



082 415 3646

gary@gete.co.za

<http://www.gete.co.za>

Gary Edwards

Professional
Traffic Engineer
B.Hons Transportation

262 Bontrokkie Street
Leeuwfontein Estates
Kameelfontein
0035

PASSIONATE | DEDICATED | PROFESSIONAL

TRAFFIC IMPACT ASSESSMENT

Garankuwa
Erf 1427 & Erf 1719

City of Tshwane Metropolitan Municipality
225 Madiba Street
Capital Towers North
Pretoria
0001

October 2022



TRAFFIC IMPACT ASSESSMENT

GARANKUWA ERF 1427 & ERF 1719

**Gary Edwards Traffic
Engineering (Pty) Ltd.**
262 Bontrokkie Street
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**City of Tshwane
Metropolitan Municipality**
Capital Towers North
225 Madiba Street
Pretoria
0001

October 2022

4 October 2022

City of Tshwane Metropolitan Municipality

Roads & Stormwater Department

Room C312

Capitol Towers North

225 Madiba Street

Pretoria

0001

Attention: Hellen Msiza

**TRAFFIC IMPACT ASSESSMENT
GARANKUWA ERF 1427 & ERF 1719**

It is herewith certified that this Traffic Impact Assessment has been prepared according to the requirements of the South African Traffic Impact and Site Traffic Assessment Manual.

Please do not hesitate to contact me should you wish to discuss any aspect of the report or need any additional information.

Regards,

Gary Edwards (PrEng)

ECSA Reg No 20050184

B Hons (Transportation)



Gary Edwards Traffic Engineering (Pty) Ltd.

262 Bontrokkie Street

Leeuwfontein Estates

Kameelfontein

0035



Email: gary@gete.co.za

Website: <http://www.gete.co.za>

Cell: +27 (82) 415 3646



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Traffic Engineer

262 Bontrokkie Street
Leeuwfontein Estates,
Kameelfontein, 0035

082 415 3646

gary@gete.co.za

Company Registration

Reg No: 2015/285410/07

VAT Reg No: 4790271524

BBEE Certification

Level 4

Memberships

Engineering Council
of South Africa
(ECSA): 20050184

South African Institute
of Civil Engineers
(SAICE): 969115



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TRAFFIC IMPACT ASSESSMENT GARANKUWA ERF 1427 & ERF 1719

EXECUTIVE SUMMARY

APPLICATION	Proposed Subdivision of Garankuwa Erf 1427 & Erf 1719
PROPERTY SIZE	11.17 ha
PROPOSED DEVELOPMENT	Erf 1427: 368 residential 1 stands Erf 1719: 384 residential 1 stands Total: 752 residential 1 stands
TRIP GENERATION	<ul style="list-style-type: none"> • Weekday AM: 384 trips (96 trips inbound and 288 trips outbound) • Weekday PM: 384 trips (269 trips inbound and 115 trips outbound)
ACCESS	Access is proposed via the extension of the existing municipal road network
ROAD IMPROVEMENTS	<ul style="list-style-type: none"> • Installation of a traffic signal along Lucas Mangope Drive at the access to Garankuwa (Road D) • Construction of the collector road along the eastern boundary of Erf 1419 (Road C) • Construction of the collector road between Erf 1427 and Erf 1419 (Road A) • Construction of the internal road network within Erf 1427 and Erf 1419
PUBLIC TRANSPORT AND NMT FACILITIES	<ul style="list-style-type: none"> • Construction of 4 minibus-taxi lay-bys at the accesses to the site. • Construction of a 2m wide paved pedestrian walkway along the street frontage of Erf 1427 and Erf 1719.
CONCLUSION	The proposed subdivision of Garankuwa Erf 1427 & Erf 1719 into 368 and 384 residential 1 stands be supported from a traffic engineering point of view.

TRAFFIC IMPACT ASSESSMENT GARANKUWA ERF 1427 & ERF 1719

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TRAFFIC IMPACT ASSESSMENT

GARANKUWA ERF 1427 & ERF 1719

1 INTRODUCTION

1.1 DEVELOPMENT PARTICULARS

A subdivision application was submitted by Durapi Consulting on behalf of the City of Tshwane Human Settlements Department for Erf 1427 and Erf 1719, Garankuwa to allow the following:

- Erf 1427: 368 Residential 1 stands
- Erf 1719: 384 Residential 1 stands

The combined site is approximately 11.17ha in extent and is located in the south-western area of Garankuwa – see *Figure 1 (next page)*.

The preliminary township layout is shown in *Appendix A*.

Gary Edwards Traffic Engineering (Pty) Ltd. was appointed to conduct the traffic impact assessment of the planned township. This report addresses the following aspects:

- Existing surrounding road network and road master planning;
- Expected development trip generation, distribution and assignment;
- Operational conditions on the road network;
- Required road improvements; and
- Ancillary transport issues.

1.2 STUDY AREA

The following 6 intersections were included in the investigation. Owing to a lack of street names, reference is made to Road A, Road B, Road C and Road D – see *Figure 1*:

- Intersection 1 – Road A / Road B – 2 Way Stop;
- Intersection 2 – Road B / Road C – 1 Way Stop;
- Intersection 3 – Road B / Road D – Roundabout;
- Intersection 4 – Road D / M21 / Lucas Mangope Drive – 4 Way Stop;
- Intersection 5 – Rahube Street / Road B – 4 Way Stop; and
- Intersection 6 – Rahube Street / Main Street – 1 Way Stop.



Figure 1 – Locality Plan

2 TRAFFIC VOLUMES

2.1 EXISTING TRAFFIC VOLUMES

A site visit was conducted on Friday 16 September 2022 to evaluate the layout of the surrounding road network and to observe the current peak operating conditions at the critical surrounding intersections. Weekday morning and afternoon peak period traffic counts were conducted on Tuesday 20 September between 06h15 and 08h30 in the morning and between 16h00 and 18h15 in the afternoon at the critical intersections to identify the existing peak hour traffic volumes on the surrounding road network. The recorded weekday AM (06h30 to 07h30) and PM (16h30 to 17h30) peak hour traffic volumes are shown in *Figure 2* (next page). During the traffic surveys, it was noted that no capacity constraints occurred on the roads near the site (Roads A to D) and low peak hour volumes prevailed.

2.2 LATENT DEVELOPMENTS

No known latent developments exist in the immediate surrounding area.

2.3 EXPECTED FUTURE VOLUMES

The expected future background traffic volumes were calculated by considering the recommended growth rates as contained in the TMH 17 document^(ref 1):

Table 2-1: Typical Growth Rates

Growth	Growth Rate
Low growth areas	0 – 3%
Average growth areas	3 – 4%
Above average growth areas	4 – 6%
Fast growing areas	6 – 8%
Exceptionally high growth areas	> 8%

A growth rate of 3% was considered appropriate for this study. The expected future (2027) background volumes are shown in *Figure 3*.

