flat roadway. CoRTN calculates this variation, however it does not take into account noise from heavy vehicle engine braking. The modelled road alignment file *60501930-REF-00-0000-CA-ULTIMATE_PLAN_option 1* (AECOM, June 2016) included 3D geometry and this information was captured in the noise model. This is consistent with the road alignment in the final design drawings in Volume II.
Road surface	Road surfaces would determine the level of road / tyre interfacial noise created. Dense graded asphalt (DGA) is accepted as the standard road surface with other road surfaces such as stone mastic asphalt (SMA) being considered 'low noise' surfaces. Corrections were applied to the road traffic noise model to account for the existing road surfaces in accordance with the detailed design models, in line with Environmental Noise Management Manual (ENMM). The following road surface corrections were applied, consistent with the corrections presented in the ENMM. **Surface** / **Traffic noise correction, dB** **Dense graded asphaltic concrete** / 0 **Stone mastic asphalt** / -2.5 The existing road surface modelled along Drake Brockman Drive was assumed to be DGA, however the use of SMA was considered as a noise mitigation option, discussed in Section 11.6.1.
Ground absorption	Road traffic noise levels reduce with increasing distance from the noise source along the ground. The noise validation model verified that a ground absorption factor of 0.6 used throughout the project area, which, in AECOM's experience, has provided a good representation of generally grassed areas, such as in the project area.

Parameter	Comment
Terrain	Natural topographical features such as hills and valleys can shield sensitive receivers from road traffic noise. These effects are taken account of in the model which incorporates one metre terrain contours.
Buildings	The height of receiver buildings in the study area affects the road traffic noise exposure. It can also affect the amount of acoustic shielding provided to other nearby buildings. The heights of all buildings within the study area were provided by SLR Consultants.
Fencing	Existing property fences to the rear of residences located along Drake Brockman Drive shield both private open spaces and building facades of properties east of McNaughton Street. Fencing has been modelled with 1dB reflection loss. Existing fencing was modelled 1.8m above natural ground level based on observations on site. Increasing the height of property fencing has been considered as a mitigation measure, discussed in Section 11.6.3
Noise barriers	No noise barriers were included.
façade	A correction of 2.5 dB(A) was added to road traffic noise levels, where appropriate, to take account of façade reflection effects. Noise levels have been calculated and assessed at each façade of each sensitive receiver location. Only the most affected façade for each receiver is presented in this report.
Road network	For this project noise levels at sensitive receiver locations are predominantly controlled by Drake Brockman Drive. This was verified by attended noise measurements throughout the study extents of the project.
Standard corrections	CoRTN provides L_{A10} road traffic noise levels. A -1.7 dB correction for Australian conditions has been applied to all results. From the Australian Road Research Board (ARRB) Transport Research (Saunders et al 1983) and referred to in Austroads Research Report (ARR), "*An Approach to the Validation of Road Traffic Noise Models"* (2002).
Calibration factor	No calibration factor was implemented as modelled predictions from the existing noise model showed good correlation with monitored levels.

11.5.4 Noise modelling results

Existing noise model validation

The existing traffic flows (2016) from Table 31 were incorporated in the noise model to facilitate validation of the model with road traffic noise measurements. This model is referred to as the 'Existing road traffic noise model'.

As discussed in Table 32, the CoRTN algorithm was utilised to calculate road traffic noise. For a project corridor of 600 metres either side of the road, this algorithm has a well-documented accuracy of ±2 dB. If the differences between measured and predicted road traffic noise levels fall within this factor, then the model is considered to have a suitable level of accuracy for that location.

Table 27 presents noise monitoring results of two logging locations suitable for model validation. Provided below in Table 33 is a summary of the road traffic noise model calibration results at these locations. It can be seen that the predicted road traffic noise levels were inside the ±2 dB allowance.

Design year noise model

From the increase in traffic alone, noise levels are predicted to increase by approximately 10 dB by 2041. Considering the alignment would be moving away from the worst affected residences to the north of Drake Brockman Drive, these receivers will benefit slightly from distance loss associated with the noise propagation.

The prediction of traffic noise at a design year of 2041, 25 years in the future, does not account for potential advances in technology which may reduce traffic noise emissions. Forecasting changes in vehicle noise is difficult and outside the scope of this assessment, however it is likely noise levels in reality will below predicted noise results.

Results from the assessment to both criteria presented in Table 29 are presented below.

Façade assessment

Noise logging on Drake Brockman Drive identified that existing sound levels are compliant with the façade noise criteria of 63 dB(A). Noise logging measured existing noise levels of 62 dB(A). Noise modelling was carried out to predict sound levels at building façades in the year 2041. Results assuming a road surface of DGA and incorporating a surface of SMA (conservatively modelled to achieve a 2.5 dB reduction in overall noise emissions) are summarised in Table 34. More details are included in Appendix H.

Table 33 Drake Brockman Drive noise logging results summary

Measurement location	Location on property	Monitored level	Modelled level	Difference
		$L_{A10(18hour)}$ dB(A)		
130 Drake Brockman Drive	Front Façade	62	63.2	1.2
38 Davidson Street	Backyard	52	52.1	0.1

Table 34 Receivers predicted to exceed façade criteria

Receiver Address	Criteria, dB(A)	Predicted noise impact L_{A10}, dB(A)		Exceedance, dB	
		DGA	SMA	DGA	SMA
5 Macnaughton Street	63	66	64	3	1
122 Drake Brockman Drive	63	67	64	4	1
1 Macnaughton Street	63	67	65	4	2
122 Drake Brockman Drive	63	67	64	4	1
124 Drake Brockman Drive	63	67	64	4	1
126 Drake Brockman Drive	63	67	65	4	2
128 Drake Brockman Drive	63	67	65	4	2
130 Drake Brockman Drive	63	67	64	4	1
132 Drake Brockman Drive	63	67	64	4	1
134 Drake Brockman Drive	63	67	65	4	2

Receiver Address	Criteria, dB(A)	Predicted noise impact L_{A10}, dB(A)		Exceedance, dB	
		DGA	SMA	DGA	SMA
136 Drake Brockman Drive	63	67	64	4	1
138 Drake Brockman Drive	63	67	65	4	2
140 Drake Brockman Drive	63	67	65	4	2
142 Drake Brockman Drive	63	65	63	2	0
144 Drake Brockman Drive	63	65	62	2	0
148 Drake Brockman Drive	63	65	62	2	0
150 Drake Brockman Drive	63	66	64	3	1
4 Trickett Street	63	65	62	2	0
6A Trickett Street	63	65	63	2	0
3 Trickett Street	63	66	63	3	0
170 Drake Brockman Drive	63	65	63	2	0
172 Drake Brockman Drive	63	65	63	2	0
174 Drake Brockman Drive	63	65	62	2	0
176 Drake Brockman Drive	63	66	63	3	0
178 Drake Brockman Drive	63	66	64	3	1
180 Drake Brockman Drive	63	66	63	3	0
182 Drake Brockman Drive	63	66	64	3	1
184 Drake Brockman Drive	63	67	64	4	1
186 Drake Brockman Drive	63	65	62	2	0
Total number of exceedances				**29**	**17**

Results show 29 receivers are predicted to exceed residential façade noise criteria when a DGA road surface is modelled, with exceedances of up to 4 dB predicted. Where an SMA road surface has been modelled 17 receivers are predicted to exceed criteria, with a maximum predicted exceedance of 2 dB.

It should be noted that a 2 dB exceedance of criteria is considered 'minor', where a 2 dB change in noise levels is considered barely perceptible to the average person.

Although the guidelines only require that the noise level at these residential receivers remain equal to or less than existing noise levels, where reasonable and feasible it is preferred to reduce noise levels to meet the applicable overall criteria ($L_{Aeq(18hour)}$ 63 dB(A)). Therefore options for architectural treatment to receivers exceeding criteria and installation of a median barrier have been considered and are discussed in Section 11.6.2.

Private open space assessment

Noise contours are presented in Appendix G to illustrate the operational noise emissions of Stockdill Drive and Drake Brockman Drive in 2041 in residential private open spaces. The noise contours show that the predicted private open space noise levels will comply with criteria presented in Table 29 (ie., 58 dB(A)), except for some minor exceedances in the rear yard of 57 O'Sullivan Street, Higgins.

Residences west of Macnaughton Street have rear yards located on the opposite side of their houses to Drake Brockman Drive, and these yards are shown to comply with the private open space criteria of 58 dB(A).

The minor encroachment of the 58 dB(A) noise contour into the rear yard of 57 O'Sullivan Street is expected to represent a 1 dB exceedance of private open space criteria for a small section of the yard.

Noise mitigation options are discussed in Section 11.6

11.6 Mitigation Options

A total of 29 receivers west of Macnaughton Street are identified to exceed the noise criteria. These receivers' driveways currently directly access Drake Brockman Drive and will do so in the future with the current design. It is imperative that access to these properties is maintained, and as such it is not feasible to build a noise wall to reduce airborne noise for these receivers. A noise barrier would also adversely impact the visual amenity of receivers to the north of Drake Brockman Drive, who currently have an uninterrupted view of scenery towards the south.

For these reasons, recommended noise mitigation options have been presented below in order of preference, based on efficacy and feasibility.

11.6.1 Road surface treatment

Existing noise levels measured near the façade of $L_{Aeq(18hour)}$ of 62 dB(A) are compliant with façade criteria of 63 dB(A). Modelled predictions show an exceedance of up to 4 dB at 29 receivers when DGA road surface is used, and an exceedance of up to 2 dB is predicted at 17 receivers when SMA road surface is used along the length of Drake Brockman Drive.

The treatment of the road surface would benefit all receivers affected by road traffic noise on Drake Brockman Drive, as opposed to shielding which has localised benefits.

11.6.2 Architectural treatment

Due to the minor nature of exceedances (2 dB or less), and the cost of retrofitting treatment to existing residences, namely inspection of existing constructions, cost of materials and installation, architectural treatment is not considered reasonable.

11.6.3 Higher property boundary fence

Residential boundary fences to the rear of residences on Drake Brockman Drive, east of Macnaughton Street have been modelled based on a 1.8 metres high timber fence consistent with the ACT Planning and Land Authority's '*Residential Boundary Fences General Codes*' (March 2008).

One minor exceedance of private open space criterion has been identified at 57 O'Sullivan Street Higgins. Considering the modelling accuracy of noise predictions is ±2 dB, the minor nature of the exceedance, the small area of non-compliance and the likely cost of noise mitigation to eliminate this exceedance, such as erecting a higher fence, further noise mitigation is not considered justifiable.

11.6.4 Median Noise Wall

A median noise wall (a noise wall between the eastbound and westbound carriageways), may reduce noise from the westbound carriageway reaching residences north of Drake Brockman Drive. Since a large proportion of traffic is forecast to travel along the westbound carriageway relative to the eastbound, as shown in Table 31, the benefit of a median noise wall will be higher than a road with even traffic in either direction. The need for a noise wall, however, is low, considering the minor exceedances of 2 dB after the incorporation of a SMA road surface. The noise barrier benefit would also be offset by additional reflections from the near carriageway caused by the barrier. A maximum reduction of approximately 2 dB would be expected from a median noise wall. Typically a minimum noise reduction of 5 dB is required before a noise wall is considered reasonable.

On the basis that a median noise wall would provide an indiscernible reduction in noise, combined with other factors such as cost and landscaping, it is not considered justifiable to provide a median noise wall in this location.

11.7 Conclusion

General findings are:

- 29 receivers are predicted to exceed façade noise criteria by up to 4 dB for the Year 2041, with the proposed geometric design and DGA pavement.
- 17 receivers are predicted to exceed façade noise criteria by up to 2 dB for the Year 2041, with the proposed geometric design and SMA pavement.
- The private open spaces along Drake Brockman Drive generally comply the private open space criteria of 58 dB(A) 1 m within the property boundaries where the criteria applies. Noise levels exceed criteria by approximately 1 dB at 57 O'Sullivan Street, Higgins. However the contours also show that the property does have a location further back from the boundary that is compliant with the applicable criteria.

Noise mitigation measures have been discussed in Section 11.6. In consideration of access requirements, visual amenity, cost and benefit, the SMA road surface treatment is recommended. It should be noted that a 2 dB exceedance of criteria is considered 'minor', where a 2 dB change in noise levels is considered barely perceptible to the average person.

The extent of the exceedance, if any, will need to be monitored in future. Changes in vehicle technology and mode use may mean that no mitigation will be necessary, beyond the SMA road surface treatment.

12.0 Environmental Studies

12.1 Environmental Impact Assessment and Planning Approvals Context

The Stockdill Drive / Drake Brockman Drive road upgrade Project has been considered within the broader planning and approvals strategy for the West Belconnen development. The West Belconnen development comprises two major components:

- **Development of urban areas and the associated provision of services and infrastructure**. This includes an extension of Ginninderra Drive, installation of a sewer pipeline, and the upgrade of Drake Brockman Drive / Stockdill Drive (this Project), and other road upgrade works.
- **Creation of the West Belconnen Conservation Corridor (WBCC) along the riparian areas of the Murrumbidgee River and Ginninderra Creek.** This component will provide biodiversity protection and enhancement, bushfire protection, recreational facilities, and contribute to urban amenity for the community of West Belconnen.

The West Belconnen development spans across both the ACT and NSW. The Drake Brockman Drive / Stockdill Drive upgrade is located entirely within the ACT, on Territory land.

12.1.1 Commonwealth planning approval

In early planning phases it was determined that the West Belconnen development has the potential to have a significant impact on a number of Matters of National Environmental Significance (MNES) protected under the *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act).

If a proposed action is likely to have a significant impact on one or more MNES, the project is usually determined as a 'controlled action' by the Commonwealth Department of the Environment and requires formal assessment and approval under the EPBC Act before it can proceed. As such, in July 2014, the Commonwealth Government entered into an agreement with Riverview Projects (ACT) Pty Ltd (Riverview) to undertake a Strategic Assessment (SA) of the West Belconnen development under Part 10 of the EPBC Act, to assess the potential impacts from the West Belconnen development on MNES and agree on holistic mitigation and offset measures. The area covered by the SA includes an indicative width along Drake Brockman / Stockdill Drive for the purposes of including the Project within the West Belconnen SA.

Strategic Assessment allows the holistic assessment of proposed actions at a large scale over a longer timeframe than traditional project-by-project assessments. The SA process will ensure that direct, indirect and cumulative impacts are well understood and that avoidance, mitigation and offset strategies can be clearly described and addressed at a landscape scale.

The SA requires the preparation of a Program Report and Assessment Report, both of which are currently in draft form and were recently on public exhibition from 14 May 2016 to 10 June 2016:

- **Program Report** (A T Adams Consulting, prepared for Riverview, April 2016): sets out the program of works, actions, management and funding arrangements, and commitments for the protection of MNES. The program is to be presented to the Commonwealth Minister for the Environment for endorsement and consideration of an approval for a class of actions for urban development under Part 10 of the EPBC Act.
- **Assessment Report** (Umwelt Pty Ltd, prepared for Riverview, April 2016): presents an assessment of the impacts of the program on MNES and the extent to which those impacts will be avoided, mitigated or offset by actions proposed as part of the program.

Following the exhibition period and receipt of submissions, Riverview is addressing any issues raised to finalise the Program Report and Assessment Report. The Commonwealth Minister for the Environment may then consider Endorsing the Program under section 149 of the EPBC Act and approving a class of actions for urban development under Part 10 of the EPBC Act.

12.1.2 ACT planning approval

Whilst the SA enables approval for the West Belconnen development under the EPBC Act, development approval is also required under the applicable State / Territory legislation before development can commence. Therefore the component of the West Belconnen development within the ACT requires approval by the ACT Environment and Planning Directorate (EPD) under the *Planning and Development Act 2007* (PD Act).

In accordance with the PD Act, a development in the ACT is assessed in one of three possible tracks depending on a number of factors including its location, size and the possible impact on the surrounding area:

- **Code track**: code track applies to simple developments that meet all the relevant rules in the Territory Plan. With the increase in development types that can now be considered exempt, there are few developments that are currently considered in this track.
- **Merit track**: most developments fall into this track including applications to vary a lease. Multi-unit and commercial developments are usually considered under the merit track, as are single houses when they do not meet all the relevant rules of the Territory Plan.
- **Impact track**: for developments that have a major impact on the environment of the ACT. This track has the highest level of scrutiny and notification.

Schedule 4 of the PD ACT stipulates triggers for developments which must be assessed in the impact track due to the nature of the proposal. One or more of these triggers apply to the West Belconnen development, due to the presence of threatened species and ecological communities in the development footprint. As such, the West Belconnen development would be assessed in the impact track. Developments assessed in the impact track typically require the preparation of an Environmental Impact Statement (EIS) prior to a development application being considered. However the opportunity exists for the West Belconnen development to be exempted from the requirement for an EIS, under section 211 of the PD Act.

A section 211 exemption can be granted if the ACT Minister for the Environment is satisfied that previous studies have adequately characterised the existing conditions and potential impacts of the proposal. The suite of investigations supporting the SA together with a number of studies completed for the draft Territory Plan Variation 351 (discussed further below), are considered by Knight Frank as adequate to support an exemption application for the entire West Belconnen development. As such Riverview intend to submit an application for a section 211 exemption for the entire West Belconnen development. If granted, a development application pertaining to the West Belconnen development, including this Project, can be lodged in the impact track without an EIS.

Since the Project will be constructed in a number a stages, there will be a number of development applications for the Project. All development applications for the Project, regardless of what works the development application is seeking approval for, will need to be lodged after a section 211 EIS exemption is granted. This is because the trigger for an assessment under the impact track, and requirement for an EIS, occurs at the project level (in this case the West Belconnen development, including the Drake Brockman Drive / Stockdill Drive upgrade), not the development application level.

Before a section 211 EIS exemption is granted the SA will need to be endorsed by the Commonwealth Minister for the Environment. This is to provide certainty to the EPD that the impacts to MNES including box gum woodland have been adequately assessed and offset.

For a development application to be approved by the EPD, it must be compliant with the relevant development criteria of the applicable land use zone/s under the Territory Plan. The Drake Brockman Drive / Stockdill Drive upgrade is located within the following land use zones under the Territory Plan:

- **NUZ3**: Non-Urban Zone - Hills, Ridges and Buffer Areas.
- **NUZ1**: Non-Urban Zone – Broadacre.

The Territory Plan is being varied to facilitate the West Belconnen development; however this variation (TPV 351) does not include the land affected by the Drake Brockman Drive / Stockdill Drive upgrade. Therefore a development application for the Drake Brockman Drive / Stockdill Drive upgrade project will need to meet the relevant criteria of the Non-Urban Zones Development Code pertaining to the NUZ3 and NUZ1 land use zones.

The Non-Urban Zones Development Code includes the requirement for the development application to be accompanied by an Assessment of Environmental Effects Report addressing, but not limited to, the following:

a. the amount of traffic likely to be generated and the likely impacts on the road system;

b. impacts on the amenity of surrounding land uses;

c. impacts on the role and character of the hills and ridges as a visual backdrop;

d. impacts on rural character;

e. provision of landscaping;

f. impacts on water supply catchments; and

g. impacts of earthworks or rehabilitation works on soil stability and quality.

Any development application for the Drake Brockman Drive / Stockdill Drive upgrade will also need to be compliant with the endorsed SA Program, to meet the requirements of the EPBC Act.

12.2 Environmental Impacts

12.2.1 Biodiversity

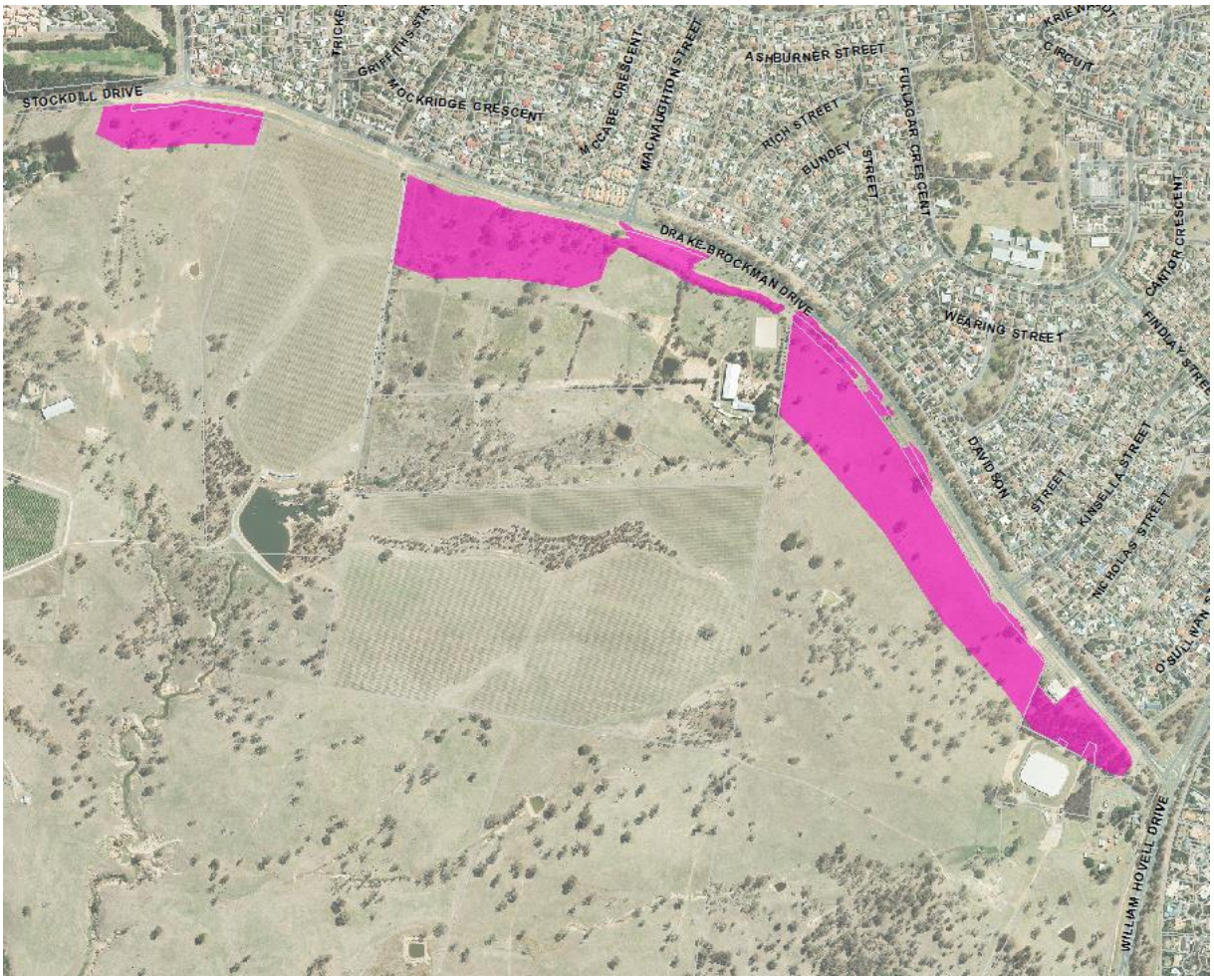
Although the exact impact footprint of the Drake Brockman Drive / Stockdill Drive upgrade was not known at the time of the preparation of the draft SA[1], the SA considered an indicative width of the works along the corridor for the purposes of the assessment, and notionally included all land adjoining the existing road corridor to a distance of up to 20 metres south of the existing fence line. This provided the basis for estimated impacts to biodiversity values within the road corridor and at the time of the draft preparation was considered by Umwelt to be an over-estimation of the impact footprint in order to consider a worst-case scenario for the Project. This area was subject to an ecological inspection by Umwelt in December 2015. There was no physical inspection of the areas south of the fence line[2] due to access limitations, and therefore the findings of the ecological inspection south of the fence line were based on visual assessment from the fence.

Based on existing mapping published on ACTmapi, in conjunction with field validation undertaken during the ecological inspection in December 2015, the SA identified the occurrence of the threatened ecological community, box gum woodland, within the Drake Brockman Drive / Stockdill Drive area (shown in Table 31). This community is listed as a Critically Endangered Ecological Community (CEEC) under the EPBC Act (referred to as white box – yellow box – Blakely's red gum grassy woodland and derived native grassland). The patches in the corridor are low quality remnants that occur along the roadside and generally only meet the definition of the EPBC listed community as a result of being contiguous with larger occurrences of the community that extend into the adjoining private properties to the south. The quality of the vegetation along the road alignment meeting the box gum woodland definition is generally poor and typified by low native grass diversity and few non-grass species. As noted by Umwelt, the areas of mapped box gum woodland in Table 31 are considered accurate only for an area extending to 20 m south of the existing fence line. Beyond this distance to the south, the mapped extent has been extrapolated from aerial photography interpretation and from mapping published on ACTmapi. Notwithstanding the limitations of the methodology applied, Umwelt consider that additional field survey is unlikely to result in a different determination in the extent of apparent quality of the woodland.

Box gum woodland is also listed under the ACT's *Nature Conservation Act 2014* (NC Act) (referred to as Yellow box/ red gum grassy woodland), however the definition under the NC Act differs from the definition of white box – yellow box – Blakely's red gum grassy woodland and derived native grassland listed under the EPBC Act. Umwelt have noted that the majority of the box gum woodland identified within the Project corridor does not meet the definition under the NC Act due to being consistent with the Action Plan 27 (ACT Government, 2004) description of 'highly modified' woodland. The exception to this is an area of 'modified' woodland comprising approximately 7,800 m^2 extending for 275 m towards the Kingsford Smith Drive / William Hovell Drive intersection from the eastern side of the entry to 'Pegasus' opposite the intersection of Cussen Street with Drake Brockman Drive. This woodland in accordance with the NC Act is restricted to within the road reserve however as previously noted, direct inspection of the paddocks south of the fence line was not undertaken. Umwelt have noted that this and the potential effect of seasonal variation may result in a different finding should a more detailed survey be undertaken at optimal times for the identification of diagnostic species. Mapping has not been provided by Umwelt for the area of NC Act listed box gum woodland, therefore it is not delineated in Table 31.

[1] The design of the Project commenced after the draft SA had been prepared by Knight Frank and Umwelt.
[2] At the time of the ecological inspection, the fence line was assumed to represent the road reserve boundary (Umwelt, pers. comm.). However it was later determined that the fence line does not follow the road reserve boundary and in some places, encroached adjoining blocks to the south. This however does not affect the findings of the ecological inspection and its implications.

Figure 29 The extent of EPBC Act listed box gum woodland in the Project area (shown in pink)



***Source**: Mapped by Umwelt, following the ecological inspection in December 2015.*

The extent of EPBC Act listed box gum woodland identified in the Project area (Figure 29) informed the characterisation of impacts to threatened ecological communities in the draft SA. The draft SA reported that up to 3.8 hectares of the EPBC Act listed box gum woodland in the Drake Brockman Drive / Stockdill Drive upgrade area would be directly impacted by the Project, through clearing. This quantum of impact is considered within the draft SA as not significant. The draft SA explains that while superficially the clearing of 3.8 ha of box gum woodland indicates a potentially significant impact, it is not when the context for the impact is understood. The justification is detailed in the draft SA.

Despite the impact to EPBC Act listed box gum woodland not being considered significant in the draft SA, a component of the offset package for the wider West Belconnen program has been developed to address the small scale impact to box gum woodland to address cumulative impacts.

Of the 3.8 ha of EPBC Act listed box gum woodland that was estimated to be cleared as a result of the Project in the draft SA, 0.7 ha of this is also considered to be potential habitat for the superb parrot (*Polytelis swainsonii*), regent honeyeater (*Xanthomyza Phrygia*), and swift parrot (*Lathamus discolor*), albeit marginal. These bird species are all listed under the EPBC Act and NC Act. The removal of this potential habitat is not considered within the draft SA to have a significant impact on these species. The justification for this is detailed in the draft SA.

The estimated clearing of up to 3.8 ha of EPBC Act listed box gum woodland as a result of the Project was calculated for the draft SA based on the footprint considered at the time to be an over-estimation of the actual footprint, and as such, a worst case scenario. Early designs of the Project, which have been developed after the draft SA was prepared, exceeded 3.8 ha of clearing (based on the box gum woodland area mapped by Umwelt, Figure 29). As such, the design has been amended to ensure the amount of box gum woodland requiring clearing does not exceed 3.8 ha, consistent with the SA. An alternative option to amending the design was to revise the SA to increase the impacts to box gum woodland, however this option was considered by Knight Frank

and Umwelt to be unfeasible due to the fact that the draft SA had already been on public exhibition.

The amended design results in 3.56 hectares of EPBC Act listed box gum woodland requiring clearing, which does not exceed the quantum of clearing reported within the SA, and therefore will be within the approved impacts to the community when the SA is endorsed by the Minister for the Environment. Again, this quantum of impact has been calculated based on the box gum woodland area mapped by Umwelt (Figure 29). As previously discussed, this mapping is considered accurate only for an area extending to 20 m south of the fence line. As such, a further field survey could be undertaken to validate the mapping beyond this extent, however it is considered by Umwelt unlikely that further survey would result in a different determination in the extent of the woodland. Furthermore, most of the project impact footprint does not extend beyond 20 m south of the fence line; therefore should the area of box gum woodland be modified through field validation, this would have a minimal if not negligible impact on the quantum of impact to the community.

The amount of NC Act listed box gum woodland requiring clearing has not been determined because no mapping has been provided by Umwelt which delineates the area of box gum woodland which meets the community definition under the NC Act. As previously discussed, Umwelt have noted that the extent of NC Act listed box gum woodland may change following a detailed survey of the areas south of the fence line which could not be accessed during the ecological inspection. A survey of these areas is unlikely to change the quantum of NC Act listed box gum woodland to be cleared because the project impact footprint does not extend beyond the fence line in the area where NC Act listed box gum woodland has already been identified.

The project impact footprint assessed includes consideration of site compounds and areas required for construction vehicle/plant movement. The project impact footprint excludes the Bicentennial trail. The Bicentennial trail has been excluded from the area considered to be the project impact footprint because no construction works including vegetation disturbance are required for its establishment, and the use of the trail by horses is not expected to have notable impacts on vegetation including box gum woodland.

12.2.2 Heritage

Although impacts to heritage as a result of the West Belconnen development have been considered with the SA, the ACT Land Cultural Heritage Assessment used to inform the SA (Biosis, 2015) did not include the Drake Brockman Drive / Stockdill Drive upgrade corridor. As such, a desktop review of heritage constraints and initial consultation with ACT Heritage has been undertaken to inform the potential heritage constraints associated with the Project. The outcomes of these tasks are described in the following sections.

12.2.2.1 Desktop review

Any known or Aboriginal or non-Aboriginal heritage items which potentially occur within 1 km of the upgrade corridor were identified through the following heritage registers:

National Heritage List

Australia's list of natural, historic and Indigenous places of outstanding significance to the nation. Listings within 1 km of the Proposal site were searched through the Australian Heritage Database, accessed from <http://www.environment.gov.au/cgi-bin/ahdb/search.pl>.

Commonwealth Heritage List

A list of natural, Indigenous an historic heritage places owned or controlled by the Australian Government. Listings within 1 km of the Proposal site searched through the EPBC Act Protected Matters Search Tool, administered by the Commonwealth Department of Environment and accessed from <http://www.environment.gov.au/epbc/pmst/index.html>.

ACT Heritage Register

A list of natural, Indigenous and historic heritage places throughout the ACT. These include places of particular importance to the people of the ACT and those that are legally protected under the *Heritage Act 2004*. Listings within 1 km of the Proposal site were searched for using ACTMAPi interactive mapping service, maintained by ACT EPD, accessed from <http://www.actmapi.act.gov.au/html5.html>.

The following items were identified as potentially occurring within 1 km of the upgrade corridor:

Non-Aboriginal Heritage

Commonwealth Heritage List:

— No items identified within 1 km of the upgrade corridor.

National Heritage List:

— No items identified within 1 km of the upgrade corridor.

ACT Heritage Register:

— Block 1257 Belconnen: Weetangera Cemetery (Heritage ID 259) – Significant for its age, location, composition of its burials, and intact nature. The cemetery is one of the oldest in the ACT and its burials include early pioneers of the Canberra district.

Aboriginal Heritage

Commonwealth Heritage List:

— No items identified within 1 km of the upgrade corridor.

National Heritage List:

- No items identified within 1 km of the upgrade corridor.

ACT Heritage Register:

- Various Aboriginal items are located in the following blocks (exact locations not available through online resources):

— Block 1593 Belconnen: WB2 (Heritage ID 1172).

— Block 1372 Belconnen: CLB19 (B19).

— Block 1591 Belconnen: If15 (Heritage ID 1172).

— Block 1599: WBIF1 (Heritage ID 1172).

— Block 1598: Aboriginal Places in Canberra Nature Park Fire Trails (Heritage ID 1247).

— Block 1660 Belconnen: WBIF1 (Heritage ID 1172).

— Block 1382 Belconnen: If15 (Heritage ID 1172).

— Block 1601 Belconnen: MOL A9 (Heritage ID 1172).

— Block 1605: CLSN2 (Heritage ID 1162).

— Block 1632 Belconnen: CLSN1 (Heritage ID 1162).

— Block 1607 Belconnen: CLSN4 (Heritage ID 1162).

— Block 1368 Belconnen: Aboriginal Places along Urban and Rural Bushfire Containment Lines (Heritage ID: 1162).

— Block 1370 CLB21 (B21) (Heritage ID 1162).

— Block 9 and 10, Section 26 Hawker (CLB21 (B21) (Heritage ID 1162).

12.2.2.2 Consultation

In July 2016, AECOM undertook initial consultation with ACT Heritage (Meaghan Russell), in order to further understand the exact locations of the listed heritage sites in the area identified through the desktop searches, and to gain early advice on likely heritage assessment requirements. ACT Heritage subsequently disclosed the locations of the heritage sites which indicate that the Proposal would not impact any listed heritage sites. Notwithstanding, ACT Heritage advised that a Cultural Heritage Assessment (CHA) would be required for the project as the land adjacent to Drake Brockman Drive / Stockdill Drive has potential to contain Aboriginal places and objects, and areas of low disturbance within the existing road corridors may also have potential for Aboriginal places to occur.

The CHA would need to be prepared in accordance with ACT Heritage Council policy requirements and in consultation with Representative Aboriginal Organisations, and also include an archaeological survey of the proposed Project impact footprint, including any associated work areas (site compounds etc.). ACT Heritage further noted that a potential archaeological deposit (PAD) occurs within the project area and the potential effects to this area should also be addressed within the CHA.

A CHA would determine the potential impact of the Project on heritage places and objects, recommend appropriate management strategies and enable the preparation of a Statement of Heritage Effect (SHE). The CHA and SHE would inform the ACT Heritage Council's evaluation of a section 211 EIS exemption with regard to the Project. The CHA and SHE would need to be submitted either with or prior to the submission of the section 211 EIS exemption application. ACT Heritage recommended that the CHA and SHE is submitted as soon as possible, prior to the section 211 EIS application to facilitate an efficient assessment of the section 211 EIS application.

12.2.3 Contamination

There are no known contamination investigations that have been undertaken for the upgrade corridor. A review of land uses and potential contamination sources indicates potential for contamination to be present as a result of agricultural activities such as the use of chemicals (pesticides and sheep dips etc).

Further, fill material of unknown origin may have been imported to the site which would require environmental classification prior to excavation and subsequent offsite disposal or beneficial re-use.

In consideration of the potential contamination within the Project area, a Preliminary Site Investigation (PSI) is recommended to avoid unexpected finds during construction and subsequent delays in construction.

The objective of undertaking a PSI as defined by the National Environment Protection (Assessment of Site Contamination) Measure (ASC NEPM) is to identify:

- Potential sources of contamination and associated contaminants of concern.;
- Areas of potential contamination, commonly referred to as areas of environmental concern; and
- Potentially affected media (soil, sediment, groundwater, surface water, indoor and ambient air).

Key items incorporated in the PSI include:

- A review of site history and any existing contamination records held by the ACT Environment Protection Authority (EPA);
- Assessment of the site's environmental setting, including local geology and hydrogeology; and
- A site inspection.

The outcome of the PSI is a conceptual site model (CSM), which identifies linkages, or pathways, between potential sources of contamination and possible sensitive receptors, based on the site's current or proposed land use. The risk of harm to those receptors can then be qualitatively assessed, based on the nature and completeness of the pathway.

Where complete pathways are identified, these scenarios are used to guide the development of further investigations (a detailed site investigation involving sampling) for the quantitative risk of harm to the receptors to be established and the requirements for remediation or on-going management can be determined.

It is likely that an assessment of contamination would be required for the section 211 EIS exemption application which covers the Project impact footprint. Without this, when the section 211 exemption application is referred to the EPA, there is the possibility that the EPA may impose conditions on the section 211 exemption which relate to the need for assessment of contamination. If no assessment is required, there remains the risk of contamination being discovered during construction. This could result in construction ceasing and extended delays while the contamination is managed in consultation with the EPA.

12.3 Recommendations

The following sections summarise the recommendations and requirements for further environmental investigations, consultation, and approvals for the Project.

12.3.1 Biodiversity

The Project has been included within the West Belconnen SA. As such, the formal assessment of the Project's impacts to MNES including EPBC-listed box gum woodland is included within the West Belconnen SA. No additional biodiversity assessments are required to satisfy the requirements of the EPBC Act. However,

it is critical that this Project does not exceed 3.8 ha of removal of EPBC Act listed box-gum woodland which is allowed for in the SA3.

Therefore should there be further refinements to the design post-feasibility stage, the area of impact needs to be re-calculated to ensure the quantum of EPBC Act listed box gum woodland to be cleared does not exceed 3.8 ha.

As discussed in Section 12.2.1, a further box gum woodland survey beyond 20 m south of the fence line could (although unlikely) lead to the adjustment of the areas mapped as EPBC Act listed box gum woodland and hence the quantum of impacts, however any adjustments would unlikely have a notable impact on the quantum of impact to the community because most of the project impact footprint does not extend beyond 20 m south of the fence line. As such, a further survey is not considered necessary; however this should be confirmed by Riverview with Umwelt.

[3] This assumes the impacts and offsets reported within the draft SA will be carried over to the final SA and these are endorsed by the Minister for the Environment.

The SA is currently in draft, and it is strongly recommended that Riverview make the following minor amendments to the SA before it is finalised:

- Amend the description of the Project Area to reflect the actual project impact footprint determined by the Project's design, rather than the current description, "all land adjoining the existing road corridor to a distance of up to 20 m south of the existing cadastral boundary". The project impact footprint extends beyond this distance, and it should be noted that the existing fence line does not represent the cadastral boundary. Further the project footprint extends to areas adjoining the intersection with the existing Kingsford Smith Drive and William Hovell Drive corridor. It is additionally strongly recommended that the figures in the SA reflect this corrected Project Area. This will avoid any risk of EPD disputing that the Project is covered by the SA.
- Amend the figures showing box gum woodland to reflect the mapping provided by Umwelt following the ecological inspection in December 2015. The mapped areas provided Umwelt supersede the mapping published by ACTmapi which is currently what is shown in the SA. The figure should also show the area of woodland that meets the definition for box gum woodland under the NC Act.

In terms of biodiversity values protected under the NC Act, there is one area of box gum woodland identified within the road reserve corridor which meets the criteria for the listing under the NC Act. The quantum of impacts to this area has not been determined because mapping of this NC Act listed area has not been provided by Umwelt. Umwelt have noted that the extent of this NC Act listed patch could change following a detailed survey south of the fence line undertaken at optimal times for the identification of diagnostic species. However such a survey may not be considered necessary because the project impact footprint does not extend beyond the fence line in the area where NC Act listed box gum woodland has already been identified. As such any changes to the extent of NC Act listed box gum woodland beyond the fence line would unlikely change the quantum of impacts NC Act listed box gum woodland. Notwithstanding it is recommended that the need for further survey should be confirmed by Riverview with Umwelt. It is further recommended that mapping of the box gum woodland areas which meet the criteria for listing under the NC Act is provided by Umwelt to AECOM for the determination of the quantum of impacts under the NC Act when the project impact footprint has been finalised. This information should also be documented to support the application for a section 211 EIS exemption and satisfy the requirements under the PD Act with respect to consideration of the NC Act (refer Section 12.1.2).

A tree survey is also recommended to be undertaken when the project impact footprint has been finalised. This will inform the Conservator of Flora and Fauna's evaluation of a development application for any works involving tree removal, with consideration of the *Tree Protection Act 2005.*

12.3.2 Heritage

As discussed in Section 12.2.2.2, initial consultation with ACT Heritage identified the requirement for a CHA to be undertaken as the land adjacent to Drake Brockman Drive / Stockdill Drive has potential to contain Aboriginal places and objects, and areas of low disturbance within the existing road corridors may also have potential for Aboriginal places to occur.

A CHA would determine the potential impact of the Project on heritage places and objects, recommend appropriate management strategies and enable the preparation of a Statement of Heritage Effect (SHE).

The CHA and SHE would inform the ACT Heritage Council's evaluation of a section 211 EIS exemption with regard to the Project. The CHA and SHE would need to be submitted either with or prior to the submission of the section 211 EIS exemption application. ACT Heritage recommended that the CHA and SHE is submitted as soon as possible, prior to the section 211 EIS application to facilitate an efficient assessment of the section 211 EIS application.

12.3.3 Contamination

As discussed previously, it is likely that an assessment of contamination would be required for the section 211 EIS exemption application which covers the Project impact footprint. Without this, when the section 211 exemption applications is referred to the EPA, there is the possibility that the EPA may impose conditions on the section 211 exemption which relate to the need for assessment of contamination. As such it is recommended that Riverview commission a PSI as soon as possible to avoid potential delays, particularly if a PSI identifies the requirement for further investigations. If a contamination assessment is not undertaken and not requested by the EPA in conditions of a section 211 EIS exemption, there remains the risk of contamination being discovered during construction. This could result in construction ceasing and extended delays while the contamination is managed in consultation with the EPA.

12.3.4 Planning approvals program

This Project involves a number of planning approvals and as such, the consideration of their timing is critical.

The endorsement of the SA by the Commonwealth Minister of the Environment will provide Project approval under the Commonwealth EPBC Act (refer Section 12.1.1). Endorsement is anticipated to occur around January 2017.

AECOM understands that Riverview intend to seek a section 211 EIS exemption under the ACT PD Act which covers the whole of the West Belconnen development including the Drake Brockman Drive / Stockdill Drive upgrade. A section 211 EIS exemption will enable a development application for the Project to be lodged without an EIS (refer Section 12.1.2). The section 211 EIS exemption would need to be granted prior to lodging any development application the Project, regardless of the nature of works the development application is seeking approval for. This is because the trigger for an assessment under the impact track, and requirement for an EIS, occurs at the project level (in this case the West Belconnen development, including the Drake Brockman Drive / Stockdill Drive upgrade), not the development application level. Once granted, a section 211 exemption would be valid for the duration of the development of West Belconnen (in accordance with Section 211I(b) of the PD Act), and thus will cover all stages of the Project.

The PD Act does not stipulate any statutory timeframes for the assessment of a section 211 EIS exemption application. However it is estimated the process could take 3 to 4 months from preparation of the application to an exemption being granted.

There are also a number of tasks that would need to be completed prior to the submission of a section EIS exemption application. A section 211 EIS exemption relies on the ACT Minister for the Environment being satisfied that previous studies have adequately identified the potential impacts of the proposal, and measures to mitigate the impacts have been identified. As such, the ACT Minister for the Environment would require the SA to be endorsed by the Commonwealth Minister for the Environment prior to granting a section 211 exemption. This would be to ensure the impacts to MNES including box gum woodland have been adequately assessed and mitigated/offset.

ACT Heritage have also advised that a section 211 exemption would not be granted without a CHA and a SHE submitted prior to or with the section 211 exemption application. A CHA and SHE could take between three and eight months to prepare, depending on whether the need for further investigation is identified in the first phases of assessment.

ACT Heritage recommended that the CHA and SHE is submitted to ACT Heritage to as soon as possible, prior to the section 211 EIS application to facilitate an efficient assessment of the section 211 EIS application by the ACT Heritage Council. As such it is recommended that a heritage assessment is commissioned as soon as possible. The project impact footprint will need to be finalised before the finalisation of a CHA and SHE.

ACT Heritage also advised that if a significant amount of time passes between the ACT Heritage Council endorsing the CHA and SHE (and hence the section 211 EIS exemption), and the lodgement of a development application for any works involving ground disturbance, then the CHA and SHE may need to be refreshed. The extent of the refreshment will be set by the ACT Heritage Council and will depend on the circumstances of the Project at the time.

It is likely that the EPA would want to see a contamination investigation, which covers the Project impact footprint, with the section 211 EIS exemption application. A PSI would take approximately 1 to 2 months to prepare; however the assessment of contamination may take longer if a PSI identifies the requirement for further investigations. It is recommended that a PSI is commissioned as soon as possible.

In summary, the following items need to be completed prior to the submission of the section 211 EIS exemption.

- SA endorsement by the Commonwealth Minister for the Environment.
- CHA and SHE (can be submitted for endorsement with the section 211 EIS exemption application).
- An assessment of contamination (a PSI is the first stage for this).

The section 211 EIS exemption needs to be granted before any development application for the Project can be lodged.

13.0 Urban Design and Landscape

13.1 Introduction

The duplication of Drake Brockman Drive will facilitate the future urban development proposed for West Belconnen. It will change the existing landscape character and site context. These changes will need to be considered and addressed as part of an integrated urban design process including the proposed staging of works.

The West Belconnen Strategic Assessment (SA), prepared by AT Adams Consulting (2016) detailed the key environmental considerations that would be impacted by the development, including surrounding context. These include:

- Threatened Ecological Communities;
- Threatened Flora and Fauna; and
- Visual and operational noise impacts.

Some of these environmental considerations extend into the Drake Brockman Drive road corridor and will be impacted as part of the duplication. In addition to the environmental considerations, other elements that require consideration in developing a coordinated urban design and landscape proposal include:

- Traffic and transport demands;
- Pedestrian, cyclist and recreational connectivity;
- Existing and proposed adjacent land use;
- Elements of significant heritage; and
- Addressing various impacts to the local community.

Establishing a clear urban design framework, with guiding design objectives and principles, will ensure the Stage 3 road duplication is carefully considered together with the surrounding context, is coordinated with key design disciplines and will provide an integrated built outcome.

13.2 Existing Site Context

Drake Brockman Drive runs east-west between Kingsford Smith Drive and Spofforth Street, then Stockdill Drive from Spofforth Street to just west of Britten-Jones Drive. The north side of the road comprises the residential suburbs of Higgins and Holt, with the south side of the road alignment predominantly open space, including broadacre, recreational reserve and commercial uses.

Drake Brockman Drive is currently single-lane in each direction servicing the residents of Higgins and Holt. The intersection with Cussens Street provides access to key amenities in Higgins including playing fields, former Higgins Primary School, Baptist Church and Higgins Neighbourhood Shopping Centre.

Macnaughton Street services key community amenities in Holt including the Kippax Group Shopping Centre, Kingsford Smith School, Kippax playing fields and a number of community facilities and services. Additional intersections at Kinsella Street, Trickett Street and Spofforth Street service the residential communities of Higgins and Holt. Stockdill Street and Spofforth Street also interface with the Belconnen Golf Club to the west, and includes an associated residential community.

13.2.1 Existing Land Use and Landscape Character

The existing adjacent land use along Drake Brockman Drive is predominantly low density residential with community facilities to the central core of each suburb. Medium density residential and aged-care facilities have increasingly been built around the central core. The predominant landscape character for the suburbs of Higgins and Holt is native. This is carried through along both sides of Drake Brockman Drive, especially along the southern side where it interfaces with threatened ecological community of Box Gum Woodland. The residential (north) side of Drake Brockman Drive consists of street tree planting consistent of typical native street tree planting of suburban Canberra.

Between Kingsford Smith Drive and Macnaughton Street (Higgins interface) there are no residential frontages along Drake Brockman Drive, only rear property fences with native tree planting providing a vegetated buffer along Drake Brockman Drive. These residences are serviced from access roads behind. Between Macnaughton Street and Spofforth Street the residents front directly onto Drake Brockman Drive with structured street tree planting along this side of the street. Residents value the views to the immediate open space of vineyards, nature reserve and the distant Brindabella mountain ranges.

The open space on the south side of Drake Brockman Drive contains the threatened ecological community of Box Gum Woodland that will be subject to disturbance to accommodate the duplication. The existing trees range in height and maturity, however provide a distinctive landscape interface along Drake Brockman Drive. Further native tree planting has been undertaken to reinforce this existing character. An electricity easement also runs along this frontage which will impact on the duplication of the road.

Stockdill Drive is a rural road in nature. It has a golf course on the northern side between Spofforth Street and Britten-Jones Drive and is skirted by pine trees separating the tenth fairway from the road. Some of these trees will be removed as part of an approved new pathway to connect Spofforth Street to the Woodhaven Estate, located west of the golf course.

West of Britten-Jones Drive there is some open space and a nearby golf course car park on the northern side. A Development Application has been approved for residential development adjacent to here (Woodhaven Estate). Further west of here will be the future West Belconnen urban development, which will be residential uses north of the road.

There is open space associated with rural uses on the southern side of Stockdill Drive. This is not expected to change in the foreseeable future.

13.2.2 Transport and Connectivity

Drake Brockman Drive and Stockdill Drive are arterial roads that will be the primary traffic feeder for the future West Belconnen urban development. With the proposed urban development of West Belconnen, the demand for Drake Brockman Drive as a public transport route will increase. With the Stage 3 design of the arterial road to be 2 lanes in each direction, the integration of bus stop locations along the alignment will be critical to ensure that they effectively service the local residential communities, are legible within the wider public transport network and do not impede traffic flow along the road corridor.

An existing pedestrian footpath runs along the full length on the residential (north) side of Drake Brockman Drive, connecting to the broader Belconnen Town Centre cycleway and pedestrian network. The southern side of the road contains an equestrian trail connecting the open space and nature reserve activities. Reinforcing and enhancing these connections will be a key component of the duplication, as well as to ensure integration with surrounding and future cyclist, recreation and pedestrian links.

13.3 Environmental Considerations

In addition to the civil infrastructure requirements, the duplication of Drake Brockman Drive will need to consider impacts on the following environmental aspects of the design:

- Threatened ecological communities – in particular flora, but also fauna habitat;
- Visual impacts of duplication; and
- Noise attenuation impacts from increased traffic.

The West Belconnen SA identified patches of Box Gum Woodland in the adjacent open space and broadacre areas on the southern side of Drake Brockman Drive road corridor. The proposed Stage 3 duplication will encroach on these patches, as well as potential fauna habitat this Woodland provides.

While the SA did not identify heritage items of significance, a desktop review of the heritage overlay should be undertaken to identify heritage elements of significant Aboriginal and European significance. Elements identified as significant will be protected and if possible, incorporated as part of an integrated interpretation strategy.

The expectations of the existing community will also need to be considered, especially residents who will be directly impacted by the duplication, fronting onto Drake Brockman Drive. The key environmental considerations that will impact these residents include accessibility, visual and noise, as well as a potential loss of amenity.

