

Traffic Impact Assessment

God's Window – Skywalk Project

Final

Mapulana Canyon (Pty)

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Glossary of Terms

AADT	Average Annual Daily Traffic
CBD	Central Business District
DoT	Department of Transport
EIA	Environmental Impact Assessment
GLA	Gross Leasable Area
HCM	Highway Capacity Manual
LOS	Levels of Service
NMT	Non-Motorised Transport
PT	Public Transport
RAMS	Road Asset Management System
SATGRM	South African Trip Generation Rates Manual
STA	Site Traffic Assessment
SIDRA	Signalised & unsignalised Intersection Design and Research Aid
TIA	Traffic Impact Assessment
TMH	Technical Methods for Highways
v/c	volume/capacity ratio
vph	Vehicles per hour

1 Introduction

1.1 Background

Zutari (PTY) Ltd was appointed by Mapulana Canyon (Pty) to conduct a Traffic Impact Assessment (TIA) for the redevelopment of a new visitor's attraction site at God's Window.

The God's Window tourist attraction is in the Blyde River Canyon in the Ehlanzeni District Municipality, Mpumalanga Province. Blyde River Canyon forms part of the Greater Drakensberg escarpment and features on the scenic Panorama Route along with Sabie Falls, Mac Mac Falls and includes the famous Kruger National Park nature reserve, among others.

The proposed redevelopment will include a 12 m long Skywalk suspended off the edge of the cliff. The development will also offer other activities (e.g., rock climbing, skyswing) and will be supported by other facilities including restaurants, market stalls, conference auditoriums, retreat accommodation and administration offices.

1.2 Development site locality

The proposed redevelopment (hereafter the Site) is located approximately 9 km northeast of Graskop town in Mpumalanga Province. According to the Mpumalanga Road Asset Management System (RAMS) the land use of the areas surrounding the development site are mining, forestry and conservation. There are not many developments within the vicinity of the site except for a similar establishment, Wonder View, which is located 1.3 km northeast of the site.

The site is currently accessed off the R534 which is a provincial road. Most of the roads within the vicinity of the site are provincial roads. The existing access will be utilised for the future development.

Figure 1-1 shows God's Window locality and the surrounding road network.

1.3 Purpose and scope of this report

This TIA report provides the assessment of the impact of additional traffic expected to be generated by the proposed Gods Window development onto the surrounding road network; and recommendations made to improve the road network to accommodate the additional traffic. The report also presents the assessment and mitigation measures recommended to meet the requirement of development site access, public transport (PT), and non-motorised transport (NMT) needs.

The scope of the TIA study includes the following:

- ▶ Meeting with the Mpumalanga Province and Local Municipality road authorities to discuss the Site access and study methodology;
- ▶ Collection of traffic data on the surrounding road network;
- ▶ Estimation of the expected Site trip generation, distribution, and assignment;
- ▶ Capacity analysis of nearby intersections;
- ▶ Site access queuing analysis;
- ▶ Public transport and NMT assessment;
- ▶ Environmental Impact Assessment (EIA)
- ▶ Concluding summary and recommendations.

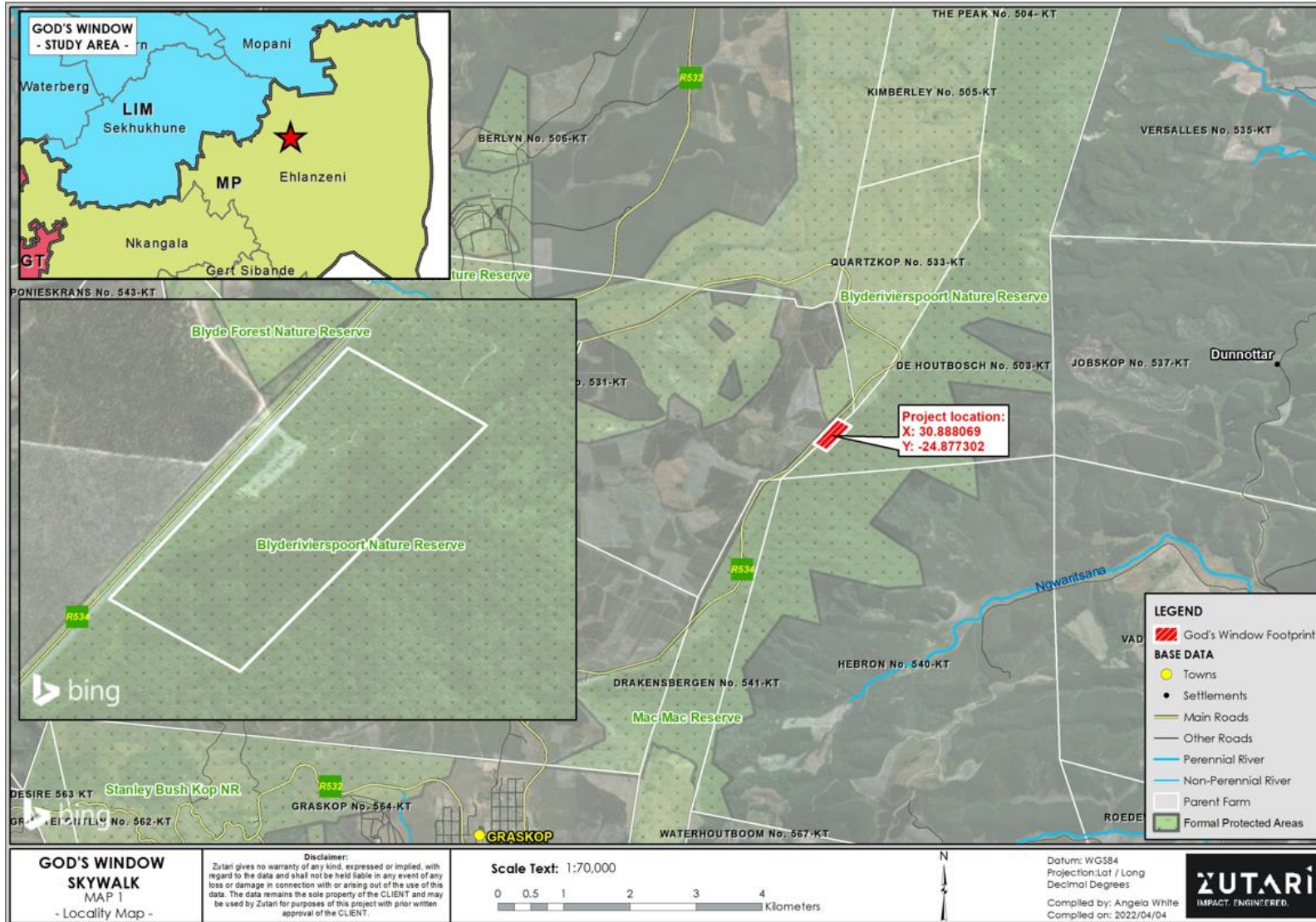


Figure 1-1: Locality Map

2 Study Methodology

The TIA methodology adopted in this study was based on the Technical Methods for Highways (TMH) 16 South African Traffic Impact and Site Traffic Assessment Manual and Standards and Requirements Manual, Volume 1 and 2, respectively (2012, 2014) (TMH 16) and the TMH 17 South African Trip Data Manual (2013) (TMH 17).

2.1 Extent of the study area

TMH 16 Volume 1 defines the primary study area to consist of the development site, site access, affected communities in the immediate adjacent road network within a maximum distance of 1.5 km from the site access. However, the manual gives exception for sensitive areas beyond the 1.5km demarcation. Because most of vehicles visiting God's Window pass through Graskop town, one critical intersection in Graskop town was included in the study area as it is anticipated that the proposed development vehicular traffic is likely to have a notable impact on the town.

