

Mogale Ext. 54-59

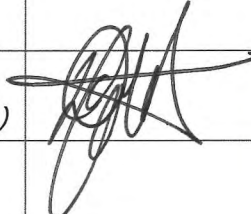
(Proposed New Residential Development)

TRAFFIC IMPACT ASSESSMENT

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1. Introduction & Background

Dhubecon Consulting Engineers (Pty) Ltd have been appointed to undertake this Traffic Impact Assessment (TIA) as part of the township application for the proposed new residential townships known as Mogale Ext. 54-59, which is to be situated on Part of the Remainder of Portion 23, a Part of Portion 162 and Part of the Remainder of Portion 196 of the Farm Nooitgedacht 534-JQ, approximately 4.8km south of the Lanseria International Airport. The site location is shown in attached Figure 1 and Figure 2 and falls under the jurisdiction of the Mogale City municipality. It is, however, to note that the boundary between Mogale City and the City of Johannesburg (CoJ) is situated in the vicinity of the site and that the subject site falls under the jurisdiction of Mogale City while most of the existing **analysed key intersections instead falls under the CoJ's and Gautrans' jurisdiction**. As a result, this report will be submitted to Mogale City as well as the City of Johannesburg and Gautrans for comments and/or approvals on this TIA. The municipal boundary separating Mogale City and the CoJ is also indicated in Figure 2 for ease of reference.

The subject site, as a whole, is approximately 39.9ha in extent and comprises of six (6) proposed townships. **With reference to the town planner's** combined Township Layout Plan in Annexure A, the proposed townships will be residential developments **that would comprise out of 'Residential 3' and 'Residential 4' units**. Mogale Extensions 54-56 are **earmarked for 'Residential 3' units** with a development density of 40 units/ha while Extensions 57-59 are earmarked for high density **'Residential 4' units with a development density of 130 units/ ha**. Based on the area of each township, the combined permissible extent of the site jointly calculates to 2,106 units (927 **'Residential 3' units** and 1,179 **'Residential 4' units**). The proposed townships will primarily cater for the lower-income households, similar to most new developments in the area.

This study investigates the impact of the additional traffic to be generated by the proposed development on the immediate surrounding road network and determines whether it is necessary to implement any road and/or intersection improvements to mitigate the anticipated traffic impact. New traffic counts had been undertaken at identified key intersections in the study area in order to quantify and assess the traffic flow operations. The study also investigates the proposed site layout, the site access arrangements and provides comments with respect to non-motorised and public transport.

2. Site Location & Surrounding Road Network

2.1 SITE LOCATION

As shown in attached Figures 1 and 2, the subject site is situated on the south-western corner of the interchange between Malibongwe Drive (R512) and the N14-freeway. The following existing and future roads are relevant to the study area:

2.2 EXISTING ROAD NETWORK

Malibongwe Drive (R512 / P103-1 / K29) is a Class 2 provincial road, which borders the subject site to the east. It is an important north-south major arterial in the study area and connects the subject site with the N14-freeway, just to the north. The existing site access intersection is provided off Malibongwe Drive, which will be focussed on in more detail in *Section 3.2* of this report. Further north of the subject site, this road travels to Lanseria, while further south of the subject site, this road travels through areas such as Kya Sand and North Riding. The road primarily comprises of a 4-lane dual carriageway road (i.e., 2 lanes per direction), with additional left- and right-turn lanes at its intersections. Most of **this road's** main intersections are also signalised, but at the N14 ramp terminals and the intersection with the R114, the signals have been stolen/ vandalised in recent years. These intersections currently operate as all-way stop controlled intersections, however, it has been assumed that the authorities would reinstate these signals in the future. This road carries very high traffic volumes during the peak hours; according to the recent surveys the traffic volumes on Malibongwe Drive, past the subject site, are in the order of 2,800vph and 2,600vph (total in both directions) during the weekday AM and PM peaks, respectively.

N14 Freeway (P158-2): This provincial freeway (Class 1 road) is located directly north of the subject site. It is considered of importance to the subject site since it would provide regional accessibility to the subject site via the nearby diamond interchange with Malibongwe Drive. To note is that both the interchange bridge and ramp terminals were signalised intersections until a few years ago; after continued vandalism and theft, it would appear as if the authorities had decided to not reinstate the signals for now. As can be expected, large volumes of traffic use the two N14 terminals during the peak hours. In the vicinity of its interchange with Malibongwe Drive, the current traffic volumes on the N14 northern terminal are in the order of 1,600vph and 1,200vph during the weekday AM and PM peak hours, respectively. Similarly, on the N14 southern terminal, these volumes are currently about 1,300vph and 1,400vph, respectively.

Road R114 (P39-1 / Future K52) is a Class 2 provincial road, which intersects Malibongwe Drive about 750m south of the existing site access intersection. It is the nearest intersection to the south of the subject site. This road is an important east-west major arterial, travelling parallel to the N14-freeway, and therefore serving as an alternative route to this freeway in the study area. Further south-west of the subject site, this road travels to Muldersdrift, while further north-east of the subject site, this road travels to Diepsloot. The R114 is currently only a 2-lane (undivided) single carriageway road along the majority of its length, but widens to 2 lanes per direction at its intersection with Malibongwe Drive. The existing peak hour traffic volumes on this road, in the vicinity of this intersection, are in the order of 2,000vph and 1,800vph (total both directions) during the weekday AM and PM peak hours, respectively.

2.3 PLANNED FUTURE ROAD NETWORK

2.3.1 Provincial Road Network

An extract of Gautrans' Strategic Major Road Network (2007) is shown in Figure 3, which indicates various planned future major routes in the vicinity of the subject site. The K29 follows the existing alignment of Malibongwe Drive, not only past the subject site, but also further to the north and south. The majority of this road has already been upgraded to dual carriageways with two lanes per direction and separate turning lanes at its intersections. Therefore, the most relevant future provincial road is the Future K52, which will be an upgrade of the existing R114 road south of the subject site. This future K-route will also terminate via the existing intersection between the R114 and Beyers Naude Drive (M5), further to the west of the subject site, while further to the east this future K-route will travel all the way through Diepsloot. It must be noted that there are preliminary designs/ basic planning for this planned K-route in the vicinity of its intersection with Malibongwe Drive (K29), but which have not been accepted by the MEC of the Gauteng Department of Roads and Transport (GPDRT) as yet.

At this stage it is not known when the future K52 will be constructed or upgraded to full K-route standards. However, the full doubling of this road and upgrade to full K-route standards will only occur in the long term, as more developments unfold along the R114. It is confirmed that the subject site is not directly affected by the road reserve and splays of this future K-route.

Where relevant and necessary, the proposed Township Layout Plan attached in Annexure A has taken full account of the road reserves and splays of the adjacent K29 and N14-freeway (P158-2).

2.3.2 Local Road Network

In terms of the future local road network, it can be noted that at the time this study was undertaken, there was no approved local road masterplan available for the study area. Therefore, as part of this particular development, three (3) new public municipal roads, which is to fall under the jurisdiction of Mogale City, have been proposed to improve the overall accessibility of each township while also taking into consideration the accessibility of the neighbouring vacant properties. These roads have also been incorporated into the combined Township Layouts for the development in Annexure A and as a result its proposed road reserves and splays have already been accounted for. For the purposes of this study, **these roads have been referred to as 'Road A', 'Road B' and 'Road C', as per Figure 2 and also Drawing No. 0583/CL/O1, respectively.**

Briefly, the following information is relevant for each proposed public road:

- # **'Road A':** is a proposed south-east to north-west road which will intersect with Malibongwe Drive (R512 / P103-1 / K29) at the eastern boundary of the site. The position of **this intersection coincides with Gautrans' approved intersections along the K29** and it is confirmed that this intersection has already been constructed. However, in the case of the **western approach of this intersection (i.e., 'Road A') an approximate 60m of paved road** has been constructed after which the road continues as an unpaved gravel road. Traveling further in a north-westbound on this gravel road, the road eventually crosses underneath the N14 freeway as well. The implementation of **'Road A'** will be necessary to provide access to the townships as a whole.

With reference to Annexure A, it is proposed to formalize the existing gravel road by assigning a 32m road reserve **for 'Road A' up to its planned intersection with 'Road C'**. After this intersection, the road reserve is intended to be reduced to 25m. **Appropriate splays have also been provided at its planned intersections with 'Road B' and 'Road C', respectively. 'Road A' can therefore be viewed as a Class 3 distributor road up to its intersection with 'Road C' after which it is then classified as a Class 4a collector road instead.**

As part of the subject development, the developer intends to construct the planned section of **'Road A' that traverses the site, which essentially is the portion of 'Road A' that travels between Malibongwe Drive (R512 / P103-1) and 'Road B'**. A shared access for the proposed Mogale Ext. 54 & 55 townships will also be provided from **'Road A', as the south-western approach of its intersection with 'Road C' (see also Section 3.3).**

- ▣ **'Road B':** is a proposed south-west to north-east road which will form a T-intersection with **'Road A' at the north-eastern corner** of the Mogale Ext. 59 township. A 25m road reserve has been proposed for this road. For the purposes of this study, this future road can be classified as a Class 4b collector road. Direct access to the Mogale Ext. 56 & 59 townships will be provided from this road and it is the **developer's intention to construct the portion of this road that traverses the subject property up to the direct accesses to Mogale Ext. 56 & 59.**
- ▣ **'Road C':** is a proposed south-west to north-east road with a proposed 20m road reserve. This road is classified as a Class 5b local street which will form the north-eastern approach of **its intersection with 'Road A'. As per the site's combined township layout plan in Annexure A, a turning facility is proposed at the end of 'Road C' from which separate accesses to the Mogale Ext. 57 & 58 townships will be provided.**

It is confirmed that specialist input has been provided with regards to the location, the proposed road reserves and splays of these planned roads. Thus, from a traffic engineering perspective these planned local roads are therefore supported in this TIA.

3. Proposed Development & Site Access

3.1 PROPOSED DEVELOPMENT

The subject site for the proposed townships is to be situated on Part of the Remainder of Portion 23, a Part of Portion 162 and Part of the Remainder of Portion 196 of the Farm Nooitgedacht 534-JQ and which extends a total area of approximately 39.9ha. The site location is shown in attached Figure 1 and Figure 2 and falls under the jurisdiction of Mogale City.

With reference to the town planner's combined Township Layout Plan in Annexure A, the proposed development will comprise of six (6) residential townships which will be known as Mogale Ext. 54-59. The proposed townships will be residential developments that would comprise out of 'Residential 3' and 'Residential 4' units. Mogale Extensions 54-56 are earmarked for 'Residential 3' units with a development density of 40 units/ha while Extensions 57-59 are earmarked for high density 'Residential 4' units with a development density of 130 units/ ha. Based on the area of each township, the combined permissible extent of the site jointly calculates to 2,106 units (927 'Residential 3' units and 1,179 'Residential 4' units). Considering the proposed development densities and its location, the subject development will primarily cater for the lower-income households, similar to most new developments in the area.

The proposed townships, developable area and permissible extent are summarised in Table 1 below. The intention of the multiple (6) townships is to facilitate the phasing of the development.

Table 1: Permissible Development Extents – Mogale Ext. 54-59

Proposed Township	Developable Area	Land Use	
		Residential ('Res 3' @ 40 units/ha)	Residential ('Res 4' @ 130 units/ ha)
Mogale Ext. 54	6.7768 ha	271 units	-
Mogale Ext. 55	6.6569 ha	266 units	-
Mogale Ext. 56	9.7840 ha	390 units	-
Mogale Ext. 57	3.9301 ha	-	510 units
Mogale Ext. 58	2.4176 ha	-	314 units
Mogale Ext. 59	2.7314 ha	-	355 units
TOTAL	32.2968 ha	927 'Res 3' Units	1,179 'Res 4' units

Parking for each township will be provided as per the requirements of the relevant Town Planning Scheme, or as separately motivated otherwise.

3.2 PROPOSED SITE ACCESS INTERSECTIONS

In light of the adjacent provincial Class 2 road, namely Malibongwe Drive (R512 / P103-1 / K29), no direct access to individual properties will be allowed off this higher order road. As a result, in order to provide access to the proposed townships (entire site) as a whole, one access intersection is proposed to tie in with the existing road network, which will be provided off Malibongwe Road (R512 / P103-1 / K29) by the formalization of 'Road A'.

As mentioned in Section 2.3.2, the intersection of 'Road A' and Malibongwe Drive (R512 / P103-1) is already present and the location of this intersection coincides with Gautrans approved intersections on

the K29 road. However, the western approach of this intersection, which is particularly relevant for this development, has only been constructed as a paved asphalt road up to a certain point (approximately a 60m section of road is present) after which the road continues as an unpaved gravel road. Therefore, to provide adequate accessibility to the townships, **'Road A' will be extended further as shown conceptually in Drawing No. 0583/CL/01 and also discussed in Section 2.3.2.**

With regards to the intersection between 'Road A' and Malibongwe Drive (R512/ P103-1) the following upgrades will be required to accommodate the estimated development traffic:

- Southern Approach: The implementation of a short dedicated left turning slip-way (Gautrans Standard);
- Eastern Approach: Road widening at the southern side of the road to implement a short shared through and left turning lane with a right turning lane; and
- Western Approach: Road widening of the existing road to accommodate a short dedicated left turning slip-way, a shared through and right turning lane as well as a dedicated right turning lane. The through traffic at this approach would be minimal as this road only leads to another property and would not attract any significant traffic from the subject site. Therefore, the proposed through and right turning lane is supported based on this expected low through volume.
- It is further recommended that this intersection should be signalized by the developer. However, signals should only be installed at a time **when the development's traffic had realized to such an extent that the warrants for traffic signals as per the *Southern African Roads Traffic Signs Manual (SARTSM)* are met.** Until these signal warrants are not met, it is recommended that this intersection should be converted into an all-way stop controlled intersection in the interim.

With regards to the proposed intersection between 'Road A' and 'Road C', it is recommended that a double circulating traffic circle with double lane approaches **on 'Road A' and an approximate outside diameter of 43m** be implemented. From this traffic circle, at the western approach of the intersection, a shared security-controlled access to the Mogale Ext. 54-55 townships will also be provided (see Section 3.3 below).

At the proposed turning facility which the proposed township layout has made provision for on **'Road C'**, it is proposed to construct a smaller traffic circle with single lane approaches and an approximate outside diameter of 20m. From this traffic circle, separate security-controlled accesses will be provided for the Mogale Ext. 57 & 58 townships, respectively.

At the proposed **T-intersection between 'Road A' and 'Road B'**, it is recommended to implemented a priority stop controlled T-intersection with **free-flow conditions prevailing along 'Road A'**.

The above-mentioned upgrades, proposed new public roads and intersections, which will have to be implemented as part of the development is shown conceptually in a key plan of the site as per Drawing No. 0583/CL/01.

3.3 LOCAL TOWNSHIP ACCESS ARRANGEMENTS

Important to note is that all the proposed residential townships (i.e., Extensions 54-59) will have security-controlled accesses and therefore adequate stacking distance should be provided to ensure that inbound vehicles queuing at the security gates do not impact on other traffic along the adjacent roads. The latest and most relevant guideline, namely the *THM 16 (Vol 2): South African Traffic Impact and Site Traffic Assessment Standards and Requirement Manual (Committee Draft 2.0, October 2019)* was used to determine the required stacking distance requirements for each of the residential township accesses, which is summarised in Table 2 below.

With reference to Annexure A, a total of six (6) residential townships are proposed. However, the developer intends to notarially tie Ext. 54 & 55 in order to provide a single security-controlled access for these two townships. Thus, the development would have five (5) security-controlled accesses in total. For ease of reference, the accesses in this study are numbered, and also indicated on Figure 2, in the following order:

- ✦ Access 1: The access which serves the Mogale Ext. 54-55 townships;
- ✦ Access 2: The access which serves the Mogale Ext. 57 township;
- ✦ Access 3: The access which serves the Mogale Ext. 58 township;
- ✦ Access 4: The access which serves the Mogale Ext. 56 township; and
- ✦ Access 5: The access which serves the Mogale Ext. 59 township.

With regards to the access configuration, it is proposed that each access have two inbound lanes and two outbound lanes as the access control as conceptually indicated in Drawing No. 0583/CL/O1.

Also note that the following assumptions were made, which are relevant to each access:

- ✦ The estimated PM peak inbound traffic is viewed as the governing ('worst case') traffic that determines the required stacking distance at the access (the PM inbound volume for each access was based on the volumes as per Table 4 in Section 4.3.2 and by using the recommended TMH17 split of 70:30 (IN:OUT) for the PM peak hour);
- ✦ A service flow rate of 450vph was assumed for 'Swipe magnetic card'; it is expected that this system will be used and/or something very similar, such as a biometric system;
- ✦ Peak hour factor (PHF) = 0.85;
- ✦ The traffic ratio percentages calculated are for the 90th percentile queue; and
- ✦ The recommended stacking distances are all measured from the road reserve to the security/boom gate.

Table 2: Minimum Required Stacking Distances at Residential Township Accesses

Access Number	PM Peak Inbound Traffic (vph)	Minimum Theoretical Required Stacking (m)	Minimum Recommended Stacking (m)
Access 1	177	6.5	25
Access 2	146	6.5	10
Access 3	90	6.5	10
Access 4	128	6.5	15
Access 5	102	6.5	15

From the above table it can be seen that each access only needs a theoretical stacking distance of 6.5m, which is taken as the length of a typical light vehicle, i.e., both inbound lanes must be able to accommodate at least one vehicle. It is recommended, however, that the stacking be implemented as per the last column of Table 2. These recommended stacking distances are based on the requirements in Table 30 of the *TMH 16 (Vol 2)*, which is governed by the class of road from which the access is provided; in this case minimum 25m for accesses off Class 4a roads, 15m for accesses off Class 4b roads and 10m for accesses of Class 5b roads.

In order to accommodate emergency and service vehicles, it is also necessary to ensure that at least one traffic lane (inbound or outbound) of each access has a width of at least 3.5m wide with a total free-space of 4.5m and a height clearance of 5.2m, or as per the requirements of the local authority.

It is further to note, that the position of Access 4 & Access 5 is not final at this stage and may **change in the future to meet the developer's requirements. However, the final position of these accesses should be spaced a distance of at least 100m away from the priority stop controlled T-intersection between 'Road A' and 'Road B'. This recommended** spacing is also in accordance with the spacing requirements of Table 8 from the *TMH 16 (Vol 2)*.

More details of the access arrangements will be provided as part of the submission of the final **Site Development Plans (SDP's)** for each township.

4. Traffic Flows & Development Trip Generation

4.1 EXISTING TRAFFIC FLOWS & OPERATION

Given the type and extent of the proposed development, new detailed traffic surveys were carried out to quantify the existing traffic operations. These surveys comprised manual traffic counts which were carried out on the 7th of June 2022 at the following key intersections:

1. Malibongwe Drive (R512 / P103-1) & 'Road A';
2. Malibongwe Drive (R512 / P103-1) & N14 (P158-2) Northern Ramp Terminal;
3. Malibongwe Drive (R512 / P103-1) & N14 (P158-2) Southern Ramp Terminal; and
4. Malibongwe Drive (R512 / P103-1) & R114 (P39-1).

Note that classified traffic counts were conducted at **Malibongwe Drive's** intersection with Road R114, in order to quantify the public transport activity in the vicinity of the site. It was found that the weekday morning (AM) peak hour traffic occurred at 06:45 – 07:45, while the afternoon (PM) peak hour traffic occurred at 16:30 – 17:30. The existing 2022 weekday AM and PM peak hour traffic volumes at the abovementioned key intersections are summarised in Figure 5.

4.2 FUTURE BACKGROUND TRAFFIC FLOWS

Apart from the existing 2022 traffic flows, a future base traffic flow scenario had been considered for the report, namely future 2027. The future 2027 background traffic presented in this document comprises traffic growth over 5 years at the rate discussed on the following page.

4.2.1 Traffic growth

The *THM16, Volume 1, South African Traffic Impact and Site Traffic Assessment Manual (Committee Draft, October 2019)* suggests that for developments which generate more than 50 peak hour trips, it is necessary to undertake a full traffic impact assessment which must also include traffic growth and/or the potential traffic generations of other nearby approved developments that still need to realise.

In order to make provision for other developments in the area and increases in traffic along the main routes, traffic growth is added. In this case the traffic growth makes provision for those other developments not accounted for in Section 4.2.2 below.

For the purposes of this study, it has been assumed that the background traffic would increase at a rate of 2% per annum for 5 years to 2027. These growth rates are considered appropriate for the study as the traffic growth is applied in addition to the extensive latent rights/ other developments which have been included in this study, and as discussed below.

4.2.2 Trips Generations from 'Other Developments' (Latent Rights)

As indicated in Figure 2, four (4) other nearby developments in this case have been included as latent rights developments. These include Cosmo City Ext. 33-49, Malibongwe Ridge, Cosmo City Ext. 15 (otherwise known as Cosmo Business Park) and Cosmo City Ext. 16, which are all located to the south of the site. The development extent and trip generations of these townships are briefly discussed below:

- **Cosmo City Ext. 33-49:** The site for this mixed land-use development is located to the south-east of the subject site and is situated on the eastern corner of the intersection between Malibongwe Drive and the R114. This site was previously home to Lion Park. The breakdown of the land use rights, quantities and trip generation data for this development was obtained from the approved TIA conducted by Dhubecon Consulting Engineers in November 2018.

Based on the approved TIA, this mixed land use development will comprise a total of **approximately 2,721 single residential stands ('Residential 1') and 1,289 'Residential 3' units** upon completion. The other land uses that will be developed include a small neighbourhood shopping centre of approximately 11,040m² GLA, public- and private schools, crèches, community facilities, a taxi rank and ample public- and private open spaces.

With regards to trip generations, it was estimated in the approved TIA that these townships, as a whole, would generate a total of 2,425 new trips during the weekday AM peak and 2,295 new trips during the weekday PM peak, which is substantial. It can be seen on Figure 2 that the development of these townships is already well underway and the majority of the internal public road network has already been completed, along with many of the private roads.

Attached Figure 5a indicates the total remaining trips to be generated by Cosmo City Ext. 33-49 through the study area, during the weekday AM and PM peak hours.

- **Malibongwe Ridge:** The site for this proposed mixed land-use development is located south of the subject site and is bordered by the R114 and Malibongwe Drive to the north and east, respectively. The development comprises of four (4) townships, which will be known as Malibongwe Ridge Proper and Malibongwe Ridge Extensions 1-3, with the primary land uses being 'Residential' and 'Business'.

The breakdown of the land use rights, quantities and trip generation data for this development was obtained from the approved TIA conducted by Dhubecon Consulting Engineers in November 2018 for the Cosmo City Ext. 33-49 townships, in which this development was also included as latent rights. The townships will cater for lower income households and will jointly comprise of approximately 3,240 low-income housing units with rental rooms, as well as 244 low-income freestanding houses, 669 finance-linked partially subsidized houses, 604 bonded houses and 754 rental or "social" housing units. Since the target market household has a rather low socio-economic profile, an equivalent low vehicle ownership can be expected. Other land uses proposed include a neighbourhood shopping centre of approximately 20,000m² GLA, office parks of approximately 12,000m² GLA, commercial space of approximately 5,000m² GLA, future primary and secondary schools, crèches, community facilities, a taxi rank and ample public open spaces.

It was estimated in the approved TIA that this development, as a whole, will generate approximately 2,085 and 2,595 vehicle trips during the weekday AM and PM peak hours, respectively. Since the development of this site is already underway, it was assumed that 50% of the development has been complete and as a result the remaining 50% of the trips was included as latent rights for the purposes of this study. Figure 5b indicates the estimated total trips to be generated by Malibongwe Ridge through the study area, during the weekday AM and PM peak hours.

- **Cosmo City Ext. 16:** This proposed township is located immediately to the south-west of the Cosmo City Ext. 33-49 Townships (see Figure 2) and is primarily earmarked for a residential development that will cater for the lower income households. The breakdown of the land use rights, quantities and trip generation data for this development was obtained from the approved TIA conducted by Dhubecon Consulting Engineers in November 2018 for the Cosmo City Ext. 33-49 townships, in which this development was also included as latent rights. The proposed township makes provision for about 570 residential units, which includes individual erven and complexes, as well as a business site with the potential for a shopping centre of approximately 8,000m² GLA.

None of this township has been developed as yet and therefore the full trips have been taken into account in this TIA as part of latent rights. It is estimated that Cosmo City Ext. 16 will generate a total of approximately 345 and 515 vehicle trips (IN plus OUT) during the weekday AM and PM peak hours, respectively. Attached Figure 5c indicates the estimated total trips to

be generated by Cosmo City Ext. 16 through the study area, during the weekday AM and PM peak hours.

- **Cosmo City Ext. 15 (Cosmo Business Park):** This is an Industrial development south-east of the Cosmo City Ext. 16 township which uses Rietvallei Road as its access onto Malibongwe Drive. The township, as a whole, is about 40ha in extent and has a total development potential of approximately 200,000m² GLA of industrial use. To note is that the majority of this site has been developed already. It is estimated that the site is currently approximately 90% developed and therefore about 20,000m² GLA of industrial use can still be developed. By applying a trip rate of 0.6 trips/100m² it implies that this township can still generate approximately 120 vehicle trips (IN plus OUT) during the weekday AM and PM peak hours. Figure 5d indicates the estimated total trips still to be generated by Cosmo City Ext. 15 (Cosmo Business Park), during the weekday AM and PM peak hours.

The total estimated latent rights trips, which represents the combined impact of all the above-mentioned latent rights developments, is summarised in Figure 6.

At this stage, it is not known what the exact status and implementation timelines are for some of the above developments, especially Malibongwe Ridge and Cosmo City Ext. 16, but it has been assumed for the purposes of this TIA that all of these developments will be completed by 2027. Therefore, the estimated total future 2027 background traffic presented in this document, and as summarised in Figure 7, consists of two components, namely the background traffic growth over 5 years (at 2% per annum) and the trips from the latent rights development that still needs to realise, as discussed above.

4.3 DEVELOPMENT TRIP GENERATION

In order to determine the expected trip generations of the proposed development, the latest and most relevant guideline, entitled *TMH 17 Volume 1, South African Trip Data Manual (Committee Draft 2.0, May 2018)* was used as a basis, which is based on a more comprehensive data base and which makes provision for the different types of residential developments, as well different income levels of developments, vehicle ownership and availability of public transport services.

4.3.1 Development Trip Generation

Given the location of the site and the type of development proposed, the lower income market is being targeted, which has a lower vehicle ownership and consequently the trip generation characteristics are lower than usual. Apart from a lower vehicle ownership itself, many of these residents still find it more affordable to use public transport for commuting instead of their own private vehicles.

The *Trip Data Manual* allows for '*Multi-level Townhouses*' ('Residential 3') and '*Apartments and Flats*' ('Residential 4'), which is viewed as the most accurate description of the type of units that will be developed. The *Trip Data Manual* allows for adjustments in terms of '*Low Vehicle Ownership*', '*Transit Nodes and Corridors*' (i.e., availability of public transport) and '*Mixed-use Development*' (i.e., shared trips).

The following assumptions and notes are relevant with respect to the trip generation calculations:

- ❖ Standard trip rates for '*Multi-level Townhouses*' and '*Apartments and Flats*' are 0.75 trips/ unit and 0.65 trips/unit, respectively;
- ❖ '*Multi-level Townhouses*' and '*Apartments and Flats*' adjustment factor allowed for low vehicle ownership is 30% and that for very low vehicle ownership is 50%. For the purposes of this study, a conservative 30% reduction had been applied to account for low vehicle ownership.
- ❖ For '*Transit nodes or Corridors*' (i.e. availability of public transport) a maximum adjustment of 15% is allowed. For the purposes of this study, a reduction of 10% had been applied, considering the ample amount of public transport services in the area (see Section 7.2).

- ❖ **No 'Mixed Land Use' reduction factor had been applied, since this would only be a residential development.**

Based on the above assumptions, the reduced trip rate has been estimated as follows:

- 'Residential 3' units = Weekday AM/PM: $0.75 \times 0.70 \times 0.90 = 0.47$ trips/unit
- 'Residential 4' units = Weekday AM/PM: $0.65 \times 0.70 \times 0.90 = 0.41$ trips/unit

By applying the above trip rates to the number of units proposed, the maximum number of peak hour trips is estimated at:

- For 927 'Residential 3' units = 436 trips
- For 1,179 'Residential 4' units = 483 trips

In summation, the total residential trips during the AM and PM peak hours for the proposed townships are estimated at 919 peak hour trips. Using the recommended directional splits (IN:OUT) of 25:75 and 70:30 for the AM and PM peaks, respectively, the total trips are summarised in Table 3 below.

Table 3: Estimated Development Trips: Residential

Peak	Development Trips (vph)		
	IN	OUT	TOTAL
Weekday AM Peak hr	230	689	919
Weekday PM Peak hr	643	276	919

4.3.2 Trip Generation Contribution of Each Township

Although this study had been prepared for the proposed development as a whole, comprising six (6) townships (as per Table 1), it is necessary to quantify the traffic generations of each township individually. Table 4 below summarises the proportionate traffic contribution of the respective townships. Using the values from Table 4, **the required stacking for the townships' access could also be determined.**

Table 4: Proportional Trip Generation Contribution of Each Township

Proposed Township:	Development Extent	AM Peak Hour Trips	PM Peak Hour Trips	% Contribution
Mogale Ext. 54	271 'Res 3' Units	127	127	14%
Mogale Ext. 55	266 'Res 3' Units	125	125	14%
Mogale Ext. 56	390 'Res 3' Units	183	183	20%
Mogale Ext. 57	510 'Res 4' Units	209	209	23%
Mogale Ext. 58	314 'Res 4' Units	129	129	14%
Mogale Ext. 59	355 'Res 4' Units	146	146	16%
TOTAL	927 'Res 3' Units and 1,179 'Res 4' Units	919	919	100%

4.4 TRIP DISTRIBUTION & ASSIGNMENT

Assumptions on the expected trip distribution were based on the location of the proposed site accesses and local streets in relation to the surrounding existing road network, existing traffic volumes and patterns in the study area, the type of development in relation to employment as well as our knowledge of the area.

Figures 9 depicts the expected trip distribution of the proposed residential development onto the surrounding road network.

Given the above distribution, Figures 10 summarizes the estimated development trips at the identified key intersections during the weekday AM and PM peak hours.

4.5 ASSESSMENT TRAFFIC FLOWS WITH DEVELOPMENT

Figure 11 shows the total existing 2022 peak hour traffic volumes with the estimated traffic generations from the proposed residential development, which is the summation of Figures 5 and 10.

Figure 12 shows the total future 2027 base traffic volumes with the estimated traffic generations from the latent rights developments and the proposed residential development, which is the summation of Figures 8 and 10.

In this study, Figures 5, 8, 11 and 12 had been used for assessing the current traffic conditions, as well as the traffic impact of the proposed development and future background traffic flows (including the latent rights developments), onto the surrounding road network.

5. Traffic Impact & Capacity Analyses

In order to determine and quantify the traffic impact of the proposed development, the latest *PTV Vistro 2022* traffic engineering software had been used to undertake capacity analyses at the various key intersections. With reference to the analyses of the various scenarios, this section comments on the current traffic operations without the additional development traffic, as well as the likely traffic flow conditions with the additional development traffic. Where necessary and feasible, intersection improvements have been identified that would mitigate the likely traffic impact and/or improve current traffic flow conditions.