The visual impact of the Stage 3 duplication will require an extensive visual impact and landscape character assessment to be undertaken. This will accurately determine the existing landscape value and visual impact of the duplication on the most sensitive receivers. The visual impact and landscape character assessment will also recommend measures to mitigate these impacts.

Accessibility will also require consideration and integration as part of the urban design, including access to residences fronting onto Drake Brockman Drive, connectivity to public transport, as well as coordination and upgrading of pedestrian, cyclist and recreational paths.

Integration of civil elements including services, utilities and lighting will all be considered as part of the coordinated urban design response.

13.4 Urban Design and Landscape Proposal

A coordinated approach to the duplication of Drake Brockman Drive will ensure all of the above issues and constraints will be considered and resolved as part of an integrated design approach.

Establishment of key design objectives and principles that consider and provide parameters for the design and context will provide a structure for the development of a strong urban design and landscape outcome. The purpose of the framework will be to ensure the key design elements for the road corridor are coordinated and provide the opportunity to develop a strong and recognisable character for the road.

The aim is to develop a structure identifying the key components of the road corridor and develop a coordinated and integrated urban design response that provides a structured design outcome.

Acknowledging the design and construction for Drake Brockman Drive will be undertaken in stages, the urban design will need to consider the progression for each stage and ensure a progressive structure is built upon to develop the Stage 3 duplication.

13.4.1 Urban design and landscape tasks

To develop a coordinated urban design and landscape the following tasks will need to be delivered:

- Undertake a contextual analysis;
- Establish the urban design objectives and principles
- Undertake landscape character and visual impact assessment; and
- Prepare urban and landscape design concept design proposal (PSP)

13.4.2 Contextual analysis

The contextual analysis will provide an overarching appraisal of the surrounding environmental and cultural context that will inform the urban design principles and objectives. The contextual analysis will involve:

- Review and critically assess relevant reports, studies and background documents for the road corridor; and
- Site visit to undertake a thorough contextual analysis.

13.4.3 Establish urban design objectives and principles

The establishment of key urban design objectives and principles at the beginning of the design process will provide a series of design ‘rules’ to govern the key urban design elements. These will be developed in accordance with the following:

- In collaboration with the project team, advise and assist in the development of project-wide design objectives and principles; and
- Facilitate workshop at inception of PSP Stage to develop design ideas and establish design principles for the road corridor.

13.4.4 Landscape character and visual impact assessment

The landscape character and visual impact assessment will identify the key components that make up the landscape character of the surrounding area, including an assessment of the natural, cultural and heritage landscape elements. The visual impact assessment will highlight locations / receptors of low, medium and high impact and provide outcomes on how to address these impacts. It will incorporate:

1. Site visit in order to gain an understanding of the concept design, measured against the site’s constraints and opportunities, in order to undertake a landscape character and visual impact assessment;

2. Undertake a landscape character and visual impact assessment of the proposed concept design, similar to RMS' *Environmental Impact Assessment Practice Note: Guidelines for landscape character and visual impact assessment*.

13.4.5 Concept design development (PSP)

The preparation of an urban design and landscape concept design will ensure the proposed road duplication is integrated within the existing surrounding context, and outline a methodology to treat adjacent areas impacted by the works. The concept design will also demonstrate how the proposed works will respond to the surrounding environmental, ecological and heritage requirements. It will incorporate:

- Liaision with whole of design team conveying opportunities and considerations for improved urban design outcomes based on findings of landscape character and visual impact assessment;
- Review and drive interdisciplinary cross checks of design – ensuring a whole of project outcome for roadworks, earthworks, drainage, lighting, road furniture and fixings and local road interfaces; and
- Provide feedback and assist the project design team's development of the measures to avoid or minimise any likely adverse impacts identified during the landscape character and visual impact assessment.

14.0 Opinion of Probable Costs

An opinion of probable costs for Stage 1, Stage 2 and Stage 3 design are listed in Table 35. The following assumptions have been made for all stages in the opinion of probable costs:

- Rates are exclusive of GST
- Existing pavement is retained where possible and no rehabilitation of existing pavement is allowed
- Land acquisition costs are excluded
- Road furniture such as barriers, and noise walls excluded
- All approvals including tree removals, etc. are excluded
- New utilities required to service West Belconnen development are excluded
- Stage 1 is to commence during 2017, Stage 2 is to commence during 2021, and Stage 3 is to commence during 2031

The below cost assessments include the following allowances:

- Preliminaries (15%)
- Contingency (40%)
- Escalation (1% per year)

Table 35 Opinion of Probable Costs

Stage	Description of works	Opinion of Probable Cost
1	Minor civil works including line marking and minor widening works.	$370,000
2	Full construction of Stockdill Drive / Drake Brockman Drive west of Macnaughton Street earthworks formation with single westbound traffic lane except at Macnaughton Street where the full intersection is built. Provision of service road for local access.	$29,000,000
3	Duplication of the remainder of Drake Brockman Drive/Stockdill Drive. Upgrades to Cussen Street, Kinsella Street and Kingsford Smith Drive/William Hovell Drive intersection. Signalisation of Spofforth, Trickett and Kinsella intersections.	$26,000,000
	TOTAL	**$56M (excl. GST)**

DISCLAIMER

AECOM Australia Pty Ltd has no control over the cost of labour, materials, equipment or services furnished by others, neither has it control over contractors methods for determining prices, competitive bidding or market conditions. The assessment of probable construction cost produced by AECOM is made on the basis of our best judgement as an experienced and qualified engineering consultant, familiar with the construction industry. AECOM cannot and will not guarantee that any tenders or actual construction costs will not vary from this assessment of probable construction cost.

15.0 Cost Benefit Analysis

15.1 Introduction

A cost benefit analysis (CBA) was undertaken to assess the net benefit of key design options.

A CBA is a method of economic appraisal that considers the merit of a project from a base-case which, under this study, is the continuation of the status quo (do-nothing scenario). Of interest are the differences between the base case and the defined option(s): those factors that are common between options have no bearing on choosing the most worthwhile option (Transport for NSW 2013).

The CBA undertaken for this study follows guidelines set out by *Australian Transport Council's National Guidelines for Transport System Management (2015)*, the *ACT Cost Benefit Analysis Assumption Guide (2009)* as well as assumptions sourced from the *Transport for NSW Principles and Guidelines for Economic Appraisal of Transport Investment and Initiatives (2013)*.

The economic evaluation was conducted on the following three design options against the base case do-nothing scenario:

- **Stage 1**: Minor line marking works to introduce turn pockets and reduce lane widths. Introduction of pedestrian refuge islands. (Optional reduction to 70km/h on Drake Brockman Drive east of Macnaughton Street)
- **Stage 2**: A new 2-way road with one lane in each direction and service road between Spofforth Street and Macnaughton Street, including reconstruction of intersections along this section of road and traffic signals at the Macnaughton Street intersection
- **Stage 3**: Duplication of the full extent of Drake Brockman Drive and Stockdill Drive including new traffic signals at Spofforth Street, Trickett Street and Kinsella Street. This includes Stage 2 works above.

15.2 Key Assumptions

Key assumptions of the CBA which were applicable to Options 1, 2, and 3 have been summarised in Table 36. The full list of assumptions with sources and explanations is provided in Table 45 of Appendix J.

Table 36 Key CBA assumptions

Assumption	Value
General parameters	
Price year	2016
Real discount rate	7%
Evaluation period	30 years
Benefit realisation start date and duration	1st January 2018, 28 years
Timing	
Construction start date and duration – Stage 1	1st January 2017; 1 year
Construction start date and duration – Stage 2	1st January 2017; 1 year
Construction start date and duration – Stage 3	1st January 2017; 1 year
Road maintenance start date – Stage 1	1st January 2028

Assumption	Value
Road maintenance start date – Stage 2	1st January 2028
Road maintenance start date – Stage 3	1st January 2028
Traffic parameters	
Peak hour traffic volume annual expansion factor	1,225
Mean vehicle occupancy – cars	1.2
Cumulative annual growth rate (CAGR) of traffic volume	5.5%
Construction costs	
Stage 1	$370,000
Stage 2	$28,000,000
Stage 3 (full build out including stage 2)	$53,000,000
Construction cost contingency	40%
Maintenance costs	
See Appendix A	
Crash reductions	
Estimated number of crashes avoided as a result of design changes (per year)	**Stage 1: +4.4** **Stage 2: -1.4** **Stage 3: -4.8**

Source AECOM, 2016

15.3 Parameters / Inputs / Outputs

The cost/benefit modelling parameters used in this assessment were obtained from outputs from the Drake Brockman Drive SIDRA model. The key outputs are:

- ***Vehicle Operating Cost (VOC)****:* VOC per kilometre has been used as a key output from the SIDRA model which is determined through a number of factors including the current average fuel price, the ratio of running cost to fuel and vehicle fuel consumption.
- ***Travel Time****:* Travel time is determined though SIDRA as the number of vehicle hours that occur in the network in the peak hour period (veh-h/h). Travel time is used as a key indicator of the overall operation of the network, showing what the overall network travel time change is, dependent on changes in the network.

The other key consideration, which is not an output from the SIDRA model, for the economic model is the accident cost savings.

- ***Accident Cost****:* The Accident costs have been determined using the Austroads Guide to Road Safety: Part 8. This guide outlines the impacts on intersection crash types as a result of the introduction of changes to an intersection arrangement. This includes the percentage reductions or increases in accident types for each of the key crash types.

15.4 Results

The results from the CBA modelling incremental to the base case are presented in Table 37 below. The benefit cost ratio (BCR) is highest in Stage 3, this is due to the full duplication of Drake Brockman Drive.

The minor works and safety improvements proposed for Stage 1 indicate a negative BCR primarily due to the increased travel time costs of reducing the speed limit. The benefits related to the crash savings of this option totalled over $1.1 million over the life of the analysis.

Table 37 CBA results (incremental to the base case)

Option	NPV ($'000)	NPVI	BCR
Stage 1 (excl speed reduction)	-$405	-1.03	0.52
Stage 1 (incl speed reduction)	-$4,693	-15.22	-6.14
Stage 2	-$26,031	-0.99	0.03
Stage 3 (full build out including stage 2)	$172,136	4.13	5.05

Source: AECOM
Note: NPV – net present value
NPVI – net present value index
BCR – benefit cost ratio

The high BCR values are the result of a combination of relatively low capital expenditure and the length of the period for which it is assumed that the project provides benefits. A 30-year benefits period has been used in the analysis; however, to the extent that the benefits period is less than this, the BCR values will be lower. The high level of benefits in the early years following the improvements indicates that the project provides high value for money even in the short term (after the first year or two of negative impacts).

15.5 Sensitivity testing

The sensitivity test cases shown in

Table 38 were applied to assess changes in the economic indicators that may arise as a result of uncertainty.

Table 38 Assumptions in sensitivity test cases

Assumption	Base Case	Case 1	Case 2	Case 3
Description	**Base Case**	**Discount rate down**	**Discount rate up**	**Construction cost up**
Real discount rate	7%	4%	10%	7%
Construction cost contingency	40%	40%	40%	80%
Realisation of traffic volume forecast	100%	100%	100%	100%

Source AECOM

The economic indicators under each sensitivity test case are summarised in Table 39.

Table 39 Results from Sensitivity Tests

Economics indicator	Base Case	Case 1	Case 2	Case 3
Stage 1 (excl speed reduction)				
NPV ($'000)	-$4,693	-$7,288	-$3,232	-$4,791
NPVI	-15.22	-21.91	-11.28	-12.08
BCR	-6.14	-6.68	-5.56	-5.42
Stage 1 (incl speed reduction)				
NPV ($'000)	-$405	-$476	-$359	-$503
NPVI	-1.03	-1.22	-0.93	-1.02
BCR	0.52	0.57	0.46	0.46
Stage 2				
NPV ($'000)	-$26,031	-$41,028	-$20,701	-$33,508
NPVI	-0.99	-1.56	-0.77	-0.99
BCR	0.03	-0.52	0.24	0.02
Stage 3				
NPV ($'000)	$172,136	$378,571	$71,897	$157,984
NPVI	4.13	8.12	2.02	2.99
BCR	5.05	8.87	2.99	3.94

Source AECOM

15.6 Conclusion

The cost benefit appraisal comparing the net benefit of Stage 1, Stage 2, Stage 3 against the do-nothing scenario found that Option 3 has a higher NPV and BCR and will provide the most benefits relative to costs.

16.0 Staging

16.1 Introduction

Three stages of construction have been proposed, as follows:

1. **Stage 1**: line-marking, pedestrian refuge islands and minor widening for an exit lane;
2. **Stage 2**: upgrade Stockdill Drive with a full earthworks formation, single lanes in each direction, turn pockets, and construct new service road between Spofforth Street and Macnaughton Street with a new signal at Macnaughton Street;
3. **Stage 3**: duplicate Drake Brockman Drive between William Hovell Drive and Macnaughton Street, including the upgrade of intersections affected by the duplication; and new signals at Trickett Street and Spofforth Street.

These can be combined into fewer stages, or disaggregated into more stages by separately undertaking component works of each stage.

The trigger for the stages of work is dependent upon when certain traffic volumes are achieved. This increase in traffic volumes can be attributed to a variety of sources such as the Riverview Development, Woodhaven Estate, or other proposed developments that occur along the corridor.

Therefore, changes in traffic volumes should be reassessed over time as new developments may occur along the corridor.

Some comments on the content and timing of the above stages of work are as follows. The costs of the component works are summarised in Chapter 14.

Table 40 Triggers for Future Road Upgrades

Work	Triggers	Comment
Stage 1: Safety improvements	Safety Audit, community complaints, new development, construction works.	Will cater for future traffic growth, increased traffic access and reduce crash risks.
Stage 2: Service road	Safe access/egress to local properties. Desirable for volumes exceeding 500 veh/h adjacent to driveways. Highly desirable for traffic volumes exceeding 900 veh/h.	Will greatly improve access to local properties to alleviate increased traffic and longer delays accessing Drake Brockman Drive. Will improve intersection performance A number of other 2-way 2-lane roads with driveway access in ACT currently carry higher traffic volumes than 900 veh/h.
Stage 3: Duplication	Traffic congestion, dependent on intersection delays. Typically becomes an issue for traffic volumes exceeding 15,000 veh/day.	Intersections are the main constraint and resolution of intersection issues can delay the need for duplication, well beyond 15,000 veh/day. The intersection at William Hovell is the main constraint and this has ample capacity to carry higher volumes of traffic.

16.2 Stage 1

These works may be able proceed without the need to go through a Development Application (DA) process and thus avoid having to wait for the 211 EIS exemption. It would mean that the works could commence early in 2017, rather than mid-2017.

There is a risk that such works as minor road widening to provide improved access to Pegasus may trigger the need for a DA, delaying work by about 6 months. However, this is subject to early discussions with EPD in a pre-app meeting. The earlier these discussions the better in relation to defining the Stage 1 PSP design.

In Stage 1 no provision is made for on-road cycling, other than the use of the proposed eastbound parking lane between Spofforth Street and Macnaughton Street. The road would need to be widened to make provision, but it is not warranted given the likely low number of cyclists initially and the costs associated with abortive works. The focus of the Stage 1 works is improving safety for right turns at intersections and into driveways, as well as pedestrian safety.

A new shared pathway will be built between the Woodhaven Estate and Spofforth Street on the northern side of Stockdill Drive, as part of the Woodhaven off-site works. No other new paths are proposed in Stage 1.

The Stage 1 works will provide refuge for pedestrians to stage their crossing of Drake Brockman Drive. This will include five concrete pedestrian refuges at bus stop locations.

Access to the Woodhaven Estate will be restricted to left-in / left-out with the Stage 1 works. The timing of this should coincide with the new access to Woodhaven form the Stage 1 EDP site.

To aid in the process of introducing the new line marking scheme and reduced speed environments predicted for the Stage 2 and 3, it is proposed to reduce the 80 km/h speed environment east of Cussen Street to 70 km/h and retain a 60 km/h speed limit west of Cussen Street.

16.3 Stage 2

This involves building a new road formation and service road between Spofforth Street and Macnaughton Street and the upgrade of Stockdill Drive. It will include the signalisation of Macnaughton Street intersection in its Stage 3 arrangement, as illustrated in the 2031 SIDRA diagram in Table 14. This will enable safe movement of pedestrians to / from nearby bus stops to be built as part of this upgrade.

The new road will be built on the Stage 3 road alignment, with one through lane each way and turn lanes at intersections. The kerbside lanes of the Stage 3 design will form the through lanes at this stage of construction.

The intersection works will include provision for bus stops, future on-road cycling and improved pedestrian connections in their Stage 3 form. These works will be local to the intersection improvement.

The works in Stage 2 will involve significant changes to both the horizontal and vertical alignment of the road on approach to Spofforth Street, especially on the Stockdill Drive approach.

At this time, Stockdill Drive will also be reconstructed in a similar form to Drake Brockman Drive, so as to provide a similar continuous road environment through to West Belconnen Avenue the main access road into the new West Belconnen urban development.

The posted speed along this whole section of road should remain at 60 km/h until the Stage 3 design is completed. This will assist safe traffic operations for pedestrian movements at other intersections and bus stop locations to the west of Macnaughton Street. Increases to the posted speed west of Cussens Street are not warranted until the section of road between Macnaughton Street and Cussens Street is upgraded, in the Stage 3 construction.

The works will include the provision for on-road cycling along the length of the new Stage 2 works west of Drake Brockman Drive and including Stockdill Drive. The interface between Stockdill Drive and West Belconnen Avenue is to be include slip ramps to allow cyclists to merge to the off road shared paths of the Stage 1 EDP.

The Ultimate form of off-road shared paths will be built on the northern verge between Spofforth Street and Macnaughton Street; this will connect with the shared path to be built west of Spofforth Street as part of the Woodhaven off-site works.

These works are likely to need to be implemented within 4 to 5 years, due to loss of amenity and safety for adjoining residents between Spofforth Drive and Macnaughton Street and the need to make provision for on-road cycling[4]. This should be assessed with in the future as development progresses to understand the triggers for the updgrade.

16.4 Stage 3

This involves the first stage of duplication works where traffic volumes are higher – east of Macnaughton Street. This will include the reconstruction of the Kingsford Smith Drive roundabout in its Ultimate layout, as illustrated in the Ultimate SIDRA diagram in Table 8.

This is the final stage, with full duplication of the remaining western part of the road project. It will include new traffic signals at the Spofforth Street and Trickett Street intersections

The Ultimate form of off-road shared paths will be built on the northern verge between Macnaughton Street and Kingsford Smith Drive; this will connect the 2.5 m shared path along the whole length of the road project.

Duplication of Drake Brockman Drive is likely to be required within 10 to 15 years based on expected traffic growth and changes to traffic congestion along this road.

[4] Within 4 years, traffic volumes on Stockdill Street west of Spofforth Street will grow to about 6,700 veh/day and on Drake Brockman Drive west of Macnaughton Street will grow to about 10,000 veh/day. In the AM peak hour, the eastbound flow on Drake Brockman Drive will be about 930 veh/hr, which is close to the capacity of a single lane in an urban environment. It equates to about one vehicle every 4 s on average, which is difficult for traffic to access in a forwards direction from adjoining driveways; impossible in a reverse direction.

Appendix A

Stakeholder Consultation Notes

Appendix A Stakeholder Consultation Notes

Riverview Projects (ACT)
PTY LTD ABN 30 165 870 539

Drake Brockman Drive Design Reference Group

Meeting Three

5.30pm – 8.00pm
3 June 2016
West Belconnen Project Office Kippax

Attendees

W.Taylor	Jen Gibson	T.Debortaoli	S.Debortaoli
S.Mclay	Patrick Ceeney	H.Clementine	B.Collins
Rhys Davies (Riverview)	Neil Graham (AECOM)	Ralf Sieberer (AECOM)	Imran Khan (Riverview)
Susan Davis (Riverview)			

Meeting notes

Welcome and Introduction
Rhys Davies welcomed everyone to the third meeting of the Drake Brockman Drive (DBD) Design Reference Group. Attendees introduced themselves and identified where they were from. Rhys Davies also outlined the purpose of the meeting to seek early feedback on the feasibility study prior to finalising the work and submission to TAMS for consideration.

Recap on Previous Meeting
Rhys Davies reviewed the previous meeting minutes noting that most actions had been completed. A question was raised regarding the acoustic analysis and in particular the location of the noise monitors. An action item for AECOM was to provide a copy of the ACT Guidelines and an outlined methodology prior to the next residents meeting in which the Acoustic Consultant will present and answer any further questions.

Development Update
Imran Khan provided a brief update on the progress of the West Belconnen development noting:

- That the EPBC was currently on exhibition until the 10 June;
- The LDA and Riverview have now formalised their Joint Venture agreement; and
- Stage 1 is currently still progressing for civil works to commence early 2017 (March-April).

Shop 2, Kippax Fair, Hardwick Crescent, Holt ACT 2615
P.O Box 3908 Manuka ACT 2603
Phone: 02 6255 1158 Fax: 02 6239 6004

AECOM Design Consultants Presentation

AECOM presented a number of slides (copy attached) responding to the actions captured in the previous minutes:

- Implications of bringing Ginninderra Drive forward – AECOM explained that early construction of the proposed Ginninderra Drive extension had little or no impact on the distribution of traffic on DBD. Rhys Davies noted that the total volume of traffic actually increases on the network as a result of the increased capacity resulting from Ginninderra Drive Extension. Some questions were raised as to the difference in the volume figures at the beginning and end of DBD – some residents believe this does not accurately reflect the 'rat running' occurring through Holt. Rhys Davies explained that the increased volumes of traffic on DBD could be forcing these motorists to seek other routes to their destination – AECOM to review model for reason for this changed traffic pattern.
- Pedestrian and Traffic Surveys – AECOM presented the results of the pedestrian and traffic counts undertaken in May 2016. Residents noted that the numbers seemed low which could be the result of the winter – darker and colder nights, it was also noted that the street lights are currently not working on DBD. Data in Hobart suggests a 26% drop in pedestrian numbers in winter; Hobart has a similar climate to Canberra. Rhys Davies stressed that the low pedestrian volumes will not affect the future justification for implementing pedestrian facilities on DBD; it will assist in defining where crossings should go and also inform what improvements need to be made to increase pedestrian activity along the corridor. It was noted that pedestrian activity is higher on the weekends and some questions were raised as to why the pedestrian counts weren't captured on the weekends. Rhys Davies and AECOM explained that counts are captured during the worst case scenario and we were looking at times when potential conflicts could occur between traffic volume and pedestrian – this is more likely on a weekday. AECOM noted that the traffic volumes along the corridor had increased since the last surveys confirming what the DBD residents had said at the last meeting.
- Safety Audit Results – AECOM presented the results of the recent safety audit which was undertaken by a Level 3 Accredited Auditor. A number of deficiencies in the road design and characteristics of the corridor were noted and these will need to be addressed during the design process. Of particular note was the lack of pedestrian and cycle facilities which compromise the safety of these users along the corridor. A question was raised about obtaining crash data from insurance companies – AECOM noted this was not possible as insurance companies would not release this data.
- Noise – a slide was presented on noise noting the recent data collection that had been undertaken along the corridor. The Acoustic Consultants will present their results at the next meeting.
- Project Program – AECOM noted there had been a slight delay to the feasibility stage of the project; however the overall project program was not impacted.

AECOM Initial Design Presentation

AECOM presented the initial design work that had been drafted for Stage 2 and the Ultimate design of DBD. Rhys Davies noted that this was very preliminary and a lot more design work needs to be done including various inputs from the acoustic analysis and transport modelling.

A roundtable discussion was had on the design with residents noting the following preferences and questions:

- To have the road alignment pushed further to the south to minimise noise and visual impact on the properties, especially just west of Macnaughton Street where the design shows the main road coming close to the proposed service road;
- All residents agreed with the proposed cul-de-sac service road proposal to minimise 'rat running' however raised some concerns with queues exiting the service road during peak times – AECOM to investigate the intersections further and provide further details at the next meeting;
- Questions were raised in relation to stormwater – AECOM have yet to undertake this analysis and will report back at the next meeting on this element;
- A question was raised on speed – Rhys Davies explained at this stage following a meeting with TAMS the ultimate solution was likely to be 70kph a compromise from TAMS' requirements of 80kph. It was noted however we are still working this through and will look to create a road environment which minimise speeding along the corridor;
- Question was raised on pavement types and existing pavement conditions – AECOM explained this has not been considered as yet and will report back at the next meeting;
- Questions were raised around the William Hovell Drive (WHD) roundabout and how this would change in the future noting the existing configuration had issues with speeding motorists. AECOM to investigate this further and explained a number of options were still under consideration including a bigger roundabout and signals;
- Pedestrian mid-block crossings were preferred along the corridor for ease of crossing due to the width of the road; and
- Stage 1 – unfortunately the stage one drawings were not available for the meeting and therefore these will be circulated following the meeting.

Next meeting

Proposed Schedule:

- Early August - TBC

Actions:

1. Acoustics consultant to attend the next meeting when they have analysed the future changes in traffic noise in the corridor and options to manage noise impacts, noting that the design is an evolving process.
2. Rhys Davies to circulate the Stage 1 Design for comment - Complete
3. AECOM to review DBD forecasted traffic figures and report back on the 'rat running' through Holt;
4. AECOM to report back on the Stormwater analysis at next meeting;
5. AECOM to report back on the WHD / DBD roundabout analysis at the next meeting

Attachments

- AECOM PowerPoint presentation

From: Sieberer, Ralf
Sent: Thursday, 7 July 2016 10:08 AM
To: Rhys Davies; Imran Khan (imran@riverviewgroup.com.au); Weeks, Rod
Cc: Nam, Justin; Graham, Neil
Subject: minutes from Pine Ridge

Follow Up Flag: Follow up
Flag Status: Completed

Rhys, Imran, and Rod,

We noted that there were no official minutes from our meeting with Jenny at Pineridge. This is what I have. If anyone else would like to add something, please do.

On 14/4/16 a site visit was held at Pineridge at 11 a.m.

In attendance was

Jenny - Pineridge
Imran Khan – Riverview
Rhys Davies – ISG projects
Rod Weeks – AECOM
Ralf Sieberer – AECOM

At the meeting:

- We discussed the current project and its schedule
- Jenny voiced her concerns about access
- Jenny commented that there have been a number of near misses at their driveway entrance
- Jenny commented that most of their traffic is during peak hours with horse floats coming in the morning and leaving late afternoon or after five
- Jenny commented that with the steep grade it is hard for a truck with a horse float to merge into traffic
- The steepness of the entrance was physical observed onsite
- Rod commented that the driveway probably does not meet current standards
- Jenny commented that their predominate movement out of the site is to the east
- Jenny commented that their preferred outcome is to have a left out movement with a roundabout to turn around at
- It was observed that site distance is extremely poor, particularly to the west.

Ralf Sieberer
Director - Civil Infrastructure/Construction Services
D +61 2 6201 3055 M +61 418 981 216
Ralf.Sieberer@aecom.com

AECOM
Level 2, St George Centre, 60 Marcus Clarke Street, Canberra, ACT 2601
PO Box 1942 Canberra City 2601
T +61 2 6201 3000 F +61 2 6201 3099
aecom.com

Appendix B

Safety Audit of Existing Road

Appendix B Safety Audit of Existing Road

DRAFT

West Belconnen Off-site Infrastructure

Drake Brockman Drive and Stockdill Drive Upgrade

Road Safety Audit of Existing Road

Revision: 1

D R A F T

Drake Brockman Drive and Stockdill Drive Upgrade

Road Safety Audit of Existing Road

Client: Riverview Projects (ACT)

ABN: 33 165 870 539

Prepared by

AECOM Services Pty Ltd
Level 2, 60 Marcus Clarke Street, Canberra ACT 2600, Australia
T +61 2 6201 3000 F +61 2 6201 3099 www.aecom.com
ABN 46 000 691 690

27-May-2016

Job No.: N/A

AECOM in Australia and New Zealand is certified to the latest version of ISO9001, ISO14001, AS/NZS4801 and OHSAS18001.

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Quality Information

Document Drake Brockman Drive and Stockdill Drive Upgrade

Ref N/A

Date 27-May-2016

Prepared by Neil Graham

Reviewed by Tom Brimson

Revision History

Revision	Revision Date	Details	Authorised	
			Name/Position	Signature
1	9/05/2016	Draft	Ralf Sieberer Project Manager	

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Executive Summary

The upgrade of the Stockdill Drive / Drake Brockman Drive is part of the preparatory works for managing increased traffic from the proposed West Belconnen development. To inform the design of the roadway an existing conditions road safety audit was undertaken.

The Audit was undertaken by qualified roads safety auditors who are independent of the design. It was conducted in accordance with the Austroads Guide to Road Safety requirements and the safe system framework outlined by the Institute of Public Works Engineers Australia.

The highest safety risks that were identified are:

- Pedestrians and cyclists on Stockdill Drive (no pathway or on-road facilities, nor adequate lighting)
- Poor road alignment and sight distance at intersection with Spofforth Street
- Pedestrians crossing at bus stop and major pedestrian links to suburbs (wide roads and no crossing facilities, including lack of lighting)
- Right turn and rear-end collisions at the intersections with Trickett Street, Macnaughton Street, Cussen Street and Kinsella Street (no provision for right turns, turn volumes and speed)
- Poor protection of parked vehicles with wide unmarked pavement between Spofforth Street and Trickett Street, with no formal provision for cyclists or turning vehicles
- Wide sweeping road between Macnaughton Street and William Hovell Drive, with no formal provision for cyclists or turning vehicles
- Vehicles entering from Pine Ridge access and property access just west of William Hovell Drive (poor sight distance and speed)
- Vehicles entering Pegasus access, especially trucks or large vehicles (eg., cars towing horse floats)
- Vehicles entering or exiting rural property accesses generally, especially in the 80 km/h section
- Driveway accesses between Trickett Street and Macnaughton Street, especially in section with rock retaining walls (124 to 142 Drake Brockman Drive) (poor sight distance)
- The roundabout at Kingsford Smith Drive and William Hovell Drive (poor southern approach alignment and small roundabout diameter)
- Pedestrian and cycle facilities connecting to William Hovell Drive, Kingsford Smith Drive and Hawker

The pedestrian and intersection crash risks are higher east of Cussen Street where the speed limit is 80 km/h.

Some potential remedial measures have been suggested to address crash risks at various locations along the subject road. These can either be addressed via routine maintenance (ACT government) or as part of the Stage 1 design.

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1.0 Introduction

1.1 Project Purpose

The upgrade of the Stockdill Drive / Drake Brockman Drive is part of the preparatory works for managing increased traffic from the proposed West Belconnen development. In Stage 1 of the works, the project involves minor widening and intersection improvements. The future Stage 2 works will involve duplication of the road.

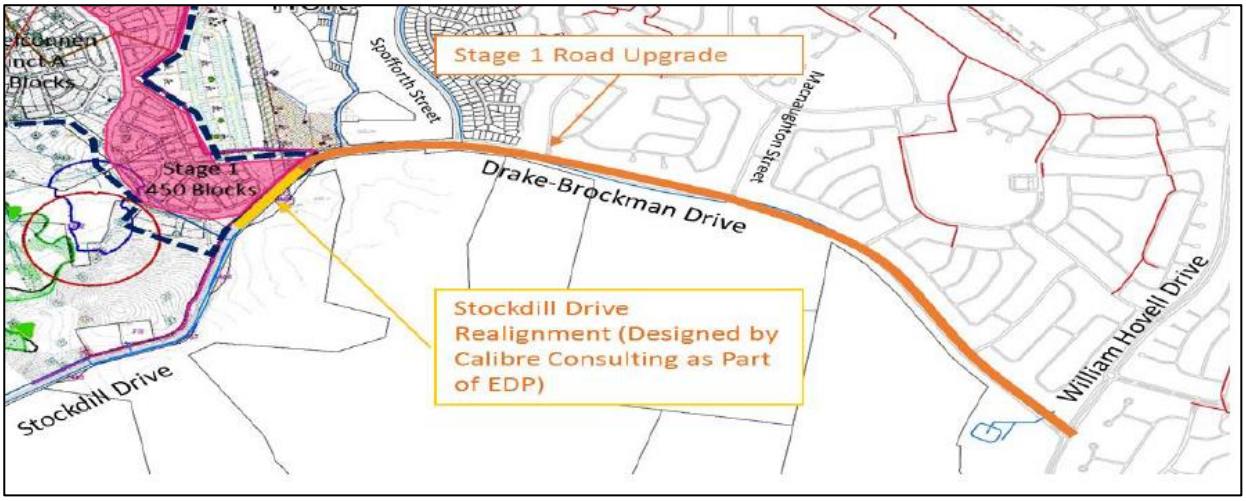
To inform the design of the roadway an existing conditions road safety audit was undertaken. A road safety audit has the greatest potential for improving safety. An audit of the existing road will inform the design team of the current deficiencies and provide a safety focus up front to avoid retrofitting or design compromise during design, as well as to address current community concerns regarding road safety. It will also allow design efficiencies to be integrated into the design. A detailed on-site review from a safety focus increases the likelihood of elements associated with site which may not be evident when reviewing plans, e.g. sun glare at critical conflict points (as it is an east west link).

The Audit was undertaken by qualified roads safety auditors who are independent of the design. It was conducted in accordance with the Austroads Guide to Road Safety requirements and the safe system framework outlined by the Institute of Public Works Engineers Australia.

1.2 Location

This report provides a safety review of Stockdill Drive and Drake Brockman Drive between the proposed West Belconnen development access (west of Britten-Jones Avenue) and William Hovell Drive, highlighted by the orange line in Figure 1.

Figure 1 Location Plan



1.3 Scope of the Safety Review

This is a review of the current road and pathway system to identify departures from the Austroads guidelines detailed in Austroads Guide to Road Safety, so as to inform the project of the existing road's crash potential and safety performance.

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2.0 Assessment Methodology

2.1 Overview

The review methodology is based on the experience and skill of team members, as well as their knowledge of the Austroads Guidelines. Only a daytime inspection was undertaken, but note was taken of lighting facilities and their likely effectiveness.

2.2 Meetings and Site Inspection Details

The safety review methodology involved the activities shown in Table 1.

Table 1 Meetings and assessments

Activity	Date	Attendees
Opening meeting	7 Apr 2016	Neil Graham, Alex Jiao
Sight inspection	11 Apr 2016	Neil Graham, Tom Brimson & Alex Jiao

2.3 Risk Classification Methodology

Safety deficiencies were identified then an assessment was made of their importance and crash risks.

2.3.1 Risk assessment system

The rating of the importance of the deficiency was undertaken based on the crash likelihood and consequence, in accordance with the methodology and risk matrix described below. The crash likelihood and consequence are based on the team's assessment and are necessarily subjective.

For each deficiency identified, the review team identified a risk ranking, adopting the methodology from Roads and Maritime, *Guide for Risk Management*, ILC-MI-TP0-201-G01, June 2009. This adopted the following 3-step process, modified for the purpose of this safety audit:

- Identification of the likelihood of the event occurring – using the likelihood criteria provided in Table 2 (ILC-MI-TP0-201-G01).
- Identifying the consequence (impact) – based upon the criteria for operational safety provided in Table 3 (ILC-MI-TP0-201-G01).
- Establishing a "Risk Ranking" for each item – by combining the likelihood and consequence rankings as described in the matrix in Table 3 (ILC-MI-TP0-201-G01).

2.3.2 Crash likelihood

The probable frequency of crash occurrence, resulting from each safety issue identified in the safety review is assessed from the options presented in Table 2.

Table 2 Crash Likelihood

Frequency	Description		Probability parameters
Almost Certain	The event is expected to occur in most circumstances	>95%	>1 in 1 year
Expected	Quite likely within first few years of operation	>85%< 95%	< 1 in 1 year >1 in 2 years
Probable	The event will probably occur in most circumstances	51% to 85% probability	< 1 in 2 years > 1 in 20 years
Likely	The event should occur in most circumstances	20% to 50% probability	<1 in 20 years > 1 in in 80 years
Possible	The event could occur at some time	10% to 20% probability >10% < 20%	<1 in 80 years >1 in 250 years

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Frequency	Description		Probability parameters
Rare	The event might occur in exceptional circumstances	<10%	<1 in 250 years >1 in 1000 years

Source: Table 1, derived from Roads and Maritime, Guide for Risk Management, ILC-MI-TP0-201-G01, June 2009

2.3.3 Crash consequence

The consequence of the crash resulting from the identified safety issue is rated from the choices presented in Table 3.

Table 3 Crash consequence

Consequence	Description	Examples
Multiple fatality	Multiple Liability >$250,000 The crash is likely to result in multiple deaths or permanent loss of physical/ mental amenity.	High / medium speed multiple vehicle and/ or HOV passenger vehicle collision High / medium speed, HOV passenger vehicle collision with a fixed object Pedestrians struck at high speed Cyclists hit by car
Single fatality	Liability >$250,000 The crash is likely to result in death or permanent loss of physical/ mental amenity or alternatively major infrastructure damage	Substantial property damage (fire, critical infrastructure damaged, environmentally disastrous)loss of threatened species
Critical Injury	Liability >$250,000 The crash is likely to result in death or permanent loss of physical/ mental amenity.	High / medium speed vehicle collision High / medium speed collision with a fixed object Pedestrian struck at high speed Cyclist hit by car
Acute injury	Liability $10,001- $250,000 Lost time >5 days	Some lower speed vehicle collisions Pedestrian struck at lower speed Cyclist hit by car travelling at moderate speeds
Casualty Injury	Liability $1,001- $10,000 Lost time 1 to 4 days	Some slow speed collisions. Pedestrian walks into object (No head injury) Cyclist falls. Rear end crashes
First Aid Injury	Liability $500 - $1,001 Lost time 1 days	Minor car park incidents
Property Damage	Liability $251- $500 Lost time <1 day	Car reverses into post

Source: AECOM modified Table 2, Roads and Maritime, Guide for Risk Management, ILC-MI-TP0-201-G01, June 2009

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The risk assessment is based on:

1. Normal operating characteristics expected of the road.
2. The risk matrix in Table 4.

Table 4 Risk matrix

**Probability	**Risk level** ❶ = Negligible through to ❼ = Extreme						
	***Severity of consequence**						
	Property damage	**First-aid injury**	**Casualty injury**	**Acute injury**	**Critical injury**	**Single fatality**	**Multiple fatality (Bus)**
	Fatality equivalent 0.004	Fatality equivalent 0.009	Fatality equivalent 0.024	Fatality equivalent 0.072	Fatality equivalent 0.251	Fatality equivalent 1.000	Fatality equivalent 4.667
Almost Certain	❸ 0.400	❸ 0.900	❹ 2.400	❺ 7.200	❻ 25.100	❼ 100.000	❼ 466.700
Expected	❷ 0.180	❸ 0.405	❹ 1.080	❹ 3.24	❺ 11.295	❻ 45.000	❼ 210.015
Probable	❷ 0.080	❷ 0.180	❸ 0.480	❹ 1.440	❺ 5.020	❺ 20.000	❻ 93.340
Likely	❶ 0.040	❷ 0.090	❸ 0.240	❸ 0.720	❹ 2.510	❺ 10.000	❺ 46.670
Possible	❶ 0.018	❶ 0.041	❷ 0.108	❸ 0.324	❹ 1.130	❺ 4.500	❺ 21.002
Rare	❶ 0.008	❶ 0.018	❶ 0.048	❷ 0.144	❸ 0.502	❹ 2.000	❺ 9.334
Key Risk	Negligible	Very Low	Low	moderate	High	Very High	Extreme

Fatality equivalent values are based on Rural Generic Costs per Accident (Economic Analysis Manual, Appendix B, Table 12, 2003. 14 injuries are equivalent to 1 fatality).

** Severity of consequence is a log relationship y=0.0006e1.838x based on fatality-equivalent intercepts at Property Damage = 0.004, Acute = 0.072, Fatality = 1.*

*** Part of a power series (1.10)2n*

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3.0 Deficiency Details

3.1 Road Safety Deficiencies

The findings of the road safety review are detailed in Table 6. The reference numbering for each of the issues commence at the western end of the site on Stockdill Drive at the approximate location where the first access to the future West Belconnen development will occur.

3.1.1 Summary of deficiency / improvement types

The following safety improvements were identified as possible during the inspection:

- Address sight distance issues

3.1.2 Highest risks

The highest safety risks that were identified are:

- Pedestrians and cyclists on Stockdill Drive (no pathway or on-road facilities, nor adequate lighting)
- Poor road alignment and sight distance at intersection with Spofforth Street
- Pedestrians crossing at bus stop and major pedestrian links to suburbs (wide roads and no crossing facilities, including lack of lighting)
- Right turn and rear-end collisions at the intersections with Trickett Street, Macnaughton Street, Cussen Street and Kinsella Street (no provision for right turns, turn volumes and speed)
- Poor protection of parked vehicles with wide unmarked pavement between Spofforth Street and Trickett Street, with no formal provision for cyclists or turning vehicles
- Wide sweeping road between Macnaughton Street and William Hovell Drive, with no formal provision for cyclists or turning vehicles
- Vehicles entering from Pine Ridge access and property access just west of William Hovell Drive (poor sight distance and speed)
- Vehicles entering Pegasus access, especially trucks or large vehicles (eg., cars towing horse floats)
- Vehicles entering or exiting rural property accesses generally, especially in the 80 km/h section
- Driveway accesses between Trickett Street and Macnaughton Street, especially in section with rock retaining walls (124 to 142 Drake Brockman Drive) (poor sight distance)
- The roundabout at Kingsford Smith Drive and William Hovell Drive (poor southern approach alignment and small roundabout diameter)
- Pedestrian and cycle facilities connecting to William Hovell Drive, Kingsford Smith Drive and Hawker

The pedestrian and intersection crash risks are higher east of Cussen Street where the speed limit is 80 km/h.

3.2 Road Crashes and Traffic Volumes

To put the list of deficiencies in context an analysis of past crashes and traffic volumes is summarised in this Section of the report.

3.2.1 Crash history

Maps showing the nature and location of the crashes that occurred in the five year period between 1st January 2009 and 31st December 2013 are presented in Appendix A. A summary of key crash statistics follow.

General:

- 48 crashes between 1st January 2009 and 31st December 2013.
- 0 fatal crashes, 6 injury crashes (12%), 42 property damage only crashes (88%).
- Most common crash type: Rear end collision (65%).
- 15% of crashes occurred during inclement weather.

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- 87% of crashes occurred during daylight hours.
- 81% of crashes occurred at intersections.
- 9 crashes occurred in April (19%), 89% of these crashes occurred in the AM (100% of crashes in fine weather conditions).
- 9 crashes occurred in November (19%), 67% of these crashes occurred in the PM (100% of crashes in fine weather conditions).

A number of crashes may have been due to east-west sun glare.

Drake Brockman Drive / Trickett Street Intersection:

- 4 crashes between 1st January 2009 and 31st December 2013.
- 100% of crashes were rear end collisions.
- 25% of crashes occurred during inclement weather.

Drake Brockman Drive / Macnaughton Street Intersection:

- 9 crashes between 1st January 2009 and 31st December 2013.
- 89% of crashes were rear end collisions.

Drake Brockman Drive / Cussen Street Intersection:

- 3 crashes between 1st January 2009 and 31st December 2013.
- 100% of crashes were rear end collisions.

Drake Brockman Drive / Kinsella Street Intersection:

- 7 crashes between 1st January 2009 and 31st December 2013.
- 86% of crashes were rear end collisions.
- 43% of crashes involved injury.

Drake Brockman Drive / William Hovell Drive / Kingsford Smith Drive Intersection:

- 16 crashes between 1st January 2009 and 31st December 2013.
- 38% of crashes were rear end collisions
- 32% of crashes were same direction side swipes
- 19% of crashes were right angle collisions
- 25% of crashes were during inclement weather.

Mid-block:

- 9 crashes between 1st January 2009 and 31st December 2013
- 56% of crashes were rear end collisions
- 22% of crashes involved injury

D R A F T

3.2.2 Traffic volumes

Some estimates of daily traffic volumes along Stockdill Drive and Drake Brockman Drive are provided in Figure 2 and Table 5. Traffic volumes increase eastwards along this road corridor. There are quite large jumps in traffic at Trickett Street and Macnaughton Street.

Figure 2: Daily traffic volumes in Local Area

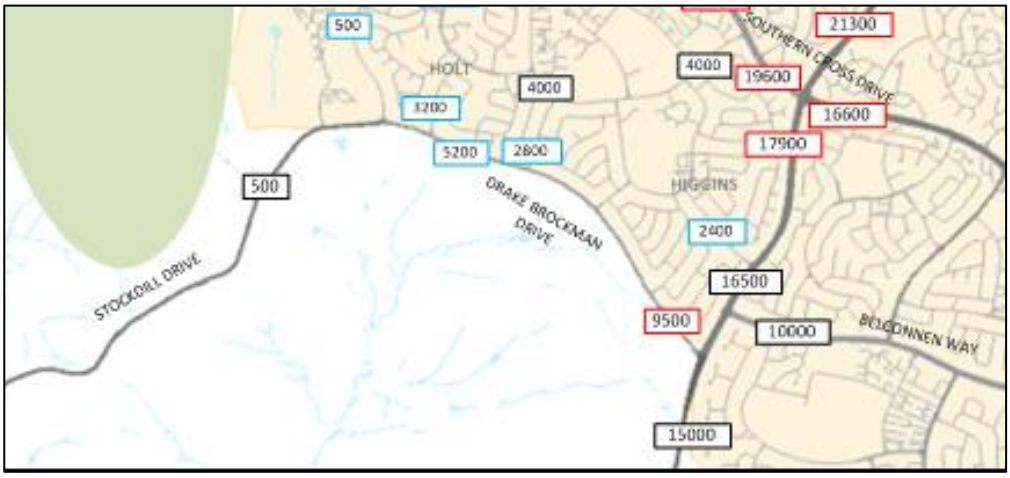


Table 5: AM peak hour and daily traffic volumes in road corridor

Location	AM Peak Hour Traffic (maximum one-way)	Estimated Daily Traffic (two-way)
Estate entry and Britten-Jones Drive	*40*	*500*
Britten-Jones Drive and Spofforth Street	*90*	*1,500*
Spofforth Street and Trickett Street	*110*	*1,800*
Trickett Street and Macnaughton Street	*360*	*5,200*
Macnaughton Street and Cussen Street	*510*	*7,500*
Cussen Street and Kinsella Street	*700*	*9,000*
Kinsella Street and Kingsford Smith Drive	*780*	*9,500*

Source: Sites shown with a red box based on recent 24/7 tube counts or SCATS counts; whilst others are derived from previous TAMS tube counts (shown in blue boxes) or derived from previous peak hour count data.

D R A F T

Table 6 Road safety deficiency table

Ref No.	Location	Photo 1	Photo 2	Description of deficiency	Reason deficiency considered a safety issue	Probability	Severity of Consequence	Risk Level (1=negligible 7=extreme)	Potential remedial measures
1	Stockdill Drive from proposed Estate access to Spofforth Street (60 km/h zone)	 		No provision for pedestrians or off-road cyclists	The narrow road places pedestrians and cyclist at risk of being struck by passing traffic – especially at night.	Possible	Single fatality	High	Provide pathways in Stage 1 design (shared pathway link proposed on north side of road to Spofforth Street as part of Woodview Estate construction).
2a	Stockdill Drive near western end of project			Narrow road seal & shoulder	Road seal < 7m & sealed shoulder < 0.5m . Road widens on approach to Britten-Jones Drive and to east of there, but remains <8m sealed total. Potential for run off road and head on crashes. Reference :Less than standard (Table 4.5, Guide to Road Design Part 3; AADT 500-1000 & > 15% trucks).	Possible	Acute injury	Low	Widen road to suit future traffic volumes.

D R A F T

Ref No.	Location	Photo 1	Photo 2	Description of deficiency	Reason deficiency considered a safety issue	Probability	Severity of Consequence	Risk Level (1=negligible 7=extreme)	Potential remedial measures
2b				Poor sight distance on horizontal curve	Sight distance around curve appears to be inadequate for expected travel speeds.	Possible	Critical injury	Moderate	Provide sight distance for expected travel speeds and reaction times.
3	Stockdill Drive just west of Britten-Jones Drive intersection			Poor sight distance on horizontal curve	Sight distance around curve appears to be inadequate for expected travel speeds	Possible	Acute injury	Low	Provide sight distance for expected travel speeds and reaction times.
4a	Britten-Jones Drive intersection			Restricted Safe intersection Entering Sight distance	Trees block view of eastbound approaching vehicles. Potential for higher speed right angle crashes which have a high rate of injury consequence.	Possible	Critical injury	Moderate	Trim trees.

D R A F T

Ref No.	Location	Photo 1	Photo 2	Description of deficiency	Reason deficiency considered a safety issue	Probability	Severity of Consequence	Risk Level (1=negligible 7=extreme)	Potential remedial measures
4b				No provision for right turns	No provision for vehicles to store whilst waiting to turn right leading to potential for rear end crashes which can push the waiting turning vehicle into oncoming traffic. This type of crash has a high injury rate. Although current traffic volumes are low they are expected to increase in the future.	Possible	Critical Injury	Moderate	Provide turn slot.
4c				Poor lighting	Inadequate lighting provided for intersection. Potential pedestrian / cycle and vehicle crashes.	Rare	Critical injury	Low	Upgrade lighting to urban intersection standards.
6	Pine Ridge access, just east of Britten-Jones Drive intersection			Restricted Intersection Stopping sight distance	Access is on the inside of a tight curve and driveway grades down from the road, as well as nearby Britten-Jones intersection; all exacerbating the access problem. Potential for rear end crashes with vehicles stopping unexpectedly.	Likely	Critical injury	Moderate	Review access in context of nearby Britten-Jones Drive intersection.

D R A F T

Ref No.	Location	Photo 1	Photo 2	Description of deficiency	Reason deficiency considered a safety issue	Probability	Severity of Consequence	Risk Level (1=negligible 7=extreme)	Potential remedial measures
7a	Spofforth Street intersection			Inadequate Intersection stopping sight distance (1.15m to zero)	Eastbound vehicles could overshoot the intersection and crash into other vehicles within the intersection.	Possible	Critical injury	Moderate	Consider advance warning sign.
7b				Poor horizontal alignment	The departure from the intersection eastbound does not align with the approach to the intersection with potential for vehicles to travel across the traffic islands into oncoming traffic. The situation is exacerbated because of the unexpected change in priority at the intersection.	Possible	Critical injury	Moderate	Realign to make Drake Brockman Drive and Stockdill Drive continuous, with Spofforth Street teeing into it.
7c				Poor vertical alignment	Vertical intersection stopping sight distance 1.15 to zero likely to remain inadequate for expected travel speeds when priority is altered.	Probable	Critical injury	High	Consider options for improving vertical alignment of road.

