4.2.1 Proposed Road Hierarchy

In accordance with the principles identified above a potential road layout was formulated.

Principal direct connections to the external road network include:

- JGD via a large traffic signal controlled intersection (Major Access 1).
- JGD via traffic signal controlled intersection with Cotter Road (Major Access 2).
- Left in/left out service roads.

A highly permeable connective style grid iron layout is proposed in accordance with the latest planning directions. Key features of the road hierarchy plan include:

- A short sub arterial road providing primary access to JGD surrounded to the east and west by mixed use development.
- An interconnected permeable network of lower order residential streets.
- Small section of shared driveways providing access to a limited number of plots (4 or less) which will not require truck access.

4.2.2 Proposed Road Cross Sections

It is proposed to provide the internal road network with varying cross sectional width requirements dependent upon the road category. The proposed road hierarchy cross sections are shown on the figures included within **Appendix A**. The road cross sections are described below:

- 55m reserve – Major Collector that provides access between JGD and the internal road network. A variable width median of up to 23.9m and 10m wide verges provide a boulevard entry feature. In either direction the carriageway is made up of a 3.75m wide trafficable lane, 1.5m wide marked on road bicycle lane with a 2.8m parking bay (3.5m for proposed bus stops) proposed at appropriate locations.
- 31.1m reserve – Major / Minor Collector that provides access between JGD and the internal road network. There is no central median however the 10m wide verges are maintained on either side. In either direction the carriageway is made up of a 3.75 metre wide trafficable lane and 1.5m wide marked on road bicycle lane. Again a 2.8m parking bay and 3.5m bus bay are proposed at appropriate locations.
- 40m reserve – Minor Collector that serves as the main spine road for west Coombs. A wide 8.9m median and 10m verges again provide a boulevard statement. The carriageway is made up of 3.75m wide trafficable lane, 1.5m wide marked on road bicycle lane in either direction.
- 26m to 30m reserves – Local Access C with variable verge widths (between 7.2m and 10.75m) to suit urban form and infrastructure requirements. The carriageway is typically 3.75m trafficable lanes with 2.8m indented parking bays as required. No on road marked cycling is provided.
- 22m reserves – Local Access B generally with 7.25m wide verges and 3.75m wide trafficable lanes. Adjacent to open space the reserve drops down due to a 2m narrowed verge on the open space side.
- 56.7m reserve – Local Access A. Road reserve accommodates a 37.4m median in 'dress circle' area in the northern tip of Coombs. A single direction 3.5m wide trafficable lane is accommodated together with a 6.15m wide verge.

4.2.3 Pedestrian / Cycle Facilities

Cycling and walking are supported by the ACT Government and are recognised as healthy, low cost and environmentally friendly forms of transport. The ACT Government has adopted the National Strategy for

Ecologically Sustainable Development and the National Greenhouse Strategy. Both of these strategies support an increase in commuter cycling and walking in favour of private car use. Recreation policies also strongly support walking and cycling as a means of improving community health and fitness, and of helping to reduce greenhouse gas emissions and vehicle-produced noise and air pollution.

The ACT Sustainable Transport Plan (2004) aims to increase the mode share of walking and cycling from 4.1% and 2.3% respectively in 2001 to 7% each by 2021. Ensuring that greenfield developments are provided with high quality walking and cycling facilities is an integral part of achieving this target. It is recognised that encouraging walking and cycling as recreational pursuits can lead to increases in walking and cycling for commuting and other trip purposes.

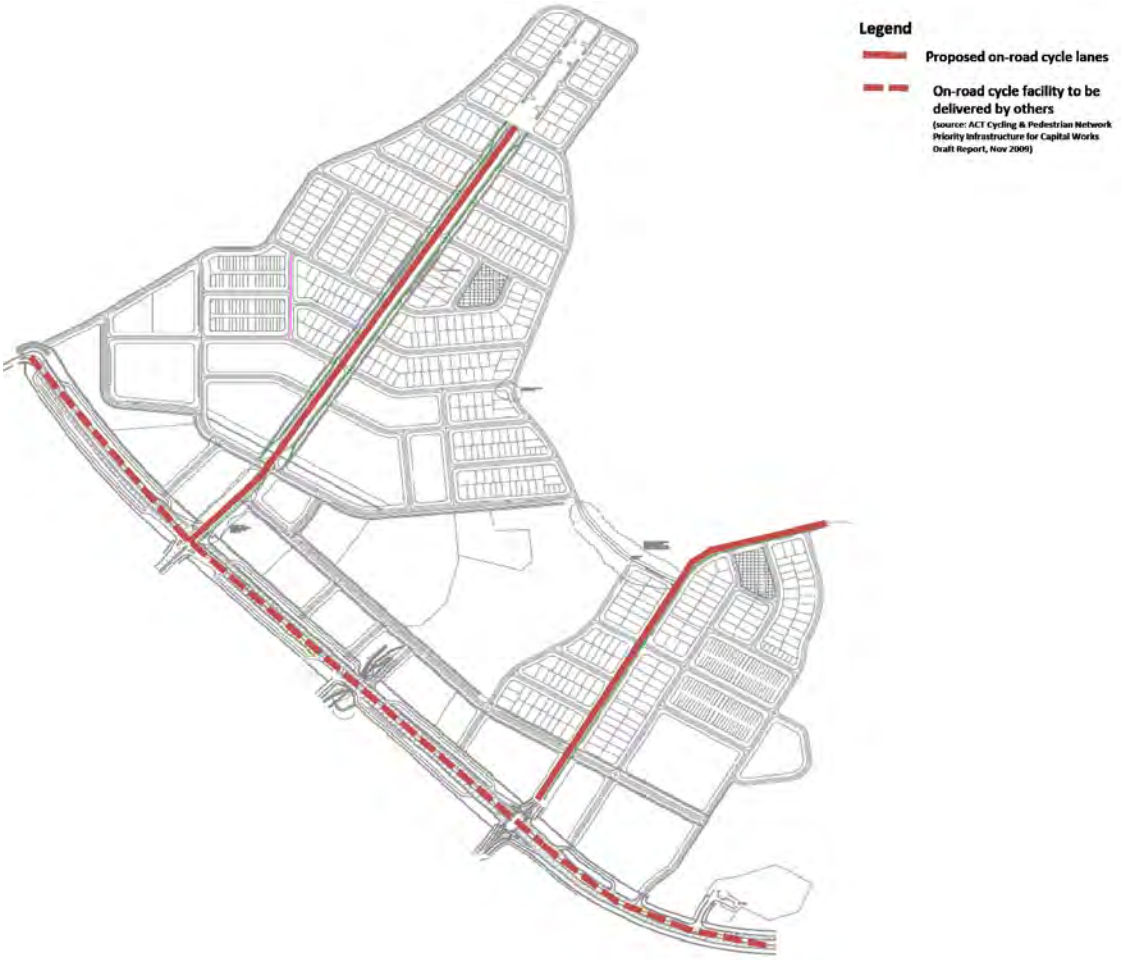
Key features for Coombs which encourage walking and cycling include:

- The provision of mixed use developments along the public transport spine (JGD), facilitating multi-purpose trips involving public transport and walking.
- The provision of footpaths along both sides of all streets, facilitating safe walking environments for all walkers and less confident cyclists.
- The provision of on-road cycling facilities along key road links through the site, linking to the proposed Main Routes Network.
- Provision of an off-road link through the open space corridor in the south-east of the suburb, linking with the proposed Roads Main Routes Network at Cotter Road and with Wright.

Design Standard 13, Drawing No. 11 (DS13-11) illustrates the ACT Government Main Routes Network and was last updated in June 2007 following preparation of the *Commuter Cycling Network: Priorities for Capital Works* report by CBRE. DS13-11 does not include the Molonglo area, however the infrastructure required in Molonglo was considered as part of the report. A review of the 2007 report is presently underway and it is anticipated that the Main Routes Network and DS13-11 will be updated accordingly. The provision of pedestrian and cycling facilities in Coombs has been developed consistent with the links recommended in the *Pedestrian and Cycling Network: Priority Infrastructure for Capital Works Draft Report* (Cardno, November 2009).

Figure 4.1 shows the proposed and cyclist facilities within Coombs. Locations where at-grade crossings, such as refuge islands, will be required have been identified. Specific crossing treatments will be determined during detailed design.

Figure 4.1 Proposed Cyclist Facilities in Coombs



4.2.4 Public Transport Provision

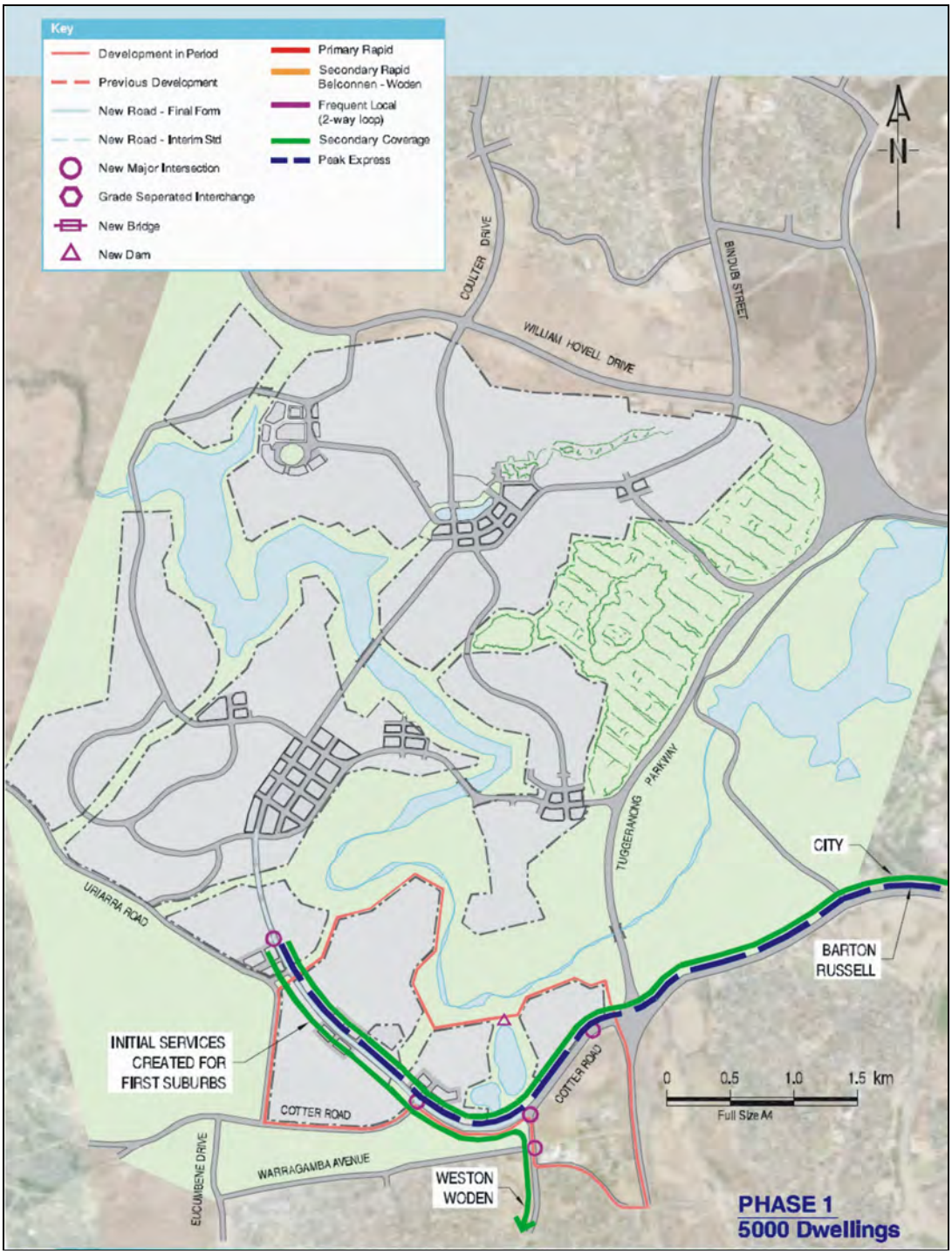
In 2009, the ACT Government commissioned McCormack Rankin Cagney to prepare a strategic network plan for public transport in Canberra (*ACT Strategic Public Transport Network Plan & Service Design*, McCormack Rankin Cagney, June 2009) over the next 20 years. The strategy has produced a strategic network plan with appropriate service levels which will be used to guide land use planning in the future. As a part of this strategy, servicing the Molonglo urban release area was considered thoroughly and a strategy developed for five interim development phases and full development as shown in **Figure 4.2**.

Coombs, along with North Weston and Wright, forms part of Phase 1 of the Molonglo release area. The recommended public transport services for Phase 1 include:

- An all-day service running from Coombs/Wright to City via JGD, Cotter Road, Adelaide Avenue, and Commonwealth Avenue, generally at 30 minute headways. It is intended that this service grow into a 'Rapid' service running much more frequently throughout the day.
- A 'Peak Express' service from Coombs/Wright to Barton and Russell, running in the peak direction during peak periods only with a frequency to be determined by demand (initial service would probably be every 30 minutes across the two-hour peak).
- A 'Coverage' service from Coombs/Wright to Woden via Coleman Court.

The recommended services for Phase 1 are shown **Figure 4.3**. It is likely that all the of the proposed plan area will be within a convenient 400 metre walk distance of a bus service pending finalisation of bus stop locations by Action Buses.

Figure 4.2 ACT STNP – Recommended Service Plan for Molonglo Phase 1



Source: ACT Strategic Public Transport Network Plan

Figure 4.3 Public Transport Network

4.3 ROAD NETWORK PERFORMANCE

Assessments were undertaken to examine the road network operational performance on both a mid block basis and at the identified key intersections of the higher order road network for both the assessed assignment methods.

4.3.1 ACT Classification of Residential Streets

Table 4.1 sets out the ACT Classification of Residential Streets.

Table 4.1 ACT Classification of Residential Streets

Residential Street level, type and function	Desirable speed environment (km/h)*	Indicative traffic volume (vehicles per day) **
LOCAL ACCESS STREETS		
Rear lane	25	Residents and service vehicles: 0–100
Local access A	40	0–300
Local access B	40	301–1000
Local access C	50	1001–2000
Local access streets are generally streets where the residential environment is dominant, traffic is subservient, speed and volume are low, and pedestrian and cycle movements are facilitated. Local access streets are categorised as A, B and C according to traffic volumes and width requirements for the road reservation as per Table 4. Rear lanes and Local Access A provide access to sites without any traffic generated by sites in other streets.		
COLLECTOR STREETS		
Minor collector	50	1000–3000
The collector street collects traffic from access streets and carries higher volumes of traffic. A reasonable level of residential amenity and safety is maintained by restricting traffic volumes and vehicle speeds. Vehicle speeds are controlled by street alignment, intersection design and, in some cases, by speed-control measures.		
Major collector	60	3000–6000
The major collector is generally short and connects the collector street with the corridor network. Fronting development should still be encouraged, but with siting conditions which ensure acceptable amenity and safety.		
* This is the intended maximum speed at which most drivers will travel given the inbuilt environmental speed controls created by the street layout and design. It is not a design speed for sight distance cornering or other geometric properties of the carriageway.		
** The indicative maximum traffic volume is a target volume that may be exceeded in a few cases where significant lack of economic or design quality would otherwise result.		

Based upon the traffic generation, distribution and assignment of the Masterplan each street had a daily traffic volume identified such that it could be assessed against the ACTPLA Residential Subdivision Development Code. Drawings 292347-C-RHP-01 to 04 provide a summary of the mid block volumes and road hierarchy for Coombs estate.

Road C03 northbound and southbound between JGD and C08W are classified as major collector roads and each carry approximately 3,600 – 4,400 vehicles a day. Similarly, C04 between JGD and C07 is classified as a major collector with the road carrying some 5,000 – 5,900 vehicles a day.

4.3.2 Intersection Performance

The intersections detailed below were assessed using the SIDRA 5.0 software package for the weekday AM peak and PM peak for internal intersections and AM peak for JGD intersections to determine the degree of saturation (DS), average delays (d), Level of Service (LoS) and queue lengths (QL) at each intersection:

- JGD/Road C03 / Road 01 (Wright) - Signalised.
- JGD/Cotter Road/Road C04 – Signalised.
- Road C03/Road C28 – Priority Controlled
- Road C03/Road C08 – Signalised and Roundabout.
- Road C08/Road C07 – Priority Controlled
- Road C20/Road C09 – Priority Controlled
- Road C07/Road C04 – Signalised, Priority Controlled and Roundabout.

The intersections with JGD were assessed with intersection configurations based on layouts developed by other consultants in the reports referenced. As it is proposed to construct JGD in stages as the Molonglo Valley is being progressively developed, SIDRA analyses for the interim stage for year 2021 and ultimate stage for year 2031 have been carried out as part of the intersection assessment. Through traffic volumes for the 2021 and 2031 were extracted from the Molonglo Transport Model review based on the highest mid-block modelled volumes on John Gorton Drive.

Internal intersections have been assessed based on the AM peak and PM peak hour traffic volumes generated from the proposed Coombs development for year 2031.

Not all internal intersections have been assessed using SIDRA, as most intersections carry very low volumes of traffic. We have analysed 5 internal intersections based on those with higher traffic volumes and where excessive queuing could adversely impact on John Gorton Drive. Although Road C28 will carry low volumes of traffic east of Road C03, this intersection has been assessed as it will be important to confirm that the surrounding intersections can cater for the redistribution of traffic.

The intersections located along JGD have been assessed for the following 3 scenarios in the AM Peak:

Year 2021 Interim

- Intersection layout based on GHD report on Molonglo Infrastructure Stage 1 Traffic report for Intersection 1 and Intersection 4 interim layouts.
- Through traffic volumes based on Molonglo Transport Model Review (AECOM) 2021 with construction of the East-West Arterial link to Tuggeranong Parkway scenario.

Year 2021 Ultimate

- Intersection layout based on GHD report on Molonglo Infrastructure Stage 1 Traffic report for Intersection 1 and Intersection 4 ultimate layouts.
- Through traffic volumes based on Molonglo Transport Model Review (AECOM) 2021 with construction of the East-West Arterial link to Tuggeranong Parkway.

Year 2031 Ultimate

- Intersection layout based on GHD report on Molonglo Infrastructure Stage 1 Traffic report for Intersection 1 and Intersection 4 ultimate layout.
- Through traffic volumes based on Molonglo Transport Model Review (AECOM) 2031 with construction of a third (western) road crossing of Molonglo River scenario.JGD/Road C03/Road 01 (Wright)

The signalised intersection is tested based on the following layouts as shown below in **Figure 4.4** and **Figure 4.5**:

Figure 4.4 JGD/Road C03/Road 01 Interim Stage Intersection Layout

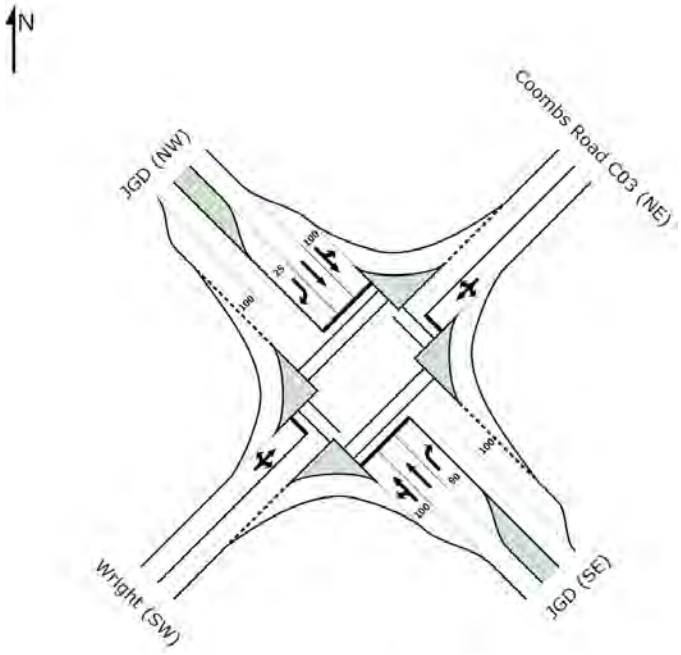


Figure 4.5 JGD/Road C03/Road 01 Ultimate Stage Intersection Layout

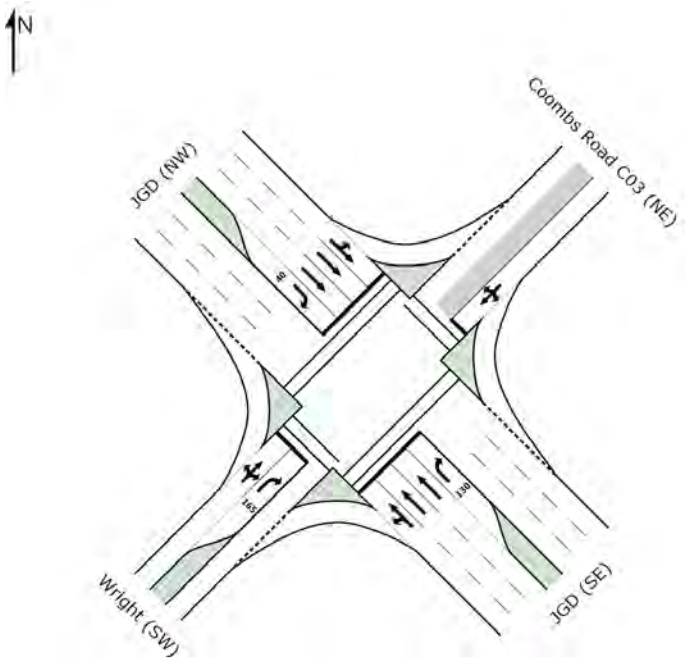


Table 4.2 details the intersection performance for JGD/Road C03/Road 01 (Wright) based on the full development of Coombs and Wright. Detailed results of this analysis are provided in **Appendix B.**

Table 4.2 AM Weekday Intersection Performance JGD/Road C03/ Road 01 (Wright)

Intersection Layout	Year	Performance Criteria			
		Degree of Saturation	Delays (s)	Level of Service	Queue Length (metres)
Interim	2021	>1.000	>120	F	>500
Ultimate	2021	0.792	25.3	B	155
Ultimate	2031	0.811	26.1	B	236

DS = Degree of Saturation d = Delay (seconds)
Q = Queue Length (m) LoS = Level of Service

Results from the SIDRA analyses indicated:

- The intersection with the interim layout will be over capacity in 2021, operating at a Level of Service F with maximum delays and queue lengths due to the high through movements on JGD. It can be concluded that the Ultimate road upgrade for JGD will need to be implemented at an earlier date than Year 2031 to enable the intersections along JGS to operate satisfactorily.
- With the ultimate layout, the intersection performs satisfactorily at a LoS B in 2021 and 2031.
- It is important to note that the worst movement for the intersection is the right turn from JGD into Coombs development where delays of up to approximately 60 seconds are expected in 2031.

JGD/Cotter Road/Road C04

The signalised intersection has been assessed based on the following layout as shown below in **Figure 4.6** and **Figure 4.7**:

Figure 4.6 JGD/Cotter Road/Road C04 Interim Stage Intersection Layout

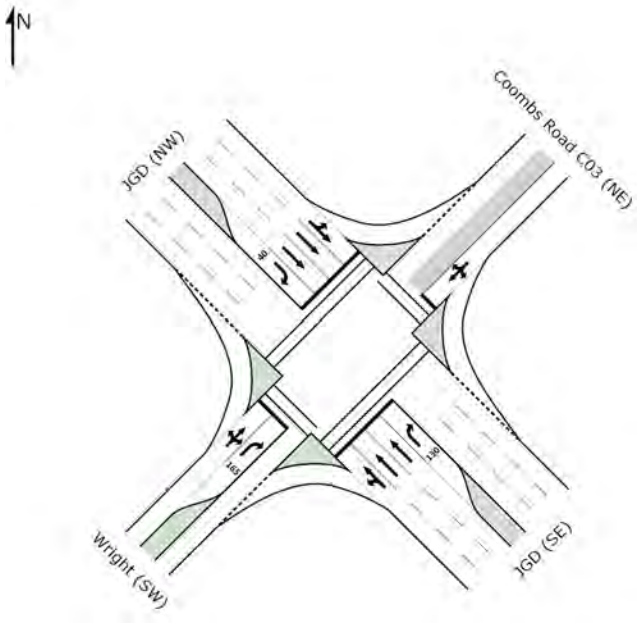


Figure 4.7 JGD/Cotter Road/Road C04 Ultimate Stage Intersection Layout

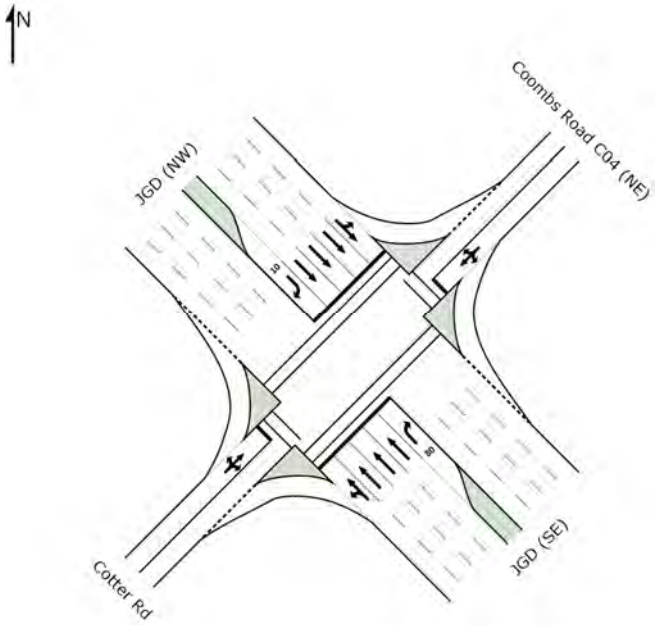


Table 4.3 details the intersection performance for JGD/Cotter Road/Road C04 based on the full development of Coombs and Wright. Detailed results of this analysis are provided in **Appendix B**.

Table 4.3 AM Weekday Intersection Performance for JGD/Cotter Road/Road C04

Intersection Layout	Year	Performance Criteria			
		Degree of Saturation	Delays (s)	Level of Service	Queue Length (metres)
Interim	2021	>1.000	71.3	F	>500
Ultimate	2021	0.695	22.0	B	137
Ultimate	2031	0.827	26.3	B	193

DS = Degree of Saturation d = Delay (seconds)
Q = Queue Length (m) LoS = Level of Service

Results from the SIDRA analysis indicated:

- The intersection with the interim layout will be over capacity in 2021, operating at a Level of Service F with maximum delays and queue lengths due to the high through movements on JGD.
- With the ultimate layout, the intersection performs satisfactorily at a LoS B in 2021 and LoS D in 2031.
- The highest delay for the intersection is the right turn from JGD into Coombs where delays of up to 98 seconds and queue lengths of 75 metres are expected in 2031.

Road C03/Road C28

The t-junction has been assessed assuming all movements are permitted.

Figure 4.8 Road 03/Road 28

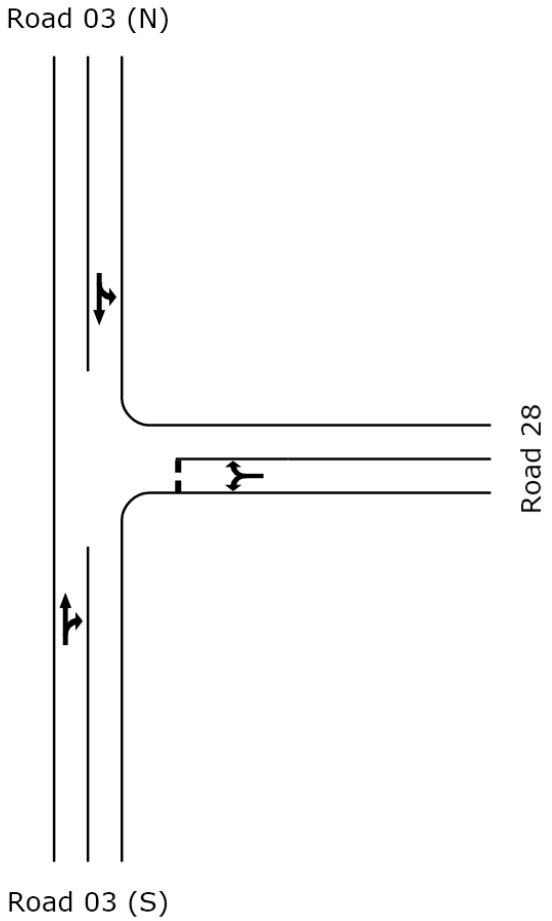


Table 4.4 AM Weekday Intersection Performance for Road 03/Road 28

Year	Performance Criteria			
	Degree of Saturation	Delays (s)	Level of Service	Queue Length (metres)
2031 AM	>1.000	>120	F	>500

DS = Degree of Saturation d = Delay (seconds)
Q = Queue Length (m) LoS = Level of Service
LoS values based on worst delay of any vehicle movement

The results have revealed that:

- Vehicles on Road 28 will experience high delays and significant queue lengths and operate a Level of Service F.

An alternative arrangement where only left in/left out movements are permitted has been assessed and internal traffic distributed at the surrounding intersections taking into consideration these changes.

The priority controlled intersection has been analysed based on the following configuration as shown below in **Figure 4.9**.

Figure 4.9 Road03/Road28 Intersection Layout

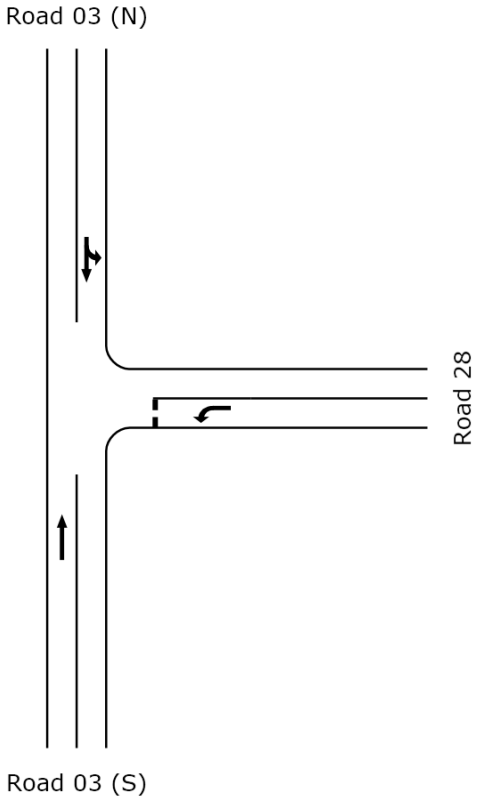


Table 4.5 shows the intersection performance for Road C03/Road C27 based on the full development of Coombs. Detailed results of this analysis are provided in **Appendix B.**

It is important to note that low traffic volumes are expected on Road 28, as this road will be designed to maximise pedestrian connectivity between the surrounding land uses. This can be achieved by LATM measures to reduce its attractiveness for through traffic and permitting left in left out movements only. The majority of vehicles travelling to the school or child care centre will use the roundabout (Road 08/Road07) and turn right into Road 07.

Table 4.5 Weekday Intersection Performance for Road 03/Road 28

Year	Performance Criteria			
	Degree of Saturation	Delays (s)	Level of Service	Queue Length (metres)
2031 AM	0.099	11.9	A	3
2031 PM	0.051	8.7	A	2

DS = Degree of Saturation d = Delay (seconds)
Q = Queue Length (m) LoS = Level of Service
LoS values based on worst delay of any vehicle movement

The results have revealed that:

- The priority-controlled intersection operates at good Level of Service A with minimal delays up to 12 seconds expected for vehicles turning from Road 28 onto Road 03 in the AM peak.
- In the PM peak, the intersection operates at a Level of Service A.

