ACT Government
Transport Canberra and City Services

FREEDOM OF INFORMATION COVERSHEET

The following information is provided pursuant to section 28 of the *Freedom of Information Act 2016*.

FOI reference: TCCSFOI 21-043

Information to be published	Status
1. Access application	Published
2. Decision notice and schedule	Published
3. Documents	Published
4. Additional information identified	n/a
5. Fees	n/a
6. Processing time (in working days)	20 days
7. Decision made by Ombudsman	n/a
8. Additional information identified by Ombudsman	n/a
9. Decision made by ACAT	n/a
10. Additional information identified by ACAT	n/a

From: [redacted]
To: TCCS_FreedomOfInformation
Cc: [redacted]
Subject: FOI REQUEST - THARWA DRIVE
Date: Wednesday, 12 May 2021 4:19:00 PM
Attachments: image002.png

Good afternoon,

RE: FOI REQUEST – THARWA DRIVE TRAFFIC INVESTIGATION

I write to request under the *Freedom of Information Act 2016* any documentation related to the Tharwa Drive traffic investigation.

I ask that my request be transferred to other entities that may hold relevant documents.

Duplicate documents may be excluded.

Should you require any further information or clarification about my request, please contact my office on [redacted].

Kind regards,

[redacted]

ACT Government
Transport Canberra and City Services

[redacted]

Dear [redacted]

Freedom of Information Request - Reference 21-043

I refer to your application for access to government information received by Transport Canberra and City Services (TCCS) on 12 May 2021 under the *Freedom of Information Act 2016* (FOI Act) seeking the following government information:

> *Any documentation related to the Tharwa Drive and Lawrence Wackett Crescent intersection traffic study.*

Through conversations with your office, the scope of the access application was refined on 24 May 2021 to include the study only.

I am an Information Officer appointed by the Director-General under section 18 of the Act to deal with access applications made under Part 5 of the FOI Act.

A decision on your application is due by 10 June 2021.

Decision on access
In accordance with the FOI Act, a search was conducted of records held by TCCS. This search identified one record and its appendices as relevant to your request. In reviewing the information within this document, I have found it contrary to the public interest to disclose some information. As such, I have decided to provide you with partial access to this government information. My reasons for this decision are detailed in the statement of reasons below.

Statement of Reasons
In making my decision on disclosing government information, I must identify all relevant factors in schedule 2 of the FOI Act and determine, on balance, where the public interest lies. In reaching my access decision, I have taken the following into account:

Factors favouring disclosure in the public interest (Schedule 2, Section 2.1)

- Section 2.1(a)(i) - promote open discussion of public affairs and enhance the government's accountability;
- Section 2.1(a)(iii) - inform the community of the government's operations, including the policies, guidelines and codes of conduct followed by the government in its dealings with members of the community;
- Section 2.1(a) (xi) - reveal environmental or health risks or measures relating to public health and safety; and

- Section 2.1(a)(viii) - reveal the reason for a government decision and any background or contextual information that informed the decision.

Factors favouring non-disclosure (Schedule 2, Section 2.2)

- Schedule 2.2(a)(ii) - prejudice the protection of an individual's right to privacy or any other right under the *Human Rights Act 2016.*
- Schedule 2.2(a)(iii) -prejudice security, law enforcement or public safety.
- Schedule 2.2(a)(xi) -prejudice trade secrets, business affairs or research of an agency or person.
- Schedule 2.2(a)(xii) - prejudice the competitive commercial activities of an agency.

I consider that it is in the public interest to release most of this information. However, in some instances, I have found that the disclosure of some information to be contrary to the public interest.

Personal information and privacy

Personal information means information or an opinion whether true or not about an individual whose identity is apparent or can be ascertained from the information or opinion. The *Information Privacy Act 2014* prescribes how government collects, uses, shares, and stores this information.

I have considered the reason that TCCS has come into the possession of the personal or sensitive information together with the Territory Privacy Principles. As a general rule an agency that holds personal or sensitive information about an individual that has been collected for a particular purpose must not disclose the information to a third party without consent (*Information Privacy Act 2014* - Territory Privacy Principle 6).

I have further found that disclosing this information is likely to prejudice an individual's right to privacy or any other right under the *Human Rights Act 2004.*

In this instance I have found that, on balance, the disclosure of the personal or sensitive information is contrary to the public interest.

Public safety

The drawings within pages 60 – 63 and 666 detail underground utility services. I have found that the disclosure of this information could prejudice the security of the asset and therefore prejudice public safety. For this reason, I have found that the disclosure of the location of underground utility services to be contrary to the public interest.

Business affairs

In reviewing the report and appendices, I have identified information relating to third party's business methodology. I have found that the disclosure of this information is likely to prejudice their business affairs and, on balance, find that it is contrary to the public interest to disclose.

Competitive commercial activities

I have also identified cost estimates which are influential to future procurement negotiations. I have found that the disclosure of this information is likely to prejudice the competitive commercial activities of TCCS and are therefore contrary to the public interest to disclose.

A copy of the information, with deletions applied to information which is contrary to the public interest, is enclosed at Attachment B.

Charges

Pursuant to *Freedom of Information (Fees) Determination 2018* processing charges are applicable for this request because the total number of pages to release to you exceeds the charging threshold of 50 pages. However, the charges have been waived in accordance with section 107(2)(e) of the Act.

Online publishing – disclosure log

Under section 28 of the Act, TCCS maintains an online record of access applications called a disclosure log. Your original access application, my decision and documents will be published in the TCCS disclosure between 3 – 10 business days from the date of this decision.

Your personal contact details will not be published. You may view the TCCS' disclosure log at https://www.cityservices.act.gov.au/about-us/freedom_of_information/disclosure-log .

Ombudsman review

My decision on your access request is a reviewable decision as identified in Schedule 3 of the Act. You have the right to seek an Ombudsman review of this outcome under section 73 of the Act within 20 working days from the day that my decision is published in TCCS' disclosure log or a longer period allowed by the Ombudsman.

If you wish to request a review of my decision, you may write to the Ombudsman at:

The ACT Ombudsman
GPO Box 442
CANBERRA ACT 2601
Via email: actfoi@ombudsman.gov.au

ACT Civil and Administrative Tribunal (ACAT) review

Under section 84 of the Act, if a decision is made under section 82 on an Ombudsman review, you may apply to the ACAT for review of the Ombudsman decision.

Further information may be obtained from ACAT at:

ACT Civil and Administrative Tribunal
Level 4, 1 Moore Street
GPO Box 370
CANBERRA CITY ACT 2601
Telephone: (02) 6207 1740
www.acat.act.gov.au

If you have any queries concerning the directorate's processing of your request, or would like further information, please contact the TCCS FOI team on (02) 6207 2987 or email to tccs.foi@act.gov.au.

Yours sincerely



Kristine Scheul
Information Officer

9 June 2021

FREEDOM OF INFORMATION REQUEST SCHEDULE

Please be aware that under the *Freedom of Information Act 2016*, some of the information provided to you will be released to the public through the ACT Government's Open Access Scheme. The Open Access release status column of the table below indicates what documents are intended for release online through open access.

Personal information or business affairs information will not be made available under this policy. If you think the content of your request would contain such information, please inform the contact officer immediately.

Information about what is published on open access is available online at: https://www.tccs.act.gov.au/about-us/freedom_of_information/disclosure-log

Factors favouring non-disclosure:

Schedule 2.2(a)(ii) - prejudice the protection of an individual's right to privacy or any other right under the *Human Rights Act 2016.*

Schedule 2.2(a)(iii) -prejudice security, law enforcement or public safety.

Schedule 2.2(a)(xi) -prejudice trade secrets, business affairs or research of an agency or person.

File number	WHAT ARE THE PARAMETERS OF THE REQUEST
FOI – 21-043	**Tharwa Drive traffic investigation**

Ref No	Page numbers	Description	Date	Status	Reason for non-release or deferral	Open Access release status
1	**1 - 52**	Tharwa Drive Duplication Feasibility Study and Concept Design (Draft)	19 February 2021	Partial access	Schedule 2.2(a)(ii)	Documents to be published on the TCCS Disclosure Log.
2	**53 - 63**	Appendix A - Topographic Survey and Utility Tracing	October 2020	Partial access	Schedule 2.2(a)(ii) Schedule 2.2(a)(iii)	
3	**64 - 94**	Appendix B - Geotechnical Investigation	15 February 2021	Partial access	Schedule 2.2(a)(ii)	
4	**95 - 639**	Appendix C - Traffic Assessment (business affairs)		Partial access	Schedule 2.2(a)(ii) Schedule 2.2(a)(xi)	

5	**640 -750**	Appendix D - Environmental Assessment (personal information)	9 December 2020	Partial access	Schedule 2.2(a)(ii) Schedule 2.2(a)(iii)	
6	**751 -768**	Appendix E - Tree Assessment Report	November 2020	Partial access	Schedule 2.2(a)(ii)	
7	**769 - 822**	Appendix F - Noise Assessment	December 2020	Partial access	Schedule 2.2(a)(ii)	
8	**823 - 843**	Appendix G - Drawings	November 2020	Partial access	Schedule 2.2(a)(ii)	

Tharwa Drive Duplication Feasibility Study and Concept Design

Prepared for IDPG on behalf of TCCS

19 February 2021

Calibre Professional Services Pty Ltd
55 070 683 037



QUALITY ASSURANCE STATEMENT

TASK	NAME	SIGNATURE
Project Manager	[redacted]	
Prepared by		
Reviewed by		
Approved for Issue by		

DOCUMENT CONTROL

ISSUE	DATE	ISSUE DETAILS	AUTHOR	CHECKED	APPROVED
A	19/02/2021	First Issue	[redacted]		

20-000580 Tharwa Drive Feasibility Study And Concept Design - Design Options Study Report.Docx

COMMERCIAL IN CONFIDENCE

This document including any intellectual property is confidential and proprietary to Calibre and may not be disclosed in whole or in part to any third party nor used in any manner whatsoever other than for the purposes expressly consented to by Calibre in writing. Calibre reserves all legal rights and remedies in relation to any infringement of its rights in respect of its confidential information | © Calibre Group Pty Ltd.

Contents

Executive Summary **1**

1. Introduction **5**
1.1 Background 5
1.2 Tharwa Drive 5
1.3 Project Objectives 6

2. Existing Conditions **7**
2.1 Overview 7
2.2 Alignment 9
2.3 Cross Section 9
2.4 Intersections 10
2.5 Pavement and Delineation 15
2.6 Roadside Environment 15
2.7 Underpasses 19
2.8 Other 20

3. Background Information **21**
3.1 Work-As-Executed Drawings 21
3.2 Knoke Avenue to Johnson Drive Feasibility Study 21
3.3 Tharwa Drive / Drakeford Drive Duplication Design 22

4. Studies and Investigations **23**
4.1 Topographic Survey and Utility Tracing 23
4.2 Geotechnical Investigation 23
4.3 Traffic Assessment 24
4.4 Environmental Assessment 28
4.5 Tree Assessment 29
4.6 Noise Assessment 29

5. Statutory Planning **31**

6. Road Design **32**
6.1 Design Standards and Criteria 32
6.2 Opportunities and Constraints 33
6.3 Upgrade Options for Key Elements 34

7. Multi Criteria Analysis of Options **36**

8. Design Option Outcomes **37**
8.1 Area 01 – Intersection of Tharwa Drive / Woodcock Drive / Box Hill Avenue (north) 37
8.2 Area 02 – Intersection of Tharwa Drive / Norman Lindsay Street 38
8.3 Area 03 – Northern Underpass 39
8.4 Area 04 – Midblock Norman Lindsay Street and Box Hill Avenue (south) 40
8.5 Area 05 – Intersection of Tharwa Drive / Box Hill Avenue (south) 41
8.6 Area 06 – Southern Underpass 42
8.7 Area 07 – Midblock Box Hill Avenue (south) to Pockett Avenue 43
8.8 Area 08 – Intersection of Tharwa Drive / Pockett Avenue / Knoke Avenue 44
8.9 Summary of Recommendations 45

9. Construction **46**
9.1 Staging 46

9.2 Timing 46

10. Opinion of Probable Costs 47

10.1 Cost Estimate Assumptions 47

10.2 Cost Estimate 47

11. Limitations and Further Work 48

11.1 Limitations 48

11.2 Further Design Work 48

Tables

Table 1: Northbound Maximum Hourly Midblock Traffic Volumes 26
Table 2: Southbound Maximum Hourly Midblock Traffic Volumes 26
Table 3: Current Intersection Performance Summary 26
Table 4: 2031 Existing Intersection Performance Summary 27
Table 5: 2041 Existing Intersection Performance Summary 27
Table 6: 2041 Future Intersection Performance Summary - Roundabouts 28
Table 7: 2041 Future Intersection Performance Summary – Traffic Signals 28
Table 8: Design Criteria for Tharwa Drive 32
Table 9: Design Criteria for Intersections 33
Table 10: Design Options Outcome Summary 45

Figures

Figure 1: Preferred Option Plan 3
Figure 2: Project Location 6
Figure 3: Project Features 8
Figure 4: Road Cross Section 10
Figure 5: Woodcock Drive Roundabout 11
Figure 6: Norman Lindsay Street Unsignalised T 12
Figure 7: Box Hill Avenue Roundabout 13
Figure 8: Pockett Avenue Roundabout 14
Figure 9: High Pressure Gas Main in the Eastern Verge 16
Figure 10: Trees in the Corridor 17
Figure 11: Staged Signalised Pedestrian Midblock Crossing 18
Figure 12: Underpass / Floodway Arrangement 19
Figure 13: Arch Profile 21
Figure 14: Underpass Widening WAE 21
Figure 15: Scope of Previous Duplication 22
Figure 16: Territory Plan Overlay 31
Figure 17: Project Areas 36

Appendices

Appendix A Topographic Survey and Utility Tracing
Appendix B Geotechnical Investigation
Appendix C Traffic Assessment
Appendix D Environmental Assessment

Appendix E Tree Assessment
Appendix F Noise Assessment
Appendix G Drawings

Executive Summary

INTRODUCTION

In September 2020, Infrastructure Delivery Partners Group (IDPG) on behalf of Transport Canberra and City Services (TCCS) engaged Calibre to undertake the Tharwa Drive Duplication Feasibility Study and Concept Design.

The project includes the area within the existing Tharwa Drive road reserve between Woodcock Drive and Pockett Avenue intersections. This section of Tharwa Drive is approximately 1.9km long. The two end intersections are included in the scope of the study as are the intermediate intersections of Norman Lindsay Street and Box Hill Avenue.

The objective of this study is to investigate options for the upgrading of Tharwa Drive between Woodcock Drive and Pocket Avenue, to increase safety and efficiency of traffic operations, to provide the required connectivity and address the known congestion issues.

This report covers the Design Options Study Phase of the project.

EXISTING CONDITIONS

The project area is the last section of Tharwa Drive (north-south alignment), through developed urban area yet to be duplicated. The roadway generally comprises of two 3.5m traffic lanes and 1m shoulders each side. The existing roadway is crowned with 3% crossfall. There are no sections with superelevation. The shoulders are sub-standard width for on-road cycling. At intersection approaches and departures there are auxiliary lanes and some sections of central median.

There is continuous kerb each side of the roadway. The verge is a minimum of 4m on the eastern side. There is no formalised verge on the western side, however it appears that some earthworks were undertaken during the original construction to facilitate future duplication.

There are two intersections at the limits of the project and two intermediate intersections. Three of these are roundabouts and the fourth is an unsignalised T intersection.

The intersections from north to south are as follows:

- Intersection 1 – Woodcock Drive.
- Intersection 2 - Norman Lindsay Street.
- Intersection 3 – Box Hill Avenue.
- Intersection 4 – Pockett Avenue.

The posted speed is 60km/h between the Woodcock Drive roundabout to approximately 200m south of Norman Lindsay Street intersection. The remainder of the project is posted 80km/h.

There are two underpasses along the corridor with floodways passing beneath. The northern floodway is directly south of Norman Lindsay Street intersection whilst the southern floodway is directly south of Box Hill Avenue intersection. The underpasses comprise precast arches with spandrel walls. Clearance for pedestrians is 2.5m horizontally and vertically.

STUDIES AND INVESTIGATIONS

Studies and investigations undertaken include:

- Topographic survey.
- Desktop geotechnical investigation.
- Traffic assessment.
- Environmental assessment.
- Tree assessment.
- Noise assessment.

TRAFFIC ASSESSMENT

Tharwa Drive is an Arterial Road with mid-block capacity of 900 vph. The Traffic Assessment found that the section between Woodcock Drive and Box Hill Avenue (south) intersections exceeds this limit in the current year during peak periods. The section between Box Hill Avenue (south) and Pockett Avenue intersections is not expected to exceed 900 vph within the next 20 years. Intermediate intersections will require upgrade to suit the duplication.

DESIGN OPTIONS

The project was divided into 8 areas for the purpose of identifying optimum upgrades along the corridor.

Area	Options	Recommendation	Rationale
Area 01 - Intersection of Tharwa Drive / Woodcock Drive / Box Hill Avenue (north)	• Do nothing • Traffic signals	Do nothing	There is no tangible benefit to upgrading the intersection
Area 02 – Intersection of Tharwa Drive / Norman Lindsay Street	• Large roundabout • Traffic signals and removal of midblock signalised staged pedestrian crossing	Traffic signals	There is insufficient room in the road corridor for a roundabout at this location
Area 03 – Northern Underpass	• Extend arch structure • Separate arch structure • Separate plank bridge	Extend arch structure	Extension of the arch structure avoids the need for median barriers, minimises environmental impacts, overall footprint and earthworks volumes
Area 04 - Midblock Norman Lindsay Street and Box Hill Avenue (south)	• Duplication on west side with 6m median • Duplication on west side with 8m median	Duplication on west side with 6m median	The 6m median minimises environmental impacts, overall footprint and earthworks volumes. The straight alignment mitigates safety issues associated with vehicles crossing the median into oncoming traffic
Area 05 - Intersection of Tharwa Drive / Box Hill Avenue (south)	• Larger roundabout • Traffic signals	Traffic signals	Extension of the arch structure avoids the need for median barriers, minimises environmental impacts, overall footprint and earthworks volumes
Area 06 – Southern Underpass	• Extend arch structure • Separate arch structure • Separate plank bridge	Extend arch structure	Extension of the arch structure avoids the need for median barriers, minimises environmental impacts, overall footprint and earthworks volumes
Area 07 - Midblock between Box Hill Avenue (south) and Pockett Avenue	• Merge back to single carriageway • Duplication on west side with 6m median • Duplication on west side with 8m median	Merge back to single carriageway	There is no tangible benefit to duplication of this section of roadway
Area 08 - Intersection of Tharwa Drive / Pockett Avenue / Knoke Avenue	• Do nothing • Larger roundabout • Traffic signals	Do nothing	There is no tangible benefit to upgrading the intersection. An upgrade would only be needed if duplication of Tharwa Drive directly north of this intersection was required

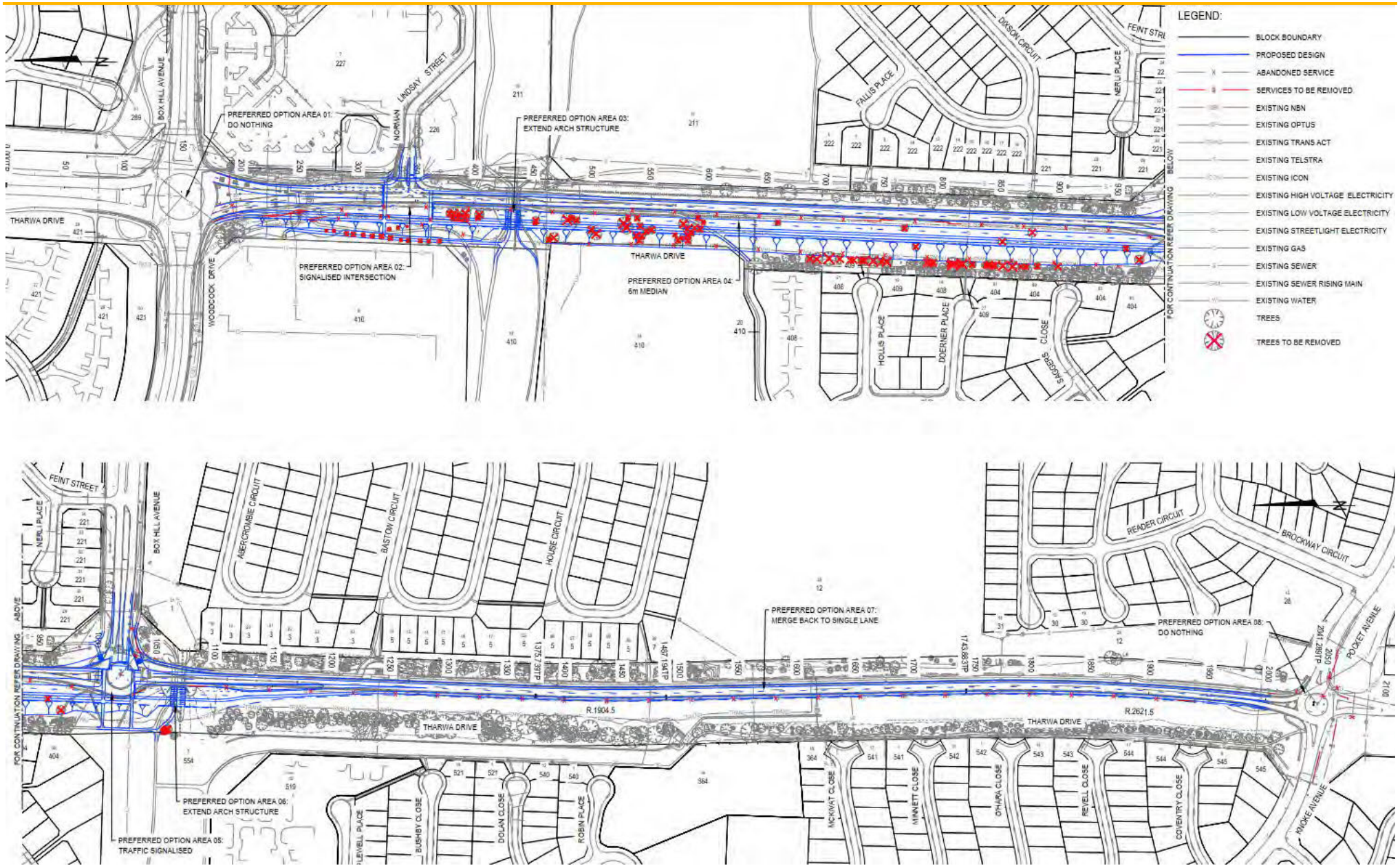


Figure 1: Preferred Option Plan

CONSTRUCTION

Construction timing is currently unknown but could potentially commence as soon as 2021 should funding become available. It is envisaged that the detail design would take approximately six months. The construction is likely to take 12 months.

OPINION OF PROBABLE COST

Construction cost for the preferred options (detailed above) is estimated to be approximately [redacted] contingency [redacted] without contingency).

Construction cost for complete duplication is estimated to be approximately [redacted] contingency ([redacted] without contingency).

Costs exclude design, procurement and contract administration.

LIMITATIONS

The following is a list of unresolved issues:

- Requirements for utility service relocations.
- Completion of the geotechnical subsurface conditions to determine parameters for pavement design, earthworks slopes and structures foundation.
- Availability of fill material for earthworks.
- Availability of precast arch units.

FURTHER DESIGN WORK

The next phase of work is a Cost Benefit Analysis followed by Preliminary Sketch Plan (PSP) design.

1. Introduction

In September 2020, Infrastructure Delivery Partners Group (IDPG) on behalf of Transport Canberra and City Services (TCCS) engaged Calibre to undertake the Tharwa Drive Duplication Feasibility Study and Concept Design.

The project includes the area within the existing Tharwa Drive road reserve between Woodcock Drive and Pockett Avenue intersections. This section of Tharwa Drive is approximately 1.9km long. The two end intersections are included in the scope of the study as are the intermediate intersections of Norman Lindsay Street and Box Hill Avenue.

This report covers the Design Options Study phase. The next phase of the project is Preliminary Sketch Plan (PSP).

1.1 Background

Current users of Tharwa Drive experience delays in peak periods. This situation is expected to be exacerbated by additional traffic generated by the development in Tuggeranong as well as steady organic traffic growth over the coming years.

This congestion will trigger the need to upgrade Tharwa Drive by adding additional lanes and providing a separation between traffic flows by incorporation of a central median.

1.2 Tharwa Drive

Tharwa Drive is an arterial road in the southern section of the Australian Capital Territory (ACT). It connects Monaro Highway in the east with Drakeford Drive and the village of Tharwa in the south. The total length of roadway is approximately 11.5km in length. The corridor forms a major transport route between Tuggeranong and Canberra City.

Tharwa Drive forms part of Tourist Drive 5, which is the Science and Nature loop, taking in attractions such as Tidbinbilla Nature Reserve, Deep Space Tracking Station, Cotter Dam, various nature parks and reserves, Lanyon Homestead, Cuppacumbalong and much more

The Tharwa Drive roadway comprises three major sections:

1. Section 1 - A 3.4km central section between Drakeford Drive and Pockett Avenue at the southern limit of the suburb of Banks
2. Section 2 - A 3.3km eastern section between Drakeford Drive and the Monaro Highway.
3. Section 3 - A 4.8km southern section between the suburb of Banks and Tharwa village.

Sections 1 and 2 are predominantly urban in character with kerbs, footpaths, street lighting and adjacent residential development. The corridors are generally wide allowing ultimately for fully duplicated four lane roadways.

The portion of roadway between Drakeford Drive and Woodcock Drive was duplicated circa 2009 matching the four lane configuration of Drakeford Drive further north. The median for this section is 8.0m wide.

Section 3 is relatively narrow and surrounded by rural blocks. This section crosses the Murrumbidgee River via the heritage listed Tharwa Bridge. The lack of kerbs, verges, footpaths and street lighting in this area is consistent with the rural environment.

This project is concerned with the remainder of unduplicated road within Section 1 south of Woodcock Drive intersection. Available work-as-executed (WAE) information from 1993 suggests that this section was last upgraded in the early 1990's.

The Project Location is shown in Figure 2.



Figure 2: Project Location

1.3 Project Objectives

The objective of this study is to provide design options for the upgrading of Tharwa Drive between Woodcock Drive and Pocket Avenue, to increase safety and efficiency of traffic operations, to provide the required connectivity and address the known congestion issues.

Important items for consideration include, but are not limited to, the following:

1. Existing and future traffic volumes.
2. Provisions for sustainable transport modes including walking and cycling.
3. Appropriate design criteria.
4. Constraints including cadastral boundaries, utility services, stormwater structures, bridges, trees and road infrastructure.
5. Minimisation of impacts to the environment.
6. Safety and amenity for all road users.
7. Cost effectiveness of the solution with an aim to provide value for money for the Territory.
8. Development of a solution that is acceptable to the community.
9. Construction staging that considers an appropriate staged delivery.

2. Existing Conditions

2.1 Overview

The section of Tharwa Drive within the project area (Section 1) is surrounded by the suburbs of Gordon on the west and Conder and Banks on the east. It is mostly one lane in each direction over the 1.9km length. The existing carriageway is biased towards the eastern side of the road reserve allowing room for duplication.

Woodcock Drive connects at the northern roundabout. Box Hill Avenue connects at both the northern and central roundabouts. Knoke Avenue and Pocket Avenue connect at the southern roundabout.

Lanyon Market Place is adjacent to Tharwa Drive on the eastern side directly south of Box Hill Avenue (north). This includes a small shopping centre, a service station and at grade car parking. The marketplace connects directly to Tharwa Drive via the Norman Lindsay Street intersection.

Directly opposite Lanyon Marketplace is Amala Independent Retirement Village on the western side of Tharwa Drive directly south of Woodcock Drive.

There are two floodways crossing under Tharwa Drive. The northern one is directly south of Norman Lindsay Street. The southern one is directly south of Box Hill Avenue. Both floodways include pedestrian facilities via underpasses. The floodways converge further west at Point Hut Pond.

Lanyon Vikings Oval is located adjacent to Tharwa Drive directly south of the northern floodways on the eastern side. Gordon District Playing Fields are similar located directly south of the northern floodway but on the western side of Tharwa Drive. Lanyon Little Athletics Oval is located midway between Box Hill Avenue and Pockett Avenue intersections on the eastern side.

Elsewhere, residential development is located adjacent to the corridor. Access is via the local road network in the three adjacent suburbs. No houses front directly onto Tharwa Drive.

The posted speed is 60km/h between the Woodcock Drive roundabout to approximately 200m south of Norman Lindsay Street intersection. The remainder of the project is posted 80km/h.

Project features are shown in Figure 3.



Figure 3: Project Features

2.2 Alignment

2.2.1 Chainage System

Calibre has adopted a chainage system running from north to south commencing 150m north of the Woodcock Drive intersection and concluding 200m south of the Pockett Avenue intersection.

A list of key chainages follows:

- Chainage 0 – Start of alignment.
- Chainage 150 – Intersection of Tharwa Drive, Woodcock Drive and Box Hill Avenue (north).
- Chainage 245 – Staggered signalised midblock pedestrian crossing.
- Chainage 344 – Intersection Tharwa Drive and Norman Lindsay Street.
- Chainage 431 – Northern underpass / arch structure.
- Chainage 1020 – Intersection of Tharwa Drive and Box Hill Avenue (south).
- Chainage 1068 – Southern underpass / arch structure.
- Chainage 2044 – Intersection Tharwa Drive, Pockett Avenue and Knoke Avenue.
- Chainage 2250 – End of alignment.

2.2.2 Horizontal Alignment

The control line has been produced by 'line of best fit' utilising the topographic survey and is generally located on the invert of the left-hand kerb of the existing roadway. The horizontal alignment is relatively straight and includes some large radius curves in the southern third.

The details of horizontal elements of the alignment are as follows:

- Straight 1 – 1376m long.
- Curve 1 – 1094.5m radius, 109m long.
- Straight 2 – 257m long.
- Curve 2 – 2621.5m radius, 297m long.
- Straight 3 – 159m long.

The minimum curve radius is 1094.5m. This radius is suitable for a design speed of 90km/h and posted speed of 80km/h as per existing conditions.

2.2.3 Vertical Alignment

The vertical alignment comprises one crest vertical curve and two sag curves. The minimum continuous grade is 1% and the maximum continuous grade is 2.5%.

The details of vertical curves from DBD intersection to CCR intersection are as follows:

- Straight 1 – 1% upgrade.
- Curve 1 – 260m long (crest – 118K).
- Straight 2 – 1.2% downgrade.
- Curve 2 – 400m long (sag – 145K).
- Straight 3 – 1.55% upgrade.
- Curve 3 – 200m long (sag - 210K).
- Straight 4 – 2.5% upgrade.

The vertical geometry is suitable for a design speed of 90km/h and posted speed of 80km/h as per existing conditions.

The 400m long sag curve does present a possible drainage issue with a long length of kerb less than 1% grade.

2.3 Cross Section

The typical cross section of Tharwa Drive generally comprises two 3.5m traffic lanes and 1m shoulders each side. The shoulders are sub-standard width for on-road cycling. At intersection approaches and departures there are auxiliary lanes and some sections of central median.

There is continuous kerb each side of the roadway. The verge is a minimum of 4m on the eastern side. There is no formalised verge on the western side, however it appears that some earthworks were undertaken during the original construction to facilitate future duplication.

The existing roadway is crowned with 3% crossfall. There are no sections with superelevation.

Street lighting is continuous on the western side of the roadway and supplemented at intersections. There are sections where log bollards exist adjacent to the kerb to restrict vehicular access to adjacent green spaces.

The road cross section is shown in Figure 4.



Figure 4: Road Cross Section

2.4 Intersections

There are two intersections at the limits of the project and two intermediate intersections. Three of these are roundabouts and the fourth is an unsignalised T intersection.

The intersections from north to south are as follows:

- Intersection 1 – Woodcock Drive.
- Intersection 2 - Norman Lindsay Street.
- Intersection 3 – Box Hill Avenue.
- Intersection 4 – Pockett Avenue.

2.4.1 Woodcock Drive Roundabout

The Woodcock Drive intersection is a dual lane roundabout. The northern and southern legs are Tharwa Drive. The western leg is Woodcock Drive and the eastern leg is Box Hill Avenue (north). Refer to Figure 5.



Figure 5: Woodcock Drive Roundabout

The central island radius is approximately 20m radius and does not include an apron. The dual lane carriageway circulating width is 10.2m. This geometry is suitable for a 25m B-Double.

There are two lanes on each approach, whilst the Woodcock Drive and Box Hill Drive departures are only one lane. A change in roundabout lane configuration occurred circa 2016 in order to facilitate incorporation of bus stops on Box Hill Drive adjacent to the Lanyon Marketplace.

The southern departure on Tharwa Drive merges in approximately 60m.

There is a staggered signalised pedestrian crossing approximately halfway between this intersection and the next.

2.4.2 Norman Lindsay Street Unsignalised T

The Norman Lindsay Street Unsignalised T intersection is approximately 194m south of the Woodcock Drive roundabout. The northern and southern legs are Tharwa Drive. The eastern leg is Norman Lindsay Street. All movements are catered for. Refer to Figure 6.

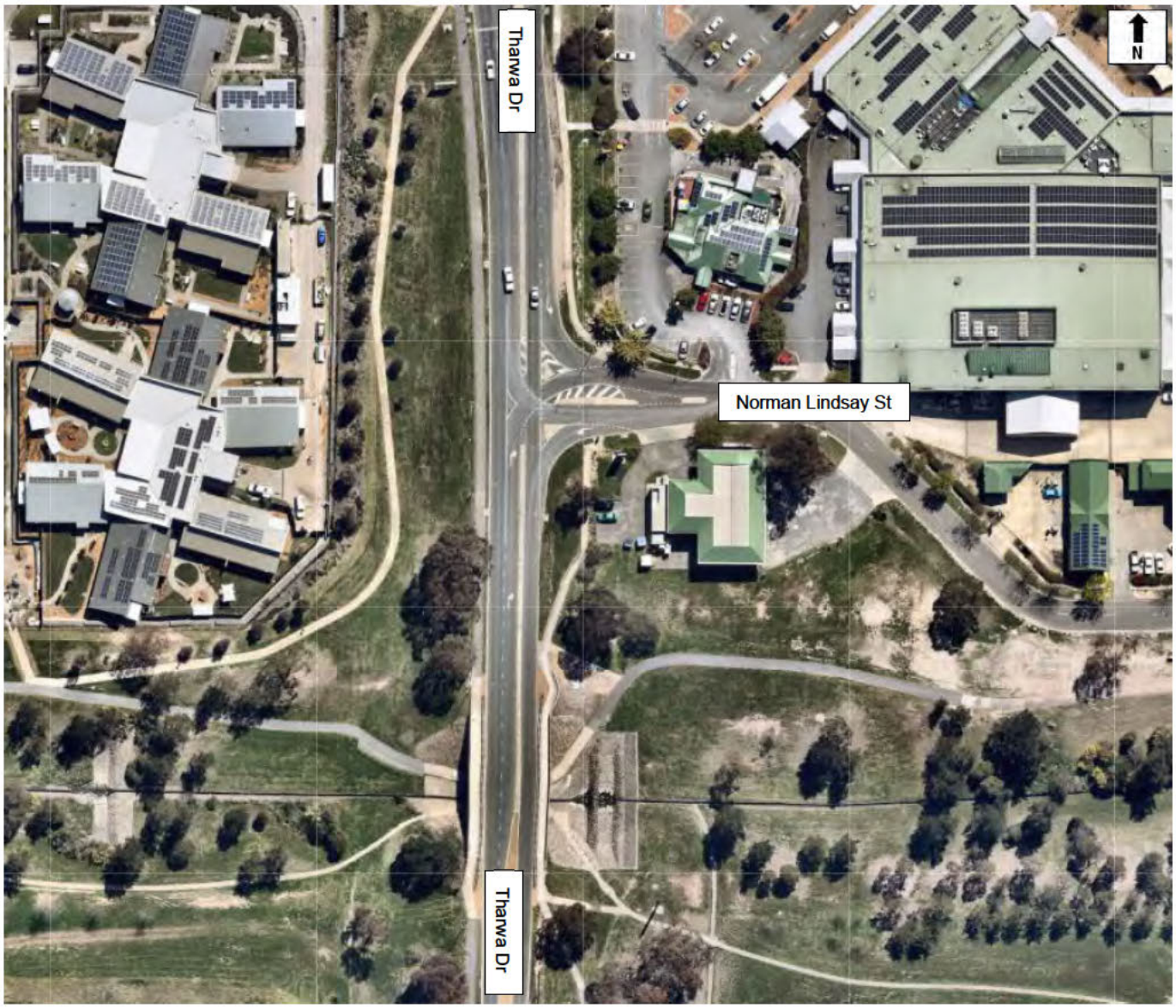


Figure 6: Norman Lindsay Street Unsignalised T

The Norman Lindsay Street intersection approach includes a right turn and low angle entry left turn onto Tharwa Drive. There is one departure lane.

The Tharwa Drive northbound approach includes an exclusive right turn lane. The Tharwa Drive southbound approach includes an exclusive low angle left turn. There is a dedicated departure lane on Tharwa Drive for vehicles turning right out of Norman Lindsay Drive.

The centre of the intersection is only 87m from the first underpass further south.

This intersection was retrofitted to Tharwa Drive circa 1997 in order to provide access to the Conder Group Centre.

2.4.3 Box Hill Avenue Roundabout

The Box Hill Avenue roundabout is almost halfway along the alignment and comprises three legs. The northern and southern legs are Tharwa Drive. The eastern leg is Box Hill Avenue. Refer to Figure 7.



Figure 7: Box Hill Avenue Roundabout

The central island radius is approximately 12m radius and includes a 1m apron. The single lane carriageway circulating width is 6m. This geometry is suitable for a 12m single unit truck.

There is a single lane approach and departure on all legs.

The centre of the roundabout is only 48m from the second underpass further south.

2.4.4 Pockett Avenue Roundabout

The Pockett Avenue roundabout comprises four legs. The northern and southern legs are Tharwa Drive. The western leg is Knoke Avenue and the eastern leg is Pockett Avenue. Refer to Figure 8.



Figure 8: Pockett Avenue Roundabout

The central island radius is approximately 9.7m radius and includes a 1m apron. The single lane carriageway circulating width is 7m. This geometry is suitable for a 12m single unit truck.

There is a single lane approach and departure on all legs.

2.5 Pavement and Delineation

The existing pavement surface has been resealed over the entire project length. It is unclear what the condition of underlying pavement is from visual observation.

Linemarking is in relatively good condition although there is some wear at the intersections. Signage is also in relatively good condition. There does not appear to be any many missing or faded signs.

There are some intersections that could be swept to remove crash debris.

2.6 Roadside Environment

2.6.1 Earthworks

The existing roadway is primarily raised above the surrounding landform. Batters of 1V:5H exist at the interface within the corridor.

It is likely that the road was originally raised in order to provide clearance for major stormwater assets beneath the pavement and to allow formation of roadside open drains as part of the overall suburban drainage scheme.

The northern section of the project has earthworks formation of adequate width for the existing carriageway only. South of the southern underpass, the earthworks formation width is satisfactory for both carriageways.

There will be a requirement to import fill material for the duplication. Initial volume calculations indicate that this will be in the order of magnitude of 30,000 cubic meters. The magnitude of cut will be negligible.

2.6.2 Barriers

There are roadside barriers where Tharwa Drive passes over the two underpasses.

For the northern underpass, the vehicular barrier is directly behind the kerb and comprises double sided w-beam. The terminals at each end are non-compliant. There is a separate pedestrian barrier at the back of the footpath.

For the southern underpass, the vehicular barrier is at the back of the footpath and comprises single sided w-beam. A custom pedestrian barrier has been retrofitted to the w-beam. It is likely that this pedestrian barrier is non-compliant and may be a spearing hazard in an accident. The approach to the w-beam uses a tradition MELT terminal.

2.6.3 Stormwater Drainage

There is a comprehensive stormwater system within the project vicinity.

Two major floodways pass under Tharwa Drive. The northern floodway comprises several concrete drop structures and extensive stone pitching. The low flow invert is also concrete. This floodway has been referred to as ‘Point Hut Floodway Underpass’ in some WAE documentation. The southern floodway is similar, but not as wide. The floodways converge further west at Point Hut Pond.

There are several major gross pollutant traps in the corridor upstream of the floodways.

On both side of Tharwa Drive, longitudinal drainage exists in the form of wide open drains. There are some stone pitched drop structures to reduce the grade in the southern section. This stormwater is conveyed across the road from west to east via major culverts.

Cross drainage culverts include:

- A 1350 diameter pipe at Chainage 1238. This include a major trash rack adjacent to the eastern kerb.
- A 1850mm diameter pipe at Chainage 1510 near Lanyon Little Athletics Oval.
- A 1500mm diameter pipe at Chainage 1520. This includes a major trash track at the outlet.

There is also a formal drainage system associated with the roadway kerb and gutter. This includes several R-sumps and pipes around 300mm and 375mm diameter pipes.

2.6.4 Utility Services

There are several utilities along the Tharwa Drive corridor. The majority of these are on the eastern side of the road reserve.

Utilities in the Tharwa Drive corridor include:

- A 750mm diameter gravity sewer between Woodcock Drive roundabout and Box Hill Avenue roundabout on the eastern side.
- A 300mm diameter gravity sewer adjacent to Lanyon Little Athletics oval on the eastern side.
- A 150mm diameter gravity north on Knoke Avenue on the western side.
- A 200mm diameter sewer rising main crossing directly south of the Woodcock Avenue roundabout.
- A 225mm diameter sewer rising main along the southern edge of the northern floodway.
- A 150mm diameter water main between the Woodcock Drive roundabout and Norman Lindsay Street intersection on the eastern side.
- 150mm diameter water mains crossing north and south of the Box Hill Avenue roundabout.
- A 300mm diameter water main directly south of the Pockett Avenue roundabout.
- [redacted]
- Street lighting continuous on the western side just behind the kerb.
- High voltage power between the Woodcock Drive roundabout and Norman Lindsay Street intersection on the eastern side.
- High voltage power crossing at the Lanyon Marketplace.
- High voltage power crossing directly north of the Box Hill Avenue roundabout and Lanyon Little Athletics oval.
- ICON communication assets between the Woodcock Drive roundabout and Norman Lindsay Street intersection on the eastern side
- NBN assets continuous on the eastern side.
- Optus assets between Woodcock Drive roundabout and Lanyon Little Athletics oval on the eastern side.
- Telstra assets continuous on the eastern side.
- TransACT assets between Woodcock Drive roundabout and Lanyon Little Athletics oval on the western side.



Figure 9: High Pressure Gas Main in the Eastern Verge

2.6.5 Trees

There are approximately 517 trees on the western side of the corridor and 289 trees on the eastern side. The majority of trees are close to the outside edge of the road reserve.

There are 48 trees within 30m of the existing carriageway between Norman Lindsay Street and Box Hill Avenue intersections on the western side. These trees are likely to require removal regardless of the duplication option selected.

The composition of tree species within the corridor is as follows:

- Casuarina – 116 west, 32 east.
- Conifers – 66 west, 32 east.
- Dead – 20 west, 4 east.
- Deciduous – 32 west, 5 east.
- Eucalyptus – 276 west, 232 east.
- Ornamental – 2 west.
- Poplar – 4 east.
- Unspecified – 5 west, 7 east.



Figure 10: Trees in the Corridor

2.6.6 Landscaping

Beyond trees and grass, the only other landscaping is shrubs in and around the three roundabouts and along the edges of the residential areas.

2.6.7 Pedestrian Facilities

There is a 1.8m path continuous along the eastern side of the roadway. The path is generally 2m offset but varies from being directly adjacent to the kerb over the underpasses up to 20m offset near the Lanyon Vikings Oval.

Similarly, there is a 1.8m path continuous along the western side of Tharwa Drive. This path is mostly on the very outer edge of the road reserve adjacent to houses but only 2m offset from the kerb elsewhere.

The two floodways have paths on the northern side. These pass under Tharwa Drive via underpasses.

The three roundabouts have unsignalised path crossings of legs within the vicinity of splitter islands and central medians. These are all at least one car length back from the give way line. There is also a unsignalised crossing of the minor leg of the Norman Lindsay Street intersection.

There is a staged signalised pedestrian midblock crossing between Woodcock Drive roundabout and Norman Lindsay Street intersection. This crossing is pedestrian actuated and contains loops in both directions on Tharwa Drive. The local path network suggests that the crossing is intended for residents of the retirement village to access the Lanyon Marketplace.



Figure 11: Staged Signalised Pedestrian Midblock Crossing

2.6.8 Cyclist Facilities

There are no cyclist facilities beyond the path network within the corridor. The 1.0m shoulders on Tharwa Drive are too narrow for dedicated on-road cycling.

The choice of intersection upgrade types will need to consider provisions for cyclists and connectivity to the existing path system.

2.7 Underpasses

The underpasses from north to south are as follows:

- Underpass 1 – Directly south of Norman Lindsay Street intersection (northern underpass).
- Underpass 2 - Directly south of Box Hill Avenue intersection (southern underpass).

The two underpasses comprise precast arches with spandrel walls on each side. The structure number for the northern underpass is 5235, whilst the southern underpass is 5258. The underpasses are co-located with the floodways.

Each underpass has 10 precast reinforced arch units, each 1.8m wide. The unit dimensions are 12.4m long and 4m high with an elliptical profile. WAE information indicates that the arches are designed to NAASRA A14 and T44 loading requirements. This is consistent with the age of the structure.

The spandrel walls comprise multiple precast units and there are precast retaining wingwall units for the underpass approaches. The wingwall units for the northern underpass are parallel to the roadway whilst for the southern underpass they are at 45 degrees.

The provision for pedestrians and cyclists is offset to the north of the arch centre for both underpasses but the minimum vertical clearance of 2.5m is achieved despite the elliptical profile. A minimum path width of 2.5m is also achieved adjacent to the floodways. The storm event the paths are designed for is not known.



Figure 12: Underpass / Floodway Arrangement

The northern underpass structure was modified circa 1997 as part of the construction of the Norman Lindsay Street intersection. The spandrel walls were raised to provide space for the addition right turn lane over the underpass on Tharwa Drive. The modification included new pavement, paths and barriers for vehicles and pedestrians.

2.8 Other

2.8.1 Hydrology

The overland flow catchments adjacent to the project area generally falls from south east to north west and converges to two major flood ways. There are two existing bridges, one south of Norman Lindsay Street, the other one south of Box Hill Avenue over these two flood ways. All stormwater flows will be collected by Point Hut Pond. ACTMAPi Flood Map indicates the project area is not within the 1% AEP flood level or subject to known flood hazard.

The duplication intended to extend existing cross drainage infrastructures and expect minimal changes to the existing Hydrology.

2.8.2 Heritage

ACTMAPi Heritage Map indicates the project area do not contain any Heritage places / objects. However, Point Hut Pond downstream of the project area contains a registered Heritage place / object MRC37c (with no publicly available information on the ACT Heritage Register). Additional Erosion and Sediment Control measures may be required during construction of the duplication to mitigate potential impacts.

2.8.3 Bushfire

According to ACTMAPi, the project area and surrounding suburbs of Gordon, Conder and Banks are surrounded by Bushfire Prone Areas. This should not impact on the design of the duplication. However, construction program and staging may be required to maintain access through Tharwa Drive during bushfire season.

2.8.4 Ecological

According to ACTMAPi, there are no significant species, vegetation communities and registered trees within the project area.

3. Background Information

3.1 Work-As-Executed Drawings

The work-as-executed (WAE) information for the original construction of the road could not be obtained during preparation of this study. Nonetheless, the topographic survey and geotechnical investigation contain adequate information to inform the design of the duplication.

WAE was obtained for the original construction of the northern underpass near Norman Lindsay Street intersection. This includes detail of the floodway, arches and the spandrel walls.

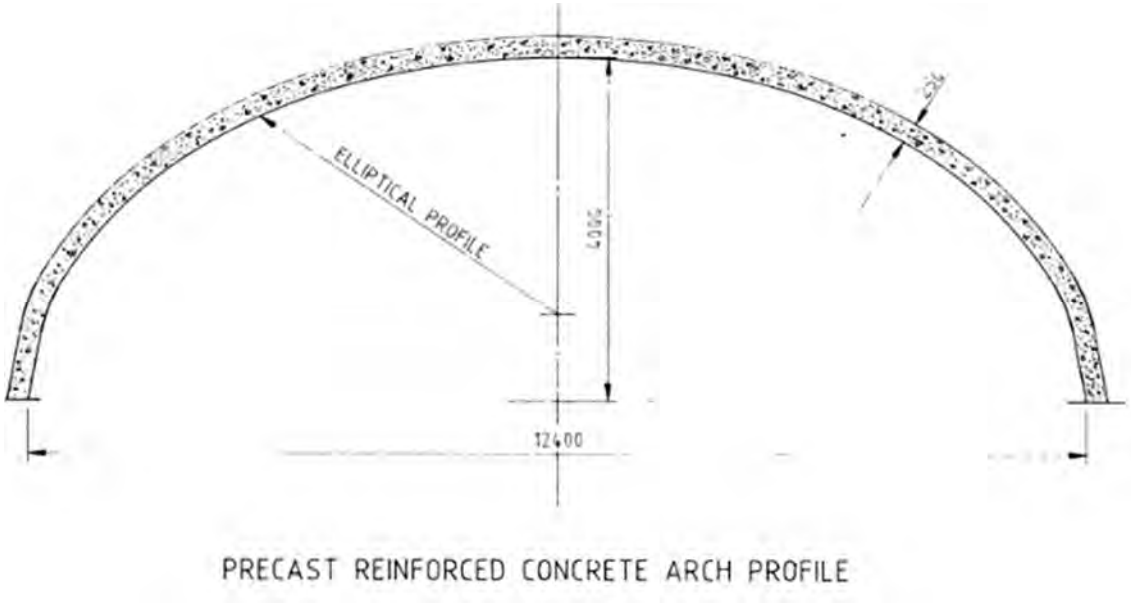


Figure 13: Arch Profile

WAE was located for the construction of Norman Lindsay Street intersection. This shows the extension of spandrel walls, barriers and new road pavement for the northern underpass. It also includes intersection details such as new kerbs, pavement, linemarking and signage.

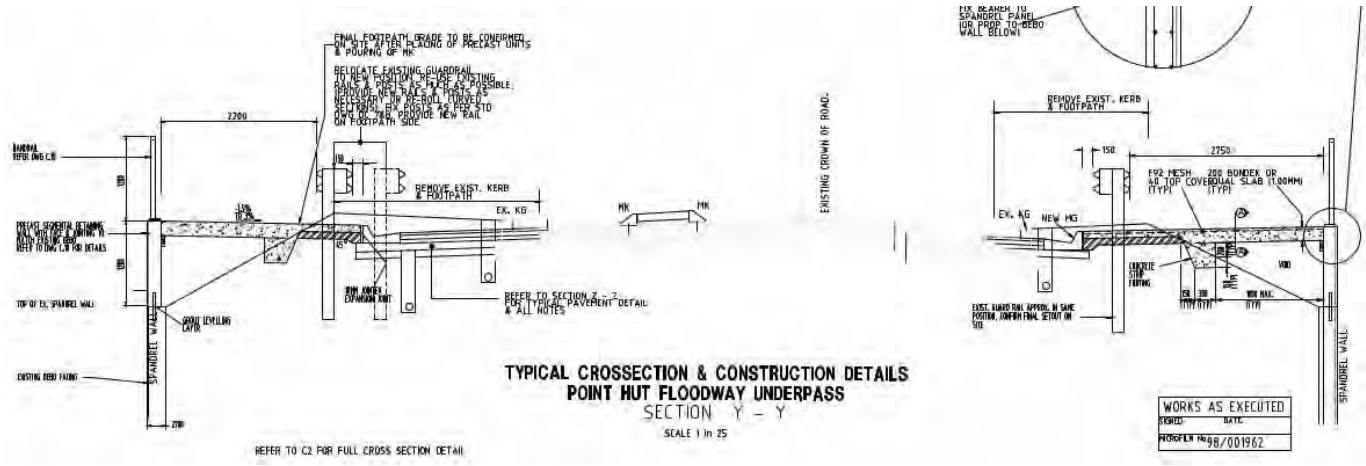


Figure 14: Underpass Widening WAE

3.2 Knoke Avenue to Johnson Drive Feasibility Study

In August 2007, Brown Consulting completed a Feasibility Study for Duplication of Tharwa Drive between Knoke Avenue to Johnson Drive. The report discussed existing conditions, traffic analysis and design options. The traffic analysis at the time indicated that carriageway duplication was only required north of Box Hill Avenue (north).

3.3 Tharwa Drive / Drakeford Drive Duplication Design

Following the recommendations of the 2007 Feasibility Study, Brown Consulting completed the design of the duplication of Tharwa Drive / Drakeford Drive from Johnson Avenue to Box Hill Avenue (north).

The length of duplication is approximately 2km.

Key features of the design include:

- A new south carriageway between Johnson Drive and Box Hill Avenue (north) on the eastern side of Tharwa Drive. The new carriageway includes two 3.5m lanes and a 2m shoulder. Median width a constant 8m.
- A new larger Mentone View roundabout to be a larger 16m radius and include dual circulating lanes.
- Two new BEBO arch underpasses with precast spandrel walls matching the existing.
- Extension to the existing underpass with one 1.8m wide arch unit and new spandrel wall.
- Replacement of existing w-beam bridge barriers with rigid Type F barriers.

The duplication was constructed in 2008. The construction cost was approximately $7.2M.

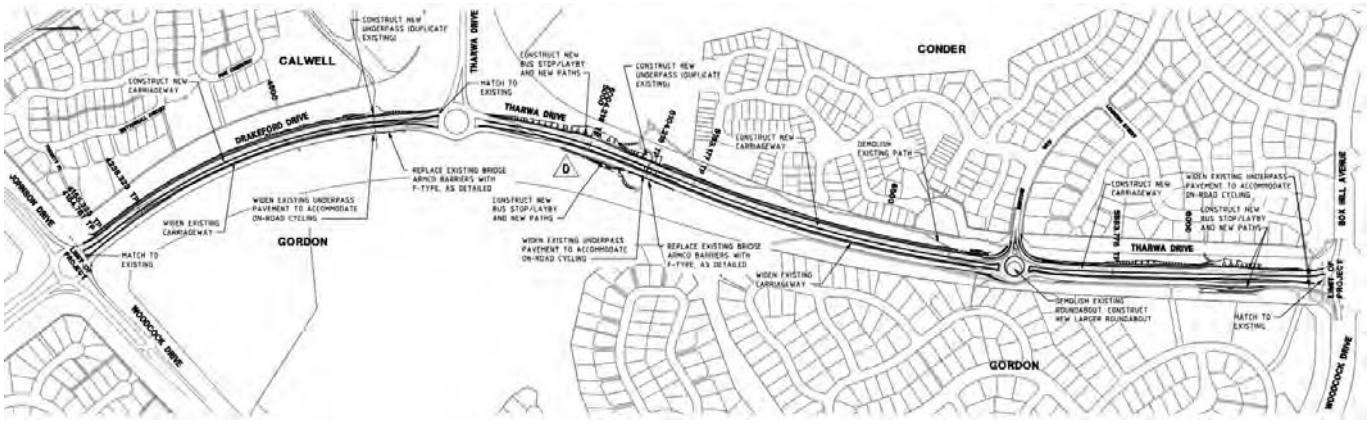


Figure 15: Scope of Previous Duplication

4. Studies and Investigations

4.1 Topographic Survey and Utility Tracing

Steger and Associates prepared detailed topographic survey for the project in October 2020. It includes the following components:

- Feature survey (kerbs, paths, signs, trees etc).
- Survey infrastructure (survey marks and stations).
- Hydraulics survey (details of stormwater drainage and sewer assets including sizes, invert levels etc).
- Utilities survey (tracing of non-hydraulic utility services).
- 3D triangulation.

The survey is suitable for detail design and as the basis for setout during construction.

Refer Appendix A for Topographic Survey.

4.2 Geotechnical Investigation

A desktop geotechnical investigation was undertaken by Douglas Partners in December 2020. The assessment included review of geological maps, review of previous investigations and a site visit by a Senior Geotechnical Engineer.

4.2.1 Estimated Site Conditions

The site conditions along the alignment are expected to vary slightly between the southern half to the northern half. The southern half of the alignment is mostly near-level and is likely to be close to the design levels for the proposed road duplication with minimal cut/fill required. The subsurface conditions likely to comprise shallow topsoil/topsoil fill, fill and variable deep colluvial and alluvial soils.

The northern half of the alignment is likely to comprise the fill batter from the existing Tharwa Drive roadway along its eastern parts where it meets the lower western parts of the alignment which are at similar levels to the surrounding land and on a more gradual and constant slope towards the west. The subsurface conditions likely to comprise shallow topsoil/topsoil fill, fill and variable alluvial and colluvial soils overlying dacite weathered rock, generally more than 5 m deep from existing levels and deeper where the road embankment has been constructed.

The existing fill material is not expected to be well compacted and most probably contain large portions of unsuitable material including silt, sand and boulders based on experience with other road duplication projects across Canberra.

4.2.2 Geotechnical Constraints

The assessment has identified several possible constraints to the development, which are:

- Potential for poor subgrade performance from existing service trenches and existing surface drainage swales within the future duplication alignment.
- Deep extensively root affected soils from existing trees and other vegetation.
- Potential for unsuitable material used in existing embankment filling.
- Potential for unsuitable natural materials (silts and sands).
- The potential for groundwater seepages and/or water impacted soils (swale/culvert areas).

4.2.3 Earthworks

Earthworks for the preparation of new embankment filling placement and compaction will most likely require but not limited to the following:

- Stripping of vegetation and topsoil.
- Assessment of the stripped surface to support filling placement (i.e.: are silts/sands or poorly compacted fill materials present).
- Assessment of the stripped surface for possible groundwater drainage measures.
- Assessment of the extent and conditions of any existing service trench backfill materials.

- If deemed unacceptable, either strip unsuitable material or place a bridging layer (the type depends on the conditions at the time of construction).
- Lift thicknesses of foundation treatment measures and/or initial filling layers will depend on the condition of the foundation and type of material.

4.2.4 Pavements

In areas of existing filling, the design of pavements will most likely be dictated by constructability/serviceability rather than from a CBR perspective. The existing filling material is likely to be poorly compacted and comprise unsuitable fractions. Based on experience road embankment filling beyond the edge of the existing pavement could be partially unsuitable or wholly unsuitable. Until subsurface investigations are undertaken further comment on suitability cannot be made.

Significant over-excavation and replacement/recompaction of existing filling must be anticipated. Preliminary design CBR values are suggested to be between 3 – 5% depending on the quality of the existing fill and the composition of the natural alluvial and colluvial soils along the alignment.

4.2.5 Structural Foundations

The extent of future structures is expected to comprise matching Bebo arches and culvert pipe crossing structures to those identified during the site walkover. The current locations of these arch and culvert structures are within gully lines or low-lying areas and it is expected that poor foundation conditions could be encountered, pending prior weather conditions.

Depending on the structural loading and required allowable bearing pressure for the structure foundation, over-excavation of unsuitable material and replacement with a rock bridging layer is highly likely. Subsoil drainage maybe required in the base of gully lines. Allowable bearing pressures of in excess of 100 -150 kPa for a soil type foundation in most cases would be unrealistic. Should higher bearing pressure be required then piled footings would need to be founded within the bedrock. Until subsurface investigations are undertaken further comment on the likely depth to a suitable bearing stratum and design foundations parameters cannot be made.

4.2.6 Site Drainage

Subsoil drains, rubble drains or deep table drains will be required on the side of road formations on grade or in cut. Other drainage systems may also be required but would be dependent on the conditions prior to and during construction. It is suggested that where required in the duplication works, table drains be constructed a minimum 0.5 m deeper than subgrade level

Refer Appendix B for Desktop Geotechnical Investigation. Note that a full Geotechnical Investigation including fieldwork is currently underway.

4.3 Traffic Assessment

4.3.1 Road Network

Tharwa Drive is considered an arterial road extending from Monaro Highway to Naas Road. For the section investigated in this report, the roads connecting with Tharwa Drive are predominantly classified as arterial roads or major collector roads. The speed limit along this section of Tharwa Drive is predominantly 80km/h but decreases to 60km/h adjacent to the Lanyon Marketplace. Between Woodcock Drive and Pockett Avenue, Tharwa Drive typically consists of a single carriageway with one traffic lane in each direction. To the north of the investigated area, Tharwa Drive consists of two dual-lane carriageways separated by an 8m wide median.

4.3.2 Active Travel

There are shared paths present along both sides of Tharwa Drive between Woodcock Drive and Pockett Avenue, which together form a part of a local community route. This route connects into other local community routes which provide access to Gordon, Conder, and Banks. The local community route along Tharwa Drive transitions into a Principal Canberra Cycle Route which runs along Tharwa Drive to the north of the Woodcock Drive / Box Hill Avenue intersection. An on-road cycle route is also present extending north from this location. Both of these routes connect Lanyon Market with Greenway and in extension, the wider Canberra active travel network.

4.3.3 Public Transport

There are six bus routes which currently originate and/or terminate at the Lanyon Marketplace bus terminal. Of these, four of the routes travel along Tharwa Drive to the north of the intersection of Woodcock Drive / Box Hill Avenue. The remaining two routes cross Tharwa Drive at the Knoke Avenue / Pockett Avenue intersection. None of the bus routes travel along Tharwa Drive between the intersections of Woodcock Drive / Box Hill Avenue and Knoke Avenue / Pockett Avenue.

4.3.4 Crash Analysis

As part of the traffic assessment, the crash data for the last five years along Tharwa Drive was evaluated to determine areas which were prone to accidents. From this assessment, three sections were identified as having over 20 crashes in the last five years.

The first of these was the roundabout of Tharwa Drive, Woodcock Drive, and Box Hill Avenue. This intersection recorded 52 crashes, with the most common type being rear-end crashes (28 total). Crashes predominantly occurred along the north and south legs of the intersection and only rarely resulted in injury, suggesting they mostly occurred at low speeds.

The second location was the intersection of Tharwa Drive and Norman Lindsay Street. This intersection recorded 29 crashes within the last five years, with the most common crash type being collisions with right turning vehicles (19 total). The frequency of these crashes suggests that vehicles were having trouble picking gaps within oncoming northbound or southbound traffic.

The final location identified as being accident prone was the roundabout of Tharwa Drive and Box Hill Avenue. This intersection recorded 25 crashes over the past five years, with collisions between through and right turning vehicles being the most common (13 total). The majority of crashes at this intersection only resulted in property damage, suggesting that they occur at low speeds. It is noted that the diameter of the central island of this roundabout is below the Austroads minimum recommended diameter for an 80km/h road. This is expected to contribute to the frequency of crashes at this site.

4.3.5 Traffic Volumes

Current traffic volumes along the section of Tharwa Drive assessed were determined from traffic counts taken at the four major intersections along this section of Tharwa Drive. Due to the COVID-19 restrictions enacted in the Canberra region, it is assumed that the traffic count volumes would be lower than what would generally be observed at these locations in normal years. As such, SCATS data from the signalised pedestrian crossing was used to determine the percentage reduction in traffic volumes caused by the restrictions. Traffic count data was then scaled based on this factor, allowing the overall magnitude of the traffic demands to be representative of conditions before the restrictions were adopted.

Traffic volume estimates for the years of 2031 and 2041 were also generated based off the traffic count volumes. These were calculated using the growth rates for the area surrounding Tharwa Drive assumed within the CSTM models for 2031 and 2041.

4.3.6 Midblock Capacity

Based off the traffic count data, the maximum hourly midblock traffic volumes were calculated in both northbound and southbound directions between the four main intersections along this section of Tharwa Drive. This was done to determine whether duplication of this section of Tharwa Drive was warranted from a traffic volume standpoint. As per *Austroads Guide to Road Design Part 3: Transport Study and Analysis Methods*, the midblock capacity for a single lane in an undivided road is 900vph.

It was found that the section of Tharwa Drive between Woodcock Drive and Box Hill Avenue (south) intersections exceeds this limit in the current year. The section of Tharwa Drive between Box Hill Avenue (south) and Pockett Avenue intersections is not expected to exceed 900vph within the next 20 years however, and so could be duplicated as a separate stage of the project, should this be desirable.

Table 1: Northbound Maximum Hourly Midblock Traffic Volumes

Midblock Section	Year		
	Current (vph)	2031 (vph)	2041 (vph)
Woodcock Dr to Norman Lindsay St	925	969	990
Norman Lindsay St to Box Hill Ave	924	968	989
Box Hill Ave to Pockett Ave	516	541	552

Table 2: Southbound Maximum Hourly Midblock Traffic Volumes

Midblock Section	Year		
	Current	2031	2041
Woodcock Dr to Norman Lindsay St	971	1015	1038
Norman Lindsay St to Box Hill Ave	936	980	1001
Box Hill Ave to Pockett Ave	479	502	512

4.3.7 Base Intersection Performance Analysis

For the base scenarios, it was found that the intersection of Tharwa Drive / Norman Lindsay Street failed during both AM and PM peak periods within the current year. This is expected to continue to worsen within the 2031 and 2041 scenarios. The poor performance at this intersection is attributed to it being priority controlled. The delays occur along Norman Lindsay Street, as there aren't sufficient gaps in the northbound and southbound traffic along Tharwa Drive to allow the vehicles within this leg to turn out.

Within the PM peak period of the 2031 base scenarios, the intersection of Tharwa Drive / Woodcock Drive / Box Hill Avenue (north) is also expected to exceed acceptable limits for DOS. This is expected to worsen within the 2041 PM scenario, with delay also exceeding acceptable levels during that period. These high values occur along the northern leg of the intersection (Tharwa Drive) and are likely caused by the large number of vehicles travelling along these lanes combined with the moderate number of through and right turning volumes from the western leg (Woodcock Drive).

Within the 2031 and 2041 PM peak scenarios, the signalised pedestrian crossing along the road is expected to produce queue lengths which exceed the provided storage length of the northern lanes. This results in the queue from these signals to occasionally back up into the Tharwa Drive / Woodcock Drive / Box Hill Avenue roundabout.

Table 3: Current Intersection Performance Summary

Intersection	AM Peak Hour				PM Peak Hour			
	DOS	Delay	LOS	Queue	DOS	Delay	LOS	Queue
Tharwa Dr / Box Hill Ave / Woodcock Dr	0.55	13s	A	10m	0.84	9s	A	25m
Tharwa Dr Pedestrian Crossing	0.27	1s	A	19s	0.51	1s	A	57m
Tharwa Dr / Norman Lindsay St	0.95	95s	F	22m	0.99	126s	F	24m
Tharwa Dr / Box Hill Ave	0.56	8s	A	15m	0.59	12s	A	18m
Tharwa Dr / Pockett Ave / Knoke Ave	0.22	10s	A	4m	0.36	11s	A	7m

Table 4: 2031 Existing Intersection Performance Summary

Intersection	AM Peak Hour				PM Peak Hour			
	DOS	Delay	LOS	Queue	DOS	Delay	LOS	Queue
Tharwa Dr / Box Hill Ave / Woodcock Dr	0.58	14s	A	11m	0.99	31s	C	69m
Tharwa Dr Pedestrian Crossing	0.28	1s	A	19m	0.54	1s	A	62m
Tharwa Dr / Norman Lindsay St	1.12	194s	F	47m	1.18	253s	F	52m
Tharwa Dr / Box Hill Ave	0.60	15s	B	17m	0.62	12s	A	20m
Tharwa Dr / Pockett Ave / Knoke Ave	0.22	11s	A	4m	0.38	11s	A	8m

Table 5: 2041 Existing Intersection Performance Summary

Intersection	AM Peak Hour				PM Peak Hour			
	DOS	Delay	LOS	Queue	DOS	Delay	LOS	Queue
Tharwa Dr / Box Hill Ave / Woodcock Dr	0.59	14s	A	12m	1.06	79s	F	200m
Tharwa Dr Pedestrian Crossing	0.28	1s	A	20m	0.55	1s	A	64m
Tharwa Dr / Norman Lindsay St	1.24	287s	F	69m	1.31	360s	F	73m
Tharwa Dr / Box Hill Ave	0.63	16s	B	18m	0.63	12s	A	21m
Tharwa Dr / Pockett Ave / Knoke Ave	0.23	11s	A	4m	0.39	11s	A	8m

4.3.8 Proposed Intersection Upgrades and Performance

For the SIDRA Modelling of the future upgraded intersection, it was assumed that Tharwa Drive had been duplicated between Woodcock Drive and Pockett Avenue. As such, all the intersections showed an increase in the number of lanes on approaches and exits. Several major intersection upgrades were also modelled to resolve the performance issues identified within the base scenarios.

The intersection of Tharwa Drive and Norman Lindsay Street was upgraded from priority-controlled to signalised, with the left turn slip-lanes along the southbound and westbound legs being removed. The signalised pedestrian crossing to the north was also removed and incorporated into this intersection, with pedestrian crossing facilitated along the north and east legs.

The intersections of Tharwa Drive / Box Hill Avenue (south) and Tharwa Drive / Knoke Avenue / Pockett Avenue were modelled as both a widened roundabout and as a signalised option. For the roundabout, the central island diameter was increased to 40m to make it compliant with Austroads recommendations. Two circulating lanes were also provided around the full roundabout to facilitate the additional carriageway. For the signal options, two through lanes were assumed along both northbound and southbound approaches. The left turn movement shared one of the through lanes while right turn movements received a dedicated short lane. This allowed the right turn movements to run separately to the through movements.

With the adoption of these upgrades, the road network is expected to improve to acceptable levels for all intersections. It is noted that both the options of increasing the roundabout size and upgrading the intersections to signals will result in acceptable levels of performance, however the performance of the network is noted to be improved with the adoption of the roundabout layouts.

Table 6: 2041 Future Intersection Performance Summary - Roundabouts

Intersection	AM Peak Hour				PM Peak Hour			
	DOS	Delay	LOS	Queue	DOS	Delay	LOS	Queue
Tharwa Dr / Box Hill Ave / Woodcock Dr	0.60	8s	A	12m	0.69	7s	B	21m
Tharwa Dr Pedestrian Crossing	0.29	1s	A	12m	0.35	3s	A	27m
Tharwa Dr / Norman Lindsay St	0.39	5s	A	7m	0.41	5s	A	6m
Tharwa Dr / Box Hill Ave	0.45	7s	A	8m	0.32	5s	A	5m
Tharwa Dr / Pockett Ave / Knoke Ave	0.24	6s	A	3m	0.19	6s	A	3m

Table 7: 2041 Future Intersection Performance Summary – Traffic Signals

Intersection	AM Peak Hour				PM Peak Hour			
	DOS	Delay	LOS	Queue	DOS	Delay	LOS	Queue
Tharwa Dr / Box Hill Ave / Woodcock Dr	0.84	27s	B	88m	0.87	29s	C	114m
Tharwa Dr Pedestrian Crossing	-	-	-	-	-	-	-	-
Tharwa Dr / Norman Lindsay St	0.41	20s	B	37m	0.67	14s	A	58m
Tharwa Dr / Box Hill Ave	0.55	30s	C	69m	0.57	18s	B	62m
Tharwa Dr / Pockett Ave / Knoke Ave	0.51	36s	C	49m	0.62	39s	C	54m

Refer Appendix C for Traffic Assessment.

4.4 Environmental Assessment

A Preliminary Site Investigation (PSI) covering the project area was completed by Lanterra in November 2020, to identify and assess the potential risk of contamination and determine the suitability of the proposed road duplication works.

The scope of this PSI comprised of the following:

- Acquisition and review of desktop documentation and associated historical information to assess whether there are any known contaminating activities either on the site or on neighbouring properties.
- A review of the environmental setting with regards to geology, topography, hydrology, and hydrogeology.
- Site visit to characterise the property setting, including inspection of the site surface for obvious and visible signs of potential contamination and / or contaminant sources.
- A visual evaluation of surrounding land uses to identify any neighbouring activities which may have affected or present a potential risk to the environmental quality of the site.

Investigations across the site and its surroundings have identified two (2) areas of environmental concern (AECs):

- AEC 1 – Potential imported fill material used for the Tharwa Drive construction including, the associated road reserve.
- AEC 2 – Storage of construction and imported materials within the western verge in the southern portion of the site. Construction materials such as asphalt, gravel potentially mixed with soil is stored just southeast of the Pockett Avenue roundabout, located just outside the feasibility study area.

The contaminants of potential concern (COCPs) that may be associated with the presence of these AECs include the following:

- Total Recoverable Hydrocarbons (TRH);
- Benzene, toluene, ethylbenzene xylenes (BTEX);
- Polycyclic Aromatic Hydrocarbons (PAH);
- Organochlorine pesticides (OCP);
- Organophosphorous pesticides (OPP);
- Polychlorinated biphenyls (PCB);
- Heavy metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc);
- Phenols; and
- Asbestos.

Based on the results of the investigation, there is currently insufficient information to assess whether AEC 1 and AEC 2 are suitable for the proposed road duplication from a contamination perspective. A more detailed investigation with soil sampling is recommended to further investigate the contamination risk associated with AEC 1 and AEC 2.

Lanterra considers the remaining project area poses a low risk of contamination, and no further assessment is required.

Refer Appendix D For Environmental Assessment.

4.5 Tree Assessment

A tree assessment covering the project area was completed by EnviroLinks in November 2020. A total of 11 individual trees and 37 Groups were assessed.

The trees are predominantly Cassuarina cunnninghamiana and mixed Eucalyptus species plantings as linear tree groups, following the orientation of the existing road. There are a number of exotic trees (Populus alba and Polupus deltoides). Eucalyptus species identified on the site are Eucalyptus mannifera, Eucalyptus melliodora, Eucalyptus sideroxylon, Eucalyptus polyanthemos, Eucalyptus bridgesiana, Eucalyptus nicholii, Eucalyptus nortonii, Eucalyptus viminalis and Eucalyptus cinerea.

The assessment identified:

- 30 medium quality tree groups
- 6 medium quality individual trees
- 8 poor quality tree groups; and
- 5 poor quality individual tree.

The 30 medium quality tree groups are predominantly planted of either Casuarina cunninghamiana or mixed Eucalyptus. These make up the majority of trees within the assessment area and provide a good visual buffer to the adjoining residence. They also create a strong landscape character that focuses the view along the road. In addition, they provide shade to the pedestrian paths.

Refer Appendix E for Tree Assessment.

4.6 Noise Assessment

WSP Australia Pty Ltd has conducted a preliminary road noise assessment for the Feasibility Study of the proposed duplication of Tharwa Drive in Tuggeranong.

This noise assessment has been completed to determine the potential noise impact of the duplication of an existing road on existing residences surrounding the Project area. All assessments are conducted in accordance with the Roads ACT Noise Management Guidelines (2018).

An analysis of existing traffic volumes and a high-level assessment of potential noise impacts has been conducted to understand the implications of the Project and to understand the potential noise mitigation and managements that may be required.

The following findings are made based on analysis of the noise monitoring and traffic count results as well as review of traffic forecast (2041) and duplication concept design:

- Overall, the duplication project is not expected cause acoustically significant change in noise levels. Residential receivers to the west of the duplication are expected to experience a noise level increase of <2dB. Residential receivers to the east of the duplication are expected to experience a decrease in noise levels or minimal change.
- Residential receivers to the east of the road alignment between Woodcock Drive and Box Hill Avenue would likely experience slight decrease or minimal change in road noise levels. Consideration of noise mitigation expected not required.
- Residential receivers to the west of the road alignment between Woodcock Drive and Box Hill Avenue would likely experience increase of noise levels of <2dB, which is generally considered acoustically insignificant. However, consideration of noise mitigation expected required in strict adherence Roads ACT Noise Management Guidelines, which require road noise levels to not increase above existing levels.
- Residential receivers to the east of the road alignment between Box Hill Avenue and Pockett Avenue would likely experience slight decrease or minor change in road noise levels. Consideration of noise mitigation expected not required.
- Residential receivers to the west of the road alignment between Box Hill Avenue and Pockett Avenue would likely experience increase of noise levels of <2dB, which is generally considered acoustically insignificant. Future road noise levels are expected still be ≤60 Leq, 15hr, which is the planning guideline level of absolute road noise levels for these receivers. Consideration of noise mitigation expected not required.

Limitations: it should be noted that the findings above are based on the high level noise assessment undertaken as described in this feasibility study. These findings are subject to more detailed noise modelling and assessment in future planning stages and may change.

Refer Appendix F for Noise Assessment.

5. Statutory Planning

The duplication of Tharwa Drive is likely to be fully contained within the road reserve. ACTmapi Territory Plan overlay indicates that this corridor is classified as Transport Services Zone TSZ1. The Intertown Public Transport route extending down from the north through to Norman Lindsay Street intersection.

It is anticipated that a Development Application (DA) will be required during detailed design.



Figure 16: Territory Plan Overlay

The studies and investigations undertaken as part of this feasibility study will be also suitable for supporting the planning approval submission.

As Tharwa Drive is not a ‘Main Avenue and Approach Route’ or National Capital Authority (NCA) ‘Designated Land’, NCA Works Approval will not be required for the project.

6. Road Design

6.1 Design Standards and Criteria

Table 8: Design Criteria for Tharwa Drive

Criterion	Value	Comment
Road classification	Arterial	ACT Road Hierarchy Map
Design speed	90km/h	10km above posted speed. AUSTROADS Guide to Road Design, Part 3 Geometric Design
Posted speed	60 and 80km/h	As per current situation
Sight distance	SISD: 214m; SSD: 139m (Based on a car, R_T = 2.0s).	AUSTROADS Guide to Road Design, Part 4A Unsignalised and Signalised Intersections, Section 3 Sight Distance and AUSTROADS Guide to Road Design, Part 3 Geometric Design, Section 5.3.1 Car Stopping Sight Distance
Normal crossfall	3% down	
Superelevation	N/A	
Batter slope	1V:4H Fill 1V:4H Cut	For grass mowing. Note that this needs to be confirmed by a geotechnical investigation
Vehicular lane width	3.5m	TCCS Standards, Part 3 Road Design, Section 3.3.7 Typical Cross Section
Median width	6.0 to 8.0m	Allows adequate room for a right turn lane and carriageway separation elsewhere
Shoulder width	2.0m for exclusive bicycle lane	AUSTROADS Guide to Road Design, Part 3 Geometric Design, Section 4.8.7 Exclusive Bicycle Lanes
Clear zone	8.0m	Guide to Road Design – Part 6 Roadside Design, Safety and Barriers
Barriers	Concrete barriers over underpass	To comply with AS5100
Roadside edge	Kerb and gutter	As per current situation
Stormwater drainage	Q100 for cross drainage	TCCS Trunk Road Infrastructure Standards TRIS02 Road Design – Supplement to AUSTROADS Guide to Road Design, Part 5 Drainage, Clause 6.2
	Q10 for road drainage	TCCS Trunk Road Infrastructure Standards TRIS02 Road Design – Supplement to AUSTROADS Guide to Road Design, Part 5 Drainage, Table 4.11 Minor System Design ARI
Street lighting	Continuous along corridor	As per current situation
Horizontal Alignment		
Desirable Minimum Radius	660m for adverse crossfall	AUSTROADS Guide to Road Design, Part 3 Geometric Design, Section 7.8 Curves with Adverse Crossfall
Vertical Alignment		
Minimum desirable longitudinal grade	1%	To allow adequate drainage
Maximum desirable longitudinal grades	General – 4% to 6%	AUSTROADS Guide to Road design, Part 3 Geometric Design, Section 8.5.3 – Rolling Terrain

Minimum K values	Crest: 42.9 Sag: 26	AUSTROADS Guide to Road design, Part 3 Geometric Design, Section 8.6 Vertical Curves. Based on R_T = 2.0s. Sag value based on headlight criteria.
Noise		
Maximum level	60 dBA $LA_{eq\ 15\ hour}$	Roads ACT Noise Management Guidelines

Table 9: Design Criteria for Intersections

Criterion	Value	Comment
Design vehicles	AUSTROADS 19m Semi-trailer and Steer Tag Bus	
Check vehicle	AUSTROADS 25m B-Double	B-Double Route
Normal crossfall	3%	
Minimum Level of Service	D	TCCS Guidelines for Transport Impact Assessment

6.2 Opportunities and Constraints

6.2.1 Other Sections of Tharwa Drive

Further north on Tharwa Drive and Drakeford Drive through to Johnson Drive, the road comprises two 9m carriageways and an 8m median. All intersections are roundabouts and all the underpasses are arches with spandrel walls.

The project area also contains three roundabouts and two arch underpasses.

Consistency with existing is likely to be a consideration for selecting upgrade options.

6.2.2 Road Reserve Width

The Tharwa Drive road reserve is generally 70m wide but narrows down to 53m adjacent to the Gordon District Playing Fields.

The existing carriageway is located within the eastern portion of the corridor. The remaining road reserve width is generally adequate for a new northbound carriageway. However, there is not a huge amount of room and this may restrict the width allowance for a central median. Typically, this would vary from 6m through to 12m but may need to be restricted to say 8m. This is the minimum width that avoids the need for a central barrier whilst allowing room for right turn lanes at intersections.

Due consideration will need to be given to space requirements for earthworks batters. The proximity of the new carriageway to adjacent residents also has possible noise implications.

The Norman Lindsay road reserve width is only 16.5m wide. The narrowness is highly restrictive in terms of room available for lanes and selection of possible intersection upgrade types.

6.2.3 Alignment

The horizontal and vertical alignment of the existing Tharwa Drive would be considered a constraint in determining the location of the new carriageway. Furthermore, adequate vertical clearance is required for pedestrians and cyclists in new underpass locations.

6.2.4 Intersection Locations

The Norman Lindsay Street intersection is located relatively close to both the Woodcock Drive roundabout and the northern underpass. Selection of the upgrade for this intersection will have traffic and geometric consequences that may affect these adjacent features.

Similarly, Box Hill Avenue roundabout is very close to the southern underpass. An increase in the intersection area may force a specific and possibly limiting type of upgrade to the underpass.

6.2.5 Utility Services

Utility services and major stormwater drainage structures are generally within the eastern verge of the roadway. This limits the duplication to the western side but also restricts any possible adjustments to the existing carriageway.

6.2.6 Topography

The earthworks embankment constructed for the existing carriageway is up to 5m higher than the adjacent landform in the vicinity of the Box Hill Avenue intersection. Consideration will need to be given to the location of the new carriageway to avoid extensive earthworks batters and the requirement to import a large amount of fill material.

6.2.7 Trees

The medium quality groups and individual trees should be considered constraints as much as practicable and removal avoided. Nonetheless, there is likely to be opportunity to plant additional trees in the space remaining in the corridor after road construction has been completed.

6.2.8 Pedestrian and Cyclist Facilities

The duplication provides a good opportunity for incorporating on-road cycling into the corridor. There are also several missing pedestrian links that could be included to improve pedestrian accessibility.

6.3 Upgrade Options for Key Elements

6.3.1 Northbound Carriageway

Duplication of Tharwa Drive would involve conversion of the existing carriageway into a southbound only roadway and construction of a new northbound carriageway. Both carriageways would have two traffic lanes and a shoulder suitable for on-road cycling.

The options for the northbound carriageway primarily involve the width of the new central median. The minimum width could be as low as 6m to cater for right turn lanes at intersection, however this may require incorporation of a central barrier at some locations to avoid vehicles crossing into the other carriageway. As the alignment is relatively straight, the likelihood of vehicles crossing the median is low. The primary advantages with the narrower median are reduced earthworks, reduced impact upon trees and minimisation of crossing length for pedestrians at intersections.

Beyond 6m width the median could be increased in 2m increments up to 12m, however, there is no real advantage to going beyond 8m width.

The best solution is likely to be utilisation of a 6m median north of Box Hill Avenue intersection where the road reserve is narrower and increase to 8m in the southern section where space and topography permits.

6.3.2 Intersection Upgrades

The Woodcock Drive intersection is currently a dual lane roundabout. Potential upgrades include signalising one or more approaches or full conversion to traffic signals. As the current arrangement performs adequately in future scenarios, at this stage it is not proposed to upgrade this intersection.

The Norman Lindsay Street intersection is currently a priority control intersection. Potential upgrades include conversion to a seagull intersection or full signalisation. A roundabout is not feasible as there is insufficient room in the Norman Lindsay Street corridor. As a seagull arrangement is not preferred due to inherent safety concerns it is likely that this intersection will be fully signalised and incorporate pedestrian facilities. Any other option would require retention of the existing midblock signalised pedestrian crossing.

The Box Hill Avenue intersection is currently a single lane roundabout. Potential upgrades include conversion to a dual lane roundabout or full signalisation. Whilst conversion to a dual lane roundabout is possibly feasible, the local

topography and proximity of the southern underpass make this arrangement much more difficult. It is likely that this intersection will be fully signalised and incorporate pedestrian facilities.

The Pockett Avenue intersection is also currently a single lane roundabout. Potential upgrades include conversion to a dual lane roundabout or full signalisation. Either option is feasible, however the roundabout option is more likely to be chosen due to its superior performance.

6.3.3 Structure Types

Both northern and southern underpasses are currently precast arches with spandrel walls. The choice of new adjacent structure type is somewhat dependent upon the adjacent intersection upgrades.

Where the adjacent intersection upgrade is full signalisation, a right turn bay is required on Tharwa Drive. This right turn bay would extend over the underpass and the residual central median would be either 2.5m or 4.5m locally. As this does not allow adequate room for a completely separate structure, it is likely that the existing arch structure would need to be extended and a new spandrel wall incorporated.

Where the adjacent intersection upgrade is conversion to a dual lane roundabout, the median width flares to suit the central island and no additional right turn lane is required. In this case it may be possible to have a separate structure for the new carriageway. It is likely that this would still be arches as per the existing adjacent structure to continue the family of bridges concept.

Nonetheless, if a separate structure is selected, it is possible that this could be a precast plank bridge or Super-T bridge with low profile.

6.3.4 Staging of Duplications

It is possible to undertake a staged approach to the duplication. As the majority of the traffic is in the northern half of the project, this section of roadway should be prioritised.

A transition from dual carriageway to single carriageway could be located directly south of the southern underpass near Box Hill Avenue intersection. The transition length would be approximately 150m leaving 800m of roadway not duplicated. This would also avoid the need to upgrade the Pockett Avenue roundabout.

Notwithstanding the above, the cost saving with this approach would not be significant as big ticket items such as earthworks, structures and traffic signals are in the northern portion of the project.

7. Multi Criteria Analysis of Options

The project was divided into 8 areas for the purpose of identifying optimum upgrades along the corridor. From north to south these areas are as follows:

- Area 01 - Intersection of Tharwa Drive / Woodcock Drive / Box Hill Avenue (north).
- Area 02 – Intersection of Tharwa Drive / Norman Lindsay Street.
- Area 03 – Northern Underpass.
- Area 04 - Midblock Norman Lindsay Street and Box Hill Avenue (south).
- Area 05 - Intersection of Tharwa Drive / Box Hill Avenue (south).
- Area 06 – Southern Underpass.
- Area 07 - Midblock between Box Hill Avenue (south) and Pockett Avenue.
- Area 08 - Intersection of Tharwa Drive / Pockett Avenue / Knoke Avenue.

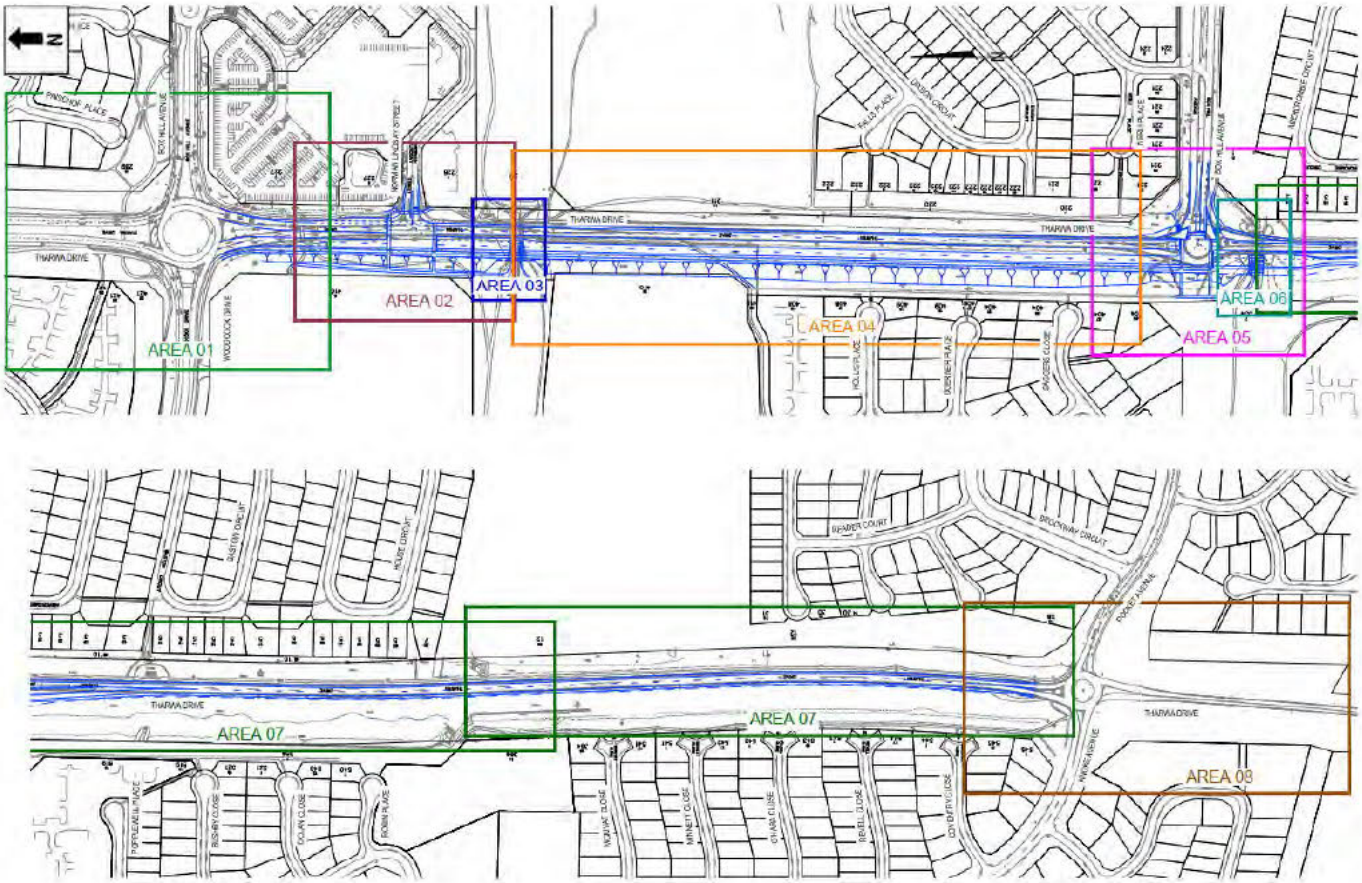


Figure 17: Project Areas

Options for each area have been compared using the following criteria:

- Traffic performance.
- Provisions for pedestrians and cyclists.
- Safety.
- Environmental impacts.
- Impact upon stormwater drainage and utility services.
- Footprint and earthworks volumes.
- Constructability.
- Likely construction cost.

The following criteria were omitted because they were found to be fundamentally the same for all options:

- Operational and maintenance costs.

8. Design Option Outcomes

8.1 Area 01 – Intersection of Tharwa Drive / Woodcock Drive / Box Hill Avenue (north)

This intersection is currently a dual lane roundabout. Options for upgrade are 'do nothing' or construct traffic signals.

The roundabout is currently functioning adequately. The geometry suits the duplication of Tharwa Drive with two lane approaches and departures on both the northern and southern legs. The roundabout also caters for future traffic volumes.

8.1.1 Traffic Performance

Both the existing roundabout layout and traffic signals perform adequately with current and predicted future traffic volumes. The roundabout has a better overall level of service.

8.1.2 Provisions for Pedestrians and Cyclists

Whilst not catering for on-road cycling the existing roundabout does have a pedestrian path network that allows for crossing of intersection legs. There is also an underpass beneath Tharwa Drive directly north of the intersection.

A traffic signals arrangement is superior for pedestrians and cyclists having dedicated facilities within the intersection on all legs.

8.1.3 Safety

The likelihood of vehicular accidents with the existing roundabout is greater than for traffic signals, however the severity of accidents is generally going to be lower with the reduced speeds associated with navigating the roundabout.

The roundabout is generally less safe for pedestrians and cyclists as they do not have dedicated facilities.

8.1.4 Environmental Impacts

There is no difference in environmental impacts between the existing roundabout and traffic signals.

8.1.5 Impact upon Stormwater Drainage and Utility Services

A conversion to traffic signals is going to have significant impact upon existing stormwater drainage and utility services. Protection and relocation of assets will be required to suit the revised intersection layout.

8.1.6 Footprint and Earthworks Volumes

The footprint of a conversion to traffic signals is likely to be similar to the existing roundabout. This is due to the layout including High Angle entry Left Turns (HALT) on each approach, required to achieve adequate intersection performance.

Earthworks volumes for a conversion to traffic signals would not be significant.

8.1.7 Constructability

Whilst there is not likely to be any significant technical issues, the conversion to traffic signals would be a major inconvenience to road users in the area during the construction period, especially as alternative routes in the area are limited.

8.1.8 Recommendation

It is recommended that this intersection remain unchanged for the foreseeable future. There is no tangible benefit in any of the upgrade options.

8.2 Area 02 – Intersection of Tharwa Drive / Norman Lindsay Street

This intersection is currently an unsignalised T and requires upgrade to suit the dual carriageway arrangement. Options for upgrade are construct a roundabout or construct traffic signals.

There is also a staggered signalised pedestrian midblock crossing in close proximity to be considered.

8.2.1 Traffic Performance

Both roundabout and traffic signals perform adequately with current and predicted future traffic volumes. The roundabout has a better overall level of service.

8.2.2 Provisions for Pedestrians and Cyclists

The roundabout does not include facilities for pedestrians and cyclists. A traffic signals arrangement is superior for pedestrians and cyclists having dedicated facilities within the intersection on all three legs.

There is an underpass south of the intersection, but this provides only a circuitous route across Tharwa Drive. If a roundabout was to be adopted, then it would be prudent to retain the stagged signalised pedestrian crossing north of the intersection.

8.2.3 Safety

The likelihood of vehicular accidents with a roundabout is greater than for traffic signals, however the severity of accidents is generally going to be lower with the reduced speeds associated with navigating the roundabout.

The roundabout is generally less safe for pedestrians and cyclists as they do not have dedicated facilities.

8.2.4 Environmental Impacts

The roundabout requires more tree removals than traffic signals due to its larger footprint.

8.2.5 Impact upon Stormwater Drainage and Utility Services

A roundabout is likely to have a greater impact upon existing stormwater drainage and utility services due to its larger footprint. Protection and relocation of assets will be required irrespective of the option selected.

8.2.6 Footprint and Earthworks Volumes

The roundabout central island radius would need to be 20m to suit the design speed and carriageway arrangements. This combined with a circulating lane width of 10.2m to suit B-doubles, the overall footprint would be considerably bigger than traffic signals, taking up all the road reserve width on both Tharwa Drive and Norman Lindsay Street.

Earthworks volumes for both options will be significant.

8.2.7 Constructability

Whilst there is not likely to be any significant technical issues, the conversion to either roundabout or traffic signals would be a major inconvenience to road users in the area during the construction period, especially as alternative routes in the area are limited.

8.2.8 Other

Geometry requirements associated with traffic signals may limit the options available for upgrading the underpass directly south of the intersection.

8.2.9 Recommendation

It is recommended that the intersection be upgraded to traffic signals.

8.3 Area 03 – Northern Underpass

The existing northern underpass comprises precast arches with spandrel walls on each side. Options for upgrade are extend arch structure, construct a separate arch structure or construct a separate plank bridge.

8.3.1 Traffic Performance

A right turn lane on Tharwa Drive is required if the Norman Lindsay Street intersection is upgraded to traffic signals. The geometry required is more readily achieved if the existing arch is extended allowing a minimum median width for the roadway.

8.3.2 Provisions for Pedestrians and Cyclists

If carefully designed, all options provide for pedestrians and cyclist on and below Tharwa Drive.

A separate plank bridge would need to achieve the minimum 2.5m vertical clearance for pedestrians as per the arch options.

8.3.3 Safety

Extending of the existing arch structure would minimise the length of structure for pedestrians travelling beneath Tharwa Drive and possibly be less appealing for unsocial behaviour. This option also avoids the need for barriers on the Tharwa Drive roadway in the median.

A separate arch or plank bridge provides more natural light into the underpass improving visibility for pedestrians and cyclists.

8.3.4 Environmental Impacts

A separate arch or plank bridge may require more tree removals due to the larger overall footprint and increased separation from the existing roadway.

8.3.5 Impact upon Stormwater Drainage and Utility Services

All options have similar impacts upon existing stormwater drainage and utility services. Protection and relocation of assets will be required irrespective of the option selected.

8.3.6 Footprint and Earthworks Volumes

Extending the existing arch minimises the overall length of underpass. Separate structures require barriers and inner shoulder in the median adjacent to the void between new and existing.

Earthworks volumes will consequently be greater for separate structures.

8.3.7 Constructability

None of the three options have any particular technical issues associated with construction. Stability of the existing structure will need to be considered regardless of option selected. Construction methodology will need be developed for accessibility, physical space and level requirements for piling rigs and cranes for installation of precast units.

The existing median may need to be removed to allow adequate space for vehicular traffic if widening the existing arch.

A separate plank bridge is likely to be slightly more complicated due to the requirement to cast abutments etc in-situ.

8.3.8 Other

A separate plank bridge is likely to be less aesthetically pleasing than an arch structure.

8.3.9 Recommendation

It is recommended that the existing arch is extended.

8.4 Area 04 – Midblock Norman Lindsay Street and Box Hill Avenue (south)

This section of Tharwa Drive is currently one lane in each direction and requires duplication. Options for upgrade are duplication on the west side with an 6m median or duplication on the west side with an 8m median.

8.4.1 Traffic Performance

The median width selected has no appreciable effect on traffic performance.

8.4.2 Provisions for Pedestrians and Cyclists

The median width selected has no appreciable effect on provisions for pedestrians and cyclists.

8.4.3 Safety

The 8m median provides a safer road environment than the narrower 6m median due to the increased separation of opposing traffic.

A 6m median allows for incorporation of a central barrier to prevent vehicles crossing into the opposing carriageway. As the alignment is relatively straight with large radius curves, a central barrier is probably not necessary.

8.4.4 Environmental Impacts

The 6m median marginally reduces noise levels experienced by adjacent residents, compared to an 8m median, as the roadway is two metres further away.

The 8m wide median requires more tree removals due to the larger overall footprint and new carriageway being pushed further west into the trees.

8.4.5 Impact upon Stormwater Drainage and Utility Services

Both options have similar impacts upon existing stormwater drainage and utility services. Protection and relocation of assets will be required irrespective of the option selected.

As the new carriageway is on the western side, most existing utility services are unaffected.

8.4.6 Footprint and Earthworks Volumes

The 8m median has a greater overall footprint than the 6m median. The extra 2m increases earthworks volumes in this area significantly.

8.4.7 Constructability

Constructability is not appreciably different between the two median width options, however availability of the extra imported material associated with the wider median will need to be considered.

8.4.8 Recommendation

It is recommended that 6m median be adopted.

8.5 Area 05 – Intersection of Tharwa Drive / Box Hill Avenue (south)

This intersection is currently a single lane roundabout suitable for a single carriageway only. Options for upgrade are construct a larger roundabout or construct traffic signals.

8.5.1 Traffic Performance

Both roundabout and traffic signals perform adequately with current and predicted future traffic volumes. The roundabout has a better overall level of service.

8.5.2 Provisions for Pedestrians and Cyclists

The roundabout does not include facilities for pedestrians and cyclists. A traffic signals arrangement is superior for pedestrians and cyclists having dedicated facilities within the intersection on all three legs.

There is an underpass south of the intersection, but this provides only a circuitous route across Tharwa Drive.

8.5.3 Safety

The likelihood of vehicular accidents with a roundabout is greater than for traffic signals, however the severity of accidents is generally going to be lower with the reduced speeds associated with navigating the roundabout.

The roundabout is generally less safe for pedestrians and cyclists as they do not have dedicated facilities.

8.5.4 Environmental Impacts

The roundabout requires more tree removals than traffic signals due to its larger footprint.

8.5.5 Impact upon Stormwater Drainage and Utility Services

A roundabout is likely to have a greater impact upon existing stormwater drainage and utility services due to its larger footprint. Protection and relocation of assets will be required irrespective of the option selected.

8.5.6 Footprint and Earthworks Volumes

The roundabout central island radius would need to be 20m to suit the design speed and carriageway arrangements. This combined with a circulating lane width of 10.2m to suit B-doubles, the overall footprint would be considerably bigger than traffic signals, taking up all the road reserve width on both Tharwa Drive and Box Hill Avenue.

Earthworks volumes would be significantly more for the roundabout due to the increased footprint.

8.5.7 Constructability

Whilst there is not likely to be any significant technical issues, the conversion to either roundabout or traffic signals would be a major inconvenience to road users in the area during the construction period, especially as alternative routes in the area are limited.

8.5.8 Other

Geometry requirements associated with traffic signals may limit the options available for upgrading the underpass directly south of the intersection.

8.5.9 Recommendation

It is recommended that the intersection be upgraded to traffic signals.

8.6 Area 06 – Southern Underpass

The existing southern underpass comprises precast arches with spandrel walls on each side. Options for upgrade are extend arch structure, construct a separate arch structure or construct a separate plank bridge.

8.6.1 Traffic Performance

A right turn lane on Tharwa Drive is required if the Box Hill Avenue intersection is upgraded to traffic signals. The geometry required is more readily achieved if the existing arch is extended allowing a minimum median width for the roadway.

8.6.2 Provisions for Pedestrians and Cyclists

If carefully designed, all options provide for pedestrians and cyclist on and below Tharwa Drive.

A separate plank bridge would need to achieve the minimum 2.5m vertical clearance for pedestrians as per the arch options.

8.6.3 Safety

Extending of the existing arch structure would minimise the length of structure for pedestrians travelling beneath Tharwa Drive and possibly be less appealing for unsocial behaviour. This option also avoids the need for barriers on the Tharwa Drive roadway in the median.

A separate arch or plank bridge provides more natural light into the underpass improving visibility for pedestrians and cyclists.

8.6.4 Environmental Impacts

A separate arch or plank bridge may require more tree removals due to the larger overall footprint and increased separation from the existing roadway.

8.6.5 Impact upon Stormwater Drainage and Utility Services

All options have similar impacts upon existing stormwater drainage and utility services. Protection and relocation of assets will be required irrespective of the option selected.

8.6.6 Footprint and Earthworks Volumes

Extending the existing arch minimises the overall length of underpass. Separate structures require barriers and inner shoulder in the median adjacent to the void between new and existing. This would be complicated by the proximity of the Box Hill Avenue intersection directly north.

Earthworks volumes will consequently be greater for separate structures.

8.6.7 Constructability

None of the three options have any particular technical issues associated with construction. Stability of the existing structure will need to be considered regardless of option selected. Construction methodology will need be developed for accessibility, physical space and level requirements for piling rigs and cranes for installation of precast units.

A separate plank bridge is likely to be slightly more complicated due to the requirement to cast abutments etc in-situ.

8.6.8 Other

A separate plank bridge is likely to be less aesthetically pleasing than an arch structure.

8.6.9 Recommendation

It is recommended that the existing arch is extended.

8.7 Area 07 – Midblock Box Hill Avenue (south) to Pockett Avenue

This section of Tharwa Drive is currently one lane in each direction. Options for upgrade are merge back to a single carriageway, duplication on the west side with an 6m median or duplication on the west side with an 8m median.

8.7.1 Traffic Performance

A single carriageway is adequate for traffic volumes in the foreseeable future. The median width selected for duplication options has no appreciable effect on traffic performance.

8.7.2 Provisions for Pedestrians and Cyclists

One carriageway does not adequately provide for on-road cycling. The median width selected for duplication options has no appreciable effect on provisions for pedestrians and cyclists.

8.7.3 Safety

A single carriageway is the least safe option with no separation between opposing traffic.

A 6m median allows for incorporation of a central barrier to prevent vehicles crossing into the opposing carriageway. As the alignment is relatively straight with large radius curves, a central barrier is probably not necessary.

The 8m median provides a safer road environment than the narrower 6m median due to the increased separation of opposing traffic.

8.7.4 Environmental Impacts

A merge back to single carriageway has minimal environmental impacts.

The 6m median marginally reduces noise levels experienced by adjacent residents, compared to an 8m median, as the roadway is two metres further away.

The 8m wide median requires more tree removals due to the larger overall footprint and new carriageway being pushed further west into the trees.

8.7.5 Impact upon Stormwater Drainage and Utility Services

A merge back to single carriageway has minimal impact upon existing assets.

Both duplication options have similar impacts upon existing stormwater drainage and utility services. Protection and relocation of assets will be required irrespective of the option selected.

As the new carriageway is on the western side, most existing utility services are unaffected by duplication.

8.7.6 Footprint and Earthworks Volumes

The 8m median has a greater overall footprint than the 6m median. The extra 2m increases earthworks volumes in this area significantly.

8.7.7 Constructability

Constructability is not appreciably different between the two duplication options, however availability of the extra imported material associated with the wider median will need to be considered.

8.7.8 Recommendation

It is recommended that a merge back to a single carriageway be adopted. There is no tangible benefit in duplicating this section of roadway.

8.8 Area 08 – Intersection of Tharwa Drive / Pockett Avenue / Knoke Avenue

This intersection is currently a single lane roundabout. Options for upgrade are 'do nothing' or construct a larger roundabout or construct traffic signals.

This intersection only requires upgrade if the section of Tharwa Drive directly north is duplicated.

8.8.1 Traffic Performance

All options perform adequately with current and predicted future traffic volumes. The larger roundabout has a better overall level of service.

8.8.2 Provisions for Pedestrians and Cyclists

The roundabout does not include facilities for pedestrians and cyclists. A traffic signals arrangement is superior for pedestrians and cyclists having dedicated facilities within the intersection on all four legs.

8.8.3 Safety

The likelihood of vehicular accidents with the existing roundabout is greater than for traffic signals, however the severity of accidents is generally going to be lower with the reduced speeds associated with navigating the roundabout.

The roundabout is generally less safe for pedestrians and cyclists as they do not have dedicated facilities.

8.8.4 Environmental Impacts

The 'do nothing' option has no environmental impacts.

The larger roundabout requires more tree removals than traffic signals due to its larger footprint.

8.8.5 Impact upon Stormwater Drainage and Utility Services

Any upgrade option is going to have impact upon existing stormwater drainage and utility services. Protection and relocation of assets will be required to suit the revised intersection layout.

8.8.6 Footprint and Earthworks Volumes

The larger roundabout central island radius would need to be 20m to suit the design speed and carriageway arrangements. This combined with a circulating lane width of 10.2m to suit B-doubles, the overall footprint would be considerably bigger than traffic signals. Nonetheless, there is adequate room in the road reserve for this option.

Earthworks volumes for any upgrade would not be significant.

8.8.7 Constructability

Whilst there is not likely to be any significant technical issues, any upgrade would be a major inconvenience to road users in the area during the construction period, especially as alternative routes in the area are limited.

8.8.8 Recommendation

It is recommended that this intersection remain unchanged for the foreseeable future. There is no tangible benefit in any of the upgrade options.

An upgrade would only be needed if duplication of Tharwa Drive directly north of this intersection was required.

8.9 Summary of Recommendations

Refer Table 10 for a summary of recommendations for each area.

Table 10: Design Options Outcome Summary

Area	Options	Recommendation	Rationale
Area 01 - Intersection of Tharwa Drive / Woodcock Drive / Box Hill Avenue (north)	• Do nothing • Traffic signals	Do nothing	There is no tangible benefit to upgrading the intersection
Area 02 – Intersection of Tharwa Drive / Norman Lindsay Street	• Large roundabout • Traffic signals and removal of midblock signalised staged pedestrian crossing	Traffic signals	There is insufficient room in the road corridor for a roundabout at this location
Area 03 – Northern Underpass	• Extend arch structure • Separate arch structure • Separate plank bridge	Extend arch structure	Extension of the arch structure avoids the need for median barriers, minimises environmental impacts, overall footprint and earthworks volumes
Area 04 - Midblock Norman Lindsay Street and Box Hill Avenue (south)	• Duplication on west side with 6m median • Duplication on west side with 8m median	Duplication on west side with 6m median	The 6m median minimises environmental impacts, overall footprint and earthworks volumes. The straight alignment mitigates safety issues associated with vehicles crossing the median into oncoming traffic
Area 05 - Intersection of Tharwa Drive / Box Hill Avenue (south)	• Larger roundabout • Traffic signals	Traffic signals	Extension of the arch structure avoids the need for median barriers, minimises environmental impacts, overall footprint and earthworks volumes
Area 06 – Southern Underpass	• Extend arch structure • Separate arch structure • Separate plank bridge	Extend arch structure	Extension of the arch structure avoids the need for median barriers, minimises environmental impacts, overall footprint and earthworks volumes
Area 07 - Midblock between Box Hill Avenue (south) and Pockett Avenue	• Merge back to single carriageway • Duplication on west side with 6m median • Duplication on west side with 8m median	Merge back to single carriageway	There is no tangible benefit to duplication of this section of roadway
Area 08 - Intersection of Tharwa Drive / Pockett Avenue / Knoke Avenue	• Do nothing • Larger roundabout • Traffic signals	Do nothing	There is no tangible benefit to upgrading the intersection. An upgrade would only be needed if duplication of Tharwa Drive directly north of this intersection was required

9. Construction

9.1 Staging

Construction would most likely follow the following staging sequence:

- Establish site compound. A suitable location would be near the Pockett Avenue roundabout.
- Implement temporary traffic management measures. This would likely include a posted speed reduction. There may be a requirement to incorporate concrete barriers adjacent to the works to increase worker safety.
- Tree removals, clearing and grubbing.
- Implement sediment and erosion control measures such as silt fences and sump inlet protection.
- Construct stormwater drainage management systems such as temporary diversion drains and dams.
- Utility services relocations.
- Construct underpasses and modifications to floodways.
- Undertake earthworks.
- Installation of road drainage.
- Pavement works.
- Road furniture including safety barriers and street lighting.
- Linemarking and signage.
- Placement of topsoil, grassing, consolidation and maintenance.

9.2 Timing

Construction timing is currently unknown but could potentially occur as soon as 2021 should funding become available.

It is envisaged that the detail design would take approximately six months. The construction is likely to take 12 months.

10. Opinion of Probable Costs

10.1 Cost Estimate Assumptions

The following assumptions and allowances have been made in the preparation of the Opinion of Cost:

- The costing is based upon the recommendations from Section 8.
- All values are inclusive of GST.
- Rates used are current at the time of this design and assume construction in 2021.
- Rates used are an average of tender rates received from the JGD3B project.
- Fees for design, procurement and contract administration and surveillance are not included.

10.2 Cost Estimate

A cost estimation has been prepared for the project and is summarised as follows:

Section Description	Estimated Cost
[redacted]	

Construction cost for complete duplication is estimated to be approximately [redacted] without contingency). This includes full dual carriageway south of Box Hill Avenue (south) intersection and upgrade of the Pockett Avenue intersection to suit.

11. Limitations and Further Work

11.1 Limitations

The following is a list of unresolved issues:

- Requirements for utility service relocations.
- Completion of the geotechnical subsurface conditions to determine parameters for pavement design, earthworks slopes and structures foundation.
- Availability of fill material for earthworks.
- Availability of precast arch units.

11.2 Further Design Work

Following completion of this feasibility study further design phase work is required including:

- Cost Benefit Analysis.
- Preliminary Sketch Plan (PSP) design.

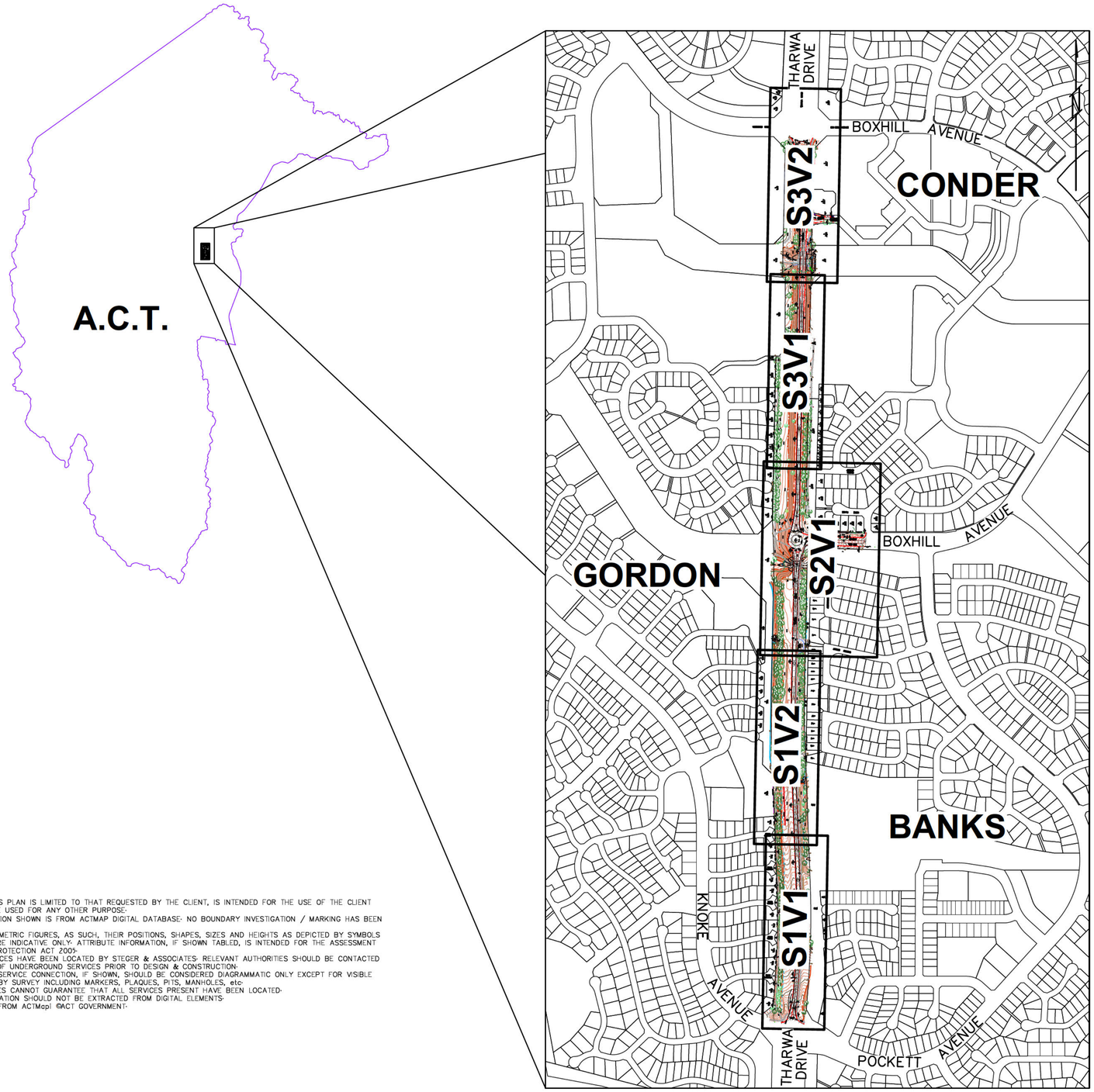
Appendix A Topographic Survey and Utility Tracing

THARWA DRIVE DUPLICATION

FEATURE SURVEY

LEGEND

- COMMUNICATION–MANHOLE – PMG
- COMMUNICATION–PILLAR
- COMMUNICATION–PIT
- ELECTRICITY–EARTH ROD
- ELECTRICITY–FUSE BOX
- ELECTRICITY–MINI PILLAR
- ELECTRICITY–PIT
- ELECTRICITY–POLE & LIGHT
- ELECTRICITY–STREET LIGHT
- GAS–CATHODE POST
- GAS–MARKER PLAQUE
- GAS–MARKER POST
- GAS–MARKER SIGN
- GAS–VALVE
- MINOR STRUCTURE–BOLLARD
- ROAD–SIGNAL CONTROL BOX
- ROAD–SIGNAL LIGHT
- ROAD–SIGNAL MANHOLE
- SEWERAGE–MANHOLE
- SEWERAGE–VENT
- SIGNAGE–ONE POST
- SIGNAGE–THREE POST
- SIGNAGE–TWO POST
- STORM WATER–GRATED PIT
- STORM WATER–MANHOLE
- STORM WATER–SUBSOIL
- STORM WATER–SUMP
- VEGETATION–SHRUB
- VEGETATION–TREE
- WATER SERVICE–HYDRANT
- WATER SERVICE–STOP VALVE
- MINOR STRUCTURE–FENCE
- MINOR STRUCTURE–LOG BARRIER
- ROAD–GUARD RAIL
- ROAD–KERB BACK
- ROAD–KERB INVERT
- ROAD–KERB LIP
- ROAD–KERB TOP
- ROAD–SIGNAL CONTROL BOX
- ROAD–SIGNAL DETECTOR
- ROAD–TRACK
- SIGNAGE–TWO POST
- STORM WATER–CULVERT BOX
- STORM WATER–SPOON DRAIN
- STORM WATER–SUMP
- STORM WATER–WATER COURSE
- TOPOGRAPHIC–BOTTOM OF BANK
- TOPOGRAPHIC–TOP OF BANK
- TRAFFIC–LINE BARRIER (B1)
- TRAFFIC–LINE BARRIER (B4)
- TRAFFIC–LINE BARRIER (B5)
- TRAFFIC–LINE CHEVRON WHITE
- TRAFFIC–LINE CONTINUITY (C1)
- TRAFFIC–LINE CONTINUITY (C3)
- TRAFFIC–LINE DASHED
- TRAFFIC–LINE EDGE (E3)
- TRAFFIC–LINE HOLD (HL1)
- TRAFFIC–LINE LANE (L1)
- TRAFFIC–LINE MERGE (M1)
- TRAFFIC–LINE MERGE (M2)
- TRAFFIC–LINE SEPERATION (S1–12)
- TRAFFIC–LINE SEPERATION (S1–24)
- TRAFFIC–LINE SEPERATION (S2)
- TRAFFIC–LINE SOLID
- TRAFFIC–LINE STOP (SL1)
- VEGETATION–DRIPLINE
- VEGETATION–HEDGE



NOTES:

- INFORMATION ON THIS PLAN IS LIMITED TO THAT REQUESTED BY THE CLIENT, IS INTENDED FOR THE USE OF THE CLIENT AND SHOULD NOT BE USED FOR ANY OTHER PURPOSE.
- BOUNDARY INFORMATION SHOWN IS FROM ACTMAP DIGITAL DATABASE. NO BOUNDARY INVESTIGATION / MARKING HAS BEEN UNDERTAKEN.
- TREES ARE NOT GEOMETRIC FIGURES, AS SUCH, THEIR POSITIONS, SHAPES, SIZES AND HEIGHTS AS DEPICTED BY SYMBOLS ON THIS DRAWING ARE INDICATIVE ONLY. ATTRIBUTE INFORMATION, IF SHOWN TABLED, IS INTENDED FOR THE ASSESSMENT OF THE ACT TREE PROTECTION ACT 2005.
- UNDERGROUND SERVICES HAVE BEEN LOCATED BY STEGER & ASSOCIATES. RELEVANT AUTHORITIES SHOULD BE CONTACTED FOR THE LOCATION OF UNDERGROUND SERVICES PRIOR TO DESIGN & CONSTRUCTION.
- ANY UNDERGROUND SERVICE CONNECTION, IF SHOWN, SHOULD BE CONSIDERED DIAGRAMMATIC ONLY EXCEPT FOR VISIBLE FEATURES LOCATED BY SURVEY INCLUDING MARKERS, PLAQUES, PITS, MANHOLES, etc.
- STEGER & ASSOCIATES CANNOT GUARANTEE THAT ALL SERVICES PRESENT HAVE BEEN LOCATED.
- DIMENSIONAL INFORMATION SHOULD NOT BE EXTRACTED FROM DIGITAL ELEMENTS.
- IMAGERY IF SHOWN FROM ACTMapi ©ACT GOVERNMENT.