D R A F T

Ref No.	Location	Photo 1	Photo 2	Description of deficiency	Reason deficiency considered a safety issue	Probability	Severity of Consequence	Risk Level (1=negligible 7=extreme)	Potential remedial measures
8	Looking west from driveway of 188 Drake Brockman Drive			Poor sight distance	Restricted safe entering sight distance for vehicles exiting the residential driveway, affected by higher speed left turns, verge vegetation and drivers looking towards Stockdill Drive not expecting traffic to enter from the driveway.	Probable	Acute injury	Moderate	Trim vegetation in short-term Realignment of intersection and kerb return radii.
9	East of Spofforth Street intersection			Poor protection for parked cars	Risk of rear end collision with parked car or car entering driveway. Wide road (about 12m) encourages speed.	Possible	Acute injury	Low	Continue line-marking for parking lane in short-term. Potential service road to be considered in Stage 1 design.
10	Looking west from near driveway of 186 Drake Brockman Drive			Poor sight distance	Poor sight distance for pedestrians & vehicles due to vegetation on verge. Potential for higher speed right angle crashes which have a high rate of injury consequence.	Possible	Acute injury	Low	Trim vegetation. Continue line-marking for parking lane in short-term.

D R A F T

Ref No.	Location	Photo 1	Photo 2	Description of deficiency	Reason deficiency considered a safety issue	Probability	Severity of Consequence	Risk Level (1=negligible 7=extreme)	Potential remedial measures
11	Adjacent to bus stop, located opposite 174 Drake Brockman Drive			No provision for pedestrians	Wide road with no pedestrian refuge, but relatively low vehicle volumes exist currently. Risk of vehicle – pedestrian crashes.	Rare	Single fatality	Moderate	Consider future provision for pedestrians in Stage 1 design.
12	Looking west from near driveway of 168, 170 & 172 Drake Brockman Drive			Poor sight distance	Poor sight distance for pedestrians & vehicles due to vegetation on verge, affecting accesses to 168, 170 and 172 Drake Brockman Drive. Potential for higher speed right angle crashes which have a high rate of injury consequence.	Rare	Acute injury	Very Low	Trim vegetation. Continue line-marking for parking lane in short-term.
13a	Trickett Street intersection			Poor provision for pedestrians	Pram crossing provided on southern side & well worn dirt path and traffic island on northern side. Rocks adjacent to pram crossing to deter trail bikes a trip hazard.	Rare	Single fatality	Moderate	Consider pedestrian refuge in short-term. Replace rocks with suitable barriers. Consider intersection channelisation as part of Stage 1 work and potential longer-term traffic signals.

D R A F T

Ref No.	Location	Photo 1	Photo 2	Description of deficiency	Reason deficiency considered a safety issue	Probability	Severity of Consequence	Risk Level (1=negligible 7=extreme)	Potential remedial measures
13b				No provision for right turns	Risk of rear-end crashes with relatively high volume of right turners in PM peak, which could push vehicles into opposing flow.	Likely	Acute injury	Low	Re-linemark in short-term to make provision for right turns. Consider intersection channelisation as part of Stage 1 work and potential longer-term traffic signals.
13c				Speed and sight distance for left turners	Smooth alignment of left turns encourages speed and inhibits sight distance to traffic on Drake Brockman Drive or to nearby driveways on Drake Brockman Drive. Potential for right angle and rear end collisions.	Possible	Acute injury	Low	Realign the left turn lanes to a high entry angle.

D R A F T

Ref No.	Location	Photo 1	Photo 2	Description of deficiency	Reason deficiency considered a safety issue	Probability	Severity of Consequence	Risk Level (1=negligible 7=extreme)	Potential remedial measures
14	View of road between Trickett Street and Macnaughton Street (60 km/h zone)			Unsafe for right turners	Risk of rear-end collision for vehicles turning right into driveways.	Rare	Acute injury	Very Low	Consider changed line-marking with central painted median and northern parking lane only; retaining wall on south side would need to be relocated further south to ensure there is adequate clear zone from the edge of the westbound traffic lane.
15	Looking west between 152 and 154 Drake Brockman Drive, adjacent to bus stop and major path link			Poor provision for pedestrians	Pram crossing provided on southern side & well worn dirt path and major pathway link to Holt suburb on northern side. No provision for pedestrians crossing wide road with potential for vehicle – pedestrian crashes. Rocks adjacent to pram crossing to deter trail bikes a trip hazard.	Possible	Single fatality	High	Replace rocks with suitable barriers. Consider pedestrian refuge now and in future Stage 1 design.

D R A F T

Ref No.	Location	Photo 1	Photo 2	Description of deficiency	Reason deficiency considered a safety issue	Probability	Severity of Consequence	Risk Level (1=negligible 7=extreme)	Potential remedial measures
16	Looking west from driveway of 148 Drake Brockman Drive			Poor sight distance	Vegetation in verge of 150 Drake Brockman Drive affects safe access from driveways for 146 and 148 Drake Brockman Drive, as well as safe pedestrian crossing. Potential for higher speed right angle crashes which have a high rate of injury consequence.	Rare	Acute injury	Very Low	Trim vegetation.
17	Aerial view of 124 to 142 Drake Brockman Drive			Poor sight distance	Retaining walls and vegetation affect safe access from driveways for 124 and 142 Drake Brockman Drive, as well as safe pedestrian crossing at major pathway link east of 126 Drake Brockman Drive. Potential for higher speed right angle crashes which have a high rate of injury consequence.	Probable	Acute injury	Moderate	Trim vegetation in short-term. Potential service road to be considered in Stage 1 design.

D R A F T

Ref No.	Location	Photo 1	Photo 2	Description of deficiency	Reason deficiency considered a safety issue	Probability	Severity of Consequence	Risk Level (1=negligible 7=extreme)	Potential remedial measures
18	Major pathway link crossing between 124 and 126 Drake Brockman Drive			Poor provision for pedestrians	Pram crossing provided on southern side connecting to nearby bus stop and major pathway link to Holt suburb on northern side. No provision for pedestrians crossing wide road with potential for vehicle – pedestrian crashes.	Possible	Single fatality	High	Consider pedestrian refuge now and in future Stage 1 design.
19	Bus stops just east of 122 Drake Brockman Drive			No provision for pedestrians	No pedestrian crossing facilities on a wide busy road adjacent to bus stops. No provision for pedestrians crossing wide road with potential for vehicle – pedestrian crashes.	Possible	Single fatality	High	Consider pedestrian refuge now and in future Stage 1 design, including appropriate lighting.

D R A F T

Ref No.	Location	Photo 1	Photo 2	Description of deficiency	Reason deficiency considered a safety issue	Probability	Severity of Consequence	Risk Level (1=negligible 7=extreme)	Potential remedial measures
20a	Macnaughton Street intersection			No provision for right turns	Risk of rear-end crashes with relatively high volume of right turners in PM peak, which could push vehicles into opposing flow.	Probable	Acute injury	Moderate	Re-linemark in short-term to make provision for right turns. Consider intersection channelisation as part of Stage 1 work and potential longer-term traffic signals.
20b				Speed and sight distance for left turners	Smooth alignment of left turns encourages speed and inhibits sight distance to traffic on Drake Brockman Drive or from nearby driveways. Potential for right angle and rear end collisions.	Likely	Acute injury	Low	Realign the left turn lanes to a high entry angle, taking account of B-Double movements here.

D R A F T

Ref No.	Location	Photo 1	Photo 2	Description of deficiency	Reason deficiency considered a safety issue	Probability	Severity of Consequence	Risk Level (1=negligible 7=extreme)	Potential remedial measures
20c				Poor provision for pedestrians	Pram crossing provided on southern side & well worn dirt path and pram crossing with path links on northern side. No provision for pedestrians crossing wide road with potential for vehicle – pedestrian crashes. Inadequate lighting here. Rocks adjacent to pram crossing to deter trail bikes a trip hazard.	Possible	Single fatality	High	Consider pedestrian refuge in short-term, including appropriate lighting. Replace rocks with suitable barriers. Consider intersection channelisation as part of Stage 1 work and potential longer-term traffic signals.
21	Macnaughton Street to Cussen Street (60 km/h zone)			Excess speed & safety of pedestrians and turning vehicles	Wide sweeping road encourages speeds above posted 60 km/h limit creating safety risks for pedestrians and turning vehicles. About 12.5m wide, almost wide enough for four traffic lanes, makes it difficult to control speeds and enable safe pedestrian crossings.	Rare	Single fatality	Moderate	Consider lane narrowing and refuges for pedestrians at key locations.

D R A F T

Ref No.	Location	Photo 1	Photo 2	Description of deficiency	Reason deficiency considered a safety issue	Probability	Severity of Consequence	Risk Level (1=negligible 7=extreme)	Potential remedial measures
22	Looking west about 250m north-west of Cussen Street intersection			Trees in clear zone	Trees close to traffic lane present a safety risk to errant vehicles.	Rare	Critical injury	Low	Remove trees within clear zone.
23	Looking east, about 270m south-east of Macnaughton Street intersection, near bus stops			Poor provision for pedestrians	Pram crossing provided on southern side & well worn dirt path connecting to nearby bus stop and major pathway link to Holt & Higgins suburbs on northern side. No provision for pedestrians crossing wide road with potential for vehicle – pedestrian crashes. No lighting here.	Possible	Single fatality	High	Consider pedestrian refuge now and in future Stage 1 design, including appropriate lighting.
24	Looking east about 190m north-west of Cussen Street intersection, east of bus stop			Safety risk for pedestrians	Rocks adjacent to driveway crossing to deter trail bikes and alternative access to Pegasus a trip hazard.	Rare	Casualty injury	Negligible	Replace rocks with suitable barriers.

D R A F T

Ref No.	Location	Photo 1	Photo 2	Description of deficiency	Reason deficiency considered a safety issue	Probability	Severity of Consequence	Risk Level (1=negligible 7=extreme)	Potential remedial measures
25a	Pegasus access			Restricted sight distance	Access on the inside of a curve, close to the Cussen Street intersection and trees on verge affect sight distance, especially for speeding vehicles. Risk of right angle collisions exiting driveway and rear-end crashes with vehicles entering the driveway.	Possible	Acute injury	Low	Consider lane narrowing and refuges for pedestrians at key locations, including potential provision for right turns at Pegasus access. Also, improved signage would assist.
25b				No provision for right turns	Risk of rear-end crashes, although low volume of right turners from west.	Probable	Acute injury	Moderate	Consider channelisation of access as part of Stage 1 work and potential longer-term left-in / left-out.
26a	Cussen Street intersection			Rock wall in clear zone	Rock wall located within clear zone of traffic lane, risk to errant vehicles.	Possible	Acute injury	Low	Consider relocating rock wall and removing nearby trees, as part of Stage 1 design.

D R A F T

Ref No.	Location	Photo 1	Photo 2	Description of deficiency	Reason deficiency considered a safety issue	Probability	Severity of Consequence	Risk Level (1=negligible 7=extreme)	Potential remedial measures
26b				No provision for right turns	Risk of rear-end crashes with relatively high volume of right turners in PM peak, which could push vehicles into opposing flow.	Likely	Acute injury	Low	Re-linemark in short-term to make provision for right turns. Consider intersection channelisation as part of Stage 1 work and potential longer-term roundabout to signal change in speed environment.
26c				Speed and sight distance for left turners	Smooth alignment of left turns encourages speed and inhibits sight distance to traffic on Drake Brockman Drive or to nearby driveways. Potential for right angle and rear end collisions.	Possible	Acute injury	Low	Realign the left turn lanes to a high entry angle.

D R A F T

Ref No.	Location	Photo 1	Photo 2	Description of deficiency	Reason deficiency considered a safety issue	Probability	Severity of Consequence	Risk Level (1=negligible 7=extreme)	Potential remedial measures
27	Cussen Street to Kinsella Street (80 km/h zone)			Excess speed & safety of pedestrians and turning vehicles	Wide sweeping road encourages speeds above posted 80 km/h limit creating safety risks for pedestrians and turning vehicles. About 12.5m wide, almost wide enough for four traffic lanes.	Rare	Single fatality	Moderate	Consider lane narrowing and refuges for pedestrians at key locations.
28	Looking north-west about 240m south-east of Cussen Street (adjacent to pathway link)			Poor provision for pedestrians	Pram crossing provided on both sides connecting to pathway link to Higgins on north-eastern side, but no bus stop at present and little evidence of pedestrian activity here. No lighting here.	Rare	Single fatality	Moderate	Consider pedestrian refuge in future design when bus stops are likely to be located near here, including appropriate lighting.
29a	Kinsella Street intersection			No provision for right turns	Risk of rear-end crashes with relatively high volume of right turners in PM peak, which could push vehicles into opposing flow.	Probable	Critical injury	High	Re-linemark in short-term to make provision for right turns. Consider intersection channelisation as part of Stage 1 work.

D R A F T

Ref No.	Location	Photo 1	Photo 2	Description of deficiency	Reason deficiency considered a safety issue	Probability	Severity of Consequence	Risk Level (1=negligible 7=extreme)	Potential remedial measures
29b				Speed and sight distance for left turners	Smooth alignment of left turns encourages speed and inhibits sight distance to traffic on Drake Brockman Drive or from nearby driveways. Potential for right angle and rear end collisions.	Likely	Critical injury	Moderate	Realign the left turn lanes to a high entry angle.
30	Kinsella Street to Kingsford Smith Drive (80 km/h zone)			Excess speed & safety of pedestrians and turning vehicles	Wide sweeping road encourages speeds above posted 80 km/h limit creating safety risks for pedestrians and turning vehicles. About 12.5m wide, almost wide enough for four traffic lanes.	Rare	Single fatality	Moderate	Consider lane narrowing and refuges for pedestrians at key locations.
31	Rural property access, just north of Kinsella Street intersection			No provision for right turns	Risk of rear-end crashes on a high speed section of road, although low volume of turning traffic.	Possible	Acute injury	Low	Consider channelisation of access as part of Stage 1 work and potential longer-term left-in / left-out.

D R A F T

Ref No.	Location	Photo 1	Photo 2	Description of deficiency	Reason deficiency considered a safety issue	Probability	Severity of Consequence	Risk Level (1=negligible 7=extreme)	Potential remedial measures
32	Looking south-east about 150m south-east of Kinsella Street, near bus stops			Poor provision for pedestrians	Bus stop pads on both sides of road but no pram crossing; connects to pathway link to Higgins on northern side. No provision for pedestrians crossing wide road with potential for vehicle – pedestrian crashes. No lighting here.	Likely	Single fatality	High	Consider pedestrian refuge now and in future Stage 1 design, including appropriate lighting.
33	Rural fire truck access			No warning for fire trucks	No warning of exiting fire trucks creates a safety risk on a high speed road. Also, risk of rear-end crashes for vehicles entering the driveway.	Rare	Critical injury	Low	Consider advance warning signs and future emergency signals.
34a	Looking south-east about 100m north-west of Kingsford Smith Drive intersection			Poor provision for pedestrians	Pram crossing provided on both sides connecting to pathway link to Kingsford Smith Drive on north-eastern side. No provision for pedestrians crossing wide road with potential for vehicle – pedestrian crashes. No lighting here.	Possible	Single fatality	High	Consider pedestrian refuge in future design, including appropriate lighting.

D R A F T

Ref No.	Location	Photo 1	Photo 2	Description of deficiency	Reason deficiency considered a safety issue	Probability	Severity of Consequence	Risk Level (1=negligible 7=extreme)	Potential remedial measures
34b				ACTEW pit in clear zone	Concrete pit close to traffic lane presents a safety risk.	Rare	Critical injury	Low	Consider protection from pit for errant traffic.
35	Access to reservoir and private property about 80m north-west of William Hovell Drive intersection			Risk of collision with turning vehicles	Access is located close to nearby intersection in a high speed (80 km/h) environment. High risk of right angle and rear-end crashes.	Likely	Critical injury	Moderate	Consider median turn lane in Stage 1 design and advance warning sign of nearby access.
36a	William Hovell Drive – Kingsford Smith Drive intersection			Speed of northbound traffic through roundabout	Limited deflection for northbound traffic through roundabout creates safety risks for traffic entering roundabout from Drake Brockman Drive.	Probable	Acute injury	Moderate	Consider increasing centre island diameter and modifying northbound carriageway alignment.
36b				Speed of left turning traffic	High speed turn radii encourage higher speed, although provision needs to be made for B-doubles.	Possible	Acute injury	Low	Consider modifying left turn radii, with provision for B-doubles to mount kerb.

D R A F T

Ref No.	Location	Photo 1	Photo 2	Description of deficiency	Reason deficiency considered a safety issue	Probability	Severity of Consequence	Risk Level (1=negligible 7=extreme)	Potential remedial measures
37	Shared use pathway adjacent to northbound carriageway on William Hovell Drive, on approach to Drake Brockman Drive			Narrow pathway not maintained	Northbound on-road cycle lane diverts onto this path on approach to the intersection, with inadequate width and close proximity to obstacles. Risk of cyclist falling off bicycle or collision with pedestrian.	Likely	Critical injury	Moderate	Consider reconstruction and widening of path and relocation of light poles in design.
38a	Shared use pathway adjacent to southbound carriageway on William Hovell Drive, just south of Drake Brockman Drive roundabout			Narrow pathway not maintained	Northbound on-road cycle lane diverts onto this path on approach to the intersection, with inadequate width and close proximity to obstacles. Risk of cyclist falling off bicycle or collision with pedestrian.	Likely	Critical injury	Moderate	Consider reconstruction and widening of path and relocation of light poles in design.
38b				Inadequate provision for pedestrians	Risk of vehicle or bicycle collision with pedestrian.	Possible	Single fatality	High	Consider redesign of pathways in design, including appropriate lighting.

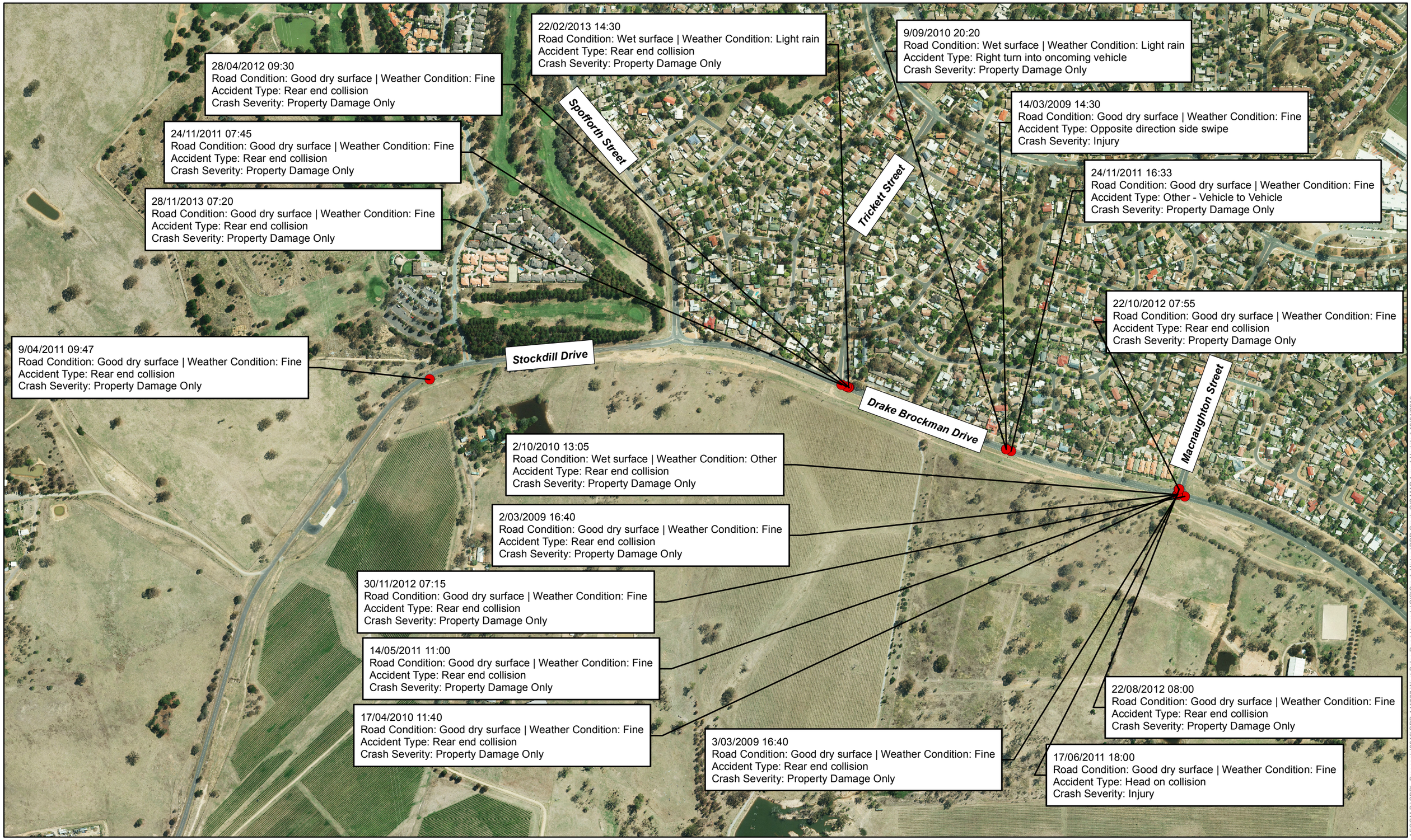
D R A F T

Ref No.	Location	Photo 1	Photo 2	Description of deficiency	Reason deficiency considered a safety issue	Probability	Severity of Consequence	Risk Level (1=negligible 7=extreme)	Potential remedial measures
39a	Local pathway connection from western side of Drake Brockman Drive roundabout, to Hawker			Poor connection to local pathway	Risk of cyclist falling off bicycle or collision with pedestrian.	Likely	Critical injury	Moderate	Consider reconstruction and widening of path and improved lighting.
39b				Narrow pathway not maintained	Risk of cyclist falling off bicycle or collision with pedestrian.	Likely	Critical injury	Moderate	Consider reconstruction and widening of path and improved lighting.
39c				Narrow pathway not maintained	Erosion has caused concrete path to be buried under soil	Likely	Critical injury	Moderate	Consider reconstruction and widening of path and improved lighting.

Appendix C

Crashes

Appendix C Crashes



WEST BELCONNEN OFF-SITE INFRASTRUCTURE
CRASH PLAN 1

N

Legend

- CRASH SITE

APR 2016

0 75 150 300 Meters

6/03/2010 20:00
Road Condition: Good dry surface | Weather Condition: Fine
Accident Type: Rear end collision
Crash Severity: Property Damage Only

28/03/2011 16:55
Road Condition: Good dry surface | Weather Condition: Fine
Accident Type: Right angle collision
Crash Severity: Property Damage Only

21/04/2010 08:00
Road Condition: Good dry surface | Weather Condition: Fine
Accident Type: Rear end collision
Crash Severity: Property Damage Only

31/01/2009 06:40
Road Condition: Good dry surface | Weather Condition: Fine
Accident Type: Rear end collision
Crash Severity: Property Damage Only

6/05/2011 10:00
Road Condition: Good dry surface | Weather Condition: Fine
Accident Type: Rear end collision
Crash Severity: Property Damage Only

16/09/2011 03:43
Road Condition: Good dry surface | Weather Condition: Fine
Accident Type: Struck object (Off Road)
Crash Severity: Injury

14/05/2010 08:59
Road Condition: Good dry surface | Weather Condition: Fine
Accident Type: Rear end collision
Crash Severity: Injury

16/11/2013 12:30
Road Condition: Good dry surface | Weather Condition: Fine
Accident Type: Other - Vehicle to Vehicle
Crash Severity: Injury

3/04/2013 07:45
Road Condition: Good dry surface | Weather Condition: Fine
Accident Type: Rear end collision
Crash Severity: Property Damage Only

3/01/2012 18:05
Road Condition: Good dry surface | Weather Condition: Fine
Accident Type: Rear end collision
Crash Severity: Property Damage Only

27/07/2011 09:20
Road Condition: Good dry surface | Weather Condition: Fine
Accident Type: Rear end collision
Crash Severity: Property Damage Only

27/05/2009 08:25
Road Condition: Loose surface | Weather Condition: Fog
Accident Type: Rear end collision
Crash Severity: Property Damage Only

27/07/2010 07:30
Road Condition: Good dry surface | Weather Condition: Fog
Accident Type: Rear end collision
Crash Severity: Injury

29/04/2011 09:20
Road Condition: Good dry surface | Weather Condition: Fine
Accident Type: Rear end collision
Crash Severity: Property Damage Only

22/10/2009 05:30
Road Condition: Good dry surface | Weather Condition: Fine
Accident Type: Rear end collision
Crash Severity: Property Damage Only

SEE CRASH PLAN 3

Cussen Street
Drake Brockman Drive
Kinsella Street
Kingsford Smith Drive
William Hovell Drive

WEST BELCONNEN OFF-SITE INFRASTRUCTURE
CRASH PLAN 2

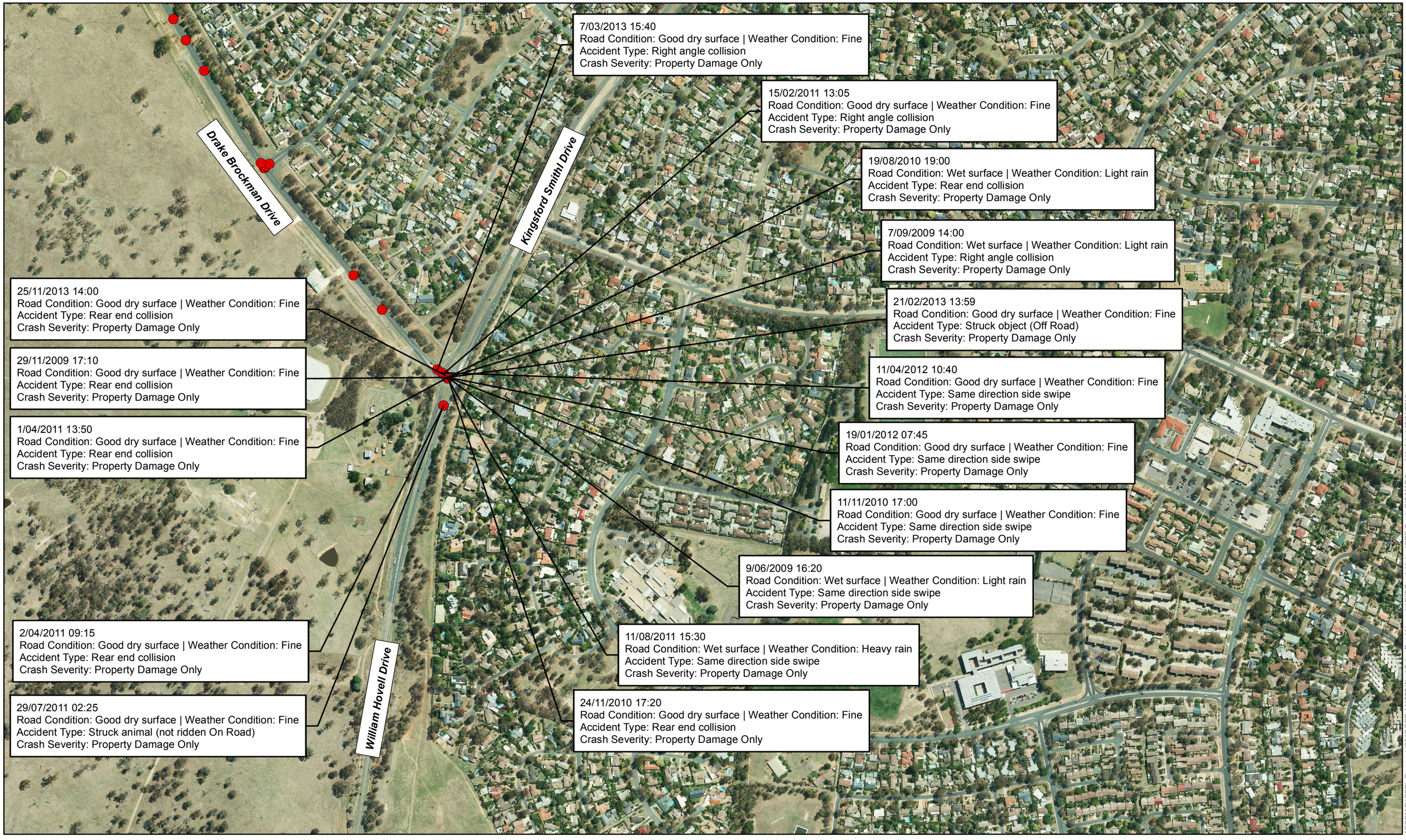
N

Legend

- CRASH SITE

APR 2016

0 75 150 300 Meters



WEST BELCONNEN OFF-SITE INFRASTRUCTURE
CRASH PLAN 3

N

APR 2016

Legend

- CRASH SITE

0 75 150 300 Meters

Appendix D

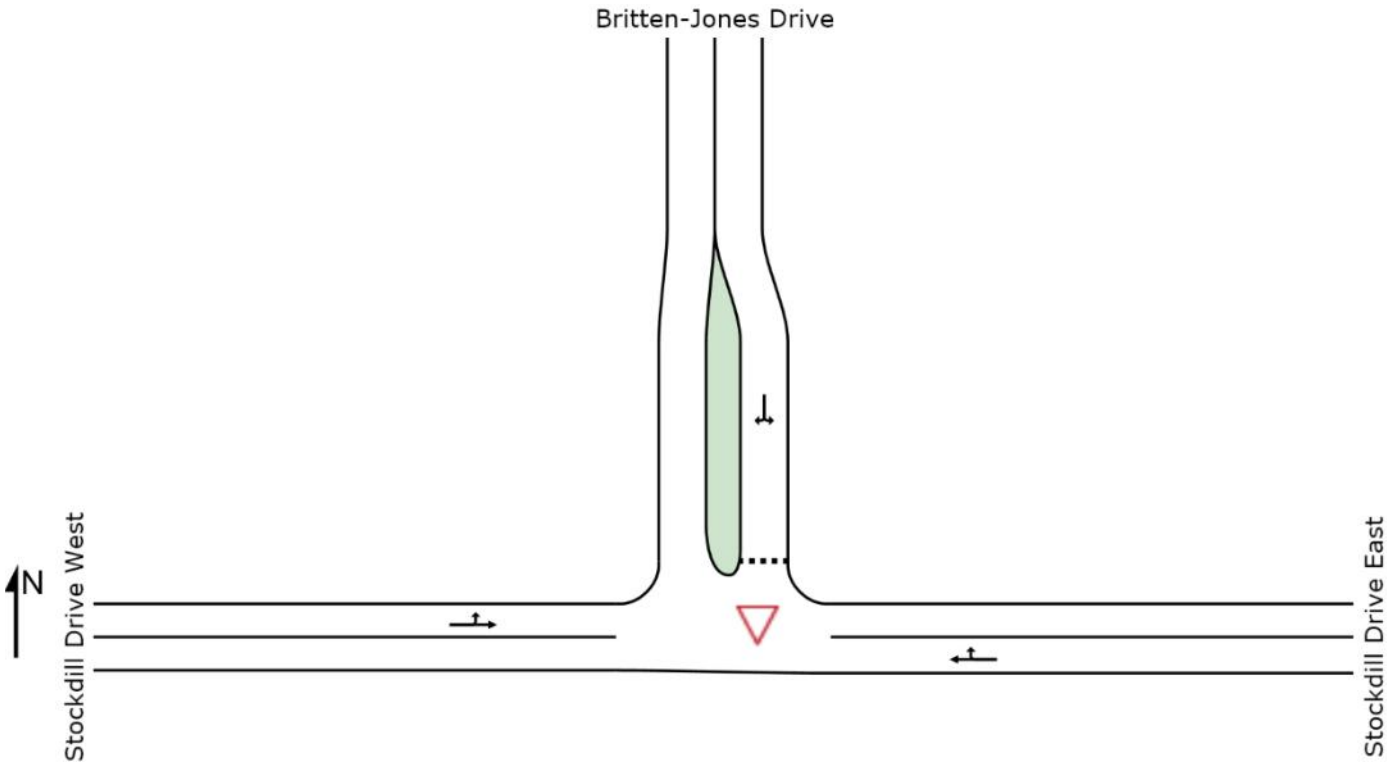
SIDRA Results

Appendix D SIDRA Results

SITE LAYOUT

Site: 2016 AM Stockdill Drive / Britten-Jones Drive

Giveway / Yield (Two-Way)



MOVEMENT SUMMARY

Site: 2016 AM Stockdill Drive / Britten-Jones Drive

Network: 2016 AM

Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Stockdill Drive East													
5	T1	33	2.5	33	2.5	0.021	0.0	LOS A	0.0	0.3	0.03	0.10	58.8
6	R2	7	2.5	7	2.5	0.021	5.6	LOS A	0.0	0.3	0.03	0.10	56.6
Approach		40	2.5	40	2.5	0.021	1.0	NA	0.0	0.3	0.03	0.10	58.4
North: Britten-Jones Drive													
7	L2	61	2.5	61	2.5	0.039	5.6	LOS A	0.2	1.1	0.07	0.55	50.5
9	R2	1	2.5	1	2.5	0.039	5.7	LOS A	0.2	1.1	0.07	0.55	53.2
Approach		62	2.5	62	2.5	0.039	5.6	LOS A	0.2	1.1	0.07	0.55	50.6
West: Stockdill Drive West													
10	L2	1	2.5	1	2.5	0.010	5.6	LOS A	0.0	0.0	0.00	0.03	58.0
11	T1	18	2.5	18	2.5	0.010	0.0	LOS A	0.0	0.0	0.00	0.03	59.4
Approach		19	2.5	19	2.5	0.010	0.3	NA	0.0	0.0	0.00	0.03	59.3
All Vehicles		121	2.5	121	2.5	0.039	3.3	NA	0.2	1.1	0.04	0.32	55.0

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

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

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

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

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

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

MOVEMENT SUMMARY

Site: 2016 PM Stockdill Drive / Britten-Jones Drive

Network: 2016 PM

Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Stockdill Drive East													
5	T1	11	2.5	11	2.5	0.038	0.2	LOS A	0.2	1.3	0.16	0.46	54.6
6	R2	54	2.5	54	2.5	0.038	5.7	LOS A	0.2	1.3	0.16	0.46	52.7
Approach		65	2.5	65	2.5	0.038	4.8	NA	0.2	1.3	0.16	0.46	53.0
North: Britten-Jones Drive													
7	L2	43	2.5	43	2.5	0.030	5.7	LOS A	0.1	0.8	0.14	0.54	50.1
9	R2	2	2.5	2	2.5	0.030	6.0	LOS A	0.1	0.8	0.14	0.54	52.9
Approach		45	2.5	45	2.5	0.030	5.8	LOS A	0.1	0.8	0.14	0.54	50.3
West: Stockdill Drive West													
10	L2	4	2.5	4	2.5	0.033	5.6	LOS A	0.0	0.0	0.00	0.04	57.9
11	T1	60	2.5	60	2.5	0.033	0.0	LOS A	0.0	0.0	0.00	0.04	59.3
Approach		64	2.5	64	2.5	0.033	0.4	NA	0.0	0.0	0.00	0.04	59.2
All Vehicles		174	2.5	174	2.5	0.038	3.4	NA	0.2	1.3	0.10	0.32	54.1

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

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

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

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

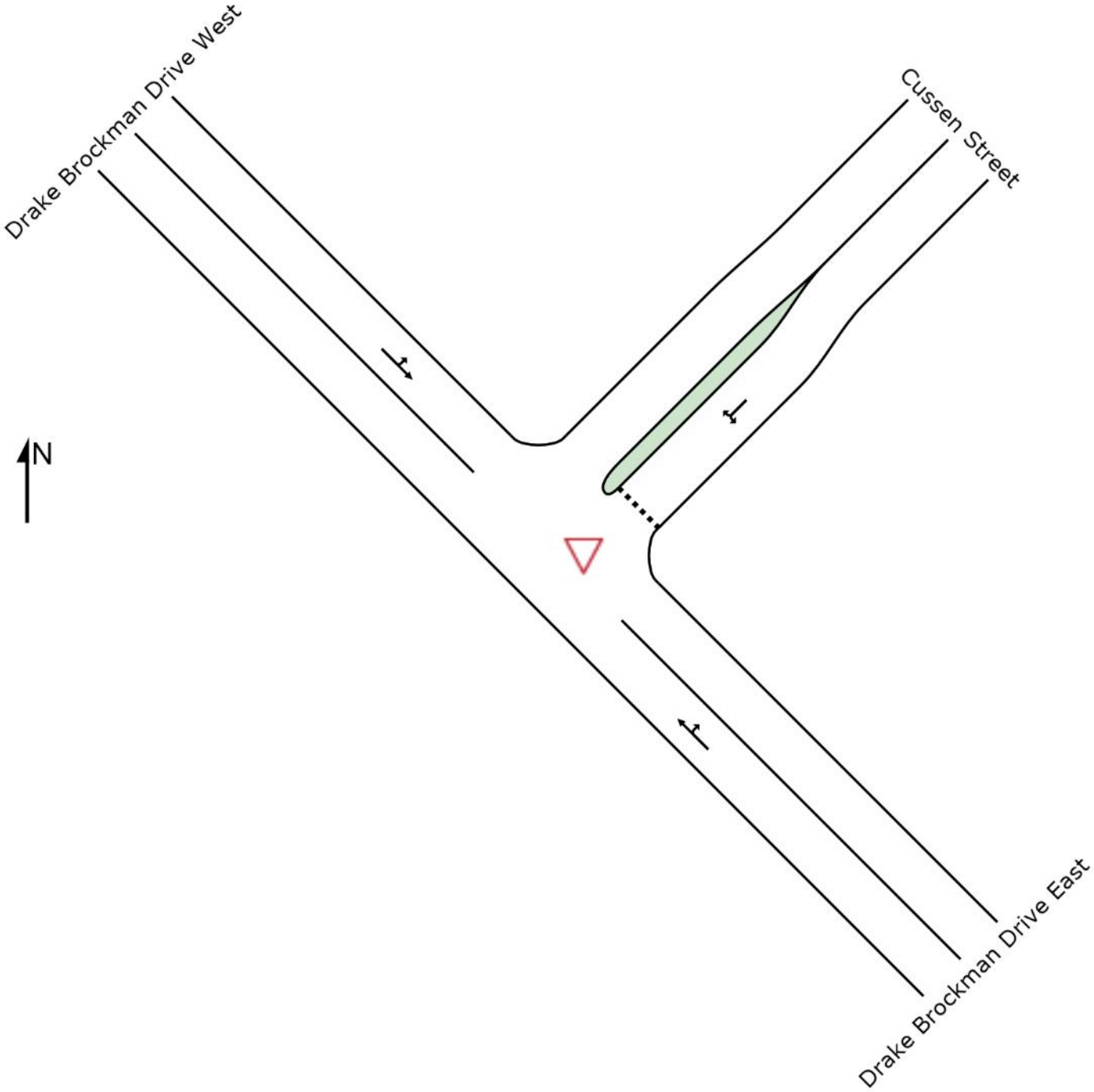
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

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

SITE LAYOUT

Site: 2016 AM DBD / Cussen Street

Giveway / Yield (Two-Way)



MOVEMENT SUMMARY

Site: 2016 AM DBD / Cussen Street

Network: 2016 AM

Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: Drake Brockman Drive East													
22	T1	171	2.5	171	2.5	0.130	1.6	LOS A	0.6	3.9	0.31	0.12	55.4
23	R2	36	2.5	36	2.5	0.130	9.9	LOS A	0.6	3.9	0.31	0.12	55.1
Approach		207	2.5	207	2.5	0.130	3.0	NA	0.6	3.9	0.31	0.12	55.3
NorthEast: Cussen Street													
24	L2	127	2.5	127	2.5	0.186	9.7	LOS A	0.7	4.9	0.62	0.84	37.8
26	R2	2	2.5	2	2.5	0.186	12.8	LOS B	0.7	4.9	0.62	0.84	37.8
Approach		129	2.5	129	2.5	0.186	9.7	LOS A	0.7	4.9	0.62	0.84	37.8
NorthWest: Drake Brockman Drive West													
27	L2	1	2.5	1	2.5	0.350	5.6	LOS A	0.0	0.0	0.00	0.00	57.3
28	T1	729	2.5	729	2.5	0.350	0.0	LOS A	0.0	0.0	0.00	0.00	59.9
Approach		730	2.5	730	2.5	0.350	0.0	NA	0.0	0.0	0.00	0.00	59.9
All Vehicles		1066	2.5	1066	2.5	0.350	1.8	NA	0.7	4.9	0.14	0.13	56.5

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

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

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

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

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

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

MOVEMENT SUMMARY

Site: 2016 PM DBD / Cussen Street

Network: 2016 PM

Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: Drake Brockman Drive East													
22	T1	629	2.5	629	2.5	0.388	0.4	LOS A	1.2	8.8	0.18	0.09	57.3
23	R2	116	2.5	116	2.5	0.388	7.1	LOS A	1.2	8.8	0.18	0.09	56.4
Approach		745	2.5	745	2.5	0.388	1.4	NA	1.2	8.8	0.18	0.09	57.1
NorthEast: Cussen Street													
24	L2	46	2.5	46	2.5	0.052	6.4	LOS A	0.2	1.3	0.36	0.60	41.8
26	R2	6	2.5	6	2.5	0.052	13.4	LOS B	0.2	1.3	0.36	0.60	41.8
Approach		52	2.5	52	2.5	0.052	7.2	LOS A	0.2	1.3	0.36	0.60	41.8
NorthWest: Drake Brockman Drive West													
27	L2	6	2.5	6	2.5	0.128	5.6	LOS A	0.0	0.0	0.00	0.01	57.2
28	T1	260	2.5	260	2.5	0.128	0.0	LOS A	0.0	0.0	0.00	0.01	59.7
Approach		266	2.5	266	2.5	0.128	0.1	NA	0.0	0.0	0.00	0.01	59.6
All Vehicles		1063	2.5	1063	2.5	0.388	1.4	NA	1.2	8.8	0.15	0.10	57.1

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

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

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

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

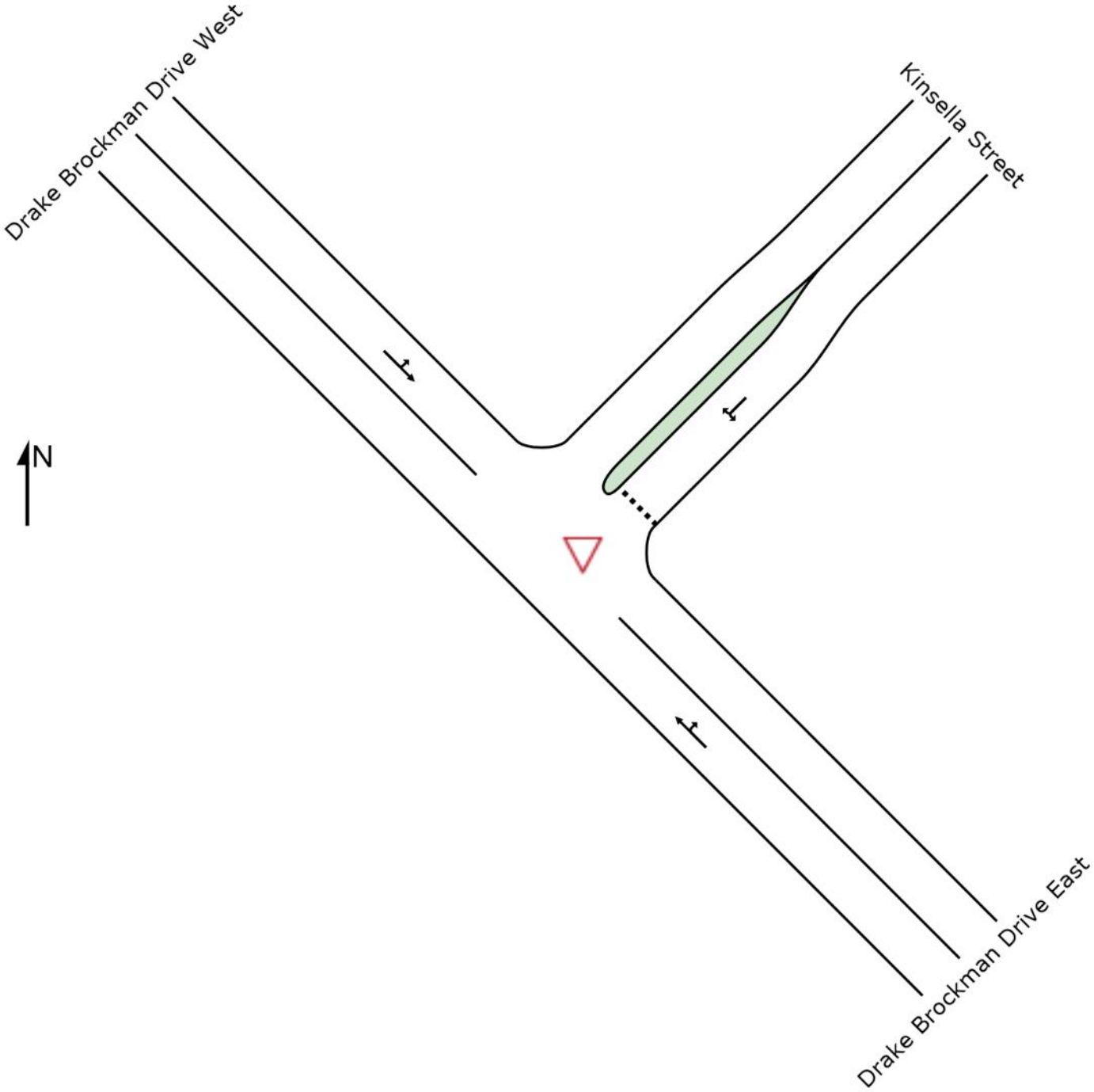
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

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

SITE LAYOUT

Site: 2016 AM DBD / Kinsella Street

Giveway / Yield (Two-Way)



MOVEMENT SUMMARY

Site: 2016 AM DBD / Kinsella Street

Network: 2016 AM

Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: Drake Brockman Drive East													
22	T1	211	2.5	211	2.5	0.111	0.4	LOS A	0.1	1.0	0.07	0.02	58.6
23	R2	6	2.5	6	2.5	0.111	11.5	LOS B	0.1	1.0	0.07	0.02	57.9
Approach		217	2.5	217	2.5	0.111	0.7	NA	0.1	1.0	0.07	0.02	58.6
NorthEast: Kinsella Street													
24	L2	64	2.5	64	2.5	0.118	10.8	LOS B	0.4	2.9	0.68	0.86	44.3
26	R2	2	2.5	2	2.5	0.118	14.9	LOS B	0.4	2.9	0.68	0.86	44.3
Approach		66	2.5	66	2.5	0.118	11.0	LOS B	0.4	2.9	0.68	0.86	44.3
NorthWest: Drake Brockman Drive West													
27	L2	5	2.5	5	2.5	0.409	5.6	LOS A	0.0	0.0	0.00	0.00	58.3
28	T1	848	2.5	848	2.5	0.409	0.1	LOS A	0.0	0.0	0.00	0.00	59.8
Approach		853	2.5	853	2.5	0.409	0.1	NA	0.0	0.0	0.00	0.00	59.8
All Vehicles		1136	2.5	1136	2.5	0.409	0.8	NA	0.4	2.9	0.05	0.06	58.6

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

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

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

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

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

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

MOVEMENT SUMMARY

Site: 2016 PM DBD / Kinsella Street

Network: 2016 PM

Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: Drake Brockman Drive East													
22	T1	739	2.5	739	2.5	0.391	0.2	LOS A	0.6	4.4	0.08	0.04	58.6
23	R2	48	2.5	48	2.5	0.391	7.4	LOS A	0.6	4.4	0.08	0.04	57.9
Approach		787	2.5	787	2.5	0.391	0.6	NA	0.6	4.4	0.08	0.04	58.5
NorthEast: Kinsella Street													
24	L2	23	2.5	23	2.5	0.028	6.6	LOS A	0.1	0.7	0.39	0.60	48.4
26	R2	3	2.5	3	2.5	0.028	14.6	LOS B	0.1	0.7	0.39	0.60	48.4
Approach		26	2.5	26	2.5	0.028	7.5	LOS A	0.1	0.7	0.39	0.60	48.4
NorthWest: Drake Brockman Drive West													
27	L2	7	2.5	7	2.5	0.148	5.6	LOS A	0.0	0.0	0.00	0.01	58.3
28	T1	301	2.5	301	2.5	0.148	0.0	LOS A	0.0	0.0	0.00	0.01	59.8
Approach		308	2.5	308	2.5	0.148	0.1	NA	0.0	0.0	0.00	0.01	59.7
All Vehicles		1121	2.5	1121	2.5	0.391	0.7	NA	0.6	4.4	0.07	0.04	58.6

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

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

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

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

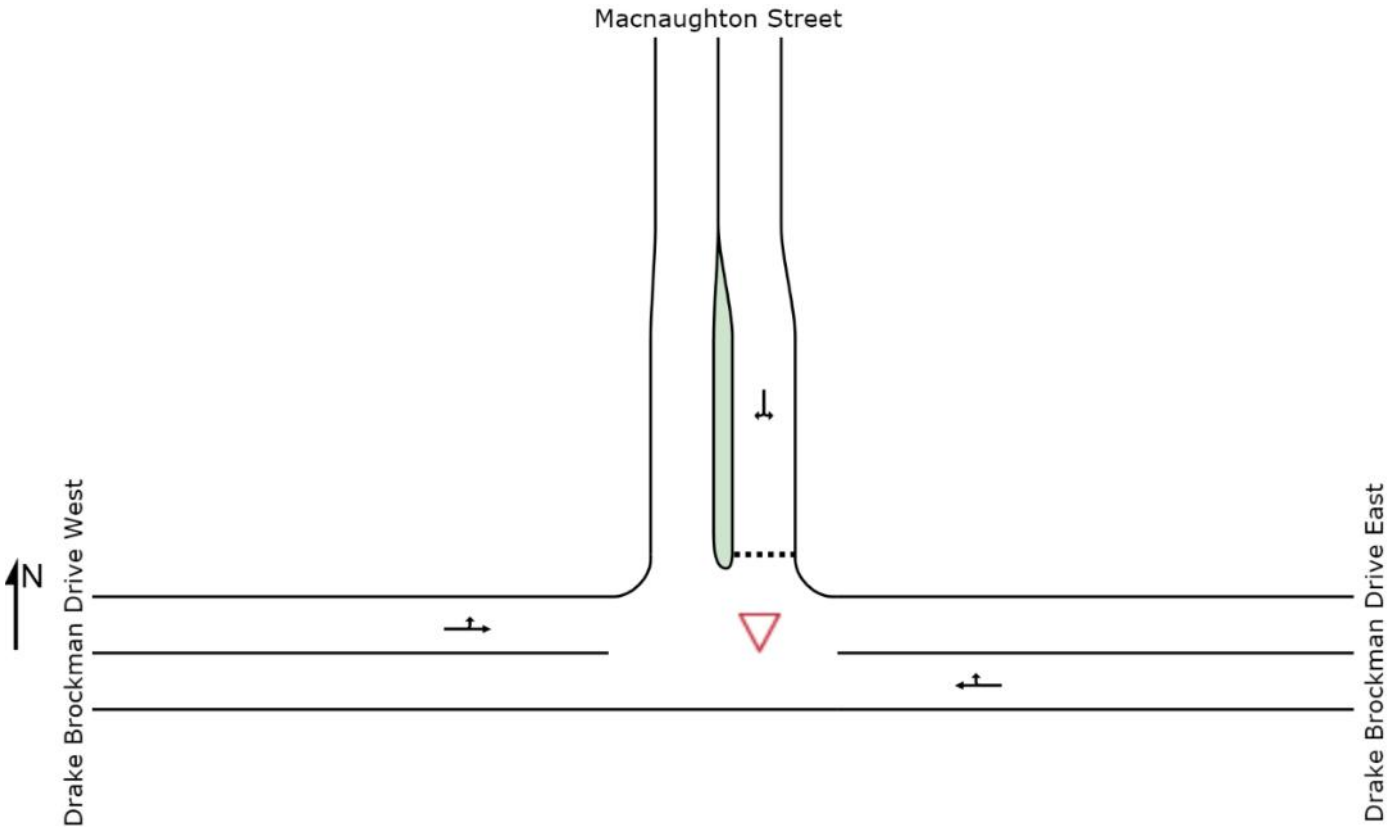
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