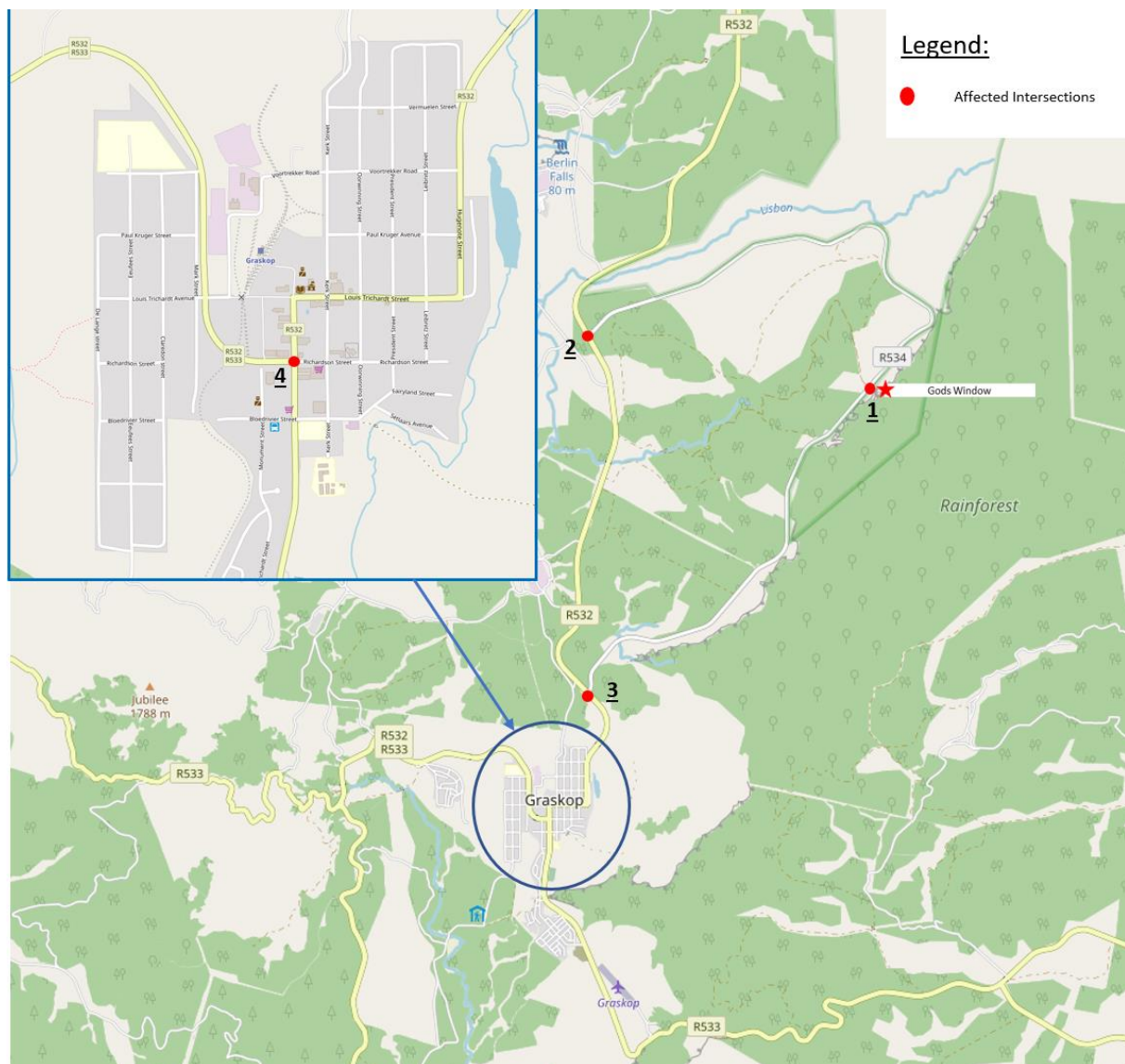


Figure 2-1: Study area

2.2 Traffic count survey

TMH 16 and TMH 17 recommends that Traffic counts be done on normal days of the year whereby traffic patterns tend to be stable and not influenced by events such as school holidays and public holidays. However, for land uses such as resorts, TMH 16 and TMH 17 recommends that traffic counts also be conducted on abnormal days where traffic pattern deviate from normal days due to events such as public holidays and school holidays.

On this basis, the following traffic counts were conducted:

- Friday (10 June 2022) and Saturday (11 June 2022) from 06h00 to 18h00 on each day. Respectively, these were normal weekday and normal weekend day without any school holidays or public holidays.
- Friday (17 June 2022) and Saturday (18 June 2022) from 06h00 to 18h00 on each day. Due to the public holiday on Thursday, 16 June 2022, schools were closed on 17 June 2022 and thus making this weekend a long weekend. Hence traffic patterns on this Friday and Saturday were abnormal.

2.3 Scenarios analysed

In accordance with TMH 16, a 5-year design horizon was used for this study. The year of 2022 was adopted as the base year and 2027 as the design horizon year.

To assess the impact of the existing and future traffic volumes on the relevant road network, the following scenarios were analysed:

- ▶ 2022 Base year - Existing traffic demand (Normal Day);
- ▶ 2022 Base year - Existing traffic demand (Abnormal Day);
- ▶ 2027 Background Traffic - Future traffic demand (Normal Day);
- ▶ 2027 Background Traffic - Future traffic demand (Abnormal Day);
- ▶ 2027 Background traffic with the proposed new development (Normal day); and
- ▶ 2027 Background traffic with the proposed new development (Abnormal day).

2.4 Peak hours analysed

TMH 16 recommends that the assessment be conducted for the hours which have the highest combined demand of the background traffic and the development traffic. Based on the traffic count data, the peak hours were between 14h00 to 15h00 on Friday and between 10h30 to 11h30 on a Saturday.

2.5 Development traffic

TMH 17 does not provide trip generation rates for tourist attractions such as the proposed redevelopment. Hence, the Site trip generation was estimated from traffic engineering first principles using the anticipated visitors and the number of employees.

2.6 Traffic growth rate

The TMH 17 South African Trip Data Manual stipulates that traffic growth rates are dependent on the characteristics of the development area.

The Ehlanzeni District Municipality Spatial Development Framework (2010/2011) (not updated to date) categorised Graskop as having:

- ▶ Low levels of formal local economic activity;
- ▶ High dependence on higher order settlements for specialised goods and services; and

- ▶ High levels of public sector Investment.

Although the same document lists Graskop as a potential second-order activity node where both public and private capital investment is needed to be focussed, low economic growth has been realised in the past 10 years.

The TMH 17 recommends traffic growth rates of between 0 to 3% for low growth areas. A growth rate of 2 % was adopted for this study.

2.7 Capacity analysis

The Signalised & unsignalised Intersection Design and Research Aid (SIDRA) traffic analysis software application was used for the capacity analysis of the affected intersections in the study area.

3 Existing Conditions

This chapter describes the existing development operations, existing road network layout, existing traffic patterns, and PT and NMT activities, within the study area.

The details of this chapter of the report was informed by a desktop study, a site visit and review of previous traffic studies conducted at the Site, as well as district municipality spatial and transport documents and the Mpumalanga RAMS.

The Site visit was conducted during the typical weekday AM and PM peak periods on 2 and 3 February 2022, to observe the existing transport conditions.

3.1 Existing development access

The development site currently has one access point off the R534. The intersection of the development access and R534 operates as a priority-controlled T-junction with the access road controlled by a stop sign and priority for the through movement on R534.

The access entrance is currently controlled with the use of a boom gate. This boom gate, however, is not electronically controlled but rather controlled by a security guard (i.e. manned gate). To get through the boom gate, individuals pay a fee using cash or card to the security guard which was observed to cause notable delays during the Site visit. The slow payment processing time results in long queues at the gate which overflow onto the R534 as there currently is not enough stacking space (see **Figure 3-1** facing the inbound gate access).



Photo taken on 03/02/2022

Figure 3-1: Existing Development Site Entrance

3.2 Existing road network

The road network that is likely to be affected by the new development is described below:

- ▶ The **R534** is a Class 4 District Collector road from which the site gains direct access. This road is a single-carriageway road with one lane in each direction. The road is approximately 15 km long and runs in the form of a loop and connects to the R532 at two points (North and South) which are approximately 6 km apart.
- ▶ The **R532** is the road that connects with the R534 which eventually leads to the site. This road is a Class 2 Regional Distributor. It is a single-carriageway road and travels mostly in a north south direction from its intersection with the R36 near Draasloot in Limpopo to its intersection with the R37 near Sabie in Mpumalanga. Along its path, the R532 passes Sabie, Graskop, Moremela and Leroro-A. Its connection to the R36 leads to the N1 near Bandelierkop in Limpopo. Furthermore, the R532 connection with the R37 leads to the N4 near Mbombela in Mpumalanga.
- ▶ The **R533** is also a Class 2 Regional Distributor. It is a single-carriageway road that travels mostly in an east west direction from its intersection with the R36 near Ohrigstad, Limpopo to its intersection with the R40 in Bushbuckridge. Along its path, the R533 only passes through/by Pilgrimsrest, Graskop and Bushbuckridge. Its connection with the R40 leads to the N4 near Mbombela in Mpumalanga. Furthermore, the R533 connection with the R36 leads to the N1 near Bandelierkop in Limpopo as well the N17 near Ermelo in Mpumalanga.

A visual depiction of the relevant roads traversing through the study area is illustrated in **Table 3-1** below.

Table 3-1: Site Visit Images of the Relevant Roads

	
Louis Trichardt Avenue (R532)	Main Street (R532)
	
Main Street (R533)	R534

Photos taken on 03/02/2022

Outlined below are the intersections, in addition to the development access intersection with R534, that are likely to be affected by the traffic generated by the proposed development. The intersections were considered based on the possible routes that may be used to access the site.

The following intersections were considered:

- ▶ **02 - R534/R532 Intersection (North):** This intersection is a priority controlled T-junction with R534 controlled by a stop sign. All the approaches have one lane in each direction, barring the north western approach (R532) which has an additional shared short left-turn and through lane.
- ▶ **03 - R534/R532 Intersection (South):** Similar to the previous intersection, this intersection operates as a priority controlled T-junction with R534 controlled by a stop sign. All the approaches have one lane in each direction. In addition, the south eastern approach (R532) has one shared right-turn and through lane and the north western approach (R532) has one shared short left-turn and through lane.
- ▶ **04 - Main Street/R532/Richardson Avenue:** This intersection operates as a 4-legged all-way stop-controlled intersection. The eastern and western approaches both have one lane in each direction. The southern and northern approaches have two lanes in each direction which include one shared left-turn and through lane, and one shared right-turn and through lane.

All the traffic to and from God's Window from other areas passing through Graskop town pass the last two intersection located in the heart of the town's Central Business District (CBD).

3.3 Existing traffic conditions

As previously indicated in Section 2.2 of this report, 12-hour traffic accounts (06h00 to 18h00) were conducted on a normal weekday (Friday) and weekend day (Saturday) and for an abnormal weekday (Friday) and weekend day (Saturday) on the following dates:

- Normal days - Friday (10 June 2022) and Saturday (11 June 2022) from 06h00 to 18h00 on each day.
- Abnormal day (Over long weekend) - Friday (17 June 2022) and Saturday (18 June 2022) from 06h00 to 18h00 on each day.

The traffic count surveys were conducted at the following intersections:

- ▶ 01 - R534 and Site Access
- ▶ 02 – R534 and R532 (North)
- ▶ 03 – R534 and R532 (South)
- ▶ 04 – Main Street and R532 and Richardson Avenue

The surveys were conducted when road rehabilitation construction works was taking place on the R532 between it's intersections with the R534 (i.e. Intersection 02 and 03). Furthermore, the R534 from it's intersection with the R532 (Intersection 2) leading up to the God's Window access (Intersection 1) was closed.. As such, access to God's Window could only be taken at intersection 03 – the R534 and R532 (South) intersection.

Although the construction activity caused some delays due to the “stop and go” traffic control on this stretch of road, these were not significant as the traffic volumes along R532 were observed and counted to be generally low.

A comparison was done between the 2019 Mpumalanga RAMs traffic volumes and the traffic count volumes to check if some traffic could have diverted to other roads due to the construction activity along the R532. The Mpumalanga RAMS specified average annual daily traffic (AADT) for 2019 as ranging between 500 and 1 000 vehicles (both directions) along this stretch of R532. The 12-hr traffic count data is shown below.

