PRELIMINARY ROUTE DETERMINATION REPORT – PHASE 01 OF THE GAUTRAIN RAPID RAIL INTEGRATED NETWORK EXTENSION FROM MARLBORO STATION TO LITTLE FALLS STATION

November 2021

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1 Scope of Appointment

1.1 Introduction

The 25-Year Gauteng Integrated Transport Master Plan ("GITMP25") that was commissioned by the Gauteng Provincial Government to enable amongst others; province-wide mobility and societal development in the future; affirmed that the passenger rail network should form the backbone of a modernized, and integrated transport system in the Province.

Noting the affirmation above; it was necessary for the Gautrain Management Agency ("GMA"), under its mandate in relation to the integrated public transport and railway-related functions of the MEC responsible for provincial roads contemplated in Section 50 of the Gauteng Transport Infrastructure Act, Act No 8 of 2001 as amended ("the GTIA"), to develop a comprehensive strategy to improve rail coverage in Gauteng. As such, the GMA undertook and completed a comprehensive feasibility study for the possible extensions to the existing Gauteng Rapid Rail Integrated Network ("GRRIN"). This study was carried out under the framework for Public Private Partnerships ("PPP") in terms of the relevant National Treasury regulations of the Public Finance Management Act, 1999 ("PFMA").

This feasibility study report concludes that the extended GRRIN will provide significant economic and transport related benefits to the Gauteng Province that include the transformation of spatial development, reindustrialisation of the transport industry, and economic stimulus.

The project to extend the rapid rail network is currently awaiting the outcome of the Treasury Approval I ("TA1") application for Phase 1 of the proposed GRRIN extensions. Phase 1 is approximately 32km and extends from the existing Marlboro Station to a new station and depot facility at Little Falls on the West Rand, including an upgraded Sandton Station, as well as additional stations at Randburg, and Cosmo City. This phase of the extensions is therefore located within the boundaries of the City of Johannesburg ("CoJ") and will further connect to Soweto from Little Falls with an additional station at Roodepoort

In October 2018, the GMA appointed a consortium of engineering consultants to undertake the Preliminary Route Alignment Study that will enable the MEC for Public Transport and Roads Infrastructure in the Province to determine the route for Phase 1 of the proposed GRRIN extensions. This project is being executed in terms of the Gauteng Transport Infrastructure Act, Act No 8 of 2001 ('the GTIA' as amended); once concluded, it affords the MEC the power to protect the corridor for the proposed extension.

The implication for the properties that are located within this protected corridor for the proposed extension is that should any local authority in whose jurisdiction the determined route in located, receive an application for any proposed land-use change that falls within this protected strip of land, that local authority is required to forward such an application to the MEC for Public Transport and Roads Infrastructure (the MEC) for his/her comment prior to the approval of such an application by that local authority.

1.2 Route Determination

Route Determination is the first phase of the process of defining the railway reserve. The alignment that will be selected as part this Route Determination process will go through further refinement during the Preliminary Design process that follows after the conclusion of the determination of the route. This stage of the project will include the undertaking of a full Environmental Impact Assessment (EIA), as well as further consultation with affected parties.

1.3 Scope of Work

The scope of the project is to undertake the Preliminary Route Determination (PRD) study of Phase 01 of the GRRIN Extensions. The PRD includes the positioning of the proposed new maintenance depot as well as the position of the five proposed stations. The maintenance depot and stations will be located in the following areas:

- Little Falls – new station and maintenance depot
- Cosmo City – new station
- Randburg – new station
- Sandton – existing station
- Marlboro – existing station

The route that was proposed as part of the Feasibility Study of the possible extensions to the existing GRRIN was used as the base alignment in this study from which further alternatives have been developed. In this report, the original Feasibility Study Alignment is referred to as Proposed Route Alignment 01.

1.4 List of Drawings

Several different routes alignments have been investigated and based on a technical and environmental review three (3) route alternatives have been identified for more detailed investigation and consultation. Each of these three routes are shown in a separate set of drawings.

List of Drawings:

PRO-ROUTES 00-00 : Proposed Route Alignments Key Plan
PRO-ROUTES 01-01 : Proposed Route Alignment 1 (Sheet 1 of 4)
PRO-ROUTES 01-02 : Proposed Route Alignment 1 (Sheet 2 of 4)
PRO-ROUTES 01-03 : Proposed Route Alignment 1 (Sheet 3 of 4)
PRO-ROUTES 01-04 : Proposed Route Alignment 1 (Sheet 4 of 4)
PRO-ROUTES 02-01 : Proposed Route Alignment 2 (Sheet 1 of 4)
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PRO-ROUTES 03-04 : Proposed Route Alignment 3 (Sheet 4 of 4)

The drawings have been included at a reduced scale in **Appendix A** of this report. The original drawings are available as a separate book of drawings and are being kept at the Gautrain Management Agency.

2 Description of the Route

2.1 Destinations

The route will start at the proposed location of the new Little Falls Station (at grade station) which is located to the east of Hendrik Potgieter Road in Willowbrook. Leaving Little Falls Station, the route follows a north easterly direction towards Zandspruit where the route will pass to the west of Jackal Creek Golf Estate. The route then changes to a south easterly direction where it will run to the newly proposed Cosmo City station (elevated station). Leaving Cosmo Station, the route will continue in a south easterly direction towards the newly proposed Randburg Station (underground station), passing through North Riding, Olivedale, Bryanston, and Ferndale.

The route will continue in a south easterly direction through Randburg, Bordeaux and Hurlingham. Once it has reached Sandhurst the route will change direction towards the existing Sandton Station (new/upgraded underground station). Leaving Sandton station the route will run in a north easterly direction through Sandton, Sandown, Marlboro, and Alexandra towards the existing Marlboro Station where the existing station will be upgraded to accommodate the new alignment.

2.2 Route Options

During the initial stage of the Route Determination process, six route options were developed. The six route options were developed to cover as many route options as possible. During the initial evaluation of these route options, it became clear that some of these options would be more advantageous than some of the other options. The initial evaluation included high level evaluation of impact on the environment, the cost of the system, the land effected, social impact, economic impact, design standards for rapid rail systems, and the position of the stations.

After the initial evaluation a decision was taken to only discuss the three most likely route options in the Route Determination Report. These three options include the original alignment (option 01) which was developed during the Feasibility Study.

The detailed evaluation of the three selected route options is discussed in this Route Determination Report. The detail evaluation process included the impact on the environment, the cost of the system, the land effected, social impact, economic impact, and the position of the stations. Each of these aspects were given a rating and a weighting and the route option with the highest score was Route Option 03 (preferred route).

2.3 Suburbs Affected

The preferred route will run through the following suburbs:

- Amarosa;
- Aanwins AH;
- Willowbrook;
- Ruimsig AH;
- Sonnedal AH;
- Jackal Creek Golf Estate;
- Cosmo City;
- North Riding AH;
- Northgate;
- Bellairs Park;
- North Riding;
- Sharonlea;
- Ferndale;
- Blairgowrie;
- Bordeaux;
- Craighall;

- Glenadrienne SP1;
- Hurlingham;
- Sandhurst;
- Sandown;
- Barlow Park; and
- Marlboro Gardens.

It is not the intention of a PRD study to determine the extent of the rail reserve that will be required. However, in order to assess the high-level impact of the route on the suburbs identified an indicative rail reserve has been determined.

2.4 Major Industries, Commercial and Educational Developments Affected

During the PRD study all efforts have been made to align the rail line in such a way that it will have minimal impact on existing industrial, commercial, and educational developments. This was not entirely possible, and the following existing non-residential developments will be impacted on by the preferred alignment (Option 3):

- Mellow Oaks Academy (PLG Schools) – Educational (Aanwins AH);
- Parking Area of Club Motors - BMW Car Dealership (Ferndale);
- 90 Oxford Street – French Park (Ferndale); and
- Provantage Media Group (Bordeaux).

The impact of the preferred route alignment determined as part of this study on the above land uses, as well as other residential land issues, will only be quantified in more detail once the Preliminary Design of the preferred route alignment takes place.

2.5 Major Road Crossings

The PRD was done in such a way as to accommodate all existing and planned major roads. This will ensure minimal disruption to the major road network during and after the construction of any extensions to the GRRIN. The following major roads will be crossed, either as a rail over road or as a road over rail configuration, by the preferred route identified:

- Hendrik Potgieter Road
- Beyers Naude Drive;

- Slovenia Street;
- Northumberland Avenue;
- Malibongwe Drive;
- Bellairs Drive;
- President Fouche Road;
- N1 Western Bypass;
- Bram Fischer Drive; and
- Bordeaux Drive.

These major roads were accommodated in such a way that the accessibility of suburbs affected by the GRRIN alignment will not be adversely affected. Accessibility to all these suburbs will be maintained as links to the major road network will be retained. During the Preliminary Design phase of the project this will be confirmed and accessibility on an erf-by-erf basis will be ensured. If it is determined during the Preliminary Design that an erf cannot be provided with access, then these erven will be expropriated as part of the rail reserve. If it is found at that stage that erven can be consolidated and sold off as new stands, then a separate town planning process will be initiated in order to achieve this.

3 Land Use and Stations

3.1 Existing Land Use around Stations

The GRRIN Extensions will undoubtedly have an impact on existing and future land use along the alignment. The extensions will play a major role in supporting economic activities in the various areas along the route.

One of the areas where the GRRIN Extensions will have the biggest impact will be at the newly proposed station locations. Experience on the existing stations on current Gautrain has shown that stations add much value to the land in the surrounding areas.

3.1.1 Marlboro Station

Marlboro Station as seen in **Figure 1** below is an existing Gautrain Station located on the northern side of the Alexandra Township. Alexandra is a high-density township near the Gautrain Station. Also in close proximity is the Linbro Park Agricultural Holdings, Frankenwald, East Gate, and Wynberg.

Frankenwald is an existing industrial, warehousing, and commercial area, whereas Linbro Park Agricultural Holdings is still developing. The type of land uses supported on the Linbro Park Agricultural

Holdings include high density residential and related land uses. The land uses in the East Gate area include office and retail related land uses. Wynberg, located to the west of the Alexandra Township, has developed as an industrial and commercial precinct.

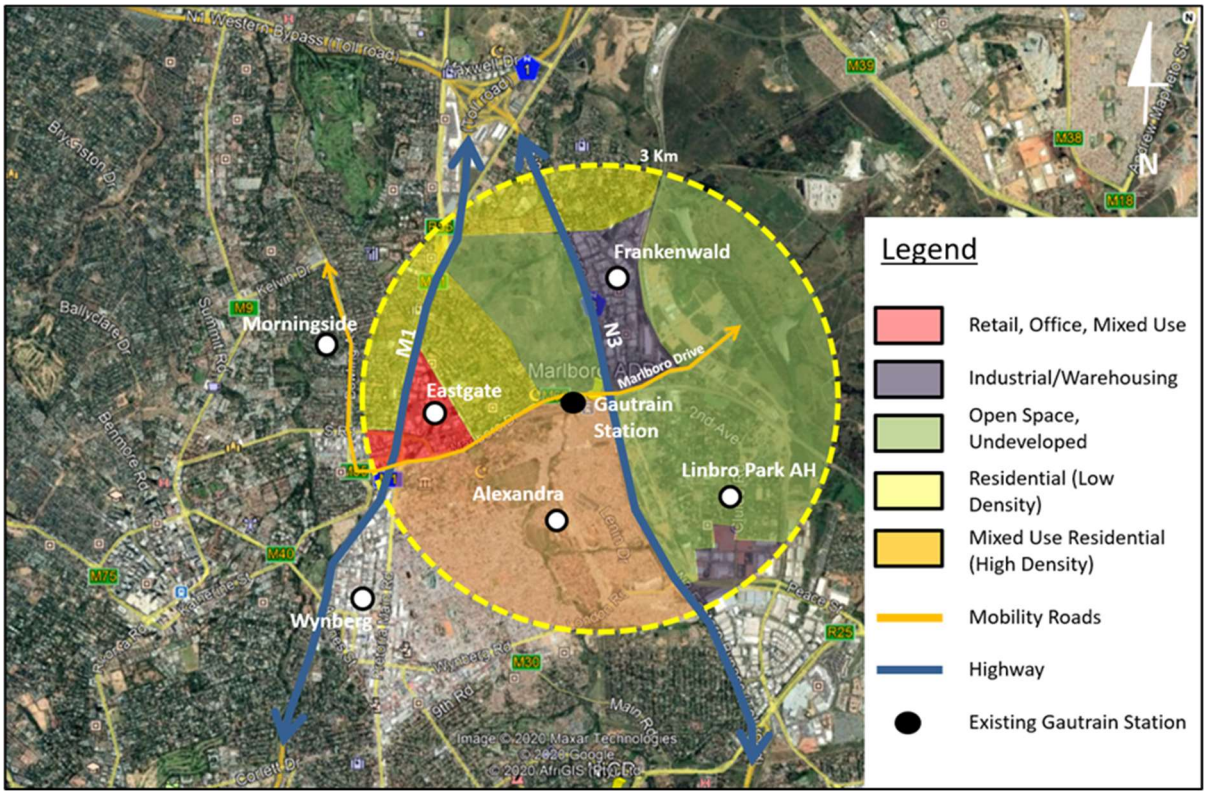

Figure 1: Broad Land Use around the Marlboro Gautrain Station

*Note: 3km radius around stations indicative of scale and not representative of catchment area.

3.1.2 Sandton Station

The Sandton Gautrain Station as seen in **Figure 2** below is also an existing Station located within walking distance of the Sandton City Mall. Sandton is known as the financial and business hub of not only South Africa, but also Africa. The area is characterized by its high-rise buildings housing head offices of large companies including:

- Financial Institutions;
- International hotels; and
- The International Convention Centre.

Sandton developed as a regional node prior to the existence of the Gautrain but having a Gautrain Station in Sandton further supported the already established node.