Road C03/Road C08

The roundabout intersection has been analysed based on the following configuration as shown below in **Figure 4.10.**

Figure 4.10 Road C03/Road C08 Intersection Layout

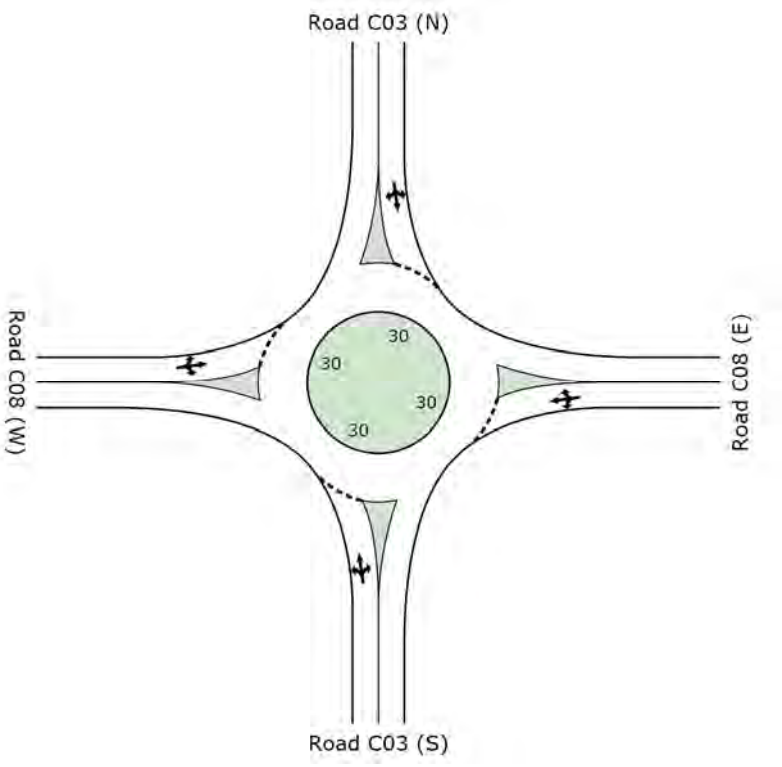


Table 4.6 shows the average intersection performance for Road C03/Road C08 based on the full development of Coombs and Wright. Detailed results of this analysis are provided in **Appendix B.**

Table 4.6 Weekday Intersection Performance for Road C03/Road C08

Year	Performance Criteria			
	Degree of Saturation	Delays (s)	Level of Service	Queue Length (metres)
2031 AM	0.370	8.1	A	22
2031 PM	0.027	11.0	A	2

DS = Degree of Saturation d = Delay (seconds)
Q = Queue Length (m) LoS = Level of Service
LoS values based on worst delay of any vehicle movement

The results have revealed that:

- The roundabout intersection operates at good Level of Service A with minimal delays or queues are experienced in the 2031 AM peak hour and PM peak hour.

Consideration has been given to signalising this intersection, principally driven by the anticipated pedestrian demand. There are a number of criteria that need to be considered in order to assess the warrant for signalisation. The minimum volume thresholds (600 vph on the main road and 200 vph on the minor road over 4 hours in a day) warrant for signalisation is met at this location. While pedestrian safety and amenity is superior at a signalised intersection over a roundabout, given the nature of the site (low speed environment, passively re-enforced by the short midblocks – <200m – on the busier southern legs) and the fact that pedestrians are only required to cross a single traffic lane with a wide median island provided with considerable area to store safely on the north south legs, many of the disadvantages are mitigated.

Signals could be considered at this location, the analysis indicated that without upgrading Road 3 to a four lane, two-way midblock between JGD and Road 8 (approximately 200m), the intersection will perform unsatisfactorily during the critical PM peak period in 2031. In particular, if signals were installed queues would occasionally develop beyond the midblock length present between JGD and Road 8. Measures could be developed to accommodate a signalised intersection at C3/C8 (duplicating the southern approach / constructing a long right turn slot) if considered necessary to meet other desired outcomes, however the roundabout is considered the more appropriate treatment from traffic point of view.

Road C08/Road C07

The give-way controlled intersection has been analysed based on the following configuration as shown below in

Figure 4.11. Road 08 (W) and Road 07 have been modelled with priority as they carry higher peak hour volumes compared to Road 08 (E). If the standard intersection priority of Road 08 having priority was to be provided, the intersection will experience excessive delays and is not recommended.

The intersection of Road C08/Road C07 has also been tested with an alternative configuration to analyse the operation under a roundabout configuration as shown in **Figure 4.12**.

Figure 4.11 Road C08/Road C07 Give-Way Intersection Layout

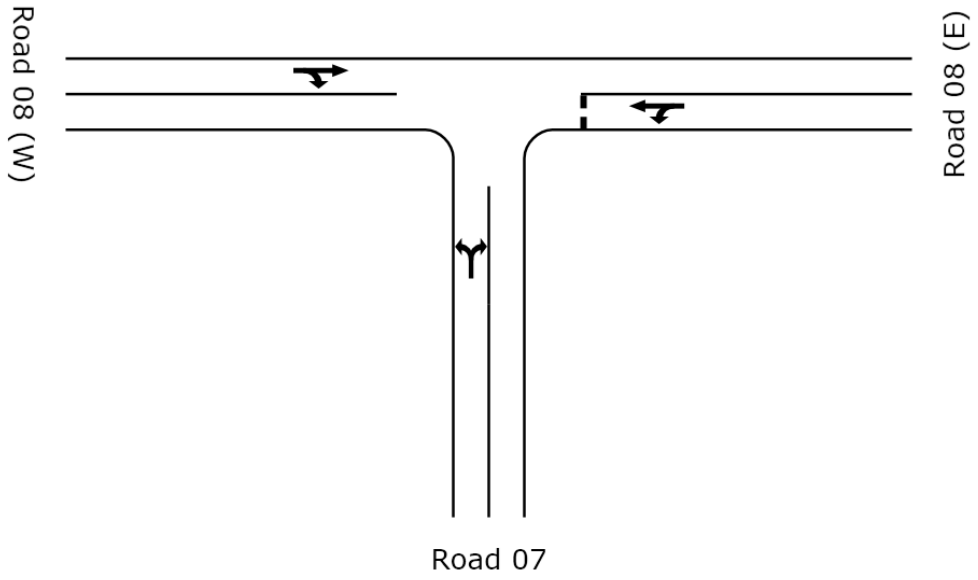


Figure 4.12 Road C08/Road C07 Roundabout Intersection Layout

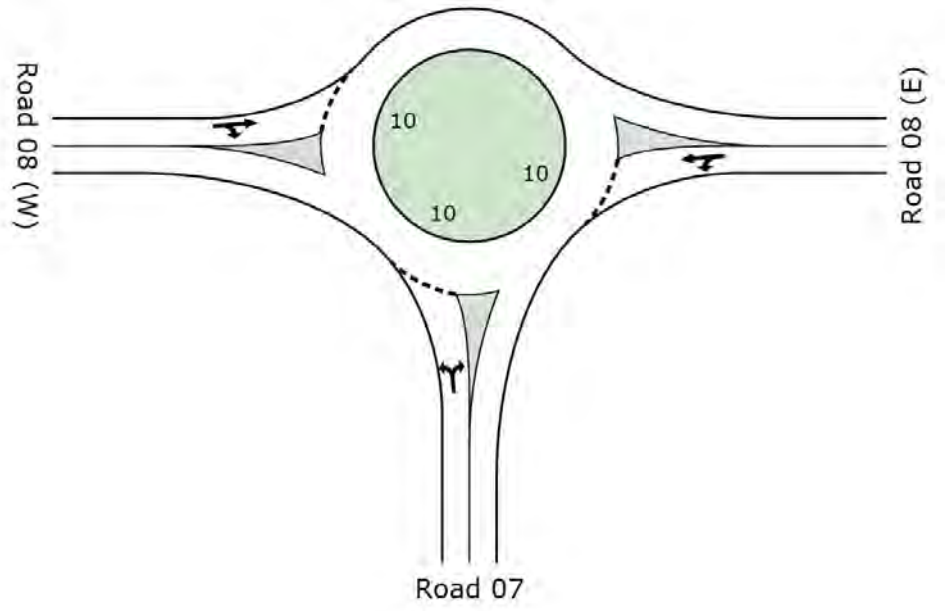


Table 4.7 shows the average intersection performance for Road C08/Road C07 based on the full development of Coombs and Wright. Detailed results of this analysis are provided in **Appendix B.**

Table 4.7 Weekday Intersection Performance for Road C08/Road C07

Intersection Layout	Year	Performance Criteria			
		Degree of	Delays (s)	Level of	Queue

		Saturation		Service	Length (metres)
Give Way	2031 AM	0.374	5.9	A	18
Give Way	2031 PM	0.324	7.5	A	14
Roundabout	2031 AM	0.463	8.6	A	32
Roundabout	2031 PM	0.384	9.1	A	24

DS = Degree of Saturation d = Delay (seconds)
Q = Queue Length (m) LoS = Level of Service
LoS values based on worst delay of any vehicle movement

The results have revealed that:

- The give-way intersection performs satisfactorily during the AM and PM peak hour period with minimal delays of less than 8 seconds for the worst approach at Road 08 (east).
- Similarly, the roundabout intersection operates satisfactorily with low delays and queue lengths in the AM peak and PM peak period.

Road C20/Road C09

The give-way intersection has been analysed based on the following configuration as shown below in **Figure 4.13**.

Figure 4.13 Road C20/Road C09 Intersection Layout

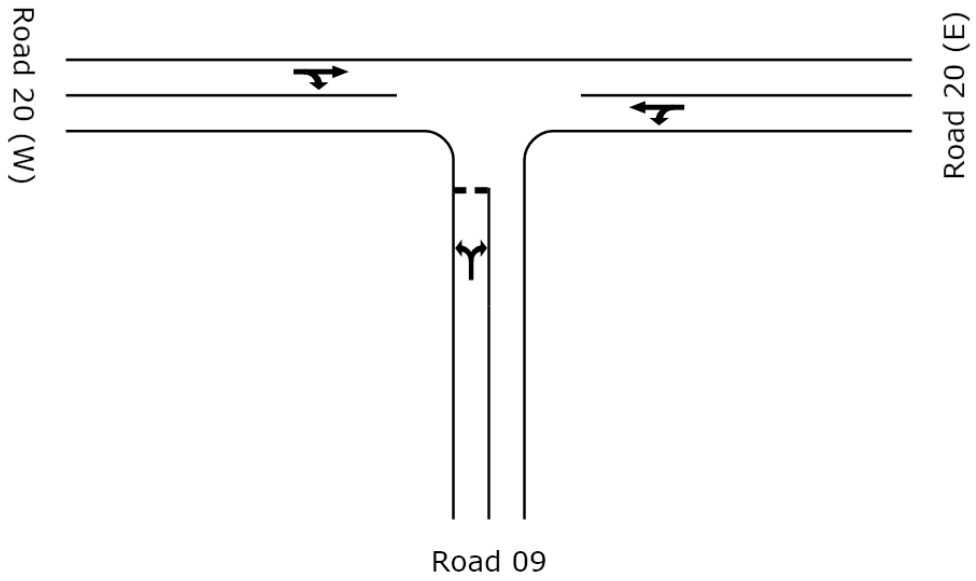


Table 4.8 shows the average intersection performance for Road C20/Road C09 based on the full development of Coombs and Wright. Detailed results of this analysis are provided in **Appendix B.**

Table 4.8 Weekday Intersection Performance for Road C20/Road C09

Year	Performance Criteria			
	Degree of Saturation	Delays (s)	Level of Service	Queue Length (metres)
2031 AM	0.098	11.9	A	3
2031 PM	0.054	15.3	B	2

DS = Degree of Saturation d = Delay (seconds)
Q = Queue Length (m) LoS = Level of Service
LoS values based on worst delay of any vehicle movement

The results have revealed that:

- The intersection operates at good Level of Service A with minimal delays or queues are experienced in the 2031 AM peak hour.
- In the PM peak hour, the intersection operates a Level of Service B.

Road C04/Road C07

The intersection of Road C04/Road C07 has been assessed based on 3 intersection configurations, a roundabout, a give-way intersection with priority to the N-S traffic and a signalised concept. The roundabout and giveway configurations are shown below in **Figure 4.14** and **Figure 4.15**.

Figure 4.14 Road C04/Road C07 Roundabout Intersection

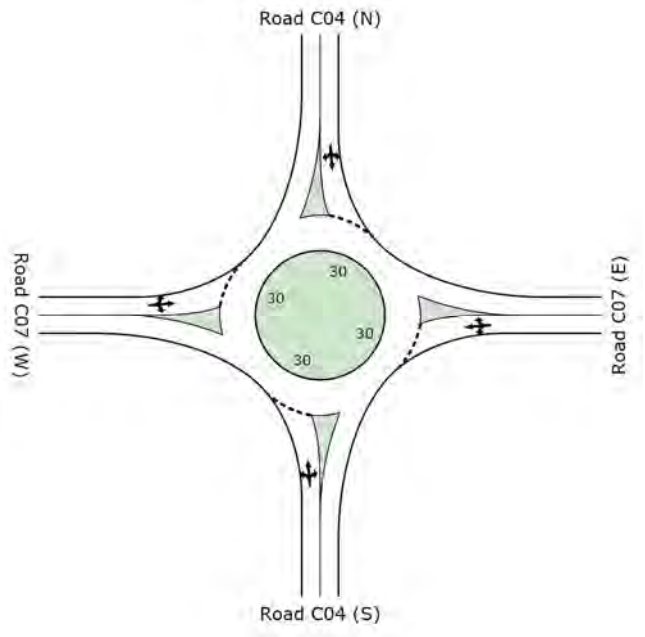


Figure 4.15 Road C04/Road C07 Give-Way Intersection

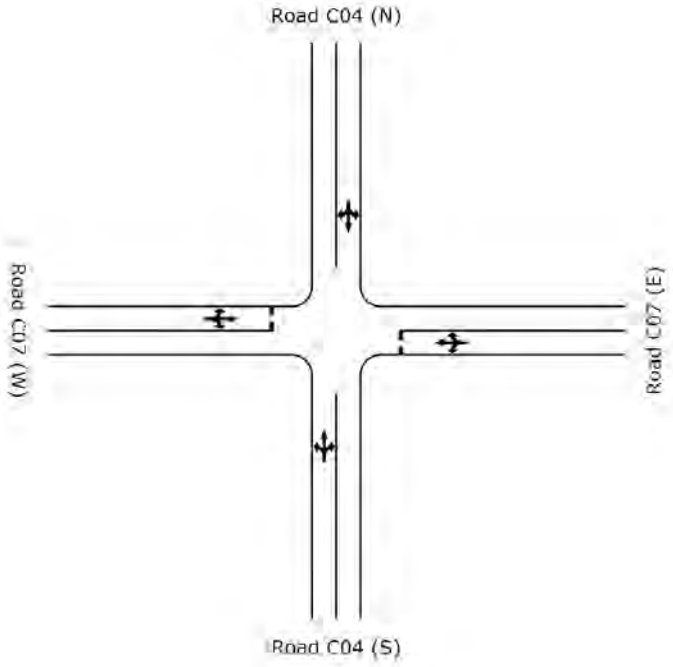


Table 4.9 shows the average intersection performance for both configurations for Road C04/Road C07 based on the full development of Coombs and Wright. Detailed results of this analysis are provided in **Appendix B.**

Table 4.9 Weekday Intersection Performance for Road C07/Road C04

Intersection Layout	Year	Performance Criteria			
		Degree of Saturation	Delays (s)	Level of Service	Queue Length (metres)
Give Way	2031 AM	>1.000	>120	F	>500
Give Way	2031 PM	>1.000	>120	F	279
Roundabout	2031 AM	0.129	9.7	A	8
Roundabout	2031 PM	0.056	8.5	A	3

DS = Degree of Saturation d = Delay (seconds)
Q = Queue Length (m) LoS = Level of Service
LoS values based on worst delay of any vehicle movement

The results have revealed that:

- With a priority-controlled intersection, the heavy right turn movement from Road C07 (W) will experience significant delays causing the intersection leg to fail at a Level of Service F.
- The roundabout intersection analysis showed that the junction will operate satisfactorily at a Level of Service A with minimal delays and queue lengths.

Signalisation of this intersection was considered for similar reasons as are discussed for the intersection between Road 3 / Road 8. Ultimately, similar disadvantages exist at this site as were discussed for Road 3 / Road 8, however signalisation can be achieved if additional road infrastructure is provided.

5 SUMMARY & CONCLUSIONS

This road hierarchy and traffic analysis report has been undertaken to assist in the formulation of the residential development of Coombs which is a precinct within Stage 1 of the Molonglo Valley Development.

The study is summarised as follows:

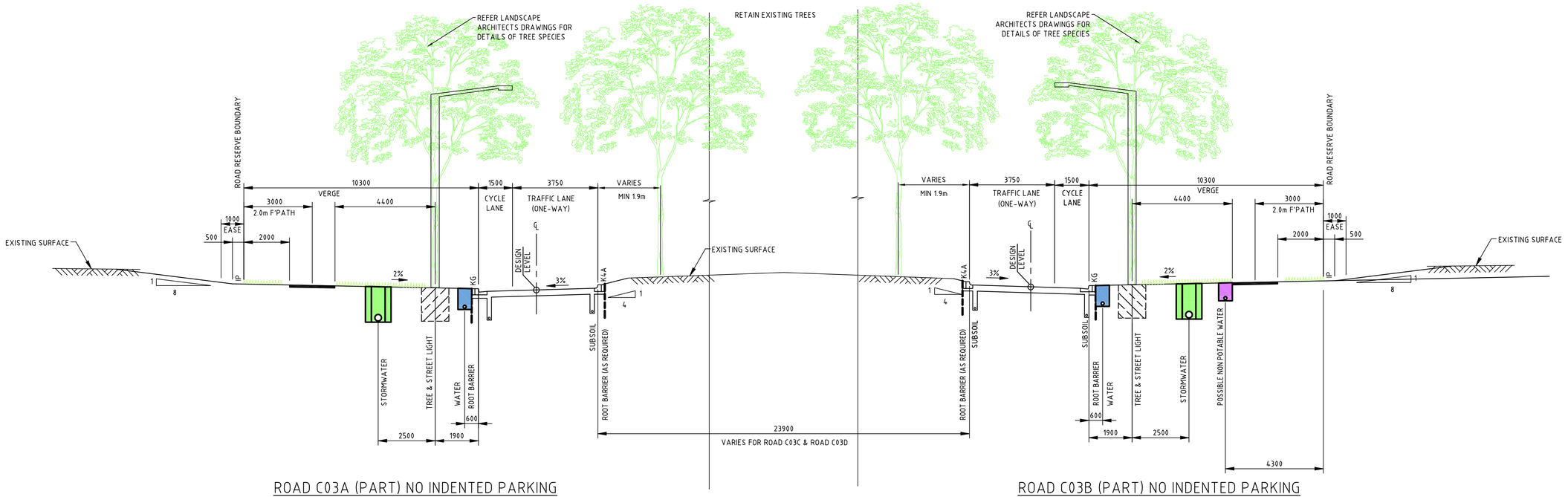
- The Coombs Estate Development Plan is proposed as an initial stage of development of the wider Molonglo Valley development.
- Access to the proposed land release areas located along the Molonglo Valley will be via JGD which will be constructed in stages as land is progressively developed.
- Stage 1A, 1B & 1C of the JGD construction will provide the principal access route for the Coombs Estate Development Plan area.
- The Coombs Estate Development Plan envisages residential, commercial and community facilities.
- Conservative forecast traffic volumes were estimated based upon likely and maximum permissible development yields.
- An assessment of the operational performance at a number of identified key intersection locations along JGD was undertaken and identified acceptable levels of operation in 2021 with the ultimate layout configuration.
- The Road C03/C28 operates at Level of Service F in the 2031 AM peak if all movements are permitted as per the Masterplan proposal. Hence this intersection has been modified to allow left in/left out movements only at Road C03 and traffic distributed to the surrounding intersections accordingly.
- The operational performance of the roundabout intersection of Road C03/C08 in 2031 operates satisfactorily at a Level of Service A. Signalisation at this intersection is only achievable if additional road infrastructure is provided.
- The Road C07/Road C04 intersection operates a Level of Service F in 2031 with a give-way intersection configuration. Installing a one lane roundabout at the intersection will result in satisfactory operation for all movements. Signalisation at this intersection is only achievable if additional road infrastructure is provided.
- The intersection of Road C08/RoadC07 needs priority to be allocated to Road C08E (west) and Road C07 in order to operate at a satisfactory Level of Service in 2031, or alternatively requires a one lane roundabout, which is considered more appropriate.
- The section of Road C28 between C03 and Road C07 should be designed to minimise traffic volumes, enhancing pedestrian amenity between the park and the Town Centre. The analysis confirms that the surrounding intersection and midblock capacities can cater for this.
- Intersections within the lower order residential road network volumes are consistent with AUSTROADS minimum for acceptable operational performance. LATM measures consisting of road narrowings and pedestrian refuges could assist in reducing vehicle speeds to improve potential safety performance. It is recommended that LATM measures other than pedestrian refuges are favoured unless a genuine pedestrian desire line exists.
- A set of road hierarchy principles were established.
- The proposed road hierarchy was described.
- Public transport routes and bus / cycle facilities within the internal precinct were described.

In summary the proposed internal road network will provide an acceptable level of peak hour road network operation and the road network will carry daily traffic volumes appropriate to their design geometry.

Appendix A

Proposed Road Cross Sections

DO NOT SCALE



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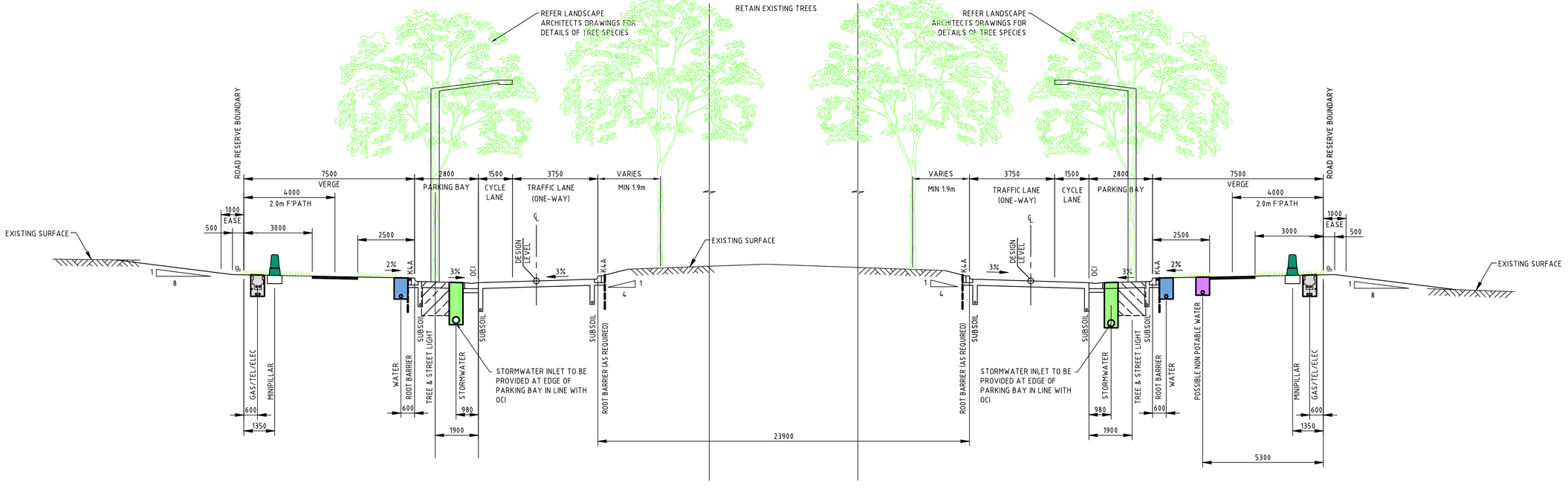
ROAD C03B (PART) NO INDENTED PARKING



ROAD C03A (PART) WITH INDENTED PARKING

ROAD C03B (PART) WITH INDENTED PARKING

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1 : 100–A1 1 : 200–A3

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COOMBS RESIDENTIAL ESTATE
ESTATE DEVELOPMENT PLAN

TYPICAL SECTIONS
SHEET 1 OF 7

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DEC 2010	AHD	AS SHOWN	A1

Drawing Number	Page No	Revision
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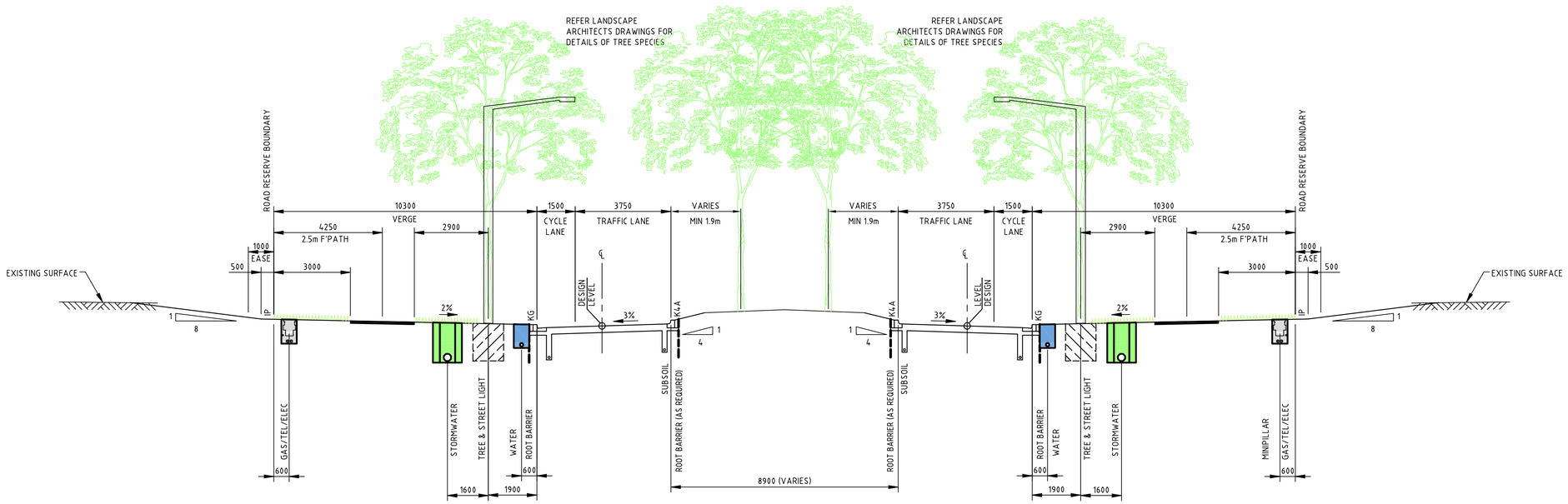
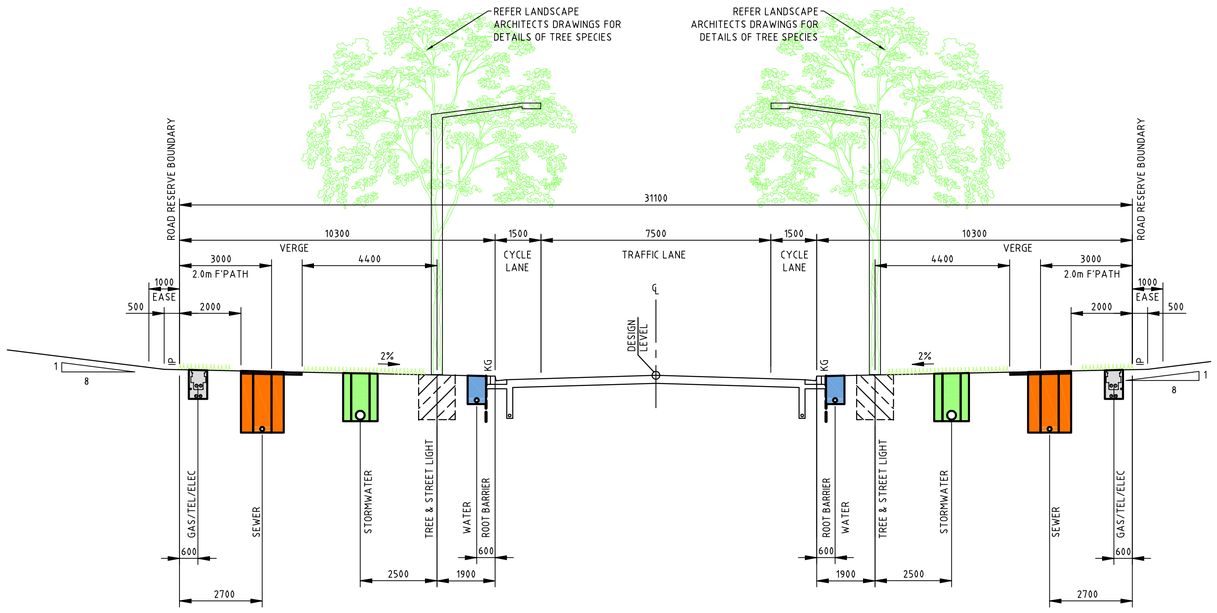
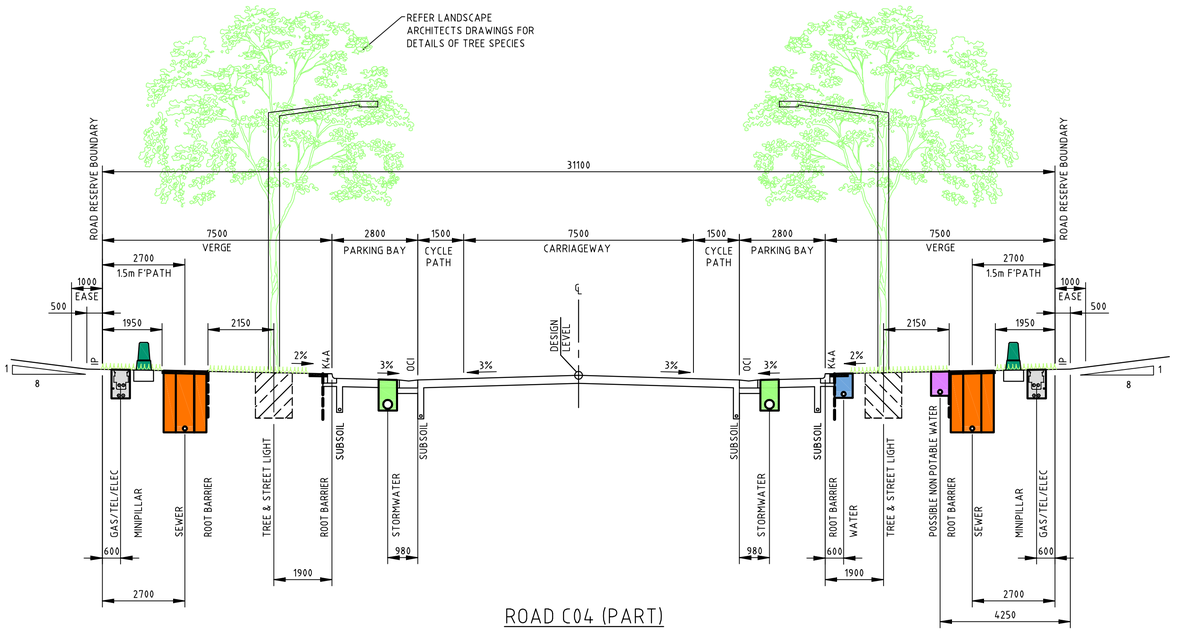


ROAD C03C

ROAD C03D



ROAD C04 (PART) MAJOR COLLECTOR



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TYPICAL SECTIONS
SHEET 2 OF 7