AMENDMENTS	SURVEY	DRAWN	CHECK	APPROVED	ZONE	SURVEY	ISSUE
ORIGINAL ISSUE	■	■	■	■		23/10/20	26/10/20
A							
B							
C							
D							
E							

Notes:
TREE TABLE IS ON SHEET 4

Surveyor Registered Under
the ACT Surveyors Act 2007

DRAWING NUMBER	DRAWING DESCRIPTION
001	Feature Survey
002	Locality
003	Stormwater & Sewer
004	Utilities
005	Excavation - Pitpoles
006	Excavation - Trenches
007	Survey Control - Vertical
008	Survey Control - Horizontal
009	Triangulation
010	Scanning (Road Quality)

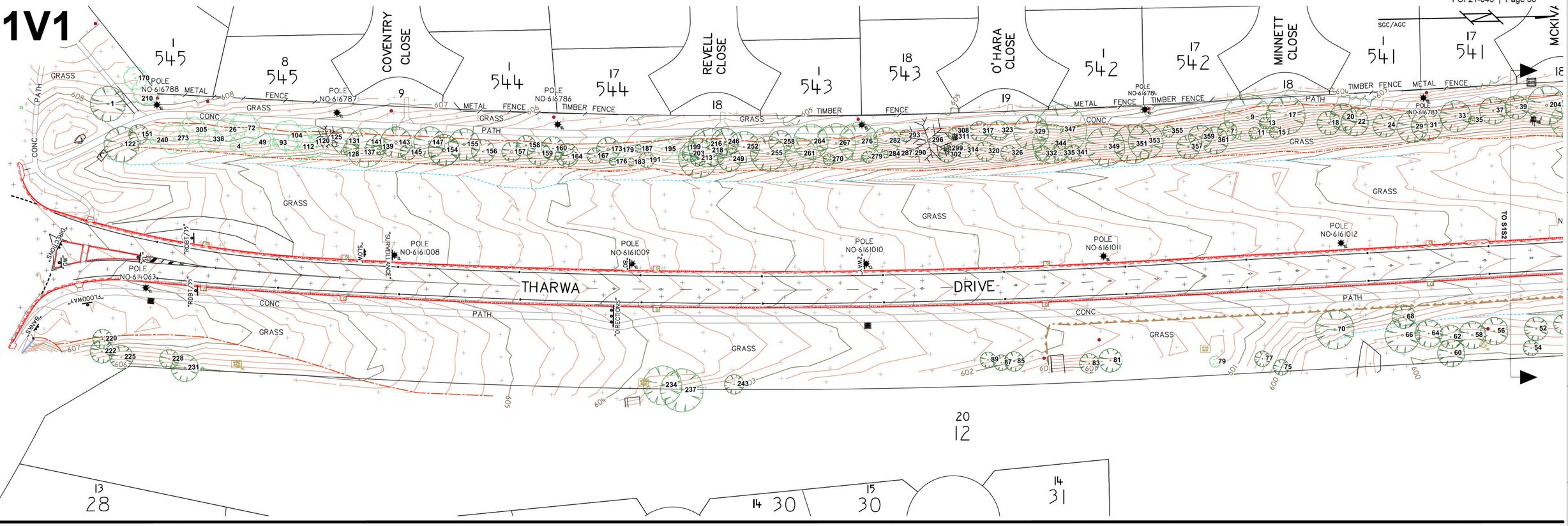
Prepared By:
STEGER & ASSOCIATES
registered land surveyors
Unit 2, 10 Kett Street
KAMBAH ACT 2902
PO Box 2001
KAMBAH ACT 2902
P - (02) 6296 4089
F - (02) 6296 4090
enquiries@steger.com.au
www.steger.com.au
ABN 12 920 463 267

Client:
calibre
GPO BOX 261
CANBERRA
ACT 2601

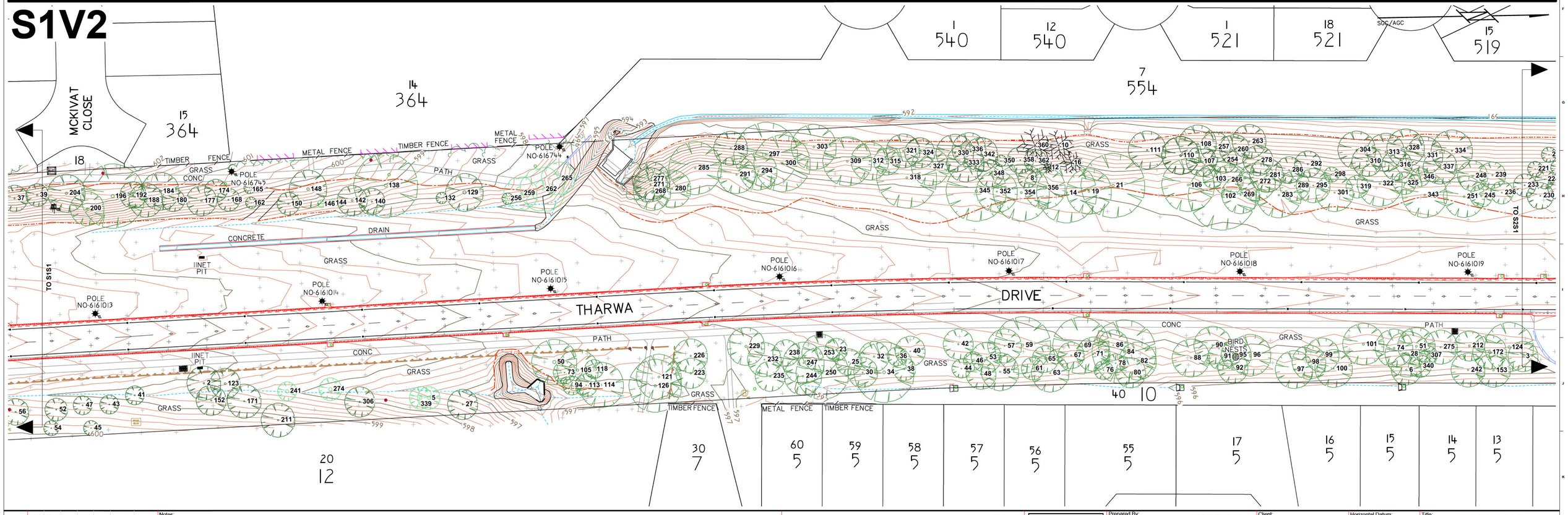
Horizontal Datum: SGC/AGC
Vertical Datum:
MARK: SR796
LEVEL: RL596.117
SYSTEM: AHD 71
Contour Interval: 0.20m

Title: **THARWA DRIVE**
FEATURE SURVEY
DISTRICT: TUGGERNANONG
Job: 20038 Scale (metres): 1:500 0 2.5 5 10 15
Sheet: 0 of 4 Size: A1 Drawing: 20038_001.dwg

S1V1



S1V2



ORIGINAL ISSUE	SURVEY	DRAWN	CHECK	APPROVED	ZONE	SURVEY	ISSUE
	■	■	■	■		23/10/20	26/10/20
AMENDMENTS A							
B							
C							
D							
E							

Notes:
TREE TABLE IS ON SHEET 4

S1V1 | S1V2 | S2V1 | S3V1 | S3V2

DRAWING NUMBER	DRAWING DESCRIPTION
001	Feature Survey
002	Cadastre
003	Stormwater & Sewer
004	Utilities
005	Excavation - Pipelines
006	Excavation - Structures
007	Survey Control - Vertical
008	Survey Control - Horizontal
009	Triangulation
010	Scanning (Point Clouds)

Prepared By:
STEGER & ASSOCIATES registered land surveyors
Unit 2, 10 Kett Street
KAMBAH ACT 2902
PO Box 2001
KAMBAH ACT 2902
P - (02) 6296 4089
F - (02) 6296 4090
enquiries@steger.com.au
www.steger.com.au
ABN 12 920 463 267

Client:
calibre
GPO BOX 261
CANBERRA
ACT 2601

Horizontal Datum: SGC/AGC
Vertical Datum:
MARK: SR796
LEVEL: RL596.117
SYSTEM: AHD 71
Contour Interval: 0.20m

Title:
THARWA DRIVE
FEATURE SURVEY
DISTRICT: TUGGERANONG

Job: 20038
Scale (metres): 1:500 0 2.5 5 10 15
Sheet: 1 of 4
Size: A1
Drawing: 20038_001.dwg

S2V1

THARWA DRIVE

ABERCROMBIE CIRCUIT

BASTOW CIRCUIT

BOX HILL AVENUE

NERLI PLACE

DIXSON CIRCUIT

METAL FENCE

GRASS

CONC

PATH

GRAVEL

TIMBER FENCE

"POLLUTION TRAP"

"FLOODWAY"

"GORDON"

"DIRECTIONS"

"CHEVRON"

"BANKS"

"GW"

"BOX HILL FEINT"

POLE NO-6161022

POLE NO-616377

POLE NO-613169

POLE NO-616379

POLE NO-6161023

POLE NO-6161024

POLE NO-613170

POLE NO-316168

POLE NO-614026

POLE NO-613167

POLE NO-614025

NBN PILLAR

NBN PIT

NBN ELEC PIT

TELSTRA PIT

TO S1S2

TO S3S1

SGC/AGC

DRAWING NUMBER	DRAWING DESCRIPTION
001	Feature Survey
002	Cadastre
003	Stormwater & Sewer
004	Utilities
005	Excavation - Pothole
006	Excavation - Services
007	Survey Control - Vertical
008	Survey Control - Horizontal
009	Triangulation
010	Scanning (Point Clouds)

S1V1 | S1V2 | S2V1 | S3V1 | S3V2

ORIGINAL ISSUE	SURVEY	DRAWN	CHECK	APPROVED	ZONE	SURVEY	ISSUE
						23/10/20	26/10/20
AMENDMENTS A							
B							
C							
D							
E							

Notes:
TREE TABLE IS ON SHEET 4

Prepared By:
STEGER & ASSOCIATES registered land surveyors
Unit 2, 10 Kett Street
KAMBAH ACT 2902
PO Box 2001
KAMBAH ACT 2902
P - (02) 6296 4089
F - (02) 6296 4090
enquiries@steger.com.au
www.steger.com.au
ABN 12 920 463 267

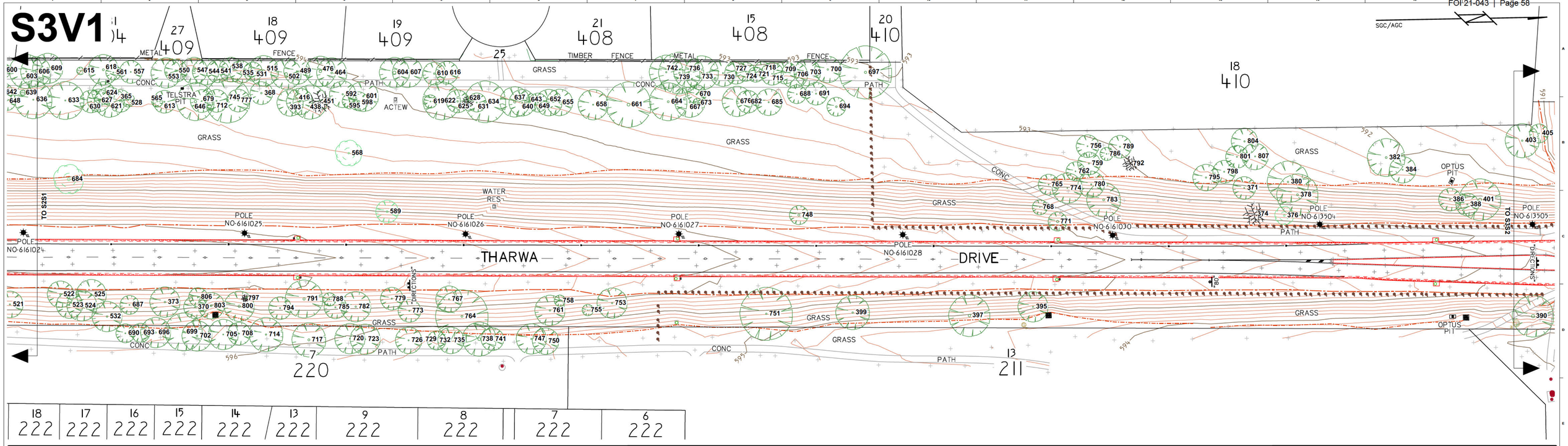
Client:
calibre
GPO BOX 261
CANBERRA
ACT 2601

Horizontal Datum: SGC/AGC
Vertical Datum:
MARK: SR796
LEVEL: RL596.117
SYSTEM: AHD 71
Contour Interval: 0.20m

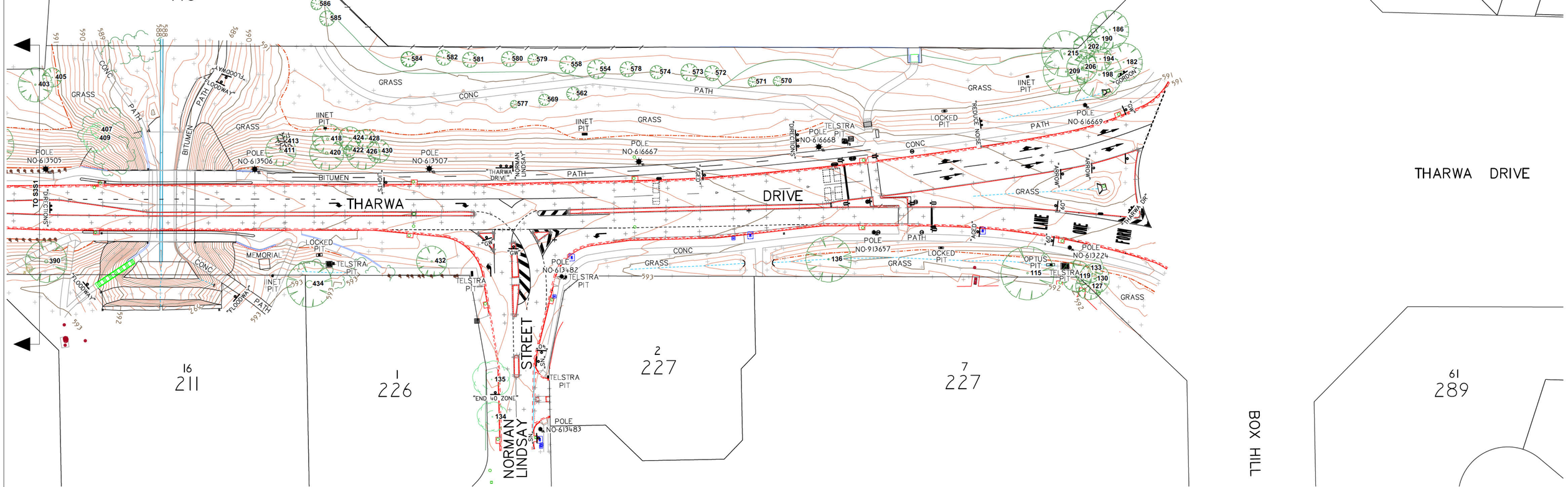
Title:
THARWA DRIVE
FEATURE SURVEY
DISTRICT: TUGGERNANONG

Job: 20038
Scale (metres): 1:500 0 2.5 5 10 15
Sheet: 2 of 4
Size: A1
Drawing: 20038_001.dwg

S3V1



S3V2



ORIGINAL ISSUE	SURVEY	DRAWN	CHECK	APPROVED	ZONE	SURVEY	ISSUE
	■	■	■	■		23/10/20	26/10/20
A							
B							
C							
D							
E							

AMENDMENTS

Notes:
TREE TABLE IS ON SHEET 4

S1V1 | S1V2 | S2V1 | S3V1 | S3V2

DRAWING NUMBER	DRAWING DESCRIPTION
001	Feature Survey
002	Cadastre
003	Stormwater & Sewer
004	Utilities
005	Excavation - Pipelines
006	Excavation - Structures
007	Survey Control - Vertical
008	Survey Control - Horizontal
009	Triangulation
010	Scanning (Road Kerb Audit)

Prepared By:
STEGER & ASSOCIATES
registered land surveyors
Unit 2, 10 Kett Street
KAMBAH ACT 2902
PO Box 2001
KAMBAH ACT 2902
P - (02) 6296 4089
F - (02) 6296 4090
enquiries@steger.com.au
www.steger.com.au
ABN 12 920 463 267

Client:
calibre
GPO BOX 261
CANBERRA
ACT 2601

Horizontal Datum: SGC/AGC
Vertical Datum:
MARK: SR796
LEVEL: RL596.117
SYSTEM: AHD 71
Contour Interval: 0.20m

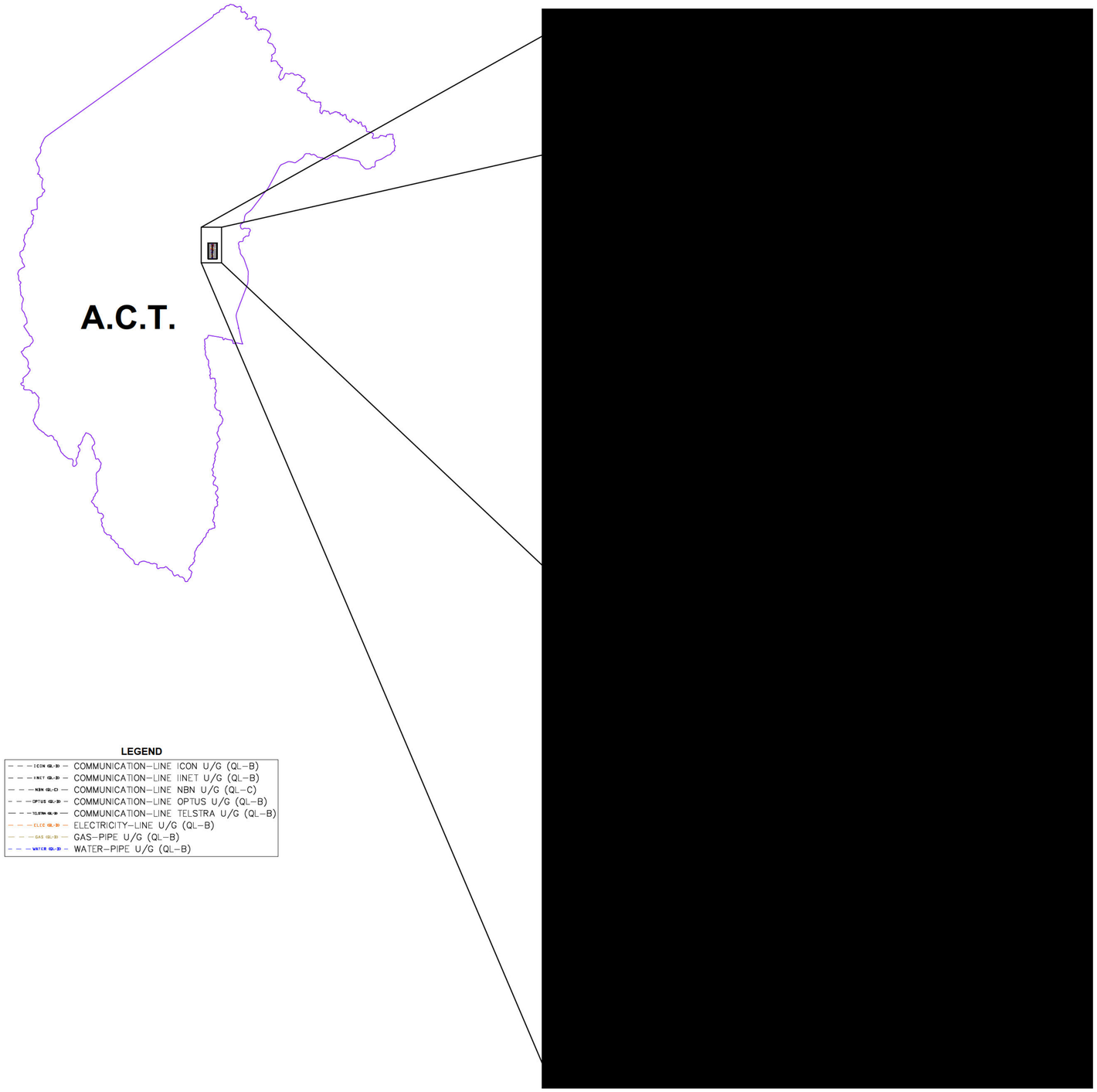
Title:
THARWA DRIVE
FEATURE SURVEY
DISTRICT: TUGGERNANONG

Job: 20038
Scale (metres): 1:500 (0 2.5 5 10 15)
Sheet: 3 of 4
Size: A1
Drawing: 20038_001.dwg

Tree No.	Easting	Northing	Trunk Dia.(m)	Canopy Dia.(m)	Type	Height.(m)	No. Trunks
1	207260.86	582591.96	0.44	9.0	CASUARINA	14.0	1
2	207319.01	582995.09	0.38	9.0	CASUARINA	12.0	1
3	207318.53	583345.16	0.42	8.0	EUCALYPT	14.0	1
4	207272.45	582623.94	0.25	2.0	DECIDUOUS	5.0	3
5	207324.04	583054.35	0.80	6.0	POPLAR	23.0	4
6	207321.48	583312.29	0.39	8.0	EUCALYPT	12.0	1
7	207273.34	582878.04	0.23	5.0	CASUARINA	12.0	1
8	207319.90	583213.35	0.19	5.0	CASUARINA	10.0	1
9	207269.87	582883.22	0.53	12.0	EUCALYPT	14.0	1
10	207260.50	583221.69	0.35	8.0	DEAD	25.0	1
11	207273.81	582884.97	0.08	3.0	CASUARINA	5.0	1
12	207266.27	583219.01	0.21	3.0	DEAD	9.0	1
13	207271.36	582887.71	0.08	3.0	CASUARINA	6.0	1
14	207273.00	583223.63	0.42	16.0	EUCALYPT	15.0	1
15	207273.79	582890.25	0.08	3.0	CASUARINA	8.0	1
16	207265.08	583224.97	0.32	6.0	DEAD	17.0	1
17	207269.48	582893.03	0.46	10.0	CASUARINA	16.0	1
18	207271.61	582903.97	0.40	6.0	CASUARINA	12.0	2
19	207272.82	583229.49	0.42	12.0	EUCALYPT	17.0	1
20	207270.23	582907.78	0.42	7.0	CASUARINA	11.0	2
21	207271.39	582925.86	0.66	17.0	EUCALYPT	20.0	1
22	207271.55	582910.64	0.42	7.0	CASUARINA	12.0	3
23	207313.31	583162.04	0.20	6.0	EUCALYPT	12.0	1
24	207272.53	582918.20	0.28	6.0	CASUARINA	12.0	1
25	207316.60	583215.28	0.20	7.0	EUCALYPT	12.0	1
26	207268.09	582622.00	0.32	6.0	DECIDUOUS	13.0	1
27	207325.90	582863.24	0.29	8.0	CASUARINA	11.0	1
28	207317.95	583312.75	0.60	12.0	EUCALYPT	17.0	3
29	207273.07	582925.36	0.30	8.0	CASUARINA	14.0	1
30	207319.45	583168.90	0.30	8.0	EUCALYPT	12.0	1
31	207272.71	582929.03	0.39	8.0	CASUARINA	11.0	2
32	207315.33	583171.98	0.40	8.0	EUCALYPT	11.0	2
33	207270.50	582938.39	0.36	8.0	CASUARINA	11.0	1
34	207319.50	583174.55	0.73	16.0	EUCALYPT	18.0	1
35	207271.65	582940.68	0.20	2.0	CASUARINA	4.0	3
36	207315.38	583177.97	0.14	5.0	EUCALYPT	7.0	1
37	207269.30	582946.06	0.35	7.0	CASUARINA	13.0	1
38	207318.50	583179.90	0.21	6.0	EUCALYPT	12.0	1
39	207268.52	582952.04	0.40	8.0	CASUARINA	10.0	1
40	207314.11	583181.55	0.21	8.0	EUCALYPT	13.0	1
41	207321.87	582976.80	0.26	5.0	CASUARINA	10.0	1
42	207312.46	583194.26	0.36	8.0	EUCALYPT	16.0	1
43	207324.16	582970.08	0.24	5.0	CASUARINA	10.0	1
44	207318.91	583194.94	0.21	5.0	EUCALYPT	11.0	1
45	207280.80	582965.11	0.16	4.0	CASUARINA	8.0	1
46	207316.98	583198.03	0.21	5.0	EUCALYPT	8.0	2
47	207281.24	582982.99	0.24	5.0	CASUARINA	10.0	1
48	207320.49	583200.12	0.38	8.0	EUCALYPT	14.0	2
49	207271.52	582629.55	0.32	8.0	DECIDUOUS	6.0	1
50	207315.17	583087.63	0.85	12.0	EUCALYPT	13.0	3
51	207315.26	583155.09	0.50	10.0	EUCALYPT	16.0	1
52	207325.24	583956.02	0.38	6.0	CASUARINA	9.5	1
53	207316.10	583201.59	0.21	8.0	EUCALYPT	8.0	1
54	207330.17	582954.61	0.20	4.0	CASUARINA	6.0	1
55	207319.05	583205.15	0.40	10.0	EUCALYPT	13.0	1
56	207325.65	582945.31	1.62	7.0	CASUARINA	16.0	1
57	207319.15	583206.47	0.25	9.0	EUCALYPT	11.0	1
58	207325.65	582939.53	0.42	7.0	CASUARINA	14.0	1
59	207319.35	583206.47	0.30	8.0	EUCALYPT	11.0	1
60	207316.74	583213.76	0.20	6.0	EUCALYPT	11.0	1
61	207316.92	583271.23	0.50	11.0	EUCALYPT	15.0	2
62	207326.92	582934.10	0.25	6.0	CASUARINA	6.0	2
63	207320.56	583218.37	0.30	10.0	EUCALYPT	14.0	1
64	207325.92	582928.52	0.27	7.0	CASUARINA	11.0	1
65	207316.82	583217.12	0.25	7.0	EUCALYPT	11.0	1
66	207326.26	582921.79	0.45	9.0	CASUARINA	11.0	2
67	207315.98	583223.98	0.29	7.0	EUCALYPT	18.0	1
68	207311.51	582922.21	0.26	6.0	CASUARINA	11.0	1
69	207313.40	583226.65	0.92	15.0	EUCALYPT	16.0	1
70	207324.47	582904.50	0.40	10.0	CASUARINA	11.0	1
71	207315.76	583229.83	0.26	9.0	EUCALYPT	13.0	1
72	207267.83	582626.82	0.67	8.0	DECIDUOUS	10.0	2
73	207317.57	583209.27	0.25	6.0	EUCALYPT	14.0	1
74	207315.65	583309.19	0.40	10.0	EUCALYPT	15.0	1
75	207333.86	582890.64	0.17	4.0	CASUARINA	6.0	1
76	207320.04	583232.43	0.20	5.0	EUCALYPT	9.0	1
77	207331.59	582885.89	0.24	4.0	CASUARINA	6.0	2
78	207318.28	583235.66	0.20	5.0	EUCALYPT	14.0	1
79	207332.08	582873.81	0.01	3.0	DECIDUOUS	4.0	1
80	207320.87	583239.61	0.30	8.0	EUCALYPT	13.0	1
81	207331.27	582947.01	0.30	6.0	CASUARINA	8.0	1
82	207317.90	583241.48	0.40	10.0	EUCALYPT	15.0	1
83	207331.93	582941.58	0.24	5.0	CASUARINA	8.0	1
84	207315.36	583237.97	0.28	5.0	EUCALYPT	12.0	1
85	207331.07	582922.30	0.28	5.0	CASUARINA	7.0	2
86	207315.57	583242.05	0.26	6.0	EUCALYPT	11.0	1
87	207331.57	582917.66	0.42	8.0	CASUARINA	11.0	1
88	207315.49	583246.29	0.30	8.0	EUCALYPT	11.0	1
89	207331.23	582912.98	0.42	8.0	CASUARINA	11.0	1
90	207315.40	583252.96	0.30	8.0	EUCALYPT	11.0	1
91	207331.07	582908.01	0.42	8.0	CASUARINA	11.0	1
92	207315.31	583260.27	0.30	8.0	EUCALYPT	11.0	1
93	207330.91	582903.36	0.42	8.0	CASUARINA	11.0	1
94	207315.22	583267.58	0.30	8.0	EUCALYPT	11.0	1
95	207330.75	582898.71	0.42	8.0	CASUARINA	11.0	1
96	207315.13	583274.89	0.30	8.0	EUCALYPT	11.0	1
97	207330.59	582894.06	0.42	8.0	CASUARINA	11.0	1
98	207315.04	583282.20	0.30	8.0	EUCALYPT	11.0	1
99	207330.43	582889.41	0.42	8.0	CASUARINA	11.0	1
100	207314.96	583289.51	0.30	8.0	EUCALYPT	11.0	1
101	207330.27	582884.76	0.42	8.0	CASUARINA	11.0	1
102	207314.87	583297.13	0.30	8.0	EUCALYPT	11.0	1
103	207330.11	582879.98	0.42	8.0	CASUARINA	11.0	1
104	207314.79	583304.74	0.30	8.0	EUCALYPT	11.0	1
105	207329.95	582875.33	0.42	8.0	CASUARINA	11.0	1
106	207314.70	583312.36	0.30	8.0	EUCALYPT	11.0	1
107	207329.79	582870.68	0.42	8.0	CASUARINA	11.0	1
108	207314.62	583319.97	0.30	8.0	EUCALYPT	11.0	1
109	207329.63	582866.03	0.42	8.0	CASUARINA	11.0	1
110	207314.53	583327.59	0.30	8.0	EUCALYPT	11.0	1
111	207329.47	582861.38	0.42	8.0	CASUARINA	11.0	1
112	207314.45	583335.20	0.30	8.0	EUCALYPT	11.0	1
113	207329.31	582856.73	0.42	8.0	CASUARINA	11.0	1
114	207314.36	583342.82	0.30	8.0	EUCALYPT	11.0	1
115	207329.15	582852.08	0.42	8.0	CASUARINA	11.0	1
116	207314.28	583350.43	0.30	8.0	EUCALYPT	11.0	1
117	207328.99	582847.43	0.42	8.0	CASUARINA	11.0	1
118	207314.19	583358.05	0.30	8.0	EUCALYPT	11.0	1
119	207328.83	582842.78	0.42	8.0	CASUARINA	11.0	1
120	207314.11	583365.66	0.30	8.0	EUCALYPT	11.0	1
121	207328.67	582838.13	0.42	8.0	CASUARINA	11.0	1
122	207314.02	583373.28	0.30	8.0	EUCALYPT	11.0	1
123	207328.51	582833.48	0.42	8.0	CASUARINA	11.0	1
124	207313.94	583380.89	0.30	8.0	EUCALYPT	11.0	1
125	207328.35	582828.83	0.42	8.0	CASUARINA	11.0	1
126	207313.86	583388.51	0.30	8.0	EUCALYPT	11.0	1
127	207328.19	582824.18	0.42	8.0	CASUARINA	11.0	1
128	207313.77	583396.12	0.30	8.0	EUCALYPT	11.0	1
129	207328.03	582819.53	0.42	8.0	CASUARINA	11.0	1
130	207313.69	583403.74	0.30	8.0	EUCALYPT	11.0	1
131	207327.87	582814.88	0.42	8.0	CASUARINA	11.0	1
132	207313.61	583411.35	0.30	8.0	EUCALYPT	11.0	1
133	207327.71	582810.23	0.42	8.0	CASUARINA	11.0	1
134	207313.52	583418.97	0.30	8.0	EUCALYPT	11.0	1
135	207327.55	582805.58	0.42	8.0	CASUARINA	11.0	1
136	207313.44	583426.58	0.30	8.0	EUCALYPT	11.0	1
137	207327.39	582800.93	0.42	8.0	CASUARINA	11.0	1
138	207313.36	583434.19	0.30	8.0	EUCALYPT	11.0	1
139	207327.23	582796.28	0.42	8.0	CASUARINA	11.0	1
140	207313.27	583441.80	0.30	8.0	EUCALYPT	11.0	1
141	207327.07	582791.63	0.42	8.0	CASUARINA	11.0	1
142	207313.19	583449.42	0.30	8.0	EUCALYPT	11.0	1
143	207326.91	582786.98	0.42	8.0	CASUARINA	11.0	1
144	207313.11	583457.03	0.30	8.0	EUCALYPT	11.0	1
145	207326.75	582782.33	0.42	8.0	CASUARINA	11.0	1
146	207313.02	583464.64	0.30	8.0	EUCALYPT	11.0	1
147	207326.59	582777.68	0.42	8.0	CASUARINA	11.0	1
148	207312.94	583472.25	0.30	8.0	EUCALYPT	11.0	1
149	207326.43	582773.03	0.42	8.0	CASUARINA	11.0	1
150	207312.86	583479.86	0.30	8.0	EUCALYPT	11.0	1
151	207271.57	583817.67	0.20	6.0	DEAD	8.5	1
152	207266.81	583836.66	0.25	6.0	EUCALYPT	9.0	1
153	207266.61	583840.65	0.25	4.0	CONIFER	6.0	1
154	207267.02	583836.11	0.25	6.0	CONIFER	8.0	1
155	207266.64	583699.11	0.10	3.0	CONIFER	5.0	1
156	207324.72	583936.09	0.35	8.0	CASUARINA	9.5	1
157	207261.09	583697.46	0.35	4.0	CASUARINA	9.0	1
158	207261.05	583692.86	0.20	4.0	EUCALYPT	6.5	2
159	207260.98	583697.18	0.25	5.0	EUCALYPT	7.0	1
160	207260.78	583697.96	0.20	4.0	EUCALYPT	6.5	2
161	207260.68	583702.40	0.30	4.5	DECIDUOUS	9.5	2
162	207259.89	583655.67	0.30	9.0	EUCALYPT	12.0	1
163	207343.47	583618.90	0.15	3.0	DECIDUOUS	5.6	1
164	207261.01	583180.68	0.40	7.0	EUCALYPT	11.6	1
165	207329.22	583636.37	0.60	12.0	EUCALYPT	11.0	1
166	207329.09	583638.46	0.30	6.0	EUCALYPT	14.0	1
167	207350.99	583555.69	0.20	8.0	EUCALYPT	11.0	1
168	207267.46	583611.09	0.25	6.0	EUCALYPT	10.5	1
169	207329.59	583636.37	0.30	8.0	EUCALYPT	14.0	1
170	207343.47	583618.90	0.15	3.0	DECIDUOUS	5.6	1
171	207261.01	583180.68	0.40	7.0	EUCALYPT	11.6	1
172	207329.22	583636.37	0.60	12.0	EUCALYPT	11.0	1
173	207329.09	583638.46	0.30	6.0	EUCALYPT	14.0	1
174	207350.99	583555.69	0.20	8.0	EUCALYPT	11.0	1
175	207267.46	583611.09	0.25	6.0	EUCALYPT	10.5	1
176	207329.59	583636.37	0.30	8.0	EUCALYPT	14.0	1
177	207329.46	583638.46	0.30	6.0	EUCALYPT	14.0	1
178	207350.99	583555.69	0.20	8.0	EUCALYPT	11.0	1
179	207267.46	583611.09	0.25	6.0	EUCALYPT	10.5	1
180	207329.59	583636.37	0.30	8.0	EUCALYPT	14.0	1
181	207329.46	583638.46	0.30	6.0	EUCALYPT	14.0	1
182	207350.99	583555.69	0.20	8.0	EUCALYPT	11.0	1
183	207267.46	583611.09	0.25	6.0	EUCALYPT	10.5	1
184	207329.59	583636.37	0.30	8.0	EUCALYPT	14.0	1
185	207329.46	583638.46	0.30	6.0	EUCALYPT	14.0	1
186	207350.99	583555.69	0.20	8.0	EUCALYPT	11.0	1
187	207267.46	583611.09	0.25	6.0	EUCALYPT	10.5	1
188	207329.59	583636.37	0.30	8.0	EUCALYPT	14.0	1
189	207329.46	583638.46	0.30	6.0	EUCALYPT	14.0	1
190	207350.99	583555.69	0.20	8.0	EUCALYPT	11.0	1
191	207267.46	583611.09	0.25	6.0	EUCALYPT	10.5	1
192	207329.59	583636.37	0.30	8.0	EUCALYPT	14.0	1
193	207329.46	583638.46	0.30	6.0	EUCALYPT	14.0	1
194	207350.99	583555.69	0.20	8.0	EUCALYPT	11.0	1
195	207267.46	583611.09	0.25	6.0	EUCALYPT	10.5	1
196	207329.59	583636.37	0.30	8.0	EUCALYPT	14.0	1
197	207329.46	583638.46	0.30	6.0	EUCALYPT	14.0	1
198	207350.99	583555.69	0.20	8.0	EUCALYPT	11.0	1
199	207267.46	583611.09	0.25	6.0	EUCALYPT	10.5	1
200	207329.59	583636.37	0.30	8.0	EUCALYPT	14.0	1
201	207329.46	583638.46	0.30	6.0	EUCALYPT	14.0	1
202	207350.99	583555.69	0.20	8.0	EUCALYPT	11.0	1
203	207267.46	583611.09	0.25	6.0	EUCALYPT	10.5	1
204	207329.59	583636.37	0.30	8.0	EUCALYPT	14.0	1
205	207329.46	583638.46	0.30	6.0	EUCALYPT	14.0	1
206	207350.99	583555.69	0.20	8.0	EUCALYPT	11.0	1
207	207267.46	583611.09	0.25	6.0	EUCALYPT	10.5	1
208	207329.59	583636.37	0.30	8.0	EUCALYPT	14.0	1
209	207329.46	583638.46	0.30	6.0	EUCALYPT	14.0	1
210	207350.99	583555.69	0.20	8.0	EUCALYPT	11.0	1
211	207267.46	583611.09	0.25	6.0	EUCALYPT	10.5	1
212	207329.59	583636.37	0.30	8.0	EUCALYPT	14.0	1
213	207329.46	583638.46	0.30	6.0	EUCALYPT	14.0	1
214	207350.99	583555.69	0.20	8.0	EUCALYPT	11.0	1
215	207267.46	583611.09	0.25	6.0	EUCALYPT	10.5	1
216	207329.59	583636.37	0.30	8.0	EUCALYPT	14.0	1
217	207329.46	583638.46	0.30	6.0	EUCALYPT	14.0	1
218	207350.99	583555.69	0.20	8.0	EUCALYPT	11.0	1
219	207267.46	583611.09	0.25	6.0	EUCALYPT	10.5	1
220	207329.59	583636.37	0.30	8.0	EUCALYPT	14.0	1
221	207329.46	583638.46	0.30	6.0	EUCALYPT	14.0	1
222	207350.99	583555.69	0.20	8.0	EUCALYPT	11.0	1
223	207267.46	583611.09	0.25	6.0	EUCALYPT	10.5	1
224	207329.59	583636.37	0.30	8.0	EUCALYPT	14.0	1
225	207329.46	583638.46	0.30	6.0	EUCALYPT	14.0	1
226	207350.99	583555.69	0.20	8.0	EUCALYPT	11.0	1
227	207267.46	583611.09	0.25	6.0	EUCALYPT	10.5	1
228	207329.59	583636.37	0.30	8.0	EUCALYPT	14.0	1
229	207329.46	583638.46	0.30	6.0	EUCALYPT	14.0	1
230	207350.99	583555.69	0.20	8.0	EUCALYPT	11.0	1
231	207267.46	583611.09	0.25	6.0	EUCALYPT	10.5	1
232	207329.59	583636.37	0.30	8.0	EUCALYPT	14.0	1
233	207329.46	583638.46	0.30	6.0	EUCALYPT	14.0	1
234	207350.99	583555.69	0.20	8.0	EUCALYPT	11.0	1
235	207267.46	583611.09	0.25	6.0	EUCALYPT	10.5	1
236	207329.59	583636.37	0.30	8.0	EUCALYPT	14.0	1
237	207329.46	583638.46	0.30	6.0	EUCALYPT	14.0	1
238	207350.99	583555.69	0.20	8.0	EUCALYPT	11.0	1
239	207267.46	583611.09	0.25	6.0	EUCALYPT	10.5	1
240	207329.59	583636.37	0.30	8.0	EUCALYPT	14.0	1
241	207329.46	583638.46	0.30	6.0	EUCALYPT	14.0	1
242	207350.99	583555.69	0.20	8.0	EUCALYPT	11.0	1
243	207267.46	583611.09	0.25	6.0	EUCALYPT	10.5	1
244	207329.59	583636.37	0.30	8.0	EUCALYPT	14.0	1
245	207329.46	583638.46	0.30	6.0	EUCALYPT	14.0	1
246	207350.99	583555.69	0.20	8.0	EUCALYPT	11.0	1
247	207267.46	583611.09	0.25	6.0	EUCALYPT	10.5	1
248	207329.59	583636.37	0.30	8.0	EUCALYPT	14.0	1
249	207329.46	583638.46	0.30	6.0	EUCALYPT	14.0	1
250	207350.99	583555.69	0.20	8.0	EUCALYPT	11.0	1
251	207267.46	583611.09	0.25	6.0	EUCALYPT	10.5	1
252	207329.59	583636.37	0.30	8.0	EUCALYPT	14.0	1
253	207329.46	583638.46	0.30	6.0	EUCALYPT	14.0	1
254	207350.99	583555.69	0.20	8.0	EUCALYPT	11.0	1
255	207267.46	583611.09	0.25	6.0	EUCALYPT	10.5	1
256	207329.59	583636.37	0.30	8.0	EUCALYPT	14.0	1
257	207329.46	583638.46	0.30	6.0	EUCALYPT	14.0	1
258	207350.99	583555.69	0.20	8.0	EUCALYPT	11.0	1
259	207267.46	583611.09	0.25	6.0	EUCALYPT	10.5	1
260	207329.59	583636.37	0.30	8.0	EUCALYPT	14.0	1
261	207329.46	583638.46	0.30	6.0	EUCALYPT	14.0	1
262	207350.99	583555.69	0.20	8.0	EUCALYPT	11.0	1
263	207267.46	583611.09	0.25	6.0	EUCALYPT	10.5	1
264	207329.59	583636.37	0.30	8.0	EUCALYPT	14.0	1
265	207329.46	583638.46	0.30	6.0	EUCALYPT	14.0	1
266	207350.99	583555.69	0.20	8.0	EUCALYPT	11.0	1
267	207267.46	583611.09	0.25	6.0	EUCALYPT	10.5	1
268	207329.59	583636.37	0.30	8.0	EUCALYPT	14.0	1
269	207329.46	583638.46	0.30	6.0	EUCALYPT	14.0	1
270	207350.99	583555.69	0.20	8.0	EUCALYPT	11.0	1
271	207267.46	583611.09	0.25	6.0	EUCALYPT	10.5	1
272	207329.59	583636.37	0.30	8.0	EUCALYPT	14.0	1
273	207329.46	583638.46	0.30	6.0	EUCALYPT	14.0	1
274	207350.99	583555.69	0.20	8.0	EUCALYPT	11.0	1
275	207267.46	583611.09	0.25	6.0	EUCALYPT	10.5	1
276	207329.59	583636.37	0.30	8.0	EUCALYPT	14.0	1
277	207329.46	583638.46	0.30	6.0	EUCALYPT	14.0	1
278	207350.99	583555.69	0.20	8.0	EUCALYPT	11.0	1
279	207267.46	583611.09	0.25	6.0	EUCALYPT	10.5	1
280	207329.59	583636.37	0.30	8.0	EUCALYPT	14.0	1
281	207329.46	583638.46	0.30	6.0	EUCALYPT	14.0	1
282	207350.99	583555.69	0.20	8.0	EUCALYPT	11.0	1
283	207267.46	583611.09	0.25	6.0	EUCALYPT	10.5	1
284	207329.59	583636.37	0.30	8.0	EUCALYPT	14.0	1
285	207329.46	583638.46	0.30	6.0	EUCALYPT	14.0	1
286	207350.99	583555.69	0.20	8.0	EUCALYPT	11.0	1
287	207267.46	583611.09	0.25	6.0	EUCALYPT	10.5	1
288	207329.59	583636.37	0.30	8.0	EUCALYPT	14.0	1
289	207329.46	583638.46	0.30	6.0	EUCALYPT	14.0	1
290	207350.99	583555.69	0.20	8.0	EUCALYPT	11.0	1
291	207267.46	583611.09	0.25	6.0	EUCALYPT	10.5	1
292	207329.59	583636.37	0.30	8.0	EUCALYPT	14.0	1
293	207329.46	583638.46	0.30	6.0	EUCALYPT	14.0	1
294	207350.99	583555.69	0.20	8.0	EUCALYPT	11.0	1
295	207267.46	583611.09	0.25	6.0	EUCALYPT	10.5	1
296	207329.59	583636.37	0.30	8.0	EUCALYPT	14.0	1
297	207329.46	583638.46	0.30	6.0	EUCALYPT	14.0	1
298	207350.99	583555.69	0.20	8.0	EUCALYPT	11.0	1
299	207267.46	583611.09	0.25	6.0	EUCALYPT	10.5	1
300	207329.59	583636.37	0.30	8.0	EUCALYPT	14.0	1
301	207274.34	583294.26	0.31	10.0	EUCALYPT	16.0	1
302	207277.92	583806.22	0.15	4.0	CASUARINA	10.0	2
303	207259.71	583157.14	0.45	12.0	EUCALYPT	17.0	1
304	207263.21	583830.32	0.40	10.0	CASUARINA	18.0	1
305	207267.99	583613.50	0.25	6.0	DECIDUOUS	12.0	1
306	207324.72	583036.09	0.35	8.0	CASUARINA	9.5	1
307	207317.73	583318.07	0.12	5.0	EUCALYPT	7.0	1
308	207324.72	583036.09	0.35	8.0	CASUARINA	9.5	1
309	207263.67	583165.89	0.44	13.0	EUCALYPT	17.0	1
310	207266.27	583302.97	0.30	8.0	EUCALYPT	12.0	1
311	207263.33	583181.81	0.46	16.0	EUCALYPT	17.0	1
312	207263.83	583187.28	0.08	2.0	DEAD	5.0	1
313	207263.72	583183.15	0.46	16.0	EUCALYPT	17.0	1
314	207262.63	583178.02	0.19	4.0	CASUARINA	9.0	1
315	207262.36	583173.89	0.46	16.0	EUCALYPT	17.0	1
316	207262.09	583169.76	0.19	4.0	CASUARINA	9.0	1
317	207261.82	583164.63	0.46	16.0	EUCALYPT	17.0	1
318	207261.55	583160.50	0.19	4.0	CASUARINA	9.0	1
319	207261.28	583156.37	0.46	16.0	EUCALYPT	17.0	1
320	207261.01	583152.24

A DRIVE DUPLICATION

UTILITIES SURVEY



DIAL BEFORE YOU DIG
www.1100.com.au

AS 5488 SUI - UG SERVICES CLASSIFICATION	CERTAINTY / RISK
(QL-A) VALIDATED - DIRECTLY MEASURED TO SERVICE	CLASS (QL-A)
(QL-B) TRACED - ELECTRONICALLY DETECTED SERVICE	(QL-B)
(QL-C) ALIGNED - SURFACE JOINED SERVICE MARKERS	(QL-C)
(QL-D) COMPILED - ESTIMATED SERVICE FROM DIAGRAMS	(QL-D)

WARNING
- CLASSIFICATION CHART IS PROVIDED TO INDICATE CERTAINTY OF IDENTIFIED SERVICE SHOWN OR LOCATED.
- REFER TO "AS5488" FOR CLASSIFICATION DEFINITIONS OF SUBSURFACE UTILITY INFORMATION
- SERVICES SHOWN CLASS "QL-B", "QL-C" OR "QL-D" MAY BE INACCURATE IN BOTH VERTICAL AND HORIZONTAL POSITION.
- SERVICES SHOWN: "QL-A++" INCLUDE ABSOLUTE ACCURACY IN HORIZ/VERT +/- 50mm/10mm
- SERVICES SHOWN: "QL-A+" INCLUDE ABSOLUTE ACCURACY OF HORIZ/VERT +/- 50mm/20mm
- SERVICES SHOWN: "QL-A" INCLUDE ABSOLUTE ACCURACY OF HORIZ/VERT +/- 50mm/50mm
- SERVICES SHOWN: "QL-B" INCLUDE RELATIVE ACCURACY OF HORIZ/VERT +/- 300mm/500mm
- SERVICES SHOWN: "QL-C" INCLUDE RELATIVE ACCURACY OF HORIZ/VERT +/- 300mm/ NILL
- SERVICES SHOWN: "QL-D" INCLUDE RELATIVE ACCURACY OF HORIZ/VERT +/- NILL/NILL
- MULTIPLE SERVICES MAY STILL EXIST IN SINGLE TRENCH, THEREFORE, SERVICES SHOWN MAY NOT REFLECT OTHER SERVICES ABOVE OR BELOW.
- SINGLE LINES SHOWN MAY NOT REPRESENT MULTIPLE CONDUITS, PIPES OR CABLES OF SERVICES LOCATED.
- UNKNOWN SERVICES MAY STILL EXIST THAT COULD NOT BE ELECTRONICALLY DETECTED. PLEASE CONSULT SERVICE PROVIDERS DIAGRAMS OR CALL "DIAL-BEFORE-YOU-DIG" SERVICE PROVIDER TO IDENTIFY DUTY OF CARE OBLIGATIONS PRIOR TO ANY EXCAVATION/CONSTRUCTION.

PHI-0

POINT – DENOTES TRACED ELECTRONICALLY UNDERGROUND SERVICE (QL-B)
POINT – DENOTES TRACED SURVEY POINT AT RL GROUND LEVEL (QL-B)
LINE – DENOTES TRACED ELECTRONICALLY UNDERGROUND SERVICE (QL-B)
POINT – DENOTES TRACED SURVEY POINT AT GROUND LEVEL (QL-B)
POTHOLE – DENOTES VALIDATED SURVEY POINT AT RL TOP-OF-SERVICE (QL-A)
LINE – DENOTES EXPOSED & CONFIRMED UNDERGROUND SERVICE (QL-A)
WAE – DENOTES SURVEY CAPTURED WAE AT RL TOP-OF-SERVICE (QL-A)
WITH ATTRIBUTE TAG (CLASS/DEPTH/MATERIAL/DIAMETER/QTY)

QL-A++,0.4,OPVC,100mm(X2)
QL-A++,0.4,OPVC,100mm(X2)

NOTES:

) TO THAT REQUESTED BY THE CLIENT, IS INTENDED FOR THE USE OF THE CLIENT OTHER PURPOSE.
OM ACTMAP DIGITAL DATABASE. NO BOUNDARY INVESTIGATION / MARKING HAS BEEN

AS SUCH, THEIR POSITIONS, SHAPES, SIZES AND HEIGHTS AS DEPICTED BY SYMBOLS Y. ATTRIBUTE INFORMATION, IF SHOWN TABLED, IS INTENDED FOR THE ASSESSMENT JOB.
.OCATED BY STEGER & ASSOCIATES. RELEVANT AUTHORITIES SHOULD BE CONTACTED SERVICES PRIOR TO DESIGN & CONSTRUCTION.
ON, IF SHOWN, SHOULD BE CONSIDERED DIAGRAMMATIC ONLY EXCEPT FOR VISIBLE DING MARKERS, PLAQUES, PITS, MANHOLES, etc.
NTEE THAT ALL SERVICES PRESENT HAVE BEEN LOCATED.
IT BE EXTRACTED FROM DIGITAL ELEMENTS.
CT GOVERNMENT.

LEGEND

ICON QL-B	COMMUNICATION–LINE ICON U/G (QL–B)
INET QL-B	COMMUNICATION–LINE INET U/G (QL–B)
NBN QL-C	COMMUNICATION–LINE NBN U/G (QL–C)
OPTUS QL-B	COMMUNICATION–LINE OPTUS U/G (QL–B)
TELSTRA QL-B	COMMUNICATION–LINE TELSTRA U/G (QL–B)
ELEC QL-B	ELECTRICITY–LINE U/G (QL–B)
GAS QL-B	GAS–PIPE U/G (QL–B)
WATER QL-B	WATER–PIPE U/G (QL–B)

Surveyor Registered Under the ACT Surveyors Act 2007

S1V1 S1V2 S2V1 S3V1 S3V2

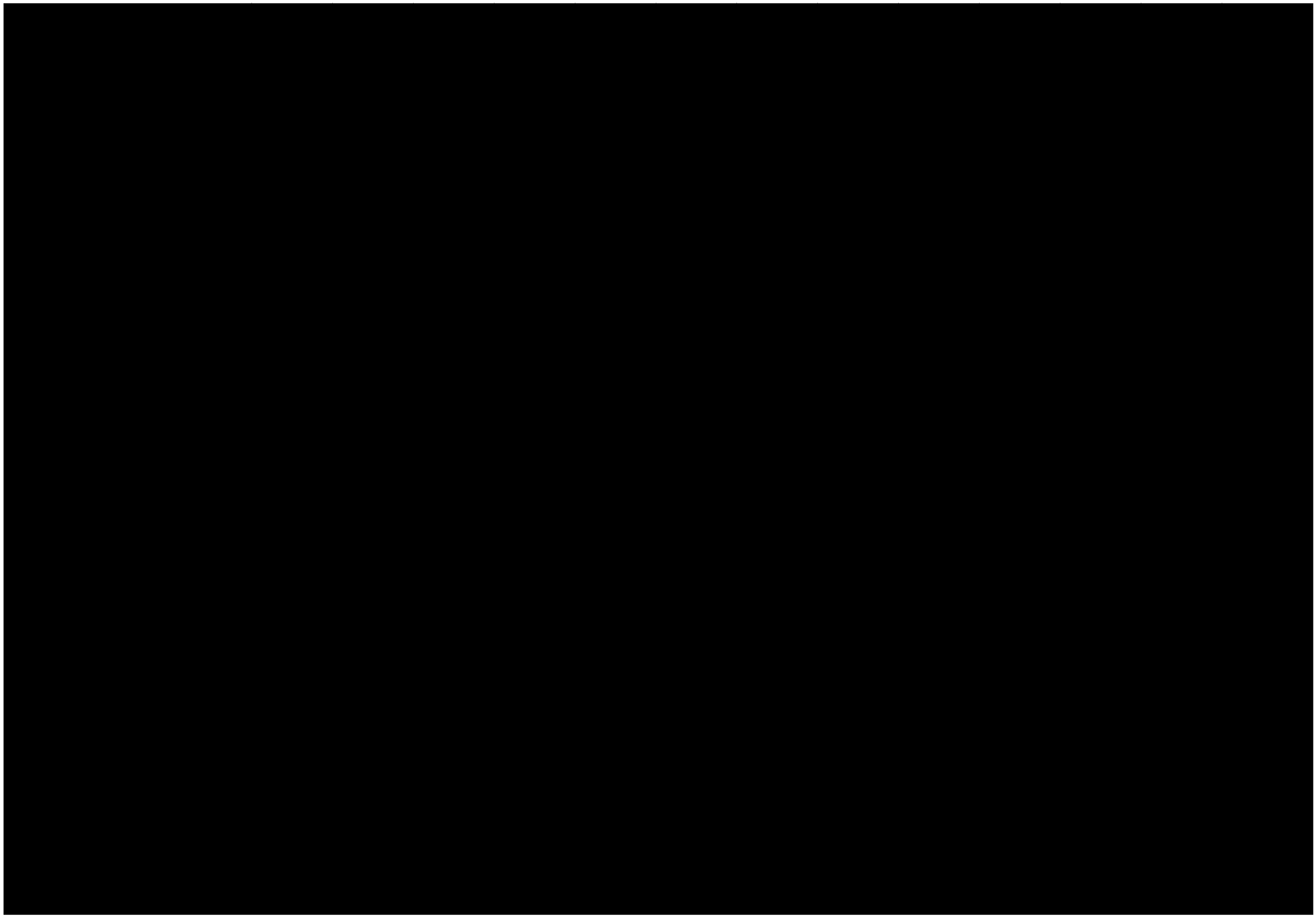
DRAWING NUMBER	DRAWING DESCRIPTION
001	Feature Survey
002	Cadastre
003	Stormwater & Sewer
004	Utilities
005	Excavation - Potholes
006	Excavation - Strainers
007	Survey Control - Vertical
008	Survey Control - Horizontal
009	Triangulation
010	Scanning (Point Clouds)

Prepared By:
STEGER & ASSOCIATES
registered land surveyors
Unit 2, 10 Kett Street
KAMBAH ACT 2902
PO Box 2001
KAMBAH ACT 2902
P - (02) 6296 4089
F - (02) 6296 4090
enquiries@steger.com.au
www.steger.com.au
ABN 12 920 463 267

Client:
calibre
GPO BOX 261
CANBERRA
ACT 2601

Horizontal Datum:	SGC/AGC
Vertical Datum:	
MARK:	
LEVEL:	RL596.117
SYSTEM:	AHD 71
Contour Interval:	0.20m
Job:	20038
Scale (metres):	1:500 (0 2.5 5 10 15)
Sheet:	0 of 3
Size:	A1
Drawing:	20038_001.dwg

Title: **THARWA DRIVE**
UTILITIES SURVEY
DISTRICT: TUGGERANONG





Appendix B Geotechnical Investigation

Douglas Partners
Geotechnics / Environment / Groundwater

Integrated Practical Solutions

Report on
Geotechnical Desktop Assessment

Proposed Tharwa Drive Duplication
Tharwa Drive, Gordon

Prepared for
Calibre Professional Services Pty Ltd

Project 46225.03
December 2020



Douglas Partners
Geotechnics / Environment / Groundwater

Document History

Document details

Project No.	46225.03	Document No.	R.001.Rev0
Document title	Report on Geotechnical Desktop Assessment Proposed Tharwa Drive Duplication		
Site address	Tharwa Drive, Gordon		
Report prepared for	Calibre Professional Services Pty Ltd		
File name	46225.03.R.001.Rev0.Gordon Tharwa Drive Desktop Geo		

Document status and review

Status	Prepared by	Reviewed by	Date issued
Revision 0	[redacted]	[redacted]	8 December 2020

Distribution of copies

Status	Electronic	Paper	Issued to
Revision 0	1	0	Calibre Professional Services Pty Ltd

The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

	Signature	Date
Author	[redacted]	8 December 2020
Review	[redacted]	8 December 2020

bsi. ISO 9001 Quality Management
FS 604853

Douglas Partners Pty Ltd
ABN 75 053 980 117
www.douglaspartners.com.au
Unit 2, 73 Sheppard Street
Hume ACT 2620
PO Box 1487
Fyshwick ACT 2609
Phone (02) 6260 2788

Douglas Partners
Geotechnics | Environment | Groundwater

Table of Contents

Page

1. Introduction 1
2. Proposed Development 1
3. Site Description 2
4. Assessment Methods 3
   - 4.1 Information Review 3
   - 4.2 Previous Investigations 3
   - 4.3 Site Inspection 4
5. Assessment Results 4
   - 5.1 Soil and Landscape 4
   - 5.2 Regional Geology 5
   - 5.3 Previous Investigation 6
     - 5.3.1 Site 1 6
     - 5.3.2 Site 2 6
     - 5.3.3 Site 3 7
   - 5.4 Site Inspection 7
6. Comments 8
   - 6.1 General 8
   - 6.2 Estimated Site Conditions 8
   - 6.3 Geotechnical Constraints 9
   - 6.4 Development Considerations 9
     - 6.4.1 Earthworks 9
     - 6.4.2 Pavements 10
     - 6.4.3 Structure Foundations 11
     - 6.4.4 Site Drainage 11
7. References 11
8. Limitations 12

Appendix A: About This Report

Appendix B: Site Photographs

Appendix C: Drawing 1 – Site Plan and Site Features

Report on Geotechnical Desktop Assessment
Proposed Tharwa Drive Duplication
Tharwa Drive, Gordon

1. Introduction

This report presents the results of a geotechnical desktop assessment undertaken for the proposed Tharwa Drive duplication of a section of Tharwa Drive, Gordon. The assessment was commissioned in an email dated 17 September 2020 by Calibre Professional Services Pty Ltd and was undertaken in accordance with Douglas Partners' proposal CAN200219 dated 28 July 2020.

The aim of the assessment was to provide broad geotechnical comment on the following:

- existing geotechnical reports;
- existing site features;
- an estimated site model;
- possible geotechnical constraints to the development;
- site preparation and earthworks;
- excavations;
- foundations for structural elements;
- preliminary bearing pressures;
- preliminary parameters for the design of new pavements; and
- site drainage.

The assessment comprised a review of published information and field mapping by a Senior Geotechnical Engineer followed by engineering analysis and reporting. Details of the work undertaken are given in the report, together with comments relating to the items mentioned above.

This report must be read in conjunction with the notes “About this Report” which are included in Appendix A.

2. Proposed Development

It is understood that the development of the site will comprise the duplication of approximately 1.9 km of Tharwa Drive, from its intersection with Knoke Avenue to the intersection with Woodcock Drive in Gordon. The assessment covers the western side of the current road corridor which is understood to have been reserved for the future duplication and will comprise two north bound lanes.

3. Site Description

The road duplication site is estimated to be in the order of 1.9 km and orientated in a north-south direction. It is located between Knoke Avenue (at the southern end) and Woodcock Drive (at the northern end) and along the western side of the existing road, see Figure 1.



Figure 1: Approximate extents of the proposed road duplication

The existing pavement of Tharwa Drive has a sealed surface with one lane in each direction widening to two lanes in each direction at the Woodcock Drive roundabout approach at the northern end of the site. It is located to the east of the proposed duplication. The site is surrounded mostly by existing residential development with Lanyon Market Place at the north east corner of the site. Some open space/playing fields are located at the northern and southern ends.

Site levels within the southern half of the development area fall in an overall northerly direction at grades of 1 in 25 to 1 in 50 with a maximum difference in level of about 18 m.

Site levels in the northern half alignment are mostly governed by the existing 2 – 4 m high road embankment (with batter slopes of 1V:3H to 1V:10H). Overall surrounding levels in this northern portion fall in a westerly direction at grades of 1 in 20 to 1 in 60 with generally less than 5 m difference in levels across this part of the site.

Further comment on the site conditions at the time of the site inspection are provided in Section 4.4.

4. Assessment Methods

4.1 Information Review

A review of existing geological, soil and landform maps were undertaken as part of the assessment. The relevant maps reviewed were as follows:

- 1:100,000 Soil Landscape Sheet for Canberra (Ref 1)
- 1:100,000 Geological Series Sheet for Canberra (Ref 2)

4.2 Previous Investigations

From DP's records, three sites with geotechnical investigations have been assessed by Douglas Partners Pty Ltd (DP) in the vicinity of the site which includes:

- Investigation for a proposed commercial development approximately 250 m east of the northern end of the site (2007) – **Site 1**;
- Several Investigations for a proposed residential development approximately 50 m west of the northern end of the site (2010 – 2019) – **Site 2**; and
- Site classification for a block approximately 50 m east from near the midpoint of the site (2017) – **Site 3**.

A brief summary of the subsurface conditions encountered at each site is given in Section 4.3.

4.3 Site Inspection

A site inspection was undertaken by a Senior Geotechnical Engineer, which included an assessment of the current road alignment characteristics and mapping of site features. A series of photographs illustrating notable site features are presented in Appendix B. A site plan with the noted site features is presented on Drawing 1 in Appendix C.

5. Assessment Results

5.1 Soil and Landscape

Reference to the 1:100 000 'Canberra Soil Landscape Series Sheet' by Jenkins, B.R. (2000) indicates that the section of the road alignment to be duplicated is mapped as being underlain by the Williamsdale soil group of the alignment, see Figure 2 below.

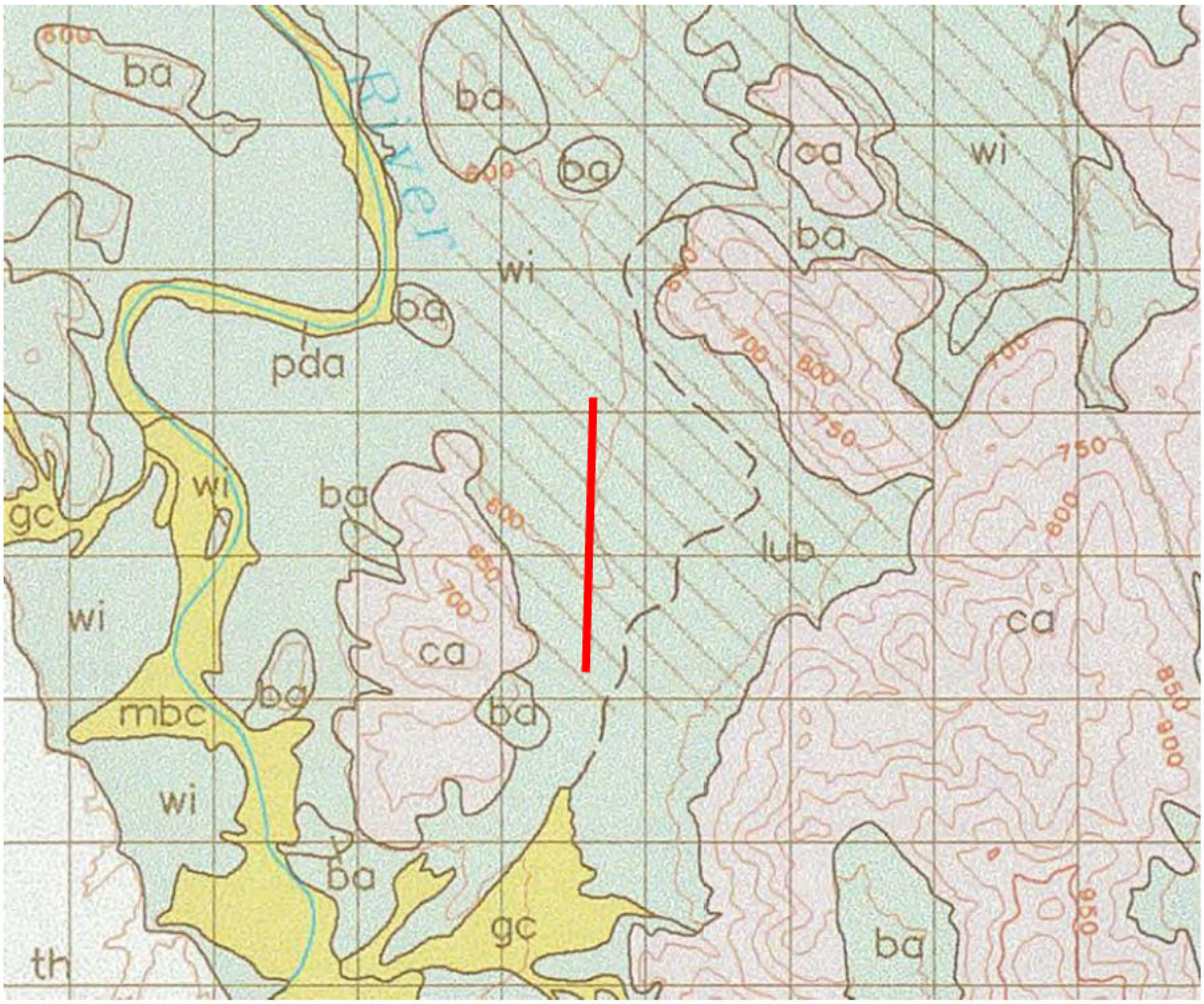


Figure 2: Soil Landscape mapping along the alignment (approximately marked with a read line)

The Williamsdale soil group is characterised by undulating rises, alluvial fans and valley flats on Silurian Volcanics of Canberra Lowlands. Generally, little or no rock outcrops occur, within this soil group although. Soils are moderately deep, well drained podzolic soils, red and brown earths on upper rises and fan elements and moderately to very deep, poorly to imperfectly drained solodic soils on lower rises and fan elements. The limitations of this soil group are noted as its erodible and dispersible nature, its acidity, potential for seasonal waterlogging and localised flooding hazard.

5.2 Regional Geology

Reference to the Canberra 1:100 000 Geological Series Sheet by Abell, R.S. (1992) indicates that the section of road alignment to be duplicated (see Figure 3 below) lies within the Quaternary alluvium in the northern portion of the alignment. The alluvium is likely to be underlain by Quaternary colluvium. The alluvium is absent in the southern portion of the alignment which is mapped as Quaternary colluvium. The alluvium and colluvium are then in turn underlain by the Deakin Volcanics, an early Silurian age igneous rock unit.

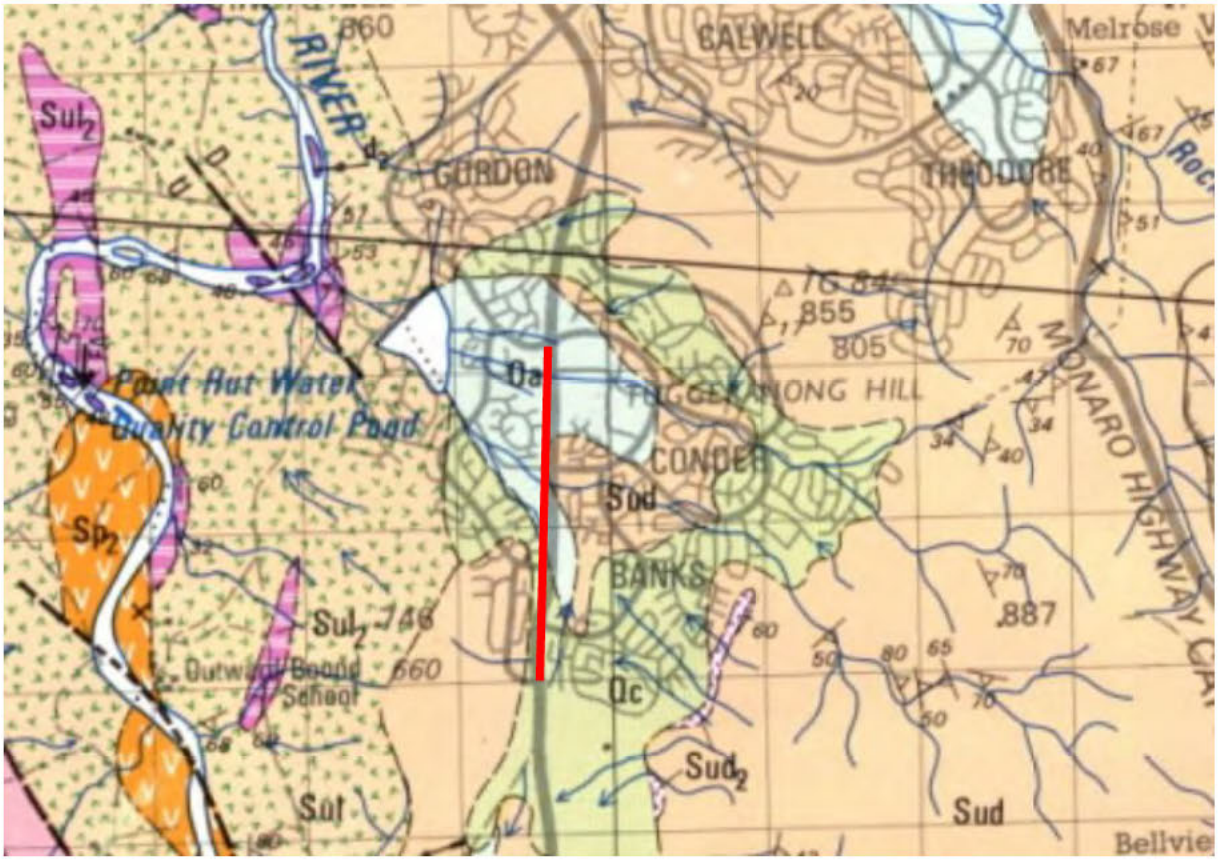


Figure 3: Geology mapping along the alignment (approximately marked with a red line)

A summary of the geological units are as follows:

- Quaternary alluvium typically comprises clay, silt, sand and gravel;
- Quaternary colluvium typically comprises fanglomerate and poorly cemented conglomerate, gravel and sand; and
- The Deakin Volcanics typically comprise rhyodacitic ignimbrite with minor volcaniclastic and argillaceous sedimentary rocks.

5.3 Previous Investigation

5.3.1 Site 1

Variable subsurface conditions were encountered underlying Site 1, broadly summarised as follows:

- Filling : brown gravelly clayey sand filling to 0.2 m depth.
- Topsoil: grey silt with rootlets to 0.2 – 0.3 m depth.
- Alluvium: very stiff to hard/medium dense to dense alluvial soils to the limit of investigation of 1.6 – 2.6 m. The alluvium comprised varying quantities of silt, sand and gravel to about 1.5 – 2.0 m depth where after silty clays were encountered.

No free groundwater was observed during excavation of the test pits. However, longer term monitoring of groundwater levels was not possible because, for safety reasons, the test pits were backfilled immediately following excavation.

5.3.2 Site 2

Several investigations from December 2010 to October 2019 were undertaken across Site 2 which comprised the drilling of boreholes and the excavation of test pits. Investigations depths have ranged from ranging from 1.1 – 7.9 m. The test locations encountered variable subsurface conditions underlying the site with the principal succession of strata broadly summarised as follows:

The boreholes and test pits encountered a subsurface profile which can be summarised as follows:

- Filling – typically medium dense mixture of clayey sand, gravelly clayey sand and sandy clayey gravel, and some very stiff or hard sandy clay of low, medium and high plasticity, to depths ranging between 0.4 m to 4.9 m.
- Alluvium - silty clayey sand, gravelly clayey sand and some low, medium and high plasticity sandy clay and gravelly sandy clay - medium dense to dense, dry to moist, cemented, found to 2.0 m to 3.5 m depth (where not replaced by filling), then silty clayey sand, gravelly clayey sand and clayey sand and low plasticity sandy silty clay - medium dense, moist, found to 4.0 m to 5.5 m depth (where not replaced by filling), then sandy clayey gravel/gravelly clayey sand - medium dense, moist/wet or wet, some cobbles and possibly small boulders, found to 5.0 m to 7.5 m depth.
- Bedrock – rhyodacite - extremely low strength to low strength, extremely and highly weathered, encountered at depths ranging from 5.1 m to 7.2 m.

A significant feature of the site is an old creek line that was initially backfilled in the early 1990s. The backfill of the creek line is in the order of 3.5 m deep and 10 m to 20 m wide. The backfilled creek line is orientated in an east to west direction and is likely to continue under the northern end of this Tharwa Drive duplication site.

The alluvium between about 1.0 m and 2.5 m depth was typically cemented, and often dry to moist.

Groundwater seepages were encountered in the basal sandy and gravelly alluvium in the boreholes that had extended beyond about 5.0 m depth. Seepage water levels measured in boreholes left open after drilling or where piezometers were installed, had risen to depths of between about 2.7 m and 5.5 m.

It should be noted that groundwater conditions are affected by weather conditions, soil permeability and other factors, and can vary with time. Seepages may be present at various levels within perched alluvial/colluvial aquifers, and are likely to be encountered at depths as shallow as 2 m after wet years.

5.3.3 Site 3

The subsurface conditions encountered comprised firm to stiff, moist, medium plasticity sandy clay to 0.2 m depth, dense/ dry to moist, fine to medium grained clayey silty sand with sub-angular gravels (alluvium) to 0.6 m depth, then stiff, moist low to medium plasticity sandy silty clay to 0.8 m depth overlying hard, dry to moist, medium to high plasticity gravelly silty clay with ironstone nodules to refusal depth of 1.3m due to tree roots. No free groundwater was observed during the drilling of the boreholes.

5.4 Site Inspection

The 1.9 km of site of the duplication roadway traverses slightly varying terrain. The southern half of the site (south of the Box Hill Roundabout) comprises shallow cut and fill or at-grade sections, with the most for the future road formation at similar levels to the existing roadway, albeit near-level to slight sloping to the west away from the existing roadway.

In contrast, northern half of the site of the duplication is set well below the existing roadway. The existing Tharwa Drive roadway, including the Box Hill roundabout is constructed along of fill embankment ranging in height from 2 – 4 m above the land to its west where the duplication site is proposed. A broad summary of the site features has been indicated on Drawing 1 in Appendix B. The principal observations are as follows based on road chainages (Ch0 m) starting at from the Knoke Avenue / Pocket Avenue roundabout :

- This section of Tharwa Drive to be duplicated comprises three intersections along the road alignment, all are roundabouts. Knoke Avenue / Pocket Avenue connect as a cross-intersection at the southern end, as does Woodcock Avenue / Box Hill Avenue at the northern end. Box Hill Avenue also connects at a T-intersection at about the midpoint (CH1020 m) along the alignment;
- A culvert pipe(s) crossing structure at about CH530 m which leads into an incised drainage swale along the western side of the site. The culvert structure comprised energy dissipating baffles indicating high flow rates are likely from the pipes on. Heavy reed growth was present in the swale along with ponded water. The swale directs stormwater north from CH530 – CH970 m where it connects to another stormwater swale flowing east to west direction.

- Two drainage swales flow east to west at approximately CH 970 m and CH1610 m. The channels for these are stone pitched and/or concrete lined where they pass under the existing roadway. Concrete Bebo arch bridges have been constructed over these two swales.
- Buried services pits where mostly located in the northern 400 m of the site just south of the Woodcock Avenue intersection.
- Fill embankment heights vary from less than 0.5 m to about a maximum of 4 m;
- Fill embankment slopes vary from as steep as 1V:3H to 1V:10H (vertical:horizontal);
- Cut batter heights vary from less than 0.5 m to about a maximum of 2 m and are only in the southern parts of the site;
- Cut slopes comprise variable slopes of 1V:3H to 1V:5H;
- Observation of the type of filling and/or cut materials was very limited due to the batter slopes being largely vegetated;
- Ground surface was generally lightly to heavily grassed with some bare patches of earth in the southern portion of the site, mostly adjacent to the existing carriageway.
- Stands of semi-mature and mature trees occupy parts of the northern section of the duplication site and most of the western edge of the duplication is border by trees; and
- No major areas of soil erosion were observed.

Due to the heavy vegetation cover, other site features present may have been unable to be observed.

6. Comments

6.1 General

The following comments are based on the results of site reconnaissance, review of existing information and our involvement in similar projects. It is understood that the site is proposed to be the subject of further investigations that will be undertaken at the appropriate time as the planning and designing proceeds. Accordingly, this report and the comments given within must be considered as being preliminary in nature.

6.2 Estimated Site Conditions

The site conditions along the alignment are expected to vary slightly between the southern half to the northern half. The southern half of the alignment is mostly near-level and is likely to be close to the design levels for the proposed road duplication with minimal cut/fill required. The subsurface conditions likely to comprise shallow topsoil/topsoil fill, fill and variable deep colluvial and alluvial soils.

The northern half of the alignment is likely to comprise the fill batter from the existing Tharwa Drive roadway along its eastern parts where it meets the lower western parts of the alignment which are at similar levels to the surrounding land and on a more gradual and constant slope towards the west. The subsurface conditions likely to comprise shallow topsoil/topsoil fill, fill and variable alluvial and colluvial soils overlying dacite weathered rock, generally more than 5 m deep from existing levels and deeper where the road embankment has been constructed.

The existing fill material is not expected to be well compacted and most probably contain large portions of unsuitable material including silt, sand and boulders based on experience with other road duplication projects across Canberra.

6.3 Geotechnical Constraints

The assessment has identified a number of possible constraints to the development, which are:

- Potential for poor subgrade performance from existing service trenches and existing surface drainage swales within the future duplication alignment;
- Deep extensively root affected soils from existing trees and other vegetation;
- Potential for unsuitable material used in existing embankment filling;
- Potential for unsuitable natural materials (silts and sands); and
- The potential for groundwater seepages and/or water impacted soils (swale/culvert areas).

Other constraints may be evident during/following geotechnical investigations and/or construction that could not be reasonably discovered at the time of this assessment.

The above constraints are further discussed in the following sections.

6.4 Development Considerations

6.4.1 Earthworks

It is strongly recommended that any future design work and earthworks is undertaken in conjunction with a geotechnical consultant and the end client (ACT Government).

Earthworks for the preparation of new embankment filling placement and compaction will most likely require but not limited to the following:

- Stripping of vegetation and topsoil;
- Assessment of the stripped surface to support filling placement (i.e.: are silts/sands or poorly compacted fill materials present);
- Assessment of the stripped surface for possible groundwater drainage measures;
- Assessment of the extent and conditions of any existing service trench backfill materials;

- If deemed unacceptable, either strip unsuitable material or place a bridging layer (the type depends on the conditions at the time of construction); and
- Lift thicknesses of foundation treatment measures and/or initial filling layers will depend on the condition of the foundation and type of material.

The design of the proposed duplication works must take into consideration the poor subgrade support including from loosely backfilled service trenches and/or wet subgrade soils provide and allow for extensive site preparation measures or factor in some form of bridging solution such that near-uniform support can be provided to the future pavement.

A significant risk will exist in relation to the existing filling material. The degree to which that risk is mitigated depends on the expectations of the end client. To a large degree, the performance of the existing filling will be difficult to gauge until the time of construction, though geotechnical investigations will be able to provide some more detailed comment. As a minimum though, all existing filling should be stripped from within 1 m of finished pavement surface and keyed/over-excavated 3 m (laterally) into the existing fill embankment. Furthermore, it is recommended that where encountered underneath the future pavement, all old service trenches be over-excavated of pipes/conduits and backfill material to expose suitable natural soils and backfilled with approved materials and compacted to the required compaction ratio.

The excavatability of site materials are expected to be relatively straightforward in natural soils and given the depth to rock is likely to be several metres, difficult rock excavations are not anticipated.

The excavatability of the existing filling may pose some challenges in handling of possible boulders present in the filling.

6.4.2 Pavements

Based on experience in the area, variations in design CBR values are expected based on the alluvial/colluvial soils present. The design CBR in areas of new filling will be dependent on the quality of the material used and would need to be confirmed during construction. Unlike the northern half of the alignment where significant filling will be required to raise levels to match the existing roadway, pavement performance in the southern part of the site will be governed by the existing subsurface conditions as limited cut and fill is expected.

In areas of existing filling, the design of pavements will most likely be dictated by constructability/serviceability rather than from a CBR perspective. The existing filling material is likely to be poorly compacted and comprise unsuitable fractions. Based on experience road embankment filling beyond the edge of the existing pavement could be partially unsuitable or wholly unsuitable. Until subsurface investigations are undertaken further comment on suitability cannot be made.

As mentioned above, significant over-excavation and replacement/recompaction of existing filling must be anticipated.

Preliminary design CBR values are suggested to be between 3 – 5% depending on the quality of the existing fill and the composition of the natural alluvial and colluvial soils along the alignment.

6.4.3 Structure Foundations

The extent of future structures is expected to comprise matching Bebo arches and or culvert pipe crossing structures to those identified during the site walkover. The current locations of these arch and culvert structures are within gully lines or low-lying areas and it is expected that poor foundation conditions could be encountered, pending prior weather conditions. Depending on the structural loading and required allowable bearing pressure for the structure foundation, over-excavation of unsuitable material and replacement with a rock bridging layer is highly likely. Subsoil drainage maybe required in the base of gully lines. Allowable bearing pressures of in excess of 100 -150 kPa for a soil type foundation in most cases would be unrealistic. Should higher bearing pressure be required then piled footings would need to found within the bedrock. Until subsurface investigations are undertaken further comment on the likely depth to a suitable bearing stratum and design foundations parameters cannot be made

6.4.4 Site Drainage

In undertaking earthworks operations on the site, it should be recognised that the drainage characteristics of the site will be altered, and that temporary and permanent measures will be required during construction to divert stormwater and/or subsurface water flow from the site.

The area is known for groundwater seepages and therefore future geotechnical investigations should aim to characterise as best as possible if groundwater flows are present to the depth of investigation.

Across the development area, infiltrated rainwater can become contained in the upper semi-pervious silty/sandy stratum on the underlying practically impervious clayey strata (where encountered). Seepage water may also be present in between layers of alluvium or colluvium and at the base of fill layers. Seepage water may rise to the ground surface further downslope as springs or from low lying areas and gully lines. The extent of any drainage measures will be dictated by prior weather conditions and can only be determined onsite during construction.

Subsoil drains, rubble drains or deep table drains will be required on the side of road formations on grade or in cut. Other drainage systems may also be required but would be dependent on the conditions prior to and during construction. It is suggested that where required in the duplication works, table drains be constructed a minimum 0.5 m deeper than subgrade level.

7. References

Abell, R.S. (1992). *Geology of Canberra Geological Series* Sheet 8727, 1:100 000. Canberra, Australia: Bureau of Mineral Resources Geology and Geophysics.

Jenkins, B.R. (2000). *Canberra Soil Landscape Series*, Sheet 8727, 1:100 000. Sydney, Australia: NSW Department of Land and Water Conservation.

8. Limitations

Douglas Partners (DP) has prepared this report for this project at Tharwa Drive in Gordon in accordance with DP's proposal dated 28 July 2020 and acceptance received from Calibre Professional Services Pty Ltd (Calibre) dated 17 September 2020. . This report is provided for the exclusive use of Calibre for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the surface conditions at the time of the assessment and the sub-surface conditions on the nearby sites only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the surface conditions encountered during this assessment. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site between and beyond the areas observed or observable. The advice may also be limited by budget constraints imposed by others or by site accessibility.

The assessment of atypical safety hazards arising from this advice is restricted to the geotechnical components set out in this report and based on known project conditions and stated design advice and assumptions. While some recommendations for safe controls may be provided, detailed 'safety in design' assessment is outside the current scope of this report and requires additional project data and assessment.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

The scope for work for this investigation/report did not include the assessment of surface or sub-surface materials or groundwater for contaminants, within or adjacent to the site. Should evidence of filling of unknown origin be noted in the report, and in particular the presence of building demolition materials, it should be recognised that there may be some risk that such filling may contain contaminants and hazardous building materials.

Douglas Partners Pty Ltd

Appendix A

About This Report

About this Report

Douglas Partners

Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Copyright

This report is the property of Douglas Partners Pty Ltd. The report may only be used for the purpose for which it was commissioned and in accordance with the Conditions of Engagement for the commission supplied at the time of proposal. Unauthorised use of this report in any form whatsoever is prohibited.

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

Appendix B

Site Photographs



Photo 1 – View south of the Knoke Avenue / Pocket Avenue roundabout



Photo 2 – View north along the duplication alignment from near the south end of the site

Douglas Partners Geotechnics | Environment | Groundwater	**Site Photographs** **Proposed Tharwa Drive Duplication** **Tharwa Drive, Gordon**	PROJECT: 46225.03 PLATE No: 1 REV: 0
	CLIENT: Calibre Prof. Services P/L	DATE: Nov. 2020



Photo 3 – View north along the southern section of the duplication (~CH400 m)



Photo 4 – View south along the southern section of the alignment adjacent the incised swale

Douglas Partners Geotechnics | Environment | Groundwater	**Site Photographs** **Proposed Tharwa Drive Duplication** **Tharwa Drive, Gordon**	PROJECT: 46225.03 PLATE No: 2 REV: 0
	CLIENT: Calibre Prof. Services P/L	DATE: Nov. 2020



Photo 5 – View north from the southern end (~CH 530 m) of the incised swale adjacent to the site



Photo 6 – Culvert pipe structure (~CH530 m)

Douglas Partners Geotechnics | Environment | Groundwater	**Site Photographs** **Proposed Tharwa Drive Duplication** **Tharwa Drive, Gordon**	PROJECT: 46225.03 PLATE No: 3 REV: 0
	CLIENT: Calibre Prof. Services P/L	DATE: Nov. 2020



Photo 7 – View north of Bedo Arch structure and swale at ~CH 970 m



Photo 8 – View east of Bedo Arch structure and swale at ~CH 970 m

Douglas Partners Geotechnics | Environment | Groundwater	**Site Photographs** **Proposed Tharwa Drive Duplication** **Tharwa Drive, Gordon**	PROJECT: 46225.03 PLATE No: 4 REV: 0
	CLIENT: Calibre Prof. Services P/L	DATE: Nov. 2020



Photo 9 – View south of the Box Hill T-intersection roundabout (~CH1020 m)



Photo 10 – View north along the northern portion of the duplication alignment (~CH1050 m)

Douglas Partners Geotechnics | Environment | Groundwater	**Site Photographs** **Proposed Tharwa Drive Duplication** **Tharwa Drive, Gordon**	PROJECT: 46225.03 PLATE No: 5 REV: 0
	CLIENT: Calibre Prof. Services P/L	DATE: Nov. 2020



Photo 11 – View north along the northern section of the duplication alignment (~CH1300 m)



Photo 12 – View south along the northern section of the duplication alignment (~CH1300 m)

Douglas Partners Geotechnics | Environment | Groundwater	**Site Photographs** **Proposed Tharwa Drive Duplication** **Tharwa Drive, Gordon**	PROJECT: 46225.03 PLATE No: 6 REV: 0
	CLIENT: Calibre Prof. Services P/L	DATE: Nov. 2020



Photo 13 – View north along the northern section of the duplication alignment (~CH1500 m)



Photo 14 – View southeast of Bedo Arch structure and swale at ~CH 1610 m

Douglas Partners Geotechnics | Environment | Groundwater	**Site Photographs** **Proposed Tharwa Drive Duplication** **Tharwa Drive, Gordon**	PROJECT: 46225.03 PLATE No: 7 REV: 0
	CLIENT: Calibre Prof. Services P/L	DATE: Nov. 2020



Photo 15 – View northeast of Bedo Arch structure and swale at ~CH 1610 m



Photo 16 – View east of Bedo Arch structure and swale at ~CH 1610 m

Douglas Partners Geotechnics | Environment | Groundwater	**Site Photographs** **Proposed Tharwa Drive Duplication** **Tharwa Drive, Gordon**	PROJECT: 46225.03 PLATE No: 8 REV: 0
	CLIENT: Calibre Prof. Services P/L	DATE: Nov. 2020



Photo 17 – View south along the duplication alignment from near the north end of the site

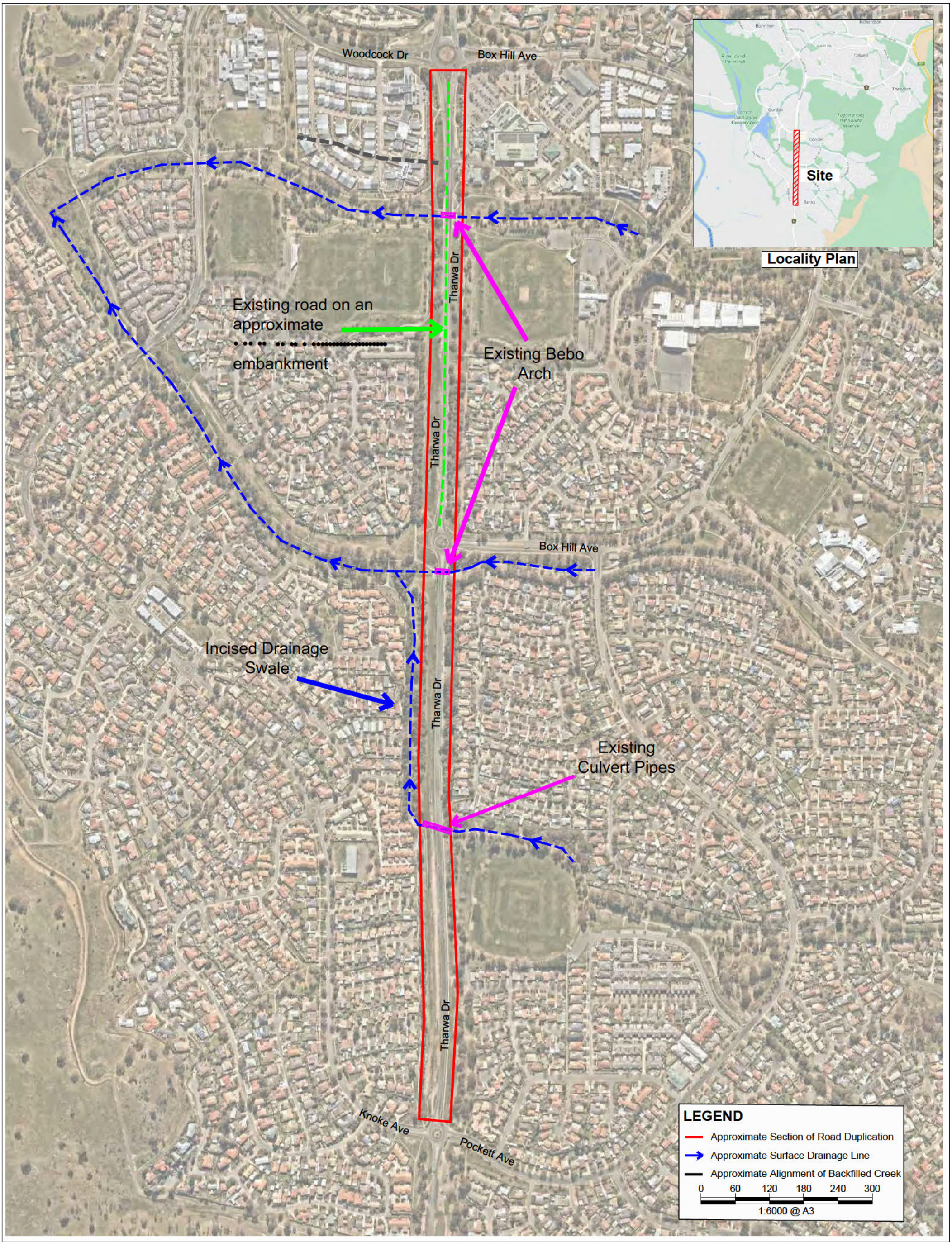


Photo 18 – View north of the Woodcock Avenue / Box Hill Avenue roundabout

Douglas Partners Geotechnics | Environment | Groundwater	**Site Photographs** **Proposed Tharwa Drive Duplication** **Tharwa Drive, Gordon**	PROJECT: 46225.03 PLATE No: 9 REV: 0
	CLIENT: Calibre Prof. Services P/L	DATE: Nov. 2020

Appendix C

Drawing 1 – Site Plan and Site Features



Douglas Partners
Geotechnics | Environment | Groundwater

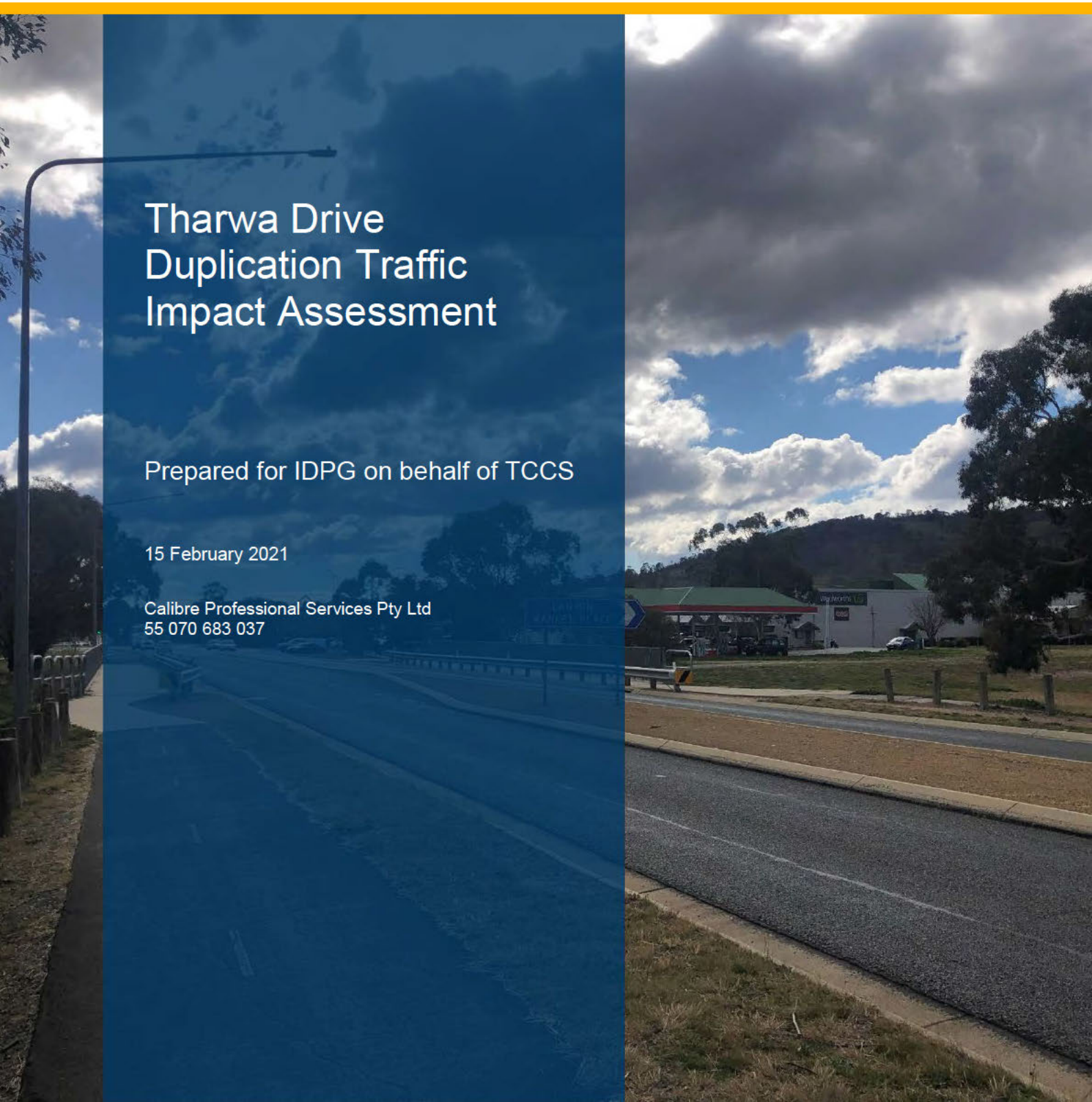
TITLE: **Site Plan and Site Features**
Proposed Tharwa Drive Duplication
Tharwa Drive, Gordon

OFFICE: Canberra
DRAWN BY: APH
DATE: 01.11.2020

CLIENT: Calibre Professional Services Pty Ltd
PROJECT No: 46255.03
DRAWING No: 1
REVISION: A
SCALE: As shown

Appendix C Traffic Assessment

Report



Tharwa Drive Duplication Traffic Impact Assessment

Prepared for IDPG on behalf of TCCS

15 February 2021

Calibre Professional Services Pty Ltd
55 070 683 037

QUALITY ASSURANCE STATEMENT

TASK	NAME	SIGNATURE
Project Manager	[redacted]	
Prepared by	[redacted]	
Reviewed by	[redacted]	
Approved for Issue by	[redacted]	

DOCUMENT CONTROL

ISSUE	DATE	ISSUE DETAILS	AUTHOR	CHECKED	APPROVED
01	07-12-20	Draft	[redacted]	[redacted]	[redacted]
02	15-02-21	Design Options Study	[redacted]	[redacted]	[redacted]

20-000580 Tharwa Drive Traffic Impact Assessment.Docx

COMMERCIAL IN CONFIDENCE

This document including any intellectual property is confidential and proprietary to Calibre and may not be disclosed in whole or in part to any third party nor used in any manner whatsoever other than for the purposes expressly consented to by Calibre in writing. Calibre reserves all legal rights and remedies in relation to any infringement of its rights in respect of its confidential information | © Calibre Group Pty Ltd.

Contents

Executive Summary **1**

1. Introduction **3**
1.1 Scope of Investigation 3

2. Existing Conditions **4**
2.1 Road Network 4
2.2 Current Intersection Layouts 6
2.3 Active Travel 11
2.4 Public Transport 12
2.5 Crash Analysis 13

3. Midblock Traffic Volumes **16**
3.1 Existing Traffic Demands 16
3.2 Background Traffic Growth 16
3.3 Midblock Capacity Review 17

4. Intersection Performance Analysis **18**
4.1 Performance Criteria 18
4.2 Existing Scenario Intersection Performance 19
4.3 Base Scenario Intersection Performance 19
4.4 Proposed Intersection Upgrades 21
4.5 Upgraded Intersection Performance 25

5. Conclusion **29**

Tables

Table 3.1 Traffic Scaling Factors during Peak Periods for COVID restrictions 16
Table 3.2 Adopted Background Growth Rates (per annum) 16
Table 3.3 Northbound Maximum Hourly Midblock Traffic Volumes 17
Table 3.4 Southbound Maximum Hourly Midblock Traffic Volumes 17
Table 4.1 Maximum Practical DOS by Intersection Control 18
Table 4.2 LOS Criteria for Intersections (RTA NSW Method) 18
Table 4.3 Current Intersection Performance Summary 19
Table 4.4 2031 Future Intersection Performance Summary 20
Table 4.5 2041 Future Intersection Performance Summary 21
Table 4.6 2031 Future Network Performance Comparison – AM Peak 26
Table 4.7 2031 Future Network Performance Comparison – PM Peak 26
Table 4.8 2041 Future Network Performance Comparison – AM Peak 28
Table 4.9 2041 Future Network Performance Comparison – PM Peak 28

Figures

Figure 1.1 Site Location Map 3
Figure 2.1 B-double Route Map 5
Figure 2.2 Current Layout – Tharwa Drive / Woodcock Drive / Box Hill Avenue Intersection 6
Figure 2.3 Current Layout – Tharwa Drive Pedestrian Crossing 7
Figure 2.4 Current Layout – Tharwa Drive / Norman Lindsay Street Intersection 8

Figure 2.5 Current Layout – Tharwa Drive / Box Hill Avenue Intersection 9
Figure 2.6 Current Layout – Tharwa Drive / Box Hill Avenue Intersection 10
Figure 2.7 Active Travel Network 11
Figure 2.8 Bus Route Map 12
Figure 2.9 ACT Road Crash Heat Map for Tharwa Drive Area 13
Figure 2.10 Crash Distribution for Tharwa Drive / Woodcock Drive / Box Hill Avenue 14
Figure 2.11 Crash Distribution for Tharwa Drive / Norman Lindsay Street 14
Figure 2.12 Crash Distribution for Tharwa Drive / Box Hill Avenue (South) 15
Figure 4.1 Tharwa Drive / Box Hill Avenue / Woodcock Drive Layout – Existing Layout (Left) vs. Proposed Layouts (Centre and Right) 22
Figure 4.2 Tharwa Drive / Norman Lindsay Street Layout – Existing Layout (Left) vs. Proposed Layouts (Centre and Right) 23
Figure 4.3 Tharwa Drive Pedestrian Crossing – Existing Layout (Left) vs. Duplicated Layout (Right) 23
Figure 4.4 Tharwa Drive / Box Hill Avenue Layout – Existing Layout (Left) vs. Proposed Layouts (Centre and Right) 24
Figure 4.5 Tharwa Drive / Pockett Avenue / Knoke Avenue Layout – Existing Layout (Left) vs. Proposed Layouts (Centre and Right) 25

Appendices

Appendix A Accident Diagrams
Appendix B Traffic Count Volumes
Appendix C SIDRA Results

Executive Summary

Introduction

Calibre Professional Services (Calibre) has been engaged by Infrastructure Delivery Partners Group (IDPG) on behalf of Transport Canberra and City Services (TCCS) to deliver a feasibility and concept design for the duplication of Tharwa Drive. The duplication is planned to cover approximately 1.9km of the road between Woodcock Drive and Pockett Avenue. As part of the feasibility study, a traffic impact assessment of the road and intersections was conducted.

Road Network

Tharwa Drive is considered an arterial road extending from Monaro Highway to Naas Road. For the section investigated in this report, the roads connecting with Tharwa Drive are predominantly classified as arterial roads or major collector roads. The speed limit along this section of Tharwa Drive is predominantly 80km/h, but decreases to 60km/h adjacent to the Lanyon Marketplace. Between Woodcock Drive and Pockett Avenue, Tharwa Drive typically consists of a single carriageway with one traffic lane in each direction. To the north of the investigated area, Tharwa Drive consists of two dual-lane carriageways separated by an 8m wide median.

Active Travel

There are shared paths present along both sides of Tharwa Drive between Woodcock Drive and Pockett Avenue, which together form a part of a local community route. This route connects into other local community routes which provide access to Gordon, Conder, and Banks. The local community route along Tharwa Drive transitions into a Principal Canberra Cycle Route which runs along Tharwa Drive to the north of the Woodcock Drive / Box Hill Avenue intersection. An on-road cycle route is also present extending north from this location. Both of these routes connect Lanyon Market with Greenway and in extension, the wider Canberra active travel network.

Public Transport

There are six bus routes which currently originate and/or terminate at the Lanyon Marketplace bus terminal. Of these, four of the routes travel along Tharwa Drive to the north of the intersection of Woodcock Drive / Box Hill Avenue. The remaining two routes cross Tharwa Drive at the Knoke Avenue / Pockett Avenue intersection. None of the bus routes travel along Tharwa Drive between the intersections of Woodcock Drive / Box Hill Avenue and Knoke Avenue / Pockett Avenue.

Crash Analysis

As part of the traffic assessment, the crash data for the last five years along Tharwa Drive was evaluated to determine areas which were prone to accidents. From this assessment, three sections were identified as having over 20 crashes in the last five years.

The first of these was the roundabout of Tharwa Drive, Woodcock Drive, and Box Hill Avenue. This intersection recorded 52 crashes, with the most common type being rear-end crashes (28 total). Crashes predominantly occurred along the north and south legs of the intersection and only rarely resulted in injury, suggesting they mostly occurred at low speeds.

The second location was the intersection of Tharwa Drive and Norman Lindsay Street. This intersection recorded 29 crashes within the last five years, with the most common crash type being collisions with right turning vehicles (19 total). The frequency of these crashes suggests that vehicles were having trouble picking gaps within oncoming northbound or southbound traffic.

The final location identified as being accident prone was the roundabout of Tharwa Drive and Box Hill Avenue. This intersection recorded 25 crashes over the past five years, with collisions between through and right turning vehicles being the most common (13 total). The majority of crashes at this intersection only resulted in property damage, suggesting that they occur at low speeds. It is noted that the diameter of the central island of this roundabout is below the Austroads minimum recommended diameter for an 80km/h road. This is expected to contribute to the frequency of crashes at this site.

Traffic Volumes

Current traffic volumes along the section of Tharwa Drive assessed were determined from traffic counts taken at the four major intersections along this section of Tharwa Drive. Due to the COVID-19 restrictions enacted in the Canberra region, it is assumed that the traffic count volumes would be lower than what would generally be observed at these locations in normal years. As such, SCATS data from the signalised pedestrian crossing was used to determine the percentage

reduction in traffic volumes caused by the restrictions. Traffic count data was then scaled based on this factor, allowing the overall magnitude of the traffic demands to be representative of conditions before the restrictions were adopted.

Traffic volume estimates for the years of 2031 and 2041 were also generated based off the traffic count volumes. These were calculated using the growth rates for the area surrounding Tharwa Drive assumed within the CSTM models for 2031 and 2041.

Midblock Capacity

Based off the aforementioned traffic count data, the maximum hourly midblock traffic volumes were calculated in both northbound and southbound directions between the four main intersections along this section of Tharwa Drive. This was done to determine whether duplication of this section of Tharwa Drive was warranted from a traffic volume standpoint. As per *Austroads Guide to Road Design Part 3: Transport Study and Analysis Methods*, the midblock capacity for a single lane in an undivided road is 900vph. It was found that the section of Tharwa Drive between Woodcock Drive and Box Hill Avenue (south) intersections exceeds this limit in the current year. The section of Tharwa Drive between Box Hill Avenue (south) and Pockett Avenue intersections is not expected to exceed 900vph within the next 20 years however, and so could be duplicated as a separate stage of the project, should this be desirable.

Base Intersection Performance Analysis

For the base scenarios, it was found that the intersection of Tharwa Drive / Norman Lindsay Street failed during both AM and PM peak periods within the current year. This is expected to continue to worsen within the 2031 and 2041 scenarios. The poor performance at this intersection is attributed to it being priority controlled. The delays occur along Norman Lindsay Street, as there aren't sufficient gaps in the northbound and southbound traffic along Tharwa Drive to allow the vehicles within this leg to turn out.

Within the PM peak period of the 2031 base scenarios, the intersection of Tharwa Drive / Woodcock Drive / Box Hill Avenue (north) is also expected to exceed acceptable limits for DOS. This is expected to worsen within the 2041 PM scenario, with delay also exceeding acceptable levels during that period. These high values occur along the northern leg of the intersection (Tharwa Drive) and are likely caused by the large number of vehicles travelling along these lanes combined with the moderate number of through and right turning volumes from the western leg (Woodcock Drive).

Within the 2031 and 2041 PM peak scenarios, the signalised pedestrian crossing along the road is expected to produce queue lengths which exceed the provided storage length of the northern lanes. This results in the queue from these signals to occasionally back up into the Tharwa Drive / Woodcock Drive / Box Hill Avenue roundabout.

Proposed Intersection Upgrades and Performance

For the SIDRA Modelling of the future upgraded intersection, it was assumed that Tharwa Drive had been duplicated between Woodcock Drive and Pockett Avenue. As such, all the intersections showed an increase in the number of lanes on approaches and exits. Several major intersection upgrades were also modelled to resolve the performance issues identified within the base scenarios.

The intersection of Tharwa Drive and Norman Lindsay Street was upgraded from priority-controlled to signalised, with the left turn slip-lanes along the southbound and westbound legs being removed. The signalised pedestrian crossing to the north was also removed and incorporated into this intersection, with pedestrian crossing facilitated along the north and east legs.

The intersections of Tharwa Drive / Box Hill Avenue (south) and Tharwa Drive / Knoke Avenue / Pockett Avenue were modelled as both a widened roundabout and as a signalised option. For the roundabout, the central island diameter was increased to 40m to make it compliant with Austroads recommendations. Two circulating lanes were also provided around the full roundabout to facilitate the additional carriageway. For the signal options, two through lanes were assumed along both northbound and southbound approaches. The left turn movement shared one of the through lanes while right turn movements received a dedicated short lane. This allowed the right turn movements to run separately to the through movements.

With the adoption of these upgrades, the road network is expected to improve to acceptable levels for all intersections. It is noted that both the options of increasing the roundabout size and upgrading the intersections to signals will result in acceptable levels of performance, however the performance of the network is noted to be improved with the adoption of the roundabout layouts.

1. Introduction

In September 2020, Calibre was engaged by Infrastructure Delivery Partners Group (IDPG) on behalf of Transport Canberra and City Services (TCCS) to deliver the feasibility and concept design for the duplication of Tharwa Drive between Woodcock Drive and Pockett Avenue (approx. 1.9km). This report has been prepared to support the proposed development through the analysis and assessment of the impacts of existing and future traffic impacts.

1.1 Scope of Investigation

The scope of this traffic impact assessment is as follows:

- Assessment of the existing active travel and public transport networks within the extent of the site.
- Assessment of the historical crash history within the extent of the site.
- AM and PM peak performance analysis for the current year, 10-year horizon, and 20-year horizon of the following intersections:
    1. Tharwa Drive / Box Hill Avenue / Woodcock Drive intersection;
    2. Tharwa Drive pedestrian crossing between Woodcock Drive and Norman Lindsay Street;
    3. Tharwa Drive / Norman Lindsay Street
    4. Tharwa Drive / Box Hill Avenue (south); and
    5. Tharwa Drive / Pockett Avenue / Knoke Avenue.
- Consideration and modelling of any upgrades required along these intersections to improve traffic performance.

The extent of the site and location of each of the key intersections can be seen in Figure 1.1.



Figure 1.1 Site Location Map

2. Existing Conditions

2.1 Road Network

Tharwa Drive is an arterial road that extends from Monaro Highway to the east and turns into Naas Road to the south. The section assessed within this report extends from the Woodcock Drive / Box Hill Avenue intersection to the Knoke Avenue / Pockett Avenue intersection. The majority of the assessed section of Tharwa Drive has a posted speed of 80km/h and typically possesses a single carriageway with a single 3.5m wide traffic lane and 0.5m wide sealed shoulder in each direction. The exception to this is adjacent to the Lanyon Marketplace, where the posted speed drops to 60km/h and the road separates into two carriageways divided by a median (typically between 1.2m and 4m). The Two carriageways continue to the north of the Woodcock Drive / Box Hill Avenue intersection, with two traffic lanes being provided in each direction and separated by an 8m median. The cross section varies depending on direction within this section, with the northbound traffic transitioning from a single 3.5m wide traffic lane to two 3.5m wide traffic lanes. The southbound direction maintains a single 3.5m wide traffic lane. Both directions have no painted shoulder present. It is noted that Tharwa Drive is designated as a B-double route between the Monaro Highway and Norman Lindsay Street (See Figure 2.1).

Box Hill Avenue is a major collector road that connects to Tharwa Drive at both ends. The road has a posted speed of 60km/h along its length. Three separate 40km/h school zones are present along this road, but do not extend to either intersection with Tharwa Drive. Box Hill Avenue typically possesses a single 9m wide carriageway with a single traffic lane in each direction. Two bus stops are located along the road. It is also noted that Box Hill Avenue is designated as a B-double route between Tharwa Drive (north) and Sidney Nolan Street. Its use for B-double vehicles is as a turn-around route (See Figure 2.1).

Woodcock Drive is an arterial road that connects into Drakeford Drive to the north and Tharwa Drive to the south. The posted speed is 60km/h between Tharwa Drive and Jim Pike Avenue, with a 40km/h school zone also present. Past Jim Pike Avenue, the posted speed increases to 80km/h. Woodcock Drive typically supports a dual carriageway, separated by a 5.5m wide median. Each carriageway supports a single 3.3m wide traffic lane and a 2.5m wide painted shoulder. It is noted that the entire length of Woodcock Drive is designated as a B-double route.

Norman Lindsay Street is a local access road which connects Tharwa Drive to the west with Sidney Nolan Street to the east. The entire road is posted at 40km/h. Norman Lindsay Street typically has a single carriageway with supports two 3.3m wide traffic lanes. It is noted that the full length of Norman Lindsay Street is designated as a B-double route, and is part of a turnaround movement utilising Box Hill Avenue and Sidney Nolan Street (See Figure 2.1).

Pockett Avenue is a major collector road extending from Box Hill Avenue to the north and Tharwa Drive to the south. The full length of the road has a posted speed of 60km/h. Pockett Avenue has a single carriageway which typically supports a single 4.5m wide traffic lane in each direction. A discontinuous on-road cycle lane is also present in both directions along the length of the road and takes 1.2m of the traffic lane where it is present. There are five sets of bus stops along the length of the road.

Knoke Avenue is a major collector road connecting to Woodcock Drive to the north and Tharwa Drive to the south. The road has a posted speed of 60km/h along its length. Knoke Avenue possesses a single carriageway which supports a 4.5m wide traffic lane in each direction. There are five sets of bus stops along the length of the road.



Figure 2.1 B-double Route Map

2.2 Current Intersection Layouts

2.2.1 Tharwa Drive / Woodcock Drive / Box Hill Ave

The intersection between Tharwa Drive, Woodcock Drive, and Box Hill Avenue currently forms a four-legged roundabout. The roundabout has a central island with a diameter of 40m and two circulating lanes on the east, south and west sides of the roundabout. The number of circulating lanes drops to one along the north side. All entry legs to the roundabout consist of two lanes and typically exit into a single lane, with the exception of the northern exit which exits into two lanes. The current layout of this intersection and the model used for analysis can be seen in Figure 2.2.



Figure 2.2 Current Layout – Tharwa Drive / Woodcock Drive / Box Hill Avenue Intersection

2.2.2 Tharwa Drive Signalised Pedestrian Crossing

Along Tharwa Drive, between the intersections with Woodcock Drive / Box Hill Avenue and Norman Lindsay Street, a signalised pedestrian crossing is located. The crossing is set out as a staged crossing, with the crossings offset by 4m along the road. Pedestrian storage is provided within the 3.5m wide median between the two carriageways and is bounded by a low pedestrian fence. The pedestrian crossing traverses a single 4m wide travel lane in the southbound direction and two travel lanes totalling 8.5m in the northbound direction. The signals are triggered through the use of push buttons, and so only stop vehicles when pedestrians are present. The current layout of the crossing and model used for analysis in SIDRA can be seen in Figure 2.3.

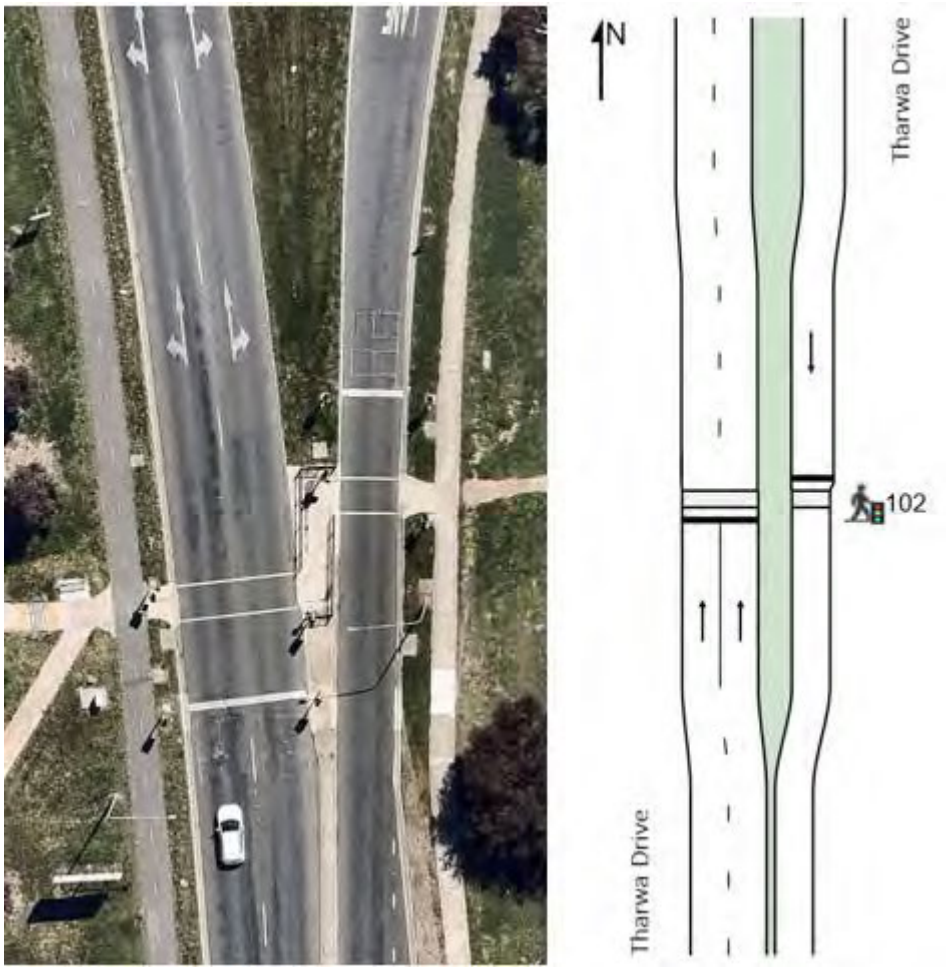


Figure 2.3 Current Layout – Tharwa Drive Pedestrian Crossing

2.2.3 Tharwa Drive / Norman Lindsay Street

The intersection between Tharwa Drive and Norman Lindsay Street is currently a priority-controlled T-intersection. The major legs consist of Tharwa Drive to the north and south, while Norman Lindsay Street to the east is controlled by a give-way sign. Both Tharwa Drive legs of the intersection have a single full-length through lane and a short turn lane. The left-turns from the north and east legs utilise high-angle slip turns, while the right-turn movements from the east and south legs are give-way controlled. It is noted that the right-out movement from the east has its own northbound lane. However, as this is only delineated by a small painted island and relatively short length of solid painted white line, confidence to take this right-out movement against oncoming northbound traffic is limited and impacts the efficiency of this intersection. The northbound and southbound carriageways are separated by a 1.2m median at this location. The current layout of the intersection and the model used for analysis within SIDRA can be seen in Figure 2.4.

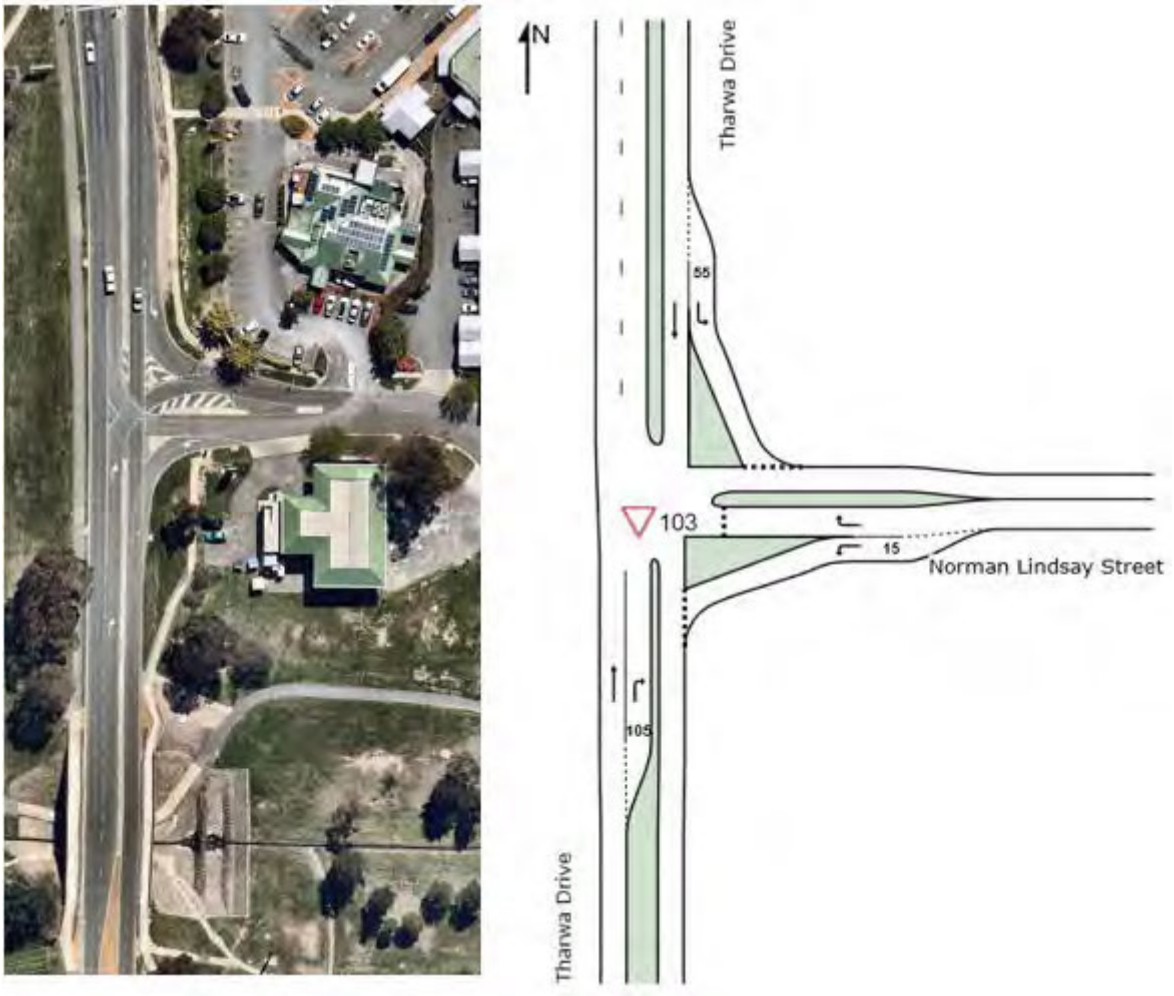


Figure 2.4 Current Layout – Tharwa Drive / Norman Lindsay Street Intersection

2.2.4 Tharwa Drive / Box Hill Avenue

The intersection between Tharwa Drive and Box Hill Avenue is currently set out as a three-legged roundabout. The roundabout has a central island with a diameter of 24m and has a single circulating lane on all sides. It is noted that this diameter is below the Austroads minimum recommended diameter for a roundabout along an 80km/h road (28m, as per Table 4.1 of *Austroads Guide to Road Design Part 4B*). All legs of the intersection support a single entry and exit lane. The current layout of the roundabout and the model used for SIDRA analysis can be seen in Figure 2.5.

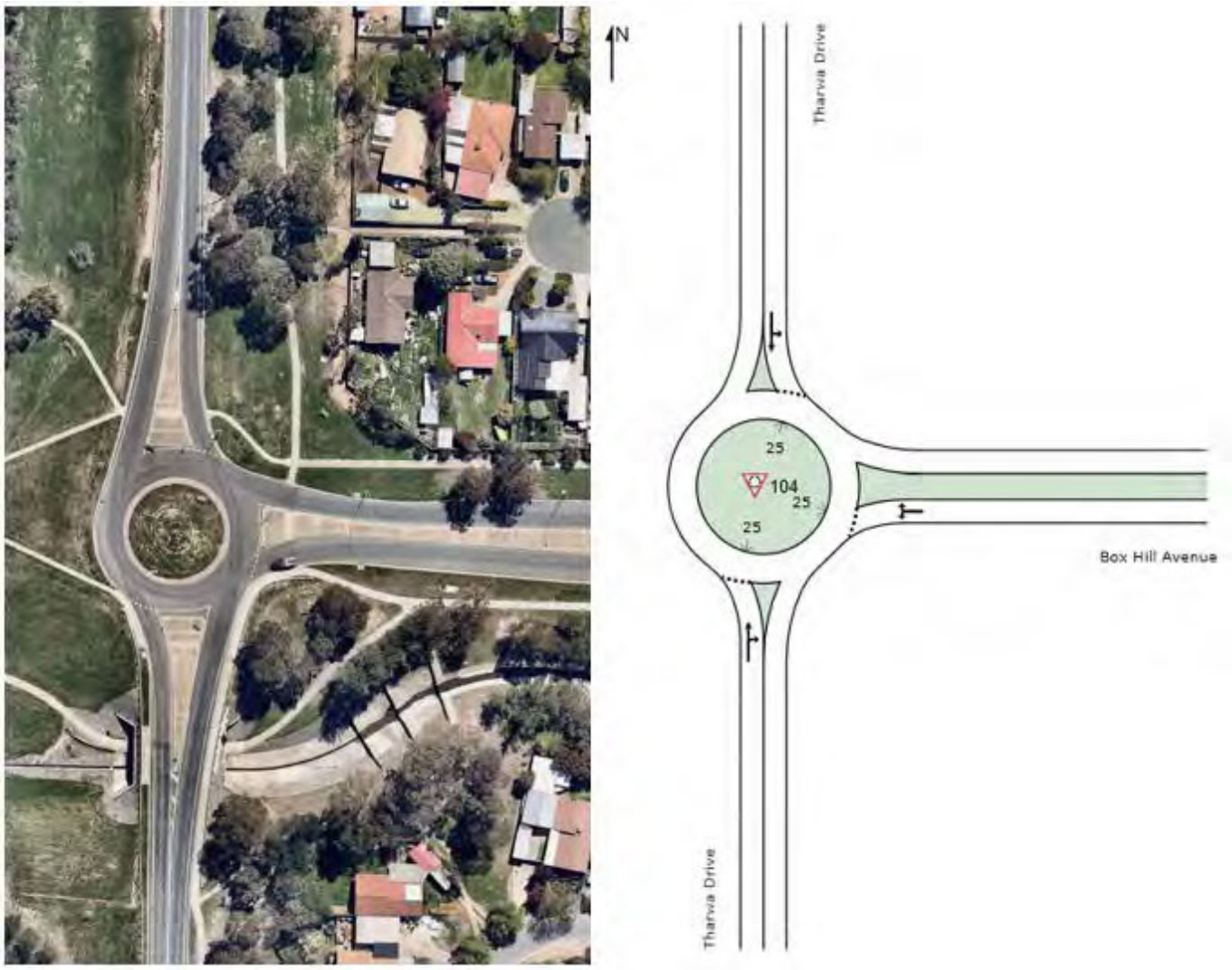


Figure 2.5 Current Layout – Tharwa Drive / Box Hill Avenue Intersection

2.2.5 Tharwa Drive / Pockett Avenue / Knoke Avenue

The intersection between Tharwa Drive, Pockett Avenue, and Knoke Avenue is currently set out as a four-legged roundabout. The roundabout has a central island diameter of 20m and has a single circulating lane in all directions. It is noted that this diameter is well below the Austroads minimum recommended diameter for a roundabout along an 80km/h road (28m, as per Table 4.1 of *Austroads Guide to Road Design Part 4B*). All legs of the intersection support a single entry and exit lane. The current layout of the roundabout and the model used for SIDRA analysis can be seen in Figure 2.6.

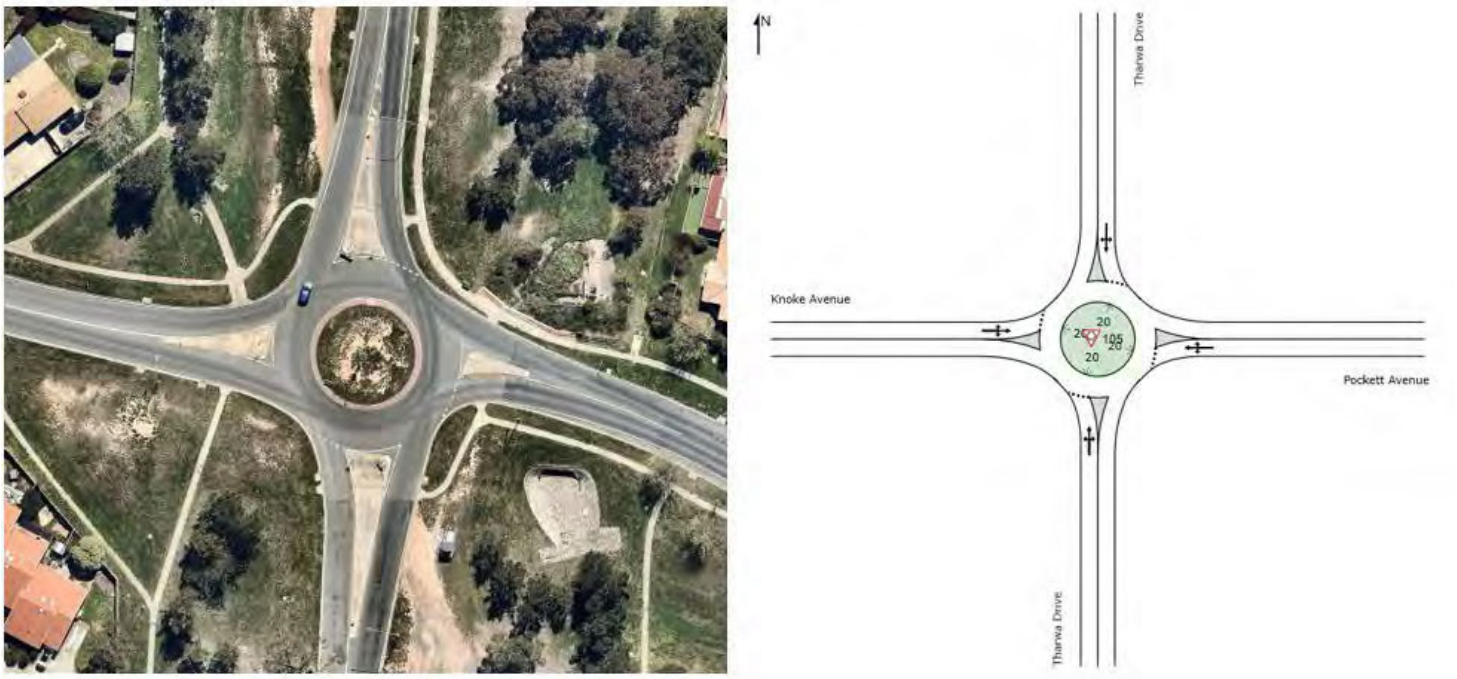


Figure 2.6 Current Layout – Tharwa Drive / Box Hill Avenue Intersection

2.3 Active Travel

A review of the Active Travel Infrastructure Practitioner Tool indicates that there are a number of strategic active travel routes located within close proximity to the section of Tharwa Drive planned for duplication (see Figure 2.7). A local community route is located along the full length of the site and connects in with other local community routes at Lanyon Marketplace, Pockett Avenue, Knoke Avenue, and Box Hill Avenue. These connections provide access to the wider active travel networks through Gordon, Conder, and Banks. The community route consists of a 1.8m wide paved shared path along both sides of Tharwa Drive. The path along the western verge increases to a 2.7m wide asphalt shared path between Woodcock Drive and the bottom of Gordon District Playing Field #3.

The local community route along Tharwa Drive connects into a Principal Canberra Cycle Route to the north of the Woodcock Drive / Box Hill Avenue intersection. This route connects Lanyon Marketplace with Greenway, and in extension, the wider Canberra active travel network.

An on-road cycle route also runs along Tharwa Drive just to the north of the site, continuing along to the on-road networks along Drakeford Drive and the Monaro Highway.

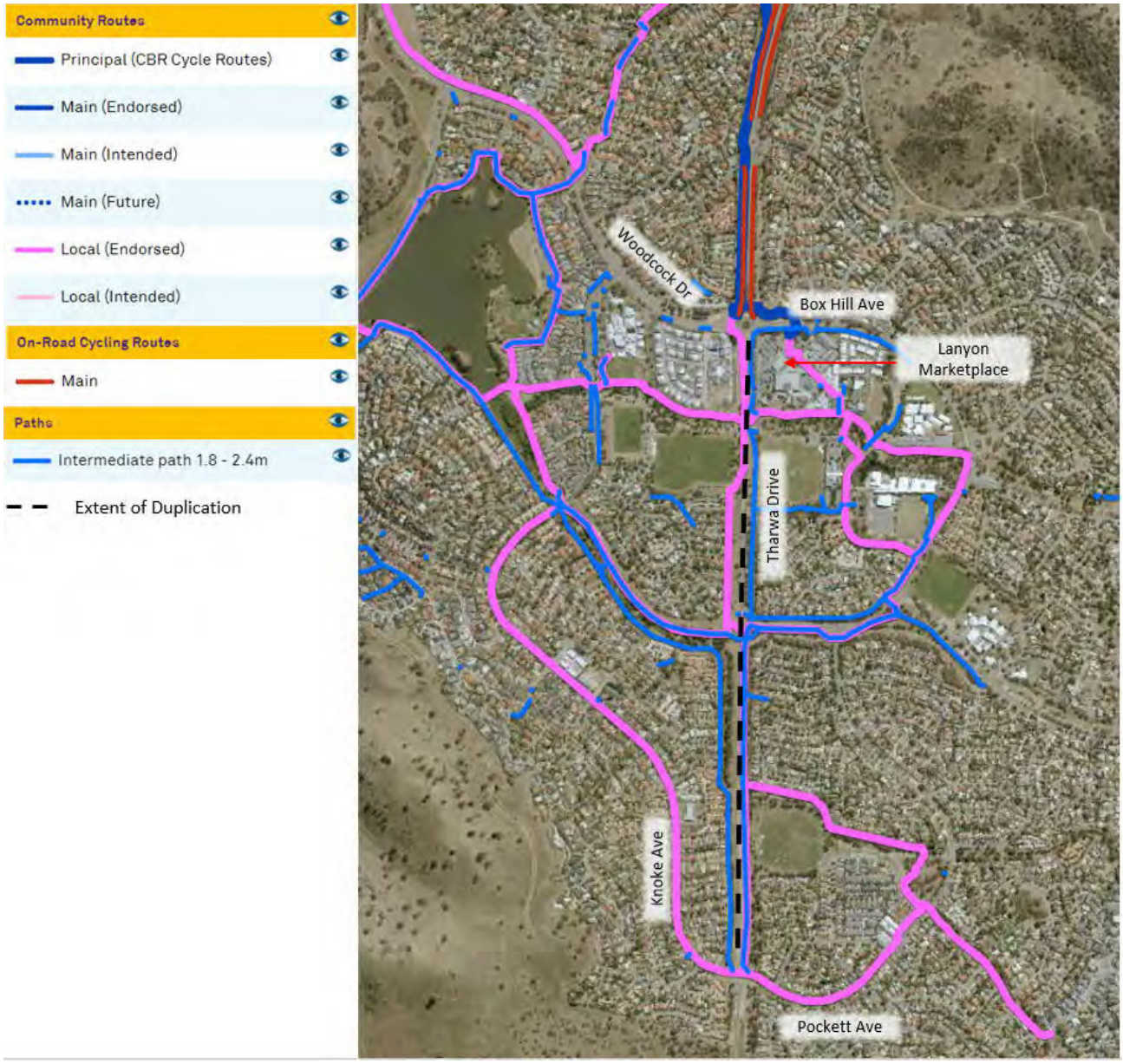


Figure 2.7 Active Travel Network

2.4 Public Transport

There are currently no bus routes which travel along the section of Tharwa Drive being assessed in this report, despite the proximity of the Lanyon Bus Station located at the Lanyon Marketplace. There are two local bus routes, three peak services routes and one rapid route which originate and / or terminate at the Lanyon Bus Station. Rapid Route R5, local route 80, and peak services routes 180 and 182 all utilise the intersection of Tharwa Drive / Woodcock Drive / Box Hill Avenue. The local route 81 and peak services route 181 cross Tharwa Drive at the Pockett Avenue / Knoke Avenue intersection. The location of each of these bus routes in relation to the site can be seen in Figure 2.8.

During the weekday, the R5 rapid route operates at intervals of 10 minutes all day. This increases to 30 minutes on the weekend. The local routes 80 and 81 operate less regularly than the rapid route, with 20-minute intervals during peak hours and 30-minute intervals outside of the peaks. On weekends, the busses run at 1-hour intervals between 6am and 12pm, then at 2-hour intervals from 12pm to 12am. The peak services routes 180, 181, and 182 are used to transport working people from the outer suburbs of Canberra into the City and Parliamentary Triangle during peak hours. As such, these services only operate on weekdays from 6.30am to 7.30am and from 4pm to 6pm. These routes operate at 30-minute intervals.

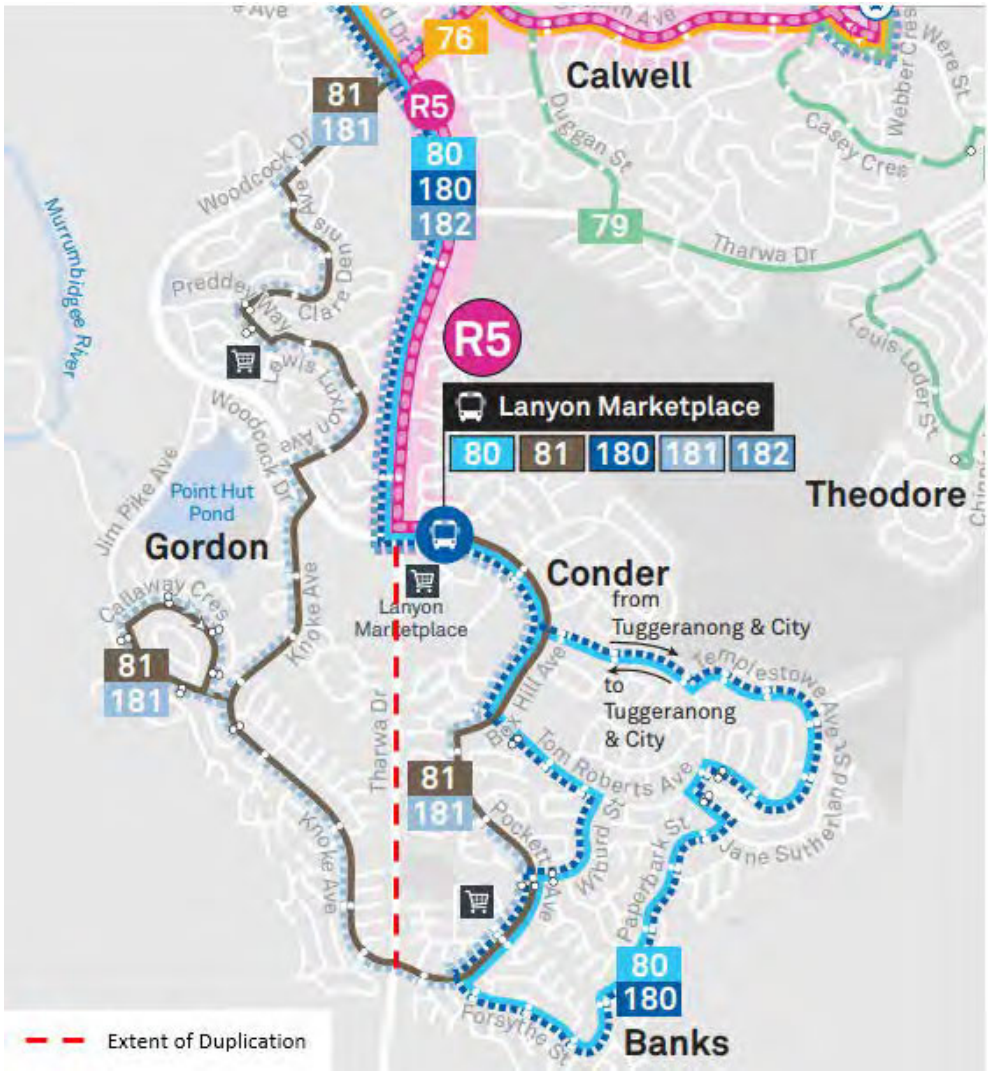


Figure 2.8 Bus Route Map

2.5 Crash Analysis

As part of this assessment, the historical crash data for the length of Tharwa Drive between Woodcock Drive and Pockett Avenue was evaluated to identify potentially hazardous areas. The data was provided by TCCS and lists the location, type, and outcomes of all reported crashes which occurred between the 29/01/2015 and the 25/12/2019.