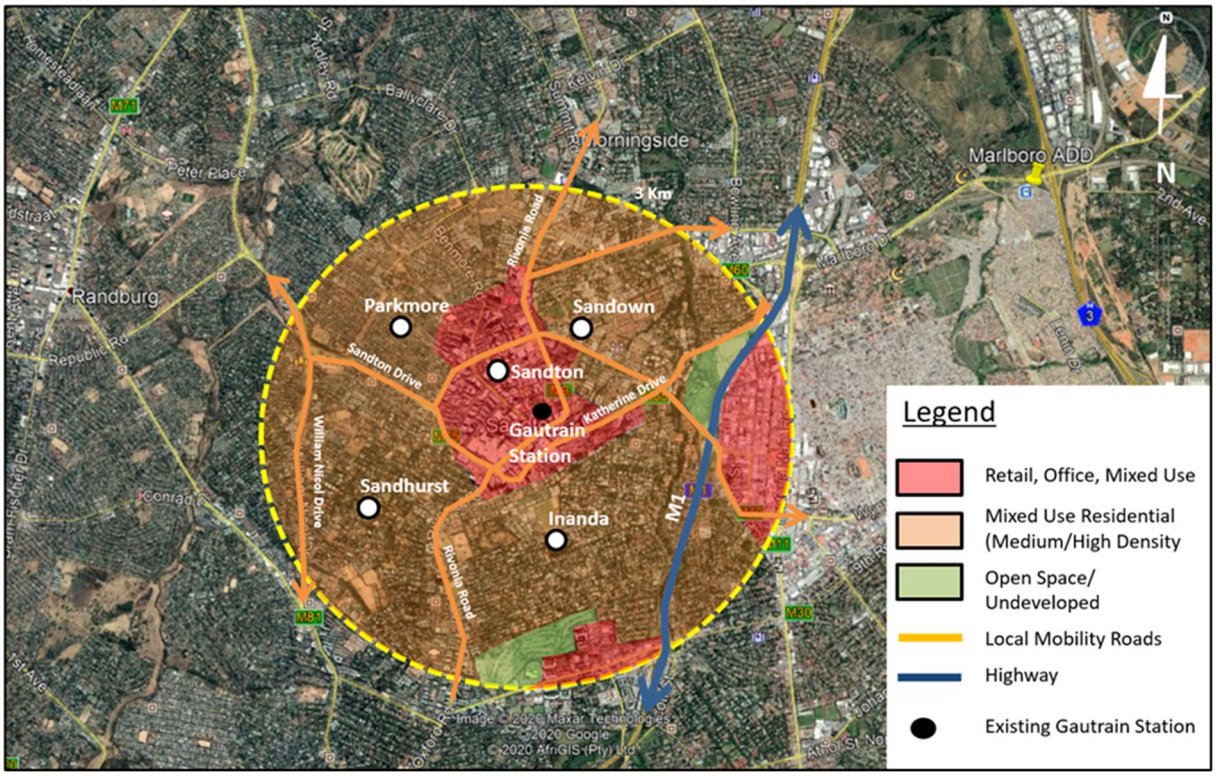

Figure 2: Broad Land Use around the Sandton Gautrain Station

*Note: 3km radius around stations indicative of scale and not representative of catchment area.

3.1.3 Randburg Station

The proposed Randburg Station is located in the Randburg Central Business District (CBD). The Randburg CBD as seen in **Figure 3** below is an existing node comprising a mix of land uses such as a pedestrian mall, offices, a public square, the Randburg Municipal offices, and residential buildings. The residential density within the Randburg CBD is mostly 2-3 story walk-ups with a few taller apartment blocks scattered throughout the CBD.

On the periphery of the Randburg CBD, the dominant land use is low density residential. Concentrations of medium residential densities are located along the main roads such as Malibongwe Drive, Republic Road and Bram Fischer Drive. Noteworthy land uses on the periphery of the CBD include St Stithians College, Damelin College, the Multi Choice offices precinct, and the Randburg Taxi Rank.

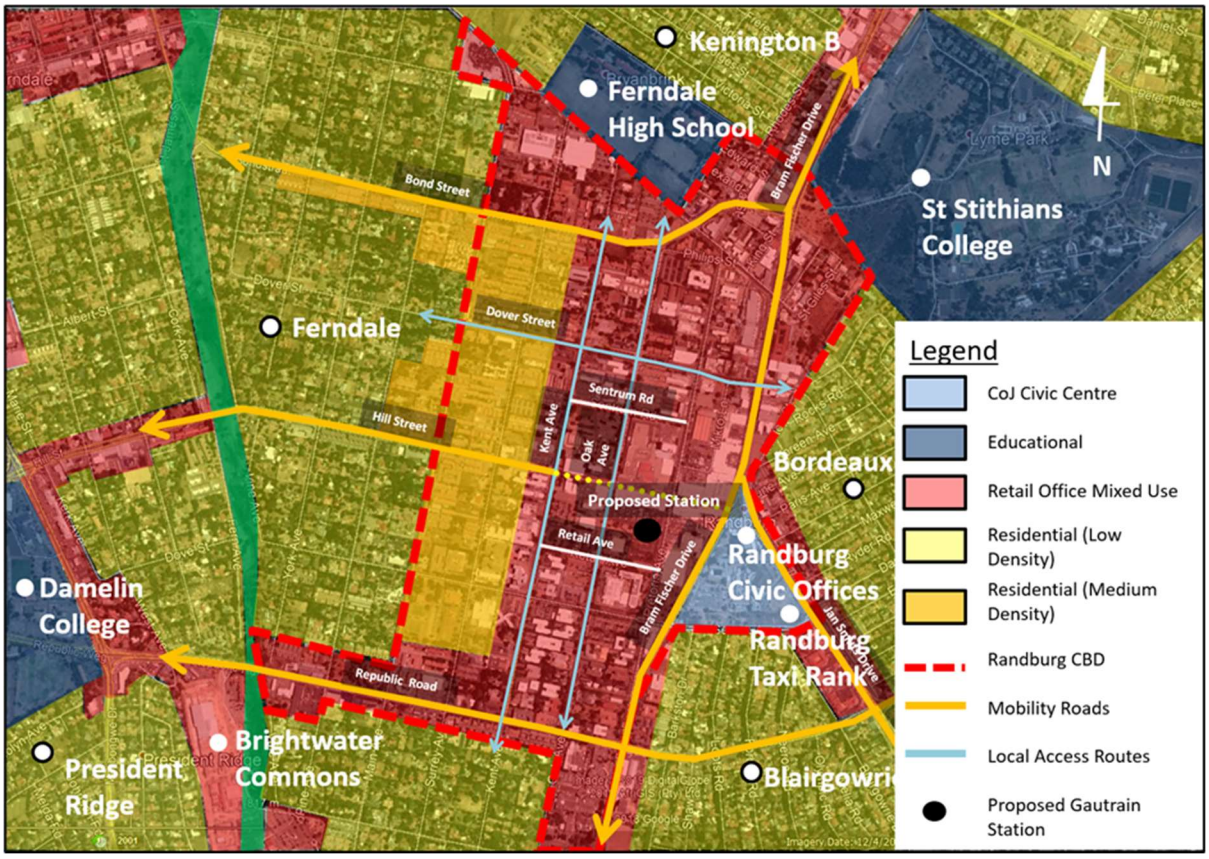

Figure 3: Broad Land Use around the Proposed Randburg Gautrain Station

3.1.4 Cosmo Station

The proposed Cosmo City Station as shown in **Figure 4** is located to the north of the existing Northgate Shopping Centre. The area around the proposed Cosmo City Station includes retail, residential and industrial land uses with undeveloped or agricultural holdings to the west of Northumberland Road. The proposed station is located to the north of the Northgate Shopping Centre on land currently being used as agricultural holdings. This area seems to be under pressure for development as a few 3 story walk-ups were constructed along Northumberland Road.

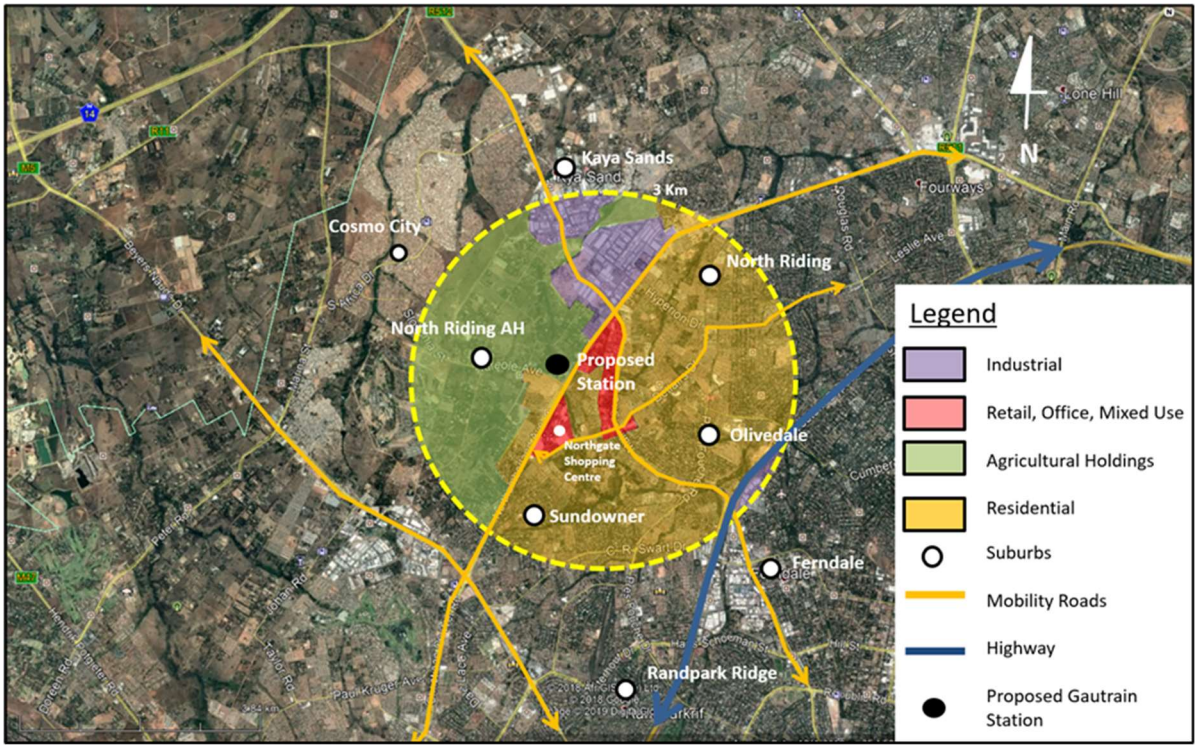

Figure 4: Broad Land Use around Cosmo City Station.

*Note: 3km radius around stations indicative of scale and not representative of catchment area.

3.1.5 Little Falls Station

The proposed Little Falls Station as shown in **Figure 5** is located to the west of Beyers Naude Drive, the south of Peter Road and is near the east of Hendrik Potgieter Road. Land uses surrounding the station include residential to the east, west and south of the station with the Wilgespruit passing the site directly to the north-east. Regional nodes near the station include Retail Crossing and Lifestyle Crossing shopping centres to the south, the Clearwater Mall and Makro retail centres further to the southeast along Hendrik Potgieter Drive.

The average residential density near the station according to the City of Johannesburg's zoning information is approximately 40 units per hectare. This station is situated close to the western edge of the City of Johannesburg, but the 3km radius that was used as a guide when the land use was investigated still falls within the municipal boundary of the City of Johannesburg.

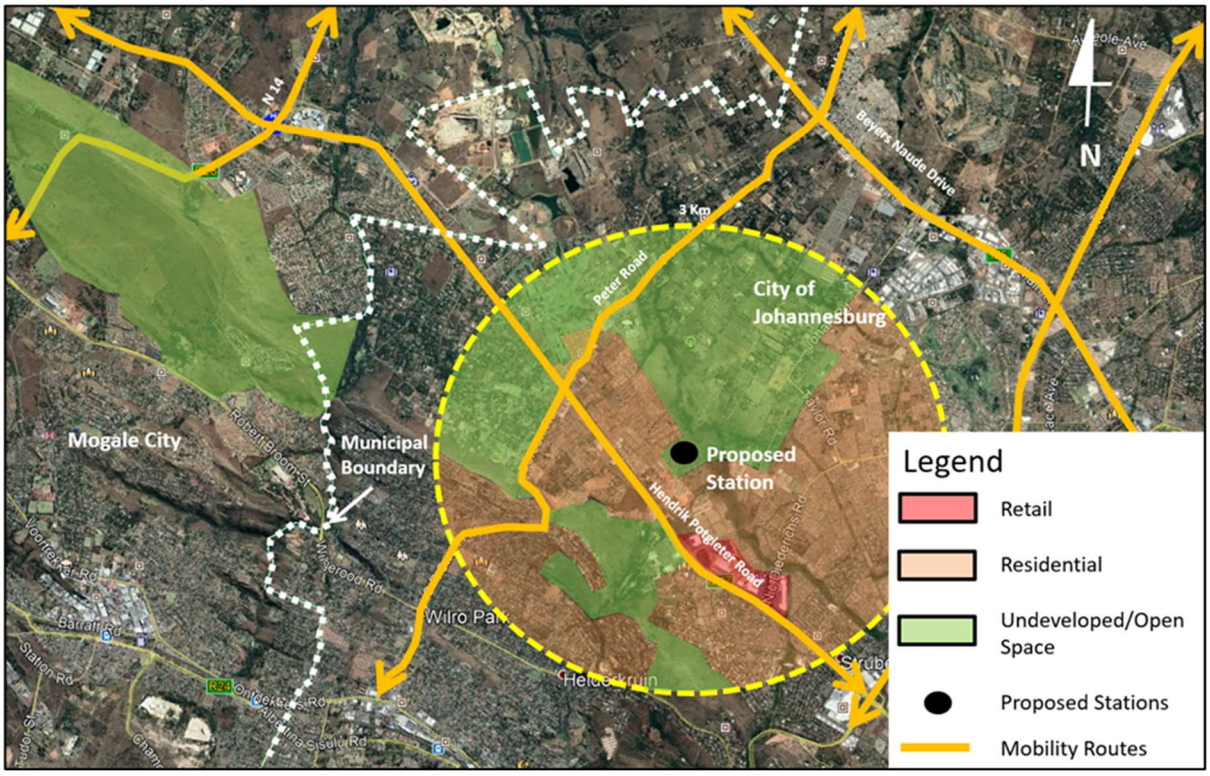

Figure 5: Broad Land Uses around the Proposed Little Falls Gautrain Station

*Note: 3km radius around stations indicative of scale and not representative of catchment area.

3.2 Future Land Use

The future land use around proposed stations provided in the section below is based on the information received from the City of Johannesburg Metropolitan Municipality (CoJ). All the stations proposed for GRRIN Phase 1 Extension are located within the CoJ.

The biggest impact on the future land use around the proposed stations will be at Randburg, Cosmo City and Little Falls Stations. The other stations also affected by the GRINN Phase 1 Extension are Sandton and Marlboro Stations. In both cases, the future land use may not be affected as much as both locations have existing Gautrain Stations.

3.2.1 Randburg Station

There are two policies used by the City of Johannesburg to guide the future development around the Randburg Station. The CoJ employ the Regional Spatial Development Framework for Region B and the Randburg Urban Development Framework to guide development.

The main objective of the Regional Spatial Development Framework for the Randburg Central Business District is to revitalize and upgrade the node as a regional node. Strategies proposed to achieve this is centred around:

- The intensification of land use such as offices, retail and residential land uses in appropriate locations in support of all modes of transport including NMT and pedestrian movement; and
- Improving the management of the precinct through increased security and the redevelopment of open space.