The intersection capacity analyses were done for the weekday AM- and PM peak hours at the following six (6) key intersections:

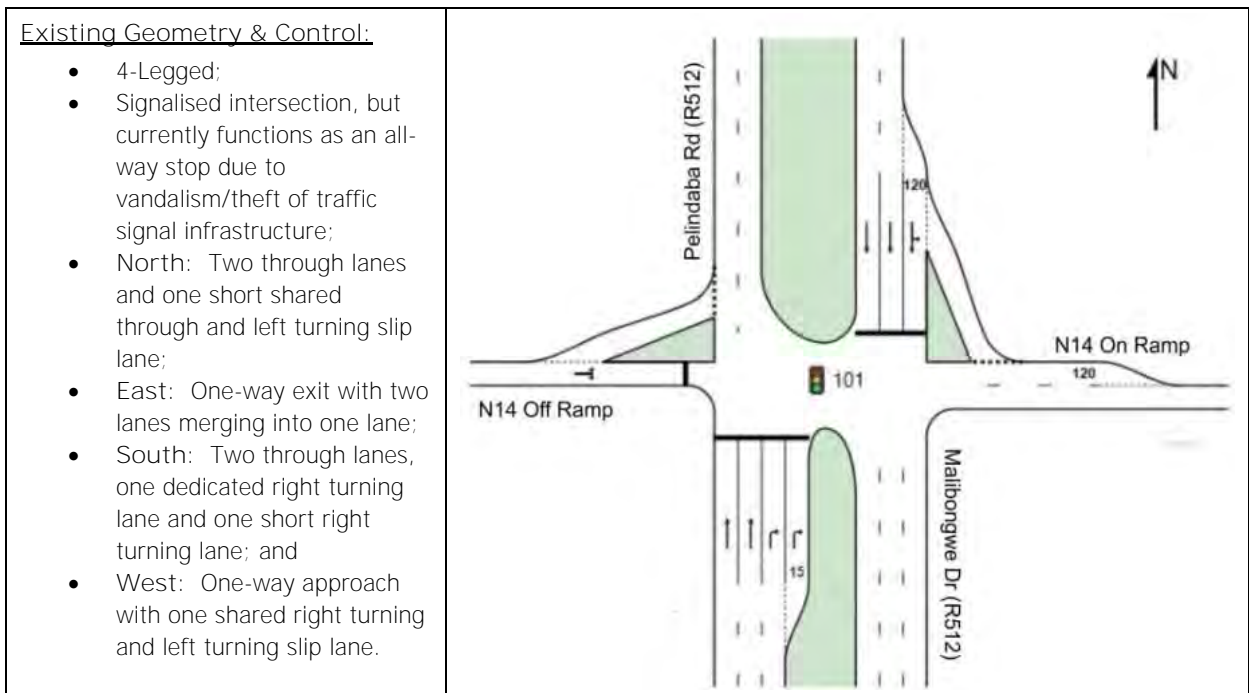
1. Malibongwe Drive (R512 / P103-1) & N14 (P158-2) Northern Ramp Terminal;
2. Malibongwe Drive (R512 / P103-1) & N14 (P158-2) Southern Ramp Terminal;
3. Malibongwe Drive (R512 / P103-1) & R114 (P39-1) Intersection;
4. Malibongwe Drive (R512 / P103-1) & 'Road A' Intersection;
5. 'Road A' / 'Road C' / Access 1; and
6. 'Road A' / 'Road B'.

The following scenarios were analysed, namely:

- Scenario 1: 2022 weekday AM and PM peak hour traffic volumes WITHOUT the proposed development (as per Figure 5);
- Scenario 2: Future 2027 base weekday AM and PM peak hour traffic volumes PLUS latent rights trips, but WITHOUT the proposed development (as per Figure 7);
- Scenario 3: 2022 weekday AM and PM peak hour traffic volumes PLUS the estimated development trips (as per Figure 11);
- Scenario 4: Future 2027 base weekday AM and PM peak hour traffic volumes PLUS latent rights trips PLUS the estimated development trips (as per Figure 12);

Results of the *PTV Vistro* intersection capacity analyses at the various key intersections are discussed in the following sub sections, with the details of the outputs enclosed in Annexures B. It must be noted that for all signalized intersections, optimised traffic signal phasing had been used in the traffic analyses.

5.1 MALIBONGWE DRIVE (R512) & N14 NORTHERN TERMINAL



Analysis Results & Conclusion			Intersection: Malibongwe Dr & N14 Northern Terminal			
Detailed Results: Annexures B1 to B10						
Scenario	Geometry & Control	Peak	Overall			Comment
			LOS	Delay(s)	v/C _{max}	
Scenario 1	Existing geometry	AM	C	22	0.70	Acceptable overall level of operation
Scenario 2	Existing geometry	AM	D	40	0.89	Poor level of operation in terms of delay
Scenario 3	Existing geometry	AM	C	24	0.75	Acceptable overall level of operation
Scenario 4	Existing geometry	AM	D	52	0.94	Poor level of operation in terms of delay
Scenario 4	Proposed geometry	AM	C	21	0.67	Acceptable overall level of operation
Scenario 1	Existing geometry	PM	B	15	0.46	Good overall level of operation
Scenario 2	Existing geometry	PM	C	20	0.68	Acceptable overall level of operation
Scenario 3	Existing geometry	PM	B	16	0.52	Good overall level of operation
Scenario 4	Existing geometry	PM	C	24	0.74	Acceptable overall level of operation
Scenario 4	Proposed geometry	PM	B	18	0.58	Good overall level of operation

Conclusion:	The intersection is able to accommodate the current traffic volumes. However, for future scenarios with the additional development traffic, background traffic growth as well as the latent rights trips included, the intersection operates with poor delays during the AM peak hour. The N14 off-ramp (western approach) currently has one shared right turning and left turning slip-way and it is expected that the delays at this approach would increase significantly with the future analysed traffic (especially for the right turning movement). Therefore, it is recommended that an additional short right turning lane be implemented at this approach which would make a considerable improvement to the overall operation of the intersection. This upgrade would also benefit the larger through traffic movement on Malibongwe Drive as the provision of the extra capacity at the off-ramp would allow for more green time of the signal timing plans to be allocated to the main movement on Malibongwe Drive.
Upgrade Required:	Yes, as per Drawing No. 0583/CL/02.
Upgrade Responsibility:	Developer

5.2 MALIBONGWE DRIVE (R512) & N14 SOUTHERN TERMINAL

<p><u>Existing Geometry & Control:</u></p> <ul style="list-style-type: none"> • 4-Legged; • Signalised intersection, but currently functions as an all-way stop due to vandalism/theft of traffic signal infrastructure; • North: Three through lanes and one short right turning lane; • East: One-way approach with two dedicated right turning lanes and one left turning slip lane; • South: Two dedicated through lanes (one being a short lane) and one shared through and left turning slip lane; and • West: One-way exit with one lane. 	
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Analysis Results & Conclusion

Intersection: Malibongwe Dr & N14 Southern Terminal

Detailed Results: Annexures B1 to B4 & B6 to B9

Scenario	Geometry & Control	Peak	Overall			Comment
			LOS	Delay(s)	v/C _{max}	
Scenario 1	Existing geometry	AM	B	14	0.41	Good overall level of operation
Scenario 2	Existing geometry	AM	B	17	0.56	Good overall level of operation
Scenario 3	Existing geometry	AM	B	16	0.47	Good overall level of operation
Scenario 4	Existing geometry	AM	B	20	0.62	Good overall level of operation
Scenario 1	Existing geometry	PM	B	13	0.41	Good overall level of operation
Scenario 2	Existing geometry	PM	B	14	0.50	Good overall level of operation
Scenario 3	Existing geometry	PM	B	13	0.43	Good overall level of operation
Scenario 4	Existing geometry	PM	B	14	0.53	Good overall level of operation
Conclusion:	The southern terminal of the N14 on- and off-ramp on Malibongwe Drive has sufficient capacity to easily accommodate the future background traffic volumes with the additional development and latent rights traffic included. Therefore, no geometric upgrades are required to be undertaken by the developer.					
Upgrade Required:	None					
Upgrade Responsibility:	N/A					

5.3 MALIBONGWE DRIVE (R512) & ROAD R114

<p><u>Existing Geometry & Control:</u></p> <ul style="list-style-type: none"> • 4-legged; • Signalized, but currently functions as an all-way stop due to vandalism/theft of traffic signal infrastructure; • North: Two through lanes, one short right turning lane and one short left turning slip-way; • South: Two through lanes, one short right turning lane and one short left turning slip lane; • East: One shared through and left turning lane and one shared through and right turning lane; and • West: One shared through and left turning lane and one shared through and right turning lane. 	
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Analysis Results & Conclusion			Intersection: Malibongwe Dr & Road R114			
Detailed Results: Annexures B1 to B10						
Scenario	Geometry & Control	Peak	Overall			Comment
			LOS	Delay(s)	v/c _{max}	
Scenario 1	Existing geometry	AM	D	40	0.69	Acceptable overall level of operation
Scenario 2	Existing geometry	AM	F	111	1.03	Very poor overall level of operation
Scenario 3	Existing geometry	AM	D	46	0.76	Acceptable overall level of operation
Scenario 4	Existing geometry	AM	F	>150	1.10	Very poor overall level of operation
Scenario 4	Proposed geometry	AM	C	31	0.72	Acceptable overall level of operation
Scenario 1	Existing geometry	PM	C	34	0.68	Acceptable overall level of operation
Scenario 2	Existing geometry	PM	F	82	0.97	Very poor overall level of operation
Scenario 3	Existing geometry	PM	D	46	0.80	Poor level of operation in terms of delay
Scenario 4	Existing geometry	PM	F	113	1.06	Very poor overall level of operation
Scenario 4	Proposed geometry	PM	C	32	0.73	Acceptable overall level of operation

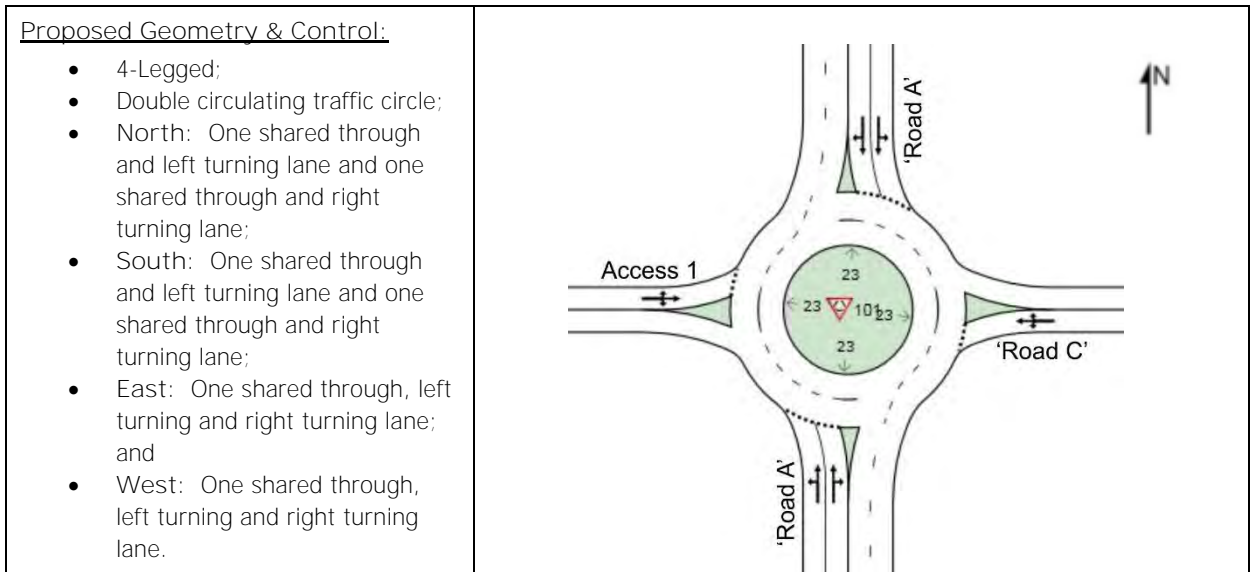
Conclusion:	<p>In the approved TIA for the Cosmo City Ext. 33-49 townships (issued in Nov 2018), upgrades were proposed at this intersection as part of the required upgrades for these townships. These upgrades are shown in Drawing No. 0583/CL/03a and are also listed in more detail in Section 6.1. These upgrades would make a substantial improvement in the overall operation of the intersection, but with the subject development's additional traffic, further upgrades would be required to restore the intersection to an acceptable overall level of service.</p> <p>To allow for optimal phasing of the signal timing plans, it is recommended that an additional short shared through and left turning lane be implemented at the western approach. The implementation of this additional lane would make it possible to convert the existing shared through and left turning lane into a dedicated through lane and the existing shared through and right turning lane can then become a dedicated right turning lane (which is the recommended geometry for signalized intersections). It is further recommended that the short receiving lane at the eastern approach be extended to allow for the two receiving lanes on Road R114 to safely merge into one lane in an eastbound direction.</p>
Upgrade Required:	Yes, as per Drawing No. 0583/CL/03a-b.
Upgrade Responsibility:	Upgrades as per Drawing No. 0583/CL/03a forms part of the Cosmo City Ext. 33 to 49 development and the additional upgrades proposed as per attached Drawing No. 0583/CL/03b should form of the subject development.

5.4 MALIBONGWE DRIVE (R512) & 'ROAD A'

<p><u>Proposed Geometry & Control:</u></p> <ul style="list-style-type: none"> • 4-Legged; • Signalized (when warranted); • North: Two through lanes, one short right turning lane and one short left turning lane; • East: One shared through and left turning lane and one right turning lane; • South: Two through lanes, one short right turning lane and one short left turning slip lane; and • West: One shared through and right turning lane, one right turning lane and one dedicated left turning slip-way. 	
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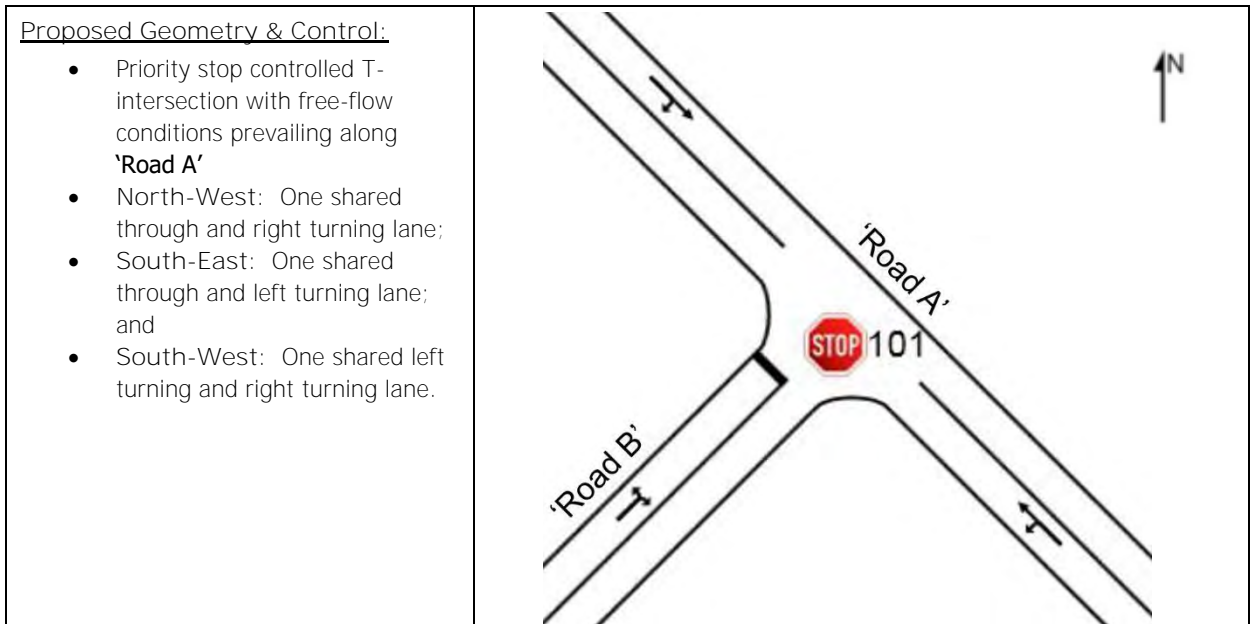
Analysis Results & Conclusion			Intersection: Malibongwe Dr & Road A			
Detailed Results: Annexures B3 to B4 & B8 to B9						
Scenario	Geometry & Control	Peak	Overall			Comment
			LOS	Delay(s)	v/c _{max}	
Scenario 3	Proposed geometry	AM	B	17	0.60	Good overall level of operation
Scenario 4	Proposed geometry	AM	B	20	0.77	Good overall level of operation
Scenario 3	Proposed geometry	PM	B	16	0.59	Good overall level of operation
Scenario 4	Proposed geometry	PM	B	19	0.69	Good overall level of operation
Conclusion:		<p>All of the development's estimated traffic is expected to distribute onto Malibongwe Drive via the western approach of this intersection. Therefore, it is important to ensure that this intersection would be able to accommodate the estimated future traffic. The recommended geometry as conceptually shown in Drawing No. 0583/CL/01 and also described in Section 6.2.1 would sufficiently be able to accommodate the design traffic with a good overall level of operation achieved during both the AM and PM peaks.</p> <p>This intersection is currently a priority stop controlled intersection, but as part of the development's upgrades it is recommended that this intersection should become signalized in the future. However, these signals should only be installed when the development's traffic had realized to such an extent that the warrants for traffic signals as per the <i>Southern African Roads Traffic Signs Manual (SARTSM)</i> are met. Until these signal warrants are not met, it is recommended that this intersection should be converted into an all-way stop controlled intersection in the interim.</p>				
Upgrade Required:		Yes, as per Drawing No. 0583/CL/01.				
Upgrade Responsibility:		Developer				

5.5 'ROAD A' & 'ROAD C' & ACCESS 1



Analysis Results & Conclusion			Intersection: Road A & Road C & Access 1			
Detailed Results: Annexures B3 to B4 & B8 to B9						
Scenario	Geometry & Control	Peak	Overall			Comment
			LOS	Delay(s)	v/C _{max}	
Scenario 3	Proposed geometry	AM	A	5	0.30	Very good overall level of operation
Scenario 4	Proposed geometry	AM	A	5	0.30	Very good overall level of operation
Scenario 3	Proposed geometry	PM	A	5	0.25	Acceptable overall level of operation
Scenario 4	Proposed geometry	PM	A	5	0.25	Acceptable overall level of operation
Conclusion:		The proposed double circulating traffic circle geometry would adequately be able to accommodate the anticipated traffic generated by the subject development. As per the capacity analysis results, a Level of Service (LOS A) is achieved for all the analysed scenarios with ample spare capacity still available. If the through traffic on 'Road A' increases further due to the neighbouring vacant sites being developed , then it is anticipated that this traffic circle would be able to accommodate the higher traffic volumes with relative ease.				
Upgrade Required:		Yes, as per Drawing No. 0583/CL/01.				
Upgrade Responsibility:		Developer				

5.6 'ROAD A' & 'ROAD B'



Analysis Results & Conclusion			Intersection: Road A & Road B			
Detailed Results: Annexures B3 to B4 & B8 to B9						
Scenario	Geometry & Control	Peak	Stop Approach			Comment
			LOS	Delay(s)	v/c _{max}	
Scenario 3	Proposed geometry	AM	A	10	0.26	Very good overall level of operation
Scenario 4	Proposed geometry	AM	A	10	0.26	Very good overall level of operation
Scenario 3	Proposed geometry	PM	A	10	0.11	Very good overall level of operation
Scenario 4	Proposed geometry	PM	A	10	0.11	Very good overall level of operation
Conclusion:		The proposed geometry would be able to accommodate the anticipated development traffic with relative ease and it is expected that vehicles at the stop approach would be able to find sufficient gaps to turn from 'Road B' and onto 'Road A'.				
Upgrade Required:		Yes, as per Drawing No. 0583/CL/01.				
Upgrade Responsibility:		Developer				

6. Road and/or Intersection Upgrades

Based on the estimated additional traffic generations of the proposed development as a whole, its projected distribution onto the surrounding road network during the weekday AM and PM peak hours, the capacity analyses in Section 5 as well as on-site observations during the peaks, the various road and intersection upgrades as outlined below are proposed.

6.1 UPGRADES BY OTHER DEVELOPMENTS & AUTHORITIES

At the relevant key intersections of this study, the following intersection upgrades have been identified in the approved TIA, issued in November 2018 by Dhubecon Consulting Engineers (Pty) Ltd, for the Cosmo City Ext. 33-49 townships:

Malibongwe Drive (R512 / P103-1) / Road R114 (P39-1) Intersection:

(Refer to Drawing No. 0583/CL/03a):

- ❖ Additional through lanes along Malibongwe Drive (R512/P103) (both directions) at the intersection;
- ❖ Additional turning lanes on the eastern approach of the R114 are required; and
- ❖ Upgrading of existing traffic signals for additional phasing as well as new timing plans.

The upgrades at this intersection have been taken into account in this study together with the added traffic generations of the subject development and it is confirmed that with the added development traffic, additional upgrades would be required at this specific intersection as per Section 6.2.1.

Furthermore, it would form part of **the authorities'** responsibility to reinstate the traffic signals, which had been vandalized/stolen over the years, at the following key intersections:

- ❖ Malibongwe Drive (R512/ P103-1) / N14 (P158-2) Northern Terminal;
- ❖ Malibongwe Drive (R512/ P103-1) / N14 (P158-2) Southern Terminal; and
- ❖ Malibongwe Drive (R512/ P103-1) / Road R114 (P39-1).

6.2 UPGRADES BY DEVELOPER OF MOGALE EXT. 54-59

6.2.1 Proposed External Road & Intersection Upgrades

■ Malibongwe Drive (R512 / P103-1) / N14 (P158-2) Northern Terminal

(Refer to Drawing No. 0583/CL/02)

- Additional short right turning lane at the N14 off-ramp (western approach).
- Updated traffic signal timing plans (once the signals have been reinstated by the authorities).

■ Malibongwe Drive (R512 / P103-1) / Road R114 (P39-1) Intersection:

(Refer to Drawing No. 0583/CL/03b)

- The implementation of an additional short through and left turning lane at the western approach on Road R114 (P39-1) and the extension of the opposing existing short receiving lane to allow for traffic to safely merge from two lanes into one. The western approach of the intersection would then comprise of one short shared through and left turning lane, one through lane as well as one right turning lane;

- Updated traffic signal timing plans (once the signals have been reinstated by the authorities);

✦ Malibongwe Drive (R512 / P103-1) / 'Road A' Intersection:

(Refer to Drawing No. 0583/CL/01)

- Additional Gautrans standard dedicated left turning slip-way on the southern approach (Malibongwe Drive (R512/ P103-1));
- Road widening at the southern side of the eastern approach to implement a short shared through and left turning lane with a right turning lane;
- Road widening of the existing road to accommodate a short dedicated left turning slip-way, a shared through and right turning lane as well as a dedicated right **turning lane at the western approach ('Road A')**; and
- Signalisation of the intersection at a time when the development's traffic had realized to such an extent that the warrants for traffic signals as per the *Southern African Roads Traffic Signs Manual (SARTSM)* are met.

6.2.2 Proposed Local Road Network Geometry in the Site Area

Refer to the key plan enclosed in Drawing No. 0583/CL/01 for the proposed local road upgrades required in the vicinity of the site and as outlined below:

✦ 'Road A' / 'Road C' / Access 1 Intersection:

- Proposed new traffic circle (minimum 43m outside diameter) with double circulating lanes;
- 'Road A' to have two lanes per direction in the vicinity of the circle;
- 'Road C' and Access 1 to have one lane per direction in the vicinity of the circle; and
- For Access 1 and after the circle, the road is to widen to accommodate 2x inbound and 2x outbound lanes for the access to the Mogale Ext. 54-55 townships.

✦ 'Road C' / Access 2 / Access 3 Intersection:

- Proposed new traffic circle (approximately 20m outside diameter) with a single circulating lane;
- Access 2 (for the Mogale Ext. 57 township) should comprise of 2x inbound and 2x outbound lanes; and
- Access 3 (for the Mogale Ext. 58 township) should comprise of 2x inbound and 2x outbound lanes.

✦ 'Road A' / 'Road B' Intersection:

- Proposed new priority stop controlled intersection with free-flow conditions **prevailing along 'Road A'**. No additional turning lanes are required.

✦ 'Road B' / Access 4 / Access 5 Intersection:

- Proposed new priority stop controlled intersection with free-flow conditions **prevailing along 'Road B'**. No additional turning lanes are required.
- Access 4 (for the Mogale Ext. 56 township) should comprise of 2x inbound and 2x outbound lanes; and

- Access 5 (for the Mogale Ext. 59 township) should comprise of 2x inbound and 2x outbound lanes; and

- ✦ **'Road A'**: New Class 3/4a public road of approximately 440m.
- ✦ **'Road B'**: New Class 4b public road of approximately 120m.
- ✦ **'Road C'**: New Class 5b public road of approximately 50m.

In the event of bulk engineering contributions payable with respect to roads and stormwater, it is recommended that at least part of the contribution be off-set against the proposed road and intersection upgrades, as outlined above, since these upgrades will also benefit other future developments and the relevant road authorities. It is acknowledged that the off-setting of costs against provincial roads could be a problem in terms of the legislation, but it is recommended that CoJ, Mogale City and Gautrans come to some agreement in this respect.

6.3 PROPOSED PHASING OF UPGRADES

The upgrading of the relevant roads and intersections as proposed in Section 6.2 above and shown in the attached drawings are applicable to the proposed townships as a whole, which is also the most appropriate way to investigate the overall traffic impact and identify the necessary upgrades. However, due to the high costs of implementing the engineering services for the townships, it is more feasible for a developer to implement the development in phases, which is made possible with smaller townships. This is the main reason for the multiple townships. In giving consideration to the kick-off needed for certain road infrastructure and considering the anticipated traffic generation contribution of each township (or phase) as identified in Table 4 of this report, Table 5 below proposes the partial implementation of the upgrades, linked to the various townships/ phases. The practical and construction implications of the upgrades had also been taken into account.

Table 5: Proposed Phasing of Road & Intersection Upgrades

Proposed Township:	Development Extent	Proposed Upgrades (see Drawing No. 0583/CL/01-3)
Mogale Ext. 58 (PHASE 1)	314 'Res 4' Units	<ul style="list-style-type: none"> • Malibongwe Drive (R512 / P103-1) / 'Road A': intersection upgrades to be implemented as per Section 6.2.1; • 'Road A': Approx. 190m section of new Class 3 public collector road (road to be constructed up to the proposed traffic circle on 'Road A'); • 'Road A' / 'Road C' / Access 1: Proposed new traffic circle with double lane approaches on 'Road A'. Note that Access 1 (western approach) does not need to be constructed during this phase. • 'Road C': Approx. 50m section of new Class 5b public road; • 'Road C' / Access 2 / Access 3: Proposed new traffic circle with single lane approaches. Note that only Access 3 needs to be constructed during this phase and not Access 2 as well; and • Internal township streets and intersections.
Mogale Ext. 54 (PHASE 2)	271 'Res 3' Units	<ul style="list-style-type: none"> • 'Road A' / 'Road C' / Access 1: Implementation of the western approach (i.e., Access 1) to provide access to the township; and • Internal township streets and intersections.

Mogale Ext. 57 (PHASE 3)	510 'Res 4' Units	<ul style="list-style-type: none"> Malibongwe Drive (R512 / P103-1) / Road R114 (P39-1): intersection upgrades to be implemented as per Section 6.2.1; 'Road C' / Access 2 / Access 3: Access 2 to be constructed (i.e., an additional approach is to be implemented at the traffic circle) Internal township streets and access intersections.
Mogale Ext. 55 (PHASE 4)	266 'Res 3' Units	<ul style="list-style-type: none"> Internal township streets and access intersections.
Mogale Ext. 59 (PHASE 5)	355 'Res 4' Units	<ul style="list-style-type: none"> 'Road A': The remaining extent of 'Road A' which traverses the site must be constructed (i.e., the portion of 'Road A' between its intersections with 'Road B' and 'Road C'. Approx. 250m section of new Class 4a public collector road; 'Road A' / 'Road B': Proposed new priority stop controlled T-intersection with free-flow conditions along 'Road A'; 'Road B': Approx. 120m section of new Class 4b public collector road; 'Road B / Access 4 / Access 5: Only Access 5 needs to be implemented during this phase and not Access 4 as well; and Internal township streets and intersections.
Mogale Ext. 56 (PHASE 6)	334 'Res 3' Units	<ul style="list-style-type: none"> Malibongwe Drive (R512 / P103-1) N14 Northern Terminal (P158-2): intersection upgrades to be implemented as per Section 6.2.1; Road B / Access 4 / Access 5: Only the implementation of Access 4 is required; and Internal township streets and intersections.

NOTE: With regards to the signalization of the intersection of 'Road A' and Malibongwe Drive (R512 / P103-1), the implementation of these signals should not form part of any specific township's required upgrades. Instead, it is recommended that the intersection operates as an all-way stop in the interim so that the intersection can be monitored as the development's traffic realizes. Only once the traffic from the development has realised to the extent that traffic signals are warranted in terms of the *SARTSM*, then the signals should be installed by the developer.

Furthermore, depending on the availability of other engineering services such as electricity, water and sewer, as well as market demand, it could be possible that some townships be implemented before others and consequently it may affect the proposed phasing of the road infrastructure implementation. More details of the road upgrades will follow later as part of the services agreement and detail designs to be submitted by the civil engineer.

7. Non-Motorised & Public Transport

7.1 AVAILABILITY OF SERVICES & FACILITIES

Malibongwe Drive (R512), which borders the subject site to the east, is known to be a popular public transport route. On-site observations also revealed that both the N14-freeway and the R114 (P39-1), are popular public transport routes for buses and minibus-taxis. The above-mentioned roads are serving and connecting several townships in the area such as Cosmo City, Lion Park and even Diepsloot. Malibongwe Drive (R512) **is also one of Joburg's SPTN (Strategic Public Transport Network) routes.** To note is that there are currently several bus stops along this route, at its intersections with other major roads.

The classified traffic count undertaken at the Malibongwe Drive and Road R114 confirmed that approximately 12% and 9% of the total traffic through this intersection during the weekday AM and PM peak hours, respectively, were minibus taxis. These percentages are considerable, especially if one takes into account that Malibongwe Drive is a major arterial route that carries a high volume of through traffic. Similarly, the classified traffic count showed that approximately 3% and 5% of the total traffic through this intersection during the weekday AM and PM peak hours, respectively, were heavy vehicles, which consisted of a notable number of buses. These percentages confirm that a large portion of commuters in the study area make use of public transport services. Since these public transport services are located in close proximity to the subject site, it can be concluded that the subject site is very well located with regards to public transport services such as buses and minibus taxis.

In terms of existing public transport facilities, a set of public transport laybys (bus laybys; Gautrans standard) are currently in place at the site access intersection (**i.e., Malibongwe Drive and 'Road A'**). However, no paved pedestrian walkways are currently provided at the intersection.

It is expected that the proposed development and other nearby developments (*i.e.*, latent rights), as they develop over time, will further stimulate the demand for public transport services and it is expected that particularly minibus taxis would respond to this demand by providing more services. With regards to the public roads traversing the site, it is very likely that **'Road A' will become a popular public transport route in the future.**

7.2 PROPOSED FACILITIES

In order to make provision for the users of public transport, generated by the proposed development, the following are proposed:

- ✦ **Pedestrian Walkways:** With reference to Drawing No. 0583/CL/01, it is recommended that paved pedestrian walkways of at least 1.8m wide be **constructed on either side of 'Road A' from its intersection with Malibongwe Drive (R512) and up to the proposed traffic circle intersection between 'Road A' and 'Road C'. After this traffic circle, it is recommended that the sidewalk continue on only one side of the road as indicated. This sidewalk should be implemented along at least one side of 'Road B' as well.**
- ✦ **Public Transport Laybys:** Since many of the residents, employees (*e.g.*, domestic workers, security personnel) are expected to make use of public transport services, it is suggested that a new set of public transport laybys be constructed **at the intersection between 'Road A' and 'Road C'** as per Drawing No. 0583/CL/01.

More details of the above would be submitted as part of the Site Development Plans and/or detail designs of the external roads. The final location of the proposed sidewalks and laybys can be discussed with the authorities at design stage of the external roads.

8. Summary, Conclusions & Recommendations

Based on the content of this document, the following key conclusions and recommendations are relevant:

1. This Traffic Impact Assessment (TIA) forms part of the township application for the proposed new residential townships known as Mogale Ext. 54-59, which is to be situated on Part of the Remainder of Portion 23, a Part of Portion 162 and Part of the Remainder of Portion 196 of the Farm Nooitgedacht 534-JQ, approximately 4.8km south of the Lanseria International Airport. The site location is shown in attached Figure 1 and Figure 2 and falls under the jurisdiction of the Mogale City municipality. It is, however, to note that the boundary between Mogale City and the City of Johannesburg (CoJ) is situated in the vicinity of the site and that the subject site falls under the jurisdiction of Mogale City while most of the existing analysed key intersections instead falls **under the CoJ's and Gautrans' jurisdiction. As a result, this report will be submitted to Mogale City** as well as the City of Johannesburg and Gautrans for comments and/or approvals on this TIA. The municipal boundary separating Mogale City and the CoJ is also indicated in Figure 2 for ease of reference.
2. The subject site, as a whole, is approximately 39.9ha in extent and comprises of six (6) proposed **townships. With reference to the town planner's combined Township Layout Plan in Annexure A, the proposed townships will be residential developments that would comprise out of 'Residential 3' and 'Residential 4' units. Mogale Extensions 54-56 are earmarked for 'Residential 3' units with a development density of 40 units/ha while Extensions 57-59 are earmarked for high density 'Residential 4' units with a development density of 130 units/ ha. Based on the area of each township, the combined permissible extent of the site jointly calculates to 2,106 units (927 'Residential 3' units and 1,179 'Residential 4' units). The proposed townships will primarily cater for the lower-income households, similar to most new developments in the area.**
3. LOCAL ROAD NETWORK: As part of this particular development, three (3) new public municipal roads, which is to fall under the jurisdiction of Mogale City, have been proposed to improve the overall accessibility of each township while also taking into consideration the accessibility of the neighbouring vacant properties. These roads have also been incorporated into the combined Township Layouts for the development in Annexure A and as a result its proposed road reserves and splays have already been accounted for. For the purposes of this study, these roads have **been referred to as 'Road A', 'Road B' and 'Road C', as per** Figure 2 and also the conceptual key plan of the site (Drawing No. 0583/CL/01). See Section 2.3.2 for specific details on each of these future roads.
4. PROPOSED SITE ACCESS INTERSECTIONS: In light of the adjacent provincial Class 2 road, namely Malibongwe Drive (R512 / P103-1 / K29), no direct access to individual properties will be allowed off this higher order road. Therefore, in order to provide access to the proposed townships (entire site) as a whole, one access intersection is proposed to tie in with the existing road network, which will be provided off Malibongwe Road (R512 / P103-1 / K29) by the **formalization of 'Road A'**. The required upgrades for this intersection by the developer is discussed in Section 3.2 as well as Section 6.2 in further detail.

