

Annexure K

Traffic Impact Study

FARM THE KLOOF 2921, BLOEMFONTEIN

TOWNSHIP ESTABLISHMENT
TRAFFIC IMPACT STUDY

JULY 2017



Project: 7067

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REPORT SHEET

Property Description:	<i>Farm The Kloof 2921, Bloemfontein.</i>
Municipal Area:	<i>Mangaung Metro Municipality</i>
Application:	<i>Township Establishment</i>
Type of Report:	<i>Traffic Impact Study</i>
Project Number:	<i>7067</i>
Compiled By:	<i>Koot Marais Pr Eng</i>
Declaration	<i>I, Koot Marais, author of this traffic impact study, hereby certify that I am a professional traffic engineer (registration No 920023) and that I have the required experience and training in the field of traffic and transportation engineering as required by the Engineering Council of South Africa (ECSA), to compile this traffic impact study and I take full responsibility for the content, including all calculations, conclusions and recommendations made herein.</i>
Signed:	 920023
Date:	<i>July 2017</i>

PREPARED BY:



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1 INTRODUCTION

1.1 Aim of the Study

The aim of this study is to determine the traffic impact of an intended township establishment on the **Farm The Kloof 2921**.

1.2 Background

It is the intention to undertake township establish on the said portion.

This document reports on the expected impact of the application.

The developer is: Jumali Investments Pty. Ltd.
39 Ocean View Drive
Green Point

1.3 Site Location

The development is situated to the west of the R700 (A54), opposite the T185.

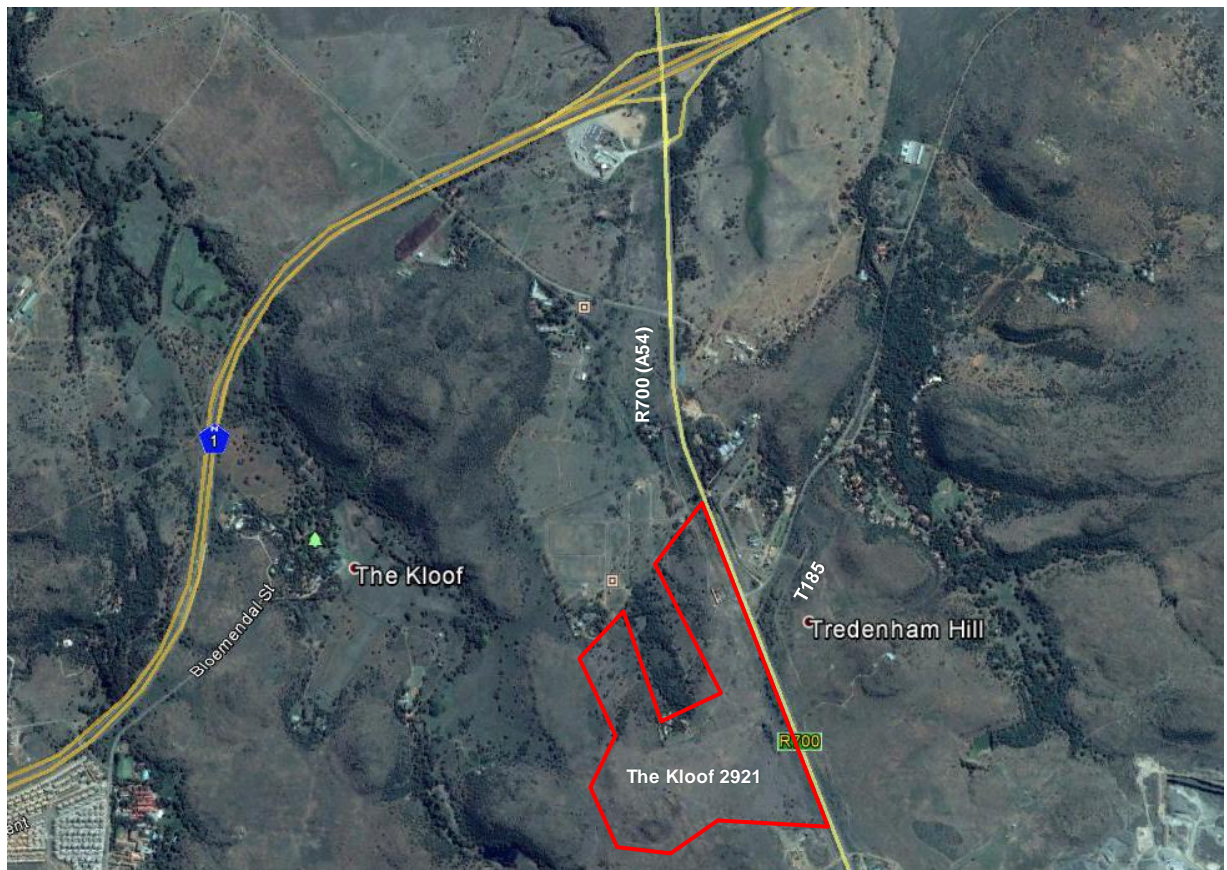


Figure 1.1 Location Plan

1.4 Development



The development will make provision for the following. Most of the erven will be given a special use zoning restricting the extent to the values indicated.

Zoning	Erven	Size	Units	Development Size
	No	Hectare		
Single Residential	1-39		Units	39
General Residential 2	45	0.5953	Units	135
	46	0.572	Units	135
	47	0.5733	Units	135
	49	0.5457	Units	120
	50	0.5505	Units	120
	51	0.5505	Units	120
	71	0.6959	Units	150
	72	0.7872	Units	150
	79	0.5839	Units	135
	80	0.8626	Units	150
General Residential 3	55	0.3126	Units	10
	56	0.2753	Units	10
	57	0.2961	Units	10
	58	0.2961	Units	10
	59	0.2961	Units	10
	60	0.2961	Units	10
	61	0.2961	Units	10
	62	0.2957	Units	10
	63	0.2762	Units	9
	64	0.2375	Units	7
	66	0.1871	Units	4
	67	0.1786	Units	4
	68	0.1786	Units	4
	69	0.1764	Units	4
	74	0.2937	Units	10
	75	0.2961	Units	10
	76	0.2961	Units	10
	77	0.2961	Units	10
	82	0.3227	Units	9
	83	0.2999	Units	7
Retirement Village	41	3.8206	Units	80
Care Centre	43	1.157	beds	120
Private Hospital	44	3.5929	beds	300
Businesss	53	1.1124	m ²	11720
	54	2.144	m ²	5000
	65	0.9255	m ²	4700

1.5 Scope of Analysis

1.5.1 Period for Analysis

Both the morning and afternoon peak hours were investigated. Although a reasonable portion of business is included in the development, traffic volumes in the area are relatively low during the Saturday peak with the result that this period was not fully investigated. The only intersection within the study area with significant volumes during the Saturday peak is the R700 / Christo Groenewald Street intersection. This intersection was investigated for the Saturday peak.

1.5.2 Assessment Years

As excessive Latent Rights are assumed and there is little chance of densification in this area other than the Latent Rights, a horizon year growth rate is not really deemed appropriate. To ensure a conservative approach, a growth rate of 1% was nonetheless assumed. As the development could potentially generate in excess of 2000 trips, the base year and ten years after the base year have been analysed. The base year was assumed to be 2019.

1.5.3 Warrants for a Traffic Impact Study

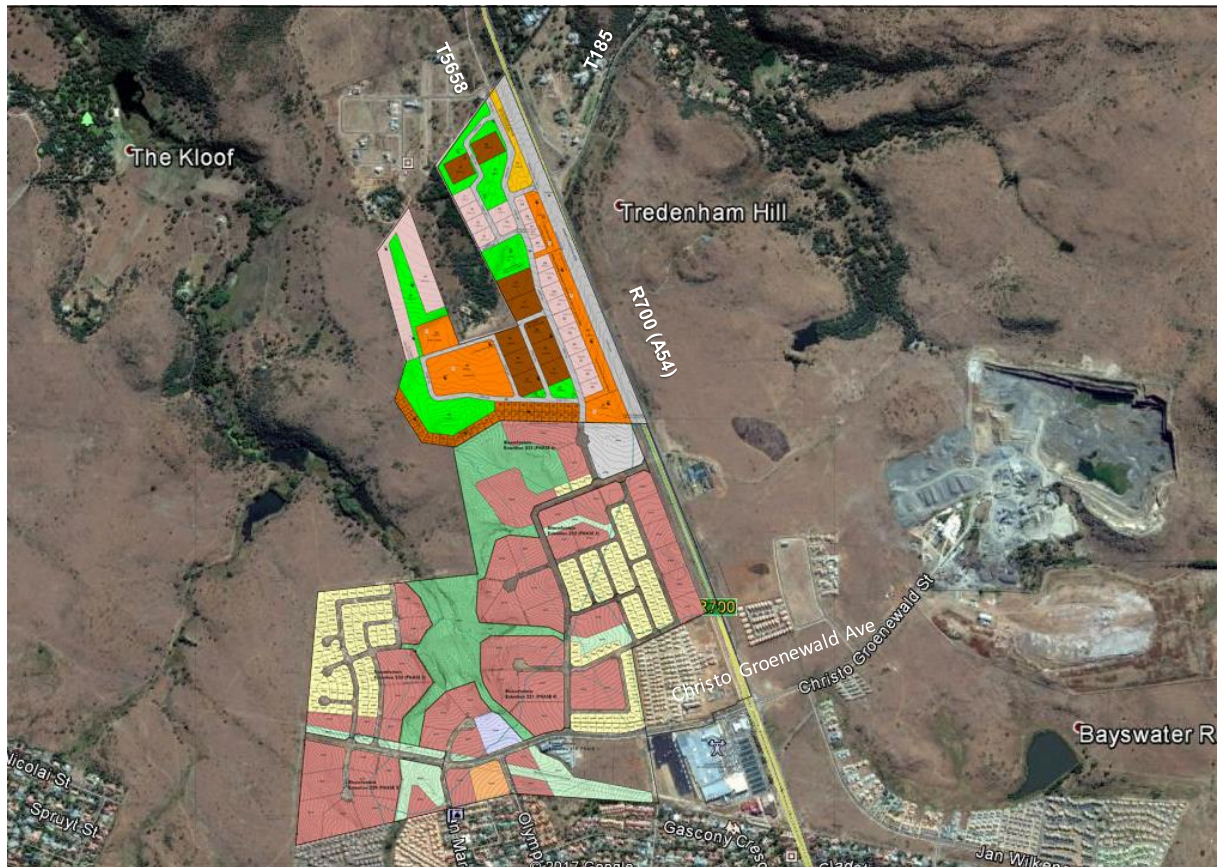
The change in land use is expected to generate in excess of 150 peak hour trips and according to the “Manual for Traffic Impact Studies”¹, a Traffic Impact Study is warranted.

1.5.4 Extent of Analysis

All intersections where the increase in the critical lane volumes is expected to exceed 75, within 1.5 km of the development should be analysed.

In this specific case the site can be developed on its own before the northern part of the adjacent Wild Olive Estate is developed (**Scenario 1**) in which case all trips will be via the T185 / T5658 / R700 Intersection. If the two areas are however developed at the same time or the area is developed after development of the northern portion of Wild Olive Estate, some trips will be via Wild Olive Estate area (**Scenario 2**)

The relationship between the two township establishments is shown below.



In the case of Scenario 1 only intersections A, B and C qualify. In the case of Scenario 2 Intersection D will also qualify. Due to the traffic sensitivity of the area, additional intersections as shown below were also investigated. Trip distribution was extended up to the N1 and along Kenneth Kaunda Road corridor up to Waverley Road.

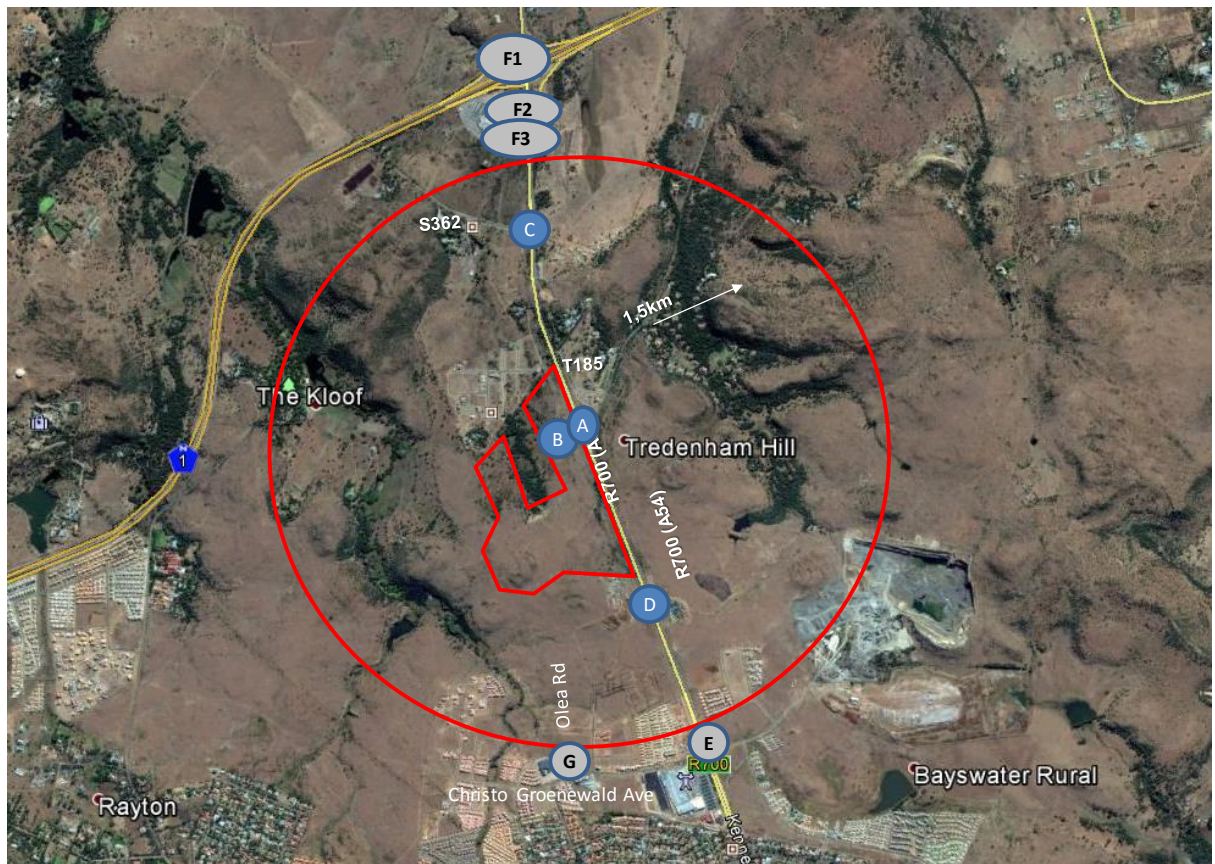


Figure 1.3 Intersections Analysed

Intersections within 1.5km radius

- a) Intersection A: T185 / T5658 / R700 Intersection
- b) Intersection B: Main internal intersection
- c) Intersection C: R700 / Access of Sangiro Lodge / S362 intersection
- d) Intersection D: R700 / Northern Wild Olive Estate Access

Additional Intersections

- e) Intersection E: R700 / Christo Groenewald Avenue Intersection
- f) Intersection F: R700 / N1 interchange (different on- and off-ramps)
- g) Intersection G: Olea Road / Christo Groenewald Avenue Intersection

1.6 Available Information

1.6.1 Traffic Counts

The following traffic counts were used.

Intersection	Source	Date Counted	Growth Rate
Kenneth Kaunda Road / Christo Groenewald Avenue	Counted by KMA for The Kloof TIS	23 &24/05/2017	1%
Kenneth Kaunda Road / Gladstone Road	Counted by KMA for Erf 30376	26 &27/01/2016	1%
T185 / R700	Counted by KMA for The Kloof TIS	23 &24/05/2017	1%
S362 / R700	Counted by KMA for The Kloof TIS	30/05/2017	1%
R700 / N1 interchange (different on- and off-ramps)	Counted by KMA for The Kloof TIS	31/05/2017	1%
Olea Road / Christo Groenewald Avenue	Counted by KMA for The Kloof TIS	23/05/2017	1%

Notes:

(1) All traffic counts undertaken by KMA are done by Koot Marais PR Eng personally or under his direct supervision.

1.6.2 Latent Rights

The Manual for Traffic Impact Studies describes Background Traffic as the existing traffic volumes, approved developments and anticipated developments. All applied for developments, and more accurately rezonings or township establishments for which traffic impact studies have been compiled, are normally assumed to be anticipated developments. In practice only a portion of applied for developments actually realise as some are not approved, whilst a large portion of applications do not proceed to the final stage. As a result, not all applications are actually anticipated. The assumption of all applied for applications as anticipated is a conservative approach, but in areas with high development interest and limited capacity this could result in a situation where a positive traffic impact study cannot be compiled, whilst a large portion of the assumed Latent Rights will not realise.

In this corridor the above mentioned point is reached, as a result it is necessary to look closer at what is actually anticipated.

No	Description	Project No	Note	Impact in Study Area
1	The planned township establishment on a portion of the remainder of the farm Bayswater 2865,	6179	Was assumed to be 25% complete	Yes
2	The already in principle approved, but yet to be developed Hillside 2830 development;	6433	It was assumed that an additional 22 single residential units and 159 town houses could still be developed.	Yes
3	The planned extension to the Hillside 2830 residential development	6267	15% complete	Yes
4	The township establishment on the Farm Padlang 2145 and Portion 2 (Vinknes) (of 1) of the Farm Tredenham 2153	6184	Mostly not yet implemented	Yes
5	The intended housing development on Erf 180 Helicon Heights	6290	1/3 of retirements units still to be constructed	Yes
6	Township establishment on a portion of Annex Wildeals Kloof 2607, (Sangiro Lodge).	6303	Approved but uncertain	Yes
7	Rezoning of Erven 29573 and 29574 Bloemfontein Extension 181	6309	Not yet implemented	Yes
8	Subdivision 2 (Kiepersol) of the Farm Strathearn 2154	6492	Not yet implemented	Yes
9	Subdivision 1 (Somerton) of the Farm Penrose 2378	6753	Commenced no reduction yet	Yes
10	Plot 8 Mimosa Park, Bloemfontein	6638	Existing no additional trips	Yes
11	Rezoning of Erven 29571 and 29572 Hillside	6647	Not yet implemented	Yes
12	Remainder of Portion 1 of and Portion 3 (of 1) of the Farm Strathearn 2154,	6380		Yes
13	Township establishment on Portion 6 of the Farm Wildealskloof 2607	6447	Re-submitted	Yes
14	Portion 5 of the Farm Annex Wildealskloof No 2607	6606	Re-submitted	Yes
15	Establishment of a School on the Remainder of Farm Mountain View	6787	Uncertain	Yes
16	Remainder of Portion 1 of the Farm Tredenham 2153,	6446		Yes
17	Portion 4 of Bayswater 2753, Bloemfontein Change in General Plan	6424	Approved but application for Amendment	Yes
17	Erf 1784 Waverley	6597		Yes
18	Woodland Hills Wildlife Estate Phase 2		Approved	Yes
19	Erf 30376 and a portion of street	6940	Approved	Yes

2 BACKGROUND INFORMATION

2.1 Existing Road Network

The most important roads in the area are the following:

Street / Road	Road No	Route No	Description	Geometry	Classification	Functional Classification	Jurisdiction
Kenneth Kaunda Road	A54-P21/1	R700	Main access road into the city providing access to individual erven in the urban area	Four lane divided street to the south of R700 / Christo Groenewald Avenue intersection and a three lane undivided road to the north up to the N1 interchange (A54) from where it becomes a two-lane road (P20/1)	Arterial	Arterial	Free State Province / Mangaung Metro Municipality
Christo Groenewald Avenue			This road serves individual erven	Urban Street	Not classified	Collector	Mangaung Metro Municipality
S362			This road serves properties	The first portion of the road is tarred , becoming a rural gravel road	Not classified,		Free State Province
T185			This road serves properties including Oubos	The first portion of the road is tarred , becoming a rural gravel road	Not classified,		Free State Province
T5658			The road is located opposite the T185 and serves properties including Somerton	Tarred rural road	Not classified,		Free State Province
Olea Road			Serves properties	Urban two lane street	Local Street	Major Residential Access Link	Mangaung Metro Municipality

2.2 Existing Land Use

The area is currently undeveloped and is surrounded by undeveloped areas as well as areas under development such as the Somerton Estate to the north of the site and Wild Olive Estate to the south.

2.3 Road Planning

There are no specific road improvements that will directly affect the development. Various improvements have however been identified as part of other development applications in the corridors.

3 TRIP GENERATION

Due to the inclusion of land uses that are not included in The South African Trip Generation Rates document as well as the fact that the latter document does not have much detail on Saturday trip generation, the TMH17 was used.

Use of the South African Trip Generation Rates document for the land uses covered in this document would have resulted in a slightly higher trip generation during the afternoon peak. In this instance a significant percentage of internal trips or trips between the area and Wild Olive Estate would have been assumed in the Trip Distribution, which is covered by the mixed land use reduction in TMH 17, with the result that external trip generation would have been very similar. Pass-by trips according to the South African Trip Generation Rates document are also higher than TMH 17.

3.1 Trip Generation Rates

Relevant land uses for this development as described in the TMH 17 are as follows:

3.1.1 Single Dwelling Units 210

Single dwelling units are detached houses on individual erven. The units usually have individual accesses to streets.

3.1.2 Town Houses Multi Level 232

Dwelling units provided in clusters in multi-level complexes. Individual townhouses can be provided on different levels. Individual townhouse could consist of one storey or could be multi-storeyed.

3.1.3 Retirement Village 251

Dwelling units intended for senior adults. Dwelling units could be either detached or provided in one building structure.

3.1.4 Private Hospital 612

An institution where private medical care is provided. The land-use includes related facilities normally associated with hospitals, including doctor consulting rooms, pharmacies and other medical services. The consulting rooms are those used by doctors whose primary duty is to provide health care at the hospital. Other rooms must be treated as medical consulting rooms.

3.1.5 Nursing home 620

A facility whose primary function is to care for persons who are unable to care for themselves. Care is mostly provided by nursing staff and by visiting doctors. Traffic is primary generated by employees, deliveries and visitors and not by residents.

3.1.6 Shopping Centre 820

A shopping centre is an integrated (mixed-use) group of commercial establishments that operate as a unit. May include small components of other land uses, such as restaurants, hardware and paint shops, etc.

4 TRIP DISTRIBUTION

Trip distribution was based on the analogue method with consideration of gravitational distributions.

