srk consulting

Transport Impact Assessment for Erf 11305 and Erf 1948 Housing Developments, Port Elizabeth

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Executive Summary

This Transport Impact Assessment (TIA) has been prepared for two Housing Developments that are proposed on Erf 11305 and Erf 1948 in Walmer, Port Elizabeth.

A TIA report (Draft 1.0) was prepared in August 2015 for the two development sites. This subsequent TIA report has been prepared following changes to the proposed internal layout of the Erf 11305 development. The proposed internal layout of Erf 1948 remains unchanged.

The purpose of the TIA is to assess the impact of the additional traffic generated by the proposed developments on the surrounding road network. Consideration is also given to future road network planning, parking requirements, non-motorised transport and public transport services and facilities.

It is anticipated that the proposed developments will be implemented over a 10 year time period. The TIA has been based on the assumption that both developments would be 50% developed by 2022 (5 years) and 100% developed by 2027 (10 years).

The proposed mixed-use developments will primarily consist of residential, business, and community land uses. Mixed-use developments tend to generate much less external traffic than conventional developments of a similar size, since residents are able to live, work and do business within the same area, with less need to travel elsewhere.

Access to the Erf 11305 development is proposed from an existing intersection on Beethoven Avenue to the north of the site (via Walmer Heights), and from a new access on Victoria Drive to the south of the site. Access to the Erf 1948 development will be from an existing intersection on Victoria Drive to the north of the site.

Classified traffic counts were carried out during the weekday morning and afternoon peak traffic periods. The SIDRA INTERSECTION 7.0 software package was used to analyse a total of ten intersections that would be affected by the proposed developments.

The analysis results indicate that, for the 5 year analysis period (2022), two intersections require geometric upgrades to meet capacity requirements. For the 10 year analysis period (2027), one intersection requires geometric upgrades to meet capacity requirements. None of the existing intersections within the Walmer Heights residential area require geometric upgrades as a result of the proposed developments.

Various conclusions and recommendations have been formulated to address the identified needs with regards to parking requirements, non-motorised transport and public transport services and facilities, as included in the TIA. The TIA also includes an assessment of potential impacts and proposed mitigation measures.

1. Introduction

GIBB Pty (Ltd) has been appointed by SRK Consulting to undertake a Transport Impact Assessment (TIA) for two proposed Housing Developments on Erf 11305 (Walmer Heights) and Erf 1948 (Walmer Gqebera) in Port Elizabeth.

A TIA report (Draft 1.0) was prepared in August 2015 for the two development sites. This subsequent TIA report has been prepared following changes to the proposed internal layout of the Erf 11305 development. The proposed internal layout of Erf 1948 remains unchanged.

The extent of the study area of this TIA consists of Buffelsfontein Road (M9) between Victoria Drive and 17th Avenue, Victoria Drive (M18) between Buffelsfontein Road and Glendore Road, and Glendore Road between Victoria Drive and Buffelsfontein Road, as shown in **Figure 1**.

The purpose of this TIA is to assess the traffic volumes generated by the proposed developments and analyse the impact it may have on the surrounding road network. Due to the nature of the proposed developments, consideration is also given to parking requirements, non-motorised transport (NMT) and public transport services and facilities.

At present, it is anticipated that the developments will be implemented over a 10 year time period. This TIA has therefore been based on the assumption that both developments would be 50% developed by 2022 (5 years) and 100% developed by 2027 (10 years).

1.1 Erf 11305 Development

The purpose of the proposed mixed-use housing development is to provide housing and associated facilities and infrastructure on Erf 11305, in order to accommodate the increasing number of residents living in informal housing in the adjacent Gqebera area.

The intention is to provide a mixed-use housing development consisting of Free Basic Housing (FBH), Government owned housing (Social Housing), Government and Privately subsidised housing (GAP) and discounted housing (Open Market housing).

The proposed site is currently undeveloped land. The locality of the site is shown in **Figure 1**. The site measures approximately 43.74ha in size and is currently zoned for Agriculture and Industrial 3 use.

Currently two site layout options (Option A and Option B) are being considered, taking into account the environmental and community concerns that have been raised to date. The two site layout options have varying land use layouts and sizes, although the access points remain the same for both options. The two site layout options are discussed in further detail below.

1.1.1 Option A

The proposed site layout option will comprise of approximately 619 FBH, 732 Social Housing residential units, and 252 GAP and Open Market housing units. A total number of 1 603 residential units will thus be provided.

The proposed land uses for the Option A site layout are shown in **Table 1**. The proposed Option A Site Development Plan (SDP) is shown in **Figure 2**.

Table 1: Erf 11305 Proposed Land Use Composition - Option A

Component	Size (m^2) GLA
Residential Zone 4	59 000
Residential Zone 1 (FBH)	95 700
Residential Zone 1 (GAP)	52 300
Business Zone 1	12 300
Institutional Zone 3	1 200
Institutional Zone 1	28 300
Authority Zone	2 300
Special Zone	1 600
Total	**252 700**

1.1.2 Option B

The proposed site layout option will comprise of approximately 536 FBH, 530 Social Housing residential units, and 170 GAP and Open Market housing units. A total number of 1 236 residential units will thus be provided.

The proposed land uses for the Option B site layout are shown in **Table 2**. The proposed Option B SDP is shown in **Figure 3**.

Table 2: Erf 11305 Proposed Land Use Composition - Option B

Component	Size (m2) GLA
Residential Zone 4	42 700
Residential Zone 1 (FBH)	84 100
Residential Zone 1 (GAP)	35 000
Business Zone 1	11 600
Institutional Zone 3	1 200
Institutional Zone 1	25 600
Authority Zone	2 300

Component	Size (m2) GLA
Special Zone	1 600
Total	**204 100**

1.2 Erf 1948 Development

Similar to Erf 11305, the purpose of the proposed housing development is to provide housing and associated facilities and infrastructure on Erf 1948, in order to accommodate the increasing number of residents currently living in informal housing in the Gqebera area.

The proposed development will be implemented in two phases, namely:

- **Phase 1A** – Transitional (5 years), will consist of housing and rudimentary services infrastructure on a portion of Erf 1948 to cater for the residents being relocated from Gqebera.
- **Phase 1B** – Construction (5 years), will consist of the construction of permanent housing and associated facilities and infrastructure. This will start simultaneously with the transitional phase but construction will take place around the area allocated to the transitional phase.
- **Phase 2** – Removal of Transitional Phase (10 years) will consist of the removal of all transitional housing to start the development of this part of the site to link up with the construction phase development on the remainder of the site.

The intention is construct approximately 2000 temporary residential units during the transition phase. Upon completion, the development will provide a mixed-use housing development consisting of FBH, GAP and high density housing, similar to Erf 11305. A total number of 1900 residential units will be constructed on Erf 1948.

The proposed mixed-use development will comprise of approximately 1600 low-income residential units, 300 middle-income free standing GAP housing.

The proposed site is currently undeveloped land. The locality of the site is shown in **Figure 1**. The site measures approximately 64ha in size and is currently zoned for Agriculture and Community 1 use. The proposed land uses for Erf 1948 are shown in **Table 3**, and the proposed SDP is shown in **Figure 4**.

Table 3: Erf 1948 Proposed Land Use Composition

Component	Size (m2) GLA
Residential Zone 4	143 200
Residential Zone 4 (GAP)	45 900
Residential Zone 3 (Social Housing)	60 600
Business Zone 1	1 250
School	42 300

Component	Size (m2) GLA
Mixed-Use Informal Trading	3 100
Authority Zone 3	1 620
Community Facility	14 100
Total	**312 070**