The intersection of **'Road A' and Malibongwe Drive (R512 / P103-1)** is already present and the location of this intersection coincides with Gautrans planning of the K29 road. However, the western approach of this intersection, which is particularly relevant for this development, has only been constructed as a paved asphalt road up to a certain point (approximately a 60m section of road is present) after which the road continues as an unpaved gravel road. Therefore, to provide adequate accessibility to the townships, **'Road A' will be extended further as shown conceptually in** Drawing No. 0583/CL/01 and also discussed in Section 2.3.2.

5. LOCAL TOWNSHIP ACCESS ARRANGEMENTS: Important to note is that all the proposed residential townships (i.e., Extensions 54-59) will have security-controlled accesses and therefore

adequate stacking distance should be provided to ensure that inbound vehicles queuing at the security gates do not impact on other traffic along the adjacent roads. The latest and most relevant guideline, namely the *THM 16 (Vol 2): South African Traffic Impact and Site Traffic Assessment Standards and Requirement Manual (Committee Draft 2.0, October 2019)* was used to determine the required stacking distance requirements for each of the residential township accesses, which is summarised in Table 2 in Section 3.3. With regards to the recommended access configuration, it is proposed that each access have two inbound lanes and two outbound lanes as the access control as conceptually indicated in Drawing No. 0583/CL/01.

Furthermore, as per Annexure A, a total of six (6) residential townships are proposed. However, the developer intends to notarially tie Ext. 54 & 55 in order to provide a single security-controlled access for these two townships. Thus, the development would have five (5) security-controlled accesses in total.

6. To accommodate emergency and service vehicles, it is also necessary to ensure that at least one traffic lane (inbound or outbound) of each access has a width of at least 3.5m wide with a total free-space of 4.5m and a height clearance of 5.2m, or as per the requirements of the local authority. More details of the access arrangements will be provided as part of the submission of **the final Site Development Plans (SDP's) for each township.**
7. TRIP GENERATION: It is estimated that the proposed townships as a whole will generate approximately 919vph (total IN plus OUT) during both the weekday AM and PM peak hours, respectively.
8. ROAD & INTERSECTION UPGRADES: Based on the estimated additional traffic generations of the proposed development as a whole, its projected distribution onto the surrounding road network during the weekday AM and PM peak hours, the capacity analyses in Section 5 as well as on-site observations during the peaks, road and intersection upgrades will be required.

At the intersection of Malibongwe Drive (R512 / P103-1) and Road R114 (P39-1) upgrades have been identified in the approved TIA, issued in 2018 by Dhubecon Consulting Engineers (Pty) Ltd, for the Cosmo City Ext. 33-49 townships. These upgrades are listed in Section 6.1 of the report and also conceptually shown in Drawing No. 0583/CL/03a

Furthermore, it would form part of the authorities' responsibility to reinstate the traffic signals, which have been vandalized/ stolen over the years, at the following key intersections:

- Malibongwe Drive (R512/ P103-1) / N14 (P158-2) Northern Terminal;
- Malibongwe Drive (R512/ P103-1) / N14 (P158-2) Southern Terminal; and
- Malibongwe Drive (R512/ P103-1) / Road R114 (P39-1).

As part of the subject Mogale Ext. 54 – 59 townships, upgrades at the following roads and intersections will be required (see Section 6.2 for further details):

- Malibongwe Drive (R512 / P103-1) / N14 (P158-2) Northern Terminal (Refer to Drawing No. 0583/CL/02);
- Malibongwe Drive (R512 / P103-1) / Road R114 (P39-1) (Refer to Drawing No. 0583/CL/03b);
- Malibongwe Drive (R512 / P103-1) / 'Road A' (Refer to Drawing No. 0583/CL/01); and
- **The implementation of 'Road A', 'Road B' and 'Road C'** with all of its relevant intersections as listed and described in Section 6.2.2 and conceptually shown in Drawing No. 0583/CL/01.

9. In the event of bulk engineering contributions payable with respect to roads and stormwater, it is recommended that at least part of the contribution be off-set against the proposed road and

intersection upgrades, as outlined above, since these upgrades will also benefit other future developments and the relevant road authorities. It is acknowledged that the off-setting of costs against provincial roads could be a problem in terms of the legislation, but it is recommended that CoJ, Mogale City and Gautrans come to some agreement in this respect.

10. **PROPOSED PHASING OF UPGRADES:** The upgrading of the relevant roads and intersections as proposed in Section 6.2 and shown in the attached drawings are applicable to the proposed townships as a whole, which is also the most appropriate way to investigate the overall traffic impact and identify the necessary upgrades. However, due to the high costs of implementing the engineering services for the townships, it is more feasible for a developer to implement the development in phases, which is made possible with smaller townships. This is the main reason for the multiple townships. In giving consideration to the kick-off needed for certain road infrastructure and considering the anticipated traffic generation contribution of each township (or phase) as identified in Table 4 of this report, Table 5 in Section 6.3 proposes the partial implementation of the upgrades, linked to the various townships/ phases. The practical and construction implications of the upgrades had also been taken into account.

Furthermore, depending on the availability of other engineering services such as electricity, water and sewer, as well as market demand, it could be possible that some townships be implemented before others and consequently it may affect the proposed phasing of the road infrastructure implementation. More details of the road upgrades will follow later as part of the services agreement and detail designs to be submitted by the civil engineer.

11. **PROPOSED NON-MOTORISED & PUBLIC TRANSPORT FACILITIES:** It is expected that the proposed development and other nearby developments (i.e., latent rights), as they develop over time, will stimulate the demand for public transport services and it is expected that particularly minibus taxis would respond to this demand by providing more services. With regards to the **public roads traversing the site, it is very likely that 'Road A' will become a popular public transport route in the future.** Therefore, in order to make provision for the users of public transport, generated by the proposed development, the following facilities are proposed:

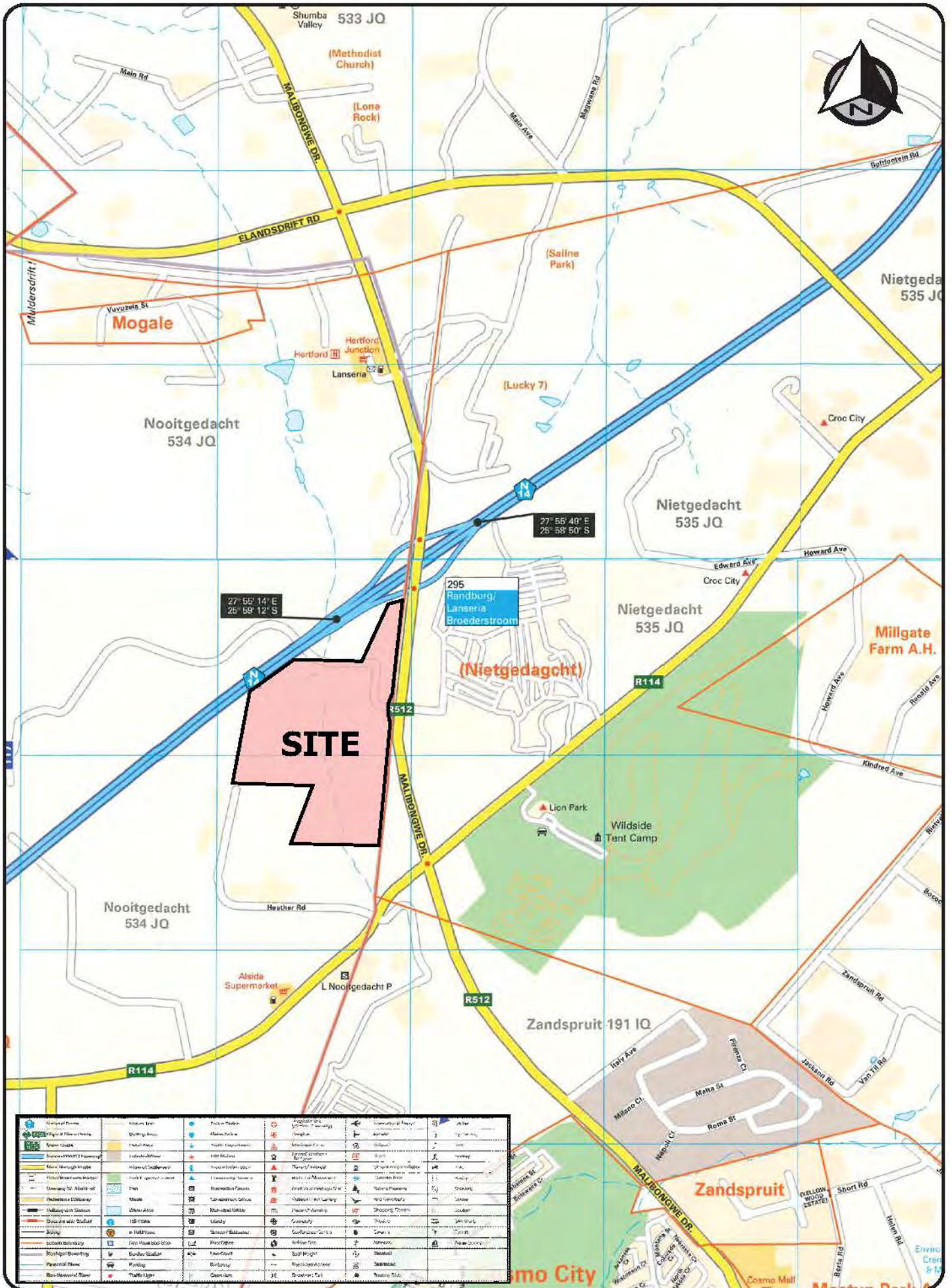
- **Pedestrian Walkways:** With reference to Drawing No. 0583/CL/01, it is recommended that paved pedestrian walkways of at least 1.8m wide be constructed on **either side of 'Road A' from its intersection with Malibongwe Drive (R512) and up to the proposed traffic circle intersection between 'Road A' and 'Road C'.** After this traffic circle, it is recommended that the sidewalk continue on only one side of the road as indicated. This sidewalk should be implemented along at least one side of **'Road B' as well.**
- **Public Transport Laybys:** Since many of the residents, employees (e.g., domestic workers, security personnel) are expected to make use of public transport services, it is suggested that a new set of public transport laybys be constructed at the intersection **between 'Road A' and 'Road C' as per** Drawing No. 0583/CL/01.

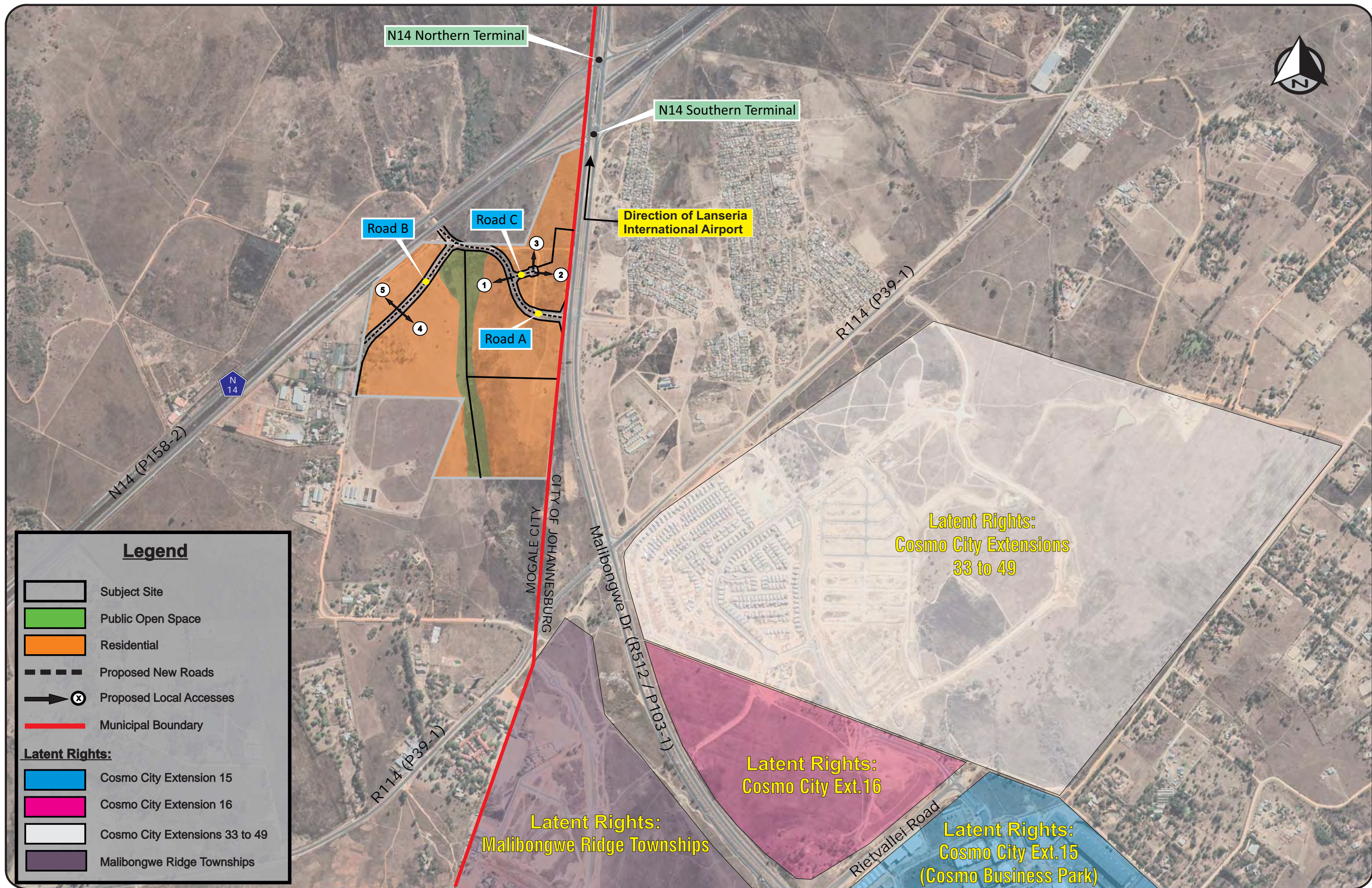
More details of the above would be submitted as part of the Site Development Plans and/or detail designs of the external roads. The final location of the proposed sidewalks and laybys can be discussed with the authorities at design stage of the external roads.

From a traffic engineering perspective, the proposed residential townships known as Mogale Ext 54-59 is supported, provided that the proposed site accesses, external road/intersection upgrades and public transport facilities as proposed in this TIA are being implemented to the relevant design standards of the local and provincial authorities (where relevant).

Figures

- Figure 1 Locality Plan
- Figure 2 Site Aerial View & Key Plan
- Figure 3 **Extract of Gautrans' Strategic Major Road Network (2007)**
- Figure 4 Existing 2022 Peak Hour Traffic Volumes
- Figure 5a Latent Rights Trips: Cosmo City Ext. 33-49
- Figure 5b Latent Rights Trips: Malibongwe Ridge
- Figure 5c Latent Rights Trips: Cosmo City Ext. 16
- Figure 5d Latent Rights Trips: Cosmo City Ext. 15
- Figure 6 TOTAL Latent Rights Trips
- Figure 7 Future 2027 Base Peak Hour Traffic Volumes PLUS
TOTAL Latent Rights Trips
- Figure 8 Expected Development Trip Distribution
- Figure 9 Estimated Development Trips
- Figure 10 Existing 2022 Peak Hour Traffic Volumes PLUS
Estimated Development Trips
- Figure 11 Future 2027 Base Peak Hour Traffic Volumes PLUS
Estimated Development Trips PLUS TOTAL Latent Rights Trips





Legend

- Subject Site
- Public Open Space
- Residential
- Proposed New Roads
- ⊗ Proposed Local Accesses
- Municipal Boundary

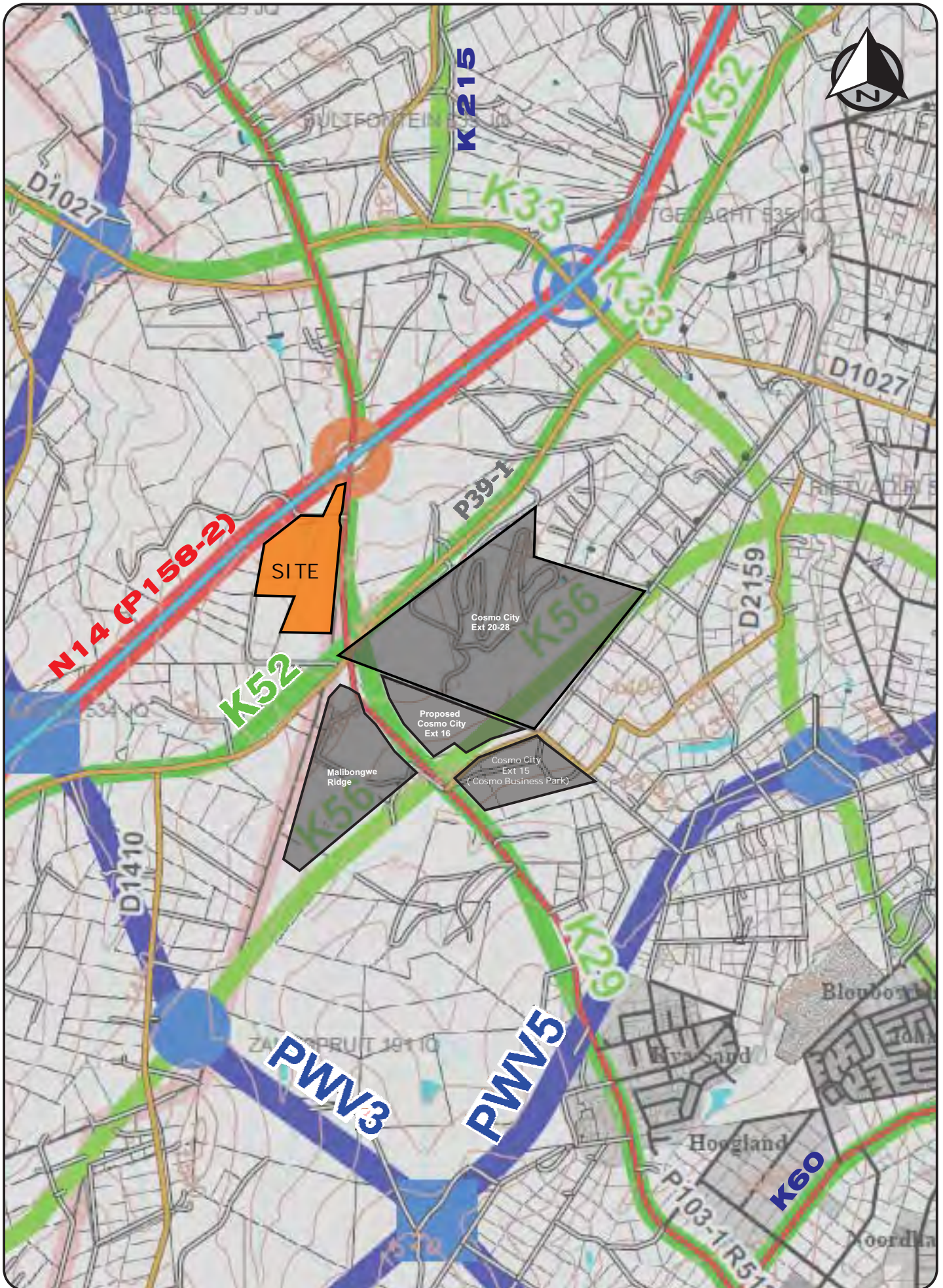
Latent Rights:

- Cosmo City Extension 15
- Cosmo City Extension 16
- Cosmo City Extensions 33 to 49
- Malibongwe Ridge Townships

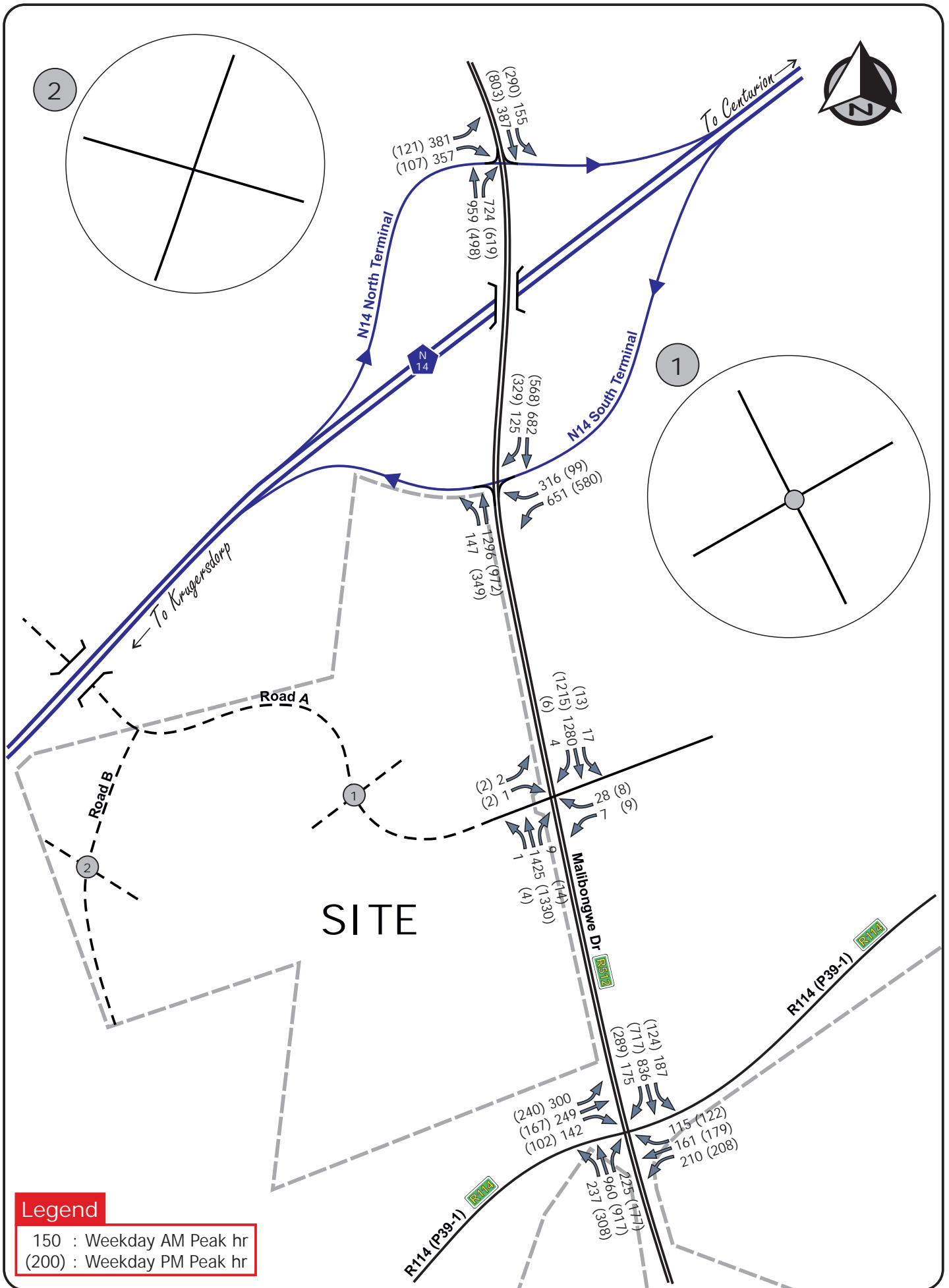
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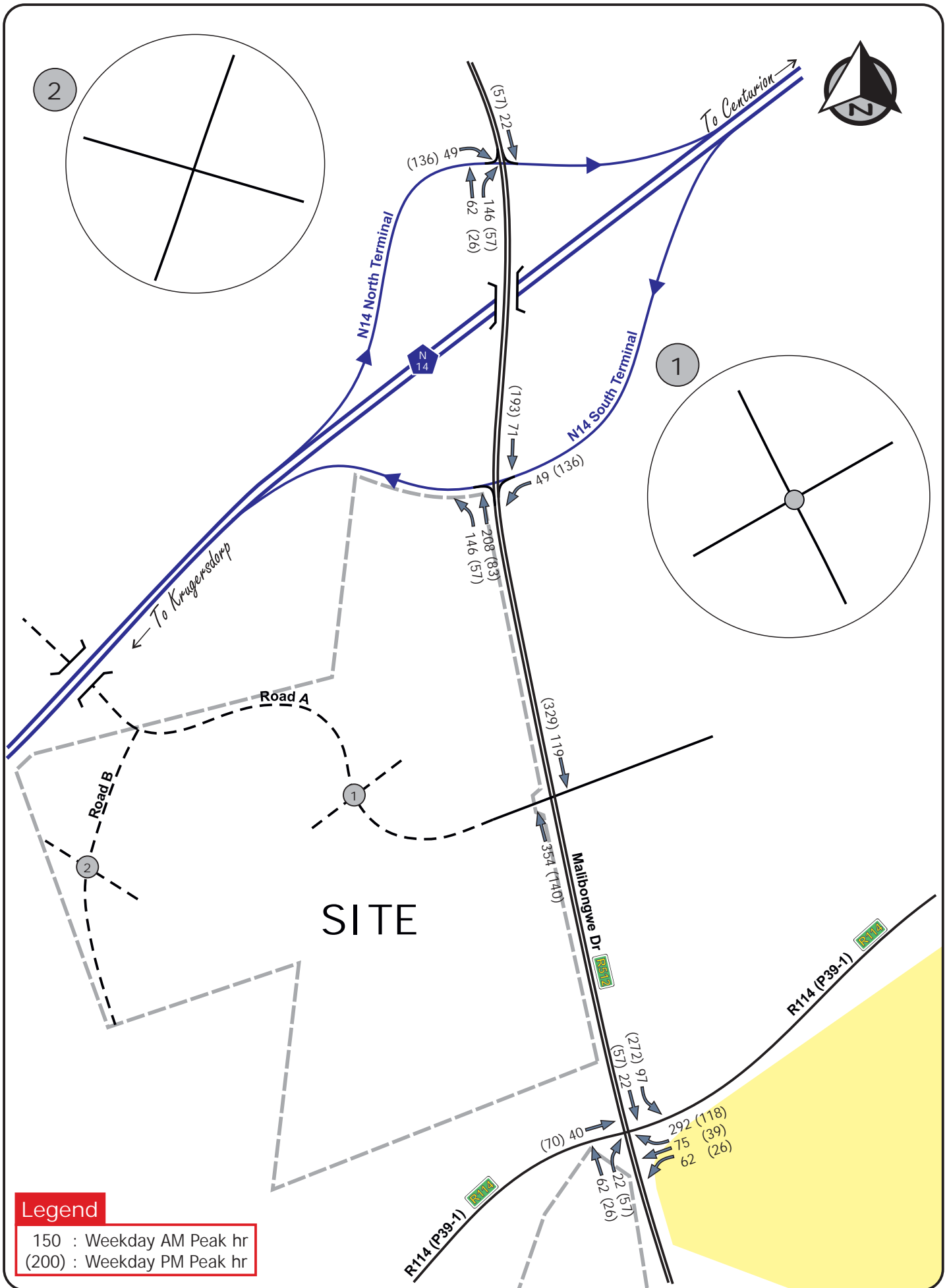
Project Name	Mogale Ext. 54-59
Description	Site Aerial View & Key Plan