4.1 Scenario 1 – No Trip Distribution via Wild Olive Estate

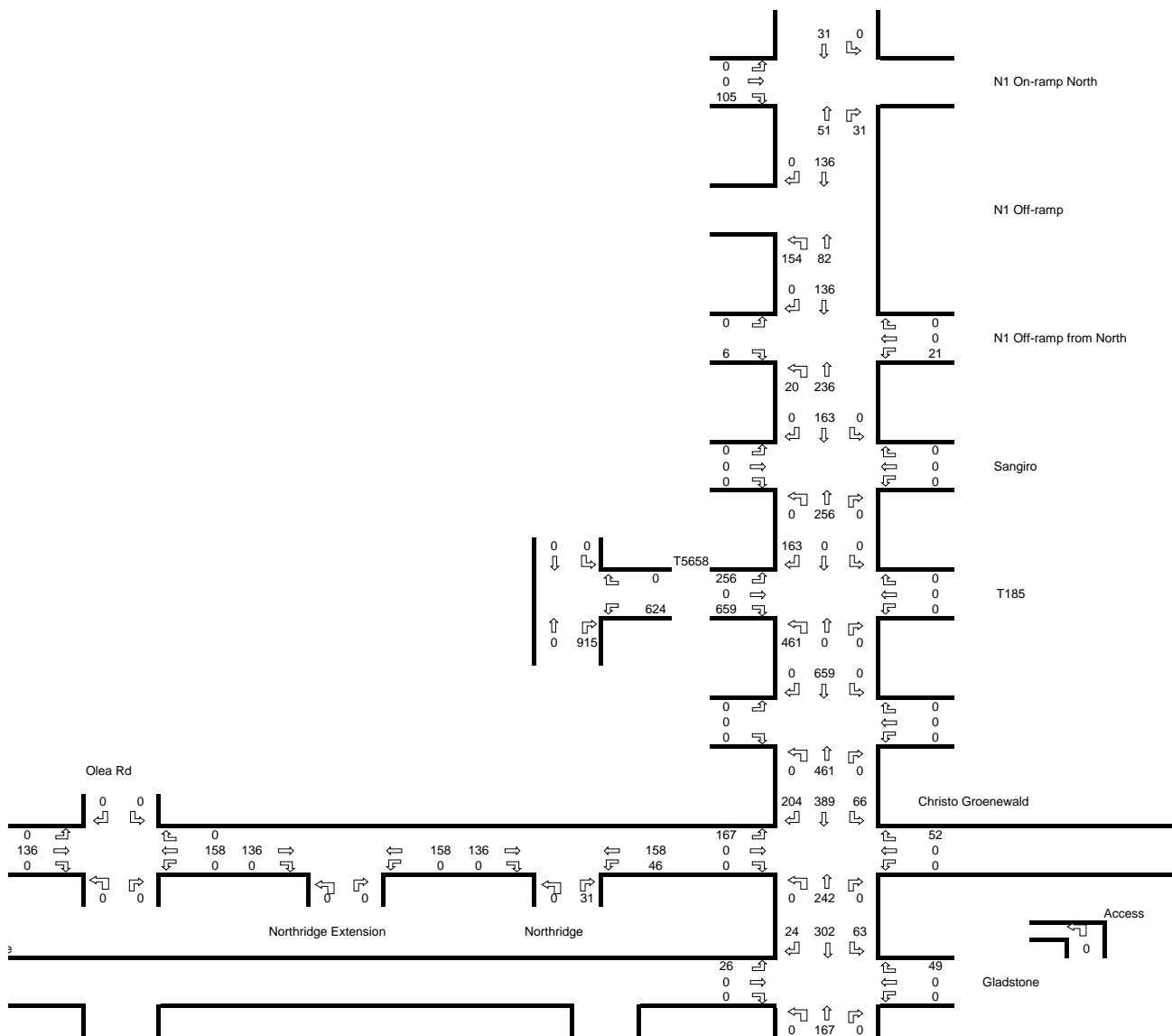


Figure 4.1a: AM Peak Trip Distribution

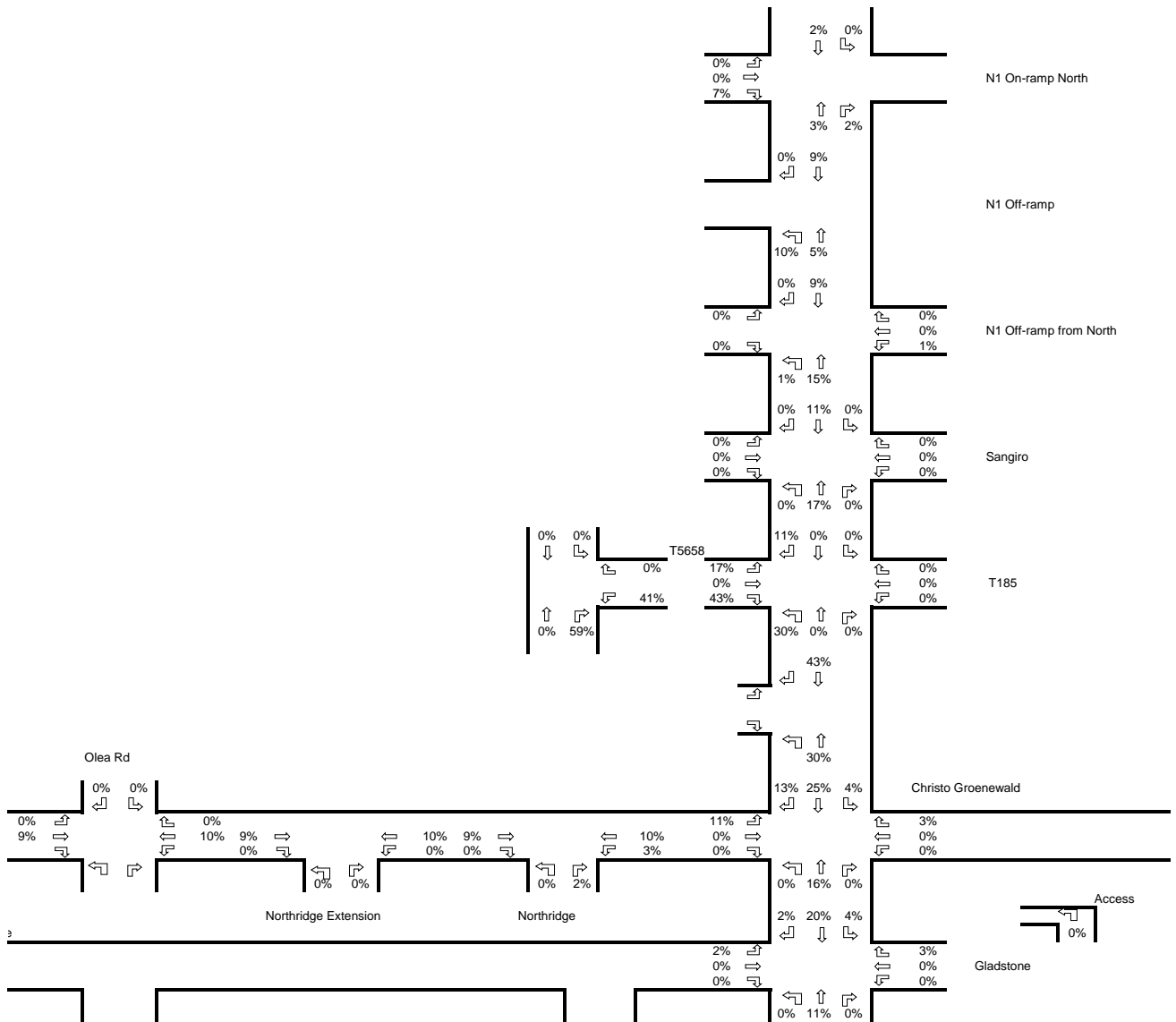


Figure 4.1b: AM Peak Trip Distribution

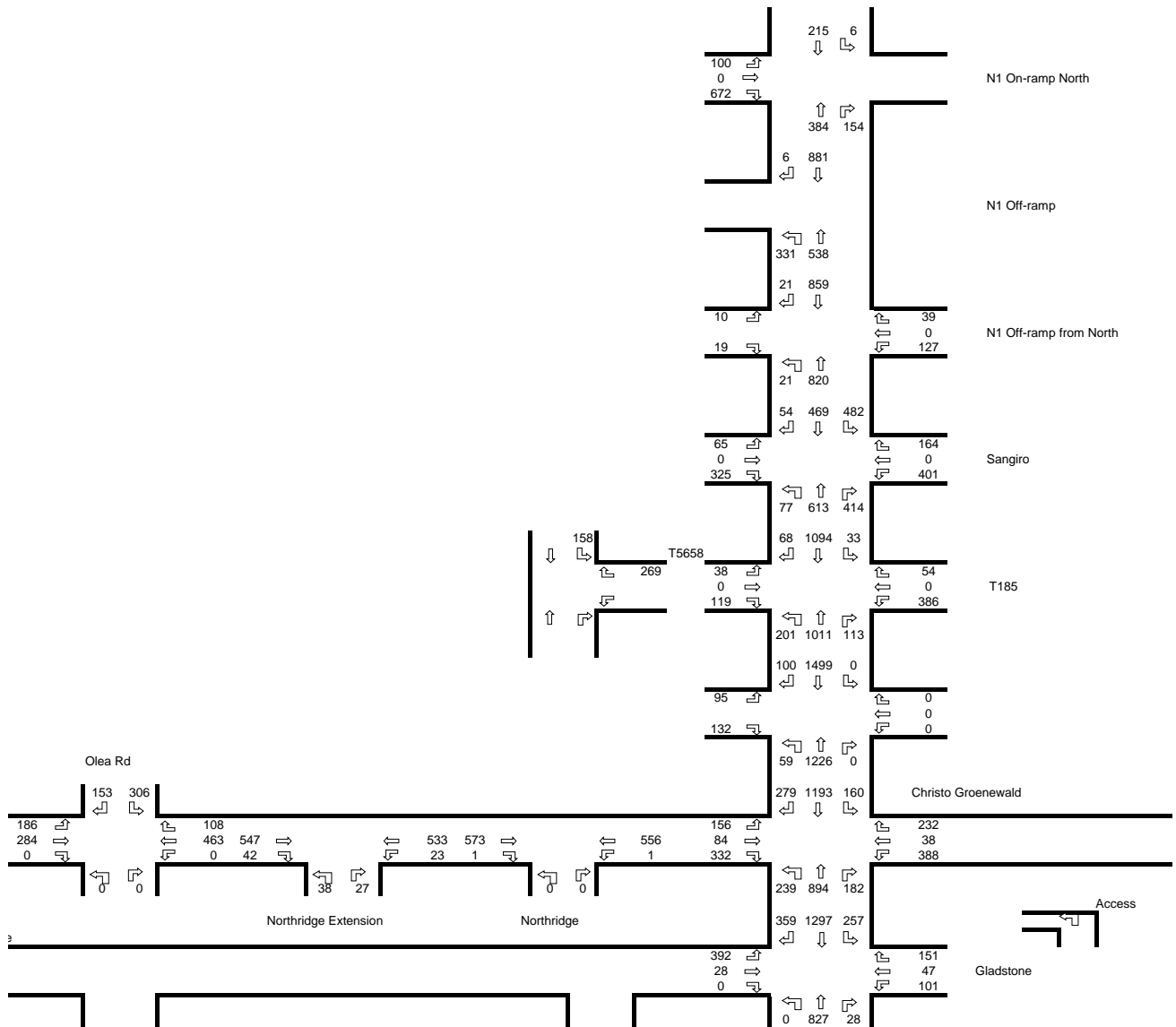


Figure 4.1c: AM Latent Rights

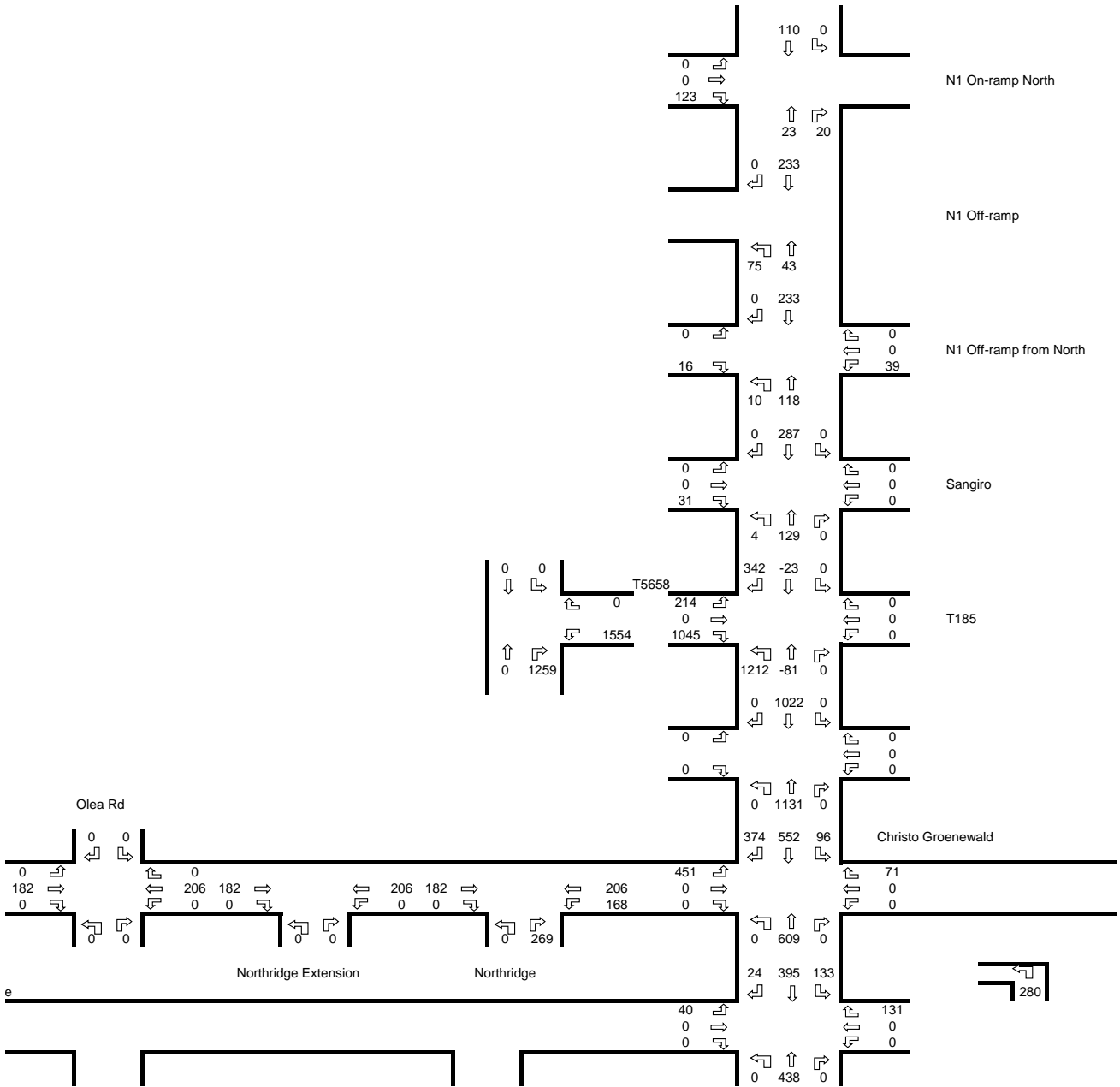


Figure 4.2a: PM Peak Trip Distribution

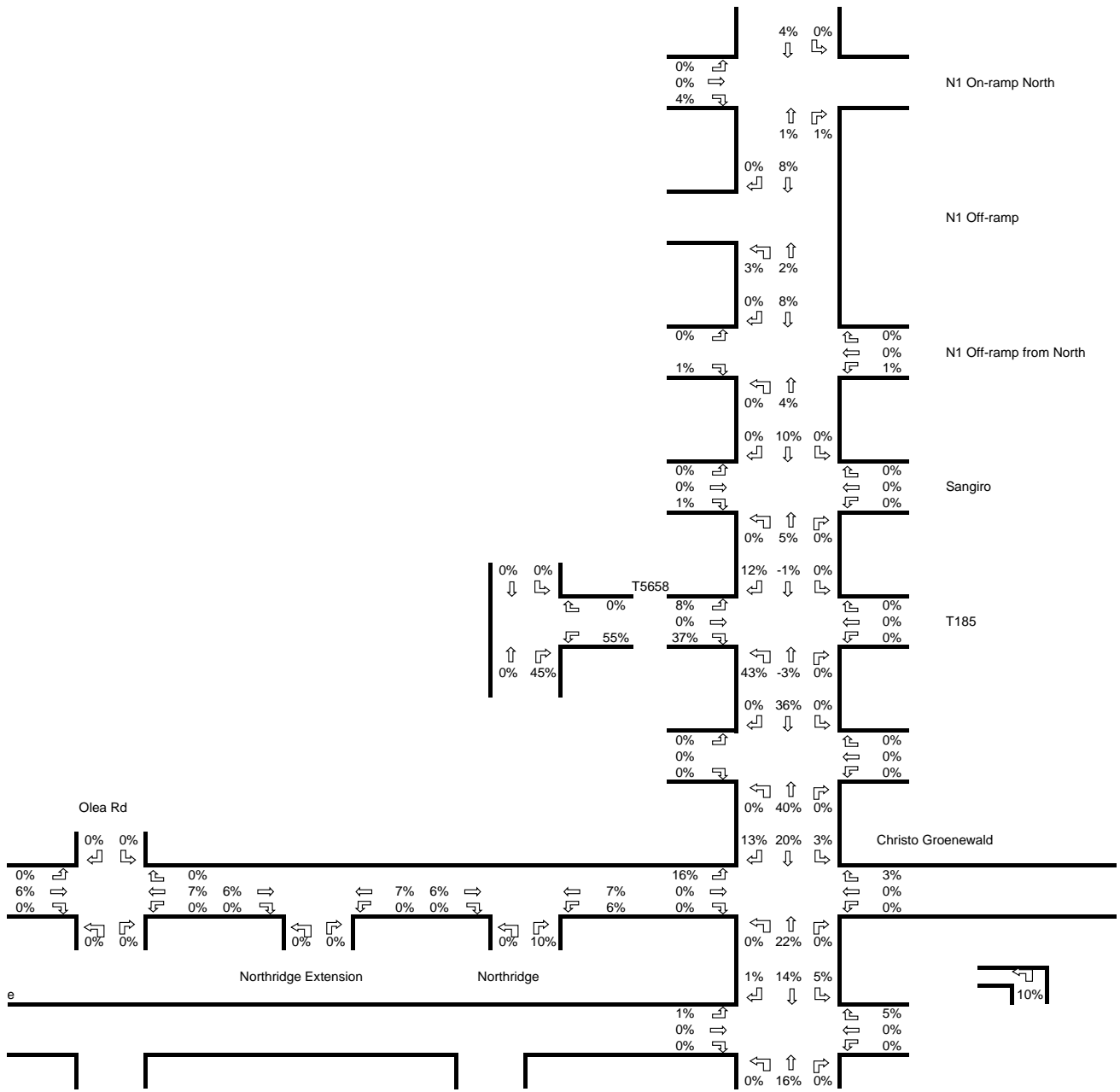


Figure 4.2b: PM Peak Trip Distribution

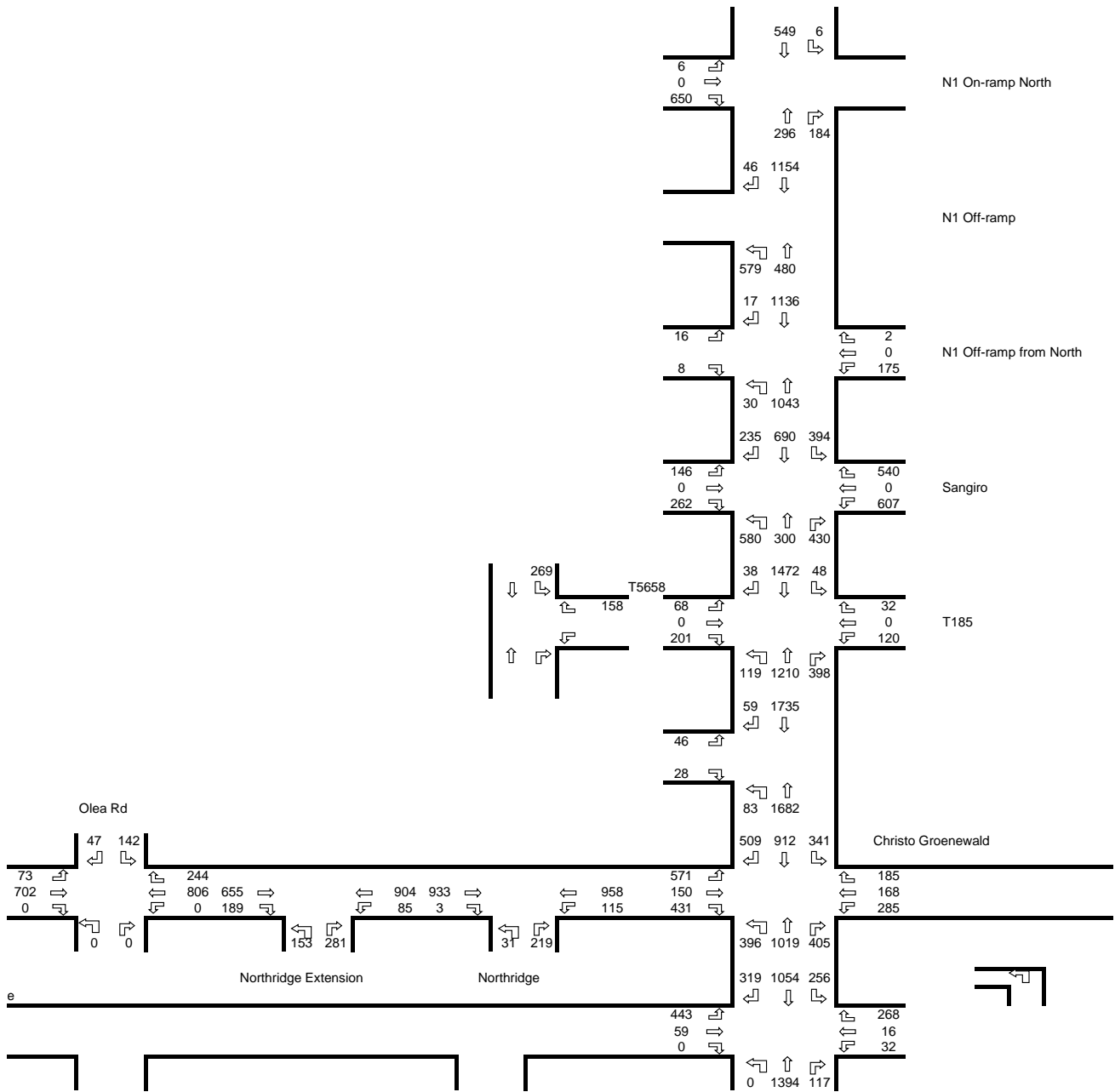


Figure 4.2c: PM Latent Rights

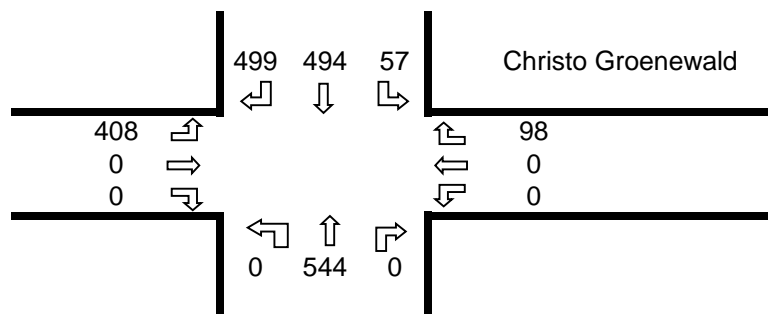


Figure 4.3a: Saturday Peak Trip Distribution

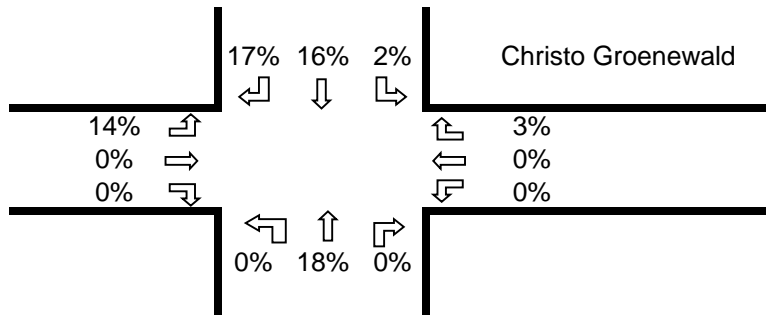


Figure 4.3b: Saturday Peak Trip Distribution

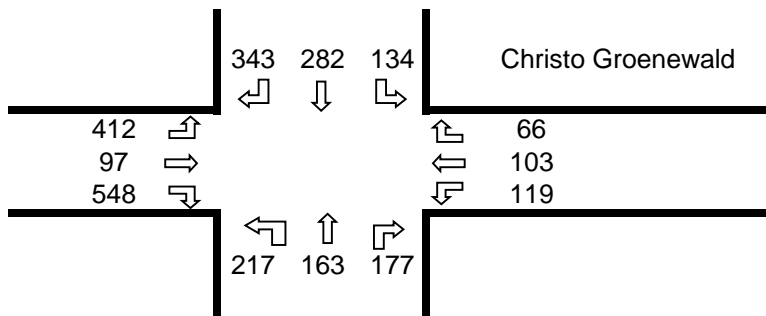


Figure 4.3c: Saturday Latent Rights

4.2 Scenario 2 – Some Trip Distribution via Wild Olive Estate

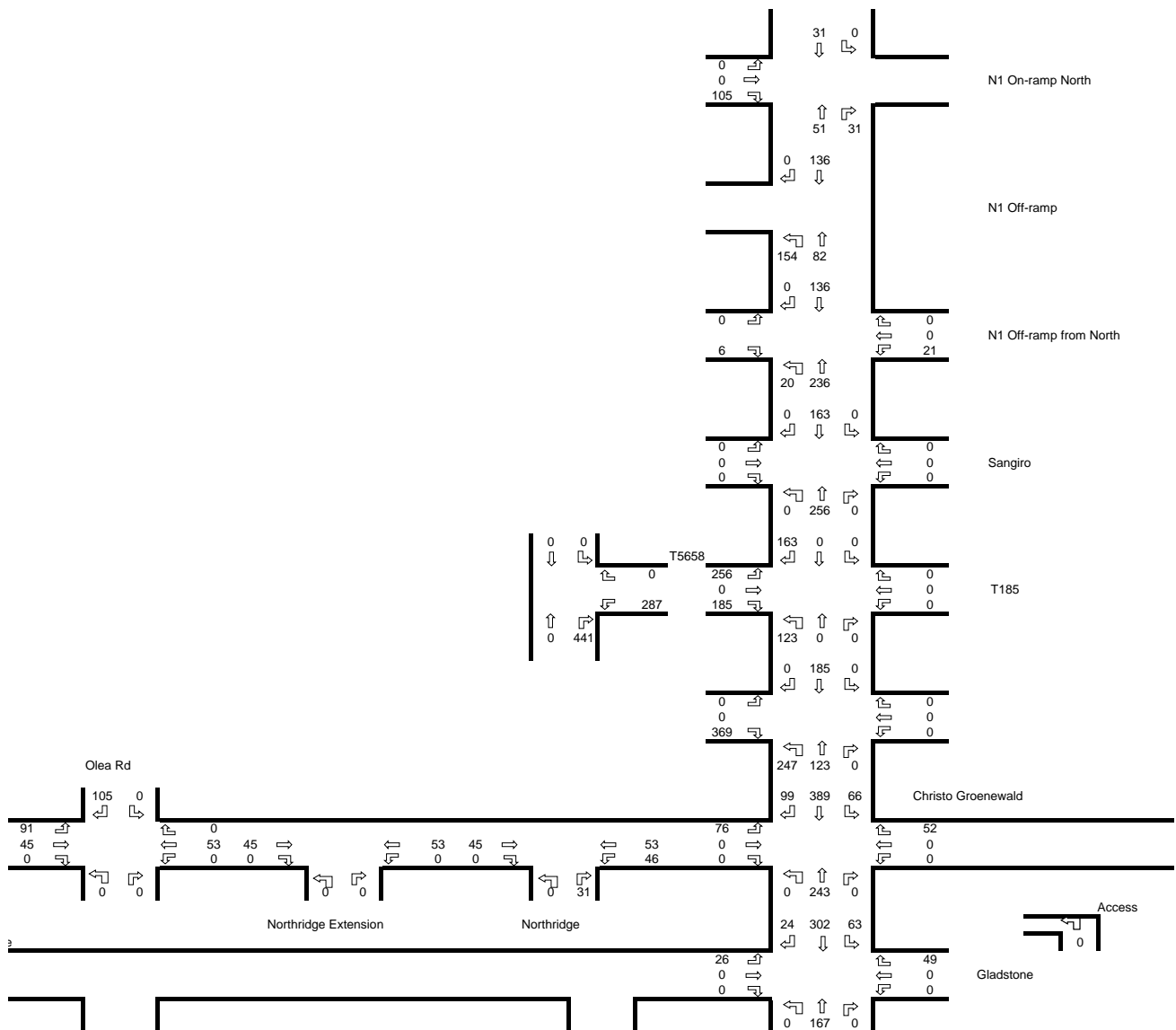