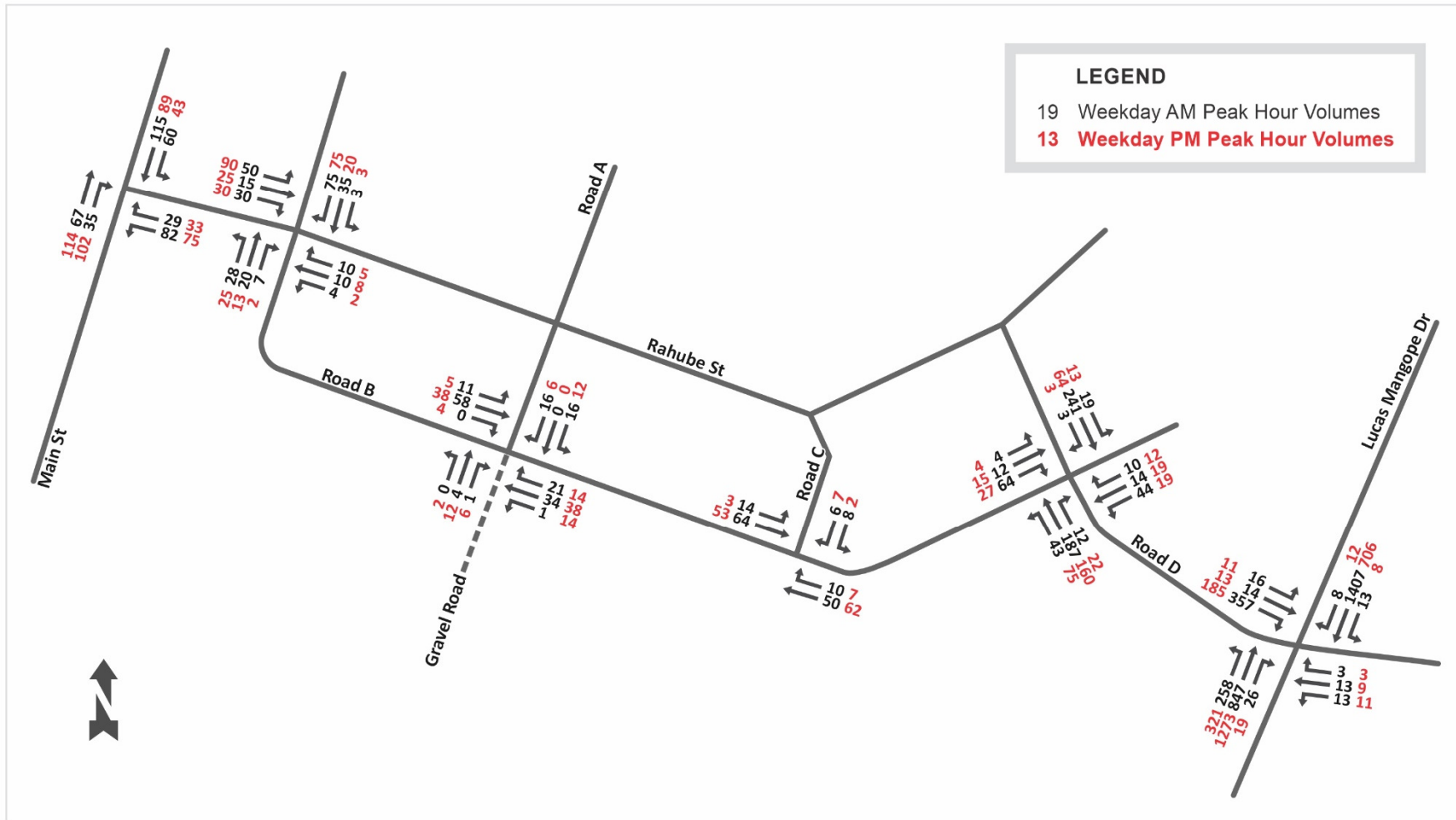


Figure 2 – Existing Weekday Peak Hour Traffic Volumes (2022)

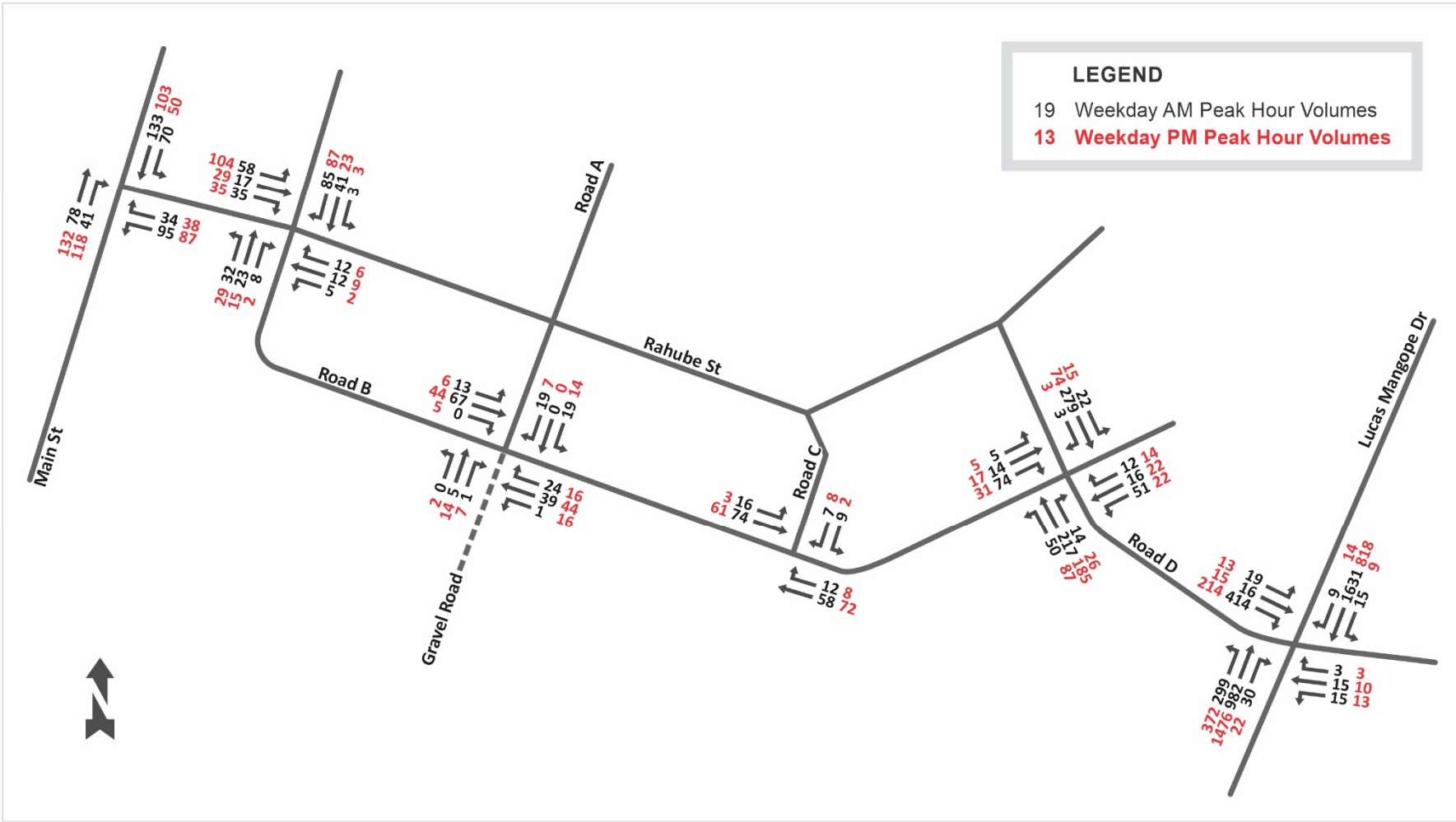


Figure 3 – Expected Future (2027) Background Volumes

3 ANALYSES

3.1 ROAD PLANNING

The road planning of the City of Tshwane Metropolitan Municipality (CTMM) for the area surrounding the site is shown below:

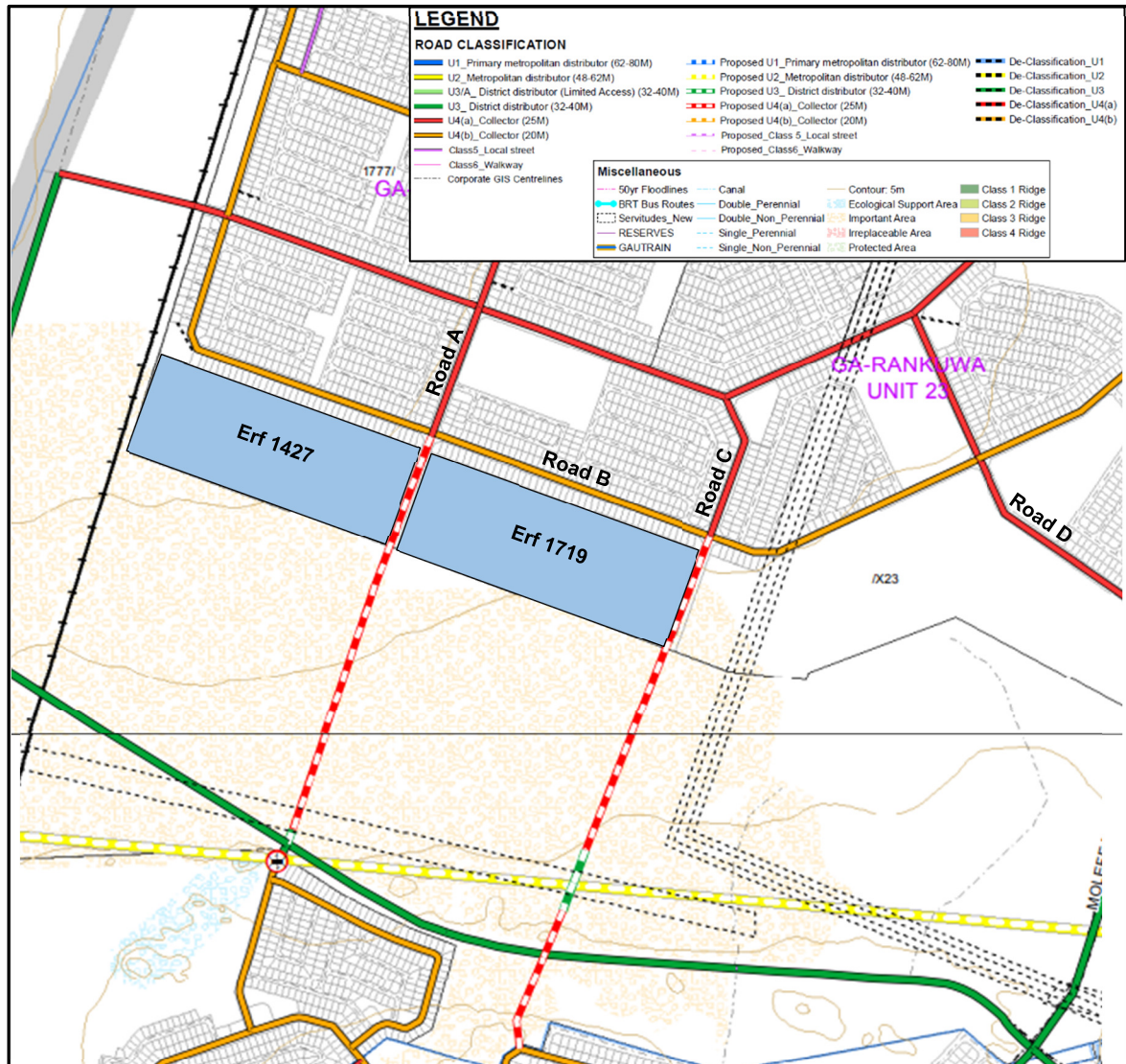


Figure 4 – CTMM Road Planning

The following should be noted from the above planning:

- Road A is classified as a U4(b) collector road and will be extended to the south between Erf 1427 and Erf 1719.
- Road C is classified as a U4(b) collector road and will be extended to the south along the eastern boundary of Erf 1719.

3.2 TRIP GENERATION, DISTRIBUTION AND ASSIGNMENT

The expected peak hour trip generation of the planned township was calculated using the rates provided in the TMH17 document compiled by the Committee of Transport Officials^(ref 1). As recommended in the guideline document, reduction factors were applied to the trip generation rates to cater for the following:

- The planned erven are small (typically 210 m²) and will cater for the low income group. It is also clear from the traffic counts that low vehicle ownership prevails in the area.
- Residents are expected to depend heavily on public transport and a high percentage of minibus-taxi travel on the surrounding road network.

The trip generation and reduction factors are summarised below.

- **Residential 1**

Land Use Code: 210 – Single Dwelling Units
 Weekday AM Rate: 1.0 trip per unit (25% inbound and 75% outbound)
 Reduction factors: Low vehicle ownership 40%, Transit nodes 15%
Reduced AM Rate: 0.51 trips per unit

Weekday PM Rate: 1.0 trips per unit (70% inbound and 30% outbound)
 Reduction factors: Low vehicle ownership 40%, Transit nodes 15%
Reduced PM Rate: 0.51 trips per unit

The expected peak hour trip generation of the township is shown in the table below:

Table 3-1: Expected Peak Hour Trip Generation

Erf	Extent	Trip Rate	Directional Split		Expected Peak Hour Trip Generation		
			Inbound	Outbound	Inbound	Outbound	Total
Weekday AM Peak Hour							
Erf 1427	368 units	0.51	25%	75%	47 trips	141 trips	188 trips
Erf 1719	384 units	0.51	70%	30%	49 trips	147 trips	196 trips
Total					96 trips	288 trips	384 trips
Weekday PM Peak Hour							
Erf 1427	368 units	0.51	70%	30%	132 trips	56 trips	188 trips
Erf 1719	384 units	0.51	70%	30%	137 trips	59 trips	196 trips
Total					269 trips	115 trips	384 trips

The above shown trip estimation is considered to represent an absolute worst case scenario as the vehicle ownership of the residents is likely to be extremely low. In Ekurhuleni, the Local Council supports a trip generation rate of 0.30 trips per unit (instead of the 0.51 trips per unit applied in the above calculation) for similar “low income” residential developments.

The following trip distribution was used in the analyses and is based on the layout of the surrounding road network and the existing distribution of traffic along the surrounding road network.

Table 3-2: Assumed Trip Distribution

Road	From Direction	Percentage of trips
Lucas Mangope Drive	North	10%
Lucas Mangope Drive	South	40%
Road D	East	5%
Main Street	North	10%
Main Street	South	25%
Road A	North	5%
Road B	Northeast	5%
Total		100 %

The assignment of the additional development traffic on the road network during the critical weekday AM and PM peak hours are shown in *Figure 5* (next page). The expected 2022 and 2027 peak hour traffic volumes with the additional Garankuwa Erf 1427 and Erf 1719 traffic are shown in *Figure 6* and *Figure 7*.