The focus of the Randburg Urban Development Framework (UDF) is to appropriately intensify land uses by integrating the network of transport routes and facilities with appropriate supporting land uses and to improve the quality of the public environment and experience in the node and establish a safe and walkable environment.

The objectives of the Spatial Development Framework (SDF) and Randburg UDF are implemented through specific implementable proposals per precinct. The Randburg UDF identified 4 precincts namely:

- Residential precinct;
- Office Precinct;
- Retail Precinct; and
- Civic Precinct.

The proposed station as shown in **Figure 6** is situated in the Randburg CBD between Bram Fischer and Oak Avenue, in close proximity to the Civil Precinct, within the Retail Precinct and within walking distance of the office and residential precincts.

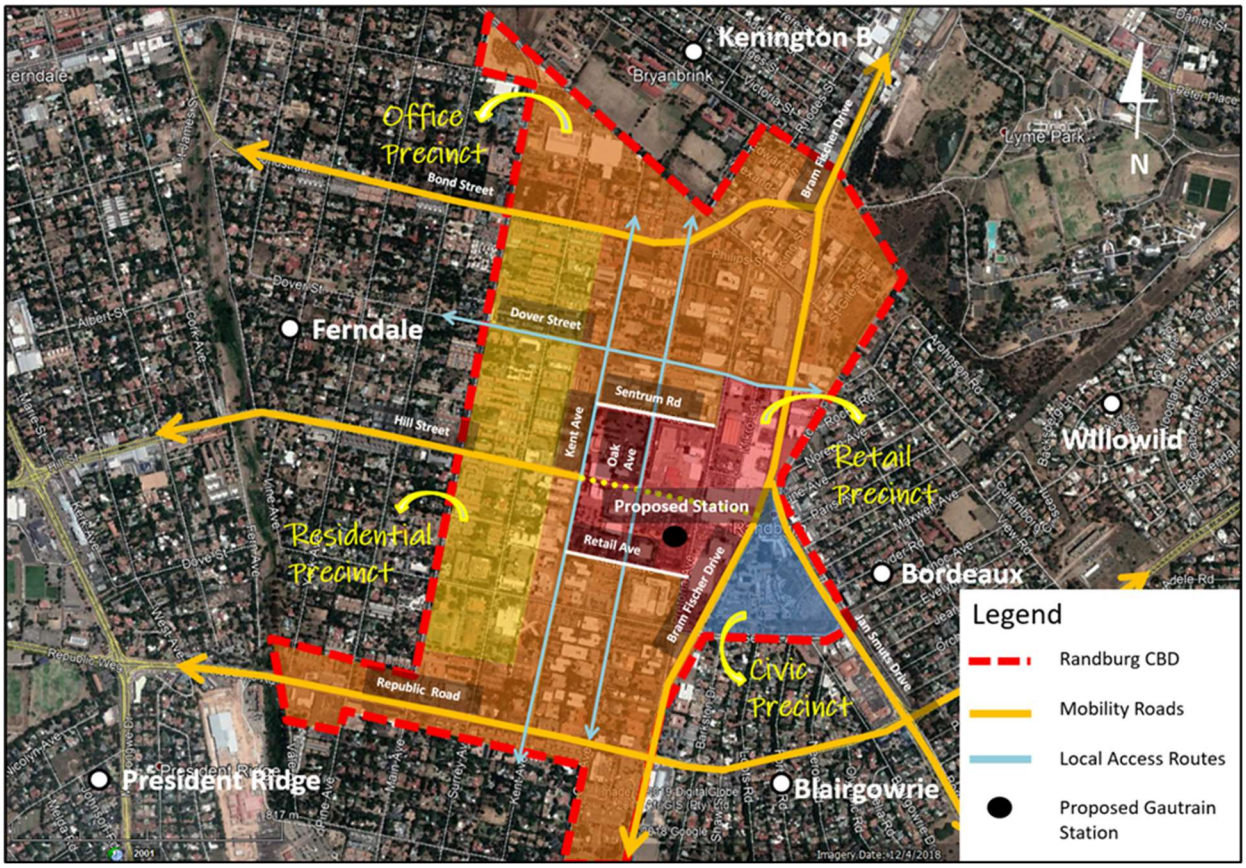

Figure 6: Randburg CBD's Precincts.

The Randburg UDF (refer to **Figure 7**) has precinct specific land uses proposal to achieve its objective. The land use proposals can be summarized as follows:

- Civic Precinct
  - Extensive council and government functions, re-instating the functions that have been relocated and adding additional functions such as a Thusong Centre;
  - A multi-modal, multi-level public transport facility accommodating taxi's, BRT busses and the Gautrain feeder route;
  - A multi-level structured parking area;
  - A variety of land uses such as medium to high density residential, offices, retail, entertainment, refreshment and recreational;
  - A hawker's market linked to the taxi facility; and
  - Public open spaces to celebrate the civic function of the site.

Figure 7: Development Concept and Civic Precinct Development Proposal

- Retail Precinct
  - Proposed land uses include mixed uses that will generate 24-hour activity such as retail and residential including high density residential, shops and restaurants; and
  - Development controls proposed include net residential density in excess of 100 units per hectare, building height should be at least 10 storeys, coverage of 60% and parking ratios should be lowered in proximity of public transport hubs (refer to **Figure 8**).

Figure 8: Retail Precinct Development Concept

- Office Precinct
  - Vertical mixed land uses should be encouraged to increase the population density within a 500m to 1 km radius catchment of the public transport hub;
  - Medium and large-scale home enterprises should be encouraged and supported in transitional zones between non-residential and residential;
  - Retail should be limited and subservient to the office and residential catchment;
  - Conference facilities and hotels should be allowed and promoted; and
  - Development controls proposed include building heights of between 4 and 8 storeys, net residential density of between 60 and 80 units per hectare, coverage of 50% and parking rations to be lowered (refer to **Figure 9**).

Figure 9: Proposed Redevelopment Compared to Existing

- Residential Precinct
  - The net current residential density is 42 units per hectare. The proposed density for this precinct is between 40 and 60 units per hectare; and
  - No further invasion of non-residential uses to be allowed unless where social services are subservient to the residential development.

The Randburg node can be revitalized to support the station by allowing for more retail, office, and residential developments to take place. The focus should be on investment promotion in the medium to long term. An existing Gautrain Station node such as the Rosebank Station node could be used as a benchmark in terms of land use.

The demand analysis from the Feasibility Study indicated that Randburg would generate trips from all other stations (Little Falls, Cosmo City, Sandton, Midrand, Rosebank, and Park Stations). The catchment area of the station is large and can generate commuter trips to other stations such as Sandton, Rosebank and Park Stations as well as airport trips to OR Tambo International Airport.

3.2.2 Cosmo City Station

The proposed Cosmo City Station is situated in Region C, sub area 3 of the City of Johannesburg Metropolitan Municipality. Currently the policy governing future land use is the 2009/2010 Regional Spatial Development Framework (RSDF). The development objective for this sub-region is to strengthen public and private investment in the Northgate Regional node. The RSDF 2009/2010 proposes the following interventions:

- Promote regional functions and land uses within the nodal boundary, with specific reference to:
  - Vehicular and pedestrian movement;
  - Optimising mobility and accessibility;
  - Inter-modal facilities;
  - Incorporate informal trade;
  - Bicycle storage facilities at the mall; and
  - Support densification within the node in support of public transport.

The possibility of locating a Gautrain Station in this locality may act as a catalyst that will impact the exiting character and current development pattern of the area. The CoJ indicated that the Regional Spatial Development Framework will need to be updated soon. The type and extent of land uses to support in the area will have to be determined by a detailed study, but development proposals may include:

- Medium to high density residential developments to be developed in the larger pockets of land to the east of the proposed station location; and
- The current industrial areas north of the station can also be considered to be further developed which can only increase the potential of the area around the station.

An existing Gautrain Station node such as the Sandton Station node can be used as a benchmark for the retail, offices, and recreational facilities with lesser emphasis on the office uses in terms of land use.

The demand analysis from the Feasibility Study indicated that there would be a substantial generation of trips from the Cosmo area to Sandton, Randburg, and Park Stations. Similarly, to the Randburg area, the catchment of the station is large and can generate commuter trips as well as airport trips to OR Tambo International Airport.

3.2.3 Little Falls Station

The City of Johannesburg's Regional Spatial Development Framework (RSDF) was approved in 2009/10. The RSDF does not at this stage consider the possibility of the Gautrain Station located in this position. This will however have an impact on the land use proposals currently proposed in the RSDF.

During initial discussion with the Municipality, the town planner for the region indicated that the Region C Spatial Development Framework needs to be updated. According to the Integrated Development Plan, the Region C Spatial Development Framework will be revised in 2019/2020.

The City of Johannesburg's RSDF proposes higher density residential development in the vicinity of the proposed station with some retail at specific nodal points along Hendrik Potgieter Road. Residential densities around the proposed Gautrain Station range between 30 and 40 units per hectare. To the north of the proposed station is undeveloped/agricultural holdings which according to the spatial development framework is under pressure for development.

In summary, the Little Falls node is currently only a residential node with supporting retail use in close proximity. The future Gautrain Station can enable the node to be developed in future to allow for more retail use, and possibly further high-density residential developments such as residential complexes or townhouses. Office use can also be considered. An existing Gautrain Station node such as the Centurion Station node could be used as a benchmark in terms of land use.

The demand analysis from the Feasibility Study indicated that there would be a substantial generation of trips from the Little Falls area to Sandton and Randburg. The Little Falls Station is ideally located to function as an origin station.

Figure 10 shows the urban edge as delineated in the City of Johannesburg's Spatial Development Framework.

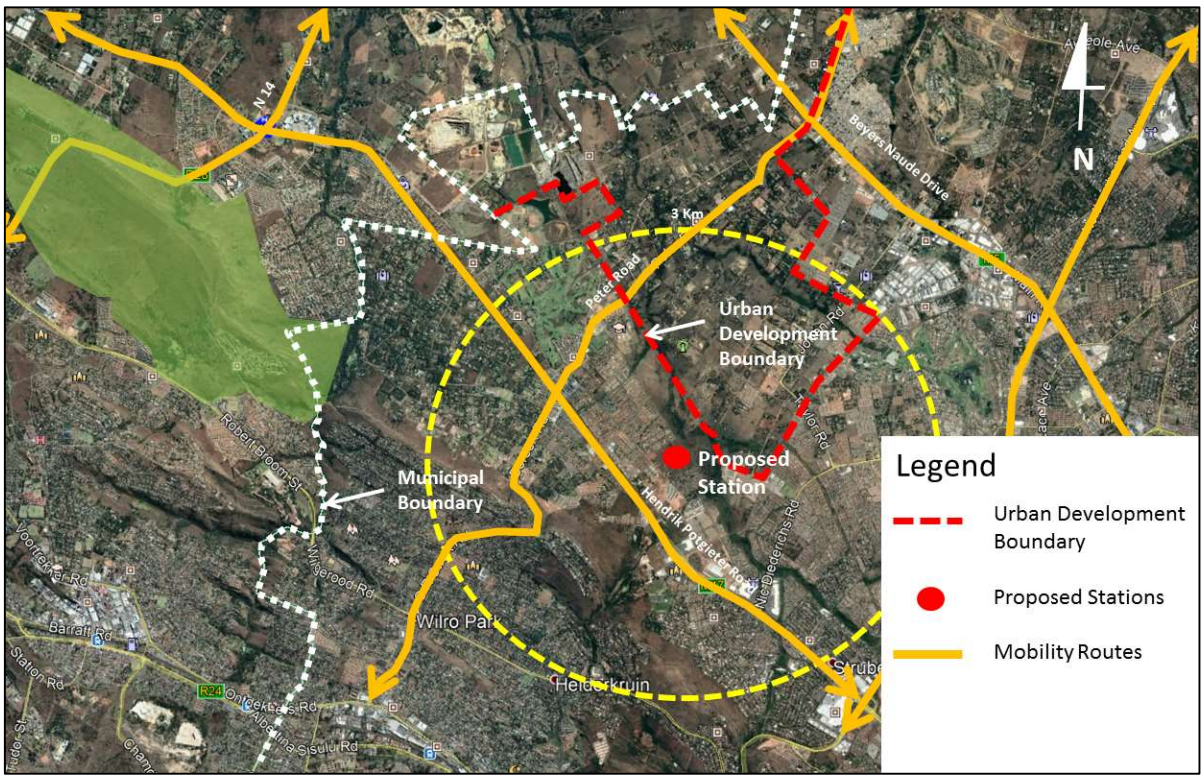

Figure 10: Urban Edge

*Note: 3km radius around stations indicative of scale and not representative of catchment area.

3.3 Accessibility of Proposed Stations

This section of the report will focus on the Randburg, Cosmo City and Little Falls Stations. This is mainly due to the fact that both the Sandton and Marlboro Stations are existing stations where accessibility has already been addressed and any further updates of this will be done during the Preliminary Design stage of the project.

3.3.1 Randburg Station

a. Existing Non-Motorised Transport Infrastructure

Non-Motorised Transport (NMT) upgrades have been completed from the taxi rank and along the pedestrianised section of Hill Street which goes through the Randburg Square. There are signalized pedestrian crossings along this upgraded section. There are existing paved sidewalks along Hill Street, Bram Fischer Drive, Jan Smuts Avenue, Pretoria Avenue, Oak Avenue, Retail Avenue and Sentrum Road. **Figure 11** below indicates the pedestrianised section of Hill Street.

Figure 11: NMT, Public Transport and Road Network around Proposed Randburg Station

b. Existing Road Network

The major arterials going north and south through the node are, Malibongwe Drive situated to the west of the proposed station location, and Bram Fischer Drive and Jan Smuts Avenue to the east of the proposed station location. Bond Street, Hill Street and Republic Road are minor arterials which run in the east-west direction. The proposed location for the station is situated on the block bounded by Sentrum Road, Oak Avenue and Pretoria Avenue. Access to this location from the main roads can be via Hill Street from the west onto Kent Avenue and then onto either Retail Avenue or Sentrum Road to gain access to Oak Avenue. From the north, via Bram Fischer Drive onto Dover Street and Oak Avenue/Pretoria Avenue, or via Jan Smuts Avenue and Bram Fischer Drive from the south onto Selkirk Avenue/Harley Street and then onto Oak Avenue/Pretoria Avenue. **Figure 11** indicates the road network.

c. Ideal Public Transport Interfaces

Current Metrobus routes pass the node but there is an opportunity to increase the routes or number of buses serving this node with a new station. There is a BRT (Rea Vaya) service planned in future to run through this node (from the Sandton node) along Republic Road, Bram Fischer, and Jan Smuts

Drive. Existing minibus taxis can still serve the station but similarly to Metrobus, there may be an opportunity to increase the routes or number of taxis serving this node.