Figure 4.1d: AM Peak Trip Distribution

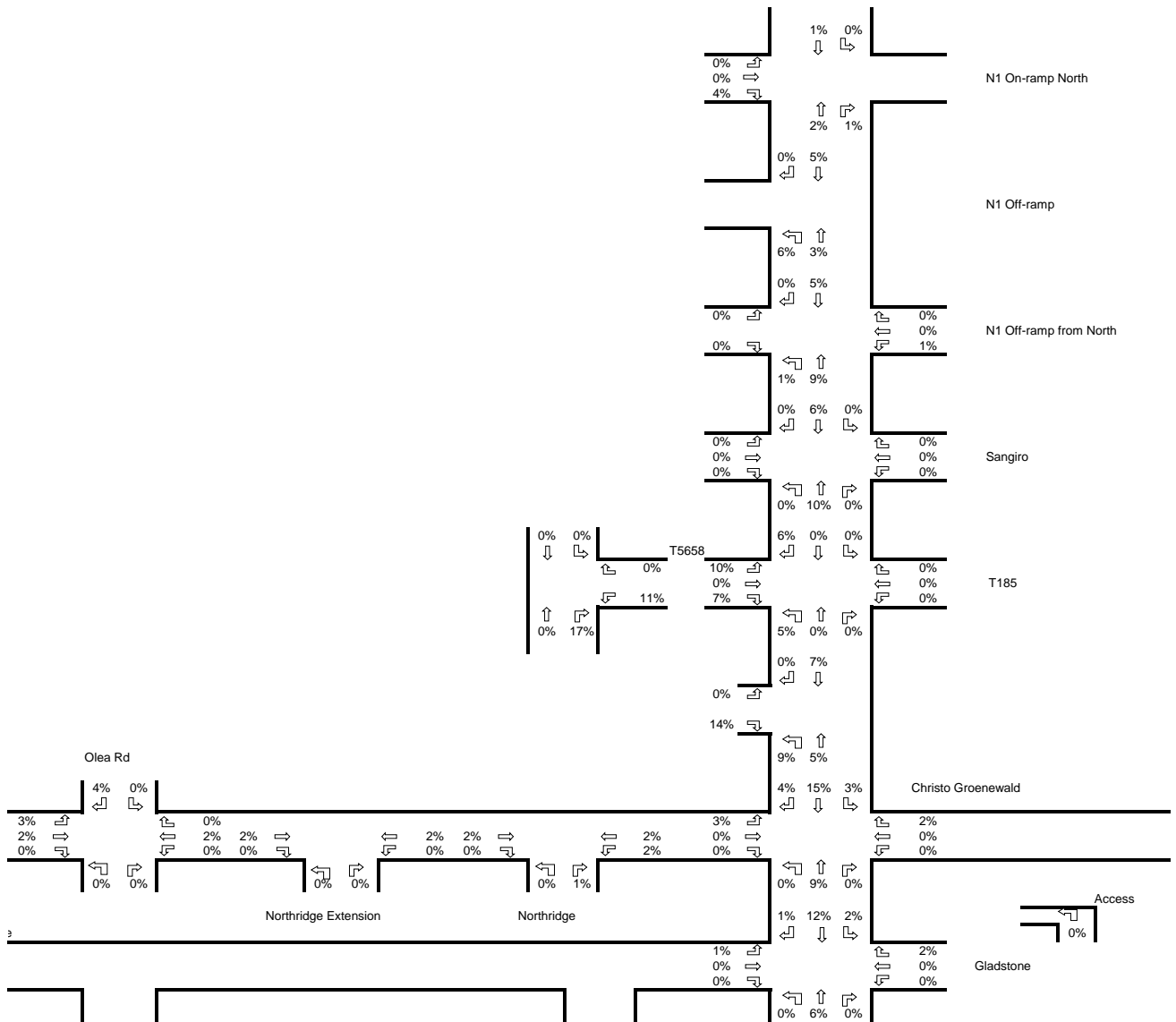


Figure 4.1e: AM Peak Trip Distribution

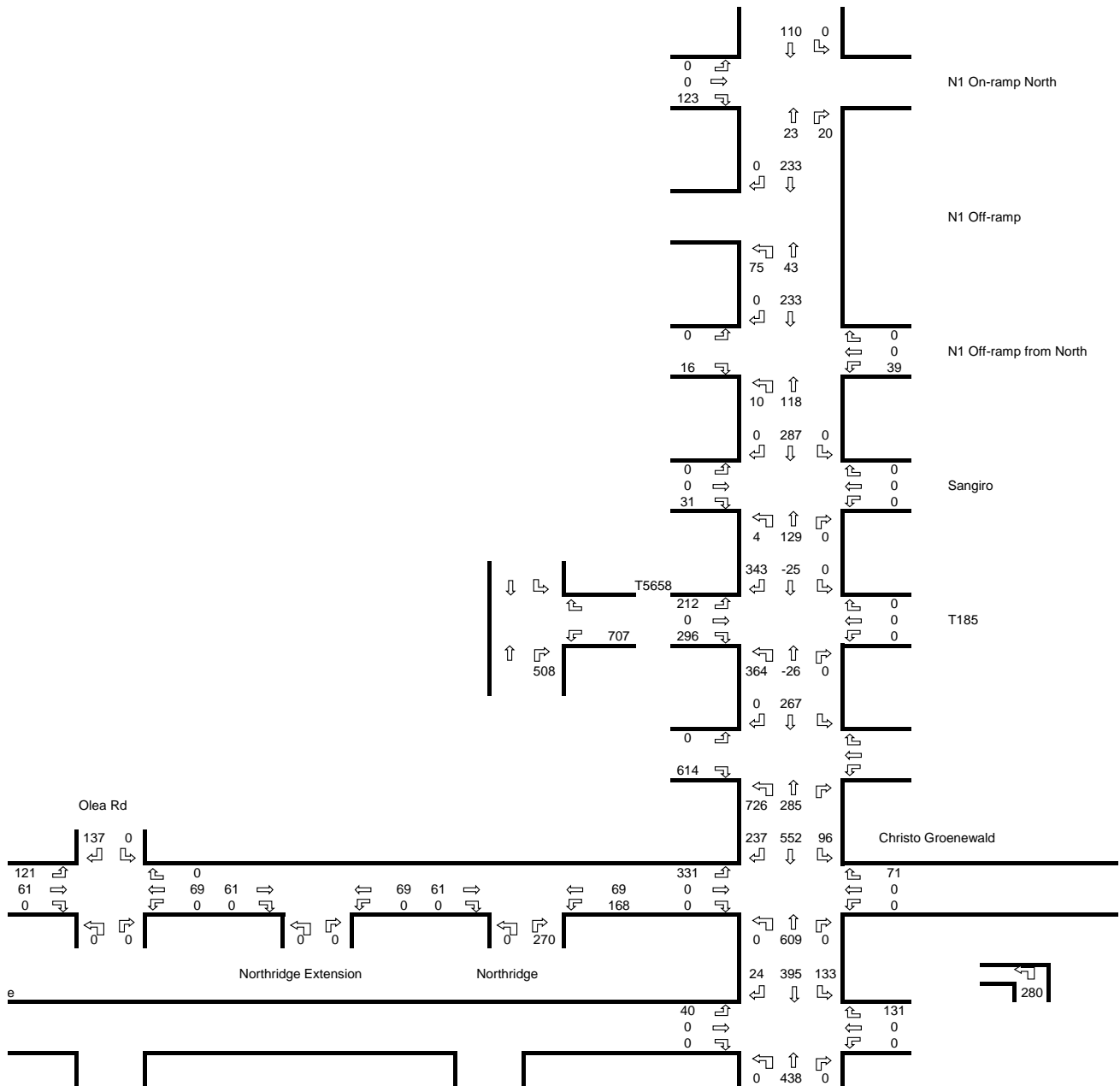


Figure 4.2d: PM Peak Trip Distribution

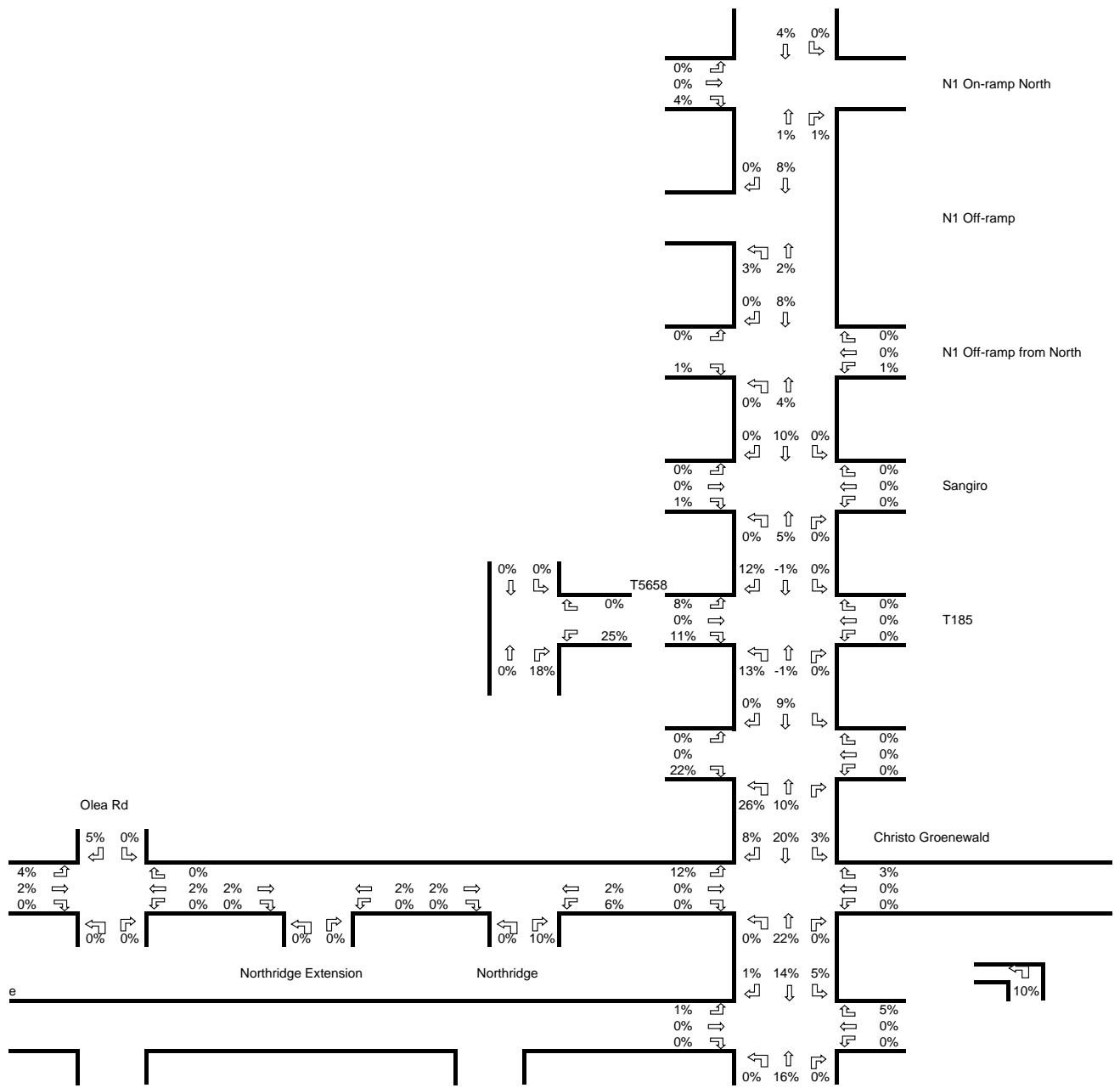


Figure 4.2e: PM Peak Trip Distribution

5 TRIP ASSIGNMENT

The generated trips have been assigned to the background traffic volumes. The following figures show the traffic volumes for the different peak periods and scenarios.

5.1 Scenario 1 – No Trip Distribution via Wild Olive Estate

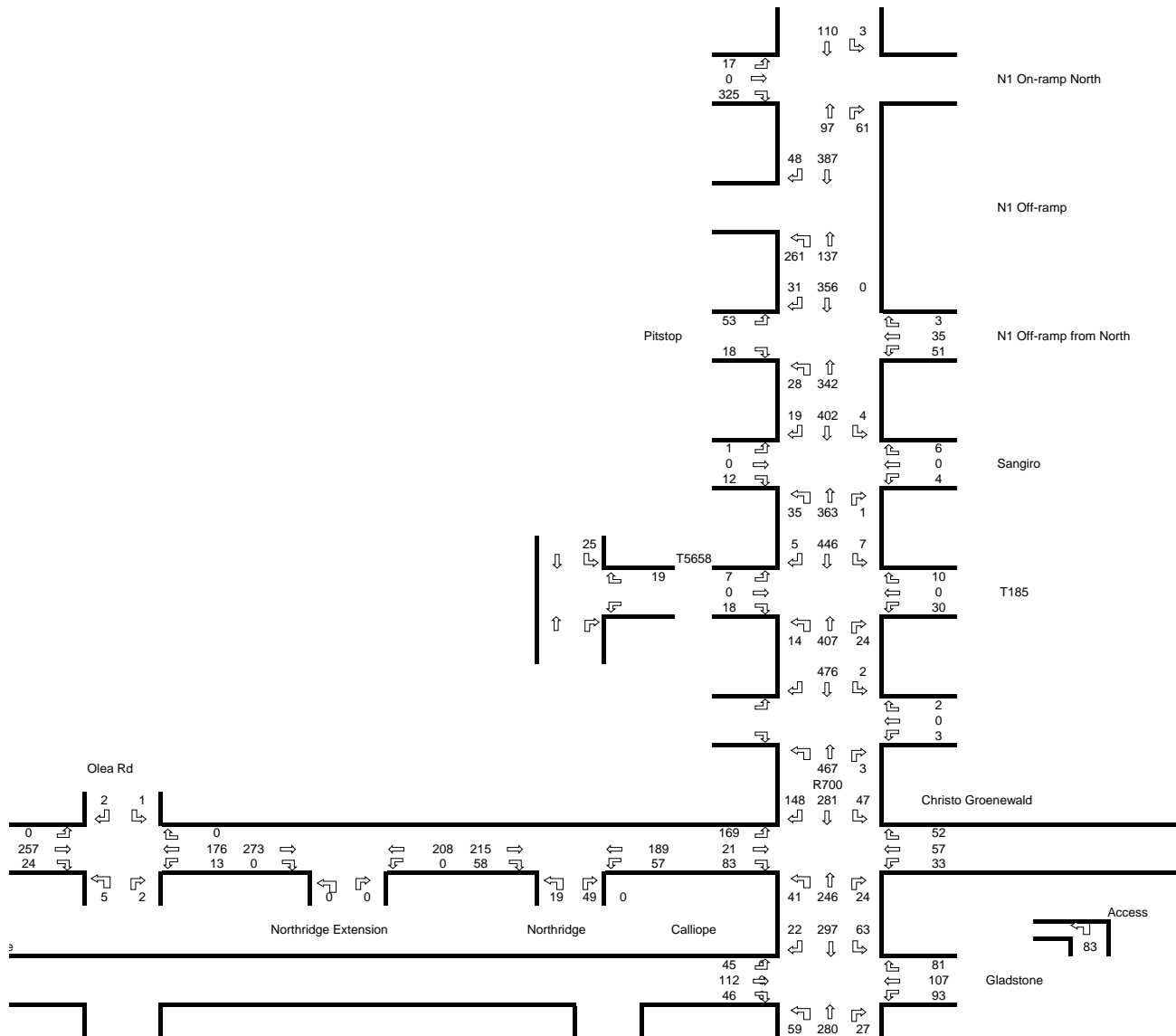


Figure 5.1a: 2017 AM Peak Volumes

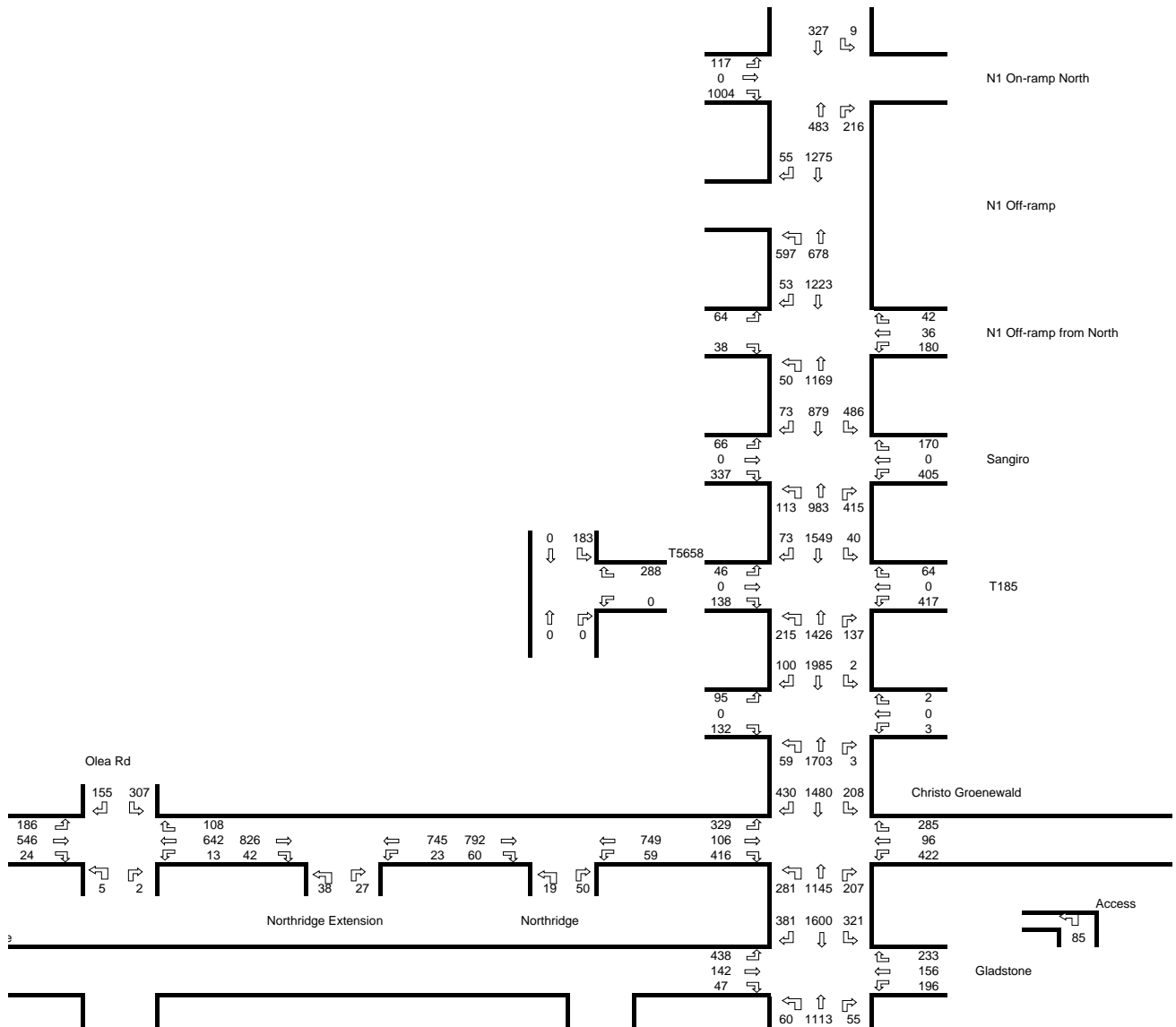


Figure 5.1b: 2019 AM Background Peak (Including Latent Rights)

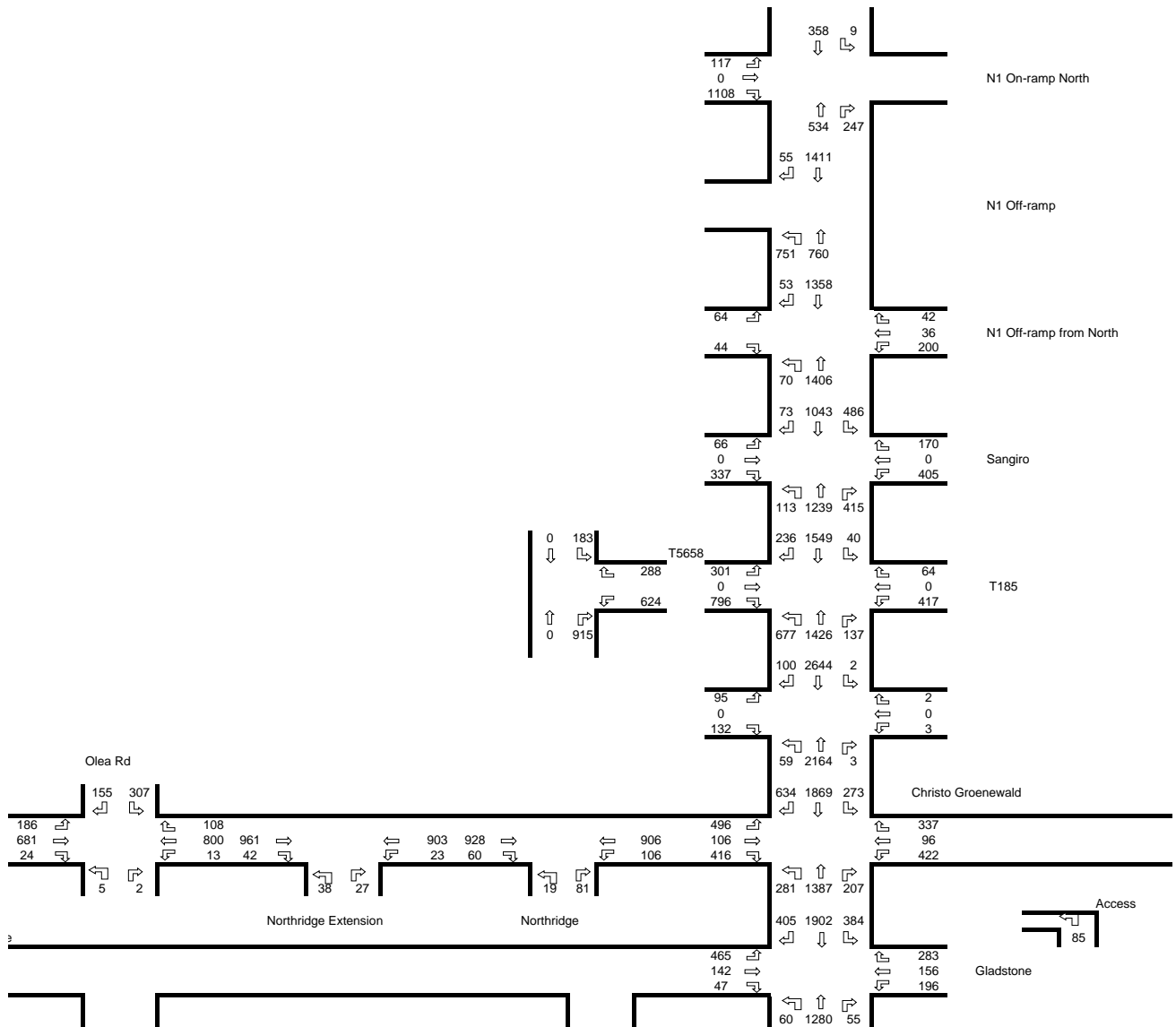


Figure 5.2a: 2019 AM Background Peak with Development

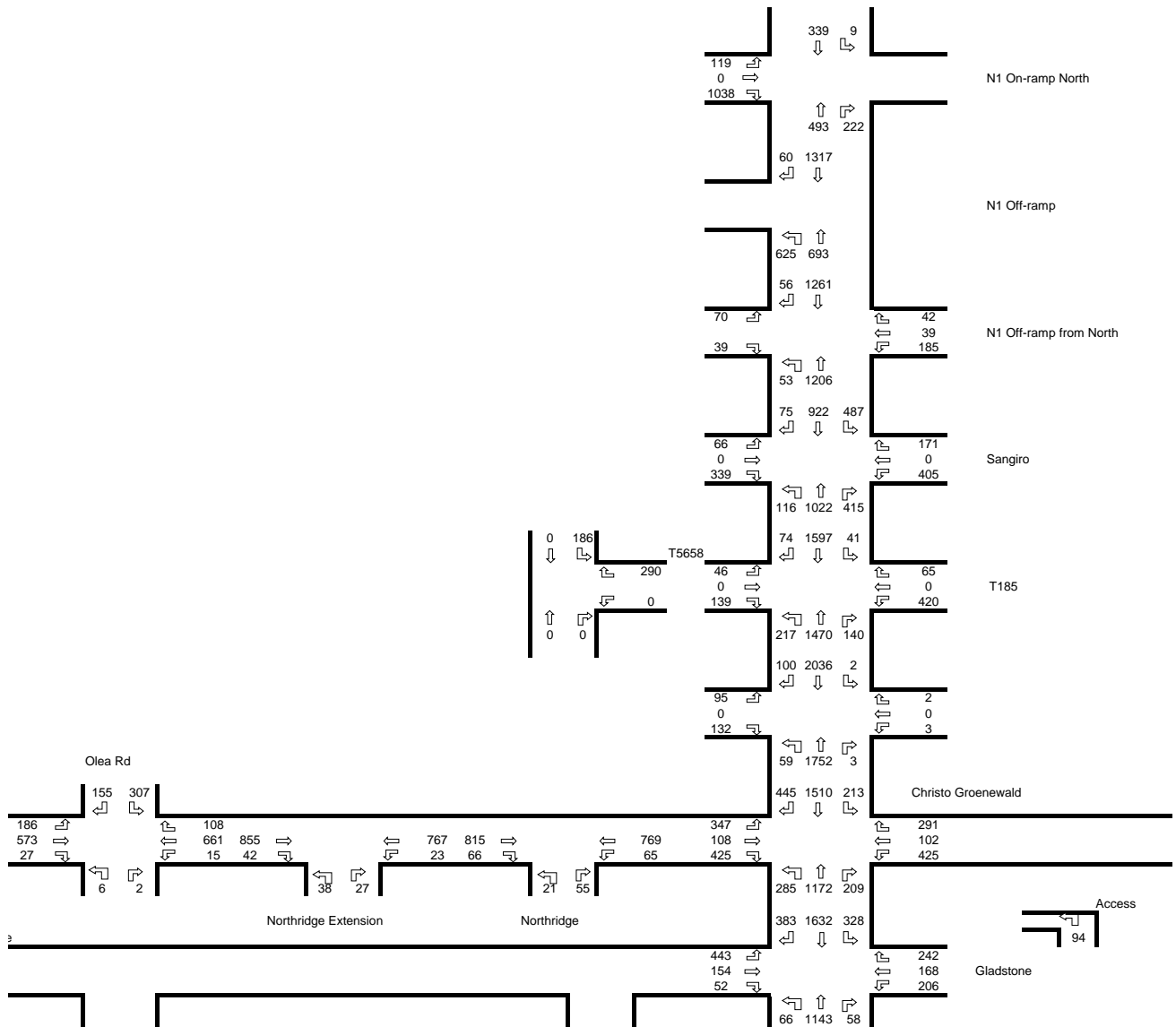


Figure 5.3: 2029 AM Peak Background Peak (Including Latent Rights)