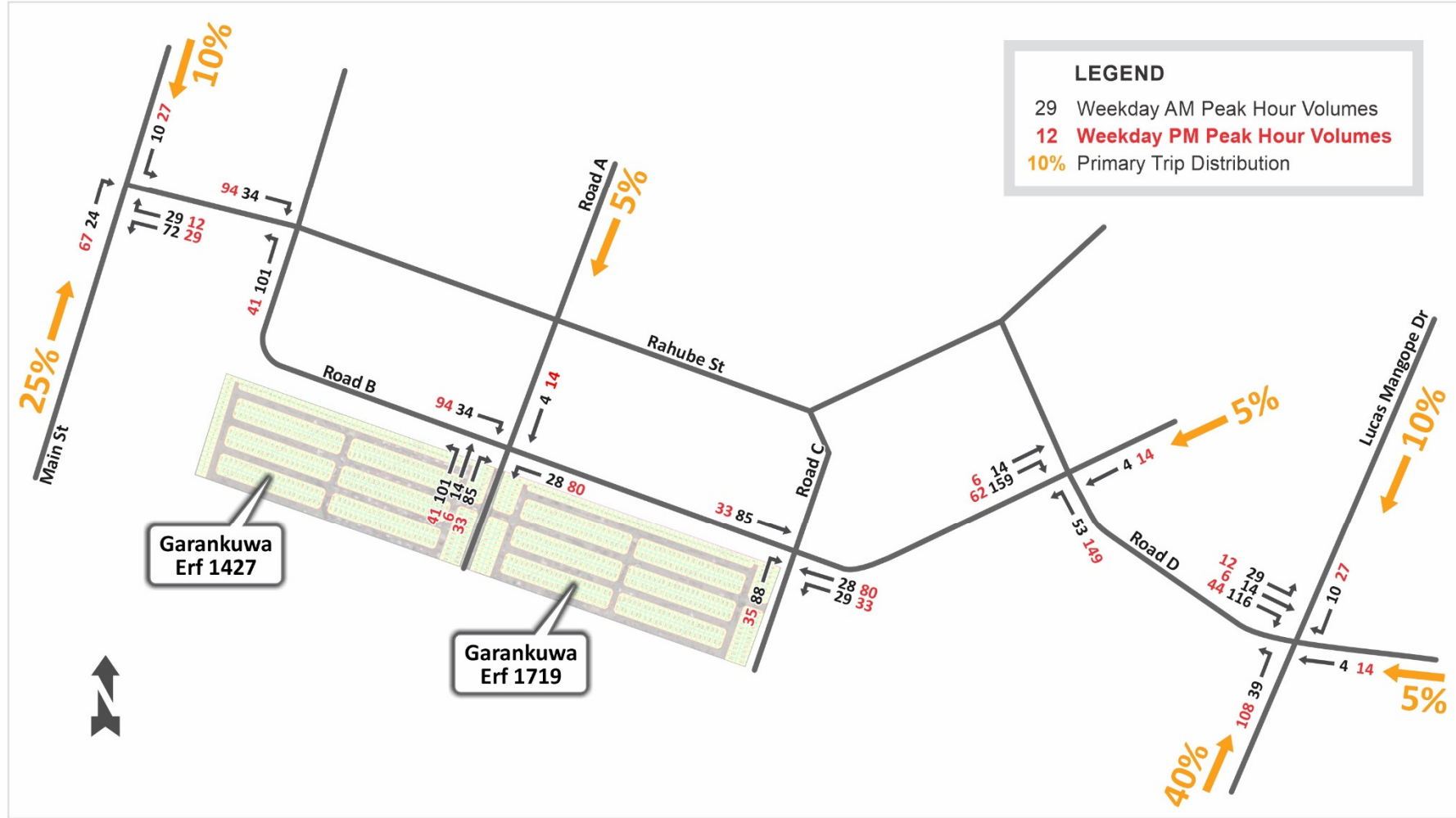


Figure 5 – Expected Erf 1427 & Erf 1719 Development Traffic

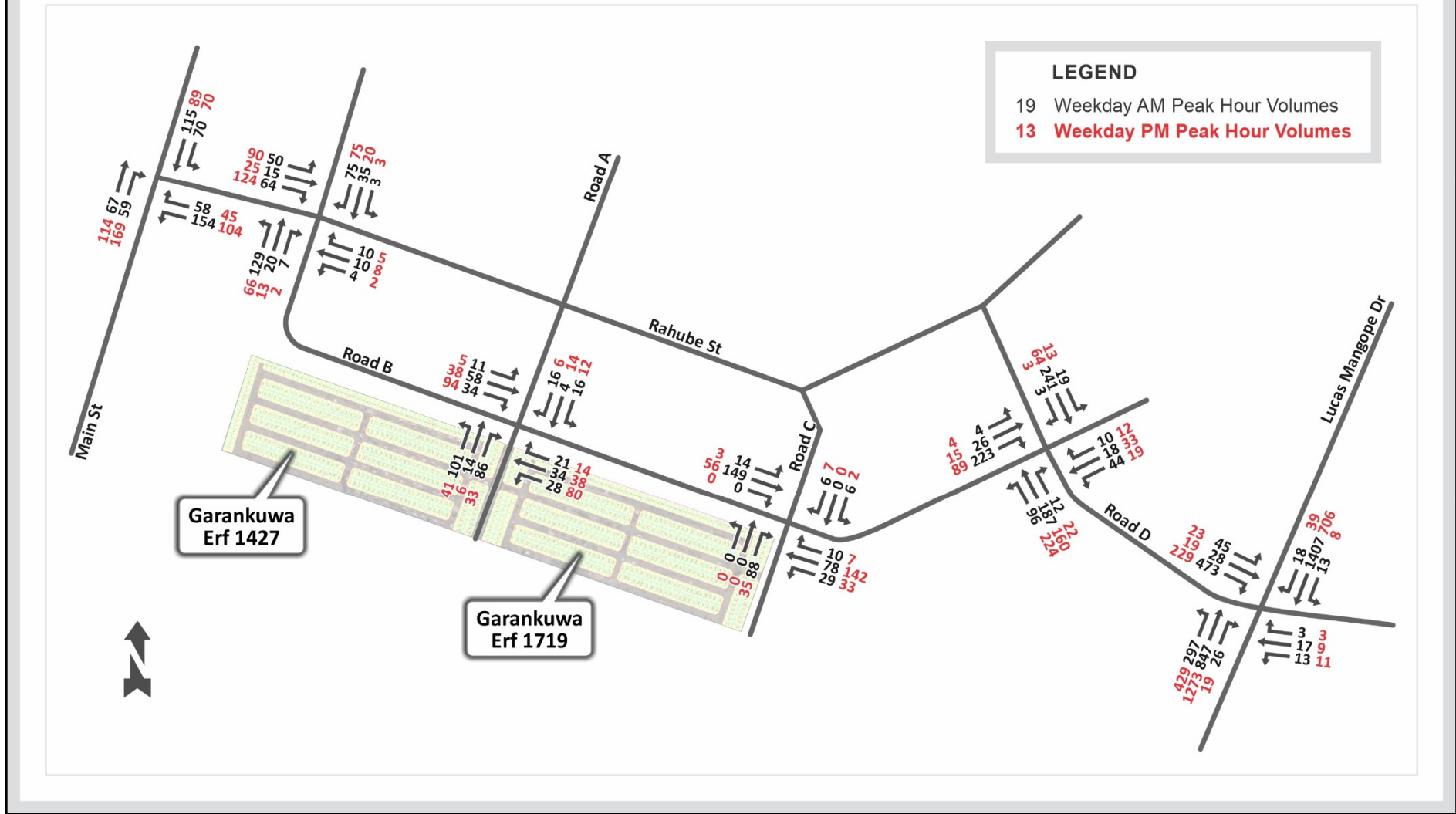


Figure 6 – Expected 2022 Weekday Peak Hour Traffic With Erf 1427 & Erf 1719 Development Traffic

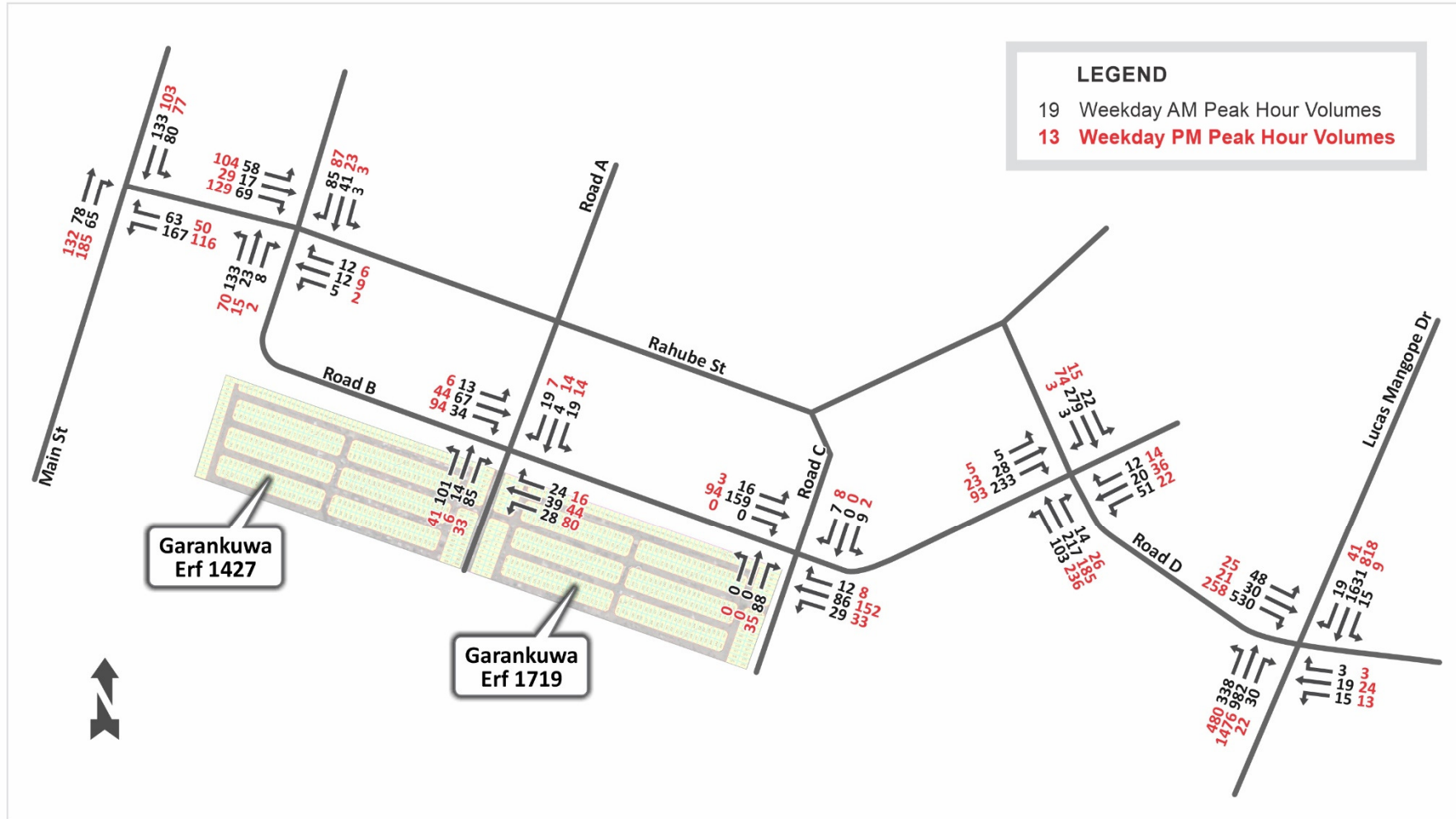


Figure 7 – Expected 2027 Weekday Peak Hour Traffic With Erf 1427 & Erf 1719 Development Traffic

4 CAPACITY ANALYSES

4.1 CAPACITY ANALYSES RESULTS

Capacity analyses were performed to evaluate the expected operating conditions on the surrounding road network. The PTV Vistro software^(ref 2) was used in the analyses. The output of the analyses is given as levels-of-service (LOS) which range from A (very good with minimum delay) to F (very bad with unacceptable delays). These levels-of-service (LOS) are based on the average delay experienced. The following scenarios were analysed:

- Scenario 1: 2022 Status Quo Weekday Peak Hour Volumes
- Scenario 2: Expected 2027 Weekday Peak Hour Background Volumes
- Scenario 3: Expected 2022 Weekday Peak Hour Traffic With Erf 1427 & Erf 1719 Traffic
- Scenario 4: Expected 2027 Weekday Peak Hour Traffic With Erf 1427 & Erf 1719 Traffic

The intersection levels of service are summarised below, and the detailed results are summarised and attached in *Appendix E*:

Table 4-1: Expected Operational Conditions

Intersection	Intersection Level of Service							
	Scenario 1		Scenario 2		Scenario 3		Scenario 4	
	AM	PM	AM	PM	AM	PM	AM	PM
Intersection 1 Road A / Road B	A	A	A	A	A	A	A	A
Intersection 2 Road B / Road C	A	A	A	A	A	A	A	A
Intersection 3 Road B / Road D	A	A	A	A	A	A	A	A
Intersection 4 Road D / Lucas Mangope Drive	F	F	F	F	F	F	F	F
Intersection 5 Rahube Street / Road B	A	A	A	A	A	A	A	A
Intersection 6 Rahube Street / Main Street	B	B	B	B	B	C	B	C

4.2 INTERSECTION IMPROVEMENTS

Except for the intersection of Road D and Lucas Mangope Drive, the intersections provide sufficient capacity to cater for the existing and well as expected future background traffic volumes on the road network.