In the future design phases of the extension, the implementation of a comprehensive feeder bus service around the proposed Randburg Station should be investigated as it should be beneficial to reduce the private vehicle traffic in the area (Randburg and Bryanston areas). Appropriate drop-off areas must be allowed for at the station (Metrobus, Feeder and Distribution Services (GFDS), metered taxis, E-hailing services, corporate shuttles, and private vehicles).

d. Beneficial Road Network and NMT Access

Main roads such as Malibongwe Drive, Bram Fischer Drive, Jan Smuts Avenue, Hill Street and Republic Road already provide the station with a network for good access. Sentrum Road, Pretoria Avenue, Oak Avenue, Kent Avenue, Dover Street and Selkirk Avenue/Harley Street would need to be upgraded where possible and intersections upgraded to allow increased turning volumes to the station. Traffic impact assessments would need to be carried out for the network around the proposed station to identify the extent of the upgrades required.

NMT routes will have to be improved along all roads where necessary to accommodate both pedestrians and cyclists and intersection crossings to improve safety would need to be undertaken. The traffic impact assessment should identify these routes and intersections as well as the extent of the upgrades required to support easy access to the station for all modes of transport.

e. Conclusion

The proposed Randburg Station is located within the existing Randburg CBD. The advantage of the proposed location is that there is existing development and infrastructure that can be capitalized on to support the Gautrain.

Land uses within the CBD include residential, at various densities, commercial (office and retail), civic and educational uses. The existing land uses need to be strengthened by updating the Spatial Development Frameworks to fully support the station with development that will increase train ridership.

The area around the proposed Randburg Station has a good road network to support the station from an accessibility point of view and already has an NMT walkway leading passengers to the station. The potential for integration with other public transport is clear as bus or minibus taxis users can easily alight from these modes of transport and then access the station. Access to parking and drop-off areas

should be considered off Kent Avenue, as it allows access from all directions via Hill Street, Republic Road and Bram Fischer Drive via Dover Street or Bond Street.

3.3.2 Cosmo City Station

a. Existing NMT Infrastructure

NMT provision is very poor in this area. There are no paved sidewalks along the roads closest to the proposed station location. There are only sidewalks along Olivenhout Avenue.

b. Existing Public Transport Services

The area is not well served by buses around the node. There is a Metrobus service running from Gandhi Square to Northgate. Minibus taxis serve the area well along Malibongwe Drive from the Cosmo City area.

c. Existing Road Network

The major arterial going north and south through the node is Malibongwe Drive. Northumberland Avenue is also a major arterial which passes through the node in an east-west direction. Olivenhout Avenue/Bellairs Drive are minor arterials running in the east-west direction. Aureole Avenue runs to the north into the Cosmo City area. The proposed location for the station is situated at the corner of Northumberland Avenue and Aureole Avenue. Access to this location from the main roads can be via Northumberland Avenue onto Aureole Avenue. **Figure 12** below indicates the road network.

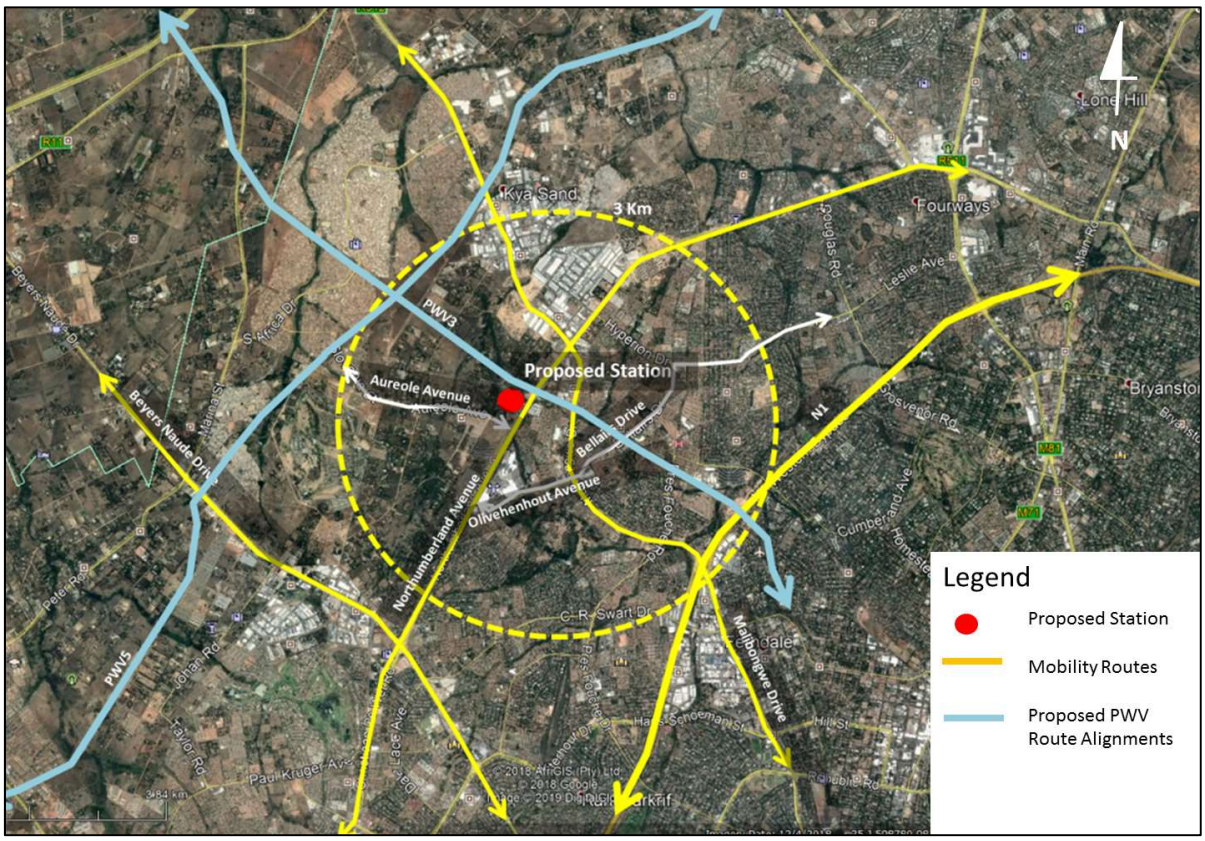

Figure 12: Road Network around Proposed Cosmo Station

d. Ideal Public Transport Interfaces

There is currently only one Metrobus route from Gandhi Square to Northgate. There are plans from Metrobus to implement either new routes or extend existing routes to the Cosmo City area which would most likely run along Malibongwe Drive. With the proposed station location, there may be an opportunity to further increase the routes serving this node or the number of buses passing by. There is no planned Rea Vaya route currently to serve this node in future. However, this could be developed with the notion of a new station situated in the area. Existing minibus taxis from Cosmo City can still serve the area but there may be an opportunity to increase the routes or number of taxis serving this Cosmo City node in future.

A few GRRIN feeder bus routes for the residential areas around Cosmo (including wider surrounding suburbs and Laser Commercial Park) should be implemented as it would be beneficial to reduce the private vehicle traffic out of the area towards the Randburg and Sandton nodes. Appropriate drop-off areas must be allowed for at the station (Metrobus, GFDS, metered taxis, E-hailing services, corporate shuttles, and private vehicles).

e. Beneficial Road Network and NMT Access

Roads such as Malibongwe Drive, and Northumberland Avenue provide the station with good access to the station. Northumberland Avenue will however need to be upgraded to a dual carriageway in sections where it is currently only a single lane. Aureole Avenue would also need to be upgraded where possible and intersections upgraded to allow increased turning volumes to the station. Traffic impact assessments would need to be carried out for the network around the proposed station to identify the extent of the upgrades required.

NMT routes would need to be identified and implemented towards the station, particularly from the Northgate node. Improving sidewalks where necessary to accommodate both pedestrians and cyclists must be considered. Safe pedestrian crossings at intersections should also be implemented, particularly across Northumberland Avenue as it is a high-speed road which carries large volumes of traffic in both directions. The traffic impact assessment should identify these locations as well as the extent of the upgrades required to support easy access to the station.

f. Conclusion

The proposed Cosmo City Station is located within an area currently used as agricultural holdings, which, from initial observation, is under pressure for development. Development in close proximity to the proposed station include residential, commercial, and retail land uses. There is an opportunity to influence the future development of the area at an early stage by updating the Spatial Development Frameworks in line with the identified role and function of the station and promote land uses that will support the rail infrastructure.

From a transportation perspective, a good NMT corridor from the station to the Northgate node would be beneficial. Public Transport integration is possible with drop-offs strategically situated along Northumberland Road close to the station. Access to parking and drop-off areas should be considered off Aureole Avenue. There could be potential for this station to be used as a Park-and- Ride location once the PWV3 is in place.

3.3.3 Little Falls Station

a. Existing NMT Infrastructure

NMT provision is non-existent in this area. There are no paved sidewalks along any roads close to the proposed station location.

b. Existing Public Transport Services

There is a Metrobus service running from Gandhi Square to Ruimsig along Hendrik Potgieter Road. Minibus taxis also run along Hendrik Potgieter Road.

c. Existing Road Network

The main road going north and south through the node is Hendrik Potgieter Road. Doreen Road/Peter Road is the only road running in the east-west direction. Van Dalen Road runs to the proposed station location which can be accessed via Van Der Kloof Road from Hendrik Potgieter or directly off Peter Road. The proposed location for the station is situated on the block bounded by the proposed PWV5, Van Dalen Road and existing residential developments. **Figure 13** indicates the road network.

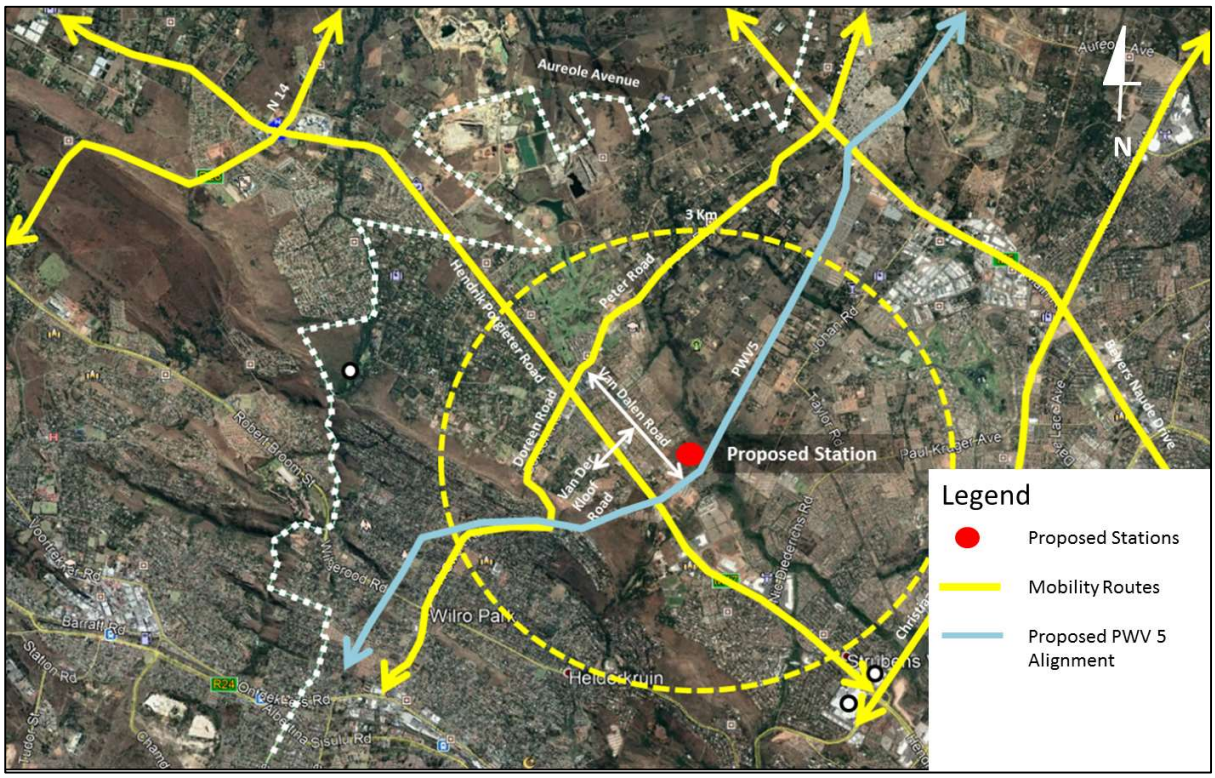

Figure 13: Road Network around Proposed Cosmo Station

d. Ideal Public Transport Interfaces

There is currently only one Metrobus route from Gandhi Square to Ruimsig which runs along Hendrik Potgieter Road. There is an opportunity for Metrobus to implement either new routes or extend existing routes to the Little Falls area. There is no planned Rea Vaya route currently to serve this node in future. However, this could be developed with the notion of a new Gautrain Station situated in the area. There may also be an opportunity to increase the routes or number of taxis serving this node in future.

Gautrain feeder bus routes around Little Falls should be implemented as it would be beneficial to reduce the private vehicle traffic out of the area towards the Randburg and Sandton nodes. Appropriate drop-off areas must be allowed for at the station (Metrobus, Gautrain bus, metered taxis, E-hailing, corporate shuttles, and private vehicles)

e. Beneficial Road Network and NMT Access

Hendrik Potgieter Road provides the station with good access to the station from the Ruimsig and Strubens Valley area. The road will however need to be upgraded to dual carriageway in sections where it is currently only a single lane in each direction. Van der Kloof Road and Van Dalen Road would need to be upgraded where possible and intersections upgraded to allow increased turning volumes to the station. Traffic impact assessments would need to be carried out for the network around the proposed station to identify the extent of the upgrades required.

NMT routes would need to be identified and implemented towards the station, particularly leading directly from Hendrik Potgieter Road to the station. Improving sidewalks where necessary to accommodate both pedestrians and cyclists must be considered. Safe pedestrian crossings at intersections should also be implemented. The traffic impact assessment should identify these routes and intersections as well as the extent of the upgrades required to support easy access to the station for all modes.

f. Conclusion

The proposed Little Falls Station is located within an area currently earmarked as agricultural holdings. This area is under pressure for development as the proposed station is surrounded by inter alia residential, commercial, and retail land uses. The Spatial Development Frameworks for the area will have to be updated to support the proposed rail by promoting land uses that will support the role and function of the stations and increase ridership.