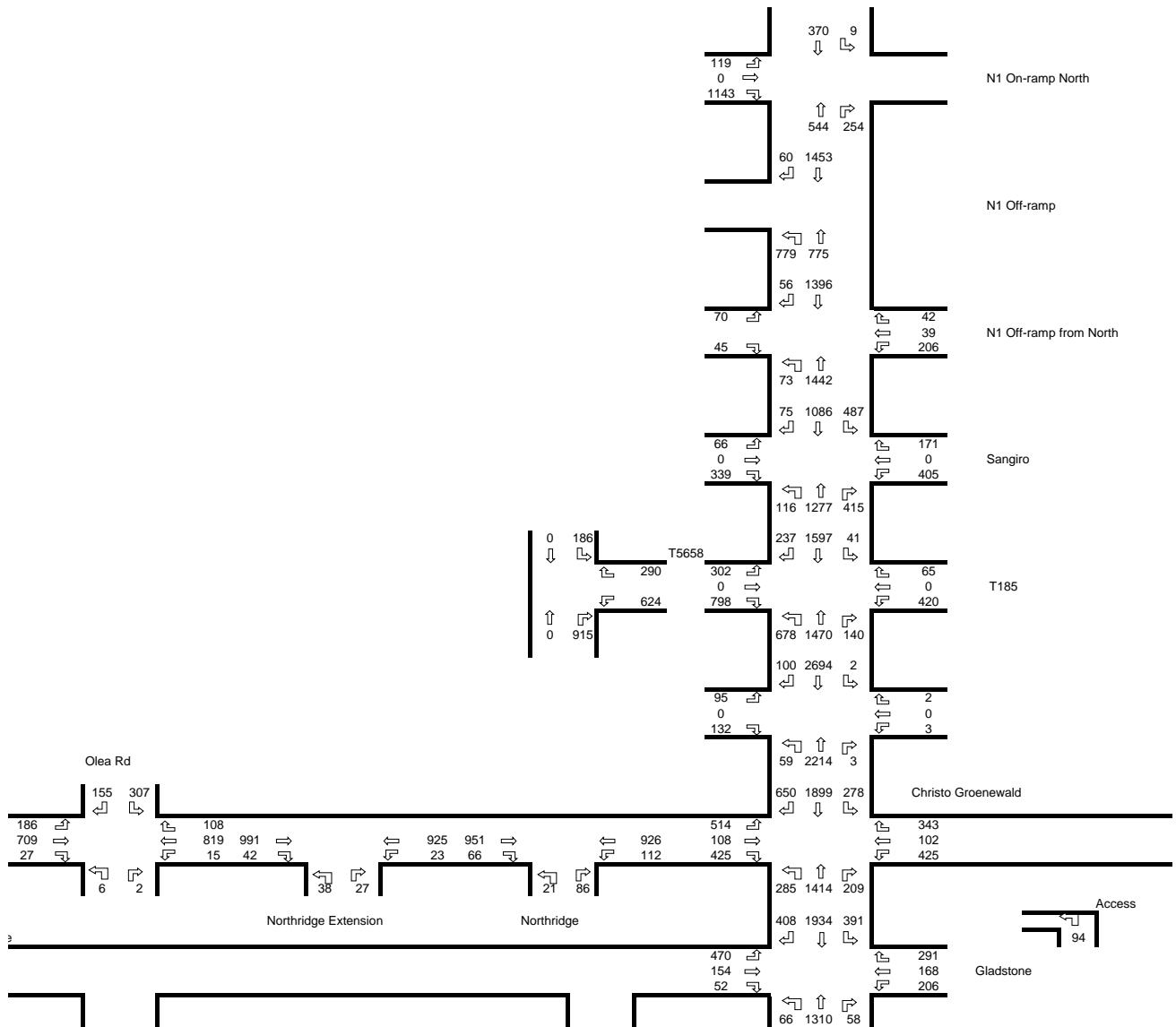


Figure 5.4a: 2029 AM Background Peak with Development

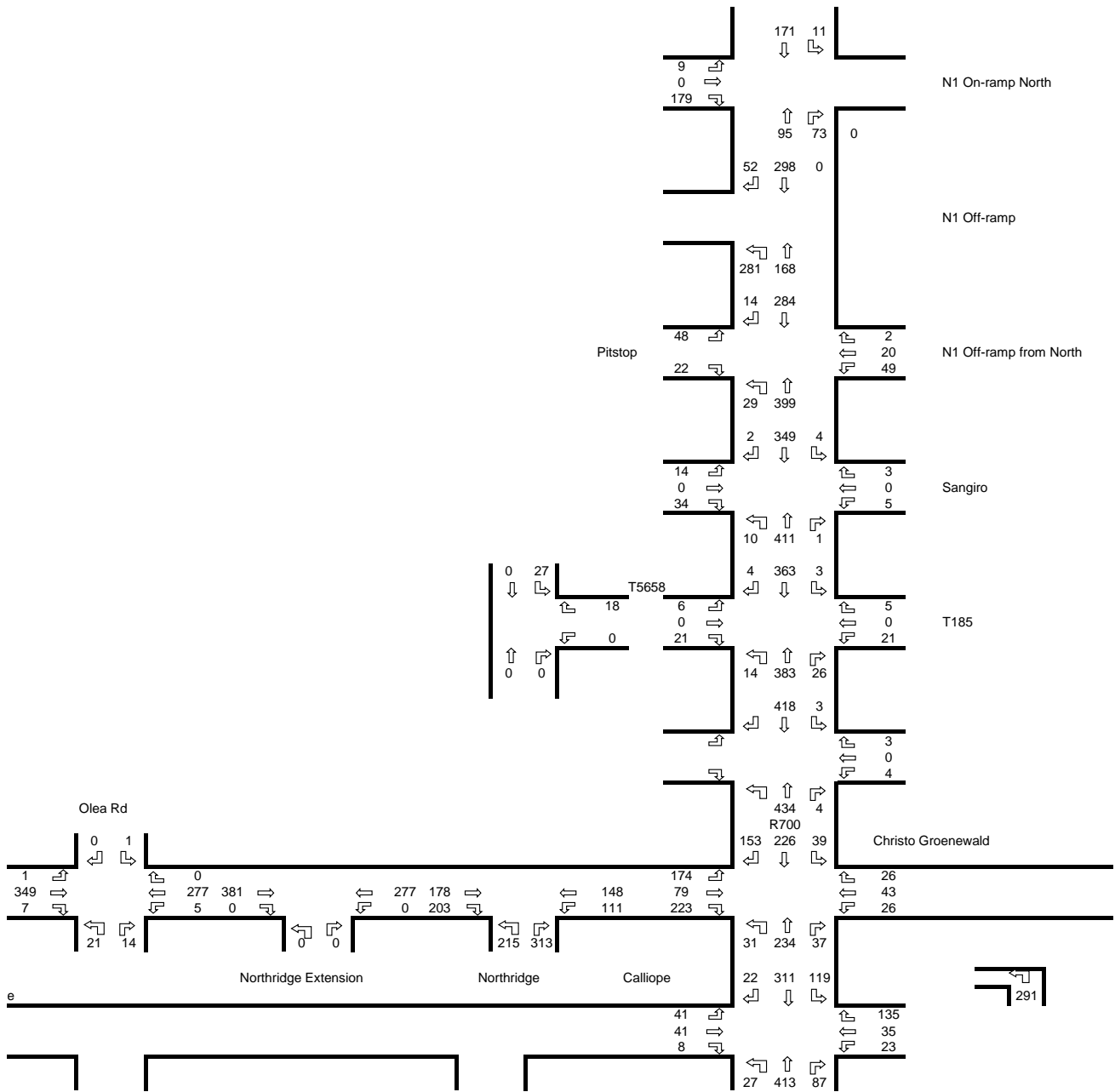


Figure 5.5a: 2017 PM Peak Volumes

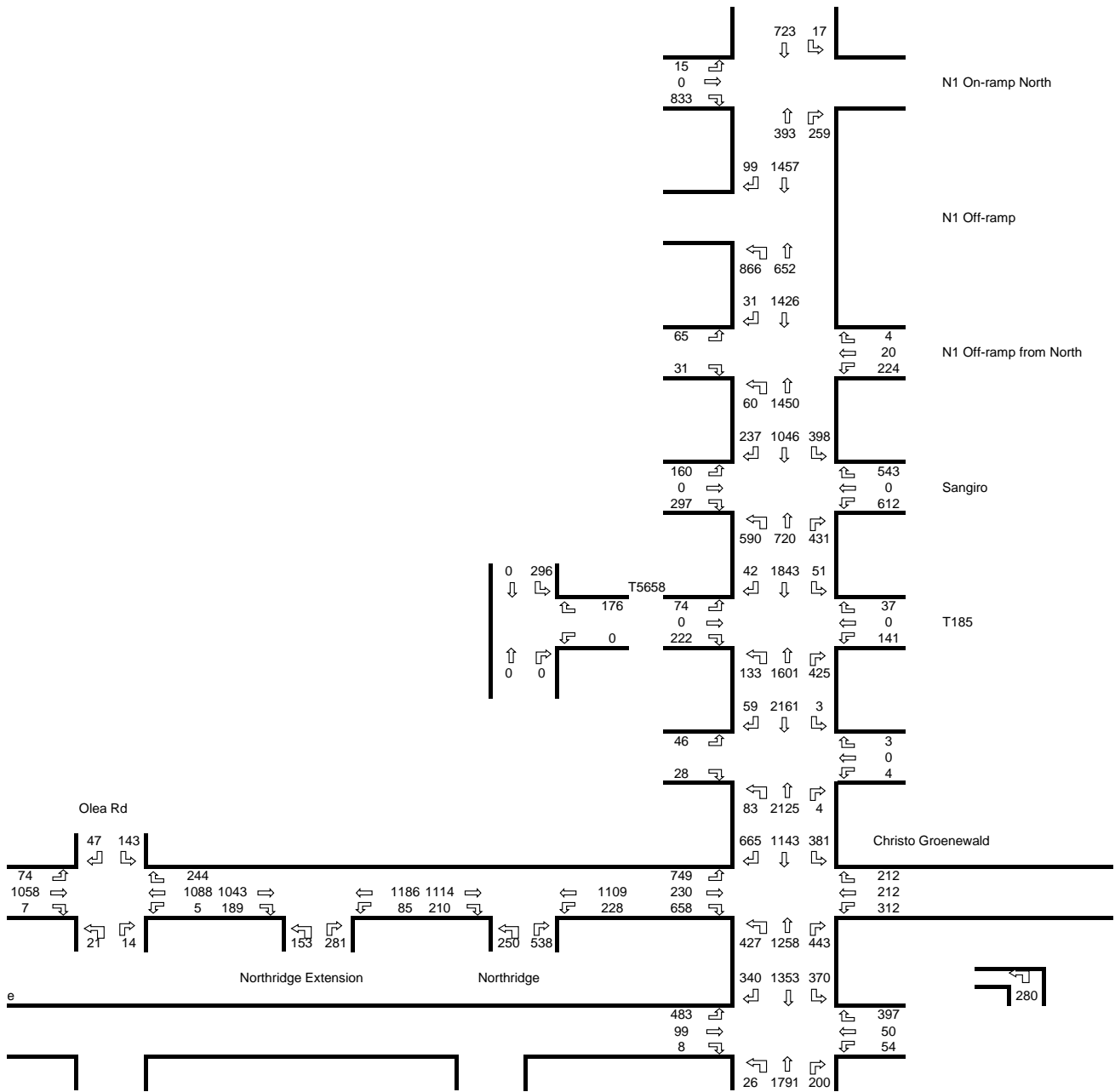


Figure 5.5b: 2019 PM Background Peak (Including Latent Rights)

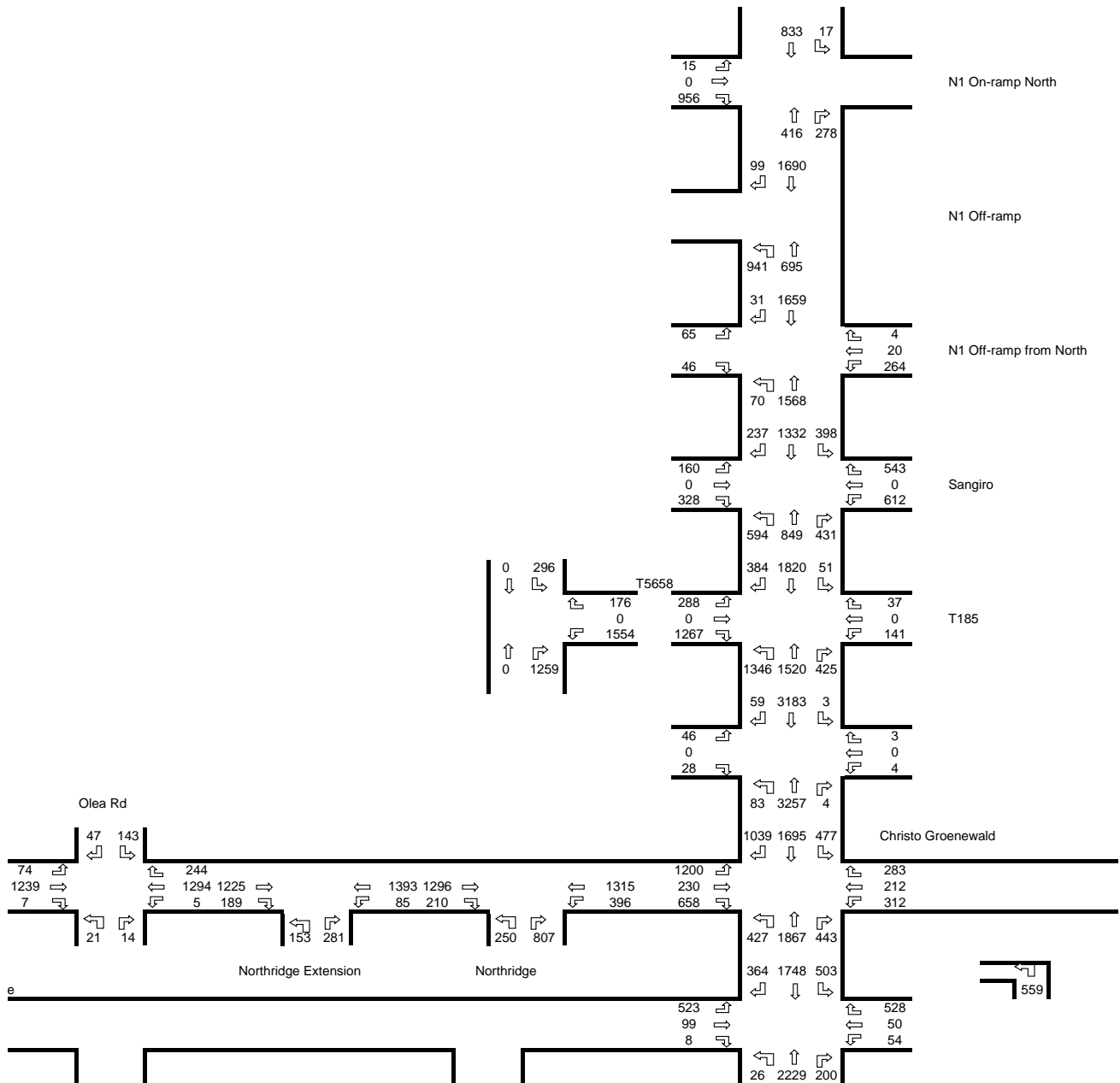


Figure 5.6a: 2019 PM Background Peak with Development

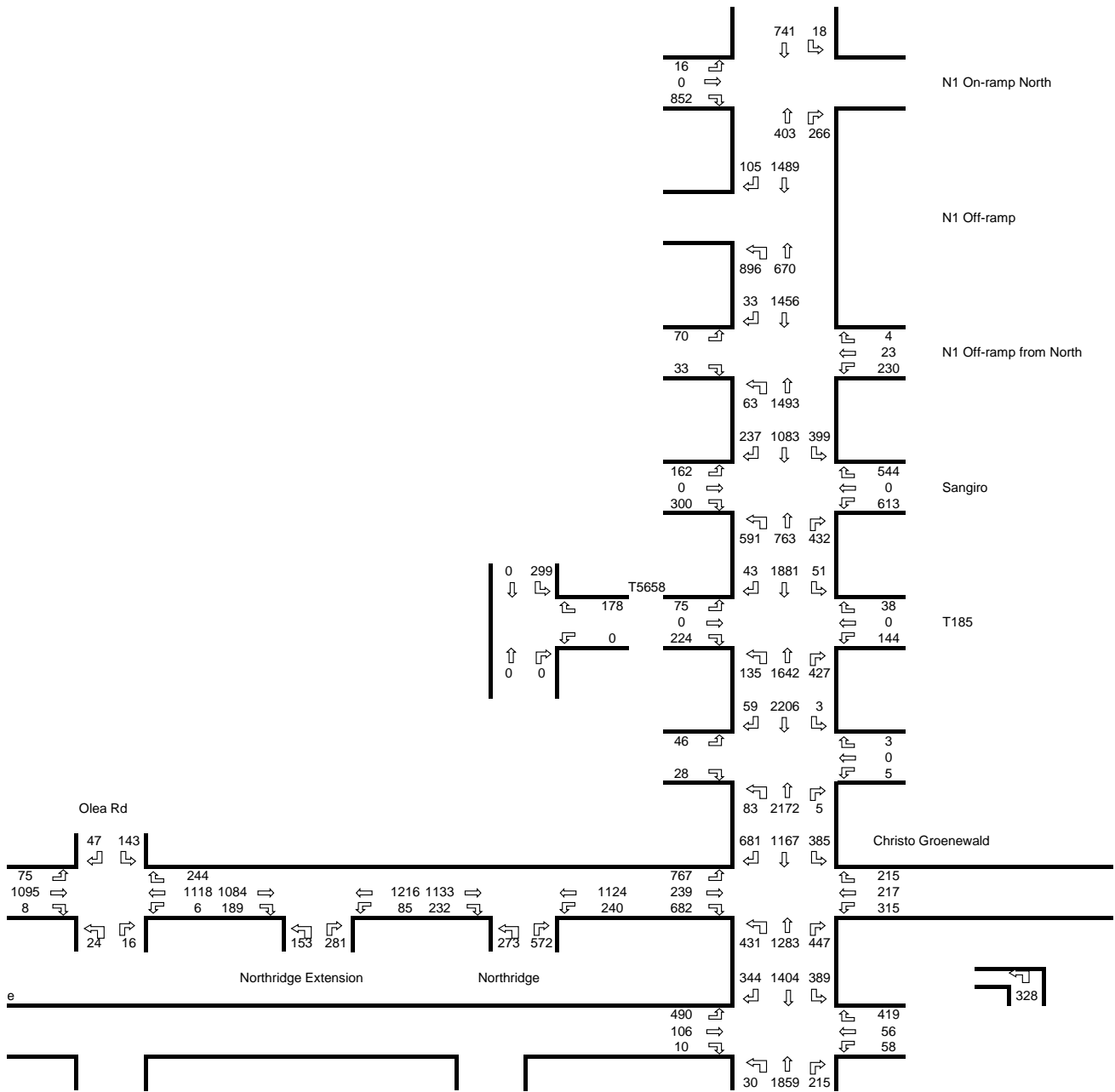


Figure 5.7: 2029 PM Peak Background Peak (Including Latent Rights)

