CITY OF PARRAMATTA COUNCIL

Traffic Engineering Advisory Group Agenda Item

ITEM NO: 2311 B1

SUBJECT: Hill Road, Wentworth Point – Update on the proposed improvements

APPLICANT: City of Parramatta Council

REPORT OF: Traffic and Transport Investigations Engineer

WARD: Rosehill

SED: Parramatta

Purpose

The purpose of this report is to provide an update to Council regarding improvements on Hill Road, Wentworth Point as well as other works in the area which may affect traffic. Accordingly, the report provides an update on the following works:

1. Bennelong Bridge Load Limit
2. Traffic Signals at the intersection of Hill Road and Bennelong Parkway
3. Roundabout and pedestrian crossings at the intersection of Hill Road and Burroway Road
4. Pedestrian Refuge Island in Hill Road near Half Street
5. Cyclist bridge at Haslams Creek and crossing facility at Wentworth Commons
6. An update on the Federal Government Funding
7. An update on the Stormwater improvements

OFFICER'S RECOMMENDATIONS:

That the update regarding improvements on Hill Road, Wentworth Point be noted.

Background

Council, at its meeting held on 14 March 2022 considered a report regarding Hill Road and resolved:

1. *That a monthly update be provided to Ward Councillors regarding the status of the Federal Funding application under its Stimulus Program.*
2. *That should the outcomes of the Federal Funding be unsuccessful or not received by end of July 2022, that Council will endeavour to secure alternative funding for the traffic signal upgrade at Hill Road and Bennelong Parkway, to ensure these works are completed in the 2022/23 financial year.*
3. *That Council continue to contact the developer advising of Council's resolution calling for the urgent construction of the planned roundabout and street crossing at the corner of Hill Road and Burroway Road.*

4. *Further, that updates on both projects referred to in this report be provided to each meeting of the Parramatta Traffic Committee and included in the minutes reported to Council until the projects are complete.*

In addition, an email from Councillor Noack was received on 5 April 2022 requesting the following items also be included within each TEAG agenda:

1. *As per Council resolution a report on the work being done on the traffic lights at the corner of Bennelong Parkway and Hill Road*
2. *As per Council resolution a report on work being done on the roundabout and pedestrian crossing at Hill Road and Burroway Road*
3. *Update on lighting on Hill Road. This is the change to LED lightning*
4. *Update on drainage for Hill Road*
5. *Haslams Creek Bridge Update on Bennelong Road*
6. *Crossing from Wentworth Common across Bennelong Road*

Bennelong Bridge 5 tonne Load Limit

Council is undertaking a review of Bennelong Parkway Bridge that crosses Haslams Creek. During the review as a safety precaution a 5 tonne load limit has been introduced to the bridge. Temporary detours for larger vehicles are being established with the relevant authorities.

Traffic Signals at Bennelong Parkway Intersection

A change in the location for the signalised crossing on the slip lane is currently being investigated. This change is required as one of the traffic signal posts for the signalised crossing is adversely affected by underground services. It was initially intended that a non-standard footing design could be used to address this issue. However, excavation of the area has shown that a non-standard footing is not a feasible solution. The new location would be approximately 10m south of the initially proposed location.

Subject to the outcome of the investigation and design for the new crossing location, it is anticipated that completion of the project will occur between December 2023 and February 2024.

Figure 1: A drone captured image of the completed works at the intersection of Hill Road and Burroway Road, Wentworth Point

As advised in the previous TEAG reports on the subject, Council has a dedicated webpage which provides the community with updates on the projects. 'What's Happening Here' corflute signs have been installed around the site which have a QR Code link to this page. The page can be accessed through the below link:

https://www.cityofparramatta.nsw.gov.au/vision/precinct-planning/installation-of-traffic-and-pedestrian-signals-at-wentworth-point

Proposed roundabout and pedestrian crossing at Burroway Road intersection

In response to a Council Notice of Motion, a report was provided to Council at the meeting held on 24 April 2023 which considered various options for delivery of the proposed roundabout and pedestrian crossings at the intersection of Hill Road and Burroway Road, Wentworth Point. When considering the options, Council resolved in part:

> *(a) That Council allow Sekisui House Australia (Sekisui) to complete the planned and required project for a roundabout and pedestrian facilities at the intersection of Hill Road and Burroway Road, Wentworth Point, as this is the quickest and lowest cost option for the overall project based on advice from the developer.*

Since the above resolution, Council staff and the developer have worked together to finalise the detail design for the roundabout and pedestrian crossings which was given the final approval on 16 August 2023. In total, there have been four formal meetings between Council staff and Sekisui to discuss the roundabout since September 2022. Three of the meetings primarily discussed design issues, all of which have been resolved. The final meeting discussed traffic management arrangements during construction and Sekisui also provided an update on approvals required from utility services.

There have also been three phone calls since mid-August 2023 to obtain updates and construction timings. At this stage, Council is hopeful that construction will commence this

calendar year, however, it is understood that this is subject to Ausgrid approval of the street lighting plans.

Pedestrian Refuge Island in Hill Road at Half Street

Council has previously approved the concept design of a pedestrian refuge island in Hill Road, Wentworth Point immediately north of Half Street as shown in Figure 2 below (ref. PTC 2202 A4). Council is currently undertaking the detail design of this facility and is intending to construct the facility in the current financial year subject to the availability of funding.

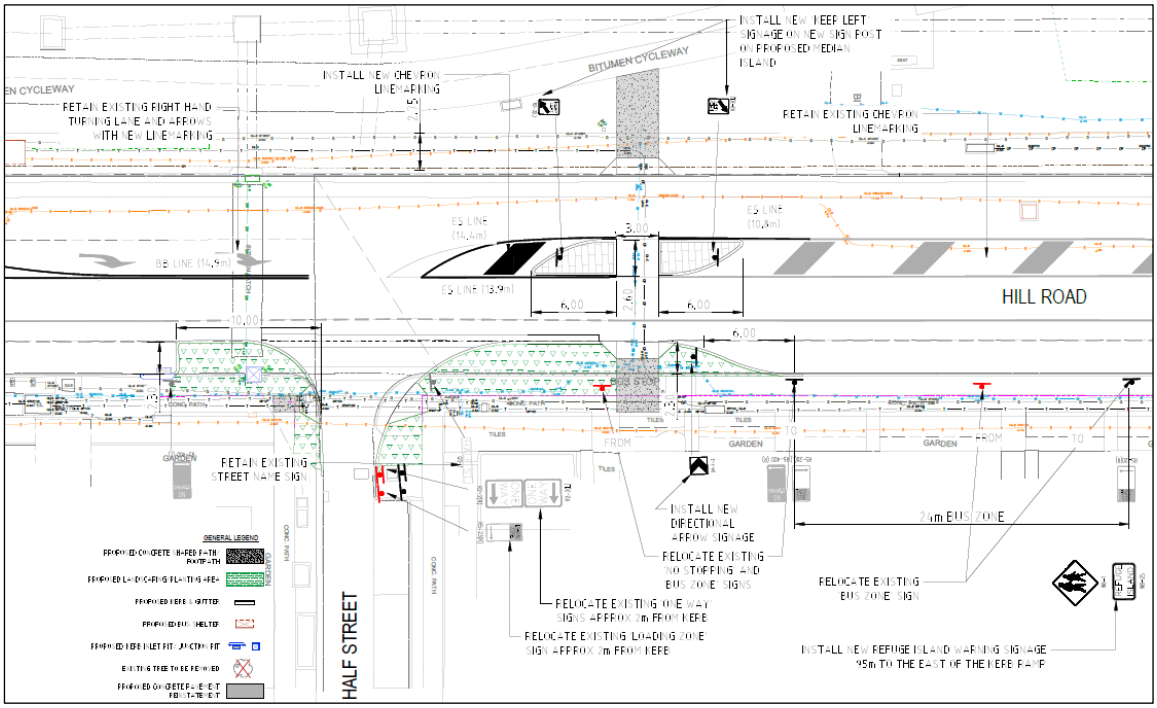


Figure 2: A concept plan of a proposed pedestrian refuge island in Hill Road, Wentworth Point immediately north of Half Street

Proposed pedestrian and cyclist bridge at Haslams Creek on Bennelong Parkway and pedestrian refuge island in Bennelong Parkway at Wentworth Common

Council has appointed BECA to undertake detail design of a new pedestrian and cyclist bridge over Haslams Creek on the east side of Bennelong Parkway. The project includes designing pedestrian and cyclist paths to connect to the west, and a pedestrian and bicycle crossing of Bennelong Parkway at Wentworth Common (subject to Sydney Olympic Park Authority approval).

The bridge detail design has been delayed due to Environmental Impact Statement matters and confirmation of the priority crossing. Once the design has been finalised it will be placed on public exhibition for community feedback. Subject to the results of consultation and reporting to Council, Council would seek external grant funding for construction commencing in the 2024/25 financial year.

Federal Government Funds

The Federal Government has committed $8.5 million for the upgrade of Hill Road, Wentworth Point. It is envisaged that these funds will be utilised to implement various components of the Hill Road Masterplan which include but are not limited to the following:

1. The installation of traffic signals at the intersection of Hill Road and Bennelong Parkway
2. Lighting and street furniture upgrades in Hill Road
3. Stormwater drainage Works
4. Public domain improvements

The relevant federal department has confirmed that the funding will be provided under the Infrastructure Investment Program. At the request of the department, Council has submitted the Project Proposal Report to the Department of Infrastructure including the traffic signal installation at the intersection of Hill Road and Bennelong Parkway.

Drainage upgrades for Hill Road

The Technical Civil Works Design Brief of the Stormwater Masterplan for Hill Road has now been completed. Council staff are currently investigating funding opportunities to engage a consultant to undertake the study for the drainage masterplan. The funding options include either utilising internal Council funds or utilising part of the Federal Government funds for the upgrade of Hill Road.

FINANCIAL IMPLICATIONS

This report only provides an update on the proposed traffic improvements and other proposed works on Hill Road and Bennelong Parkway, Wentworth Point and Sydney Olympic Park. Therefore, this report has no financial impact upon Council's budget.

Behzad Saleh
Acting Traffic and Transport Team Leader
26/10/2023
Attachments – Nil

CITY OF PARRAMATTA COUNCIL

Traffic Engineering Advisory Group Agenda Item

ITEM NO:	2311 B2
SUBJECT:	Darcy Road at Cumberland Highway, Wentworthville – Proposed upgrade of intersection
APPLICANT:	City of Parramatta Council
REPORT OF:	Senior Traffic and Transport Engineer
WARD:	Parramatta
SED:	Winston Hills

Purpose

This report recommends a preferred option to upgrade at the intersection of Darcy Road and Cumberland Highway, Wentworthville to reduce traffic congestion.

OFFICER'S RECOMMENDATION:

1. That Option 1 from the Bitzios Consulting report be the preferred longer-term option to reduce traffic congestion at the intersection of Darcy Road and Cumberland Highway, Wentworthville. This option includes road widening to provide 3 lanes on the eastern approach to the intersection.
2. That the Lord Mayor write to the NSW Minister for Transport and the Secretary TNSW, as previously resolved by Council, with the aim of constructing, as a priority, Option 1.

Background

City of Parramatta Council at its meeting held on 11 September 2023 considered a Lord Mayoral Minute regarding traffic congestion at the intersection of Darcy Road and Cumberland Highway, Wentworthville and resolved:

(a) That Council note the ongoing and worsening traffic congestion issues at the Darcy Road and Cumberland Highway intersection at Westmead;

(b) That the Lord Mayor write to the NSW Minister for Transport and the Secretary, Transport for NSW (TNSW) requesting short-term improvements to alleviate congestion, including an increased length of time for the green phase in Darcy Road at Cumberland Highway for westbound traffic and consideration of other measures to reduce congestion at the intersection;

(c) That Council staff undertake a high-level review of longer-term options to reduce traffic congestion in Darcy Road at Cumberland Highway;

(d) That a report be submitted to the Traffic Engineering Advisory Group in November 2023 and subsequently to Council that identifies longer-term options to reduce traffic congestion in Darcy Road at the Cumberland Highway, for further investigation by TNSW; and

(e) *That, following identification of Council's preferred option, the Lord Mayor write to the NSW Minister for Transport and the Secretary TNSW with the aim of constructing, as a priority, a longer-term option to reduce congestion.*

In accordance with Council's resolution (c) above, Bitzios Consulting was commissioned to undertake traffic modelling using SIDRA for the following four (4) options. Diagrams for each of the options are provided in the attachments.

Option 1:

- Provide one left turn lane, one through lane and one 60m right turn lane on the Darcy Road eastern approach. Note that road widening is needed for this arrangement.
- No changes to existing diamond phase for Darcy Road motorists.

Option 2:

- Provide split phasing for the Darcy Road approaches (currently diamond phasing)
- Provide one left turn slip lane and one shared through/right turn lane on the Darcy Road eastern approach.

Option 3:

- Provide split phasing for the Darcy Road approaches.
- Provide one shared left turn/through lane and one shared through/right turn lane on the Darcy Road east approach.
- Provide an additional 30m departure lane on Darcy Road west of the intersection. Road widening is needed for this arrangement.

Option 4:

- As per Option 3, but also provide one shared left turn/through lane and one shared through/right turn lane on the Darcy Road western approach. Road widening is not needed for this arrangement.

This report presents the findings of the traffic modelling undertaken in accordance with Council's resolution (d) to determine the cost-effective long-term options that would reduce queueing and delays along Darcy Road (westbound) without impacting the performance of the traffic signals at Cumberland Highway.

Location Description

Darcy Road is a regional road under the control of Council and Cumberland Highway is a state road under the control of Transport for NSW (TfNSW). The intersection is controlled by traffic signals. The westbound approach to the intersection provides one right turn lane and one shared straight and left turn lane. This approach experiences extensive traffic congestion and queuing during peak hours. The lane arrangements at the intersection are shown in Figure 1.

Figure 1: Aerial View of the area near the intersection of Darcy Road at Cumberland Highway, Wentworthville

A seven-hour traffic count survey was undertaken at this intersection on Tuesday 29 August 2023 during morning and afternoon hours (6:30-9:30am and 2:30-6:30pm). The summary of traffic movements in Table 1 indicates that the westbound left turn and straight through movements are significantly higher than the right turns.

Table 1: Traffic count data at the intersection of Darcy Road and Cumberland Highway, Wentworthville

Time Period	Westbound traffic in Darcy Road at Cumberland Highway			
	Left Turn	**Through**	**Right Turn**	**Total**
AM Peak: 7:45 – 8:45 (1 Hour)	236	211	69	516
PM Peak: 16:30 – 17:30 (1 Hour)	351	204	94	649
AM total: 6:30 – 9:30 (3 Hours)	**597**	**427**	**140**	1,164
PM total: 14:30 – 18:30 (4 Hours)	**1,199**	**764**	**350**	2,313

Findings from Traffic Modelling

The key findings from the traffic modelling report undertaken by Bitzois Consulting (see attached) on the four options for the intersection of Cumberland Highway and Darcy Road, Wentworthville are:

- *The Darcy Road east approach left turn and through movements are currently operating with average delays of over 3 to 7 minutes per vehicle, and 95th percentile queues of 335m and 691m during AM and PM peaks respectively*

- *Option 1 provides the greatest improvements with Level of Service B/C overall, and significant reductions in average delays by between 69% and 97% per vehicle, and in 95th percentile queues by between 77% and 87% for the Darcy Road east approach left turn and through movements due to having separate lane allocation to each turning movement*
- *The Darcy Road east approach through movement is forecast to have average delays of over 1 to 2 minutes per vehicle under Options 2-4 due to the shared through/right turn lane*
- *The Darcy Road west approach through movement Level of Service is forecast to significantly worsen under Options 2-4, with average delays of over 4 to 13 minutes per vehicle due to the split phasing and lane reduction.*
- *Despite the property impacts envisaged under Option 1, it would provide the greatest benefits to Darcy Road without impacting the performance of the Cumberland Highway. It also retains the current double diamond phasing and provides signal flexibility and greater efficiency compared to split phasing.*

In light of the above, Option 1 - provision of one left, one through and one right turn lane on the eastern approach is the preferred option. Figure 2 shows the proposed layout of the intersection.

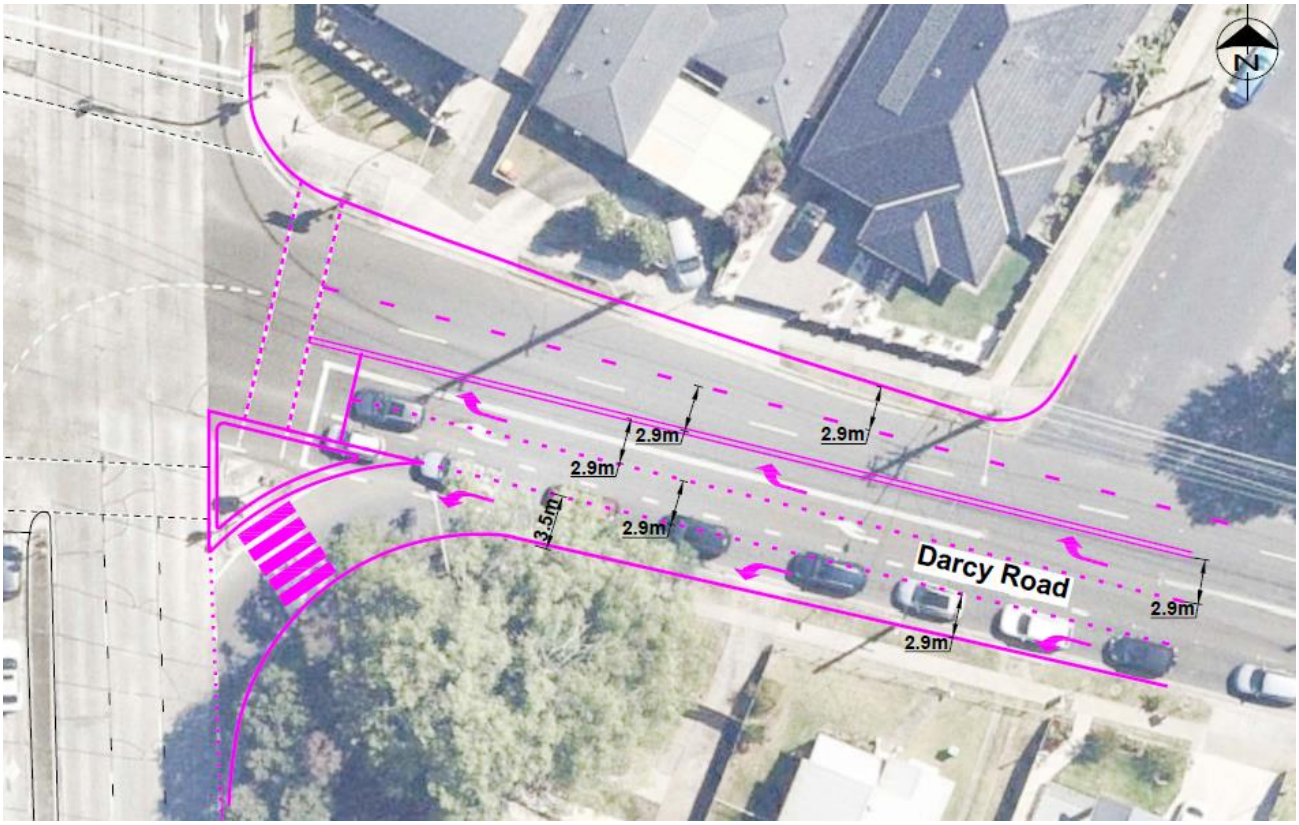


Figure 2: Option 1 concept plan for lane arrangements in Darcy Road (westbound)

Note that the 'diamond phase' in Cumberland Highway may be affected by the proposed changes to line marking in Darcy Road. This could affect the ability for two trucks to simultaneously make the right turns from Cumberland Highway into Darcy Road (northbound and southbound). The specific requirements for the sizes of trucks for simultaneous movement would be set by TfNSW. To meet the TfNSW requirements there may be a need to change the above concept plan. Furthermore, minor property acquisition may be required to ensure adequate footpath widths are provided.

FINANCIAL IMPLICATIONS

This report presents the finding of the traffic modelling study undertaken by Bitzois Consulting to reduce traffic congestion and improve efficiency at the signalised intersection of Darcy Road and Cumberland Highway, Wentworthville. In accordance with Council's resolution, this report is to be forwarded to TfNSW for investigation and reply to Council. As such, this item has no impacts on Council's budgets at this stage.

Iman Mohammadi
Senior Traffic and Transport Engineer
Date: 01/11/2023

Attachments – 1. Traffic Modelling Study Report from Bitzois Consulting

Issue History

File Name	Prepared	Reviewed	Issued	Date	Issued to
P6241.001T Cumberland Hwy-Darcy Rd Upgrade SIDRA Assessment	R. Tuputala / S. Daizli	A. Grey	S. Daizli	27/10/2023	SSharmeen@cityofparramatta.nsw.gov.au

Cumberland Highway / Darcy Road Intersection, Wentworthville

Upgrade SIDRA Assessment

1. Introduction

1.1 Background

The signalised Cumberland Highway/Darcy Road intersection in Wentworthville (TCS 2329) as shown in Figure 1.1 experiences significant queueing and delays at peak times, particularly on the Darcy Road east approach. This queueing is sometimes exacerbated by downstream congestion on the Cumberland Highway towards the Great Western Highway/ M4, however, this congestion is mostly due to the configuration of the east approach.

The Darcy Road east approach includes a dedicated right turn lane that is often under-utilised, and a through lane which has a left turn with care slip lane coming off it. Both movements have higher volumes than the right turn movement. However, in the case that two vehicles are waiting to head straight through (westbound) from the kerbside lane, the left turn slip lane would be blocked, resulting in a long queue. This queue often extends back to and through the Railway Street roundabout and sometimes even further back to the Briens Road roundabout.

Bitzios Consulting has been engaged by City of Parramatta Council (Council) to undertake SIDRA modelling of the intersection to evaluate four proposed upgrade options to reduce queueing and delays along Darcy Road without impacting the performance of the Cumberland Highway while potentially reducing traffic rerouting in peak times via surrounding roads like Bridge Road.

The most recently available five years of crash data in proximity to the intersection was also analysed to ensure that any recommended options would not exacerbate existing safety issues and preferably mitigate them where possible.

This technical note summarises the outcomes of the assessment.

Adapted from Google Maps / Nearmap

Figure 1.1: Cumberland Highway / Darcy Road Intersection

1.2 Upgrade Options

The four proposed upgrade options are described below:

Option 1:

- Provide one left turn lane, one through lane and one 60m right turn lane on the Darcy Road east approach.

Option 2:

- Provide split phasing for the Darcy Road approaches (currently diamond phasing)
- Provide one “Left Turn With Care” slip lane and one shared through/right turn lane on the Darcy Road east approach.

Option 3:

- Provide split phasing for the Darcy Road approaches
- Provide one shared basic left turn/through lane and one shared through/right turn lane on the Darcy Road east approach
- Provide an additional 30m exit lane on the Darcy Road west approach.

Option 4:

- As per Option 3, but also provide one shared left turn/through lane and one shared through/right turn lane on the Darcy Road west approach.

2. Crash Data Analysis

2.1 Overview

The most recent five years of crash data between January 2018 and December 2022 was obtained from Transport for NSW and used to assess the crash history within 150m of the intersection.

Under Rule 287 (3) of the *Road Rules 2014*, crashes are only recorded if they are reported to the police and when:

- Any person is killed or injured
- Drivers involved in the crash do not exchange particulars
- When a vehicle involved in the crash is towed away.

2.2 Annual Crashes and Casualties

Figure 2.1 presents the annual number of crashes and casualties. A total of 17 crashes were recorded, resulting in 12 casualties. There was a peak of 6 crashes and 5 casualties in 2020.