Status: EDP SUBMISSION

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DEC 2010	AHD	AS SHOWN	A1

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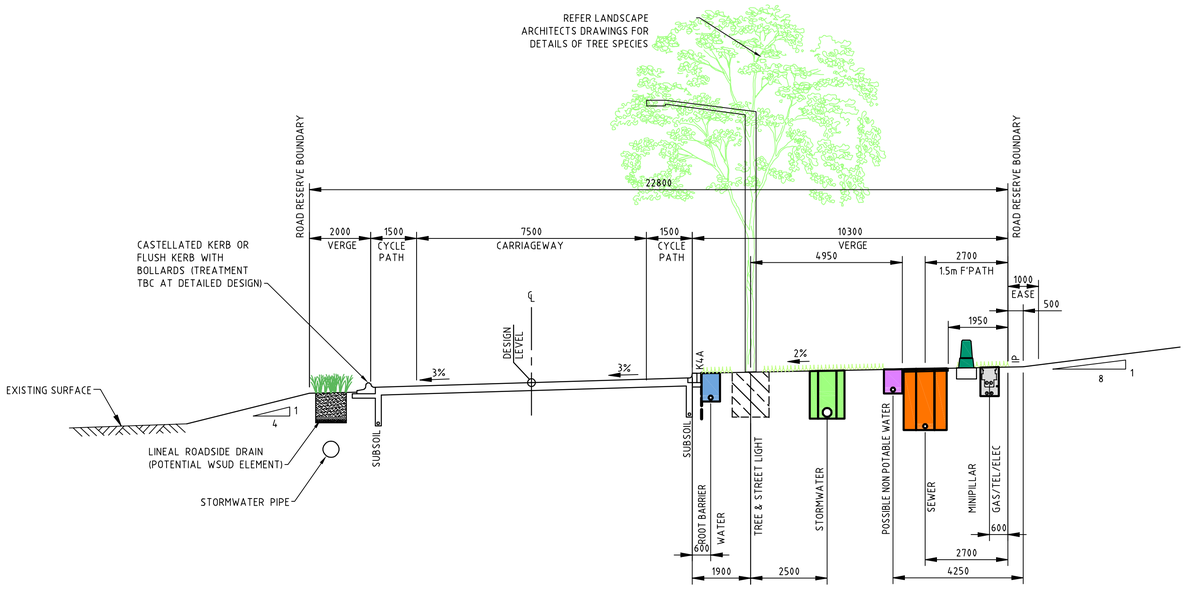

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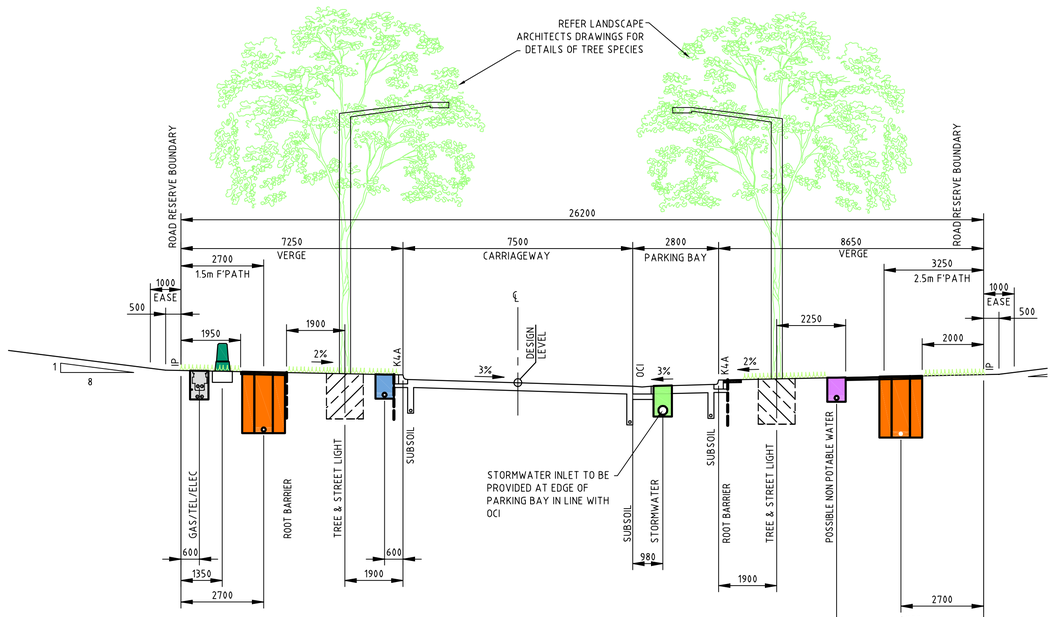
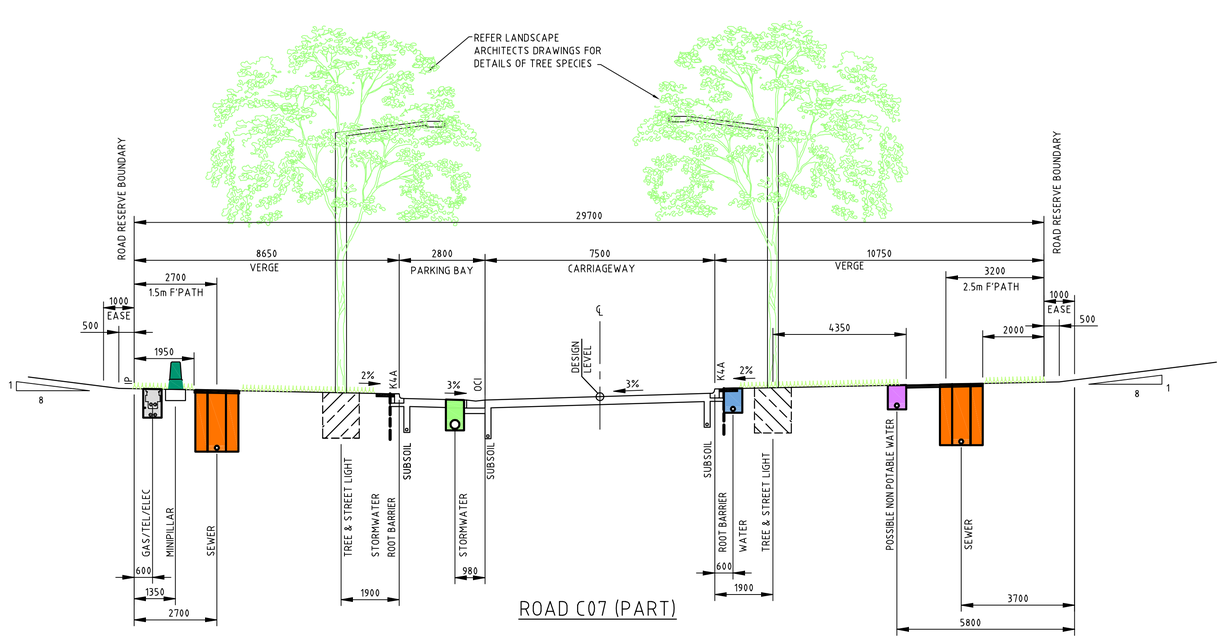


ROAD C08E (PART)



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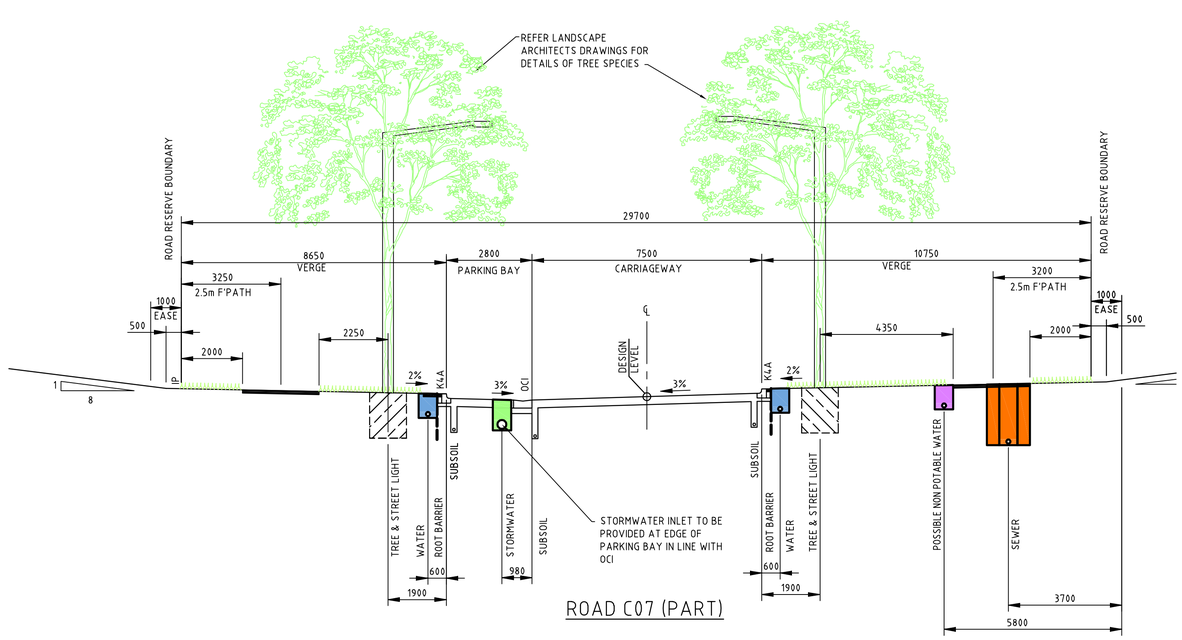

ROAD C07 (PART)

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TYPICAL SECTIONS
SHEET 3 OF 7

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DEC 2010	AHD	AS SHOWN	A1

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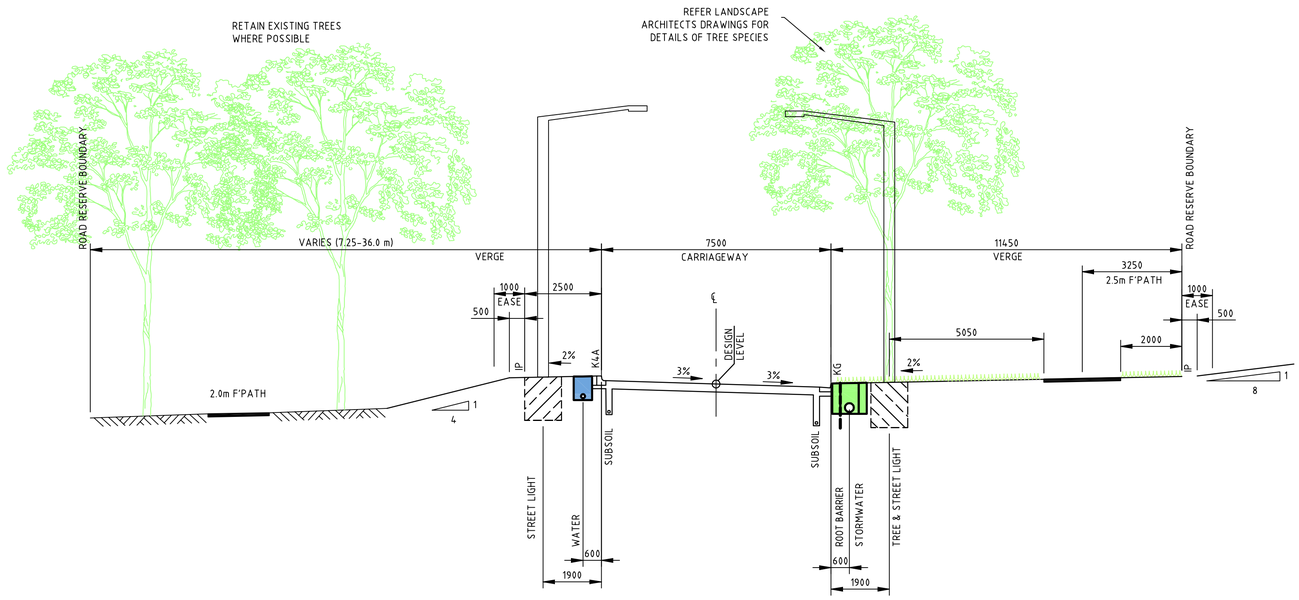

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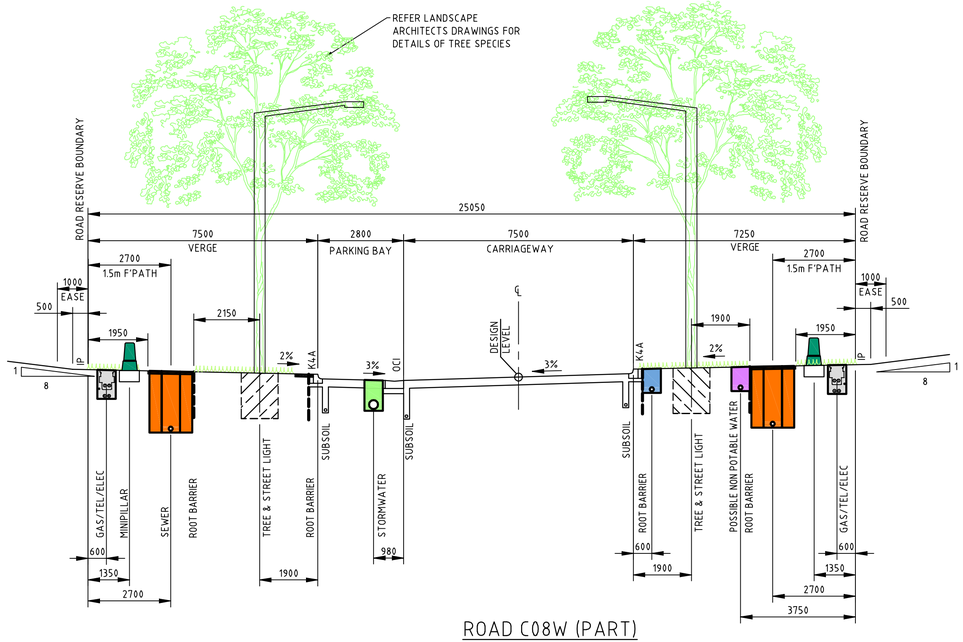

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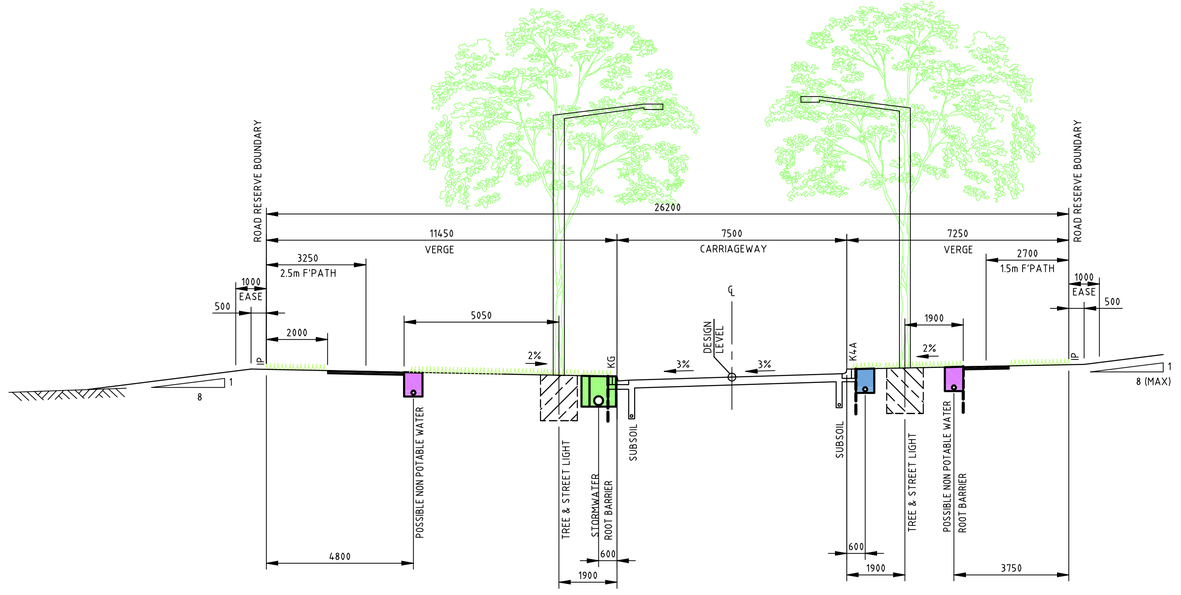

ROAD C08W (PART)

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1 : 100-A1 1 : 200-A3

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SHEET 4 OF 7

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Date	Datum	Scale	Size
DEC 2010	AHD	AS SHOWN	A1

Drawing Number	Page No	Revision
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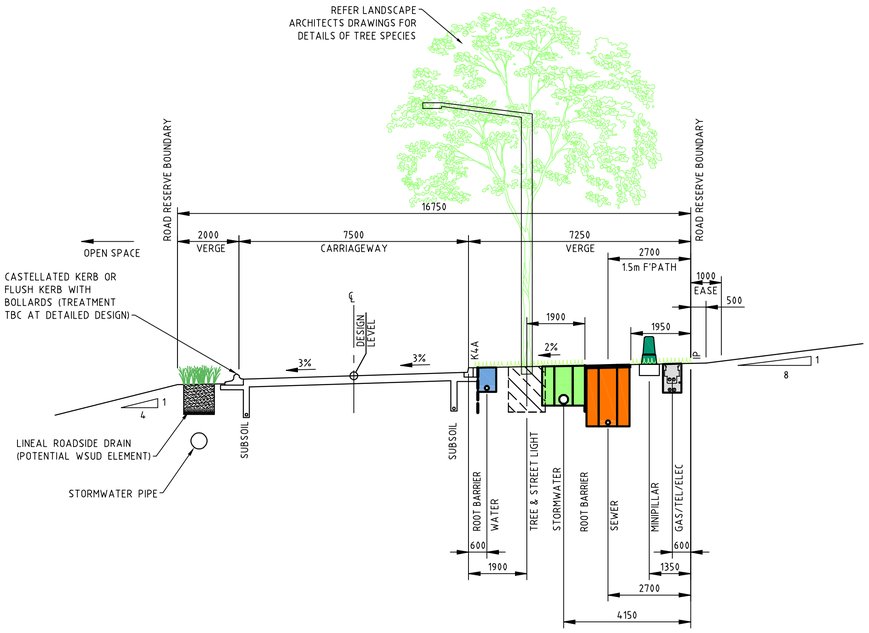

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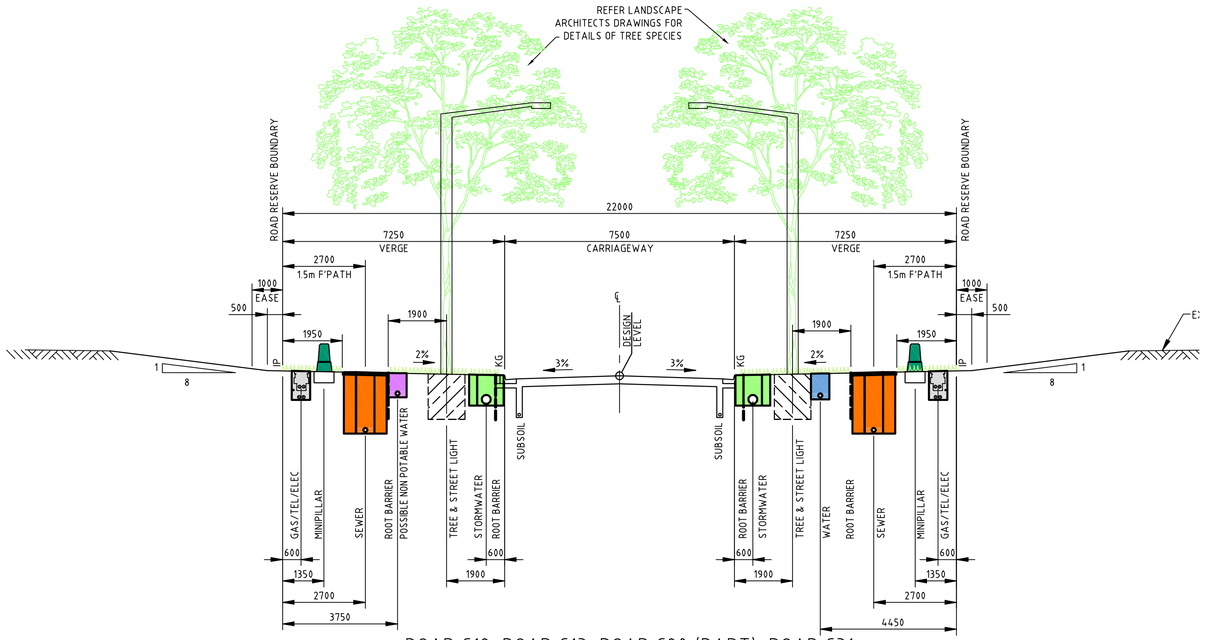

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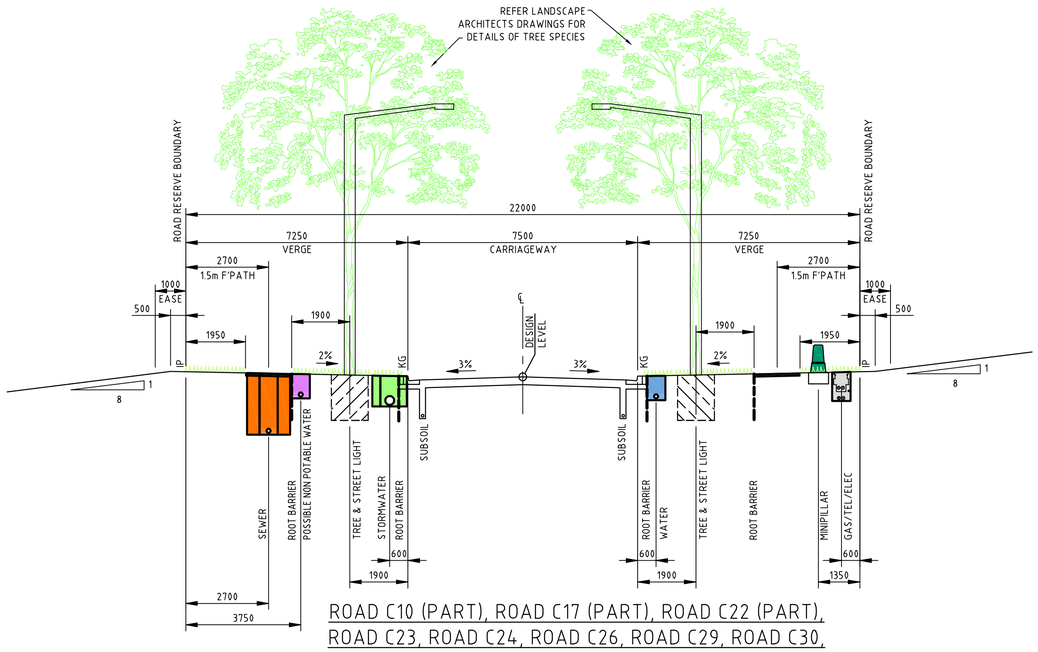

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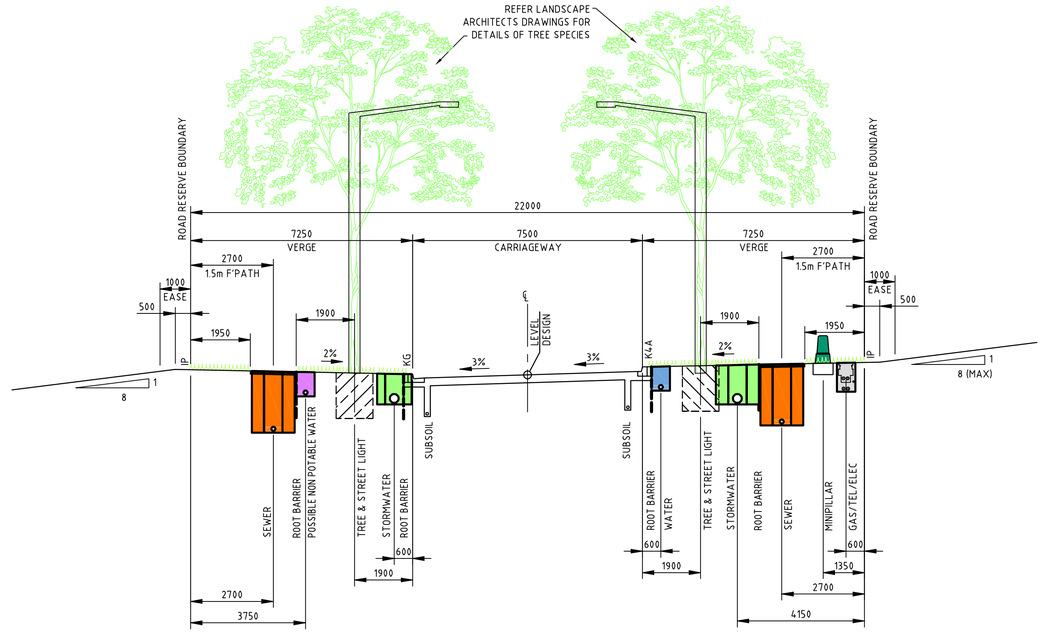

ROAD C20 (PART), ROAD C27, ROAD C33, ROAD C36, ROAD C38, ROAD C41, ROAD C43

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1 : 100-A1 1 : 200-A3

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TYPICAL SECTIONS
SHEET 5 OF 7

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Date	Datum	Scale	Size
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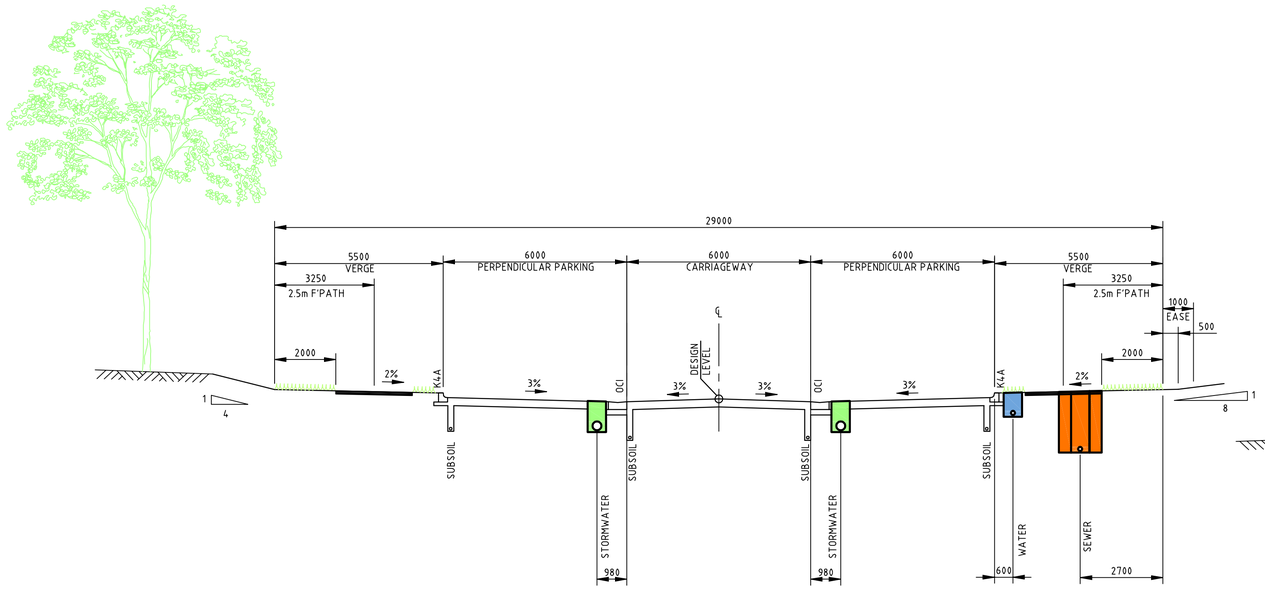

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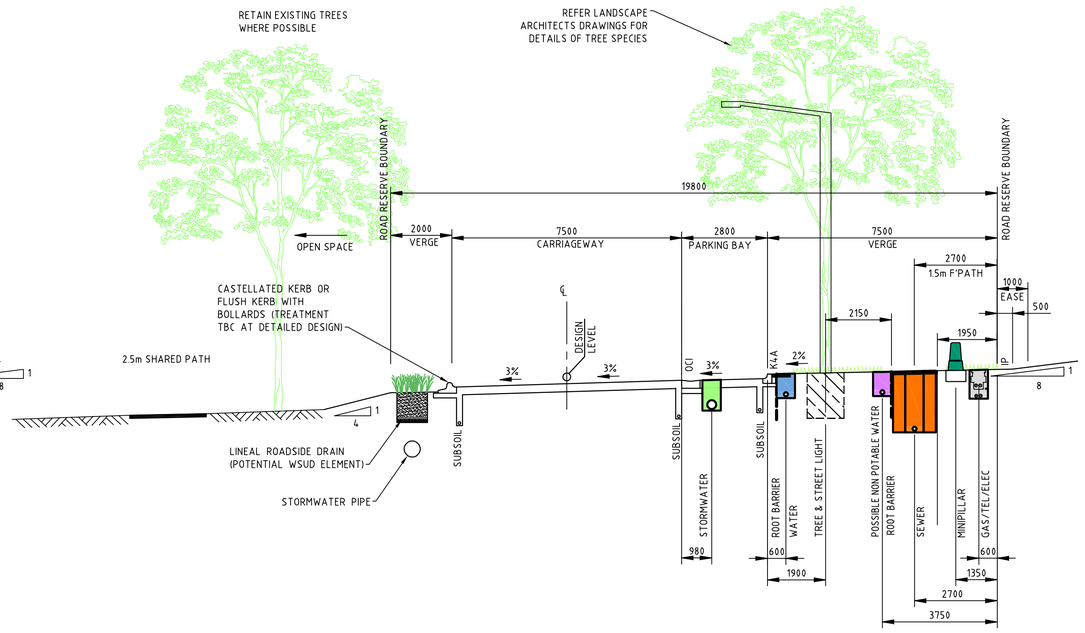

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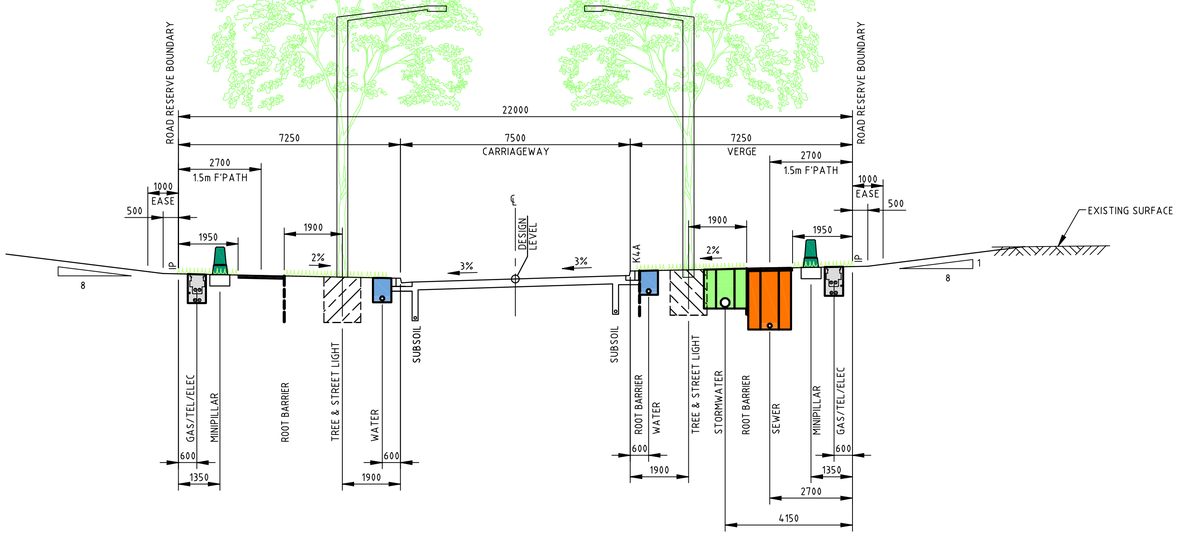
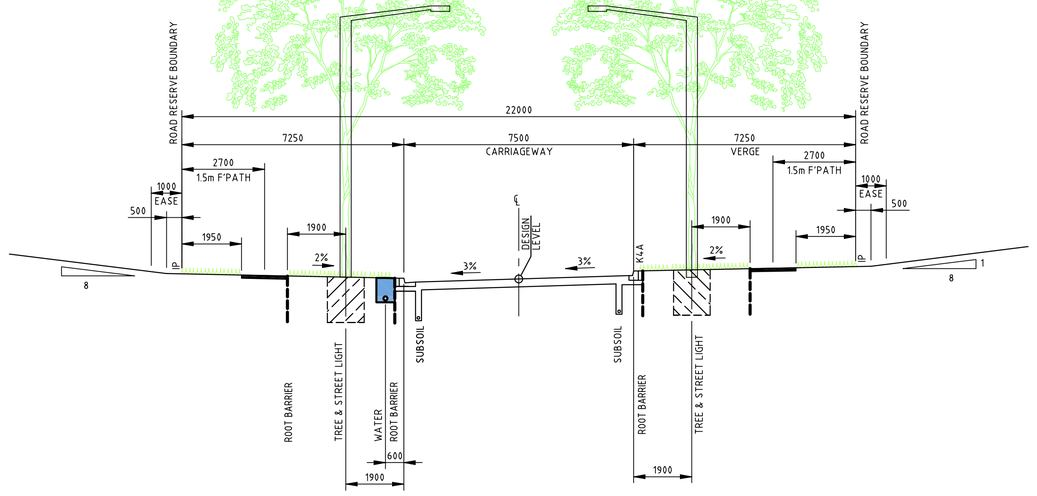