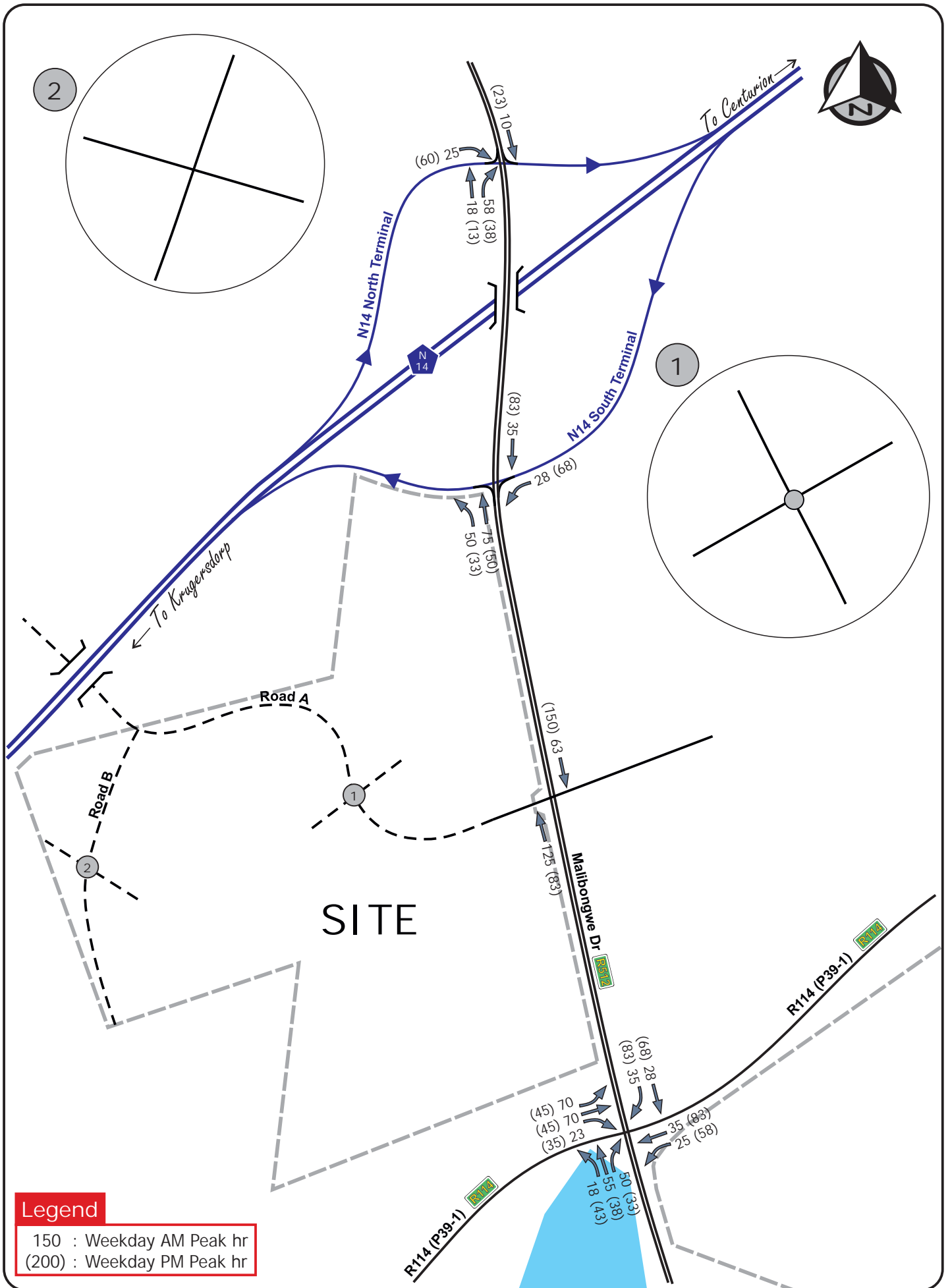
Proj Ref.	P0583
Figure	2

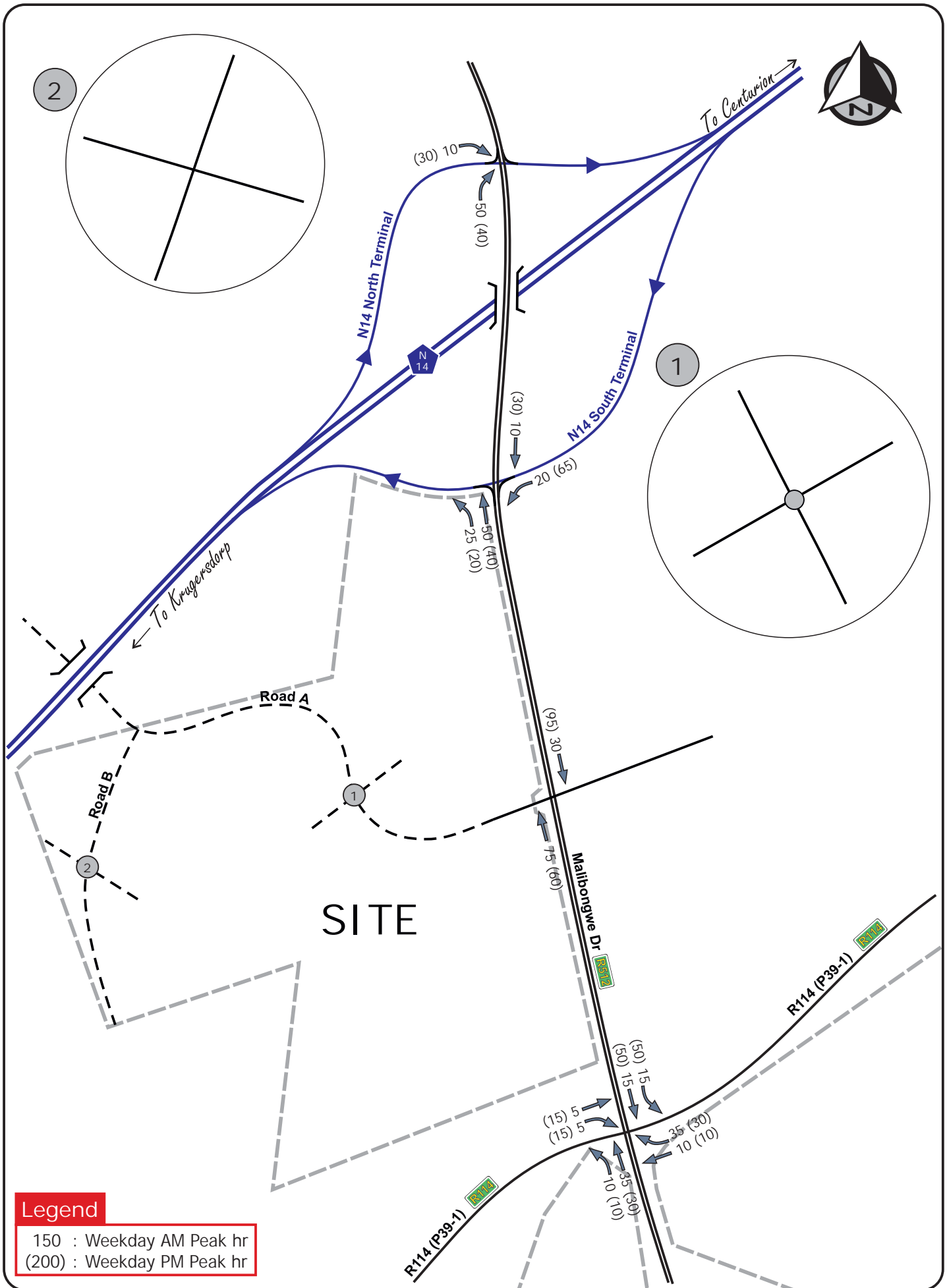


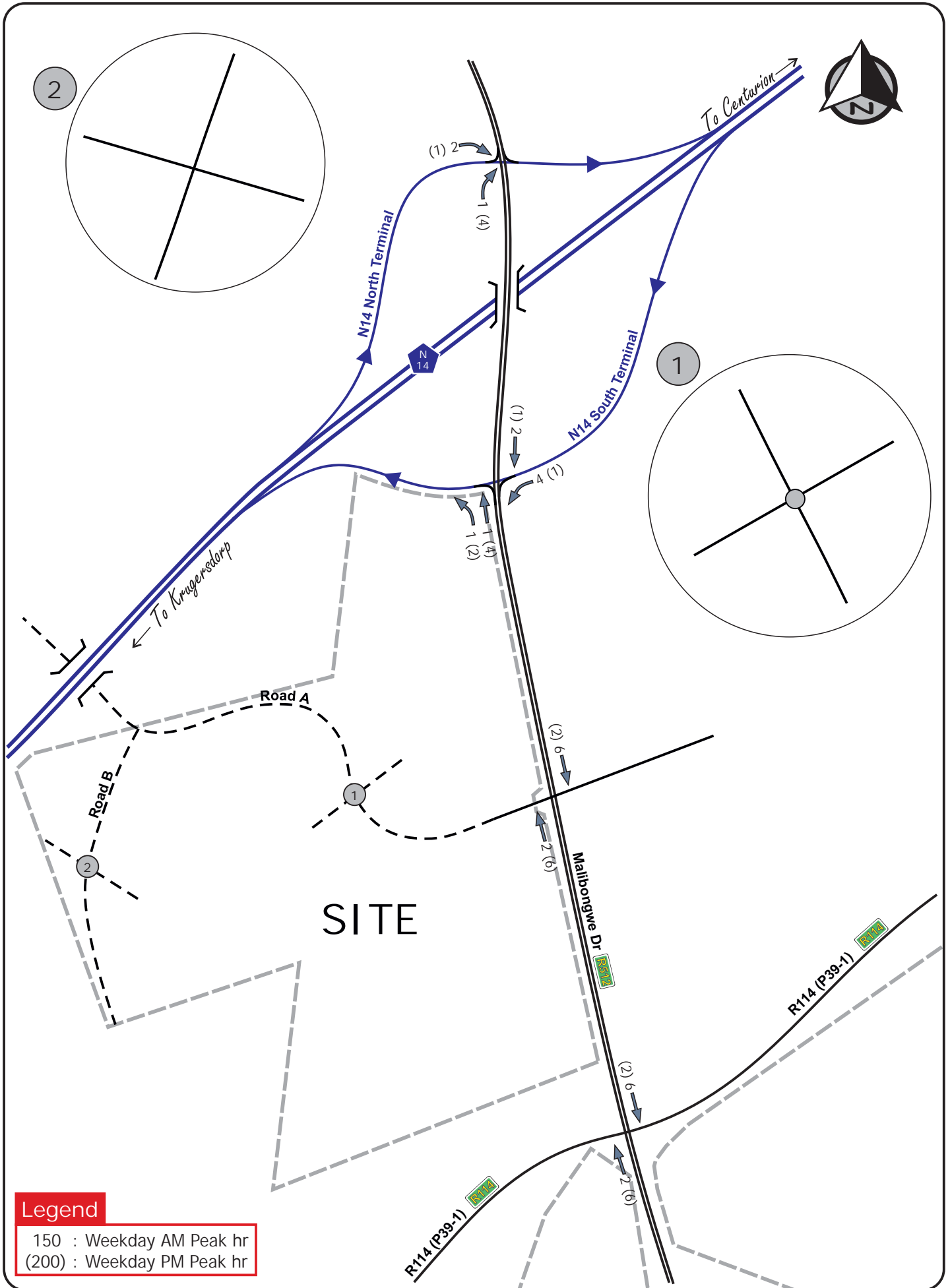
Project Name	Mogale Ext. 54-59	Proj Ref.	P0583
Description	Extract of Gautrans' Strategic Road Network (2007)	Figure	3







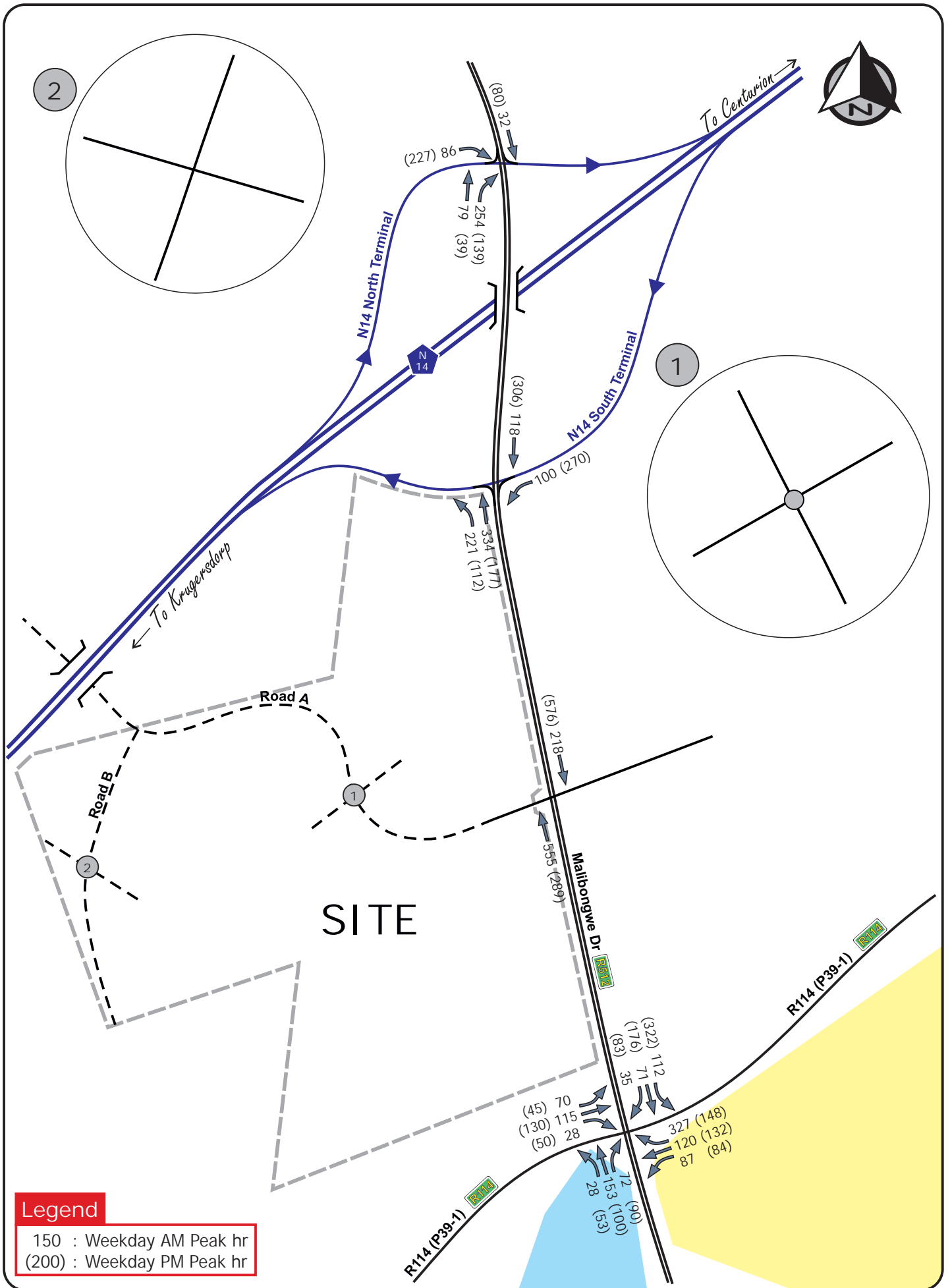


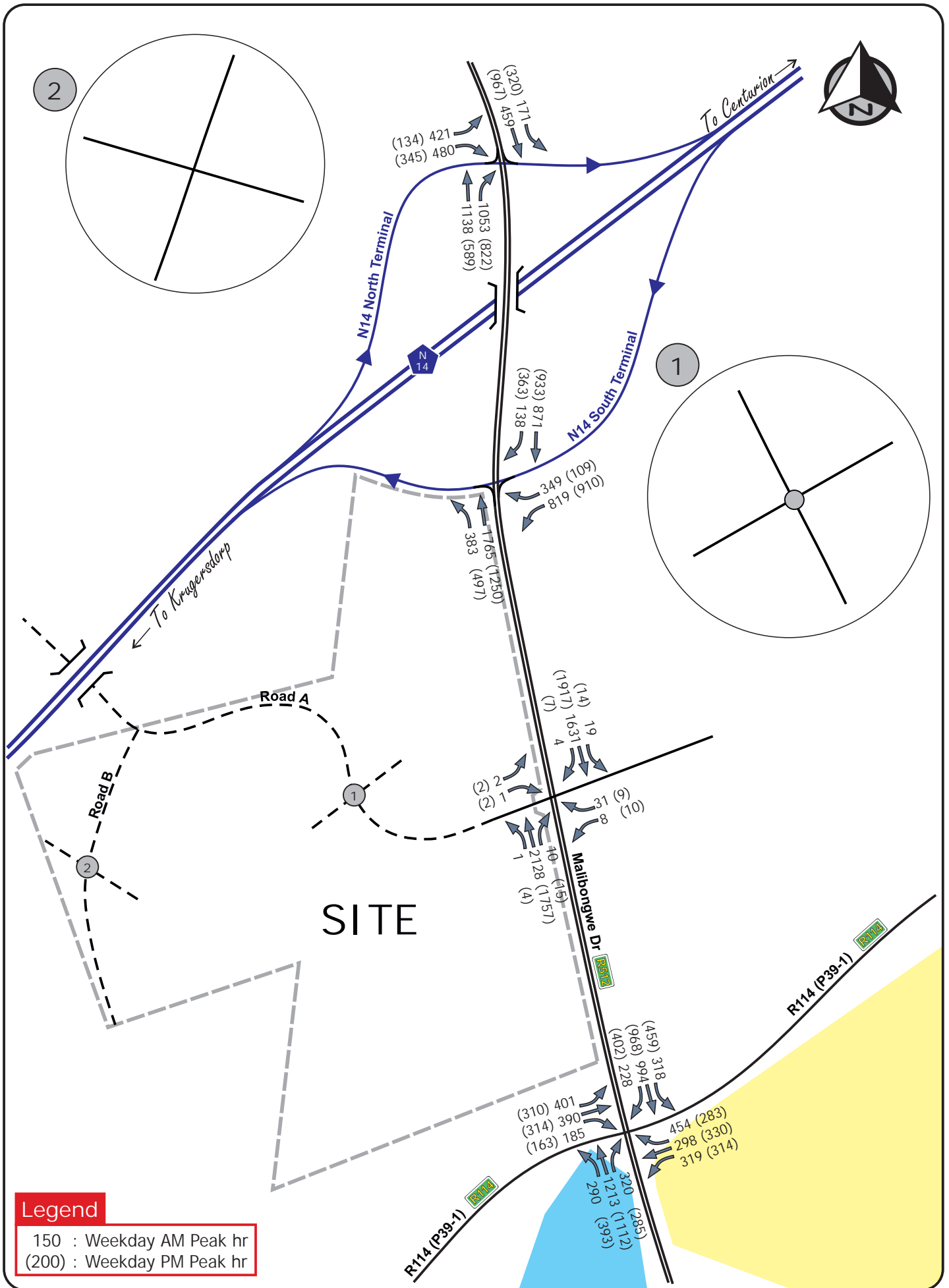


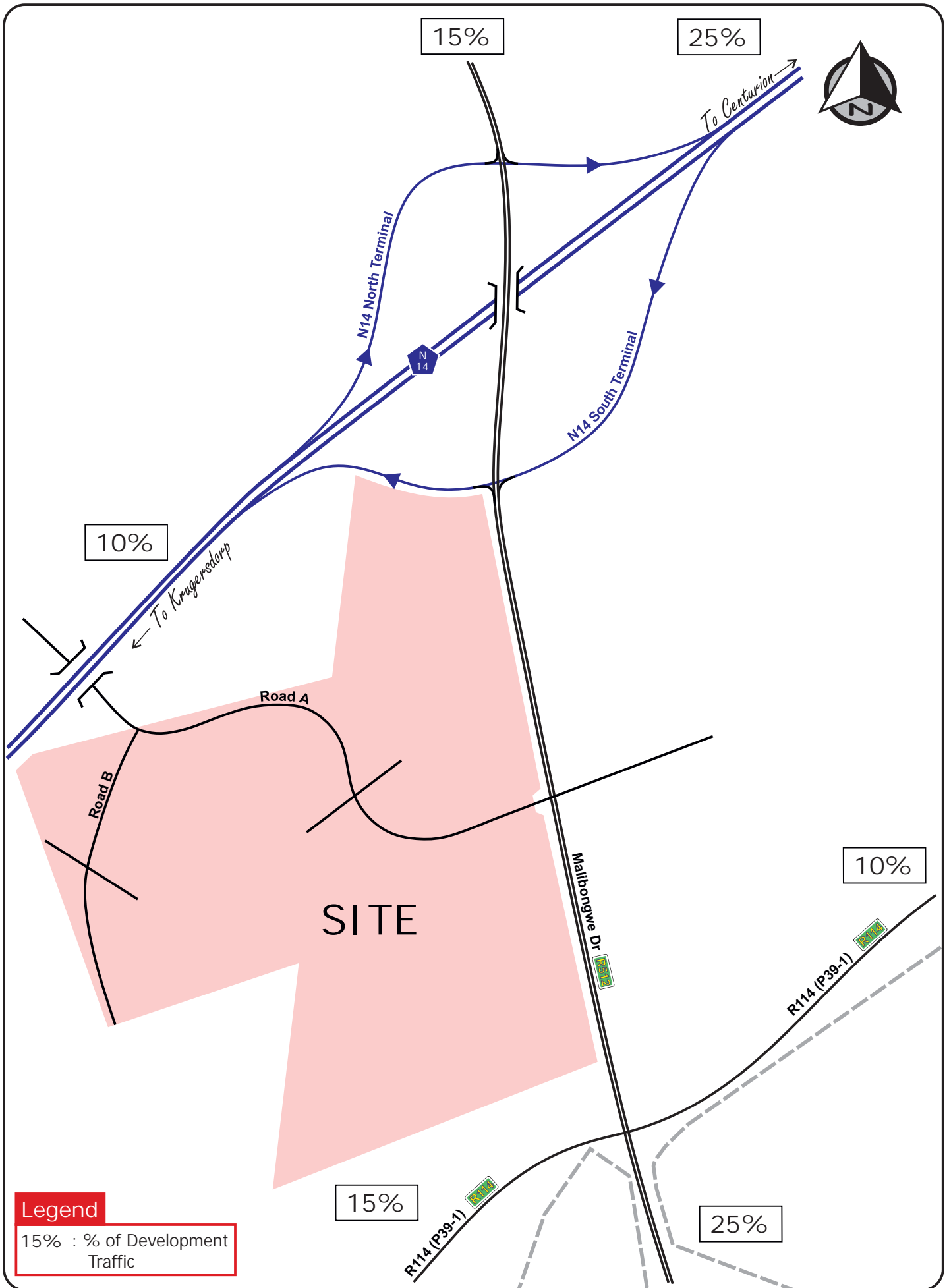
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 150 : Weekday AM Peak hr
 (200) : Weekday PM Peak hr



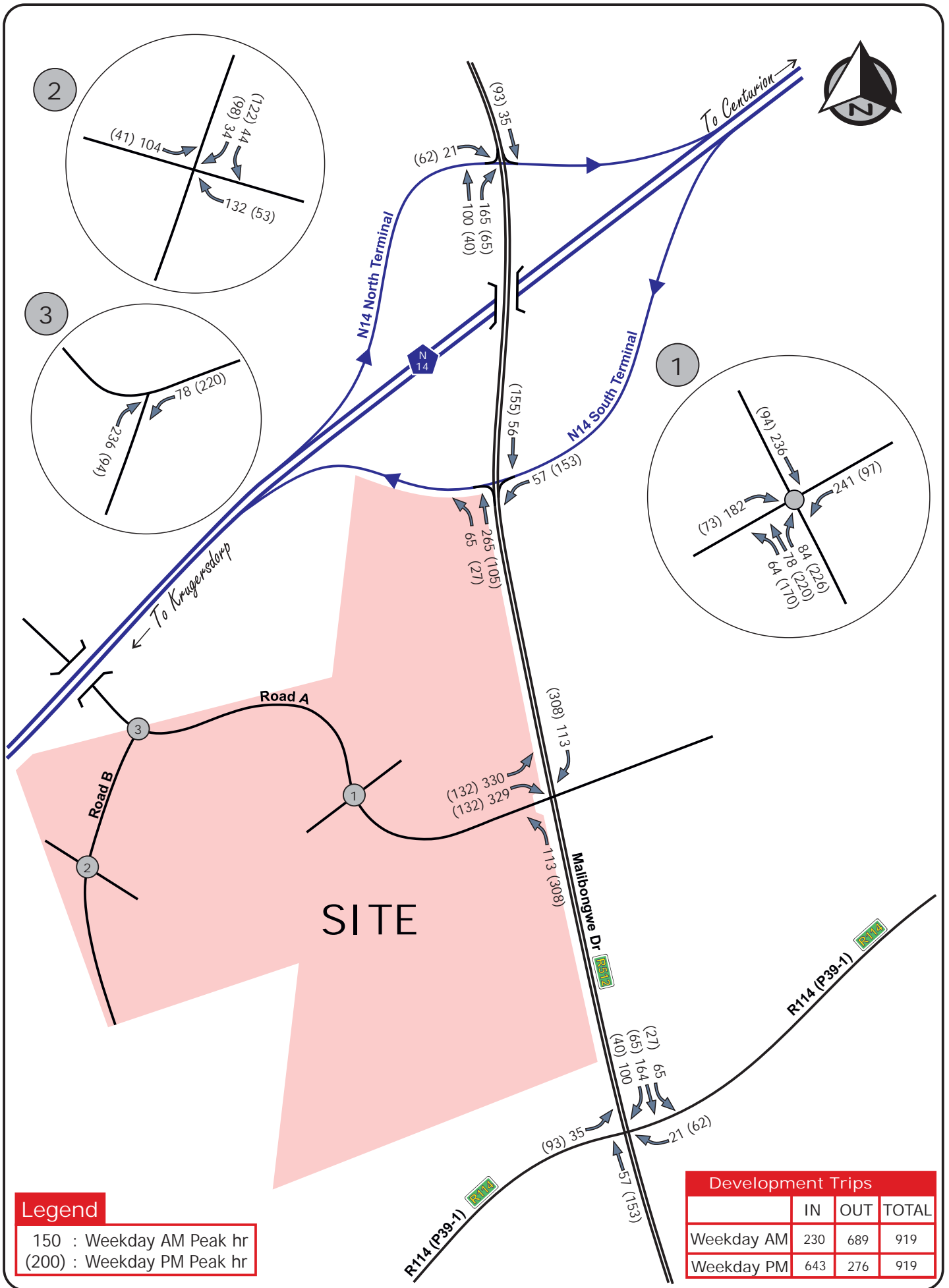
Project Name	Mogale Ext. 54-59	Proj Ref.	P0583
Description	Latent Rights Trips: Cosmo City Ext. 15 (Cosmo Business Park)	Figure	5d







Project Name	Mogale Ext. 54-59	Proj Ref.	P0583
Description	Expected Development Trip Distribution	Figure	8



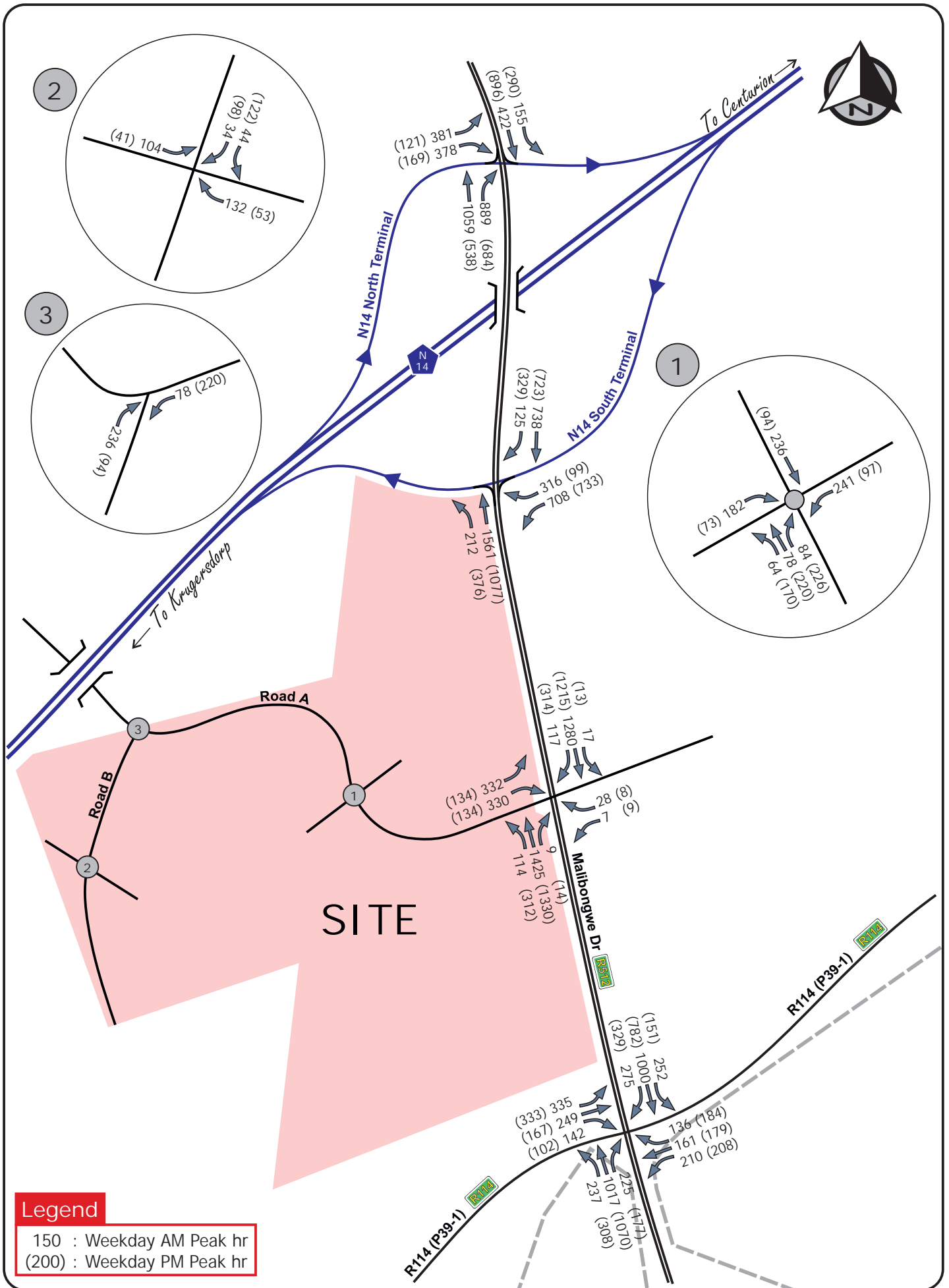
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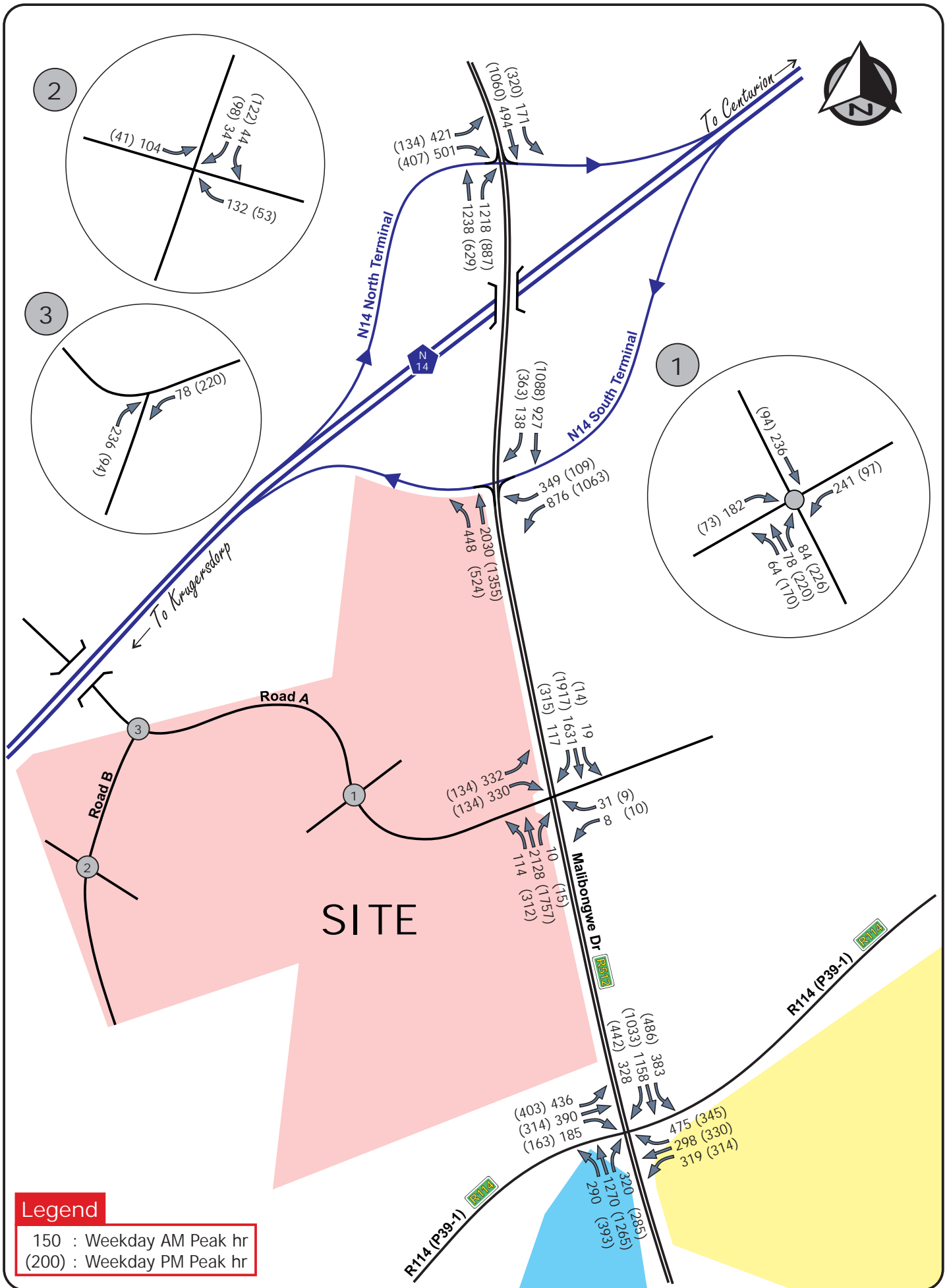
150 : Weekday AM Peak hr
 (200) : Weekday PM Peak hr

