



MERCHELLE'S
COLLECTIVE
REFLECTING THE FUTURE

FINAL REPORT

Hartebeespoort W&S Feasibility Study Traffic Impact Assessment

05/07/2018

RECORD OF REVISIONS

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EXECUTIVE SUMMARY

A feasibility study is underway for the Housing Development Agency (HDA) in developing the site at Portion 237 of Farm Hartebeesport 238 JR 772 JR for residential occupation. The site is in Jan Niemand Park and is bound by Stormvoel Road on the northern boundary, Derdepoort Road on the eastern boundary and a railway line on the southern boundary. The development typology will be mostly residential in nature.

A Traffic Assessment is required due to the change in land use from Agricultural Holdings to a township establishment. This report covers the feasibility of the site in terms of the existing transport structure, accessibility of the site and the ability of the road and public transport network to accommodate the potential trips generated by the development. The report also investigates whether the development type and location serve the transport policies that the City of Tshwane has adopted. In terms of the latter, and in light of the future planned BRT Line 4 that runs adjacent the site, the Tshwane IRPTN SDF Planning Policy Guidelines and Densification Report promotes densification and nodal development along transit corridors. This is critical to the promotion and development of the site as it satisfies government's planning policies for a compact city, designed around sustainable transport networks.

Vehicular access to the site is proposed on Stormvoel Rd. via existing access intersections on Stormvoel/Bloureier Rd. and a new LILLO intersection off Derdepoort Rd. just north of the existing Derdepoort/Mosaic Rd. Intersection. Based on the South African Trip Data Manual, TMH 18, Volume 1. COTO. September 2012, the development will generate a total of 1314 trips/hr in the AM peak hour period and 1569 trips/hr in the PM peak hours.

In addition to private vehicle access, a well-connected network of sidewalks and cycle routes should be planned and implemented. The routes should provide direct, convenient access between the development and major trip attractors such as the BRT stations, rail stations and nearby work opportunities.

The presence of the BRT, a world class public transport system, in such close proximity to the development should ideally influence the travel choice of residents. With this in place, the transport network is well placed to accommodate the travel demand of the development.

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LIST OF ACRONYMS

IRPTN	Integrated Rapid Public Transport Network
LILO	Left In, Left Out
BRT	Bus Rapid Transit
TRT	Tshwane Rapid Transit
TBS	Tshwane Bus Service

1 INTRODUCTION

Merchelle's Collective (Pty) Ltd was appointed by V3 Consulting Engineers to undertake a Traffic Impact Assessment for the development of an Integrated Human Settlement Project on Portion 237 of Farm Hartebeesport 238 JR 772 JR. The Client is the Housing Development Agency (HDA), whose terms of reference for this project is to conduct a comprehensive feasibility study and development modelling of the site.

The purpose of the Transport Assessment is to:

- Review existing structuring elements which involves the analysis of movement networks, connectivity and their influence on the study area
- Evaluate the roads and accessibility to and from the property
- Model current and future access demands
- Identify any impacts to the surrounding road network and proposed mitigation measures
- Identify any road improvements deemed necessary

This report addresses the evaluation of the supporting road network and accessibility to the site, the current and future traffic demand for the final development scenario, and the potential access points onto the road network including proposed improvements thereof.

1.1 Background and Report Purpose

The site under consideration is identified as an inner-city project that is earmarked for the development of an integrated human settlement. The strategic principles that will inform the development typology is that contained within the Gauteng Spatial Development Framework (GSDF) which aims to establish a common future spatial structure for the Gauteng Province. The primary structuring elements contained in both the GSDF and the Municipal Strategic Development Framework (MSDF) for Tshwane, which it informs, are:

- Open space and green system
- Urban mixed-use activity nodes
- Public transit and movement routes
- Urban corridors and activity spines.

The above principles support better integration between transport and land use planning and guarantee that future development of towns and cities move towards more sustainable human settlement patterns.

The evaluation of the existing and future planned transport network in the vicinity of the development is therefore a critical factor in determining the success and sustainability of the development. This report therefore analyses the nature of the planned development and subsequent demand for travel to and from the site, and thereafter the capacity of the road and public transport infrastructure to accommodate this demand. Moreover, the report investigates whether the development type and location serve the transport policies that the City of Tshwane has adopted.

1.2 Approach and Methodology

The Client requires a detailed traffic study to support the development proposals. Once the development yield is determined by the urban planner, the Traffic Impact Assessment is undertaken as follows:

- Analyse the provincial, regional and local road network influencing the transport and road planning in the study area.
- Evaluate the road hierarchy and access management planning in the area based on provincial and national government requirements and identify conditions to which access may be granted for new intersection points (if required).
- Determine the future traffic demand for the final development scenario, based on the trip generation rates contained in the South African Trip Data Manual, TMH 18, Volume 1. COTO. September 2012. The analysis will include the envisaged trip generation, trip distribution, modal split and trip assignment onto the road network.
- Determine access points onto the road network for the development-related trips, including appropriate distribution to the road network in order to avoid over-loading existing intersections.

2 STATUS QUO ANALYSIS

2.1 Study Area

The site is located on Portion 237 of Farm Hartebeespoort 328 JR., falling under the jurisdiction of the City of Tshwane. The farm is part of the Jan Niemand suburb and in close proximity to the Silverton and Waltloo industrial areas. A locality map is provided in Figure 2-1 below:

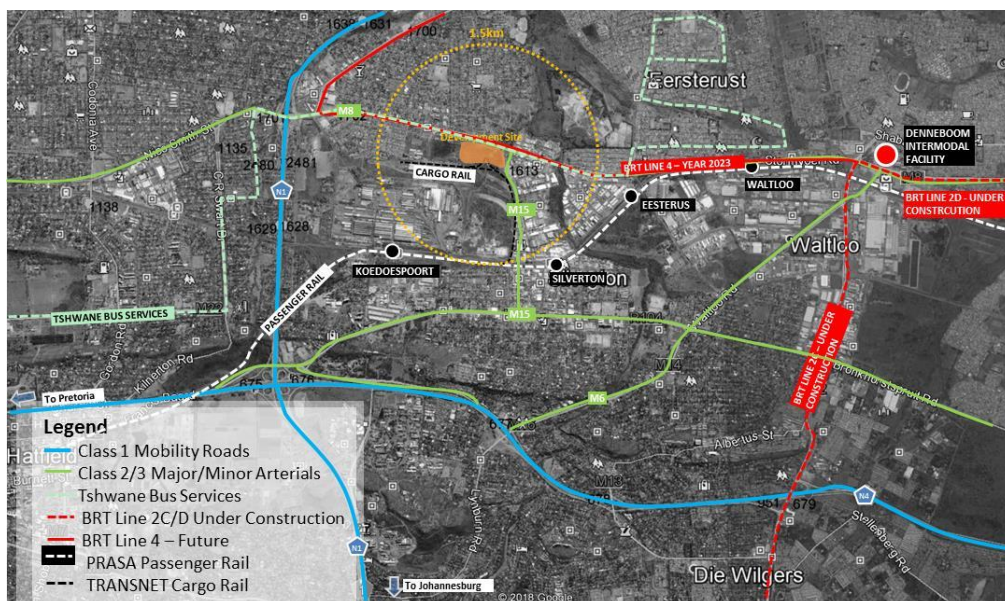


Figure 2-1 Locality Map showing Farm Hartbeespoort, City of Tshwane

2.1.1 Structuring Elements

The structuring elements, in terms of transport infrastructure relates to the road, rail and bus network that provide linkages across regions and towns. The network is shown in Figure 2-1 above and described in more detail below.

2.1.2 Existing Road Network

The site is bound to the north by the M8, Stormvoel Rd. and to the east by the M15, Derdepoort Rd. The site can be accessed both locally and regionally via the following road network:

- **N1/N4:** The N1 and N4 are Class U1 roads that form part of the freeway system providing high mobility between provinces and towns. The N1 notably connects Pretoria to Johannesburg and the N4 connects Pretoria CBD to Emalahleni in the east. Both roads are within very close proximity to the site and easily accessible via the Stormvoel/N1 Interchange and thereafter the N1/N4 Proefplaas Systems Interchange.
- **Stormvoel Rd. (M8):** The M8 is a Class U2 Metropolitan Distributor that connects to the N1 (2.6km east of the site), providing regional mobility, in the east-west direction between surrounding towns and suburbs. Access is limited to intersections spaced at 600m., while left in, left out (LILLO) accesses have been allowed at reduced spacings. Stormvoel Rd. becomes Tsamaya Ave. to the west, which is the main access corridor in the Mamelodi residential township. To the east of the N1, the road becomes Nico Smith St. linking to Koedoespoort and Wonderboom South.
- **Derdepoort Rd. (M15):** The M15 is a Class U3 District Distributor running in a north-south direction and providing access to the industrial area. The road connects to Bronkhorstspuit Rd. approximately 2km to the south, which distributes traffic in an east-west direction to the areas of Nelmapius and Silverlakes in the east.
- **Jan Coetzee St.:** Jan Coetzee St. is a Class 4U Distributor that provides full, signalised access onto Stormvoel Rd. from the residential area of Jan Niemand Park.
- **Bencon St.:** Bencon St. is a Class 4U Collector that is part of the internal road network providing access to existing development to the west of the site. The intersection has marginal access i.e., Left In Left Out access onto Stormvoel Rd.
- **Bloureier St.:** Bloureier St. is a Class 4U Distributor that provides full, signalised access onto Stormvoel Rd. from the residential areas located to the north and south of Stormvoel Rd.
- **Anne St.:** Anne St. is a Class 5 Collector that has marginal access i.e., Left In Left Out access onto Stormvoel Rd.