ROAD C34 (PART)



ROAD C51

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1 : 100–A1 1 : 200–A3

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TYPICAL SECTIONS
SHEET 6 OF 7

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Date	Datum	Scale	Size
DEC 2010	AHD	AS SHOWN	A1

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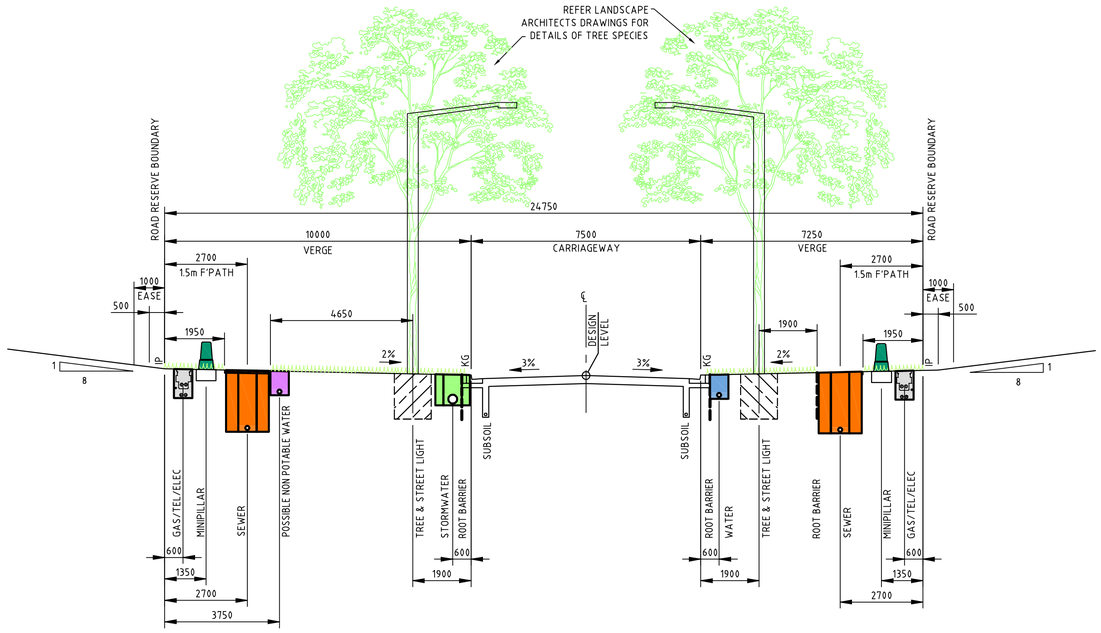
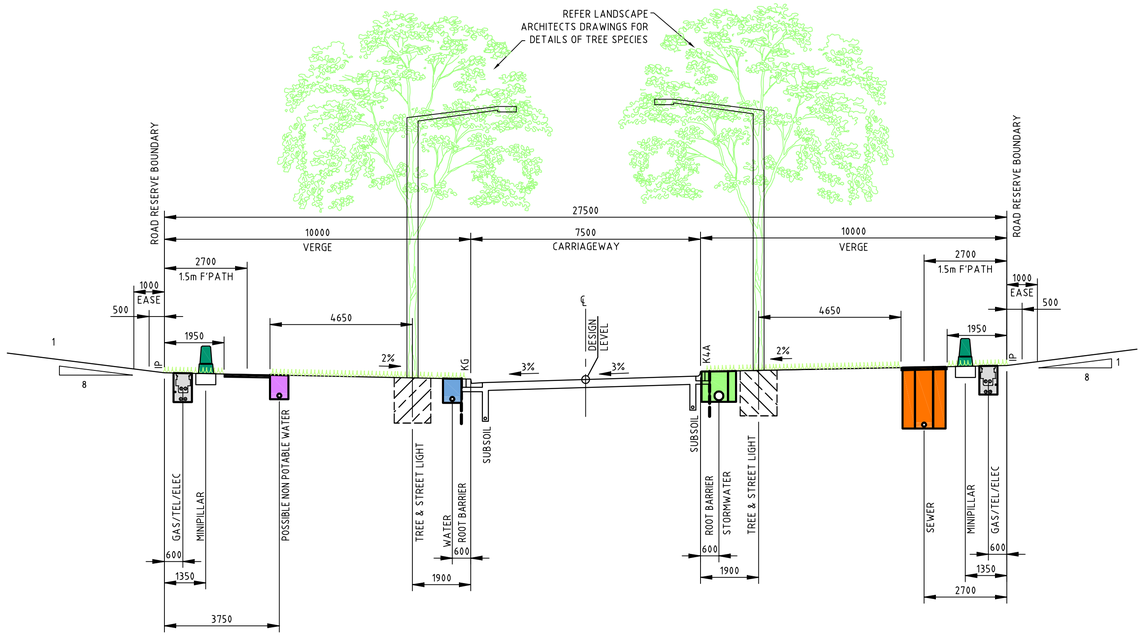
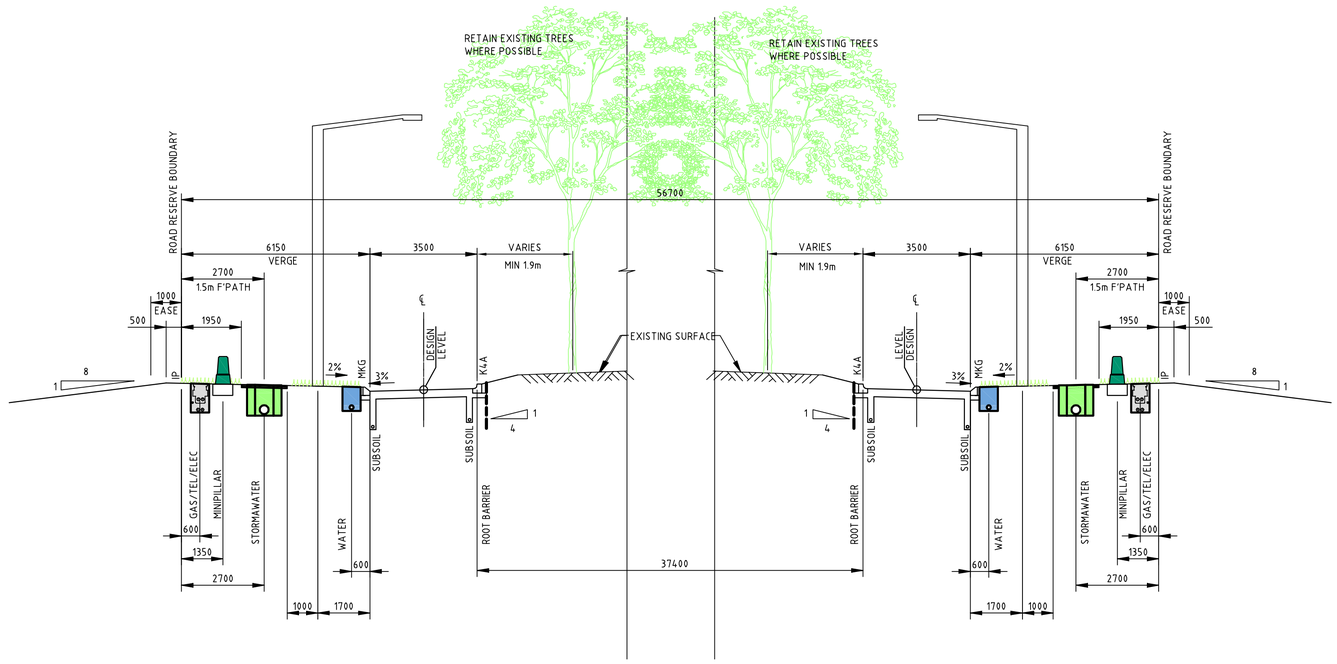


ROAD C22 (PART), ROAD C14, ROAD C16 (MIRRORED)



ROAD C35, ROAD C15



ROAD C46 (ONE-WAY TRAFFIC FLOW)

2 1 0 2 4 6 8 m

1 : 100-A1 1 : 200-A3

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TYPICAL SECTIONS
SHEET 7 OF 7

Status: EDP SUBMISSION

Date	Datum	Scale	Size
DEC 2010	AHD	AS SHOWN	A1

Drawing Number	Page No	Revision
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Appendix B

SIDRA Movement Summaries

MOVEMENT SUMMARY

Site: 2021 JGD-Main Intersection (Interim)

JGD-Main Intersection 2021 AM Peak
(Interim)
Signals - Fixed Time Cycle Time = 150 seconds (Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: JGD (SE)											
21	L	64	0.0	0.310	17.2	LOS B	6.2	44.7	0.45	0.82	41.7
22	T	807	5.0	0.592	17.1	LOS B	30.2	220.1	0.63	0.57	39.0
23	R	135	0.0	1.090	270.9	LOS F	21.8	152.6	1.00	1.42	7.1
Approach		1006	4.0	1.090	51.2	LOS D	30.2	220.1	0.67	0.70	24.4
North East: Coombs Road C03 (NE)											
24	L	414	0.0	1.108	248.4	LOS F	91.8	642.9	1.00	1.42	7.7
25	T	5	0.0	1.087	240.5	LOS F	91.8	642.9	1.00	1.42	7.7
26	R	180	0.0	1.107	248.7	LOS F	91.8	642.9	1.00	1.42	7.6
Approach		599	0.0	1.108	248.4	LOS F	91.8	642.9	1.00	1.42	7.7
North West: JGD (NW)											
27	L	66	0.0	0.594	21.7	LOS B	12.7	92.2	0.50	0.88	38.7
28	T	1595	5.0	1.136	260.3	LOS F	255.1	1862.3	0.91	1.92	7.3
29	R	28	0.0	0.355	82.3	LOS F	3.0	20.7	0.98	0.72	18.3
Approach		1689	4.7	1.136	248.0	LOS F	255.1	1862.3	0.90	1.86	7.6
South West: Wright (SW)											
30	L	109	0.0	0.533	19.3	LOS B	14.6	102.5	0.67	0.80	39.1
31	T	5	0.0	0.532	11.4	LOS A	14.6	102.5	0.67	0.60	41.2
32	R	255	0.0	0.533	19.6	LOS B	14.6	102.5	0.67	0.82	39.0
Approach		369	0.0	0.533	19.4	LOS B	14.6	102.5	0.67	0.81	39.1
All Vehicles		3663	3.3	1.136	171.0	LOS F	255.1	1862.3	0.83	1.36	10.4

Level of Service (Aver. Int. Delay): LOS F. Based on average delay for all vehicle movements. LOS Method: Delay (RTA NSW).
Level of Service (Worst Movement): LOS F. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on average delay for all vehicle movements.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow	Average Delay	Level of Service	Average Back of Queue		Prop. Queued	Effective Stop Rate
					Pedestrian	Distance		
		ped/h	sec		ped	m		per ped
P9	Across SE approach	53	59.0	LOS E	0.2	0.2	0.89	0.89
P11	Across NE approach	53	13.2	LOS B	0.1	0.1	0.42	0.42
P13	Across NW approach	53	59.0	LOS E	0.2	0.2	0.89	0.89
P15	Across SW approach	53	13.2	LOS B	0.1	0.1	0.42	0.42
All Pedestrians		212	36.1				0.65	0.65

Level of Service (Aver. Int. Delay): LOS D. Based on average delay for all pedestrian movements. LOS Method: Delay (HCM).
Level of Service (Worst Movement): LOS E. LOS Method for individual pedestrian movements: Delay (HCM).

PHASING SUMMARY

Site: 2021 JGD-Main Intersection (Interim)

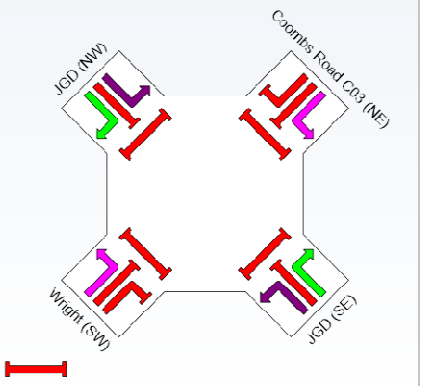
JGD-Main Intersection 2021 AM Peak
(Interim)
Signals - Fixed Time Cycle Time = 150 seconds (Practical Cycle Time)

Phase times determined by the program
Sequence: 4-Phase (phase reduction applied)
Input Sequence: A, B, C, D
Output Sequence: A, C, D

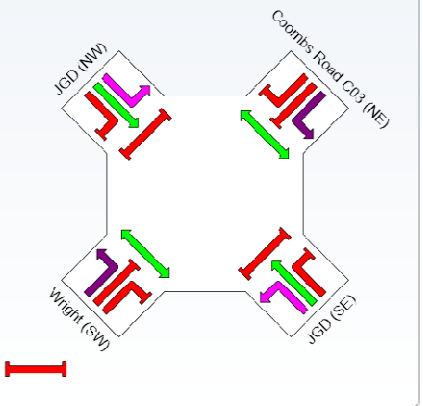
Phase Timing Results

Phase	A	C	D
Green Time (sec)	10	92	30
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	16	98	36
Phase Split	11 %	65 %	24 %

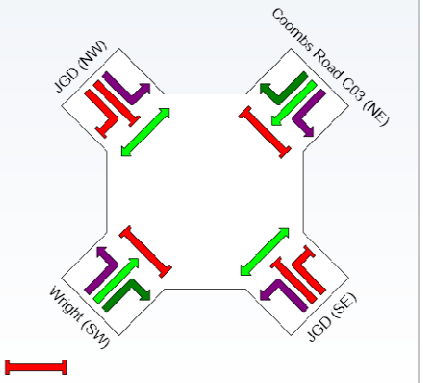
Phase A



Phase C



Phase D



	Normal Movement		Permitted/Opposed
	Slip-Lane Movement		Opposed Slip-Lane
	Stopped Movement		Continuous Movement
	Turn On Red		Undetected Movement
			Phase Transition Applied

MOVEMENT SUMMARY

Site: 2021 JGD-Main Intersection (Ultimate)

JGD-Main Intersection 2021 AM Peak
(Ultimate)
Signals - Fixed Time Cycle Time = 80 seconds (Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: JGD (SE)											
21	L	64	0.0	0.403	25.5	LOS B	9.5	68.7	0.78	0.86	36.7
22	T	795	5.0	0.402	19.3	LOS B	9.9	72.6	0.78	0.66	37.2
23	R	147	0.0	0.792	51.7	LOS D	8.0	56.0	1.00	0.92	24.7
Approach		1006	4.0	0.792	24.4	LOS B	9.9	72.6	0.81	0.71	34.6
North East: Coombs Road C03 (NE)											
24	L	414	0.0	0.636	20.2	LOS B	13.2	92.7	0.76	0.90	38.6
25	T	5	0.0	0.641	12.4	LOS A	13.2	92.7	0.76	0.75	40.1
26	R	180	0.0	0.636	20.4	LOS B	13.2	92.7	0.76	0.91	38.6
Approach		599	0.0	0.636	20.2	LOS B	13.2	92.7	0.76	0.90	38.6
North West: JGD (NW)											
27	L	66	0.0	0.781	34.8	LOS C	21.2	154.4	0.95	0.95	32.2
28	T	1595	5.0	0.780	26.7	LOS B	21.3	155.8	0.95	0.90	32.8
29	R	25	0.0	0.135	45.1	LOS D	1.4	10.0	0.94	0.71	26.8
Approach		1686	4.7	0.780	27.3	LOS B	21.3	155.8	0.95	0.90	32.7
South West: Wright (SW)											
30	L	109	0.0	0.140	11.2	LOS A	1.8	12.7	0.41	0.71	46.0
31	T	5	0.0	0.140	3.3	LOS A	1.8	12.7	0.41	0.33	50.5
32	R	255	0.0	0.534	33.7	LOS C	10.2	71.4	0.88	0.82	31.1
Approach		369	0.0	0.534	26.7	LOS B	10.2	71.4	0.74	0.78	34.6
All Vehicles		3660	3.3	0.792	25.3	LOS B	21.3	155.8	0.86	0.84	34.3

Level of Service (Aver. Int. Delay): LOS B. Based on average delay for all vehicle movements. LOS Method: Delay (RTA NSW).
Level of Service (Worst Movement): LOS D. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on average delay for all vehicle movements.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow	Average Delay	Level of Service	Average Back of Queue		Prop. Queued	Effective Stop Rate
					Pedestrian	Distance		
		ped/h	sec		ped	m		per ped
P9	Across SE approach	53	34.2	LOS D	0.1	0.1	0.93	0.93
P11	Across NE approach	53	18.9	LOS B	0.1	0.1	0.69	0.69
P13	Across NW approach	53	34.2	LOS D	0.1	0.1	0.93	0.93
P15	Across SW approach	53	20.3	LOS C	0.1	0.1	0.71	0.71
All Pedestrians		212	26.9				0.81	0.81

Level of Service (Aver. Int. Delay): LOS C. Based on average delay for all pedestrian movements. LOS Method: Delay (HCM).
Level of Service (Worst Movement): LOS D. LOS Method for individual pedestrian movements: Delay (HCM).

PHASING SUMMARY

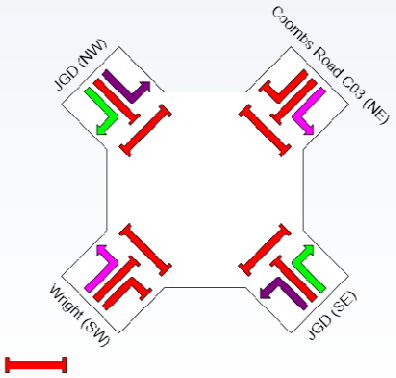
JGD-Main Intersection 2021 AM Peak
(Ultimate)
Signals - Fixed Time Cycle Time = 80 seconds (Practical Cycle Time)

Phase times determined by the program
Sequence: 4-Phase (phase reduction applied)
Input Sequence: A, B, C, D
Output Sequence: A, C, D

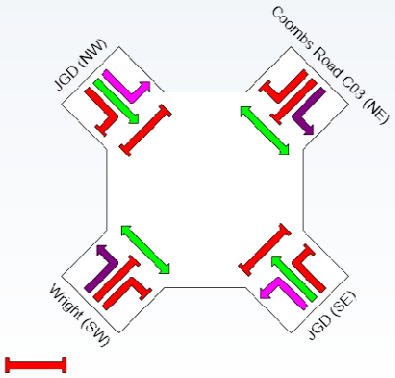
Phase Timing Results

Phase	A	C	D
Green Time (sec)	8	30	24
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	14	36	30
Phase Split	18 %	45 %	38 %

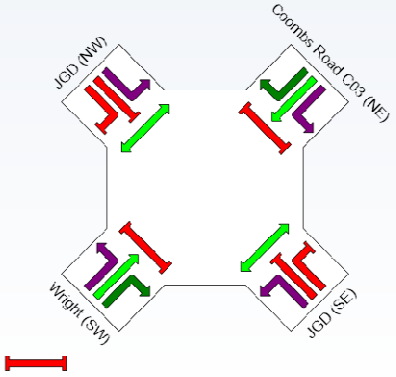
Phase A



Phase C



Phase D



	Normal Movement		Permitted/Opposed
	Slip-Lane Movement		Opposed Slip-Lane
	Stopped Movement		Continuous Movement
	Turn On Red		Undetected Movement
			Phase Transition Applied

MOVEMENT SUMMARY

Site: 2031 JGD-Main Intersection (Ultimate)

JGD- Main Intersection 2031 AM Peak
(Ultimate)
Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: JGD (SE)											
21	L	64	0.0	0.399	24.7	LOS B	12.5	90.5	0.68	0.88	37.1
22	T	1024	5.0	0.399	17.6	LOS B	12.8	93.7	0.69	0.60	38.6
23	R	147	0.0	0.792	61.4	LOS E	9.5	66.2	1.00	0.90	22.3
Approach		1235	4.1	0.792	23.1	LOS B	12.8	93.7	0.72	0.65	35.5
North East: Coombs Road C03 (NE)											
24	L	414	0.0	0.771	31.4	LOS C	19.1	134.0	0.90	1.00	32.3
25	T	5	0.0	0.772	23.5	LOS B	19.1	134.0	0.90	0.93	32.8
26	R	180	0.0	0.771	31.6	LOS C	19.1	134.0	0.90	1.00	32.2
Approach		599	0.0	0.771	31.4	LOS C	19.1	134.0	0.90	1.00	32.3
North West: JGD (NW)											
27	L	66	0.0	0.814	35.1	LOS C	32.3	234.7	0.92	0.95	32.1
28	T	2142	5.0	0.811	26.5	LOS B	32.4	236.3	0.92	0.87	32.9
29	R	28	0.0	0.151	54.0	LOS D	2.0	13.7	0.95	0.72	24.2
Approach		2236	4.8	0.811	27.1	LOS B	32.4	236.3	0.92	0.87	32.8
South West: Wright (SW)											
30	L	109	0.0	0.293	13.0	LOS A	5.9	41.5	0.49	0.74	44.2
31	T	5	0.0	0.293	5.1	LOS A	5.9	41.5	0.49	0.42	47.9
32	R	255	0.0	0.293	25.8	LOS B	6.1	42.4	0.65	0.77	35.2
Approach		369	0.0	0.293	21.7	LOS B	6.1	42.4	0.60	0.76	37.6
All Vehicles		4439	3.6	0.811	26.1	LOS B	32.4	236.3	0.84	0.82	33.8

Level of Service (Aver. Int. Delay): LOS B. Based on average delay for all vehicle movements. LOS Method: Delay (RTA NSW).
Level of Service (Worst Movement): LOS E. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on average delay for all vehicle movements.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow	Average Delay	Level of Service	Average Back of Queue		Prop. Queued	Effective Stop Rate
					Pedestrian	Distance		
		ped/h	sec		ped	m		per ped
P9	Across SE approach	53	44.2	LOS E	0.1	0.1	0.94	0.94
P11	Across NE approach	53	16.2	LOS B	0.1	0.1	0.57	0.57
P13	Across NW approach	53	44.2	LOS E	0.1	0.1	0.94	0.94
P15	Across SW approach	53	17.4	LOS B	0.1	0.1	0.59	0.59
All Pedestrians		212	30.5				0.76	0.76

Level of Service (Aver. Int. Delay): LOS D. Based on average delay for all pedestrian movements. LOS Method: Delay (HCM).
Level of Service (Worst Movement): LOS E. LOS Method for individual pedestrian movements: Delay (HCM).

PHASING SUMMARY

Site: 2031 JGD-Main Intersection (Ultimate)

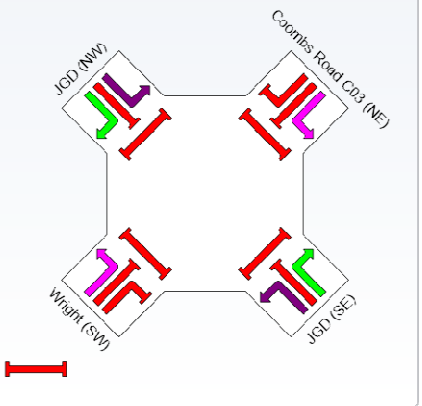
JGD- Main Intersection 2031 AM Peak
(Ultimate)
Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Phase times determined by the program
Sequence: 4-Phase (phase reduction applied)
Input Sequence: A, B, C, D
Output Sequence: A, C, D

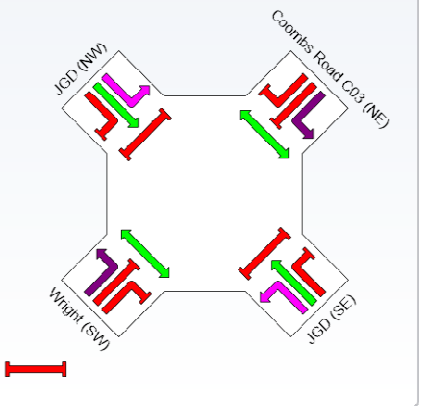
Phase Timing Results

Phase	A	C	D
Green Time (sec)	10	48	24
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	16	54	30
Phase Split	16 %	54 %	30 %

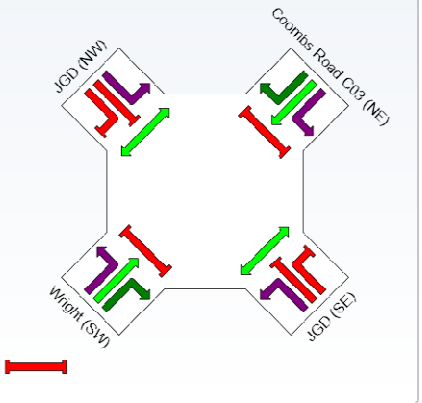
Phase A



Phase C



Phase D



	Normal Movement		Permitted/Opposed
	Slip-Lane Movement		Opposed Slip-Lane
	Stopped Movement		Continuous Movement
	Turn On Red		Undetected Movement
			Phase Transition Applied

MOVEMENT SUMMARY

Site: 2021 JGD-Cotter Rd (Interim)

JGD-Cotter Rd 2021 AM Peak
(Interim)
Signals - Fixed Time Cycle Time = 150 seconds (Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: JGD (SE)											
21	L	44	0.0	0.247	19.7	LOS B	5.9	42.4	0.49	0.83	39.9
22	T	935	5.0	0.472	17.9	LOS B	22.2	161.3	0.59	0.52	38.5
23	R	80	0.0	1.000[3]	82.3	LOS F	7.5	52.3	1.00	0.76	18.4
Approach		1059	4.2	1.000	22.8	LOS B	22.2	161.3	0.61	0.55	35.6
North East: Coombs Road C04 (NE)											
24	L	261	0.0	0.744	61.1	LOS E	22.9	160.2	0.95	1.03	22.5
25	T	5	0.0	0.744	53.3	LOS D	22.9	160.2	0.95	1.00	22.6
26	R	130	0.0	0.744	61.3	LOS E	22.9	160.2	0.95	1.03	22.4
Approach		396	0.0	0.744	61.1	LOS E	22.9	160.2	0.95	1.03	22.4
North West: JGD (NW)											
27	L	47	0.0	0.523	19.9	LOS B	12.6	91.2	0.47	0.89	39.9
28	T	2314	5.0	1.046	97.3	LOS F	175.9	1284.1	0.93	1.21	15.9
29	R	19	0.0	0.518	68.5	LOS E	1.8	12.9	0.89	0.71	20.8
Approach		2380	4.9	1.046	95.5	LOS F	175.9	1284.1	0.92	1.20	16.2
South West: Cotter Rd											
30	L	12	0.0	0.071	20.6	LOS B	1.5	10.3	0.60	0.72	38.5
31	T	5	0.0	0.071	12.7	LOS A	1.5	10.3	0.60	0.46	40.9
32	R	28	0.0	0.071	20.7	LOS B	1.5	10.3	0.60	0.74	38.4
Approach		45	0.0	0.071	19.8	LOS B	1.5	10.3	0.60	0.70	38.7
All Vehicles		3880	4.1	1.046	71.3	LOS F	175.9	1284.1	0.84	1.00	19.8

Level of Service (Aver. Int. Delay): LOS F. Based on average delay for all vehicle movements. LOS Method: Delay (RTA NSW).
Level of Service (Worst Movement): LOS F. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on average delay for all vehicle movements.

3 x = 1.00 due to short lane. Refer to the Lane Summary report for information about excess flow and related conditions.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow	Average Delay	Level of Service	Average Back of Queue		Prop. Queued	Effective Stop Rate
					Pedestrian	Distance		
		ped/h	sec		ped	m		per ped
P9	Across SE approach	53	69.1	LOS F	0.2	0.2	0.96	0.96
P11	Across NE approach	53	15.9	LOS B	0.1	0.1	0.46	0.46
P13	Across NW approach	53	69.1	LOS F	0.2	0.2	0.96	0.96
P15	Across SW approach	53	15.9	LOS B	0.1	0.1	0.46	0.46
All Pedestrians		212	42.5				0.71	0.71

Level of Service (Aver. Int. Delay): LOS E. Based on average delay for all pedestrian movements. LOS Method: Delay (HCM).
Level of Service (Worst Movement): LOS F. LOS Method for individual pedestrian movements: Delay (HCM).