Development Trips			
	IN	OUT	TOTAL
Weekday AM	230	689	919
Weekday PM	643	276	919



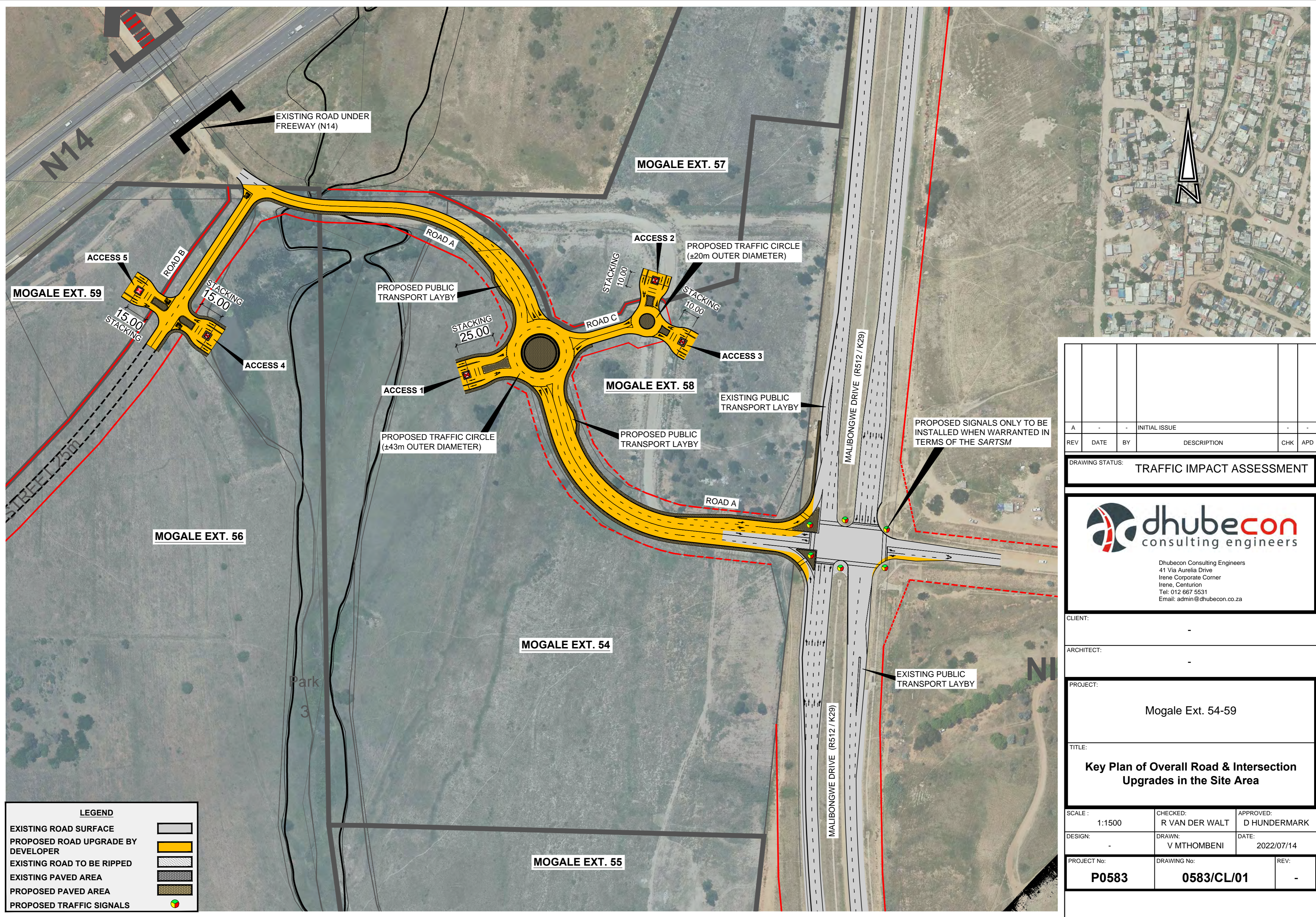
Project Name	Mogale Ext. 54-59	Proj Ref.	P0583
Description	Estimated Development Trips	Figure	9





Drawings

Drawing No. 0583/CL/01	Key Plan of Overall Road & Intersection Upgrades in the Site Area
Drawing No. 0583/CL/02	Proposed Road & Intersection Upgrades: Malibongwe Drive (R512/ P103-1) & the N14 (P158-2) Northern Terminal
Drawing No. 0583/CL/03a	Proposed Road & Intersection Upgrades: Malibongwe Drive (R512/ P103-1) & Road R114 (P39-1) [For Authorities/Other Developments]
Drawing No. 0583/CL/03b	Proposed Road & Intersection Upgrades: Malibongwe Drive (R512/ P103-1) & Road R114 (P39-1) [For Subject Development]



LEGEND

EXISTING ROAD SURFACE	
PROPOSED ROAD UPGRADE BY DEVELOPER	
EXISTING ROAD TO BE RIPPED	
EXISTING PAVED AREA	
PROPOSED PAVED AREA	
PROPOSED TRAFFIC SIGNALS	

A	-	-	INITIAL ISSUE	-	-
REV	DATE	BY	DESCRIPTION	CHK	APD

DRAWING STATUS: **TRAFFIC IMPACT ASSESSMENT**

dhubecon
consulting engineers

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41 Via Aurelia Drive
Irene Corporate Corner
Irene, Centurion
Tel: 012 667 5531
Email: admin@dhubecon.co.za

CLIENT: -

ARCHITECT: -

PROJECT: **Mogale Ext. 54-59**

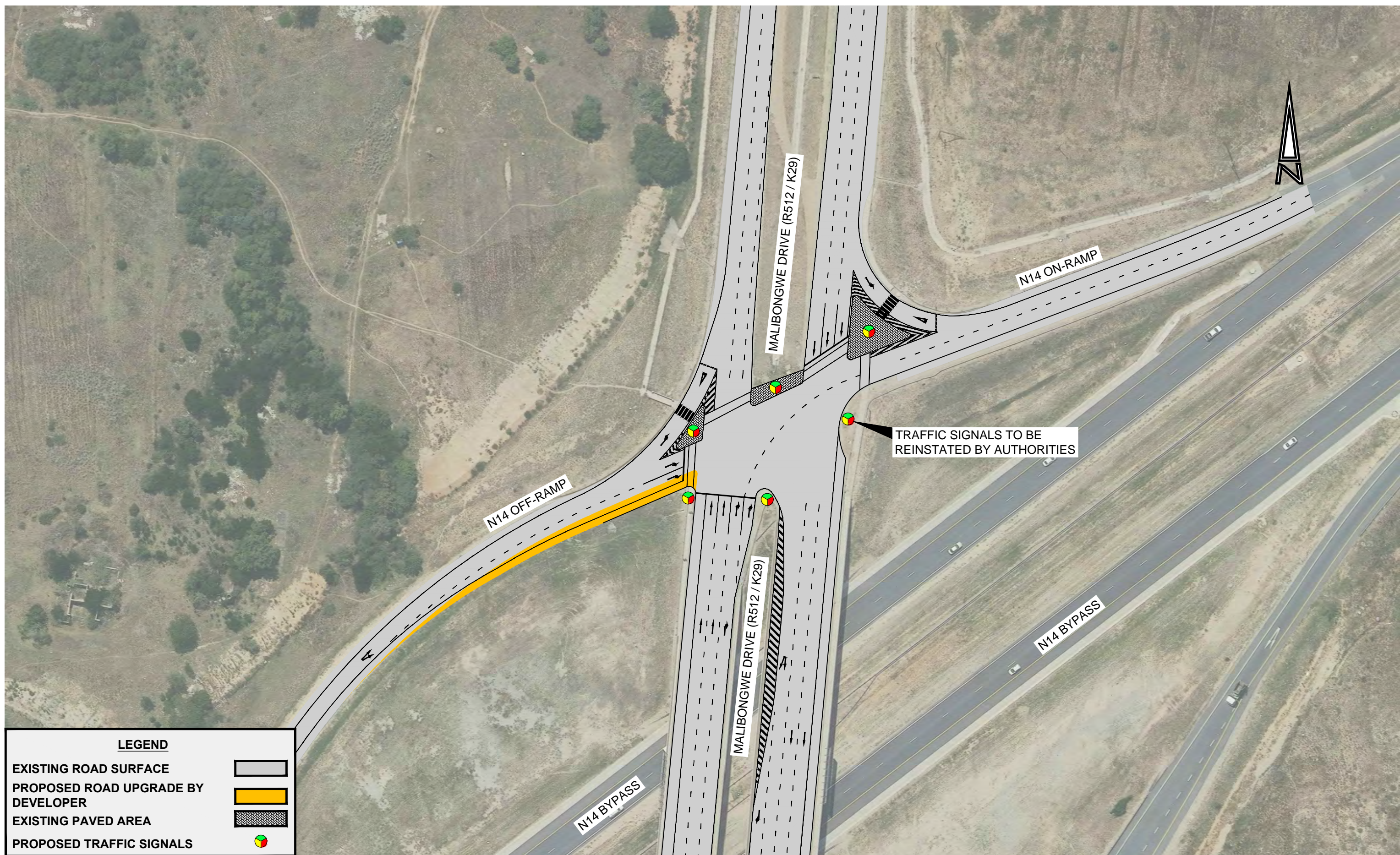
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SCALE: 1:1500	CHECKED: R VAN DER WALT	APPROVED: D HUNDERMARK
DESIGN: -	DRAWN: V MTHOMBENI	DATE: 2022/07/14

PROJECT No: P0583	DRAWING No: 0583/CL/01	REV: -
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PROPOSED SIGNALS ONLY TO BE INSTALLED WHEN WARRANTED IN TERMS OF THE SARTSM

EXISTING PUBLIC TRANSPORT LAYBY



LEGEND

- EXISTING ROAD SURFACE
- PROPOSED ROAD UPGRADE BY DEVELOPER
- EXISTING PAVED AREA
- PROPOSED TRAFFIC SIGNALS

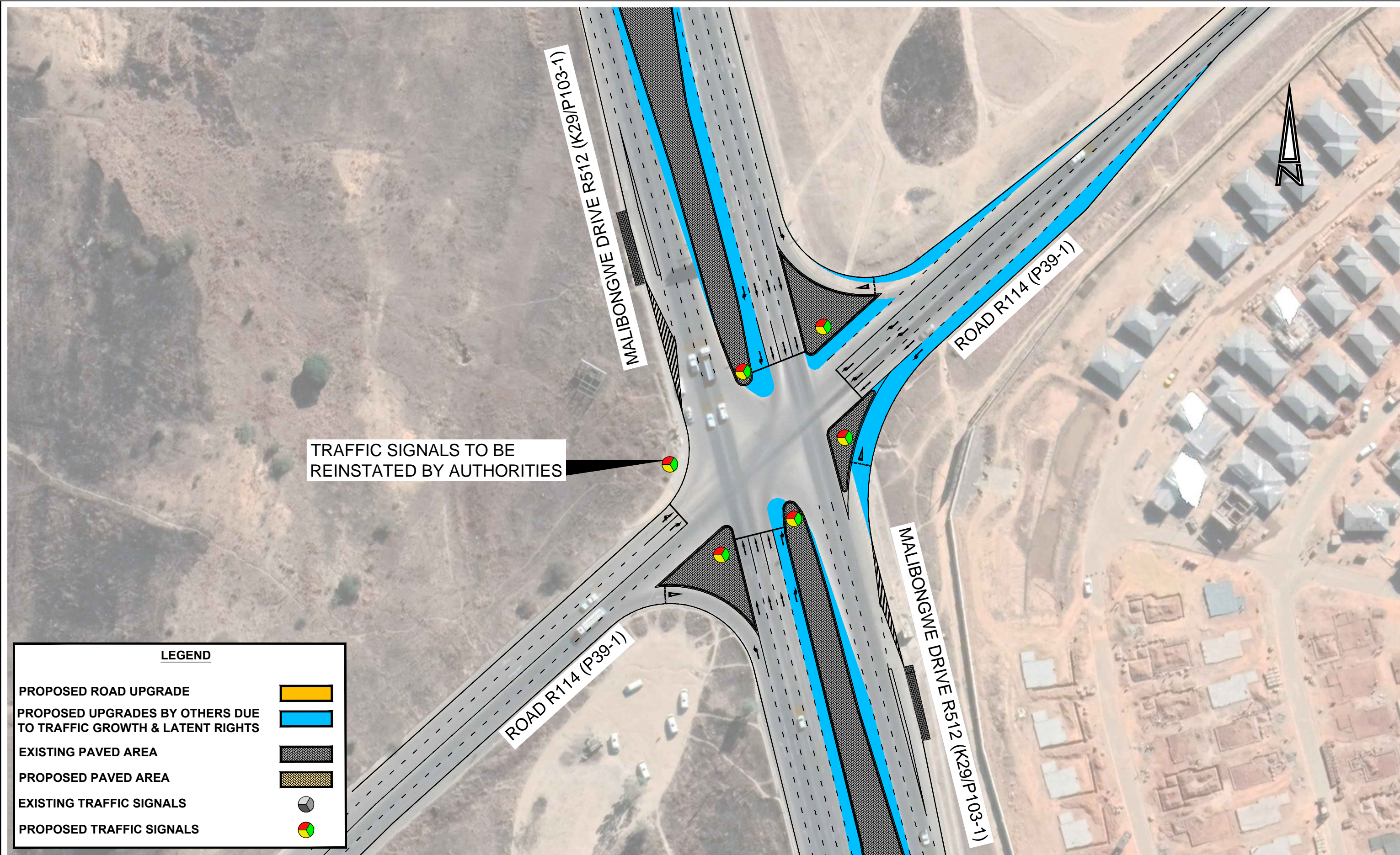
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DRAWING STATUS: TRAFFIC IMPACT ASSESSMENT					

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 41 Via Aurelia Drive
 Irene Corporate Corner
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PROJECT:	Mogale Ext. 54-59
TITLE:	Proposed Road & Intersection Upgrades: Malibongwe Drive (R512 / P103-1) & the N14 (P158-2) Northern Terminal

SCALE:	1:1000	CHECKED:	R VAN DER WALT	APPROVED:	D HUNDERMARK
DESIGN:	-	DRAWN:	V MTHOMBENI	DATE:	2022/06/13
PROJECT No:	P0583	DRAWING No:	0583/CL/02	REV:	-



LEGEND	
PROPOSED ROAD UPGRADE	
PROPOSED UPGRADES BY OTHERS DUE TO TRAFFIC GROWTH & LATENT RIGHTS	
EXISTING PAVED AREA	
PROPOSED PAVED AREA	
EXISTING TRAFFIC SIGNALS	
PROPOSED TRAFFIC SIGNALS	

REV	DATE	BY	DESCRIPTION	CHK	APD
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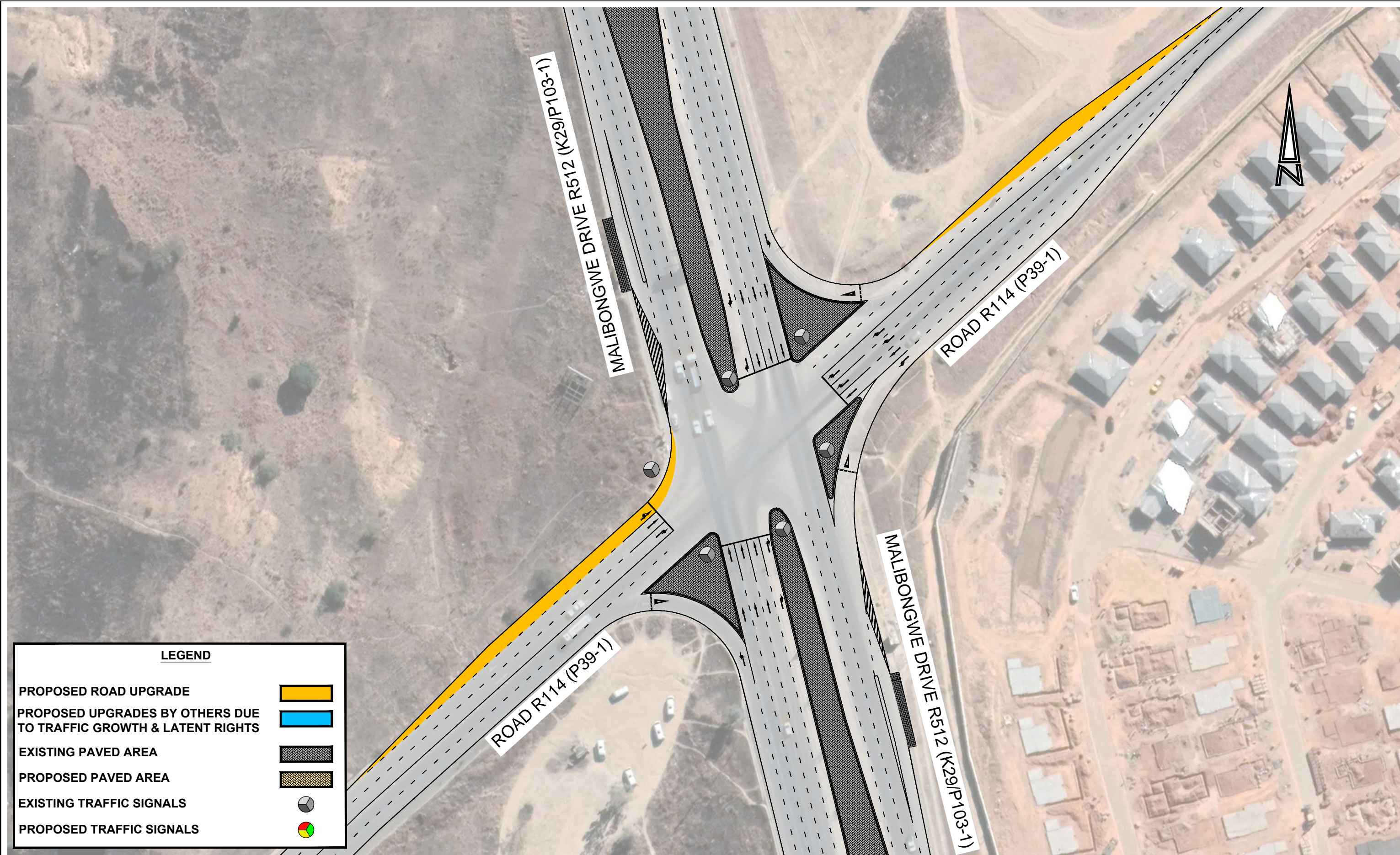
DRAWING STATUS: TRAFFIC IMPACT ASSESSMENT

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 Email: admin@dhubecon.co.za



PROJECT:	Mogale Ext. 54-59
TITLE:	Proposed Intersection Upgrade: Malibongwe Drive R514 (K29/P103-1) & Road R114 (P39-1) [For Authorities / Other Developments]

SCALE:	1:1000	CHECKED:	R VAN DER WALT	APPROVED:	D HUNDERMARK
DESIGN:	-	DRAWN:	T MALEKANE	DATE:	2022/07/14
PROJECT No:	P0583	DRAWING No:	0583/CL/03a	REV:	-



LEGEND	
PROPOSED ROAD UPGRADE	
PROPOSED UPGRADES BY OTHERS DUE TO TRAFFIC GROWTH & LATENT RIGHTS	
EXISTING PAVED AREA	
PROPOSED PAVED AREA	
EXISTING TRAFFIC SIGNALS	
PROPOSED TRAFFIC SIGNALS	

REV	DATE	BY	DESCRIPTION	CHK	APD
A	-	-	INITIAL ISSUE	-	-

DRAWING STATUS: TRAFFIC IMPACT ASSESSMENT

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 Irene Corporate Corner
 Irene, Centurion
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PROJECT:	Mogale Ext. 54-59		
TITLE:	Proposed Intersection Upgrade: Malibongwe Drive R514 (K29/P103-1) & Road R114 (P39-1) [For Subject Development]		
SCALE:	1:1000	CHECKED:	R VAN DER WALT
DESIGN:	-	DRAWN:	T MALEKANE
PROJECT No:	P0583	DRAWING No:	0583/CL/03b
		APPROVED:	D HUNDERMARK
		DATE:	2022/06/13
		REV:	-

Annexures

- Annexure A **Town Planner's Proposed** Combined Township Layout Plan
- Annexure B Relevant Outputs of the PTV Vistro 2022 Intersection Capacity Analyses

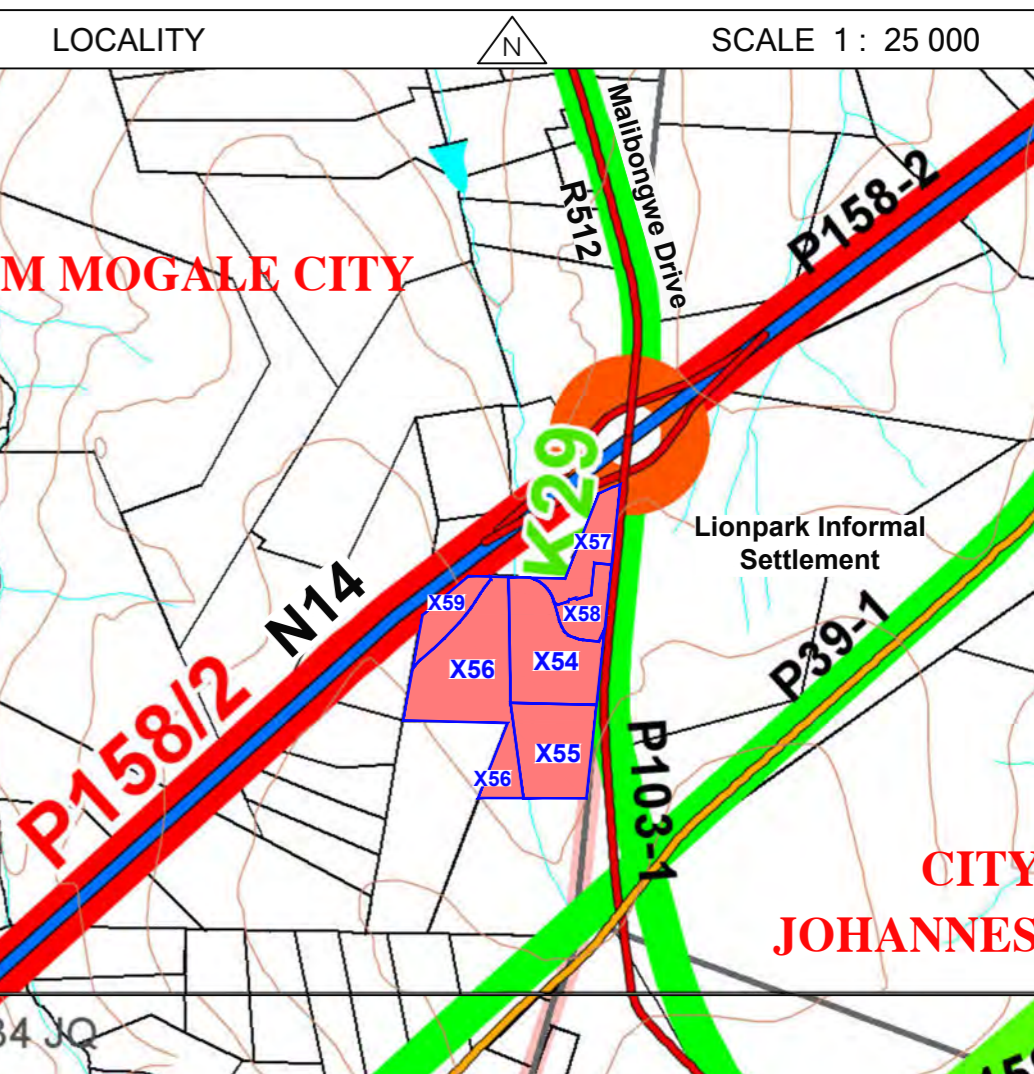
Annexure A

Town Planner's Proposed Combined Township Layout Plan

LION PRIDE EXTENSION

MOGALE EXT. 54 - X59

To be Situated on
Part of Remainder of Portion 23,
Part of Portion 162, and
Part of Remainder of Portion 196
of the farm **NOOITGEDACHT 534-JQ**



MOGALE EXT. 54

USES	No. OF ERVEN	ERF NUMBERS	AREA (ha)	%
Residential 3 40 units / ha	1	1	6,7768	70.96
Private Open Space	1	2	1,3393	14.02
Existing street			1,4339	15.02
Total	2		9,5500	100.00

MOGALE EXT. 55

USES	No. OF ERVEN	ERF NUMBERS	AREA (ha)	%
Residential 3 40 units / ha	1	1	6,6569	86.70
Private Open Space	1	2	1,0208	13.30
Total	2		7,6777	100.00

MOGALE EXT. 56

USES	No. OF ERVEN	ERF NUMBERS	AREA (ha)	%
Residential 3 40 units / ha	2	1-2	9,7840	72.94
Private Open Space	1	3	2,3259	17.34
Existing street			1,3032	9.72
Total	3		13,4131	100.00

MOGALE EXT. 57

USES	No. OF ERVEN	ERF NUMBERS	AREA (ha)	%
Residential 4 130 units / ha	2	1-2	3,9301	100.00
Total	2		3,9301	100.00

MOGALE EXT. 58

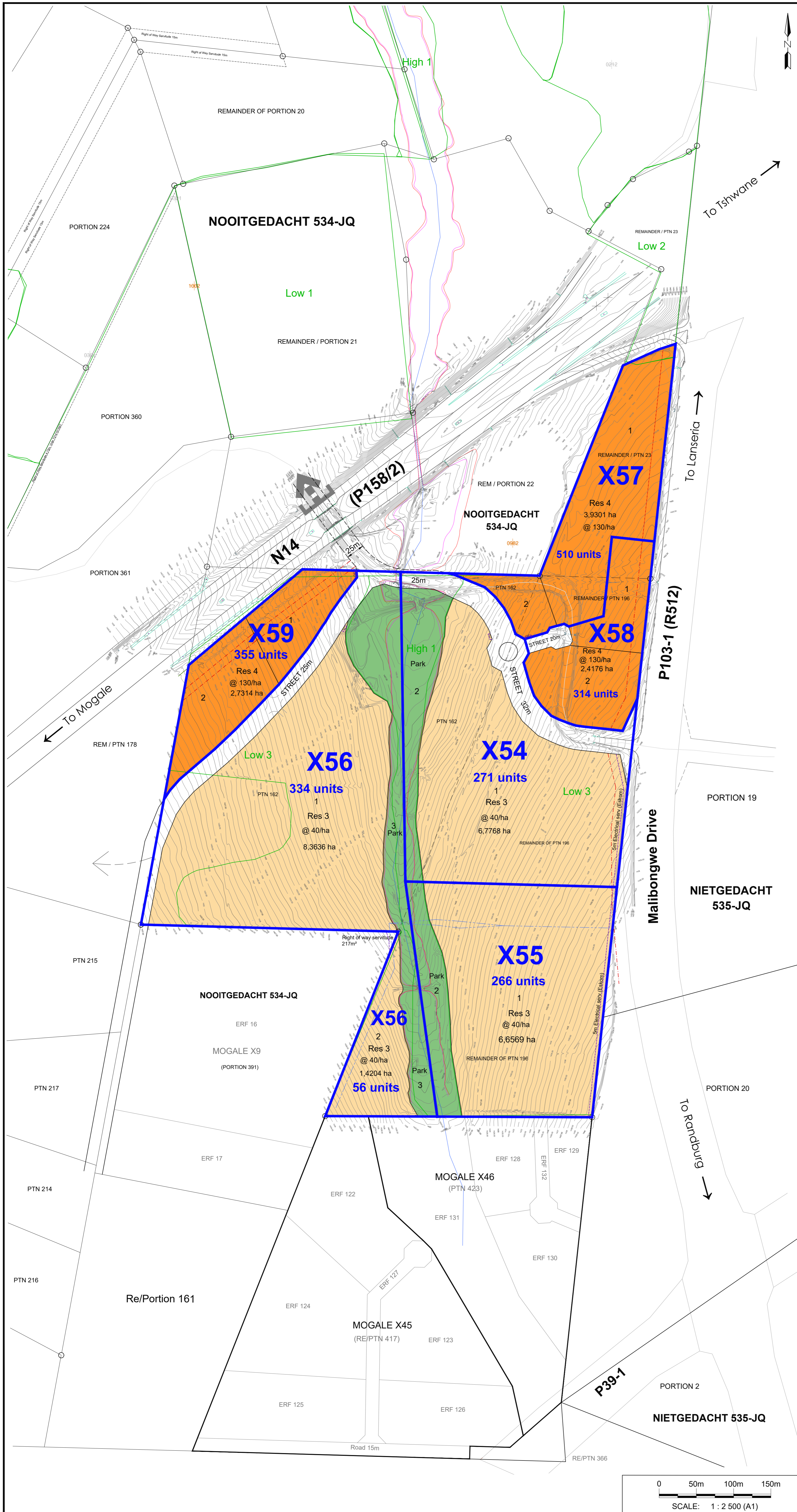
USES	No. OF ERVEN	ERF NUMBERS	AREA (ha)	%
Residential 4 130 units / ha	2	1-2	2,4176	94.24
Existing Street			0,1478	5.76
Total	2		2,5654	100.00

MOGALE EXT. 59

USES	No. OF ERVEN	ERF NUMBERS	AREA (ha)	%
Residential 4 130 units / ha	2	1-2	2,7314	100.00
Total	2		2,7314	100.00

Total number of units

Res 4 (130/ha)	: 1 179
Res 3 (40/ha)	: 927
Total	: 2 106



Sonya Messner-Roloff
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Highveld Office Park
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PLAN NUMBER: SMRS86 / combined 10
DATE: JUNE 2022

Annexure B

Relevant Outputs of the PTV Vistro 2022 Intersection Capacity Analyses
(Order of Appearance)




Peak Hour	Analysis Scenario (as per Section 5)	Relevant Intersections (as per Section 5)	Annexure
Weekday AM Peak	Scenario 1	Intersections 1-3	B1
	Scenario 2	Intersections 1-3	B2
	Scenario 3	Intersections 1-6	B3
	Scenario 4	Intersections 1-6	B4
	Scenario 4 (Proposed Upgrades)	Intersections 1 & 3	B5
Weekday PM Peak	Scenario 1	Intersections 1-3	B6
	Scenario 2	Intersections 1-3	B7
	Scenario 3	Intersections 1-6	B8
	Scenario 4	Intersections 1-6	B9
	Scenario 4 (Proposed Upgrades)	Intersections 1 & 3	B10

Intersection Level Of Service Report

Intersection 1: Malibongwe Dr (R512 / K29) - N14 Northern Terminal

Control Type:	Signalized	Delay (sec / veh):	21.5
Analysis Method:	HCM 7th Edition	Level Of Service:	C
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.698

Intersection Setup

Name	Malibongwe			Malibongwe			N14 Off-Ramp			N14 On-Ramp		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.50	3.70	3.70	3.70	3.70	3.50	3.70	3.70	3.70	3.50	3.50	3.50
No. of Lanes in Entry Pocket	0	0	1	1	0	0	0	0	0	0	0	0
Entry Pocket Length [m]	30.48	30.48	15.00	110.00	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Speed [km/h]	60.00			60.00			60.00			60.00		
Grade [%]	0.00			0.00			0.00			0.00		
Curb Present	No			No			No					
Crosswalk	No			No			No			No		

Movement, Approach, & Intersection Results

d_M, Delay for Movement [s/veh]	0.00	16.26	20.02	29.00	24.93	0.00	26.42	26.42	26.42	0.00	0.00	0.00
Movement LOS		B	C	C	C		C	C	C			
d_A, Approach Delay [s/veh]		17.88		26.09			26.42			0.00		
Approach LOS		B		C			C			A		
d_I, Intersection Delay [s/veh]	21.51											
Intersection LOS	C											
Intersection V/C	0.698											

Other Modes

g_Walk,mi, Effective Walk Time [s]	0.0		0.0			0.0			0.0		
M_corner, Corner Circulation Area [m²/pec]	0.00		0.00			0.00			0.00		
M_CW, Crosswalk Circulation Area [m²/pec]	0.00		0.00			0.00			0.00		
d_p, Pedestrian Delay [s]	0.00		0.00			0.00			0.00		
l_p,int, Pedestrian LOS Score for Intersection	0.000		0.000			0.000			0.000		
Crosswalk LOS	F		F			F			F		
s_b, Saturation Flow Rate of the bicycle lane	2000		2000			2000			2000		
c_b, Capacity of the bicycle lane [bicycles/h]	700		267			833			0		
d_b, Bicycle Delay [s]	12.68		22.53			10.21			30.00		
l_b,int, Bicycle LOS Score for Intersection	3.132		1.984			2.953			4.132		
Bicycle LOS	C		A			C			D		

Sequence

Ring 1	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	-	6	-	8	-	-	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-






Intersection Level Of Service Report

Intersection 2: Malibongwe Dr (R512 / K29) - N14 Southern Terminal

Control Type:	Signalized	Delay (sec / veh):	14.3
Analysis Method:	HCM 7th Edition	Level Of Service:	B
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.407

Intersection Setup

Name	Malibongwe			Malibongwe			N14 On-Ramp			N14 Off-Ramp		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.70	3.70	3.50	3.50	3.70	3.70	3.50	3.50	3.50	3.70	3.70	3.70
No. of Lanes in Entry Pocket	0	0	1	0	0	1	0	0	0	1	0	1
Entry Pocket Length [m]	30.48	30.48	90.00	30.48	30.48	90.00	30.48	30.48	30.48	150.00	30.48	90.00
No. of Lanes in Exit Pocket	1	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	90.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Speed [km/h]	60.00			60.00			60.00			60.00		
Grade [%]	0.00			0.00			0.00			0.00		
Curb Present	No			No						No		
Crosswalk	No			No			No			No		

Movement, Approach, & Intersection Results

d_M, Delay for Movement [s/veh]	19.14	17.48	0.00	0.00	5.21	9.13	0.00	0.00	0.00	0.00	20.45	20.45
Movement LOS	B	B			A	A					C	C
d_A, Approach Delay [s/veh]	17.65				5.82		0.00				20.45	
Approach LOS	B				A		A				C	
d_I, Intersection Delay [s/veh]	14.27											
Intersection LOS	B											
Intersection V/C	0.407											