Table 3-2: 12-hr traffic volumes along R532 south of intersection 02 – R534 and R532 (North) - 2022

Day	Normal day (vehicles- both direction)	Abnormal day (vehicles- both direction)
Friday	892	1132
Saturday	751	718

The table above shows the 12-hr volumes as per the traffic count, the daily volumes could be slightly higher. Comparing the two sets of data (i.e., the 2019 Mpumalanga RAMs traffic volumes and the 2022 traffic count), also considering the COVID19 lockdown impact traffic volumes in the past two years, the 2022 volumes are within the 2019 ADT range and even higher. Thus, it can be concluded that there were no traffic diversions due to the construction, and if any then negligible.

For the assessment of future background traffic, traffic travelling to and from the north toward Moremela were assumed to use the R534 at intersection 02 – R534 and R532 (North) to access God's Window.

Table 3-3 summarises the peak hour traffic volumes along the roads in the study area.

Traffic flow figures are in Appendix A.

Table 3-3: Existing Traffic Volumes (Normal and Abnormal Day)

Road	Friday peak hour (Two-way)	Saturday peak hour (Two-way)
R534	115-140	125-140
R532 (Between northern and southern intersection)	160-190	120-135
R532 (Graskop)	350-1250	340-930

Table 3-3 shows that the volumes within the vicinity of God's Window vary between 115 to 190 vehicles per hour (both directions) and 120 to 140 vehicles per hour (both directions), for Friday and Saturday respectively. There are higher traffic volumes along R532 towards Graskop within the magnitude of 350 to 1250 and 340 to 930, for Friday and Saturday respectively.

3.4 Existing PT and NMT

3.4.1 Public transport

During the site visit, a few mini-bus taxis were observed travelling along the R534 in the vicinity of the site. A notable number of buses and minibus taxis were observed along the R532 travelling to / from Graskop, from the northern communities of Molemela and Leroro.

The development site has an existing bus lay-by facility along the development frontage. Within Graskop, there is a taxi rank (which is the closest taxi rank to the site) as well as a railway station. The minibus taxi rank serves nearby towns of Lydenburg, Sabie and Matibidi as well as long distance travel to other provinces such as Gauteng.



Photo taken on 03/02/2022

Figure 3-2: Mini-Bus Taxis along R532



Photo taken on 03/02/2022

Figure 3-3: PT facility in the vicinity of the site

3.4.2 Non-Motorised Transport

Pedestrians were observed walking along the R534 to and from the site. These pedestrians mainly comprise of individuals who sell souvenirs at the craft market at God's Window. There are no walkways along the R534, as such, pedestrians were observed walking in the roadway or along the verge of the road.

4 Trip Generation and Distribution

4.1 Trip generation

The trip generation process considered that God's Window is currently operational and vehicle trips accessing the current development are already on the road network. Therefore, to assess the impact of the proposed future development, only the impact of the additional traffic (i.e., future development generated traffic minus existing development traffic) was to be assessed.

Traditionally, development vehicular traffic is estimated by applying trip generation rates from the South African Trip Generation Rates manual (SATGR) (DoT, 1995) or the TMH 17. However, neither of the two documents have recommended trip rates for the proposed development.

Accordingly, the trip generation analysis in this chapter has been derived on a first principles basis using traffic counts for the existing development and using the number of daily visitors and employees expected to access the future development, which was based on the facility's capacity.

4.1.1 Existing development trip generation

4.1.1.1 Historic visitors' numbers

A TIA study was previously conducted for the same proposed development in 2016. Figure 4-1 shows the historic God's Window monthly visitor numbers for 2009 / 2010 extracted from the previous TIA.

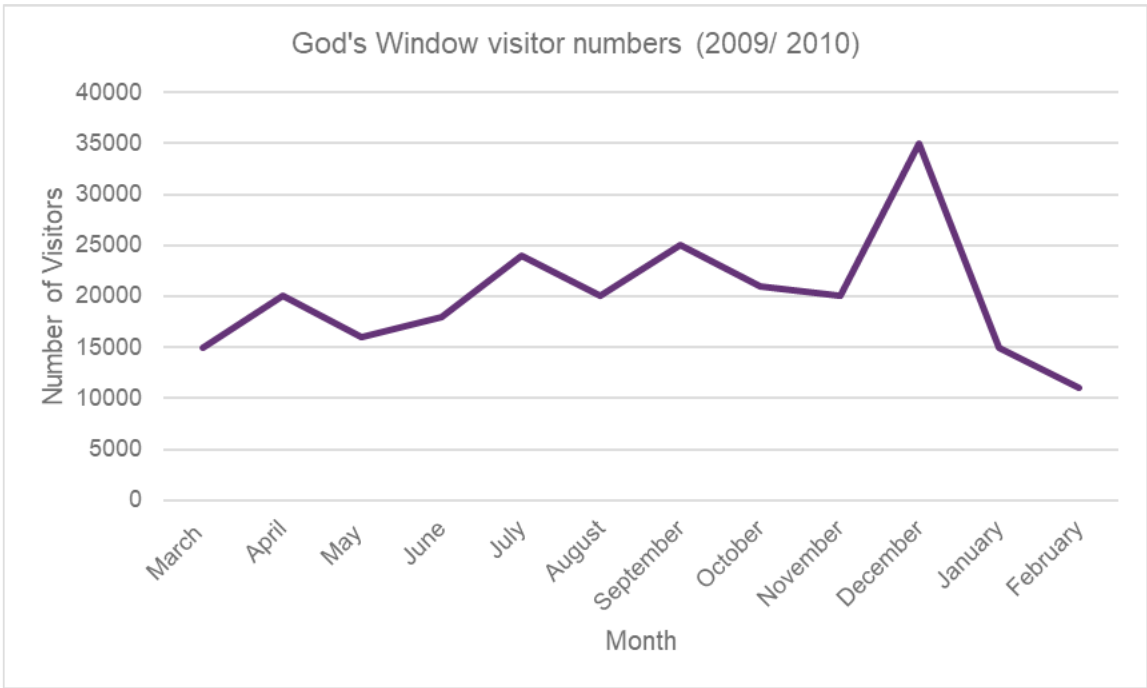


Figure 4-1: God's Window visitor numbers (2009 / 2010)

Figure 4-1 shows that the number of visitors to God's Window fluctuates throughout the year with the months of January to May being the off-peak season (though April has higher volumes due to some public holidays). The month of June to November are within the shoulder season between the off-peak and the peak season that occurs during the December holidays. The average daily visitor volumes in 2009 / 2010 for off-peak season was about 500 visitors, shoulder season was about 700 visitors and for the peak about 1130 visitors. The season between the off-peak and the peak best reflect the average demand throughout the year.

Since the traffic count was counted in June, it was assumed that the count reflected the current average demand at the existing development and thus no adjustment seasonal factors were applied to the count.

4.1.1.2 Traffic count data

The traffic count data was collected during the month of June as discussed in Section 2.2 of this report.

Table 4-1 summarises the number of vehicles counted entering and exiting God’s Window on the days the counts were undertaken as well as the respective peak hour volumes for the same days.

Table 4-2 summarises the mode split of the vehicles accessing God’s Window.

Table 4-1: Vehicle trips at Site access (per day and peak hour)

Day	Friday - Day vehicle volumes		Friday - Peak hour vehicles		Saturday- Day vehicle volumes		Saturday - Peak hour vehicles	
	In	Out	In	Out	In	Out	In	Out
Normal Day	105	105	13	13	647	647	88	41
Abnormal day	771	771	93	97	1519	1519	206	97

Table 4-2: Daily mode split of vehicles at Site access

Mode	Friday		Saturday	
	Normal day	Abnormal day	Normal day	Abnormal day
Daily vehicle volumes				
Car	94	695	573	1346
Bus	2	12	11	27
Minibus Taxi	9	64	63	147
Total	105	771	647	1520
Peak hour vehicle volumes				
Car	12	83	72	170
Bus	0	1	1	2
Minibus Taxi	1	9	14	34
Total	13	93	87	206

Based on the traffic count, the following observations can be made:

- ▶ Saturdays generally have more visitors than Fridays. On a Friday, about 100 and 770 vehicles were counted entering God’s Window on a normal and abnormal day, respectively. In comparison, about 650 vehicles and 1 520 vehicles were respectively counted on normal day and abnormal day, on a Saturday.
- ▶ 12% of the vehicle trips counted on Friday (either on a normal day or abnormal day) were counted during the peak hour. For Saturday counts, 10% were counted during the peak hour. In other words, the Friday peaking factor (both normal and abnormal day) is 0.12 while is 0,1 on on Saturday.

- ▶ On Fridays, the directional split (in:out) for the peak hours was approximately 50:50 on both days and on Saturdays, the split was approximately 70:30.
- ▶ The private car was the main mode of transport with about 90% modeshare of all vehicles followed by minibus taxi (8%) and bus (2%)

4.1.1.3 Proposed development

The future development accommodation schedule was developed by the Project Team (consisting of the architect and the engineering team). The accommodation schedule details the number of daily visitors and employees expected to access the future development as well as the mode split, vehicle occupancy and parking bays,

The proposed re-development and / or Facility capacity, is estimated to accommodate 1 089 visitors and 161 employees (accommodation schedule proposed by the Project Team), totalling to 1 250 person per day. The number of visitors that each of the proposed areas are expected to attract are outlined below:

- ▶ Tourist centre: 1047 people per day;
- ▶ Corporate retreat: 24 people per day; and
- ▶ Exclusive retreat: 18 people per day.

The proposed access to the site is to be situated at the existing location. As per the site plan, the parking is to be completely redeveloped to consist of the following parking bays:

- ▶ 160 visitor parking bays;
- ▶ 14 taxi parking bays;
- ▶ 6 bus parking bays; and
- ▶ 20 staff parking bays.

The following average vehicle occupancy has been assumed for the future development (based on accommodation schedule):

- ▶ Private car – 3 persons per vehicle
- ▶ Bus – 60 persons per vehicle
- ▶ Mini-bus Taxi – 14 persons per vehicle.