Figure 1: Locality Plan and Study Area

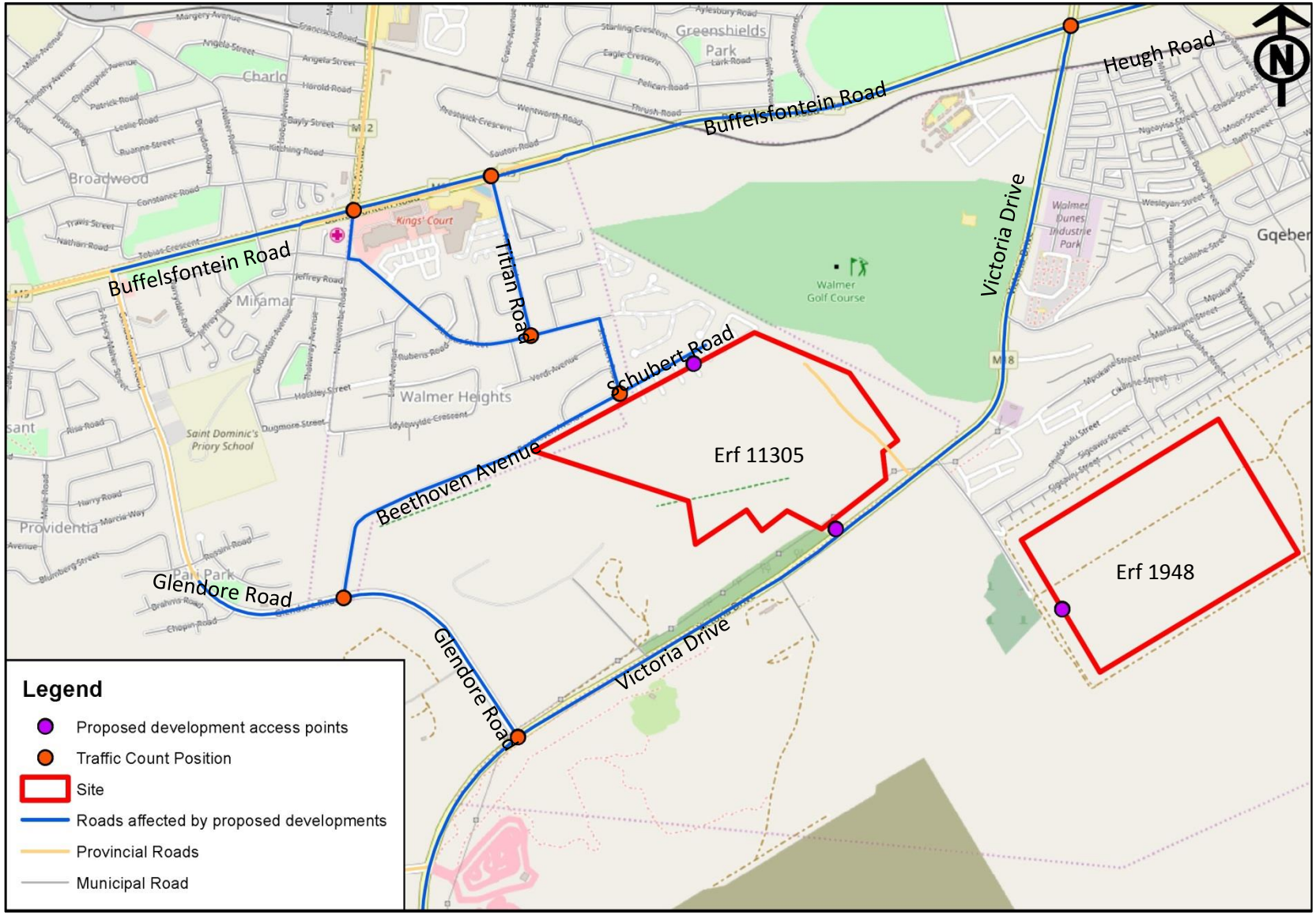


Figure 2: Erf 11305 Site Development Plan – Option A

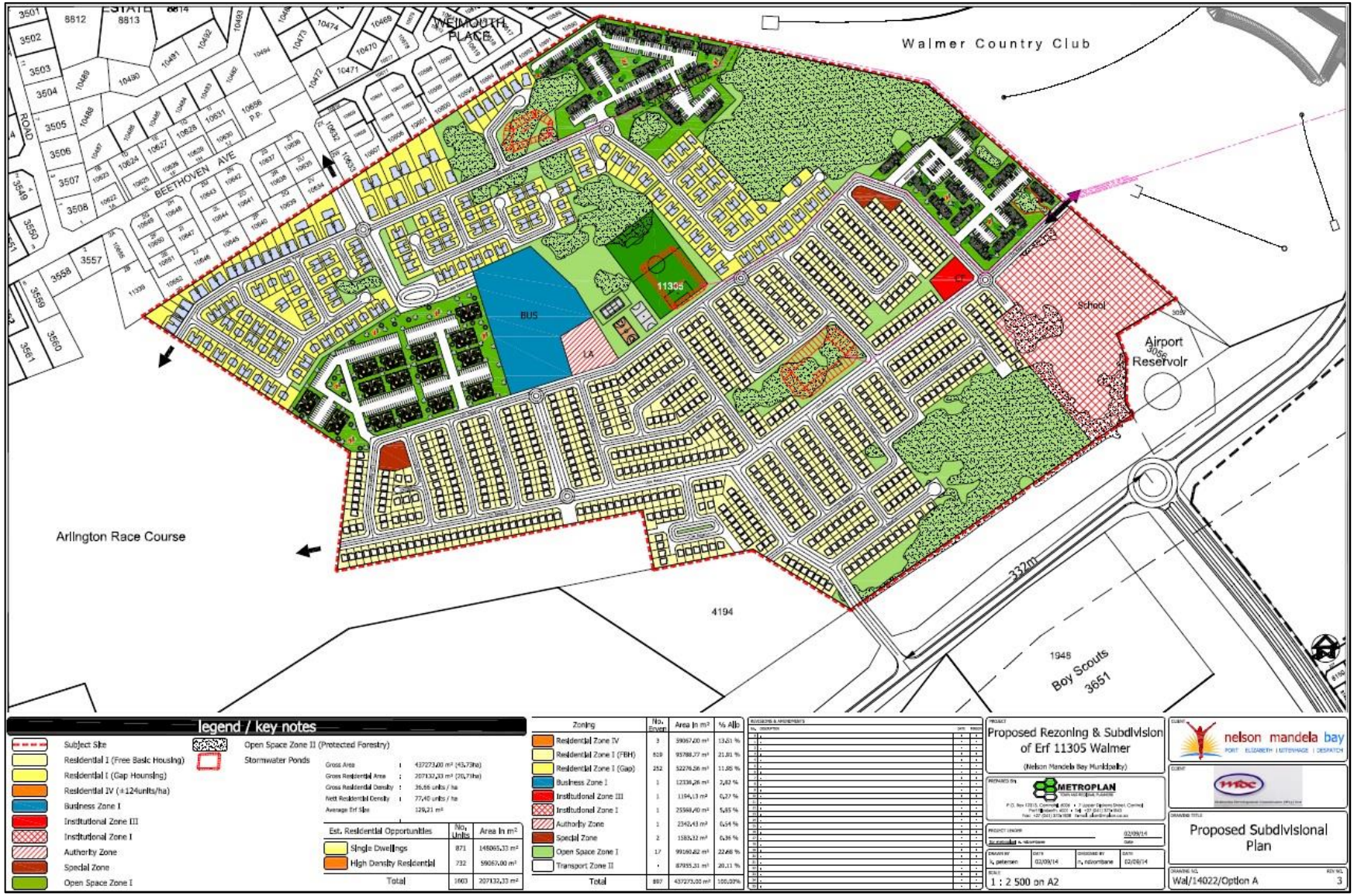


Figure 3: Erf 11305 Site Development Plan – Option B

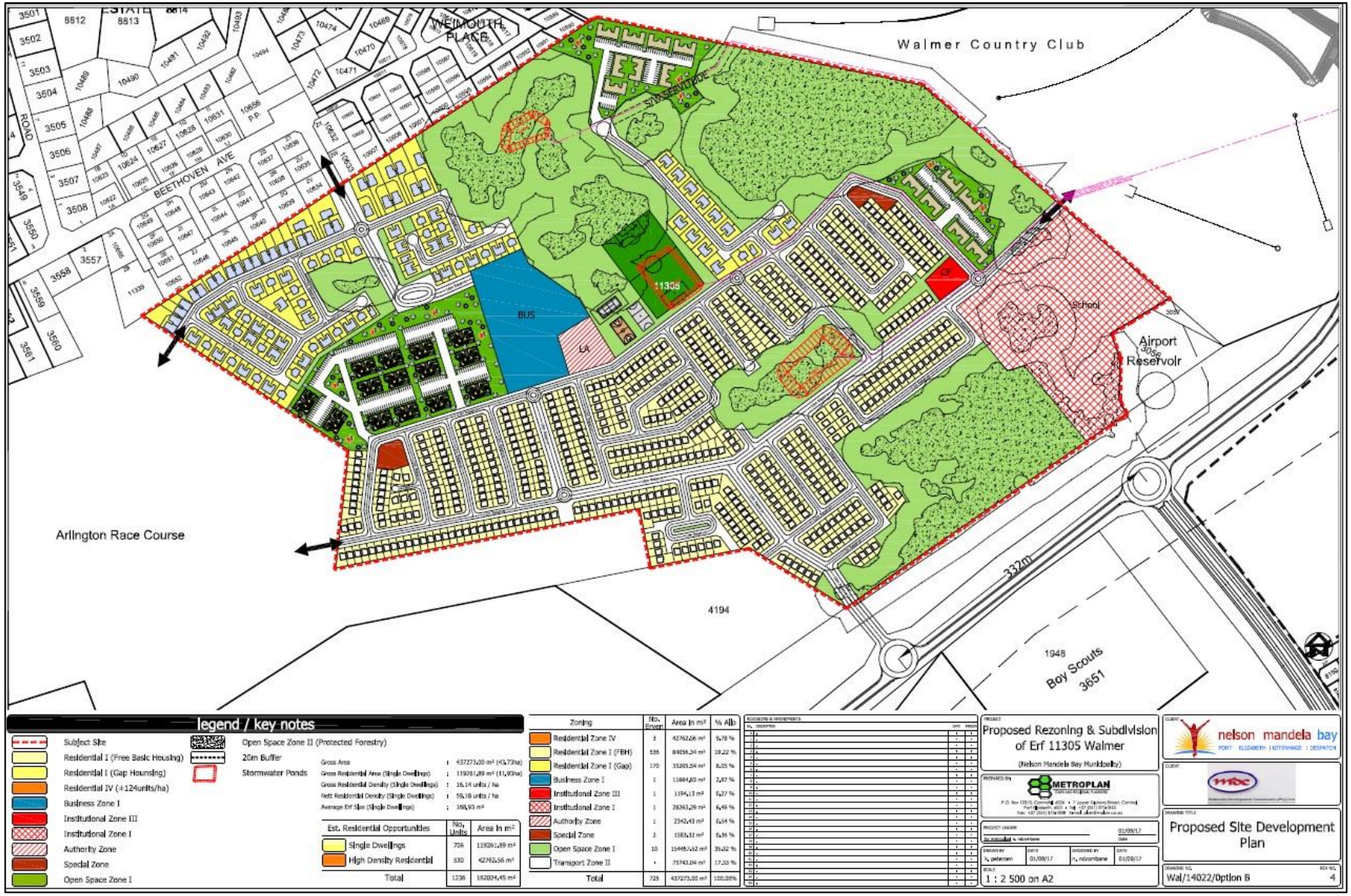
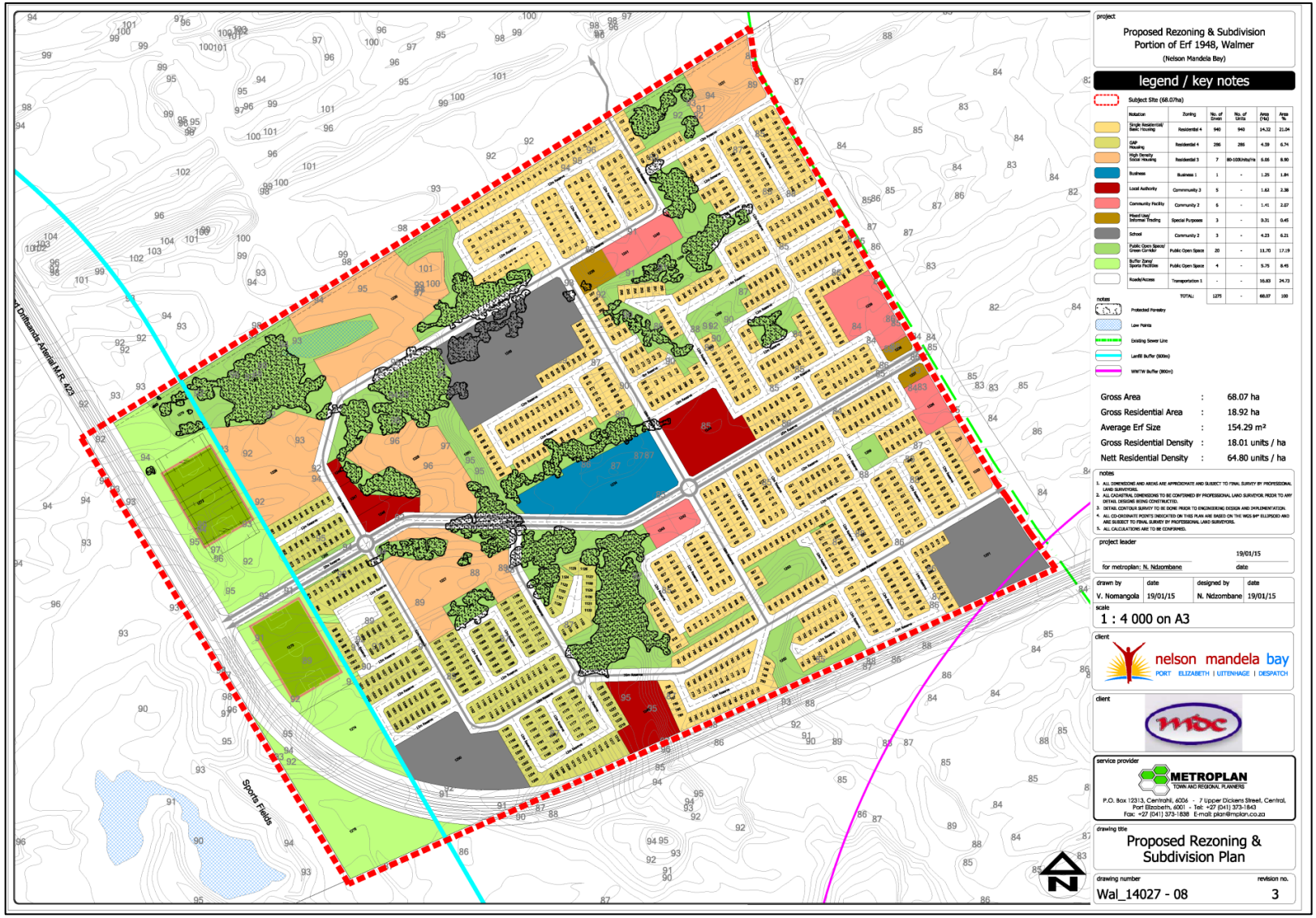


Figure 4: Erf 1948 Site Development Plan



2 Study Methodology

This TIA was approached and conducted in a systematic manner, as indicated by the adopted methodology.

The following guideline documents were used in the preparation of this TIA:

- South African Traffic Impact and Site Assessment Standards and Requirements Manual (Committee of Transport Officials, 2010);
- South African Trip Data Manual, TMH 17 (Committee of Transport Officials, 2012);
- South African Parking Standards, PG3/85(Department of Transport, 1985);
- Manual for Traffic Impact Studies, RR 93/635 (Department of Transport, 1995);
- South African Trip Generation Rates, RR 92/228 (Department of Transport, 1995); and
- Nelson Mandela Bay Municipality's (NMBM) 2008 Review Road Access Management (RRAM).

The following methodology was adopted for the preparation of this TIA:

- Collection of all relevant available information and documentation, including other transport related studies in the vicinity of the site (e.g. other TIAs, Integrated Transport Plan, etc.) and historical traffic count station data from the relevant road authority.
- Liaison with client / architect / town planners to obtain the proposed site development information and drawings.
- Identification of affected intersections for traffic counts in order to determine the existing traffic flows on the roads surrounding the site. The preparation of traffic counting sheets and briefing of enumerators also form part of this step.
- Site inspection to assess the safety of proposed access points; to observe existing transport operations; and to record existing road widths and intersection geometry. Any other transport features considered relevant is also documented, e.g. presence of public transport, pedestrians, cyclists, etc.
- Conduct traffic counts; process traffic data and generate traffic flow diagrams as a base from which future traffic volumes can be estimated.
- A conventional four step transport planning process is typically used to determine the future traffic flows, namely:
    - Calculation of the number of trips that will be generated by the proposed development during peak hours;
    - Distribution of the generated trips between the anticipated origins and destinations;
    - Modal split (the split of passenger trips between private vehicles and public transport), if applicable, as well as any heavy vehicle trips (e.g. trucks, waste removal) during peak hours;
    - Trip assignment by assigning each vehicle to a particular route on the road network.

- The newly generated traffic is then added to the existing background traffic, along with any additional traffic generated by other planned developments in the vicinity of the site.
- Analysis of traffic impact at access points and affected intersections using the SIDRA software package, to identify the need for physical road improvements and the extent thereof.
- Preparation of a TIA report that summarises all of the above, along with conclusions and recommendations.
- Submission of the TIA report to the relevant road authority for consideration and approval.

3 Existing and Future Road Network

3.1 Existing Road Network

The *Nelson Mandela Bay Municipality's* (NMBM) *2008 Review Road Access Management* (RRAM), was used to classify the existing roads within the study area. The existing roads are all external to the two development sites. The classification of the existing road network is described as follow:

- **Buffelsfontein Road** is a 22m wide dual carriageway road, between 17th Avenue and Wentworth Road, and transitions to an 8.2m wide two-lane undivided carriageway road from Wentworth Road to 3rd Avenue. The road can be classified as a Class 3 Activity Arterial (Provincial Road), linking the south-western residential suburbs of Walmer, Walmer Heights, Mount Pleasant and Charlo with Port Elizabeth's Central Business District (CBD). According to the NMBM's *2011/2012 Comprehensive Integrated Transport Plan* (CITP), the route serves as a public transport route and abnormal load route. The majority of the road length is not kerbed and has a posted speed limit of 60km/h.

- **Victoria Drive** is an 11.5m wide two-lane undivided carriageway road and can be classified as a Class 3 Activity Arterial (Provincial Road), serving the Schoenmakerskop and Sardinia Bay residential areas. The road is a public transport route and provides access for residential traffic. The road has a posted speed limit of 60km/h between Buffelsfontein Road and the access points to the proposed developments, from where the speed limit increases to 100km/h.

- **Glendore Road** is a 7.2m wide two-lane undivided carriageway road and can be classified as a Class 4 Activity Street. The road leads to the Walmer Heights, Pari Park and Providentia residential areas and serves public transport and residential traffic.

- **Titian Road** is a 7.2m wide two-lane undivided carriageway road and can be classified as a Class 4 Activity Street. The road leads to the Walmer Heights residential area and serves public transport and residential traffic.

- **Beethoven Avenue** is a 6m wide two-lane undivided carriageway road and can be classified as a Class 5 Local Street. The road leads to the Walmer Heights and Pari Park residential areas and serves public transport and residential traffic.

- **Sibelius Street** is a 6.4m wide two-lane undivided carriageway road and can be classified as a Class 5 Local Street. The road leads to the Walmer Heights residential area and serves public transport and residential traffic.

- **Schubert Road** is a 6m wide two-lane undivided carriageway road and can be classified as a Class 5 Local Street. The road leads to the Walmer Heights residential area and serves public transport and residential traffic.

The intersections within the study area that will most likely be impacted by the proposed developments can be seen in **Figure 1**, i.e. the traffic count positions.

3.2 Future Road Network

According to the NMBM's 2011/2012 CITP, it is recommended that Buffelsfontein Road be upgraded to a 4 lane dual–carriageway road from Titian Road in the west to 3rd Avenue in the east, in order to accommodate traffic growth along this route. The CITP furthermore recommends that this road capacity improvement should be implemented during the 2011/2012 – 2015/2016 financial periods.

The upgrading of this section of Buffelsfontein Road has not commenced, and there are currently no plans in place to implement the recommended road widening. It has therefore been assumed that the upgrading of Buffelsfontein Road will only occur beyond the forecast period of this TIA, i.e. beyond 2027.

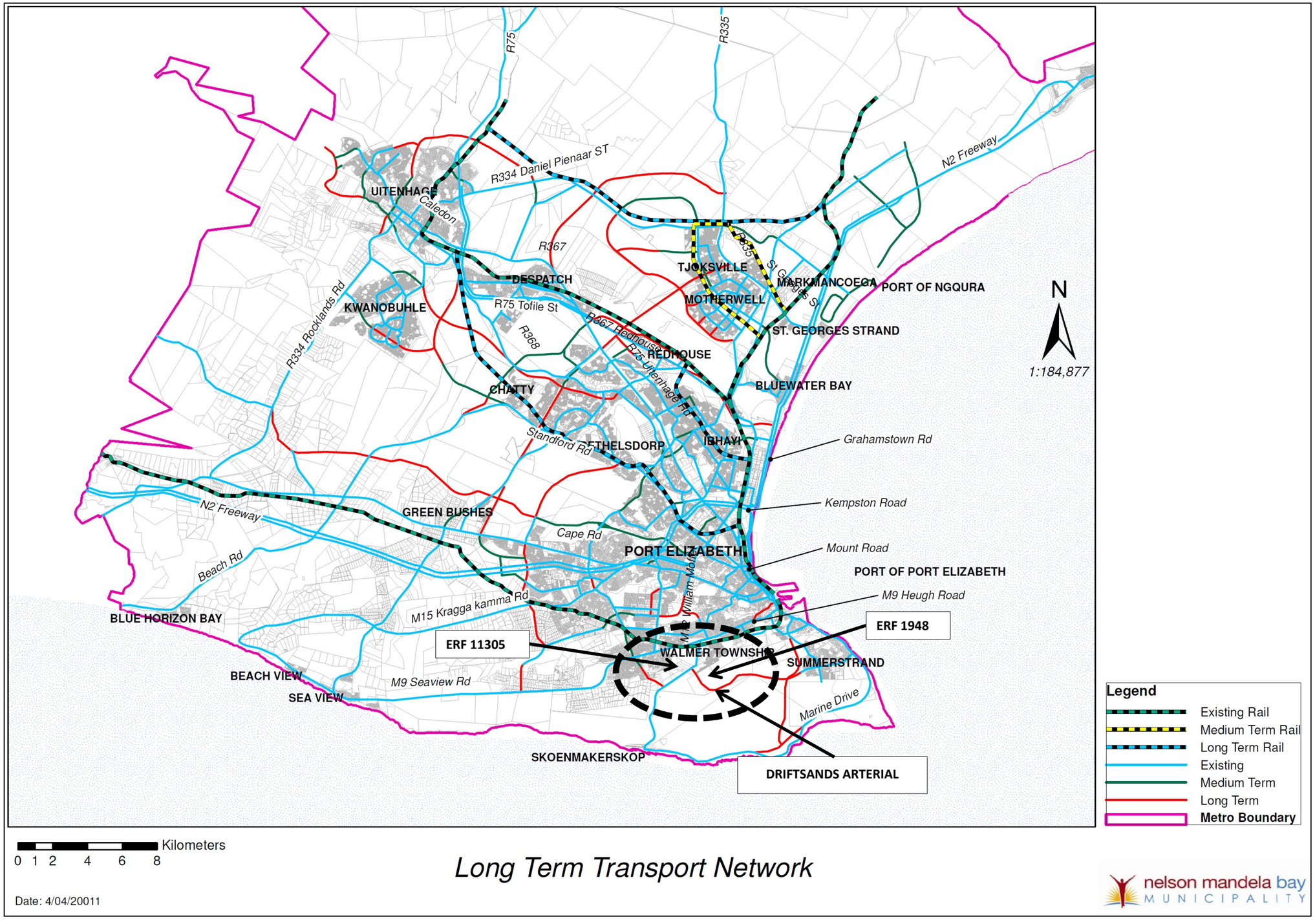
Additionally, the construction of the Driftsands Arterial is a major new road planned in proximity to the proposed developments. The Driftsands Arterial was initially planned to follow an alignment along the western boundary of the Walmer Country Club towards Buffelsfontein Road. This road alignment has subsequently changed following the sale of the Walmer Country Club, which originally belonged to the NMBM. The latest proposed alignment of the Driftsands Arterial is from Victoria Drive in the west (also forming the main access road to the Erf 1948 development) heading in a southward direction which then turns east to link up to the existing Driftsands Arterial in Summerstrand, as shown in **Figure 5**.

The NMBM's Long Term Transport Network Plan (**Figure 5**), as contained in the 2011/2012 CITP, indicates that this road is planned for the long term, i.e. 20 years, which is beyond the forecast period of this TIA.

Consultation with the NMBM also revealed that there are currently no other road upgrades or new roads planned in the vicinity of the proposed developments that would influence the outcome of this study.

This TIA is therefore based on the existing road network without any of the proposed network changes described above. It is anticipated that the future widening of Buffelsfontein Road and the construction of the Driftsands Arterial should decrease traffic congestion in the area, improving conditions, and therefore should not negatively impact traffic conditions in the study area.

Figure 5: NMBM Long Term Transport Network Plan



(Source: NMBM CITP, 2011)

4 Background Traffic

4.1 2017 Background Traffic

As part of the initial TIA (Draft 1.0) prepared in August 2015, classified traffic counts were carried out on Wednesday 29 July 2015 during the weekday morning (AM) peak period (6:30 to 08:15) and afternoon (PM) peak period (16:15 to 18::00) at the following intersections:

- Buffelsfontein Road / Victoria Drive
- Buffelsfontein Road / Titian Road
- Buffelsfontein Road / 17th Avenue
- Victoria Drive / Glendore Road
- Glendore Road / Beethoven Avenue
- Beethoven Avenue / Schubert Road
- Titian Road / Sibelius Street

The results of the surveys indicate the AM and PM peak traffic hours to be from **06:45** to **07:45** and from **16:45** to **17:45**, respectively.

A 'control count' was carried out on 19 September 2017 at the Buffelsfontein Road / Victoria Drive intersection to determine whether the July 2015 traffic count data was still relevant to the 2017 traffic volumes. The count data indicates that the peak traffic hours remained unchanged, whilst annual traffic growth was calculated to be 1% per annum over the 2-year period (2015 - 2017).

The 2017 background traffic volumes for the weekday AM and PM peak hours are shown in **Figure 6** and **Figure 7**, respectively.

4.2 2022 and 2027 Background Traffic

The *COTO South African Traffic Impact and Site Traffic Assessment Standards & Requirements Manual* (Dec 2010) recommends an assessment period of 10 years for developments generating more than 2000 peak hour trips. Although each development generates less than 2000 peak hour trips, the TIA is bases on 5 year and 10 year assessment periods to tie in with the planned implementation phasing of the two developments.

The areas surrounding the two sites are only partially developed at present. Further development in this area may therefore occur during the assessment period of this TIA. Traffic growth is therefore anticipated in the study area over the next 10 years.

The 2022 and 2027 background traffic volumes were calculated based on the actual annual traffic growth rate (i.e. 1%) calculated through the 'control count' done at the Buffelsfontein Road / Victoria Drive intersection in 2015 and 2017. The calculated annual traffic growth rate is considered to be realistic and appropriate to apply to the future forecast periods of this TIA.

This growth rate also makes provision for traffic growth as a result of other future developments (excluding Erf 11305 and Erf 1948) in this area.