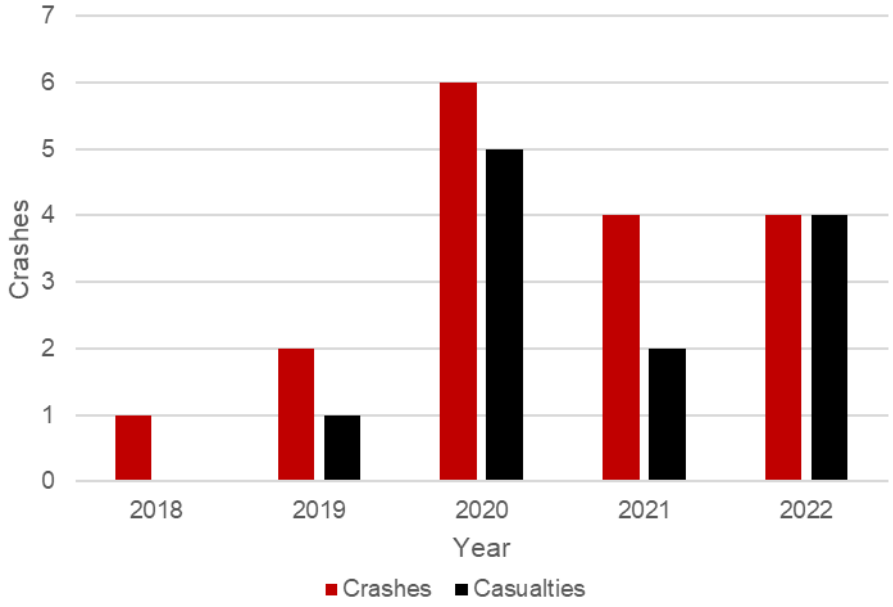


Figure 2.1: Annual Crashes and Casualties (2018-2022)

2.3 Crash Locations

The locations of crashes are presented in Figure 2.2 by degree and Figure 2.3 by type, and show that:

- 1 crash resulted in serious injury (6%)
- 7 crashes resulted in moderate injury (41%)
- 3 crashes resulted in minor injury (18%)
- 6 crashes resulted in a towaway (35%)
- 14 crashes occurred at or near the intersection (82%), including:
  - 6 ‘rear end’ crashes, all of which resulted in injury, including the serious injury
  - 2 ‘adjacent direction’ crashes.

Adapted from NSW_High Resolution Image Service

Figure 2.2: Crash Degree Locations

Adapted from NSW_High Resolution Image Service

Figure 2.3: Crash Type Locations

2.4 Crash Degree

Table 2.1 summarises the number and percentages of crash degrees and casualties. No fatalities were recorded.

Table 2.1: Crash Degree

Crash Degree	Crashes	Percentage	Casualties	Percentage
Fatal	0	0%	0	0%
Serious injury	1	6%	1	8%
Moderate injury	7	41%	8	67%
Minor/Other injury	3	18%	3	25%
Non-casualty (towaway)	6	35%	0	0%

2.5 Crash Type

Table 2.2 summarises the number and percentages of crash types and casualties. The 6 'rear end' crashes (35%) resulted in 6 casualties (50%).

Table 2.2: Crash Type

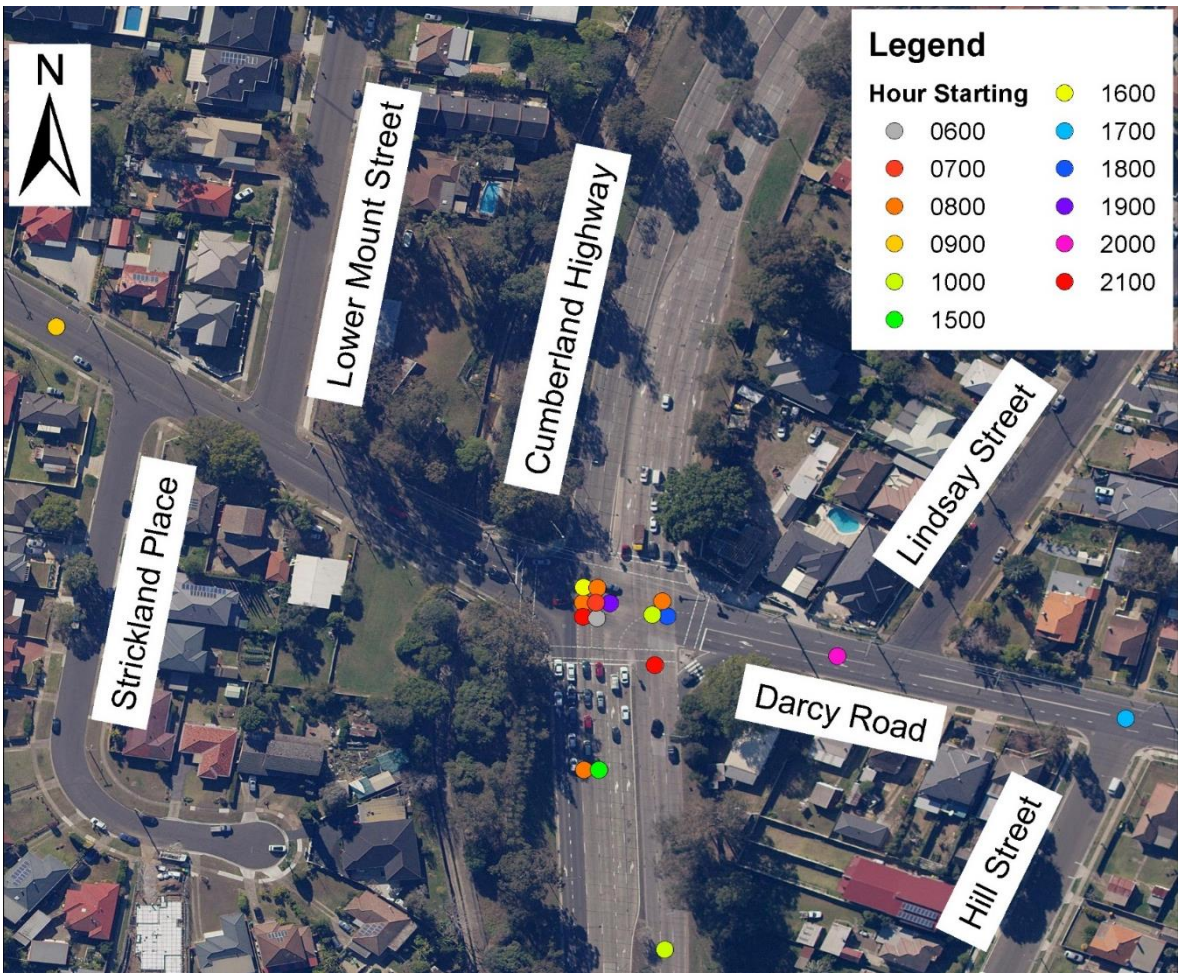
RUM Code	RUM Description	Crashes	Percentage	Casualties	Percentage
10	Cross traffic	1	6%	0	0%
12	Left far	1	6%	2	17%
21	Right through	1	6%	1	8%
30	Rear end	6	35%	6	50%
32	Right rear	1	6%	1	8%
33	Lane sideswipe	1	6%	0	0%
34	Lane change right	1	6%	1	8%
36	Right turn sideswipe	1	6%	0	0%
37	Left turn sideswipe	1	6%	0	0%
39	Other same direction	1	6%	0	0%
71	Left off carriageway into object/parked vehicle	2	12%	1	8%

2.6 Vulnerable Road Users

Vulnerable road users (VRUs) include pedestrians, cyclists and motorcyclists. No crashes involved VRUs.

2.7 Hour of Day

Figure 2.4 presents the locations of crashes by the hour they occurred and Figure 2.5 summarises the number of crashes by hour. They show that most crashes occurred between 8:00-9:00am with 4 crashes (24%), followed by 10:00-11:00am and 9:00-10:00pm with 2 crashes each (12%). All but one of these crashes occurred at or near the intersection.



Adapted from NSW_High Resolution Image Service

Figure 2.4: Crash Hour Locations

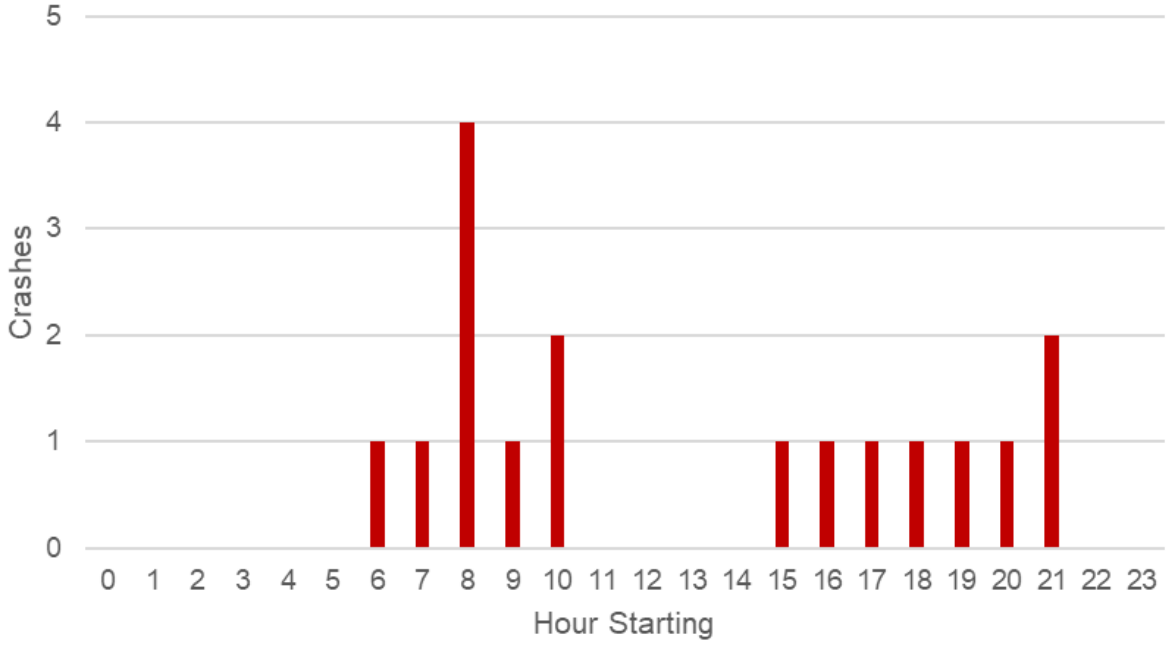


Figure 2.5: Crash Hour

3. Base Model Development

3.1 Geometric Layout

The Cumberland Highway/Darcy Road intersection 2023 Base SIDRA layout is shown in Figure 3.1. All models were developed using SIDRA Intersection 9.1.

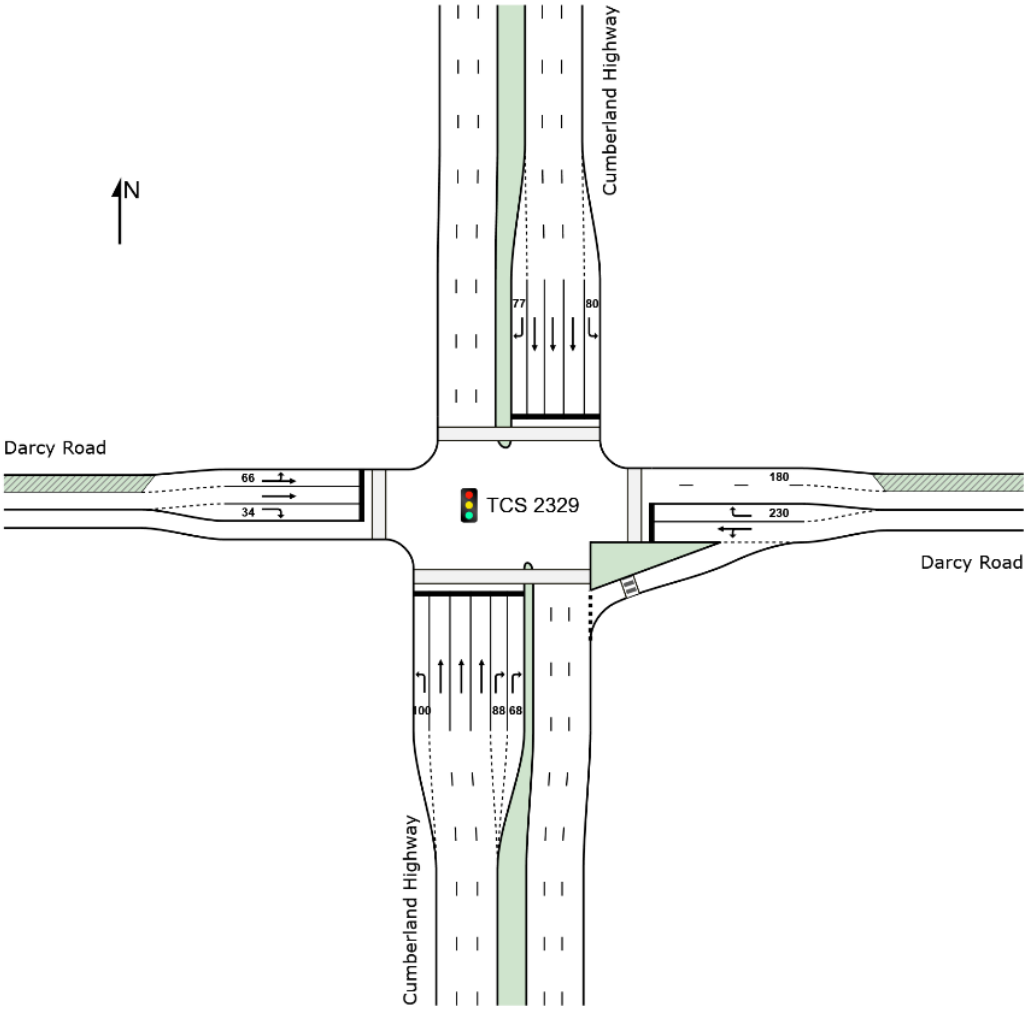


Figure 3.1: Cumberland Highway / Darcy Road 2023 Base SIDRA Layout

3.2 Traffic Surveys

Council provided turn count surveys undertaken by Matrix Traffic and Transport Data on Tuesday, 29 August 2023 between 6:30-9:30am and 2:30-6:30pm. The counts were classified into light vehicles, heavy vehicles, buses and pedestrians, and recorded every 15 minutes.

The AM and PM peak hours identified were 7:30-8:30am and 4:30-5:30pm respectively. The AM and PM peak hour turning volumes are shown in Figure 3.2 and Figure 3.3 respectively.

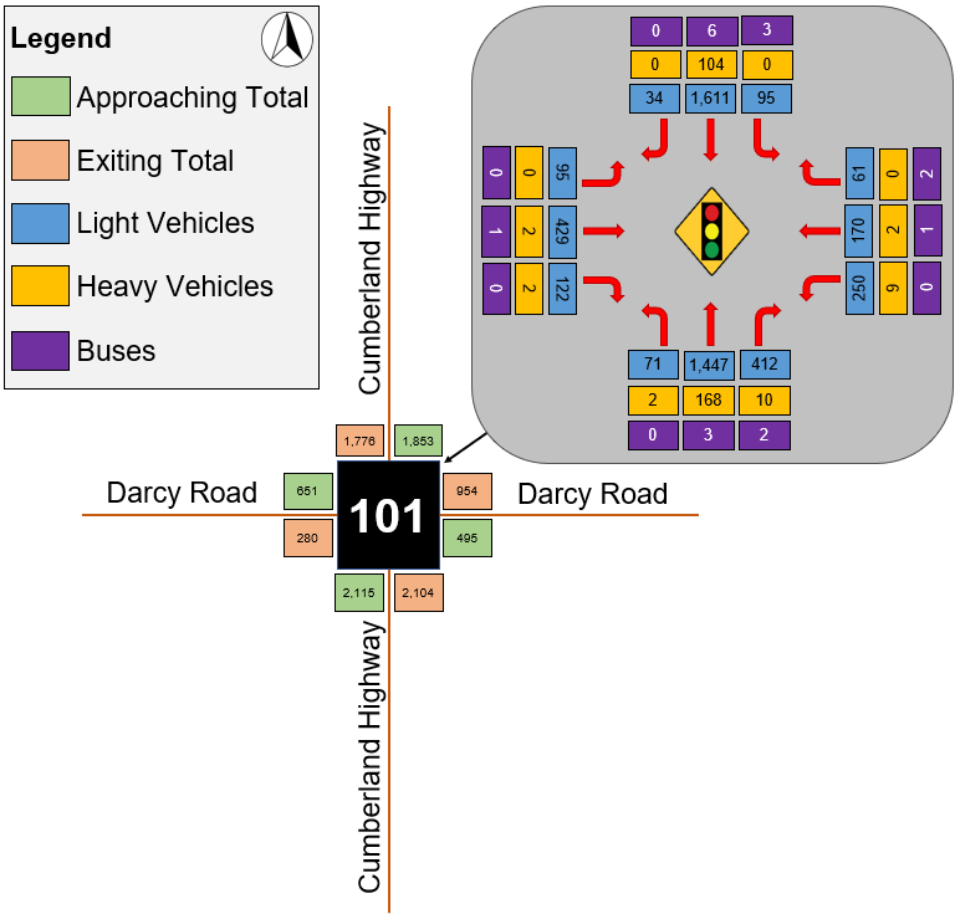


Figure 3.2: **Cumberland Highway / Darcy Road AM Peak Turning Volumes**

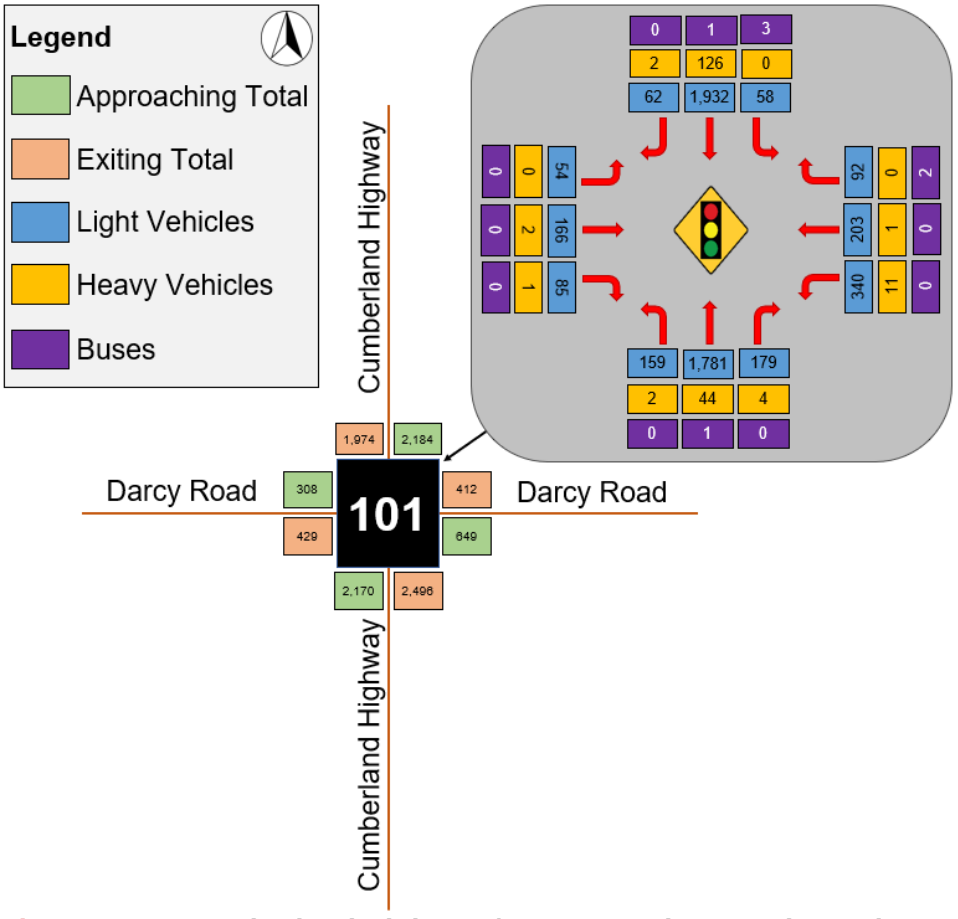
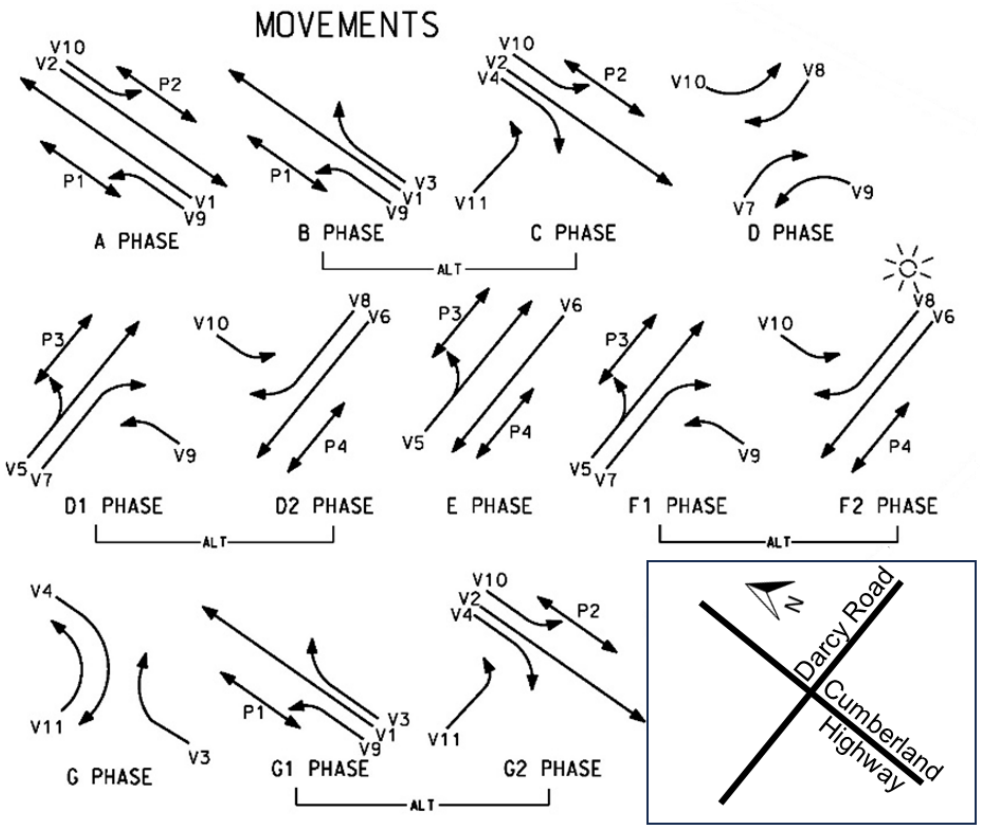


Figure 3.3: **Cumberland Highway / Darcy Road PM Peak Turning Volumes**

3.3 Signal Phasing

The TCS plan was obtained from Transport for NSW to identify the phasing of the intersection as illustrated in Figure 3.4.



Source: Transport for NSW

Figure 3.4: Cumberland Highway / Darcy Road Phase Sequence (TCS 2329)

The AM and PM peak phase sequences modelled were AB*DEG and ADEG respectively.

**A phase frequency of 60% was applied based on site observations.*

3.4 Site Inspections

Site inspections were undertaken on Tuesday, 17 October 2023 during the AM and PM peak hours to:

- Observe existing traffic conditions and driver behaviour
- Observe queueing and congestion
- Record signal phase times for use in the SIDRA models, including intergreen and pedestrian protection
- Record vehicle queue lengths to calibrate and validate the base SIDRA models.

The primary issues were observed on the Darcy Road east approach, including:

- Extensive queues in the left turn/through lane for the majority of both peaks
- Drivers in the right turn lane cutting into the left turn/through lane, particularly those turning out of Lindsay Street. This caused some drivers turning right into the Cumberland Highway north to cross the median to avoid them.

3.5 Calibration and Validation

The base SIDRA models were validated to the observed queue lengths. The acceptable validation error ranges were adopted from the *VicRoads Transport Modelling Guidelines (2020)*, replicated in Table 3.1.

Table 3.1: Observed Queue Validation Targets

Observed Queue Range (m)	Acceptable Validation Error (m)
1-20	±10
21-50	±15
51-100	±20
101-150	±25
151-200	±30
201-250	±35
251-500	±100
501-1000	±150
1000+	±200

Source: VicRoads Transport Modelling Guidelines Volume 5: Intersection Modelling (DRAFT, June 2020), Table 28

The observed and modelled 95th percentile queue lengths during the AM and PM peaks are compared in Table 3.2.