The person trip modal split for the future God's Window development, based on the accommodation schedule, has been proposed as follows:

- ▶ Private car - 46%
- ▶ Bus - 35%
- ▶ Minibus taxi - 19%

Table 4-3 illustrates the number of persons (visitors and employees) per mode and number of vehicles (estimated using the proposed vehicle occupancy per mode), expected to access God's Window daily. Based on the development schedule (facility capacity), about 240 vehicles are estimated to access the future development per day.

Table 4-3: Daily number of persons and vehicles per mode (Proposed development)

Mode	Persons	Vehicles
Car	579	207
Bus	434	8
Minibus Taxi	236	24
Total	1250	239

In terms of traffic movement each vehicle is expected to generate an inbound and outbound movement per day resulting to at least two trips. On this basis, the future development can be expected to generate about 480 vehicle trips per day.

Table 4-4 shows the expected peak hour volumes which were estimated using the 12% derived from peak hour traffic of the traffic count conducted for this study.

Table 4-4: Proposed development peak hour trip generation

Mode	In	Out
Car	26	26
Bus	1	1
Minibus Taxi	3	3
Total	30	30

Based on the above trip generation results, the proposed development is expected to generate about 60 trips during the peak hour.

Table 4-5 summarises the trip generation result of the existing development and the future proposed development.

Table 4-5: Comparison of the existing development and future development trip generation

Mode	Peak hour trip generation (vehicles)	Difference: Proposed development peak hour traffic minus existing development peak hour traffic (vehicles)
Proposed development	60	
Existing development – Friday normal day	26	34
Existing development – Saturday normal day	129	-69
Existing development – Friday abnormal day	190	-130
Existing development – Saturday abnormal day	206	-146

The peak hour trip generation for the future development is estimated to be approximately double the current development trip generation for a normal weekday (in this case, Friday) but less than half of the current normal weekend (in this case Saturday). The future development trip generation is also estimated to be less than the average week peak hour traffic $((129+26)/2=78)$. However, the proposed development is meant to offer a more attractive tourism destination and thus attract more visitors than the existing development.

A market study prepared by DEMACON Market Studies in July 2022 for the proposed God's Window Skywalk Project considered two scenarios for the market potential and demand estimations including:

- ▶ **Baseline demand estimation scenario:** This scenario was based on the current offering and assumes that there would be no redevelopment at God's Window. The demand growth trajectory was based on the existing development historical growth trend prior COVID impact. The annual growth rate obtained was $\pm 3.1\%$ for the short term (5 years), $\pm 2.0\%$ for medium term and a long-term growth rate of $\pm 1.4\%$.
- ▶ **Optimistic demand estimation scenario:** This scenario took into consideration a new, modernised and expanded tourism offering, with proportional higher support from tourists. The annual growth rate obtained for this scenario was 10 % to 15 % for short term (5 years), $\pm 5-9\%$ and $\pm 3-5\%$ for medium and long term respectively.

On this basis, it was decided to conduct a sensitivity analysis to test a wide range of scenarios pertaining possible trip generate scenarios by the future proposed development. The scenarios included the following for the short term (TIA design horizon-5 years):

- ▶ Low growth scenario - based on current growth trajectory – 2% per annum (as per traffic background growth estimate)
- ▶ High growth scenario - based on optimistic demand scenario of 15% growth rate per annum
- ▶ Medium growth scenario - Average between low and high scenario - 8.5%.

4.2 Trip Distribution and Trip Assignment

The trip distribution onto the surrounding road network was determined by the existing traffic volume distribution except for Intersection 02 and 03 which were affected by the road closure due to the road rehabilitation construction works. The distribution at Intersection 02 and 03 was based on the previous TIA distribution which estimated that 65 % of the trips to/from the development site make use of the southern intersection and the remaining 35 % make use of the northern intersection.

5 Intersection Capacity Analyses

The capacity analysis of intersections within the study area was carried out using the SIDRA Intersection Edition 9 software application. The purpose of the analysis was to determine the Levels of Service (LOS), volume/capacity ratio (v/c) and delays that may occur at intersections with the introduction of the proposed development.

5.1 Assessment criteria

The performance criteria for the intersection's capacity analysis are indicated in Table 5-1 below. The LOS, delay and v/c ratios have been defined in accordance with the Highway Capacity Manual 2010 (HCM 2010).

Table 5-1 Performance criteria

Level of Service	Control delay Per Vehicle (Seconds(d))	
	Signal and Roundabouts	Stop and Give-Way/Yield Signs
A	$d \leq 10$	$d \leq 10$
B	$10 < d \leq 20$	$10 < d \leq 15$
C	$20 < d \leq 35$	$15 < d \leq 25$
D	$35 < d \leq 55$	$25 < d \leq 35$
E	$55 < d \leq 80$	$35 < d \leq 50$
F	$d > 80$	$d \leq 50$

The capacity analysis in this TIA is set to use the average control delay as the LOS measure for priority-controlled intersections (including roundabouts), whereas for signalised intersections v/c is used. LOS A to F are used, with LOS A indicating the best operating conditions and LOS F the worst. The LOS A to D was taken as acceptable for the purpose of this traffic impact assessment. As industry standard dictates, the volume/capacity (v/c) for signalised intersections should not exceed 0.95.

5.2 Background traffic capacity analysis

This section details the analysis results of the base year (2022) and horizon year (2027). The 2027 traffic volumes were estimated by applying the traffic growth rate of 2%.

The following intersections were analysed in this section:

- ▶ 02 – R534 and R532 (North)
- ▶ 03 – R534 and R532 (South)
- ▶ 04 – Main Street and R532 and Richardson Avenue

Intersection 01 is analysed in the Access Capacity Analysis Section.

5.2.1 Analysis results for base year (2022) and 2027 (normal day)

This section discusses the capacity analysis results for the base year (2022) and 2027 for normal days.

The results from the analysis performance for a normal day in the base year (2022) and 2027 are shown in Table 5-2.

Table 5-2: Background (2022 and 2027) traffic capacity analysis (normal day)

Intersection	Type of Intersection	Movement	2022 Background Traffic						2027 Background Traffic					
			FRI Peak Hour			SAT Peak Hour			FRI Peak Hour			SAT Peak Hour		
			V/C	Delay(s)	LOS	V/C	Delay(s)	LOS	V/C	Delay(s)	LOS	V/C	Delay(s)	LOS
02- R534 and R532 (North)	Priority	South	0.024	0.1	NA	0.025	0.1	NA	0.026	0.1	NA	0.028	0.1	NA
		East	0.011	8.5	A	0.018	8.5	A	0.012	8.6	A	0.020	8.6	A
		North	0.021	1.6	NA	0.017	1.9	NA	0.023	1.6	NA	0.019	1.9	NA
		Overall	0.024	1.4	NA	0.025	1.8	NA	0.026	1.4	NA	0.028	1.8	NA
03 – R534 and R53– (South)	Priority	South	0.059	3.9	NA	0.057	4.4	NA	0.065	3.9	NA	0.063	4.5	NA
		East	0.032	8.2	A	0.050	8.2	A	0.036	8.3	A	0.056	8.2	A
		North	0.015	2.0	NA	0.010	3.4	NA	0.017	2.0	NA	0.011	3.4	NA
		Overall	0.059	4.4	NA	0.057	5.6	NA	0.065	4.4	NA	0.063	5.6	NA
04- Main Street and R532 and Richardson Avenue	Priority	South	0.253	15.2	C	0.227	15.4	C	0.280	15.7	C	0.250	15.9	C
		East	0.302	17.0	C	0.273	16.2	C	0.333	17.5	C	0.302	16.6	C
		North	0.237	15.7	C	0.236	15.7	C	0.262	16.3	C	0.260	16.2	C
		West	0.264	15.5	C	0.277	16.3	C	0.291	15.9	C	0.306	16.7	C
		Overall	0.302	15.8	C	0.277	15.9	C	0.333	16.3	C	0.306	16.4	C

The following comments are made in relation to the above analysis.

02- R534 and R532 (North)

For both the 2022 Friday and Saturday peak periods, the stop-controlled approach (eastern approach) operates at LOS A which is deemed acceptable. In 2027, the situation at this intersection remains relatively unchanged as the stop-controlled approach will continue to operate at LOS A. This is due to the relatively low volumes observed at this intersection.

03- R534 and R532 (South)

For both the 2022 Friday and Saturday peak periods, the stop-controlled approach (eastern approach) operates at LOS A which is deemed acceptable. Much like the previous intersection, in 2027, the situation at this intersection remains relatively unchanged as the stop-controlled approach will still operate at LOS A.

03 – Main Street and R532 and Richardson Avenue

For both the 2022 Friday and Saturday peak periods, the intersection operates at LOS C which is deemed acceptable. The growth in background traffic increasing up to 2027 results in an average delay increase of 0.5 seconds for both the 2022 Friday and Saturday peak periods. Notwithstanding the increase in delay, the intersection will still operate at LOS C during both the 2027 Friday and Saturday peak periods.

5.2.2 Analysis results for base year (2022) and 2027 (abnormal day)

The results from the analysis performance for an abnormal day in the base year (2022) and 2027 are shown in Table 5-3.