From a roads and transportation perspective, an NMT walkway leading passengers to the station from Hendrik Potgieter Road is a must especially for people using public transport to and from the station. The potential for integration with other public transport is clear as bus or minibus taxis users can easily alight from these modes and then access the Gautrain Station from Hendrik Potgieter Road via the NMT walkway. Access to parking and drop-off areas should be considered off Van Dalen Road. There is also the potential for this station to be used as a Park-and- Ride location once the PWV5 is realized.

4 Impact on the Environment

4.1 National and International Policies

The extension of the existing GRRIN will impact not only the socio-economic environment but also the biophysical environment. This impact needs to be contextualized within both national and international policies, as it provides insights into the South African Government's vision from a sustainable development perspective and provides insights into the importance that the South African Government places on environmental issues. In this regard both the National Development Plan: Vision for 2030 (NDP) as well as the Medium-Term Strategic Framework (MTSF) are of consequence to the GRINN extension.

The NDP stipulates twelve (12) priority areas to eliminate poverty, create jobs and reduce inequality by 2030. In addition to these twelve (12) priority areas, the NDP also acknowledges the need for "building environmental sustainability and resilience" and that change is needed to ensure the protection of the natural environment whilst enabling benefits for humans from natural resources (NPC, 2012[1]).

The Medium-Term Strategic Framework (MTSF) has further identified fourteen (14) Outcomes as focus policy priority areas (RSA, 2014[2]). A number of the Outcomes of the MTSF are relevant in terms of the GRINN extension e.g., Outcome 4: Economy, Outcome 6: Infrastructure, Outcome 8: Human Settlements, Outcome 10: Environment and Outcome 12: Public Service. Of particular interest to the context of this report is Outcome 10, which talks about: "Environmental assets and natural resources that are well protected and continually enhanced."

[1] NPC (National Planning Commission) (2012). National development plan 2030: Our future-make it work. Government of South Africa, South Africa

[2] RSA (Republic of South Africa) (2014). Medium-term strategic framework 2014-2019. South Africa

Outcome 10 makes specific reference to the obligation placed on the Government to give effect to the environmental right in the Constitution. The Constitution has entrenched environmental governance strongly in Section 24, which states that "Everyone has the right to an environment that is not harmful to their health or wellbeing and to have the environment protected through reasonable legislative measures". Five sub-outcomes have been identified in Outcome 10 (RSA, 2014[3]); all of which are relevant to this project:

- Sub-outcome 1: Ecosystems are sustained, and natural resources are used efficiently;
- Sub-outcome 2: An effective climate change mitigation and adaptation response;
- Sub-outcome 3: An environmentally sustainable, low-carbon economy resulting from a well-managed just transition;
- Sub-outcome 4: Enhanced governance systems and capacity; and
- Sub-outcome 5: Sustainable human communities.

It is clear from the above that the GRINN extension, therefore, has to at its core, aim to help create sustainable connected human communities, prescribe to the principles of Duty of Care by sustaining ecosystems and ecosystem services and implement effective climate change mitigation and adaptation response within the framework of effective governance systems.

Additional obligations are placed on the GRINN extension by both the Millennium Development Goals (MDGs) as well as the Sustainable Development Goals. The Sustainable Development Goals (SDGs) are a set of seventeen (17) goals to end poverty, fight inequality and injustice and tackle climate change by 2030 (UN General Assembly, 2015)[4].

The SDGs are much broader than the MDGs in scope. While recognising that poverty and hunger is still a major concern across the world, with an estimated 800 million still suffering from hunger word-wide (UN, 2015), the SDGs have expanded their area of impact. The SDGs, therefore, seek to include issues that can provide a more integrated approach to sustainable development.

Related to the Agenda 2030 and its associated SDGs is the concept of 'green' economy which has appeared increasingly in discourse particularly since the United Nations Conference on Sustainable Development in Rio de Janeiro (RIO+20) (Benson and Greenfield, 2012)[5]. According to the United

[3] RSA (Republic of South Africa) (2014). Medium-term strategic framework 2014-2019. South Africa
[4] UN General Assembly (2015). Transforming our world: The 2030 agenda for sustainable development. New York: UN General Assembly. Available from: www.un.org/ga/search/view_doc.asp?symbol=A/70/L.1&Lang=E
[5] Benson, E. and Greenfield, O. (2012). Surveying the 'Green Economy' and 'Green Growth' landscape. Green Economy Coalition, International Institute for Environment and Development

Nations Environment Programme (UNEP, 2012)[6], a green economy is "one that results in human well-being and spatial equity, while significantly reducing environmental risks and ecological scarcities". Spatial equity and the creation of a connected and integrated society is of particular interest in terms of the GRINN extension. It is useful to consider that where the SDGs are the elements to be achieved towards sustainable development, the majority consensus is that the green economy is a means by which to do it. As such the green economy has identified a number of priorities that demands an economy that is low-carbon, resource-efficient and socially inclusive, reduces pollution and waste, enhances energy and resource use efficiency, and prevents biodiversity degradation and the loss of ecosystem services (UNEP, 2012).

Within the African continent sustainable development is enshrined within Agenda 2063 which is a strategic framework promoting socio-economic transformation for the African continent up to 2063. Agenda 2063 envisions: "a prosperous continent where the citizens have a high standard of living, are well educated with a skilled labour force, transformed economies, productive agriculture and healthy ecosystems, with the well-preserved environment and a continent resilient to climate change" (African Union Commission, 2015)[7].

The NDP, further recognises that South Africa needs to move away from unsustainable use of resources. In this regard, the NDP aims at transitioning to a low carbon economy in a cost-effective manner which remains consistent with current policies. Being a key national policy, the NDP has a target timeframe period similar to that of the SDG's, which is 2030 (this 2030 timeframe of the NDP is reflected within other influential policy timeframes).

The Southern African Development Community (SADC) also recognises the importance of sustainable development, especially in the fight against poverty and food insecurity. A significant realisation is that economic development is interlinked with the concerns of the people as well as the environment that people depend on.

Lastly, in The Green Book compiled by the Centre for Scientific and Industrial Research (CSIR) (CSIR, 2019)[8], the CSIR and its partners investigated the anticipated impact that a changing climate and growing urban population will have on the settlements and key resources of South Africa. The research predicts that in Africa, whilst the urban population grew from 15% of the total population in 1960 to over 40% in 2010, it is predicted to exceed 60% by 2050. South Africa is expected to follow this trend and experience high population growth and urbanisation.

[6] UNEP (United Nations Environmental Programme) (2012). Towards a Green Economy: Pathways to Sustainable Development and poverty eradication. available at: https://sustainabledevelopment.un.org/index.php?page=view&type=400&nr=126&menu=35
[7] African Union Commission (2015). Agenda 2063: The Africa we want: A shared strategic framework for inclusive growth and development, first ten-year implementation plan 2014-2023
[8] Le Roux, A., Arnold, K., Makhanya, S. & Mans, G. 2019. Green Book. South Africa's urban future: Growth projections for 2050. Pretoria: CSIR. Available at: https://pta-gis 2- web1.csir.co.za/portal/apps/GBCascade/index.html

Five (5) of South Africa's eight (8) Metropolitan Municipalities are thus expected to experience high population growth and increases in population pressure, these include:

- City of Cape Town;
- City of Johannesburg;
- City of Tshwane (Pretoria);
- Nelson Mandela Bay (Port Elizabeth); and
- City of Ekurhuleni (CSIR, 2019).

The City of Johannesburg Metropolitan Municipality, as the fastest-growing municipality in Gauteng, is projected to grow by 84% (3.6 million people) by 2050. The City of Tshwane Metropolitan Municipality is projected to grow by 76% (2.2 million people), followed by Ekurhuleni Metropolitan Municipality which will grow by 60% (1.7 million people).

The Green Book (CSIR, 2019) further expands on the settlement vulnerability of the various municipalities by representing the settlement vulnerability of the City of Johannesburg in terms of six (6) composite indicators e.g., low access to services, high socio-economic vulnerabilities, poor regional connectivity, environmental pressure, or high economic pressures. This allows for an investigation of the relative vulnerabilities of settlements within a specific local municipality.

Based on the risk profile the Green Book proposes a range of planning and design actions that can be taken by the municipality to adapt to the impacts of climate change, reduce exposure to hazards, and exploit opportunities for sustainable development. Two of these actions are to:

- Protect critical infrastructure; and
- Connect key transit nodes.

It is recommended that key transit nodes are connected to support climate resilience and disaster response. The creation of compact, connected, and well-arranged settlements that allow for short distances and climate-friendly mobility options to decrease the transport cost burden is preferred.

4.2 Legislative Framework

The legislative environment applicable to the GRINN extension is defined as follows:

- The Constitution, 1996 (Act No. 108 of 1996);
- National Environmental Management Act (NEMA), 1998 (Act No. 107 of 1998) as amended; including associated published guidelines;

- Environmental Impact Assessment Regulations, 2014 (as amended);
- National Environmental Management: Waste Act (NEM: WA), 2008 (Act No. 59 of 2008);
- National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004);
- National Water Act, 1998 (Act No. 36 of 1998);
- National Heritage Resources Act, 1999 (Act No. 25 of 1999);
- National Environment Management: Biodiversity Act, 2004 (Act No. 10 of 2004);
- Gauteng Transport Infrastructure Act, 2001 (Act No. 8 of 2001, amended 2003);
- Occupational Health and Safety Act, 1993 (Act No.85 of 1993);
- Climate Change Bill, 2018;
- Green Transport Strategy;
- Gauteng Environmental Management Framework; and
- Municipal Bylaws and associated requirements for Trade Permits.

Table 2 below details the applicability of the legislation to the GRINN extension project.

4.3 Environmental Legal Requirements in Terms of the NEMA

The National Environmental Management Act (Act no. 107 of 1998) (NEMA) and the 2014 EIA Regulations (as amended) is the primary South African legislative framework governing the requirements for Environmental Impact Assessment. In terms of Section 24(2) of the NEMA, the Minister of Environmental Affairs has identified activities which may not commence without prior authorisation from the Minister or Member of the Executive Committee (MEC).

The Minister has, in accordance with the above, published Listed Activities in Government Notice (GN) R 983 (Listing Notice 1), GN R 984 (Listing Notice 2) and GN R 985 (Listing Notice 3) (as amended, dated 7 April 2017). These activities may not commence prior to the receipt of Environmental Authorisation (EA) from the Minister or MEC. More specifically:

- Listing Notice 1 identifies activities that require Environmental Authorisation (EA), subject to a Basic Assessment (BA) process;
- Listing Notice 2 identifies activities that require EA subject to the undertaking of a Scoping and Environmental Impact Reporting (S&EIR) process; and
- Listing Notice 3 identifies activities, within specified geographical areas, that require EA, subject to a BA process.

In the light of the Listed Activities and licensing requirements identified, the proposed development will require a full Scoping and EIA (S&EIR) Process. These processes form part of the next phase of this project, i.e., the Preliminary Design phase of the project. The Listed Activities may not commence without Environmental Authorisation from the Competent Authority.

In addition, revision of the identified Listed Activities may be required to include more Listed Activities once further details of the proposed development becomes known through further phases of the design process. This can be resolved either during the final design phase or alternatively through authority pre-application meetings in the next phase of the project.

During the Preliminary Route Determination phase (this phase) of the project, an Environmental Screening Report, aiming to identify clear fatal flaws in the alignments from an environmental point of view, was commissioned. This Environmental Screening Report is attached as **Appendix D.**

The Environmental Screening Report assessed 6 possible route alternatives. As discussed in **Section 2.2** above, the Preliminary Route Determination Report (this report) discusses 3 possible route alignment options. **Table 1** indicates the 3 environmental alternatives which refers to the relevant 3 route alignment options of this report:

Table 1 : Environmental alternatives aligned with Road Options

Environmental Screening Report	Preliminary Route Determination Report
Alternative 5	Proposed Route 01
Alternative 2	Proposed Route 02
Alternative 6	Proposed Route 03

Table 2 : Impact of Legislation on the GRINN Extension

LEGISLATION	APPLICABILITY TO THE PROJECT
The Constitution of the Republic of South Africa, Section 24 (Environmental Right):	1) Everyone has the right a) to an environment that is not harmful to their health or well-being; and b) to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that: i) prevent pollution and ecological degradation; ii) promote conservation; and iii) secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development." In light of this development and potential impacts on the environment, the provisions of the constitution need to be supported. By applying the principles of Duty of Care and undertaking a full EIA for the proposed development, these provisions will be addressed.
National Environmental Management Act, 1998 (Act no. 107 of 1998) (NEMA)) and EIA Regulations, 2014.	The NEMA is the key environmental management legislation and states in section 2(4)(k) that "the environment is held in public trust for the people, the beneficial use of resources must serve the public interest and the environment must be protected as the people's common heritage" thereby paving the way for an EIA process to assess developments that may have a harmful impact on the environment. Section 28 of NEMA ensures that environmental screening is incorporated into each activity, although it is not formally termed as such. Section 28 (1) imposes a duty which requires that:

LEGISLATION	APPLICABILITY TO THE PROJECT
	"Every person who causes, has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring, or, in so far as such harm to the environment is authorised by law or cannot reasonably be avoided or stopped, to minimise and rectify such pollution or degradation of the environment". The EIA regulations describe the EIA process to be followed including the Public Participation Process and the Listed Activities that may have a harmful impact on the environment and must be assessed. For the purpose of this project, a full EIA and associated specialist studies will be required.
National Environmental Management: Waste Act, 2008 (Act no. 59 of 2008) (NEM: WA)	This Act provides for regulating waste management in order to protect health and the environment by providing reasonable measures for the prevention of pollution and ecological degradation. Also, to provide for national norms and standards for regulating the management of waste by all spheres of government; to provide for specific waste management measures; to provide for the licensing and control of waste management activities. Although none of the proposed activities is likely to trigger activities in terms of the Waste Act, waste will still be generated during construction and needs to be managed accordingly. By undertaking an EIA and associated EMPr, certain mitigation measures will be implemented to reduce the potential impacts of waste generation in all its forms.
National Environmental Management: Air Quality Act, 2004 (Act no. 39 of 2004); (NEM: AQA)	Whilst the proposed development is unlikely to trigger a Listed Activity in terms of section 21 of the NEM: AQA, consideration must be given to any potential activities that are believed to have a significant detrimental effect on the environment. No person may conduct an activity so listed without a provisional atmospheric emission license.
National Environmental Management: Air Quality Act, 2004 (Act no. 39 of	The purpose of the regulations is to prescribe general measures for the control of dust in all areas.