The 2022 and 2027 weekday AM and PM background traffic volumes are shown in **Appendix A.**

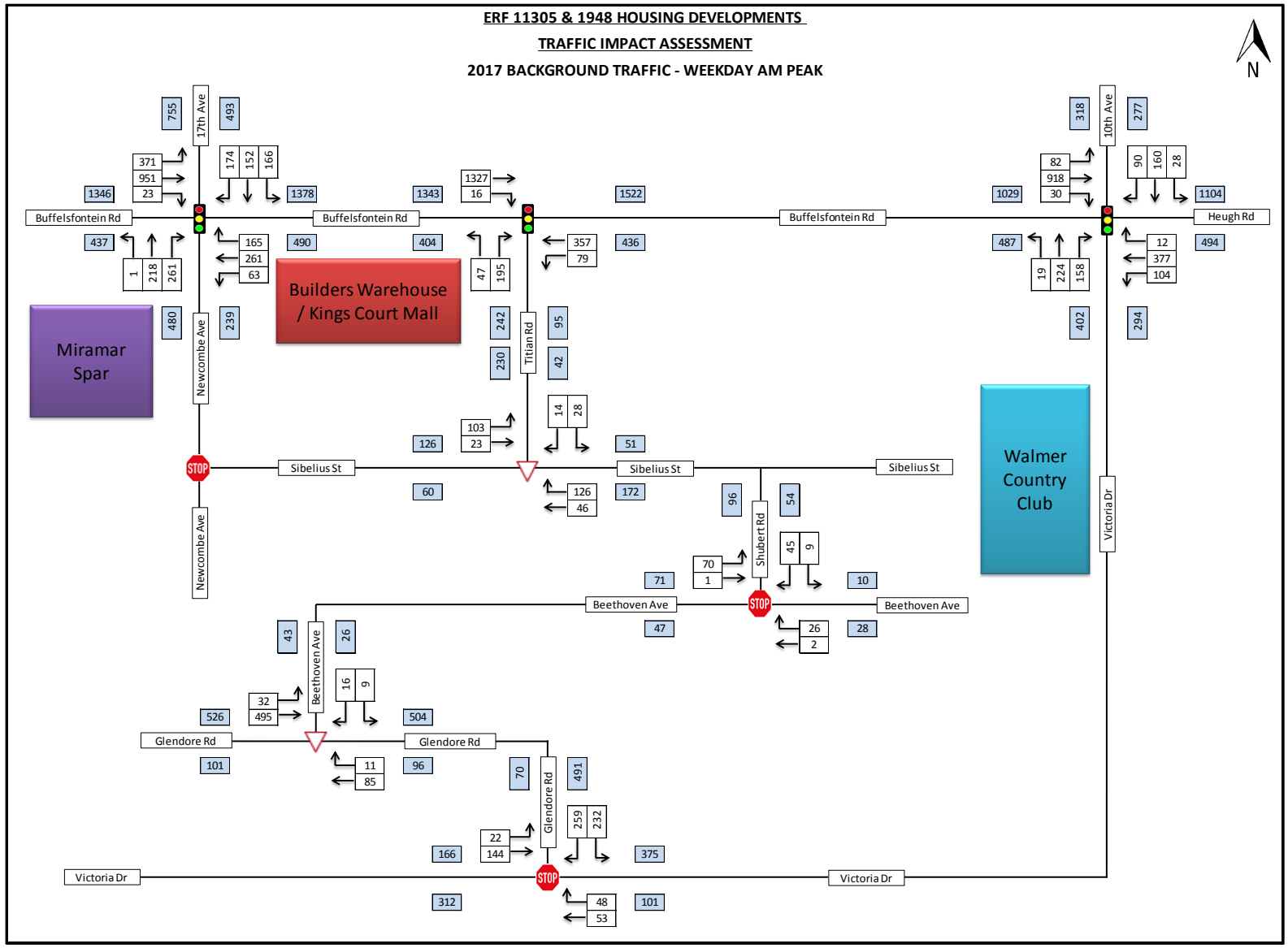


Figure 6: Background Traffic 2017 Weekday AM Peak

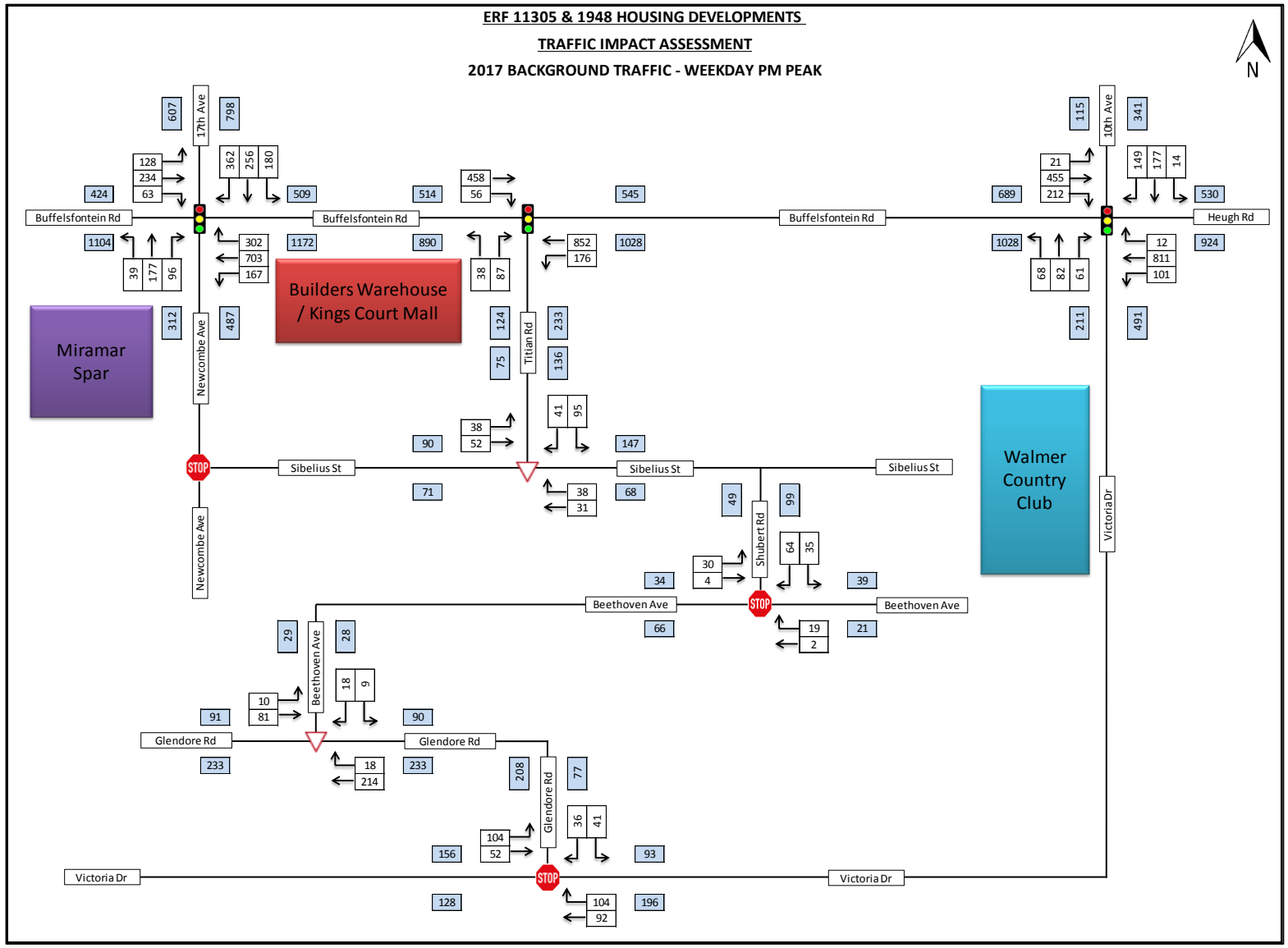


Figure 7: Background Traffic 2017 Weekday PM Peak

5 Access

The two developments will primarily be accessible from existing roads, i.e. Victoria Drive and Beethoven Avenue, as can be seen in **Figure 1**. The SDPs (**Figure 2, Figure 3** and **Figure 4**) also indicate provision for secondary access points via the extension of internal roads to the adjacent areas. The secondary access points would only become operational once the adjacent sites have been adequately developed. It is currently unknown when this situation may arise, hence the focus of the TIA is on the primary access points to the two developments.

5.1 Erf 11305 Development (Option A and Option B)

The proposed site does not have fencing around the entire perimeter and is currently accessed by pedestrians traveling from Gqebera to Walmer Heights and Miramar via Victoria Drive and Beethoven Avenue. This route is currently used as a shortcut between these two areas.

In future, it is anticipated that pedestrians will continue to walk through this area, and hence the development. Pedestrian facilities should therefore be provided along the main pedestrian routes through the development. Please refer to *Section 9.2: Non-Motorised Transport* for further detailed information in this regard.

Vehicles will primarily access the development via the new Victoria Drive / Access Road intersection to the south, as well as the extension of the existing Beethoven Avenue / Access Road cul de sac to the north, as shown in the following figures.

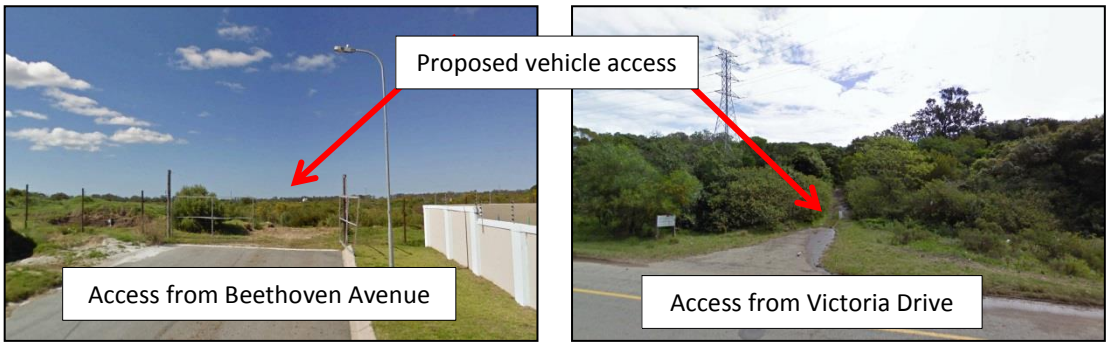


Figure 8: Proposed vehicle access to Erf 11305

5.1.1 Access Spacing

According to the NMBM's 2008 RRAM guideline, the minimum allowable access spacing along a road such as Beethoven Avenue is between 45m and 65m, and Victoria Drive is 160m.

The access spacing from the proposed vehicle access along Beethoven Avenue to the west and east is 78m and 65m, respectively, as shown in **Figure 9**. The available access spacing meets the minimum guideline requirement of 45m and is therefore considered to be acceptable.

The access spacing from the proposed vehicle access along Victoria Drive to the west and east is 160m and 332m, respectively, as shown in **Figure 9**. The available access spacing also meets the minimum guideline requirement of 160m and is therefore considered to be acceptable.

5.1.2 Sight Distance Requirements

The DOT's *Guidelines for the Geometric Design of Urban Arterial Roads* (UTG1, 1986), was used to determine the minimum required sight distances that must be provided at the proposed vehicle access points. The minimum shoulder sight distance required for a stop-controlled and signalised intersection for a passenger car and a single unit truck (e.g. refuse truck) configuration along the access roads, based on a 60km/h speed limit, is 120m and 175m respectively.

- **Beethoven Avenue:** The existing shoulder sight distance in the westerly and easterly direction is comfortably in excess of 300m and 175m, respectively. The available sight distances exceed the minimum requirement of 120m and 175m and are therefore considered to be acceptable.
- **Victoria Drive:** The existing shoulder sight distance in the westerly and easterly direction is comfortably in excess of 450m and 580m, respectively. The available sight distances exceed the minimum requirement of 120m and 175m and are therefore considered to be acceptable.

It is recommended that a minimum shoulder sight distance of 175m be maintained at the site accesses points during the construction stage of the development, by ensuring there are no objects (dirt bins, temporary road signs, etc.) present that can obstruct the sight distances of construction vehicles.

The locations of the proposed vehicle accesses to the Erf 11305 development (Option A and Option B) are shown in **Figure 9**.

The positions of existing and proposed speed limit signage on Victoria Drive, in the vicinity of the new access intersection, are also shown in **Figure 9**. It is recommended that the 100km/h speed limit on the western part of Victoria Drive be reduced to 60km/h (eastbound direction) at a point approximately 100m west of the new access intersection for Erf 11305, and that new speed limit signage be introduced accordingly. This speed reduction through the new access intersection will assist to increase the safety of road users at this intersection.

Figure 9: Proposed vehicle access locations for Erf 11305 and Erf 1948

5.2 Erf 1948 Development

The proposed site is fenced off at present and is only accessible via a gate on the existing access road.

Vehicles will access the development via the extension of the existing Access Road that currently intersects with Victoria Drive, as shown in the following figures.

Figure 10: Proposed vehicle access to Erf 1948

5.2.1 Access Spacing

According to the NMBM's 2008 RRAM guideline, the minimum allowable access spacing along a road such as Victoria Drive is 160m.

The existing access spacing from the proposed vehicle access along Victoria Drive to the west and east is 100m and 250m, respectively, as shown in **Figure 9**. It should be noted however that the 100m spacing to the west is to an existing property access, and although not ideal, this situation will in all likelihood have to remain as is. The available access spacing to the east meets the minimum guideline requirement of 160m and is considered to be acceptable.

5.2.2 Sight Distance Requirements

The DOT's *Guidelines for the Geometric Design of Urban Arterial Roads* (UTG1, 1986), was used to determine the minimum required sight distances that must be provided at the proposed vehicle access. The minimum shoulder sight distance required for a stop-controlled and signalised intersection for a passenger car and a single unit truck (e.g. refuse truck) configuration along a road such as Victoria Drive, based on a 60km/h speed limit, is 120m and 175m respectively.

The existing shoulder sight distance in the northerly and southerly direction is 485m and 780m, respectively. The available sight distances exceed the minimum requirement of 120m and 175m and are therefore considered to be acceptable.

It is recommended that a minimum shoulder sight distance of 175m be maintained at the site access points during the construction stage of the development, by ensuring there are no objects (dirt bins, temporary road signs, etc.) present that can obstruct the sight distances of construction vehicles.

The location of the proposed vehicle access to the Erf 1948 development is shown in **Figure 9.**

5.3 Primary Access Configuration on Considerations

The proposed primary access points for the two developments will be located on Victoria Drive. Site observations revealed a moderate presence of pedestrians and cyclists along Victoria Drive, and also in the vicinity of the primary access points.

Given the nature of the developments (i.e. mixed-use), the anticipated traffic volumes and the types of road users currently present, consideration was given to the most suitable traffic control configurations for the primary access intersections on Victoria Drive, namely stop control, traffic circles or traffic signal control.

Two-way stop-controlled intersections, with the stop control on the minor roads (i.e. Erf 11305 and Erf 1948 access roads) turned out to be suitable solutions for the developments' primary access intersections along Victoria Drive. Pedestrian movements can also be safely accommodated at stop-controlled intersections.

Traffic circles on the other hand pose a higher safety risk to pedestrians in comparison to a signalised intersection. This is primarily because of the continuous movement of vehicles through a traffic circle, whilst only yielding occasionally to approaching vehicles or vehicles within the circle. Limited opportunity may therefore exist for pedestrians to safely cross the approach roads, especially during peak traffic periods when high volumes of traffic are present. Based on the above, this option was not considered to be suitable.

Given that the access intersections would function adequately under stop-control, the use of traffic signal control in these locations was not considered to be warranted.

6 Trip Generation and Distribution

6.1 Trip Generation

The *Committee of Transport Officials' (COTO) South African Trip Data Manual (September 2012)* was used to estimate the number of vehicle trips generated by the proposed mixed-use development.

6.1.1 Trip Reduction Factors – General

It should be noted that the *South African Trip Data Manual* introduces various trip rate reduction factors that can be motivated for, subject to the proposed land use mix and the prevailing site conditions. The *Manual* defines four different trip reductions factors that can be used as summarised below:

- **Mixed land-use**: Developments in an area that consist of two or more single-use developments between which trips can be made by means of non-motorised modes of transport (such as walking).
- **Low vehicle ownership**: Majority of households (more than 50%) do not own a vehicle and rely on public transport for transportation.
- **Very low vehicle ownership**: Almost all households (more than 90%) do not own a vehicle and rely on public transport for transportation.
- **Transit nodes or corridors**: Developments that are located within a reasonable walking distance from a major transit node or stops on a major transit corridor.

6.1.2 Trip Reduction Factors – Site Specific

The proposed developments will consist of a number of land uses namely; residential, business, school, community and retail. Mixed-use developments tend to generate much less external traffic than conventional developments of a similar size, since residents are able to live, work and do business within the same area, with less need to travel elsewhere. The study area is considered a "mixed land-use" area as per the COTO definition and the application of the associated reduction factor for this criterion was therefore considered suitable.

Given that the residential components of the proposed developments are aimed at low income groups, it is considered appropriate to assume that the level of vehicle ownership in this area will be low once fully inhabited. The study areas are therefore considered a "low vehicle ownership" area as per the COTO definition and the application of the associated reduction factor for this criterion was therefore considered suitable.

6.2 Estimated New Vehicle Trips Generated

6.2.1 Erf 11305 Development – Option A

The number of vehicle trips estimated to be generated by the Option A site layout and the percentage directional split calculations for the weekday AM and PM peak hours are shown in **Table 4**.

It is estimated that a total of 1220 external vehicle trips will be generated by the proposed development during the weekday AM and PM peak traffic hours.

6.2.2 Erf 11305 Development – Option B

The number of vehicle trips estimated to be generated by the Option B site layout and the percentage directional split calculations for the weekday AM and PM peak hours are shown in **Table 5**.

It is estimated that a total of 977 external vehicle trips will be generated by the proposed development during the weekday AM and PM peak traffic hours.

6.2.3 Erf 1948 Development

The number of vehicle trips estimated to be generated by the proposed development and the percentage directional split calculations for the weekday AM and PM peak hours are shown in **Table 6**.

It is estimated that a total of 736 external vehicle trips will be generated by the proposed development during the weekday AM and PM peak traffic hours.

6.2.4 Trip Generation Selection and Use

For the purpose of this study, Option A is considered to be a 'worst case scenario' from a vehicle trip generation perspective for the Erf 11305 development, since this site layout will generate the highest number of weekday peak hour vehicle trips. The trip generation values for Option A, along with the trip generation values for the Erf 1948 development, was thus taken forward to the capacity analysis section of this TIA.

Below is further information relating to the trip generation assumptions and calculations for Erf 11305 Option A and Erf 1948, based on the development information available at the time of preparing this TIA. Assumptions for the two development sites differ slightly due to the type of information available for each. However, these assumptions are not considered to be detrimental to the trip generation calculations, or ultimately the conclusions and recommendation of this TIA.

For mixed-use developments, the community related land uses (e.g. crèche and church) are intended to serve the residential land uses and are not expected to generate external trips. It is also considered reasonable to assume that 75% to 80% of the trips generated by the business land uses in the development will be internal trips coming from the residential areas. The remainder of the trips generated by the business land uses will therefore be external trips.

For Erf 11305 Option A, this trip generation approach equates to approximately 25% of residential trips being internal trips travelling to the business and institutional land uses, and the balance of the residential trips being external trips.

For Erf 1948, this trip generation approach equates to approximately 43% of residential trips being internal trips travelling to the business land uses, and the balance of the residential trips being external trips.

Overall this means that 46% of all trips generated by the Erf 11305 Option A development are internal trips and 54% are external trips. Similarly for the Erf 1948 development, 58% of all generated trips are internal trips and 42% are external trips.

The anticipated student numbers for the planned schools (crèches, primary and secondary schools) were unavailable at the time of preparing this TIA. Since these will predominantly be low to middle income areas, it is anticipated that the average family size (i.e. number of people per dwelling unit, including children) will be less than what is typically found in middle to high income areas, mainly due to the physical space limitations of the dwelling units. This characteristic influences the number of scholars expected at the proposed schools, although it does not have a major impact on the trip generation calculations, seeing that the schools will primarily attract trips internal to the development.