Table 5-3: Background (2022 and 2027) traffic capacity analysis (abnormal day)

Intersection	Type of Intersection	Movement	2022 Background Traffic						2027 Background Traffic					
			FRI Peak Hour			SAT Peak Hour			FRI Peak Hour			SAT Peak Hour		
			V/C	Delay(s)	LOS	V/C	Delay(s)	LOS	V/C	Delay(s)	LOS	V/C	Delay(s)	LOS
02- R534 and R532 (North)	Priority	South	0.029	0.1	NA	0.023	0.1	NA	0.032	0.1	NA	0.026	0.1	NA
		East	0.013	8.7	A	0.016	8.4	A	0.015	8.8	A	0.018	8.5	A
		North	0.027	1.7	NA	0.016	1.9	NA	0.029	1.7	NA	0.018	1.9	NA
		Overall	0.029	1.5	NA	0.023	1.9	NA	0.032	1.5	NA	0.026	1.9	NA
03 – R534 and R53– (South)	Priority	South	0.078	4.0	NA	0.053	4.5	NA	0.086	4.1	NA	0.059	4.6	NA
		East	0.043	8.6	A	0.047	8.4	A	0.048	8.7	A	0.052	8.5	A
		North	0.020	2.1	NA	0.009	3.4	NA	0.022	2.1	NA	0.010	3.4	NA
		Overall	0.078	4.6	NA	0.053	5.8	NA	0.086	4.6	NA	0.059	5.8	NA
04- Main Street and R532 and Richardson Avenue	Priority	South	0.826	52.2	F	0.666	35.7	E	0.912	67.3	F	0.735	42.2	E
		East	1.122	105.5	F	0.793	37.8	E	1.239	148.7	F	0.875	48.0	E
		North	0.935	75.4	F	0.664	36.0	E	1.033	100.1	F	0.733	42.5	E
		West	1.080	95.8	F	0.826	41.6	E	1.192	134.8	F	0.912	54.3	F
		Overall	1.122	83.7	F	0.826	37.8	E	1.239	115.0	F	0.912	46.9	E

02- R534 and R532 (North)

For both the 2022 Friday and Saturday peak periods, the stop-controlled approach (eastern approach) operates at LOS A which is deemed acceptable. With the growth in background traffic increasing up to 2027, the situation at this intersection remains relatively unchanged as the stop-controlled approach will still operate at LOS A on an abnormal day.

03- R534 and R532 (South)

For both the 2022 Friday and Saturday peak periods, the stop-controlled approach (eastern approach) operates at LOS A which is deemed acceptable. Much like the previous intersection, with the growth in background traffic increasing up to 2027, the situation at this intersection remains relatively unchanged as the stop-controlled approach will still operate at LOS A on an abnormal day.

03 – Main Street and R532 and Richardson Avenue

The entirety of the approaches at the intersection operate at an LOS F and E for both the 2022 Friday and Saturday peak periods, respectively, which is deemed not acceptable. The situation worsens with the growth in background traffic increasing up to 2027. For the 2027 Friday peak period, all the approaches will remain operating at LOS F with an overall increase in average delay from 83.7 seconds to 115 seconds. For the 2027 Saturday peak period, all the approaches will remain operating as LOS E with the exception of the western approach which will operate at LOS F. Therefore, it is imperative to note that the frequency of the intersection operating at this level will be relatively low throughout the year.

5.3 2027 horizon year with development traffic analysis

A sensitivity analysis was conducted, as discussed in Section 4.1.3, for the development traffic to consider a wide range of additional trips that can be expected at the proposed development.

5.3.1 Low growth scenario

In this scenario, no additional trips will be generated at the proposed development. Therefore, the traffic volumes and capacity analysis results in this scenario will be the same as that of the 2027 Background traffic scenario discussed in Section 5.2. The traffic figures are found in Appendix A.

5.3.2 Medium growth scenario

In this scenario, the proposed development is expected to attract a magnitude of additional trips that is equivalent to 50 % of the current trips at the site. This was conducted for both the normal and abnormal days. The traffic figures are found in Appendix A.

Table 5-4: Background and development traffic capacity analysis (medium growth scenario)

Intersection	Type of Intersection	Movement	Normal Day						Abnormal Day					
			FRI Peak Hour			SAT Peak Hour			FRI Peak Hour			SAT Peak Hour		
			V/C	Delay(s)	LOS	V/C	Delay(s)	LOS	V/C	Delay(s)	LOS	V/C	Delay(s)	LOS
02- R534 and R532 (North)	Priority	South	0.026	0.1	NA	0.028	0.1	NA	0.031	0.1	NA	0.025	0.2	NA
		East	0.021	8.7	A	0.048	8.9	A	0.083	9.1	A	0.086	9.1	A
		North	0.023	2.0	NA	0.037	3.6	NA	0.040	3.3	NA	0.071	4.5	NA
		Overall	0.026	2.0	NA	0.048	3.4	NA	0.083	3.8	NA	0.086	4.6	NA
03 – R534 and R53– (South)	Priority	South	0.073	4.1	NA	0.116	5.1	NA	0.141	4.7	NA	0.183	5.4	NA
		East	0.048	8.3	A	0.093	8.4	A	0.130	8.6	A	0.138	8.6	A
		North	0.017	2.2	NA	0.021	4.2	NA	0.023	2.9	NA	0.034	4.7	NA
		Overall	0.073	4.8	NA	0.116	6.1	NA	0.141	5.7	NA	0.183	6.4	NA
04- Main Street and R532 and Richardson Avenue	Priority	South	0.284	15.7	C	0.290	16.7	C	1.038	91.9	F	0.771	43.1	E
		East	0.341	17.8	C	0.333	16.5	C	1.240	153.1	F	0.898	48.7	E
		North	0.276	16.4	C	0.310	17.2	C	1.048	98.3	F	0.830	50.7	F
		West	0.300	16.3	C	0.391	19.3	C	1.127	109.7	F	1.027	81.7	F
		Overall	0.341	16.5	C	0.391	17.4	C	1.240	111.9	F	1.027	55.9	F

From the above table, it is evident that the development traffic, for this scenario, will not have a significant impact on the intersections considered. All the approach LOS’s at the intersections are like those obtained from the 2027 Background traffic scenario. There is however one exception on the abnormal Saturday peak period whereby the development traffic worsens on the northern approach from LOS E to LOS F.

5.3.3 High growth scenario

In this scenario, proposed development will attract a magnitude of additional trips that is equivalent to 100 % of the current trips at the site. This was conducted for both the normal and abnormal days. The traffic figures are found in Appendix A

Table 5-5: Background and development traffic capacity analysis (high growth scenario)

Intersection	Type of Intersection	Movement	Normal Day						Abnormal Day					
			FRI Peak Hour			SAT Peak Hour			FRI Peak Hour			SAT Peak Hour		
			V/C	Delay(s)	LOS	V/C	Delay(s)	LOS	V/C	Delay(s)	LOS	V/C	Delay(s)	LOS
02- R534 and R532 (North)	Priority	South	0.026	0.1	NA	0.028	0.1	NA	0.031	0.1	NA	0.025	0.2	NA
		East	0.023	8.7	A	0.058	8.9	A	0.106	9.3	A	0.111	9.3	A
		North	0.023	2.1	NA	0.046	3.9	NA	0.050	3.6	NA	0.092	4.7	NA
		Overall	0.026	2.1	NA	0.058	3.8	NA	0.106	4.2	NA	0.111	5.0	NA
03 – R534 and R53– (South)	Priority	South	0.076	4.2	NA	0.134	5.2	NA	0.160	4.9	NA	0.228	5.6	NA
		East	0.050	8.3	A	0.105	8.4	A	0.161	8.6	A	0.173	8.8	A
		North	0.017	2.2	NA	0.025	4.3	NA	0.027	3.1	NA	0.042	4.8	NA
		Overall	0.076	4.8	NA	0.134	6.2	NA	0.161	6.0	NA	0.228	6.5	NA
04- Main Street and R532 and Richardson Avenue	Priority	South	0.285	15.7	C	0.302	17.0	C	1.051	95.6	F	0.800	46.7	E
		East	0.343	17.8	C	0.343	16.5	C	1.254	158.6	F	0.921	52.3	F
		North	0.282	16.5	C	0.327	17.5	C	1.082	108.1	F	0.869	56.8	F
		West	0.304	16.4	C	0.419	20.3	C	1.157	120.7	F	1.093	102.2	F
		Overall	0.343	16.6	C	0.419	17.8	C	1.254	119.2	F	1.093	64.3	F

From the above table, it is evident that, even for the high growth scenario, the development will not have a significant impact on the relevant intersections due to all the approach LOS's at the intersections being similar to those obtained from the 2027 Background traffic scenario. There is however one exception on the abnormal Saturday peak period whereby the LOS at the northern and eastern approaches deteriorates from LOS E to LOS F.

Regarding the sensitivity analysis, it is evident that for the wide range of assumptions that were considered for the proposed development traffic, there will not be a significant impact on the surrounding road network.

5.4 Proposed road upgrades

5.4.1 R534 and R532 (North)

No road upgrades are proposed at this intersection as the intersection will operate at an acceptable level in 2027 during the normal and abnormal days.

5.4.2 R534 and R532 (South)

No road upgrades are proposed at this intersection as the intersection will operate at an acceptable level in 2027 during the normal and abnormal days.

5.4.3 Main Street and R532 and Richardson Avenue

On a normal day, the intersection will operate at an acceptable level and will therefore not require any upgrades. On an abnormal day, as previously mentioned, the intersection currently does not operate at an acceptable level and will slightly worsen up until 2027. A way to remedy the poor operational performance of the intersection is to signalise the intersection.

Table 5-6 illustrates the results from the capacity analysis if this intersection were to be signalised.

Table 5-6: Signalized Main Street and R532 and Richardson Avenue Capacity Analysis

Intersection Type of Intersection	Movement	Normal Day						Abnormal Day					
		FRI Peak Hour			SAT Peak Hour			FRI Peak Hour			SAT Peak Hour		
		V/C	Delay(s)	LOS	V/C	Delay(s)	LOS	V/C	Delay(s)	LOS	V/C	Delay(s)	LOS
Low Growth Scenario	South	0.222	14.9	B	0.210	15.5	B	0.997	37.7	D	0.669	18.5	B
	East	0.244	10.5	B	0.218	10.3	B	0.850	29.4	C	0.660	13.6	B
	North	0.192	15.0	B	0.217	15.6	B	0.714	25.4	C	0.690	18.8	B
	West	0.244	10.7	B	0.220	10.2	B	1.000	58.6	E	0.668	13.7	B
	Overall	0.244	12.9	B	0.220	13.0	B	1.123	37.5	D	0.690	16.2	B
Medium Growth Scenario	South	0.227	14.8	B	0.247	15.1	B	1.123	48.7	D	0.803	20.6	C
	East	0.249	10.5	B	0.266	10.8	B	0.957	41.9	D	0.828	19.4	B
	North	0.205	15.1	B	0.264	15.7	B	0.860	25.3	C	0.851	22.7	C
	West	0.245	10.7	B	0.256	10.6	B	1.097	85.3	F	0.739	15.4	B
	Overall	0.249	12.9	B	0.282	13.1	B	1.123	49.1	D	0.851	19.6	B
High Growth Scenario	South	0.229	14.8	B	0.258	15.0	B	1.175	55.7	E	0.711	21.6	C
	East	0.251	10.6	B	0.281	10.9	B	0.980	47.3	D	0.816	21.9	C
	North	0.211	15.1	B	0.282	15.8	B	0.920	27.6	C	0.849	23.8	C
	West	0.247	10.8	B	0.266	10.7	B	1.112	90.7	F	0.698	16.3	B
	Overall	0.251	13.0	B	0.282	13.2	B	1.175	54.0	D	0.849	21.0	C

Table 5-6 shows that the intersection will operate at an overall LOS D or better during the normal and abnormal days when the intersection is signalised.