From the data, three locations were identified as being prone to accidents, with over 20 crashes recorded during the 5-year period. These locations were:

1. Roundabout of Tharwa Drive, Woodcock Drive and Box Hill Avenue;
2. Intersection of Tharwa Drive and Norman Lindsay Street; and
3. Roundabout of Tharwa Drive and Box Hill Avenue.

These key locations were also identified within the ACT Government Open Data Portal Crash Heat Map, which can be seen in Figure 2.9. Greater detail on the crash types and locations along the full project area can be seen in the accident diagrams included within Appendix A.

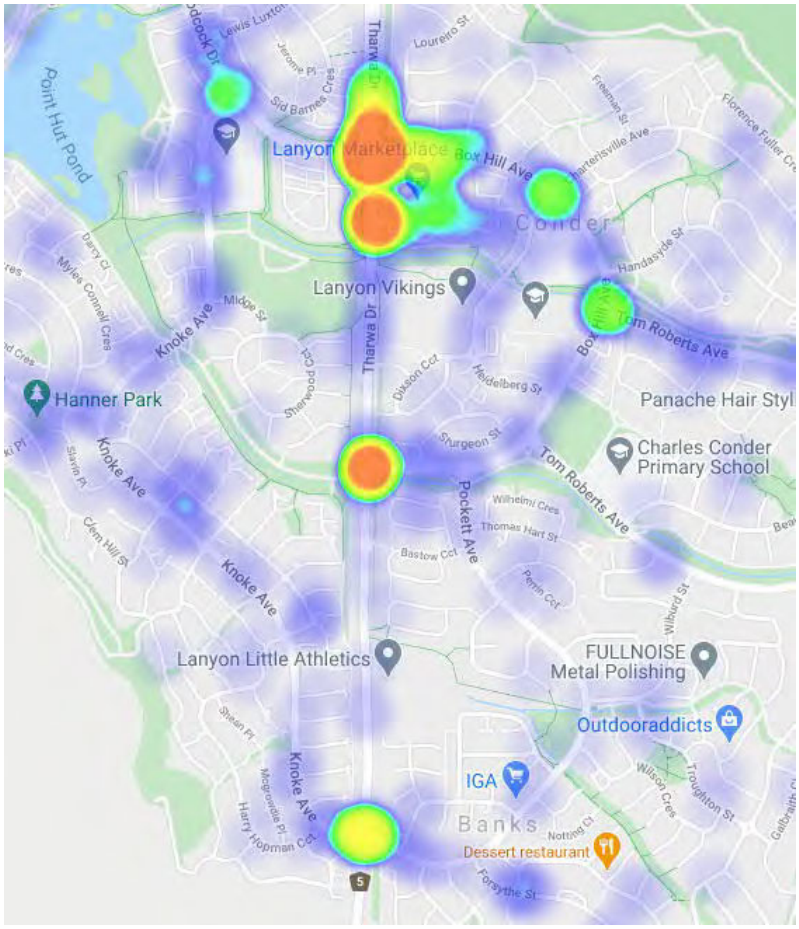


Figure 2.9 ACT Road Crash Heat Map for Tharwa Drive Area

The roundabout between Tharwa Drive, Woodcock Drive, and Box Hill Avenue had 52 crashes reported over the 5-year period, averaging approximately 10 crashes each year. Of these 52 crashes, 28 were noted to be rear-end crashes (RUM 301). These crashes generally occurred along the northern and southern (Tharwa Drive) legs of the roundabout. Despite the frequency of crashes at this intersection, only one crash resulted in a minor injury, while the rest resulted in property damage only. This suggests the crashes typically occurred at low speeds. A map of the crash locations at this intersection was extracted from the ACT Road Crash Map and can be seen in Figure 2.10.

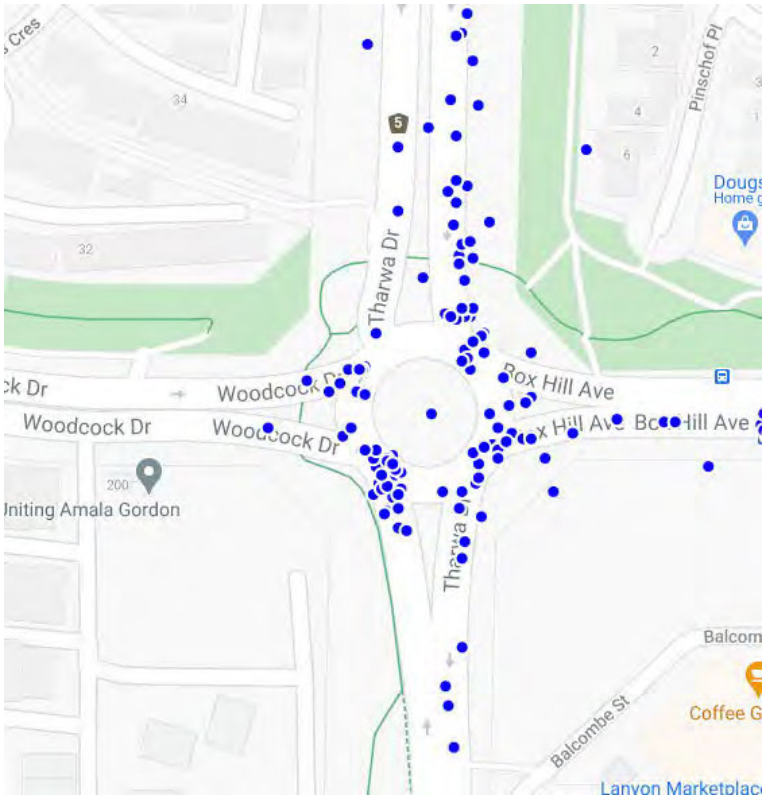


Figure 2.10 Crash Distribution for Tharwa Drive / Woodcock Drive / Box Hill Avenue

The intersection of Tharwa Drive and Norman Lindsay Street had 29 crashes reported over the 5-year period, with crashes relatively evenly distributed over the years. The major crash types observed at this intersection were noted to include right turning vehicles, with either through-right crashes (RUM 104 and 202) or right-right crashes (RUM 105). The three aforementioned crash types had a combined total of 19 crashes within this intersection. The frequency of these crash types suggests that vehicles are having trouble picking gaps in the oncoming traffic and signalising the intersection would significantly reduce this issue. It was also noted that the majority of crashes occurred either during the night (12 crashes) or within the interpeak periods (10 crashes). The high volume of night crashes may signify an issue surrounding lighting of the intersection. It is also possible that within these periods, the signalised pedestrian crossing does not activate as frequently and so does not create breaks in the southbound through traffic as regularly. A map of the crash locations at this intersection was extracted from the ACT Road Crash Map and can be seen in Figure 2.11.

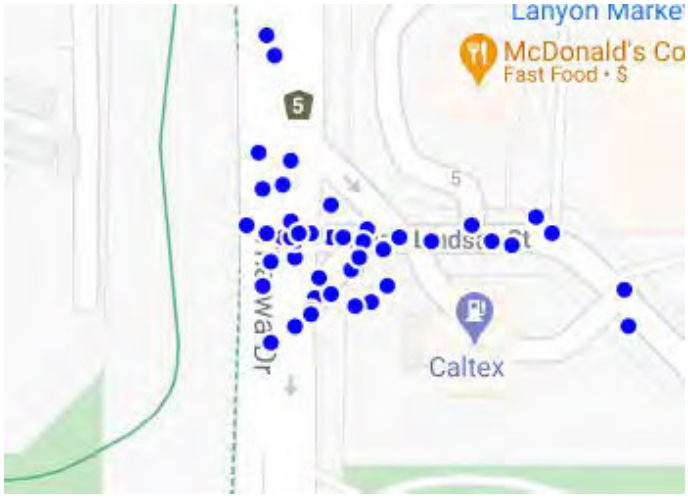


Figure 2.11 Crash Distribution for Tharwa Drive / Norman Lindsay Street

The roundabout of Tharwa Drive and Box Hill Avenue has 25 crashes reported over the 5-year period, with crashes relatively evenly distributed over the years. The main crash type reported at this intersection was for through-right crashes (RUM 104) between southbound and westbound directions, with 13 crashes being attributed to this. Despite the frequency of this crash type, the number of minor and serious injuries were relatively low, with only one minor injury and one serious injury recorded. As mentioned in Section 2.2.4, the diameter of the central island is below the Austroads minimum diameter for a roundabout along an 80km/h road. This smaller radius may contribute to the high number of through-right crashes, with vehicles being unable to judge approaching vehicle speed and pick sufficient gaps. A map of the crash locations at this intersection was extracted from the ACT Road Crash Map and can be seen in Figure 2.12.

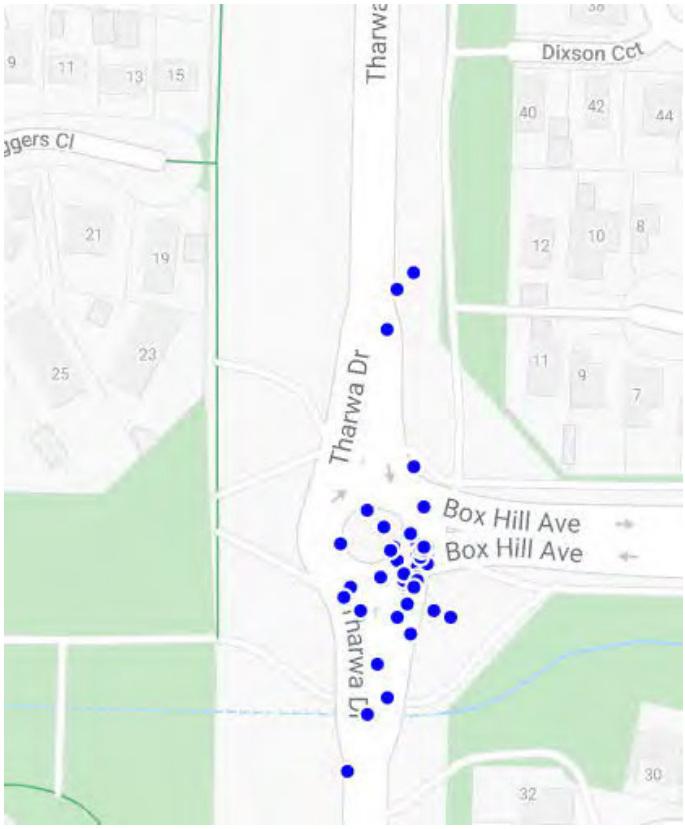


Figure 2.12 Crash Distribution for Tharwa Drive / Box Hill Avenue (South)

3. Midblock Traffic Volumes

3.1 Existing Traffic Demands

The existing traffic demands and vehicle movements along Tharwa Drive were determined through intersection counts conducted at the four intersections along the section of road. This count information can be found in Appendix B. These counts were conducted by Trans Traffic Survey on the 6th November 2020 and detailed all vehicle movements and classifications through each of the intersections for two-hour periods around both AM and PM peaks.

Due to the supressed traffic demands resulting from the COVID-19 restrictions at the time of the analysis, it is expected that the results of these surveys would show a smaller number of vehicle movements than what would typically be expected. To allow for this difference, the SCATS data for the signalised pedestrian crossing along Tharwa Drive was requested for both the 27th February 2020 (before COVID-19 restrictions) and for the 17th September 2020 (impacted by COVID-19 restrictions). The difference between vehicle volumes on these two dates was then calculated and used to determine the typical traffic conditions along this section of road. In this way, the overall magnitude of the traffic demands should be representative of conditions before the COVID-19 restrictions were adopted. The calculated scaling rates for both peak periods can be seen in Table 3.1. As the value for the AM peak actually saw an increase in traffic volumes compared to the pre-COVID volumes, no scaling was applied for this period.

Table 3.1 Traffic Scaling Factors during Peak Periods for COVID restrictions

Period	SCATS Volumes		Difference (%)	Adopted Scaling Factor
	27th Feb 2020	17th Sep 2020		
AM Peak	1288	1343	4%	1.00
PM Peak	1446	1395	-4%	1.04

3.2 Background Traffic Growth

Outputs from the Canberra Strategic Transport Model (CSTM) were sourced from Transport Canberra and City Services (TCCS). These strategic model outputs show traffic demand forecasts along key road links throughout the Canberra area, based on projected population, employment, education and retail growth. CSTM peak hour traffic volumes for the years of 2021, 2031, and 2041 were sourced for the length of Tharwa Drive being investigated for duplication. From this data, the linear annual growth rates were derived for both AM and PM peak periods. Due to different growth rates noted between Tharwa Drive and the surrounding roads connecting with it, two separate annual growth rates were adopted. These growth rates can be seen in Table 3.2.

Table 3.2 Adopted Background Growth Rates (per annum)

Period	AM Peak Hour	PM Peak Hour
Along Tharwa Drive		
2021 to 2031	0.5%	0.7%
2031 to 2041	0.2%	0.1%
Along Side Roads		
2021 to 2031	0.2%	0.4%
2031 to 2041	0.3%	0.3%

3.3 Midblock Capacity Review

Based off the traffic count data collected for each of the intersections and the annual background growth rates shown in Table 3.2, the predicted traffic volumes for the peak hour periods was determined throughout the network for the current year as well as the future years of 2031 and 2041. The peak hour midblock volumes expected throughout the network can be seen in Table 3.3 and Table 3.4. For these values, the maximum hourly traffic volume observed in a single traffic lane was taken. Due to the tidal nature of the residential houses within this area, the maximum northbound midblock traffic volumes were recorded from the AM peak hour, while the southbound midblock traffic volumes were recorded from the PM peak hour.

Table 3.3 Northbound Maximum Hourly Midblock Traffic Volumes

Midblock Section	Year		
	Current (vph)	2031 (vph)	2041 (vph)
Woodcock Dr to Norman Lindsay St	925	969	990
Norman Lindsay St to Box Hill Ave	924	968	989
Box Hill Ave to Pockett Ave	516	541	552

Table 3.4 Southbound Maximum Hourly Midblock Traffic Volumes

Midblock Section	Year		
	Current	2031	2041
Woodcock Dr to Norman Lindsay St	971	1015	1038
Norman Lindsay St to Box Hill Ave	936	980	1001
Box Hill Ave to Pockett Ave	479	502	512

From Table 6.1 of *Austroads Guide to Road Design Part 3: Transport Study and Analysis Methods*, the midblock capacity for a single lane in an undivided road is 900vph. As the current volumes along Tharwa Drive between Woodcock Drive and Box Hill Avenue (south) exceed 900 vehicles in both north and southbound lanes, the duplication of Tharwa Drive would be warranted at any stage from the current date.

It is noted that the section of Tharwa Drive between Box Hill Avenue (south) and Pockett Avenue is not expected to exceed this 900vph capacity within the next 20 years, still falling around 400vph short of this limit in 2041. Should a staged development of Tharwa Drive be preferable, duplication of the section of road between Woodcock Drive and Box Hill Avenue (south) could be undertaken before the section between Box Hill Avenue (south) and Pockett Avenue and still maintain adequate performance along the road. Having said this, duplication of Tharwa Drive between Box Hill Avenue (south) and Pockett Avenue would still provide improvements to the safety and amenity of this section of the road, such as extending the on-road cycling network. As such, duplicating the full length of Tharwa Drive within one section should still be considered.

4. Intersection Performance Analysis

Intersection performance analysis was undertaken using SIDRA Intersection 8 modelling software. This software was used to model each of the key intersections within the scope of the project. Given the proximity of each of these intersections to one another and the fact they are directly connected, the traffic scenarios have been modelled in a network including all the intersections.

4.1 Performance Criteria

The *RMS Traffic Modelling Guidelines* identify the maximum practical DOS for various intersection controls as presented in **Table 4.1**.

Table 4.1 Maximum Practical DOS by Intersection Control

Intersection Control	Maximum Practical DOS
Traffic Signals	0.90
Roundabouts (incl. Metered)	0.85
Priority-Controlled	0.80

Intersections operating in excess of their maximum practical capacity typically experience unstable traffic flow whereby small disruptions result in excessive congestion and flow breakdown.

The *RMS Traffic Modelling Guidelines* also identify LOS criteria for intersections as shown in Table 4.2.

Table 4.2 LOS Criteria for Intersections (RTA NSW Method)

LOS	Average delay per vehicle	Description
A	≤ 14s	Good operation
B	15s – 28s	Acceptable delays and spare capacity
C	29s – 42s	Satisfactory
D	43s – 56s	Near capacity
E	57s – 70s	At capacity, priority-control not suitable
F	> 70s	Unsatisfactory with excessive queueing

The TCCS *Draft Guidelines for SIDRA Analysis* similarly identifies intersections operating at LOS E or better as acceptable.

95th percentile queue lengths have been assessed to ensure that queues in short lanes do not impact traffic in adjacent lanes and queues in full-length lanes do not impact upstream intersections.

4.2 Existing Scenario Intersection Performance

The performance of each of the abovementioned sites was calculated in a network scenario within SIDRA. A summary of the results for these simulations can be seen in Table 4.3. For further information, refer to the SIDRA models included within Appendix C.

Table 4.3 Current Intersection Performance Summary

Intersection	AM Peak Hour				PM Peak Hour			
	DOS	Delay	LOS	Queue	DOS	Delay	LOS	Queue
Tharwa Dr / Box Hill Ave / Woodcock Dr	0.55	13s	A	10m	0.84	9s	A	25m
Tharwa Dr Pedestrian Crossing	0.27	1s	A	19s	0.51	1s	A	57m
Tharwa Dr / Norman Lindsay St	0.95	95s	F	22m	0.99	126s	F	24m
Tharwa Dr / Box Hill Ave	0.56	8s	A	15m	0.59	12s	A	18m
Tharwa Dr / Pockett Ave / Knoke Ave	0.22	10s	A	4m	0.36	11s	A	7m

As can be seen from the above table, all bar one of the intersections perform at acceptable levels of DOS and delay during the existing conditions. The intersection of Tharwa Drive with Norman Lindsay Street is the one exception to this, with both DOS and delay greatly exceeding acceptable levels. This poor performance is isolated to within the eastern leg of the intersection and is caused by the high through movement volumes along the southbound carriageway of Tharwa Drive.

Queueing is also noted to reach the storage length to the north of the signalised pedestrian crossing. At this location, a queue of 57m shall end just before the roundabout of Tharwa Drive / Woodcock Drive / Box Hill Avenue (58m away).

4.3 Base Scenario Intersection Performance

4.3.1 2031 Scenario

Based off the scaled traffic count data collected at each of the intersections and the background growth rates listed in Table 3.2 above, the expected 2031 future traffic volumes were calculated throughout the network. SIDRA analysis of the intersections was completed using these volumes to generate a base model for the intersection performance within this year. The performance metrics defined in Section 4.1 were then used to quantify performance and enable comparison between years and options.

A summary of the results for this model is presented in Table 4.4. For further information, refer to the SIDRA models included within Appendix C.

Table 4.4 2031 Future Intersection Performance Summary

Intersection	AM Peak Hour				PM Peak Hour			
	DOS	Delay	LOS	Queue	DOS	Delay	LOS	Queue
Tharwa Dr / Box Hill Ave / Woodcock Dr	0.58	14s	A	11m	0.99	31s	C	69m
Tharwa Dr Pedestrian Crossing	0.28	1s	A	19m	0.54	1s	A	62m
Tharwa Dr / Norman Lindsay St	1.12	194s	F	47m	1.18	253s	F	52m
Tharwa Dr / Box Hill Ave	0.60	15s	B	17m	0.62	12s	A	20m
Tharwa Dr / Pockett Ave / Knoke Ave	0.22	11s	A	4m	0.38	11s	A	8m

During the AM peak period, only the intersection of Tharwa Drive and Norman Lindsay Street is expected to exceed acceptable levels, with DOS and LOS above the limits for a priority-controlled intersection. As in the existing conditions, these delays occur along the eastern leg of the intersection and are due to the high volume of southbound movements along Tharwa Drive. All other intersections are expected to operate at acceptable levels, with no issues expected.

During the PM peak period, the intersection of Tharwa Drive / Norman Lindsay Street, the roundabout of Tharwa Drive / Box Hill Avenue / Woodcock Drive and the signalised pedestrian crossing are expected to exceed acceptable levels. The intersection of Tharwa Drive and Norman Lindsay Street is expected to experience the same issues as were seen in the AM peak period, with long vehicle wait times along the eastern leg. The roundabout is expected to experience high DOS values along the northern leg (Tharwa Drive), exceeding the practical limit for a roundabout. This high value is attributed to the large traffic volumes along this leg combined with the opposing through and right turning volumes from the west leg (Woodcock Drive).

The signalised pedestrian crossing is expected to perform at acceptable levels for both DOS and delay during the PM peak. The queue length however is expected to exceed the 58m long queuing distance and extend back into the roundabout at times. This can cause issues related to expectancy and road safety.

4.3.2 2041 Scenario

As with the 2031 scenario, the 2041 traffic volumes were generated through scaling the traffic count data for each of the intersections using the background growth rates listed in Table 3.2 above. The performance metrics defined in Section 4.1 were then used to quantify performance and enable comparison between years and options.

A summary of the results for this model is presented in Table 4.6. For further information, refer to the SIDRA models included within Appendix C.

Table 4.5 2041 Future Intersection Performance Summary

Intersection	AM Peak Hour				PM Peak Hour			
	DOS	Delay	LOS	Queue	DOS	Delay	LOS	Queue
Tharwa Dr / Box Hill Ave / Woodcock Dr	0.59	14s	A	12m	1.06	79s	F	200m
Tharwa Dr Pedestrian Crossing	0.28	1s	A	20m	0.55	1s	A	64m
Tharwa Dr / Norman Lindsay St	1.24	287s	F	69m	1.31	360s	F	73m
Tharwa Dr / Box Hill Ave	0.63	16s	B	18m	0.63	12s	A	21m
Tharwa Dr / Pockett Ave / Knoke Ave	0.23	11s	A	4m	0.39	11s	A	8m

As with the 2031 base scenario, only the intersection of Tharwa Drive and Norman Lindsay Street exceed acceptable values within the AM peak period. Both DOS values and delay values along the eastern leg of the intersection are beyond the practical maximum for a priority-controlled intersection, with DOS reaching 1.34 and delay reaching 287s. Upon reaching these unsuitable levels of performance, it is expected that some of the traffic may redistribute to the intersection of Tharwa Drive / Box Hill Avenue/ Woodcock Drive. This would be expected to improve performance along Norman Lindsay Street but would worsen performance at the Box Hill Avenue / Woodcock Drive intersection, which is also experiencing issues.

During the PM peak period, both the intersections of Tharwa Drive / Box Hill Avenue/ Woodcock Drive and Tharwa Drive / Norman Lindsay Street exceeds acceptable limits for DOS and delay. The intersection of Tharwa Drive / Box Hill Avenue / Woodcock Drive falls over within the southbound through movement, with the high volumes of through volumes from the west and right turn volumes from the south preventing vehicle movements. The intersection of Tharwa Drive / Norman Lindsay Street experiences the same issue that was noted within the AM peak, where through volumes from the north and south restrict turning movements from the east. Issues are also expected to arise from the signalised pedestrian crossing during the PM peak, with the queue length exceeding the 58m storage length and overflowing back into the roundabout to the north at times.

All the other intersections are expected to perform at acceptable levels during both peak periods.

4.4 Proposed Intersection Upgrades

As part of the proposed works, the length of Tharwa Drive between Woodcock Drive and Box Hill Avenue to the north, and Pockett Avenue and Knoke Avenue to the south will be duplicated. This development could potentially be separated into two stages, with stage 1 consisting of works between Woodcock Drive to just south of the Box Hill Avenue (south) intersection and stage 2 consisting of works south of stage 1 to the Pockett Avenue / Knoke Avenue intersection.

It is assumed that the duplication will see two full length lanes in each direction separated by a wide (assumed 8m) median. These works will require the adjustment and upgrade of the intersections within the network to facilitate this additional carriageway. Upgrades to several of the intersections are also required due to deficiencies with existing performance and / or safety. Several possible upgrades for these intersections are detailed below.

4.4.1 Tharwa Drive / Box Hill Avenue / Woodcock Drive

Despite the poor performance of this intersection during the base scenario PM peaks, it is expected that the additional full length through lane combined with the gaps in traffic produced by the signals proposed at the intersection of Tharwa Drive / Norman Lindsay Street (see Section 4.4.2) will allow the roundabout to operate at acceptable levels without major works being required. The upgraded roundabout layout for this intersection can be seen in the central image of Figure 4.1, compared to the existing layout in the left image of Figure 4.1. The only change with this layout is the extension of the merge lane along the southern exit lanes.

A signalised option for this intersection has also been modelled, as the signals would be expected to assist in controlling traffic and address a number of the safety issues present at the intersection. As with the previous option, this intersection also extends the southbound exit lane to a full length lane, allowing for two through lanes in both northbound and southbound directions. To manage the moderate turning volumes within this intersection, dedicated right-turn short lanes have been included along all legs. Left turn slip-lanes are also present along all legs. The signalised layout can be seen in the rightmost image of Figure 4.1. Given the size of the roundabout these signals would be replacing, the footprint of the intersection is no expected to increase and so impacts outside of the road corridor are not expected. The cost of this option is however expected to far exceed that of the previous option and may prove restrictive in its construction.

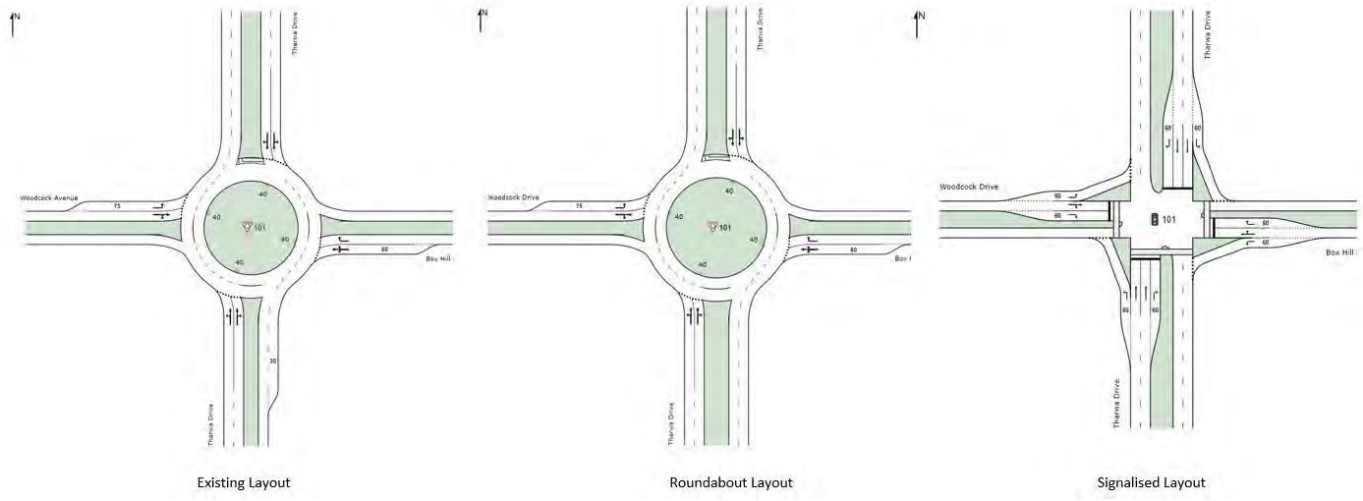


Figure 4.1 Tharwa Drive / Box Hill Avenue / Woodcock Drive Layout – Existing Layout (Left) vs. Proposed Layouts (Centre and Right)

4.4.2 Tharwa Drive / Norman Lindsay Street Intersection

Due to the poor performance of this intersection within the existing conditions and the moderate number of historical crashes, it is recommended that this intersection be changed from priority-controlled to a signalised intersection. The signalised layout modelled within SIDRA can be seen in the central image of Figure 4.2. This arrangement would remove the high angle slip lanes along the southbound and westbound carriageways, but otherwise would have a very similar layout to the existing intersection.

With the signalisation of this intersection, the signalised pedestrian crossing just to the north would become redundant. As such, it is recommended that this crossing be removed, with pedestrian crossing facilities instead being provided across the north and east legs of the intersection. This has the benefits of increasing the offset between the roundabout to the north and signals reducing queue impacts and increasing the distance between conflict points.

Another option which was explored for this intersection was the upgrade of the intersection to a roundabout. This roundabout would consist of a central island diameter of 28m, and have two circulating lanes along all sides. The layout used for modelling this roundabout can be seen as the rightmost image in Figure 4.2. It is noted that this layout is not expected to be favourable for this location due to the increased intersection footprint.

Adopting a roundabout at this location also removes the potential for combining the signalised pedestrian crossing with the intersection, thus requiring its inclusion to the north. This crossing would be upgraded to include an additional southbound lane and widened median. The duplicated layout used for this crossing can be seen compared against the existing layout in Figure 4.3, with the existing layout and duplicated layout being the left and right images respectively.

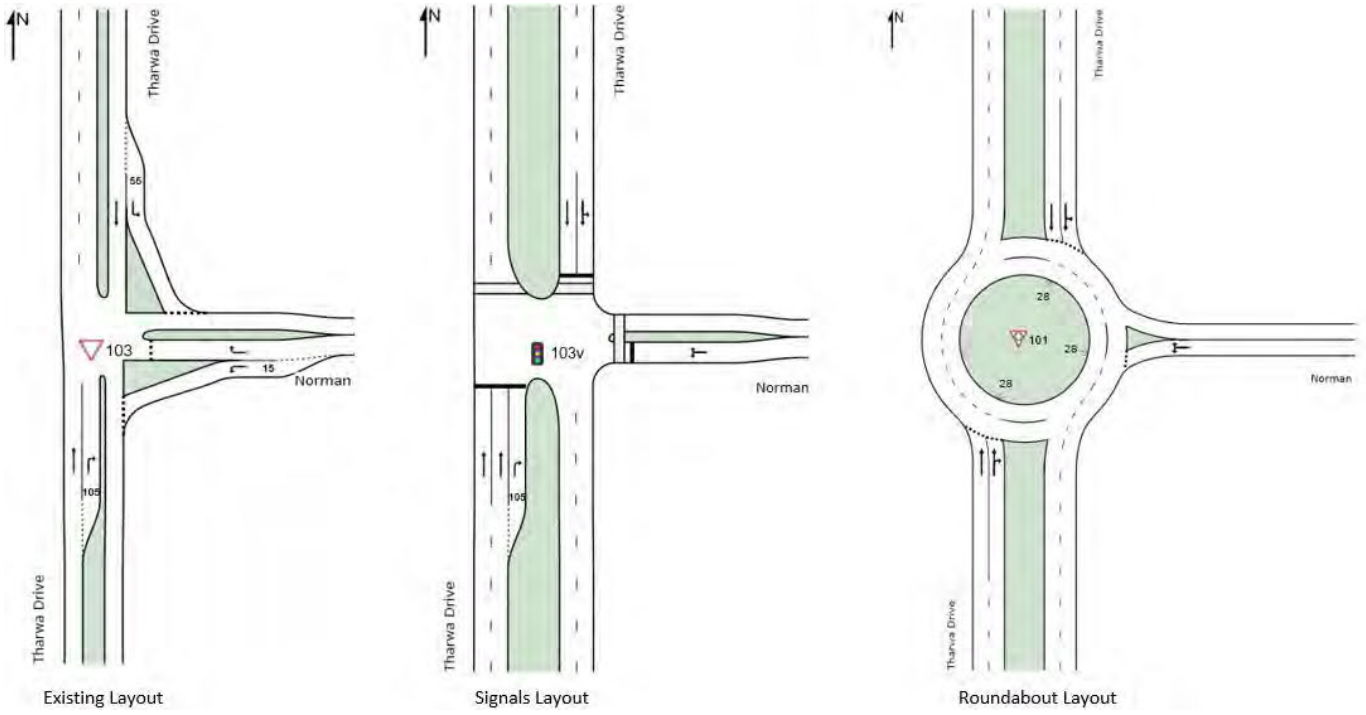


Figure 4.2 Tharwa Drive / Norman Lindsay Street Layout – Existing Layout (Left) vs. Proposed Layouts (Centre and Right)

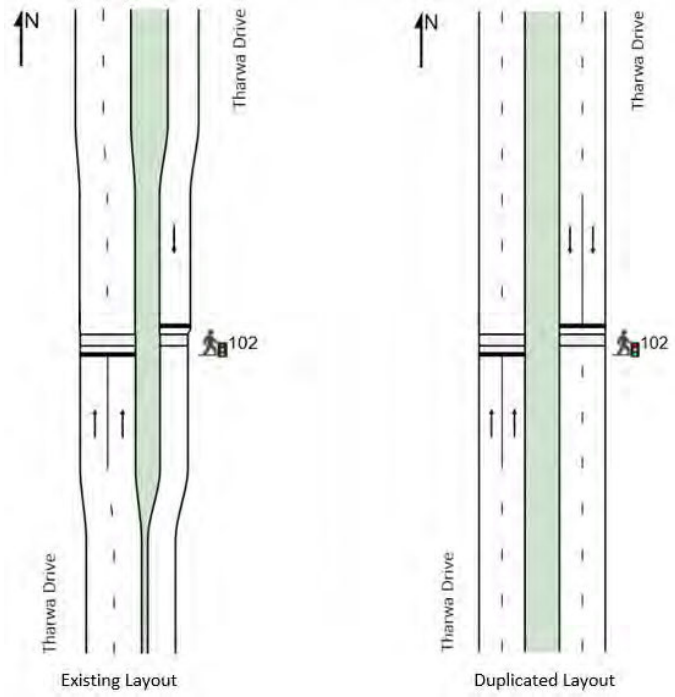


Figure 4.3 Tharwa Drive Pedestrian Crossing – Existing Layout (Left) vs. Duplicated Layout (Right)

4.4.3 Tharwa Drive / Box Hill Avenue

The intersection of Tharwa Drive and Box Hill Avenue is currently noted as having a roundabout diameter of 24m, which is below the recommended minimum diameter of a roundabout island in an 80km/h zone (See Table 4.1 of *Austroads Guide to Road Design Part 4B*). A moderate number of crashes have also been recorded at this intersection since 2015. As such, it is recommended to increase the island diameter of this roundabout to 40m. This would make it compliant with Austroads Standards. The new roundabout layout which was modelled in SIDRA can be seen in the central image of Figure 4.4.

Alternatively, the existing roundabout could also be converted into a signalised T-intersection. This layout would require a smaller footprint then widening the roundabout but would also require the installation of additional hardware to support the signals. The SIDRA model for the signalised layout of this intersection can be seen in the right image of Figure 4.4.

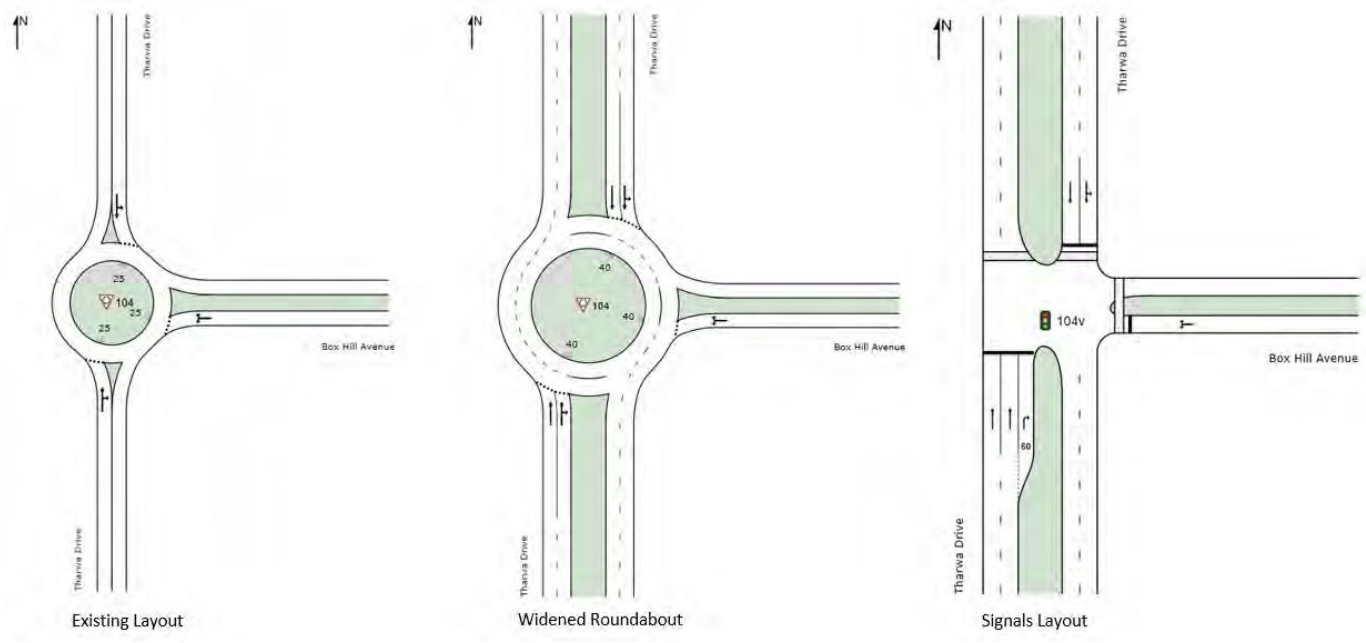


Figure 4.4 Tharwa Drive / Box Hill Avenue Layout – Existing Layout (Left) vs. Proposed Layouts (Centre and Right)

4.4.4 Tharwa Drive / Pockett Avenue / Knoke Avenue

As with the aforementioned Tharwa Drive / Box Hill Avenue roundabout, the roundabout of Tharwa Drive, Pockett Avenue, and Knoke Avenue has a roundabout diameter of less than the recommended minimum from Austroads, with a diameter of 20m. To make this intersection compliant with Austroads, the island diameter would need to be increased to 40m. To allow for full utilisation of the two through lanes along the northern leg and accommodate any possible future duplication of Tharwa Drive to the south of this intersection, it is recommended that short lanes be included along the approach and exit lanes along the southern leg of the roundabout. The new roundabout layout can be seen in the central image of Figure 4.5.

Alternatively, the existing roundabout could also be converted into a signalised cross-intersection. This layout would require a smaller footprint then widening the roundabout but would also require the installation of additional hardware to support the signals. The SIDRA model for the signalised layout of this intersection can be seen in the right image of Figure 4.5.

As discussed in Section 3.3, the section of Tharwa Drive between this intersection and the Box Hill Avenue (South) intersection is predicted to have suitable midblock volumes for a single lane in 2041. Combined with acceptable performance from this intersection seen in the 2041 base scenario (Section 4.3.2), it is also a possible option to not duplicate Tharwa Drive down to this intersection. Tharwa Drive would instead merge back into a single carriageway between this intersection and the Box Hill Avenue (South) intersection. Should this option be utilised, the existing layout of the intersection could be retained.

If no works are completed on the roundabout, the central island diameter will remain below the value recommended within Austroads. As only a low number of crashes have been recorded at the intersection over the past 5 years however, this discrepancy is not expected to result in major safety issues.

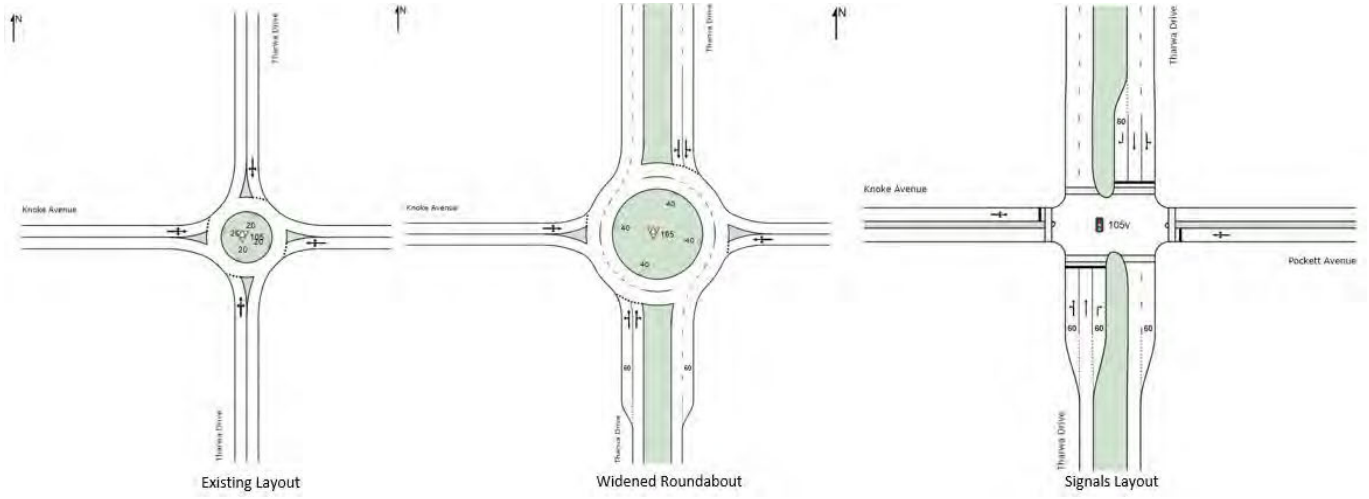


Figure 4.5 Tharwa Drive / Pockett Avenue / Knoke Avenue Layout – Existing Layout (Left) vs. Proposed Layouts (Centre and Right)

4.5 Upgraded Intersection Performance

Using the same traffic volumes that were used within the 2031 and 2041 base scenarios, SIDRA analysis was completed for each of the upgraded intersections described in Section 4.4. The performance metrics outlined in Section 4.1 were used to quantify the results from this analysis and allowed for comparison between these results and the base scenario results.

Given the number of options considered for each of the intersections along the road, testing all combinations of the options was considered impractical. As such, four network options were considered for each year. These were as follows:

1. The roundabouts at Woodcock Drive and Pockett Avenue are left as they currently are, the intersection of Norman Lindsay Street is upgraded to a signalised intersection, and the Box Hill Avenue (South) roundabout is widened and duplicated;
2. The Woodcock Drive roundabout is not upgraded, while the other three intersections are converted to signals;
3. All intersections are converted to signals; and
4. Woodcock Drive intersection is not upgraded while the remaining three intersections are upgraded to roundabouts.

4.5.1 2031 Scenario

A summary of the performance of the upgraded intersections within the year 2031 is presented within Table 4.6 and Table 4.7 below. For further information on the performance of the intersections, refer to the SIDRA models included within Appendix C.

Table 4.6 2031 Future Network Performance Comparison – AM Peak

Intersection	Option 1			Option 2			Option 3			Option 4		
	DOS	LOS	Queue	DOS	LOS	Queue	DOS	LOS	Queue	DOS	LOS	Queue
Tharwa Dr / Box Hill Ave / Woodcock Dr	0.58	A	10m	0.58	A	10m	0.83	B	81m	0.58	A	11m
Tharwa Dr Ped Crossing	-	-	-	-	-	-	-	-	-	0.39	A	11m
Tharwa Dr / Norman Lindsay St	0.44	B	34m	0.44	B	34m	0.40	B	38m	0.38	A	7m
Tharwa Dr / Box Hill Ave	0.43	A	8m	0.65	B	56m	0.55	C	65m	0.44	A	8m
Tharwa Dr / Pockett Ave / Knoke Ave	0.22	A	4m	0.71	C	38m	0.50	C	45m	0.23	A	3m

Table 4.7 2031 Future Network Performance Comparison – PM Peak

Intersection	Option 1			Option 2			Option 3			Option 4		
	DOS	LOS	Queue	DOS	LOS	Queue	DOS	LOS	Queue	DOS	LOS	Queue
Tharwa Dr / Box Hill Ave / Woodcock Dr	0.67	B	20m	0.67	B	20m	0.87	B	107m	0.66	B	20m
Tharwa Dr Ped Crossing	-	-	-	-	-	-	-	-	-	0.53	A	17m
Tharwa Dr / Norman Lindsay St	0.77	B	67m	0.68	B	71m	0.66	A	53m	0.38	A	6m
Tharwa Dr / Box Hill Ave	0.32	A	5m	0.60	B	54m	0.57	A	57m	0.32	A	5m
Tharwa Dr / Pockett Ave / Knoke Ave	0.38	A	8m	0.66	C	47m	0.63	C	52m	0.19	A	3m

As can be seen from the tables, all four of the network options modelled are expected to operate at acceptable levels during the 2031 AM and PM peaks. The performance issues observed within the Norman Lindsay Street intersection during the 2031 base scenario were resolved by both the signalised and roundabout upgrades. This is attributed to the vehicles within the eastern leg being able to turn more regularly. The high DOS noted within the Woodcock Avenue intersection during the base scenario PM peak has also been resolved due to the duplication leading to improved vehicle flow through the network. With the combining of the pedestrian crossing with the Norman Lindsay Street intersection in most of the options, the issues noted around queuing at that location during the PM peak have also been resolved as there is more separation between the two intersections. In Option 4 where the crossing is still present, the duplication of the road at this location was sufficient to significantly lower queue lengths. None of the other queue lengths are expected to impact any adjacent intersections within the network.

Comparing the performance of the different options, it can be seen that the signalised layouts of intersections generally operate with higher DOS and delays compared to the roundabout layouts. The signalised intersections were also seen to have slightly improved performance when numerous adjacent intersections within the network were signalised, due to bunching effects of traffic.

Although not explicitly tested, the performance of the individual intersections and the networks as a whole suggests that any combination of the above options will result in acceptable levels of performance.

4.5.2 2041 Scenario

A summary of the performance of the upgraded intersections within the year 2041 is presented within Table 4.8 and Table 4.9 below. For further information on the performance of the intersections, refer to the SIDRA models included within Appendix C.

As can be seen from the tables, all four of the network options modelled are expected to operate at acceptable levels during the 2041 AM and PM peaks. The values of DOS, LOS and queue lengths are expected to generally increase slightly from the 2031 values, but do not increase to the extent that any performance issues arise. As such, the performance issues observed within the 2041 base scenario are expected to be resolved via the upgrades, in much the same manner as described in Section 4.5.2 above.

As with the 2031 upgrade scenarios, it can be seen from comparing the options that the signalised layouts of intersections generally operate with higher DOS and delays compared to the roundabout layouts. The signalised intersections were also seen to have slightly improved performance when numerous adjacent intersections within the network were signalised, due to bunching effects of traffic.

Although not explicitly tested, the performance of the individual intersections and the networks as a whole suggests that any combination of the above options will result in acceptable levels of performance.

Table 4.8 2041 Future Network Performance Comparison – AM Peak

Intersection	Option 1			Option 2			Option 3			Option 4		
	DOS	LOS	Queue	DOS	LOS	Queue	DOS	LOS	Queue	DOS	LOS	Queue
Tharwa Dr / Box Hill Ave / Woodcock Dr	0.60	A	11m	0.60	A	11m	0.84	B	88m	0.60	A	12m
Tharwa Dr Ped Crossing	-	-	-	-	-	-	-	-	-	0.29	A	12m
Tharwa Dr / Norman Lindsay St	0.61	A	25m	0.46	B	43m	0.41	B	37m	0.39	A	7m
Tharwa Dr / Box Hill Ave	0.45	A	9m	0.67	B	59m	0.55	C	69m	0.45	A	8m
Tharwa Dr / Pockett Ave / Knoke Ave	0.23	A	4m	0.73	C	39m	0.51	C	49m	0.24	A	3m

Table 4.9 2041 Future Network Performance Comparison – PM Peak

Intersection	Option 1			Option 2			Option 3			Option 4		
	DOS	LOS	Queue	DOS	LOS	Queue	DOS	LOS	Queue	DOS	LOS	Queue
Tharwa Dr / Box Hill Ave / Woodcock Dr	0.69	B	21m	0.69	B	22m	0.87	C	114m	0.69	B	21m
Tharwa Dr Ped Crossing	-	-	-	-	-	-	-	-	-	0.35	A	27m
Tharwa Dr / Norman Lindsay St	0.74	B	71m	0.74	B	71m	0.67	A	58m	0.41	A	6m
Tharwa Dr / Box Hill Ave	0.32	A	5m	0.61	B	57m	0.57	B	62m	0.32	A	5m
Tharwa Dr / Pockett Ave / Knoke Ave	0.39	A	8m	0.68	C	50m	0.62	C	54m	0.19	A	3m

5. Conclusion

In September 2020, Calibre was engaged by Infrastructure Delivery Partners Group (IDPG) on behalf of Transport Canberra and City Services (TCCS) to deliver the feasibility and concept design for the duplication of Tharwa Drive between Woodcock Drive and Pockett Avenue. This site covers a section of Tharwa Drive approximately 1.9km long, with four intersections and one signalised crossing along the site. These key locations are as follows:

1. Tharwa Drive / Woodcock Drive / Box Hill Avenue
2. Tharwa Drive Signalised Pedestrian Crossing
3. Tharwa Drive / Norman Lindsay Street
4. Tharwa Drive / Box Hill Avenue
5. Tharwa Drive / Pockett Avenue / Knoke Avenue

It is noted that the roundabouts of Tharwa Drive / Box Hill Avenue and Tharwa Drive / Pockett Avenue / Knoke Avenue have smaller island radii than are recommended within Austroads.

There are several active travel networks along this length of Tharwa Drive. A local community route runs the full length of the site and connects into additional local community routes near Lanyon Marketplace and along Pockett Avenue, Knoke Avenue and Box Hill Avenue. These connections provide access throughout Gordon, Conder and Banks. A Principal CBR cycle route and on-road cycle route also connect into the local community route just north of Lanyon Marketplace and provide access to Greenway and the wider Canberra active travel network.

A bus station is located within the Lanyon Marketplace, just to the east of the site. Six bus routes utilise this station to service the suburbs of Conder and Gordon. Four of the routes utilise the intersection of Tharwa Drive / Woodcock Drive / Box Hill Avenue, while the remaining two bus routes cross Tharwa Drive at the intersection of Tharwa Drive / Pockett Avenue / Knoke Avenue. No busses currently utilise the section of Tharwa Drive proposed for duplication in a north south movement.

Historical crash data from the last five years was provided by TCCS for the full length of the site. From this data, three locations were identified as being prone to accidents. The locations were:

1. Roundabout of Tharwa Drive / Woodcock Drive / Box Hill Avenue
2. Intersection of Tharwa Drive / Norman Lindsay Street
3. Roundabout of Tharwa Drive / Box Hill Avenue

The prominent crash type noted at the intersection of Tharwa Drive / Woodcock Drive / Box Hill Avenue was rear end crashes (RUM 301), with 28 of the 52 crashes reported being attributed to this type. The intersection of Tharwa Drive and Norman Lindsay Street noted a high number of crashes between right turning vehicles from the south and east legs (RUM 104 & 202), with 19 of the 29 crashes attributed to this type. The intersection of Tharwa Drive and Box Hill Avenue reported a high number of through-right crashes (RUM 104), with 13 of the 25 crashes reported being attributed to this type. It is noted that a small roundabout radius may be a factor for causing this crash type.

Existing traffic volumes throughout the network were determined through traffic counts conducted at each of the four main intersections along this length of road. As traffic volumes are expected to still be reduced due to COVID-19 restrictions, the count volumes were scaled using SCATS data. Traffic volumes for the future years of 2031 and 2041 were simulated by scaling the traffic count volumes up using the adopted growth rates utilised within the CSTM model for the area.

From these traffic counts, the midblock volumes were assessed to determine the necessity and timeframe for duplication of this section of Tharwa Drive. From this, it was determined that the section of Tharwa Drive between Woodcock Drive and Box Hill Avenue (south) has the traffic volumes of sufficient magnitude within the current year to support duplication. The section of Tharwa Drive between Box Hill Avenue (south) and Pockett Avenue is not expected to have high enough traffic volumes along the road to require duplication within the next 20 years. As such, staging the duplication works would be feasible, with the section between Woodcock Drive and Box Hill Avenue (south) intersections being duplicated separately before the section between Box Hill Avenue (south) and Pockett Avenue intersections, should this be desired.

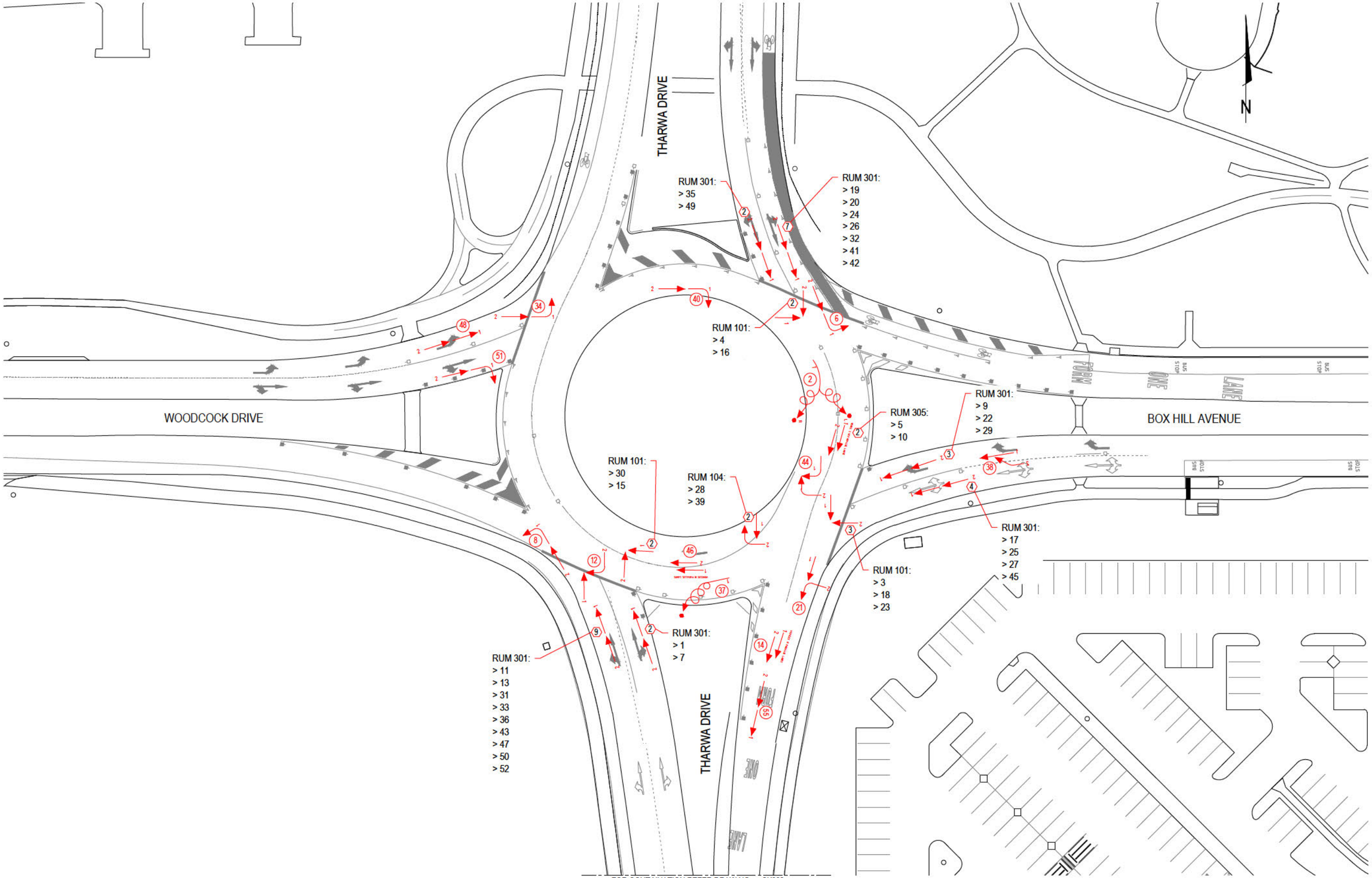
Traffic Analysis of the four key intersections and the signalised pedestrian crossing has shown that the intersection of Tharwa Drive / Norman Lindsay Street will exceed acceptable limits during both AM and PM peaks during the current

year. Within the future years of 2031 and 2041, the intersection of Tharwa Drive / Woodcock Drive / Box Hill Avenue is also expected to exceed acceptable limits during the PM peak period. Issues with queueing at the pedestrian crossing were also noted.

Several options to upgrade these intersections, predominantly signalising, widening of roundabouts, or leaving, were considered to be included as part of the duplication works. Four combinations of the various options were modelled and from the results, it was found that all four of the combinations are expected to improve performance of the network and resolve the issues observed within the base scenarios.

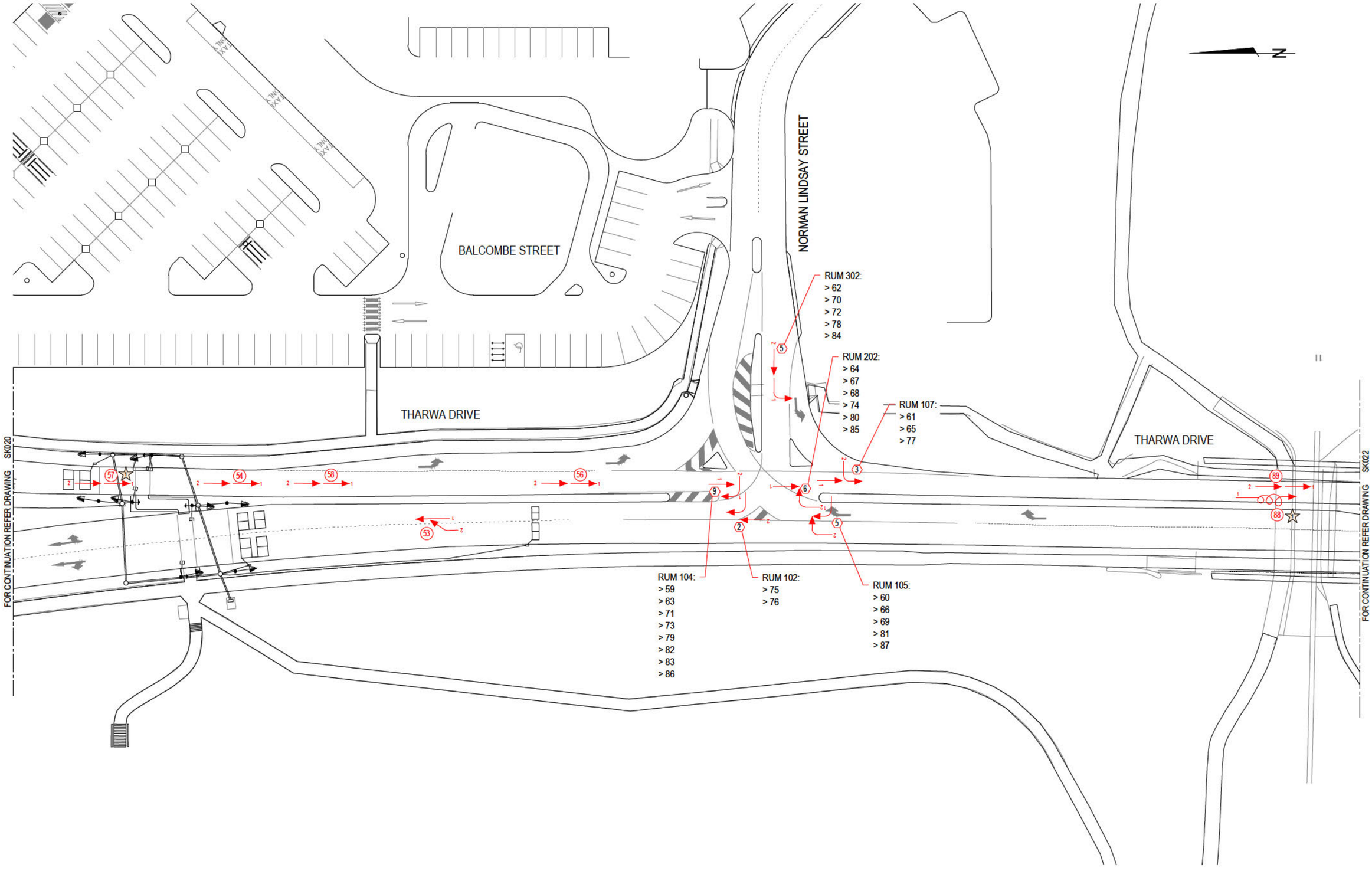
Although not tested, it is expected that any combination of the proposed upgrades would be effective at improving the performance of the network to acceptable levels.

Appendix A Accident Diagrams



H:\20\20-0056\06_Model\Civil3D\Sketches\SK020 - ACCIDENT DIAGRAMS.dwg

THARWA DRIVE ACCIDENT DIAGRAMS
For Discussion Purposes Only

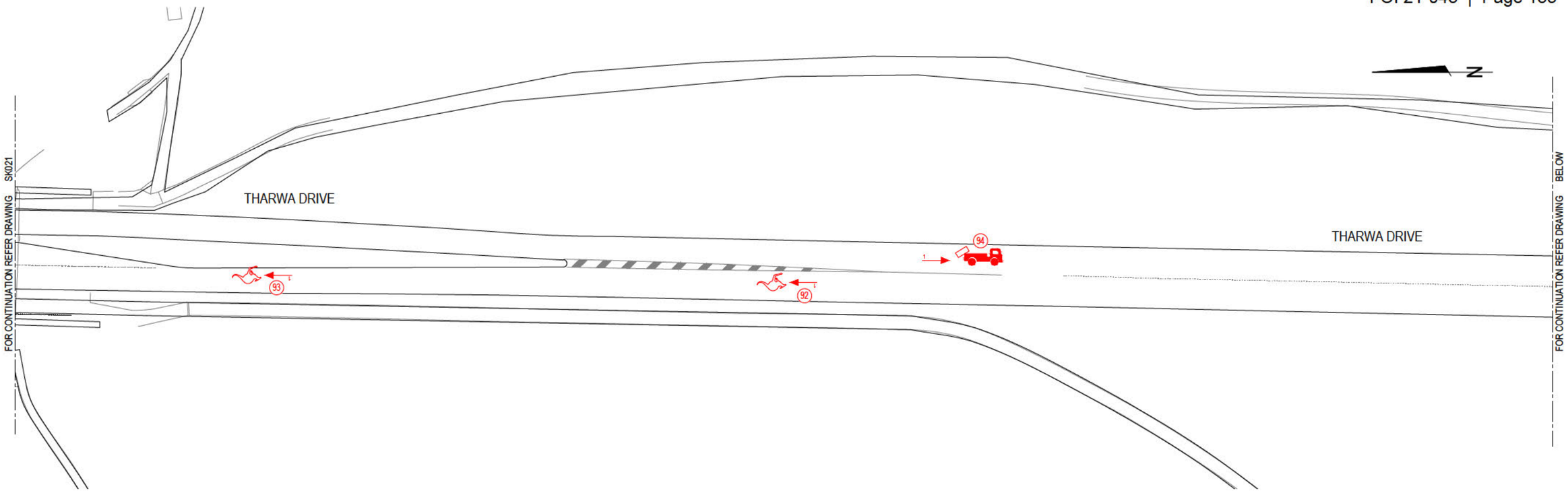


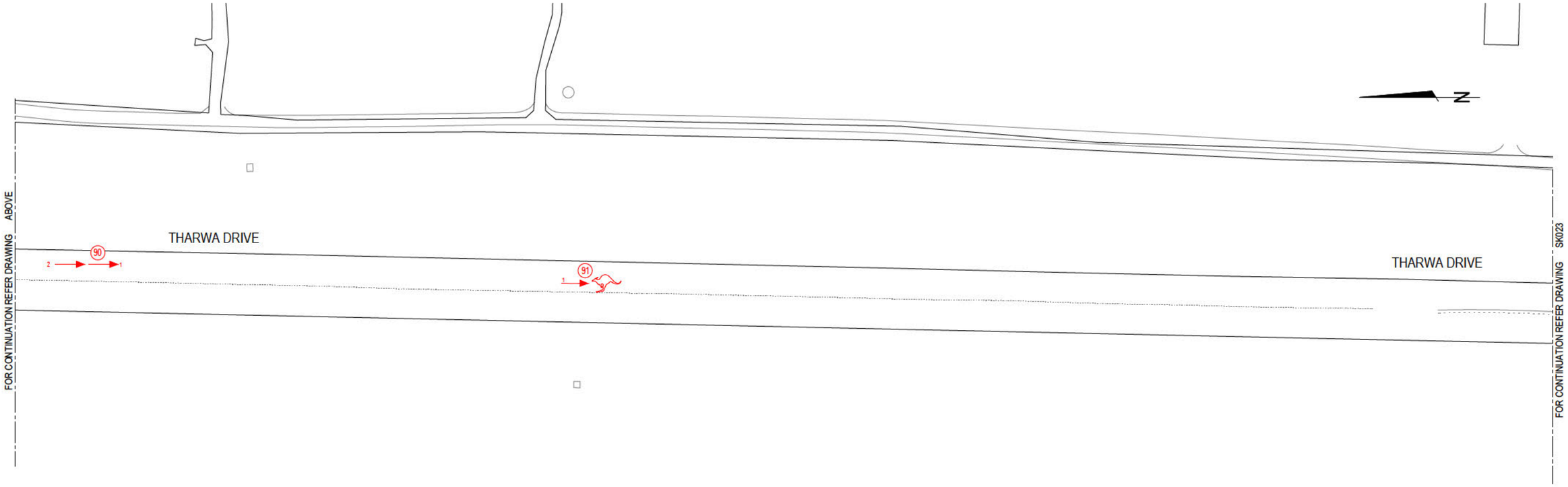
0 3.0 6.0 9.0 12.0 15.0 18.0 21.0 24.0
SCALE 1:300 (A1) SCALE 1:600 (A3)

©

THARWA DRIVE ACCIDENT DIAGRAMS
For Discussion Purposes Only

H:\20\20-0056\16_Model\Civil\3D\Sketches\SK020 - ACCIDENT DIAGRAMS.dwg





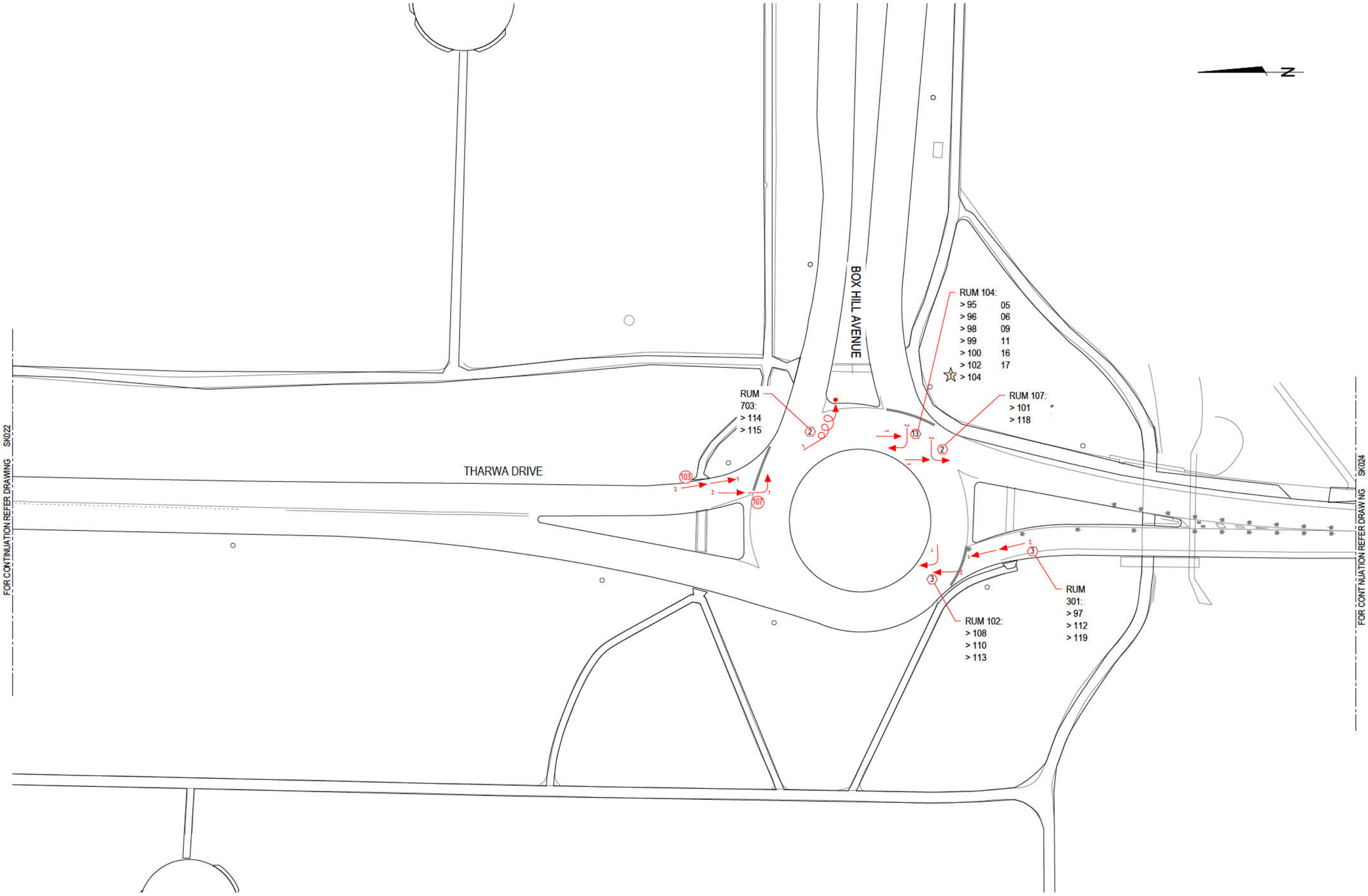
0 3.0 6.0 9.0 12.0 15.0 18.0 21.0 24.0
SCALE 1:300 (A1) SCALE 1:600 (A3)

©

calibre

THARWA DRIVE ACCIDENT DIAGRAMS
For Discussion Purposes Only

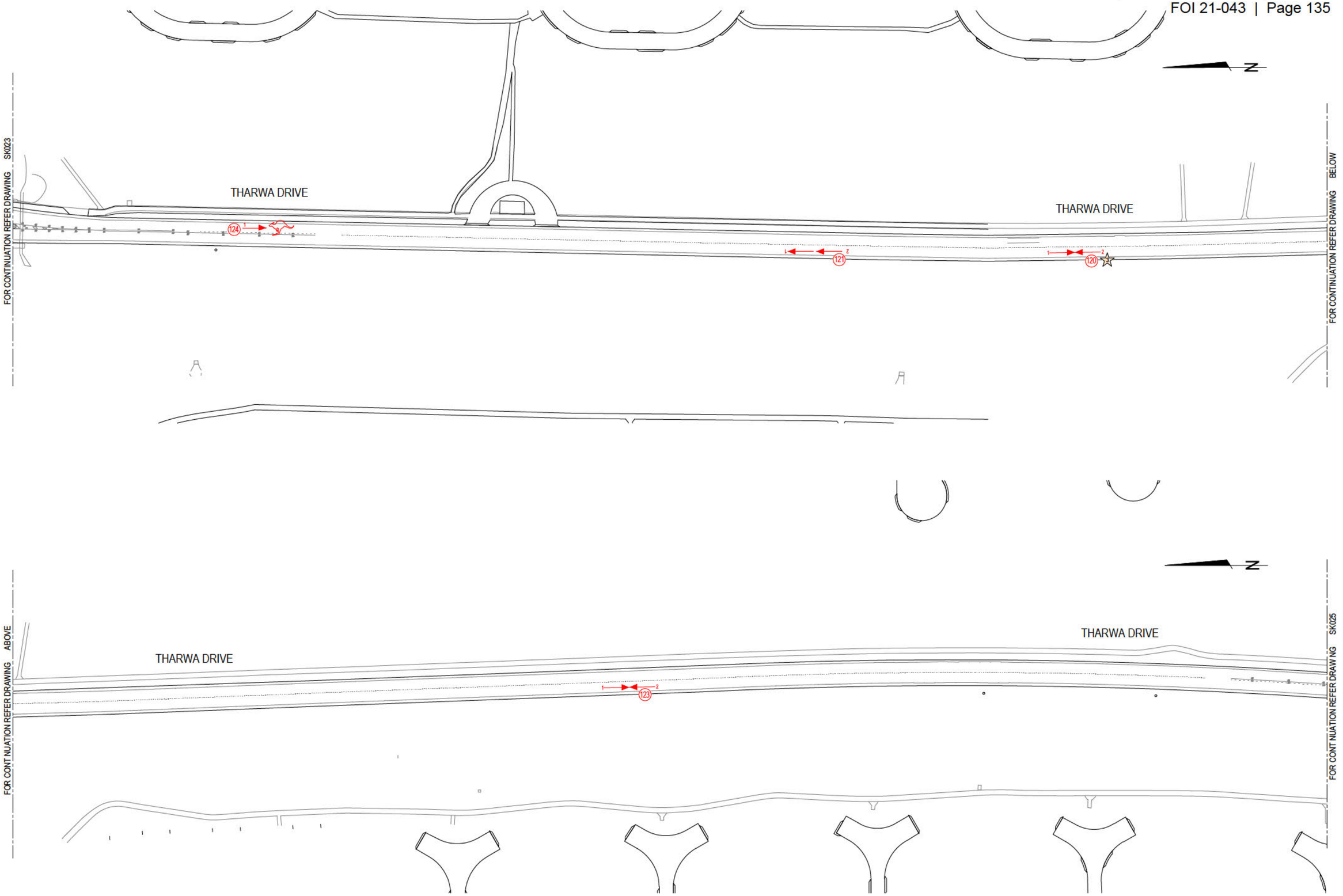
H:\20\20-0005816_Model\Civil\3D\Sketches\SK020 - ACCIDENT DIAGRAMS.dwg



©

THARWA DRIVE ACCIDENT DIAGRAMS
For Discussion Purposes Only

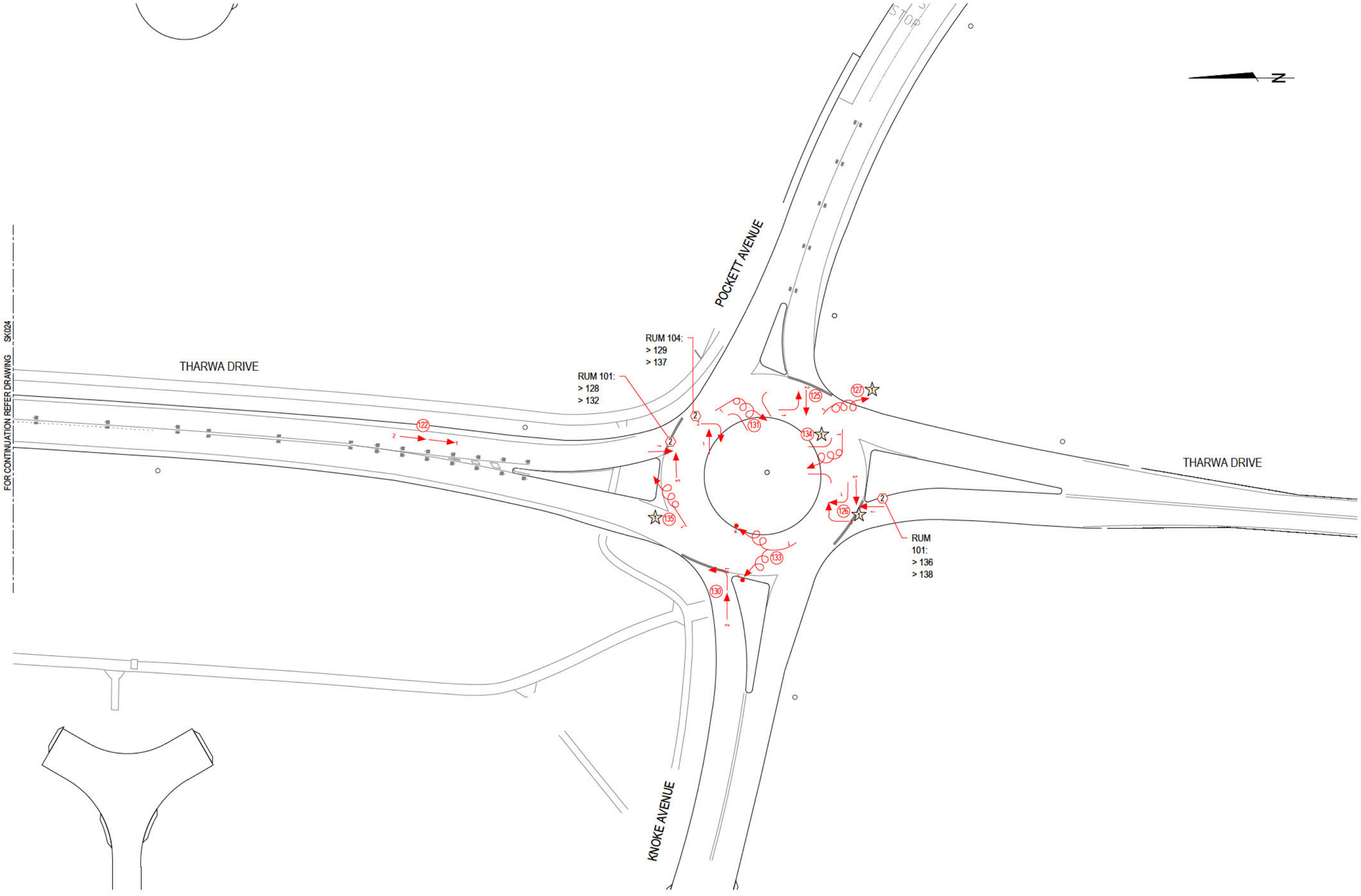
H:\2020-0006896_Model\Civil\3D\Sketches\SK020 - ACCIDENT DIAGRAMS.dwg



©

THARWA DRIVE ACCIDENT DIAGRAMS
For Discussion Purposes Only

H:\2020\00569\6_Model\Civil\3D\Sketches\SK020 - ACCIDENT DIAGRAMS.dwg



©

THARWA DRIVE ACCIDENT DIAGRAMS
For Discussion Purposes Only

H:\2020\0056976_Model\Civil3D\Sketches\SK020 - ACCIDENT DIAGRAMS.dwg

20-000580 Tharwa Drive Traffic Impact Assessment.docx

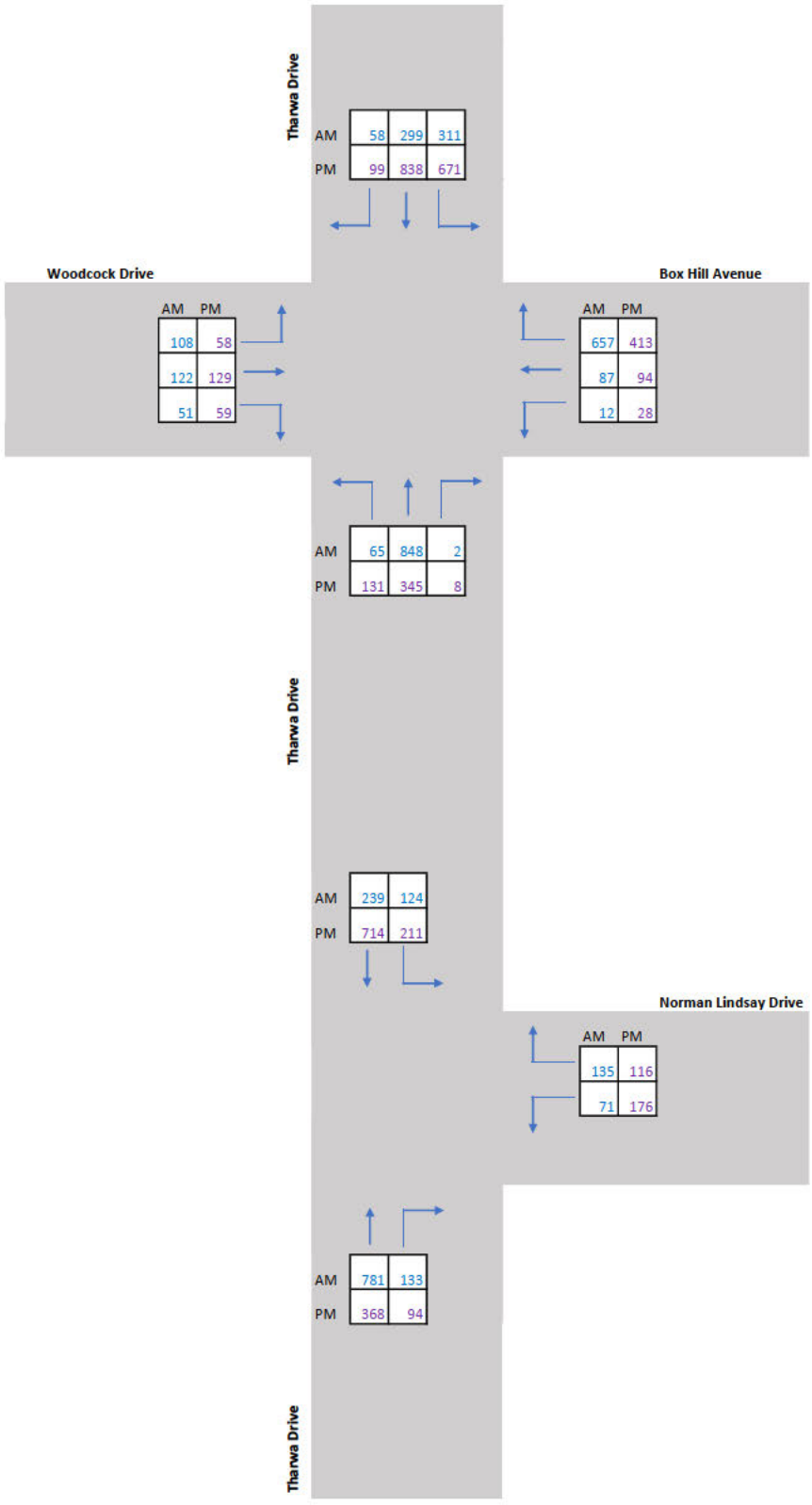
Appendix B Traffic Count Volumes

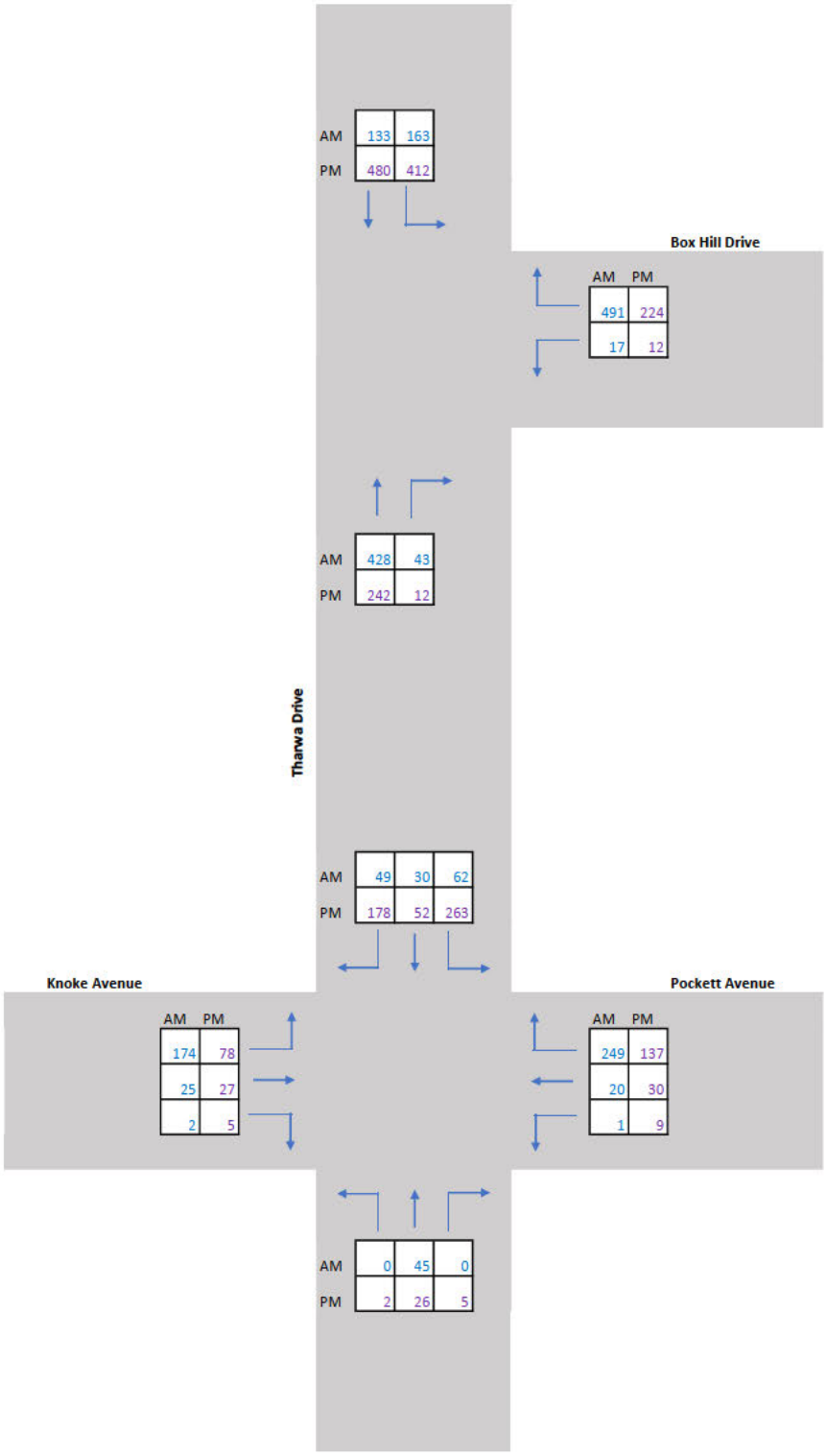
Tharwa Drive Traffic Count Data

AM Peak Period between 8AM and 9AM

PM Peak Period between 5PM and 6PM

Completed on 5th November 2020 by Trans Traffic Survey




AM 133 163
PM 480 412
Box Hill Drive
AM PM
491 224
17 12
AM 428 43
PM 242 12
Tharwa Drive
AM 49 30 62
PM 178 52 263
Knoke Avenue
Pockett Avenue
AM PM
174 78
25 27
2 5
AM PM
249 137
20 30
1 9
AM 0 45 0
PM 2 26 5

20-000580 Tharwa Drive Traffic Impact Assessment.docx

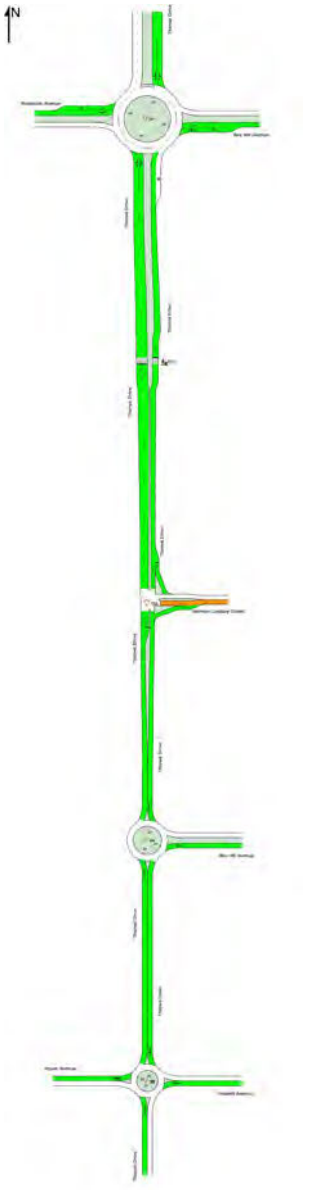
Appendix C [redacted]

DEGREE OF SATURATION

Ratio of Demand Volume to Capacity, v/c ratio per lane

Network: N101 [Existing Conditions_Tharwa Drive AM peak]

New Network
Network Category: (None)



Colour code based on Degree of Saturation

[< 0.6]	[0.6 – 0.7]	[0.7 – 0.8]	[0.8 – 0.9]	[0.9 – 1.0]	[> 1.0]

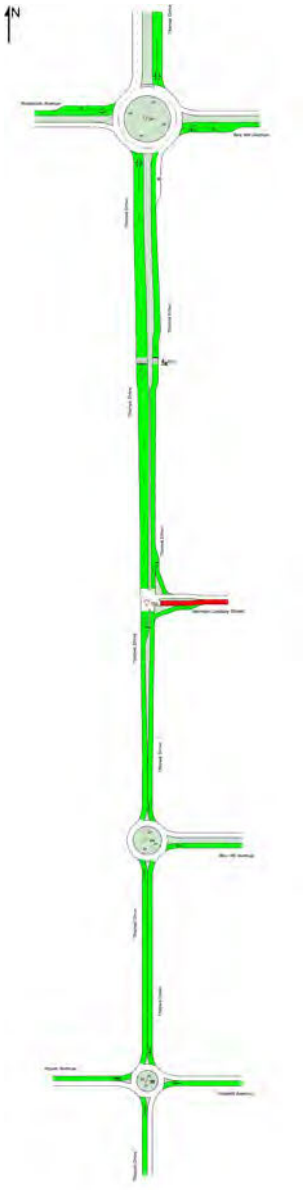
SIDRA INTERSECTION 8.0 | Copyright © 2000-2019 Akcelik and Associates Pty Ltd | sidrasolutions.com

LANE LEVEL OF SERVICE

Lane Level of Service for Network Sites

Network: N101 [Existing Conditions_Tharwa Drive AM peak]

New Network
Network Category: (None)



Colour code based on Level of Service

LOS A	LOS B	LOS C	LOS D	LOS E	LOS F

Delay model settings are specified for individual Sites forming the Network.

USER REPORT FOR NETWORK SITE

Project: Existing Conditions

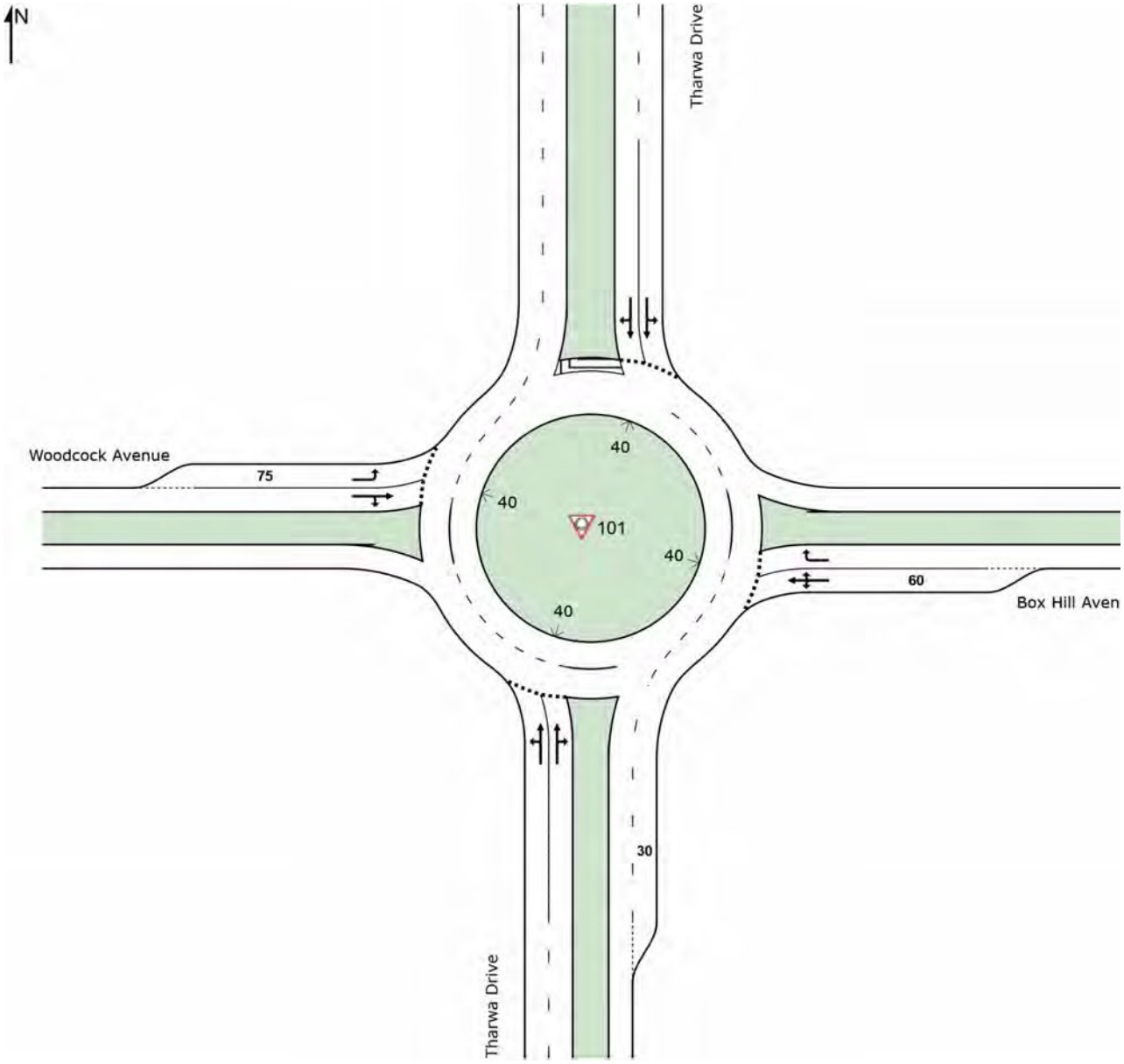
Template: Default Site User Report (2)

Site: 101 [Existing_AM Peak_Tharwa Drive / Woodcock Drive]

Network: 1 [Existing Conditions_Tharwa Drive AM peak]

Two Lane Roundabout
Site Category: AM Peak Existing Conditions
Roundabout

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
1	L2	72	2.3	72	2.3	0.550	6.3	LOS A	1.5	10.4	0.72	0.76	0.85	48.8
2	T1	900	2.3	900	2.3	0.550	6.6	LOS A	1.5	10.4	0.73	0.81	0.87	53.6
3	R2	2	2.3	2	2.3	0.550	13.3	LOS A	1.4	9.7	0.73	0.87	0.89	39.8
Approach		974	2.3	974	2.3	0.550	6.6	LOS A	1.5	10.4	0.73	0.81	0.87	53.3
East: Box Hill Avenue														
4	L2	13	2.3	13	2.3	0.388	5.1	LOS A	0.9	6.7	0.59	0.69	0.59	33.8
5	T1	94	2.3	94	2.3	0.388	4.9	LOS A	0.9	6.7	0.59	0.69	0.59	49.2
6	R2	720	2.3	720	2.3	0.388	11.5	LOS A	0.9	6.7	0.59	0.73	0.59	50.6
Approach		826	2.3	826	2.3	0.388	10.7	LOS A	0.9	6.7	0.59	0.72	0.59	50.3
North: Tharwa Drive														
7	L2	345	2.3	345	2.3	0.268	3.9	LOS A	0.7	5.2	0.44	0.48	0.44	53.3
8	T1	327	2.3	327	2.3	0.248	3.2	LOS A	0.7	5.0	0.41	0.39	0.41	50.5
9	R2	64	2.3	64	2.3	0.248	10.1	LOS A	0.7	5.0	0.41	0.39	0.41	57.3
Approach		737	2.3	737	2.3	0.268	4.1	LOS A	0.7	5.2	0.43	0.43	0.43	52.7
West: Woodcock Avenue														
10	L2	118	2.3	118	2.3	0.202	7.9	LOS A	0.4	2.6	0.73	0.84	0.73	52.6
11	T1	128	2.3	128	2.3	0.217	5.8	LOS A	0.4	3.1	0.74	0.71	0.74	50.8
12	R2	55	2.3	55	2.3	0.217	12.8	LOS A	0.4	3.1	0.74	0.71	0.74	44.7
Approach		301	2.3	301	2.3	0.217	7.9	LOS A	0.4	3.1	0.74	0.76	0.74	50.9
All Vehicles		2838	2.3	2838	2.3	0.550	7.3	LOS A	1.5	10.4	0.61	0.68	0.66	51.9

[redacted]

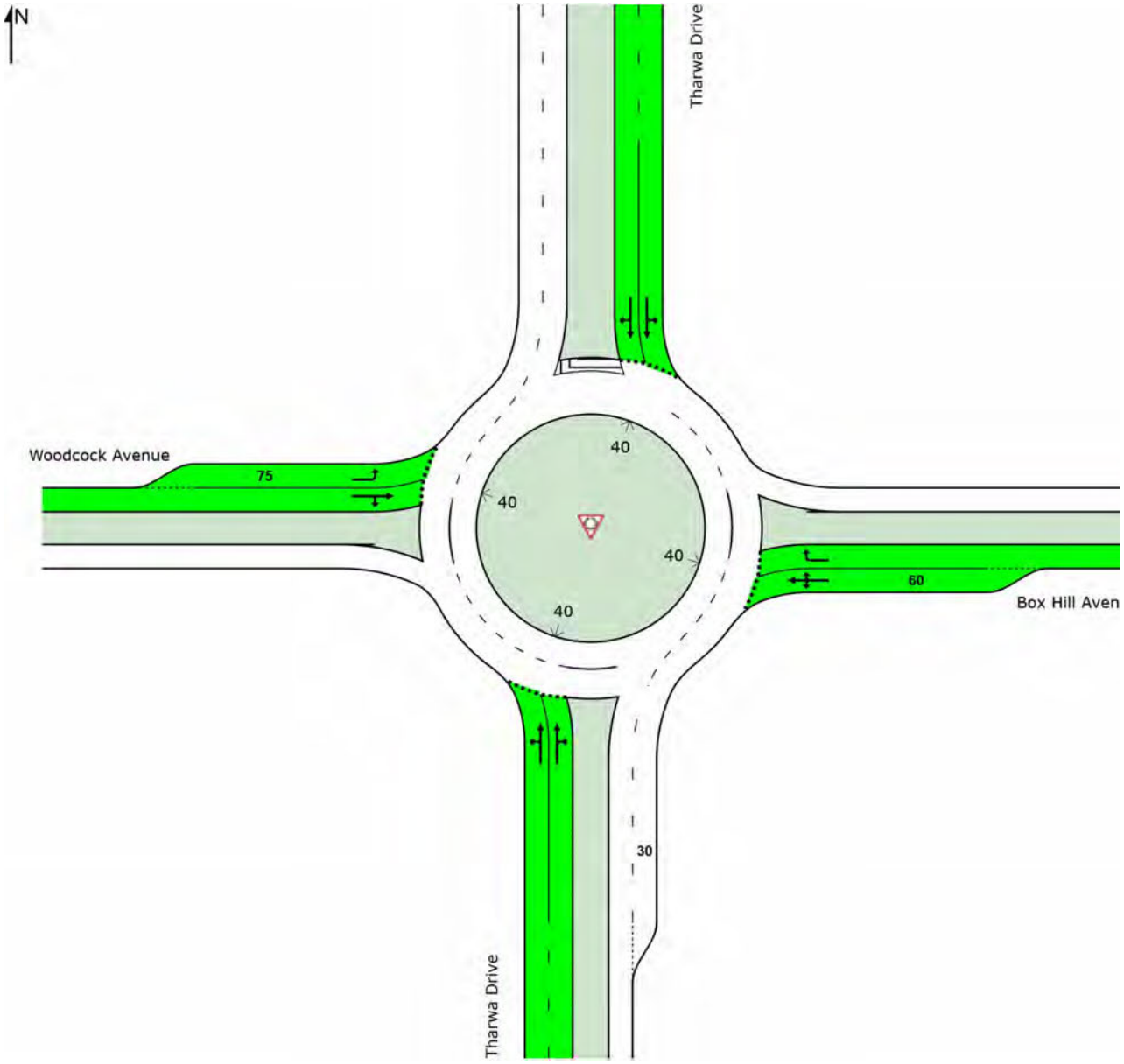
Lane Use and Performance

	Demand Flows		Arrival Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	Aver. Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
South: Tharwa Drive															
Lane 1[d]	542	2.3	542	2.3	985	0.550	100	6.1	LOS A	1.5	10.4	Full	75	0.0	0.0
Lane 2	432	2.3	432	2.3	785	0.550	100	7.1	LOS A	1.4	9.7	Full	75	0.0	0.0
Approach	974	2.3	974	2.3		0.550		6.6	LOS A	1.5	10.4				
East: Box Hill Avenue															
Lane 1[d]	446	2.3	446	2.3	1151	0.388	100	9.8	LOS A	0.9	6.7	Short	60	0.0	NA
Lane 2	380	2.3	380	2.3	980	0.388	100	11.7	LOS A	0.9	6.4	Full	150	0.0	0.0
Approach	826	2.3	826	2.3		0.388		10.7	LOS A	0.9	6.7				
North: Tharwa Drive															
Lane 1	345	2.3	345	2.3	1288	0.268	100	3.9	LOS A	0.7	5.2	Full	490	0.0	0.0
Lane 2[d]	392	2.3	392	2.3	1578	0.248	93[5]	4.3	LOS A	0.7	5.0	Full	490	0.0	0.0
Approach	737	2.3	737	2.3		0.268		4.1	LOS A	0.7	5.2				
West: Woodcock Avenue															
Lane 1	118	2.3	118	2.3	584	0.202	100	7.9	LOS A	0.4	2.6	Short	75	0.0	NA
Lane 2[d]	183	2.3	183	2.3	845	0.217	100	7.9	LOS A	0.4	3.1	Full	380	0.0	0.0
Approach	301	2.3	301	2.3		0.217		7.9	LOS A	0.4	3.1				
Intersection	2838	2.3	2838	2.3		0.550		7.3	LOS A	1.5	10.4				

[redacted]

Lane Level of Service

	Approaches				Intersection
	South	East	North	West	
LOS	A	A	A	A	A



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

[redacted]

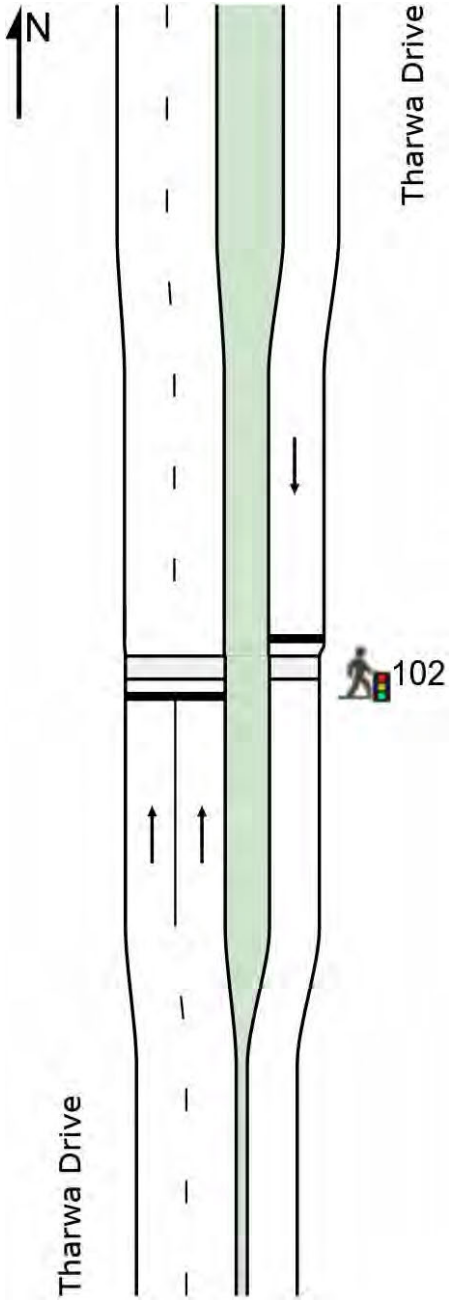
Site: 102 [Existing_AM Peak_Tharwa Drive Pedestrian Crossing]

Network: 1 [Existing Conditions_Tharwa Drive AM peak]

Pedestrian Crossing
Site Category: AM Peak Existing Conditions
Pedestrian Crossing (Signals) - Fixed Time Isolated Cycle Time = 133 seconds (Site User-Given Phase Times)

Timings based on settings in the Site Phasing & Timing dialog
Phase Times specified by the user
Phase Sequence: Two-Phase
Reference Phase: Phase A
Input Phase Sequence: A, B
Output Phase Sequence: A, B

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
2	T1	974	2.3	974	2.3	0.267	1.0	LOS A	2.6	18.5	0.15	0.13	0.15	50.6
Approach		974	2.3	974	2.3	0.267	1.0	LOS A	2.6	18.5	0.15	0.13	0.15	50.6
North: Tharwa Drive														
8	T1	395	2.3	395	2.3	0.211	0.9	LOS A	2.0	14.1	0.14	0.12	0.14	50.6
Approach		395	2.3	395	2.3	0.211	0.9	LOS A	2.0	14.1	0.14	0.12	0.14	50.6
All Vehicles		1368	2.3	1368	2.3	0.267	1.0	LOS A	2.6	18.5	0.15	0.13	0.15	50.6

[redacted]

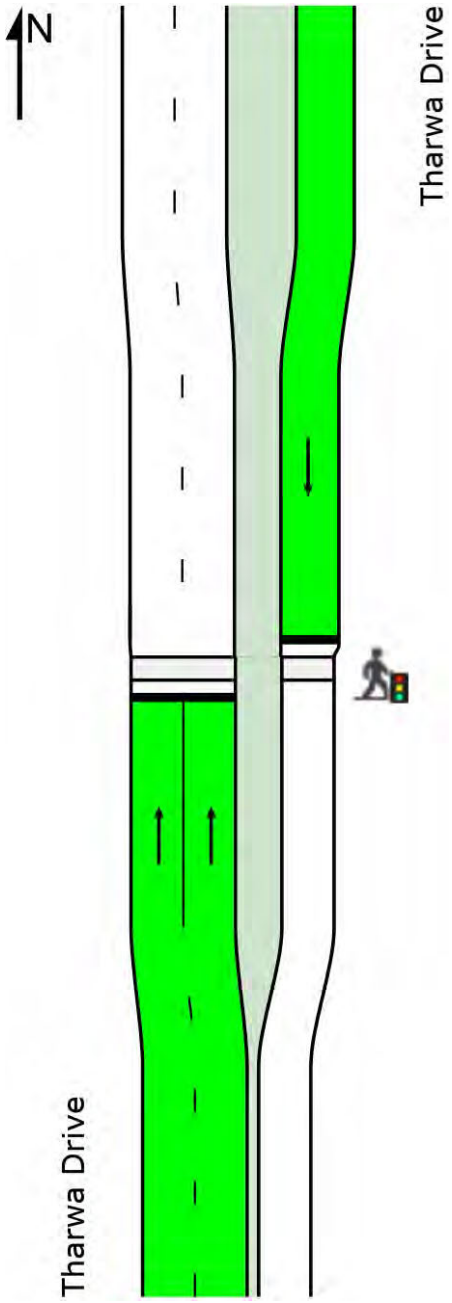
Lane Use and Performance

	Demand Flows		Arrival Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	Aver. Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
South: Tharwa Drive															
Lane 1	487	2.3	487	2.3	1826	0.267	100	1.0	LOS A	2.6	18.5	Full	80	0.0	0.0
Lane 2	487	2.3	487	2.3	1826	0.267	100	1.0	LOS A	2.6	18.5	Full	80	0.0	0.0
Approach	974	2.3	974	2.3		0.267		1.0	LOS A	2.6	18.5				
North: Tharwa Drive															
Lane 1	395	2.3	395	2.3	1871	0.211	100	0.9	LOS A	2.0	14.1	Full	75	0.0	0.0
Approach	395	2.3	395	2.3		0.211		0.9	LOS A	2.0	14.1				
Intersection	1368	2.3	1368	2.3		0.267		1.0	LOS A	2.6	18.5				

[redacted]

Lane Level of Service

	Approaches		Intersection
	South	North	
LOS	A	A	A



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Phase Timing Summary

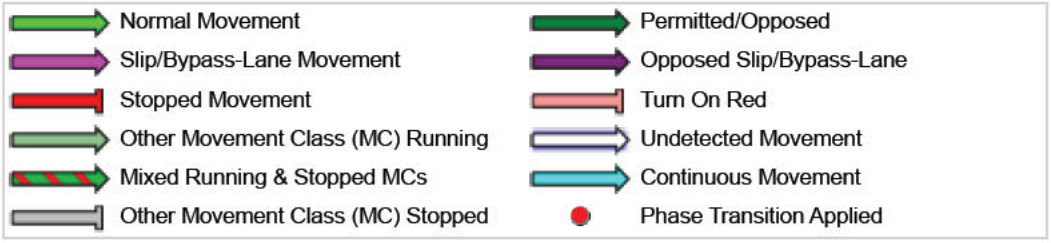
Phase	A	B
Phase Change Time (sec)	0	122
Green Time (sec)	119	5
Phase Time (sec)	125	8
Phase Split	94%	6%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase

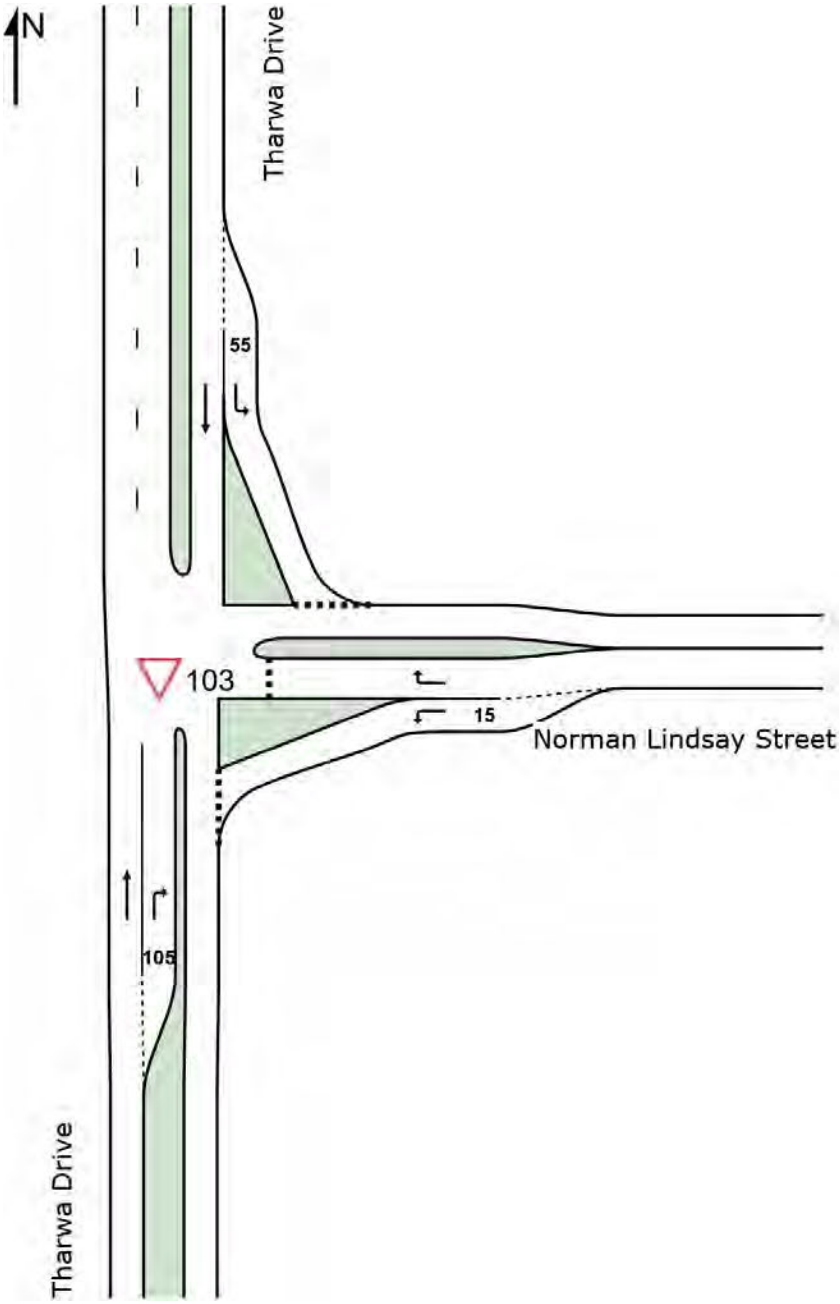


Site: 103 [Existing_AM Peak_Tharwa Drive / Norman Lindsay Street]

Network: 1 [Existing Conditions_Tharwa Drive AM peak]

Priority-Controlled T-Intersection
Site Category: AM Peak Existing Conditions
Giveway / Yield (Two-Way)

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
2	T1	832	2.3	832	2.3	0.435	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
3	R2	141	2.3	141	2.3	0.101	6.5	LOS A	0.2	1.3	0.37	0.59	0.37	49.1
Approach		973	2.3	973	2.3	0.435	1.0	NA	0.2	1.3	0.05	0.09	0.05	57.9
East: Norman Lindsay Street														
4	L2	75	2.3	75	2.3	0.059	4.6	LOS A	0.1	0.7	0.34	0.55	0.34	26.5
6	R2	143	2.3	143	2.3	0.947	94.9	LOS F	3.0	21.5	0.99	1.56	3.29	2.0
Approach		218	2.3	218	2.3	0.947	63.9	LOS E	3.0	21.5	0.77	1.21	2.28	3.0
North: Tharwa Drive														
7	L2	134	2.3	134	2.3	0.093	5.6	LOS A	0.2	1.1	0.24	0.53	0.24	31.0
8	T1	262	2.3	262	2.3	0.136	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
Approach		396	2.3	396	2.3	0.136	1.9	LOS A	0.2	1.1	0.08	0.18	0.08	42.5
All Vehicles		1586	2.3	1586	2.3	0.947	9.9	NA	3.0	21.5	0.16	0.26	0.37	43.1



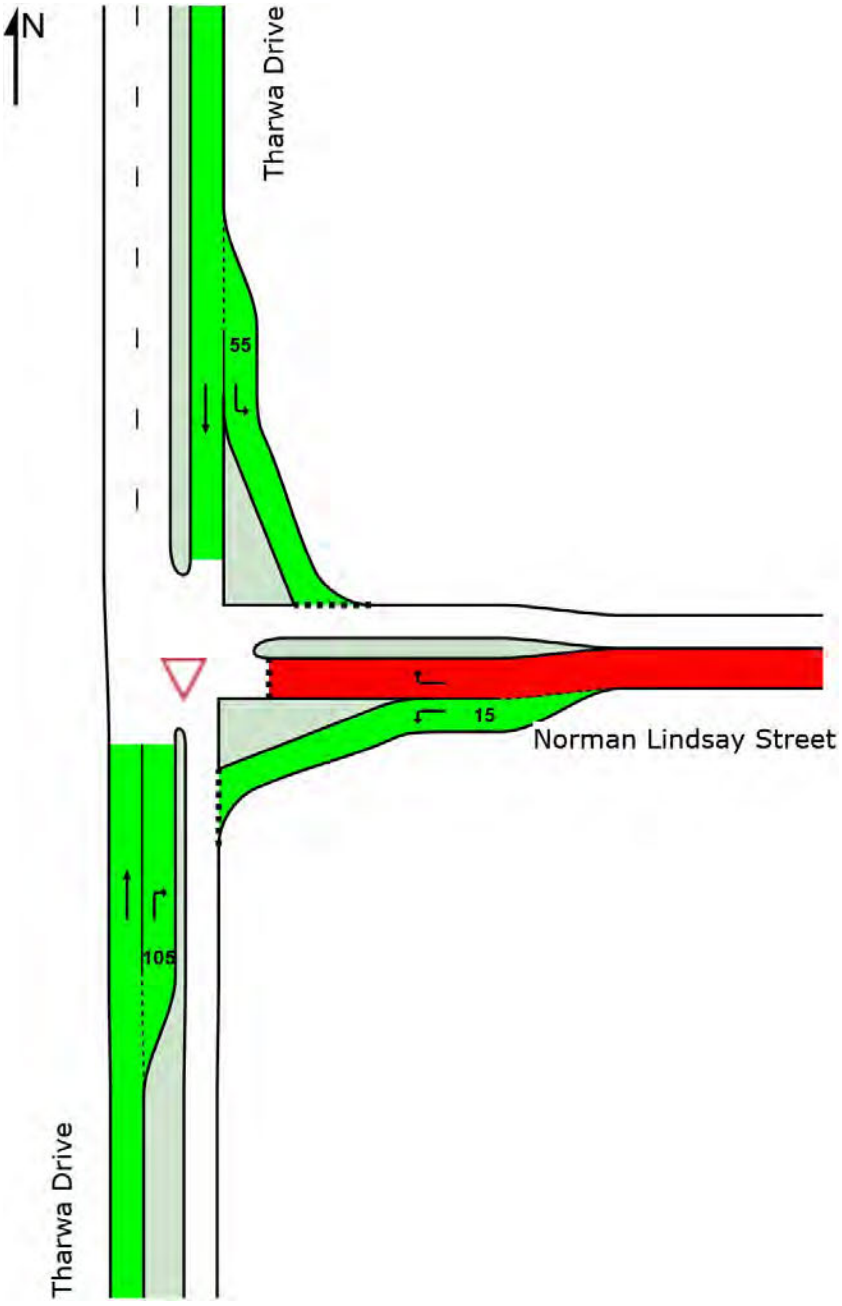
Lane Use and Performance

	Demand Flows		Arrival Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	Aver. Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
South: Tharwa Drive															
Lane 1	832	2.3	832	2.3	1911	0.435	100	0.1	LOS A	0.0	0.0	Full	640	0.0	0.0
Lane 2	141	2.3	141	2.3	1394	0.101	100	6.5	LOS A	0.2	1.3	Short	105	0.0	NA
Approach	973	2.3	973	2.3		0.435		1.0	NA	0.2	1.3				
East: Norman Lindsay Street															
Lane 1	75	2.3	75	2.3	1277	0.059	100	4.6	LOS A	0.1	0.7	Short	15	0.0	NA
Lane 2	143	2.3	143	2.3	151	0.947	100	94.9	LOS F	3.0	21.5	Full	40	0.0	14.3
Approach	218	2.3	218	2.3		0.947		63.9	LOS E	3.0	21.5				
North: Tharwa Drive															
Lane 1	134	2.3	134	2.3	1431	0.093	100	5.6	LOS A	0.2	1.1	Short	55	0.0	NA
Lane 2	262	2.3	262	2.3	1921	0.136	100	0.0	LOS A	0.0	0.0	Full	80	0.0	0.0
Approach	396	2.3	396	2.3		0.136		1.9	LOS A	0.2	1.1				
Intersection	1586	2.3	1586	2.3		0.947		9.9	NA	3.0	21.5				

[redacted]

Lane Level of Service

	Approaches			Intersection
	South	East	North	
LOS	NA	E	A	NA



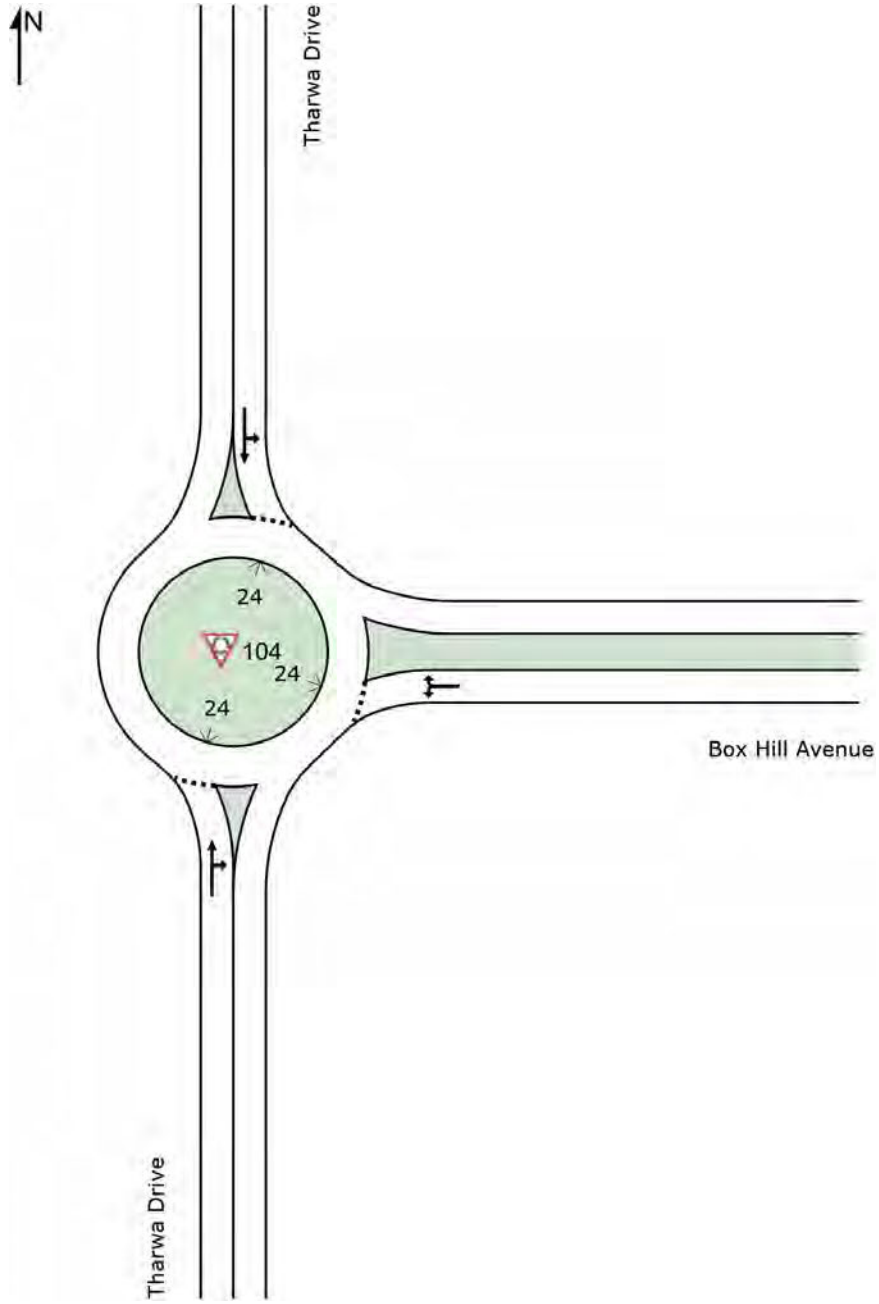
Colour code based on Level of Service

Site: 104 [Existing_AM Peak_Tharwa Drive / Box Hill Avenue]

Network: 1 [Existing Conditions_Tharwa Drive AM peak]

Single Lane Roundabout
Site Category: AM Peak Existing Conditions
Roundabout

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
2	T1	459	2.3	459	2.3	0.564	9.0	LOS A	2.1	14.7	0.82	0.87	0.95	52.0
3	R2	45	2.3	45	2.3	0.564	14.2	LOS A	2.1	14.7	0.82	0.87	0.95	51.2
Approach		504	2.3	504	2.3	0.564	9.5	LOS A	2.1	14.7	0.82	0.87	0.95	51.9
East: Box Hill Avenue														
4	L2	18	2.3	18	2.3	0.415	4.6	LOS A	1.2	8.3	0.42	0.63	0.42	28.7
6	R2	521	2.3	521	2.3	0.415	9.8	LOS A	1.2	8.3	0.42	0.63	0.42	28.7
Approach		539	2.3	539	2.3	0.415	9.7	LOS A	1.2	8.3	0.42	0.63	0.42	28.7
North: Tharwa Drive														
7	L2	174	2.3	174	2.3	0.223	3.9	LOS A	0.6	4.5	0.21	0.41	0.21	53.5
8	T1	151	2.3	151	2.3	0.223	4.0	LOS A	0.6	4.5	0.21	0.41	0.21	53.5
Approach		324	2.3	324	2.3	0.223	4.0	LOS A	0.6	4.5	0.21	0.41	0.21	53.5
All Vehicles		1367	2.3	1367	2.3	0.564	8.2	LOS A	2.1	14.7	0.52	0.67	0.57	48.3

[redacted]

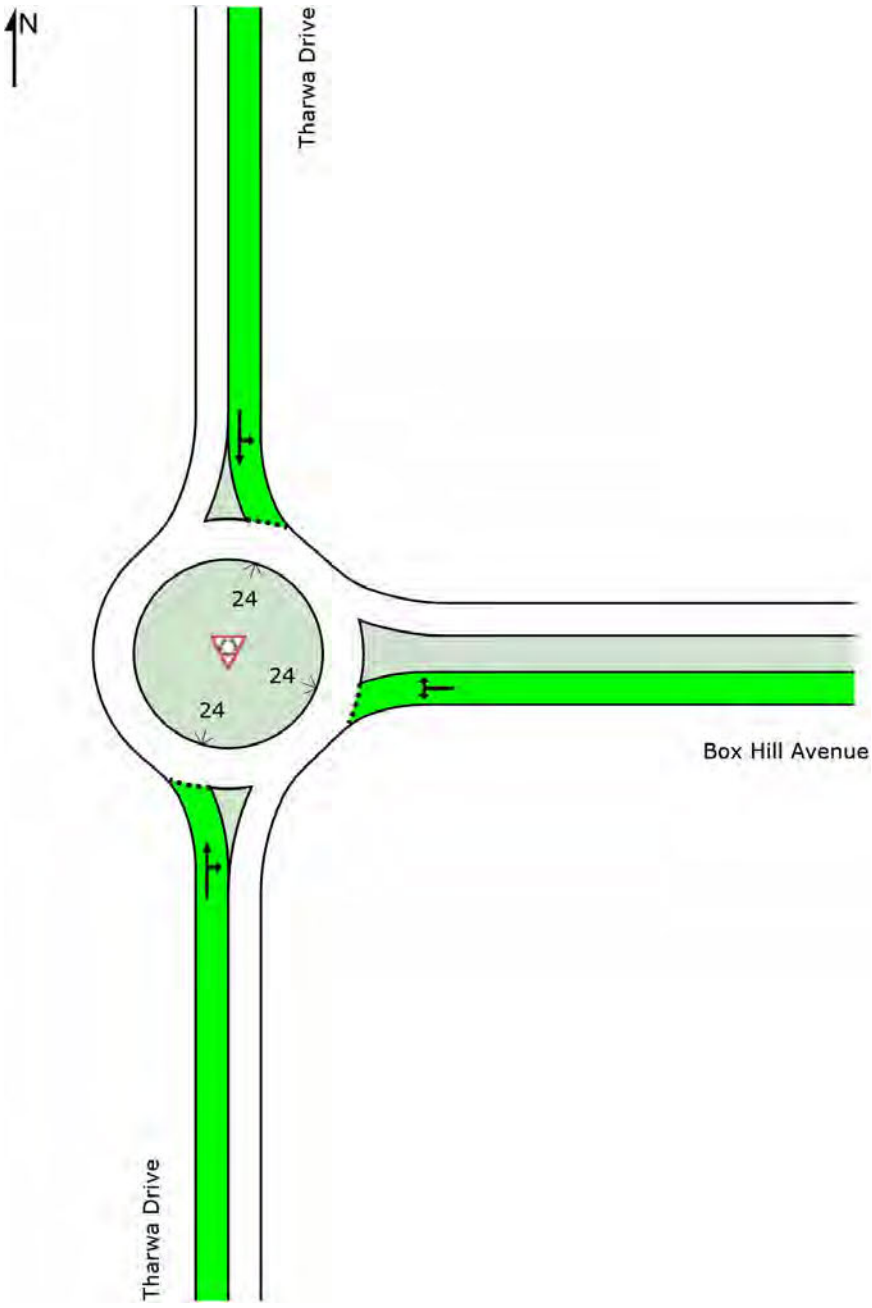
Lane Use and Performance

	Demand Flows		Arrival Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	Aver. Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
South: Tharwa Drive															
Lane 1[d]	504	2.3	504	2.3	893	0.564	100	9.5	LOS A	2.1	14.7	Full	990	0.0	0.0
Approach	504	2.3	504	2.3		0.564		9.5	LOS A	2.1	14.7				
East: Box Hill Avenue															
Lane 1[d]	539	2.3	539	2.3	1299	0.415	100	9.7	LOS A	1.2	8.3	Full	105	0.0	0.0
Approach	539	2.3	539	2.3		0.415		9.7	LOS A	1.2	8.3				
North: Tharwa Drive															
Lane 1[d]	324	2.3	324	2.3	1454	0.223	100	4.0	LOS A	0.6	4.5	Full	640	0.0	0.0
Approach	324	2.3	324	2.3		0.223		4.0	LOS A	0.6	4.5				
Intersection	1367	2.3	1367	2.3		0.564		8.2	LOS A	2.1	14.7				

[redacted]

Lane Level of Service

	Approaches			Intersection
	South	East	North	
LOS	A	A	A	A



Colour code based on Level of Service

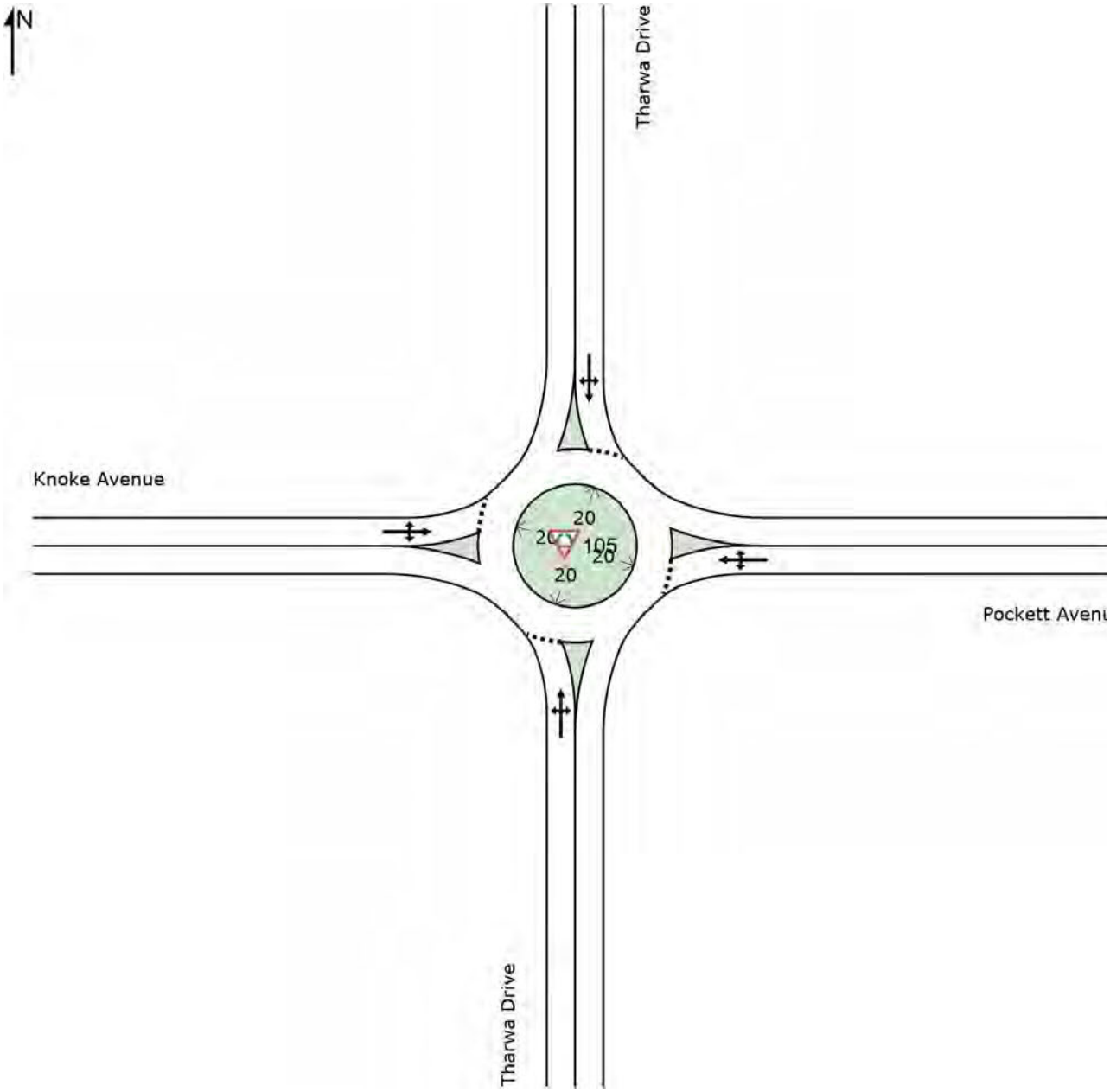
LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site: 105 [Existing_AM Peak_Tharwa Drive / Pockett Avenue]

Network: 1 [Existing Conditions_Tharwa Drive AM peak]

Single-Lane Roundabout
Site Category: AM Peak Existing Conditions
Roundabout

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
1	L2	1	2.3	1	2.3	0.047	5.5	LOS A	0.1	0.7	0.47	0.52	0.47	49.6
2	T1	47	2.3	47	2.3	0.047	5.7	LOS A	0.1	0.7	0.47	0.52	0.47	49.3
3	R2	1	2.3	1	2.3	0.047	10.4	LOS A	0.1	0.7	0.47	0.52	0.47	47.8
Approach		49	2.3	49	2.3	0.047	5.8	LOS A	0.1	0.7	0.47	0.52	0.47	49.3
East: Pockett Avenue														
4	L2	2	2.3	2	2.3	0.218	3.9	LOS A	0.5	3.5	0.26	0.60	0.26	47.6
5	T1	26	2.3	26	2.3	0.218	4.1	LOS A	0.5	3.5	0.26	0.60	0.26	12.8
6	R2	265	2.3	265	2.3	0.218	8.8	LOS A	0.5	3.5	0.26	0.60	0.26	28.0
Approach		294	2.3	294	2.3	0.218	8.3	LOS A	0.5	3.5	0.26	0.60	0.26	24.2
North: Tharwa Drive														
7	L2	68	2.3	68	2.3	0.109	4.0	LOS A	0.2	1.8	0.15	0.51	0.15	45.6
8	T1	34	2.3	34	2.3	0.109	4.3	LOS A	0.2	1.8	0.15	0.51	0.15	56.6
9	R2	55	2.3	55	2.3	0.109	8.9	LOS A	0.2	1.8	0.15	0.51	0.15	45.4
Approach		157	2.3	157	2.3	0.109	5.8	LOS A	0.2	1.8	0.15	0.51	0.15	48.1
West: Knoke Avenue														
10	L2	187	2.3	187	2.3	0.204	5.6	LOS A	0.5	3.3	0.49	0.59	0.49	31.4
11	T1	28	2.3	28	2.3	0.204	5.8	LOS A	0.5	3.3	0.49	0.59	0.49	23.7
12	R2	3	2.3	3	2.3	0.204	10.4	LOS A	0.5	3.3	0.49	0.59	0.49	52.2
Approach		219	2.3	219	2.3	0.204	5.7	LOS A	0.5	3.3	0.49	0.59	0.49	30.3
All Vehicles		719	2.3	719	2.3	0.218	6.8	LOS A	0.5	3.5	0.32	0.58	0.32	40.1

[redacted]

Lane Use and Performance

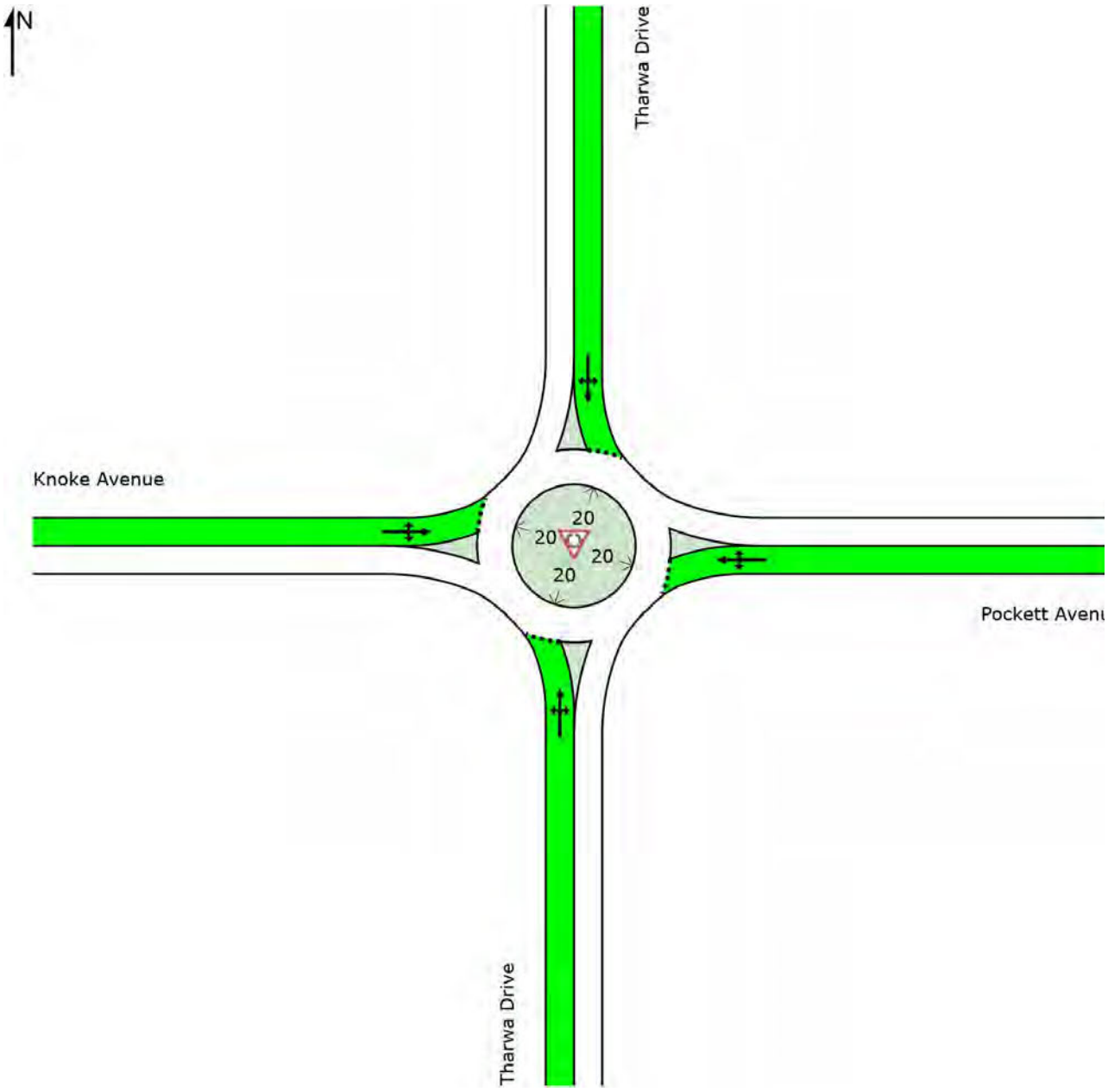
	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	Aver. Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Tharwa Drive															
Lane 1[d]	49	2.3	49	2.3	1046	0.047	100	5.8	LOS A	0.1	0.7	Full	500	0.0	0.0
Approach	49	2.3	49	2.3		0.047		5.8	LOS A	0.1	0.7				
East: Pockett Avenue															
Lane 1[d]	294	2.3	294	2.3	1348	0.218	100	8.3	LOS A	0.5	3.5	Full	80	0.0	0.0
Approach	294	2.3	294	2.3		0.218		8.3	LOS A	0.5	3.5				
North: Tharwa Drive															
Lane 1[d]	157	2.3	157	2.3	1445	0.109	100	5.8	LOS A	0.2	1.8	Full	990	0.0	0.0
Approach	157	2.3	157	2.3		0.109		5.8	LOS A	0.2	1.8				
West: Knoke Avenue															
Lane 1[d]	219	2.3	219	2.3	1072	0.204	100	5.7	LOS A	0.5	3.3	Full	95	0.0	0.0
Approach	219	2.3	219	2.3		0.204		5.7	LOS A	0.5	3.3				
Intersection	719	2.3	719	2.3		0.218		6.8	LOS A	0.5	3.5				

[redacted]

d Dominant lane on roundabout approach

Lane Level of Service

	Approaches				Intersection
	South	East	North	West	
LOS	A	A	A	A	A



Colour code based on Level of Service

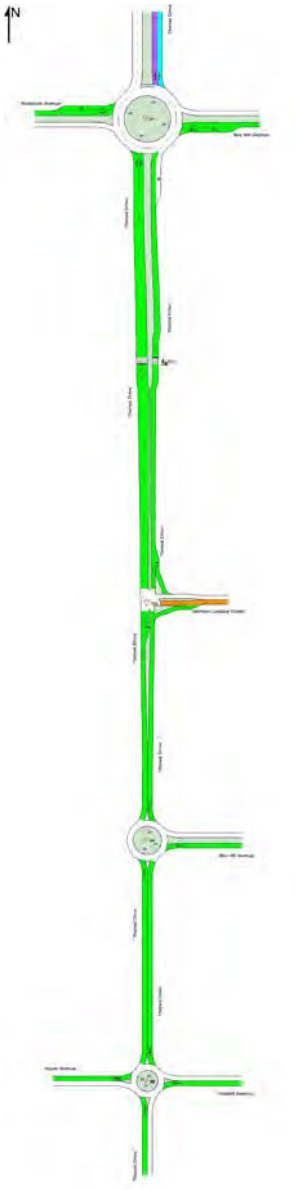
LOS A LOS B LOS C LOS D LOS E LOS F

DEGREE OF SATURATION

Ratio of Demand Volume to Capacity, v/c ratio per lane

Network: N101 [Existing Conditions_Tharwa Drive PM peak]

New Network
Network Category: (None)



Colour code based on Degree of Saturation

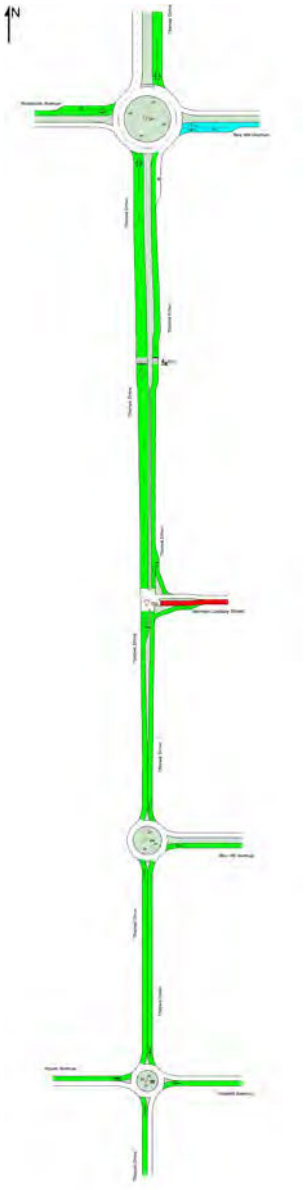
[< 0.6]	[0.6 – 0.7]	[0.7 – 0.8]	[0.8 – 0.9]	[0.9 – 1.0]	[> 1.0]

LANE LEVEL OF SERVICE

Lane Level of Service for Network Sites

Network: N101 [Existing Conditions_Tharwa Drive PM peak]

New Network
Network Category: (None)



Colour code based on Level of Service

LOS A	LOS B	LOS C	LOS D	LOS E	LOS F

Delay model settings are specified for individual Sites forming the Network.