In agreement with the Development Planners, allowance was made for one scholar (student) per residential unit for the Erf 11305 Option A development. This provides for scholars for crèches, primary schools and secondary schools. The total number of students was allocated to each school type as follow for trip generation calculation purposes:

- Crèche – 20% (assumed to be 100% internal trips)
- Primary School – 40% (assumed to be 50% internal / 50% external trips)
- Secondary School – 40% (assumed to be 50% internal / 50% external trips)

For Erf 1948 it was assumed that the primary school will cater for approximately 400 pupils and the secondary school will cater for approximately 1000 pupils. The SDP indicate that two primary schools and one secondary school will be provided as part of the Erf 1948 development, providing for 100% internal trips to serve to residential components of the development.

Based on the implementation timeframes for the two developments, the TIA assumes that 50% of the total traffic will be generated by 2022 (5 years) and 100% by 2027 (10 years).

Table 4: Peak hour vehicle trips generated by Erf 11305 – Option A

Land-use	Area (m^2) GLA / No. Units / Students	Trip Generation (DOT Rate)		Total Development Trips		Development Trips			Internal Trips		External Trips		AM Peak		PM Peak	
						COTO Combined Reduction Factor %	Adjusted Trips									
		AM	PM	AM	PM		AM	PM	AM	PM	AM	PM	In	Out	In	Out
Residential 1 - (Gap & Affordable Market Housing) (Residential -210)	252	1 / Unit	1 / Unit	252	252	54%	116	116	0	0	116	116	29	87	81	35
Residential 1 - (Free Base House) (Residential - 210)	619	1 / Unit	1 / Unit	619	619	54%	284	284	108	102	176	182	44	132	127	55
Residential IV - (Walk ups) (Residential -220)	732	0.65 / Unit	0.65 / Unit	476	476	49%	241	241	65	59	176	182	44	132	127	55
Business Zone 1 (Shopping Centre - 820)	12300	0.60 / $100m^2$	3.40 / $100m^2$	74	418	46%	40	224	30	168	10	56	6	3	28	28
Institututional Zone III (Church Sites/Community Facility) (Office - 710)	1200	2.1 / $100m^2$	2.1 / $100m^2$	25	25	46%	14	14	14	14	0	0	0	0	0	0
Institututional Zone I – (Public Secondary School - 530)	641	0.75 / Student	0.25 / Student	481	160	70%	143	48	72	24	72	24	36	36	12	12
Institututional Zone I – (Public Primary School - 520)	641	0.85 / Student	0.30 / Student	545	192	70%	162	57	81	29	81	29	41	41	14	14
Institututional Zone I – (Crèche, Pre - School -565)	321	1.0 / Student	0.80 / Student	321	256	60%	129	104	129	104	0	0	0	0	0	0
Authority Zone - (Office - 710)	2300	2.1 / $100m^2$	2.1 / $100m^2$	48	48	46%	26	26	26	26	0	0	0	0	0	0
Special Zone	1600	No Trip Generation during peak hour														
Total							**1155**	**1114**	**525**	**526**	**631**	**589**	**200**	**431**	**389**	**199**
50% Development Trips by 2022							**577**	**557**	**262**	**263**	**315**	**294**	**100**	**215**	**194**	**99**
100% Development Trips by 2027							**1155**	**1114**	**525**	**526**	**631**	**589**	**200**	**431**	**389**	**199**

Note that 75% of the generated Business Zone trips are assumed to be from people living within the Residential components of this development, thus internal trips. Approximately 25% of all Residential trips are internal trips to the Business and Institutional components (schools). For the Primary and Secondary Schools it was assumed that 50% of the generated trips would be internal trips (from the Residential components) and 50% would be external trips (from outside the development). For the Church Sites/Community Facility, Crèche/Pre-School and Authority Zone it was assumed that 100% of the generated trips would be internal trips (from the Residential components). Therefore, 46% of all generated trips are internal trips whilst 54% are external trips.

Table 5: Peak hour vehicle trips generated by Erf 11305 – Option B

Land-use	Area (m²) GLA / No. Units / Students	Trip Generation (DOT Rate)		Total Development Trips		Development Trips			Internal Trips		External Trips		AM Peak		PM Peak	
						COTO Combined Reduction Factor %	Adjusted Trips									
		AM	PM	AM	PM		AM	PM	AM	PM	AM	PM	In	Out	In	Out
Residential 1 - (Gap & Affordable Market Housing) (Residential -210)	170	1 / Unit	1 / Unit	170	170	54%	78	78	0	0	78	78	20	59	55	23
Residential 1 - (Free Base House) (Residential - 210)	536	1 / Unit	1 / Unit	536	536	54%	246	246	103	87	143	159	36	107	112	48
Residential IV - (Walk ups) (Residential -220)	530	0.65 / Unit	0.65 / Unit	345	345	49%	174	174	32	15	143	159	36	107	112	48
Business Zone 1 (Shopping Centre - 820)	11600	0.60 / 100m²	3.40 / 100m²	70	394	46%	37	211	28	158	9	53	6	3	26	26
Institututional Zone III (Church Sites/Community Facility) (Office - 710)	1200	2.1 / 100m²	2.1 / 100m²	25	25	46%	14	14	14	14	0	0	0	0	0	0
Institututional Zone I – (Public Secondary School - 530)	494	0.75 / Student	0.25 / Student	371	124	70%	110	37	55	18	55	18	28	28	9	9
Institututional Zone I – (Public Primary School - 520)	494	0.85 / Student	0.30 / Student	420	148	70%	125	44	63	22	63	22	31	31	11	11
Institututional Zone I – (Crèche, Pre - School -565)	247	1.0 / Student	0.80 / Student	247	198	60%	100	80	100	80	0	0	0	0	0	0
Authority Zone - (Office - 710)	2300	2.1 / 100m²	2.1 / 100m²	48	48	46%	26	26	26	26	0	0	0	0	0	0
Special Zone	1600	No Trip Generation during peak hour														
Total							**911**	**910**	**420**	**421**	**488**	**489**	**157**	**335**	**324**	**165**
50% Development Trips by 2022							**455**	**455**	**210**	**210**	**244**	**244**	**78**	**166**	**162**	**81**
100% Development Trips by 2027							**911**	**910**	**420**	**421**	**488**	**489**	**157**	**335**	**324**	**165**

Note that 75% of the generated Business Zone trips are assumed to be from people living within the Residential components of this development, thus internal trips. Approximately 31% of all Residential trips are internal trips to the Business and Institutional components (schools). For the Primary and Secondary Schools it was assumed that 50% of the generated trips would be internal trips (from the Residential components) and 50% would be external trips (from outside the development). For the Church Sites/Community Facility, Crèche/Pre-School and Authority Zone it was assumed that 100% of the generated trips would be internal trips (from the Residential components). Therefore, 46% of all generated trips are internal trips whilst 54% are external trips.

Table 6: Peak hour vehicle trips generated by Erf 1948

Land-use	Area (m²) GLA / No. Units	Trip Rate (DOT Rate)		Number of Vehicle Trips	Internal Trips		External Trips		Distributed External Trips Weekday AM		Distributed External Trips Weekday PM	
		AM Peak	PM Peak		%	Trips	%	Trips	IN	OUT	IN	OUT
Basic and High Density (Low income)	1640	0.5/ unit	0.5 / unit	820	30%	245	70%	575	201	374	374	201
GAP Housing (Middle income)	286	1.1 / unit	1.1 / unit	315	88%	276	12%	39	10	29	29	10
Institutional Zone 1 (Primary School)	800 scholars	Internal Trips ONLY										
Institutional Zone 3 (Secondary School)	1000 scholars	Internal Trips ONLY										
Business Zone 1 (General Offices: Suburban)	26600	2.3 / 100m²	2.3 / 100m²	288+324	80%	490	20%	122	104	18	18	104
Authority Zone (General Offices: CBD)	16200	Internal Trips ONLY										
Total				**1747**	**58%**	**1011**	**42%**	**736**	**421**	**315**	**315**	**421**
50% Development Trips by 2022				**874**	**58%**	**506**	**42%**	**368**	**211**	**157**	**157**	**211**
100% Development Trips by 2027				**1747**	**58%**	**1011**	**42%**	**736**	**421**	**315**	**315**	**421**

Note that 80% of the generated Business trips are assumed to be from people living within the Residential component of this development, thus internal trips. This equates to approximately 43% of all Residential trips being internal trips to the Business component. It is further assumed that 10% of the Middle Income Housing trips will be internal trips to the school components. Therefore, 58% of all generated trips are internal trips whilst 42% are external trips.

6.3 Trip Distribution

The new external vehicles trips (i.e. development traffic) generated during the weekday AM and PM peak periods were distributed in accordance with the existing background traffic volumes (2017, derived from 2015 data) observed on the surrounding road network, and hence the directions in which the traffic currently travels to / from.

It is anticipated that the majority of the new vehicle trips will travel along Victoria Drive, since it is a Mobility Arterial road which provides access to other major roads in the area. For the Erf 1948 development, 100% of the new vehicle trips were distributed along Victoria Drive from the main access point, where 70% would travel to/from the east and 30% would travel to/from the west.

For the Erf 11305 (Option A) development, 70% of the new vehicle trips were distributed along Victoria Drive (southern access point), where these trips would split further with 50% travelling to/from the east and 20% travelling to/from the west, whilst 30% of the new vehicle trips were distributed to the north via Beethoven Avenue (northern access point). These splits in vehicle trips are based on the development's internal layout and the anticipated ease of access.

The 2022 weekday AM and PM peak hour Development Traffic scenarios (i.e. vehicle trips generated by the proposed developments only), and the 2022 weekday AM and PM peak hour Combined Traffic scenarios are included in **Appendix B**.

The ultimate 2027 weekday AM and PM peak hour Combined Traffic scenarios (i.e. future background traffic + 100% development traffic) are shown in **Figure 11** and **Figure 12**.

6.4 Latent Development Rights

Enquiries with the NMBM revealed that latent developments do exist in the vicinity of the study area (e.g. Arlington Racecourse; along Victoria Drive and Glendore Road), although formal development approvals, including approved TIAs, were not available for these planned developments at the time of preparing this TIA.

Given that there are numerous factors (e.g. implementation timelines; development rate of available land; income levels; vehicle ownership levels; availability of public transport; etc.) that influence the amount of traffic that may be generated by latent developments in future, the allowance for background traffic growth in this TIA should be adequate to cater for this occurrence.

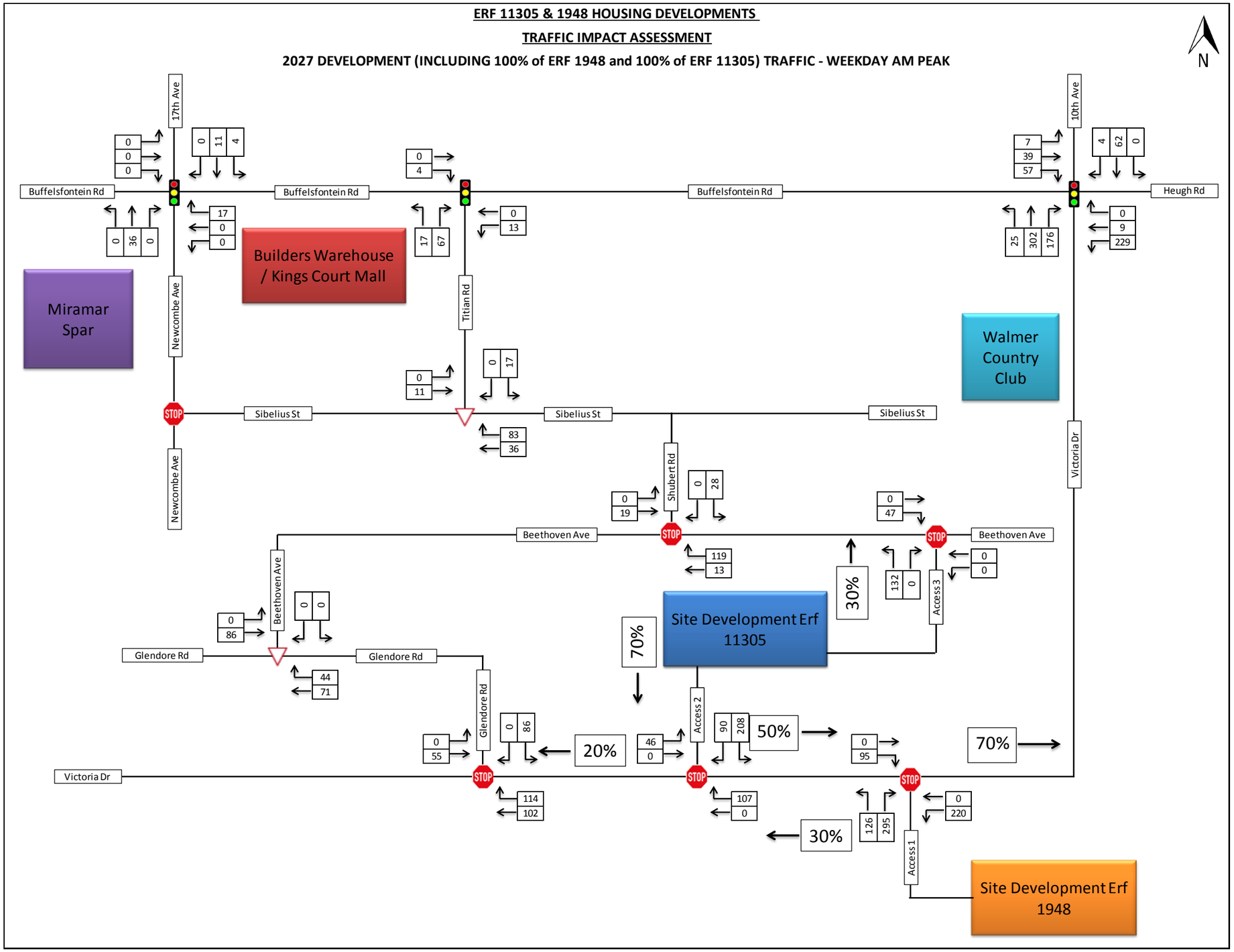


Figure 11: 2027 Future Combined Traffic - Weekday AM Peak

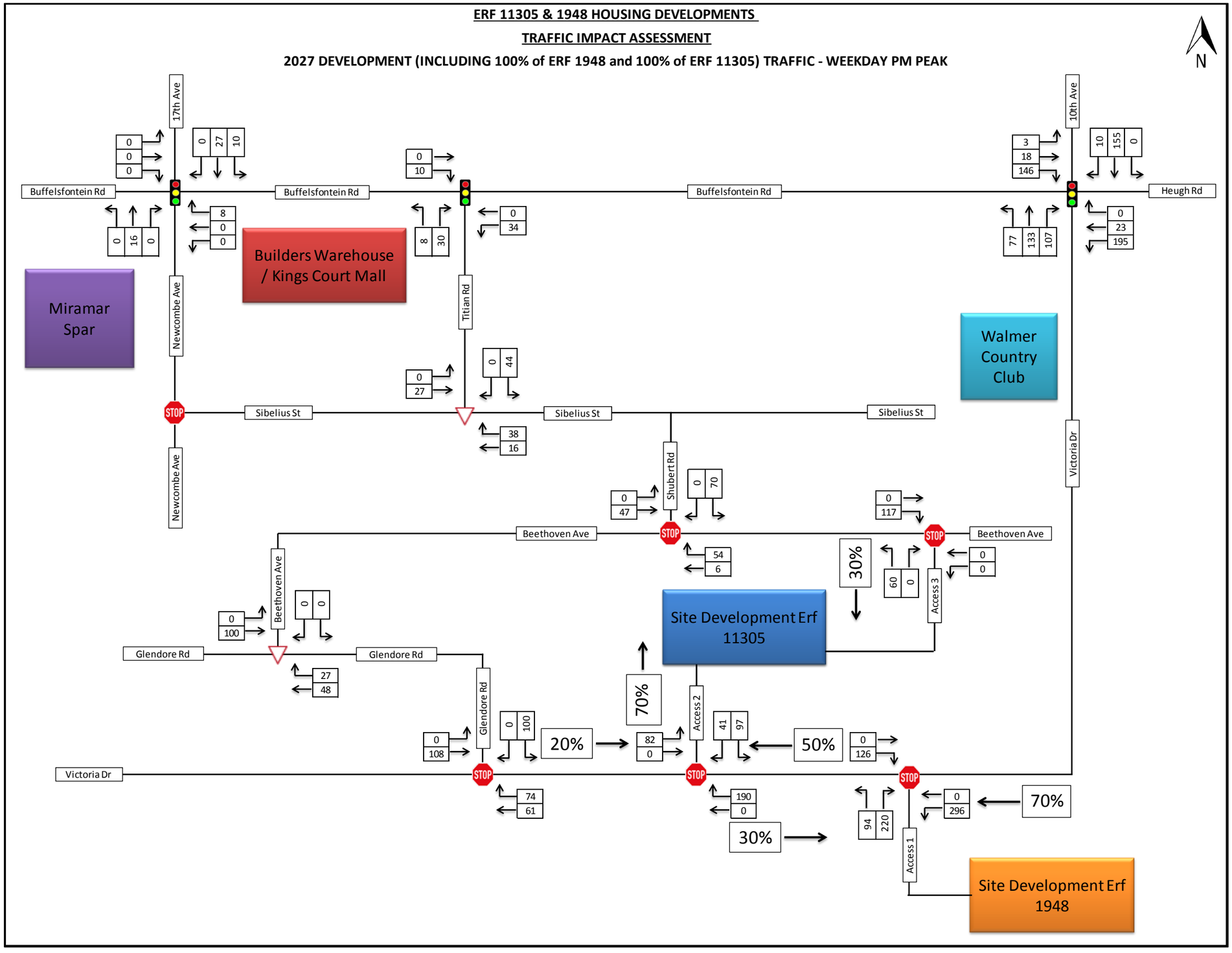


Figure 12: 2027 Future Combined Traffic - Weekday PM Peak

7 *Intersection Capacity Analysis*

The SIDRA INTERSECTION 7.0 software package was used to analyse the following intersections for the weekday AM and PM peak hours:

- Buffelsfontein Road / Victoria Drive
- Buffelsfontein Road / Titian Road
- Buffelsfontein Road / 17th Avenue
- Victoria Drive / Glendore Road
- Glendore Road / Beethoven Avenue
- Beethoven Avenue / Schubert Road
- Titian Road / Sibelius Street
- Victoria Drive / Access Road (Erf 1948)
- Beethoven Avenue / Access Road (Erf 11305)
- Victoria Drive / Access Road (Erf 11305)

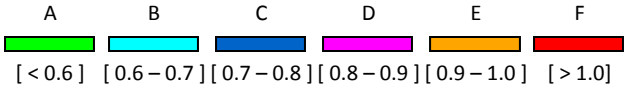
The following scenarios were analysed:

- 2017 Background Traffic
- 2022 Background Traffic (excluding development traffic)
- 2022 Future Traffic (including 50% development traffic) – Erf 1948
- 2022 Future Traffic (including 50% of Erf 1948 & 50% development traffic) – Erf 11305
- 2027 Background Traffic (excluding development traffic)
- 2027 Future Traffic (including 100% development traffic) – Erf 1948
- 2027 Future Traffic (including 100% of Erf 1948 & 100% development traffic) – Erf 11305

The Level of Service (LOS) is a measure that is used to assess the operation of existing transportation infrastructure, as well as the effectiveness of proposed infrastructure improvements. LOS is categorised by the letters A to F (with A being the best and F being the worst) based on the average control delay experienced by vehicles on the section of roadway under investigation. The following is a description of the LOS represented by each letter from A to F:

A = Free Flow
B = Reasonable Free Flow
C = Stable Flow
D = Approaching Unstable Flow
E = Unstable Flow
F = Forced or Breakdown Flow

Colour code based on Queue Storage Ratio



The LOS and 95th percentile vehicle queues (measured in metres) for the 2017, 2022 and 2027 traffic scenarios for the weekday AM and PM peak hour are discussed in the following sub-sections**.**

Note that SIDRA does not calculate the overall intersection LOS for two-way stop controlled intersections. Refer to the SIDRA appendix for the LOS of each individual movement.