PHASING SUMMARY

Site: 2021 JGD-Cotter Rd (Interim)

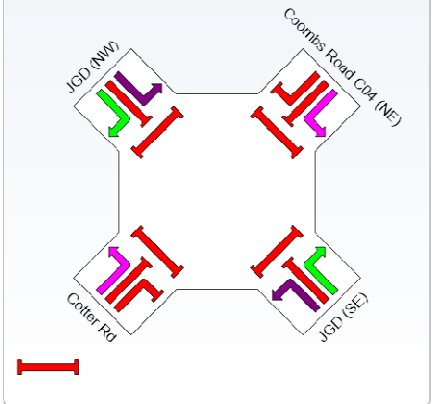
JGD-Cotter Rd 2021 AM Peak
(Interim)
Signals - Fixed Time Cycle Time = 150 seconds (Practical Cycle Time)

Phase times determined by the program
Sequence: 4-Phase
Input Sequence: A, B, C, D
Output Sequence: A, B, C, D

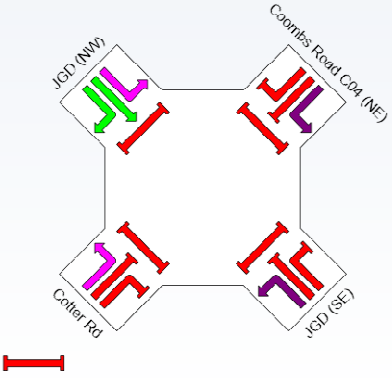
Phase Timing Results

Phase	A	B	C	D
Green Time (sec)	12	4	86	24
Yellow Time (sec)	4	4	4	4
All-Red Time (sec)	2	2	2	2
Phase Time (sec)	18	10	92	30
Phase Split	12 %	7 %	61 %	20 %

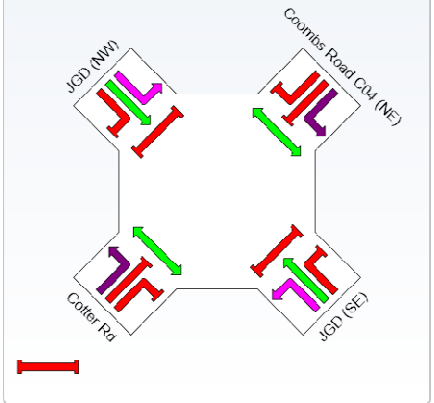
Phase A



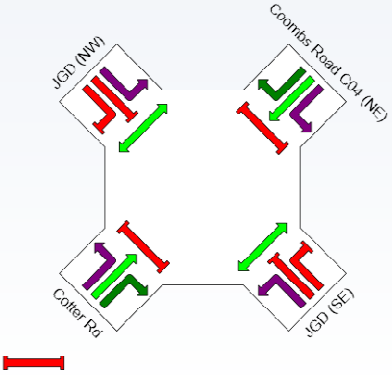
Phase B



Phase C



Phase D



	Normal Movement		Permitted/Opposed
	Slip-Lane Movement		Opposed Slip-Lane
	Stopped Movement		Continuous Movement
	Turn On Red		Undetected Movement
			Phase Transition Applied

MOVEMENT SUMMARY

Site: 2021 JGD-Cotter Rd (Ultimate)

JGD-Cotter Rd 2021 AM Peak
(Ultimate)
Signals - Fixed Time Cycle Time = 120 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: JGD (SE)											
21	L	44	0.0	0.389	39.6	LOS C	11.8	85.8	0.82	0.85	29.8
22	T	887	5.0	0.388	33.7	LOS C	12.2	88.9	0.83	0.70	29.8
23	R	128	0.0	0.689	67.7	LOS E	9.4	65.7	1.00	0.83	21.0
Approach		1059	4.2	0.689	38.1	LOS C	12.2	88.9	0.85	0.72	28.4
North East: Coombs Road C04 (NE)											
24	L	261	0.0	0.466	18.1	LOS B	12.5	87.8	0.62	0.79	40.1
25	T	5	0.0	0.465	10.3	LOS A	12.5	87.8	0.62	0.53	42.3
26	R	130	0.0	0.466	18.1	LOS B	12.5	87.8	0.62	0.79	40.1
Approach		396	0.0	0.466	18.0	LOS B	12.5	87.8	0.62	0.78	40.2
North West: JGD (NW)											
27	L	47	0.0	0.695	22.6	LOS B	18.4	133.8	0.85	0.89	39.0
28	T	2314	5.0	0.695	15.3	LOS B	18.8	137.2	0.86	0.76	39.8
29	R	19	0.0	0.347	41.0	LOS C	1.2	8.6	0.75	0.68	28.2
Approach		2380	4.9	0.695	15.7	LOS B	18.8	137.2	0.85	0.76	39.7
South West: Cotter Rd											
30	L	12	0.0	0.055	17.1	LOS B	1.5	10.8	0.49	0.72	41.0
31	T	5	0.0	0.055	9.2	LOS A	1.5	10.8	0.49	0.38	44.2
32	R	28	0.0	0.055	17.1	LOS B	1.5	10.8	0.49	0.72	41.0
Approach		45	0.0	0.055	16.2	LOS B	1.5	10.8	0.49	0.68	41.4
All Vehicles		3880	4.1	0.695	22.0	LOS B	18.8	137.2	0.82	0.75	35.9

Level of Service (Aver. Int. Delay): LOS B. Based on average delay for all vehicle movements. LOS Method: Delay (RTA NSW).
Level of Service (Worst Movement): LOS E. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on average delay for all vehicle movements.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow	Average Delay	Level of Service	Average Back of Queue		Prop. Queued	Effective Stop Rate
					Pedestrian	Distance		
		ped/h	sec		ped	m		per ped
P9	Across SE approach	53	54.2	LOS E	0.2	0.2	0.95	0.95
P11	Across NE approach	53	45.9	LOS E	0.2	0.2	0.88	0.88
P13	Across NW approach	53	54.2	LOS E	0.2	0.2	0.95	0.95
P15	Across SW approach	53	45.9	LOS E	0.2	0.2	0.88	0.88
All Pedestrians		212	50.0				0.91	0.91

Level of Service (Aver. Int. Delay): LOS E. Based on average delay for all pedestrian movements. LOS Method: Delay (HCM).
Level of Service (Worst Movement): LOS E. LOS Method for individual pedestrian movements: Delay (HCM).

PHASING SUMMARY

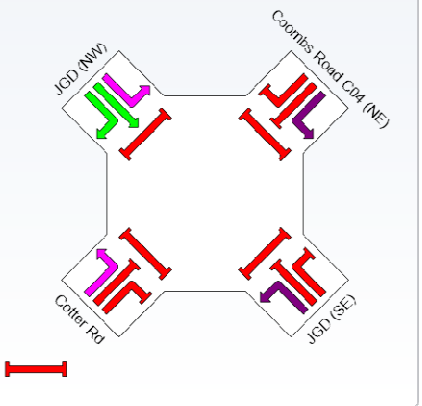
JGD-Cotter Rd 2021 AM Peak
(Ultimate)
Signals - Fixed Time Cycle Time = 120 seconds (User-Given Cycle Time)

Phase times determined by the program
Sequence: New Sequence - 3
Input Sequence: A, B, C, D
Output Sequence: A, B, C, D

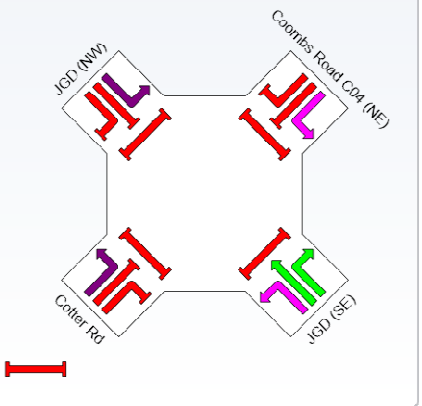
Phase Timing Results

Phase	A	B	C	D
Green Time (sec)	34	12	20	30
Yellow Time (sec)	4	4	4	4
All-Red Time (sec)	2	2	2	2
Phase Time (sec)	40	18	26	36
Phase Split	33 %	15 %	22 %	30 %

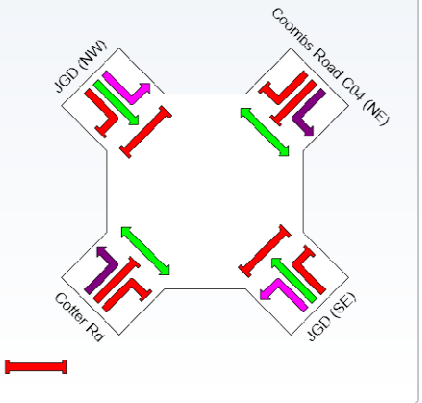
Phase A



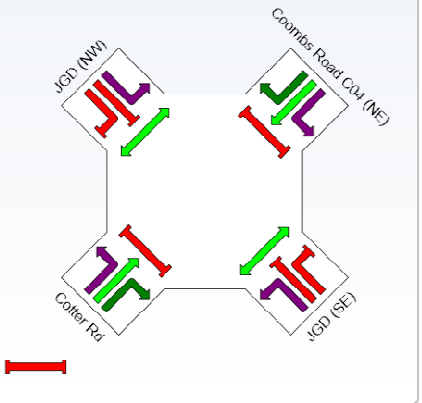
Phase B



Phase C



Phase D



	Normal Movement		Permitted/Opposed
	Slip-Lane Movement		Opposed Slip-Lane
	Stopped Movement		Continuous Movement
	Turn On Red		Undetected Movement
			Phase Transition Applied

MOVEMENT SUMMARY

Site: 2031 JGD-Cotter Rd (Ultimate)

JGD-Cotter Rd 2031 AM Peak
(Ultimate)
Signals - Fixed Time Cycle Time = 120 seconds (Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: JGD (SE)											
21	L	38	0.0	0.573	47.7	LOS D	15.8	115.1	0.92	0.86	27.0
22	T	1120	5.0	0.574	40.9	LOS C	16.0	117.0	0.92	0.78	27.1
23	R	128	0.0	0.827	74.1	LOS F	9.9	69.3	1.00	0.93	19.8
Approach		1286	4.4	0.827	44.4	LOS D	16.0	117.0	0.93	0.80	26.1
North East: Coombs Road C04 (NE)											
24	L	261	0.0	0.469	21.5	LOS B	13.9	97.0	0.67	0.80	37.8
25	T	5	0.0	0.465	13.7	LOS A	13.9	97.0	0.67	0.57	39.4
26	R	130	0.0	0.469	21.6	LOS B	13.9	97.0	0.67	0.80	37.8
Approach		396	0.0	0.469	21.5	LOS B	13.9	97.0	0.67	0.79	37.8
North West: JGD (NW)											
27	L	47	0.0	0.825	26.3	LOS B	26.0	189.0	0.93	0.93	36.8
28	T	2863	5.0	0.826	18.9	LOS B	26.5	193.2	0.93	0.86	37.2
29	R	17	0.0	0.288	36.4	LOS C	1.0	7.1	0.70	0.68	30.0
Approach		2927	4.9	0.826	19.1	LOS B	26.5	193.2	0.93	0.86	37.2
South West: Cotter Rd											
30	L	8	0.0	0.043	23.6	LOS B	1.4	10.1	0.58	0.72	36.7
31	T	5	0.0	0.043	15.7	LOS B	1.4	10.1	0.58	0.44	38.7
32	R	18	0.0	0.043	23.6	LOS B	1.4	10.1	0.58	0.72	36.7
Approach		31	0.0	0.043	22.4	LOS B	1.4	10.1	0.58	0.67	37.0
All Vehicles		4640	4.3	0.827	26.3	LOS B	26.5	193.2	0.91	0.84	33.3

Level of Service (Aver. Int. Delay): LOS B. Based on average delay for all vehicle movements. LOS Method: Delay (RTA NSW).
Level of Service (Worst Movement): LOS F. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on average delay for all vehicle movements.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow	Average Delay	Level of Service	Average Back of Queue		Prop. Queued	Effective Stop Rate
					Pedestrian	Distance		
		ped/h	sec		ped	m		per ped
P9	Across SE approach	53	54.2	LOS E	0.2	0.2	0.95	0.95
P11	Across NE approach	53	49.5	LOS E	0.2	0.2	0.91	0.91
P13	Across NW approach	53	54.2	LOS E	0.2	0.2	0.95	0.95
P15	Across SW approach	53	49.5	LOS E	0.2	0.2	0.91	0.91
All Pedestrians		212	51.8				0.93	0.93

Level of Service (Aver. Int. Delay): LOS E. Based on average delay for all pedestrian movements. LOS Method: Delay (HCM).
Level of Service (Worst Movement): LOS E. LOS Method for individual pedestrian movements: Delay (HCM).

PHASING SUMMARY

Site: 2031 JGD-Cotter Rd (Ultimate)

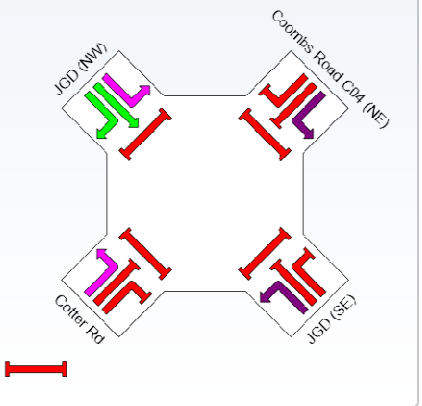
JGD-Cotter Rd 2031 AM Peak
(Ultimate)
Signals - Fixed Time Cycle Time = 120 seconds (Practical Cycle Time)

Phase times determined by the program
Sequence: New Sequence - 3
Input Sequence: A, B, C, D
Output Sequence: A, B, C, D

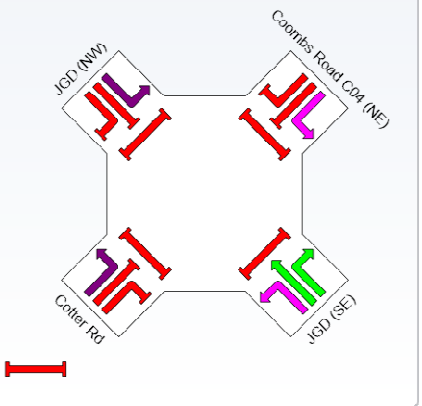
Phase Timing Results

Phase	A	B	C	D
Green Time (sec)	40	10	16	30
Yellow Time (sec)	4	4	4	4
All-Red Time (sec)	2	2	2	2
Phase Time (sec)	46	16	22	36
Phase Split	38 %	13 %	18 %	30 %

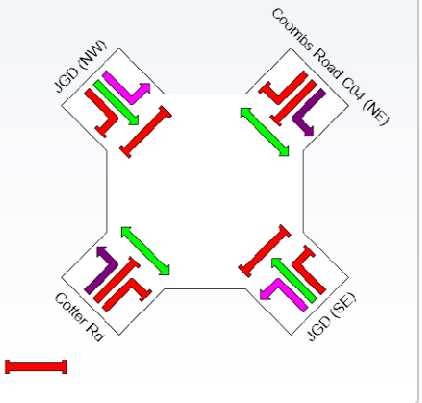
Phase A



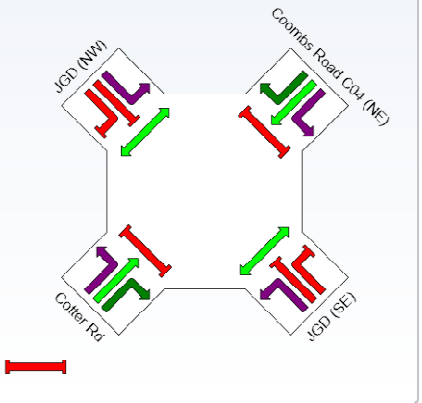
Phase B



Phase C



Phase D



	Normal Movement		Permitted/Opposed
	Slip-Lane Movement		Opposed Slip-Lane
	Stopped Movement		Continuous Movement
	Turn On Red		Undetected Movement
			Phase Transition Applied

MOVEMENT SUMMARY

Site: Road C03-C08 Roundabout

Road 34-19-13 Roundabout AM PEAK
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Road C03 (S)											
1	L	5	0.0	0.250	1.4	LOS A	2.0	14.3	0.13	0.17	38.3
2	T	65	0.0	0.249	0.3	LOS A	2.0	14.3	0.13	0.05	38.9
3	R	342	0.0	0.249	5.8	LOS A	2.0	14.3	0.13	0.56	35.9
Approach		412	0.0	0.249	4.9	LOS A	2.0	14.3	0.13	0.47	36.3
East: Road C08 (E)											
4	L	382	0.0	0.372	3.6	LOS A	3.2	22.1	0.64	0.49	36.2
5	T	10	0.0	0.370	2.5	LOS A	3.2	22.1	0.64	0.41	36.1
6	R	10	0.0	0.370	8.1	LOS A	3.2	22.1	0.64	0.80	35.5
Approach		402	0.0	0.372	3.7	LOS A	3.2	22.1	0.64	0.50	36.2
North: Road C03 (N)											
7	L	14	0.0	0.311	3.6	LOS A	2.3	16.4	0.58	0.47	37.0
8	T	327	0.0	0.309	2.5	LOS A	2.3	16.4	0.58	0.36	37.0
9	R	3	0.0	0.300	8.0	LOS A	2.3	16.4	0.58	0.92	35.8
Approach		344	0.0	0.309	2.6	LOS A	2.3	16.4	0.58	0.37	37.0
West: Road C08 (W)											
10	L	2	0.0	0.077	3.0	LOS A	0.5	3.5	0.49	0.41	36.3
11	T	2	0.0	0.077	1.9	LOS A	0.5	3.5	0.49	0.34	36.4
12	R	82	0.0	0.077	7.5	LOS A	0.5	3.5	0.49	0.61	34.8
Approach		86	0.0	0.077	7.3	LOS A	0.5	3.5	0.49	0.60	34.9
All Vehicles		1244	0.0	0.372	4.0	LOS A	3.2	22.1	0.44	0.46	36.3

Level of Service (Aver. Int. Delay): LOS A. Based on average delay for all vehicle movements. LOS Method: Delay (RTA NSW).
Level of Service (Worst Movement): LOS A. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on the worst delay for any vehicle movement.
Roundabout Capacity Model: SIDRA Standard.

MOVEMENT SUMMARY

Site: Road C07-C04

Road C04-C07 AM PEAK
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow 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
South: Road C04 (S)											
1	L	189	0.0	0.259	6.6	LOS A	2.8	19.4	0.68	0.19	35.4
2	T	260	0.0	0.259	2.1	LOS A	2.8	19.4	0.68	0.00	35.1
3	R	24	0.0	0.258	7.0	LOS A	2.8	19.4	0.68	0.79	35.5
Approach		473	0.0	0.259	4.2	LOS A	2.8	19.4	0.68	0.12	35.3
East: Road C07 (E)											
4	L	75	0.0	0.226	10.6	LOS A	1.0	7.3	0.57	0.71	33.0
5	T	22	0.0	0.227	9.2	LOS A	1.0	7.3	0.57	0.73	33.4
6	R	12	0.0	0.226	11.0	LOS A	1.0	7.3	0.57	0.84	32.9
Approach		109	0.0	0.226	10.3	LOS A	1.0	7.3	0.57	0.73	33.1
North: Road C04 (N)											
7	L	21	0.0	0.247	7.5	LOS A	2.6	18.5	0.62	0.24	35.3
8	T	323	0.0	0.246	3.0	LOS A	2.6	18.5	0.62	0.00	35.7
9	R	61	0.0	0.246	7.9	LOS A	2.6	18.5	0.62	0.85	35.2
Approach		405	0.0	0.246	4.0	LOS A	2.6	18.5	0.62	0.14	35.6
West: Road C07 (W)											
10	L	31	0.0	1.292	604.8	LOS F	100.5	703.5	1.00	10.99	3.0
11	T	5	0.0	1.250	603.4	LOS F	100.5	703.5	1.00	8.68	3.0
12	R	271	0.0	1.309	605.2	LOS F	100.5	703.5	1.00	8.32	3.0
Approach		307	0.0	1.311	605.1	LOS F	100.5	703.5	1.00	8.60	3.0
All Vehicles		1294	0.0	1.311	147.2	NA	100.5	703.5	0.73	2.19	10.0

LOS (Aver. Int. Delay): NA. The average intersection delay is not a good LOS measure for two-way sign control due to zero delays associated with major road movements.
Level of Service (Worst Movement): LOS F. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on the worst delay for any vehicle movement.

MOVEMENT SUMMARY

Site: Road C07-C04 - Rdabt

Road C04-C07 AM PEAK
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow 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
South: Road C04 (S)											
1	L	189	0.0	0.325	1.8	LOS A	3.0	21.2	0.34	0.24	37.7
2	T	260	0.0	0.325	0.8	LOS A	3.0	21.2	0.34	0.13	38.0
3	R	24	0.0	0.324	6.3	LOS A	3.0	21.2	0.34	0.79	36.1
Approach		473	0.0	0.325	1.5	LOS A	3.0	21.2	0.34	0.21	37.7
East: Road C07 (E)											
4	L	75	0.0	0.129	5.2	LOS A	1.1	7.4	0.73	0.62	35.9
5	T	22	0.0	0.129	4.1	LOS A	1.1	7.4	0.73	0.58	35.7
6	R	12	0.0	0.129	9.7	LOS A	1.1	7.4	0.73	0.80	34.6
Approach		109	0.0	0.129	5.5	LOS A	1.1	7.4	0.73	0.63	35.7
North: Road C04 (N)											
7	L	21	0.0	0.356	3.2	LOS A	3.3	22.9	0.61	0.43	36.7
8	T	323	0.0	0.356	2.2	LOS A	3.3	22.9	0.61	0.34	36.6
9	R	61	0.0	0.357	7.7	LOS A	3.3	22.9	0.61	0.82	35.9
Approach		405	0.0	0.356	3.1	LOS A	3.3	22.9	0.61	0.42	36.5
West: Road C07 (W)											
10	L	31	0.0	0.267	3.0	LOS A	2.2	15.6	0.55	0.44	36.1
11	T	5	0.0	0.263	2.0	LOS A	2.2	15.6	0.55	0.36	36.1
12	R	271	0.0	0.267	7.6	LOS A	2.2	15.6	0.55	0.64	34.8
Approach		307	0.0	0.267	7.0	LOS A	2.2	15.6	0.55	0.61	34.9
All Vehicles		1294	0.0	0.356	3.6	LOS A	3.3	22.9	0.51	0.41	36.4

Level of Service (Aver. Int. Delay): LOS A. Based on average delay for all vehicle movements. LOS Method: Delay (RTA NSW).
Level of Service (Worst Movement): LOS A. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on the worst delay for any vehicle movement.
Roundabout Capacity Model: SIDRA Standard.

MOVEMENT SUMMARY

Site: Road 03-Road 28-Shared Zone

Road 03-Road 28 AM PEAK
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Road 03 (S)											
2	T	415	0.0	0.213	0.0	LOS A	0.0	0.0	0.00	0.00	40.0
Approach		415	0.0	0.213	0.0	LOS A	0.0	0.0	0.00	0.00	40.0
East: Road 28											
4	L	39	0.0	0.099	11.9	LOS A	0.4	2.8	0.69	0.85	32.2
Approach		39	0.0	0.099	11.9	LOS A	0.4	2.8	0.69	0.85	32.2
North: Road 03 (N)											
7	L	9	0.0	0.409	4.5	LOS A	0.0	0.0	0.00	0.70	36.7
8	T	774	0.0	0.402	0.0	LOS A	0.0	0.0	0.00	0.00	40.0
Approach		783	0.0	0.402	0.1	LOS A	0.0	0.0	0.00	0.01	40.0
All Vehicles		1237	0.0	0.402	0.4	NA	0.4	2.8	0.02	0.03	39.7

LOS (Aver. Int. Delay): NA. The average intersection delay is not a good LOS measure for two-way sign control due to zero delays associated with major road movements.
Level of Service (Worst Movement): LOS A. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on the worst delay for any vehicle movement.

MOVEMENT SUMMARY

Site: Road 03-Road 28-Main Road

Road 03-Road 28 AM PEAK
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Road 03 (S)											
2	T	170	0.0	0.634	12.7	LOS A	6.9	48.3	1.00	0.00	29.9
3	R	280	0.0	0.633	17.6	LOS B	6.9	48.3	1.00	1.28	29.9
Approach		450	0.0	0.634	15.8	LOS B	6.9	48.3	1.00	0.80	29.9
East: Road 28											
4	L	318	0.0	3.347	4276.2	LOS F	551.6	3861.1	1.00	22.02	0.5
6	R	298	0.0	3.348	4276.6	LOS F	551.6	3861.1	1.00	17.89	0.5
Approach		616	0.0	3.354	4276.4	LOS F	551.6	3861.1	1.00	20.02	0.5
North: Road 03 (N)											
7	L	298	0.0	0.413	4.5	LOS A	0.0	0.0	0.00	0.62	36.7
8	T	493	0.0	0.413	0.0	LOS A	0.0	0.0	0.00	0.00	40.0
Approach		791	0.0	0.413	1.7	LOS A	0.0	0.0	0.00	0.23	38.7
All Vehicles		1857	0.0	3.354	1423.1	NA	551.6	3861.1	0.57	6.94	1.3

LOS (Aver. Int. Delay): NA. The average intersection delay is not a good LOS measure for two-way sign control due to zero delays associated with major road movements.
Level of Service (Worst Movement): LOS F. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on the worst delay for any vehicle movement.

MOVEMENT SUMMARY

Site: Road 08-Road 07

Road 08 - Road 07 AM PEAK
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow 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
South: Road 07											
1	L	352	0.0	0.350	4.5	LOS A	0.0	0.0	0.00	0.51	36.7
3	R	298	0.0	0.350	4.9	LOS A	0.0	0.0	0.00	0.60	36.4
Approach		650	0.0	0.350	4.7	LOS A	0.0	0.0	0.00	0.55	36.5
East: Road 08 (E)											
4	L	298	0.0	0.374	7.2	LOS A	2.5	17.8	0.50	0.71	35.0
5	T	61	0.0	0.374	5.9	LOS A	2.5	17.8	0.50	0.71	35.5
Approach		359	0.0	0.374	7.0	LOS A	2.5	17.8	0.50	0.71	35.1
West: Road 08 (W)											
11	T	85	0.0	0.205	0.0	LOS A	0.0	0.0	0.00	0.00	40.0
12	R	300	0.0	0.205	4.9	LOS A	0.0	0.0	0.00	0.62	36.4
Approach		385	0.0	0.205	3.8	LOS A	0.0	0.0	0.00	0.48	37.1
All Vehicles		1394	0.0	0.374	5.0	NA	2.5	17.8	0.13	0.57	36.3

LOS (Aver. Int. Delay): NA. The average intersection delay is not a good LOS measure for two-way sign control due to zero delays associated with major road movements.
Level of Service (Worst Movement): LOS A. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on the worst delay for any vehicle movement.

MOVEMENT SUMMARY

Site: Road 08-Road 07 - Roundabout

Road 08 - Road 07 AM PEAK
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Road 07											
1	L	352	0.0	0.455	3.9	LOS A	5.2	36.6	0.34	0.41	36.3
3	R	298	0.0	0.455	7.1	LOS A	5.2	36.6	0.34	0.60	34.8
Approach		650	0.0	0.455	5.4	LOS A	5.2	36.6	0.34	0.50	35.6
East: Road 08 (E)											
4	L	298	0.0	0.367	5.8	LOS A	3.3	23.4	0.64	0.64	35.5
5	T	61	0.0	0.367	4.9	LOS A	3.3	23.4	0.64	0.59	35.4
Approach		359	0.0	0.367	5.7	LOS A	3.3	23.4	0.64	0.63	35.5
West: Road 08 (W)											
11	T	85	0.0	0.385	4.9	LOS A	3.4	23.8	0.62	0.57	35.2
12	R	300	0.0	0.384	9.1	LOS A	3.4	23.8	0.62	0.72	34.1
Approach		385	0.0	0.384	8.2	LOS A	3.4	23.8	0.62	0.69	34.4
All Vehicles		1394	0.0	0.455	6.2	LOS A	5.2	36.6	0.50	0.58	35.2

Level of Service (Aver. Int. Delay): LOS A. Based on average delay for all vehicle movements. LOS Method: Delay (RTA NSW).
Level of Service (Worst Movement): LOS A. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on the worst delay for any vehicle movement.
Roundabout Capacity Model: SIDRA Standard.

MOVEMENT SUMMARY

Site: Road 20-Road 09

Road C20-RoadC09 AM PEAK
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow 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
South: Road 09											
1	L	53	0.0	0.098	11.6	LOS A	0.4	3.0	0.47	0.71	45.4
3	R	9	0.0	0.098	11.9	LOS A	0.4	3.0	0.47	0.86	45.3
Approach		62	0.0	0.098	11.6	LOS A	0.4	3.0	0.47	0.73	45.4
East: Road 20 (E)											
4	L	9	0.0	0.170	8.2	LOS A	0.0	0.0	0.00	1.07	49.0
5	T	319	0.0	0.168	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		328	0.0	0.168	0.2	LOS A	0.0	0.0	0.00	0.03	59.6
West: Road 20 (W)											
11	T	381	0.0	0.208	1.8	LOS A	2.1	15.0	0.52	0.00	51.0
12	R	13	0.0	0.210	10.3	LOS A	2.1	15.0	0.52	0.97	49.3
Approach		394	0.0	0.208	2.1	LOS A	2.1	15.0	0.52	0.03	51.0
All Vehicles		784	0.0	0.208	2.1	NA	2.1	15.0	0.30	0.09	53.7

LOS (Aver. Int. Delay): NA. The average intersection delay is not a good LOS measure for two-way sign control due to zero delays associated with major road movements.
Level of Service (Worst Movement): LOS A. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on the worst delay for any vehicle movement.

MOVEMENT SUMMARY

Site: Road C03-C08 Roundabout

Road C03-C08 PM PEAK
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Road C03 (S)											
1	L	102	0.0	0.593	1.5	LOS A	6.8	47.4	0.23	0.21	37.9
2	T	410	0.0	0.594	0.4	LOS A	6.8	47.4	0.23	0.10	38.4
3	R	478	0.0	0.594	6.0	LOS A	6.8	47.4	0.23	0.65	35.9
Approach		990	0.0	0.594	3.2	LOS A	6.8	47.4	0.23	0.37	37.0
East: Road C08 (E)											
4	L	258	0.0	0.189	1.5	LOS A	1.4	9.9	0.22	0.21	38.0
5	T	11	0.0	0.190	0.4	LOS A	1.4	9.9	0.22	0.09	38.5
6	R	14	0.0	0.189	6.0	LOS A	1.4	9.9	0.22	0.71	36.0
Approach		283	0.0	0.189	1.7	LOS A	1.4	9.9	0.22	0.23	37.9
North: Road C03 (N)											
7	L	11	0.0	0.068	3.4	LOS A	0.5	3.2	0.55	0.46	36.8
8	T	49	0.0	0.068	2.3	LOS A	0.5	3.2	0.55	0.36	36.9
9	R	11	0.0	0.068	7.9	LOS A	0.5	3.2	0.55	0.80	35.6
Approach		71	0.0	0.068	3.4	LOS A	0.5	3.2	0.55	0.45	36.6
West: Road C08 (W)											
10	L	4	0.0	0.027	6.5	LOS A	0.2	1.5	0.76	0.59	35.5
11	T	11	0.0	0.027	5.4	LOS A	0.2	1.5	0.76	0.55	35.5
12	R	5	0.0	0.027	11.0	LOS A	0.2	1.5	0.76	0.75	34.0
Approach		20	0.0	0.027	7.0	LOS A	0.2	1.5	0.76	0.61	35.1
All Vehicles		1364	0.0	0.594	3.0	LOS A	6.8	47.4	0.25	0.35	37.2

Level of Service (Aver. Int. Delay): LOS A. Based on average delay for all vehicle movements. LOS Method: Delay (RTA NSW).
Level of Service (Worst Movement): LOS A. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on the worst delay for any vehicle movement.
Roundabout Capacity Model: SIDRA Standard.

MOVEMENT SUMMARY

Site: Road C03-C08 Signals

RoadC03-C08 Signals PM PEAK
Signals - Fixed Time Cycle Time = 140 seconds (Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Road C03 (S)											
1	L	102	0.0	0.639	32.9	LOS C	31.3	219.2	0.76	0.94	24.3
2	T	578	0.0	0.639	28.4	LOS B	31.3	219.2	0.76	0.79	24.6
3	R	310	0.0	1.000 [3]	37.5	LOS C	13.2	92.4	1.00	0.85	22.8
Approach		990	0.0	1.000	31.7	LOS C	31.3	219.2	0.84	0.82	24.0
East: Road C08 (E)											
4	L	258	0.0	0.930	89.4	LOS F	22.9	160.4	1.00	1.10	14.3
5	T	11	0.0	0.928	84.9	LOS F	22.9	160.4	1.00	1.10	14.2
6	R	14	0.0	0.170	77.9	LOS F	1.5	10.4	0.99	0.68	15.6
Approach		283	0.0	0.930	88.6	LOS F	22.9	160.4	1.00	1.08	14.4
North: Road C03 (N)											
7	L	11	0.0	0.272	59.9	LOS E	4.8	33.3	0.96	0.78	18.4
8	T	49	0.0	0.272	55.4	LOS D	4.8	33.3	0.96	0.75	18.4
9	R	11	0.0	0.151	65.3	LOS E	1.1	7.4	0.93	0.66	17.3
Approach		71	0.0	0.272	57.6	LOS E	4.8	33.3	0.95	0.74	18.2
West: Road C08 (W)											
10	L	4	0.0	0.050	59.1	LOS E	1.3	9.4	0.89	0.70	18.5
11	T	11	0.0	0.050	54.6	LOS D	1.3	9.4	0.89	0.62	18.5
12	R	5	0.0	0.061	76.7	LOS F	0.5	3.8	0.98	0.64	15.7
Approach		20	0.0	0.061	61.0	LOS E	1.3	9.4	0.91	0.64	17.7
All Vehicles		1364	0.0	1.000	45.3	LOS D	31.3	219.2	0.88	0.87	20.6

Level of Service (Aver. Int. Delay): LOS D. Based on average delay for all vehicle movements. LOS Method: Delay (RTA NSW).
Level of Service (Worst Movement): LOS F. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on average delay for all vehicle movements.