Other Modes

g_Walk,mi, Effective Walk Time [s]	0.0		0.0		0.0		0.0	
M_corner, Corner Circulation Area [m²/pec]	0.00		0.00		0.00		0.00	
M_CW, Crosswalk Circulation Area [m²/pec]	0.00		0.00		0.00		0.00	
d_p, Pedestrian Delay [s]	0.00		0.00		0.00		0.00	
l_p,int, Pedestrian LOS Score for Intersection	0.000		0.000		0.000		0.000	
Crosswalk LOS	F		F		F		F	
s_b, Saturation Flow Rate of the bicycle lane	2000		2000		2000		2000	
c_b, Capacity of the bicycle lane [bicycles/h]	700		1133		0		400	
d_b, Bicycle Delay [s]	12.68		5.63		30.00		19.20	
l_b,int, Bicycle LOS Score for Intersection	2.506		2.138		4.132		2.220	
Bicycle LOS	B		B		D		B	

Sequence





Ring 1	-	2	-	4	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	5	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Intersection Level Of Service Report
Intersection 3: Malibongwe Dr (R512 / K29) - R114

Control Type:	Signalized	Delay (sec / veh):	39.9
Analysis Method:	HCM 7th Edition	Level Of Service:	D
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.687

Intersection Setup

Name	Malibongwe			Malibongwe			R114			R114		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70
No. of Lanes in Entry Pocket	1	0	1	1	0	1	0	0	0	1	0	0
Entry Pocket Length [m]	120.00	30.48	90.00	120.00	30.48	90.00	30.48	30.48	30.48	90.00	30.48	30.48
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	1	0	0
Exit Pocket Length [m]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	90.00	0.00	0.00
Speed [km/h]	60.00			60.00			60.00			60.00		
Grade [%]	0.00			0.00			0.00			0.00		
Curb Present	No			No			No			No		
Crosswalk	No			No			No			No		

Movement, Approach, & Intersection Results

d_M, Delay for Movement [s/veh]	0.00	44.77	25.15	0.00	35.37	24.15	48.18	40.25	39.42	49.98	42.81	41.75
Movement LOS		D	C		D	C	D	D	D	D	D	D
d_A, Approach Delay [s/veh]	41.04			33.43			43.53			45.66		
Approach LOS	D			C			D			D		
d_I, Intersection Delay [s/veh]	39.93											
Intersection LOS	D											
Intersection V/C	0.687											

Other Modes

g_Walk,mi, Effective Walk Time [s]	0.0			0.0			0.0			0.0		
M_corner, Corner Circulation Area [m²/pec]	0.00			0.00			0.00			0.00		
M_CW, Crosswalk Circulation Area [m²/pec]	0.00			0.00			0.00			0.00		
d_p, Pedestrian Delay [s]	0.00			0.00			0.00			0.00		
l_p,int, Pedestrian LOS Score for Intersection	0.000			0.000			0.000			0.000		
Crosswalk LOS	F			F			F			F		
s_b, Saturation Flow Rate of the bicycle lane	2000			2000			2000			2000		
c_b, Capacity of the bicycle lane [bicycles/h]	471			471			424			306		
d_b, Bicycle Delay [s]	24.85			24.85			26.41			30.49		
l_b,int, Bicycle LOS Score for Intersection	2.700			2.548			2.270			2.092		
Bicycle LOS	B			B			B			B		

Sequence

Ring 1	1	2	-	4	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	5	6	-	-	-	8	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-






Intersection Level Of Service Report

Intersection 1: Malibongwe Dr (R512 / K29) - N14 Northern Terminal

Control Type:	Signalized	Delay (sec / veh):	39.8
Analysis Method:	HCM 7th Edition	Level Of Service:	D
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.888

Intersection Setup

Name	Malibongwe			Malibongwe			N14 Off-Ramp			N14 On-Ramp		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.50	3.70	3.70	3.70	3.70	3.50	3.70	3.70	3.70	3.50	3.50	3.50
No. of Lanes in Entry Pocket	0	0	1	1	0	0	0	0	0	0	0	0
Entry Pocket Length [m]	30.48	30.48	15.00	110.00	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Speed [km/h]	60.00			60.00			60.00			60.00		
Grade [%]	0.00			0.00			0.00			0.00		
Curb Present	No			No			No					
Crosswalk	No			No			No			No		

Movement, Approach, & Intersection Results

d_M, Delay for Movement [s/veh]	0.00	19.80	47.44	44.97	34.01	0.00	58.30	58.30	58.30	0.00	0.00	0.00
Movement LOS		B	D	D	C		E	E	E			
d_A, Approach Delay [s/veh]		33.08		36.98			58.30			0.00		
Approach LOS		C		D			E			A		
d_I, Intersection Delay [s/veh]		39.85										
Intersection LOS		D										
Intersection V/C		0.888										

Other Modes

g_Walk,mi, Effective Walk Time [s]		0.0		0.0			0.0			0.0		
M_corner, Corner Circulation Area [m²/pec]		0.00		0.00			0.00			0.00		
M_CW, Crosswalk Circulation Area [m²/pec]		0.00		0.00			0.00			0.00		
d_p, Pedestrian Delay [s]		0.00		0.00			0.00			0.00		
I_p,int, Pedestrian LOS Score for Intersection		0.000		0.000			0.000			0.000		
Crosswalk LOS		F		F			F			F		
s_b, Saturation Flow Rate of the bicycle lane		2000		2000			2000			2000		
c_b, Capacity of the bicycle lane [bicycles/h]		708		215			862			0		
d_b, Bicycle Delay [s]		13.57		25.88			10.53			32.50		
I_b,int, Bicycle LOS Score for Intersection		3.573		2.035			3.235			4.132		
Bicycle LOS		D		B			C			D		

Sequence

Ring 1	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	-	6	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-






Intersection Level Of Service Report

Intersection 2: Malibongwe Dr (R512 / K29) - N14 Southern Terminal

Control Type:	Signalized	Delay (sec / veh):	17.3
Analysis Method:	HCM 7th Edition	Level Of Service:	B
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.562

Intersection Setup

Name	Malibongwe			Malibongwe			N14 On-Ramp			N14 Off-Ramp		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.70	3.70	3.50	3.50	3.70	3.70	3.50	3.50	3.50	3.70	3.70	3.70
No. of Lanes in Entry Pocket	0	0	1	0	0	1	0	0	0	1	0	1
Entry Pocket Length [m]	30.48	30.48	90.00	30.48	30.48	90.00	30.48	30.48	30.48	150.00	30.48	90.00
No. of Lanes in Exit Pocket	1	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	90.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Speed [km/h]	60.00			60.00			60.00			60.00		
Grade [%]	0.00			0.00			0.00			0.00		
Curb Present	No			No						No		
Crosswalk	No			No			No			No		

Movement, Approach, & Intersection Results

d_M, Delay for Movement [s/veh]	25.59	20.21	0.00	0.00	4.23	13.71	0.00	0.00	0.00	0.00	27.20	27.20
Movement LOS	C	C			A	B					C	C
d_A, Approach Delay [s/veh]	21.17				5.52		0.00				27.20	
Approach LOS	C				A		A				C	
d_I, Intersection Delay [s/veh]	17.27											
Intersection LOS	B											
Intersection V/C	0.562											

Other Modes

g_Walk,mi, Effective Walk Time [s]	0.0		0.0		0.0		0.0	
M_corner, Corner Circulation Area [m²/pec]	0.00		0.00		0.00		0.00	
M_CW, Crosswalk Circulation Area [m²/pec]	0.00		0.00		0.00		0.00	
d_p, Pedestrian Delay [s]	0.00		0.00		0.00		0.00	
l_p,int, Pedestrian LOS Score for Intersection	0.000		0.000		0.000		0.000	
Crosswalk LOS	F		F		F		F	
s_b, Saturation Flow Rate of the bicycle lane	2000		2000		2000		2000	
c_b, Capacity of the bicycle lane [bicycles/h]	862		1262		0		308	
d_b, Bicycle Delay [s]	10.53		4.43		32.50		23.27	
l_b,int, Bicycle LOS Score for Intersection	2.914		2.255		4.132		2.276	
Bicycle LOS	C		B		D		B	

Sequence





Ring 1	-	2	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	5	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Intersection Level Of Service Report
Intersection 3: Malibongwe Dr (R512 / K29) - R114

Control Type:	Signalized	Delay (sec / veh):	111.2
Analysis Method:	HCM 7th Edition	Level Of Service:	F
Analysis Period:	15 minutes	Volume to Capacity (v/c):	1.026

Intersection Setup

Name	Malibongwe			Malibongwe			R114			R114		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70
No. of Lanes in Entry Pocket	1	0	1	1	0	1	0	0	0	1	0	0
Entry Pocket Length [m]	120.00	30.48	90.00	120.00	30.48	90.00	30.48	30.48	30.48	90.00	30.48	30.48
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	1	0	0
Exit Pocket Length [m]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	90.00	0.00	0.00
Speed [km/h]	60.00			60.00			60.00			60.00		
Grade [%]	0.00			0.00			0.00			0.00		
Curb Present	No			No			No			No		
Crosswalk	No			No			No			No		

Movement, Approach, & Intersection Results

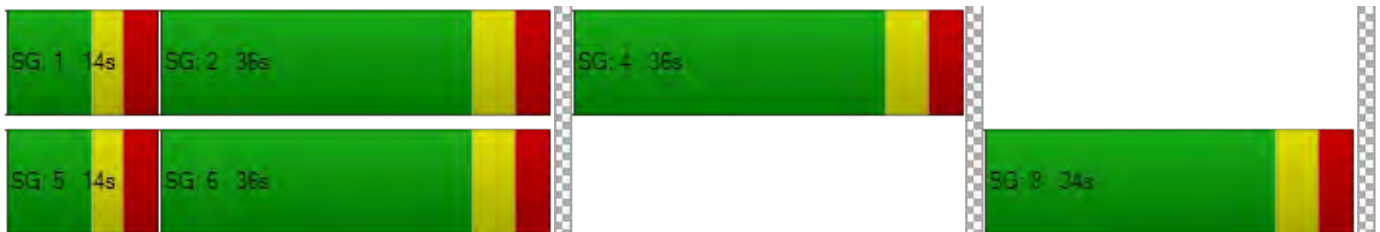
d_M, Delay for Movement [s/veh]	0.00	138.36	130.66	0.00	65.37	52.14	138.85	104.41	98.55	145.45	131.67	103.52
Movement LOS		F	F		E	D	F	F	F	F	F	F
d_A, Approach Delay [s/veh]		136.75			62.90			117.44			123.85	
Approach LOS		F			E			F			F	
d_I, Intersection Delay [s/veh]		111.16										
Intersection LOS		F										
Intersection V/C		1.026										

Other Modes

g_Walk,mi, Effective Walk Time [s]		0.0			0.0			0.0			0.0	
M_corner, Corner Circulation Area [m²/pec]		0.00			0.00			0.00			0.00	
M_CW, Crosswalk Circulation Area [m²/pec]		0.00			0.00			0.00			0.00	
d_p, Pedestrian Delay [s]		0.00			0.00			0.00			0.00	
I_p,int, Pedestrian LOS Score for Intersection		0.000			0.000			0.000			0.000	
Crosswalk LOS		F			F			F			F	
s_b, Saturation Flow Rate of the bicycle lane		2000			2000			2000			2000	
c_b, Capacity of the bicycle lane [bicycles/h]		483			483			450			483	
d_b, Bicycle Delay [s]		34.50			34.50			36.04			34.50	
I_b,int, Bicycle LOS Score for Intersection		3.002			2.731			2.519			2.601	
Bicycle LOS		C			B			B			B	

Sequence

Ring 1	1	2	-	4	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	5	6	-	-	-	8	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-






Intersection Level Of Service Report

Intersection % Malibongwe Dr (R512 / K29) ! N14 Northern Terminal

Control Type:	Signalized	Delay (sec / veh):	24.5
Analysis Method:	HCM 7th Edition	Level Of Service:	C
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.754

Intersection Setup

Name	Malibongwe			Malibongwe			N14 Off-Ramp			N14 On-Ramp		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.50	3.70	3.70	3.70	3.70	3.50	3.70	3.70	3.70	3.50	3.50	3.50
No. of Lanes in Entry Pocket	0	0	1	1	0	0	0	0	0	0	0	0
Entry Pocket Length [m]	30.48	30.48	15.00	110.00	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Speed [km/h]	60.00			60.00			60.00			60.00		
Grade [%]	0.00			0.00			0.00			0.00		
Curb Present	No			No			No					
Crosswalk	No			No			No			No		

Movement, Approach, & Intersection Results

d_M, Delay for Movement [s/veh]	0.00	17.40	27.68	29.96	25.58	0.00	28.76	28.76	28.76	0.00	0.00	0.00
Movement LOS		B	C	C	C		C	C	C			
d_A, Approach Delay [s/veh]	22.09			26.76			28.76			0.00		
Approach LOS	C			C			C			A		
d_I, Intersection Delay [s/veh]	24.45											
Intersection LOS	C											
Intersection V/C	0.754											

Other Modes

g_Walk,mi, Effective Walk Time [s]	0.0			0.0			0.0			0.0		
M_corner, Corner Circulation Area [m²/pec]	0.00			0.00			0.00			0.00		
M_CW, Crosswalk Circulation Area [m²/pec]	0.00			0.00			0.00			0.00		
d_p, Pedestrian Delay [s]	0.00			0.00			0.00			0.00		
I_p,int, Pedestrian LOS Score for Intersection	0.000			0.000			0.000			0.000		
Crosswalk LOS	F			F			F			F		
s_b, Saturation Flow Rate of the bicycle lane	2000			2000			2000			2000		
c_b, Capacity of the bicycle lane [bicycles/h]	700			267			833			0		
d_b, Bicycle Delay [s]	12.68			22.53			10.21			30.00		
I_b,int, Bicycle LOS Score for Intersection	3.363			2.004			2.989			4.132		
Bicycle LOS	C			B			C			D		

Sequence

Ring 1	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	-	6	-	8	-	-	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-






Intersection Level Of Service Report

Intersection & Malibongwe Dr (R512 / K29) ! N14 Southern Terminal

Control Type:	Signalized	Delay (sec / veh):	16.2
Analysis Method:	HCM 7th Edition	Level Of Service:	B
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.471

Intersection Setup

Name	Malibongwe			Malibongwe			N14 On-Ramp			N14 Off-Ramp		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.70	3.70	3.50	3.50	3.70	3.70	3.50	3.50	3.50	3.70	3.70	3.70
No. of Lanes in Entry Pocket	0	0	1	0	0	1	0	0	0	1	0	1
Entry Pocket Length [m]	30.48	30.48	90.00	30.48	30.48	90.00	30.48	30.48	30.48	150.00	30.48	90.00
No. of Lanes in Exit Pocket	1	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	90.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Speed [km/h]	60.00			60.00			60.00			60.00		
Grade [%]	0.00			0.00			0.00			0.00		
Curb Present	No			No						No		
Crosswalk	No			No			No			No		

Movement, Approach, & Intersection Results

d_M, Delay for Movement [s/veh]	22.95	19.87	0.00	0.00	4.85	11.06	0.00	0.00	0.00	0.00	21.66	21.66
Movement LOS	C	B			A	B					C	C
d_A, Approach Delay [s/veh]	20.24				5.75		0.00				21.66	
Approach LOS	C				A		A				C	
d_I, Intersection Delay [s/veh]	16.15											
Intersection LOS	B											
Intersection V/C	0.471											

Other Modes

g_Walk,mi, Effective Walk Time [s]	0.0		0.0		0.0		0.0	
M_corner, Corner Circulation Area [m²/pec]	0.00		0.00		0.00		0.00	
M_CW, Crosswalk Circulation Area [m²/pec]	0.00		0.00		0.00		0.00	
d_p, Pedestrian Delay [s]	0.00		0.00		0.00		0.00	
l_p,int, Pedestrian LOS Score for Intersection	0.000		0.000		0.000		0.000	
Crosswalk LOS	F		F		F		F	
s_b, Saturation Flow Rate of the bicycle lane	2000		2000		2000		2000	
c_b, Capacity of the bicycle lane [bicycles/h]	733		1167		0		367	
d_b, Bicycle Delay [s]	12.03		5.21		30.00		20.01	
l_b,int, Bicycle LOS Score for Intersection	2.697		2.170		4.132		2.220	
Bicycle LOS	B		B		D		B	

Sequence





Ring 1	-	2	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	5	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Intersection Level Of Service Report
Intersection ' : Malibongwe Dr (R512 / K29) ! R114

Control Type:	Signalized	Delay (sec / veh):	45.9
Analysis Method:	HCM 7th Edition	Level Of Service:	D
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.760

Intersection Setup

Name	Malibongwe			Malibongwe			R114			R114		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70
No. of Lanes in Entry Pocket	1	0	1	1	0	1	0	0	0	1	0	0
Entry Pocket Length [m]	120.00	30.48	90.00	120.00	30.48	90.00	30.48	30.48	30.48	90.00	30.48	30.48
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	1	0	0
Exit Pocket Length [m]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	90.00	0.00	0.00
Speed [km/h]	60.00			60.00			60.00			60.00		
Grade [%]	0.00			0.00			0.00			0.00		
Curb Present	No			No			No			No		
Crosswalk	No			No			No			No		

Movement, Approach, & Intersection Results

d_M, Delay for Movement [s/veh]	0.00	48.76	24.39	0.00	45.93	27.95	58.12	43.77	43.61	59.89	48.96	46.32
Movement LOS		D	C		D	C	E	D	D	E	D	D
d_A, Approach Delay [s/veh]	44.34			42.06			50.37			52.78		
Approach LOS	D			D			D			D		
d_I, Intersection Delay [s/veh]	45.87											
Intersection LOS	D											
Intersection V/C	0.760											

Other Modes

g_Walk,mi, Effective Walk Time [s]	0.0			0.0			0.0			0.0		
M_corner, Corner Circulation Area [m²/pec]	0.00			0.00			0.00			0.00		
M_CW, Crosswalk Circulation Area [m²/pec]	0.00			0.00			0.00			0.00		
d_p, Pedestrian Delay [s]	0.00			0.00			0.00			0.00		
I_p,int, Pedestrian LOS Score for Intersection	0.000			0.000			0.000			0.000		
Crosswalk LOS	F			F			F			F		
s_b, Saturation Flow Rate of the bicycle lane	2000			2000			2000			2000		
c_b, Capacity of the bicycle lane [bicycles/h]	475			475			400			275		
d_b, Bicycle Delay [s]	23.26			23.26			25.60			29.76		
I_b,int, Bicycle LOS Score for Intersection	2.750			2.778			2.301			2.110		
Bicycle LOS	B			C			B			B		

Sequence

Ring 1	1	2	-	4	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	5	6	-	-	-	8	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-







Intersection Level Of Service Report

Intersection (: Malibongwe Dr (R512 / K29) f#cUX'5 fi

Control Type:	Signalized	Delay (sec / veh):	16.8
Analysis Method:	HCM 7th Edition	Level Of Service:	B
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.596

Intersection Setup

Name	Malibongwe			Malibongwe			'Road A'			Unnamed Road		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.70	3.70	3.70	3.70	3.70	3.70	3.50	3.50	3.50	3.50	3.50	3.50
No. of Lanes in Entry Pocket	1	0	1	1	0	1	1	0	0	0	0	1
Entry Pocket Length [m]	75.00	30.48	75.00	90.00	30.48	75.00	60.00	30.48	30.48	30.48	30.48	60.00
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Speed [km/h]	60.00			60.00			60.00			60.00		
Grade [%]	0.00			0.00			0.00			0.00		
Curb Present	No			No			No			No		
Crosswalk	No			No			No			No		

Movement, Approach, & Intersection Results

d_M, Delay for Movement [s/veh]	0.00	24.11	19.51	3.74	6.50	11.60	0.00	27.10	27.10	18.58	18.58	21.13
Movement LOS		C	B	A	A	B		C	C	B	B	C
d_A, Approach Delay [s/veh]	24.08			6.89			27.10			20.63		
Approach LOS	C			A			C			C		
d_I, Intersection Delay [s/veh]	16.79											
Intersection LOS	B											
Intersection V/C	0.596											

Other Modes

g_Walk,mi, Effective Walk Time [s]	0.0			0.0			0.0			0.0		
M_corner, Corner Circulation Area [m²/pec]	0.00			0.00			0.00			0.00		
M_CW, Crosswalk Circulation Area [m²/pec]	0.00			0.00			0.00			0.00		
d_p, Pedestrian Delay [s]	0.00			0.00			0.00			0.00		
l_p,int, Pedestrian LOS Score for Intersection	0.000			0.000			0.000			0.000		
Crosswalk LOS	F			F			F			F		
s_b, Saturation Flow Rate of the bicycle lane	2000			2000			2000			2000		
c_b, Capacity of the bicycle lane [bicycles/h]	767			1200			333			333		
d_b, Bicycle Delay [s]	11.41			4.80			20.83			20.83		
l_b,int, Bicycle LOS Score for Intersection	2.915			2.898			2.243			1.730		
Bicycle LOS	C			C			B			A		

Sequence

Ring 1	-	2	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	5	6	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Intersection Level Of Service Report
Intersection) : fRoad Af- fFcUX'7 fl'5 VVVgg'%

Control Type:	Roundabout	Delay (sec / veh):	5.0
Analysis Method:	HCM 7th Edition	Level Of Service:	A
Analysis Period:	15 minutes		

Intersection Setup

Name	'Road A' —			'Road A'			Access 1			'Road C'		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration	⇌			⇌			+			+		
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
No. of Lanes in Entry Pocket	0	0	0	1	0	0	0	0	0	0	0	0
Entry Pocket Length [m]	30.48	30.48	30.48	50.00	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48
No. of Lanes in Exit Pocket	0	0	0	1	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0.00	0.00	0.00	50.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Speed [km/h]	60.00			60.00			60.00			60.00		
Grade [%]	0.00			0.00			0.00			0.00		
Crosswalk	No			No			No			No		

Volumes

Name												
Base Volume Input [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Base Volume Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Heavy Vehicles Percentage [%]	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Proportion of CAVs [%]	Southbound 0.00											
Growth Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	64	78	84	0	236	0	0	0	182	241	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	64	78	84	0	236	0	0	0	182	241	0	0
Peak Hour Factor	0.9500	0.9500	0.9500	0.9500	0.9500	0.9500	0.9500	0.9500	0.9500	0.9500	0.9500	0.9500
Other Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total 15-Minute Volume [veh/h]	17	21	22	0	62	0	0	0	48	63	0	0
Total Analysis Volume [veh/h]	67	82	88	0	248	0	0	0	192	254	0	0
Pedestrian Volume [ped/h]	0			0			0			0		

Intersection Settings

Number of Conflicting Circulating Lanes	2			2			1			1		
Circulating Flow Rate [veh/h]	0			286			173			449		
Exiting Flow Rate [veh/h]	708			84			68			90		
Demand Flow Rate [veh/h]	64	78	84	0	236	0	0	0	182	241	0	0
Adjusted Demand Flow Rate [veh/h]	67	82	88	0	248	0	0	0	192	254	0	0

Lanes

Override Calculated Critical Headway	No	No	No	No	No	No
User-Defined Critical Headway [s]	4.00	4.00	4.00	4.00	4.00	4.00
Override Calculated Follow-Up Time	No	No	No	No	No	No
User-Defined Follow-Up Time [s]	3.00	3.00	3.00	3.00	3.00	3.00
A (intercept)	1420.00	1350.00	1420.00	1350.00	1380.00	1380.00
B (coefficient)	0.00085	0.00092	0.00085	0.00092	0.00102	0.00102
HV Adjustment Factor	0.98	0.98	0.98	0.98	0.98	0.98
Entry Flow Rate [veh/h]	129	114	135	119	196	260
Capacity of Entry and Bypass Lanes [veh/h]	1420	1350	1114	1039	1157	874
Pedestrian Impedance	1.00	1.00	1.00	1.00	1.00	1.00
Capacity per Entry Lane [veh/h]	1393	1324	1093	1018	1134	856
X, volume / capacity	0.09	0.08	0.12	0.11	0.17	0.30

Movement, Approach, & Intersection Results

Lane LOS	A	A	A	A	A	A
95th-Percentile Queue Length [veh]	0.30	0.28	0.41	0.39	0.61	1.25
95th-Percentile Queue Length [m]	2.26	2.10	3.12	2.95	4.64	9.49
Approach Delay [s/veh]	3.34		4.45		4.67	7.45
Approach LOS	A		A		A	A
Intersection Delay [s/veh]	5.03					
Intersection LOS	A					

Intersection Level Of Service Report

Intersection * : fRoad Afil fRoad Bfi

Control Type:	Two-way stop	Delay (sec / veh):	10.0
Analysis Method:	HCM 7th Edition	Level Of Service:	A
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.256

Intersection Setup

Name	'Road A'		'Road A'		'Road B'	
Approach	Northbound		Southbound		Westbound	
Lane Configuration						
Turning Movement	Left	Right	Thru	Right	Left	Thru
Lane Width [m]	3.50	3.50	3.50	3.50	3.50	3.50
No. of Lanes in Entry Pocket	0	0	0	0	0	0
Entry Pocket Length [m]	30.48	30.48	30.48	30.48	30.48	30.48
No. of Lanes in Exit Pocket	0	0	0	0	0	0
Exit Pocket Length [m]	0.00	0.00	0.00	0.00	0.00	0.00
Speed [km/h]	60.00		60.00		60.00	
Grade [%]	0.00		0.00		0.00	
Crosswalk	No		No		No	

Volumes

Name						
Base Volume Input [veh/h]	0	0	0	0	0	0
Base Volume Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Heavy Vehicles Percentage [%]	2.00	2.00	2.00	2.00	2.00	2.00
Growth Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
In-Process Volume [veh/h]	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	236	0	0	78	0
Diverted Trips [veh/h]	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0
Total Hourly Volume [veh/h]	0	236	0	0	78	0
Peak Hour Factor	0.9500	0.9500	0.9500	0.9500	0.9500	0.9500
Other Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total 15-Minute Volume [veh/h]	0	62	0	0	21	0
Total Analysis Volume [veh/h]	0	248	0	0	82	0
Pedestrian Volume [ped/h]	0		0		0	

Intersection Settings

Priority Scheme	Stop	Free	Free
Flared Lane	No		
Storage Area [veh]	0	0	0
Two-Stage Gap Acceptance	No		
Number of Storage Spaces in Median	0	0	0

Movement, Approach, & Intersection Results




V/C, Movement V/C Ratio	0.00	0.26	0.00	0.00	0.00	0.00
d_M, Delay for Movement [s/veh]	9.76	9.98	0.00	7.38	0.00	0.00
Movement LOS	A	A	A	A	A	A
95th-Percentile Queue Length [veh/ln]	1.02	1.02	0.00	0.00	0.00	0.00
95th-Percentile Queue Length [m/ln]	7.76	7.76	0.00	0.00	0.00	0.00
d_A, Approach Delay [s/veh]	9.98		3.69		0.00	
Approach LOS	A		A		A	
d_I, Intersection Delay [s/veh]	7.50					
Intersection LOS	A					

Intersection Level Of Service Report

Intersection 1: Malibongwe Dr (R512 / K29) ! N14 Northern Terminal

Control Type:	Signalized	Delay (sec / veh):	51.7
Analysis Method:	HCM 7th Edition	Level Of Service:	D
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.943

Intersection Setup

Name	Malibongwe			Malibongwe			N14 Off-Ramp			N14 On-Ramp		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.50	3.70	3.70	3.70	3.70	3.50	3.70	3.70	3.70	3.50	3.50	3.50
No. of Lanes in Entry Pocket	0	0	1	1	0	0	0	0	0	0	0	0
Entry Pocket Length [m]	30.48	30.48	15.00	110.00	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Speed [km/h]	60.00			60.00			60.00			60.00		
Grade [%]	0.00			0.00			0.00			0.00		
Curb Present	No			No			No					
Crosswalk	No			No			No			No		

Movement, Approach, & Intersection Results

d_M, Delay for Movement [s/veh]	0.00	22.80	64.22	71.31	50.47	0.00	71.12	71.12	71.12	0.00	0.00	0.00
Movement LOS		C	F	E	D		E	E	E			
d_A, Approach Delay [s/veh]		43.34		55.83			71.12			0.00		
Approach LOS		D		E			E			A		
d_I, Intersection Delay [s/veh]	51.73											
Intersection LOS	D											
Intersection V/C	0.943											

Other Modes

g_Walk,mi, Effective Walk Time [s]	0.0		0.0		0.0		0.0		0.0
M_corner, Corner Circulation Area [m²/pec]	0.00		0.00		0.00		0.00		0.00
M_CW, Crosswalk Circulation Area [m²/pec]	0.00		0.00		0.00		0.00		0.00
d_p, Pedestrian Delay [s]	0.00		0.00		0.00		0.00		0.00
I_p,int, Pedestrian LOS Score for Intersection	0.000		0.000		0.000		0.000		0.000
Crosswalk LOS	F		F		F		F		F
s_b, Saturation Flow Rate of the bicycle lane	2000		2000		2000		2000		2000
c_b, Capacity of the bicycle lane [bicycles/h]	775		200		875		0		
d_b, Bicycle Delay [s]	15.01		32.40		12.66		40.00		
I_b,int, Bicycle LOS Score for Intersection	3.803		2.055		3.271		4.132		
Bicycle LOS	D		B		C		D		

Sequence

Ring 1	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	-	6	-	8	-	-	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-




Intersection Level Of Service Report

Intersection & Malibongwe Dr (R512 / K29) ! N14 Southern Terminal

Control Type:	Signalized	Delay (sec / veh):	19.8
Analysis Method:	HCM 7th Edition	Level Of Service:	B
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.623

Intersection Setup

Name	Malibongwe			Malibongwe			N14 On-Ramp			N14 Off-Ramp		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.70	3.70	3.50	3.50	3.70	3.70	3.50	3.50	3.50	3.70	3.70	3.70
No. of Lanes in Entry Pocket	0	0	1	0	0	1	0	0	0	1	0	1
Entry Pocket Length [m]	30.48	30.48	90.00	30.48	30.48	90.00	30.48	30.48	30.48	150.00	30.48	90.00
No. of Lanes in Exit Pocket	1	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	90.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Speed [km/h]	60.00			60.00			60.00			60.00		
Grade [%]	0.00			0.00			0.00			0.00		
Curb Present	No			No						No		
Crosswalk	No			No			No			No		

Movement, Approach, & Intersection Results

d_M, Delay for Movement [s/veh]	30.79	22.92	0.00	0.00	3.99	16.11	0.00	0.00	0.00	0.00	30.87	30.87
Movement LOS	C	C			A	B					C	C
d_A, Approach Delay [s/veh]	24.34				5.56		0.00				30.87	
Approach LOS	C				A		A				C	
d_I, Intersection Delay [s/veh]	19.79											
Intersection LOS	B											
Intersection V/C	0.623											

Other Modes

g_Walk,mi, Effective Walk Time [s]	0.0		0.0		0.0		0.0	
M_corner, Corner Circulation Area [m²/pec]	0.00		0.00		0.00		0.00	
M_CW, Crosswalk Circulation Area [m²/pec]	0.00		0.00		0.00		0.00	
d_p, Pedestrian Delay [s]	0.00		0.00		0.00		0.00	
l_p,int, Pedestrian LOS Score for Intersection	0.000		0.000		0.000		0.000	
Crosswalk LOS	F		F		F		F	
s_b, Saturation Flow Rate of the bicycle lane	2000		2000		2000		2000	
c_b, Capacity of the bicycle lane [bicycles/h]	943		1314		0		286	
d_b, Bicycle Delay [s]	9.78		4.11		35.00		25.71	
l_b,int, Bicycle LOS Score for Intersection	3.105		2.287		4.132		2.276	
Bicycle LOS	C		B		D		B	

Sequence





Ring 1	-	2	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	5	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Intersection Level Of Service Report
Intersection 3: Malibongwe Dr (R512 / K29) - R114

Control Type:	Signalized	Delay (sec / veh):	159.4
Analysis Method:	HCM 7th Edition	Level Of Service:	F
Analysis Period:	15 minutes	Volume to Capacity (v/c):	1.101

Intersection Setup

Name	Malibongwe			Malibongwe			R114			R114		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70
No. of Lanes in Entry Pocket	1	0	1	1	0	1	0	0	0	1	0	0
Entry Pocket Length [m]	120.00	30.48	90.00	120.00	30.48	90.00	30.48	30.48	30.48	90.00	30.48	30.48
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	1	0	0
Exit Pocket Length [m]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	90.00	0.00	0.00
Speed [km/h]	60.00			60.00			60.00			60.00		
Grade [%]	0.00			0.00			0.00			0.00		
Curb Present	No			No			No			No		
Crosswalk	No			No			No			No		