USER REPORT FOR NETWORK SITE

Project: Existing Conditions

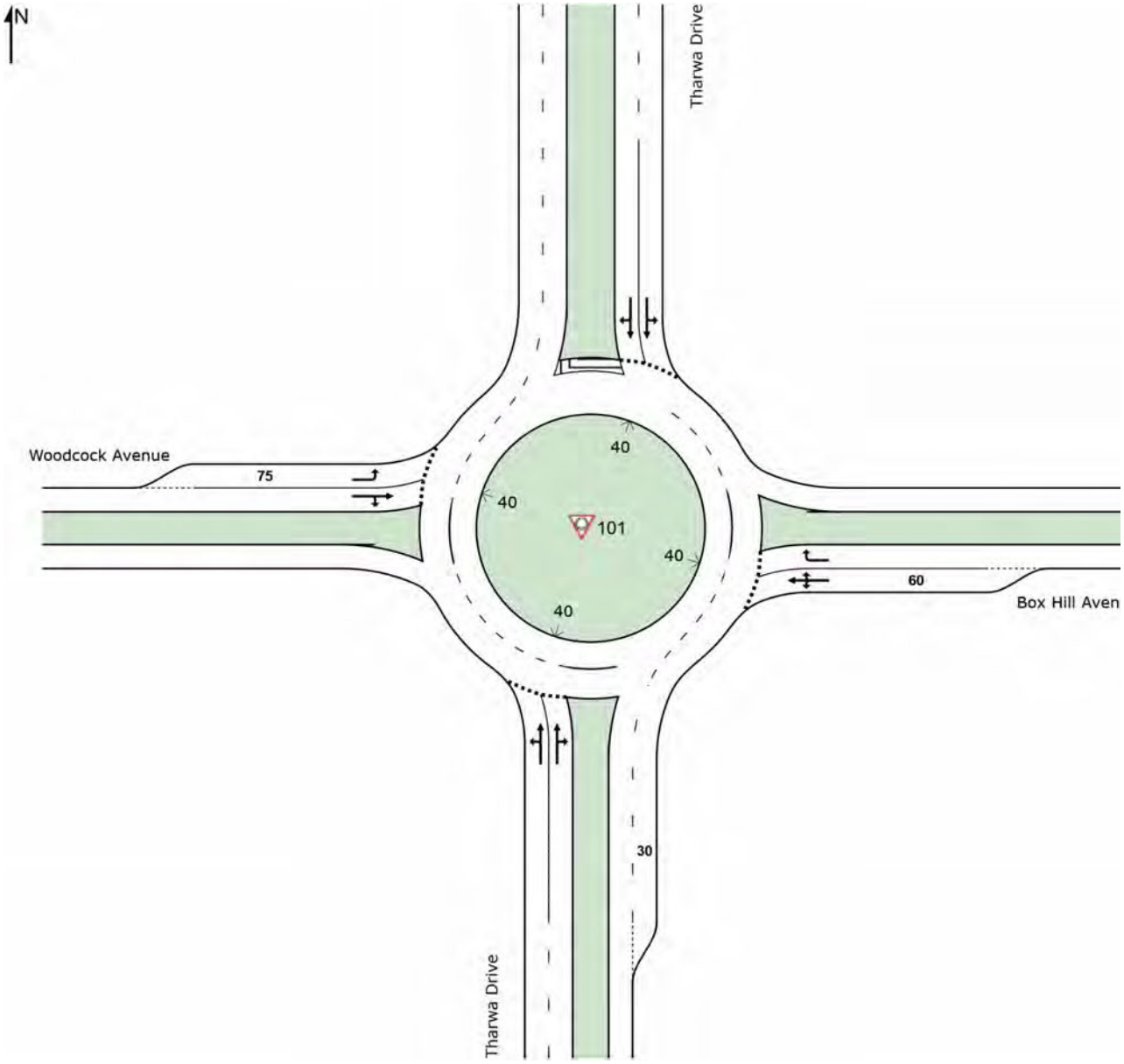
Template: Default Site User Report (2)

Site: 101 [Existing_PM Peak_Tharwa Drive / Woodcock Drive]

Network: 2 [Existing Conditions_Tharwa Drive PM peak]

Two Lane Roundabout
Site Category: PM Peak Existing Conditions
Roundabout

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
1	L2	144	1.5	144	1.5	0.290	4.6	LOS A	0.6	4.5	0.64	0.58	0.64	49.9
2	T1	382	1.5	382	1.5	0.290	4.7	LOS A	0.6	4.5	0.64	0.57	0.64	54.4
3	R2	8	1.5	8	1.5	0.290	11.0	LOS A	0.6	4.2	0.65	0.57	0.65	40.5
Approach		535	1.5	535	1.5	0.290	4.8	LOS A	0.6	4.5	0.64	0.57	0.64	53.1
East: Box Hill Avenue														
4	L2	31	1.5	31	1.5	0.586	17.6	LOS B	2.6	18.3	1.00	1.13	1.37	23.2
5	T1	102	1.5	102	1.5	0.586	17.5	LOS B	2.6	18.3	1.00	1.13	1.37	39.6
6	R2	474	1.5	474	1.5	0.586	25.2	LOS B	2.6	18.3	1.00	1.14	1.38	40.7
Approach		606	1.5	606	1.5	0.586	23.5	LOS B	2.6	18.3	1.00	1.14	1.38	40.1
North: Tharwa Drive														
7	L2	760	1.5	760	1.5	0.604	4.6	LOS A	2.3	16.1	0.65	0.58	0.65	52.2
8	T1	927	1.5	927	1.5	0.844	5.2	LOS A	3.5	24.9	0.64	0.58	0.71	48.9
9	R2	108	1.5	108	1.5	0.844	12.2	LOS A	3.5	24.9	0.64	0.58	0.71	56.1
Approach		1796	1.5	1796	1.5	0.844	5.4	LOS A	3.5	24.9	0.64	0.58	0.69	50.9
West: Woodcock Avenue														
10	L2	63	1.5	63	1.5	0.090	6.0	LOS A	0.1	1.1	0.60	0.71	0.60	54.1
11	T1	142	1.5	142	1.5	0.220	4.4	LOS A	0.4	2.8	0.61	0.59	0.61	52.1
12	R2	64	1.5	64	1.5	0.220	11.3	LOS A	0.4	2.8	0.61	0.59	0.61	46.0
Approach		269	1.5	269	1.5	0.220	6.4	LOS A	0.4	2.8	0.61	0.62	0.61	51.6
All Vehicles		3206	1.5	3206	1.5	0.844	8.8	LOS A	3.5	24.9	0.71	0.69	0.80	48.6

[redacted]

Lane Use and Performance

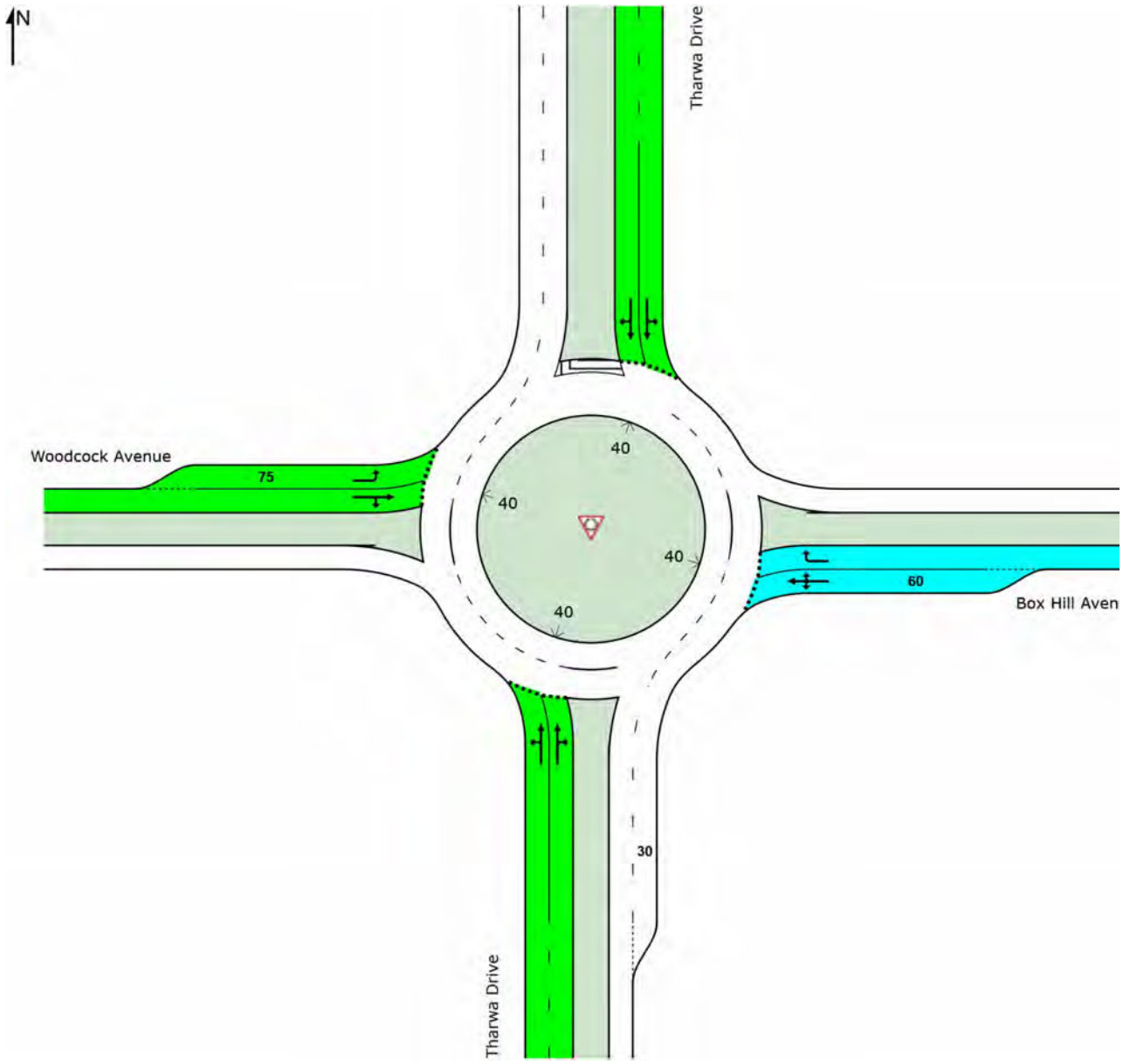
	Demand Flows		Arrival Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	Aver. Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
South: Tharwa Drive															
Lane 1[d]	293	1.5	293	1.5	1011	0.290	100	4.5	LOS A	0.6	4.5	Full	75	0.0	0.0
Lane 2	242	1.5	242	1.5	836	0.290	100	5.1	LOS A	0.6	4.2	Full	75	0.0	0.0
Approach	535	1.5	535	1.5		0.290		4.8	LOS A	0.6	4.5				
East: Box Hill Avenue															
Lane 1[d]	343	1.5	343	1.5	586	0.586	100	21.4	LOS B	2.6	18.3	Short	60	0.0	NA
Lane 2	263	1.5	263	1.5	450	0.586	100	26.3	LOS B	2.2	15.8	Full	150	0.0	0.0
Approach	606	1.5	606	1.5		0.586		23.5	LOS B	2.6	18.3				
North: Tharwa Drive															
Lane 1	760	1.5	760	1.5	1258	0.604	72[5]	4.6	LOS A	2.3	16.1	Full	490	0.0	0.0
Lane 2[d]	1036	1.5	1036	1.5	1227	0.844	100	6.0	LOS A	3.5	24.9	Full	490	-21.9[N3]	0.0
Approach	1796	1.5	1796	1.5		0.844		5.4	LOS A	3.5	24.9				
West: Woodcock Avenue															
Lane 1	63	1.5	63	1.5	699	0.090	100	6.0	LOS A	0.1	1.1	Short	75	0.0	NA
Lane 2[d]	206	1.5	206	1.5	937	0.220	100	6.6	LOS A	0.4	2.8	Full	380	-8.9[N3]	0.0
Approach	269	1.5	269	1.5		0.220		6.4	LOS A	0.4	2.8				
Intersection	3206	1.5	3206	1.5		0.844		8.8	LOS A	3.5	24.9				

[redacted]

5 Lane under-utilisation found by the program
d Dominant lane on roundabout approach
N3 Capacity Adjustment due to downstream lane blockage determined by the program.

Lane Level of Service

	Approaches				Intersection
	South	East	North	West	
LOS	A	B	A	A	A



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

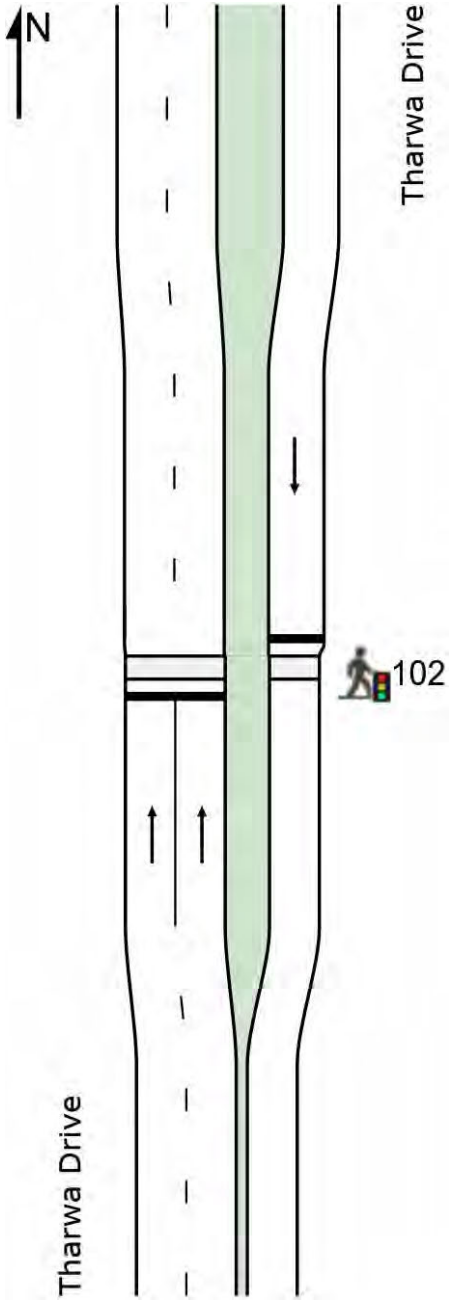
Site: 102 [Existing_PM Peak_Tharwa Drive Pedestrian Crossing]

Network: 2 [Existing Conditions_Tharwa Drive PM peak]

Pedestrian Crossing
Site Category: PM Peak Existing Conditions
Pedestrian Crossing (Signals) - Fixed Time Isolated Cycle Time = 259 seconds (Site User-Given Phase Times)

Timings based on settings in the Site Phasing & Timing dialog
Phase Times specified by the user
Phase Sequence: Two-Phase
Reference Phase: Phase A
Input Phase Sequence: A, B
Output Phase Sequence: A, B

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
2	T1	535	1.5	535	1.5	0.138	0.4	LOS A	1.2	8.7	0.07	0.06	0.07	55.4
Approach		535	1.5	535	1.5	0.138	0.4	LOS A	1.2	8.7	0.07	0.06	0.07	55.4
North: Tharwa Drive														
8	T1	1022	1.5	1022	1.5	0.514	0.8	LOS A	8.0	56.6	0.12	0.11	0.12	52.2
Approach		1022	1.5	1022	1.5	0.514	0.8	LOS A	8.0	56.6	0.12	0.11	0.12	52.2
All Vehicles		1557	1.5	1557	1.5	0.514	0.7	LOS A	8.0	56.6	0.10	0.09	0.10	53.3



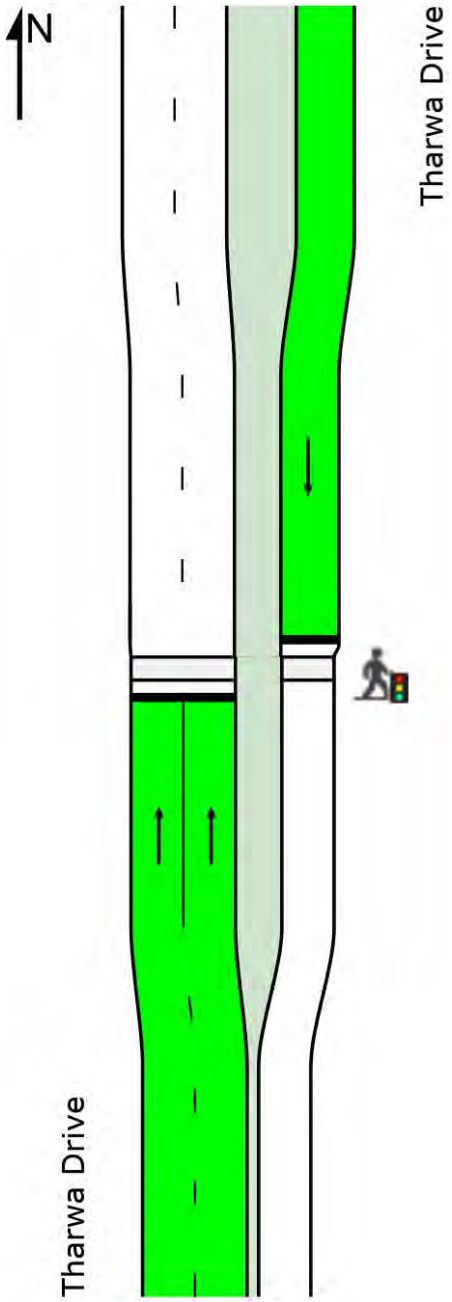
Lane Use and Performance

	Demand Flows		Arrival Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	Aver. Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
South: Tharwa Drive															
Lane 1	267	1.5	267	1.5	1941	0.138	100	0.4	LOS A	1.2	8.7	Full	80	0.0	0.0
Lane 2	267	1.5	267	1.5	1941	0.138	100	0.4	LOS A	1.2	8.7	Full	80	0.0	0.0
Approach	535	1.5	535	1.5		0.138		0.4	LOS A	1.2	8.7				
North: Tharwa Drive															
Lane 1	1022	1.5	1022	1.5	1988	0.514	100	0.8	LOS A	8.0	56.6	Full	75	0.0	23.9
Approach	1022	1.5	1022	1.5		0.514		0.8	LOS A	8.0	56.6				
Intersection	1557	1.5	1557	1.5		0.514		0.7	LOS A	8.0	56.6				

[redacted]

Lane Level of Service

	Approaches		Intersection
	South	North	
LOS	A	A	A



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Phase Timing Summary

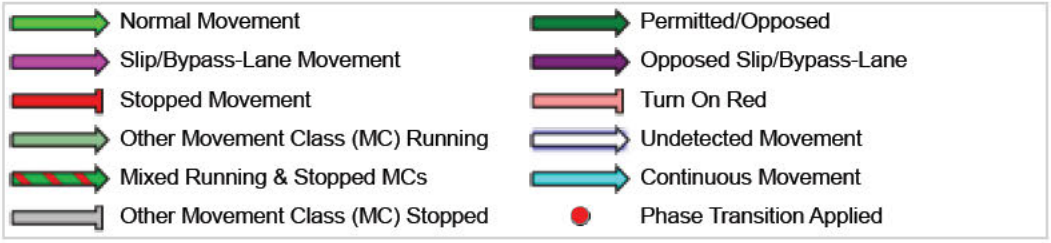
Phase	A	B
Phase Change Time (sec)	0	248
Green Time (sec)	245	5
Phase Time (sec)	251	8
Phase Split	97%	3%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase

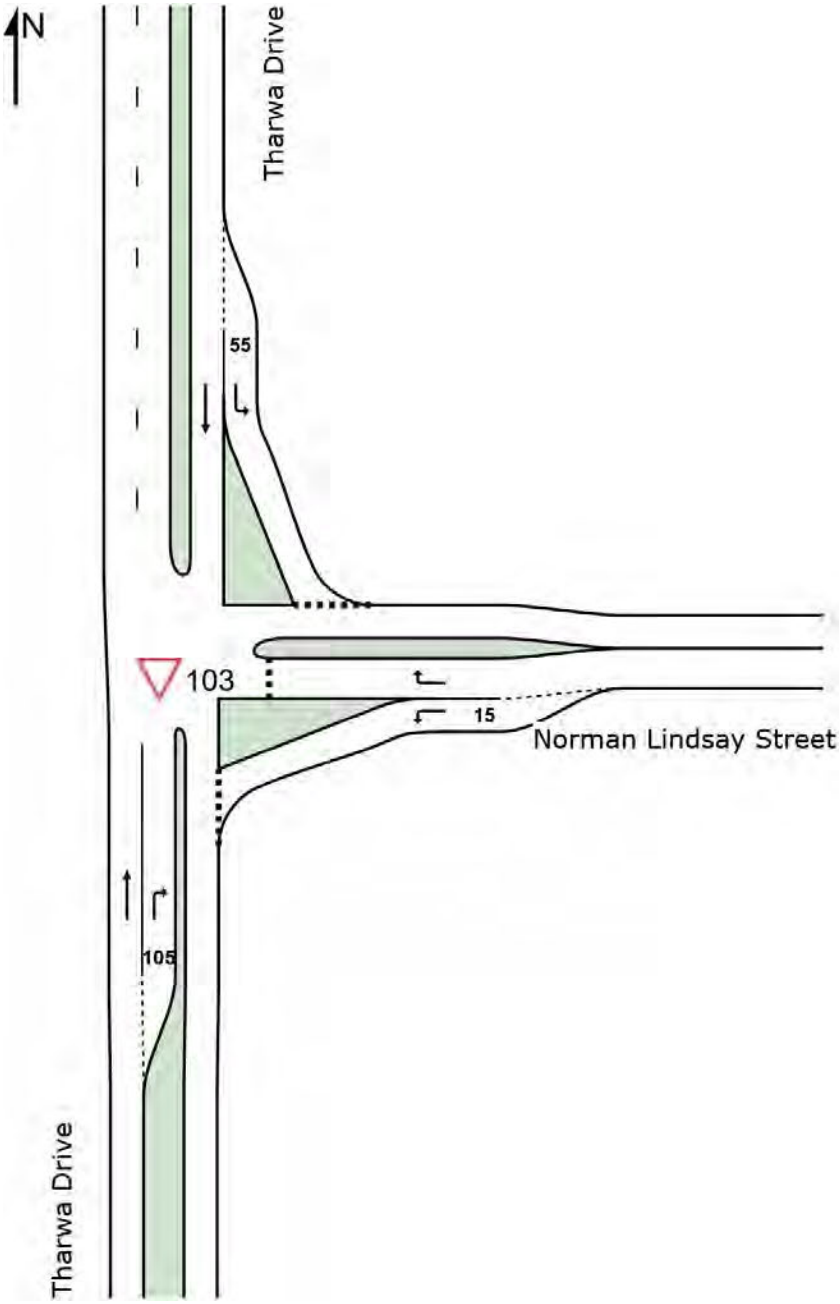


Site: 103 [Existing_PM Peak_Tharwa Drive / Norman Lindsay Street]

Network: 2 [Existing Conditions_Tharwa Drive PM peak]

Priority-Controlled T-Intersection
Site Category: PM Peak Existing Conditions
Giveway / Yield (Two-Way)

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
2	T1	408	1.5	408	1.5	0.213	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
3	R2	102	1.5	102	1.5	0.146	10.0	LOS A	0.2	1.6	0.65	0.85	0.65	46.3
Approach		511	1.5	511	1.5	0.213	2.0	NA	0.2	1.6	0.13	0.17	0.13	56.5
East: Norman Lindsay Street														
4	L2	192	1.5	192	1.5	0.295	9.1	LOS A	0.5	3.6	0.68	0.88	0.80	17.7
6	R2	126	1.5	126	1.5	0.991	126.3	LOS F	3.4	24.3	1.00	1.63	3.62	1.5
Approach		318	1.5	318	1.5	0.991	55.6	LOS D	3.4	24.3	0.81	1.18	1.92	3.6
North: Tharwa Drive														
7	L2	232	1.5	232	1.5	0.156	5.5	LOS A	0.3	1.9	0.21	0.53	0.21	31.2
8	T1	792	1.5	792	1.5	0.410	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
Approach		1023	1.5	1023	1.5	0.410	1.3	LOS A	0.3	1.9	0.05	0.12	0.05	46.7
All Vehicles		1852	1.5	1852	1.5	0.991	10.8	NA	3.4	24.3	0.20	0.32	0.39	34.4



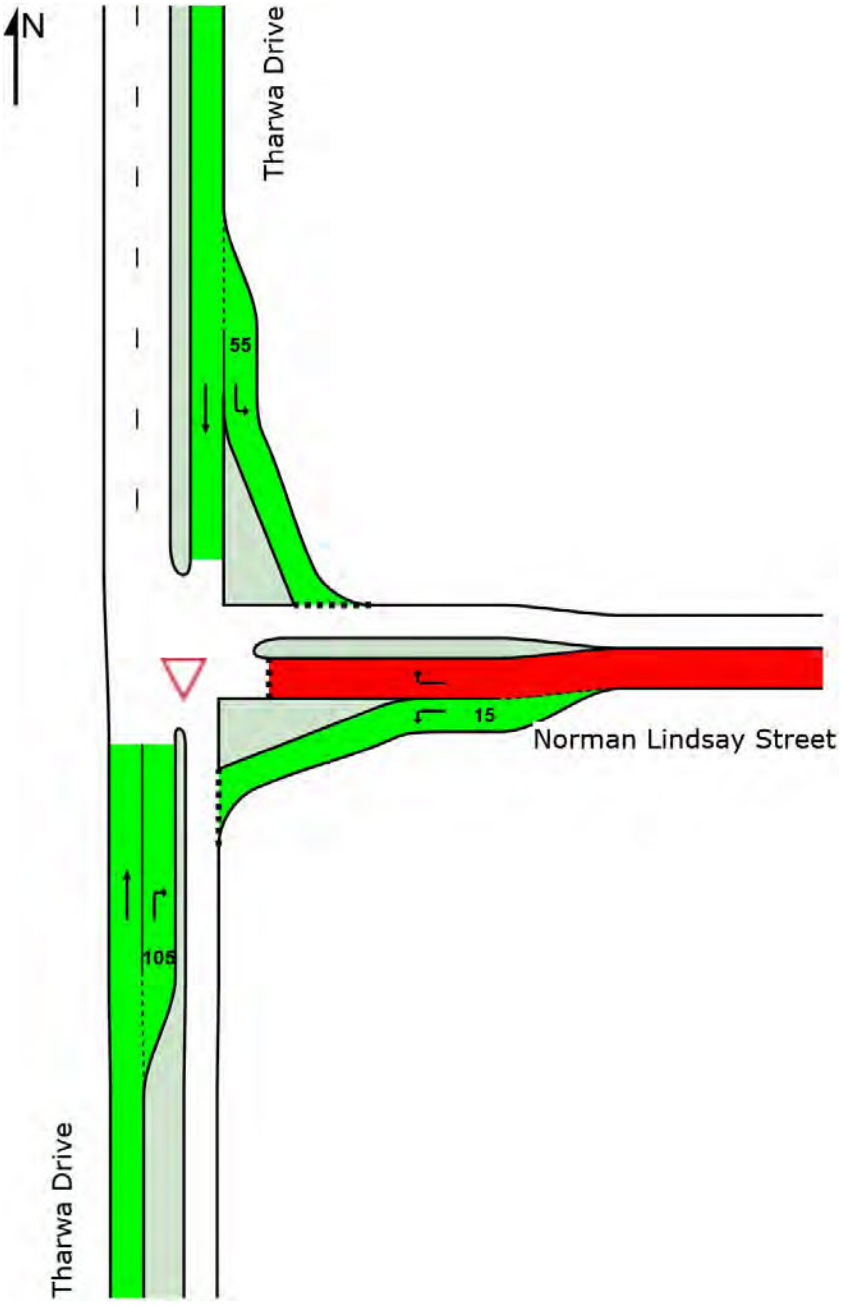
Lane Use and Performance

	Demand Flows		Arrival Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	Aver. Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
South: Tharwa Drive															
Lane 1	408	1.5	408	1.5	1917	0.213	100	0.0	LOS A	0.0	0.0	Full	640	0.0	0.0
Lane 2	102	1.5	102	1.5	698	0.146	100	10.0	LOS A	0.2	1.6	Short	105	0.0	NA
Approach	511	1.5	511	1.5		0.213		2.0	NA	0.2	1.6				
East: Norman Lindsay Street															
Lane 1	192	1.5	192	1.5	650	0.295	100	9.1	LOS A	0.5	3.6	Short	15	0.0	NA
Lane 2	126	1.5	126	1.5	127	0.991	100	126.3	LOS F	3.4	24.3	Full	40	0.0	18.9
Approach	318	1.5	318	1.5		0.991		55.6	LOS D	3.4	24.3				
North: Tharwa Drive															
Lane 1	232	1.5	232	1.5	1489	0.156	100	5.5	LOS A	0.3	1.9	Short	55	0.0	NA
Lane 2	792	1.5	792	1.5	1931	0.410	100	0.0	LOS A	0.0	0.0	Full	80	0.0	0.0
Approach	1023	1.5	1023	1.5		0.410		1.3	LOS A	0.3	1.9				
Intersection	1852	1.5	1852	1.5		0.991		10.8	NA	3.4	24.3				

[redacted]

Lane Level of Service

	Approaches			Intersection
	South	East	North	
LOS	NA	D	A	NA



Colour code based on Level of Service

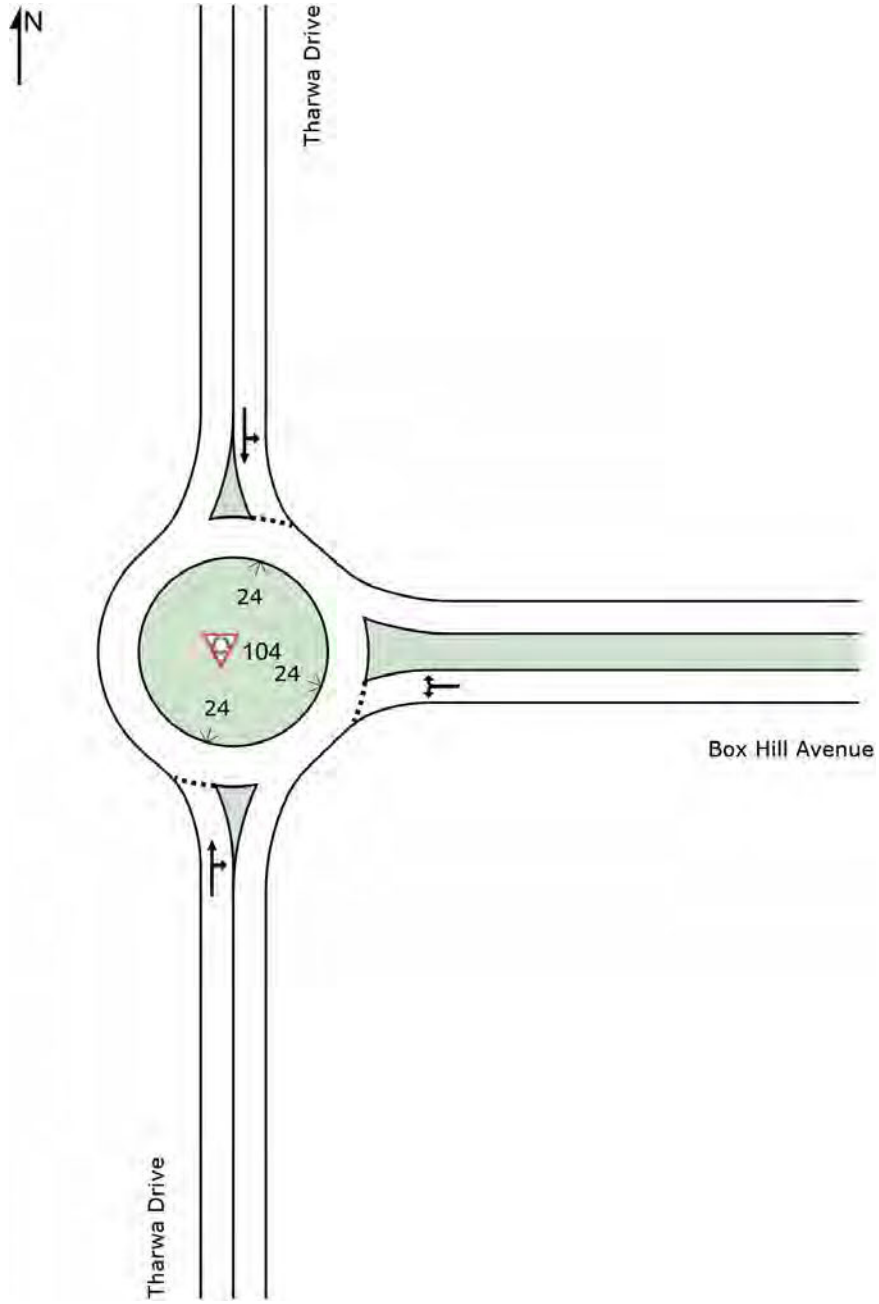
LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site: 104 [Existing_PM Peak_Tharwa Drive / Box Hill Avenue]

Network: 2 [Existing Conditions_Tharwa Drive PM peak]

Single Lane Roundabout
Site Category: PM Peak Existing Conditions
Roundabout

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
2	T1	267	1.5	267	1.5	0.253	5.0	LOS A	0.6	4.6	0.50	0.53	0.50	54.0
3	R2	13	1.5	13	1.5	0.253	10.2	LOS A	0.6	4.6	0.50	0.53	0.50	52.9
Approach		280	1.5	280	1.5	0.253	5.2	LOS A	0.6	4.6	0.50	0.53	0.50	54.0
East: Box Hill Avenue														
4	L2	13	1.5	13	1.5	0.279	6.9	LOS A	0.7	4.8	0.64	0.77	0.64	27.0
6	R2	247	1.5	247	1.5	0.279	12.1	LOS A	0.7	4.8	0.64	0.77	0.64	27.0
Approach		260	1.5	260	1.5	0.279	11.8	LOS A	0.7	4.8	0.64	0.77	0.64	27.0
North: Tharwa Drive														
7	L2	455	1.5	455	1.5	0.586	3.8	LOS A	2.6	18.3	0.14	0.40	0.14	53.8
8	T1	531	1.5	531	1.5	0.586	3.9	LOS A	2.6	18.3	0.14	0.40	0.14	53.9
Approach		985	1.5	985	1.5	0.586	3.9	LOS A	2.6	18.3	0.14	0.40	0.14	53.9
All Vehicles		1525	1.5	1525	1.5	0.586	5.5	LOS A	2.6	18.3	0.30	0.48	0.30	51.8



Lane Use and Performance

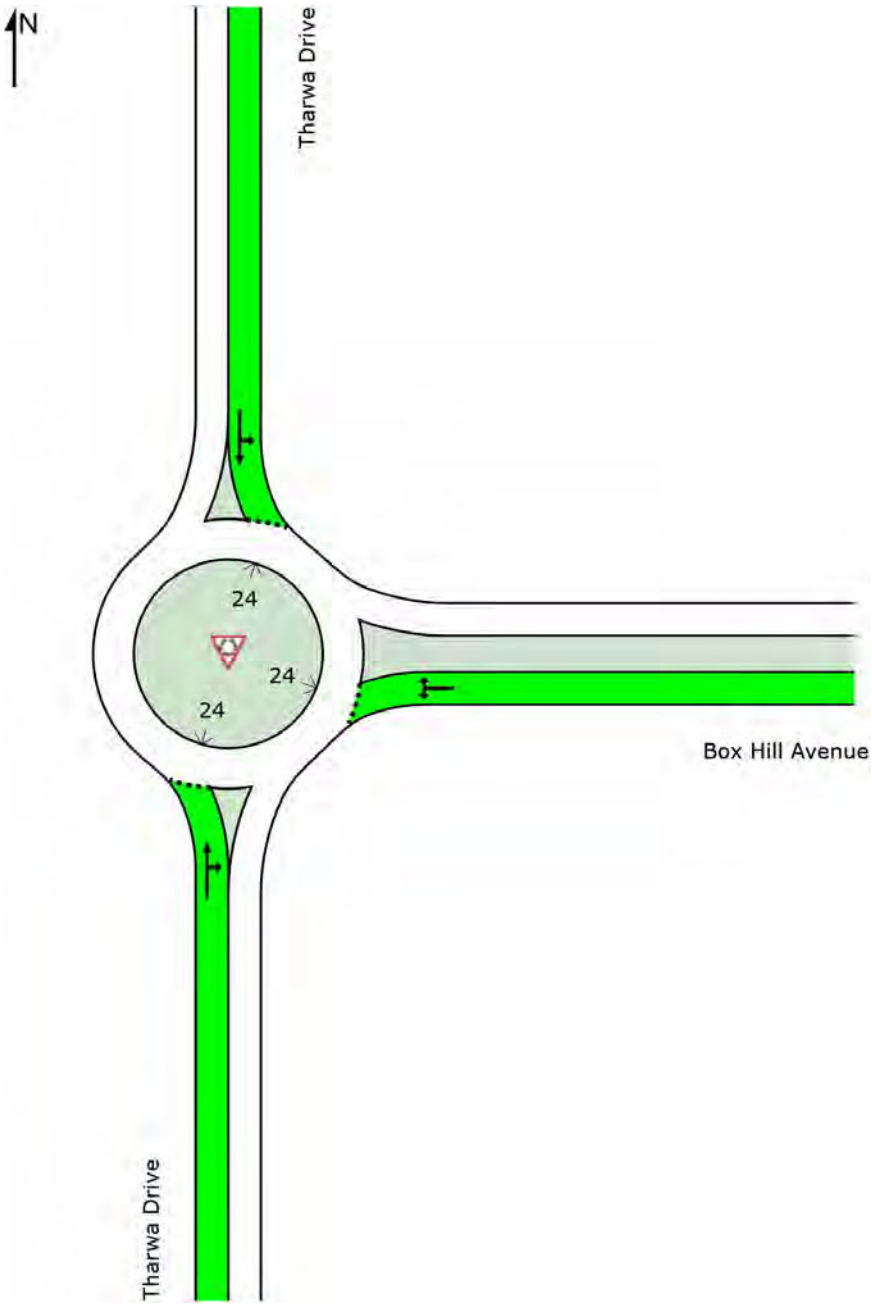
	Demand Flows		Arrival Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	Aver. Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
South: Tharwa Drive															
Lane 1[d]	280	1.5	280	1.5	1108	0.253	100	5.2	LOS A	0.6	4.6	Full	990	0.0	0.0
Approach	280	1.5	280	1.5		0.253		5.2	LOS A	0.6	4.6				
East: Box Hill Avenue															
Lane 1[d]	260	1.5	260	1.5	933	0.279	100	11.8	LOS A	0.7	4.8	Full	105	0.0	0.0
Approach	260	1.5	260	1.5		0.279		11.8	LOS A	0.7	4.8				
North: Tharwa Drive															
Lane 1[d]	985	1.5	985	1.5	1681	0.586	100	3.9	LOS A	2.6	18.3	Full	640	0.0	0.0
Approach	985	1.5	985	1.5		0.586		3.9	LOS A	2.6	18.3				
Intersection	1525	1.5	1525	1.5		0.586		5.5	LOS A	2.6	18.3				

[redacted]

d Dominant lane on roundabout approach

Lane Level of Service

	Approaches			Intersection
	South	East	North	
LOS	A	A	A	A



Colour code based on Level of Service

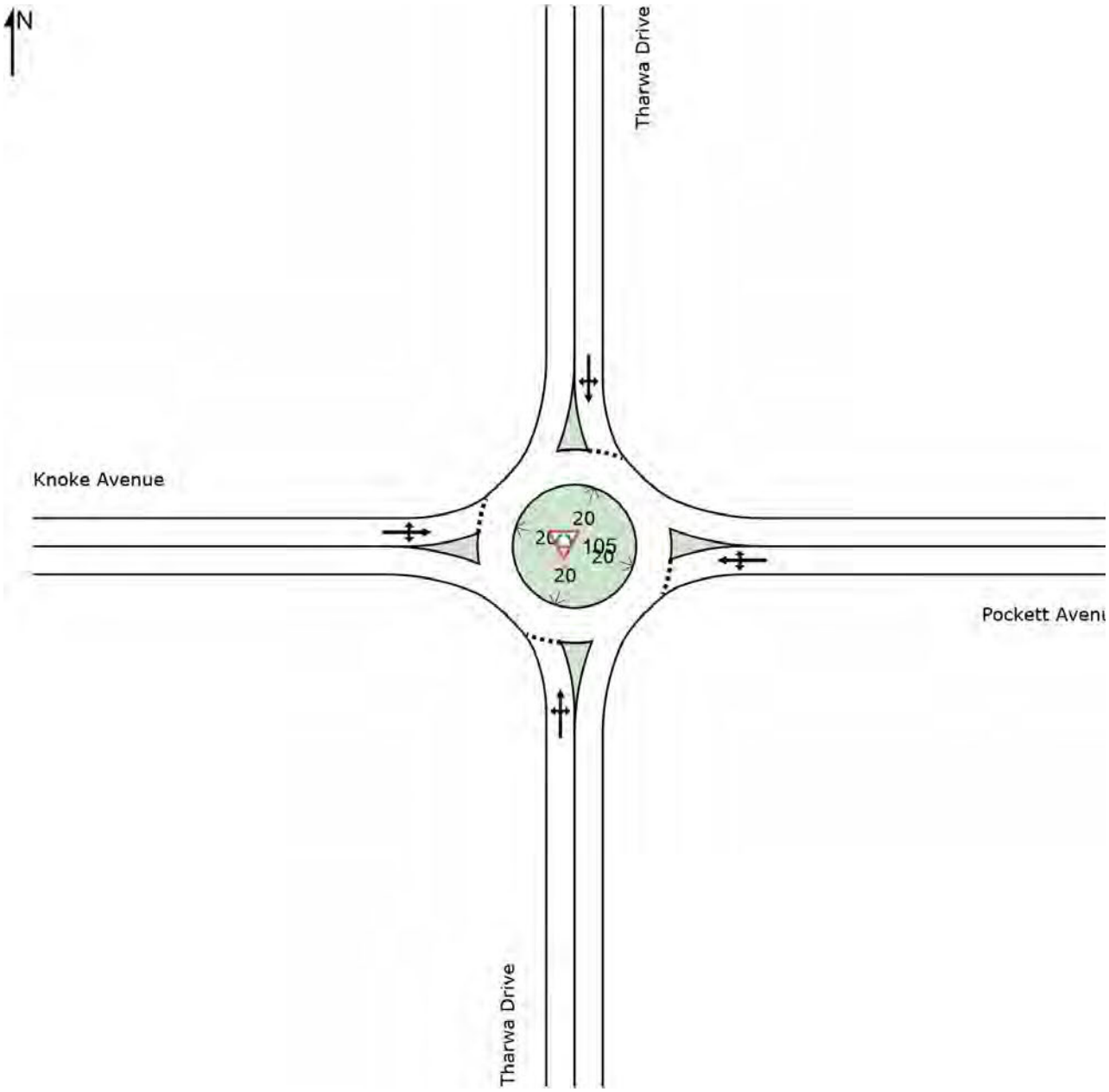
LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site: 105 [Existing_PM Peak_Tharwa Drive / Pockett Avenue]

Network: 2 [Existing Conditions_Tharwa Drive PM peak]

Single-Lane Roundabout
Site Category: PM Peak Existing Conditions
Roundabout

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
1	L2	2	1.5	2	1.5	0.035	5.6	LOS A	0.1	0.5	0.48	0.55	0.48	49.1
2	T1	28	1.5	28	1.5	0.035	5.9	LOS A	0.1	0.5	0.48	0.55	0.48	48.7
3	R2	5	1.5	5	1.5	0.035	10.5	LOS A	0.1	0.5	0.48	0.55	0.48	47.4
Approach		36	1.5	36	1.5	0.035	6.5	LOS A	0.1	0.5	0.48	0.55	0.48	48.5
East: Pockett Avenue														
4	L2	9	1.5	9	1.5	0.176	4.8	LOS A	0.4	2.7	0.44	0.65	0.44	47.5
5	T1	36	1.5	36	1.5	0.176	5.0	LOS A	0.4	2.7	0.44	0.65	0.44	12.6
6	R2	152	1.5	152	1.5	0.176	9.7	LOS A	0.4	2.7	0.44	0.65	0.44	27.5
Approach		197	1.5	197	1.5	0.176	8.6	LOS A	0.4	2.7	0.44	0.65	0.44	22.8
North: Tharwa Drive														
7	L2	289	1.5	289	1.5	0.361	4.1	LOS A	1.0	7.3	0.21	0.52	0.21	45.5
8	T1	58	1.5	58	1.5	0.361	4.4	LOS A	1.0	7.3	0.21	0.52	0.21	56.4
9	R2	197	1.5	197	1.5	0.361	9.0	LOS A	1.0	7.3	0.21	0.52	0.21	45.3
Approach		544	1.5	544	1.5	0.361	5.9	LOS A	1.0	7.3	0.21	0.52	0.21	46.7
West: Knoke Avenue														
10	L2	86	1.5	86	1.5	0.107	4.8	LOS A	0.2	1.6	0.37	0.51	0.37	32.7
11	T1	35	1.5	35	1.5	0.107	4.9	LOS A	0.2	1.6	0.37	0.51	0.37	24.3
12	R2	5	1.5	5	1.5	0.107	9.6	LOS A	0.2	1.6	0.37	0.51	0.37	52.6
Approach		126	1.5	126	1.5	0.107	5.0	LOS A	0.2	1.6	0.37	0.51	0.37	30.9
All Vehicles		903	1.5	903	1.5	0.361	6.4	LOS A	1.0	7.3	0.29	0.55	0.29	43.9

[redacted]

Lane Use and Performance

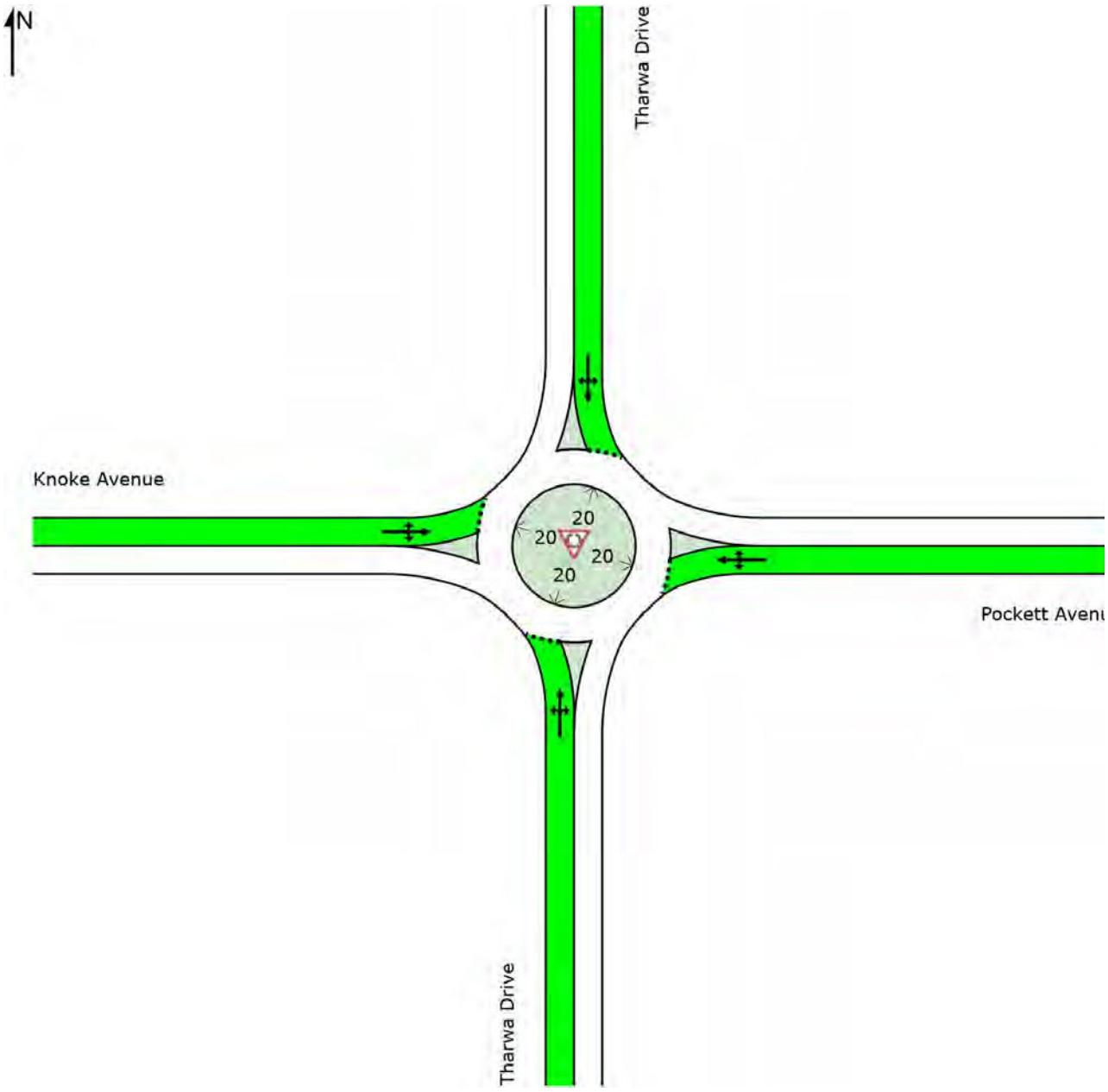
	Demand Flows		Arrival Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	Aver. Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
South: Tharwa Drive															
Lane 1[d]	36	1.5	36	1.5	1019	0.035	100	6.5	LOS A	0.1	0.5	Full	500	0.0	0.0
Approach	36	1.5	36	1.5		0.035		6.5	LOS A	0.1	0.5				
East: Pockett Avenue															
Lane 1[d]	197	1.5	197	1.5	1118	0.176	100	8.6	LOS A	0.4	2.7	Full	80	0.0	0.0
Approach	197	1.5	197	1.5		0.176		8.6	LOS A	0.4	2.7				
North: Tharwa Drive															
Lane 1[d]	544	1.5	544	1.5	1506	0.361	100	5.9	LOS A	1.0	7.3	Full	990	0.0	0.0
Approach	544	1.5	544	1.5		0.361		5.9	LOS A	1.0	7.3				
West: Knoke Avenue															
Lane 1[d]	126	1.5	126	1.5	1178	0.107	100	5.0	LOS A	0.2	1.6	Full	95	0.0	0.0
Approach	126	1.5	126	1.5		0.107		5.0	LOS A	0.2	1.6				
Intersection	903	1.5	903	1.5		0.361		6.4	LOS A	1.0	7.3				

[redacted]

d Dominant lane on roundabout approach

Lane Level of Service

	Approaches				Intersection
	South	East	North	West	
LOS	A	A	A	A	A



Colour code based on Level of Service

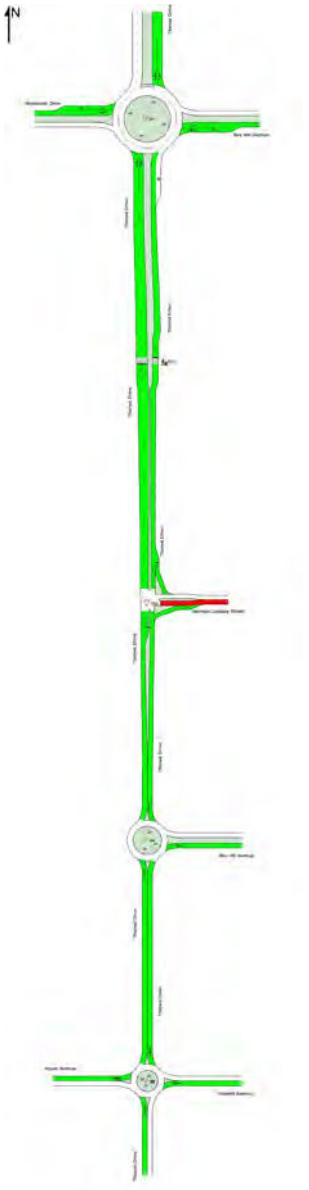
LOS A LOS B LOS C LOS D LOS E LOS F

DEGREE OF SATURATION

Ratio of Demand Volume to Capacity, v/c ratio per lane

Network: N101 [2031 Future Conditions_Tharwa Drive AM peak - Base]

2031 Future Conditions - Existing Layout
Network Category: (None)



Colour code based on Degree of Saturation

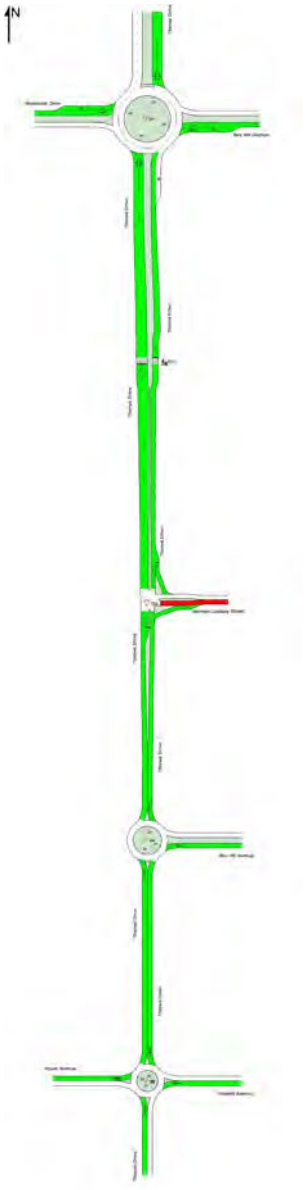
[< 0.6]	[0.6 – 0.7]	[0.7 – 0.8]	[0.8 – 0.9]	[0.9 – 1.0]	[> 1.0]

LANE LEVEL OF SERVICE

Lane Level of Service for Network Sites

Network: N101 [2031 Future Conditions_Tharwa Drive AM peak - Base]

2031 Future Conditions - Existing Layout
Network Category: (None)



Colour code based on Level of Service

LOS A	LOS B	LOS C	LOS D	LOS E	LOS F

Delay model settings are specified for individual Sites forming the Network.

USER REPORT FOR NETWORK SITE

Project: 2031 Conditions

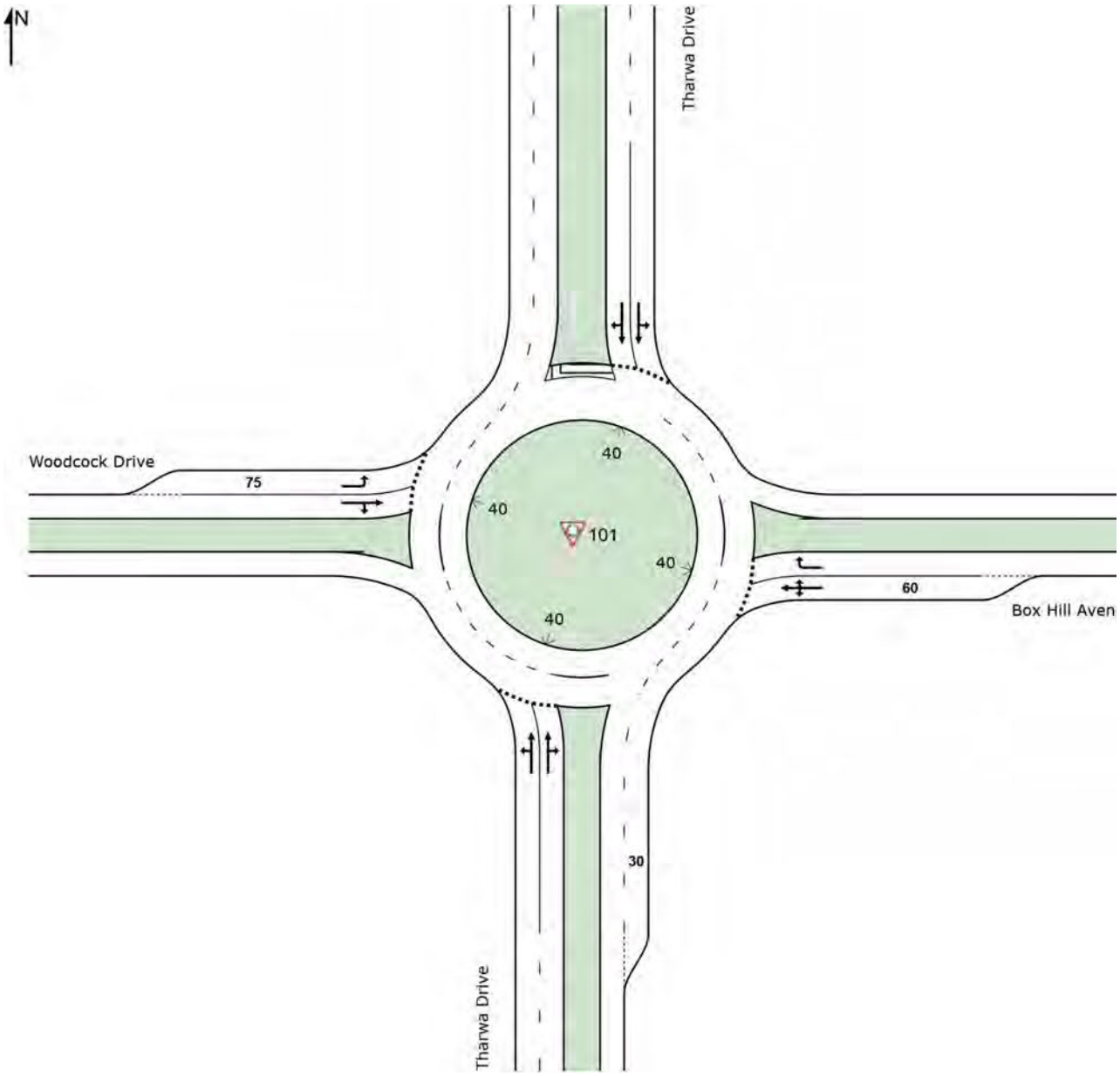
Template: Default Site User Report (2)

Site: 101 [2031_AM Peak_Tharwa Drive / Woodcock Drive - Base]

Network: 1 [2031 Future Conditions_Tharwa Drive AM peak - Base]

Two Lane Roundabout - Existing Layout
Site Category: AM Peak 2031 Conditions
Roundabout

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
1	L2	75	2.3	74	2.3	0.577	6.6	LOS A	1.6	11.3	0.74	0.80	0.90	48.6
2	T1	943	2.3	929	2.3	0.577	6.9	LOS A	1.6	11.3	0.75	0.84	0.92	53.3
3	R2	2	2.3	2	2.3	0.577	13.6	LOS A	1.5	10.6	0.75	0.89	0.94	39.2
Approach		1020	2.3	1005[N1]	2.3	0.577	6.9	LOS A	1.6	11.3	0.75	0.84	0.91	53.0
East: Box Hill Avenue														
4	L2	13	2.3	13	2.3	0.402	5.2	LOS A	1.0	7.1	0.61	0.70	0.61	33.7
5	T1	96	2.3	96	2.3	0.402	5.1	LOS A	1.0	7.1	0.61	0.70	0.61	49.1
6	R2	737	2.3	737	2.3	0.402	11.7	LOS A	1.0	7.1	0.61	0.74	0.61	50.5
Approach		845	2.3	845	2.3	0.402	10.8	LOS A	1.0	7.1	0.61	0.73	0.61	50.2
North: Tharwa Drive														
7	L2	362	2.3	362	2.3	0.282	3.9	LOS A	0.8	5.6	0.45	0.49	0.45	53.2
8	T1	343	2.3	343	2.3	0.261	3.2	LOS A	0.7	5.3	0.42	0.40	0.42	50.5
9	R2	67	2.3	67	2.3	0.261	10.1	LOS A	0.7	5.3	0.42	0.40	0.42	57.3
Approach		773	2.3	773	2.3	0.282	4.1	LOS A	0.8	5.6	0.44	0.44	0.44	52.6
West: Woodcock Drive														
10	L2	121	2.3	121	2.3	0.213	8.1	LOS A	0.4	2.8	0.75	0.84	0.75	52.4
11	T1	132	2.3	132	2.3	0.226	5.9	LOS A	0.5	3.3	0.76	0.72	0.76	50.7
12	R2	56	2.3	56	2.3	0.226	12.9	LOS A	0.5	3.3	0.76	0.72	0.76	44.6
Approach		308	2.3	308	2.3	0.226	8.0	LOS A	0.5	3.3	0.75	0.77	0.75	50.7
All Vehicles		2946	2.3	2931[N1]	2.3	0.577	7.4	LOS A	1.6	11.3	0.63	0.70	0.68	51.7

[redacted]

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

Lane Use and Performance

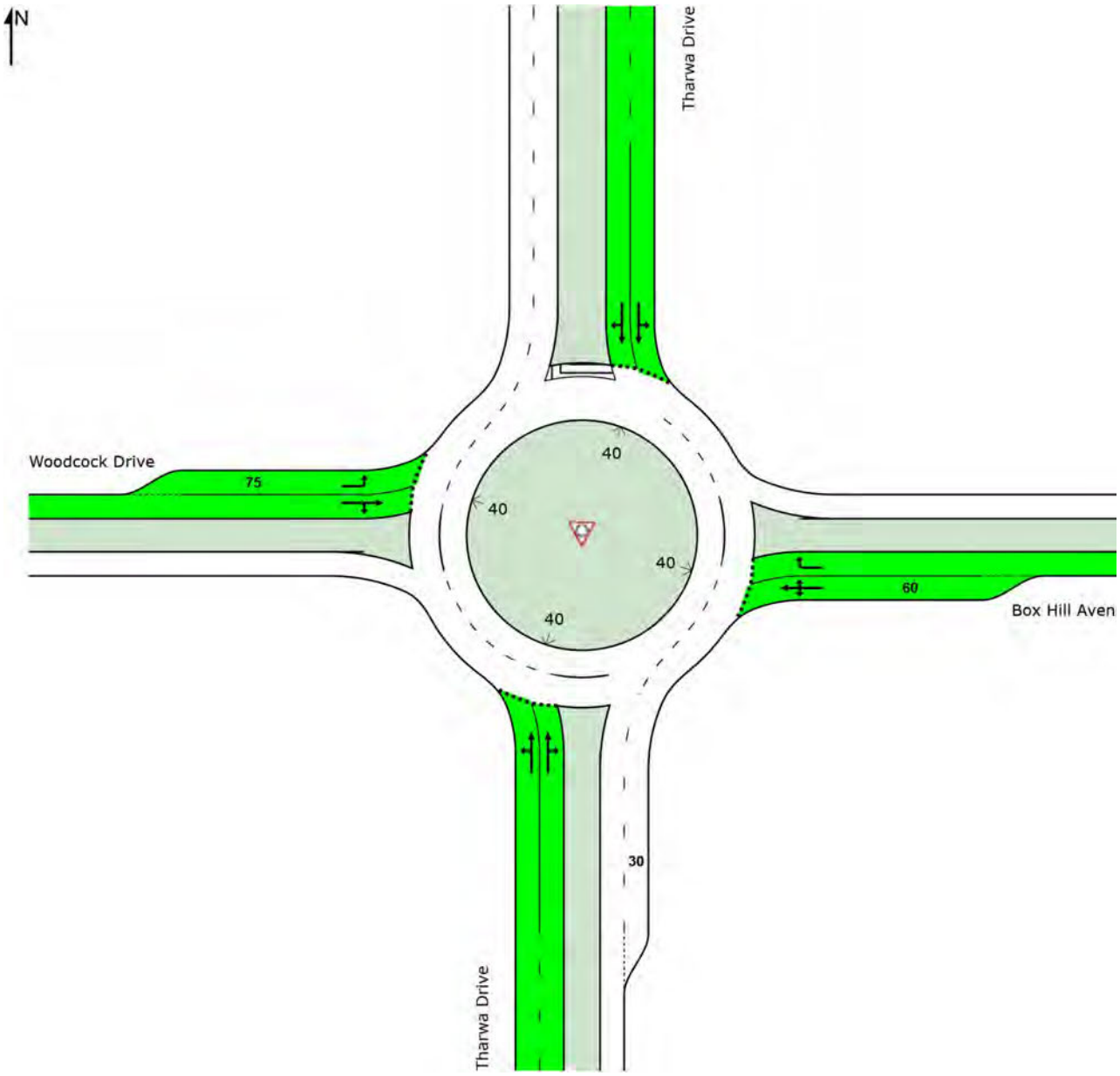
	Demand Flows		Arrival Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	Aver. Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
South: Tharwa Drive															
Lane 1[d]	568	2.3	560	2.3	970	0.577	100	6.4	LOS A	1.6	11.3	Full	75	0.0	0.0
Lane 2	452	2.3	445	2.3	771	0.577	100	7.5	LOS A	1.5	10.6	Full	75	0.0	0.0
Approach	1020	2.3	1005[N1]	2.3		0.577		6.9	LOS A	1.6	11.3				
East: Box Hill Avenue															
Lane 1[d]	457	2.3	457	2.3	1136	0.402	100	9.9	LOS A	1.0	7.1	Short	60	0.0	NA
Lane 2	388	2.3	388	2.3	964	0.402	100	11.9	LOS A	0.9	6.7	Full	150	0.0	0.0
Approach	845	2.3	845	2.3		0.402		10.8	LOS A	1.0	7.1				
North: Tharwa Drive															
Lane 1	362	2.3	362	2.3	1282	0.282	100	3.9	LOS A	0.8	5.6	Full	490	0.0	0.0
Lane 2[d]	411	2.3	411	2.3	1573	0.261	92[5]	4.3	LOS A	0.7	5.3	Full	490	0.0	0.0
Approach	773	2.3	773	2.3		0.282		4.1	LOS A	0.8	5.6				
West: Woodcock Drive															
Lane 1	121	2.3	121	2.3	567	0.213	100	8.1	LOS A	0.4	2.8	Short	75	0.0	NA
Lane 2[d]	187	2.3	187	2.3	828	0.226	100	8.0	LOS A	0.5	3.3	Full	380	0.0	0.0
Approach	308	2.3	308	2.3		0.226		8.0	LOS A	0.5	3.3				
Intersection	2946	2.3	2931[N1]	2.3		0.577		7.4	LOS A	1.6	11.3				

[redacted]

5 Lane under-utilisation found by the program
d Dominant lane on roundabout approach
N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

Lane Level of Service

	Approaches				Intersection
	South	East	North	West	
LOS	A	A	A	A	A



Colour code based on Level of Service

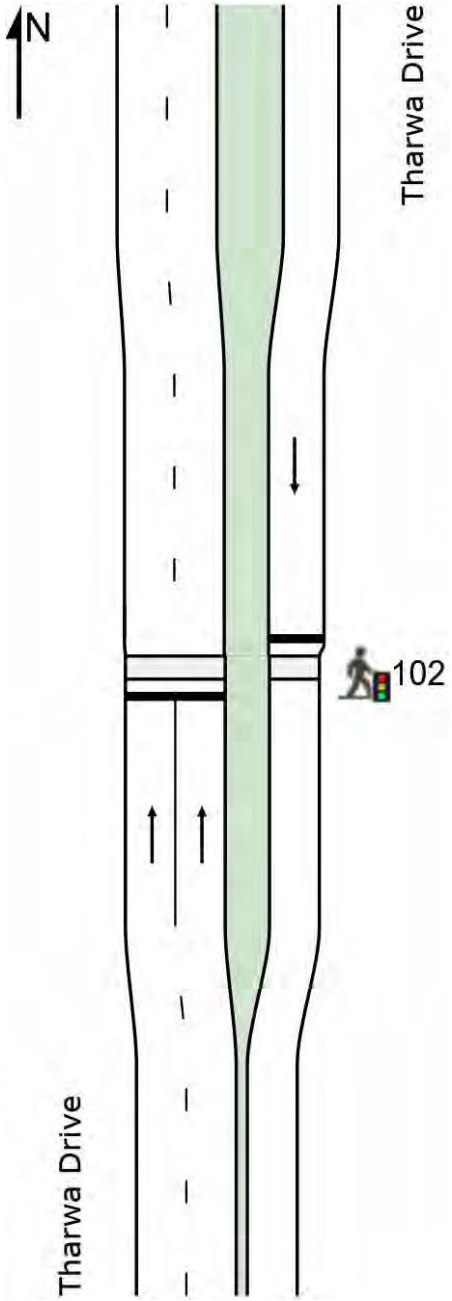
Site: 102 [2031_AM Peak_Tharwa Drive Pedestrian Crossing - Base]

Network: 1 [2031 Future Conditions_Tharwa Drive AM peak - Base]

Pedestrian Crossing - Existing Layout
Site Category: AM Peak 2031 Conditions
Pedestrian Crossing (Signals) - Fixed Time Isolated Cycle Time = 133 seconds (Site User-Given Phase Times)

Timings based on settings in the Site Phasing & Timing dialog
Phase Times specified by the user
Phase Sequence: Two-Phase
Reference Phase: Phase A
Input Phase Sequence: A, B
Output Phase Sequence: A, B

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
2	T1	1020	2.3	1005	2.3	0.275	1.0	LOS A	2.7	19.3	0.15	0.14	0.15	50.5
Approach		1020	2.3	1005[N1]	2.3	0.275	1.0	LOS A	2.7	19.3	0.15	0.14	0.15	50.5
North: Tharwa Drive														
8	T1	412	2.3	412	2.3	0.220	1.0	LOS A	2.1	14.8	0.14	0.13	0.14	50.5
Approach		412	2.3	412	2.3	0.220	1.0	LOS A	2.1	14.8	0.14	0.13	0.14	50.5
All Vehicles		1432	2.3	1416[N1]	2.3	0.275	1.0	LOS A	2.7	19.3	0.15	0.13	0.15	50.5

[redacted]

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

Lane Use and Performance

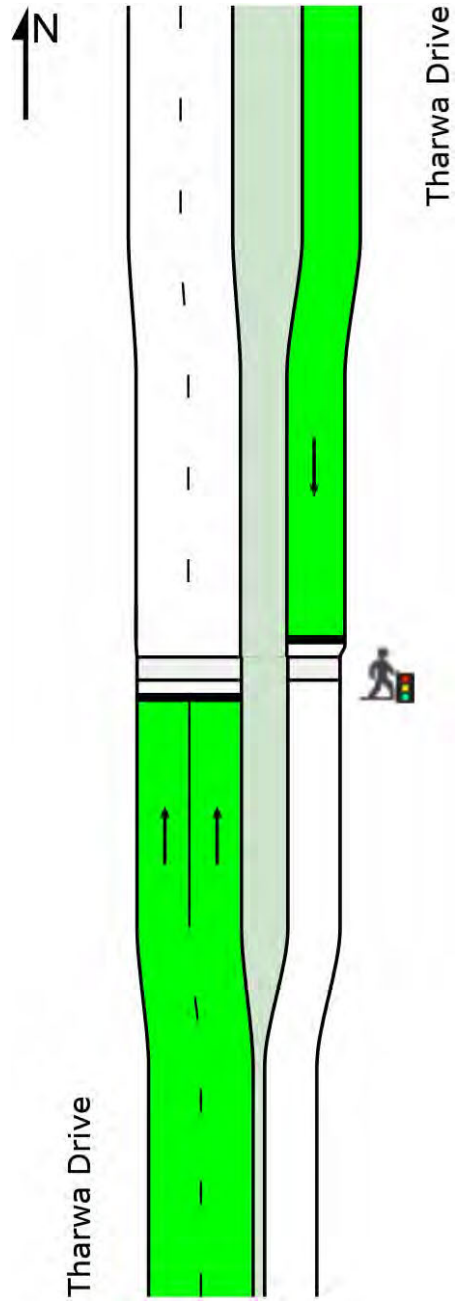
	Demand Flows		Arrival Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	Aver. Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
South: Tharwa Drive															
Lane 1	510	2.3	502	2.3	1826	0.275	100	1.0	LOS A	2.7	19.3	Full	80	0.0	0.0
Lane 2	510	2.3	502	2.3	1826	0.275	100	1.0	LOS A	2.7	19.3	Full	80	0.0	0.0
Approach	1020	2.3	1005[N1]	2.3		0.275		1.0	LOS A	2.7	19.3				
North: Tharwa Drive															
Lane 1	412	2.3	412	2.3	1871	0.220	100	1.0	LOS A	2.1	14.8	Full	75	0.0	0.0
Approach	412	2.3	412	2.3		0.220		1.0	LOS A	2.1	14.8				
Intersection	1432	2.3	1416[N1]	2.3		0.275		1.0	LOS A	2.7	19.3				

[redacted]

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

Lane Level of Service

	Approaches		Intersection
	South	North	
LOS	A	A	A



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Phase Timing Summary

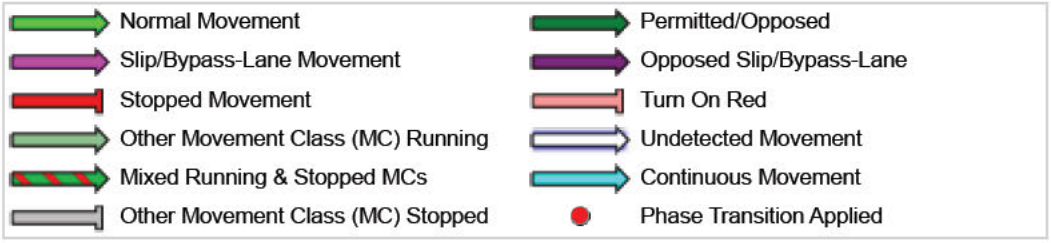
Phase	A	B
Phase Change Time (sec)	0	122
Green Time (sec)	119	5
Phase Time (sec)	125	8
Phase Split	94%	6%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase

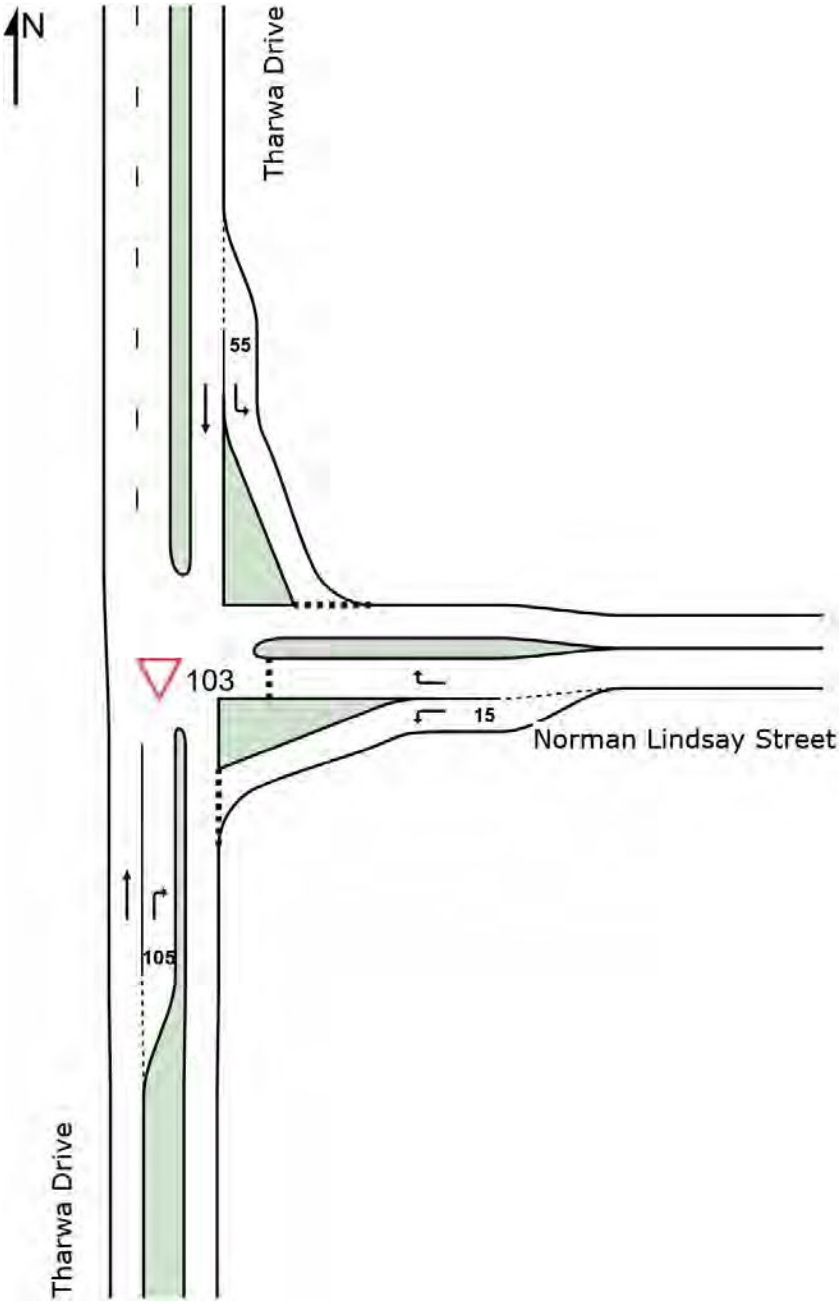


Site: 103 [2031_AM Peak_Tharwa Drive / Norman Lindsay Street - Base]

Network: 1 [2031 Future Conditions_Tharwa Drive AM peak - Base]

Priority-Controlled T-Intersection - Existing Layout
Site Category: AM Peak 2031 Conditions
Giveway / Yield (Two-Way)

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
2	T1	871	2.3	871	2.3	0.456	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
3	R2	147	2.3	147	2.3	0.107	6.5	LOS A	0.2	1.4	0.38	0.60	0.38	49.0
Approach		1018	2.3	1018	2.3	0.456	1.0	NA	0.2	1.4	0.06	0.09	0.06	57.9
East: Norman Lindsay Street														
4	L2	77	2.3	77	2.3	0.061	4.6	LOS A	0.1	0.7	0.35	0.56	0.35	26.4
6	R2	146	2.3	146	2.3	1.115	193.5	LOS F	6.5	46.6	1.00	2.12	5.64	1.0
Approach		223	2.3	223	2.3	1.115	128.4	LOS F	6.5	46.6	0.78	1.58	3.81	1.5
North: Tharwa Drive														
7	L2	140	2.3	140	2.3	0.098	5.7	LOS A	0.2	1.1	0.24	0.54	0.24	30.9
8	T1	275	2.3	275	2.3	0.143	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
Approach		415	2.3	415	2.3	0.143	1.9	LOS A	0.2	1.1	0.08	0.18	0.08	42.5
All Vehicles		1656	2.3	1656	2.3	1.115	18.4	NA	6.5	46.6	0.16	0.31	0.57	34.8



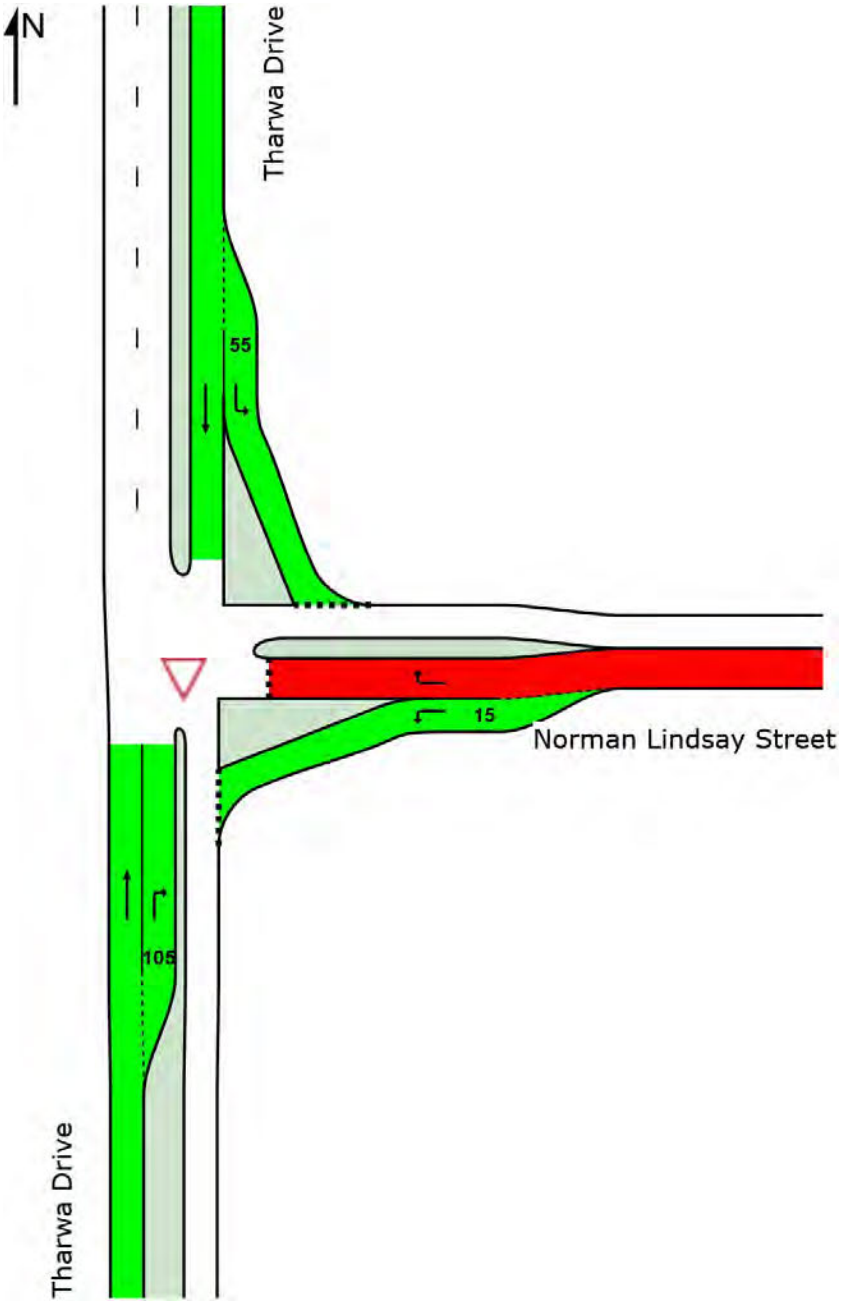
Lane Use and Performance

	Demand Flows		Arrival Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	Aver. Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
South: Tharwa Drive															
Lane 1	871	2.3	871	2.3	1910	0.456	100	0.1	LOS A	0.0	0.0	Full	640	0.0	0.0
Lane 2	147	2.3	147	2.3	1376	0.107	100	6.5	LOS A	0.2	1.4	Short	105	0.0	NA
Approach	1018	2.3	1018	2.3		0.456		1.0	NA	0.2	1.4				
East: Norman Lindsay Street															
Lane 1	77	2.3	77	2.3	1261	0.061	100	4.6	LOS A	0.1	0.7	Short	15	0.0	NA
Lane 2	146	2.3	146	2.3	131	1.115	100	193.5	LOS F	6.5	46.6	Full	40	0.0	87.2
Approach	223	2.3	223	2.3		1.115		128.4	LOS F	6.5	46.6				
North: Tharwa Drive															
Lane 1	140	2.3	140	2.3	1423	0.098	100	5.7	LOS A	0.2	1.1	Short	55	0.0	NA
Lane 2	275	2.3	275	2.3	1921	0.143	100	0.0	LOS A	0.0	0.0	Full	80	0.0	0.0
Approach	415	2.3	415	2.3		0.143		1.9	LOS A	0.2	1.1				
Intersection	1656	2.3	1656	2.3		1.115		18.4	NA	6.5	46.6				

[redacted]

Lane Level of Service

	Approaches			Intersection
	South	East	North	
LOS	NA	F	A	NA



Colour code based on Level of Service

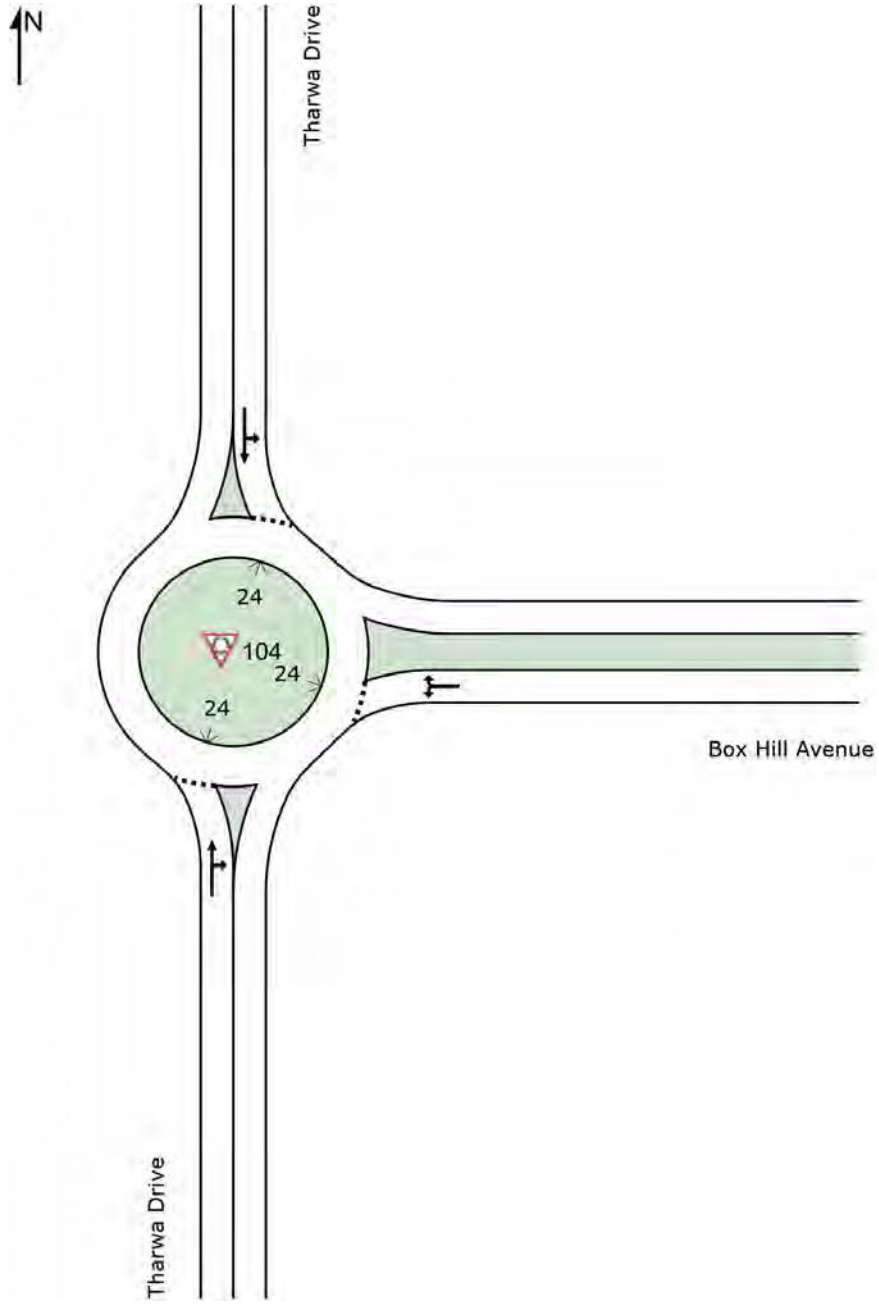
LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site: 104 [2031_AM Peak_Tharwa Drive / Box Hill Avenue - Base]

Network: 1 [2031 Future Conditions_Tharwa Drive AM peak - Base]

Single Lane Roundabout - Existing Layout
Site Category: AM Peak 2031 Conditions
Roundabout

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
2	T1	481	2.3	481	2.3	0.599	9.7	LOS A	2.4	16.8	0.85	0.91	1.02	51.5
3	R2	47	2.3	47	2.3	0.599	15.0	LOS B	2.4	16.8	0.85	0.91	1.02	50.7
Approach		528	2.3	528	2.3	0.599	10.2	LOS A	2.4	16.8	0.85	0.91	1.02	51.4
East: Box Hill Avenue														
4	L2	18	2.3	18	2.3	0.428	4.7	LOS A	1.2	8.7	0.43	0.63	0.43	28.6
6	R2	534	2.3	534	2.3	0.428	9.9	LOS A	1.2	8.7	0.43	0.63	0.43	28.6
Approach		552	2.3	552	2.3	0.428	9.7	LOS A	1.2	8.7	0.43	0.63	0.43	28.6
North: Tharwa Drive														
7	L2	182	2.3	182	2.3	0.234	4.0	LOS A	0.7	4.8	0.22	0.42	0.22	53.4
8	T1	158	2.3	158	2.3	0.234	4.0	LOS A	0.7	4.8	0.22	0.42	0.22	53.4
Approach		340	2.3	340	2.3	0.234	4.0	LOS A	0.7	4.8	0.22	0.42	0.22	53.4
All Vehicles		1420	2.3	1420	2.3	0.599	8.5	LOS A	2.4	16.8	0.54	0.69	0.60	48.0

[redacted]

Lane Use and Performance

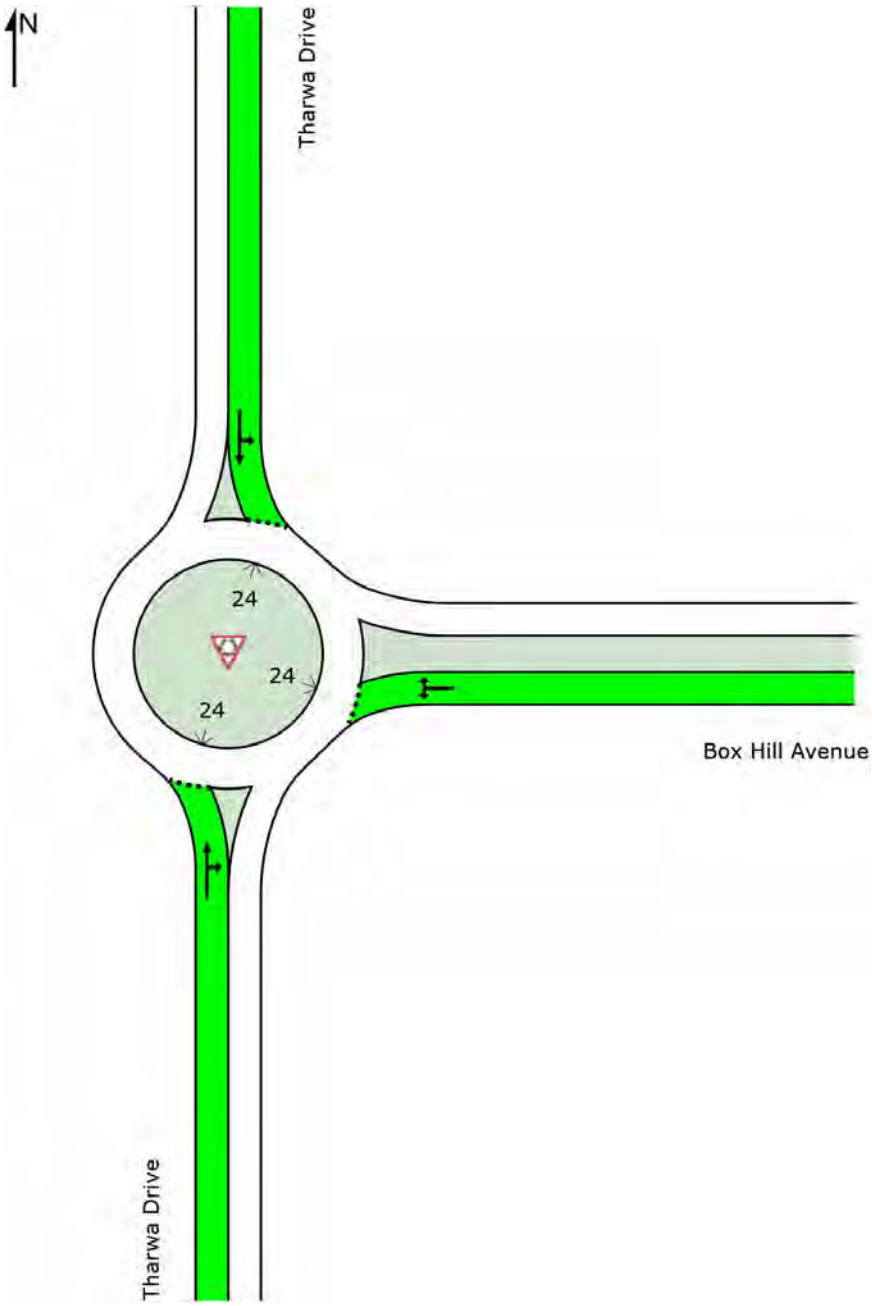
	Demand Flows		Arrival Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	Aver. Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
South: Tharwa Drive															
Lane 1[d]	528	2.3	528	2.3	882	0.599	100	10.2	LOS A	2.4	16.8	Full	990	0.0	0.0
Approach	528	2.3	528	2.3		0.599		10.2	LOS A	2.4	16.8				
East: Box Hill Avenue															
Lane 1[d]	552	2.3	552	2.3	1289	0.428	100	9.7	LOS A	1.2	8.7	Full	105	0.0	0.0
Approach	552	2.3	552	2.3		0.428		9.7	LOS A	1.2	8.7				
North: Tharwa Drive															
Lane 1[d]	340	2.3	340	2.3	1451	0.234	100	4.0	LOS A	0.7	4.8	Full	640	0.0	0.0
Approach	340	2.3	340	2.3		0.234		4.0	LOS A	0.7	4.8				
Intersection	1420	2.3	1420	2.3		0.599		8.5	LOS A	2.4	16.8				

[redacted]

d Dominant lane on roundabout approach

Lane Level of Service

	Approaches			Intersection
	South	East	North	
LOS	A	A	A	A



Colour code based on Level of Service

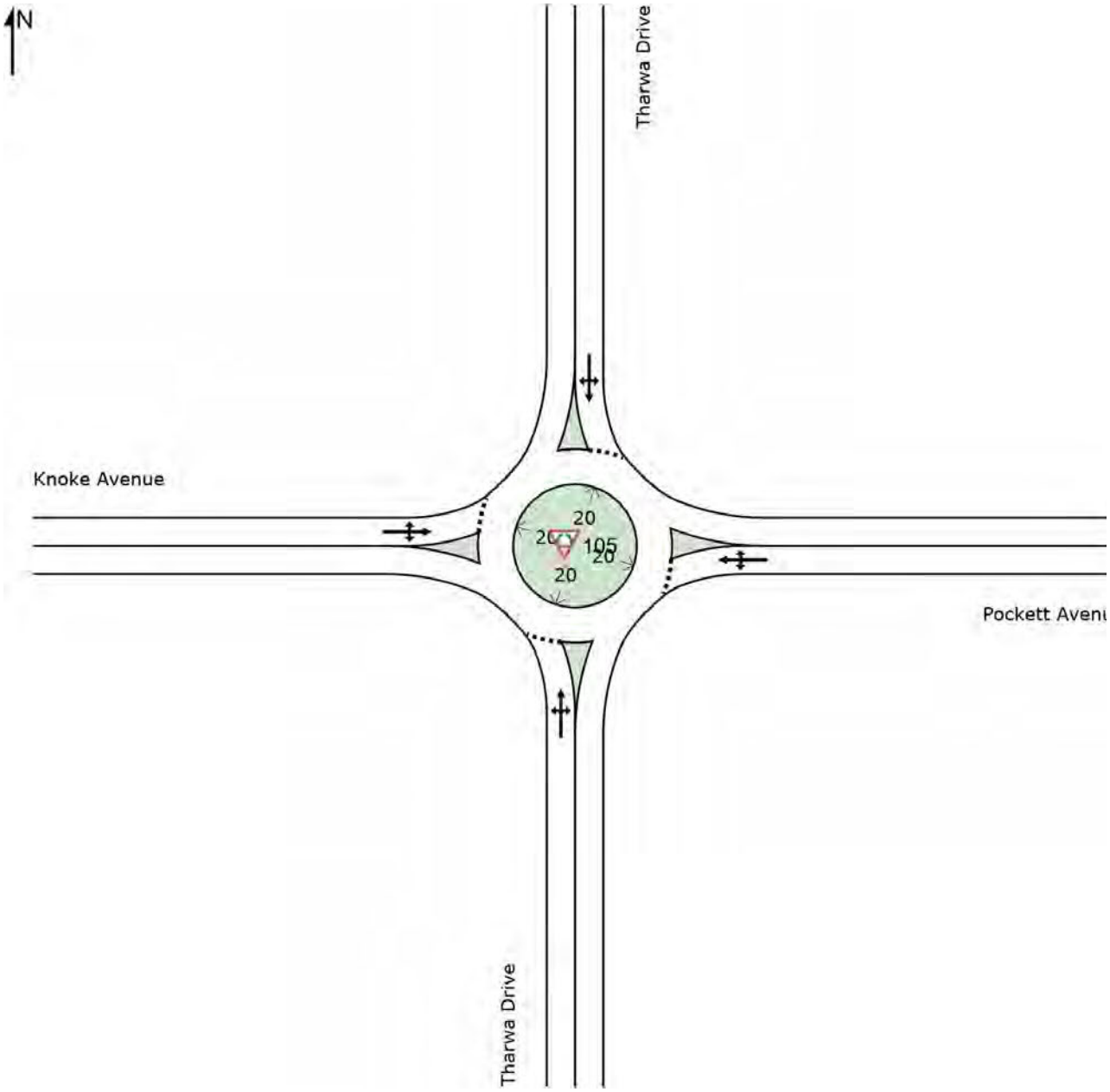
LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site: 105 [2031_AM Peak_Tharwa Drive / Pockett Avenue - Base]

Network: 1 [2031 Future Conditions_Tharwa Drive AM peak - Base]

Single Lane Roundabout - Existing Layout
Site Category: AM Peak 2031 Conditions
Roundabout

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
1	L2	1	2.3	1	2.3	0.050	5.6	LOS A	0.1	0.7	0.47	0.52	0.47	49.6
2	T1	49	2.3	49	2.3	0.050	5.8	LOS A	0.1	0.7	0.47	0.52	0.47	49.3
3	R2	1	2.3	1	2.3	0.050	10.4	LOS A	0.1	0.7	0.47	0.52	0.47	47.8
Approach		52	2.3	52	2.3	0.050	5.9	LOS A	0.1	0.7	0.47	0.52	0.47	49.2
East: Pockett Avenue														
4	L2	2	2.3	2	2.3	0.224	3.9	LOS A	0.5	3.6	0.27	0.61	0.27	47.6
5	T1	27	2.3	27	2.3	0.224	4.1	LOS A	0.5	3.6	0.27	0.61	0.27	12.8
6	R2	272	2.3	272	2.3	0.224	8.8	LOS A	0.5	3.6	0.27	0.61	0.27	28.0
Approach		301	2.3	301	2.3	0.224	8.3	LOS A	0.5	3.6	0.27	0.61	0.27	24.1
North: Tharwa Drive														
7	L2	72	2.3	72	2.3	0.114	4.0	LOS A	0.3	1.8	0.15	0.51	0.15	45.6
8	T1	36	2.3	36	2.3	0.114	4.3	LOS A	0.3	1.8	0.15	0.51	0.15	56.6
9	R2	57	2.3	57	2.3	0.114	8.9	LOS A	0.3	1.8	0.15	0.51	0.15	45.4
Approach		164	2.3	164	2.3	0.114	5.8	LOS A	0.3	1.8	0.15	0.51	0.15	48.1
West: Knoke Avenue														
10	L2	192	2.3	192	2.3	0.211	5.6	LOS A	0.5	3.4	0.50	0.60	0.50	31.3
11	T1	29	2.3	29	2.3	0.211	5.8	LOS A	0.5	3.4	0.50	0.60	0.50	23.7
12	R2	3	2.3	3	2.3	0.211	10.5	LOS A	0.5	3.4	0.50	0.60	0.50	52.1
Approach		224	2.3	224	2.3	0.211	5.7	LOS A	0.5	3.4	0.50	0.60	0.50	30.2
All Vehicles		741	2.3	741	2.3	0.224	6.8	LOS A	0.5	3.6	0.33	0.58	0.33	40.1

[redacted]

Lane Use and Performance

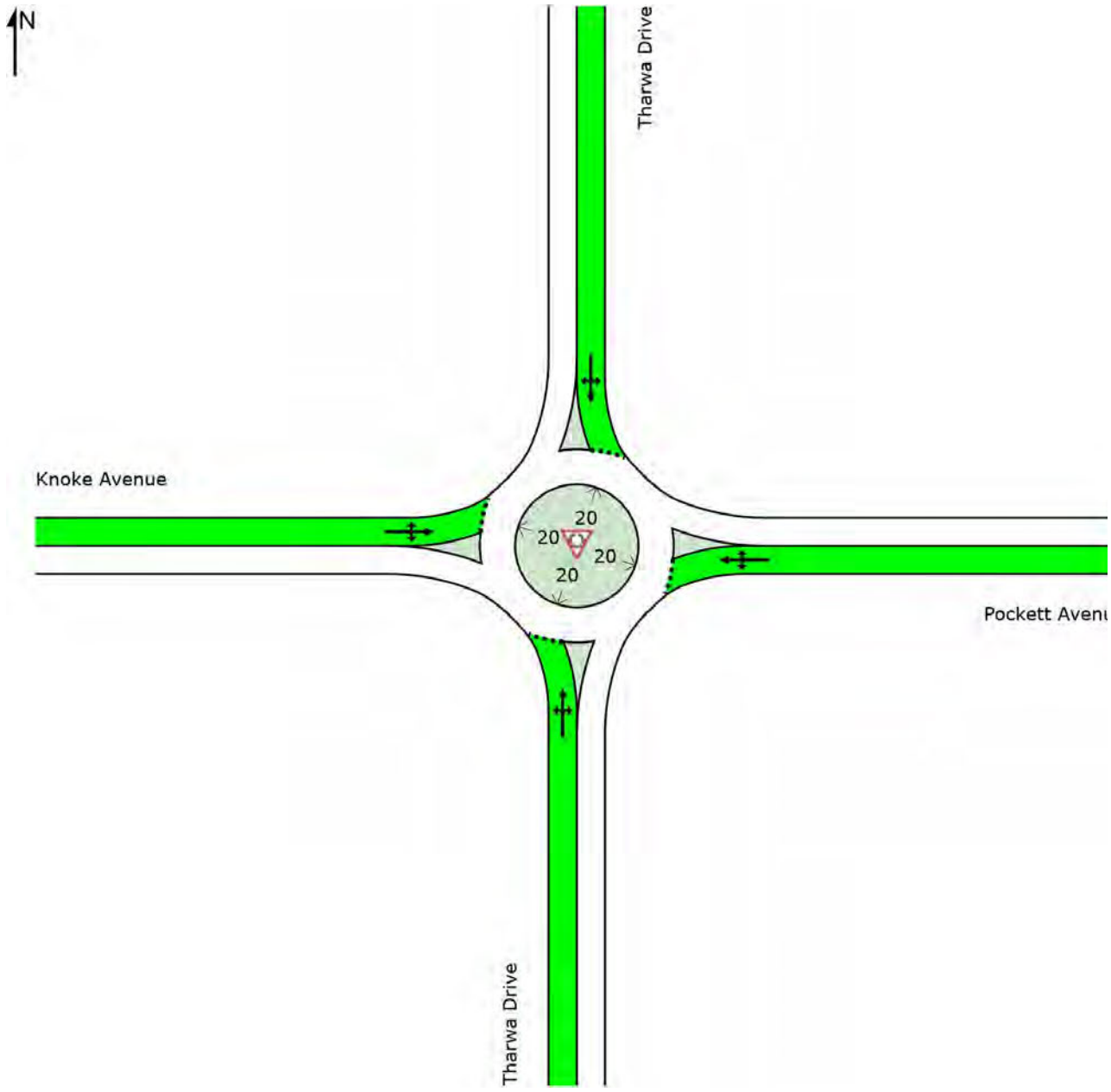
	Demand Flows		Arrival Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	Aver. Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
South: Tharwa Drive															
Lane 1[d]	52	2.3	52	2.3	1039	0.050	100	5.9	LOS A	0.1	0.7	Full	500	0.0	0.0
Approach	52	2.3	52	2.3		0.050		5.9	LOS A	0.1	0.7				
East: Pockett Avenue															
Lane 1[d]	301	2.3	301	2.3	1342	0.224	100	8.3	LOS A	0.5	3.6	Full	80	0.0	0.0
Approach	301	2.3	301	2.3		0.224		8.3	LOS A	0.5	3.6				
North: Tharwa Drive															
Lane 1[d]	164	2.3	164	2.3	1445	0.114	100	5.8	LOS A	0.3	1.8	Full	990	0.0	0.0
Approach	164	2.3	164	2.3		0.114		5.8	LOS A	0.3	1.8				
West: Knoke Avenue															
Lane 1[d]	224	2.3	224	2.3	1065	0.211	100	5.7	LOS A	0.5	3.4	Full	95	0.0	0.0
Approach	224	2.3	224	2.3		0.211		5.7	LOS A	0.5	3.4				
Intersection	741	2.3	741	2.3		0.224		6.8	LOS A	0.5	3.6				

[redacted]

d Dominant lane on roundabout approach

Lane Level of Service

	Approaches				Intersection
	South	East	North	West	
LOS	A	A	A	A	A



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

DEGREE OF SATURATION

Ratio of Demand Volume to Capacity, v/c ratio per lane

Network: N101 [2031 Future Conditions with Upgrades_Tharwa Drive AM peak - Op1]

2031 Future Conditions - Upgraded Layout
Network Category: (None)



Colour code based on Degree of Saturation

[< 0.6]	[0.6 – 0.7]	[0.7 – 0.8]	[0.8 – 0.9]	[0.9 – 1.0]	[> 1.0]

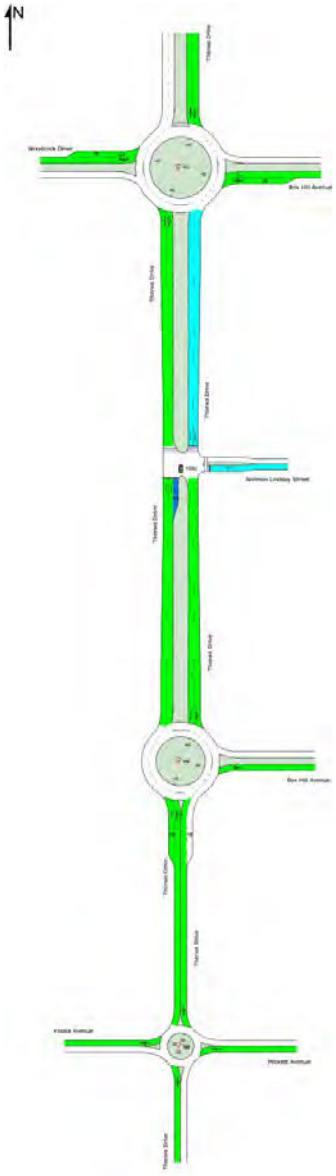
SIDRA INTERSECTION 8.0 | Copyright © 2000-2019 Akcelik and Associates Pty Ltd | sidrasolutions.com

LANE LEVEL OF SERVICE

Lane Level of Service for Network Sites

Network: N101 [2031 Future Conditions with Upgrades_Tharwa Drive AM peak - Op1]

2031 Future Conditions - Upgraded Layout
Network Category: (None)



Colour code based on Level of Service

LOS A	LOS B	LOS C	LOS D	LOS E	LOS F

Delay model settings are specified for individual Sites forming the Network.