It should be noted that the local municipality is responsible for providing road upgrades required due to existing traffic conditions or background traffic growth.

However, it is imperative to note that the frequency of abnormal days is far less than those of normal days. Therefore, due to the intersection operating at an acceptable level during normal days, the signalisation of the intersection is deemed not necessary.

6 Development Access Analysis

6.1 Access capacity analyses

was used to analyse the Site access. The analysis entailed assessing whether the proposed access will have sufficient capacity to accommodate the expected traffic.

The existing access off the R534 will be used which is a 3-legged priority-controlled intersection with priority given to vehicles traveling along the R534 and stop-control for the movements exiting the site.

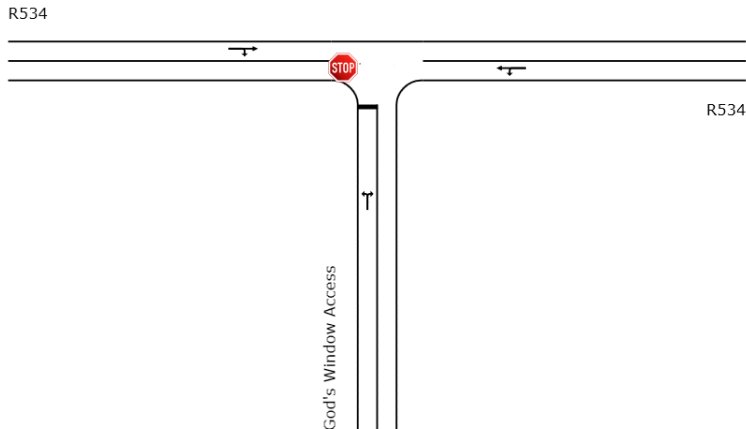


Figure 6-1: God's Window Access Layout

Table 6-1 and Table 6-2 display the results of the access capacity analysis for the Medium and High growth scenarios.

Table 6-1: Access capacity analysis (medium growth scenario)

Intersection	Type of Intersection	Movement	Normal Day						Abnormal Day					
			FRI Peak Hour			SAT Peak Hour			FRI Peak Hour			SAT Peak Hour		
			V/C	Delay(s)	LOS	V/C	Delay(s)	LOS	V/C	Delay(s)	LOS	V/C	Delay(s)	LOS
01 - God's Window Access	Priority	South	0.018	3.9	NA	0.116	4.6	NA	0.139	4.2	NA	0.301	5.3	NA
		East	0.028	7.9	A	0.096	8.3	A	0.231	8.5	A	0.278	9.5	A
		North	0.007	4.7	NA	0.051	5.0	NA	0.058	4.6	NA	0.119	5.0	NA
		Overall	0.028	5.8	NA	0.116	5.8	NA	0.231	6.2	NA	0.301	6.4	NA

Table 6-2: Access capacity analysis (high growth scenario)

Intersection	Type of Intersection	Movement	Normal Day						Abnormal Day					
			FRI Peak Hour			SAT Peak Hour			FRI Peak Hour			SAT Peak Hour		
			V/C	Delay(s)	LOS	V/C	Delay(s)	LOS	V/C	Delay(s)	LOS	V/C	Delay(s)	LOS
01- God's Window Access	Priority	South	0.020	4.1	NA	0.136	4.9	NA	0.160	4.5	NA	0.361	5.7	NA
		East	0.033	7.9	A	0.116	8.4	A	0.282	8.7	A	0.357	10.2	B
		North	0.009	4.9	NA	0.059	5.1	NA	0.067	4.8	NA	0.140	5.1	NA
		Overall	0.033	5.9	NA	0.136	5.9	NA	0.282	6.4	NA	0.361	6.9	NA

From the above tables it is evident that, when all development traffic scenarios are considered, the intersection will operate at an acceptable level during the normal and abnormal days. Therefore, no road upgrades at the intersection will be required.

6.2 Queuing analysis

The access queuing analysis was conducted to assess the proposed development layouts at the entrance gate. The analysis entailed verifying if the proposed inbound and outbound lanes would be adequate to cater for the expected development traffic. Furthermore, the required stacking space or throat length, from the development gate to the nearest intersection, was determined.

According to the proposed site development plan, the proposed development will have two inbound gates as well as two outbound gates.

In all circumstances, it is assumed that access will be provided via a push button ticket dispenser. A service rate of 220 vehicles per hour (vph) was therefore assumed and a 90th percentile queue length is deemed acceptable to assess the required stacking space, as stipulated by THM 16 Volume 2.

The access queuing analysis will inform the following:

- ▶ If the two inbound and two outbound gates are adequate for all three growth scenarios; and if so
- ▶ How much stacking space is required for the proposed access layout (assuming vehicle length plus spacing of 6 m).

6.2.1 Low growth scenario

Table 6-3 shows the queuing analysis results for the low growth scenario.

Table 6-3: Access inbound and outbound queuing analysis (low growth scenario)

Description	Normal Day		Abnormal Day	
	Inbound	Outbound	Inbound	Outbound
Peak Hour Inbound Traffic Volume	97	46	227	107
Average arrival rate (vph)	123	48	287	113
Average service flow rate (Sec/Vehicle)	16.4	16.4	16.4	16.4
Average service flow rate (Vehicle/Hour)	220	220	220	220
Traffic Intensity	0.56	0.22	1.31	0.51
Number of channels (gates)	2	2	2	2
90 th percentile queue length (<n vehicles)	1	1	5	2
Average number of vehicles in the system	0.1	0.0	7.1	0.1
Average number of vehicles per gate	0.0	0.0	0.0	0.0
Average delay	3.5	0.3	113.1	2.3

The analysis indicates that for a normal day and abnormal day, the two inbound and outbound gate layouts would be adequate. There is a probability of one vehicle queuing per gate at this access during the normal day and five vehicle queuing per gate at this access during the abnormal day, therefore a minimum ingress throat length of 30 m would be required.

6.2.2 Medium growth scenario

Table 6-4 shows the queuing analysis results for the medium growth scenario.

Table 6-4: Access Inbound and Outbound Queuing Analysis (Medium growth scenario)

Description	Normal Day		Abnormal Day	
	Inbound	Outbound	Inbound	Outbound
Peak Hour Inbound Traffic Volume	146	69	341	161
Average arrival rate (vph)	185	73	432	169
Average service flow rate (Sec/Vehicle)	16.4	16.4	16.4	16.4
Average service flow rate (Vehicle/Hour)	220	220	220	220
Traffic Intensity	0.84	0.33	1.97	0.77
Number of channels (gates)	2	2	3	2
90 th percentile queue length (<n vehicles)	2	1	4	2
Average number of vehicles in the system	0.6	0.0	14.6	0.4
Average number of vehicles per	0.0	0.0	153.9	0.0
Average delay	13.7	0.7	4.9	8.3

The analysis indicates that for a normal day, the two inbound and outbound gate layouts would be adequate to accommodate the inbound and outbound volumes in the medium growth scenario. There is a probability of one vehicle queuing per gate at this access during the normal day, therefore the minimum ingress throat length of 25m is required (as per TMH 16 minimum requirements for an access off a Class 4 road).

However, for the abnormal day, 3 inbound gates would be required and there is a probability of 4 vehicles queuing per gate requiring a 25m stacking space.

6.2.3 High growth scenario

Table 6-5 shows the queuing analysis results for the high growth scenario.

Table 6-5: Access Inbound and Outbound Queuing Analysis (High growth scenario)

Description	Normal Day		Abnormal Day	
	Inbound	Outbound	Inbound	Outbound
Peak Hour Inbound Traffic Volume	194	92	454	214
Average arrival rate (vph)	246	97	575	225
Average service flow rate (Sec/Vehicle)	16.4	16.4	16.4	16.4
Average service flow rate (Vehicle/Hour)	220	220	220	220
Traffic Intensity	1.12	0.44	2.62	1.03
Number of channels (gates)	2	2	4	2
90 th percentile queue length (<n vehicles)	3	1	4	4
Average number of vehicles in the system	2.5	0.0	28.8	1.5
Average number of vehicles per	0.0	0.0	228.2	0.0
Average delay	46.9	1.5	7.2	25.8

Like the medium growth scenario, the proposed 2 inbound and outbound gates would be adequate with a longer stacking space 18m to accommodate 3 vehicles queuing per gate. The abnormal day would require 4 inbound gates

The a frequency of normal days within a year are significantly greater than that of abnormal day. The maximum amount of hourly trips (threshold) that the two inbound and outbound gates could adequately accommodate is 269 vehicle trips per hour for the inbound and outbound directions, respectively. This translates to about 1 350 visitors per hour.

It is, however, recommended that provision should be made for abnormal day demand by, perhaps, providing an additional parking space outside of the development site.

7 Public Transport and NMT

7.1 Public transport

From the information obtained on the proposed development, it was assumed that about 55 % of the person trips will be made by public transport vehicles (as per the accommodation schedule). The proposed development will have a designated drop off area for buses and minibus taxis within the parking lot area.

Considering vehicle queues at the private vehicle entrance that are bound to spill onto the access road, it is recommended that there be two inbound lanes into the site whereby one will be for public transport vehicles and the other for light vehicles entering their designated parking area. This would provide ease of movement of the public transport vehicles to conduct drop offs and pickups.

7.2 NMT infrastructure

It is anticipated that the development will not generate a notable amount of NMT trips as the main mode of transport considering most communities are sparsely located far from the site. This, also considering that public transport facilities would be provided within the development.