The road network is illustrated in Figure 2-2 below:

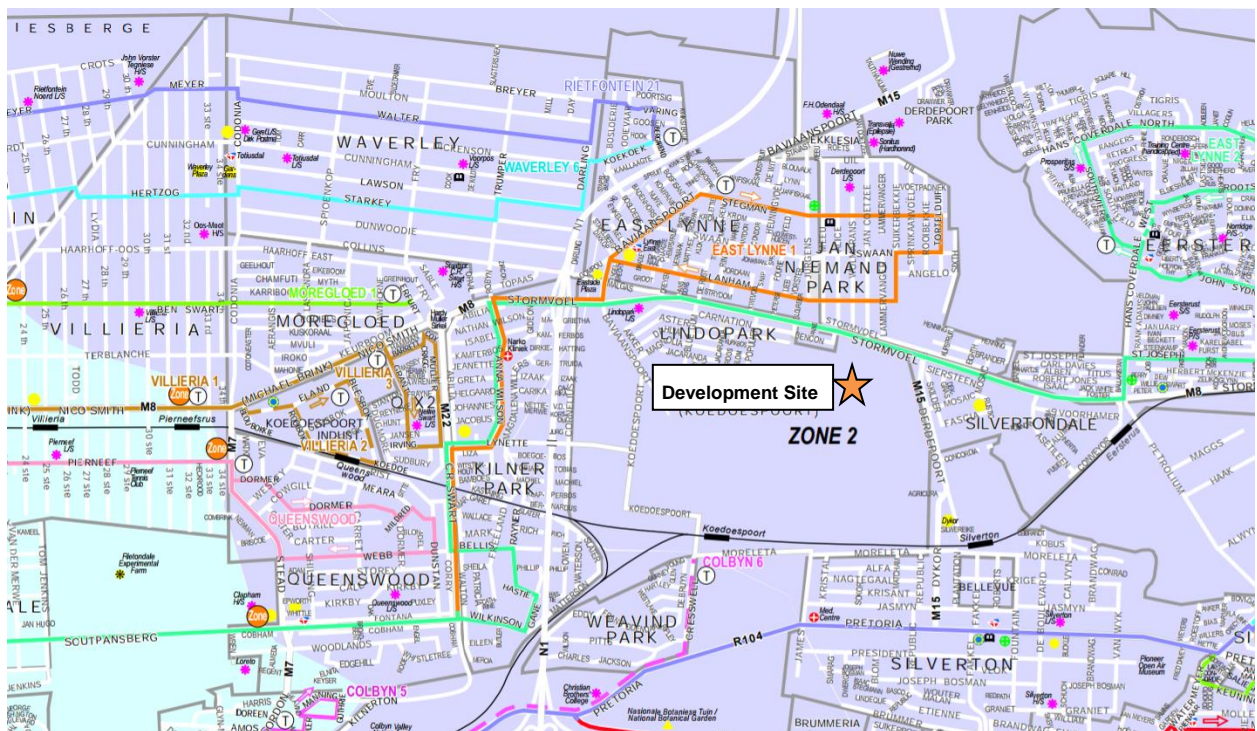


Figure 2-3 Tshwane Bus Service Network (Ref: CoT Website)

2.1.4 Transport Planning Proposals

In line with National Department of Transport's transportation goals for the country, the City of Tshwane (CoT) is developing an Integrated Public Transport Network (IPTN) designed to meet the needs of all the people of Tshwane in a sustainable and affordable manner.

The A Re Yeng network represents the **Bus Rapid Transit (BRT)** component of the IPTN and will be developed in several phases over a period of up to 20 years to provide an extensive high-quality transportation network, stimulating and supporting social and economic development.

The first BRT trunk line was constructed between the Pretoria CBD and Hatfield and is currently operational. The next line that will be operational is the Wonderboom to Hatfield line (via the CBD) with further extensions to Mamelodi currently under construction (Line 2C and 2D). The network will be further extended and implemented in several phases. Line 4, which is of interest to this study as it runs along Stormvoel Rd. passing the development site, is expected to be implemented by 2024. The line connects Denneboom to Rainbow Junction, where transfers are available to other parts of the public transport network. The alignment of Line 4 (2016-2028 A Re Yeng Operational Plan, CoT) is shown in .

The proximity of this line to the development site has significant implications for the viability of the development site, as discussed in the following chapters.

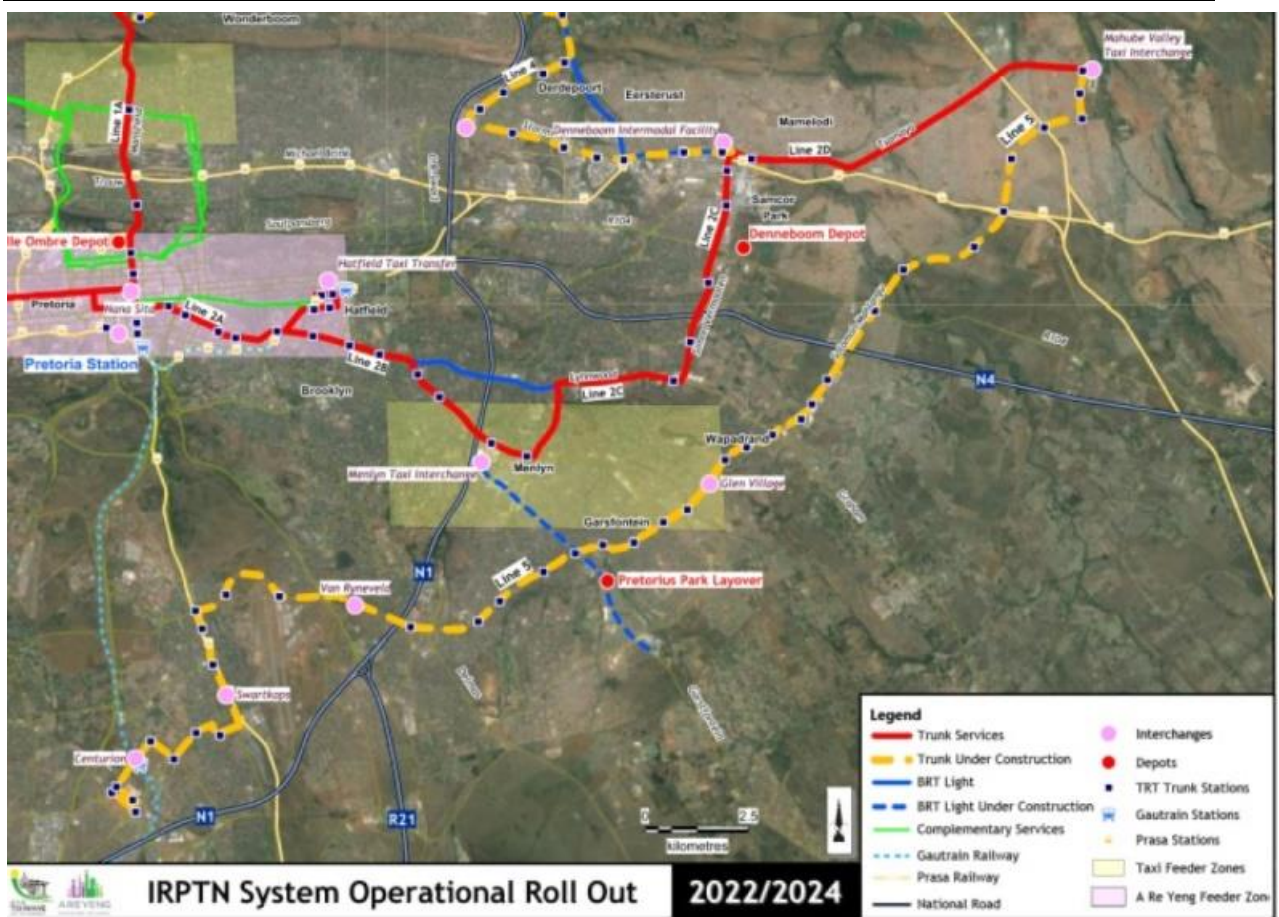


Figure 2-4 IRPTN System Operational Roll Out for 2022/2024 - Line 4

2.2 Data Collection

2.2.1 Traffic Volumes

Three existing intersections were identified as critical junctions surrounding the development and traffic surveys were commissioned for these intersections on a typical weekday. The traffic counts were conducted in March 2018 covering a 12-hour period from 06:00 to 18:00. The survey consisted of classified, turning movement volume counts and the vehicles were classified as light and heavy vehicles per direction in 15-minute intervals.

The three intersections are listed below and shown spatially in **Error! Reference source not found.**

- Stormvoel Road & Jan Coetzee street
- Stormvoel Road & Derdepoort Road
- Derdepoort Road & Mosaic Road

After liaising with the City of Tshwane regarding potential access points to the development, the study area was expanded to include a further 3 intersections and as a result, spot counts were undertaken during June 2018 as follows:

- Stormvoel Rd. & Bloureier St.
- Stormvoel Rd. and Anne St.
- Stormvoel Rd. and Bencon St.



Figure 2-5 Traffic Count Locations

The AM Peak hour and PM Peak Hour turning movement volumes are provided in Figure 2-6.