The high traffic volumes along Lucas Mangope Drive cause constraints at the intersection with road D. It is recommended that the control of this intersection be changed from a 4-way stop to a signalised intersection to allow the following improved operating conditions in the future with the growth in background volumes and the additional development traffic:

Table 4-2: Expected Improved Operating Conditions – Intersection of Road D / Lucas Mangope Drive Signalised

Peak Hour	Scenario	Intersection LOS	Southern Approach				Eastern Approach				Northern Approach				Western Approach			
			Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right
			Lucas Mangope Drive				Road D				Lucas Mangope Drive				Road D			
AM	4	C	B	B	B	D	B	B	B	B	C	C	C	B	D	B	B	D
PM	4	A	A	A	A	A	C	C	C	C	A	A	A	A	D	C	C	D

The following road construction will be required to provide adequate access to the development on Erf 1427 and Erf 1719 – see *Figure 8 (next page)*.

- Extension of Road A from Road B to the southern boundary of Erf 1427
- Extension of Road C from Road B to the southern boundary of Erf 1719

The above roads should consist of 1 lane per direction, each lane at least 3m wide. As shown in the photo below, the road reserve catering for the extension of Road A is available.



Photo 1 – Road Reserve for the Southern Extension of Road A (southbound view)

A residential dwelling has unfortunately been constructed along the alignment of the southern extension of Road C. This dwelling unit will need to be relocated.



Photo 2 – Aerial View (Road C Extension)

5 PUBLIC TRANSPORT AND PEDESTRIAN FACILITIES

5.1 PUBLIC TRANSPORT FACILITIES

The residents in Garankuwa depend heavily on public transport and it can be expected that taxi routes will expand into the township as development takes place. According to the COTO Manual^(ref 3) public transport stops should be located within acceptable walking distances from generators, attractors and modal transfer facilities. Walking distances to stops should preferably be within 400m but not more than 800m.

A formal lay-by facility is available along Road B, approximately 290m west of the intersection with Road A.



Photo 3 – Existing Minibus-taxi layby along Road B

With the extension of Road A, additional lay-by facilities should be provided on either side of this road, downstream of the access to Erf 1427 and Erf 1719 – see *Figure 8*. It is also recommended that additional lay-bys be provided along the extension of Road C, at the access to Erf 1719 (also shown in *Figure 8*).

5.2 PEDESTRIAN FACILITIES

A 1.5m wide formal pedestrian walkway is currently available along the northern side of Road B. Speedhumps and pedestrian crossing facilities are also provided at various locations along Road B.



Photo 4 – Existing Pedestrian Walkway along Road B (Eastbound View along Road B)

With the southern extension of Road A and Road C, formal pedestrian walkways (at least 1.8m wide but preferably 2m wide) should be provided along the street front of Erf 1427 and Erf 1719 – also shown in *Figure 8*.

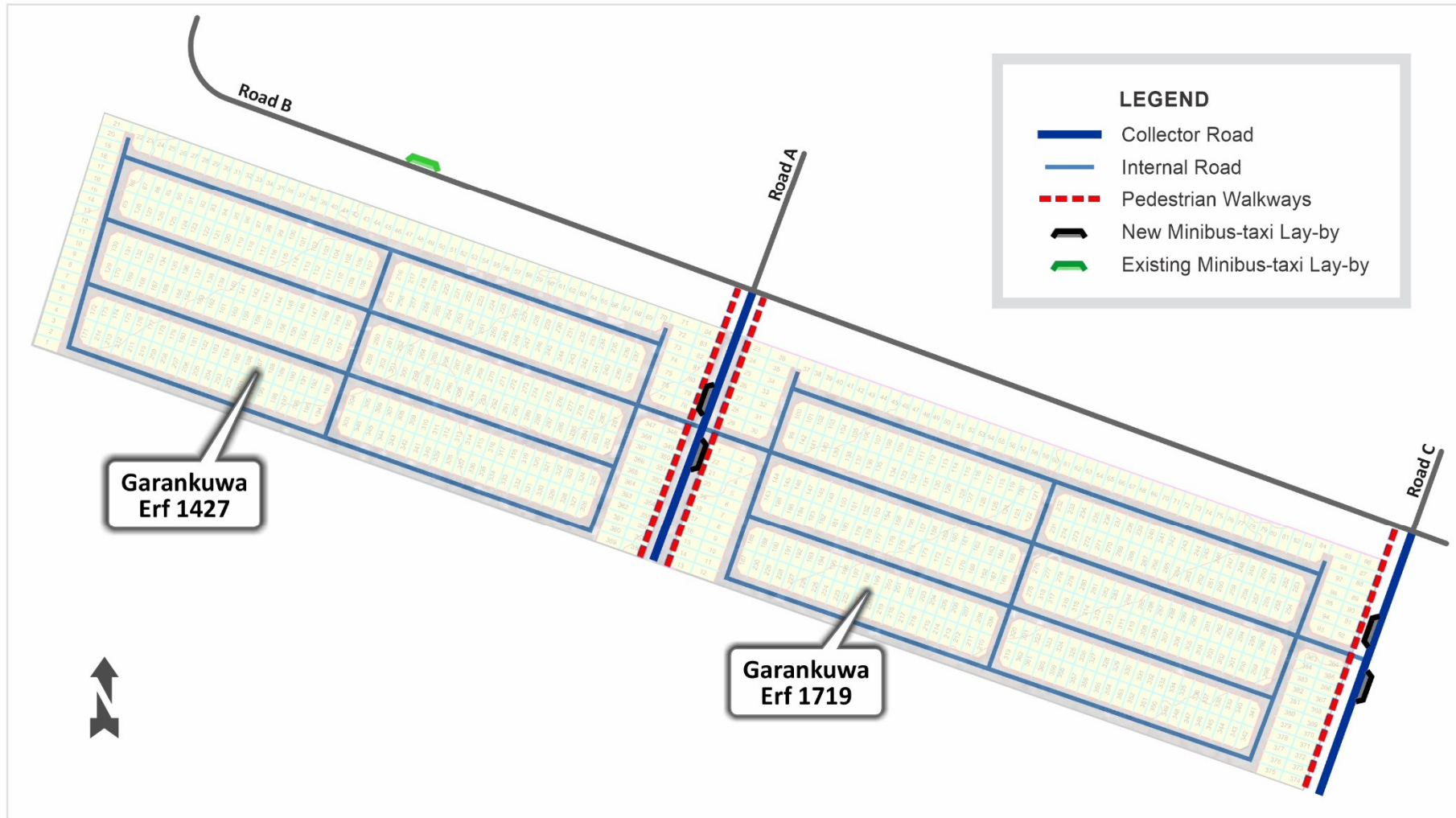


Figure 8 – Required Road Construction Including Public Transport and Pedestrian Facilities

6 CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations are made from this study:

6.1 CONCLUSIONS

- A subdivision application was submitted by Durapi Consulting on behalf of the City of Tshwane Human Settlements Department for Erf 1427 and Erf 1719, Garankuwa to allow 752 residential 1 erven (low income housing).
- The combined site is approximately 11.17 ha in extent and is located in the south-western area of Garankuwa.
- Low peak hour traffic volumes are currently present along the surrounding road network and no capacity constraints occur.
- The CTMM road planning for the area caters for the following:
 - The southern extension of Road A (U4(b) collector road) between Erf 1427 and Erf 1719.
 - The southern extension of Road C (U4(b) collector road) along the eastern boundary of Erf 1719.
- The road reserve for the extension of Road A is available but a dwelling unit will need to be relocated to allow the southern extension of Road C.
- The proposed township is expected to generate the following additional worst case peak hour trips:
 - Weekday AM: 384 trips (96 trips inbound and 288 trips outbound)
 - Weekday PM: 384 trips (269 trips inbound and 115 trips outbound)
- The existing road network will need to be extended to provide adequate access to the proposed township.
- A minibus-taxi layby and a formal pedestrian walkway is available along Road B (near Erf 1427 and Erf 1719).