LEGISLATION	APPLICABILITY TO THE PROJECT
2004) – National Dust Control Regulations	The proposed development will generate dust emissions during the construction phase, which must fall within the dustfall standard of the particular land use.
National Water Act, 1998 (Act no. 36 of 1998) (NWA)	This Act provides for the protection and management of water resources. A Water Use License Application (WULA) is made to authorise water use activities pertaining to the altering of the bed, bank, course and characteristics of the watercourse and for the abstraction of water for use during the operational phases (where applicable). The GMA will be required to register the respective water uses as a result of the proposed development.
National Heritage Resources Act, 1999 (Act No. 25 of 1999); (NHRA)	The NHRA serves to introduce an integrated and interactive system for the identification, assessment and management of the heritage resources of South Africa. The NHRA promotes good governance and the empowerment of civil society to preserve their heritage for future generations and sets out the principles of heritage resource management whilst making provision for legislation protecting national heritage The GMA will be required to obtain approval from the Provincial Heritage Resources Authority Gauteng (PHRAG) in consultation with the South African Heritage Resources Agency (SAHRA).
National Environmental Management: Biodiversity Act, 2004 (Act no. 10 of 2004) (NEM: BA)	The Biodiversity Act provides for the management and protection of the country's biodiversity within the framework established by NEMA. It provides for the protection of species and ecosystems in need of protection, sustainable use of indigenous biological resources, and equity in bio-prospecting. In terms of fauna (wildlife) occurring at the site, at the time of a site visit a few locally common bird species were observed. No large mammal species, rare or threatened species were observed during the visit, however, there is a possibility that some of these could potentially utilise the wetland and ridge habitats. This would need to be further investigated by a specialist. The GMA would need to appoint an Ecological specialist in order to determine the potential threat to biodiversity.

LEGISLATION	APPLICABILITY TO THE PROJECT
Occupational Health and Safety Act, 1993 (Act no. 85 of 1993) (OHSA)	While consideration for management of health and safety falls outside the scope of the environmental investigation, there are a number of overlaps and synergies that are relevant in terms of environmental management. The OHS Act imposes various duties on employers. This includes ensuring the health and safety of their employees, including taking steps as may be reasonably practicable to eliminate or mitigate any hazard or potential hazard to the health and safety of their employees, providing the necessary information, instructions, training and supervision, as well as not permitting any employee to do any work or to produce, process, use, store, handle or transport any article or substance or to operate any plant or machinery unless the precautionary measures have been taken. In addition, there is a veritable myriad of regulations promulgated under the OHS Act which may have relevance to the depot project and stations, with regard to safe working conditions in that context. They include the General Administrative Regulations, General Safety Regulations, Construction Regulations and the Environmental Regulations for Workplaces. The GMA needs to consider the general duties of employers to their employees with regards to Health and Safety. The GMA will also need to consider the general duties of employers and self-employed persons to persons other than their employees.
Gauteng Transport Infrastructure Act, 2001 (Act No. 8 of 2001, amended 2003)	Part 2, Section 6 (1) (2) and (3) of the Infrastructure Act reads as follows: *Part 2: Route Determination and Preliminary Design of Provincial Roads and Railway Lines* *6. Route Determination* *(1) In determining the route of a provincial road or railway line the amendment of a route published in terms of subsection (9) or deemed to have been published in terms of subsection 10 (1) or the amendment of a route of an existing provincial road or railway line, the MEC must cause a preliminary route alignment to be done in the form of a written report as*

LEGISLATION	APPLICABILITY TO THE PROJECT
	prescribed and containing recommendations with respect to the route and the MEC must therefore follow the procedure set out in this section. *(2) Before determining a route or amended route, the MEC must cause such environmental investigation and report in respect thereof to be done as the competent authority contemplated in section 22 of ECA, or the authority contemplated in the relevant corresponding sections of NEMA once those sections come into operation, may decide.* *(3) The MEC must thereafter cause a notice to be published in the prescribed form and manner, containing -* *a) broad description of the route;* *b) particulars of the times and places at which the preliminary route report and environmental report can be inspected, and copies be made;* *c) An invitation to all interested and affected parties to comment in writing before a date, not less than 30 days after publication of the notice, on the recommended route; and* *d) A reference to the regulatory measures which take effect in terms of section 7 on the publication of the route in terms of subsection (11).* An Environmental Investigation and report, as set out in Clause 6(2) of the GTIA must be undertaken. The Environmental Investigation must be subject to Public Inquiry for which a qualified commission must be established.
Climate Change Bill, 2018	The aim of the Climate Change Bill, 2018 is to build an effective climate change response and safeguard the long-term, just transition to a climate-resilient and lower carbon economy and society. This will be done within the framework of sustainable development and will provide for all matters related to climate change. The Bill acknowledges that anthropogenic climate change represents a critical threat to all society and the environment, and requires an effective, broad-minded and well-coordinated response. It further emphasises that, amongst others, anticipated local climate change impacts have the potential to destabilise the country's development goals, and that responses to climate change

LEGISLATION	APPLICABILITY TO THE PROJECT
	raise distinctive challenges, thus requiring a legislative framework for the implementation of the country's national climate change response. The Bill further addresses issues related to institutional and coordination arrangement across the three spheres of government namely national, provincial and local. It highlights the need for the spheres of government and entities, sectors as well business to respond to challenges of climate change. It lastly addresses the matters relating to the national adaptation to impacts of climate change, greenhouse gas emissions and removals, and policy alignment and institutional arrangements[9]. The objectives are thus defined to be: • to provide for the coordinated and integrated response to climate change and its impacts by all spheres of government in accordance with the principles of cooperative governance; • to provide for the effective management of inevitable climate change impacts through enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change, with a view to building social, economic, and environmental resilience and an adequate national adaptation response in the context of the global climate change response; and • to make a fair contribution to the global effort to stabilise greenhouse gas concentrations in the atmosphere at a level that avoids dangerous anthropogenic interference with the climate system within a timeframe and in a manner that enables economic, employment, social and environmental development to proceed in a sustainable manner.[10]

[9] https://pmg.org.za/call-for-comment/683/

[10] Climate Change Bill, 2018. https://www.environment.gov.za/sites/default/files/legislations/climatechangebill2018_gn41689.pdf

LEGISLATION	APPLICABILITY TO THE PROJECT
	The implementation of the next phase of the Gauteng Rapid Rail Integrated Network extension, within the context of the Bill, therefore, places the onus on the GMA to implement the project in a manner that engages all spheres of Government in order to provide an integrated response to climate change. It further steers the development in the direction of managing climate impacts related to the project in a manner which will enhance adaptive capacity as well as strengthen resilience and reduce vulnerability (through all phases of the project).
Green Transport Strategy	According to South Africa's Low Emission Development Strategy produced by the DEA in 2018 *"much attention with regard to climate change impacts in the transport sector, has been on mitigating the potential for these impacts, rather than focusing on adaptation and resilience measures to cope with these impacts. The vulnerability of this sector to climate-impacts relates to physical transportation infrastructure (i.e., buildings, pipelines, roads and railways). Looking to the future, specific measures and developments in the sector will need to be implemented to enhance the resilience of transport infrastructure against potential climate impacts"*[11]. To this end, South Africa's Green Transport Strategy (GTS) was launched by the Department of Transport (DoT) in 2018 to promote a transport system that is environmentally friendly and helps boost economic growth and create jobs. In South Africa, the transport sector is the most rapidly growing source of greenhouse gas (GHG) emissions, and its continued growth is expected to have an increasing impact on biodiversity, air quality, land resources and water quality. It accounts for 10.8% of emissions in the country, with road transport responsible for 91.2% of that[12]. The vision and mission of the GTS is to *"substantially reduce GHG emissions and other environmental impacts from transportation with 5% by 2050"* and *to "support the contribution of the transport sector to the social and economic development of the country*

[11] Department of Environmental Affairs (2018). South Africa's Low Emission Development Strategy 2018
[12] https://sdg.iisd.org/news/south-africa-launches-green-transport-strategy/

LEGISLATION	APPLICABILITY TO THE PROJECT
	while incrementally initiating innovative green alternative transformations in the sector to assist with the reduction of harmful emissions and negative environmental impacts associated with transport systems".[13] To achieve these objectives, the GST highlights: • ensuring that South Africa has environmentally sustainable low carbon fuels by 2022 by converting 5% of the public and national sector fleet to cleaner alternative fuel and efficient technology vehicles. • promoting fuel economy norms and standards and implementing regulations that promote improved efficiency in fossil-fuel powered vehicles; • ensuring a modal shift from road to rail transport by encouraging a 30% shift for freight transport, from road to rail, and a 20% shift of passenger transport from private cars to public and eco-mobility transport; • investing in green energy infrastructure, such as biogas filling stations and electric car charging points; • reviewing current levels of the environmental levy on new motor vehicle CO^2 emissions and expanding it to commercial vehicles; and • helping ensure that freight vehicles only enter urban hubs during off-peak hours, by possibly implementing road freight permits and road-use charges.[14] In summary, the GST proposes the following measures to ensure that transport infrastructure is resilient to harsh climatic conditions: • constructing low-carbon and climate-resilient road transport infrastructure (i.e. bus lanes, railways and non-motorised transport infrastructure), which tackle climate change by both reducing emissions as well as adapting to its inevitable impacts;

[13] http://www.energy.gov.za/files/biogas/2017-Biogas-Conference/day1/Green-transport-strategy-Transport.pdf
[14] https://sdg.iisd.org/news/south-africa-launches-green-transport-strategy/

LEGISLATION	APPLICABILITY TO THE PROJECT
	• developing strategies that build climate resilience into urban and rural integrated transit planning and systems; and • creating standards and guidelines for climate-resilient materials for construction, maintenance and upgrading of road networks in the country.[15] With the implementation of the next phase of the Gauteng Rapid Rail Integrated Network extension the GMA will contribute to ensuring a modal shift from road to rail transport by encouraging a shift of passenger transport from private cars to public and eco-mobility transport. It is hoped that this action will further contribute to the construction of low-carbon and climate-resilient transport infrastructure.
Gauteng Environmental Management Framework	The Gauteng Department of Agriculture and Rural Development (GDARD) commissioned the compilation of an Environmental Management Framework for the Gauteng Province (GPEMF). The GPEMF replaces all other EMFs in Gauteng with the exception of the Cradle of Humankind World Heritage Site which is incorporated within the GPEMF. The objective of the GPEMF is to guide sustainable land use management within the Gauteng Province. The GPEMF, inter alia, serves the following purposes: • To provide a strategic and overall framework for environmental management in Gauteng; • Align sustainable development initiatives with the environmental resources, developmental pressures, as well as the growth imperatives of Gauteng; • Determine geographical areas where certain activities can be excluded from an EIA process; and • Identify appropriate, inappropriate and conditionally compatible activities in various Environmental Management Zones in a manner that promotes proactive decision-making[16].

[15] Department of Environmental Affairs (2018). South Africa's Low Emission Development Strategy 2018

[16] Gauteng Provincial Environmental Management Framework, 2014, Environomics

LEGISLATION	APPLICABILITY TO THE PROJECT
	The planned expansion is located within Zone 1 of the GPEMF. Zone 1 is referred to as the Urban Development Zone. The intention of this zone is to streamline urban development activities in it and to promote development infill, densification and concentration of urban development, in order to establish a more effective and efficient city region that will minimise urban sprawl into rural areas[17]. Any further development past the Little Falls Station may, however, fall within the Zone 2: High Control Zone (within the Urban Development Zone). This zone is identified as sensitive to development activities with only conservation being allowed in this zone. This constraint needs to be taken into consideration in any additional planning. Another constraint placed on planning towards the Cradle of Humankind World Heritage site is the Special Control Zone SCZ (b) which aims to incorporate the Cradle of Humankind World Heritage Site EMF into the Gauteng EMF. It has its own management zones and management guidelines that must be followed[18].
Municipal Bylaws	The City of Johannesburg Metropolitan Municipality may have certain requirements in terms of bylaws and trade permits, and a few of these may be applicable to this proposed development, namely the following: • Disaster Management Bylaws; • Electricity Supply Bylaws; • Environmental Health; • Keeping of Animals; • Nuisances; • Solid Waste Bylaws;

[17] http://www.klipsa.org.za/Data/Sites/1/media/policies/gpemfposter.pdf
[18] http://www.klipsa.org.za/Data/Sites/1/media/policies/gpemfposter.pdf

LEGISLATION	APPLICABILITY TO THE PROJECT
	• Storm Water Management Bylaws; and Water Services Bylaws. The GMA will need to consider the above during the implementation of the project.

4.4 Potential Permit/ License Applications

The proposed development will be within 500m of a watercourse and thus requires a Section 21 (c) and (i) Water Use License Application (WULA) from the Department of Water and Sanitation (DWS). **Table 3** list activities are applicable in terms of the National Water Act, 1998 (Act no. 36 of 1998) (NWA):

Table 3 : Potential sections of the National Water Act triggered

Activity	Description
Section 21 (c)	Impeding and diverting the flow of water in a watercourse
Section 21 (i)	Altering the bed, bank, course or characteristics of a watercourse

*other water uses may be applicable related to discharge

Permits to remove/relocate sensitive species may also be required. The National Forest Act, 1998 (Act No. 84 of 1998) enforces the protection of a number of indigenous trees. The removal of thinning or relocation of protected flora will require a permit prior to the commencement of said activities.

5 Design Standards

During the initial stages of the route alignment study, it became clear that there are different design standards that have been applied during different stages of the Gautrain project. These standards were applied as follows:

1. Preliminary design of phase one of the Gautrain also referred to as Gautrain 01.
2. Detail design of Gautrain 01.
3. Feasibility study for the extensions to the Gautrain Rapid Rail Integrated Network.

It was agreed that the Preliminary Route Alignment study for the GRRIN will be done based on the standards as listed in **Table 4**.