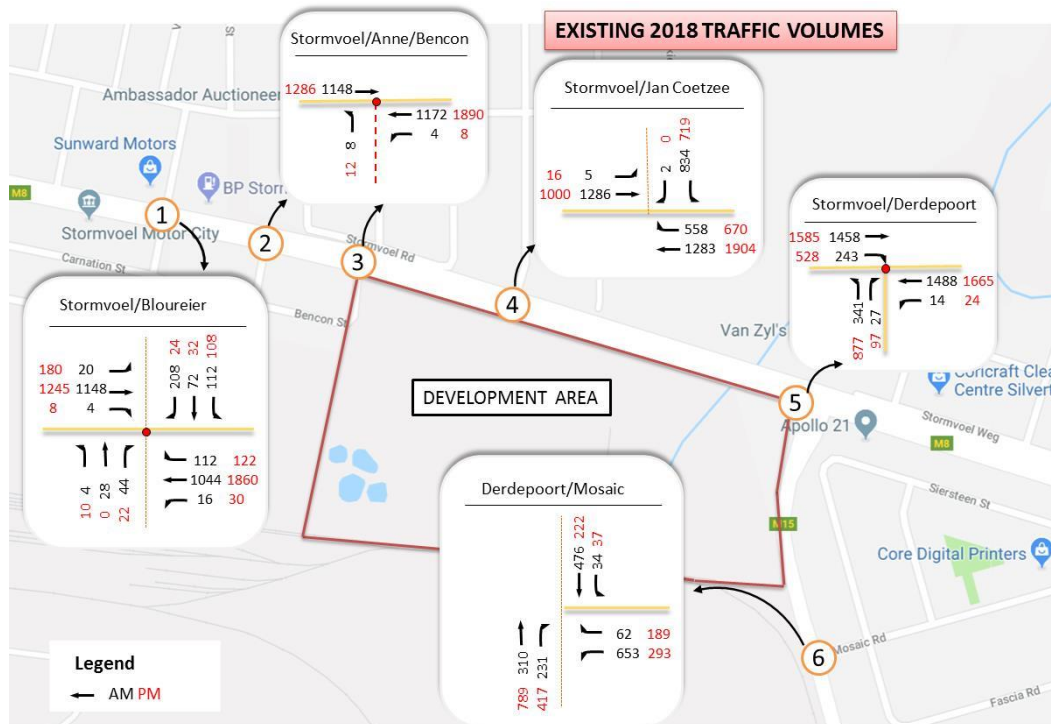


Figure 2-6 AM and PM Peak Hour Turning Movement Volumes

2.3 Capacity Evaluation

The critical intersections were analysed using a traffic analysis software tool called SIDRA (Signalised and Unsignalized Intersection Design and Research Aid). The AM and PM peak hour traffic volumes from the traffic survey were used for the analysis that was carried out.

The operational performance of each intersection was evaluated in terms of delay experienced on each approach as well as capacity of the junction to process the current traffic flows. The performance measurement is the Level of Service (LOS) defined by the Highway Capacity Manual in which letters A through F are used. LOS A depicts free flow conditions while LOS F denotes a breakdown in traffic flow due to over-capacity operations.

Table 2-1 shows the LOS results for each approach as well as the overall intersection performance during the AM and PM Peak Hours respectively.

Discussion of Results:

Stormvoel Rd. and Jan Coetzee Rd.

This is a signalised intersection that operates at LOS F during the AM peak hour. This is due to high volumes of traffic on Stormvoel Rd. During the PM peak hour, the intersection operates at LOS D and the V/C ratio indicates that the intersection is operating at full capacity.

Stormvoel Rd. and Derdepoort Rd

This is a signalised intersection that operates at LOS F in the AM peak hour and LOS D in the PM peak hour. This is due to the heavy traffic along Stormvoel road in the east/west direction.

Derdepoort Rd. and Mosaic Rd

This is a giveaway/yield-controlled intersection. The intersection operates at LOS F during the AM and PM peak hours due to long queues forming along Mosaic road. A significant volume lot of motorists use Mosaic Rd. as a rat run – bypassing the busy Derdepoort Rd./Stormvoel Rd. Intersection.

Table 2-1 Base Year 2018 SIDRA Results

Peak Hour	ID	Intersection	OPERATIONAL CONDITIONS							
			Approach	Approach				Intersection		
				Demand	V/C	Delay	LOS	V/C	Delay	LOS
AM	1	Stormvoel Rd & Jan Coetzee Rd	East	1979	1,33	63,7	E	1,23	106,4	F
			North	985	1,25	156,9	F			
			West	1457	1,12	98,7	F			
	2	Stormvoel Rd & Derdepoort Rd	South	411	0,37	16,3	B	1,037	66,0	E
			East	1620	1,22	140,5	F			
			West	2561	1,52	41,2	E			
	3	Derdepoort Rd & Mosaic Rd	South	608	0,44	5,6	A	0,96	175,6	F
			East	892	2,12	520,6	F			
			North	663	0,32	0,5	A			
PM	1	Stormvoel Rd & Jan Coetzee Rd	East	2668	1,39	59,1	E	1,097	51,0	D
			North	721	0,97	53,6	D			
			West	1177	0,93	40,2	D			
	2	Stormvoel Rd & Derdepoort Rd	South	1082	1	46,1	D	0,943	52,9	D
			East	1744	1,13	101,6	F			
			West	1847	0,7	10,9	B			
	3	Derdepoort Rd & Mosaic Rd	South	1340	0,46	2,7	A	2,82	1042,9	F
			East	607	7,87	3125	F			
			North	296	0,13	0,9	A			

SIDRA analysis of the three critical intersections indicates that the intersections typically operate over-capacity during the AM or PM Peak Hour Periods. The intersections will be further investigated to determine the required infrastructure improvements in order to accommodate existing traffic volumes and future traffic volumes to be generated by the development.

3 SPATIAL CONCEPT

The spatial vision for the site is to create a liveable and sustainable human settlement for an affordable market. In terms of transportation, the supporting spatial design principles that are important is that the development design should be of a residential nature that supports a diversity of income groups, tenureship and building typologies and that the development promote public transport, walkability and other alternative modes of transport.

The spatial vision developed by the Urban Planner is illustrated in **Figure 3-1**.

3.1 Proposed Land Uses

The predominant land use is high density residential, supported by social and recreational facilities serving the local community. Commercial uses will be developed on a smaller scale and the concept of live-work-play will be supported.

3.2 Proposed Residential Yield

The total site area is 18.75ha. Deducting non-developable area (due to servitudes and environmentally sensitive areas) a total of 11.75ha is available for development. The developable area consists of the following proposed land use types:

- Public open space (10%): 1.175ha
- Commercial and social facilities (10%): 1.175ha
- Circulation space (15%): 1.763ha

Total area available for residential development: 7.637ha

- Residential coverage will be approximately 50% of the available area: 3.8ha

The proposed development option consists of two options for residential units. Option 2A has 768 CRU/Fully subsidised housing (35%), 790 Social rental housing (36%) and 649 FLISP/Bonded (29%) housing with total of 2207 residential units.

Option 2B has 145 CRU/Fully subsidised housing (10%), 632 Social rental housing (44%) and 649 FLISP/Bonded (46%) housing with total of 1426 residential units.

Figure 3-1 below shows the spatial concept of the development.



Figure 3-1 Spatial Visioning, Concept Layout

4 INTEGRATED LAND USE AND TRANSPORT PLANNING

The National Public Transport Strategy, approved in January 2007, gives impetus to the development of public transport networks, giving them priority over private transport. The strategy focuses on improving the quality of the public transport fleet and its current operations, while implementing high quality public transport networks of car-competitive services, namely Rapid Rail and Bus Rapid Transit systems, in major cities.

The strategy has since evolved to include supporting policy approaches, tools and mechanisms to ensure that the BRT achieves its intended purpose. One of which is the drive for densification around transit corridors and developing Transit Oriented Development (TOD) at key stations.

The Mayoral Committee Cluster: Infrastructure and Planning released a document in February 2014 (City Planning and Development Department) titled “***Tshwane Rapid Transit (TRT): Spatial Development Policy: Densification and Intensification Guidelines***” that provide guidelines in terms of planning for TRT corridors.

The guideline aims to drive spatial transformation through densification and compact development around transit corridors. This implies that developments that cater for or align themselves along public transport routes will be prioritised. Figure 4-1 below, from the ***Tshwane IRPTN SDF Planning Policy Guidelines and Densification*** provides an overview of the spatial vision for the city.

The document further describes potential catalytic interventions and quick wins. A development of this nature would undoubtedly qualify as a catalytic intervention along the Line 4 BRT Corridor as it promotes densification and follows the principles of spatial transformation with development for low and mixed income groups centred around economic opportunities.

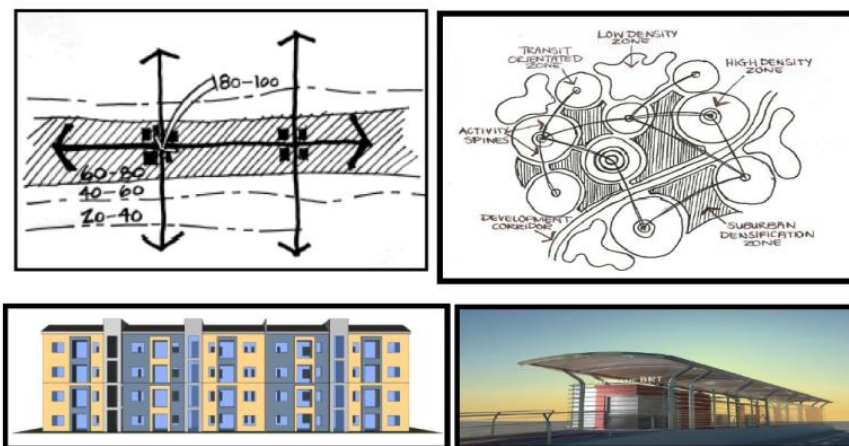


Figure 4-1 Spatial vision for development around transit corridors

5 TRANSPORT IMPACT ASSESSMENT

5.1 Future Road Planning

K-Route 139 is the planned northern extension of Derdepoort Rd., linking to the M15 in the north. The planned extension will be Provincial Route, with the existing Derdepoort Rd. remaining under the jurisdiction of Tshwane. The K-Route is currently being designed by the CoT's consultants Glad Africa and KBK Engineers. The road will have a significant impact to the area by providing a direct link between Silverton to the south and Derdepoort Park in the north. The majority of these movements are currently on the network via Jan Coetzee St. and Stormvoel Rd.