USER REPORT FOR NETWORK SITE

Project: 2031 Conditions

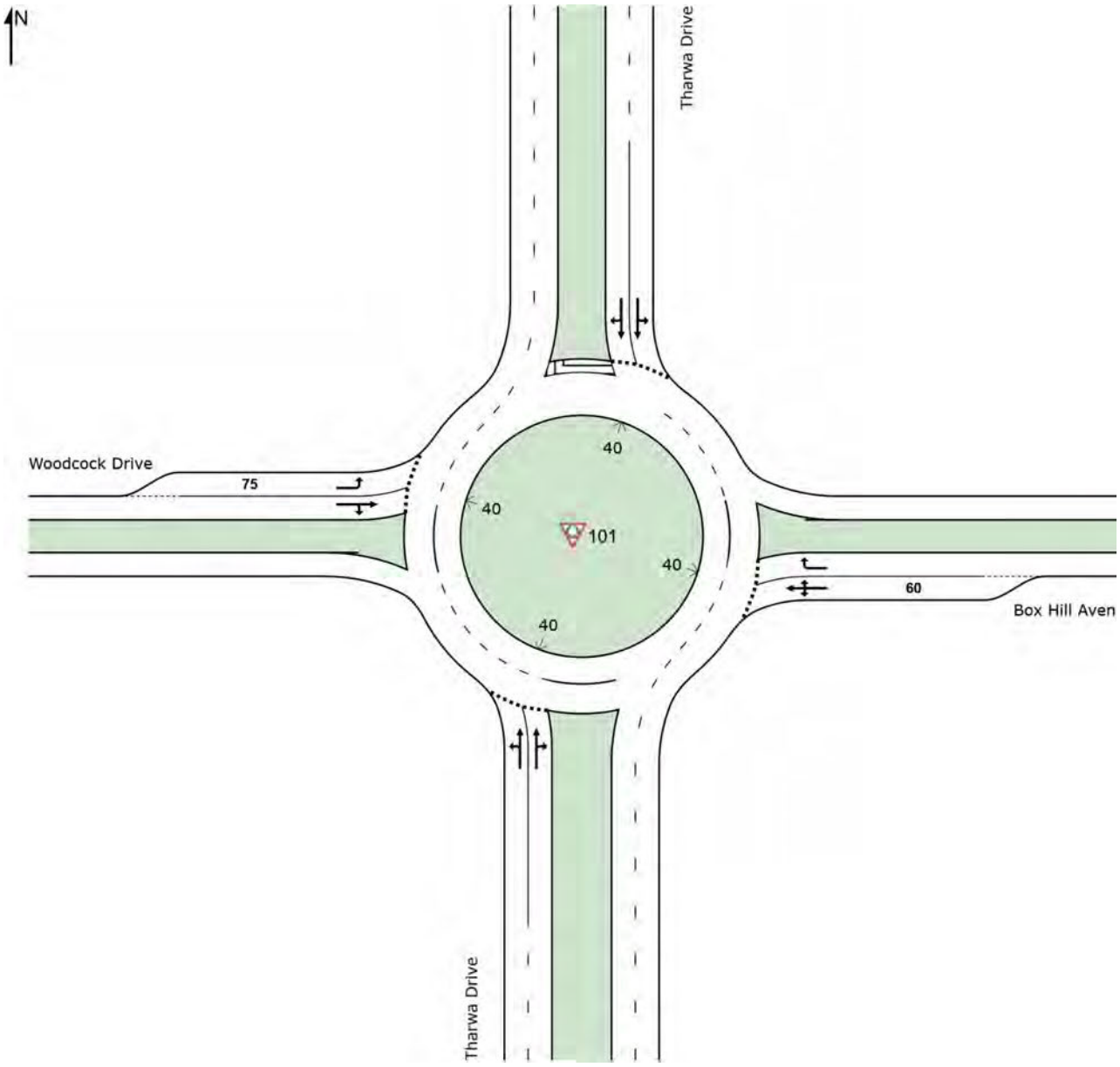
Template: Default Site User Report (2)

Site: 101 [2031_AM Peak_Tharwa Drive / Woodcock Drive - Duplicated]

Network: 4 [2031 Future Conditions with Upgrades_Tharwa Drive AM peak - Op1]

Two lane roundabout with no ped xing to south - Duplicated
Site Category: AM Peak 2031 Conditions
Roundabout

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
1	L2	75	2.3	75	2.3	0.578	7.0	LOS A	1.4	10.1	0.67	0.73	0.80	49.5
2	T1	943	2.3	943	2.3	0.578	7.1	LOS A	1.4	10.1	0.68	0.77	0.82	53.6
3	R2	2	2.3	2	2.3	0.578	14.1	LOS A	1.3	9.4	0.70	0.82	0.85	42.3
Approach		1020	2.3	1020	2.3	0.578	7.1	LOS A	1.4	10.1	0.68	0.77	0.82	53.3
East: Box Hill Avenue														
4	L2	13	2.3	13	2.3	0.390	4.8	LOS A	0.8	6.0	0.55	0.69	0.55	34.1
5	T1	96	2.3	96	2.3	0.390	4.6	LOS A	0.8	6.0	0.55	0.69	0.55	49.4
6	R2	737	2.3	737	2.3	0.390	11.2	LOS A	0.8	6.0	0.56	0.73	0.56	50.7
Approach		845	2.3	845	2.3	0.390	10.4	LOS A	0.8	6.0	0.56	0.73	0.56	50.5
North: Tharwa Drive														
7	L2	362	2.3	362	2.3	0.271	3.7	LOS A	0.8	5.6	0.43	0.44	0.43	53.4
8	T1	343	2.3	343	2.3	0.271	3.4	LOS A	0.8	5.6	0.45	0.43	0.45	50.3
9	R2	67	2.3	67	2.3	0.271	10.4	LOS A	0.7	5.3	0.45	0.43	0.45	57.0
Approach		773	2.3	773	2.3	0.271	4.1	LOS A	0.8	5.6	0.44	0.44	0.44	52.6
West: Woodcock Drive														
10	L2	121	2.3	121	2.3	0.205	8.2	LOS A	0.4	2.8	0.75	0.85	0.75	52.3
11	T1	132	2.3	132	2.3	0.220	6.1	LOS A	0.5	3.5	0.77	0.73	0.77	50.6
12	R2	56	2.3	56	2.3	0.220	13.1	LOS A	0.5	3.5	0.77	0.73	0.77	44.4
Approach		308	2.3	308	2.3	0.220	8.2	LOS A	0.5	3.5	0.76	0.78	0.76	50.6
All Vehicles		2946	2.3	2946	2.3	0.578	7.4	LOS A	1.4	10.1	0.59	0.67	0.64	52.0

[redacted]

Lane Use and Performance

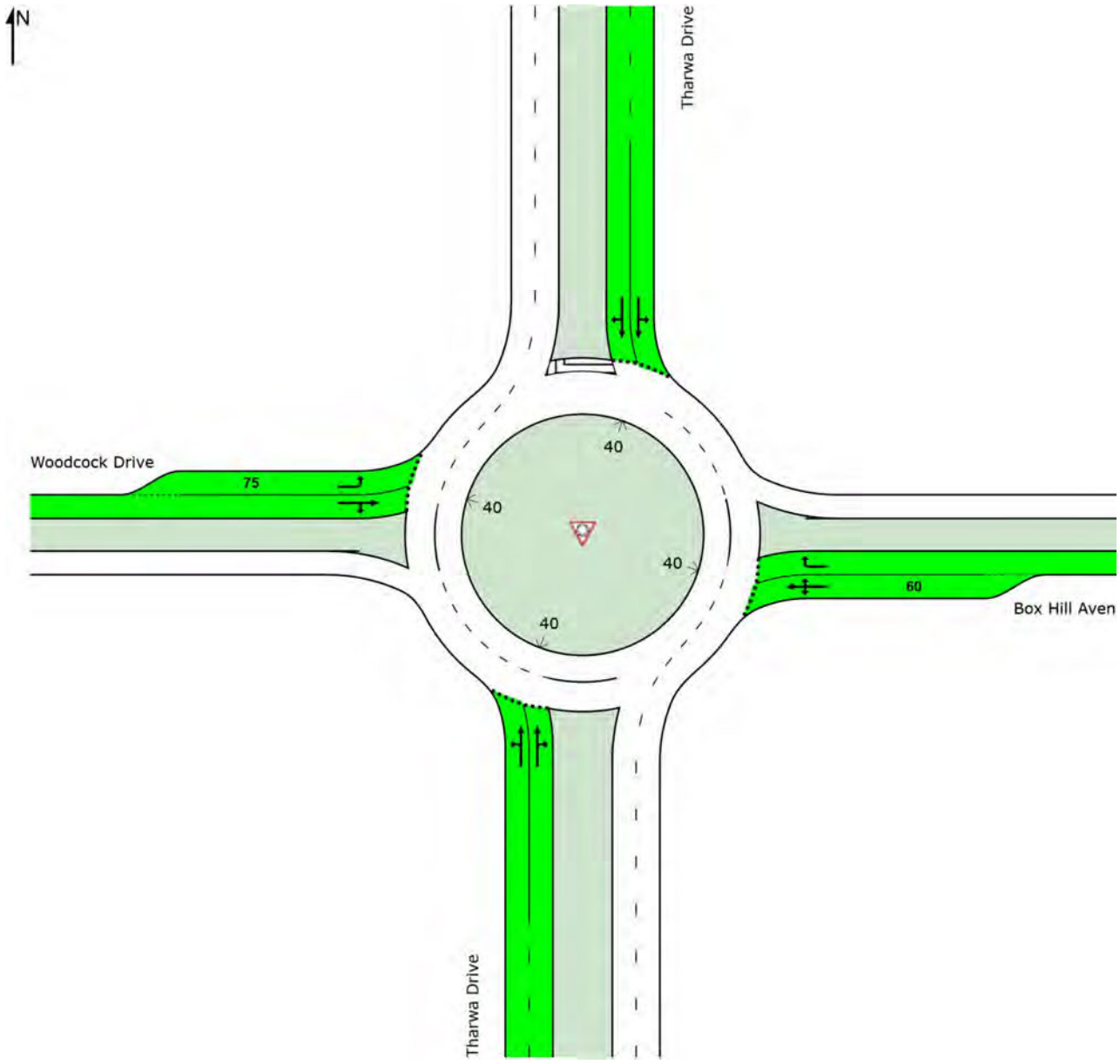
	Demand Flows		Arrival Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	Aver. Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
South: Tharwa Drive															
Lane 1[d]	568	2.3	568	2.3	983	0.578	100	6.7	LOS A	1.4	10.1	Full	165	0.0	0.0
Lane 2	452	2.3	452	2.3	781	0.578	100	7.7	LOS A	1.3	9.4	Full	165	0.0	0.0
Approach	1020	2.3	1020	2.3		0.578		7.1	LOS A	1.4	10.1				
East: Box Hill Avenue															
Lane 1[d]	458	2.3	458	2.3	1174	0.390	100	9.5	LOS A	0.8	6.0	Short	60	0.0	NA
Lane 2	388	2.3	388	2.3	995	0.390	100	11.4	LOS A	0.8	5.8	Full	150	0.0	0.0
Approach	845	2.3	845	2.3		0.390		10.4	LOS A	0.8	6.0				
North: Tharwa Drive															
Lane 1[d]	427	2.3	427	2.3	1572	0.271	100	3.6	LOS A	0.8	5.6	Full	490	0.0	0.0
Lane 2	346	2.3	346	2.3	1275	0.271	100	4.8	LOS A	0.7	5.3	Full	490	0.0	0.0
Approach	773	2.3	773	2.3		0.271		4.1	LOS A	0.8	5.6				
West: Woodcock Drive															
Lane 1	121	2.3	121	2.3	590	0.205	100	8.2	LOS A	0.4	2.8	Short	75	0.0	NA
Lane 2[d]	187	2.3	187	2.3	851	0.220	100	8.2	LOS A	0.5	3.5	Full	380	0.0	0.0
Approach	308	2.3	308	2.3		0.220		8.2	LOS A	0.5	3.5				
Intersection	2946	2.3	2946	2.3		0.578		7.4	LOS A	1.4	10.1				

[redacted]

d Dominant lane on roundabout approach

Lane Level of Service

	Approaches				Intersection
	South	East	North	West	
LOS	A	A	A	A	A



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

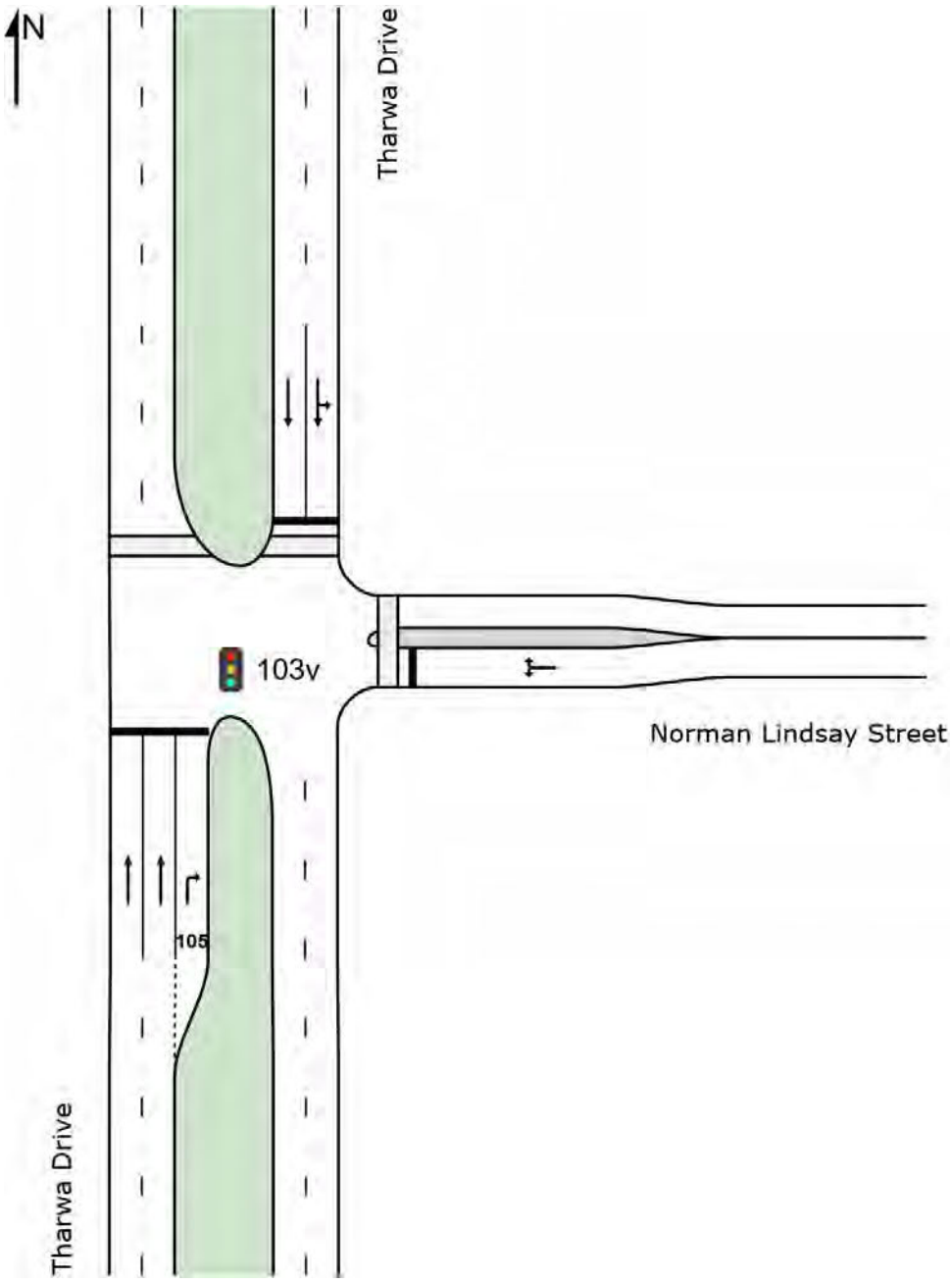
Site: 103v [2031_AM Peak_Tharwa Drive / Norman Lindsay Street - Signals]

Network: 4 [2031 Future Conditions with Upgrades_Tharwa Drive AM peak - Op1]

Signalised T-Intersection - Duplicated
Site Category: AM Peak 2031 Conditions
Signals - Fixed Time Isolated Cycle Time = 60 seconds (Site User-Given Cycle Time)

Timings based on settings in the Site Phasing & Timing dialog
Phase Times determined by the program
Downstream lane blockage effects included in determining phase times
Phase Sequence: Sequence1
Reference Phase: Phase A
Input Phase Sequence: A, B, C
Output Phase Sequence: A, B, C

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
2	T1	871	2.3	871	2.3	0.425	9.2	LOS A	4.7	33.8	0.65	0.56	0.65	48.6
3	R2	147	2.3	147	2.3	0.440	30.2	LOS C	2.5	17.6	0.93	0.79	0.93	33.7
Approach		1018	2.3	1018	2.3	0.440	12.2	LOS A	4.7	33.8	0.69	0.59	0.69	45.5
East: Norman Lindsay Street														
4	L2	77	2.3	77	2.3	0.442	23.8	LOS B	3.4	24.5	0.88	0.79	0.88	7.2
6	R2	146	2.3	146	2.3	0.442	23.8	LOS B	3.4	24.5	0.88	0.79	0.88	7.2
Approach		223	2.3	223	2.3	0.442	23.8	LOS B	3.4	24.5	0.88	0.79	0.88	7.2
North: Tharwa Drive														
7	L2	140	2.3	140	2.3	0.439	26.7	LOS B	3.2	22.8	0.89	0.77	0.89	10.0
8	T1	275	2.3	275	2.3	0.439	21.1	LOS B	3.3	23.5	0.89	0.74	0.89	19.5
Approach		415	2.3	415	2.3	0.439	23.0	LOS B	3.3	23.5	0.89	0.75	0.89	14.3
All Vehicles		1656	2.3	1656	2.3	0.442	16.5	LOS B	4.7	33.8	0.76	0.66	0.76	34.7

[redacted]

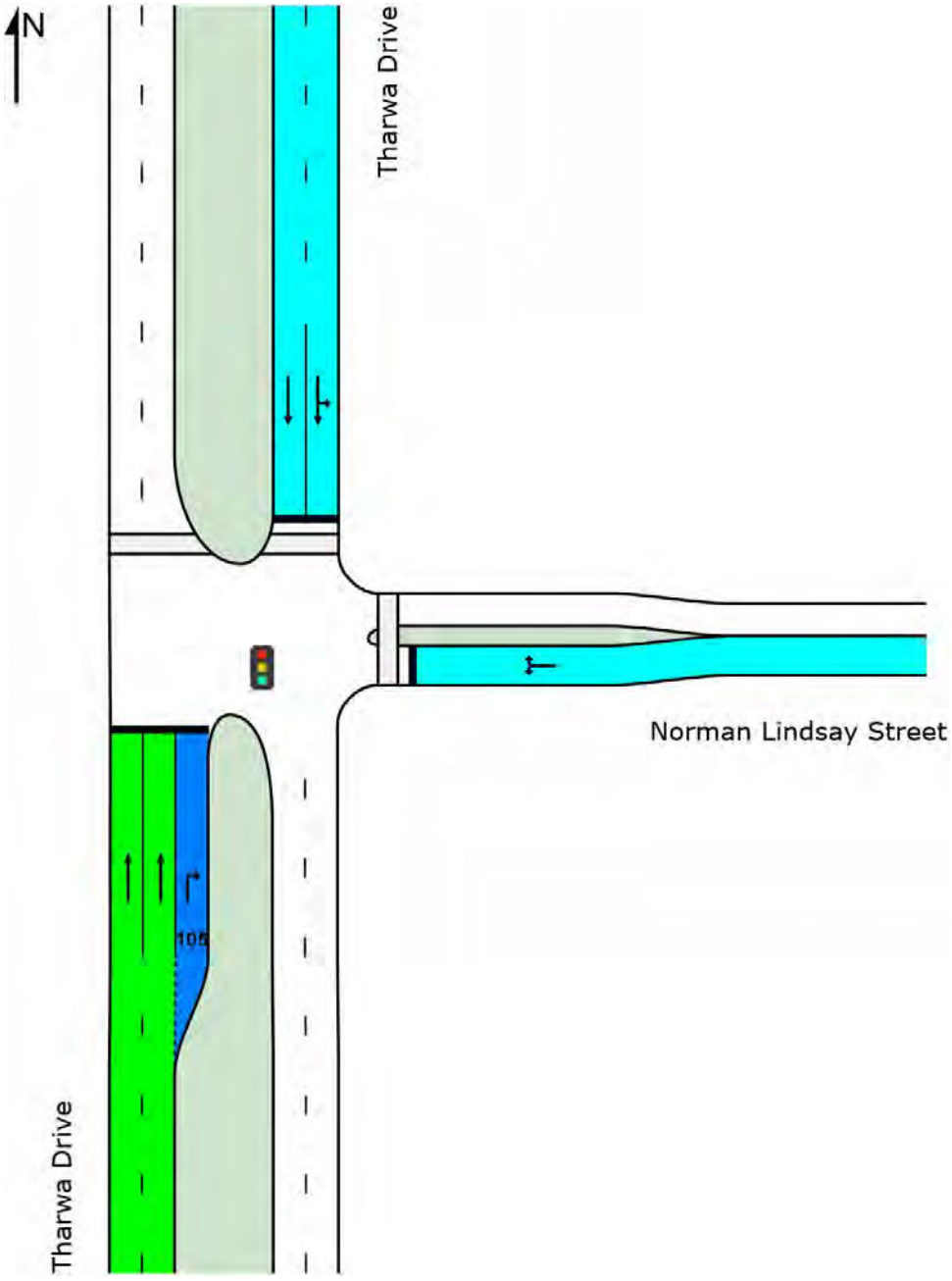
Lane Use and Performance

	Demand Flows		Arrival Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	Aver. Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
South: Tharwa Drive															
Lane 1	435	2.3	435	2.3	1025	0.425	100	9.2	LOS A	4.7	33.8	Full	640	0.0	0.0
Lane 2	435	2.3	435	2.3	1025	0.425	100	9.2	LOS A	4.7	33.8	Full	640	0.0	0.0
Lane 3	147	2.3	147	2.3	335	0.440	100	30.2	LOS C	2.5	17.6	Short	105	0.0	NA
Approach	1018	2.3	1018	2.3		0.440		12.2	LOS A	4.7	33.8				
East: Norman Lindsay Street															
Lane 1	223	2.3	223	2.3	505	0.442	100	23.8	LOS B	3.4	24.5	Full	40	0.0	5.1
Approach	223	2.3	223	2.3		0.442		23.8	LOS B	3.4	24.5				
North: Tharwa Drive															
Lane 1	204	2.3	204	2.3	464	0.439	100	25.0	LOS B	3.2	22.8	Full	165	0.0	0.0
Lane 2	211	2.3	211	2.3	480	0.439	100	21.1	LOS B	3.3	23.5	Full	165	0.0	0.0
Approach	415	2.3	415	2.3		0.439		23.0	LOS B	3.3	23.5				
Intersection	1656	2.3	1656	2.3		0.442		16.5	LOS B	4.7	33.8				

[redacted]

Lane Level of Service

	Approaches			Intersection
	South	East	North	
LOS	A	B	B	B



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

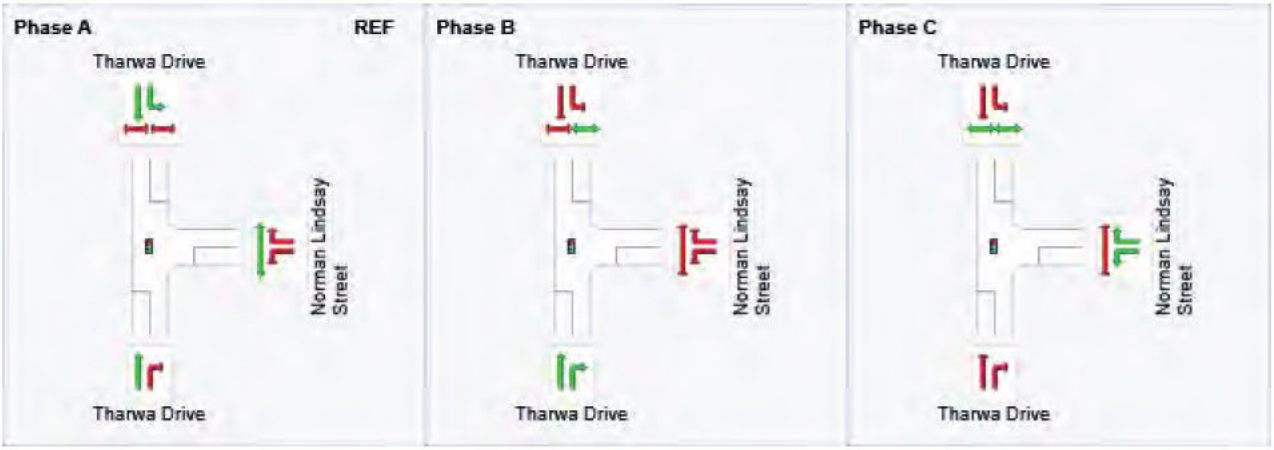
[redacted]

Phase Timing Summary

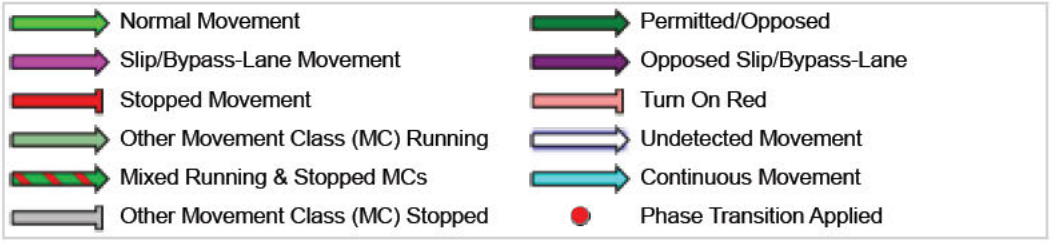
Phase	A	B	C
Phase Change Time (sec)	0	21	38
Green Time (sec)	15	11	16
Phase Time (sec)	21	17	22
Phase Split	35%	28%	37%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase

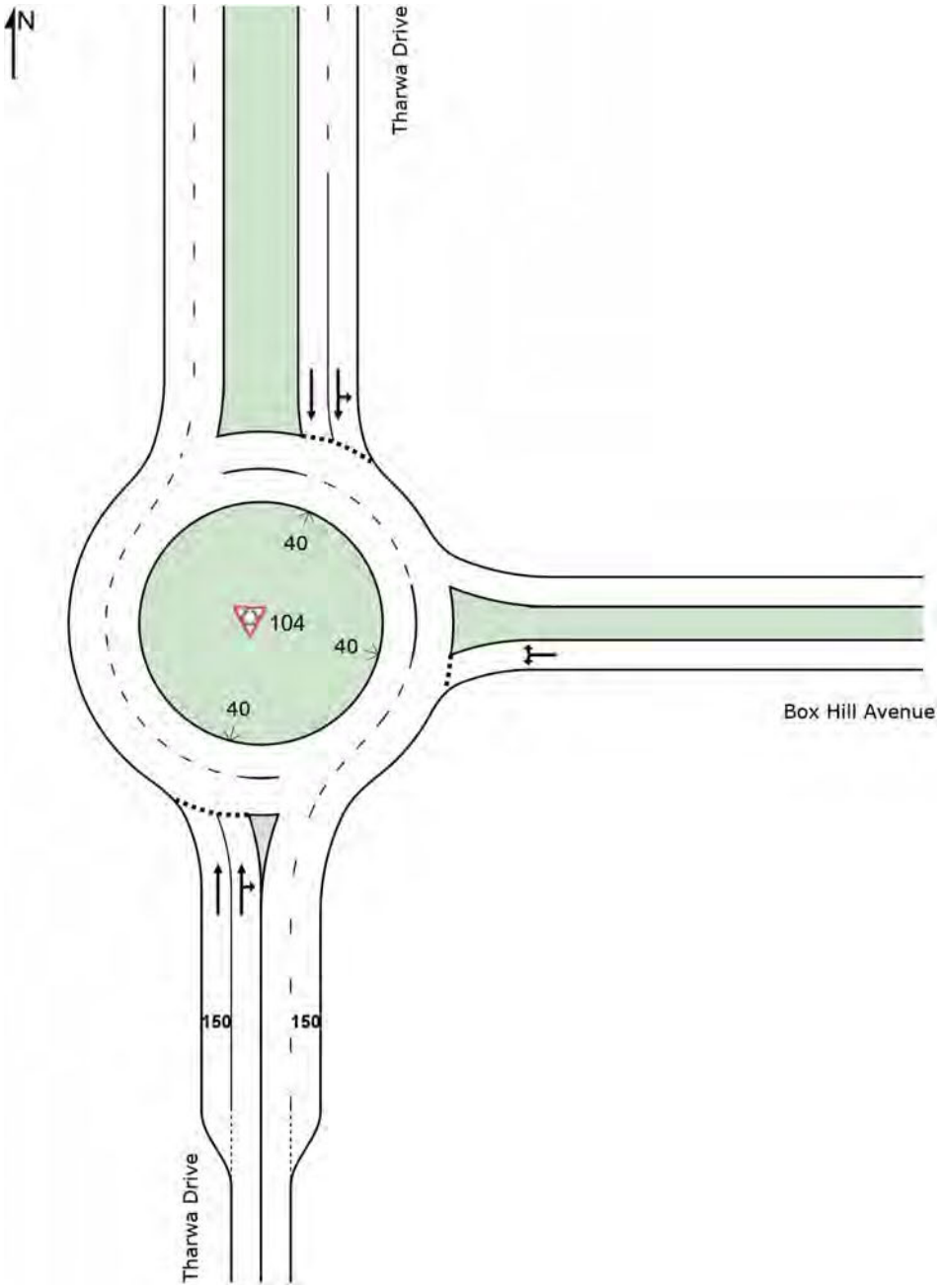


Site: 104 [2031_AM Peak_Tharwa Drive / Box Hill Avenue - Roundabout to one lane]

Network: 4 [2031 Future Conditions with Upgrades_Tharwa Drive AM peak - Op1]

Dual Lane Roundabout - Duplicated to north, returning to single carriageway to south
Site Category: AM Peak 2031 Conditions
Roundabout

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
2	T1	481	2.3	481	2.3	0.259	5.1	LOS A	0.6	4.4	0.60	0.55	0.60	53.7
3	R2	47	2.3	47	2.3	0.259	12.0	LOS A	0.6	4.2	0.61	0.60	0.61	52.6
Approach		528	2.3	528	2.3	0.259	5.7	LOS A	0.6	4.4	0.60	0.55	0.60	53.6
East: Box Hill Avenue														
4	L2	18	2.3	18	2.3	0.434	3.9	LOS A	1.2	8.4	0.38	0.61	0.38	30.6
6	R2	534	2.3	534	2.3	0.434	10.3	LOS A	1.2	8.4	0.38	0.61	0.38	30.6
Approach		552	2.3	552	2.3	0.434	10.1	LOS A	1.2	8.4	0.38	0.61	0.38	30.6
North: Tharwa Drive														
7	L2	182	2.3	182	2.3	0.117	3.3	LOS A	0.2	1.5	0.13	0.39	0.13	55.6
8	T1	158	2.3	158	2.3	0.114	2.9	LOS A	0.2	1.4	0.14	0.29	0.14	55.1
Approach		340	2.3	340	2.3	0.117	3.1	LOS A	0.2	1.5	0.13	0.34	0.13	55.4
All Vehicles		1420	2.3	1420	2.3	0.434	6.8	LOS A	1.2	8.4	0.41	0.53	0.41	49.7

[redacted]

Lane Use and Performance

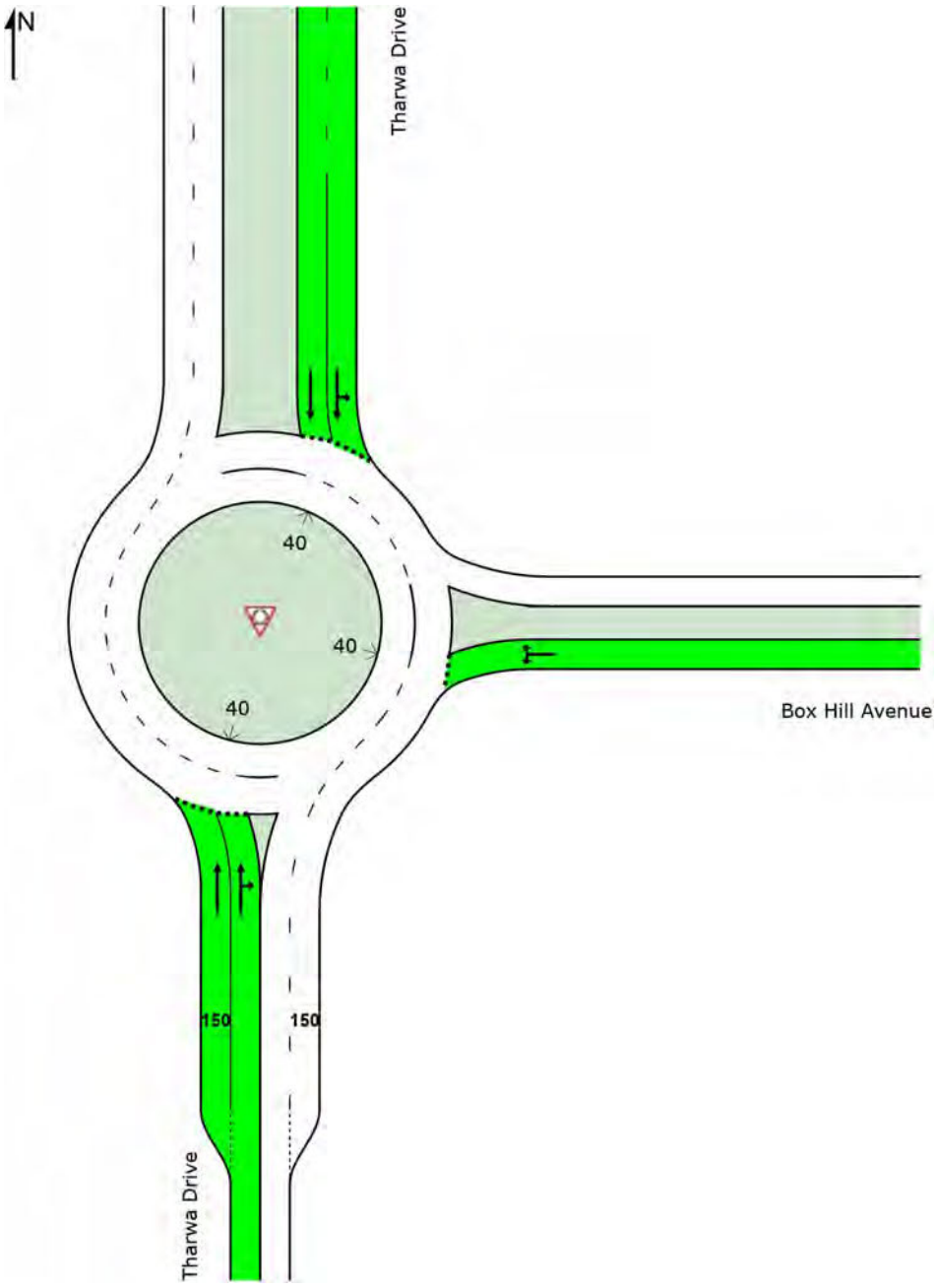
	Demand Flows		Arrival Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	Aver. Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
South: Tharwa Drive															
Lane 1[d]	285	2.3	285	2.3	1102	0.259	100	4.9	LOS A	0.6	4.4	Short	150	0.0	NA
Lane 2	243	2.3	243	2.3	940	0.259	100	6.6	LOS A	0.6	4.2	Full	990	0.0	0.0
Approach	528	2.3	528	2.3		0.259		5.7	LOS A	0.6	4.4				
East: Box Hill Avenue															
Lane 1[d]	552	2.3	552	2.3	1271	0.434	100	10.1	LOS A	1.2	8.4	Full	105	0.0	0.0
Approach	552	2.3	552	2.3		0.434		10.1	LOS A	1.2	8.4				
North: Tharwa Drive															
Lane 1[d]	182	2.3	182	2.3	1557	0.117	100	3.3	LOS A	0.2	1.5	Full	640	0.0	0.0
Lane 2	158	2.3	158	2.3	1389	0.114	97[5]	2.9	LOS A	0.2	1.4	Full	640	0.0	0.0
Approach	340	2.3	340	2.3		0.117		3.1	LOS A	0.2	1.5				
Intersection	1420	2.3	1420	2.3		0.434		6.8	LOS A	1.2	8.4				

[redacted]

5 Lane under-utilisation found by the program
d Dominant lane on roundabout approach

Lane Level of Service

	Approaches			Intersection
	South	East	North	
LOS	A	A	A	A



Colour code based on Level of Service

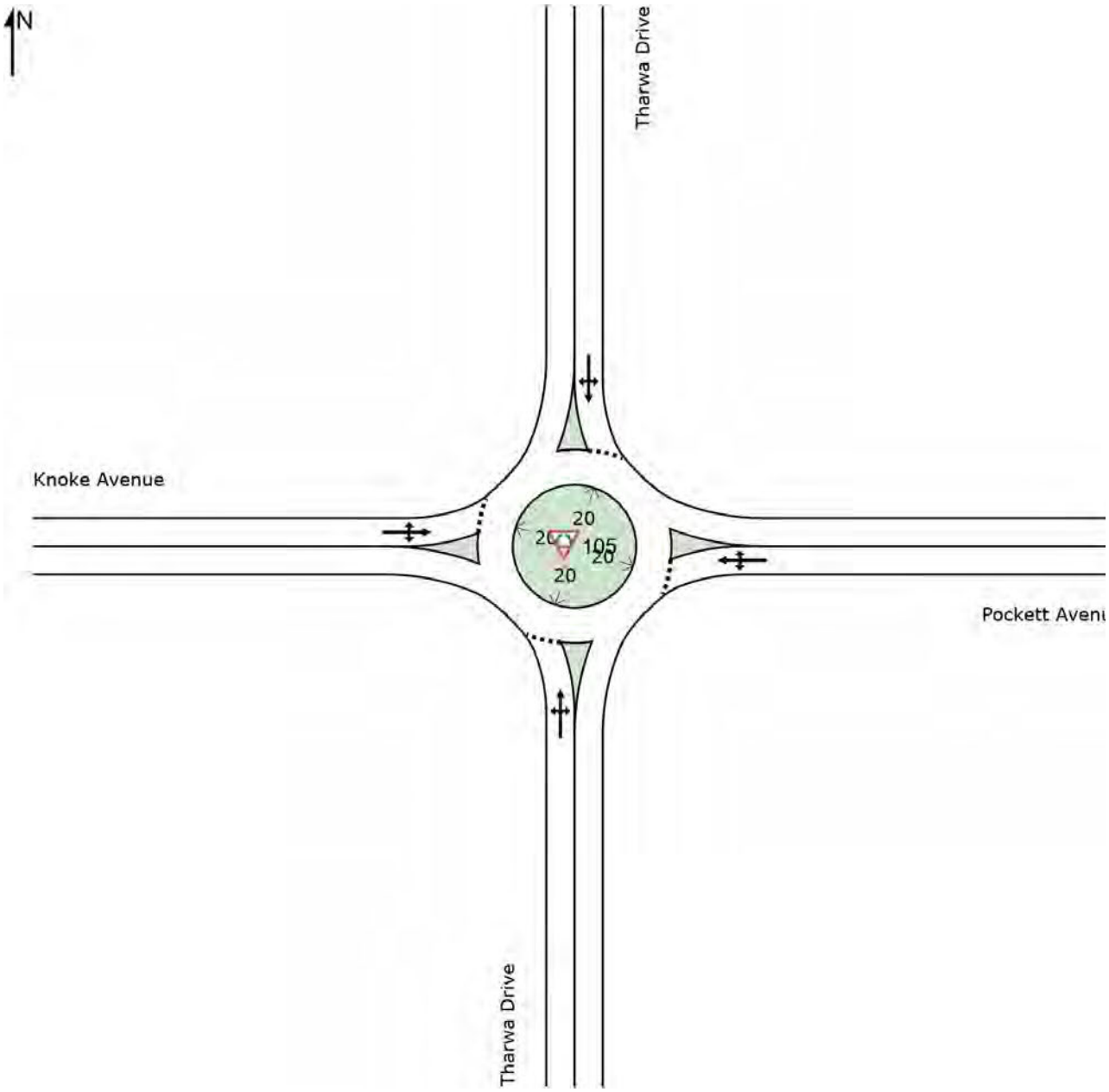
LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site: 105 [2031_AM Peak_Tharwa Drive / Pockett Avenue - Base]

Network: 4 [2031 Future Conditions with Upgrades_Tharwa Drive AM peak - Op1]

Single Lane Roundabout - Existing Layout
Site Category: AM Peak 2031 Conditions
Roundabout

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
1	L2	1	2.3	1	2.3	0.050	5.6	LOS A	0.1	0.7	0.47	0.52	0.47	49.6
2	T1	49	2.3	49	2.3	0.050	5.8	LOS A	0.1	0.7	0.47	0.52	0.47	49.3
3	R2	1	2.3	1	2.3	0.050	10.4	LOS A	0.1	0.7	0.47	0.52	0.47	47.8
Approach		52	2.3	52	2.3	0.050	5.9	LOS A	0.1	0.7	0.47	0.52	0.47	49.2
East: Pockett Avenue														
4	L2	2	2.3	2	2.3	0.224	3.9	LOS A	0.5	3.6	0.27	0.61	0.27	47.6
5	T1	27	2.3	27	2.3	0.224	4.1	LOS A	0.5	3.6	0.27	0.61	0.27	12.8
6	R2	272	2.3	272	2.3	0.224	8.8	LOS A	0.5	3.6	0.27	0.61	0.27	28.0
Approach		301	2.3	301	2.3	0.224	8.3	LOS A	0.5	3.6	0.27	0.61	0.27	24.1
North: Tharwa Drive														
7	L2	72	2.3	72	2.3	0.114	4.0	LOS A	0.3	1.8	0.15	0.51	0.15	45.6
8	T1	36	2.3	36	2.3	0.114	4.3	LOS A	0.3	1.8	0.15	0.51	0.15	56.6
9	R2	57	2.3	57	2.3	0.114	8.9	LOS A	0.3	1.8	0.15	0.51	0.15	45.4
Approach		164	2.3	164	2.3	0.114	5.8	LOS A	0.3	1.8	0.15	0.51	0.15	48.1
West: Knoke Avenue														
10	L2	192	2.3	192	2.3	0.211	5.6	LOS A	0.5	3.4	0.50	0.60	0.50	31.3
11	T1	29	2.3	29	2.3	0.211	5.8	LOS A	0.5	3.4	0.50	0.60	0.50	23.7
12	R2	3	2.3	3	2.3	0.211	10.5	LOS A	0.5	3.4	0.50	0.60	0.50	52.1
Approach		224	2.3	224	2.3	0.211	5.7	LOS A	0.5	3.4	0.50	0.60	0.50	30.2
All Vehicles		741	2.3	741	2.3	0.224	6.8	LOS A	0.5	3.6	0.33	0.58	0.33	40.1



Lane Use and Performance

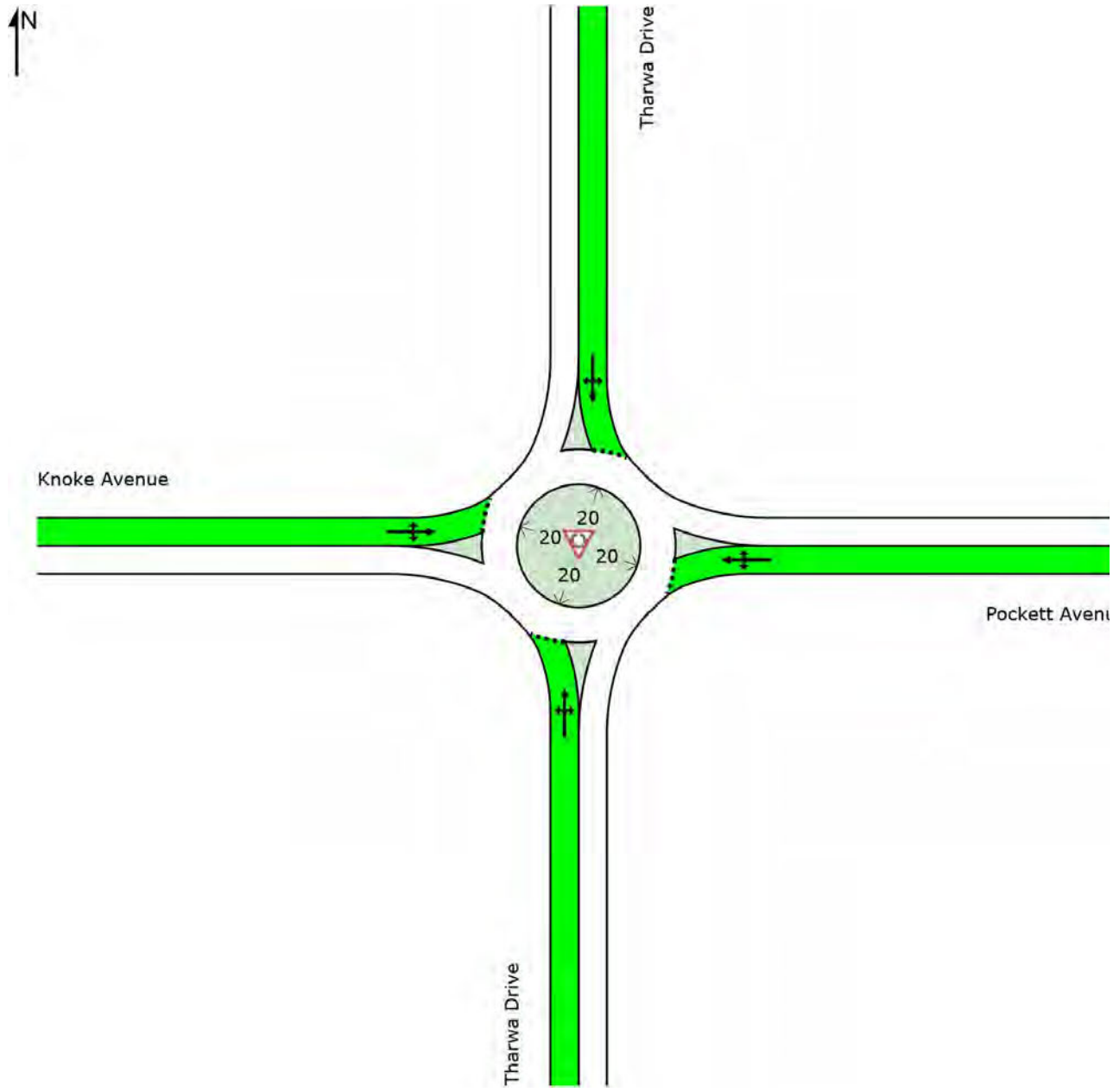
	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	Aver. Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Tharwa Drive															
Lane 1[d]	52	2.3	52	2.3	1039	0.050	100	5.9	LOS A	0.1	0.7	Full	500	0.0	0.0
Approach	52	2.3	52	2.3		0.050		5.9	LOS A	0.1	0.7				
East: Pockett Avenue															
Lane 1[d]	301	2.3	301	2.3	1342	0.224	100	8.3	LOS A	0.5	3.6	Full	80	0.0	0.0
Approach	301	2.3	301	2.3		0.224		8.3	LOS A	0.5	3.6				
North: Tharwa Drive															
Lane 1[d]	164	2.3	164	2.3	1445	0.114	100	5.8	LOS A	0.3	1.8	Full	990	0.0	0.0
Approach	164	2.3	164	2.3		0.114		5.8	LOS A	0.3	1.8				
West: Knoke Avenue															
Lane 1[d]	224	2.3	224	2.3	1065	0.211	100	5.7	LOS A	0.5	3.4	Full	95	0.0	0.0
Approach	224	2.3	224	2.3		0.211		5.7	LOS A	0.5	3.4				
Intersection	741	2.3	741	2.3		0.224		6.8	LOS A	0.5	3.6				

[redacted]

d Dominant lane on roundabout approach

Lane Level of Service

	Approaches				Intersection
	South	East	North	West	
LOS	A	A	A	A	A



Colour code based on Level of Service

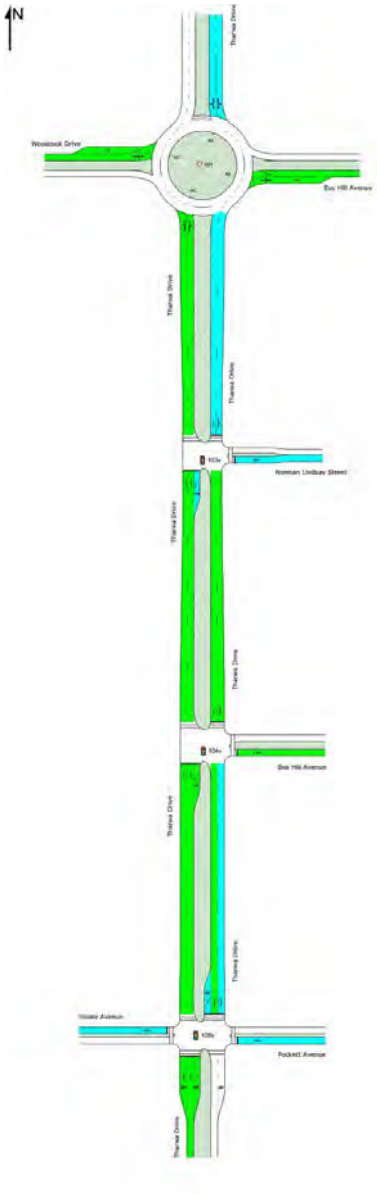
LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

DEGREE OF SATURATION

Ratio of Demand Volume to Capacity, v/c ratio per lane

Network: N101 [2031 Future Conditions with Upgrades_Tharwa Drive PM peak - Op2]

2031 Future Conditions - Upgraded Layout (Op2)
Network Category: (None)
Network Cycle Time = 75 seconds (Network User-Given Cycle Time)



Colour code based on Degree of Saturation

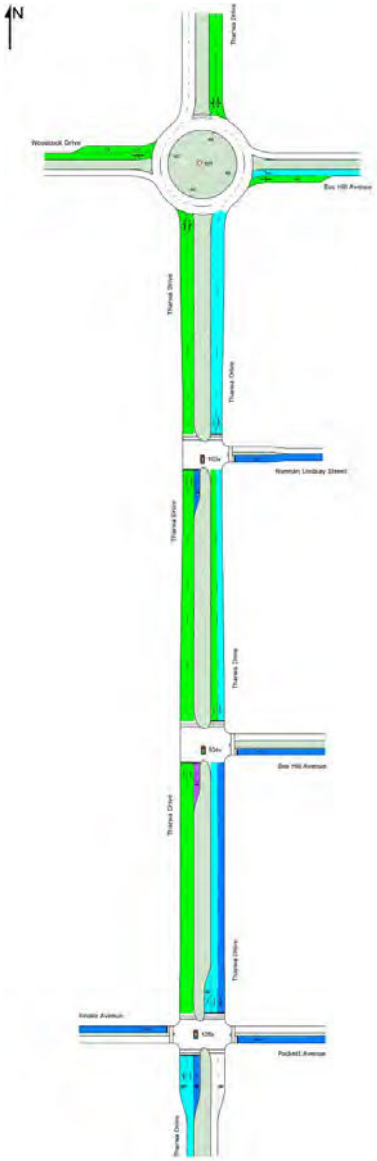
[< 0.6]	[0.6 – 0.7]	[0.7 – 0.8]	[0.8 – 0.9]	[0.9 – 1.0]	[> 1.0]

LANE LEVEL OF SERVICE

Lane Level of Service for Network Sites

Network: N101 [2031 Future Conditions with Upgrades_Tharwa Drive PM peak - Op2]

2031 Future Conditions - Upgraded Layout (Op2)
Network Category: (None)
Network Cycle Time = 75 seconds (Network User-Given Cycle Time)



Colour code based on Level of Service

LOS A	LOS B	LOS C	LOS D	LOS E	LOS F

Delay model settings are specified for individual Sites forming the Network.

USER REPORT FOR NETWORK SITE

Project: 2031 Conditions

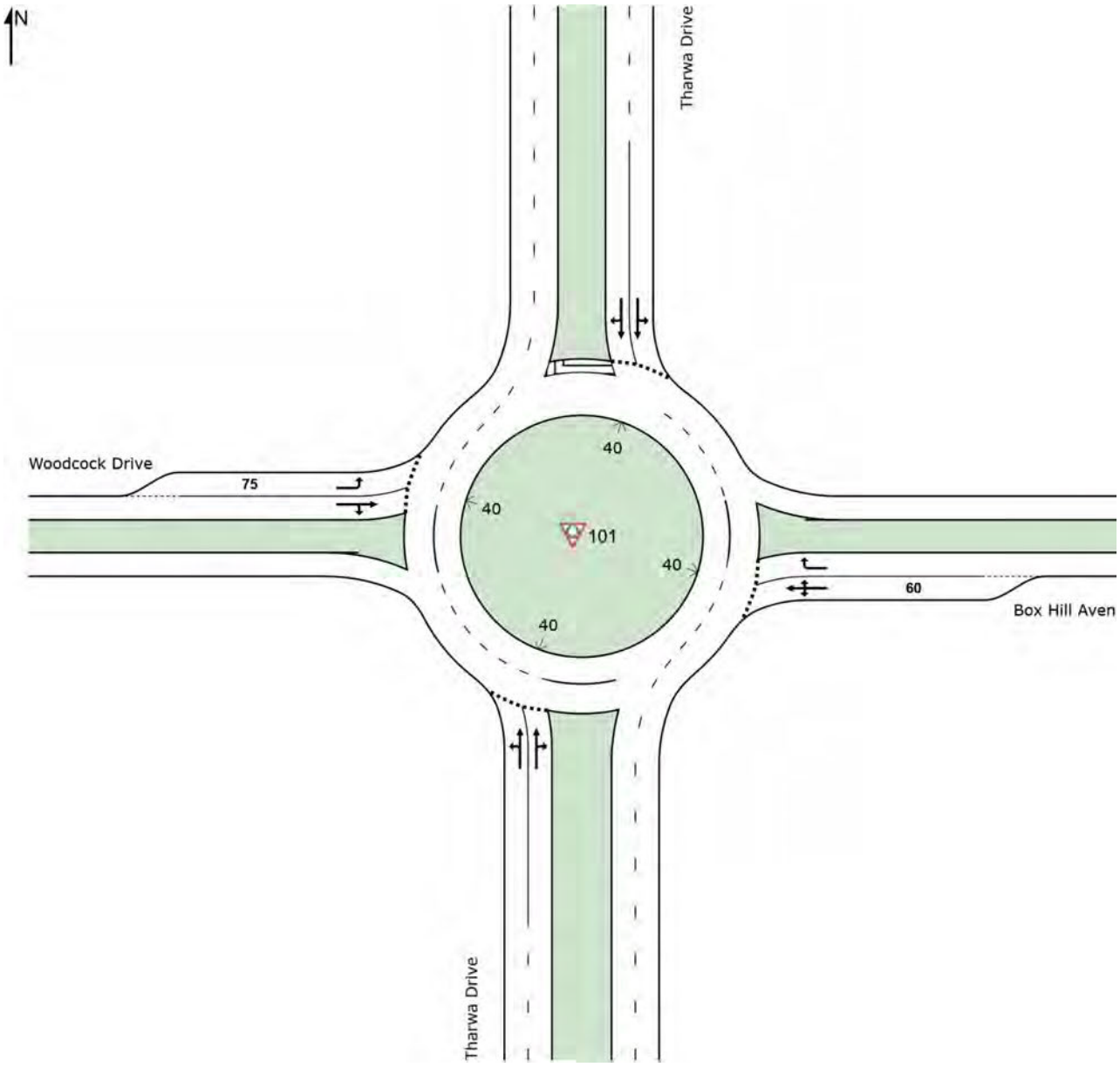
Template: Default Site User Report (2)

Site: 101 [2031_AM Peak_Tharwa Drive / Woodcock Drive - Duplicated]

Network: 8 [2031 Future Conditions with Upgrades_Tharwa Drive AM peak - Op2]

Two lane roundabout with no ped xing to south - Duplicated
Site Category: AM Peak 2031 Conditions
Roundabout

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
1	L2	75	2.3	75	2.3	0.578	7.0	LOS A	1.4	10.1	0.67	0.73	0.80	49.5
2	T1	943	2.3	943	2.3	0.578	7.1	LOS A	1.4	10.1	0.68	0.77	0.82	53.6
3	R2	2	2.3	2	2.3	0.578	14.1	LOS A	1.3	9.4	0.70	0.82	0.85	42.3
Approach		1020	2.3	1020	2.3	0.578	7.1	LOS A	1.4	10.1	0.68	0.77	0.82	53.3
East: Box Hill Avenue														
4	L2	13	2.3	13	2.3	0.390	4.8	LOS A	0.8	6.0	0.55	0.69	0.55	34.1
5	T1	96	2.3	96	2.3	0.390	4.6	LOS A	0.8	6.0	0.55	0.69	0.55	49.4
6	R2	737	2.3	737	2.3	0.390	11.2	LOS A	0.8	6.0	0.56	0.73	0.56	50.7
Approach		845	2.3	845	2.3	0.390	10.4	LOS A	0.8	6.0	0.56	0.73	0.56	50.5
North: Tharwa Drive														
7	L2	362	2.3	362	2.3	0.271	3.7	LOS A	0.8	5.6	0.43	0.44	0.43	53.4
8	T1	343	2.3	343	2.3	0.271	3.4	LOS A	0.8	5.6	0.45	0.43	0.45	50.3
9	R2	67	2.3	67	2.3	0.271	10.4	LOS A	0.7	5.3	0.45	0.43	0.45	57.0
Approach		773	2.3	773	2.3	0.271	4.1	LOS A	0.8	5.6	0.44	0.44	0.44	52.6
West: Woodcock Drive														
10	L2	121	2.3	121	2.3	0.205	8.2	LOS A	0.4	2.8	0.75	0.85	0.75	52.3
11	T1	132	2.3	132	2.3	0.220	6.1	LOS A	0.5	3.5	0.77	0.73	0.77	50.6
12	R2	56	2.3	56	2.3	0.220	13.1	LOS A	0.5	3.5	0.77	0.73	0.77	44.4
Approach		308	2.3	308	2.3	0.220	8.2	LOS A	0.5	3.5	0.76	0.78	0.76	50.6
All Vehicles		2946	2.3	2946	2.3	0.578	7.4	LOS A	1.4	10.1	0.59	0.67	0.64	52.0



Lane Use and Performance

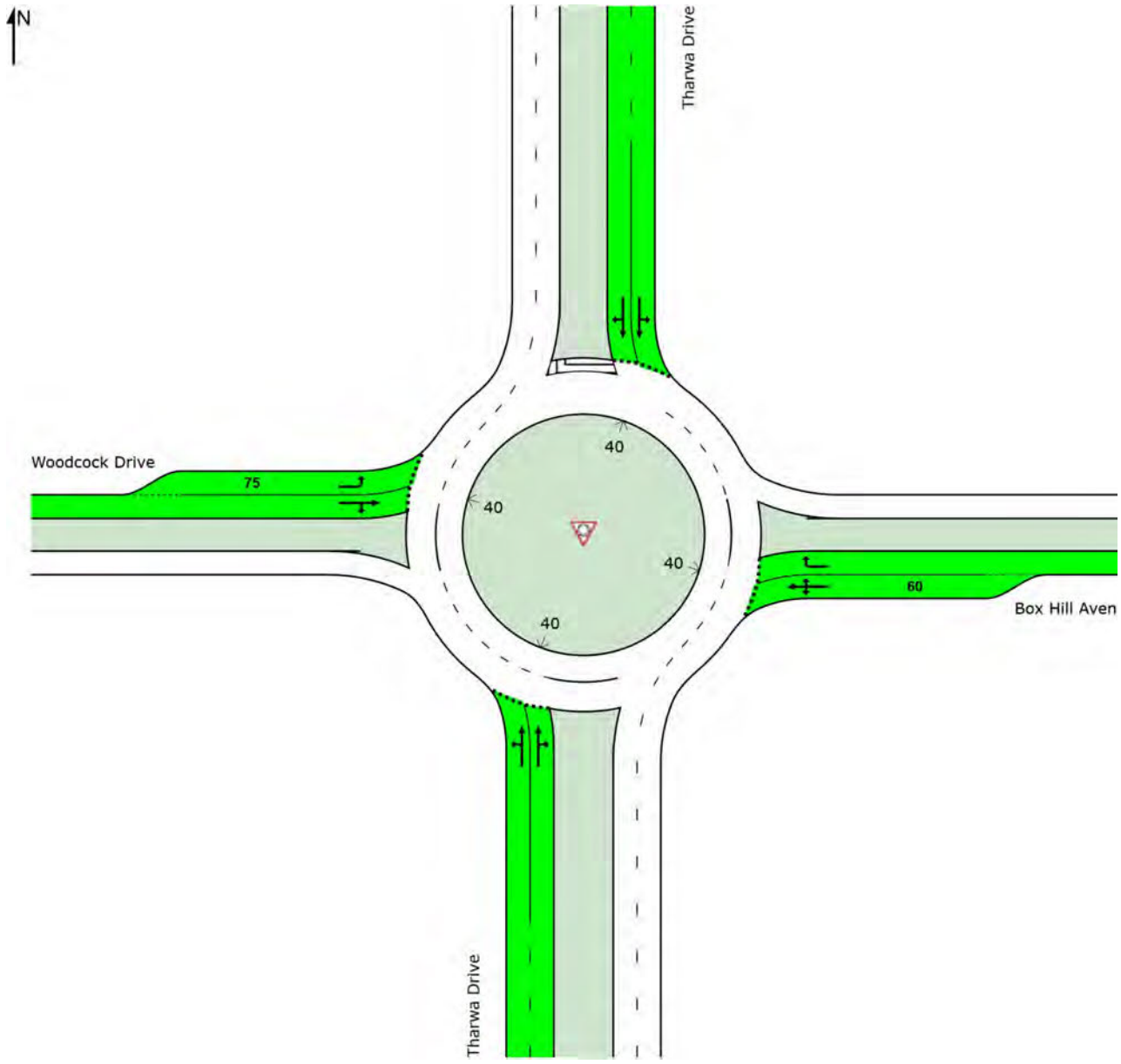
	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	Aver. Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Tharwa Drive															
Lane 1[d]	568	2.3	568	2.3	983	0.578	100	6.7	LOS A	1.4	10.1	Full	165	0.0	0.0
Lane 2	452	2.3	452	2.3	781	0.578	100	7.7	LOS A	1.3	9.4	Full	165	0.0	0.0
Approach	1020	2.3	1020	2.3		0.578		7.1	LOS A	1.4	10.1				
East: Box Hill Avenue															
Lane 1[d]	458	2.3	458	2.3	1174	0.390	100	9.5	LOS A	0.8	6.0	Short	60	0.0	NA
Lane 2	388	2.3	388	2.3	995	0.390	100	11.4	LOS A	0.8	5.8	Full	150	0.0	0.0
Approach	845	2.3	845	2.3		0.390		10.4	LOS A	0.8	6.0				
North: Tharwa Drive															
Lane 1[d]	427	2.3	427	2.3	1572	0.271	100	3.6	LOS A	0.8	5.6	Full	490	0.0	0.0
Lane 2	346	2.3	346	2.3	1275	0.271	100	4.8	LOS A	0.7	5.3	Full	490	0.0	0.0
Approach	773	2.3	773	2.3		0.271		4.1	LOS A	0.8	5.6				
West: Woodcock Drive															
Lane 1	121	2.3	121	2.3	590	0.205	100	8.2	LOS A	0.4	2.8	Short	75	0.0	NA
Lane 2[d]	187	2.3	187	2.3	851	0.220	100	8.2	LOS A	0.5	3.5	Full	380	0.0	0.0
Approach	308	2.3	308	2.3		0.220		8.2	LOS A	0.5	3.5				
Intersection	2946	2.3	2946	2.3		0.578		7.4	LOS A	1.4	10.1				

[redacted]

d Dominant lane on roundabout approach

Lane Level of Service

	Approaches				Intersection
	South	East	North	West	
LOS	A	A	A	A	A



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

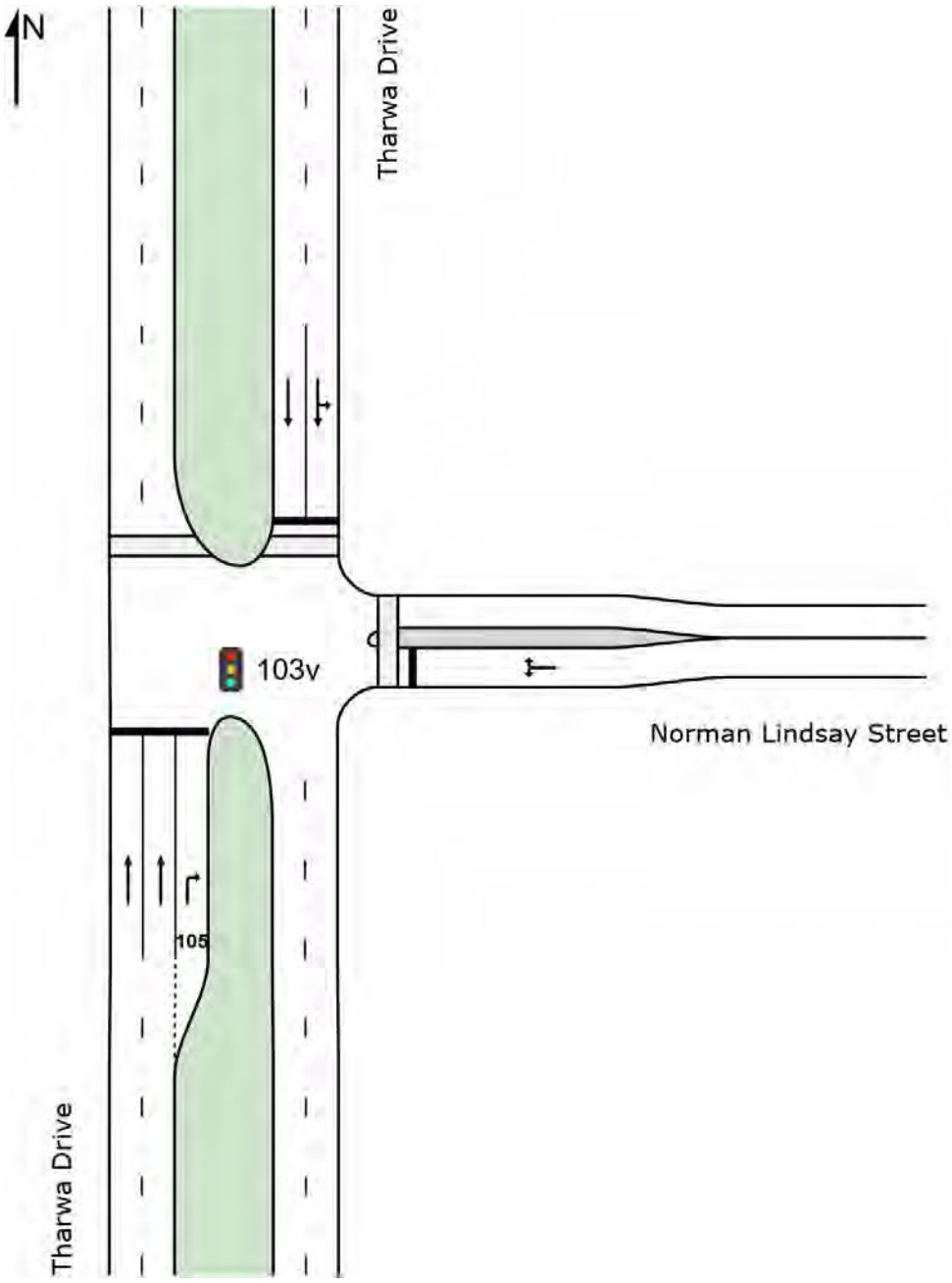
Site: 103v [2031_AM Peak_Tharwa Drive / Norman Lindsay Street - Signals]

Network: 8 [2031 Future Conditions with Upgrades_Tharwa Drive AM peak - Op2]

Signalised T-Intersection - Duplicated
Site Category: AM Peak 2031 Conditions
Signals - Fixed Time Coordinated Cycle Time = 60 seconds (Network User-Given Cycle Time)

Timings based on settings in the Network Timing dialog
Phase Times determined by the program
Downstream lane blockage effects included in determining phase times
Phase Sequence: Sequence1
Reference Phase: Phase A
Input Phase Sequence: A, B, C
Output Phase Sequence: A, B, C

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
2	T1	871	2.3	871	2.3	0.425	9.2	LOS A	4.7	33.8	0.65	0.56	0.65	48.6
3	R2	147	2.3	147	2.3	0.440	35.1	LOS C	2.7	19.6	1.00	0.80	1.00	31.6
Approach		1018	2.3	1018	2.3	0.440	12.9	LOS A	4.7	33.8	0.70	0.60	0.70	44.9
East: Norman Lindsay Street														
4	L2	77	2.3	77	2.3	0.442	23.8	LOS B	3.4	24.5	0.88	0.79	0.88	7.2
6	R2	146	2.3	146	2.3	0.442	23.8	LOS B	3.4	24.5	0.88	0.79	0.88	7.2
Approach		223	2.3	223	2.3	0.442	23.8	LOS B	3.4	24.5	0.88	0.79	0.88	7.2
North: Tharwa Drive														
7	L2	140	2.3	140	2.3	0.439	26.7	LOS B	3.2	22.8	0.89	0.77	0.89	10.0
8	T1	275	2.3	275	2.3	0.439	21.1	LOS B	3.3	23.5	0.89	0.74	0.89	19.5
Approach		415	2.3	415	2.3	0.439	23.0	LOS B	3.3	23.5	0.89	0.75	0.89	14.3
All Vehicles		1656	2.3	1656	2.3	0.442	16.9	LOS B	4.7	33.8	0.77	0.66	0.77	34.4

[redacted]

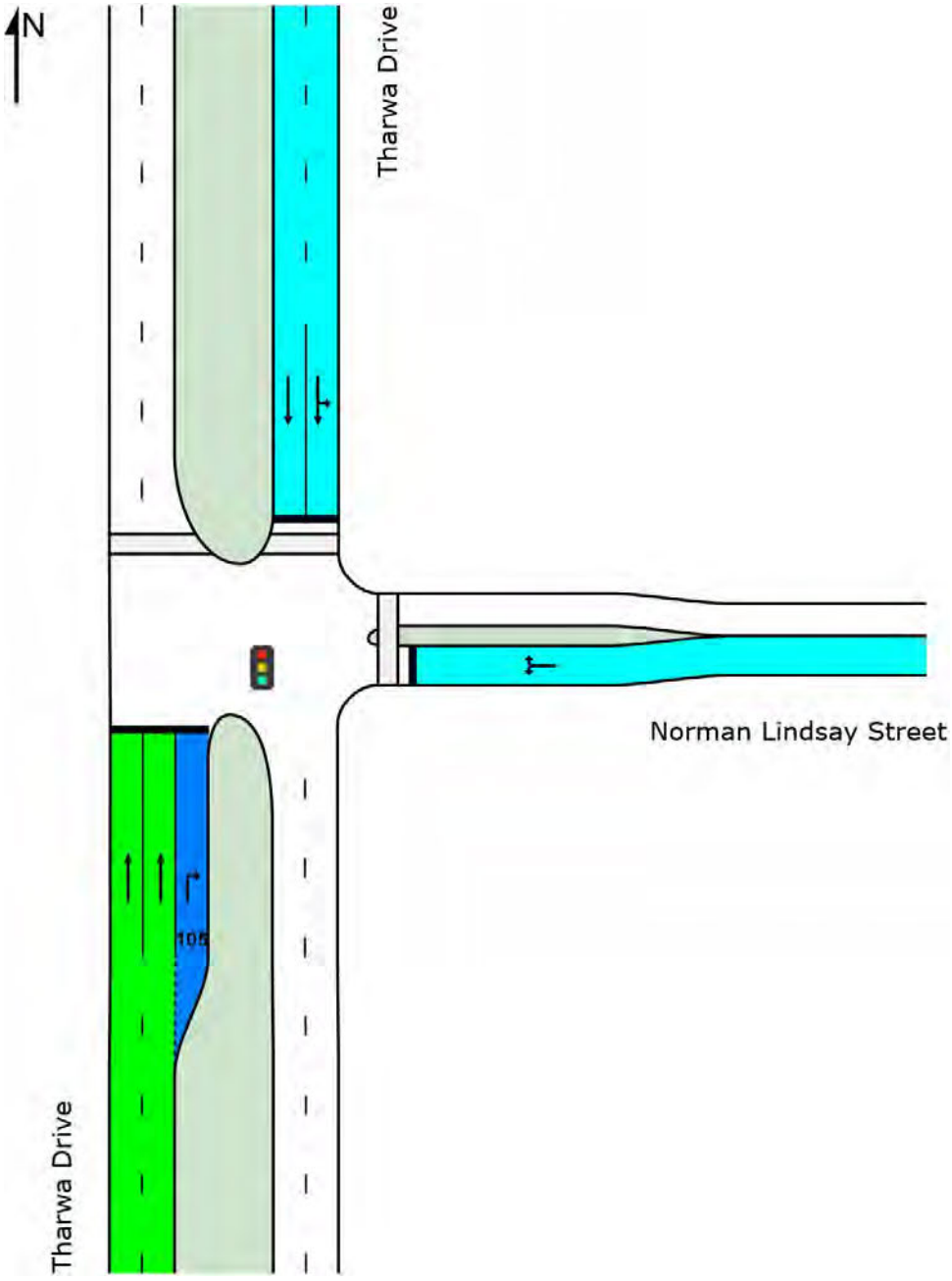
Lane Use and Performance

	Demand Flows		Arrival Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	Aver. Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
South: Tharwa Drive															
Lane 1	435	2.3	435	2.3	1025	0.425	100	9.2	LOS A	4.7	33.8	Full	640	0.0	0.0
Lane 2	435	2.3	435	2.3	1025	0.425	100	9.2	LOS A	4.7	33.8	Full	640	0.0	0.0
Lane 3	147	2.3	147	2.3	335	0.440	100	35.1	LOS C	2.7	19.6	Short	105	0.0	NA
Approach	1018	2.3	1018	2.3		0.440		12.9	LOS A	4.7	33.8				
East: Norman Lindsay Street															
Lane 1	223	2.3	223	2.3	505	0.442	100	23.8	LOS B	3.4	24.5	Full	40	0.0	5.1
Approach	223	2.3	223	2.3		0.442		23.8	LOS B	3.4	24.5				
North: Tharwa Drive															
Lane 1	204	2.3	204	2.3	464	0.439	100	25.0	LOS B	3.2	22.8	Full	165	0.0	0.0
Lane 2	211	2.3	211	2.3	480	0.439	100	21.1	LOS B	3.3	23.5	Full	165	0.0	0.0
Approach	415	2.3	415	2.3		0.439		23.0	LOS B	3.3	23.5				
Intersection	1656	2.3	1656	2.3		0.442		16.9	LOS B	4.7	33.8				

[redacted]

Lane Level of Service

	Approaches			Intersection
	South	East	North	
LOS	A	B	B	B



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

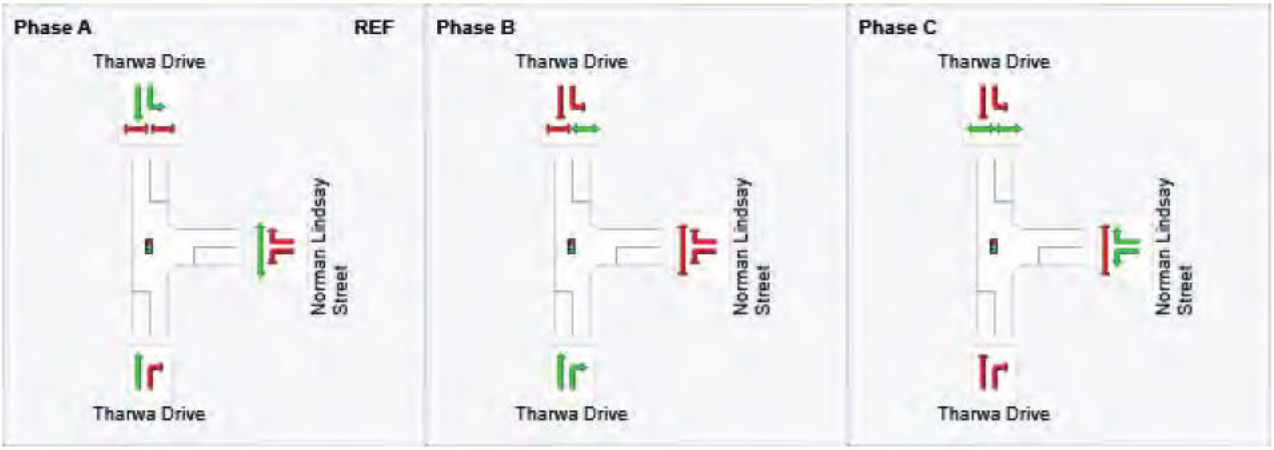
[redacted]

Phase Timing Summary

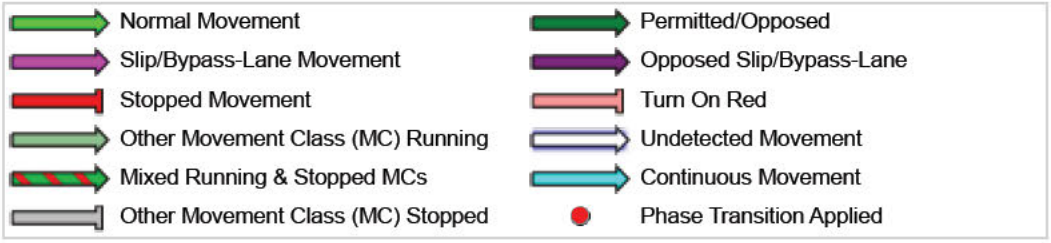
Phase	A	B	C
Phase Change Time (sec)	14	35	52
Green Time (sec)	15	11	16
Phase Time (sec)	21	17	22
Phase Split	35%	28%	37%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase



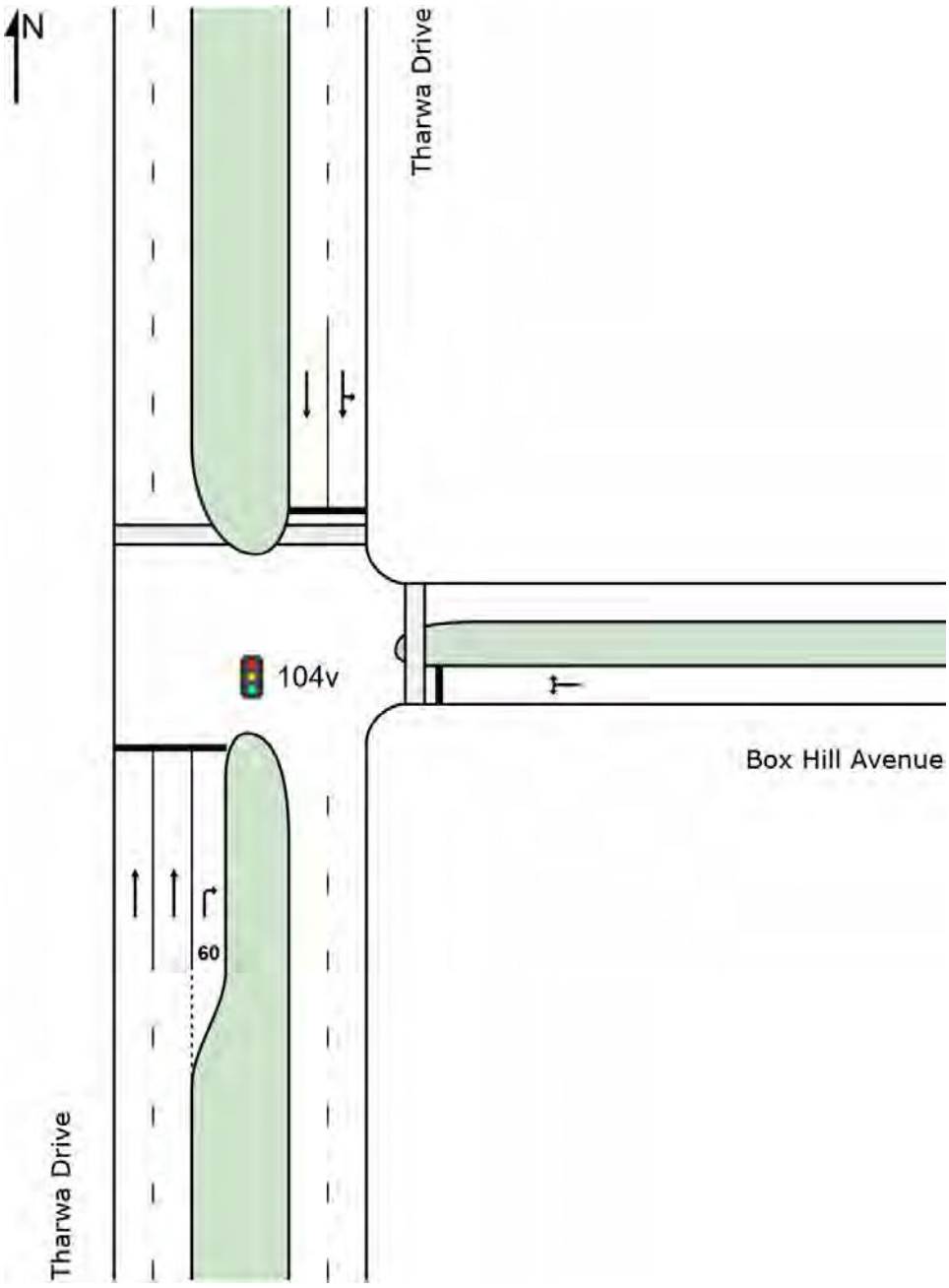
Site: 104v [2031_AM Peak_Tharwa Drive / Box Hill Avenue - Signals]

Network: 8 [2031 Future Conditions with Upgrades_Tharwa Drive AM peak - Op2]

Signalised T-intersection - Duplicated
Site Category: AM Peak 2031 Conditions
Signals - Fixed Time Coordinated Cycle Time = 60 seconds (Network User-Given Cycle Time)

Timings based on settings in the Network Timing dialog
Phase Times determined by the program
Downstream lane blockage effects included in determining phase times
Phase Sequence: Sequence1
Reference Phase: Phase A
Input Phase Sequence: A, B, C
Output Phase Sequence: A, B, C

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
2	T1	481	2.3	481	2.3	0.345	22.7	LOS B	4.3	30.5	1.00	0.83	1.00	43.5
3	R2	47	2.3	47	2.3	0.257	37.0	LOS C	0.9	6.4	1.00	0.74	1.00	37.9
Approach		528	2.3	528	2.3	0.345	24.0	LOS B	4.3	30.5	1.00	0.82	1.00	42.9
East: Box Hill Avenue														
4	L2	18	2.3	18	2.3	0.647	19.6	LOS B	7.8	55.7	0.83	0.83	0.83	16.2
6	R2	534	2.3	534	2.3	0.647	19.6	LOS B	7.8	55.7	0.83	0.83	0.83	16.2
Approach		552	2.3	552	2.3	0.647	19.6	LOS B	7.8	55.7	0.83	0.83	0.83	16.2
North: Tharwa Drive														
7	L2	182	2.3	182	2.3	0.641	22.1	LOS B	2.6	18.5	0.78	0.76	0.80	39.4
8	T1	158	2.3	158	2.3	0.529	8.1	LOS A	1.3	9.0	0.44	0.35	0.44	49.7
Approach		340	2.3	340	2.3	0.641	15.6	LOS B	2.6	18.5	0.62	0.57	0.63	43.2
All Vehicles		1420	2.3	1420	2.3	0.647	20.3	LOS B	7.8	55.7	0.84	0.77	0.85	38.0

[redacted]

Lane Use and Performance

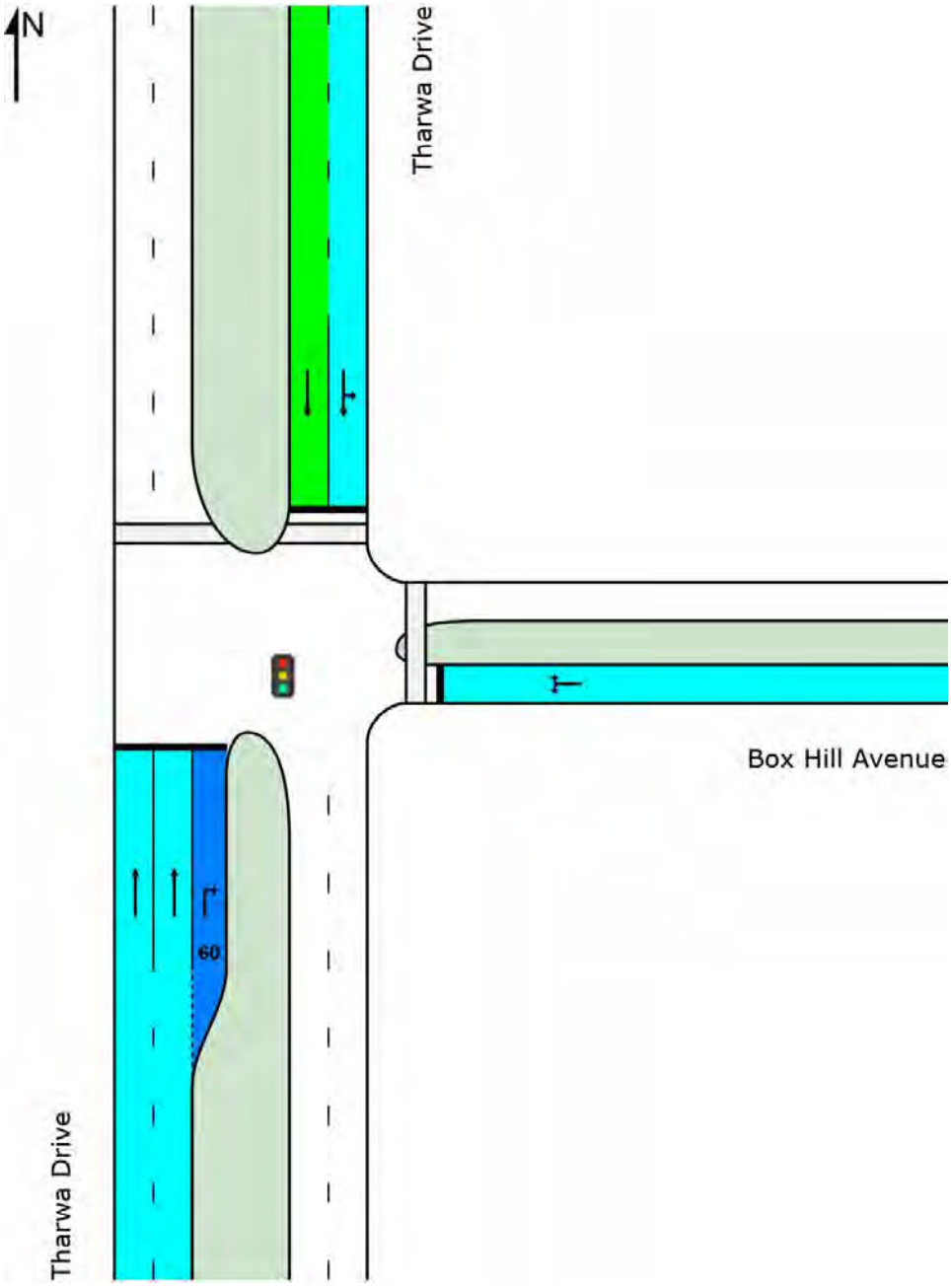
	Demand Flows		Arrival Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	Aver. Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
South: Tharwa Drive															
Lane 1	241	2.3	241	2.3	697	0.345	100	22.1	LOS B	4.1	29.4	Full	990	0.0	0.0
Lane 2	241	2.3	241	2.3	697	0.345	100	23.4	LOS B	4.3	30.5	Full	990	0.0	0.0
Lane 3	47	2.3	47	2.3	185	0.257	100	37.0	LOS C	0.9	6.4	Short	60	0.0	NA
Approach	528	2.3	528	2.3		0.345		24.0	LOS B	4.3	30.5				
East: Box Hill Avenue															
Lane 1	552	2.3	552	2.3	852	0.647	100	19.6	LOS B	7.8	55.7	Full	105	0.0	0.0
Approach	552	2.3	552	2.3		0.647		19.6	LOS B	7.8	55.7				
North: Tharwa Drive															
Lane 1	182	2.3	182	2.3	284	0.641	100	22.1	LOS B	2.6	18.5	Full	640	0.0	0.0
Lane 2	158	2.3	158	2.3	299	0.529	82[5]	8.1	LOS A	1.3	9.0	Full	640	0.0	0.0
Approach	340	2.3	340	2.3		0.641		15.6	LOS B	2.6	18.5				
Intersection	1420	2.3	1420	2.3		0.647		20.3	LOS B	7.8	55.7				

[redacted]

5 Lane under-utilisation found by the program

Lane Level of Service

	Approaches			Intersection
	South	East	North	
LOS	B	B	B	B



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

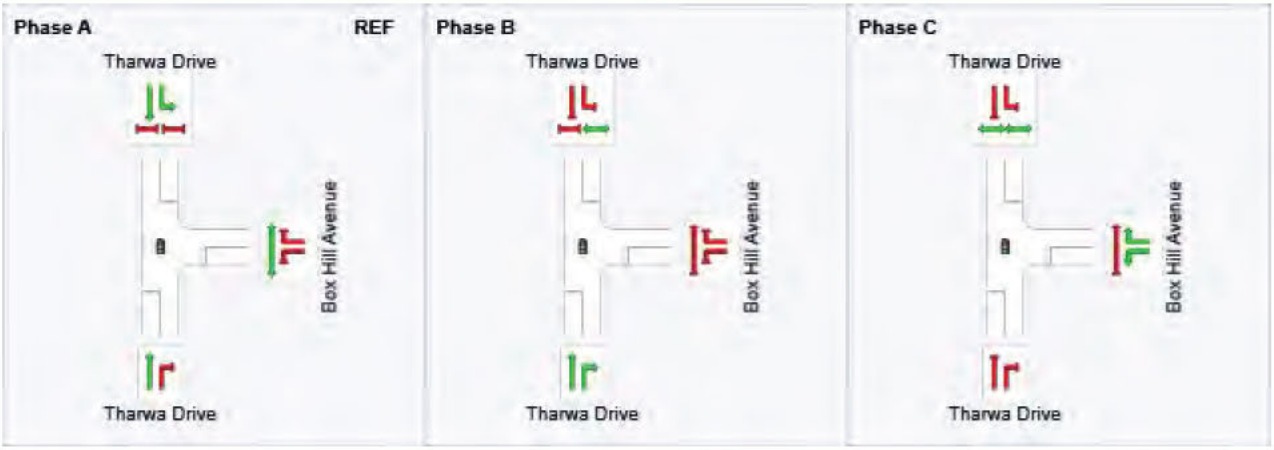
[redacted]

Phase Timing Summary

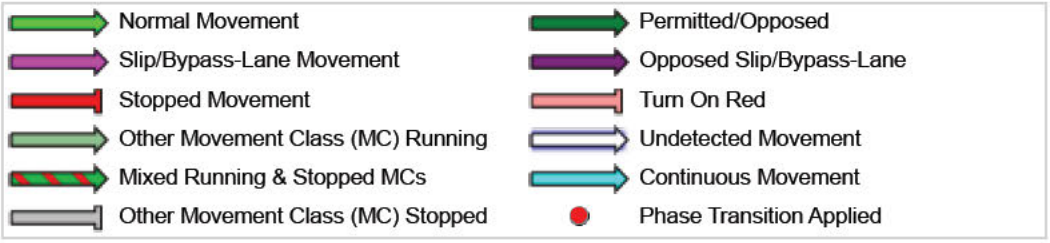
Phase	A	B	C
Phase Change Time (sec)	45	60	12
Green Time (sec)	9	6	27
Phase Time (sec)	15	12	33
Phase Split	25%	20%	55%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase



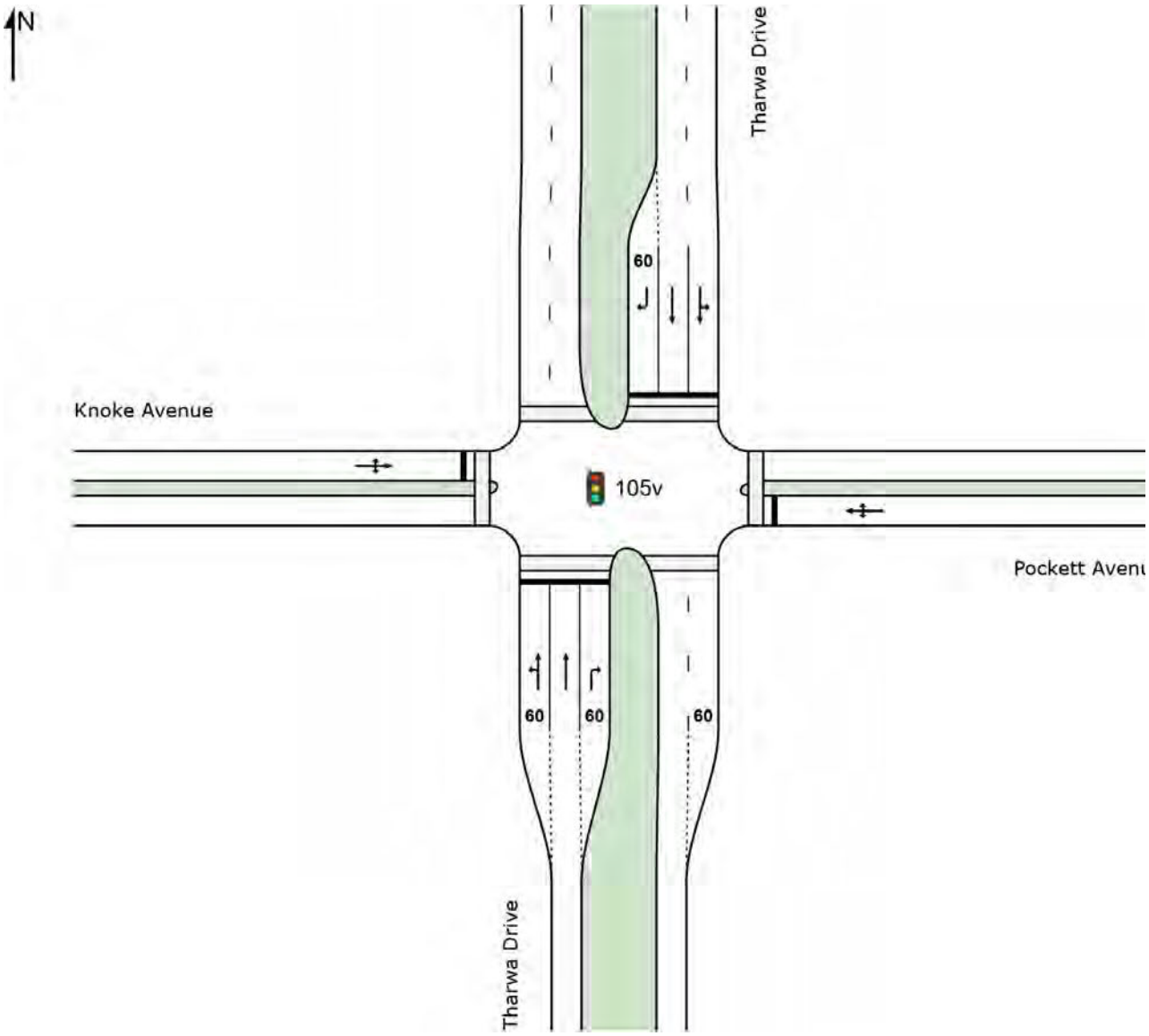
Site: 105v [2031_AM Peak_Tharwa Drive / Pockett Avenue - Roundabout]

Network: 8 [2031 Future Conditions with Upgrades_Tharwa Drive AM peak - Op2]

Signalised cross intersection - Duplicated
Site Category: AM Peak 2031 Conditions
Signals - Fixed Time Coordinated Cycle Time = 60 seconds (Network User-Given Cycle Time)

Timings based on settings in the Network Timing dialog
Phase Times determined by the program
Downstream lane blockage effects included in determining phase times
Phase Sequence: Diamond Phasing
Reference Phase: Phase A
Input Phase Sequence: A, B, C, D
Output Phase Sequence: A, B, C, D

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
1	L2	1	2.3	1	2.3	0.127	33.7	LOS C	0.4	3.1	0.94	0.67	0.94	17.2
2	T1	49	2.3	49	2.3	0.127	28.1	LOS B	0.4	3.1	0.94	0.67	0.94	31.3
3	R2	1	2.3	1	2.3	0.006	32.5	LOS C	0.0	0.1	0.92	0.59	0.92	30.3
Approach		52	2.3	52	2.3	0.127	28.3	LOS B	0.4	3.1	0.94	0.67	0.94	30.6
East: Pockett Avenue														
4	L2	2	2.3	2	2.3	0.678	29.5	LOS C	5.3	37.6	0.96	0.86	1.03	32.3
5	T1	27	2.3	27	2.3	0.678	24.3	LOS B	5.3	37.6	0.96	0.86	1.03	17.3
6	R2	272	2.3	272	2.3	0.678	29.5	LOS C	5.3	37.6	0.96	0.86	1.03	10.3
Approach		301	2.3	301	2.3	0.678	29.0	LOS C	5.3	37.6	0.96	0.86	1.03	11.3
North: Tharwa Drive														
7	L2	72	2.3	72	2.3	0.378	34.9	LOS C	1.3	9.3	0.98	0.75	0.98	38.0
8	T1	36	2.3	36	2.3	0.180	30.9	LOS C	0.7	4.8	1.00	0.72	1.00	44.7
9	R2	57	2.3	57	2.3	0.300	37.2	LOS C	1.1	7.7	1.00	0.75	1.00	37.4
Approach		164	2.3	164	2.3	0.378	34.8	LOS C	1.3	9.3	0.99	0.74	0.99	39.5
West: Knoke Avenue														
10	L2	192	2.3	192	2.3	0.706	33.7	LOS C	4.2	29.8	1.00	0.88	1.13	10.1
11	T1	29	2.3	29	2.3	0.706	28.2	LOS B	4.2	29.8	1.00	0.88	1.13	15.5
12	R2	3	2.3	3	2.3	0.706	33.8	LOS C	4.2	29.8	1.00	0.88	1.13	31.0
Approach		224	2.3	224	2.3	0.706	33.0	LOS C	4.2	29.8	1.00	0.88	1.13	11.4
All Vehicles		741	2.3	741	2.3	0.706	31.5	LOS C	5.3	37.6	0.98	0.83	1.05	25.0

[redacted]

Lane Use and Performance

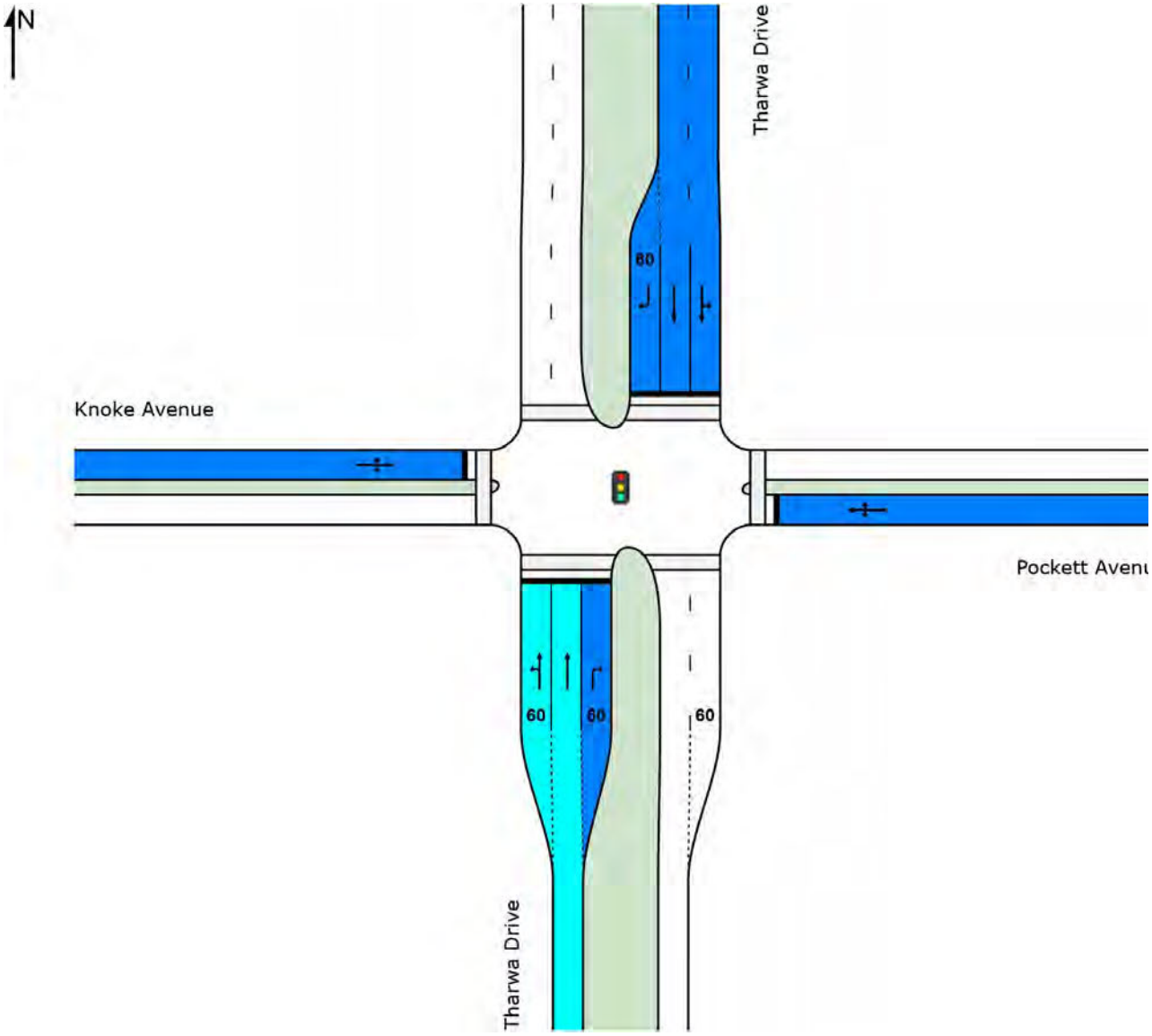
	Demand Flows		Arrival Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	Aver. Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
South: Tharwa Drive															
Lane 1	25	2.3	25	2.3	199	0.127	100	28.3	LOS B	0.4	3.1	Short	60	0.0	NA
Lane 2	25	2.3	25	2.3	199	0.127	100	28.1	LOS B	0.4	3.1	Full	500	0.0	0.0
Lane 3	1	2.3	1	2.3	189	0.006	100	32.5	LOS C	0.0	0.1	Short	60	0.0	NA
Approach	52	2.3	52	2.3		0.127		28.3	LOS B	0.4	3.1				
East: Pockett Avenue															
Lane 1	301	2.3	301	2.3	444	0.678	100	29.0	LOS C	5.3	37.6	Full	80	0.0	0.0
Approach	301	2.3	301	2.3		0.678		29.0	LOS C	5.3	37.6				
North: Tharwa Drive															
Lane 1	72	2.3	72	2.3	189	0.378	100	34.9	LOS C	1.3	9.3	Full	990	0.0	0.0
Lane 2	36	2.3	36	2.3	199	0.180	48[5]	30.9	LOS C	0.7	4.8	Full	990	0.0	0.0
Lane 3	57	2.3	57	2.3	189	0.300	100	37.2	LOS C	1.1	7.7	Short	60	0.0	NA
Approach	164	2.3	164	2.3		0.378		34.8	LOS C	1.3	9.3				
West: Knoke Avenue															
Lane 1	224	2.3	224	2.3	318	0.706	100	33.0	LOS C	4.2	29.8	Full	95	0.0	0.0
Approach	224	2.3	224	2.3		0.706		33.0	LOS C	4.2	29.8				
Intersection	741	2.3	741	2.3		0.706		31.5	LOS C	5.3	37.6				

[redacted]

5 Lane under-utilisation found by the program

Lane Level of Service

	Approaches				Intersection
	South	East	North	West	
LOS	B	C	C	C	C



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Phase Timing Summary

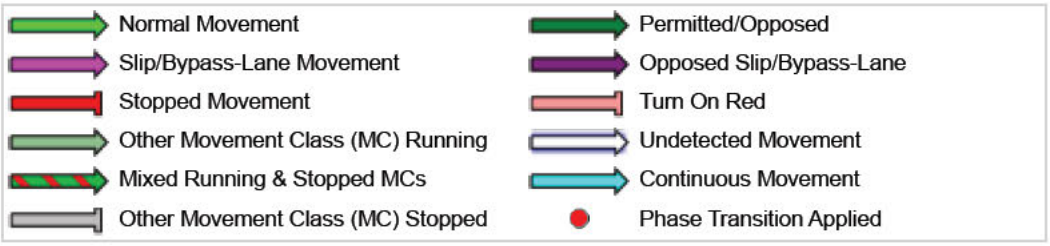
Phase	A	B	C	D
Phase Change Time (sec)	0	12	24	44
Green Time (sec)	6	6	14	10
Phase Time (sec)	12	12	20	16
Phase Split	20%	20%	33%	27%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase

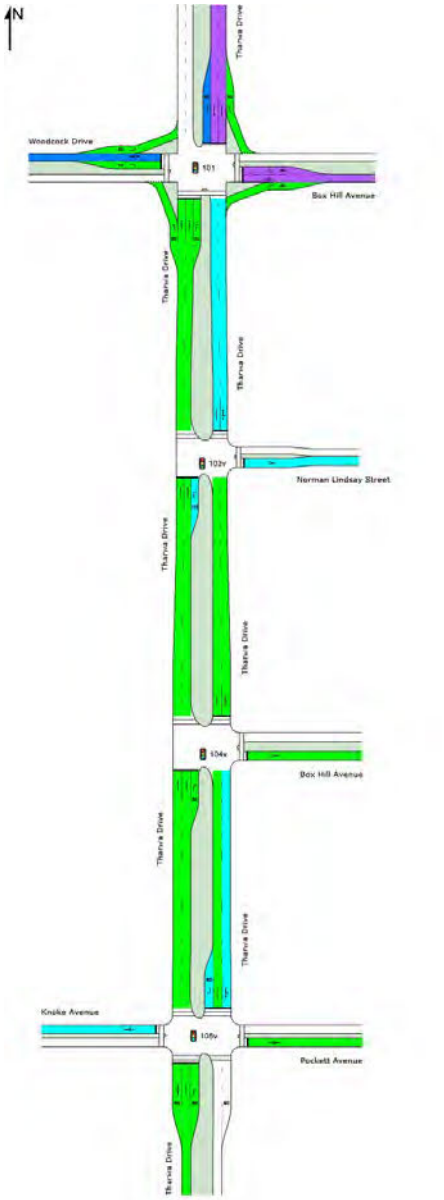


DEGREE OF SATURATION

Ratio of Demand Volume to Capacity, v/c ratio per lane

Network: N101 [2031 Future Conditions with Upgrades_Tharwa Drive PM peak - Op3]

2031 Future Conditions - Upgraded Layout (Op3)
Network Category: (None)
Network Cycle Time = 85 seconds (Network User-Given Cycle Time)



Colour code based on Degree of Saturation

[< 0.6]	[0.6 – 0.7]	[0.7 – 0.8]	[0.8 – 0.9]	[0.9 – 1.0]	[> 1.0]

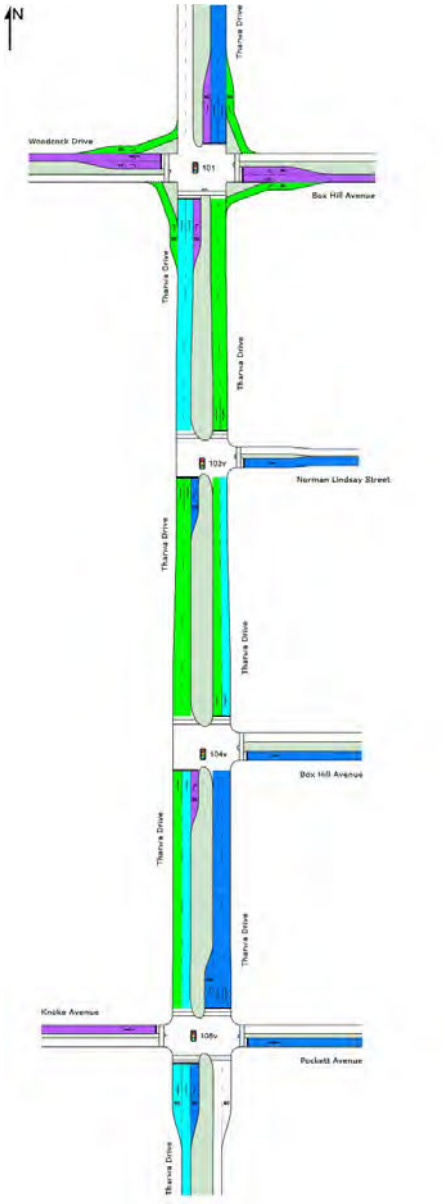
SIDRA INTERSECTION 8.0 | Copyright © 2000-2019 Akcelik and Associates Pty Ltd | sidrasolutions.com

LANE LEVEL OF SERVICE

Lane Level of Service for Network Sites

Network: N101 [2031 Future Conditions with Upgrades_Tharwa Drive PM peak - Op3]

2031 Future Conditions - Upgraded Layout (Op3)
Network Category: (None)
Network Cycle Time = 85 seconds (Network User-Given Cycle Time)



Colour code based on Level of Service

LOS A	LOS B	LOS C	LOS D	LOS E	LOS F

Delay model settings are specified for individual Sites forming the Network.

USER REPORT FOR NETWORK SITE

Project: 2031 Conditions

Template: Default Site User Report (2)

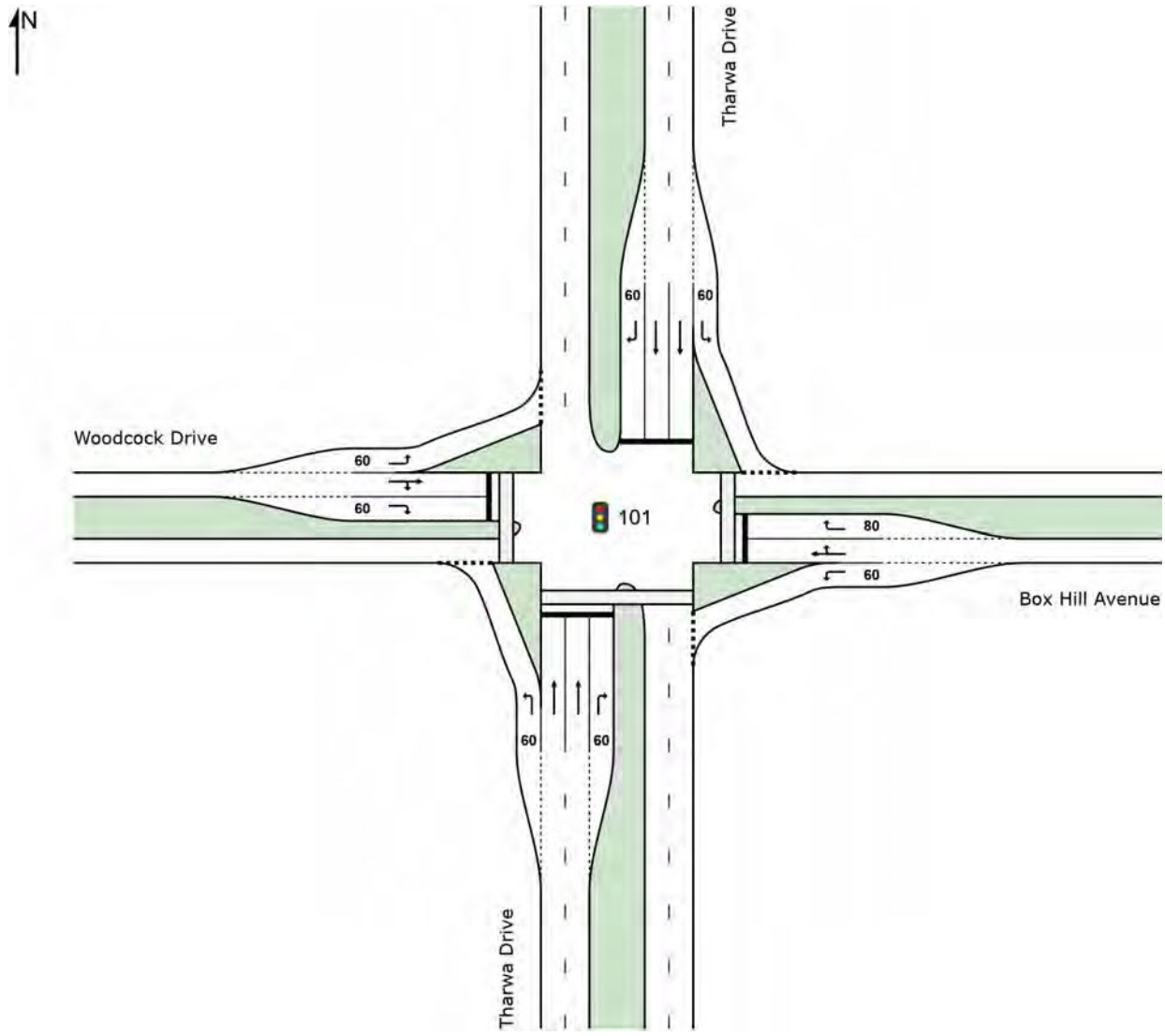
Site: 101 [2031_AM Peak_Tharwa Drive / Woodcock Drive - Signals]

Network: 9 [2031 Future Conditions with Upgrades_Tharwa Drive AM peak - Op3]

Signalised Cross Intersection with no ped xing to the south - Duplicated
Site Category: AM Peak 2031 Conditions
Signals - Fixed Time Coordinated Cycle Time = 85 seconds (Network User-Given Cycle Time)

Timings based on settings in the Network Timing dialog
Phase Times determined by the program
Downstream lane blockage effects included in determining phase times
Phase Sequence: Variable Phasing
Reference Phase: Phase A
Input Phase Sequence: A, B, C, D
Output Phase Sequence: A, B, C, D

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
1	L2	75	2.3	75	2.3	0.054	5.8	LOS A	0.0	0.3	0.03	0.56	0.03	50.1
2	T1	943	2.3	943	2.3	0.826	12.3	LOS A	9.4	67.1	0.69	0.63	0.73	46.0
3	R2	2	2.3	2	2.3	0.016	48.8	LOS D	0.1	0.4	1.00	0.61	1.00	17.1
Approach		1020	2.3	1020	2.3	0.826	11.9	LOS A	9.4	67.1	0.64	0.62	0.68	46.1
East: Box Hill Avenue														
4	L2	13	2.3	13	2.3	0.010	7.1	LOS A	0.1	0.4	0.25	0.59	0.25	35.5
5	T1	96	2.3	96	2.3	0.830	37.6	LOS C	11.3	80.8	1.00	0.96	1.19	26.5
6	R2	737	2.3	737	2.3	0.830	43.3	LOS D	11.3	80.8	1.00	0.96	1.19	28.5
Approach		845	2.3	845	2.3	0.830	42.1	LOS C	11.3	80.8	0.99	0.95	1.17	28.3
North: Tharwa Drive														
7	L2	362	2.3	362	2.3	0.246	6.9	LOS A	1.6	11.1	0.27	0.63	0.27	49.9
8	T1	343	2.3	343	2.3	0.301	25.2	LOS B	3.4	24.3	0.82	0.67	0.82	32.8
9	R2	67	2.3	67	2.3	0.517	50.0	LOS D	1.8	12.8	1.00	0.76	1.01	30.6
Approach		773	2.3	773	2.3	0.517	18.8	LOS B	3.4	24.3	0.57	0.66	0.58	39.3
West: Woodcock Drive														
10	L2	121	2.3	121	2.3	0.150	16.5	LOS B	1.6	11.1	0.60	0.70	0.60	45.2
11	T1	132	2.3	132	2.3	0.823	48.2	LOS D	3.7	26.7	1.00	0.94	1.37	24.5
12	R2	56	2.3	56	2.3	0.367	48.0	LOS D	1.4	10.2	0.98	0.75	0.98	20.0
Approach		308	2.3	308	2.3	0.823	35.7	LOS C	3.7	26.7	0.84	0.81	1.00	31.4
All Vehicles		2946	2.3	2946	2.3	0.830	24.9	LOS B	11.3	80.8	0.74	0.75	0.83	36.2

[redacted]

Lane Use and Performance

	Demand Flows		Arrival Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	Aver. Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
South: Tharwa Drive															
Lane 1	75	2.3	75	2.3	1386	0.054	100	5.8	LOS A	0.0	0.3	Short	60	0.0	NA
Lane 2	472	2.3	472	2.3	571	0.826	100	8.6	LOS A	6.8	48.9	Full	165	0.0	0.0
Lane 3	472	2.3	472	2.3	571	0.826	100	16.0	LOS B	9.4	67.1	Full	165	0.0	0.0
Lane 4	2	2.3	2	2.3	130	0.016	100	48.8	LOS D	0.1	0.4	Short	60	0.0	NA
Approach	1020	2.3	1020	2.3		0.826		11.9	LOS A	9.4	67.1				
East: Box Hill Avenue															
Lane 1	13	2.3	13	2.3	1260	0.010	100	7.1	LOS A	0.1	0.4	Short	60	0.0	NA
Lane 2	418	2.3	418	2.3	504[1]	0.830	100	41.9	LOS C	11.3	80.8	Full	150	0.0	0.0
Lane 3	415	2.3	415	2.3	500	0.830	100	43.3	LOS D	11.2	80.2	Short	80	0.0	NA
Approach	845	2.3	845	2.3		0.830		42.1	LOS C	11.3	80.8				
North: Tharwa Drive															
Lane 1	362	2.3	362	2.3	1475	0.246	100	6.9	LOS A	1.6	11.1	Short	60	0.0	NA
Lane 2	172	2.3	172	2.3	571	0.301	100	25.2	LOS B	3.4	24.3	Full	490	0.0	0.0
Lane 3	172	2.3	172	2.3	571	0.301	100	25.2	LOS B	3.4	24.3	Full	490	0.0	0.0
Lane 4	67	2.3	67	2.3	130	0.517	100	50.0	LOS D	1.8	12.8	Short	60	0.0	NA
Approach	773	2.3	773	2.3		0.517		18.8	LOS B	3.4	24.3				
West: Woodcock Drive															
Lane 1	121	2.3	121	2.3	809	0.150	100	16.5	LOS B	1.6	11.1	Short	60	0.0	NA
Lane 2	132	2.3	132	2.3	160	0.823	100	48.2	LOS D	3.7	26.7	Full	380	0.0	0.0
Lane 3	56	2.3	56	2.3	152	0.367	45[5]	48.0	LOS D	1.4	10.2	Short	60	0.0	NA
Approach	308	2.3	308	2.3		0.823		35.7	LOS C	3.7	26.7				
Intersection	2946	2.3	2946	2.3		0.830		24.9	LOS B	11.3	80.8				

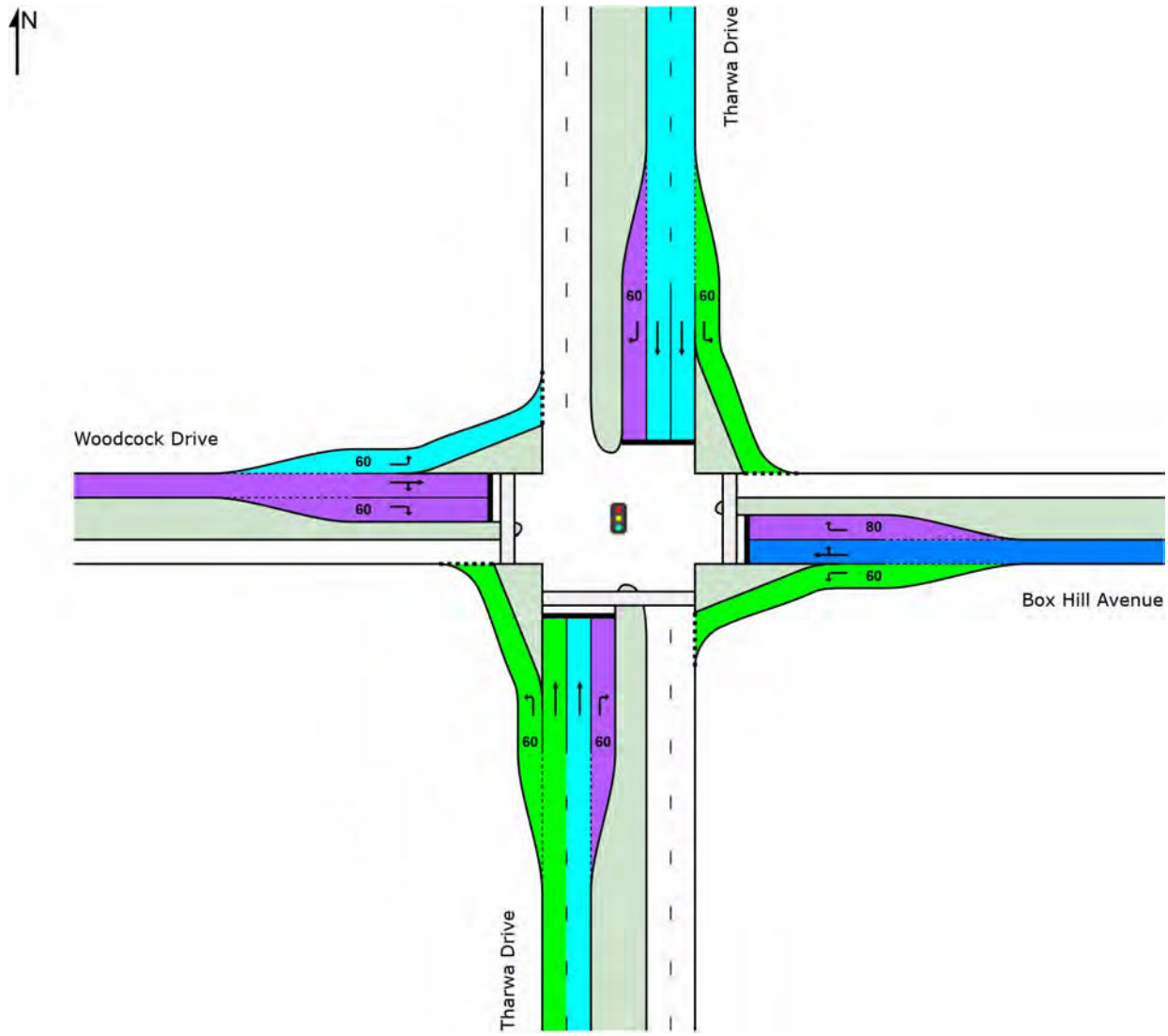
[redacted]

1 Reduced capacity due to a short lane effect. Short lane queues may extend into the full-length lanes. Some upstream delays at entry to short lanes are not included.