Table 3.2: Base Model 95th Percentile Queue Validation Results

Approach	Turn/s	Observed (m)	Acceptable Queue Range (m)	Modelled (m)	Within Acceptable Range?	Difference if Outside Acceptable Range (m)
AM Peak						
Cumberland Highway (N)	R	24	9-39	16	Yes	-
	T	144	119-169	167	Yes	-
	L	12	2-22	20	Yes	-
Darcy Road (E)	R	30	15-45	32	Yes	-
	L/T	300	200-400	335	Yes	-
Cumberland Highway (S)	R	72	52-92	81	Yes	-
	T	210	175-245	177	Yes	-
	L	24	9-39	14	Yes	-
Darcy Road (W)	R	66	46-86	74	Yes	-
	L/T	138	113-163	162	Yes	-
PM Peak						
Cumberland Highway (N)	R	30	15-45	31	Yes	-
	T	102	77-127	102	Yes	-
	L	6	0-16	12	Yes	-
Darcy Road (E)	R	66	46-86	69	Yes	-
	L/T	612	462-762	691	Yes	-
Cumberland Highway (S)	R	54	34-74	44	Yes	-
	T	54	34-74	73	Yes	-
	L	24	9-39	32	Yes	-
Darcy Road (W)	R	60	40-80	52	Yes	-
	L/T	120	95-145	77	No	18

As shown in the above table, all but one modelled queue are within the acceptable queue range. The maximum range in which this occurs is only three vehicles long and was caused by a short, sharp burst of traffic late in the PM peak.

To meet the queue validation targets, the following parameters were adjusted in the SIDRA models from their default values:

- Area Type Factor: to reflect environmental effects (i.e. pedestrians, parking manoeuvres, tight turns etc.) on saturation flow (queue discharge)
- Lane Utilisation Ratio: to reflect observed lane usage for movements which are allowed across multiple lanes
- Arrival Type Factor: to reflect signal coordination effects.

3.6 2023 Base Performance

The 2023 Base AM and PM peak intersection performance is summarised in Table 3.3. Key observations include that:

- The intersection is currently operating at Level of Service (LoS) D/E and over theoretical capacity (Degree of Saturation (DoS) of 1.00) in both peaks
- In the AM and PM peaks, the Darcy Road east approach left turn and through movements are currently operating with average delays of over 3 to 7 minutes per vehicle, and 95th percentile queues of 335m and 691m respectively.

Table 3.3: Cumberland Highway / Darcy Road 2023 Base Performance

Approach	Turn	Traffic Volume (veh/h)	DoS (v/c)	Average Delay (s)	LoS	95th Percentile Queue (m)
AM Peak						
Cumberland Highway (N)	R	34	0.24	81	F	16
	T	1,721	0.62	20.9	B	167
	L	98	0.09	24.2	B	20
Darcy Road (E)	R	63	0.47	75.6	F	32
	T	173	1.11	185.6	F	335
	L	259	1.11	130.2	F	335
Cumberland Highway (S)	R	424	0.94	64.8	E	81
	T	1,618	0.61	16.7	B	177
	L	73	0.06	18.3	B	14
Darcy Road (W)	R	124	0.95	125.6	F	74
	T	432	0.94	104.8	F	162
	L	95	0.94	80.2	F	162
Intersection		**5,114**	**1.11**	**46.1**	**D**	**335**
PM Peak						
Cumberland Highway (N)	R	64	0.36	74.2	F	31
	T	2,059	0.57	6.6	A	102
	L	61	0.05	18.5	B	12
Darcy Road (E)	R	94	1.07	179.1	F	69
	T	204	1.46	526.3	F	691
	L	351	1.46	458.6	F	691
Cumberland Highway (S)	R	183	0.48	74.9	F	44
	T	1,826	0.46	6.2	A	73
	L	161	0.11	18.4	B	32
Darcy Road (W)	R	86	0.97	116.2	F	52
	T	168	0.64	71.8	F	77
	L	54	0.13	45.6	D	19
Intersection		**5,311**	**1.46**	**67.3**	**E**	**691**

4. Option Scenarios Assessment

4.1 Geometric Layouts

The Cumberland Highway/Darcy Road intersection 2023 Option SIDRA layouts are shown in Figure 4.1.

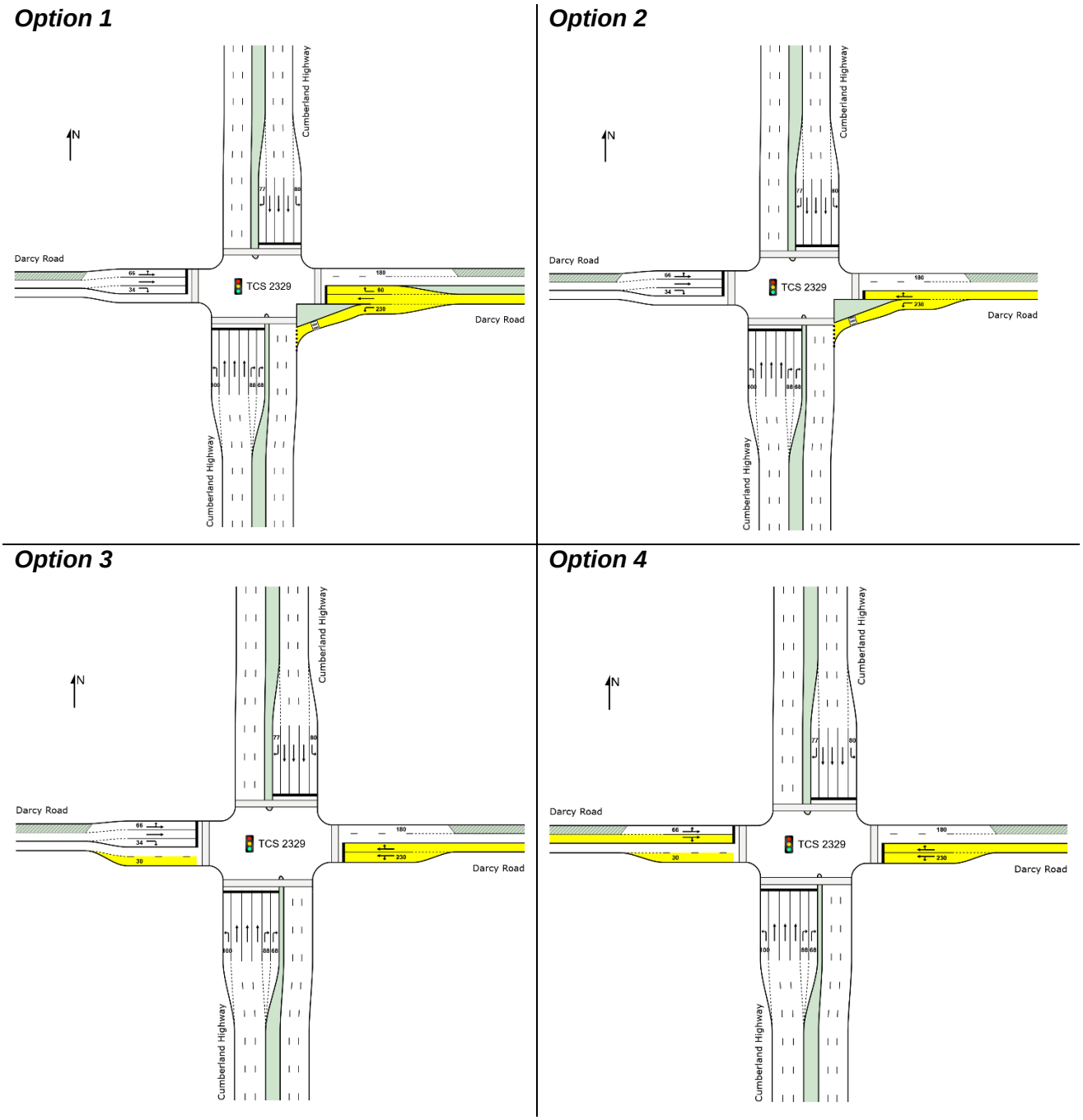


Figure 4.1: Cumberland Highway / Darcy Road 2023 Option SIDRA Layouts

4.2 Signal Phasing

Due to the split phasing proposed in Options 2-4, Phases D and E were reallocated to the Darcy Road west and east approaches respectively. The phase times did not need to be changed.

4.3 2023 Option 1 Performance

The 2023 Option 1 AM and PM peak intersection performance is summarised in Table 4.1. Key observations include:

- The intersection is forecast to operate at LoS B/C
- The intersection is forecast to operate within theoretical capacity in the AM peak
- The Darcy Road east approach left turn and through movements are forecast to significantly improve, with reductions in average delays by between 69% and 97% per vehicle, and in 95th percentile queues by between 77% and 87% due to separate lane allocation to each turning movement.

Table 4.1: Cumberland Highway / Darcy Road 2023 Option 1 Performance

Approach	Turn	Traffic Volume (veh/h)	DoS (v/c)	Average Delay (s)	LoS	95th Percentile Queue (m)
AM Peak						
Cumberland Highway (N)	R	34	0.24	80.7	F	16
	T	1,721	0.62	20.9	B	167
	L	98	0.09	24.2	B	20
Darcy Road (E)	R	63	0.47	75.6	F	32
	T	173	0.52	58.2	E	79
	L	259	0.31	11.9	A	46
Cumberland Highway (S)	R	424	0.94	64.8	E	80
	T	1,618	0.61	16.7	B	177
	L	73	0.06	18.3	B	14
Darcy Road (W)	R	124	0.95	125.6	F	74
	T	432	0.94	104.8	F	162
	L	95	0.94	80.2	F	162
Intersection		**5,114**	**0.95**	**35.8**	**C**	**177**
PM Peak						
Cumberland Highway (N)	R	64	0.36	74.2	F	31
	T	2,059	0.57	6.6	A	102
	L	61	0.05	18.5	B	12
Darcy Road (E)	R	94	1.07	158.2	F	69
	T	204	0.68	61.2	E	94
	L	351	0.49	11.9	A	89
Cumberland Highway (S)	R	183	0.48	75.0	F	44
	T	1,826	0.46	6.2	A	73
	L	161	0.11	18.4	B	32
Darcy Road (W)	R	86	0.97	116.2	F	52
	T	168	0.64	71.8	F	77
	L	54	0.13	45.6	D	19
Intersection		**5,311**	**1.07**	**19.5**	**B**	**102**

4.4 2023 Option 2 Performance

The 2023 Option 2 AM and PM peak intersection performance is summarised in Table 4.2. Key observations include:

- The intersection is forecast to operate at LoS F in the AM peak and over theoretical capacity in both peaks
- The Darcy Road east approach through movement is forecast to have:
  - Average delays of over 1 to 2 minutes per vehicle due to the shared through/right turn lane
  - Reduced 95th percentile queues of up to 70% due to having a separate through lane from the high-volume left turn movement.
- The Darcy Road east approach left turn slip lane is forecast to operate at LoS A and have reduced 95th percentile queues of up to 89% due to having a separate lane from the high-volume through movement
- The Darcy Road west approach through movement LoS is forecast to significantly worsen with average delays of over 4 to 9 minutes per vehicle due to the split phasing.

Table 4.2: Cumberland Highway / Darcy Road 2023 Option 2 Performance

Approach	Turn	Traffic Volume (veh/h)	DoS (v/c)	Average Delay (s)	LoS	95th Percentile Queue (m)
AM Peak						
Cumberland Highway (N)	R	34	0.24	80.7	F	16
	T	1,721	0.62	20.9	B	167
	L	98	0.08	17.9	B	14
Darcy Road (E)	R	63	0.74	67.0	E	115
	T	173	0.74	62.5	E	115
	L	259	0.30	11.3	A	45
Cumberland Highway (S)	R	424	0.94	64.6	E	81
	T	1,618	0.61	16.7	B	177
	L	73	0.06	17.0	B	14
Darcy Road (W)	R	124	0.72	109.4	F	63
	T	432	1.51	557.0	F	369
	L	95	1.51	517.6	F	369
Intersection		**5,114**	**1.51**	**81.6**	**F**	**369**
PM Peak						
Cumberland Highway (N)	R	64	0.36	74.2	F	31
	T	2,059	0.57	6.6	A	102
	L	61	0.04	11.2	A	5
Darcy Road (E)	R	94	1.03	130.4	F	206
	T	204	1.03	125.8	F	206
	L	351	0.46	10.7	A	77
Cumberland Highway (S)	R	183	0.48	74.9	F	44
	T	1,826	0.46	6.2	A	73
	L	161	0.10	16.7	B	29
Darcy Road (W)	R	86	0.62	93.0	F	42
	T	168	1.22	295.4	F	162
	L	54	0.20	39.8	C	17
Intersection		**5,311**	**1.22**	**27.9**	**B**	**206**

4.5 2023 Option 3 Performance

The 2023 Option 3 AM and PM peak intersection performance is summarised in Table 4.3. Key observations include:

- The intersection is forecast to operate at LoS F in the AM peak and over theoretical capacity in both peaks
- The Darcy Road east approach through movement is forecast to have:
  - Average delays of over 1 to 2 minutes per vehicle due to the shared through/right turn lane
  - Reduced 95th percentile queues of up to 70% due to two lane allocation to the through movement
- The Darcy Road east approach signalised left turn will result in LoS C/E
- The Darcy Road west approach through movement LoS is forecast to significantly worsen with average delays of over 4 to 9 minutes per vehicle due to the split phasing.

Table 4.3: Cumberland Highway / Darcy Road 2023 Option 3 Performance

Approach	Turn	Traffic Volume (veh/h)	DoS (v/c)	Average Delay (s)	LoS	95th Percentile Queue (m)
AM Peak						
Cumberland Highway (N)	R	34	0.24	80.7	F	16
	T	1,721	0.62	20.9	B	167
	L	98	0.08	17.9	B	14
Darcy Road (E)	R	63	0.74	67.0	E	115
	T	173	0.74	62.5	E	115
	L	259	0.43	36.2	C	78
Cumberland Highway (S)	R	424	0.94	64.6	E	81
	T	1,618	0.61	16.7	B	177
	L	73	0.06	17.4	B	14
Darcy Road (W)	R	124	0.72	109.4	F	63
	T	432	1.51	557.0	F	369
	L	95	1.51	517.6	F	369
Intersection		**5,114**	**1.51**	**82.9**	**F**	**369**
PM Peak						
Cumberland Highway (N)	R	64	0.36	74.2	F	31
	T	2,059	0.57	6.6	A	102
	L	61	0.04	11.2	A	5
Darcy Road (E)	R	94	1.03	130.4	F	206
	T	204	1.03	125.8	F	206
	L	351	0.86	63.8	E	169
Cumberland Highway (S)	R	183	0.48	74.9	F	44
	T	1,826	0.46	6.2	A	73
	L	161	0.10	17.2	B	29
Darcy Road (W)	R	86	0.62	93.0	F	42
	T	168	1.22	295.4	F	162
	L	54	0.20	39.8	C	17

Approach	Turn	Traffic Volume (veh/h)	DoS (v/c)	Average Delay (s)	LoS	95th Percentile Queue (m)
Intersection		**5,311**	**1.22**	**31.4**	**C**	**206**

4.6 2023 Option 4 Performance

The 2023 Option 4 AM and PM peak intersection performance is summarised in Table 4.4. Key observations include:

- The intersection is forecast to operate at LoS E/F and significantly over theoretical capacity in both peaks
- The Darcy Road east approach through movement is forecast to have:
  - Average delays of over 1 to 2 minutes per vehicle due to the shared through/right turn lane
  - Reduced 95th percentile queues of up to 70% due to having multiple lanes.
- The Darcy Road east approach signalised left turn will result in LoS C/E
- The Darcy Road west approach through movement LoS is forecast to significantly worsen with average delays of over 13 minutes per vehicle due to the split phasing and lane reduction.

Table 4.4: Cumberland Highway / Darcy Road 2023 Option 4 Performance

Approach	Turn	Traffic Volume (veh/h)	DoS (v/c)	Average Delay (s)	LoS	95th Percentile Queue (m)
AM Peak						
Cumberland Highway (N)	R	34	0.24	80.7	F	16
	T	1,721	0.62	20.9	B	167
	L	98	0.08	17.7	B	14
Darcy Road (E)	R	63	0.74	67.0	E	115
	T	173	0.74	62.5	E	115
	L	259	0.43	36.2	C	78
Cumberland Highway (S)	R	424	0.94	64.5	E	81
	T	1,618	0.61	16.7	B	177
	L	73	0.06	17.4	B	14
Darcy Road (W)	R	124	1.78	806.1	F	496
	T	432	1.78	794.1	F	514
	L	95	1.78	763.4	F	514
Intersection		**5,114**	**1.78**	**124.4**	**F**	**514**
PM Peak						
Cumberland Highway (N)	R	64	0.36	74.2	F	31
	T	2,059	0.57	6.6	A	102
	L	61	0.04	11.1	A	5
Darcy Road (E)	R	94	1.03	130.4	F	206
	T	204	1.03	125.8	F	206
	L	351	0.86	63.8	E	169
Cumberland Highway (S)	R	183	0.48	74.8	F	44
	T	1,826	0.46	6.2	A	73
	L	161	0.10	17.2	B	29
Darcy Road (W)	R	86	1.77	822.1	F	395
	T	168	1.77	817.6	F	395
	L	54	0.20	84.8	F	17
Intersection		**5,311**	**1.77**	**60.2**	**E**	**395**

Detailed SIDRA modelling outputs are provided in **Attachment A**.

5. Conclusions

The key findings from the assessment of four proposed upgrade options for the Cumberland Highway/Darcy Road intersection in Wentworthville (TCS 2329) are summarised as follows:

Crash Data Analysis

- A total of 17 crashes were recorded within 150m of the intersection between January 2018 and December 2022, resulting in 12 casualties
- No fatalities were recorded
- No crashes involved pedestrians, cyclists or motorcyclists
- 14 crashes occurred at or near the intersection, including:
  - 6 'rear end' crashes occurred at or near the intersection, all of which resulted in injury (including 1 serious injury) and 6 casualties
  - 2 'adjacent direction' crashes.

SIDRA Modelling

- The Darcy Road east approach left turn and through movements are currently operating with average delays of over 3 to 7 minutes per vehicle, and 95th percentile queues of 335m and 691m during AM and PM peaks respectively
- Option 1 provides the greatest improvements with Level of Service B/C overall, and significant reductions in average delays by between 69% and 97% per vehicle, and in 95th percentile queues by between 77% and 87% for the Darcy Road east approach left turn and through movements due to having separate lane allocation to each turning movement
- The Darcy Road east approach through movement is forecast to have average delays of over 1 to 2 minutes per vehicle under Options 2-4 due to the shared through/right turn lane
- The Darcy Road west approach through movement LoS is forecast to significantly worsen under Options 2-4, with average delays of over 4 to 13 minutes per vehicle due to the split phasing and lane reduction.

Despite the property impacts envisaged under Option 1, it would provide the greatest benefits to Darcy Road without impacting the performance of the Cumberland Highway. It also retains the current double diamond phasing and provides signal flexibility and greater efficiency compared to split phasing.

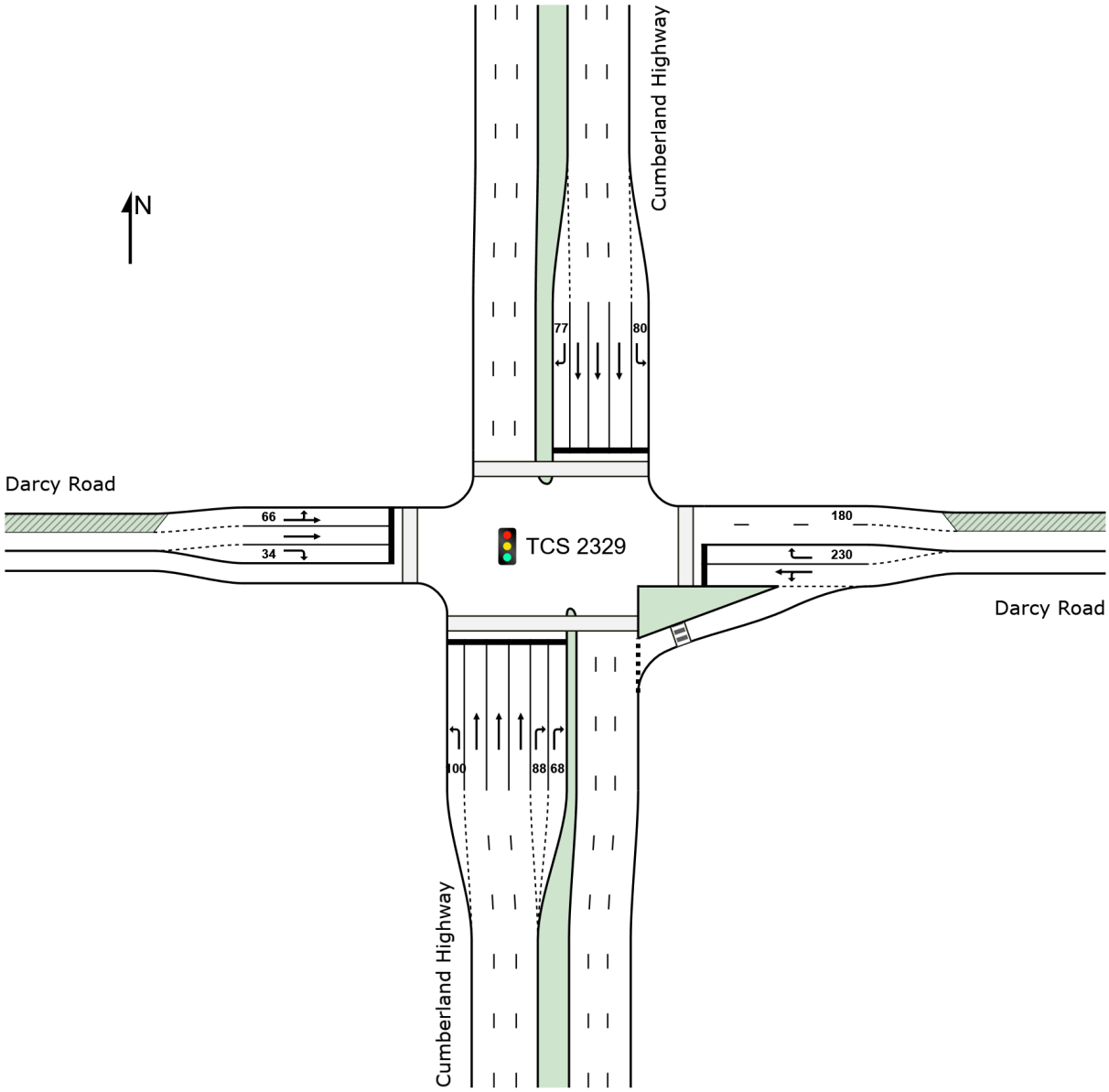
Attachment A: SIDRA Modelling Outputs

SITE LAYOUT

Site: TCS 2329 [AM Peak (Site Folder: 2023 Base)]

0730 - 0830
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Coordinated

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



MOVEMENT SUMMARY

Site: TCS 2329 [AM Peak (Site Folder: 2023 Base)]