Stormvoel Rd. is also a Provincial Route, Route K-16. The road is currently at capacity and, although earmarked for a future BRT Line, there are no immediate plans for capacity improvements. The construction of the K139 will however alleviate some congestion on Stormvoel Rd.

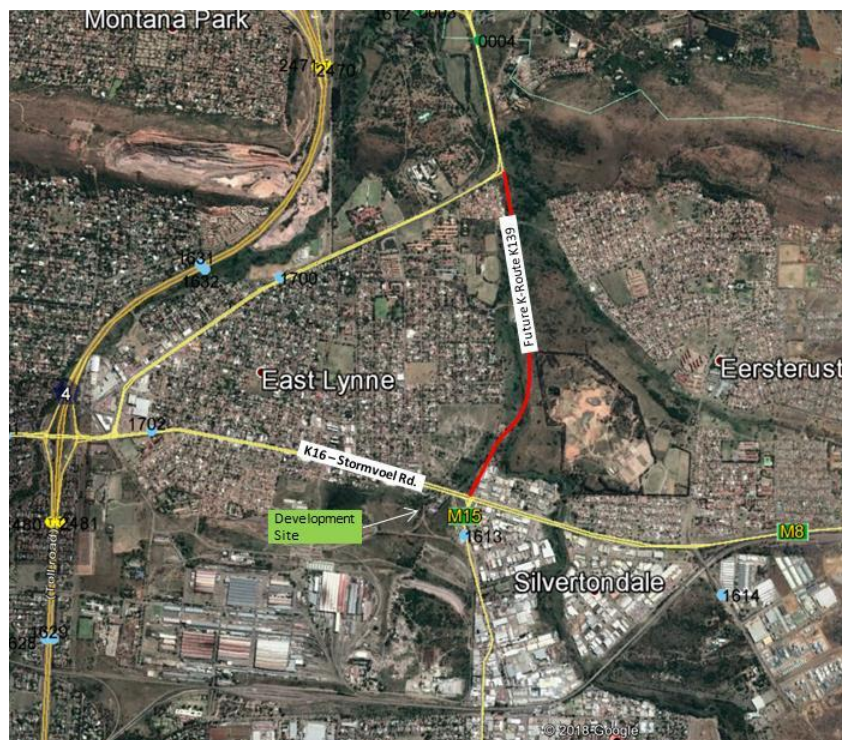


Figure 5-1 Planned Road Network

5.2 Site access

Several access arrangements were analysed and put forward to the City of Tshwane Traffic Impact Assessment and Development Planning Departments as follows:

- Stormvoel Road/Jan Coetzee St. Intersection:** A fourth leg into the development site was proposed at the existing signalised junction. This access was deemed the most attractive to the site in that it penetrated directly into the heart of the development. The consultant was subsequently informed by the CoT that:

-
- This intersection currently has a problematic right turn movement off Jan Coetzee Rd. causing significant delay to Stormvoel Rd. The City would therefore not allow an additional leg to this junction (adding more conflicting movements and worsening the existing situation).
 - Stormvoel Rd. currently has a line of no access on the southern limit between the Derdepoort Intersection and Bloureier Rd. Intersection i.e. no new access points will be allowed.
 - Stormvoel Rd. is a K-Route under the jurisdiction of the GPDRT. Any new access points need to conform with their intersection spacing requirements of 600m (potential access points to the site do not conform to this requirement). CoT indicated that GPDRT need to be engaged with supporting designs if a new access is proposed.
 - **Derdepoort/Mosaic Rd. Intersection:** A fourth leg into the development and signalisation of the existing Giveway/Yield controlled intersection was proposed, with re-alignment of Derdepoort Rd. in the vicinity of the intersection. This proposal was initially undesirable as it interfered with the future K-Route alignment of Derdepoort Rd. north of Stormvoel Rd. The City eventually agreed that the site would be landlocked without full access from either Derdepoort Rd. or Stormvoel Rd. They therefore proposed full access at Mosaic Rd. with the internal road network connecting to Bloureier Rd. This was on condition that the Mosaic Rd. Intersection could accommodate heavy vehicle turning movements and that the Consultants (Glad Africa and KBK) designing the future K-Route are informed of the proposed intersection and it is accommodated in their design.
 - **Stormvoel/Blourivier St. intersection:** This is an existing signalised intersection and the only feasible connection to Stormvoel Rd. at this point in time.
 - **Derdepoort/Existing access intersection into the site:** This intersection was also evaluated as both a full and marginal access point into the site (prior to CoT accepting the Mosaic Rd. proposals).

The site can also be accessed via the following secondary access points:

- Stormvoel/Anne St.: Marginal – LILO access
- Stormvoel/Bencon St.: Marginal – LILO access

The abovementioned access options are illustrated in Figure 5-2 below.

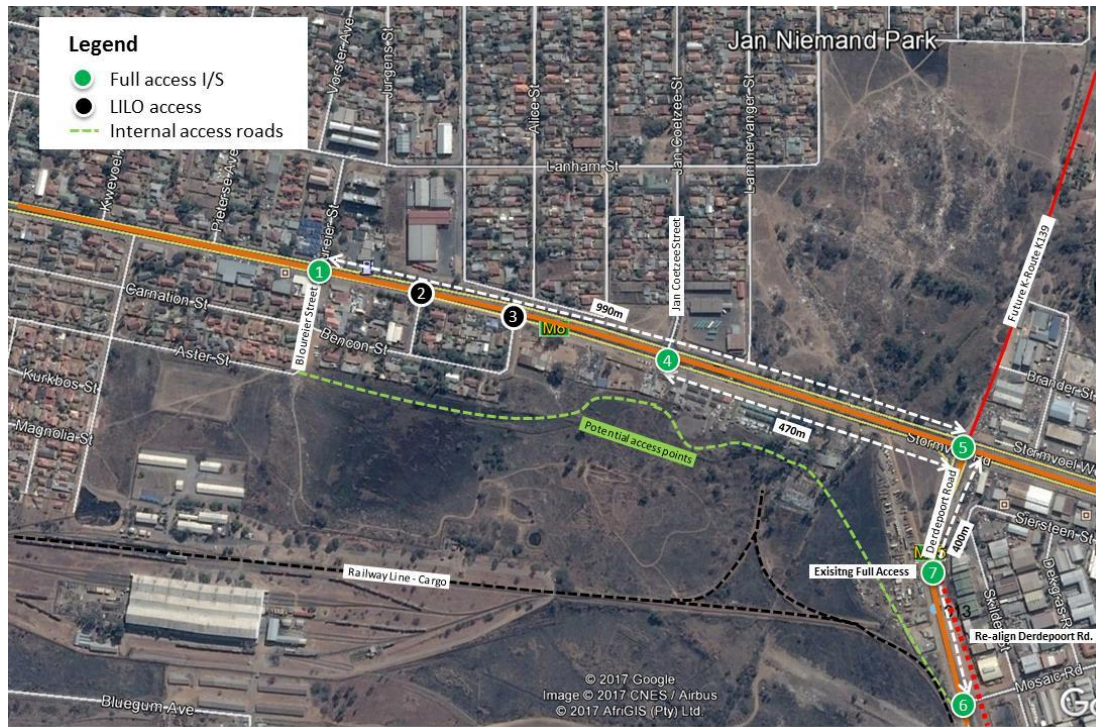


Figure 5-2 Access Options from the existing Road Network

Secondary access points will be used by motorists once the main access points become congested, resulting in network equilibrium. This will ensure that access points on Stormvoel Rd. become equally loaded to some extent (use of the LILO’S will depend on origin/destination).

5.3 Trip Generation

The development is planned to be constructed in three phases and thus the generated trips are expected to impact on the environment gradually with the completion of each phase. This traffic impact analysis only considers the full development (i.e. final development stage). This approach is more practical and reasonable from a road construction point of view to avoid the disruption of traffic with each phase. Trip generation was carried out for Option 2 because it has the highest residential yield of 2207 residential units.

The COTO TMH 17 Volume 1 South African Trip Data Manual was used to calculate the potential number of trips generated for each development type at completion stage of the development. The trip generation was calculated for the worst case traffic scenarios, namely AM, PM and including a Saturday Peak hour.

Table 5-1 COTO Trip Rates

Land Use	AM Peak Hour	PM Peak Hour	Saturday Peak Hour
Residential (trips per unit): Multi-level townhouses	0.75	0.75	0.4
Residential (trips per unit): Apartments and Flats	0.65	0.65	0.35

Office (trips per 100m ² GLA)	2.1	2.1	0.45
Retail – Shopping Centre (trips per 100m ² GLA, and using adjustment factors for the size of the development)	2.899	16.429	21.745
Amusement Park (1 ha)	0.5	10	47
Restaurant Family Sit down (trips per 100m ² GLA)	-	8.0	20
Pre-school – Day care centre (trips per student – assume 50 students)	1.0	0.80	0
Health and fitness centre (trips per 100m ² GLA)	5.0	9.5	0

Table 5-2 shows the number of AM and PM Peak hour trips generated by the various developments, including the COTO Code that applies to the development type.