6.2 RECOMMENDATIONS

It is recommended that:

- The proposed subdivision of Erf 1427 and Erf 1719 to allow 752 residential 1 erven be supported from a traffic engineering point of view.
- The following road improvements should be implemented as part of the township:
 - Installation of a traffic signal along Lucas Mangope Drive at the access to Garankuwa (Road D);
 - Extension of Road A (U4(b) Collector road) from Road B to the southern boundary of Erf 1427;
 - Extension of Road C (U4(b) Collector road) from Road B to the southern boundary of Erf 1719;
 - Construction of public transport lay-by facilities along the U4(b) collector roads at the main intersections providing access to Erf 1427 and Erf 1719.
 - Construction of the municipal road network within the township;
 - Construction of formal pedestrian walkways (preferably 2m wide) along the U4(b) collector roads along the street front of Erf 1427 and Erf 1719.

7 REFERENCES

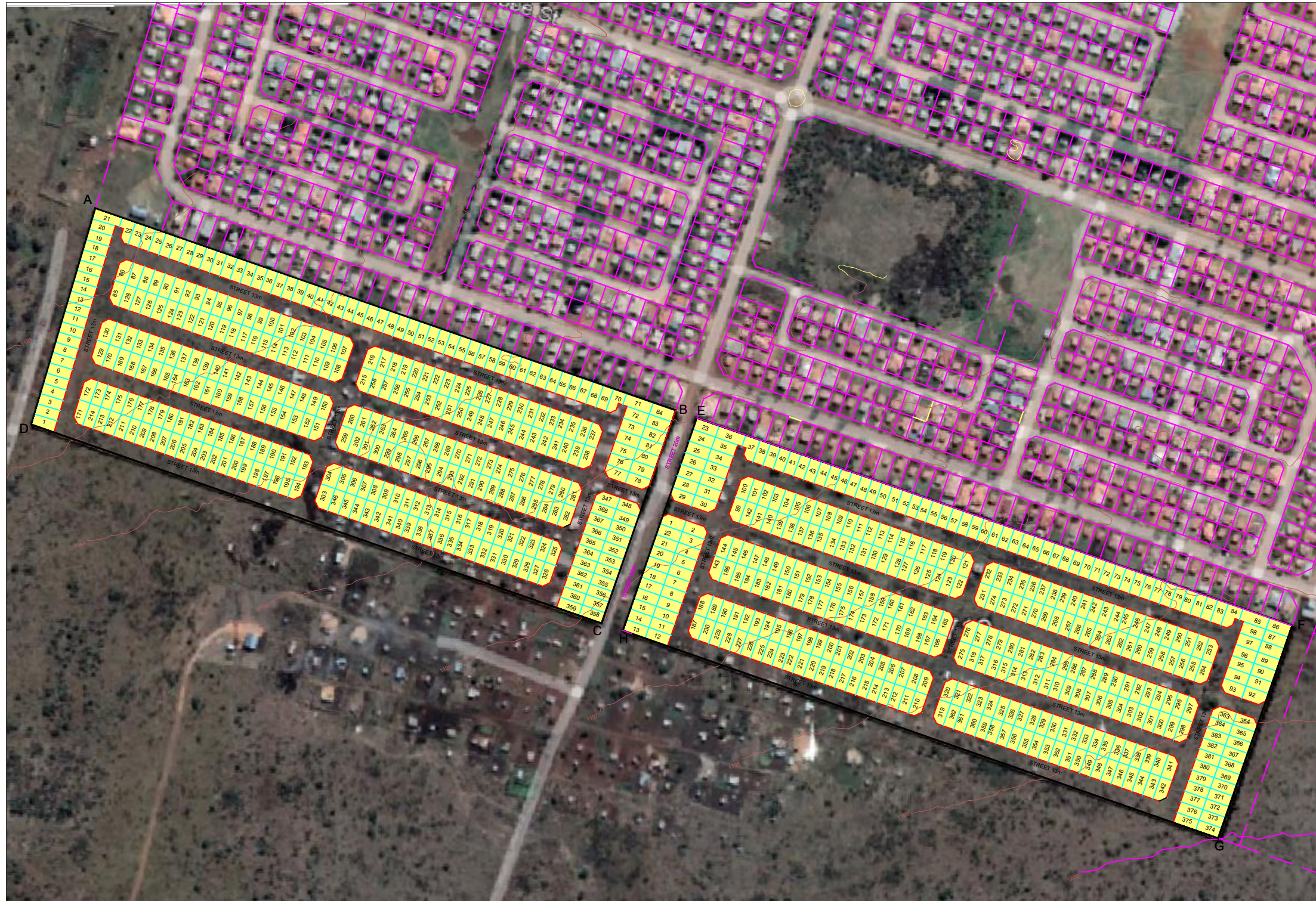
1. Committee of Transport Officials, **TMH17, South African Trip Data Manual**, Committee Draft 2.0, May 2018.
2. PTV Group, **PTV Vistro 2022 (SP 0-3)**, 2022.
3. Committee of Transport Officials, **South African Traffic Impact and Site Traffic Assessment Manual, TMH 16**, Committee Draft 2.0, May 2018.

APPENDIX A
Proposed Subdivision – Erf 1427 & Erf 1719

PROPOSED SUBDIVISION
GARANKUWA
 ERF 1427 & Erf 1719

The figure A B C D A represents ERF 1427, Garankuwa, measuring 10,8060ha in extent proposed to be subdivided into 368 Portions. (See table below)

The figure E F G H E represents ERF 1719, Garankuwa, measuring 11,1743ha in extent, proposed to be subdivided into 384 Portions. (See table below)



ERF 1427		ERF 1719	
ERF NO.	ERF SIZE	ERF NO.	ERF SIZE
1	214	1, 2	213
2 to 20	204	3 TO 11	210
21	238	12	212
22	202	13	214
23 to 69	200	14 TO 22	210
70	209	23	227
71	270	24 TO 28	227
72 to 76	228	29, 30	218
77, 78	218	31 TO 35	227
79 to 84	228	36	271
85	212	37	235
86	232	38 TO 83	200
87 to 106	207	84	240
107,108	218	85	274
109 to 128	207	86	226
129	232	87 to 91	222
130	252	92	238
131 to 149	214	93	239
150, 151	218	94 to 98	222
152 to 170	214	99, 100	218
171	200	101 to 120	207
172	221	121, 122	218
173 to 191	202	123 to 142	207
192	200	143, 144	218
193, 194	218	145 to 164	207
195	200	165, 166	218
196 to 214	202	167 to 186	207
215, 216	252	187, 188	218
217 to 236	207	189 to 208	207
237, 238	218	209, 210	218
239 to 258	207	211 to 230	207
259, 260	252	231, 232	218
261 to 280	207	233 to 252	206
281, 282	218	253, 254	218
283 to 302	207	255 to 274	206
303, 304	271	275,276	218
305 to 324	207	277 to 296	207
325, 326	236	297, 298	208
327 to 346	207	299 to 318	207
347, 348	218	319, 320	218
349 to 368	210	321 to 340	207
		341, 342	218
		343 TO 362	207
		363, 364	223
		365 to 373	210
		374, 375	202
		376 to 384	210

SCALE: 1: 4000 (A 3 Paper)

PLAN NO: xxxxxxx

Town Planner:
 TH Strydom
 Pr. Pln A/2027/2015

Date: 26/07/2022

CLIENT:



DURAPI
CONSULTING

Tel: 011 312 8629/8599
 Fax: 011 312 8638
 manjith@durapi.co.za
 herman@durapi.co.za

APPENDIX B

Capacity Analyses Results

Summary of Results

Peak Hour	Scenario	Intersection LOS	South				East				North				West			
			Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right
Road D / Lucas Mangope Drive																		
			Lucas Mangope Drive				Road D				Lucas Mangope Drive				Road D			
AM	1	F	F	F	F	F	B	B	B	B	F	F	F	F	F	F	F	F
	2	F	F	F	F	F	B	B	B	B	F	F	F	F	F	F	F	F
	3	F	F	F	F	F	B	B	B	B	F	F	F	F	F	F	F	F
	4	F	F	F	F	F	B	B	B	B	F	F	F	F	F	F	F	F
PM	1	F	F	F	F	F	B	B	B	B	E	E	E	E	C	C	C	C
	2	F	F	F	F	F	B	B	B	B	F	F	F	F	D	D	D	D
	3	F	F	F	F	F	B	B	B	B	E	E	E	E	D	D	D	D
	4	F	F	F	F	F	B	B	B	B	F	F	F	F	E	E	E	E
Road B / Rahube Street																		
			Road B				Rahube Drive				Road B				Rahube Drive			
AM	1	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
	2	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
	3	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
	4	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
PM	1	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
	2	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
	3	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
	4	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Rahube Street / Main Street																		
			Main Street				Rahube Drive				Main Street				Rahube Drive			
AM	1	B	A	-	A	A	B	A	-	B	A	A	A	-	-	-	-	-
	2	B	A	-	A	A	B	B	-	B	A	A	A	-	-	-	-	-
	3	B	A	-	A	A	B	B	-	B	A	A	A	-	-	-	-	-
	4	B	A	-	A	A	B	B	-	B	A	A	A	-	-	-	-	-
PM	1	B	A	-	A	A	B	A	-	B	A	A	A	-	-	-	-	-
	2	B	A	-	A	A	B	B	-	B	A	A	A	-	-	-	-	-
	3	B	A	-	A	A	B	B	-	C	A	A	A	-	-	-	-	-
	4	B	A	-	A	A	B	B	-	C	A	A	A	-	-	-	-	-