Output produced by SIDRA INTERSECTION Version: 9.1.4.221

0730 - 0830
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Coordinated Cycle Time = 143 seconds (Site User-Given Phase Times)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Cumberland Highway															
1	L2	All MCs	73	2.7	73	2.7	0.063	18.3	LOS B	2.0	14.4	0.43	0.69	0.43	41.2
2	T1	All MCs	1618	10.6	1618	10.6	0.610	16.7	LOS B	23.1	176.5	0.57	0.51	0.57	51.1
3	R2	All MCs	424	2.8	424	2.8	*0.940	64.8	LOS E	11.4	81.4	1.00	0.96	1.36	21.3
Approach			2115	8.7	2115	8.7	0.940	26.4	LOS B	23.1	176.5	0.65	0.61	0.73	41.5
East: Darcy Road															
4	L2	All MCs	259	3.5	259	3.5	1.105	130.2	LOS F	46.7	334.8	1.00	1.43	1.85	9.8
5	T1	All MCs	173	1.7	173	1.7	*1.105	185.6	LOS F	46.7	334.8	1.00	1.43	1.85	11.8
6	R2	All MCs	63	3.2	63	3.2	0.468	75.6	LOS F	4.4	31.6	1.00	0.76	1.00	22.4
Approach			495	2.8	495	2.8	1.105	142.6	LOS F	46.7	334.8	1.00	1.34	1.74	11.5
North: Cumberland Highway															
7	L2	All MCs	98	3.1	98	3.1	0.092	24.2	LOS B	2.7	19.6	0.58	0.72	0.58	41.6
8	T1	All MCs	1721	6.4	1721	6.4	*0.616	20.9	LOS B	22.6	167.1	0.61	0.54	0.61	48.9
9	R2	All MCs	34	0.0	34	0.0	0.235	80.7	LOS F	2.3	16.3	0.99	0.72	0.99	25.9
Approach			1853	6.1	1853	6.1	0.616	22.2	LOS B	22.6	167.1	0.61	0.55	0.61	46.0
West: Darcy Road															
10	L2	All MCs	95	0.0	95	0.0	*0.942	80.2	LOS F	23.1	162.2	1.00	1.08	1.35	24.7
11	T1	All MCs	432	0.7	432	0.7	0.942	104.8	LOS F	23.1	162.2	1.00	1.12	1.37	19.8
12	R2	All MCs	124	1.6	124	1.6	*0.948	125.6	LOS F	10.4	73.9	1.00	1.09	1.49	19.7
Approach			651	0.8	651	0.8	0.948	105.2	LOS F	23.1	162.2	1.00	1.11	1.39	18.3
All Vehicles			5114	6.2	5114	6.2	1.105	46.1	LOS D	46.7	334.8	0.72	0.72	0.87	30.9

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Green.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance

Mov ID	Crossing	Input Vol. ped/h	Dem. Flow ped/h	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Ped ped	Dist] m	Prop. Que	Eff. Stop Rate	Travel Time sec	Travel Dist. m	Aver. Speed m/sec
South: Cumberland Highway												
P1	Full	7	7	65.6	LOS F	0.0	0.0	0.96	0.96	232.3	200.0	0.86
East: Darcy Road												

P2	Full	1	1	65.6	LOS F	0.0	0.0	0.96	0.96	232.3	200.0	0.86
North: Cumberland Highway												
P3	Full	14	14	65.7	LOS F	0.1	0.1	0.96	0.96	232.3	200.0	0.86
West: Darcy Road												
P4	Full	1	1	65.6	LOS F	0.0	0.0	0.96	0.96	232.3	200.0	0.86
All Pedestrians		23	23	65.7	LOS F	0.1	0.1	0.96	0.96	232.3	200.0	0.86

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

PHASING SUMMARY

Site: TCS 2329 [AM Peak (Site Folder: 2023 Base)]

Output produced by SIDRA INTERSECTION Version: 9.1.4.221

0730 - 0830
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Coordinated Cycle Time = 143 seconds (Site User-Given Phase Times)

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

Phase Timing Summary

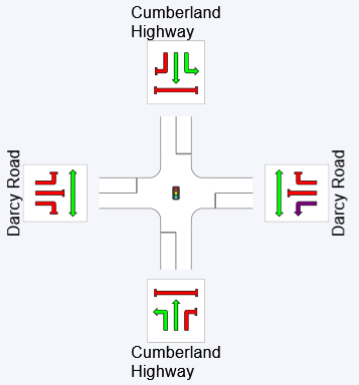
Phase	A	B	D	E	G
Phase Change Time (sec)	0	64	79	94	127
Green Time (sec)	57	8	11	25	9
Phase Time (sec)	64	12	19	32	16
Phase Split	45%	8%	13%	22%	11%
Phase Frequency (%)	100.0	60.0[1]	100.0	91.4[2]	100.0

See the Timing Analysis 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, Minor Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

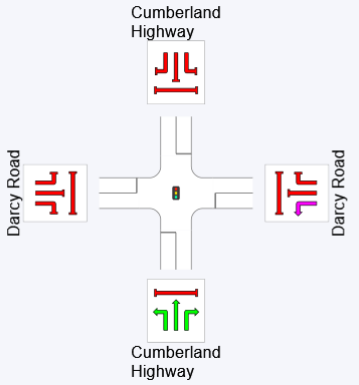
1 Phase Frequency has been given with User-Specified Phase Times.
2 Phase Frequency is implied by a Phase Time specified by the user that is less than the Required Movement Time.

Output Phase Sequence

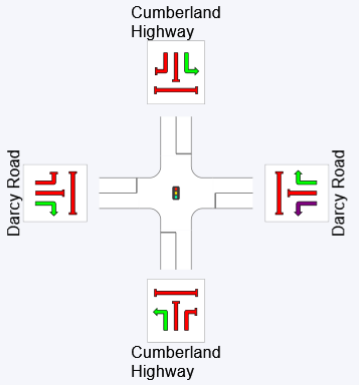
Phase A **REF**



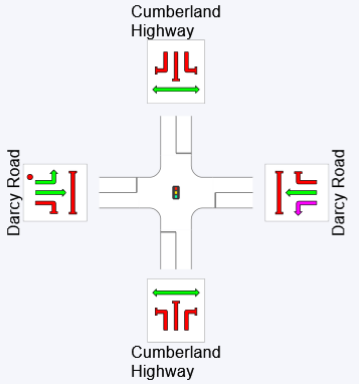
Phase B



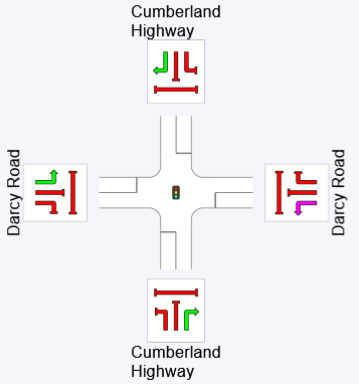
Phase D



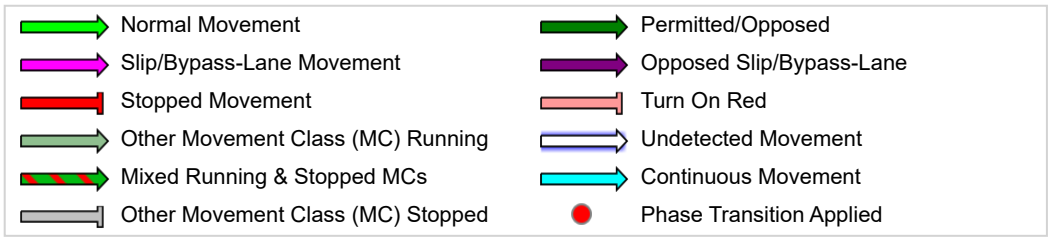
Phase E



Phase G



REF: Reference Phase
VAR: Variable Phase



MOVEMENT SUMMARY

Site: TCS 2329 [PM Peak (Site Folder: 2023 Base)]

Output produced by SIDRA INTERSECTION Version: 9.1.4.221

1630 - 1730
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Coordinated Cycle Time = 140 seconds (Site User-Given Phase Times)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Cumberland Highway															
1	L2	All MCs	161	1.2	161	1.2	0.108	18.4	LOS B	4.5	31.6	0.45	0.71	0.45	41.1
2	T1	All MCs	1826	2.5	1826	2.5	0.455	6.2	LOS A	10.2	72.8	0.27	0.24	0.27	61.2
3	R2	All MCs	183	2.2	183	2.2	*0.480	74.9	LOS F	6.2	44.4	1.00	0.77	1.00	19.1
Approach			2170	2.4	2170	2.4	0.480	12.9	LOS A	10.2	72.8	0.35	0.32	0.35	52.2
East: Darcy Road															
4	L2	All MCs	351	3.1	351	3.1	1.464	458.6	LOS F	96.9	691.1	1.00	2.07	3.11	4.1
5	T1	All MCs	204	0.5	204	0.5	*1.464	526.3	LOS F	96.9	691.1	1.00	2.07	3.11	5.1
6	R2	All MCs	94	2.1	94	2.1	*1.066	179.1	LOS F	9.7	68.8	1.00	1.22	1.91	13.4
Approach			649	2.2	649	2.2	1.464	439.4	LOS F	96.9	691.1	1.00	1.95	2.94	4.9
North: Cumberland Highway															
7	L2	All MCs	61	4.9	61	4.9	0.045	18.5	LOS B	1.6	11.8	0.42	0.68	0.42	42.9
8	T1	All MCs	2059	6.2	2059	6.2	*0.571	6.6	LOS A	13.9	102.1	0.32	0.29	0.32	60.8
9	R2	All MCs	64	3.1	64	3.1	0.362	74.2	LOS F	4.3	30.6	0.99	0.75	0.99	26.5
Approach			2184	6.0	2184	6.0	0.571	8.9	LOS A	13.9	102.1	0.35	0.32	0.35	57.5
West: Darcy Road															
10	L2	All MCs	54	0.0	54	0.0	0.133	45.6	LOS D	2.8	19.4	0.83	0.72	0.83	32.7
11	T1	All MCs	168	1.2	168	1.2	0.638	71.8	LOS F	10.9	77.2	0.99	0.81	0.99	24.1
12	R2	All MCs	86	1.2	86	1.2	0.974	116.2	LOS F	7.4	52.1	1.00	1.08	1.63	18.9
Approach			308	1.0	308	1.0	0.974	79.6	LOS F	10.9	77.2	0.96	0.87	1.14	21.9
All Vehicles			5311	3.8	5311	3.8	1.464	67.3	LOS E	96.9	691.1	0.46	0.55	0.71	25.6

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Green.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance

Mov ID	Crossing	Input Vol. ped/h	Dem. Flow ped/h	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Ped ped	Dist] m	Prop. Que	Eff. Stop Rate	Travel Time sec	Travel Dist. m	Aver. Speed m/sec
South: Cumberland Highway												
P1	Full	16	16	64.2	LOS F	0.1	0.1	0.96	0.96	230.8	200.0	0.87
East: Darcy Road												

P2	Full	1	1	64.1	LOS F	0.0	0.0	0.96	0.96	230.8	200.0	0.87
North: Cumberland Highway												
P3	Full	8	8	64.1	LOS F	0.0	0.0	0.96	0.96	230.8	200.0	0.87
West: Darcy Road												
P4	Full	1	1	64.1	LOS F	0.0	0.0	0.96	0.96	230.8	200.0	0.87
All Pedestrians		26	26	64.2	LOS F	0.1	0.1	0.96	0.96	230.8	200.0	0.87

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

PHASING SUMMARY

Site: TCS 2329 [PM Peak (Site Folder: 2023 Base)]

Output produced by SIDRA INTERSECTION Version: 9.1.4.221

1630 - 1730
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Coordinated Cycle Time = 140 seconds (Site User-Given Phase Times)

Timings based on settings in the Site Phasing & Timing dialog
Phase Times specified by the user
Phase Sequence: Variable Phasing
Input Phase Sequence: A, D, E, G
Output Phase Sequence: A, D, E, G
Reference Phase: Phase A

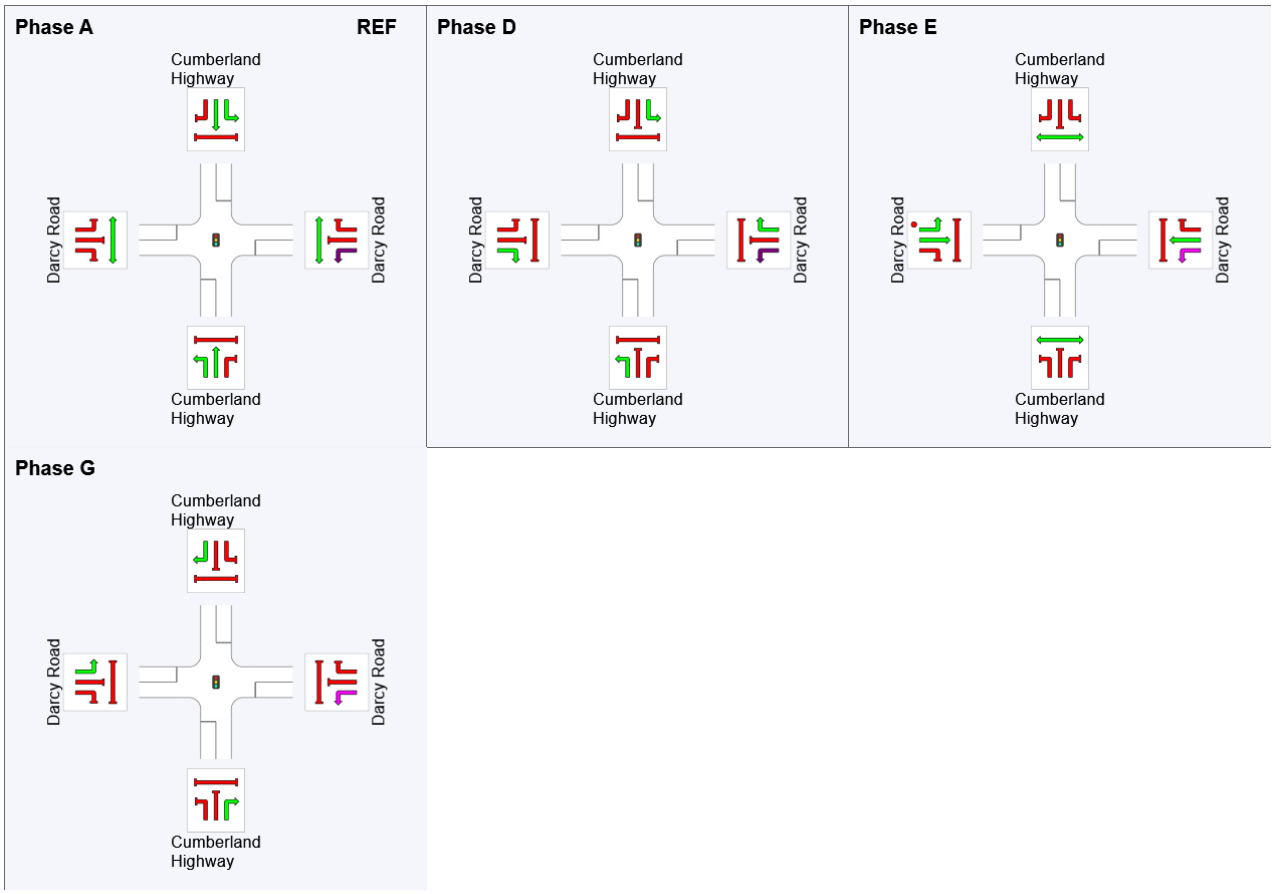
Phase Timing Summary

Phase	A	D	E	G
Phase Change Time (sec)	0	78	92	122
Green Time (sec)	71	7	22	11
Phase Time (sec)	78	15	29	18
Phase Split	56%	11%	21%	13%
Phase Frequency (%)	100.0	100.0	82.9[2]	100.0

See the Timing Analysis 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, Minor Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

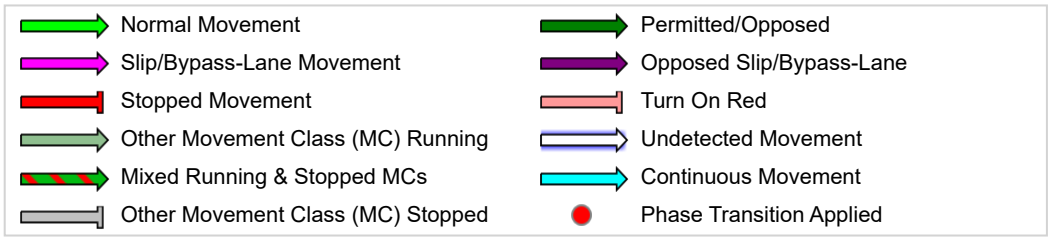
2 Phase Frequency is implied by a Phase Time specified by the user that is less than the Required Movement Time.

Output Phase Sequence



REF: Reference Phase

VAR: Variable Phase

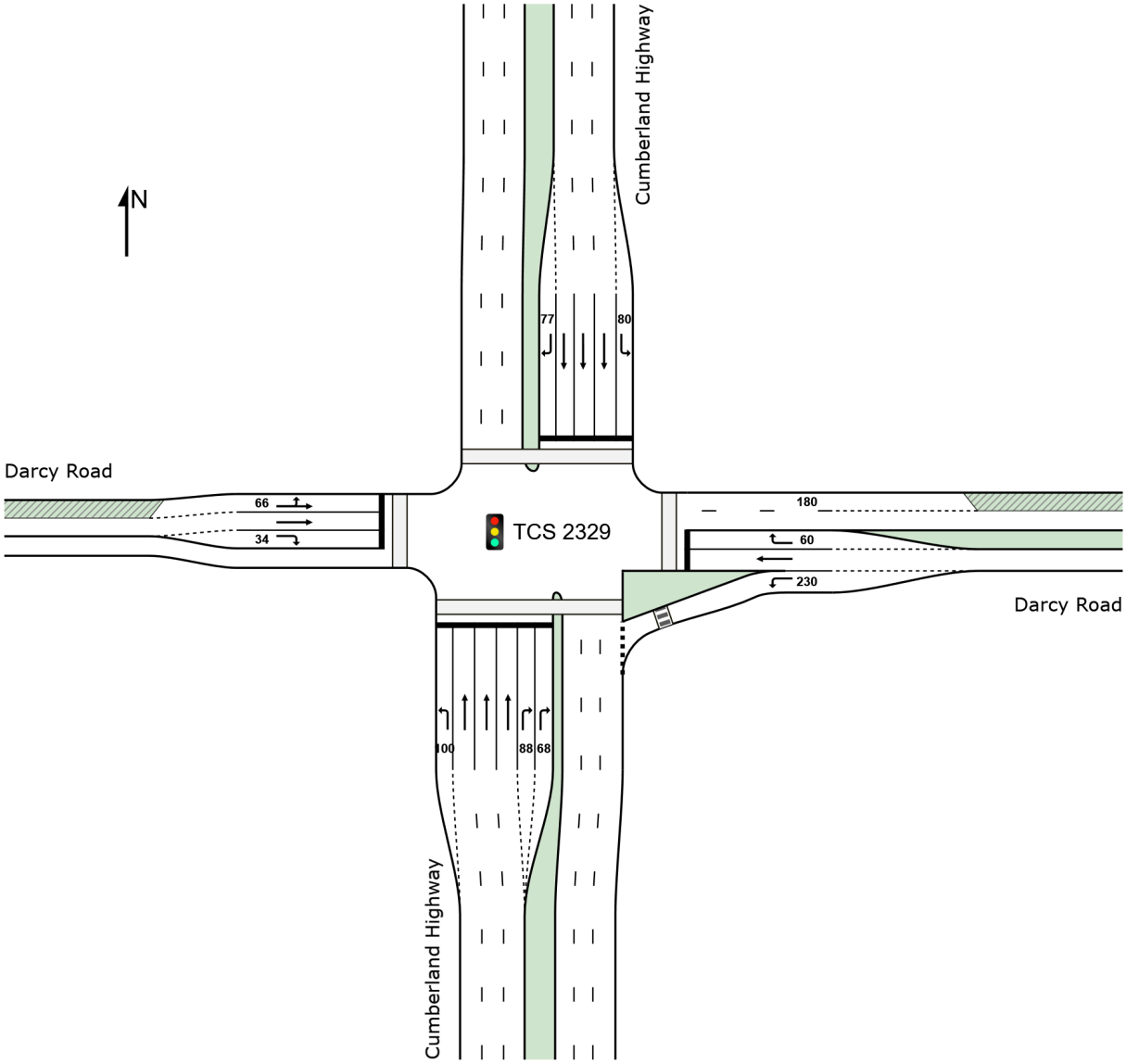


SITE LAYOUT

Site: TCS 2329 [AM Peak (Site Folder: 2023 Option 1)]

0730 - 0830
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Coordinated

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



MOVEMENT SUMMARY

Site: TCS 2329 [AM Peak (Site Folder: 2023 Option 1)]

Output produced by SIDRA INTERSECTION Version: 9.1.4.221

0730 - 0830
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Coordinated Cycle Time = 143 seconds (Site User-Given Phase Times)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Cumberland Highway															
1	L2	All MCs	73	2.7	73	2.7	0.063	18.3	LOS B	2.0	14.4	0.43	0.69	0.43	41.2
2	T1	All MCs	1618	10.6	1618	10.6	0.610	16.7	LOS B	23.1	176.5	0.57	0.51	0.57	51.1
3	R2	All MCs	424	2.8	424	2.8	*0.935	64.8	LOS E	11.2	80.0	1.00	0.97	1.36	21.3
Approach			2115	8.7	2115	8.7	0.935	26.4	LOS B	23.1	176.5	0.65	0.61	0.73	41.6
East: Darcy Road															
4	L2	All MCs	259	3.5	259	3.5	0.306	11.9	LOS A	6.4	46.3	0.45	0.66	0.45	41.5
5	T1	All MCs	173	1.7	173	1.7	0.521	58.2	LOS E	11.1	78.6	0.96	0.79	0.96	24.5
6	R2	All MCs	63	3.2	63	3.2	0.468	75.6	LOS F	4.4	31.6	1.00	0.76	1.00	22.4
Approach			495	2.8	495	2.8	0.521	36.2	LOS C	11.1	78.6	0.70	0.72	0.70	29.7
North: Cumberland Highway															
7	L2	All MCs	98	3.1	98	3.1	0.092	24.2	LOS B	2.7	19.6	0.58	0.72	0.58	41.6
8	T1	All MCs	1721	6.4	1721	6.4	*0.616	20.9	LOS B	22.6	167.1	0.61	0.54	0.61	48.9
9	R2	All MCs	34	0.0	34	0.0	0.235	80.7	LOS F	2.3	16.3	0.99	0.72	0.99	25.9
Approach			1853	6.1	1853	6.1	0.616	22.2	LOS B	22.6	167.1	0.61	0.55	0.61	46.0
West: Darcy Road															
10	L2	All MCs	95	0.0	95	0.0	*0.942	80.2	LOS F	23.1	162.2	1.00	1.08	1.35	24.7
11	T1	All MCs	432	0.7	432	0.7	*0.942	104.8	LOS F	23.1	162.2	1.00	1.12	1.37	19.8
12	R2	All MCs	124	1.6	124	1.6	*0.948	125.6	LOS F	10.4	73.9	1.00	1.09	1.49	19.7
Approach			651	0.8	651	0.8	0.948	105.2	LOS F	23.1	162.2	1.00	1.11	1.39	18.3
All Vehicles			5114	6.2	5114	6.2	0.948	35.8	LOS C	23.1	176.5	0.69	0.66	0.77	35.8

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Green.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance

Mov ID	Crossing	Input Vol. ped/h	Dem. Flow ped/h	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Ped ped	Dist] m	Prop. Que	Eff. Stop Rate	Travel Time sec	Travel Dist. m	Aver. Speed m/sec
South: Cumberland Highway												
P1	Full	7	7	65.6	LOS F	0.0	0.0	0.96	0.96	232.3	200.0	0.86
East: Darcy Road												

P2	Full	1	1	65.6	LOS F	0.0	0.0	0.96	0.96	232.3	200.0	0.86
North: Cumberland Highway												
P3	Full	14	14	65.7	LOS F	0.1	0.1	0.96	0.96	232.3	200.0	0.86
West: Darcy Road												
P4	Full	1	1	65.6	LOS F	0.0	0.0	0.96	0.96	232.3	200.0	0.86
All Pedestrians		23	23	65.7	LOS F	0.1	0.1	0.96	0.96	232.3	200.0	0.86

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

PHASING SUMMARY

Site: TCS 2329 [AM Peak (Site Folder: 2023 Option 1)]

Output produced by SIDRA INTERSECTION Version: 9.1.4.221

0730 - 0830
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Coordinated Cycle Time = 143 seconds (Site User-Given Phase Times)