The SIDRA data output sheets have been included in **Appendix C**.

7.1 Buffelsfontein Road / Victoria Drive / Heugh Road intersection

7.1.1 Existing Geometry

The existing geometry of the Signalised intersection is shown in the following figure.

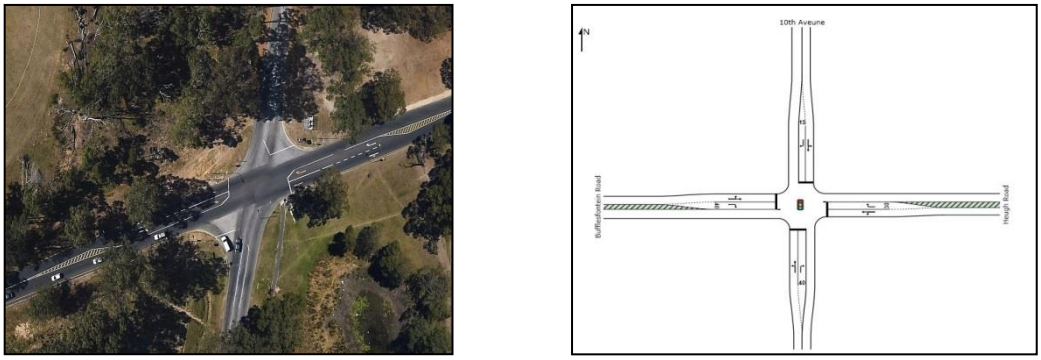


Figure 13: Aerial view of intersection and Intersection geometry

7.1.2 2017 Background Traffic

The intersection currently operates at an overall LOS C and LOS D during the weekday AM and PM peak hours respectively, which is considered to be acceptable. These results are based on the traffic signal timings provided by the NMBM.

The highest average vehicle queue length for single lane traffic during both the AM and PM peak hours is 270.5m and 247.7m respectively.

7.1.3 2022 Background Traffic

The intersection will operate at an overall LOS C during the weekday AM and PM peak hours respectively, which is considered to be acceptable. These results are based on the existing intersection geometry but with signal timing optimisation.

The highest average vehicle queue length for single lane traffic during both the AM and PM peak hours is 245.0m and 151.2m.

7.1.4 2022 Future Traffic – Erf 1948 (Including 50% Development Traffic) - Upgrades

The intersection will operate at an overall LOS C and LOS F during the weekday AM and PM peak hours, which is unacceptable. The highest average vehicle queue length for single lane traffic during the weekday AM and PM peak hours are 350m and 516.1m respectively.

In order to improve the LOS at this intersection, the following geometric upgrades are required:

- Lengthen the right-turn lane on the western approach on Buffelsfontein Road;
- Widen the western and eastern approaches of Buffelsfontein Road to dual carriageway roads;
- Provide a solid 5m median on Buffelsfontein Road;
- Lengthen the right-turn lane on the southern approach on 10th avenue; and
- Provide an additional 3.3m short exit lane on the southern approach of Victoria Drive.

Based on the upgraded intersection layout, the intersection would operate at an overall LOS B during the weekday AM and PM peak hours, which is acceptable.

The highest average vehicle queue length for single lane traffic during both the weekday AM and PM peak hours is 104.3m and 60.2m respectively, which is considered to be acceptable.

7.1.5 2022 Future Traffic – Erf 11305 (Including 50% of Erf 1948 and 50% Development Traffic)

The intersection will operate at a LOS B during the weekday AM and PM peak hours, which is considered to be acceptable.

The highest average vehicle queue length for single lane traffic during both the weekday AM and PM peak hours is 136.8m and 66.4m respectively.

7.1.6 2027 Background Traffic

The intersection will operate at an overall LOS B during the weekday AM and PM peak hours respectively, which is considered to be acceptable.

The highest average vehicle queue length for single lane traffic during both the AM and PM peak hours is 100.7m and 64.5m. These results are based on the existing intersection geometry but with signal timing optimisation.

7.1.7 2027 Future Traffic – Erf 1948 (Including 100% Development Traffic)

The intersection will operate at an overall LOS B during the weekday AM and PM peak hours, which is considered to be acceptable.

The highest average vehicle queue length for single lane traffic during both the weekday AM and PM peak hours is 137.1m and 66.7m respectively.

7.1.8 2027 Future Traffic – Erf 11305 (Including 100% of Erf 1948 and 100% Development Traffic)

The intersection will operate at an overall LOS D during both the weekday AM and PM peak hours respectively, which is considered to be acceptable.

The highest average vehicle queue length for single lane traffic during both the AM and PM peak hours is 383.7m and 216.9m.

It is noted that the right-turn lane on the southern leg and the through and right turn lane on the western leg operates at a LOS F. However, given that this traffic scenario is 10 years into the future, and numerous influencing factors may change by then, the need for geometric intersection upgrades should best be reviewed at that point in time.

The influencing factors that could change between now and 2027 are for example: future traffic growth being less than what has been projected; road network changes; rate of uptake of vacant land in the vicinity, etc. These factors could delay or perhaps even expedite the need for the upgrading of this intersection, hence the need for reassessment prior to 2027.

7.2 Buffelsfontein Road / Titian Road Intersection

7.2.1 Existing Geometry

The existing geometry of the signalised intersection is shown in the following figure.

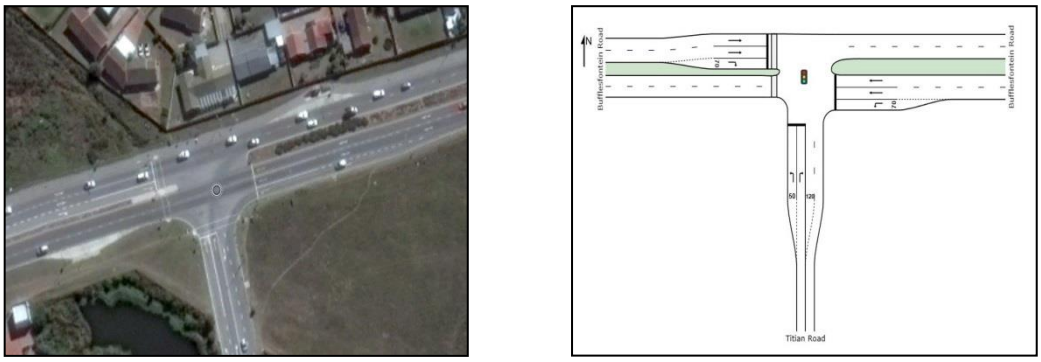


Figure 14: Aerial view of intersection and Intersection geometry

7.2.2 2017 Background Traffic

The intersection currently operates at an overall LOS B during the weekday AM and PM peak hours respectively, which is considered to be acceptable. These results are based on the traffic signal timings provided by the NMBM.

The highest average vehicle queue length for single lane traffic during the AM and PM peak hours is 133.6m and 72.3m respectively.

7.2.3 2022 Background Traffic

The intersection is will operate at an overall LOS A during the weekday AM and PM peak hours respectively, which is considered to be acceptable. These results are based on the existing intersection geometry but with signal timing optimisation.

The highest average vehicle queue length for single lane traffic during the AM and PM peak hours is 80.8m and 37.3m respectively.

7.2.4 2022 Future Traffic – Erf 1948 (Including 50% Development Traffic)

The intersection will operate at an overall LOS A during the weekday AM and PM peak hours respectively, which is considered to be acceptable.

The highest average vehicle queue length for single lane traffic during the AM and PM peak hours is 80.8m and 37.3m respectively.

7.2.5 2022 Future Traffic – Erf 11305 (Including 50% of Erf 1948 and 50% Development Traffic)

The intersection will operate at an overall LOS B and LOS A during the weekday AM and PM peak hours respectively, which is considered to be acceptable.

The highest average vehicle queue length for single lane traffic during the AM and PM peak hours is 88.4m and 39.3m respectively.

7.2.6 2027 Background Traffic

The intersection will operate at an overall LOS A during the weekday AM and PM peak hours respectively, which is considered to be acceptable.

The highest average vehicle queue length for single lane traffic during both the AM and PM peak hours is 87.4m and 39.8m.

7.2.7 2027 Future Traffic – Erf 1948 (Including 100% Development Traffic)

The intersection will operate at an overall LOS A during the weekday AM and PM peak hours, which is considered to be unacceptable.

The highest average vehicle queue length for single lane traffic during both the weekday AM and PM peak hours is 87.4m and 39.8m respectively.

7.2.8 2027 Future Traffic – Erf 11305 (Including 100% of Erf 1948 and 100% Development Traffic)

The intersection will operate at an overall LOS B and A during the weekday AM and PM peak hours respectively, which is considered to be acceptable.

The highest average vehicle queue length for single lane traffic during both the AM and PM peak hours is 95.5m and 44.1m.

7.3 Buffelsfontein Road / 17th Avenue Intersection

7.3.1 Existing Geometry

The existing geometry of the signalised intersection is shown in the following figure.

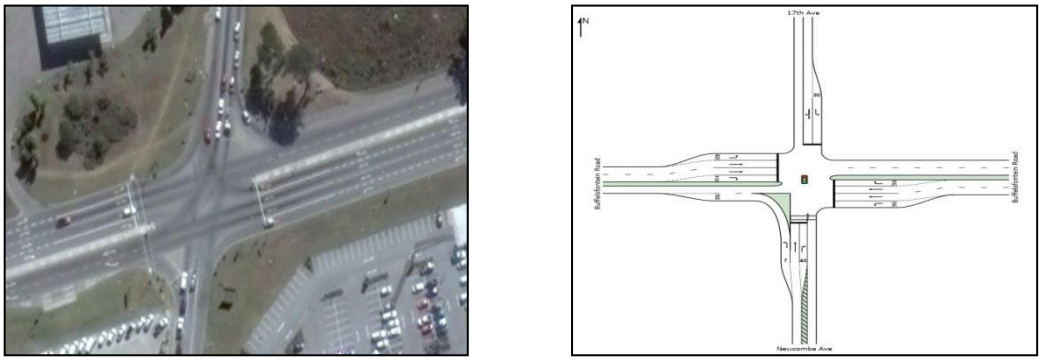


Figure 15: Aerial view of intersection and Intersection geometry

7.3.2 2017 Background Traffic

The intersection currently operates at an overall LOS F during the weekday AM and PM peak hours respectively, which is considered to be unacceptable. These results are based on the traffic signal timings provided by the NMBM.

The highest average vehicle queue length for single lane traffic during the AM and PM peak hours is 658.4m and 2456.1m respectively.

In order to improve the LOS at this intersection, the following additional upgrades are required:

- Implement signal timing optimisation.

Based on the upgraded intersection, the intersection would operate at an overall LOS C and LOS D during the weekday AM and PM peak hours respectively, which is considered to be acceptable.

The highest average vehicle queue length for single lane traffic during the AM and PM peak hours is 159.4m and 313.7m respectively.

7.3.3 2022 Background Traffic

Based on the upgrades from the previous scenario, the intersection would operate at an overall LOS D and LOS E during the weekday AM and PM peak hours respectively, which is considered to be unacceptable.

The highest average vehicle queue length for single lane traffic during the AM and PM peak hours is 179.3m and 437.4m respectively.

In order to improve the LOS at this intersection, the following geometric upgrades are required:

- The extension of the 3.3m short left-turn lane on the western approach of Buffelsfontein Road;
- An additional 3.3m through lane on the northern approach of 17th Avenue;
- An additional 3.3m exit lane on the northern approach of 17th Avenue;
- The extension of the short left-turn lane to a continuous left-turn and through lane on the southern approach of Newcombe Avenue; and
- The extension of the short exit lane to a continuous exit lane on the western approach of Buffelsfontein Road.

Based on the upgraded intersection layout, the intersection would operate at an overall LOS C during the weekday AM and PM peak hours respectively, which is considered to be acceptable. The highest average vehicle queue length for single lane traffic during the AM and PM peak hours is 121.9m and 101.5m respectively.

7.3.4 2022 Future Traffic – Erf 1948 (Including 50% Development Traffic)

The intersection will operate at an overall LOS C during the weekday AM and PM peak hours respectively, which is considered to be acceptable.

The highest average vehicle queue length for single lane traffic during the AM and PM peak hours is 121.9m and 101.5m respectively.

7.3.5 2022 Future Traffic – Erf 11305 (Including 50% of Erf 1948 and 50% Development Traffic)

The intersection will operates at an overall LOS C during the weekday AM and PM peak hours respectively, which is considered to be acceptable.

The highest average vehicle queue length for single lane traffic during the AM and PM peak hours is 121.9m and 101.5m respectively.

7.3.6 2027 Background Traffic

The intersection will operate at an overall LOS C during the weekday AM and PM peak hours respectively, which is considered to be acceptable.

The highest average vehicle queue length for single lane traffic during both the AM and PM peak hours is 136.6m and 113.1m.

7.3.7 2027 Future Traffic – Erf 1948 (Including 100% Development Traffic)

The intersection will operate at an overall LOS C during the weekday AM and PM peak hours respectively, which is considered to be acceptable.

The highest average vehicle queue length for single lane traffic during both the weekday AM and PM peak hours is 136.6m and 113.1m respectively.

7.3.8 2027 Future Traffic – Erf 11305 (Including 100% of Erf 1948 and 100% Development Traffic)

The intersection will operate at an overall LOS C during the weekday AM and PM peak hours respectively, which is considered to be acceptable.

The highest average vehicle queue length for single lane traffic during both the AM and PM peak hours is 136.6m and 113.1m.

7.4 Victoria Drive / Glendore Road Intersection

7.4.1 Existing Geometry

The existing geometry of the Stop controlled intersection is shown in the following figure.

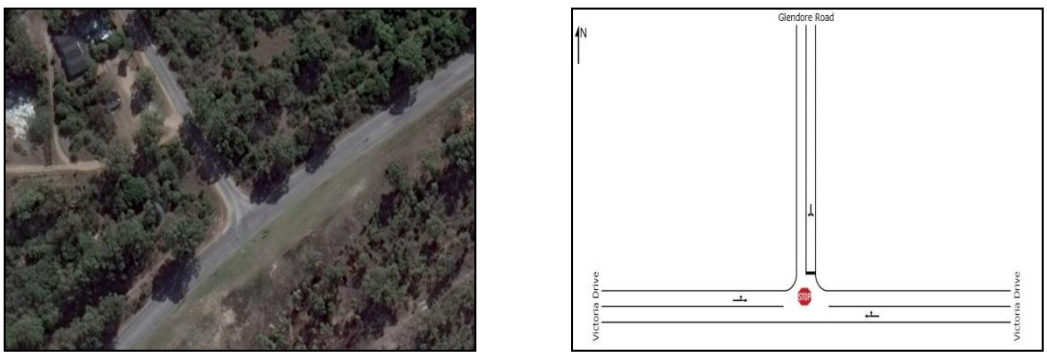


Figure 16: Aerial view of intersection and Intersection geometry

7.4.2 2017 Background Traffic

The intersection currently operates with an average delay of 6.8 and 4.4 seconds during the weekday AM and PM peak hours respectively, which is considered to be acceptable.

The worst movement at the intersection will operate at a LOS A during the weekday AM and PM peak hours respectively, which is considered to be acceptable.

The highest average vehicle queue length for single lane traffic during both the AM and PM peak hours is 21.3m and 3.8m.

7.4.3 2022 Background Traffic

The intersection will operate with an average delay of 7.0 seconds and 4.5 seconds during the weekday AM and PM peak hours respectively, which is considered to be acceptable.

The worst movement at the intersection will operate at a LOS B and LOS A during the weekday AM and PM peak hours, which is considered to be acceptable.

The highest average vehicle queue length for single lane traffic during both the weekday AM and PM peak hours is 24.8m and 4.0m respectively.

7.4.4 2022 Future Traffic – Erf 1948 (Including 50% Development Traffic)

The intersection will operate with an average delay of 7.3 seconds and 4.4 seconds during the weekday AM and PM peak hours respectively, which is considered to be acceptable.

The worst movement at the intersection will operate at a LOS B and LOS A during the weekday AM and PM peak hours, which is considered to be acceptable.

The highest average vehicle queue length for single lane traffic during both the weekday AM and PM peak hours is 32.0m and 5.2m respectively.

7.4.5 2022 Future Traffic – Erf 11305 (Including 50% of Erf 1948 and 50% Development Traffic)

The intersection will operate with an average delay of 7.6 seconds and 4.5 seconds during the weekday AM and PM peak hours respectively, which is considered to be acceptable.

The worst movement at the intersection will operate at a LOS B during the weekday AM and PM peak hour, which is considered to be acceptable.

The highest average vehicle queue length for single lane traffic during both the weekday AM and PM peak hours is 36.5m and 5.7m respectively.

7.4.6 2027 Background Traffic

The intersection will operate with an average delay of 7.3 seconds and 4.5 seconds during the weekday AM and PM peak hours respectively, which is considered to be acceptable.

The worst movement at the intersection will operate at a LOS B and LOS A during the weekday AM and PM peak hours respectively, which is considered to be acceptable.

The highest average vehicle queue length for single lane traffic during both the weekday AM and PM peak hours is 29.1m and 4.2m respectively.

7.4.7 2027 Future Traffic – Erf 1948 (Including 100% Development Traffic)

The intersection will operate with an average delay of 8.2 seconds and 4.4 seconds during the weekday AM and PM peak hours respectively, which is considered to be acceptable.

The worst movement at the intersection will operate at a LOS B and LOS A during the weekday AM and PM peak hours respectively, which is considered to be acceptable.