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

SITE LAYOUT

Site: 2016 AM DBD / Macnaughton Street

Giveway / Yield (Two-Way)



Organisation: AECOM AUSTRALIA PTY LTD | Created: Wednesday, 3 August 2016 11:25:35 AM
Project: P:\CBR\60501930\4. Tech work area\4.1 Traffic\SIDRA\DBD SIDRA rev2.sip6

MOVEMENT SUMMARY

Site: 2016 AM DBD / Macnaughton Street

Network: 2016 AM

Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Drake Brockman Drive East													
5	T1	96	2.5	96	2.5	0.114	1.5	LOS A	0.6	4.1	0.44	0.29	52.3
6	R2	74	2.5	74	2.5	0.114	7.6	LOS A	0.6	4.1	0.44	0.29	54.6
Approach		170	2.5	170	2.5	0.114	4.2	NA	0.6	4.1	0.44	0.29	53.6
North: Macnaughton Street													
7	L2	263	2.5	263	2.5	0.263	7.8	LOS A	1.1	8.0	0.52	0.74	47.4
9	R2	4	2.5	4	2.5	0.263	9.6	LOS A	1.1	8.0	0.52	0.74	47.4
Approach		267	2.5	267	2.5	0.263	7.8	LOS A	1.1	8.0	0.52	0.74	47.4
West: Drake Brockman Drive West													
10	L2	8	2.5	8	2.5	0.224	5.6	LOS A	0.0	0.0	0.00	0.01	58.3
11	T1	459	2.5	459	2.5	0.224	0.0	LOS A	0.0	0.0	0.00	0.01	59.8
Approach		467	2.5	467	2.5	0.224	0.1	NA	0.0	0.0	0.00	0.01	59.8
All Vehicles		904	2.5	904	2.5	0.263	3.1	NA	1.1	8.0	0.24	0.28	55.0

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

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

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

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

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

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

MOVEMENT SUMMARY

Site: 2016 PM DBD / Macnaughton Street

Network: 2016 PM

Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Drake Brockman Drive East													
5	T1	374	2.5	374	2.5	0.358	0.6	LOS A	2.0	14.5	0.32	0.24	53.3
6	R2	259	2.5	259	2.5	0.358	6.6	LOS A	2.0	14.5	0.32	0.24	55.2
Approach		633	2.5	633	2.5	0.358	3.1	NA	2.0	14.5	0.32	0.24	54.3
North: Macnaughton Street													
7	L2	76	2.5	76	2.5	0.074	6.2	LOS A	0.3	2.0	0.29	0.58	48.7
9	R2	9	2.5	9	2.5	0.074	11.0	LOS B	0.3	2.0	0.29	0.58	48.7
Approach		85	2.5	85	2.5	0.074	6.7	LOS A	0.3	2.0	0.29	0.58	48.7
West: Drake Brockman Drive West													
10	L2	11	2.5	11	2.5	0.096	5.6	LOS A	0.0	0.0	0.00	0.03	58.1
11	T1	189	2.5	189	2.5	0.096	0.0	LOS A	0.0	0.0	0.00	0.03	59.5
Approach		200	2.5	200	2.5	0.096	0.3	NA	0.0	0.0	0.00	0.03	59.4
All Vehicles		918	2.5	918	2.5	0.358	2.8	NA	2.0	14.5	0.25	0.23	54.9

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

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

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

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

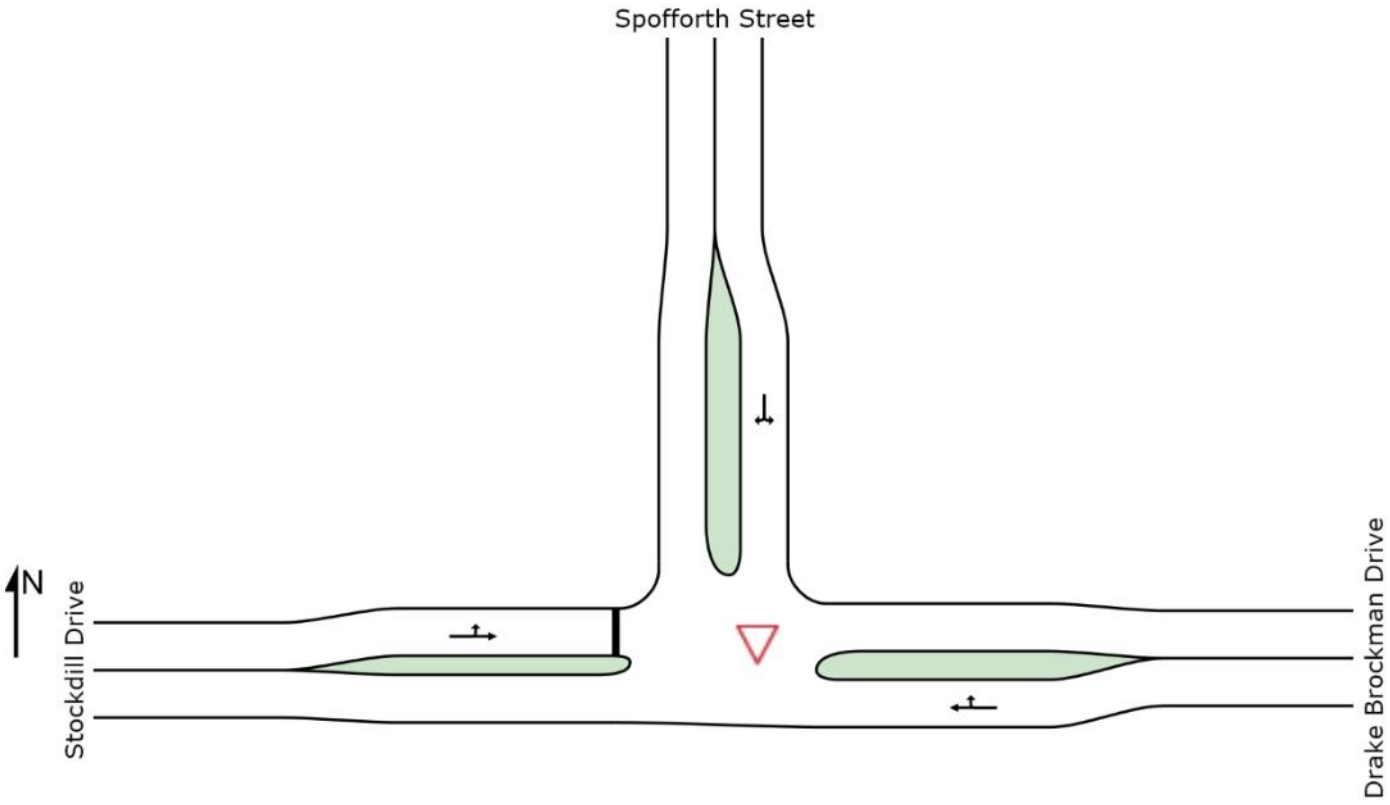
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

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

SITE LAYOUT

Site: 2016 AM DBD / Spofforth Street / Stockdill Drive

Giveway / Yield (Two-Way)



Organisation: AECOM AUSTRALIA PTY LTD | Created: Wednesday, 3 August 2016 11:26:05 AM
Project: P:\CBR\60501930\4. Tech work area\4.1 Traffic\SIDRA\DBD SIDRA rev2.sip6

MOVEMENT SUMMARY

Site: 2016 AM DBD / Spofforth Street / Stockdill Drive

Network: 2016 AM

Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Drake Brockman Drive													
5	T1	97	2.5	97	2.5	0.049	0.0	LOS A	0.0	0.2	0.00	0.02	59.3
6	R2	4	2.5	4	2.5	0.049	5.6	LOS A	0.0	0.2	0.00	0.02	58.1
Approach		101	2.5	101	2.5	0.049	0.2	NA	0.0	0.2	0.00	0.02	59.1
North: Spofforth Street													
7	L2	86	2.5	86	2.5	0.044	5.6	LOS A	0.0	0.0	0.01	0.57	53.5
9	R2	1	2.5	1	2.5	0.044	5.9	LOS A	0.0	0.0	0.01	0.57	53.5
Approach		87	2.5	87	2.5	0.044	5.6	NA	0.0	0.0	0.01	0.57	53.5
West: Stockdill Drive													
10	L2	39	2.5	39	2.5	0.090	8.1	LOS A	0.3	2.5	0.02	0.99	52.2
11	T1	64	2.5	64	2.5	0.090	8.6	LOS A	0.3	2.5	0.02	0.99	43.9
Approach		103	2.5	103	2.5	0.090	8.4	LOS A	0.3	2.5	0.02	0.99	48.9
All Vehicles		291	2.5	291	2.5	0.090	4.7	NA	0.3	2.5	0.01	0.53	52.5

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

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

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

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

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

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

MOVEMENT SUMMARY

Site: 2016 PM DBD / Spofforth Street / Stockdill Drive

Network: 2016 PM

Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Drake Brockman Drive													
5	T1	33	2.5	33	2.5	0.018	0.0	LOS A	0.0	0.1	0.01	0.05	58.4
6	R2	3	2.5	3	2.5	0.018	5.6	LOS A	0.0	0.1	0.01	0.05	57.9
Approach		36	2.5	36	2.5	0.018	0.5	NA	0.0	0.1	0.01	0.05	58.2
North: Spofforth Street													
7	L2	109	2.5	109	2.5	0.060	5.6	LOS A	0.0	0.4	0.02	0.57	53.5
9	R2	8	2.5	8	2.5	0.060	5.7	LOS A	0.0	0.4	0.02	0.57	53.5
Approach		117	2.5	117	2.5	0.060	5.6	NA	0.0	0.4	0.02	0.57	53.5
West: Stockdill Drive													
10	L2	50	2.5	50	2.5	0.129	8.1	LOS A	0.5	3.7	0.02	0.99	52.2
11	T1	96	2.5	96	2.5	0.129	8.6	LOS A	0.5	3.7	0.02	0.99	43.8
Approach		146	2.5	146	2.5	0.129	8.4	LOS A	0.5	3.7	0.02	0.99	48.6
All Vehicles		299	2.5	299	2.5	0.129	6.4	NA	0.5	3.7	0.02	0.71	51.3

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

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

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

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

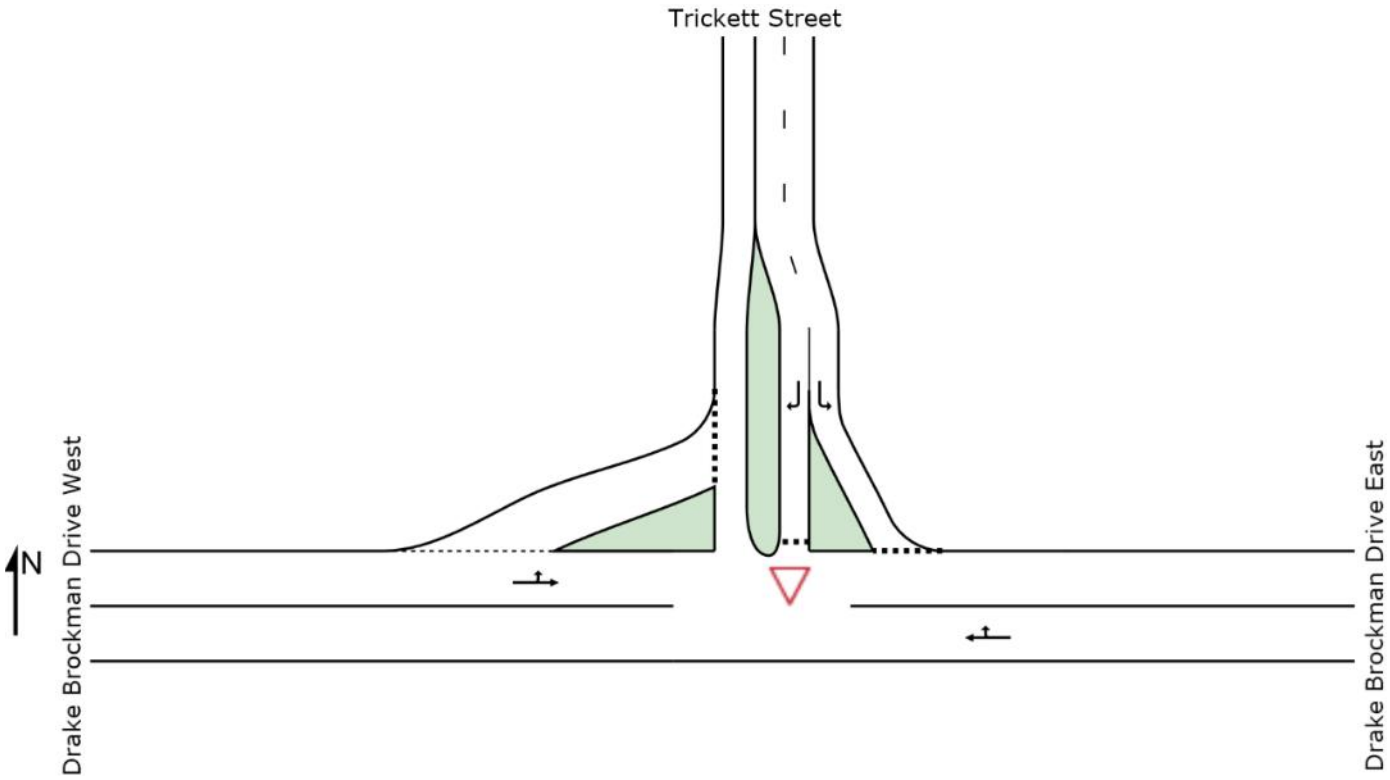
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

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

SITE LAYOUT

Site: 2016 AM DBD / Trickett Street

Giveway / Yield (Two-Way)



Organisation: AECOM AUSTRALIA PTY LTD | Created: Wednesday, 3 August 2016 11:25:51 AM
Project: P:\CBR\60501930\4. Tech work area\4.1 Traffic\SIDRA\DBD SIDRA rev2.sip6

MOVEMENT SUMMARY

Site: 2016 AM DBD / Trickett Street

Network: 2016 AM

Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Drake Brockman Drive East													
5	T1	61	2.5	61	2.5	0.056	0.4	LOS A	0.2	1.6	0.23	0.22	55.4
6	R2	39	2.5	39	2.5	0.056	6.2	LOS A	0.2	1.6	0.23	0.22	56.1
Approach		100	2.5	100	2.5	0.056	2.6	NA	0.2	1.6	0.23	0.22	55.8
North: Trickett Street													
7	L2	274	2.5	274	2.5	0.199	6.3	LOS A	0.9	6.4	0.31	0.56	49.2
9	R2	9	2.5	9	2.5	0.009	6.6	LOS A	0.0	0.2	0.32	0.57	49.3
Approach		283	2.5	283	2.5	0.199	6.3	LOS A	0.9	6.4	0.31	0.56	49.2
West: Drake Brockman Drive West													
10	L2	7	2.5	7	2.5	0.092	5.8	LOS A	0.0	0.3	0.01	0.02	58.5
11	T1	183	2.5	183	2.5	0.092	0.0	LOS A	0.0	0.3	0.01	0.02	59.2
Approach		190	2.5	190	2.5	0.092	0.2	NA	0.0	0.3	0.01	0.02	59.1
All Vehicles		573	2.5	573	2.5	0.199	3.7	NA	0.9	6.4	0.20	0.32	52.8

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

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

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

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

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

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

MOVEMENT SUMMARY

Site: 2016 PM DBD / Trickett Street

Network: 2016 PM

Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Drake Brockman Drive East													
5	T1	162	2.5	162	2.5	0.214	0.4	LOS A	1.2	8.2	0.26	0.32	54.0
6	R2	212	2.5	212	2.5	0.214	6.1	LOS A	1.2	8.2	0.26	0.32	55.3
Approach		374	2.5	374	2.5	0.214	3.6	NA	1.2	8.2	0.26	0.32	54.9
North: Trickett Street													
7	L2	66	2.5	66	2.5	0.046	6.0	LOS A	0.2	1.3	0.22	0.53	49.7
9	R2	11	2.5	11	2.5	0.014	7.8	LOS A	0.0	0.3	0.44	0.65	48.1
Approach		77	2.5	77	2.5	0.046	6.3	LOS A	0.2	1.3	0.25	0.54	49.5
West: Drake Brockman Drive West													
10	L2	16	2.5	16	2.5	0.074	6.4	LOS A	0.1	0.8	0.08	0.06	57.7
11	T1	129	2.5	129	2.5	0.074	0.1	LOS A	0.1	0.8	0.08	0.06	56.9
Approach		145	2.5	145	2.5	0.074	0.8	NA	0.1	0.8	0.08	0.06	57.1
All Vehicles		596	2.5	596	2.5	0.214	3.3	NA	1.2	8.2	0.21	0.29	54.6

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

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

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

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

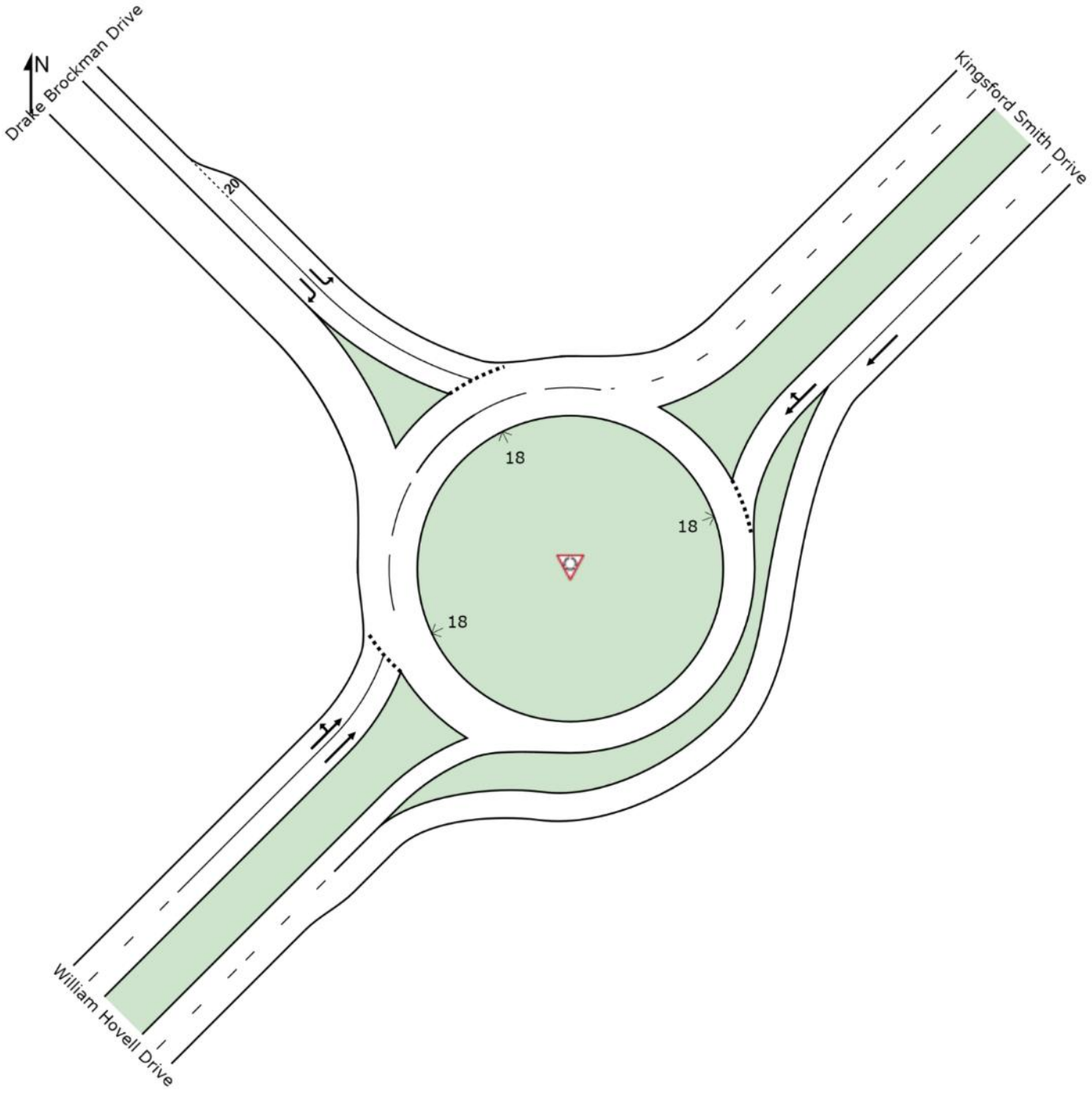
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

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

SITE LAYOUT

Site: 2016 AM DBD / WHD / KSD

Roundabout



MOVEMENT SUMMARY

Site: 2016 AM DBD / WHD / KSD

Network: 2016 AM

Roundabout

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
NorthEast: Kingsford Smith Drive													
25	T1	980	2.5	980	2.5	0.344	5.0	LOS A	2.4	16.8	0.20	0.51	54.3
26	R2	80	2.5	80	2.5	0.344	11.3	LOS B	2.4	16.8	0.70	0.72	41.0
Approach		1060	2.5	1060	2.5	0.344	5.4	LOS A	2.4	16.8	0.24	0.52	53.7
NorthWest: Drake Brockman Drive													
27	L2	353	2.5	353	2.5	0.352	5.8	LOS A	2.0	14.6	0.49	0.61	51.6
29	R2	562	2.5	562	2.5	0.472	10.1	LOS B	3.2	22.7	0.52	0.69	51.2
Approach		915	2.5	915	2.5	0.472	8.4	LOS A	3.2	22.7	0.51	0.66	51.4
SouthWest: William Hovell Drive													
30	L2	138	2.5	138	2.5	0.132	4.6	LOS A	0.9	6.3	0.27	0.46	51.0
31	T1	236	2.5	236	2.5	0.132	4.7	LOS A	0.9	6.3	0.28	0.43	53.8
Approach		374	2.5	374	2.5	0.132	4.6	LOS A	0.9	6.3	0.28	0.44	53.0
All Vehicles		2349	2.5	2349	2.5	0.472	6.5	LOS A	3.2	22.7	0.35	0.56	52.6

Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 2016 PM DBD / WHD / KSD

Network: 2016 PM

Roundabout

Movement Performance - Vehicles

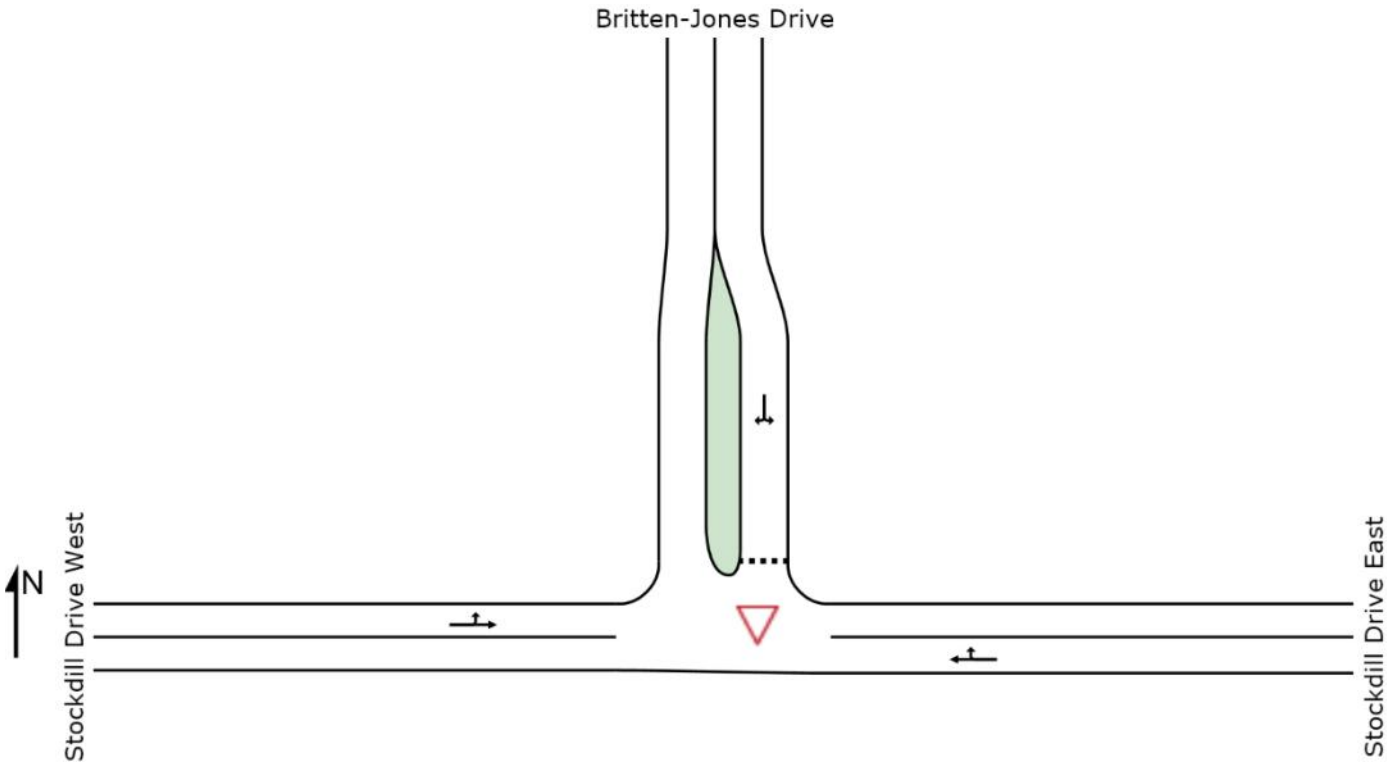
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
NorthEast: Kingsford Smith Drive													
25	T1	294	2.5	294	2.5	0.144	4.2	LOS A	0.0	0.0	0.00	0.42	55.6
26	R2	239	2.5	239	2.5	0.175	9.2	LOS A	1.0	7.5	0.37	0.62	39.7
Approach		533	2.5	533	2.5	0.175	6.5	LOS A	1.0	7.5	0.17	0.51	50.6
NorthWest: Drake Brockman Drive													
27	L2	151	2.5	151	2.5	0.342	10.9	LOS B	1.9	13.5	0.84	0.94	47.5
29	R2	173	2.5	173	2.5	0.318	13.7	LOS B	1.8	13.1	0.85	0.95	49.4
Approach		324	2.5	324	2.5	0.342	12.4	LOS B	1.9	13.5	0.85	0.94	48.6
SouthWest: William Hovell Drive													
30	L2	551	2.5	551	2.5	0.714	6.9	LOS A	8.6	61.8	0.76	0.66	47.9
31	T1	1223	2.5	1223	2.5	0.714	7.7	LOS A	9.0	64.1	0.79	0.70	51.2
Approach		1774	2.5	1774	2.5	0.714	7.5	LOS A	9.0	64.1	0.78	0.69	50.4
All Vehicles		2631	2.5	2631	2.5	0.714	7.9	LOS A	9.0	64.1	0.67	0.68	50.2

Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

Site: 2021 AM Stockdill Drive / Britten-Jones Drive

Giveway / Yield (Two-Way)



MOVEMENT SUMMARY

Site: 2021 AM Stockdill Drive / Britten-Jones Drive

Network: 2021 AM

Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Stockdill Drive East													
5	T1	232	2.5	232	2.5	0.156	0.7	LOS A	0.4	3.1	0.21	0.09	58.1
6	R2	38	2.5	38	2.5	0.156	8.1	LOS A	0.4	3.1	0.21	0.09	55.9
Approach		270	2.5	270	2.5	0.156	1.7	NA	0.4	3.1	0.21	0.09	57.8
North: Britten-Jones Drive													
7	L2	67	2.5	67	2.5	0.073	7.8	LOS A	0.3	1.9	0.50	0.70	47.9
9	R2	1	2.5	1	2.5	0.073	10.3	LOS B	0.3	1.9	0.50	0.70	51.7
Approach		68	2.5	68	2.5	0.073	7.8	LOS A	0.3	1.9	0.50	0.70	48.0
West: Stockdill Drive West													
10	L2	5	2.5	5	2.5	0.272	5.6	LOS A	0.0	0.0	0.00	0.01	58.2
11	T1	523	2.5	523	2.5	0.272	0.0	LOS A	0.0	0.0	0.00	0.01	59.8
Approach		528	2.5	528	2.5	0.272	0.1	NA	0.0	0.0	0.00	0.01	59.8
All Vehicles		866	2.5	866	2.5	0.272	1.2	NA	0.4	3.1	0.10	0.09	58.0

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

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

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

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

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

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

MOVEMENT SUMMARY

Site: 2021 PM Stockdill Drive / Britten-Jones Drive

Network: 2021 PM

Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Stockdill Drive East													
5	T1	207	2.5	207	2.5	0.415	1.6	LOS A	3.0	21.5	0.50	0.46	54.2
6	R2	412	2.5	412	2.5	0.415	7.3	LOS A	3.0	21.5	0.50	0.46	52.2
Approach		619	2.5	619	2.5	0.415	5.4	NA	3.0	21.5	0.50	0.46	52.9
North: Britten-Jones Drive													
7	L2	31	2.5	31	2.5	0.027	6.5	LOS A	0.1	0.7	0.35	0.58	49.0
9	R2	1	2.5	1	2.5	0.027	11.4	LOS B	0.1	0.7	0.35	0.58	52.3
Approach		32	2.5	32	2.5	0.027	6.6	LOS A	0.1	0.7	0.35	0.58	49.2
West: Stockdill Drive West													
10	L2	15	2.5	15	2.5	0.150	5.6	LOS A	0.0	0.0	0.00	0.03	58.0
11	T1	275	2.5	275	2.5	0.150	0.0	LOS A	0.0	0.0	0.00	0.03	59.4
Approach		290	2.5	290	2.5	0.150	0.3	NA	0.0	0.0	0.00	0.03	59.3
All Vehicles		941	2.5	941	2.5	0.415	3.8	NA	3.0	21.5	0.34	0.33	54.1

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

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

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

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

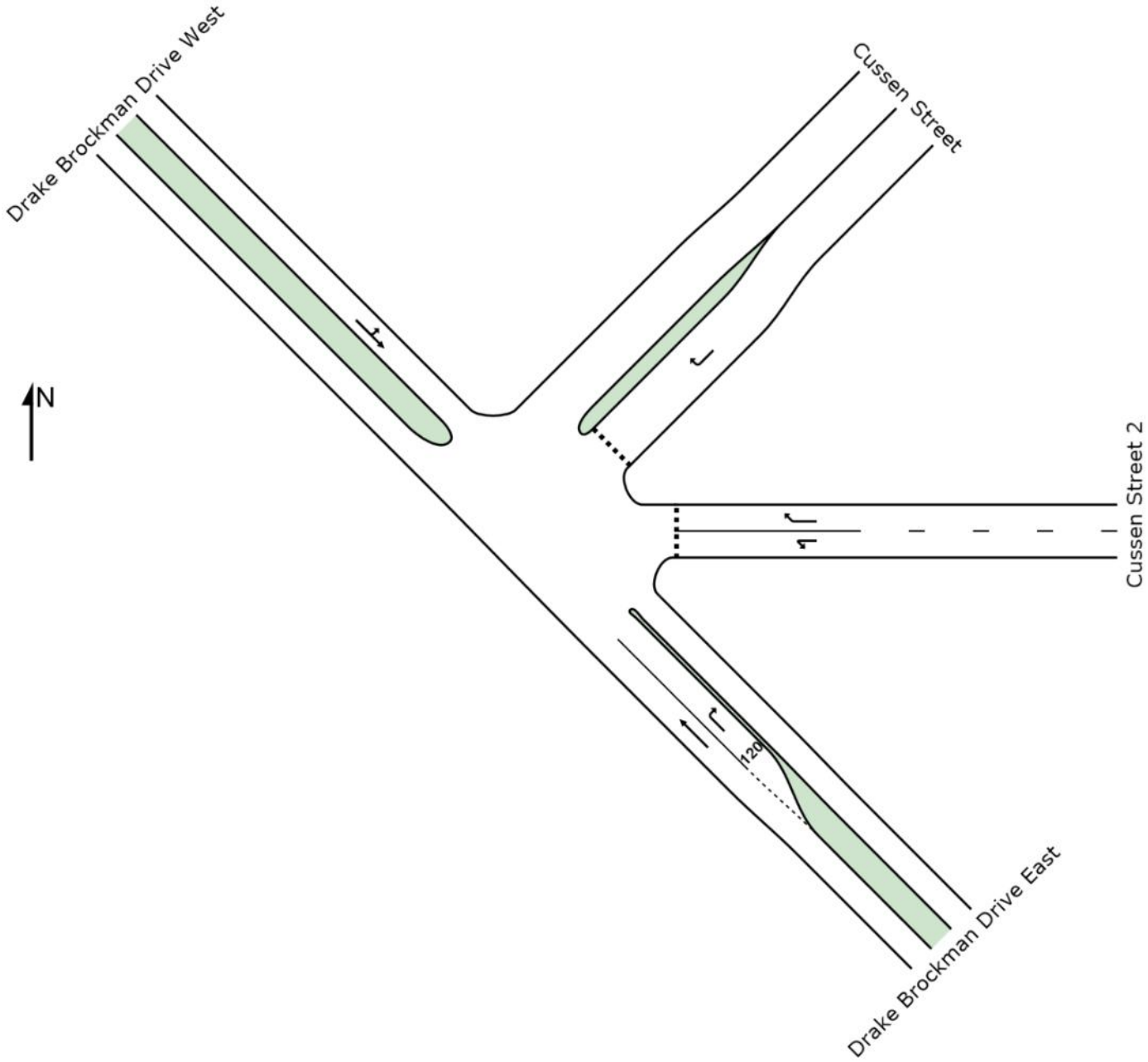
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

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

SITE LAYOUT

Site: 2021 AM DBD / Cussen Street

Giveway / Yield (Two-Way)



Organisation: AECOM AUSTRALIA PTY LTD | Created: Wednesday, 3 August 2016 11:27:49 AM
Project: P:\CBR\60501930\4. Tech work area\4.1 Traffic\SIDRA\DBD SIDRA rev2.sip6

MOVEMENT SUMMARY

Site: 2021 AM DBD / Cussen Street

Network: 2021 AM

Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: Drake Brockman Drive East													
22	T1	277	2.5	277	2.5	0.143	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
23	R2	45	2.5	45	2.5	0.136	16.4	LOS C	0.5	3.3	0.83	0.93	44.4
Approach		322	2.5	322	2.5	0.143	2.3	NA	0.5	3.3	0.12	0.13	56.3
East: Cussen Street 2													
4b	L3	146	2.5	146	2.5	0.455	21.1	LOS C	1.8	12.9	0.88	1.03	26.8
6a	R1	2	2.5	2	2.5	0.003	6.5	LOS A	0.0	0.1	0.41	0.52	43.1
Approach		148	2.5	148	2.5	0.455	20.9	LOS C	1.8	12.9	0.87	1.03	26.9
NorthEast: Cussen Street													
26	R2	2	2.5	2	2.5	0.024	45.4	LOS E	0.1	0.5	0.92	0.97	16.1
Approach		2	2.5	2	2.5	0.024	45.4	LOS E	0.1	0.5	0.92	0.97	16.1
NorthWest: Drake Brockman Drive West													
27	L2	11	2.5	11	2.5	0.579	5.7	LOS A	0.0	0.0	0.00	0.01	57.1
28	T1	1111	2.5	1111	2.5	0.579	0.1	LOS A	0.0	0.0	0.00	0.01	59.7
Approach		1122	2.5	1122	2.5	0.579	0.2	NA	0.0	0.0	0.00	0.01	59.6
All Vehicles		1594	2.5	1594	2.5	0.579	2.6	NA	1.8	12.9	0.11	0.13	55.2

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

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

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

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

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

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

MOVEMENT SUMMARY

Site: 2021 PM DBD / Cussen Street

Network: 2021 PM

Giveway / Yield (Two-Way)

Movement Performance - Vehicles													
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: Drake Brockman Drive East													
22	T1	1080	2.5	1080	2.5	0.557	0.1	LOS A	0.0	0.0	0.00	0.00	59.8
23	R2	157	2.5	157	2.5	0.114	6.6	LOS A	0.5	3.7	0.38	0.60	51.1
Approach		1237	2.5	1237	2.5	0.557	0.9	NA	0.5	3.7	0.05	0.08	58.1
East: Cussen Street 2													
4b	L3	36	2.5	36	2.5	0.028	7.4	LOS A	0.1	0.8	0.34	0.60	41.1
6a	R1	4	2.5	4	2.5	0.046	41.4	LOS E	0.1	0.9	0.92	0.96	17.1
Approach		40	2.5	40	2.5	0.046	10.9	LOS B	0.1	0.9	0.40	0.64	35.9
NorthEast: Cussen Street													
26	R2	4	2.5	4	2.5	0.007	9.2	LOS A	0.0	0.2	0.50	0.63	38.7
Approach		4	2.5	4	2.5	0.007	9.2	LOS A	0.0	0.2	0.50	0.63	38.7
NorthWest: Drake Brockman Drive West													
27	L2	5	2.5	5	2.5	0.140	5.6	LOS A	0.0	0.0	0.00	0.01	57.2
28	T1	267	2.5	267	2.5	0.140	0.0	LOS A	0.0	0.0	0.00	0.01	59.8
Approach		272	2.5	272	2.5	0.140	0.1	NA	0.0	0.0	0.00	0.01	59.7
All Vehicles		1553	2.5	1553	2.5	0.557	1.1	NA	0.5	3.7	0.05	0.08	57.9

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

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

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

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

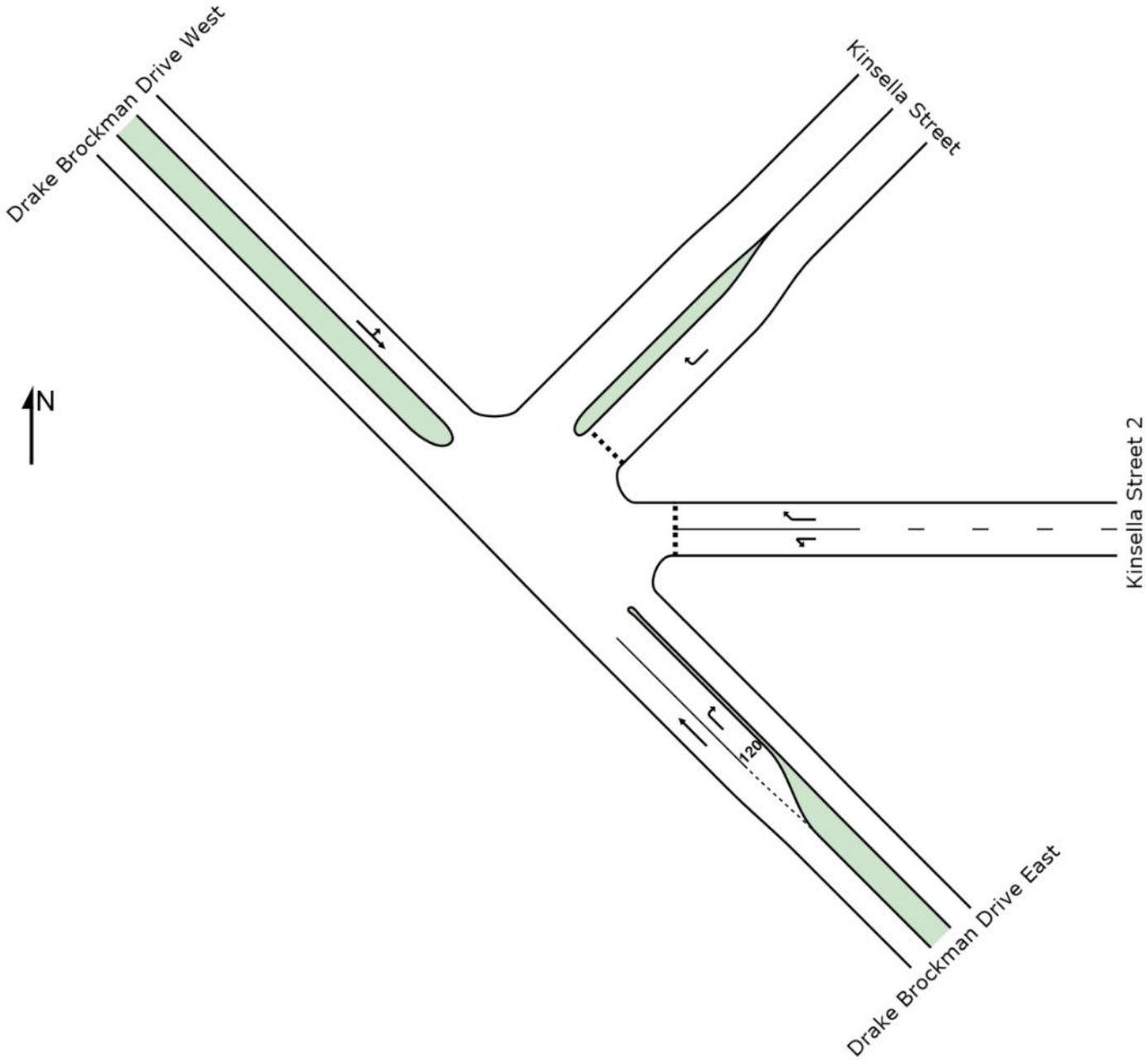
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

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

SITE LAYOUT

Site: 2021 AM DBD / Kinsella Street

Giveway / Yield (Two-Way)



MOVEMENT SUMMARY

Site: 2021 AM DBD / Kinsella Street

Network: 2021 AM

Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: Drake Brockman Drive East													
22	T1	344	2.5	344	2.5	0.177	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
23	R2	9	2.5	9	2.5	0.027	15.8	LOS C	0.1	0.6	0.82	0.92	46.4
Approach		353	2.5	353	2.5	0.177	0.4	NA	0.1	0.6	0.02	0.02	59.1
East: Kinsella Street 2													
4b	L3	71	2.5	71	2.5	0.221	18.0	LOS C	0.7	5.3	0.84	0.95	38.1
6a	R1	2	2.5	2	2.5	0.003	7.2	LOS A	0.0	0.1	0.46	0.55	48.7
Approach		73	2.5	73	2.5	0.221	17.7	LOS C	0.7	5.3	0.83	0.94	38.4
NorthEast: Kinsella Street													
26	R2	2	2.5	2	2.5	0.024	44.6	LOS E	0.1	0.5	0.92	0.97	24.6
Approach		2	2.5	2	2.5	0.024	44.6	LOS E	0.1	0.5	0.92	0.97	24.6
NorthWest: Drake Brockman Drive West													
27	L2	8	2.5	8	2.5	0.579	5.7	LOS A	0.0	0.0	0.00	0.00	58.2
28	T1	1114	2.5	1114	2.5	0.579	0.1	LOS A	0.0	0.0	0.00	0.00	59.7
Approach		1122	2.5	1122	2.5	0.579	0.2	NA	0.0	0.0	0.00	0.00	59.7
All Vehicles		1550	2.5	1550	2.5	0.579	1.1	NA	0.7	5.3	0.04	0.05	58.1

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

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

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

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

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

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

MOVEMENT SUMMARY

Site: 2021 PM DBD / Kinsella Street

Network: 2021 PM

Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: Drake Brockman Drive East													
22	T1	1318	2.5	1318	2.5	0.680	0.2	LOS A	0.0	0.0	0.00	0.00	59.7
23	R2	71	2.5	71	2.5	0.052	6.5	LOS A	0.2	1.6	0.37	0.58	52.3
Approach		1389	2.5	1389	2.5	0.680	0.5	NA	0.2	1.6	0.02	0.03	58.9
East: Kinsella Street 2													
4b	L3	18	2.5	18	2.5	0.014	7.3	LOS A	0.1	0.4	0.33	0.58	48.0
6a	R1	2	2.5	2	2.5	0.076	120.1	LOS F	0.2	1.4	0.98	0.99	12.3
Approach		20	2.5	20	2.5	0.076	19.2	LOS C	0.2	1.4	0.40	0.63	36.9
NorthEast: Kinsella Street													
26	R2	2	2.5	2	2.5	0.003	8.2	LOS A	0.0	0.1	0.45	0.58	47.5
Approach		2	2.5	2	2.5	0.003	8.2	LOS A	0.0	0.1	0.45	0.58	47.5
NorthWest: Drake Brockman Drive West													
27	L2	5	2.5	5	2.5	0.139	5.6	LOS A	0.0	0.0	0.00	0.01	58.3
28	T1	265	2.5	265	2.5	0.139	0.0	LOS A	0.0	0.0	0.00	0.01	59.8
Approach		270	2.5	270	2.5	0.139	0.1	NA	0.0	0.0	0.00	0.01	59.8
All Vehicles		1681	2.5	1681	2.5	0.680	0.7	NA	0.2	1.6	0.02	0.03	58.6

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

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

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

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

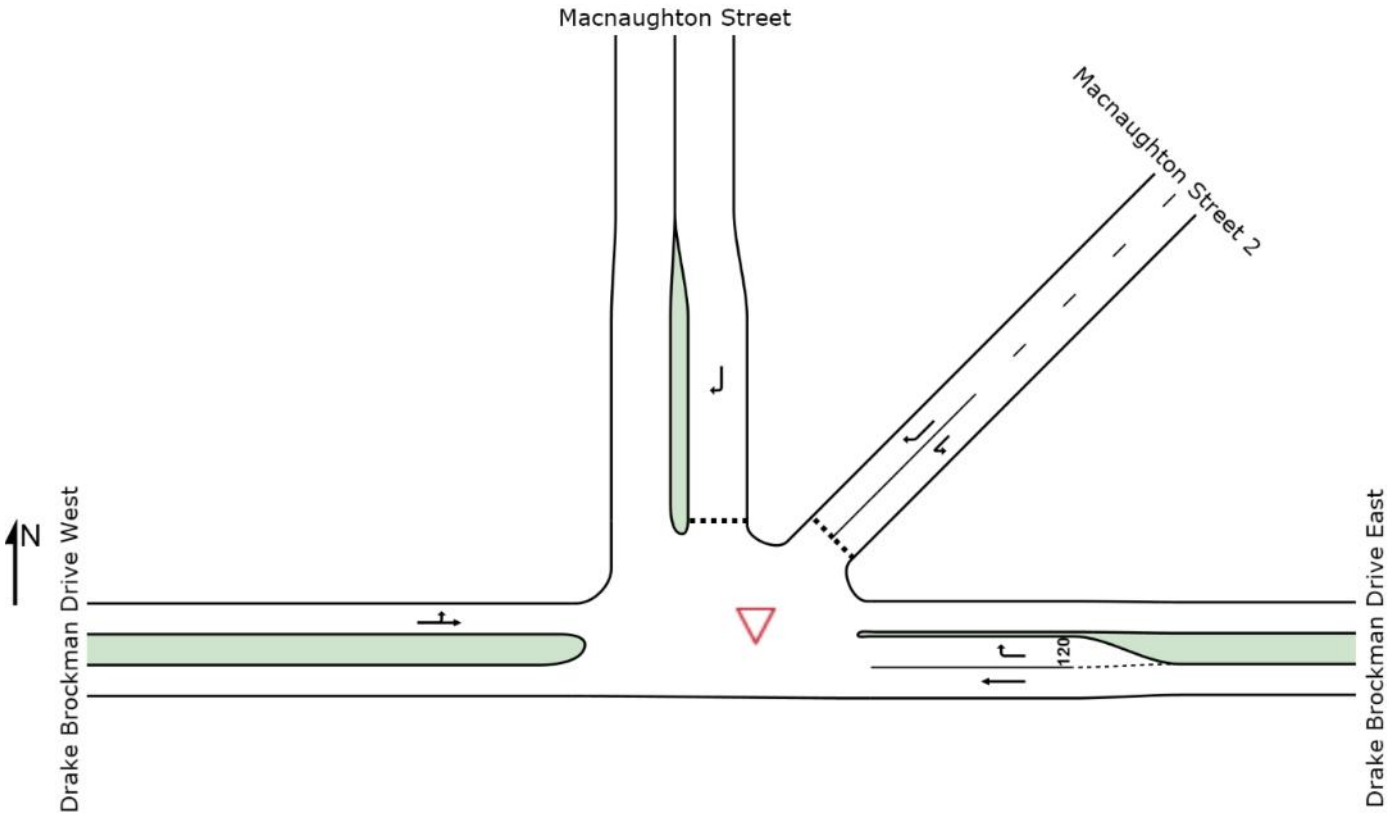
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

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

SITE LAYOUT

Site: 2021 AM DBD / Macnaughton Street

Giveway / Yield (Two-Way)



Organisation: AECOM AUSTRALIA PTY LTD | Created: Wednesday, 3 August 2016 11:28:14 AM
Project: P:\CBR\60501930\4. Tech work area\4.1 Traffic\SIDRA\DBD SIDRA rev2.sip6

MOVEMENT SUMMARY

Site: 2021 AM DBD / Macnaughton Street

Network: 2021 AM

Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Drake Brockman Drive East													
5	T1	209	2.5	209	2.5	0.108	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
6	R2	112	2.5	112	2.5	0.202	11.9	LOS B	0.8	5.5	0.74	0.89	48.6
Approach		321	2.5	321	2.5	0.202	4.2	NA	0.8	5.5	0.26	0.31	53.6
NorthEast: Macnaughton Street 2													
24b	L3	302	2.5	302	2.5	0.568	16.5	LOS C	3.1	21.9	0.83	1.08	38.6
26a	R1	4	2.5	4	2.5	0.005	5.9	LOS A	0.0	0.1	0.35	0.51	49.8
Approach		306	2.5	306	2.5	0.568	16.3	LOS C	3.1	21.9	0.82	1.08	38.7
North: Macnaughton Street													
9	R2	4	2.5	4	2.5	0.026	27.1	LOS D	0.1	0.6	0.85	0.94	31.2
Approach		4	2.5	4	2.5	0.026	27.1	LOS D	0.1	0.6	0.85	0.94	31.2
West: Drake Brockman Drive West													
10	L2	14	2.5	14	2.5	0.465	5.6	LOS A	0.0	0.0	0.00	0.01	58.2
11	T1	887	2.5	887	2.5	0.465	0.1	LOS A	0.0	0.0	0.00	0.01	59.7
Approach		901	2.5	901	2.5	0.465	0.2	NA	0.0	0.0	0.00	0.01	59.7
All Vehicles		1532	2.5	1532	2.5	0.568	4.3	NA	3.1	21.9	0.22	0.29	53.6