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

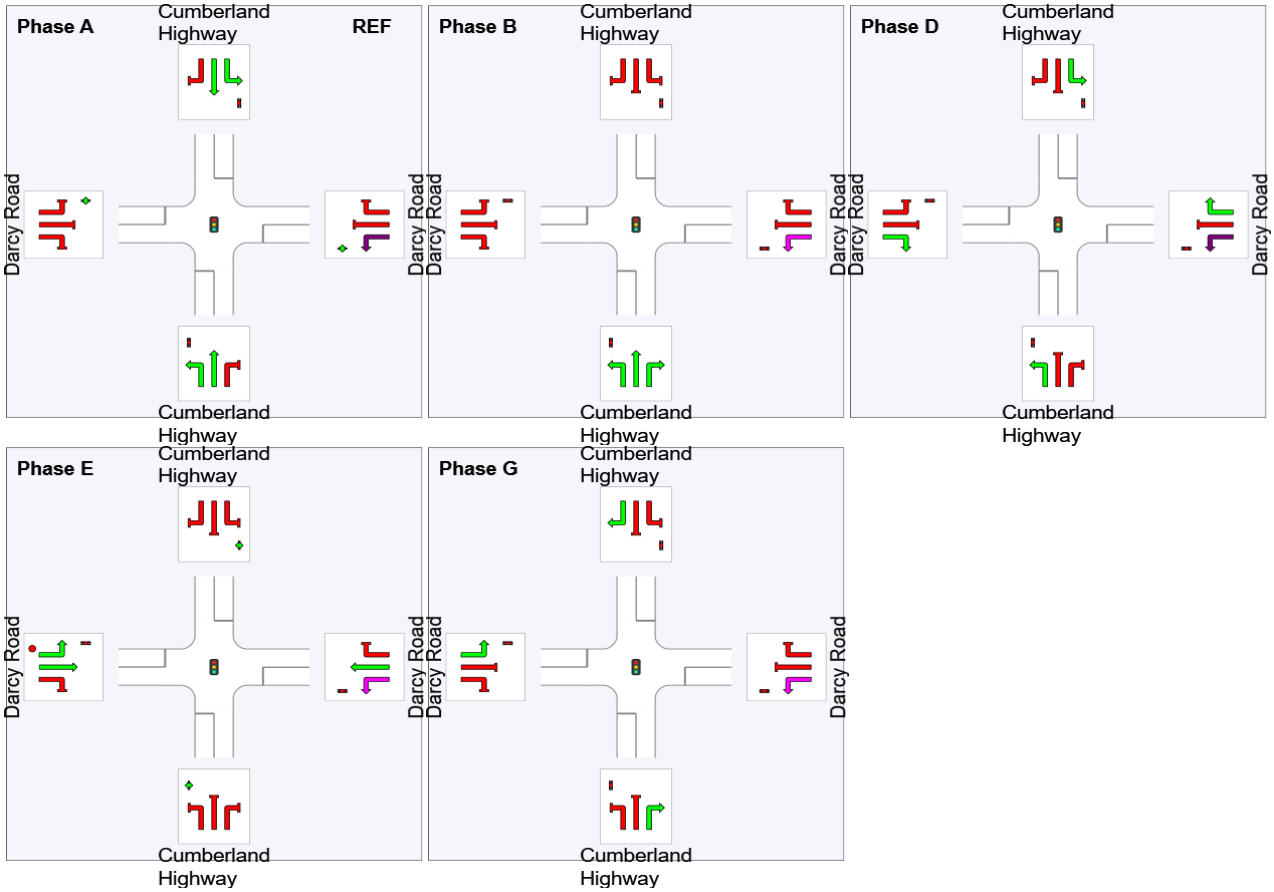
Phase Timing Summary

Phase	A	B	D	E	G
Phase Change Time (sec)	0	64	79	94	127
Green Time (sec)	57	8	11	25	9
Phase Time (sec)	64	12	19	32	16
Phase Split	45%	8%	13%	22%	11%
Phase Frequency (%)	100.0	60.0[1]	100.0	91.4[2]	100.0

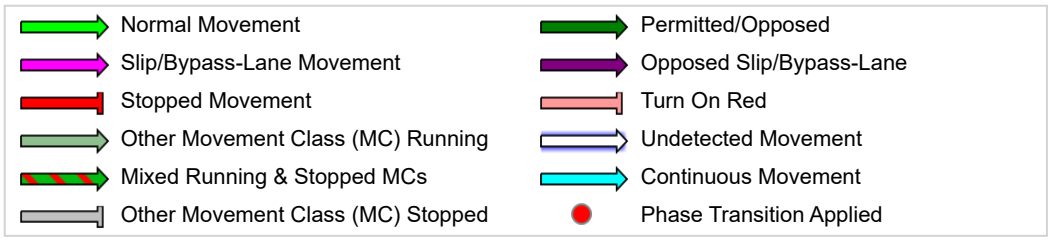
See the Timing Analysis report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Minor Phase Actuation and Phase Frequency values (user-specified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

1 Phase Frequency has been given with User-Specified Phase Times.
2 Phase Frequency is implied by a Phase Time specified by the user that is less than the Required Movement Time.

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase



MOVEMENT SUMMARY

Site: TCS 2329 [PM Peak (Site Folder: 2023 Option 1)]

Output produced by SIDRA INTERSECTION Version: 9.1.4.221

1630 - 1730
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Coordinated Cycle Time = 140 seconds (Site User-Given Phase Times)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Cumberland Highway															
1	L2	All MCs	161	1.2	161	1.2	0.108	18.4	LOS B	4.5	31.6	0.45	0.71	0.45	41.1
2	T1	All MCs	1826	2.5	1826	2.5	0.455	6.2	LOS A	10.2	72.8	0.27	0.24	0.27	61.2
3	R2	All MCs	183	2.2	183	2.2	* 0.478	75.0	LOS F	6.2	44.1	1.00	0.77	1.00	19.2
Approach			2170	2.4	2170	2.4	0.478	12.9	LOS A	10.2	72.8	0.35	0.32	0.35	52.3
East: Darcy Road															
4	L2	All MCs	351	3.1	351	3.1	0.490	11.9	LOS A	12.4	89.3	0.62	0.75	0.62	41.7
5	T1	All MCs	204	0.5	204	0.5	* 0.678	61.2	LOS E	13.4	94.3	1.00	0.84	1.01	23.9
6	R2	All MCs	94	2.1	94	2.1	* 1.066	158.2	LOS F	9.7	68.8	1.00	1.22	1.91	13.4
Approach			649	2.2	649	2.2	1.066	48.6	LOS D	13.4	94.3	0.79	0.85	0.93	25.9
North: Cumberland Highway															
7	L2	All MCs	61	4.9	61	4.9	0.045	18.5	LOS B	1.6	11.8	0.42	0.68	0.42	42.9
8	T1	All MCs	2059	6.2	2059	6.2	* 0.571	6.6	LOS A	13.9	102.1	0.32	0.29	0.32	60.8
9	R2	All MCs	64	3.1	64	3.1	0.362	74.2	LOS F	4.3	30.6	0.99	0.75	0.99	26.5
Approach			2184	6.0	2184	6.0	0.571	8.9	LOS A	13.9	102.1	0.35	0.32	0.35	57.6
West: Darcy Road															
10	L2	All MCs	54	0.0	54	0.0	0.133	45.6	LOS D	2.8	19.4	0.83	0.72	0.83	32.7
11	T1	All MCs	168	1.2	168	1.2	0.638	71.8	LOS F	10.9	77.2	0.99	0.81	0.99	24.1
12	R2	All MCs	86	1.2	86	1.2	0.974	116.2	LOS F	7.4	52.1	1.00	1.08	1.63	18.9
Approach			308	1.0	308	1.0	0.974	79.6	LOS F	10.9	77.2	0.96	0.87	1.14	21.9
All Vehicles			5311	3.8	5311	3.8	1.066	19.5	LOS B	13.9	102.1	0.44	0.41	0.46	45.6

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Green.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance

Mov ID	Crossing	Input Vol. ped/h	Dem. Flow ped/h	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Ped ped	Dist] m	Prop. Que	Eff. Stop Rate	Travel Time sec	Travel Dist. m	Aver. Speed m/sec
South: Cumberland Highway												
P1	Full	16	16	64.2	LOS F	0.1	0.1	0.96	0.96	230.8	200.0	0.87
East: Darcy Road												

P2	Full	1	1	64.1	LOS F	0.0	0.0	0.96	0.96	230.8	200.0	0.87
North: Cumberland Highway												
P3	Full	8	8	64.1	LOS F	0.0	0.0	0.96	0.96	230.8	200.0	0.87
West: Darcy Road												
P4	Full	1	1	64.1	LOS F	0.0	0.0	0.96	0.96	230.8	200.0	0.87
All Pedestrians		26	26	64.2	LOS F	0.1	0.1	0.96	0.96	230.8	200.0	0.87

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

PHASING SUMMARY

Site: TCS 2329 [PM Peak (Site Folder: 2023 Option 1)]

Output produced by SIDRA INTERSECTION Version: 9.1.4.221

1630 - 1730
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Coordinated Cycle Time = 140 seconds (Site User-Given Phase Times)

Timings based on settings in the Site Phasing & Timing dialog
Phase Times specified by the user
Phase Sequence: Variable Phasing
Input Phase Sequence: A, D, E, G
Output Phase Sequence: A, D, E, G
Reference Phase: Phase A

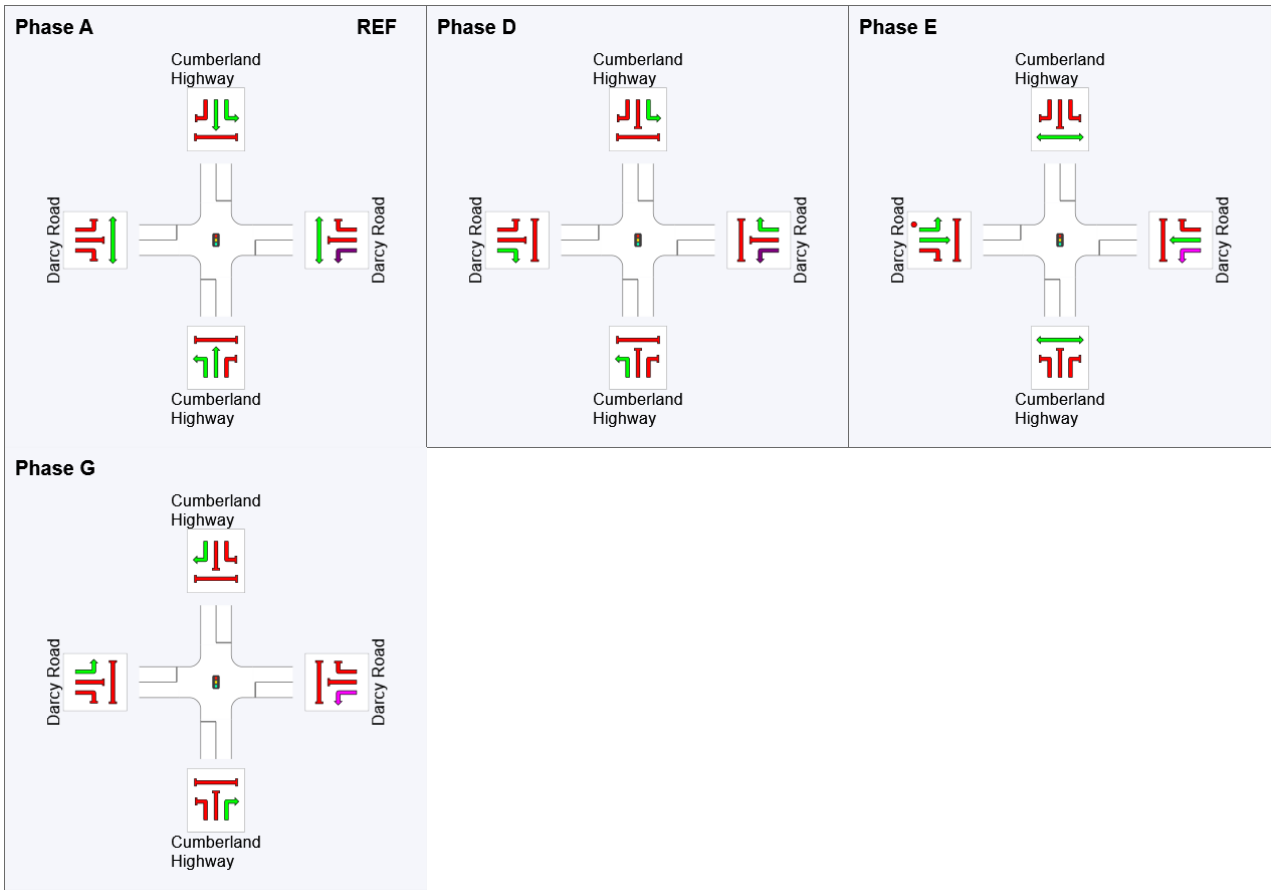
Phase Timing Summary

Phase	A	D	E	G
Phase Change Time (sec)	0	78	92	122
Green Time (sec)	71	7	22	11
Phase Time (sec)	78	15	29	18
Phase Split	56%	11%	21%	13%
Phase Frequency (%)	100.0	100.0	82.9[2]	100.0

See the Timing Analysis 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, Minor Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

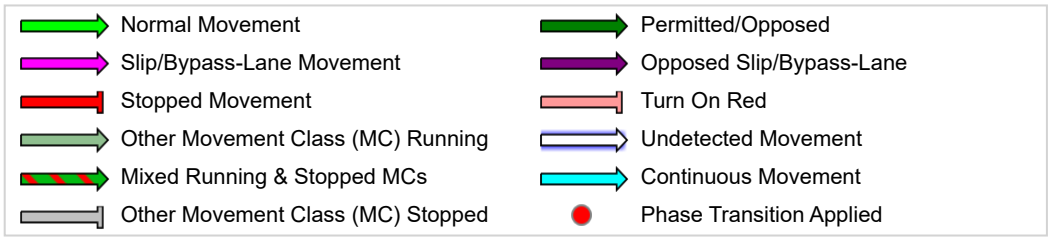
2 Phase Frequency is implied by a Phase Time specified by the user that is less than the Required Movement Time.

Output Phase Sequence



REF: Reference Phase

VAR: Variable Phase

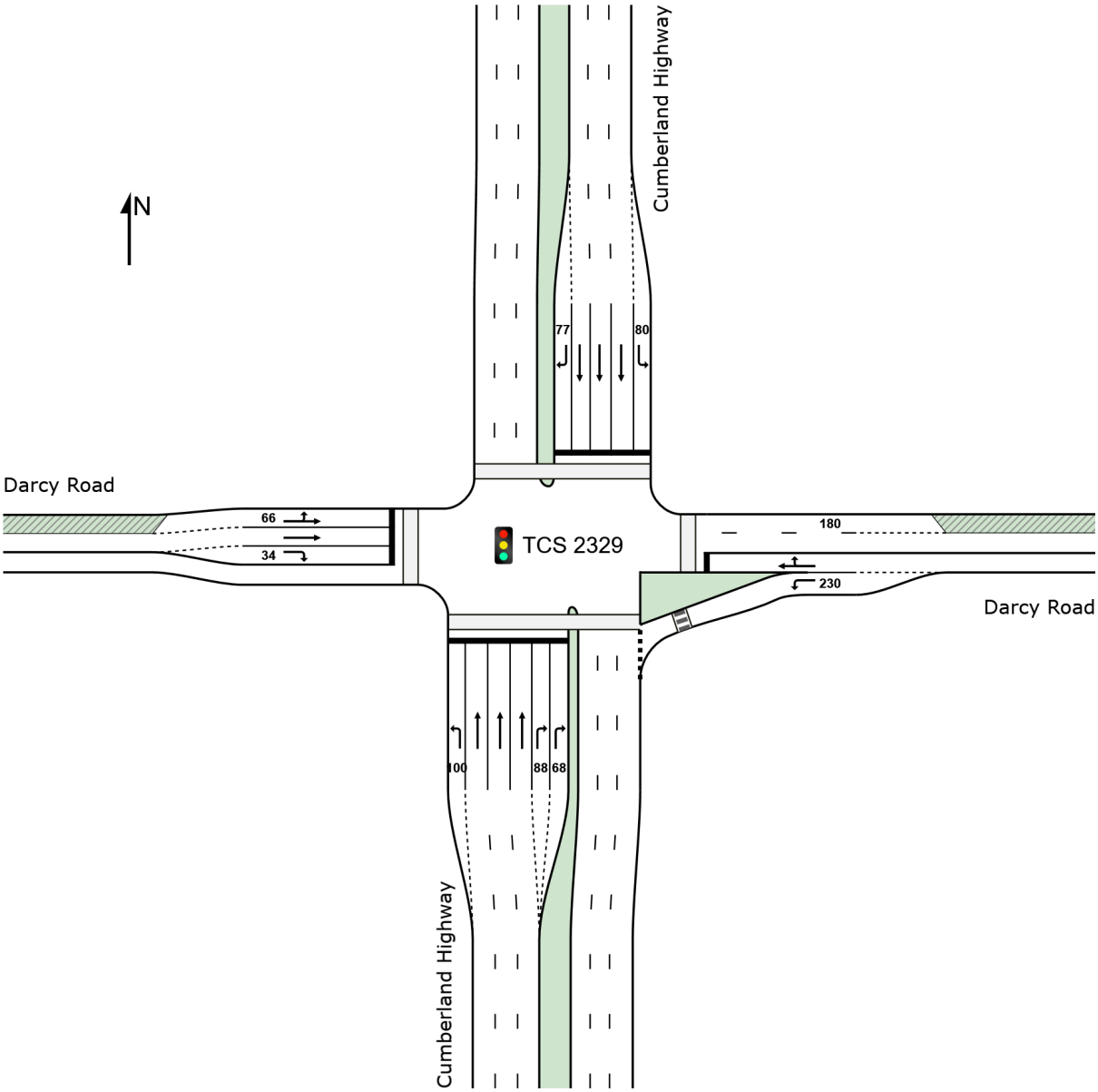


SITE LAYOUT

Site: TCS 2329 [AM Peak (Site Folder: 2023 Option 2)]

0730 - 0830
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Coordinated

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



MOVEMENT SUMMARY

Site: TCS 2329 [AM Peak (Site Folder: 2023 Option 2)]

Output produced by SIDRA INTERSECTION Version: 9.1.4.221

0730 - 0830
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Coordinated Cycle Time = 143 seconds (Site User-Given Phase Times)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Cumberland Highway															
1	L2	All MCs	73	2.7	73	2.7	0.061	17.0	LOS B	1.9	13.6	0.41	0.69	0.41	41.9
2	T1	All MCs	1618	10.6	1618	10.6	0.610	16.7	LOS B	23.1	176.5	0.57	0.51	0.57	51.1
3	R2	All MCs	424	2.8	424	2.8	*0.940	64.6	LOS E	11.4	81.4	1.00	0.96	1.36	21.3
Approach			2115	8.7	2115	8.7	0.940	26.3	LOS B	23.1	176.5	0.65	0.61	0.72	41.5
East: Darcy Road															
4	L2	All MCs	259	3.5	259	3.5	0.295	11.3	LOS A	6.2	44.7	0.41	0.65	0.41	42.0
5	T1	All MCs	173	1.7	173	1.7	*0.738	62.5	LOS E	16.1	115.0	1.00	0.88	1.05	23.4
6	R2	All MCs	63	3.2	63	3.2	0.738	67.0	LOS E	16.1	115.0	1.00	0.88	1.05	24.8
Approach			495	2.8	495	2.8	0.738	36.3	LOS C	16.1	115.0	0.69	0.76	0.71	29.7
North: Cumberland Highway															
7	L2	All MCs	98	3.1	98	3.1	0.076	17.9	LOS B	1.9	13.6	0.47	0.69	0.47	45.6
8	T1	All MCs	1721	6.4	1721	6.4	*0.616	20.9	LOS B	22.6	167.1	0.61	0.54	0.61	48.9
9	R2	All MCs	34	0.0	34	0.0	0.235	80.7	LOS F	2.3	16.3	0.99	0.72	0.99	25.9
Approach			1853	6.1	1853	6.1	0.616	21.8	LOS B	22.6	167.1	0.61	0.55	0.61	46.2
West: Darcy Road															
10	L2	All MCs	95	0.0	95	0.0	*1.508	517.6	LOS F	52.6	369.4	1.00	1.88	3.21	6.1
11	T1	All MCs	432	0.7	432	0.7	*1.508	557.0	LOS F	52.6	369.4	1.00	2.04	3.21	4.7
12	R2	All MCs	124	1.6	124	1.6	0.720	109.4	LOS F	8.9	63.0	1.00	0.86	1.09	22.9
Approach			651	0.8	651	0.8	1.508	466.0	LOS F	52.6	369.4	1.00	1.79	2.81	5.6
All Vehicles			5114	6.2	5114	6.2	1.508	81.6	LOS F	52.6	369.4	0.68	0.75	0.95	22.6

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Green.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance

Mov ID	Crossing	Input Vol. ped/h	Dem. Flow ped/h	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Ped ped	Dist] m	Prop. Que	Eff. Stop Rate	Travel Time sec	Travel Dist. m	Aver. Speed m/sec
South: Cumberland Highway												
P1	Full	7	7	65.6	LOS F	0.0	0.0	0.96	0.96	232.3	200.0	0.86
East: Darcy Road												

P2	Full	1	1	65.6	LOS F	0.0	0.0	0.96	0.96	232.3	200.0	0.86
North: Cumberland Highway												
P3	Full	14	14	65.7	LOS F	0.1	0.1	0.96	0.96	232.3	200.0	0.86
West: Darcy Road												
P4	Full	1	1	65.6	LOS F	0.0	0.0	0.96	0.96	232.3	200.0	0.86
All Pedestrians		23	23	65.7	LOS F	0.1	0.1	0.96	0.96	232.3	200.0	0.86

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

PHASING SUMMARY

Site: TCS 2329 [AM Peak (Site Folder: 2023 Option 2)]

Output produced by SIDRA INTERSECTION Version: 9.1.4.221

0730 - 0830
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Coordinated Cycle Time = 143 seconds (Site User-Given Phase Times)

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

Phase Timing Summary

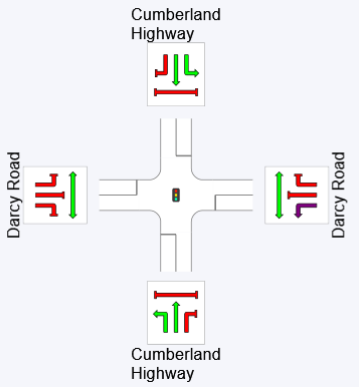
Phase	A	B	D	E	G
Phase Change Time (sec)	0	64	79	97	127
Green Time (sec)	57	8	14	25	9
Phase Time (sec)	64	12	19	32	16
Phase Split	45%	8%	13%	22%	11%
Phase Frequency (%)	100.0	60.0[1]	57.6[2]	91.4[2]	100.0

See the Timing Analysis 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, Minor Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

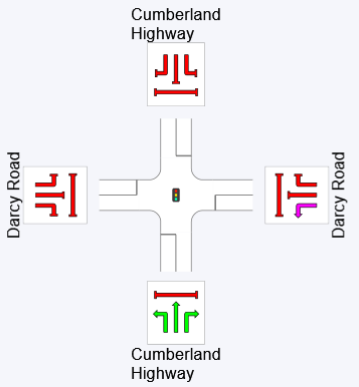
1 Phase Frequency has been given with User-Specified Phase Times.
2 Phase Frequency is implied by a Phase Time specified by the user that is less than the Required Movement Time.