The following assumptions were made when determining the trips generated by the development:

- The public park space will be 40% of the public open space
- Sports fields are 60% of the public open space
- Shops are 70% of the commercial space
- Restaurants are 30% of the commercial space
- CRU & Social housing are apartment & flat residential types
- Bonded housing are multi-level townhouse residential types

Table 5-2 Generated Trips

Total trips generated	AM Peak Hour		PM Peak Hour		Saturday Peak	
	In	Out	In	Out	In	Out
Residential (1558 units): Apartments and Flats	253	760	709	304	273	273
Residential (649 units): Multi-level townhouses	122	365	341	146	130	130
Office (9555m ² GLA)	171	30	40	161	24	19
Retail – Shopping Centre (1980m ² GLA)	37	20	163	163	215	215
Restaurant Family Sit down (847m ² GLA)	-	-	44	24	102	68
Pre-school – Day care centre (50 students)	25	25	20	20	-	-
Health and fitness centre (7050m ² GLA)	5	4	10	7	-	-
Public Park – Amusement park (4700m ²)	0	4	3	2	13	9
Total trips	613	1208	1329	825	756	714

The Saturday Peak proved to be lower than the weekday peak trip generation; hence this scenario is discarded from further analysis.

The COTO TMH 17 Volume 1 South African Trip Data Manual stipulates that trips may be discounted due to low car ownership, mixed-use nodes and the proximity of transit nodes or corridors. Given the building typologies proposed and the dispersed income groups that are envisaged, this development qualifies for these discounts.

The following Adjustment Factors obtained from the manual were applied to the trip generation calculated using the trip generation rates above:

- Transit Nodes or corridors: 15%
- Low vehicle ownership (for Apartments and Flats only): 30% (Not approved by CoT since Silverton is not historically a low car ownership area)
- Mixed-Use Node: Adjustment factor varies for each development type

Table 5-3 shows the adjusted AM and PM Peak hour generated trips.

Table 5-3 Generated trips adjusted

Total trips generated	Combined Discount Factor	AM Peak Hour		PM Peak Hour	
		In	Out	In	Out
Residential (1558 units): Apartments and Flats	28%	183	549	512	220
Residential (649 units): Multi-level townhouses	28%	88	264	246	106
Office (9555m ² GLA)	32%	116	20	27	109
Retail – Shopping Centre (1980m ² GLA)	24%	29	15	124	124
Restaurant Family Sit down (847m ² GLA)	24%	0	0	34	18
Pre-school – Day care centre (50 students)	19%	20	20	16	16
Health and fitness centre (7050m ² GLA)	28%	4	3	7	5
Public Park – Amusement park (4700m ²)	19%	0	3	2	2
Total trips		440	875	970	599

The above trip generation rates, discounts applied and final trip generation was checked by the CoT TIA Department and their comments were included in the calculations above and approved.

5.4 Trip Distribution

The development site is in close proximity to industrial nodes of Pretoria namely Watloo and Silverton. It is also near the Pretoria CBD and Menlyn economic nodes and it is assumed that generated trips from the development site will be largely commuter trips headed in the direction of work opportunities with some trips headed towards the development itself from surrounding residential areas. Majority of the trips will be towards these industrial and economic nodes.

Table 5-4 Distribution of trips to potential work destinations

Origin/Destination	Guesstimate	Trip Length (km)	Inverse weighting	% probability based on route length	Averaged Distribution	AM Peak		PM Peak	
						In	Out	In	Out
Watloo Industrial Area	20%	4.3	0.23	22%	21%	92	184	204	126
Silverton Industrial Areas	20%	2.5	0.4	38%	29%	127	254	281	174
Menlyn CBD	20%	11.5	0.09	8%	14%	62	122	136	84
Pretoria CBD	20%	10	0.1	10%	15%	66	131	145	90
Pretoria West	7%	17	0.06	6%	6.50%	29	57	63	39
Wonderboom	5%	14.7	0.07	7%	6%	31	61	68	42
Mamelodi	5%	17	0.06	6%	5.50%	24	48	53	33
Rayton	3%	35	0.03	3%	3%	13	26	29	18
TOTAL	100%	112	1.04	1	100%	444	883	979	605

Table 5-5 below shows the potential trip distribution to surrounding nodes.

Table 5-5 Distribution of trips to potential work destinations

Origin/Destination	Guesstimate	Trip Length (km)	Inverse weighting	% probability based on route length	Averaged Distribution	AM Peak		PM Peak	
						In	Out	In	Out
Watloo Industrial Area	20%	4.3	0.23	22%	21%	92	184	204	126
Silverton Industrial Areas	20%	2.5	0.4	38%	29%	127	254	281	174
Menlyn CBD	20%	11.5	0.09	8%	14%	62	122	136	84
Pretoria CBD	20%	10	0.1	10%	15%	66	131	145	90
Pretoria West	7%	17	0.06	6%	6.50%	29	57	63	39
Wonderboom	5%	14.7	0.07	7%	6%	31	61	68	42
Mamelodi	5%	17	0.06	6%	5.50%	24	48	53	33
Rayton	3%	35	0.03	3%	3%	13	26	29	18
TOTAL	100%	112	1.04	1	100%	444	883	979	605

The distribution is shown spatially in Figure 5-3 below.

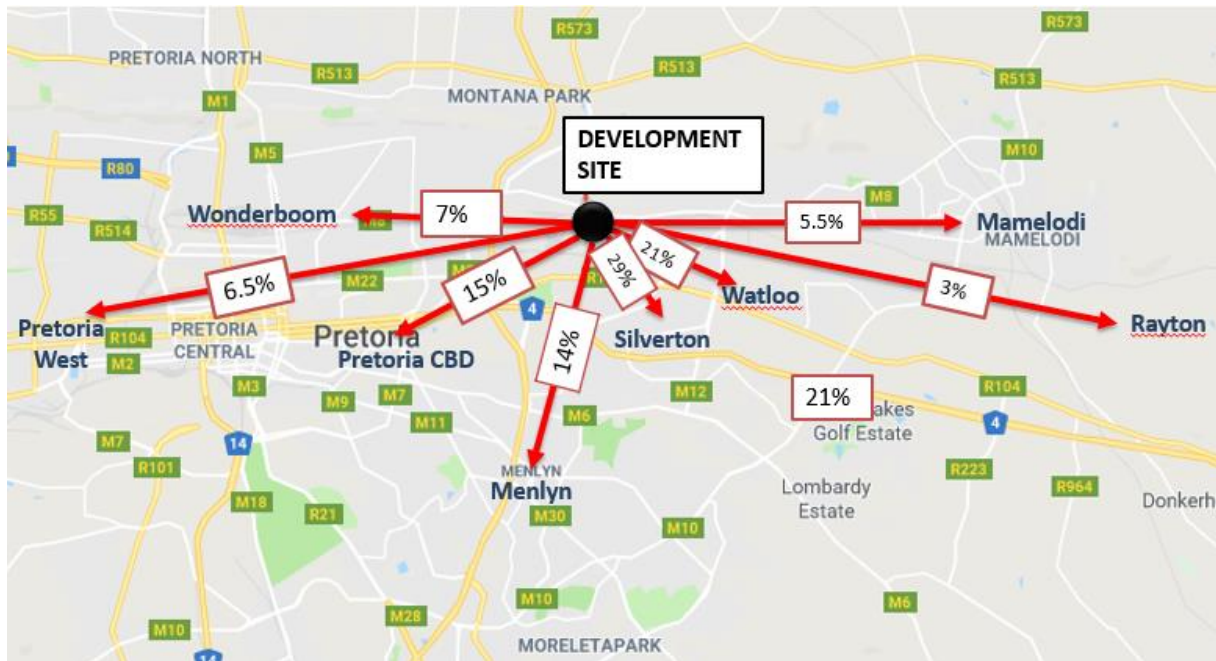


Figure 5-3 Spatial distribution of trips to the Road Network

The following distribution was applied to the road network:

Table 5-6 Trip Distribution to Accesses

No.	Potential Destinations	% of trips	No. of trips (AM/PM)	Proposed Access
1	Watloo Industrial Area	21%	276/329	Mosaic Rd. (50% continue along Derdepoort Rd., 50% to Stormvoel Rd.)
2	Silverton Industrial Area	29%	381/455	Mosaic Rd. (78% to Derdepoort Rd., 28% to Stormvoel Rd.)
3	Menlyn CBD	14%	184/220	Bloureier Rd. (100% inbound, 33% outbound; 33% outbound Anne St. and 33% outbound Bencon St.)
4	Pretoria CBD	15%	197/235	50% Bloureier Rd. and 50% Mosaic Rd.
5	Pretoria West	6.5%	85/102	50% Bloureier Rd. and 50% Mosaic Rd.
6	Wonderboom	7%	92/110	100% Bloureier Rd.
7	Mamelodi	5.5%	72/86	Mosaic Rd. (continue to Stormvoel Rd.)
8	Rayton	3%	39/47	Mosaic Rd. (continue to Stormvoel Rd.)

The AM and PM peak hour traffic volumes at each intersection for the generated trips are shown in Figure 5-4 below. Black indicates the AM peak hour volumes and red the PM peak hour volumes.