Movement, Approach, & Intersection Results

d_M, Delay for Movement [s/veh]	0.00	199.25	50.79	0.00	148.97	53.19	193.39	147.32	142.60	208.52	193.22	156.08
Movement LOS		F	D		F	D	F	F	F	F	F	F
d_A, Approach Delay [s/veh]		169.36			127.84			166.31			181.54	
Approach LOS		F			F			F			F	
d_I, Intersection Delay [s/veh]		159.43										
Intersection LOS		F										
Intersection V/C		1.101										

Other Modes

g_Walk,mi, Effective Walk Time [s]		0.0			0.0			0.0			0.0	
M_corner, Corner Circulation Area [m²/pec]		0.00			0.00			0.00			0.00	
M_CW, Crosswalk Circulation Area [m²/pec]		0.00			0.00			0.00			0.00	
d_p, Pedestrian Delay [s]		0.00			0.00			0.00			0.00	
I_p,int, Pedestrian LOS Score for Intersection		0.000			0.000			0.000			0.000	
Crosswalk LOS		F			F			F			F	
s_b, Saturation Flow Rate of the bicycle lane		2000			2000			2000			2000	
c_b, Capacity of the bicycle lane [bicycles/h]		450			450			417			433	
d_b, Bicycle Delay [s]		36.04			36.04			37.60			36.82	
I_b,int, Bicycle LOS Score for Intersection		3.052			2.961			2.549			2.619	
Bicycle LOS		C			C			B			B	

Sequence

Ring 1	1	2	-	4	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	5	6	-	-	-	8	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-







Intersection Level Of Service Report

Intersection 4: Malibongwe Dr (R512 / K29) - 'Road A'

Control Type:	Signalized	Delay (sec / veh):	19.7
Analysis Method:	HCM 7th Edition	Level Of Service:	B
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.768

Intersection Setup

Name	Malibongwe			Malibongwe			'Road A'			Unnamed Road		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.70	3.70	3.70	3.70	3.70	3.70	3.50	3.50	3.50	3.50	3.50	3.50
No. of Lanes in Entry Pocket	1	0	1	1	0	1	1	0	0	0	0	1
Entry Pocket Length [m]	75.00	30.48	75.00	90.00	30.48	75.00	60.00	30.48	30.48	30.48	30.48	60.00
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Speed [km/h]	60.00			60.00			60.00			60.00		
Grade [%]	0.00			0.00			0.00			0.00		
Curb Present	No			No			No			No		
Crosswalk	No			No			No			No		

Movement, Approach, & Intersection Results

d_M, Delay for Movement [s/veh]	0.00	23.97	18.35	2.94	6.08	25.38	0.00	54.78	54.78	35.64	35.64	55.75
Movement LOS		C	B	A	A	C		D	D	D	D	E
d_A, Approach Delay [s/veh]		23.94		7.33		54.78		51.82				
Approach LOS		C		A		D		D				
d_I, Intersection Delay [s/veh]		19.70										
Intersection LOS		B										
Intersection V/C		0.768										

Other Modes

g_Walk,mi, Effective Walk Time [s]		0.0		0.0		0.0		0.0	
M_corner, Corner Circulation Area [m²/pec]		0.00		0.00		0.00		0.00	
M_CW, Crosswalk Circulation Area [m²/pec]		0.00		0.00		0.00		0.00	
d_p, Pedestrian Delay [s]		0.00		0.00		0.00		0.00	
l_p,int, Pedestrian LOS Score for Intersection		0.000		0.000		0.000		0.000	
Crosswalk LOS		F		F		F		F	
s_b, Saturation Flow Rate of the bicycle lane		2000		2000		2000		2000	
c_b, Capacity of the bicycle lane [bicycles/h]		1200		1460		260		260	
d_b, Bicycle Delay [s]		8.00		3.65		37.85		37.85	
l_b,int, Bicycle LOS Score for Intersection		3.528		3.205		2.243		1.738	
Bicycle LOS		D		C		B		A	

Sequence

Ring 1	-	2	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	5	6	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Intersection Level Of Service Report
Intersection 5: 'Road A' - 'Road C' - Access 1

Control Type:	Roundabout	Delay (sec / veh):	5.0
Analysis Method:	HCM 7th Edition	Level Of Service:	A
Analysis Period:	15 minutes		

Intersection Setup

Name	'Road A'			'Road A'			Access 1			'Road C'		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration	⇌⇌			⇌⇌			+			+		
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
No. of Lanes in Entry Pocket	0	0	0	1	0	0	0	0	0	0	0	0
Entry Pocket Length [m]	30.48	30.48	30.48	50.00	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48
No. of Lanes in Exit Pocket	0	0	0	1	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0.00	0.00	0.00	50.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Speed [km/h]	60.00			60.00			60.00			60.00		
Grade [%]	0.00			0.00			0.00			0.00		
Crosswalk	No			No			No			No		

Volumes

Name												
Base Volume Input [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Base Volume Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Heavy Vehicles Percentage [%]	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Proportion of CAVs [%]	0.00											
Growth Factor	1.1041	1.1041	1.1041	1.1041	1.1041	1.1041	1.1041	1.1041	1.1041	1.1041	1.1041	1.1041
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	64	78	84	0	236	0	0	0	182	241	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	64	78	84	0	236	0	0	0	182	241	0	0
Peak Hour Factor	0.9500	0.9500	0.9500	0.9500	0.9500	0.9500	0.9500	0.9500	0.9500	0.9500	0.9500	0.9500
Other Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total 15-Minute Volume [veh/h]	17	21	22	0	62	0	0	0	48	63	0	0
Total Analysis Volume [veh/h]	67	82	88	0	248	0	0	0	192	254	0	0
Pedestrian Volume [ped/h]	0			0			0			0		

Intersection Settings

Number of Conflicting Circulating Lanes	2			2			1			1		
Circulating Flow Rate [veh/h]	0			286			173			449		
Exiting Flow Rate [veh/h]	708			84			68			90		
Demand Flow Rate [veh/h]	64	78	84	0	236	0	0	0	182	241	0	0
Adjusted Demand Flow Rate [veh/h]	67	82	88	0	248	0	0	0	192	254	0	0

Lanes

Override Calculated Critical Headway	No	No	No	No	No	No
User-Defined Critical Headway [s]	4.00	4.00	4.00	4.00	4.00	4.00
Override Calculated Follow-Up Time	No	No	No	No	No	No
User-Defined Follow-Up Time [s]	3.00	3.00	3.00	3.00	3.00	3.00
A (intercept)	1420.00	1350.00	1420.00	1350.00	1380.00	1380.00
B (coefficient)	0.00085	0.00092	0.00085	0.00092	0.00102	0.00102
HV Adjustment Factor	0.98	0.98	0.98	0.98	0.98	0.98
Entry Flow Rate [veh/h]	129	114	135	119	196	260
Capacity of Entry and Bypass Lanes [veh/h]	1420	1350	1114	1039	1157	874
Pedestrian Impedance	1.00	1.00	1.00	1.00	1.00	1.00
Capacity per Entry Lane [veh/h]	1393	1324	1093	1018	1134	856
X, volume / capacity	0.09	0.08	0.12	0.11	0.17	0.30

Movement, Approach, & Intersection Results

Lane LOS	A	A	A	A	A	A
95th-Percentile Queue Length [veh]	0.30	0.28	0.41	0.39	0.61	1.25
95th-Percentile Queue Length [m]	2.26	2.10	3.12	2.95	4.64	9.49
Approach Delay [s/veh]	3.34		4.45		4.67	7.45
Approach LOS	A		A		A	A
Intersection Delay [s/veh]	5.03					
Intersection LOS	A					

Intersection Level Of Service Report
Intersection 6: 'Road A' - 'Road B'

Control Type:	Two-way stop	Delay (sec / veh):	10.0
Analysis Method:	HCM 7th Edition	Level Of Service:	A
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.256

Intersection Setup

Name	'Road A'		'Road A'		'Road B'	
Approach	Northbound		Southbound		Westbound	
Lane Configuration	↶		↷		↵	
Turning Movement	Left	Right	Thru	Right	Left	Thru
Lane Width [m]	3.50	3.50	3.50	3.50	3.50	3.50
No. of Lanes in Entry Pocket	0	0	0	0	0	0
Entry Pocket Length [m]	30.48	30.48	30.48	30.48	30.48	30.48
No. of Lanes in Exit Pocket	0	0	0	0	0	0
Exit Pocket Length [m]	0.00	0.00	0.00	0.00	0.00	0.00
Speed [km/h]	60.00		60.00		60.00	
Grade [%]	0.00		0.00		0.00	
Crosswalk	No		No		No	

Volumes

Name						
Base Volume Input [veh/h]	0	0	0	0	0	0
Base Volume Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Heavy Vehicles Percentage [%]	2.00	2.00	2.00	2.00	2.00	2.00
Growth Factor	1.1041	1.1041	1.1041	1.1041	1.1041	1.1041
In-Process Volume [veh/h]	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	236	0	0	78	0
Diverted Trips [veh/h]	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0
Total Hourly Volume [veh/h]	0	236	0	0	78	0
Peak Hour Factor	0.9500	0.9500	0.9500	0.9500	0.9500	0.9500
Other Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total 15-Minute Volume [veh/h]	0	62	0	0	21	0
Total Analysis Volume [veh/h]	0	248	0	0	82	0
Pedestrian Volume [ped/h]	0		0		0	

Intersection Settings

Priority Scheme	Stop	Free	Free
Flared Lane	No		
Storage Area [veh]	0	0	0
Two-Stage Gap Acceptance	No		
Number of Storage Spaces in Median	0	0	0

Movement, Approach, & Intersection Results




V/C, Movement V/C Ratio	0.00	0.26	0.00	0.00	0.00	0.00
d_M, Delay for Movement [s/veh]	9.76	9.98	0.00	7.38	0.00	0.00
Movement LOS	A	A	A	A	A	A
95th-Percentile Queue Length [veh/ln]	1.02	1.02	0.00	0.00	0.00	0.00
95th-Percentile Queue Length [m/ln]	7.76	7.76	0.00	0.00	0.00	0.00
d_A, Approach Delay [s/veh]	9.98		3.69		0.00	
Approach LOS	A		A		A	
d_I, Intersection Delay [s/veh]	7.50					
Intersection LOS	A					

Intersection Level Of Service Report

Intersection 1: Malibongwe Dr (R512 / K29) - N14 Northern Terminal

Control Type:	Signalized	Delay (sec / veh):	20.7
Analysis Method:	HCM 7th Edition	Level Of Service:	C
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.671

Intersection Setup

Name	Malibongwe			Malibongwe			N14 Off-Ramp			N14 On-Ramp		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.50	3.70	3.70	3.70	3.70	3.50	3.70	3.70	3.70	3.50	3.50	3.50
No. of Lanes in Entry Pocket	0	0	1	1	0	0	0	0	1	0	0	0
Entry Pocket Length [m]	30.48	30.48	15.00	110.00	30.48	30.48	30.48	30.48	90.00	30.48	30.48	30.48
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Speed [km/h]	60.00			60.00			60.00			60.00		
Grade [%]	0.00			0.00			0.00			0.00		
Curb Present	No			No			No					
Crosswalk	No			No			No			No		

Movement, Approach, & Intersection Results

d_M, Delay for Movement [s/veh]	0.00	11.79	25.99	24.86	22.13	0.00	25.73	25.73	22.40	0.00	0.00	0.00
Movement LOS		B	C	C	C		C	C	C			
d_A, Approach Delay [s/veh]		18.84		22.83			23.92			0.00		
Approach LOS		B		C			C			A		
d_I, Intersection Delay [s/veh]		20.65										
Intersection LOS		C										
Intersection V/C		0.671										

Other Modes

g_Walk,mi, Effective Walk Time [s]		0.0		0.0			0.0			0.0		
M_corner, Corner Circulation Area [m²/pec]		0.00		0.00			0.00			0.00		
M_CW, Crosswalk Circulation Area [m²/pec]		0.00		0.00			0.00			0.00		
d_p, Pedestrian Delay [s]		0.00		0.00			0.00			0.00		
I_p,int, Pedestrian LOS Score for Intersection		0.000		0.000			0.000			0.000		
Crosswalk LOS		F		F			F			F		
s_b, Saturation Flow Rate of the bicycle lane		2000		2000			2000			2000		
c_b, Capacity of the bicycle lane [bicycles/h]		933		367			600			0		
d_b, Bicycle Delay [s]		8.53		20.01			14.70			30.00		
I_b,int, Bicycle LOS Score for Intersection		3.803		2.055			3.271			4.132		
Bicycle LOS		D		B			C			D		

Sequence





Ring 1	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	-	6	-	8	-	-	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Intersection Level Of Service Report
Intersection 3: Malibongwe Dr (R512 / K29) / R114

Control Type:	Signalized	Delay (sec / veh):	30.9
Analysis Method:	HCM 7th Edition	Level Of Service:	C
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.718

Intersection Setup

Name	Malibongwe			Malibongwe			R114			R114		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70
No. of Lanes in Entry Pocket	1	0	3	1	0	2	1	0	1	1	0	2
Entry Pocket Length [m]	120.00	30.48	150.00	120.00	30.48	120.00	90.00	30.48	90.00	90.00	30.48	120.00
No. of Lanes in Exit Pocket	0	0	0	1	0	0	0	0	0	1	0	0
Exit Pocket Length [m]	0.00	0.00	0.00	60.00	0.00	0.00	0.00	0.00	0.00	90.00	0.00	0.00
Speed [km/h]	60.00			60.00			60.00			60.00		
Grade [%]	0.00			0.00			0.00			0.00		
Curb Present	No			No			No			No		
Crosswalk	No			No			No			No		

Movement, Approach, & Intersection Results

d_M, Delay for Movement [s/veh]	0.00	33.30	33.05	0.00	30.97	36.73	37.97	28.68	17.02	0.00	25.56	22.70
Movement LOS		C	C		C	D	D	C	B		C	C
d_A, Approach Delay [s/veh]		33.25			32.24			30.55			23.80	
Approach LOS		C			C			C			C	
d_I, Intersection Delay [s/veh]		30.88										
Intersection LOS		C										
Intersection V/C		0.718										

Other Modes

g_Walk,mi, Effective Walk Time [s]		0.0			0.0			0.0			0.0	
M_corner, Corner Circulation Area [m²/pec]		0.00			0.00			0.00			0.00	
M_CW, Crosswalk Circulation Area [m²/pec]		0.00			0.00			0.00			0.00	
d_p, Pedestrian Delay [s]		0.00			0.00			0.00			0.00	
I_p,int, Pedestrian LOS Score for Intersection		0.000			0.000			0.000			0.000	
Crosswalk LOS		F			F			F			F	
s_b, Saturation Flow Rate of the bicycle lane		2000			2000			2000			2000	
c_b, Capacity of the bicycle lane [bicycles/h]		494			494			565			565	
d_b, Bicycle Delay [s]		24.09			24.09			21.89			21.89	
I_b,int, Bicycle LOS Score for Intersection		2.591			2.531			2.549			3.014	
Bicycle LOS		B			B			B			C	

Sequence

Ring 1	1	2	3	4	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	5	6	7	8	-	-	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-






Intersection Level Of Service Report

Intersection 1: Malibongwe Dr (R512 / K29) - N14 Northern Terminal

Control Type:	Signalized	Delay (sec / veh):	14.5
Analysis Method:	HCM 7th Edition	Level Of Service:	B
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.460

Intersection Setup

Name	Malibongwe			Malibongwe			N14 Off-Ramp			N14 On-Ramp		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.50	3.70	3.70	3.70	3.70	3.50	3.70	3.70	3.70	3.50	3.50	3.50
No. of Lanes in Entry Pocket	0	0	1	1	0	0	0	0	0	0	0	0
Entry Pocket Length [m]	30.48	30.48	15.00	110.00	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Speed [km/h]	60.00			60.00			60.00			60.00		
Grade [%]	0.00			0.00			0.00			0.00		
Curb Present	No			No			No					
Crosswalk	No			No			No			No		

Movement, Approach, & Intersection Results

d_M, Delay for Movement [s/veh]	0.00	6.71	12.76	19.89	17.42	0.00	19.13	19.13	19.13	0.00	0.00	0.00
Movement LOS		A	B	B	B		B	B	B			
d_A, Approach Delay [s/veh]		10.06		18.07			19.13			0.00		
Approach LOS		B		B			B			A		
d_I, Intersection Delay [s/veh]	14.50											
Intersection LOS	B											
Intersection V/C	0.460											

Other Modes

g_Walk,mi, Effective Walk Time [s]	0.0		0.0			0.0			0.0		
M_corner, Corner Circulation Area [m²/pec]	0.00		0.00			0.00			0.00		
M_CW, Crosswalk Circulation Area [m²/pec]	0.00		0.00			0.00			0.00		
d_p, Pedestrian Delay [s]	0.00		0.00			0.00			0.00		
l_p,int, Pedestrian LOS Score for Intersection	0.000		0.000			0.000			0.000		
Crosswalk LOS	F		F			F			F		
s_b, Saturation Flow Rate of the bicycle lane	2000		2000			2000			2000		
c_b, Capacity of the bicycle lane [bicycles/h]	1033		600			500			0		
d_b, Bicycle Delay [s]	7.01		14.70			16.88			30.00		
l_b,int, Bicycle LOS Score for Intersection	2.641		2.303			2.066			4.132		
Bicycle LOS	B		B			B			D		

Sequence

Ring 1	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	-	6	-	8	-	-	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Intersection Level Of Service Report

Intersection 2: Malibongwe Dr (R512 / K29) - N14 Southern Terminal

Control Type:	Signalized	Delay (sec / veh):	13.0
Analysis Method:	HCM 7th Edition	Level Of Service:	B
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.411

Intersection Setup

Name	Malibongwe			Malibongwe			N14 On-Ramp			N14 Off-Ramp		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.70	3.70	3.50	3.50	3.70	3.70	3.50	3.50	3.50	3.70	3.70	3.70
No. of Lanes in Entry Pocket	0	0	1	0	0	1	0	0	0	1	0	1
Entry Pocket Length [m]	30.48	30.48	90.00	30.48	30.48	90.00	30.48	30.48	30.48	150.00	30.48	90.00
No. of Lanes in Exit Pocket	1	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	90.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Speed [km/h]	60.00			60.00			60.00			60.00		
Grade [%]	0.00			0.00			0.00			0.00		
Curb Present	No			No						No		
Crosswalk	No			No			No			No		

Movement, Approach, & Intersection Results

d_M, Delay for Movement [s/veh]	17.85	15.26	0.00	0.00	4.63	13.84	0.00	0.00	0.00	0.00	18.65	18.65
Movement LOS	B	B			A	B					B	B
d_A, Approach Delay [s/veh]	15.94				8.01		0.00				18.65	
Approach LOS	B				A		A				B	
d_I, Intersection Delay [s/veh]	12.99											
Intersection LOS	B											
Intersection V/C	0.411											

Other Modes

g_Walk,mi, Effective Walk Time [s]	0.0		0.0		0.0		0.0	
M_corner, Corner Circulation Area [m²/pec]	0.00		0.00		0.00		0.00	
M_CW, Crosswalk Circulation Area [m²/pec]	0.00		0.00		0.00		0.00	
d_p, Pedestrian Delay [s]	0.00		0.00		0.00		0.00	
I_p,int, Pedestrian LOS Score for Intersection	0.000		0.000		0.000		0.000	
Crosswalk LOS	F		F		F		F	
s_b, Saturation Flow Rate of the bicycle lane	2000		2000		2000		2000	
c_b, Capacity of the bicycle lane [bicycles/h]	733		1167		0		367	
d_b, Bicycle Delay [s]	12.03		5.21		30.00		20.01	
I_b,int, Bicycle LOS Score for Intersection	2.435		2.190		4.132		1.842	
Bicycle LOS	B		B		D		A	

Sequence





Ring 1	-	2	-	4	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	5	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Intersection Level Of Service Report
Intersection 3: Malibongwe Dr (R512 / K29) - R114

Control Type:	Signalized	Delay (sec / veh):	34.3
Analysis Method:	HCM 7th Edition	Level Of Service:	C
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.677

Intersection Setup

Name	Malibongwe			Malibongwe			R114			R114		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70
No. of Lanes in Entry Pocket	1	0	1	1	0	1	0	0	0	1	0	0
Entry Pocket Length [m]	120.00	30.48	90.00	120.00	30.48	90.00	30.48	30.48	30.48	90.00	30.48	30.48
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	1	0	0
Exit Pocket Length [m]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	90.00	0.00	0.00
Speed [km/h]	60.00			60.00			60.00			60.00		
Grade [%]	0.00			0.00			0.00			0.00		
Curb Present	No			No			No			No		
Crosswalk	No			No			No			No		

Movement, Approach, & Intersection Results

d_M, Delay for Movement [s/veh]	0.00	38.28	18.12	0.00	28.67	25.01	44.55	36.52	36.52	43.39	37.72	36.39
Movement LOS		D	B		C	C	D	D	D	D	D	D
d_A, Approach Delay [s/veh]		35.02			27.62			40.31			39.72	
Approach LOS		D			C			D			D	
d_I, Intersection Delay [s/veh]		34.26										
Intersection LOS		C										
Intersection V/C		0.677										

Other Modes

g_Walk,mi, Effective Walk Time [s]		0.0			0.0			0.0			0.0	
M_corner, Corner Circulation Area [m²/pec]		0.00			0.00			0.00			0.00	
M_CW, Crosswalk Circulation Area [m²/pec]		0.00			0.00			0.00			0.00	
d_p, Pedestrian Delay [s]		0.00			0.00			0.00			0.00	
I_p,int, Pedestrian LOS Score for Intersection		0.000			0.000			0.000			0.000	
Crosswalk LOS		F			F			F			F	
s_b, Saturation Flow Rate of the bicycle lane		2000			2000			2000			2000	
c_b, Capacity of the bicycle lane [bicycles/h]		453			453			320			320	
d_b, Bicycle Delay [s]		22.43			22.43			26.46			26.46	
I_b,int, Bicycle LOS Score for Intersection		2.620			2.544			2.113			2.112	
Bicycle LOS		B			B			B			B	

Sequence

Ring 1	1	2	-	4	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	5	6	-	-	-	8	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-






Intersection Level Of Service Report

Intersection 1: Malibongwe Dr (R512 / K29) - N14 Northern Terminal

Control Type:	Signalized	Delay (sec / veh):	20.4
Analysis Method:	HCM 7th Edition	Level Of Service:	C
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.677

Intersection Setup

Name	Malibongwe			Malibongwe			N14 Off-Ramp			N14 On-Ramp		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.50	3.70	3.70	3.70	3.70	3.50	3.70	3.70	3.70	3.50	3.50	3.50
No. of Lanes in Entry Pocket	0	0	1	1	0	0	0	0	0	0	0	0
Entry Pocket Length [m]	30.48	30.48	15.00	110.00	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Speed [km/h]	60.00			60.00			60.00			60.00		
Grade [%]	0.00			0.00			0.00			0.00		
Curb Present	No			No			No					
Crosswalk	No			No			No			No		

Movement, Approach, & Intersection Results

d_M, Delay for Movement [s/veh]	0.00	8.06	20.91	27.48	22.08	0.00	26.79	26.79	26.79	0.00	0.00	0.00
Movement LOS		A	C	C	C		C	C	C			
d_A, Approach Delay [s/veh]		15.55		23.42			26.79				0.00	
Approach LOS		B		C			C				A	
d_I, Intersection Delay [s/veh]		20.43										
Intersection LOS		C										
Intersection V/C		0.677										

Other Modes

g_Walk,mi, Effective Walk Time [s]		0.0		0.0		0.0		0.0
M_corner, Corner Circulation Area [m²/pec]		0.00		0.00		0.00		0.00
M_CW, Crosswalk Circulation Area [m²/pec]		0.00		0.00		0.00		0.00
d_p, Pedestrian Delay [s]		0.00		0.00		0.00		0.00
I_p,int, Pedestrian LOS Score for Intersection		0.000		0.000		0.000		0.000
Crosswalk LOS		F		F		F		F
s_b, Saturation Flow Rate of the bicycle lane		2000		2000		2000		2000
c_b, Capacity of the bicycle lane [bicycles/h]		967		533		567		0
d_b, Bicycle Delay [s]		8.01		16.13		15.41		30.00
I_b,int, Bicycle LOS Score for Intersection		2.896		2.416		2.502		4.132
Bicycle LOS		C		B		B		D

Sequence

Ring 1	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	-	6	-	8	-	-	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-






Intersection Level Of Service Report

Intersection 2: Malibongwe Dr (R512 / K29) - N14 Southern Terminal

Control Type:	Signalized	Delay (sec / veh):	13.7
Analysis Method:	HCM 7th Edition	Level Of Service:	B
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.502

Intersection Setup

Name	Malibongwe			Malibongwe			N14 On-Ramp			N14 Off-Ramp		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.70	3.70	3.50	3.50	3.70	3.70	3.50	3.50	3.50	3.70	3.70	3.70
No. of Lanes in Entry Pocket	0	0	1	0	0	1	0	0	0	1	0	1
Entry Pocket Length [m]	30.48	30.48	90.00	30.48	30.48	90.00	30.48	30.48	30.48	150.00	30.48	90.00
No. of Lanes in Exit Pocket	1	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	90.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Speed [km/h]	60.00			60.00			60.00			60.00		
Grade [%]	0.00			0.00			0.00			0.00		
Curb Present	No			No						No		
Crosswalk	No			No			No			No		

Movement, Approach, & Intersection Results

d_M, Delay for Movement [s/veh]	19.31	15.32	0.00	0.00	4.30	21.86	0.00	0.00	0.00	0.00	22.26	22.26
Movement LOS	B	B			A	C					C	C
d_A, Approach Delay [s/veh]	16.45		9.22		0.00		22.26					
Approach LOS	B		A		A		C					
d_I, Intersection Delay [s/veh]	13.68											
Intersection LOS	B											
Intersection V/C	0.502											

Other Modes

g_Walk,mi, Effective Walk Time [s]	0.0		0.0		0.0		0.0					
M_corner, Corner Circulation Area [m²/pec]	0.00		0.00		0.00		0.00					
M_CW, Crosswalk Circulation Area [m²/pec]	0.00		0.00		0.00		0.00					
d_p, Pedestrian Delay [s]	0.00		0.00		0.00		0.00					
l_p,int, Pedestrian LOS Score for Intersection	0.000		0.000		0.000		0.000					
Crosswalk LOS	F		F		F		F					
s_b, Saturation Flow Rate of the bicycle lane	2000		2000		2000		2000					
c_b, Capacity of the bicycle lane [bicycles/h]	862		1262		0		308					
d_b, Bicycle Delay [s]	10.53		4.43		32.50		23.27					
l_b,int, Bicycle LOS Score for Intersection	2.682		2.421		4.132		1.860					
Bicycle LOS	B		B		D		A					

Sequence





Ring 1	-	2	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	5	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Intersection Level Of Service Report
Intersection 3: Malibongwe Dr (R512 / K29) - R114

Control Type:	Signalized	Delay (sec / veh):	81.7
Analysis Method:	HCM 7th Edition	Level Of Service:	F
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.967

Intersection Setup

Name	Malibongwe			Malibongwe			R114			R114		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70
No. of Lanes in Entry Pocket	1	0	1	1	0	1	0	0	0	1	0	0
Entry Pocket Length [m]	120.00	30.48	90.00	120.00	30.48	90.00	30.48	30.48	30.48	90.00	30.48	30.48
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	1	0	0
Exit Pocket Length [m]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	90.00	0.00	0.00
Speed [km/h]	60.00			60.00			60.00			60.00		
Grade [%]	0.00			0.00			0.00			0.00		
Curb Present	No			No			No			No		
Crosswalk	No			No			No			No		

Movement, Approach, & Intersection Results

d_M, Delay for Movement [s/veh]	0.00	93.82	47.69	0.00	42.95	118.93	105.41	80.78	74.81	113.20	92.76	79.71
Movement LOS		F	D		D	F	F	F	E	F	F	E
d_A, Approach Delay [s/veh]		84.41			65.24			89.23			95.71	
Approach LOS		F			E			F			F	
d_I, Intersection Delay [s/veh]		81.73										
Intersection LOS		F										
Intersection V/C		0.967										

Other Modes

g_Walk,mi, Effective Walk Time [s]		0.0			0.0			0.0			0.0	
M_corner, Corner Circulation Area [m²/pec]		0.00			0.00			0.00			0.00	
M_CW, Crosswalk Circulation Area [m²/pec]		0.00			0.00			0.00			0.00	
d_p, Pedestrian Delay [s]		0.00			0.00			0.00			0.00	
I_p,int, Pedestrian LOS Score for Intersection		0.000			0.000			0.000			0.000	
Crosswalk LOS		F			F			F			F	
s_b, Saturation Flow Rate of the bicycle lane		2000			2000			2000			2000	
c_b, Capacity of the bicycle lane [bicycles/h]		476			533			381			438	
d_b, Bicycle Delay [s]		30.48			28.23			34.40			32.02	
I_b,int, Bicycle LOS Score for Intersection		2.884			2.860			2.354			2.476	
Bicycle LOS		C			C			B			B	

Sequence

Ring 1	1	2	-	4	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	5	6	-	-	-	8	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-






Intersection Level Of Service Report

Intersection % Malibongwe Dr (R512 / K29) / N14 Northern Terminal

Control Type:	Signalized	Delay (sec / veh):	15.5
Analysis Method:	HCM 7th Edition	Level Of Service:	B
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.521

Intersection Setup

Name	Ma/ K			Pe/ K			N14 Off-Ramp			N14 On-Ramp		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.50	3.70	3.70	3.70	3.70	3.50	3.70	3.70	3.70	3.50	3.50	3.50
No. of Lanes in Entry Pocket	0	0	1	1	0	0	0	0	0	0	0	0
Entry Pocket Length [m]	30.48	30.48	15.00	110.00	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Speed [km/h]	60.00			60.00			60.00			60.00		
Grade [%]	0.00			0.00			0.00			0.00		
Curb Present	No			No			No					
Crosswalk	No			No			No			No		

Movement, Approach, & Intersection Results

d_M, Delay for Movement [s/veh]	0.00	6.81	14.22	20.92	18.16	0.00	20.94	20.94	20.94	0.00	0.00	0.00
Movement LOS		A	B	C	B		C	C	C			
d_A, Approach Delay [s/veh]	10.96			18.84			20.94			0.00		
Approach LOS	B			B			C			A		
d_I, Intersection Delay [s/veh]	15.50											
Intersection LOS	B											
Intersection V/C	0.521											

Other Modes

g_Walk,mi, Effective Walk Time [s]	0.0			0.0			0.0			0.0		
M_corner, Corner Circulation Area [m²/pec]	0.00			0.00			0.00			0.00		
M_CW, Crosswalk Circulation Area [m²/pec]	0.00			0.00			0.00			0.00		
d_p, Pedestrian Delay [s]	0.00			0.00			0.00			0.00		
l_p,int, Pedestrian LOS Score for Intersection	0.000			0.000			0.000			0.000		
Crosswalk LOS	F			F			F			F		
s_b, Saturation Flow Rate of the bicycle lane	2000			2000			2000			2000		
c_b, Capacity of the bicycle lane [bicycles/h]	1033			600			500			0		
d_b, Bicycle Delay [s]	7.01			14.70			16.88			30.00		
l_b,int, Bicycle LOS Score for Intersection	2.731			2.357			2.174			4.132		
Bicycle LOS	B			B			B			D		

Sequence

Ring 1	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	-	6	-	8	-	-	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-






Intersection Level Of Service Report

Intersection & Malibongwe Dr (R512 / K29) ! N14 Southern Terminal

Control Type:	Signalized	Delay (sec / veh):	12.6
Analysis Method:	HCM 7th Edition	Level Of Service:	B
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.434

Intersection Setup

Name	Malibongwe			Malibongwe			N14 On-Ramp			N14 Off-Ramp		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.70	3.70	3.50	3.50	3.70	3.70	3.50	3.50	3.50	3.70	3.70	3.70
No. of Lanes in Entry Pocket	0	0	1	0	0	1	0	0	0	1	0	1
Entry Pocket Length [m]	30.48	30.48	90.00	30.48	30.48	90.00	30.48	30.48	30.48	150.00	30.48	90.00
No. of Lanes in Exit Pocket	1	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	90.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Speed [km/h]	60.00			60.00			60.00			60.00		
Grade [%]	0.00			0.00			0.00			0.00		
Curb Present	No			No						No		
Crosswalk	No			No			No			No		

Movement, Approach, & Intersection Results

d_M, Delay for Movement [s/veh]	18.00	15.13	0.00	0.00	4.40	14.37	0.00	0.00	0.00	0.00	19.54	19.54
Movement LOS	B	B			A	B					B	B
d_A, Approach Delay [s/veh]	15.87		7.52		0.00		19.54					
Approach LOS	B		A		A		B					
d_I, Intersection Delay [s/veh]	12.64											
Intersection LOS	B											
Intersection V/C	0.434											