5 Lane under-utilisation found by the program

Lane Level of Service

	Approaches				Intersection
	South	East	North	West	
LOS	A	C	B	C	B



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Phase Timing Summary

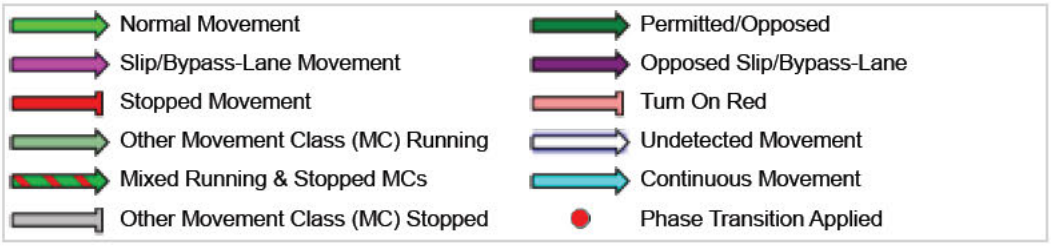
Phase	A	B	C	D
Phase Change Time (sec)	84	30	59	72
Green Time (sec)	25	23	7	6
Phase Time (sec)	31	29	13	12
Phase Split	36%	34%	15%	14%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase



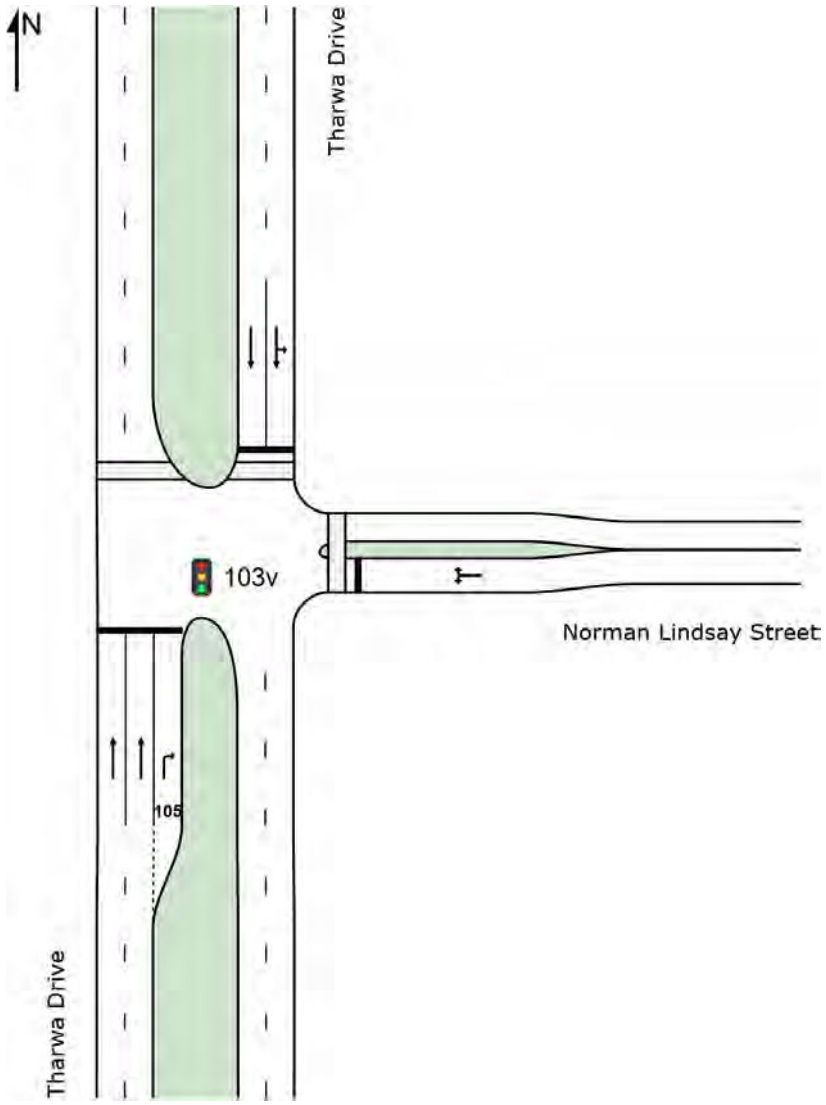
Site: 103v [2031_AM Peak_Tharwa Drive / Norman Lindsay Street - Signals]

Network: 9 [2031 Future Conditions with Upgrades_Tharwa Drive AM peak - Op3]

Signalised T-Intersection - Duplicated
Site Category: AM Peak 2031 Conditions
Signals - Fixed Time Coordinated Cycle Time = 85 seconds (Network User-Given Cycle Time)

Timings based on settings in the Network Timing dialog
Phase Times determined by the program
Downstream lane blockage effects included in determining phase times
Phase Sequence: Sequence1
Reference Phase: Phase A
Input Phase Sequence: A, B, C
Output Phase Sequence: A, B, C

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
2	T1	871	2.3	871	2.3	0.401	10.7	LOS A	5.4	38.4	0.53	0.46	0.53	47.0
3	R2	147	2.3	147	2.3	0.381	41.5	LOS C	3.6	25.5	0.98	0.80	0.98	29.2
Approach		1018	2.3	1018	2.3	0.401	15.2	LOS B	5.4	38.4	0.59	0.51	0.59	43.0
East: Norman Lindsay Street														
4	L2	77	2.3	77	2.3	0.401	29.6	LOS C	4.6	32.8	0.85	0.79	0.85	5.9
6	R2	146	2.3	146	2.3	0.401	29.6	LOS C	4.6	32.8	0.85	0.79	0.85	5.9
Approach		223	2.3	223	2.3	0.401	29.6	LOS C	4.6	32.8	0.85	0.79	0.85	5.9
North: Tharwa Drive														
7	L2	140	2.3	140	2.3	0.389	32.4	LOS C	4.0	28.9	0.82	0.75	0.82	9.3
8	T1	275	2.3	275	2.3	0.389	26.8	LOS B	4.6	32.5	0.87	0.74	0.87	16.6
Approach		415	2.3	415	2.3	0.389	28.7	LOS C	4.6	32.5	0.85	0.74	0.85	12.8
All Vehicles		1656	2.3	1656	2.3	0.401	20.5	LOS B	5.4	38.4	0.69	0.61	0.69	32.0



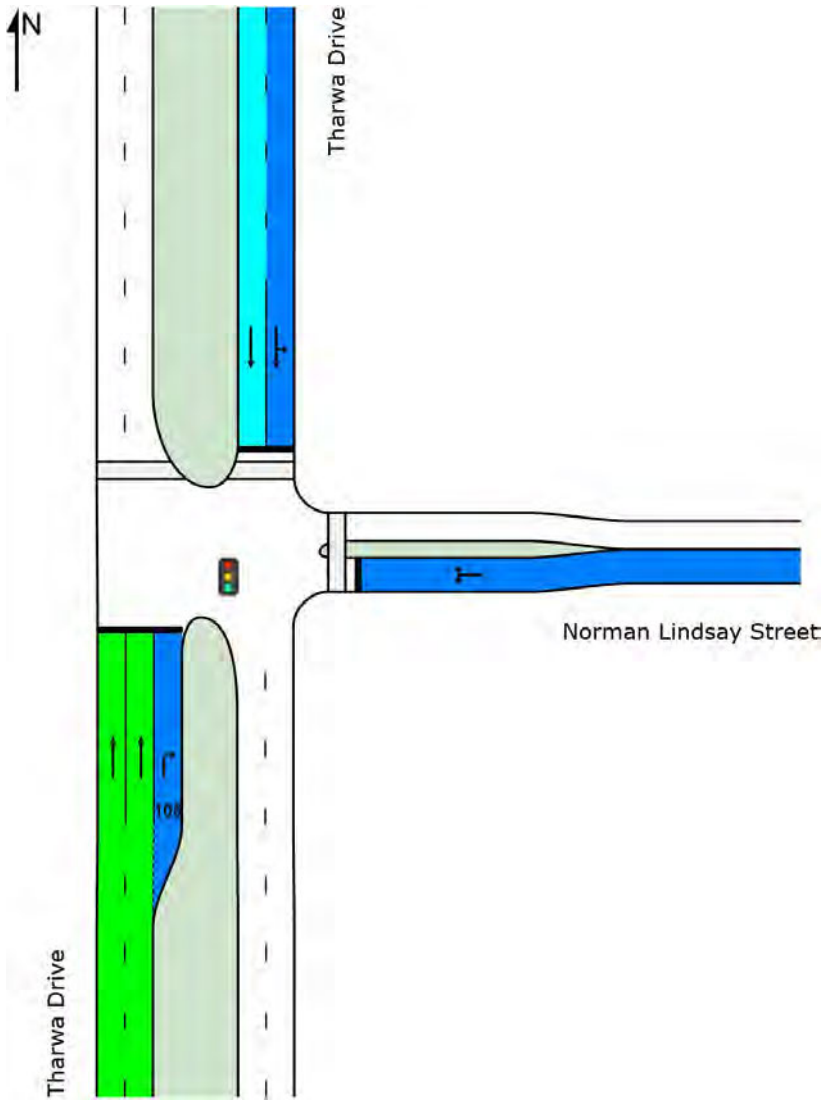
Lane Use and Performance

	Demand Flows		Arrival Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	Aver. Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
South: Tharwa Drive															
Lane 1	435	2.3	435	2.3	1085	0.401	100	10.7	LOS A	5.4	38.4	Full	640	0.0	0.0
Lane 2	435	2.3	435	2.3	1085	0.401	100	10.7	LOS A	5.4	38.4	Full	640	0.0	0.0
Lane 3	147	2.3	147	2.3	387	0.381	100	41.5	LOS C	3.6	25.5	Short	105	0.0	NA
Approach	1018	2.3	1018	2.3		0.401		15.2	LOS B	5.4	38.4				
East: Norman Lindsay Street															
Lane 1	223	2.3	223	2.3	557	0.401	100	29.6	LOS C	4.6	32.8	Full	40	0.0	31.5
Approach	223	2.3	223	2.3		0.401		29.6	LOS C	4.6	32.8				
North: Tharwa Drive															
Lane 1	204	2.3	204	2.3	524	0.389	100	30.7	LOS C	4.0	28.9	Full	165	0.0	0.0
Lane 2	211	2.3	211	2.3	542	0.389	100	26.8	LOS B	4.6	32.5	Full	165	0.0	0.0
Approach	415	2.3	415	2.3		0.389		28.7	LOS C	4.6	32.5				
Intersection	1656	2.3	1656	2.3		0.401		20.5	LOS B	5.4	38.4				

[redacted]

Lane Level of Service

	Approaches			Intersection
	South	East	North	
LOS	B	C	C	B



Colour code based on Level of Service

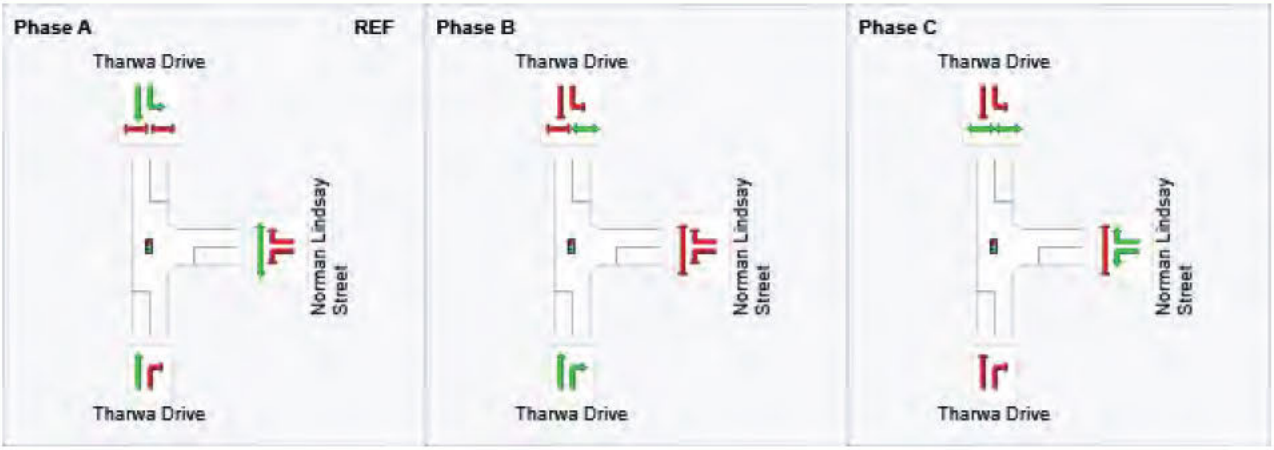
LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Phase Timing Summary

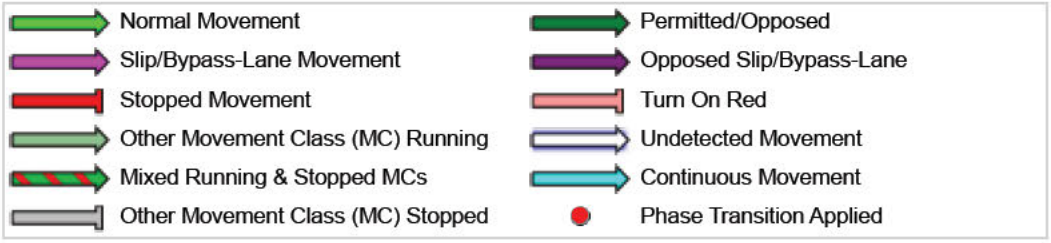
Phase	A	B	C
Phase Change Time (sec)	74	19	43
Green Time (sec)	24	18	25
Phase Time (sec)	30	24	31
Phase Split	35%	28%	36%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase



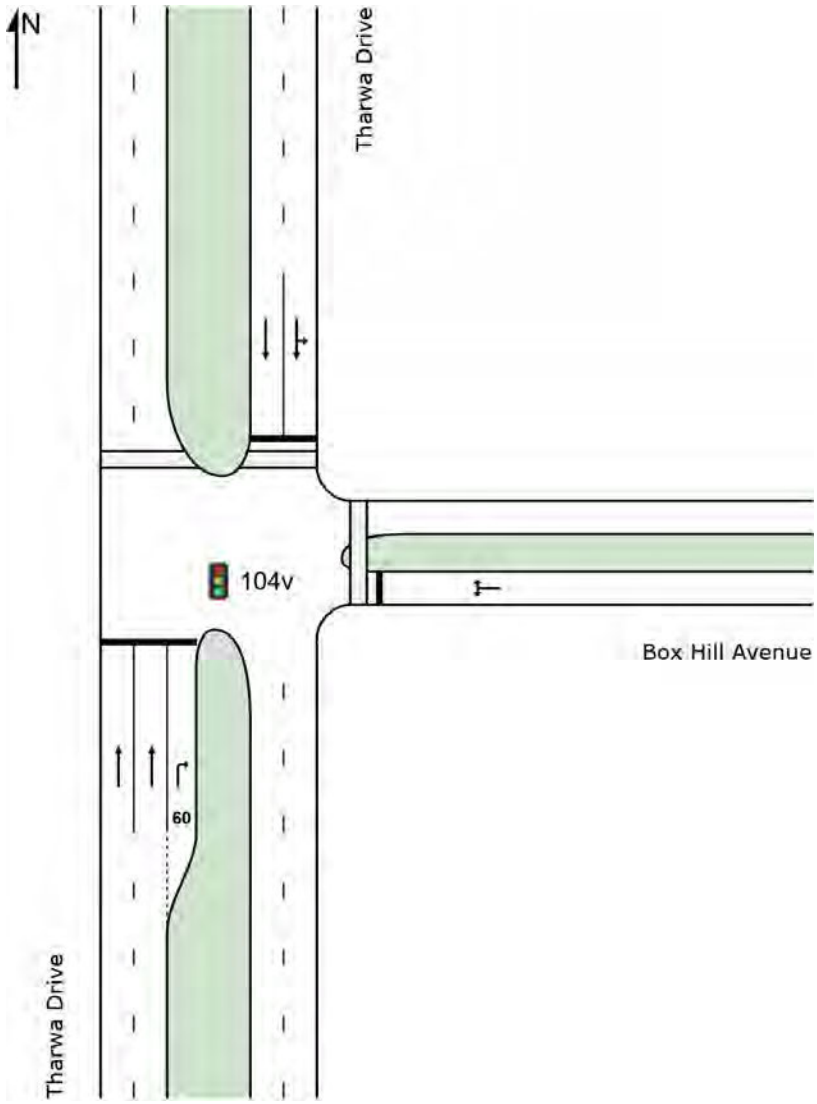
Site: 104v [2031_AM Peak_Tharwa Drive / Box Hill Avenue - Signals]

Network: 9 [2031 Future Conditions with Upgrades_Tharwa Drive AM peak - Op3]

Signalised T-intersection - Duplicated
Site Category: AM Peak 2031 Conditions
Signals - Fixed Time Coordinated Cycle Time = 85 seconds (Network User-Given Cycle Time)

Timings based on settings in the Network Timing dialog
Phase Times determined by the program
Downstream lane blockage effects included in determining phase times
Phase Sequence: Sequence1
Reference Phase: Phase A
Input Phase Sequence: A, B, C
Output Phase Sequence: A, B, C

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
2	T1	481	2.3	481	2.3	0.380	32.3	LOS C	6.0	42.8	0.98	0.82	0.98	39.0
3	R2	47	2.3	47	2.3	0.363	51.6	LOS D	1.3	9.1	1.00	0.74	1.00	33.3
Approach		528	2.3	528	2.3	0.380	34.0	LOS C	6.0	42.8	0.98	0.81	0.98	38.4
East: Box Hill Avenue														
4	L2	18	2.3	18	2.3	0.538	19.1	LOS B	9.0	64.5	0.70	0.79	0.70	16.5
6	R2	534	2.3	534	2.3	0.538	19.1	LOS B	9.0	64.5	0.70	0.79	0.70	16.5
Approach		552	2.3	552	2.3	0.538	19.1	LOS B	9.0	64.5	0.70	0.79	0.70	16.5
North: Tharwa Drive														
7	L2	182	2.3	182	2.3	0.545	41.1	LOS C	4.4	31.7	0.98	0.81	0.98	31.0
8	T1	158	2.3	158	2.3	0.449	34.7	LOS C	3.7	26.5	0.95	0.76	0.95	31.8
Approach		340	2.3	340	2.3	0.545	38.1	LOS C	4.4	31.7	0.96	0.79	0.96	31.3
All Vehicles		1420	2.3	1420	2.3	0.545	29.2	LOS C	9.0	64.5	0.87	0.80	0.87	32.8

[redacted]

Lane Use and Performance

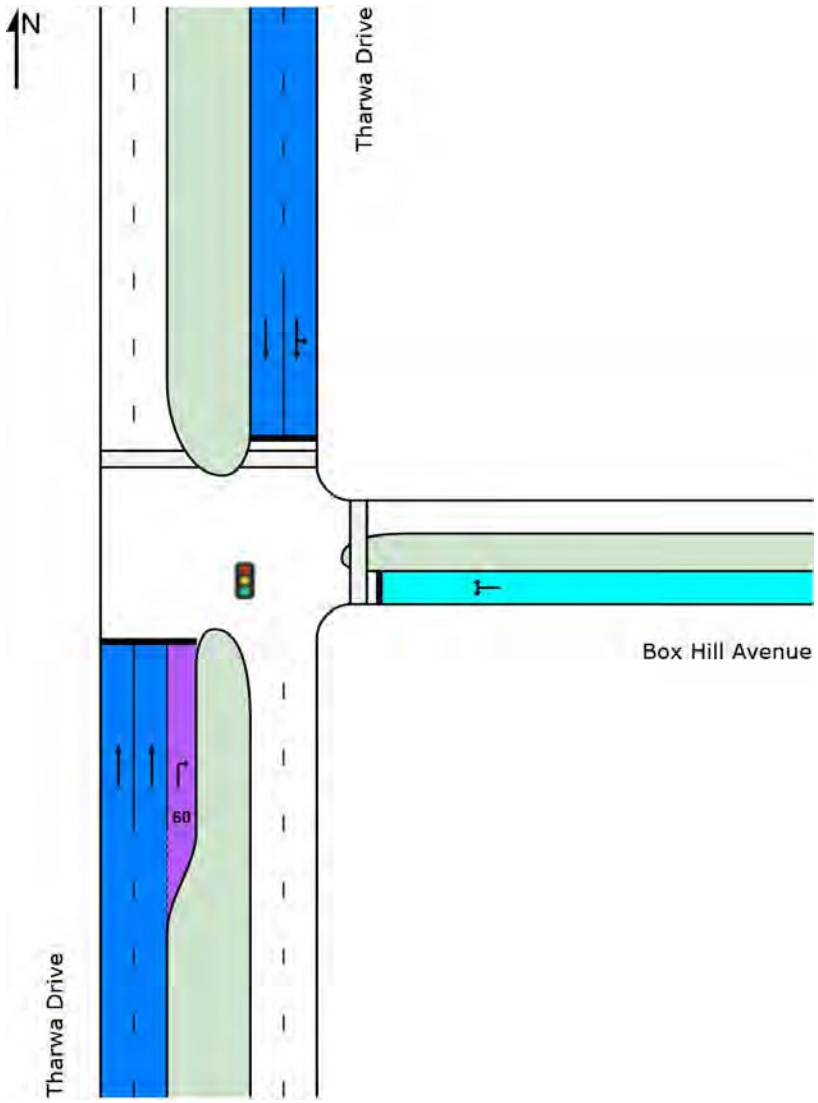
	Demand Flows		Arrival Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	Aver. Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
South: Tharwa Drive															
Lane 1	241	2.3	241	2.3	633	0.380	100	30.2	LOS C	5.5	39.5	Full	990	0.0	0.0
Lane 2	241	2.3	241	2.3	633	0.380	100	34.3	LOS C	6.0	42.8	Full	990	0.0	0.0
Lane 3	47	2.3	47	2.3	130	0.363	100	51.6	LOS D	1.3	9.1	Short	60	0.0	NA
Approach	528	2.3	528	2.3		0.380		34.0	LOS C	6.0	42.8				
East: Box Hill Avenue															
Lane 1	552	2.3	552	2.3	1025	0.538	100	19.1	LOS B	9.0	64.5	Full	105	0.0	5.2
Approach	552	2.3	552	2.3		0.538		19.1	LOS B	9.0	64.5				
North: Tharwa Drive															
Lane 1	182	2.3	182	2.3	334	0.545	100	41.1	LOS C	4.4	31.7	Full	640	0.0	0.0
Lane 2	158	2.3	158	2.3	351	0.449	82[5]	34.7	LOS C	3.7	26.5	Full	640	0.0	0.0
Approach	340	2.3	340	2.3		0.545		38.1	LOS C	4.4	31.7				
Intersection	1420	2.3	1420	2.3		0.545		29.2	LOS C	9.0	64.5				

[redacted]

5 Lane under-utilisation found by the program

Lane Level of Service

	Approaches			Intersection
	South	East	North	
LOS	C	B	C	C



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

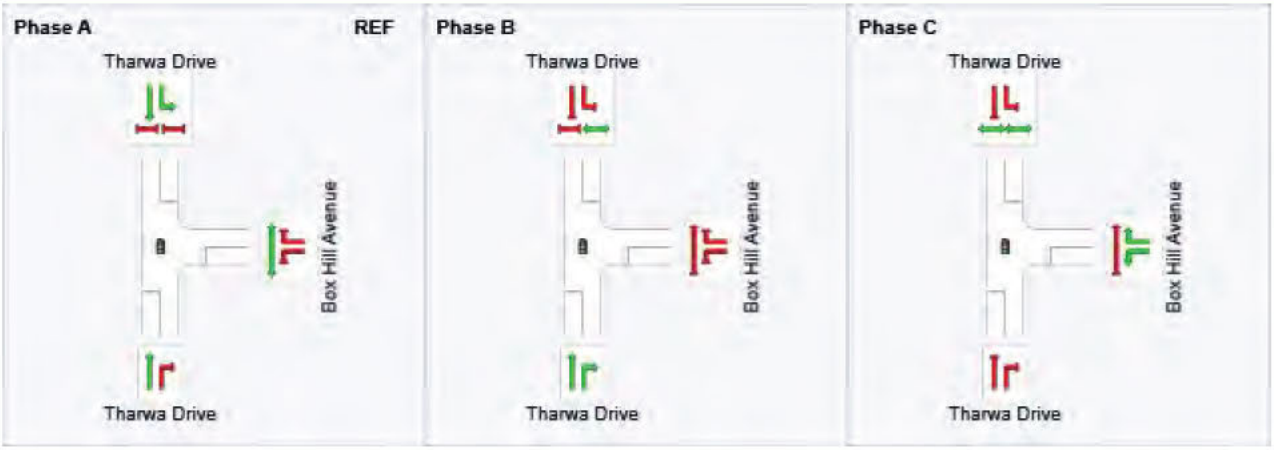
[redacted]

Phase Timing Summary

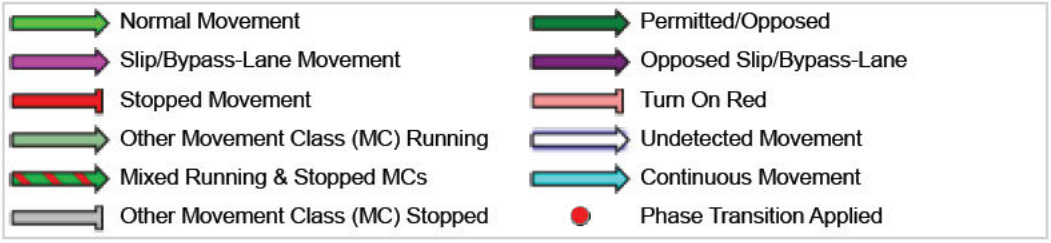
Phase	A	B	C
Phase Change Time (sec)	45	66	78
Green Time (sec)	15	6	46
Phase Time (sec)	21	12	52
Phase Split	25%	14%	61%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase



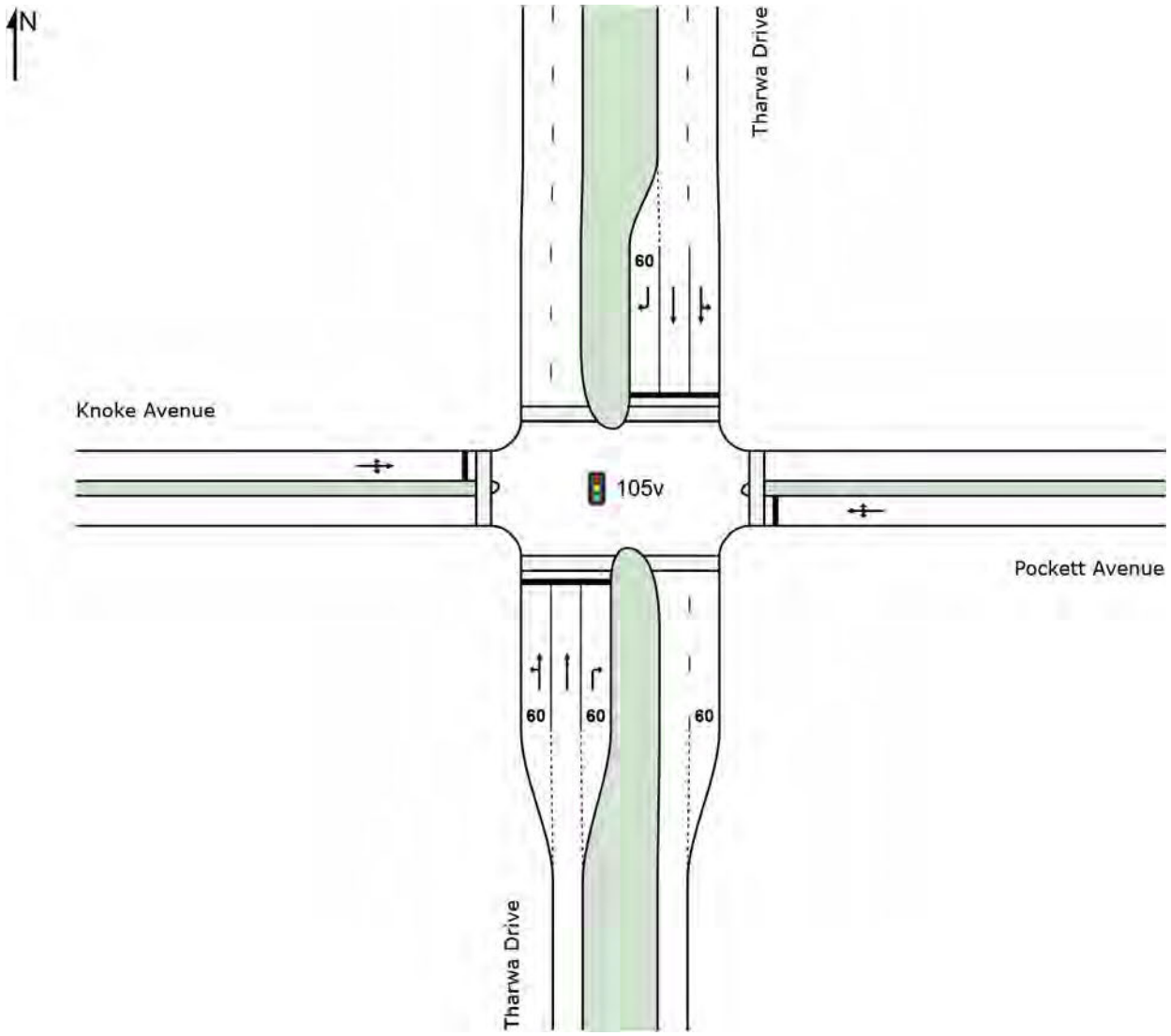
Site: 105v [2031_AM Peak_Tharwa Drive / Pockett Avenue - Roundabout]

Network: 9 [2031 Future Conditions with Upgrades_Tharwa Drive AM peak - Op3]

Signalised cross intersection - Duplicated
Site Category: AM Peak 2031 Conditions
Signals - Fixed Time Coordinated Cycle Time = 85 seconds (Network User-Given Cycle Time)

Timings based on settings in the Network Timing dialog
Phase Times determined by the program
Downstream lane blockage effects included in determining phase times
Phase Sequence: Diamond Phasing
Reference Phase: Phase A
Input Phase Sequence: A, B, C, D
Output Phase Sequence: A, B, C, D

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
1	L2	1	2.3	1	2.3	0.135	45.2	LOS D	0.6	4.4	0.95	0.68	0.95	15.8
2	T1	49	2.3	49	2.3	0.135	39.7	LOS C	0.6	4.4	0.95	0.68	0.95	26.1
3	R2	1	2.3	1	2.3	0.008	46.2	LOS D	0.0	0.2	0.95	0.59	0.95	25.4
Approach		52	2.3	52	2.3	0.135	39.9	LOS C	0.6	4.4	0.95	0.68	0.95	25.7
East: Pockett Avenue														
4	L2	2	2.3	2	2.3	0.498	30.7	LOS C	6.3	44.8	0.86	0.80	0.86	31.7
5	T1	27	2.3	27	2.3	0.498	25.6	LOS B	6.3	44.8	0.86	0.80	0.86	16.7
6	R2	272	2.3	272	2.3	0.498	30.7	LOS C	6.3	44.8	0.86	0.80	0.86	9.9
Approach		301	2.3	301	2.3	0.498	30.3	LOS C	6.3	44.8	0.86	0.80	0.86	10.9
North: Tharwa Drive														
7	L2	72	2.3	72	2.3	0.402	46.9	LOS D	1.8	12.6	0.96	0.75	0.96	34.1
8	T1	36	2.3	36	2.3	0.191	43.3	LOS D	0.9	6.7	1.00	0.73	1.00	40.5
9	R2	57	2.3	57	2.3	0.425	33.8	LOS C	1.1	8.0	0.75	0.70	0.75	38.6
Approach		164	2.3	164	2.3	0.425	41.6	LOS C	1.8	12.6	0.89	0.73	0.89	37.1
West: Knoke Avenue														
10	L2	192	2.3	192	2.3	0.500	36.5	LOS C	5.0	36.0	0.92	0.80	0.92	9.5
11	T1	29	2.3	29	2.3	0.500	31.0	LOS C	5.0	36.0	0.92	0.80	0.92	14.6
12	R2	3	2.3	3	2.3	0.500	36.5	LOS C	5.0	36.0	0.92	0.80	0.92	29.8
Approach		224	2.3	224	2.3	0.500	35.8	LOS C	5.0	36.0	0.92	0.80	0.92	10.7
All Vehicles		741	2.3	741	2.3	0.500	35.1	LOS C	6.3	44.8	0.89	0.78	0.89	23.5

[redacted]

Lane Use and Performance

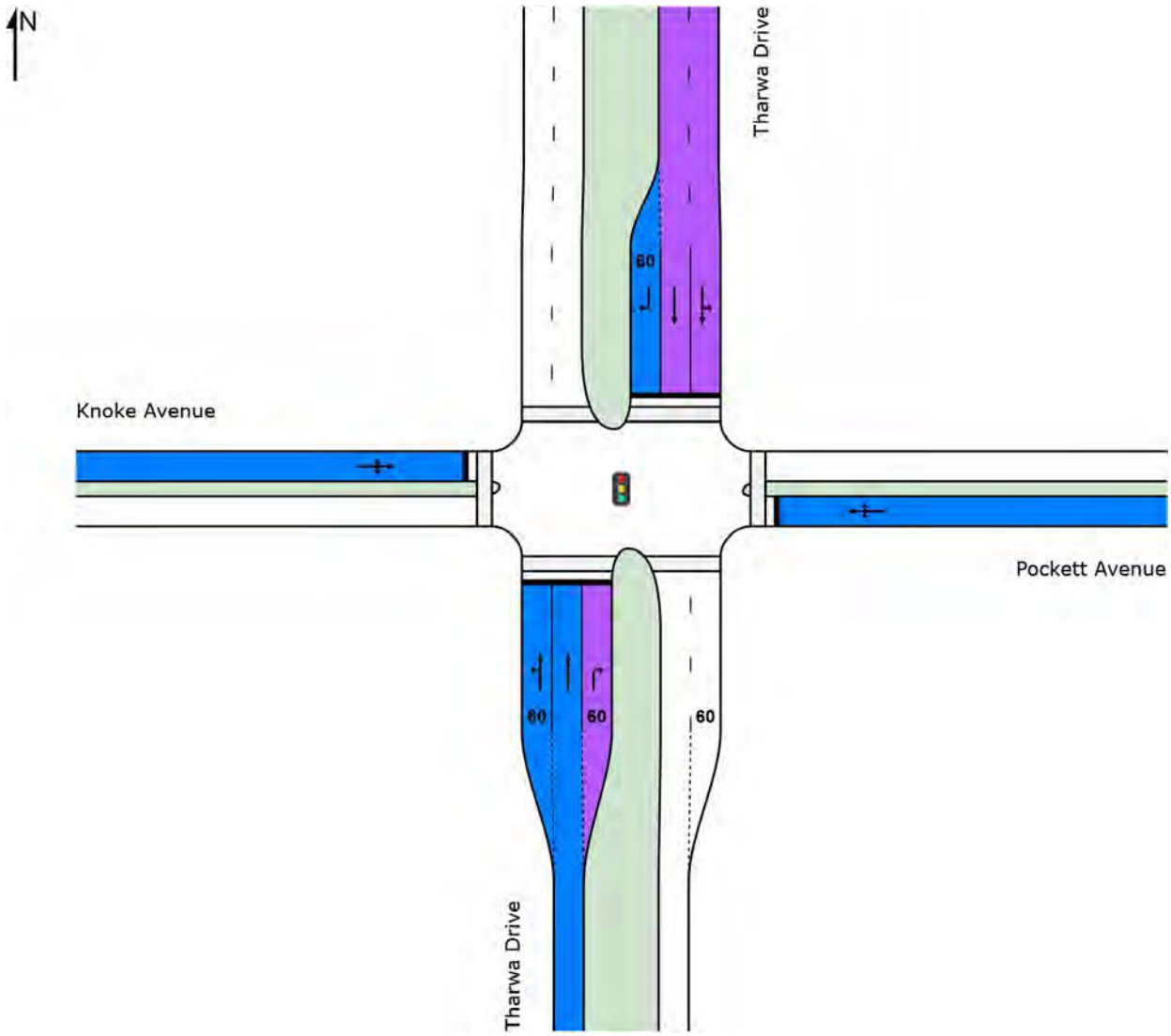
	Demand Flows		Arrival Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	Aver. Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
South: Tharwa Drive															
Lane 1	25	2.3	25	2.3	187	0.135	100	39.9	LOS C	0.6	4.4	Short	60	0.0	NA
Lane 2	25	2.3	25	2.3	187	0.135	100	39.7	LOS C	0.6	4.4	Full	500	0.0	0.0
Lane 3	1	2.3	1	2.3	134	0.008	100	46.2	LOS D	0.0	0.2	Short	60	0.0	NA
Approach	52	2.3	52	2.3		0.135		39.9	LOS C	0.6	4.4				
East: Pockett Avenue															
Lane 1	301	2.3	301	2.3	604	0.498	100	30.3	LOS C	6.3	44.8	Full	80	0.0	0.0
Approach	301	2.3	301	2.3		0.498		30.3	LOS C	6.3	44.8				
North: Tharwa Drive															
Lane 1	72	2.3	72	2.3	178	0.402	100	46.9	LOS D	1.8	12.6	Full	990	0.0	0.0
Lane 2	36	2.3	36	2.3	187	0.191	48[5]	43.3	LOS D	0.9	6.7	Full	990	0.0	0.0
Lane 3	57	2.3	57	2.3	134	0.425	100	33.8	LOS C	1.1	8.0	Short	60	0.0	NA
Approach	164	2.3	164	2.3		0.425		41.6	LOS C	1.8	12.6				
West: Knoke Avenue															
Lane 1	224	2.3	224	2.3	448	0.500	100	35.8	LOS C	5.0	36.0	Full	95	0.0	0.0
Approach	224	2.3	224	2.3		0.500		35.8	LOS C	5.0	36.0				
Intersection	741	2.3	741	2.3		0.500		35.1	LOS C	6.3	44.8				

[redacted]

5 Lane under-utilisation found by the program

Lane Level of Service

	Approaches				Intersection
	South	East	North	West	
LOS	C	C	C	C	C



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Phase Timing Summary

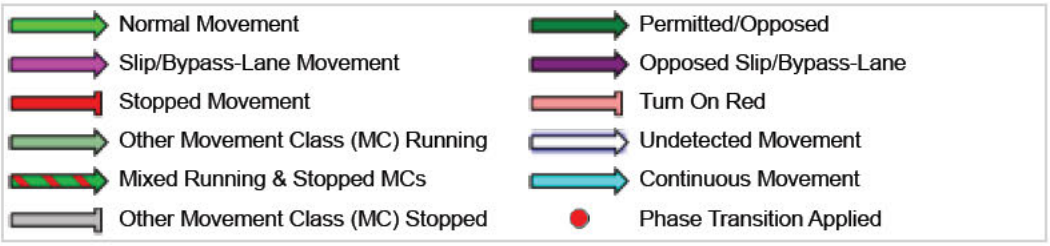
Phase	A	B	C	D
Phase Change Time (sec)	0	14	26	59
Green Time (sec)	8	6	27	20
Phase Time (sec)	14	12	33	26
Phase Split	16%	14%	39%	31%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase

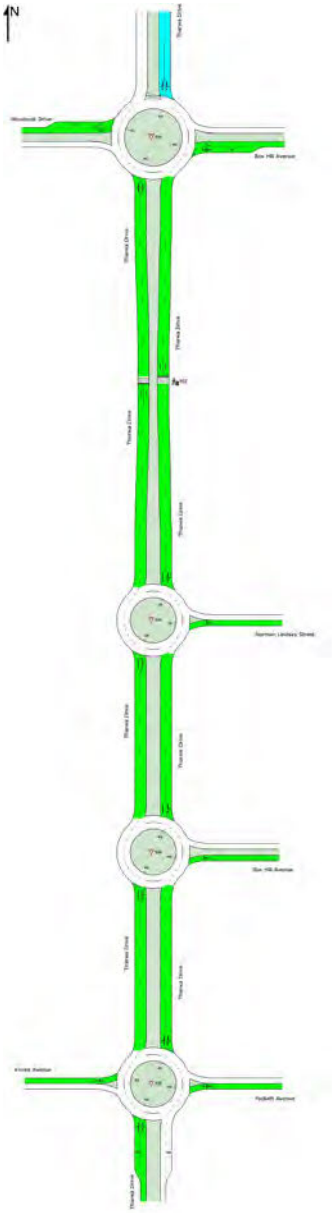


DEGREE OF SATURATION

Ratio of Demand Volume to Capacity, v/c ratio per lane

Network: N101 [2031 Future Conditions with Upgrades_Tharwa Drive PM peak - Op4]

2031 Future Conditions - Upgraded Layout
Network Category: (None)



Colour code based on Degree of Saturation

[< 0.6]	[0.6 – 0.7]	[0.7 – 0.8]	[0.8 – 0.9]	[0.9 – 1.0]	[> 1.0]

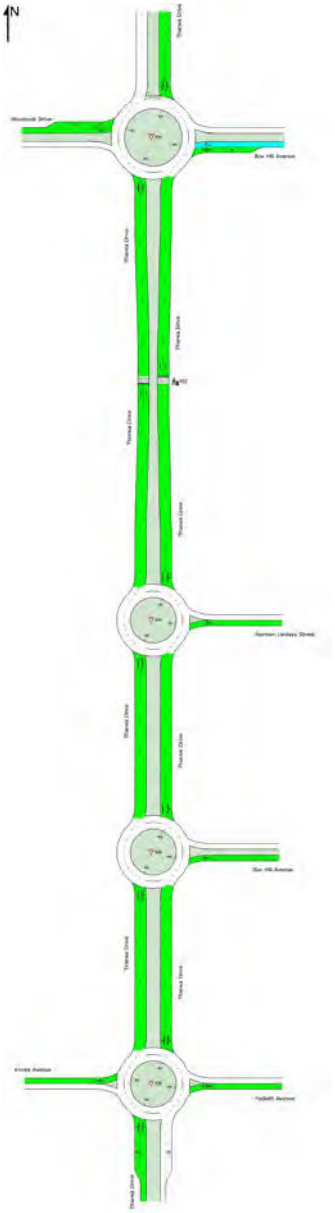
SIDRA INTERSECTION 8.0 | Copyright © 2000-2019 Akcelik and Associates Pty Ltd | sidrasolutions.com

LANE LEVEL OF SERVICE

Lane Level of Service for Network Sites

Network: N101 [2031 Future Conditions with Upgrades_Tharwa Drive PM peak - Op4]

2031 Future Conditions - Upgraded Layout
Network Category: (None)



Colour code based on Level of Service

LOS A	LOS B	LOS C	LOS D	LOS E	LOS F

Delay model settings are specified for individual Sites forming the Network.

USER REPORT FOR NETWORK SITE

Project: 2031 Conditions

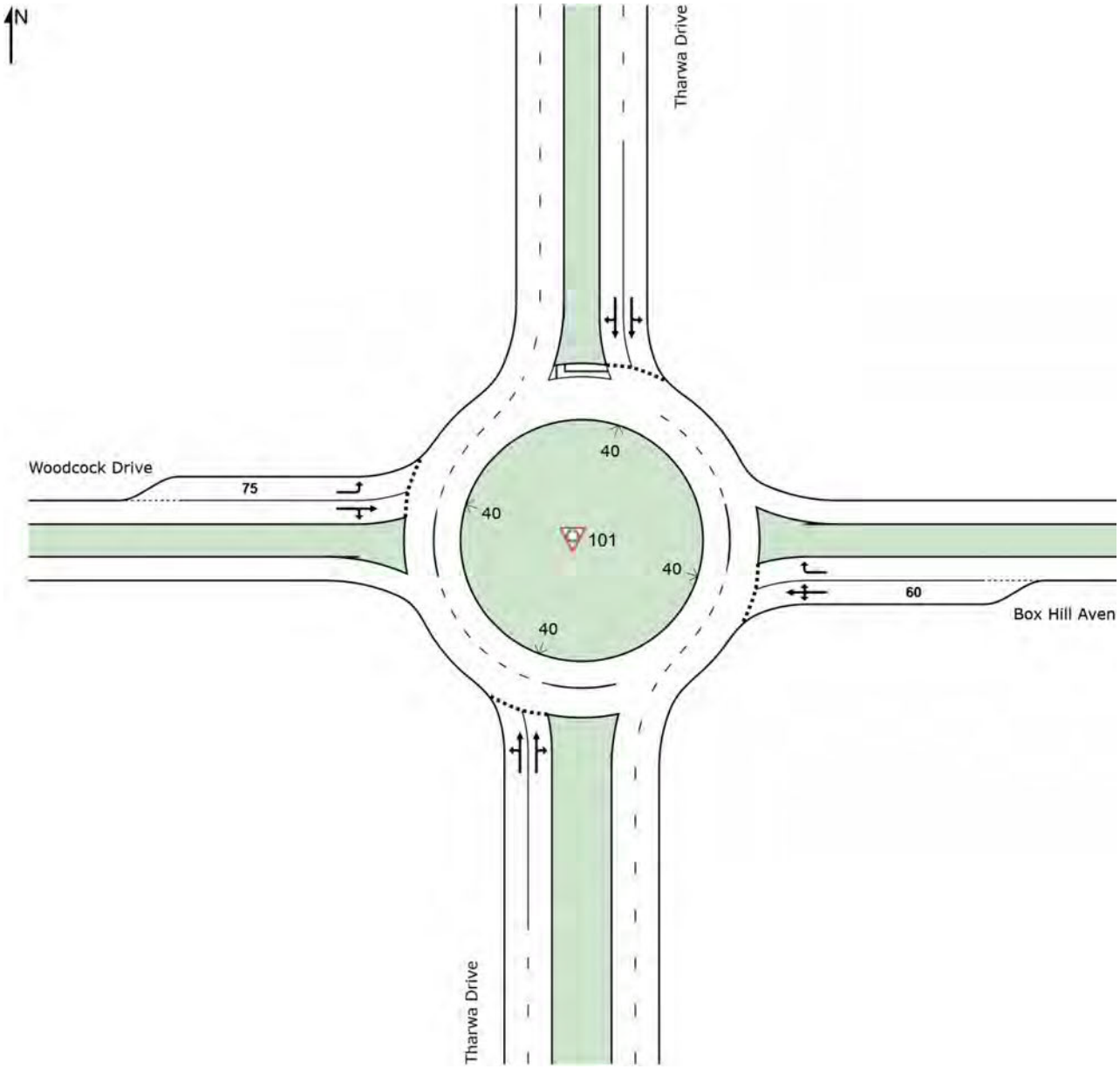
Template: Default Site User Report (2)

Site: 101 [2031_AM Peak_Tharwa Drive / Woodcock Drive - Duplicated w. Ped Xing]

Network: 12 [2031 Future Conditions with Upgrades_Tharwa Drive AM peak - Op4]

Two lane roundabout with ped xing to south - Duplicated
Site Category: AM Peak 2031 Conditions
Roundabout

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
1	L2	75	2.3	75	2.3	0.578	6.4	LOS A	1.4	10.2	0.67	0.77	0.80	49.2
2	T1	943	2.3	943	2.3	0.578	6.8	LOS A	1.4	10.2	0.68	0.81	0.83	53.7
3	R2	2	2.3	2	2.3	0.578	13.5	LOS A	1.3	9.4	0.70	0.85	0.86	39.5
Approach		1020	2.3	1020	2.3	0.578	6.7	LOS A	1.4	10.2	0.68	0.81	0.83	53.4
East: Box Hill Avenue														
4	L2	13	2.3	13	2.3	0.390	4.8	LOS A	0.8	6.0	0.55	0.69	0.55	34.1
5	T1	96	2.3	96	2.3	0.390	4.6	LOS A	0.8	6.0	0.55	0.69	0.55	49.4
6	R2	737	2.3	737	2.3	0.390	11.2	LOS A	0.8	6.0	0.56	0.73	0.56	50.7
Approach		845	2.3	845	2.3	0.390	10.4	LOS A	0.8	6.0	0.56	0.73	0.56	50.5
North: Tharwa Drive														
7	L2	362	2.3	362	2.3	0.271	3.7	LOS A	0.8	5.6	0.43	0.44	0.43	53.4
8	T1	343	2.3	343	2.3	0.271	3.4	LOS A	0.8	5.6	0.45	0.43	0.45	50.3
9	R2	67	2.3	67	2.3	0.271	10.4	LOS A	0.7	5.3	0.45	0.43	0.45	57.0
Approach		773	2.3	773	2.3	0.271	4.1	LOS A	0.8	5.6	0.44	0.44	0.44	52.6
West: Woodcock Drive														
10	L2	121	2.3	121	2.3	0.207	8.2	LOS A	0.4	2.8	0.75	0.85	0.75	52.3
11	T1	132	2.3	132	2.3	0.221	6.1	LOS A	0.5	3.4	0.77	0.73	0.77	50.6
12	R2	56	2.3	56	2.3	0.221	13.0	LOS A	0.5	3.4	0.77	0.73	0.77	44.5
Approach		308	2.3	308	2.3	0.221	8.2	LOS A	0.5	3.4	0.76	0.78	0.76	50.6
All Vehicles		2946	2.3	2946	2.3	0.578	7.2	LOS A	1.4	10.2	0.59	0.68	0.64	51.9

[redacted]

Lane Use and Performance

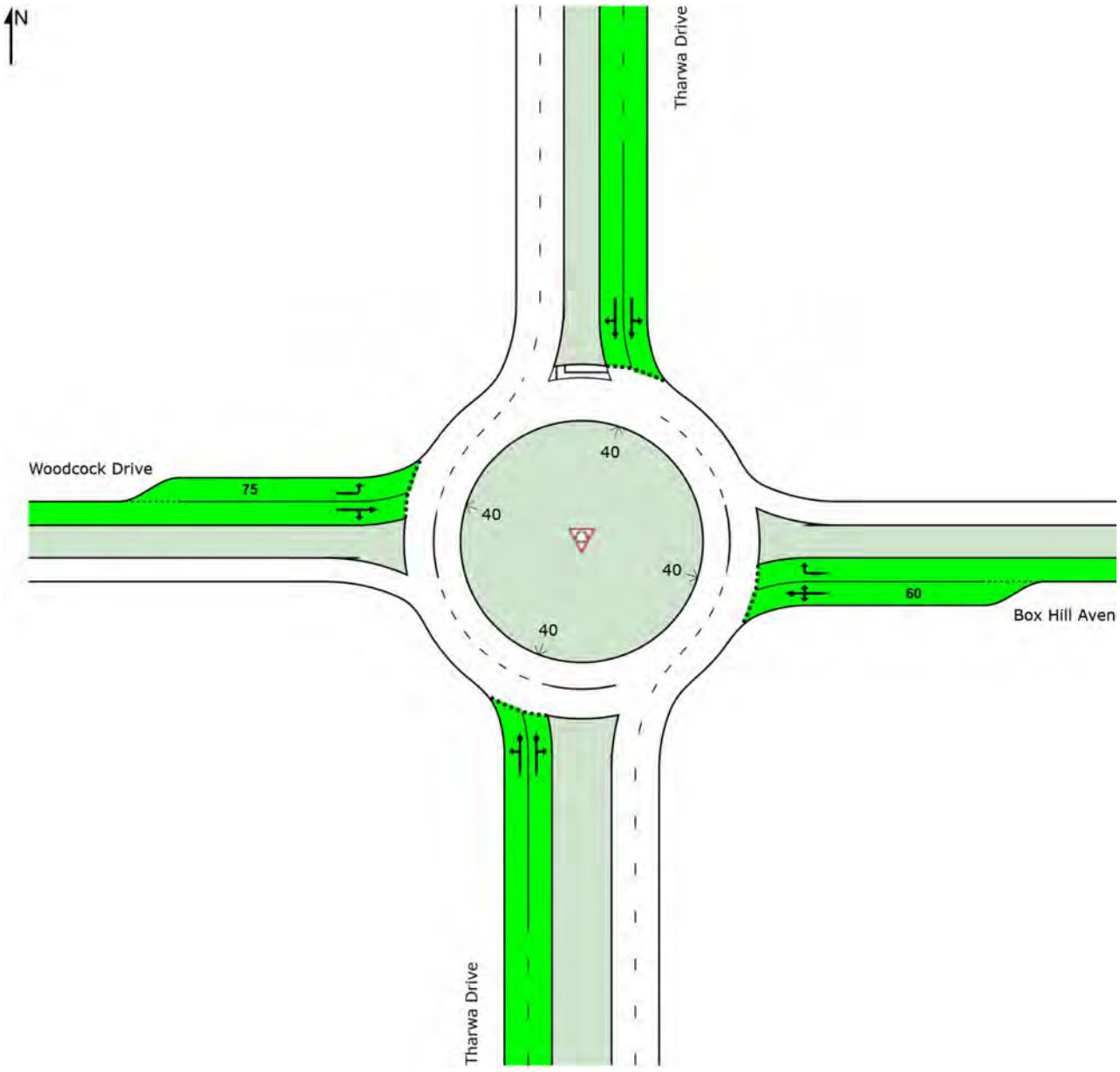
	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	Aver. Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Tharwa Drive															
Lane 1[d]	568	2.3	568	2.3	983	0.578	100	6.3	LOS A	1.4	10.2	Full	75	0.0	0.0
Lane 2	452	2.3	452	2.3	781	0.578	100	7.4	LOS A	1.3	9.4	Full	75	0.0	0.0
Approach	1020	2.3	1020	2.3		0.578		6.7	LOS A	1.4	10.2				
East: Box Hill Avenue															
Lane 1[d]	458	2.3	458	2.3	1175	0.390	100	9.5	LOS A	0.8	6.0	Short	60	0.0	NA
Lane 2	388	2.3	388	2.3	995	0.390	100	11.4	LOS A	0.8	5.8	Full	150	0.0	0.0
Approach	845	2.3	845	2.3		0.390		10.4	LOS A	0.8	6.0				
North: Tharwa Drive															
Lane 1[d]	427	2.3	427	2.3	1573	0.271	100	3.6	LOS A	0.8	5.6	Full	490	0.0	0.0
Lane 2	346	2.3	346	2.3	1275	0.271	100	4.8	LOS A	0.7	5.3	Full	490	0.0	0.0
Approach	773	2.3	773	2.3		0.271		4.1	LOS A	0.8	5.6				
West: Woodcock Drive															
Lane 1	121	2.3	121	2.3	586	0.207	100	8.2	LOS A	0.4	2.8	Short	75	0.0	NA
Lane 2[d]	187	2.3	187	2.3	848	0.221	100	8.2	LOS A	0.5	3.4	Full	380	0.0	0.0
Approach	308	2.3	308	2.3		0.221		8.2	LOS A	0.5	3.4				
Intersection	2946	2.3	2946	2.3		0.578		7.2	LOS A	1.4	10.2				



d Dominant lane on roundabout approach

Lane Level of Service

	Approaches				Intersection
	South	East	North	West	
LOS	A	A	A	A	A



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

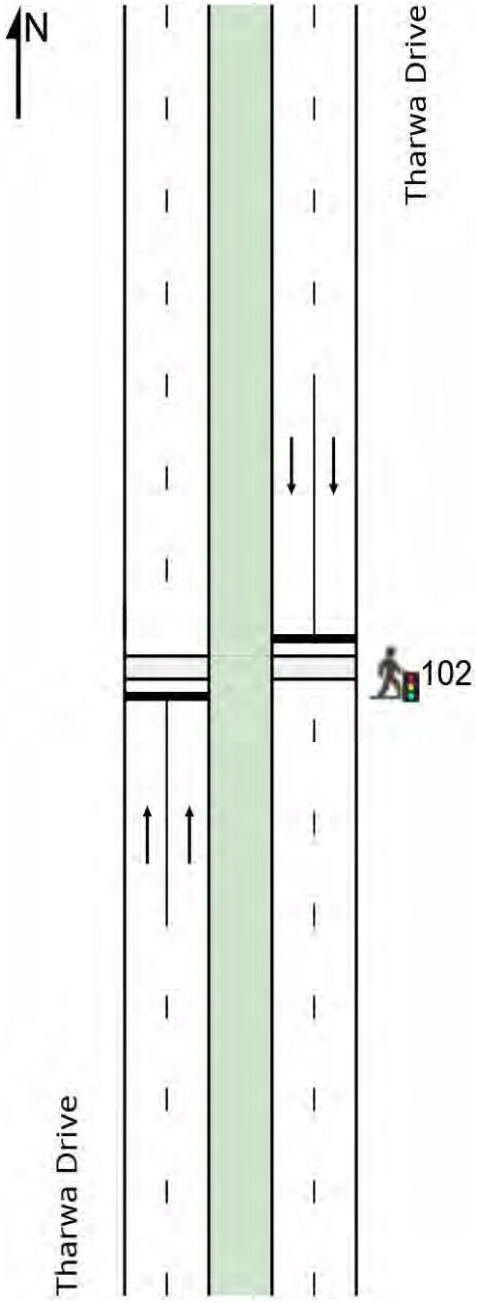
Site: 102 [2031_AM Peak_Tharwa Drive Pedestrian Crossing - Duplicated]

Network: 12 [2031 Future Conditions with Upgrades_Tharwa Drive AM peak - Op4]

Pedestrian Crossing - Duplicated
Site Category: AM Peak 2031 Conditions
Pedestrian Crossing (Signals) - Fixed Time Isolated Cycle Time = 20 seconds (Site Practical Cycle Time)

Timings based on settings in the Site Phasing & Timing dialog
Phase Times determined by the program
Downstream lane blockage effects included in determining phase times
Phase Sequence: Two-Phase
Reference Phase: Phase A
Input Phase Sequence: A, B
Output Phase Sequence: A, B

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
2	T1	1020	2.3	1020	2.3	0.394	1.9	LOS A	1.5	10.8	0.50	0.43	0.50	43.5
Approach		1020	2.3	1020	2.3	0.394	1.9	LOS A	1.5	10.8	0.50	0.43	0.50	43.5
North: Tharwa Drive														
8	T1	412	2.3	412	2.3	0.159	1.5	LOS A	0.5	3.6	0.41	0.34	0.41	45.7
Approach		412	2.3	412	2.3	0.159	1.5	LOS A	0.5	3.6	0.41	0.34	0.41	45.7
All Vehicles		1432	2.3	1432	2.3	0.394	1.8	LOS A	1.5	10.8	0.48	0.40	0.48	44.1

[redacted]

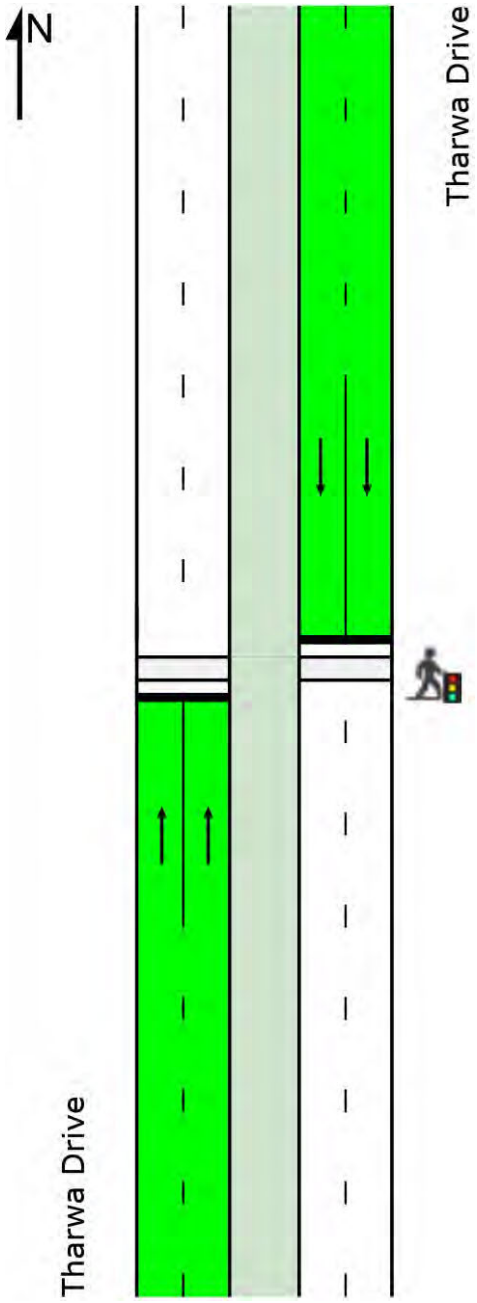
Lane Use and Performance

	Demand Flows		Arrival Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	Aver. Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
South: Tharwa Drive															
Lane 1	510	2.3	510	2.3	1294	0.394	100	1.9	LOS A	1.5	10.8	Full	80	0.0	0.0
Lane 2	510	2.3	510	2.3	1294	0.394	100	1.9	LOS A	1.5	10.8	Full	80	0.0	0.0
Approach	1020	2.3	1020	2.3		0.394		1.9	LOS A	1.5	10.8				
North: Tharwa Drive															
Lane 1	206	2.3	206	2.3	1294	0.159	100	1.5	LOS A	0.5	3.6	Full	75	0.0	0.0
Lane 2	206	2.3	206	2.3	1294	0.159	100	1.5	LOS A	0.5	3.6	Full	75	0.0	0.0
Approach	412	2.3	412	2.3		0.159		1.5	LOS A	0.5	3.6				
Intersection	1432	2.3	1432	2.3		0.394		1.8	LOS A	1.5	10.8				

[redacted]

Lane Level of Service

	Approaches		Intersection
	South	North	
LOS	A	A	A



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Phase Timing Summary

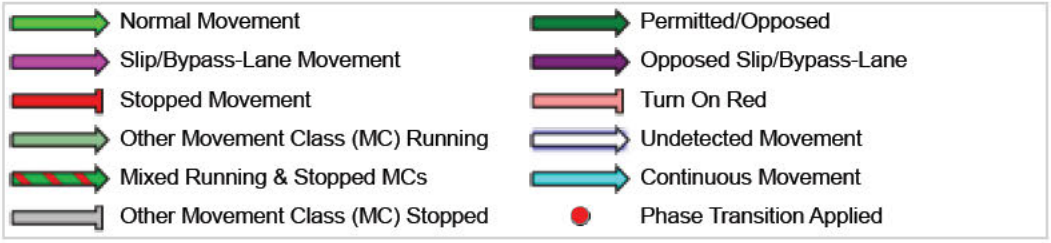
Phase	A	B
Phase Change Time (sec)	0	19
Green Time (sec)	13	1
Phase Time (sec)	13	7
Phase Split	65%	35%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase

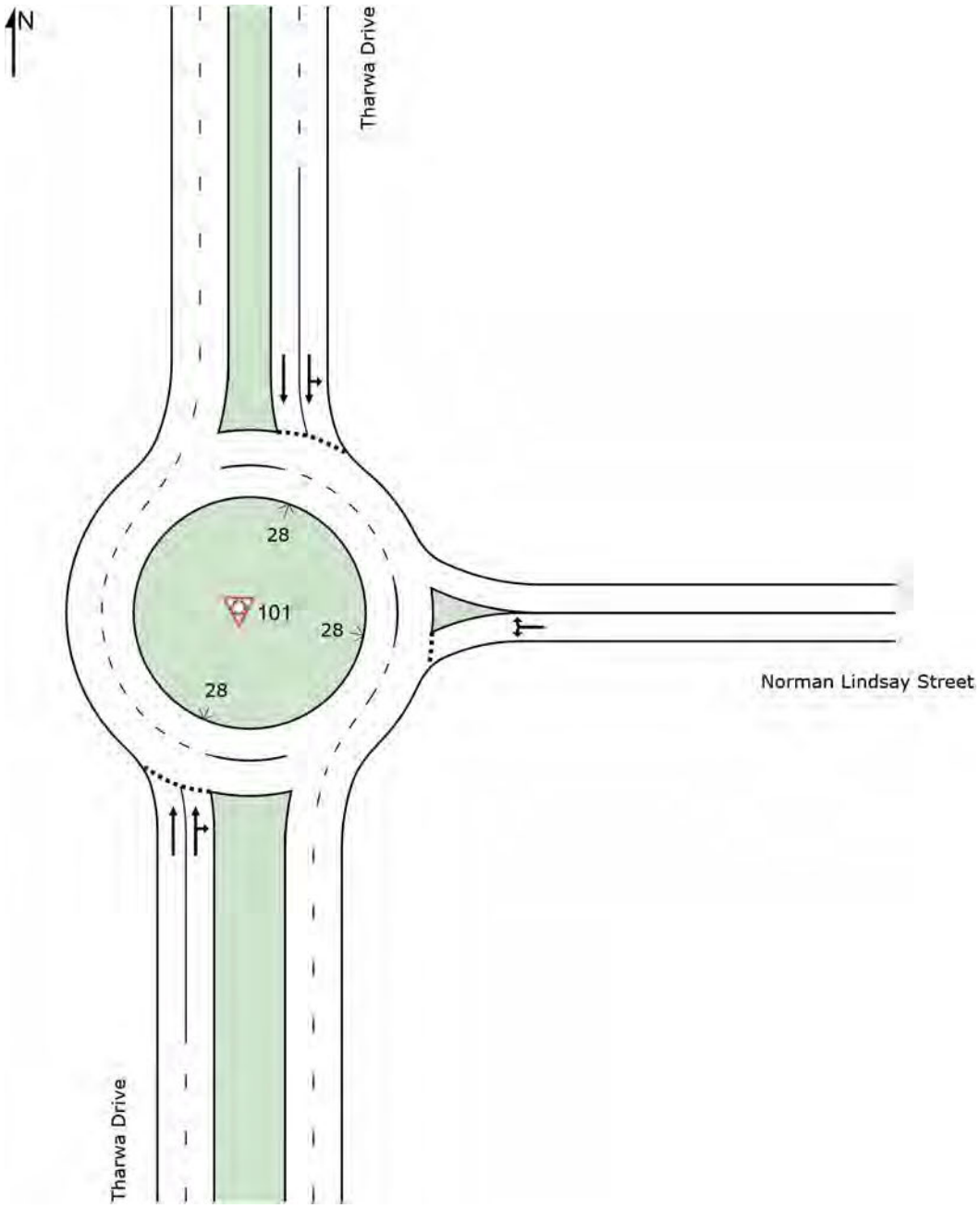


Site: 101 [2031_AM Peak_Tharwa Drive / Norman Lindsay Street - Roundabout]

Network: 12 [2031 Future Conditions with Upgrades_Tharwa Drive AM peak - Op4]

Two lane roundabout with ped xing to the north - Duplicated
Site Category: AM Peak 2031 Conditions
Roundabout

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
2	T1	871	2.3	871	2.3	0.377	4.3	LOS A	0.9	6.5	0.35	0.46	0.35	51.9
3	R2	147	2.3	147	2.3	0.377	9.9	LOS A	0.9	6.5	0.36	0.51	0.36	49.8
Approach		1018	2.3	1018	2.3	0.377	5.1	LOS A	0.9	6.5	0.35	0.46	0.35	51.6
East: Norman Lindsay Street														
4	L2	77	2.3	77	2.3	0.206	3.1	LOS A	0.4	2.8	0.39	0.64	0.39	27.5
6	R2	146	2.3	146	2.3	0.206	8.4	LOS A	0.4	2.8	0.39	0.64	0.39	27.5
Approach		223	2.3	223	2.3	0.206	6.6	LOS A	0.4	2.8	0.39	0.64	0.39	27.5
North: Tharwa Drive														
7	L2	140	2.3	140	2.3	0.167	3.8	LOS A	0.3	1.9	0.24	0.44	0.24	14.7
8	T1	275	2.3	275	2.3	0.167	3.8	LOS A	0.3	1.9	0.25	0.41	0.25	36.5
Approach		415	2.3	415	2.3	0.167	3.8	LOS A	0.3	1.9	0.25	0.42	0.25	23.2
All Vehicles		1656	2.3	1656	2.3	0.377	5.0	LOS A	0.9	6.5	0.33	0.48	0.33	46.6

[redacted]

Lane Use and Performance

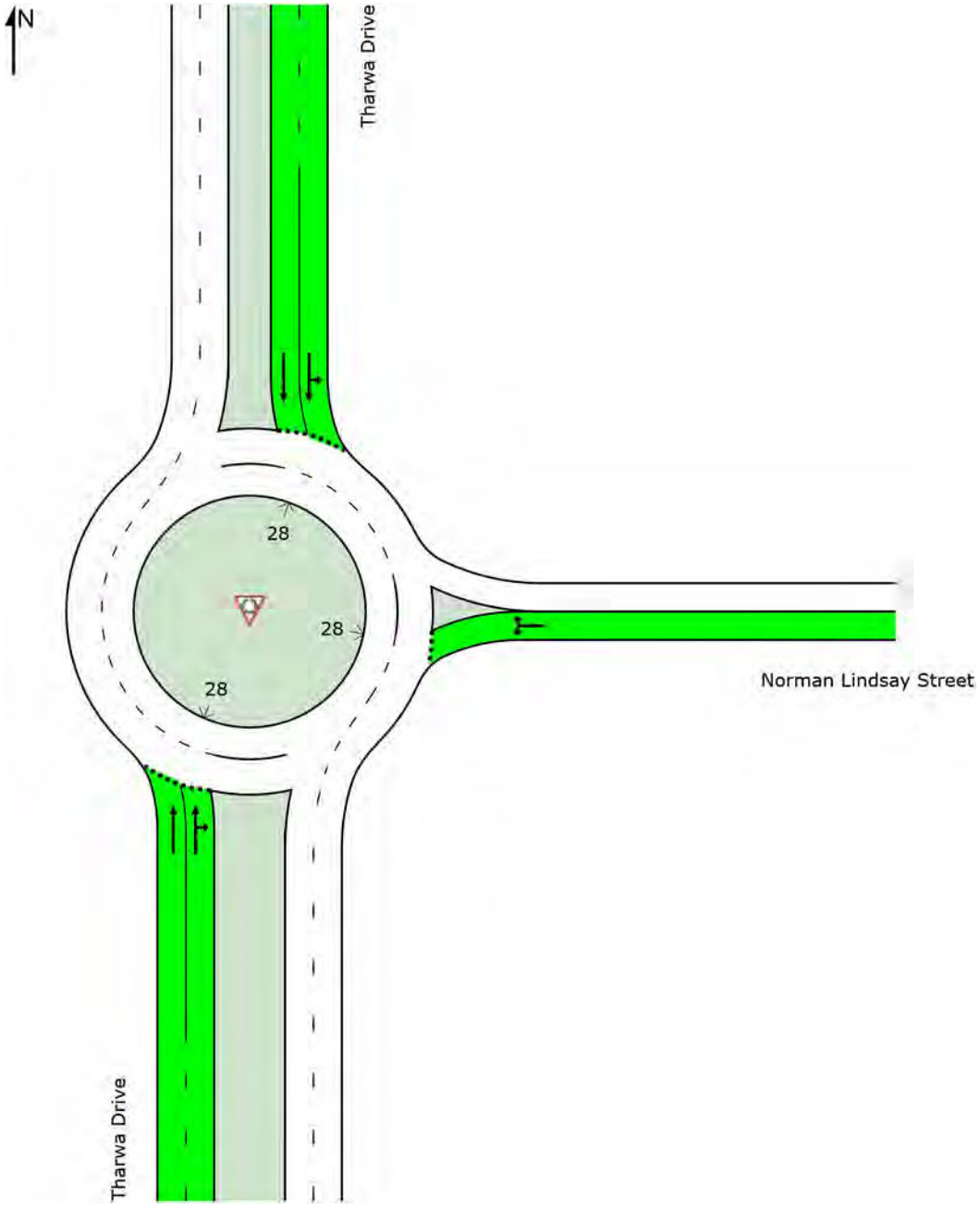
	Demand Flows		Arrival Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	Aver. Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
South: Tharwa Drive															
Lane 1[d]	533	2.3	533	2.3	1415	0.377	100	4.3	LOS A	0.9	6.5	Full	640	0.0	0.0
Lane 2	485	2.3	485	2.3	1288	0.377	100	6.1	LOS A	0.9	6.5	Full	640	0.0	0.0
Approach	1018	2.3	1018	2.3		0.377		5.1	LOS A	0.9	6.5				
East: Norman Lindsay Street															
Lane 1[d]	223	2.3	223	2.3	1082	0.206	100	6.6	LOS A	0.4	2.8	Full	40	0.0	0.0
Approach	223	2.3	223	2.3		0.206		6.6	LOS A	0.4	2.8				
North: Tharwa Drive															
Lane 1[d]	215	2.3	215	2.3	1290	0.167	100	3.8	LOS A	0.3	1.9	Full	80	0.0	0.0
Lane 2	200	2.3	200	2.3	1199	0.167	100	3.8	LOS A	0.3	1.9	Full	80	0.0	0.0
Approach	415	2.3	415	2.3		0.167		3.8	LOS A	0.3	1.9				
Intersection	1656	2.3	1656	2.3		0.377		5.0	LOS A	0.9	6.5				

[redacted]

d Dominant lane on roundabout approach

Lane Level of Service

	Approaches			Intersection
	South	East	North	
LOS	A	A	A	A



Colour code based on Level of Service

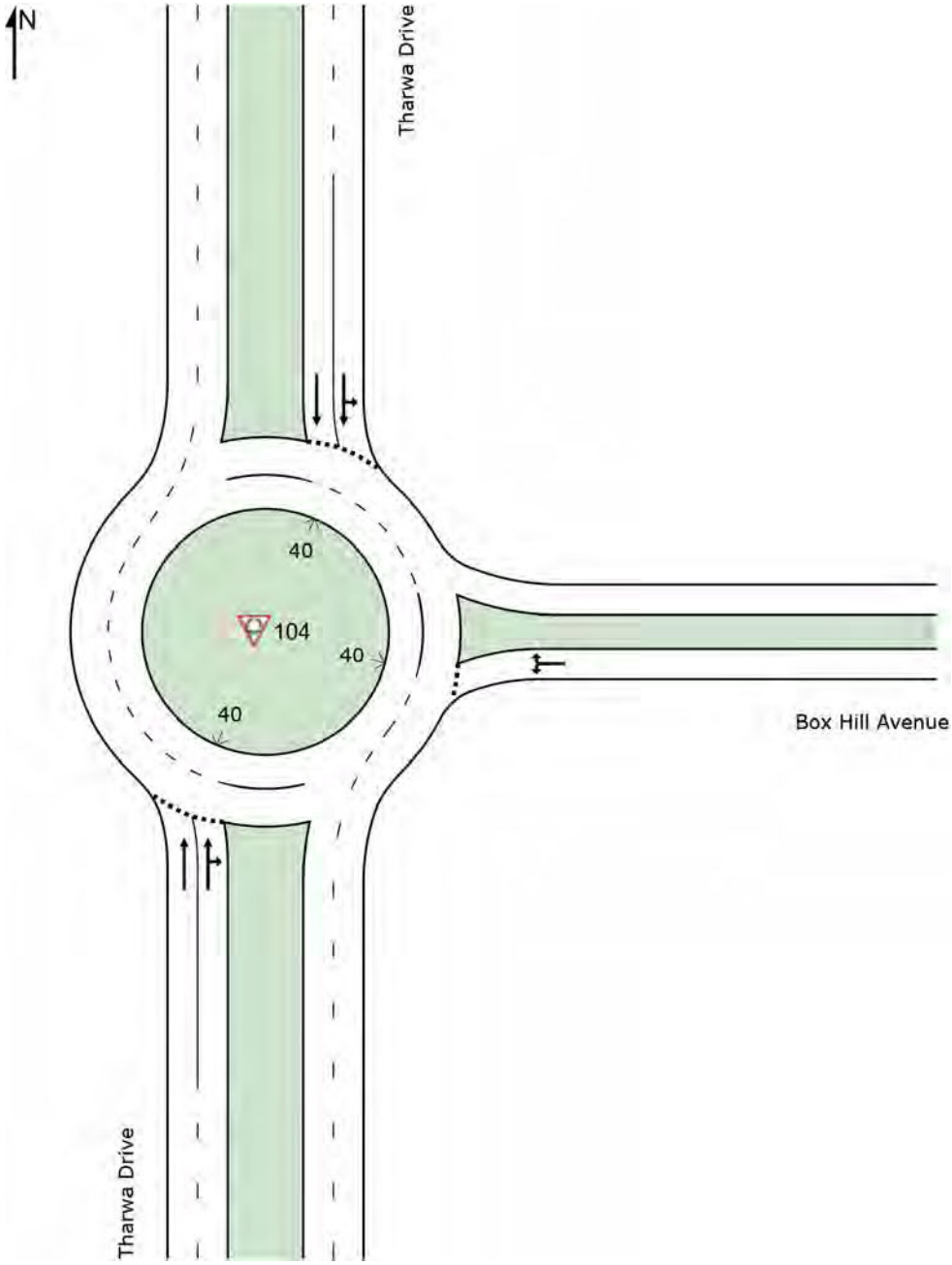
LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site: 104 [2031_AM Peak_Tharwa Drive / Box Hill Avenue - Roundabout]

Network: 12 [2031 Future Conditions with Upgrades_Tharwa Drive AM peak - Op4]

Single Lane Roundabout - Duplicated
Site Category: AM Peak 2031 Conditions
Roundabout

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
2	T1	481	2.3	481	2.3	0.258	5.1	LOS A	0.6	4.4	0.60	0.55	0.60	53.7
3	R2	47	2.3	47	2.3	0.258	12.0	LOS A	0.6	4.2	0.61	0.60	0.61	52.6
Approach		528	2.3	528	2.3	0.258	5.7	LOS A	0.6	4.4	0.60	0.55	0.60	53.6
East: Box Hill Avenue														
4	L2	18	2.3	18	2.3	0.437	3.9	LOS A	1.0	7.5	0.38	0.63	0.38	30.7
6	R2	534	2.3	534	2.3	0.437	10.3	LOS A	1.0	7.5	0.38	0.63	0.38	30.7
Approach		552	2.3	552	2.3	0.437	10.1	LOS A	1.0	7.5	0.38	0.63	0.38	30.7
North: Tharwa Drive														
7	L2	182	2.3	182	2.3	0.117	3.3	LOS A	0.2	1.7	0.16	0.39	0.16	55.4
8	T1	158	2.3	158	2.3	0.114	2.9	LOS A	0.2	1.6	0.16	0.29	0.16	54.9
Approach		340	2.3	340	2.3	0.117	3.1	LOS A	0.2	1.7	0.16	0.34	0.16	55.2
All Vehicles		1420	2.3	1420	2.3	0.437	6.8	LOS A	1.0	7.5	0.41	0.53	0.41	49.7

[redacted]

Lane Use and Performance

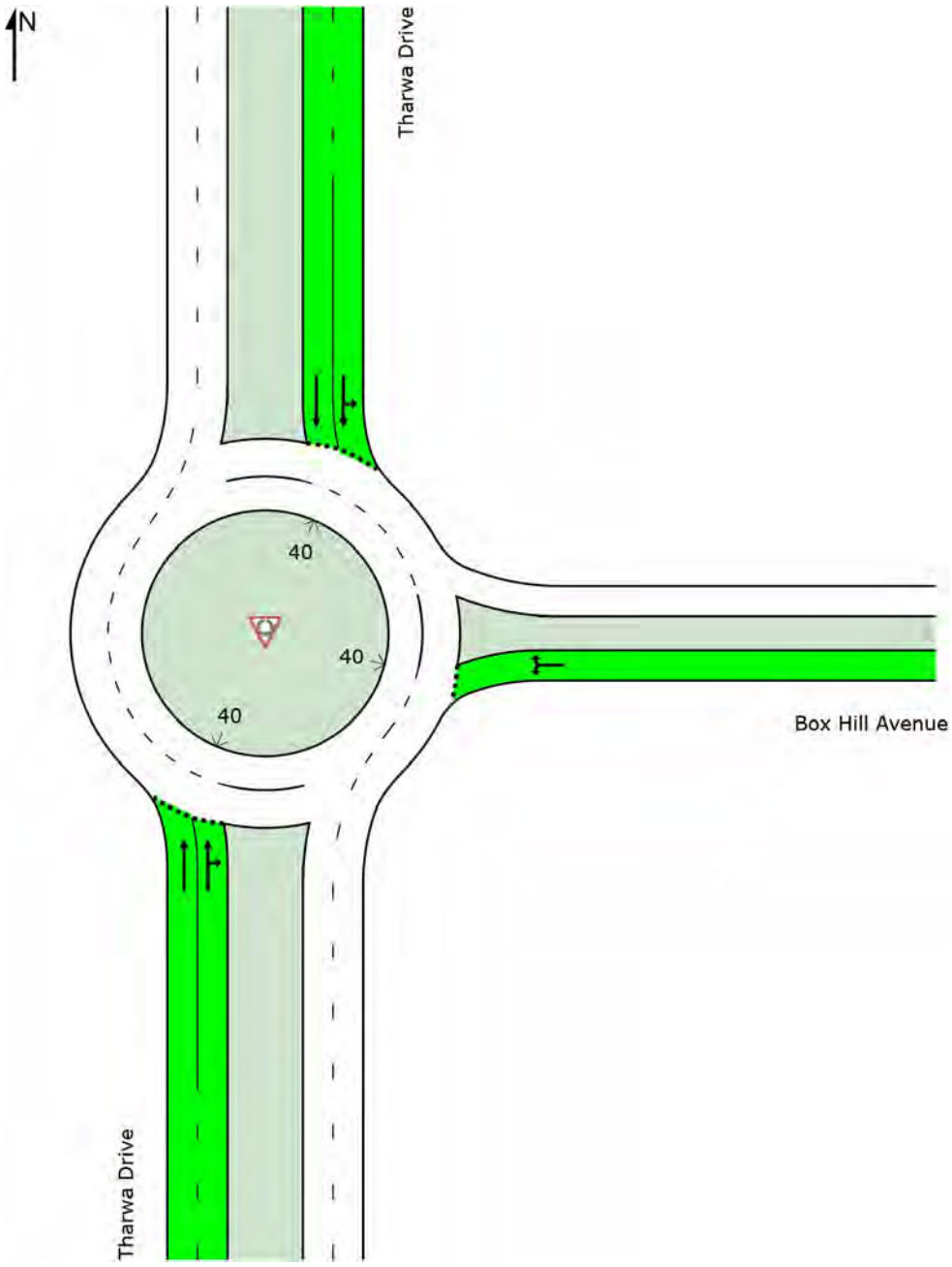
	Demand Flows		Arrival Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	Aver. Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
South: Tharwa Drive															
Lane 1[d]	285	2.3	285	2.3	1104	0.258	100	4.9	LOS A	0.6	4.4	Full	990	0.0	0.0
Lane 2	243	2.3	243	2.3	941	0.258	100	6.6	LOS A	0.6	4.2	Full	990	0.0	0.0
Approach	528	2.3	528	2.3		0.258		5.7	LOS A	0.6	4.4				
East: Box Hill Avenue															
Lane 1[d]	552	2.3	552	2.3	1263	0.437	100	10.1	LOS A	1.0	7.5	Full	105	0.0	0.0
Approach	552	2.3	552	2.3		0.437		10.1	LOS A	1.0	7.5				
North: Tharwa Drive															
Lane 1[d]	182	2.3	182	2.3	1557	0.117	100	3.3	LOS A	0.2	1.7	Full	640	0.0	0.0
Lane 2	158	2.3	158	2.3	1389	0.114	97[5]	2.9	LOS A	0.2	1.6	Full	640	0.0	0.0
Approach	340	2.3	340	2.3		0.117		3.1	LOS A	0.2	1.7				
Intersection	1420	2.3	1420	2.3		0.437		6.8	LOS A	1.0	7.5				

[redacted]

5 Lane under-utilisation found by the program
d Dominant lane on roundabout approach

Lane Level of Service

	Approaches			Intersection
	South	East	North	
LOS	A	A	A	A



Colour code based on Level of Service

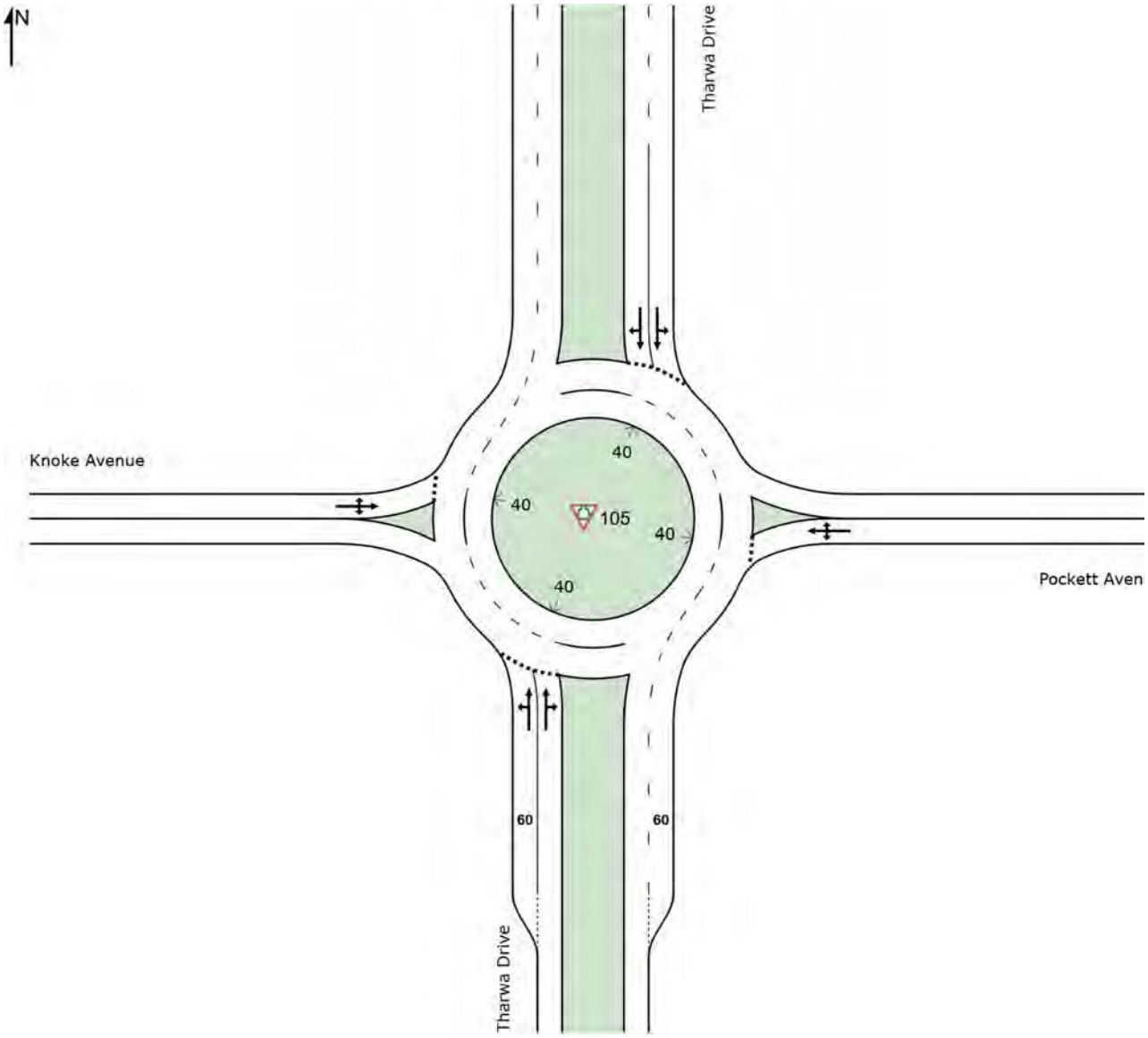
LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site: 105 [2031_AM Peak_Tharwa Drive / Pockett Avenue - Roundabout]

Network: 12 [2031 Future Conditions with Upgrades_Tharwa Drive AM peak - Op4]

Two lane roundabout - Duplicated
Site Category: AM Peak 2031 Conditions
Roundabout

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
1	L2	1	2.3	1	2.3	0.022	4.2	LOS A	0.0	0.3	0.39	0.39	0.39	52.9
2	T1	49	2.3	49	2.3	0.022	3.8	LOS A	0.0	0.3	0.39	0.40	0.39	51.4
3	R2	1	2.3	1	2.3	0.022	10.6	LOS A	0.0	0.3	0.40	0.42	0.40	50.1
Approach		52	2.3	52	2.3	0.022	4.0	LOS A	0.0	0.3	0.39	0.40	0.39	51.4
East: Pockett Avenue														
4	L2	2	2.3	2	2.3	0.229	3.0	LOS A	0.4	3.1	0.23	0.60	0.23	48.9
5	T1	27	2.3	27	2.3	0.229	2.8	LOS A	0.4	3.1	0.23	0.60	0.23	14.9
6	R2	272	2.3	272	2.3	0.229	9.3	LOS A	0.4	3.1	0.23	0.60	0.23	31.1
Approach		301	2.3	301	2.3	0.229	8.7	LOS A	0.4	3.1	0.23	0.60	0.23	27.4
North: Tharwa Drive														
7	L2	72	2.3	72	2.3	0.052	3.3	LOS A	0.1	0.7	0.12	0.38	0.12	55.9
8	T1	36	2.3	36	2.3	0.059	2.8	LOS A	0.1	0.8	0.11	0.52	0.11	57.2
9	R2	57	2.3	57	2.3	0.059	9.5	LOS A	0.1	0.8	0.11	0.52	0.11	44.5
Approach		164	2.3	164	2.3	0.059	5.4	LOS A	0.1	0.8	0.12	0.46	0.12	51.8
West: Knoke Avenue														
10	L2	192	2.3	192	2.3	0.209	4.2	LOS A	0.4	2.7	0.42	0.52	0.42	35.4
11	T1	29	2.3	29	2.3	0.209	4.0	LOS A	0.4	2.7	0.42	0.52	0.42	27.9
12	R2	3	2.3	3	2.3	0.209	10.7	LOS A	0.4	2.7	0.42	0.52	0.42	57.7
Approach		224	2.3	224	2.3	0.209	4.3	LOS A	0.4	2.7	0.42	0.52	0.42	34.5
All Vehicles		741	2.3	741	2.3	0.229	6.3	LOS A	0.4	3.1	0.27	0.53	0.27	43.0



Lane Use and Performance

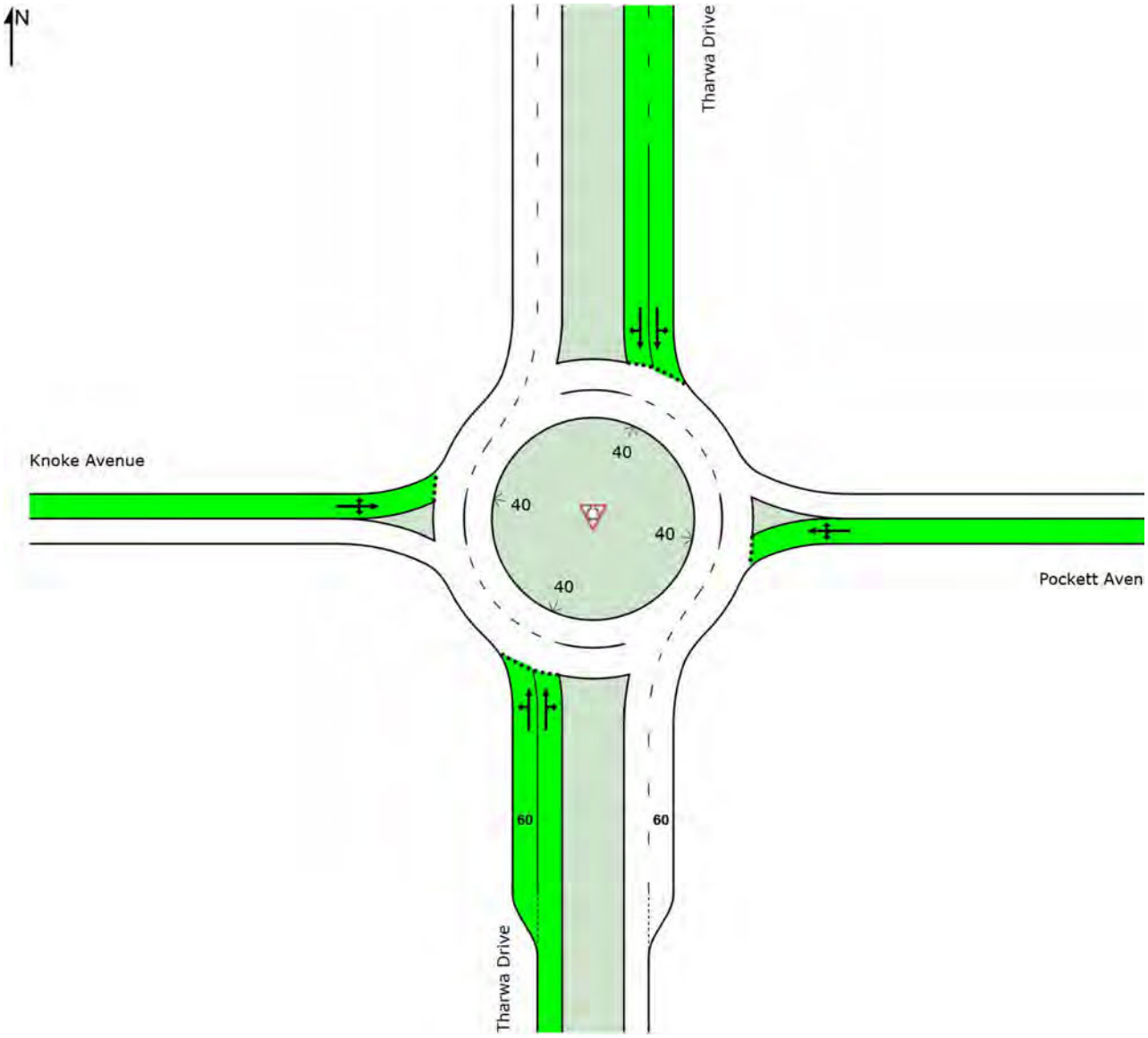
	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	Aver. Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Tharwa Drive															
Lane 1[d]	27	2.3	27	2.3	1259	0.022	100	3.8	LOS A	0.0	0.3	Short	60	0.0	NA
Lane 2	24	2.3	24	2.3	1107	0.022	100	4.2	LOS A	0.0	0.3	Full	500	0.0	0.0
Approach	52	2.3	52	2.3		0.022		4.0	LOS A	0.0	0.3				
East: Pockett Avenue															
Lane 1[d]	301	2.3	301	2.3	1313	0.229	100	8.7	LOS A	0.4	3.1	Full	80	0.0	0.0
Approach	301	2.3	301	2.3		0.229		8.7	LOS A	0.4	3.1				
North: Tharwa Drive															
Lane 1	72	2.3	72	2.3	1375	0.052	88[5]	3.3	LOS A	0.1	0.7	Full	990	0.0	0.0
Lane 2[d]	93	2.3	93	2.3	1558	0.059	100	6.9	LOS A	0.1	0.8	Full	990	0.0	0.0
Approach	164	2.3	164	2.3		0.059		5.4	LOS A	0.1	0.8				
West: Knoke Avenue															
Lane 1[d]	224	2.3	224	2.3	1073	0.209	100	4.3	LOS A	0.4	2.7	Full	95	0.0	0.0
Approach	224	2.3	224	2.3		0.209		4.3	LOS A	0.4	2.7				
Intersection	741	2.3	741	2.3		0.229		6.3	LOS A	0.4	3.1				



5 Lane under-utilisation found by the program
d Dominant lane on roundabout approach

Lane Level of Service

	Approaches				Intersection
	South	East	North	West	
LOS	A	A	A	A	A



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

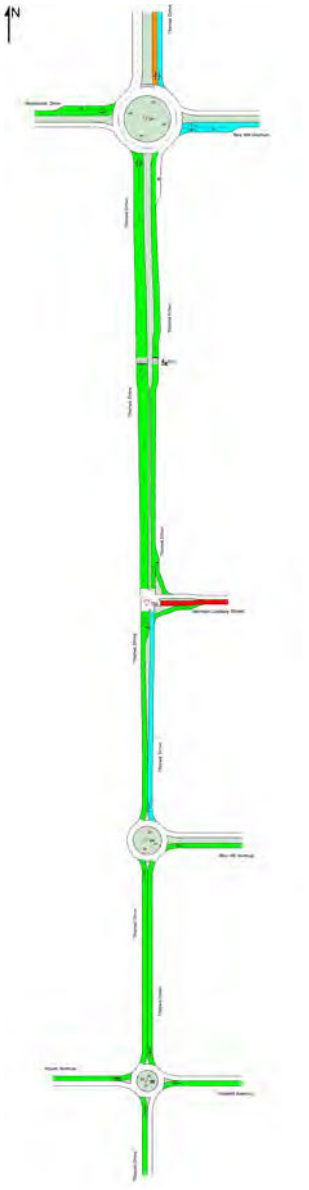
[redacted]

DEGREE OF SATURATION

Ratio of Demand Volume to Capacity, v/c ratio per lane

Network: N101 [2031 Future Conditions_Tharwa Drive PM peak - Base]

Future PM Peak Conditions - Existing Layout
Network Category: (None)



Colour code based on Degree of Saturation

[< 0.6]	[0.6 – 0.7]	[0.7 – 0.8]	[0.8 – 0.9]	[0.9 – 1.0]	[> 1.0]

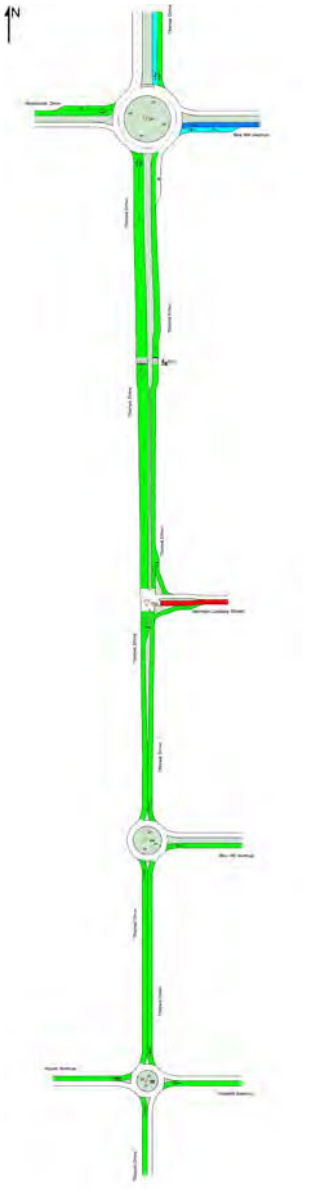
SIDRA INTERSECTION 8.0 | Copyright © 2000-2019 Akcelik and Associates Pty Ltd | sidrasolutions.com

LANE LEVEL OF SERVICE

Lane Level of Service for Network Sites

Network: N101 [2031 Future Conditions_Tharwa Drive PM peak - Base]

Future PM Peak Conditions - Existing Layout
Network Category: (None)



Colour code based on Level of Service

LOS A	LOS B	LOS C	LOS D	LOS E	LOS F

Delay model settings are specified for individual Sites forming the Network.

USER REPORT FOR NETWORK SITE

Project: 2031 Conditions

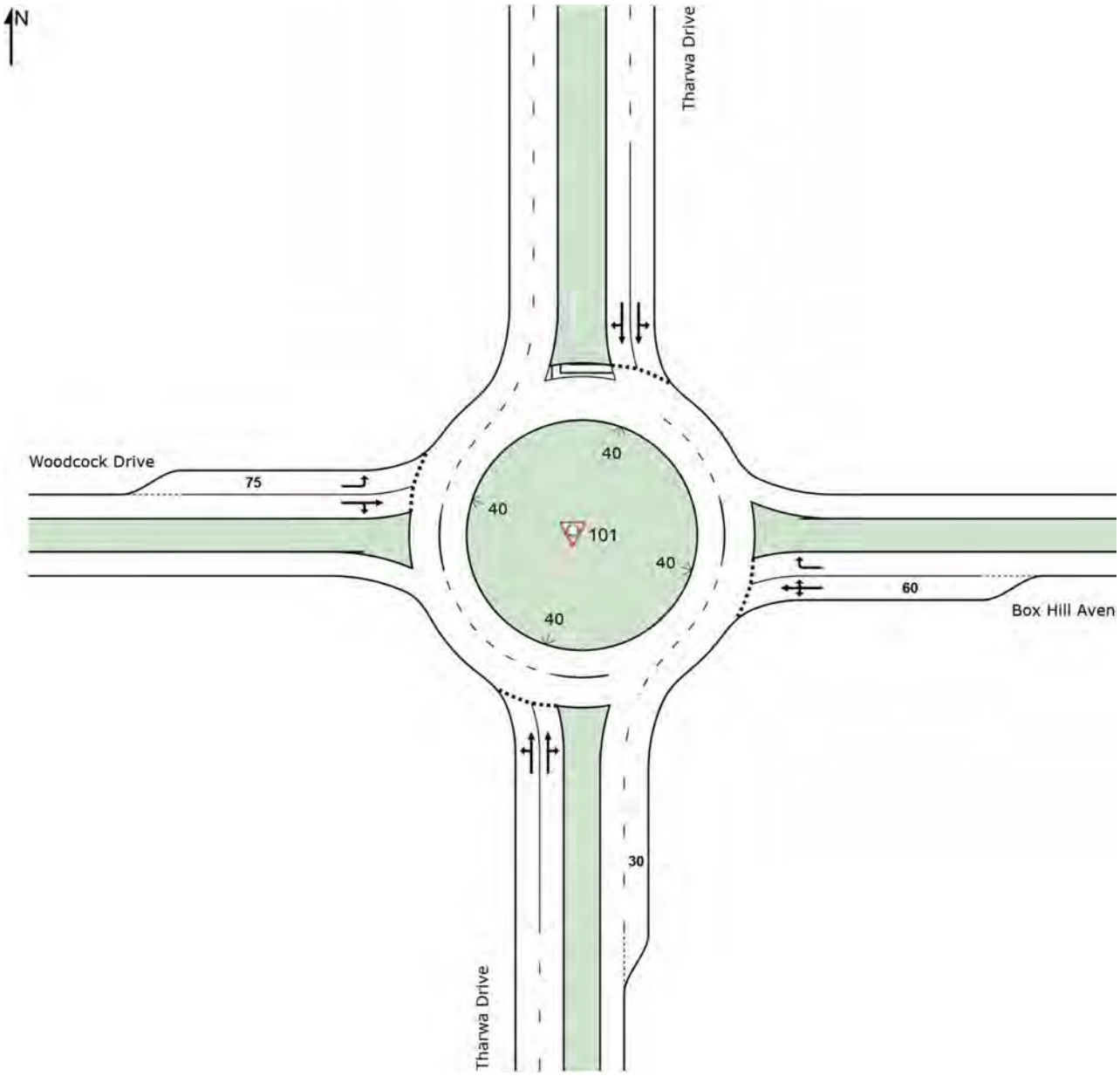
Template: Default Site User Report (2)

Site: 101 [2031_PM Peak_Tharwa Drive / Woodcock Drive - Base]

Network: 2 [2031 Future Conditions_Tharwa Drive PM peak - Base]

Two Lane Roundabout - Existing Layout
Site Category: PM Peak 2031 Conditions
Roundabout

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
1	L2	151	1.5	145	1.5	0.296	4.6	LOS A	0.6	4.6	0.65	0.58	0.65	49.8
2	T1	400	1.5	386	1.5	0.296	4.7	LOS A	0.6	4.6	0.65	0.58	0.65	54.3
3	R2	9	1.5	9	1.5	0.296	11.1	LOS A	0.6	4.3	0.66	0.58	0.66	40.4
Approach		560	1.5	540[N1]	1.5	0.296	4.8	LOS A	0.6	4.6	0.65	0.58	0.65	53.1
East: Box Hill Avenue														
4	L2	32	1.5	32	1.5	0.662	23.8	LOS B	3.3	23.5	1.00	1.22	1.57	19.7
5	T1	105	1.5	105	1.5	0.662	23.7	LOS B	3.3	23.5	1.00	1.22	1.57	35.6
6	R2	485	1.5	485	1.5	0.662	31.7	LOS C	3.3	23.5	1.00	1.21	1.57	37.0
Approach		622	1.5	622	1.5	0.662	29.9	LOS C	3.3	23.5	1.00	1.22	1.57	36.2
North: Tharwa Drive														
7	L2	797	1.5	797	1.5	0.637	4.8	LOS A	2.5	17.6	0.68	0.59	0.68	52.0
8	T1	972	1.5	972	1.5	0.985	20.1	LOS B	9.7	68.9	0.67	1.02	1.42	36.8
9	R2	113	1.5	113	1.5	0.985	27.0	LOS B	9.7	68.9	0.67	1.02	1.42	45.9
Approach		1881	1.5	1881	1.5	0.985	14.0	LOS A	9.7	68.9	0.68	0.84	1.10	43.3
West: Woodcock Drive														
10	L2	65	1.5	65	1.5	0.094	6.0	LOS A	0.2	1.1	0.60	0.71	0.60	54.1
11	T1	145	1.5	145	1.5	0.238	4.4	LOS A	0.4	2.9	0.62	0.59	0.62	52.1
12	R2	66	1.5	66	1.5	0.238	11.4	LOS A	0.4	2.9	0.62	0.59	0.62	45.9
Approach		277	1.5	277	1.5	0.238	6.5	LOS A	0.4	2.9	0.62	0.62	0.62	51.5
All Vehicles		3340	1.5	3320[N1]	1.5	0.985	14.9	LOS B	9.7	68.9	0.73	0.85	1.08	43.4

[redacted]

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

Lane Use and Performance

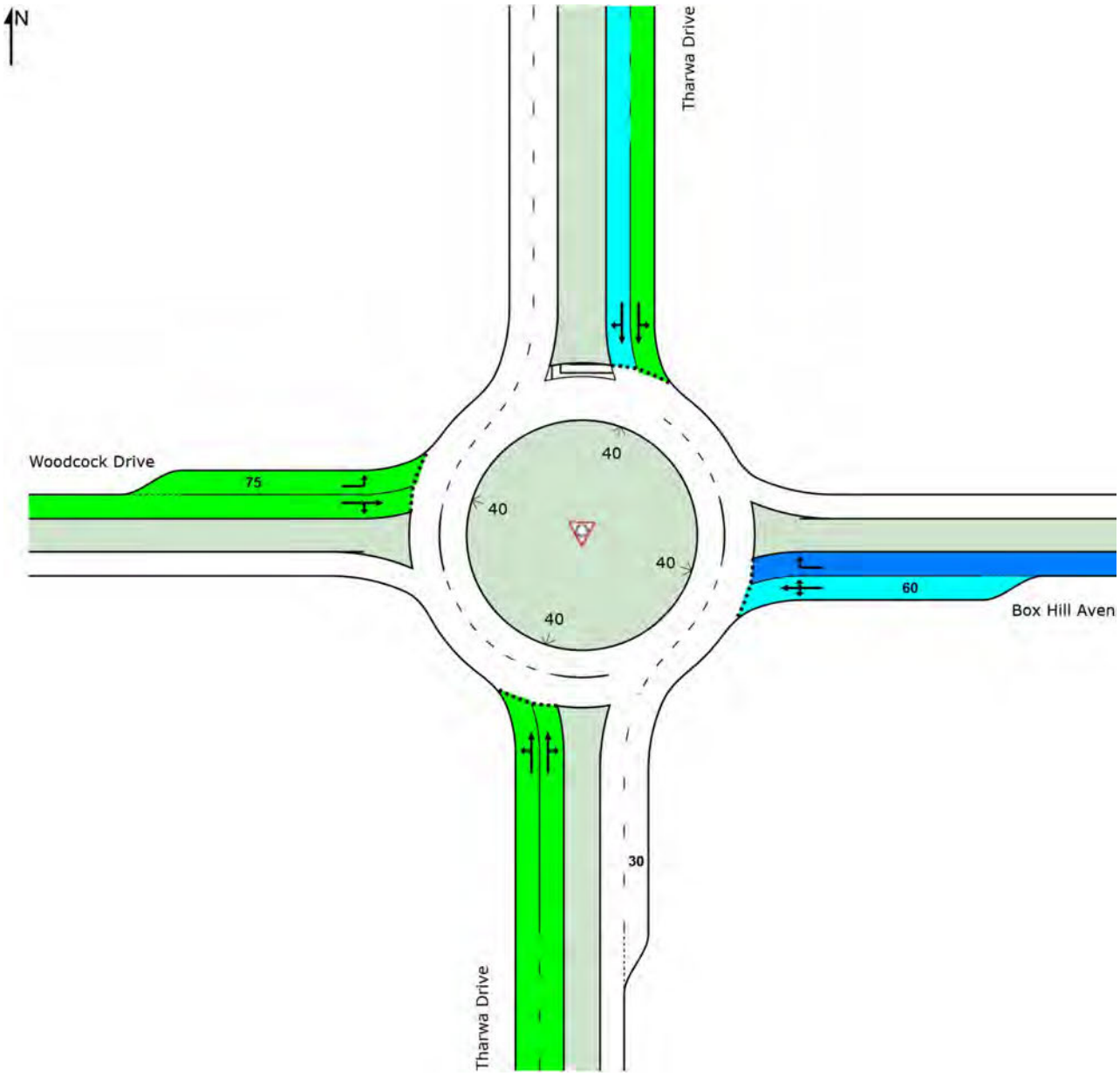
	Demand Flows		Arrival Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	Aver. Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
South: Tharwa Drive															
Lane 1[d]	307	1.5	296	1.5	1000	0.296	100	4.5	LOS A	0.6	4.6	Full	75	0.0	0.0
Lane 2	253	1.5	244	1.5	824	0.296	100	5.2	LOS A	0.6	4.3	Full	75	0.0	0.0
Approach	560	1.5	540[N1]	1.5		0.296		4.8	LOS A	0.6	4.6				
East: Box Hill Avenue															
Lane 1[d]	353	1.5	353	1.5	533	0.662	100	27.6	LOS B	3.3	23.5	Short	60	0.0	NA
Lane 2	269	1.5	269	1.5	406	0.662	100	33.0	LOS C	2.8	19.8	Full	150	0.0	0.0
Approach	622	1.5	622	1.5		0.662		29.9	LOS C	3.3	23.5				
North: Tharwa Drive															
Lane 1	797	1.5	797	1.5	1251	0.637	65[5]	4.8	LOS A	2.5	17.6	Full	490	0.0	0.0
Lane 2[d]	1084	1.5	1084	1.5	1100	0.985	100	20.8	LOS B	9.7	68.9	Full	490	-29.6[N3]	0.0
Approach	1881	1.5	1881	1.5		0.985		14.0	LOS A	9.7	68.9				
West: Woodcock Drive															
Lane 1	65	1.5	65	1.5	697	0.094	100	6.0	LOS A	0.2	1.1	Short	75	0.0	NA
Lane 2[d]	212	1.5	212	1.5	891	0.238	100	6.6	LOS A	0.4	2.9	Full	380	-12.8[N3]	0.0
Approach	277	1.5	277	1.5		0.238		6.5	LOS A	0.4	2.9				
Intersection	3340	1.5	3320[N1]	1.5		0.985		14.9	LOS B	9.7	68.9				

[redacted]

5 Lane under-utilisation found by the program
d Dominant lane on roundabout approach
N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.
N3 Capacity Adjustment due to downstream lane blockage determined by the program.

Lane Level of Service

	Approaches				Intersection
	South	East	North	West	
LOS	A	C	A	A	B



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

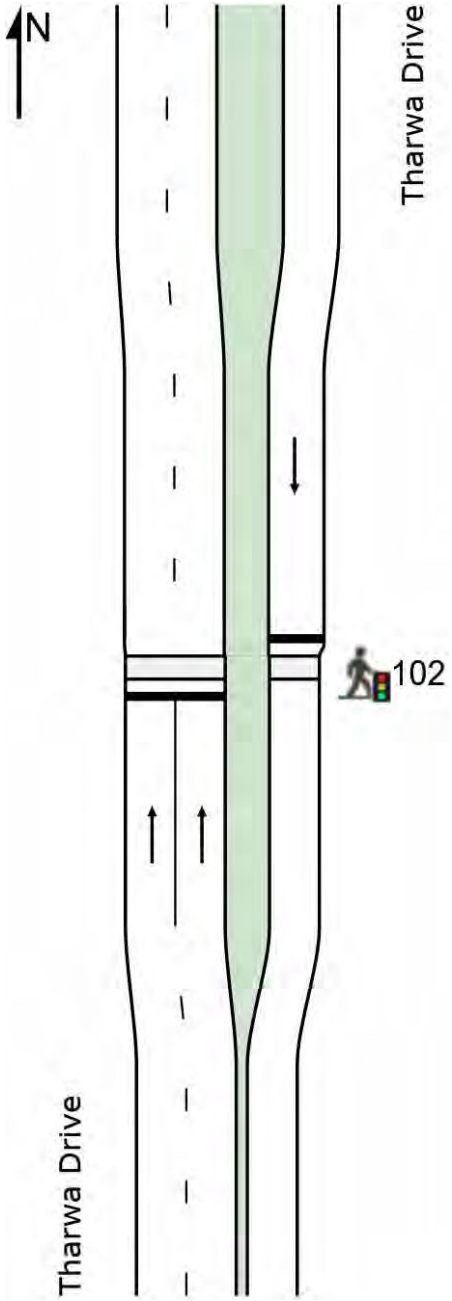
Site: 102 [2031_PM Peak_Tharwa Drive Pedestrian Crossing - Base]

Network: 2 [2031 Future Conditions_Tharwa Drive PM peak - Base]

Pedestrian Crossing - Existing Layout
Site Category: PM Peak 2031 Conditions
Pedestrian Crossing (Signals) - Fixed Time Isolated Cycle Time = 259 seconds (Site User-Given Phase Times)

Timings based on settings in the Site Phasing & Timing dialog
Phase Times specified by the user
Phase Sequence: Two-Phase
Reference Phase: Phase A
Input Phase Sequence: A, B
Output Phase Sequence: A, B

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
2	T1	560	1.5	540	1.5	0.139	0.4	LOS A	1.2	8.8	0.07	0.06	0.07	55.4
Approach		560	1.5	540[N1]	1.5	0.139	0.4	LOS A	1.2	8.8	0.07	0.06	0.07	55.4
North: Tharwa Drive														
8	T1	1068	1.5	1068	1.5	0.537	0.8	LOS A	8.7	61.8	0.12	0.12	0.12	51.9
Approach		1068	1.5	1068	1.5	0.537	0.8	LOS A	8.7	61.8	0.12	0.12	0.12	51.9
All Vehicles		1628	1.5	1609[N1]	1.5	0.537	0.7	LOS A	8.7	61.8	0.10	0.10	0.10	53.1

[redacted]

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

Lane Use and Performance

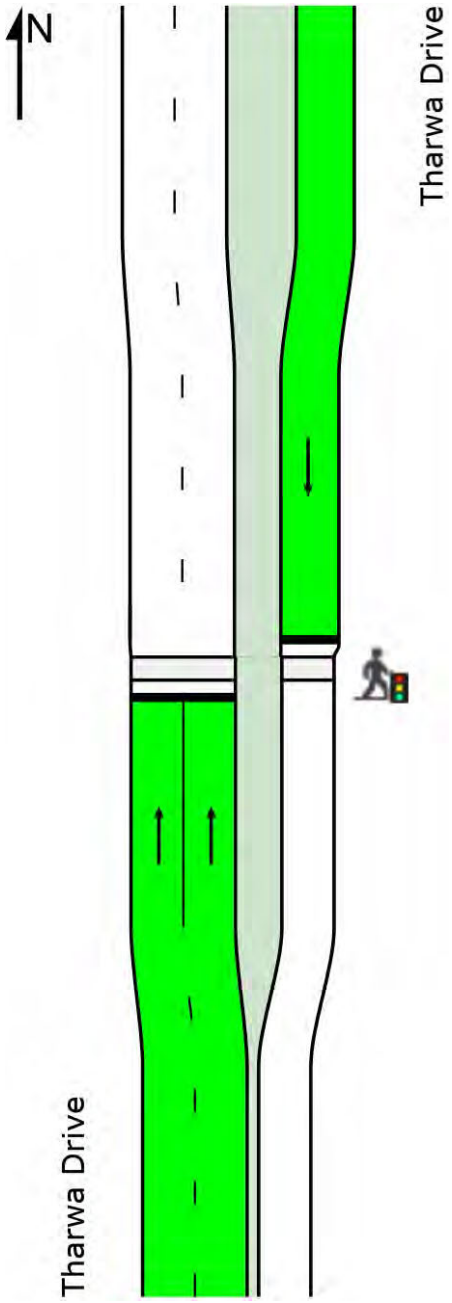
	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	Aver. Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Tharwa Drive															
Lane 1	280	1.5	270	1.5	1941	0.139	100	0.4	LOS A	1.2	8.8	Full	80	0.0	0.0
Lane 2	280	1.5	270	1.5	1941	0.139	100	0.4	LOS A	1.2	8.8	Full	80	0.0	0.0
Approach	560	1.5	540[N1]	1.5		0.139		0.4	LOS A	1.2	8.8				
North: Tharwa Drive															
Lane 1	1068	1.5	1068	1.5	1988	0.537	100	0.8	LOS A	8.7	61.8	Full	75	0.0	32.0
Approach	1068	1.5	1068	1.5		0.537		0.8	LOS A	8.7	61.8				
Intersection	1628	1.5	1609[N1]	1.5		0.537		0.7	LOS A	8.7	61.8				

[redacted]

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

Lane Level of Service

	Approaches		Intersection
	South	North	
LOS	A	A	A



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Phase Timing Summary

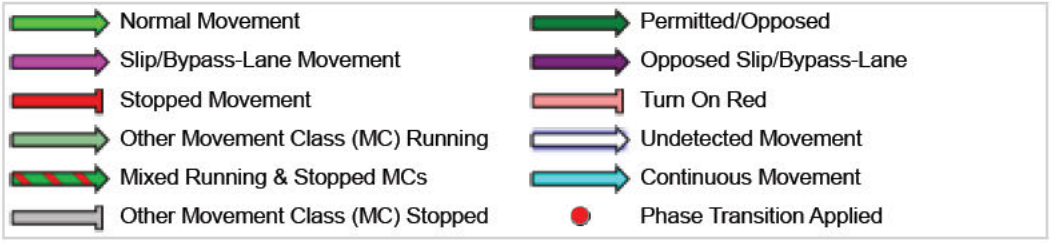
Phase	A	B
Phase Change Time (sec)	0	248
Green Time (sec)	245	5
Phase Time (sec)	251	8
Phase Split	97%	3%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase

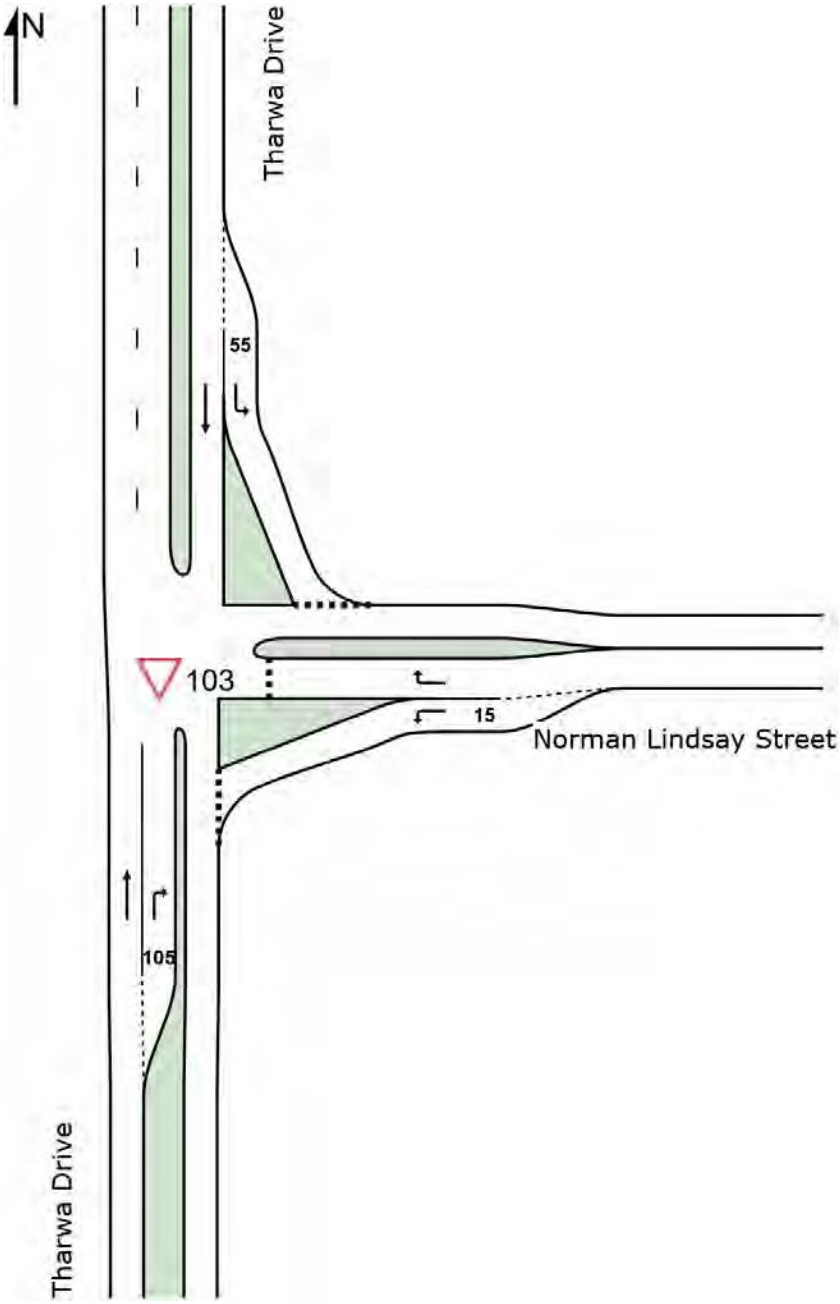


Site: 103 [2031_PM Peak_Tharwa Drive / Norman Lindsay Street - Base]

Network: 2 [2031 Future Conditions_Tharwa Drive PM peak - Base]

Priority-Controlled T-Intersection - Existing Layout
Site Category: PM Peak 2031 Conditions
Giveway / Yield (Two-Way)

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
2	T1	427	1.5	427	1.5	0.223	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
3	R2	107	1.5	107	1.5	0.164	10.5	LOS A	0.3	1.8	0.67	0.86	0.67	45.9
Approach		535	1.5	535	1.5	0.223	2.1	NA	0.3	1.8	0.14	0.17	0.14	56.3
East: Norman Lindsay Street														
4	L2	197	1.5	197	1.5	0.322	9.8	LOS A	0.6	4.0	0.71	0.91	0.87	16.8
6	R2	129	1.5	129	1.5	1.181	252.8	LOS F	7.3	52.1	1.00	2.19	6.05	0.7
Approach		326	1.5	326	1.5	1.181	106.2	LOS F	7.3	52.1	0.82	1.42	2.92	1.9
North: Tharwa Drive														
7	L2	242	1.5	242	1.5	0.163	5.5	LOS A	0.3	2.0	0.22	0.53	0.22	31.2
8	T1	828	1.5	828	1.5	0.429	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
Approach		1071	1.5	1071	1.5	0.429	1.3	LOS A	0.3	2.0	0.05	0.12	0.05	46.6
All Vehicles		1932	1.5	1932	1.5	1.181	19.2	NA	7.3	52.1	0.20	0.35	0.56	25.8

[redacted]

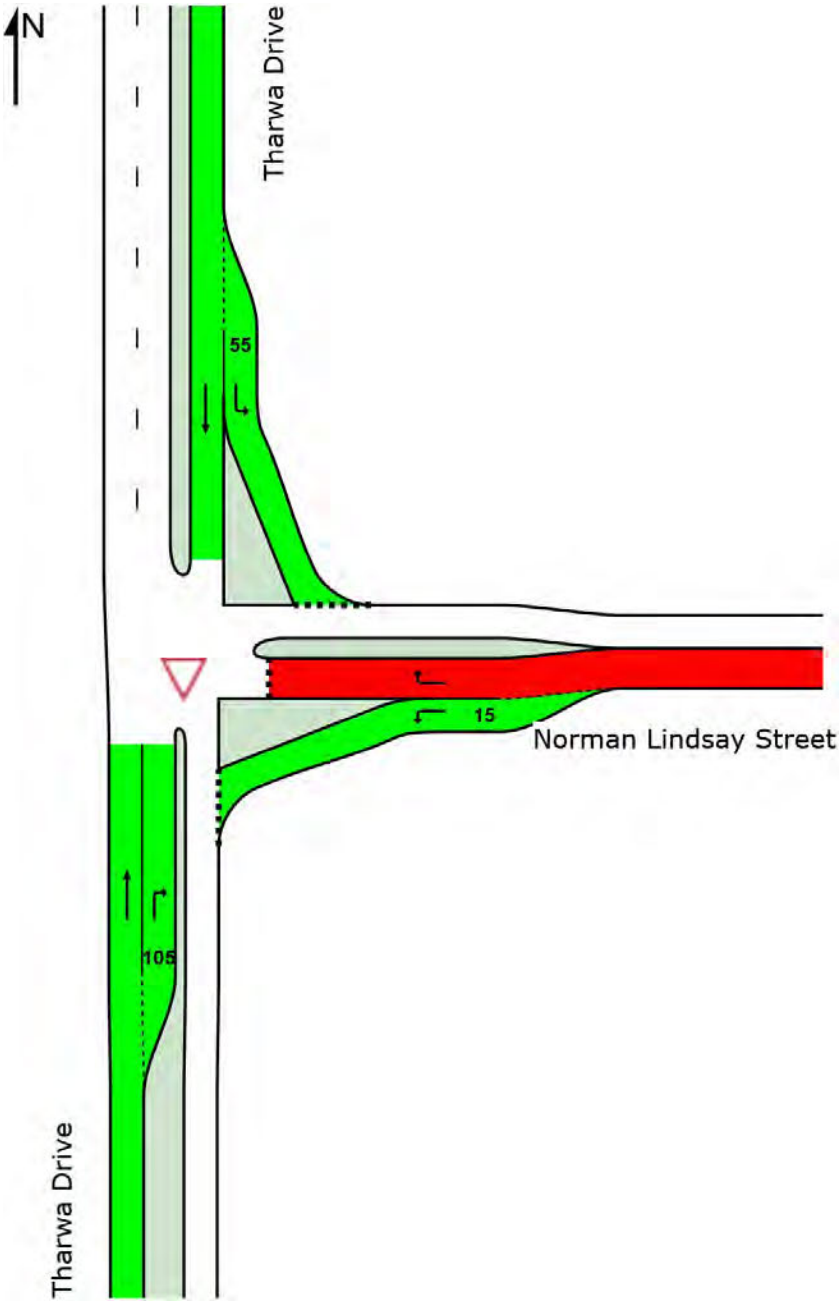
Lane Use and Performance

	Demand Flows		Arrival Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	Aver. Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
South: Tharwa Drive															
Lane 1	427	1.5	427	1.5	1916	0.223	100	0.0	LOS A	0.0	0.0	Full	640	0.0	0.0
Lane 2	107	1.5	107	1.5	656	0.164	100	10.5	LOS A	0.3	1.8	Short	105	0.0	NA
Approach	535	1.5	535	1.5		0.223		2.1	NA	0.3	1.8				
East: Norman Lindsay Street															
Lane 1	197	1.5	197	1.5	611	0.322	100	9.8	LOS A	0.6	4.0	Short	15	0.0	NA
Lane 2	129	1.5	129	1.5	110	1.181	100	252.8	LOS F	7.3	52.1	Full	40	0.0	100.0
Approach	326	1.5	326	1.5		1.181		106.2	LOS F	7.3	52.1				
North: Tharwa Drive															
Lane 1	242	1.5	242	1.5	1482	0.163	100	5.5	LOS A	0.3	2.0	Short	55	0.0	NA
Lane 2	828	1.5	828	1.5	1931	0.429	100	0.0	LOS A	0.0	0.0	Full	80	0.0	0.0
Approach	1071	1.5	1071	1.5		0.429		1.3	LOS A	0.3	2.0				
Intersection	1932	1.5	1932	1.5		1.181		19.2	NA	7.3	52.1				

[redacted]

Lane Level of Service

	Approaches			Intersection
	South	East	North	
LOS	NA	F	A	NA



Colour code based on Level of Service

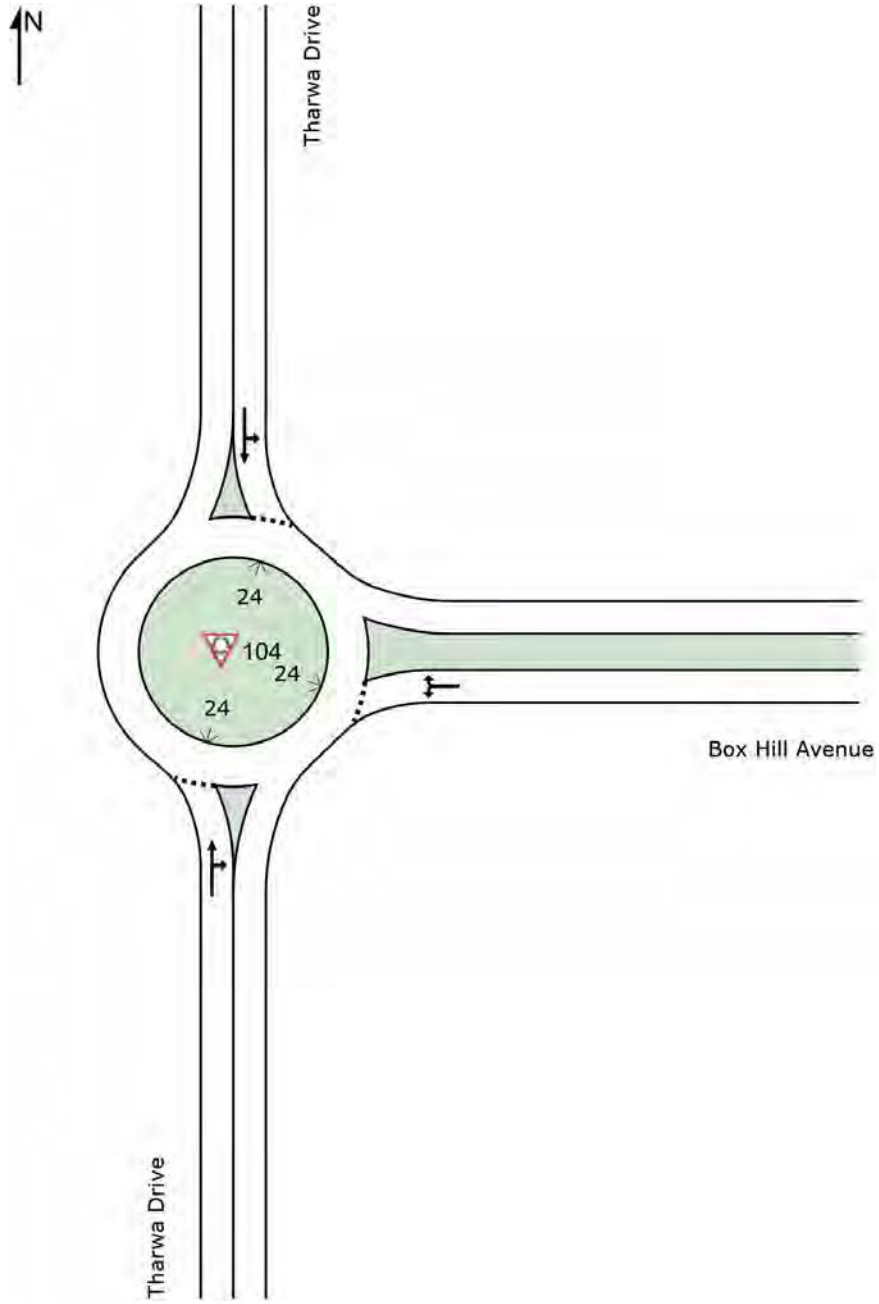
LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site: 104 [2031_PM Peak_Tharwa Drive / Box Hill Avenue - Base]

Network: 2 [2031 Future Conditions_Tharwa Drive PM peak - Base]

Single Lane Roundabout - Existing Layout
Site Category: PM Peak 2031 Conditions
Roundabout

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
2	T1	280	1.5	280	1.5	0.267	5.1	LOS A	0.7	4.9	0.51	0.54	0.51	54.0
3	R2	14	1.5	14	1.5	0.267	10.3	LOS A	0.7	4.9	0.51	0.54	0.51	52.9
Approach		294	1.5	294	1.5	0.267	5.3	LOS A	0.7	4.9	0.51	0.54	0.51	53.9
East: Box Hill Avenue														
4	L2	14	1.5	14	1.5	0.292	7.1	LOS A	0.7	5.1	0.66	0.79	0.66	26.7
6	R2	254	1.5	254	1.5	0.292	12.3	LOS A	0.7	5.1	0.66	0.79	0.66	26.7
Approach		267	1.5	267	1.5	0.292	12.0	LOS A	0.7	5.1	0.66	0.79	0.66	26.7
North: Tharwa Drive														
7	L2	477	1.5	477	1.5	0.616	3.8	LOS A	2.9	20.4	0.16	0.39	0.16	53.7
8	T1	556	1.5	556	1.5	0.616	3.9	LOS A	2.9	20.4	0.16	0.39	0.16	53.8
Approach		1033	1.5	1033	1.5	0.616	3.9	LOS A	2.9	20.4	0.16	0.39	0.16	53.8
All Vehicles		1594	1.5	1594	1.5	0.616	5.5	LOS A	2.9	20.4	0.31	0.49	0.31	51.7



Lane Use and Performance

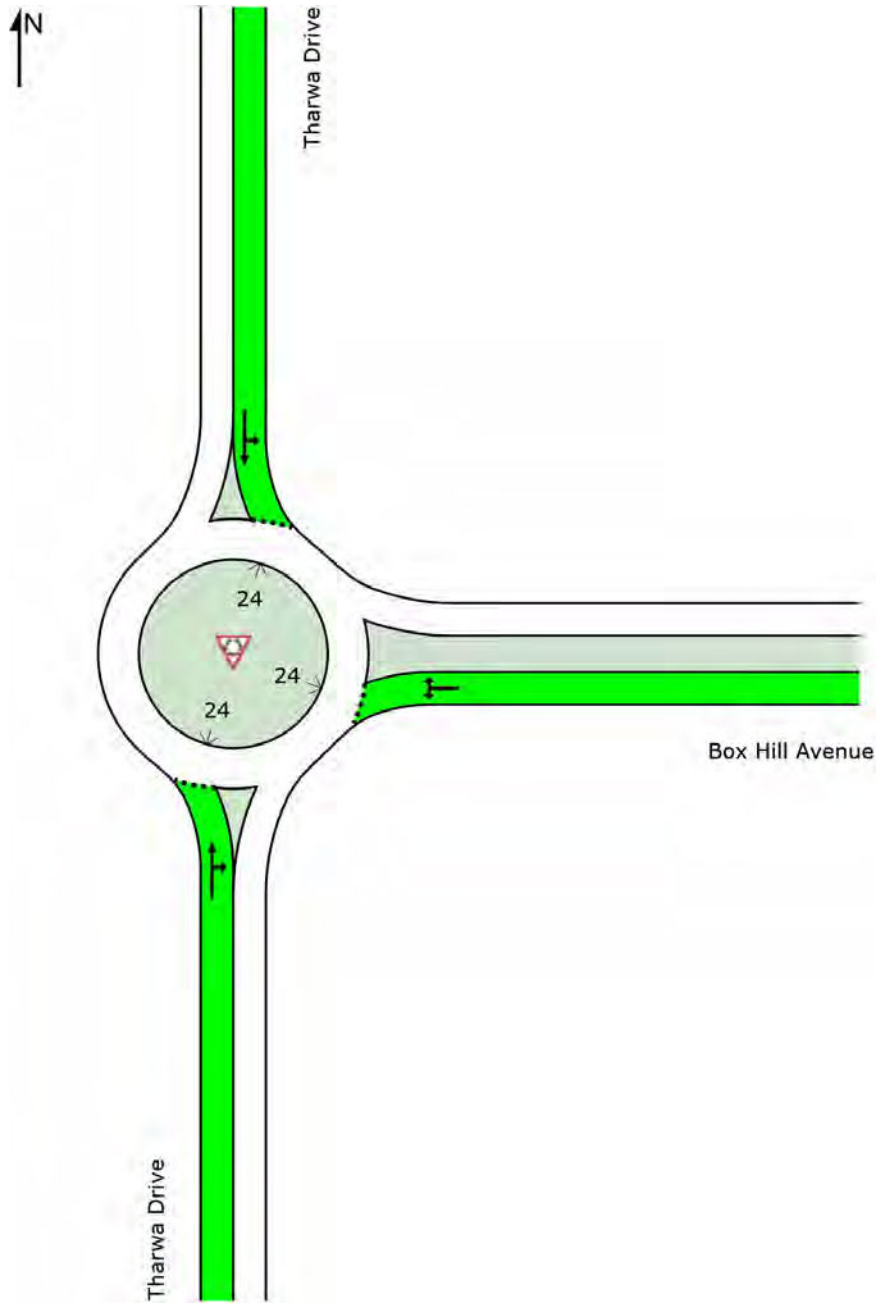
	Demand Flows		Arrival Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	Aver. Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
South: Tharwa Drive															
Lane 1[d]	294	1.5	294	1.5	1101	0.267	100	5.3	LOS A	0.7	4.9	Full	990	0.0	0.0
Approach	294	1.5	294	1.5		0.267		5.3	LOS A	0.7	4.9				
East: Box Hill Avenue															
Lane 1[d]	267	1.5	267	1.5	914	0.292	100	12.0	LOS A	0.7	5.1	Full	105	0.0	0.0
Approach	267	1.5	267	1.5		0.292		12.0	LOS A	0.7	5.1				
North: Tharwa Drive															
Lane 1[d]	1033	1.5	1033	1.5	1677	0.616	100	3.9	LOS A	2.9	20.4	Full	640	0.0	0.0
Approach	1033	1.5	1033	1.5		0.616		3.9	LOS A	2.9	20.4				
Intersection	1594	1.5	1594	1.5		0.616		5.5	LOS A	2.9	20.4				

[redacted]

d Dominant lane on roundabout approach

Lane Level of Service

	Approaches			Intersection
	South	East	North	
LOS	A	A	A	A



Colour code based on Level of Service

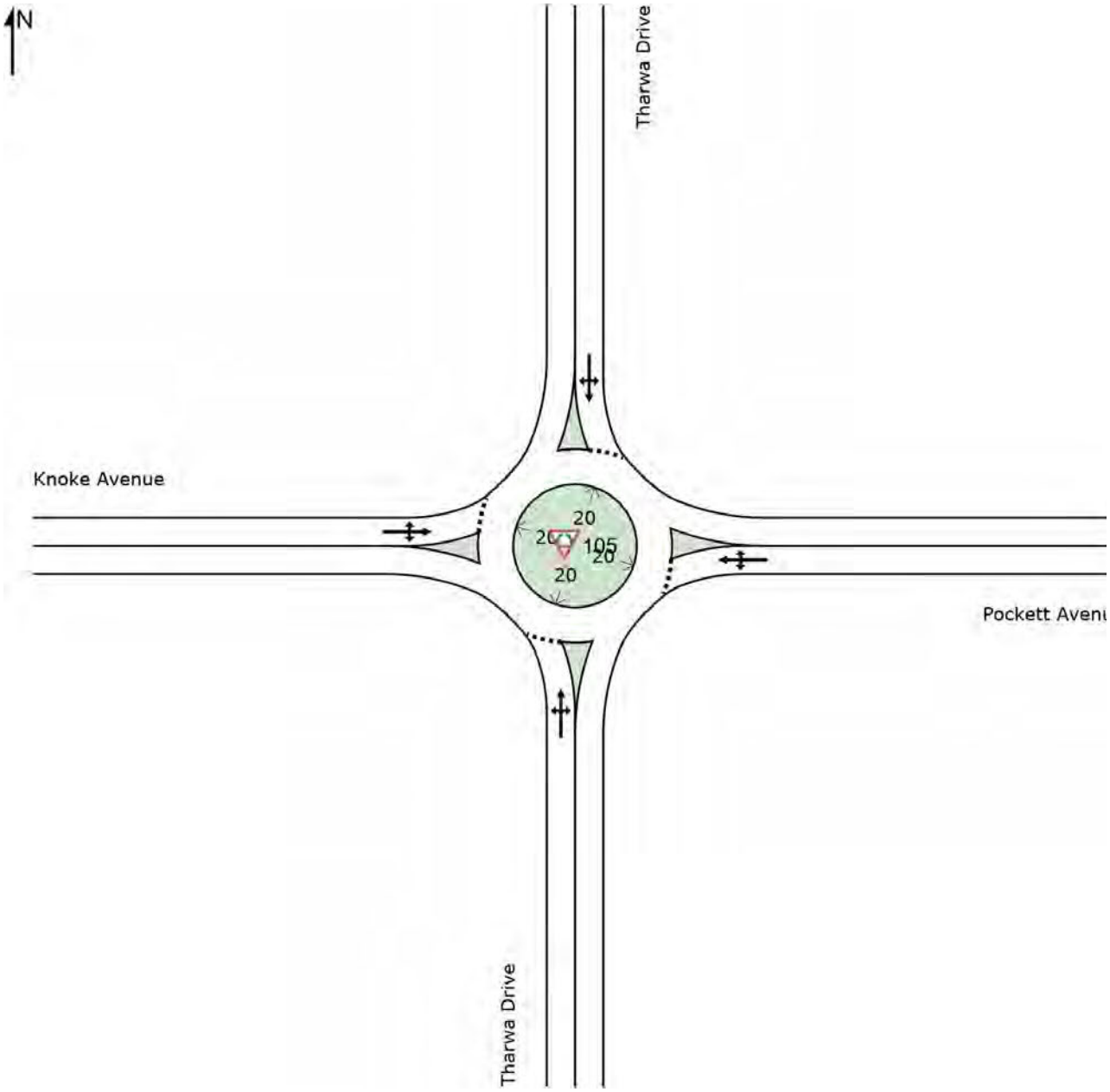
LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site: 105 [2031_PM Peak_Tharwa Drive / Pockett Avenue - Base]

Network: 2 [2031 Future Conditions_Tharwa Drive PM peak - Base]

Single-Lane Roundabout - Existing Layout
Site Category: PM Peak 2031 Conditions
Roundabout

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
1	L2	2	1.5	2	1.5	0.037	5.7	LOS A	0.1	0.5	0.49	0.55	0.49	49.1
2	T1	29	1.5	29	1.5	0.037	6.0	LOS A	0.1	0.5	0.49	0.55	0.49	48.7
3	R2	5	1.5	5	1.5	0.037	10.6	LOS A	0.1	0.5	0.49	0.55	0.49	47.3
Approach		37	1.5	37	1.5	0.037	6.6	LOS A	0.1	0.5	0.49	0.55	0.49	48.5
East: Pockett Avenue														
4	L2	11	1.5	11	1.5	0.183	4.8	LOS A	0.4	2.9	0.45	0.65	0.45	47.5
5	T1	37	1.5	37	1.5	0.183	5.1	LOS A	0.4	2.9	0.45	0.65	0.45	12.6
6	R2	156	1.5	156	1.5	0.183	9.7	LOS A	0.4	2.9	0.45	0.65	0.45	27.5
Approach		203	1.5	203	1.5	0.183	8.6	LOS A	0.4	2.9	0.45	0.65	0.45	22.9
North: Tharwa Drive														
7	L2	303	1.5	303	1.5	0.378	4.1	LOS A	1.1	7.8	0.22	0.52	0.22	45.4
8	T1	61	1.5	61	1.5	0.378	4.4	LOS A	1.1	7.8	0.22	0.52	0.22	56.4
9	R2	205	1.5	205	1.5	0.378	9.0	LOS A	1.1	7.8	0.22	0.52	0.22	45.2
Approach		569	1.5	569	1.5	0.378	5.9	LOS A	1.1	7.8	0.22	0.52	0.22	46.7
West: Knoke Avenue														
10	L2	88	1.5	88	1.5	0.110	4.8	LOS A	0.2	1.7	0.37	0.51	0.37	32.6
11	T1	36	1.5	36	1.5	0.110	5.0	LOS A	0.2	1.7	0.37	0.51	0.37	24.2
12	R2	5	1.5	5	1.5	0.110	9.6	LOS A	0.2	1.7	0.37	0.51	0.37	52.6
Approach		129	1.5	129	1.5	0.110	5.0	LOS A	0.2	1.7	0.37	0.51	0.37	30.8
All Vehicles		939	1.5	939	1.5	0.378	6.4	LOS A	1.1	7.8	0.30	0.55	0.30	43.9

[redacted]

Lane Use and Performance

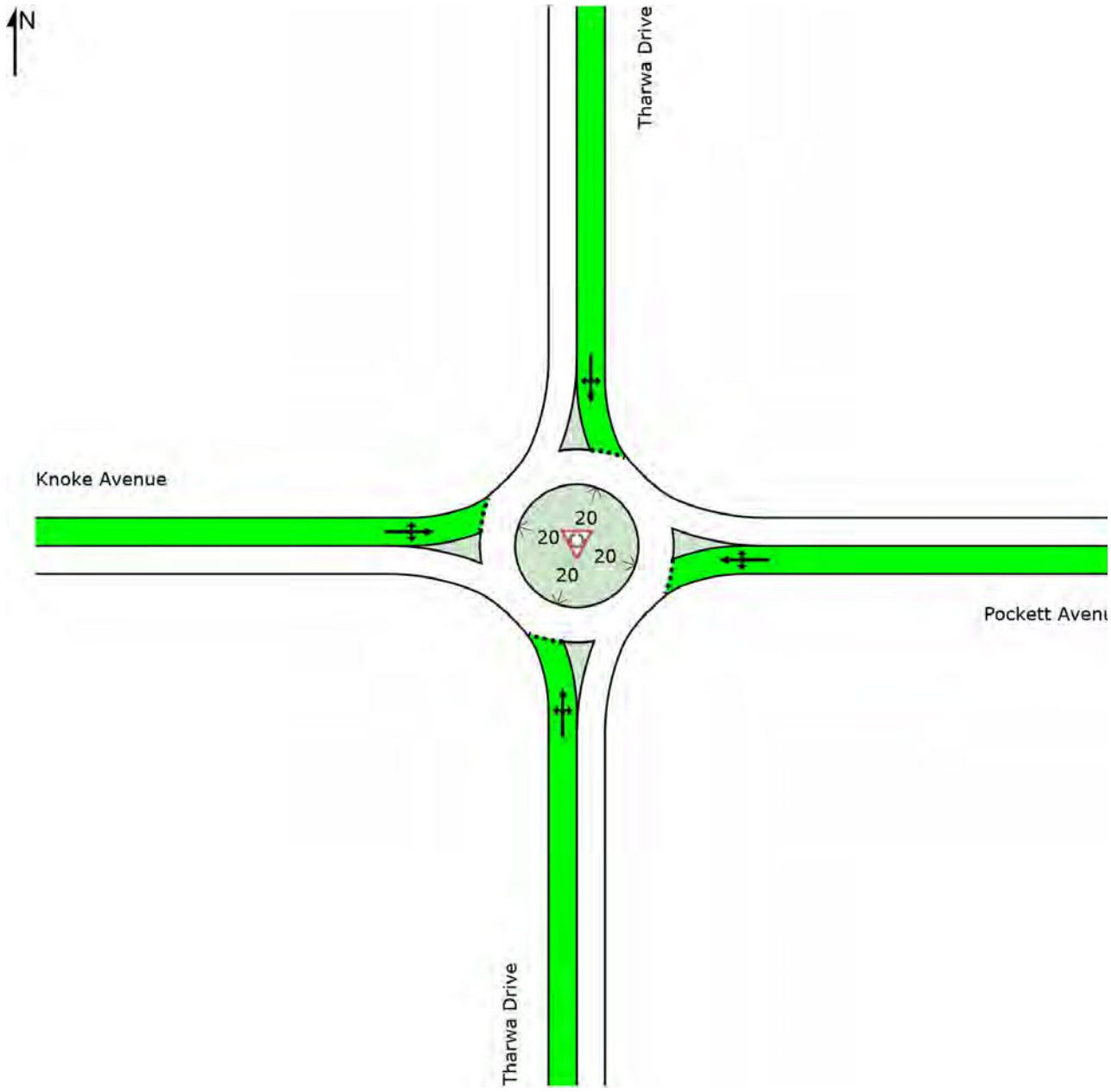
	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	Aver. Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Tharwa Drive															
Lane 1[d]	37	1.5	37	1.5	1008	0.037	100	6.6	LOS A	0.1	0.5	Full	500	0.0	0.0
Approach	37	1.5	37	1.5		0.037		6.6	LOS A	0.1	0.5				
East: Pockett Avenue															
Lane 1[d]	203	1.5	203	1.5	1108	0.183	100	8.6	LOS A	0.4	2.9	Full	80	0.0	0.0
Approach	203	1.5	203	1.5		0.183		8.6	LOS A	0.4	2.9				
North: Tharwa Drive															
Lane 1[d]	569	1.5	569	1.5	1506	0.378	100	5.9	LOS A	1.1	7.8	Full	990	0.0	0.0
Approach	569	1.5	569	1.5		0.378		5.9	LOS A	1.1	7.8				
West: Knoke Avenue															
Lane 1[d]	129	1.5	129	1.5	1172	0.110	100	5.0	LOS A	0.2	1.7	Full	95	0.0	0.0
Approach	129	1.5	129	1.5		0.110		5.0	LOS A	0.2	1.7				
Intersection	939	1.5	939	1.5		0.378		6.4	LOS A	1.1	7.8				

[redacted]

d Dominant lane on roundabout approach

Lane Level of Service

	Approaches				Intersection
	South	East	North	West	
LOS	A	A	A	A	A



Colour code based on Level of Service

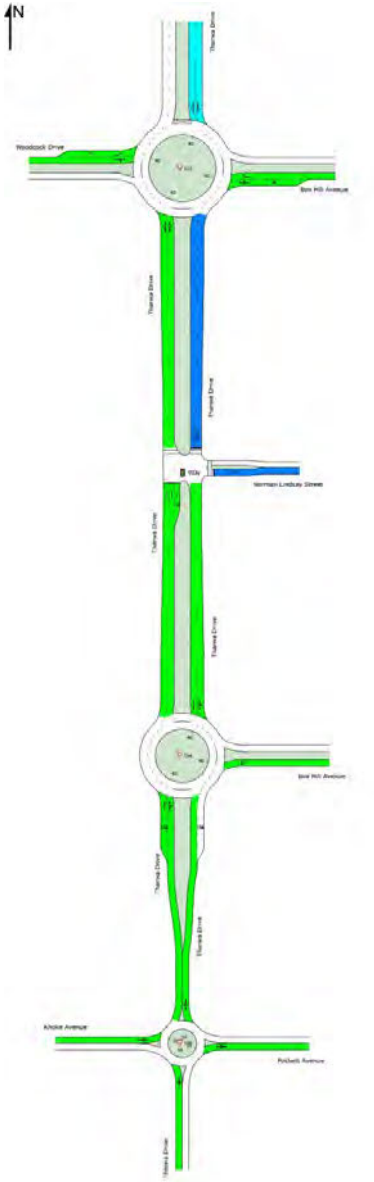
LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

DEGREE OF SATURATION

Ratio of Demand Volume to Capacity, v/c ratio per lane

Network: N101 [2031 Future Conditions with Upgrades_Tharwa Drive PM peak - Op1]

2031 Future Conditions - Upgraded Layout
Network Category: (None)



Colour code based on Degree of Saturation

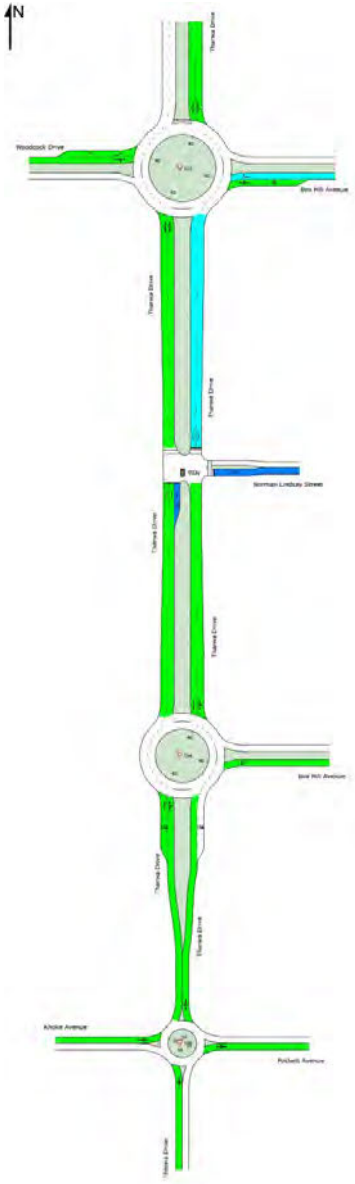
[< 0.6]	[0.6 – 0.7]	[0.7 – 0.8]	[0.8 – 0.9]	[0.9 – 1.0]	[> 1.0]

LANE LEVEL OF SERVICE

Lane Level of Service for Network Sites

Network: N101 [2031 Future Conditions with Upgrades_Tharwa Drive PM peak - Op1]

2031 Future Conditions - Upgraded Layout
Network Category: (None)



Colour code based on Level of Service

LOS A	LOS B	LOS C	LOS D	LOS E	LOS F

Delay model settings are specified for individual Sites forming the Network.