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

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

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

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

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

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

MOVEMENT SUMMARY

Site: 2021 PM DBD / Macnaughton Street

Network: 2021 PM

Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Drake Brockman Drive East													
5	T1	718	2.5	718	2.5	0.370	0.0	LOS A	0.0	0.0	0.00	0.00	59.9
6	R2	353	2.5	353	2.5	0.278	7.1	LOS A	1.4	10.0	0.48	0.67	51.7
Approach		1071	2.5	1071	2.5	0.370	2.4	NA	1.4	10.0	0.16	0.22	55.6
NorthEast: Macnaughton Street 2													
24b	L3	59	2.5	59	2.5	0.050	7.6	LOS A	0.2	1.4	0.38	0.63	47.2
26a	R1	7	2.5	7	2.5	0.025	14.8	LOS B	0.1	0.6	0.72	0.84	39.8
Approach		66	2.5	66	2.5	0.050	8.4	LOS A	0.2	1.4	0.42	0.65	46.3
North: Macnaughton Street													
9	R2	7	2.5	7	2.5	0.019	13.2	LOS B	0.1	0.5	0.65	0.77	41.4
Approach		7	2.5	7	2.5	0.019	13.2	LOS B	0.1	0.5	0.65	0.77	41.4
West: Drake Brockman Drive West													
10	L2	16	2.5	16	2.5	0.177	5.6	LOS A	0.0	0.0	0.00	0.03	58.1
11	T1	327	2.5	327	2.5	0.177	0.0	LOS A	0.0	0.0	0.00	0.03	59.6
Approach		343	2.5	343	2.5	0.177	0.3	NA	0.0	0.0	0.00	0.03	59.5
All Vehicles		1487	2.5	1487	2.5	0.370	2.2	NA	1.4	10.0	0.14	0.20	56.0

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

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

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

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

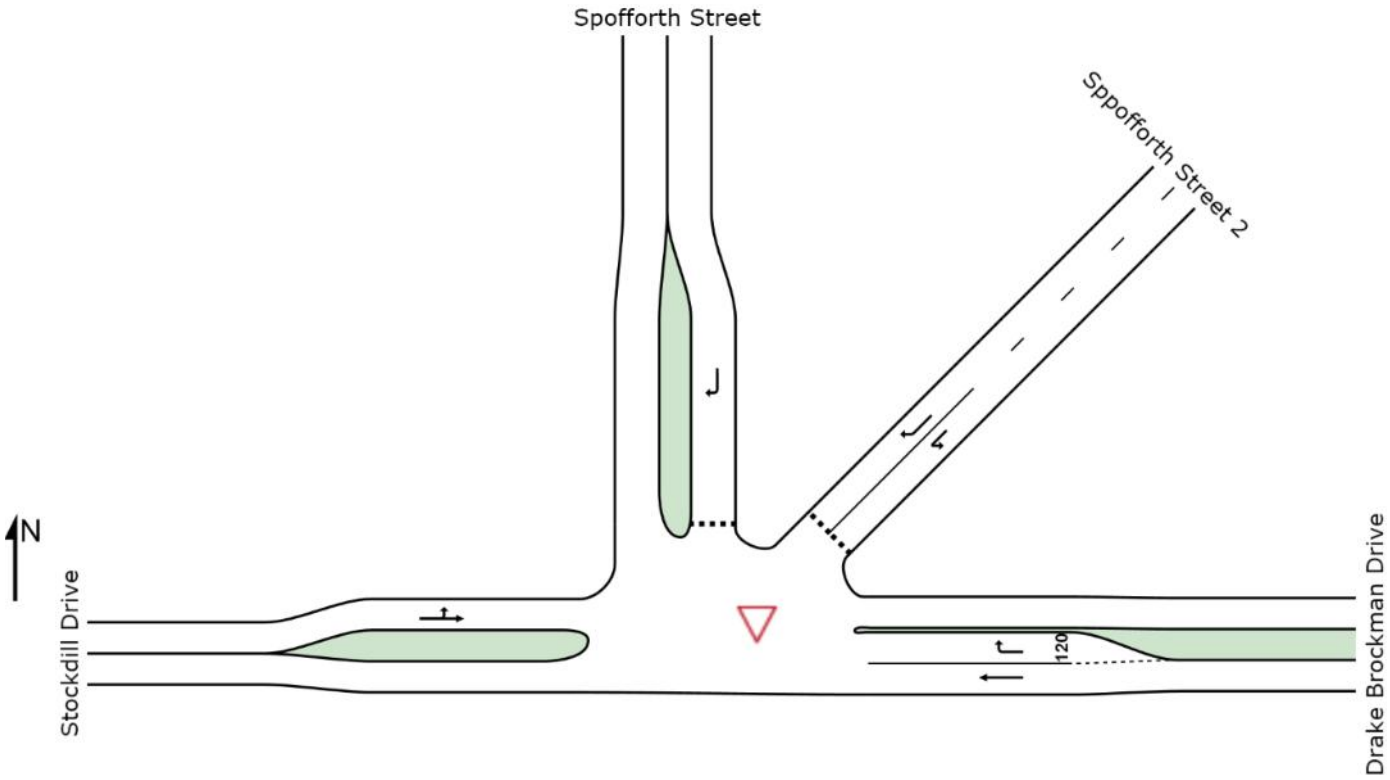
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

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

SITE LAYOUT

Site: 2021 AM DBD / Spofforth Street / Stockdill Drive

Giveway / Yield (Two-Way)



Organisation: AECOM AUSTRALIA PTY LTD | Created: Wednesday, 3 August 2016 11:28:48 AM
Project: P:\CBR\60501930\4. Tech work area\4.1 Traffic\SIDRA\DBD SIDRA rev2.sip6

MOVEMENT SUMMARY

Site: 2021 AM DBD / Spofforth Street / Stockdill Drive

Network: 2021 AM

Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Drake Brockman Drive													
5	T1	234	2.5	234	2.5	0.121	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
6	R2	8	2.5	8	2.5	0.008	7.6	LOS A	0.0	0.2	0.51	0.62	52.0
Approach		242	2.5	242	2.5	0.121	0.3	NA	0.0	0.2	0.02	0.02	59.0
NorthEast: Sppofforth Street 2													
24b	L3	99	2.5	99	2.5	0.087	7.9	LOS A	0.3	2.4	0.42	0.66	51.0
26a	R1	1	2.5	1	2.5	0.001	5.4	LOS A	0.0	0.0	0.29	0.49	53.4
Approach		100	2.5	100	2.5	0.087	7.9	LOS A	0.3	2.4	0.42	0.66	51.0
North: Spofforth Street													
9	R2	1	2.5	1	2.5	0.001	7.6	LOS A	0.0	0.0	0.43	0.58	51.5
Approach		1	2.5	1	2.5	0.001	7.6	LOS A	0.0	0.0	0.43	0.58	51.5
West: Stockdill Drive													
10	L2	161	2.5	161	2.5	0.277	5.6	LOS A	0.0	0.0	0.00	0.58	53.9
11	T1	368	2.5	368	2.5	0.277	5.8	LOS A	0.0	0.0	0.00	0.58	47.9
Approach		529	2.5	529	2.5	0.277	5.8	NA	0.0	0.0	0.00	0.58	51.1
All Vehicles		872	2.5	872	2.5	0.277	4.5	NA	0.3	2.4	0.05	0.44	52.3

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

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

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

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

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

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

MOVEMENT SUMMARY

Site: 2021 PM DBD / Spofforth Street / Stockdill Drive

Network: 2021 PM

Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Drake Brockman Drive													
5	T1	548	2.5	548	2.5	0.283	0.0	LOS A	0.0	0.0	0.00	0.00	59.9
6	R2	40	2.5	40	2.5	0.030	6.5	LOS A	0.1	0.9	0.38	0.58	52.4
Approach		588	2.5	588	2.5	0.283	0.5	NA	0.1	0.9	0.03	0.04	58.3
NorthEast: Sppofforth Street 2													
24b	L3	84	2.5	84	2.5	0.063	7.2	LOS A	0.3	1.8	0.30	0.60	51.5
26a	R1	6	2.5	6	2.5	0.010	7.4	LOS A	0.0	0.2	0.48	0.63	51.7
Approach		91	2.5	91	2.5	0.063	7.2	LOS A	0.3	1.8	0.32	0.60	51.5
North: Spofforth Street													
9	R2	6	2.5	6	2.5	0.007	6.7	LOS A	0.0	0.1	0.33	0.58	52.2
Approach		6	2.5	6	2.5	0.007	6.7	LOS A	0.0	0.1	0.33	0.58	52.2
West: Stockdill Drive													
10	L2	81	2.5	81	2.5	0.154	5.6	LOS A	0.0	0.0	0.00	0.58	53.9
11	T1	213	2.5	213	2.5	0.154	5.8	LOS A	0.0	0.0	0.00	0.58	47.9
Approach		294	2.5	294	2.5	0.154	5.8	NA	0.0	0.0	0.00	0.58	50.9
All Vehicles		979	2.5	979	2.5	0.283	2.7	NA	0.3	1.8	0.05	0.26	54.1

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

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

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

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

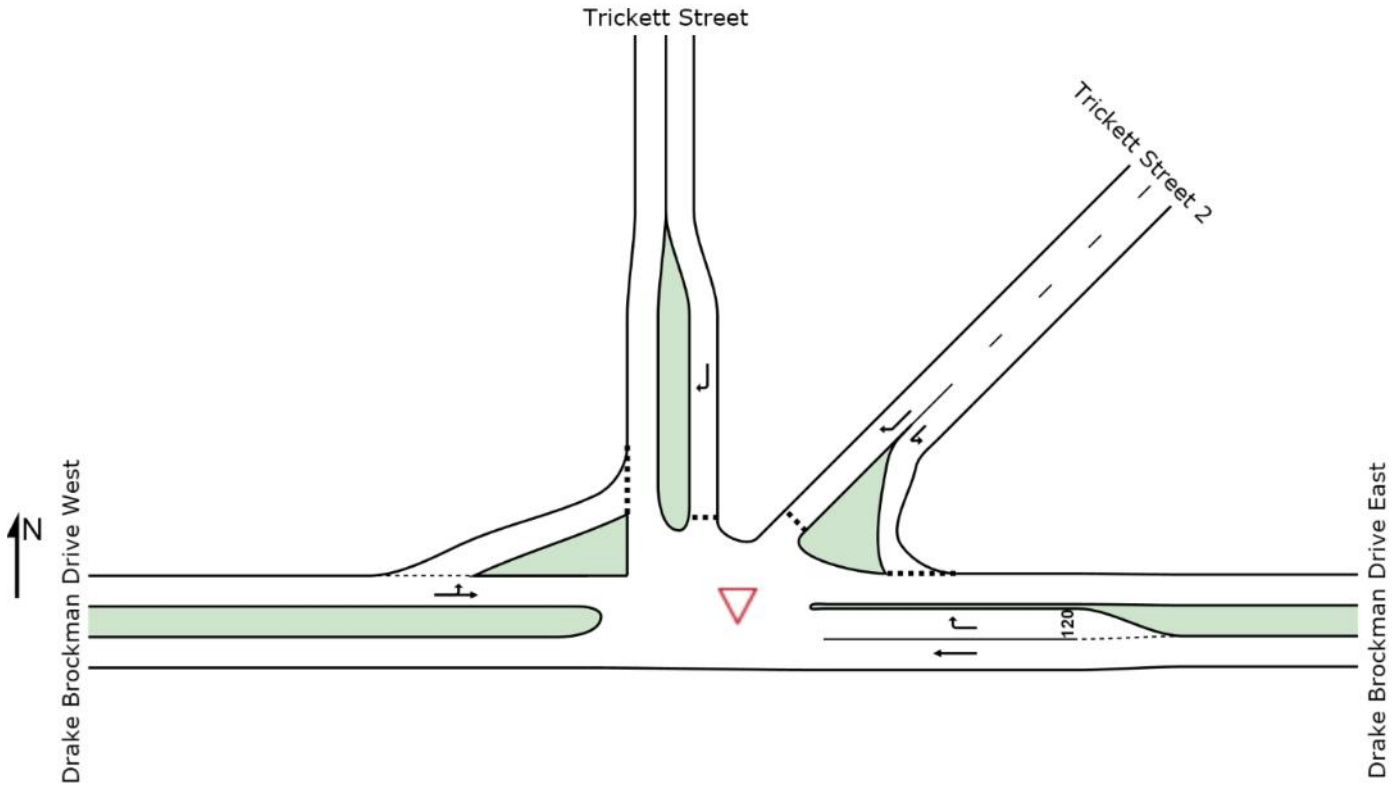
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

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

SITE LAYOUT

Site: 2021 AM DBD / Trickett Street

Giveway / Yield (Two-Way)



Organisation: AECOM AUSTRALIA PTY LTD | Created: Wednesday, 3 August 2016 11:28:34 AM
Project: P:\CBR\60501930\4. Tech work area\4.1 Traffic\SIDRA\DBD SIDRA rev2.sip6

MOVEMENT SUMMARY

Site: 2021 AM DBD / Trickett Street

Network: 2021 AM

Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Drake Brockman Drive East													
5	T1	224	2.5	224	2.5	0.116	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
6	R2	102	2.5	102	2.5	0.102	7.9	LOS A	0.4	3.1	0.54	0.73	52.1
Approach		326	2.5	326	2.5	0.116	2.5	NA	0.4	3.1	0.17	0.23	56.2
NorthEast: Trickett Street 2													
24b	L3	315	2.5	315	2.5	0.342	10.0	LOS B	1.7	12.2	0.58	0.86	45.8
26a	R1	11	2.5	11	2.5	0.014	6.2	LOS A	0.1	0.4	0.37	0.56	50.0
Approach		325	2.5	325	2.5	0.342	9.9	LOS A	1.7	12.2	0.58	0.85	45.9
North: Trickett Street													
9	R2	10	2.5	10	2.5	0.027	13.1	LOS B	0.1	0.7	0.65	0.80	42.3
Approach		10	2.5	10	2.5	0.027	13.1	LOS B	0.1	0.7	0.65	0.80	42.3
West: Drake Brockman Drive West													
10	L2	18	2.5	18	2.5	0.292	6.1	LOS A	0.1	1.0	0.02	0.02	58.5
11	T1	541	2.5	541	2.5	0.292	0.0	LOS A	0.1	1.0	0.02	0.02	59.1
Approach		559	2.5	559	2.5	0.292	0.2	NA	0.1	1.0	0.02	0.02	59.1
All Vehicles		1220	2.5	1220	2.5	0.342	3.5	NA	1.7	12.2	0.21	0.30	53.4

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

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

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

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

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

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

MOVEMENT SUMMARY

Site: 2021 PM DBD / Trickett Street

Network: 2021 PM

Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Drake Brockman Drive East													
5	T1	414	2.5	414	2.5	0.214	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
6	R2	347	2.5	347	2.5	0.236	6.3	LOS A	1.2	8.7	0.36	0.60	52.9
Approach		761	2.5	761	2.5	0.236	2.9	NA	1.2	8.7	0.17	0.28	55.5
NorthEast: Trickett Street 2													
24b	L3	51	2.5	51	2.5	0.038	7.4	LOS A	0.1	1.1	0.29	0.57	48.0
26a	R1	8	2.5	8	2.5	0.015	8.3	LOS A	0.1	0.4	0.51	0.64	47.2
Approach		59	2.5	59	2.5	0.038	7.5	LOS A	0.1	1.1	0.32	0.58	47.9
North: Trickett Street													
9	R2	8	2.5	8	2.5	0.018	11.1	LOS B	0.1	0.4	0.57	0.73	44.3
Approach		8	2.5	8	2.5	0.018	11.1	LOS B	0.1	0.4	0.57	0.73	44.3
West: Drake Brockman Drive West													
10	L2	21	2.5	21	2.5	0.125	7.0	LOS A	0.2	1.3	0.10	0.05	57.7
11	T1	207	2.5	207	2.5	0.125	0.2	LOS A	0.2	1.3	0.10	0.05	57.0
Approach		228	2.5	228	2.5	0.125	0.8	NA	0.2	1.3	0.10	0.05	57.1
All Vehicles		1056	2.5	1056	2.5	0.236	2.8	NA	1.2	8.7	0.16	0.25	55.2

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

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

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

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

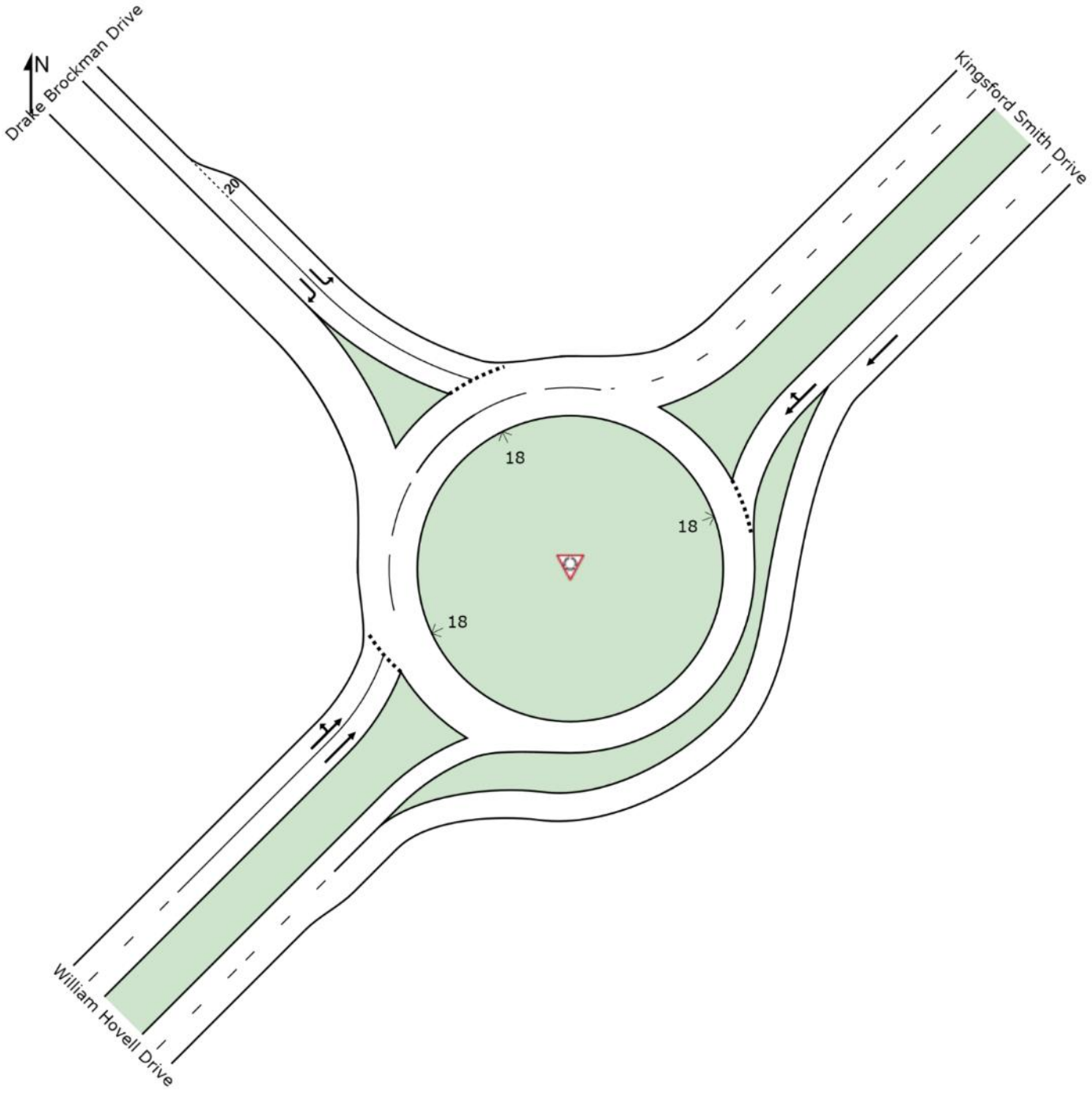
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

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

SITE LAYOUT

Site: 2021 AM DBD / WHD / KSD

Roundabout



Organisation: AECOM AUSTRALIA PTY LTD | Created: Wednesday, 3 August 2016 11:26:49 AM
Project: P:\CBR\60501930\4. Tech work area\4.1 Traffic\SIDRA\DBD SIDRA rev2.sip6

MOVEMENT SUMMARY

Site: 2021 AM DBD / WHD / KSD

Network: 2021 AM

Roundabout

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
NorthEast: Kingsford Smith Drive													
25	T1	924	2.5	924	2.5	0.350	5.2	LOS A	2.5	17.8	0.18	0.51	54.2
26	R2	105	2.5	105	2.5	0.350	13.0	LOS B	2.5	17.8	0.80	0.82	39.2
Approach		1029	2.5	1029	2.5	0.350	6.0	LOS A	2.5	17.8	0.24	0.54	53.4
NorthWest: Drake Brockman Drive													
27	L2	432	2.5	432	2.5	0.365	4.8	LOS A	2.4	17.2	0.30	0.50	52.3
29	R2	786	2.5	786	2.5	0.541	9.2	LOS A	4.6	33.0	0.35	0.60	51.8
Approach		1218	2.5	1218	2.5	0.541	7.6	LOS A	4.6	33.0	0.33	0.56	51.9
SouthWest: William Hovell Drive													
30	L2	67	2.5	67	2.5	0.053	4.6	LOS A	0.3	2.4	0.30	0.47	50.9
31	T1	77	2.5	77	2.5	0.053	4.8	LOS A	0.3	2.4	0.31	0.43	53.6
Approach		144	2.5	144	2.5	0.053	4.7	LOS A	0.3	2.4	0.31	0.45	52.6
All Vehicles		2391	2.5	2391	2.5	0.541	6.7	LOS A	4.6	33.0	0.29	0.55	52.5

Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 2021 PM DBD / WHD / KSD

Network: 2021 PM

Roundabout

Movement Performance - Vehicles

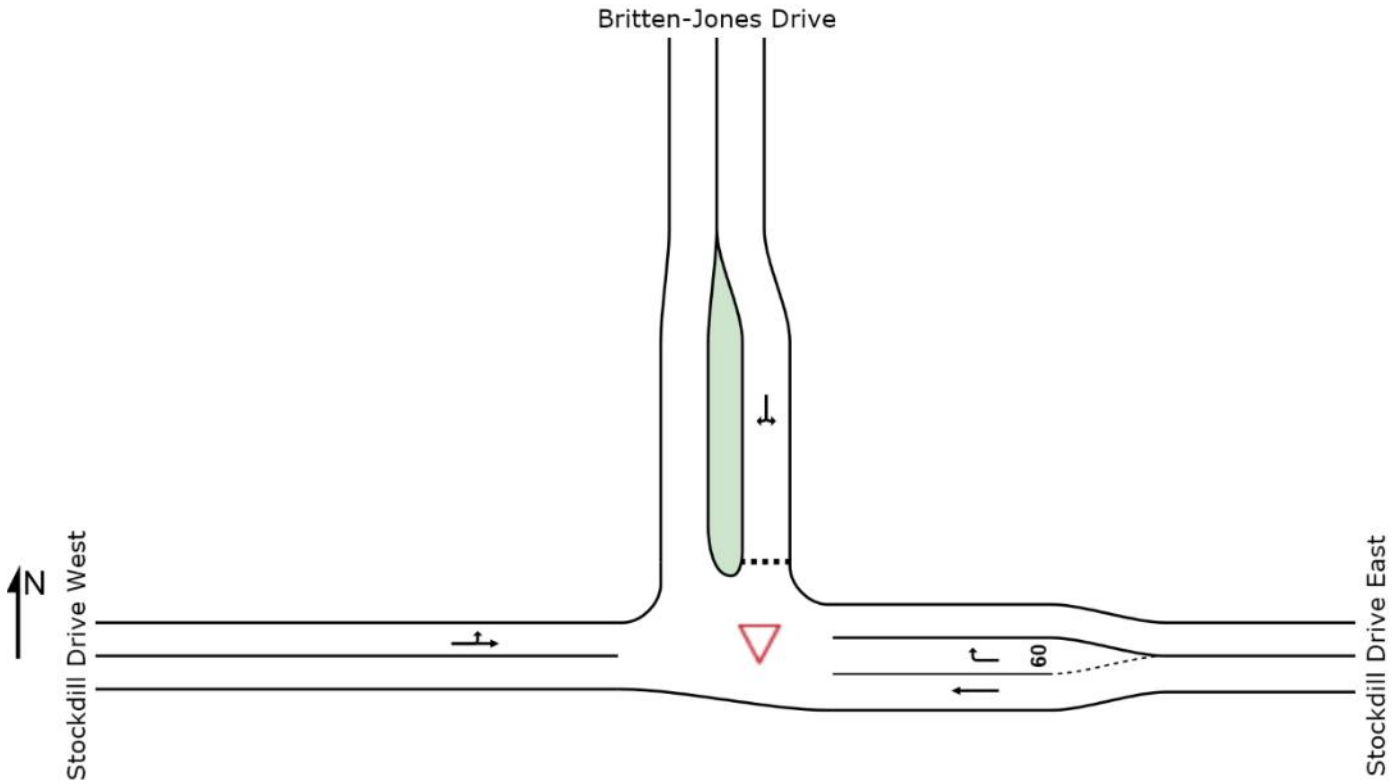
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
NorthEast: Kingsford Smith Drive													
25	T1	386	2.5	386	2.5	0.189	4.2	LOS A	0.0	0.0	0.00	0.42	55.6
26	R2	346	2.5	346	2.5	0.249	9.2	LOS A	1.6	11.2	0.38	0.63	39.6
Approach		732	2.5	732	2.5	0.249	6.6	LOS A	1.6	11.2	0.18	0.52	50.2
NorthWest: Drake Brockman Drive													
27	L2	140	2.5	140	2.5	0.241	8.7	LOS A	1.3	9.3	0.76	0.88	49.4
29	R2	172	2.5	172	2.5	0.251	12.4	LOS B	1.4	10.2	0.77	0.89	50.2
Approach		312	2.5	312	2.5	0.251	10.7	LOS B	1.4	10.2	0.76	0.88	49.9
SouthWest: William Hovell Drive													
30	L2	585	2.5	585	2.5	0.657	8.0	LOS A	7.4	52.9	0.80	0.76	47.5
31	T1	882	2.5	882	2.5	0.657	8.9	LOS A	7.4	52.9	0.82	0.80	50.9
Approach		1467	2.5	1467	2.5	0.657	8.6	LOS A	7.4	52.9	0.81	0.78	49.8
All Vehicles		2511	2.5	2511	2.5	0.657	8.3	LOS A	7.4	52.9	0.62	0.72	49.9

Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

Site: 2031 AM Stockdill Drive / Britten-Jones Drive

Giveway / Yield (Two-Way)



Organisation: AECOM AUSTRALIA PTY LTD | Created: Wednesday, 3 August 2016 11:47:59 AM
Project: P:\CBR\60501930\4. Tech work area\4.1 Traffic\SIDRA\DBD SIDRA rev2.sip6

MOVEMENT SUMMARY

Site: 2031 AM Stockdill Drive / Britten-Jones Drive

Network: 2031 AM

Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Stockdill Drive East													
5	T1	476	2.5	476	2.5	0.242	0.0	LOS A	0.0	0.0	0.00	0.00	59.9
6	R2	39	2.5	39	2.5	0.123	16.8	LOS C	0.4	2.9	0.84	0.93	44.1
Approach		515	2.5	515	2.5	0.242	1.3	NA	0.4	2.9	0.06	0.07	58.4
North: Britten-Jones Drive													
7	L2	63	2.5	63	2.5	0.222	17.5	LOS C	0.7	5.2	0.85	0.95	37.7
9	R2	1	2.5	1	2.5	0.222	72.8	LOS F	0.7	5.2	0.85	0.95	45.0
Approach		64	2.5	64	2.5	0.222	18.4	LOS C	0.7	5.2	0.85	0.95	37.8
West: Stockdill Drive West													
10	L2	11	2.5	11	2.5	0.587	5.7	LOS A	0.0	0.0	0.00	0.01	58.0
11	T1	1126	2.5	1126	2.5	0.587	0.1	LOS A	0.0	0.0	0.00	0.01	59.7
Approach		1137	2.5	1137	2.5	0.587	0.2	NA	0.0	0.0	0.00	0.01	59.6
All Vehicles		1716	2.5	1716	2.5	0.587	1.2	NA	0.7	5.2	0.05	0.06	58.1

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

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

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

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

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

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

MOVEMENT SUMMARY

Site: 2031 PM Stockdill Drive / Britten-Jones Drive

Network: 2031 PM

Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Stockdill Drive East													
5	T1	884	2.5	884	2.5	0.449	0.0	LOS A	0.0	0.0	0.00	0.00	59.9
6	R2	156	2.5	156	2.5	0.147	7.7	LOS A	0.6	4.6	0.53	0.72	50.6
Approach		1040	2.5	1040	2.5	0.449	1.2	NA	0.6	4.6	0.08	0.11	58.3
North: Britten-Jones Drive													
7	L2	60	2.5	60	2.5	0.091	7.5	LOS A	0.3	2.3	0.55	0.71	46.2
9	R2	3	2.5	3	2.5	0.091	44.9	LOS E	0.3	2.3	0.55	0.71	50.7
Approach		63	2.5	63	2.5	0.091	9.3	LOS A	0.3	2.3	0.55	0.71	46.6
West: Stockdill Drive West													
10	L2	15	2.5	15	2.5	0.254	5.6	LOS A	0.0	0.0	0.00	0.02	58.1
11	T1	476	2.5	476	2.5	0.254	0.0	LOS A	0.0	0.0	0.00	0.02	59.6
Approach		491	2.5	491	2.5	0.254	0.2	NA	0.0	0.0	0.00	0.02	59.5
All Vehicles		1594	2.5	1594	2.5	0.449	1.2	NA	0.6	4.6	0.07	0.10	58.1

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

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

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

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

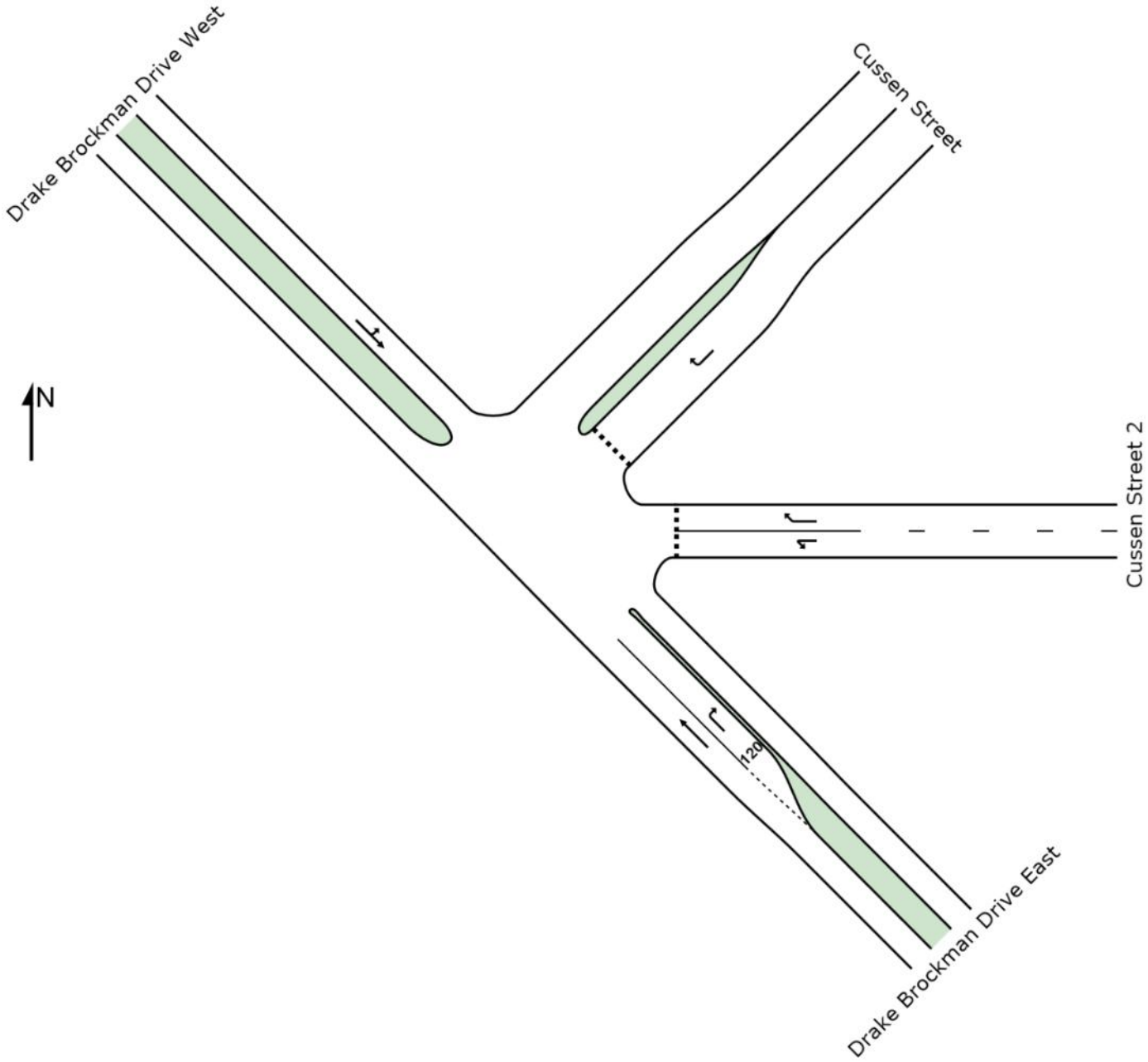
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

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

SITE LAYOUT

Site: 2031 AM DBD / Cussen Street

Giveway / Yield (Two-Way)



Organisation: AECOM AUSTRALIA PTY LTD | Created: Wednesday, 3 August 2016 11:46:37 AM
Project: P:\CBR\60501930\4. Tech work area\4.1 Traffic\SIDRA\DBD SIDRA rev2.sip6

MOVEMENT SUMMARY

Site: 2031 AM DBD / Cussen Street

Network: 2031 AM

Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: Drake Brockman Drive East													
22	T1	548	2.5	548	2.5	0.283	0.0	LOS A	0.0	0.0	0.00	0.00	59.9
23	R2	45	2.5	45	2.5	0.661	104.9	LOS F	2.2	15.8	0.99	1.07	19.7
Approach		593	2.5	593	2.5	0.661	8.0	NA	2.2	15.8	0.07	0.08	49.4
East: Cussen Street 2													
4b	L3	6	2.5	6	2.5	0.089	54.1	LOS F	0.2	1.7	0.96	0.98	14.4
6a	R1	1	2.5	1	2.5	0.002	10.2	LOS B	0.0	0.1	0.59	0.61	37.2
Approach		7	2.5	7	2.5	0.089	47.8	LOS E	0.2	1.7	0.91	0.93	15.7
NorthEast: Cussen Street													
26	R2	1	2.5	1	2.5	0.090	281.0	LOS F	0.2	1.5	0.99	1.00	3.3
Approach		1	2.5	1	2.5	0.090	281.0	LOS F	0.2	1.5	0.99	1.00	3.3
NorthWest: Drake Brockman Drive West													
27	L2	16	2.5	16	2.5	0.820	5.9	LOS A	0.0	0.0	0.00	0.01	56.7
28	T1	1573	2.5	1573	2.5	0.820	0.4	LOS A	0.0	0.0	0.00	0.01	59.2
Approach		1589	2.5	1589	2.5	0.820	0.4	NA	0.0	0.0	0.00	0.01	59.1
All Vehicles		2190	2.5	2190	2.5	0.820	2.8	NA	2.2	15.8	0.02	0.03	55.2

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

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

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

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

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

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

MOVEMENT SUMMARY

Site: 2031 PM DBD / Cussen Street

Network: 2031 PM

Giveway / Yield (Two-Way)

Movement Performance - Vehicles													
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: Drake Brockman Drive East													
22	T1	1438	2.5	1438	2.5	0.742	0.3	LOS A	0.0	0.0	0.00	0.00	59.5
23	R2	105	2.5	105	2.5	0.091	7.4	LOS A	0.4	3.1	0.49	0.65	50.7
Approach		1543	2.5	1543	2.5	0.742	0.8	NA	0.4	3.1	0.03	0.04	58.6
East: Cussen Street 2													
4b	L3	67	2.5	67	2.5	0.063	8.2	LOS A	0.3	1.9	0.46	0.66	40.3
6a	R1	1	2.5	1	2.5	0.087	253.9	LOS F	0.2	1.5	0.99	0.99	3.7
Approach		68	2.5	68	2.5	0.087	12.0	LOS B	0.3	1.9	0.46	0.67	35.0
NorthEast: Cussen Street													
26	R2	1	2.5	1	2.5	0.002	10.3	LOS B	0.0	0.1	0.55	0.61	37.0
Approach		1	2.5	1	2.5	0.002	10.3	LOS B	0.0	0.1	0.55	0.61	37.0
NorthWest: Drake Brockman Drive West													
27	L2	7	2.5	7	2.5	0.234	5.6	LOS A	0.0	0.0	0.00	0.01	57.2
28	T1	446	2.5	446	2.5	0.234	0.0	LOS A	0.0	0.0	0.00	0.01	59.8
Approach		453	2.5	453	2.5	0.234	0.1	NA	0.0	0.0	0.00	0.01	59.7
All Vehicles		2065	2.5	2065	2.5	0.742	1.0	NA	0.4	3.1	0.04	0.06	58.2

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

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

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

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

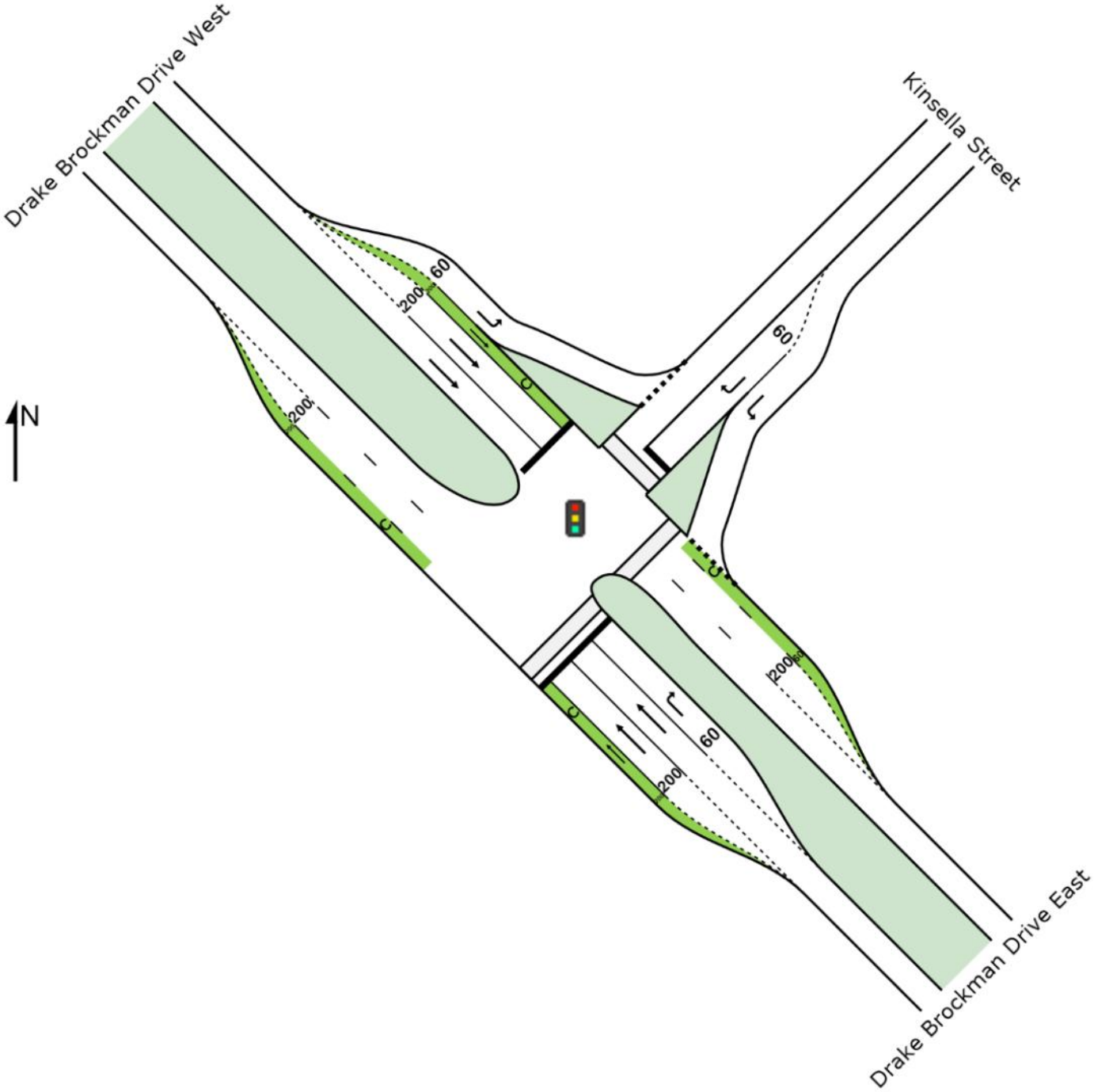
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

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

SITE LAYOUT

Site: 2031 AM DBD / Kinsella Street

Signals - Fixed Time Isolated



MOVEMENT SUMMARY

Site: 2031 AM DBD / Kinsella Street

Network: 2031 AM

Signals - Fixed Time Coordinated Cycle Time = 100 seconds (Network Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: Drake Brockman Drive East													
22	T1	631	2.5	631	2.5	0.237	6.4	LOS A	5.7	40.8	0.41	0.35	49.2
23	R2	11	2.5	11	2.5	0.099	56.1	LOS E	0.5	3.8	0.97	0.67	30.7
Approach		642	2.5	642	2.5	0.237	7.3	LOS A	5.7	40.8	0.42	0.36	48.0
NorthEast: Kinsella Street													
24	L2	201	2.5	201	2.5	0.250	11.7	LOS B	3.7	26.4	0.46	0.69	43.6
26	R2	2	2.5	2	2.5	0.005	39.6	LOS D	0.1	0.6	0.82	0.61	26.4
Approach		203	2.5	203	2.5	0.250	12.0	LOS B	3.7	26.4	0.47	0.69	43.3
NorthWest: Drake Brockman Drive West													
27	L2	13	2.5	13	2.5	0.008	6.0	LOS A	0.0	0.3	0.13	0.57	54.2
28	T1	1581	2.5	1581	2.5	0.621	15.2	LOS B	22.0	157.3	0.70	0.63	42.4
Approach		1594	2.5	1594	2.5	0.621	15.2	LOS B	22.0	157.3	0.70	0.63	42.5
All Vehicles		2439	2.5	2439	2.5	0.621	12.8	LOS B	22.0	157.3	0.60	0.56	43.7

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P5	SouthEast Full Crossing	21	44.2	LOS E	0.1	0.1	0.94	0.94
P6	NorthEast Full Crossing	21	12.5	LOS B	0.0	0.0	0.50	0.50
All Pedestrians		42	28.4	LOS C			0.72	0.72

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

MOVEMENT SUMMARY

Site: 2031 PM DBD / Kinsella Street

Network: 2031 PM

Signals - Fixed Time Coordinated Cycle Time = 100 seconds (Network Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: Drake Brockman Drive East													
22	T1	1733	2.5	1733	2.5	0.553	3.8	LOS A	14.7	105.4	0.39	0.36	53.0
23	R2	54	2.5	54	2.5	0.172	44.5	LOS D	2.3	16.4	0.89	0.74	34.0
Approach		1787	2.5	1787	2.5	0.553	5.0	LOS A	14.7	105.4	0.40	0.37	51.2
NorthEast: Kinsella Street													
24	L2	34	2.5	34	2.5	0.029	6.4	LOS A	0.2	1.2	0.17	0.58	49.8
26	R2	4	2.5	4	2.5	0.026	52.5	LOS D	0.2	1.3	0.94	0.64	22.4
Approach		38	2.5	38	2.5	0.029	11.3	LOS B	0.2	1.3	0.25	0.59	44.1
NorthWest: Drake Brockman Drive West													
27	L2	6	2.5	6	2.5	0.004	6.2	LOS A	0.0	0.2	0.14	0.57	54.2
28	T1	446	2.5	446	2.5	0.172	10.7	LOS B	4.3	31.1	0.50	0.42	46.4
Approach		452	2.5	452	2.5	0.172	10.7	LOS B	4.3	31.1	0.50	0.42	46.6
All Vehicles		2277	2.5	2277	2.5	0.553	6.2	LOS A	14.7	105.4	0.42	0.38	49.9

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

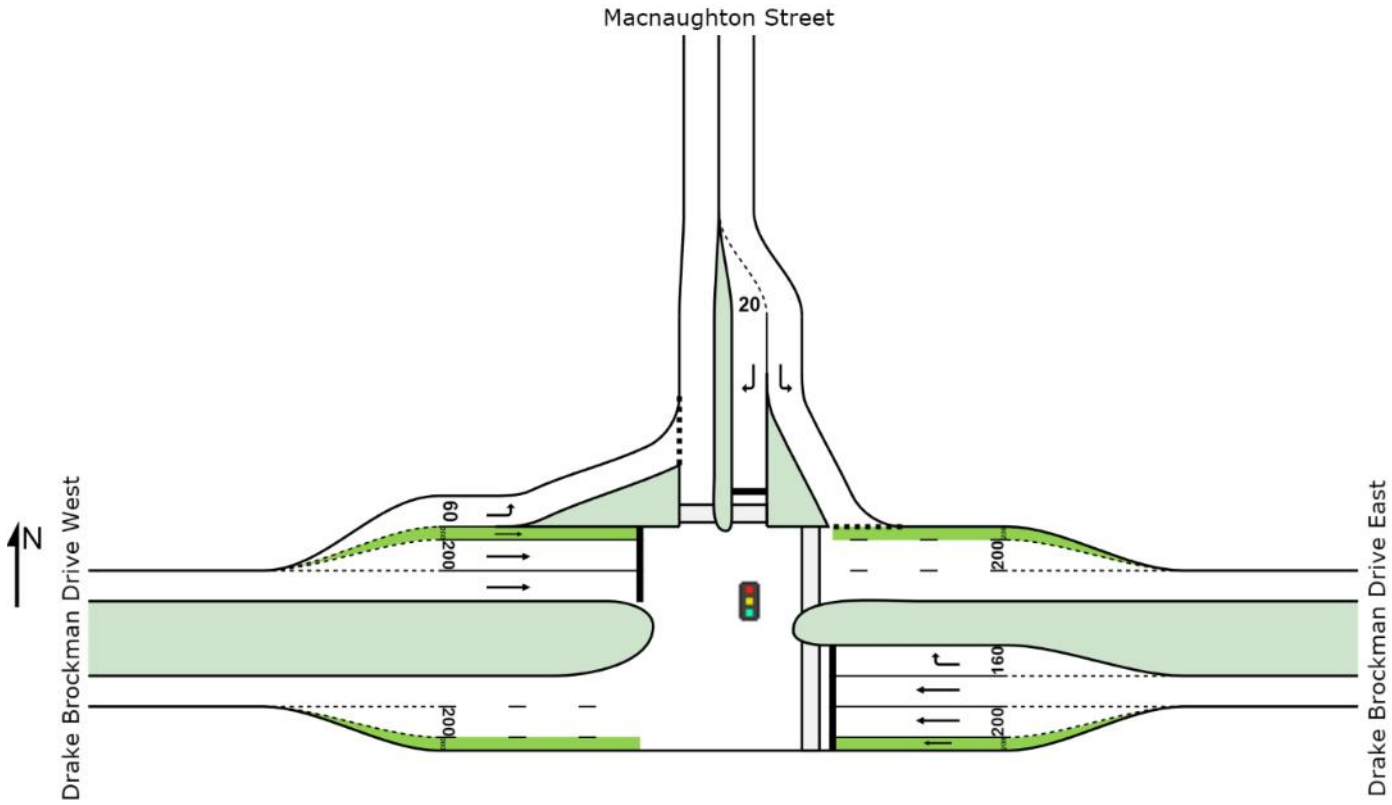
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P5	SouthEast Full Crossing	21	44.2	LOS E	0.1	0.1	0.94	0.94
P6	NorthEast Full Crossing	21	12.0	LOS B	0.0	0.0	0.49	0.49
All Pedestrians		42	28.1	LOS C			0.72	0.72

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

SITE LAYOUT

Site: 2031 AM DBD / Macnaughton Street

Signals - Fixed Time Isolated



Organisation: AECOM AUSTRALIA PTY LTD | Created: Wednesday, 3 August 2016 11:46:56 AM
Project: P:\CBR\60501930\4. Tech work area\4.1 Traffic\SIDRA\DBD SIDRA rev2.sip6

MOVEMENT SUMMARY

Site: 2031 AM DBD / Macnaughton Street

Network: 2031 AM

Signals - Fixed Time Isolated Cycle Time = 95 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Drake Brockman Drive East													
5	T1	485	2.5	485	2.5	0.155	2.0	LOS A	2.4	16.8	0.23	0.20	55.8
6	R2	107	2.5	107	2.5	0.560	51.5	LOS D	5.0	35.6	1.00	0.79	31.3
Approach		592	2.5	592	2.5	0.560	11.0	LOS B	5.0	35.6	0.37	0.30	45.0
North: Macnaughton Street													
7	L2	272	2.5	272	2.5	0.390	10.9	LOS B	4.7	33.7	0.47	0.70	43.8
9	R2	5	2.5	5	2.5	0.042	52.6	LOS D	0.2	1.6	0.96	0.64	21.5
Approach		277	2.5	277	2.5	0.390	11.7	LOS B	4.7	33.7	0.48	0.70	43.0
West: Drake Brockman Drive West													
10	L2	19	2.5	19	2.5	0.013	6.5	LOS A	0.1	0.7	0.19	0.58	53.9
11	T1	1431	2.5	1431	2.5	0.569	10.2	LOS B	18.3	130.8	0.61	0.55	47.1
Approach		1450	2.5	1450	2.5	0.569	10.1	LOS B	18.3	130.8	0.60	0.55	47.1
All Vehicles		2319	2.5	2319	2.5	0.569	10.5	LOS B	18.3	130.8	0.53	0.51	46.2

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P2	East Full Crossing	20	41.7	LOS E	0.1	0.1	0.94	0.94
P3	North Full Crossing	20	8.9	LOS A	0.0	0.0	0.43	0.43
All Pedestrians		40	25.3	LOS C			0.68	0.68