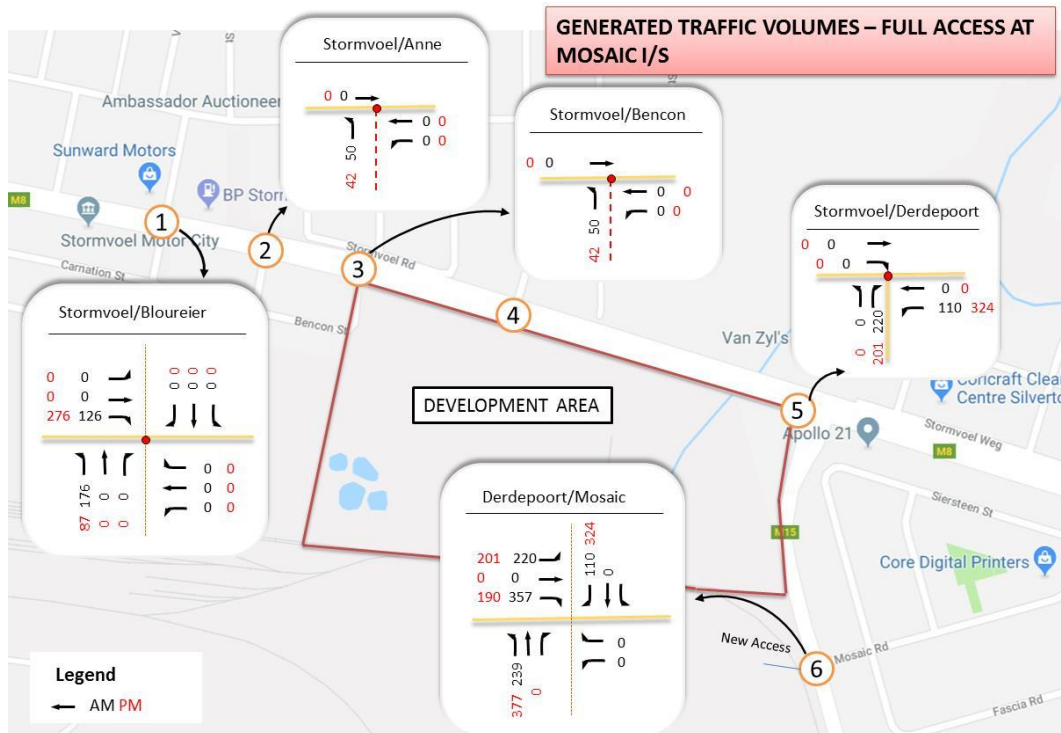


Figure 5-4 Generated Traffic Volumes

5.5 Project Impact on the Road Network

5.5.1 Development Opening Year 2023

It is anticipated that the development will be fully established by year 2023. Future background traffic between 2018 and 2023 was estimated to be 3% (as agreed with CoT). This is because the land use surrounding the development is well established with no significant growth in vehicle ownership expected. The growth in future background traffic value was applied to the traffic count data at each intersection to estimate traffic volumes during the opening year 2023.

The generated traffic volumes were added to the projected opening year volumes and the intersections were evaluated using SIDRA analysis software. Figure 5-5 below shows that total traffic volumes used during analysis.

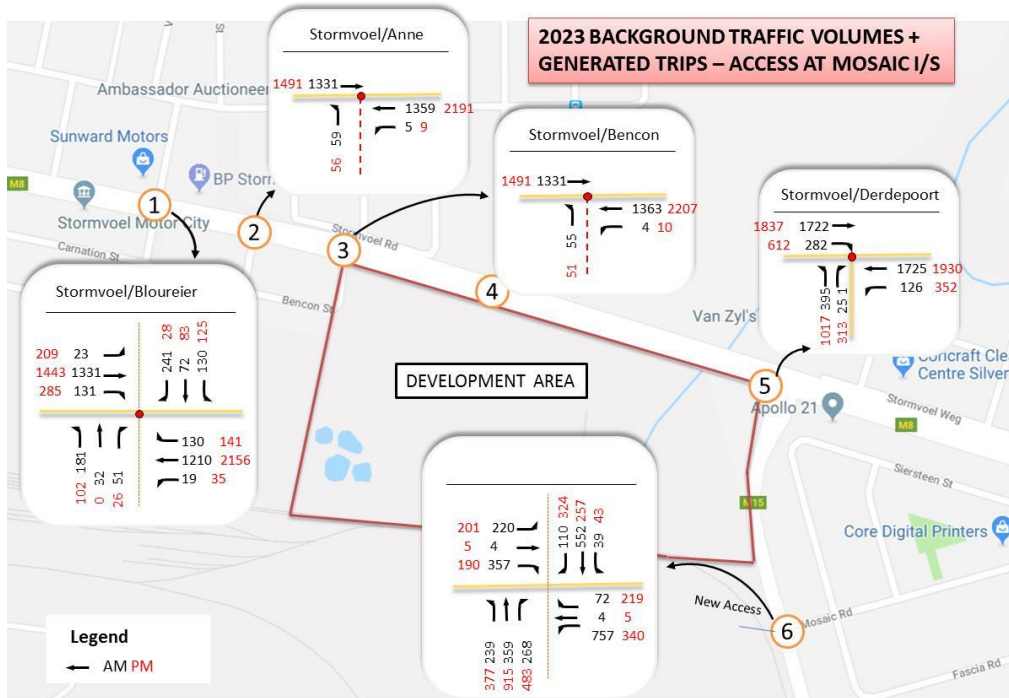


Figure 5-5 Opening Year 2023 Total Traffic Volumes

Since the existing intersections are operating at or over capacity and require geometric layout and/or control upgrades, the geometric layout as well as signal phases and timings were optimized in SIDRA to ensure that the intersections operate at satisfactory conditions of LoS A to D. Stormvoel Rd. to the west of the Derdepoort Rd. intersection needs to be upgraded to 3 lanes per direction, however, these capacity upgrades were not applied due to the planned BRT line. The Stormvoel/Derdepoort Rd. I/S was however upgraded as this is one of the critical intersections in the study area.

The results of the SIDRA analysis are shown in Table 5-7 below and recommended infrastructure improvements are detailed in Section 6 of the report.

Table 5-7 SIDRA Analysis Results: 2023 Background Traffic and Development Traffic

Peak Hour	ID	Intersection	Control Type	OPERATIONAL CONDITIONS							
				Approach	Approach				Intersection		
					Demand	V/C	Delay	LOS	V/C	Delay	LOS
AM	1	Stormvoel Rd. & Bloureier St.	Signal	South	278	0.797	45.8	D	1.4	40.5	D
				East	1431	1.4	39.2	D			
				North	466	0.873	42.7	D			
				West	1563	1.144	40.2	D			
	2	Stormvoel Rd. & Anne St. LILO	Stop	South	74	0.136	13.8	B	0.388	0.7	A
				East	1436	0.388	0.1	A			
	3	Stormvoel Rd. & Bencon St. LILO	Stop	South	65	0.115	13.4	B	0.401	0.8	A
				East	1483	0.401	0.2	A			
	5	Stormvoel Rd & Derdepoort Rd	Signal	South	738	0.722	26.1	C	0.918	20.8	C
				East	2035	0.918	37.3	B			
				West	2436	0.508	5.4	A			
				North	884	0.607	25.7	C			
6	Derdepoort Rd. & Mosaic Rd.	Signal	South	957	0.467	16.4	B	0.607	18.4	B	
			East	1038	0.522	8.6	A				
			North	884	0.607	25.7	C				
			West	612	0.587	27.8	C				
PM	1	Stormvoel Rd. & Bloureier St.	Signal	South	136	0.289	15.7	B	1.207	91.6	F
				East	2455	1.207	130.5	F			
				North	248	0.769	46.3	D			
				West	2039	0.986	55.3	E			
	2	Stormvoel Rd. & Anne St. LILO	Stop	South	70	0.203	17.3	C	0.626	0.7	A
				East	2317	0.626	0.2	A			
	3	Stormvoel Rd. & Bencon St. LILO	Stop	South	60	0.195	13.6	C	0.555	0.8	A
				East	2052	0.555	0.1	A			
	5	Stormvoel Rd & Derdepoort Rd	Signal	South	1478	1.118	82.8	F	1.19	77.4	E
				East	2399	1.19	134.4	F			
				West	2689	1.067	23.7	C			
	6	Derdepoort Rd. & Mosaic Rd.	Signal	South	1956	0.985	36.6	D	0.985	31.7	C
East				697	0.963	30.3	C				
North				743	0.48	24.5	C				
West				417	0.37	23.5	C				

Discussion of results:*Stormvoel Rd. and Derdepoort Rd. Intersection*

With optimized signal timings, this intersection operates at an acceptable LoS C during the AM peak hour period and LoS E during the PM peak hour. The I/S experiences some strain during the afternoon peak hour due to the high volumes of traffic from the east (Mamelodi).

Derdepoort Rd. and Mosaic Rd. Intersection

This intersection was upgraded to signal control, and a slip lane was introduced from Mosaic Rd. along with other layout improvements the intersection operates at satisfactory LoS B and C during the AM and PM Peak Hours.

Stormvoel Rd. and Bloureier Rd. Intersection

The intersection northern and southern approaches were upgraded, including optimization of signal timings. No upgrades were applied to Stormvoel Rd. as this needs to be part of a wider strategy for the traffic management along this major arterial.

The Anne and Bencon St. marginal accesses all operate within capacity during the AM and PM Peak hours.

The estimated development opening year coincides with the planned BRT line 4 and it is assumed that once the BRT line 4 is operational, traffic will divert to other routes or some of the corridor demand will shift onto public transport.

At this point in time, the exact mode shift is difficult to forecast, and the standard 15% allowance as per the COTO TMH 17 Volume 1 South African Trip Data Manual will be assumed. It is anticipated that the implementation of the BRT line along with the construction of the K139 will significantly reduce the delay on Stormvoel Rd.

5.5.2 Design Year 2028

A 5-year design horizon from the opening year 2023 to 2028 has been evaluated and the growth in future background traffic was estimated to be 3%. This value was applied to projected 2023 background traffic to assess the performance of the intersections over a 5-year period.

The expected traffic volumes at each of the intersections is shown in Figure 5-6.