2027 Weekday AM With Erf 1427 & Erf 1719

Intersection of Road A and Road B

2027 Weekday AM with Erf 1427 and Erf 1719

Number	1											
Intersection	Road A / Road B											
Notes												
Control Type	All-way stop											
Analysis Method	HCM 7th Edition											
Name	Road A			Road A			Road B			Road B		
Show Name	☑			☑			☑			☑		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration	+			+			+			+		
Turning Movement	<i>Left</i>	<i>Thru</i>	<i>Right</i>	<i>Left</i>	<i>Thru</i>	<i>Right</i>	<i>Left</i>	<i>Thru</i>	<i>Right</i>	<i>Left</i>	<i>Thru</i>	<i>Right</i>
Base Volume Input [veh/h]	0	4	1	16	0	16	11	58	0	1	34	21
Total Analysis Volume [veh/h]	112	21	96	21	4	21	14	74	38	32	43	27
Movement, Approach, & Intersection Results												
Average Lane Delay [s/veh]	8.90			7.81			8.55			8.22		
95th-Percentile Queue Length [veh]	1.11			0.18			0.58			0.44		
95th-Percentile Queue Length [m]	8.46			1.40			4.41			3.37		
Approach Delay [s/veh]	8.90			7.81			8.55			8.22		
Approach LOS	A			A			A			A		
Intersection Delay [s/veh]	8.57											
Intersection LOS	A											
Calculation converged	Yes (after 3 iterations)											

2027 Weekday PM with Erf 1427 and Erf 1719

Number	1											
Intersection	Road A / Road B											
Notes												
Control Type	All-way stop											
Analysis Method	HCM 7th Edition											
Name	Road A			Road A			Road B			Road B		
Show Name	☑			☑			☑			☑		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration	+			+			+			+		
Turning Movement	<i>Left</i>	<i>Thru</i>	<i>Right</i>	<i>Left</i>	<i>Thru</i>	<i>Right</i>	<i>Left</i>	<i>Thru</i>	<i>Right</i>	<i>Left</i>	<i>Thru</i>	<i>Right</i>
Base Volume Input [veh/h]	2	12	6	12	0	6	5	38	4	14	38	14
Total Analysis Volume [veh/h]	48	22	44	16	16	8	7	49	110	107	49	18
Movement, Approach, & Intersection Results												
Average Lane Delay [s/veh]	8.30			7.86			8.77			8.13		
95th-Percentile Queue Length [veh]	0.50			0.16			0.79			0.74		
95th-Percentile Queue Length [m]	3.81			1.23			6.03			5.62		
Approach Delay [s/veh]	8.30			7.86			8.77			8.13		
Approach LOS	A			A			A			A		
Intersection Delay [s/veh]	8.36											
Intersection LOS	A											
Calculation converged	Yes (after 3 iterations)											

Intersection of Road B and Road C

2027 Weekday AM with Erf 1427 and Erf 1719

Number	25												
Intersection	Road B / Road C												
Notes													
Control Type	All-way stop												
Analysis Method	HCM 7th Edition												
Name	Road C			Road C			Road B			Road B			
Show Name	☑			☑			☑			☑			
Approach	Northbound			Southbound			Eastbound			Westbound			
Lane Configuration	+			+			+			+			
Turning Movement	<i>Left</i>	<i>Thru</i>	<i>Right</i>	<i>Left</i>	<i>Thru</i>	<i>Right</i>	<i>Left</i>	<i>Thru</i>	<i>Right</i>	<i>Left</i>	<i>Thru</i>	<i>Right</i>	
Base Volume Input [veh/h]	0	0	0	8	0	6	14	64	0	0	50	10	
Total Analysis Volume [veh/h]	0	0	98	10	0	8	18	177	0	32	96	13	
▼ Movement, Approach, & Intersection Results													
Average Lane Delay [s/veh]	8.61			7.64			8.59			8.15			
95th-Percentile Queue Length [veh]	0.46			0.07			0.90			0.60			
95th-Percentile Queue Length [m]	3.48			0.53			6.85			4.58			
Approach Delay [s/veh]	8.61			7.64			8.59			8.15			
Approach LOS	A			A			A			A			
Intersection Delay [s/veh]	8.42												
Intersection LOS	A												
Calculation converged	Yes (after 3 iterations)												

2027 Weekday PM with Erf 1427 and Erf 1719

Number	25												
Intersection	Road B / Road C												
Notes													
Control Type	All-way stop												
Analysis Method	HCM 7th Edition												
Name	Road C			Road C			Road B			Road B			
Show Name	☑			☑			☑			☑			
Approach	Northbound			Southbound			Eastbound			Westbound			
Lane Configuration	+			+			+			+			
Turning Movement	<i>Left</i>	<i>Thru</i>	<i>Right</i>	<i>Left</i>	<i>Thru</i>	<i>Right</i>	<i>Left</i>	<i>Thru</i>	<i>Right</i>	<i>Left</i>	<i>Thru</i>	<i>Right</i>	
Base Volume Input [veh/h]	0	0	0	2	0	7	3	53	0	0	62	7	
Total Analysis Volume [veh/h]	0	0	39	2	0	9	3	104	0	92	169	9	
▼ Movement, Approach, & Intersection Results													
Average Lane Delay [s/veh]	8.18			7.87			7.88			8.59			
95th-Percentile Queue Length [veh]	0.17			0.04			0.43			1.24			
95th-Percentile Queue Length [m]	1.28			0.34			3.30			9.44			
Approach Delay [s/veh]	8.18			7.87			7.88			8.59			
Approach LOS	A			A			A			A			
Intersection Delay [s/veh]	8.35												
Intersection LOS	A												
Calculation converged	Yes (after 3 iterations)												

Intersection of Road B and Road D

2027 Weekday AM with Erf 1427 and Erf 1719

Number	998004											
Intersection	Road B / Road D											
Notes												
Control Type	Roundabout											
Analysis Method	HCM 7th Edition											
Name	Road D			Road D			Road B			Road B		
Show Name	☑			☑			☑			☑		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration	+			+			+			+		
Turning Movement	<i>Left</i>	<i>Thru</i>	<i>Right</i>	<i>Left</i>	<i>Thru</i>	<i>Right</i>	<i>Left</i>	<i>Thru</i>	<i>Right</i>	<i>Left</i>	<i>Thru</i>	<i>Right</i>
Base Volume Input [veh/h]	43	187	12	19	241	3	4	12	64	44	14	10
Total Analysis Volume [veh/h]	114	241	16	24	310	3	6	31	259	57	22	13
▼ Movement, Approach, & Intersection Results												
Average Lane Delay [s/veh]	5.16			7.01			6.20			5.91		
Lane LOS	A			A			A			A		
95th-Percentile Queue Length [veh]	1.15			1.48			1.17			0.41		
95th-Percentile Queue Length [m]	8.78			11.25			8.89			3.09		
Approach Delay [s/veh]	5.16			7.01			6.20			5.91		
Approach LOS	A			A			A			A		
Intersection Delay [s/veh]	6.07											
Intersection LOS	A											

2027 Weekday PM with Erf 1427 and Erf 1719

Number	998004											
Intersection	Road B / Road D											
Notes												
Control Type	Roundabout											
Analysis Method	HCM 7th Edition											
Name	Road D			Road D			Road B			Road B		
Show Name	☑			☑			☑			☑		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration	+			+			+			+		
Turning Movement	<i>Left</i>	<i>Thru</i>	<i>Right</i>	<i>Left</i>	<i>Thru</i>	<i>Right</i>	<i>Left</i>	<i>Thru</i>	<i>Right</i>	<i>Left</i>	<i>Thru</i>	<i>Right</i>
Base Volume Input [veh/h]	75	160	22	13	64	3	4	15	27	19	19	12
Total Analysis Volume [veh/h]	262	206	29	17	82	3	6	26	103	24	40	16
▼ Movement, Approach, & Intersection Results												
Average Lane Delay [s/veh]	6.39			3.79			4.49			3.75		
Lane LOS	A			A			A			A		
95th-Percentile Queue Length [veh]	1.82			0.28			0.43			0.23		
95th-Percentile Queue Length [m]	13.91			2.17			3.29			1.72		
Approach Delay [s/veh]	6.39			3.79			4.49			3.75		
Approach LOS	A			A			A			A		
Intersection Delay [s/veh]	5.49											
Intersection LOS	A											