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

MOVEMENT SUMMARY

Site: 2031 PM DBD / Macnaughton Street

Network: 2031 PM

Signals - Fixed Time Isolated Cycle Time = 55 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Drake Brockman Drive East													
5	T1	1153	2.5	1153	2.5	0.444	4.5	LOS A	7.2	51.3	0.50	0.44	51.7
6	R2	236	2.5	236	2.5	0.477	24.3	LOS C	5.5	39.3	0.88	0.80	41.5
Approach		1389	2.5	1389	2.5	0.477	7.9	LOS A	7.2	51.3	0.56	0.50	48.2
North: Macnaughton Street													
7	L2	105	2.5	105	2.5	0.099	7.3	LOS A	0.6	4.4	0.35	0.63	47.9
9	R2	19	2.5	19	2.5	0.092	30.8	LOS C	0.5	3.5	0.93	0.69	29.3
Approach		124	2.5	124	2.5	0.099	10.9	LOS B	0.6	4.4	0.44	0.64	43.7
West: Drake Brockman Drive West													
10	L2	15	2.5	15	2.5	0.013	7.2	LOS A	0.1	0.6	0.32	0.60	53.4
11	T1	513	2.5	513	2.5	0.450	17.6	LOS B	5.7	41.1	0.86	0.72	40.8
Approach		528	2.5	528	2.5	0.450	17.4	LOS B	5.7	41.1	0.85	0.71	41.2
All Vehicles		2041	2.5	2041	2.5	0.477	10.5	LOS B	7.2	51.3	0.63	0.57	45.7

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

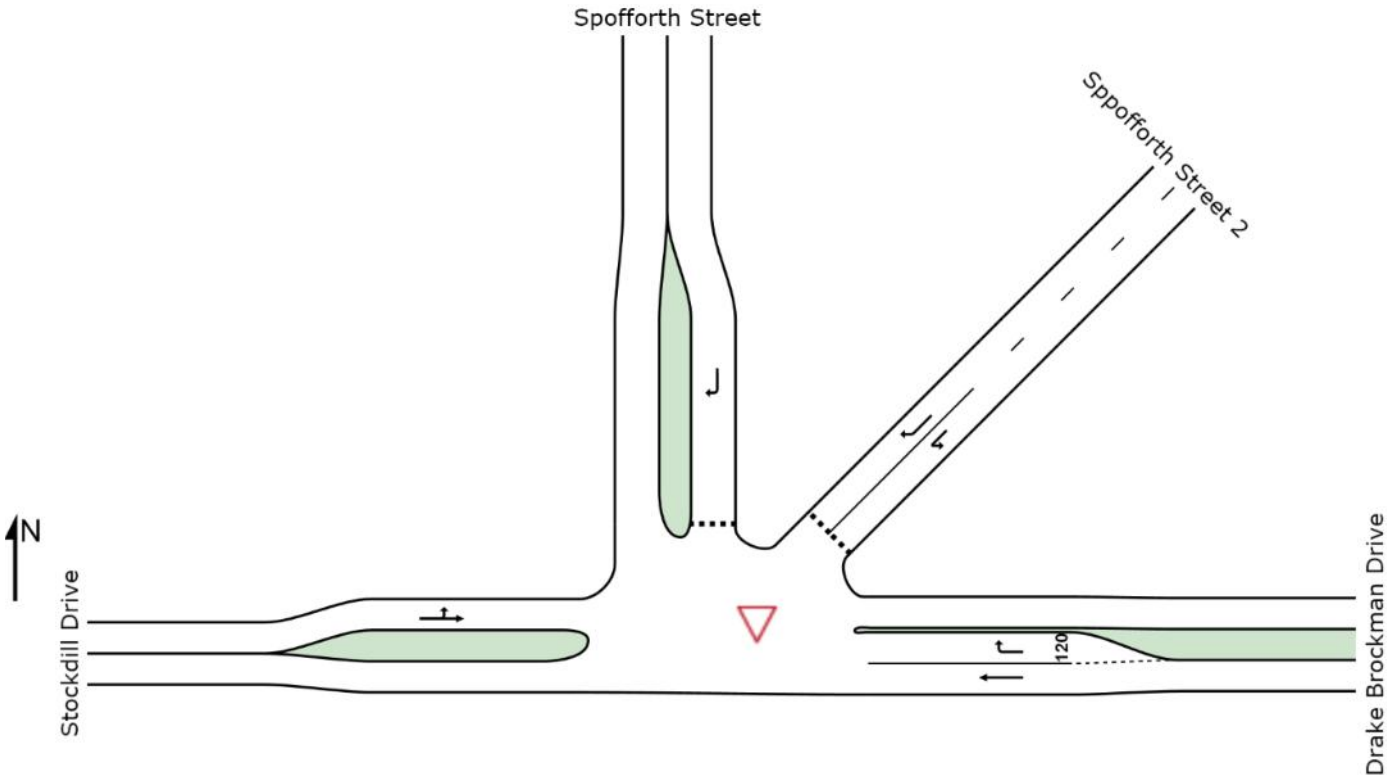
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P2	East Full Crossing	20	21.8	LOS C	0.0	0.0	0.89	0.89
P3	North Full Crossing	20	19.3	LOS B	0.0	0.0	0.84	0.84
All Pedestrians		40	20.5	LOS C			0.86	0.86

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

SITE LAYOUT

Site: 2031 AM DBD / Spofforth Street / Stockdill Drive

Giveway / Yield (Two-Way)



Organisation: AECOM AUSTRALIA PTY LTD | Created: Wednesday, 3 August 2016 11:47:43 AM
Project: P:\CBR\60501930\4. Tech work area\4.1 Traffic\SIDRA\DBD SIDRA rev2.sip6

MOVEMENT SUMMARY

Site: 2031 AM DBD / Spofforth Street / Stockdill Drive

Network: 2031 AM

Giveway / Yield (Two-Way)

Movement Performance - Vehicles													
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Drake Brockman Drive													
5	T1	474	2.5	474	2.5	0.244	0.0	LOS A	0.0	0.0	0.00	0.00	59.9
6	R2	11	2.5	11	2.5	0.035	16.4	LOS C	0.1	0.8	0.83	0.93	46.4
Approach		485	2.5	485	2.5	0.244	0.4	NA	0.1	0.8	0.02	0.02	58.7
NorthEast: Sppofforth Street 2													
24b	L3	94	2.5	94	2.5	0.204	14.0	LOS B	0.7	5.1	0.76	0.92	46.1
26a	R1	1	2.5	1	2.5	0.001	6.7	LOS A	0.0	0.0	0.44	0.55	52.4
Approach		95	2.5	95	2.5	0.204	13.9	LOS B	0.7	5.1	0.76	0.91	46.2
North: Spofforth Street													
9	R2	1	2.5	1	2.5	0.004	16.7	LOS C	0.0	0.1	0.79	0.82	44.0
Approach		1	2.5	1	2.5	0.004	16.7	LOS C	0.0	0.1	0.79	0.82	44.0
West: Stockdill Drive													
10	L2	180	2.5	180	2.5	0.593	5.6	LOS A	0.0	0.0	0.00	0.58	53.8
11	T1	960	2.5	960	2.5	0.593	5.9	LOS A	0.0	0.0	0.00	0.58	47.7
Approach		1140	2.5	1140	2.5	0.593	5.9	NA	0.0	0.0	0.00	0.58	49.7
All Vehicles		1721	2.5	1721	2.5	0.593	4.8	NA	0.7	5.1	0.05	0.44	50.9

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

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

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

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

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

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

MOVEMENT SUMMARY

Site: 2031 PM DBD / Spofforth Street / Stockdill Drive

Network: 2031 PM

Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Drake Brockman Drive													
5	T1	963	2.5	963	2.5	0.497	0.0	LOS A	0.0	0.0	0.00	0.00	59.8
6	R2	39	2.5	39	2.5	0.037	7.5	LOS A	0.2	1.1	0.50	0.66	52.1
Approach		1002	2.5	1002	2.5	0.497	0.3	NA	0.2	1.1	0.02	0.03	58.8
NorthEast: Sppofforth Street 2													
24b	L3	159	2.5	159	2.5	0.149	8.3	LOS A	0.6	4.3	0.46	0.71	50.8
26a	R1	12	2.5	12	2.5	0.038	14.0	LOS B	0.1	0.8	0.76	0.88	46.0
Approach		171	2.5	171	2.5	0.149	8.6	LOS A	0.6	4.3	0.48	0.72	50.5
North: Spofforth Street													
9	R2	11	2.5	11	2.5	0.015	8.0	LOS A	0.0	0.3	0.45	0.66	51.1
Approach		11	2.5	11	2.5	0.015	8.0	LOS A	0.0	0.3	0.45	0.66	51.1
West: Stockdill Drive													
10	L2	70	2.5	70	2.5	0.255	5.6	LOS A	0.0	0.0	0.00	0.59	53.9
11	T1	421	2.5	421	2.5	0.255	5.8	LOS A	0.0	0.0	0.00	0.59	47.8
Approach		491	2.5	491	2.5	0.255	5.8	NA	0.0	0.0	0.00	0.59	49.7
All Vehicles		1675	2.5	1675	2.5	0.497	2.8	NA	0.6	4.3	0.06	0.26	53.7

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

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

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

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

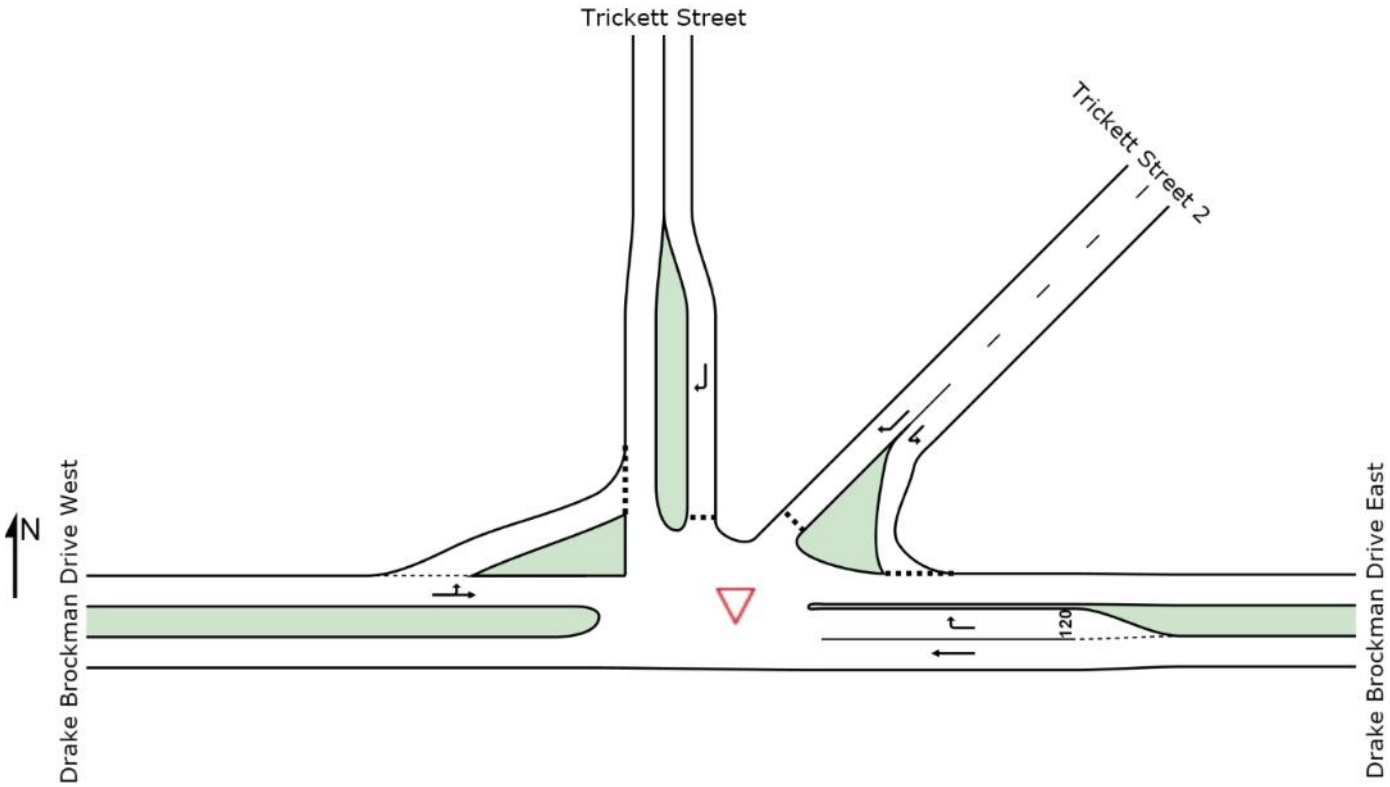
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

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

SITE LAYOUT

Site: 2031 AM DBD / Trickett Street

Giveway / Yield (Two-Way)



Organisation: AECOM AUSTRALIA PTY LTD | Created: Wednesday, 3 August 2016 11:47:14 AM
Project: P:\CBR\60501930\4. Tech work area\4.1 Traffic\SIDRA\DBD SIDRA rev2.sip6

MOVEMENT SUMMARY

Site: 2031 AM DBD / Trickett Street

Network: 2031 AM

Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Drake Brockman Drive East													
5	T1	487	2.5	487	2.5	0.251	0.0	LOS A	0.0	0.0	0.00	0.00	59.9
6	R2	94	2.5	94	2.5	0.291	18.6	LOS C	1.1	7.7	0.86	0.98	45.9
Approach		581	2.5	581	2.5	0.291	3.0	NA	1.1	7.7	0.14	0.16	55.6
NorthEast: Trickett Street 2													
24b	L3	299	2.5	299	2.5	0.980	68.7	LOS F	12.0	85.8	1.00	1.97	19.1
26a	R1	9	2.5	9	2.5	0.019	9.4	LOS A	0.1	0.5	0.55	0.69	45.9
Approach		308	2.5	308	2.5	0.980	66.9	LOS F	12.0	85.8	0.98	1.93	19.5
North: Trickett Street													
9	R2	9	2.5	9	2.5	0.131	55.8	LOS F	0.4	2.6	0.94	0.98	21.5
Approach		9	2.5	9	2.5	0.131	55.8	LOS F	0.4	2.6	0.94	0.98	21.5
West: Drake Brockman Drive West													
10	L2	24	2.5	24	2.5	0.600	6.4	LOS A	0.3	2.2	0.02	0.01	58.6
11	T1	1131	2.5	1131	2.5	0.600	0.0	LOS A	0.3	2.2	0.02	0.01	59.4
Approach		1155	2.5	1155	2.5	0.600	0.2	NA	0.3	2.2	0.02	0.01	59.3
All Vehicles		2053	2.5	2053	2.5	0.980	11.2	NA	12.0	85.8	0.20	0.35	42.5

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

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

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

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

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

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

MOVEMENT SUMMARY

Site: 2031 PM DBD / Trickett Street

Network: 2031 PM

Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Drake Brockman Drive East													
5	T1	903	2.5	903	2.5	0.466	0.1	LOS A	0.0	0.0	0.00	0.00	59.9
6	R2	274	2.5	274	2.5	0.235	7.4	LOS A	1.1	7.7	0.50	0.71	52.5
Approach		1177	2.5	1177	2.5	0.466	1.8	NA	1.1	7.7	0.12	0.17	57.0
NorthEast: Trickett Street 2													
24b	L3	96	2.5	96	2.5	0.089	8.4	LOS A	0.3	2.5	0.45	0.67	47.2
26a	R1	16	2.5	16	2.5	0.087	23.4	LOS C	0.3	2.0	0.84	0.93	34.0
Approach		112	2.5	112	2.5	0.089	10.5	LOS B	0.3	2.5	0.50	0.71	44.8
North: Trickett Street													
9	R2	15	2.5	15	2.5	0.042	13.7	LOS B	0.1	1.0	0.67	0.84	41.8
Approach		15	2.5	15	2.5	0.042	13.7	LOS B	0.1	1.0	0.67	0.84	41.8
West: Drake Brockman Drive West													
10	L2	22	2.5	22	2.5	0.233	6.8	LOS A	0.2	1.4	0.05	0.03	58.2
11	T1	416	2.5	416	2.5	0.233	0.1	LOS A	0.2	1.4	0.05	0.03	58.3
Approach		438	2.5	438	2.5	0.233	0.4	NA	0.2	1.4	0.05	0.03	58.3
All Vehicles		1742	2.5	1742	2.5	0.466	2.1	NA	1.1	7.7	0.13	0.17	56.2

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

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

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

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

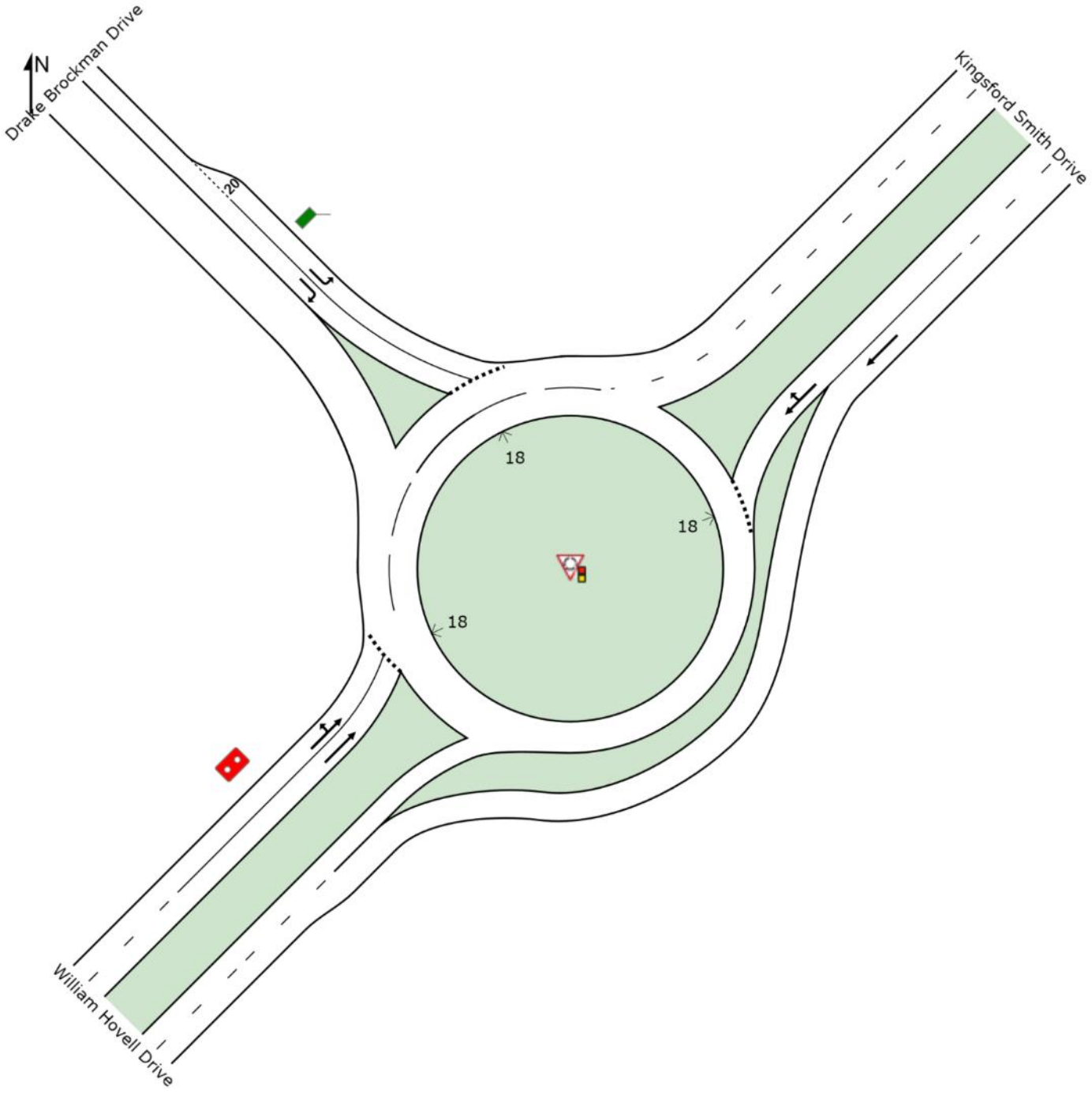
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

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

SITE LAYOUT

Site: 2031 AM DBD / WHD / KSD

Roundabout Metering



MOVEMENT SUMMARY

Site: 2031 AM DBD / WHD / KSD

Network: 2031 AM

Roundabout Metering

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
NorthEast: Kingsford Smith Drive													
25	T1	829	2.5	829	2.5	0.371	4.8	LOS A	2.5	18.2	0.08	0.47	54.7
26	R2	154	2.5	154	2.5	0.371	15.7	LOS B	2.5	18.2	0.91	0.95	34.8
Approach		983	2.5	983	2.5	0.371	6.5	LOS A	2.5	18.2	0.21	0.54	52.6
NorthWest: Drake Brockman Drive													
27	L2	491	2.5	491	2.5	0.431	4.5	LOS A	1.5	10.7	0.31	0.54	52.3
29	R2	1187	2.5	1187	2.5	0.814	9.2	LOS A	6.8	48.7	0.53	0.70	51.2
Approach		1678	2.5	1678	2.5	0.814	7.9	LOS A	6.8	48.7	0.47	0.66	51.5
SouthWest: William Hovell Drive													
30	L2	327	2.5	327	2.5	0.797	22.2	LOS C	12.2	87.0	1.00	1.10	34.9
31	T1	171	2.5	171	2.5	0.529	17.2	LOS B	5.4	38.9	0.93	0.95	44.6
Approach		498	2.5	498	2.5	0.797	20.5	LOS C	12.2	87.0	0.98	1.05	38.7
All Vehicles		3159	2.5	3159	2.5	0.814	9.4	LOS A	12.2	87.0	0.47	0.68	49.9

Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 2031 PM DBD / WHD / KSD

Network: 2031 PM

Roundabout Metering

Movement Performance - Vehicles

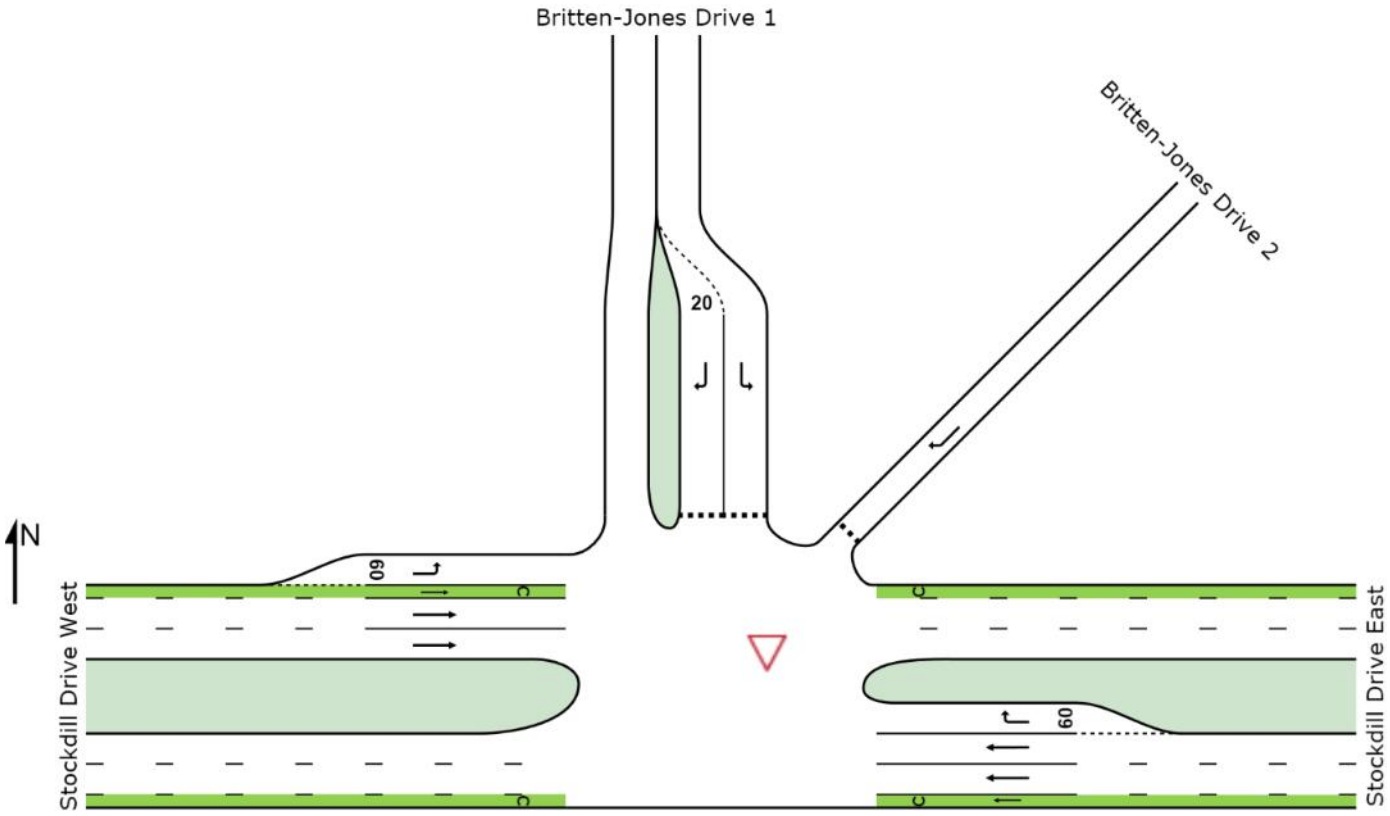
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
NorthEast: Kingsford Smith Drive													
25	T1	259	2.5	259	2.5	0.127	4.2	LOS A	0.0	0.0	0.00	0.42	55.6
26	R2	558	2.5	558	2.5	0.908	50.6	LOS D	35.6	254.8	1.00	1.14	17.0
Approach		817	2.5	817	2.5	0.908	35.9	LOS D	35.6	254.8	0.68	0.91	26.9
NorthWest: Drake Brockman Drive													
27	L2	203	2.5	203	2.5	0.283	8.2	LOS A	2.1	15.1	0.75	0.71	49.8
29	R2	288	2.5	288	2.5	0.350	12.2	LOS B	2.8	20.4	0.77	0.74	50.3
Approach		491	2.5	491	2.5	0.350	10.5	LOS B	2.8	20.4	0.76	0.73	50.1
SouthWest: William Hovell Drive													
30	L2	1030	2.5	1030	2.5	0.916	31.6	LOS C	40.4	288.5	1.00	1.15	29.6
31	T1	764	2.5	764	2.5	0.827	19.7	LOS B	20.8	148.7	1.00	0.99	43.0
Approach		1794	2.5	1794	2.5	0.916	26.5	LOS C	40.4	288.5	1.00	1.08	35.6
All Vehicles		3102	2.5	3102	2.5	0.916	26.5	LOS C	40.4	288.5	0.88	0.98	35.7

Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

Site: 2041 AM Stockdill Drive / Britten-Jones Drive

Giveway / Yield (Two-Way)



Organisation: AECOM AUSTRALIA PTY LTD | Created: Wednesday, 3 August 2016 11:50:50 AM
Project: P:\CBR\60501930\4. Tech work area\4.1 Traffic\SIDRA\DBD SIDRA rev2.sip6

MOVEMENT SUMMARY

Site: 2041 PM Stockdill Drive / Britten-Jones Drive

Network: 2041 PM

Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Stockdill Drive East													
5	T1	2545	2.5	2545	2.5	0.650	0.1	LOS A	0.0	0.0	0.00	0.00	59.5
6	R2	17	2.5	17	2.5	0.026	9.2	LOS A	0.1	0.6	0.45	0.63	50.2
Approach		2562	2.5	2562	2.5	0.650	0.2	NA	0.1	0.6	0.00	0.00	59.4
NorthEast: Britten-Jones Drive 2													
26a	R1	83	2.5	83	2.5	0.338	21.6	LOS C	1.3	9.0	0.82	0.95	44.4
Approach		83	2.5	83	2.5	0.338	21.6	LOS C	1.3	9.0	0.82	0.95	44.4
North: Britten-Jones Drive 1													
7	L2	83	2.5	83	2.5	0.108	8.8	LOS A	0.5	3.4	0.54	0.70	46.8
9	R2	4	2.5	4	2.5	0.005	8.5	LOS A	0.0	0.2	0.51	0.58	51.8
Approach		87	2.5	87	2.5	0.108	8.7	LOS A	0.5	3.4	0.54	0.70	47.2
West: Stockdill Drive West													
10	L2	8	2.5	8	2.5	0.004	5.6	LOS A	0.0	0.0	0.00	0.58	53.6
11	T1	830	2.5	830	2.5	0.212	0.0	LOS A	0.0	0.0	0.00	0.00	59.7
Approach		838	2.5	838	2.5	0.212	0.1	NA	0.0	0.0	0.00	0.01	59.2
All Vehicles		3570	2.5	3570	2.5	0.650	0.9	NA	1.3	9.0	0.03	0.04	58.5

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

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

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

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

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

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

MOVEMENT SUMMARY

Site: 2041 AM Stockdill Drive / Britten-Jones Drive

Network: 2041 AM

Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Stockdill Drive East													
5	T1	864	2.5	864	2.5	0.221	0.0	LOS A	0.0	0.0	0.00	0.00	59.8
6	R2	9	2.5	9	2.5	0.046	27.0	LOS D	0.1	1.1	0.84	0.93	39.1
Approach		873	2.5	873	2.5	0.221	0.3	NA	0.1	1.1	0.01	0.01	59.4
NorthEast: Britten-Jones Drive 2													
26a	R1	1	2.5	1	2.5	0.002	6.1	LOS A	0.0	0.0	0.34	0.49	54.5
Approach		1	2.5	1	2.5	0.002	6.1	LOS A	0.0	0.0	0.34	0.49	54.5
North: Britten-Jones Drive 1													
7	L2	69	2.5	69	2.5	0.281	26.6	LOS D	1.3	9.2	0.86	0.98	32.3
9	R2	1	2.5	1	2.5	0.004	22.1	LOS C	0.0	0.1	0.81	0.74	43.5
Approach		70	2.5	70	2.5	0.281	26.6	LOS D	1.3	9.2	0.86	0.97	32.5
West: Stockdill Drive West													
10	L2	23	2.5	23	2.5	0.012	5.6	LOS A	0.0	0.0	0.00	0.58	53.6
11	T1	2307	2.5	2307	2.5	0.934	1.8	LOS A	0.0	0.0	0.00	0.00	56.5
Approach		2330	2.5	2330	2.5	0.934	1.8	NA	0.0	0.0	0.00	0.01	56.2
All Vehicles		3274	2.5	3274	2.5	0.934	2.0	NA	1.3	9.2	0.02	0.03	56.6

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

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

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

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

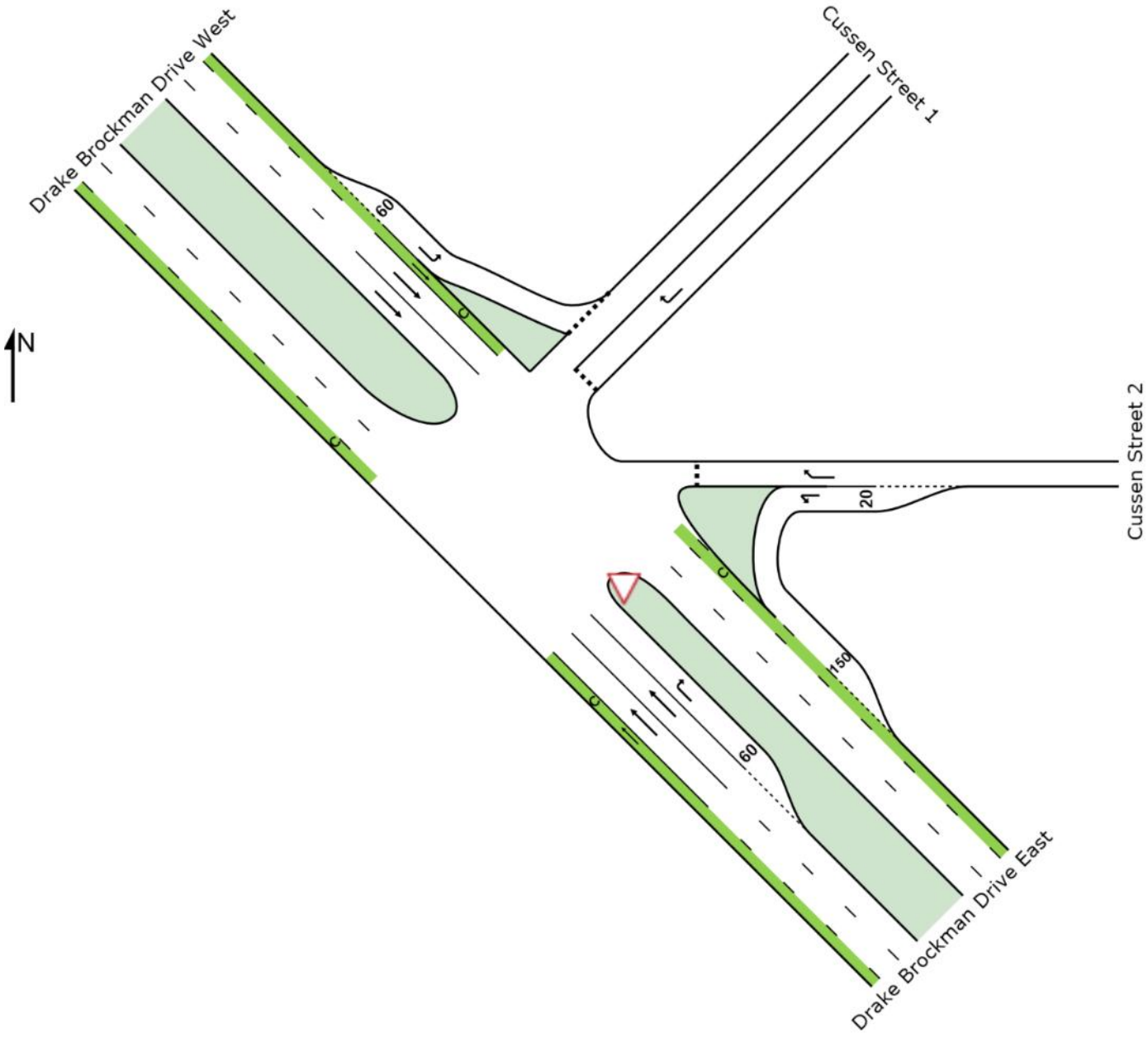
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

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

SITE LAYOUT

Site: 2041 AM DBD / Cussen Street

Giveway / Yield (Two-Way)



MOVEMENT SUMMARY

Site: 2041 PM DBD / Cussen Street

Network: 2041 PM

Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: Drake Brockman Drive East													
22	T1	2780	2.5	2780	2.5	0.710	0.2	LOS A	0.0	0.0	0.00	0.00	59.3
23	R2	28	2.5	28	2.5	0.040	8.8	LOS A	0.1	1.0	0.42	0.63	50.1
Approach		2808	2.5	2808	2.5	0.710	0.3	NA	0.1	1.0	0.00	0.01	58.9
East: Cussen Street 2													
4b	L3	88	2.5	88	2.5	0.055	6.9	LOS A	0.0	0.0	0.00	0.58	49.7
6a	R1	12	2.5	12	2.5	0.054	21.9	LOS C	0.2	1.4	0.78	0.88	35.3
Approach		100	2.5	100	2.5	0.055	8.7	LOS A	0.2	1.4	0.09	0.61	47.4
NorthEast: Cussen Street 1													
26	R2	12	2.5	12	2.5	0.015	8.2	LOS A	0.1	0.5	0.49	0.61	40.3
Approach		12	2.5	12	2.5	0.015	8.2	LOS A	0.1	0.5	0.49	0.61	40.3
NorthWest: Drake Brockman Drive West													
27	L2	8	2.5	8	2.5	0.005	5.7	LOS A	0.0	0.2	0.05	0.53	52.0
28	T1	761	2.5	761	2.5	0.194	0.0	LOS A	0.0	0.0	0.00	0.00	59.7
Approach		769	2.5	769	2.5	0.194	0.1	LOS A	0.0	0.2	0.00	0.01	59.2
All Vehicles		3689	2.5	3689	2.5	0.710	0.5	NA	0.2	1.4	0.01	0.02	58.5

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

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

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

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

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

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

MOVEMENT SUMMARY

Site: 2041 AM DBD / Cussen Street

Network: 2041 AM

Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: Drake Brockman Drive East													
22	T1	834	2.5	834	2.5	0.213	0.0	LOS A	0.0	0.0	0.00	0.00	59.7
23	R2	8	2.5	8	2.5	0.046	32.0	LOS D	0.2	1.1	0.86	0.94	36.6
Approach		842	2.5	842	2.5	0.213	0.3	NA	0.2	1.1	0.01	0.01	58.9
East: Cussen Street 2													
4b	L3	143	2.5	143	2.5	0.089	6.9	LOS A	0.0	0.0	0.00	0.58	49.7
6a	R1	2	2.5	2	2.5	0.003	6.1	LOS A	0.0	0.0	0.33	0.52	50.2
Approach		145	2.5	145	2.5	0.089	6.8	LOS A	0.0	0.0	0.00	0.57	49.7
NorthEast: Cussen Street 1													
26	R2	2	2.5	2	2.5	0.009	27.1	LOS D	0.0	0.3	0.84	0.78	23.0
Approach		2	2.5	2	2.5	0.009	27.1	LOS D	0.0	0.3	0.84	0.78	23.0
NorthWest: Drake Brockman Drive West													
27	L2	27	2.5	27	2.5	0.017	5.7	LOS A	0.1	0.6	0.02	0.54	52.1
28	T1	2644	2.5	2644	2.5	0.675	0.2	LOS A	0.0	0.0	0.00	0.00	59.4
Approach		2671	2.5	2671	2.5	0.675	0.2	LOS A	0.1	0.6	0.00	0.01	59.0
All Vehicles		3660	2.5	3660	2.5	0.675	0.5	NA	0.2	1.1	0.00	0.03	58.5

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

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

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

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

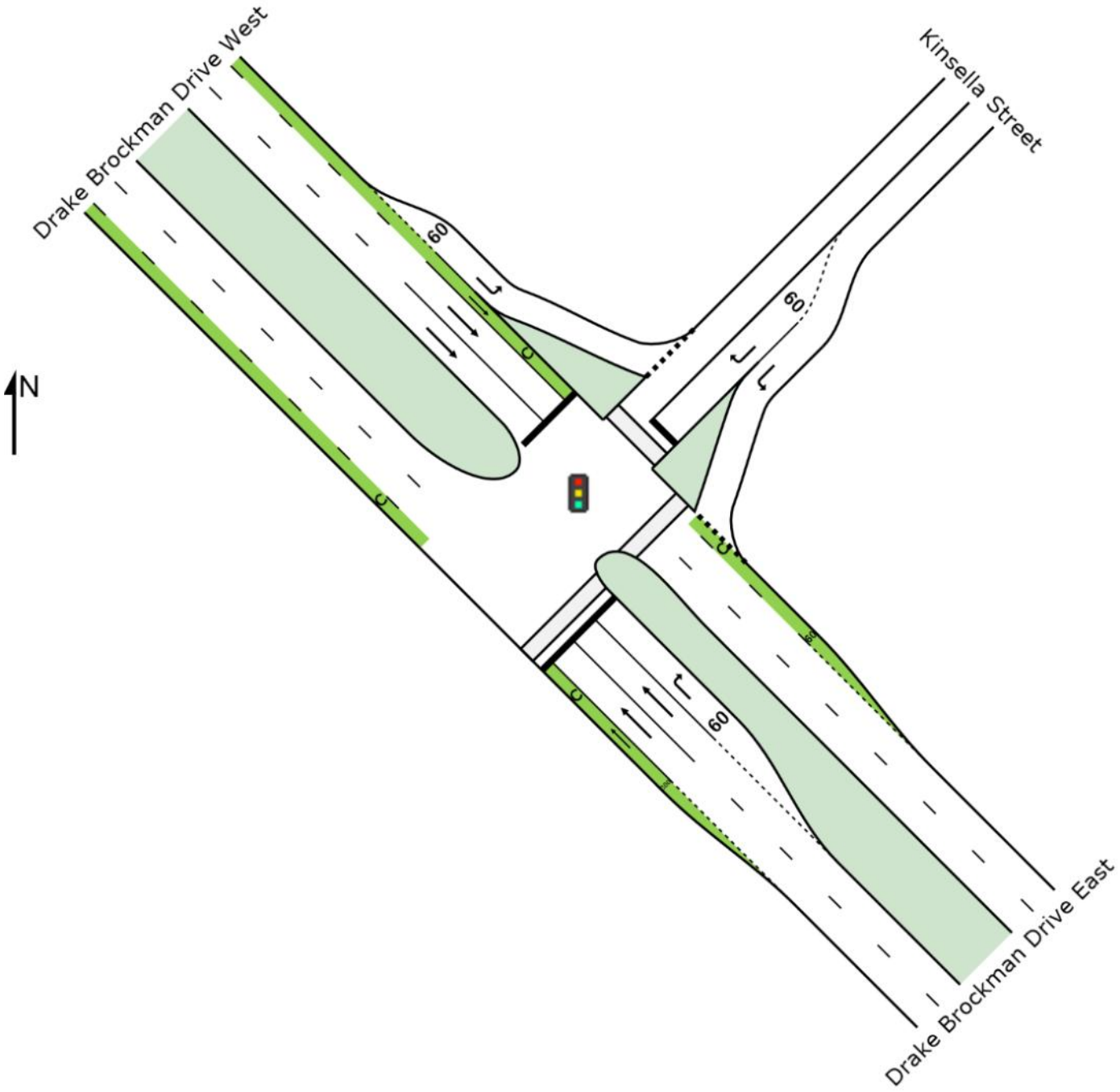
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

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

SITE LAYOUT

Site: 2041 AM DBD / Kinsella Street

Signals - Fixed Time Isolated



MOVEMENT SUMMARY

Site: 2041 PM DBD / Kinsella Street

Network: 2041 PM

Signals - Fixed Time Coordinated Cycle Time = 100 seconds (Network Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: Drake Brockman Drive East													
22	T1	2943	2.5	2943	2.5	0.948	29.7	LOS C	80.8	578.2	0.88	0.98	30.0
23	R2	30	2.5	30	2.5	0.232	55.7	LOS E	1.5	10.5	0.98	0.72	30.8
Approach		2973	2.5	2973	2.5	0.948	29.9	LOS C	80.8	578.2	0.88	0.98	30.0
NorthEast: Kinsella Street													
24	L2	46	2.5	46	2.5	0.048	6.9	LOS A	0.3	2.3	0.22	0.60	49.1
26	R2	6	2.5	6	2.5	0.040	52.7	LOS D	0.3	2.0	0.95	0.65	22.3
Approach		52	2.5	52	2.5	0.048	12.2	LOS B	0.3	2.3	0.30	0.60	43.2
NorthWest: Drake Brockman Drive West													
27	L2	4	2.5	4	2.5	0.003	6.0	LOS A	0.0	0.1	0.12	0.56	54.2
28	T1	763	2.5	763	2.5	0.251	7.8	LOS A	7.8	55.5	0.50	0.43	49.5
Approach		767	2.5	767	2.5	0.251	7.8	LOS A	7.8	55.5	0.50	0.43	49.5
All Vehicles		3792	2.5	3792	2.5	0.948	25.2	LOS C	80.8	578.2	0.79	0.86	33.3

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P5	SouthEast Full Crossing	21	44.2	LOS E	0.1	0.1	0.94	0.94
P6	NorthEast Full Crossing	21	7.6	LOS A	0.0	0.0	0.39	0.39
All Pedestrians		42	25.9	LOS C			0.67	0.67

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

MOVEMENT SUMMARY

Site: 2041 AM DBD / Kinsella Street

Network: 2041 AM

Signals - Fixed Time Coordinated Cycle Time = 150 seconds (Network Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: Drake Brockman Drive East													
22	T1	872	2.5	872	2.5	0.283	4.6	LOS A	8.4	60.1	0.30	0.26	51.8
23	R2	9	2.5	9	2.5	0.122	84.4	LOS F	0.7	4.8	0.99	0.67	24.7
Approach		881	2.5	881	2.5	0.283	5.4	LOS A	8.4	60.1	0.30	0.27	50.5
NorthEast: Kinsella Street													
24	L2	76	2.5	76	2.5	0.151	23.9	LOS C	2.8	20.2	0.57	0.71	34.1
26	R2	2	2.5	2	2.5	0.008	65.5	LOS E	0.1	0.9	0.89	0.62	19.3
Approach		78	2.5	78	2.5	0.151	24.9	LOS C	2.8	20.2	0.58	0.70	33.4
NorthWest: Drake Brockman Drive West													
27	L2	27	2.5	27	2.5	0.016	5.9	LOS A	0.1	0.6	0.08	0.57	54.4
28	T1	2631	2.5	2631	2.5	0.820	15.0	LOS B	55.9	399.6	0.71	0.67	42.6
Approach		2658	2.5	2658	2.5	0.820	14.9	LOS B	55.9	399.6	0.70	0.67	42.7
All Vehicles		3617	2.5	3617	2.5	0.820	12.8	LOS B	55.9	399.6	0.60	0.57	43.9

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

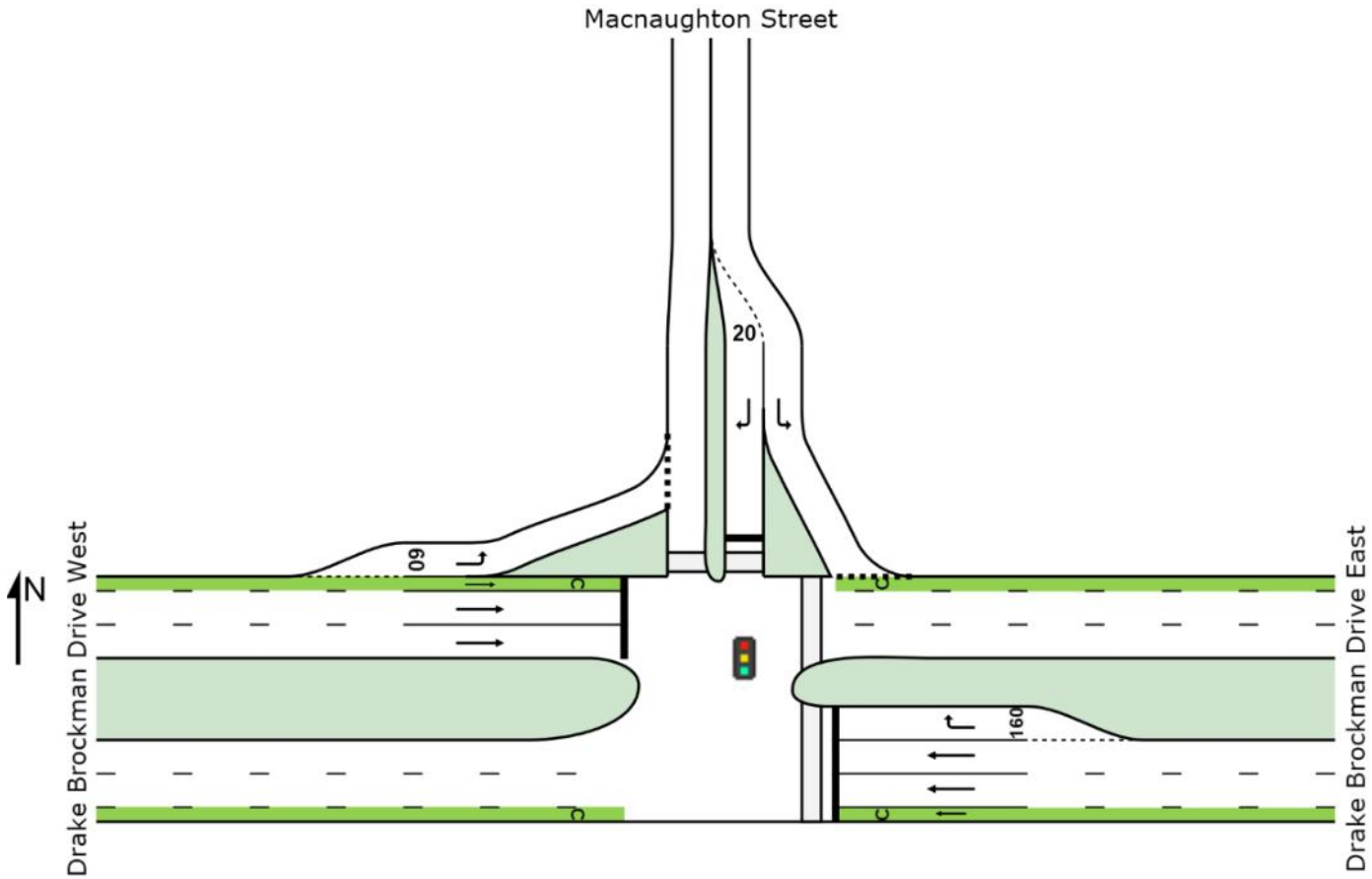
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P5	SouthEast Full Crossing	21	69.2	LOS F	0.1	0.1	0.96	0.96
P6	NorthEast Full Crossing	21	8.3	LOS A	0.0	0.0	0.33	0.33
All Pedestrians		42	38.8	LOS D			0.65	0.65

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

SITE LAYOUT

Site: 2041 AM DBD / Macnaughton Street

Signals - Fixed Time Isolated



Organisation: AECOM AUSTRALIA PTY LTD | Created: Wednesday, 3 August 2016 11:49:33 AM
Project: P:\CBR\60501930\4. Tech work area\4.1 Traffic\SIDRA\DBD SIDRA rev2.sip6

MOVEMENT SUMMARY

Site: 2041 PM DBD / Macnaughton Street

Network: 2041 PM

Signals - Fixed Time Coordinated Cycle Time = 100 seconds (Network Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Drake Brockman Drive East													
5	T1	2675	2.5	2675	2.5	0.846	5.6	LOS A	37.3	266.8	0.64	0.61	50.2
6	R2	27	2.5	27	2.5	0.248	57.2	LOS E	1.3	9.5	0.98	0.71	29.8
Approach		2702	2.5	2702	2.5	0.846	6.1	LOS A	37.3	266.8	0.64	0.61	49.4
North: Macnaughton Street													
7	L2	146	2.5	146	2.5	0.164	7.1	LOS A	1.2	8.2	0.24	0.62	48.3
9	R2	17	2.5	17	2.5	0.150	56.5	LOS E	0.8	6.0	0.98	0.69	20.5
Approach		163	2.5	163	2.5	0.164	12.2	LOS B	1.2	8.2	0.32	0.62	42.4
West: Drake Brockman Drive West													
10	L2	9	2.5	9	2.5	0.006	6.1	LOS A	0.0	0.2	0.13	0.57	54.2
11	T1	878	2.5	878	2.5	0.320	6.1	LOS A	8.0	57.5	0.41	0.36	51.5
Approach		887	2.5	887	2.5	0.320	6.1	LOS A	8.0	57.5	0.41	0.37	51.4
All Vehicles		3752	2.5	3752	2.5	0.846	6.3	LOS A	37.3	266.8	0.57	0.55	49.6

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P2	East Full Crossing	20	44.2	LOS E	0.1	0.1	0.94	0.94
P3	North Full Crossing	20	6.9	LOS A	0.0	0.0	0.37	0.37
All Pedestrians		40	25.5	LOS C			0.66	0.66