Output Phase Sequence

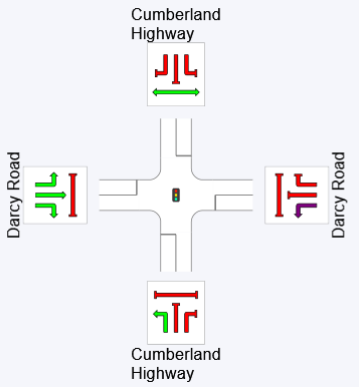
Phase A **REF**



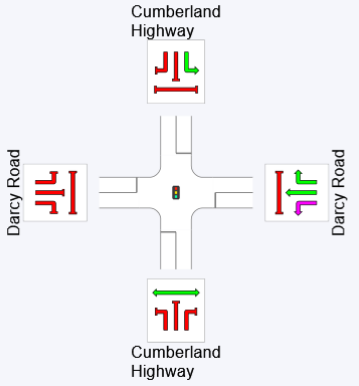
Phase B



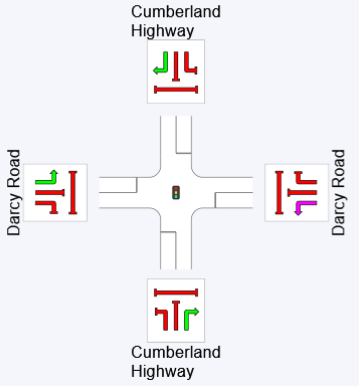
Phase D



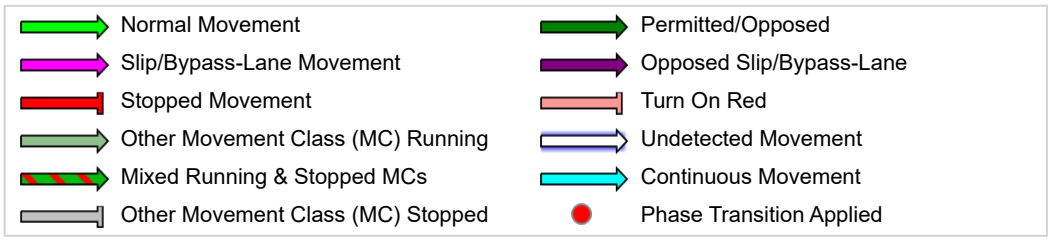
Phase E



Phase G



REF: Reference Phase
VAR: Variable Phase



MOVEMENT SUMMARY

Site: TCS 2329 [PM Peak (Site Folder: 2023 Option 2)]

Output produced by SIDRA INTERSECTION Version: 9.1.4.221

1630 - 1730
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Coordinated Cycle Time = 140 seconds (Site User-Given Phase Times)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Cumberland Highway															
1	L2	All MCs	161	1.2	161	1.2	0.103	16.7	LOS B	4.1	29.3	0.41	0.70	0.41	42.1
2	T1	All MCs	1826	2.5	1826	2.5	0.455	6.2	LOS A	10.2	72.8	0.27	0.24	0.27	61.2
3	R2	All MCs	183	2.2	183	2.2	* 0.480	74.9	LOS F	6.2	44.4	1.00	0.77	1.00	19.1
Approach			2170	2.4	2170	2.4	0.480	12.8	LOS A	10.2	72.8	0.34	0.32	0.34	52.3
East: Darcy Road															
4	L2	All MCs	351	3.1	351	3.1	0.464	10.7	LOS A	10.8	77.3	0.51	0.70	0.51	42.6
5	T1	All MCs	204	0.5	204	0.5	* 1.032	125.8	LOS F	29.1	205.6	1.00	1.35	1.63	15.3
6	R2	All MCs	94	2.1	94	2.1	1.032	130.4	LOS F	29.1	205.6	1.00	1.35	1.63	15.9
Approach			649	2.2	649	2.2	1.032	64.2	LOS E	29.1	205.6	0.73	1.00	1.02	22.2
North: Cumberland Highway															
7	L2	All MCs	61	4.9	61	4.9	0.041	11.2	LOS A	0.7	5.4	0.36	0.67	0.36	48.3
8	T1	All MCs	2059	6.2	2059	6.2	* 0.571	6.6	LOS A	13.9	102.1	0.32	0.29	0.32	60.8
9	R2	All MCs	64	3.1	64	3.1	0.362	74.2	LOS F	4.3	30.6	0.99	0.75	0.99	26.5
Approach			2184	6.0	2184	6.0	0.571	8.7	LOS A	13.9	102.1	0.34	0.32	0.34	57.8
West: Darcy Road															
10	L2	All MCs	54	0.0	54	0.0	0.202	39.8	LOS C	2.4	17.1	0.91	0.73	0.91	34.5
11	T1	All MCs	168	1.2	168	1.2	* 1.217	295.4	LOS F	22.9	161.6	1.00	1.59	2.39	8.4
12	R2	All MCs	86	1.2	86	1.2	0.620	93.0	LOS F	6.0	42.4	1.00	0.81	1.04	23.1
Approach			308	1.0	308	1.0	1.217	194.0	LOS F	22.9	161.6	0.98	1.22	1.75	12.0
All Vehicles			5311	3.8	5311	3.8	1.217	27.9	LOS B	29.1	205.6	0.43	0.45	0.51	40.3

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Green.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance

Mov ID	Crossing	Input Vol. ped/h	Dem. Flow ped/h	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Ped ped	Dist] m	Prop. Que	Eff. Stop Rate	Travel Time sec	Travel Dist. m	Aver. Speed m/sec
South: Cumberland Highway												
P1	Full	16	16	64.2	LOS F	0.1	0.1	0.96	0.96	230.8	200.0	0.87
East: Darcy Road												

P2	Full	1	1	64.1	LOS F	0.0	0.0	0.96	0.96	230.8	200.0	0.87
North: Cumberland Highway												
P3	Full	8	8	64.1	LOS F	0.0	0.0	0.96	0.96	230.8	200.0	0.87
West: Darcy Road												
P4	Full	1	1	64.1	LOS F	0.0	0.0	0.96	0.96	230.8	200.0	0.87
All Pedestrians		26	26	64.2	LOS F	0.1	0.1	0.96	0.96	230.8	200.0	0.87

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

PHASING SUMMARY

Site: TCS 2329 [PM Peak (Site Folder: 2023 Option 2)]

Output produced by SIDRA INTERSECTION Version: 9.1.4.221

1630 - 1730
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Coordinated Cycle Time = 140 seconds (Site User-Given Phase Times)

Timings based on settings in the Site Phasing & Timing dialog
Phase Times specified by the user
Phase Sequence: Variable Phasing
Input Phase Sequence: A, D, E, G
Output Phase Sequence: A, D, E, G
Reference Phase: Phase A

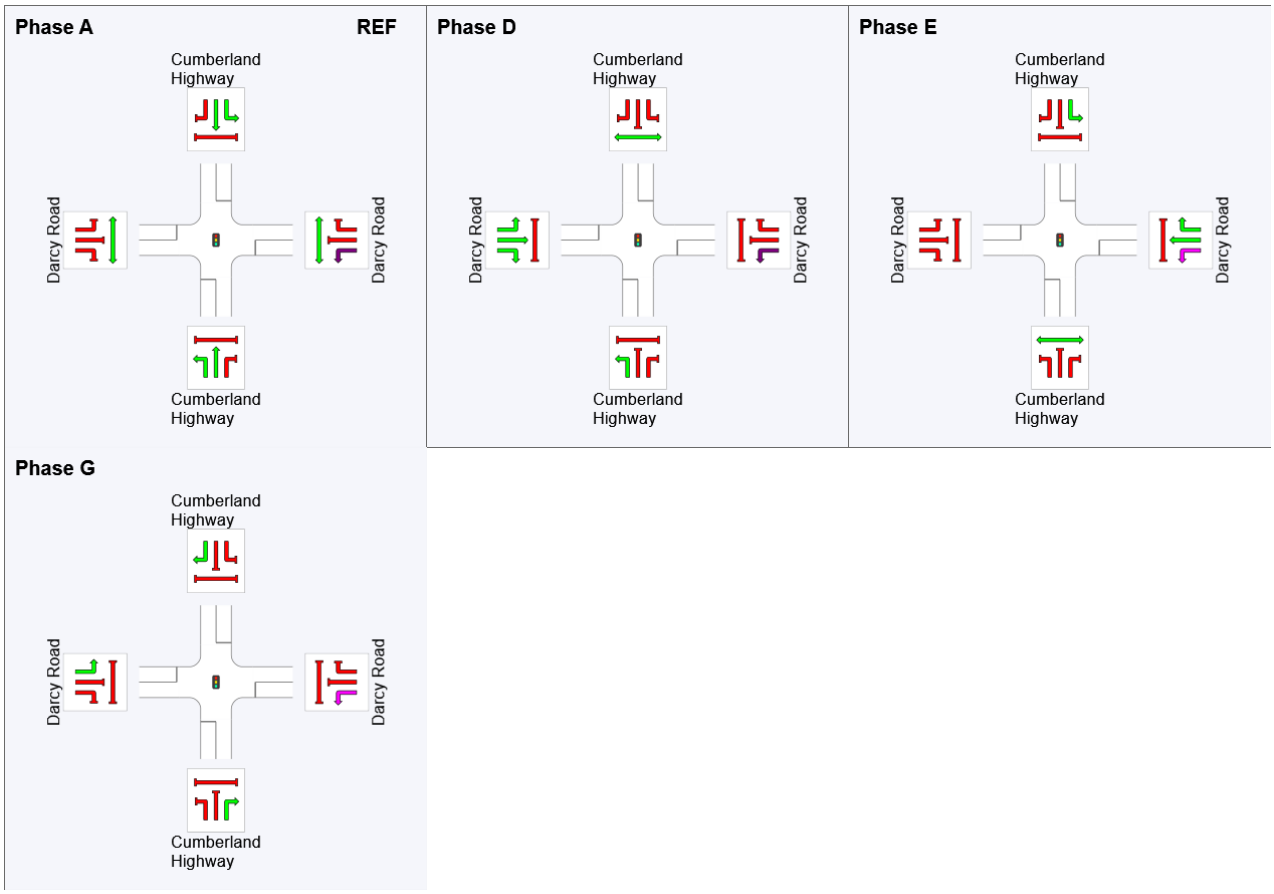
Phase Timing Summary

Phase	A	D	E	G
Phase Change Time (sec)	0	78	96	122
Green Time (sec)	71	11	22	11
Phase Time (sec)	78	15	29	18
Phase Split	56%	11%	21%	13%
Phase Frequency (%)	100.0	45.5[2]	82.9[2]	100.0

See the Timing Analysis 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, Minor Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

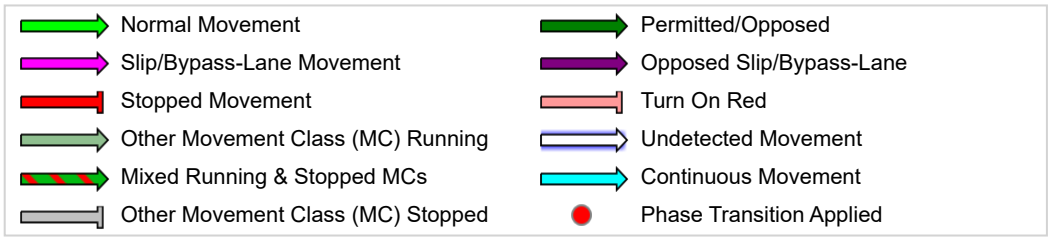
2 Phase Frequency is implied by a Phase Time specified by the user that is less than the Required Movement Time.

Output Phase Sequence



REF: Reference Phase

VAR: Variable Phase

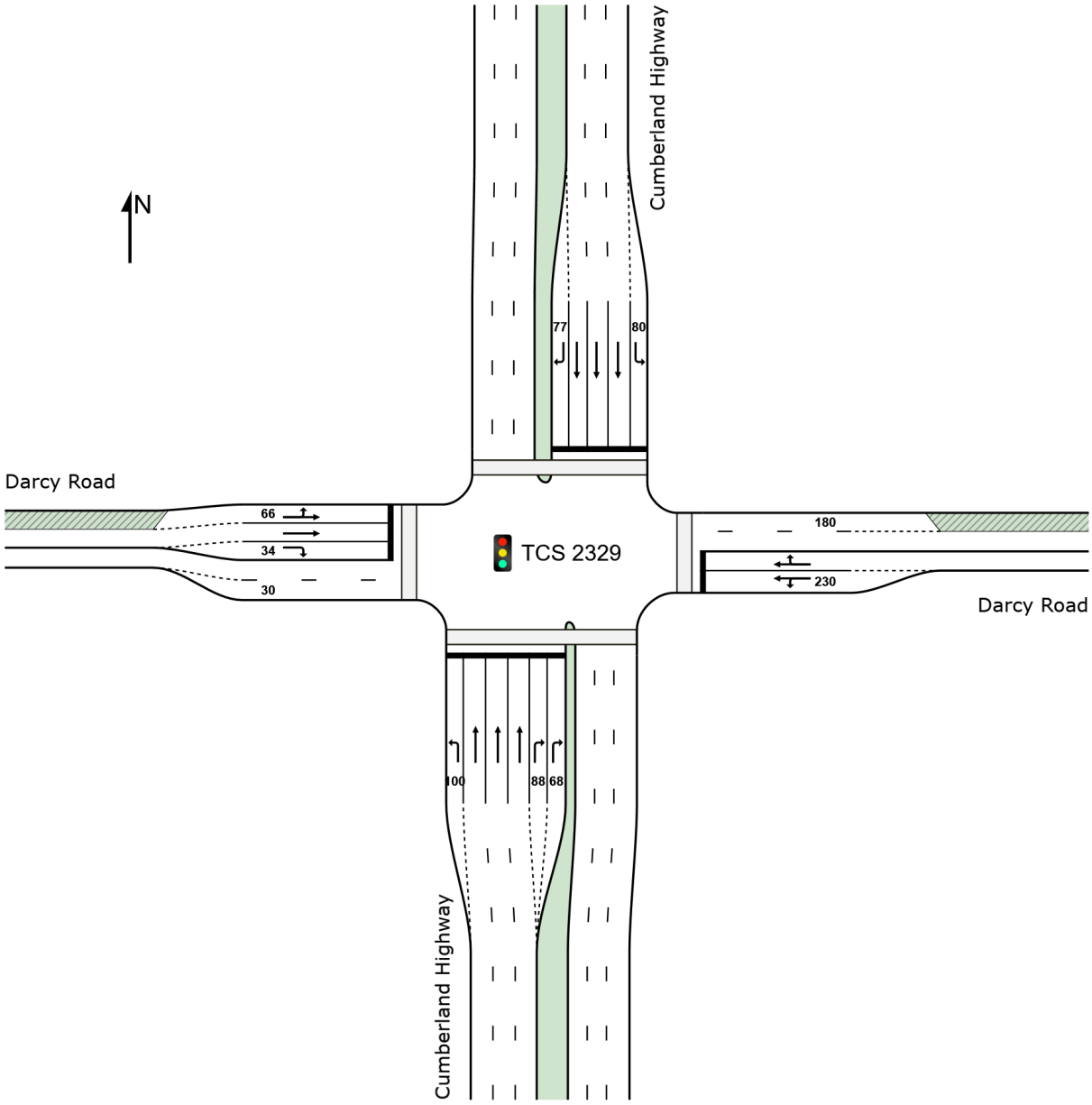


SITE LAYOUT

Site: TCS 2329 [AM Peak (Site Folder: 2023 Option 3)]

0730 - 0830
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Coordinated

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



MOVEMENT SUMMARY

Site: TCS 2329 [AM Peak (Site Folder: 2023 Option 3)]

Output produced by SIDRA INTERSECTION Version: 9.1.4.221

0730 - 0830
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Coordinated Cycle Time = 143 seconds (Site User-Given Phase Times)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Cumberland Highway															
1	L2	All MCs	73	2.7	73	2.7	0.061	17.4	LOS B	1.9	13.6	0.41	0.69	0.41	41.9
2	T1	All MCs	1618	10.6	1618	10.6	0.610	16.7	LOS B	23.1	176.5	0.57	0.51	0.57	51.1
3	R2	All MCs	424	2.8	424	2.8	*0.940	64.6	LOS E	11.4	81.4	1.00	0.96	1.36	21.3
Approach			2115	8.7	2115	8.7	0.940	26.3	LOS B	23.1	176.5	0.65	0.61	0.72	41.6
East: Darcy Road															
4	L2	All MCs	259	3.5	259	3.5	0.433	36.2	LOS C	10.8	77.9	0.82	0.86	0.82	28.1
5	T1	All MCs	173	1.7	173	1.7	*0.738	62.5	LOS E	16.1	115.0	1.00	0.88	1.05	23.4
6	R2	All MCs	63	3.2	63	3.2	0.738	67.0	LOS E	16.1	115.0	1.00	0.88	1.05	24.8
Approach			495	2.8	495	2.8	0.738	49.3	LOS D	16.1	115.0	0.91	0.87	0.93	25.6
North: Cumberland Highway															
7	L2	All MCs	98	3.1	98	3.1	0.076	17.9	LOS B	1.9	13.6	0.47	0.69	0.47	45.6
8	T1	All MCs	1721	6.4	1721	6.4	*0.616	20.9	LOS B	22.6	167.1	0.61	0.54	0.61	48.9
9	R2	All MCs	34	0.0	34	0.0	0.235	80.7	LOS F	2.3	16.3	0.99	0.72	0.99	25.9
Approach			1853	6.1	1853	6.1	0.616	21.8	LOS B	22.6	167.1	0.61	0.55	0.61	46.2
West: Darcy Road															
10	L2	All MCs	95	0.0	95	0.0	*1.508	517.6	LOS F	52.6	369.4	1.00	1.88	3.21	6.1
11	T1	All MCs	432	0.7	432	0.7	*1.508	557.0	LOS F	52.6	369.4	1.00	2.04	3.21	4.7
12	R2	All MCs	124	1.6	124	1.6	0.720	109.4	LOS F	8.9	63.0	1.00	0.86	1.09	22.9
Approach			651	0.8	651	0.8	1.508	466.0	LOS F	52.6	369.4	1.00	1.79	2.81	5.6
All Vehicles			5114	6.2	5114	6.2	1.508	82.9	LOS F	52.6	369.4	0.70	0.76	0.97	22.4

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Green.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance

Mov ID	Crossing	Input Vol. ped/h	Dem. Flow ped/h	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Ped ped	Dist] m	Prop. Que	Eff. Stop Rate	Travel Time sec	Travel Dist. m	Aver. Speed m/sec
South: Cumberland Highway												
P1	Full	7	7	65.6	LOS F	0.0	0.0	0.96	0.96	232.3	200.0	0.86
East: Darcy Road												

P2	Full	1	1	65.6	LOS F	0.0	0.0	0.96	0.96	232.3	200.0	0.86
North: Cumberland Highway												
P3	Full	14	14	65.7	LOS F	0.1	0.1	0.96	0.96	232.3	200.0	0.86
West: Darcy Road												
P4	Full	1	1	65.6	LOS F	0.0	0.0	0.96	0.96	232.3	200.0	0.86
All Pedestrians		23	23	65.7	LOS F	0.1	0.1	0.96	0.96	232.3	200.0	0.86

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

PHASING SUMMARY

Site: TCS 2329 [AM Peak (Site Folder: 2023 Option 3)]

Output produced by SIDRA INTERSECTION Version: 9.1.4.221

0730 - 0830
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Coordinated Cycle Time = 143 seconds (Site User-Given Phase Times)

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

Phase Timing Summary

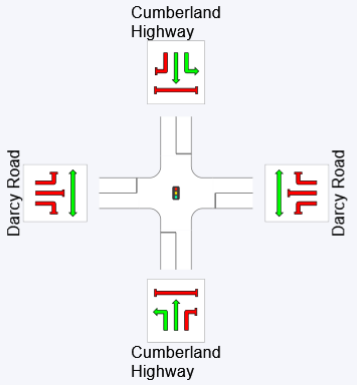
Phase	A	B	D	E	G
Phase Change Time (sec)	0	64	79	97	127
Green Time (sec)	57	8	14	25	9
Phase Time (sec)	64	12	19	32	16
Phase Split	45%	8%	13%	22%	11%
Phase Frequency (%)	100.0	60.0[1]	57.6[2]	91.4[2]	100.0

See the Timing Analysis 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, Minor Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

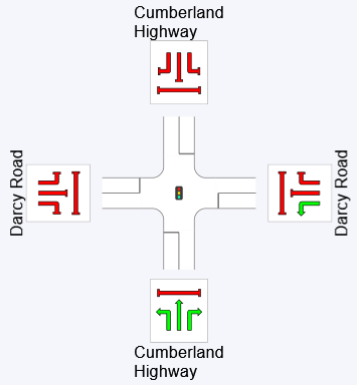
1 Phase Frequency has been given with User-Specified Phase Times.
2 Phase Frequency is implied by a Phase Time specified by the user that is less than the Required Movement Time.

Output Phase Sequence

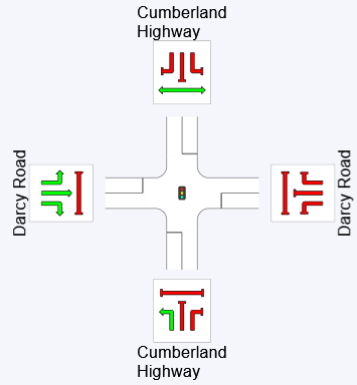
Phase A **REF**



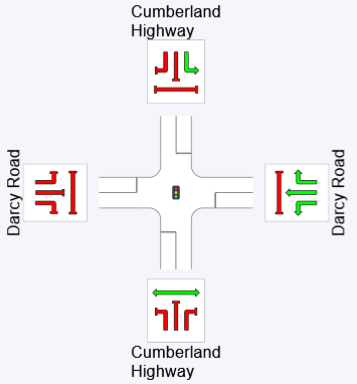
Phase B



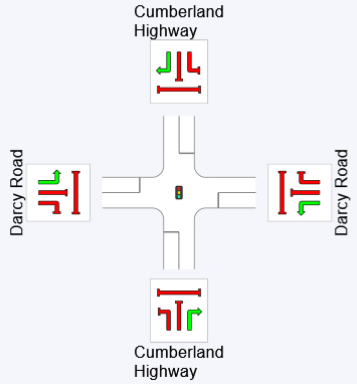
Phase D



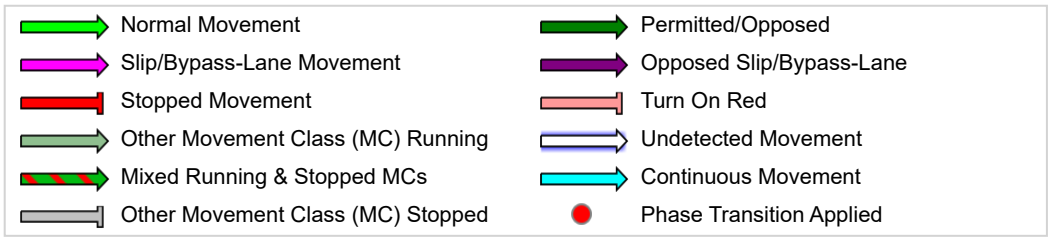
Phase E



Phase G



REF: Reference Phase
VAR: Variable Phase



MOVEMENT SUMMARY

Site: TCS 2329 [PM Peak (Site Folder: 2023 Option 3)]

Output produced by SIDRA INTERSECTION Version: 9.1.4.221

1630 - 1730
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Coordinated Cycle Time = 140 seconds (Site User-Given Phase Times)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Cumberland Highway															
1	L2	All MCs	161	1.2	161	1.2	0.103	17.2	LOS B	4.1	29.3	0.41	0.70	0.41	42.1
2	T1	All MCs	1826	2.5	1826	2.5	0.455	6.2	LOS A	10.2	72.8	0.27	0.24	0.27	61.2
3	R2	All MCs	183	2.2	183	2.2	0.480	74.9	LOS F	6.2	44.4	1.00	0.77	1.00	19.1
Approach			2170	2.4	2170	2.4	0.480	12.8	LOS A	10.2	72.8	0.34	0.32	0.34	52.4
East: Darcy Road															
4	L2	All MCs	351	3.1	351	3.1	* 0.859	63.8	LOS E	23.5	169.2	1.00	0.97	1.15	20.6
5	T1	All MCs	204	0.5	204	0.5	1.032	125.8	LOS F	29.1	205.6	1.00	1.35	1.63	15.3
6	R2	All MCs	94	2.1	94	2.1	1.032	130.4	LOS F	29.1	205.6	1.00	1.35	1.63	15.9
Approach			649	2.2	649	2.2	1.032	93.0	LOS F	29.1	205.6	1.00	1.14	1.37	17.5
North: Cumberland Highway															
7	L2	All MCs	61	4.9	61	4.9	0.041	11.2	LOS A	0.7	5.4	0.36	0.67	0.36	48.3
8	T1	All MCs	2059	6.2	2059	6.2	* 0.571	6.6	LOS A	13.9	102.1	0.32	0.29	0.32	60.8
9	R2	All MCs	64	3.1	64	3.1	0.362	74.2	LOS F	4.3	30.6	0.99	0.75	0.99	26.5
Approach			2184	6.0	2184	6.0	0.571	8.7	LOS A	13.9	102.1	0.34	0.32	0.34	57.8
West: Darcy Road															
10	L2	All MCs	54	0.0	54	0.0	0.202	39.8	LOS C	2.4	17.1	0.91	0.73	0.91	34.5
11	T1	All MCs	168	1.2	168	1.2	* 1.217	295.4	LOS F	22.9	161.6	1.00	1.59	2.39	8.4
12	R2	All MCs	86	1.2	86	1.2	0.620	93.0	LOS F	6.0	42.4	1.00	0.81	1.04	23.1
Approach			308	1.0	308	1.0	1.217	194.0	LOS F	22.9	161.6	0.98	1.22	1.75	12.0
All Vehicles			5311	3.8	5311	3.8	1.217	31.4	LOS C	29.1	205.6	0.46	0.47	0.55	38.4