The highest average vehicle queue length for single lane traffic during both the weekday AM and PM peak hours is 46.6m and 5.5m respectively.

7.4.8 2027 Future Traffic – Erf 11305 (Including 100% of Erf 1948 and 100% Development Traffic)

The intersection will operate with an average delay of 8.6 seconds and 4.6 seconds during the weekday AM and PM peak hours respectively, which is considered to be acceptable.

The worst movement at the intersection will operate at a LOS C and LOS B during the weekday AM and PM peak hours respectively, which is considered to be acceptable.

The highest average vehicle queue length for single lane traffic during both the weekday AM and PM peak hours is 53.6m and 8.2m respectively.

7.5 Glendore Road / Beethoven Avenue Intersection

7.5.1 Existing Geometry

The existing geometry of the Yield controlled intersection is shown in the following figure.

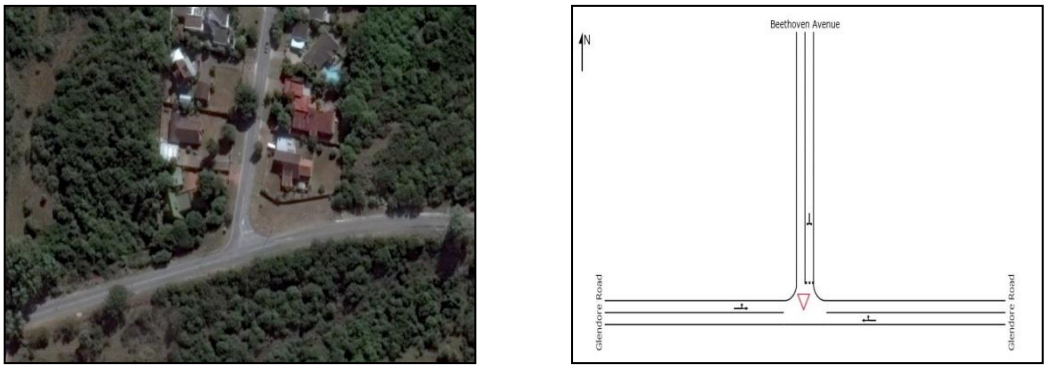


Figure 17: Aerial view of intersection and Intersection geometry

7.5.2 2017 Background Traffic

The intersection currently operates with an average delay of 0.8 and 1.0 seconds during the weekday AM and PM peak hours respectively, which is considered to be acceptable.

The worst movement at the intersection will operate at a LOS A during the weekday AM and PM peak hours, which is considered to be acceptable.

The highest average vehicle queue length for single lane traffic during both the AM and PM peak hours is 0.8m and 0.9m.

7.5.3 2022 Background Traffic

The intersection will operate with an average delay of 0.8 seconds and 1.0 seconds during the weekday AM and PM peak hours respectively, which is considered to be acceptable.

The worst movement at the intersection will operate at a LOS A during the weekday AM and PM peak hours, which is considered to be acceptable.

The highest average vehicle queue length for single lane traffic during both the weekday AM and PM peak hours is 0.9m.

7.5.4 2022 Future Traffic – Erf 1948 (Including 50% Development Traffic)

The intersection will operate with an average delay of 1.0 seconds and 0.9 seconds during the weekday AM and PM peak hours respectively, which is considered to be acceptable.

The worst movement at the intersection will operate at a LOS A during the weekday AM and PM peak hours, which is considered to be acceptable.

The highest average vehicle queue length for single lane traffic during both the weekday AM and PM peak hours is 1.8m and 1.1m respectively.

7.5.5 2022 Future Traffic – Erf 11305 (Including 50% of Erf 1948 and 50% Development Traffic)

The intersection will operate with an average delay of 1.1 seconds and 1.0 seconds during the weekday AM and PM peak hours respectively, which is considered to be acceptable.

The worst movement at the intersection will operate at a LOS A during the weekday AM and PM peak hours, which is considered to be acceptable.

The highest average vehicle queue length for single lane traffic during both the weekday AM and PM peak hours is 2.6m and 1.6m respectively.

7.5.6 2027 Background Traffic

The intersection will operate with an average delay of 1.7 seconds and 1.0 seconds during the weekday AM and PM peak hours respectively, which is considered to be acceptable.

The worst movement at the intersection will operate at a LOS A during the weekday AM and PM peak hours, which is considered to be acceptable.

The highest average vehicle queue length for single lane traffic during both the weekday AM and PM peak hours is 3.2m and 1.0m respectively.

7.5.7 2027 Future Traffic – Erf 1948 (Including 100% Development Traffic)

The intersection will operate with an average delay of 1.2 seconds and 1.1 seconds during the weekday AM and PM peak hours respectively, which is considered to be acceptable.

The worst movement at the intersection will operate at a LOS A during the weekday AM and PM peak hour, which is considered to be acceptable.

The highest average vehicle queue length for single lane traffic during both the weekday AM and PM peak hours is 3.1m and 1.9m respectively.

7.5.8 2027 Future Traffic – Erf 11305 (Including 100% of Erf 1948 and 100% Development Traffic)

The intersection will operate with an average delay of 1.3 seconds and 1.1 seconds during the weekday AM and PM peak hours respectively, which is considered to be acceptable.

The worst movement at the intersection will operate at a LOS B and LOS A during the weekday AM and PM peak hours, which is considered to be acceptable.

The highest average vehicle queue length for single lane traffic during both the weekday AM and PM peak hours is 3.9m and 2.5m respectively.

7.6 Beethoven Avenue / Schubert Road Intersection

7.6.1 Existing Geometry

The existing geometry of the Stop controlled intersection is shown in the following figure.

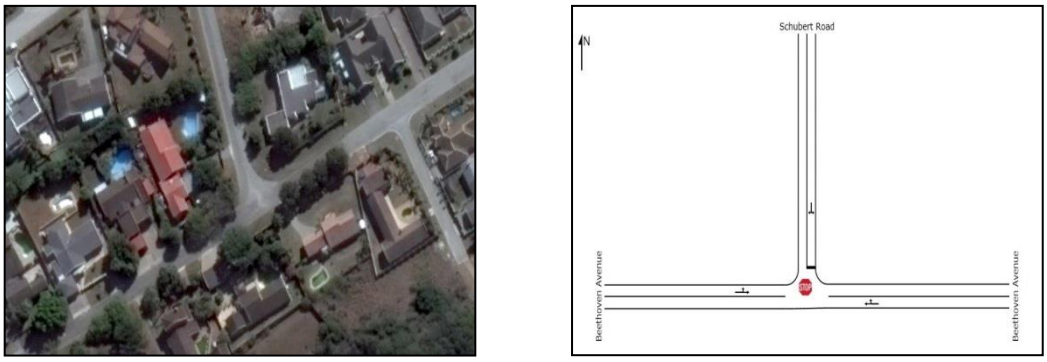


Figure 18: Aerial view of intersection and Intersection geometry

7.6.2 2017 Background Traffic

The intersection currently operates with an average delay of 6.2 and 6.7 seconds during the weekday AM and PM peak hours respectively, which is considered to be acceptable.

The worst movement at the intersection will operate at a LOS A during the weekday AM and PM peak hours respectively, which is considered to be acceptable.

The highest average vehicle queue length for single lane traffic during both the AM and PM peak hours is 1.1m and 2.1m.

7.6.3 2022 Background Traffic

The intersection will operate with an average delay of 6.3 seconds and 6.7 seconds during the weekday AM and PM peak hours respectively, which is considered to be acceptable.

The worst movement at the intersection will operate at a LOS A during the weekday AM and PM peak hour, which is considered to be acceptable.

The highest average vehicle queue length for single lane traffic during both the weekday AM and PM peak hours is 1.3m and 2.3m respectively.

7.6.4 2022 Future Traffic – Erf 1948 (Including 50% Development Traffic)

The intersection will operate with an average delay of 6.3 seconds and 6.8 seconds during the weekday AM and PM peak hours respectively, which is considered to be acceptable.

The worst movement at the intersection will operate at a LOS A during the weekday AM and PM peak hour, which is considered to be acceptable.

The highest average vehicle queue length for single lane traffic during both the weekday AM and PM peak hours is 1.3m and 2.3m respectively.

7.6.5 2022 Future Traffic – Erf 11305 (Including 50% of Erf 1948 and 50% Development Traffic)

The intersection will operate with an average delay of 5.9 seconds and 6.0 seconds during the weekday AM and PM peak hours respectively, which is considered to be acceptable.

The worst movement at the intersection will operate at a LOS A during the weekday AM and PM peak hours, which is considered to be acceptable.

The highest average vehicle queue length for single lane traffic during both the weekday AM and PM peak hours is 1.9m and 4.3m respectively.

7.6.6 2027 Background Traffic

The intersection will operate with an average delay of 6.3 seconds and 6.8 seconds during the weekday AM and PM peak hours respectively, which is considered to be acceptable.

The worst movement at the intersection will operate at a LOS A during the weekday AM and PM peak hours, which is considered to be acceptable.

The highest average vehicle queue length for single lane traffic during both the weekday AM and PM peak hours is 1.3m and 2.3m respectively.

7.6.7 2027 Future Traffic – Erf 1948 (Including 100% Development Traffic)

The intersection will operate with an average delay of 6.3 seconds and 6.8 seconds during the weekday AM and PM peak hours respectively, which is considered to be acceptable.

The worst movement at the intersection will operate at a LOS A during the weekday AM and PM peak hours, which is considered to be acceptable.

The highest average vehicle queue length for single lane traffic during both the weekday AM and PM peak hours is 1.3m and 2.3m respectively.

7.6.8 2027 Future Traffic – Erf 11305 (Including 100% of Erf 1948 and 100% Development Traffic)

The intersection will operate with an average delay of 5.9 seconds and 6.0 seconds during the weekday AM and PM peak hours respectively, which is considered to be acceptable.

The worst movement at the intersection will operate at a LOS A during the weekday AM and PM peak hours, which is considered to be acceptable.

The highest average vehicle queue length for single lane traffic during both the weekday AM and PM peak hours is 1.9m and 4.3m respectively.

7.7 Titian Road / Sibelius Street Intersection

7.7.1 Existing Geometry

The existing geometry of the Yield controlled intersection is shown in the following figure.

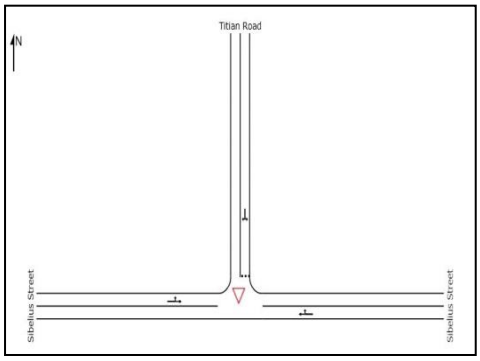


Figure 19: Aerial view of intersection and Intersection geometry

7.7.2 2017 Background Traffic

The intersection currently operates with an average delay of 4.6 and 4.1 seconds during the weekday AM and PM peak hours respectively, which is considered to be acceptable.

The worst movement of the intersection will operate at a LOS A during the weekday AM and PM peak hours respectively, which is considered to be acceptable.

The highest average vehicle queue length for single lane traffic during both the AM and PM peak hours is 3.5m and 2.6m.

7.7.3 2022 Background Traffic

The intersection will operate with an average delay of 4.6 seconds and 4.1 seconds during the weekday AM and PM peak hours respectively, which is considered to be acceptable.

The worst movement at the intersection will operate at a LOS A during the weekday AM and PM peak hours, which is considered to be acceptable.

The highest average vehicle queue length for single lane traffic during both the weekday AM and PM peak hours is 3.7m and 2.8m respectively.

7.7.4 2022 Future Traffic – Erf 1948 (Including 50% Development Traffic)

The intersection will operate with an average delay of 4.6 seconds and 4.1 seconds during the weekday AM and PM peak hours respectively, which is considered to be acceptable.

The worst movement at the intersection will operate at a LOS A during the weekday AM and PM peak hours, which is considered to be acceptable.

The highest average vehicle queue length for single lane traffic during both the weekday AM and PM peak hours is 3.7m and 2.8m respectively.

7.7.5 2022 Future Traffic – Erf 11305 (Including 50% of Erf 1948 and 50% Development Traffic)

The intersection will operate with an average delay of 4.6 seconds and 4.1 seconds during the weekday AM and PM peak hours respectively, which is considered to be acceptable.

The worst movement at the intersection will operate at a LOS A during the weekday AM and PM peak hours, which is considered to be acceptable.

The highest average vehicle queue length for single lane traffic during both the weekday AM and PM peak hours is 5.1m and 3.3m respectively.

7.7.6 2027 Background Traffic

The intersection will operate with an average delay of 4.7 seconds and 4.2 seconds during the weekday AM and PM peak hours respectively, which is considered to be acceptable.

The worst movement at the intersection will operate at a LOS A during the weekday AM and PM peak hours, which is considered to be acceptable.

The highest average vehicle queue length for single lane traffic during both the weekday AM and PM peak hours is 4.0m and 3.0m respectively.

7.7.7 2027 Future Traffic – Erf 1948 (Including 100% Development Traffic)

The intersection will operate with an average delay of 4.7 seconds and 4.2 seconds during the weekday AM and PM peak hours respectively, which is considered to be acceptable.

The worst movement at the intersection will operate at a LOS A during the weekday AM and PM peak hours, which is considered to be acceptable.

The highest average vehicle queue length for single lane traffic during both the weekday AM and PM peak hours is 4.0m and 3.0m respectively.

7.7.8 2027 Future Traffic – Erf 11305 (Including 100% of Erf 1948 and 100% Development Traffic)

The intersection will operate with an average delay of 4.6 seconds and 4.2 seconds during the weekday AM and PM peak hours respectively, which is considered to be acceptable.

The worst movement at the intersection will operate at a LOS A during the weekday AM and PM peak hours, which is considered to be acceptable.

The highest average vehicle queue length for single lane traffic during both the weekday AM and PM peak hours is 5.3m and 4.0m respectively.

7.8 Victoria Drive / Access 1 (Erf 1948) Road Intersection

7.8.1 Existing Geometry

The existing intersection geometry is shown in the following figure. This intersection is currently uncontrolled, possibly due to the limited number of vehicles that make use of this intersection to access the Gqebera informal settlement area. It is recommended that stop control be introduced at this intersection to improve the safety of road users.

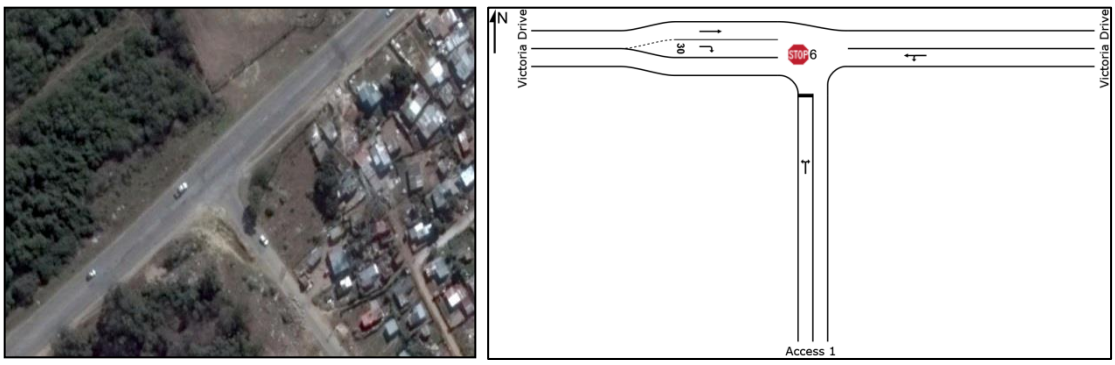


Figure 20: Aerial view of intersection and Intersection geometry

7.8.2 2022 Future Traffic – Erf 1948 (Including 50% Development Traffic)

The intersection will operate with an average delay of 4.3 seconds and 4.0 seconds during the weekday AM and PM peak hours respectively, which is considered to be acceptable.

The worst movement at the intersection will operate at a LOS C and LOS B during the weekday AM and PM peak hours, which is considered to be acceptable.

The highest average vehicle queue length for single lane traffic during both the weekday AM and PM peak hours is 12.7m and 7.3m respectively.

7.8.3 2022 Future Traffic – Erf 11305 (Including 50% of Erf 1948 and 50% Development Traffic)

The intersection will operate with an average delay of 4.5 seconds and 4.1 seconds during the weekday AM and PM peak hours respectively, which is considered to be acceptable.

The worst movement at the intersection will operate at a LOS C and LOS B during the weekday AM and PM peak period, which is considered to be acceptable.

The highest average vehicle queue length for single lane traffic during both the weekday AM and PM peak hours is 17.2m and 7.4m respectively.

7.8.4 2027 Future Traffic – Erf 1948 (Including 100% Development Traffic)

The intersection will operate with an average delay of 12.8 seconds and 4.0 seconds during the weekday AM and PM peak hours respectively, which is considered to be acceptable.

The worst movement at the intersection will operate at a LOS E and LOS B during the weekday AM and PM peak hour, which is considered to be acceptable.

The highest average vehicle queue length for single lane traffic during both the weekday AM and PM peak hours is 91.7m and 7.6m respectively.

It is noted that the Access Road (northbound traffic lane) operates at a LOS F. However, given that this traffic scenario is 10 years into the future, and numerous influencing factors may change by then, the need for geometric intersection upgrades should best be reviewed at that point in time.

7.8.5 2027 Future Traffic – Erf 11305 (Including 100% of Erf 1948 and 100% Development Traffic)

The intersection will operate with an average delay of 126.1 seconds and 8.8 seconds during the weekday AM and PM peak hours respectively, which is considered to be unacceptable for the AM scenario.

The worst movement of the intersection will operate at a LOS F and LOS D during the weekday AM and PM peak hours, which is considered to be unacceptable for the AM scenario.

The highest average vehicle queue length for single lane traffic during both the weekday AM and PM peak hours is 759.5m and 45.2m respectively.

It is noted that the Access Road (northbound traffic lane) operates at a LOS F. However, given that this traffic scenario is 10 years into the future, and numerous influencing factors may change by then, the need for geometric intersection upgrades should best be reviewed at that point in time.

7.9 Victoria Drive / Access 2 (Erf 11305) Road Intersection

7.9.1 Existing Geometry

The existing intersection geometry is shown in the following figure. This intersection is currently uncontrolled, possibly due to the limited number of vehicles that make use of the access. It is recommended that stop control be introduced at this intersection (on the Access Road approach) to improve the safety of road users.