3 x = 1.00 due to short lane. Refer to the Lane Summary report for information about excess flow and related conditions.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow	Average Delay	Level of Service	Average Back of Queue Pedestrian	Average Back of Queue Distance	Prop. Queued	Effective Stop Rate
		ped/h	sec		ped	m		per ped
P1	Across S approach	53	58.5	LOS E	0.2	0.2	0.91	0.91
P3	Across E approach	53	64.1	LOS F	0.2	0.2	0.96	0.96
P5	Across N approach	53	58.5	LOS E	0.2	0.2	0.91	0.91
P7	Across W approach	53	20.1	LOS C	0.1	0.1	0.54	0.54
All Pedestrians		212	50.3				0.83	0.83

Level of Service (Aver. Int. Delay): LOS E. Based on average delay for all pedestrian movements. LOS Method: Delay (HCM).
Level of Service (Worst Movement): LOS F. LOS Method for individual pedestrian movements: Delay (HCM).

PHASING SUMMARY

Site: Road C03-C08 Signals

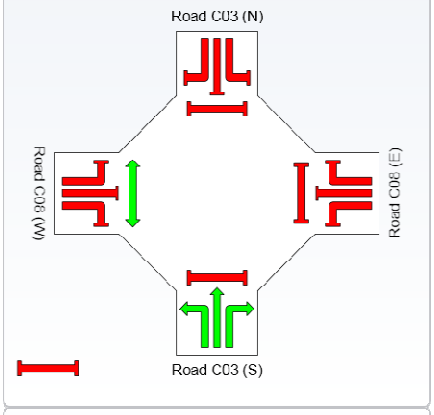
RoadC03-C08 Signals PM PEAK
Signals - Fixed Time Cycle Time = 140 seconds (Practical Cycle Time)

Phase times determined by the program
Sequence: Sequence B - Copy
Input Sequence: A, B, C, D
Output Sequence: A, B, C, D

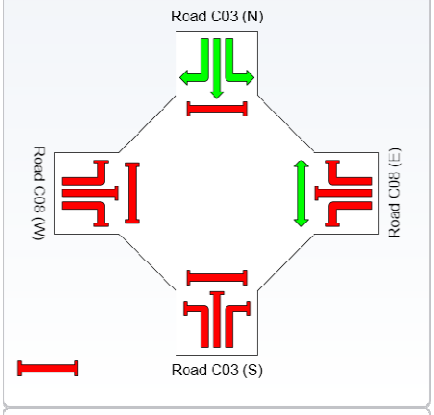
Phase Timing Results

Phase	A	B	C	D
Green Time (sec)	74	15	21	6
Yellow Time (sec)	4	4	4	4
All-Red Time (sec)	2	2	2	2
Phase Time (sec)	80	21	27	12
Phase Split	57 %	15 %	19 %	9 %

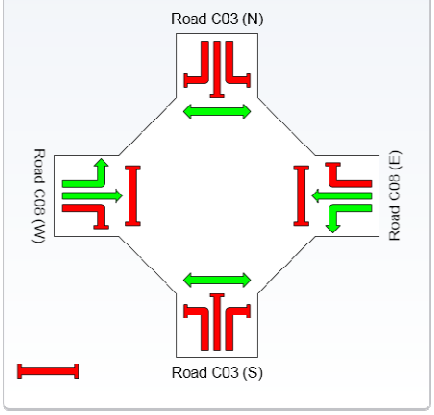
Phase A



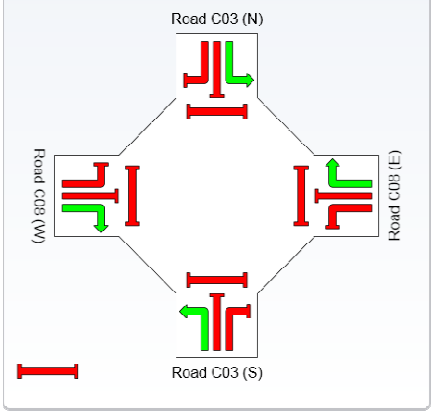
Phase B



Phase C



Phase D



	Normal Movement		Permitted/Opposed
	Slip-Lane Movement		Opposed Slip-Lane
	Stopped Movement		Continuous Movement
	Turn On Red		Undetected Movement
			Phase Transition Applied

MOVEMENT SUMMARY

Site: Road C07-C04

Road C04-C07 PM PEAK
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow 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
South: Road C04 (S)											
1	L	250	0.0	0.352	6.5	LOS A	3.8	26.9	0.68	0.19	35.3
2	T	297	0.0	0.351	2.0	LOS A	3.8	26.9	0.68	0.00	35.0
3	R	69	0.0	0.352	6.9	LOS A	3.8	26.9	0.68	0.76	35.4
Approach		616	0.0	0.351	4.4	LOS A	3.8	26.9	0.68	0.16	35.2
East: Road C07 (E)											
4	L	27	0.0	0.141	12.3	LOS A	0.6	4.3	0.58	0.66	32.0
5	T	5	0.0	0.139	11.0	LOS A	0.6	4.3	0.58	0.72	32.4
6	R	22	0.0	0.140	12.7	LOS A	0.6	4.3	0.58	0.83	31.9
Approach		54	0.0	0.141	12.3	LOS A	0.6	4.3	0.58	0.74	32.0
North: Road C04 (N)											
7	L	12	0.0	0.190	8.2	LOS A	2.2	15.6	0.65	0.23	35.0
8	T	281	0.0	0.191	3.7	LOS A	2.2	15.6	0.65	0.00	35.5
9	R	31	0.0	0.191	8.7	LOS A	2.2	15.6	0.65	0.90	34.9
Approach		324	0.0	0.191	4.4	LOS A	2.2	15.6	0.65	0.09	35.5
West: Road C07 (W)											
10	L	61	0.0	1.070	195.0	LOS F	39.8	278.8	1.00	5.43	8.1
11	T	22	0.0	1.048	193.6	LOS F	39.8	278.8	1.00	4.40	8.1
12	R	204	0.0	1.068	195.4	LOS F	39.8	278.8	1.00	4.32	8.1
Approach		287	0.0	1.067	195.2	LOS F	39.8	278.8	1.00	4.56	8.1
All Vehicles		1281	0.0	1.067	47.5	NA	39.8	278.8	0.74	1.15	20.1

LOS (Aver. Int. Delay): NA. The average intersection delay is not a good LOS measure for two-way sign control due to zero delays associated with major road movements.
Level of Service (Worst Movement): LOS F. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on the worst delay for any vehicle movement.

MOVEMENT SUMMARY

Site: Road C07-C04 - Rdabt

Road C04-C07 PM PEAK
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow 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
South: Road C04 (S)											
1	L	250	0.0	0.395	1.6	LOS A	4.0	27.7	0.27	0.22	37.9
2	T	297	0.0	0.395	0.6	LOS A	4.0	27.7	0.27	0.10	38.3
3	R	69	0.0	0.394	6.1	LOS A	4.0	27.7	0.27	0.76	36.1
Approach		616	0.0	0.395	1.6	LOS A	4.0	27.7	0.27	0.22	37.8
East: Road C07 (E)											
4	L	27	0.0	0.056	3.9	LOS A	0.4	3.0	0.62	0.49	36.1
5	T	5	0.0	0.056	2.9	LOS A	0.4	3.0	0.62	0.44	36.0
6	R	22	0.0	0.056	8.5	LOS A	0.4	3.0	0.62	0.69	35.0
Approach		54	0.0	0.056	5.7	LOS A	0.4	3.0	0.62	0.57	35.6
North: Road C04 (N)											
7	L	12	0.0	0.286	3.1	LOS A	2.5	17.2	0.57	0.40	36.9
8	T	281	0.0	0.284	2.0	LOS A	2.5	17.2	0.57	0.31	36.9
9	R	31	0.0	0.284	7.6	LOS A	2.5	17.2	0.57	0.84	36.0
Approach		324	0.0	0.284	2.6	LOS A	2.5	17.2	0.57	0.36	36.8
West: Road C07 (W)											
10	L	61	0.0	0.268	3.6	LOS A	2.2	15.5	0.61	0.51	35.9
11	T	22	0.0	0.268	2.6	LOS A	2.2	15.5	0.61	0.44	35.8
12	R	204	0.0	0.267	8.1	LOS A	2.2	15.5	0.61	0.70	34.9
Approach		287	0.0	0.267	6.7	LOS A	2.2	15.5	0.61	0.64	35.2
All Vehicles		1281	0.0	0.395	3.2	LOS A	4.0	27.7	0.44	0.37	36.8

Level of Service (Aver. Int. Delay): LOS A. Based on average delay for all vehicle movements. LOS Method: Delay (RTA NSW).
Level of Service (Worst Movement): LOS A. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on the worst delay for any vehicle movement.
Roundabout Capacity Model: SIDRA Standard.

MOVEMENT SUMMARY

Site: Road C04-C7 Signals

Road C04-C07 Signals PM PEAK
Signals - Fixed Time Cycle Time = 100 seconds (Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Road C03 (S)											
1	L	250	0.0	0.852	48.6	LOS D	27.2	190.1	1.00	1.12	20.4
2	T	297	0.0	0.851	44.1	LOS D	27.2	190.1	1.00	1.12	20.4
3	R	69	0.0	0.234	30.9	LOS C	3.5	24.2	0.75	0.71	24.7
Approach		616	0.0	0.851	44.5	LOS D	27.2	190.1	0.97	1.07	20.8
East: Road C08 (E)											
4	L	27	0.0	0.110	44.6	LOS D	2.1	14.5	0.90	0.71	21.1
5	T	5	0.0	0.110	40.2	LOS C	2.1	14.5	0.90	0.66	21.2
6	R	22	0.0	0.088	46.5	LOS D	1.5	10.3	0.91	0.70	20.7
Approach		54	0.0	0.110	45.0	LOS D	2.1	14.5	0.90	0.70	20.9
North: Road C03 (N)											
7	L	12	0.0	0.846	63.3	LOS E	16.9	118.5	1.00	1.07	17.9
8	T	281	0.0	0.851	58.9	LOS E	16.9	118.5	1.00	1.07	17.8
9	R	31	0.0	0.288	42.5	LOS D	1.9	13.6	0.88	0.69	21.5
Approach		324	0.0	0.851	57.5	LOS E	16.9	118.5	0.99	1.03	18.1
West: Road C08 (W)											
10	L	61	0.0	0.284	46.1	LOS D	5.1	35.4	0.93	0.76	20.9
11	T	22	0.0	0.284	41.6	LOS C	5.1	35.4	0.93	0.72	20.9
12	R	204	0.0	0.816	56.3	LOS D	12.3	86.4	1.00	0.96	18.8
Approach		287	0.0	0.816	53.0	LOS D	12.3	86.4	0.98	0.90	19.3
All Vehicles		1281	0.0	0.851	49.7	LOS D	27.2	190.1	0.97	1.01	19.7

Level of Service (Aver. Int. Delay): LOS D. Based on average delay for all vehicle movements. LOS Method: Delay (RTA NSW).
Level of Service (Worst Movement): LOS E. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on average delay for all vehicle movements.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow	Average Delay	Level of Service	Average Back of Queue Pedestrian	Average Back of Queue Distance	Prop. Queued	Effective Stop Rate
		ped/h	sec		ped	m		per ped
P1	Across S approach	53	44.2	LOS E	0.1	0.1	0.94	0.94
P3	Across E approach	53	42.3	LOS E	0.1	0.1	0.92	0.92
P5	Across N approach	53	44.2	LOS E	0.1	0.1	0.94	0.94
P7	Across W approach	53	30.4	LOS D	0.1	0.1	0.78	0.78
All Pedestrians		212	40.3				0.90	0.90

Level of Service (Aver. Int. Delay): LOS E. Based on average delay for all pedestrian movements. LOS Method: Delay (HCM).
Level of Service (Worst Movement): LOS E. LOS Method for individual pedestrian movements: Delay (HCM).

PHASING SUMMARY

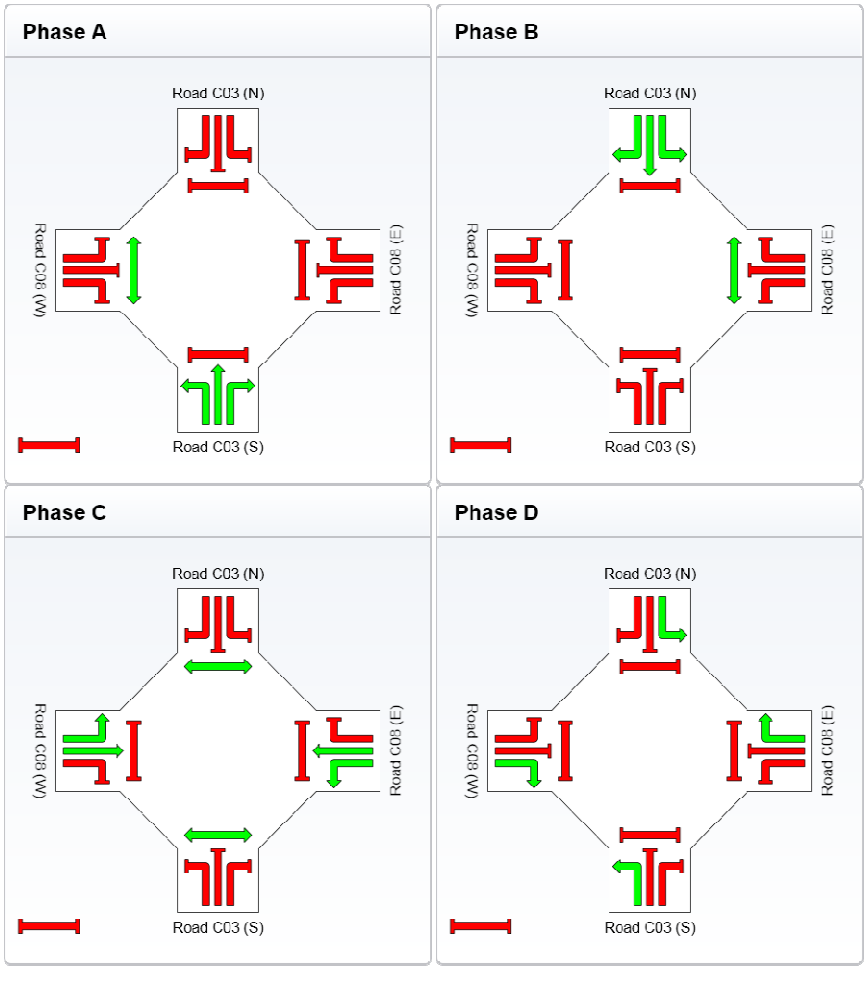
Site: Road C04-C7 Signals

Road C04-C07 Signals PM PEAK
Signals - Fixed Time Cycle Time = 100 seconds (Practical Cycle Time)

Phase times determined by the program
Sequence: Sequence B - Copy
Input Sequence: A, B, C, D
Output Sequence: A, B, C, D

Phase Timing Results

Phase	A	B	C	D
Green Time (sec)	31	17	15	13
Yellow Time (sec)	4	4	4	4
All-Red Time (sec)	2	2	2	2
Phase Time (sec)	37	23	21	19
Phase Split	37 %	23 %	21 %	19 %



	Normal Movement		Permitted/Opposed
	Slip-Lane Movement		Opposed Slip-Lane
	Stopped Movement		Continuous Movement
	Turn On Red		Undetected Movement
			Phase Transition Applied

MOVEMENT SUMMARY

Site: Road 03-Road 28-Shared Zone

Road 03-Road 28 PM PEAK
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow 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
South: Road 03 (S)											
2	T	968	0.0	0.496	0.0	LOS A	0.0	0.0	0.00	0.00	40.0
Approach		968	0.0	0.496	0.0	LOS A	0.0	0.0	0.00	0.00	40.0
East: Road 28											
4	L	29	0.0	0.051	8.7	LOS A	0.2	1.5	0.54	0.74	34.1
Approach		29	0.0	0.051	8.7	LOS A	0.2	1.5	0.54	0.74	34.1
North: Road 03 (N)											
7	L	9	0.0	0.300	4.5	LOS A	0.0	0.0	0.00	0.70	36.7
8	T	581	0.0	0.303	0.0	LOS A	0.0	0.0	0.00	0.00	40.0
Approach		590	0.0	0.303	0.1	LOS A	0.0	0.0	0.00	0.01	39.9
All Vehicles		1587	0.0	0.496	0.2	NA	0.2	1.5	0.01	0.02	39.9

LOS (Aver. Int. Delay): NA. The average intersection delay is not a good LOS measure for two-way sign control due to zero delays associated with major road movements.
Level of Service (Worst Movement): LOS A. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on the worst delay for any vehicle movement.

MOVEMENT SUMMARY

Site: Road 08-Road 07

Road 08 - Road 07 PM PEAK
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow 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
South: Road 07											
1	L	225	0.0	0.242	4.5	LOS A	0.0	0.0	0.00	0.50	36.7
3	R	224	0.0	0.242	4.9	LOS A	0.0	0.0	0.00	0.60	36.4
Approach		449	0.0	0.242	4.7	LOS A	0.0	0.0	0.00	0.55	36.5
East: Road 08 (E)											
4	L	224	0.0	0.324	7.5	LOS A	2.0	13.8	0.55	0.79	34.8
5	T	64	0.0	0.323	6.1	LOS A	2.0	13.8	0.55	0.71	35.3
Approach		288	0.0	0.324	7.2	LOS A	2.0	13.8	0.55	0.77	34.9
West: Road 08 (W)											
11	T	76	0.0	0.276	0.0	LOS A	0.0	0.0	0.00	0.00	40.0
12	R	441	0.0	0.276	4.9	LOS A	0.0	0.0	0.00	0.60	36.4
Approach		517	0.0	0.276	4.2	LOS A	0.0	0.0	0.00	0.52	36.9
All Vehicles		1254	0.0	0.324	5.1	NA	2.0	13.8	0.13	0.59	36.3

LOS (Aver. Int. Delay): NA. The average intersection delay is not a good LOS measure for two-way sign control due to zero delays associated with major road movements.
Level of Service (Worst Movement): LOS A. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on the worst delay for any vehicle movement.

MOVEMENT SUMMARY

Site: Road 08-Road 07 - Roundabout

Road 08 - Road 07 PM PEAK
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Road 07											
1	L	225	0.0	0.324	3.8	LOS A	3.2	22.6	0.30	0.41	36.4
3	R	224	0.0	0.324	7.1	LOS A	3.2	22.6	0.30	0.60	34.9
Approach		449	0.0	0.324	5.5	LOS A	3.2	22.6	0.30	0.51	35.6
East: Road 08 (E)											
4	L	224	0.0	0.339	6.8	LOS A	3.0	20.7	0.72	0.72	35.2
5	T	64	0.0	0.339	5.9	LOS A	3.0	20.7	0.72	0.68	35.1
Approach		288	0.0	0.339	6.6	LOS A	3.0	20.7	0.72	0.71	35.2
West: Road 08 (W)											
11	T	76	0.0	0.463	4.4	LOS A	4.5	31.6	0.60	0.52	35.3
12	R	441	0.0	0.463	8.6	LOS A	4.5	31.6	0.60	0.68	34.2
Approach		517	0.0	0.463	8.0	LOS A	4.5	31.6	0.60	0.66	34.4
All Vehicles		1254	0.0	0.463	6.8	LOS A	4.5	31.6	0.52	0.62	35.0

Level of Service (Aver. Int. Delay): LOS A. Based on average delay for all vehicle movements. LOS Method: Delay (RTA NSW).
Level of Service (Worst Movement): LOS A. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on the worst delay for any vehicle movement.
Roundabout Capacity Model: SIDRA Standard.

MOVEMENT SUMMARY

Site: Road 08-Road 07 - Roundabout

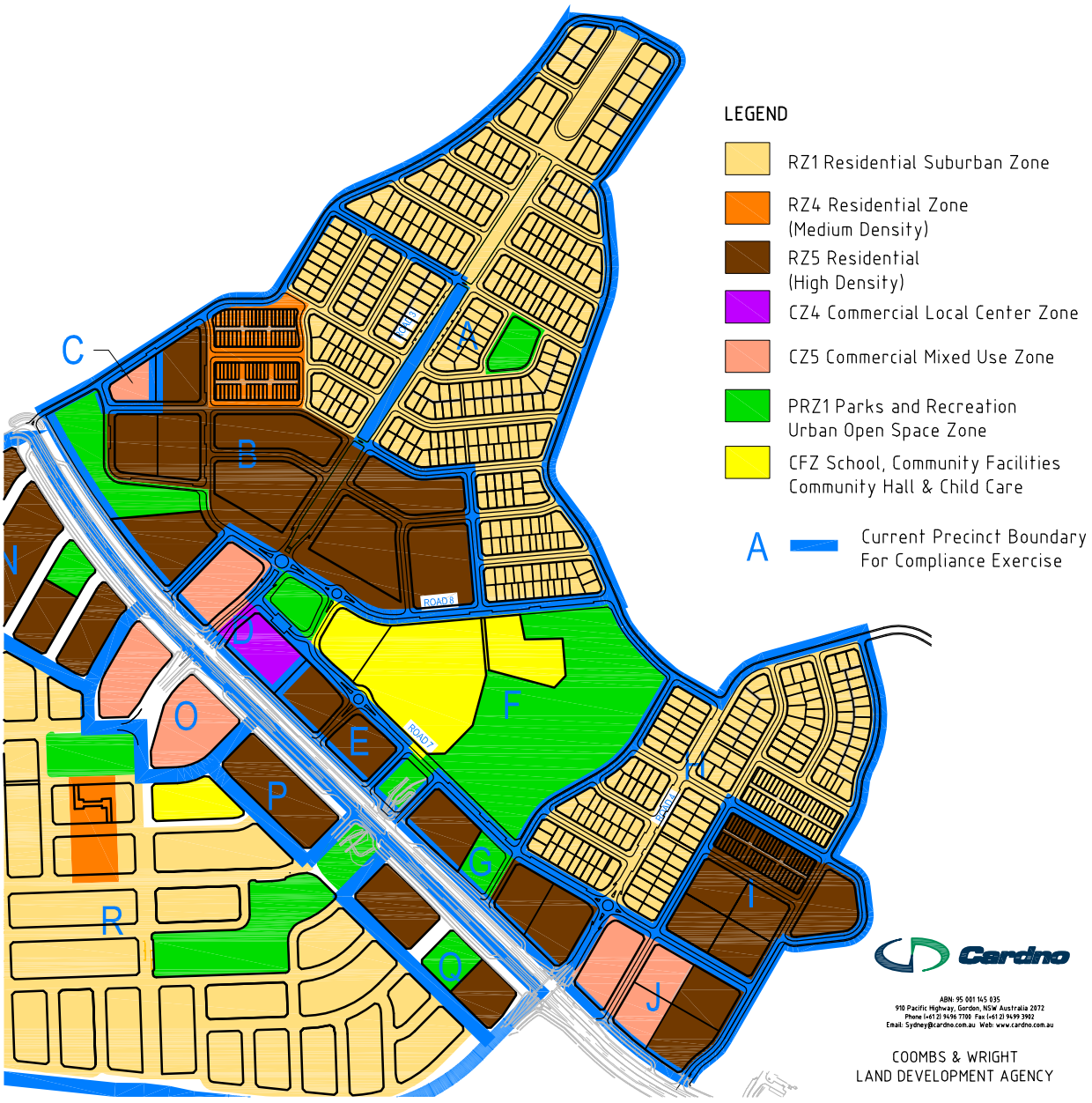
Road 08 - Road 07 PM PEAK
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Road 07											
1	L	225	0.0	0.324	3.8	LOS A	3.2	22.6	0.30	0.41	36.4
3	R	224	0.0	0.324	7.1	LOS A	3.2	22.6	0.30	0.60	34.9
Approach		449	0.0	0.324	5.5	LOS A	3.2	22.6	0.30	0.51	35.6
East: Road 08 (E)											
4	L	224	0.0	0.339	6.8	LOS A	3.0	20.7	0.72	0.72	35.2
5	T	64	0.0	0.339	5.9	LOS A	3.0	20.7	0.72	0.68	35.1
Approach		288	0.0	0.339	6.6	LOS A	3.0	20.7	0.72	0.71	35.2
West: Road 08 (W)											
11	T	76	0.0	0.463	4.4	LOS A	4.5	31.6	0.60	0.52	35.3
12	R	441	0.0	0.463	8.6	LOS A	4.5	31.6	0.60	0.68	34.2
Approach		517	0.0	0.463	8.0	LOS A	4.5	31.6	0.60	0.66	34.4
All Vehicles		1254	0.0	0.463	6.8	LOS A	4.5	31.6	0.52	0.62	35.0

Level of Service (Aver. Int. Delay): LOS A. Based on average delay for all vehicle movements. LOS Method: Delay (RTA NSW).
Level of Service (Worst Movement): LOS A. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on the worst delay for any vehicle movement.
Roundabout Capacity Model: SIDRA Standard.

Appendix B
Precinct Boundaries



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COOMBS & WRIGHT
LAND DEVELOPMENT AGENCY

Appendix C
Bushfire Risk Assessment

BUSHFIRE RISK ASSESSMENT REPORT

FOR THE

COOMBS ESTATE DEVELOPMENT PLAN [SOUTH OF HOLDENS CREEK]

AUSTRALIAN CAPITAL TERRITORY

PREPARED FOR THE

LAND DEVELOPMENT AGENCY

FEBRUARY 2011

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BUSHFIRE RISK ASSESSMENT REPORT

FOR THE

COOMBS ESTATE DEVELOPMENT PLAN
[SOUTH OF HOLDENS CREEK]

AUSTRALIAN CAPITAL TERRITORY

PREPARED FOR THE

LAND DEVELOPMENT AGENCY

FEBRUARY 2011

Assessment Number	Document	Preparation Date	Issue Date	Directors Approval
B101406 – A3	Final	10.2.2011	14.6.2011	*G.L.Swain*

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EXECUTIVE SUMMARY

The Land Development Agency is engaged to complete the planning, design, construction, development and marketing of land in the new suburb of Coombs, ACT in accordance with the Government's Land Release Program.

The proposed landuse in the new suburb consists of RZ1 Residential Suburban Zone; RZ5 Residential Zone – High Density; CZ5 Commercial Mixed Use Zone; PRZ1 – Parks & Recreation Urban Open Space Zone and School, Community Facilities Community Hall & Childcare.

Australian Bushfire Protection Planners Pty Limited prepared the Stage 1 & Stage 2 Bushfire Risk Assessments for the Molonglo Valley, including Western Broadacre for ACTPLA as part of the information accompanying the Molonglo Valley Draft Variation 281.

These reports were prepared in 2005 & 2006 and provided advice on the bushfire protection measures which were deemed to be necessary to protect the future urban and Broadacre development in the valley.

The assessment of bushfire risk and the provision of advice on the bushfire protection measures required to mitigate the identified risk in Molonglo Valley Stage 2 Bushfire Risk Assessment was determined on the basis that the Molonglo River corridor would be dammed downstream of Coppins Crossing Road and the lake and river corridor would be managed as a Foreshore Reserve/Open Space Reserve in order to reduce the risk posed by a fire burning along the river corridor, from the northwest.

Since the preparation of the Stage 1 & Stage 2 Molonglo Bushfire Risk Assessments the ACT Rural Fire Service / ESA have updated the Strategic Bushfire Risk Management Plan for the ACT and also investigated and mapped the urban edge of Canberra to determine the 'Asset Interface Classification [AIC].

Furthermore, *Planning for Bushfire Risk Mitigation* has been updated and now includes the provision of Asset Protection Zones based on the AIC and wider Home Asset Protection Zones [Ember Zones] in order to address potential ignition of structures from burning ember attack.

An Aprasia Habitat study has also been prepared for ACTPLA and the Molonglo Riparian Strategy for Coombs & North Weston is being undertaken jointly for LDA/ACTPLA/TAMS.

The Aprasia Habitat study found habitat for the endangered species Pink Tailed Worm [*Aprasia parapulchella*] located in the Holdens Creek corridor and on the rocky embankment of the Molonglo River. The need to retain this habitat and retention of the vegetation in the river corridor changes the status of the advice on which the previous 2005 & 2006 Bushfire Risk Assessments were prepared.

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As part of the planning for the new suburb, Australian Bushfire Protection Planners Pty Limited prepared, in April 2010, a Bushfire Risk Assessment for the suburb of Coombs for the Land Development Agency [LDA]. This report identified that the potential risk to the proposed development in the suburb of Coombs, which is located adjacent to the river corridor, is extreme.

The recommended fire protection measures, based on the assumption that the vegetation within the river corridor would be managed to the standards of an Outer Asset Protection Zone required a 50 metre wide Inner Asset Protection Zone be provided to the northwest of the residential precinct which faces Misery Point whilst a 40 metre wide Inner Asset Protection Zone be provided to the remainder of the river corridor.

The Ember Zone [HAPZ] to the residential precinct which faces Misery Point and the remainder of the river corridor was recommended to be BAL 29 for 100 metres plus BAL 19.0 for the next 150 metres, in accordance with A.S. 3959 – 2009 – *'Construction of Buildings in Bushfire Prone Areas'* and the stormwater detention ponds on Holdens Creek, Weston Creek and the internal creek lines maintained as an Inner Asset Protection Zone.

These recommendations were supported by ESA. However, recent advice from ESA, later in 2010, has resulted in the determination that the Outer Asset Protection Zone shall be 100 metres with the remaining bushfire protection measures as per the recommendations of the April 2010 Bushfire Risk Assessment.

Furthermore, following discussions & field investigations with TAMS, ESA, LAPS, ACTPLA & LDA it has been agreed the fuel loads of high quality Pink Tailed Worm Lizard [PTWL] habitats are compatible with the management requirements of an Outer Asset Protection Zone and the conservation requirements of the PTWL.

This report therefore re-examines the potential bushfire risks to the new suburb of Coombs, in accordance with the provisions of Australian Standard for Risk Management, AS/NZS 4360:2004 and *Planning for Bushfire Risk Mitigation,* taking into account the status of the planning / construction of the adjacent development in the new suburb of Wright and the potential risk from a fire occurrence in the vegetated Molonglo River corridor and updates the report prepared by ABPP in April 2010 to include a detailed assessment of the risk presented by the Aprasia Habitat and the potential management of the habitat to mitigate the risk.

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TABLE OF CONTENTS.

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SECTION 1

INTRODUCTION

1.1 Aim of the Brief.

The aim of this brief is to re-assess the bushfire risk posed by a vegetated Molonglo River corridor, including the Aprasia Habitat located to the northwest of the north-eastern portion of the Estate, southeast of Misery Point; the risk posed by the vegetation on the land to the northwest of Holdens Creek and the vegetation in the reserve between Cotter Road and the suburbs of Duffy/Holder and prepare a bushfire risk assessment for the new suburb of Coombs, in accordance with Australian Standard for Risk Management, AS/NZS 4360:2004 and the ACTPLA "*Planning for Bushfire Risk Mitigation"* guideline.

1.2 Background Information.

1.2.1 Pink Tailed Worm Lizard [PTWL] Study.

The Coombs Bushfire Risk Assessment prepared by ABPP [April 2010] examined the Coombs Estate Development Plan, identified the level of risk to the future suburb from a bushfire occurrence in the Molonglo River corridor and recommended the provision of an Outer Asset Protection Zone and Inner Asset Protection Zone to the temporary and permanent urban edge, south of Holdens Creek.

The Coombs Bushfire Risk Assessment [April 2010] recommended fire protection zones which occupied the area up to and beyond the south-eastern bank of the Molonglo River and to the northwest of Holdens Creek.