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Green.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance

Mov ID	Crossing	Input Vol. ped/h	Dem. Flow ped/h	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Ped ped	Dist] m	Prop. Que	Eff. Stop Rate	Travel Time sec	Travel Dist. m	Aver. Speed m/sec
South: Cumberland Highway												
P1	Full	16	16	64.2	LOS F	0.1	0.1	0.96	0.96	230.8	200.0	0.87
East: Darcy Road												

P2	Full	1	1	64.1	LOS F	0.0	0.0	0.96	0.96	230.8	200.0	0.87
North: Cumberland Highway												
P3	Full	8	8	64.1	LOS F	0.0	0.0	0.96	0.96	230.8	200.0	0.87
West: Darcy Road												
P4	Full	1	1	64.1	LOS F	0.0	0.0	0.96	0.96	230.8	200.0	0.87
All Pedestrians		26	26	64.2	LOS F	0.1	0.1	0.96	0.96	230.8	200.0	0.87

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

PHASING SUMMARY

Site: TCS 2329 [PM Peak (Site Folder: 2023 Option 3)]

Output produced by SIDRA INTERSECTION Version: 9.1.4.221

1630 - 1730
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Coordinated Cycle Time = 140 seconds (Site User-Given Phase Times)

Timings based on settings in the Site Phasing & Timing dialog
Phase Times specified by the user
Phase Sequence: Variable Phasing
Input Phase Sequence: A, D, E, G
Output Phase Sequence: A, D, E, G
Reference Phase: Phase A

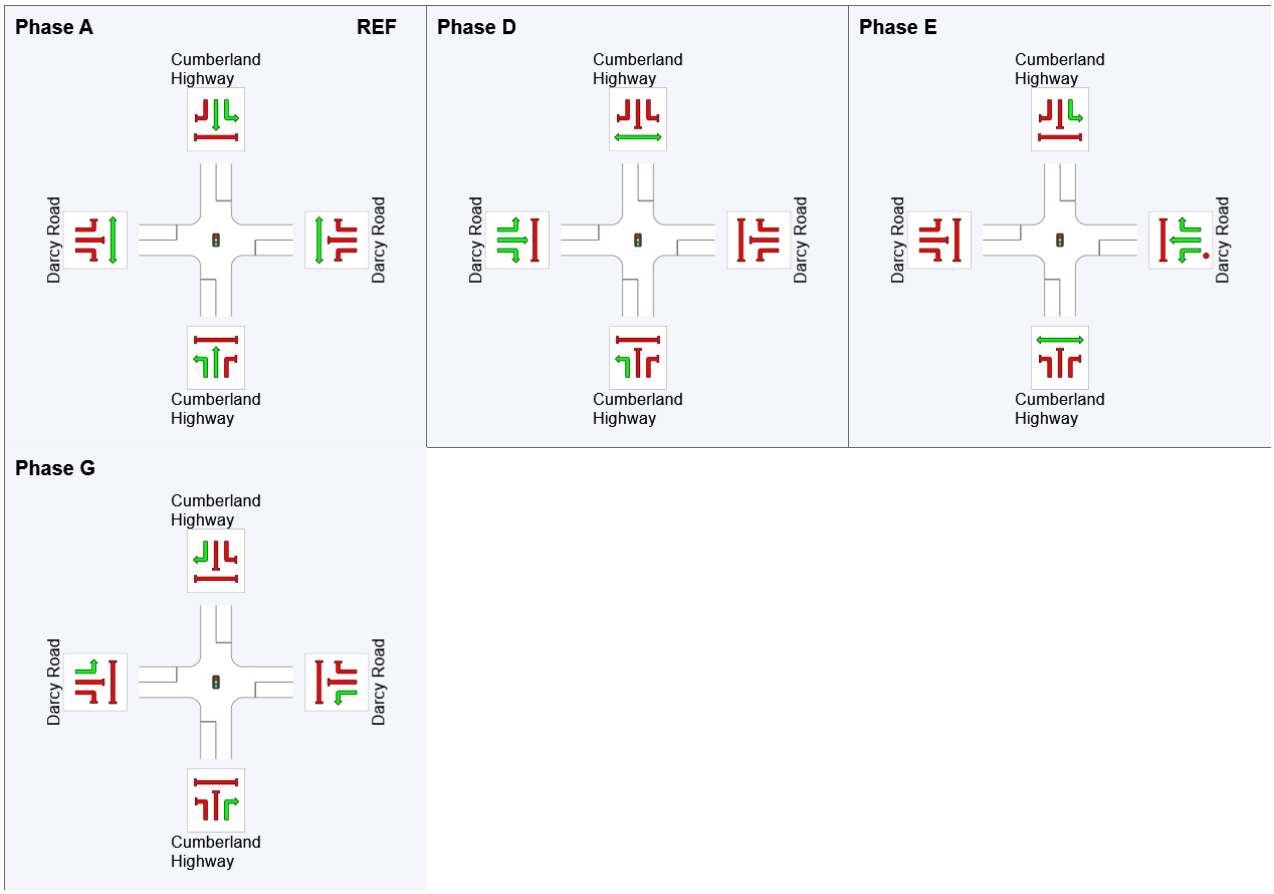
Phase Timing Summary

Phase	A	D	E	G
Phase Change Time (sec)	0	78	96	122
Green Time (sec)	71	11	22	11
Phase Time (sec)	78	15	29	18
Phase Split	56%	11%	21%	13%
Phase Frequency (%)	100.0	45.5[2]	82.9[2]	100.0

See the Timing Analysis 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, Minor Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

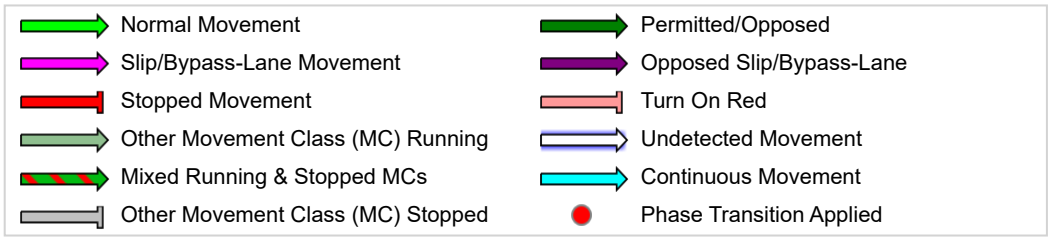
2 Phase Frequency is implied by a Phase Time specified by the user that is less than the Required Movement Time.

Output Phase Sequence



REF: Reference Phase

VAR: Variable Phase

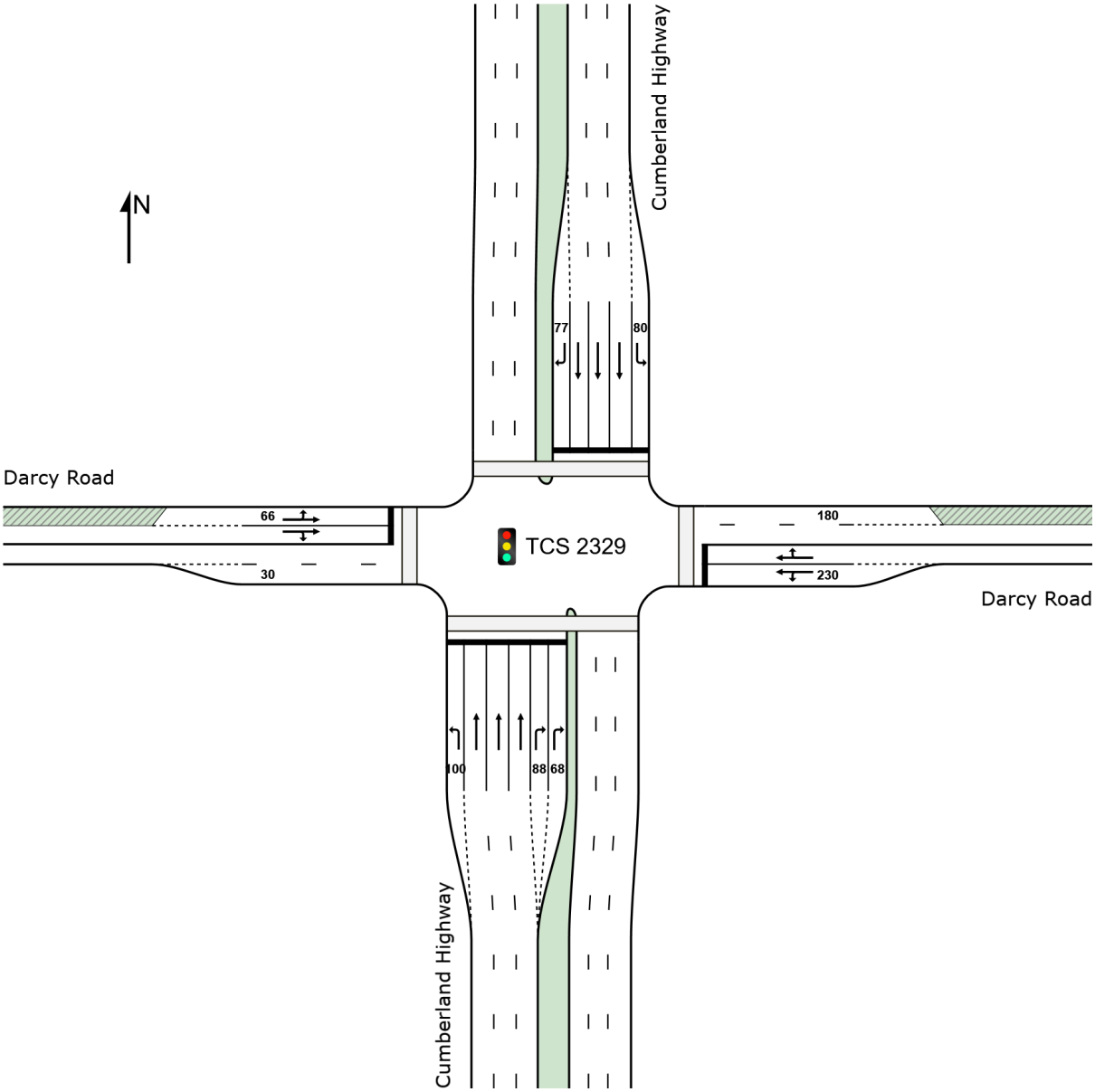


SITE LAYOUT

Site: TCS 2329 [AM Peak (Site Folder: 2023 Option 4)]

0730 - 0830
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Coordinated

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



MOVEMENT SUMMARY

Site: TCS 2329 [AM Peak (Site Folder: 2023 Option 4)]

Output produced by SIDRA INTERSECTION Version: 9.1.4.221

0730 - 0830
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Coordinated Cycle Time = 143 seconds (Site User-Given Phase Times)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Cumberland Highway															
1	L2	All MCs	73	2.7	73	2.7	0.061	17.4	LOS B	1.9	13.6	0.41	0.69	0.41	41.9
2	T1	All MCs	1618	10.6	1618	10.6	0.610	16.7	LOS B	23.1	176.5	0.57	0.51	0.57	51.1
3	R2	All MCs	424	2.8	424	2.8	*0.940	64.5	LOS E	11.4	81.4	1.00	0.96	1.36	21.3
Approach			2115	8.7	2115	8.7	0.940	26.3	LOS B	23.1	176.5	0.65	0.61	0.72	41.5
East: Darcy Road															
4	L2	All MCs	259	3.5	259	3.5	0.433	36.2	LOS C	10.8	77.9	0.82	0.86	0.82	28.1
5	T1	All MCs	173	1.7	173	1.7	*0.738	62.5	LOS E	16.1	115.0	1.00	0.88	1.05	23.4
6	R2	All MCs	63	3.2	63	3.2	0.738	67.0	LOS E	16.1	115.0	1.00	0.88	1.05	24.8
Approach			495	2.8	495	2.8	0.738	49.3	LOS D	16.1	115.0	0.91	0.87	0.93	25.6
North: Cumberland Highway															
7	L2	All MCs	98	3.1	98	3.1	0.076	17.7	LOS B	1.9	13.6	0.47	0.69	0.47	45.6
8	T1	All MCs	1721	6.4	1721	6.4	*0.616	20.9	LOS B	22.6	167.1	0.61	0.54	0.61	48.9
9	R2	All MCs	34	0.0	34	0.0	0.235	80.7	LOS F	2.3	16.3	0.99	0.72	0.99	25.9
Approach			1853	6.1	1853	6.1	0.616	21.8	LOS B	22.6	167.1	0.61	0.55	0.61	46.2
West: Darcy Road															
10	L2	All MCs	95	0.0	95	0.0	*1.783	763.4	LOS F	73.1	513.7	1.00	2.10	3.82	4.3
11	T1	All MCs	432	0.7	432	0.7	*1.783	794.1	LOS F	73.1	513.7	1.00	2.32	3.82	3.3
12	R2	All MCs	124	1.6	124	1.6	1.783	806.1	LOS F	70.3	496.3	1.00	2.58	3.82	3.7
Approach			651	0.8	651	0.8	1.783	791.9	LOS F	73.1	513.7	1.00	2.33	3.82	3.5
All Vehicles			5114	6.2	5114	6.2	1.783	124.4	LOS F	73.1	513.7	0.70	0.83	1.10	16.9

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Green.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance

Mov ID	Crossing	Input Vol. ped/h	Dem. Flow ped/h	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Ped ped	Dist] m	Prop. Que	Eff. Stop Rate	Travel Time sec	Travel Dist. m	Aver. Speed m/sec
South: Cumberland Highway												
P1	Full	7	7	65.6	LOS F	0.0	0.0	0.96	0.96	232.3	200.0	0.86
East: Darcy Road												

P2	Full	1	1	65.6	LOS F	0.0	0.0	0.96	0.96	232.3	200.0	0.86
North: Cumberland Highway												
P3	Full	14	14	65.7	LOS F	0.1	0.1	0.96	0.96	232.3	200.0	0.86
West: Darcy Road												
P4	Full	1	1	65.6	LOS F	0.0	0.0	0.96	0.96	232.3	200.0	0.86
All Pedestrians		23	23	65.7	LOS F	0.1	0.1	0.96	0.96	232.3	200.0	0.86

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

PHASING SUMMARY

Site: TCS 2329 [AM Peak (Site Folder: 2023 Option 4)]

Output produced by SIDRA INTERSECTION Version: 9.1.4.221

0730 - 0830
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Coordinated Cycle Time = 143 seconds (Site User-Given Phase Times)

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

Phase Timing Summary

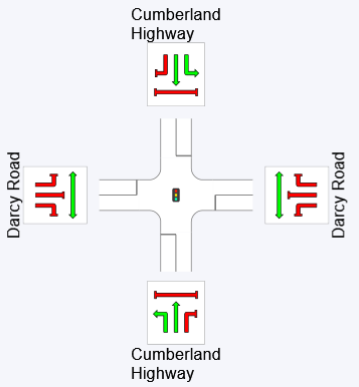
Phase	A	B	D	E	G
Phase Change Time (sec)	0	64	79	97	127
Green Time (sec)	57	8	14	25	9
Phase Time (sec)	64	12	19	32	16
Phase Split	45%	8%	13%	22%	11%
Phase Frequency (%)	100.0	60.0[1]	57.6[2]	91.4[2]	100.0

See the Timing Analysis 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, Minor Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

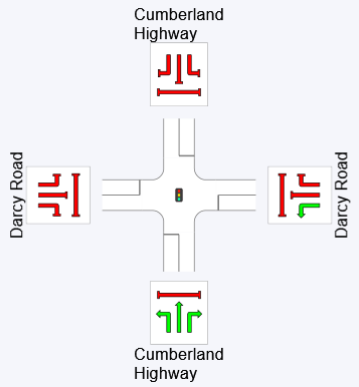
1 Phase Frequency has been given with User-Specified Phase Times.
2 Phase Frequency is implied by a Phase Time specified by the user that is less than the Required Movement Time.

Output Phase Sequence

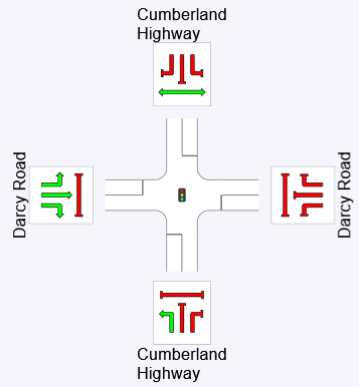
Phase A **REF**



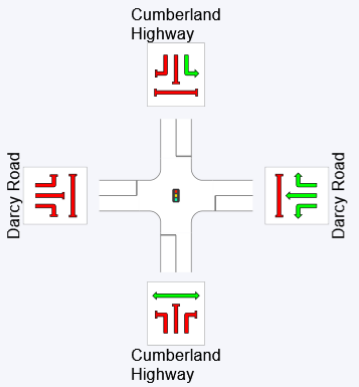
Phase B



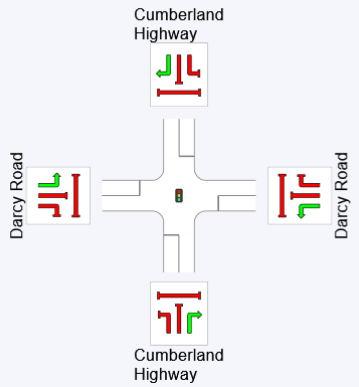
Phase D



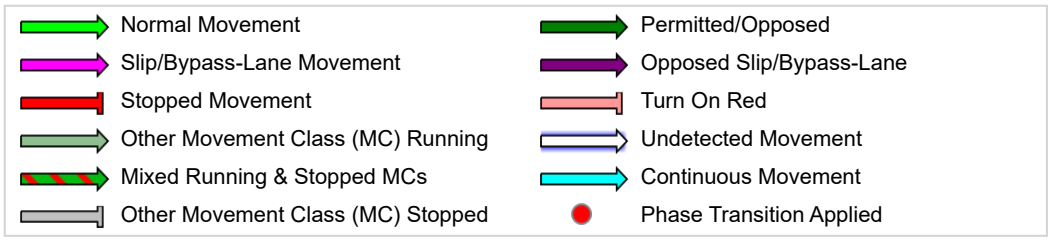
Phase E



Phase G



REF: Reference Phase
VAR: Variable Phase



MOVEMENT SUMMARY

Site: TCS 2329 [PM Peak (Site Folder: 2023 Option 4)]

Output produced by SIDRA INTERSECTION Version: 9.1.4.221

1630 - 1730
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Coordinated Cycle Time = 140 seconds (Site User-Given Phase Times)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Cumberland Highway															
1	L2	All MCs	161	1.2	161	1.2	0.103	17.2	LOS B	4.1	29.3	0.41	0.70	0.41	42.1
2	T1	All MCs	1826	2.5	1826	2.5	0.455	6.2	LOS A	10.2	72.8	0.27	0.24	0.27	61.2
3	R2	All MCs	183	2.2	183	2.2	0.480	74.8	LOS F	6.2	44.4	1.00	0.77	1.00	19.1
Approach			2170	2.4	2170	2.4	0.480	12.8	LOS A	10.2	72.8	0.34	0.32	0.34	52.3
East: Darcy Road															
4	L2	All MCs	351	3.1	351	3.1	* 0.859	63.8	LOS E	23.5	169.2	1.00	0.97	1.15	20.6
5	T1	All MCs	204	0.5	204	0.5	1.032	125.8	LOS F	29.1	205.6	1.00	1.35	1.63	15.3
6	R2	All MCs	94	2.1	94	2.1	1.032	130.4	LOS F	29.1	205.6	1.00	1.35	1.63	15.9
Approach			649	2.2	649	2.2	1.032	93.0	LOS F	29.1	205.6	1.00	1.14	1.37	17.5
North: Cumberland Highway															
7	L2	All MCs	61	4.9	61	4.9	0.041	11.1	LOS A	0.7	5.4	0.36	0.67	0.36	48.3
8	T1	All MCs	2059	6.2	2059	6.2	* 0.571	6.6	LOS A	13.9	102.1	0.32	0.29	0.32	60.8
9	R2	All MCs	64	3.1	64	3.1	0.362	74.2	LOS F	4.3	30.6	0.99	0.75	0.99	26.4
Approach			2184	6.0	2184	6.0	0.571	8.7	LOS A	13.9	102.1	0.34	0.32	0.34	57.8
West: Darcy Road															
10	L2	All MCs	54	0.0	54	0.0	0.202	84.8	LOS F	2.4	17.1	0.91	0.73	0.91	34.5
11	T1	All MCs	168	1.2	168	1.2	* 1.773	817.6	LOS F	55.8	394.5	1.00	2.42	3.86	3.4
12	R2	All MCs	86	1.2	86	1.2	1.773	822.1	LOS F	55.8	394.5	1.00	2.42	3.86	3.7
Approach			308	1.0	308	1.0	1.773	690.4	LOS F	55.8	394.5	0.98	2.13	3.35	4.0
All Vehicles			5311	3.8	5311	3.8	1.773	60.2	LOS E	55.8	394.5	0.46	0.52	0.64	27.9

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Green.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance

Mov ID	Crossing	Input Vol. ped/h	Dem. Flow ped/h	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Ped ped	Dist] m	Prop. Que	Eff. Stop Rate	Travel Time sec	Travel Dist. m	Aver. Speed m/sec
South: Cumberland Highway												
P1	Full	16	16	64.2	LOS F	0.1	0.1	0.96	0.96	230.8	200.0	0.87
East: Darcy Road												

P2	Full	1	1	64.1	LOS F	0.0	0.0	0.96	0.96	230.8	200.0	0.87
North: Cumberland Highway												
P3	Full	8	8	64.1	LOS F	0.0	0.0	0.96	0.96	230.8	200.0	0.87
West: Darcy Road												
P4	Full	1	1	64.1	LOS F	0.0	0.0	0.96	0.96	230.8	200.0	0.87
All Pedestrians		26	26	64.2	LOS F	0.1	0.1	0.96	0.96	230.8	200.0	0.87

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

PHASING SUMMARY

Site: TCS 2329 [PM Peak (Site Folder: 2023 Option 4)]

Output produced by SIDRA INTERSECTION Version: 9.1.4.221

1630 - 1730
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Coordinated Cycle Time = 140 seconds (Site User-Given Phase Times)

Timings based on settings in the Site Phasing & Timing dialog
Phase Times specified by the user
Phase Sequence: Variable Phasing
Input Phase Sequence: A, D, E, G
Output Phase Sequence: A, D, E, G
Reference Phase: Phase A