To accommodate NMT trips to the site and public transport users that might alight outside of the development site and pedestrians walking from external parking, should it be provided, 2m pedestrian walkways are recommended along the frontage of the development site on R534 to promote a safe environment for NMT users. It is also recommended that separate gates for NMT users be provided at a convenient location at the development access.

In addition, traffic calming measures could be considered along R534 should they be deemed warranted for NMT safety; albeit subject of a detailed Site Traffic Assessment (STA) downstream of this TIA study.

8 Environmental Impact Assessment

The traffic impact of the proposed development on the adjacent road network focuses on determining the vehicular trips generated by the development activities during construction and operation phases, and investigating traffic engineering issues and concerns on road capacity, road safety, public transportation, and non-motorised transport within the study area.

This section measures the extent of the potential impacts in both the pre-mitigation and post-mitigation case. The impacts discussed are a result of both the environment in which the activity takes place, as well as the activity itself. The methodology utilised to assess the significance of the potential impacts is described in Appendix B.

The activities discussed in Table 8-1 will be assessed.

Table 8-1: Summary of Project Activities

Phase	Activity
Construction Phase	▶ Transportation of construction equipment
	▶ Transportation of construction workers
Operational Phase	▶ Private vehicle transportation for both the employees and visitors
	▶ Public transportation (buses and minibus taxis) for both the employees and visitors
	▶ Non-motorised transport for both the employees and visitors
	▶ Delivery and refuse vehicles

8.1 Impacts of Activity

The activities, during the construction and operation phases, that may have potential impacts on road capacity, road safety, road conditions, public transport services and facilities and NMT facilities are illustrated in Table 8-2.

Table 8-2: Impacts of Activity

Phase	Impact
Construction	<p>Transportation of construction equipment and employees will have the following impacts:</p> <ul style="list-style-type: none"> ▶ Increase traffic volumes resulting in a reduction in road capacity ▶ Increase road safety risk ▶ Deterioration of road conditions ▶ Increase public transport and NMT activity ▶ Disturbance for community of Graskop
Operation	<p>Transportation of visitors and employee's activity will have the following impacts:</p> <ul style="list-style-type: none"> ▶ Increase traffic volumes resulting in a reduction in road capacity ▶ Increase public transport and NMT demand ▶ Increase road safety risk

8.2 Traffic impact rating table

8.2.1 Construction phase

to Table 8-6 indicate the ratings associated with the impact of increased traffic during the construction phase and determines its overall “significance”.

Table 8-3: Environmental impact rating (construction) – road capacity

Ref:	1			
Project phase	Construction			
Impact	Increase traffic volumes resulting in a reduction in road capacity			
Description of impact	During the construction phase, several heavy vehicles will be used to transport the construction equipment and material, and construction workers are expected to access the site by private cars and public transport vehicles. The additional vehicles on the road network are expected to increase traffic volumes on the road and reduce the existing road capacity.			
Mitigatability	Medium	Mitigation exists and will notably reduce significance of impacts		
Potential mitigation	The capacity analysis showed that the road network is operating well below capacity on normal days and the impact of the additional traffic is expected to be negligible. It is anticipated that construction will not take place on abnormal days (long weekend and December holidays). Therefore, no mitigation measures are required.			
Assessment	Without mitigation		With mitigation	
Nature	Negative		Negative	
Duration	Short term	impact will last between 1 and 5 years	Short term	impact will last between 1 and 5 years
Extent	Local	Extending across the site and to nearby settlements	Local	Extending across the site and to nearby settlements
Intensity	Negligible	Natural and/ or social functions and/ or processes are negligibly altered	Negligible	Natural and/ or social functions and/ or processes are negligibly altered
Probability	Unlikely	Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur	Unlikely	Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur
Confidence	Medium	Determination is based on common sense and general knowledge	Medium	Determination is based on common sense and general knowledge
Reversibility	High	The affected environmental will be able to recover from the impact	High	The affected environmental will be able to recover from the impact
Resource irreplaceability	Low	The resource is not damaged irreparably or is not scarce	Low	The resource is not damaged irreparably or is not scarce
Significance	Negligible - negative		Negligible - negative	

Table 8-4: Environmental impact rating (construction) – Road safety risk

Ref:	2			
Project phase	Construction			
Impact	Increased road safety risk			
Description of impact	The speed variation between the heavy vehicles and the light vehicles may lead to aggressive behaviour from light vehicles which could result in an accident			
Mitigatability	Medium	Mitigation exists and will notably reduce significance of impacts		
Potential mitigation	<ul style="list-style-type: none"> ▶ Ensure heavy vehicles and abnormal load vehicles comply with limitations on vehicle dimensions and axle, vehicle masses and safety standards set out in the Road Traffic Act, 1996 (Act No 93 of 1996) and the National Road Traffic Regulations, 2000 for vehicle using a public road. ▶ Discourage routing of heavy vehicle traffic through populated area. ▶ Avoid transporting abnormal load during peak periods. ▶ Heavy vehicle drivers should attend a specialised road safety and driving course that sensitises them to the impact that they have on driving conditions for other road users. 			
Assessment	Without mitigation		With mitigation	
Nature	Negative		Negative	
Duration	Short term	impact will last between 1 and 5 years	Short term	impact will last between 1 and 5 years
Extent	Regional	Impacts felt at a regional / provincial level	Regional	Impacts felt at a regional / provincial level
Intensity	High	Natural and/ or social functions and/ or processes are notably altered	Moderate	Natural and/ or social functions and/ or processes are moderately altered
Probability	Probable	The impact has occurred here or elsewhere and could therefore occur	Rare / improbable	Conceivable, but only in extreme circumstances, and/or might occur for this project although this has rarely been known to result elsewhere
Confidence	Medium	Determination is based on common sense and general knowledge	Medium	Determination is based on common sense and general knowledge
Reversibility	High	The affected environmental will be able to recover from the impact	High	The affected environmental will be able to recover from the impact
Resource irreplaceability	Low	The resource is not damaged irreparably or is not scarce	Low	The resource is not damaged irreparably or is not scarce
Significance	Minor - negative		Negligible - negative	

Table 8-5: Environmental impact rating (construction) – road condition

Ref:	3			
Project phase	Construction			
Impact	Deterioration of road conditions			
Description of impact	The presence of heavy construction vehicles on road network is likely to accelerate the deterioration of these roads			
Mitigatability	Medium	Mitigation exists and will notably reduce significance of impacts		
Potential mitigation	<ul style="list-style-type: none"> ▶ Ensure heavy vehicles and abnormal load vehicles comply with limitations on vehicle dimensions and axle, vehicle masses and safety standards set out in the Road Traffic Act, 1996 (Act No 93 of 1996) and the National Road Traffic Regulations, 2000 for vehicle using a public road. 			
Assessment	Without mitigation		With mitigation	
Nature	Negative		Negative	
Duration	Short term	impact will last between 1 and 5 years	Short term	impact will last between 1 and 5 years
Extent	Local	Extending across the site and to nearby settlements	Local	Extending across the site and to nearby settlements
Intensity	High	Natural and/ or social functions and/ or processes are notably altered	Moderate	Natural and/ or social functions and/ or processes are moderately altered
Probability	Probable	The impact has occurred here or elsewhere and could therefore occur	Unlikely	Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur
Confidence	Medium	Determination is based on common sense and general knowledge	Medium	Determination is based on common sense and general knowledge
Reversibility	High	The affected environmental will be able to recover from the impact	High	The affected environmental will be able to recover from the impact
Resource irreplaceability	Low	The resource is not damaged irreparably or is not scarce	Low	The resource is not damaged irreparably or is not scarce
Significance	Minor - negative		Negligible - negative	

Table 8-6: Environmental impact rating (construction) – public transport and NMT demand

Ref:	4			
Project phase	Construction			
Impact	Increase public transport and NMT activity			
Description of impact	The construction phase is expected to generate a significant number of public transport and NMT users which will require additional public transport services and result in increased pedestrian activity in the vicinity of the site.			
Mitigatability	Medium	Mitigation exists and will notably reduce significance of impacts		
Potential mitigation	<ul style="list-style-type: none"> ▶ A construction traffic management plan will be required to give guidance on provision of temporary public transport and NMT infrastructure requirements during construction. ▶ Regular pedestrian and cycling activity awareness for staff working on site during all construction, as part of regular Health and Safety briefings. 			
Assessment	Without mitigation		With mitigation	
Nature	Negative		Positive	
Duration	Short term	impact will last between 1 and 5 years	Short term	impact will last between 1 and 5 years
Extent	Very limited	Limited to specific isolated parts of the site	Very limited	Limited to specific isolated parts of the site
Intensity	Very low	Natural and/ or social functions and/ or processes are slightly altered	Negligible	Natural and/ or social functions and/ or processes are negligibly altered
Probability	Unlikely	Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur	Rare / improbable	Conceivable, but only in extreme circumstances, and/or might occur for this project although this has rarely been known to result elsewhere
Confidence	Medium	Determination is based on common sense and general knowledge	Medium	Determination is based on common sense and general knowledge
Reversibility	High	The affected environmental will be able to recover from the impact	High	The affected environmental will be able to recover from the impact
Resource irreplaceability	Low	The resource is not damaged irreparably or is not scarce	Low	The resource is not damaged irreparably or is not scarce
Significance	Negligible - negative		Negligible - positive	

Table 8-7: Environmental impact rating (construction) – town/ residential area

Ref:	5			
Project phase	Construction			
Impact	Disturbance for community of Graskop			
Description of impact	There is a possibility of there being noise pollution, air pollution and vibrations experienced by the Graskop residents while they are at home			
Mitigatability	Medium	Mitigation exists and will notably reduce significance of impacts		
Potential mitigation	Ensure that heavy vehicles do not travel in the early and late hours of the day			
Assessment	Without mitigation		With mitigation	
Nature	Negative		Negative	
Duration	Short term	impact will last between 1 and 5 years	Short term	impact will last between 1 and 5 years
Extent	Very limited	Limited to specific isolated parts of the site	Very limited	Limited to specific isolated parts of the site
Intensity	Very low	Natural and/ or social functions and/ or processes are slightly altered	Negligible	Natural and/ or social functions and/ or processes are negligibly altered
Probability	Unlikely	Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur	Rare / improbable	Conceivable, but only in extreme circumstances, and/or might occur for this project although this has rarely been known to result elsewhere
Confidence	Medium	Determination is based on common sense and general knowledge	Medium	Determination is based on common sense and general knowledge
Reversibility	High	The affected environmental will be able to recover from the impact	High	The affected environmental will be able to recover from the impact
Resource irreplaceability	Low	The resource is not damaged irreparably or is not scarce	Low	The resource is not damaged irreparably or is not scarce
Significance	Negligible - negative		Negligible - negative	

8.2.2 Operation phase

Table 8-9 to **Error! Reference source not found.** indicate the ratings associated with the impact of increased traffic during operation and determine its overall “significance”.