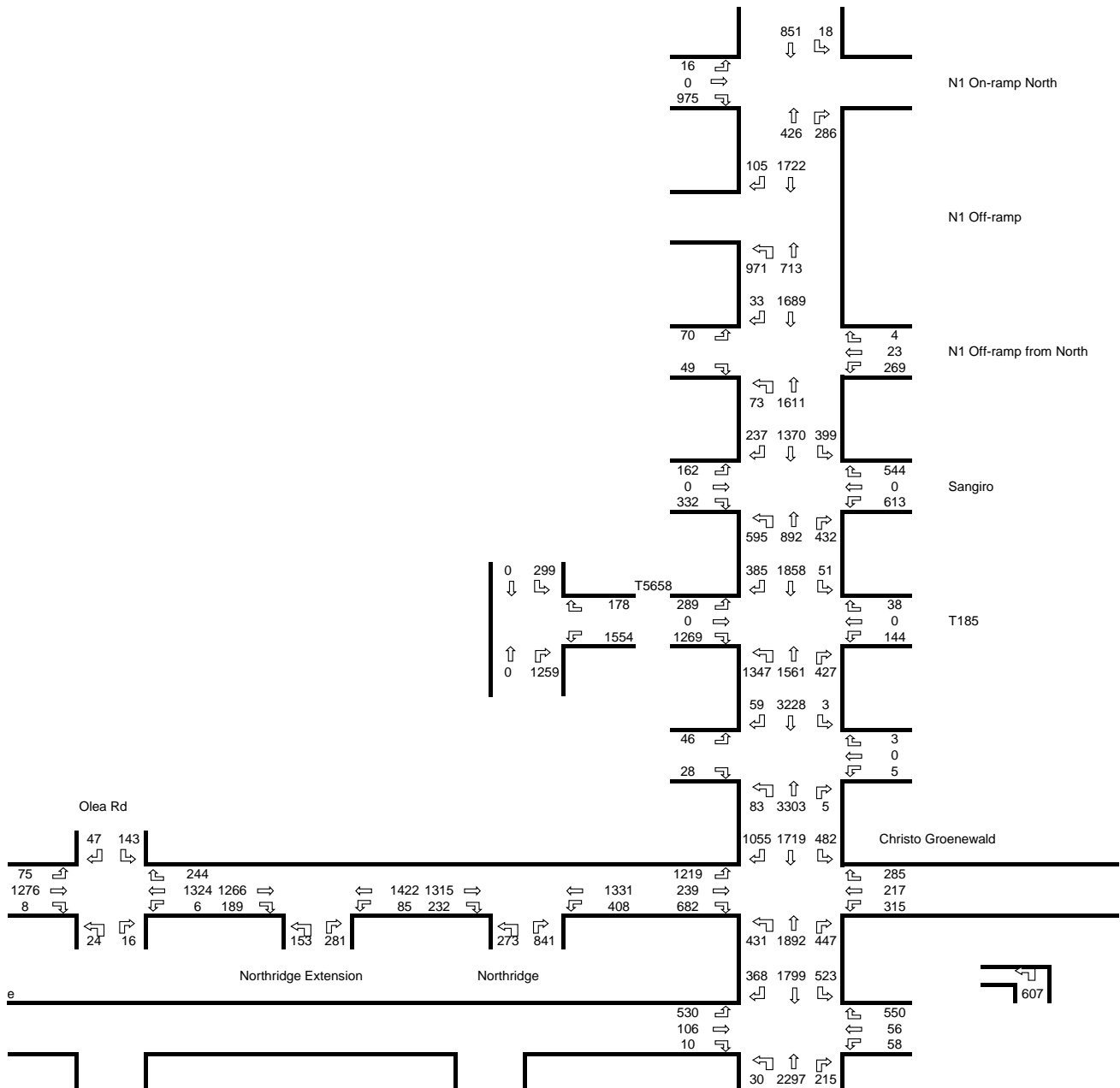


Figure 5.8a: 2029 PM Background Peak with Development

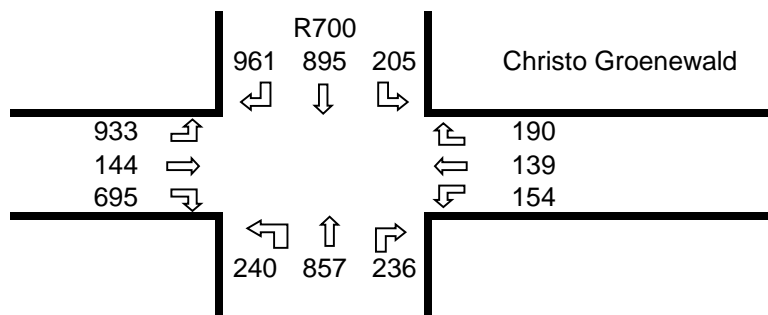


Figure 5.12a: 2029 Saturday Peak with Development

5.2 Scenario 2 – Some Trip Distribution via Wild Olive Estate

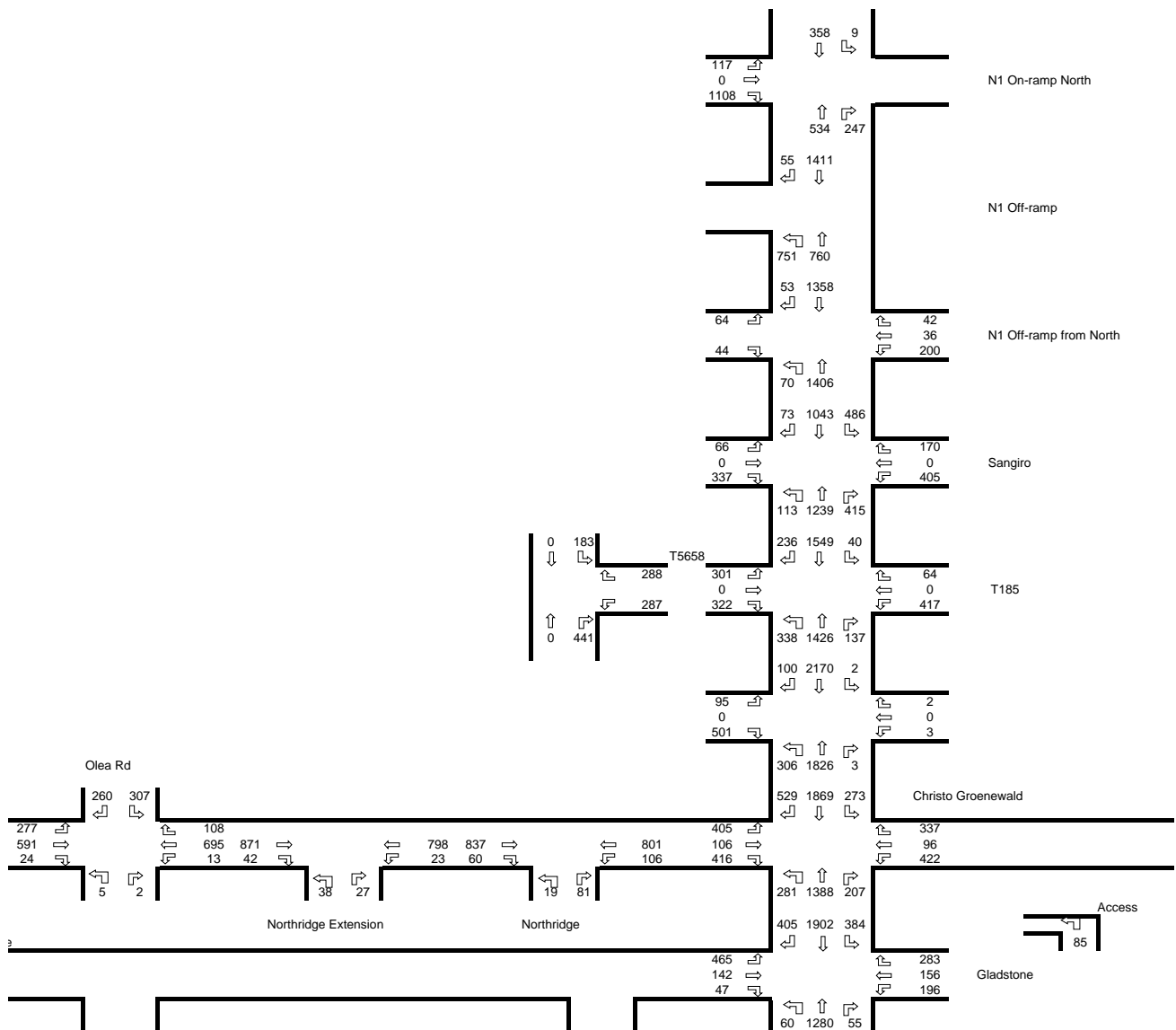


Figure 5.2b: 2019 AM Background Peak with Development

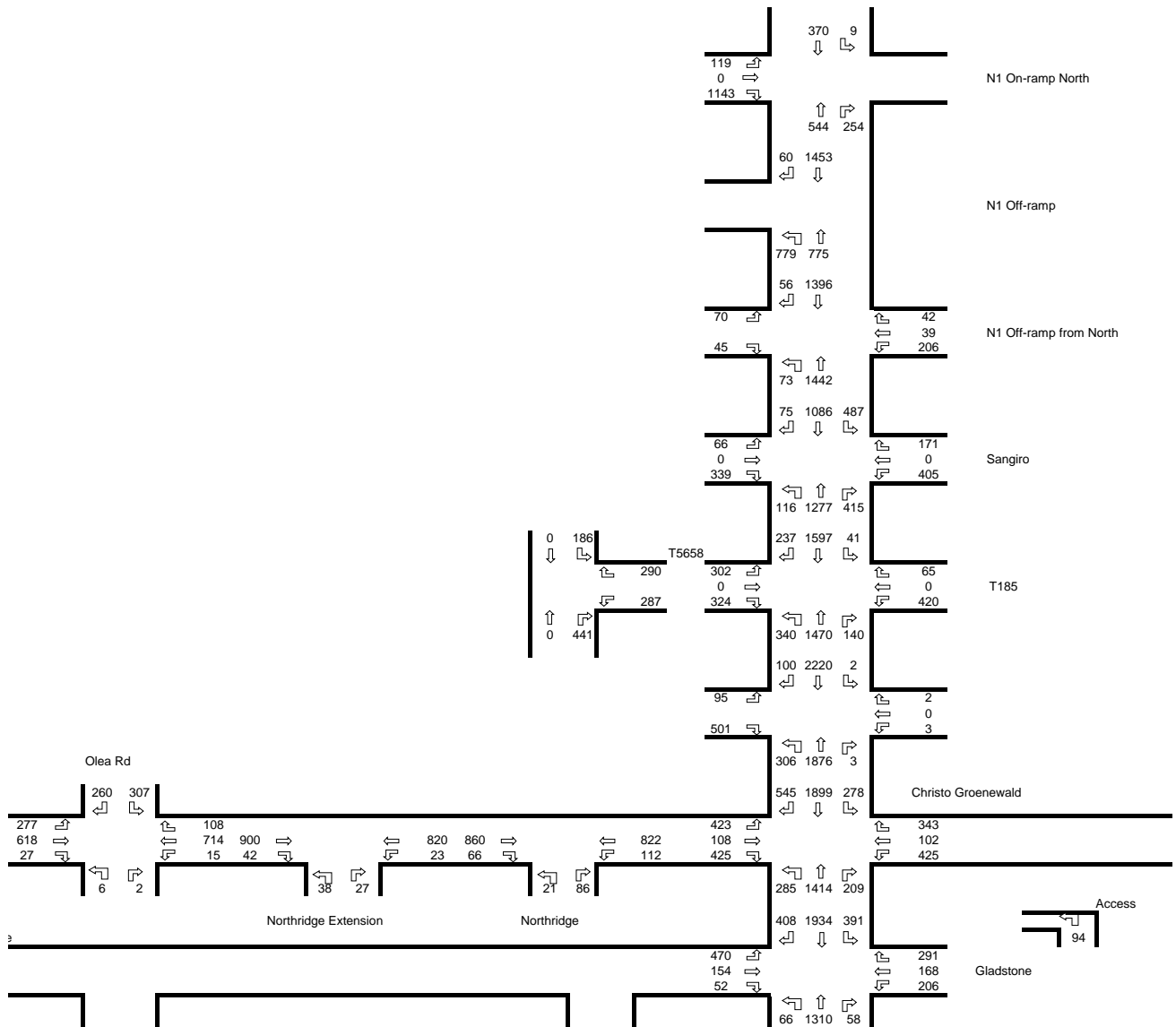


Figure 5.4b: 2029 AM Background Peak with Development

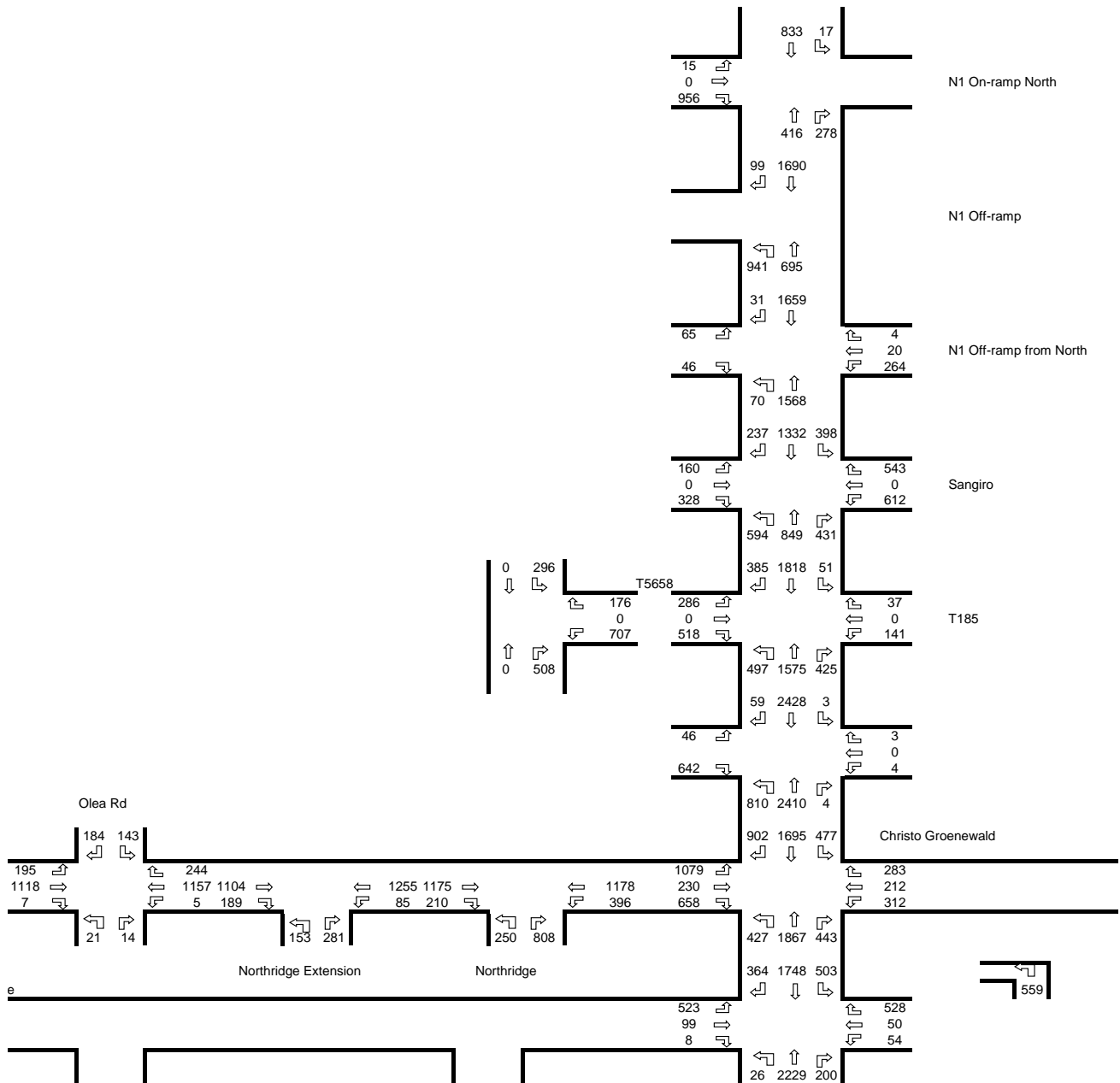


Figure 5.6b: 2019 PM Background Peak with Development

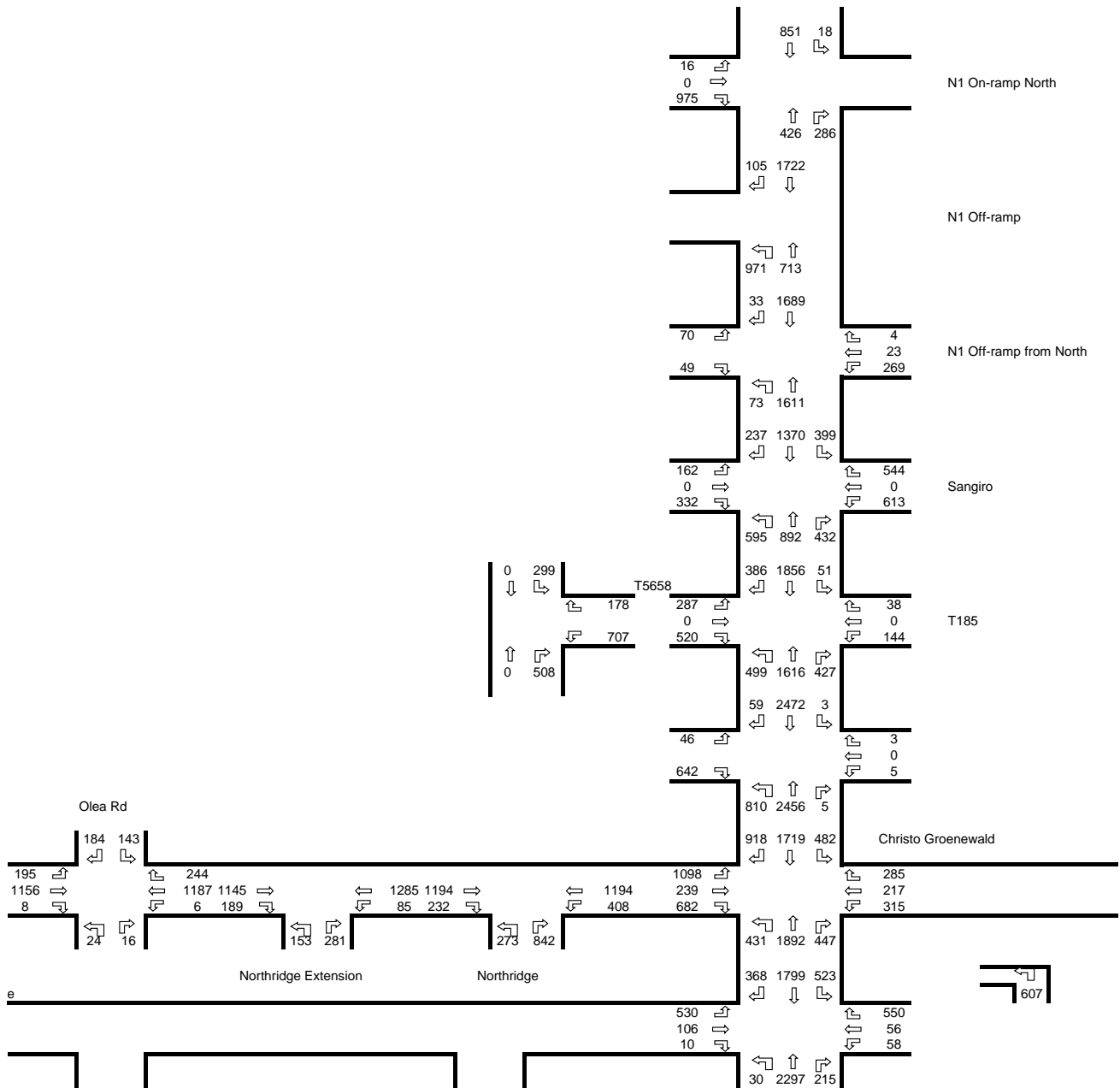


Figure 5.8b: 2029 PM Background Peak with Development

6 CAPACITY ANALYSIS

Capacity analyses were performed by means of the SIDRA program. The tables below show the Levels of Service of the different traffic movements. Levels of Service (LOS) give an indication of operational characteristics in a traffic stream and their perception by motorists and passengers. Levels of service A to D are usually assumed to be acceptable, with LOS E regarded as the maximum flow rate, or capacity of the facility.

The following intersections were investigated.

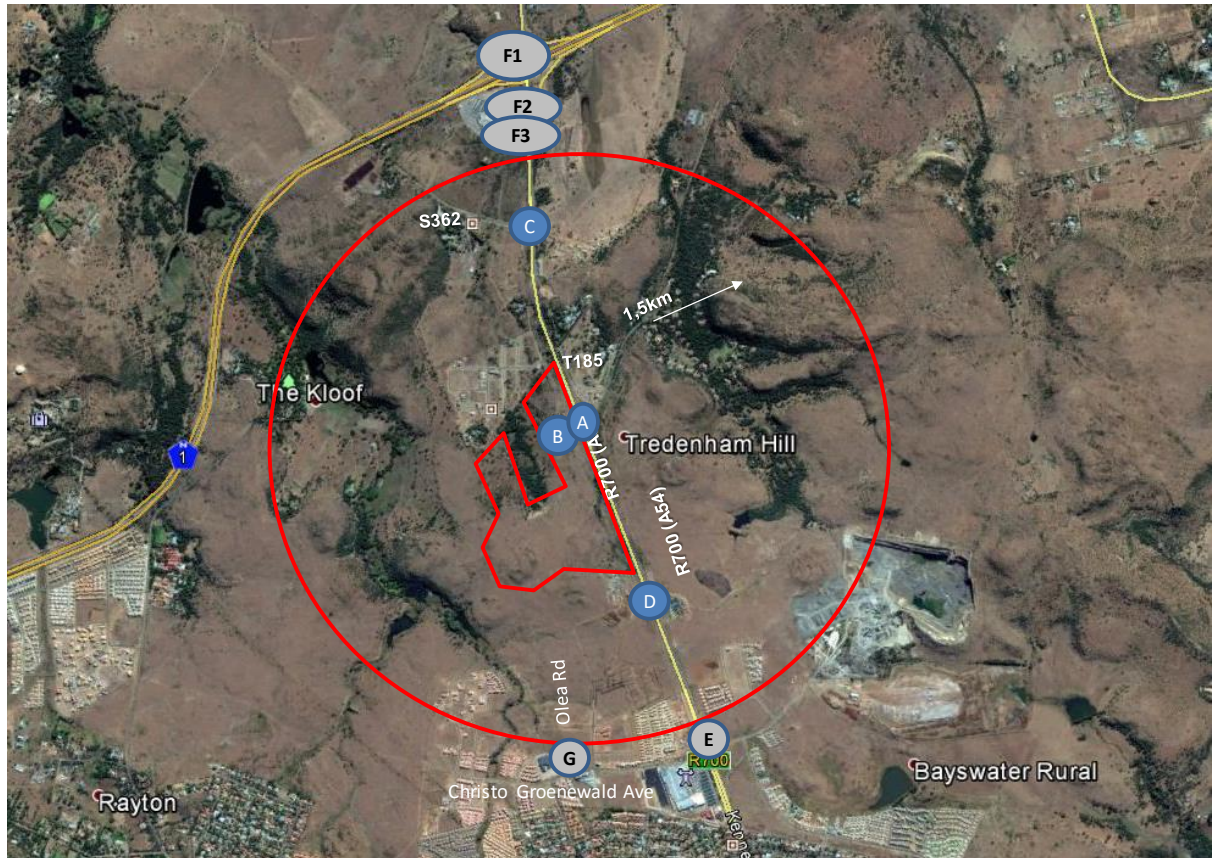


Figure 6.1 Intersections Analysed

Intersections within 1.5km radius

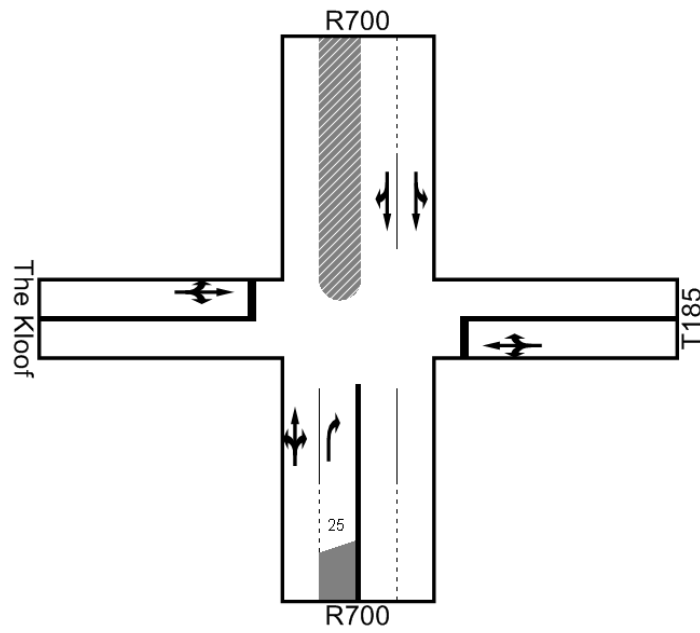
- a) Intersection A: T185 / T5658 / R700 Intersection
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Additional Intersections

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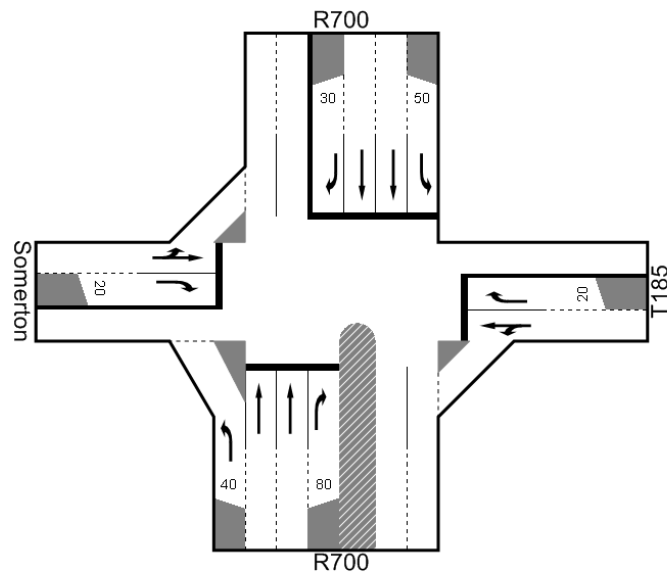
6.1 Intersection A: T185 / R700 intersection

The current layout is as follows:



Current Layout

It was previously shown that the intersection will experience capacity problems with the latent rights. The following signalised layout was previously identified.

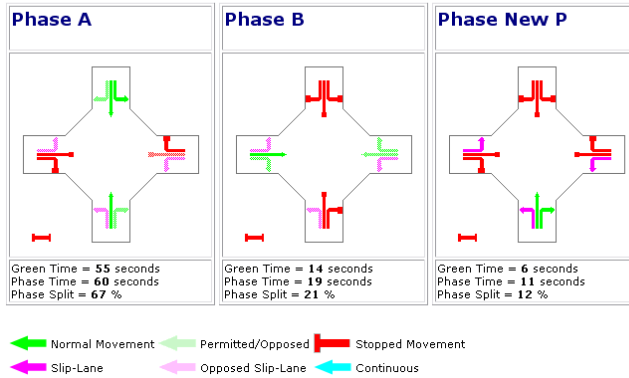


Phasing Summary

T185 R700

2017 AM Peak Background with Development

C = 90 seconds
Cycle Time Option: **User-specified cycle time**
Phase times determined by the program.

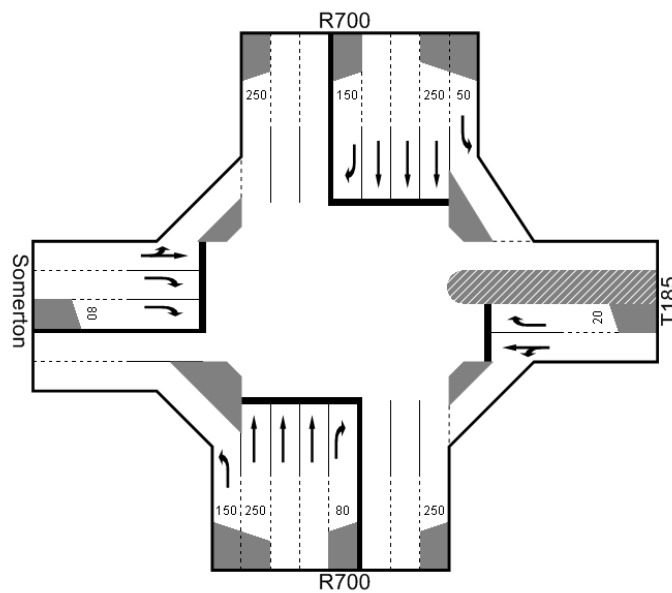


Previously Identified Layout

With this layout levels of service will be as follows for the worst case scenarios for Scenario 1

Intersection: R700/T185		North			East			South			West		
		L	T	R	L	T	R	L	T	R	L	T	R
3a	2029 AM Background Peak	C	D	D	A	A	D	A	A	C	A	A	D
4a	2029 AM Peak with Development	C	F	D	A	A	D	A	B	C	F	F	D
7a	2029 PM Background Peak	B	C	C	A	A	D	A	A	D	D	D	D
8a	2022 PM Peak with Development	B	C	C	A	A	D	A	A	D	C	B	D

The upgraded intersection will not suffice for the situation with the development and will require further upgrading as follows:

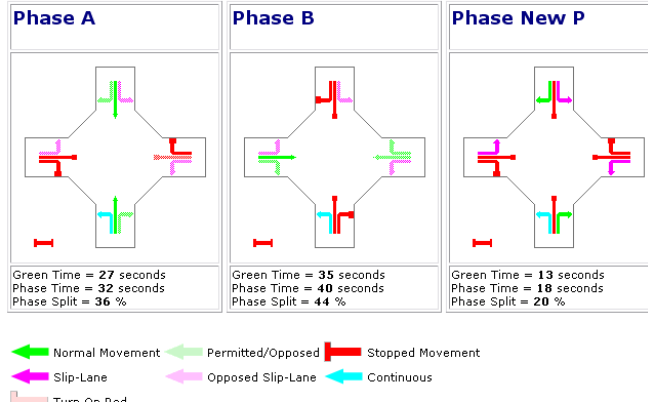


Phasing Summary

T185 R700

2029 PM Peak Background with Dev

C = 90 seconds
Cycle Time Option: **User-specified cycle time**
Phase times determined by the program.

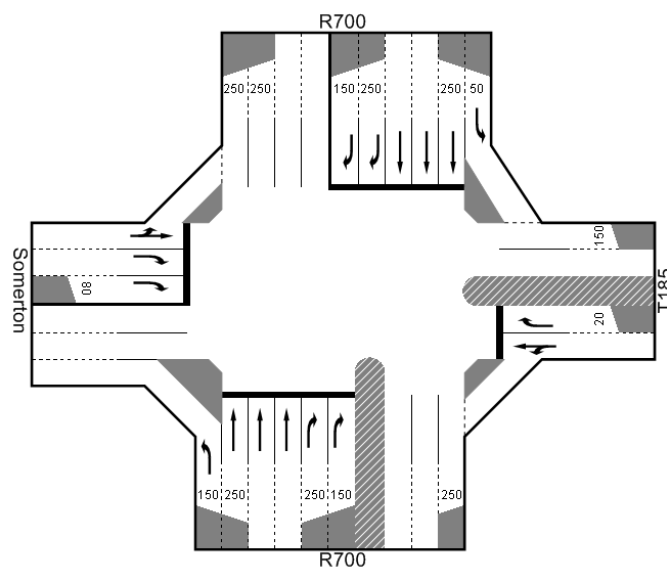


Further Upgraded Layout

Worst case levels of service with this layout will be as follows:

Intersection: R700/T185		North			East			South			West		
		L	T	R	L	T	R	L	T	R	L	T	R
3a	2029 AM Background Peak	C	D	D	A	A	D	A	A	C	A	A	D
4a	2029 AM Peak with Development	C	F	D	A	A	D	A	B	C	F	F	D
7a	2029 PM Background Peak	A	C	B	B	A	D	A	C	C	B	A	D
8a	2029 PM Peak with Development	A	F	F	B	A	C	E	D	E	B	A	F

The layout will not suffice for the afternoon peak and will have to be further upgraded as follows. This is probably the maximum practical upgrading possible:

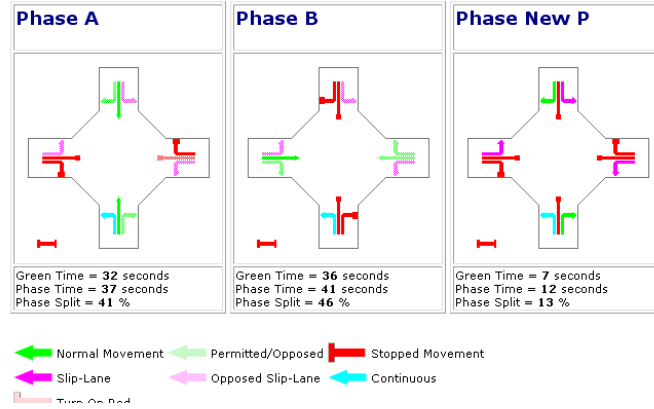


Phasing Summary

T185 R700

2029 PM Peak Background with Development

C = 90 seconds
Cycle Time Option: **User-specified cycle time**
Phase times determined by the program.

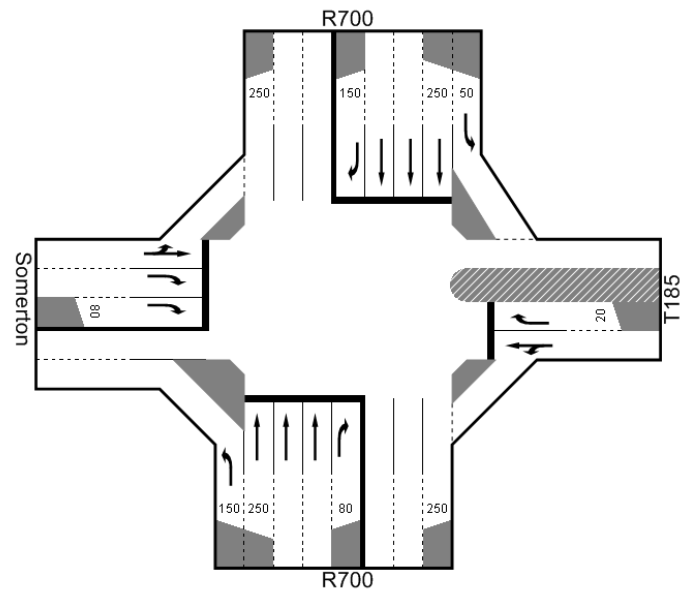


Maximum Practical Upgraded Layout

Worst case levels of service will be as follows:

Intersection: R700/T185		North			East			South			West		
		L	T	R	L	T	R	L	T	R	L	T	R
8a	2029 PM Peak with Development	A	D	C	B	B	C	D	C	D	B	A	D

If the trip distribution through Wild Olive Estate is possible (Scenario 2), the following layout will be required.



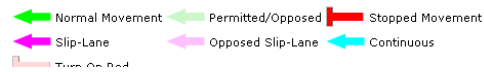
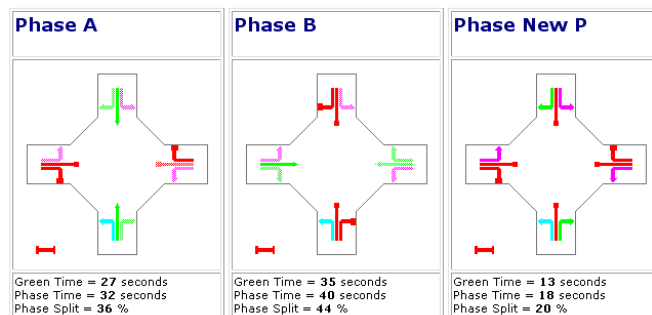
SIDRA
INTERSECTION

Phasing Summary

T185 R700

2029 PM Peak Background with Dev

C = 90 seconds
Cycle Time Option: User-specified cycle time
Phase times determined by the program.



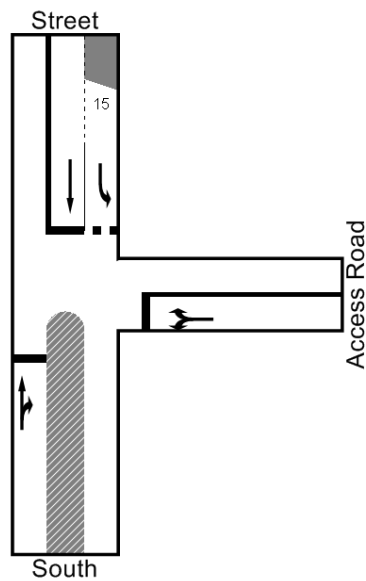
Upgraded Layout

Worst case levels of service with this layout will be as follows:

Intersection: R700/T185		North			East			South			West		
		L	T	R	L	T	R	L	T	R	L	T	R
4b	2029 AM Peak with Development	C	D	D	A	A	D	A	B	C	B	B	D
8b	2029 PM Peak with Development	A	B	D	B	A	D	A	B	D	B	A	D

6.2 Intersection B: Main Internal Intersection

The current layout is as follows:

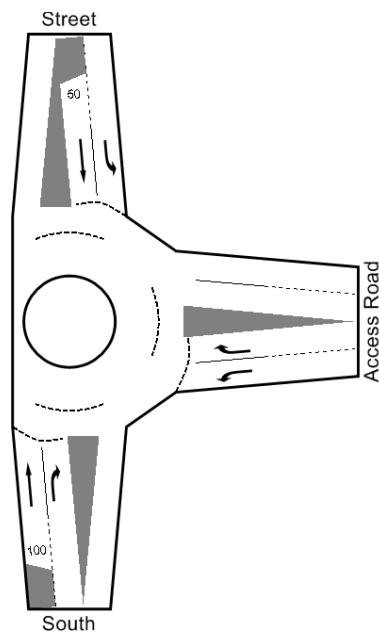


Current Layout

The SIDRA program is not necessarily accurate with regards to all-way stop control, but indicates the following worst case levels of service:

Intersection: Internal Intersection		North			East			South			West		
		L	T	R	L	T	R	L	T	R	L	T	R
4a	2029 AM Peak with Development	B	E		F		F		F	F			
8a	2029 PM Peak with development	B	E		F		F		F	F			

The layout will thus not suffice. An appropriate layout in this position would be a circle as shown below.