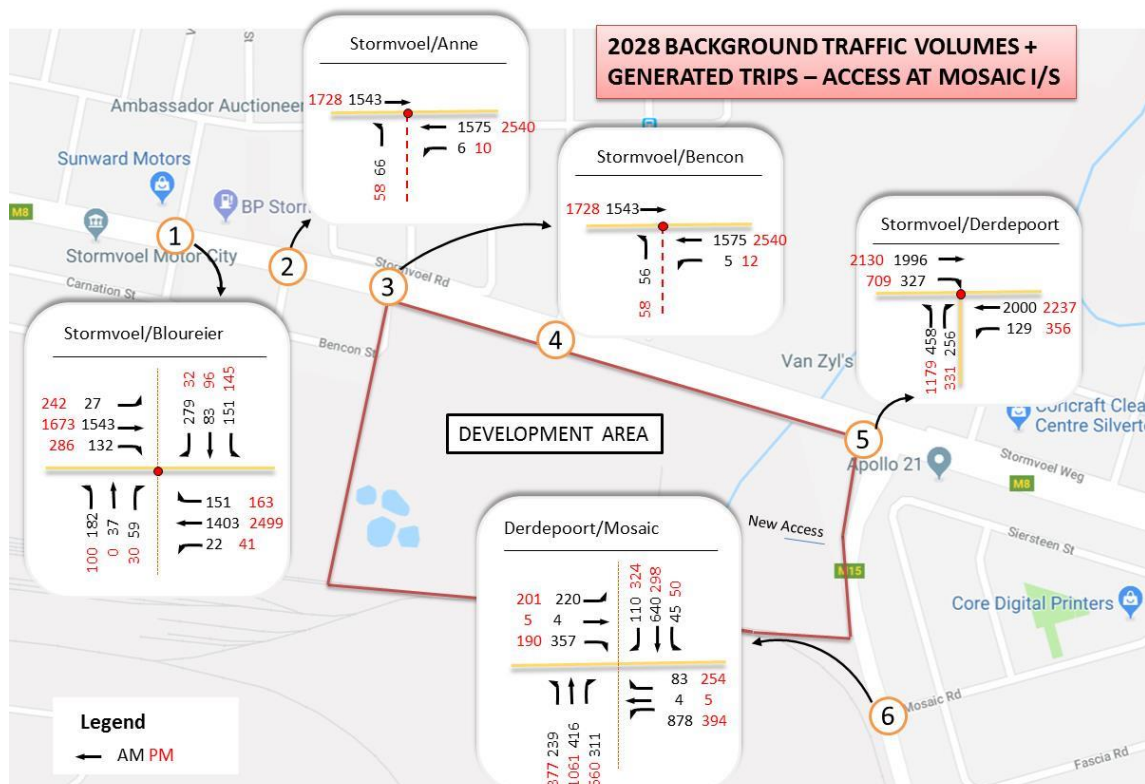


Figure 5-6 Design Year Horizon 2028 Total Traffic Volumes

The results of the SIDRA analysis are shown in Table 5-8 below.

Table 5-8 SIDRA Analysis Results: 2028 Design Year

Peak Hour	ID	Intersection	Control Type	OPERATIONAL CONDITIONS								
				Approach	Approach				Intersection			
					Demand	V/C	Delay	LOS	V/C	Delay	LOS	
AM	1	Stormvoel Rd. & Bloureier St.	Signal	South	293	0.712	54.5	D	0.935	46.2	D	
				East	1659	0.911	39	E				
				North	540	0.935	66.5	D				
				West	1792	0.928	45.3	D				
	2	Stormvoel Rd. & Anne St. LILO	Stop	South	83	0.19	15.9	C	0.45	0.8	A	
				East	1665	0.45	0.1	A				
	3	Stormvoel Rd. & Bencon St. LILO	Stop	South	66	0.152	15.7	C	0.45	0.7	A	
				East	1664	0.45	0.1	A				
	5	Stormvoel Rd & Derdepoort Rd	Signal	South	814	0.654	27.2	C	0.894	19.1	B	
				East	2335	0.894	30.4	C				
				West	2823	0.677	7.4	A				
	6	Derdepoort Rd. & Mosaic Rd.	Signal	South	1069	0.541	17.1	B	0.682	18.7	B	
East				1203	0.606	8.9	A					
North				1006	0.68	25.1	C					
West				612	0.682	30.4	C					
PM	1	Stormvoel Rd. & Bloureier St.	Signal	South	138	0.437	17.7	B	1.345	123.9	F	
				East	2845	1.345	185.9	F				
				North	287	0.891	53.3	D				
				West	2317	1.046	62.9	E				
	2	Stormvoel Rd. & Anne St. LILO	Stop	South	73	0.337	25.4	D	0.726	0.9	A	
				East	2685	0.726	0.3	A				
	3	Stormvoel Rd. & Bencon St. LILO	Stop	South	68	0.316	25.1	D	0.727	0.9	A	
				East	2688	0.727	0.3	A				
	5	Stormvoel Rd & Derdepoort Rd	Signal	South	1678	1.44	186.3	F	1.44	98.0	F	
				East	2720	1.196	130.2	F				
				West	3117	0.951	22.4	C				
	6	Derdepoort Rd. & Mosaic Rd.	Signal	South	2204	1.116	61.6	E	1.117	48.2	D	
East				808	1.117	47.9	D					
North				808	0.494	24.9	C					
West				417	0.37	23.5	C					

Stormvoel Rd. and Derdepoort Rd. Intersection

The operating conditions of this intersection remain unchanged with acceptable LoS B during the AM peak hour period and a poor LoS F during the PM peak hour. As discussed above, an overall traffic management plan is required for Stormvoel Rd.

Derdepoort Rd. and Mosaic Rd. Intersection

Operating conditions of this intersection deteriorates to LoS D during the PM Peak Hour. LoS D is acceptable even though it allows for relatively poor operating conditions.

Stormvoel Rd. and Bloureier Rd. Intersection

This intersection experiences satisfactory levels of service during the morning peak hour however it is overcapacity during the PM Peak hour. A significant portion of the through volume from the east direction will become left turn movements once the K139 is constructed, thereby alleviating some of the congestion. The intersection may even operate within capacity once this vital link in the network is constructed.

5.6 Capacity of the Transport Network

5.6.1 Road Capacity

The AM Peak hour is the most critical design hour for the road network. An investigation of the existing intersections as discussed in Section 2.3 indicates that the identified intersections are currently operating over capacity and that Stormvoel Rd. requires capacity improvements. Access into the development site is proposed via the Stormvoel Rd. and Derdepoort Rd. and in their current state these intersections will not be able to absorb new vehicle trips from the development. The construction of the K139 and the introduction of a BRT Line on Stormvoel Rd. will have a major positive impact to the existing levels of congestion on this major arterial.

It is possible that vehicle trips generated may be lower than anticipated since Silverton and Waltloo are within walking distance considering that these two areas attract the largest percentage of the generated trips. The provision of good NMT infrastructure could also promote cycling and walking modes to these destinations.

5.6.2 Public Transport Capacity

Although **rail** ridership has been in a steady decline over the past decade, the proximity of the Koedoespoort and Silverton Stations may attract public transit users to the mode. Due to the large drop in rail passengers, it is assumed that there is sufficient capacity to accommodate additional passengers.

The planned **BRT**, which is a world class public transport system would have a higher attraction to the residents of the development. It is anticipated that the mode would have a significantly higher proportion of public transit users than rail, depending on the development of the full network and subsequent origins/destinations available to users. Owing to the fact that this is a new mode of transport with a drive to attract users, there should be sufficient capacity.

5.6.3 NMT

A well-connected network of sidewalks and cycle routes should be planned and implemented. The routes should provide direct, convenient access between the development and major trip attractors such as the BRT stations, rail stations and nearby work opportunities e.g. Silverton and Waltloo. Walking and cycling should be encouraged as modes of transport in their own right and sufficient facilities that make NMT safe, convenient and attractive (such as lighting, safety and security measures, cycle racks etc.), be provided.

Sidewalks should be provided on the internal road network as well, to provide a continuous pathway between the point of origin and the destination.

5.6.4 Security Control

It is assumed that the development will have some form of security control at all access points onto the external road network. This should be in the form of a gate or remote-controlled boom. Not only will this improve security, it will also prevent external road users from using the development network as a rat run in-between Stormvoel and Derdepoort roads to avoid congested conditions at the Stormvoel/Derdepoort Rd. Intersection.

6 INFRASTRUCTURE REQUIREMENTS

6.1 Road Network

6.1.1 Improvements to existing infrastructure

The three critical intersections that were evaluated carry high traffic volumes and operate well over-capacity during one or more of the peak hour periods.

An overall **traffic management plan** is required to manage the demand on **Stormvoel Rd.** This is currently being implemented by the CoT in the form of implementing the K139 (currently in design phase) and a planned BRT Line. The BRT introduces a more sustainable transport option, which in turn needs to be supported by densification along the proposed lines. This development, including the City's initiatives to promote a modal shift from private to public transit is therefore key to the success of the public transit system.

The following road and intersection upgrades are proposed to cater for current and future traffic demands beyond 2023.

- Bloureier/Stormvoel Rd. I/S.:
 - Bloureier St. Northern Approach: Exclusive short right turn lane
 - Bloureier St. Southern Approach: Exclusive short left turn and right turn lanes
- Stormvoel/Derdepoort Rd. I/S.:
 - Stormvoel Rd. Eastern Approach: 3rd through lane, 3rd exit lane
 - Stormvoel Rd. Western Approach: 3rd through lane, 3rd exit lane
- Derdepoort/Mosaic Rd. I/S:
 - Re-alignment of Derdepoort Rd. to the east to accommodate an access leg into the Development.
 - Intersection control upgrade from stop control to signal control
 - New access (fourth) leg into the development with left turn slip lane, through and exclusive right turn lane.
 - 2-lane dual carriageway on Derdepoort Rd. (planned upgrading in conjunction with construction of K139)
 - Derdepoort Rd. Southern Approach: short slip lane

The proposed access and intersection layout for each intersection is shown in Figure 6-1 to Figure 6-3 below. The SIDRA Analysis results for the proposed improved intersection layout are shown in Table 5-7 and Table 5-8 for years 2023 and 2028 respectively.