Table 4 : Design Standards

Design Element	**Criteria**	
Design Speed	**180km**	**160km**
Train configuration	12/8/4 cars	12/8/4 cars
Axle loading	18t/a	18t/a
Minimum curve radius (See table below)	1800m	1500m
Station curve radius	600	600
Radius – vertical (See table below)	24504.2	17210.08
K-value	245	172.1
Track spacing (c/c)	4m	4m
Staging grades	1: 800 (Ideally flat)	1: 800 (Ideally flat)
Maximum slope (ruling gradient)	4% (Ideally 2%)	4% (Ideally 2%)
Turnouts	1:18	1:18
Rail	60kg/m	60kg/m
Distance between station & 1st turnout (Platform edge to start of set)	25m	25m
Transition length	See table below	See table below
Pocket track length	Train length between clearance markers	Train length between clearance markers

5.1 Horizontal Alignment

The approach during the PRD was to apply the design speed of 180km/h, but in the vicinity of the stations this could be reduced to 100km/h as the trains will only be allowed to pass through a station at a maximum speed of 100km/h. This allowed the alignment to be adjusted in such a way that the best position for the station could be achieved without having an impact on the speed that will be achieved along the route. This is important as the overall speed will determine the travel times and therefore the level of service that can be provided. **Table 5** lists the curve radii used:

Table 5 : Horizontal alignment – Curve radii

Ruling Speed	Horizontal Radius		Transition Length	
	Absolute Minimum	Preferred Minimum	Absolute Minimum	Preferred Minimum
100	550	600	164	150
120	750	800	206	193
140	1100	1200	221	201
160	1400	1500	257	240
180	1800	1900	283	268
200	2500	2800	278	247
220	2800	3000	330	307

Table 6, **Table 7** and **Table 8** show the horizontal alignment information for each of the three alternative route alignments:

Table 6 : Horizontal alignment – Route Alignment 1

Curve Number	Transition Curve (m)	Curve Radius (m)	Design Speed (km/h)	Comments
1	200	3000	180	
2	240	1600	180	Close to Little Falls Station
3	240	1600	180	
4	240	1600	180	
5	200	2000	180	Close to Cosmo Station
6	240	1600	180	
7	240	500	80	Close to Sandton Station
8	210	1100	140	Close to Sandton Station
9	240	1600	180	
10	210	1000	180	Close to Marlboro Station

Table 7 : Horizontal alignment – Route Alignment 2

Curve Number	Transition Curve (m)	Curve Radius (m)	Design Speed (km/h)	Comments
1	240	1600	180	
2	200	800	120	Close to Sandton Station
3	200	800	120	Close to Sandton Station
4	150	2400	180	
5	115	1510	160	Parallel to existing alignment
6	225	1545	160	Parallel to existing alignment
7	200	1515	160	Parallel to existing alignment
8	225	1525	160	Parallel to existing alignment
9	200	1000	160	Parallel to existing alignment

Table 8 : Horizontal alignment – Route Alignment 3

Curve Number	Transition Curve (m)	Curve Radius (m)	Design Speed (km/h)	Comments
1	150	800	110	Close to Little Falls Station
2	150	800	110	Close to Little Falls Station
3	250	2000	180	
4	250	1800	180	
5	200	1500	160	Close to Cosmo Station
6	250	1800	180	
7	250	1800	180	
8	250	2000	180	
9	200	800	120	Close to Sandton Station
10	150	2400	180	
11	115	1510	160	Parallel to existing alignment
12	225	1545	160	Parallel to existing alignment
13	200	1515	160	Parallel to existing alignment
14	225	1525	160	Parallel to existing alignment
15	200	1000	160	Parallel to existing alignment

5.2 Vertical Alignment

The same approach that was used with the horizontal alignment was also used for the vertical alignments of all the routes that were investigated where the design speed was only reduced in the vicinity of the stations. This again was done to limit the impact that increased travel times would have on the ridership. **Table 9** lists the vertical curve radii used:

Table 9 : Vertical alignment – Curve radii

Ruling Speed	Vertical Curve Radius
100	4201.68
120	7260.50
140	11529.41
160	17210.08
180	24504.20
200	33613.45
220	44739.50

Table 10, **Table 11** and **Table 12** show the vertical alignment information for each of the three alternative route alignments:

Table 10 : Vertical alignment – Route Alignment 1

Curve Number	Vertical Curve Length (m)	Vertical Curve Radius (m)	Sag or Crest	Gradient In (%)	Gradient Out (%)
1	500	28700.0	Crest	0.00	-1.75
2	1100	24800.0	Sag	-1.75	2.69
3	1600	24700.0	Crest	2.69	-3.79
4	1160	24600.0	Sag	-3.79	0.93
5	480	45600.0	Crest	0.93	-0.13
6	720	28900.0	Crest	-0.13	-2.62
7	860	24600.0	Sag	-2.62	0.89
8	1200	38500.0	Sag	0.89	4.00
9	440	11000.0	Crest	4.00	0.00
10	560	24900.0	Crest	0.00	-2.25
11	680	25000.0	Sag	-2.25	0.47
12	400	25100.0	Sag	0.47	2.06
13	160	7800.0	Crest	2.06	0.00
14	160	4000.0	Crest	0.00	-4.00
15	1250	25000.0	Sag	-4.00	1.00
16	480	24900.0	Crest	1.00	-0.93
17	160	19000.0	Sag	-0.93	-0.09

Table 11 : Vertical alignment – Route Alignment 2

Curve Number	Vertical Curve Length (m)	Vertical Curve Radius (m)	Sag or Crest	Gradient In (%)	Gradient Out (%)
1	540	24800.0	Crest	0.00	-2.18
2	1400	26400.0	Sag	-2.18	3.12
3	1760	24700.0	Crest	3.12	-4.00
4	1380	24800.0	Sag	-4.00	1.56
5	400	25700.0	Crest	1.56	0.00
6	200	13100.0	Sag	0.00	1.53
7	200	3600.0	Crest	1.53	-4.00
8	920	17500.0	Sag	-4.00	1.26
9	560	32200.0	Sag	1.26	2.99
10	160	5300.0	Crest	2.99	0.00
11	160	10100.0	Crest	0.00	-1.58
12	900	24500.0	Sag	-1.58	2.10
13	520	24800.0	Crest	2.10	0.00
14	180	4700.0	Crest	0.00	-3.87
15	1500	25600.0	Sag	-3.87	2.00
16	800	40000.0	Crest	2.00	0.00
17	600	15000.0	Crest	0.00	-4.00
18	400	10000.0	Sag	-4.00	0.00

Table 12 : Vertical alignment – Route Alignment 3

Curve Number	Vertical Curve Length (m)	Vertical Curve Radius (m)	Sag or Crest	Gradient In (%)	Gradient Out (%)
1	500	25000.0	Sag	-2.00	0.00
2	500	25000.0	Sag	0.00	2.00
3	980	24500.0	Crest	2.00	-2.00
4	500	25000.0	Sag	-2.00	0.00
5	160	7513.9	Crest	0.00	-2.13
6	640	25503.3	Sag	-2.13	0.38
7	900	24862.4	Sag	0.38	4.00
8	160	4000.0	Crest	4.00	0.00
9	160	5228.8	Crest	0.00	-3.06
10	780	23639.6	Sag	-3.06	0.24
11	540	25153.6	Sag	0.24	2.39
12	160	6704.8	Crest	2.39	0.00
13	160	4137.9	Crest	0.00	-3.87
14	1020	24950.1	Sag	-3.87	0.22
15	200	90287.4	Crest	0.22	0.00

6 Design Considerations and Constraints

6.1 Traffic Aspects

The PRD was undertaken in such a way that the proposed route alignments will not have a significant impact on the major road network. All major roads were accommodated, and the alignments were designed in such a manner that all suburbs will retain their accessibility to the road network.

One aspect that will receive more attention during the Preliminary Design stage of the project will be the station precinct, where detailed traffic studies will be required to fully assess the impact of the station on the surrounding road network, and proposals made to address any traffic constraints. It must be noted that the stations will integrate with other modes of transport and the philosophy is that commuters will be motivated to make use of other modes of public transport to limit the number of private vehicles at the stations.

6.2 Topography

The CoJ is located on the north-eastern plateau of South Africa known as the Highveld, at an elevation of approximately 1700m above sea level, within the Province of Gauteng.

The identified routes are made up of approximately a third (33%) urban residential areas, with lower percentages accrued to grassland and thicket/dense bush respectively. Urban townships and urban commercial areas account for the remainder of the land cover within the identified routes, with minimal cover attributed to wetlands, woodlands/open bush and plantations/woodlots.

The topography consists of hilly terrain as well as ridges and valleys. This creates a challenge for any rail alignments to be implemented. This is clear from the high number of tunnels and viaducts along any of the three routes investigated. If the area was flatter, it would have been possible to reduce the number of tunnels and viaducts which would have reduced the overall capitol cost of the project.

6.3 Climate

The CoJ enjoys a relatively dry and sunny climate. Temperatures in Johannesburg are usually fairly mild due to the CoJ's high altitude, with an average maximum daytime temperature of 25 °C in the summer, dropping to around 17 °C in winter. In winter the temperature occasionally drops to below freezing at night, causing frost. Snow is a rare occurrence, having been recorded on six occasions in the past 60 years.

The CoJ is located in the summer rainfall region of South Africa with a very clear seasonal cycle; rain events typically occur in the form of late afternoon downpours in the months of October to April, although infrequent showers do occur through the course of the winter months. The annual average rainfall is 713 millimetres, mostly concentrated in the summer months.

The average hourly wind speed in Johannesburg experiences significant seasonal variation over the course of the year. The windier part of the year lasts for 4.1 months, from July 30 to December 2, with average wind speeds of more than 3.6 meters per second. The calmer time of year lasts for 7.9 months, from December 2 to July 30.

The changes in temperature in the rails pose a challenge as this has an impact on the lateral forces in the rails. It is necessary to understand these forces, not only because of weather changes between winter and summer, but also because of the temperature changes that will be existing between rails that are exposed to the summer sun and the rails constructed inside the tunnels where there will be no exposure to the sun. It is not in the scope of the PRD to fully assess this, but it will have to be addressed during the Preliminary and Detail Design phases of the project.

6.4 Geology

Available published geological information, previous ground investigation records and local experience indicate that the project area is underlain by the Halfway House Granites of the Pretoria- Johannesburg Granite Dome. The Basement granites range in mineralogical composition from true granites through granodiorites to quartz diorites and tonalites, and also include more basic rocks and 'islands' of metamorphosed rocks preserved within the 'sea' of granitic rocks. In the northern parts of Johannesburg, Basements Granites are generally relatively shallow, seldom more than 15m deep.

The granites often contain pegmatite veins ranging in thickness from 20mm to 1500mm. Some of the granites show a gneissic texture indicative of metamorphism, these are named granitic gneiss. Intrusive diabase and syenite sheets occur at random and it is possible that smaller dykes and / or sills, which have not been identified in the sequence, will be encountered. Occasional greenstones can be found within the dome.

Variable depths of residual soil can be expected. Residual granite soils with a collapsible grain structure are generally found above the 1500m contour on the Halfway House granite dome between the northern parts of Johannesburg and Pretoria. Corestones must be anticipated, and a shallow perched water table is often present, especially in the wet seasons.

With the existing topography and the constraints regarding the design standards that are applied the result is a rail alignment that will include a high number of tunnelled sections. This will result in high volumes of material that will have to be spoiled unless this material can be used in the construction of the rail infrastructure. From the existing information it was concluded that the existing material will be suitable for use in the rail construction.

Detailed geotechnical investigations are not part of the scope of the PRD and the necessary investigation will have to be done during the Preliminary and Detail Design stages of the project. The perched water table that are normally encountered in this area should be investigated and the designs adapted accordingly during the Preliminary and Detail Design stages of the project.

6.5 Availability of Construction Materials

The soil materials encountered along the route will generally be suitable for reuse in construction such as engineered fills or rail and road layer works. Numerous commercial quarries are located around the project area from which concrete aggregate and rail/road layer works material can be sourced.

Although a full materials investigation is not within the scope of the project it must be highlighted that the tunnel construction will probably yield high volumes of useable construction material. The practicality of this should however be investigated during the Preliminary and Detail Design stages of the project. The utilization of material by means of a mass haul diagram will have to be conducted. The cost and possible impact on the existing road network because of long haul distances and haul routes should be investigated during the Preliminary and Detail Design stages of the project.

6.6 Formation Design

The final design of the rail formation will only be determined during the Preliminary Design stage of the project. The final formation will consist of a combination of:

1. Ballasted track on pavement layers of granular material;
2. Track in concrete; and
3. Track slab.

As mentioned previously, the topography resulted in several tunnelled sections. These sections will have a different formation design to those sections that will be constructed on fills, or in cuts. Where the rail line change between the different formation types, special attention should be given to how they transition from ballasted track to track in concrete or track slab. The material properties for the granular material that will be used to construct the layer-works for ballasted track are shown in **Table 13** below:

Table 13 : Material properties of granular construction material

LAYER		MATERIAL PROPERTIES									MINIMUM COMPACTION % OF MODIFIED AASHTO DENSITY	MINIMUM STRENGTH AFTER COMPACTION CBR
		SAR INDEX	MIN GRADING MODULUS	% BY MASS PASSING SIEVE (SIEVE SIZE IN mm)					PI	MAX CBR SWELL %		
				75	13.2	2.0	0.425	0.075				
1	250mm SB	< 80	1.8	100	70 - 100	20 - 60	10 - 40	5 - 20	3 - 10	0.5	95	30 (o) (1.5-3 Mpa)
2	200mm Layer A	< 110	1.0					< 40	< 12		95 100*	
3	450mm Layer B	< 155	0.5					< 70	< 17		93 98*	
4	Bulkearthworks								< 25	2	90 95*	

NOTES:

* These densities apply to non-cohesive soils

(o) Strengths in brackets apply in place of CBR values where sub-ballast is stabilised

If the material sourced from the cut areas and tunnel sections, do not comply with these specifications, material will have to be sourced from commercial sources. This may have an impact on the overall cost of the project. Detail cost estimates are not within the scope of the PRD, and this can only be confirmed during the Preliminary and Detail Design stages of the project.

6.7 Drainage

The preliminary route alignment study was undertaken in such a manner that the alignment crosses all major drainage lines to ensure that the drainage structures that will be required underneath or over the alignment can be accommodated without any impact on the natural watercourse. Major drainage lines have been identified for each of the alignments investigated. With reference to the

alignment drawings included in **Appendix A**, major drainage lines were identified at the following chainages as shown in **Table 14** below.

Table 14 : Chainages for identified major drainage lines

Route 1	Route 2	Route 3
18 500	18 750	18 500
20 650	20 900	20 300
23 600	23 600	22 700
24 600	24 600	24 000
25 100	25 250	24 650
27 600	27 000	26 600
29 500	28 900	30 550
31 600	30 950	32 900
37 350	32 450	36 250
38 350	36 950	36 900
48 800	47 100	43 000
		46 750

The sizing an exact location of these drainage structures will only be part of the Preliminary Design stage of the project. At this stage the major drainage lines are investigated only to ensure that there are no fatal flaws with the alignment crossing drainage lines in such a way that it will have a detrimental effect on the major storm-water management system. During the Preliminary and Detail Design stages of the project the size and exact location of the drainage lines will have to be confirmed as this may have an impact on the final vertical alignment of the preferred route.