Figure 21: Aerial view of intersection and Intersection geometry

7.9.2 2022 Future Traffic – Erf 11305 (Including 50% of Erf 1948 and 50% Development Traffic)

The intersection will operate with an average delay of 2.8 seconds and 2.5 seconds during the weekday AM and PM peak hours respectively, which is considered to be acceptable.

The worst movement at the intersection will operate at a LOS B during the weekday AM and PM peak hours, which is considered to be acceptable.

The highest average vehicle queue length for single lane traffic during both the weekday AM and PM peak hours is 6.2m and 2.0m respectively.

7.9.3 2027 Future Traffic – Erf 11305 (Including 100% of Erf 1948 and 100% Development Traffic)

The intersection is expected to operate with an average delay of 4.9 seconds and 3.6 seconds during the weekday AM and PM peak hours respectively, which is considered to be acceptable.

The worst movement at the intersection will operate at a LOS C during the weekday AM and PM peak hours, which is considered to be acceptable.

The highest average vehicle queue length for single lane traffic during both the weekday AM and PM peak hours is 22.8m and 5.1m respectively.

7.10 Beethoven Avenue / Access 3 (Erf 11305) Road Intersection

7.10.1 Existing Geometry

The existing intersection geometry is shown in the following figure. This intersection is currently uncontrolled, possibly due to the limited number of properties served by the access road. It is recommended that stop control be introduced at this intersection (on the Access Road approach) to improve the safety of road users.

Figure 22: Aerial view of intersection and Intersection geometry

7.10.2 2022 Future Traffic – Erf 11305 (Including 50% of Erf 1948 and 50% Development Traffic)

The intersection will operate with an average delay of 5.2 seconds and 3.8 seconds during the weekday AM and PM peak hours respectively, which is considered to be acceptable.

The worst movement at the intersection will operate at a LOS A during the weekday AM and PM peak hours, which is considered to be acceptable.

The highest average vehicle queue length for single lane traffic during both the weekday AM and PM peak hours is 1.3m and 1.7m respectively.

7.10.3 2027 Future Traffic – Erf 11305 (Including 100% of Erf 1948 and 100% Development Traffic)

The intersection will operate with an average delay of 6.1 seconds and 4.7 seconds during the weekday AM and PM peak hours respectively, which is considered to be acceptable.

The worst movement at the intersection will operate at a LOS A during the weekday AM and PM peak hours, which is considered to be acceptable.

The highest average vehicle queue length for single lane traffic during both the weekday AM and PM peak hours is 2.8m and 3.0m respectively.

7.11 Summary

The following table summarises the results of the intersection capacity analyses for the various traffic scenarios.

Table 7: Peak Hour Intersection Capacity Analyses Results Summary

Intersection	Weekday AM		Weekday PM	
	LOS	Max. Vehicle Queue Length (m)	LOS	Max. Vehicle Queue Length (m)
2017 Background Traffic				
Buffelsfontein Road / Victoria Drive / Heugh Road	C	270.5	D	247.7
Buffelsfontein Road / Titian Road	B	133.6	B	72.3
Buffelsfontein Road / 17th Avenue	C#	159.4#	D#	313.7#
Victoria Drive / Glendore Road	A*	21.3	A*	3.8
Glendore Road / Beethoven Avenue	A*	0.8	A*	0.9
Beethoven Avenue / Schubert Road	A*	1.1	A*	2.1
Titian Road / Sibelius Street	A*	3.5	A*	2.6
2022 Background Traffic				
Buffelsfontein Road / Victoria Drive / Heugh Road	C	245.0	C	151.2
Buffelsfontein Road / Titian Road	A	80.8	A	37.3
Buffelsfontein Road / 17th Avenue	C#	121.9#	C#	101.5#
Victoria Drive / Glendore Road	B*	24.8	A*	4.0
Glendore Road / Beethoven Avenue	A*	0.9	A*	0.9
Beethoven Avenue / Schubert Road	A*	1.3	A*	2.3
Titian Road / Sibelius Street	A*	3.7	A*	2.8
2022 Future Traffic – Erf 1948 (Including 50% Development Traffic)				
Buffelsfontein Road / Victoria Drive / Heugh Road	B#	104.3#	B#	60.2#
Buffelsfontein Road / Titian Road	A	80.8	A	37.3
Buffelsfontein Road / 17th Avenue	C	121.9	C	101.5
Victoria Drive / Glendore Road	B*	32.0	A*	5.2

Intersection	Weekday AM		Weekday PM	
	LOS	Max. Vehicle Queue Length (m)	LOS	Max. Vehicle Queue Length (m)
Glendore Road / Beethoven Avenue	A*	1.8	A*	1.1
Beethoven Avenue / Schubert Road	A*	1.3	A*	2.3
Titian Road / Sibelius Street	A*	3.7	A*	2.8
Victoria Drive / Access 1 (Erf 1948)	C*	12.7	B*	7.3
2022 Future Traffic – Erf 11305 (Including 50% of Erf 1948 and 50% Development Traffic)				
Buffelsfontein Road / Victoria Drive / Heugh Road	B	136.8	B	66.4
Buffelsfontein Road / Titian Road	B	88.4	A	39.3
Buffelsfontein Road / 17th Avenue	C	121.9	C	101.5
Victoria Drive / Glendore Road	B*	36.5	B*	5.7
Glendore Road / Beethoven Avenue	A*	2.6	A*	1.6
Beethoven Avenue / Schubert Road	A*	1.8	A*	3.1
Titian Road / Sibelius Street	A*	5.1	A*	3.3
Victoria Drive / Access 1 (Erf 1948)	C*	17.2	B*	7.4
Victoria Drive / Access 2 (Erf 11305)	B*	6.2	B*	2.0
Beethoven Street / Access 3 (Erf 11305)	A*	1.3	A*	1.7
2027 Background Traffic				
Buffelsfontein Road / Victoria Drive / Heugh Road	B	100.7	B	64.5
Buffelsfontein Road / Titian Road	A	87.4	A	39.8
Buffelsfontein Road / 17th Avenue	C	136.6	C	113.1
Victoria Drive / Glendore Road	B*	29.1	A*	4.2
Glendore Road / Beethoven Avenue	A*	3.2	A*	1.0
Beethoven Avenue / Schubert Road	A*	1.3	A*	2.3
Titian Road / Sibelius Street	A*	4.0	A*	3.0
2027 Future Traffic – Erf 1948 (Including 100% Development Traffic)				
Buffelsfontein Road / Victoria Drive / Heugh Road	B	137.1	B	66.7
Buffelsfontein Road / Titian Road	A	87.4	A	39.8

Intersection	Weekday AM		Weekday PM	
	LOS	Max. Vehicle Queue Length (m)	LOS	Max. Vehicle Queue Length (m)
Buffelsfontein Road / 17th Avenue	C	136.6	C	113.1
Victoria Drive / Glendore Road	B*	46.6	A*	5.5
Glendore Road / Beethoven Avenue	A*	3.1	A*	1.9
Beethoven Avenue / Schubert Road	A*	1.3	A*	2.3
Titian Road / Sibelius Street	A*	4.0	A*	3.0
Victoria Drive / Access 1 (Erf 1948)	E*	91.7	B*	7.6
2022 Future Traffic – Erf 11305 (Including 100% of Erf 1948 and 100% Development Traffic)				
Buffelsfontein Road / Victoria Drive / Heugh Road	D	383.7	D	216.9
Buffelsfontein Road / Titian Road	B	95.5	A	44.1
Buffelsfontein Road / 17th Avenue	C	136.6	C	113.1
Victoria Drive / Glendore Road	C*	53.6	B*	8.2
Glendore Road / Beethoven Avenue	B*	3.9	A*	2.5
Beethoven Avenue / Schubert Road	A*	1.9	A*	4.2
Titian Road / Sibelius Street	A*	5.3	A*	4.0
Victoria Drive / Access 1 (Erf 1948)	F#	759.5	D#	45.2
Victoria Drive / Access 2 (Erf 11305)	C*	22.8	C*	5.1
Beethoven Street / Access 3 (Erf 11305)	A*	2.8	A*	3.0

Note:

* LOS for "worst" traffic movement at intersection.

upgraded intersection.

8 Parking Requirements

The *South African Parking Standards Manual (DOT, 1985)* was used to assess the parking requirements of the proposed developments. Being mixed-use developments, each land use component has its own parking requirements that have to be met. The parking requirements for the various land use components are summarised in the following table.

Table 8: Summary of Parking Requirements

Land Use Component	Parking Provision Rate
Residential (Dwelling Units)	1 bay / Unit
Residential (Social housing)	0.6 bay / Room
Commercial	1 bay / 100m² GLA
Educational	1 bay / Class Room + sufficient on-and off-loading areas
Community Centres	2 bays / 100m² GLA
Business (Neighbourhood Centres)	7 bays / 100m² GLA
Offices (General)	2.5 bays / 100m² GLA

At the time of preparing this TIA, no information was available regarding the proposed provision of parking bays for the various land use components. The adequacy of parking provision in the two developments could therefore not be assessed.

It is therefore recommended that the abovementioned parking requirements should be adhered to when the various land use facilities are planned and designed. It is however anticipated that vehicle ownership within the two developments will be relatively low, since the residential components will primarily cater for low to medium income groups. The parking provision rates listed in **Table 8** is therefore considered to be conservative, and should lead to ample parking being provided within the two developments.

Parking bays should also be provided for mobility impaired persons wherever possible and considered necessary.

It is also recommended that parking aisle layouts should be designed such that it allows motorists to turn their vehicle around at the end of an aisle, should no parking be available. Sufficient space should therefore be made available to carry out a U-turn manoeuvre if a parking aisle is not open ended. This is an important consideration at especially large off-street parking areas.

9 Public Transport and Non-Motorised Transport

9.1 Public Transport

9.1.1 Existing Services

The existing public transport services and facilities within the immediate vicinity of the two sites are shown in **Figure 23**.

From **Figure 23** it is evident that the proposed developments will be located within close proximity and adjacent to existing public transport corridors (i.e. Buffelsfontein Road and Victoria Drive), with numerous bus and minibus taxi services operating along these roads.

Public transport services are also located along Beethoven Street and Titian Road, which are internal to the Walmer Heights residential area located to the north of Erf 11305. These two roads mainly function as collector roads and are predominantly served by buses.

In terms of public transport vehicles, the traffic survey results indicate that minibus taxis and buses on the existing road network constitute on average 4.5% and 3.5% of the total traffic composition during the AM and PM Peaks, respectively.

There is a general lack of official public transport stops and associated infrastructure, e.g. bus embayments, signage, loading platforms and shelters, along the current public transport routes in this area. Currently, public transport vehicles tend stop in accordance with the requirements of passengers at unofficial stops along their routes, especially in the Walmer Heights area.

There is currently a high dependence on public transport by the residents of the Gqebera area, since the majority of the residents fall into the lower income groups. Vehicle ownership is therefore low in this residential area. This reliance on public transport is expected to remain when a portion of the current residents relocate to the new mixed-use developments planned on Erf 11305 and Erf 1948.

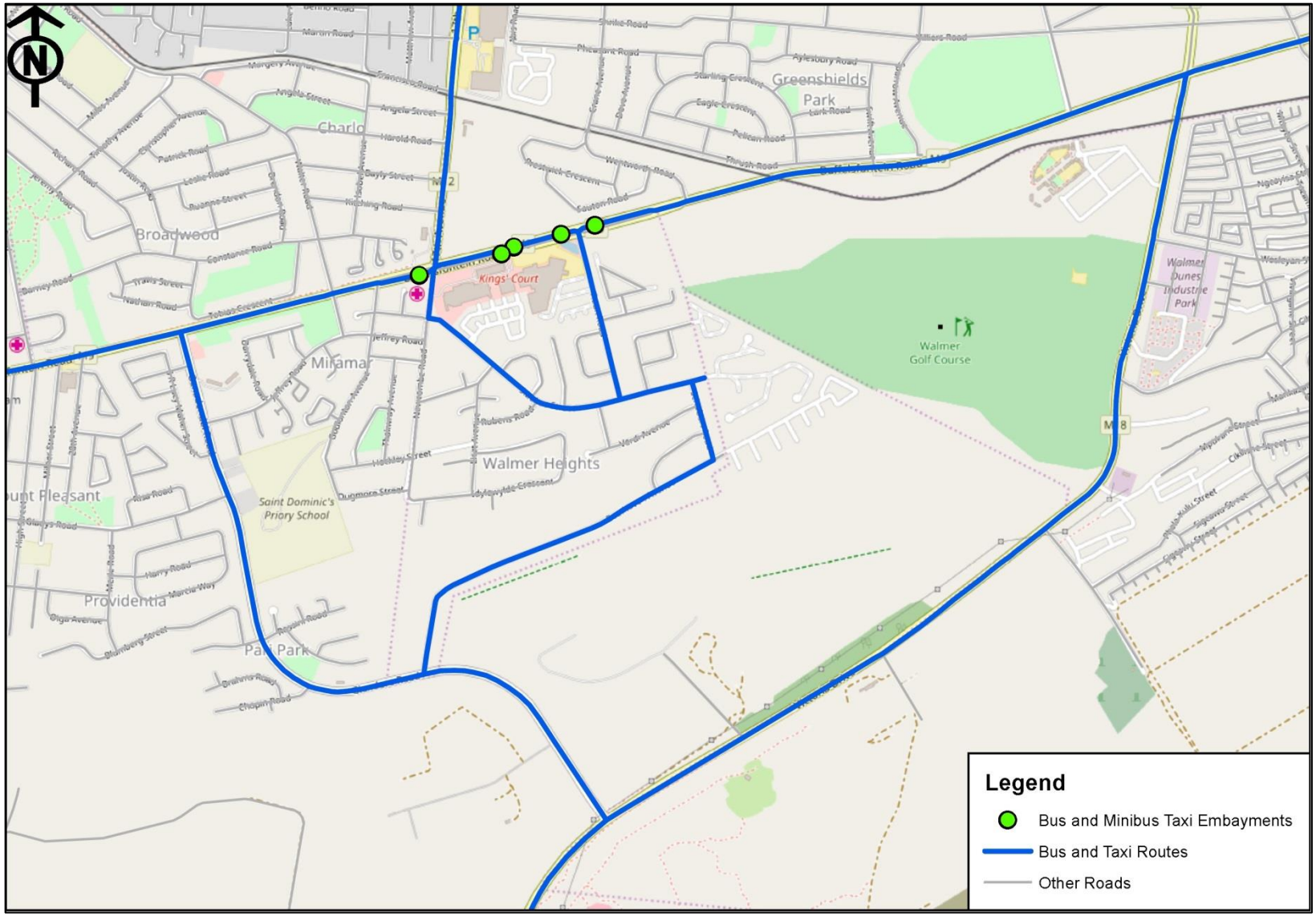


Figure 23: Existing Public Transport Services and Facilities

9.1.2 Future Services

The NMBM is committed to provide efficient and reliable public transport services to its residents. This is evident through the development of the Integrated Public Transit System (IPTS) that is in the process of being implemented in the Nelson Mandela Bay Metro.

As part of the city's IPTS network, a main bus line is planned along Buffelsfontein Road / Heugh Road that will provide public transport services between Mount Pleasant in the west and the Port Elizabeth CBD in the east, as shown in **Figure 24**. Feeder services to the main IPTS route are planned for the residential areas adjacent to the route. The proximity of the proposed developments to the main IPTS route and the feeder services has been indicated in **Figure 24**.

Upon completion of the developments, consideration should be given to the extension of the planned feeder services into the developments, or alternatively the introduction of new feeder services that can serve the residents of these developments. New feeder services could for example originate within each of the two developments and link to the Buffelsfontein Road / Heugh Road main bus line via Victoria Drive.

Figure 25 and **Figure 26** indicates the suggested locations of public transport stops along the higher order roads internal to the Erf 11305 Option A and Erf 1948 developments. It is recommended that formal embayments, loading platforms, shelters, signage, street lighting and adjacent pedestrian crossing facilities be provided, in accordance with NMBM standards, at all new public transport stops created as part of the two developments.

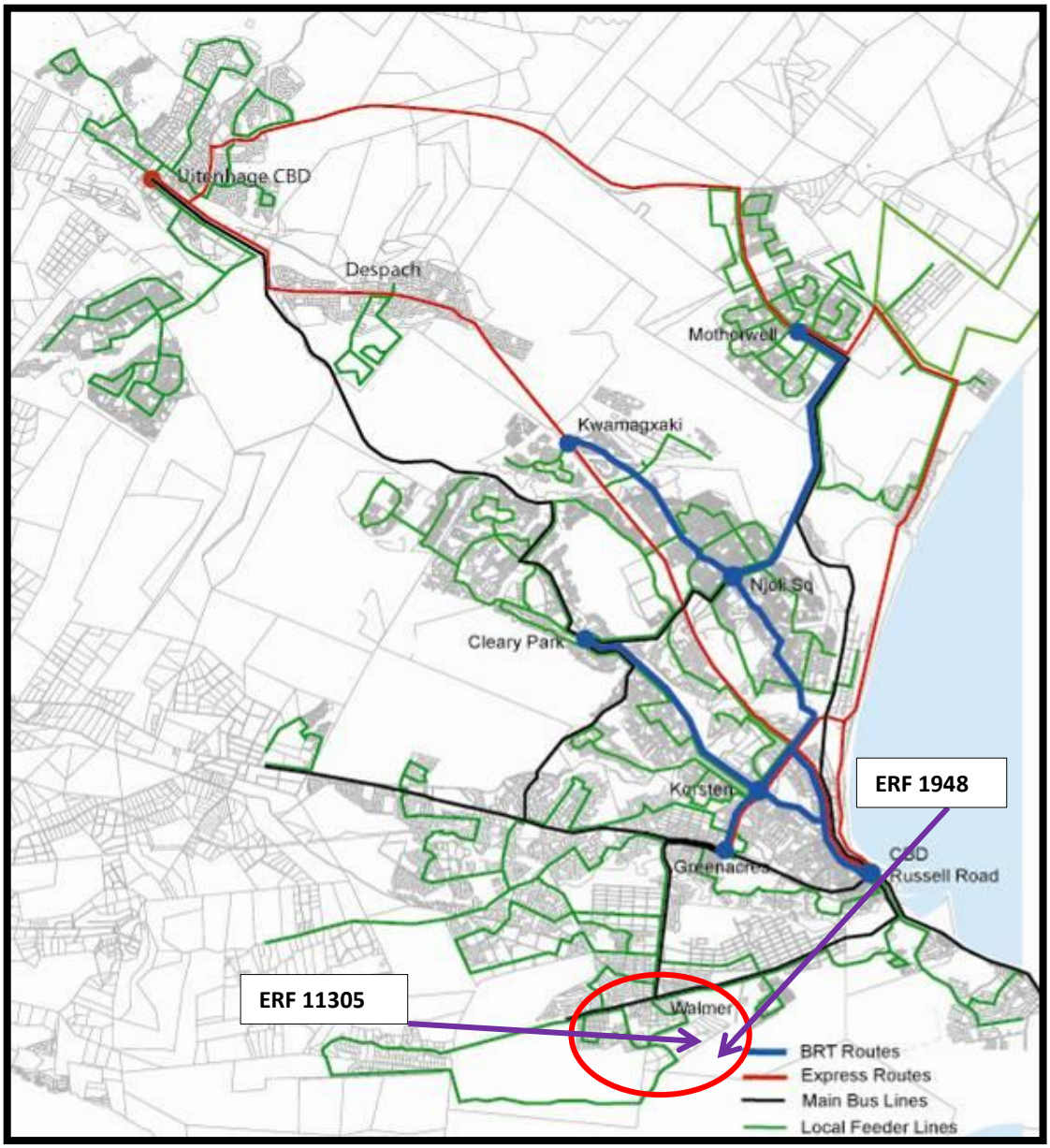


Figure 24: Proposed Public Transport Services and Facilities

(Source: NMBM CITP, 2011)

Figure 25: Erf 11305: Proposed Public Transport Stops – Option A

Figure 26: Erf 1948: Proposed Public Transport Stops

9.2 Non-Motorised Transport

Given that the proposed developments will be located within close proximity and adjacent to public transport corridors (i.e. Buffelsfontein Road and Victoria Drive), various pedestrian activities can be expected along these routes. Adequate provision should therefore be made to accommodate pedestrians in the design of the developments' new access roads and intersections.