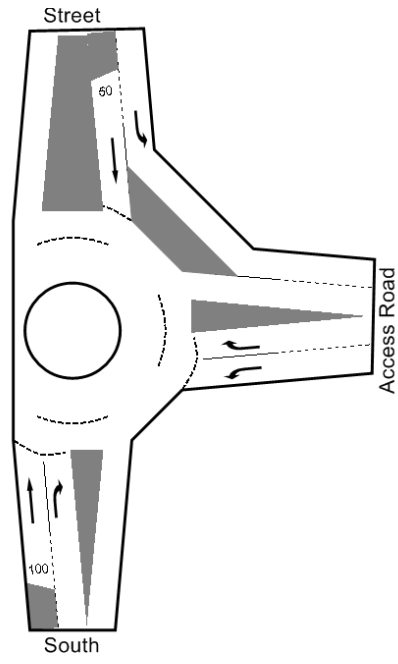


Traffic Circle Layout

Levels of service with this layout will be as follows:

Intersection:		North			East			South			West		
		L	T	R	L	T	R	L	T	R	L	T	R
4a	2029 AM Peak with Development	B	B		A		B		C	C			
8a	2029 PM Peak with development	F	C		A		B		A	B			

Left turning from the north might still be a problem and the intersection might have to be upgraded as follows:



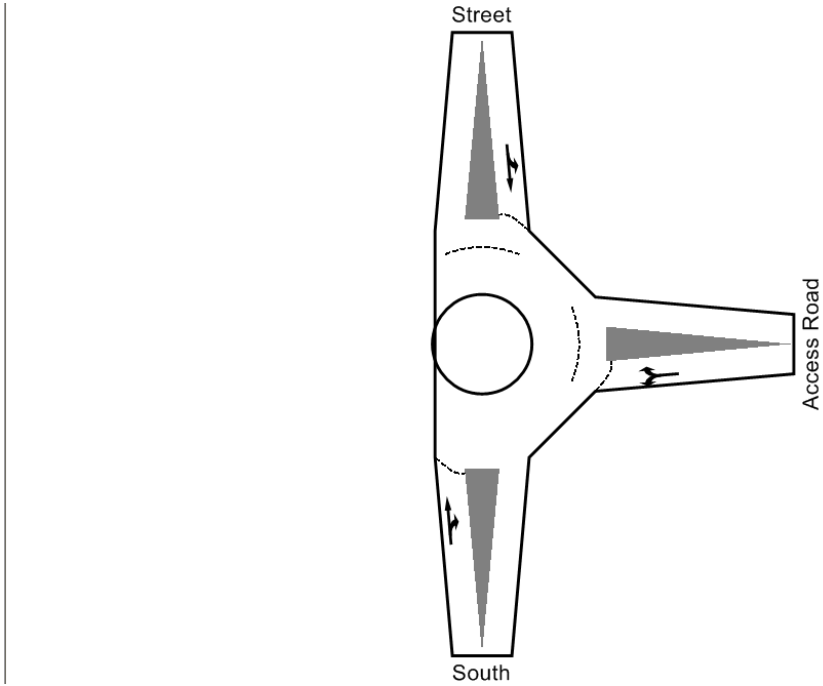
Further Improved Circle Layout

Worst case levels of service with this layout will be as follows:

Intersection:		North			East			South			West		
		L	T	R	L	T	R	L	T	R	L	T	R
8a	2029 PM Peak with development	A	C		A		B		A	B			

Levels of service will thus suffice although this will require some weaving between the intersection and the R700.

If the trip distribution through Wild Olive Estate is possible (Scenario 2), the following layout will be required



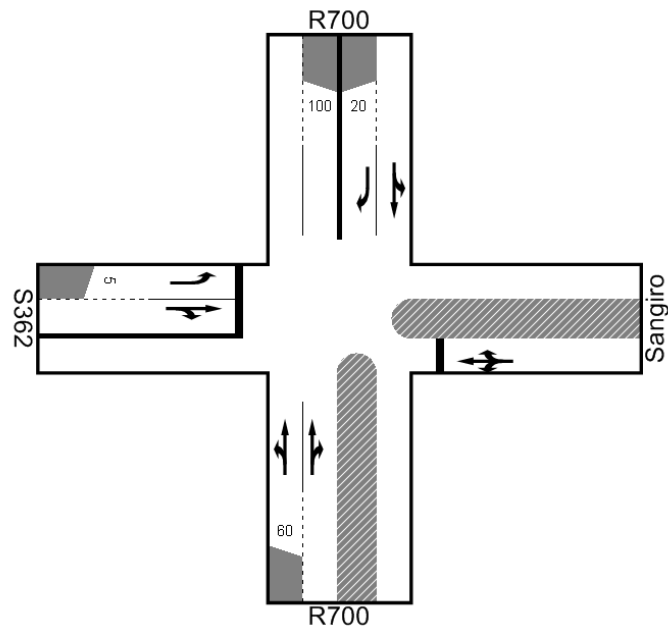
Traffic Circle Layout

Levels of service with this layout will be as follows:

Intersection:		North			East			South			West		
		L	T	R	L	T	R	L	T	R	L	T	R
4b	2029 AM Peak with Development	B	B		A		B		A	B			
8b	2029 PM Peak with development	A	A		A		B		A	B			

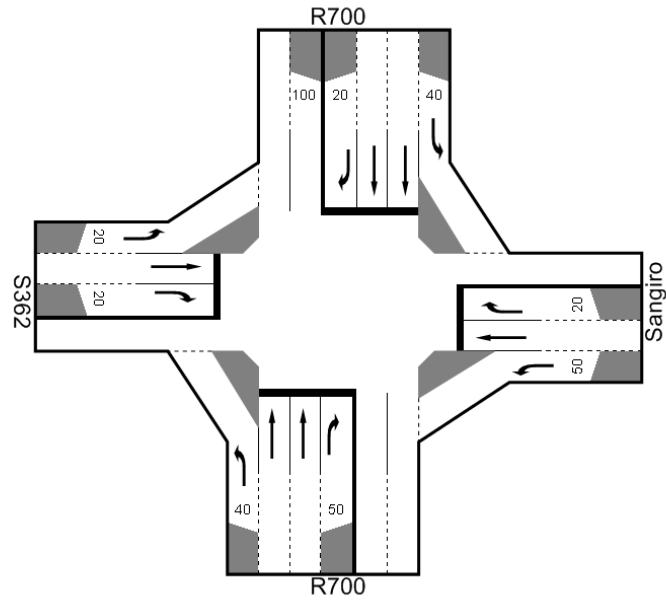
6.3 Intersection C: R700 / S362 / Sangiro Intersection

The current layout is as follows:



Current Layout

It was previously determined that this intersection will not suffice and will have to be upgraded and signalised as follows:

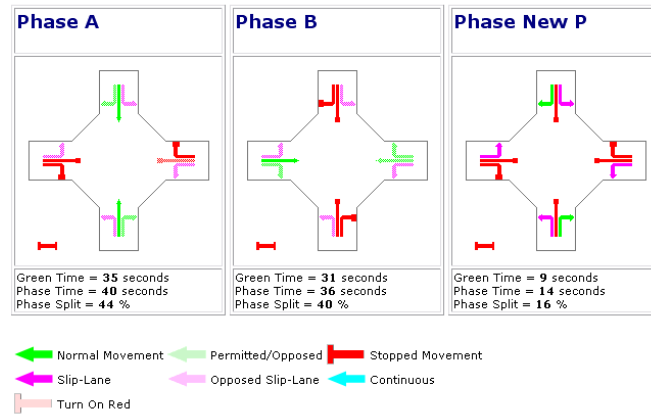


Phasing Summary

R700/Sangiro

2022 PM Peak with development

C = 90 seconds
 Cycle Time Option: User-specified cycle time
 Phase times determined by the program.



Previously Identified Improved Layout

Worst case levels of service with this layout will be as follows:

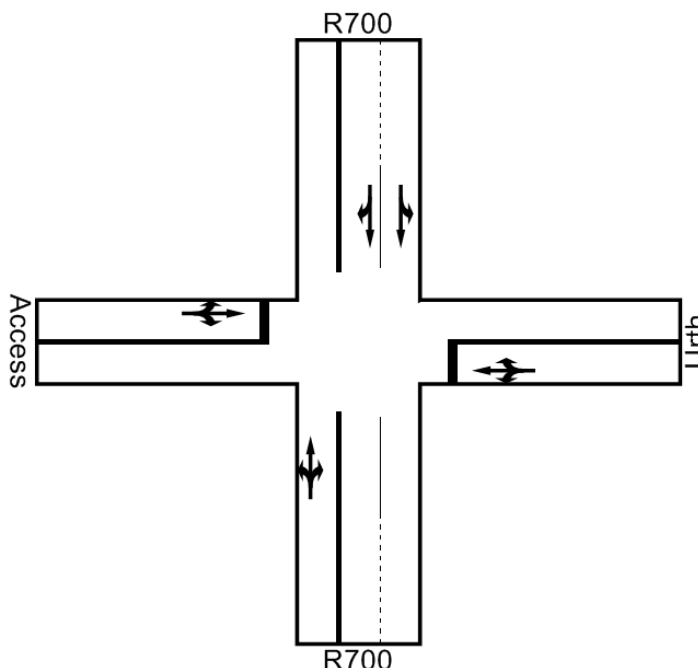
Intersection: R700/S362		North			East			South			West		
		L	T	R	L	T	R	L	T	R	L	T	R
3a	2029 AM Background Peak	B	C	C	B	C	D	A	C	C	B	C	D
4a	2029 AM Peak with Development	A	A	D	B	A	D	A	B	D	B	C	D
7a	2029 PM Background Peak	A	C	C	C	C	D	A	C	D	B	C	D
8a	2029 PM Peak with development	A	D	C	C	G	D	A	C	D	B	C	D

The layout will thus suffice.

A change in trip distribution due to trips distributed through Wild Olive Estate will not affect the trip distribution at this intersection.

6.4 Intersection D: R700 / Northern Wild Olive Estate Access

The current layout is as follows.



Existing layout

Levels of service will be as follows if no trip generation is possible through Wild Olive Estate (Scenario 1).

Intersection: R700/Northern Wild Olive Access		North			East			South			West		
		L	T	R	L	T	R	L	T	R	L	T	R
1b	2019 AM Background Peak	F	F	F	F	F	F	F	F	F	F	F	F
2a	2019 AM Peak with Development	F	F	F	F	F	F	F	F	F	F	F	F
5b	2019 PM Background Peak	F	F	F	F	F	F	F	F	F	F	F	F
6a	2019 PM Peak with Development	F	F	F	F	F	F	F	F	F	F	F	F

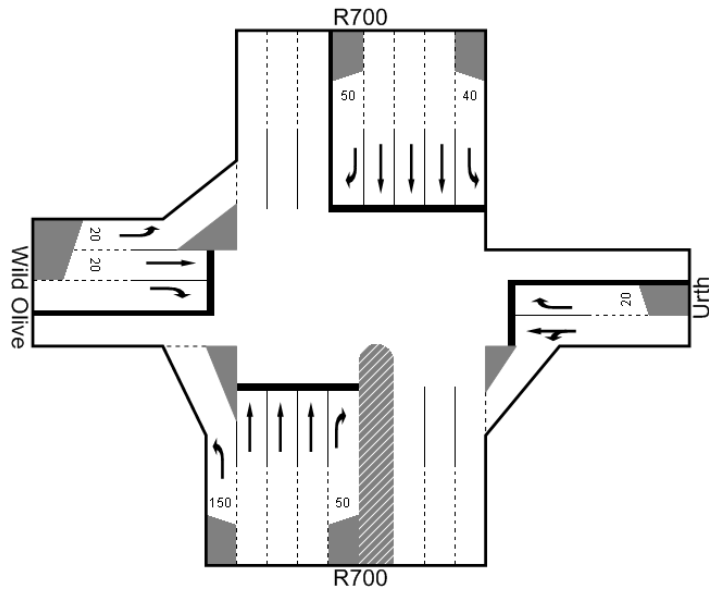
Levels of service will already be low with latent rights and although side road traffic will be relatively low, the low volumes will affect through traffic and it will not be possible to retain the intersection as a priority controlled intersection.

Expected queues are as follows:

Intersection D		North			East			South			West		
		L	T	R	L	T	R	L	T	R	L	T	R
95th Percentile Vehicles													
	Scenario 1												
5.1b	2019 AM Background Peak	0.0	124.1	56.0	13.3	13.3	13.3	376.6	376.6	376.6	211.7	211.7	211.7
5.2a	2019 AM Peak with development	0.0	525.7	56.2	13.4	13.4	13.4	583.3	583.3	583.3	330.8	330.8	330.8
5.5b	2019 PM Background Peak	186.3	186.3	26.7	10.0	10.0	10.0	482.3	482.3	482.3	143.6	143.6	143.6
5.6a	2019 PM Peak with development	511.4	511.4	511.4	21.8	21.8	21.8	1844.4	1844.4	1844.4	1883.8	1883.8	1883.8

Turning lanes will improve the intersection but acceptable level of service will not be possible and the intersection will have to be signalised.

The following layout will have to be implemented.



Signalised Layout

Worst case levels of service will be as follows:

Intersection: R700/Northern Wild Olive Access		North			East			South			West		
		L	T	R	L	T	R	L	T	R	L	T	R
4a	2029 AM Peak with Development	B	A	C	B	A	D	A	A	B	B	D	D
8a	2029 PM Peak with Development	B	A	C	B	A	D	A	A	C	B	D	D

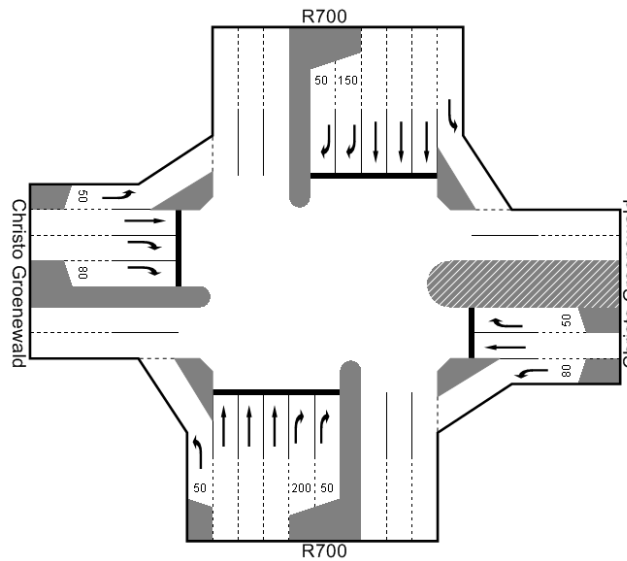
With Scenario 2 worst case levels of service will be as follows:

Intersection: R700/Northern Wild Olive Access		North			East			South			West		
		L	T	R	L	T	R	L	T	R	L	T	R
4b	2029 AM Peak with Development	B	C	D	B	A	C	A	B	D	B	B	D
8b	2029 PM Peak with Development	C	D	D	C	B	C	A	D	D	B	B	D

Similar upgrading is thus required for Scenario 2.

6.5 Intersection E: R700 / Christo Groenewald Avenue Intersection

The previously identified layout is as follows:



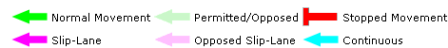
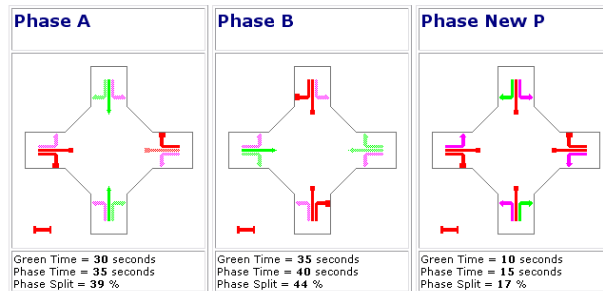
SIDRA
INTERSECTION

Phasing Summary

Christo Groenewald / R700

2019 PM Peak Background with Development

C = 90 seconds
Cycle Time Option: User-specified cycle time
Phase times determined by the program.

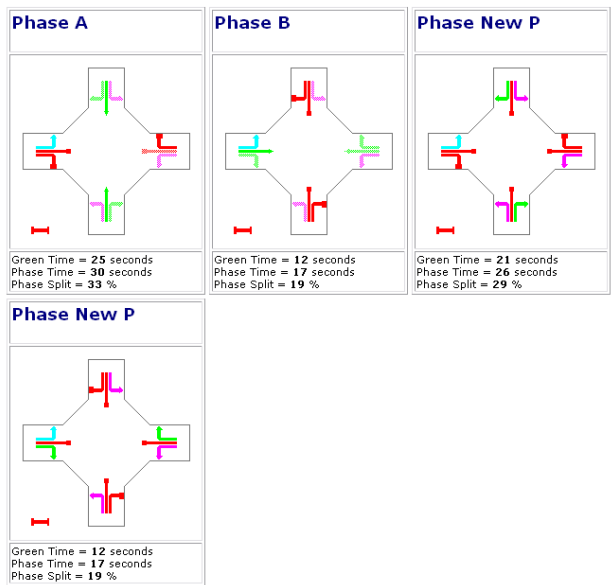
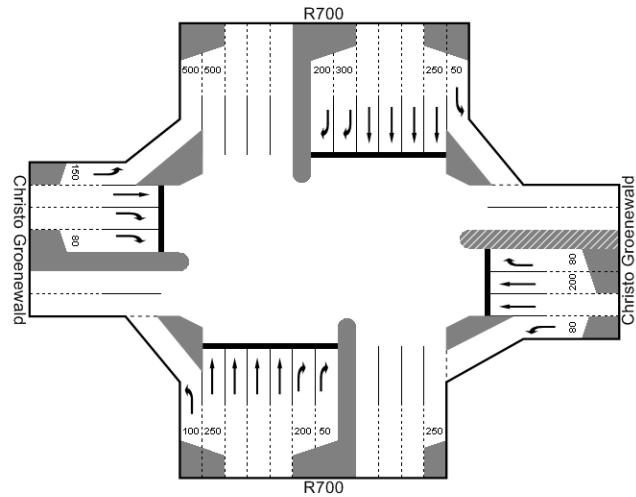


Previously Identified Layout

This will result in the following levels of service for the worst case scenario:

Intersection: R700/Christo Groenewald		North			East			South			West		
		L	T	R	L	T	R	L	T	R	L	T	R
3a	2029 AM Background Peak	A	C	C	B	C	D	A	C	C	B	C	D
4a	2029 AM Peak with Development	A	D	C	C	C	D	A	C	C	B	C	D
7a	2029 PM Background Peak	B	C	D	B	B	D	B	C	C	B	C	D
8a	2029 PM Peak with development	B	F	F	B	B	D	B	F	C	B	F	D

The intersection will have to be significantly upgraded as follows:



Further Improved Layout

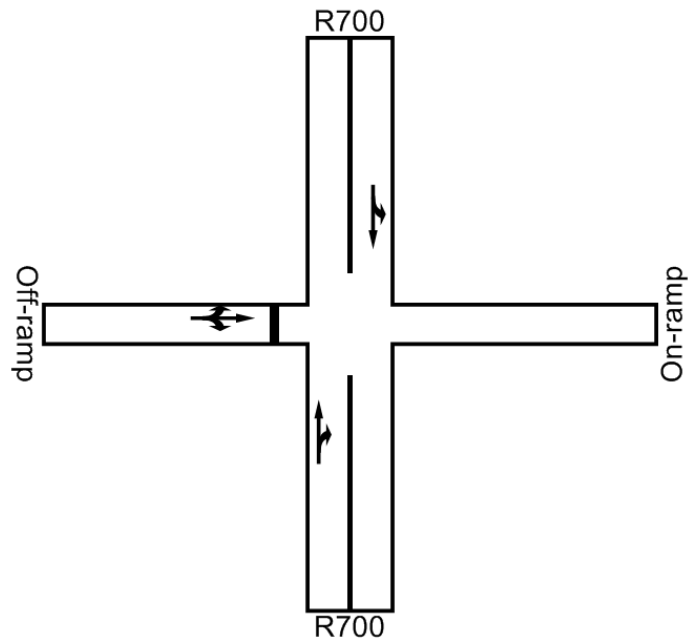
This will result in the following worst case levels of service

Intersection: R700/Christo Groenewald		North			East			South			West		
		L	T	R	L	T	R	L	T	R	L	T	R
8a	2029 PM Peak with development	B	C	D	B	D	D	B	D	C	D	D	D
12a	2029 Sat Peak with development	A	C	D	B	D	C	B	C	B	D	D	C

If trip distribution through Wild Olive Estate is possible (Scenario 2), the last mentioned layout will still be required

6.6 Intersection F1: R700 / N1 Northern Off-Ramp

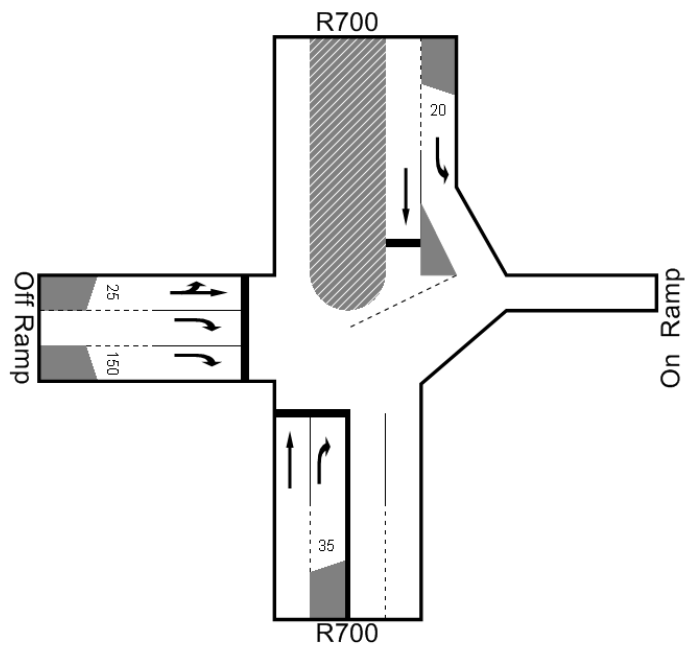
The current layout is as follows:



Existing layout

It was previously determined that the levels of service for the background traffic with this layout will be problematic

The following layout was previously determined:



Previously Determined Signalisation

Worst case levels of service with this layout will be as shown below

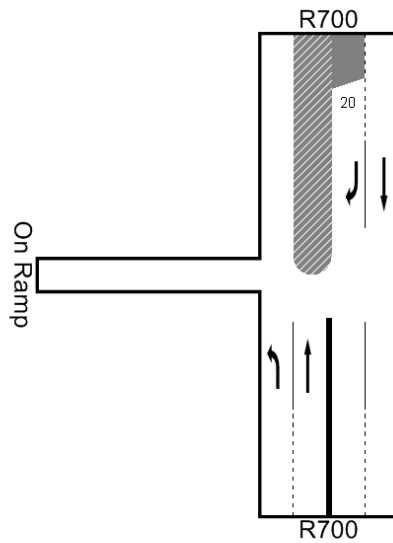
Intersection: R700/N1 Northern Off-Ramp		North			East			South			West		
		L	T	R	L	T	R	L	T	R	L	T	R
4a	2029 AM Peak with Development	A	B					C	D	B		C	
8a	2029 PM Peak with Development	A	B					B	D	C		D	

As shown the layout will suffice. This layout however requires widening of the bridge.

A change in trip distribution due to trips distributed through Wild Olive Estate will not affect the trip distribution at this intersection.

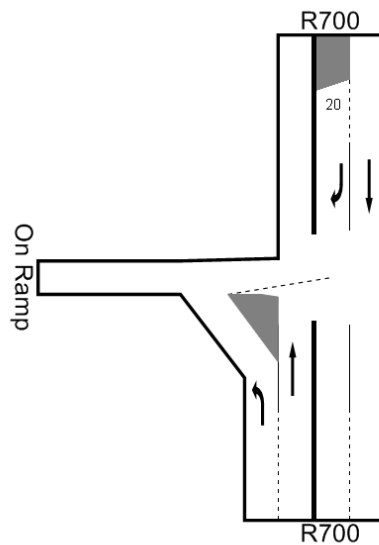
6.7 Intersection F2: R700 / N1 Southern On-Ramp

The current layout is as follows:



Existing layout

It was previously identified that the intersection should be improved as follows:



Improved layout

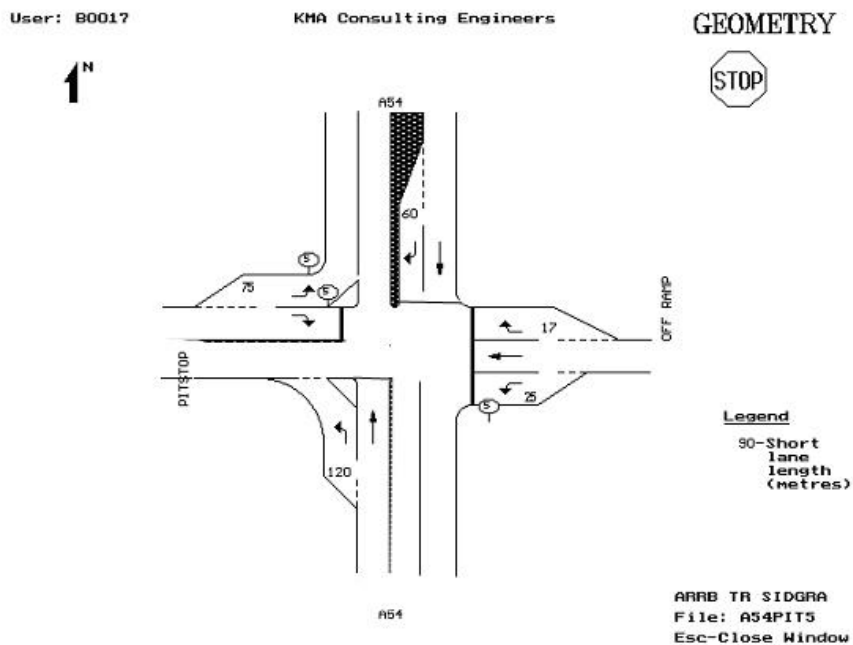
Worst case levels of service will be as shown below

Intersection: R700/N1/Filling		North			East			South			West		
		L	T	R	L	T	R	L	T	R	L	T	R
4a	2029 AM Peak with Development		A	C				A	A				
8a	2022 PM Peak with Development		A	C				C	A				

A change in trip distribution due to trips distributed through Wild Olive Estate will not affect the trip distribution at this intersection.

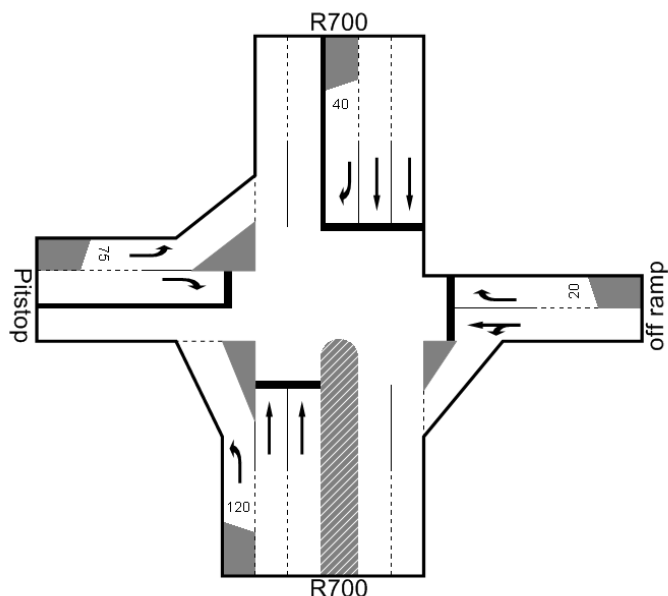
6.8 Intersection F3: R700 / N1 Northern Off-Ramp / Filling Station

The current layout is as follows. The SIDRA layout shown below was amended to reflect the actual situation as the program cannot model the existing non-standard layout.