USER REPORT FOR NETWORK SITE

Project: 2031 Conditions

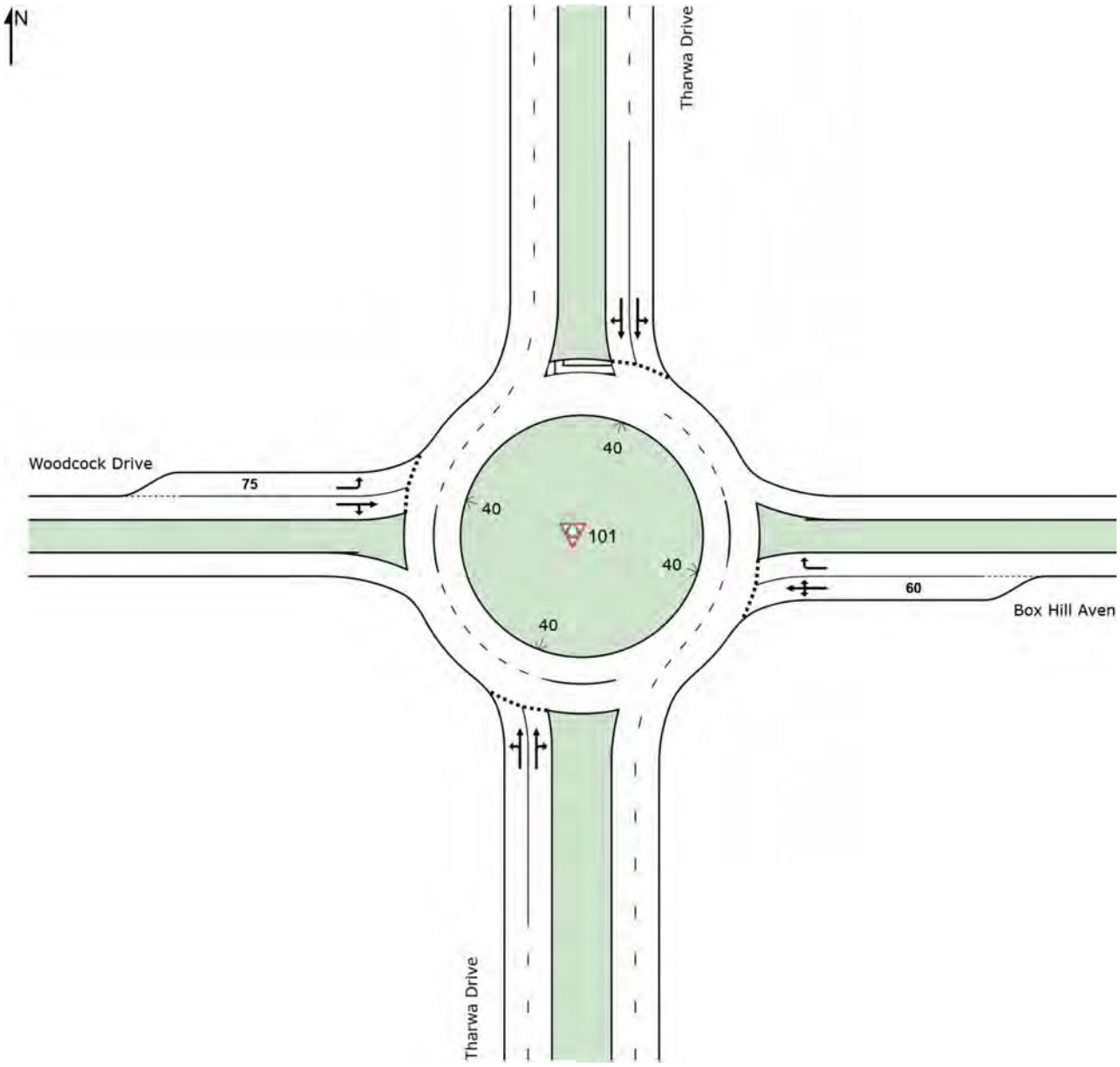
Template: Default Site User Report (2)

Site: 101 [2031_PM Peak_Tharwa Drive / Woodcock Drive - Duplicated]

Network: 5 [2031 Future Conditions with Upgrades_Tharwa Drive PM peak - Op1]

Two Lane Roundabout - Duplicated
Site Category: PM Peak 2031 Conditions
Roundabout

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
1	L2	151	1.5	151	1.5	0.298	5.2	LOS A	0.5	3.9	0.52	0.56	0.52	50.9
2	T1	400	1.5	400	1.5	0.298	5.2	LOS A	0.5	3.9	0.53	0.55	0.53	54.8
3	R2	9	1.5	9	1.5	0.298	11.8	LOS A	0.5	3.6	0.53	0.55	0.53	43.7
Approach		560	1.5	560	1.5	0.298	5.3	LOS A	0.5	3.9	0.52	0.55	0.52	53.7
East: Box Hill Avenue														
4	L2	32	1.5	32	1.5	0.443	7.9	LOS A	1.2	8.9	0.85	0.93	0.95	31.7
5	T1	105	1.5	105	1.5	0.443	7.7	LOS A	1.2	8.9	0.85	0.93	0.95	47.7
6	R2	485	1.5	485	1.5	0.443	14.9	LOS B	1.2	8.9	0.84	0.96	0.96	48.4
Approach		622	1.5	622	1.5	0.443	13.3	LOS A	1.2	8.9	0.84	0.95	0.95	47.9
North: Tharwa Drive														
7	L2	797	1.5	797	1.5	0.666	4.4	LOS A	2.8	20.1	0.65	0.52	0.65	52.0
8	T1	972	1.5	972	1.5	0.666	4.3	LOS A	2.8	20.1	0.69	0.51	0.70	48.7
9	R2	113	1.5	113	1.5	0.666	11.3	LOS A	2.8	19.5	0.71	0.50	0.71	55.7
Approach		1881	1.5	1881	1.5	0.666	4.8	LOS A	2.8	20.1	0.68	0.51	0.68	50.8
West: Woodcock Drive														
10	L2	65	1.5	65	1.5	0.090	6.0	LOS A	0.2	1.1	0.60	0.69	0.60	54.1
11	T1	145	1.5	145	1.5	0.201	4.5	LOS A	0.4	2.8	0.61	0.59	0.61	52.1
12	R2	66	1.5	66	1.5	0.201	11.4	LOS A	0.4	2.8	0.61	0.59	0.61	45.9
Approach		277	1.5	277	1.5	0.201	6.5	LOS A	0.4	2.8	0.61	0.62	0.61	51.6
All Vehicles		3340	1.5	3340	1.5	0.666	6.6	LOS A	2.8	20.1	0.68	0.61	0.70	50.7

[redacted]

Lane Use and Performance

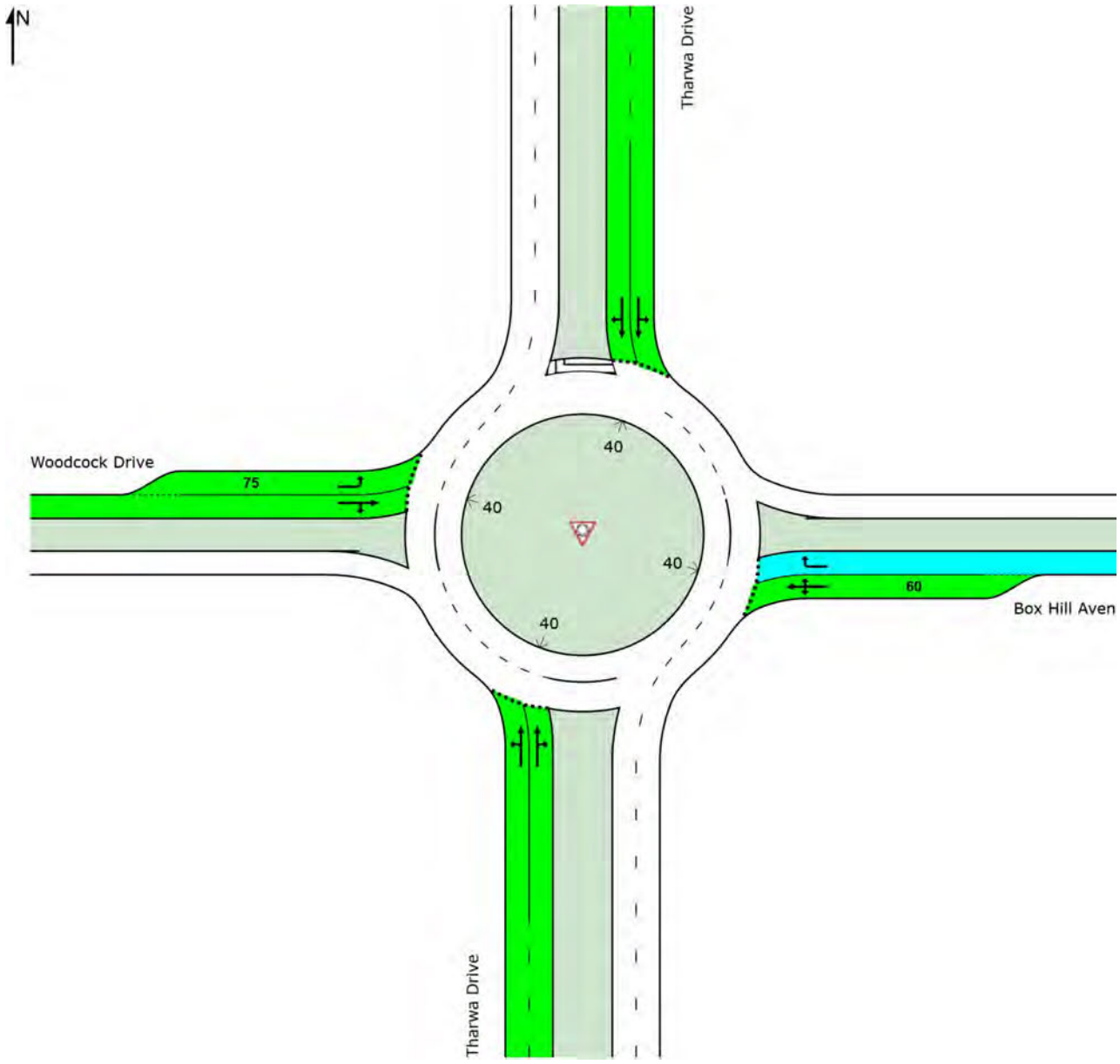
	Demand Flows		Arrival Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	Aver. Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
South: Tharwa Drive															
Lane 1[d]	307	1.5	307	1.5	1029	0.298	100	5.1	LOS A	0.5	3.9	Full	165	0.0	0.0
Lane 2	253	1.5	253	1.5	848	0.298	100	5.6	LOS A	0.5	3.6	Full	165	0.0	0.0
Approach	560	1.5	560	1.5		0.298		5.3	LOS A	0.5	3.9				
East: Box Hill Avenue															
Lane 1[d]	355	1.5	355	1.5	801	0.443	100	11.6	LOS A	1.2	8.9	Short	60	0.0	NA
Lane 2	267	1.5	267	1.5	604	0.443	100	15.5	LOS B	1.1	8.0	Full	150	0.0	0.0
Approach	622	1.5	622	1.5		0.443		13.3	LOS A	1.2	8.9				
North: Tharwa Drive															
Lane 1[d]	1042	1.5	1042	1.5	1565	0.666	100	4.3	LOS A	2.8	20.1	Full	490	0.0	0.0
Lane 2	839	1.5	839	1.5	1260	0.666	100	5.3	LOS A	2.8	19.5	Full	490	0.0	0.0
Approach	1881	1.5	1881	1.5		0.666		4.8	LOS A	2.8	20.1				
West: Woodcock Drive															
Lane 1	65	1.5	65	1.5	726	0.090	100	6.0	LOS A	0.2	1.1	Short	75	0.0	NA
Lane 2[d]	212	1.5	212	1.5	1055	0.201	100	6.7	LOS A	0.4	2.8	Full	380	0.0	0.0
Approach	277	1.5	277	1.5		0.201		6.5	LOS A	0.4	2.8				
Intersection	3340	1.5	3340	1.5		0.666		6.6	LOS A	2.8	20.1				

[redacted]

d Dominant lane on roundabout approach

Lane Level of Service

	Approaches				Intersection
	South	East	North	West	
LOS	A	A	A	A	A



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

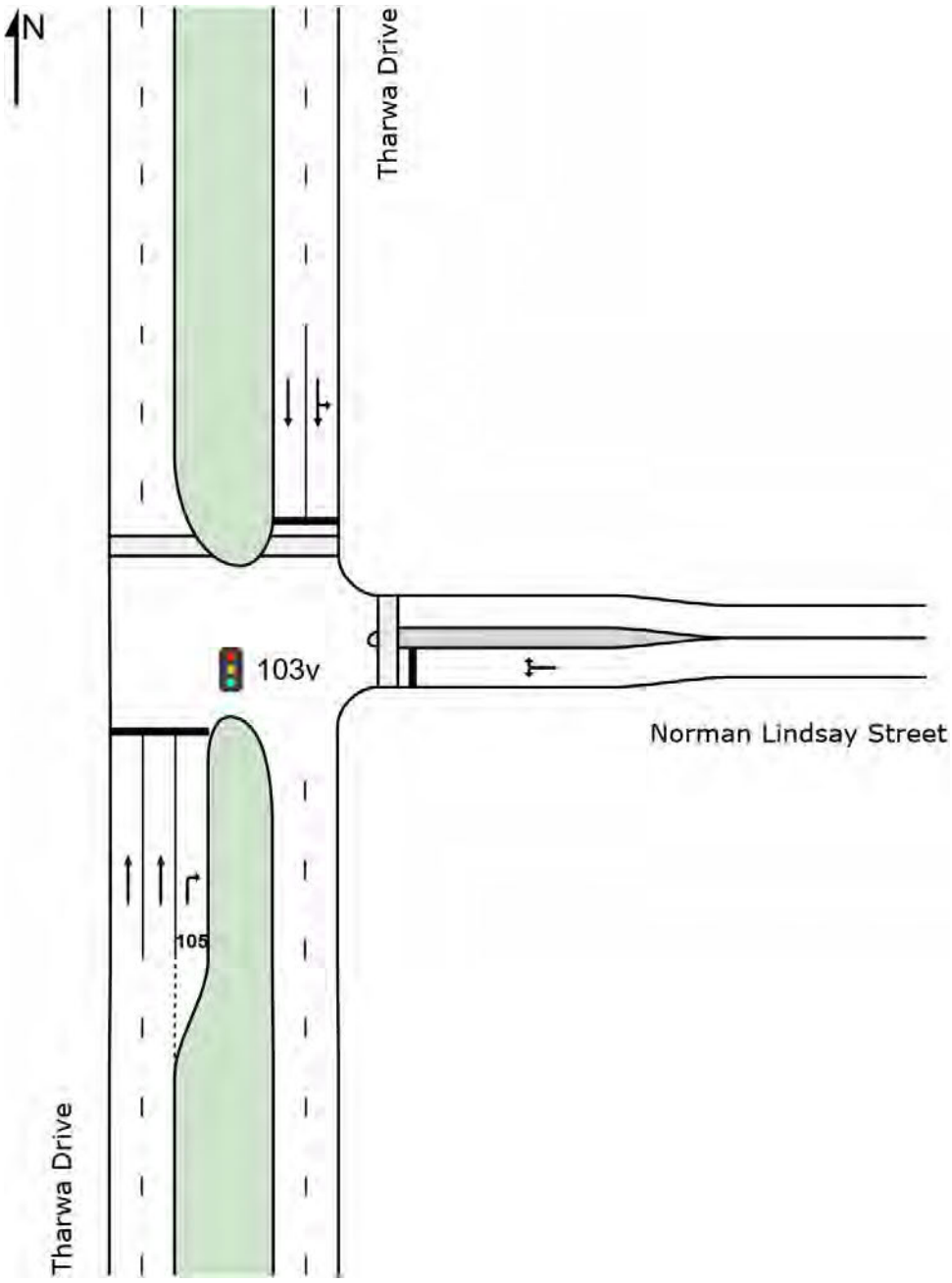
Site: 103v [2031_PM Peak_Tharwa Drive / Norman Lindsay Street - Signals]

Network: 5 [2031 Future Conditions with Upgrades_Tharwa Drive PM peak - Op1]

Signalised T-Intersection - Duplicated
Site Category: PM Peak 2031 Conditions
Signals - Fixed Time Isolated Cycle Time = 60 seconds (Site User-Given Cycle Time)

Timings based on settings in the Site Phasing & Timing dialog
Phase Times determined by the program
Downstream lane blockage effects included in determining phase times
Phase Sequence: Sequence1
Reference Phase: Phase A
Input Phase Sequence: A, B, C
Output Phase Sequence: A, B, C

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
2	T1	427	1.5	427	1.5	0.195	6.8	LOS A	1.9	13.2	0.52	0.43	0.52	51.1
3	R2	107	1.5	107	1.5	0.584	36.1	LOS C	2.0	14.3	1.00	0.80	1.07	31.2
Approach		535	1.5	535	1.5	0.584	12.7	LOS A	2.0	14.3	0.61	0.51	0.63	45.0
East: Norman Lindsay Street														
4	L2	197	1.5	197	1.5	0.734	29.2	LOS C	5.9	42.1	0.98	0.89	1.11	6.1
6	R2	129	1.5	129	1.5	0.734	29.1	LOS C	5.9	42.1	0.98	0.89	1.11	6.1
Approach		326	1.5	326	1.5	0.734	29.1	LOS C	5.9	42.1	0.98	0.89	1.11	6.1
North: Tharwa Drive														
7	L2	242	1.5	242	1.5	0.765	26.4	LOS B	9.2	65.4	0.94	0.91	1.05	10.2
8	T1	828	1.5	828	1.5	0.765	20.8	LOS B	9.4	66.7	0.94	0.90	1.05	19.7
Approach		1071	1.5	1071	1.5	0.765	22.0	LOS B	9.4	66.7	0.94	0.90	1.05	15.8
All Vehicles		1932	1.5	1932	1.5	0.765	20.6	LOS B	9.4	66.7	0.86	0.79	0.94	24.4

[redacted]

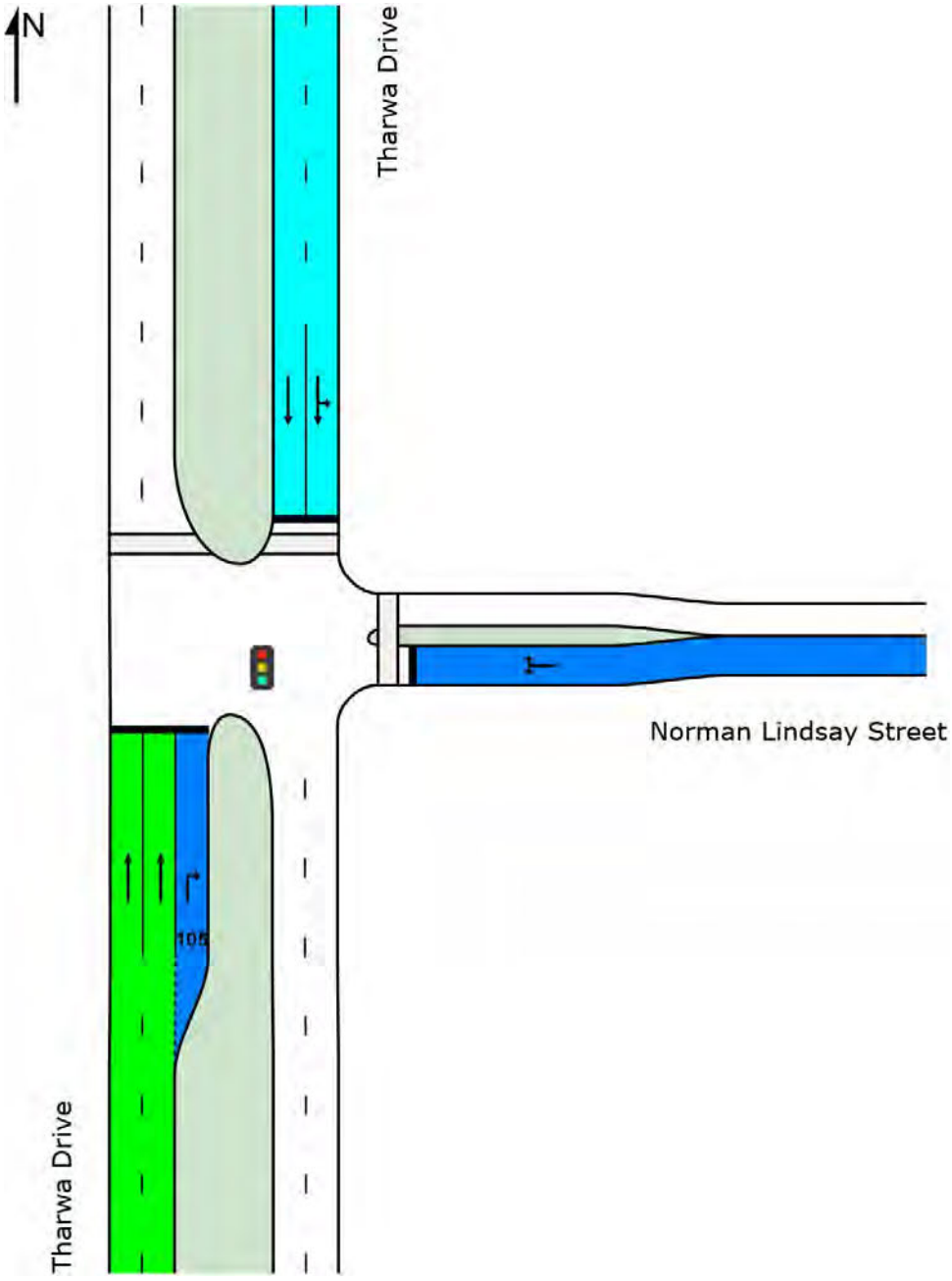
Lane Use and Performance

	Demand Flows		Arrival Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	Aver. Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
South: Tharwa Drive															
Lane 1	214	1.5	214	1.5	1094	0.195	100	6.8	LOS A	1.9	13.2	Full	640	0.0	0.0
Lane 2	214	1.5	214	1.5	1094	0.195	100	6.8	LOS A	1.9	13.2	Full	640	0.0	0.0
Lane 3	107	1.5	107	1.5	184	0.584	100	36.1	LOS C	2.0	14.3	Short	105	0.0	NA
Approach	535	1.5	535	1.5		0.584		12.7	LOS A	2.0	14.3				
East: Norman Lindsay Street															
Lane 1	326	1.5	326	1.5	444	0.734	100	29.1	LOS C	5.9	42.1	Full	40	0.0	54.9
Approach	326	1.5	326	1.5		0.734		29.1	LOS C	5.9	42.1				
North: Tharwa Drive															
Lane 1	529	1.5	529	1.5	692	0.765	100	23.4	LOS B	9.2	65.4	Full	165	0.0	0.0
Lane 2	541	1.5	541	1.5	708	0.765	100	20.7	LOS B	9.4	66.7	Full	165	0.0	0.0
Approach	1071	1.5	1071	1.5		0.765		22.0	LOS B	9.4	66.7				
Intersection	1932	1.5	1932	1.5		0.765		20.6	LOS B	9.4	66.7				

[redacted]

Lane Level of Service

	Approaches			Intersection
	South	East	North	
LOS	A	C	B	B



Colour code based on Level of Service

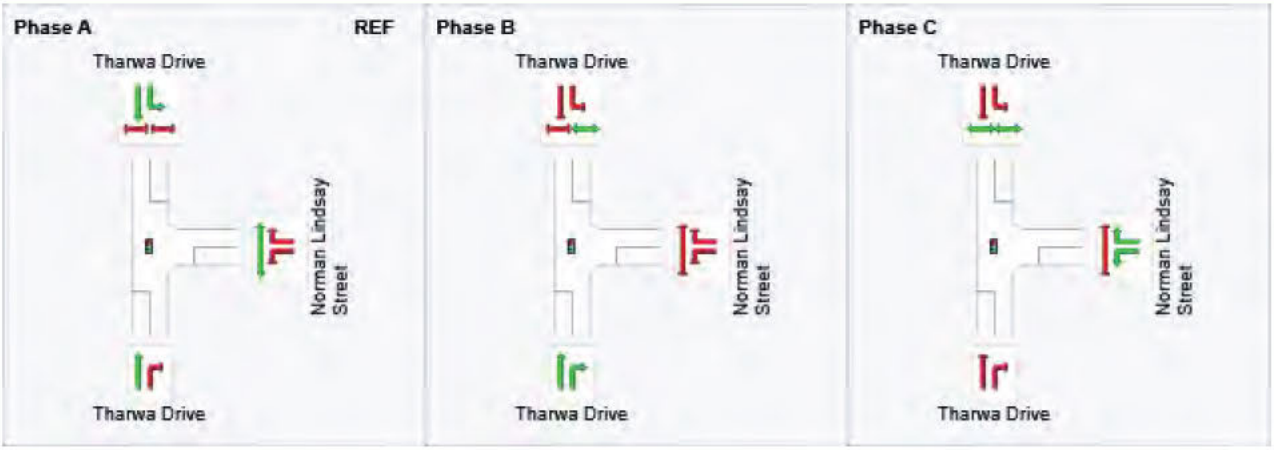
LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Phase Timing Summary

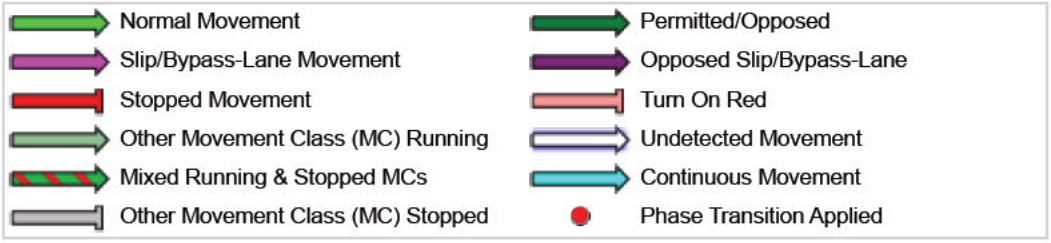
Phase	A	B	C
Phase Change Time (sec)	0	28	40
Green Time (sec)	22	6	14
Phase Time (sec)	28	12	20
Phase Split	47%	20%	33%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase

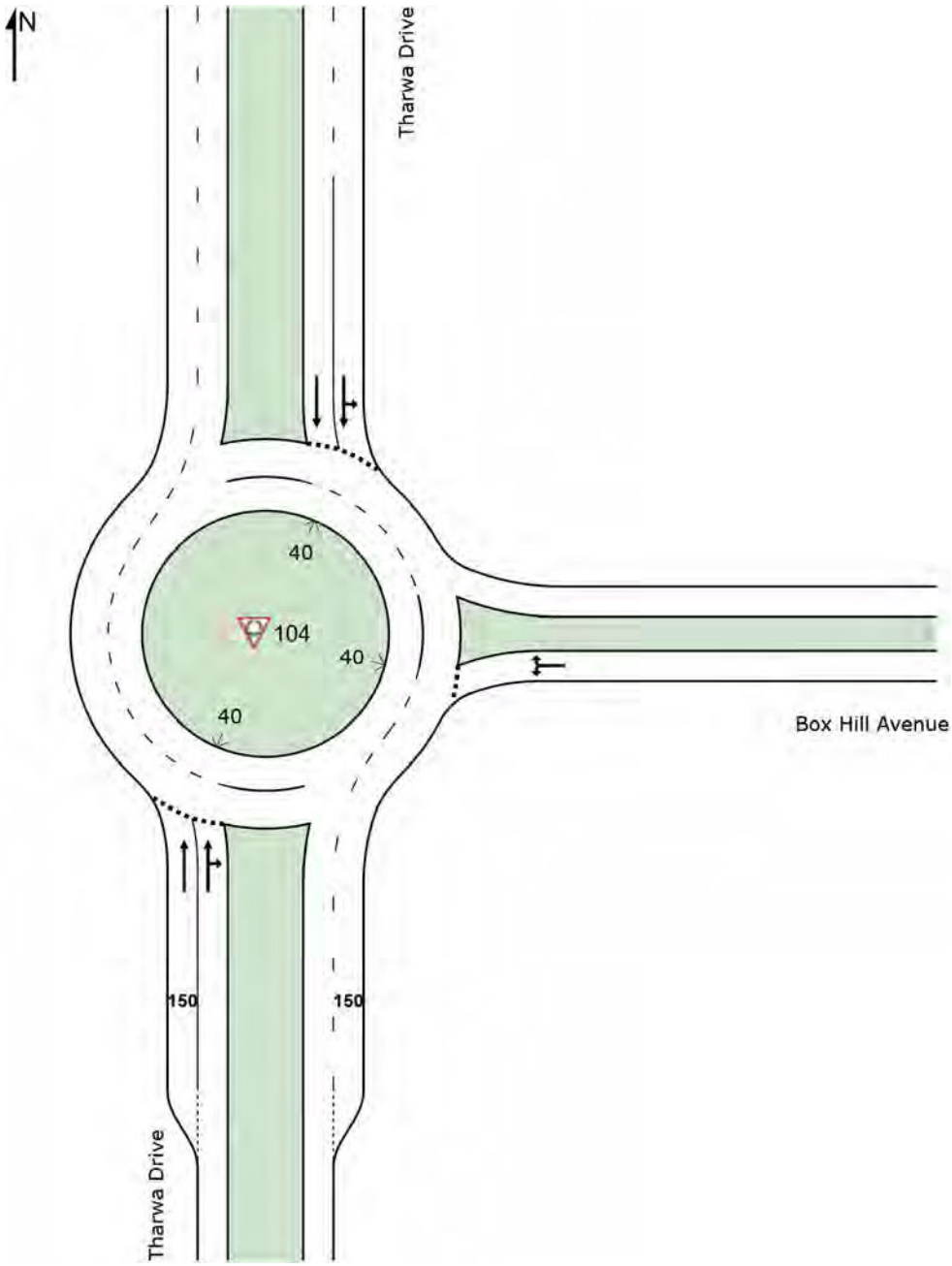


Site: 104 [2031_PM Peak_Tharwa Drive / Box Hill Avenue - Roundabout to single lane]

Network: 5 [2031 Future Conditions with Upgrades_Tharwa Drive PM peak - Op1]

Dual Lane Roundabout - Duplicated to north, remaining single carriageway to south
Site Category: PM Peak 2031 Conditions
Roundabout

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
2	T1	280	1.5	280	1.5	0.119	3.6	LOS A	0.2	1.7	0.38	0.38	0.38	55.1
3	R2	14	1.5	14	1.5	0.119	10.3	LOS A	0.2	1.7	0.39	0.41	0.39	54.0
Approach		294	1.5	294	1.5	0.119	3.9	LOS A	0.2	1.7	0.38	0.39	0.38	55.0
East: Box Hill Avenue														
4	L2	14	1.5	14	1.5	0.266	5.4	LOS A	0.6	4.3	0.55	0.72	0.55	29.6
6	R2	254	1.5	254	1.5	0.266	11.8	LOS A	0.6	4.3	0.55	0.72	0.55	29.6
Approach		267	1.5	267	1.5	0.266	11.5	LOS A	0.6	4.3	0.55	0.72	0.55	29.6
North: Tharwa Drive														
7	L2	477	1.5	477	1.5	0.318	3.2	LOS A	0.7	4.7	0.07	0.37	0.07	56.0
8	T1	556	1.5	556	1.5	0.318	2.8	LOS A	0.7	4.7	0.07	0.29	0.07	55.6
Approach		1033	1.5	1033	1.5	0.318	3.0	LOS A	0.7	4.7	0.07	0.33	0.07	55.8
All Vehicles		1594	1.5	1594	1.5	0.318	4.6	LOS A	0.7	4.7	0.21	0.40	0.21	53.4



Lane Use and Performance

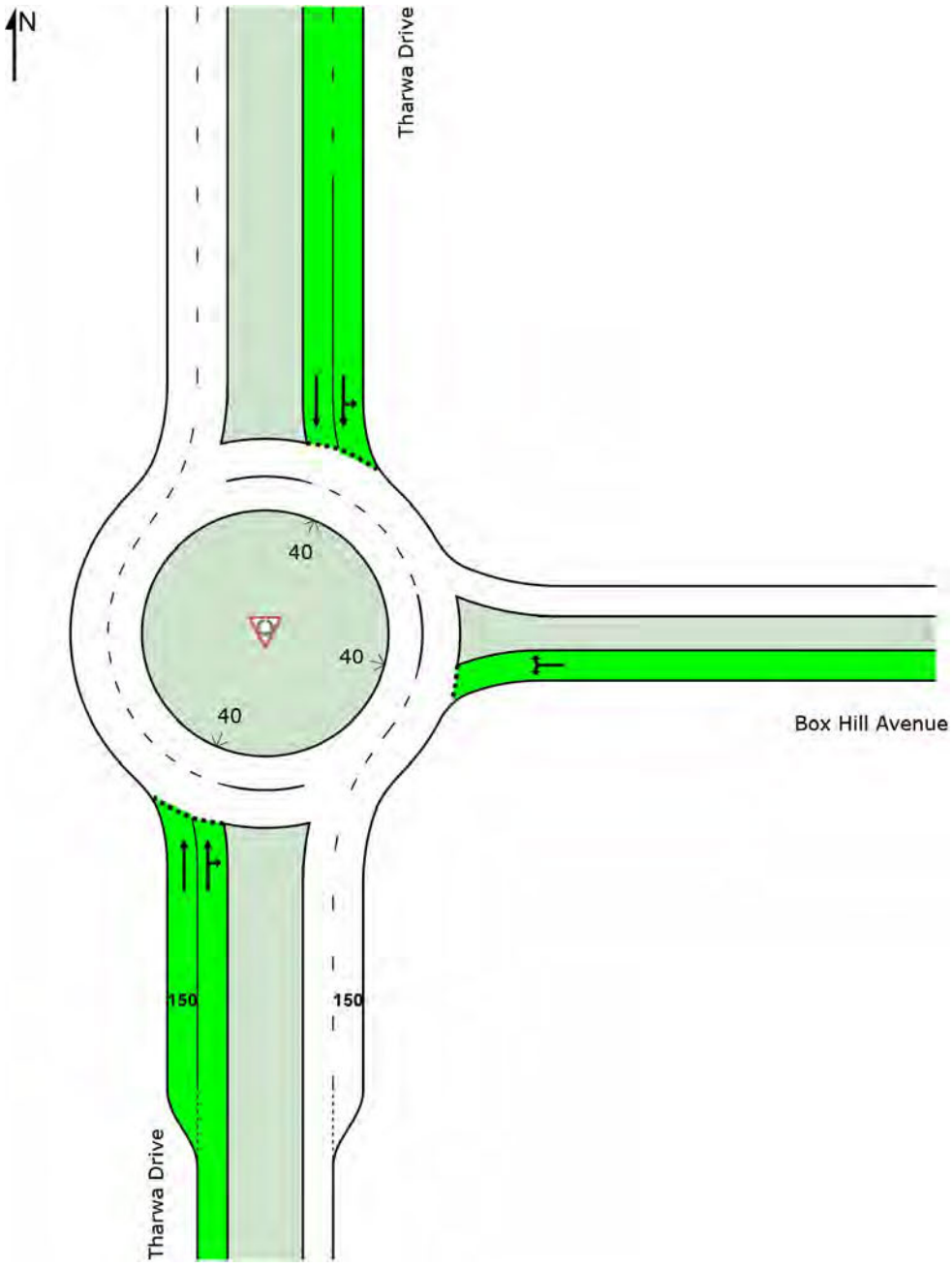
	Demand Flows		Arrival Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	Aver. Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
South: Tharwa Drive															
Lane 1[d]	155	1.5	155	1.5	1308	0.119	100	3.5	LOS A	0.2	1.7	Short	150	0.0	NA
Lane 2	139	1.5	139	1.5	1168	0.119	100	4.3	LOS A	0.2	1.7	Full	990	0.0	0.0
Approach	294	1.5	294	1.5		0.119		3.9	LOS A	0.2	1.7				
East: Box Hill Avenue															
Lane 1[d]	267	1.5	267	1.5	1003	0.266	100	11.5	LOS A	0.6	4.3	Full	105	0.0	0.0
Approach	267	1.5	267	1.5		0.266		11.5	LOS A	0.6	4.3				
North: Tharwa Drive															
Lane 1[d]	554	1.5	554	1.5	1742	0.318	100	3.2	LOS A	0.7	4.7	Full	640	0.0	0.0
Lane 2	479	1.5	479	1.5	1506	0.318	100	2.8	LOS A	0.7	4.6	Full	640	0.0	0.0
Approach	1033	1.5	1033	1.5		0.318		3.0	LOS A	0.7	4.7				
Intersection	1594	1.5	1594	1.5		0.318		4.6	LOS A	0.7	4.7				

[redacted]

d Dominant lane on roundabout approach

Lane Level of Service

	Approaches			Intersection
	South	East	North	
LOS	A	A	A	A



Colour code based on Level of Service

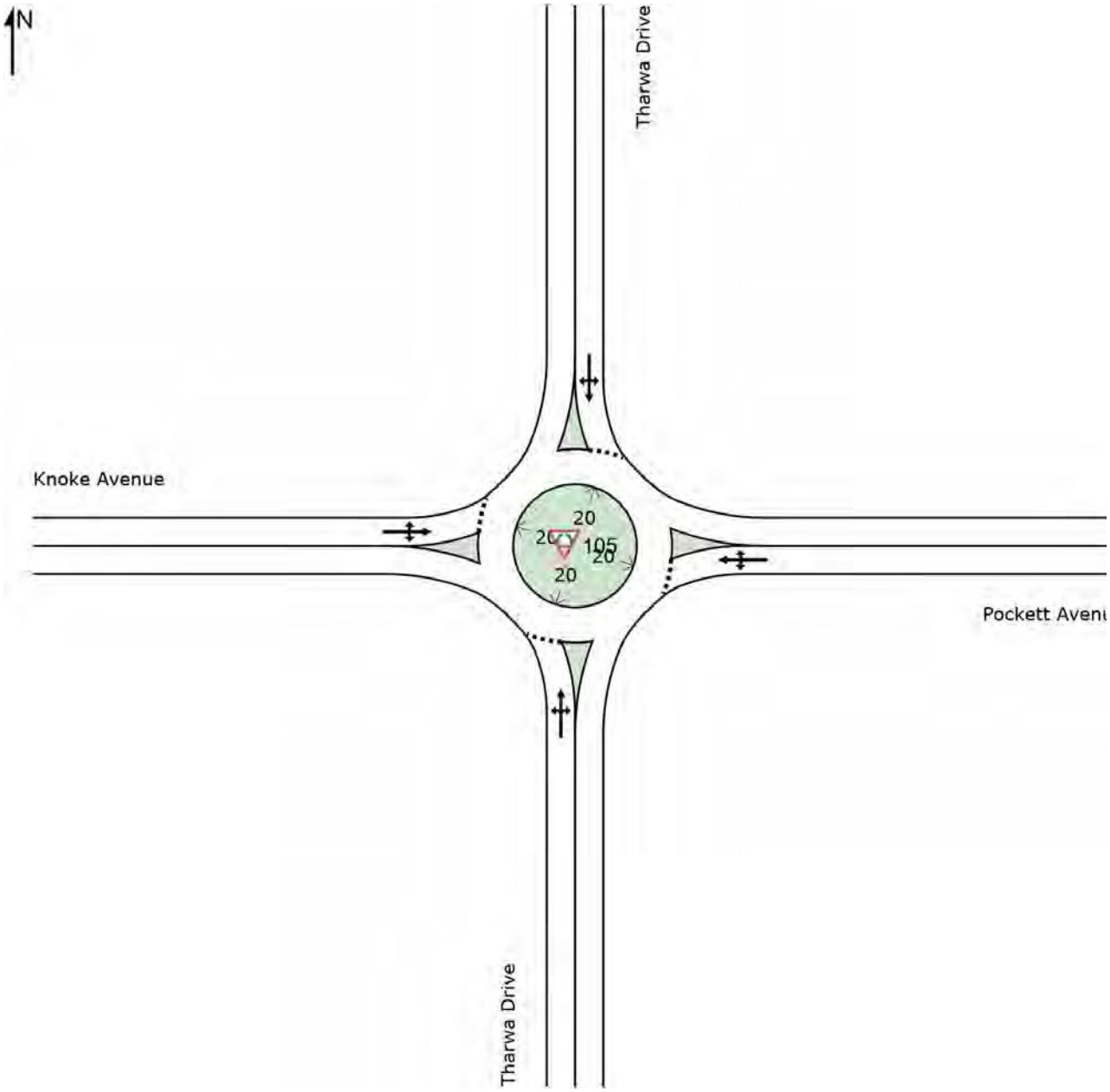
LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site: 105 [2031_PM Peak_Tharwa Drive / Pockett Avenue - Base]

Network: 5 [2031 Future Conditions with Upgrades_Tharwa Drive PM peak - Op1]

Single-Lane Roundabout - Existing Layout
Site Category: PM Peak 2031 Conditions
Roundabout

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
1	L2	2	1.5	2	1.5	0.037	5.7	LOS A	0.1	0.5	0.49	0.55	0.49	49.1
2	T1	29	1.5	29	1.5	0.037	6.0	LOS A	0.1	0.5	0.49	0.55	0.49	48.7
3	R2	5	1.5	5	1.5	0.037	10.6	LOS A	0.1	0.5	0.49	0.55	0.49	47.3
Approach		37	1.5	37	1.5	0.037	6.6	LOS A	0.1	0.5	0.49	0.55	0.49	48.5
East: Pockett Avenue														
4	L2	11	1.5	11	1.5	0.183	4.8	LOS A	0.4	2.9	0.45	0.65	0.45	47.5
5	T1	37	1.5	37	1.5	0.183	5.1	LOS A	0.4	2.9	0.45	0.65	0.45	12.6
6	R2	156	1.5	156	1.5	0.183	9.7	LOS A	0.4	2.9	0.45	0.65	0.45	27.5
Approach		203	1.5	203	1.5	0.183	8.6	LOS A	0.4	2.9	0.45	0.65	0.45	22.9
North: Tharwa Drive														
7	L2	303	1.5	303	1.5	0.378	4.1	LOS A	1.1	7.8	0.22	0.52	0.22	45.4
8	T1	61	1.5	61	1.5	0.378	4.4	LOS A	1.1	7.8	0.22	0.52	0.22	56.4
9	R2	205	1.5	205	1.5	0.378	9.0	LOS A	1.1	7.8	0.22	0.52	0.22	45.2
Approach		569	1.5	569	1.5	0.378	5.9	LOS A	1.1	7.8	0.22	0.52	0.22	46.7
West: Knoke Avenue														
10	L2	88	1.5	88	1.5	0.110	4.8	LOS A	0.2	1.7	0.37	0.51	0.37	32.6
11	T1	36	1.5	36	1.5	0.110	5.0	LOS A	0.2	1.7	0.37	0.51	0.37	24.2
12	R2	5	1.5	5	1.5	0.110	9.6	LOS A	0.2	1.7	0.37	0.51	0.37	52.6
Approach		129	1.5	129	1.5	0.110	5.0	LOS A	0.2	1.7	0.37	0.51	0.37	30.8
All Vehicles		939	1.5	939	1.5	0.378	6.4	LOS A	1.1	7.8	0.30	0.55	0.30	43.9

[redacted]

Lane Use and Performance

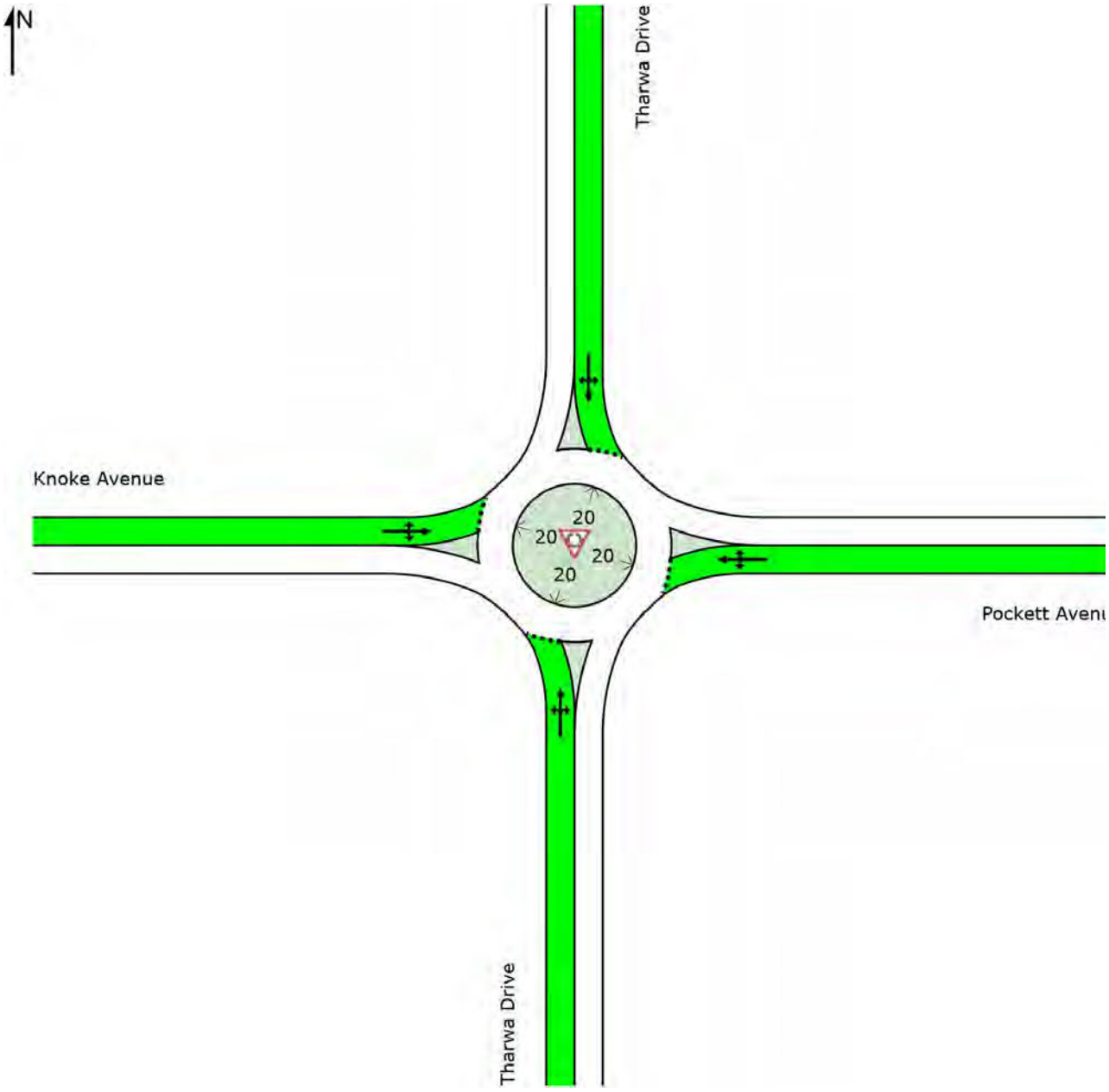
	Demand Flows		Arrival Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	Aver. Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
South: Tharwa Drive															
Lane 1[d]	37	1.5	37	1.5	1008	0.037	100	6.6	LOS A	0.1	0.5	Full	500	0.0	0.0
Approach	37	1.5	37	1.5		0.037		6.6	LOS A	0.1	0.5				
East: Pockett Avenue															
Lane 1[d]	203	1.5	203	1.5	1108	0.183	100	8.6	LOS A	0.4	2.9	Full	80	0.0	0.0
Approach	203	1.5	203	1.5		0.183		8.6	LOS A	0.4	2.9				
North: Tharwa Drive															
Lane 1[d]	569	1.5	569	1.5	1506	0.378	100	5.9	LOS A	1.1	7.8	Full	990	0.0	0.0
Approach	569	1.5	569	1.5		0.378		5.9	LOS A	1.1	7.8				
West: Knoke Avenue															
Lane 1[d]	129	1.5	129	1.5	1172	0.110	100	5.0	LOS A	0.2	1.7	Full	95	0.0	0.0
Approach	129	1.5	129	1.5		0.110		5.0	LOS A	0.2	1.7				
Intersection	939	1.5	939	1.5		0.378		6.4	LOS A	1.1	7.8				

[redacted]

d Dominant lane on roundabout approach

Lane Level of Service

	Approaches				Intersection
	South	East	North	West	
LOS	A	A	A	A	A



Colour code based on Level of Service

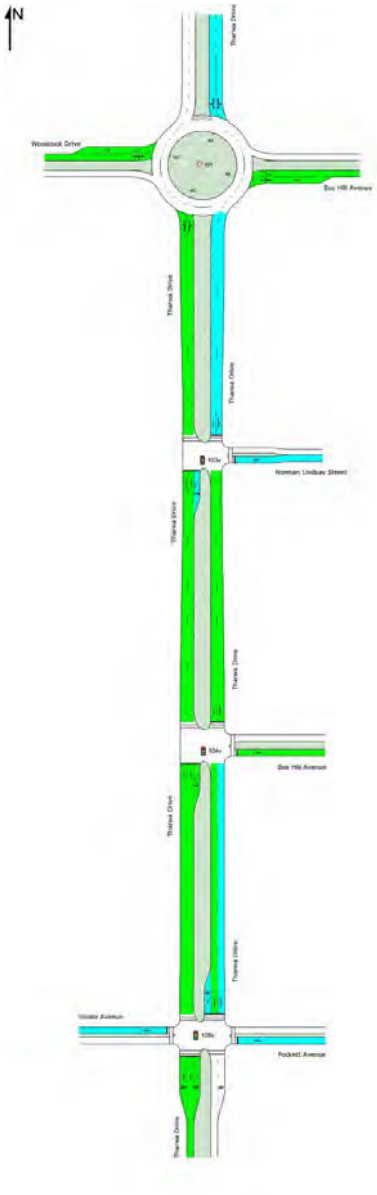
LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

DEGREE OF SATURATION

Ratio of Demand Volume to Capacity, v/c ratio per lane

Network: N101 [2031 Future Conditions with Upgrades_Tharwa Drive PM peak - Op2]

2031 Future Conditions - Upgraded Layout (Op2)
Network Category: (None)
Network Cycle Time = 75 seconds (Network User-Given Cycle Time)



Colour code based on Degree of Saturation

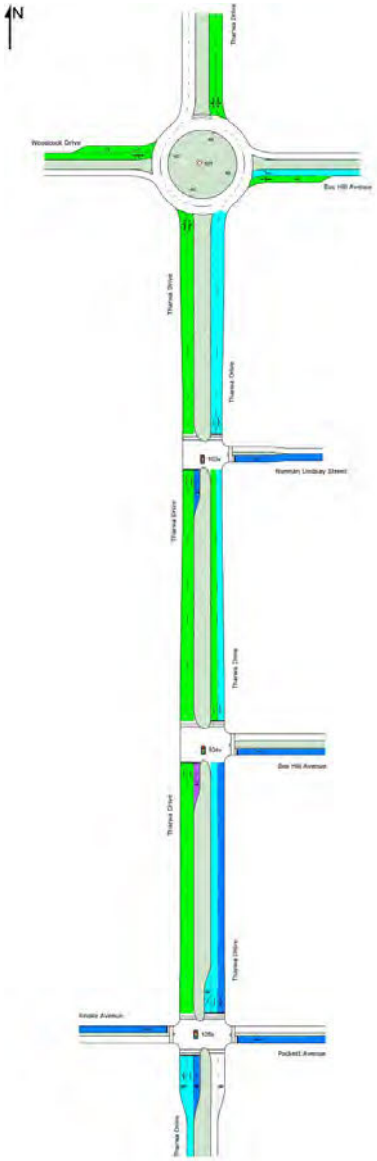
[< 0.6]	[0.6 – 0.7]	[0.7 – 0.8]	[0.8 – 0.9]	[0.9 – 1.0]	[> 1.0]

LANE LEVEL OF SERVICE

Lane Level of Service for Network Sites

Network: N101 [2031 Future Conditions with Upgrades_Tharwa Drive PM peak - Op2]

2031 Future Conditions - Upgraded Layout (Op2)
Network Category: (None)
Network Cycle Time = 75 seconds (Network User-Given Cycle Time)



Colour code based on Level of Service

LOS A	LOS B	LOS C	LOS D	LOS E	LOS F

Delay model settings are specified for individual Sites forming the Network.

USER REPORT FOR NETWORK SITE

Project: 2031 Conditions

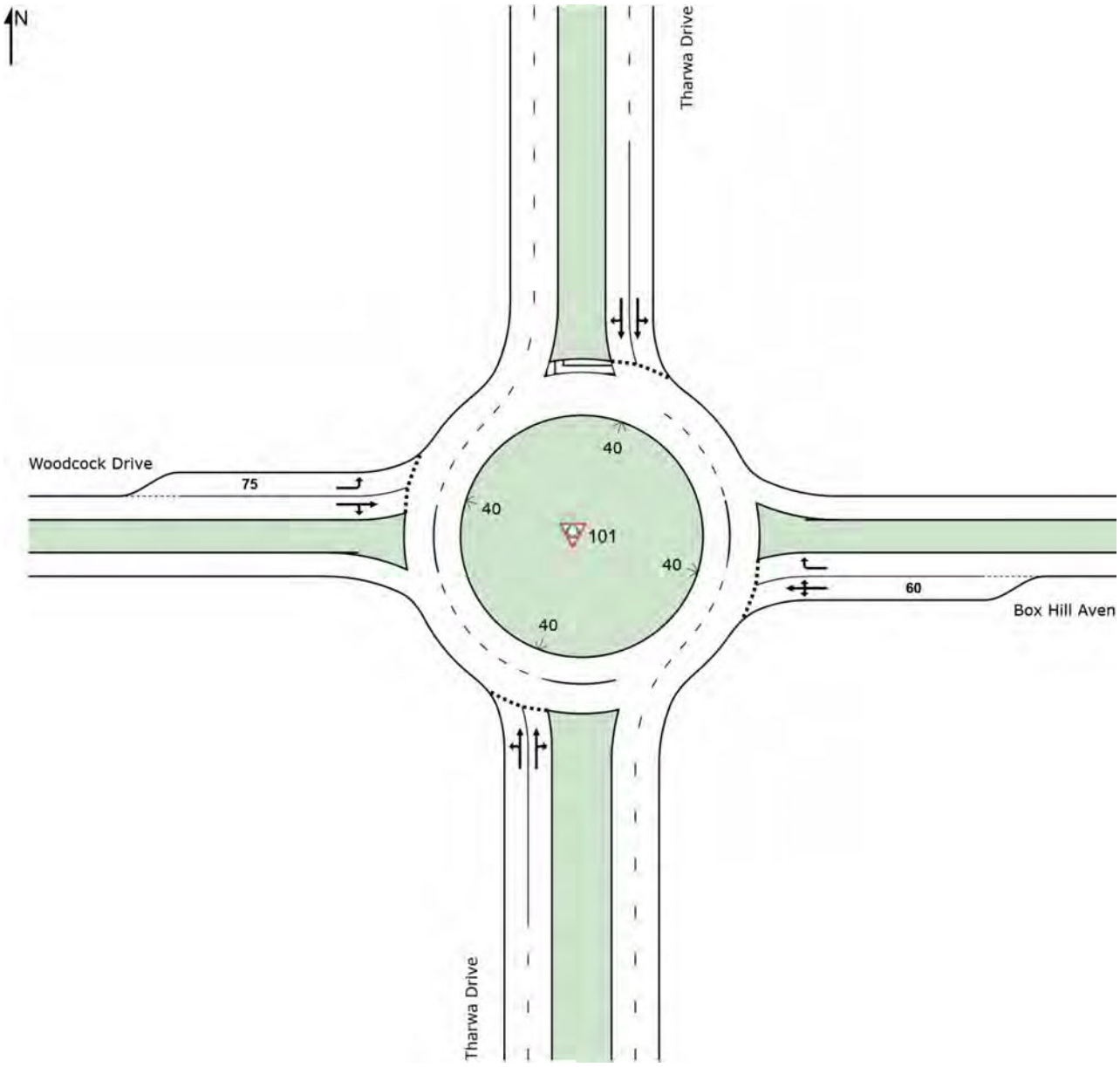
Template: Default Site User Report (2)

Site: 101 [2031_PM Peak_Tharwa Drive / Woodcock Drive - Duplicated]

Network: 7 [2031 Future Conditions with Upgrades_Tharwa Drive PM peak - Op2]

Two Lane Roundabout - Duplicated
Site Category: PM Peak 2031 Conditions
Roundabout

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
1	L2	151	1.5	151	1.5	0.298	5.2	LOS A	0.5	3.9	0.50	0.56	0.50	51.0
2	T1	400	1.5	400	1.5	0.298	5.2	LOS A	0.5	3.9	0.52	0.55	0.52	54.8
3	R2	9	1.5	9	1.5	0.298	11.8	LOS A	0.5	3.6	0.53	0.55	0.53	43.7
Approach		560	1.5	560	1.5	0.298	5.3	LOS A	0.5	3.9	0.51	0.55	0.51	53.8
East: Box Hill Avenue														
4	L2	32	1.5	32	1.5	0.443	7.9	LOS A	1.3	8.9	0.85	0.93	0.95	31.7
5	T1	105	1.5	105	1.5	0.443	7.7	LOS A	1.3	8.9	0.85	0.93	0.95	47.7
6	R2	485	1.5	485	1.5	0.443	14.9	LOS B	1.3	8.9	0.84	0.96	0.96	48.4
Approach		622	1.5	622	1.5	0.443	13.3	LOS A	1.3	8.9	0.85	0.95	0.95	47.9
North: Tharwa Drive														
7	L2	797	1.5	797	1.5	0.666	4.4	LOS A	2.8	20.1	0.65	0.52	0.65	52.0
8	T1	972	1.5	972	1.5	0.666	4.3	LOS A	2.8	20.1	0.69	0.51	0.70	48.7
9	R2	113	1.5	113	1.5	0.666	11.3	LOS A	2.8	19.5	0.71	0.50	0.71	55.7
Approach		1881	1.5	1881	1.5	0.666	4.8	LOS A	2.8	20.1	0.68	0.51	0.68	50.8
West: Woodcock Drive														
10	L2	65	1.5	65	1.5	0.090	6.0	LOS A	0.2	1.1	0.60	0.69	0.60	54.1
11	T1	145	1.5	145	1.5	0.200	4.5	LOS A	0.4	2.9	0.61	0.59	0.61	52.1
12	R2	66	1.5	66	1.5	0.200	11.4	LOS A	0.4	2.9	0.61	0.59	0.61	45.9
Approach		277	1.5	277	1.5	0.200	6.5	LOS A	0.4	2.9	0.61	0.61	0.61	51.6
All Vehicles		3340	1.5	3340	1.5	0.666	6.6	LOS A	2.8	20.1	0.68	0.61	0.70	50.7

[redacted]

Lane Use and Performance

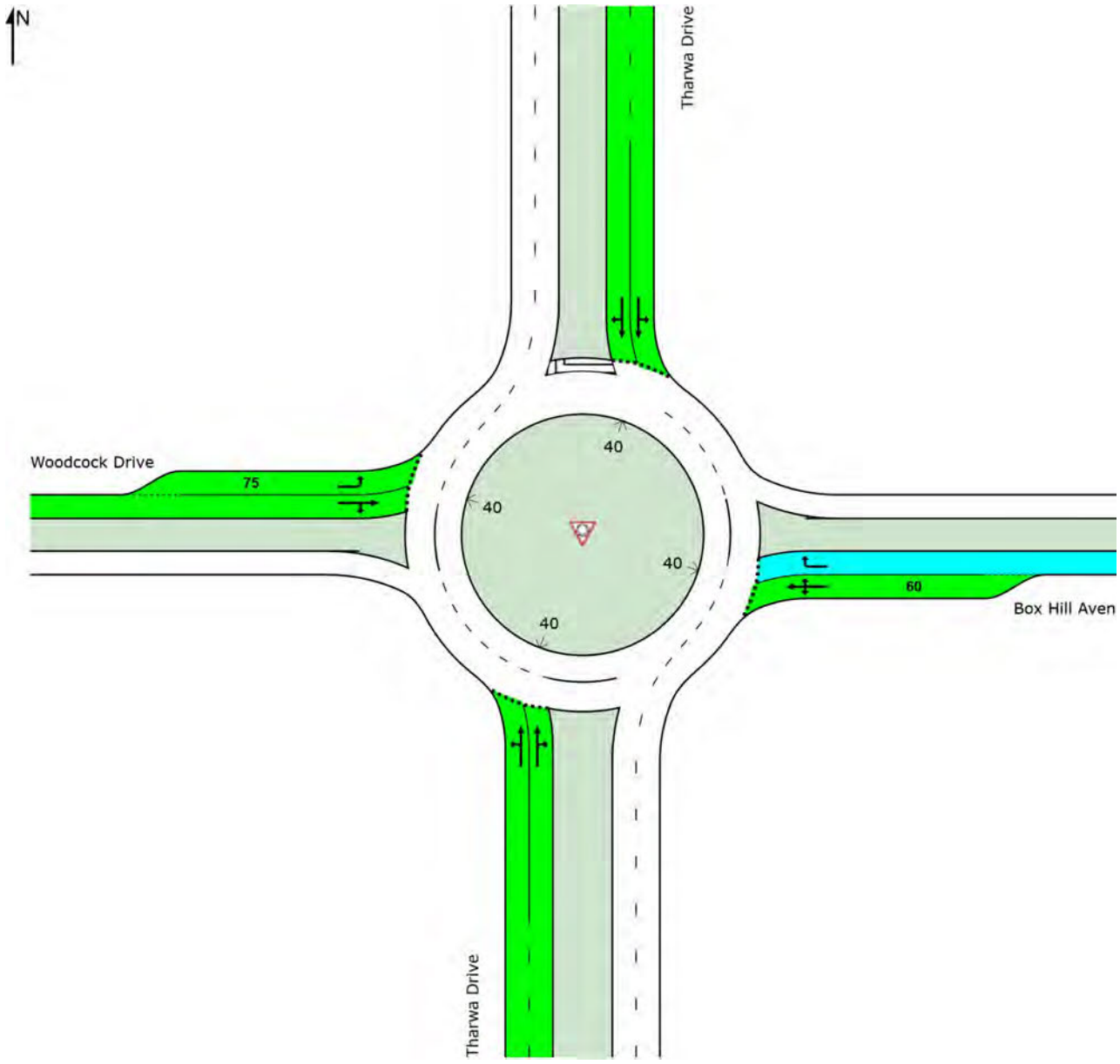
	Demand Flows		Arrival Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	Aver. Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
South: Tharwa Drive															
Lane 1[d]	307	1.5	307	1.5	1029	0.298	100	5.1	LOS A	0.5	3.9	Full	165	0.0	0.0
Lane 2	253	1.5	253	1.5	848	0.298	100	5.6	LOS A	0.5	3.6	Full	165	0.0	0.0
Approach	560	1.5	560	1.5		0.298		5.3	LOS A	0.5	3.9				
East: Box Hill Avenue															
Lane 1[d]	355	1.5	355	1.5	801	0.443	100	11.6	LOS A	1.3	8.9	Short	60	0.0	NA
Lane 2	267	1.5	267	1.5	604	0.443	100	15.5	LOS B	1.1	8.0	Full	150	0.0	0.0
Approach	622	1.5	622	1.5		0.443		13.3	LOS A	1.3	8.9				
North: Tharwa Drive															
Lane 1[d]	1042	1.5	1042	1.5	1565	0.666	100	4.3	LOS A	2.8	20.1	Full	490	0.0	0.0
Lane 2	839	1.5	839	1.5	1260	0.666	100	5.3	LOS A	2.8	19.5	Full	490	0.0	0.0
Approach	1881	1.5	1881	1.5		0.666		4.8	LOS A	2.8	20.1				
West: Woodcock Drive															
Lane 1	65	1.5	65	1.5	729	0.090	100	6.0	LOS A	0.2	1.1	Short	75	0.0	NA
Lane 2[d]	212	1.5	212	1.5	1058	0.200	100	6.7	LOS A	0.4	2.9	Full	380	0.0	0.0
Approach	277	1.5	277	1.5		0.200		6.5	LOS A	0.4	2.9				
Intersection	3340	1.5	3340	1.5		0.666		6.6	LOS A	2.8	20.1				

[redacted]

d Dominant lane on roundabout approach

Lane Level of Service

	Approaches				Intersection
	South	East	North	West	
LOS	A	A	A	A	A



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

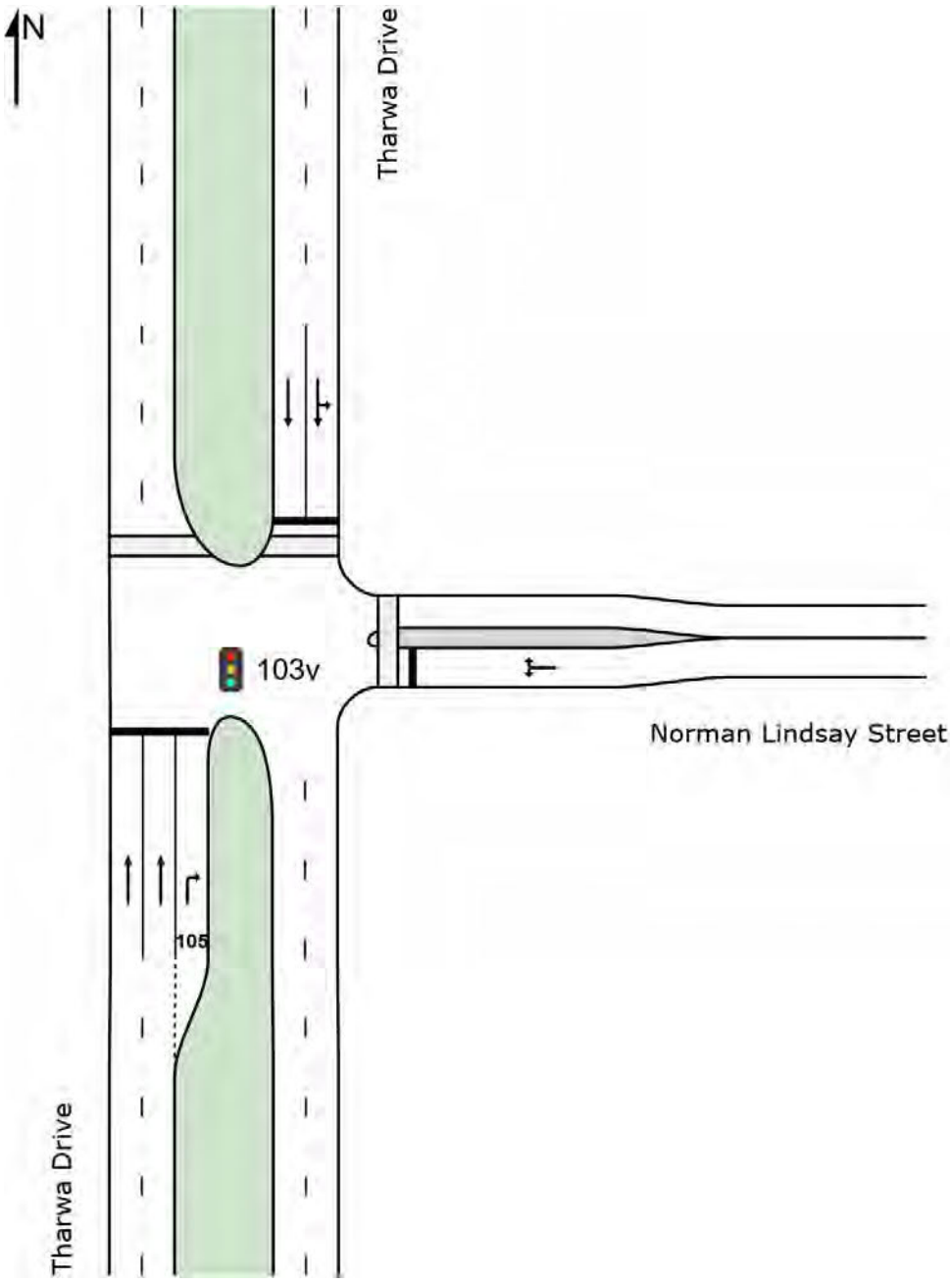
Site: 103v [2031_PM Peak_Tharwa Drive / Norman Lindsay Street - Signals]

Network: 7 [2031 Future Conditions with Upgrades_Tharwa Drive PM peak - Op2]

Signalised T-Intersection - Duplicated
Site Category: PM Peak 2031 Conditions
Signals - Fixed Time Coordinated Cycle Time = 75 seconds (Network User-Given Cycle Time)

Timings based on settings in the Network Timing dialog
Phase Times determined by the program
Downstream lane blockage effects included in determining phase times
Phase Sequence: Sequence1
Reference Phase: Phase A
Input Phase Sequence: A, B, C
Output Phase Sequence: A, B, C

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
2	T1	427	1.5	427	1.5	0.189	10.5	LOS A	3.6	25.5	0.66	0.56	0.66	47.3
3	R2	107	1.5	107	1.5	0.626	40.6	LOS C	2.4	17.2	0.97	0.79	1.02	29.5
Approach		535	1.5	535	1.5	0.626	16.5	LOS B	3.6	25.5	0.73	0.61	0.74	42.0
East: Norman Lindsay Street														
4	L2	197	1.5	197	1.5	0.676	31.9	LOS C	6.9	48.7	0.96	0.85	0.99	5.6
6	R2	129	1.5	129	1.5	0.676	31.8	LOS C	6.9	48.7	0.96	0.85	0.99	5.6
Approach		326	1.5	326	1.5	0.676	31.9	LOS C	6.9	48.7	0.96	0.85	0.99	5.6
North: Tharwa Drive														
7	L2	242	1.5	242	1.5	0.678	25.1	LOS B	9.8	69.3	0.87	0.80	0.87	10.4
8	T1	828	1.5	828	1.5	0.678	19.5	LOS B	10.0	70.8	0.87	0.78	0.87	20.5
Approach		1071	1.5	1071	1.5	0.678	20.8	LOS B	10.0	70.8	0.87	0.79	0.87	16.3
All Vehicles		1932	1.5	1932	1.5	0.678	21.5	LOS B	10.0	70.8	0.85	0.75	0.86	23.9



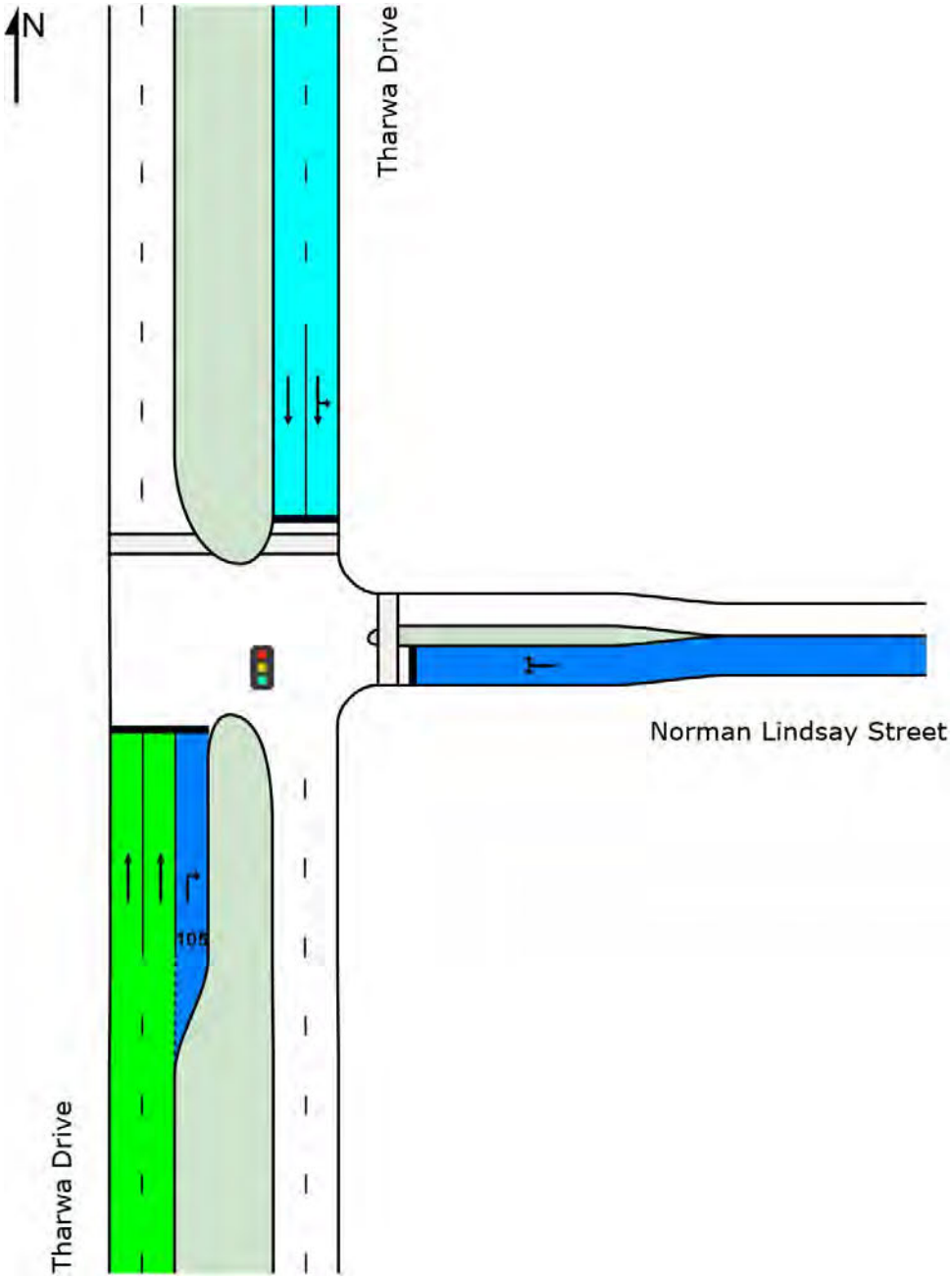
Lane Use and Performance

	Demand Flows		Arrival Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	Aver. Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
South: Tharwa Drive															
Lane 1	214	1.5	214	1.5	1133	0.189	100	7.7	LOS A	2.4	16.7	Full	640	0.0	0.0
Lane 2	214	1.5	214	1.5	1133	0.189	100	13.3	LOS A	3.6	25.5	Full	640	0.0	0.0
Lane 3	107	1.5	107	1.5	171	0.626	100	40.6	LOS C	2.4	17.2	Short	105	0.0	NA
Approach	535	1.5	535	1.5		0.626		16.5	LOS B	3.6	25.5				
East: Norman Lindsay Street															
Lane 1	326	1.5	326	1.5	482	0.676	100	31.9	LOS C	6.9	48.7	Full	40	0.0	68.7
Approach	326	1.5	326	1.5		0.676		31.9	LOS C	6.9	48.7				
North: Tharwa Drive															
Lane 1	529	1.5	529	1.5	780	0.678	100	22.0	LOS B	9.8	69.3	Full	165	0.0	0.0
Lane 2	541	1.5	541	1.5	798	0.678	100	19.5	LOS B	10.0	70.8	Full	165	0.0	0.0
Approach	1071	1.5	1071	1.5		0.678		20.8	LOS B	10.0	70.8				
Intersection	1932	1.5	1932	1.5		0.678		21.5	LOS B	10.0	70.8				

[redacted]

Lane Level of Service

	Approaches			Intersection
	South	East	North	
LOS	B	C	B	B



Colour code based on Level of Service

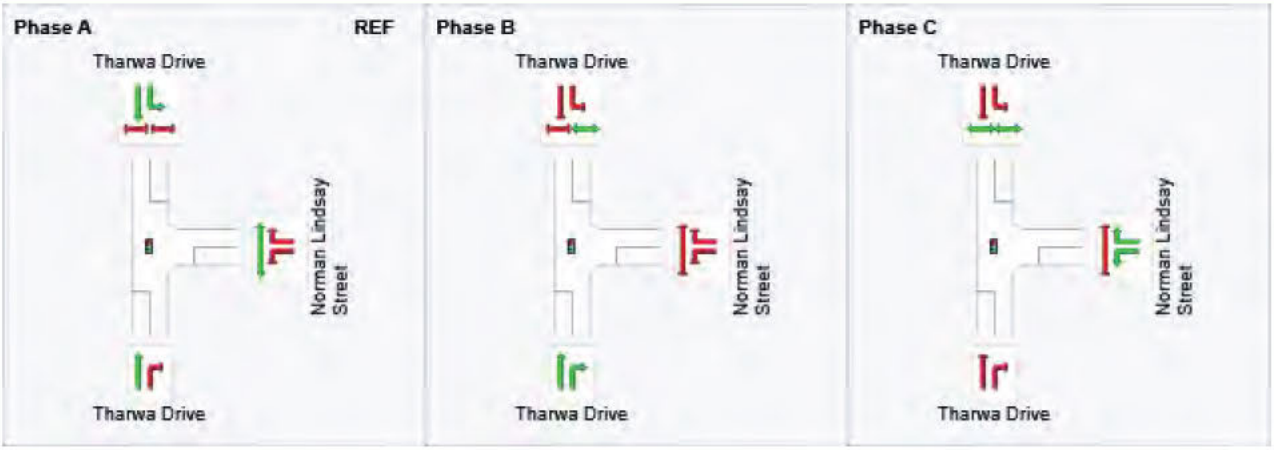
LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Phase Timing Summary

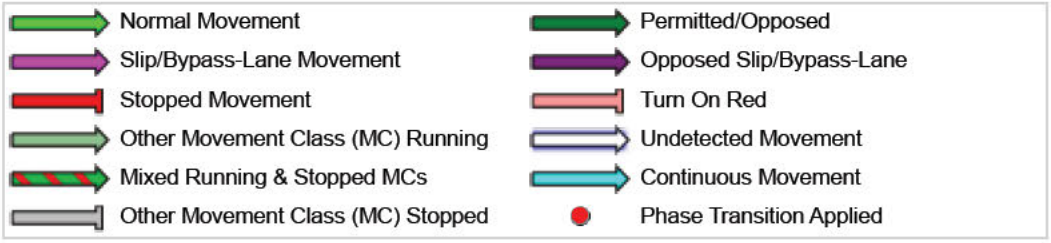
Phase	A	B	C
Phase Change Time (sec)	0	37	50
Green Time (sec)	31	7	19
Phase Time (sec)	37	13	25
Phase Split	49%	17%	33%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase



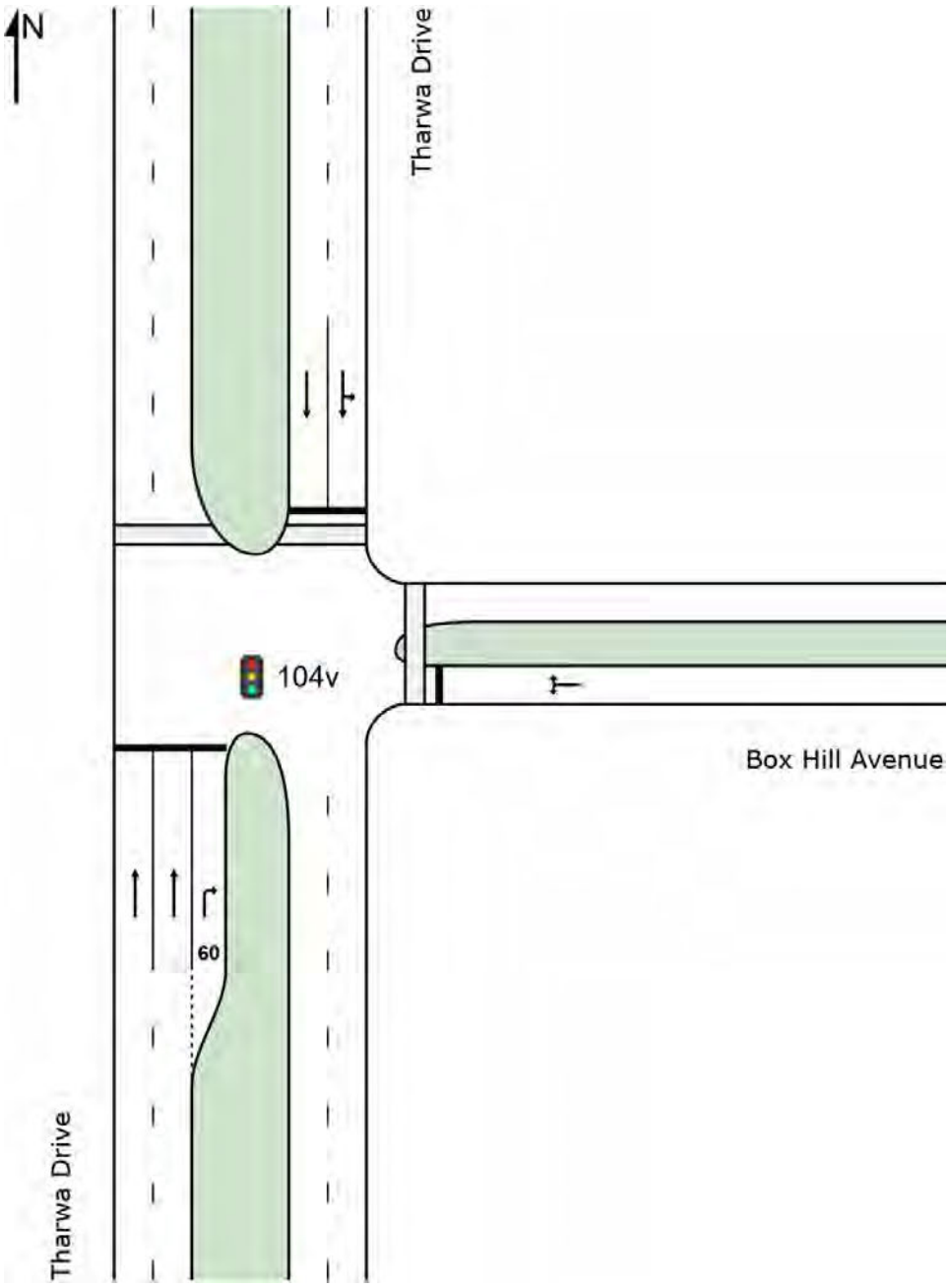
Site: 104v [2031_PM Peak_Tharwa Drive / Box Hill Avenue - Signals]

Network: 7 [2031 Future Conditions with Upgrades_Tharwa Drive PM peak - Op2]

Signalised T-intersection - Duplicated
Site Category: PM Peak 2031 Conditions
Signals - Fixed Time Coordinated Cycle Time = 75 seconds (Network User-Given Cycle Time)

Timings based on settings in the Network Timing dialog
Phase Times determined by the program
Downstream lane blockage effects included in determining phase times
Phase Sequence: Sequence1
Reference Phase: Phase A
Input Phase Sequence: A, B, C
Output Phase Sequence: A, B, C

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
2	T1	280	1.5	280	1.5	0.117	9.0	LOS A	2.5	17.9	0.56	0.46	0.56	52.2
3	R2	14	1.5	14	1.5	0.092	44.4	LOS D	0.3	2.3	1.00	0.69	1.00	35.5
Approach		294	1.5	294	1.5	0.117	10.7	LOS A	2.5	17.9	0.58	0.47	0.58	50.9
East: Box Hill Avenue														
4	L2	14	1.5	14	1.5	0.585	33.4	LOS C	5.4	38.6	0.94	0.82	0.94	10.7
6	R2	254	1.5	254	1.5	0.585	33.4	LOS C	5.4	38.6	0.94	0.82	0.94	10.7
Approach		267	1.5	267	1.5	0.585	33.4	LOS C	5.4	38.6	0.94	0.82	0.94	10.7
North: Tharwa Drive														
7	L2	477	1.5	477	1.5	0.600	21.3	LOS B	7.6	53.7	0.71	0.78	0.71	40.0
8	T1	556	1.5	556	1.5	0.600	4.4	LOS A	7.6	53.7	0.30	0.27	0.30	53.6
Approach		1033	1.5	1033	1.5	0.600	12.2	LOS A	7.6	53.7	0.49	0.51	0.49	45.8
All Vehicles		1594	1.5	1594	1.5	0.600	15.5	LOS B	7.6	53.7	0.58	0.55	0.58	42.7

[redacted]

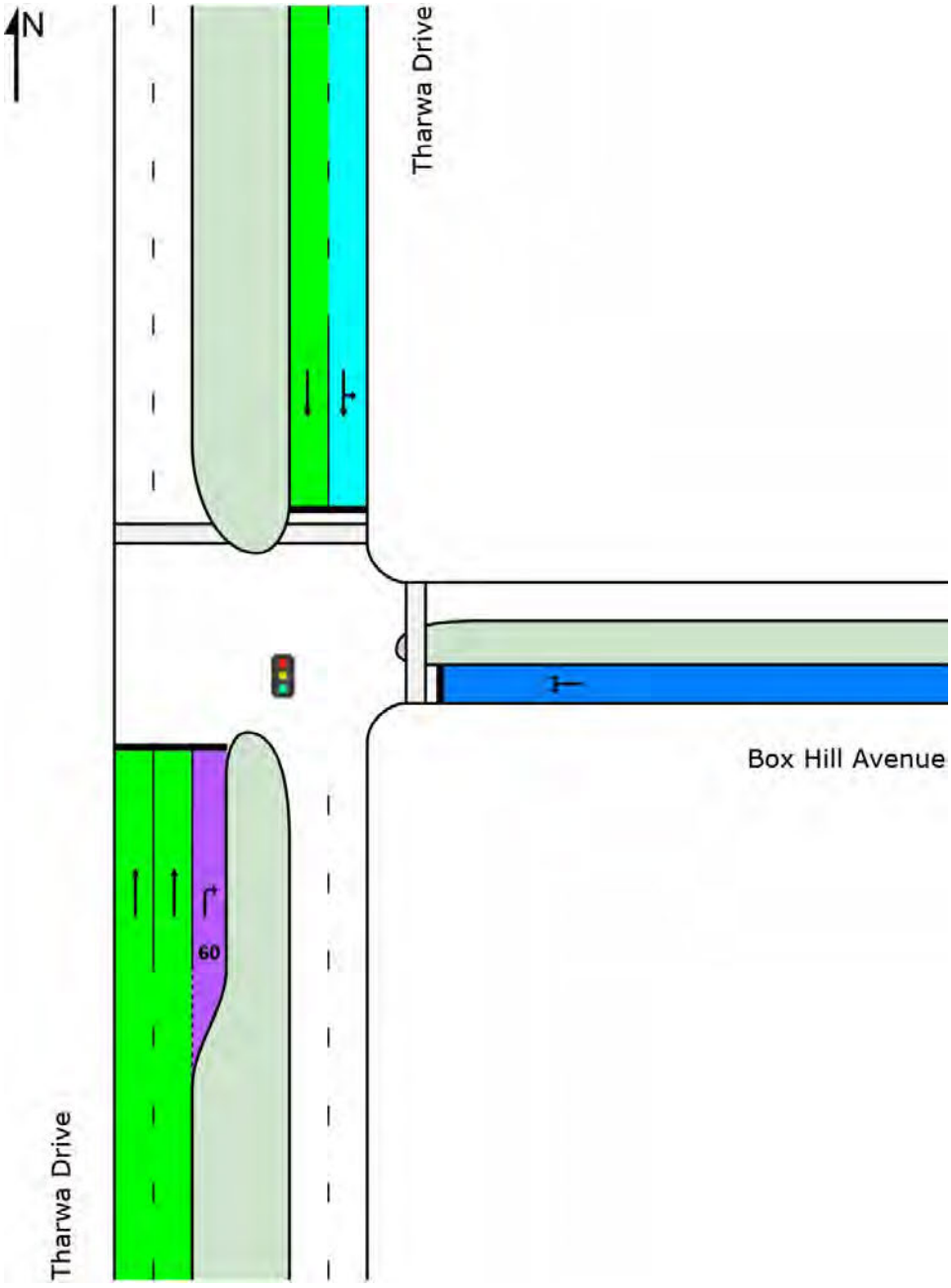
Lane Use and Performance

	Demand Flows		Arrival Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	Aver. Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
South: Tharwa Drive															
Lane 1	140	1.5	140	1.5	1201	0.117	100	4.4	LOS A	0.8	5.4	Full	990	0.0	0.0
Lane 2	140	1.5	140	1.5	1201	0.117	100	13.6	LOS A	2.5	17.9	Full	990	0.0	0.0
Lane 3	14	1.5	14	1.5	149	0.092	100	44.4	LOS D	0.3	2.3	Short	60	0.0	NA
Approach	294	1.5	294	1.5		0.117		10.7	LOS A	2.5	17.9				
East: Box Hill Avenue															
Lane 1	267	1.5	267	1.5	457	0.585	100	33.4	LOS C	5.4	38.6	Full	105	0.0	0.0
Approach	267	1.5	267	1.5		0.585		33.4	LOS C	5.4	38.6				
North: Tharwa Drive															
Lane 1	504	1.5	504	1.5	840	0.600	100	21.0	LOS B	7.6	53.7	Full	640	0.0	0.0
Lane 2	528	1.5	528	1.5	881	0.600	100	3.8	LOS A	3.1	21.9	Full	640	0.0	0.0
Approach	1033	1.5	1033	1.5		0.600		12.2	LOS A	7.6	53.7				
Intersection	1594	1.5	1594	1.5		0.600		15.5	LOS B	7.6	53.7				

[redacted]

Lane Level of Service

	Approaches			Intersection
	South	East	North	
LOS	A	C	A	B



Colour code based on Level of Service

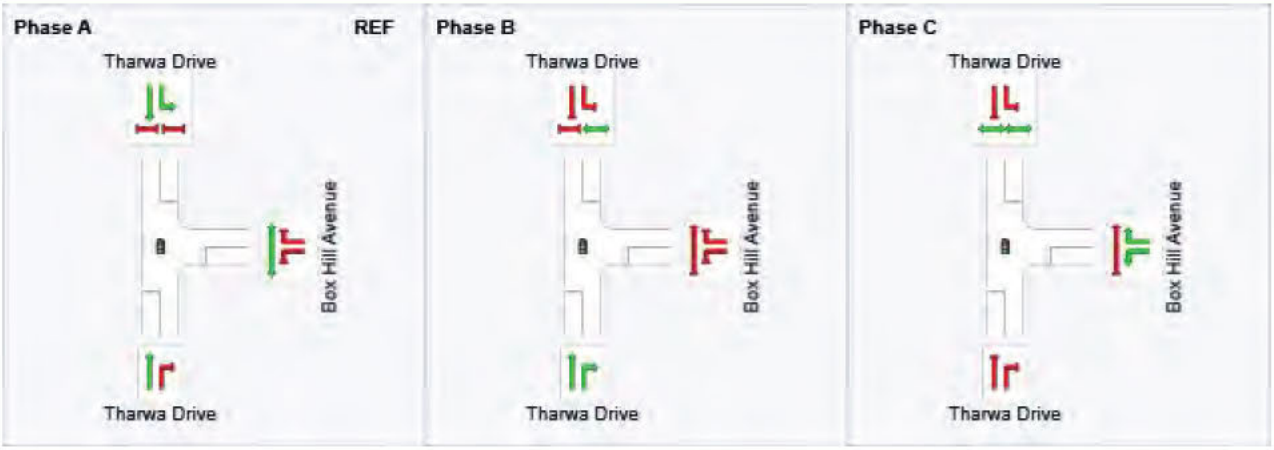
LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Phase Timing Summary

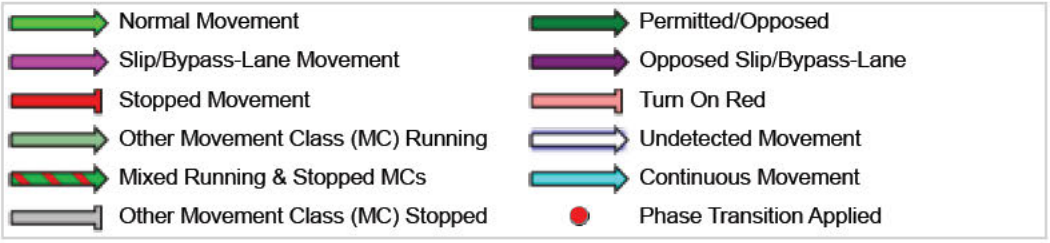
Phase	A	B	C
Phase Change Time (sec)	29	68	5
Green Time (sec)	33	6	18
Phase Time (sec)	39	12	24
Phase Split	52%	16%	32%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase



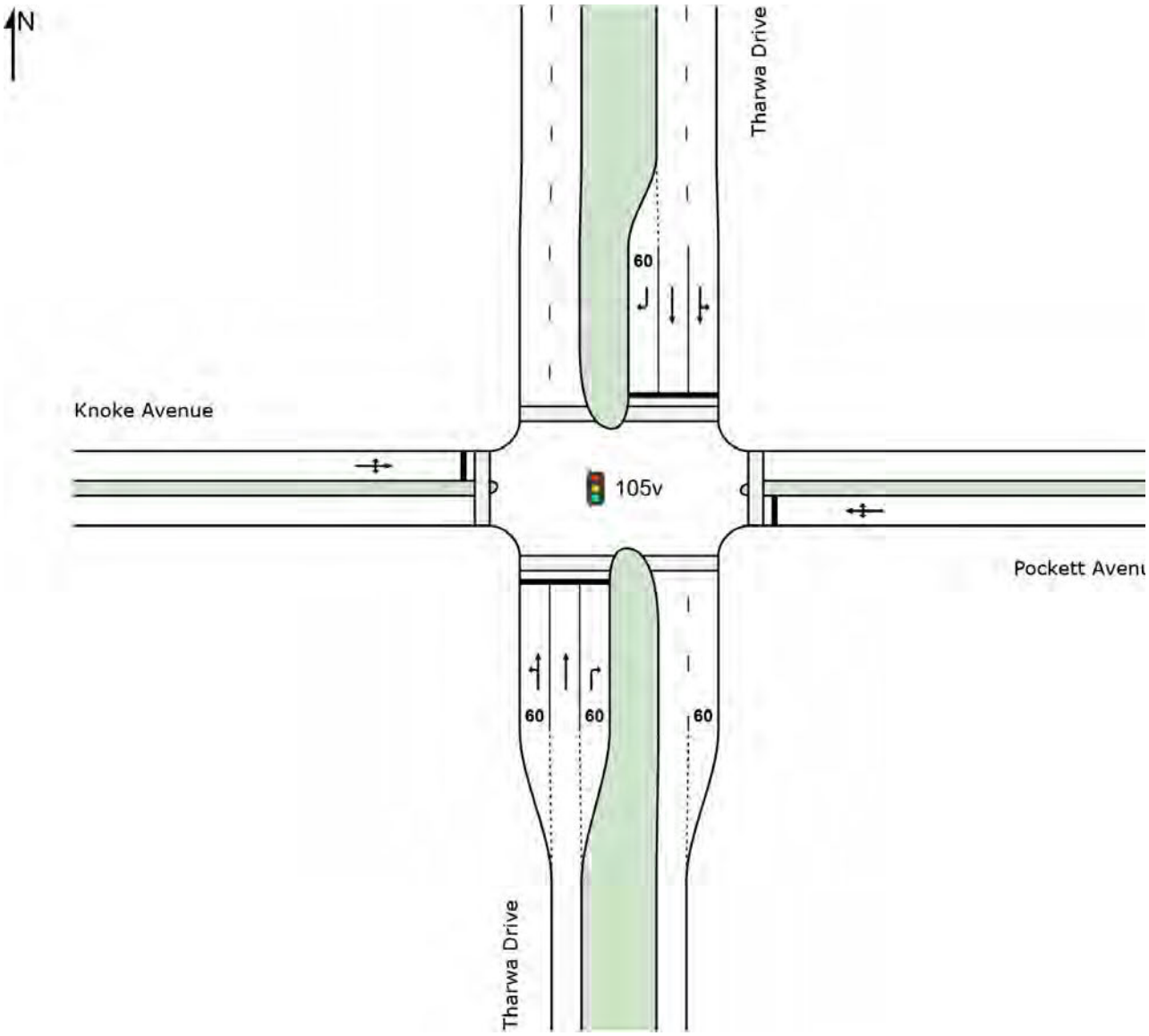
Site: 105v [2031_PM Peak_Tharwa Drive / Pockett Avenue - Signals]

Network: 7 [2031 Future Conditions with Upgrades_Tharwa Drive PM peak - Op2]

Signalised Cross Intersection - Duplicated
Site Category: PM Peak 2031 Conditions
Signals - Fixed Time Coordinated Cycle Time = 75 seconds (Network User-Given Cycle Time)

Timings based on settings in the Network Timing dialog
Phase Times determined by the program
Downstream lane blockage effects included in determining phase times
Phase Sequence: Diamond Phasing
Reference Phase: Phase A
Input Phase Sequence: A, B, C, D
Output Phase Sequence: A, B, C, D

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
1	L2	2	1.5	2	1.5	0.033	29.1	LOS C	0.3	1.9	0.79	0.57	0.79	17.8
2	T1	29	1.5	29	1.5	0.033	23.5	LOS B	0.3	1.9	0.79	0.57	0.79	33.7
3	R2	5	1.5	5	1.5	0.016	33.4	LOS C	0.1	0.7	0.85	0.64	0.85	29.9
Approach		37	1.5	37	1.5	0.033	25.3	LOS B	0.3	1.9	0.80	0.58	0.80	31.3
East: Pockett Avenue														
4	L2	11	1.5	11	1.5	0.661	39.1	LOS C	4.6	32.3	0.99	0.85	1.05	28.4
5	T1	37	1.5	37	1.5	0.661	34.0	LOS C	4.6	32.3	0.99	0.85	1.05	14.1
6	R2	156	1.5	156	1.5	0.661	39.1	LOS C	4.6	32.3	0.99	0.85	1.05	8.2
Approach		203	1.5	203	1.5	0.661	38.2	LOS C	4.6	32.3	0.99	0.85	1.05	11.0
North: Tharwa Drive														
7	L2	303	1.5	303	1.5	0.663	35.4	LOS C	6.6	47.1	1.00	0.85	1.02	37.9
8	T1	61	1.5	61	1.5	0.127	26.1	LOS B	1.2	8.8	0.93	0.71	0.93	46.5
9	R2	205	1.5	205	1.5	0.622	26.7	LOS B	3.6	25.8	0.80	0.77	0.80	41.5
Approach		569	1.5	569	1.5	0.663	31.3	LOS C	6.6	47.1	0.92	0.81	0.93	40.2
West: Knoke Avenue														
10	L2	88	1.5	88	1.5	0.629	42.8	LOS D	3.0	21.3	1.00	0.82	1.08	8.5
11	T1	36	1.5	36	1.5	0.629	37.3	LOS C	3.0	21.3	1.00	0.82	1.08	13.1
12	R2	5	1.5	5	1.5	0.629	42.9	LOS D	3.0	21.3	1.00	0.82	1.08	27.8
Approach		129	1.5	129	1.5	0.629	41.3	LOS C	3.0	21.3	1.00	0.82	1.08	11.0
All Vehicles		939	1.5	939	1.5	0.663	33.9	LOS C	6.6	47.1	0.94	0.81	0.97	33.8



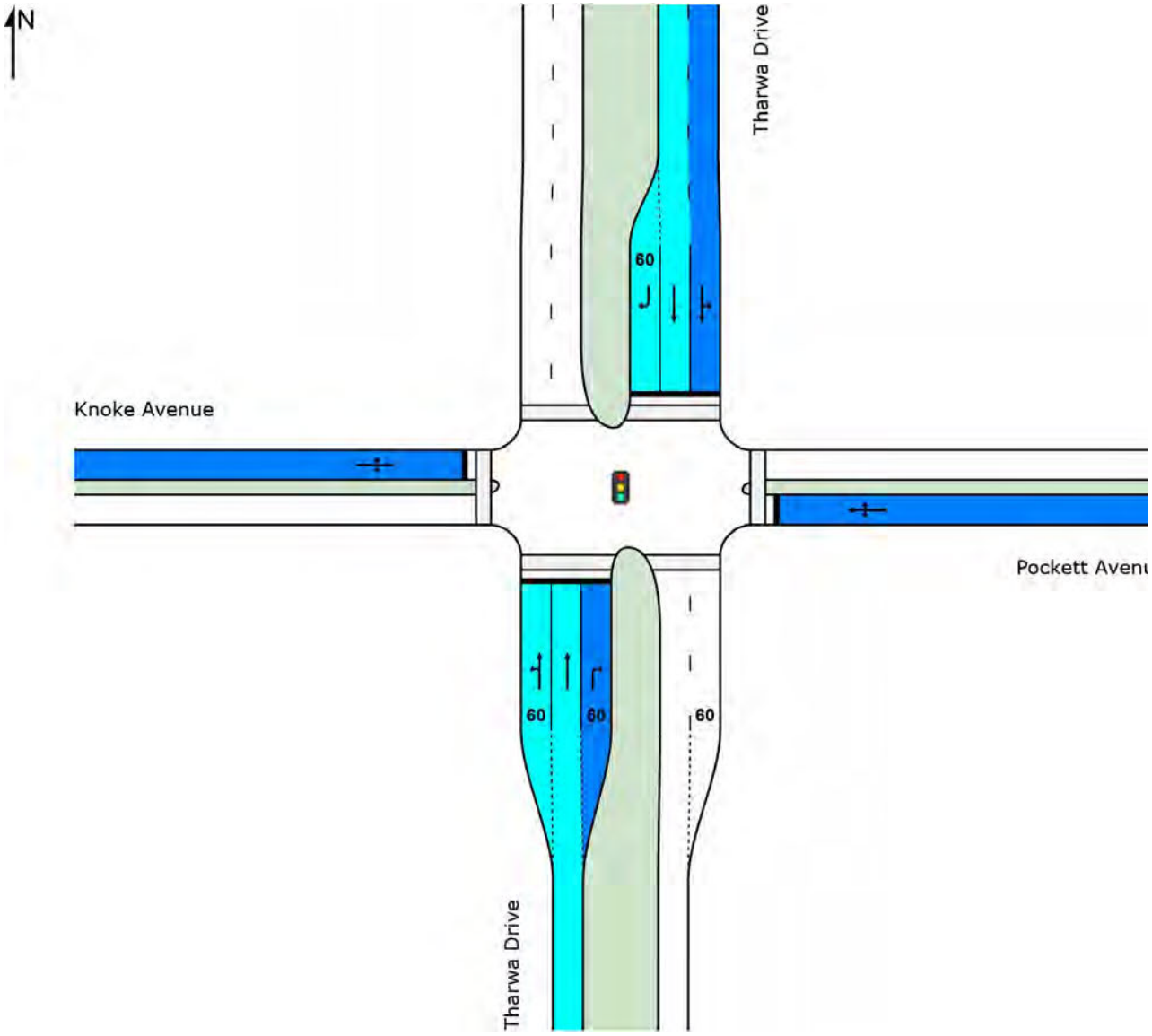
Lane Use and Performance

	Demand Flows		Arrival Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	Aver. Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
South: Tharwa Drive															
Lane 1	16	1.5	16	1.5	477	0.033	100	24.3	LOS B	0.3	1.9	Short	60	0.0	NA
Lane 2	16	1.5	16	1.5	480	0.033	100	23.5	LOS B	0.3	1.9	Full	500	0.0	0.0
Lane 3	5	1.5	5	1.5	330	0.016	100	33.4	LOS C	0.1	0.7	Short	60	0.0	NA
Approach	37	1.5	37	1.5		0.033		25.3	LOS B	0.3	1.9				
East: Pockett Avenue															
Lane 1	203	1.5	203	1.5	307	0.661	100	38.2	LOS C	4.6	32.3	Full	80	0.0	0.0
Approach	203	1.5	203	1.5		0.661		38.2	LOS C	4.6	32.3				
North: Tharwa Drive															
Lane 1	303	1.5	303	1.5	457	0.663	100	35.4	LOS C	6.6	47.1	Full	990	0.0	0.0
Lane 2	61	1.5	61	1.5	480	0.127	19[5]	26.1	LOS B	1.2	8.8	Full	990	0.0	0.0
Lane 3	205	1.5	205	1.5	330	0.622	100	26.7	LOS B	3.6	25.8	Short	60	0.0	NA
Approach	569	1.5	569	1.5		0.663		31.3	LOS C	6.6	47.1				
West: Knoke Avenue															
Lane 1	129	1.5	129	1.5	206	0.629	100	41.3	LOS C	3.0	21.3	Full	95	0.0	0.0
Approach	129	1.5	129	1.5		0.629		41.3	LOS C	3.0	21.3				
Intersection	939	1.5	939	1.5		0.663		33.9	LOS C	6.6	47.1				

[redacted]

Lane Level of Service

	Approaches				Intersection
	South	East	North	West	
LOS	B	C	C	C	C



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Phase Timing Summary

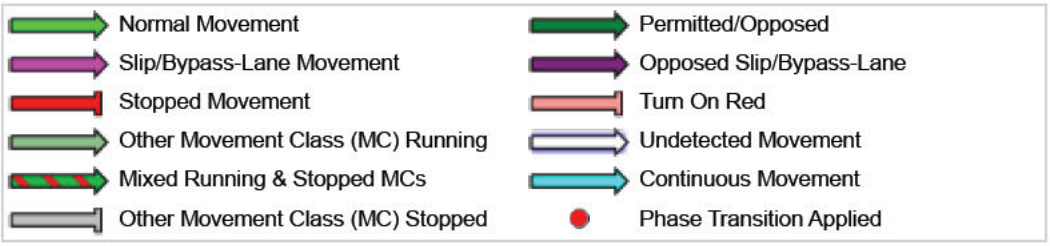
Phase	A	B	C	D
Phase Change Time (sec)	74	23	42	60
Green Time (sec)	18	13	12	8
Phase Time (sec)	24	19	18	14
Phase Split	32%	25%	24%	19%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase

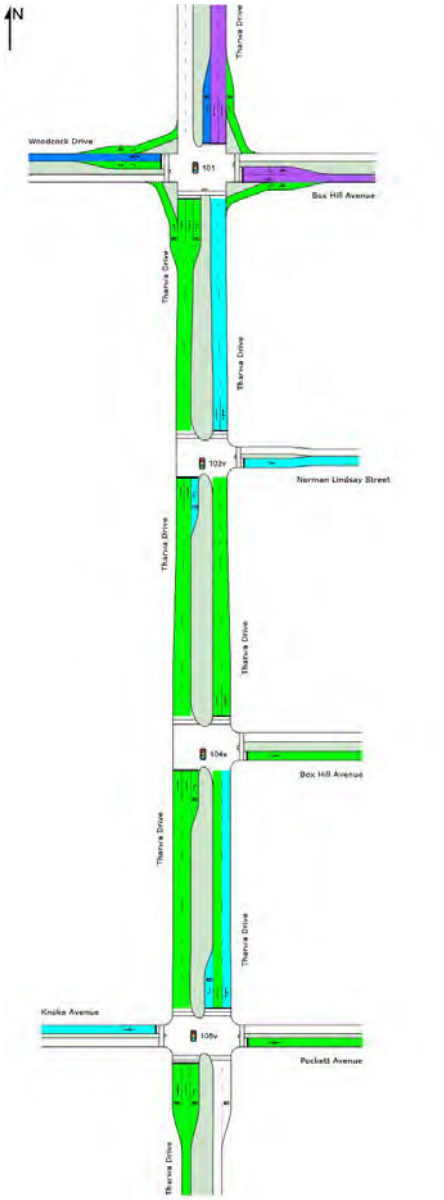


DEGREE OF SATURATION

Ratio of Demand Volume to Capacity, v/c ratio per lane

Network: N101 [2031 Future Conditions with Upgrades_Tharwa Drive PM peak - Op3]

2031 Future Conditions - Upgraded Layout (Op3)
Network Category: (None)
Network Cycle Time = 85 seconds (Network User-Given Cycle Time)



Colour code based on Degree of Saturation

[< 0.6]	[0.6 – 0.7]	[0.7 – 0.8]	[0.8 – 0.9]	[0.9 – 1.0]	[> 1.0]

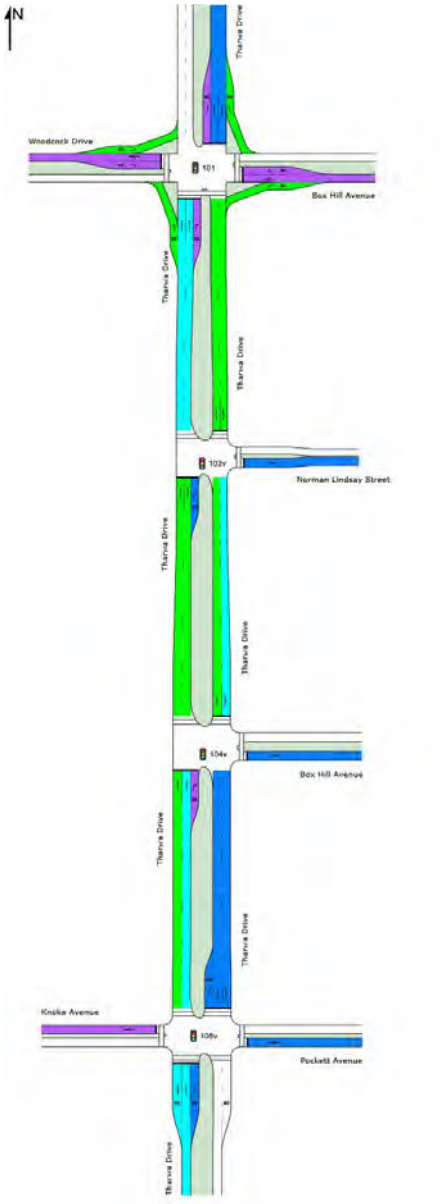
SIDRA INTERSECTION 8.0 | Copyright © 2000-2019 Akcelik and Associates Pty Ltd | sidrasolutions.com

LANE LEVEL OF SERVICE

Lane Level of Service for Network Sites

Network: N101 [2031 Future Conditions with Upgrades_Tharwa Drive PM peak - Op3]

2031 Future Conditions - Upgraded Layout (Op3)
Network Category: (None)
Network Cycle Time = 85 seconds (Network User-Given Cycle Time)



Colour code based on Level of Service

LOS A	LOS B	LOS C	LOS D	LOS E	LOS F

Delay model settings are specified for individual Sites forming the Network.

USER REPORT FOR NETWORK SITE

Project: 2031 Conditions

Template: Default Site User Report (2)

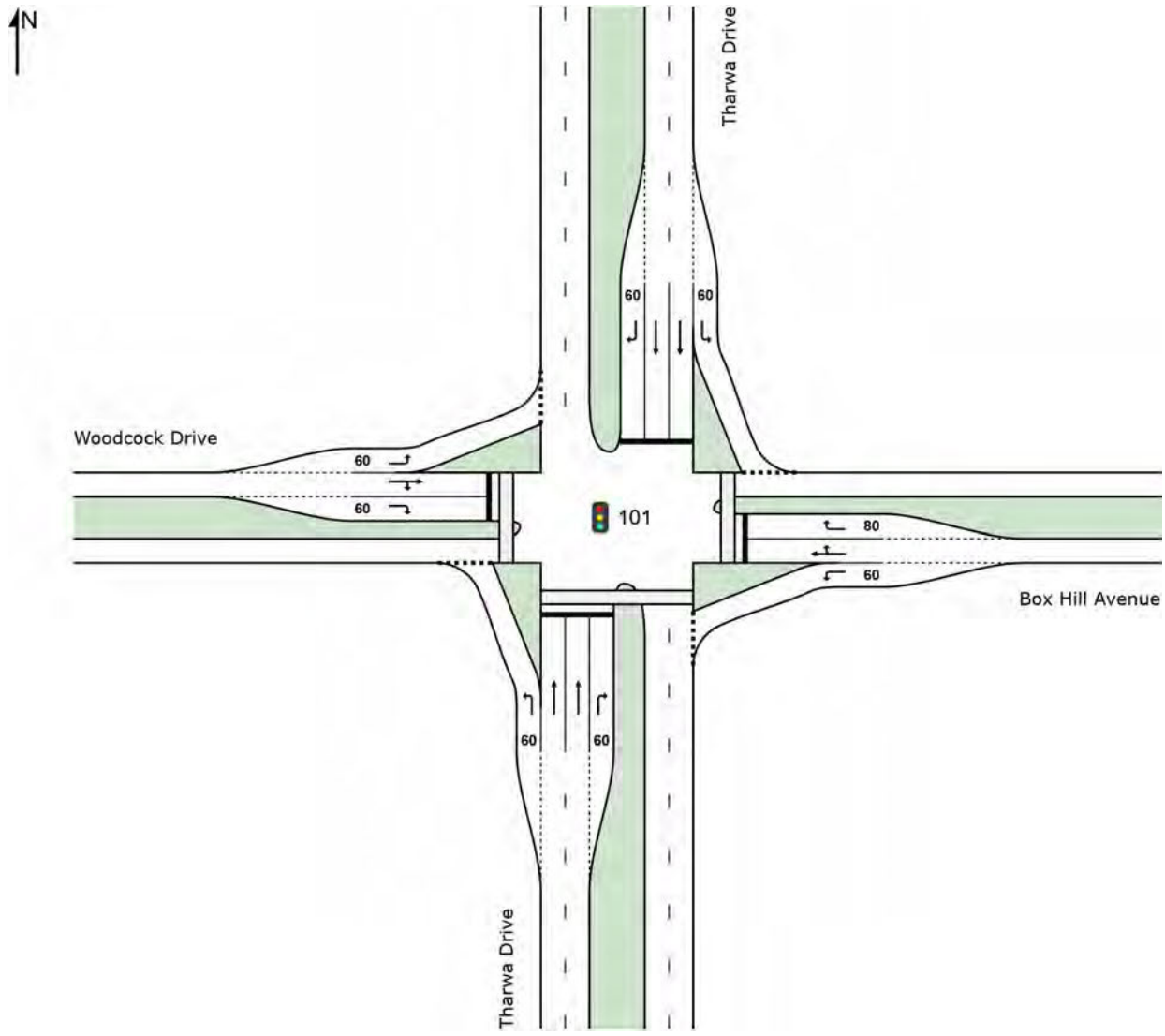
Site: 101 [2031_PM Peak_Tharwa Drive / Woodcock Drive - Signals]

Network: 10 [2031 Future Conditions with Upgrades_Tharwa Drive PM peak - Op3]

Signalised cross intersection - Duplicated
Site Category: PM Peak 2031 Conditions
Signals - Fixed Time Coordinated Cycle Time = 85 seconds (Network User-Given Cycle Time)

Timings based on settings in the Network Timing dialog
Phase Times determined by the program
Downstream lane blockage effects included in determining phase times
Phase Sequence: Variable Phasing
Reference Phase: Phase A
Input Phase Sequence: A, B, C, D
Output Phase Sequence: A, B, C, D

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
1	L2	151	1.5	151	1.5	0.113	6.2	LOS A	0.2	1.6	0.09	0.57	0.09	49.6
2	T1	400	1.5	400	1.5	0.290	15.4	LOS B	2.8	19.9	0.58	0.48	0.58	43.5
3	R2	9	1.5	9	1.5	0.062	46.0	LOS D	0.2	1.7	0.98	0.67	0.98	17.8
Approach		560	1.5	560	1.5	0.290	13.4	LOS A	2.8	19.9	0.46	0.51	0.46	44.2
East: Box Hill Avenue														
4	L2	32	1.5	32	1.5	0.034	11.3	LOS A	0.3	2.0	0.44	0.64	0.44	28.7
5	T1	105	1.5	105	1.5	0.838	42.8	LOS D	8.3	59.1	1.00	0.99	1.26	25.0
6	R2	485	1.5	485	1.5	0.838	48.5	LOS D	8.3	59.1	1.00	0.97	1.26	26.9
Approach		622	1.5	622	1.5	0.838	45.7	LOS D	8.3	59.1	0.97	0.96	1.22	26.6
North: Tharwa Drive														
7	L2	797	1.5	797	1.5	0.547	7.7	LOS A	5.3	37.9	0.40	0.68	0.40	49.1
8	T1	972	1.5	972	1.5	0.870	36.5	LOS C	15.0	106.5	0.93	0.98	1.18	27.3
9	R2	113	1.5	113	1.5	0.737	51.5	LOS D	3.1	22.0	1.00	0.87	1.22	30.2
Approach		1881	1.5	1881	1.5	0.870	25.2	LOS B	15.0	106.5	0.71	0.85	0.85	34.9
West: Woodcock Drive														
10	L2	65	1.5	65	1.5	0.058	9.3	LOS A	0.5	3.3	0.37	0.64	0.37	50.3
11	T1	145	1.5	145	1.5	0.791	46.2	LOS D	4.0	28.6	1.00	0.91	1.28	25.1
12	R2	66	1.5	66	1.5	0.380	46.9	LOS D	1.7	11.9	0.98	0.75	0.98	20.4
Approach		277	1.5	277	1.5	0.791	37.7	LOS C	4.0	28.6	0.85	0.81	0.99	29.2
All Vehicles		3340	1.5	3340	1.5	0.870	28.1	LOS B	15.0	106.5	0.73	0.81	0.87	33.6

[redacted]

Lane Use and Performance

	Demand Flows		Arrival Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	Aver. Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
South: Tharwa Drive															
Lane 1	151	1.5	151	1.5	1334	0.113	100	6.2	LOS A	0.2	1.6	Short	60	0.0	NA
Lane 2	200	1.5	200	1.5	689	0.290	100	15.4	LOS B	2.8	19.9	Full	165	0.0	0.0
Lane 3	200	1.5	200	1.5	689	0.290	100	15.3	LOS B	2.8	19.8	Full	165	0.0	0.0
Lane 4	9	1.5	9	1.5	153	0.062	100	46.0	LOS D	0.2	1.7	Short	60	0.0	NA
Approach	560	1.5	560	1.5		0.290		13.4	LOS A	2.8	19.9				
East: Box Hill Avenue															
Lane 1	32	1.5	32	1.5	932	0.034	100	11.3	LOS A	0.3	2.0	Short	60	0.0	NA
Lane 2	298	1.5	298	1.5	356	0.838	100	46.5	LOS D	8.3	59.1	Full	150	0.0	0.0
Lane 3	293	1.5	293	1.5	349	0.838	100	48.6	LOS D	8.2	58.1	Short	80	0.0	NA
Approach	622	1.5	622	1.5		0.838		45.7	LOS D	8.3	59.1				
North: Tharwa Drive															
Lane 1	797	1.5	797	1.5	1458	0.547	100	7.7	LOS A	5.3	37.9	Short	60	0.0	NA
Lane 2	425	1.5	425	1.5	489[1]	0.870	100	36.5	LOS C	11.3	79.8	Full	490	0.0	0.0
Lane 3	546	1.5	546	1.5	628[1]	0.870	100	36.4	LOS C	15.0	106.5	Full	490	0.0	0.0
Lane 4	113	1.5	113	1.5	153	0.737	100	51.5	LOS D	3.1	22.0	Short	60	0.0	NA
Approach	1881	1.5	1881	1.5		0.870		25.2	LOS B	15.0	106.5				
West: Woodcock Drive															
Lane 1	65	1.5	65	1.5	1119	0.058	100	9.3	LOS A	0.5	3.3	Short	60	0.0	NA
Lane 2	145	1.5	145	1.5	184	0.791	100	46.2	LOS D	4.0	28.6	Full	380	0.0	0.0
Lane 3	66	1.5	66	1.5	175	0.380	48[5]	46.9	LOS D	1.7	11.9	Short	60	0.0	NA
Approach	277	1.5	277	1.5		0.791		37.7	LOS C	4.0	28.6				
Intersection	3340	1.5	3340	1.5		0.870		28.1	LOS B	15.0	106.5				

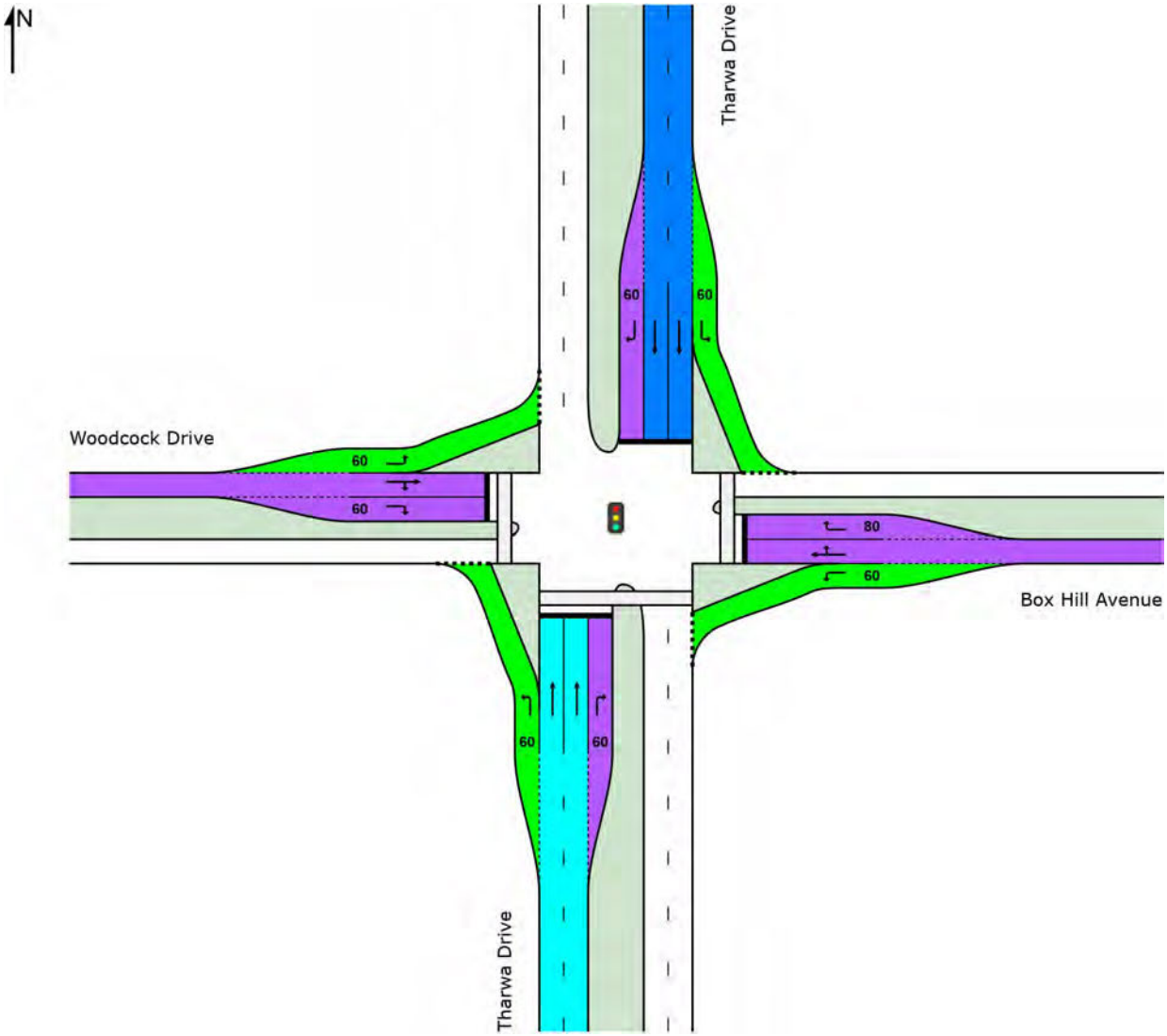
[redacted]

1 Reduced capacity due to a short lane effect. Short lane queues may extend into the full-length lanes. Some upstream delays at entry to short lanes are not included.