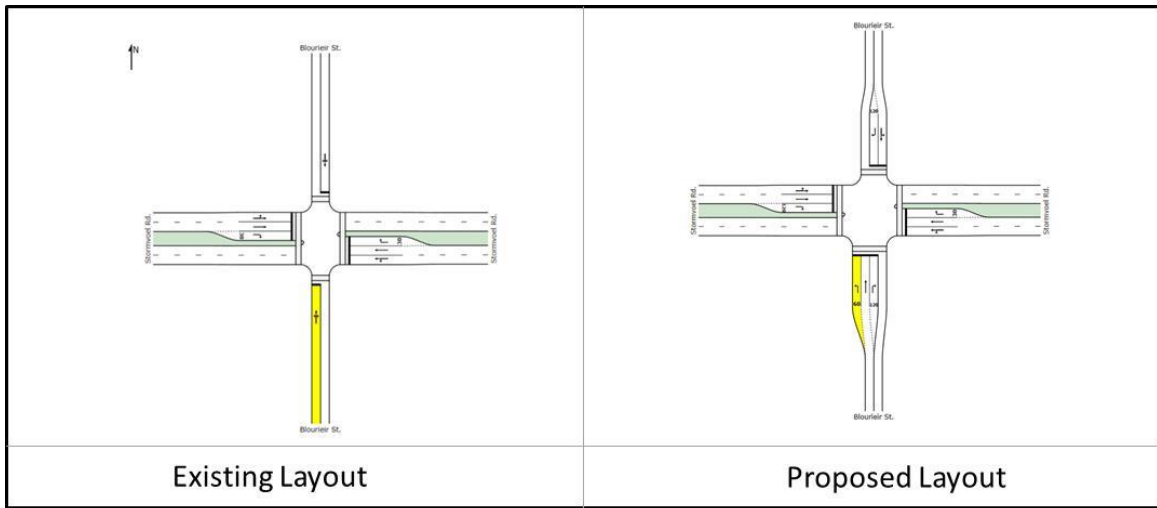


Figure 6-1 Stormvoel/Bloureier Rd. Intersection Improvements

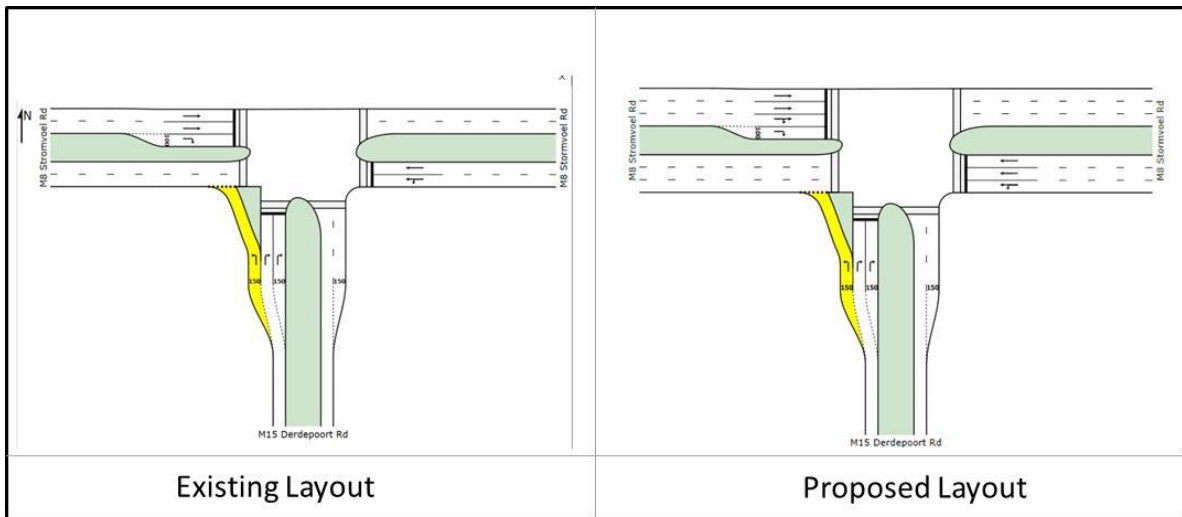


Figure 6-2 Stormvoel/Derdepoort Rd. Intersection Improvements

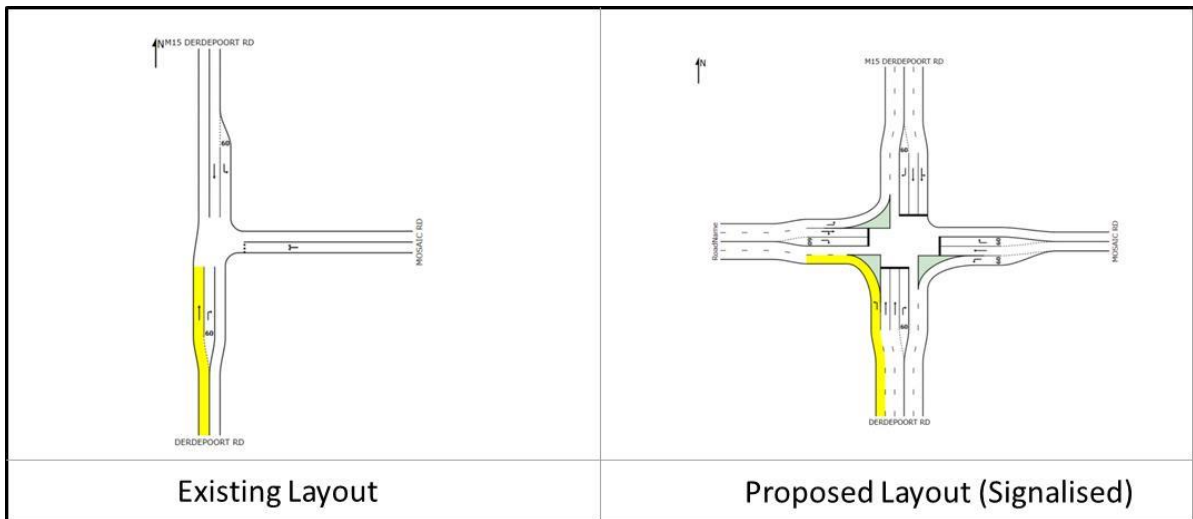


Figure 6-3 Derdepoort/Mosaic Rd. Intersection Improvements

6.2 Parking Requirements

Based on City of Tshwane's Town Planning Scheme 2008, a total of 1030 parking bays is required. It is assumed that the parking bay requirements will be discussed in more detail between the Town Planner and the CoT.

7 CHALLENGES

The following challenges were identified:

- The timeframe for implementation of the development should ideally coincide with the development of the BRT Line 4. The two developments have significant potential to support each other.
- Access spacing on Class 3 roads must be minimum 600m and as a result GDRT may not approve new approaches onto Stormvoel Rd.
- Planned BRT along Stormvoel Rd. may impact on the ability to implement the proposed infrastructure improvements.
- It is recommended that the road network be monitored and re-evaluated once the BRT lanes are open and travel patterns in the neighbourhood re-establish themselves.
- Upgrading Stormvoel Rd. to a three-lane roadway per direction may need to be put on hold until the re-evaluation of the road network capacity after construction of BRT Line 4 and the K139. The latter will remove a significant number of indirect trips currently on Stormvoel Rd. once the new link is built.

8 CONCLUSIONS

The following conclusions can be drawn from the traffic study:

1. The site has favourable road and public transit access.
2. The critical intersections surrounding the development site are currently operating over-capacity and do not have the capacity to accommodate new trips generated by the development.
3. Tshwane BRT Line 4, which runs along Stormvoel Rd. and connects from Denneboom to Rainbow Junction, is scheduled for construction between 2022-2024. The high density residential development is therefore favourably located as it is aligned with the City of Tshwane's spatial densification guidelines for current and future transit corridors.
4. The proposed development will have a residential yield of 2207 dwelling units with **1314 veh/hr** expected during the **AM Peak Hour** and **1569 veh/hr** during the **PM Peak Hour**.

5. Trips were distributed to work opportunities that are within reasonable distance from the site. Based on this distribution, the majority of trips would utilise the Derdepoort Rd./Mosaic Rd. access intersection.
6. The CoT is in agreement with **access** to the site as follows:
 - Access onto Stormvoel Rd. via Stormvoel/Bloureier Rd. I/S.
 - Introduce a fourth leg into the development site at the Derdepoort/Mosaic Rd. Intersection. This requires the re-alignment of Derdepoort Rd. to accommodate the intersection within geometric design standards. A basic geometric assessment was conducted and the intersection could work. The re-alignment of the road also needs to tie-in with the current plans to upgrade Derdepoort Rd. to a dual carriageway and construct the northern extension i.e. K139. The re-alignment of Derdepoort Rd. to accommodate a full access intersection into the development is supported by the CoT otherwise the development parcel becomes landlocked. Consultants will need to liaise further with GDRT and the K139 design consultants (Glad Africa and KBK).
 - The internal development road network should provide a continuous connection between these two points.
7. The high density development would support the proposed BRT Line 4 along Stormvoel Rd. which is in line with the CoT's Tshwane Rapid Transit (TRT): Spatial Development Policy: Densification and Intensification Guidelines (Feb 2014).
8. A well-connected network of sidewalks and cycle routes should be planned and implemented. The routes should provide direct, convenient access between the development and major trip attractors such as the BRT stations, rail stations and nearby work opportunities

It is recommended that the proposed infrastructure improvements be approved and that once the challenges are addressed, the development goes ahead.

9 REFERENCES

Tshwane Rapid Transit (TRT): Spatial Development Policy: Densification and Intensification Guidelines, *accepted by Mayoral Committee February 2014*

South African Trip Data Manual, TMH 18, Volume 1. COTO. September 2012