Current layout

This layout does not comply with the requirements for all way stop control as per the SARTSM. The following layout was previously identified.



Signalised Layout

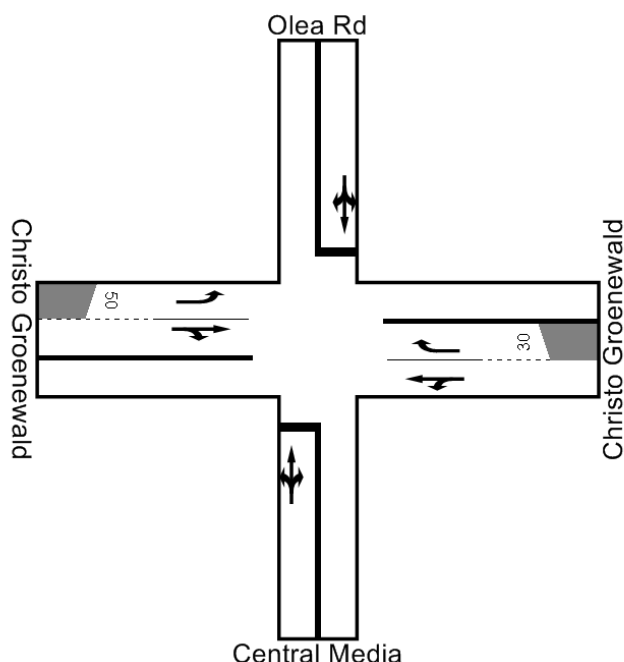
Worst case levels of service will be as follows:

Intersection: R700/N1/Filling		North			East			South			West		
		L	T	R	L	T	R	L	T	R	L	T	R
4a	2029 AM Peak with Development		B	C	B	B	C	A	B		B		C
8a	2029 PM Peak with Development		B	C	B	B	C	A	B		B		C

A change in trip distribution due to trips distributed through Wild Olive Estate will not affect the trip distribution at this intersection.

6.9 Intersection G: Olea Road / Christo Groenewald Avenue Intersection

The current layout is as follows.



Existing layout

Levels of service will be as follows if no trip generation is possible through Wild Olive Estate (Scenario 1).

Intersection: Olea Rd / Christo Groenewald Ave		North			East			South			West		
		L	T	R	L	T	R	L	T	R	L	T	R
1b	2019 AM Background Peak	F	F	F	A	A	B	F	F	F	A	A	C
2a	2019 AM Peak with Development	F	F	F	A	A	C	F	F	F	A	B	C
5a	2019 PM Background Peak	F	F	F	A	A	E	F	F	F	A	F	F
6a	2019 PM Peak with Development	F	F	F	A	A	F	F	F	F	A	F	F

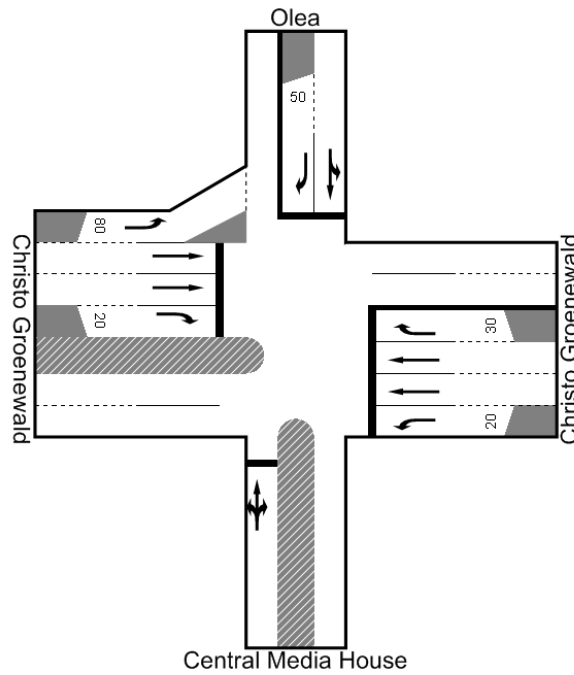
Levels of service will already be low with latent rights, and although side road traffic will be relatively low, the low volumes will affect through traffic and it will not be possible to retain the intersection as a priority controlled intersection.

Expected queues are as follows:

Intersection G		North			East			South			West		
		L	T	R	L	T	R	L	T	R	L	T	R
95th Percentile Vehicles													
Scenario 1													
5.1b	2019 AM Background Peak	257.2	257.2	257.2	0.0	0.0	1.0	0.4	0.4	0.4	0.0	9.2	9.2
5.2a	2019 AM Peak with development	311.4	311.4	311.4	0.0	0.0	1.2	0.9	0.9	0.9	0.0	12.4	12.4
5.5b	2019 PM Background Peak	100.1	100.1	100.1	0.0	0.0	8.1	13.3	13.3	13.3	0.0	27.3	27.3
5.6a	2019 PM Peak with development	511.4	511.4	511.4	21.8	21.8	21.8	1844.4	1844.4	1844.4	1883.8	1883.8	1883.8

Turning lanes will improve the intersection but acceptable level of service will not be possible and the intersection will have to be signalised.

The following layout will have to be implemented. (It was determined as part of the extension of Northridge Mall that Christo Groenewald Avenue will have to be upgraded to two lanes per direction.



**SIDRA
INTERSECTION**

Phasing Summary

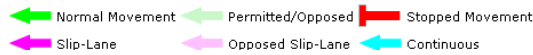
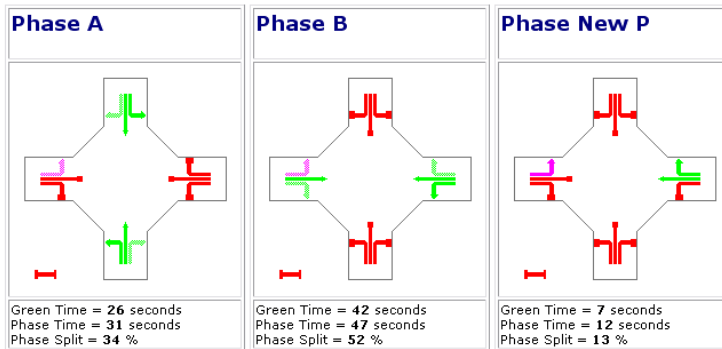
Olea / Christo Groenewald

2029 AM Peak with development

C = 90 seconds

Cycle Time Option: **User-specified cycle time**

Phase times determined by the program.



Signalised Layout

Worst case levels of service will be as follows:

Intersection: Olea Rd / Christo Groenewald Ave		North			East			South			West		
		L	T	R	L	T	R	L	T	R	L	T	R
4a	2029 AM Peak with Development	D	C	D	C	A	C	C	C	C	A	B	C
8a	2029 PM Peak with Development	D	C	D	C	A	C	C	C	C	A	B	C

With Scenario 2 worst case levels of service will be as follows:

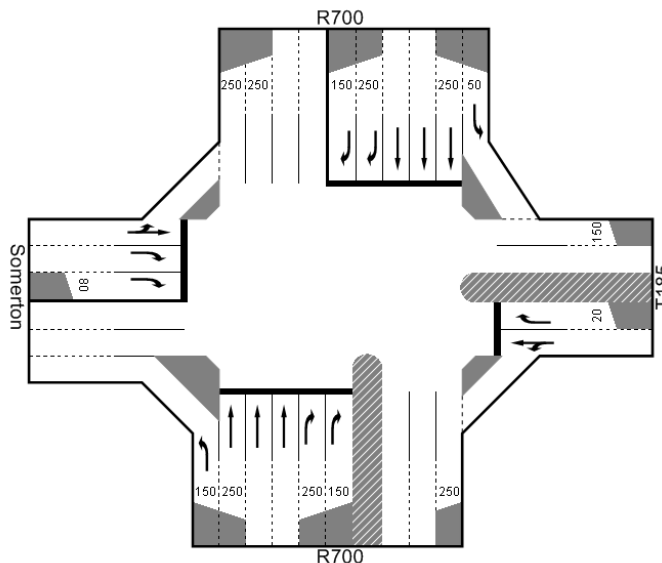
Intersection: Olea Rd / Christo Groenewald Ave		North			East			South			West		
		L	T	R	L	T	R	L	T	R	L	T	R
4b	2029 AM Peak with Development	D	C	D	A	A	C	C	C	C	A	B	C
8b	2029 PM Peak with Development	D	D	D	C	A	C	D	C	D	A	B	C

7 SUMMARY OF ROAD IMPROVEMENTS

The findings of the Capacity Analysis can be summarised as follows

7.1 Scenario 1 – No Trip Distribution via Wild Olive Estate

- a) The **T185 / R700 intersection** will experience capacity problems and even the previously identified upgrading and signalisation will not suffice. Major upgrading will be required.



SIDRA INTERSECTION

Phasing Summary

T185 R700

2029 PM Peak Background with Development

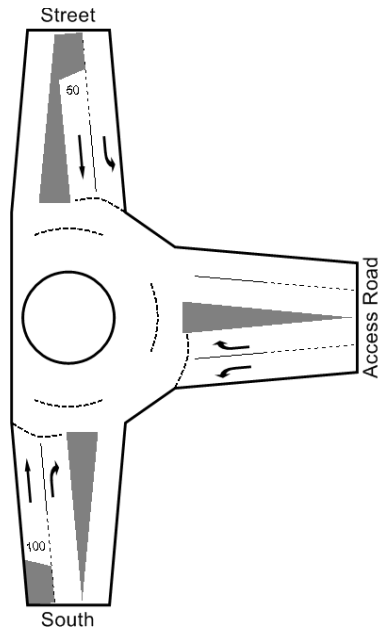
C = 90 seconds
 Cycle Time Option: User-specified cycle time
 Phase times determined by the program.

Phase A	Phase B	Phase New P
Green Time = 32 seconds Phase Time = 37 seconds Phase Split = 41 %	Green Time = 36 seconds Phase Time = 41 seconds Phase Split = 46 %	Green Time = 7 seconds Phase Time = 12 seconds Phase Split = 13 %

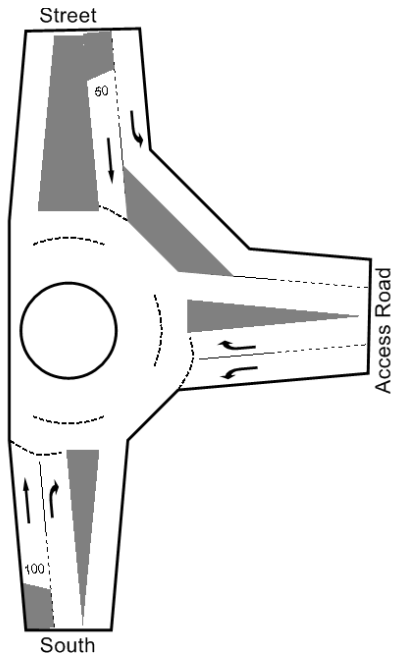
← Normal Movement ← Permitted/Opposed — Stopped Movement
← Slip-Lane ← Opposed Slip-Lane ← Continuous
— Turn On Red

The R700 servitude is of sufficient width, but the main access road (T5658) servitude might have to be widened to accommodate the lanes. This might affect erven 69, 64 and / or the powerline servitude.

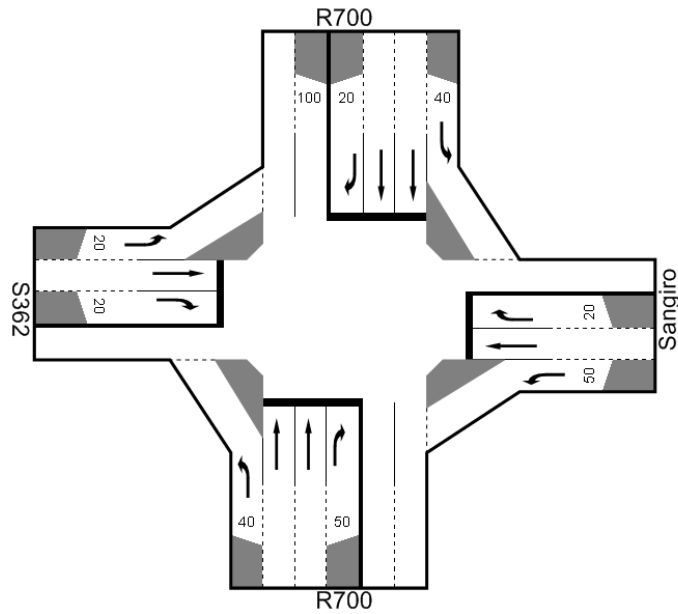
b) The **Main Internal Intersection** will have to be changed to a traffic circle as follows:



Or perhaps even as shown below.



c) The previously identified upgrading of the **R700 / S362 Intersection** will suffice.

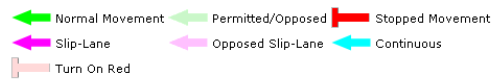
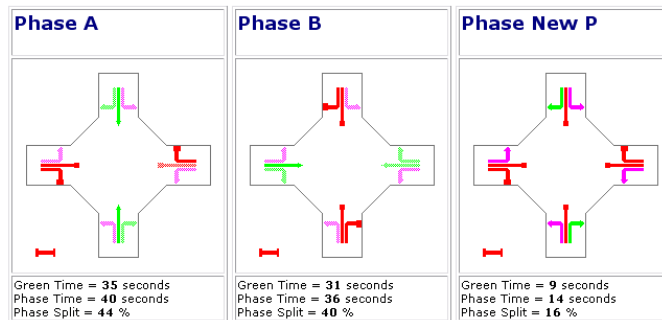


Phasing Summary

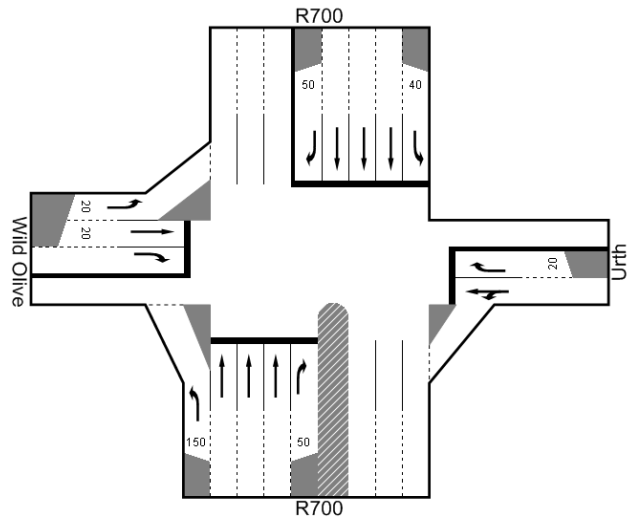
R700/Sangiro

2022 PM Peak with development

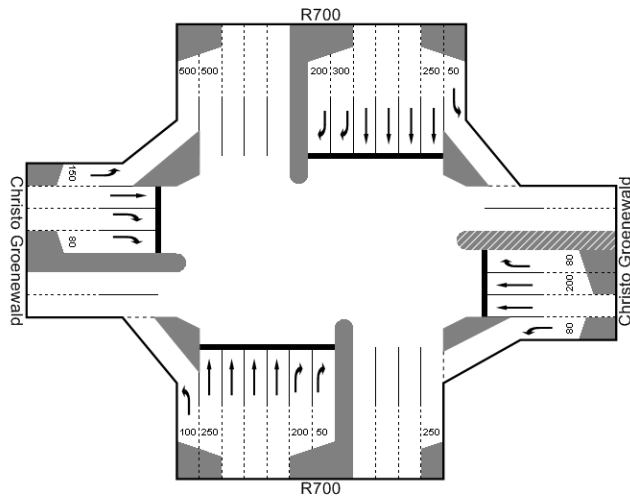
C = 90 seconds
 Cycle Time Option: **User-specified cycle time**
Phase times determined by the program.



- d) The **R700 / Wild Olive Estate Access Intersection** will have to be upgraded and signalised as follows.



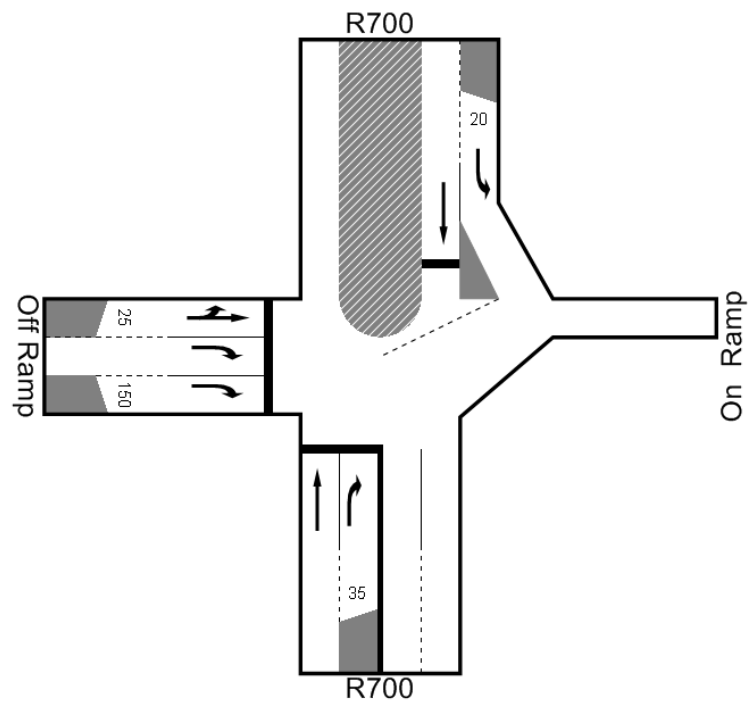
- e) The previously identified upgrading and signalisation of the **R700 / Christo Groenewald Avenue** will not suffice and the intersection will have to be significantly upgraded as follows.



Phase A	Phase B	Phase New P
Green Time = 25 seconds Phase Time = 30 seconds Phase Split = 33 %	Green Time = 12 seconds Phase Time = 17 seconds Phase Split = 19 %	Green Time = 21 seconds Phase Time = 26 seconds Phase Split = 29 %
Phase New P		
Green Time = 12 seconds Phase Time = 17 seconds Phase Split = 19 %		

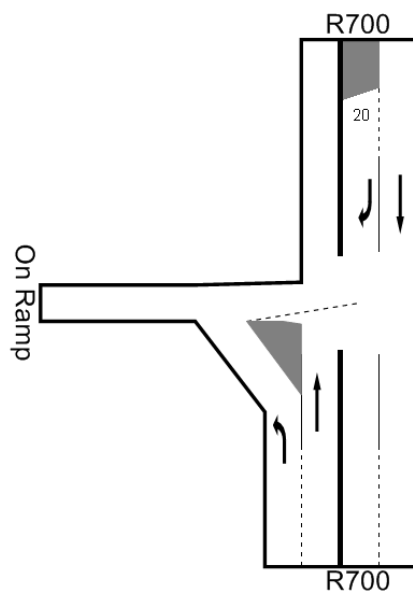
Although the upgrading is significant, sufficient space should be available

- f) The **R700 / N1 Northern Off – Ramp** will require upgrading and signalisation as previously identified.

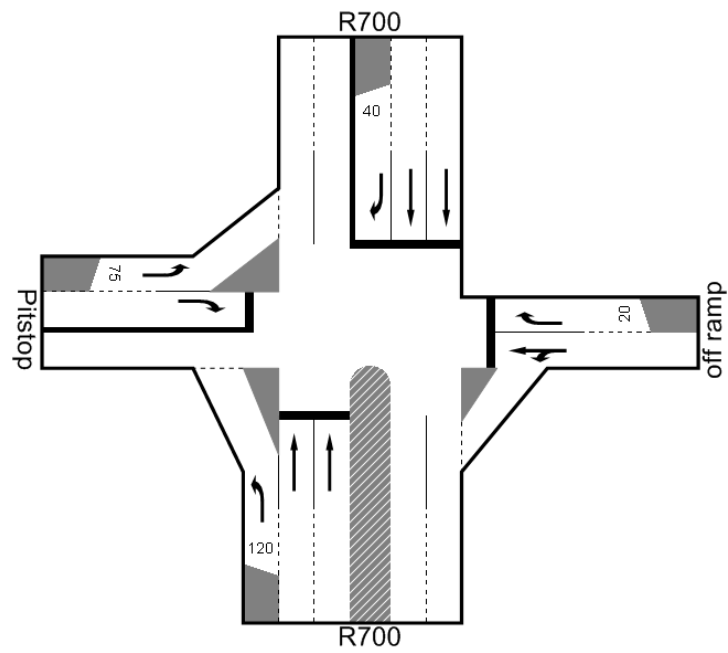


This will however require widening of the bridge over the N1.

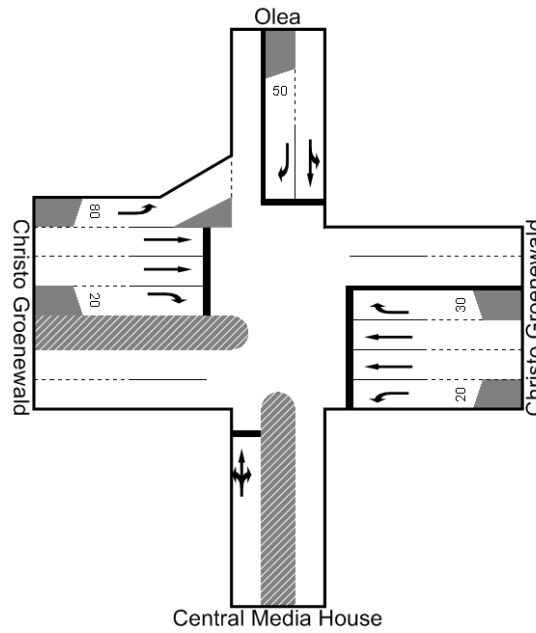
- g) The **R700 / N1 Southern On-Ramp** can be retained in its current format, but left turning from the south has to be changed to a slip.



- h) The **R700 / N1 Northern Off-Ramp / Filling Station** does not comply with the SARTSM and will experience capacity problems. The intersection will have to be signalised at the same time as the R700 / N1 Northern Off – Ramp.



- i) The **Olea Road / Christo Groenewald Avenue Intersection** will have to be upgraded and signalised as follows.



SIDRA
INTERSECTION

Phasing Summary

Olea / Christo Groenewald

2029 AM Peak with development

C = 90 seconds
Cycle Time Option: **User-specified cycle time**
Phase times determined by the program.

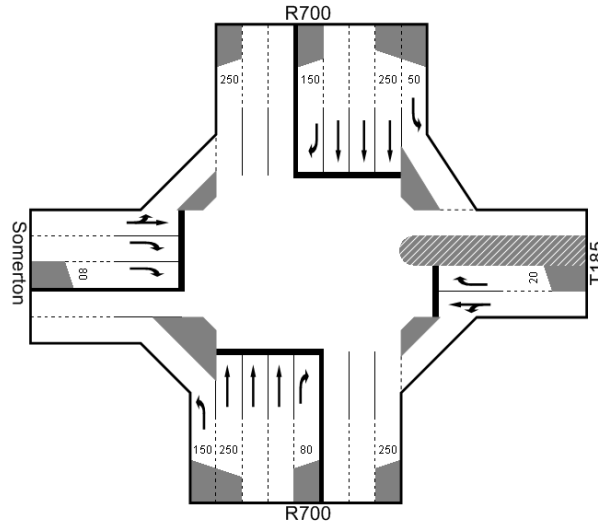
Phase A	Phase B	Phase New P
Green Time = 26 seconds Phase Time = 31 seconds Phase Split = 34 %	Green Time = 42 seconds Phase Time = 47 seconds Phase Split = 52 %	Green Time = 7 seconds Phase Time = 12 seconds Phase Split = 13 %

Normal Movement
 Permitted/Opposed
 Stopped Movement
 Slip-Lane
 Opposed Slip-Lane
 Continuous

- j) The **R700** will have to be widened to three lanes per direction at the Christo Groenewald Street intersection with even a fourth short lane through the intersection. At the T185 intersection three lanes per direction is required at the intersection. From a practical point of view, it is recommended that the R700 be upgraded to three lanes per direction from the south of the Christo Groenewald Street intersection up to the north of the T185 intersection.

7.2 Scenario 2 – Some Trip Distribution via Wild Olive Estate

- a) The **T185 / R700 intersection** will require less upgrading but will still have to be upgraded as follows.



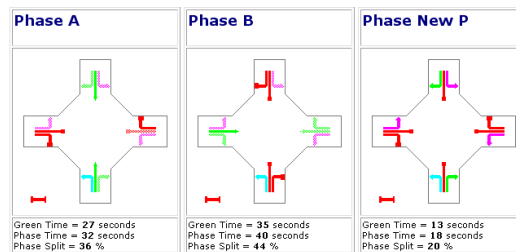
SIDRA
INTERSECTION

Phasing Summary

T185 R700

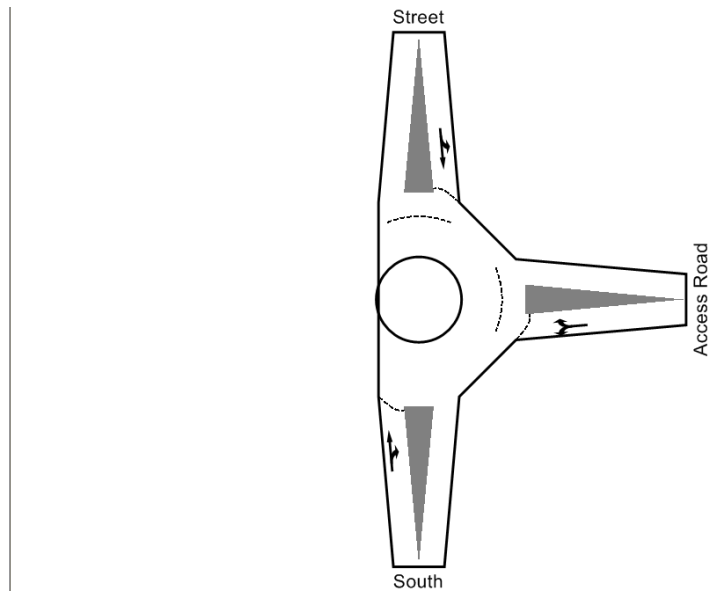
2029 PM Peak Background with Dev

C = 90 seconds
Cycle Time Option: User-specified cycle time
Phase times determined by the program.