Other Modes

g_Walk,mi, Effective Walk Time [s]	0.0		0.0		0.0		0.0					
M_corner, Corner Circulation Area [m²/pec]	0.00		0.00		0.00		0.00					
M_CW, Crosswalk Circulation Area [m²/pec]	0.00		0.00		0.00		0.00					
d_p, Pedestrian Delay [s]	0.00		0.00		0.00		0.00					
l_p,int, Pedestrian LOS Score for Intersection	0.000		0.000		0.000		0.000					
Crosswalk LOS	F		F		F		F					
s_b, Saturation Flow Rate of the bicycle lane	2000		2000		2000		2000					
c_b, Capacity of the bicycle lane [bicycles/h]	767		1200		0		333					
d_b, Bicycle Delay [s]	11.41		4.80		30.00		20.83					
l_b,int, Bicycle LOS Score for Intersection	2.512		2.279		4.132		1.842					
Bicycle LOS	B		B		D		A					

Sequence





Ring 1	-	2	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	5	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Intersection Level Of Service Report
Intersection ' : Malibongwe Dr (R512 / K29) ! R114

Control Type:	Signalized	Delay (sec / veh):	46.5
Analysis Method:	HCM 7th Edition	Level Of Service:	D
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.803

Intersection Setup

Name	Malibongwe			Malibongwe			R114			R114		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70
No. of Lanes in Entry Pocket	1	0	1	1	0	1	0	0	0	1	0	0
Entry Pocket Length [m]	120.00	30.48	90.00	120.00	30.48	90.00	30.48	30.48	30.48	90.00	30.48	30.48
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	1	0	0
Exit Pocket Length [m]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	90.00	0.00	0.00
Speed [km/h]	60.00			60.00			60.00			60.00		
Grade [%]	0.00			0.00			0.00			0.00		
Curb Present	No			No			No			No		
Crosswalk	No			No			No			No		

Movement, Approach, & Intersection Results

d_M, Delay for Movement [s/veh]	0.00	49.12	23.94	0.00	33.03	65.65	58.74	36.09	36.09	58.97	52.32	48.44
Movement LOS		D	C		C	E	E	D	D	E	D	D
d_A, Approach Delay [s/veh]	45.55			42.69			48.63			53.49		
Approach LOS	D			D			D			D		
d_I, Intersection Delay [s/veh]	46.46											
Intersection LOS	D											
Intersection V/C	0.803											

Other Modes

g_Walk,mi, Effective Walk Time [s]	0.0			0.0			0.0			0.0		
M_corner, Corner Circulation Area [m²/pec]	0.00			0.00			0.00			0.00		
M_CW, Crosswalk Circulation Area [m²/pec]	0.00			0.00			0.00			0.00		
d_p, Pedestrian Delay [s]	0.00			0.00			0.00			0.00		
l_p,int, Pedestrian LOS Score for Intersection	0.000			0.000			0.000			0.000		
Crosswalk LOS	F			F			F			F		
s_b, Saturation Flow Rate of the bicycle lane	2000			2000			2000			2000		
c_b, Capacity of the bicycle lane [bicycles/h]	526			526			421			337		
d_b, Bicycle Delay [s]	25.79			25.79			29.61			32.85		
l_b,int, Bicycle LOS Score for Intersection	2.753			2.635			2.194			2.166		
Bicycle LOS	C			B			B			B		

Sequence

Ring 1	1	2	-	4	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	5	6	-	-	-	8	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-







Intersection Level Of Service Report

Intersection (: Malibongwe Dr (R512 / K29) ! ff cUX'5 fi

Control Type:	Signalized	Delay (sec / veh):	15.8
Analysis Method:	HCM 7th Edition	Level Of Service:	B
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.588

Intersection Setup

Name	Malibongwe			Malibongwe			'Road A'			Unnamed Road		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.70	3.70	3.70	3.70	3.70	3.70	3.50	3.50	3.50	3.50	3.50	3.50
No. of Lanes in Entry Pocket	1	0	1	1	0	1	1	0	0	0	0	1
Entry Pocket Length [m]	75.00	30.48	75.00	90.00	30.48	75.00	60.00	30.48	30.48	30.48	30.48	60.00
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Speed [km/h]	60.00			60.00			60.00			60.00		
Grade [%]	0.00			0.00			0.00			0.00		
Curb Present	No			No			No			No		
Crosswalk	No			No			No			No		

Movement, Approach, & Intersection Results

d_M, Delay for Movement [s/veh]	0.00	23.04	20.57	4.09	6.86	15.92	0.00	0.00	24.06	17.83	17.83	19.40
Movement LOS		C	C	A	A	B		A	C	B	B	B
d_A, Approach Delay [s/veh]		23.02		8.69		24.06		18.57				
Approach LOS		C		A		C		B				
d_I, Intersection Delay [s/veh]		15.76										
Intersection LOS		B										
Intersection V/C		0.588										

Other Modes

g_Walk,mi, Effective Walk Time [s]		0.0		0.0		0.0		0.0	
M_corner, Corner Circulation Area [m²/pec]		0.00		0.00		0.00		0.00	
M_CW, Crosswalk Circulation Area [m²/pec]		0.00		0.00		0.00		0.00	
d_p, Pedestrian Delay [s]		0.00		0.00		0.00		0.00	
l_p,int, Pedestrian LOS Score for Intersection		0.000		0.000		0.000		0.000	
Crosswalk LOS		F		F		F		F	
s_b, Saturation Flow Rate of the bicycle lane		2000		2000		2000		2000	
c_b, Capacity of the bicycle lane [bicycles/h]		733		1167		367		367	
d_b, Bicycle Delay [s]		12.03		5.21		20.01		20.01	
l_b,int, Bicycle LOS Score for Intersection		2.838		3.010		1.903		1.699	
Bicycle LOS		C		C		A		A	

Sequence

Ring 1	-	2	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	5	6	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Intersection Level Of Service Report
Intersection) : fRoad Af- fFcUX'7 fl'5 VVVgg'%

Control Type:	Roundabout	Delay (sec / veh):	4.6
Analysis Method:	HCM 7th Edition	Level Of Service:	A
Analysis Period:	15 minutes		

Intersection Setup

Name	'Road A'			'Road A'			Access 1			'Road C'		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
No. of Lanes in Entry Pocket	0	0	0	1	0	0	0	0	0	0	0	0
Entry Pocket Length [m]	30.48	30.48	30.48	50.00	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48
No. of Lanes in Exit Pocket	0	0	0	1	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0.00	0.00	0.00	50.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Speed [km/h]	60.00			60.00			60.00			60.00		
Grade [%]	0.00			0.00			0.00			0.00		
Crosswalk	No			No			No			No		

Volumes

Name												
Base Volume Input [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Base Volume Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Heavy Vehicles Percentage [%]	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Proportion of CAVs [%]	0.00											
Growth Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	170	220	226	0	94	0	0	0	73	97	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	170	220	226	0	94	0	0	0	73	97	0	0
Peak Hour Factor	0.9500	0.9500	0.9500	0.9500	0.9500	0.9500	0.9500	0.9500	0.9500	0.9500	0.9500	0.9500
Other Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total 15-Minute Volume [veh/h]	45	58	59	0	25	0	0	0	19	26	0	0
Total Analysis Volume [veh/h]	179	232	238	0	99	0	0	0	77	102	0	0
Pedestrian Volume [ped/h]	0			0			0			0		

Intersection Settings

Number of Conflicting Circulating Lanes	2			2			1			1		
Circulating Flow Rate [veh/h]	0			321			479			180		
Exiting Flow Rate [veh/h]	284			237			183			243		
Demand Flow Rate [veh/h]	170	220	226	0	94	0	0	0	73	97	0	0
Adjusted Demand Flow Rate [veh/h]	179	232	238	0	99	0	0	0	77	102	0	0

Lanes

Overwrite Calculated Critical Headway	No	No	No	No	No	No
User-Defined Critical Headway [s]	4.00	4.00	4.00	4.00	4.00	4.00
Overwrite Calculated Follow-Up Time	No	No	No	No	No	No
User-Defined Follow-Up Time [s]	3.00	3.00	3.00	3.00	3.00	3.00
A (intercept)	1420.00	1350.00	1420.00	1350.00	1380.00	1380.00
B (coefficient)	0.00085	0.00092	0.00085	0.00092	0.00102	0.00102
HV Adjustment Factor	0.98	0.98	0.98	0.98	0.98	0.98
Entry Flow Rate [veh/h]	351	312	54	48	79	105
Capacity of Entry and Bypass Lanes [veh/h]	1420	1350	1081	1005	847	1150
Pedestrian Impedance	1.00	1.00	1.00	1.00	1.00	1.00
Capacity per Entry Lane [veh/h]	1393	1324	1060	985	830	1127
X, volume / capacity	0.25	0.23	0.05	0.05	0.09	0.09

Movement, Approach, & Intersection Results




Lane LOS	A	A	A	A	A	A
95th-Percentile Queue Length [veh]	0.98	0.89	0.16	0.15	0.31	0.30
95th-Percentile Queue Length [m]	7.45	6.80	1.19	1.13	2.33	2.27
Approach Delay [s/veh]	4.68		3.94		5.25	3.97
Approach LOS	A		A		A	A
Intersection Delay [s/veh]	4.57					
Intersection LOS	A					

Intersection Level Of Service Report

Intersection * : fRoad Afil fRoad Bfi

Control Type:	Two-way stop	Delay (sec / veh):	9.6
Analysis Method:	HCM 7th Edition	Level Of Service:	A
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.112

Intersection Setup

Name	'Road A'		'Road A'		'Road B'	
Approach	Northbound		Southbound		Westbound	
Lane Configuration						
Turning Movement	Left	Right	Thru	Right	Left	Thru
Lane Width [m]	3.50	3.50	3.50	3.50	3.50	3.50
No. of Lanes in Entry Pocket	0	0	0	0	0	0
Entry Pocket Length [m]	30.48	30.48	30.48	30.48	30.48	30.48
No. of Lanes in Exit Pocket	0	0	0	0	0	0
Exit Pocket Length [m]	0.00	0.00	0.00	0.00	0.00	0.00
Speed [km/h]	60.00		60.00		60.00	
Grade [%]	0.00		0.00		0.00	
Crosswalk	No		No		No	

Volumes

Name						
Base Volume Input [veh/h]	0	0	0	0	0	0
Base Volume Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Heavy Vehicles Percentage [%]	2.00	2.00	2.00	2.00	2.00	2.00
Growth Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
In-Process Volume [veh/h]	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	94	0	0	220	0
Diverted Trips [veh/h]	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0
Total Hourly Volume [veh/h]	0	94	0	0	220	0
Peak Hour Factor	0.9500	0.9500	0.9500	0.9500	0.9500	0.9500
Other Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total 15-Minute Volume [veh/h]	0	25	0	0	58	0
Total Analysis Volume [veh/h]	0	99	0	0	232	0
Pedestrian Volume [ped/h]	0		0		0	

Intersection Settings

Priority Scheme	Stop	Free	Free
Flared Lane	No		
Storage Area [veh]	0	0	0
Two-Stage Gap Acceptance	No		
Number of Storage Spaces in Median	0	0	0

Movement, Approach, & Intersection Results




V/C, Movement V/C Ratio	0.00	0.11	0.00	0.00	0.00	0.00
d_M, Delay for Movement [s/veh]	9.36	9.61	0.00	7.70	0.00	0.00
Movement LOS	A	A	A	A	A	A
95th-Percentile Queue Length [veh/ln]	0.38	0.38	0.00	0.00	0.00	0.00
95th-Percentile Queue Length [m/ln]	2.89	2.89	0.00	0.00	0.00	0.00
d_A, Approach Delay [s/veh]	9.61		3.85		0.00	
Approach LOS	A		A		A	
d_I, Intersection Delay [s/veh]	2.87					
Intersection LOS	A					

Intersection Level Of Service Report

Intersection % Malibongwe Dr (R512 / K29) ! N14 Northern Terminal

Control Type:	Signalized	Delay (sec / veh):	24.1
Analysis Method:	HCM 7th Edition	Level Of Service:	C
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.739

Intersection Setup

Name	Malibongwe			Malibongwe			N14 Off-Ramp			N14 On-Ramp		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.50	3.70	3.70	3.70	3.70	3.50	3.70	3.70	3.70	3.50	3.50	3.50
No. of Lanes in Entry Pocket	0	0	1	1	0	0	0	0	0	0	0	0
Entry Pocket Length [m]	30.48	30.48	15.00	110.00	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Speed [km/h]	60.00			60.00			60.00			60.00		
Grade [%]	0.00			0.00			0.00			0.00		
Curb Present	No			No			No					
Crosswalk	No			No			No			No		

Movement, Approach, & Intersection Results

d_M, Delay for Movement [s/veh]	0.00	8.19	27.88	30.30	23.72	0.00	33.76	33.76	33.76	0.00	0.00	0.00
Movement LOS		A	C	C	C		C	C	C			
d_A, Approach Delay [s/veh]	19.72		25.25			33.76			0.00			
Approach LOS	B		C			C			A			
d_I, Intersection Delay [s/veh]	24.15											
Intersection LOS	C											
Intersection V/C	0.739											

Other Modes

g_Walk,mi, Effective Walk Time [s]	0.0		0.0			0.0			0.0		
M_corner, Corner Circulation Area [m²/pec]	0.00		0.00			0.00			0.00		
M_CW, Crosswalk Circulation Area [m²/pec]	0.00		0.00			0.00			0.00		
d_p, Pedestrian Delay [s]	0.00		0.00			0.00			0.00		
I_p,int, Pedestrian LOS Score for Intersection	0.000		0.000			0.000			0.000		
Crosswalk LOS	F		F			F			F		
s_b, Saturation Flow Rate of the bicycle lane	2000		2000			2000			2000		
c_b, Capacity of the bicycle lane [bicycles/h]	967		533			567			0		
d_b, Bicycle Delay [s]	8.01		16.13			15.41			30.00		
I_b,int, Bicycle LOS Score for Intersection	2.987		2.470			2.609			4.132		
Bicycle LOS	C		B			B			D		

Sequence

Ring 1	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	-	6	-	8	-	-	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-






Intersection Level Of Service Report

Intersection & Malibongwe Dr (R512 / K29) ! N14 Southern Terminal

Control Type:	Signalized	Delay (sec / veh):	13.8
Analysis Method:	HCM 7th Edition	Level Of Service:	B
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.532

Intersection Setup

Name	Malibongwe			Malibongwe			N14 On-Ramp			N14 Off-Ramp		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.70	3.70	3.50	3.50	3.70	3.70	3.50	3.50	3.50	3.70	3.70	3.70
No. of Lanes in Entry Pocket	0	0	1	0	0	1	0	0	0	1	0	1
Entry Pocket Length [m]	30.48	30.48	90.00	30.48	30.48	90.00	30.48	30.48	30.48	150.00	30.48	90.00
No. of Lanes in Exit Pocket	1	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	90.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Speed [km/h]	60.00			60.00			60.00			60.00		
Grade [%]	0.00			0.00			0.00			0.00		
Curb Present	No			No						No		
Crosswalk	No			No			No			No		

Movement, Approach, & Intersection Results

d_M, Delay for Movement [s/veh]	21.87	16.19	0.00	0.00	4.01	20.21	0.00	0.00	0.00	0.00	21.62	21.62
Movement LOS	C	B			A	C					C	C
d_A, Approach Delay [s/veh]	17.77				8.06		0.00				21.62	
Approach LOS	B				A		A				C	
d_I, Intersection Delay [s/veh]	13.80											
Intersection LOS	B											
Intersection V/C	0.532											

Other Modes

g_Walk,mi, Effective Walk Time [s]	0.0		0.0		0.0		0.0	
M_corner, Corner Circulation Area [m²/pec]	0.00		0.00		0.00		0.00	
M_CW, Crosswalk Circulation Area [m²/pec]	0.00		0.00		0.00		0.00	
d_p, Pedestrian Delay [s]	0.00		0.00		0.00		0.00	
I_p,int, Pedestrian LOS Score for Intersection	0.000		0.000		0.000		0.000	
Crosswalk LOS	F		F		F		F	
s_b, Saturation Flow Rate of the bicycle lane	2000		2000		2000		2000	
c_b, Capacity of the bicycle lane [bicycles/h]	833		1267		0		267	
d_b, Bicycle Delay [s]	10.21		4.03		30.00		22.53	
I_b,int, Bicycle LOS Score for Intersection	2.758		2.510		4.132		1.860	
Bicycle LOS	C		B		D		A	

Sequence





Ring 1	-	2	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	5	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Intersection Level Of Service Report
Intersection ' : Malibongwe Dr (R512 / K29) ! R114

Control Type:	Signalized	Delay (sec / veh):	112.5
Analysis Method:	HCM 7th Edition	Level Of Service:	F
Analysis Period:	15 minutes	Volume to Capacity (v/c):	1.056

Intersection Setup

Name	Malibongwe			Malibongwe			R114			R114		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70
No. of Lanes in Entry Pocket	1	0	1	1	0	1	0	0	0	1	0	0
Entry Pocket Length [m]	120.00	30.48	90.00	120.00	30.48	90.00	30.48	30.48	30.48	90.00	30.48	30.48
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	1	0	0
Exit Pocket Length [m]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	90.00	0.00	0.00
Speed [km/h]	60.00			60.00			60.00			60.00		
Grade [%]	0.00			0.00			0.00			0.00		
Curb Present	No			No			No			No		
Crosswalk	No			No			No			No		

Movement, Approach, & Intersection Results

d_M, Delay for Movement [s/veh]	0.00	135.59	49.22	0.00	44.30	160.25	153.98	110.51	109.64	158.80	135.84	113.93
Movement LOS		F	D		D	F	F	F	F	F	F	F
d_A, Approach Delay [s/veh]		119.72			79.04			130.23			135.50	
Approach LOS		F			E			F			F	
d_I, Intersection Delay [s/veh]		112.54										
Intersection LOS		F										
Intersection V/C		1.056										

Other Modes

g_Walk,mi, Effective Walk Time [s]		0.0			0.0			0.0			0.0	
M_corner, Corner Circulation Area [m²/pec]		0.00			0.00			0.00			0.00	
M_CW, Crosswalk Circulation Area [m²/pec]		0.00			0.00			0.00			0.00	
d_p, Pedestrian Delay [s]		0.00			0.00			0.00			0.00	
I_p,int, Pedestrian LOS Score for Intersection		0.000			0.000			0.000			0.000	
Crosswalk LOS		F			F			F			F	
s_b, Saturation Flow Rate of the bicycle lane		2000			2000			2000			2000	
c_b, Capacity of the bicycle lane [bicycles/h]		495			552			381			419	
d_b, Bicycle Delay [s]		29.72			27.50			34.40			32.80	
I_b,int, Bicycle LOS Score for Intersection		3.017			2.951			2.435			2.529	
Bicycle LOS		C			C			B			B	

Sequence

Ring 1	1	2	-	4	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	5	6	-	-	-	8	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-







Intersection Level Of Service Report

Intersection (: Malibongwe Dr (R512 / K29) !'f cUX'5 fi

Control Type:	Signalized	Delay (sec / veh):	18.8
Analysis Method:	HCM 7th Edition	Level Of Service:	B
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.685

Intersection Setup

Name	Malibongwe			Malibongwe			'Road A'			Unnamed Road		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.70	3.70	3.70	3.70	3.70	3.70	3.50	3.50	3.50	3.50	3.50	3.50
No. of Lanes in Entry Pocket	1	0	1	1	0	1	1	0	0	0	0	1
Entry Pocket Length [m]	75.00	30.48	75.00	90.00	30.48	75.00	60.00	30.48	30.48	30.48	30.48	60.00
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Speed [km/h]	60.00			60.00			60.00			60.00		
Grade [%]	0.00			0.00			0.00			0.00		
Curb Present	No			No			No			No		
Crosswalk	No			No			No			No		

Movement, Approach, & Intersection Results

d_M, Delay for Movement [s/veh]	0.00	25.52	31.07	3.58	9.50	32.26	0.00	0.00	32.79	24.33	24.33	25.93
Movement LOS		C	C	A	A	C		A	C	C	C	C
d_A, Approach Delay [s/veh]		25.57		12.66		32.79		25.05				
Approach LOS		C		B		C		C				
d_I, Intersection Delay [s/veh]		18.85										
Intersection LOS		B										
Intersection V/C		0.685										

Other Modes

g_Walk,mi, Effective Walk Time [s]		0.0		0.0		0.0		0.0	
M_corner, Corner Circulation Area [m²/pec]		0.00		0.00		0.00		0.00	
M_CW, Crosswalk Circulation Area [m²/pec]		0.00		0.00		0.00		0.00	
d_p, Pedestrian Delay [s]		0.00		0.00		0.00		0.00	
I_p,int, Pedestrian LOS Score for Intersection		0.000		0.000		0.000		0.000	
Crosswalk LOS		F		F		F		F	
s_b, Saturation Flow Rate of the bicycle lane		2000		2000		2000		2000	
c_b, Capacity of the bicycle lane [bicycles/h]		960		1307		320		320	
d_b, Bicycle Delay [s]		10.14		4.51		26.46		26.46	
I_b,int, Bicycle LOS Score for Intersection		3.209		3.622		1.903		1.703	
Bicycle LOS		C		D		A		A	

Sequence





Ring 1	-	2	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	5	6	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Intersection Level Of Service Report
Intersection) : fRoad Af- fFcUX'7 fl'5 VVWgg'%

Control Type:	Roundabout	Delay (sec / veh):	4.6
Analysis Method:	HCM 7th Edition	Level Of Service:	A
Analysis Period:	15 minutes		

Intersection Setup

Name	'Road A'			'Road A'			Access 1			'Road C'		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
No. of Lanes in Entry Pocket	0	0	0	1	0	0	0	0	0	0	0	0
Entry Pocket Length [m]	30.48	30.48	30.48	50.00	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48
No. of Lanes in Exit Pocket	0	0	0	1	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0.00	0.00	0.00	50.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Speed [km/h]	60.00			60.00			60.00			60.00		
Grade [%]	0.00			0.00			0.00			0.00		
Crosswalk	No			No			No			No		

Volumes

Name												
Base Volume Input [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Base Volume Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Heavy Vehicles Percentage [%]	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Proportion of CAVs [%]	0.00											
Growth Factor	1.1041	1.1041	1.1041	1.1041	1.1041	1.1041	1.1041	1.1041	1.1041	1.1041	1.1041	1.1041
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	170	220	226	0	94	0	0	0	73	97	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	170	220	226	0	94	0	0	0	73	97	0	0
Peak Hour Factor	0.9500	0.9500	0.9500	0.9500	0.9500	0.9500	0.9500	0.9500	0.9500	0.9500	0.9500	0.9500
Other Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total 15-Minute Volume [veh/h]	45	58	59	0	25	0	0	0	19	26	0	0
Total Analysis Volume [veh/h]	179	232	238	0	99	0	0	0	77	102	0	0
Pedestrian Volume [ped/h]	0			0			0			0		

Intersection Settings

Number of Conflicting Circulating Lanes	2			2			1			1		
Circulating Flow Rate [veh/h]	0			321			479			180		
Exiting Flow Rate [veh/h]	284			237			183			243		
Demand Flow Rate [veh/h]	170	220	226	0	94	0	0	0	73	97	0	0
Adjusted Demand Flow Rate [veh/h]	179	232	238	0	99	0	0	0	77	102	0	0

Lanes

Override Calculated Critical Headway	No	No	No	No	No	No
User-Defined Critical Headway [s]	4.00	4.00	4.00	4.00	4.00	4.00
Override Calculated Follow-Up Time	No	No	No	No	No	No
User-Defined Follow-Up Time [s]	3.00	3.00	3.00	3.00	3.00	3.00
A (intercept)	1420.00	1350.00	1420.00	1350.00	1380.00	1380.00
B (coefficient)	0.00085	0.00092	0.00085	0.00092	0.00102	0.00102
HV Adjustment Factor	0.98	0.98	0.98	0.98	0.98	0.98
Entry Flow Rate [veh/h]	351	312	54	48	79	105
Capacity of Entry and Bypass Lanes [veh/h]	1420	1350	1081	1005	847	1150
Pedestrian Impedance	1.00	1.00	1.00	1.00	1.00	1.00
Capacity per Entry Lane [veh/h]	1393	1324	1060	985	830	1127
X, volume / capacity	0.25	0.23	0.05	0.05	0.09	0.09

Movement, Approach, & Intersection Results

Lane LOS	A	A	A	A	A	A
95th-Percentile Queue Length [veh]	0.98	0.89	0.16	0.15	0.31	0.30
95th-Percentile Queue Length [m]	7.45	6.80	1.19	1.13	2.33	2.27
Approach Delay [s/veh]	4.68		3.94		5.25	3.97
Approach LOS	A		A		A	A
Intersection Delay [s/veh]	4.57					
Intersection LOS	A					

Intersection Level Of Service Report

Intersection * : fRoad Afil fRoad Bfi

Control Type:	Two-way stop	Delay (sec / veh):	9.6
Analysis Method:	HCM 7th Edition	Level Of Service:	A
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.112

Intersection Setup

Name	'Road A'		'Road A'		'Road B'	
Approach	Northbound		Southbound		Westbound	
Lane Configuration	↩		↪		↪	
Turning Movement	Left	Right	Thru	Right	Left	Thru
Lane Width [m]	3.50	3.50	3.50	3.50	3.50	3.50
No. of Lanes in Entry Pocket	0	0	0	0	0	0
Entry Pocket Length [m]	30.48	30.48	30.48	30.48	30.48	30.48
No. of Lanes in Exit Pocket	0	0	0	0	0	0
Exit Pocket Length [m]	0.00	0.00	0.00	0.00	0.00	0.00
Speed [km/h]	60.00		60.00		60.00	
Grade [%]	0.00		0.00		0.00	
Crosswalk	No		No		No	

Volumes

Name						
Base Volume Input [veh/h]	0	0	0	0	0	0
Base Volume Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Heavy Vehicles Percentage [%]	2.00	2.00	2.00	2.00	2.00	2.00
Growth Factor	1.1041	1.1041	1.1041	1.1041	1.1041	1.1041
In-Process Volume [veh/h]	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	94	0	0	220	0
Diverted Trips [veh/h]	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0
Total Hourly Volume [veh/h]	0	94	0	0	220	0
Peak Hour Factor	0.9500	0.9500	0.9500	0.9500	0.9500	0.9500
Other Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total 15-Minute Volume [veh/h]	0	25	0	0	58	0
Total Analysis Volume [veh/h]	0	99	0	0	232	0
Pedestrian Volume [ped/h]	0		0		0	

Intersection Settings

Priority Scheme	Stop	Free	Free
Flared Lane	No		
Storage Area [veh]	0	0	0
Two-Stage Gap Acceptance	No		
Number of Storage Spaces in Median	0	0	0

Movement, Approach, & Intersection Results




V/C, Movement V/C Ratio	0.00	0.11	0.00	0.00	0.00	0.00
d_M, Delay for Movement [s/veh]	9.36	9.61	0.00	7.70	0.00	0.00
Movement LOS	A	A	A	A	A	A
95th-Percentile Queue Length [veh/ln]	0.38	0.38	0.00	0.00	0.00	0.00
95th-Percentile Queue Length [m/ln]	2.89	2.89	0.00	0.00	0.00	0.00
d_A, Approach Delay [s/veh]	9.61		3.85		0.00	
Approach LOS	A		A		A	
d_I, Intersection Delay [s/veh]	2.87					
Intersection LOS	A					

Intersection Level Of Service Report

Intersection 1: Malibongwe Dr (R512 / K29) - N14 Northern Terminal

Control Type:	Signalized	Delay (sec / veh):	18.1
Analysis Method:	HCM 7th Edition	Level Of Service:	B
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.577

Intersection Setup

Name	Malibongwe			Malibongwe			N14 Off-Ramp			N14 On-Ramp		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.50	3.70	3.70	3.70	3.70	3.50	3.70	3.70	3.70	3.50	3.50	3.50
No. of Lanes in Entry Pocket	0	0	1	1	0	0	0	0	1	0	0	0
Entry Pocket Length [m]	30.48	30.48	15.00	110.00	30.48	30.48	30.48	30.48	90.00	30.48	30.48	30.48
No. of Lanes in Exit Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Exit Pocket Length [m]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Speed [km/h]	60.00			60.00			60.00			60.00		
Grade [%]	0.00			0.00			0.00			0.00		
Curb Present	No			No			No					
Crosswalk	No			No			No			No		

Movement, Approach, & Intersection Results

d_M, Delay for Movement [s/veh]	0.00	6.53	22.31	22.04	18.65	0.00	21.51	21.51	21.36	0.00	0.00	0.00
Movement LOS		A	C	C	B		C	C	C			
d_A, Approach Delay [s/veh]	15.77			19.43			21.40			0.00		
Approach LOS	B			B			C			A		
d_I, Intersection Delay [s/veh]	18.13											
Intersection LOS	B											
Intersection V/C	0.577											

Other Modes

g_Walk,mi, Effective Walk Time [s]	0.0			0.0			0.0			0.0		
M_corner, Corner Circulation Area [m²/pec]	0.00			0.00			0.00			0.00		
M_CW, Crosswalk Circulation Area [m²/pec]	0.00			0.00			0.00			0.00		
d_p, Pedestrian Delay [s]	0.00			0.00			0.00			0.00		
I_p,int, Pedestrian LOS Score for Intersection	0.000			0.000			0.000			0.000		
Crosswalk LOS	F			F			F			F		
s_b, Saturation Flow Rate of the bicycle lane	2000			2000			2000			2000		
c_b, Capacity of the bicycle lane [bicycles/h]	1067			633			467			0		
d_b, Bicycle Delay [s]	6.53			14.01			17.63			30.00		
I_b,int, Bicycle LOS Score for Intersection	2.987			2.470			2.609			4.132		
Bicycle LOS	C			B			B			D		

Sequence





Ring 1	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	-	6	-	8	-	-	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Intersection Level Of Service Report
Intersection 3: Malibongwe Dr (R512 / K29) - R114

Control Type:	Signalized	Delay (sec / veh):	31.9
Analysis Method:	HCM 7th Edition	Level Of Service:	C
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.726

Intersection Setup

Name	Malibongwe			Malibongwe			R114			R114		
Approach	Northbound			Southbound			Eastbound			Westbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70
No. of Lanes in Entry Pocket	1	0	3	1	0	2	1	0	1	1	0	2
Entry Pocket Length [m]	120.00	30.48	150.00	120.00	30.48	120.00	90.00	30.48	90.00	90.00	30.48	120.00
No. of Lanes in Exit Pocket	0	0	0	1	0	0	0	0	0	1	0	0
Exit Pocket Length [m]	0.00	0.00	0.00	60.00	0.00	0.00	0.00	0.00	0.00	90.00	0.00	0.00
Speed [km/h]	60.00			60.00			60.00			60.00		
Grade [%]	0.00			0.00			0.00			0.00		
Curb Present	No			No			No			No		
Crosswalk	No			No			No			No		

Movement, Approach, & Intersection Results

d_M, Delay for Movement [s/veh]	0.00	35.96	22.59	0.00	27.07	43.55	44.74	28.92	18.01	0.00	29.61	20.26
Movement LOS		D	C		C	D	D	C	B		C	C
d_A, Approach Delay [s/veh]		33.50			32.01			34.13			24.83	
Approach LOS		C			C			C			C	
d_I, Intersection Delay [s/veh]		31.86										
Intersection LOS		C										
Intersection V/C		0.726										

Other Modes

g_Walk,mi, Effective Walk Time [s]		0.0			0.0			0.0			0.0	
M_corner, Corner Circulation Area [m²/ped]		0.00			0.00			0.00			0.00	
M_CW, Crosswalk Circulation Area [m²/ped]		0.00			0.00			0.00			0.00	
d_p, Pedestrian Delay [s]		0.00			0.00			0.00			0.00	
I_p,int, Pedestrian LOS Score for Intersection		0.000			0.000			0.000			0.000	
Crosswalk LOS		F			F			F			F	
s_b, Saturation Flow Rate of the bicycle lane		2000			2000			2000			2000	
c_b, Capacity of the bicycle lane [bicycles/h]		450			500			475			475	
d_b, Bicycle Delay [s]		24.03			22.50			23.26			23.26	
I_b,int, Bicycle LOS Score for Intersection		2.568			2.524			2.435			2.842	
Bicycle LOS		B			B			B			C	

Sequence

Ring 1	1	2	3	4	-	-	-	-	-	-	-	-	-	-	-	-
Ring 2	5	6	7	8	-	-	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