Investigations undertaken as part of the Molonglo River Corridor Study identified a large area of Aprasia Habitat between the north-western edge of the new suburb and the Molonglo River, within the recommended fire protection zones.

A confirmatory survey was undertaken by David Wong and William Osborne from the Institute for Applied Ecology, University of Canberra [UC] and a report prepared for the ACT Planning and Land Authority [ACTPLA] – dated 18 February 2010.

The UC report confirmed an area of Aprasia Habitat, nominated as 'Area 7', on the northwest facing slope of the ridgeline, between the proposed Coombs Estate and the Molonglo River. The investigation only found one skin even though 2816 stones were turned, suggesting that Pink-Tailed Worm Lizards occur at very low densities within Area 7.

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Figure 11 of the report identifies that Area 7 contains High Quality and Moderate Quality Potential Habitat. These Habitat Classifications are defined as:

(1) High Quality Potential Habitat:
Suitable rocky areas generally dominated by, or with a large component of Kangaroo Grass *[Thereda triandra]* and also often containing *Poa sieberiana* and, in some cases, a range of native forb species. Exotic annual species such as Haresfoot Clover *[Trifolium arevense]* and *Vulpia* spp. May also be present.

(2) Moderate Quality Potential Habitat:
Suitable rocky areas usually dominated by Spear Grasses *[Austrostipa* spp.*]* and Wallaby Grasses *[Austrodanthonia* spp.*].* Native forb species and exotic annual grasses such as Haresfoot Clover *[Trifolium arevense],* Wild Oats *[Avena* sp.*]* and Saffron Thistle may also be present.

The UC report concludes "Planning should take into account the national significance of the population and environmentally sensitive planning should take place in order to conserve the species at this location. Important considerations include appropriate positioning of future roads and careful planning of the location of other infrastructure and utilities so as not to impact on the population. Habitat areas protected for the species should contain appropriate buffer zones. Protection of the existing population and the habitat of the species will serve to fulfil legislative requirements for protecting the Pink-tailed Worm Lizard, whilst also providing broader environmental benefits and an ecological benefit for other species and communities that exist in the Molonglo River Corridor".

1.2.2 EPBC Approval.

The Commonwealth Department of Sustainability, Environment, Water and Population on the 28th September 2009 determined, pursuant to the *Environmental Protection & Biodiversity Conservation Act 1999 [EPBC Act]* that the Coombs Estate *EPBC* referral was not a controlled activity, subject to a number of conditions.

On the 16th April 2010, the Commonwealth Department of Sustainability, Environment, Water and Population, at ACTPLA's request, amended the original approval and downgraded the potential Aprasia Habitat located on the ridge in Coombs to low quality.

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Item 8.2 of the amended decision [16th April 2010] directly relates to the fire management of the potential PTWL Habitats and states that any fire, biomass management or fuel reduction required as a result of the action within 20 metres of moderate and high quality habitat will be conducted in an ecologically sympathetic manner with the conservation of Pink-tailed Worm Lizard. Grazing can only be used as a management technique when it is undertaken in accordance with expert advice.

1.2.3 Management of Native Grasslands in the ACT.

As native grass dominates PTWL Habitats, the *ACT Lowland Native Grassland Conservation Strategy* can be used as a guide to inform the management of the native grasses within the PTWL Habitat

The *ACT Lowland Native Grassland Conservation Strategy* builds on more than ten years of survey, monitoring, research, conservation planning and management in relation to lowland native grasslands in the ACT with Section 3.7.2 – Key Aspects of Best Practice Management of Native Grassland identifying the need for active management and monitoring.

The Strategy states "It is widely accepted that natural temperate grasslands need appropriate disturbance as part of a specific management regime.

The main type of disturbance needed for management is highlighted in a 'model' of *Themeda triandra* dominated natural temperate grassland, developed by Lunt and Morgan [2002]. Under the model, the key disturbance required is managing the biomass of the dominant grass [e.g. by burning, mowing/slashing and/or grazing] to maintain its health and retain a high diversity of forb species [Lunt and Morgan]".

"Activities that should generally be avoided in conservation based disturbance of grassland include ploughing, earthworks that alter drainage patterns, clearing, rock removal, cultivation, pasture improvement, adding fertilizer, excessive livestock grazing, topsoil removal and stockpiling, dumping or spreading soil [Eddy 2002; Wildlife Research Unit 1994; Sharp and Rehwinkel 1998]".

Section 3.7.4 of the *ACT Lowland Native Grassland Conservation Strategy* expands on the management of native grassland and states that "some form of defoliation is essential to maintaining the structure and botanical composition of most native grasslands *[Eddy 2002].* Without regular removal of some herbage, excess grass will accumulate and die and can inhibit the growth of many plant species in the sward".

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“Inter-tussock forbs are particularly affected; however there may also be loss of vigour of dominant grasses e.g. Kangaroo Grass. Kangaroo Grass or *Poa* tussock will need more intensive treatment than areas of poorer soils carrying spear and wallaby grasses which have much less biomass and shorter life spans”.

Grazing:
“In designing a suitable grazing management regime, the timing, selectivity, intensity and duration of grazing need consideration *[Eddy 2002].*

- *Timing:* Native grassland must be allowed to grow freely enough to replenish root reserves, flower and set seed. During flowering and seed production [mainly in late spring/early summer] grazing should be light or completely removed;

- *Selectivity:* Higher stocking for a shorter period can reduce selectivity;

- *Intensity & duration:* Stock should be removed when quantity becomes too low to maintain livestock condition.

Mowing & Slashing:
“Any mowing/slashing regime should allow for periods of good plant growth between each mowing and permit the grassland species to flower and set seed at least every few years.
Grassland should not be mowed when significant plant species are flowering or setting seed, or when animals likely to be harmed by mowing are active and depend on the vegetation for shelter or food”.

- *Season/Height prescriptions:* Minimum height of 100mm above the ground and mowing is restricted to no more than once or twice in any 12 month period.

Burning:
“Fire has been an integral part of the evolution of native grasslands and is used as a management tool to maintain biodiversity in *Themeda triandra* grasslands”

“If burning is to be used as a management tool, similar considerations apply as for other means of defoliation:

- *Timing:* Fires should be timed to allow grassland species to flower and set seed. Eddy [2002] suggests burning between the end of seed set [mid to late summer] and when the plants begin to produce flowers in spring;

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- *Intensity:* Hot, dry summer conditions and a large dry grass biomass can result in fires that are too hot. Fires should only be lit when soil is reasonably moist and temperature and wind conditions will enable the fire to be kept under control *[Eddy 2002];*

- *Frequency:* Fires should be carried out only as often as is needed to reduce excessive biomass. In the ACT a burn frequency of once every two to three years has been recommended but on low productivity sites may never or only occasionally be necessary *[Eddy];*

- *Fauna impacts:* Fire can threaten small native fauna. For this reason, patch burning is recommended *[Eddy].*

1.2.4 Current ACT Fire Management Practices for PTWL.

The ACT Parks Conservation and Lands provide the following guidelines on how to manage Pink-tailed Worm habitat whilst undertaking operations such as burning, slashing, grazing and physical removal of bushfire hazards:

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Pink Tailed Worm Lizard *(Aprasia parapulchella)*
Fuel and Fire Suppression Guidelines

(NB. In managing for good conservation outcomes, it is important to consider the ecosystem as a whole, including animals, plants, soil and soil biota, rather than thinking in terms of individual species. Disturbance to the composition or structure of the community can have impacts on the functioning of the system as a whole.)

Description
The Pink-tailed Worm Lizard is about 24 cm long with a maximum snout–vent length of about 14 cm (Jones 1992, in ACT Government 2007). The species has a dark brown to black head region and a grey to grey-brown body, becoming pink or reddish-brown beneath the tail. The body appears to have faint longitudinal lines on the upper surface because of the presence of a dark dot or longitudinal bar at the centre of each scale (Osborne and Jones 1995, in ACT Government 2007).

At most sites the Pink-tailed Worm Lizard is found sheltering beneath partially embedded rocks, thus, rocks are an important microhabitat feature for the species. Disturbance to the ground layer (particularly removal of rocks and weed infestations) remains a threat to the lizard. Livestock grazing and agricultural activities (e.g. pasture improvement, cropping) have had the greatest impact on populations of the species and their habitat through ground disturbance and changes to groundcover vegetation.

Legal Status: Vulnerable (ACT); Vulnerable (Cwlth)

Appropriate inter-fire interval if known:

Activity	**Potential impact (H=high; M=moderate; L=low; C=conditional)**	**Comments**
Low intensity fire	MC	Burning must be patchy with a low intensity mosaic over the area and no more than 70% of the area burnt. Vegetation around rocky outcrops not to be burnt.
High intensity fire	H	
Slashing	MC	Do not disturb surface rocks during the process. Do not slash below 10cm.
Physical and mechanical removal of naturally occurring shrubs, trees or ground layer plants	MC	Do not disturb surface rocks. Ground layer should not be disturbed and original structure and composition of the habitat should be preserved.
Tree and limb removal	MC	Do not disturb surface rocks during the process.
Rock picking & surface reshaping	H	This will impact directly on Pink-tailed Worm Lizard habitat.
Herbicide application	MC	No broad application – only species specific spot spraying and cut/paint methods for shrubs and trees.
Livestock grazing	MC	Grazing has impacted on Pink-tailed Worm Lizard in the past. Grazing should only be undertaken under strict conditions and after consultation with Research and Planning. Timing and intensity of grazing is important

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		and should be monitored. If grazing is impacting adversely on the habitat (rocks or vegetation composition), stock should be removed. Do not graze tussock levels below 20cm height as it is important to maintain tussock structure and inter-tussock spaces.
Use of fire suppression chemicals – fire retardant (high in phosphorous)	H	Increasing phosphorous is likely to increase weed infestation. The Pink-tailed Worm Lizard is usually associated with native grass species and does not tolerate weed infestations.
Use of fire suppression agents – fire-fighting foam (wetting agent)	H	Use of foam has been shown to have adverse effects on plants and may lead to plant damage and a decrease in species richness. The Pink-tailed Worm Lizard is usually associated with native grass species and does not tolerate weed infestations.
Being driven over by vehicles or trampled by people	MC	Surface rock is not to be disturbed.
Minor soil disturbance by hand tools (e.g. rakes)	MC	Soil disturbance only if absolutely necessary and with limited extent (e.g. fire break). Surface rocks are not to be disturbed.
Major soil disturbance (e.g. dozer/backhoe line)	H	This will impact adversely on the habitat.
Aerial water bombing (up to 1500kg of water from 100m up)	MC	As long as this practice does not cause adverse impacts on the lizard's habitat (e.g. rocks, grasses, soil).
Other – please add any other.		Disturbance of habitat can threaten this species. Any activity that dislodges surface rocks or may lead to a potential decrease in native grass cover or introduction of weed species must be avoided.

References

ACT Government 2007. *Ribbons of Life: ACT Aquatic Species and Riparian Zone Conservation Strategy*. Action Plan No. 29. Department of Territory and Municipal Services, Canberra

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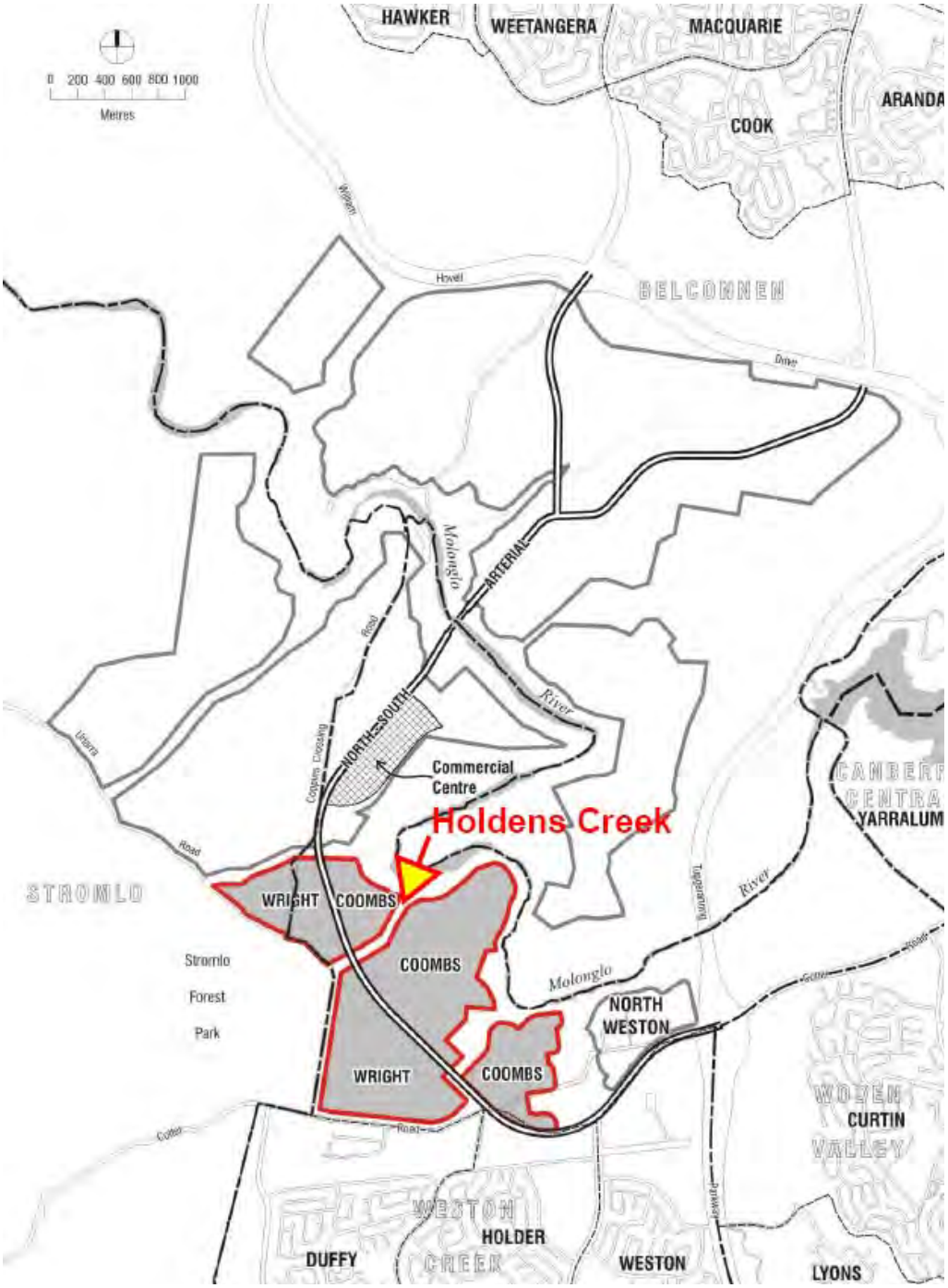
SECTION 2
DESCRIPTION OF THE COOMBS STUDY AREA

2.1 Location.

The proposed suburb of Coombs is situated in the south-eastern corner of Molonglo, north from Cotter Road, west of North Weston and south of the Molonglo River, northeast of the proposed north/south arterial. The northern extremity of the site examined in this risk assessment is Holdens Creek.

Figure 1 - Location of the Coombs development precinct.



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2.2 Existing Land Use.

The Coombs development precinct contains former Forestry ACT land, which contained prior to the 2003 bushfires, the Stromlo Radiata Pine Forest. The northern portion of the Coombs development precinct consists of former grazing land.

2.3 Surrounding Land Use.

a) North

The land to the northwest of the Coombs development precinct, beyond Holdens Creek, forms the northern portion of the future suburbs of Coombs and Wright. This land is currently being managed by TAMS.

b) Northeast & east

The land to the northeast of the Coombs development precinct consists of the Molonglo River corridor. The land to the east of the southern portion of the precinct consists of vacant land within the North Western development precinct. This precinct is proposed for residential development.

c) South

The Cotter Road carriageway extends along the southern boundary of the Coombs development precinct. Open Space land extends to the east of the Stromlo Village precinct, through to Weston Creek and Streeton Drive.

d) Southwest

The proposed north/south arterial road link forms the south-western boundary of the Coombs precinct. The new suburb of Wright occupies the land beyond the arterial road.

2.4 Topography.

2.4.1 Within the Development Precinct.

The Coombs development precinct contains two ridgelines which extend from within the Wright development precinct in a northeast direction towards the Molonglo River. The sides of the southern ridgeline slope to the southeast towards Weston Creek and to the northwest into a gully line between the southern and northern ridgeline. The southern face of the northern ridgeline falls to the southeast into the latter gully line whilst the north face falls into Holdens Creek.

The gradient of the ridgelines increases as they progress to the northeast towards the river corridor.

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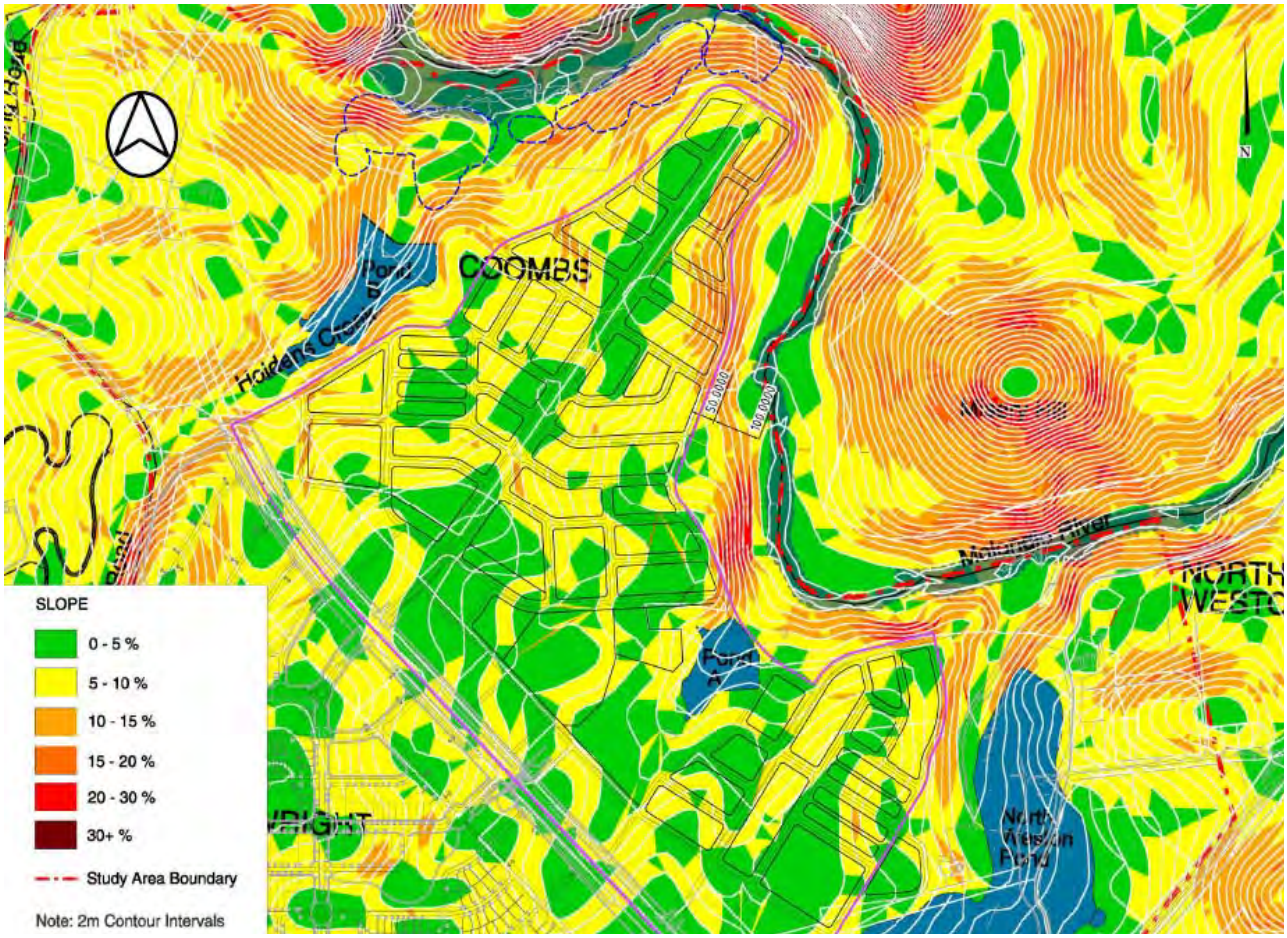
2.4.2 Beyond the Development Precinct.

The land to the north of the development precinct, within the northern portion of the Coombs/Wright precinct, rises to the northwest beyond the Holdens Creek corridor.

Land to the northeast of the Coombs development precinct, within the Molonglo River corridor forms the steep, rocky side of the river. Gradients exceed 20% in most locations, with slopes in excess of 30% common.

The land to the south of the Coombs development precinct falls to the south towards the suburb of Holder into a watercourse that flows to the east into Weston Creek. The land to the southwest, within the new suburb of Wright, rises to the southwest to a low knoll at 595 metres, adjacent to Uriarra Road, before falling to the northwest towards Holdens Creek, rising to the west and northwest towards the foot-slopes of Stromlo Mountain.

Figure 2 – Topographic Map.



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2.5 Vegetation within the Development Precinct.

The vegetation within the ACT Forests section of the development precinct consists of regrowth Pinus Radiata, weeds and grass whilst the former grazing land within the northern portion of the development precinct contains grassland which is still being grazed.

2.6 Vegetation on adjoining lands.

(a) Northwest [within the future suburb of Coombs & Wright North]

At the time of the site inspection the vegetation to the northwest of the Coombs development precinct, north from Holdens Creek, consisted of grassland whilst the vegetation within the future suburb of Coombs/Wright consisted partly of grazed grassland and partly regrowth Pinus Radiata, weeds and grass.

(b) South [Open Space between Holder & Cotter Road]

The Open Space to the east of Stromlo Village contains an area of vegetation replanting which includes a number of tree species.

(c) Southwest [within the suburb of Wright]

The suburb of Wright presently contains grassland and regrowth Pinus Radiata and weeds. This vegetation will be removed/modified as part of the development of this suburb.

(c) Northeast [within the Molonglo River corridor]

At the time of the site inspection the eastern portion of the Molonglo River corridor, being that part of the corridor previously forming part of the Stromlo Forest, contained a mixture of River Sheoak, remnant woodland species and introduced species such as Willow, Liquid Amber and Flame Trees with a dense weedy understorey. That part of the corridor which was part of the former grazing lease contains pockets of River Sheoak on the floodplain of the river with woodland being the dominant species on the steeper land.

The former grazing land contains grasses and the river corridor is relatively free of the introduced species found in the corridor to the south.

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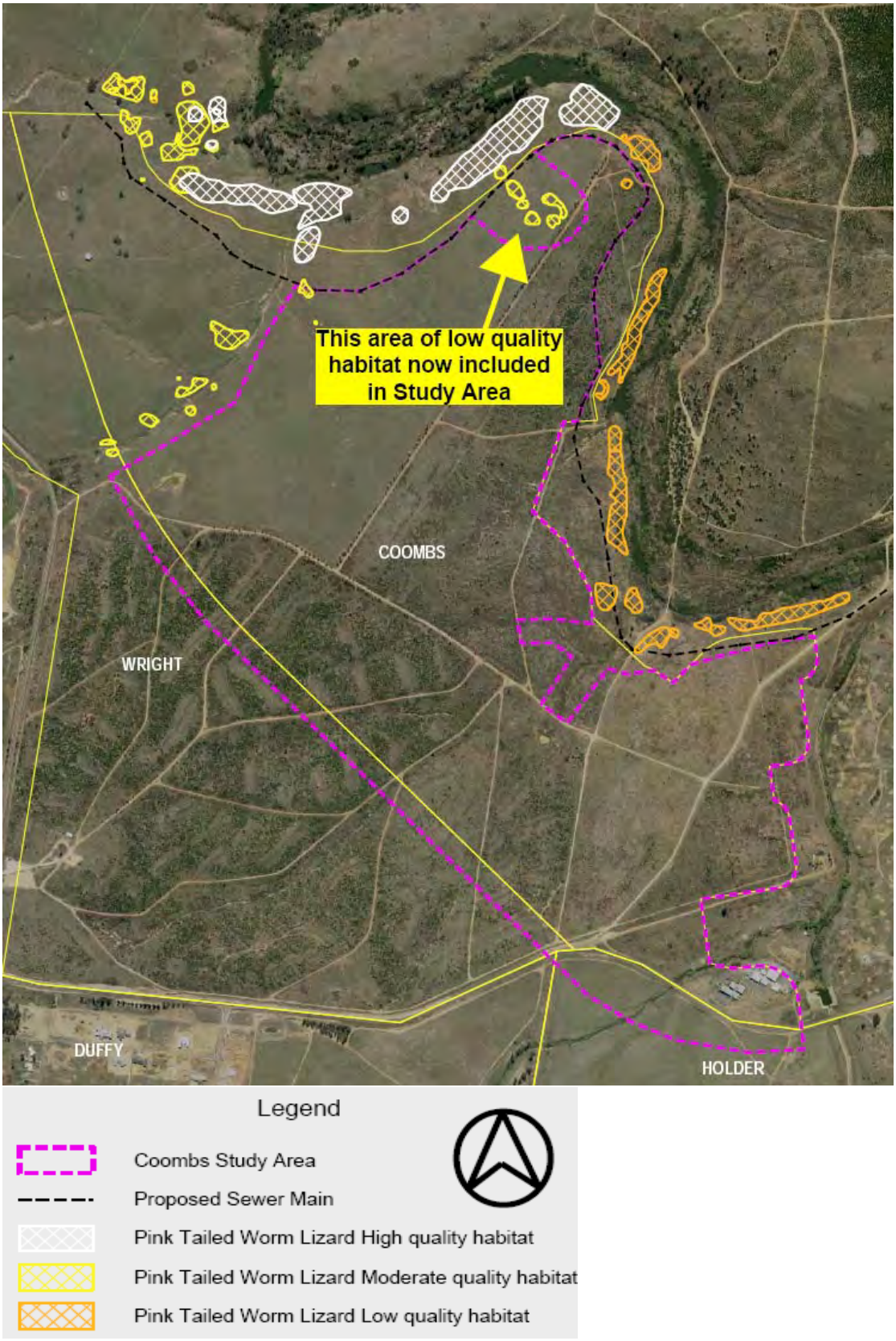
Figure 3 – Plan of Coombs and the Pink Tailed Worm Lizard Habitat - prepared by the University of Canberra [July 2009] for the proposed Molonglo Trunk Sewer.



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Note:
The *'Assessment of Pink-tailed worm lizard [Aprasia parapulchella] habitat'* prepared by the University of Canberra [July 2009] for the proposed Molonglo Trunk Sewer, reports:

'A large, and regionally important, population of Pink-tailed Worm-lizards occurs in the Molonglo Valley from near Western Creek to the confluence with the Murrumbidgee River. Much of the better habitat forms an important wildlife corridor along the southern and northern slopes of the Molonglo River'.

The indent in the north-western edge of Coombs represents an area of medium PTWL Habitat which was originally excluded from development as a result of the UC Assessment for the Trunk Sewer. This area has been downgraded to low value habitat and is now included as part of the urban area.

The *Molonglo Riparian Strategy* for Coombs & North Weston has also identified the extent of areas in the river corridor which are recommended for rehabilitation and re-vegetation as a habitat / riparian corridor. This rehabilitation intends to remove weeds and introduced species and to replant with River Sheoak and woodland/forest in order to replicate the original river corridor vegetation.

Figure 4 – Landuse Diagram provides the extent of the river corridor and its' relationship to the adjoining suburb.

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Figure 4 – Wright/Coombs Master Plan [December 2009] showing extent of the Molonglo River open space corridor.

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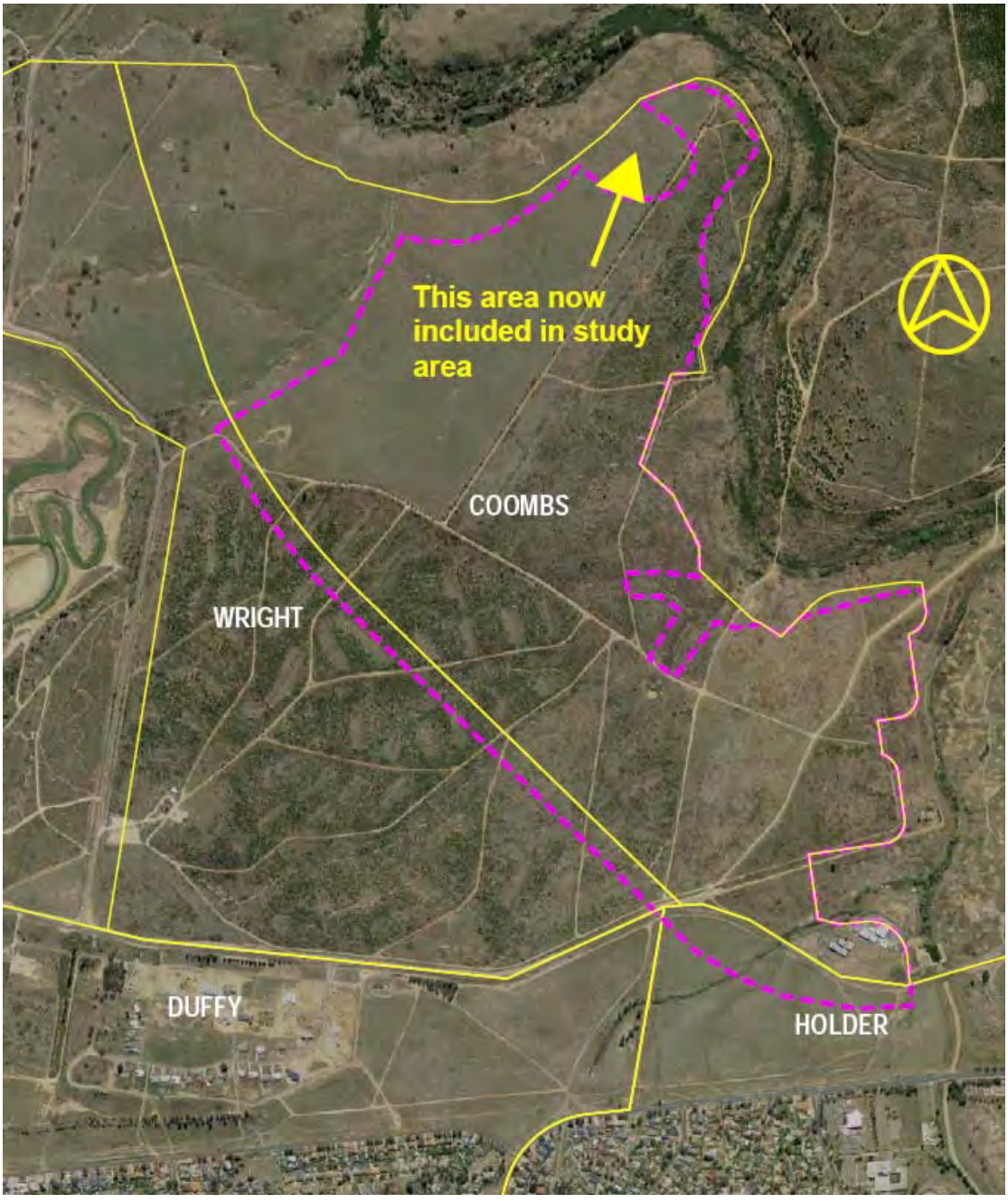
Figure 5 – Aerial Photograph of Coombs development precinct and surrounding lands.