Site observations revealed that moderate pedestrian movements occur during the peak traffic periods between the Gqebera area and the Walmer Heights area, as shown in **Figure 27**. The pedestrians that travel along this route make use of the undeveloped Erf 11305 as a shortcut between these two areas. It is anticipated that the demand for pedestrians to walk along this route will remain once the development has been implemented, and therefore provision should be made to accommodate these pedestrian movements through the site as far as possible.

Furthermore, there is an absence of pedestrian facilities (e.g. sidewalks and pedestrian crossings) in the Walmer Heights area, which results in numerous pedestrians walking in the roadway when travelling through this residential area. This occurrence increases the road safety risk not only for the pedestrians, but also for other road users.

A 1.5m wide sidewalk is present on the eastern side of Victoria Drive, between the proposed access to Erf 1948 and Buffelsfontein Road. Street lighting is also present along this route.

Based on the above, it is recommended that minimum 2m wide sidewalks be provided along the primary access roads to the Erf 11305 and Erf 1948 developments from Victoria Drive. Pedestrian crossing should be implemented at the Erf 11305 and Erf 1948 access intersections to provide safe crossing points for pedestrians across Victoria Drive in these locations.

Surfaced sidewalks of minimum 1.5m width should be provided along at least the main link roads and collector streets within each development. Consideration should be given to the installation of dropped kerbs with tactile paving on pedestrian ramps at all intersections within the developments, to assist mobility impaired persons when making use of pedestrian crossings at intersections. This should be done in accordance with NMBM standards.

It is furthermore recommended that minimum 1.5m wide sidewalks be provided along the predominant pedestrian route through the Walmer Heights area, between Erf 11305 and Miramar, as shown in **Figure 27**, to improve the safety of pedestrians along this route. The proposed sidewalks should be located along Beethoven Avenue, Schubert Road, Sibelius Street and Newcombe Avenue towards Buffelsfontein Road.

Street lighting should be provided along all new roads and walkways within the developments, to provide increased security to NMT and other road users at night.

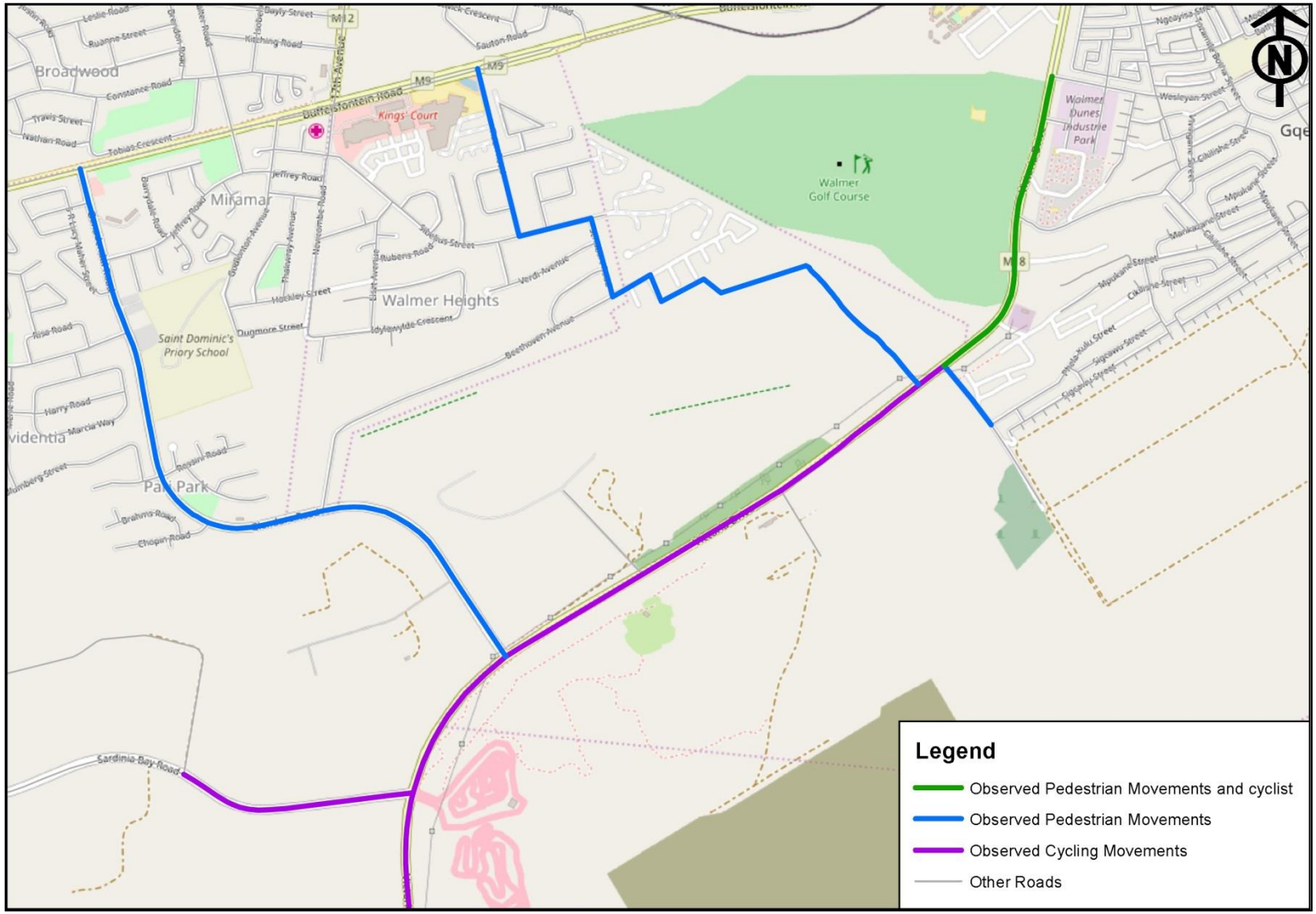


Figure 27: Existing NMT Routes

The traffic surveys and site observations revealed that there is a high presence of cyclists in the vicinity of the sites, especially along Victoria Drive, which is a popular cycle training route during weekends and early on weekday mornings.

The possible upgrading of Victoria Drive to better accommodate cyclists is considered to be outside the scope of this TIA, and is therefore not investigated in great detail. It is however recommended that the developments' new access intersections on Victoria Drive should be designed such that it is cyclist-friendly and not impact negatively on the safety of cyclists along this route.

The upgrading of the existing sidewalk on the eastern side of Victoria Drive to a segregated or shared use pedestrian / cyclist facility is also not considered feasible. Given the type of cyclist present along this route (training cyclists as opposed to leisure cyclists), the majority of these cyclists prefer to cycle on the roadway as opposed to on a separate walk / cycle way. The risk is therefore considered too high that such a shared facility will not be used by cyclists. It may be more beneficial to provide adequate road shoulders on the section of Victoria Drive, between the developments' new access intersections and Buffelsfontein Road, to improve the safety of cyclists along this route.

As for the proposed developments, it is anticipated that minimal residents will use bicycles as a mode of transport. The implementation of dedicated cycle lanes and cycle ways within the developments are therefore not considered to be warranted at present. It is however recommend that the proposed roads, sidewalks and walkways be planned such that they can function as shared use facilities able of accommodating both pedestrians and cyclists, should the use of bicycles as a mode of transport increase in this area in future.

For unsegregated shared use sidewalks and walkways that are expected to be well used, a minimum width of 3m is recommended. Where sidewalks and walkways are expected to be lightly used, a minimum width of 2m would be sufficient.

11 Conclusions

Please refer to **Appendix D** for the assessment of potential impacts identified by the TIA. The Conclusions of this traffic study are summarised as follow:

- The 2017 weekday AM and PM peak hours were identified as being **06:45** to **07:45** and from **16:45** to **17:45**, respectively.

Access Control, Spacing and Sight Distances

- Access to the Erf 11305 development will be from the existing Beethoven Avenue / Access Road intersection in the north (via Walmer Heights), and the Victoria Drive / Access Road intersection in the south.
- Access to the Erf 1948 development will be from the existing Victoria Drive / Access Road intersection in the north only.
- The proposed access spacings satisfy the minimum spacing requirements for a Class 3 Minor Arterial (Victoria Drive) and a Class 5 Collector Road (Beethoven Avenue).
- The available shoulder sight distances at the access points satisfy the minimum sight distance requirements for a passenger car and single unit truck configuration.

Trip Generation and Distribution

- A 'control count' was carried out in September 2017 to determine whether the July 2015 traffic count data was still relevant to the 2017 traffic volumes. The count data indicates that the peak traffic hours remained unchanged, whilst annual traffic growth was calculated to be 1% per annum over the 2-year period (2015 - 2017).
- The 2015 traffic was escalated to the 2017 base year traffic, and to the 2022 and 2025 horizon year traffic, by applying a traffic growth rate of 1% per annum.
- Two site layout options were considered for Erf 11305 (Option A and Option B), with Option A being identified as the 'worst case scenario' from a vehicle trip generation perspective.
- The two developments (Erf 11305 Option A and Erf 1948) will generate a total of 4016 vehicle trips during the weekday AM and PM peak hours, with 2060 being internal trips and 1956 being external trips.
- The trip generation calculations were done in accordance with a methodology that makes provision for the fact that mixed-use developments tend to generate much less external traffic than conventional developments of a similar size, since residents are able to live, work and do business within the same area, with less need to travel elsewhere.
- The TIA's assessment of the existing and future road network has been focussed on the weekday AM and PM time periods only, since these are considered to be the two most critical periods as far as total traffic volumes on the existing and future road network is concerned.
- The new external vehicle trips generated during the peak traffic periods were distributed in accordance with the existing background traffic volumes observed on the surrounding road network.

- The majority of the new external vehicle trips will travel along Victoria Drive, since it is a Mobility Arterial road that provides access to other major roads in the area.

2017 Background Traffic Scenario (Base Year)

- All the existing intersections currently operate at an acceptable LOS during the weekday AM and PM peak hours, with the Buffelsfontein Road / 17th Avenue intersection requiring signal timing optimisation in order to do so.

2022 Background Traffic Scenario (Excluding Development Traffic)

- In this traffic scenario, **one** of the existing intersections requires upgrading in order to operate at an acceptable LOS during the weekday AM and PM peak hours.

2022 Future Traffic Scenario – Erf 1948 (Including 50% Development Traffic)

- In this traffic scenario, **one** of the existing intersections requires upgrading in order to operate at an acceptable LOS during the weekday AM and PM peak hours.

2022 Future Traffic Scenario – Erf 11305 (Including 50% of Erf 1948 and 50% Development Traffic)

- In this traffic scenario, **none** of the existing intersections requires upgrading in order to operate at an acceptable LOS during the weekday AM and PM peak hours.

2027 Background Traffic Scenario (Excluding Development Traffic)

- In this traffic scenario, **none** of the existing intersections requires upgrading in order to operate at an acceptable LOS during the weekday AM and PM peak hours.

2027 Future Traffic Scenario – Erf 1948 (Including 100% Development Traffic)

- In this traffic scenario, **none** of the existing intersections requires upgrading in order to operate at an acceptable LOS during the weekday AM and PM peak hours.

2027 Future Traffic Scenario – Erf 11305 (Including 100% of Erf 1948 and 100% Development Traffic)

- In this traffic scenario, **one** of the existing intersections requires upgrading in order to operate at an acceptable LOS during the weekday AM and PM peak hours.

Public Transport and Non-Motorised Transport

- The traffic survey results indicate that minibus taxis and buses constitute on average 4.5% and 3.5% of the total traffic composition during the weekday AM and PM Peaks, respectively.
- There is a general lack of official public transport stops and associated infrastructure, e.g. bus embayments, signage, loading platforms and shelters, along the current public transport routes in this area.
- There is currently a high dependence on public transport by the residents of the Gqebera area, since the majority of the residents fall into the lower income groups. Vehicle ownership is therefore low in this residential area.
- Moderate pedestrian movements occur during the peak traffic periods between the Gqebera area and the Walmer Heights area.

- There is an absence of pedestrian facilities (e.g. sidewalks and pedestrian crossings) in the Walmer Heights area, which results in numerous pedestrians walking in the roadway when travelling through this residential area.
- There is a high presence of cyclists in the vicinity of the sites, especially along Victoria Drive, which is a popular cycle training route during weekends and early on weekday mornings.

12 Recommendations

Please refer to **Appendix D** for the assessment of mitigation measures identified by the TIA. The Recommendations of this traffic study are summarised as follow:

Access Control, Spacing and Sight Distances

- It is recommended that stop control be introduced at the Beethoven Avenue / Erf 11305 Access Road intersection (on the Access Road approach) to improve the safety of road users at this intersection.
- It is recommended that stop control be introduced at the Victoria Drive / Erf 11305 Access Road and Victoria Drive / Erf 1948 Access Road intersections to improve the safety of road users at these intersections.
- It is recommended that a minimum shoulder sight distance of 175m be maintained at the site accesses points during the construction stage of the developments, by ensuring there are no objects (dirt bins, temporary road signs, etc.) present that can obstruct the sight distances of construction vehicles.
- The 100km/h speed limit on the western part of Victoria Drive should be reduced to 60km/h (eastbound direction) at a point approximately 100m west of the new access intersection for Erf 11305, and that new speed limit signage be introduced accordingly.

2017 Background Traffic Scenario (Base Year)

- Signal timing optimisation should be carried out at the Buffelsfontein Road / 17th Avenue intersection.

2022 Background Traffic Scenario (Excluding Development Traffic)

- The Buffelsfontein Road / 17th Avenue intersection should be upgraded in order to operate at an acceptable LOS.

2022 Future Traffic Scenario – Erf 1948 (Including 50% Development Traffic)

- The Buffelsfontein Road / Victoria Drive intersection should be upgraded in order to operate at an acceptable LOS.
- The Victoria Drive / Access 1 (Erf 1948) Road intersection should be constructed.

2022 Future Traffic Scenario – Erf 11305 (Including 50% of Erf 1948 and 50% Development Traffic)

- No intersection upgrades are required at existing intersections.
- The Victoria Drive / Access 2 (Erf 11305) Road intersection should be constructed.

2027 Background Traffic Scenario (Excluding Development Traffic)

- No intersection upgrades are required at existing intersections.

2027 Future Traffic Scenario – Erf 1948 (Including 100% Development Traffic)

- No intersection upgrades are required at existing intersections.

2027 Future Traffic Scenario – Erf 11305 (Including 100% of Erf 1948 and 100% Development Traffic)

- The Buffelsfontein Road / Victoria Drive intersection would require upgrading in order to operate at an acceptable LOS. However, given that this traffic scenario is 10 years into the future, and numerous influencing factors may change by then, the need for geometric intersection upgrades should best be reviewed at that point in time.

Parking Requirements

- Parking provision should be in accordance with the *South African Parking Standards Manual (DOT, 1985)*. Parking bays should also be provided for mobility impaired persons wherever possible and considered necessary.

Public Transport and Non-Motorised Transport

- Upon completion of the developments, consideration should be given to the extension of a Public Transport feeder service into each development, or alternatively the introduction of new feeder services that can serve the residents of these developments.
- Any new public transport stops that will be created as part of these developments should consist of embayments, loading platforms, shelters and street lighting. Adjacent pedestrian crossing facilities should also be provided.
- Minimum 2m wide sidewalks should be provided along the primary access roads to the Erf 11305 and Erf 1948 developments from Victoria Drive.
- Pedestrian crossing should be implemented at the Erf 11305 and Erf 1948 access intersections to provide safe crossing points for pedestrians across Victoria Drive in these locations.
- Minimum 1.5m wide sidewalks should be provided along the predominant pedestrian route through the Walmer Heights area, between Erf 11305 and Miramar, to improve the safety of pedestrians along this route. The proposed sidewalks should be located along Beethoven Avenue, Schubert Road, Sibelius Street and Newcombe Avenue towards Buffelsfontein Road.
- Adequate provision should be made to accommodate pedestrians in the design of the developments' new access roads and intersections. Surfaced sidewalks of minimum 1.5m width should be provided along at least the main link roads and collector streets within the developments.
- Consideration should be given to the installation of dropped kerbs with tactile paving on pedestrian ramps at all intersections within the developments, to assist mobility impaired persons when making use of pedestrian crossings at intersections.
- The proposed roads, sidewalks and walkways should be planned such that they can function as shared use facilities able of accommodating cyclists as well, should the use of bicycles as a mode of transport increase in this area in future.
- For unsegregated shared use sidewalks and walkways that are expected to be well use, a minimum width of 3m is recommended. Where sidewalks and walkways are expected to be lightly used, a minimum width of 2m would be sufficient.
- Consideration should be given to the provision of adequate road shoulders on the section of Victoria Drive, between the developments' new access intersections and Buffelsfontein Road, to improve the safety of cyclists along this route.

- Street lighting should be provided along all new roads and walkways within the developments, to provide increased security to NMT and other road users at night.

13 References

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Appendix A: Traffic Volume Diagrams

Appendix B: Trip Generation Diagrams

Appendix C: Capacity Analysis Results

Note: A basic saturation flow of 1950 veh/hr/lane was used in all SIDRA runs, with a practical degree of saturation of 95%

Appendix D: Impact Assessments

Document Control and Disclaimer

FORM IP180_B

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