5 Lane under-utilisation found by the program

Lane Level of Service

	Approaches				Intersection
	South	East	North	West	
LOS	A	D	B	C	B



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Phase Timing Summary

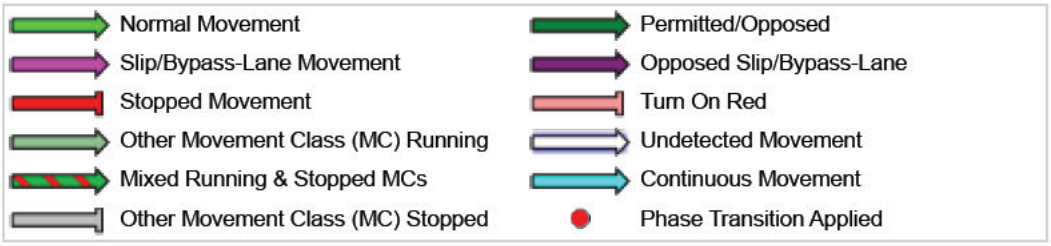
Phase	A	B	C	D
Phase Change Time (sec)	0	36	58	72
Green Time (sec)	30	16	8	7
Phase Time (sec)	36	22	14	13
Phase Split	42%	26%	16%	15%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase



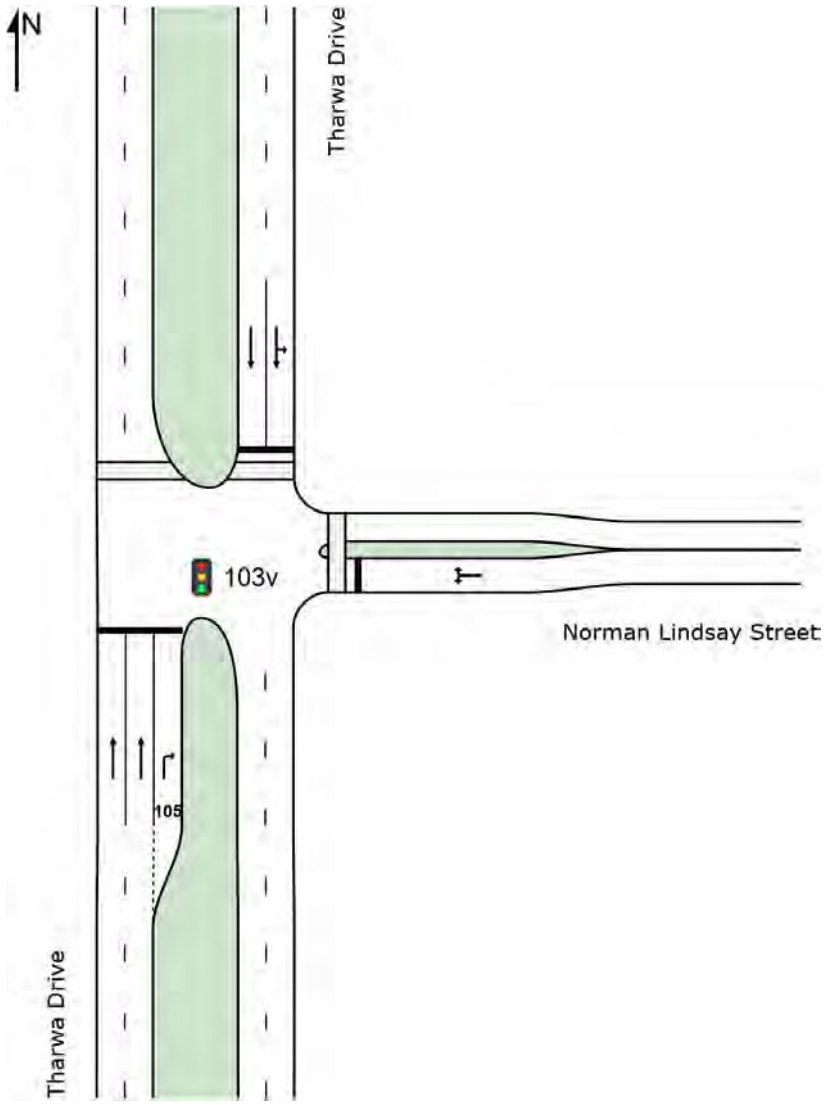
Site: 103v [2031_PM Peak_Tharwa Drive / Norman Lindsay Street - Signals]

Network: 10 [2031 Future Conditions with Upgrades_Tharwa Drive PM peak - Op3]

Signalised T-Intersection - Duplicated
Site Category: PM Peak 2031 Conditions
Signals - Fixed Time Coordinated Cycle Time = 85 seconds (Network User-Given Cycle Time)

Timings based on settings in the Network Timing dialog
Phase Times determined by the program
Downstream lane blockage effects included in determining phase times
Phase Sequence: Sequence1
Reference Phase: Phase A
Input Phase Sequence: A, B, C
Output Phase Sequence: A, B, C

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
2	T1	427	1.5	427	1.5	0.188	10.3	LOS A	3.2	22.4	0.62	0.52	0.62	47.5
3	R2	107	1.5	107	1.5	0.621	41.4	LOS C	2.6	18.5	0.93	0.78	0.95	29.3
Approach		535	1.5	535	1.5	0.621	16.5	LOS B	3.2	22.4	0.68	0.57	0.68	42.0
East: Norman Lindsay Street														
4	L2	197	1.5	197	1.5	0.633	33.4	LOS C	7.4	52.7	0.94	0.83	0.94	5.4
6	R2	129	1.5	129	1.5	0.633	33.3	LOS C	7.4	52.7	0.94	0.83	0.94	5.4
Approach		326	1.5	326	1.5	0.633	33.4	LOS C	7.4	52.7	0.94	0.83	0.94	5.4
North: Tharwa Drive														
7	L2	242	1.5	242	1.5	0.662	7.5	LOS A	1.9	13.5	0.15	0.36	0.15	13.5
8	T1	828	1.5	828	1.5	0.662	3.3	LOS A	3.7	26.0	0.24	0.29	0.24	43.1
Approach		1071	1.5	1071	1.5	0.662	4.2	LOS A	3.7	26.0	0.22	0.31	0.22	27.2
All Vehicles		1932	1.5	1932	1.5	0.662	12.6	LOS A	7.4	52.7	0.47	0.47	0.47	29.9

[redacted]

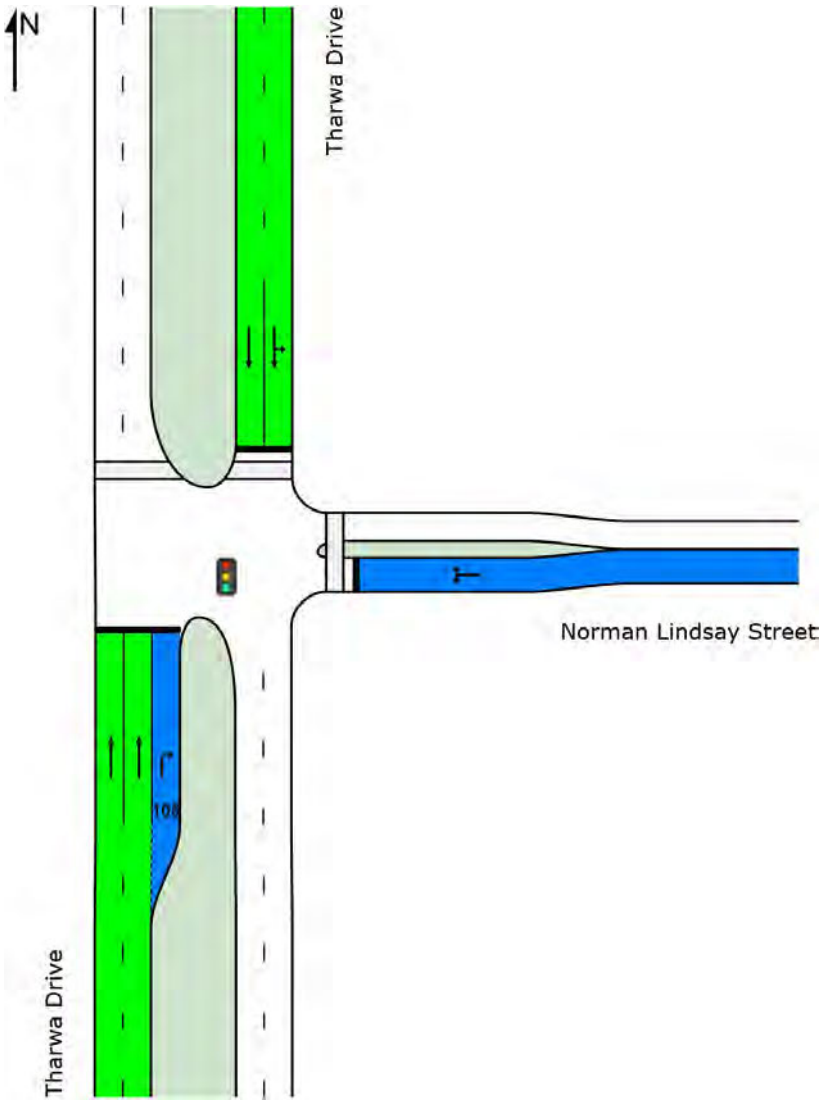
Lane Use and Performance

	Demand Flows		Arrival Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	Aver. Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
South: Tharwa Drive															
Lane 1	214	1.5	214	1.5	1136	0.188	100	10.1	LOS A	3.1	21.7	Full	640	0.0	0.0
Lane 2	214	1.5	214	1.5	1136	0.188	100	10.4	LOS A	3.2	22.4	Full	640	0.0	0.0
Lane 3	107	1.5	107	1.5	173	0.621	100	41.4	LOS C	2.6	18.5	Short	105	0.0	NA
Approach	535	1.5	535	1.5		0.621		16.5	LOS B	3.2	22.4				
East: Norman Lindsay Street															
Lane 1	326	1.5	326	1.5	515	0.633	100	33.4	LOS C	7.4	52.7	Full	40	0.0	76.4
Approach	326	1.5	326	1.5		0.633		33.4	LOS C	7.4	52.7				
North: Tharwa Drive															
Lane 1	529	1.5	529	1.5	799	0.662	100	4.5	LOS A	1.9	13.5	Full	165	0.0	0.0
Lane 2	541	1.5	541	1.5	818	0.662	100	4.0	LOS A	3.7	26.0	Full	165	0.0	0.0
Approach	1071	1.5	1071	1.5		0.662		4.2	LOS A	3.7	26.0				
Intersection	1932	1.5	1932	1.5		0.662		12.6	LOS A	7.4	52.7				

[redacted]

Lane Level of Service

	Approaches			Intersection
	South	East	North	
LOS	B	C	A	A



Colour code based on Level of Service

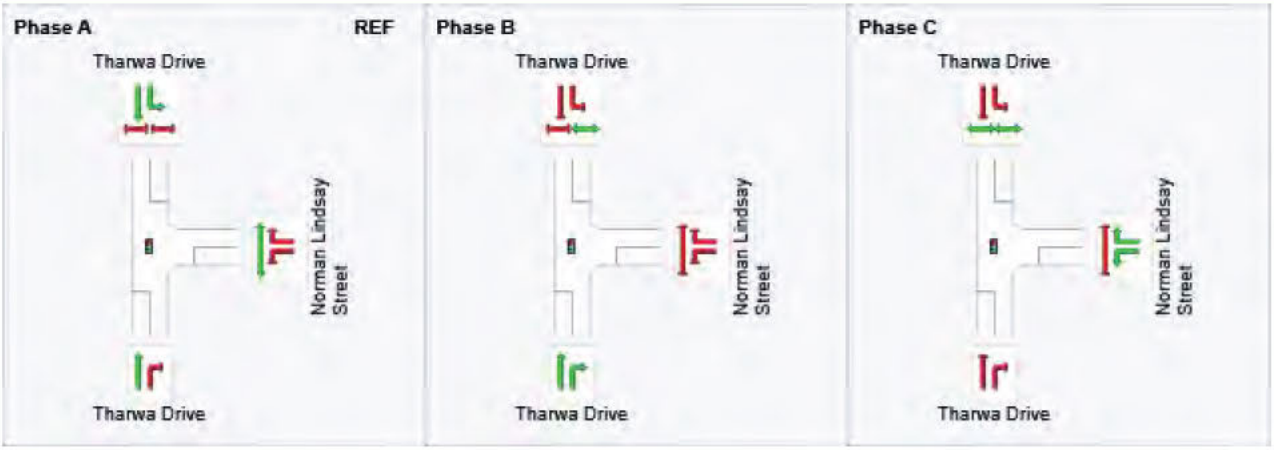
LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Phase Timing Summary

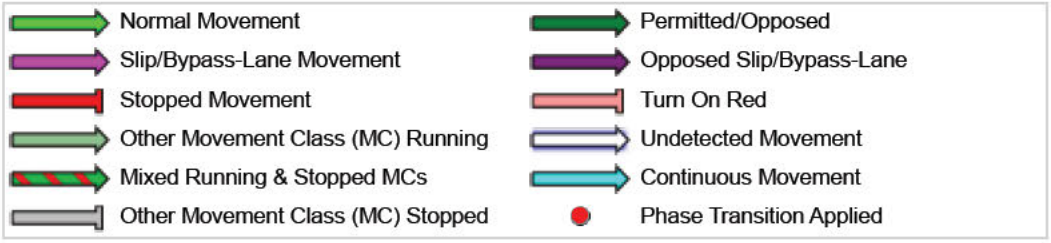
Phase	A	B	C
Phase Change Time (sec)	10	52	66
Green Time (sec)	36	8	23
Phase Time (sec)	42	14	29
Phase Split	49%	16%	34%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase



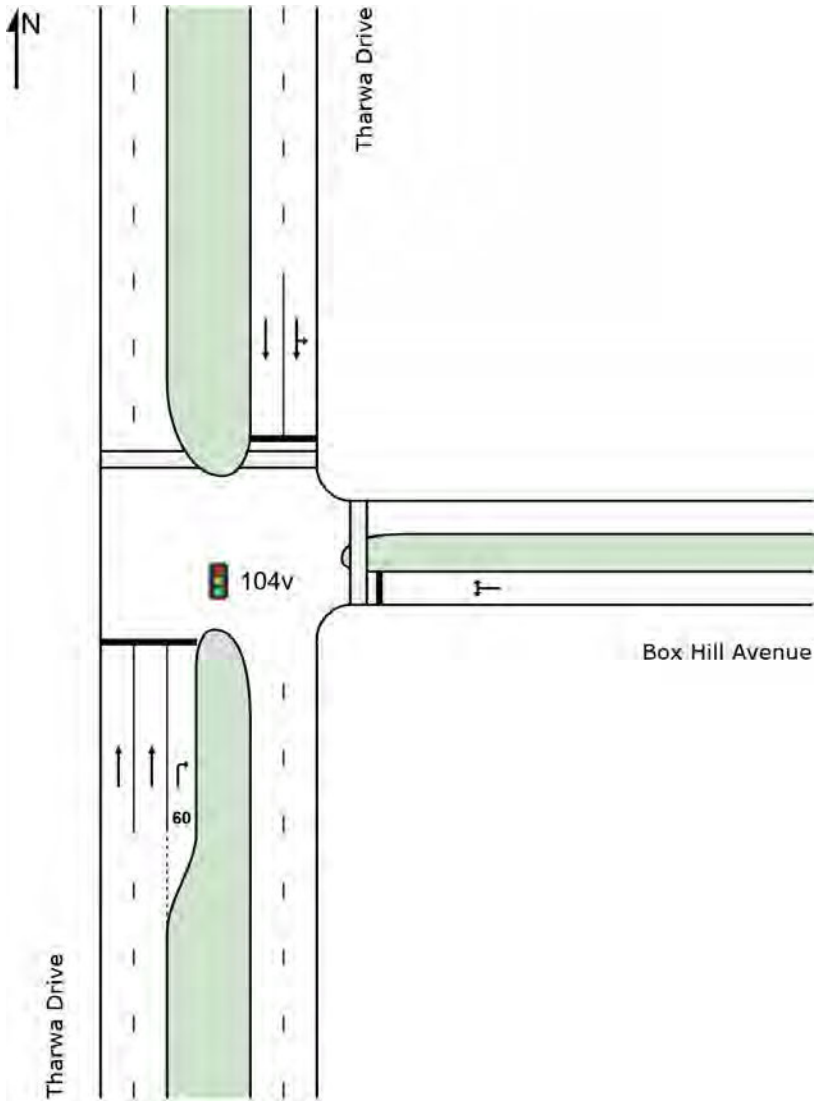
Site: 104v [2031_PM Peak_Tharwa Drive / Box Hill Avenue - Signals]

Network: 10 [2031 Future Conditions with Upgrades_Tharwa Drive PM peak - Op3]

Signalised T-intersection - Duplicated
Site Category: PM Peak 2031 Conditions
Signals - Fixed Time Coordinated Cycle Time = 85 seconds (Network User-Given Cycle Time)

Timings based on settings in the Network Timing dialog
Phase Times determined by the program
Downstream lane blockage effects included in determining phase times
Phase Sequence: Sequence1
Reference Phase: Phase A
Input Phase Sequence: A, B, C
Output Phase Sequence: A, B, C

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
2	T1	280	1.5	280	1.5	0.114	12.3	LOS A	3.1	22.2	0.73	0.60	0.73	49.8
3	R2	14	1.5	14	1.5	0.104	50.0	LOS D	0.4	2.6	1.00	0.69	1.00	33.8
Approach		294	1.5	294	1.5	0.114	14.1	LOS A	3.1	22.2	0.75	0.61	0.75	48.6
East: Box Hill Avenue														
4	L2	14	1.5	14	1.5	0.568	36.3	LOS C	6.1	43.1	0.93	0.82	0.93	10.0
6	R2	254	1.5	254	1.5	0.568	36.3	LOS C	6.1	43.1	0.93	0.82	0.93	10.0
Approach		267	1.5	267	1.5	0.568	36.3	LOS C	6.1	43.1	0.93	0.82	0.93	10.0
North: Tharwa Drive														
7	L2	477	1.5	477	1.5	0.561	21.7	LOS B	8.1	57.2	0.68	0.77	0.68	39.8
8	T1	556	1.5	556	1.5	0.561	2.5	LOS A	8.1	57.2	0.15	0.14	0.15	56.1
Approach		1033	1.5	1033	1.5	0.561	11.4	LOS A	8.1	57.2	0.39	0.43	0.39	46.5
All Vehicles		1594	1.5	1594	1.5	0.568	16.1	LOS B	8.1	57.2	0.55	0.53	0.55	42.3

[redacted]

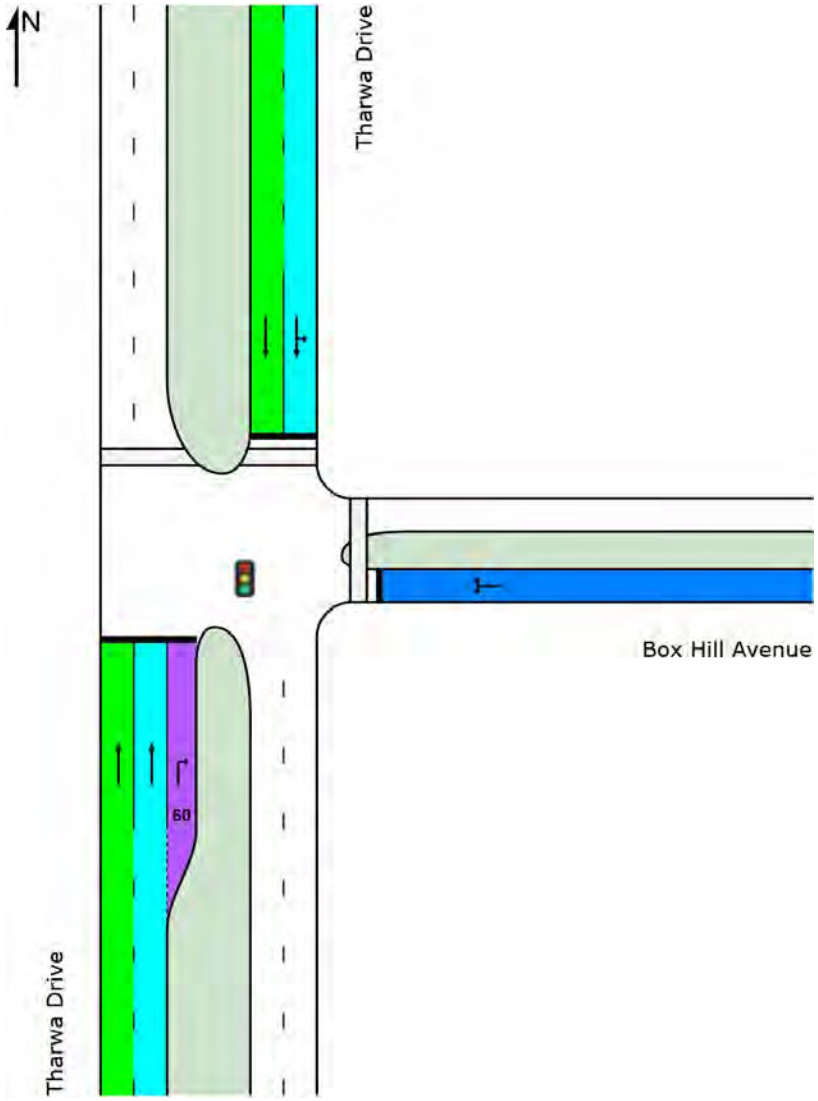
Lane Use and Performance

	Demand Flows		Arrival Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	Aver. Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
South: Tharwa Drive															
Lane 1	140	1.5	140	1.5	1224	0.114	100	8.0	LOS A	1.7	12.2	Full	990	0.0	0.0
Lane 2	140	1.5	140	1.5	1224	0.114	100	16.6	LOS B	3.1	22.2	Full	990	0.0	0.0
Lane 3	14	1.5	14	1.5	131	0.104	100	50.0	LOS D	0.4	2.6	Short	60	0.0	NA
Approach	294	1.5	294	1.5		0.114		14.1	LOS A	3.1	22.2				
East: Box Hill Avenue															
Lane 1	267	1.5	267	1.5	470	0.568	100	36.3	LOS C	6.1	43.1	Full	105	0.0	0.0
Approach	267	1.5	267	1.5		0.568		36.3	LOS C	6.1	43.1				
North: Tharwa Drive															
Lane 1	504	1.5	504	1.5	899	0.561	100	21.4	LOS B	8.1	57.2	Full	640	0.0	0.0
Lane 2	528	1.5	528	1.5	942	0.561	100	1.8	LOS A	1.5	11.0	Full	640	0.0	0.0
Approach	1033	1.5	1033	1.5		0.561		11.4	LOS A	8.1	57.2				
Intersection	1594	1.5	1594	1.5		0.568		16.1	LOS B	8.1	57.2				

[redacted]

Lane Level of Service

	Approaches			Intersection
	South	East	North	
LOS	A	C	A	B



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

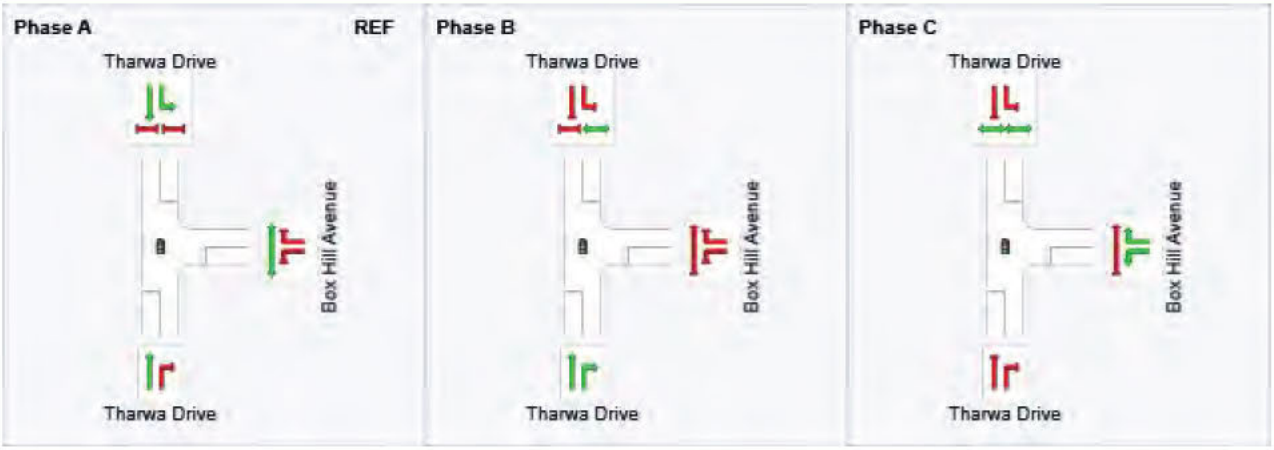
[redacted]

Phase Timing Summary

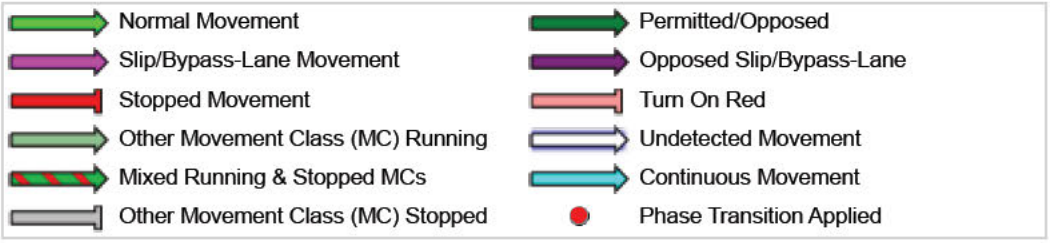
Phase	A	B	C
Phase Change Time (sec)	39	85	12
Green Time (sec)	40	6	21
Phase Time (sec)	46	12	27
Phase Split	54%	14%	32%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase



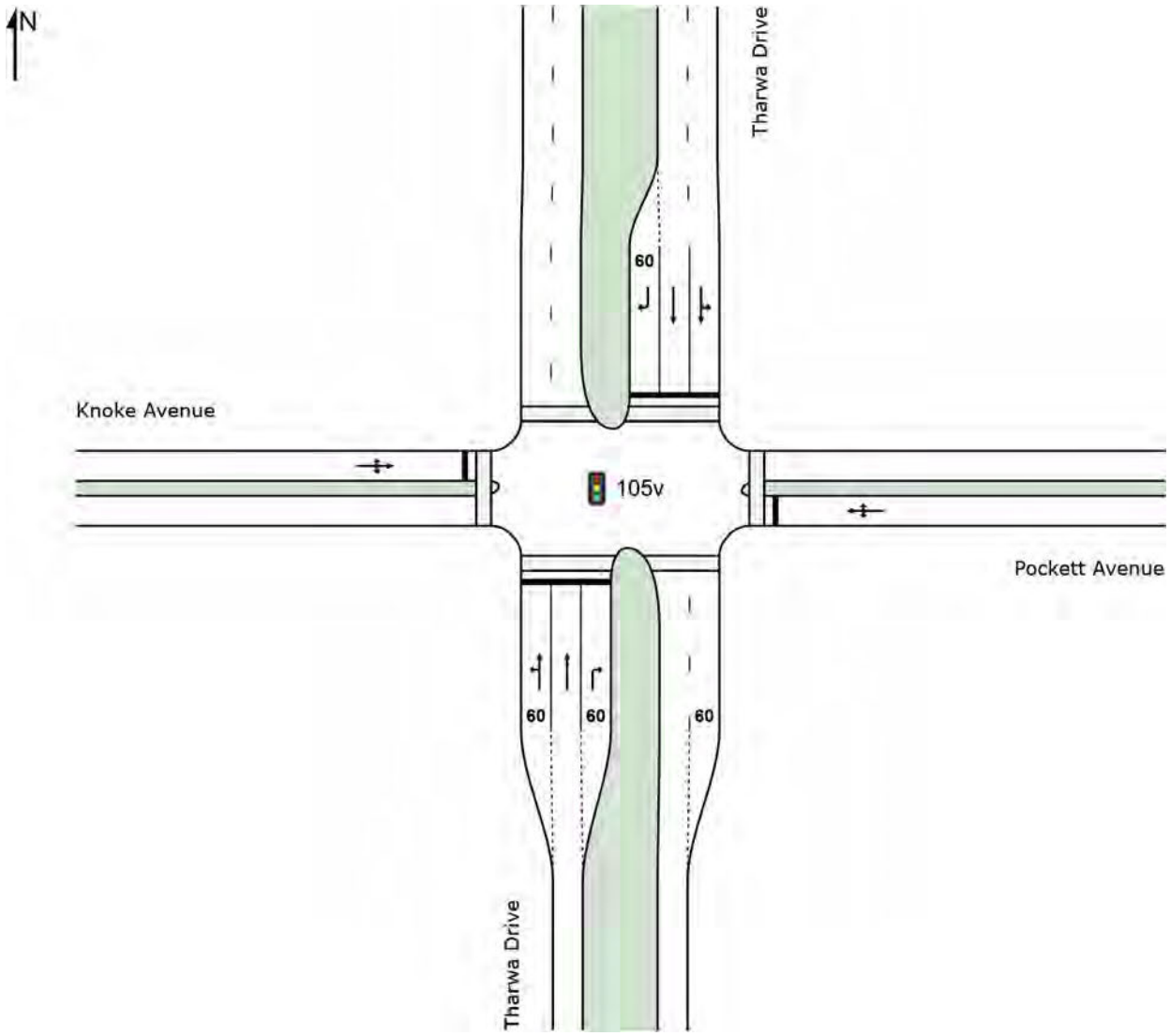
Site: 105v [2031_PM Peak_Tharwa Drive / Pockett Avenue - Signals]

Network: 10 [2031 Future Conditions with Upgrades_Tharwa Drive PM peak - Op3]

Signalised Cross Intersection - Duplicated
Site Category: PM Peak 2031 Conditions
Signals - Fixed Time Coordinated Cycle Time = 85 seconds (Network User-Given Cycle Time)

Timings based on settings in the Network Timing dialog
Phase Times determined by the program
Downstream lane blockage effects included in determining phase times
Phase Sequence: Diamond Phasing
Reference Phase: Phase A
Input Phase Sequence: A, B, C, D
Output Phase Sequence: A, B, C, D

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
1	L2	2	1.5	2	1.5	0.031	30.8	LOS C	0.3	2.1	0.77	0.56	0.77	17.6
2	T1	29	1.5	29	1.5	0.031	25.2	LOS B	0.3	2.1	0.77	0.56	0.77	32.8
3	R2	5	1.5	5	1.5	0.016	36.7	LOS C	0.1	0.8	0.85	0.65	0.85	28.6
Approach		37	1.5	37	1.5	0.031	27.2	LOS B	0.3	2.1	0.78	0.57	0.78	30.3
East: Pockett Avenue														
4	L2	11	1.5	11	1.5	0.599	41.0	LOS C	4.9	34.9	0.97	0.81	0.97	27.7
5	T1	37	1.5	37	1.5	0.599	35.9	LOS C	4.9	34.9	0.97	0.81	0.97	13.6
6	R2	156	1.5	156	1.5	0.599	41.0	LOS C	4.9	34.9	0.97	0.81	0.97	7.8
Approach		203	1.5	203	1.5	0.599	40.1	LOS C	4.9	34.9	0.97	0.81	0.97	10.6
North: Tharwa Drive														
7	L2	303	1.5	303	1.5	0.615	37.8	LOS C	7.3	51.9	0.99	0.84	0.99	37.0
8	T1	61	1.5	61	1.5	0.118	30.9	LOS C	1.4	9.8	0.93	0.71	0.93	44.7
9	R2	205	1.5	205	1.5	0.611	36.2	LOS C	4.6	32.8	0.90	0.80	0.91	37.8
Approach		569	1.5	569	1.5	0.615	36.5	LOS C	7.3	51.9	0.95	0.81	0.95	38.2
West: Knoke Avenue														
10	L2	88	1.5	88	1.5	0.633	47.5	LOS D	3.4	23.9	1.00	0.82	1.07	7.7
11	T1	36	1.5	36	1.5	0.633	42.0	LOS C	3.4	23.9	1.00	0.82	1.07	12.1
12	R2	5	1.5	5	1.5	0.633	47.6	LOS D	3.4	23.9	1.00	0.82	1.07	26.2
Approach		129	1.5	129	1.5	0.633	46.0	LOS D	3.4	23.9	1.00	0.82	1.07	10.1
All Vehicles		939	1.5	939	1.5	0.633	38.2	LOS C	7.3	51.9	0.96	0.80	0.97	32.1



Lane Use and Performance

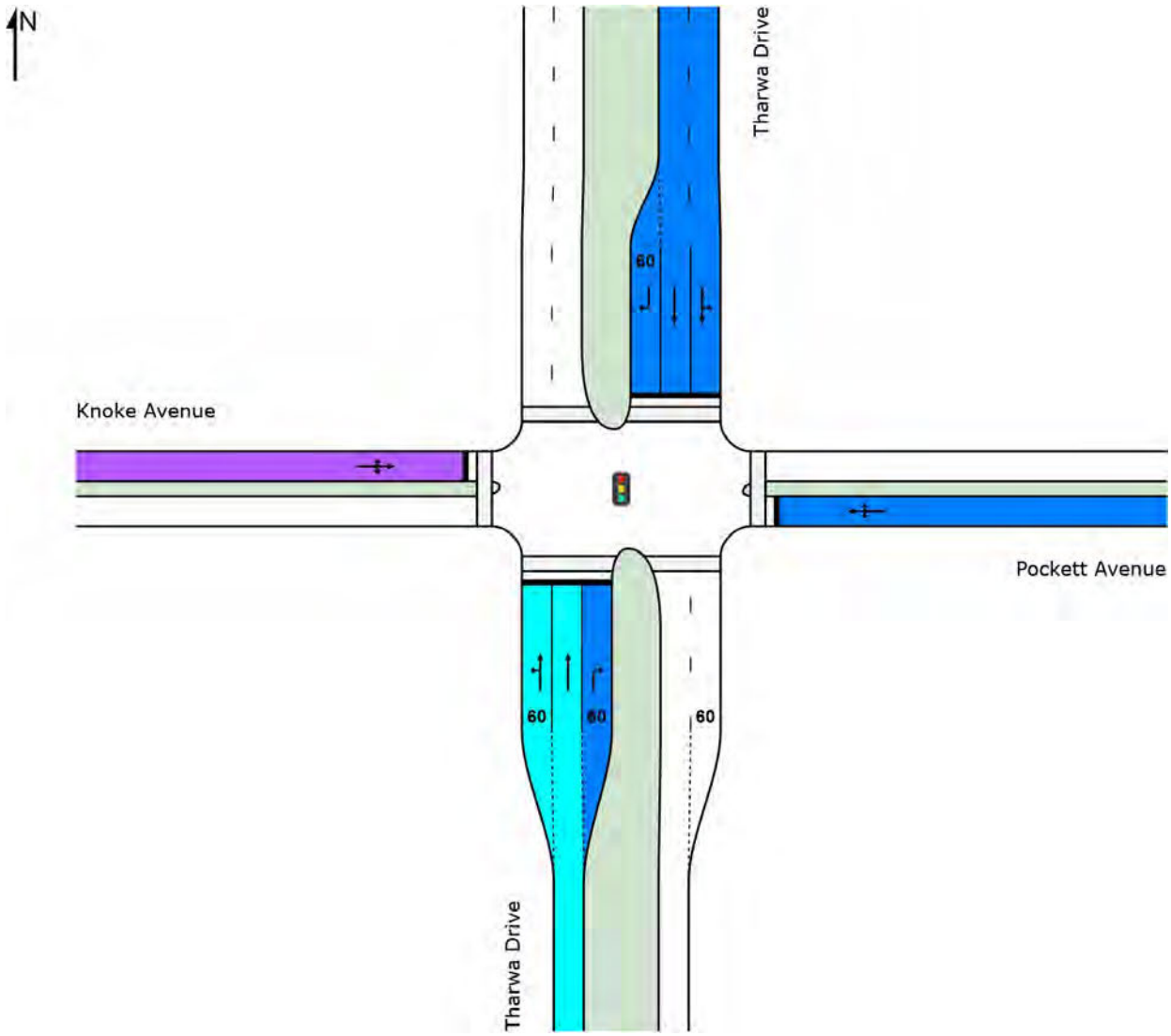
	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	Aver. Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Tharwa Drive															
Lane 1	16	1.5	16	1.5	515	0.031	100	25.9	LOS B	0.3	2.1	Short	60	0.0	NA
Lane 2	16	1.5	16	1.5	518	0.031	100	25.2	LOS B	0.3	2.1	Full	500	0.0	0.0
Lane 3	5	1.5	5	1.5	336	0.016	100	36.7	LOS C	0.1	0.8	Short	60	0.0	NA
Approach	37	1.5	37	1.5		0.031		27.2	LOS B	0.3	2.1				
East: Pockett Avenue															
Lane 1	203	1.5	203	1.5	339	0.599	100	40.1	LOS C	4.9	34.9	Full	80	0.0	0.0
Approach	203	1.5	203	1.5		0.599		40.1	LOS C	4.9	34.9				
North: Tharwa Drive															
Lane 1	303	1.5	303	1.5	493	0.615	100	37.8	LOS C	7.3	51.9	Full	990	0.0	0.0
Lane 2	61	1.5	61	1.5	518	0.118	19[5]	30.9	LOS C	1.4	9.8	Full	990	0.0	0.0
Lane 3	205	1.5	205	1.5	336	0.611	100	36.2	LOS C	4.6	32.8	Short	60	0.0	NA
Approach	569	1.5	569	1.5		0.615		36.5	LOS C	7.3	51.9				
West: Knoke Avenue															
Lane 1	129	1.5	129	1.5	204	0.633	100	46.0	LOS D	3.4	23.9	Full	95	0.0	0.0
Approach	129	1.5	129	1.5		0.633		46.0	LOS D	3.4	23.9				
Intersection	939	1.5	939	1.5		0.633		38.2	LOS C	7.3	51.9				

[redacted]

5 Lane under-utilisation found by the program

Lane Level of Service

	Approaches				Intersection
	South	East	North	West	
LOS	B	C	C	D	C



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Phase Timing Summary

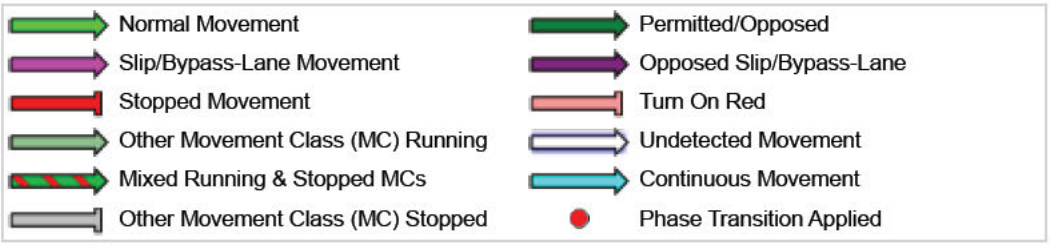
Phase	A	B	C	D
Phase Change Time (sec)	84	27	48	69
Green Time (sec)	22	15	15	9
Phase Time (sec)	28	21	21	15
Phase Split	33%	25%	25%	18%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase



USER REPORT FOR NETWORK SITE

Project: 2031 Conditions

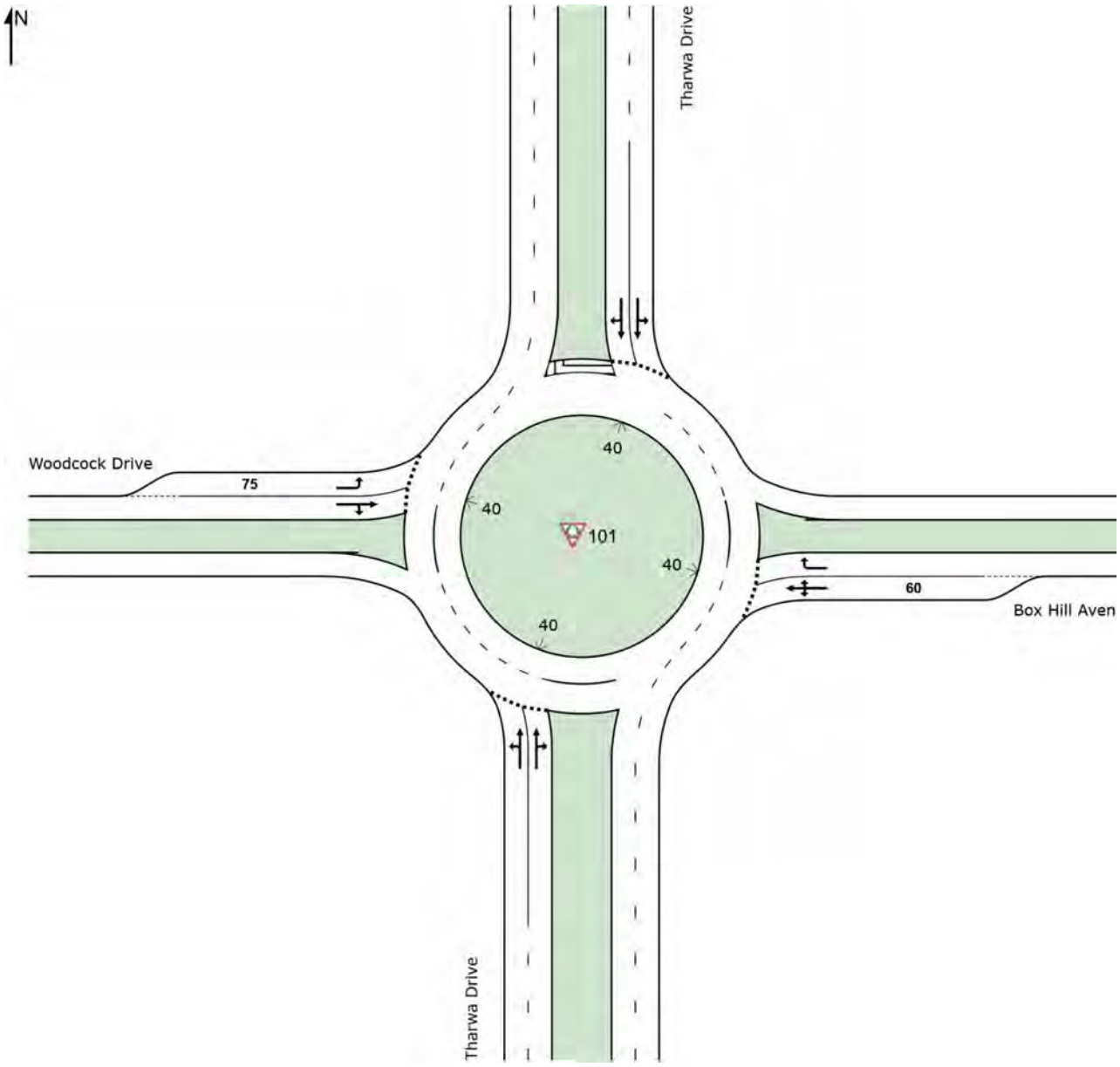
Template: Default Site User Report (2)

Site: 101 [2031_PM Peak_Tharwa Drive / Woodcock Drive - Duplicated with Ped Xing]

Network: 13 [2031 Future Conditions with Upgrades_Tharwa Drive PM peak - Op4]

Two Lane Roundabout with ped xing to south - Duplicated
Site Category: PM Peak 2031 Conditions
Roundabout

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
1	L2	151	1.5	151	1.5	0.298	4.7	LOS A	0.5	3.9	0.50	0.58	0.50	50.9
2	T1	400	1.5	400	1.5	0.298	4.8	LOS A	0.5	3.9	0.52	0.58	0.52	55.3
3	R2	9	1.5	9	1.5	0.298	11.1	LOS A	0.5	3.6	0.53	0.58	0.53	41.7
Approach		560	1.5	560	1.5	0.298	4.8	LOS A	0.5	3.9	0.52	0.58	0.52	54.1
East: Box Hill Avenue														
4	L2	32	1.5	32	1.5	0.443	7.9	LOS A	1.3	8.9	0.85	0.93	0.95	31.7
5	T1	105	1.5	105	1.5	0.443	7.7	LOS A	1.3	8.9	0.85	0.93	0.95	47.7
6	R2	485	1.5	485	1.5	0.443	14.9	LOS B	1.3	8.9	0.84	0.96	0.96	48.4
Approach		622	1.5	622	1.5	0.443	13.3	LOS A	1.3	8.9	0.85	0.95	0.95	47.9
North: Tharwa Drive														
7	L2	797	1.5	797	1.5	0.666	4.4	LOS A	2.8	20.1	0.65	0.52	0.65	52.0
8	T1	972	1.5	972	1.5	0.666	4.3	LOS A	2.8	20.1	0.69	0.51	0.70	48.7
9	R2	113	1.5	113	1.5	0.666	11.3	LOS A	2.8	19.5	0.71	0.50	0.71	55.7
Approach		1881	1.5	1881	1.5	0.666	4.8	LOS A	2.8	20.1	0.68	0.51	0.68	50.8
West: Woodcock Drive														
10	L2	65	1.5	65	1.5	0.090	6.0	LOS A	0.2	1.1	0.60	0.69	0.60	54.1
11	T1	145	1.5	145	1.5	0.200	4.5	LOS A	0.4	2.9	0.61	0.59	0.61	52.1
12	R2	66	1.5	66	1.5	0.200	11.4	LOS A	0.4	2.9	0.61	0.59	0.61	45.9
Approach		277	1.5	277	1.5	0.200	6.5	LOS A	0.4	2.9	0.61	0.61	0.61	51.6
All Vehicles		3340	1.5	3340	1.5	0.666	6.5	LOS A	2.8	20.1	0.68	0.62	0.70	50.7

[redacted]

Lane Use and Performance

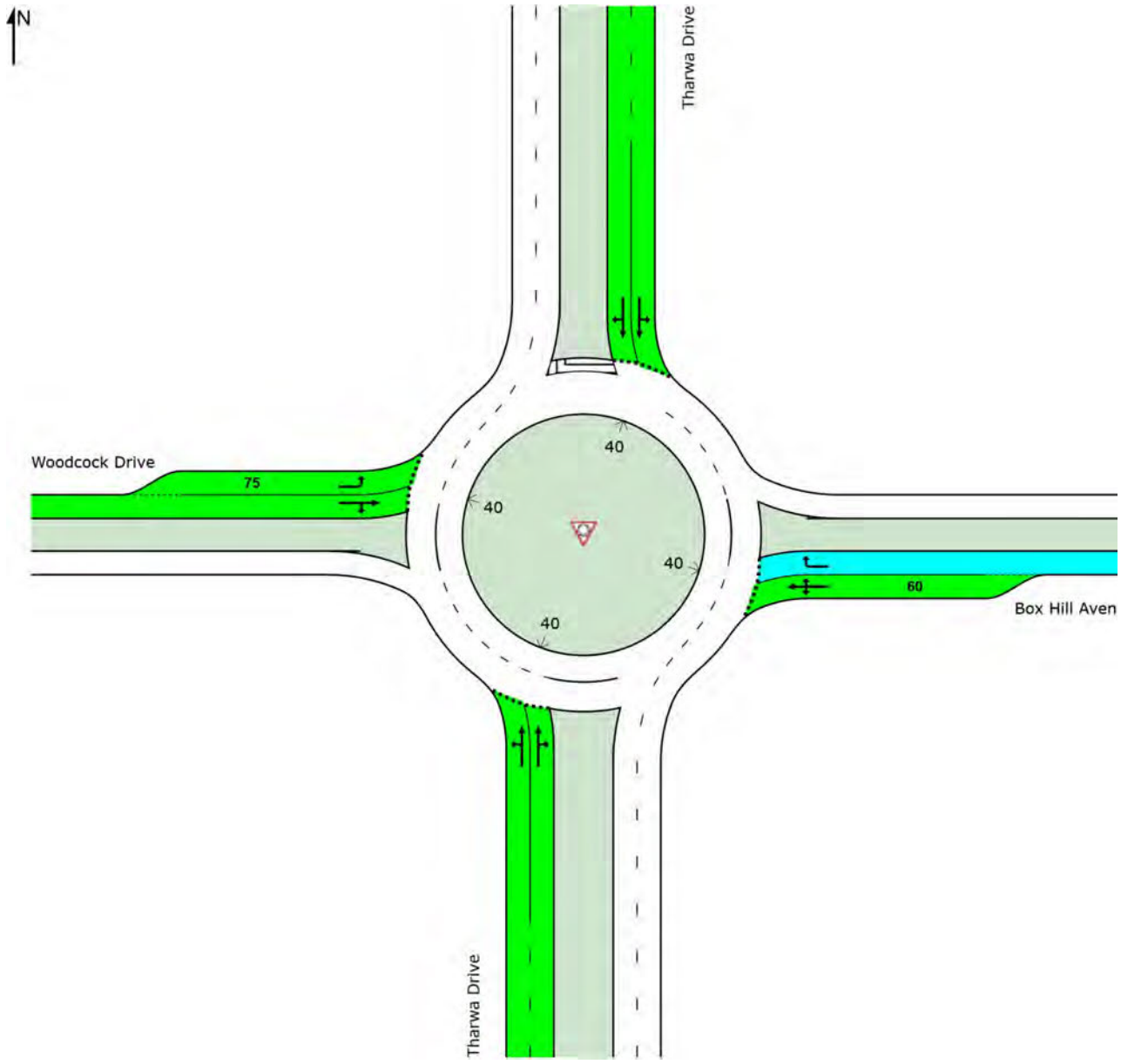
	Demand Flows		Arrival Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	Aver. Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
South: Tharwa Drive															
Lane 1[d]	307	1.5	307	1.5	1029	0.298	100	4.6	LOS A	0.5	3.9	Full	75	0.0	0.0
Lane 2	253	1.5	253	1.5	848	0.298	100	5.2	LOS A	0.5	3.6	Full	75	0.0	0.0
Approach	560	1.5	560	1.5		0.298		4.8	LOS A	0.5	3.9				
East: Box Hill Avenue															
Lane 1[d]	355	1.5	355	1.5	801	0.443	100	11.6	LOS A	1.3	8.9	Short	60	0.0	NA
Lane 2	267	1.5	267	1.5	604	0.443	100	15.5	LOS B	1.1	8.0	Full	150	0.0	0.0
Approach	622	1.5	622	1.5		0.443		13.3	LOS A	1.3	8.9				
North: Tharwa Drive															
Lane 1[d]	1042	1.5	1042	1.5	1565	0.666	100	4.3	LOS A	2.8	20.1	Full	490	0.0	0.0
Lane 2	839	1.5	839	1.5	1260	0.666	100	5.3	LOS A	2.8	19.5	Full	490	0.0	0.0
Approach	1881	1.5	1881	1.5		0.666		4.8	LOS A	2.8	20.1				
West: Woodcock Drive															
Lane 1	65	1.5	65	1.5	727	0.090	100	6.0	LOS A	0.2	1.1	Short	75	0.0	NA
Lane 2[d]	212	1.5	212	1.5	1056	0.200	100	6.7	LOS A	0.4	2.9	Full	380	0.0	0.0
Approach	277	1.5	277	1.5		0.200		6.5	LOS A	0.4	2.9				
Intersection	3340	1.5	3340	1.5		0.666		6.5	LOS A	2.8	20.1				

[redacted]

d Dominant lane on roundabout approach

Lane Level of Service

	Approaches				Intersection
	South	East	North	West	
LOS	A	A	A	A	A



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

[redacted]

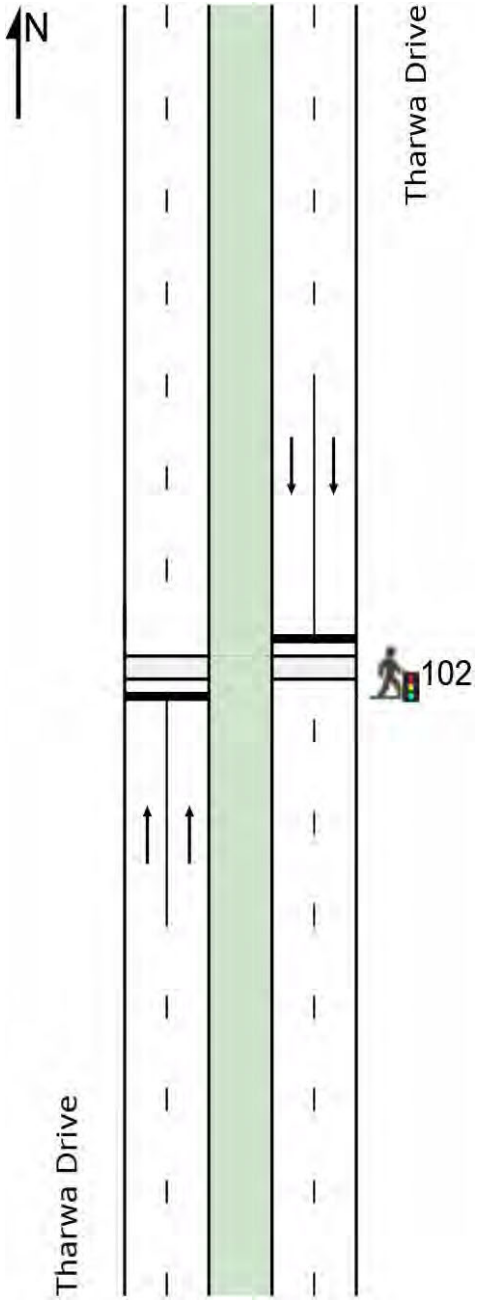
Site: 102 [2031_PM Peak_Tharwa Drive Pedestrian Crossing - Duplicated]

Network: 13 [2031 Future Conditions with Upgrades_Tharwa Drive PM peak - Op4]

Pedestrian Crossing - Duplicated
Site Category: PM Peak 2031 Conditions
Pedestrian Crossing (Signals) - Fixed Time Isolated Cycle Time = 20 seconds (Site Practical Cycle Time)

Timings based on settings in the Site Phasing & Timing dialog
Phase Times determined by the program
Downstream lane blockage effects included in determining phase times
Phase Sequence: Two-Phase
Reference Phase: Phase A
Input Phase Sequence: A, B
Output Phase Sequence: A, B

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
2	T1	560	1.5	560	1.5	0.280	3.3	LOS A	1.0	7.3	0.61	0.51	0.61	37.2
Approach		560	1.5	560	1.5	0.280	3.3	LOS A	1.0	7.3	0.61	0.51	0.61	37.2
North: Tharwa Drive														
8	T1	1068	1.5	1068	1.5	0.534	3.9	LOS A	2.3	16.5	0.73	0.62	0.73	33.9
Approach		1068	1.5	1068	1.5	0.534	3.9	LOS A	2.3	16.5	0.73	0.62	0.73	33.9
All Vehicles		1628	1.5	1628	1.5	0.534	3.7	LOS A	2.3	16.5	0.69	0.58	0.69	35.0



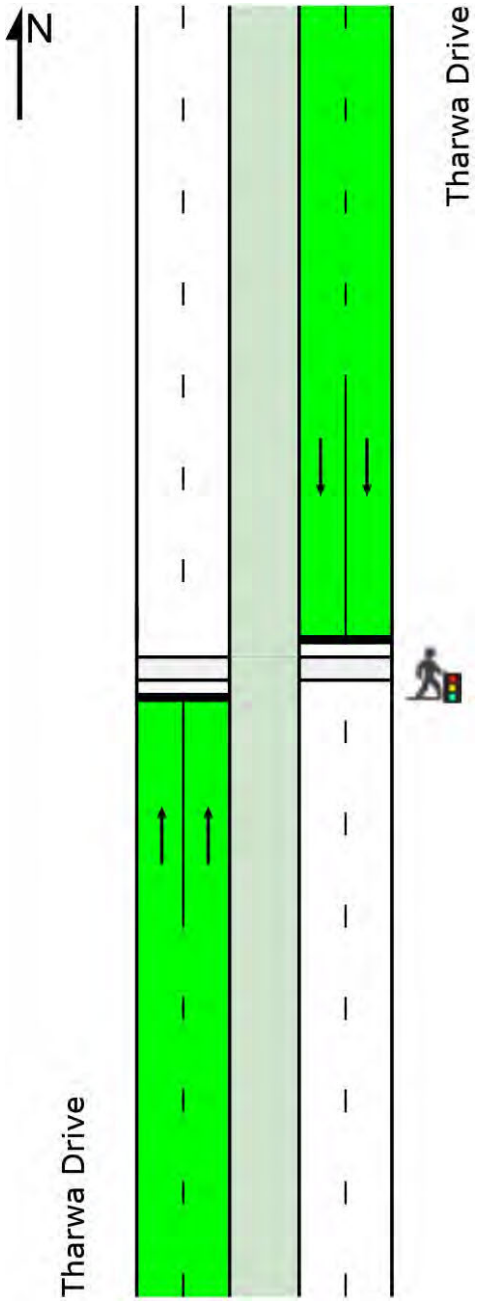
Lane Use and Performance

	Demand Flows		Arrival Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	Aver. Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
South: Tharwa Drive															
Lane 1	280	1.5	280	1.5	1001	0.280	100	3.3	LOS A	1.0	7.3	Full	80	0.0	0.0
Lane 2	280	1.5	280	1.5	1001	0.280	100	3.3	LOS A	1.0	7.3	Full	80	0.0	0.0
Approach	560	1.5	560	1.5		0.280		3.3	LOS A	1.0	7.3				
North: Tharwa Drive															
Lane 1	534	1.5	534	1.5	1001	0.534	100	3.9	LOS A	2.3	16.5	Full	75	0.0	0.0
Lane 2	534	1.5	534	1.5	1001	0.534	100	3.9	LOS A	2.3	16.5	Full	75	0.0	0.0
Approach	1068	1.5	1068	1.5		0.534		3.9	LOS A	2.3	16.5				
Intersection	1628	1.5	1628	1.5		0.534		3.7	LOS A	2.3	16.5				

[redacted]

Lane Level of Service

	Approaches		Intersection
	South	North	
LOS	A	A	A



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Phase Timing Summary

Phase	A	B
Phase Change Time (sec)	0	16
Green Time (sec)	10	2
Phase Time (sec)	12	8
Phase Split	60%	40%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase

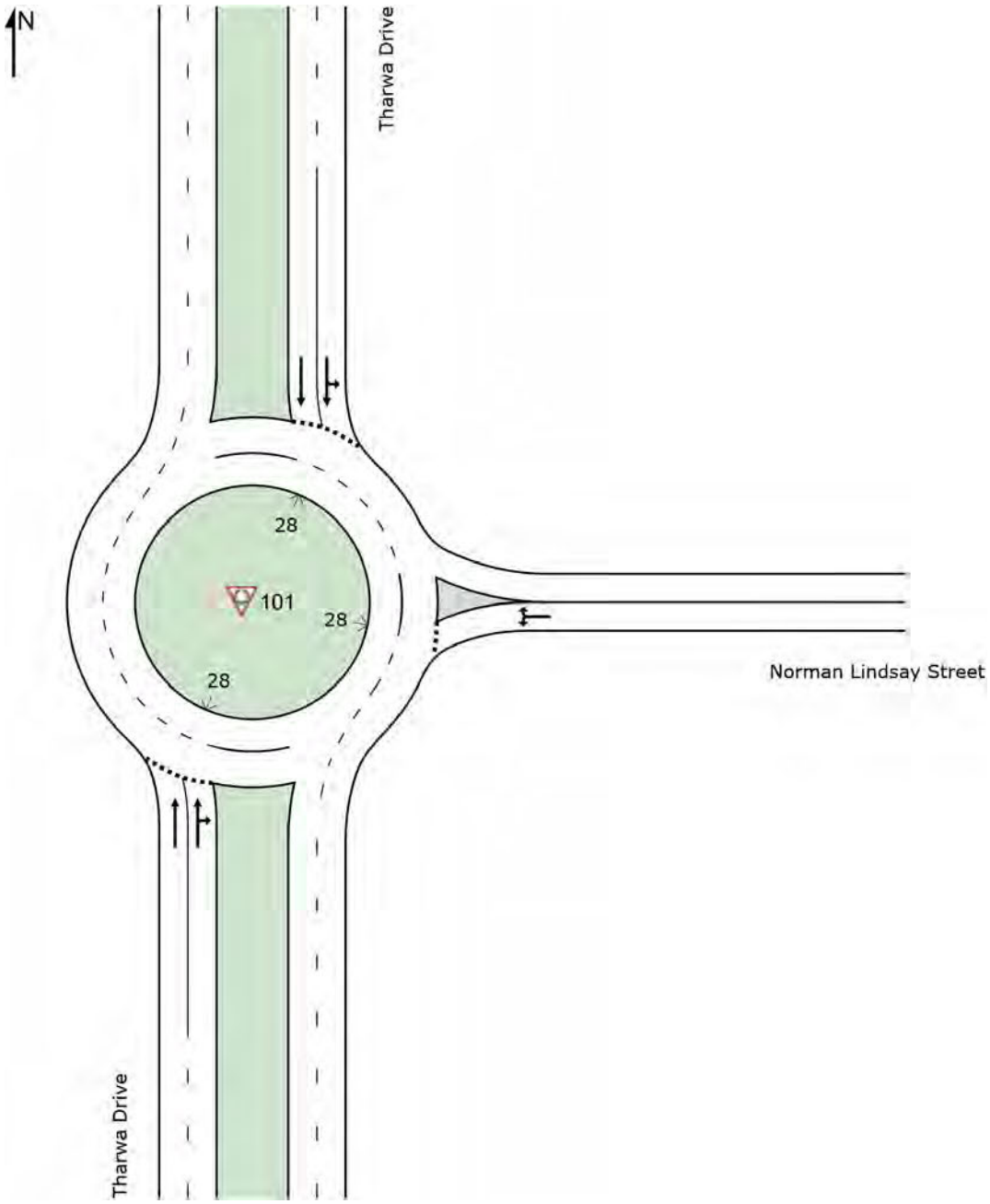
Normal Movement	Permitted/Opposed
Slip/Bypass-Lane Movement	Opposed Slip/Bypass-Lane
Stopped Movement	Turn On Red
Other Movement Class (MC) Running	Undetected Movement
Mixed Running & Stopped MCs	Continuous Movement
Other Movement Class (MC) Stopped	Phase Transition Applied

Site: 101 [2031_PM Peak_Tharwa Drive / Norman Lindsay Street - Roundabout]

Network: 13 [2031 Future Conditions with Upgrades_Tharwa Drive PM peak - Op4]

Two lane roundabout with ped xing to north - Duplicated
Site Category: PM Peak 2031 Conditions
Roundabout

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
2	T1	427	1.5	427	1.5	0.201	4.1	LOS A	0.4	3.1	0.30	0.44	0.30	52.1
3	R2	107	1.5	107	1.5	0.201	9.6	LOS A	0.4	3.1	0.31	0.52	0.31	49.6
Approach		535	1.5	535	1.5	0.201	5.2	LOS A	0.4	3.1	0.30	0.46	0.30	51.6
East: Norman Lindsay Street														
4	L2	197	1.5	197	1.5	0.367	5.3	LOS A	0.9	6.2	0.66	0.78	0.66	23.6
6	R2	129	1.5	129	1.5	0.367	10.5	LOS A	0.9	6.2	0.66	0.78	0.66	23.6
Approach		326	1.5	326	1.5	0.367	7.4	LOS A	0.9	6.2	0.66	0.78	0.66	23.6
North: Tharwa Drive														
7	L2	242	1.5	242	1.5	0.381	3.7	LOS A	0.8	5.7	0.21	0.42	0.21	15.1
8	T1	828	1.5	828	1.5	0.381	3.7	LOS A	0.8	5.7	0.22	0.40	0.22	37.0
Approach		1071	1.5	1071	1.5	0.381	3.7	LOS A	0.8	5.7	0.22	0.41	0.22	26.6
All Vehicles		1932	1.5	1932	1.5	0.381	4.8	LOS A	0.9	6.2	0.32	0.48	0.32	39.7

[redacted]

Lane Use and Performance

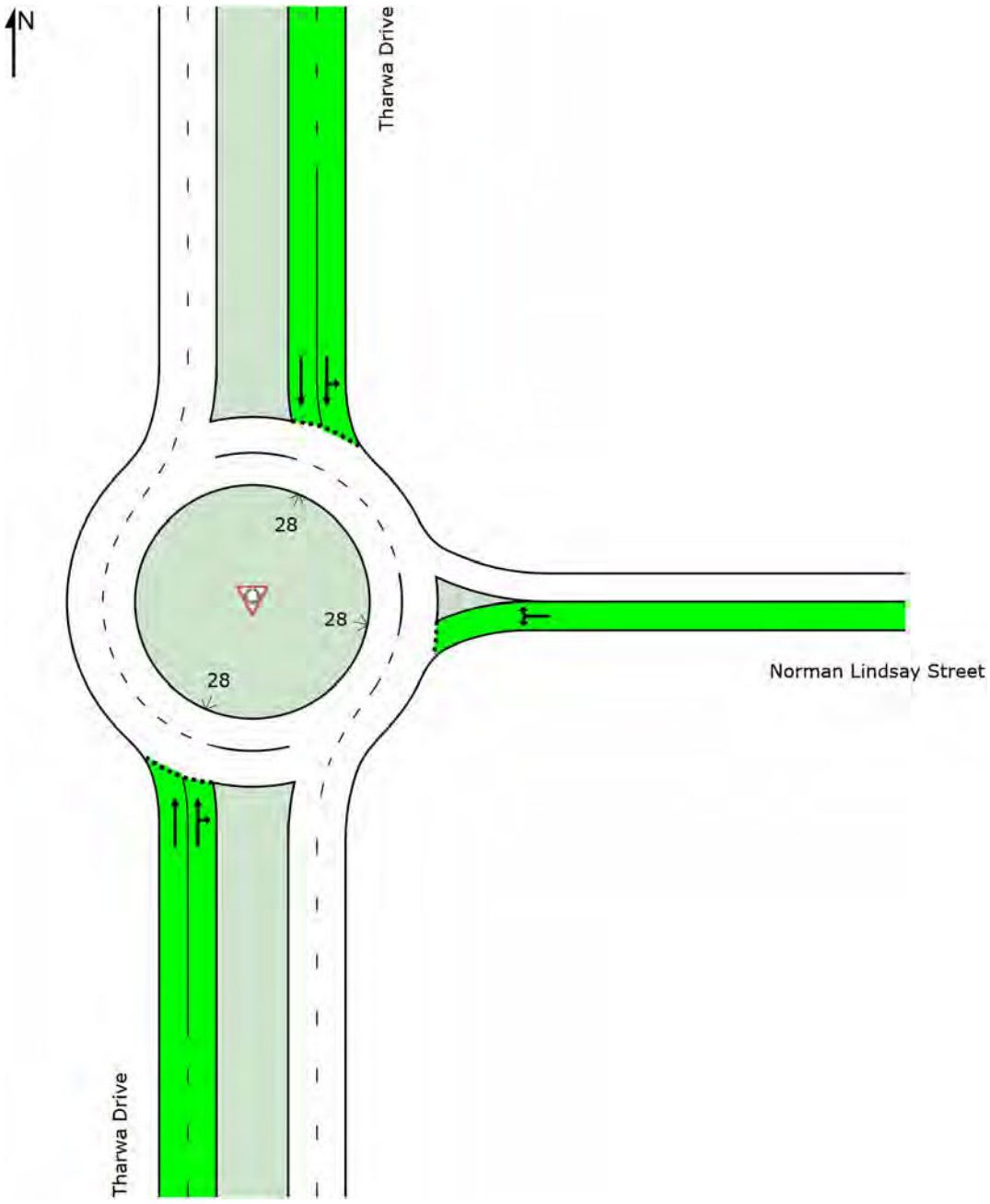
	Demand Flows		Arrival Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	Aver. Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
South: Tharwa Drive															
Lane 1[d]	279	1.5	279	1.5	1386	0.201	100	4.1	LOS A	0.4	3.1	Full	640	0.0	0.0
Lane 2	256	1.5	256	1.5	1272	0.201	100	6.5	LOS A	0.4	3.1	Full	640	0.0	0.0
Approach	535	1.5	535	1.5		0.201		5.2	LOS A	0.4	3.1				
East: Norman Lindsay Street															
Lane 1[d]	326	1.5	326	1.5	888	0.367	100	7.4	LOS A	0.9	6.2	Full	40	0.0	0.0
Approach	326	1.5	326	1.5		0.367		7.4	LOS A	0.9	6.2				
North: Tharwa Drive															
Lane 1[d]	563	1.5	563	1.5	1476	0.381	100	3.7	LOS A	0.8	5.7	Full	80	0.0	0.0
Lane 2	508	1.5	508	1.5	1332	0.381	100	3.8	LOS A	0.8	5.6	Full	80	0.0	0.0
Approach	1071	1.5	1071	1.5		0.381		3.7	LOS A	0.8	5.7				
Intersection	1932	1.5	1932	1.5		0.381		4.8	LOS A	0.9	6.2				

[redacted]

d Dominant lane on roundabout approach

Lane Level of Service

	Approaches			Intersection
	South	East	North	
LOS	A	A	A	A



Colour code based on Level of Service

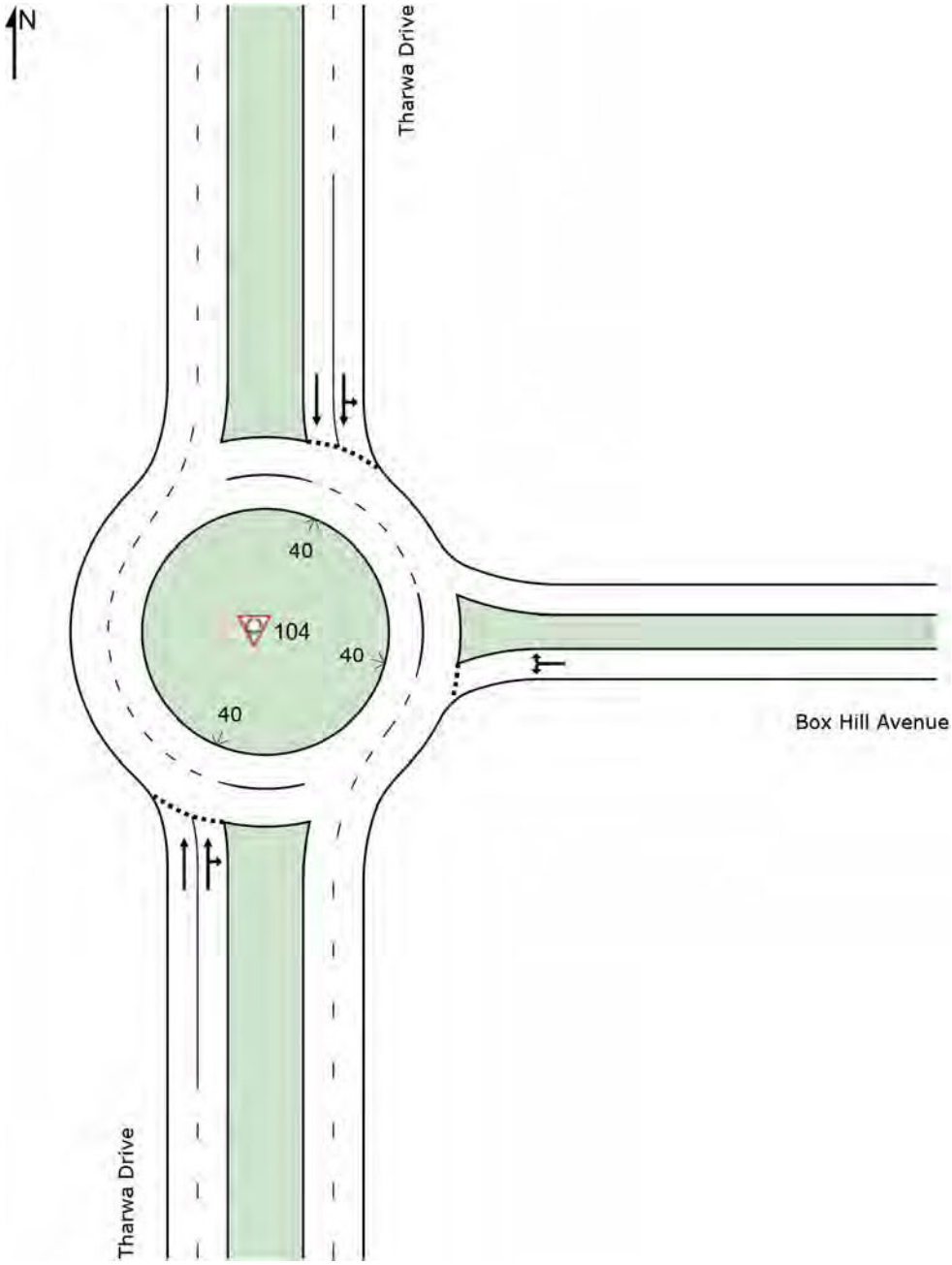
LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site: 104 [2031_PM Peak_Tharwa Drive / Box Hill Avenue - Roundabout]

Network: 13 [2031 Future Conditions with Upgrades_Tharwa Drive PM peak - Op4]

Dual Lane Roundabout - Duplicated
Site Category: PM Peak 2031 Conditions
Roundabout

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
2	T1	280	1.5	280	1.5	0.118	3.6	LOS A	0.2	1.7	0.38	0.38	0.38	55.1
3	R2	14	1.5	14	1.5	0.118	10.3	LOS A	0.2	1.7	0.39	0.41	0.39	54.0
Approach		294	1.5	294	1.5	0.118	3.9	LOS A	0.2	1.7	0.38	0.39	0.38	55.0
East: Box Hill Avenue														
4	L2	14	1.5	14	1.5	0.277	5.3	LOS A	0.5	3.6	0.53	0.77	0.53	29.7
6	R2	254	1.5	254	1.5	0.277	11.7	LOS A	0.5	3.6	0.53	0.77	0.53	29.7
Approach		267	1.5	267	1.5	0.277	11.4	LOS A	0.5	3.6	0.53	0.77	0.53	29.7
North: Tharwa Drive														
7	L2	477	1.5	477	1.5	0.318	3.2	LOS A	0.8	5.3	0.08	0.37	0.08	55.9
8	T1	556	1.5	556	1.5	0.318	2.8	LOS A	0.8	5.3	0.09	0.29	0.09	55.5
Approach		1033	1.5	1033	1.5	0.318	3.0	LOS A	0.8	5.3	0.09	0.33	0.09	55.7
All Vehicles		1594	1.5	1594	1.5	0.318	4.6	LOS A	0.8	5.3	0.21	0.41	0.21	53.4

[redacted]

Lane Use and Performance

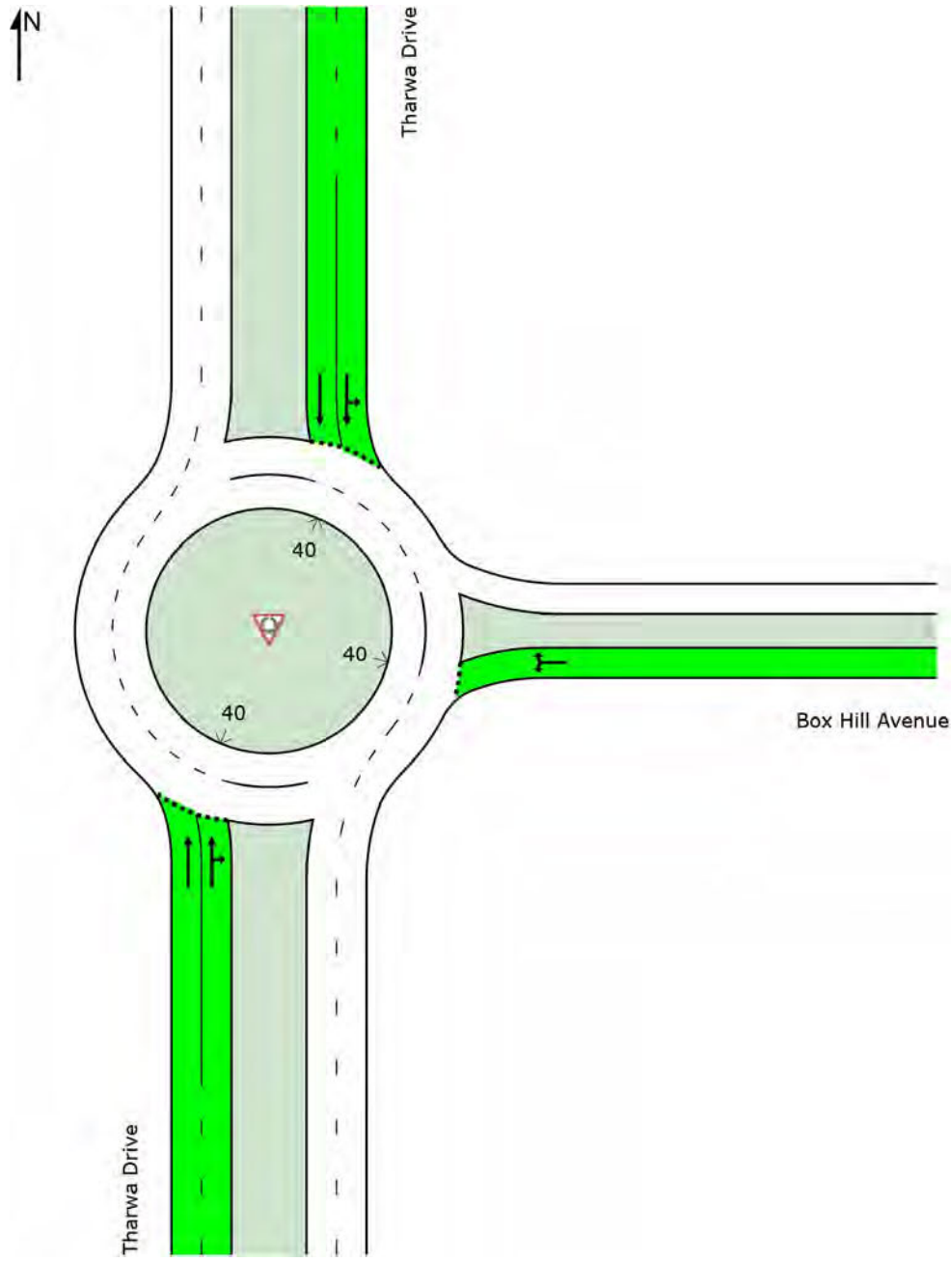
	Demand Flows		Arrival Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	Aver. Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
South: Tharwa Drive															
Lane 1[d]	155	1.5	155	1.5	1310	0.118	100	3.5	LOS A	0.2	1.7	Full	990	0.0	0.0
Lane 2	139	1.5	139	1.5	1169	0.118	100	4.3	LOS A	0.2	1.7	Full	990	0.0	0.0
Approach	294	1.5	294	1.5		0.118		3.9	LOS A	0.2	1.7				
East: Box Hill Avenue															
Lane 1[d]	267	1.5	267	1.5	965	0.277	100	11.4	LOS A	0.5	3.6	Full	105	0.0	0.0
Approach	267	1.5	267	1.5		0.277		11.4	LOS A	0.5	3.6				
North: Tharwa Drive															
Lane 1[d]	554	1.5	554	1.5	1742	0.318	100	3.2	LOS A	0.8	5.3	Full	640	0.0	0.0
Lane 2	479	1.5	479	1.5	1506	0.318	100	2.8	LOS A	0.7	5.3	Full	640	0.0	0.0
Approach	1033	1.5	1033	1.5		0.318		3.0	LOS A	0.8	5.3				
Intersection	1594	1.5	1594	1.5		0.318		4.6	LOS A	0.8	5.3				

[redacted]

d Dominant lane on roundabout approach

Lane Level of Service

	Approaches			Intersection
	South	East	North	
LOS	A	A	A	A



Colour code based on Level of Service

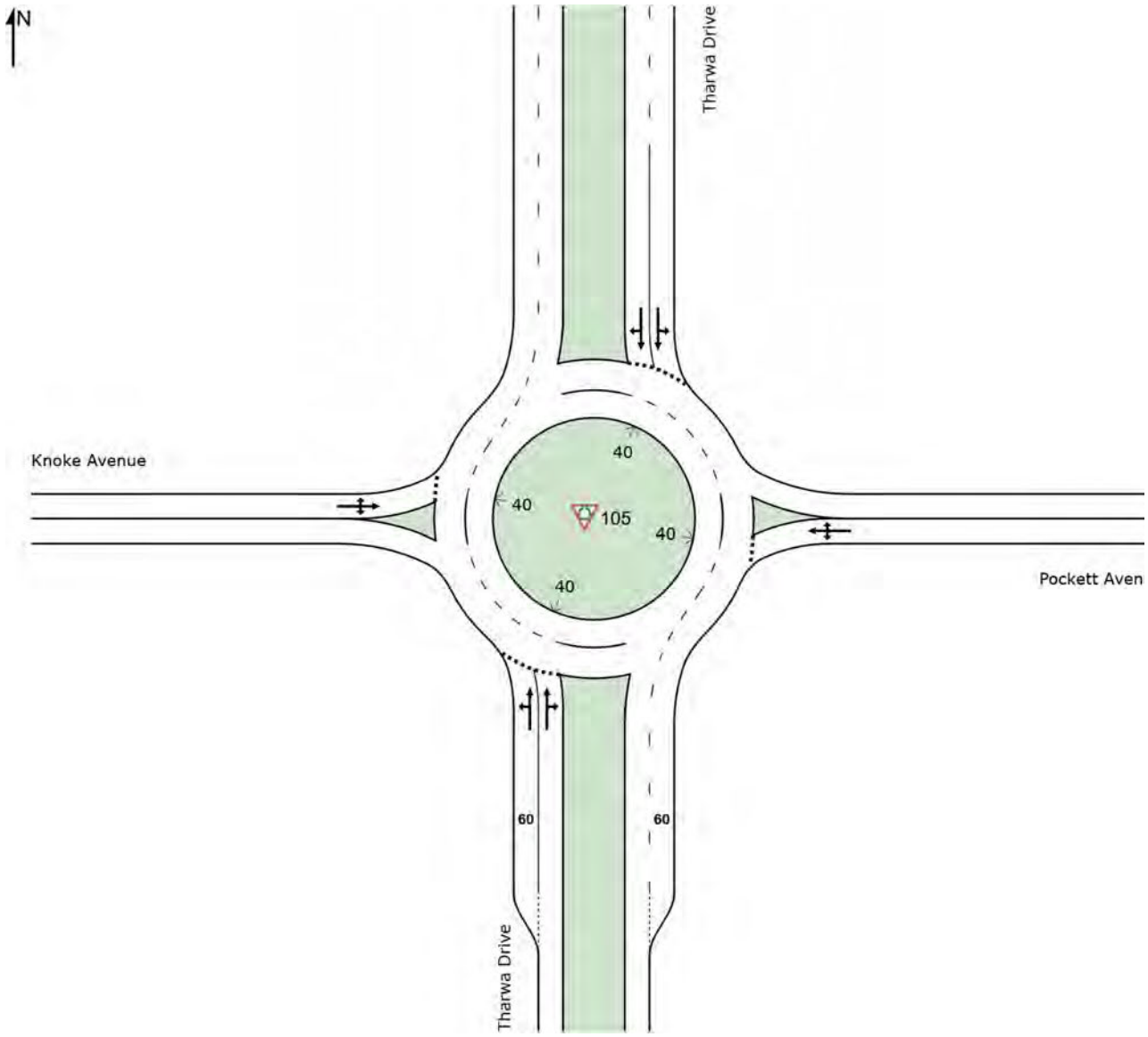
LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site: 105 [2031_PM Peak_Tharwa Drive / Pockett Avenue - Roundabout]

Network: 13 [2031 Future Conditions with Upgrades_Tharwa Drive PM peak - Op4]

Dual Lane Roundabout - Duplicated
Site Category: PM Peak 2031 Conditions
Roundabout

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
1	L2	2	1.5	2	1.5	0.016	4.3	LOS A	0.0	0.2	0.41	0.41	0.41	52.7
2	T1	29	1.5	29	1.5	0.016	4.0	LOS A	0.0	0.2	0.41	0.44	0.41	50.6
3	R2	5	1.5	5	1.5	0.016	10.8	LOS A	0.0	0.2	0.42	0.50	0.42	48.6
Approach		37	1.5	37	1.5	0.016	5.0	LOS A	0.0	0.2	0.41	0.45	0.41	50.4
East: Pockett Avenue														
4	L2	11	1.5	11	1.5	0.184	3.8	LOS A	0.3	2.4	0.39	0.63	0.39	49.1
5	T1	37	1.5	37	1.5	0.184	3.6	LOS A	0.3	2.4	0.39	0.63	0.39	14.7
6	R2	156	1.5	156	1.5	0.184	10.1	LOS A	0.3	2.4	0.39	0.63	0.39	30.9
Approach		203	1.5	203	1.5	0.184	8.6	LOS A	0.3	2.4	0.39	0.63	0.39	26.0
North: Tharwa Drive														
7	L2	303	1.5	303	1.5	0.189	3.3	LOS A	0.4	2.6	0.14	0.39	0.14	55.8
8	T1	61	1.5	61	1.5	0.187	2.9	LOS A	0.4	2.5	0.15	0.56	0.15	56.5
9	R2	205	1.5	205	1.5	0.187	9.6	LOS A	0.4	2.5	0.15	0.56	0.15	44.0
Approach		569	1.5	569	1.5	0.189	5.5	LOS A	0.4	2.6	0.15	0.47	0.15	51.0
West: Knoke Avenue														
10	L2	88	1.5	88	1.5	0.111	3.6	LOS A	0.2	1.4	0.31	0.43	0.31	37.1
11	T1	36	1.5	36	1.5	0.111	3.3	LOS A	0.2	1.4	0.31	0.43	0.31	28.8
12	R2	5	1.5	5	1.5	0.111	10.1	LOS A	0.2	1.4	0.31	0.43	0.31	58.2
Approach		129	1.5	129	1.5	0.111	3.8	LOS A	0.2	1.4	0.31	0.43	0.31	35.6
All Vehicles		939	1.5	939	1.5	0.189	5.9	LOS A	0.4	2.6	0.23	0.50	0.23	47.8

[redacted]

Lane Use and Performance

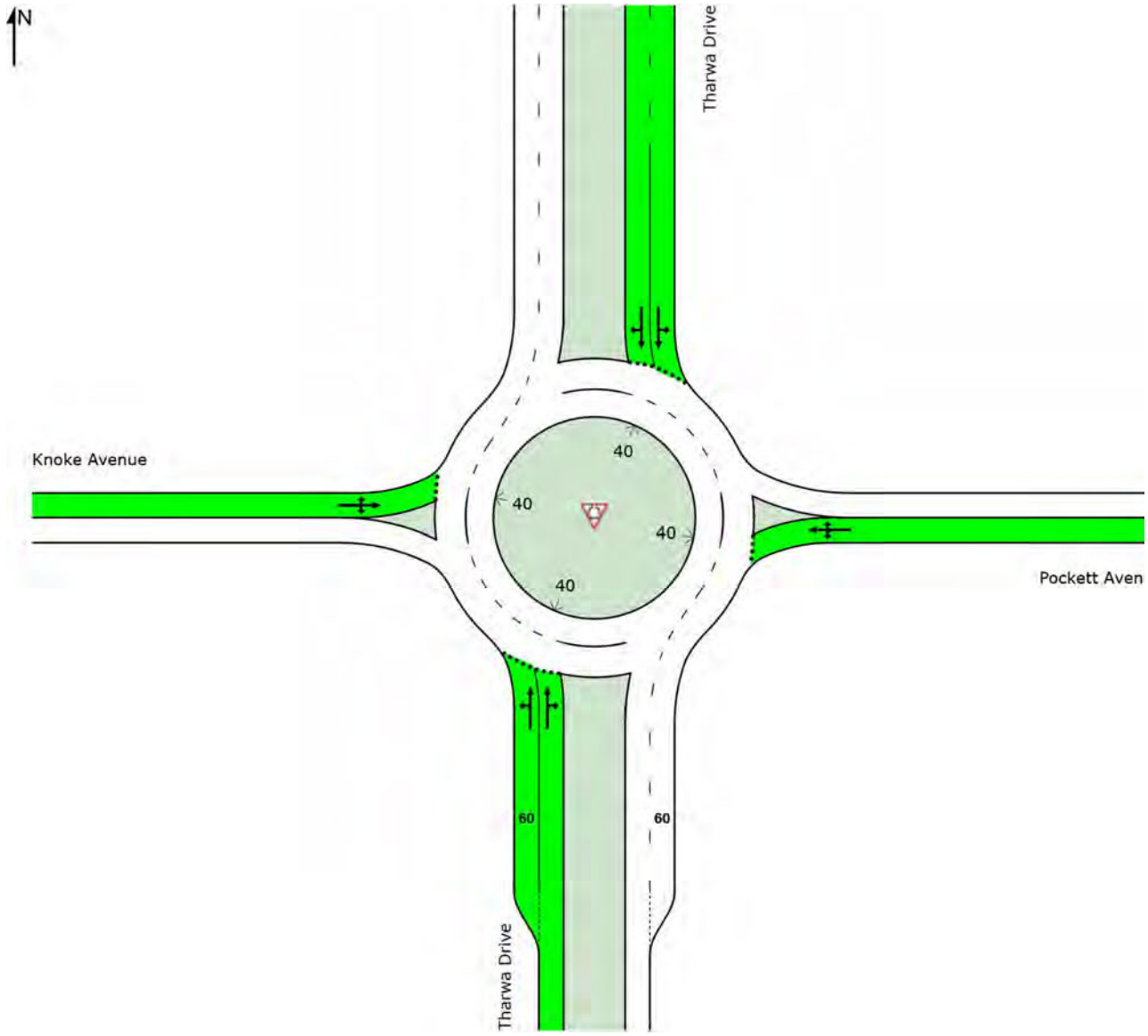
	Demand Flows		Arrival Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	Aver. Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
South: Tharwa Drive															
Lane 1[d]	20	1.5	20	1.5	1237	0.016	100	3.9	LOS A	0.0	0.2	Short	60	0.0	NA
Lane 2	17	1.5	17	1.5	1081	0.016	100	6.1	LOS A	0.0	0.2	Full	500	0.0	0.0
Approach	37	1.5	37	1.5		0.016		5.0	LOS A	0.0	0.2				
East: Pockett Avenue															
Lane 1[d]	203	1.5	203	1.5	1107	0.184	100	8.6	LOS A	0.3	2.4	Full	80	0.0	0.0
Approach	203	1.5	203	1.5		0.184		8.6	LOS A	0.3	2.4				
North: Tharwa Drive															
Lane 1[d]	303	1.5	303	1.5	1603	0.189	100	3.3	LOS A	0.4	2.6	Full	990	0.0	0.0
Lane 2	266	1.5	266	1.5	1420	0.187	99[5]	8.0	LOS A	0.4	2.5	Full	990	0.0	0.0
Approach	569	1.5	569	1.5		0.189		5.5	LOS A	0.4	2.6				
West: Knoke Avenue															
Lane 1[d]	129	1.5	129	1.5	1163	0.111	100	3.8	LOS A	0.2	1.4	Full	95	0.0	0.0
Approach	129	1.5	129	1.5		0.111		3.8	LOS A	0.2	1.4				
Intersection	939	1.5	939	1.5		0.189		5.9	LOS A	0.4	2.6				

[redacted]

5 Lane under-utilisation found by the program
d Dominant lane on roundabout approach

Lane Level of Service

	Approaches				Intersection
	South	East	North	West	
LOS	A	A	A	A	A



Colour code based on Level of Service

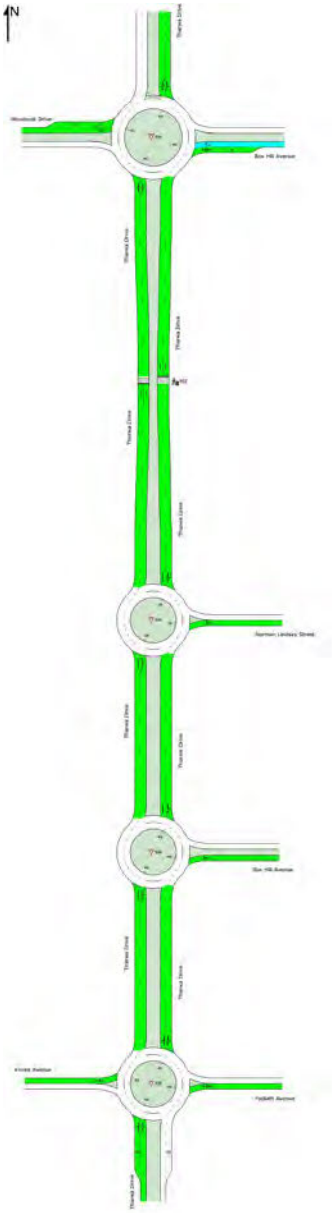
LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

LANE LEVEL OF SERVICE

Lane Level of Service for Network Sites

Network: N101 [2031 Future Conditions with Upgrades_Tharwa Drive PM peak - Op4]

2031 Future Conditions - Upgraded Layout
Network Category: (None)



Colour code based on Level of Service

LOS A	LOS B	LOS C	LOS D	LOS E	LOS F

Delay model settings are specified for individual Sites forming the Network.

USER REPORT FOR NETWORK SITE

Project: 2031 Conditions

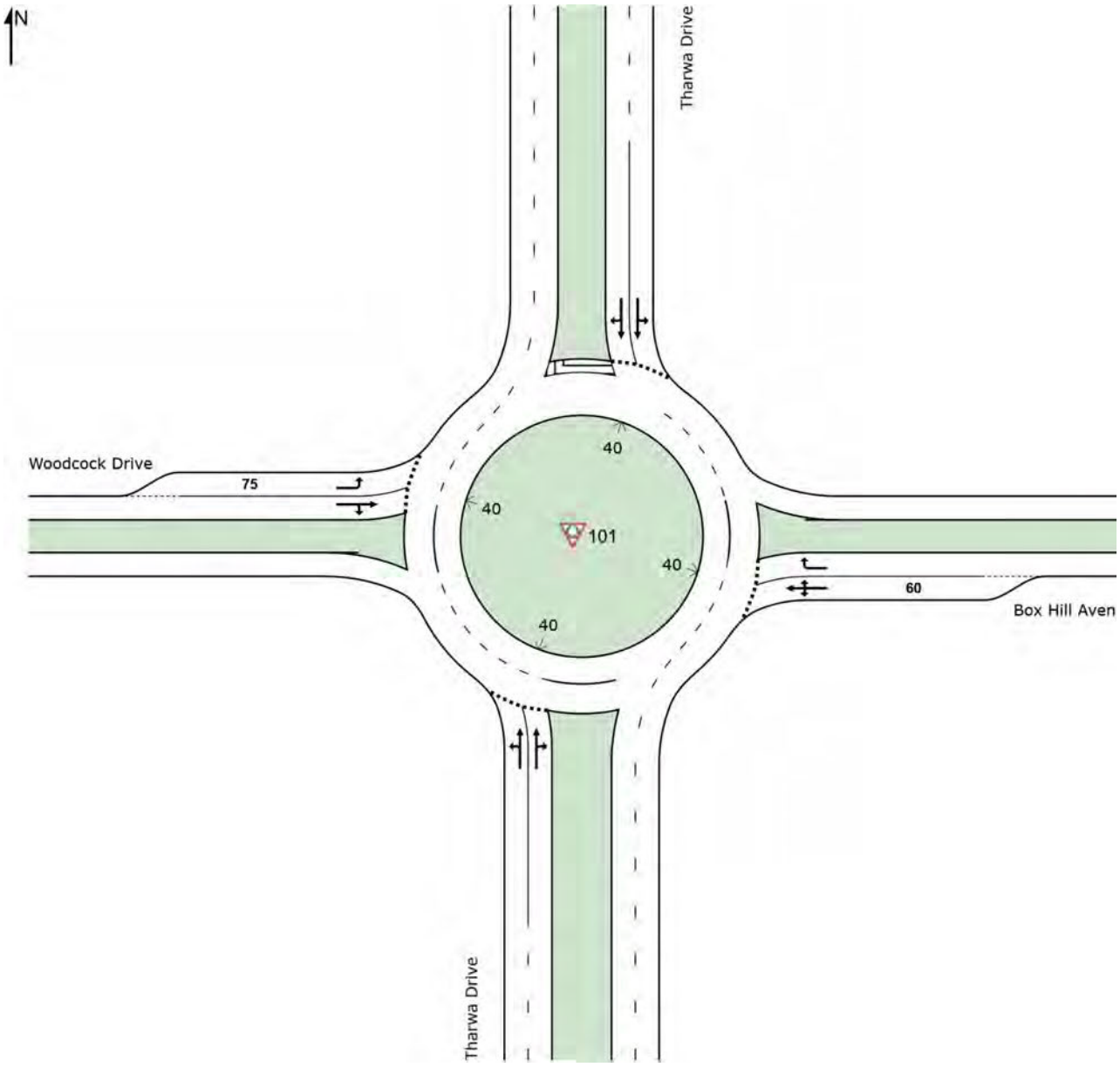
Template: Default Site User Report (2)

Site: 101 [2031_PM Peak_Tharwa Drive / Woodcock Drive - Duplicated with Ped Xing]

Network: 13 [2031 Future Conditions with Upgrades_Tharwa Drive PM peak - Op4]

Two Lane Roundabout with ped xing to south - Duplicated
Site Category: PM Peak 2031 Conditions
Roundabout

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
1	L2	151	1.5	151	1.5	0.298	4.7	LOS A	0.5	3.9	0.50	0.58	0.50	50.9
2	T1	400	1.5	400	1.5	0.298	4.8	LOS A	0.5	3.9	0.52	0.58	0.52	55.3
3	R2	9	1.5	9	1.5	0.298	11.1	LOS A	0.5	3.6	0.53	0.58	0.53	41.7
Approach		560	1.5	560	1.5	0.298	4.8	LOS A	0.5	3.9	0.52	0.58	0.52	54.1
East: Box Hill Avenue														
4	L2	32	1.5	32	1.5	0.443	7.9	LOS A	1.3	8.9	0.85	0.93	0.95	31.7
5	T1	105	1.5	105	1.5	0.443	7.7	LOS A	1.3	8.9	0.85	0.93	0.95	47.7
6	R2	485	1.5	485	1.5	0.443	14.9	LOS B	1.3	8.9	0.84	0.96	0.96	48.4
Approach		622	1.5	622	1.5	0.443	13.3	LOS A	1.3	8.9	0.85	0.95	0.95	47.9
North: Tharwa Drive														
7	L2	797	1.5	797	1.5	0.666	4.4	LOS A	2.8	20.1	0.65	0.52	0.65	52.0
8	T1	972	1.5	972	1.5	0.666	4.3	LOS A	2.8	20.1	0.69	0.51	0.70	48.7
9	R2	113	1.5	113	1.5	0.666	11.3	LOS A	2.8	19.5	0.71	0.50	0.71	55.7
Approach		1881	1.5	1881	1.5	0.666	4.8	LOS A	2.8	20.1	0.68	0.51	0.68	50.8
West: Woodcock Drive														
10	L2	65	1.5	65	1.5	0.090	6.0	LOS A	0.2	1.1	0.60	0.69	0.60	54.1
11	T1	145	1.5	145	1.5	0.200	4.5	LOS A	0.4	2.9	0.61	0.59	0.61	52.1
12	R2	66	1.5	66	1.5	0.200	11.4	LOS A	0.4	2.9	0.61	0.59	0.61	45.9
Approach		277	1.5	277	1.5	0.200	6.5	LOS A	0.4	2.9	0.61	0.61	0.61	51.6
All Vehicles		3340	1.5	3340	1.5	0.666	6.5	LOS A	2.8	20.1	0.68	0.62	0.70	50.7

[redacted]

Lane Use and Performance

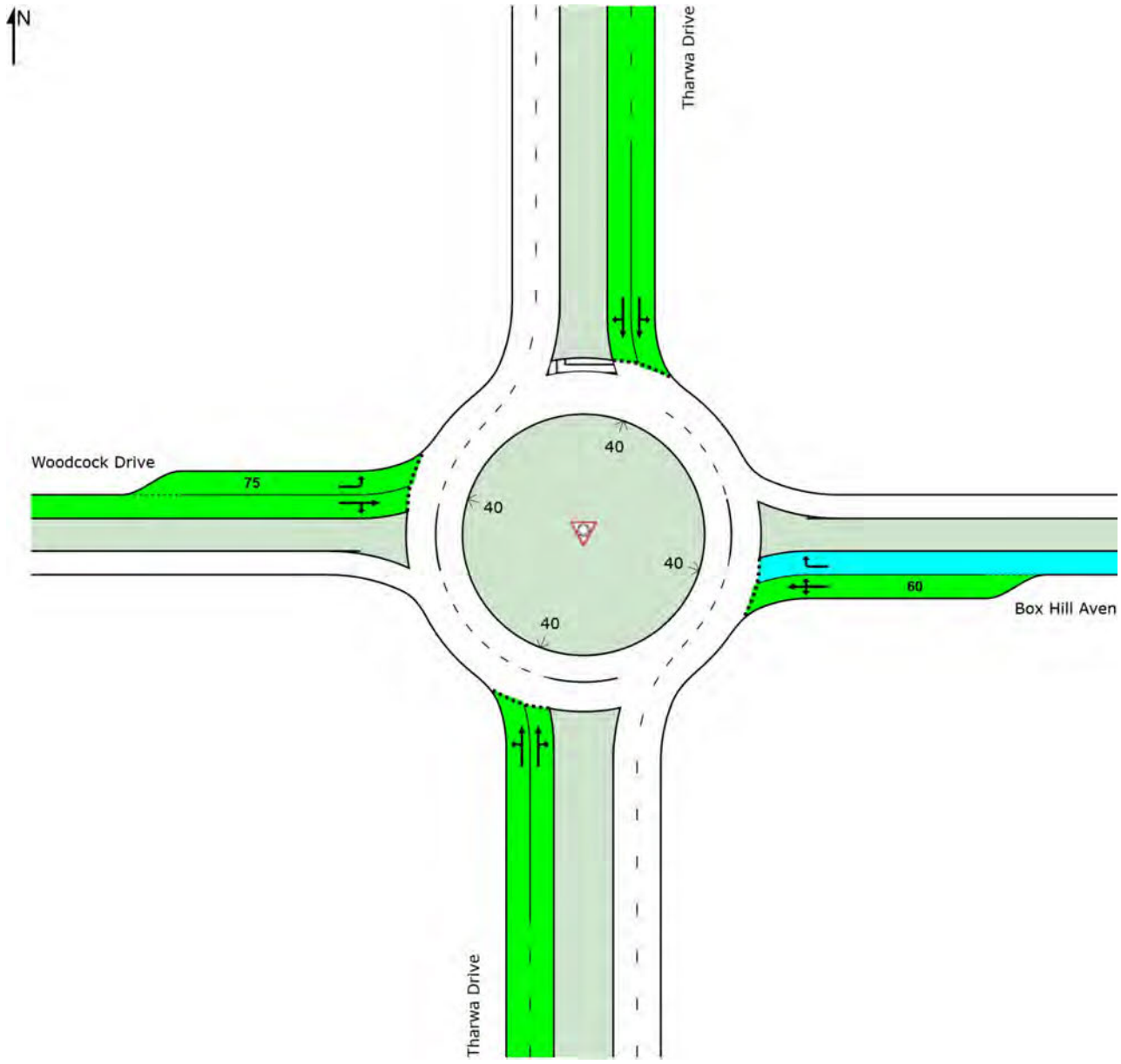
	Demand Flows		Arrival Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	Aver. Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
South: Tharwa Drive															
Lane 1[d]	307	1.5	307	1.5	1029	0.298	100	4.6	LOS A	0.5	3.9	Full	75	0.0	0.0
Lane 2	253	1.5	253	1.5	848	0.298	100	5.2	LOS A	0.5	3.6	Full	75	0.0	0.0
Approach	560	1.5	560	1.5		0.298		4.8	LOS A	0.5	3.9				
East: Box Hill Avenue															
Lane 1[d]	355	1.5	355	1.5	801	0.443	100	11.6	LOS A	1.3	8.9	Short	60	0.0	NA
Lane 2	267	1.5	267	1.5	604	0.443	100	15.5	LOS B	1.1	8.0	Full	150	0.0	0.0
Approach	622	1.5	622	1.5		0.443		13.3	LOS A	1.3	8.9				
North: Tharwa Drive															
Lane 1[d]	1042	1.5	1042	1.5	1565	0.666	100	4.3	LOS A	2.8	20.1	Full	490	0.0	0.0
Lane 2	839	1.5	839	1.5	1260	0.666	100	5.3	LOS A	2.8	19.5	Full	490	0.0	0.0
Approach	1881	1.5	1881	1.5		0.666		4.8	LOS A	2.8	20.1				
West: Woodcock Drive															
Lane 1	65	1.5	65	1.5	727	0.090	100	6.0	LOS A	0.2	1.1	Short	75	0.0	NA
Lane 2[d]	212	1.5	212	1.5	1056	0.200	100	6.7	LOS A	0.4	2.9	Full	380	0.0	0.0
Approach	277	1.5	277	1.5		0.200		6.5	LOS A	0.4	2.9				
Intersection	3340	1.5	3340	1.5		0.666		6.5	LOS A	2.8	20.1				

[redacted]

d Dominant lane on roundabout approach

Lane Level of Service

	Approaches				Intersection
	South	East	North	West	
LOS	A	A	A	A	A



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

[redacted]

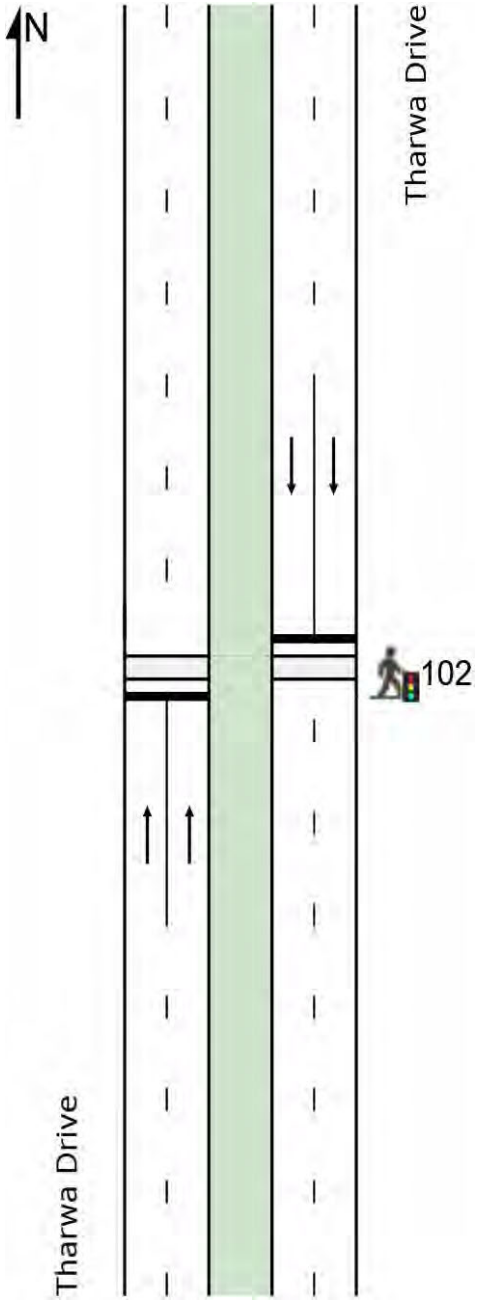
Site: 102 [2031_PM Peak_Tharwa Drive Pedestrian Crossing - Duplicated]

Network: 13 [2031 Future Conditions with Upgrades_Tharwa Drive PM peak - Op4]

Pedestrian Crossing - Duplicated
Site Category: PM Peak 2031 Conditions
Pedestrian Crossing (Signals) - Fixed Time Isolated Cycle Time = 20 seconds (Site Practical Cycle Time)

Timings based on settings in the Site Phasing & Timing dialog
Phase Times determined by the program
Downstream lane blockage effects included in determining phase times
Phase Sequence: Two-Phase
Reference Phase: Phase A
Input Phase Sequence: A, B
Output Phase Sequence: A, B

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
2	T1	560	1.5	560	1.5	0.280	3.3	LOS A	1.0	7.3	0.61	0.51	0.61	37.2
Approach		560	1.5	560	1.5	0.280	3.3	LOS A	1.0	7.3	0.61	0.51	0.61	37.2
North: Tharwa Drive														
8	T1	1068	1.5	1068	1.5	0.534	3.9	LOS A	2.3	16.5	0.73	0.62	0.73	33.9
Approach		1068	1.5	1068	1.5	0.534	3.9	LOS A	2.3	16.5	0.73	0.62	0.73	33.9
All Vehicles		1628	1.5	1628	1.5	0.534	3.7	LOS A	2.3	16.5	0.69	0.58	0.69	35.0

[redacted]

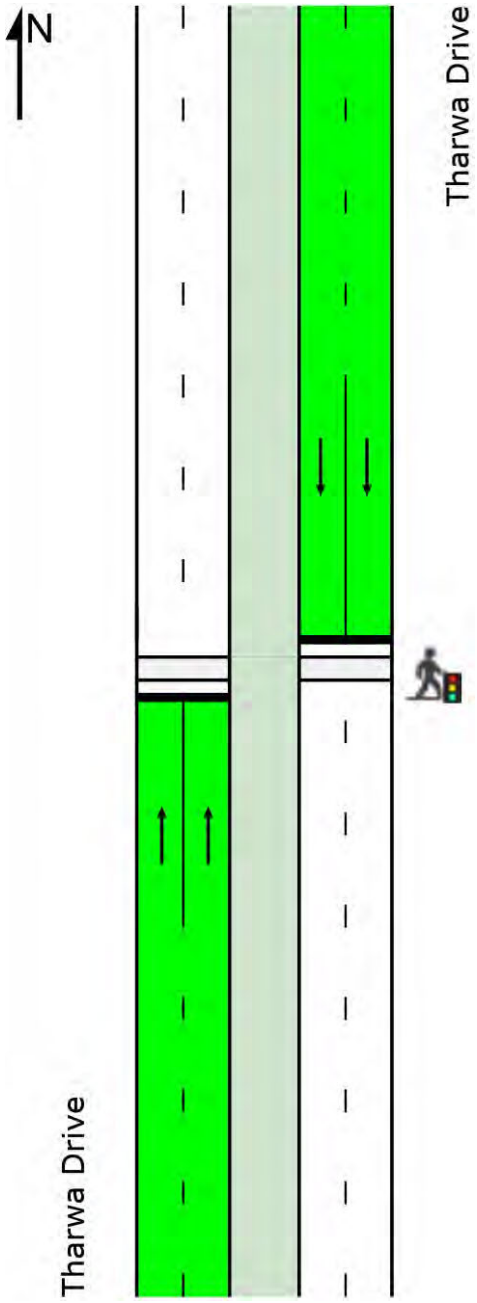
Lane Use and Performance

	Demand Flows		Arrival Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	Aver. Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
South: Tharwa Drive															
Lane 1	280	1.5	280	1.5	1001	0.280	100	3.3	LOS A	1.0	7.3	Full	80	0.0	0.0
Lane 2	280	1.5	280	1.5	1001	0.280	100	3.3	LOS A	1.0	7.3	Full	80	0.0	0.0
Approach	560	1.5	560	1.5		0.280		3.3	LOS A	1.0	7.3				
North: Tharwa Drive															
Lane 1	534	1.5	534	1.5	1001	0.534	100	3.9	LOS A	2.3	16.5	Full	75	0.0	0.0
Lane 2	534	1.5	534	1.5	1001	0.534	100	3.9	LOS A	2.3	16.5	Full	75	0.0	0.0
Approach	1068	1.5	1068	1.5		0.534		3.9	LOS A	2.3	16.5				
Intersection	1628	1.5	1628	1.5		0.534		3.7	LOS A	2.3	16.5				



Lane Level of Service

	Approaches		Intersection
	South	North	
LOS	A	A	A



Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Phase Timing Summary

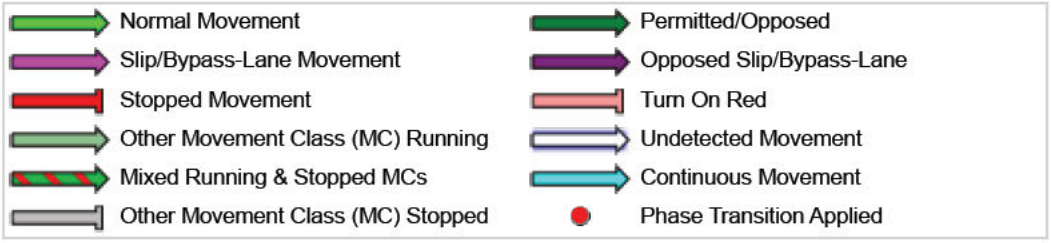
Phase	A	B
Phase Change Time (sec)	0	16
Green Time (sec)	10	2
Phase Time (sec)	12	8
Phase Split	60%	40%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase

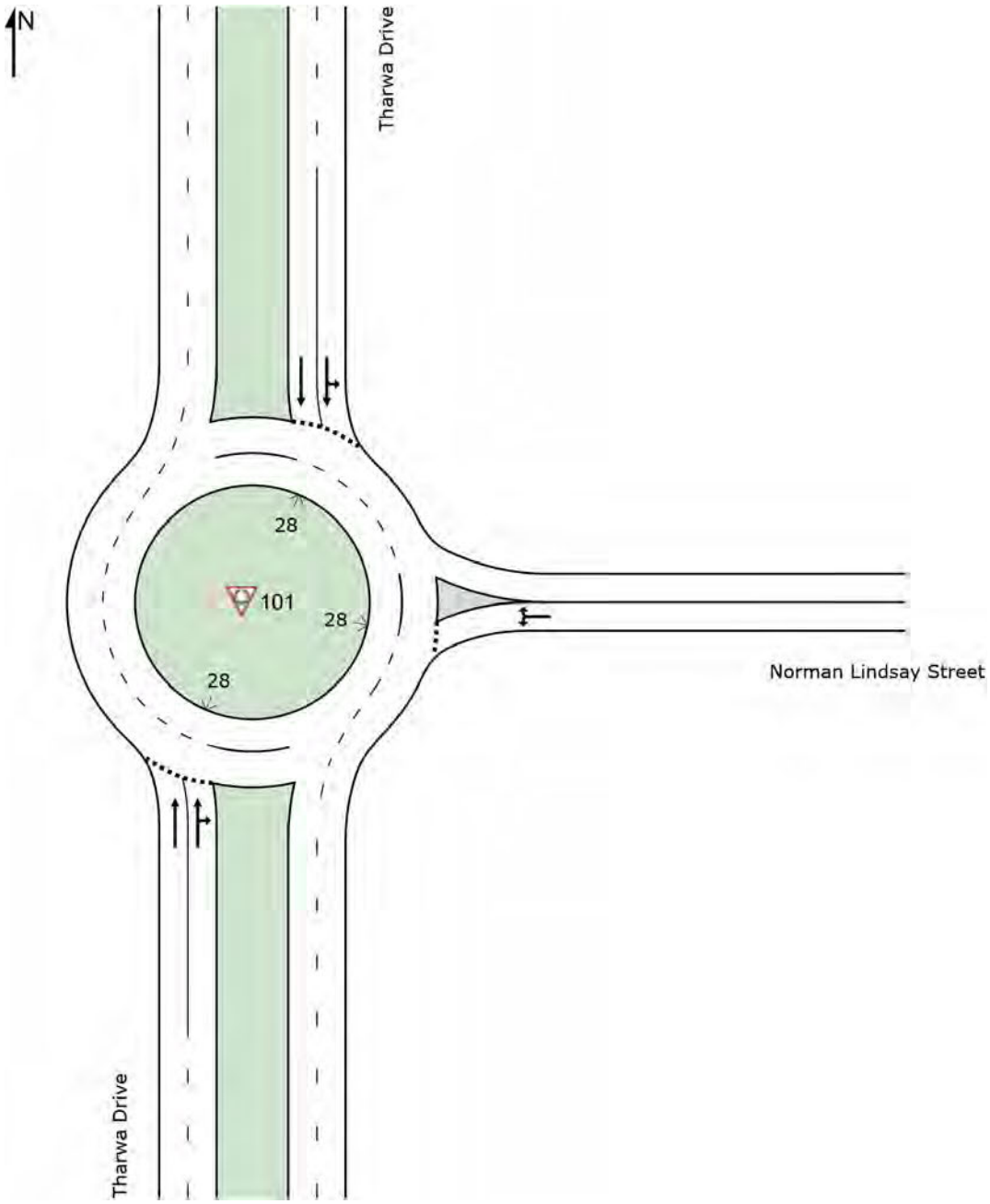


Site: 101 [2031_PM Peak_Tharwa Drive / Norman Lindsay Street - Roundabout]

Network: 13 [2031 Future Conditions with Upgrades_Tharwa Drive PM peak - Op4]

Two lane roundabout with ped xing to north - Duplicated
Site Category: PM Peak 2031 Conditions
Roundabout

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
2	T1	427	1.5	427	1.5	0.201	4.1	LOS A	0.4	3.1	0.30	0.44	0.30	52.1
3	R2	107	1.5	107	1.5	0.201	9.6	LOS A	0.4	3.1	0.31	0.52	0.31	49.6
Approach		535	1.5	535	1.5	0.201	5.2	LOS A	0.4	3.1	0.30	0.46	0.30	51.6
East: Norman Lindsay Street														
4	L2	197	1.5	197	1.5	0.367	5.3	LOS A	0.9	6.2	0.66	0.78	0.66	23.6
6	R2	129	1.5	129	1.5	0.367	10.5	LOS A	0.9	6.2	0.66	0.78	0.66	23.6
Approach		326	1.5	326	1.5	0.367	7.4	LOS A	0.9	6.2	0.66	0.78	0.66	23.6
North: Tharwa Drive														
7	L2	242	1.5	242	1.5	0.381	3.7	LOS A	0.8	5.7	0.21	0.42	0.21	15.1
8	T1	828	1.5	828	1.5	0.381	3.7	LOS A	0.8	5.7	0.22	0.40	0.22	37.0
Approach		1071	1.5	1071	1.5	0.381	3.7	LOS A	0.8	5.7	0.22	0.41	0.22	26.6
All Vehicles		1932	1.5	1932	1.5	0.381	4.8	LOS A	0.9	6.2	0.32	0.48	0.32	39.7

[redacted]

Lane Use and Performance

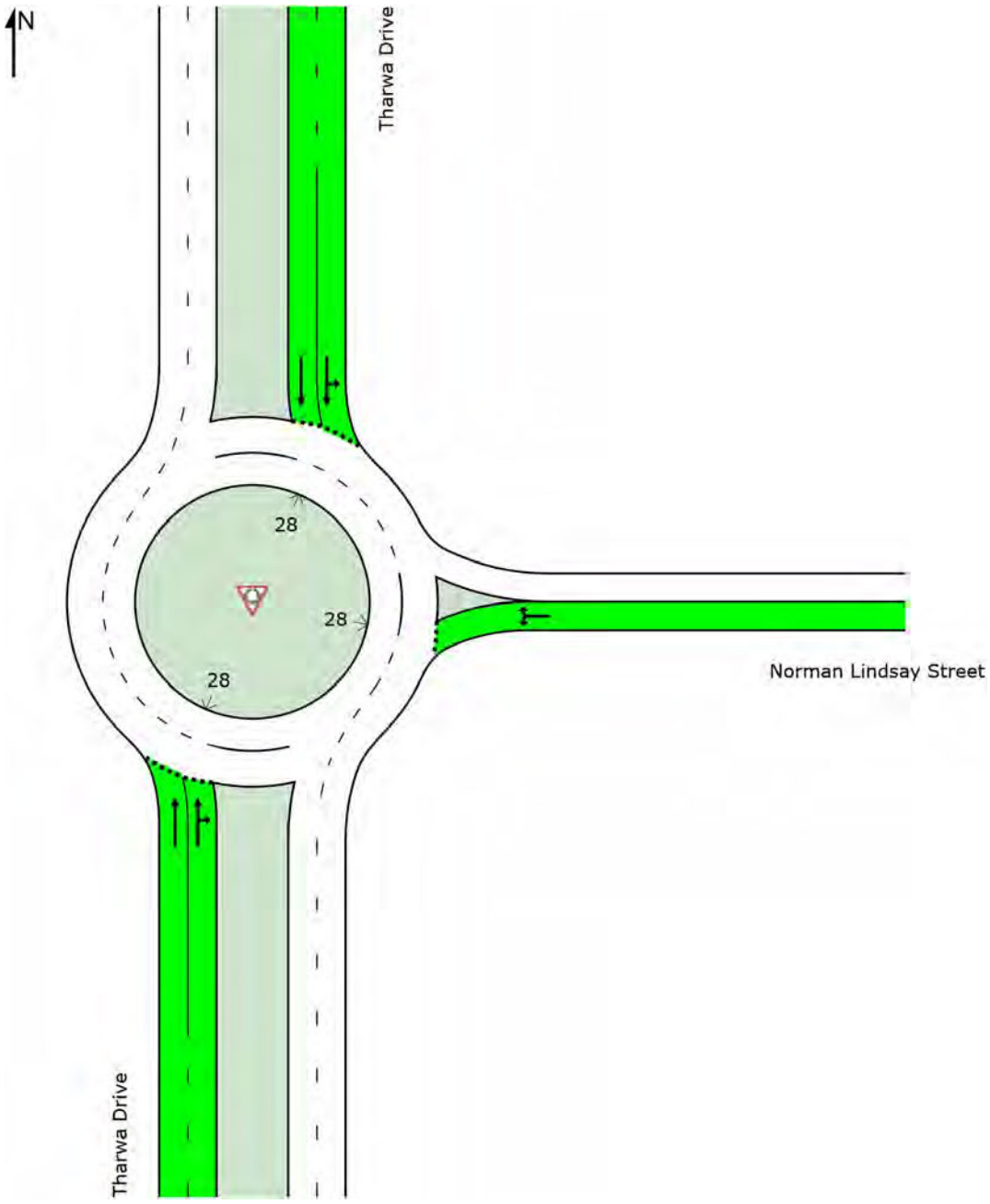
	Demand Flows		Arrival Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	Aver. Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
South: Tharwa Drive															
Lane 1[d]	279	1.5	279	1.5	1386	0.201	100	4.1	LOS A	0.4	3.1	Full	640	0.0	0.0
Lane 2	256	1.5	256	1.5	1272	0.201	100	6.5	LOS A	0.4	3.1	Full	640	0.0	0.0
Approach	535	1.5	535	1.5		0.201		5.2	LOS A	0.4	3.1				
East: Norman Lindsay Street															
Lane 1[d]	326	1.5	326	1.5	888	0.367	100	7.4	LOS A	0.9	6.2	Full	40	0.0	0.0
Approach	326	1.5	326	1.5		0.367		7.4	LOS A	0.9	6.2				
North: Tharwa Drive															
Lane 1[d]	563	1.5	563	1.5	1476	0.381	100	3.7	LOS A	0.8	5.7	Full	80	0.0	0.0
Lane 2	508	1.5	508	1.5	1332	0.381	100	3.8	LOS A	0.8	5.6	Full	80	0.0	0.0
Approach	1071	1.5	1071	1.5		0.381		3.7	LOS A	0.8	5.7				
Intersection	1932	1.5	1932	1.5		0.381		4.8	LOS A	0.9	6.2				

[redacted]

d Dominant lane on roundabout approach

Lane Level of Service

	Approaches			Intersection
	South	East	North	
LOS	A	A	A	A



Colour code based on Level of Service

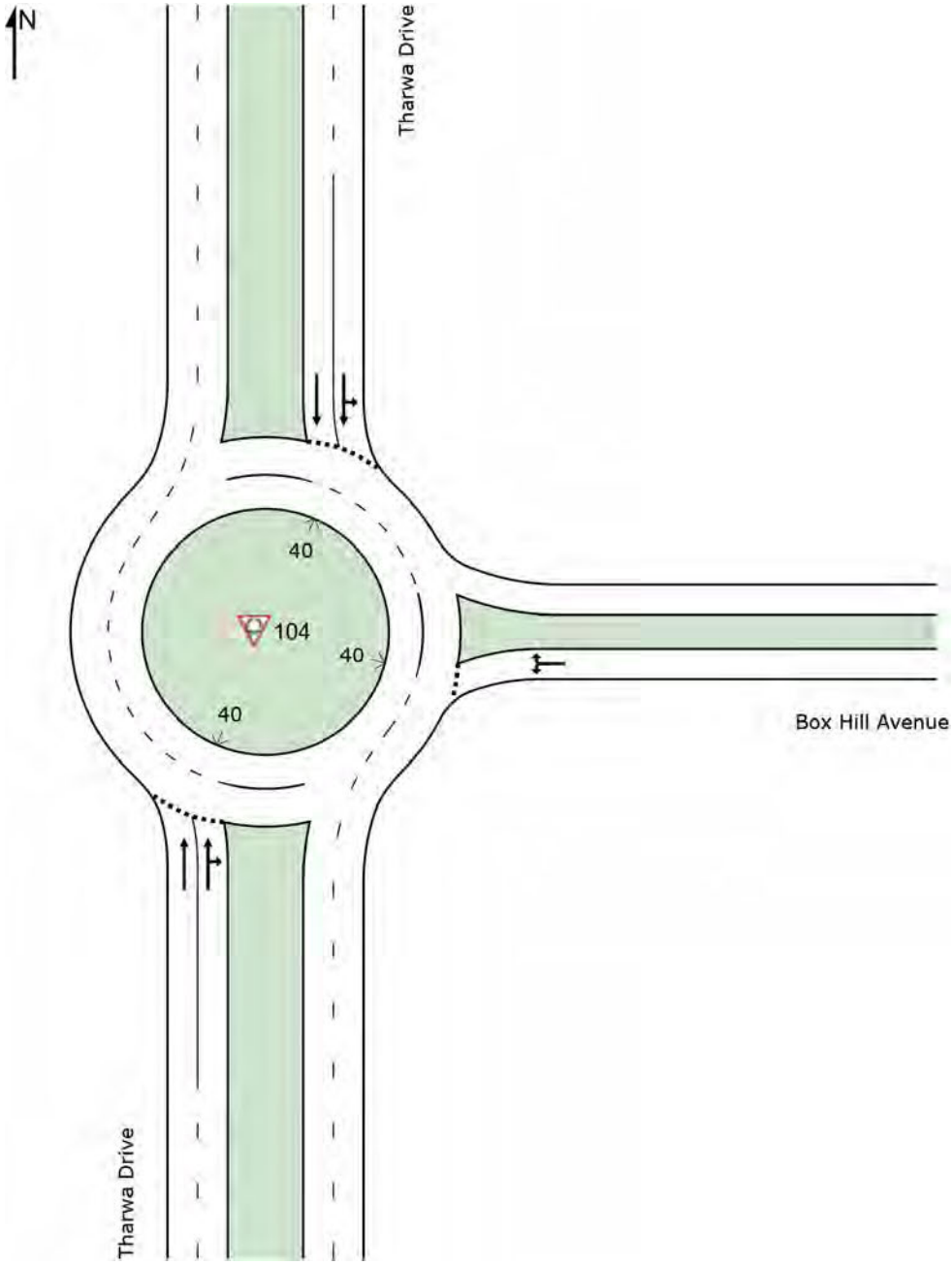
LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Site: 104 [2031_PM Peak_Tharwa Drive / Box Hill Avenue - Roundabout]

Network: 13 [2031 Future Conditions with Upgrades_Tharwa Drive PM peak - Op4]

Dual Lane Roundabout - Duplicated
Site Category: PM Peak 2031 Conditions
Roundabout

Site Layout



Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Tharwa Drive														
2	T1	280	1.5	280	1.5	0.118	3.6	LOS A	0.2	1.7	0.38	0.38	0.38	55.1
3	R2	14	1.5	14	1.5	0.118	10.3	LOS A	0.2	1.7	0.39	0.41	0.39	54.0
Approach		294	1.5	294	1.5	0.118	3.9	LOS A	0.2	1.7	0.38	0.39	0.38	55.0
East: Box Hill Avenue														
4	L2	14	1.5	14	1.5	0.277	5.3	LOS A	0.5	3.6	0.53	0.77	0.53	29.7
6	R2	254	1.5	254	1.5	0.277	11.7	LOS A	0.5	3.6	0.53	0.77	0.53	29.7
Approach		267	1.5	267	1.5	0.277	11.4	LOS A	0.5	3.6	0.53	0.77	0.53	29.7
North: Tharwa Drive														
7	L2	477	1.5	477	1.5	0.318	3.2	LOS A	0.8	5.3	0.08	0.37	0.08	55.9
8	T1	556	1.5	556	1.5	0.318	2.8	LOS A	0.8	5.3	0.09	0.29	0.09	55.5
Approach		1033	1.5	1033	1.5	0.318	3.0	LOS A	0.8	5.3	0.09	0.33	0.09	55.7
All Vehicles		1594	1.5	1594	1.5	0.318	4.6	LOS A	0.8	5.3	0.21	0.41	0.21	53.4

[redacted]

Lane Use and Performance

	Demand Flows		Arrival Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	Aver. Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
South: Tharwa Drive															
Lane 1[d]	155	1.5	155	1.5	1310	0.118	100	3.5	LOS A	0.2	1.7	Full	990	0.0	0.0
Lane 2	139	1.5	139	1.5	1169	0.118	100	4.3	LOS A	0.2	1.7	Full	990	0.0	0.0
Approach	294	1.5	294	1.5		0.118		3.9	LOS A	0.2	1.7				
East: Box Hill Avenue															
Lane 1[d]	267	1.5	267	1.5	965	0.277	100	11.4	LOS A	0.5	3.6	Full	105	0.0	0.0
Approach	267	1.5	267	1.5		0.277		11.4	LOS A	0.5	3.6				
North: Tharwa Drive															
Lane 1[d]	554	1.5	554	1.5	1742	0.318	100	3.2	LOS A	0.8	5.3	Full	640	0.0	0.0
Lane 2	479	1.5	479	1.5	1506	0.318	100	2.8	LOS A	0.7	5.3	Full	640	0.0	0.0
Approach	1033	1.5	1033	1.5		0.318		3.0	LOS A	0.8	5.3				
Intersection	1594	1.5	1594	1.5		0.318		4.6	LOS A	0.8	5.3				

[redacted]

d Dominant lane on roundabout approach