6.8 Shifting of Services

During the Route Determination the approach was to identify bulk services that will be impacted on by the proposed alignments. The following service providers were consulted with the aim to familiarize them to the project and to obtain their existing services:

- Rand Water
- Telkom
- Eskom
- Johannesburg Roads Agency
- City Power
- Johannesburg Water
- SANRAL

6.8.1 Bulk Water and Sewer Reticulation Infrastructure

- Relevant Stakeholder(s): Johannesburg Water and Rand Water

Each of the proposed rail alignments clash with water and sewer reticulations services at various locations along their respective routes. These services require relocation to accommodate the rail lines. To date, a desktop study has been carried out to determine potential clash locations, which excluded verification of the existing infrastructure (pipe) sizes. During preliminary and detail design stages, detailed information in relation to exact pipe locations, invert levels, and pipe sizes will be requested from the stakeholders upon resolution of the final route. This will inform how the existing infrastructure will be re-routed in relation to the preferred alignment option. In re-routing, the train station locations will be considered, in a bid to ensure this is carried out in the best possible value-engineered, cost-effective, and safe manner.

The study focused on information as received from Johannesburg Water (water and sewer services), and Rand Water. Rand Water services (minor pipelines) would similarly be relocated in the case of clashes. Where clashes with major infrastructure such as reservoirs and major distribution lines may be encountered, re-routing of the alignment would be investigated during preliminary and detail design stages to find the most cost-effective solution.

6.8.2 Stormwater Reticulation Infrastructure

- Relevant Stakeholder(s): Johannesburg Roads Agency

Like the discussion in the preceding above, Section 6.8.1, the desktop study identified various potential clash locations of the proposed alignments with the stormwater reticulation lines. No clashes with storm water culverts were identified at this stage.

Stormwater lines, as in the case of water and sewer lines, will need to be relocated to accommodate the preferred alignment option, where necessary.

6.8.3 Power Transmission Lines

- Relevant Stakeholder(s): ESKOM and City Power

Common to both stakeholders' existing infrastructure, clashes are expected with overhead main transmission systems (MTS), high voltage (HV) lines and underground power transmission cables. These clashes were noted to occur mainly within the following areas:

- In close proximity with Jackal Creek Golf Estate.
- Between Mahogany Street and President Fouche Road (Sharonlea); and
- Between Main Street and Garden Road (Bordeaux).

Power transmission lines can and may need to be either reduced or increased in height, to accommodate the preferred option. Alternatively, the alignment would require soffit height adjustments at specific clash areas, to ensure conformance to required clearances. This exercise will follow selection of the preferred option during preliminary and detail design stages.

6.8.4 Roads

- Relevant Stakeholder: SANRAL and Johannesburg Roads Agency

The N1 will be crossed once by a bridge structure. No relocation will be required.

Major municipal/provincial road will be crossed with relevant structures. Allowance for reinstatement of minor residential roads have been made.

6.8.5 Telecommunication

- Relevant Stakeholder: Telkom

No major relocation of existing services is envisaged.

7 Stakeholder Engagements

7.1 Consultation with Bulk Service Providers & Governmental Stakeholders

The following Bulk Service Providers & Governmental Stakeholders were consulted by sharing information of the project and the route options:

- MEC for Economic Development, Agriculture, Environmental and Rural Development
- SANRAL
- Rand Water
- Telkom/Open Serve
- Eskom
- City of Johannesburg
- Johannesburg Roads Agency
- City Power
- Johannesburg Water

None of these stakeholders expressed their objection against the project.

Written communication was received from all and is attached as **Appendix B.**

The communication is summarized in **Table 15** below.

Table 15: Summary of feedback from the stakeholder process

Stakeholder name	Comments
City of Johannesburg	• Support for the project has been received from COJ, especially the location of Randburg Station, with limited concerns for the location of Cosmo City and Little Falls Stations.
MEC for Economic Development, Agriculture, Environmental and Rural Development	• The Department deems the work done during this phase as appropriate for the purposes of the process of determining the route. • Requested engagement during further phases of this project.
SANRAL	• The road network under SANRAL's jurisdiction will only be crossed once (N1 western bypass) on elevated structures.
Rand Water	• Only one Rand Water's service pipes are affected by the proposed alignments, especially alignment 2 and 4. • The water, sewer and storm-water services are not considered fatal flaws where the services intersect with any of the alignments. These services are generally 1-1.5m below ground level (maximum of 5m in limited cases), and thus substantially less than the minimum 20m tunnelling requirements.
Johannesburg Water	• The water, sewer and storm-water services are not considered fatal flaws where the services intersect with any of the alignments. These services are generally 1-1.5m below ground level (maximum of 5m in limited cases), and thus substantially less than the minimum 20m tunnelling requirements.
Johannesburg Road Agency	• For major roads - class 1 and 2, sufficient clearances (>= 7m below or above) have been allowed for on the proposed alignments to avoid the need to realign road sections at points of intersection.

	• For residential areas provision has been made to allow for easy of reinstatement of access roads.
Eskom	• The overhead lines are a concern where sufficient clearances may not be achieved. Clashes with the Main Transmission line are likely to occur between chainage 36400m and 38500m. Clearances are not achieved on the following alignments: • Feasibility: chainage 23900m - rail line is 3.5m above NGL • Alignment 1: chainage 23750m - rail line is 20m above NGL : chainage 37000m - rail line is 5m above NGL • Alignment 2: chainage 36000m - rail line is 25m above NGL • Alignment 3: chainage 23900m - rail line is 25m above NGL : chainage 36200m & 37000m - rail line is 5m above NGL • Alignment 4: chainage 23900m - rail line is 25m above NGL : chainage 30000m - rail line is 5m above NGL : chainage 36200m - rail line is 17.5m above NGL
City Power	• The overhead lines are a concern where sufficient clearances may not be achieved: • Feasibility alignment – clashes with 88kV line between 38300-38500m. Alignment approximately 35m (average) above NGL; 9m clearance • Option 1 – clashes with 88kV line between 37500-37700m. Alignment approximately 14m (average) above NGL; no or insufficient clearance • Option 2 – clashes with 88kV line between 36400-36900m. Alignment approximately 20m (average) above NGL; no or insufficient clearance • Option 3 – clashes with 88kV line between 36500-36700m. Alignment approximately 45m (average) above NGL; 19m clearance • Option 4 - clashes with 88kV line between 36600-36700m. Alignment approximately 25m (average) above NGL; no or insufficient clearance

	• With exception to the feasibility and option 3 alignments, clashes with the 88Kv line are likely to occur mainly from chainage 36400m to 38500m.
Telkom	• No fatal flaws are expected on the Telkom network.

7.2 Public Consultation Process

Route Determination, including the public participation process thereof, is legislated by the Gauteng Transport Infrastructure Act (GTIA) and is the first phase of the process of defining the railway reserve. The public participation process recently concluded, which formed part of the determination of the route for Phase 1 of the proposed GRRIN extensions, duly followed the GTIA requirements.

The GTIA prescribes that the notice of the proposed route/s be published in the Provincial Gazette. The notice must include:

- A broad description of the of the proposed route/s.
- Where the preliminary route report & environmental report can be inspected.
- An invitation to all interested and affected parties to comment in writing before closing date, not less than 30 days after publication of the notice.
- A reference to the regulatory measures which take effect in terms.

The notice for the Route Determination for Phase 1 of the GRRIN Extensions was placed in the Provincial Gazette on 13 July 2021 (Attached Annexure A). The GMA, in addition to the legislated requirement, also published the notice in the Sowetan, Star, Die Beeld (all on 09 July 2021), Randburg Sun (15 July 2021), and Sandton Chronicle (14 July 2021). Relevant information was also made available on various digital platforms throughout the comments period. (09 July 2021 - 15 August 2021).

Comments/submissions from 53 Interested & Affected Parties were received. These comments, with their respective responses are contained in **Appendix B**

8 Comparison between Alternative Routes

The philosophy during the route determination process was to design all the alignments in such a way that all three of the alignments would be technically feasible. In other words, if the alignments are tested from a technical point of view, then all the alignments would comply with the 180km/h design speed that was selected.

In order then to determine the preferred route a set of criteria was developed which was used to compare the three alignments with each other. The following have been included in the set of criteria:

- Impact on the environment;
- Cost of the system;
- Land affected;
- Social Impact;
- Economic Benefit; and
- Station Position.

8.1 Impact on the Environment

A separate report was prepared to investigate the environmental impact of each or the routes. All three the routes will have an impact on the environment. In some cases, this impact can be mitigated, and in some cases the impact will be quite severe. Out of this investigation it was found that both Route Alignment 01 and Route Alignment 02 will be going through a Class 2 Ridge, which is highly sensitive and may pose serious environmental risk. Route Alignment 03 avoids this area and has been found to be the route with the least impact on the environment. The ranking of the routes are as follows:

1. Route Alignment 03
2. Route Alignment 01
3. Route Alignment 02

8.2 Cost of the System

An order of magnitude capital cost estimate was done during the feasibility Study phase of the proposed GRRIN Extension project.

This cost estimate will be confirmed and refined after National Treasury approval process had been concluded and approval given for phase 1 of the project to progress into preliminary design phase.

From the cost estimates, the routes have been ranked as follows:

1. Route Alignment 02:
2. Route Alignment 01:
3. Route Alignment 03:

8.3 Land Affected

As mentioned previously, it is not within the scope of the Route Determination study to determine the final rail reserve, but an indicative rail reserve has been prepared for all three alignments in order to assess the impact on land. This reserve will make provision for all related infrastructure like telecommunications, overhead traction equipment, signaling, drainage and service roads.

The route reserve for each alignment has been determined as shown in **Table 16** below:

Table 16: Route reserve for each alignment

	Route Information			Total Reserve
	From	To	Distance	(m^2)
Proposed Route Alignment 1	17,460	49,247	31,787	1,353,518.2
Proposed Route Alignment 2	17,580	47,503	29,923	1,293,124.0
Proposed Route Alignment 3	16,940	47,189	30,249	1,261,350.4

From the table above the routes have been ranked based on the area of land affected. The route with the least land affected being ranked first:

1. Route Alignment 03
2. Route Alignment 02
3. Route Alignment 01

8.4 Social Impact

For every project social impact consideration need to be considered as part of developing the best solution for the project, especially in a developing country like ours. Projects of this nature involves disturbing the natural environmental and possible relocation of affected people. It is on this premises that the maximum possible benefits for communities impacted and affected by the project should be evaluated.

Along the proposed three alignments of the project (from Marlboro to Little Falls) several areas and bulk infrastructure services providers are affected, especially where the alignments intersect with existing services and built-up areas. The stakeholder engagement process is aimed at bringing on board all interested and particularly affected members of the community. The social impact in the context of this project has been evaluated for the following aspects:

Employment Creation

The Gautrain project created approximately 33 000 jobs were created for South Africans, and in particular 28 000 of those were created for historically disadvantaged individuals. With unemployment currently high in South Africa (29.1%, Q3 2019) based on the narrow definition or 34% based on the expanded definition, it is anticipated that the GRRIN Extensions project will significantly contribute towards reducing the high unemployment challenge in Gauteng. It is further anticipated that SMMEs in South Africa will benefit from the project activities.

The three alternative routes were ranked based on their impact on the community. The route with the least impact on the community was ranked number 1 and the route with the highest impact on the community was ranked number 3. The final ranking was as follows:

1. Route Alignment 03
2. Route Alignment 02
3. Route Alignment 01

8.5 Economic Benefit

The three alignments investigated were evaluated in terms of their Economic Benefit. The implementation of the proposed GRRIN Extensions will provide significant economic and transport-related benefits to the Gauteng Province that include the reindustrialization of the transport industry, as well as enabling economic stimulus. Phase 1 of these extensions has the capacity to create more than 30 000 jobs in Gauteng. In this study it was found that Route Alignment 02 was ranked with the highest economic benefit and Route Alignment 03 was ranked as the one with the least economic benefit to the society. This was largely based on the fact that the capital cost for Route Alignment 03 would be the highest of the routes investigated due to the high number of tunnelled sections along this alignment. Tunnelling is expensive not only from a capital cost point of view, but also from an operational cost point of view as the tunnels must be well ventilated. The final ranking was as follows:

1. Route Alignment 02
2. Route Alignment 01
3. Route Alignment 03

8.6 Station Position

In terms of station position and with reference to Section 3: Land Use and Stations above, the routes have been ranked as follows:

1. Route Alignment 03
2. Route Alignment 01
3. Route Alignment 02

The stations were ranked based on the desired station position.

8.6.1 Scoring of Routes based on Evaluation Criteria

A scoring sheet which gives different weightings to each of the evaluation criteria has been prepared. Based on the rankings discussed above a score of 3 was allocated for the highest-ranking route and a

score of 1 was allocated to the lowest ranking route. The result of the scoring is indicated in **Table 17** below:

Table 17: The score results of the three alignments

	Route No.	1	2	3
Criteria	Weighting	Rating		
Environmental Impact	10	2	1	3
Cost of the system	20	2	3	1
Land effected	10	1	2	3
Social Impact	20	1	2	3
Economic Impact	20	2	3	1
Station positions	20	2	1	3
Total Weighted Score		**1.7**	**2.1**	**2.2**

From the table above Route Alignment Option 03 has scored the highest.

9 Recommended Route

Section 8 compared the 3 route alignment options and scored them against a set criteria. Route Alignment Option 03 scored the highest.

None of the comments received during the public consultation process have a material impact on the preferred alignment to warren changes to be made to the preferred alignment.

After the public consultation process, Route Alignment Option 03 thus remains the preferred and recommended route. This route is shown in the following set of drawings.

List of Drawings:

PRO-ROUTES 00-00 : Proposed Route Alignments Key Plan

PRO-ROUTES 03-01 : Proposed Route Alignment 3 (Sheet 1 of 4)

PRO-ROUTES 03-02 : Proposed Route Alignment 3 (Sheet 2 of 4)

PRO-ROUTES 03-03 : Proposed Route Alignment 3 (Sheet 3 of 4)

PRO-ROUTES 03-04 : Proposed Route Alignment 3 (Sheet 4 of 4)

These drawings are attached as **Appendix C**.

10 Summary

This Preliminary Route Alignment Study was executed in terms of the Gauteng Transport Infrastructure Act, Act No 8 of 2001 ('the GTIA' as amended); with the aim to affords the MEC the power to protect the corridor for the proposed extension.

Various routes were investigated, of which the 3 most viable options are described in this report. The investigation included the route determination, station locations, environmental screening, cost benefit analysis and ranking of the 3 routes against a set criteria. Route Option 03 scored the highest ranking and was thus put forward as the preferred option.

All information was shared, and inputs requested from the main bulk service providers, as well as City of Johannesburg, SANRAL and the MEC for Economic Development, Agriculture, Environmental and Rural Development.

Public consultation was done in line with the "GTIA" and 53 responses were received and replied to. The stakeholder engagement phase did not change the initial alignment or ranking of the preferred route option 03.

11 Recommendations

1. That the recommended route alignment Option 3 be accepted (**Appendix C**).
2. That the MEC for Public Transport and Roads Infrastructure determines the route as proposed and in the prescribed manner.