Legend

Coombs Study Area

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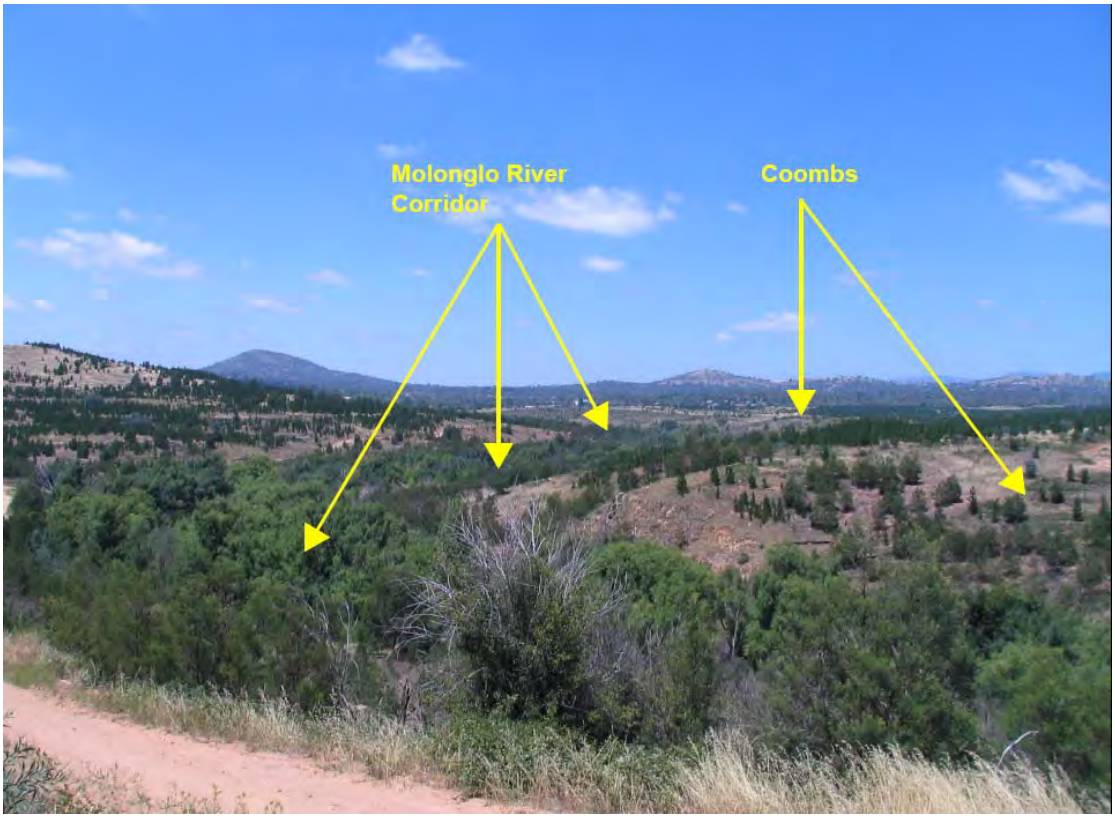
2.7 Site Photographs

Photograph No. 1 - Photograph taken from Misery Point looking southwest across Coombs to Wright – Narrabundah Hill in the background.



Photograph No. 2 - Photograph taken from the fire trail south of Misery Point looking southeast along the Molonglo River corridor.

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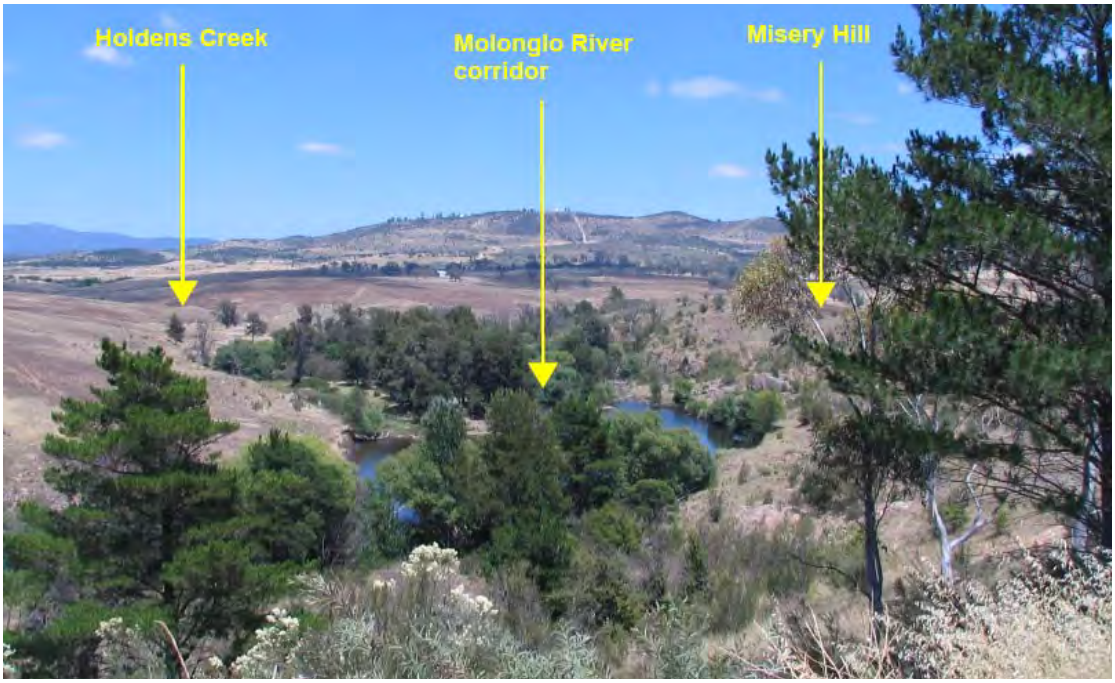
Photograph No. 3 - Photograph taken from fire trail south of Misery Point looking southwest across the Molonglo River corridor to the northern ridgeline within the Coombs development precinct – Narrabundah Hill is in the background.



Photograph No. 4 - Photograph taken from fire trail south of Misery Point looking southwest across the Molonglo River corridor to the northern ridgeline within the Coombs development precinct – Mt Stromlo is in the background.

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SECTION 3
REVIEW OF BUSHFIRE RISK ASSESSMENT

3.1 Introduction.

The Bushfire Risk Assessment undertaken by ABPP in April 2010 examined the various matters which assist in the determination of bushfire risk to future development within the new suburb of Coombs. A precise of this assessment is provided in Sections 3.2 – 3.6.

Note: The indent in the north-western edge of Coombs represents an area of medium PTWL Habitat which was originally excluded from development. This area has now been downgraded to low value habitat and is now included as part of the urban area.

3.2 Fire Paths.

The land within the river corridor, southeast from the northern ridgeline, forms the steep, rocky embankment to the River. Gradients increase to more than 25% on the steeper sections of the corridor, decreasing as the corridor turns to the northeast where it meets Weston Creek. The upslope fire path along the river, under north-westerly winds influences, will also be affected by the wind turbulence created by the shape of the river.

Figure 5 – Severe Weather Fire Paths – Northwest.

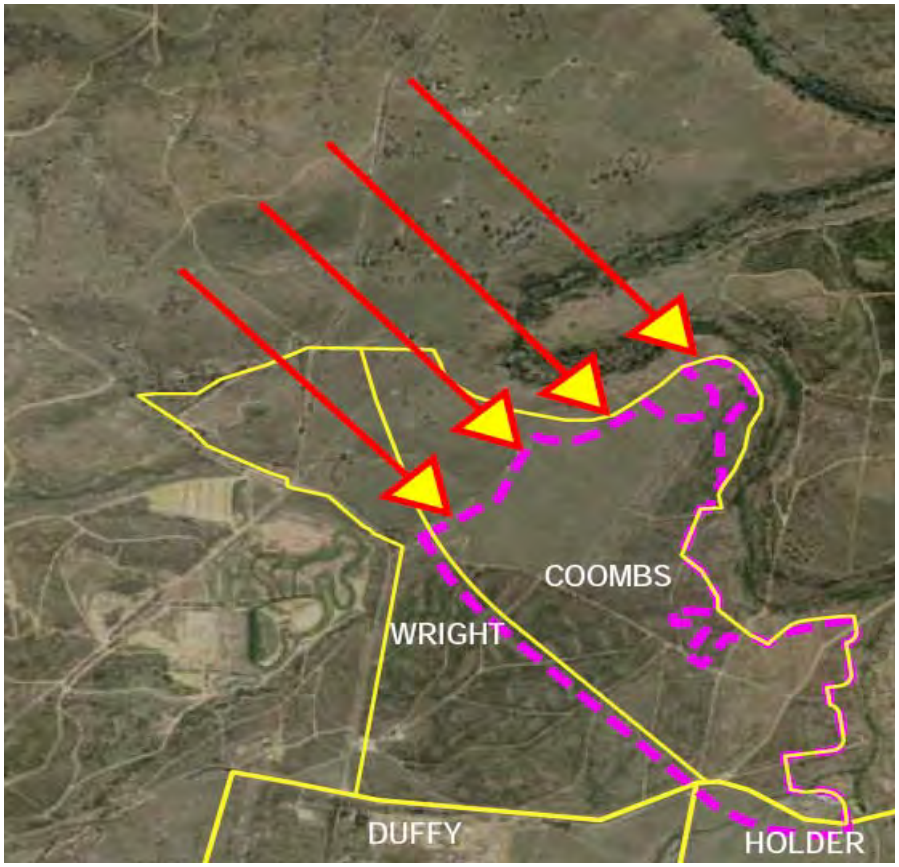

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Figure 6 – Severe Weather Fire Paths – West.

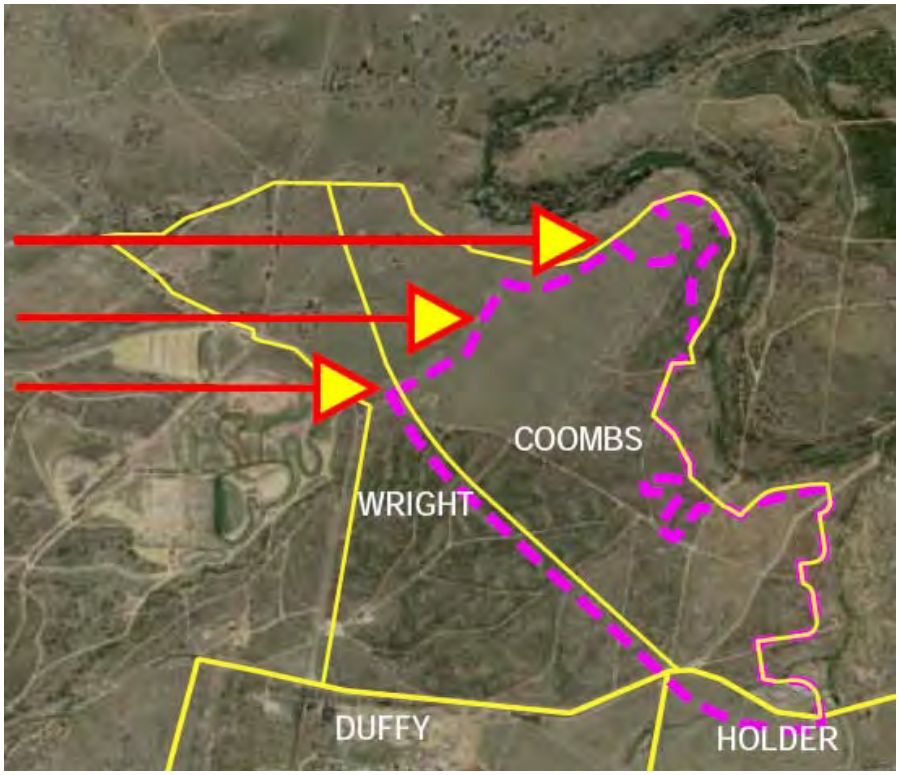

Figure 7 – Severe Weather Fire Paths – North.

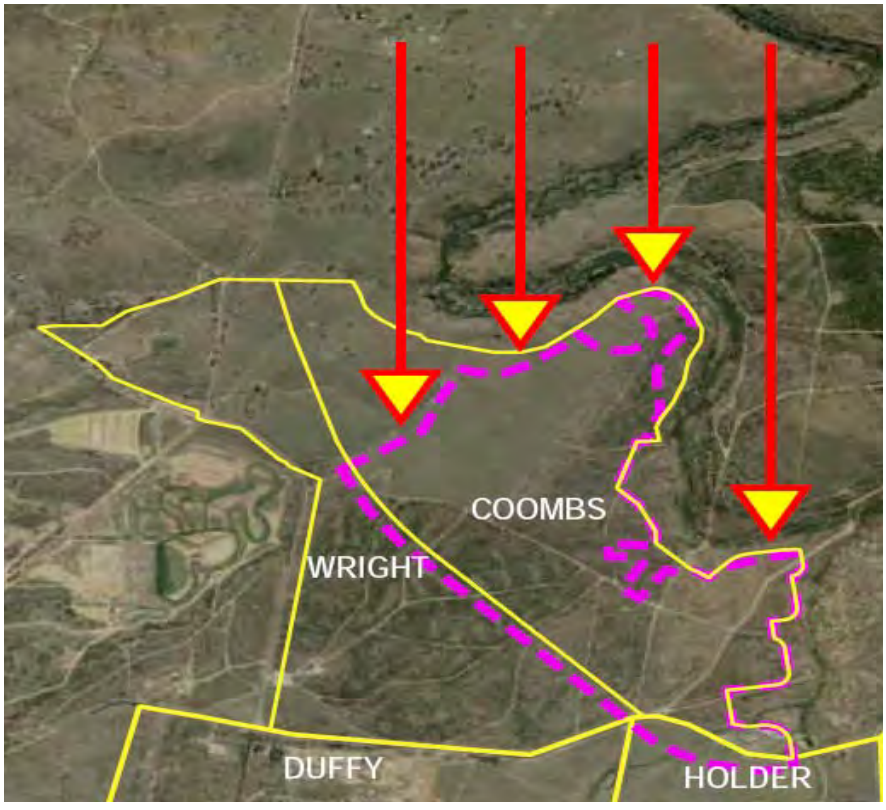

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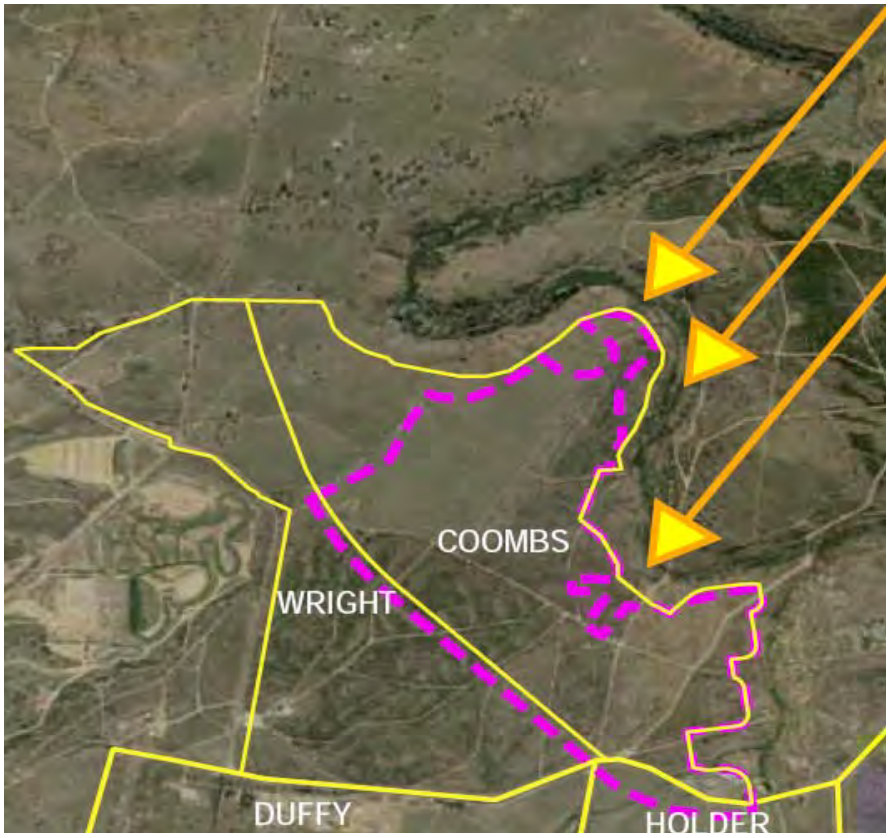
Figure 8 – Moderate Weather Fire Paths – Northeast.



3.3 Assessment of Fuel Hazard.

An overall Fuel Hazard for vegetation within the grazing land to the north, the 'woodland/forest' vegetation within the Molonglo River corridor to the northeast can be determined, from an assessment of the contributing fuel hazards.

The predominant vegetation that will create the most significant fire impact on the Coombs development precinct will be the grassland / woodland vegetation on the land to the north and the woodland/forest vegetation in the riparian corridor to the Molonglo River.

3.3.1 *Forest/Woodland vegetation within the riparian corridor to the Molonglo River.*

Using the methodology provided within the NRE Overall Fuel Hazard Guide, the following Fuel Hazard observation was determined for the Forest/Woodland vegetation in the riparian corridor to the Molonglo River.

- ***Bark Hazard*** **:**

The Forest/Woodland vegetation in the rehabilitated riparian corridor will include planted Eucalypt species some of which have a smooth trunk and long ribbons of bark into the crown of the tree. Therefore this vegetation has a High Bark hazard.

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- ***Elevated Fuel Hazard*** **:**

Elevated fuel comprises shrub, heath and suspended material. The level of hazard depends on the fuel continuity (horizontal and vertical), height, and proportion of dead material, thickness of the foliage and twigs and flammability of the live foliage.

The flammability of the elevated fuel is highest when:

- The foliage, twigs and other fuel particles are very fine (e.g. maximum thickness 1-2 mm);
- The proportion of dead material is high;
- The fuels are arranged with a high level of density and horizontal and vertical continuity that promotes the spread of flame;
- The live foliage has low, live fuel moisture content.

The vegetation type and time lapse since the most recent fire substantially determines the level of elevated fuel hazard. An estimated Elevated Fuel Hazard of Very High is likely to occur in the river corridor as part of the rehabilitation process.

- ***Surface Fine Fuel Hazard*** **:**

Surface Fine Fuel Hazard is assessed by measuring litter-bed height. Near surface fuels – i.e. grass tussocks, dead bracken, low shrubs or low wiregrass up to 0.5m high – interact with surface litter to increase fire behaviour and therefore need to be considered when assessing Surface Fine Fuel Hazard and the next highest Surface Fine Fuel Hazard rating.

Due to the extent of the 'near-surface fuels' component of this vegetation an estimated Surface Fine Fuel Hazard of High was determined for this vegetation.

Assessment of Overall Fuel Hazard – Forest/Open Woodland Vegetation:

The Overall Fuel Hazard for the Forest/Woodland vegetation within the river corridor [without management] is Very High.

3.4 Asset Interface Classification [AIC].

The ACT ESA & Rural Fire Service have developed a methodology for determining the classification of potential exposure of the urban edge to severe bushfires and introduces Asset Interface Classification [AIC], which is defined as the boundary between an asset and the bushfire paths that approach it. It is determined by an assessment of:

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- The maximum fire size an asset may be subject to;

- The part of the fire [head, flank, back] an asset maybe subject to recognizing the major fire threat from the north and west;

- The fire run length criteria and the length of fire run.

The following table provides an Asset Interface Classification [AIC], at a broader scale for the urban edge of Canberra;

Table 1: Asset Interface Classification

	Length of Fire Run to Asset Interface (through unmanaged vegetation)		
Aspect of Fire Run	<100	100 – 350	>350
N	**Secondary**	**Primary**	**Primary**
NW	**Secondary**	**Primary**	**Primary**
W	**Secondary**	**Primary**	**Primary**
SW	**Lee**	**Secondary**	**Primary**
S	**Lee**	**Secondary**	**Secondary**
SE	**Lee**	**Lee**	**Lee**
E	**Lee**	**Lee**	**Secondary**
NE	**Lee**	**Lee**	**Secondary**

An examination of the Asset Interface Classification at a precinct level for the Coombs estate identifies that the northern, north-western and western aspects of the development precinct have a primary classification – based on the vegetation in the Stromlo Forest Park, the Open grassy Woodland vegetation on the land to the northwest of Holdens Creek and the Woodland vegetation within the Molonglo River corridor not being managed, in order to reduce the fuel hazard.

The AIC to the north-eastern aspect of Coombs is secondary – based on potential unmanaged vegetation on the land to the northeast of the river corridor whilst the AIC to the south, from the vegetation in the corridor between Cotter Road and Holder, if the vegetation is not managed, is 'Secondary'.

3.5 Likely Fire Scenarios.

The following fire scenarios have been identified as a probability for impact on the development site:

Fire Scenario No. 1:

A fire in the open grassy woodland vegetation on the former leased land to the northwest of the development precinct and northwest of Holdens Creek, spreading under north-westerly winds towards the northern edge of Coombs. This potential fire impact will remain if the current management practices are removed or are not effective during periods of growth in the grass/woodland vegetation.

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This fire occurrence is likely during consecutive fire seasons when conditions are such that the grassland vegetation has not been grazed/managed and the Fire Danger Index is Extreme (FDI > 50);

Fire Scenario No. 2:

A fire in the Forest/Woodland vegetation within the Stromlo Forest Park to the west of the suburb of Wright, spreading across Uriarra Road and the Holdens Creek corridor towards the north-western edge of Wright and Coombs.

This potential fire impact will remain so long as the Stromlo Forest Park development project does not proceed to the extent as shown on the Master Plan. The risk remains that the management of re-vegetation of the Stromlo Forest Park will not address the provision of a fuel managed vegetation community to the west and northwest of the new suburb of Wright and with a resulting impact on the north-western corner of Coombs.

Should the Stromlo Forest Park not be managed to mitigate the potential fire paths from the west and northwest, the potential for fire impact on the north-western corner of Wright, spreading into the Holdens Creek corridor towards Coombs is almost certain during any fire season when conditions are such that fine fuel levels are allowed to exceed maximum fuel weights for manageable fires and the FDI extends 50. The inter-fire period for major fire occurrence would be 5 - 8 years, depending on fuel management intervals and potential ignition sources of the fuel.

Fire Scenario No. 3:

A fire in the Forest/Woodland in the Molonglo River riparian corridor / PTWL Habitat spreading along the river to the southeast, under a north-westerly wind influence.

This potential fire impact will remain so long as the chance exists that ignition can occur in the area of Misery Point [& further to the north], spread by ember attack to the southern bank of the bend in the river, running upslope to the development edge as it progresses towards Weston Creek and North Weston. This fire will also spread through any unmanaged vegetation on the north-eastern side of the river towards the Australian Defence College and Tuggeranong Parkway.

Fire Scenario No. 4:

A fire occurrence in the unmanaged re-growth Pinus Radiata forest to the northeast of the Molonglo River corridor, spreading under northeast wind influences towards the north-eastern edge of the new suburb of Coombs.

This fire scenario will result in fire spreading downslope to the river. Should embers spread the fire across the river the fire will continue to spread rapidly upslope to the north-eastern edge of Coombs.

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This potential fire impact will remain so long as the land between the river corridor and the Arboretum remains unmanaged and/or undeveloped and weather conditions prevail where a fire can spread to the southwest under the influence of north-easterly winds.

Fire Scenario No. 5:

A fire occurrence in the vegetated corridor between Cotter Road and the suburb of Holder, east from Stromlo Village to Streeton Drive, spreading from the south under south-easterly winds.

This potential fire impact will remain if the vegetation in the corridor is not managed during the bushfire danger period and ignition occurs during wind changes to the southeast.

3.6 Risk Statement.

Table 2 provides a list of qualitative measures of consequence [or impact] whilst Table 3 provides a list of qualitative measures of likelihood – used to determine the level of risk in Table 5. Table 4 provides a qualitative risk analysis matrix – used to determine the level of risk in Table 5.

Table 5 provides a statement of risk for each fire scenario that may impact the Coombs estate [prior to mitigation measures being adopted/implemented] and assigns risk levels reflecting identified levels of likelihood and consequences for a 'worst case' fire occurrence which may occur if the vegetation on the land to the north, northwest, west and in the Molonglo River corridor were not managed to reduce the combustible fuels available to burn during severe fire weather conditions.

Table 2 – Qualitative Measures of Consequence or Impact.

Level	Descriptor	Detail Description
1	Insignificant	No public safety injuries or impact to buildings
2	Minor	No public safety injuries – minor impact to buildings
3	Moderate	Burns and Respiratory Issues – moderate damage to buildings
4	Major	Death of people exposed to radiant heat & major property damage
5	Catastrophic	Death of people exposed to radiant heat and total destruction of buildings

Table 3 – Qualitative Measures of Likelihood.

Level	Descriptor	Detail Description
A	Almost Certain	Is expected to occur during severe fire danger periods
B	Likely	Will probably occur during severe fire danger periods
C	Possible	May occur during severe fire danger periods
D	Unlikely	Unlikely to occur during severe fire danger periods
E	Rare	Will rarely occur during severe fire danger periods

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Table 4 – Qualitative risk analysis matrix.

Likelihood	Risk Rating / Consequences				
	Insignificant 1	Minor 2	Moderate 3	Major 4	Catastrophic 5
A – almost certain	High	High	Extreme	Extreme	Extreme
B – likely	Moderate	High	High	Extreme	Extreme
C – possible	Low	Moderate	High	Extreme	Extreme
D – unlikely	Low	Low	Moderate	High	Extreme
E – rare	Low	Low	Moderate	High	High

Table 5 – Bushfire Risk Register – Severe Bushfire Event – if high levels of combustible fuels/unmanaged vegetation exist in the landscape.

The Risk What can happen? Fire Scenario:	The consequences of an event happening Consequences	Likelihood	Adequacy of existing protection measures	Consequence Rating	Likelihood Rating	Level of Risk	Risk Priority
(1) Fire burning in unmanaged open grassy woodland to the north of Coombs – under north-westerly wind influences	Catastrophic – long fire run through unmanaged vegetation	Almost Certain	Good when site inspection undertaken Nil if current fuel management is modified	5	A	Extreme	1
(2) Fire burning in the Woodland / Forest vegetation in the Stromlo Forest Park, to the west of Wright/Coombs – under NW, westerly winds	Catastrophic – long fire run through unmanaged vegetation	Almost Certain	No fuel management present at the time of site inspection	5	A	Extreme	1
(3) Fire burning in the Molonglo River corridor – under the influence of north-westerly winds	Catastrophic – long fire run through unmanaged vegetation	Almost Certain	No fuel management present in un-grazed section of corridor at time of site inspection	5	A	Extreme	1
(4) Fire burning in the re-growth Pinus Radiata Forest vegetation on the land to the northeast of Coombs – under NE winds	Major – long fire run through unmanaged vegetation	Likely	No fuel management present at the time of site inspection	4	B	Extreme	1
(5) Fire burning in the vegetation between Cotter Road and the suburb of Holder – under SE winds	Major – long fire run through unmanaged vegetation	Possible	In adequate fuel management present at time of site inspection	4	C	High	1

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3.7 Summary of Bushfire Risk.

Fire Scenario No. 1:

Fire ignitions that occur in the open grassy woodland vegetation on the land to the north of Holdens Creek, if the current management practices are removed, will place the northern edge of Coombs at extreme level of risk from a northerly and north-westerly wind driven fire.

[Whilst the south-westerly aspect of Coombs is currently exposed to unmanaged vegetation in the future suburb of Wright and therefore an extreme level of risk, the current development works associated with the construction of the arterial road reduces bushfire risk. The removal of the existing Pinus Radiata regrowth vegetation and development works within the suburb of Wright will remove the bushfire risk to the southwest of Coombs].

Fire Scenario No. 2:

The development and management of the Stromlo Forest Park is not certain, relative to the commencement of construction of dwellings within the new suburbs of Wright & Coombs, and therefore the risk assessment has determined that the risk to the north-western corner of Wright, and therefore Holdens Creek and Coombs, is extreme during a fire event which spreads through the re-growth forest vegetation on the land northwest of the northern edge of Wright and Coombs, under the influence of north-westerly winds.

Fire Scenario No. 3:

The incorporation of a vegetated habitat/riparian corridor within the Molonglo River corridor and the potential for this vegetation not to be managed to reduce the bushfire hazard provides a 'wick' for the passage of fire along the river corridor during strong north-westerly winds.

If ignition occurs, through ember attack or by accidental or deliberate acts, the risk to the future residents located in dwellings adjacent to the river corridor is extreme, with potential fire over-run from the corridor to the proposed residential and existing development in North Weston.

The future development of the suburbs to the north of Coombs will not reduce the level of risk from a fire occurrence in the river corridor as the chance exists that the vegetation along the river, north of Misery Point will create a fire with sufficient potential to spread rapidly, under north-westerly winds, across Misery Point and burn upslope, across the PTWL Habitat, towards the residential development in Coombs – this fire event would also continue to spread to the southeast, along the corridor, being influenced by the turbulence created by the shape of the river corridor.

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Fire Scenario No. 4:
The existence of the re-generating Pinus Radiata Forest on the land to the northeast of the river corridor, northeast of the new suburb of Coombs presents an extreme level of risk to the north-eastern edge of the suburb – should a fire burn towards the river from the northeast, under a north-easterly wind influence.

Should this fire event occur, the fires advance would be slowed by the downslope fire path to the river, however if ember ignition occurs on the south-western bank of the river, this fire event has the potential to burn rapidly upslope through any unmanaged vegetation adjoining the residential development.

Fire Scenario No. 5:
The vegetation on the land between Cotter Road and the suburb of Holder, south of the southern end of the new suburb of Coombs has sufficient width [> 350m] to be accessed as having a 'Primary' Asset Interface Classification [AIC].

However, this vegetation is 'land locked' and will only present a threat if ignition occurs during periods of south-easterly wind influences. The risk has been assessed as high should management of the vegetation not be sufficient to reduce the bushfire hazard in this corridor.

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SECTION 4

REVIEW OF BUSHFIRE MANAGEMENT OPTIONS FOR THE APRASIA HABITAT

4.1 Introduction.

The *Land Development Agency* has prepared three options for the layout of the proposed development of the north-eastern corner of the new suburb of Coombs, adjacent to the Aprasia [Pink-tailed Worm Lizard] Habitat confirmed by Wong & Osborne [University of Canberra 2010].

These options have been determined given the advice from the ESA that the required width of the bushfire protection zones required to address the bushfire risk to the north-western aspect of the suburb of Coombs is the provision of a 50 metre wide Inner Asset Protection Zone [IAPZ] with a 100 metre wide Outer Asset Protection Zone [OAPZ] – a total fire protection zone of 150 metres, measured from the north-western boundary of the future blocks.

The Ember Zone/Construction standards to the future buildings remain as recommended in the April 2010 *Bushfire Risk Assessment Report* prepared by ABPP.

Option 1 – Pink-tailed Worm Lizard habitat and the **20 metre wide habitat buffer zone excluded from bushfire protection measures.**

The Molonglo River corridor [including PTWL medium/high quality habitat and 20 metre wide habitat buffer zone] is not managed for bushfire fuel reduction and a minimum 150 metre wide bushfire protection zone [OAPZ + IAPZ] is provided between the buffer zone to the medium/high quality PTWL habitat and the future development [a total of 170 metre wide separation to the PTWL medium/high quality habitat.

Option 2 – Pink-tailed Worm Lizard medium/high quality habitat excluded from bushfire protection measures with the **20 metre wide buffer zone to the medium/high quality habitat included as part of the bushfire protection zone.**

The Molonglo River corridor [including PTWL medium/high quality habitat] is not managed for bushfire fuel reduction and a minimum 150 metre wide bushfire protection zone [OAPZ + IAPZ] is provided between the PTWL medium/high quality habitat and the future development [a total of 150 metre wide separation to the PTWL medium/high quality habitat.

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Option 3 – Pink-tailed Worm Lizard medium/high quality habitat **and the 20 metre wide habitat buffer zone to the medium/high quality habitat**, is included as part of the bushfire protection zone to the northwest of the future development.

The Molonglo River corridor is not managed for bushfire mitigation and a minimum 150 metre wide buffer [OAPZ + IAPZ] is provided to the northwest of the future development, including the buffer zone and PTWL medium/high quality habitat.

Refer to Option 1, 2 & 3 layouts on following pages.

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