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

MOVEMENT SUMMARY

Site: 2041 AM DBD / Macnaughton Street

Network: 2041 AM

Signals - Fixed Time Coordinated Cycle Time = 150 seconds (Network Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Drake Brockman Drive East													
5	T1	828	2.5	828	2.5	0.244	1.4	LOS A	4.4	31.7	0.16	0.15	56.9
6	R2	8	2.5	8	2.5	0.110	84.3	LOS F	0.6	4.3	0.99	0.66	24.2
Approach		836	2.5	836	2.5	0.244	2.2	LOS A	4.4	31.7	0.17	0.15	55.3
North: Macnaughton Street													
7	L2	296	2.5	296	2.5	0.895	75.2	LOS E	26.3	188.0	1.00	1.05	17.0
9	R2	5	2.5	5	2.5	0.066	83.5	LOS F	0.4	2.6	0.99	0.64	15.6
Approach		301	2.5	301	2.5	0.895	75.4	LOS E	26.3	188.0	1.00	1.04	16.9
West: Drake Brockman Drive West													
10	L2	27	2.5	27	2.5	0.016	5.9	LOS A	0.1	0.6	0.08	0.57	54.3
11	T1	2634	2.5	2634	2.5	0.841	12.3	LOS B	66.0	471.7	0.77	0.74	45.1
Approach		2661	2.5	2661	2.5	0.841	12.3	LOS B	66.0	471.7	0.77	0.74	45.1
All Vehicles		3798	2.5	3798	2.5	0.895	15.0	LOS B	66.0	471.7	0.65	0.63	42.0

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

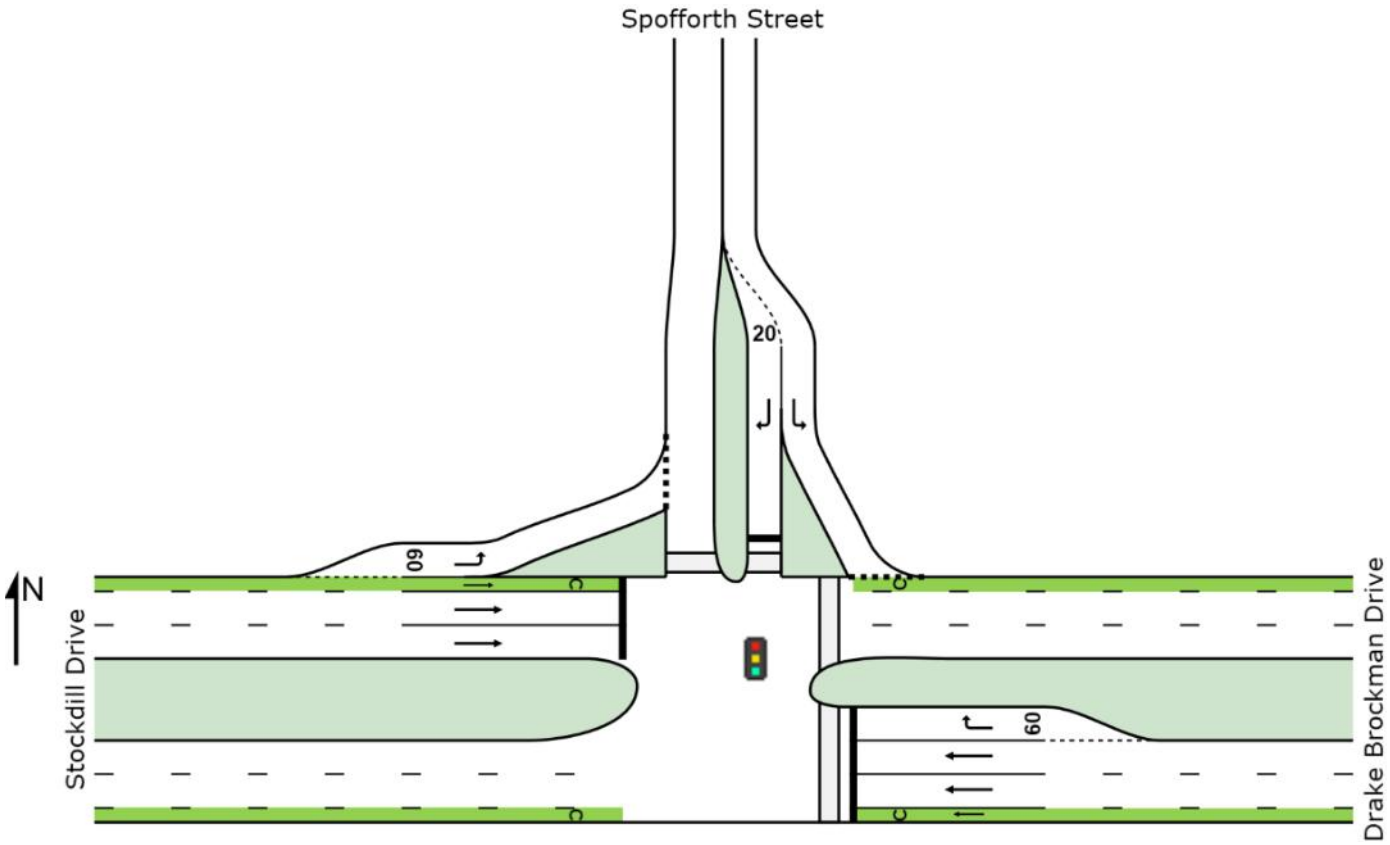
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P2	East Full Crossing	20	69.2	LOS F	0.1	0.1	0.96	0.96
P3	North Full Crossing	20	4.6	LOS A	0.0	0.0	0.25	0.25
All Pedestrians		40	36.9	LOS D			0.60	0.60

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

SITE LAYOUT

Site: 2041 AM DBD / Spofforth Street / Stockdill Drive

Signals - Fixed Time Isolated



Organisation: AECOM AUSTRALIA PTY LTD | Created: Wednesday, 3 August 2016 11:50:23 AM
Project: P:\CBR\60501930\4. Tech work area\4.1 Traffic\SIDRA\DBD SIDRA rev2.sip6

MOVEMENT SUMMARY

Site: 2041 PM DBD / Spofforth Street / Stockdill Drive

Network: 2041 PM

Signals - Fixed Time Coordinated Cycle Time = 100 seconds (Network Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Drake Brockman Drive													
5	T1	2488	2.5	2488	2.5	0.801	5.8	LOS A	33.2	237.3	0.60	0.56	45.2
6	R2	25	2.5	25	2.5	0.226	57.0	LOS E	1.2	8.8	0.98	0.71	31.2
Approach		2513	2.5	2513	2.5	0.801	6.3	LOS A	33.2	237.3	0.60	0.56	44.4
North: Spofforth Street													
7	L2	210	2.5	210	2.5	0.231	7.4	LOS A	1.9	13.6	0.27	0.63	51.7
9	R2	15	2.5	15	2.5	0.102	53.5	LOS D	0.7	5.1	0.96	0.69	27.8
Approach		225	2.5	225	2.5	0.231	10.4	LOS B	1.9	13.6	0.32	0.63	48.9
West: Stockdill Drive													
10	L2	9	2.5	9	2.5	0.006	6.1	LOS A	0.0	0.2	0.13	0.57	54.3
11	T1	866	2.5	866	2.5	0.325	6.9	LOS A	8.4	60.3	0.44	0.39	45.7
Approach		875	2.5	875	2.5	0.325	6.9	LOS A	8.4	60.3	0.44	0.39	45.8
All Vehicles		3613	2.5	3613	2.5	0.801	6.7	LOS A	33.2	237.3	0.54	0.53	45.3

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P2	East Full Crossing	21	44.2	LOS E	0.1	0.1	0.94	0.94
P3	North Full Crossing	21	8.4	LOS A	0.0	0.0	0.41	0.41
All Pedestrians		42	26.3	LOS C			0.68	0.68

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

MOVEMENT SUMMARY

Site: 2041 AM DBD / Spofforth Street / Stockdill Drive

Network: 2041 AM

Signals - Fixed Time Coordinated Cycle Time = 150 seconds (Network Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Drake Brockman Drive													
5	T1	841	2.5	841	2.5	0.273	3.4	LOS A	5.7	40.4	0.20	0.17	50.3
6	R2	8	2.5	8	2.5	0.108	77.9	LOS E	0.6	3.9	0.92	0.66	26.6
Approach		849	2.5	849	2.5	0.273	4.1	LOS A	5.7	40.4	0.20	0.18	48.7
North: Spofforth Street													
7	L2	97	2.5	97	2.5	0.203	31.5	LOS C	4.3	31.1	0.68	0.74	35.7
9	R2	1	2.5	1	2.5	0.004	65.3	LOS E	0.1	0.4	0.88	0.60	24.9
Approach		98	2.5	98	2.5	0.203	31.8	LOS C	4.3	31.1	0.68	0.74	35.6
West: Stockdill Drive													
10	L2	24	2.5	24	2.5	0.015	5.9	LOS A	0.1	0.5	0.08	0.57	54.4
11	T1	2404	2.5	2404	2.5	0.881	17.9	LOS B	67.1	479.7	0.85	0.80	33.3
Approach		2428	2.5	2428	2.5	0.881	17.7	LOS B	67.1	479.7	0.84	0.80	33.7
All Vehicles		3375	2.5	3375	2.5	0.881	14.7	LOS B	67.1	479.7	0.67	0.64	36.1

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

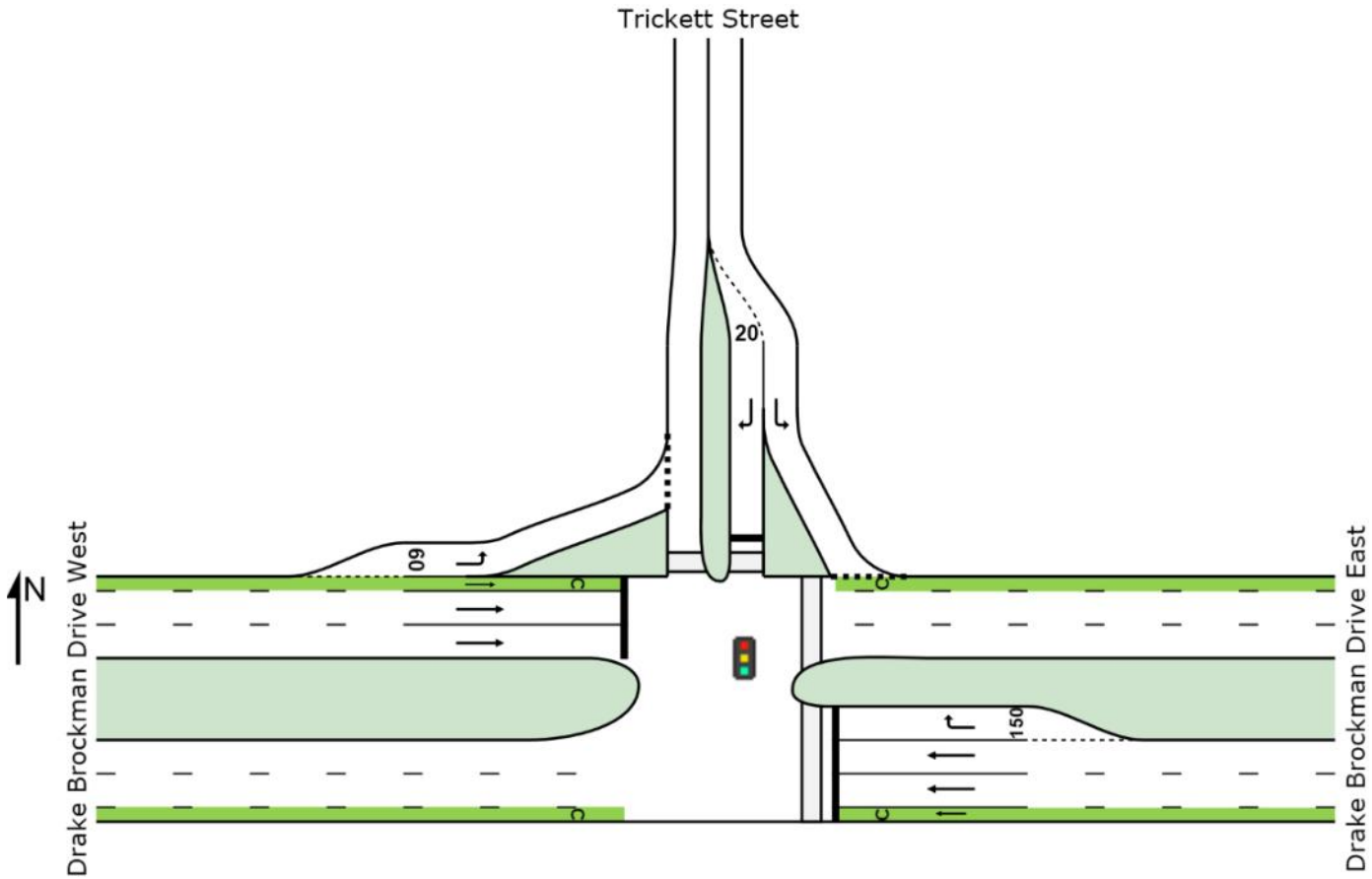
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P2	East Full Crossing	21	69.2	LOS F	0.1	0.1	0.96	0.96
P3	North Full Crossing	21	9.4	LOS A	0.0	0.0	0.35	0.35
All Pedestrians		42	39.3	LOS D			0.66	0.66

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

SITE LAYOUT

Site: 2041 AM DBD / Trickett Street

Signals - Fixed Time Isolated



Organisation: AECOM AUSTRALIA PTY LTD | Created: Wednesday, 3 August 2016 11:50:08 AM
Project: P:\CBR\60501930\4. Tech work area\4.1 Traffic\SIDRA\DBD SIDRA rev2.sip6

MOVEMENT SUMMARY

Site: 2041 PM DBD / Trickett Street

Network: 2041 PM

Signals - Fixed Time Coordinated Cycle Time = 100 seconds (Network Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Drake Brockman Drive East													
5	T1	2626	2.5	2626	2.5	0.818	5.2	LOS A	34.1	243.6	0.59	0.56	52.5
6	R2	27	2.5	27	2.5	0.244	57.1	LOS E	1.3	9.5	0.98	0.71	32.4
Approach		2653	2.5	2653	2.5	0.818	5.7	LOS A	34.1	243.6	0.60	0.56	51.8
North: Trickett Street													
7	L2	127	2.5	127	2.5	0.136	6.7	LOS A	0.8	6.0	0.21	0.61	49.5
9	R2	21	2.5	21	2.5	0.190	56.8	LOS E	1.0	7.4	0.98	0.70	21.5
Approach		148	2.5	148	2.5	0.190	13.8	LOS B	1.0	7.4	0.32	0.62	41.8
West: Drake Brockman Drive West													
10	L2	8	2.5	8	2.5	0.005	6.1	LOS A	0.0	0.2	0.13	0.57	52.3
11	T1	809	2.5	809	2.5	0.295	4.8	LOS A	5.7	41.0	0.29	0.26	47.0
Approach		817	2.5	817	2.5	0.295	4.8	LOS A	5.7	41.0	0.29	0.26	47.0
All Vehicles		3618	2.5	3618	2.5	0.818	5.8	LOS A	34.1	243.6	0.52	0.50	50.7

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P2	East Full Crossing	20	44.2	LOS E	0.1	0.1	0.94	0.94
P3	North Full Crossing	20	6.9	LOS A	0.0	0.0	0.37	0.37
All Pedestrians		40	25.5	LOS C			0.66	0.66

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

MOVEMENT SUMMARY

Site: 2041 AM DBD / Trickett Street

Network: 2041 AM

Signals - Fixed Time Coordinated Cycle Time = 150 seconds (Network Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Drake Brockman Drive East													
5	T1	888	2.5	888	2.5	0.258	1.4	LOS A	4.8	34.5	0.17	0.15	57.5
6	R2	9	2.5	9	2.5	0.122	84.4	LOS F	0.7	4.8	0.99	0.67	26.7
Approach		897	2.5	897	2.5	0.258	2.3	LOS A	4.8	34.5	0.17	0.15	56.1
North: Trickett Street													
7	L2	309	2.5	309	2.5	0.781	32.8	LOS C	19.2	137.6	0.86	0.89	29.7
9	R2	10	2.5	10	2.5	0.136	84.5	LOS F	0.7	5.3	0.99	0.67	16.4
Approach		319	2.5	319	2.5	0.781	34.4	LOS C	19.2	137.6	0.86	0.89	28.9
West: Drake Brockman Drive West													
10	L2	24	2.5	24	2.5	0.014	6.5	LOS A	0.3	1.9	0.31	0.61	51.6
11	T1	2405	2.5	2405	2.5	0.768	6.8	LOS A	38.9	278.4	0.48	0.46	43.3
Approach		2429	2.5	2429	2.5	0.768	6.8	LOS A	38.9	278.4	0.48	0.46	43.4
All Vehicles		3645	2.5	3645	2.5	0.781	8.1	LOS A	38.9	278.4	0.44	0.42	44.7

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

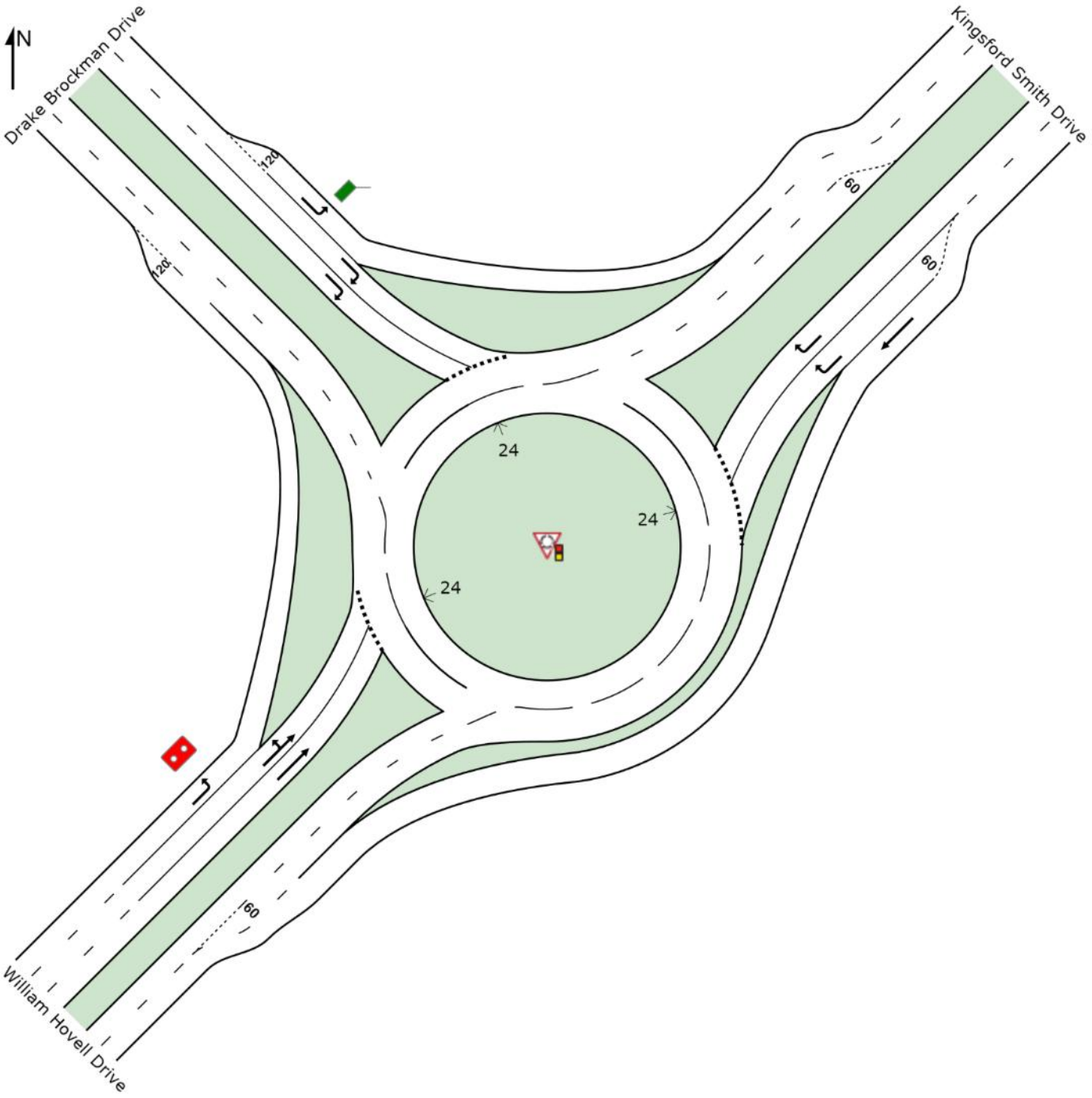
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P2	East Full Crossing	20	69.2	LOS F	0.1	0.1	0.96	0.96
P3	North Full Crossing	20	4.6	LOS A	0.0	0.0	0.25	0.25
All Pedestrians		40	36.9	LOS D			0.60	0.60

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

SITE LAYOUT

Site: 2041 AM DBD / WHD / KSD

Roundabout Metering



MOVEMENT SUMMARY

Site: 2041 PM DBD / WHD / KSD

Network: 2041 PM

Roundabout Metering

Movement Performance - Vehicles													
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
NorthEast: Kingsford Smith Drive													
25	T1	165	2.5	165	2.5	0.081	3.8	LOS A	0.0	0.0	0.00	0.38	56.8
26	R2	865	2.5	865	2.5	0.977	23.1	LOS C	15.3	109.3	0.98	1.12	28.3
Approach		1030	2.5	1030	2.5	0.977	20.0	LOS C	15.3	109.3	0.82	1.00	33.6
NorthWest: Drake Brockman Drive													
27	L2	298	2.5	298	2.5	0.162	3.5	LOS A	0.0	0.0	0.00	0.45	55.2
29	R2	487	2.5	487	2.5	0.312	10.7	LOS B	1.7	12.2	0.48	0.73	51.8
Approach		785	2.5	785	2.5	0.312	8.0	LOS A	1.7	12.2	0.30	0.63	52.8
SouthWest: William Hovell Drive													
30	L2	2076	2.5	2076	2.5	0.916	5.9	LOS A	9.5	67.6	0.37	0.66	50.5
31	T1	692	2.5	692	2.5	0.699	6.7	LOS A	6.1	43.6	0.82	0.72	51.8
Approach		2768	2.5	2768	2.5	0.916	6.1	LOS A	9.5	67.6	0.48	0.68	50.9
All Vehicles		4583	2.5	4583	2.5	0.977	9.5	LOS A	15.3	109.3	0.53	0.74	47.6

Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 2041 AM DBD / WHD / KSD

Network: 2041 AM

Roundabout Metering

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
NorthEast: Kingsford Smith Drive													
25	T1	1113	2.5	1113	2.5	0.546	3.8	LOS A	0.0	0.0	0.00	0.38	56.7
26	R2	296	2.5	296	2.5	0.302	12.4	LOS B	0.9	6.5	0.84	0.93	37.1
Approach		1409	2.5	1409	2.5	0.546	5.6	LOS A	0.9	6.5	0.18	0.50	53.9
NorthWest: Drake Brockman Drive													
27	L2	630	2.5	630	2.5	0.342	3.5	LOS A	0.0	0.0	0.00	0.45	55.1
29	R2	2108	2.5	2108	2.5	0.858	9.0	LOS A	2.8	19.8	0.30	0.66	52.3
Approach		2738	2.5	2738	2.5	0.858	7.7	LOS A	2.8	19.8	0.23	0.62	52.8
SouthWest: William Hovell Drive													
30	L2	575	2.5	575	2.5	0.385	4.3	LOS A	1.9	13.8	0.13	0.52	52.6
31	T1	102	2.5	102	2.5	0.385	9.5	LOS A	1.9	13.8	0.89	0.93	51.2
Approach		677	2.5	677	2.5	0.385	5.1	LOS A	1.9	13.8	0.24	0.58	52.3
All Vehicles		4824	2.5	4824	2.5	0.858	6.7	LOS A	2.8	19.8	0.22	0.58	53.0

Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Appendix E

Road Design Criteria

Appendix E Road Design Criteria

Item	Design parameters	1. Stockdill Dr - West Belconnen Access Ave to Spofforth St	2. Spofforth St to William Hovell Drive	3. Service Rd between Spofforth St and Macnaughton St	Relevant Standards and Guidelines
1	Road Classification	Rural/Arterial	Arterial	service road (one-way or two-way - to be revised)	
2	Design Speed	70 km/h (60 km/h posted)	80 km/h (70 km/h posted)	60 km/h (50 km/h posted)	Austroads Guide to Road Design (AGRD) Part 3. Table 3.1
3	Road Clear Zone	Design ADT >6000 6.5 m (6:1 to flat fill batter) 8.5 m (4:1 to 5:1 fill batter) 6.0 m (4:1 to 5:1 cut batter) 5.0 m (3:1 and steeper cut batter)	Design ADT >6000 6.5 m (6:1 flat fill batter) 8.5 m (4:1 to 5:1 fill batter) 6.0 m (4:1 to 5:1 cut batter) 5.0 m (3:1 and steeper cut batter)	Design ADT <750 3.0 m (6:1 to flat fill batter) 3.0 m (4:1 to 5:1 fill batter) 3.0 m (4:1 to 5:1 cut batter) 3.0 m (3:1 and steeper cut batter)	AGRD Part 6, table 4.1
4	Traffic lane, right-turn and left-turn lane width	Median lane and right and left-turn lanes: 3.5 m. Verge side lane: 4.0 m (allowance for buses)	Median lane and right and left-turn lanes: 3.5 m. Verge side lane: 4.0 m (allowance for buses)	3.2 m traffic lane; 2.3 m parking lane	AGRD Part 3, 4.2.4, Table 4.26, and Table 4.6
5	No of traffic lanes	4 (2 per carriageway)	4 (2 per carriageway)	One-way service road and parking one side	
6	Sealed shoulder width/On-road cycle lane	2.0 m	2.0 m		AGRD Part 3, 4.3
7	Median width	6.5 m Allowance for right-turn lane and pedestrian refuge at intersections	6.5 m preferred	10 m verge (minimum) separator to Drake Brockman Drive eastbound carriageway	AGRD Part 3, 4.7, and Table 4.27
8	Median edge treatment	Mountable kerb or unkerbed with 0.5 m structural shoulder	Mountable kerb or unkerbed with 0.5 m structural shoulder	kerbed	
9	Light column location	Verge proposed for whole project length with 1.0 m offset from edge of pavement (3.0 m from edge of travel lane)	Verge proposed for whole project length with 1.0 m offset from edge of pavement (3.0 m from edge of travel lane)	Southern verge	
10	Streetlighting Design	Roadway: Height: 12 m (desirable) ; Outreach: 4.5m (desirable)	Roadway: Height: 12 m (desirable) ; Outreach: 4.5m (desirable)	Roadway: Height: 12 m (desirable) ; Outreach: 4.5m (desirable)	TAMS DSUI 12, 12.3
		Cycleway: 6.5 m (desirable); Outreach: 1.5m (desirable)	Cycleway: 6.5 m (desirable); Outreach: 1.5m (desirable)	Cycleway: 6.5 m (desirable); Outreach: 1.5m (desirable)	
11	Streetlighting Category	Roadway: V3 (desirable)	Roadway: V3 (desirable)	Roadway: V3 (desirable)	AS1158
		Cycleway: P4 (desirable)	Cycleway: P4 (desirable)	Cycleway: P4 (desirable)	
12	Verge width	7.0 m (including rounding)	7.0 m (including rounding)	2.5 m with 1 m rounding	
13	Southern verge to block boundary width	Minimum of 10 m from top of batter for equestrian trail	Minimum of 10 m from top of batter for equestrian trail	N/A	AGRD Part 3, 4.4
14	Northern verge to block boundary width	Varies	Varies	Existing	AGRD Part 3, 4.4
15	Batter slope	4H:1V Maximum in fill 2H:1V Maximum in cut	4H:1V Maximum in fill 2H:1V Maximum in cut	4H:1V Maximum in fill 2H:1V Maximum in cut	AGRD Part 3, Table 4.12
16	Table drain in cut batter	4.4 m width at edge of proposed and future off-road cycle path	4.4 m width at edge of proposed and future off-road cycle path	N/A	AGRD Part 3, Figure 4.11
17	Off-road Path	2.5 m wide cycle path in the northern verge; allowance for future 2.5 m wide path in southern verge	2.5 m wide cycle path in the northern verge; allowance for future 2.5 m wide path in southern verge	N/A	Not required from ACT Active Travel
18	Equestrian trial	10 m wide (minimum) located outside batters on southern side of westbound carriageway	10 m wide (minimum) located outside batters on southern side of westbound carriageway		TAMS DSUI 20: Urban Edge Management Zone
19	Design vehicle	Semi-trailer (19 m long)	Semi-trailer (19 m long) except at Macnaughton Street where B-double (25m long) applies	12.5 m rigid truck	ACT B-double route
20	Desirable minimum curve radius with 3% superelevation and a desirable maximum side friction value	230 m (side friction value of 0.14 for trucks) and 175 m (side friction value of 0.19 for cars)	315 m (side friction value of 0.13 for trucks) and 265 m (side friction value of 0.16 for cars)	147 m (side friction value of 0.17 for trucks) and 105 m (side friction value of 0.24 for cars)	AGRD Part 3, Table 7.4 & Equation 5 P136

21	Desirable minimum curve radius with existing superelevation and a desirable maximum side friction value	150 m radius reverse curve with 0.22 side friction factor. Abs max side friction factor is 0.31 for car and 0.24 for truck.	175 m (absolute maximum side friction factor of 0.26 for cars) 220 m (absolute maximum side friction factor of 0.20 for trucks)	Existing	AGRD Part 3, Table 7.4 & Equation 5 P136
22	Absolute minimum curve radius with 5% superelevation and a absolute maximum side friction value	110 m for cars 140 m for trucks	163 m for cars 202 for trucks	Existing	AGRD Part 3, Table 7.4 &7.5
23	Minimum radii with 3% adverse crossfall and a maximum 0.10 (90 km/h) 0.16 (70 km/h) side friction value	300 m	500 m	Existing	AGRD Part 3, Table 7.10
24	Minimum curve radii with 3% adverse crossfall	300 m	500 m	N/A	
25	Pavement widening	Apply if curves 400 m radius and less	Apply if curves 400 m radius and less	N/A	
26	Maximum radius requiring a spiral	220 m	300 m	N/A	AGRD Part 3, Table 7.2
27	Minimum Spiral lengths	40 m	45 m	N/A	AGRD Part 3, Table 7.3
28	Minimum horizontal curve length	140 m	180 m	100 m	AGRD Part 3, Table 7.6
29	Shift	Apply if greater than 0.25 m	Apply if greater than 0.25 m	N/A	
30	Radii required curve widening for B-double	400 m and less (widening width depends on the radius, for example 0.22 m widening per lane required for 400 m radius and 0.3 m per lane for 300 m radius).	400 m and less (widening width depends on the radius, for example 0.22 m widening per lane required for 400 m radius and 0.3 m per lane for 300 m radius).	N/A	AGRD Part 3, Table 7.11
31	Superelevation development length	54 m for transition between 3% to -3%. 36 m on the straight and 18 m onto the curve	to be updated when know the existing superelevation of	N/A	
32	Overhead structure clearance	11.5 m overhead power line	11.5 m overhead power line	11.5 m overhead power line	To be confirmed by ActewAGL
33	Vertical clearance	5.4 m (Main and arterial roads)	5.4 m (Main and arterial roads)	4.6 m (other roads)	AGRD Part 3, Table 8.1
	Vertical				
34	Maximum grade	7 % (rolling terrain) Desirable maximum lengths of grades: Grade % Length (m) 2 1800 3 900 4 600 5 450 >6 300	7 % (rolling terrain) Desirable maximum lengths of grades: Grade % Length (m) 2 1800 3 900 4 600 5 450 >6 300	Existing	
35	Minimum vertical curve lengths	70 m	80 m	Existing	AGRD Part 3, Table 8.9
36	K Value (SSD)	19.1 Crest and 8-13 Sag (rural road with street lighting)	29.3 Crest and 10-17 Sag (rural road with street lighting)	Existing	AGRD Part 3, Table 8.7&Figure 8.7

	Intersection						
37	Horizontal alignment - General	As close to 90° All approaches are able to have straight horizontal alignment		As close to 90° All approaches are able to have straight horizontal alignment		As close to 90° All approaches are able to have straight horizontal alignment	
38	Vertical alignment	3% (desirable) 4% (maximum)		3% (desirable) 4% (maximum)		3% (desirable) 4% (maximum)	
39	Sight Distances on level road	SSD (RT =2.0 s) 92m (car) 105 m (truck) ASD (RT =2.0 s) 92m SISD (RT=2.0 s) 151 m MGSD (ta =8 s) 155 m		SSD (RT =2.0 s) 115m (car) 132 m (truck) ASD (RT =2.0 s) 114 m SISD (RT=2.0 s) 181 m MGSD (ta =8 s) 178 m		SSD (RT =2.0 s) 72 m (car) 81 m (truck) ASD (RT =2.0 s) 73 m SISD (RT =2.0 s) 123 m MGSD (ta =8 s) 133 m	AGRD Part 3, 5.3 AGRD Part 4A, 3.2.1 AGRD Part 4A, 3.2.2 AGRD Part 4A, 3.2.3
40	K values	Crest (ASD) Sag	Cars: 38 9 (70 km/h desgn speed) Trucks: 38.9 (65 km/h design speed) Cars: 13 (70 km/h desgn speed) Trucks: 13 (65 km/h design speed)	Crest (ASD) Sag	Cars: 59.5 (80 km/h desgn speed) Trucks: 59.5 (70km/h design speed) Cars: 17 (80 km/h desgn speed) Trucks: 17 (70 km/h design speed)	N/A	AGRD Part 4A, 3.2.1 AGRD Part 4A, 3.2.1 AGRD Part 4A, 3.2.1 AGRD Part 4A, 3.2.1
41	Grade correction for ASD & SISD	2% -3 3% -4 -2% 3 -4% 7		2% -4 3% -5.5 -2% 4 -4% 9		2% -2 3% -3 -2% 2 -4% 5	AGRD Part 4A, Table 3.3
42	Grade correction for SSD	2% -3 3% -5 -2% 3 -4% 7		2% -4 3% -5.5 -2% 4 -4% 9		2% -2 3% -3 -2% 2 -4% 5	AGRD Part 3, Table 5.4
43	Left and right-turn acceleration lane length (level road)	150 m (20 km/h entry curve including 70 m merge taper)		220 m (20 km/h entry curve including 80 m merge taper)		N/A	
44	Left and right-turn deceleration lane length (level road)	75 m at 2.5 m/s2 (includes a 23 m diverge taper)		100 m at 2.5 m/s2 (includes a 25 m diverge taper)		N/A	AGRD Part 4A, Table 5.2
45	Grade correction to deceleration distance, Ratio of "length on grade' to 'length on level"	0-2% upgrade 1 3-4% upgrade 0.9 0-2% downgrade 1 3-4% downgrade 1.2		0-2% upgrade 1 3-4% upgrade 0.9 0-2% downgrade 1 3-4% downgrade 1.2		0-2% upgrade 1 3-4% upgrade 0.9 0-2% downgrade 1 3-4% downgrade 1.2	AGRD Part 4, Table 5.3
46	Guard fence	4 wire WRSB where required with 2.1 m offset for LH travel lane (70 km/h) 1.0 m minimum verge behind barrier. The 0.6 m clearance to the on-road cycle lane.		4 wire WRSB where required with 2.1 m offset for LH travel lane (80 km/h) 1.0 m minimum verge behind barrier. The 0.6 m clearance to the on-road cycle lane.		N/A	600 mm clearance to cycle lane
47	Driveways: Vertical Geometry K Values	Bush Fire Brigade Trucks MRV; HRV	K = 1.12 K = 1.12	Bush Fire Brigade Trucks MRV; HRV	K = 1.12 K = 1.12	Urban Fire Trucks MRV; HRV	K = 1.4 K = 1.12
48	Bus Stops	Indented:	Shoulder width: 3 m (min) Bay length: 21 m (desirable) plus 10 m entry/exit tapers Line type: C2 OCI: Concrete paving	Indented:	Shoulder width: 3 m (min) Bay length: 21 m (desirable) plus 10 m entry/exit tapers Line type: C2 OCI: Concrete paving	Indented:	Shoulder width: 3 m (min) Bay length: 21 m (desirable) plus 10 m entry/exit tapers Line type: C2 OCI: Concrete paving TAMS DS9-06

Appendix F

Acoustic Terminology

Appendix F Acoustic Terminology

The following is a brief description of acoustic terminology used in this report.

Sound power level	The total sound emitted by a source	
Sound pressure level	The amount of sound at a specified point	
Decibel [dB]	The measurement unit of sound	
A Weighted decibels [dB(A])	The A weighting is a frequency filter applied to measured noise levels to represent how humans hear sounds. The A-weighting filter emphasises frequencies in the speech range (between 1kHz and 4 kHz) which the human ear is most sensitive to, and places less emphasis on low frequencies at which the human ear is not so sensitive. When an overall sound level is A-weighted it is expressed in units of dB(A).	
Decibel scale	The decibel scale is logarithmic in order to produce a better representation of the response of the human ear. A 3 dB increase in the sound pressure level corresponds to a doubling in the sound energy. A 10 dB increase in the sound pressure level corresponds to a perceived doubling in volume. Examples of decibel levels of common sounds are as follows:	
	0dB(A)	Threshold of human hearing
	30dB(A)	A quiet country park
	40dB(A)	Whisper in a library
	50dB(A)	Open office space
	60 dB(A)	Conversation at 1 m
	70dB(A)	Inside a car on a freeway
	80dB(A)	Outboard motor
	90dB(A)	Heavy truck pass-by
	100dB(A)	Jackhammer/Subway train
	110 dB(A)	Rock Concert
	115dB(A)	Limit of sound permitted in industry
	120dB(A)	747 take off at 250 metres
Frequency [f]	The repetition rate of the cycle measured in Hertz (Hz). The frequency corresponds to the pitch of the sound. A high frequency corresponds to a high pitched sound and a low frequency to a low pitched sound.	
Equivalent continuous sound level [L_{eq}]	The constant sound level which, when occurring over the same period of time, would result in the receiver experiencing the same amount of sound energy.	
L_{max}	The maximum sound pressure level measured over the measurement period	
L_{min}	The minimum sound pressure level measured over the measurement period	
L_{10}	The sound pressure level exceeded for 10% of the measurement period. For 10% of the measurement period it was louder than the L_{10}.	
L_{90}	The sound pressure level exceeded for 90% of the measurement period. For 90% of the measurement period it was louder than the L_{90}.	
Ambient noise	The all-encompassing noise at a point composed of sound from all sources near and far.	

Background noise	The underlying level of noise present in the ambient noise when extraneous noise (such as transient traffic and dogs barking) is removed. The L_{90} sound pressure level is used to quantify background noise.
Traffic noise	The total noise resulting from road traffic. The L_{eq} sound pressure level is used to quantify traffic noise.
Day	The period from 0700 to 1800 h Monday to Saturday and 0800 to 1800 h Sundays and Public Holidays.
Evening	The period from 1800 to 2200 h Monday to Sunday and Public Holidays.
Night	The period from 2200 to 0700 h Monday to Saturday and 2200 to 0800 h Sundays and Public Holidays.
Assessment background level [ABL]	The overall background level for each day, evening and night period for **each day** of the noise monitoring.
Rating background level [RBL]	The overall background level for each day, evening and night period for the **entire length** of noise monitoring.

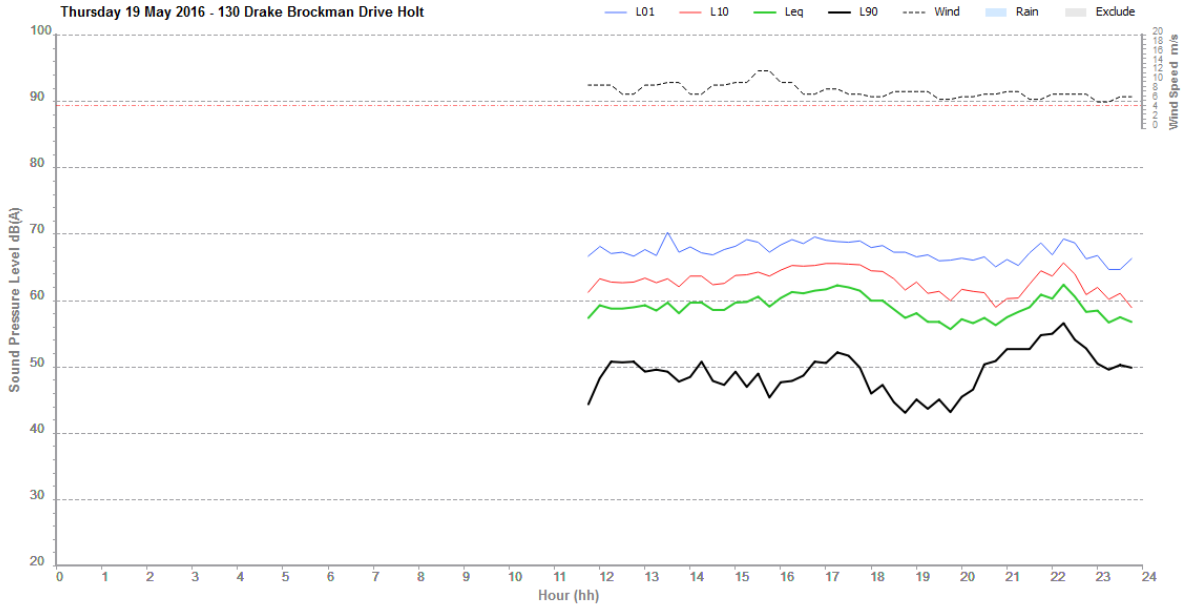
*Definitions of a number of terms have been adapted from Australian Standard AS1633:1985 *"Acoustics – Glossary of terms and related symbols"*, the EPA's NSW Industrial Noise Policy and the EPA's Road Noise Policy.