Table 8-8: Environmental impact rating (operation) – queue spillage

Ref:		1			
Project phase	Operation				
Impact	Increase traffic volumes resulting in a reduction in road capacity				
Description of impact	The additional traffic generated by the development is expected to have a negligible impact of the road network on normal days. However, the intersection of Main Street and R532 and Richardson Avenue in Graskop is currently operating over capacity during abnormal days and will worsen during the operational phase.				
Mitigatability	Medium	Mitigation exists and will notably reduce significance of impacts			
Potential mitigation	Make use of pointsman at the intersection in Graskop during abnormal days				
Assessment	Without mitigation			With mitigation	
Nature	Negative			Positive	
Duration	Permanent	Impact may be permanent, or in excess of 20 years		Permanent	Impact may be permanent, or in excess of 20 years
Extent	Very limited	Limited to specific isolated parts of the site		Very limited	Limited to specific isolated parts of the site
Intensity	Low	Natural and/ or social functions and/ or processes are somewhat altered		Low	Natural and/ or social functions and/ or processes are somewhat altered
Probability	Probable	The impact has occurred here or elsewhere and could therefore occur		Unlikely	Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur
Confidence	Medium	Determination is based on common sense and general knowledge		Medium	Determination is based on common sense and general knowledge
Reversibility	High	The affected environmental will be able to recover from the impact		High	The affected environmental will be able to recover from the impact
Resource irreplaceability	Low	The resource is not damaged irreparably or is not scarce		Low	The resource is not damaged irreparably or is not scarce
Significance	Minor - negative			Negligible - positive	

Table 8-9: Environmental impact rating (operation) – Road safety risk

Ref:	2			
Project phase	Operation			
Impact	Increased road safety risk			
Description of impact	<ul style="list-style-type: none"> Vehicles travelling along the R534 in the vicinity of the development site were observed to be speeding which may result in accidents at the development access. 			
Mitigatability	Medium	Mitigation exists and will notably reduce significance of impacts		
Potential mitigation	<ul style="list-style-type: none"> Introduce traffic calming measures along R534 in the vicinity of the site access 			
Assessment	Without mitigation		With mitigation	
Nature	Negative		Negative	
Duration	Long term	Impact will last between 10 and 15 years	Long term	Impact will last between 10 and 15 years
Extent	Local	Extending across the site and to nearby settlements	Local	Extending across the site and to nearby settlements
Intensity	Moderate	Natural and/ or social functions and/ or processes are moderately altered	Low	Natural and/ or social functions and/ or processes are somewhat altered
Probability	Probable	The impact has occurred here or elsewhere and could therefore occur	Unlikely	Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur
Confidence	Medium	Determination is based on common sense and general knowledge	Medium	Determination is based on common sense and general knowledge
Reversibility	High	The affected environmental will be able to recover from the impact	High	The affected environmental will be able to recover from the impact
Resource irreplaceability	Low	The resource is not damaged irreparably or is not scarce	Low	The resource is not damaged irreparably or is not scarce
Significance	Minor - negative		Negligible - negative	

Table 8-10: Environmental impact rating (construction) – public transport and NMT demand

Ref:	3			
Project phase	Operation			
Impact	Increase public transport and NMT demand			
Description of impact	The operation phase is expected to generate a notable number of public transport vehicle trips which will be accommodate by the proposed public transport facilities on site. It is expected that the development will generate few NMT trips			
Mitigatability	Medium	Mitigation exists and will notably reduce significance of impacts		
Potential mitigation	► Sidewalk is recommended along the development site frontage. .			
Assessment	Without mitigation		With mitigation	
Nature	Negative		Negative	
Duration	Short term	impact will last between 1 and 5 years	Short term	impact will last between 1 and 5 years
Extent	Very limited	Limited to specific isolated parts of the site	Very limited	Limited to specific isolated parts of the site
Intensity	Very low	Natural and/ or social functions and/ or processes are slightly altered	Negligible	Natural and/ or social functions and/ or processes are negligibly altered
Probability	Unlikely	Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur	Rare / improbable	Conceivable, but only in extreme circumstances, and/or might occur for this project although this has rarely been known to result elsewhere
Confidence	Medium	Determination is based on common sense and general knowledge	Medium	Determination is based on common sense and general knowledge
Reversibility	High	The affected environmental will be able to recover from the impact	High	The affected environmental will be able to recover from the impact
Resource irreplaceability	Low	The resource is not damaged irreparably or is not scarce	Low	The resource is not damaged irreparably or is not scarce
Significance	Negligible - negative		Negligible - negative	

9 Summary and Recommendations

The objective of this Traffic Impact Assessment was to evaluate the impact of the redevelopment of a new visitor's attraction at God's Window, on the operation of the local road network.

The proposed redevelopment will include a 12m long Skywalk suspended off the edge of the cliff along with other activities (e.g., rock climbing, skyswing) and will be supported by other facilities including restaurants, market stalls, conference auditoriums, retreat accommodation and administration offices.

The following points summarise the findings and recommendations of the study:

- ▶ The future proposed development is expected to attract 1 089 visitors and 161 employees per day. On this basis, the proposed development is expected to generate about 60 vehicle trips during peak hour of a normal day that does not fall in December or over a long weekend which is considered to be abnormal days.
- ▶ The existing development generates an average of 78 vehicle trips per hour on a normal day, based on a traffic count that was done on a Friday and a Saturday in June 2022. June falls on the shoulder season between peak and off peak months at the development. It is therefore considered to represent the average demand at the existing development for a year.
- ▶ Since the proposed development peak hour volumes were found to be less than the existing average demand, a sensitivity analysis was conducted to test a wide range of scenarios pertaining to the traffic volumes generated by the proposed development. The scenarios included the following:
 - Low growth scenario – No additional trips are generated at the proposed development.
 - Medium growth scenario- The proposed development will attract a magnitude of additional trips that is equivalent to 50 % of the current trips at the site.
 - High growth scenario- The proposed development will attract a magnitude of additional trips that is equivalent to 100 % of the current trips at the site.
- ▶ For normal days, the capacity analysis indicated that all intersections in the study area are currently operating at acceptable level of service and will continue to operate acceptably in the future for all proposed development growth scenarios tested.
- ▶ For abnormal days, except for the intersection of Main Street and R532 and Richardson Avenue in Gaskop, all intersections in the study area are operating at an acceptable level of service and are expected to continue to operate at a similar level of service in the future for all growth scenarios tested.
- ▶ The intersection of Main Street and R532 and Richardson Avenue is currently operating at an unacceptable level of service during abnormal days and will worsen in the future if not signalised. It is the local municipality's responsibility to upgrade roads to accommodate existing traffic demand and traffic background growth. However, it should be noted that the frequency of abnormal days are far less than normal days and the signalization of the intersection may be deemed not necessary. As such, it is recommended that arrangements be made with the local municipality that pointsmen direct traffic at this intersection during abnormal days.
- ▶ The existing access off the R534 will be used and will require no additional road upgrades the existing capacity is expected to accommodate all future growth scenarios tested.
- ▶ As per the proposed entrance layout, the development will have two inbound lanes and two outbound lanes at the access. The queuing analysis results at the access indicated two inbound lanes and two outbound lanes would be adequate for normal days for all growth scenarios tested. The medium and high growth scenarios for abnormal days would require 3 and 4 inbound lanes respectively. Hence, it is recommended that provision should be made for additional off-site parking to accommodate visitor demand on abnormal days.
- ▶ For the ease of movement of the public transport vehicles to conduct drop offs and pick ups, it is recommended that there be two inbound lanes into the site, from the intersection of the development access with R534, whereby one will be for public transport vehicles and the other for light vehicles entering their designated parking areas.

- ▶ To promote a safe environment for NMT users, a 2m wide sidewalk is recommended along the development frontage on R534. It is also recommended that separate gates for NMT users be provided at a convenient location, at the development access.
- ▶ An assessment was made of the environmental significance of traffic impacts. Although the overall impacts were determined as minor or having negligible impact, the following mitigation measures aimed at minimising any traffic impact caused by the project are recommended to be implemented by the developer:
 - Ensure heavy vehicles and abnormal load vehicles comply with limitations on vehicle dimensions and axle and vehicle masses and safety standards set out in the Road Traffic Act, 1996 (Act No 93 of 1996) and the National Road Traffic Regulations, 2000 for vehicle using a public road.
 - Discourage routing of construction heavy vehicle traffic through populated area.
 - Avoid transporting abnormal load during peak periods.
 - Drivers of all heavy vehicles be required to attend a specialised road safety and driving course that sensitises them to the impact that they have on driving conditions for other road users.
 - Provide regular pedestrian and cycling activity awareness for staff working on site during all construction, as part of regular Health and Safety briefings.

Provided that the above comments and recommendations are adhered to, the proposed application can be supported from a traffic engineering perspective.

References

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Highway Capacity Manual (HCM2010)

National Road Traffic Regulations, 2000

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Technical Methods for Highways (TMH) 16 South African Traffic Impact and Site Traffic Assessment Manual Volume 1 and 2 (2014) (TMH 16)

TMH 17 South African Trip Data Manual (2013) (TMH 17)

Ehlanzeni District Municipality Spatial Development Framework (2010/2011)

Appendix A: Traffic flow figures

In diversity there is beauty
and there is strength.

MAYA ANGELOU

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