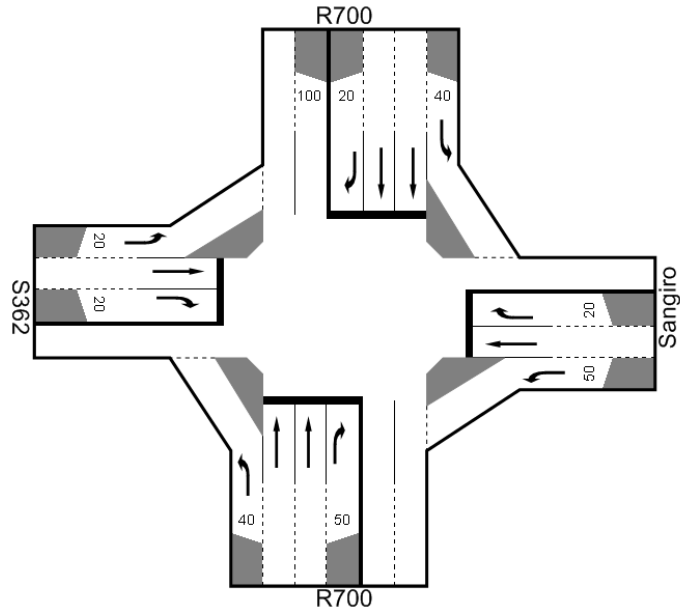


← Normal Movement ← Permitted/Opposed ← Stopped Movement
← Slip-Lane ← Opposed Slip-Lane ← Continuous
← Turn On Red

- b) The **Main Internal Intersection** will have to be changed to a traffic circle, but a lower level circle than with Scenario 1.



c) The **R700 / S362 Intersection** will still have to be upgraded as follows.

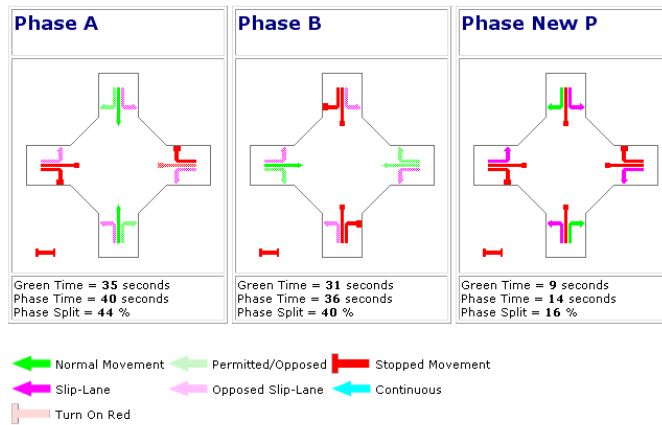


Phasing Summary

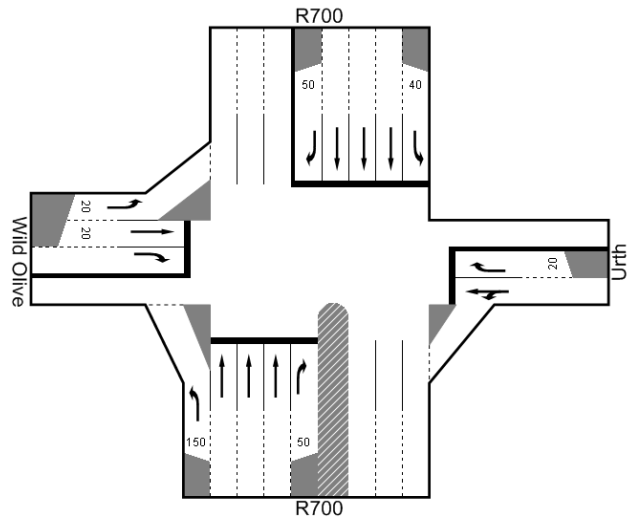
R700/Sangiro

2022 PM Peak with development

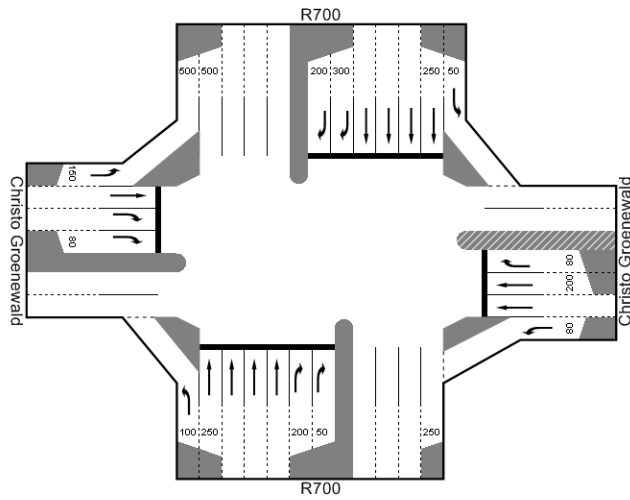
C = 90 seconds
 Cycle Time Option: **User-specified cycle time**
Phase times determined by the program.



- d) The **R700 / Wild Olive Estate Access Intersection** will still have to be upgraded and signalised as follows.

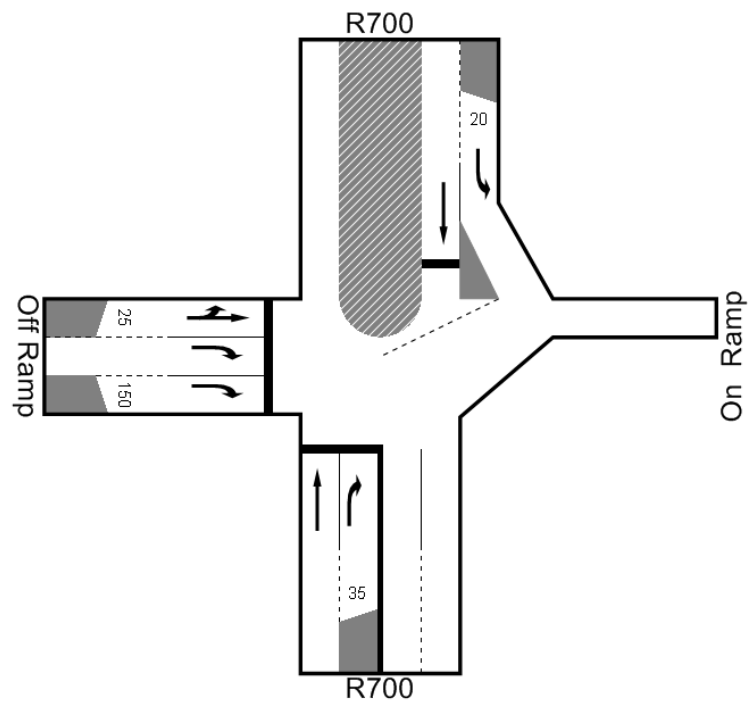


e) The R700 / Christo Groenewald Avenue will still have to be upgraded as follows.



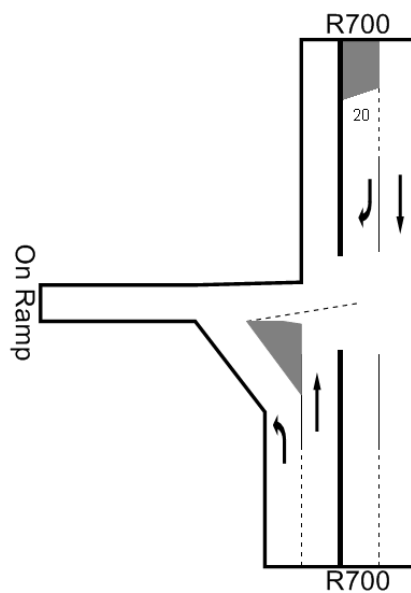
Phase A	Phase B	Phase New P
Green Time = 25 seconds Phase Time = 30 seconds Phase Split = 33 %	Green Time = 12 seconds Phase Time = 17 seconds Phase Split = 19 %	Green Time = 21 seconds Phase Time = 26 seconds Phase Split = 29 %
Phase New P		
Green Time = 12 seconds Phase Time = 17 seconds Phase Split = 19 %		

- f) The **R700 / N1 Northern Off – Ramp** will still require upgrading and signalisation as previously identified.

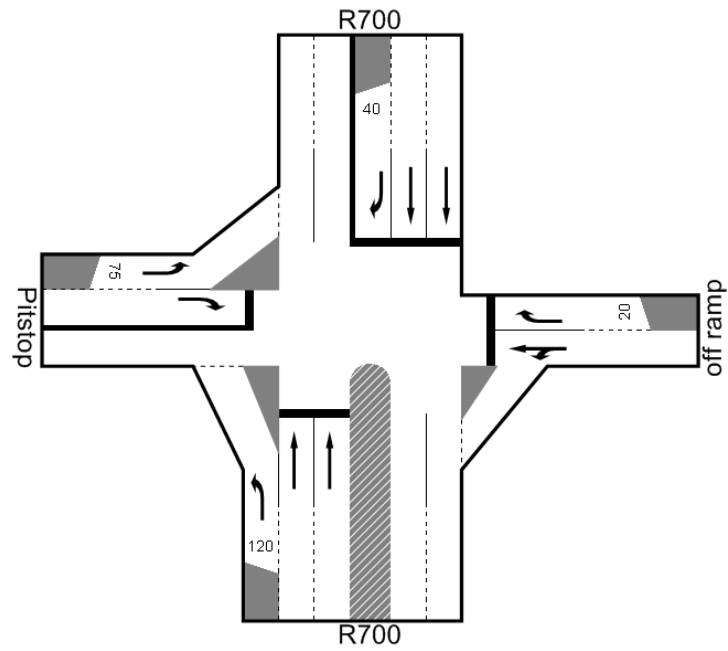


This will however require widening of the bridge over the N1.

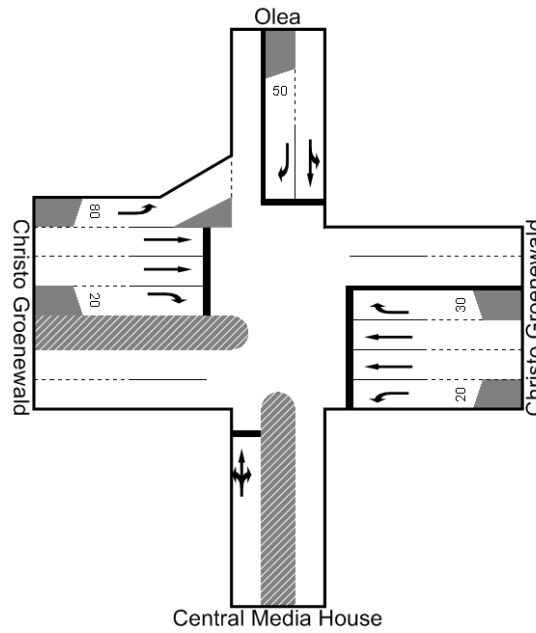
- g) The **R700 / N1 Southern On-Ramp** can be retained in its current format, but left turning from the south still has to be changed to a slip.



- h) The **R700 / N1 Northern Off-Ramp / Filling Station** does not comply with the SARTSM and will experience capacity problems. The intersection will have to be signalised at the same time as the R700 / N1 Northern Off – Ramp.



- i) The **Olea Road / Christo Groenewald Avenue Intersection** will also have to be upgraded and signalised as follows.



SIDRA
INTERSECTION

Phasing Summary

Olea / Christo Groenewald

2029 AM Peak with development

C = 90 seconds
Cycle Time Option: User-specified cycle time
Phase times determined by the program.

Phase A	Phase B	Phase New P
Green Time = 26 seconds Phase Time = 31 seconds Phase Split = 34 %	Green Time = 42 seconds Phase Time = 47 seconds Phase Split = 52 %	Green Time = 7 seconds Phase Time = 12 seconds Phase Split = 13 %

Normal Movement
 Permitted/Opposed
 Stopped Movement
 Slip-Lane
 Opposed Slip-Lane
 Continuous

- j) The **R700** will still require widening to three lanes per direction at the Christo Groenewald Street intersection with even a fourth short lane through the intersection. At the T185 intersection three lanes per direction is required at the intersection. From a practical point of view, it is recommended that the R700 be upgraded to three lanes per direction from the south of the Christo Groenewald Street intersection up to the north of the T185 intersection.

8 SITE DEVELOPMENT PLAN



The following aspects are of importance:

No	Basic Aspects
1	Intersections
a	Number of intersections
	<i>Discussion:</i>
	Six new intersections will be established.
b	Spacing
	<i>Discussion:</i>
	The table below shows access spacings.

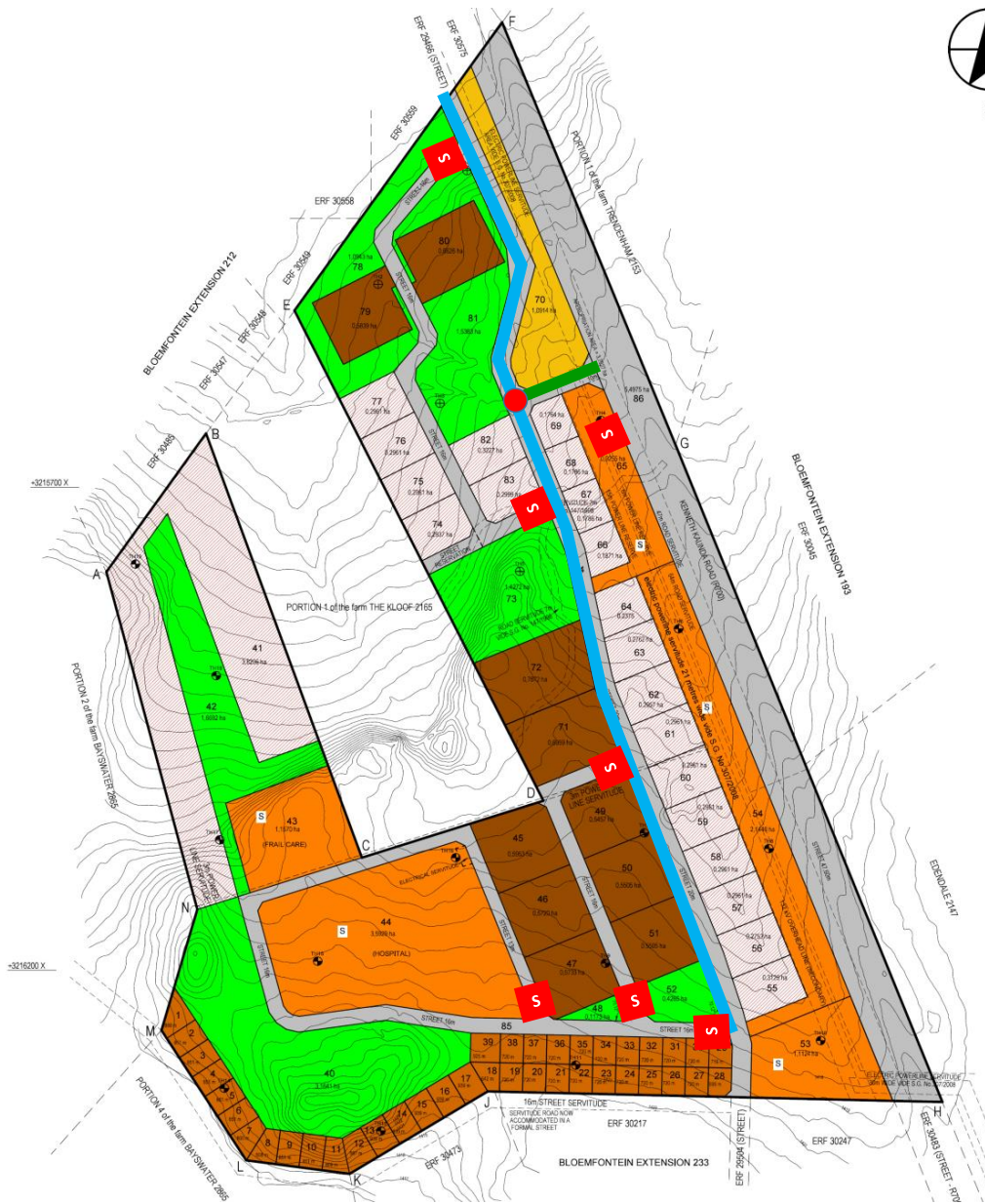
		Spacing (m) (cl-to-cl)	Functional Classification	Relevant Document	Ideal Spacing (m)	Road Width (m)
Intersection	Intersection					
1	2	300	Major Residential Access Link 5(a)	UTG 7	30	6
1	3	100	Major Residential Access Link 5(a)	UTG 7	30	6
3	4	270	Major Residential Access Link 5(a)	UTG 7	30	6
4	5	300	Major Residential Access Link 5(a)	UTG 7	30	6
5	6	100	Major Residential Access Link 5(a)	UTG 7	30	6
6	7	100	Major Residential Access Link 5(a)	UTG 7	30	6

Given the above, access spacing can be regarded as acceptable.

c Traffic Control Measures

Discussion:

The internal intersections can be developed as follows:

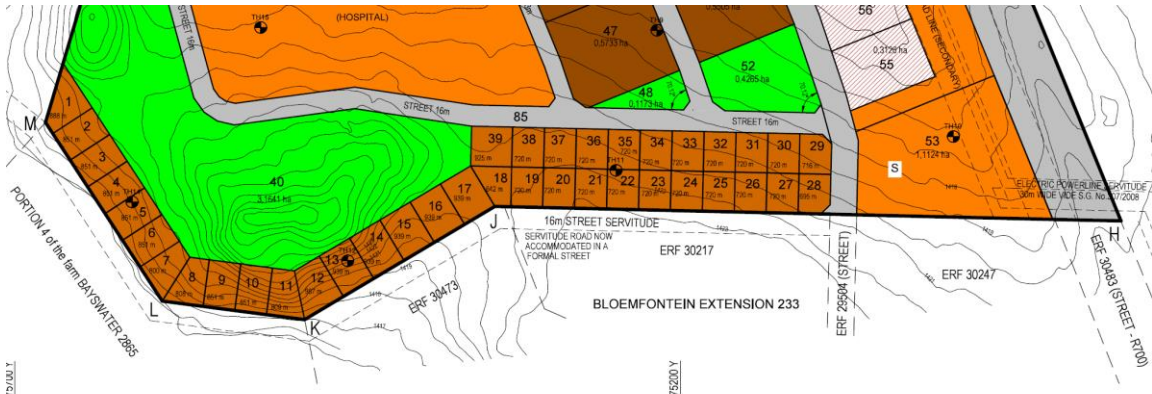


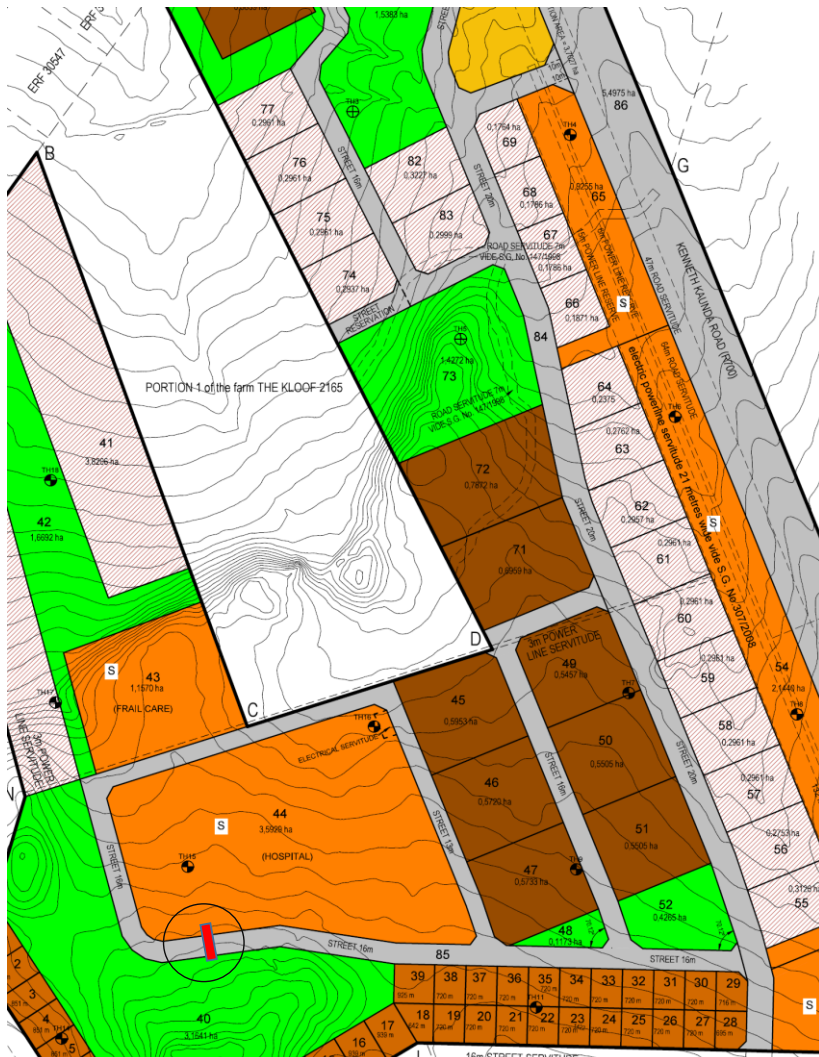
d Traffic Capacity

	<i>Discussion:</i>
	No internal intersection is expected to operate at low levels of service.
e	Provision of deceleration lanes and turning lanes
	<i>Discussion:</i>
	Given the nature of the roads, deceleration or turning lanes are not required at the internal intersections, although it is preferable to develop the intersections on the major residential access link with turning lanes.
f	Continuity of Road Reserve Boundaries
	<i>Discussion:</i>
	There are no steps in road reserve boundaries.
g	Required Improvements
	<i>Discussion:</i>
	Roads should be developed with proper sidewalks when developed.
h	Phasing of Required Improvements
	<i>Discussion:</i>
	Phasing of improvements will depend on actual development.
i	Vertical alignment of intersections
	The vertical alignment of intersections should be acceptable considering the gradient of roads. The maximum street gradient is 1:12.5.

2	Internal Roads
a	Road Classification
<i>Discussion:</i>	
The proposed road classifications are shown below.	
<div data-bbox="845 291 1388 571" style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>Classification:</p> <ul style="list-style-type: none"> Arterial Collector Major Residential Access Link 5(a) Residential Access Loop 5(b) Access cul-de-sac 5(c) Access way 5 (d) Access strip 5(f) </div>	
b	Width of Road Reserves
<i>Discussion:</i>	

	The minimum road reserve is 13m, which is acceptable.																					
c	Splays																					
	<i>Discussion:</i>																					
	All splays are 7m x 7m as a minimum																					
	Road widths																					
	<i>Discussion:</i>																					
	Road widths for higher order roads are shown in the table under 1(b). Other roads can be developed with the following widths.																					
	<table border="1"> <thead> <tr> <th>Classification</th> <th>Sub-class</th> <th>Road Width</th> </tr> </thead> <tbody> <tr> <td>Local Street</td> <td>Major Residential Access Link 5(a)</td> <td>6m</td> </tr> <tr> <td></td> <td>Residential Access Loop 5(b)</td> <td>5.5m</td> </tr> <tr> <td></td> <td>Access cul-de-sac 5(c)</td> <td>5.5m</td> </tr> <tr> <td></td> <td>Access way 5 (d)</td> <td>3m</td> </tr> <tr> <td></td> <td>Access court 5(e)</td> <td>3m</td> </tr> <tr> <td></td> <td>Access strip 5(f)</td> <td>3m</td> </tr> </tbody> </table>	Classification	Sub-class	Road Width	Local Street	Major Residential Access Link 5(a)	6m		Residential Access Loop 5(b)	5.5m		Access cul-de-sac 5(c)	5.5m		Access way 5 (d)	3m		Access court 5(e)	3m		Access strip 5(f)	3m
Classification	Sub-class	Road Width																				
Local Street	Major Residential Access Link 5(a)	6m																				
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	Access way 5 (d)	3m																				
	Access court 5(e)	3m																				
	Access strip 5(f)	3m																				
e	Road Curves																					
	<i>Discussion:</i>																					
	Road reserves mostly make provision for approximately 90-degree bends.																					
f	Super elevation																					
	<i>Discussion:</i>																					
	No super elevation would be required.																					
g	Gradient of Roads																					
	<i>Discussion:</i>																					
	Gradients range between 1:12.5 and 1:100.																					

h	Traffic Circulation
	<i>Discussion:</i>
	<p>Normal traffic circulation is possible and will be acceptable. No culs-de-sac are provided. The one aspect of importance is the southern portion of the site where the single residential erven will have access on the street that is already established on Bloemfontein Extensions 213, 229, 230, 231, 232 and 233 (Wild Olive Estate) and which will also provide access to Portion 4 of the Farm Bayswater, but which is not yet constructed.</p>  <p>The implication of this is that erven 1 to 27 can only be developed when the street is constructed, which might require agreements between the different land owners.</p> <p>A further implication is that if the streets are not extended to the south, a cul-de-sac without a turning space will be established. This will mean that Erven 28 and 65 cannot be developed until the street is extended, or alternatively a temporary turning space will have to be established.</p>
i	Capacity of Road Links
	<i>Discussion:</i>
	No road link is expected to carry traffic volumes that would require more than one lane per direction.
j	General Sight Distances
	<i>Discussion:</i>
	Sight distances are in general acceptable.
k	Pedestrian Movements
	<i>Discussion:</i>
	Moderate pedestrian movement is expected and movement will be accommodated on sidewalks.
l	Illumination of Streets
	<i>Discussion:</i>
	Street illumination should be provided
m	Refuse Removal
	<i>Discussion:</i>
	Normal refuse removal will take place and vehicles should be able to move throughout the area.
n	Public Transport
	<i>Discussion:</i>
	Provision should preferably be made for lay-bys in selected areas so that that people do not walk more than 500m to reach public transport.
o	Emergency Vehicle Access
	<i>Discussion:</i>
	Emergency vehicles should be able to access all areas.

p	Potential Conflict Areas
	<i>Discussion:</i>
	<p>With the street layout a number of potential conflict areas are created due to relatively long street sections followed by sharp bends. In these instances, speed humps or other appropriate traffic calming measures may have to be provided in strategic positions. Although there are a number of positions, the only position of real concern is shown below.</p> 
	Heavy Vehicle Usage
	<i>Discussion:</i>
	Low heavy vehicle volumes are expected.
r	Jurisdiction of Roads
	<i>Discussion:</i>
	It is the intention that the new internal roads be taken over by the Municipality.

9 CONCLUSIONS AND RECOMMENDATIONS

The following conclusions can be made from the study:

- a) The development is expected to generate 1539 and 2605 new trips during the morning and afternoon peak hours respectively.
- b) Most of the intersections in the study area will have to be significantly upgraded and/or signalise due to latent rights and / or the development under consideration.
- c) Implementation of the identified improvements will require some widening of road reserves.
- d) The layout plan is in principle acceptable.

Based on the findings of the study the development can be approved from a traffic point of view.

10 REFERENCES

1. **Manual for Traffic Impact Studies**, Department of Transport, Pretoria, 1995
2. **South African Trip Generation Rates**, Department of Transport, Pretoria, 1995
3. **ITE Trip Generation Rates, 6th Edition**, Institute of Transportation Engineers, Washington, 1998
4. **Transportation and Land Development**, Institute of Transportation Engineers, Washington, 1988
5. **UTG 1, Guidelines for the Geometric Design of Urban Arterial Roads**, CSIR, Pretoria, 1986
6. **National Guidelines for Road Management in South Africa**, COTO
7. **Spacing of Accesses on Major Arterials**, Department of Transport, Pretoria, 1993
8. **TMH 17 Volume 1**, The South African National Roads Agency Limited, Pretoria, 2012
9. **UTG 5: Geometric Design of Urban Collector Roads**, CUTA, Pretoria, 1988
10. **UTG 7: Geometric Design of Urban Local Residential Streets**, CUTA, Pretoria, 1986