Appendix G

Acoustics Logging Results

Appendix G Acoustics Logging Results

Measurement date	$L_{A10(18\ hour)}$, dB(A) 06:00 – 00:00
130 Drake Brockman Drive	
Thursday 19 May 2016	*
Friday 20 May 2016	53
Saturday 21 May 2016	52
Sunday 22 May 2016	51
Monday 23 May 2016	51
Tuesday 24 May 2016	52
Wednesday 25 May 2016	52
Thursday 26 May 2016	*
Friday 27 May 2016	*
$L_{A10(18\ hour)}$	**52**
38 Davidson Street	
Thursday 19 May 2016	63
Friday 20 May 2016	62
Saturday 21 May 2016	61
Sunday 22 May 2016	60
Monday 23 May 2016	62
Tuesday 24 May 2016	61
Wednesday 25 May 2016	61
Thursday 26 May 2016	63
Friday 27 May 2016	64
$L_{A10(18\ hour)}$	**62**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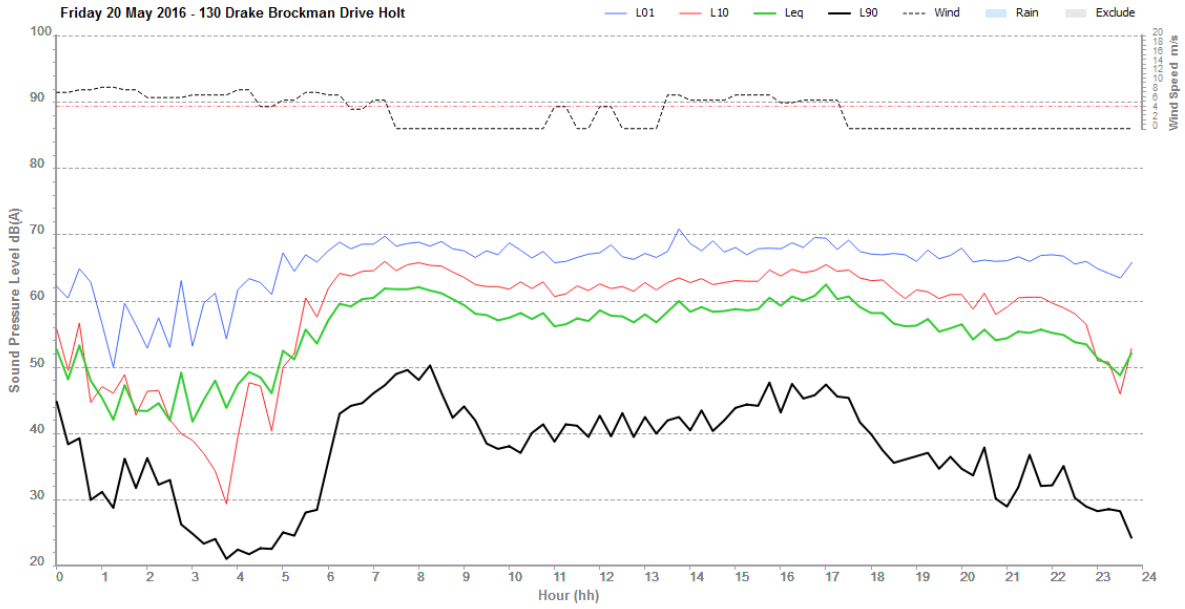
L01
L10
Leq
L90
Wind
Rain
Exclude
Sound Pressure Level dB(A)
Wind Speed m/s
Hour (hh)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Rain
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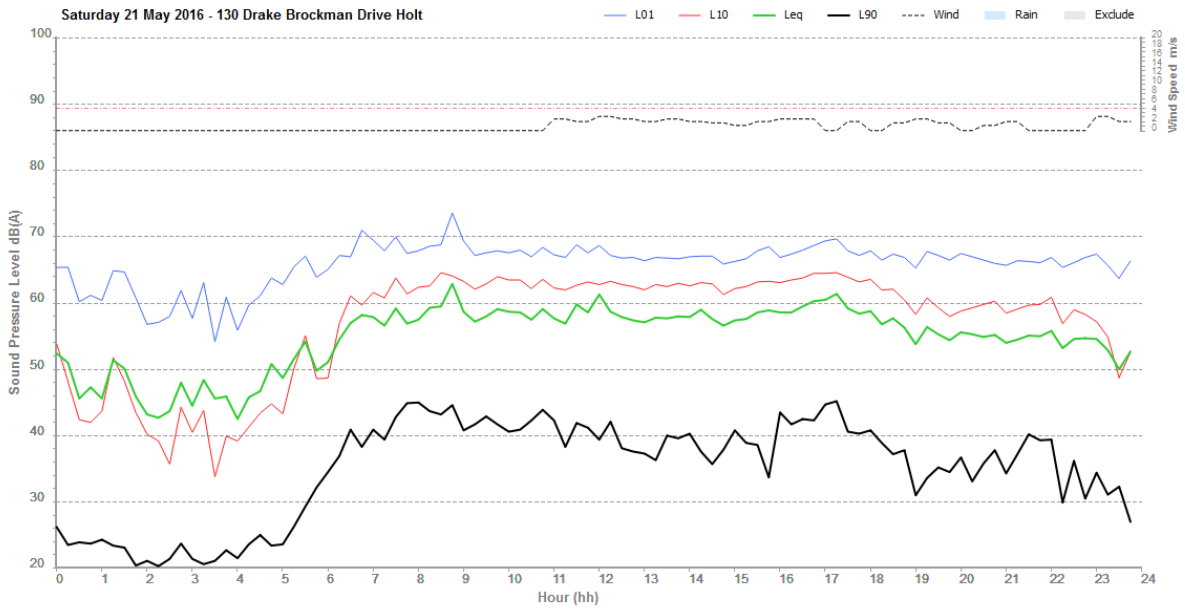
Wind Speed m/s
Hour (hh)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Wind
Rain
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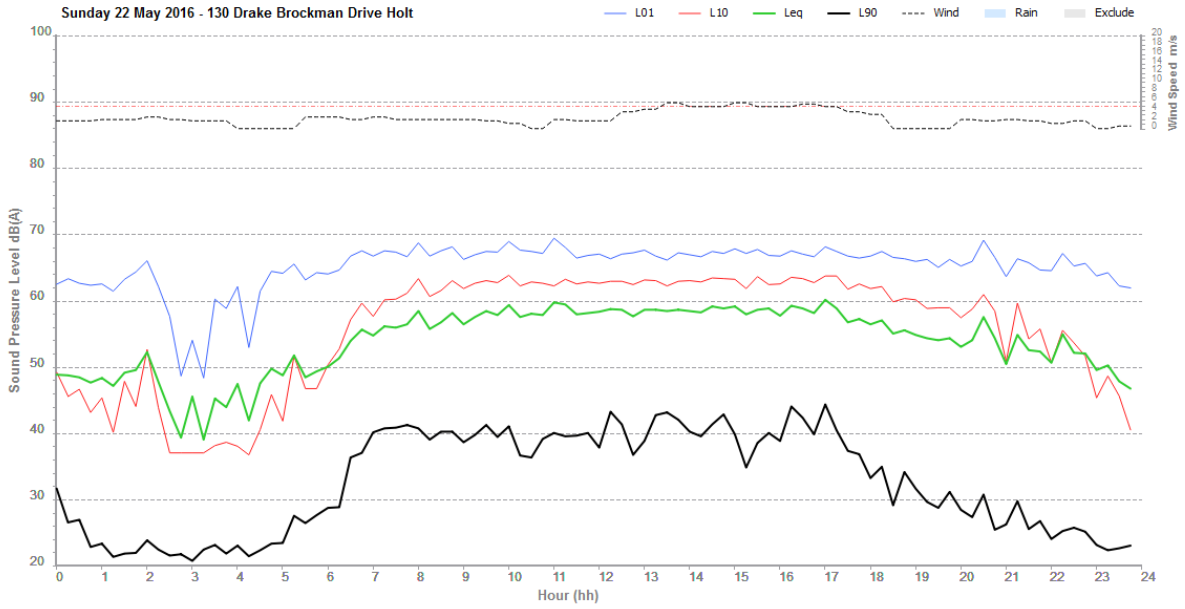
Wind Speed m/s
Hour (hh)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L90
Wind
Rain
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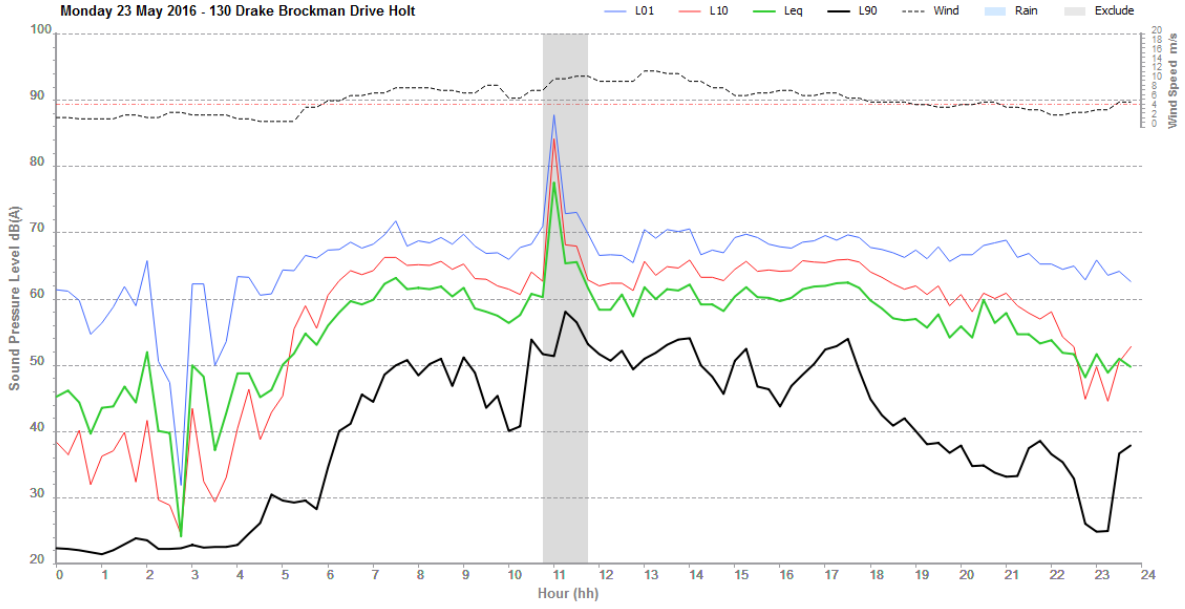
Sound Pressure Level dB(A)
Wind Speed m/s
Hour (hh)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L01
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L90
Wind
Rain
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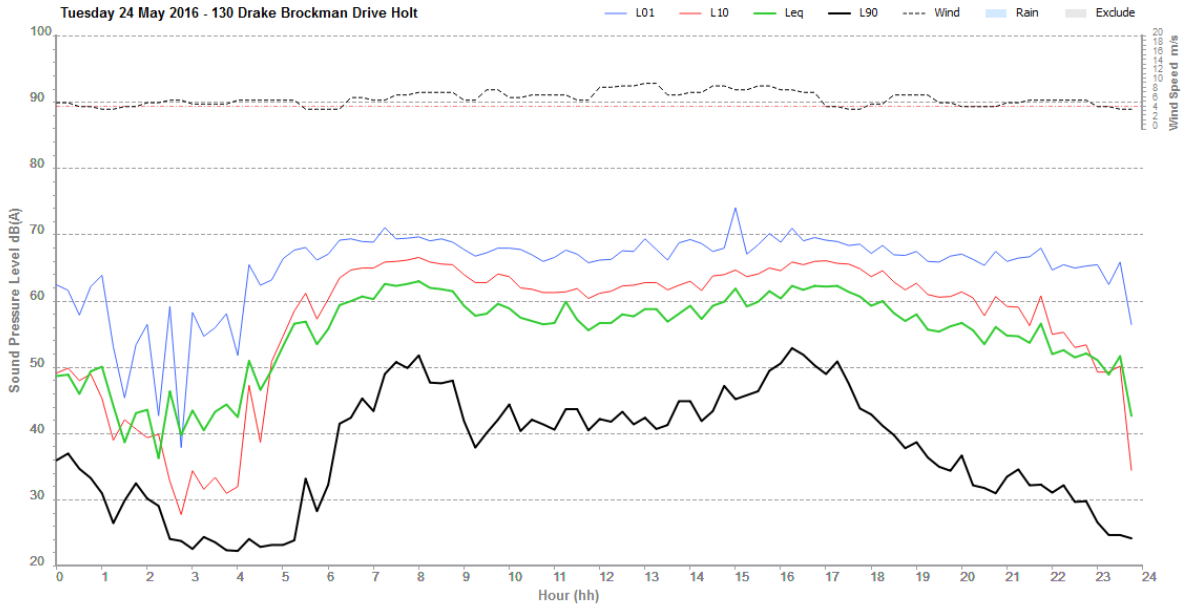
Wind Speed m/s
Hour (hh)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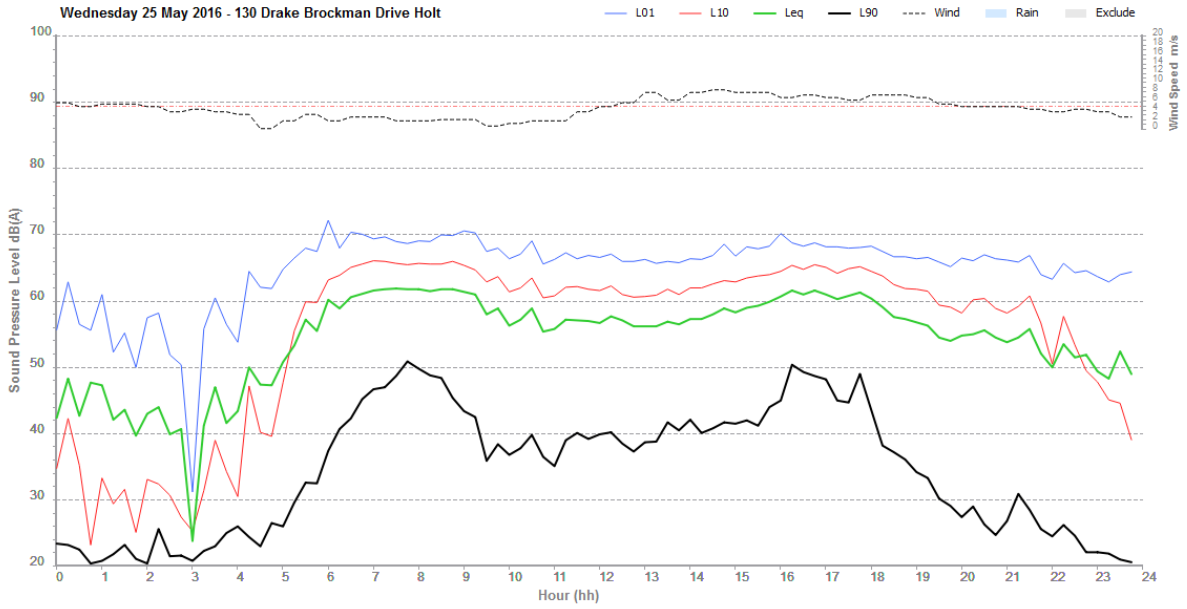
L01
L10
Leq
L90
Wind
Rain
Exclude
Sound Pressure Level dB(A)
Wind Speed m/s
Hour (hh)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L01
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Leq
L90
Wind
Rain
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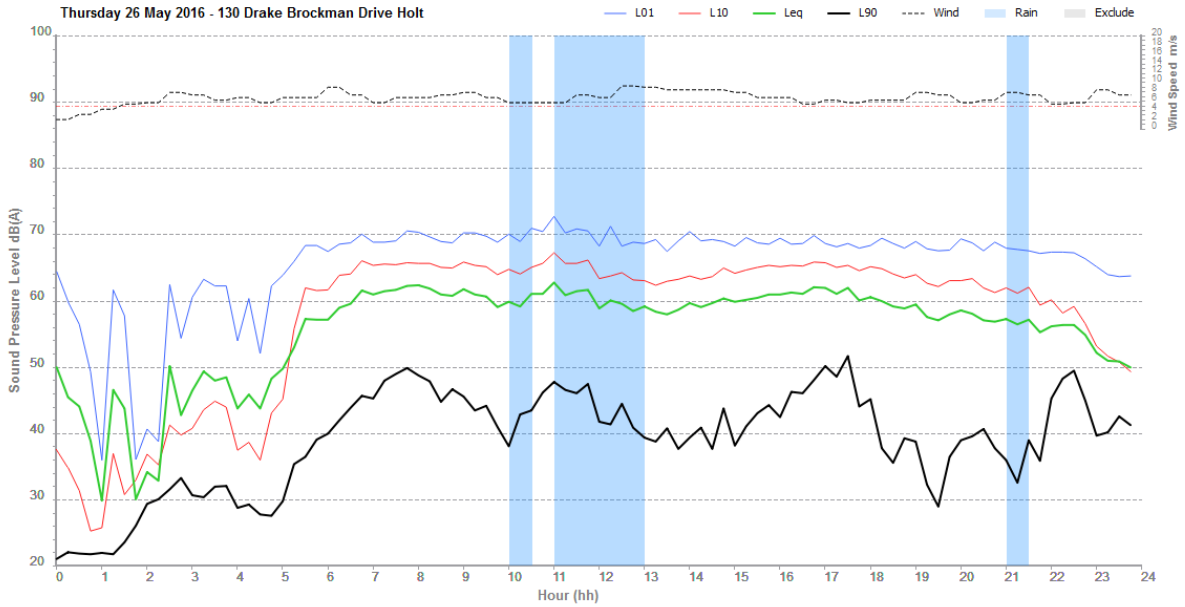
Wind Speed m/s
Hour (hh)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L90
Wind
Rain
Exclude
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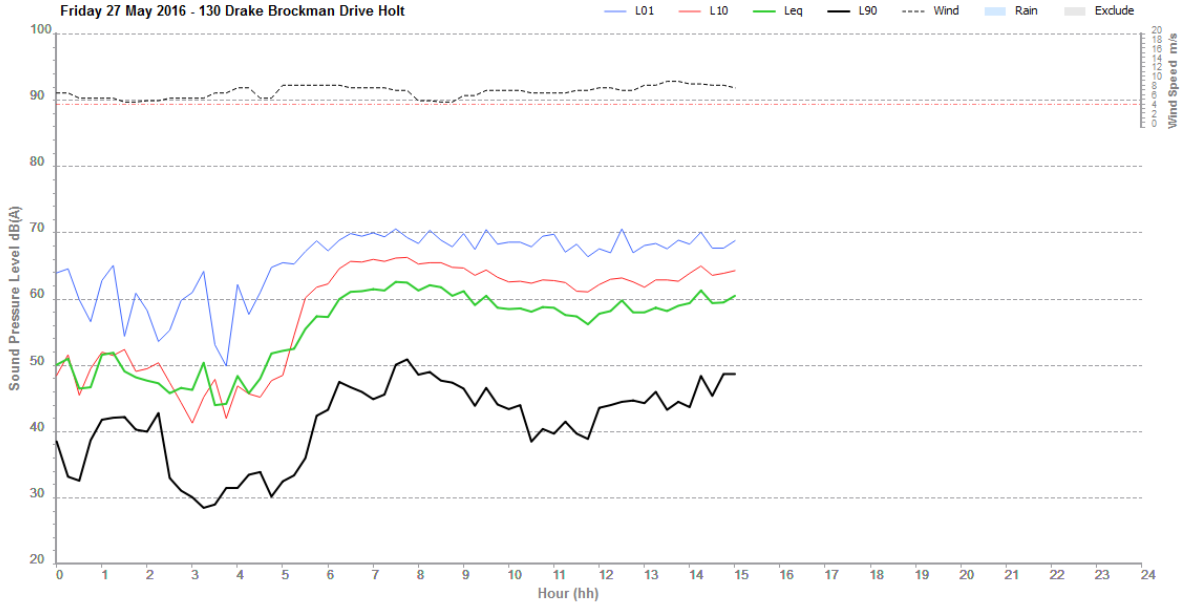
Wind Speed m/s
Hour (hh)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Leq
L90
Wind
Rain
Exclude
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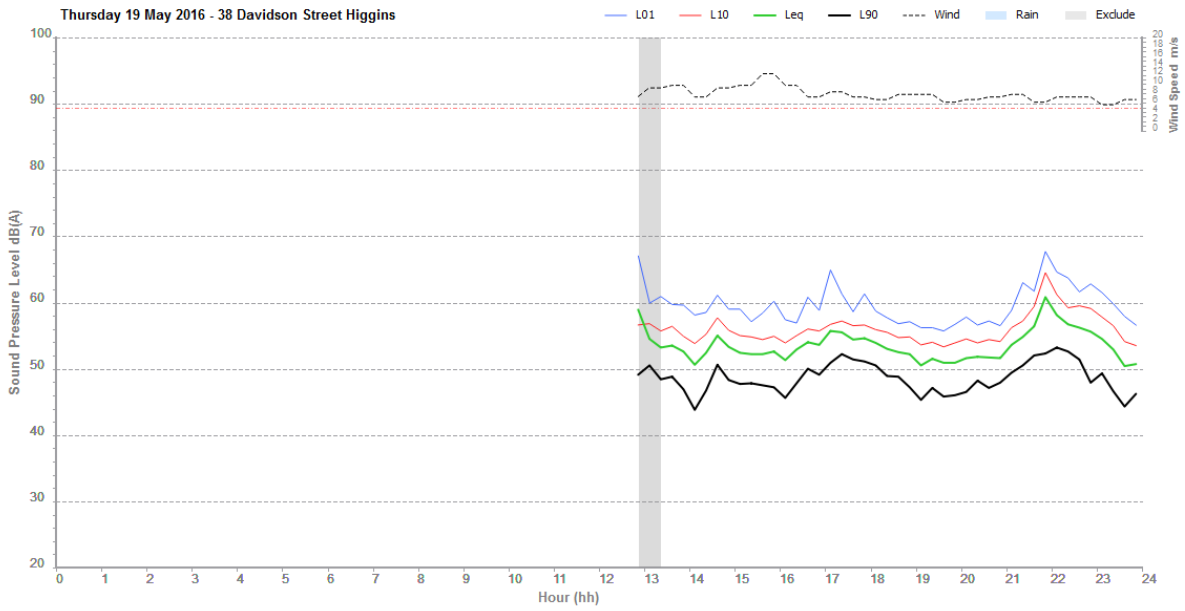
Wind Speed m/s
Hour (hh)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Leq
L90
Wind
Rain
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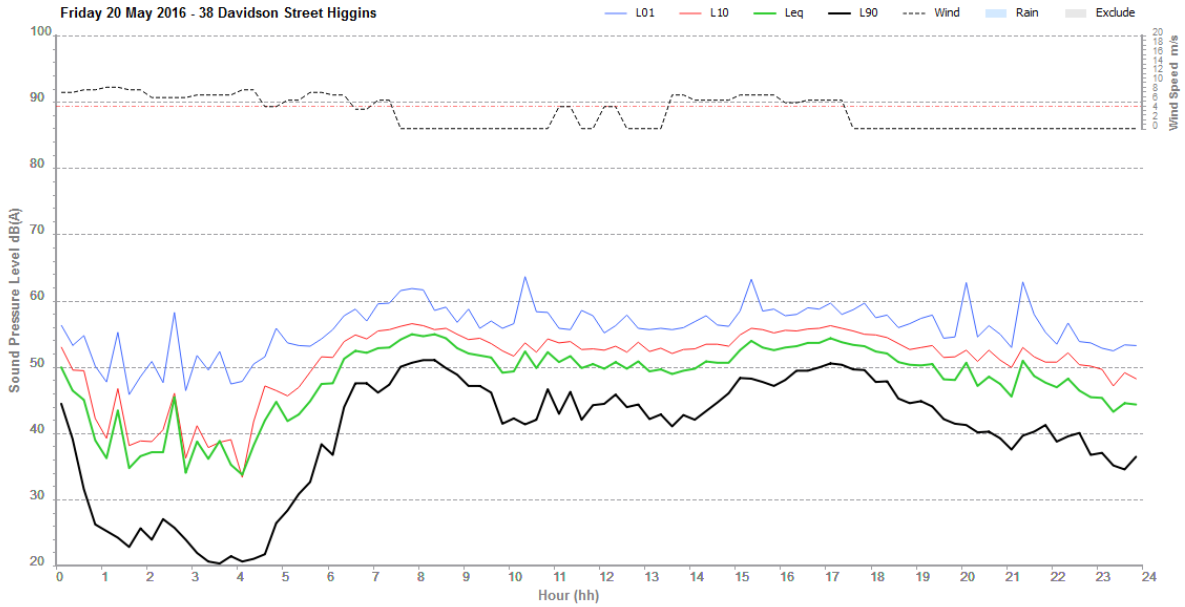
Wind Speed m/s
Hour (hh)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L90
Wind
Rain
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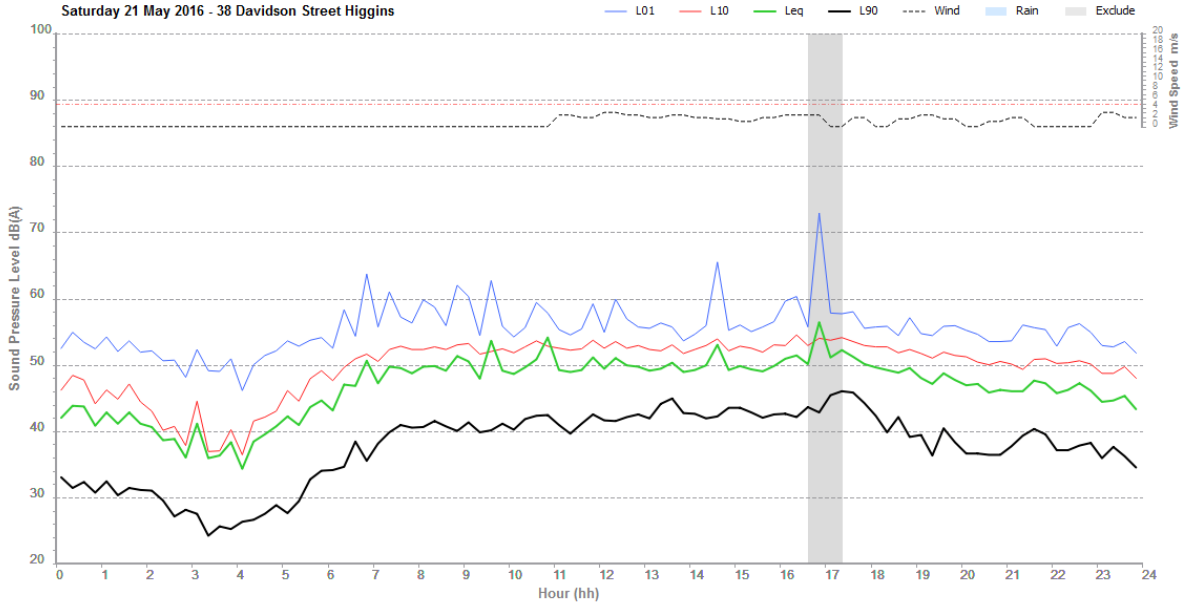
Wind Speed m/s
Hour (hh)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L01
L10
Leq
L90
Wind
Rain
Exclude
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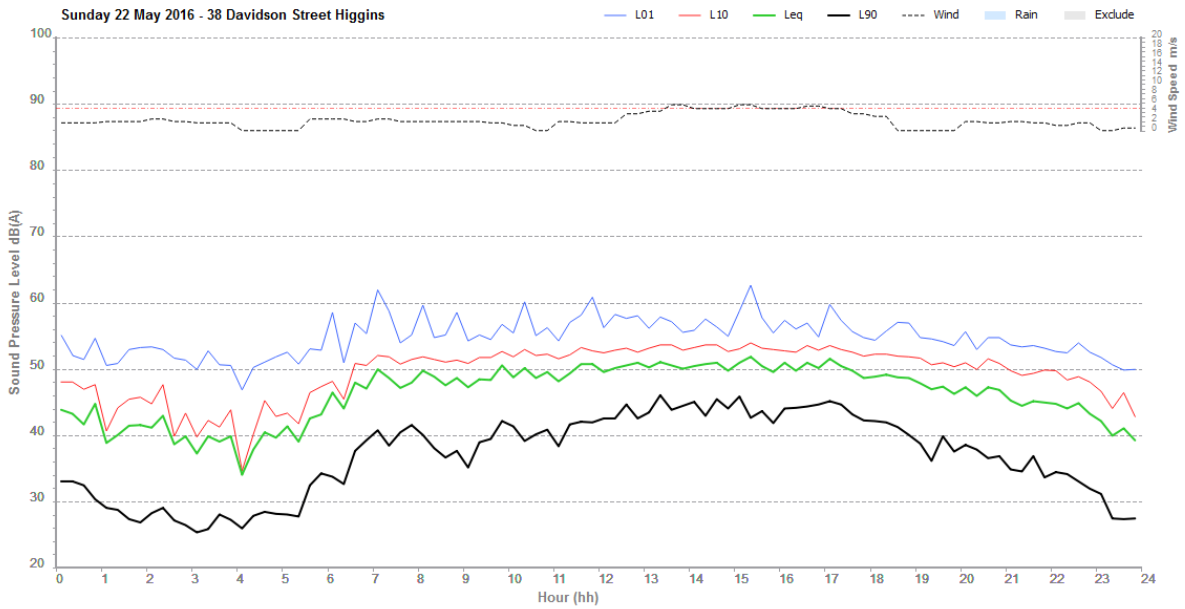
Wind Speed m/s
Hour (hh)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L01
L10
Leq
L90
Wind
Rain
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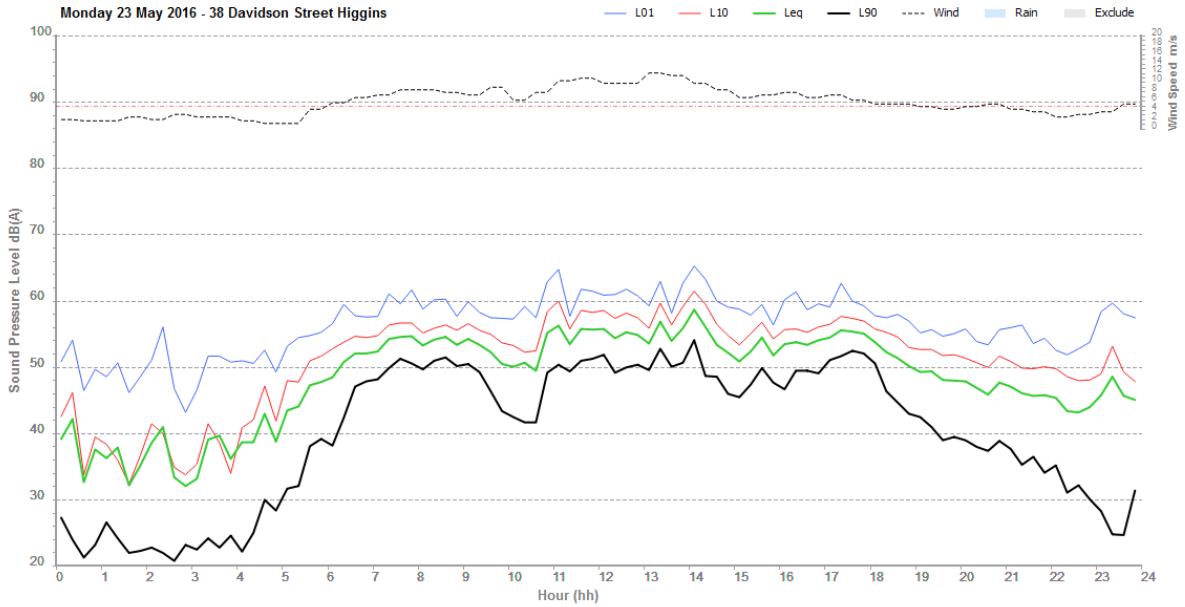
Wind Speed m/s
Hour (hh)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L10
Leq
L90
Wind
Rain
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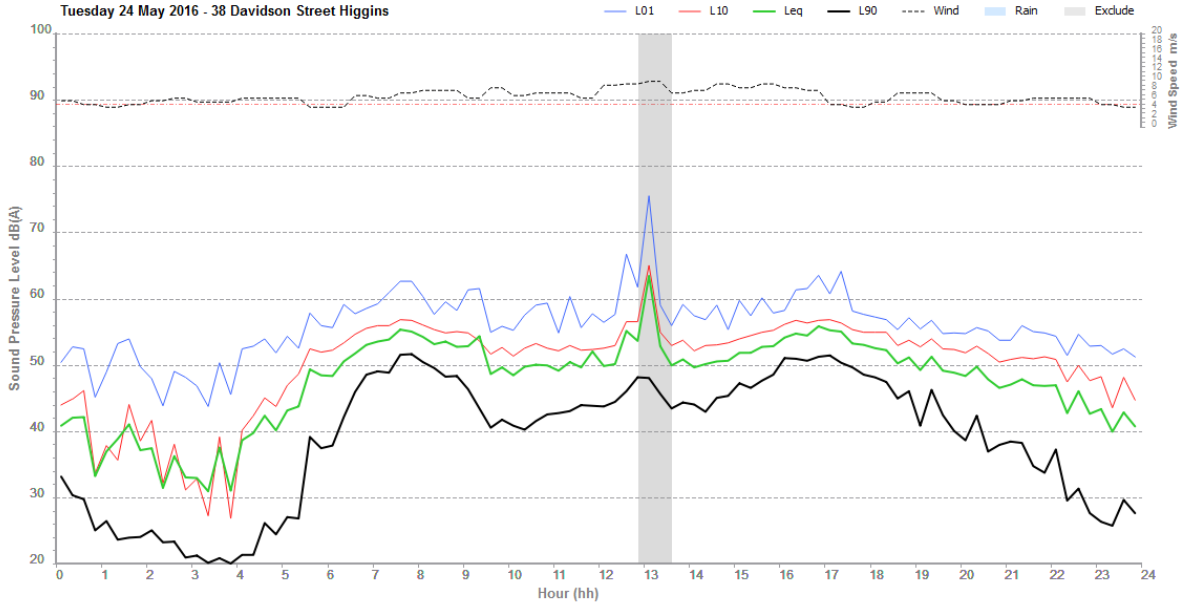
Wind Speed m/s
Hour (hh)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L90
Wind
Rain
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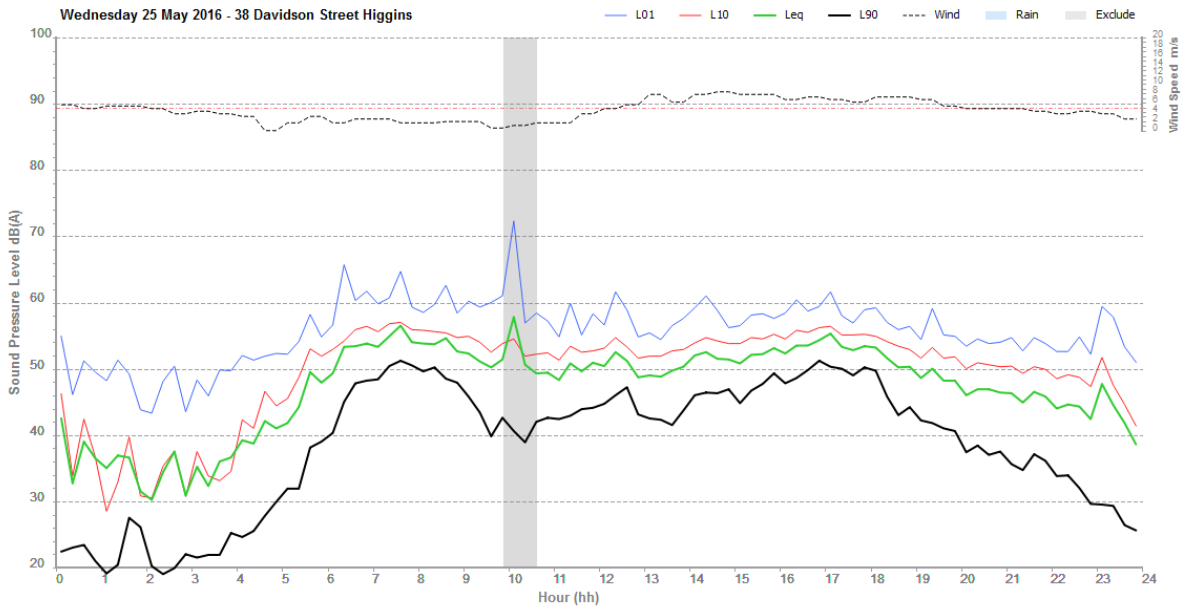
Hour (hh)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L10
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Wind
Rain
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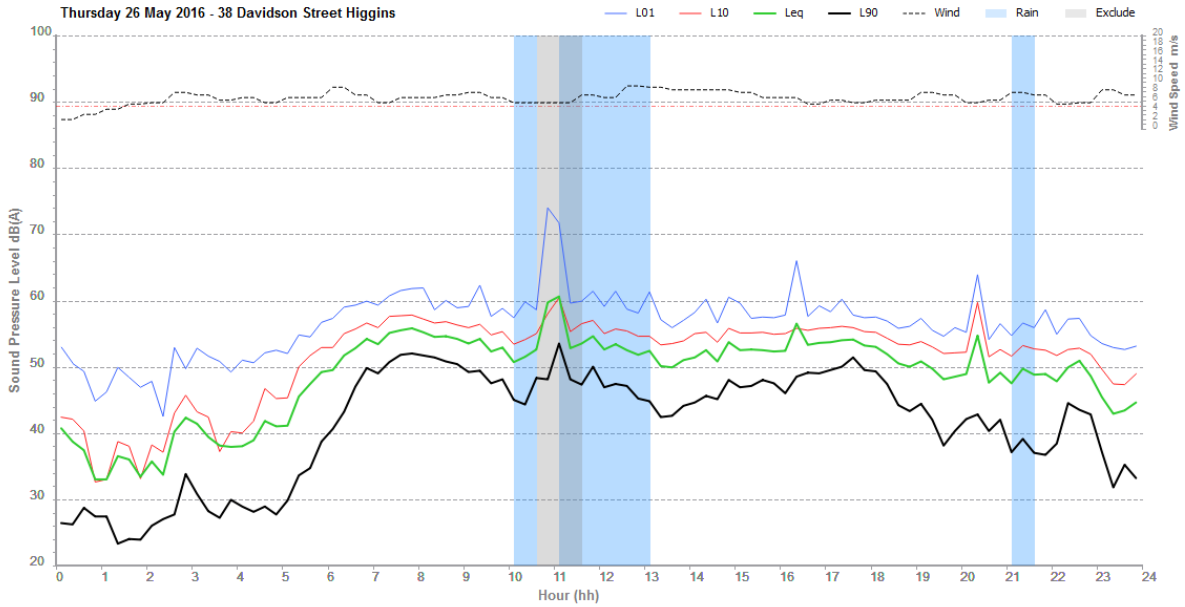
Wind Speed m/s
Hour (hh)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L01
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L90
Wind
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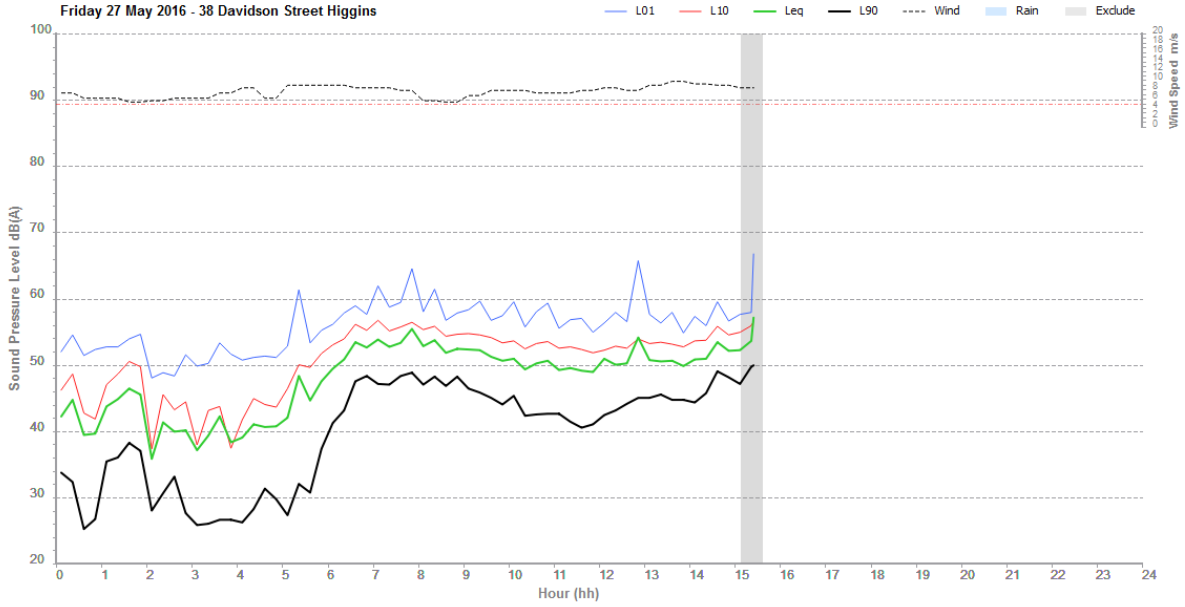
Wind Speed m/s
Hour (hh)


Friday 27 May 2016 - 38 Davidson Street Higgins
L01
L10
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L90
Wind
Rain
Exclude
Sound Pressure Level dB(A)
Wind Speed m/s
Hour (hh)

Appendix H

Noise Contour Maps

Appendix H Noise Contour Maps

AECOM

L_{A10}, dB(A)

58

West Belconnen Road Upgrade - Drake Brockman Drive

Road Traffic Noise Contours

0 50 100 200 m

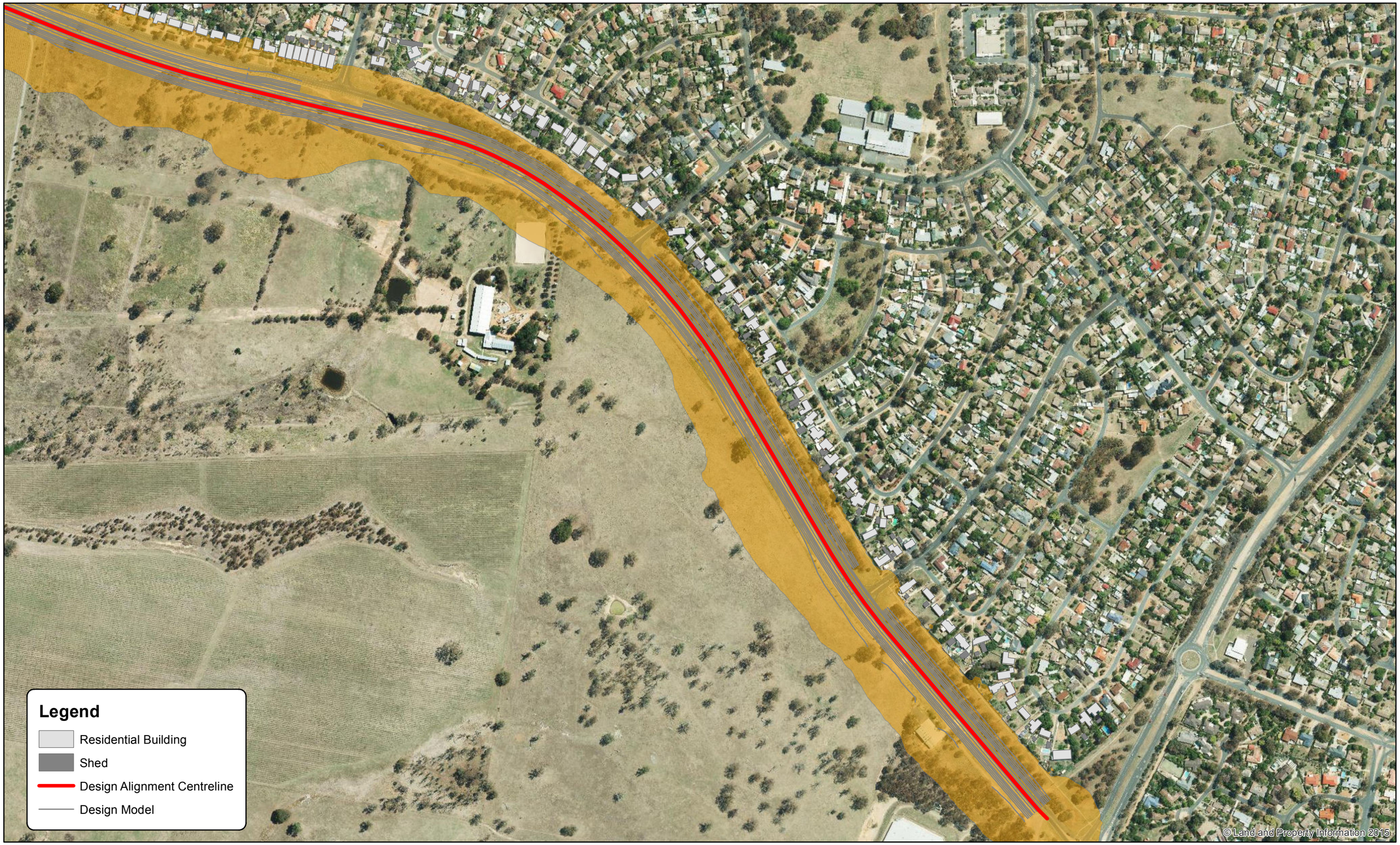
N

Jul 2016

60501930

Fig. 1

AECOM



L_{A10}, dB(A)

58

West Belconnen Road Upgrade - Drake Brockman Drive

Road Traffic Noise Contours

0 50 100 200 m

N

Jul 2016

60501930

Fig. 2

Appendix I

Predicted Noise Levels - Facade

Appendix I Predicted Noise Levels - Facade

Table 41 Drake Brockman Drive Predicted Noise Levels

Receiver number	Receiver address	Criteria, dB(A)	Predicted level, L_{10}, dB(A)		Exceedances, dB(A)	
			DGA	SMA	DGA	SMA
1	43 O'Sullivan Street	63	58	56	0	0
2	41 O'Sullivan Street	63	53	50	0	0
3	39 O'Sullivan Street	63	58	55	0	0
4	47B O'Sullivan Street	63	59	57	0	0
5	49A O'Sullivan Street	63	60	58	0	0
6	51 O'Sullivan Street	63	60	58	0	0
7	53 O'Sullivan Street	63	59	56	0	0
8	55 O'Sullivan Street	63	63	60	0	0
9	57 O'Sullivan Street	63	58	56	0	0
10	59 O'Sullivan Street	63	58	56	0	0
11	12 Nicholas Street	63	61	58	0	0
12	10 Nicholas Street	63	63	60	0	0
13	8 Nicholas Street	63	62	60	0	0
14	6 Nicholas Street	63	60	57	0	0
15	4 Nicholas Street	63	62	60	0	0
16	2 Nicholas Street	63	57	55	0	0
17	5 Kinsella Street	63	63	60	0	0
18	1 Kinsella Street	63	58	56	0	0
19	3 Kinsella Street	63	60	57	0	0
20	46 Davidson Street	63	57	55	0	0
21	48 Davidson Street	63	57	55	0	0
22	46 Davidson Street	63	57	55	0	0
23	44 Davidson Street	63	57	54	0	0
24	42 Davidson Street	63	59	57	0	0
25	40 Davidson Street	63	58	55	0	0
26	38 Davidson Street	63	58	55	0	0
27	36 Davidson Street	63	59	57	0	0
28	34 Davidson Street	63	58	55	0	0
29	32 Davidson Street	63	58	56	0	0
30	30 Davidson Street	63	55	53	0	0
31	28 Davidson Street	63	58	55	0	0
32	26 Davidson Street	63	58	55	0	0
33	24 Davidson Street	63	60	57	0	0
34	22 Davidson Street	63	58	56	0	0
35	20 Davidson Street	63	59	56	0	0
36	18 Davidson Street	63	57	55	0	0

Receiver number	Receiver address	Criteria, dB(A)	Predicted level, L_{10}, dB(A)		Exceedances, dB(A)	
			DGA	SMA	DGA	SMA
37	16 Davidson Street	63	57	54	0	0
38	14 Davidson Street	63	58	55	0	0
39	12 Davidson Street	63	58	55	0	0
40	10 Davidson Street	63	58	55	0	0
41	8 Davidson Street	63	60	58	0	0
42	6 Davidson Street	63	61	58	0	0
43	4 Davidson Street	63	63	60	0	0
44	2 Davidson Street	63	59	57	0	0
45	3 Cussen Street	63	63	60	0	0
46	1 Cussen Street	63	56	53	0	0
47	7 Ashburner Street	63	55	53	0	0
48	9 Ashburner Street	63	59	57	0	0
49	11 Ashburner Street	63	59	56	0	0
50	13 Ashburner Street	63	58	55	0	0
51	15 Ashburner Street	63	59	57	0	0
52	17 Ashburner Street	63	60	57	0	0
53	19 Ashburner Street	63	58	56	0	0
54	21 Ashburner Street	63	58	55	0	0
55	23 Ashburner Street	63	59	57	0	0
56	25 Ashburner Street	63	59	56	0	0
57	27 Ashburner Street	63	60	57	0	0
58	29 Ashburner Street	63	58	55	0	0
59	31 Ashburner Street	63	57	54	0	0
60	33 Ashburner Street	63	57	54	0	0
61	35 Ashburner Street	63	56	53	0	0
62	37 Ashburner Street	63	56	53	0	0
63	39 Ashburner Street	63	57	54	0	0
64	43 Ashburner Street	63	53	51	0	0
65	6 Macnaughton Street	63	54	52	0	0
66	4 Macnaughton Street	63	57	54	0	0
67	3 Macnaughton Street	63	58	55	0	0
68	5 Macnaughton Street	63	66	64	**3**	**1**
69	1 Macnaughton Street	63	67	65	**4**	**2**
70	122 Drake Brockman Drive	63	67	64	**4**	**1**
71	124 Drake Brockman Drive	63	67	64	**4**	**1**
72	126 Drake Brockman Drive	63	67	65	**4**	**2**
73	128 Drake Brockman Drive	63	67	65	**4**	**2**
74	130 Drake Brockman Drive	63	67	64	**4**	**1**
75	132 Drake Brockman Drive	63	67	64	**4**	**1**

Receiver number	Receiver address	Criteria, dB(A)	Predicted level, L_{10}, dB(A)		Exceedances, dB(A)	
			DGA	SMA	DGA	SMA
76	134 Drake Brockman Drive	63	67	65	4	2
77	136 Drake Brockman Drive	63	67	64	4	1
78	138 Drake Brockman Drive	63	67	65	4	2
79	140 Drake Brockman Drive	63	67	65	4	2
80	142 Drake Brockman Drive	63	65	63	2	0
81	144 Drake Brockman Drive	63	65	62	2	0
82	146 Drake Brockman Drive	63	58	55	0	0
83	148 Drake Brockman Drive	63	65	62	2	0
84	150 Drake Brockman Drive	63	66	64	3	1
85	152 Drake Brockman Drive	63	63	60	0	0
86	156 Drake Brockman Drive	63	62	59	0	0
87	160 Drake Brockman Drive	63	63	60	0	0
88	164 Drake Brockman Drive	63	62	59	0	0
89	4 Trickett Street	63	65	62	2	0
90	2 Trickett Street	63	58	56	0	0
91	6 Trickett Street	63	57	54	0	0
92	6A Trickett Street	63	65	63	2	0
93	1 Trickett Street	63	60	57	0	0
94	3 Trickett Street	63	66	63	3	0
95	168 Drake Brockman Drive	63	61	58	0	0
96	170 Drake Brockman Drive	63	65	63	2	0
97	172 Drake Brockman Drive	63	65	63	2	0
98	174 Drake Brockman Drive	63	65	62	2	0
99	176 Drake Brockman Drive	63	66	63	3	0
100	178 Drake Brockman Drive	63	66	64	3	1
101	180 Drake Brockman Drive	63	66	63	3	0
102	182 Drake Brockman Drive	63	66	64	3	1
103	184 Drake Brockman Drive	63	67	64	4	1
104	186 Drake Brockman Drive	63	65	62	2	0
105	2 Spofforth Street	63	56	54	0	0
106	4 Spofforth Street	63	54	52	0	0
107	6 Spofforth Street	63	54	51	0	0
108	8 Spofforth Street	63	53	50	0	0
109	10 Spofforth Street	63	52	49	0	0
110	12 Spofforth Street	63	52	49	0	0
111	16 Spofforth Street	63	50	47	0	0
112	14 Spofforth Street	63	49	47	0	0
113	18 Spofforth Street	63	48	46	0	0
114	20 Spofforth Street	63	48	46	0	0

Receiver number	Receiver address	Criteria, dB(A)	Predicted level, L_{10}, dB(A)		Exceedances, dB(A)	
			DGA	SMA	DGA	SMA
115	22 Spofforth Street	63	58	56	0	0
116	24 Spofforth Street	63	61	58	0	0
117	23/131 Britten-Jones Drive	63	61	59	0	0
118	19-31 Le Fevre Court	63	61	58	0	0
119	22-36 Le Fevre Court	63	61	59	0	0
120	12 Le Fevre Court	63	54	51	0	0
121	111-1 Britten-Jones Drive	63	51	48	0	0
122	2-10 Le Fevre Court	63	59	57	0	0
Total exceedances					**28**	**16**

Notes:

- *Exceedances are highlighted in **RED**, refer to Section 11.6 of this report for mitigation options.*

Appendix J

Feasibility Design Costs

Appendix J Feasibility Design Costs

Table 42 Stage 1 Feasibility Design Costs

Opinion of Probable Costs			
Item	**Description**		**$**
1	**Drake Brockman Drive/Stockdill Drive**		
1.1	Minor Civil Works - line marking and minor widening		**$ 219,479**
	Work Cost Subtotal		**$ 219,479**
	Preliminaries	15%	$ 33,000
	Contingency	40%	$ 101,000
	Escalation (1% per year)	2%	$ 8,000
	Total Cost (Stage 1)		**$ 361,479**

Table 43 Stage 2 Feasibility Design Costs

Opinion of Probable Costs			
Item	**Description**		**$**
0	**General**		
	Earthwork		$ 4,937,000
	Retaining Walls (Ch.440 – 1680)		$ 791,700
1	**Drake Brockman Drive/Stockdill Drive**		
1.1	**Intersections**		
1.1.1	Britten-Jones Drive – modify layout for right turn pocket		$ 1,383,764
1.1.2	Spofforth St (Posted Speed - 60 km/h) - modify intersection to ultimate arrangement (includes service road)		$ 1,986,275
1.1.3	Trickett St (Posted Speed - 60 km/h) - modify intersection to ultimate arrangement (includes service road)		$ 1,819,643
1.1.4	Macnaughton Street (Posted Speed - 60 km/h) - modify intersection to ultimate arrangement (includes service road and signalisation)		$ 2,522,133
1.2	**Mid-block**		
1.2.1	West Britten-Jones Drive – modify for new road		$ 348,681
1.2.2	Britten-Jones Drive to Spofforth - modify for new road		$ 499,070
1.2.3	Spofforth to Trickett - modify for new road		$ 365,951
1.2.4	Trickett to Macnaughton - modify for new road		$ 1,862,857
1.2.5	Macnaughton to Cussen - modify for new road		$ 564,430
	Work Cost Subtotal		**$ 17,074,504**
	Preliminaries	15%	$ 2,562,000
	Contingency	40%	$ 7,855,000
	Escalation (1% per year)	5%	$ 1,375,000
	Total Cost (Stage 2)		**$ 28,866,504**

Table 44 Ultimate Stage Feasibility Design Costs

Opinion of Probable Costs			
Item	**Description**		**$**
0	**General**		
	Earthwork		$ 1,620,000
	Retaining Walls (Ch 1840 – 3060)		$ 1,121,500
1	**Drake Brockman Drive**		
1.1	**Intersections**		
1.1.1	Britten-Jones Drive – modify layout for duplication		$ 209,818
1.1.2	Spofforth St (Posted Speed - 60 km/h) - modify layout for duplication and signalise		$ 590,877
1.1.3	Trickett St (Posted Speed - 60 km/h) - modify layout for duplication and signalise		$ 578,647
1.1.4	Macnaughton Street (Posted Speed - 60 km/h) - modify layout for duplication		$ 292,063
1.1.5	Cussen Street (Posted Speed - 60 km/h) - modify layout for duplication		$ 2,392,683
1.1.6	Kinsella St (Posted Speed - 60 km/h) - modify layout for duplication		$ 2,237,392
1.1.7	Kingsford Smith Drive/William Hovell Drive (Posted Speed - 80 km/h) - modify layout for duplication and build turn lanes		$ 2,759,483
1.2	**Mid block**		
1.2.1	West of Britten-Jones Drive – modify layout for duplication		$ 51,482
1.2.2	Britten-Jones Drive to Spofforth – modify layout for duplication		$ 113,891
1.2.3	Spofforth to Trickett – modify layout for duplication		$ 48,635
1.2.4	Trickett to Macnaughton – modify layout for duplication		$ 352,668
1.2.5	Macnaughton to Cussen – modify layout for duplication		$ 101,175
1.2.6	Cussen to Kinsella – modify layout for duplication		$ 1,659,084
1.2.7	Kinsella to Kingsford Smith – modify layout for duplication and right turn at median		$ 1,064,338
	Work Cost Subtotal		**$ 13,573,736**
	Preliminaries	15%	$ 2,037,000
	Contingency	40%	$ 6,245,000
	Escalation (1% per year)	15%	$ 3,279,000
	Total Cost (Ultimate Design Stage)		**$ 25,134,736**

Appendix K

CBA Parameter Assumptions

Appendix K CBA Parameter Assumptions

Table 45 List of CBA assumptions and description

Assumption	Value	Source
General parameters		
Price year	2016	
Real discount rate	7%	- ACT Treasury (2009)
Evaluation period	30 years	- The proposed developments in the West Belconnen area will be undertaken over the next 30 years.
Benefit realisation start date and duration	1st January 2018	- The benefits realisation is assumed to begin from the point at which construction of design changes is completed.
Timing		
Construction start date and duration – Option 2a	1st January 2017; 1 years	- Provided by AECOM design team
Construction start date and duration – Option 2b	1st January 2017; 1 year	- Provided by AECOM design team
Construction start date and duration – Option 3	1st January 2017; 1 year	- Provided by AECOM design team
Maintenance start date – Option 2a	1st January 2028	- Provided by AECOM design team
Maintenance start date – Option 2b	1st January 2028	- Provided by AECOM design team
Maintenance start date – Option 3	1st January 2028	- Provided by AECOM design team
Traffic parameters		
Peak hour traffic volume annual expansion factor	1,225	- This factor expands the traffic counts undertaken during the AM and PM peak hours to the annual volume of traffic benefiting from the improvement. It was assumed that traffic in peak shoulder, business peak and off-peak hours would benefit proportionately less than traffic in peak hours (0.4, 0.2 and 0.05 times respectively).
Mean vehicle occupancy – cars	1.2 per vehicle	- Vehicle occupancy for cars was calculated based on SIDRA modelling defaults.
Cumulative annual growth rate (CAGR) of traffic volume – Option 1, all vehicle types	5.5%	- Provided by AECOM transport modelling team
Construction costs		
Option 2a (inc. GST)	$28,000,000	- Provided by AECOM design team
Option 2b (inc. GST)	$43,000,000	- Provided by AECOM design team
Option 3 (inc. GST)	$53,000,000	- Provided by AECOM design team
Construction cost contingency	40%	- Provided by AECOM design team

Assumption	Value	Source
Maintenance costs		
Options 2a	Approximately $1,800,000 over 30 years	- Maintenance cost related to maintenance of asphalt. - Length of additional and maintenance unit cost provided by AECOM design team
Options 2b	Approximately $2,910,000 over 30 years	- Maintenance cost related to maintenance of asphalt. - Length of additional and maintenance unit cost provided by AECOM design team
Options 3	Approximately $3,510,000 over 30 years	- Maintenance cost related to maintenance of asphalt. - Length of additional and maintenance unit cost provided by AECOM design team
Crash costs		
Estimated number of crashes avoided as a result of design changes (per year)	Option 2A: -1.4 Option 2B: -1.4 Option 3: -4.8	- Provided by AECOM transport planning team - Reduction assumed to be realised from the point of project completion onwards

Source **AECOM, 2016**