Intersection of Road D and Lucas Mangope Drive

2027 Weekday AM with Erf 1427 and Erf 1719

Number	29											
Intersection	Lucas Mangope Drive / Road D											
Notes												
Control Type	All-way stop											
Analysis Method	HCM 7th Edition											
Name	Lucas Mangope Drive			Lucas Mangope Drive			Road D			Road D		
Show Name	↖			↖			↖			↖		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration	⇌			⇌			⇌			⇌		
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Base Volume Input [veh/h]	258	847	26	13	1407	8	16	14	357	13	13	3
Total Analysis Volume [veh/h]	356	1034	32	16	1717	20	51	32	558	16	20	3
Movement, Approach, & Intersection Results												
Average Lane Delay [s/veh]	342.22	373.08	13.20	567.14	568.54	12.88	15.02		322.27	14.28	15.21	15.01
95th-Percentile Queue Length [veh]	41.72	43.47	0.28	64.10	64.16	0.17	0.83		33.28	0.15	0.21	0.03
95th-Percentile Queue Length [m]	317.94	331.22	2.12	488.45	488.94	1.29	6.36		253.58	1.17	1.58	0.23
Approach Delay [s/veh]	349.90			561.51			282.48			14.82		
Approach LOS	F			F			F			B		
Intersection Delay [s/veh]	431.52											
Intersection LOS	F											
Calculation converged	Yes (after 3 iterations)											

2027 Weekday PM with Erf 1427 and Erf 1719

Number	29											
Intersection	Molefe Makinta Highway / Road D											
Notes												
Control Type	All-way stop											
Analysis Method	HCM 7th Edition											
Name	Molefe Makinta Highway			Molefe Makinta Highway			Road D			Road D		
Show Name	↖			↖			↖			↖		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration	⇌			⇌			⇌			⇌		
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Base Volume Input [veh/h]	321	1273	19	8	706	12	11	13	185	11	9	3
Total Analysis Volume [veh/h]	505	1554	23	9	861	43	26	22	272	14	25	3
Movement, Approach, & Intersection Results												
Average Lane Delay [s/veh]	652.29	696.40	12.48	86.68	87.25	13.00	13.88		44.79	13.70	14.88	14.53
95th-Percentile Queue Length [veh]	79.77	81.74	0.19	14.05	14.10	0.37	0.44		6.72	0.13	0.25	0.03
95th-Percentile Queue Length [m]	607.82	622.86	1.42	107.05	107.41	2.79	3.37		51.19	0.97	1.92	0.23
Approach Delay [s/veh]	667.03			83.48			40.15			14.46		
Approach LOS	F			F			E			B		
Intersection Delay [s/veh]	440.40											
Intersection LOS	F											
Calculation converged	Yes (after 4 iterations)											

Intersection of Road B and Rahube Street

2027 Weekday AM with Erf 1427 and Erf 1719

Number	11											
Intersection	Road B / Rahube Street											
Notes												
Control Type	All-way stop											
Analysis Method	HCM 7th Edition											
Name	Road B			Road B			Rahube Street			Rahube Street		
Show Name	☑			☑			☑			☑		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration	+			+			+			+		
Turning Movement	<i>Left</i>	<i>Thru</i>	<i>Right</i>	<i>Left</i>	<i>Thru</i>	<i>Right</i>	<i>Left</i>	<i>Thru</i>	<i>Right</i>	<i>Left</i>	<i>Thru</i>	<i>Right</i>
Base Volume Input [veh/h]	28	20	7	3	35	73	50	15	30	4	10	10
Total Analysis Volume [veh/h]	148	26	9	3	46	94	64	19	77	6	13	13
▼ Movement, Approach, & Intersection Results												
Average Lane Delay [s/veh]	8.14			8.77			8.70			8.04		
95th-Percentile Queue Length [veh]	0.78			0.68			0.75			0.13		
95th-Percentile Queue Length [m]	5.93			5.20			5.74			1.02		
Approach Delay [s/veh]	8.14			8.77			8.70			8.04		
Approach LOS	A			A			A			A		
Intersection Delay [s/veh]	8.48											
Intersection LOS	A											
Calculation converged	Yes (after 3 iterations)											

2027 Weekday PM with Erf 1427 and Erf 1719

Number	11											
Intersection	Road B / Rahube Street											
Notes												
Control Type	All-way stop											
Analysis Method	HCM 7th Edition											
Name	Road B			Road B			Rahube Street			Rahube Street		
Show Name	☑			☑			☑			☑		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration	+			+			+			+		
Turning Movement	<i>Left</i>	<i>Thru</i>	<i>Right</i>	<i>Left</i>	<i>Thru</i>	<i>Right</i>	<i>Left</i>	<i>Thru</i>	<i>Right</i>	<i>Left</i>	<i>Thru</i>	<i>Right</i>
Base Volume Input [veh/h]	25	13	2	3	20	75	90	25	30	2	8	5
Total Analysis Volume [veh/h]	78	17	2	3	26	97	116	32	143	2	10	7
▼ Movement, Approach, & Intersection Results												
Average Lane Delay [s/veh]	7.89			8.90			9.67			7.93		
95th-Percentile Queue Length [veh]	0.39			0.61			1.58			0.08		
95th-Percentile Queue Length [m]	3.00			4.69			12.07			0.59		
Approach Delay [s/veh]	7.89			8.90			9.67			7.93		
Approach LOS	A			A			A			A		
Intersection Delay [s/veh]	9.10											
Intersection LOS	A											
Calculation converged	Yes (after 3 iterations)											

Intersection of Rahube Street and Main Street

2027 Weekday AM with Erf 1427 and Erf 1719

Number	16					
Intersection	Main Street / Rahube Street					
Notes						
Control Type	Two-way stop					
Analysis Method	HCM 7th Edition					
Name	Main Street		Main Street		Rahube Street	
Show Name	☑		☑		☑	
Approach	Northbound		Southbound		Westbound	
Lane Configuration	↑		↓		↔	
Turning Movement	<i>Thru</i>	<i>Right</i>	<i>Left</i>	<i>Thru</i>	<i>Left</i>	<i>Right</i>
Base Volume Input [veh/h]	67	35	60	115	82	29
Total Analysis Volume [veh/h]	87	72	89	148	186	70
▼ Movement, Approach, & Intersection Results						
V/C, Movement V/C Ratio	0.00	0.05	0.00	0.00	0.22	0.13
d_M, Delay for Movement [s/veh]	0.00	7.78	0.00	0.00	11.75	14.00
d_Rank1, Delay to Rank 1 Vehicle [s/veh]	0.00	0.00	0.00	0.00	0.00	0.00
Movement LOS	A	A	A	A	B	B
Critical Movement	☐	☐	☐	☐	☐	☑
95th-Percentile Queue Length [veh/ln]	0.12	0.12	0.00	0.00	1.54	1.54
95th-Percentile Queue Length [m/ln]	0.95	0.95	0.00	0.00	11.71	11.71
d_A, Approach Delay [s/veh]	3.52		0.00		12.36	
Approach LOS	A		A		B	
V/C_I, Worst Movement V/C Ratio				0.13		
d_I, Worst Movement Control Delay [s/veh]				14.00		
d_I, Intersection Delay [s/veh]				5.71		
Intersection LOS				B		

2027 Weekday PM with Erf 1427 and Erf 1719

Number	16					
Intersection	Main Street / Rahube Street					
Notes						
Control Type	Two-way stop					
Analysis Method	HCM 7th Edition					
Name	Main Street		Main Street		Rahube Street	
Show Name	☑		☑		☑	
Approach	Northbound		Southbound		Westbound	
Lane Configuration	↑		↓		↔	
Turning Movement	<i>Thru</i>	<i>Right</i>	<i>Left</i>	<i>Thru</i>	<i>Left</i>	<i>Right</i>
Base Volume Input [veh/h]	114	102	43	89	75	33
▼ Movement, Approach, & Intersection Results						
V/C, Movement V/C Ratio	0.00	0.15	0.00	0.00	0.14	0.17
d_M, Delay for Movement [s/veh]	0.00	7.87	0.00	0.00	11.78	18.54
d_Rank1, Delay to Rank 1 Vehicle [s/veh]	0.00	0.00	0.00	0.00	0.00	0.00
Movement LOS	A	A	A	A	B	C
Critical Movement	☐	☐	☐	☐	☐	☑
95th-Percentile Queue Length [veh/ln]	0.39	0.39	0.00	0.00	1.33	1.33
95th-Percentile Queue Length [m/ln]	2.95	2.95	0.00	0.00	10.13	10.13
d_A, Approach Delay [s/veh]	4.59		0.00		13.83	
Approach LOS	A		A		B	
V/C_I, Worst Movement V/C Ratio				0.17		
d_I, Worst Movement Control Delay [s/veh]				18.54		
d_I, Intersection Delay [s/veh]				5.66		
Intersection LOS				C		