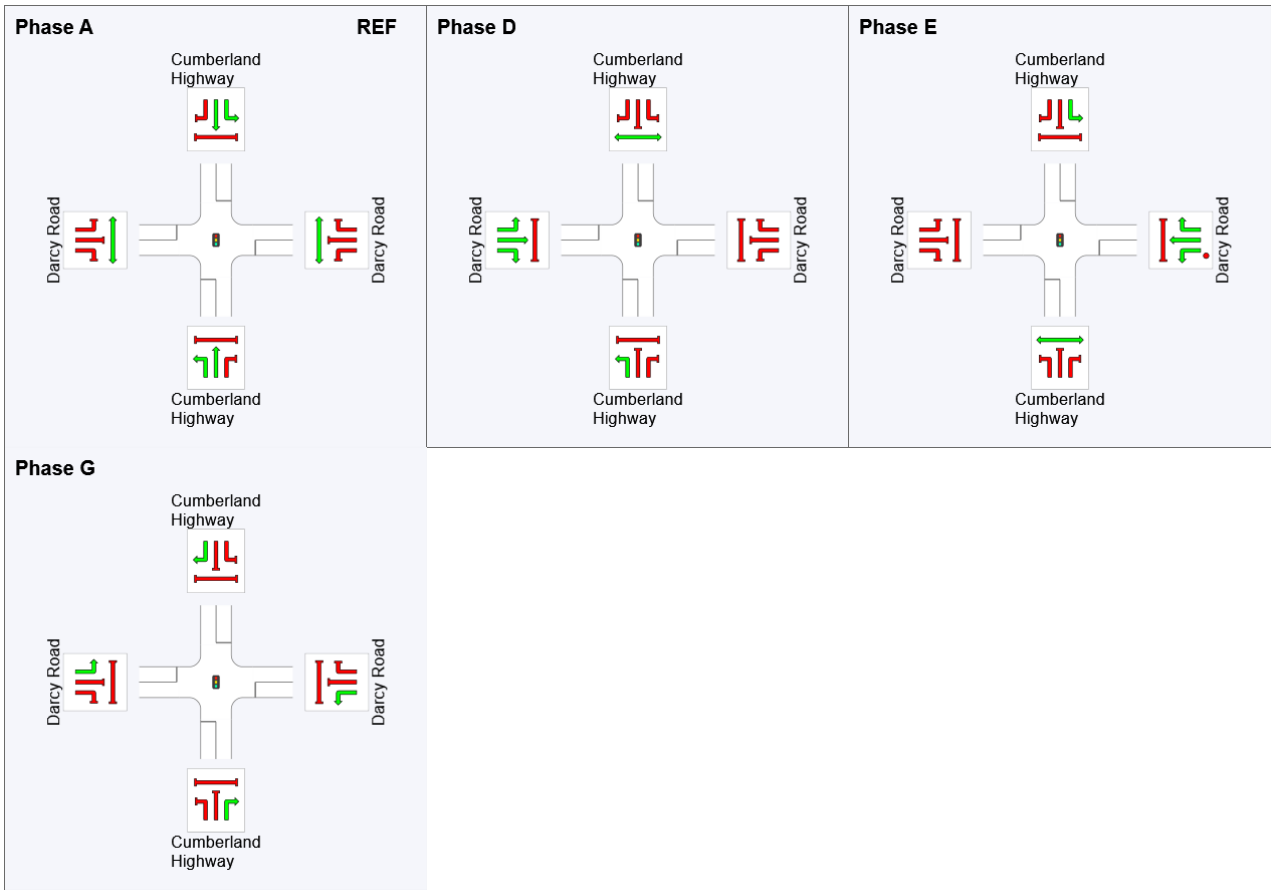
Phase Timing Summary

Phase	A	D	E	G
Phase Change Time (sec)	0	78	96	122
Green Time (sec)	71	11	22	11
Phase Time (sec)	78	15	29	18
Phase Split	56%	11%	21%	13%
Phase Frequency (%)	100.0	45.5[2]	82.9[2]	100.0

See the Timing Analysis 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, Minor Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

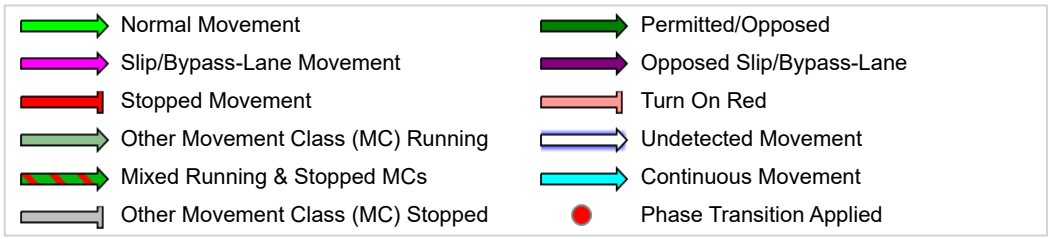
2 Phase Frequency is implied by a Phase Time specified by the user that is less than the Required Movement Time.

Output Phase Sequence



REF: Reference Phase

VAR: Variable Phase



CITY OF PARRAMATTA COUNCIL

Traffic Engineering Advisory Group Agenda Item

ITEM NO:	2311 B3
SUBJECT:	Updated Designs for Line Marking of Driveways on Local Roads
APPLICANT:	City of Parramatta Council
REPORT OF:	Traffic and Transport Engineer
WARD:	All
SED:	All

Purpose

The purpose of this report is to update the designs for line marking at driveways on local roads to deter motorists from parking across driveways.

OFFICER'S RECOMMENDATION:

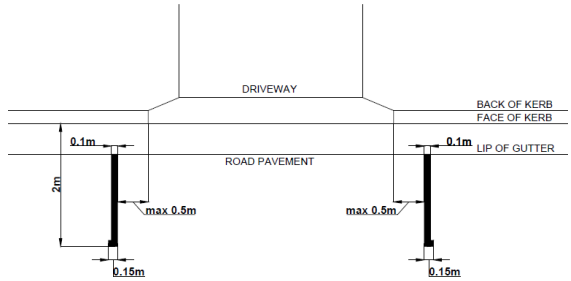
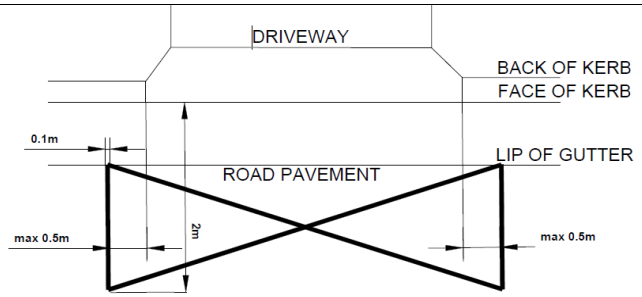
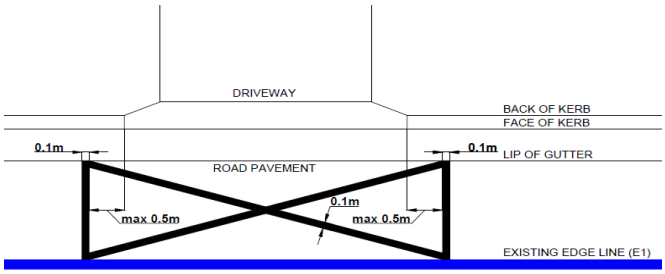
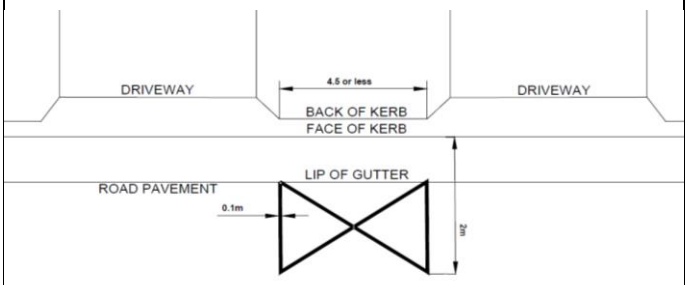
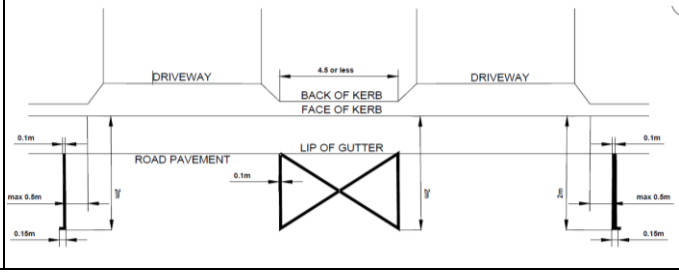
That the updated designs for line marking at driveways as shown in the report be approved.

Background

City of Parramatta Council receives a large number of requests from residents and businesses in relation to difficulties in accessing properties due to vehicles being parked across or near driveways. According to Council's records, 46 service requests have been lodged in the six month period between 15 April and 15 October 2023 requesting installation of signs and lines at driveways. These requests are generally from areas close to the CBD, town centres, employment precincts, educational institutions, hospitals, public transport and high-density developments, where the demand for on street parking is high.

Council generally does not signpost residential driveways as this would result in visual pollution and excessive maintenance costs if applied broadly, however, Council does allow residents and businesses to line mark the road surface near their driveways. The following guidelines and criteria are generally being used to determine which type of driveway line marking is appropriate for a particular location. It is to be noted that this line marking is for guidance only and is not enforceable. According to Road Rules, it is illegal to park across a driveway regardless of the line marking.

Items 4 and 5 in the table below are proposed modifications to the existing suite of line marking options that Council uses.

	Classification	Linemarking Types	Application
1.	Single standard driveway		At most driveways
2.	Single driveway poorly distinguished from footpath/nature strip		This option is only applicable in the following circumstances: – There is no formed driveway but only layback – Where it is difficult to distinguish between footpath and driveways due to the materials used and the footpath width
3.	Single driveway on roads marked with edgelines		This arrangement will advise motorists that this is a driveway, not a marked parking bay.
4.	Two driveways that are 4.5m or less distance apart – parking is a concern between the two driveways		This arrangement is suitable for locations where complaints relate to vehicles being parked between driveways where the gap is not long enough for a standard vehicle to be parked. This arrangement incurs a fee for a single driveway
5.	Two driveways that are 4.5m or less distance apart – parking is a concern on both sides of the driveways		This arrangement is suitable for locations where vehicles park on both sides of the driveways. This arrangement incurs a fee for two driveways.

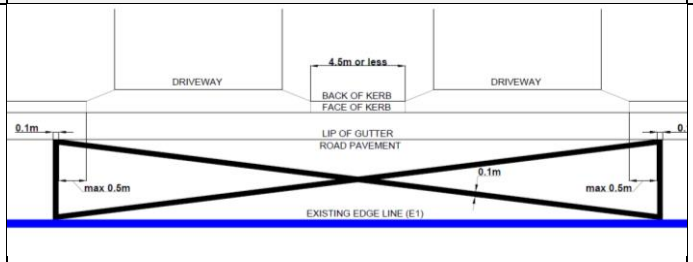
	Classification	Linemarking Types	Application
6.	Two driveways that are 4.5m or less distance apart and on roads that are marked with edgelines		This arrangement will advise motorists that this is a driveway not a marked parking bay.

Table 1: Driveway line marking options for various circumstances

FINANCIAL IMPLICATIONS

There are no changes proposed to the current financial arrangements for line marking at driveways. This report provides designs for line marking across driveways. Council can undertake the works on behalf of residents and businesses subject to fees being paid in accordance with Council's Fees and Charges Schedule which is currently $342 for the first driveway and $237 for the 2nd and subsequent driveways. This fee does not cover maintenance of the line marking. Residents and businesses may also undertake the works independently of Council subject to conditions.

Zulfiqar Ali
Traffic and Transport Engineer
20/10/2023
Attachments: Nil

CITY OF PARRAMATTA COUNCIL

Traffic Engineering Advisory Group Agenda Item

ITEM NO: 2311 B4

SUBJECT: Projects Recently Completed, Projects Currently Funded and Projects Lists for Consideration of Future Funding

APPLICANT: City of Parramatta Council

REPORT OF: Traffic and Transport Engineer

WARD: All

SED: All

Purpose

This report provides information on traffic and pedestrian projects recently completed or currently funded and projects lists that City of Parramatta Council maintains for budget planning purposes.

OFFICER'S RECOMMENDATIONS:

1. That the Projects Lists for proposed traffic works be received and noted.
2. That the two (2) traffic projects that have been completed since the last TEAG meeting be noted.

Recently Completed Projects

Information on recently completed projects is provided below.

Projects Completed by Council Through Federal and State Funding

1. Alamein Avenue, Carlingford

Project Details: Installation of a raised pedestrian crossing

Total cost of the project: $264,507.60

Funding Details: Get NSW Active

BEFORE

AFTER

Projects Completed by Developers

2. North Rocks Road and Speers Road, North Rocks

Project Details: Installation of a new roundabout, a pedestrian refuge island and a chicane

BEFORE

AFTER

Projects to be undertaken in 2023/24

Information regarding the progress on currently funded projects is provided at the start of the attachment to this report.

Future Projects

Traffic projects that are to be considered for future funding are categorised into one of four lists as detailed below:

- *Development Contributions Plan List - outside the Parramatta City Centre*

  Council adopted this list on 12 July 2021 as part of the City of Parramatta (Outside Parramatta CBD) Contributions Plan 2021 (refer to Tables 37 and 38 of the Plan via the link https://cityofparramatta.co/3HaPxLw). This list is prioritised into three categories; high (5 years), medium (5-10 years) and low (10-20 years). This work is proposed to be funded from Development Contributions, unless grant funding, a Voluntary Planning Agreement, or other source of funding is obtained.

  The Development Contributions Plan is reviewed and set approximately every 5 years. Therefore, the lists shown in Tables 37 and 38 of the City of Parramatta (Outside Parramatta CBD) Contributions Plan 2021 would also be set and fixed every 5 years (approximately) at the same time the Development Contributions Plan is approved by Council.

  These projects have a range of purposes such as improving pedestrian safety and amenity; improving sight distance (or reducing speed where sight distance is limited); upgrading an existing facility; reducing congestion; guard rail or barriers; and reducing illegal or unsafe driving. The list includes projects that would be on the Black Spot list except they have a low Benefit Cost Ratio and would not attract grant funds. These projects are also considered for grant funding applications including new proposals that would be considered in the next review of the Development Contributions Plan.

- *Traffic Projects List – within the Parramatta City Centre*

  This list includes projects that are located within the Parramatta City Centre. These projects will generally be funded from the Parramatta City Centre Developer Contributions Plan.

- *Black Spot Projects List*

  This list is for the projects where funding is being or is proposed to be sought, from the State or Federal Government under their Black Spot and Safer Roads Programs.

  The Black Spot locations generally have a high number of collisions, and the proposed work is forecast to have a significant reduction on accidents. Projects under Black Spot Program are ranked on Benefit Cost Ratio (BCR); whereas projects under Safer Roads Programs are ranked on Safety Performance Indicator (SPI). The individual funding programs also have different criteria regarding the number of accidents with injuries that have occurred. At present, a minimum of 2 injury accidents over a 5-year period is generally required for a project to be eligible for funding.

- *List of Traffic Projects Supported by Community Petition*

  This list includes locations where Council has received requests from at least 50% of households within the street for traffic calming to be installed in the street or part of the street. This support can be in the form of a petition or letters. Meeting this requirement demonstrates that the local community wants this treatment in the street. These streets often do not have a specific hazard, crash history, or concentration of vulnerable road users such as pedestrians. Often, in streets not on the list, many residents do not support traffic calming and have concerns regarding the installation

of traffic calming, particularly in regard to perceptions of noise, loss of parking, and prioritisation of funds.

Development Contribution Funds are not suitable for these projects as these projects are not related to supporting growth in the area. These projects are generally unfunded.

FINANCIAL IMPLICATIONS:

Council's Traffic and Transport Services maintains four (4) projects lists with the funding options as detailed below:

- Development Contributions Plan list - outside the Parramatta City Centre:

  These projects have been grouped into 3 categories of priority (high, medium, and long term). It is proposed to deliver the high priority projects from 2021/22 to 2025/26 using Development Contributions fund for part, or all projects.

  Applications are also lodged for State and Federal Government funding for projects that would meet the requirements of funding applications at the time of lodgement. Applications are generally lodged between August and October each year for consideration under these programs.

- Traffic Projects List – within the Parramatta City Centre:

  These projects will generally be funded from the Parramatta City Centre Section 7.11 Contribution Plan (known as Civic Improvement Plan, CIP).

- Black Spot Projects List:

  These projects will generally be funded from the State or Federal Government under their Blackspot and Safer Roads Programs. Applications are lodged between August and October each year for consideration under these programs.

  Note that Council has lodged applications for 2024/25 Black Spot fundings for three traffic projects as listed below and attached Black Spot Projects List:

  - Installation of a roundabout at the intersection of Buller Street and Gladstone Street, North Parramatta
  - Installation of raised thresholds in Redbank Road at Balmoral Road, Northmead
  - Installation of raised thresholds in Martha Street at Wentworth Street, Clyde

- List of Traffic Projects Supported by Community Petition:

  These projects could be funded from General Revenue. Councillors may wish to use part of the ward initiatives budget to deliver these projects.

External Funding:

- Council has received 100% funding offer under the State Government's FY22/23 Get NSW Active program for the construction of the following traffic facility projects by December 2023:
  - M4 Cycleway at Good Street and Alfred Street, Granville - $600,000 for the construction of two combined pedestrian and cyclist crossings
  - Orchard Road at Plympton Road, Carlingford - $250,000 for the construction of a raised pedestrian crossing
  - Alamein Avenue, Carlingford - $240,000 for the construction of a raised pedestrian crossing
  - Victoria Street at Bridge Street, Epping - $250,000 for the construction of a combined raised pedestrian and cyclists crossing
  - John Ian Wing Parade, Sydney Olympic Park - $240,000 for the construction of a combined raised pedestrian and cyclists crossing
- Council has received 100% funding offer under the State Government's Parramatta-Sydney Foreshore Link (Early Delivery Projects) Program for the construction of the following traffic facility project in FY23/24:
  - Brodie Street south of Alan Street, Rydalmere - $540,500 for the construction of a raised combined pedestrian and cyclist crossing

Internal Funding:

- Council's Delivery Program and Operational Plan generally allocates funding for the delivery of traffic projects using Development Contributions Funds. The traffic projects that are to be funded from the Development Contributions Funds in 2023/24 are listed below:
  - Traffic Signals in Carlingford Road at Hepburn Avenue Carlingford - $550k for the TfNSW plan checking fees and utility services relocations (Complete Design and Commence Construction). It is intended to complete this project in 2024/25.
  - Raised Pedestrian Crossing in Ray Road at Kent Street Epping - $340k for design and construction
  - Roundabout in North Rocks Road at Loyalty Road North Rocks - $70k for design only
  - Roundabout in Fitzwilliam Road at Tucks Road Toongabbie - $70k for design only
- Construction works has commenced on-site for the traffic signals at the intersection of Hill Road and Bennelong Parkway, Wentworth Point. This project has funding available as part of Council's Delivery Program and Operational Plan which includes $3.85 million allocated specifically for the upgrade of the Hill Road and Bennelong Parkway intersection in the 2022/23 and 2023/24 financial years.

Nathan McLauchlan
Traffic and Transport Engineer
24/10/2023
Attachments – A. Project Lists

Projects for 2023/24

Location	Treatment Type	Cost	Comments
Ward: Epping; SED: Epping			
Alamein Avenue west of Bardia Road, Carlingford	Construction of a new raised pedestrian crossing	$264,507.60 (Actual)	Completed in September 2023. This project has received 100% from the State Government's Get NSW Active program
Carlingford Road at Hepburn Avenue, Carlingford	Install traffic control signals - TfNSW plan checking fees and utility services relocations	$550,000 in 2023/24 with the remainder to be spent in 24/25	Traffic Control Signal (TCS) plan has been approved by TfNSW. Council is currently organizing relocation of services. This is design is 100% funded by Council.
Orchard Road north of North Rocks Road and Plympton Road, Beecroft	Construction of a new raised pedestrian crossing	$225,000	Completed in September 2023. This project has received 100% from the State Government's Get NSW Active program.
Ray Road at Kent Street, Epping	Install raised pedestrian crossing (Design and construct)	$340,000	Design commenced. This is project is 100% funded by Council.
Victoria Street, Epping	Construction of a combined raised pedestrian and cyclist crossing	$255,541	Project awarded. Construction will commence in November 2023. This project has received 100% from the State Government's Get NSW Active program.
Ward: North Rocks; SED: Seven Hills			
North Rocks Road at Loyalty Road, North Rocks	Install roundabout (Design only)	$70,000	Concept design is being prepared. This project is 100% funded by Council.
Ward: Parramatta; SED: Seven Hills			
Fitzwilliam Road at Tucks Road, Toongabbie	Install roundabout (Design only)	$70,000	Concept design is being prepared.

Location	Treatment Type	Cost	Comments
			This project is 100% funded by Council.
Ward: Rosehill; SED: Granville			
Brodie Street, Rydalmere	Install raised pedestrian crossing	$540,000	Approved by Council through the Parramatta Traffic Committee Process. This project is 100% funded by the 2023/24 State Government Parramatta to Sydney Foreshore Link Program.
M4 Cycleway at Good Street and Alfred Street, Granville	Construct combined raised pedestrian and cyclists crossing	$600,000	Contract awarded. Construction commenced.
Ward: Rosehill; SED: Parramatta			
Park Parade south side of railway line at pedestrian underpass to Parramatta Park, Westmead	Construct a pedestrian refuge with kerb extension and pedestrian fencing	$350,000 (Actual)	Completed in September 2023. This project is 100% funded by Council through its 2022/23 Active Transport Program (from Parramatta CBD Development Contributions Plan).
Intersection of High Street at Raymond Street, Parramatta	Install a raised pedestrian crossing in High St (north leg) and speed cushions at other 3 legs.	$262,000	Completed in September 2023. This project is 100% funded by the 2022/23 Australian Government Black Spot Program.
Ward: Rosehill; SED: Auburn			
Albion Street, Harris Park	Construction of 3 speed humps	$48,645 (Actual)	Completed in July 2023. This project is 100% funded by Council from its Ward Initiative, PTC Traffic Facilities, and Transport for NSW (TfNSW) Block Grant funds.
Hill Road at Bennelong Parkway, Wentworth Point	Construction of new Traffic Signals	$4m	Construction in progress. This project is 100% funded by Council.
John Ian Wing Parade, Newington	Construct combined raised pedestrian and cyclists crossing at Louise Savauge Pathway	$240,000	Project awarded. Construction will commence in November 2023. This project has received 100% from the State Government's Get NSW Active program.

Black Spot Projects List

BCR	Location	Treatment Type	Estimated Cost	Injury Accidents (over 5-year Period) that can be treated by the treatment	Funding Status	Comments
5.12	Martha Street at Wentworth Street and, Clyde	Install raised thresholds on both approaches to Wentworth Street	$200,000	7	Not yet funded	Applied for funding under State and Federal Government's 2024/25 Black Spots and Safer Roads Programs.
2.13	Gladstone Street at Buller Street, North Parramatta	Install a roundabout	$600,000	3	Not yet funded	Applied for funding under State and Federal Government's 2024/25 Black Spots and Safer Roads Programs.
1.88	Redbank Road at Balmoral Road, Northmead	Install raised thresholds with median island	$142,000	2 out of 4	Not yet funded	Applied for Proactive funding under State and Federal Government's 2024/25 Black Spots and Safer Roads Programs.
--	Bold Street south of Cowper Street, Granville Ward: Rosehill SED: Granville	Install a raised threshold	$180,000	7	Not yet funded	Liaising with TfNSW to determine the appropriate treatment options for this location. Reviewed the crash history and noted that the appropriate treatments cannot be installed at the intersection due to following reasons: • Close proximity to two traffic signals (at Parramatta Road and at Railway Parade) • Required to maintain 3 travel lanes (including a bus lane) in the northbound and 2 travel lanes in the southbound directions. • Required to maintain right turn access between Bold Street and Cowper Street (west leg)

Traffic Projects supported by Community Petition

Location	Proposed Treatment	Year Included on List
Ward: Epping;		
Lexington Avenue at Raimonde Road, Eastwood	Concrete median islands	2014
George Street, Epping	Chicanes (2)	2020
Ward: Parramatta		
Ballandella Road between Fitzwilliam Road and Barangaroo Road, Toongabbie	Raised Thresholds or Chicanes (2)	2015
Frances Street, Northmead	Speed humps (3) or chicanes (2)	2021
Harris Street, Constitution Hill	Speed Humps (3)	2015
Ward: North Rocks		
Barnetts Road, Winston Hills	Chicanes	2011
Ward: Rosehill		
Alice Street between Alfred and Arthur Streets	Speed Humps (2)	2020
Deakin Street, Silverwater (between Stubbs Street and the cul-de-sac)	Speed Humps	2018